MiCOM P132

Feeder Management and Bay Control

P132/EN M/Bn7

Version	P132	-306	-415/416/417/418/419	-612
	P132	-308	-420/421/425/426/427	-613
	P132	-308	-420/421/425/426/427	-614
	P132	-308	-420/421/425/426/427	-630
	P132	-308	-420/421/425/426/427	-631
	P132	-308	-420/421/425/426/427	-632

Technical Manual

Content	P132/EN M/Dc5	(-612)
	P132/EN AD/Bd7	(-613)
	P132/EN AD/Ae7	(-614)
	P132/EN AD/Ck7	(-630)
	P132/EN AD/Bm7	(-631)
	P132/EN AD/An7	(-632)

Volume 1 of 2

Schneider Electric

MiCOM P132

Feeder Management and Bay Control

P132/EN M/Dc5
(AFSV.12.10092 EN)

Version P132 -306 -415/416/417/418/419 -612

Technical Manual
Volume 1 of 2

Schneider Electric

Warning

When electrical equipment is in operation dangerous voltage will be present in certain parts of the equipment. Failure to observe warning notices, incorrect use or improper use may endanger personnel and equipment and cause personal injury or physical damage.

Before working in the terminal strip area, the device must be isolated. Where stranded conductors are used, insulated crimped wire end ferrules must be employed.

The signals 'Main: Blocked/faulty' and 'SFMON: Warning (LED)' (permanently assigned to the LEDs labeled 'OUT OF SERVICE' and 'ALARM') can be assigned to output relays to indicate the health of the device. Schneider Electric strongly recommends that these output relays are hardwired into the substation's automation system, for alarm purposes.

Any modifications to this device must be in accordance with the manual. If any other modification is made without the express permission of Schneider Electric, it will invalidate the warranty, and may render the product unsafe.

Proper and safe operation of this device depends on appropriate shipping and handling, proper storage, installation and commissioning, and on careful operation, maintenance and servicing.

For this reason only qualified personnel may work on or operate this device.

The User should be familiar with the warnings in the Safety Guide (SFTY/4LM/G11 or later version), with the warnings in Chapters 5, 9, 10 and 11 and with the content of Chapter 13, before working on the equipment. If the warnings are disregarded, it will invalidate the warranty, and may render the product unsafe.

Installation of the DHMI:

A protective conductor (ground/earth) of at least 1.5 mm^2 must be connected to the DHMI protective conductor terminal to link the DHMI and the main relay case; these must be located within the same substation.

To avoid the risk of electric shock the DHMI communication cable must not be in contact with hazardous live parts.

The DHMI communication cable must not be routed or placed alongside high-voltage cables or connections. Currents can be induced in the cable which may result in electromagnetic interference.

Qualified Personnel

are individuals who

☐ are familiar with the installation, commissioning and operation of the device and of the system to which it is being connected;

☐ are able to perform switching operations in accordance with safety engineering standards and are authorized to energize and de-energize equipment and to isolate, ground and label it;

☐ are trained in the care and use of safety apparatus in accordance with safety engineering standards;

☐ are trained in emergency procedures (first aid).

Note

The operating manual for this device gives instructions for its installation, commissioning and operation. However, the manual cannot cover all conceivable circumstances or include detailed information on all topics. In the event of questions or specific problems, do not take any action without proper authorization. Contact the appropriate Schneider Electric technical sales office and request the necessary information.

Any agreements, commitments, and legal relationships and any obligations on the part of Schneider Electric, including settlement of warranties, result solely from the applicable purchase contract, which is not affected by the contents of the operating manual.

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1 Application and Scope

1 Application and Scope

The protection functions available in the P132 provide selective short-circuit protection, ground fault protection, and overload protection in medium- and high-voltage systems. The systems can be operated as impedance-grounded, resonant-grounded, grounded-neutral or isolated-neutral systems. The multitude of protection functions incorporated into the device enable the user to cover a wide range of applications in the protection of cable and line sections, transformers and motors. The relevant protection parameters can be stored in four independent parameter subsets in order to adapt the protection device to different operating and power system management states.

The optional control functions are designed for the control of up to three electrically operated switchgear units equipped with plant status signaling and located in the bay of a medium-voltage substation or a high-voltage station with basic topology. The P132 has more than 80 predefined Bay Types stored for selection and it is also possible to load user-defined bay templates.

The control functions are available for the case 40T and the case 84T devices if an additional binary (I/O) module to control switchgear units is ordered and fitted to the following slot:
For case 40T: slot 6
For case 84T: slot 12

The number of external auxiliary devices required is largely minimized by the integration of binary signal inputs operating from any auxiliary voltage, and versatile relay output contacts, by the direct connection option for current and voltage transformers, and by the comprehensive interlocking capabilities. This simplifies the handling of switch bay protection and control technology from planning to commission.

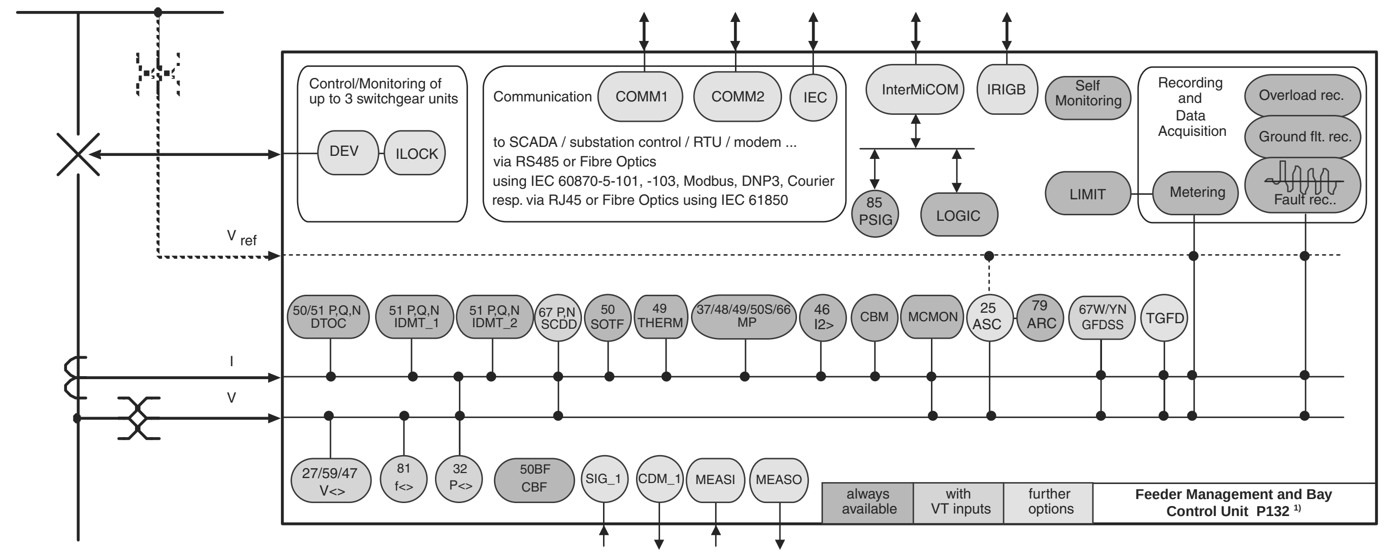
The P132 provides a large number of functions. These can be individually configured and cancelled. These features give the user the means to adapt the protection device to the functionality required in a specific application.

The powerful programmable logic provided by the protection device also makes it possible to accommodate special applications.

1 Application and Scope

(continued)

Functions



1) Function diagram for P132 with CT inputs and P132 with CT and VT inputs in 40TE resp. In 84TE case Function overview for P132 with VT inputs only resp. In 24TE case please see table "function overview".

Module configuration variants

The P132 may be ordered in various variants that differ in the number of CTs and VTs fitted. Therefore these variants also differ in the function groups available to the user. The following table lists the function groups available with the respective module configuration.

Furthermore certain function groups (identified with a "✓)1)" as an ordering option) are tied to specific module types. The function group TGFD for example requires that a transient ground fault module is fitted; the availability of the function groups COMM1, COMM2, COMM3, and IRIG-B depend on the choice of a communication module. As a further example, function groups DEV01 to DEV03 are only available if the optional binary I/O module to control switchgear units is fitted to slot 6 on a case 40T or slot 12 on a case 84T device.

Protection functions			**P132**	**P132**	**P132**
50/51 P,Q,N	DTOC	Definite-time overcurrent protection, four stages, phase-selective (includes negative-sequence overcurrent protection)		✓	✓
51 P,Q,N	IDMT1	Inverse-time overcurrent protection, one stage, phase-selective (includes negative-sequence overcurrent protection)		✓	✓
51 P,Q,N	IDMT2	Inverse-time overcurrent protection, one stage, phase-selective (includes negative-sequence overcurrent protection)		✓	✓
67 P,N	SCDD	Short-circuit direction determination			✓
50	SOTF	Switch on to fault protection		✓	✓
85	PSIG	Protective signaling		✓	✓
79	ARC	Auto-reclosing control (three-pole)		✓	✓
25	ASC	Automatic synchronism check			(✓)
67W/YN	GFDSS	Ground fault direction determination using steady-state values or admittance evaluation			✓
	TGFD	Transient ground fault direction determination			(✓)[1]
37/48/49/ 49LR/50S/66	MP	Motor protection		✓	✓
49	THERM	Thermal overload protection		✓	✓
46	I2>	Unbalance protection		✓	✓
27/59/47	V<>	Time-voltage protection	✓		✓
81	f<>	Over-/underfrequency protection	✓		✓
32	P<>	Power directional protection			✓
50BF	CBF	Circuit breaker failure protection		✓	✓
	CBM	Circuit breaker monitoring		✓	✓
	MCMON	Measuring-circuit monitoring	✓	✓	✓
	LIMIT	Limit value monitoring		✓	✓
	LOGIC	Programmable logic	✓	✓	✓

✓ = standard; (✓) = ordering option
[1] not available with P132 in a case 24T

Control functions			**P132**
	BMxx	Control and monitoring of 3 switchgear units	(✓)[1]
	CMD_1	Single-pole commands	(✓)[1]
	SIG_1	Single-pole signals	(✓)[1]
	ILOCK	Interlocking logic	(✓)[1]

(✓) = ordering option
[1] not available with P132 in a case 24T

Communication Functions			**P132**
	COMMx	2 communication interfaces, IRIG-B, InterMiCOM interface [1]	(✓)
	IRIGB	IRIG-B time synchronization	(✓)
	IEC	IEC 61850 interface	(✓)

(✓) = ordering option

Measured Value Functions			**P132** with VTs	**P132** with CTs	**P132** with CTs and VTs
	MEASI	9 inputs for resistance thermometers		(✓)[1]	(✓)[1]
	MEASI MEASO	20mA input, 2×20mA outputs, input for resistance thermometer	(✓)[1]	(✓)[1]	(✓)[1]

(✓) = ordering option

[1] not available with P132 in case 24T

Global functions			**P132**
	PSS	Parameter subset selection	✓
	F_KEY	Function keys	6 **[1]**

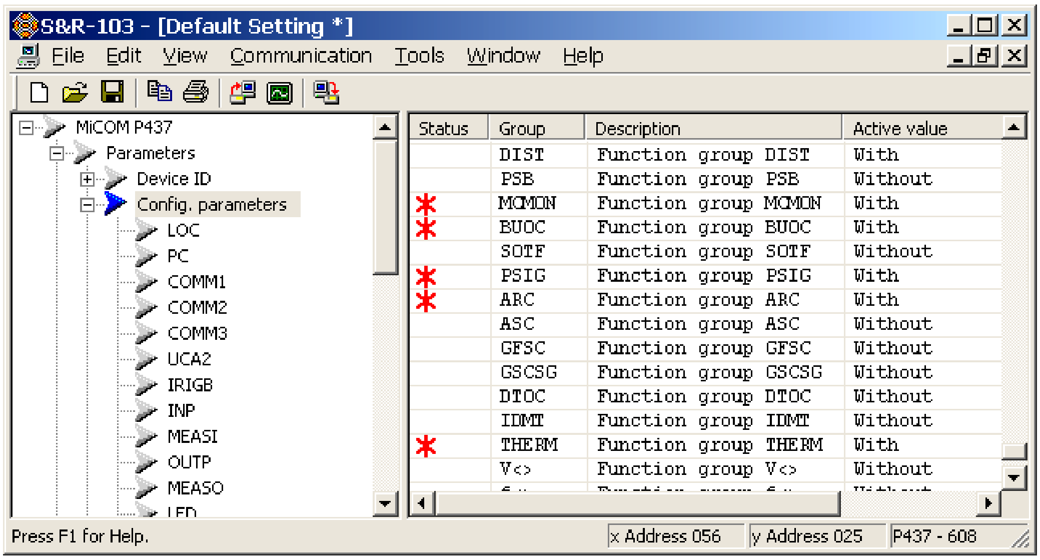
[1] not available with P132 in case 24T

For further functions see Appendix A1

General functions

The functions listed in the table above are complete function groups, which may be individually configured or cancelled (except for ILOCK), depending on the application (e.g. included in or excluded from the protection device's configuration).

A function is selected by a mouse click in the operating program:



Status	Group	Description	Active value
	DIST	Function group DIST	With
	PSB	Function group PSB	Without
*	MCMON	Function group MCMON	With
*	BUOC	Function group BUOC	With
	SOTF	Function group SOTF	Without
*	PSIG	Function group PSIG	With
*	ARC	Function group ARC	With
	ASC	Function group ASC	Without
	GFSC	Function group GFSC	Without
	GSCSG	Function group GSCSG	Without
	DTOC	Function group DTOC	Without
	IDMT	Function group IDMT	Without
*	THERM	Function group THERM	With
	V<>	Function group V<>	Without

Unused or cancelled function groups are hidden to the user, thus simplifying the menu. (An exception is the function MAIN, which is always visible.) Communication functions and measured value functions may also be configured or excluded.

This concept provides a large choice of functions and makes wide-ranging application of the protection device possible, with just one model version. On the other hand simple and clear parameter settings and adaptations to each protection scheme (and optional control purposes) can be made.

In this way the protection and control functions (except for ILOCK) can be included in or excluded from the configuration; they are arranged on the branch "General Functions" of the menu tree.

Control functions

The optional control functions available with the P132 are designed for the control of up to three electrically operated switchgear units equipped with plant status signaling. Acquisition of switchgear contact positions and control is handled via binary signal inputs and output relays situated on the optional binary I/O module X (6xI, 6xO) for switchgear control.

Control of switchgear units is accessed either though binary signal inputs, the optional communication interface or the function keys on the local control panel.

Up to 12 operation signals can be acquired though binary signal inputs and they are processed according to their primary significance (e.g. CB readiness). Each binary signal input for signals from switchgear units and single-pole operations can have the de-bouncing and chatter suppression from three groups assigned, for which the de-bouncing and chatter time can be individually set.

The P132 only issues control signals after it has checked the readiness and validity to carry out such commands, and it then monitors the operating time of the switchgear units. If the protection device detects that a switchgear unit has failed, it will signal this information (e.g. by configuration to a LED indicator).

Before a switching command is issued the interlocking logic on the P132 checks if this new switchgear status corresponds to a valid bay and substation topology.
The interlocking logic is stored in form of bay interlocking, with and without station interlocking, for each Bay Panel in the default setting. The interlocking conditions can be adapted to the actual bay and station topology. Interlocking display and operation correspond to the programmable logic.

When a P132 is included in a substation control system then 'bay interlock with substation interlock' is applied.

When the protection device is not included in a substation control system or when it is included via IEC 61850 then 'bay interlock without substation interlock' is applied, and external ring feeders or messages received via IEC 61850 (IEC-GOOSE) may be included in the interlocking logic.

If the bay and station topology are found to be valid the switching command is issued.
If a non-permissible status would result from the switching action then the issuing of such a switching command is refused and an alarm is issued.

If not all binary outputs are required by the bay type then these vacant binary outputs can be freely utilized for other purposes.

Besides issuing switching commands binary outputs may also be triggered by persistent commands.

Global functions

Global functions permit the interface adaptation of the protection device to meet system requirements, they provide the necessary support during commissioning and testing, and they supply up-to-date operational information as well as valuable analytical data when events have occurred in the system.

In addition to the listed features, and extensive self-monitoring, the P132 is equipped with the following global functions:

- ☐ Parameter subset selection
- ☐ System measurements to support the user during commissioning, testing and operation
- ☐ Operating data recording (time-tagged event logging)
- ☐ Overload data acquisition
- ☐ Overload recording (time-tagged event logging)
- ☐ Ground fault data acquisition
- ☐ Ground fault recording (time-tagged event logging)
- ☐ Fault recording (time-tagged event logging together with fault value recording of the three phase currents, the residual current as well as the three phase-to-ground voltages and the neutral-point displacement voltage).

Internal clock tracking

The MiCOM P132 includes an internal clock which can be set from the key pad on the local control panel. All events that have occurred are time tagged (1 ms resolution) and stored in the recording memories depending on significance, and are then transmitted through the communications interface.

If there is a substation control level available the internal clock may be synchronized with a time message using one of the communication protocols per MODBUS, DNP3, IEC 60870-3-103, or IEC 60870-3-101. The internal clock may also be synchronized with selectable SNTP servers using the communication protocol per IEC 61850.

Always available for time synchronization is an IRIG-B input. The time on the internal clock is tracked and during synchronization with above communication protocols it operates with a deviation of ±10 ms and with the IRIG-B input the deviation is ±1 ms.

Parameter subset selection

The relevant protection parameters can be stored in four independent parameter subsets in order to adapt the protection device to different operating and power system management conditions. Switching between these parameter subsets is carried out from the local control panel or via binary input signals.

Operating data recording

For the continuous recording of processes in system operation as well as of events, a non-volatile (NV) memory is provided (cyclic buffer) to store up to 128 entries.
The "operationally relevant" signals, each fully tagged with date and time at signal start and signal end, are recorded in chronological order. Included are control actions such as enabling or disabling functions and triggering for testing and resetting purposes.
The onset and end of events in the system that represent a deviation from normal operation such as overloads, ground faults or short-circuits are also recorded.

Overload data acquisition

System overload situations represent a deviation from normal operation and may only be permitted to continue for a limited time duration. The overload functions enabled in the protection device will detect a system overload situation and collect respective measured values of this overload, such as the magnitude of the overload current, the relative temperature increase during the overload event and the duration of the overload.

Overload recording

For the duration of the system overload situation "operationally relevant" signals, each fully tagged with date and time at signal start and signal end, are recorded in chronological order in a NV memory. Measured overload values, each fully tagged with date and time at time of detection, are also recorded.

A total of 8 system overload events can be recorded. After eight overload events have been logged, the oldest overload log will be overwritten, unless memories have been cleared in the interim.

Ground fault data acquisition

A ground fault in an isolated neutral system or a resonant-grounded system is considered a system fault but, in general, unlimited system operation may continue. The ground fault determination functions enabled in the protection device will detect a system ground fault and collect respective measured values of this ground fault, such as the magnitude of the neutral-point displacement voltage and the duration of the ground fault.

Ground fault recording

For the duration of the system ground fault situation "operationally relevant" signals, each fully tagged with date and time at signal start and signal end, are recorded in chronological order in a NV memory. Measured ground fault values, each fully tagged with date and time at time of detection, are also recorded.

A total of 8 system ground fault events can be recorded. After eight ground fault events have been logged, the oldest ground fault log will be overwritten, unless memories have been cleared in the interim.

Fault data acquisition

A short-circuit in the system is considered a fault. The short-circuit functions enabled in the protection device will detect a system short-circuit and collect respective measured values of this fault, such as the magnitude of the short-circuit current and the duration of the fault. Either the end of the fault or the time when the trip command is issued may be selected as the point of detection. Triggering from an external signal is also possible. Fault data acquisition occurs based on the measurement loop selected by the protection device and provides current, voltage, and angle values as well as impedance and reactance values.

The distance to the fault is determined from the short-circuit reactance measured value which corresponds to the 100% value set for the protected line section. Output of the fault location is made either during each general starting or only when a trip command is issued.

Fault recording

For the duration of the fault "operationally relevant" signals, each fully tagged with date and time at signal start and signal end, are recorded in chronological order in a NV memory. The measured fault values, fully tagged with the acquisition date and time, are also recorded.

Furthermore sampled values of all analog input variables such as phase currents and phase-to-ground voltages are recorded during a fault.

A total of 8 fault events can be recorded. After eight fault events have been logged, the oldest fault log will be overwritten, unless memories have been cleared in the interim.

Blocking functions

Protection functions and their respective timer stages may be temporarily blocked during commissioning or cyclic tests. For this purpose, individual as well as multiple blocking functions are available.

Blocking functions may be triggered from any of the communications interfaces, the function keys on the local control panel or using binary signal inputs on the MiCOM P132.

Resetting options

Counter and memory data, latching modes, Boolean equations, and stored measured values may be reset individually or by group functions.

A resetting function may be triggered from any of the communications interfaces, the function keys on the local control panel or using binary signal inputs on the MiCOM P132.

Furthermore it is always possible to adapt the functional range of the CLEAR key to the respective requirements.

Self-monitoring

Comprehensive monitoring routines ensure that internal hardware or software faults are detected and do not lead to protection device malfunctions.

A functional test is carried out when the auxiliary voltage is turned on. Cyclic self-monitoring tests are run during protection device operation. Should testing results differ from set values the corresponding signal will be stored in the non-volatile monitoring signal memory. Depending on the type of internal fault detected either blocking of the protection device will occur or just a warning signal will be issued.

Local control panel

All data required for operation of the protection device is entered from the local control panel, and data important for system management is read out there as well.
The following tasks can be handled from the local control panel:

- ❑ Readout and modification of settings
- ❑ Readout of cyclically updated measured operating data and status signals
- ❑ Readout of operating data logs and of monitoring signal logs
- ❑ Readout of event logs after overload situations or short-circuits in the power system
- ❑ Protection device resetting and triggering of additional control functions used in testing and commissioning

Control and display

- ❑ Local control panel including an LC display with 4 x 20 alphanumeric characters
- ❑ 23 multi-colored LED indicators (case 24T: 10 single color LED indicators), 18 of these (case 24T: 5) with user-definable function assignment
- ❑ PC interface
- ❑ Communication interfaces (optional)

Information interfaces

Information is exchanged through the local control panel, the PC interface, or two optional communication interfaces (channel 1 and channel 2).

Using one of the two available communication interfaces (communication protocols per IEC 870-5-103, IEC 60870-5-101, DNP 3, MODBUS or Courier) the numerical protection device can be wired either to the substation control system or a telecontrol system.

The second communication interface (communication protocol per IEC 60870-5-103 only) is designed for remote control.

External clock synchronization can be accomplished by using the optional IRIG-B input.

A direct link to other MiCOM protection devices can be set up by applying the optional InterMiCOM interface (channel 3).

Function keys

On the case 40T and case 84T devices there are six freely configurable function keys available. These may be used for easy control operation access.

Design

The P132 is modular in design. The plug-in modules are housed in a robust aluminum case and electrically interconnected via one analog p/c board and one digital p/c board.

Inputs and outputs

The following inputs and outputs are available:

- ☐ 4 current-measuring inputs
- ☐ 4 or 5 voltage-measuring inputs
- ☐ 4, 10 or 16 additional binary logic inputs (case 24T: 4 additional binary logic inputs) with user-definable function assignment
- ☐ 8, 16 or 24 output relays (case 24T: 8 output relays) with user-definable function assignment
- ☐ optionally 6 additional output relays (4 of these fitted with triacs) or 4 output relays fitted with high-power contacts, each with user-definable function assignment
- ☐ for case 40T and case 84T devices there are optionally 6 or 12 additional binary logic inputs (opto-coupler) and 6 or 12 additional output relays available which are used to control up to 3 switchgear units

(For detailed ordering options see Chapter "Order Information".)

The nominal currents and nominal voltages of the standard measuring inputs can be set.

The nominal voltage range of the binary signal inputs (opto-coupler) is 24 to 250 V DC. As an option binary signal input modules with a higher operate threshold are available.

The auxiliary voltage input for the power supply is also designed for an extended range. The nominal voltage ranges are 48 to 250 V DC and 100 to 230 V AC. As an option there is a variant available for the lower nominal voltage range 24 V to 36 V DC.

All output relays can be utilized for signaling and command purposes.

The optional (up to 10) inputs for resistance thermometers on the temperature p/c board are lead-compensated and balanced.

The optional 0 to 20 mA input provides open-circuit and overload monitoring, zero suppression defined by a setting, plus the option of linearizing the input variable via 20 adjustable interpolation points.

Two selectable measured variables (cyclically updated measured operating data and stored measured fault data) can be output as a burden-independent direct current via the two optional 0 to 20 mA outputs. The characteristics are defined by 3 adjustable interpolation points allowing a minimum output current (4 mA, for example) for slave-side open-circuit monitoring, knee-point definition for fine scaling, and a limitation to lower nominal currents (10 mA, for example). Where sufficient output relays are available, a selectable measured variable can be output by contacts in BCD format.

1 Application and Scope

2 Technical Data

2 Technical Data

2.1 Conformity

Notice

Applicable to P132, version -306 -415/416/417/418/419 -612.

Declaration of conformity

(Per Article 10 of EC Directive 72/73/EC.)
The product designated ‘P132 Time-Overcurrent Protection and Control Unit’ has been designed and manufactured in conformance with the European standards EN 60255-6 and EN 61010-1 and with the ‘EMC Directive’ and the ‘Low Voltage Directive’ issued by the Council of the European Community.

2.2 General Data

General device data

Design
Surface-mounted case suitable for wall installation or flush-mounted case for 19" cabinets and for control panels.

Installation Position
Vertical ± 30°.

Degree of Protection
Per DIN VDE 0470 and EN 60529 or IEC 529.
IP 52; IP 20 for rear connection space with flush-mounted case
(IP 10 for ring-terminal connection)

Weight
24 TE case: Approx. 5 kg
40 TE case: Approx. 7 kg
84 TE case: Approx. 11 kg

Dimensions and Connections
See dimensional drawings (Chapter 4) and terminal connection diagrams (Chapter 5).

Terminals

PC interface (X6): EIA RS232 connector (DIN 41652), type D-Sub, 9-pin.

Communication interfaces COMM1 to COMM3:

Optical fibers (X7, X8 and X31, X32):	F-SMA optical fiber connection per IEC 60874-2 (for plastic fibers) or optical fiber connection BFOC-ST® connector 2.5 per IEC 60874-10-1 (for glass fibers) (ST® is a registered trademark of AT&T Lightguide Cable Connectors)
or Wire leads (X9, X10 and X33):	M2 threaded terminal ends for wire cross-sections up to 1.5 mm²
or (for COMM3 only (InterMiCOM)) RS 232 (X34):	EIA RS232 (DIN 41652) connector, type D-Sub, 9-pin.

IRIG-B Interface (X11): BNC plug

Communication interface IEC 61850:

Optical fibers (X7, X8):	optical fiber connection BFOC-ST® connector 2.5 per IEC 60874-10 (for glass fibers) (ST® is a registered trademark of AT&T Lightguide Cable Connectors)
or	
Optical fibers (X13):	SC connector per IEC 60874-14-4 (for glass fibers)
Wire leads (X12):	RJ45 connector per ISO/IEC 8877.

Current Measuring Inputs:
Threaded terminal ends, pin-type cable lugs: M5,
self-centering with cage clamp to protect conductor cross-sections ≤ 4 mm^2
or:
Threaded terminal ends, ring-type cable lugs: M4

Other Inputs and Outputs:
Threaded terminal ends, pin-type cable lugs: M3,
self-centering with cage clamp to protect conductor cross-sections 0.2 to 2.5 mm^2
or:
Threaded terminal ends, ring-type cable lugs: M4

Creepage Distances and Clearances
Per EN 61010-1 or IEC 664-1
Pollution degree 3, working voltage 250 V
overvoltage category III, impulse test voltage 5 kV.

2.3 Tests

2.3.1 Type Tests

Type tests

All tests per EN 60255-6 or IEC 255-6.

Electromagnetic compatibility (EMC)

Interference Suppression
Per EN 55022 or IEC CISPR 22, Class A.

1 MHz Burst Disturbance Test
Per IEC 255 Part 22-1 or IEC 60255-22-1, Class III
Common-mode test voltage: 2.5 kV
Differential test voltage: 1.0 kV
Test duration: > 2 s
Source impedance: 200 Ω

Immunity to Electrostatic Discharge
Per EN 60255-22-2 or IEC 60255-22-2, severity level 3
Contact discharge
Single discharges: > 10
Holding time: > 5 s
Test voltage: 6 kV
Test generator: 50 to 100 MΩ, 150 pF / 330 Ω

Immunity to Radiated Electromagnetic Energy
Per EN 61000-4-3 and ENV 50204, severity level 3
Antenna distance to tested device: > 1 m on all sides
Test field strength, frequency band 80 to 1000 MHz: 10 V / m
Test using AM: 1 kHz / 80 %
Single test at 900 MHz: AM 200 Hz / 100%.

Electrical Fast Transient or Burst Requirements
Per IEC 60255-22-4, Class B:
Power supply: Amplitude: 2 kV, Burst frequency: 5 kHz
Inputs and outputs: Amplitude: 2 kV, Burst frequency: 5 kHz
Communications: Amplitude: 1 kV, Burst frequency: 5 kHz
Per EN 61000-4-4, severity level 4:
Power supply:
Amplitude: 4 kV, Burst frequency: 2.5 kHz and 5 kHz
Inputs and outputs: Amplitude: 2 kV, Burst frequency: 5 kHz
Communications: Amplitude: 2 kV, Burst frequency: 5 kHz
Rise time of one pulse: 5 ns
Impulse duration (50% value): 50 ns
Burst duration: 15 ms
Burst period: 300 ms
Source impedance: 50 Ω

Power Frequency Immunity
Per IEC 60255-22-7, Class A:
Phase-to-phase:
RMS value 150 V,
Coupling resistance 100 Ω
Coupling capacitor 0.1 µF, for 10 s.
Phase-to-ground:
RMS value 300 V,
Coupling resistance 220 Ω
Coupling capacitor 0.47 µF, for 10 s.
To comply with this standard, the parameter
INP: Filter (010 220) should be set as advised
in Chapter 7.

Current/Voltage Surge Immunity Test
Per EN 61000-4-5 or IEC 61000-4-5, insulation class 4
Testing of circuits for power supply and asymmetrical or symmetrical lines.
Open-circuit voltage, front time / time to half-value: 1.2 / 50 µs
Short-circuit current, front time / time to half-value: 8 / 20 µs
Amplitude: 4 / 2 kV, Pulses: > 5 / min,
Source impedance: 12 / 42 Ω.

Immunity to Conducted Disturbances Induced by Radio Frequency Fields
Per EN 61000-4-6 or IEC 61000-4-6, severity level 3
Test voltage: 10 V.

Power Frequency Magnetic Field Immunity
Per EN 61000-4-8 or IEC 61000-4-8, severity level 4
Test frequency: 50 Hz
Test field strength: 30 A / m.

Alternating Component (Ripple) in DC Auxiliary Energizing Quantity
Per IEC 255-11, 12 %.

Insulation

Voltage Test
Per EN 61010-1 and IEC 255-5
2 kV AC, 60 s
Only direct voltage (2.8 kV DC) must be used for the voltage test on the power supply inputs. The PC interface must not be subjected to the voltage test.

Impulse Voltage Withstand Test
Per IEC 255-5
Front time: 1.2 µs
Time to half-value: 50 µs
Peak value: 5 kV
Source impedance: 500 Ω.

Mechanical robustness

Vibration Test
Per EN 60255-21-1 or IEC 255-21-1, test severity class 1:
Frequency range in operation: 10 to 60 Hz, 0.035 mm and 60 to 150 Hz, 0.5 g
Frequency range during transport: 10 to 150 Hz, 1 g

Shock Response and Withstand Test, Bump Test
Per EN 60255-21-2 or IEC 255-21-2,
acceleration and pulse duration:
Shock Response tests are carried out to verify full operability (during operation), test severity class 1 , 5 g for 11 ms,
Shock Withstand tests are carried out to verify the endurance (during transport), test severity class 1 , 15 g for 11 ms

Seismic Test
Per EN 60255-21-3 or IEC 60255-21-3, test procedure A, class 1
Frequency range:
5 to 8 Hz, 3.5 mm / 1.5 mm, 8 to 35 Hz, 10 / 5 m/s^2, 3 x 1 cycle.

Vibration Test [1)]
Per EN 60255-21-1 or IEC 255-21-1, test severity class 2:
Frequency range in operation: 10 to 60 Hz, 0.075 mm and 60 to 150 Hz, 1.0 g
Frequency range during transport: 10 to 150 Hz, 2 g

Shock Response and Withstand Test, Bump Test [1)]
Per EN 60255-21-2 or IEC 255-21-2,
acceleration and pulse duration:
Shock Response tests are carried out to verify full operability (during operation), test severity class 2, 10 g for 11 ms;
Shock Withstand tests are carried out to verify the endurance (during transport), test severity class 1, 15 g for 11 ms
Shock bump tests are carried out to verify permanent shock (during transport), test severity class 1, 10 g for 16 ms

Seismic Test [1)]
Per EN 60255-21-3 or IEC 60255-21-3, test procedure A, class 2
Frequency range:
5 to 8 Hz, 7.5 mm / 3.5 mm, 8 to 35 Hz, 20 / 10 m/s^2, 3 x 1 cycle

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[1] Increased mechanical robustness for the following case variants:
Flush mounted case, variant 2 (with angle brackets and frame)
Surface-mounted case

2.3.2 Routine Tests

All tests per EN 60255-6 or IEC 255-6
and DIN 57435 Part 303.

Voltage Test
Per IEC 255-5
2.2 kV AC, 1 s
Only direct voltage (2.8 kV DC) must be used for the voltage test on the power supply inputs.
The PC interface must not be subjected to the voltage test.

Additional Thermal Test
100% controlled thermal endurance test, inputs loaded.

2.4 Environmental Conditions

Environment

Temperatures
Recommended temperature range: -5°C to +55°C or +23°F to +131°F
Limit temperature range: -25°C to +70°C or -13°F to +158°F.

Ambient Humidity Range
≤ 75% relative humidity (annual mean),
56 days at ≤ 95% relative humidity and 40°C (104°F), condensation not permitted.

Solar Radiation
Direct solar radiation on the front of the device must be avoided.

2.5 Inputs and Outputs

Measuring inputs

Current
Nominal current I_{nom}: 1 and 5 A AC (adjustable)
Nominal consumption per phase: < 0.1 VA at I_{nom}
Load rating:
  continuous: 4 I_{nom},
  for 10 s: 30 I_{nom},
  for 1 s: 100 I_{nom},
Nominal surge current: 250 I_{nom}

Voltage
Nominal voltage V_{nom}: 50 to 130 V AC (adjustable)
Nominal consumption per phase: < 0.3 VA at V_{nom} = 130 V AC
Load rating: continuous 150 V AC.

Frequency
Nominal frequency f_{nom}: 50 Hz and 60 Hz (adjustable)
Operating range: 0.95 to 1.05 f_{nom}
Frequency protection: 40 to 70 Hz

Binary signal inputs

Threshold Pickup and Drop-off Points as per Ordering Option
18 V standard variant ($V_{A,nom}$: = 24 to 250 V DC):
Switching threshold in the range 14 V ... 19 V

Special variants with switching thresholds from 58 to 72 % of the nominal input voltage (i.e. definitively 'low' for V_A < 58 % of the nominal supply voltage, definitively 'high' for V_A > 72 % of the nominal supply voltage)

"Special variant 73 V": Nominal supply voltage 110 V DC
"Special variant 90 V": Nominal supply voltage 127 V DC
"Special variant 146 V": Nominal supply voltage 220 V DC
"Special variant 155 V": Nominal supply voltage 250 V DC

Power consumption per input
Standard variant:
V_A = 19 ... 110 V DC: 0.5 W ± 30 %,
V_A > 110 V DC: $V_A \bullet$ 5 mA ± 30 %.

Special variant:
V_{in} > Switching threshold: $V_A \bullet$ 5 mA ± 30 %.

Notes
The standard variant of binary signal inputs (opto couplers) is recommended in most applications, as these inputs operate with any voltage from 19 V. Special versions with higher pick-up/drop-off thresholds are provided for applications where a higher switching threshold is expressly required.

The maximum voltage permitted for all binary signal inputs is 300V DC.

IRIG-B interface

Minimum / maximum input voltage level (peak-peak): 100 mVpp / 20 Vpp.
Input impedance: 33 kΩ at 1 kHz.
Electrical isolation: 2 kV

Analog Inputs and Outputs

Direct current input
Input current: 0 to 26 mA
or 0.00 to 1.20 $I_{DC,nom}$ ($I_{DC,nom\ =}$ 20 mA)
Maximum permissible continuous current: 50 mA.
Maximum permissible input voltage: 17 V.
Input resistance: 100 Ω.
Open-circuit monitoring: 0 to 10 mA (adjustable)
Overload monitoring: > 24.8 mA
Zero suppression: 0.000 to 0.200 $I_{DC,nom}$ (adjustable).

Resistance thermometer
Only PT 100 permitted for analog (I/O) module, mapping curve per IEC 75.1
PT 100, Ni 100 or Ni 120 permitted for temperature p/c board (the RTD module)
Value range: –40.0°C to +215.0°C (–40°F to +419°F)
3-wire configuration: max. 20 Ω per conductor
Open and short-circuited input permitted
Operate values of the measuring circuit monitoring signal: Θ > +215°C (+419°F) and Θ < –40°C (–40°F)

Direct current output

Output current:	0 to 20 mA
Maximum permissible load:	500 Ω
Maximum output voltage:	15 V

Output relays

Binary I/O module X (6xI, 6xO):
for switchgear control

Rated voltage:	250 V DC, 250 V AC
Continuous current:	8 A
Short-duration current:	30 A for 0.5 s
Making capacity:	1000 W (VA) at L/R = 40 ms
Breaking capacity:	0.2 A at 220 V DC and L/R = 40 ms, 4 A at 230 V AC and cosφ = 0.4

Binary I/O module X (4H):
with heavy duty contacts, use only for direct voltage/current

	250 V DC
Continuous current:	10 A
Short-duration current:	250 A for 30 ms, 30 A for 3 s
Making capacity:	30 A
Breaking capacity:	7500 W (resistive load) or 30 A at 250 V DC, Maximum values: 30 A and 300 V DC 2500 W inductive(L/R 40 ms) or 10 A at 250 V DC, Maximum values: 10 A and 300 V DC

All other modules:

Rated voltage:	250 V DC, 250 V AC
Continuous current:	5 A
Short-duration current:	30 A for 0.5 s
Making capacity:	1000 W (VA) at L/R = 40 ms
Breaking capacity:	0.2 A at 220 V DC and L/R = 40 ms, 4 A at 230 V AC and cosφ = 0.4

BCD measured data output

Maximum numerical value that can be displayed: 399

2.6 Interfaces

Local control panel

Input or output:
via 7 keys (40TE and 84TE cases: additional 6 function keys)
and a 4 x 20 character-LCD display

State and fault signals:
40TE and 84TE cases: 23 LED indicators (5 permanently assigned, 18 freely configurable)
24TE cases: 10 LED indicators (5 permanently assigned, 5 freely configurable)

PC interface

Transmission rate: 300 to 115,200 baud (adjustable)

Communication interfaces COMM1, COMM2, COMM3

The communication module can be provided with up to three communication channels, depending on the module variant. Channel 1 and 3 may either be equipped to connect wire leads or optical fibers and channel 2 is only available to connect wire leads.

For communication interface 1, communication protocols based on IEC 870-5-103, IEC 60870-5-101, MODBUS, DNP 3.0, or Courier can be set,
Transmission rate: 300 to 64,000 bits/s (adjustable).

Communication interface 2 can only be operated with the interface protocol based on IEC 60870-5-103.
Transmission rate: 300 to 57,600 bits/s (adjustable).

Communication interface 3 permits end-end channel-aided digital communication schemes to be configured for real time protective signaling between two protection devices (asynchronous, full-duplex InterMiCOM protective interface)
Transmission rate: 600 to 19,200 bits/s (adjustable).

Wire Leads
Per RS 485 or RS 422, 2 kV isolation
Distance to be bridged
Point-to-point connection: max. 1200 m
Multipoint connection: max. 100 m

Plastic Fiber Connection
Optical wavelength: typically 660 nm
Optical output: min. –7.5 dBm
Optical sensitivity: min. –20 dBm
Optical input: max. –5 dBm
Distance to be bridged: max. 45 m
(Distance to be bridged given for identical optical outputs and inputs at both ends, a system reserve of 3 dB, and typical fiber attenuation)

Glass Fiber Connection G 50/125
Optical wavelength: typically 820 nm
Optical output: min. –19.8 dBm
Optical sensitivity: min. –24 dBm
Optical input: max. –10 dBm
Distance to be bridged: max. 400 m
(Distance to be bridged given for identical optical outputs and inputs at both ends, a system reserve of 3 dB, and typical fiber attenuation)

Glass Fiber Connection G 62.5/125
Optical wavelength: typically 820 nm
Optical output: min. –16 dBm
Optical sensitivity: min. –24 dBm
Optical input: max. –10 dBm
Distance to be bridged: max. 1,400 m
(Distance to be bridged given for identical optical outputs and inputs at both ends, a system reserve of 3 dB, and typical fiber attenuation)

IEC Communication interface

Wire Leads
IEC 61850-compliant, Ethernet-based communications:
Transmission rate: 10 or 100 Mbit/s
RJ45, 1.5 kV isolation
Maximum distance: 100 m

for optical fibers (100 Mbit/s)
IEC 61850-compliant, Ethernet-based communications:
ST connector or SC connector
Optical wavelength: typically 1,300 nm
Glass fiber G50/125:
  Optical output: min. –23.5 dBm
  Optical sensitivity: min. –31 dBm
  Optical input: max. –14 dBm
Glass fiber G62.5/125:
  Optical output: min. –20 dBm
  Optical sensitivity: min. –31 dBm
  Optical input: max. –14 dBm

IRIG-B interface

B122 format
Amplitude-modulated signal
Carrier frequency: 1 kHz
BCD- coded variable data (daily)

2.7 Information Output

Counters, measured data, and indications: see Chapter 8.

2.8 Settings

Typical characteristic data

Main function
Minimum output pulse for trip command: 0.1 to 10 s (adjustable)
Minimum output pulse for close command: 0.1 to 10 s (adjustable)

Definite-time and inverse-time overcurrent protection
Shortest tripping time:
  Time-delayed stages:
    non-directional mode: approx. 0.7 period
    directional mode: approx. 1.2 period
  Residual current stage: ≤ 10 ms (with tIN> = 0 ms)
Starting reset time: approx. 1.5 period
  (from 2-fold operate value to 0):Starting and measurement resetting ratio (hysteresis): 0.95

Short-Circuit Direction Determination
Nominal acceptance angle for forward decision: ± 90°
Resetting ratio forward/backward recognition: ≤ 7°
Base point release for phase currents: 0.1 I_{nom}
Base point release for phase-to-phase voltages: 0.002 V_{nom} at V_{nom} = 100 V
Base point release for residual currents: 0.01 I_{nom}
Base point release for neutral displacement voltage: 0.015 to 0.6 $V_{nom}/\sqrt{3}$ (adjustable)

Time-Voltage Protection
Operate time including output relay (measured variable from nominal value to 1.2-fold operate value or measured variable from nominal value to 0.8-fold operate value):
≤ 40 ms, approx. 30 ms
Reset time (measured variable from 1.2-fold operate value to nominal value or measured variable from 0.8-fold operate value to nominal value):
≤ 45 ms, approx. 30 ms
Resetting ratio for V<>: 1 to 10 % (adjustable)

Power Directional Protection
Operate time including output relay (measured variable from nominal value to 1.2-fold operate value or measured variable from nominal value to 0.8-fold operate value):
≤ 60 ms, approx. 50 ms
Reset time (measured variable from 1.2-fold operate value to nominal value or measured variable from 0.8-fold operate value to nominal value):
≤ 40 ms, approx. 30 ms
Resetting ratio for
P>, Q>: 0.05 to 0.95 (adjustable)
P<, Q<: 1.05 to 20 (adjustable)

2.9 Deviations

2.9.1 Deviations of the Operate Values

Definitions

Reference Conditions
Sinusoidal signals at nominal frequency f_{nom}, total harmonic distortion ≤ 2 %, ambient temperature 20°C (68°F), and nominal auxiliary voltage $V_{A,nom}$.

Deviation
Deviation relative to the setting under reference conditions.

Measuring-Circuit Monitoring

Operate values $I_{diff>}$, $V_{min<}$
Deviation: ± 3 %

Definite-time and inverse-time overcurrent protection

Phase and Residual Current Stages
Deviation: ± 5 %

Negative-Sequence System Stages
Deviation: ± 5 %

Short-Circuit Direction Determination

Deviation: ± 10°

Motor protection and thermal overload protection (reaction time)

Deviation ± 7.5 % when I/I_{ref} = 6

Unbalance Protection

Deviation: ± 5 %

Time-Voltage Protection

Operate Values
V<>, Vpos<>: ± 1 % (in the range 0.6 to 1.4 Vnom)
VNG>, Vneg>: ± 1 % % (in the range > 0.3 Vnom)

Over-/underfrequency protection

Operate values f<>
± 30 mHz (f_{nom} = 50 Hz)
± 40 mHz (f_{nom} = 60 Hz)

Operate values df/dt
± 0.1 Hz/s (f_{nom} = 50 or 60 Hz)

Power Directional Protection

Operate Values P<>, Q<>
Deviation: ± 5 %

Ground Fault Direction Determination Using Steady-State Values (GFDSS)

Operate values V_{NG}>, $I_{N,act}$>, $I_{N,reac}$>, I_N>
Deviation: ± 3 %

Sector angle:
Deviation: 1°

Direct current input

Deviation: ± 1 %

Resistance thermometer

Deviation: ± 2° or ± 1 %

Analog measured data output

Deviation: ± 1 %
Output residual ripple with max. load: ± 1 %

2.9.2 Deviations of the Timer Stages

Definitions

Reference Conditions
Sinusoidal signals at nominal frequency f_{nom}, total harmonic distortion ≤ 2 %, ambient temperature 20°C (68°F), and nominal auxiliary voltage $V_{A,nom}$.

Deviation
Deviation relative to the setting under reference conditions.

Definite-time stages

Deviation: ± 1% + 20 to 40 ms
Residual current stage: ≤ 3 ms (with tIN> = 0 ms)

Inverse-time stages

Deviation when I ≥ 2 I_{ref}:
± 5 % + 10 to 25 ms
For IEC characteristic 'extremely inverse' and for thermal overload protection:
± 7.5 % + 10 to 20 ms

2.9.3 Deviations of Measured Data Acquisition

Definitions

Reference Conditions
Sinusoidal signals at nominal frequency f_{nom}, total harmonic distortion ≤ 2 %, ambient temperature 20°C (68°F), and nominal auxiliary voltage $V_{A,nom}$.

Deviation
Deviation relative to the setting under reference conditions.

Operating Data Measurement

Measuring Input Currents
Deviation: ± 1 %

Measuring Input Voltages
Deviation: ± 0.5 %

Internally Formed Resultant Current and Negative-Sequence System Current
Deviation: ± 2 %

Internally Formed Neutral-point Displacement Voltage and Voltages of Positive- and Negative-Sequence Systems
Deviation: ± 2 %

Active and Reactive Power / Active and Reactive Energy
Deviation: ± 2 % when $\cos \varphi = \pm 0.7$
Deviation: ± 5 % when $\cos \varphi = \pm 0.3$

Load angle
Deviation: ± 1°

Frequency
Deviation: ± 10 mHz

Direct Current of Measured Data Input and Output
Deviation: ± 1 %

Temperature
Deviation: ± 2°C

Fault data

Short-Circuit Current and Voltage
Deviation: ± 3 %

Short-Circuit Impedance, Reactance, and Fault Location
Deviation: ± 5 %

Internal clock

With free running internal clock:
Deviation: < 1 min/month

With external synchronization (with a synchronization interval ≤ 1 min):
Deviation: < 10 ms

With synchronization via IRIG-B interface: ± 1 ms

2.10 Resolution of the Fault Value Acquisition

Time resolution of fault recording

20 sampled values per period

Phase currents system

Dynamic range: 100 I_{nom} or 25 I_{nom}
Amplitude resolution:
at I_{nom} = 1 A: 6.1 mA_{rms} or 1.5 mA_{rms}
at I_{nom} = 5 A: 30.5 mA_{rms} or 7.6 mA_{rms}

Residual current

Dynamic range: 16 I_{nom} or 2 I_{nom}
Amplitude resolution:
at I_{nom} = 1 A: 0.98 mA_{rms} or 0.12 mA_{rms}
at I_{nom} = 5 A: 4.9 mA_{rms} or 0.61 mA_{rms}

Voltage

Dynamic range: 150 V
Amplitude resolution: 9.2 mV_{rms}

2.11 Recording Functions

Organization of the Recording Memories:

Operating data memory

Scope for signals: All signals relating to normal operation; from a total of 1024 different logic state signals
Depth: The 100 most recent signals

Monitoring signal memory

Scope for signals: All signals relevant for self-monitoring from a total of 1024 different logic state signals
Depth: Up to 30 signals

Overload memory

Number: The 8 most recent overload events
Scope for signals: All signals relevant for an overload event from a total of 1024 different logic state signals
Depth: 200 entries per overload event

Ground fault memory

Number: The 8 most recent ground fault events
Scope for signals: All signals relevant for a ground fault event from a total of 1024 different logic state signals
Depth: 200 entries per ground fault event

Fault memory

Number: The 8 most recent fault events

Scope for signals: Signals:
All fault-relevant signals from a total of 1024 different logic state signals

Depth for fault values:
Sampled values for all measured currents and voltages

Depth for signals Signals:
200 entries per fault event

Depth for fault values:
max. number of cycles per fault can be set by user;
820 periods in total for all faults, that is 16.4 s (for f_{nom} = 50 Hz) or
13.7 s (for f_{nom} = 60 Hz)

2.12 Power supply

Power supply

Nominal auxiliary voltage $V_{A,nom}$:
24 V DC or 48 to 250 V DC and 100 to 230 V AC (ordering option)

Operating range for direct voltage:
0.8 to 1.1 $V_{A,nom}$ with a residual ripple of up to 12 % $V_{A,nom}$
Operating range for alternating voltage: 0.9 to 1.1 $V_{A,nom}$

Nominal consumption with V_A = 220 V DC and with maximum module configuration
(relays de-energized/energized) 24 TE case: approx. 11 W / 20 W
(relays de-energized/energized): 40 TE case: approx. 11 W / 25 W
(relays de-energized/energized): 84 TE case: approx. 11 W / 44 W
Start-up peak current: < 3 A for duration of 0.25 ms
Stored energy time ≥ 50 ms for interruption of $V_A \geq$ 220 V DC

2.13 Current Transformer Specifications

The following equation is used to calculate the specifications of a current transformer for the offset maximum primary current:

$$\mathrm{V_{sat}} = (\mathrm{R_{nom}} + \mathrm{R_i}) \cdot \mathrm{n} \cdot \mathrm{I_{nom}} \geq (\mathrm{R_{op}} + \mathrm{R_i}) \cdot \mathrm{k} \cdot \mathrm{I'_{1,max}}$$

with:

V_{sat}:	saturation voltage (IEC knee point)
$I'_{1,max}$:	non-offset maximum primary current, converted to the secondary side
I_{nom}:	rated secondary current
n:	rated overcurrent factor
k:	over-dimensioning factor
R_{nom}:	rated burden
R_{op}	actual connected operating burden
R_i	internal burden

The specifications of a current transformer can then be calculated for the minimum required saturation voltage V_{sat} as follows:

$$V_{sat} \geq (R_{op} + R_i) \cdot k \cdot I'_{1,\max}$$

As an alternative, the specifications of a current transformer can also be calculated for the minimum required rated overcurrent factor n by specifying a rated power P_{nom} as follows:

$$n \geq \frac{(R_{op} + R_i)}{(R_{nom} + R_i)} \cdot k \cdot \frac{I'_{1,\max}}{I_{nom}} = \frac{(P_{op} + P_i)}{(P_{nom} + P_i)} \cdot k \cdot \frac{I'_{1,\max}}{I_{nom}}$$

With

$$P_{nom} = R_{nom} \cdot I_{nom}^2$$
$$P_{op} = R_{op} \cdot I_{nom}^2$$
$$P_i = R_i \cdot I_{nom}^2$$

Theoretically, the specifications of the current transformer could be calculated for lack of saturation by inserting instead of the required over-dimensioning factor k its maximum value:

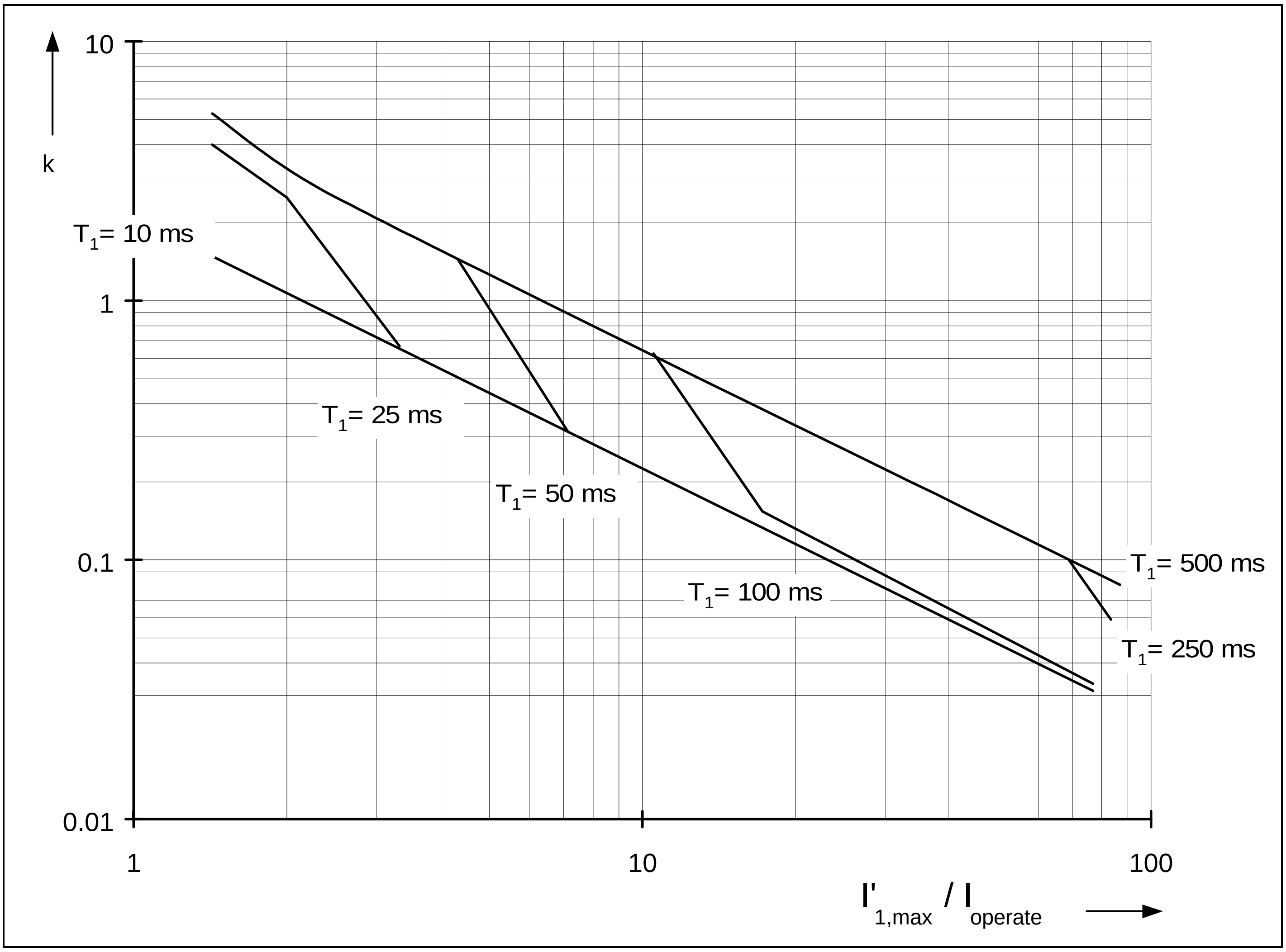
$$k_{max} \approx 1 + \omega T_1$$

with:

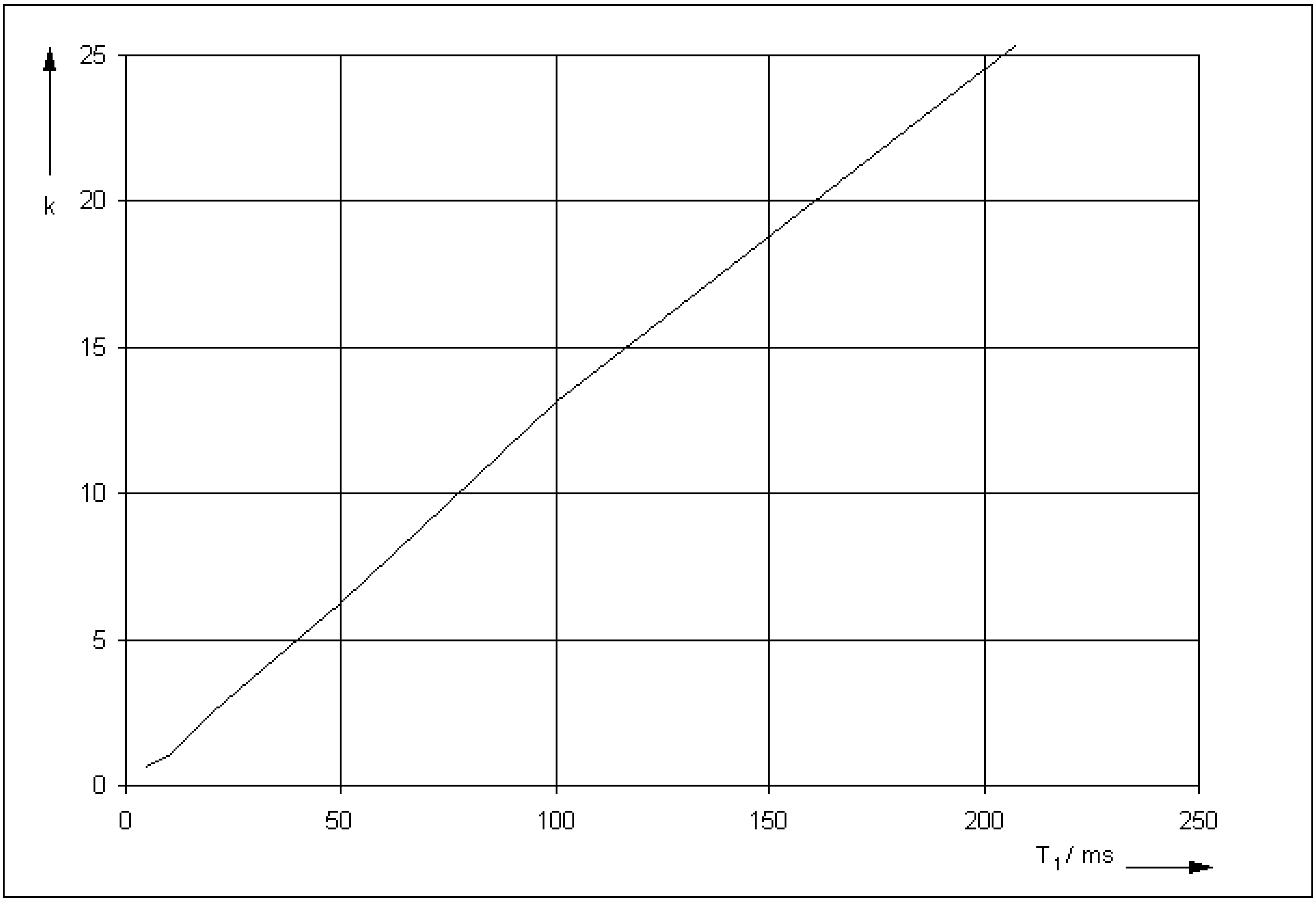
ω :	system angular frequency
T_1:	system time constant

However, this is not necessary. Instead, it is sufficient to calculate the over-dimensioning factor k such that the normal behavior of the analyzed protective function is guaranteed under the given conditions.

If the P132 is to be used for definite-time overcurrent protection, then the over-dimensioning factor k that is to be selected is primarily a function of the ratio of the maximum short-circuit current to the set operate value and, secondly, of the system time constant T_1. The required over-dimensioning factor can be read from the empirically determined curves in Figure 2-1. When inverse-time maximum current protection is used, the over-dimensioning factor can be taken from Figure 2-2.



2-1 Required over-dimensioning factor for definite-time overcurrent protection with fnom = 50 Hz

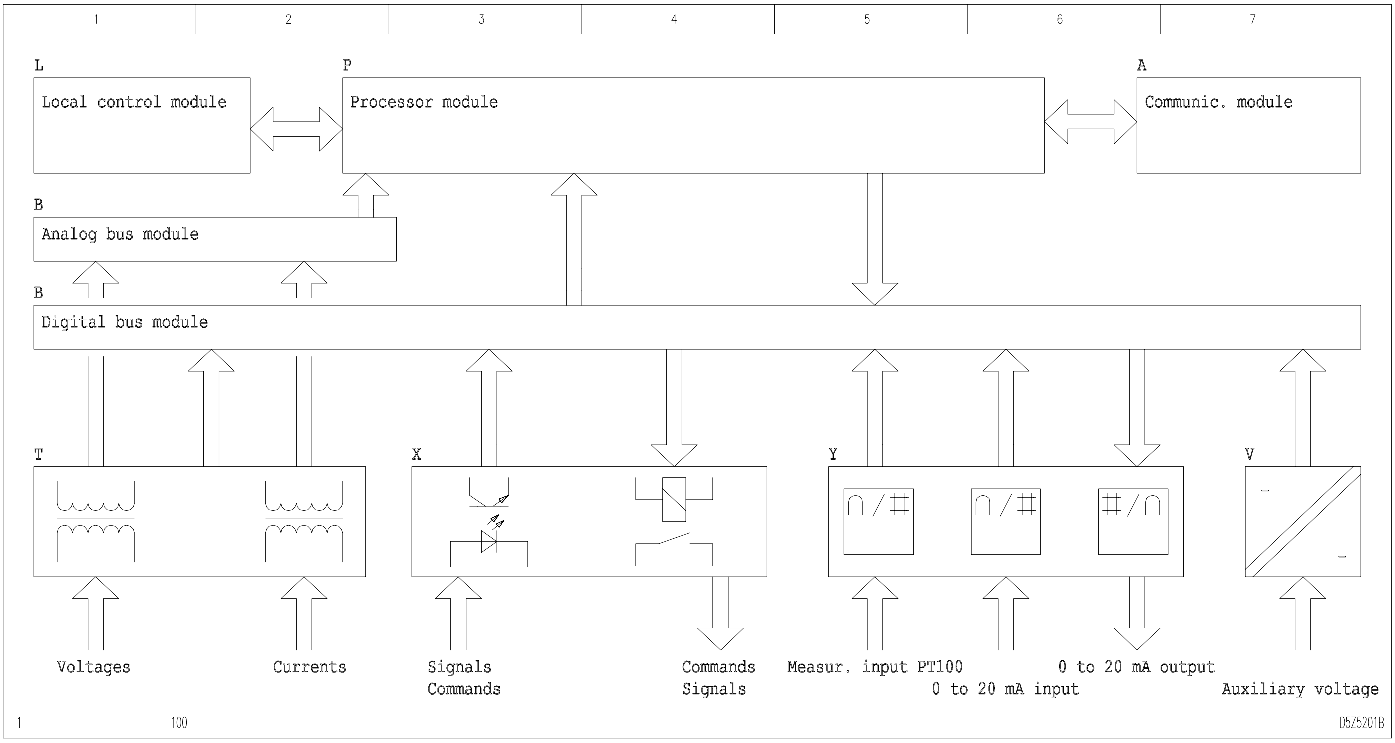


2-2 Required over-dimensioning factor for inverse-time maximum current protection with fnom = 50 Hz

3 Operation

3.1 Modular Structure

The P132, a numeric device, is part of the MiCOM P 30 family of devices. The device types included in this family are built from identical uniform hardware modules. Figure 3-1 shows the basic hardware structure of the P132.



3-1 Basic hardware structure

The external analog and binary quantities – electrically isolated – are converted to the internal processing levels by the peripheral modules T, Y, and X. Commands and signals generated by the device internally are transmitted to external destinations via floating contacts through the binary I/O modules X. The external auxiliary voltage is applied to the power supply module V, which supplies the auxiliary voltages that are required internally.

The analog data are always transferred from the transformer module T to the processor module P by way of the analog bus module.The processor module contains all the elements necessary for the conversion of measured analog variables, including multiplexers and analog/digital converters. The analog data processed by analog module Y are fed to the processor module P by way of the digital bus module. Binary signals are fed to the processor module by the binary I/O modules X via the digital bus module. The processor handles the processing of digitized measured variables and of binary signals, generates the protective trip as well as signals, and transfers them to the binary I/O modules X via the digital bus module. The processor module also handles overall device communication. As an option, communication module A can be mounted on the processor module to provide serial communication with substation control systems.

The control and display elements of the integrated local control panel and the integrated PC interface are housed on control module L.

3.2 Operator-Machine Communication

The following interfaces are available for the exchange of information between operator and device:

- ☐ Integrated local control panel
- ☐ PC interface
- ☐ Communication interface

All setting parameters and signals as well as all measured variables and control functions are arranged within the branches of the menu tree following a scheme that is uniform throughout the device family. The main branches are:

‘Parameters’ branch

This branch carries all setting parameters, including the device identification data, the configuration parameters for adapting the device interfaces to the system, and the function parameters for adapting the device functions to the process. All values in this group are stored in non-volatile memory, which means that the values will be preserved even if the power supply fails.

‘Operation’ branch

This branch includes all information relevant for operation such as measured operating data and binary signal states. This information is updated periodically and consequently is not stored. In addition, various control parameters are grouped here, for example those for resetting counters, memories and displays.

‘Events’ branch

The third branch is reserved for the recording of events. Therefore all information contained in this group is stored. In particular the start/end signals during a fault, the measured fault data as well as sampled fault records are stored here and can be read out at a later time.

Settings and signals are displayed either in plain text or as addresses, in accordance with the user’s choice.

The configuration of the local control panel also permits the installation of ‘Measured Value Panels’ on the LCD display. Different panels are automatically displayed for certain system operating conditions. Priority increases from normal operation to operation under overload conditions and finally to operation following a short circuit in the system. Thus the P132 provides the measured data relevant for the prevailing conditions.

3.3 Configuring the Measured Value Panels and Selection of the Control Point (Function Group LOC)

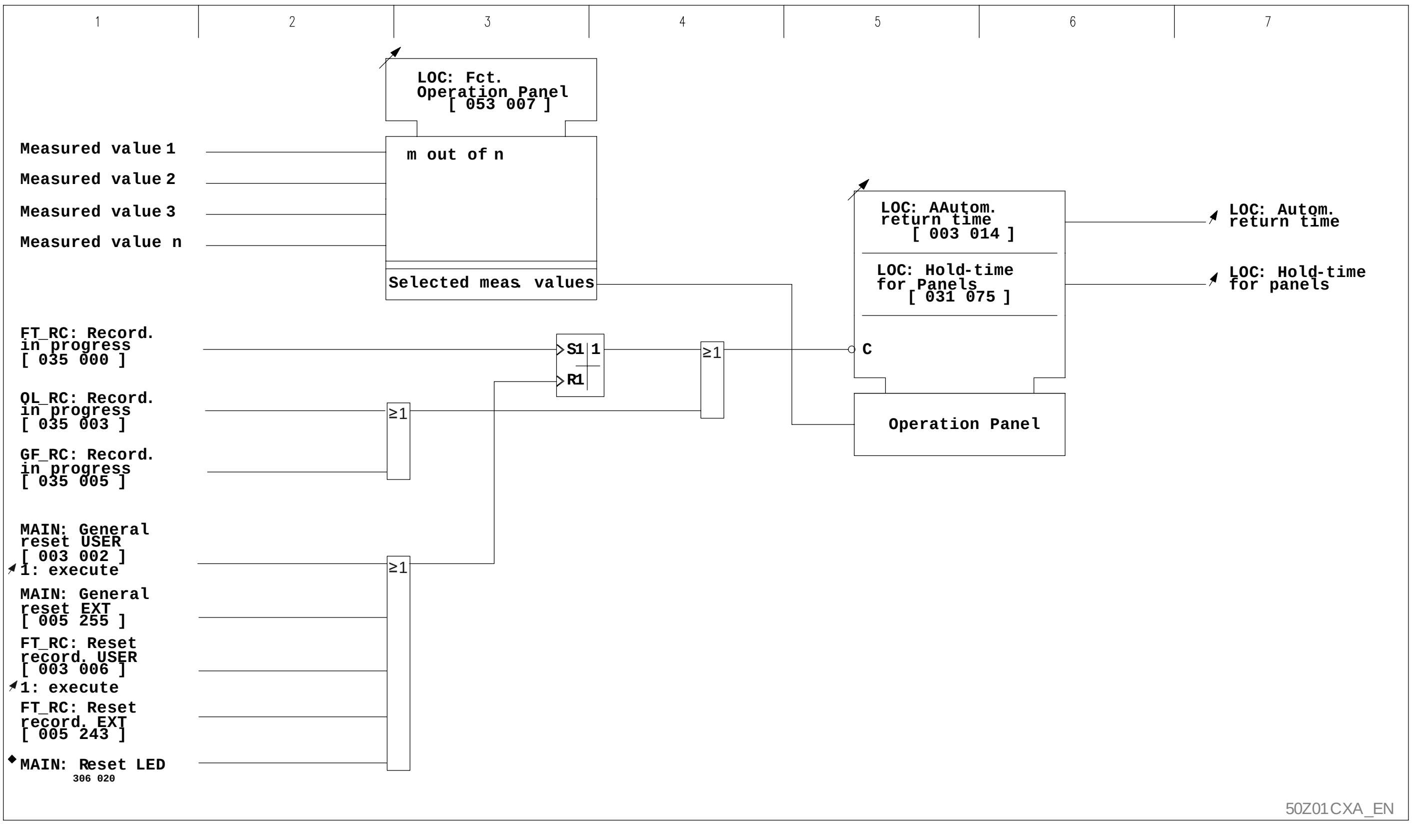
The P132 provides Measured Value Panels that display the measured values relevant at a given time.

During normal power system operation, the Operation Panel is displayed. When an event occurs, the display switches to the appropriate Event Panel – provided that measured values have been selected for the Event Panels. In the event of overload or ground fault events, the display will automatically switch to the Operation Panel at the end of the event. In the event of a fault, the Fault Panel remains active until the LED indicators or the fault memories are reset.

Operation Panel

The Operation Panel is displayed after the set return time has elapsed, provided that at least one measured value has been configured.

The user can select which of the measured operating values will be displayed on the Operation Panel by means of an ‘m out of n’ parameter. If more measured values are selected for display than the LC display can accommodate, then the display will switch to the next set of values at intervals defined by the setting at `LOC: Hold-Time for Panels` or when the appropriate key on the local control panel is pressed.

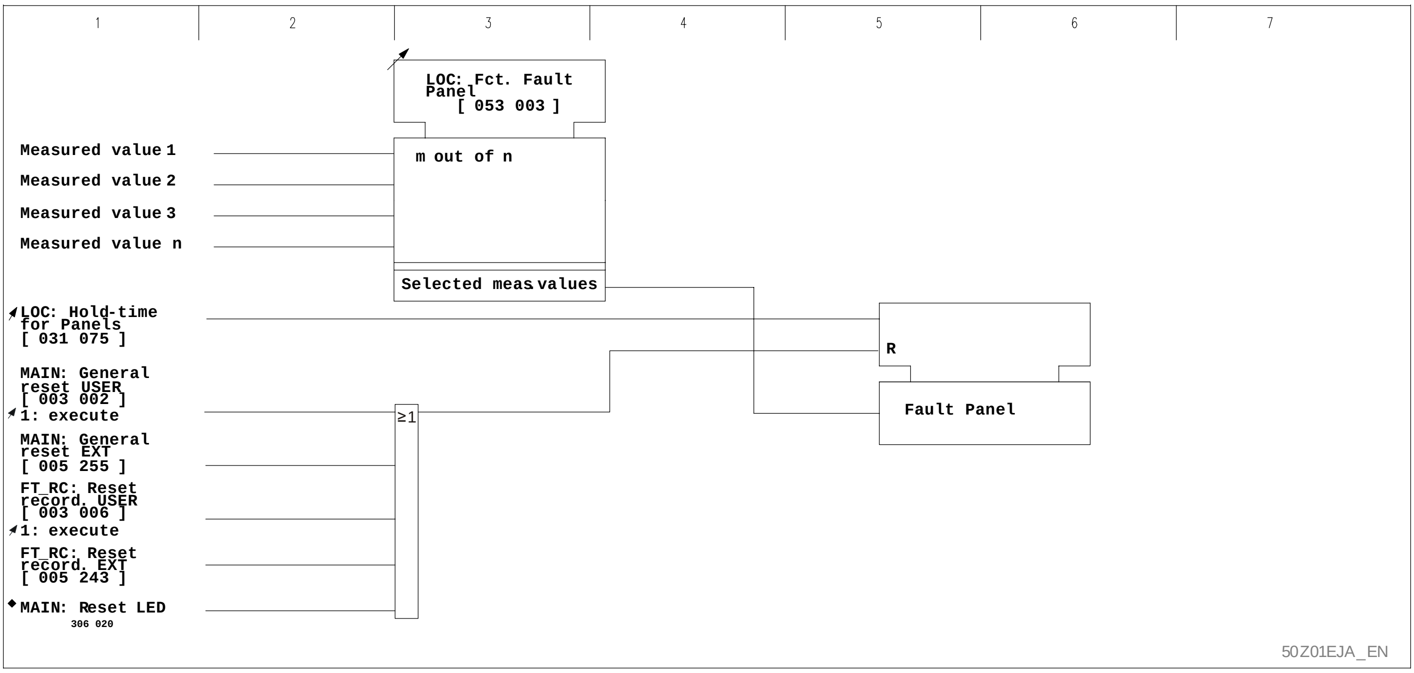


3-2 *Operation Panel*

Fault Panel

The Fault Panel is displayed in place of another data panel when there is a fault, provided that at least one measured value has been configured. The Fault Panel remains on display until the LED indicators or the fault memories are cleared.

The user can select the measured fault values that will be displayed on the Fault Panel by setting an 'm out of n' parameter. If more measured values are selected for display than the LC display can accommodate, then the display will switch to the next set of values at intervals defined by the setting at LOC: Hold-Time for Panels or when the appropriate key on the local control panel is pressed.

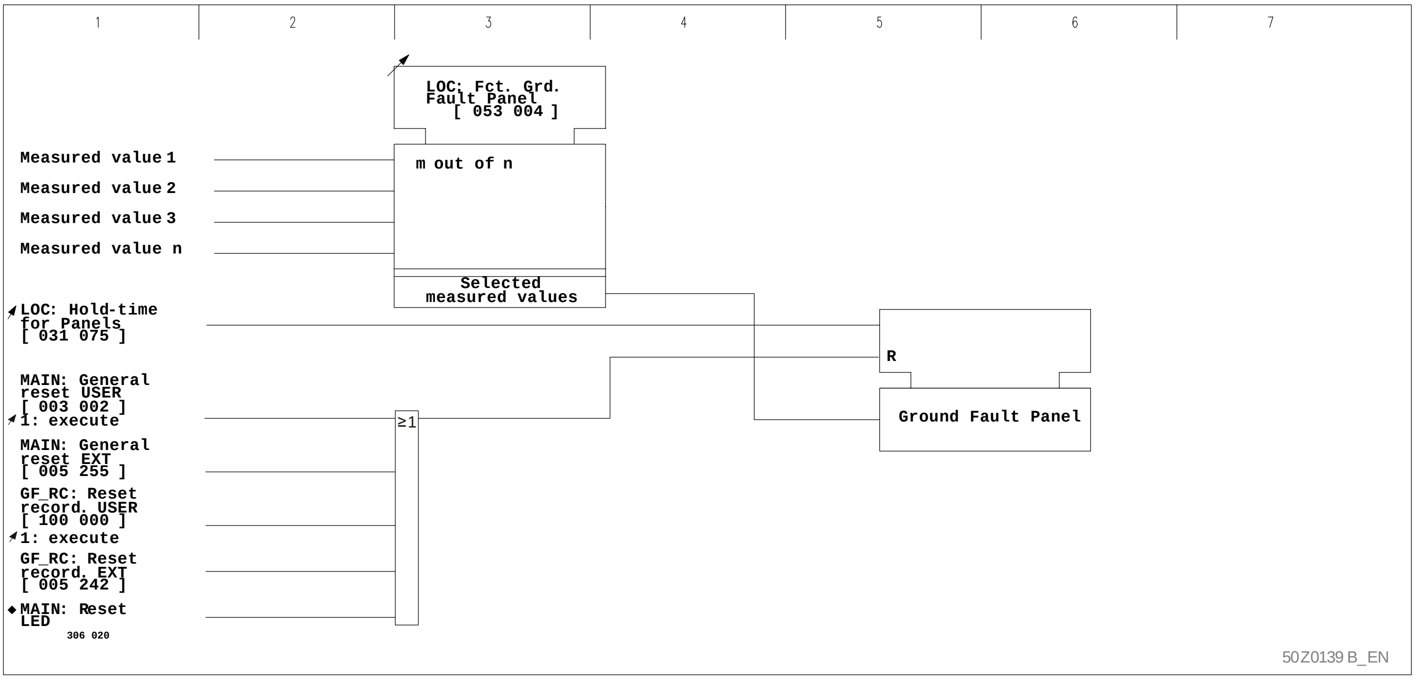


3-3 *Fault panel*

Ground Fault Panel

The Ground Fault Panel is automatically displayed in place of another data panel when there is a fault, provided that at least one measured value has been configured. The Ground Fault Panel remains on display until the ground fault ends, unless a fault occurs. In this case the display switches to the Fault Panel.

The user can select the measured values that will be displayed on the Ground Fault Panel by setting a 'm out of n' parameter. If more measured values are selected for display than the LC display can accommodate, then the display will switch to the next set of values at intervals defined by the setting at LOC: Hold-Time for Panels or when the appropriate key on the local control panel is pressed.

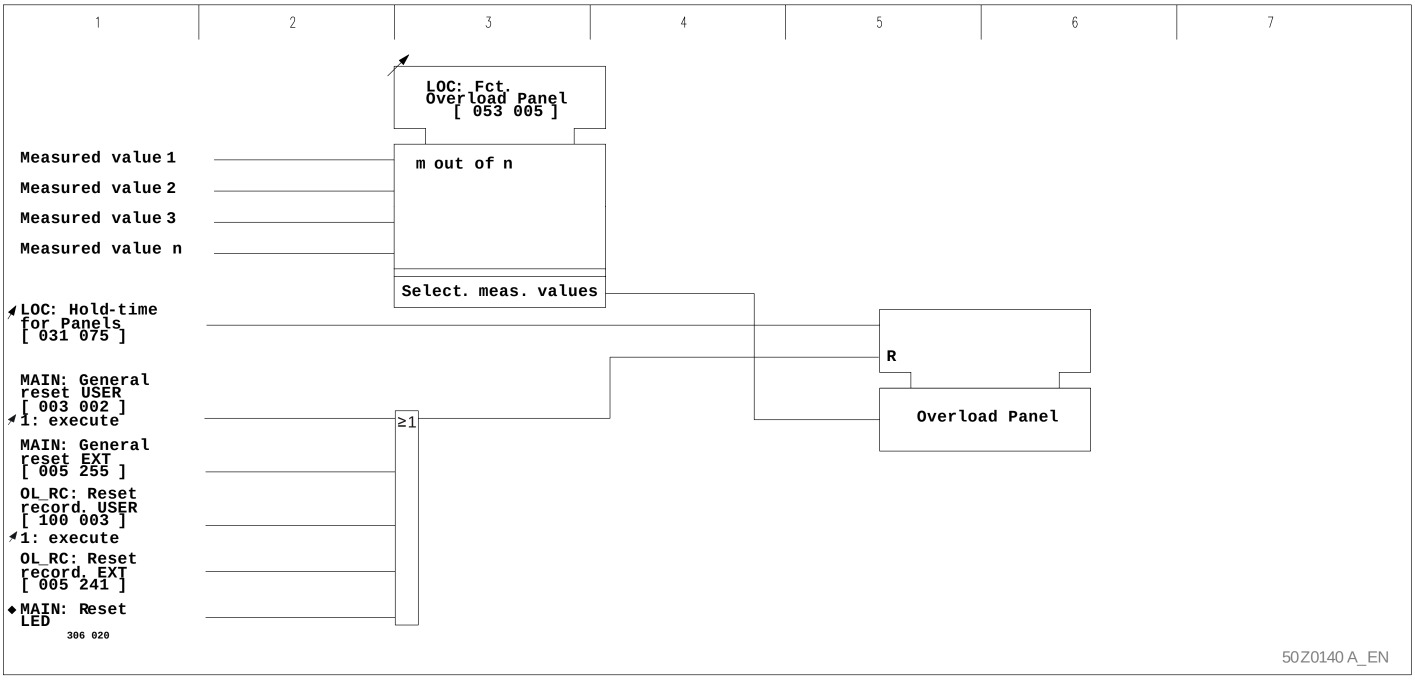


3-4 *Ground Fault Panel*

Overload Panel

The Overload Panel is automatically displayed in place of another data panel when there is an overload, provided that at least one measured value has been configured. The Overload Panel remains on display until the overload ends, unless a fault occurs. In this case the display switches to the Fault Panel.

The user can select the measured values that will be displayed on the Overload Panel by setting a 'm out of n' parameter. If more measured values are selected for display than the LC display can accommodate, then the display will switch to the next set of values at intervals defined by the setting at LOC: Hold-Time for Panels or when the appropriate key on the local control panel is pressed.



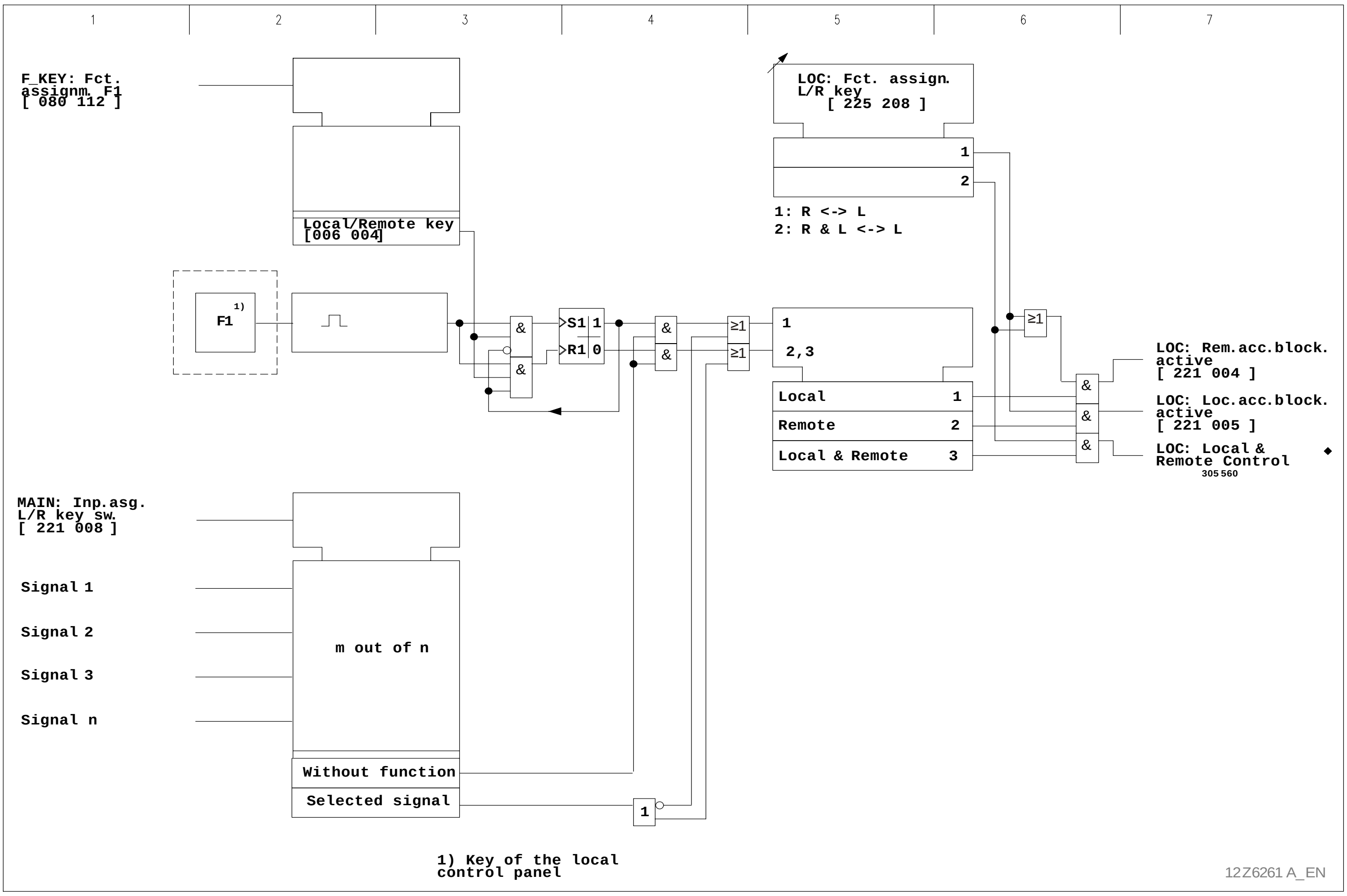
3-5 Overload Panel

Selection of the control point

Switchgear units can be controlled from a remote location or locally. Switching between local and remote control is achieved using an external key switch. The position of this switch is interrogated via an appropriately configured binary input (configuration via MAIN: Inp.asg. L/R key sw.)

This setting at LOC: Fct. assign. L/R key determines whether the switching (using the key switch) is between remote / local control (LR) or between remote and local control / local control (R&LL).

If only remote control is enabled then there will be a local access blocking. If only local control is enabled then there will be a remote access blocking.



3-6 Selection of the control point

Configurable Clear key

The P132 has a Clear key to which one or more reset functions can be assigned by selecting the required functions at `LOC: Fct. reset key`. Details on the functions' resetting mechanisms are given in section "Resetting Actions" of Chapter 3 ("Main Functions of the P132 (Function Group MAIN)").

3.4 Serial Interfaces

The P132 has a PC interface as a standard component. Communication module A is optional and can be provided with one or two communication channels – depending on the design version. Communication between the P132 and the control station’s computer is through the communication module A. Setting and interrogation is possible through all the P132's interfaces.

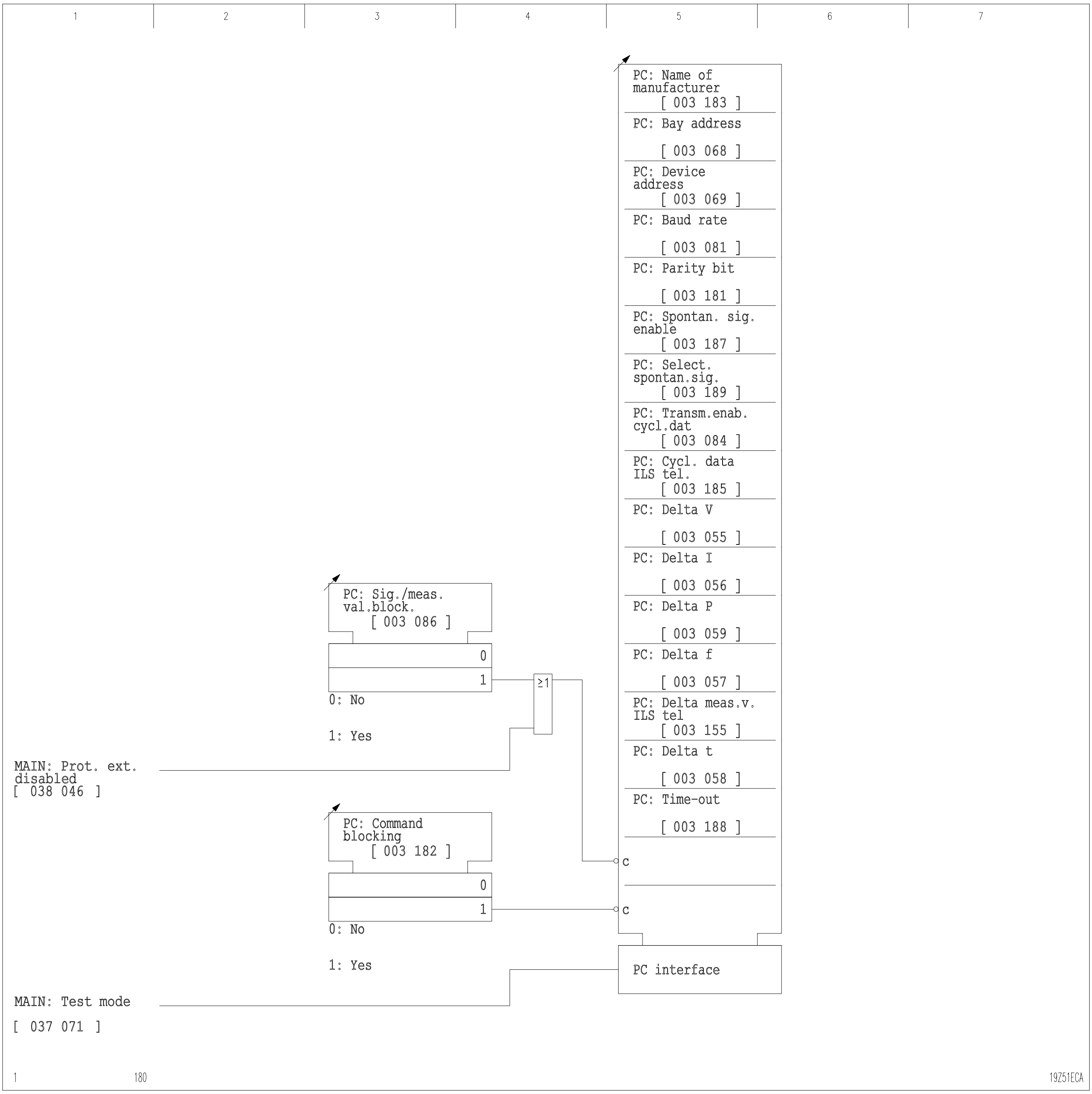
If the communication module A with two communication channels is installed, settings for two communication interfaces will be available. The setting of communication interface 1 (COMM1) may be assigned to the physical communication channels 1 or 2 (see section "Main Functions"). If the COMM1 settings have been assigned to communication channel 2, then the settings of communication interface 2 (COMM2) will automatically be active for communication channel 1. Communications channel 2 can only be used to transmit data to and from the P132 if its PC interface has been de-activated. As soon as the PC interface is used to transmit data, communications channel 2 becomes "dead".

If tests are run on the P132, the user is advised to activate the test mode. In this way the PC or the control system will recognize all incoming test signals accordingly (see section "Main Functions").

3.4.1 PC Interface (Function Group PC)

Communication between the device and a PC is through the PC interface. In order for data transfer between the P132 and the PC to function, several settings must be made in the P132.

There is an operating program available as an accessory for P132 control (see Chapter 13).



3-7 PC interface settings

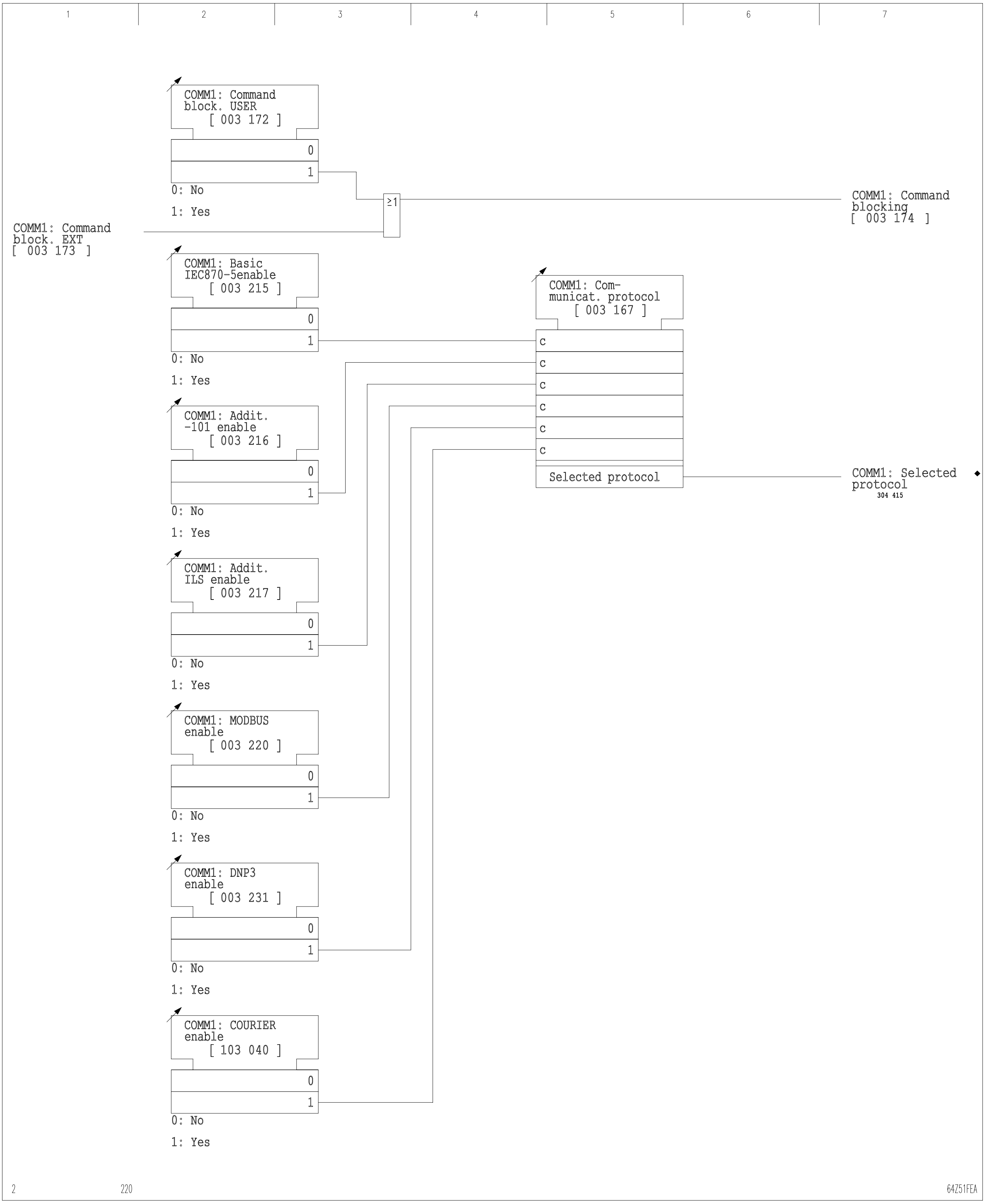
3.4.2 Communication Interface 1 (Function Group COMM1)

There are several different interface protocols available at the communication interface 1. The following user-selected interface protocols are available for use with the P132:

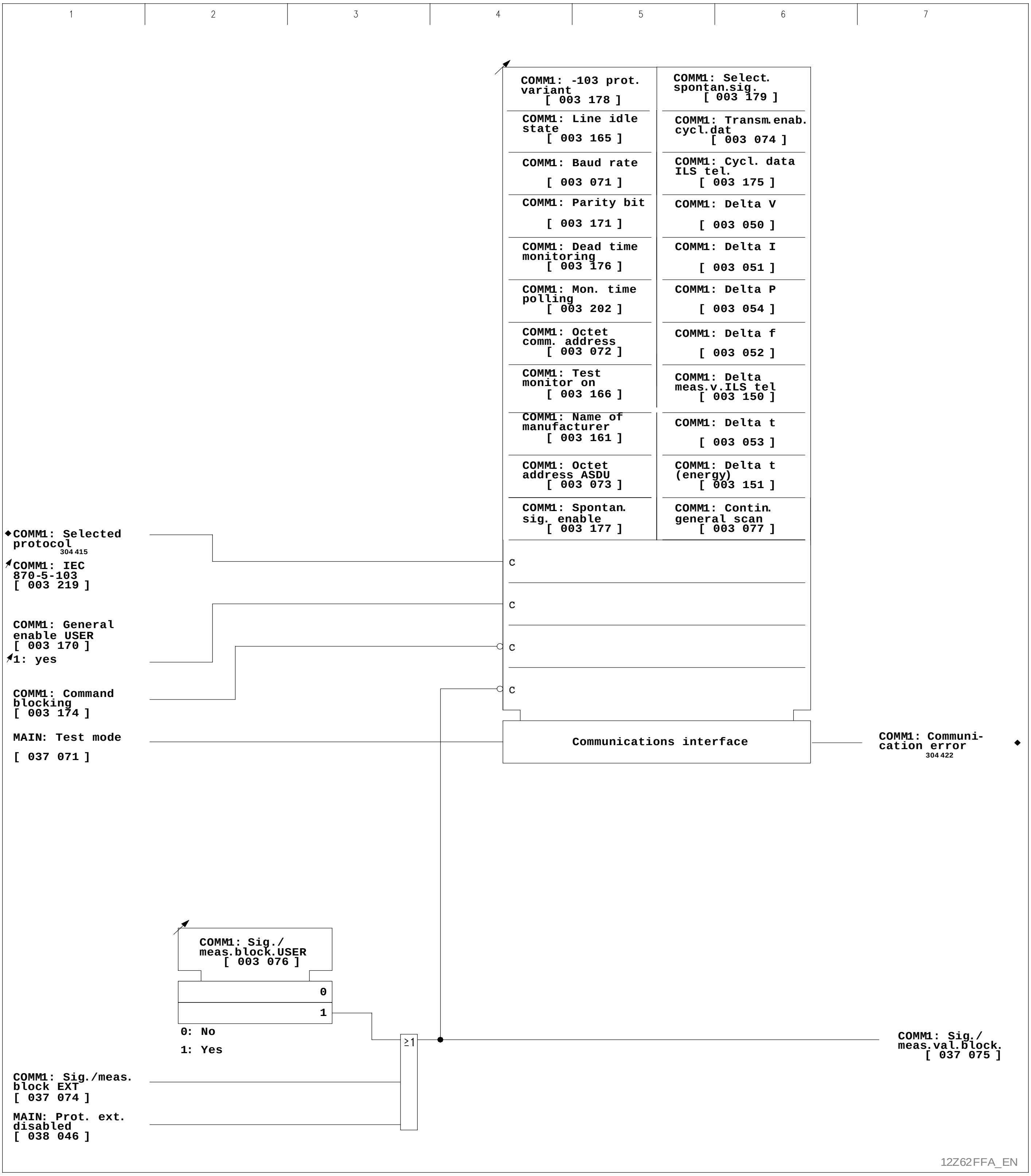
- ☐ IEC 60870-5-103, "Transmission protocols - Companion standard for the informative interface of protection equipment, first edition, 1997-12 (corresponds to VDEW / ZVEI Recommendation, "Protection communication companion standard 1, compatibility level 2", February 1995 edition) with additions covering control and monitoring
- ☐ IEC 870-5-101, "Telecontrol equipment and systems - Part 5: Transmission protocols - Section 101 Companion standard for basic telecontrol tasks," first edition 1995-11
- ☐ ILS-C, internal protocol of Schneider Electric
- ☐ MODBUS
- ☐ DNP 3.0
- ☐ COURIER

In order for data transfer to function properly, several settings must be made in the P132.

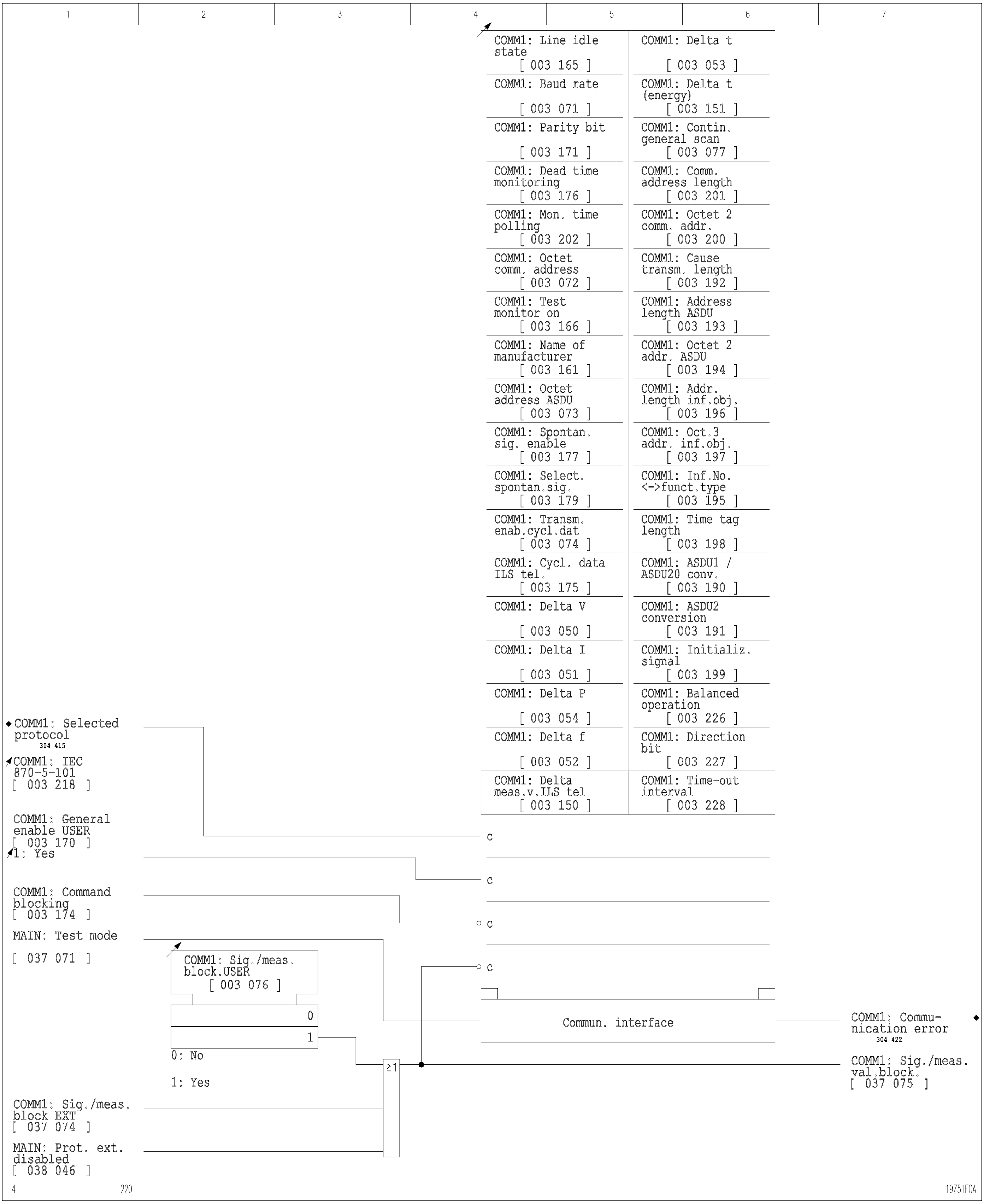
Communication interface 1 can be blocked through a binary signal input. In addition, a signal or measured-data block can also be imposed through a binary signal input.



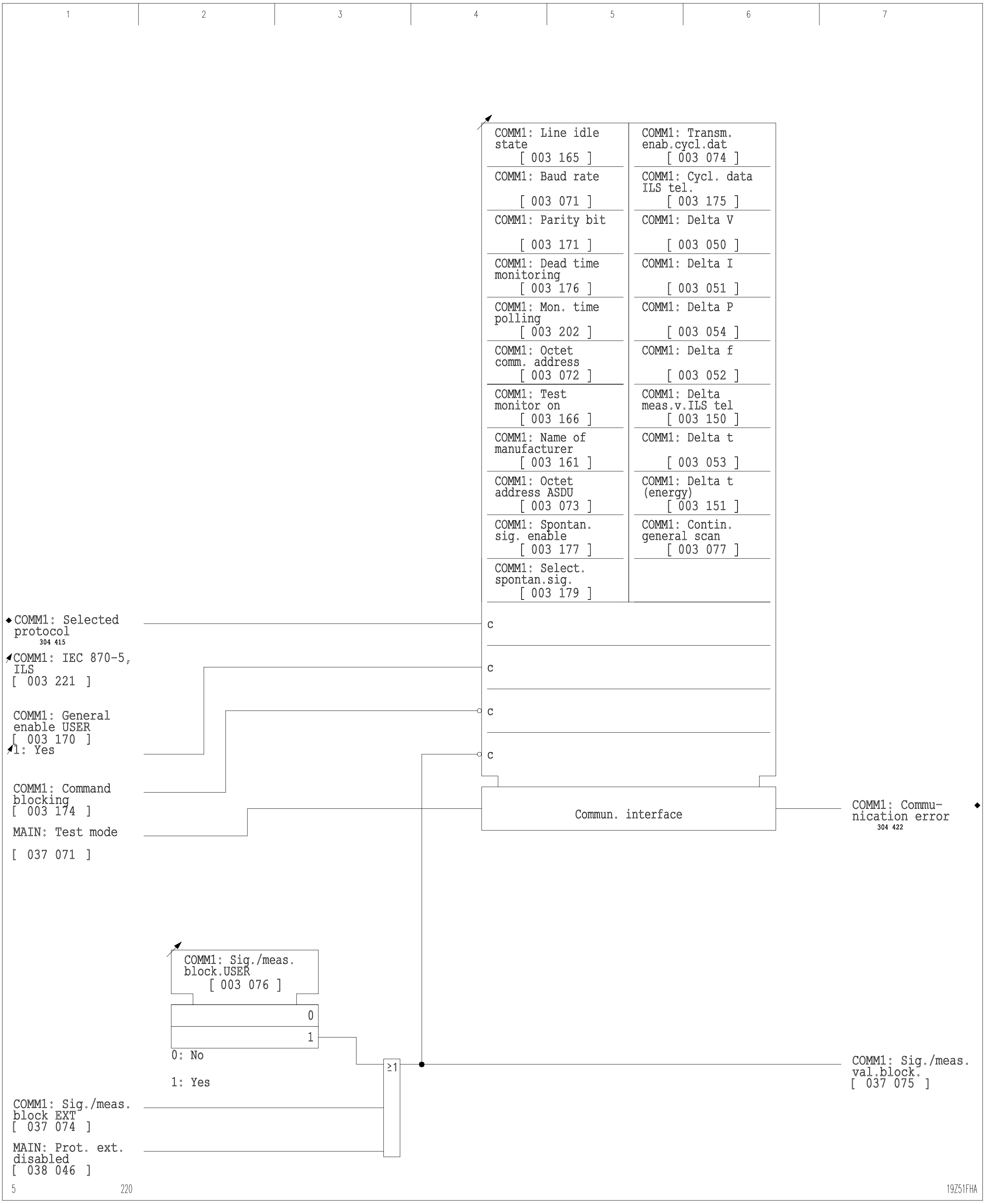
3-8 *Communication interface 1, selecting the interface protocol*



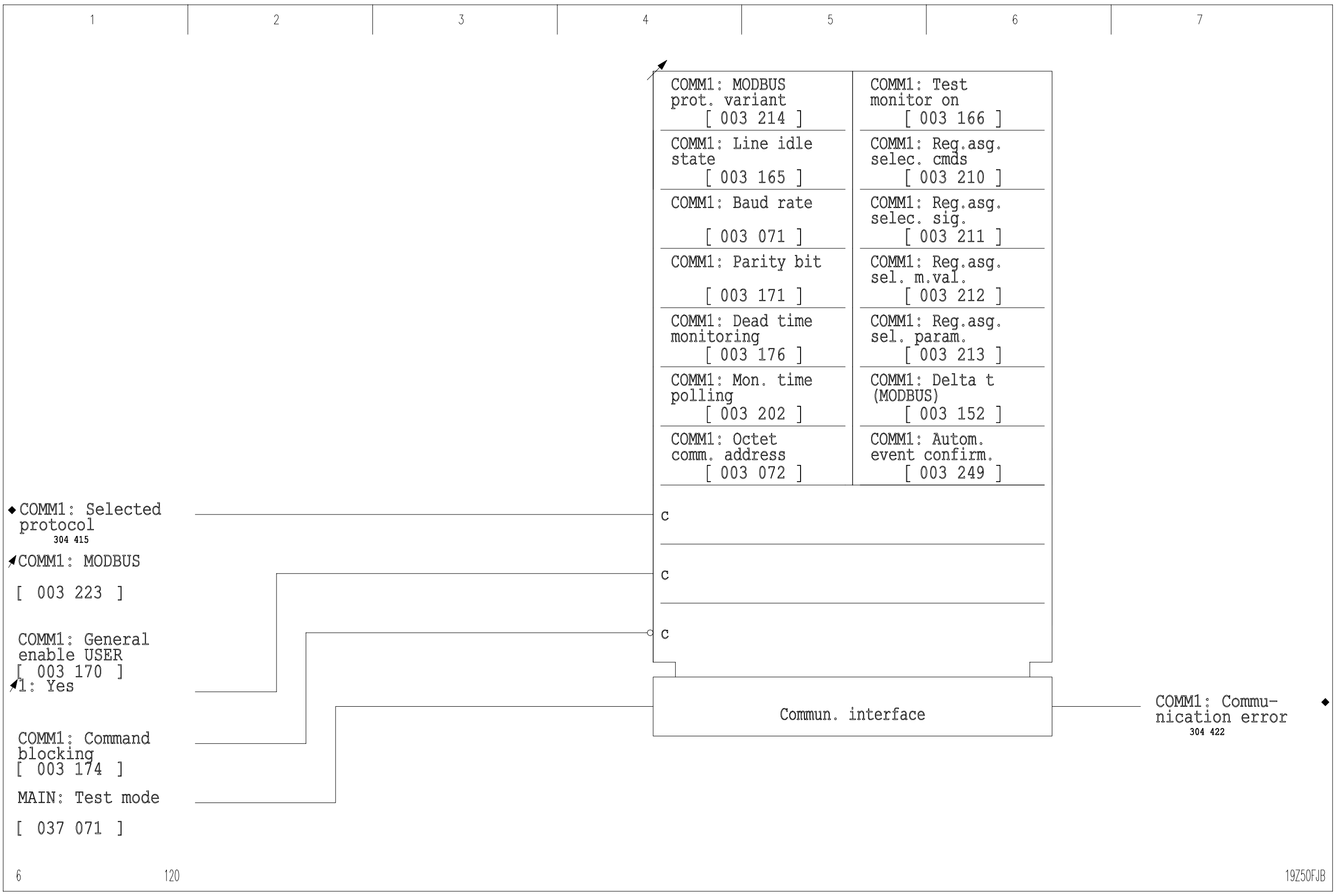
3-9 Communication interface 1, settings for the IEC 60870-5-103 interface protocol



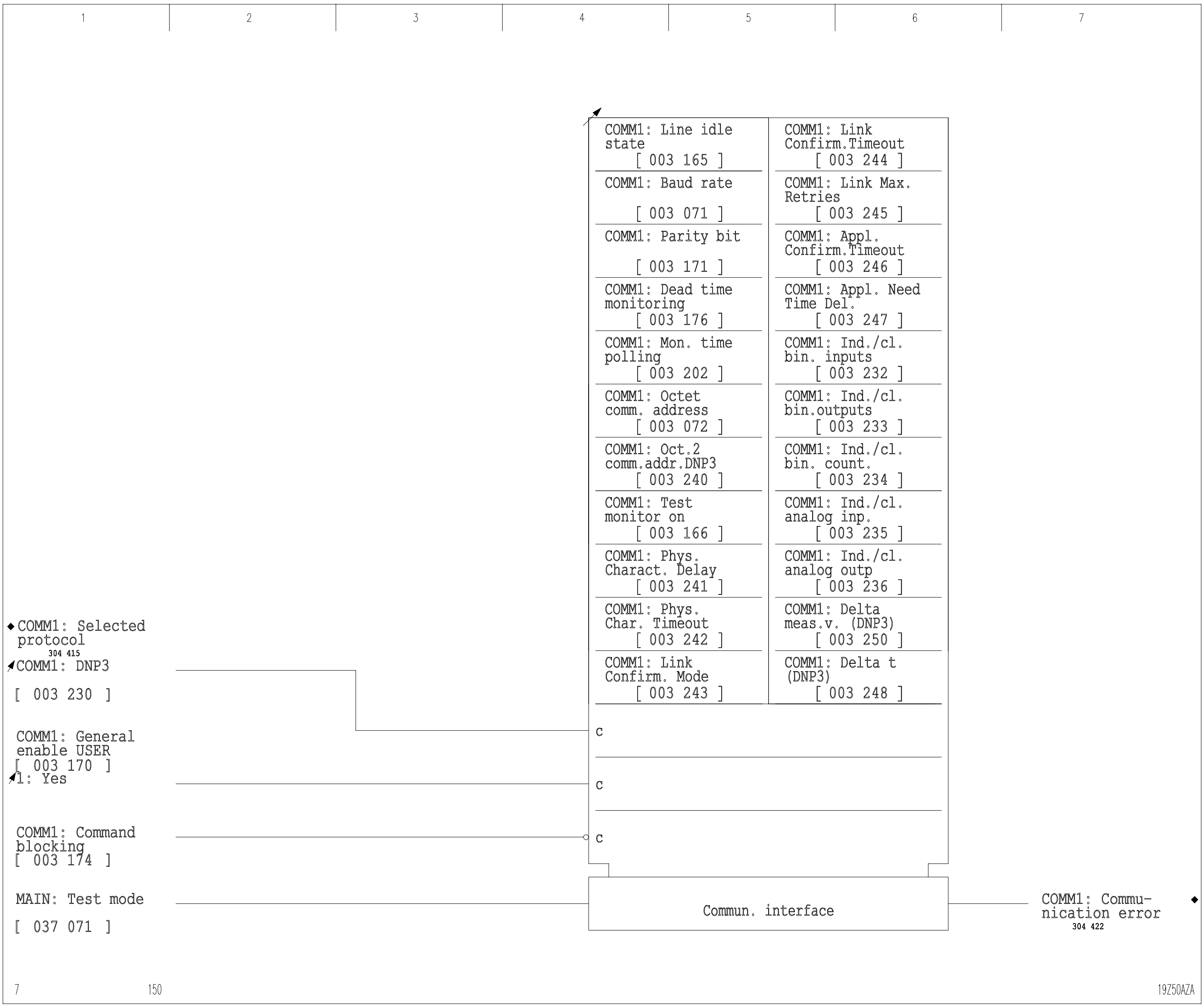
3-10 Communication interface 1, settings for the IEC 870-5-101 interface protocol



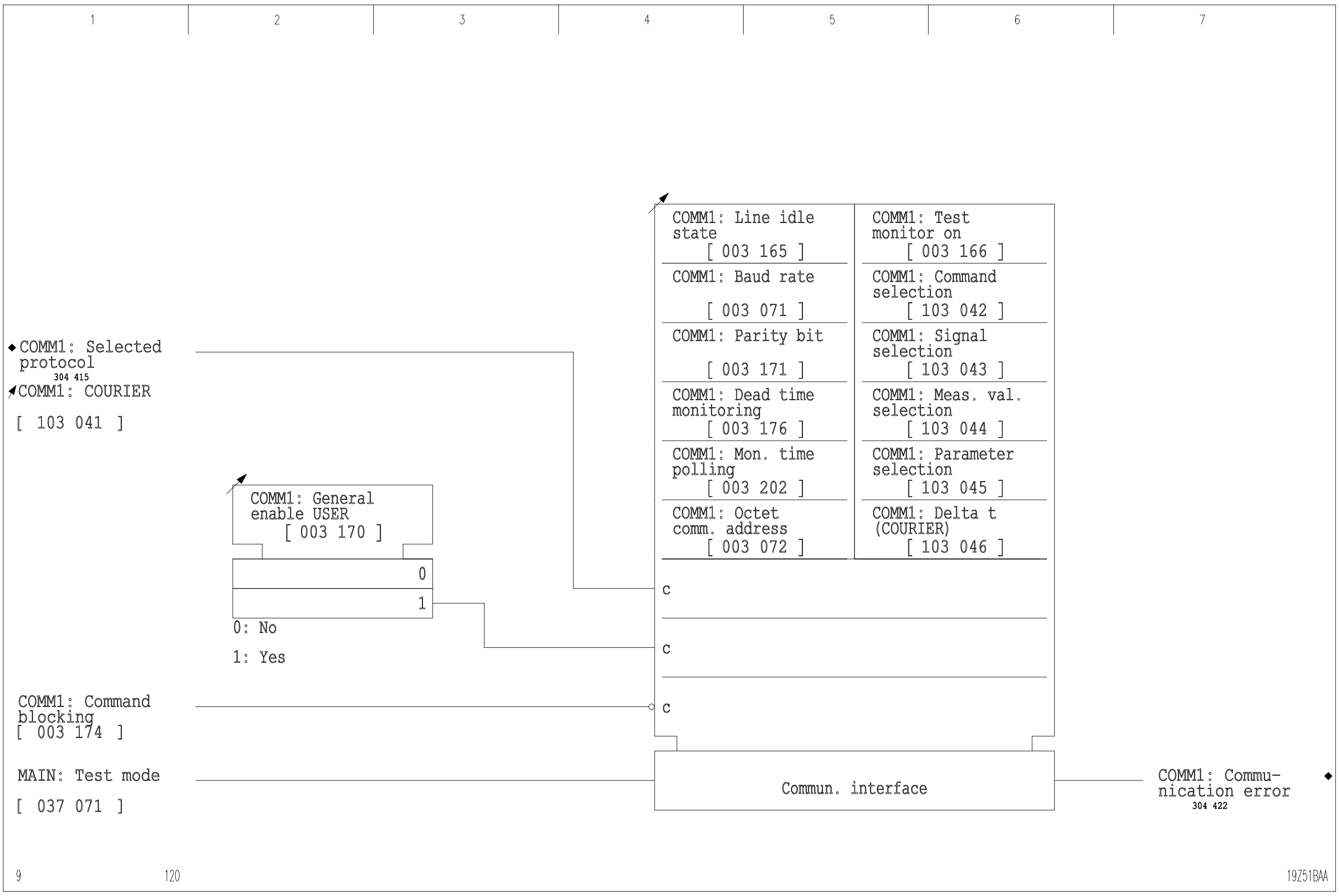
3-11 Communication interface 1, settings for the ILS_C interface protocol



3-12 Communication interface 1, settings for the MODBUS protocol



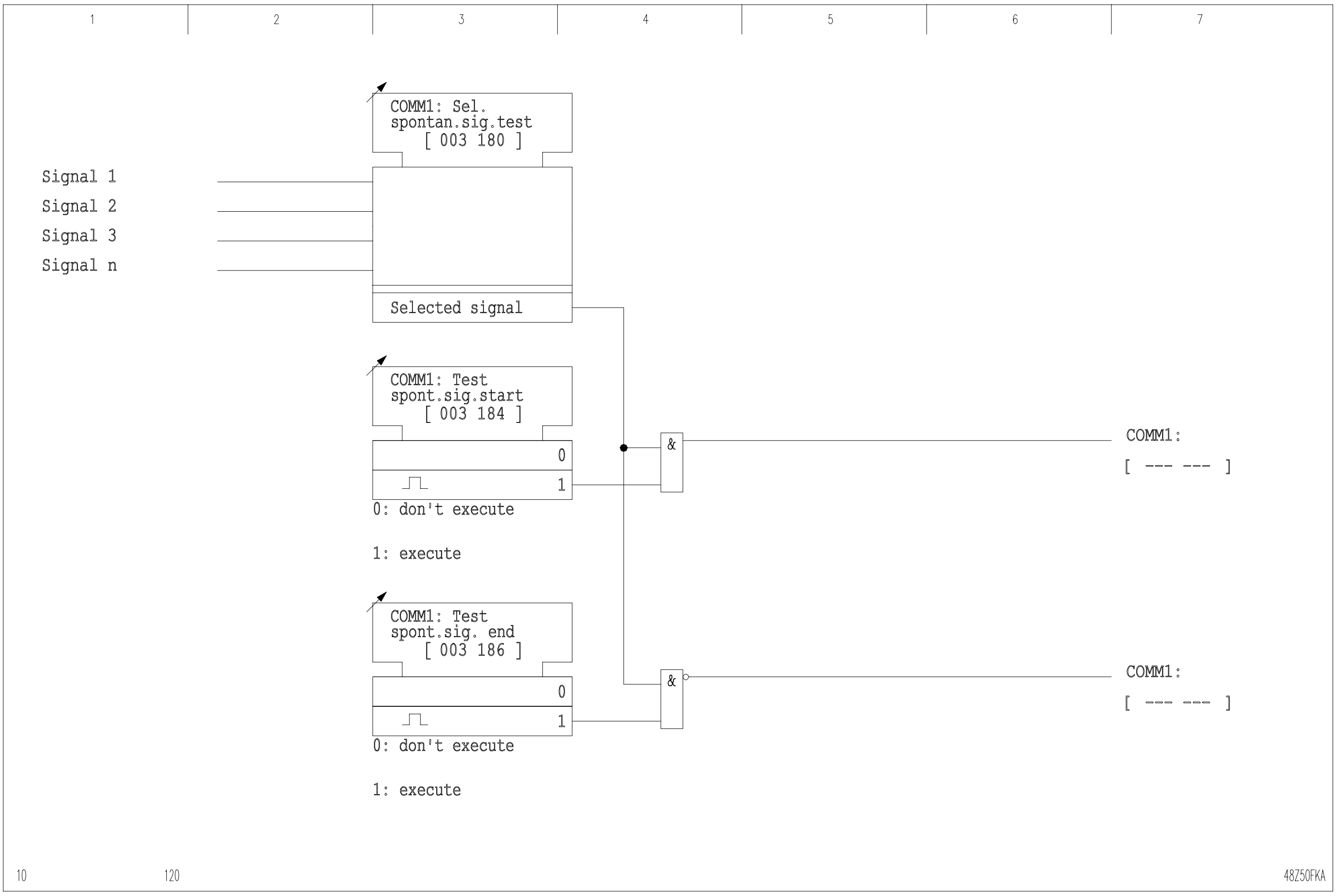
3-13 *Communication interface 1, settings for the DNP 3.0 protocol*



3-14 *Communication interface 1, settings for the COURIER protocol*

Checking spontaneous signals

For interface protocols based on IEC 60870-5-103, IEC 870-5-101, or ILS_C it is possible to select a signal for test purposes. The transmission of this signal to the control station as ‘sig. start‘ or ‘sig. end‘ can then be triggered via setting parameters.

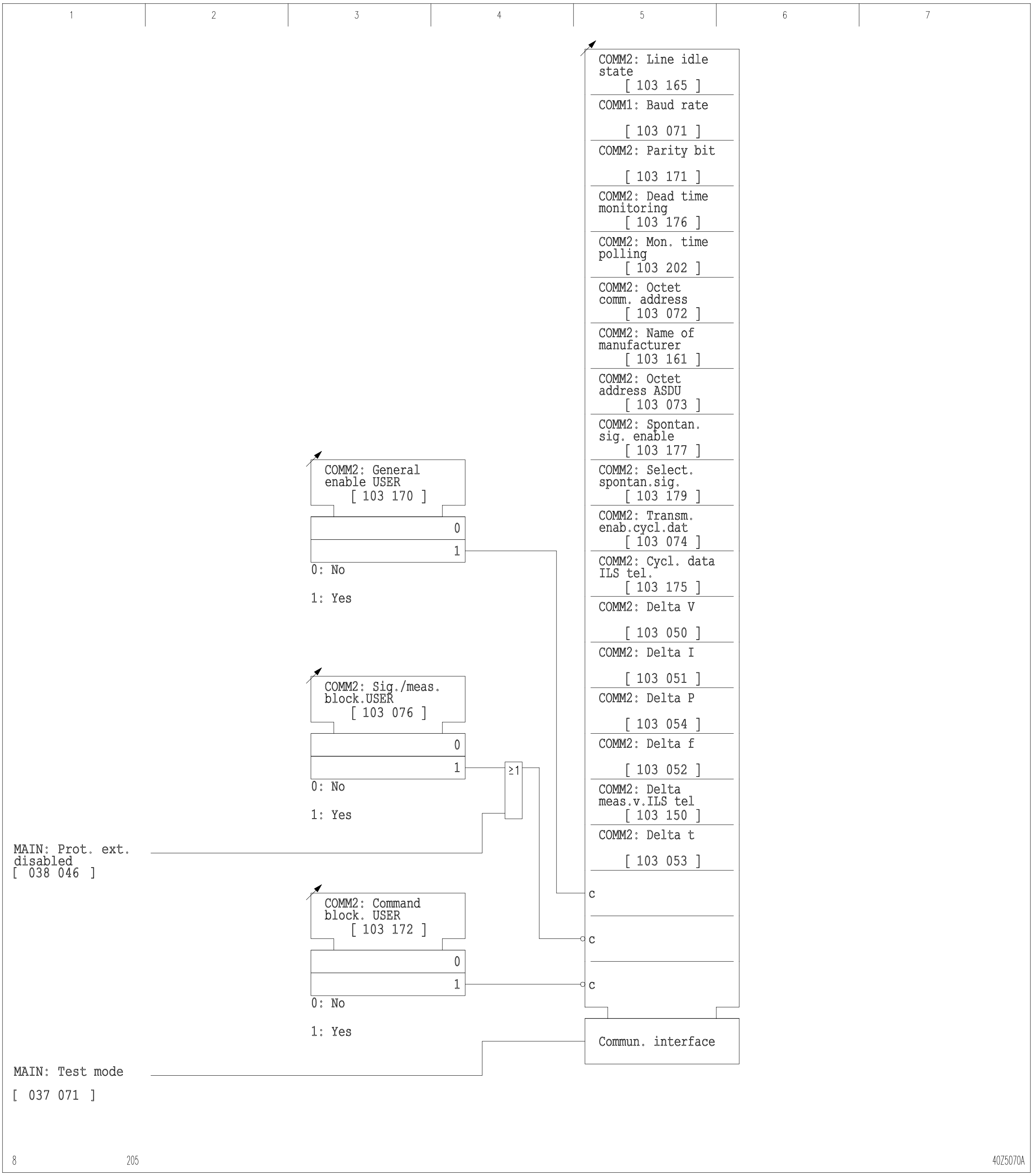


3-15 Checking spontaneous signals

3.4.3 Communication Interface 2 (Function Group COMM2)

Communication interface 2 supports the IEC 60870-5-103 interface protocol.

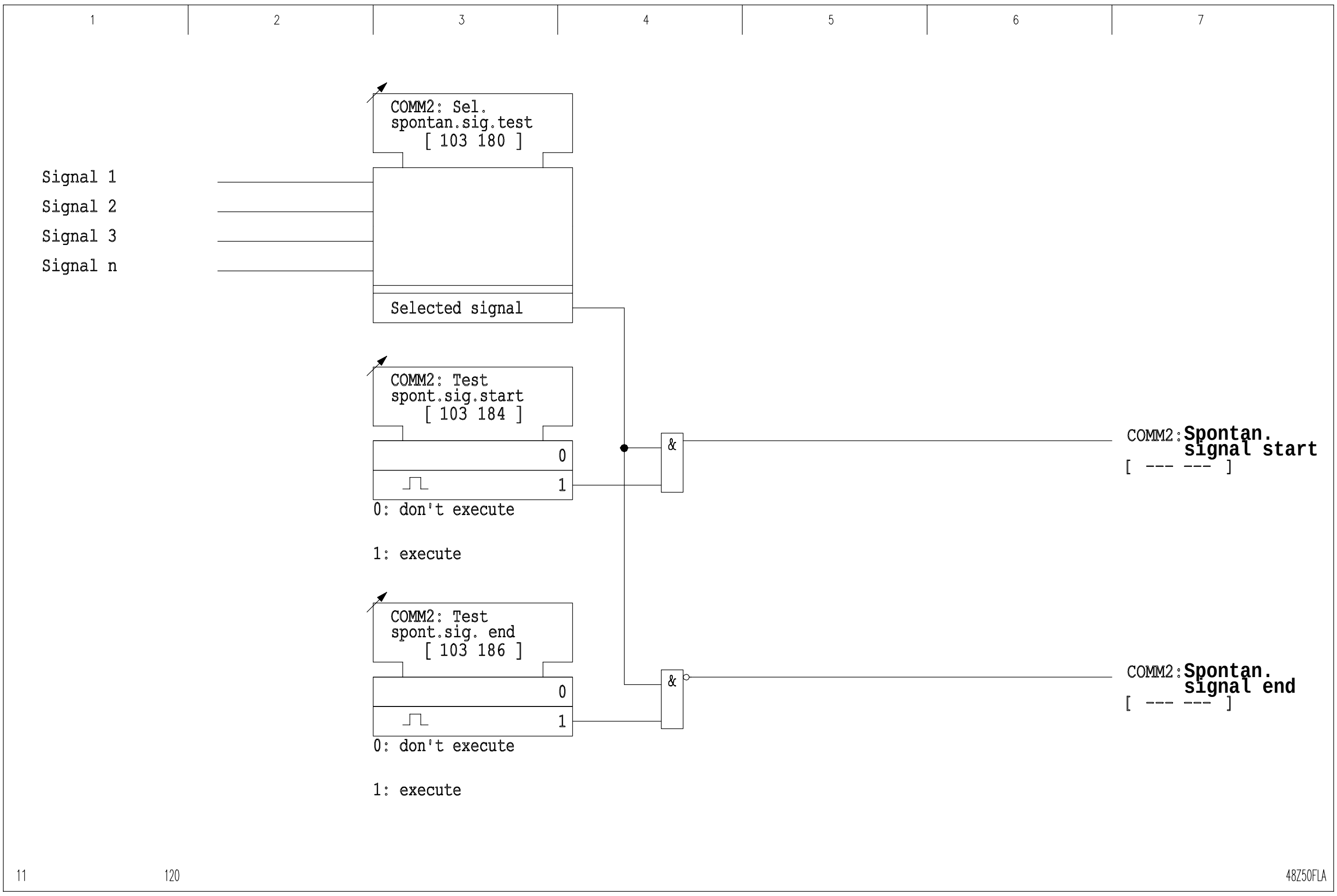
In order for data transfer to function properly, several settings must be made in the P132.



3-16 *Settings for communication interface 2*

Checking spontaneous signals

It is possible to select a signal for test purposes. The transmission of this signal to the control station as ‘sig. start‘ or ‘sig. end‘ can then be triggered via the local control panel.



3-17 *Checking spontaneous signals*

3.4.4 Communication Interface 3 (Function Group COMM3)

Application

Communication interface 3 is designed to establish a digital communication link between two MiCOM devices over which up to 8 binary protection signals may be transmitted. Whereas communication interfaces 1 and 2 are designed as information interfaces to connect to data acquisition subsystems and for remote access, communication interface 3 is designed as a protection signaling interface that will transmit real time signals (InterMiCOM protection signaling interface). Its main application is to transmit signals from protective signaling (function group PSIG). In addition, any other internal or external binary signals may also be transmitted.

Physical medium

COMM3 is provided as an asynchronous, full-duplex communication interface.
To transmit data the following physical media are available:

Direct link without use of external supplementary equipment:

☐ Glass fiber (e.g. via 2 x G62.5/125 up to max. 1.4 km)

☐ Twisted pair (RS 422 up to max. 1.2 km)

Use of external transmission equipment:

☐ FO module (e.g. OZD 485 BFOC-1300 / Hirschmann up to max. 8/14/20 km)

☐ Universal modem (e.g. PZ 511 via twisted pair 2x2x0.5 mm up to max. 10 km)

☐ Voice frequency modem (e.g. TD-32 DC / Westermo up to max. 20 km)

Digital network:

☐ Asynchronous data interface of primary multiplexing equipment

Activating and Enabling

In order to use InterMiCOM, the communication interface COMM3 has to be configured using the parameter COMM3: Function group COMM3. This setting parameter is only visible if the relevant optional communication module is fitted.
After activation of COMM3, all addresses associated to this function group (setting parameters, binary state signals etc.) become visible.
The function can then be enabled or disabled by setting
COMM3: General enable USER.

Telegram configuration

The communication baud rate is settable (COMM3: Baud rate) to adapt to the transmission channel requirements. Sending and receiving addresses (COMM3: Source address and COMM3: Receiving address can be set to different values, thus avoiding that the device communicates with itself.

The InterMiCOM protection signaling interface provides independent transmission of eight binary signals in each direction. For the send signals (COMM3: Fct. assignm. send x, with x = 1 to 8) any signal from the selection table of the binary outputs (OUTP) can be chosen. For the receive signals (COMM3: Fct. assignm. rec. x, with x = 1 to 8) any signal from the selection table of the binary inputs (INP) can be chosen.

For each receive signal, an individual operating mode can be set (`COMM3: Oper. mode receive x`, with `x = 1 to 8`), thus defining the required checks for accepting the received binary signal. In addition a specifically selected telegram structure subdivides the 8 binary signals into two groups. The signal encoding along with the set operating mode for the telegram check defines the actual balance of "Speed", "Security" and "Dependability" for each signal:

☐ Binary signals 1 to 4:
Operating mode settable to *'Blocking'* or *'Direct intertrip'*

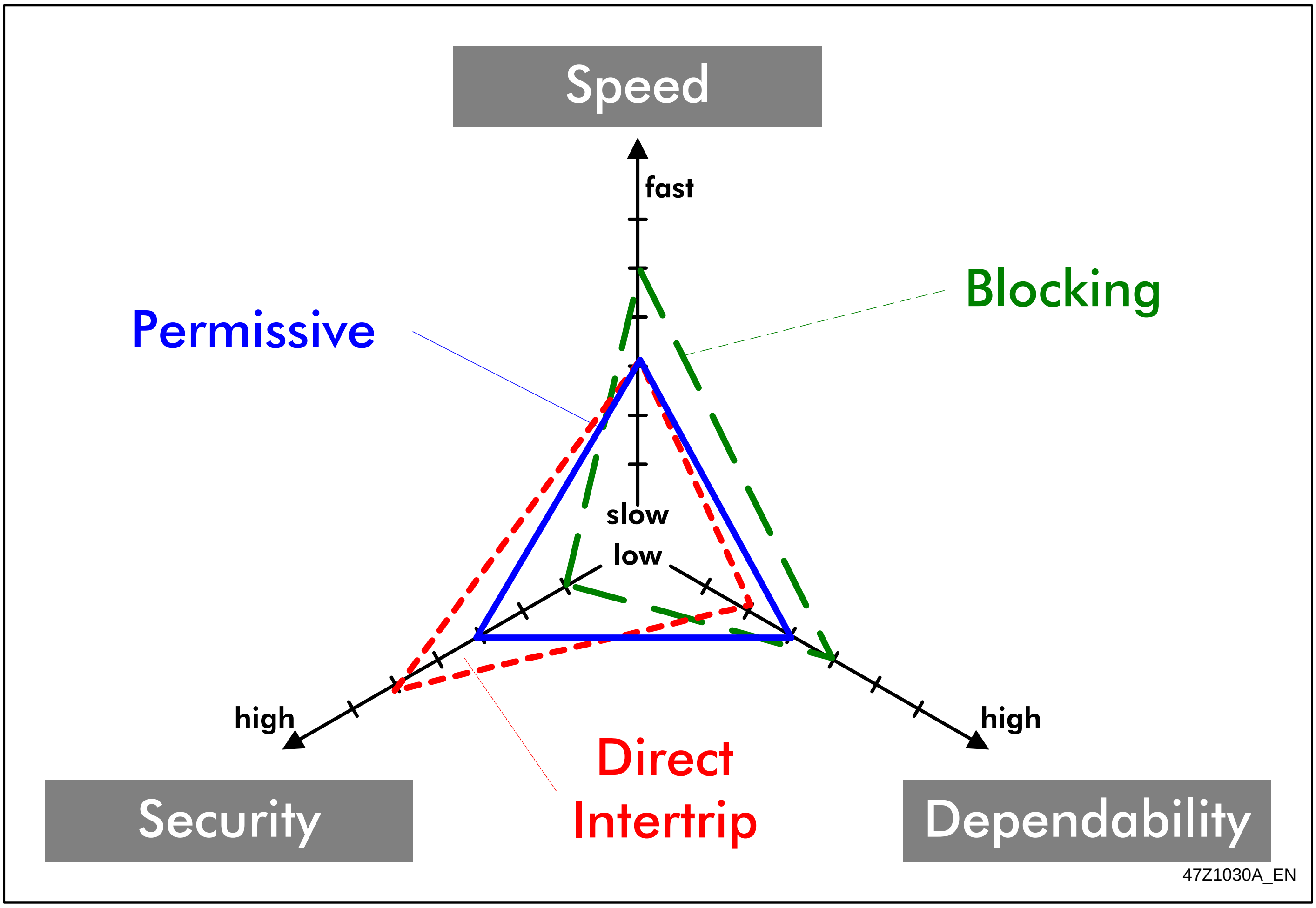
☐ Binary signals 5 to 8:
Operating mode settable to *'Permissive'* or *'Direct intertrip'*

EN 60834-1 classifies 3 categories of command based teleprotection schemes according to their specific requirements (see figure 3-19). By selection of a binary signal and by setting its operating mode appropriately, these requirements can be fulfilled as follows:

☐ Direct transfer trip or intertripping:
Preference: Security
Implication: No spurious pickup in the presence of channel noise.
Recommended setting: Select binary signal from groups 1 to 4 or 5 to 8 and set operating mode *'Direct intertrip'*

☐ Permissive teleprotection scheme:
Preference: Dependability.
Implication: Maximizes probability of signal transmission in the presence of channel noise.
Recommended setting: Select binary signal from group 5 to 8 and set operating mode *'Permissive'*

☐ Permissive teleprotection scheme:
Preference: Dependability.
Implication: Maximizes probability of signal transmission in the presence of channel noise.
Recommended setting: Select binary signal from group 1 to 8 and set operating mode *'Permissive'*

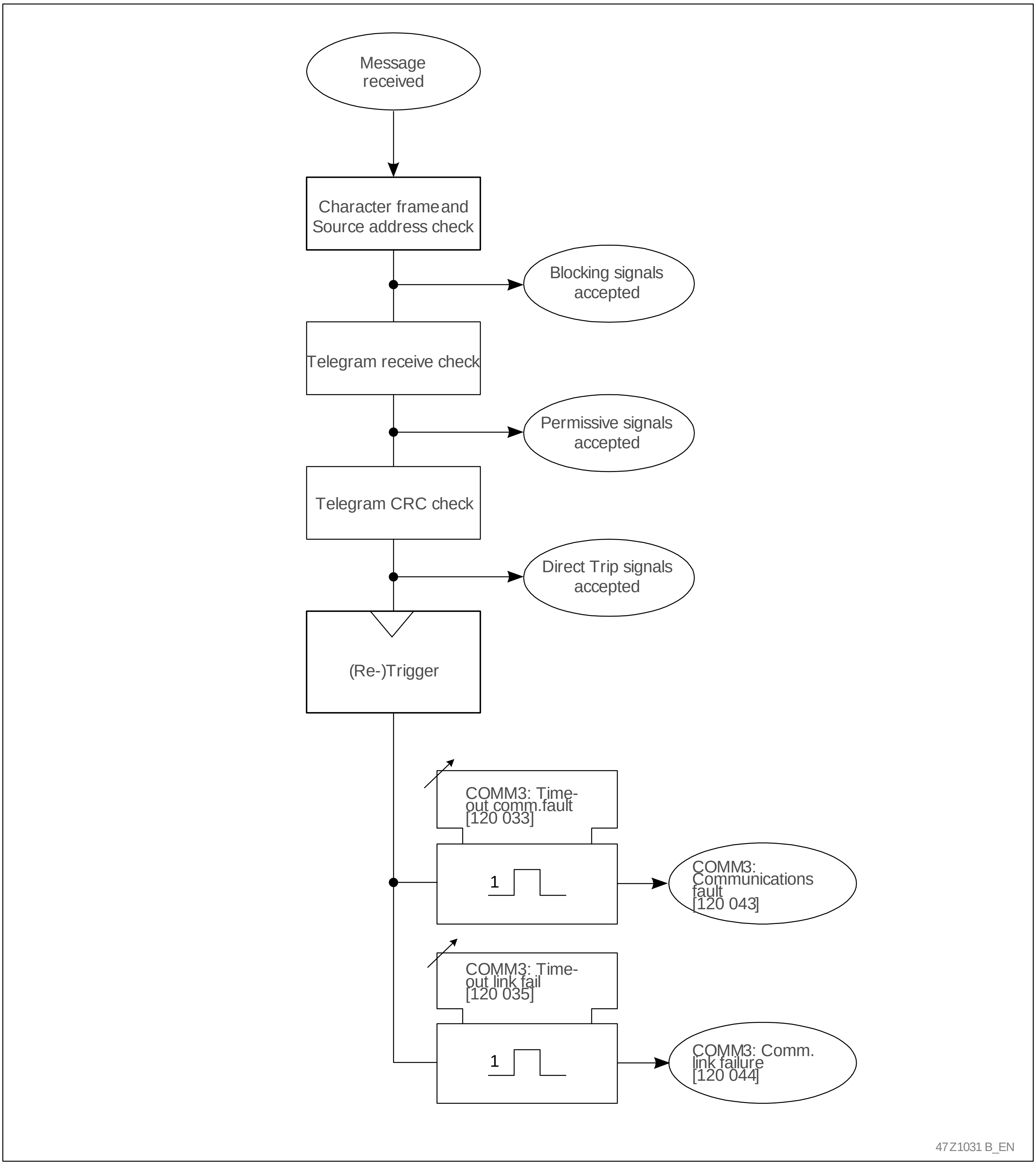


3-18 *Comparison of speed, security and dependability offered by the three operating modes.*

Communication monitoring

COMM3: Time-out comm.fault is used for monitoring the transmission channel (this timer is re-triggered with each complete and correct received telegram). The wide setting range allows adaptation to the actual channel transmission times and above all this is needed for time-critical schemes such as the blocking scheme. After the timer has elapsed, signals COMM3: Communications fault and SFMON: Communic.fault COMM3 are issued and the received signals are automatically set to their user-defined default values (COMM3: Default value rec. x, with x = 1 to 8). As the main application for this protective signaling the fault signal may be mapped to the corresponding input signal in function group PSIG with the COMM3: Sig.asg. comm.fault setting.

COMM3: Time-out link fail. is used to determine a persistent failure of the data transmission channel. After the timer has elapsed, signals COMM3: Comm. link failure and SFMON: Comm.link fail.COMM3 are issued.



3-19 *Message processing and communication monitoring*

Supervision of communication link quality

After a syntax check of each received message, InterMiCOM updates the ratio of incorrectly received messages, based on a total of the last 1000 received messages. The result is provided as an updating measurand COMM3: No. tel. errors p.u. and the overall maximum ratio can be read from
COMM3: No.t.err.,max,stored.
If the set threshold COMM3: Limit telegr. errors is exceeded the corresponding signals COMM3: Lim.exceed.,tel.err.
and SFMON: Lim.exceed.,tel.err. will be issued. All corrupted telegrams are counted (COMM3: No. telegram errors). This counter as well as the stored maximum ratio of corrupted messages can be reset via
COMM3: Rset.No.tlg.err.USER (as well as via the binary signal COMM3: Reset No.tlg.err.EXT).

Commissioning tools

The actual values of send and receive signals can be read from the device as physical state signals (COMM3: State send x and COMM3: State receive x, with x = 1 to 8). In addition, InterMiCOM provides 2 test facilities for commissioning of the protection interface.

For a loop-back test, the send output is directly linked back to the receive input.
After setting the bit pattern wanted (as an equivalent decimal number at
COMM3: Loop back send) the test can be triggered via
COMM3: Loop back test. This bit pattern is sent for the duration of the hold time set at COMM3: Hold time for test. For this test only, the source address is set to '0'; this value is not used for regular end-to-end communication. The test result can be checked as long as the hold-time is running by reading the measured operating data COMM3: Loop back result and COMM3: Loop back receive. As soon as the hold-time has expired, the loopback test is terminated and InterMiCOM reverts to the normal sending mode (e.g. sending the actual values of the configured send signals, using the set source address).

Thus, in case of problems with the InterMiCOM protection signaling interface, the loopback test can be used to verify or to exclude a defective device. The transmission channel including the receiving device can be checked manually by setting individual binary signals
(COMM3: Send signal for test) to user-defined test values
(COMM3: Log. state for test). After triggering the test by
COMM3: Send signal, test, the preset binary signal is sent with the preset value for the set hold time COMM3: Hold time for test. The 7 remaining binary signals are not affected by this test procedure and remain to be sent with their actual values. During the hold time, a received signal can be checked at the receiving device, e.g. by reading the physical state signal. After the hold time has expired, the test mode is reset automatically and the actual values of all 8 signals are transmitted again.

3.4.5 Communication Interface IEC61850 (Function groups IEC, GOOSE and GSSE)

The IEC 61850 communication protocol is implemented by these function groups and the Ethernet module.

Note:

Function group IEC is only available as an alternative to function group COMM1 (hardware ordering option!).

3.4.5.1 Communication Interface IEC 61850 (Function Group IEC)

As a further option the P132 includes an interface protocol according to the Ethernet-based communication standard IEC 61850.

IEC 61850

IEC 61850 was created jointly by users and manufacturers as an international standard. The main target of IEC 61850 is interoperability of devices. This includes the capability of two or more intelligent electronic devices (IED), manufactured by the same company or different companies, to exchange data for combined operation.

Now this new communication standard IEC 61850 has created an open and common basis for communication from the process control level down to the network control level, for the exchange of signals, data, measured values and commands.

For a standardized description of all information and services available in a field device a data model, which lists all visible functions, is created. Such a data model, specifically created for each device, is used as a basis for an exchange of data between the devices and all process control installations interested in such information. In order to facilitate engineering at the process control level a standardized description file of the device, based on XML, is created with the help of the data model. This file can be imported and processed further by the relevant configuration program used by the process control device. This makes possible an automated creation of process variables, substations and signal images.

The following documentation with the description of the IEC 61850 data model, used with the P132, is available:

- ☐ IDC file based on XML in the SCL (Substation Configuration Description Language) with a description of data, properties and services, available from the device, that are to be imported into the system configurator.
- ☐ PICS_MICS_ADL file with the following contents:
  - ☐ PICS (Protocol Implementation Conformance Statement) with an overview of available services.
  - ☐ MICS (Model Implementation Conformance Statement) with an overview of available object types.
  - ☐ ADL (Address Assignment List) with an overview of the assignment of parameter addresses (signals, measuring values, commands, etc.) used by the device with the device data model as per IEC 61850.

Ethernet Module

The optional Ethernet module provides an RJ45 connection and a fiber optic interface where an Ethernet network can be connected. The selection which of the two interfaces is to be used to connect to the Ethernet network is made by setting the parameter IEC: Ethernet media. For the optical interface on the Ethernet communications module the user may either select the ordering option ST connector or SC connector with 100 Mbit/s and 1300 nm. The RJ45 connector supports 10 Mbit/s and 100 Mbit/s.

The optional Ethernet module additionally provides an RS485 interface for remote access with the operating program MiCOM S1 (function group COMM2).

Notes: The P132 may only be equipped with the optional Ethernet module as an alternative to the standard optional communication module. Therefore the Ethernet based communication protocol IEC 61850 is only available as an alternative to function group COMM1.

Activating and Enabling

The IEC function group can be activated by setting the parameter IEC: Function group IEC. This parameter is only visible if the optional Ethernet communication module is fitted to the device. After activation of IEC, all data points associated with this function group (setting parameters, binary state signals etc.) become visible.
The function can then be enabled or disabled by setting
IEC: General enable USER.

The parameter settings for function groups IEC, GOOSE and GSSE in the device are not automatically activated. An activation occurs either when the command IEC: Enable configuration is executed or automatically when the device is switched online with MAIN: Device on-line.

Client Log-on

Communication in Ethernet no longer occurs in a restrictive master slave system, as is common with other protocols. Instead server or client functionalities, as defined in the 'Abstract Communication Service Interface' (ACSI, IEC 61870-7-2), are assigned to the devices. A 'server' is always that device which provides information to other devices.
A client may log-on to this server so as to receive information, for instance 'reports'.
In a network a server can supply any number of clients with spontaneous or cyclic information.

In its function as server the P132 can supply up to 16 clients with information.

Clock Synchronization

With IEC 61850 clock synchronization occurs via the SNTP protocol, defined as standard for Ethernet. Here the P132 functions as a SNTP client.

For clock synchronization one can select between the operating modes *Broadcast* from SNTP Server or *Request from Server*. With the first operating mode synchronization occurs by a broadcast message sent from the SNTP server to all devices in the network, and in the second operating mode the P132 requests the device specific time signal during a settable cycle.

Two SNTP servers may be set. In this case, clock synchronization is preferably performed by the first server. The second server is used only when messages are no longer received from the first server.

When looking at the source priority for clock synchronization, which is set at the MAIN function then, by selecting "COMM1", synchronization per IEC 61850 is automatically active but only if this communication protocol is applied.

Control and Monitoring of Switchgear Units

Control of switchgear units (external devices) by the P132 can be carried out from all clients that have previously logged-on to the device. Only one control command is executed at a time, i.e. further control requests issued by other clients during the execution of such a command are rejected. To control external devices the following operating modes can be set at
IEC: DEV control model:

- *Control service mode*
- *Direct control with enhanced security*
- *SBO (Select before operate) with enhanced security*

When set to the operating mode *Select before operate* the switchgear unit is selected by the client before the control command is issued. Because of this selection the switchgear unit is reserved for the client. Control requests issued by other clients are rejected. If, after a selection no control command is issued by the client, the P132 resets this selection after 2 minutes have elapsed.

The switchgear units’ contact positions signaled to the clients are made with the Report Control Blocks of the switchgear units.

Fault Transmission

Transmission of fault files is supported per "File Transfer".

Transmission of "Goose Messages"

The so-called "Goose Message" is a particular form of data transmission. Whereas normal server-client-services are transmitted at the MMS and TCP/IP level, the "Goose Message" is transmitted directly at the Ethernet level with a high transmission priority. Furthermore these "Goose Messages" can be received by all participants in the respective sub-network, independent of their server or client function. In IEC 61850 "Goose Messages" are applied for the accelerated transmission of information between two or more devices. Application fields are, for example, a reverse interlocking, a transfer trip or a decentralized substation interlock. In future the "Goose Message" will therefore replace a wired or serial protective interface.

According to IEC 61850 there are two types of "Goose Messages", GSSE and IEC-GOOSE. The GSSE is used to transmit binary information with a simple configuration by 'bit pairs', and it is compatible with UCA2. However IEC-GOOSE enables transmission of all data formats available in the data model, such as binary information, integer values or even analog measured values. But this will require more extensive configuration with the help of the data model from the field unit situated on the opposite side. With IEC-GOOSE the P132 at this time supports sending and receiving of binary information or two-pole external device states.

Communication with the Operating Program MiCOM S1 via the Ethernet Interface

Direct access by the operating program MiCOM S1 via the Ethernet interface on the device may occur through the "tunneling principle". Transmission is carried out by an Ethernet Standard Protocol, but this is only supported by the associated operating program MiCOM S1 (specific manufacturer solution). Such transmission is accomplished over the same hardware for the network, which is used for server-client communication and "Goose Messages".
Available are all the familiar functions offered by the operating program MiCOM S1 such as reading/writing of setting parameters or retrieving stored data.

The various settings, measured values and signals for function group IEC are described in chapters 7 and 8.

3.4.5.2 Generic Object Oriented Substation Event (Function Group GOOSE)

For high-speed exchange of information between individual IEDs (intelligent electronic devices) in a local network, the P132 provides function group GOOSE (IEC-GOOSE) as defined in the IEC 61850 standard. GOOSE features high-speed and secure transmission for reverse interlocking, decentralized substation interlock, trip commands, blocking, enabling, contact position signals and other signals.

"Goose Messages" are only transmitted by switches but not by routers. "Goose Messages" therefore remain in the local network to which the device is logged-on.

Activating and Enabling

Function group GOOSE can be activated by setting the parameter
GOOSE: Function group GOOSE. This parameter is only visible if the optional Ethernet communication module is fitted to the device. After activation of GOOSE, all data points associated to this function group (setting parameters, binary state signals etc.) become visible.
The function can then be enabled or disabled by setting
GOOSE: General enable USER.

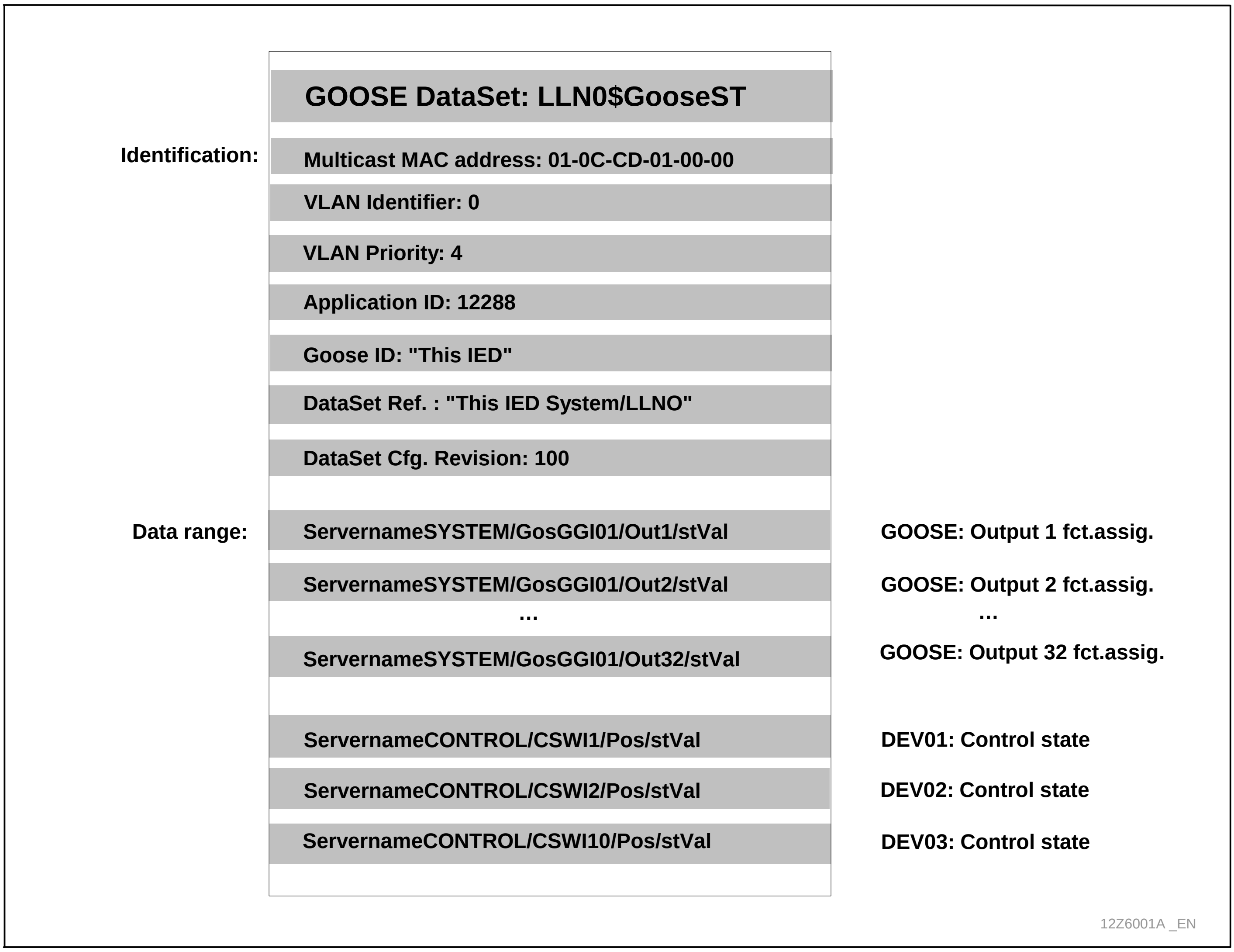
The parameter settings for function groups IEC, GOOSE and GSSE in the device are not automatically activated. An activation occurs either when the command IEC: Enable configuration is executed or automatically when the device is switched online with MAIN: Device on-line. In addition function group IEC must be configured and enabled.

Sending GOOSE

With GOOSE up to 32 logic binary state signals and up to 3 two-pole states from the maximum of 3 possible external devices associated to the P132 can be sent. Selection of binary state signals is made by setting GOOSE: Output n fct.assig. (n = 1 to 32). The up to 3 two-pole states of the external devices are a fixed part of GOOSE for which there is no necessity to set parameters. The assignment of data object indexes to logic state signals is made in the range from 1 to 32 according to the assignment to GOOSE outputs. The two-pole state signals from external devices 1 to 3 receive a permanent assignment of data object indexes in ascending order from 33 to 35.

GOOSE is automatically sent with each new state change of a configured binary state signal or an external device. There are numerous send repetitions in fixed ascending time periods (10 ms, 20 ms, 50 ms, 100 ms, 500 ms, 1000 ms, 2000 ms). If after 2 seconds there is no further state change apparent, GOOSE is then sent cyclically at 2-second intervals.

In order to have unambiguous identification of GOOSE sent, characteristics such as the Goose ID number, MAC address, application ID and VLAN identifier must be entered through parameter settings. Further characteristics are the 'Dataset Configuration Revision' with the fixed value "100" as well as the 'Dataset Reference', which is made up of the IED name (setting in function group IEC) and the fixed string "System/LLNO$GooseST".



3-20 Basic structure of sent GOOSE

Receiving GOOSE

With GOOSE up to 16 logic binary state signals and the two-pole contact position signals from up to 16 external devices can be received. Configuration of the logic state signals received (GOOSE: Input n fct.assig. (n = 1 to 16)) is made on the basis of the selection table of the binary inputs (opto coupler inputs). Contact position signals received from external devices are listed in the selection table for interlocking equations of the function group ILOCK, which are available to design a decentralized substation interlock.

For each state or contact position signal to be received from an external device the "Goose Message" must be selected that includes the information wanted by setting the Goose ID, the Application ID and the 'Dataset Reference'. With the further setting of the data object index and the data attribute index through parameters, the required information from the chosen GOOSE will be selected. The device will not evaluate the identification features VLAN identifier and ‘Dataset Configuration Revision’ that are also included in the GOOSE received.

Each GOOSE includes time information on the duration of validity of its information. This corresponds to the double time period to the next GOOSE repetition. If the duration of validity has elapsed without having received this GOOSE again (i.e. because of a communications fault), the received signals will automatically be set to their respective default values GOOSE: Input n default or GOOSE: Ext.Dev n default (n = 1 to 16).

The various settings, measured values and signals for function group GOOSE are described in chapters 7 and 8.

3.4.5.3 Generic Substation State Event (Function Group GSSE)

For high-speed exchange of information between individual IEDs (intelligent electronic devices) in a local network, the P132 provides, as an additional functionality, the function group GSSE (UCA2.0-GOOSE) as defined in the IEC 61850 standard. GSSE features high-speed and secure transmission of logic binary state signals such as reverse interlocking, trip commands, blocking, enabling and other signals.

Activating and Enabling

Function Group GSSE can be activated by setting the parameter GSSE: Function group GSSE. This parameter is only visible if the optional Ethernet communication module is fitted to the device. After activation of GSSE, all data points associated to this function group (setting parameters, binary state signals etc.) become visible.
The function can then be enabled or disabled by setting
GSSE: General enable USER.

The parameter settings for function groups IEC, GOOSE and GSSE in the device are not automatically activated. An activation occurs either when the command IEC: Enable configuration is executed or automatically when the device is switched online with MAIN: Device on-line. In addition the function group IEC must be configured and enabled.

Sending GSSE

With GSSE up to 32 logic binary state signals can be sent. Selection of binary state signals is made by setting GSSE: Output n fct.assig. (n = 1 to 32). Each selected state signal is to be assigned to a bit pair in GSSE
(GSSE: Output n bit pair (n = 1 to 32)), which will transmit this state signal.

GSSE is automatically sent with each state change of a selected state signal. There will be multiple send repetitions at ascending time periods. The first send repetition occurs at the given cycle time set with the parameter GSSE: Min. cycle. The cycles for the following send repetitions result from a conditional equation with the increment set with the parameter GSSE: Increment. Should no further state changes occur up to the time when the maximum cycle time has elapsed (GSSE: Max. cycle), then GSSE will be sent cyclically at intervals as set for the max. cycle time.

In order to have unambiguous identification of a GSSE sent, the IED name is used which was set in function group IEC.

Receiving GSSE

With GSSE up to 32 logic binary state signals can be received. Configuration of the logic binary state signals received (GSSE: Input n fct.assig. (n = 1 to 32))
is made on the basis of the selection table of the binary inputs (opto coupler inputs).

For each state signal to be received, the GSSE message, which will include the required information, must be selected by setting the IED name (GSSE: IED name).
Selection of information wanted from the selected GSSE will occur by setting the bit pair (GSSE: Bit pair).

Each GSSE includes time information on the duration of validity of its information.
This corresponds to the double time period to the next GSSE repetition. If the duration of validity has elapsed without having received this GSSE again (i.e. because of a communications fault), the signals received will automatically be set to their respective default value (GSSE: Input n default (n = 1 to 32)).

The various settings, measured values and signals for function group GOOSE are described in chapters 7 and 8.

3.5 Time Synchronization via the IRIG-B Interface (Function Group IRIGB)

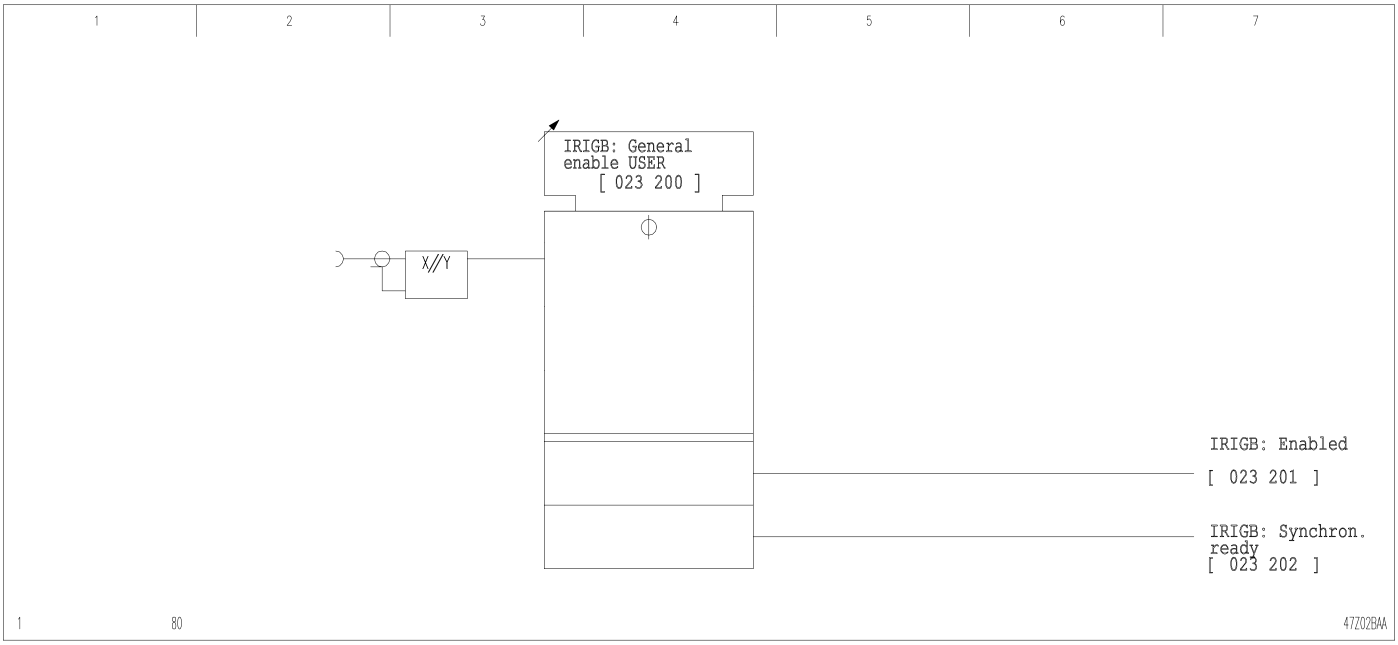
If a GPS receiver with an IRIG-B connection is available, for example, then the internal clock in the P132 can be synchronized to GPS time through the optional IRIG-B interface. The user must keep in mind that the IRIG-B signal contains only one piece of information about the date (the day as numbered since the beginning of the year). On the basis of this piece of information about the date, the P132 calculates the current date (DD.MM.YY) based on the year set in the P132.

Disabling and enabling the IRIG-B interface

The IRIG-B interface can be disabled or enabled using a setting parameter.

Synchronization readiness

Once the IRIG-B interface has been enabled and is receiving a signal, the P132 checks the received signal for plausibility. Non-plausible signals are rejected by the P132. If a correct signal is not received by the P132 continuously, then the synchronization function is no longer ready.



3-22 IRIG-B interface

3.6 Configurable Function Keys (Function Group F_KEY)

The P132 includes six additional function keys that are freely configurable. Function keys F1 toFx will only be enabled after the password has been entered at F_Key: Password funct.key x.

As an example the operation of function key F1 is shown in figure 3-22. After the password has been entered the function key will remain active for the time period set at F_KEY: Return time fct.keys. Thereafter, the function key is disabled until the password is entered again. The same is valid for function keys F2 to F6. Exception: If a function key is configured as a control key a password request is only issued when the command "Local/Remote switching" has been assigned to this function key.

Configuration of function keys with a single function

Each function key may be configured with a single function by selecting a logic state signal at F_KEY: Fct. assignm. Fx (Fx: F1 to F6), but with the exception: LOC: Trig. menu jmp x EXT (x: 1 or 2). This function is triggered by pressing the respective function key on the P132.

Configuration of function keys with menu jump lists

Instead of a single function each function key may have one of the two menu jump lists assigned at F_KEY: Fct. assignm. Fx (Fx: F1 to F6) by selecting the listing at LOC: Trig. menu jmp x EXT (x: 1 or 2). The functions of the selected menu jump list are triggered in sequence by repeated pressing of the assigned function key.

Both menu jump lists are assembled at LOC: Fct. menu jmp list x (x: 1 or 2). Up to 16 functions such as setting parameters, event counters and/or event logs may be selected.

Note: LED indicators including the six positioned directly next to the function keys are configured independently and in this respect there is no relationship to the respective function key configuration.

Configuration of the READ key

As with LOC: Fct. menu jmp list x up to 16 functions may also be selected from the same menu jump list at LOC: Assignment read key. They are triggered in sequence by repeated pressing of the "READ" key.

Configuring function keys as control keys

Each function key may be configured as a control key by selecting one of the listings at F_KEY: Fct. assignm. Fx (Fx: F1 to F6).

- MAIN: Local/Remote key
- MAIN: Device selection key
- MAIN: Device OPEN key
- MAIN: Device CLOSE key

These control functions may only be used sensibly if all four of the above commands have been configured thus engaging four of the available six function keys.

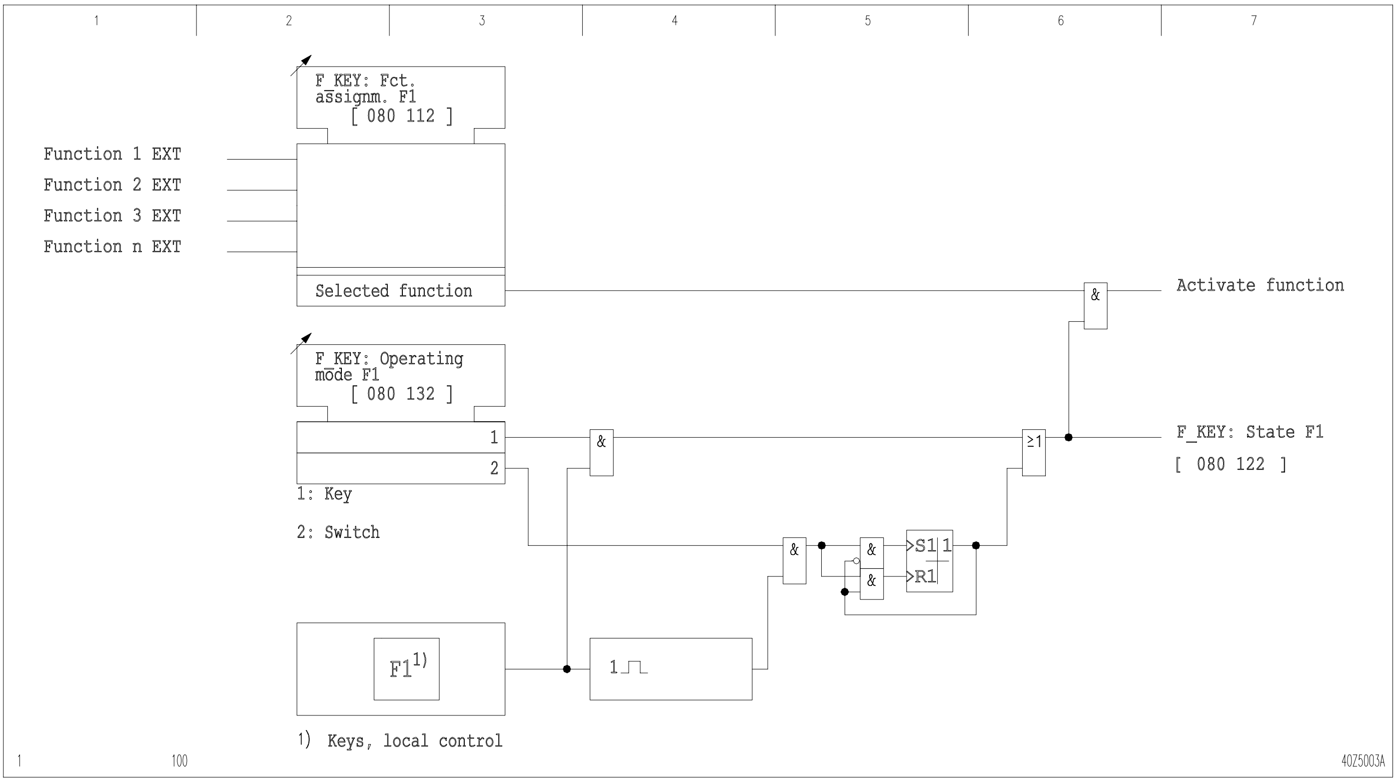
Operating mode of the function keys

For each function key the operating mode may be selected at F_KEY: Operating mode Fx (Fx: F1 to F6). Here it is possible to select whether the function key operates as a key or as a switch. In the operating mode *"Key"* the selected function is active while the function key is pressed. In the operating mode *"Switch"* the selected function is switched on or off every time the function key is pressed. The state of the function keys can be displayed.

Exception: For function keys configured as control keys the operating mode is irrelevant and it is therefore ignored.

Handling keys

If backlighting for the LC display is switched off it will automatically light up when a function key or the "READ" key is pressed. The assigned function will only be triggered when the respective key is pressed a second time. This is also valid for the other keys.



3-22 *Configuration and operating mode of function keys. The assigned function is either a single function or a menu jump list.*

3.7 Configuration and Operating Mode of the Binary Inputs (Function Group INP)

The P132 has opto coupler inputs for processing binary signals from the substation. The functions that will be activated in the P132 by triggering these binary signal inputs are defined by the configuration of the binary signal inputs. In order to ensure that during normal operation the P132 will recognize an input signal, it must persist for at least 20 ms. With the occurrence of a general starting this time period may have to be increased to 40 ms under unfavorable conditions.

Configuring the binary inputs

One function can be assigned to each binary signal input by configuration. The same function can be assigned to several signal inputs. Thus one function can be activated from several control points having different signal voltages.

In this manual, we assume that the required functions (marked 'EXT' in the address description) have been assigned to binary signal inputs by configuration.

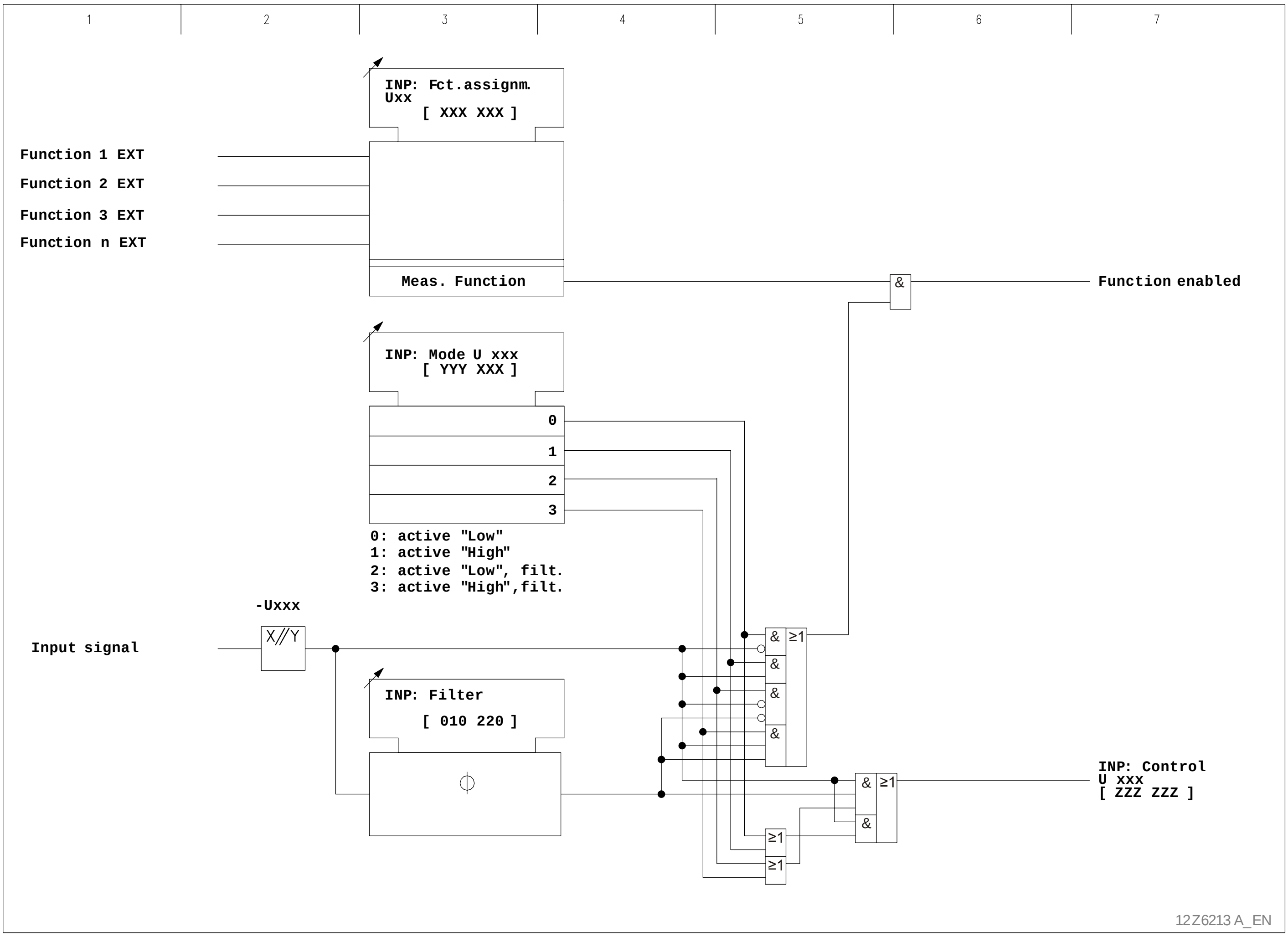
It should be noted that time-critical applications such as time synchronization commands should not be mapped to the binary signal inputs of the analog I/O module as these have an increased reaction time due to internal processing.

Operating mode of the binary inputs

The operating mode for each binary signal input can be defined. The user can specify whether the presence (*Active 'high'* mode) or absence (*Active 'low'* mode) of a voltage shall be interpreted as the logic ‘1’ signal. The display of the state of a binary signal input – "low" or "high" – is independent of the setting for the operating mode of the signal input.

Filter function

An additional filter function may be enabled in order to suppress transient interference peaks at the logic signal inputs (operating modes *Active 'high', filt.* or *Active 'low', filt.*). With this function enabled a status change at the binary logic input is only signaled when the input signal remains at a steady signal level during a set number of sampling steps (sampling step size = period / 20). The number of sampling steps is set at parameter INP: Filter.



3-23 *Configuration and operating mode of the binary signal inputs*

3.8 Measured Data Input (Function Group MEASI)

There is a second optional analog module available for the P132. In addition to the analog (I/O) module Y with analog inputs and outputs there is now a second analog module obtainable, the temperature p/c board (also called the RTD module).

When the P132 is equipped with the analog (I/O) module Y it has two analog inputs available for measured data input. Direct current is fed to the P132 through the 20 mA analog input (input channel 1). The other input is designed for connection of a PT 100 resistance thermometer.

The temperature p/c board (the RTD module) mounted in the P132 has 9 analog inputs available to connect temperature sensors T1 to T9. These analog inputs are designed for connection of PT 100, Ni 100 or Ni 120 resistance thermometers.

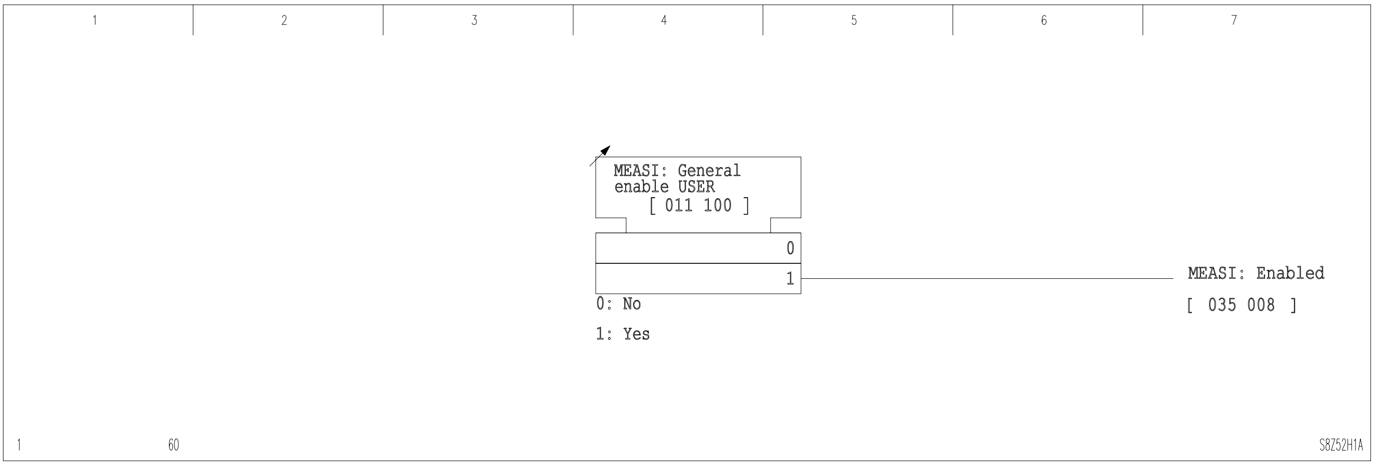
The input current I_{DC} present at the analog (I/O) module Y is displayed as a measured operating value. The current that is conditioned for monitoring purposes ($I_{D,Clin}$) is also displayed as a measured operating value. In addition, it is monitored by the Limit Value Monitoring function to detect whether it exceeds or falls below set thresholds (see "Limit Value Monitoring").

The measured temperatures are also displayed as measured operating values and monitored by the Limit Value Monitoring function to determine whether they exceed or fall below set thresholds (see "Limit Value Monitoring").

All measured variables are also forwarded to the Thermal Overload Protection function. With this protection it is possible to set whether the PT 100 resistance thermometer, the 20 mA analog input or – if configured – one of the temperature sensors T1 to T9 is to be used for the thermal replica (see "Thermal Overload Protection").

Disabling or enabling the measured data input function

The measured data input function can be disabled or enabled using a setting parameter.

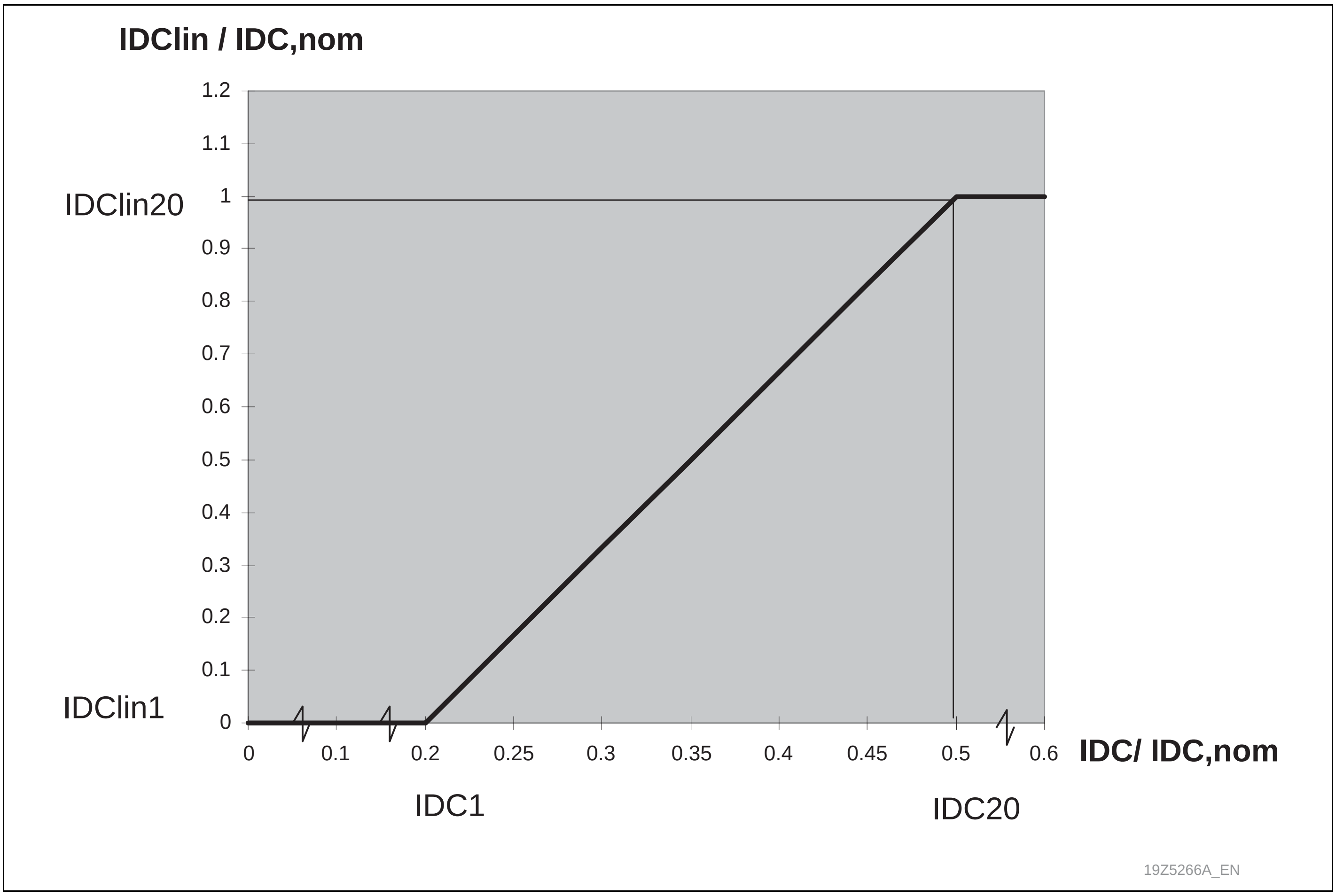


3-24 Disabling or enabling the measured data input function

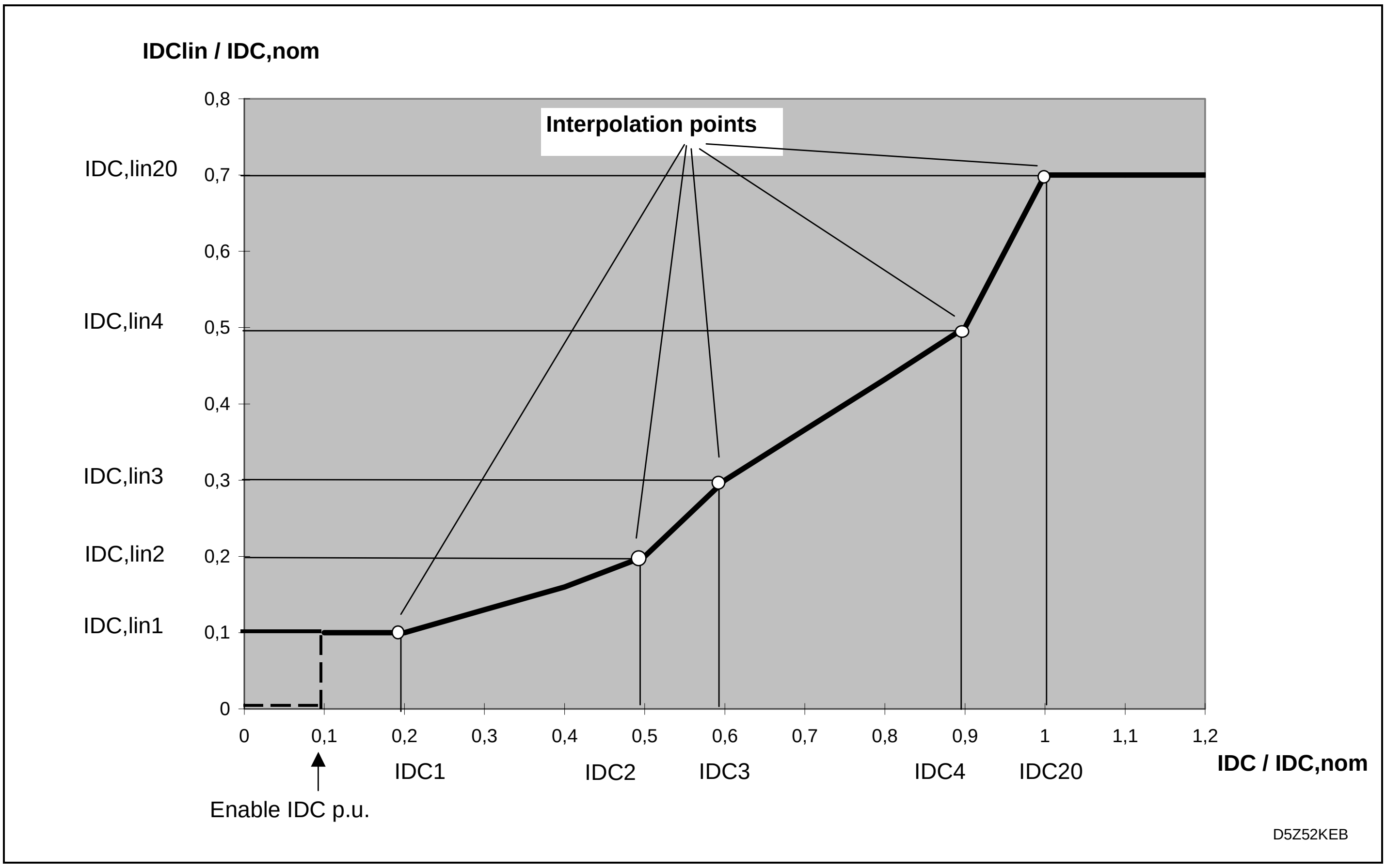
3.8.1 Direct Current Input on the Analog (I/O) Module Y

External measuring transducers normally supply an output current of 0 to 20 mA that is directly proportional to the physical quantity being measured – the temperature, for example.
If the output current of the measuring transducer is directly proportional to the measured quantity only in certain ranges, linearization can be arranged, provided that the measured data input is set accordingly. Furthermore, for certain applications it may be necessary to limit the range being monitored or to monitor certain parts of the range with a higher or lower sensitivity.
By setting the value pair `MEASI: IDC x` and `MEASI: IDC,lin x`, the user specifies which input current I_{DC} will correspond to the current that is monitored by the Limit Value Monitoring function, i.e., $I_{DC,lin}$. The resulting points, called "interpolation points", are connected by straight lines in an I_{DC}-$I_{DC,lin}$ diagram. In order to implement a simple characteristic, it is sufficient to specify two interpolation points, which are also used as limiting values (see figure 3-25). Up to 20 interpolation points are available to implement a complex characteristic.

When setting the characteristic the user must remember that only a rising/rising or falling/falling curve sense is allowed (no peak or vee-shapes). If the setting differs, the signal `MEASI: Invalid scaling IDC` will be generated.



3-25 Example of the conversion of 4 to 10 mA input current to 0 to 20 mA monitored current, IDC,lin



3-26 *Example of a characteristic with five interpolation points (characteristic with zero suppression setting of 0.1 $I_{DC,nom}$ is shown as a broken line)*

Zero suppression

Zero suppression is defined by setting MEASI: Enable IDC p.u. If the direct current does not exceed the set threshold, the per-unit input current $I_{DC\ p.u.}$ and the current $I_{DC,lin}$ will be displayed as having a value of '*0*'.

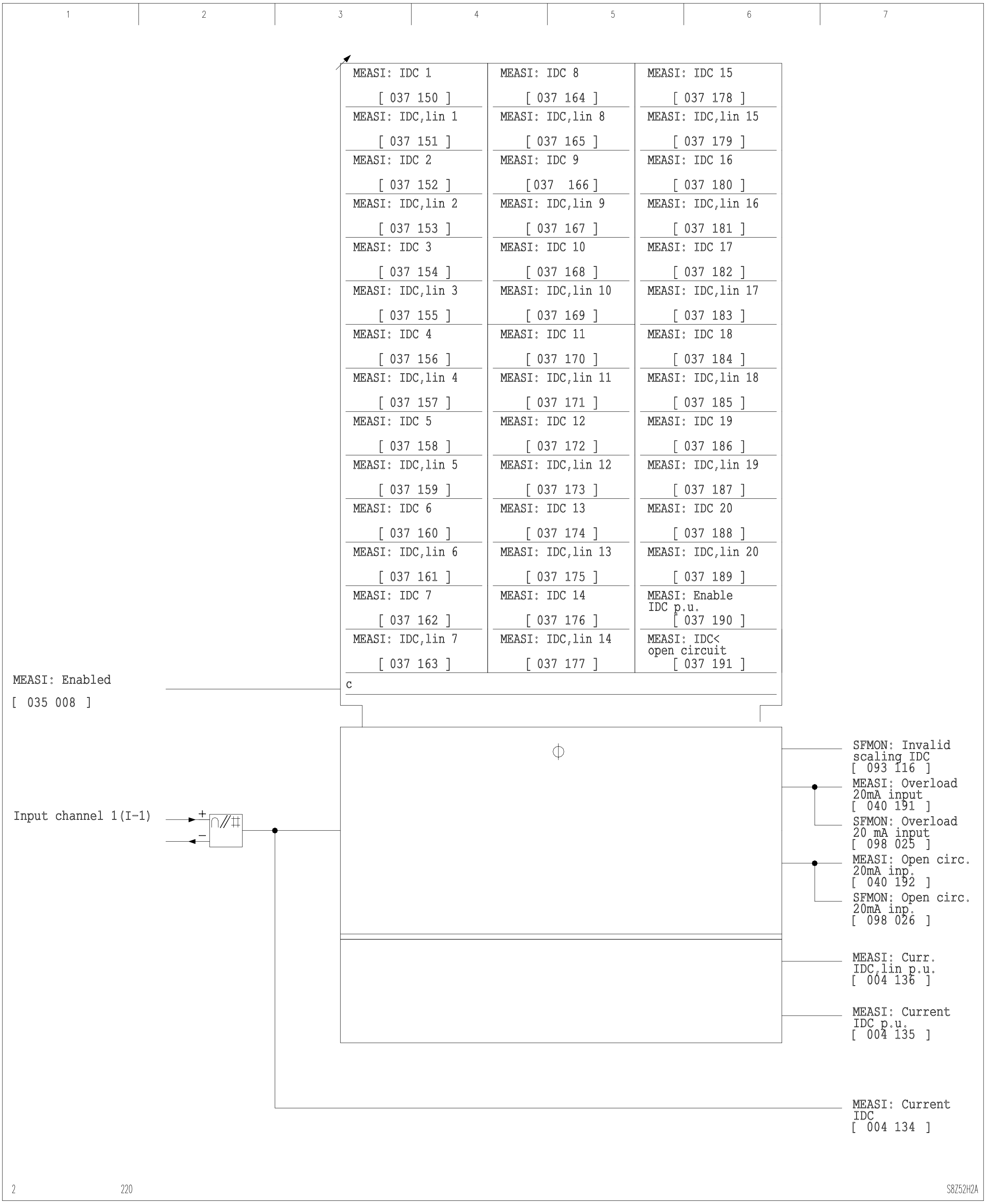
Open-circuit and overload monitoring

The device is equipped with an open-circuit monitoring function. If current I_{DC} falls below the set threshold `MEASI: IDC< open circuit,` the signal `MEASI: Open circ. 20mA inp.` is issued.

The input current is monitored in order to protect the 20 mA analog input against overloading. If it exceeds the set threshold of 24.8 mA, the signal `MEASI: Overload 20mA input` is issued.

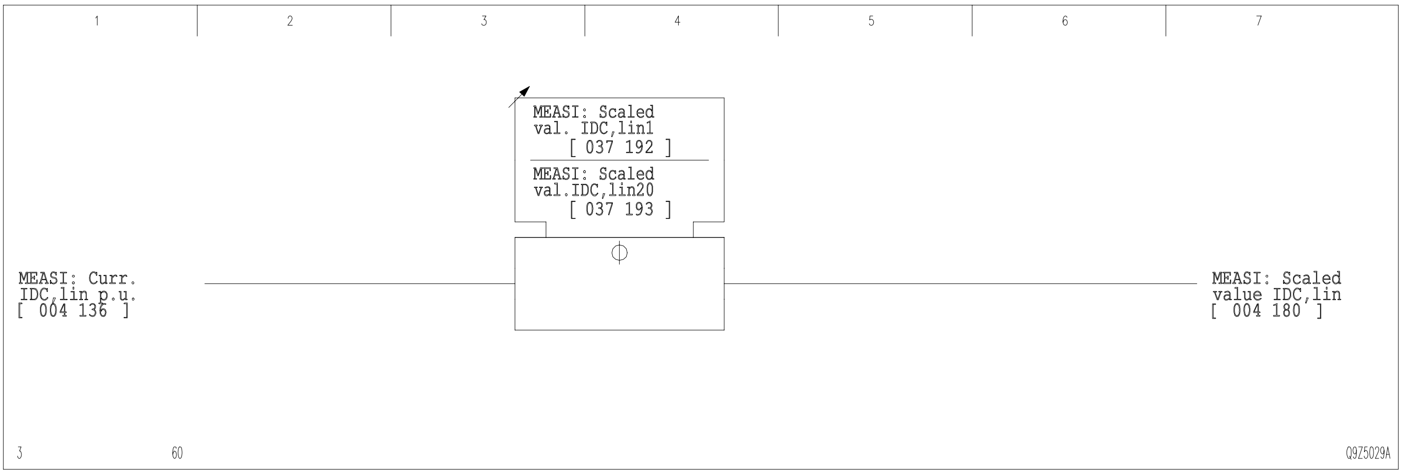
Backup sensors

The open circuit signal on the 20 mA analog input from the function group MEASI is forwarded to the Thermal Overload Protection function. Here it is possible to set whether the resistance thermometer connected to the PT 100 input or – if configured – one of the temperature sensors T1 to T9, connected to the temperature p/c board (the RTD module), is to be used as a backup sensor (see "Thermal Overload Protection").



3-27 Analog direct current input

Beyond the linearization described above, the user has the option of scaling the linearized values. Thereby negative values, for example, can be displayed as well and are available for further processing by protection functions.



3-28 *Scaling of the linearized measured value*

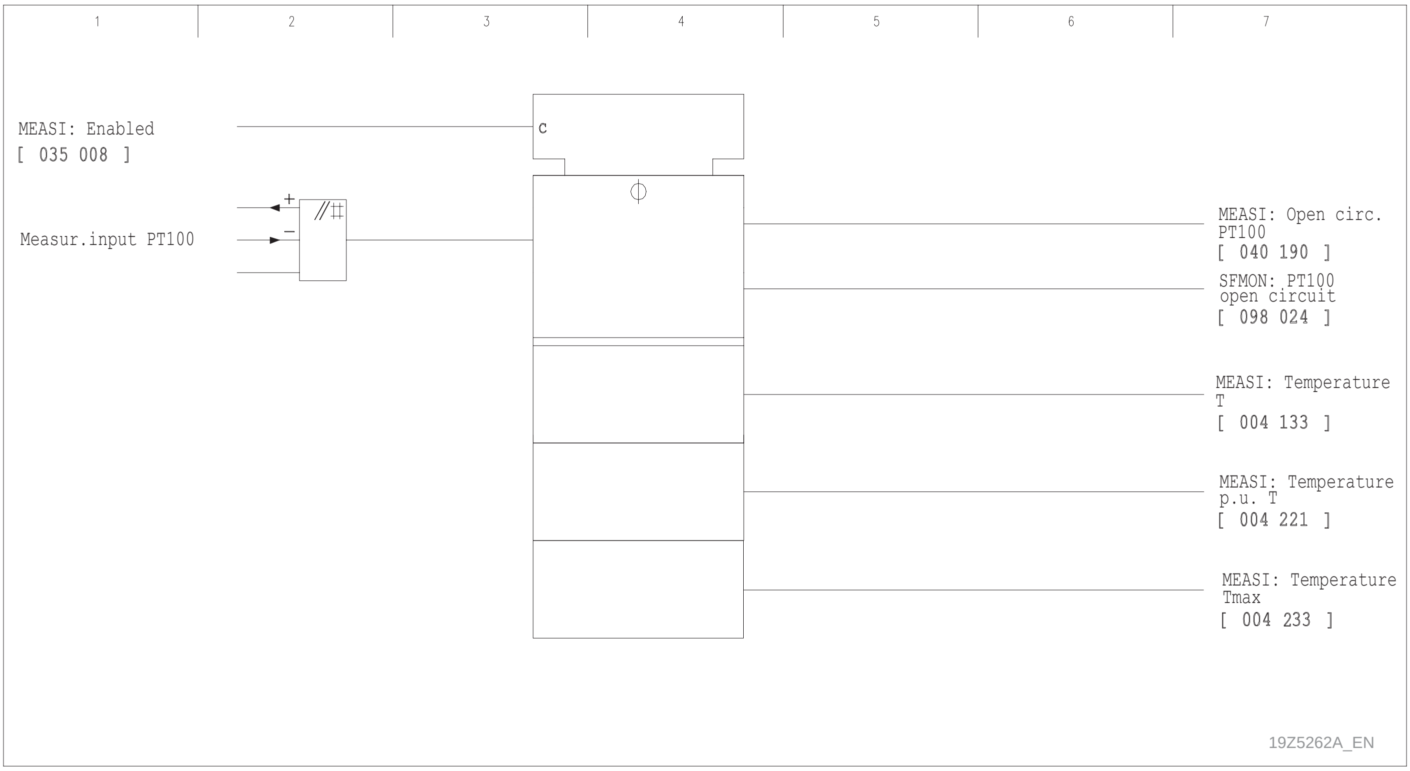
3.8.2 Connecting a Resistance Thermometer to the "PT 100 Analog Input" on the Analog (I/O) Module Y

This analog input on the analog (I/O) module Y is designed to connect a PT 100 resistance thermometer. The mapping curve R = f(T) of PT 100 resistance thermometers is defined in standard IEC 751. If the PT 100 resistance thermometer is connected using the 3-wire method, then no further calibration is required.

The result of a temperature measurement can be read out as a direct measurand (temperature T), a normalized value (temperature norm. T), and as the maximum value since the last reset.

Open-circuit monitoring

If there is an open measuring circuit due to a broken wire, the signal `MEASI: Open circ. PT100` is issued.



3-29 *Temperature measurement using a PT 100 resistance thermometer connected to the analog (I/O) module*

Backup sensors

The open circuit signal on the PT 100 analog input from the function group MEASI is forwarded to the functions Thermal Overload Protection and Limit Value Monitoring.
In the Thermal Overload Protection it is possible to set whether the 20 mA input or – if configured – one of the temperature sensors T1 to T9, connected to the temperature p/c board (the RTD module), is to be used as a backup (see "Thermal Overload Protection").
In the Limit Value Monitoring function the limit values assigned to the faulty PT 100 are blocked.

3.8.3 Connecting Temperature Sensors to the Temperature P/C Board (the RTD Module)

The temperature p/c board (the RTD module) mounted in the P132P132 has 9 analog inputs available to connect temperature sensors T1 to T9. These analog inputs are designed for connection of PT 100, Ni 100 or Ni 120 resistance thermometers.

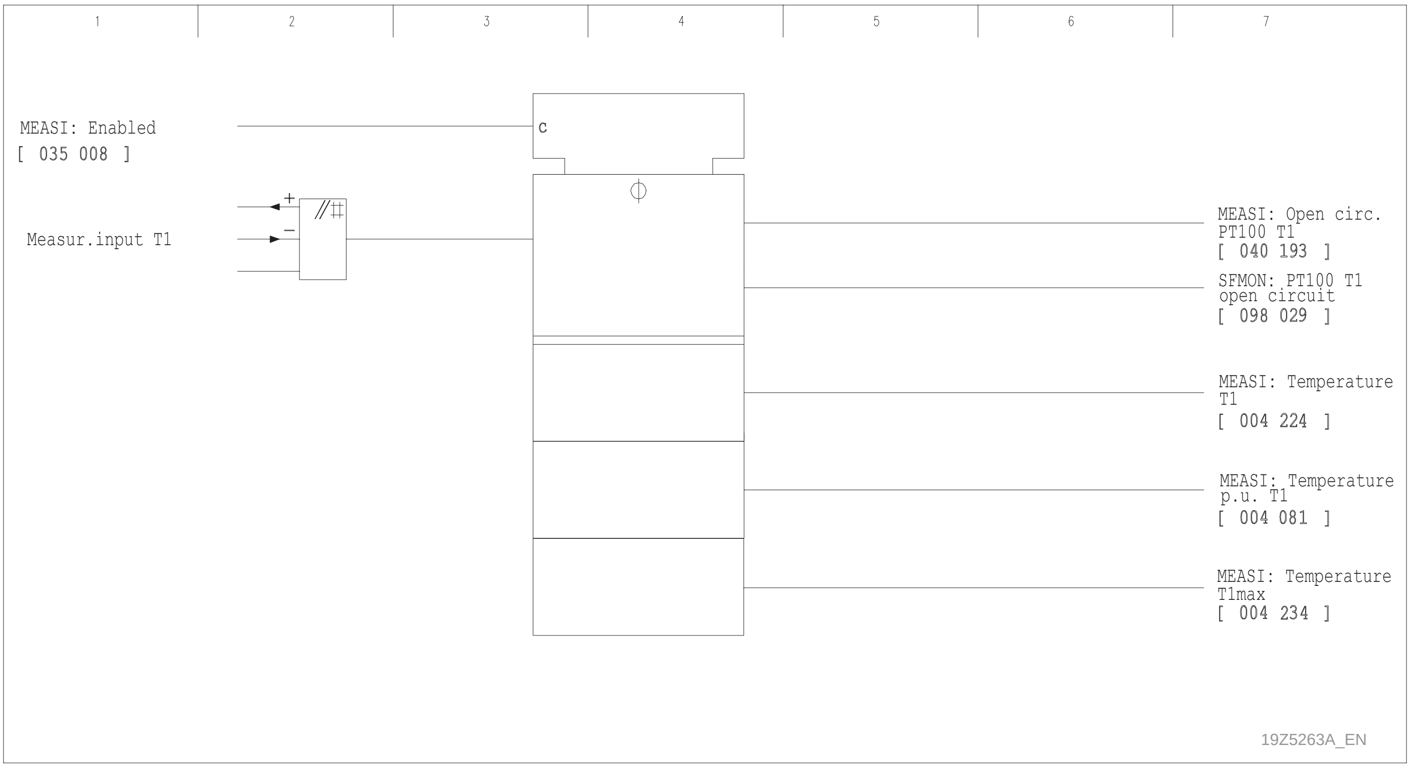
If the PT 100 resistance thermometer is connected using the 3-wire method, then no further calibration is required.

All nine temperature sensors must be of the same type, which is set under
MEASI: Type of TempSensors

The result of a temperature measurement can be read out as a direct measurand (temperature Tx), a normalized value (temperature norm. Tx) and as the maximum value since the last reset (temperature Tx max).

Open-circuit monitoring

If one of the measuring circuits is open due to a broken wire, the signal MEASI: Open circ. PT100 Tx (x = 1 to 9) is issued.



3-30 Temperature measurement with temperature sensor T1 connected to the temperature p/c board. The same applies to sensors T2 to T9.

Backup sensors

The open circuit signals from temperature sensors, issued by function group MEASI, are forwarded to the Thermal Overload Protection function. Should the main temperature sensor (that has been set in the Thermal Overload Protection) fail, it is possible to select in whether the 20 mA input or – if configured – one of the temperature sensors T1 to T9, connected to the temperature p/c board (the RTD module), is to be used as a backup sensor (see "Thermal Overload Protection").

In addition to this, the open circuit signals from the temperature sensors, issued by the function group MEASI, are forwarded to the Limit Value Monitoring function. The selection of such backup sensors for the Limit Value Monitoring function is made in the function group MEASI.

For this purpose the temperature sensors connected to the temperature p/c board (RTD board) are divided into three groups:

Group 1: T1, T2, T3
Group 2: T4, T5, T6
Group 3: T7, T8, T9

If MEASI: BackupTempSensor PSx is set to ***Without***, the Limit Value Monitoring function will operate without backup sensors.

If MEASI: BackupTempSensor PSx is set to ***Group 1 -2***, the defective temperature sensor from group 1 is replaced by the corresponding sensor from group 2.

If the backup temperature sensor from group 2 also fails it will be replaced by the corresponding sensor from group 3, under the assumption that MEASI: BackupTempSensor PSx is set to ***Group 1 –2/3***.

The association of backup temperature sensors is listed below:

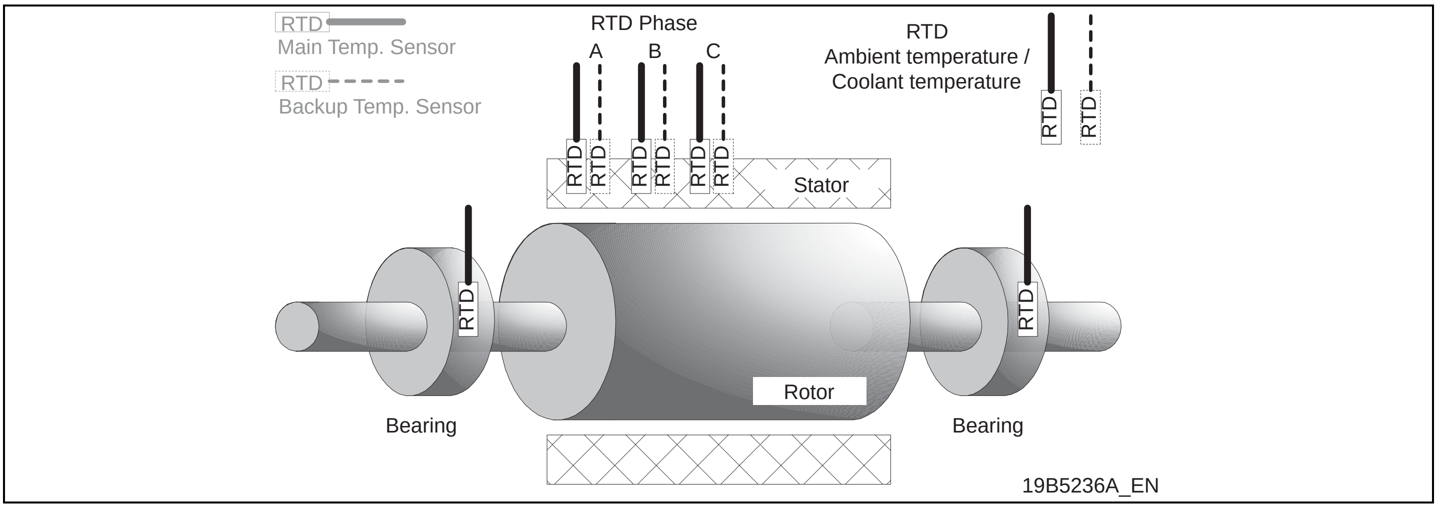
Main sensor	Backup sensor from group 2	Backup sensor from group 3
	With setting: *Group 1 -2* or *Group 1 -2/3*	With setting: *Group 1 –2/3*
T1	T4	T7
T2	T5	T8
T3	T6	T9

Should temperature sensor T1 fail, with the setting *Group 1 –2/3*, it will replaced by T4. Should temperature sensor T4 also fail it will replaced by T7.

For further details refer to section with the description of the "Limit Value Monitoring".

Application example

A motor protection application is shown in the figure below with temperature sensors T1 to T9 connected to the temperature p/c board (RTD module) and a "PT 100" resistance thermometer connected to the analog (I/O) module Y.



3-31 *Temperature measurements on a motor to be used with the Limit Value Monitoring function (L I M I T) and the Thermal Overload protection (THERM)*

3.9 Configuration, Operating Mode, and Blocking of the Output Relays (Function Group OUTP)

The P132 has output relays for the output of binary signals. The binary signals to be issued are defined by configuration.

Configuration of the output relays

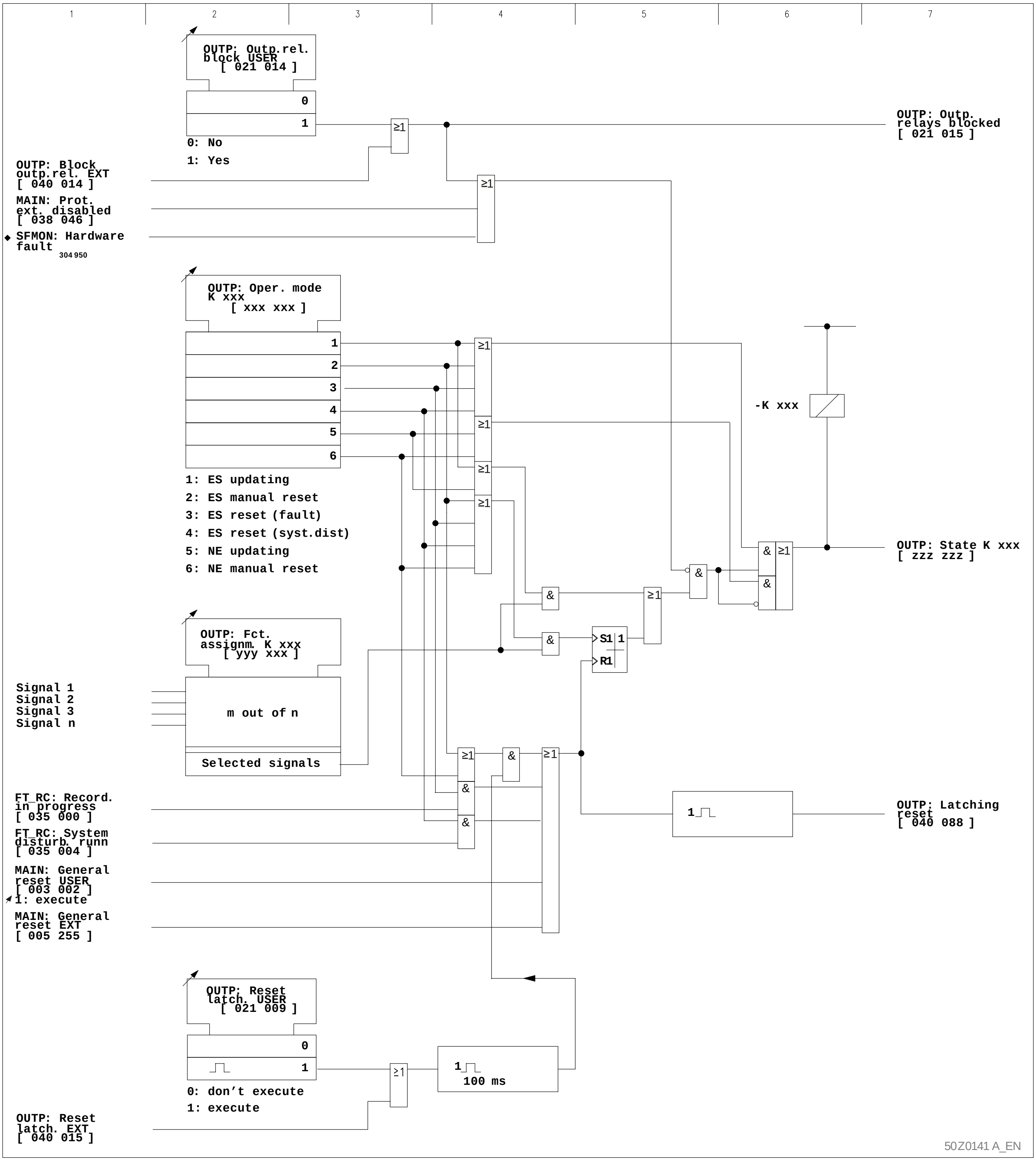
One binary signal can be assigned to each output relay. The same binary signal can be assigned to several output relays by configuration.

Operating mode of the output relays

The user can set an operating mode for each output relay. The operating mode determines whether the output relay will operate in an energize-on-signal arrangement (ES, logic “1” = energize relay coil) or normally energized arrangement (NE, logic “1” = de-energize relay coil) and whether it will operate in latching mode. Latching is disabled either manually through a user interface or an appropriately configured binary signal input either at the onset of a new fault or at the onset of a new system disturbance, depending on the operating mode selected.

Blocking the output relays

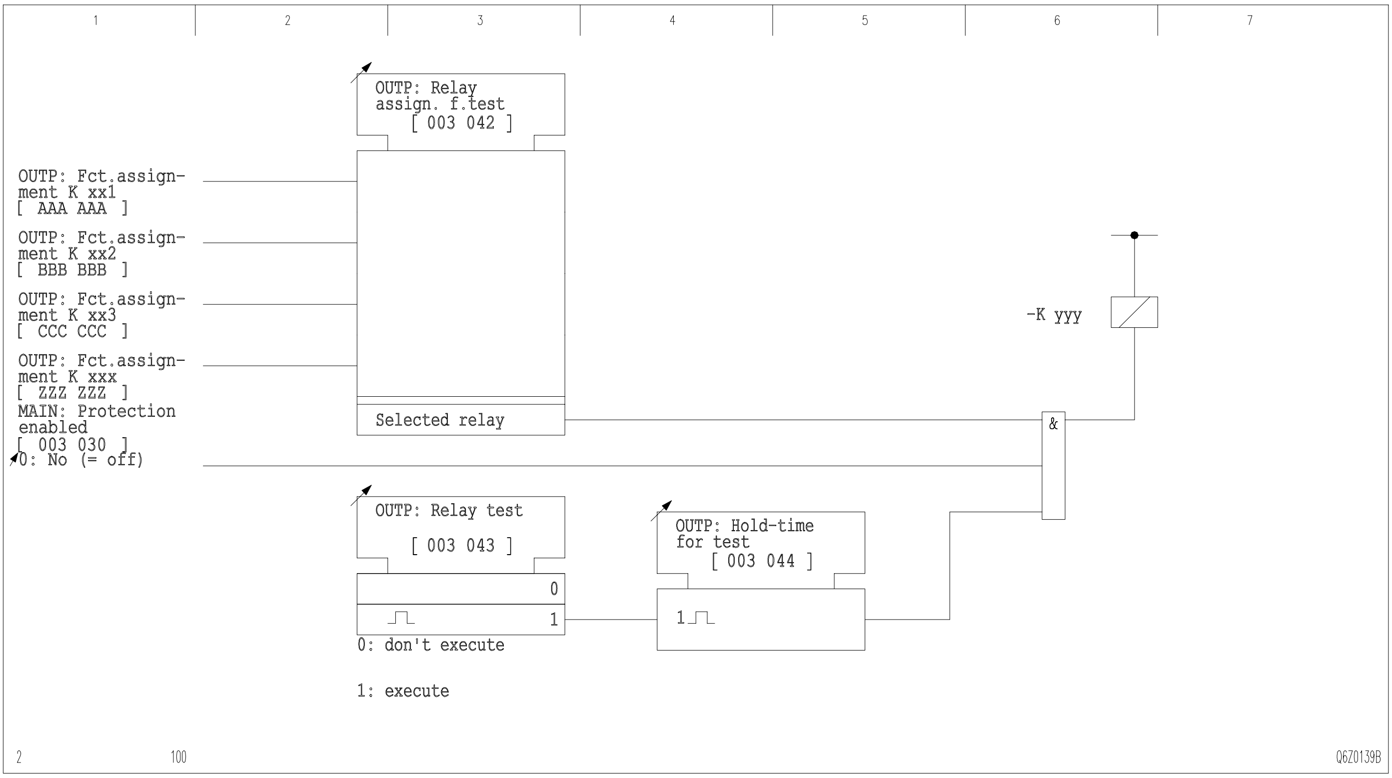
The P132 offers the option of blocking all output relays via a user interface or by way of an appropriately configured binary signal input. The output relays are likewise blocked if the device is disabled via appropriately configured binary inputs or if the self-monitoring function detects a hardware fault. An output relay configured for the signal MAIN: Blocked/faulty is not included in blocking.



3-32 *Configuration, setting the operating mode, and blocking the output relays*

Testing the output relays

For testing purposes, the user can select an output relay and trigger it via a user interface. In this case the device has to be switched to “offline”. Triggering persists for the duration of the set hold time.



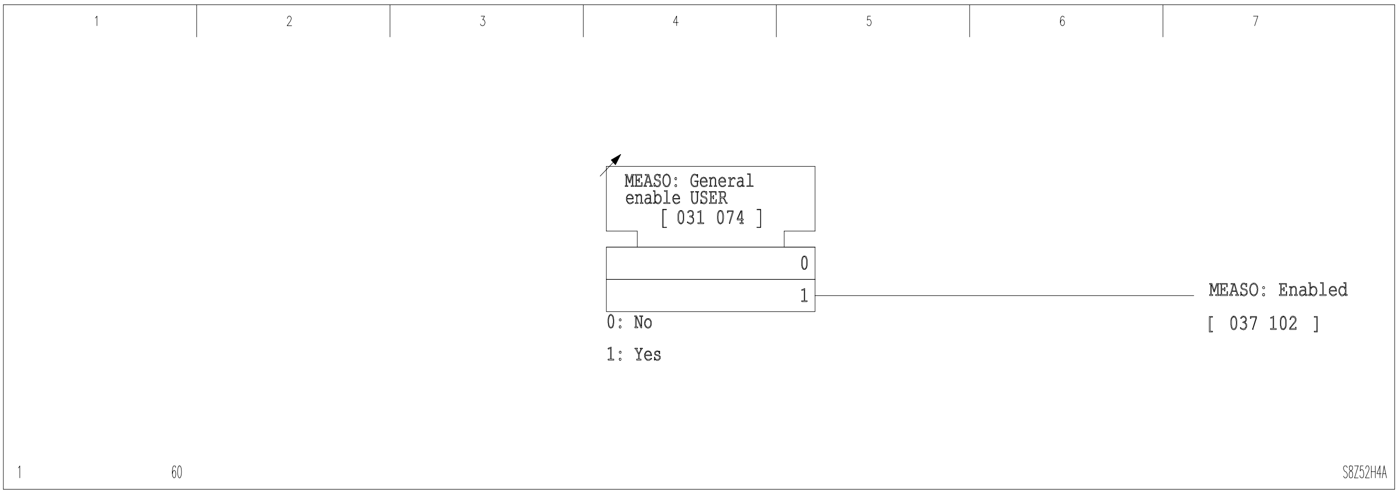
3-33 *Testing the output relays*

3.10 Measured Data Output (Function Group MEASO)

Measurands made available by the P132 can be provided in BCD (binary coded decimal) form through output relays or in analog form as direct current output. Output as direct current can only occur if the device is equipped with analog module Y. BCD-coded output is always possible, whether the device is equipped with analog module Y or not.

Disabling or enabling the measured data output function

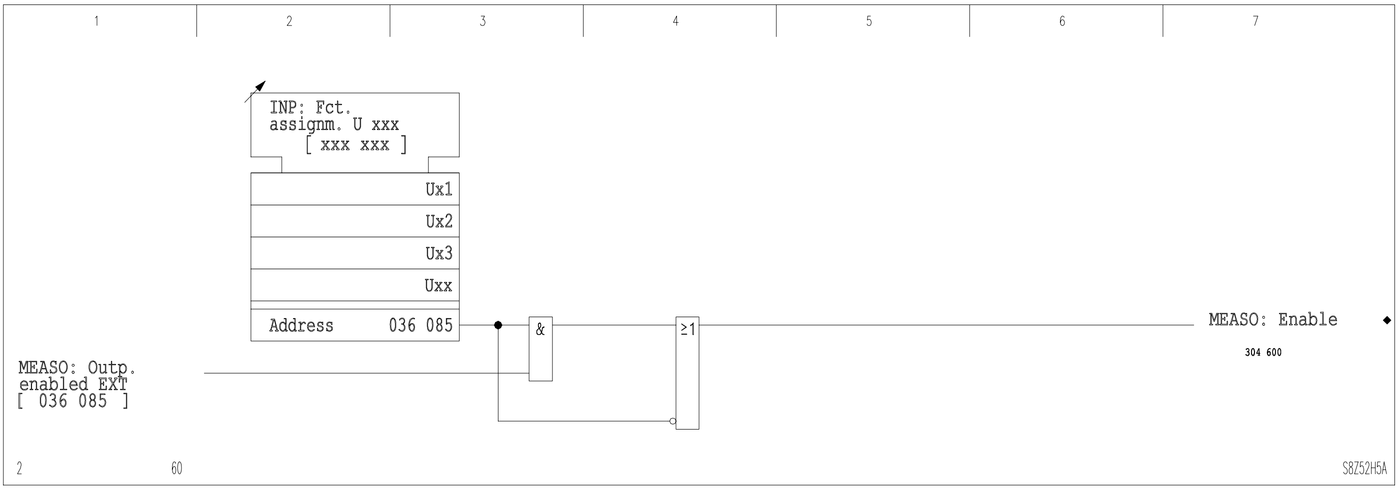
The measured data output function can be disabled or enabled using a setting parameter.



3-34 *Disabling or enabling the measured data output function*

Enabling measured data output

The measured data output can be enabled through a binary signal input, provided that the function MEASO: Outp. enabled EXT has been configured. If the function MEASO: Outp. enabled EXT has not been configured to a binary signal input, then the measured data output is always enabled.

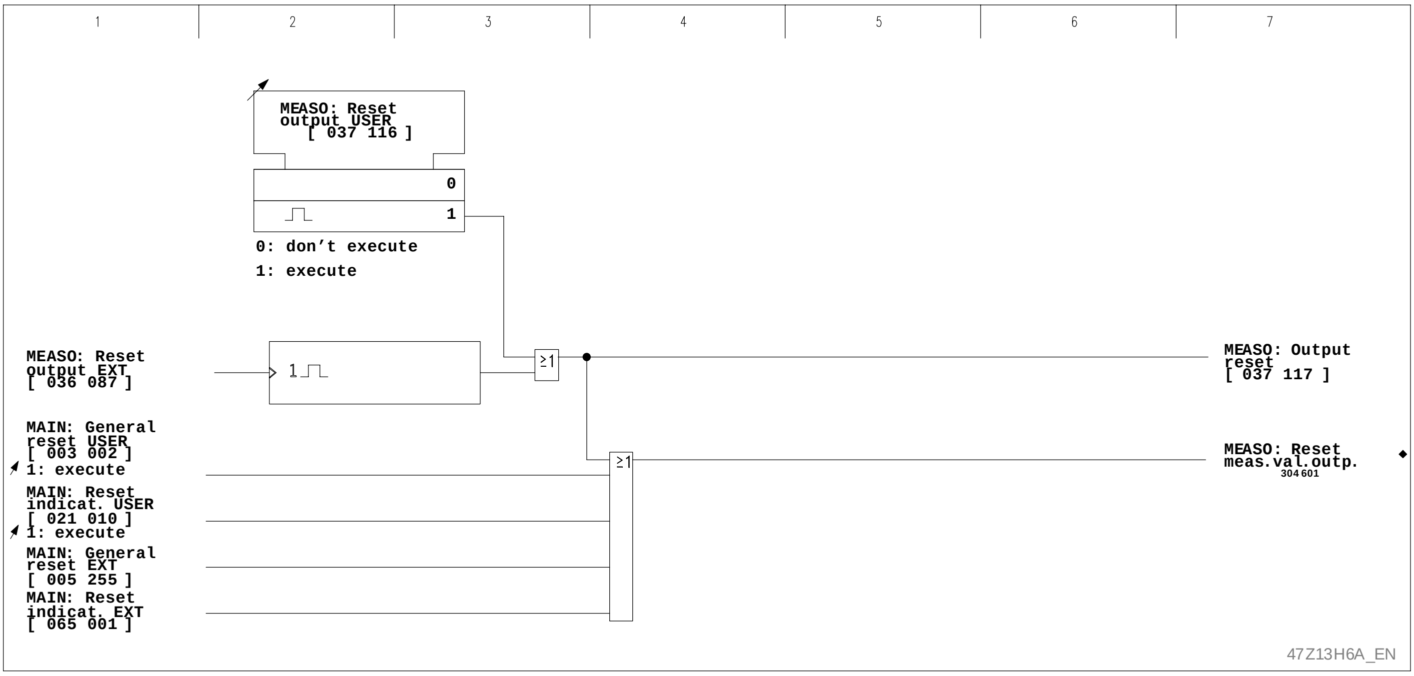


3-35 *Enabling measured data output*

Resetting the measured data output function

BCD-coded or analog output of measurands is terminated for the duration of the hold time if one of the following conditions is met:

- ☐ The measured data output function is reset through a user interface or an appropriately configured binary signal input.
- ☐ There is a general reset.
- ☐ LED indicators are reset.



3-36 *Resetting the measured data output function*

Scaling

Scaling is used to map the physical measuring range to the device inherent setting range.

Scaling of analog output is also suited for directional-signed output of some fault measurands, in particular fault location in percent.

3.10.1 BCD-coded Measured Data Output

The user can select a measurand for output in BCD-coded form by assigning output relays.

The selected measurand is available in BCD-coded form for the duration of the set hold time MEASO: Hold Time Output BCD. If the selected variable was not measured, then there is no output of a value.

Output of measured event values

If the measured event value is updated during the hold time, the measurand output memory is cleared and the hold time is re-started. This leads to immediate availability at the output of the updated value.

Output of measured operating values

The selected measured operating value is available for the duration of the set hold time. After the hold time has elapsed, the current value is saved and the hold time is re-started. If the hold time has been set to "*blocked*", the measured operating value that has been output will be stored until the measured data output function is reset.

Scaling of BCD output

In order to define the resolution for measured data output the measurand range (Mx,min ... Mx,max) in scaled form (as Mx,scal,min ... Mx,scal,max) and the associated BCD display range (BCD,min ... BCD,max) have to be set.

☐ MEASO: Scaled min. val. BCD

☐ MEASO: Scaled max. val. BCD

☐ MEASO: BCD-Out min. value

☐ MEASO: BCD-Out max. value

The BCD display range should be set so that the value 399 is never exceeded. If this should occur or if the measurand is outside the acceptable measuring range, then the value for "Overflow" (all relays triggered) is transmitted.

Measurands	**Range**
Measurands of the variable Mx	Mx,RL1 ... Mx,RL2
Associated scaled measurands	0 ... 1

Scaling is made with reference to the complete range of values for the selected measurand (variable Mx). The complete range of values is defined by their end values Mx,RL1 and Mx,RL2. (Mx,RL1 and Mx,RL2 are listed in the operating program S&R-103 - PC Access Software MiCOM S1 - under "minimum" and "maximum".)

Measurands to be output	**Range**
Measurands to be output	Mx,min. ... Mx,max.
Scaled measurands to be output	Mx,scal,min ... Mx,scal,max with: Mx,scal,min = (Mx,min - Mx,RL1) / (Mx,RL2 - Mx,RL1) Mx,scal,max = (Mx,max - Mx,RL1) / (Mx,RL2 - Mx,RL1)
Designation of the set values in the data model	"Scaled min. val. BCD" ..."Scaled max. val. BCD"

Measurands	**BCD-coded display values**
Measurands in the range "Measurands to be output":	*BCD-Out min. value … BCD-Out max. value* (*Valid BCD value*)
Measurands: Mx,RL1 = Mx = Mx,min.	*BCD-Out min. value* (BCD value not valid)
Measurands Mx: Mx,max = Mx = Mx,RL2.	*BCD-Out max. value* (BCD value not valid)
Measurands Mx: Mx < Mx,RL1 or Mx > Mx,RL2	*BCD-Out max. value* (Overflow)

Example for scaling of BCD output

The value range for the fault measurand is set from –320.00% to +320.00%. The PU fault location is given in the range from 0% to 200%.

Measurands	Range
Fault measurand: *FT_DA: Fault locat. percent*	-320,00% ... +320,00%
Associated scaled measurands	0 ... 1

Measurands to be output	Range
Measurands to be output	0% ... 200%
Scaled measurands to be output	0.5 ... 0.813 with: 0.500 = 320/640 0.813 = 520/640

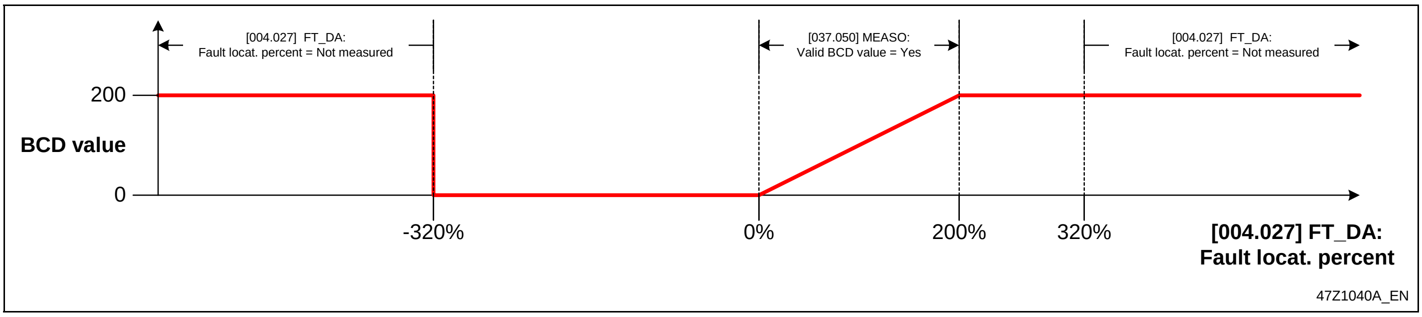
Measurands	BCD-coded display values
Measurands in the range "Measurands to be output”	0 ... 200

In this example the following device settings are selected:

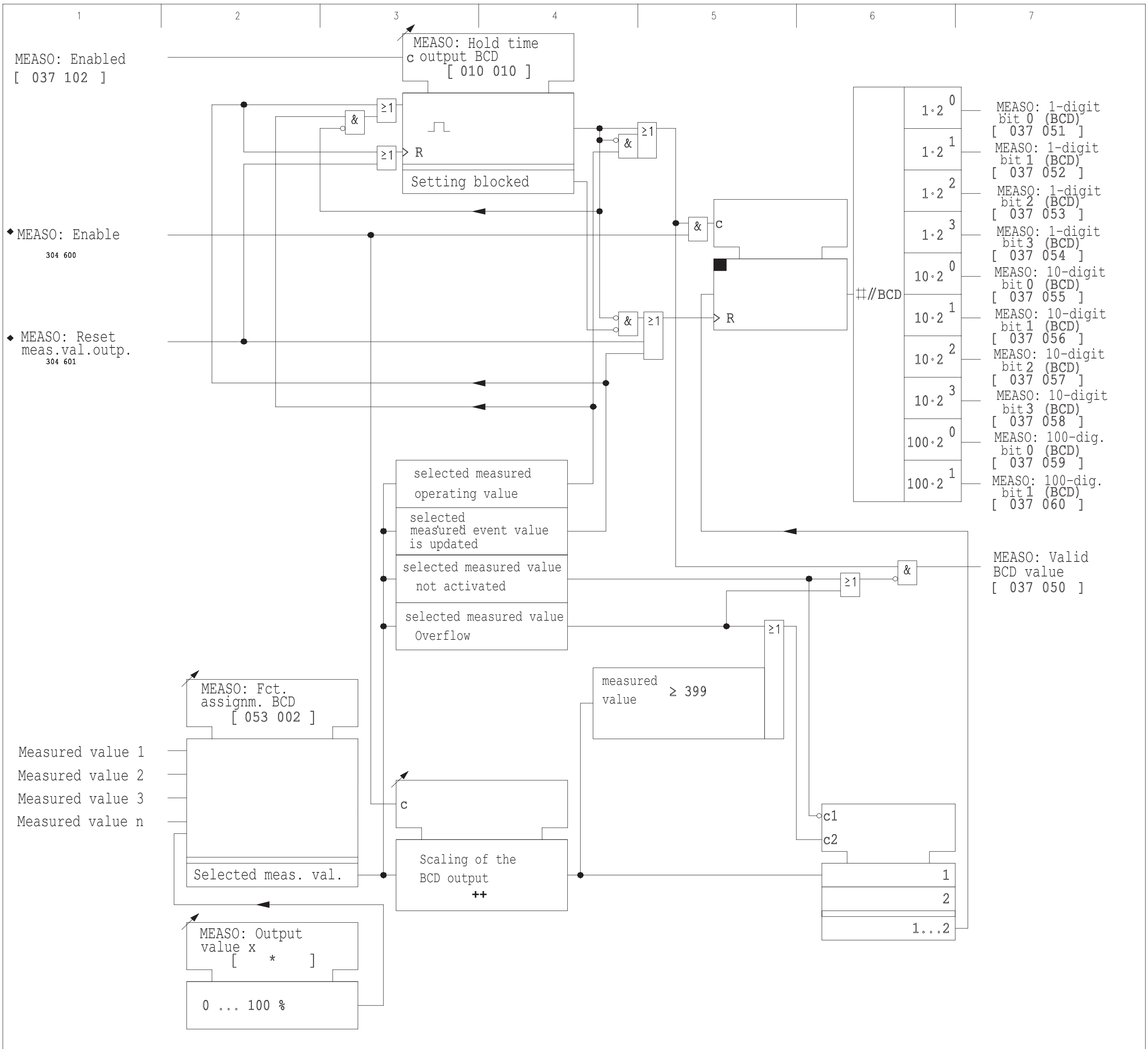
/Parameter/Config.parameters/

Address	Description	Current value
056 020	MEASO: Function group MEASO	*'With'*
031 074	MEASO: General enable USER	*'Yes'*
053 002	MEASO: Fct. assignm. BCD	*FT_DA: Fault locat. percent*
010 010	MEASO: Hold time output BCD	*1.00 s*
037 140	MEASO: Scaled min. val. BCD	*0.500*
037 141	MEASO: Scaled max. val. BCD	*0.813*
037 142	MEASO: BCD-Out min. value	*0*
037 143	MEASO: BCD-Out max. value	*200*

The following figure displays the values output as a function of the fault location. The BCD-coded value and the signal MEASO: Valid BCD value = *'Yes'* are only issued in the value range 0% to 200%.



3-37 Example of BCD coded output of fault location



* MEASO : Output value x	Address
x: 1	037 120
x: 2	037 121
x: 3	037 122

++

Scaling of the BCD output	
MEASI: Scaled min. val. BCD	**037 140**
MEASI: Scaled max. val. BCD	**037 141**
MEASI: BCD-Out min. value	**037 142**
MEASI: BCD-Out max. value	**037 143**

4 205 19Z5264A_EN

3-38 BCD-coded measured data output Overflow behavior is displayed in BCD example (see previous figure)

3.10.2 Analog Measured Data Output

Analogue output of measured data is two-channel.

The user can select two of the measurands available in the P132 for output in the form of load-independent direct current. Three interpolation points per channel can be defined for specific adjustments such as adjustment to the scaling of a measuring instrument. The direct current that is output is displayed as a measured operating value.

The selected measurand is output as direct current for the duration of the set hold time MEASO: Hold Time Output A-x. If the selected variable was not measured, then there is no output of a measurand value.

Output of measured event values

If the measured event value is updated during the hold time, the measurand output memory is cleared and the hold time is re-started. This leads to an immediate availability at the output of the updated value.

Output of measured operating values

The selected measured operating value is available for the duration of the set hold time. After the hold time has elapsed, the current value is saved and the hold time is re-started. If the hold time has been set to "*blocked*", the measured operating value that has been output will be stored until the measured data output function is reset.

Configuration of output relays assigned to the output channels

The user must keep in mind that direct current output only occurs when the output relays assigned to the output channels are configured for MEASO: Value A-x Output, since the output channels would otherwise remain short-circuited (see terminal connection diagrams).

Scaling the analog display

In order to define the resolution for measured data output the measurand range in scaled form and the associated display range have to be set. One additional value for the knee point must also be defined. In this way the user can obtain an analog output characteristic similar to the characteristic shown in Figure 3-39.

Measurand range to be output

The measurand range to be output is (Mx,min ... Mx,knee ... Mx,max),
with:

Mx,min:	minimum value to be output
Mx,knee:	Knee point value for the measurand range to be output
Mx,max:	maximum value to be output

This measurand range to be output is defined by setting the following parameters:

- ☐ MEASO: Scaled min. val. A-x
- ☐ MEASO: Scaled knee val. A-x
- ☐ MEASO: Scaled max. val. A-x

Scaling is made with reference to the complete range of values for the selected measurand (variable Mx). The complete range of values is defined by their end values Mx,RL1 and Mx,RL2. (Mx,RL1 and Mx,RL2 are listed in the operating program S&R-103 - PC Access Software MiCOM S1 - under "minimum" and "maximum".)

Measurands	Range
Measurands of the variable Mx	Mx,RL1 ... Mx,RL2
Associated scaled measurands	0 ... 1

Measurands to be output	Range
Measurands with knee-point to be output	Mx,min ... Mx,knee ... Mx,max
Scaled measurands with a scaled knee-point to be output	Mx,scal,min ... Mx,scal,knee ... Mx,scal,max with: Mx,scal,min = (Mx,min - Mx,RL1) / (Mx,RL2 - Mx,RL1) Mx,scal,knee = (Mx,knee - Mx,RL1) / (Mx,RL2 - Mx,RL1) Mx,scal,max = (Mx,max - Mx,RL1) / (Mx,RL2 - Mx,RL1)
Designation of the set values in the data model	"Scal. min. value Ax" ... ... "Scal. knee-point Ax" ... ... "Scal. max. value Ax"

Associated display range

The associated display range is defined by setting the following parameters:

☐ MEASO: AnOut min. val. A-x

☐ MEASO: AnOut knee point A-x

☐ MEASO: AnOut max. val. A-x

Measurands	**Analog display values**
Measurands in the range "Measurands to be output"	*"AnOut min. val.* A-x" ... ... *"AnOut knee point A-x"* ... ...*"AnOut max. val. A-x"* *(Value A-x valid)*
Measurands: Mx,RL1 = Mx = Mx,min	*"AnOut min. val."* (Value A-x not valid)
Measurands Mx: Mx,max = Mx = Mx,RL2	*"AnOut max. val."* (Value A-x not valid)
Measurands Mx: Mx < Mx,RL1 or Mx > Mx,RL2	*"AnOut max. val."* (Overflow)

Example for scaling of analog display ranges

Voltage A-B is selected as the measurand to be transmitted by channel A-1.
The measuring range is from 0 to 1.5 V_{nom} with V_{nom} = 100 V.
The range to be transmitted is from 0.02 to 1 V_{nom}
with the associated display range from 4 mA to 18 mA.
The knee-point of the characteristic is 0.1 V_{nom} with an associated display of 16 mA.

Measurands	**Range**
Measurands of the variable Mx	0 V ... 150 V
Associated scaled measurands	0 ... 1

Measurands to be output	**Range**
Measurands with knee-point to be output	2 V ...10 V... 100 V
Associated scaled measurands	0.013 ... 0.067 ... 0.67 with: Mx,scal,min = (2 V - 0 V) / (150 V - 0 V) = 0.013 Mx,scal,knee = (10 V - 0 V) / (150 V - 0 V) = 0.067 Mx,scal,max = (100 V - 0 V) / (150 V - 0 V) = 0.67

Measurands	**Analog display values**
Measurands in the range "Measurands to be output" 0.02 ... 0.1 V_{nom} ... 1 V_{nom}	4 mA ... 16 mA ... 18 mA

In this example the following device settings are selected:

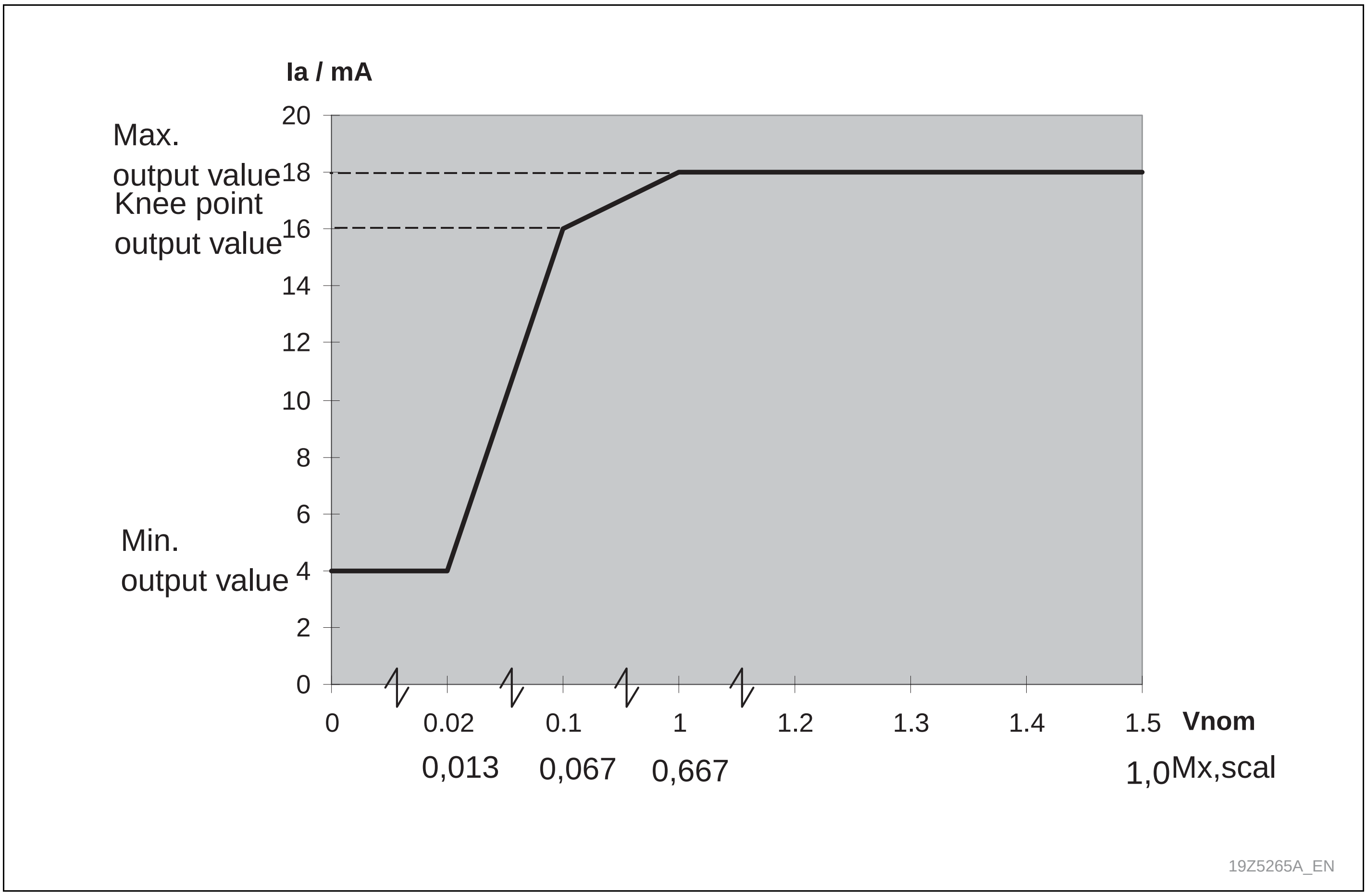
/Parameter/Config.parameters/

Address	**Description**	**Current value**
056 020	MEASO: Function group MEASO	*'With'*
031 074	MEASO: General enable USER	*'Yes'*
053 000	MEASO: Fct. assignm. A-1	*MAIN:* *Voltage A-B PU*
010 114	MEASO: Hold time output A-1	*1.00 s*
037 104	MEASO: Scaled min. val. A-1	0.013 (corresponds with *0.02 Vnom)*
037 105	MEASO: Scaled knee val. A-1	0.067 (corresponds with *0.10 Vnom)*
037 106	MEASO: Scaled max. val. A-1	0.667 (corresponds with *1.00 Vnom)*
037 107	MEASO: AnOut min. val. A-1	*4 mA*
037 108	MEASO: AnOut knee point A-1	*16 mA*
037 109	MEASO: AnOut max. val. A-1	*18 mA*

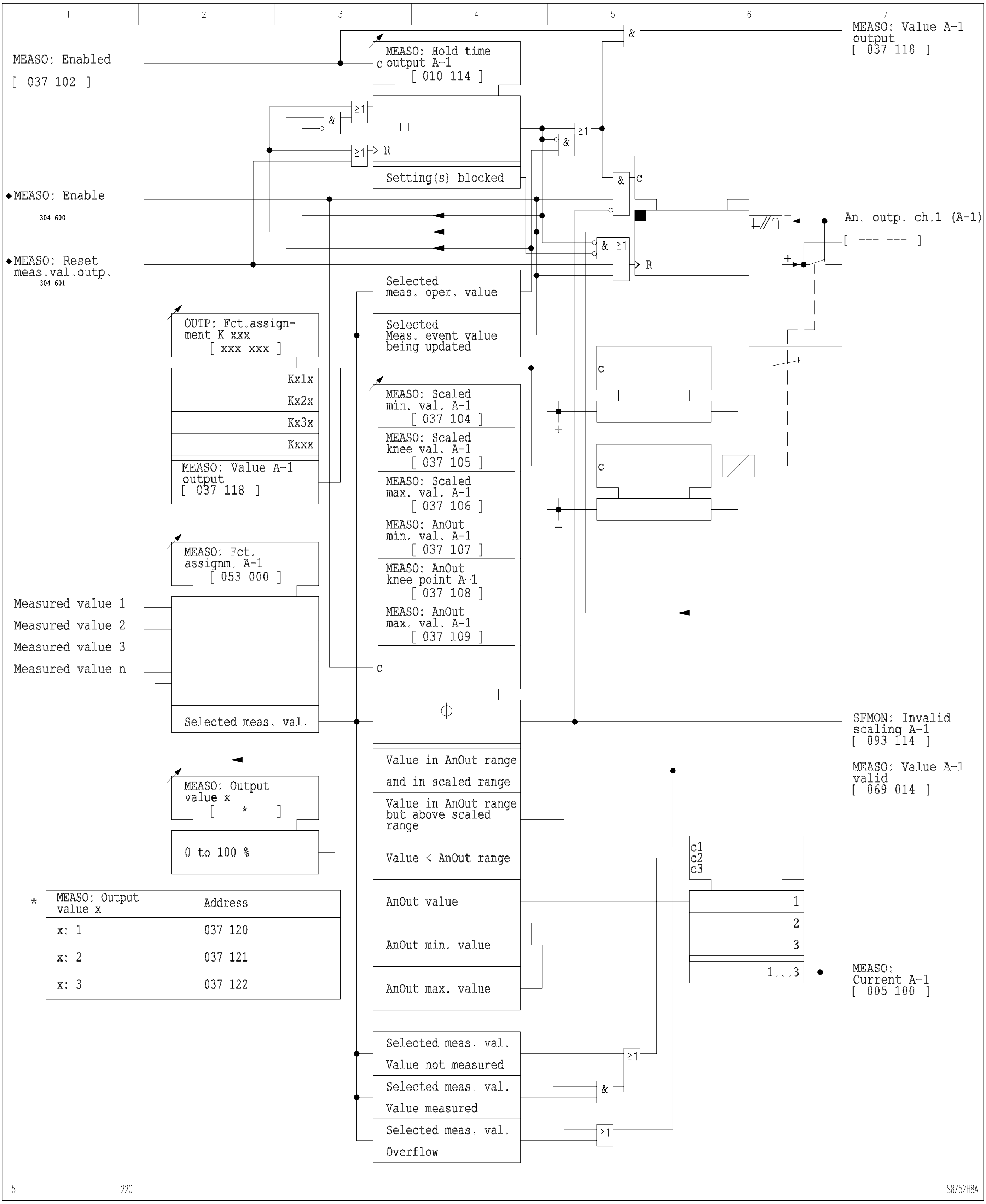
By setting MEASO: AnOut Min. val. A-x, the user can specify the output current that will be output when values are smaller than or equal to the set minimum measured value to be transmitted. The setting at MEASO: AnOut max. val. A-x defines the output current that is output for the maximum measured value to be transmitted. By defining the knee-point, the user can obtain two characteristic curve sections with different slopes. When entering this setting the user must keep in mind that only a rising/rising or falling/falling curve sense is permitted (peaky or vee shapes not allowed). If the setting was not properly entered, the signal SFMON: Invalid scaling A-x will be issued.

Note:

A check of the set characteristic and its acceptance by the device, if the setting was properly entered, will only occur after the device, with the setting MAIN: Device on-line is again switched on-line.



3-39 *Example of a characteristic curve for analog measured data output . In this example the range starting value is = 0; also possible is directional-signed output (see corresponding example in section BCD-coded Measured Data Output).*



*	MEASO: Output value x	Address
	x: 1	037 120
	x: 2	037 121
	x: 3	037 122

3-40 *Analog measured data output*

3.10.3 Output of ‘External’ Measured Data

Measured data from external devices, which must be scaled to 0 ... 100%, can be written to the following parameters of the P132 via the communications interface.

☐ MEASO: Output Value 1

☐ MEASO: Output Value 2

☐ MEASO: Output Value 3

These "external" measured values are output by the P132 either in BCD-coded data form or as load-independent direct current, provided that the BCD-coded measured data output function or the channels of the analogue measured data output function are configured accordingly.

3.11 Configuration and Operating Mode of the LED Indicators (Function Group LED)

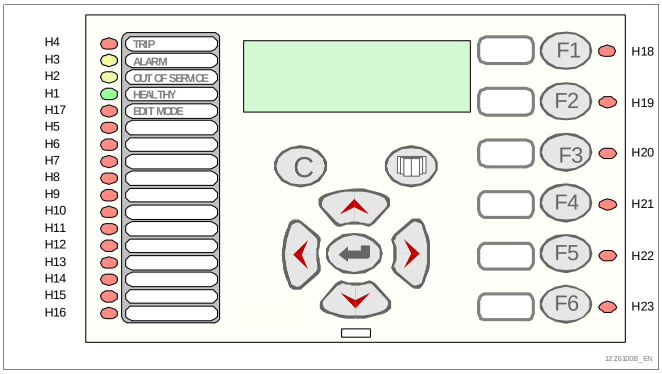
The P132 has 23 LED indicators for the indication of binary signals. Four of the LED indicators are permanently assigned to fixed functions. The other LED indicators are freely configurable. These freely configurable LEDs will emit either red or green or amber light (amber is made up of red and green light and may not be configured independently).

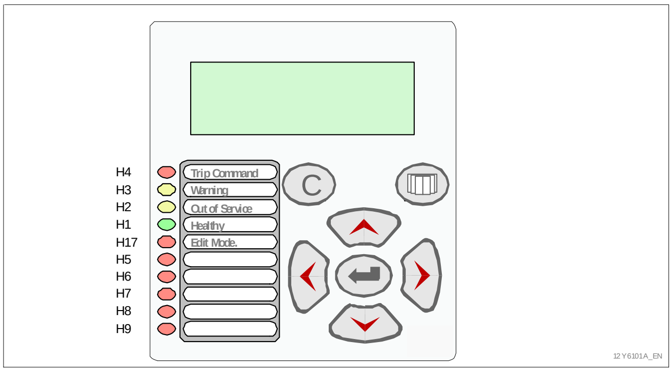
Configuring the LED indicators

One binary signal can be assigned to each of the red and green LED color indications. The same binary signal can be assigned to several LED indicators (or colors), if required.

LED indicator	Label	Configuration
H 1 (green)	“HEALTHY”	Not configurable. H 1 indicates the operational readiness of the device (supply voltage is present).
H 17 (red)	“EDIT MODE”	Not configurable. H 17 indicates the input (edit) mode. Only when the device is in this mode, can parameter settings be changed by pressing the “Up“ and “Down“ keys. (See Chapter 6, section 'Display and Keypad')
H 2 (amber)	“OUT OF SERVICE”	Permanently configured with function MAIN: Blocked/faulty.
H 3 (amber)	“ALARM”	Permanently configured with function SFMON: Warning (LED).
H 4 (red)	“TRIP COMMAND”	With the P132 this LED indicator is customarily configured with function MAIN: Gen. trip signal - but the configuration may be modified. The factory setting for LED indicator H 4 is shown in the terminal connection drawings at the end of Chapter 5 and it is included in the supporting documents.
H 4 (green)	----	Function assignment to this green LED indicator is freely configurable.
H 5 to H 16 H 18 to H 23	----	For each of these LED indicators both colors (red & green) may be configured freely and independently. (Note: H10 – H 16 & H 18 – H 23 are not available with case 24T devices.)

The following figures illustrate the layout of LED indicators situated on the local control panel with case 40T/84T (left) devices and with case 24T devices (right).





Operating mode of the LED indicators

For each of the freely configurable LED indicators, the operating mode can be selected separately. This setting will determine whether the LED indicator will operate either in energize-on-signal (ES) or normally-energized (NE) mode, whether it will be flashing and whether it will be in latching mode. Latching is disabled either manually via setting parameters or by an appropriately configured binary signal input (see "Main Functions of the P132"), at the onset of a new fault or of a new system disturbance, depending on the selected operating mode.

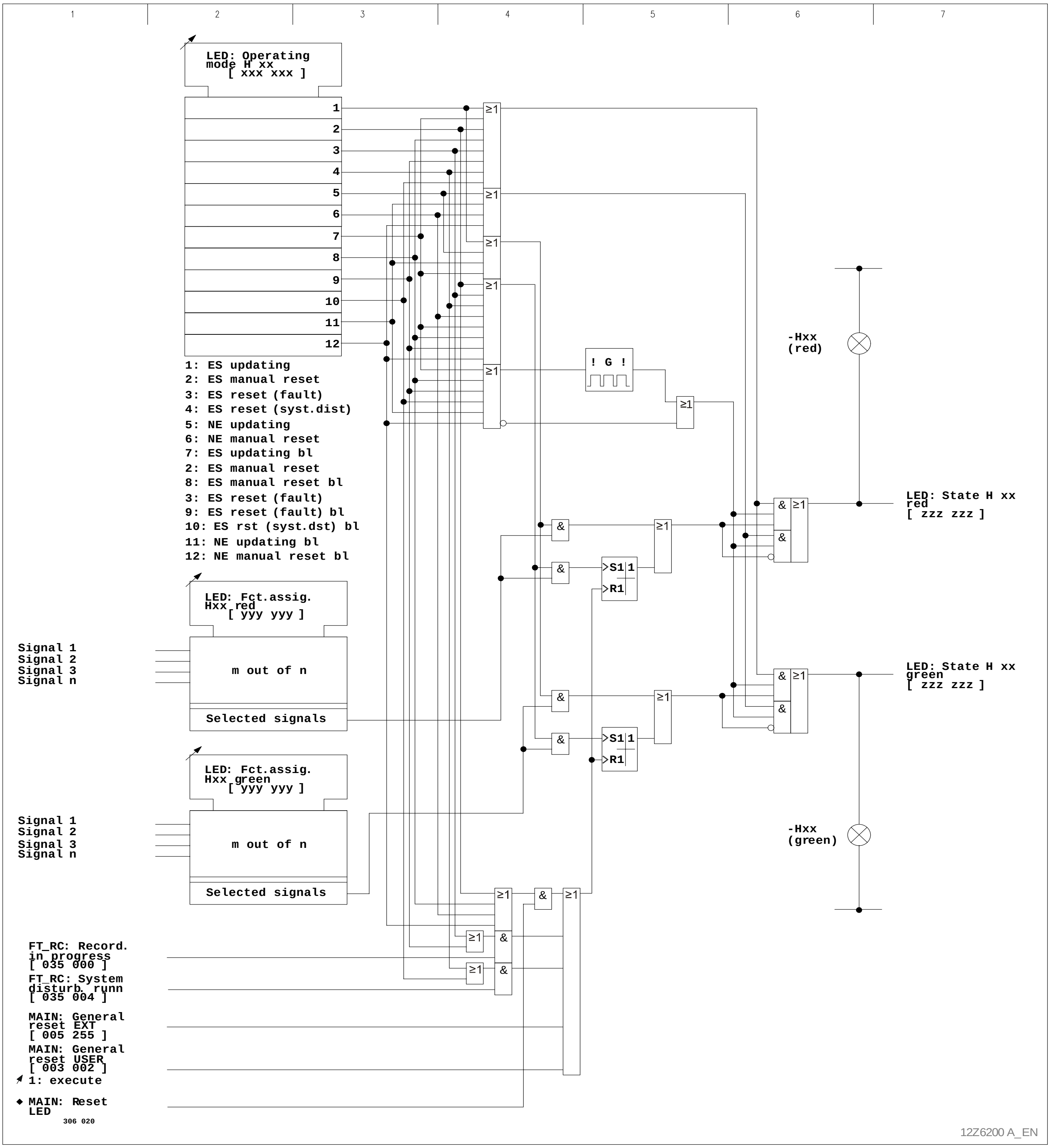
Therefore the operating modes turn out to be the 2^3=8 possible combinations of the following components:

- *flashing / continuous,*
- *energize-on-signal (ES) / normally-energized (NE),*
- *updating / latching with manual reset,*

in addition to these there are the following 4 operating modes

- *energize-on-signal (ES) with reset after new fault (flashing / continuous) and*
- *energize-on-signal (ES) with reset after new system disturbance (flashing / continuous),*

so that there are 12 possible operating modes in total.

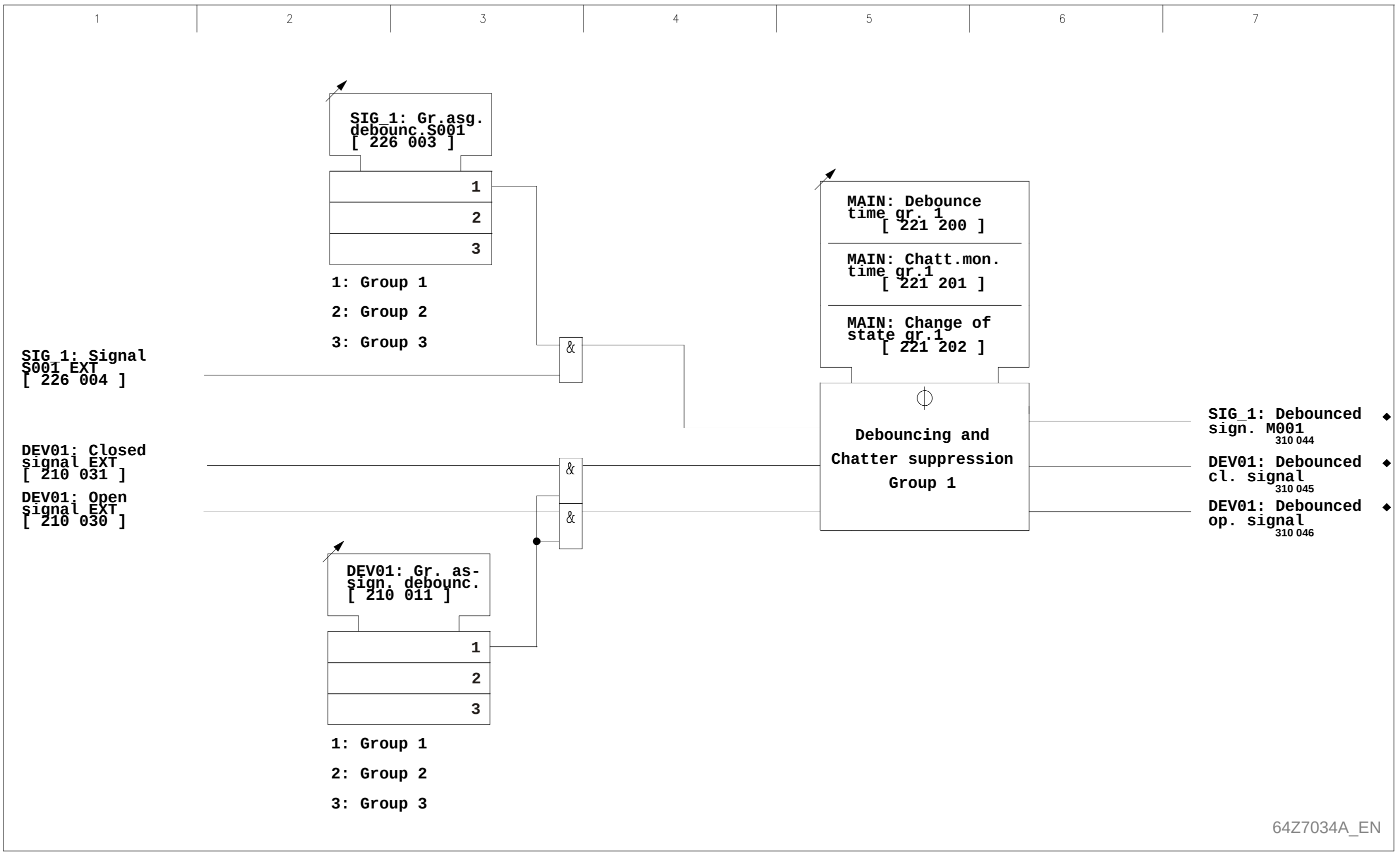


3-41 *Configuration and Operating Mode of the LED Indicators*

3.12 Main Functions of the P132 (Function Group MAIN)

3.12.1 Acquisition of Binary Signals for Control

In the acquisition of signals for control purposes, the functions real time acquisition (time tagging), debouncing and chatter suppression are included as standard. Each of these signals can be assigned to one of three groups and for each of these groups the debouncing time and chatter suppression can be set. Matching of these two parameters achieves the suppression of multiple spurious pickups.



3-42 *Group assignment and setting of debouncing and chatter suppression, illustrated for group 1*

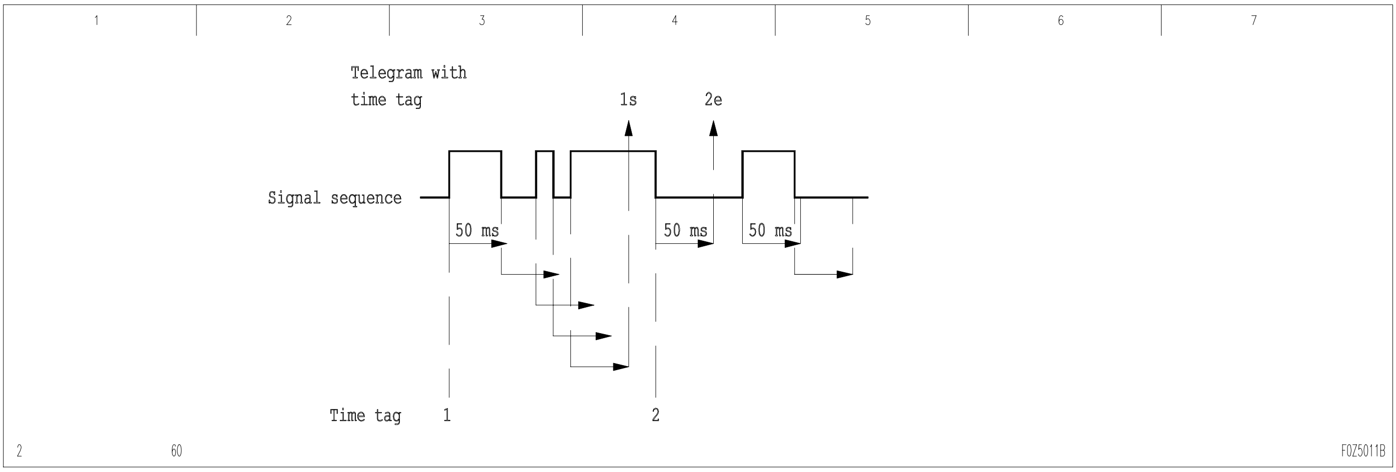
Debouncing

The first pulse edge of a signal starts a timer stage running for the duration of the set debouncing time. Each pulse edge during the debouncing time re-triggers the timer stage.

If the signal is stable until the set debouncing time elapses, a telegram containing the time tag of the first pulse edge is generated. As an alternative the time tag may be generated after debouncing by setting parameter MAIN: Time tag to the value *'After debounce time'.*

After the set debouncing time has elapsed, the state of the signal is checked. If it is the same as prior to the occurrence of the first pulse edge, no telegram is generated.

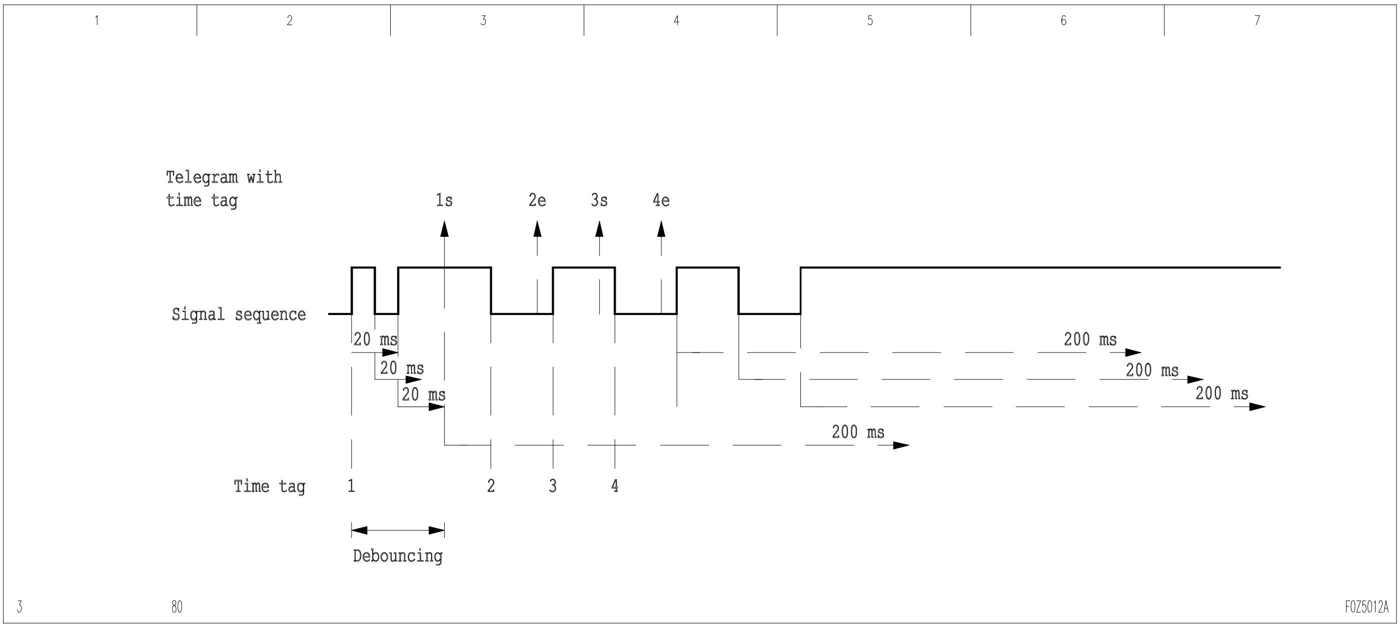
Time-tagged entries of the first pulse edge are only generated after debounce time has elapsed. If these entries are saved without delay (setting of MAIN: Time tag to the value *'1stEdge,OpMem unsort'*) they are not necessarily saved in chronological order in the operating data memory. If above parameter has been set to the value *'1stEdge,OpMem sorted'* then all entries are always saved in chronological order in the operating data memory.



3-43 Signal flow with debouncing when time tagging occurs with the 1st pulse edge
(e.g. parameter MAIN: Time tag set to the value '1stEdge,OpMem unsort' or '1stEdge,OpMem sorted'.)
Example: Set debouncing time: 50 ms
s: start
e: end

Chatter suppression

Sending of the first telegram starts a timer stage running for the duration of the set monitoring time. While the timer stage is elapsing, telegrams are generated for the admissible signal changes. The number of admissible signal changes can be set. After the first "inadmissible" signal change, no further telegrams are generated and the timer stage is re-triggered. While the timer stage is elapsing, it is re-triggered by each new signal change. Once the timer stage has elapsed, each signal change triggers a telegram.



3-44 Signal flow for debouncing and chatter suppression

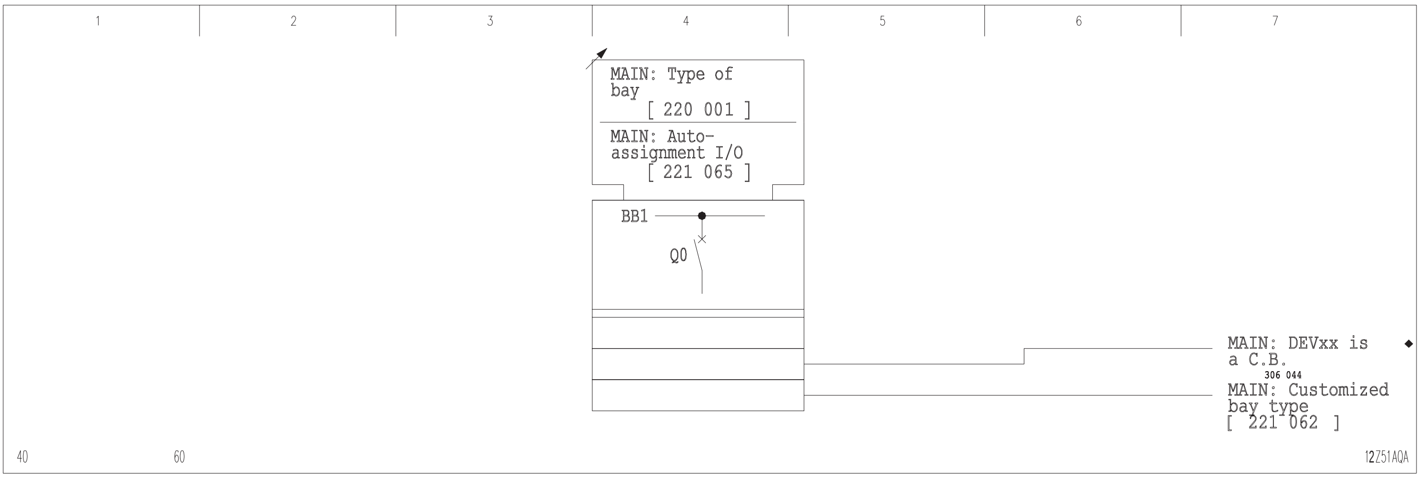
Example: Set debouncing time:	*20 ms*
Set chatter monitoring time:	*200 ms*
Number of admissible signal changes:	*4*
s:	*start*
e:	*end*

3.12.2 Bay type selection

The P132 is designed to control up to three switchgear units. The Bay Panel type defines the layout of a bay with its switchgear units.

The P132 offers a selection from pre-defined bay types. Should the required bay type be missing from the standard selection then the user can contact the manufacturer of the P132 to request the definition of a customized bay type to download into the P132. By applying the bay editor from the PC Access Software MiCOM S1 the user can also define new bay types. The number of this additional bay type will then be displayed at MAIN: Customized bay type.

Once the user has selected a bay type, the P132 can automatically configure the binary inputs and output relays with function assignments for the control of switchgear units. The assignment of inputs and outputs for an automatic configuration is shown in the List of Bay Types in the Appendix.



3-45 *Bay type selection*

3.12.3 Conditioning of the Measured Variables

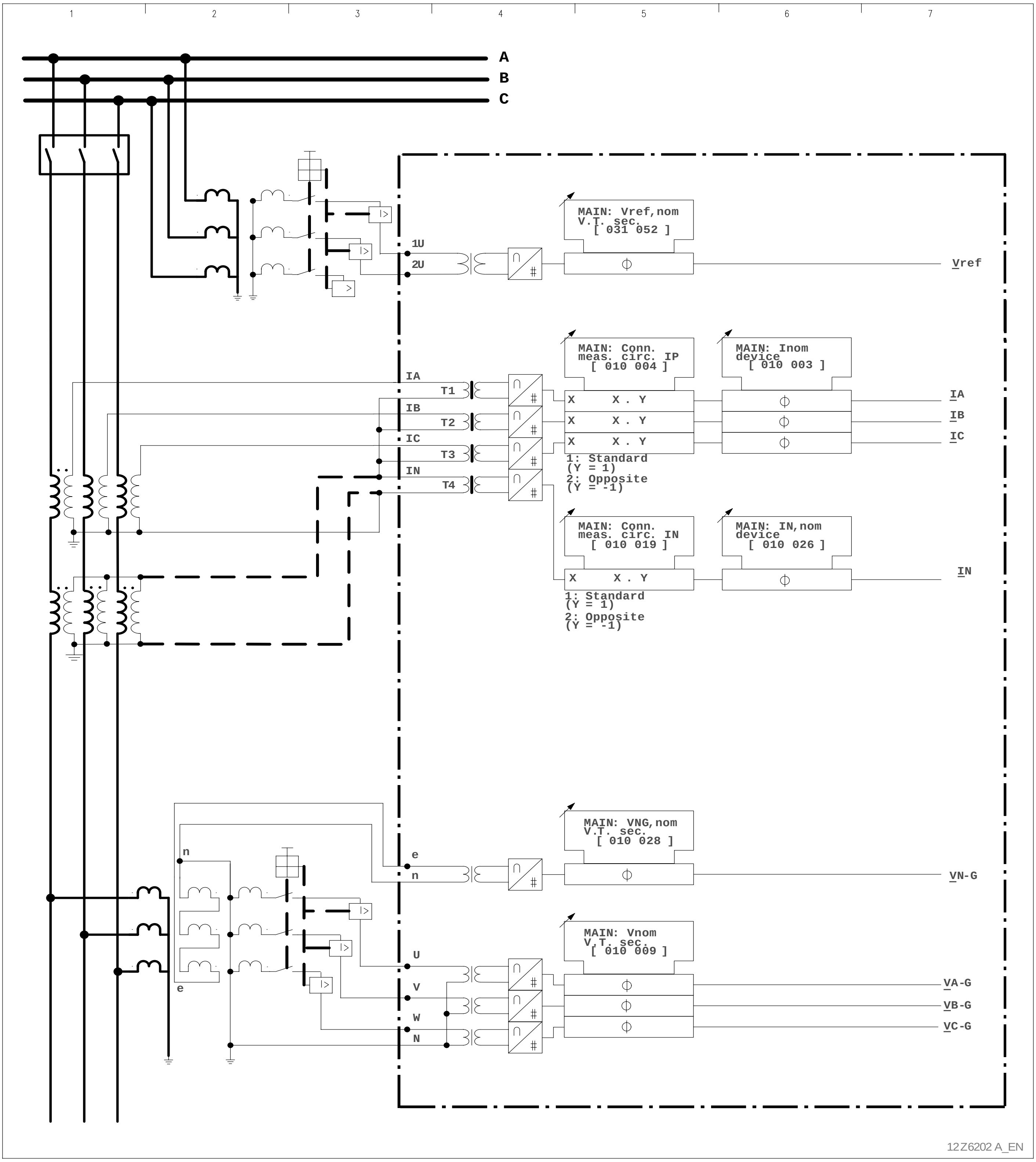
The secondary phase currents of the system transformers are fed to the P132. There is the option of connecting up to five voltage transformers. The measured variables are – electrically isolated – converted to normalized electronics levels. Air-gap transformers are used in the phase current path to suppress low frequency (DC decays and offsets) signal components. The analog quantities are digitized and are thus available for further processing.

Settings that do not refer to nominal quantities are converted by the P132 to nominal quantities. The user must therefore set the secondary nominal currents and voltages of the system transformers.

The connection direction of the measuring circuits on the P132 must also be set. Figure 3-46 shows the standard connection. By this setting the phase of the digitized currents is rotated by 180°.

If the P132 is to operate with the GFDSS function (ground fault direction determination using steady-state values), current transformer T4 needs to be connected to a current transformer in Holmgreen connection (dashed lines in Figure 3-46) or to a core balance current transformer.

When the P132 is equipped with the temperature p/c board (RTD module for PT 100, Ni 100 or Ni 120, terminal connection diagram in Annex D) further resistance thermometers, in addition to the PT 100 resistance thermometer connected to the analog module (I/O), can be connected to the RTD module as described in Chapter 3 section "Measured Data Input", ‘Connecting resistance thermometers to the RTD module’.



3-46 Connecting measuring circuits to the P132. (When the P132 is fitted with the temperature p/c board (RTD module): see references in above text.)

3.12.4 Operating Data Measurement

The P132 has an operating data measurement function for the display of currents and voltages measured as well as quantities derived from these measured values. For the display of measured values, set lower thresholds need to be exceeded, to avoid fluctuating small values from noise. If these lower thresholds are not exceeded, the value "*not measured*" is displayed. The following measured variables are displayed:

- Phase currents for all three phases
- Maximum phase current
- Minimum phase current
- Delayed and stored maximum phase current – maximum demand values
- Residual current measured by the P132 at the T 4 transformer
- Phase-to-ground voltages
- Sum of the three phase-to-ground voltages
- Phase-to-phase voltages
- Maximum phase-to-phase voltage
- Minimum phase-to-phase voltage
- Positive and negative sequence voltage referred to Vnom
- Positive- and negative-sequence current and voltage, taking into account the set phase sequence (alternative terminology: Rotary field)
- Neutral-point displacement voltage measured by the P132 at the T 90 transformer
- Reference voltage measured by the P132 at the T 15 transformer
- Active, reactive and apparent power
- Active power factor
- Load angle φ in all three phases (as a quantity and a per-unit quantity referred to 100°)
- Angle between the measured values for the residual current and the neutral-point displacement voltage (as a quantity and a per-unit quantity referred to 100°)
- Phase relation between calculated and measured residual current (as a quantity and a per-unit quantity referred to 100°)
- Frequency
- Active and reactive energy output and input

The measured data are updated at 1 s intervals. Updating is interrupted when a general starting signal is issued or if the self-monitoring function detects a hardware fault.

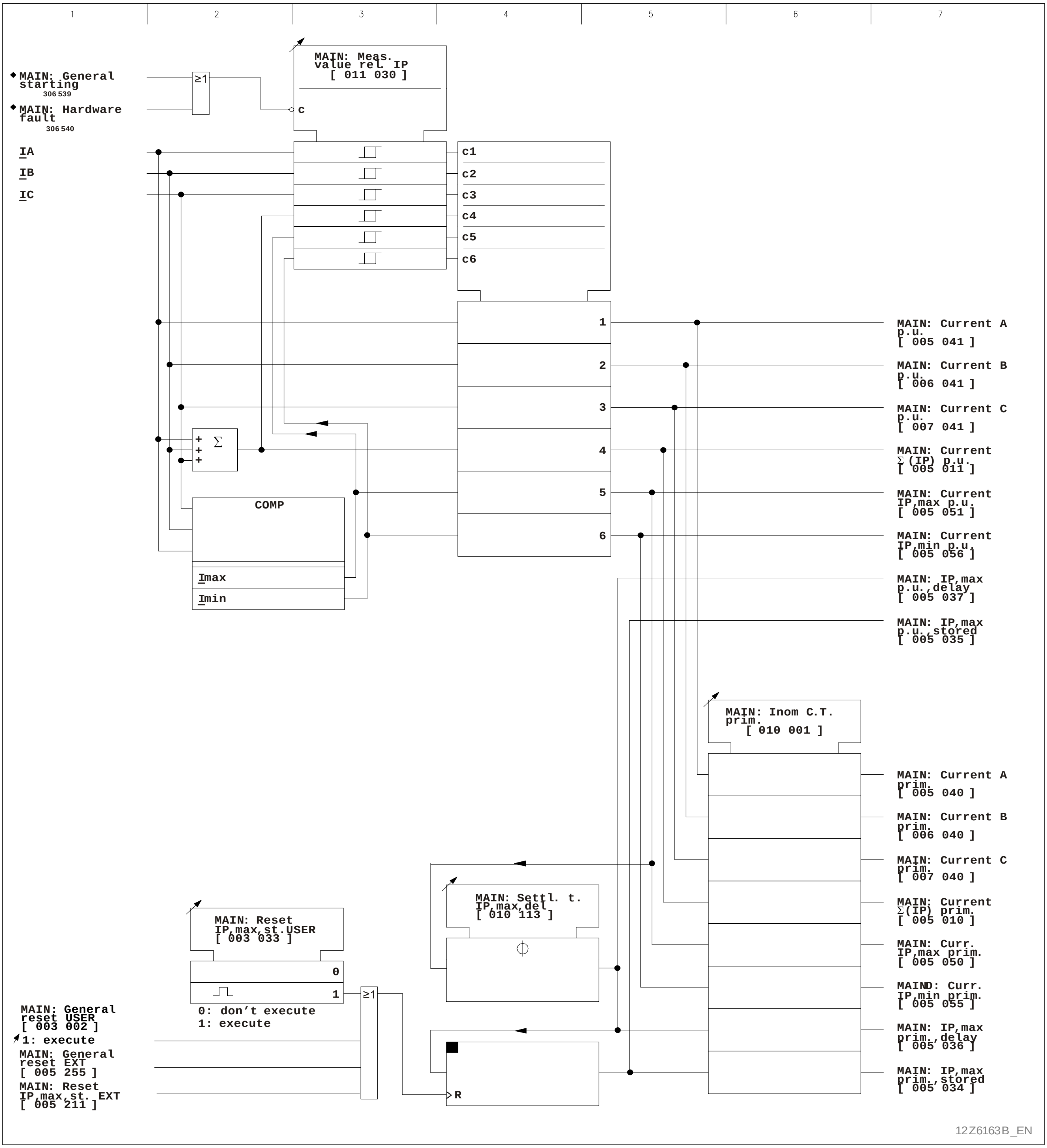
Measured current values

The measured current values are displayed both as per-unit quantities referred to the nominal quantities of the P132 and as primary quantities. To allow display in primary values, the primary nominal current of the system current transformer should be set in the P132.

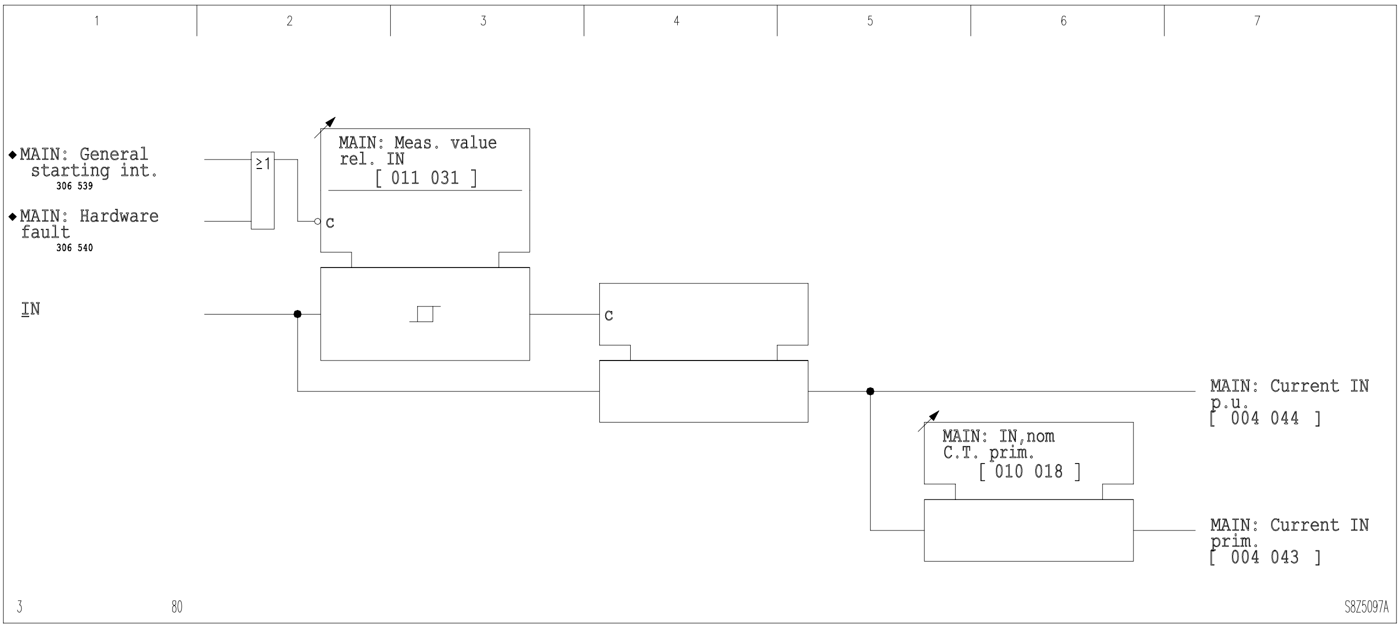
Phase sequence A-B-C (alternative terminology: clockwise rotary field)	Phase sequence A-C-B (alternative terminology: anti-clockwise rotary field)
$\underline{I}_{neg} = \frac{1}{3} \cdot \left| \left(\underline{I}_A + \underline{a}^2 \cdot \underline{I}_B + \underline{a} \cdot \underline{I}_C \right) \right|$	$\underline{I}_{neg} = \frac{1}{3} \cdot \left| \left(\underline{I}_A + \underline{a} \cdot \underline{I}_B + \underline{a}^2 \cdot \underline{I}_C \right) \right|$
$\underline{I}_{pos} = \frac{1}{3} \cdot \left| \left(\underline{I}_A + \underline{a} \cdot \underline{I}_B + \underline{a}^2 \cdot \underline{I}_C \right) \right|$	$\underline{I}_{pos} = \frac{1}{3} \cdot \left| \left(\underline{I}_A + \underline{a}^2 \cdot \underline{I}_B + \underline{a} \cdot \underline{I}_C \right) \right|$

$\underline{a} = e^{j120°}$

$\underline{a}^2 = e^{j240°}$



3-47 Measured operating data – phase current



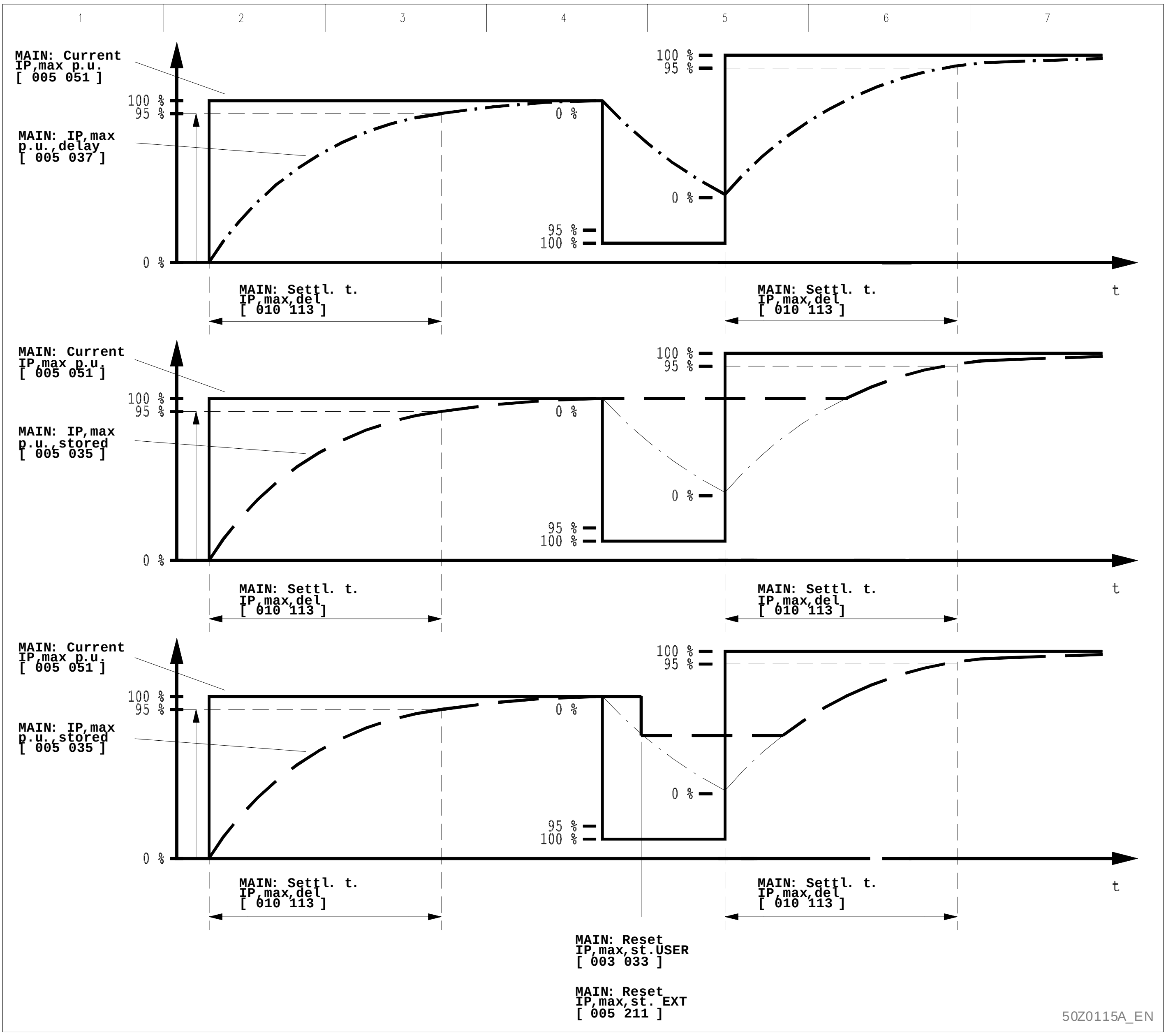
3-48 Measured operating data – residual current

Delayed maximum phase current display

The P132 offers the option of a delayed display of the maximum value of the three phase currents (thermal ammeter function). The delayed maximum phase current display is an exponential function of the maximum phase current $I_{P,max}$ (see upper curve in Figure 3-49). The time after which the delayed maximum phase current display will have reached 95 % of maximum phase current $I_{P,max}$ is set at
MAIN: Settl. t. IP,max,del.

Stored maximum phase current display

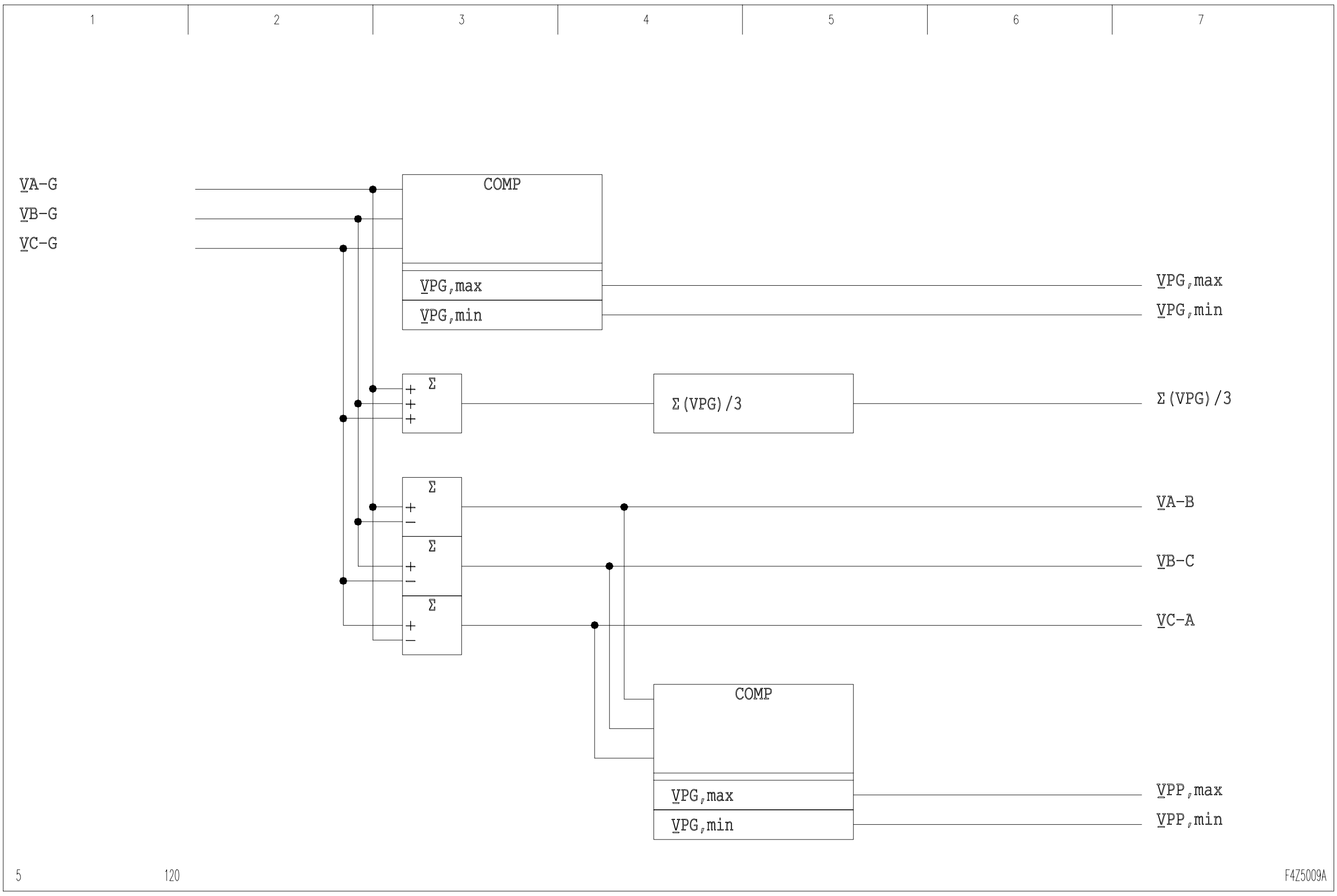
The stored maximum phase current follows the delayed maximum phase current. If the value of the delayed maximum phase current is declining, then the highest value of the delayed maximum phase current remains stored. The display remains constant until the actual delayed maximum phase current exceeds the value of the stored maximum phase current (see middle curve in Figure 3-49). The stored maximum phase current to the actual value of the delayed maximum phase current is set at
MAIN: Reset IP,max,stored (see lower curve in Figure 3-49).



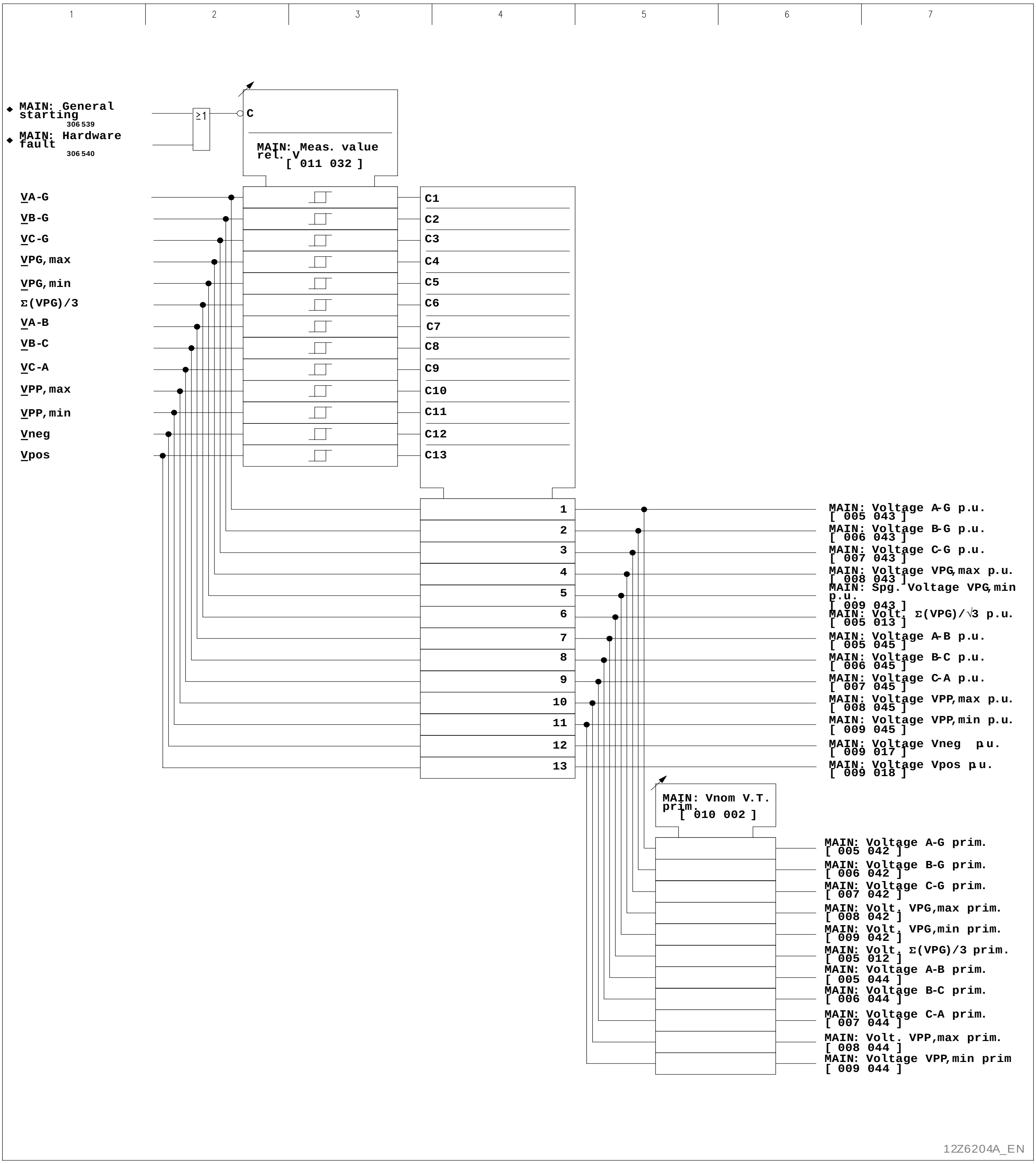
3-49 Operation of delayed and stored maximum phase current display

Measured voltage values

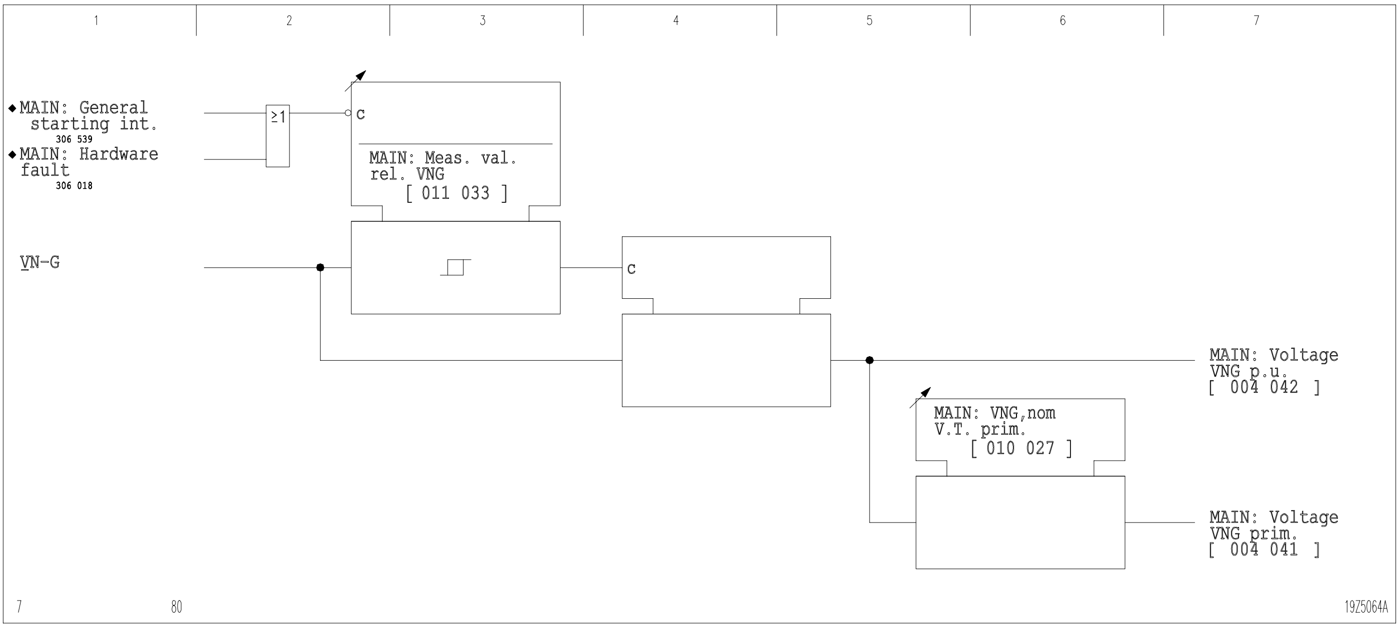
The measured voltage values are displayed both as per-unit quantities referred to the nominal quantities of the P132 and as primary quantities. To allow a display in primary values, the primary nominal voltage of the system transformer needs to be set in the P132.



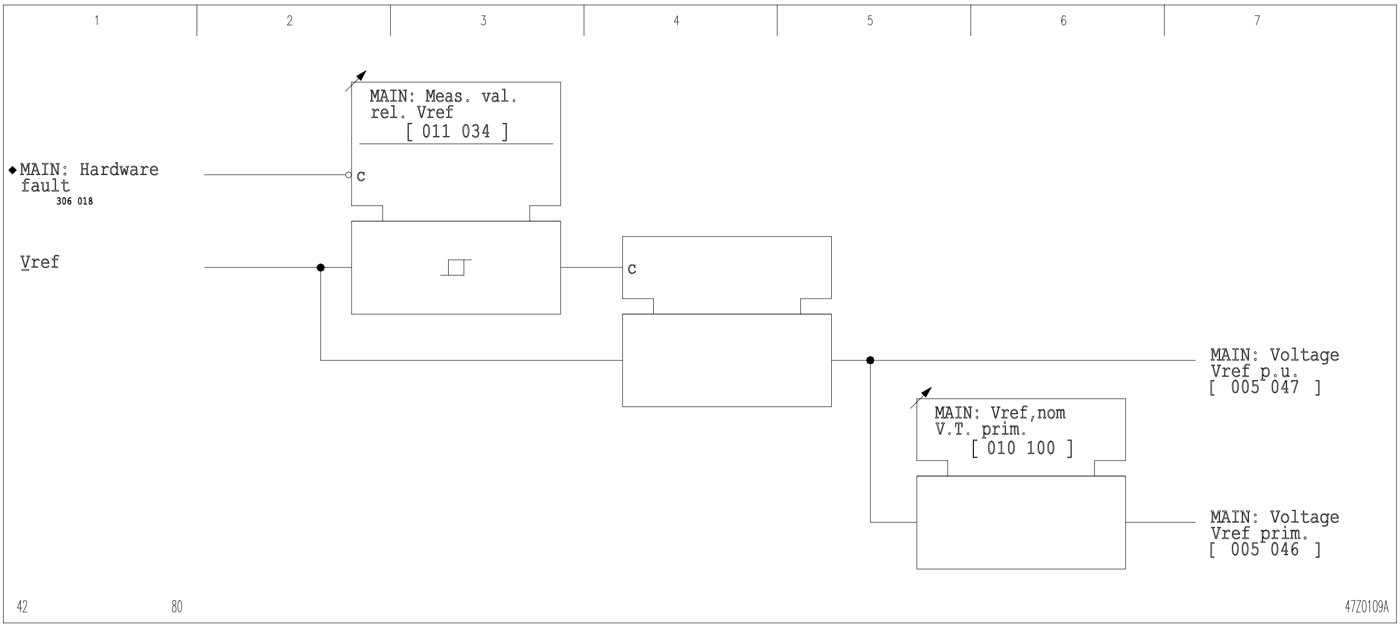
3-50 Determining the minimum and maximum phase-to-ground and phase-to-phase voltages



3-51 Measured operating data - phase-to-ground and phase-to-phase voltages



3-52 Measured operating data - neutral-point displacement voltage



3-53 Measured operating data – reference voltage

Measured values for power, active power factor, and angle

The load angle and the angle between the measured values for the residual current and the neutral-point displacement voltage are only determined when associated currents and voltages exceed minimum thresholds.

Parameter MAIN: Meas. direction P,Q may be changed from *'Standard'* to *'Opposite'* if the user wishes to have the following measured operating data displayed with the opposite sign (see figure 3-54):

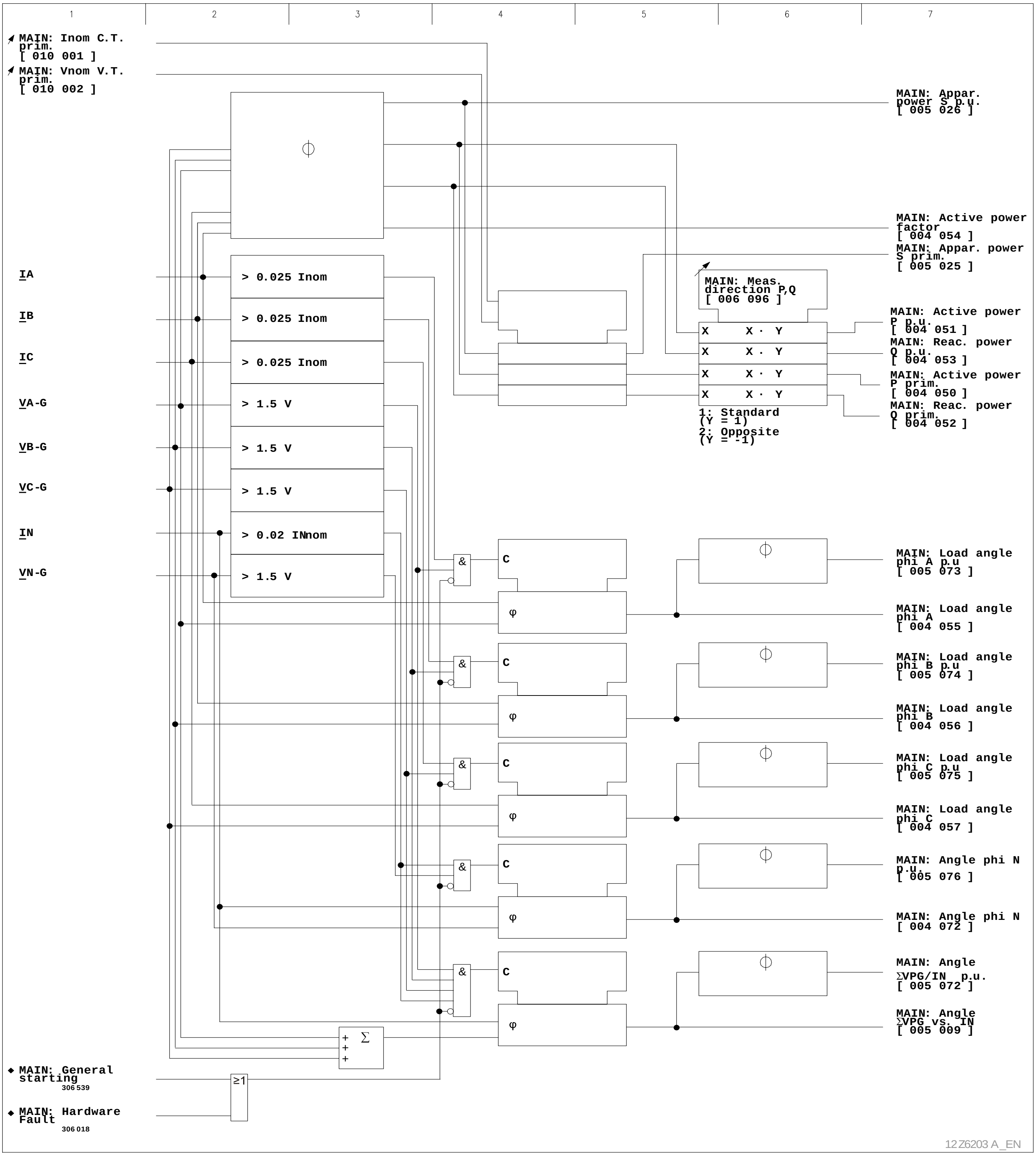
☐ MAIN: Active power P p.u

☐ MAIN: Reac. power Q p.u.

☐ MAIN: Active power P prim.

☐ MAIN: Reac. power Q prim.

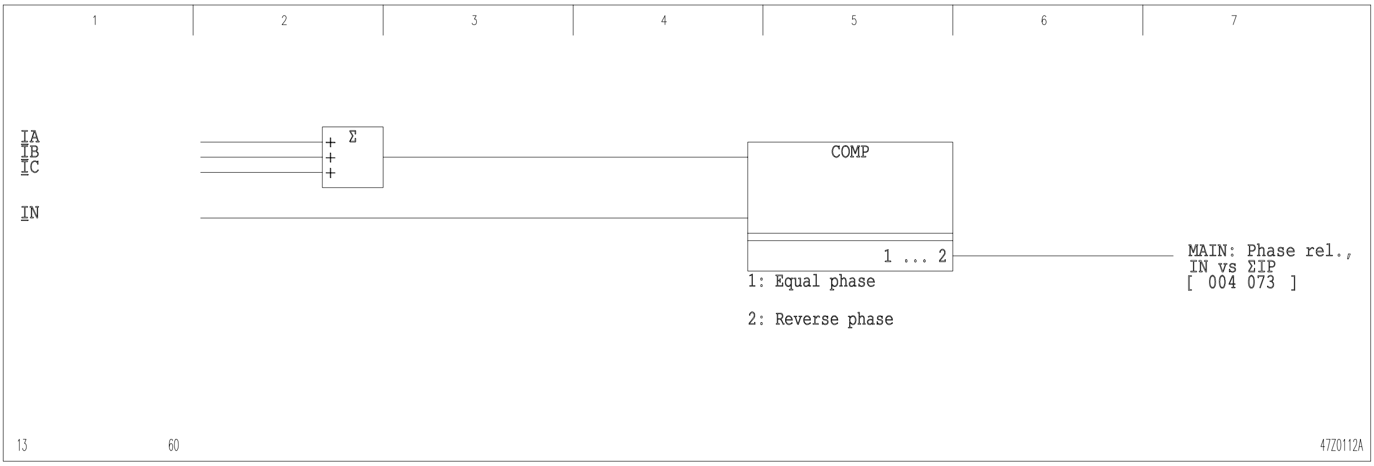
The remaining measured operating data is not influenced by the setting of this parameter. It must be noted that by inverting the sign only, the display of measured operating data is involved but all protection functions will still apply internally non-inverted measured values.



3-54 *Measured operating data - power, active power factor, and angle*

Phase relation I_N

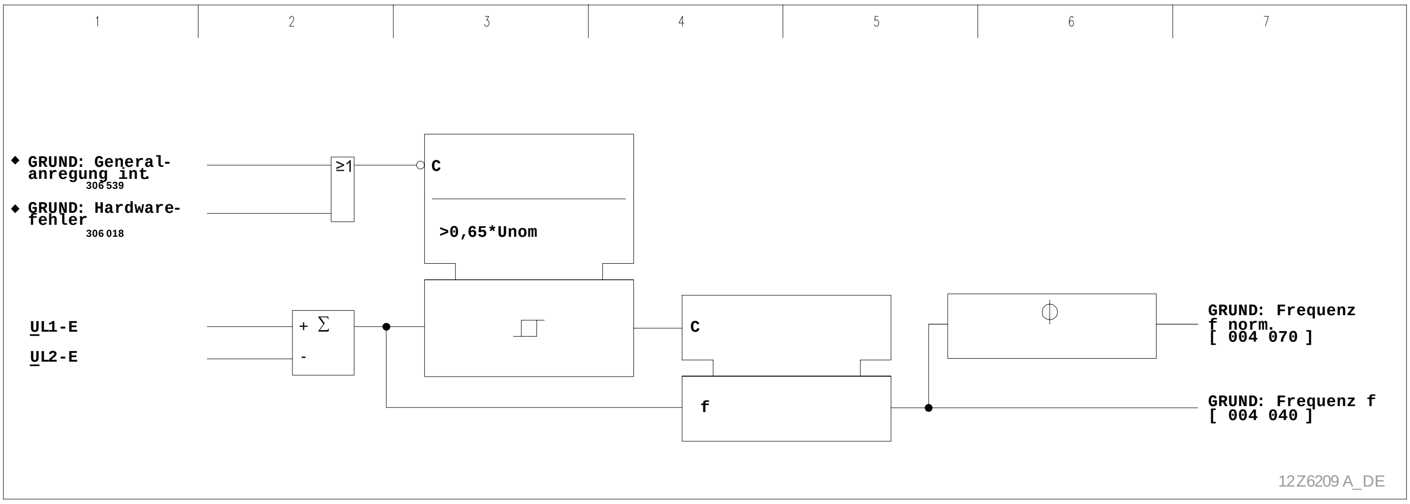
The P132 checks if the phase relations of calculated residual current and measured residual current agree. If the phase displacement between the two currents is ≤ 45°, then the indication ‘*Equal phase*’ is displayed.



3-55 Phase relation between calculated and measured residual current

Frequency

The P132 determines the frequency from the voltage $V_{A\text{-}B}$. This voltage needs to exceed a minimum threshold of 0.65 V_{nom} in order for frequency to be determined.



3-56 *Frequency measurement*

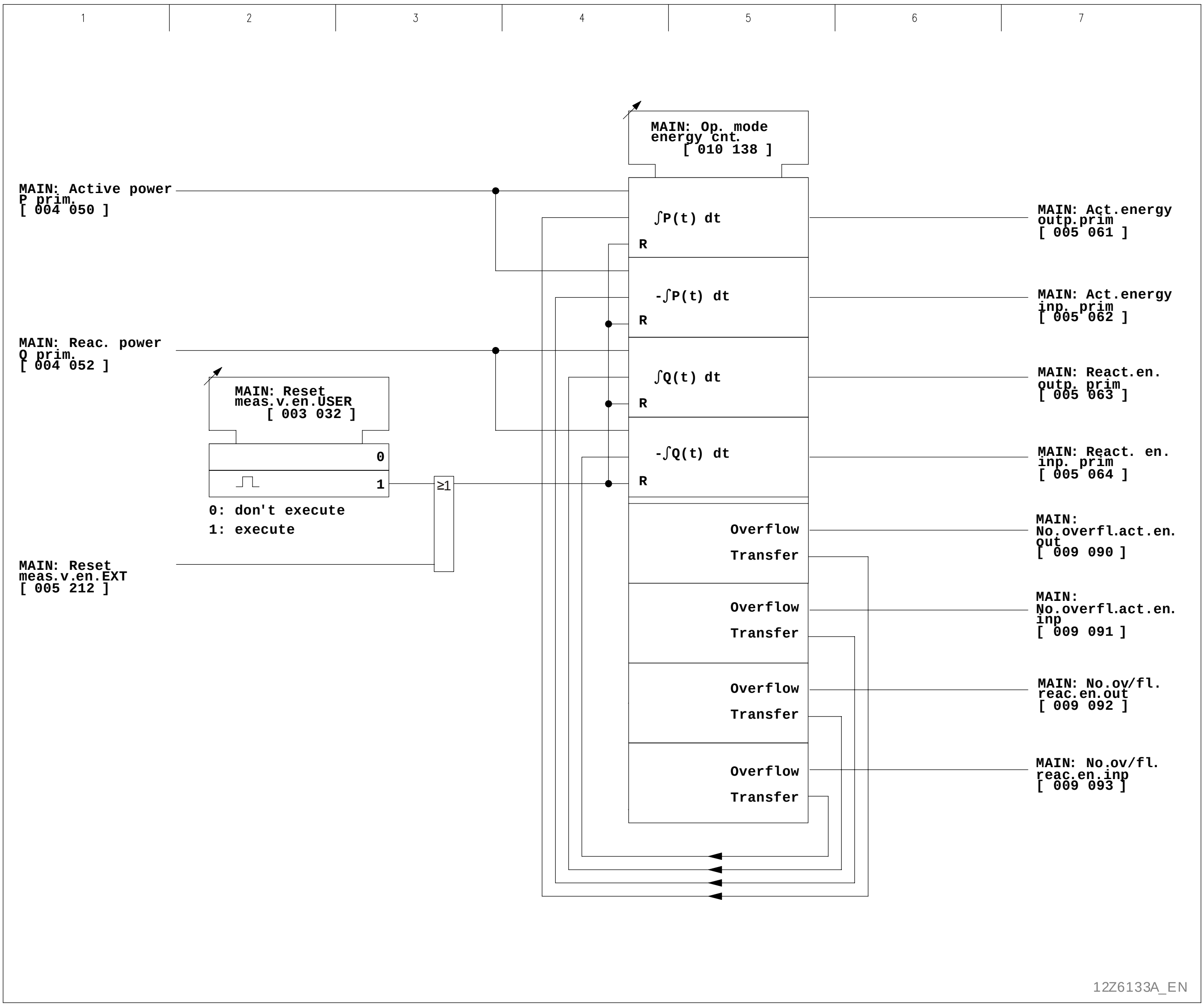
Active and reactive energy output and input

The P132 determines the active and reactive energy output and input based on the primary active or reactive power.

There are two procedures available to determine active and reactive energy.
If procedure 1 is selected, active and reactive energy are determined every 2 s (approximately). If procedure 2 is selected, active and reactive energy are determined every 100 ms (approximately). In this way higher accuracy is achieved. Whenever the maximum value of 655.35 MWh or 655.35 MVAr h is exceeded, a counter is incremented and the determination of the energy output is restarted. The value that exceeded the range is transferred to the new cycle.

The total energy is calculated as follows:

Total energy = number of overflows ∗ 655.35 + current count

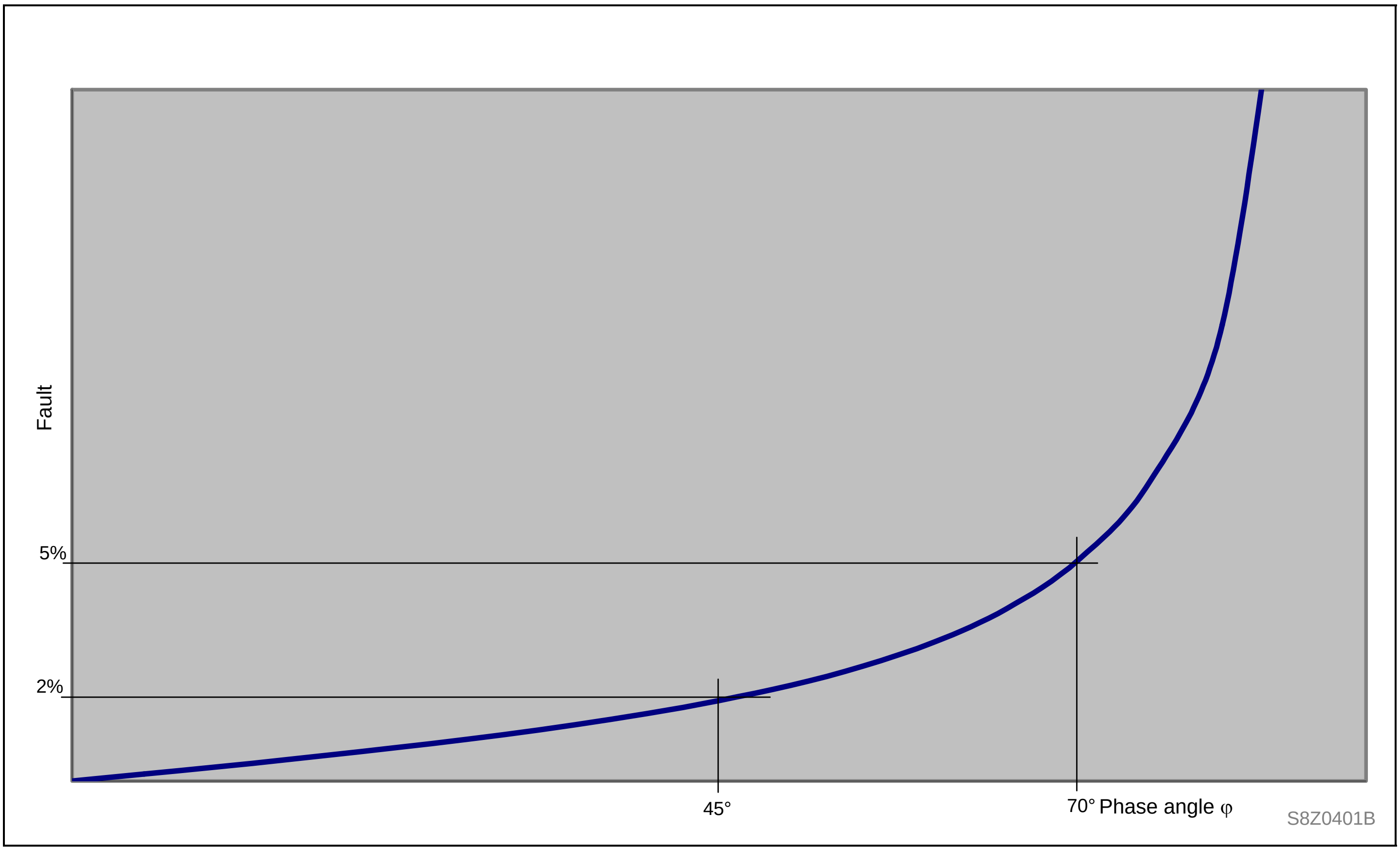


3-57 Determining the active and reactive energy output and input

Selection of the procedure to determine energy output

Procedure	Characteristics	Applications
1	☐ Determination of the active and reactive energy every 2 s (approximately) ☐ Reduced system loading	☐ Constant load and slow load variations (no significant load variations within 1 second). ☐ Phase angles below 70° (cos φ > 0.3).
2	☐ Determination of the active and reactive energy every 100 ms (approximately). ☐ Increased system loading	☐ Fast load variations ☐ Phase angles below 70° (cos φ > 0.3).

The maximum phase-angle error of the P132 of 1° leads to greater errors in measurement when the phase angle increases, as shown (for the range 0° ≤ φ < 90°) in the following diagram.



3-58 *Error of measurement in the determination of energy output resulting from the phase angle error of the P132*

Error of measurement: approx. ± 2 % of the measured value for |cos φ| ≥ 0.7
approx. ± 5 % of the measured value for |cos φ| ≥ 0.3
where the whole measuring range is -180° ≤ φ ≤ 180°.

For phase angles φ with |cosφ| < 0.3, or when the error of measurement resulting from the maximum phase-angle error is not acceptable, external counters should be used to determine the energy output.

3.12.5 Configuring and Enabling the Device Functions

The device can be adapted to the requirements of a specific high-voltage system by configuring the available function range. By including the desired device functions in the configuration and canceling all other, the user creates an individually configured device appropriate to the specific application. Parameters, signals and measured values of cancelled device functions are not displayed on the local control panel. Functions of general applicability such as operating data recording (OP_RC) or main functions (MAIN) cannot be cancelled.

Canceling a device function

The following conditions must be met before a device function can be cancelled or removed:

☐ The device function must be disabled.

☐ None of the functions of the device function to be cancelled can be assigned to a binary input.

☐ None of the signals of the device function can be assigned to a binary output or an LED indicator.

☐ No functions of the device function being cancelled can be selected in a list setting.

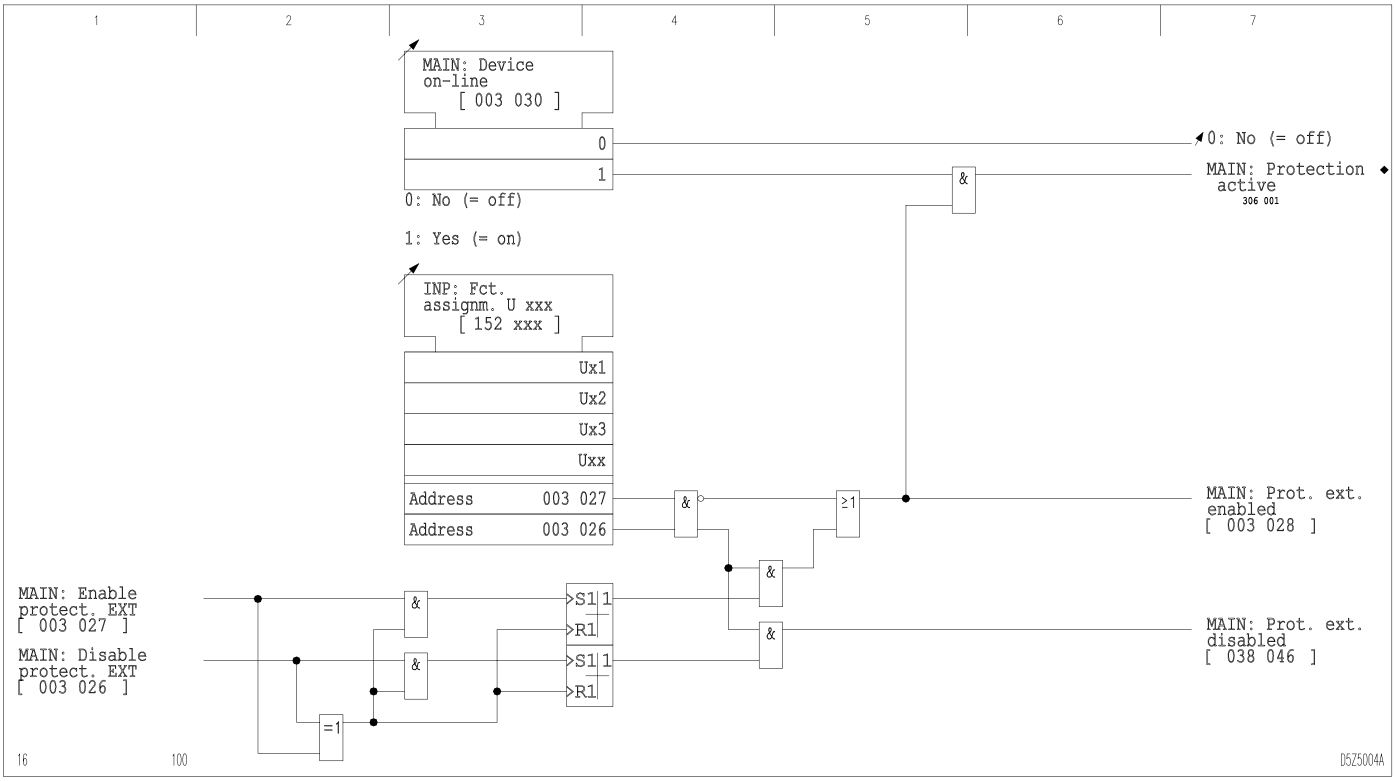
If the above conditions are met, proceed through the 'Configuration' branch of the menu tree to access the setting relevant for the device function to be cancelled.
If, for example, the "LIMIT" function group is to be cancelled, the setting of LIMIT: Function group LIMIT is set to '*Without*'. To re-include the "LIMIT" function in the device configuration, the same setting is accessed and its value is changed to '*With*'.

The device function to which a setting, a signal, or a measured value belongs is defined by the function group designation (example: "LIMIT"). In the following description of the device functions, it is presumed that the corresponding device function is included in the configuration.

Enabling or disabling a device function

Besides canceling device functions from the configuration, it is also possible to disable protection via a function parameter or binary signal inputs. Protection can only be disabled or enabled through binary signal inputs if the MAIN: Disable Protect. EXT and MAIN: Enable protect. EXT functions are both configured. When neither or only one of the two functions is configured, the condition is interpreted as "Protection externally enabled". If the triggering signals of the binary signal inputs are implausible – i.e. both are at logic level = "1" – then the last plausible state remains stored in memory.

Note: If the protection is disabled via a binary signal input that is configured for MAIN: Disable Protect. EXT, the signal MAIN: Blocked/Faulty is not issued.

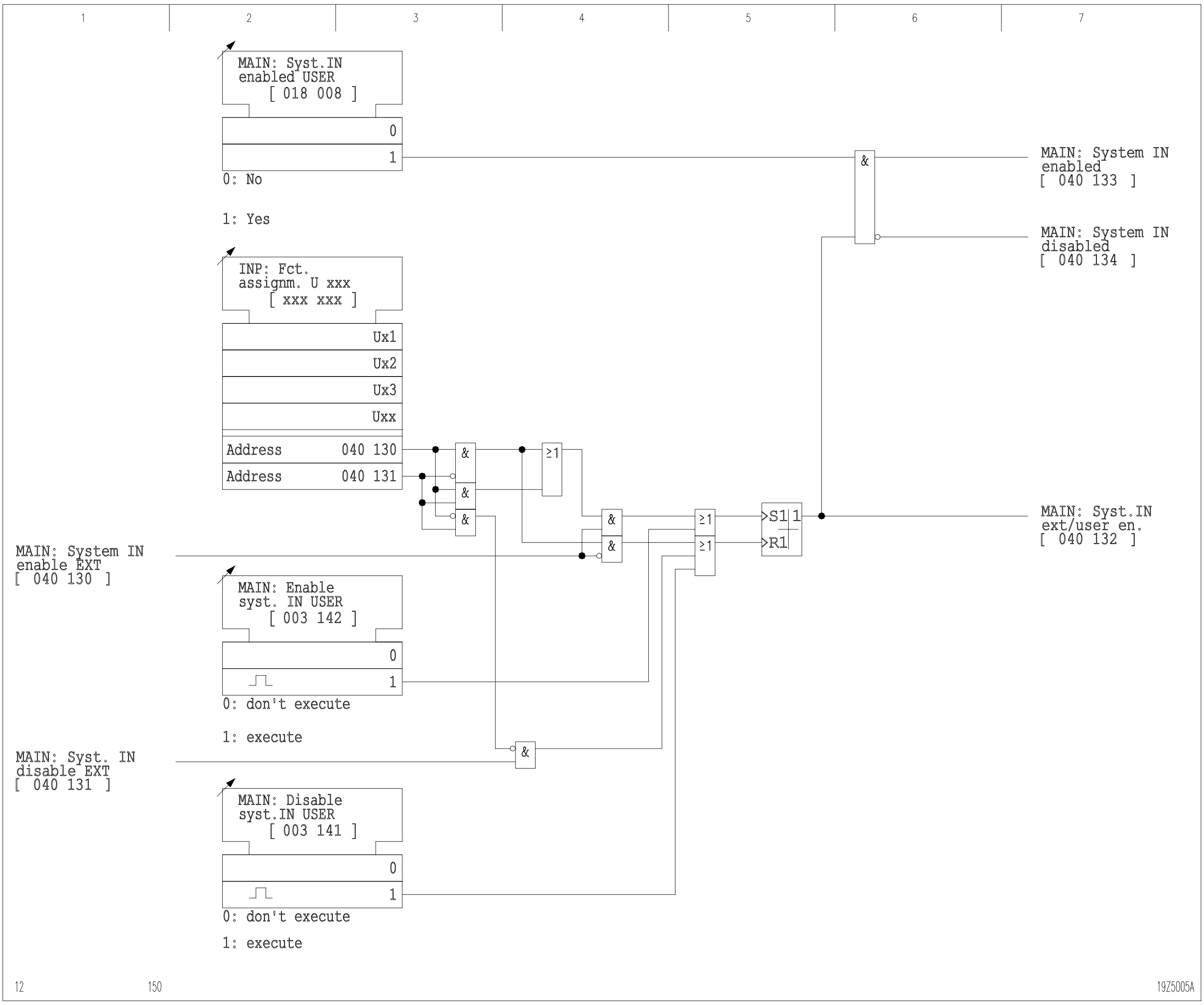


3-59 Enabling or disabling a device function

Enabling or disabling the residual current systems of the DTOC/IDMT protection

Disabling or enabling may be carried out with parameters or binary signal inputs.

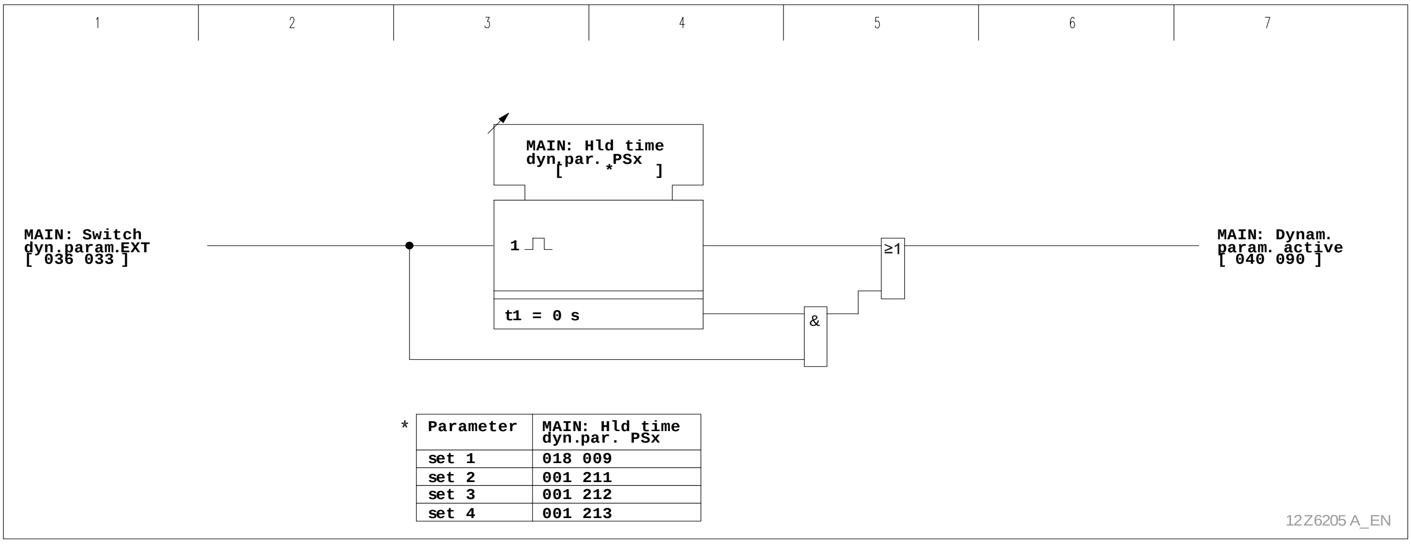
Enabling of the residual current systems of the DTOC/IDMT protection depends on the setting at MAIN: Syst.IN enabled USER. If this enabling function has been activated, the residual current systems of the DTOC/IDMT protection can be disabled or enabled with parameters or through appropriately configured binary signal inputs. Parameters and configured binary signal inputs have equal status. If only the MAIN: System IN enable EXT function is assigned to a binary signal input, then the residual current systems of the DTOC/IDMT protection will be enabled by a positive edge of the input signal and disabled by a negative edge. If only the MAIN: System IN disable EXT function has been assigned to a binary signal input, then a signal at this input will have no effect.



3-60 *Disabling or enabling the residual current systems of the DTOC/IDMT protection*

3.12.6 Activation of "Dynamic Parameters"

For several of the protection functions, it is possible for the duration of the set hold time to switch over to other settings - the "dynamic parameters" – via an appropriately configured binary signal input. If the hold time is set to 0 s, switching is effective as long as the binary signal input is being triggered.



Parameter	MAIN: Hld time dyn.par. PSx
set 1	018 009
set 2	001 211
set 3	001 212
set 4	001 213

3-61 Activation of "Dynamic Parameters"

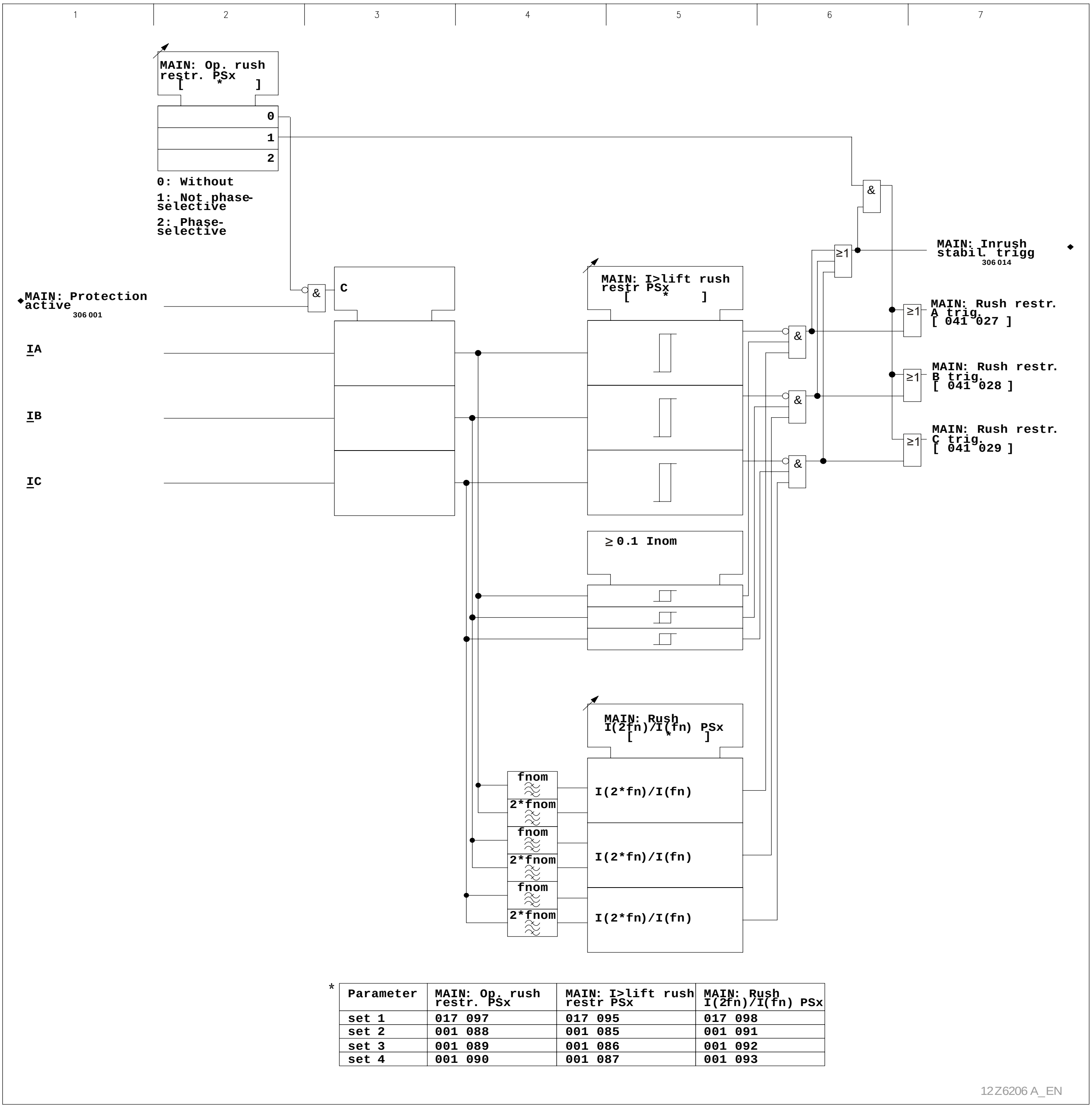
3.12.7 Inrush stabilization (harmonic restraint)

The inrush stabilization function detects high inrush current flows that occur when transformers or machines are switched on, and, if detected, it will then block the following functions:

☐ The phase current starting and negative-sequence current starting of definite-time overcurrent protection (DTOC)

☐ The phase current starting and negative-sequence current starting of inverse-time overcurrent protection (IDMT).

The inrush stabilization function identifies an inrush current by evaluating the ratio of the second harmonic current components to the fundamental. If this ratio exceeds the set threshold, then the inrush stabilization function operates. Another settable current trigger blocks inrush stabilization if the current exceeds this trigger. The setting of the operating mode determines whether inrush stabilization will operate phase-selectively or across all phases.



*

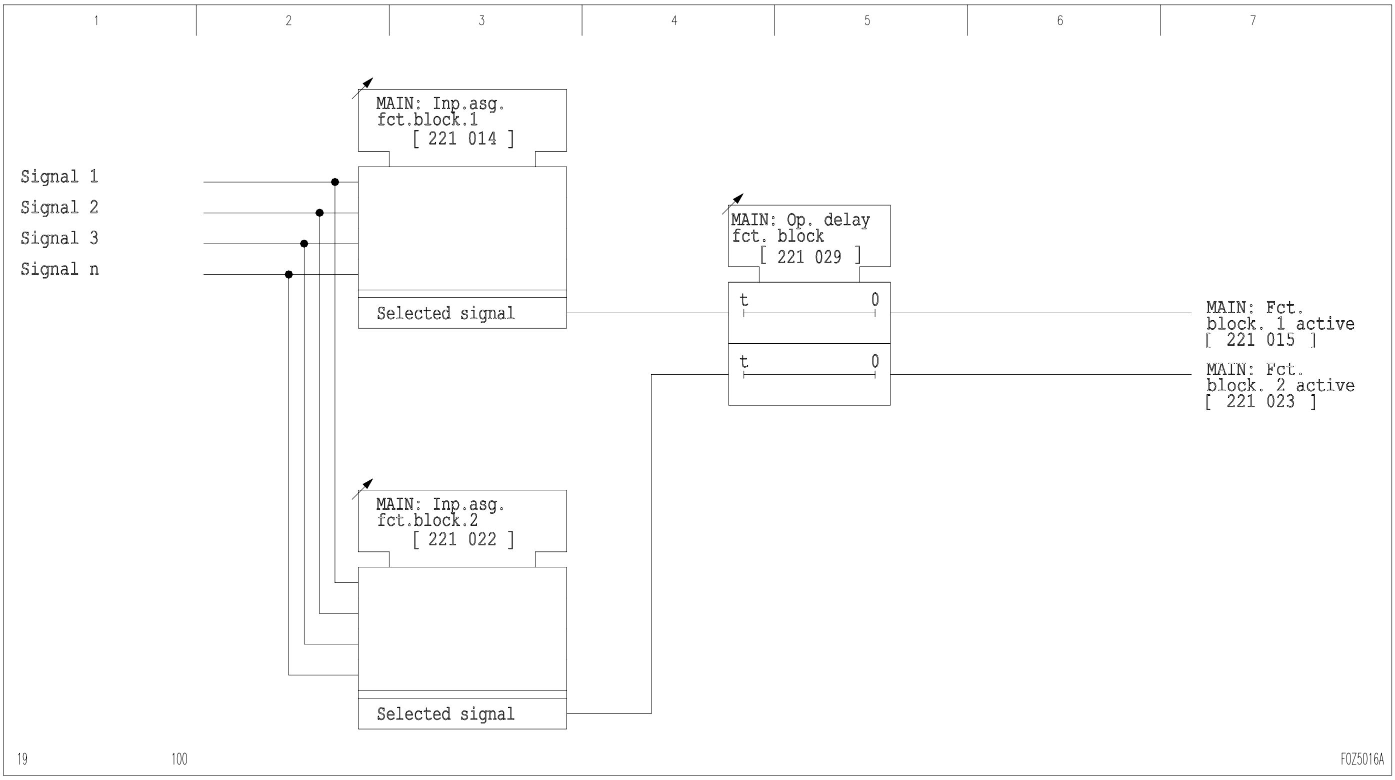
Parameter	MAIN: Op. rush restr. PSx	MAIN: I>lift rush restr PSx	MAIN: Rush I(2fn)/I(fn) PSx
set 1	017 097	017 095	017 098
set 2	001 088	001 085	001 091
set 3	001 089	001 086	001 092
set 4	001 090	001 087	001 093

3-62 Inrush stabilization

3.12.8 Function blocks

By including function blocks in the bay interlock conditions, switching operations can be prevented independent of the switching status at the time, for example, by an external signal "CB drive not ready" or by the trip command from an external protection device.

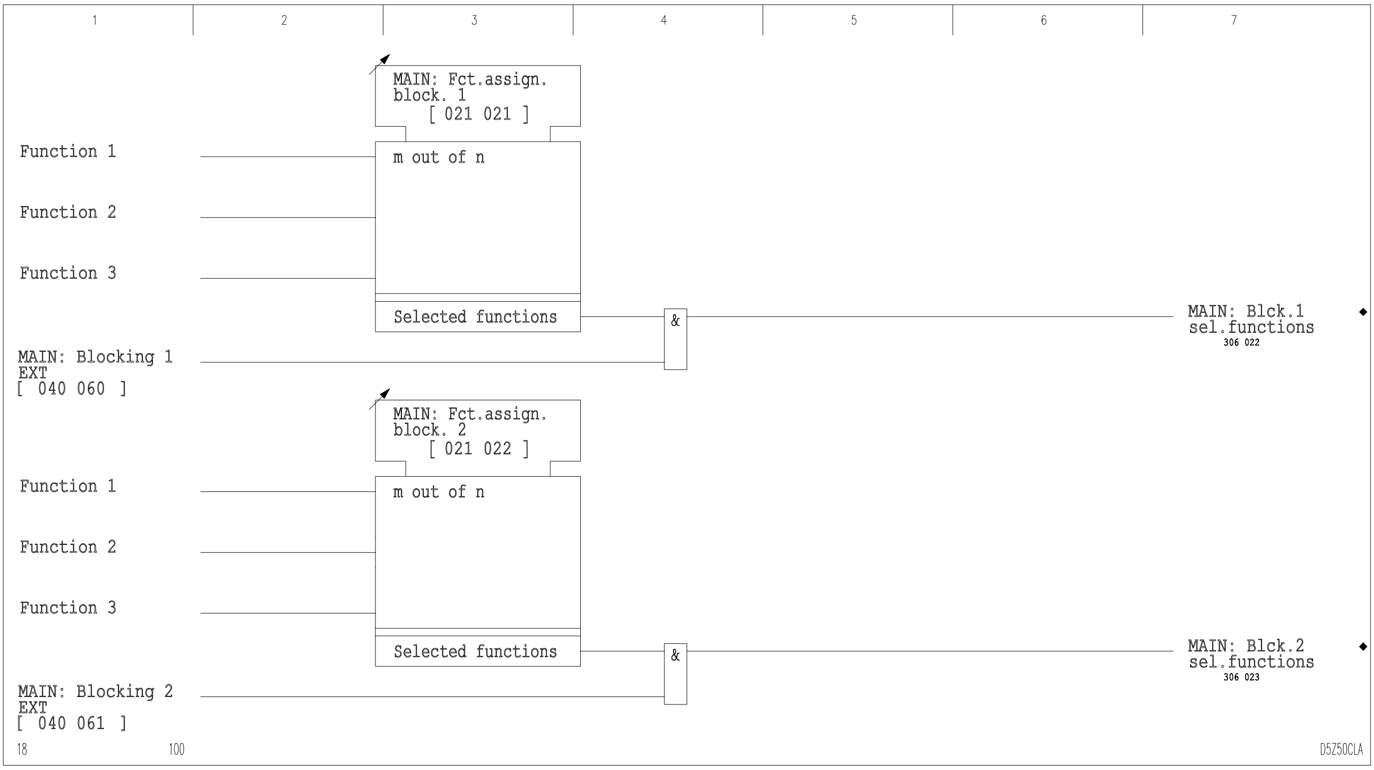
Binary input signals conditioned by debouncing and chatter suppression or output signals from the programmable logic function can be assigned to the function blocks 1 and 2 by setting a '1 out of n' parameter. The input signal from the function blocks starts a timer stage and after it has elapsed, the signal MAIN: Fct. block. X active is issued.



3-63 Function blocks

3.12.9 Multiple blocking

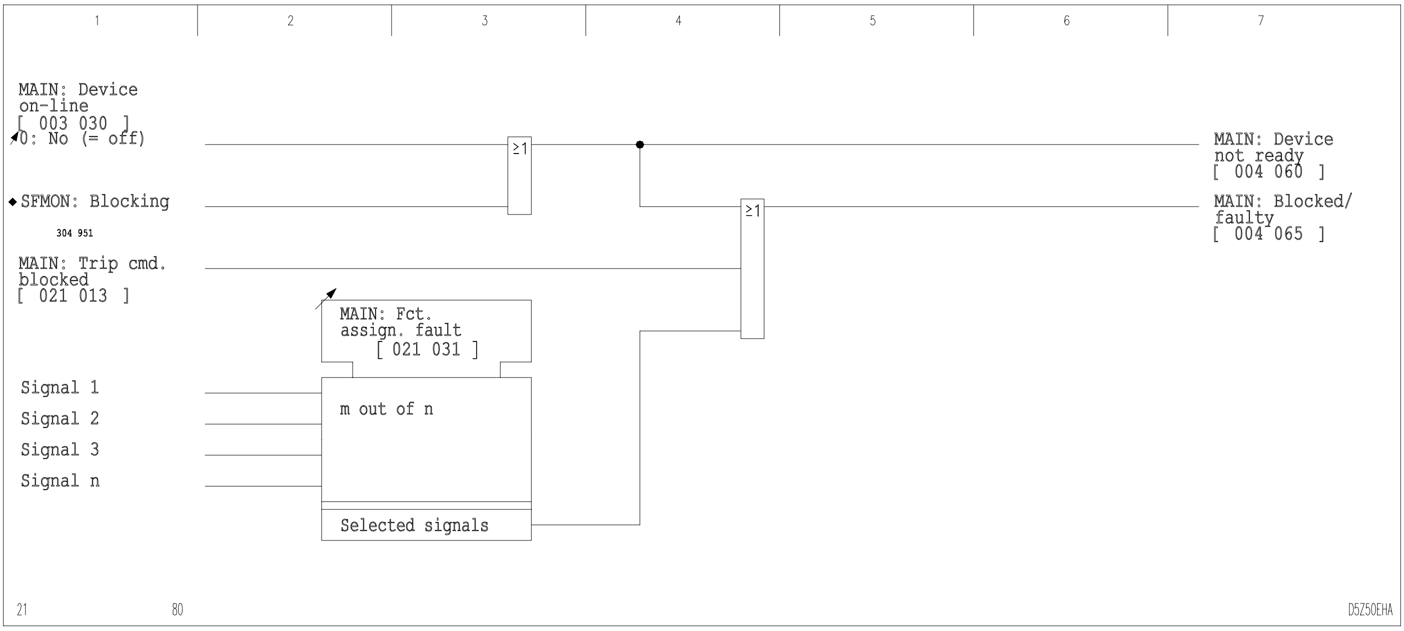
Two multiple blocking conditions can be defined via 'm out of n' parameters.
The functions defined by selection may be blocked via an appropriately configured binary signal input.



3-64 *Multiple blocking*

3.12.10 Blocked/Faulty

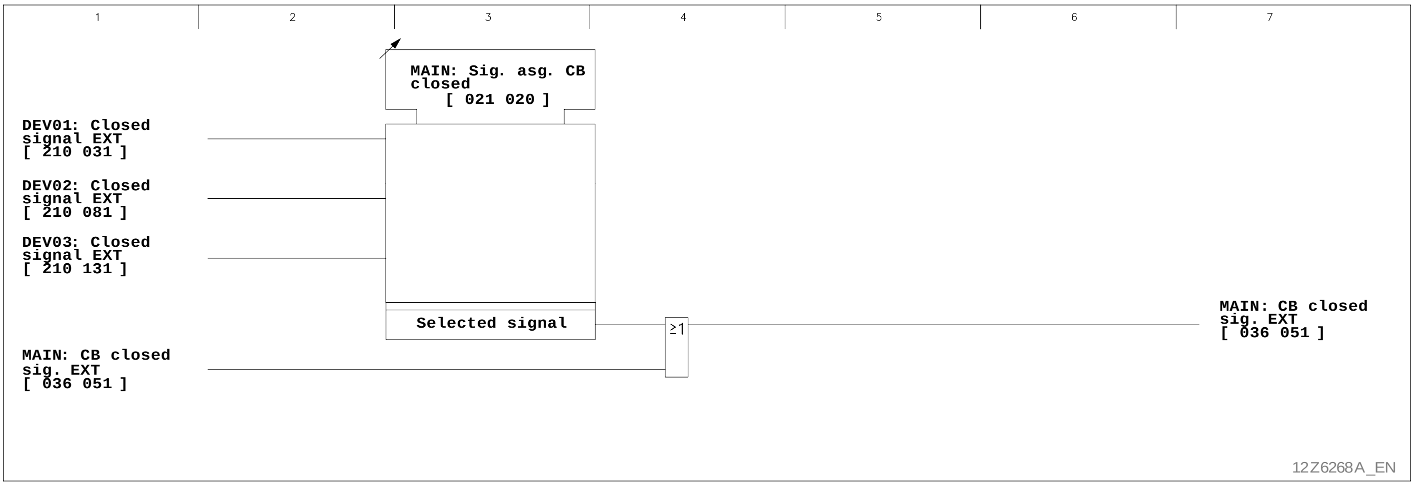
If the protective functions are blocked, the condition is signaled by continuous illumination of the amber LED indicator H 2 on the local control panel and by a signal from an output relay configured MAIN: Blocked/Faulty. In addition functions can be selected that will issue the MAIN: Blocked/Faulty signal by setting a ‘m out of n’ parameter.



3-65 "Blocked/Faulty" signal

3.12.11 Coupling between control and protection for the CB closed signal

Bay type selection defines the external device (DEV01 or DEV02 or ...) that represents the circuit breaker. Coupling between control and protection for the "Closed" position signal is made by the setting MAIN: Sig. asg. CB closed. As a result, the CB status signal needs to be assigned to one binary signal input only if this coupling is implemented.



3-66 Coupling between control and protection for the CB closed signal

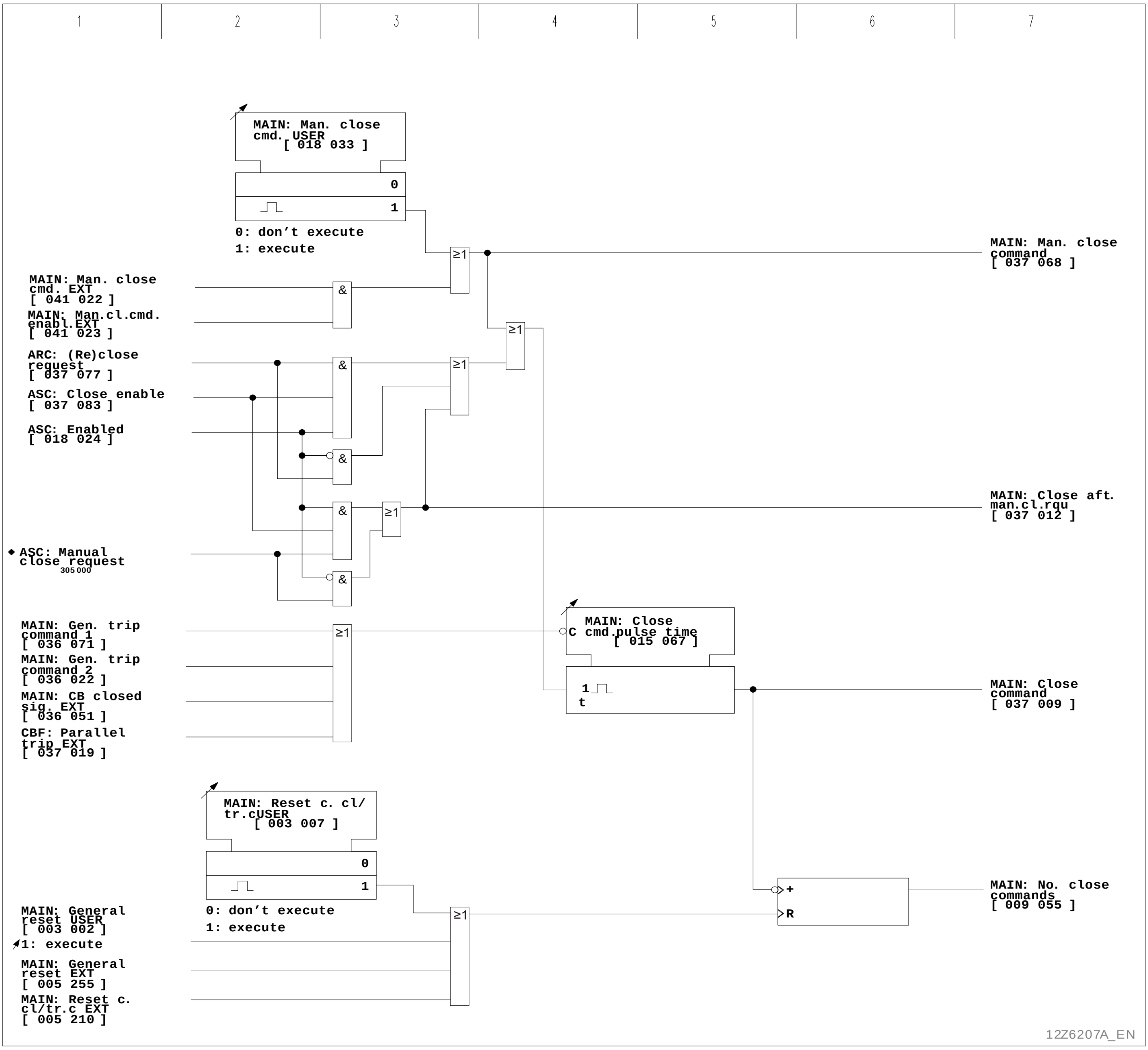
3.12.12 Close Command

The circuit breaker can be closed by the auto-reclosing control function (ARC), by the automatic synchronism check (ASC), by parameters or via an appropriately configured binary signal input. The close command by parameters or a binary signal input is only executed if there is no trip command present and no trip has been issued by a protection device operating in parallel. Moreover, the close command is not executed if there is a "CB closed" position signal present. The duration of the close command can be set.

If the ARC function issues a close request while the ASC function is enabled, then the close command requires a close enable by the ASC function.

Close command counter.

The number of close commands are counted. This counter may be reset individually or together with other counters (see section 'Resetting Actions'). If the ARC function issues a close request while the ASC function is enabled, then the close command requires a close enable by the ASC function.



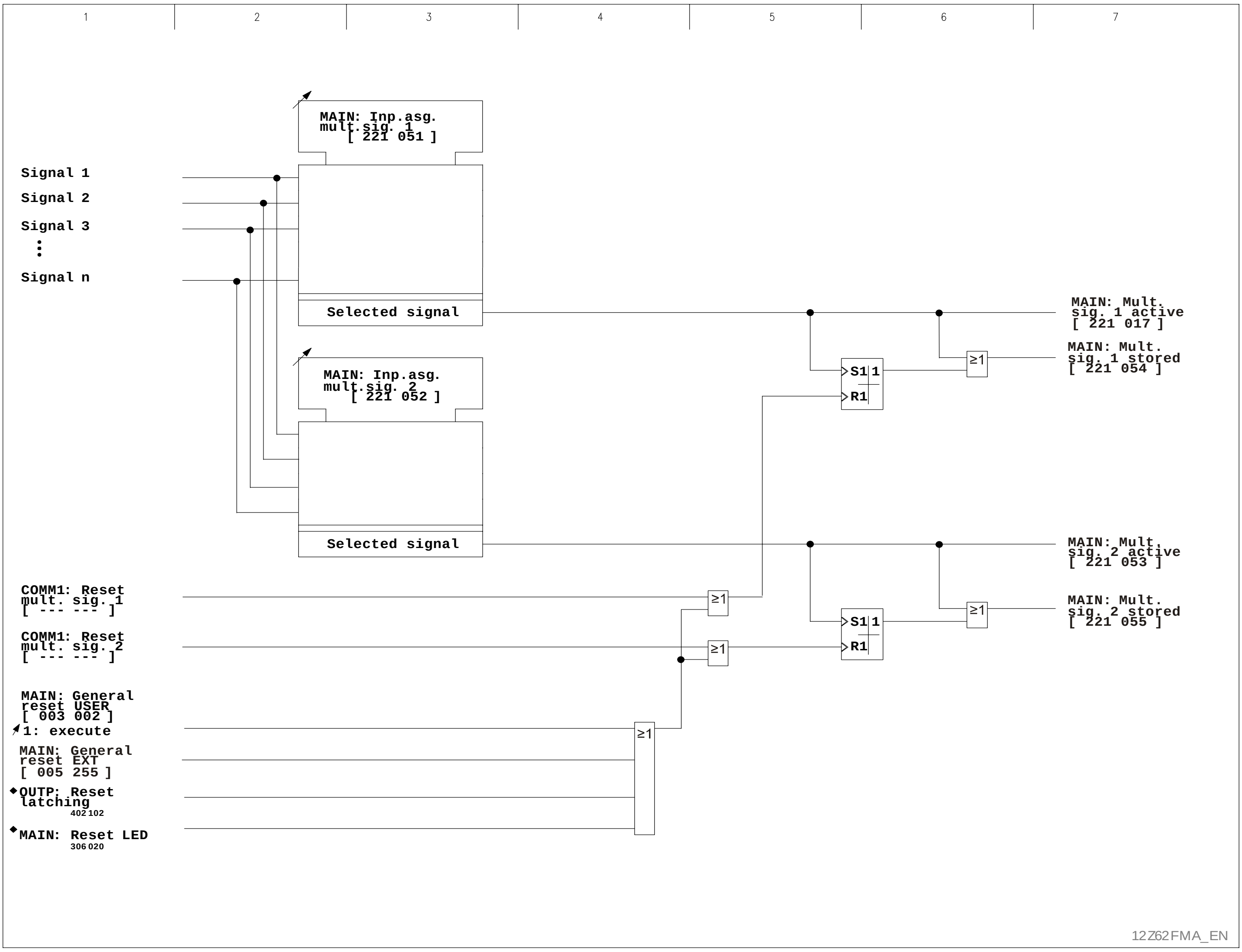
3-67 Close Command

3.12.13 Multiple signaling

The multiple signals 1 and 2 are formed by the programmable logic function using OR operators. The programmable logic output to be interpreted as multiple signaling is defined by the configuration of the binary signal input assignment with the corresponding multiple signaling. Both an updated and a stored signal are generated. The stored signal is reset by the following actions:

- General reset
- Latching reset
- LED indicators reset
- A command received through the communication interface.

If the multiple signaling is still present at the time of a reset, the stored signal will follow the updated signal.

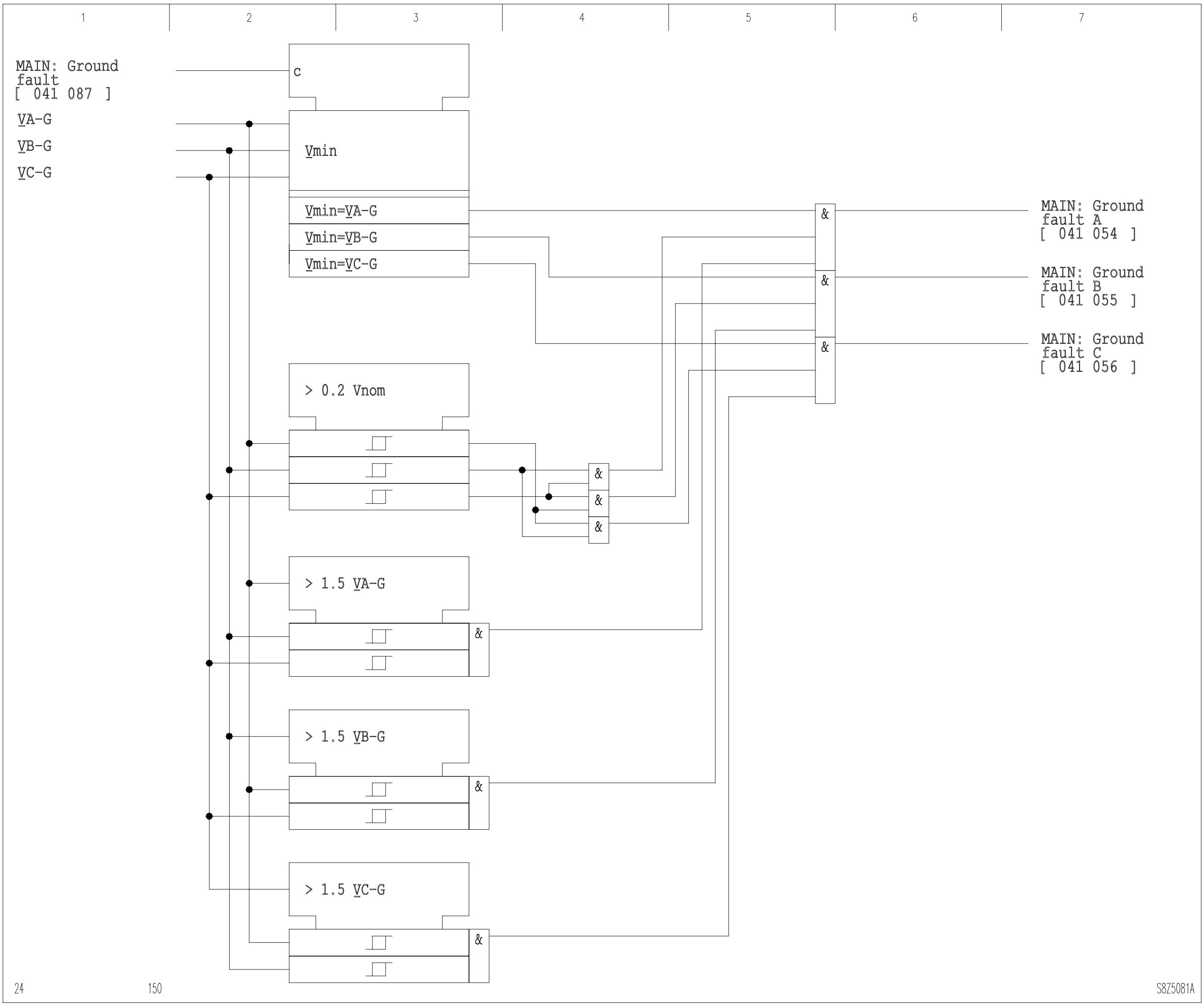


3-68 Multiple signaling

3.12.14 Ground Fault Signaling

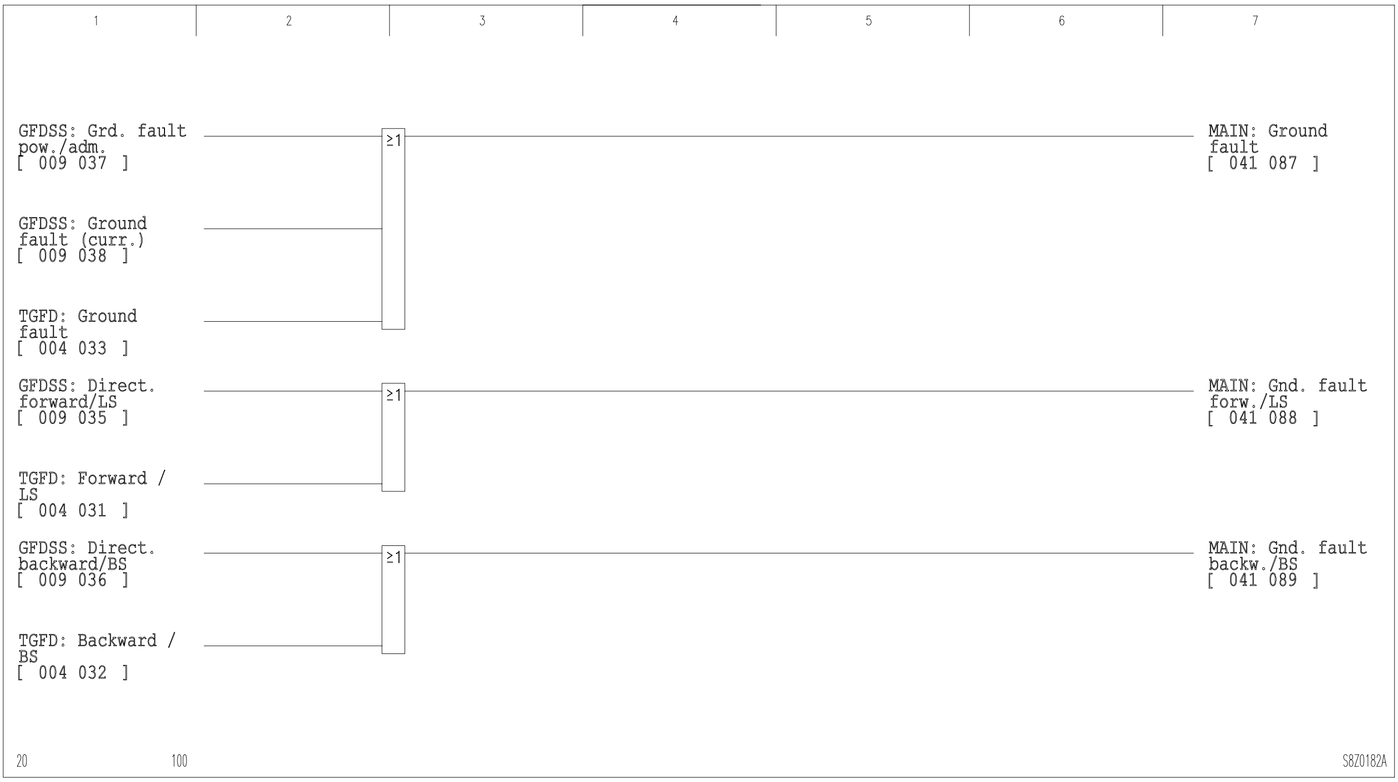
If a ground fault has been detected by either the GFDSS function (ground fault direction determination by steady-state values) or the TGFD function (transient ground fault direction determination), the P132 analyzes the phase-to-ground voltages and identifies the phase on which the ground fault has occurred.

During a ground fault, the P132 determines the lowest phase-to-ground voltage and checks if the two other phase-to-ground voltages exceed the threshold of 0.2 V_{nom}.
In addition, the two higher phase-to-ground voltages must exceed the lowest phase-to-ground voltage by a factor of 1.5. If these conditions are met, a ground fault signal is issued for the phase with the lowest phase-to-ground voltage.



3-69 *Phase-selective ground fault signaling*

Ground fault signals generated either by ground fault direction determination using steady-state values (GFDSS) or transient ground fault direction determination (TGFD) are grouped together to form multiple signaling.



3-70 *Multiple ground fault signals*

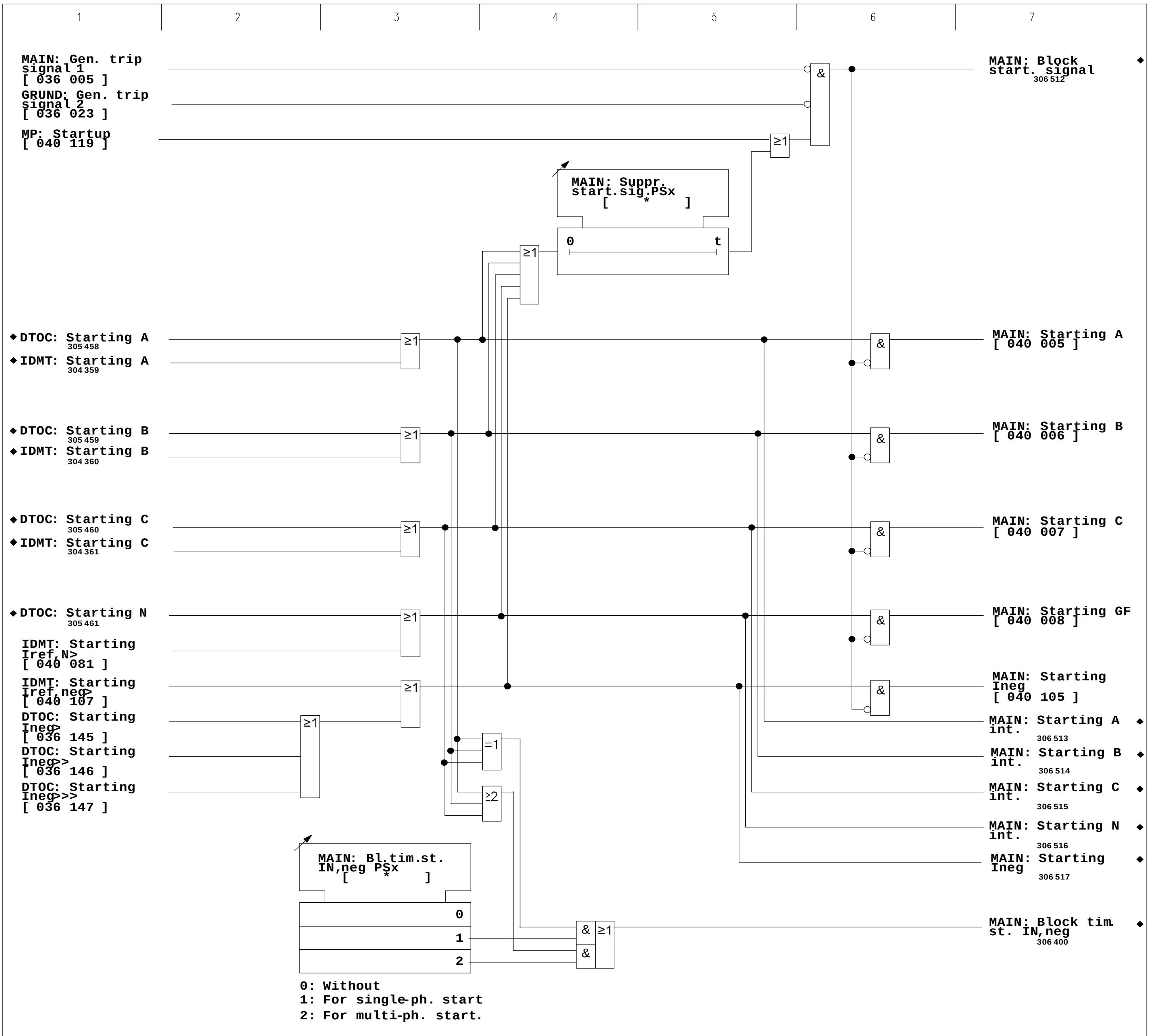
3.12.15 Starting Signals and Tripping Logic

Phase-selective starting signals

Common phase-selective starting signals are formed from the internal phase-selective starting signals of definite-time overcurrent protection and of inverse-time overcurrent protection.

An adjustable timer stage is started by the phase-selective starting signals, the residual current starting signal and the negative-sequence starting signal. While this timer stage is running, the starting signals are blocked. The starting signals are also blocked directly by the motor protection if the startup of a motor has been detected. Blocking is suspended if a trip signal is present.

The operate delays for the residual current and negative-sequence current stages of the DTOC and IDMT protection functions can be blocked for a single-pole or multi-pole starting (depending on the setting).



*

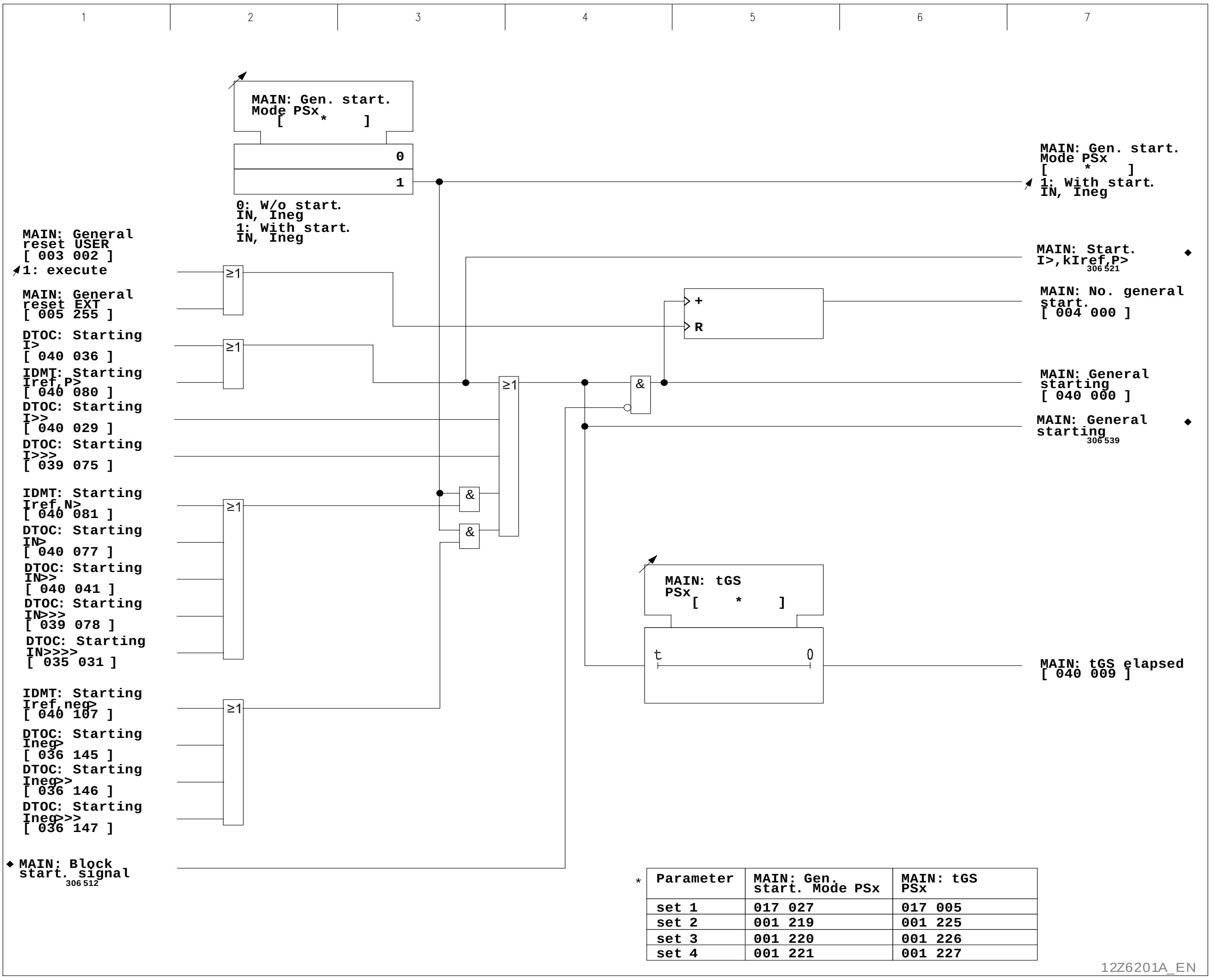
Parameter	MAIN: Suppr. start.sig.PSx	MAIN: Bl.tim.st. IN,neg PSx
set 1	017 054	017 015
set 2	001 222	001 214
set 3	001 223	001 215
set 4	001 224	001 216

12Z6208A_EN

3-71 *Phase-selective starting signals. (IDMT represents IDMT1 and IDMT2; the addresses apply to IDMT1.)*

General starting

The general starting signal is formed from the starting signals of the DTOC and IDMT protection functions. A setting governs whether the residual current stages and the negative-sequence current stage will be involved in forming the general starting signal. If the operate signal from one of the residual current stages and the negative-sequence current stage does not cause a general starting (due to the setting) then the associated operate delays will be blocked. As a result, a trip command cannot be issued by residual current and negative-sequence current stages.



Parameter	MAIN: Gen. start. Mode PSx	MAIN: tGS PSx
set 1	017 027	017 005
set 2	001 219	001 225
set 3	001 220	001 226
set 4	001 221	001 227

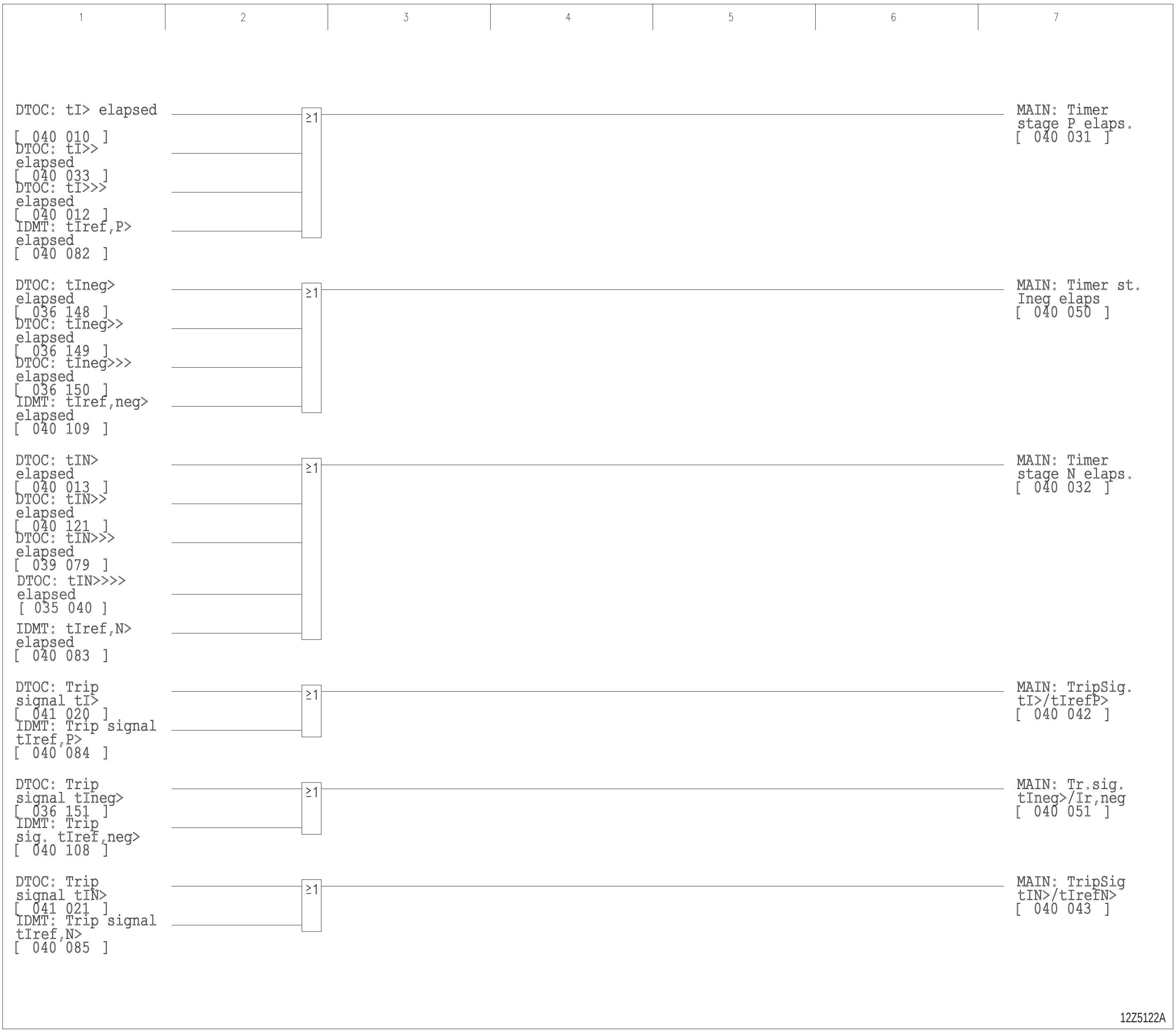
3-72 General starting (IDMT represents IDMT1 and IDMT2; the addresses apply to IDMT1.)

Counter for general starting signals.

The number of general starts is counted.

Multiple signaling by the DTOC and IDMT protection functions

The trip signals generated by the DTOC and IDMT protection functions are grouped together to form multiple signaling.



3-73 *Multiple signaling by the DTOC and IDMT protection functions (IDMT represents IDMT1 and IDMT2; the addresses apply to IDMT1.) (DTOC stage IN>>>> is available as of version -602.)*

Trip command

The P132 provides two trip commands. The functions required to issue a trip can be selected by setting a 'm out of n' parameter independently for each of the two trip commands. The minimum trip command closure time may be set. The trip signals are present only as long as the conditions for the signal are met.

Latching of the trip commands

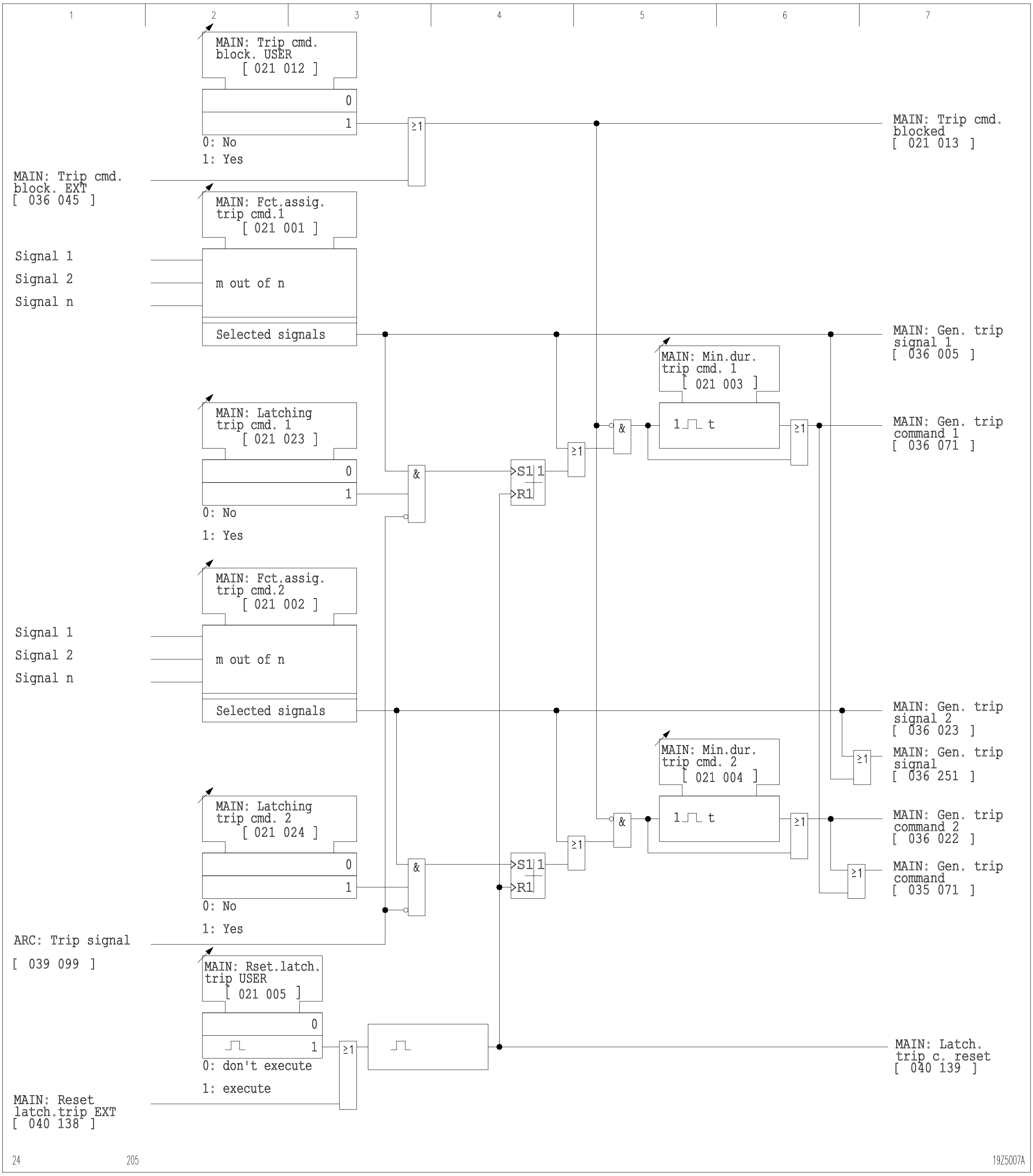
Each of the trip commands can be individually set to operate in the latching mode.
The trip command, set to latch mode, will remain active until reset by parameters or reset through an appropriately configured binary signal input. Latching is ineffective if a trip command has been issued by the ARC function.

Blocking of the trip commands

The trip commands can be blocked via parameters or an appropriately configured binary signal input. This blocking is then effective for both trip commands. The trip signals are not affected by this blocking. If the trip commands are both blocked, it is indicated by the continuously illuminated amber LED indicator H 2 on the local control panel and by a signal from an output relay configured to "Blocked/Faulty".

Trip command counter

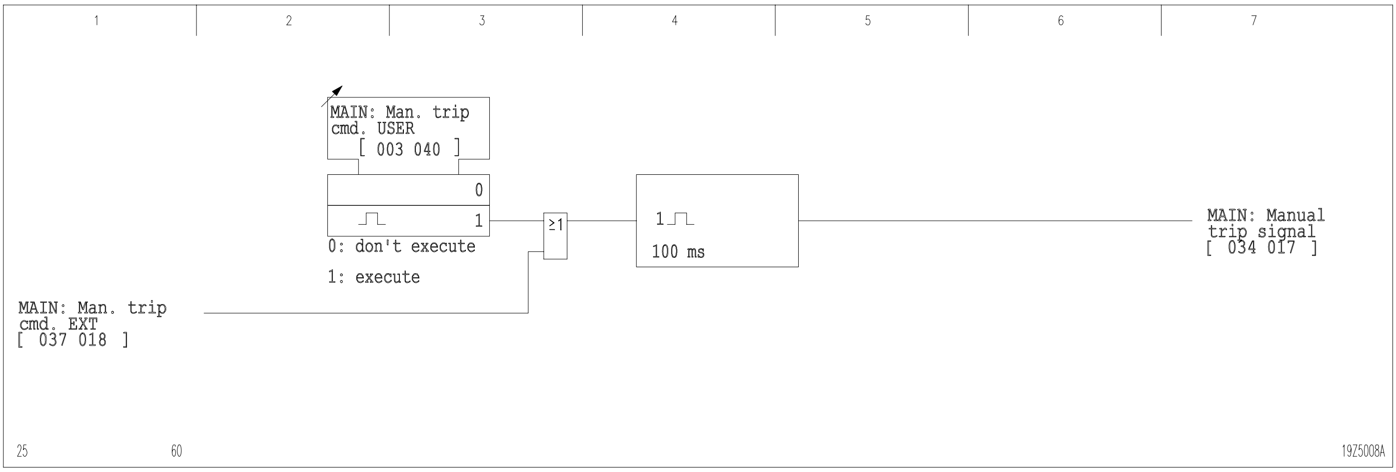
The number of trip commands is counted. The counters can be reset either individually or as a group.



3-74 *Forming the trip commands*

Manual trip command

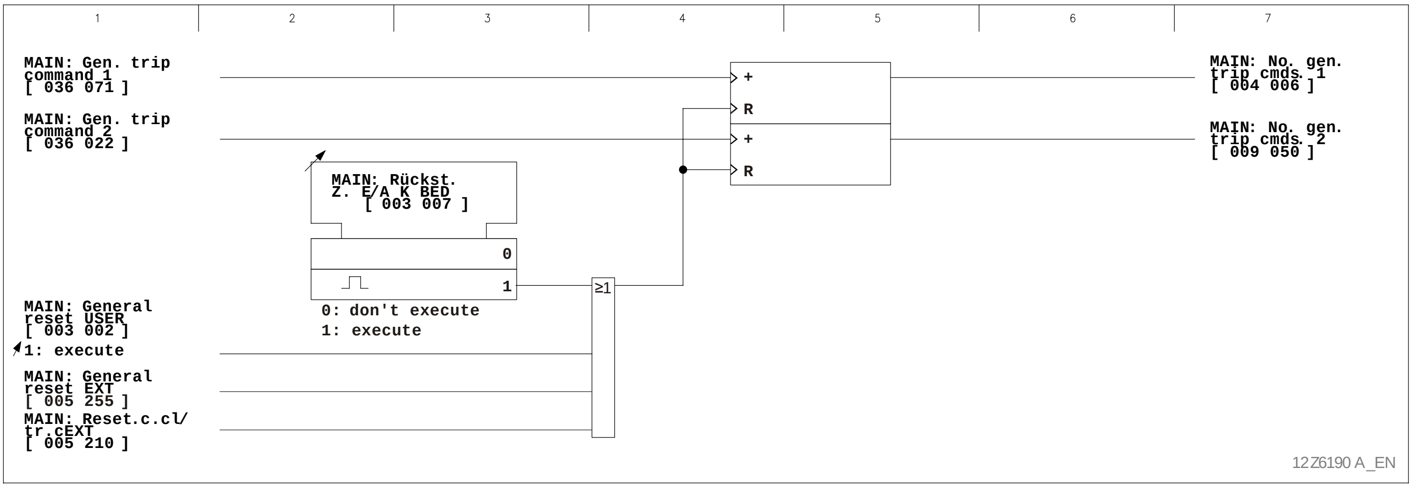
A manual trip command may be issued via a parameter or a binary signal input configured accordingly, but it is not executed unless the manual trip is included in the selection of possible functions to cause a trip.



3-75 Manual trip command

Counter of trip commands

The number of trip commands is counted. The counters can be reset either individually or as a group.



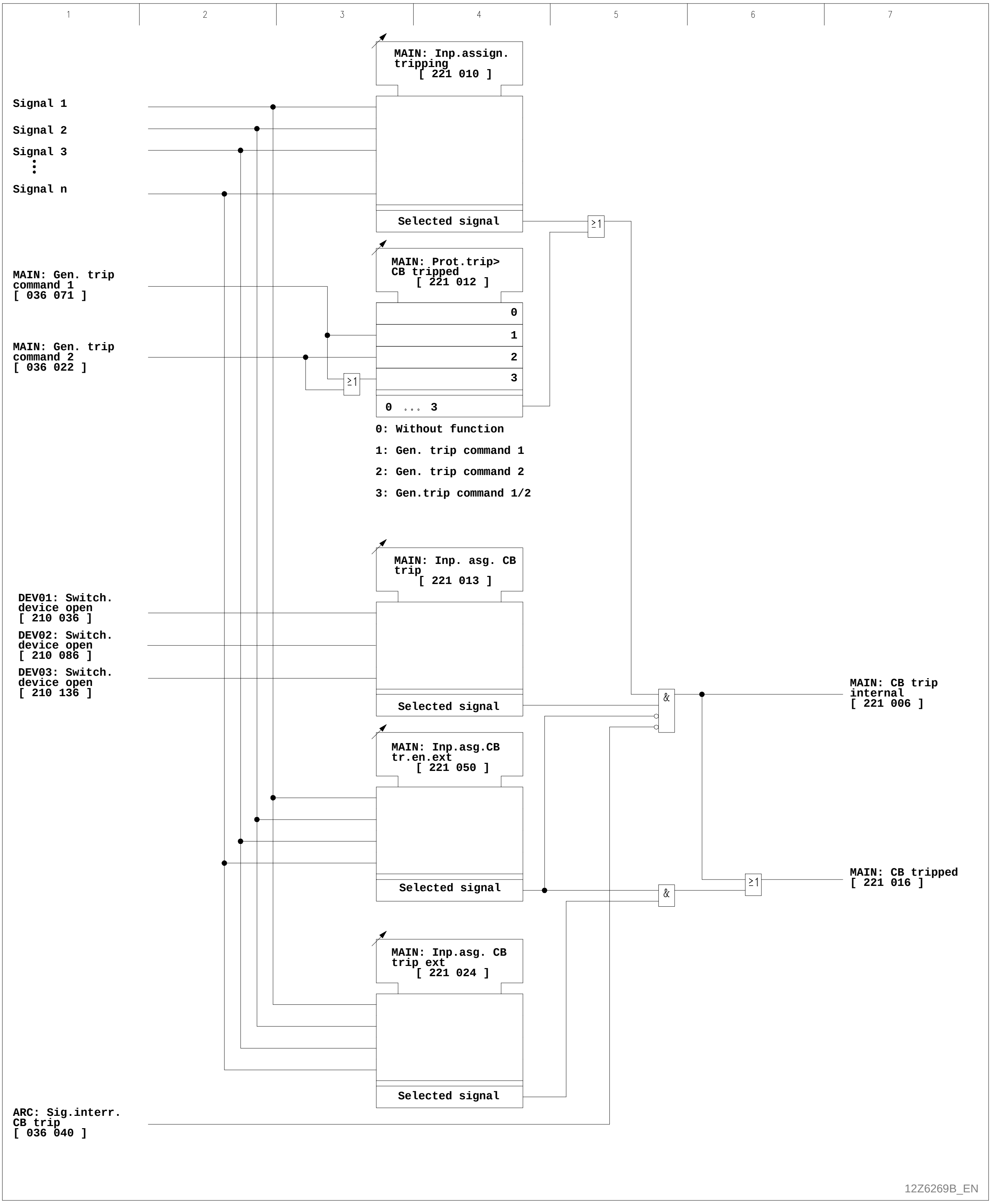
3-76 Trip command counter

3.12.16 CB trip signal

The signal MAIN: CB trip internal is issued if the following conditions are met simultaneously:

- ☐ The binary signal input configured for “tripping” is set to a logic value of '1' or the selected trip command from the P132 is present.
- ☐ At the binary signal input configured as “CB trip” a logic value of '1' is present.

The CB trip signal from an external device can also be signaled. For this task, two binary signal inputs need to be configured as “CB trip enable ext.“ and as “CB trip ext.“.

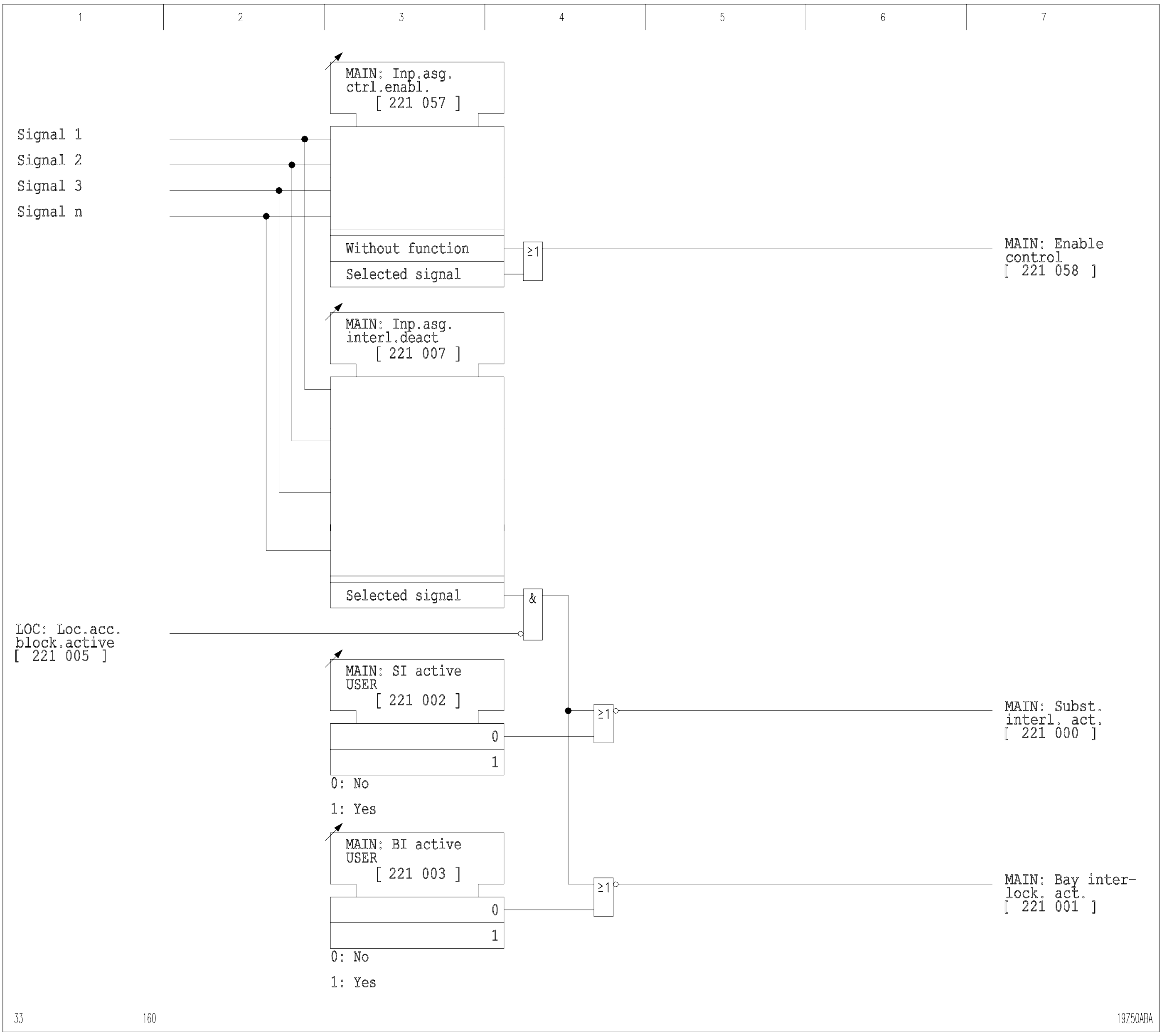


3-77 *Circuit breaker trip signal*

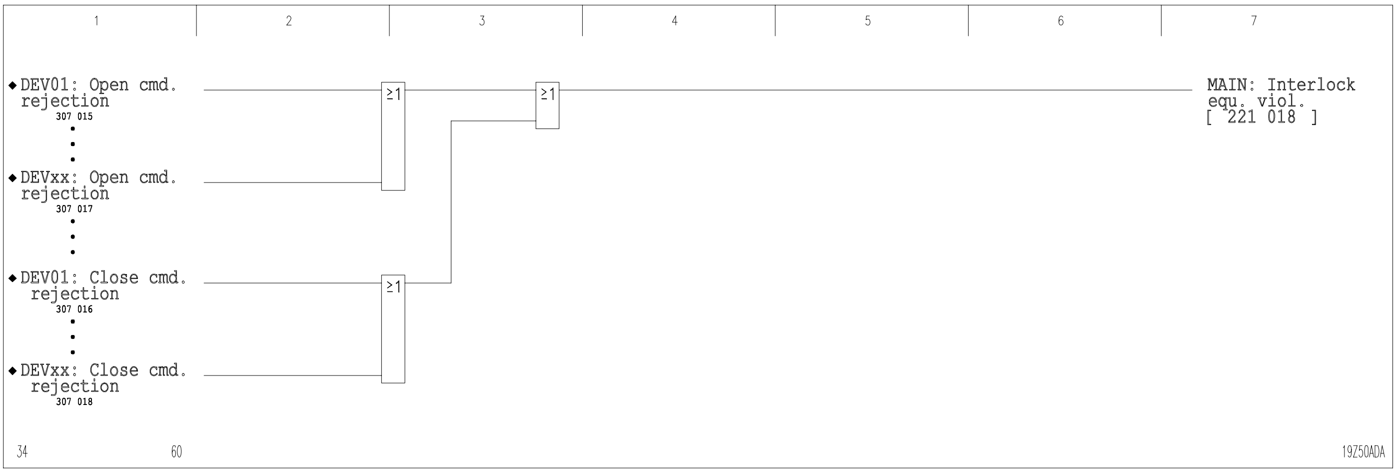
3.12.17 Enable for Switch Commands Issued by the Control Functions

Before a switching unit within the bay is closed or opened by the control functions of the P132, the P132 first checks whether the switch command may be executed. A switch command will be executed if the optional control enable has been issued and the interlock conditions are met. The interlock conditions are defined in the interlocking logic for each switching unit within the bay that is subject to control actions and for each control direction (Open/Close). Different conditions are defined for the bay interlock equations to operate with or without station interlock. The check of bay or station interlock equations can be cancelled for all electrically controllable switchgear units within a bay. If the station interlock is active, it may be cancelled selectively for each switching unit and each control direction (see section ‘Control and Monitoring of Switchgear Units').

If “Local” has been selected as the control point, the bay and station interlocks may be cancelled through an appropriately configured binary signal input.



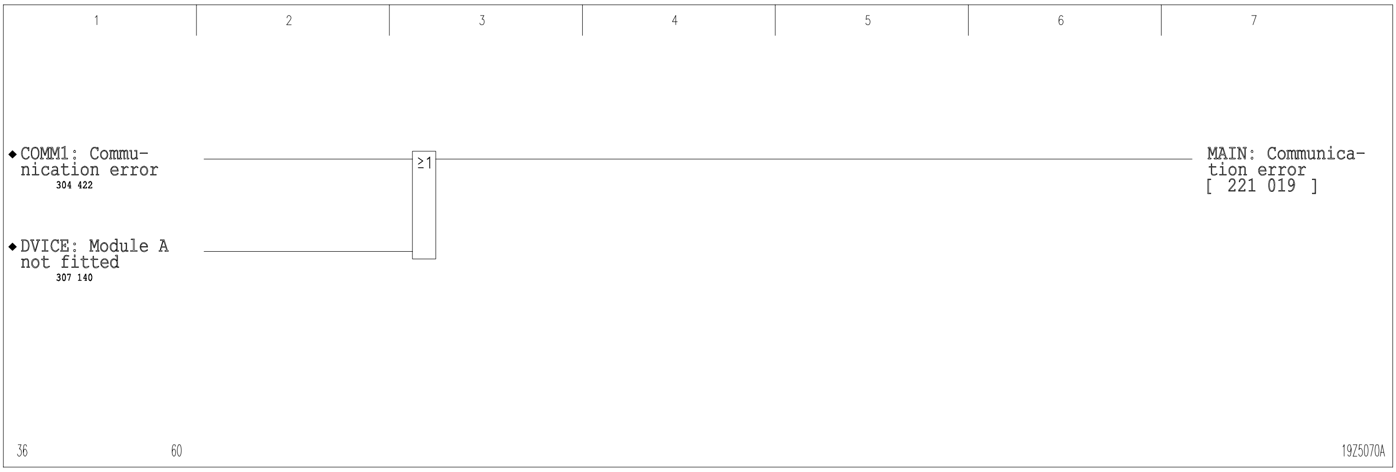
3-78 *General enable for switch commands issued by the control functions; activating or canceling the interlocks*



3-79 Rejection of switching commands

3.12.18 Communication Error

If a link to the control station cannot be established or if the link is interrupted, the signal *"Communication error"* will be issued. This signal will also be issued if communication module A is not fitted.

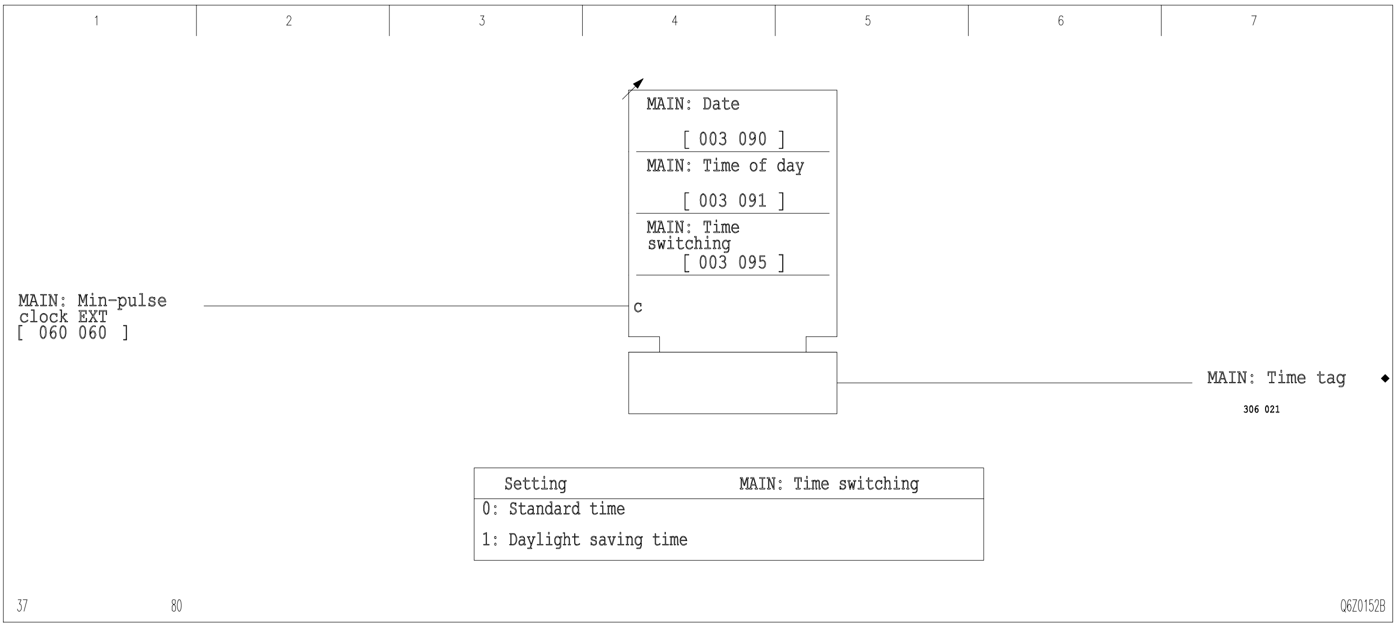


3-80 Communication Error

3.12.19 Time Tagging and Clock Synchronization

The data stored in the operating data memory, the monitoring signal memory and the event memories are date- and time-tagged. For correct tagging, the date and time need to be set in the P132.

The time of different devices may be synchronized by a pulse given to an appropriately configured binary signal input. The P132 evaluates the rising edge. This will set the clock to the nearest full minute, rounding either up or down. If several start/end signals occur (bouncing of a relay contact), only the last edge is evaluated.



3-81 Date/time setting and clock synchronization with minute pulses presented at a binary signal input

Synchronization source

The P132 provides numerous options to synchronize the internal clock:

- Telegram with the time of day via the communication interface COMM1/IEC (full time)
- Telegram with the time of day via the communication interface COMM2/PC (full time)
- IRIG-B Signal (IRIGB; time of day only)
- Minute pulse presented at a binary signal input (MAIN), see figure 3-81 and previous paragraph

With older device versions these interfaces had equal ranking i.e. clock synchronization was carried out regardless of which sub-function initiated triggering. No conflicts have to be taken into account as long as synchronization sources (communication master, IRIG-B and minute pulse source) operate at the same time of day. Should the synchronization sources operate with a different time basis unwanted step changes in the internal clock may occur. On the other hand a redundant time of day synchronization is often used so as to sustain time synchronization via IRIG-B interface even if and while the SCADA communication is out of service.

With the current device versions a primary and a backup source for time of day synchronization may now be set, where both provide the four options listed in the above.

MAIN: Prim.Source TimeSync

MAIN: BackupSourceTimeSync

With this feature synchronization occurs continuously from the primary source as long as time synchronization telegrams or minute pulses are received within a time-out period set at MAIN: Time sync. time-out. The backup source is required if after the set time-out there is no synchronization through the primary source.

When selecting the time telegram via IEC as the primary source the device will expect time synchronization telegrams from server SNTP2 after server SNTP 1 has become defective, before it will switch over to the backup source.

Time synchronization occurs solely from the primary source when the time-out stage is blocked.

3.12.20 Resetting Actions

Stored data such as event logs, measured fault data etc, can be cleared in several ways. The following types of resetting actions are possible:

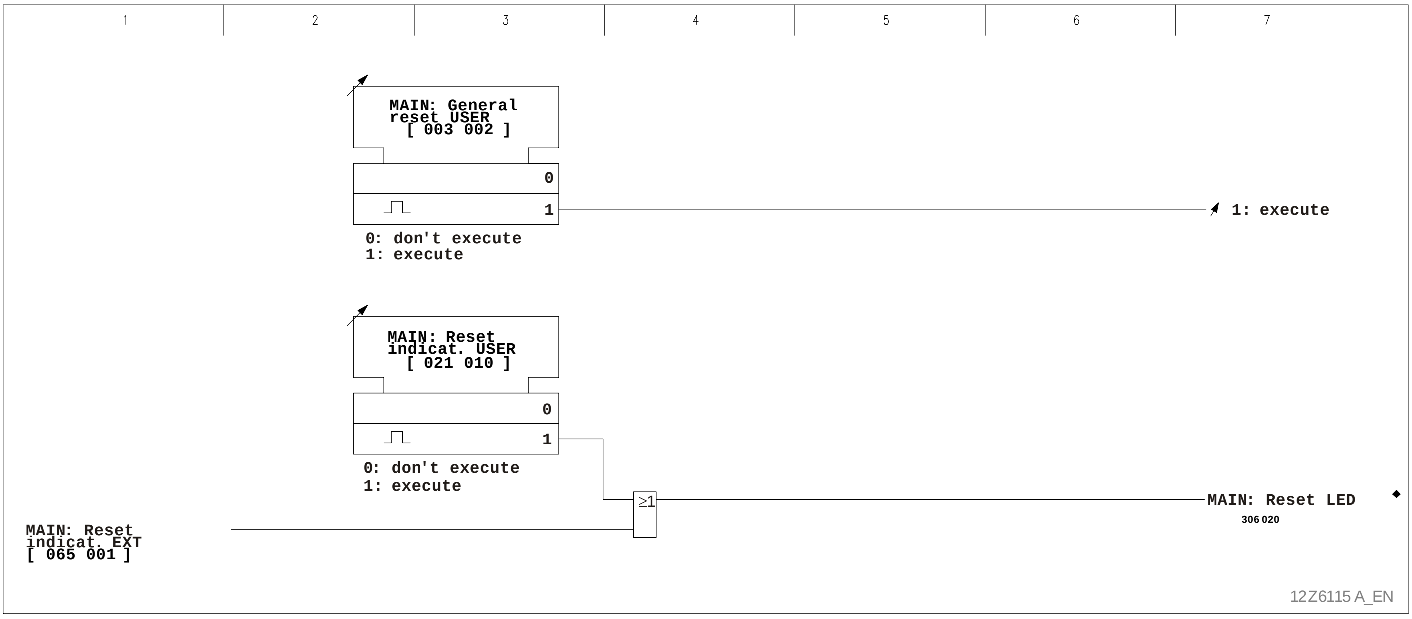
- Automatic resetting of the event signals provided by LED indicators (given that the LED operating mode has been set accordingly) and of the display of measured event data on the local control panel LCD whenever a new event occurs. In this case only the displays on the local control panel LCD are cleared but not the internal memories such as the fault memory.
- Resetting of LED indicators and measured event data displayed on the local control panel LCD by pressing the "CLEAR" key C located on the local control panel. By selecting the required function at LOC: Fct. reset key further memories may be assigned which will then also be cleared when the "CLEAR" key is pressed.
- Selective resetting of a particular memory type (e.g. only the fault memory) via setting parameters. (For this example: Navigate to menu point FT_RC: Reset record. USER and set to '*Execute'*, see also the exact step-by-step description in Chapter 6 "Local Control", section 'Reset'.)
- Selective resetting of a particular memory type (e.g. only the fault memory) through appropriately configured binary signal inputs. (For this example: Assign parameter FT_RC: Reset record. EXT to the relevant binary signal input e.g. INP: Fct. assignm. U 301.)
- Group resetting by setting parameters, by navigating to menu point MAIN: Group reset x USER and setting it to '*Execute'.* For this the relevant memories (i.e. those to be reset) must be assigned to parameter MAIN: Fct.assign. reset x.
- Group resetting through appropriately configured binary signal inputs. (That is assign parameter MAIN: Group reset. x EXT to the relevant binary signal input, e.g. INP: Fct. assignm. U 301 after memories to be reset have been assigned to parameter MAIN: Fct.assign. reset x.)
- General resetting by setting parameters (menu point MAIN: General reset USER). All memories, counters, events etc. are reset without any special configuration options.
- General resetting through appropriately configured binary signal inputs. (MAIN: General reset EXT is assigned to the relevant binary signal input.) All memories, counters, events etc. are reset without any special configuration options.

Should several resetting actions have been configured for one particular memory then they all have equal priority.

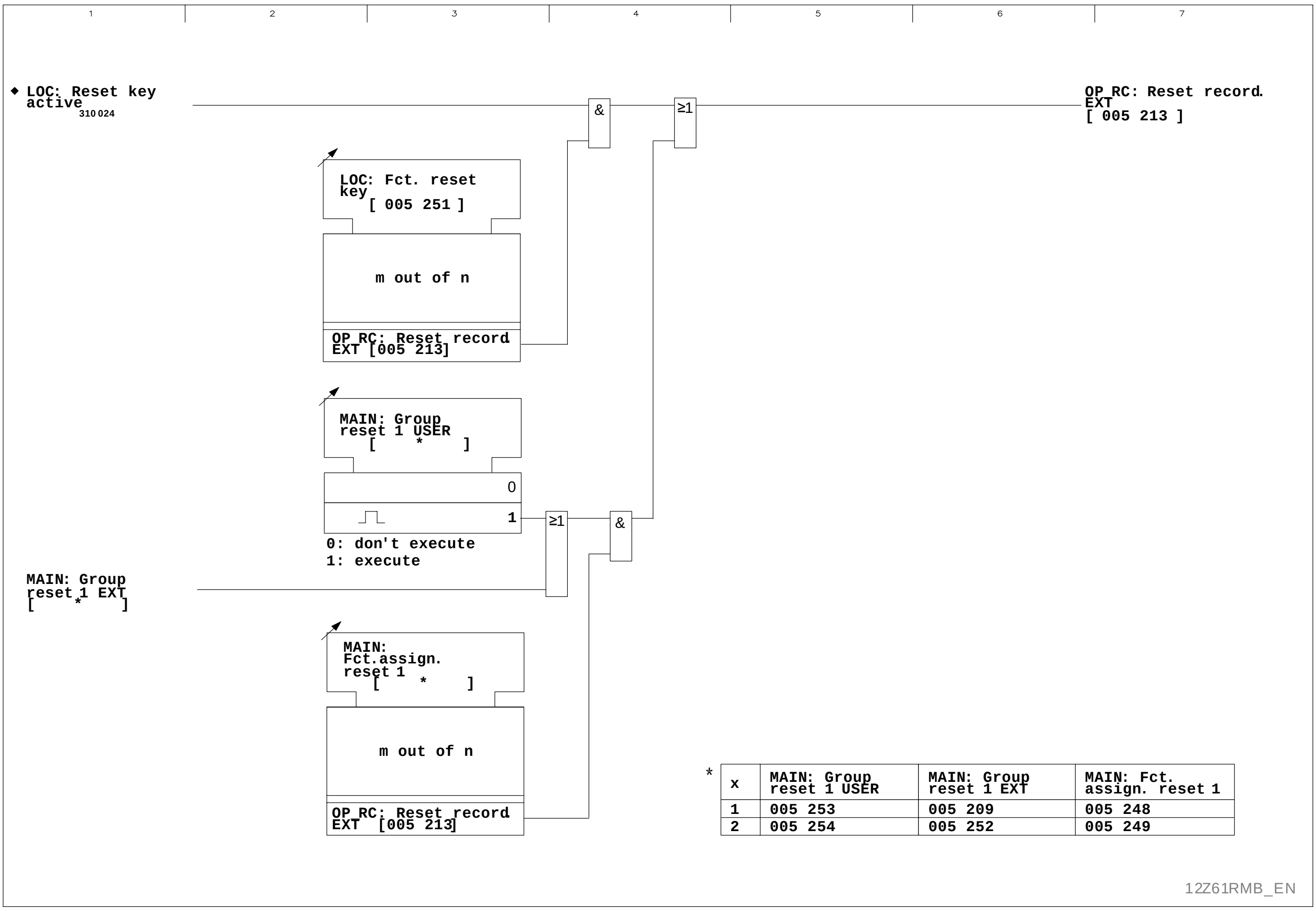
In the event of a cold restart, namely simultaneous failure of both internal battery and substation auxiliary supply, all stored signals and values will be lost.

Further resetting possibilities are basically not distinct resetting actions but make access especially easy to one of the resetting actions described above i.e. by configuring them to a function key.

- ☐ Function keys may be configured such that resetting of a specific memory is assigned. Technically this is similar to resetting through an appropriately configured binary signal input. When a function key is pressed a signal to a binary signal input is simulated. (See section 'Configurable Function Keys'.)
- ☐ Similar to this, but one step less direct, is the possibility to assign one of the two menu jump lists (LOC: Trig. Menu jmp x EXT) to a function key and to include the relevant menu point for a resetting action (e.g. OUTP: Reset latch. USER) in the definition (LOC: Fct. Menu jmp list x) of the selected menu jump list.
- ☐ The same may be achieved with the "READ" key by assigning it a menu point for a resetting action through LOC: Assignment read key.



3-82 *General reset, LED reset and measured event data reset from the local control panel*



x	MAIN: Group reset 1 USER	MAIN: Group reset 1 EXT	MAIN: Fct. assign. reset 1
1	005 253	005 209	005 248
2	005 254	005 252	005 249

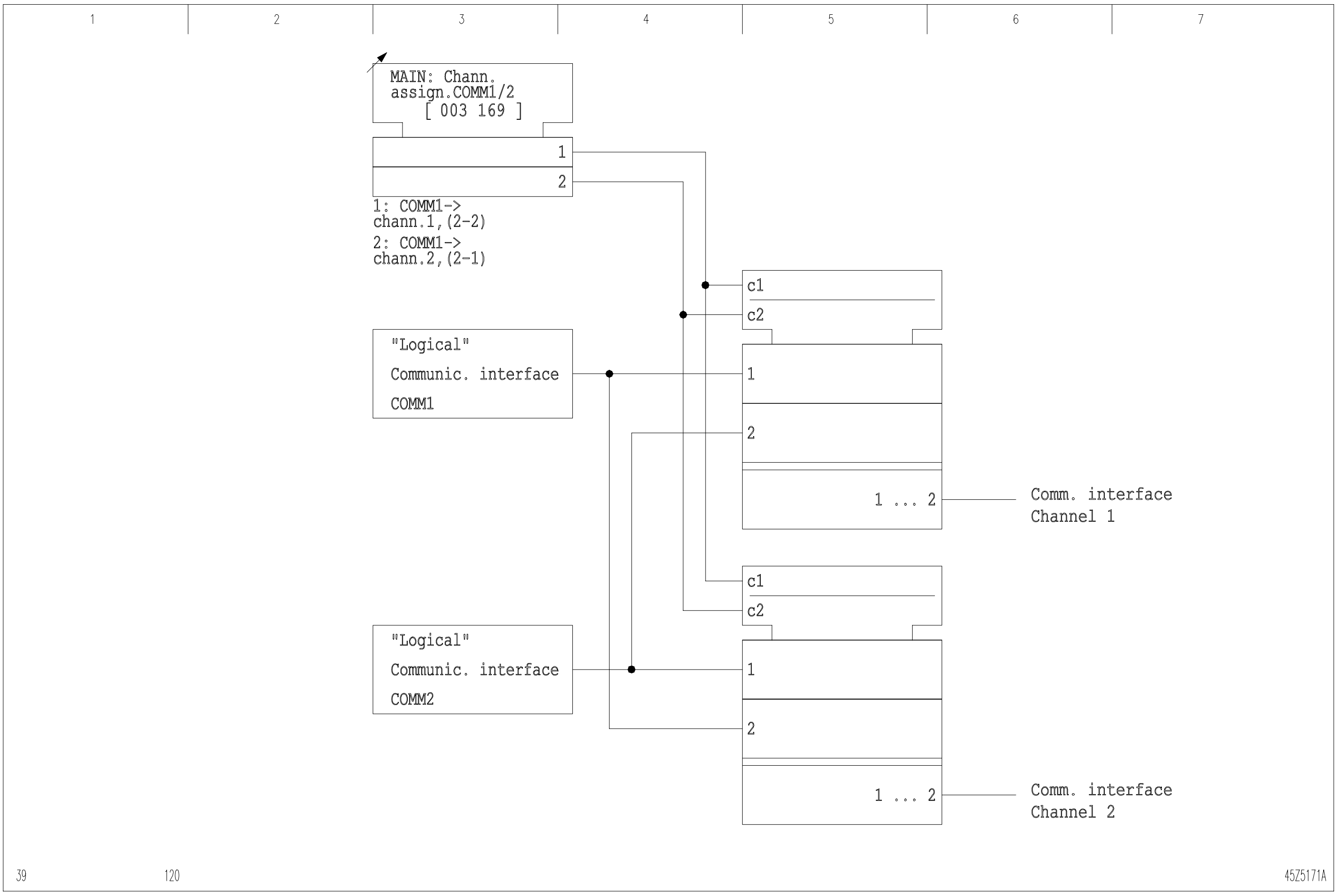
3-83 "CLEAR" key on the local control panel and, as an example, group resetting of the operating data recording (e.g. as an example for the reset signal OP_RC: Reset record. EXT); further examples for resetting signals generated in this way are:

- *[004 140] TGFD: Reset signal EXT*
- *[005 210] MAIN: Reset c. cl/tr.c EXT*
- *[005 211] MAIN: Reset IP,max,st. EXT*
- *[005 212] MAIN: Reset meas.v.en. EXT*
- *[005 240] MT_RC: Reset record. EXT*
- *[005 241] OL_RC: Reset record. EXT*
- *[005 242] GF_RC: Reset record. EXT*
- *[005 243] FT_RC: Reset record. EXT*
- *[005 244] ARC: Reset counters EXT*
- *[005 245] GFDSS: Reset counters EXT*
- *[005 246] TGFD: Reset counters EXT*
- *[005 247] CBM: Reset meas.val. EXT*
- *[005 255] MAIN: General reset EXT*
- *[006 054] COMM3: Reset No.tlg.err.EXT*
- *[006 074] ASC: Reset counters EXT*
- *[006 075] f<>: Reset meas.val. EXT*
- *[006 076] MEASI: Reset Tmax EXT*
- *[036 087] MEASI: Reset output EXT*
- *[038 061] THERM: Reset replica EXT*
- *[040 015] OUTP: Reset latch. EXT*
- *[040 138] MAIN: Reset latch.trip EXT*
- *[041 082] MP: Reset replica EXT*

3.12.21 Assigning Communications Interfaces to Physical Communications Channels

Depending on the design version of the communications module A there are up to two communications channels available (see Chapter "Technical Data"). These physical communications channels may be assigned to communications interfaces COMM1 and COMM2.

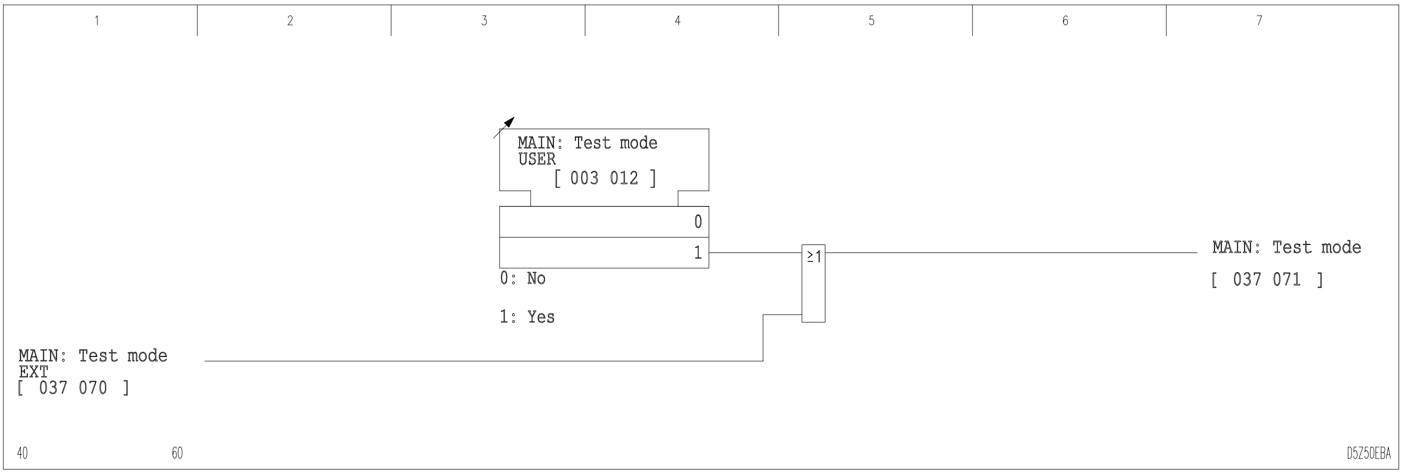
If communications interface COMM1 is assigned to communications channel 2, then the settings of communications interface COMM2 are automatically assigned to communications channel 1. Communications channel 2 can only be used to transmit data to and from the P132 if its PC interface has been de-activated. As soon as the PC interface is used to transmit data, communications channel 2 becomes "dead".



3-84 Assignment communication interfaces to physical communication channels

3.12.22 Test mode

If tests are run on the P132, the user is advised to activate the test mode so that all incoming signals via the serial interfaces will be identified accordingly.



3-85 *Setting the test mode*

3.13 Parameter Subset Selection (Function Group PSS)

The P132 allows the user to pre-set four independent parameter subsets. The user can switch between parameter subsets during operation without interrupting the protection function.

Selecting the parameter subset

The control path that will determine the active parameter subset (function parameter or binary signal input) can be selected via the function parameter PSS: Control via USER or the external signal PSS: Control via user EXT. Depending on the selection made, the parameter subset will be selected either in accordance with the pre-set function parameter PSS: Param. subs. sel. USER or as a function of external signals. The parameter subset that is active at any given time can be determined by scanning the logic state signals PSS: Actual param.subset or PSS: PSx active.

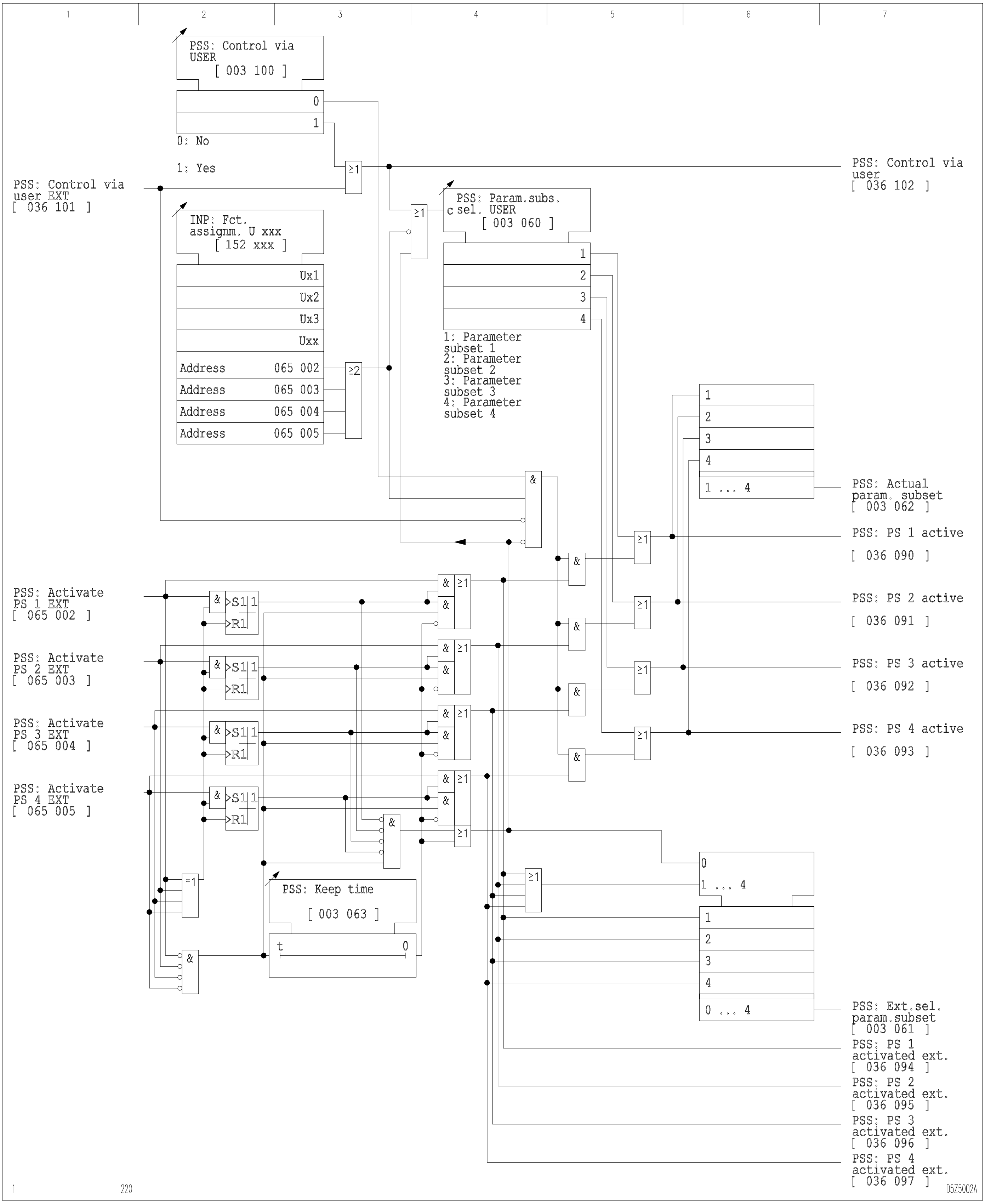
Selecting the parameter subset via binary inputs

If the binary signal inputs are to be used for parameter subset selection, then the P132 first checks to determine whether at least two binary inputs are configured for parameter subset selection. If this is not the case, then the parameter subset selected via the function parameter will be active. The P132 also checks to determine whether the signals present at the binary signal inputs allow an unambiguous parameter subset selection. This is true only when just one binary signal input is set to a logic value of ‘1’. If more than one signal input is set to a logic value of ‘1’, then the parameter subset previously selected remains active. Should a dead interval occur while switching between parameter subsets (this is the case if all binary signal inputs have a logic value of ‘0’), then the stored energy time is started. While this timer stage is running, the previously selected parameter subset remains active. As soon as a signal input has a logic value of ‘1’, the associated parameter subset becomes active. If, after the stored energy time has elapsed, there is still no signal input with a logic value of ‘1’, the parameter subset selected via a function parameter becomes active.

If, after the supply voltage is turned on, no logic value of ‘1’ is present at any of the binary signal inputs selected for the parameter subset selection, then the parameter subset selected via a function parameter will become active once the stored energy time has elapsed. The previous parameter subset remains active while the stored energy timer stage is running.

Parameter subset selection may also occur during a starting condition. When subset selection is handled via binary signal inputs, a maximum inherent delay of approximately 100 ms must be taken into account.

Settings for which only one address is given in the following sections are equally effective for all four parameter subsets.



3-86 Activating the parameter subsets

3.14 Self-Monitoring (Function Group SFMON)

Comprehensive monitoring routines in the P132 ensure that internal faults are detected and do not lead to malfunctions. The selection of function assignments to the alarm signal includes, among others, self-monitoring signals from the communication monitor, measuring-circuit monitoring (V, Vref, I), open-circuit monitoring (20 mA input, temperature sensors) and the logic outputs 30 to 32 and 30(t) to 32(t).

Tests during start-up

After the supply voltage has been turned on, various tests are carried out to verify full operability of the P132. If the P132 detects a fault in one of the tests, then start-up is terminated. The display shows which test was running when termination occurred. No control actions may be carried out. A new attempt to start up the P132 can only be initiated by turning the supply voltage off and then on again.

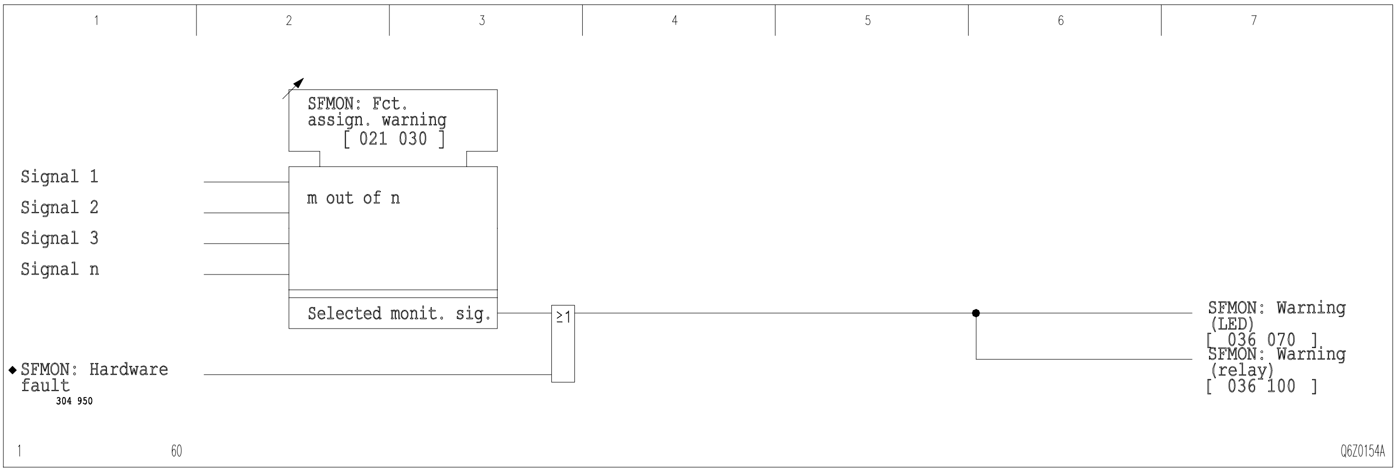
Cyclic tests

After start-up has been successfully completed, cyclic self-monitoring tests will be run during operation. In the event of a positive test result, a specified monitoring signal will be issued and stored in a non-volatile(NV) memory – the monitoring signal memory – along with the assigned date and time (see section ‘Monitoring Signal Recording’).

The self-monitoring function monitors the built-in battery for any drop below the minimum acceptable voltage level. If the associated monitoring signal is displayed, then the battery should be replaced within a month, since otherwise there is the danger of data loss if the supply voltage should fail. Chapter 11 gives further instructions on battery replacement.

Signal

The monitoring signals are also signaled via the output relay configured SFMON: Warning. The output relay operates as long as an internal fault is detected.



3-87 *Monitoring signals*

Device response

The response of the P132 is dependent on the type of monitoring signal. The following responses are possible:

☐ Signaling Only
If there is no malfunction associated with the monitoring signal, then only a signal is issued, and there are no further consequences. This situation exists, for example, when internal data acquisition memories overflow.

☐ Selective Blocking
If a fault is diagnosed solely in an area that does not affect the protective functions, then only the affected area is blocked. This would apply, for example, to the detection of a fault on the communication module or in the area of the PC interface.

☐ Warm Restart
If the self-monitoring function detects a fault that might be eliminated by a system restart – such as a fault in the hardware –, then a procedure called a warm restart is automatically initiated. During this procedure, as with any start-up, the computer system is reset to a defined state. A warm restart is characterized by the fact that no stored data and, in particular, no setting parameters are affected by the procedure. A warm restart can also be triggered manually by control action. During a warm restart sequence the protective functions and the communication through serial interfaces will be blocked. If the same fault is detected after a warm restart has been triggered by the self-monitoring system, then the protective functions remain blocked but communication through the serial interfaces will usually be possible again.

☐ Cold Restart
If a corrupted parameter subset is diagnosed during the checksum test, which is part of the self-monitoring procedure, then a cold restart is carried out. This is necessary because the protection device cannot identify which parameter in the subset is corrupted. A cold restart causes all internal memories to be reset to a defined state. This means that all the protection device settings are also erased after a cold restart. In order to establish a safe initial state, the default values have been selected so that the protective functions are blocked. Both the monitoring signal that triggered the cold restart and the value indicating parameter loss are entered in the monitoring signal memory.

Monitoring signal memory

Depending on the type of internal fault detected the device will respond by trying to eliminate the problem with a warm restart. (See above; for further details read also about device behavior with problems in Chapter 10 “Troubleshooting”.) Whether or not this measure will suffice can only be determined if the monitoring signal has not already been stored in the monitoring signal memory because of a previous fault. If it was already stored and a second fault is detected then, depending on the type of fault detected, the device will be blocked after the second warm restart.

In order to monitor this behavior better the parameter at SFMON: Mon.sig. retention is applied. This parameter may either be set to *‘blocked’* or to a time duration period (in hours).

The default for this timer stage is *‘blocked’* e.g. blocking of the protection device with two identical faults occurs independent of the time evolved since the first fault monitoring signal was issued.

The behavior caused by sporadic faults could lead to an unwanted blocking of the device if the monitoring signal memory has not been reset in the interim, for example, because the substation is difficult to reach in wintertime or reading-out and clearing of the monitoring signal memory via the communication interfaces was not enabled. To defuse this problem it is suggested to set the function parameter to a specific time duration period so that blocking will only occur if the same fault occurs again within this time period. Otherwise, the device will continue to operate normally after a warm restart.

Monitoring signal memory time tag

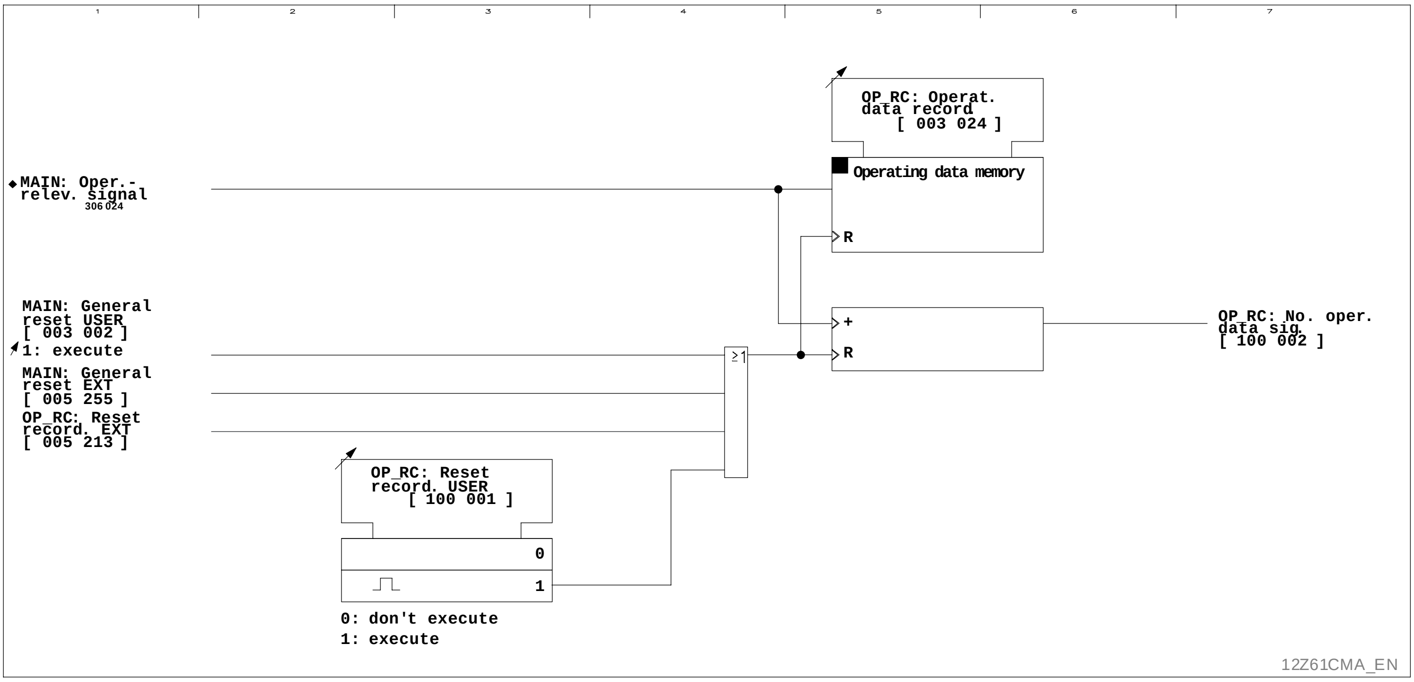
The time when the device fault occurred last is recorded.

3.15 Operating Data Recording (Function Group OP_RC)

For the continuous recording of processes in system operation as well as of events, a non-volatile ring memory is provided. The operationally relevant signals, each fully tagged with date and time at signal start and signal end, are entered in chronological order. The signals relevant for operation include control actions such as function disabling and enabling and triggers for testing and resetting. The onset and end of events in the system that represent a deviation from normal operation such as overloads, ground faults, or short-circuits are also recorded. The operating data memory can be cleared.

Counter for signals relevant to system operation

The signals stored in the operating data memory are counted.



3-88 *Operating data recording and counter for signals relevant to system operation*

3.16 Monitoring Signal Recording (Function Group MT_RC)

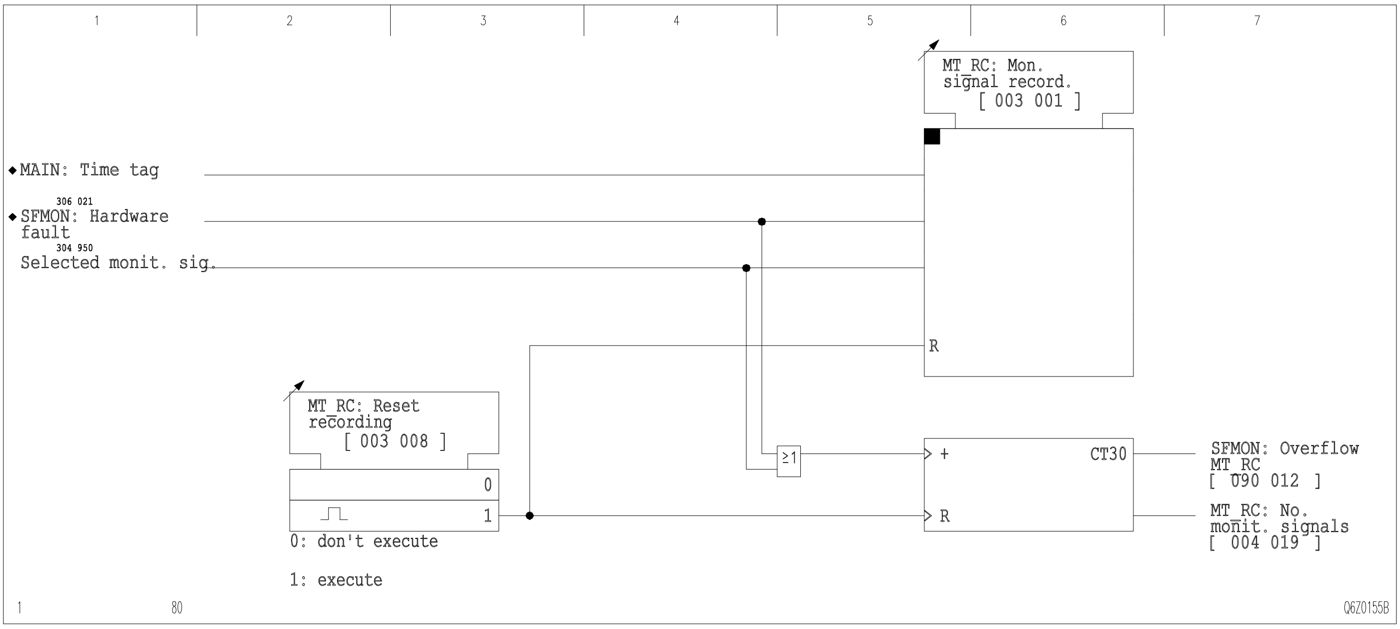
The monitoring signals generated by the self-monitoring function are recorded in the monitoring signal memory. The memory depth allows for a maximum of 30 entries. If more than 29 monitoring signals occur without interim memory clearance, the SFMON: Overflow MT_RC signal is entered as the last entry. Monitoring signals prompted by a hardware fault in the unit are always entered in the monitoring signal memory. Monitoring signals prompted by a peripheral fault can be entered into the monitoring signal memory, if desired. The user can select this option by setting an 'm out of n' parameter (see Self-Monitoring).

If at least one entry is stored in the monitoring signal memory, this fact is signaled by the red LED indicator H 3 on the local control panel. Each new entry is indicated by a flashing light.

The monitoring signal memory can only be cleared manually by a control action. Entries in the monitoring signal memory are not even cleared automatically if the corresponding test in a new test cycle has a negative result. The contents of the monitoring signal memory can be read from the local control panel or through the PC or communication interface. The time and date information assigned to the individual entries can be read out through the PC or communication interface or from the local control panel.

Monitoring signal counter

The number of entries stored in the monitoring signal memory is displayed on the monitoring signal counter (MT_RC: No. monit. signals).

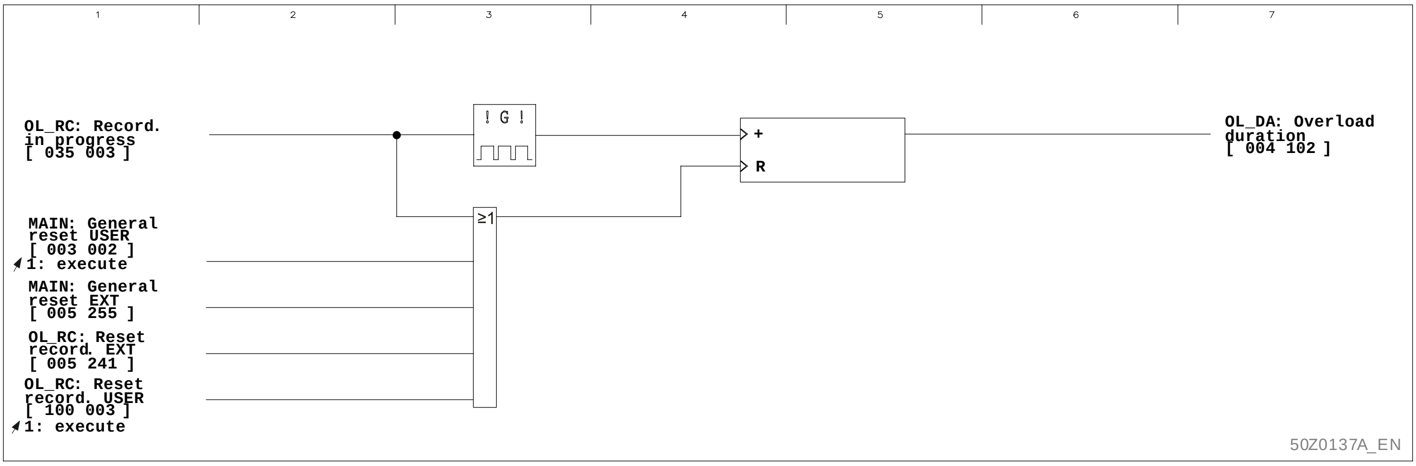


3-89 *Monitoring signal recording and the monitoring signal counter*

3.17 Overload Data Acquisition (Function Group OL_DA)

Overload duration

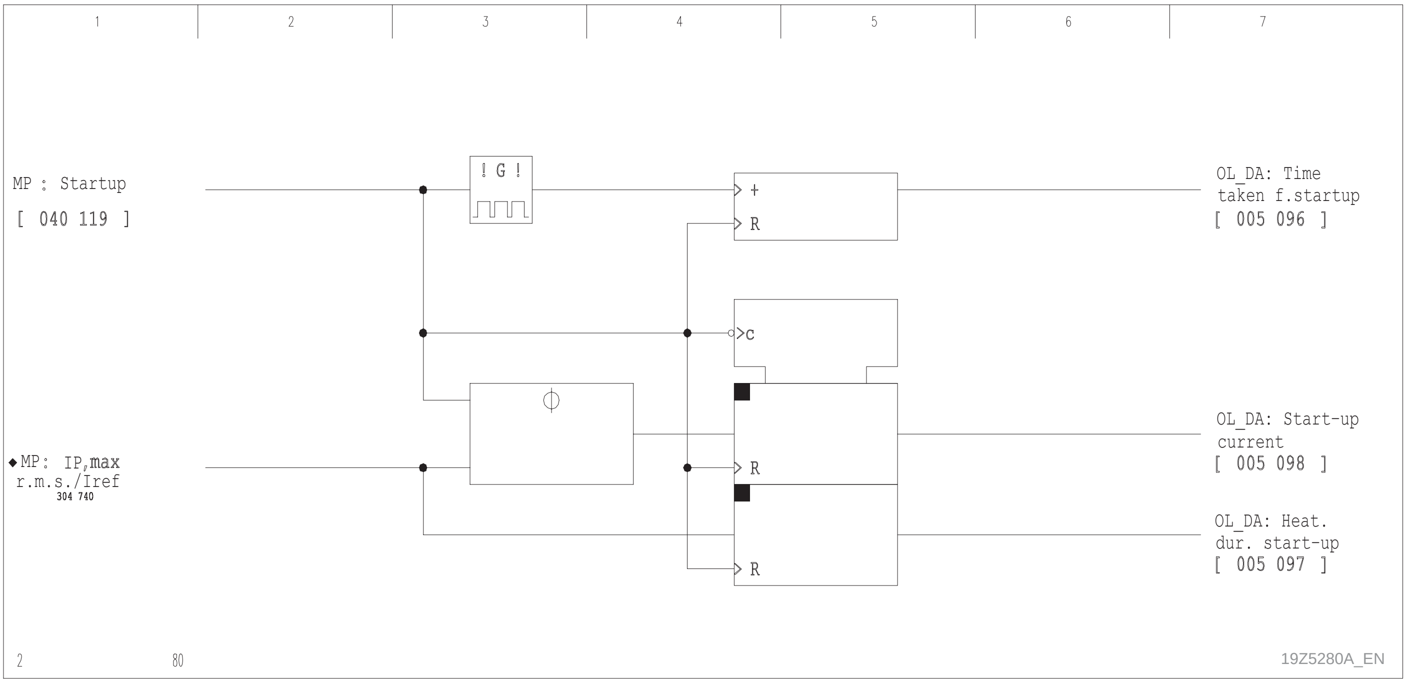
In the event of an overload, the P132 determines the overload duration. The overload duration is defined as the time between the start and end of the `OL_RC: Record. in progress` signal.



3-90 Overload duration

Acquisition of measured overload data by the motor protection function

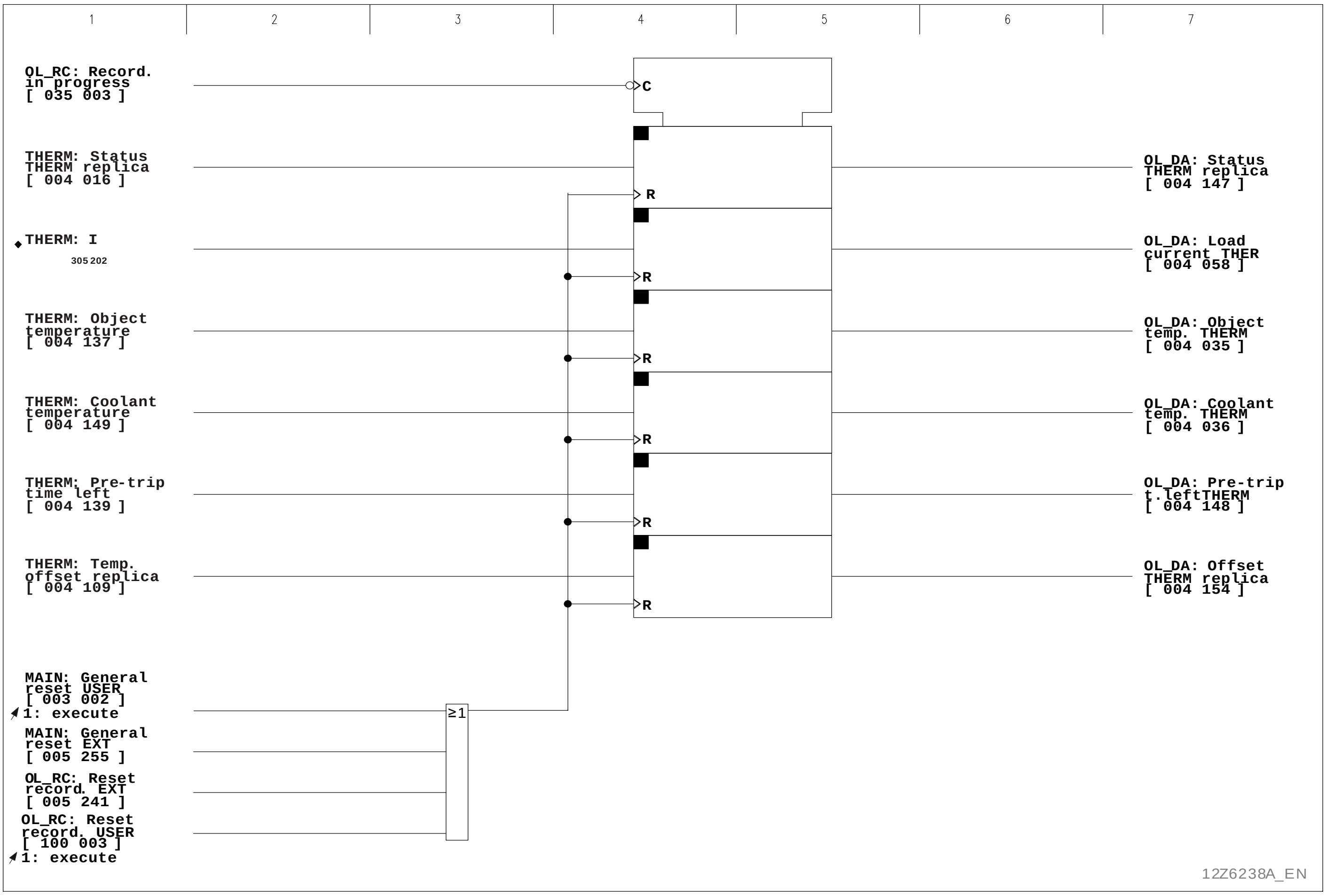
During motor startup, the measured data for the startup time, the maximum startup current and the startup heating are determined and stored at the end of the startup process.



3-91 *Measured overload data of the motor protection function*

Acquisition of the measured overload data of thermal overload protection

The measured overload data are derived from the measured operating data of the thermal overload protection function. They are stored at the end of the overload event.



3-92 *Measured overload data of thermal overload protection*

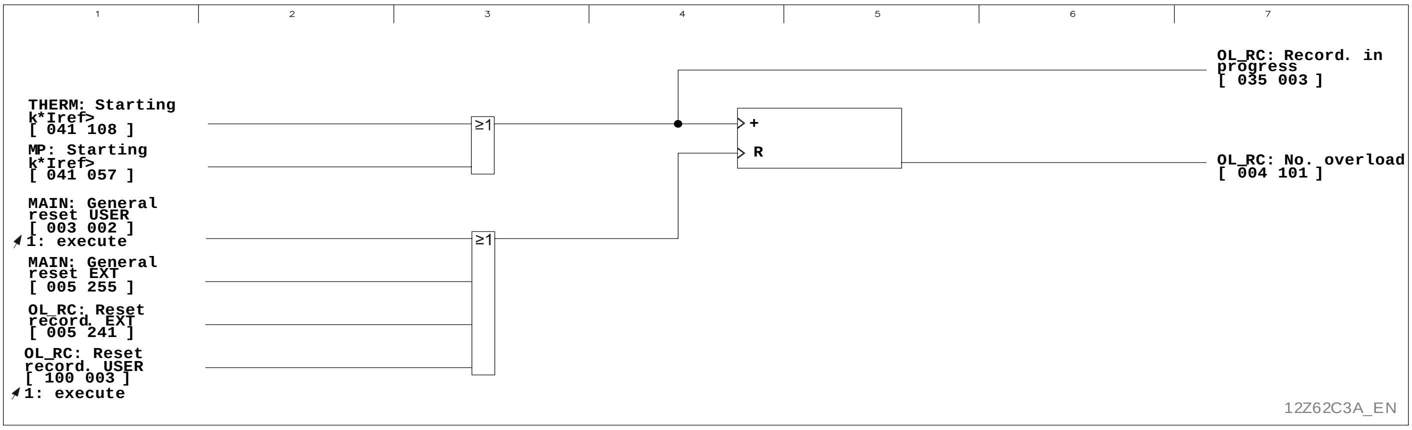
3.18 Overload Recording (Function Group OL_RC)

Start of overload recording

An overload exists and therefore overload recording begins if a starting signal is issued by either the motor protection function (MP: Starting k*Iref>) or the thermal overload protection function (THERM: Starting k*Iref>).

Counting overload events

Overload events are counted and identified by sequential number.



3-93 *Counting overload events*

Time tagging

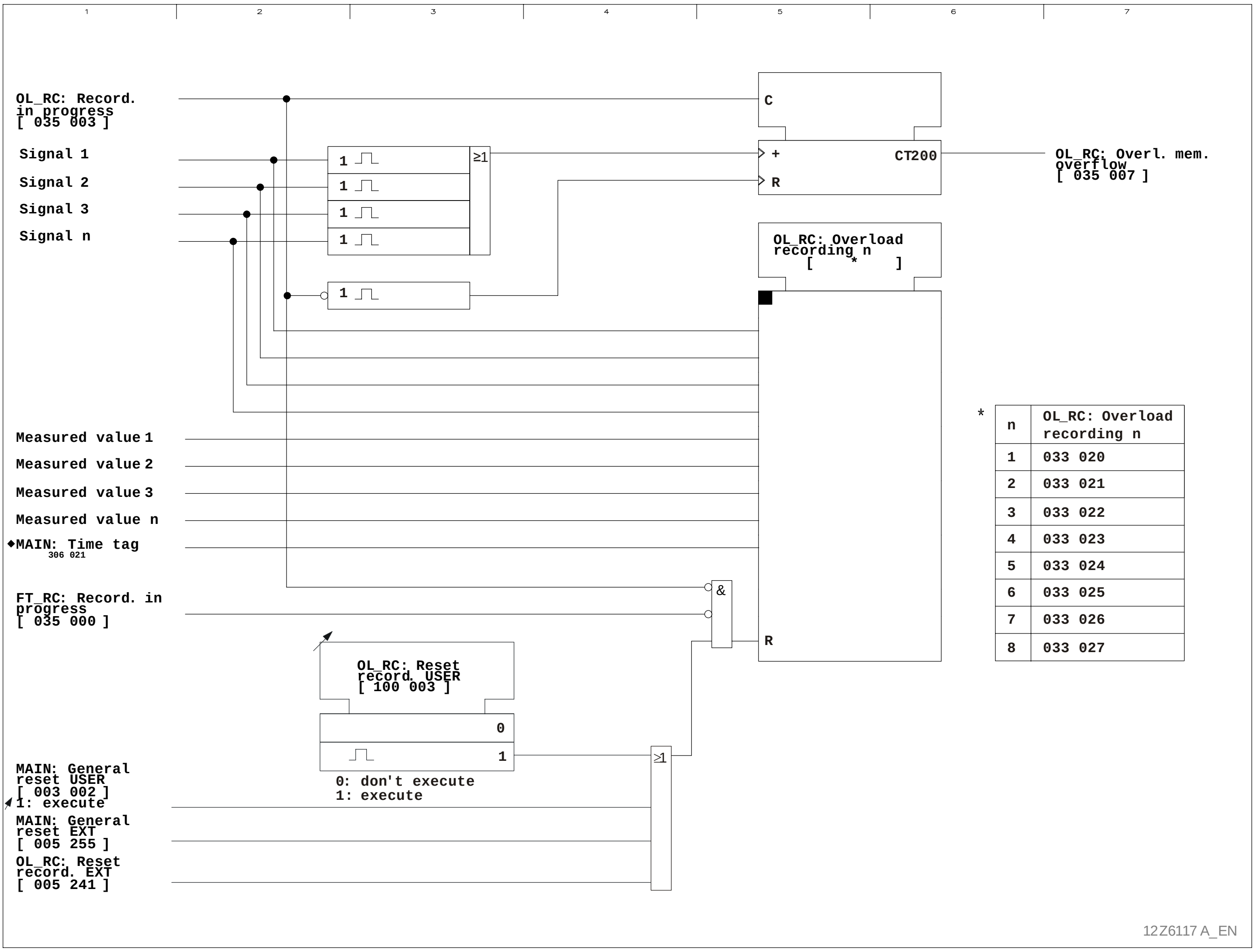
The date that is assigned to each overload event by the internal clock is stored. An overload event's individual start or end signals are likewise time-tagged by the internal clock. The date and time assigned to an overload event when the event begins can be read out from the overload memory on the local control panel or through the PC and communication interfaces. The time information (relative to the onset of the overload) that is assigned to the signals can be retrieved from the overload memory or through the PC or one of the communication interfaces.

Overload logging

Protection signals during an overload event are logged in chronological order with reference to the specific event. A total of eight overload events, each involving a maximum of 200 start or end signals, can be stored in the non-volatile overload memories. After eight overload events have been logged, the oldest overload log will be overwritten, unless memories have been cleared in the interim. If more than 199 start or end signals have occurred during a single overload event, then OL_RC: Overl. mem. overflow will be entered as the last signal.

In addition to the signals, the measured overload data are also entered in the overload memory.

The overload logs can be read from the local control panel or through the PC or communication interfaces.



*

n	OL_RC: Overload recording n
1	033 020
2	033 021
3	033 022
4	033 023
5	033 024
6	033 025
7	033 026
8	033 027

3-94 *Overload memory*

3.19 Ground Fault Data Acquisition (Function Group GF_DA)

In the event of a ground fault, the P132 acquires the following measured ground fault data:

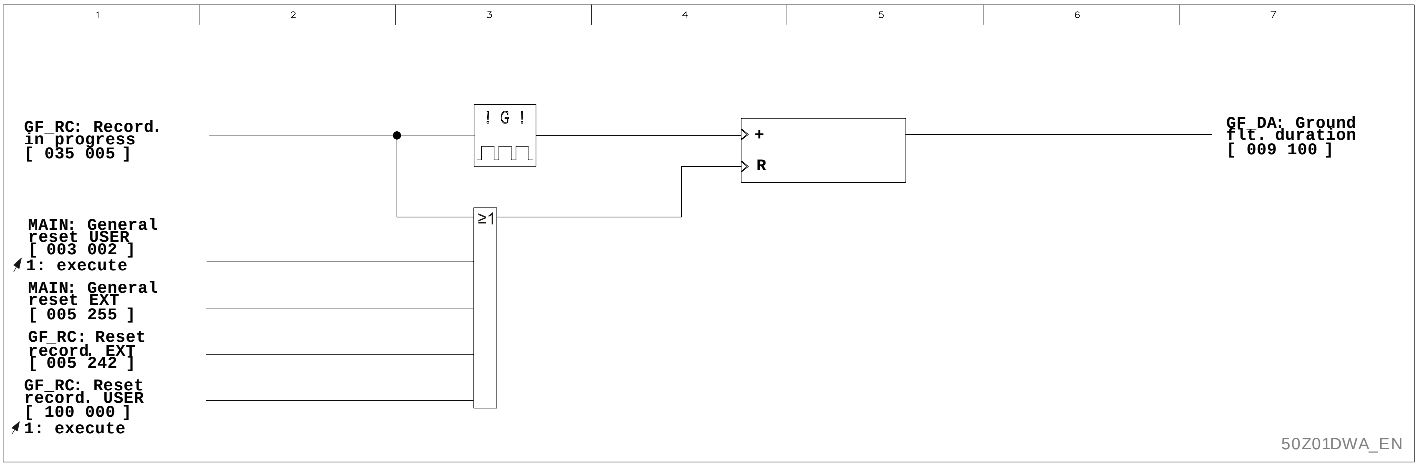
- ☐ Duration of the ground fault recording
- ☐ When the GFDSS function (ground fault direction determination using steady-state values) is enabled:
  - ■ Ground fault duration determined by steady-state power, steady-state current or admittance evaluation
  - ■ Neutral-point displacement voltage V_{NG} determined by steady-state power or admittance evaluation
  - ■ Residual current I_N
  - ■ Active component of residual current determined by steady-state power evaluation
  - ■ Reactive component of the residual current determined by steady-state power evaluation
  - ■ Filtered residual current determined by steady-state current evaluation
  - ■ Admittance, conductance and susceptance if the admittance evaluation mode is enabled

Resetting the measured ground fault data

After the reset key ‘C’ on the local control panel is pressed, the ground fault data value is displayed as ‘*Not measured*’. However, the values are not erased and can continue to be read out through the PC and communication interfaces.

Duration of the ground fault recording

The ground fault duration is defined as the time between the start and end of the `OL_RC: Record. in progress` signal.

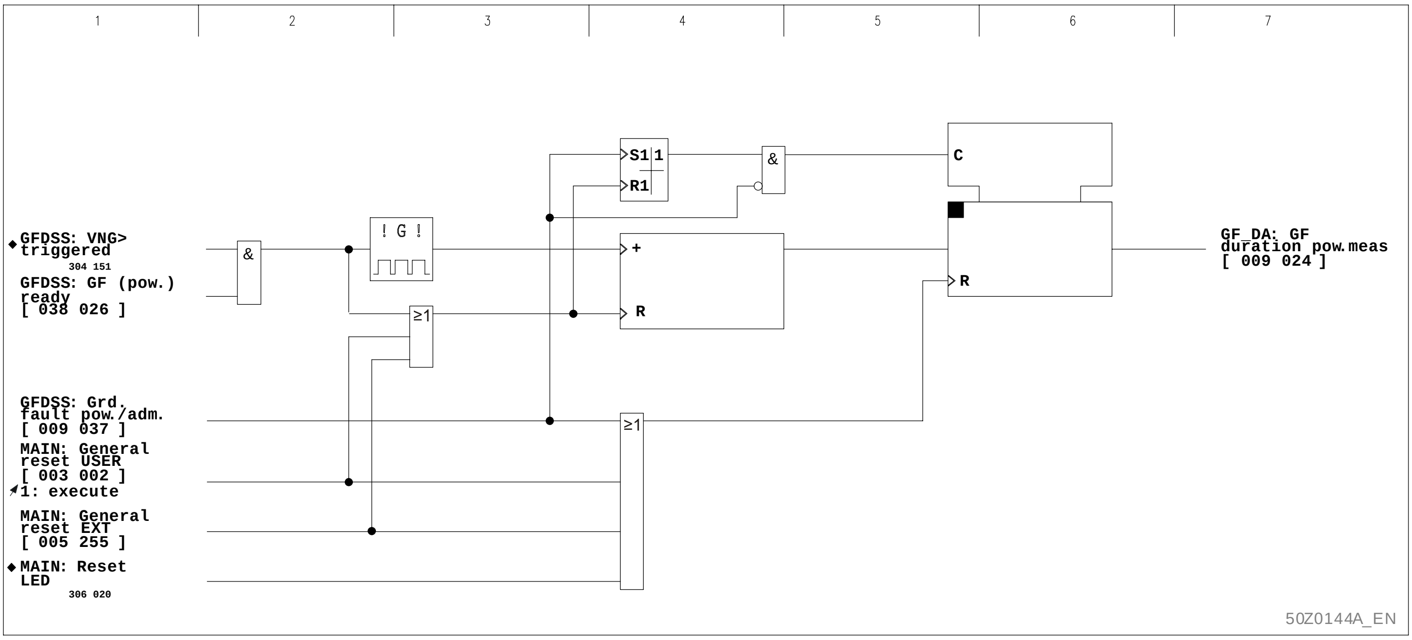


3-95 *Duration of the ground fault recording*

3.19.1 Measured Ground Fault Data from Steady-State Power Evaluation

Ground fault duration

Ground fault duration is defined as the time between operation and dropout of the trigger GFDSS: VNG>. However, there is only a time output after the end of a ground fault if the trigger GFDSS: VNG> has operated at least for the set time GFDSS: tVNG>. After GFDSS: tVNG> has elapsed, the display of the ground fault duration of the last ground fault is automatically cleared.



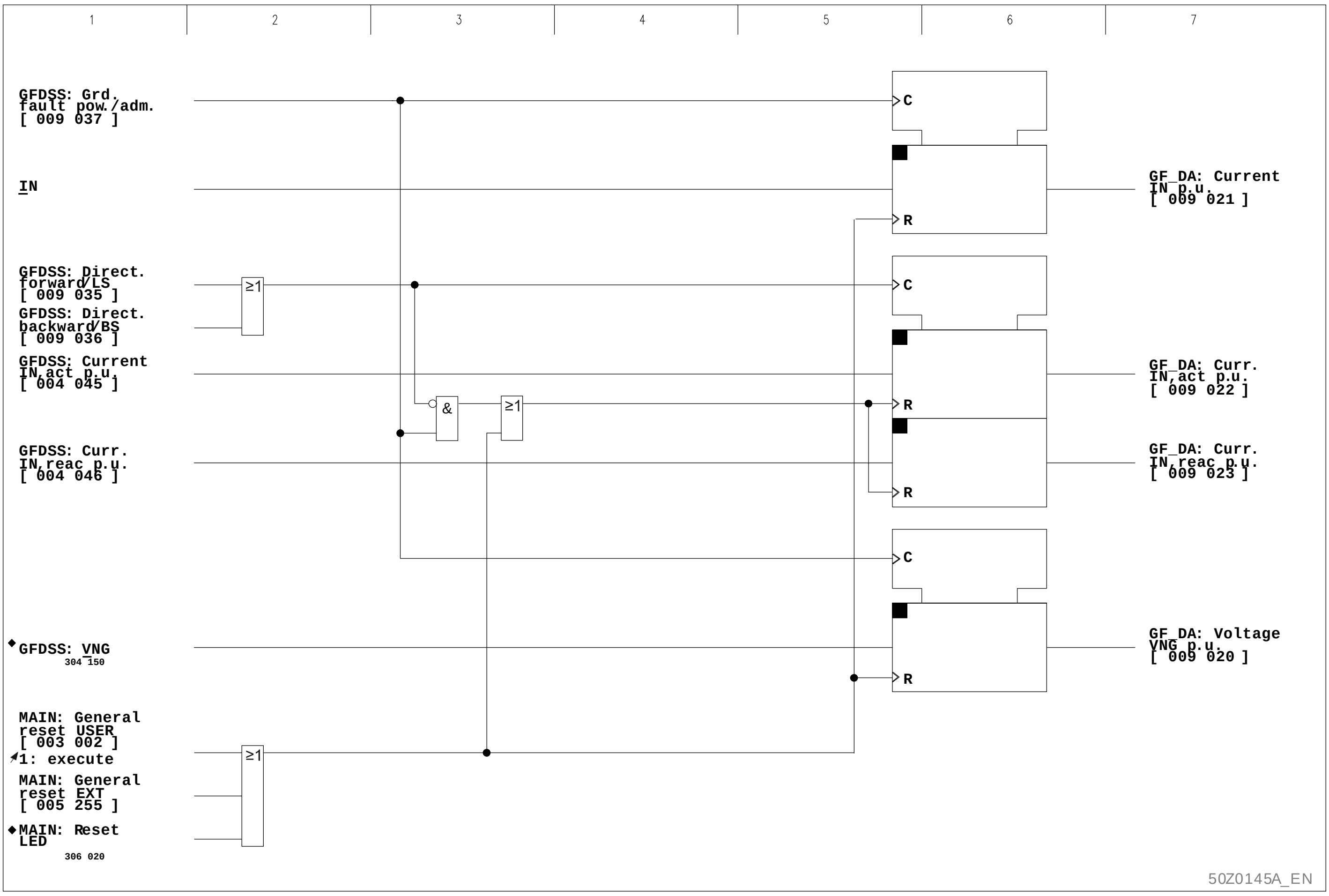
3-96 *Measurement and storage of ground fault duration, steady-state power evaluation*

Residual current

The residual current that is present at the time the timer stage GFDSS: tVNG> elapses is stored in memory. In addition, the active or reactive component of the residual current at the time of the direction decision output is also stored. All measured data are output as per-unit quantities referred to the nominal current I_{nom} of the device.

Neutral displacement voltage

The neutral displacement voltage that is present at the time the timer stage GFDSS: tVNG> elapses is stored in memory.

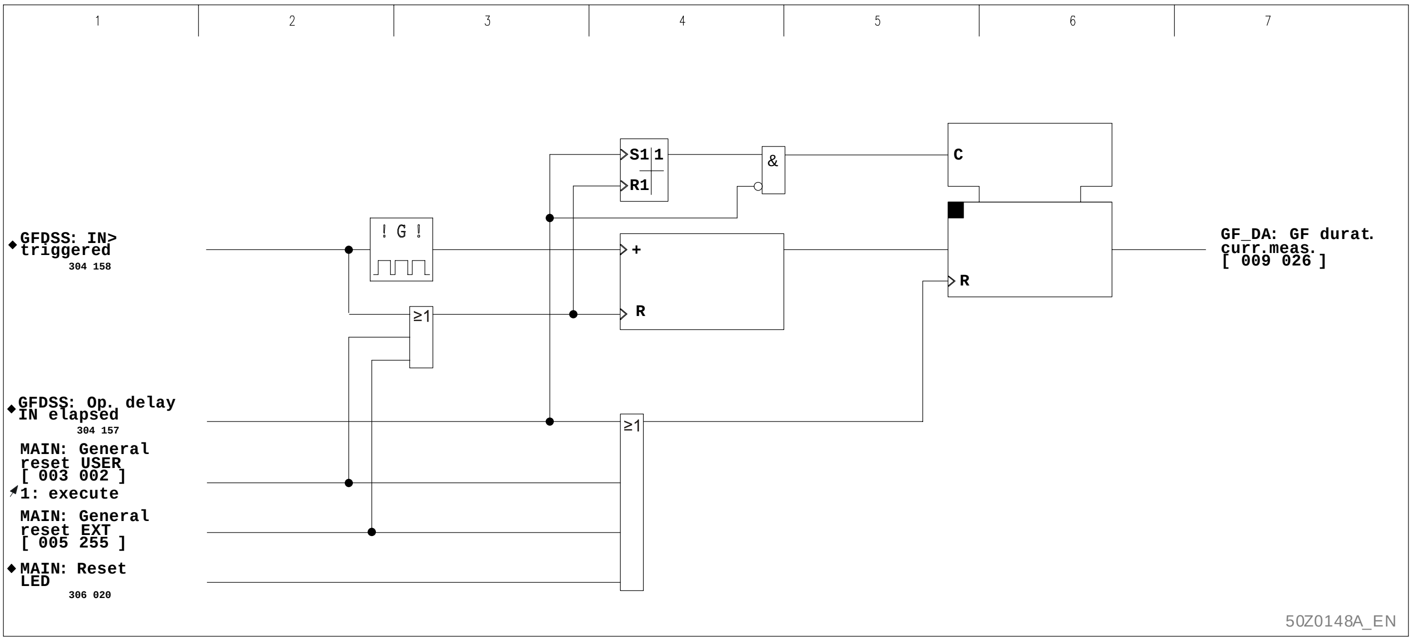


3-97 *Residual current and neutral-displacement voltage for steady-state power evaluation*

3.19.2 Measured Ground Fault Data from Steady-State Current Evaluation

Ground fault duration

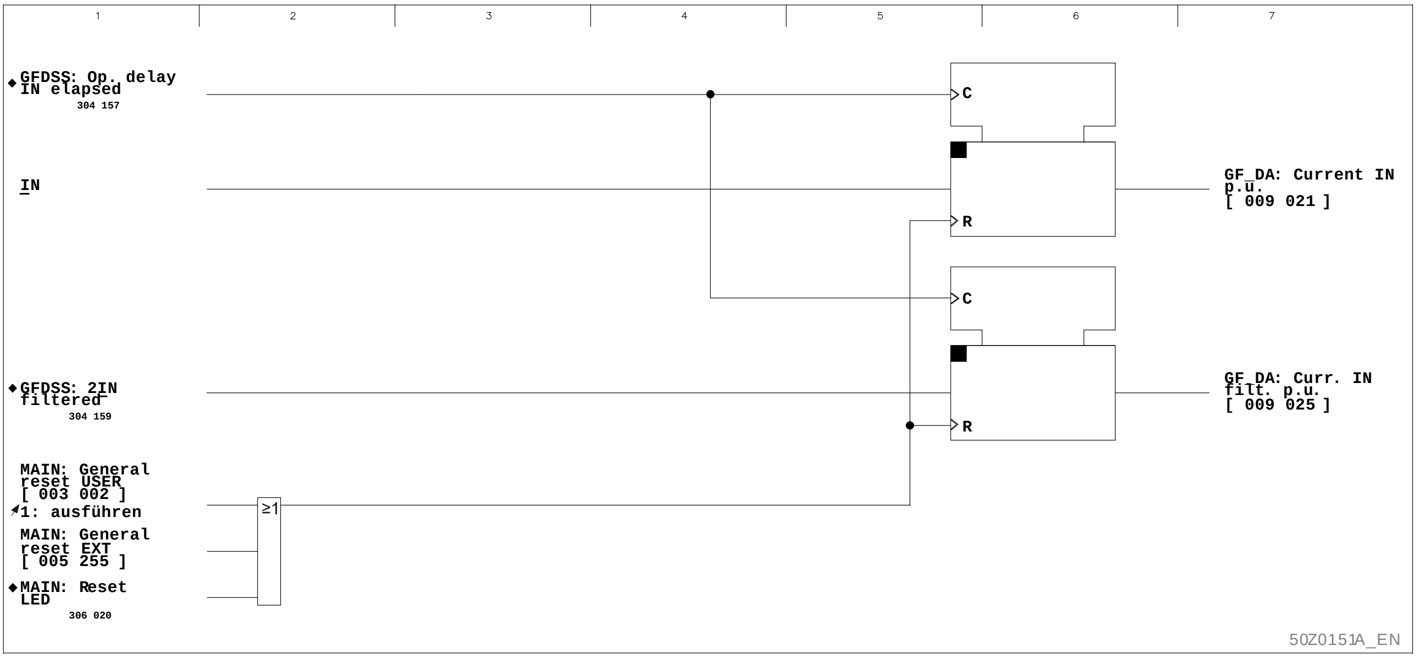
Ground fault duration is defined as the time between operation and dropout of the trigger GFDSS: IN>. However, there is only a time output after the end of a ground fault if the trigger GFDSS: IN> has operated at least for the duration of the set operate delay (GFDSS: Operate delay IN). After the operate delay has elapsed, the display of the ground fault duration of the last ground fault is automatically cleared.



3-98 Measurement and storage of ground fault duration, steady-state current evaluation

Residual current

Both the unfiltered and the filtered residual current at the time when the operate delay `GFDSS: Operate delay IN` elapses are stored.

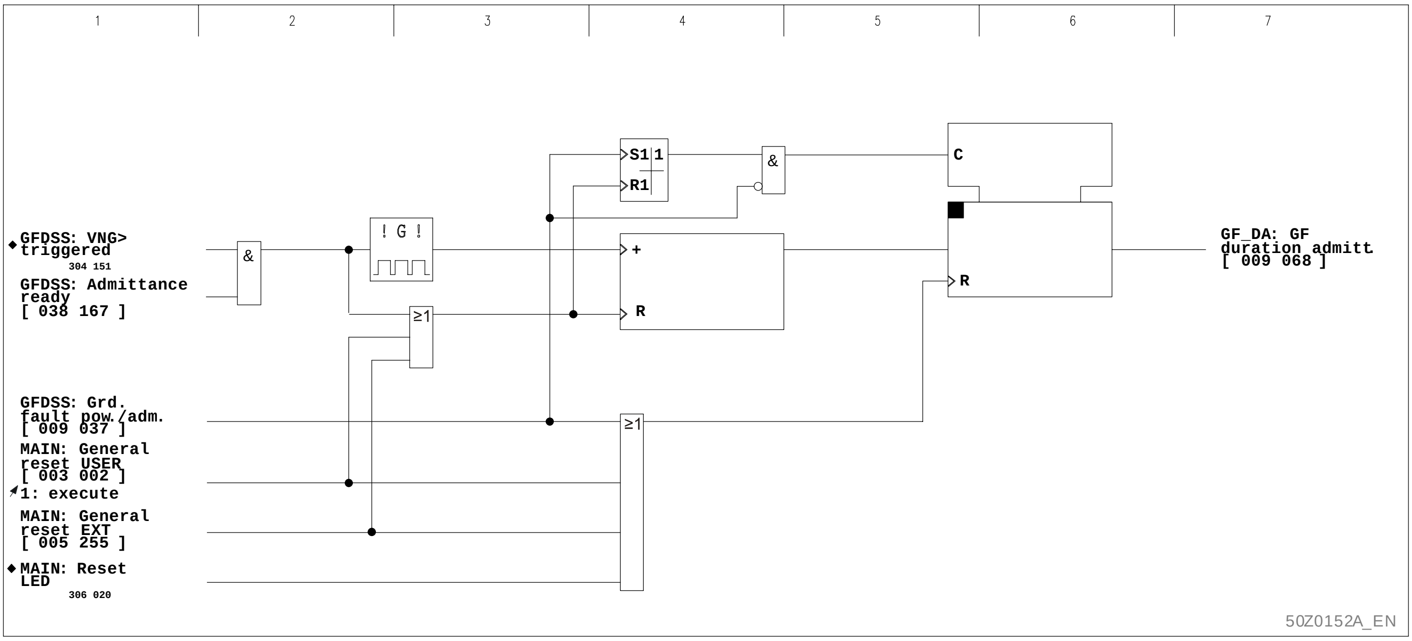


3-99 *Filtered residual current determined by steady-state current evaluation*

3.19.3 Measured Ground Fault Data from Admittance Evaluation

Ground fault duration

Ground fault duration is defined as the time between operation and dropout of the trigger GFDSS: VNG>. However, there is only a time output after the end of a ground fault if the trigger GFDSS: VNG> has operated at least for the set time GFDSS: tVNG>. After GFDSS: tVNG> has elapsed, the display of the ground fault duration of the last ground fault is automatically cleared.



3-100 Measurement and storage of ground fault duration, admittance evaluation mode

Acquisition of admittance, conductance and susceptance

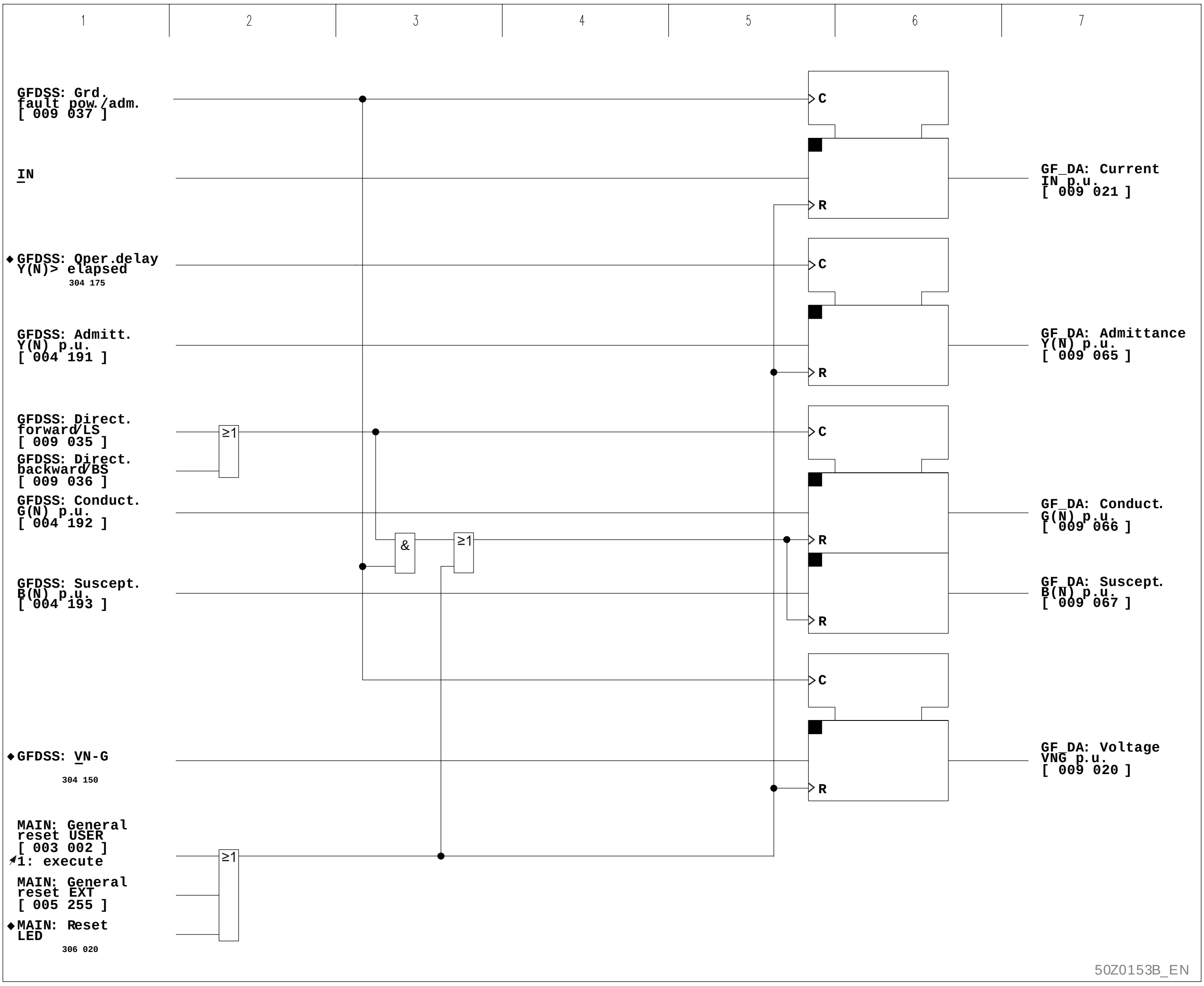
Conductance and susceptance are stored at the time when the direction decision is issued. The acquisition of the admittance data value is carried out at the time when timer stage GFDSS: Operate delay Y(N)> elapses.

Residual current

The residual current that is present at the time the timer stage GFDSS: tVNG> elapses is stored in memory. The measured data value is output as per-unit quantity referred to the nominal current I_{nom} of the device.

Neutral displacement voltage

The neutral displacement voltage that is present at the time the timer stage GFDSS: tVNG> elapses is stored in memory.



3-101 Measured ground fault data for the admittance evaluation mode

3.20 Ground Fault Recording (Function Group GF_RC)

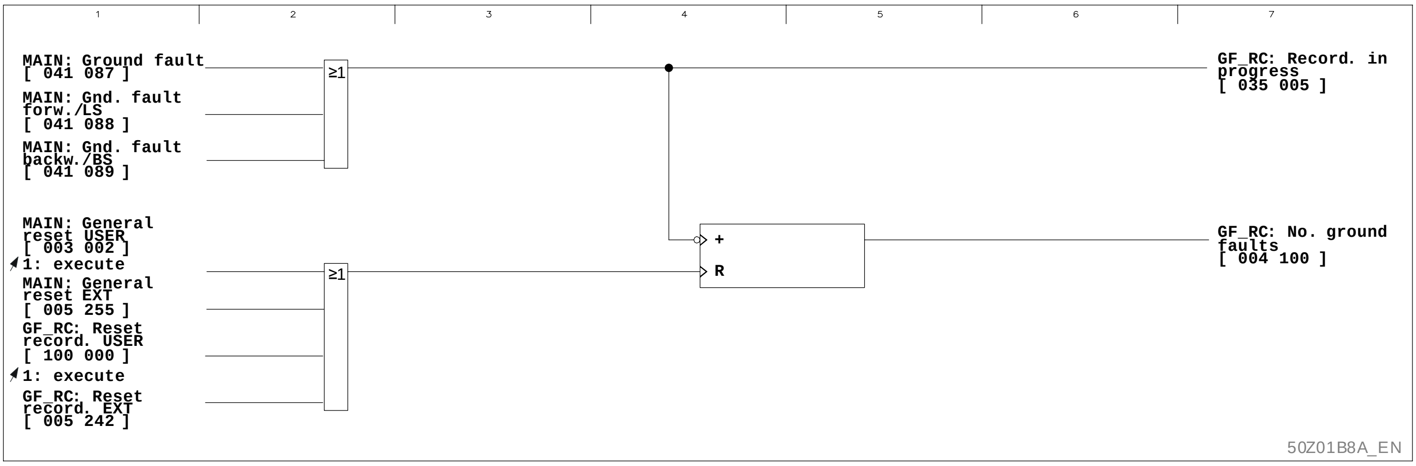
Start of ground fault recording

A fault exists, and therefore fault recording begins, if at least one of the following conditions is met:

- ☐ A ground fault has been detected by the GFDSS function (ground fault direction determination using steady-state values).
- ☐ A ground fault has been detected by transient ground fault direction determination.

Ground fault counting

The ground faults are counted and identified by sequential number.



3-102 *Ground fault counting*

Time tagging

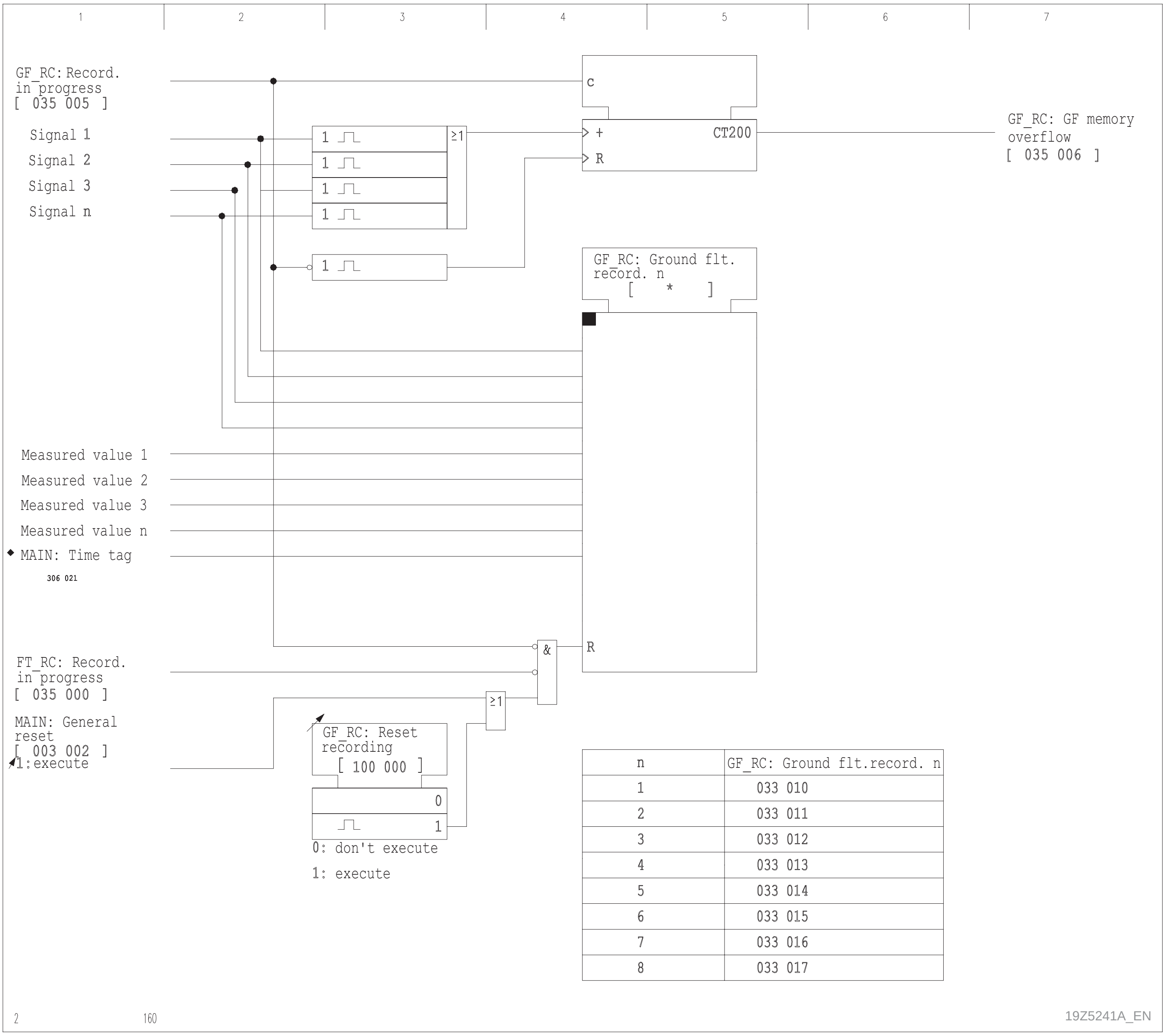
The date that is assigned to each ground fault by the internal clock is stored. A ground fault's individual start or end signals are likewise time-tagged by the internal clock. The date and time assigned to a ground fault event when the event begins can be read out from the ground fault memory on the local control panel or through the PC and communication interfaces. The time information (relative to the onset of the ground fault event) that is assigned to the signals can be retrieved from the ground fault memory or through the PC or communication interfaces.

Ground fault logging

Protection signals issued during a ground fault are logged in chronological order with reference to the specific ground fault. A total of eight ground fault logs, each involving a maximum of 200 start or end signals, can be stored in the non-volatile ground fault memories. After eight ground faults have been logged, the oldest ground fault log will be overwritten, unless memories have been cleared in the interim. If more than 199 start or end signals have occurred during a single ground fault, then GF_RC: GF memory overflow will be entered as the last signal.

In addition to the signals, the measured ground fault data are also entered in the ground fault memory.

The ground fault recordings can be read from the local control panel or through the PC or communication interfaces.



n	GF_RC: Ground flt.record. n
1	033 010
2	033 011
3	033 012
4	033 013
5	033 014
6	033 015
7	033 016
8	033 017

3-103 Ground fault memory

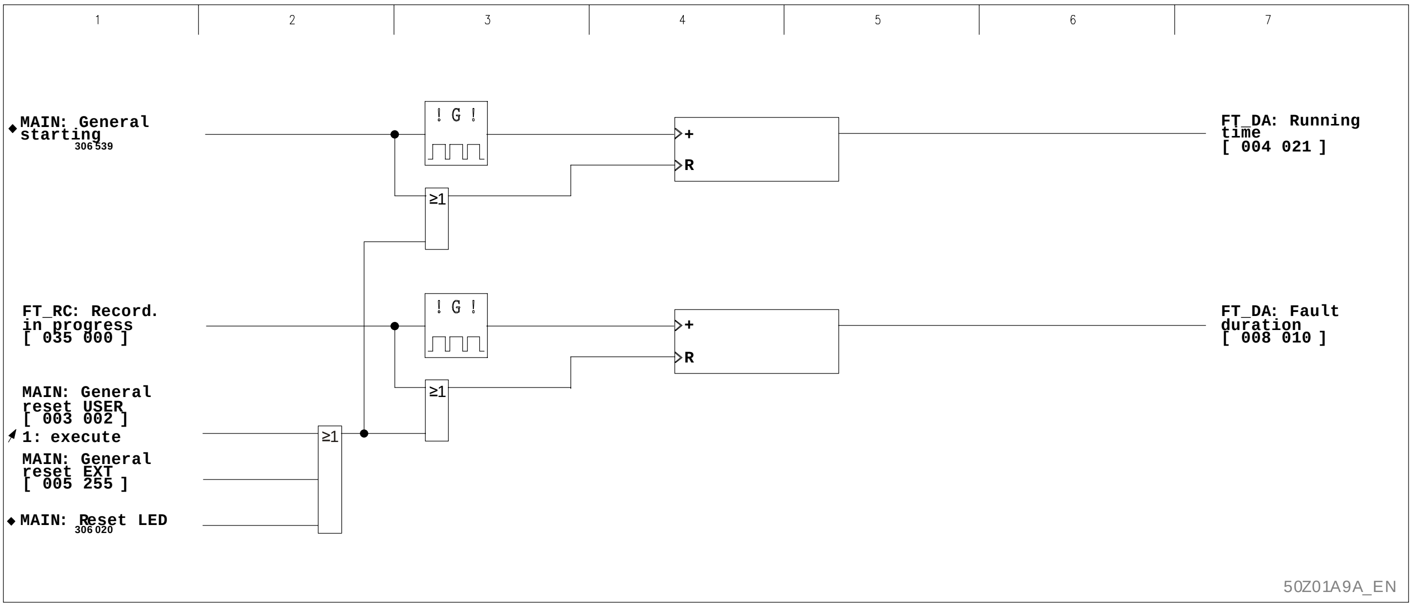
3.21 Fault Data Acquisition (Function Group FT_DA)

When there is a fault in the system, the P132 collects the following measured fault data:

- ☐ Running time
- ☐ Fault duration
- ☐ Fault current (short-circuit current)
- ☐ Fault voltage (short-circuit voltage)
- ☐ Short-Circuit Impedance
- ☐ Fault reactance (short-circuit reactance) in percent of line reactance and in Ω
- ☐ Fault angle
- ☐ Fault distance
- ☐ Ground fault current
- ☐ Ground fault angle
- ☐ Fault location in %
- ☐ Fault location in km

Running time and fault duration

The running time is defined as the time between the start and end of the general starting signal that is generated within the P132, and the fault duration is defined as the time between the start and end of the FT_RC: Record. in progress signal.



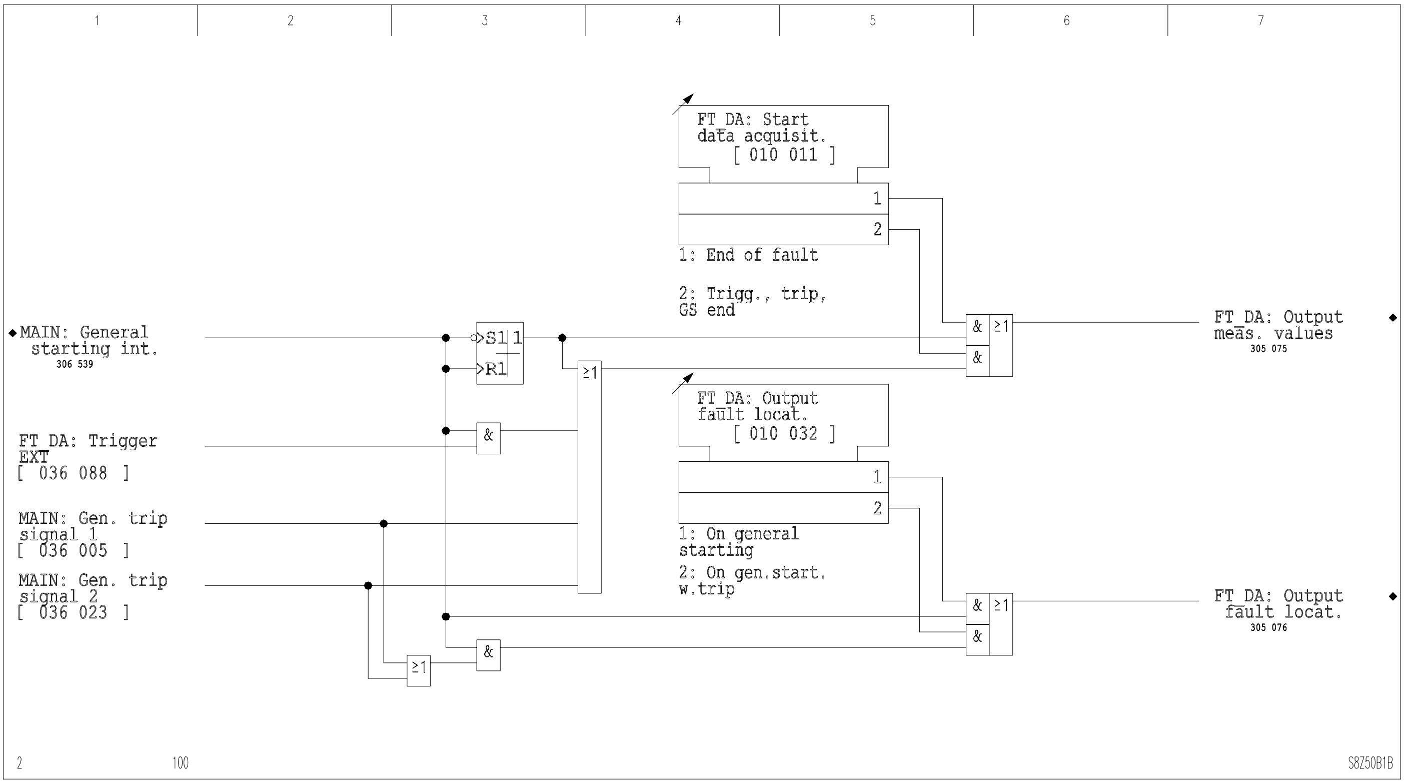
3-104 *Running time and fault duration*

Fault data acquisition time

The FT_DA: Start data acqu. setting governs the point during a fault at which the measured fault data are acquired. The following settings are possible:

- *End of fault*
  Acquisition at the end of the fault.
- *Trigg./Trip/GS end*
  Acquisition at one of the following points:
  - Triggering of an appropriately configured binary signal input during a general starting state
  - Issue of a general trip signal
  - End of a general starting state

Output of fault location occurs – depending on the setting – either when there is a general starting signal or when there is both a general starting signal and a simultaneous general trip signal.

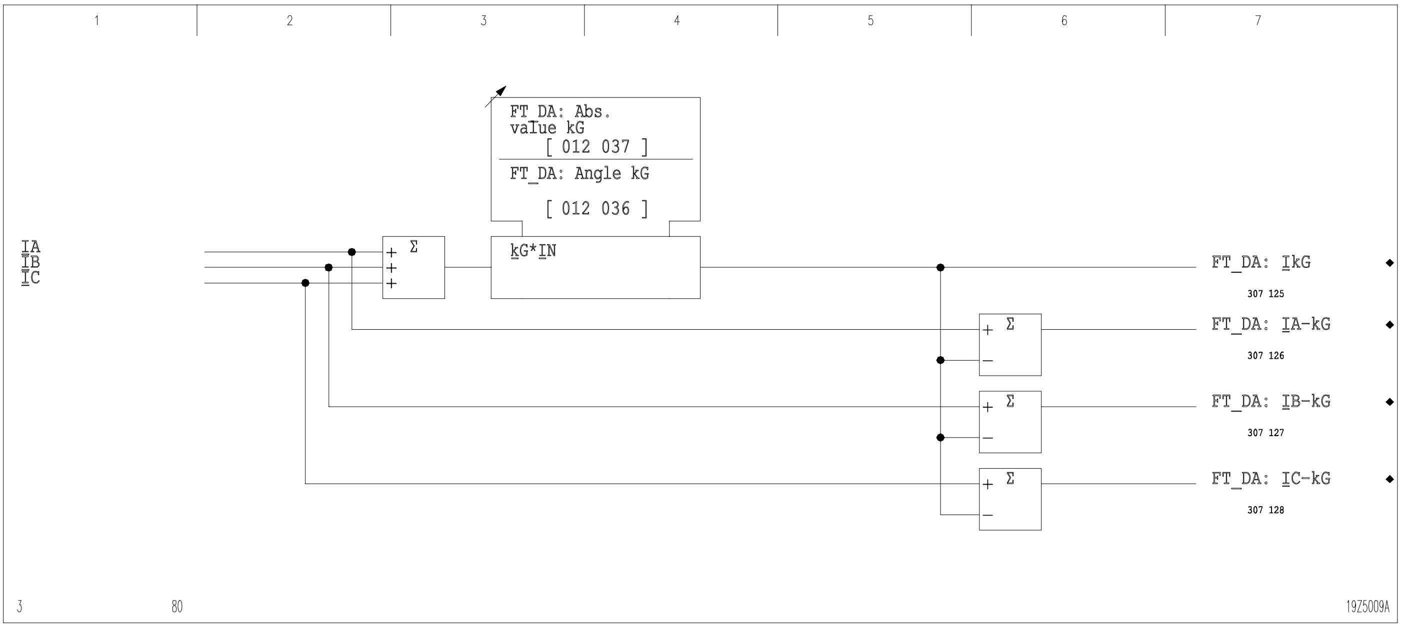


3-105 Enabling of measured fault data acquisition and fault location output

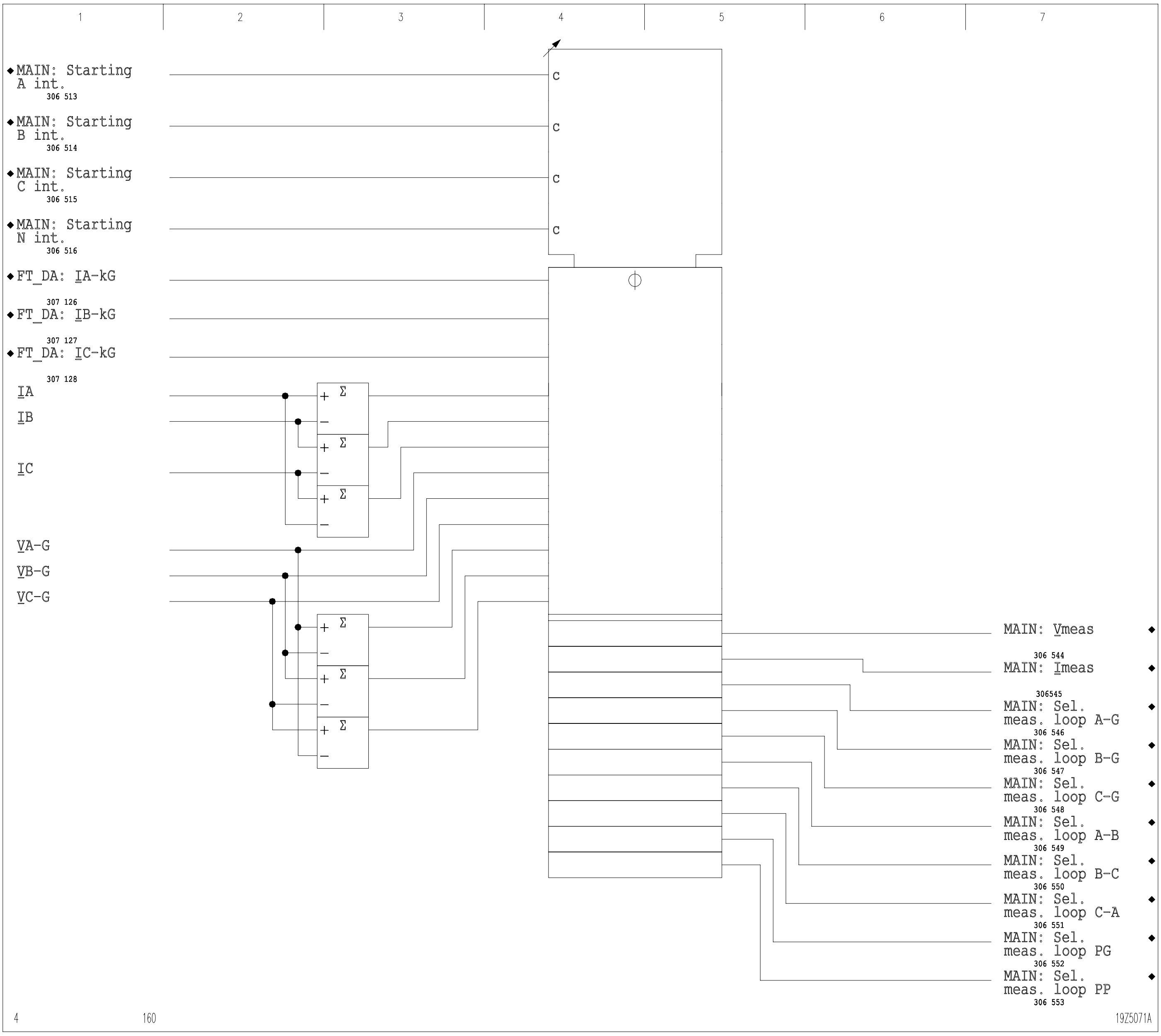
Acquisition of measured fault data

The P132 selects a measuring loop based on the phase-selective starting decision. The short-circuit impedance (fault impedance) and fault direction are determined from this measuring loop's voltage and current. In the case of single-pole starting with ground fault detection, the currents corrected by the ground factor are selected as measured variables. In the case of three-phase starting, either grounded or ungrounded, the minimum voltage of the phase-to-phase voltages and the associated phase-to-phase current are selected as measured variables.

Fault Detection	Variables Selected for Measurement
A	IA-kG / VA-G
B	IB-kG / VB-G
C	IC-kG / VC-G
A-G	IA-kG / VA-G
B-G	IB-kG / VB-G
C-G	IC-kG / VC-G
A-B	IA-B / VA-B
B-C	IB-C / VB-C
C-A	IC-A / VC-A
A-B-G	IA-B / VA-B
B-C-G	IB-C / VB-C
C-A-G	IC-A / VC-A
A-B-C	IP-P(min) / VP-P (min)
A-B-C-G	IP-P(min) / VP-P (min)



3-106 Formation of currents corrected by ground factor



3-107 Selection of measured variables for fault data acquisition

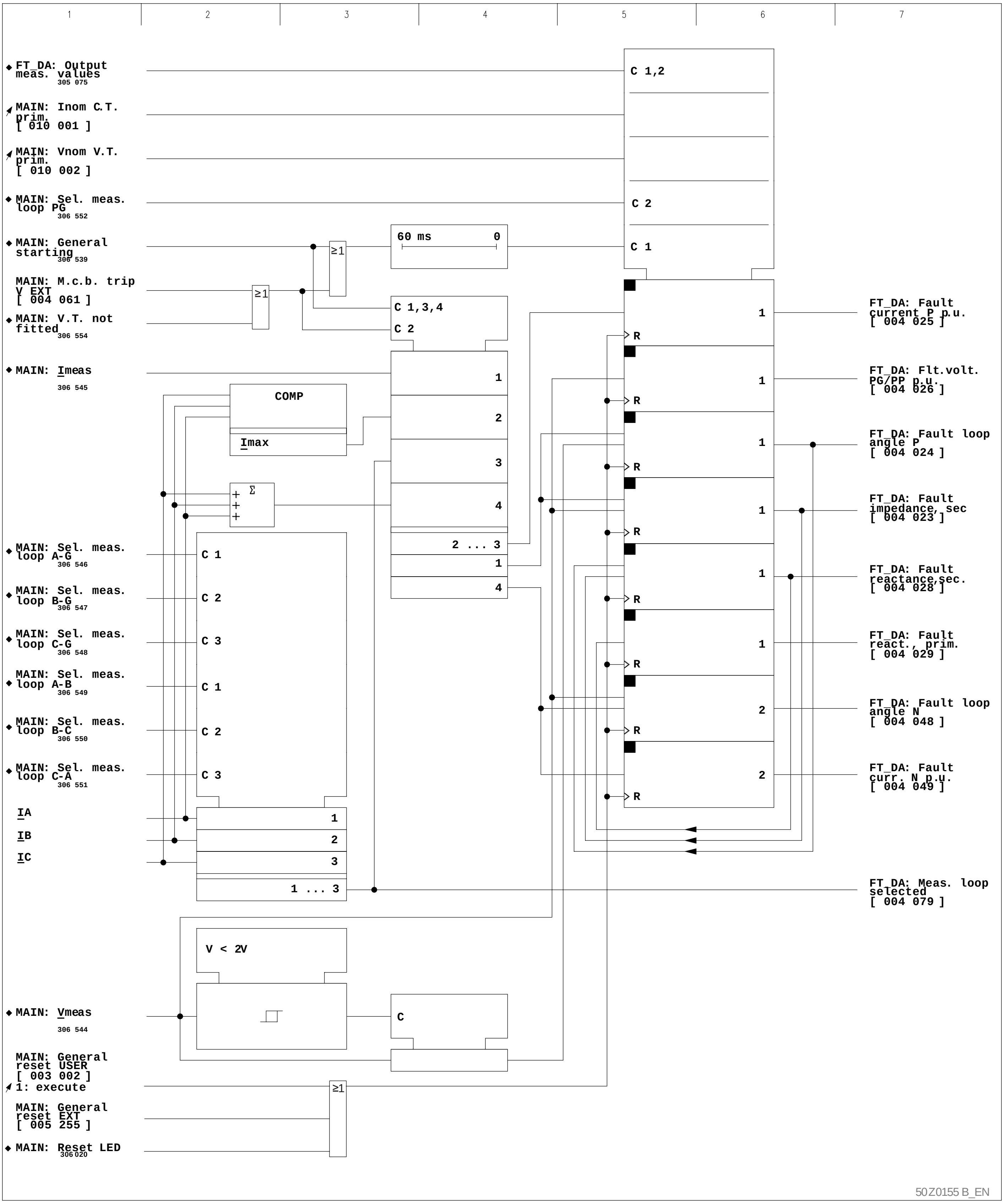
The fault must last for at least 60 ms so that the fault data can be determined.

The fault data are determined using the measured variables $\underline{I}_{meas}$ and $\underline{V}_{meas}$ selected by measured variable selection, if the fault is detected by fault data acquisition. One phase current is selected as the fault current in accordance with the measuring loop selected. In the case of multi-phase starting this is the current of the leading phase in the cycle. The primary fault reactance is calculated from the per-unit fault reactance using the nominal data for the set primary current and voltage transformers.

The ground fault data are only determined if a phase-to-ground loop has been selected for measurement in conjunction with the fault data acquisition function. The vector sum of the three phase currents is displayed as the ground fault current. The ground fault angle is the phase displacement between ground fault current and selected measuring voltage.

If there is an m.c.b. trip signal or the transformer module is not fitted with a voltage transformer, then only fault current is determined, and the maximum phase current is displayed.

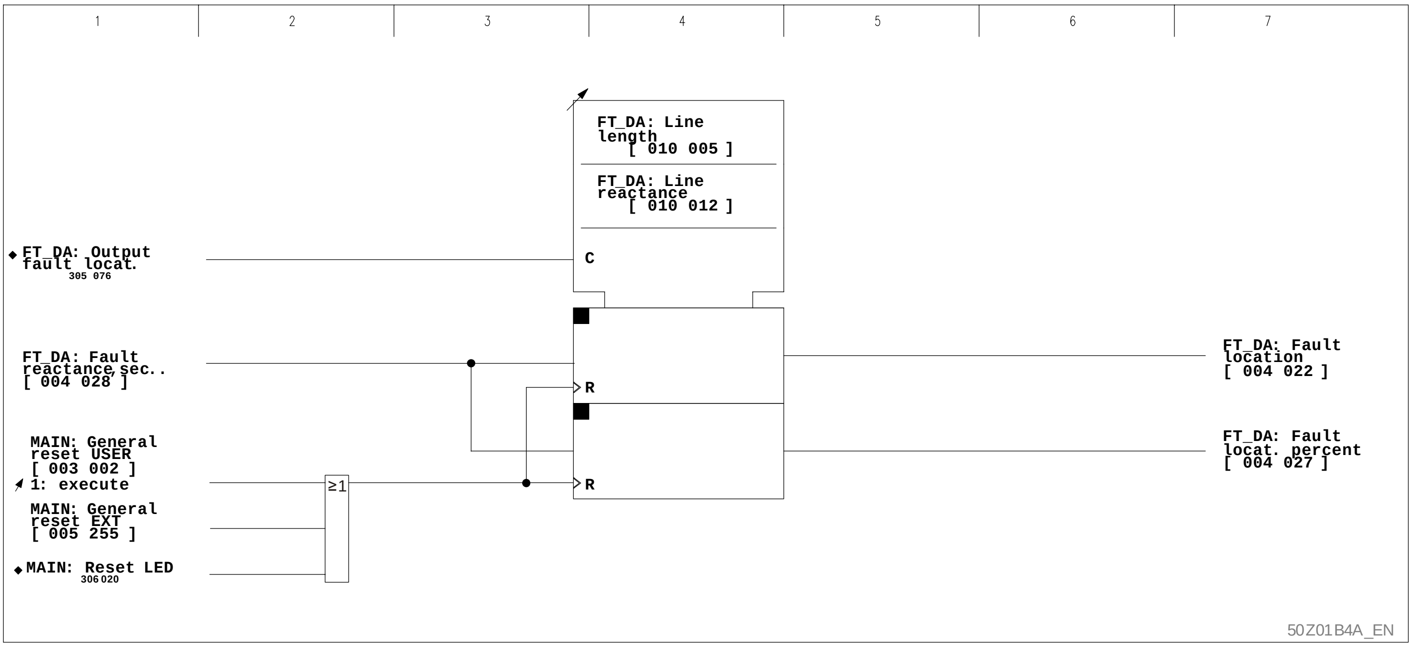
Fault current and voltage are displayed as per-unit quantities referred to I_{nom} and V_{nom}. If the measured or calculated values are outside the acceptable measuring range, the '*Overflow*' indication is displayed.



3-108 *Acquisition of fault data (short-circuit data)*

Acquisition of fault location

In order for the fault location to be determined in percent of line length and in km, the user must enter two settings in the P132: the value of the line reactance that corresponds to 100% of the line section being monitored and the value of the corresponding line length in km.



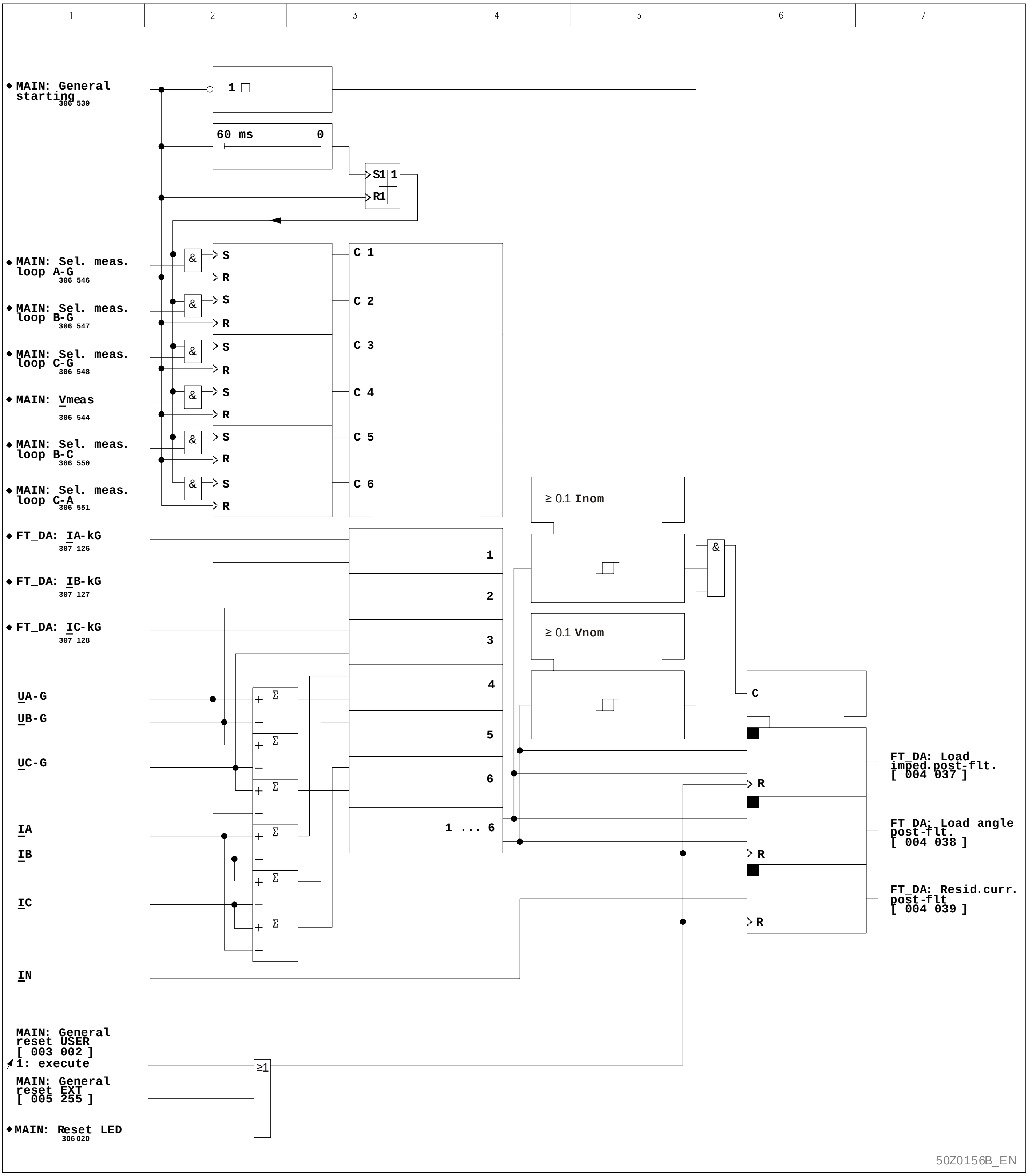
3-109 Acquisition of fault location

Acquisition of load data

In addition to fault data and fault location, the following load data are determined when the general starting signal drops out:

- ☐ Load impedance
- ☐ Load angle
- ☐ Residual current

The same measuring loop used to determine fault impedance is used to determine load impedance and load angle. The load current and the voltage must exceed the thresholds 0.1 I_{nom} and 0.1 V_{nom}, respectively, in order for the load data to be determined. If the thresholds are not reached or if the general starting signal does not last as long as 60 ms, the display '*Not measured*' appears.



3-110 Acquisition of load data

Fault data reset

After the reset key ‘C’ on the local control panel is pressed, the fault data value is displayed as ‘*Not measured*’. However, the values are not erased and can continue to be read out through the PC and communication interfaces.

3.22 Fault Recording (Function Group FT_RC)

Start of fault recording

A fault exists, and therefore fault recording begins, if at least one of the following signals is present:

☐ MAIN: General starting

☐ MAIN: Gen. Trip signal 1

☐ MAIN: Gen. trip signal 2

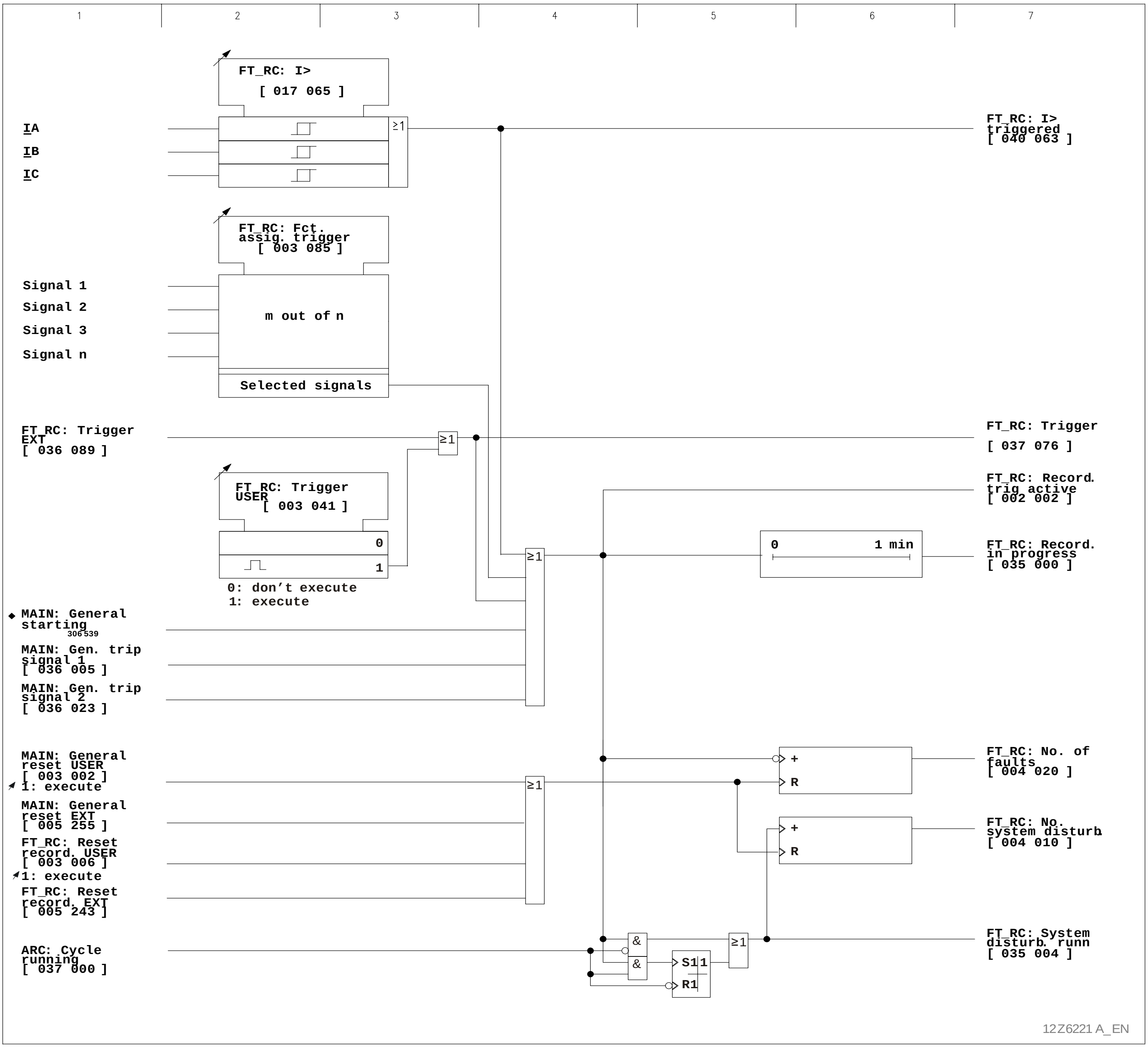
☐ FT_RC: Trigger

☐ FT_RC: I>

In addition, the user can set an 'm out of n' parameter in order to configure signals whose appearance will trigger fault recording.

Fault counting

Faults are counted and identified by sequential number.



3-111 *Start of fault recording and fault counter*

Time tagging

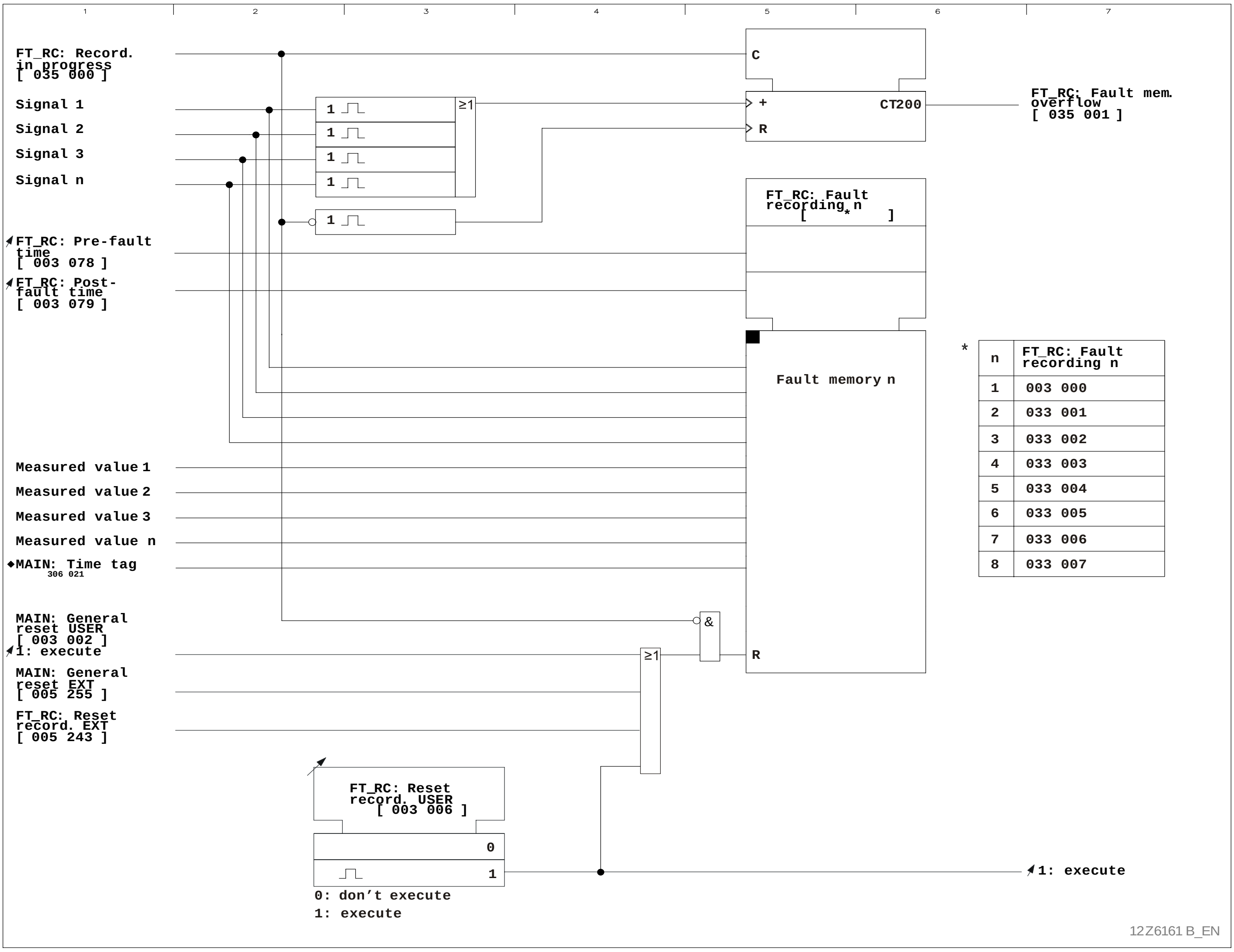
The date that is assigned to each fault by the internal clock is stored. A fault's individual start or end signals are likewise time-tagged by the internal clock. The date and time assigned to a fault when the fault begins can be read out from the fault memory on the local control panel or through the PC and communication interfaces. The time information (relative to the onset of the fault) that is assigned to the signals can be retrieved from the fault memory or through the PC or communication interfaces.

Fault recordings

Protection signals during a fault, including the signals during the settable pre-fault and post-fault times, are logged in chronological order with reference to the specific fault. A total of eight faults, each involving a maximum of 200 start or end signals, can be stored in the non-volatile fault memories. After eight faults have been recorded, the oldest fault recording will be overwritten, unless memories have been cleared in the interim. If more than 199 start or end signals have occurred during a single fault, then `FT_RC: Fault mem. overflow` will be entered as the last signal. If the time and date are changed during the pre-fault time, the signal `FT_RC: Faulty time tag` is generated.

In addition to the fault signals, the measured fault data are also entered in the fault memory.

The fault recordings can be read from the local control panel or through the PC or communication interfaces.



n	FT_RC: Fault recording n
1	003 000
2	033 001
3	033 002
4	033 003
5	033 004
6	033 005
7	033 006
8	033 007

3-112 *Fault memory*

Fault value recording

The following analog signals are recorded:

☐ Phase currents

☐ Phase-to-ground voltages

☐ Residual current, measured by the P132 at the T 4 transformer

☐ Neutral-displacement voltage, measured by the P132 at the T 90 transformer

☐ Reference voltage V_{ref} (when a synchrocheck VT is fitted).

The signals are recorded before, during and after a fault. The times for recording before and after the fault can be set. A maximum time period of 16.4 s is available for recording. This period can be divided among a maximum of eight faults. The maximum recording time per fault can be set. If a fault, including the set pre-fault and post-fault times, lasts longer than the set maximum recording time, then recording will terminate when the set maximum recording time is reached.

The pre-fault time is exactly adhered to if it is shorter than the set maximum recording time. Otherwise; the pre-fault time is set to the maximum recording time minus a sampling increment, and the post-fault time is set to zero.

If the maximum recording time of 16.4 s is exceeded, the analog values for the oldest fault are overwritten, but not the binary values. If more than eight faults have occurred since the last reset, then all data for the oldest fault are overwritten.

The analog data of the fault record can only be read out through the PC or communication interfaces.

When the supply voltage is interrupted or after a warm restart, the values of all faults remain stored.

3-113 Fault value recording

3.23 Definite-Time Overcurrent Protection (Function Group DTOC)

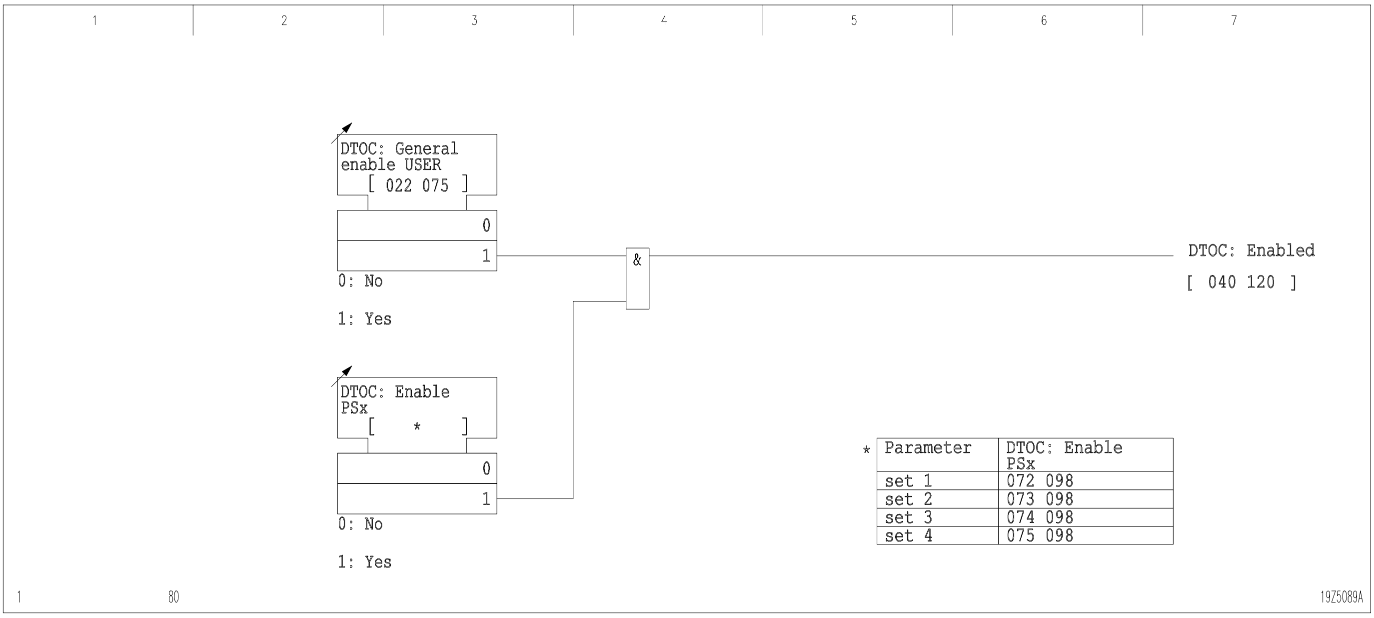
A three-stage definite-time overcurrent protection function (DTOC protection) is available in the P132. Three separate measuring systems are available for this purpose for:

- ☐ Phase currents system
- ☐ Negative-sequence current system
- ☐ Residual currents system

Either the short-circuit direction determination function (SCDD) or the auto-reclosing control may intervene in the functional sequence of the DTOC function.

Enabling or disabling DTOC protection

DTOC protection can be disabled or enabled via parameter settings. Moreover, enabling can be carried out separately for each parameter subset.



*

Parameter	DTOC: Enable PSx
set 1	072 098
set 2	073 098
set 3	074 098
set 4	075 098

3-114 *Disabling or enabling DTOC protection*

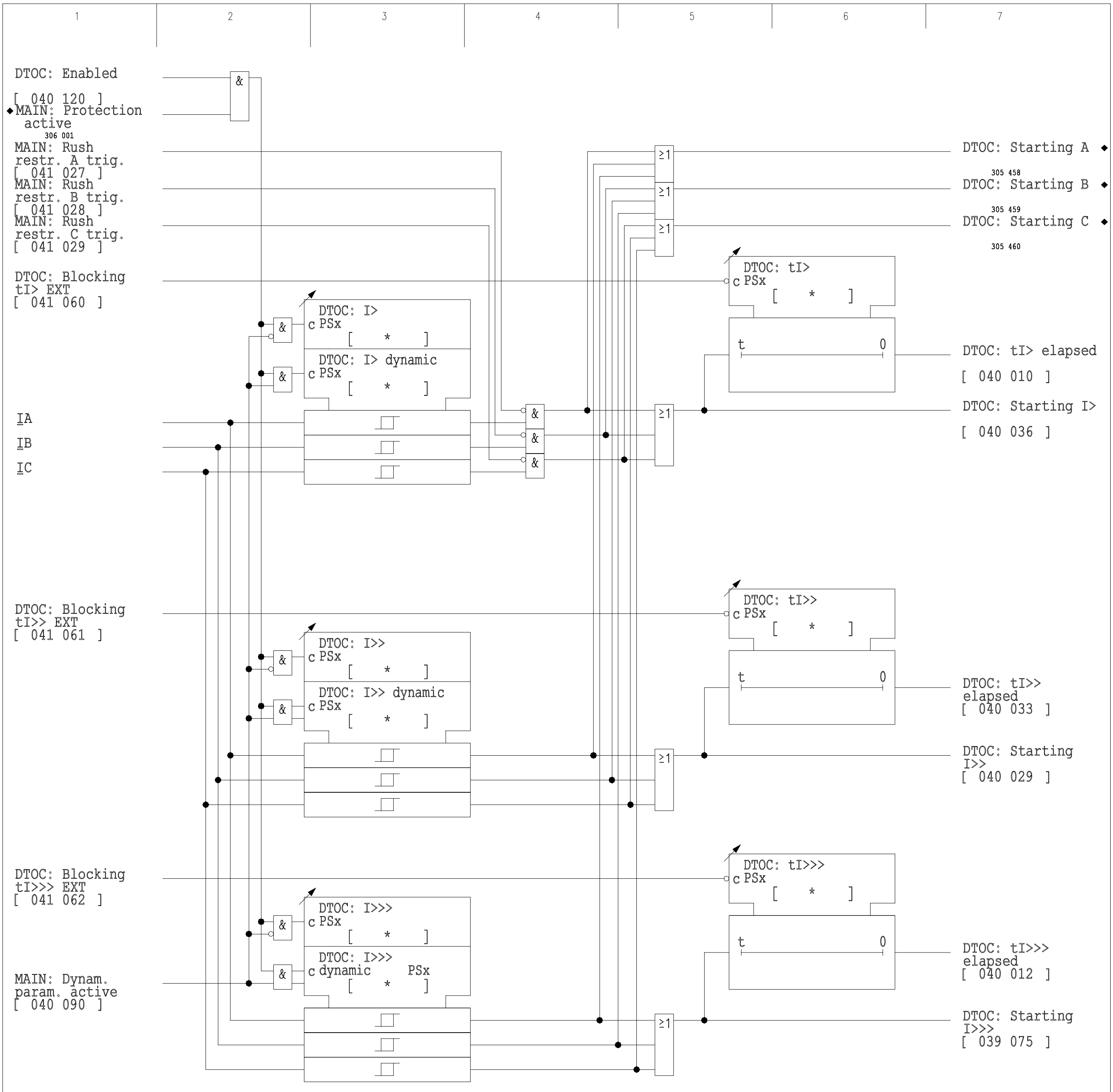
Phase current stages

The three phase currents are monitored by the P132 with three-stage functions to detect when they exceed the set thresholds. Alternatively, two different threshold types can be active. The "dynamic" thresholds are active for the set hold time (see section ‘Activation of Dynamic Parameters’) and the "normal" thresholds are active when no hold time is running. If the current exceeds the set thresholds in one phase, timer stages are started and after the time periods have elapsed, a signal is issued. The timer stages can be blocked by appropriately configured binary signal inputs.

When the inrush stabilization function (see: ‘Main Functions of the P132’) is triggered, the 1st stage of the DTOC function is blocked.

The trip signals from all phase current stages are blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.

The trip signals from the DTOC function (stages I> and I>> only) can be blocked by the short-circuit direction determination function. Depending on the setting of the short-circuit direction determination function, the trip signal of stages I> or I>> will be enabled.

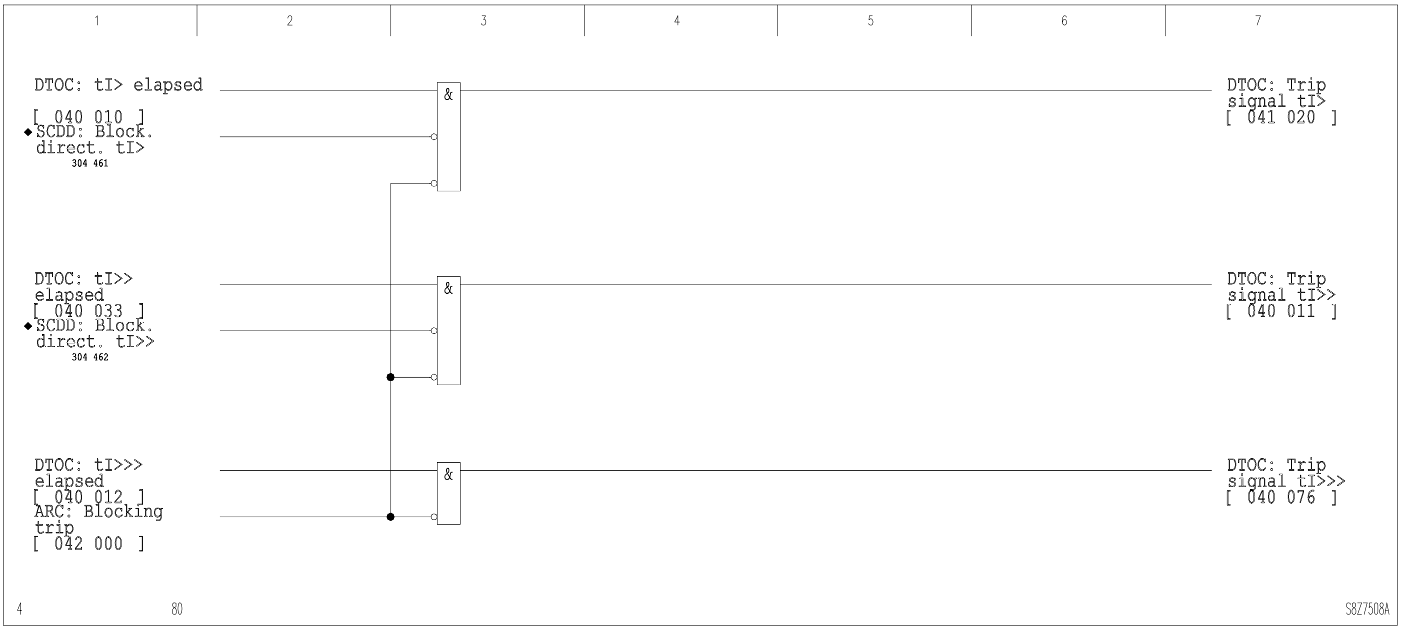


* Parameter	DTOC: I> PSx	DTOC: I> dynamic PSx	DTOC: I>> PSx	DTOC: I>> dynamic PSx
set 1	017 000	017 080	017 001	017 084
set 2	073 007	073 032	073 008	073 033
set 3	074 007	074 032	074 008	074 033
set 4	075 007	075 032	075 008	075 033

* Parameter	DTOC: I>>> PSx	DTOC: I>>> dynamic PSx	DTOC: tI> PSx	DTOC: tI>> PSx	DTOC: tI>>> PSx
set 1	017 002	017 085	017 004	017 006	170 007
set 2	073 009	073 034	073 019	073 020	073 021
set 3	074 009	074 034	074 019	074 020	074 021
set 4	075 009	075 034	075 019	075 020	075 021

2 220 S8Z7507A

3-115 Phase current stages



3-116 *Trip signals from the DTOC phase current stages*

Negative-sequence current stages

The P132 calculates the negative-sequence current from the three phase current values according to this formula. The result depends on the set phase sequence (alternative terminology: Rotary field).

Phase sequence A-B-C
(alternative terminology:
clockwise rotary field)

$$\underline{I}_{neg} = \frac{1}{3} \cdot \left| \left(\underline{I}_A + \underline{a}^2 \cdot \underline{I}_B + \underline{a} \cdot \underline{I}_C \right) \right|$$

Phase sequence A-C-B
(alternative terminology:
anti-clockwise rotary field)

$$\underline{I}_{neg} = \frac{1}{3} \cdot \left| \left(\underline{I}_A + \underline{a} \cdot \underline{I}_B + \underline{a}^2 \cdot \underline{I}_C \right) \right|$$

$$\underline{a} = e^{j120°}$$

$$\underline{a}^2 = e^{j240°}$$

The negative-sequence current is monitored by the P132 with three-stage functions to detect when it exceeds the set thresholds. Alternatively, two different threshold types can be active. The "dynamic" thresholds are active for the set hold time for the "dynamic parameters" (see section ‘Activation of Dynamic Parameters’) and the "normal" thresholds are active when no hold time is running. If the current exceeds the set thresholds, timer stages are started and after the time periods have elapsed, a trip signal is issued.

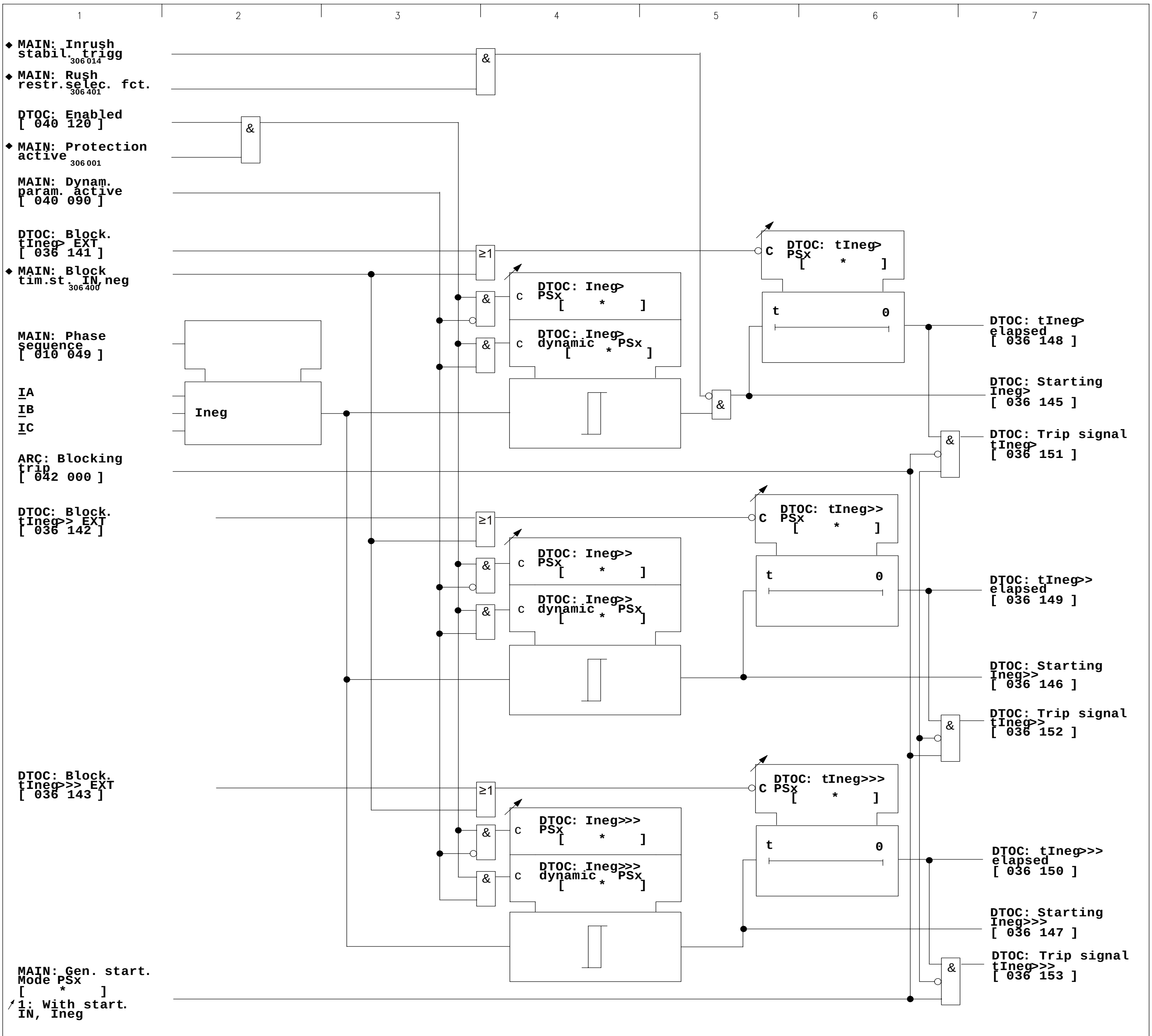
The timer stages can be blocked by appropriately configured binary signal inputs. In addition these timer stages can also be automatically blocked by single-pole or multi-pole starting (depending on the setting).

The trip signals from the negative-sequence current stages are only enabled if the operating mode for the general starting has been set to *"With starting IN, Ineg"*.

When the inrush stabilization function (see section ‘Main Functions of the P132’) is triggered, the 1st stage of the negative-sequence current function is blocked.

When the short-circuit direction determination function (SCDD) is active, trip signals from the DTOC negative-sequence current stages have no directional dependence.

The trip signals from all negative-sequence current stages are blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.



*

Parameter	DTOC: Ineg> PSx	DTOC: Ineg> dynamic PSx	DTOC: tIneg> PSx	DTOC: Ineg>> PSx	DTOC: Ineg>> dynamic PSx	DTOC: tIneg>> PSx
set 1	072 011	076 200	072 023	072 012	076 201	072 024
set 2	073 011	077 200	073 023	073 012	077 201	073 024
set 3	074 011	078 200	074 023	074 012	078 201	074 024
set 4	075 011	079 200	075 023	075 012	079 201	075 024

*

Parameter	DTOC: Ineg>>> PSx	DTOC: Ineg>>> dynamic PSx	DTOC: tIneg>>> PSx	MAIN: Gen. start. Mode PSx
set 1	072 013	076 202	072 025	017 027
set 2	073 013	077 202	073 025	001 219
set 3	074 013	078 202	074 025	001 220
set 4	075 013	079 202	075 025	001 221

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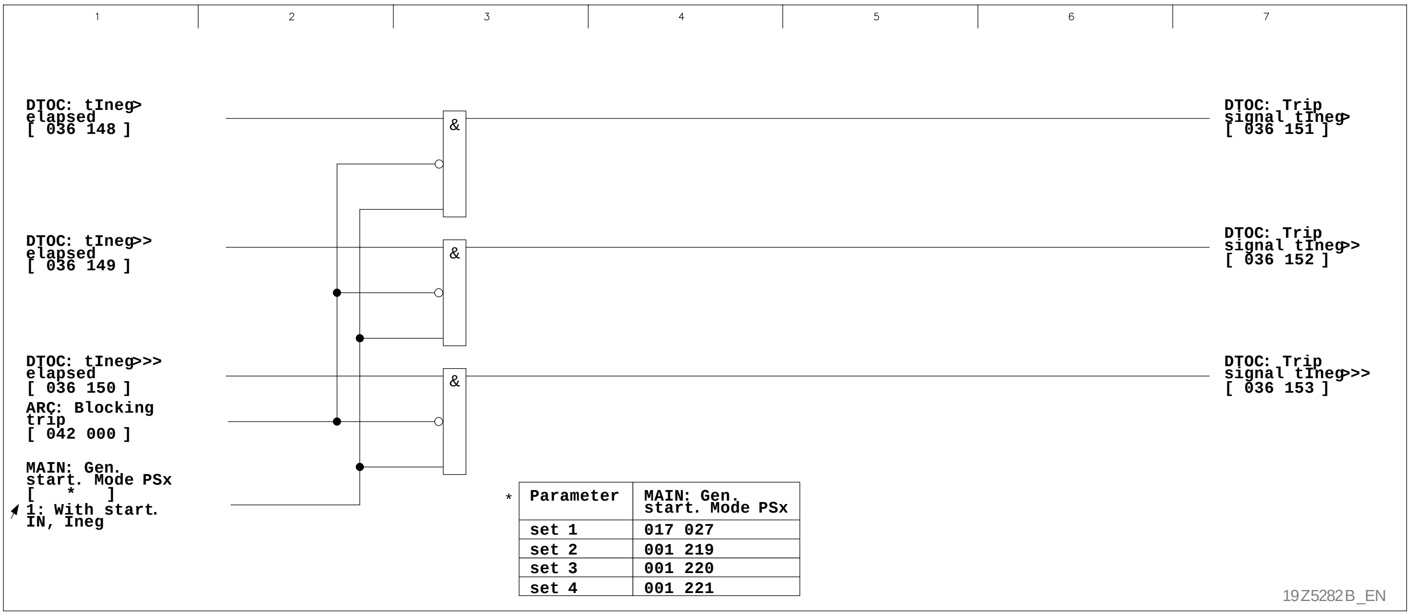
3-117 *Negative-sequence current stages*



Parameter	MAIN: Gen. start. Mode PSx
set 1	017 027
set 2	001 219
set 3	001 220
set 4	001 221

3-118 Trip signals from the DTOC negative-sequence current stages

Enable/disable the DTOC protection.

DTOC residual current stages can be disabled or enabled via setting parameters or through binary signal inputs.

Residual current stages

The residual current is monitored by the P132 with four-stage functions to detect when it exceeds the set thresholds. Alternatively, two different threshold types can be active. The "dynamic" thresholds are active for the set hold time (see section ‘Activation of Dynamic Parameters’) and the "normal" thresholds are active when no hold time is running. If the residual current exceeds the set thresholds, timer stages are started and after the time periods have elapsed, a signal is issued.

The timer stages can be blocked by appropriately configured binary signal inputs.
In addition these timer stages can also be automatically blocked by single-pole or multi-pole starting (depending on the setting).

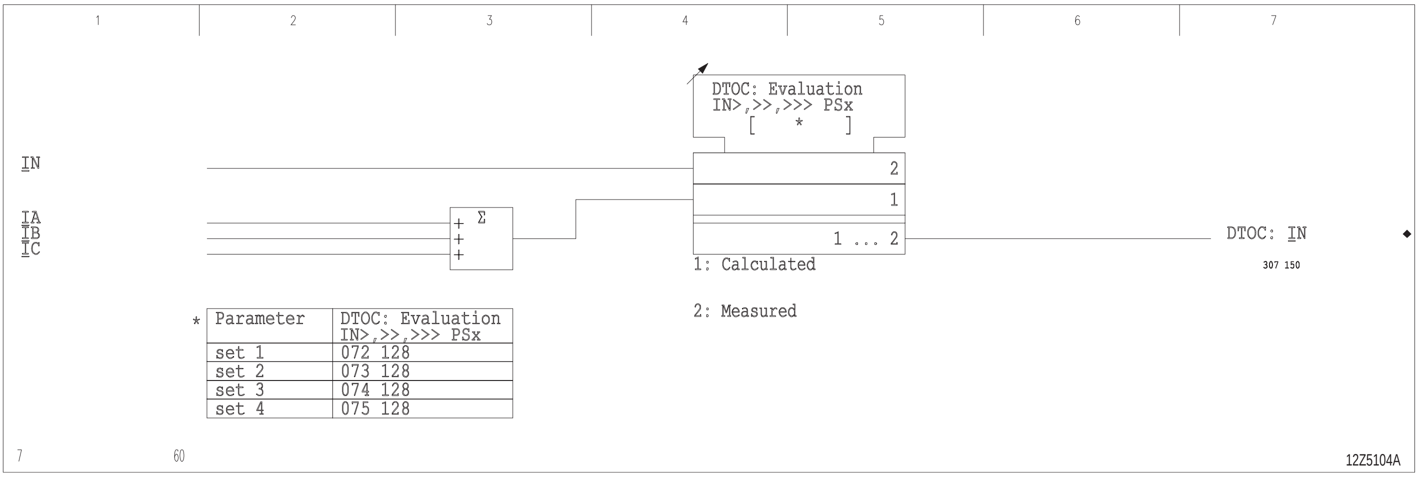
The trip signals from the residual current stages are only enabled if the operating mode for the general starting has been set to *"With starting IN, Ineg"*.

The trip signals from the residual current stages are blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.

The trip signals from the DTOC function (stages IN> and IN>> only) can be blocked by the short-circuit direction determination function (SCDD). Depending on the setting of the short-circuit direction determination function, the trip signal of stages IN> or IN>> will be enabled.

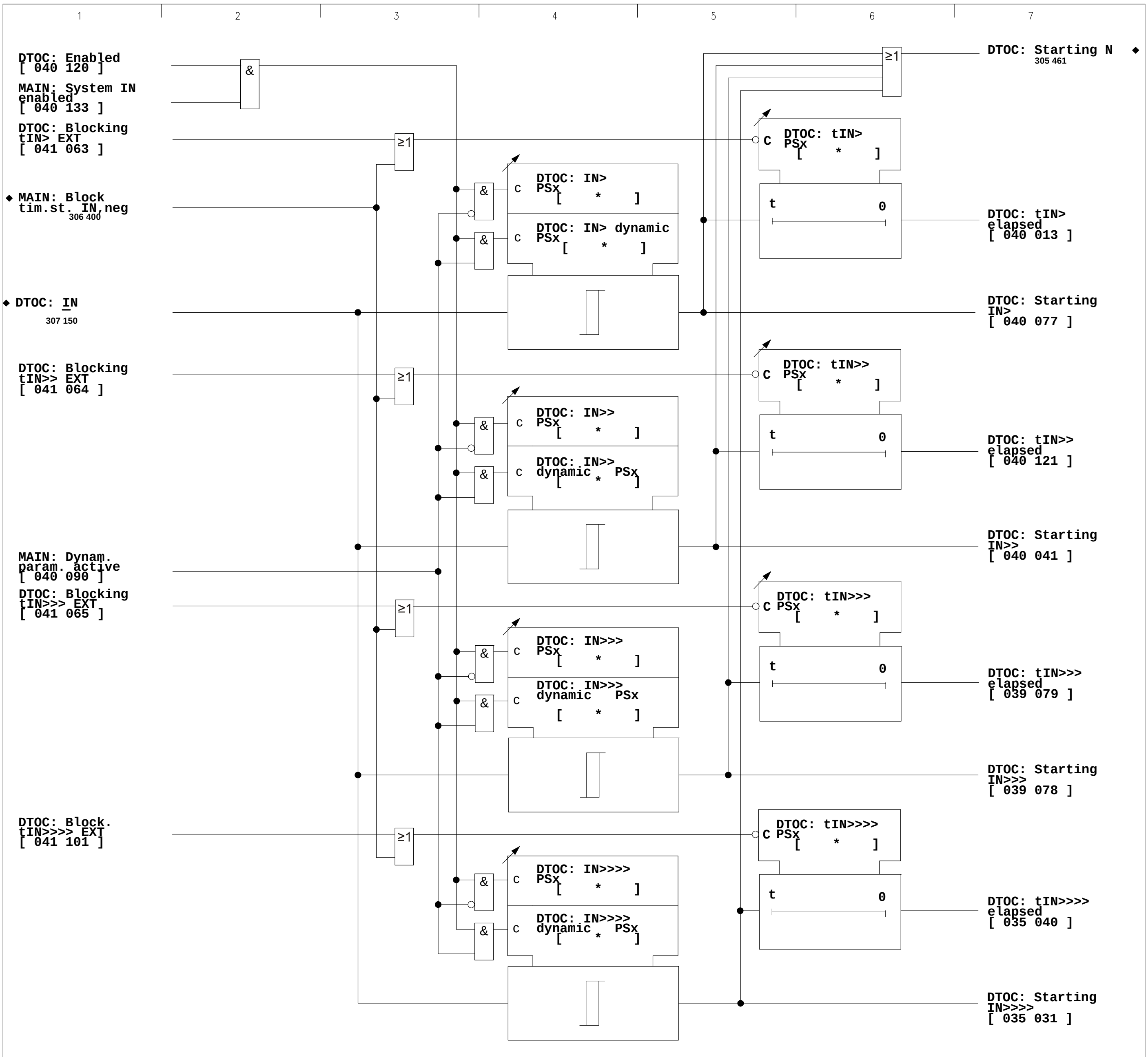
Selecting the measured variable

A setting specifies which current will be used by the P132 as the residual current of the stages IN>, IN>> AND IN>>>: either the residual current calculated from the three phase currents or the residual current directly measured at the fourth transformer (T 4).
For stage IN>>>> (available as of version –602) the calculated residual current is always used.



* Parameter	DTOC: Evaluation IN>,>>,>>> PSx
set 1	072 128
set 2	073 128
set 3	074 128
set 4	075 128

3-119 Selecting the measured variable



*

Parameter	DTOC: IN> PSx	DTOC: IN> dynamic PSx	DTOC: tIN> PSx	DTOC: IN>> PSx	DTOC: IN>> dynamic PSx	DTOC: tIN>> PSx
set 1	017 003	017 081	017 008	017 009	017 086	017 010
set 2	073 015	073 035	073 027	073 016	073 036	073 028
set 3	074 015	074 035	074 027	074 016	074 036	074 028
set 4	075 015	075 035	075 027	075 016	075 036	075 028

*

Parameter	DTOC: IN>>> PSx	DTOC: IN>>> dynamic PSx	DTOC: tIN>>> PSx	DTOC: IN>>>> PSx	DTOC: IN>>>> dynamic PSx	DTOC: tIN>>>> PSx
set 1	017 018	017 087	017 019	072 018	072 036	072 030
set 2	073 017	073 037	073 029	073 018	072 105	073 030
set 3	074 017	074 037	074 029	074 018	072 202	074 030
set 4	075 017	075 037	075 029	075 018	072 219	075 030

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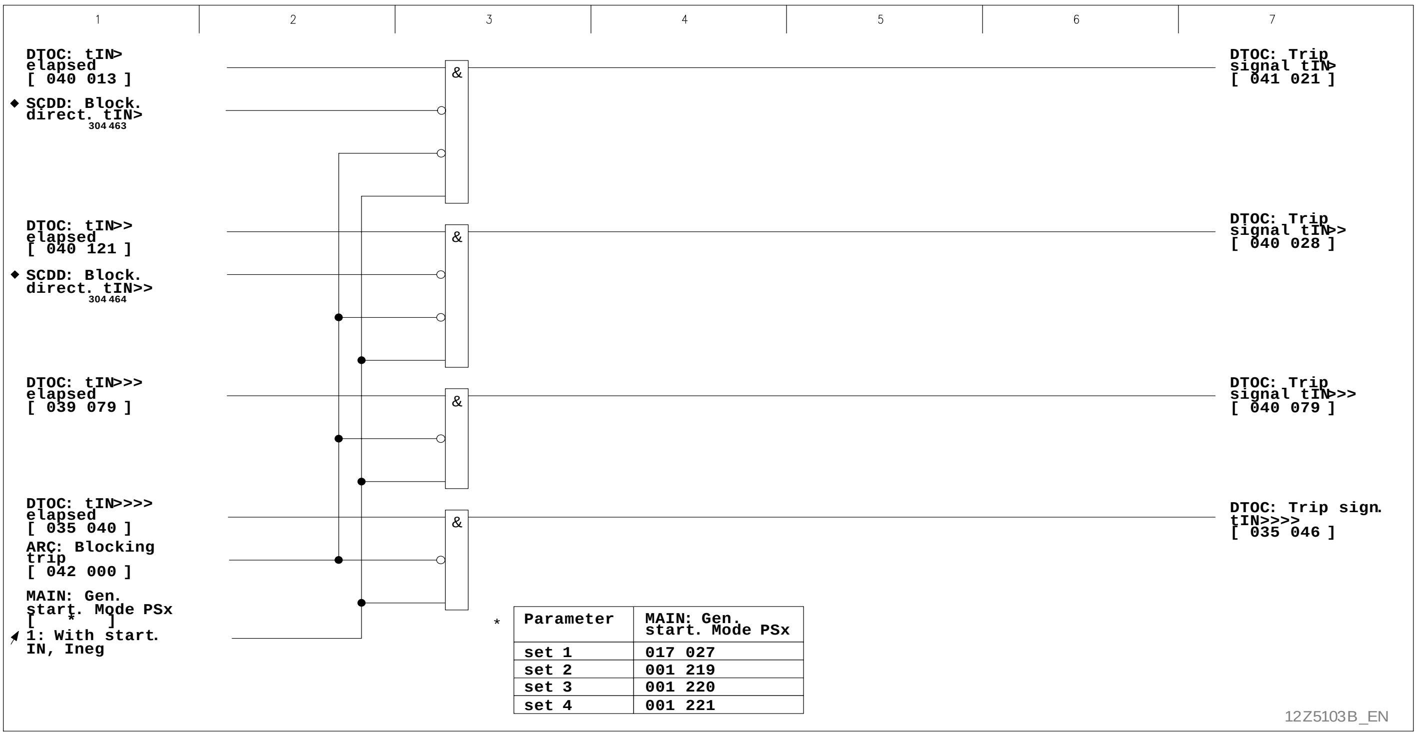
3-120 Residual current stages



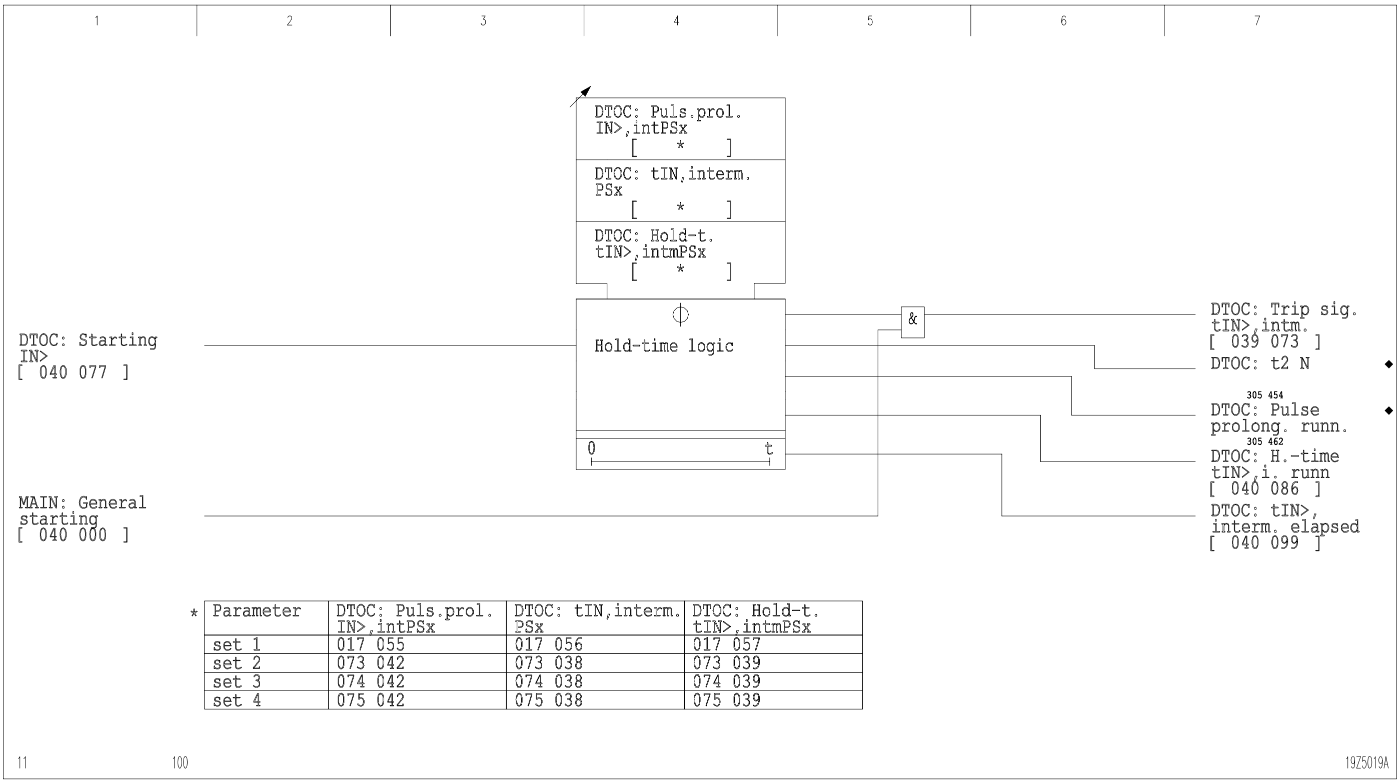
Parameter	MAIN: Gen. start. Mode PSx
set 1	017 027
set 2	001 219
set 3	001 220
set 4	001 221

3-121 *Trip signal from the DTOC residual current stages*

Hold-time logic for intermittent ground faults

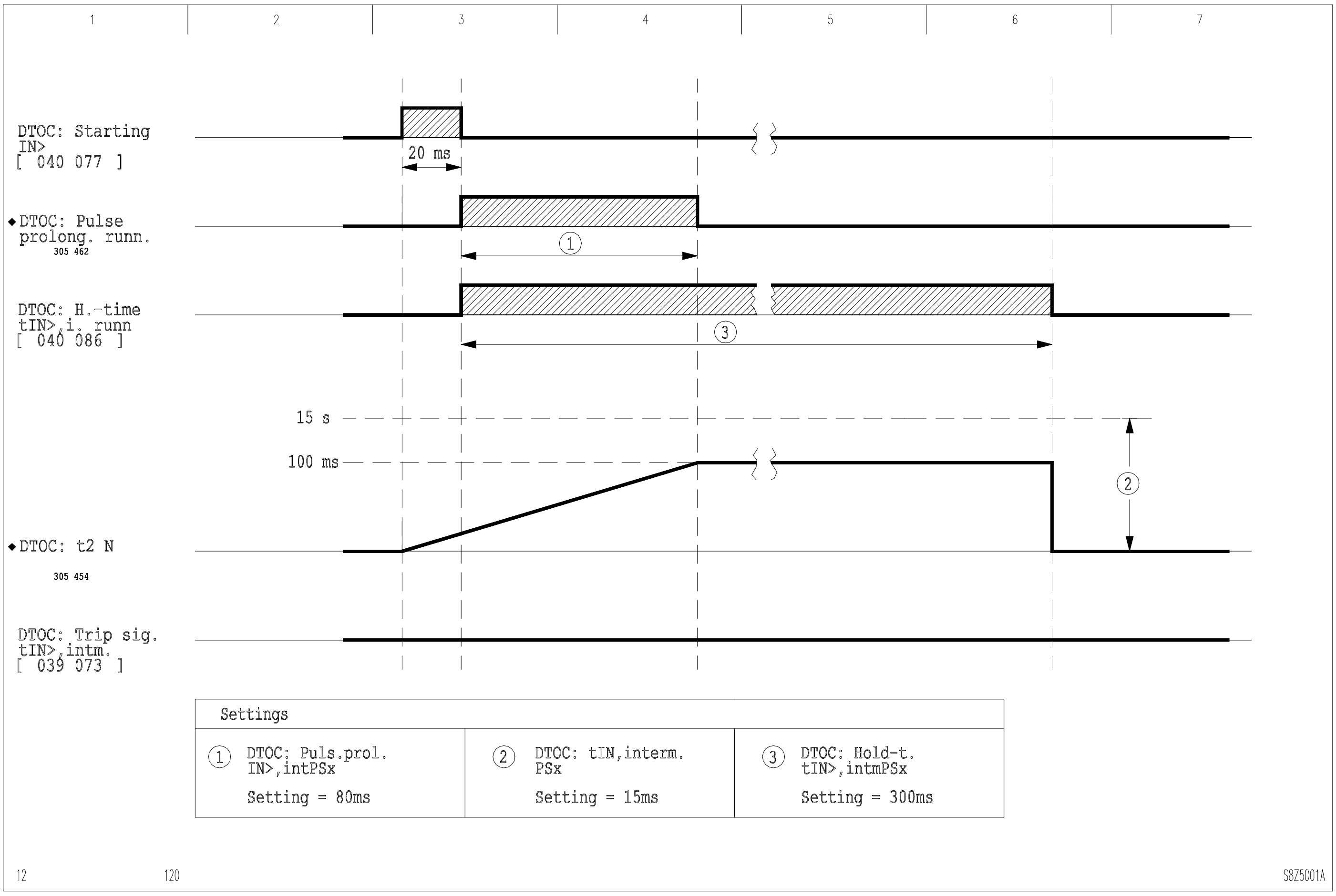
A hold-time logic for the treatment of intermittent ground faults is available in the P132.

- ☐ As the IN> starting in the residual current stage commences, the hold time is reset. At the same time, the starting time is accumulated when IN> starting commences.
- ☐ As IN> starting ends, the timer stage DTOC: Puls.prol.IN>,intPSx is started and the charging of the accumulation buffer is thereby lengthened by the set value of the timer stage.
- ☐ The accumulation result is compared with the settable limit value DTOC: tIN>, interm. PSx.
- ☐ If the limit value is reached and a general starting is present, then a trip results, provided that it is permitted by the relevant MAIN settings:
  - ■ MAIN: Block tim.st. IN,neg
    (Address 017 015)
  - ■ MAIN: Gen. starting mode
    (Address 017 027)
  - ■ MAIN: Fct.assig.trip cmd.1
    (Address 021 001)
  - ■ MAIN: Fct.assig.trip cmd.2
    (Address 021 002)
- ☐ If the limit value is reached while the timer stage DTOC: Puls.prol.IN>,intPSx is running, then a trip will occur when the next general starting phase commences.
- ☐ With each release of the trigger stage IN>, the set hold-time DTOC: Hold-t. tIN>,intmPSx is restarted. When the hold time has elapsed or after the hold-time logic has issued a trip (DTOC: Trip sig. tIN>,intm.), accumulation is stopped and the accumulation buffer is cleared.

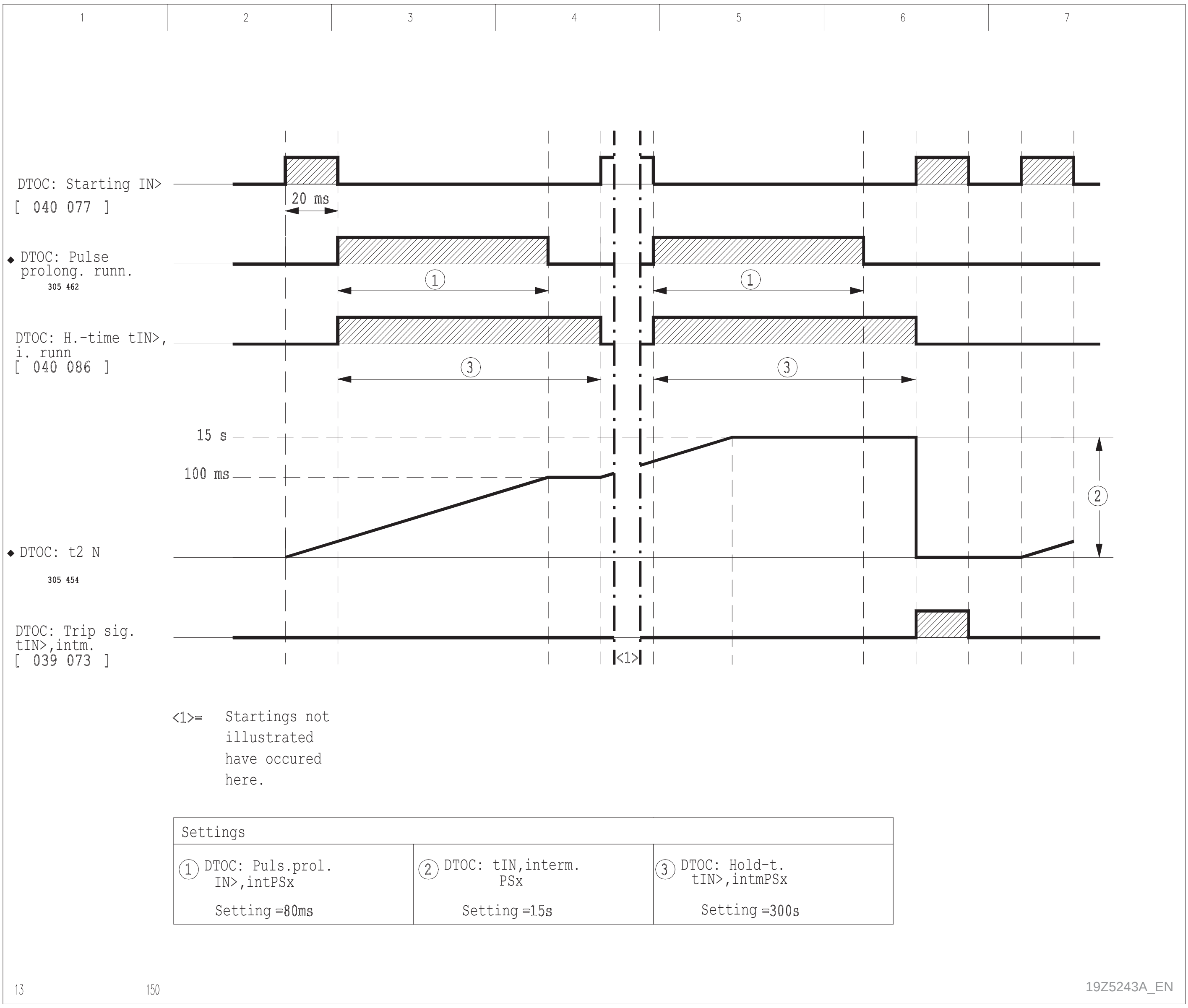


* Parameter	DTOC: Puls.prol. IN>,intPSx	DTOC: tIN,interm. PSx	DTOC: Hold-t. tIN>,intmPSx
set 1	017 055	017 056	017 057
set 2	073 042	073 038	073 039
set 3	074 042	074 038	074 039
set 4	075 042	075 038	075 039

3-122 Hold-time logic for definite-time characteristics



3-123 Signal flow for values below the accumulation limit value



<1>= Startings not illustrated have occured here.

Settings		
① DTOC: Puls.prol. IN>,intPSx Setting =80ms	② DTOC: tIN,interm. PSx Setting =15s	③ DTOC: Hold-t. tIN>,intmPSx Setting =300s

3-124 *Signal flow for values at the accumulation limit value*

3.24 Inverse-time Overcurrent Protection (Function Groups IDMT1 and IDMT2)

Note:

☞ In this section IDMT represents IDMT1.

This description is also valid for IDMT2 (if there is no indication to the contrary).

The addresses given apply to IDMT1. The addresses for function group IDMT2 are given in chapters 7 and 8.
For example, the address for IDMT1: General enable USER is 017 096 (given in the following picture), but the address for IDMT2: General enable USER is 017 052.

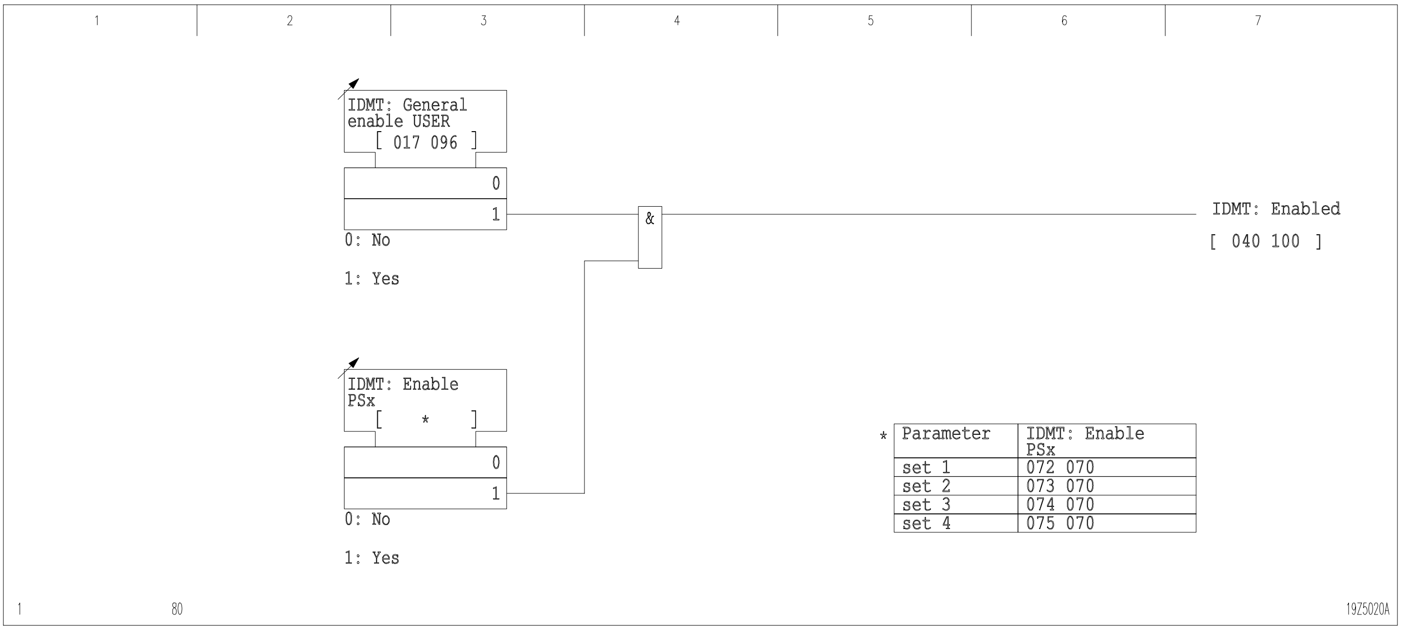
The inverse-time overcurrent protection function (IDMT) operates with three separate measuring systems for:

- ☐ Phase currents system
- ☐ Negative-sequence current
- ☐ Residual current.

Either the short-circuit direction determination function (SCDD) or the auto-reclosing control function may intervene in the functional sequence of the IDMT function.

Disabling or enabling IDMT protection

IDMT protection can be disabled or enabled via parameter settings. Moreover, enabling can be carried out separately for each parameter subset.



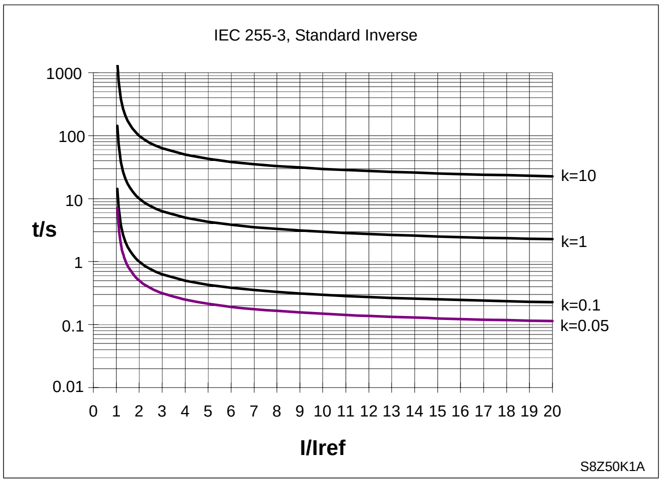
Parameter	IDMT: Enable PSx
set 1	072 070
set 2	073 070
set 3	074 070
set 4	075 070

3-125 *Disabling or enabling IDMT protection (IDMT represents IDMT1 and IDMT2; the addresses apply to IDMT1.)*

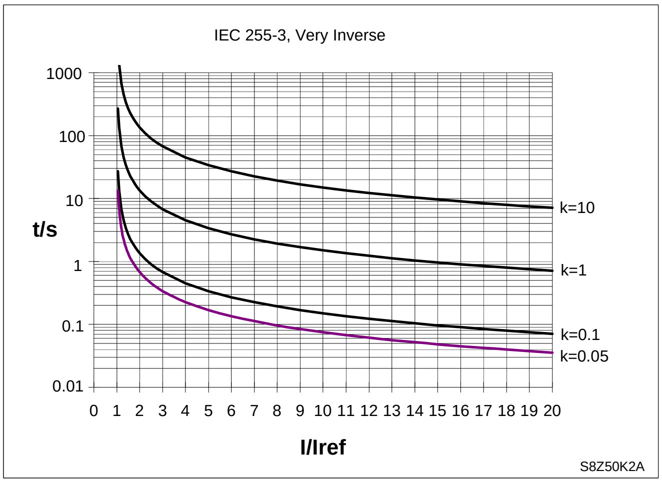
Time-dependent characteristics

The measuring systems for phase currents, residual current and negative-sequence current operate independently of each other and can be set separately. The user can select from a large number of characteristics (see table below). The measured variable is the maximum phase current, the negative-sequence current, or the residual current, depending on the measuring system. The tripping characteristics available for selection are shown in figures 3-126 to 3-129.

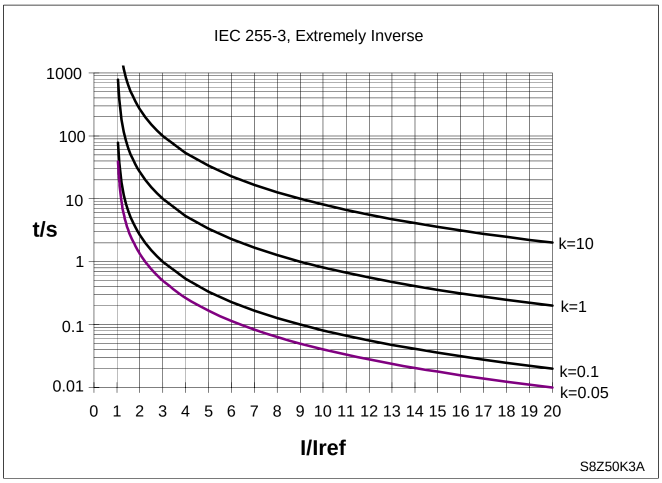
No.	Tripping Characteristic	Formula for the Tripping Characteristic	Constants			Formula for the Reset Characteristic	
	Characteristic settable factor: $k = 0.05 \ldots 10.00$		*A*	*B*	*C*		*R*
0	Definite Time	$t = k$					
	Per IEC 255-3	$t = k \cdot \frac{A}{\left(\frac{I}{I_{ref}}\right)^{b} - 1}$					
1	Standard Inverse		0.14	0.02			
2	Very Inverse		13.50	1.00			
3	Extremely Inverse		80.00	2.00			
4	Long Time Inverse		120.00	1.00			
	Per IEEE C37.112	$t = k \cdot \left(\frac{A}{\left(\frac{I}{I_{ref}}\right)^{b} - 1} + C \right)$				$t_r = \frac{k \cdot R}{\left(\frac{I}{I_{ref}}\right)^{2} - 1}$	
5	Moderately Inverse		0.0515	0.0200	0.1140		4.85
6	Very Inverse		19.6100	2.0000	0.4910		21.60
7	Extremely Inverse		28.2000	2.0000	0.1217		29.10
	Per ANSI	$t = k \cdot \left(\frac{A}{\left(\frac{I}{I_{ref}}\right)^{b} - 1} + C \right)$				$t_r = \frac{k \cdot R}{\left(\frac{I}{I_{ref}}\right)^{2} - 1}$	
8	Normally Inverse		8.9341	2.0938	0.17966		9.00
9	Short Time Inverse		0.2663	1.2969	0.03393		0.50
10	Long Time Inverse		5.6143	1.0000	2.18592		15.75
11	RI-Type Inverse	$t = k \cdot \frac{1}{0.339 - \frac{0.236}{\left(\frac{I}{I_{ref}}\right)}}$					
12	RXIDG-Type Inverse	$t = k \cdot \left(5.8 - 1.35 \cdot \ln \frac{I}{I_{ref}} \right)$					



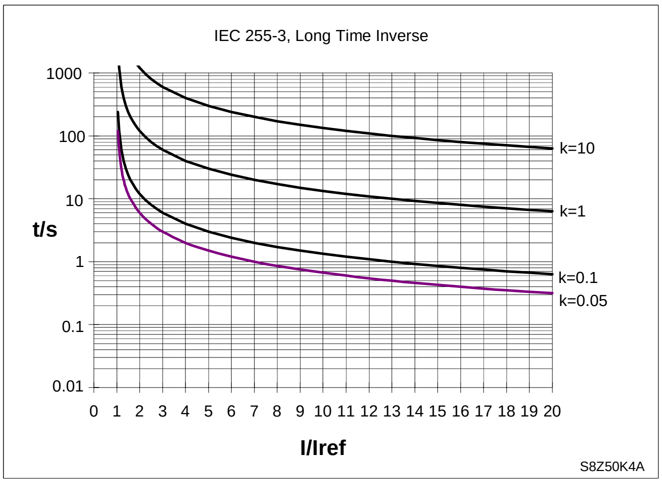
Characteristic No. 1



Characteristic No. 2

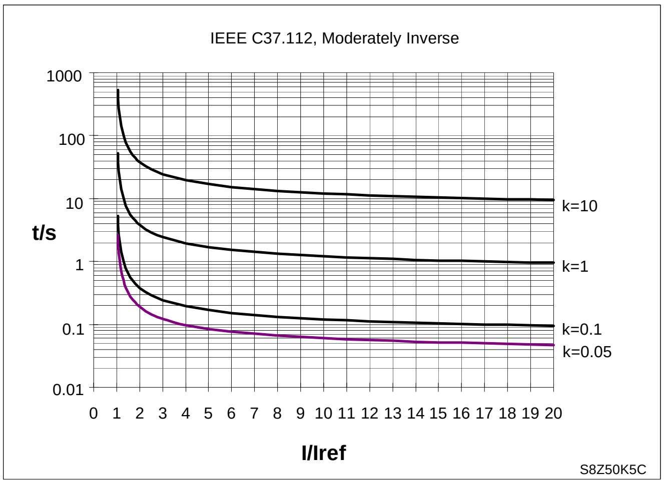


Characteristic No. 3

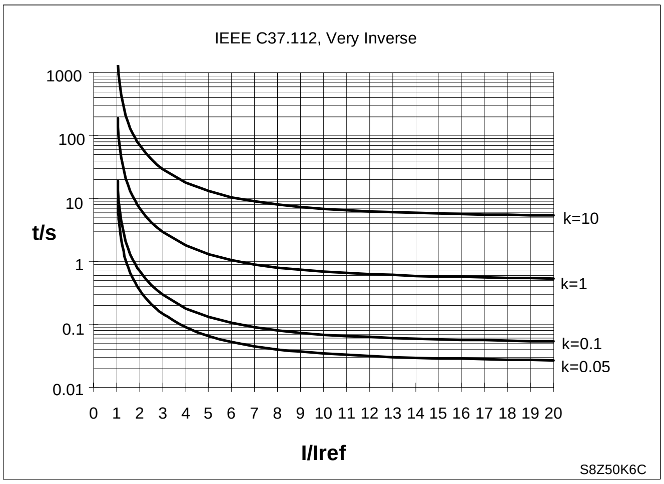


Characteristic No. 4

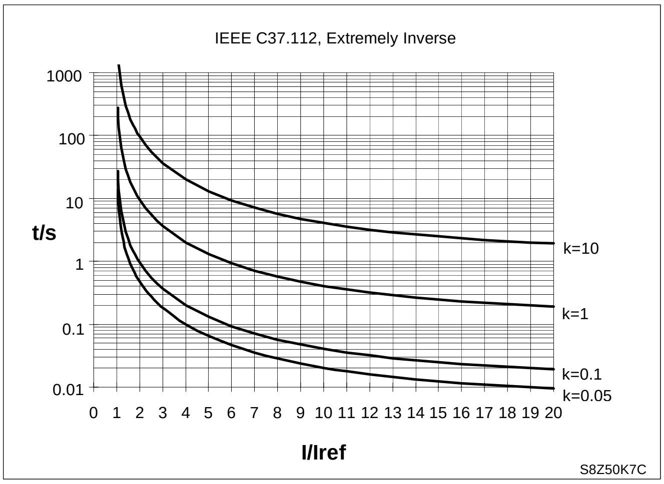
3-126 Tripping characteristics as per IEC 255-3



Characteristic No. 5

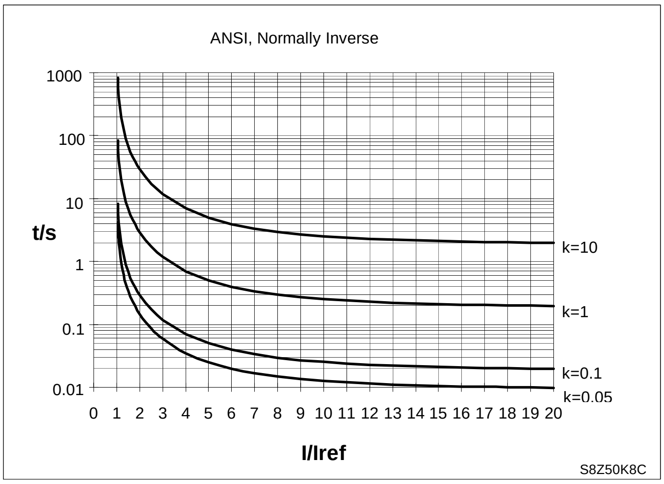


Characteristic No. 6

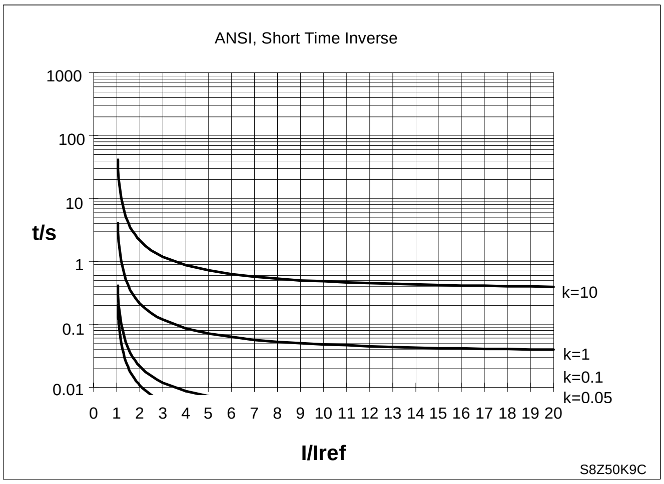


Characteristic No. 7

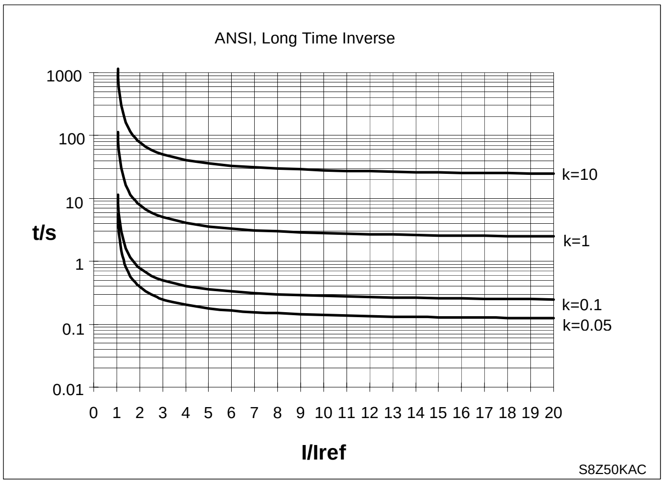
3-127 Tripping characteristics as per IEEE C37.112



Characteristic No. 8

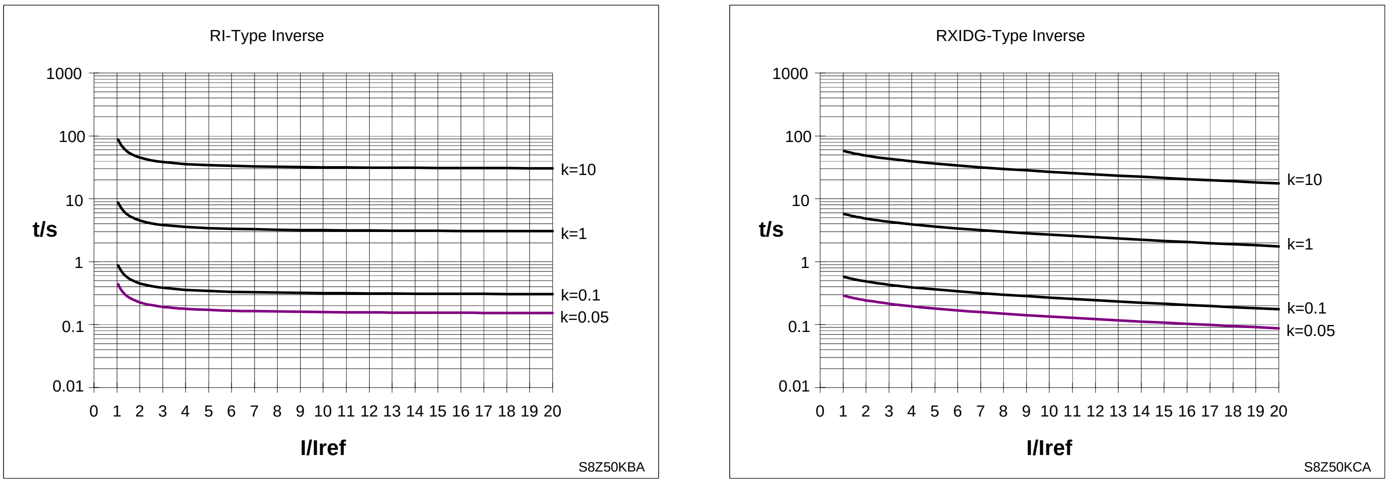


Characteristic No. 9



Characteristic No. 10

3-128 Tripping characteristics as per ANSI



Characteristic No. 11

Characteristic No. 12

3-129 RI-type inverse and RXIDG-type inverse tripping characteristics

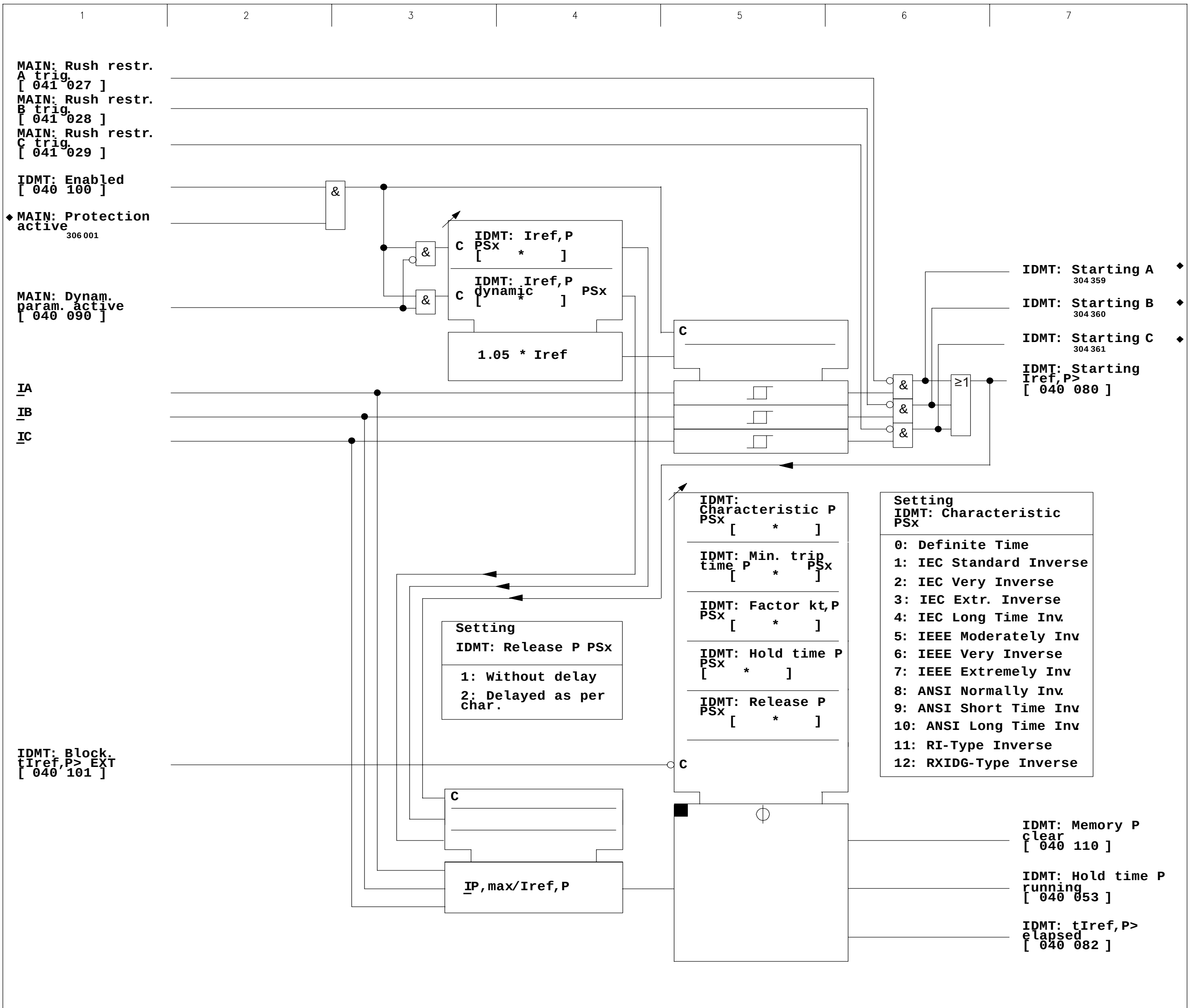
Phase current stage

The three phase currents are monitored by the P132 to detect when they exceed the set thresholds. Alternatively, two different thresholds can be active. The "dynamic" threshold is active for the set hold time for the "dynamic parameters" (see section ‘Activation of Dynamic Parameters’) and the "normal" threshold is active when no hold time is running. The IDMT protection will trigger when the 1.05-fold of the set reference current value is exceeded in one phase. The P132 will then determine the maximum current flowing in the three phases and this value is used for further processing. Depending on the characteristic selected and the current magnitude the P132 will determine the tripping time. Moreover the tripping time will under no circumstances fall below a settable minimum time threshold irrespective of the current flow magnitude.

When the inrush stabilization function (see section ‘Main Functions of the P132’) is triggered, the phase current stage is blocked.

The inverse-time stage can be blocked by an appropriately configured binary signal input.

The trip signal from the IDMT1 protection may also be blocked by the short-circuit direction determination or the auto-reclosing control function. Depending on the setting of the short-circuit direction determination the trip signal will be enabled. The trip signals of the phase current stages IDMT1 and IDMT2 are blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.



*

Parameter	IDMT: Iref,P PSx	IDMT: Iref,P dynamic PSx	IDMT: Characteristic P PSx
set 1	072 050	072 003	072 056
set 2	073 050	073 003	073 056
set 3	074 050	074 003	074 056
set 4	075 050	075 003	075 056

*

Parameter	IDMT: Factor kt,P PSx	IDMT: Min. trip time P PSx	IDMT: Hold time P PSx	IDMT: Release P PSx
set 1	072 053	072 077	072 071	072 059
set 2	073 053	073 077	073 071	073 059
set 3	074 053	074 077	074 071	074 059
set 4	075 053	075 077	075 071	075 059

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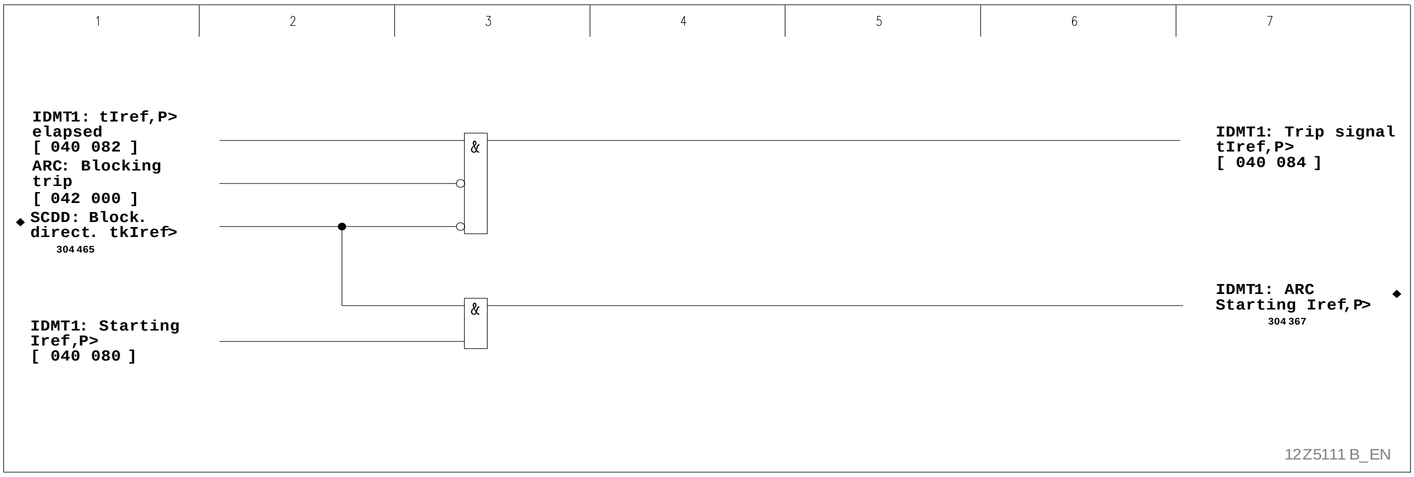
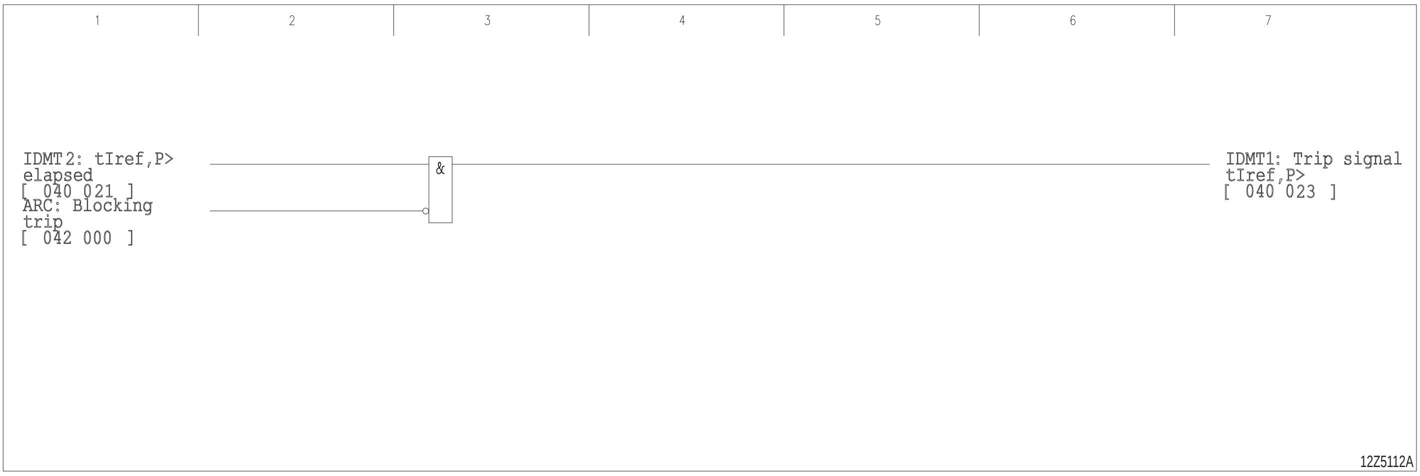
3-130 *Phase current stage (IDMT represents IDMT1 and IDMT2; the addresses apply to IDMT1.) (Trip signal: see following figure)*



3-131a Trip signal of the phase current stage IDMT1



3-131b Trip signal of the phase current stages IDMT2

Negative-sequence current stage

According to the following formulas the P132 will determine the negative-sequence current and positive-sequence current, taking into account the set phase sequence (alternative terminology: Rotary field):

Phase sequence A-B-C
(alternative terminology:
clockwise rotary field)

$$\underline{I}_{neg} = \frac{1}{3} \cdot \left| \left(\underline{I}_A + \underline{a}^2 \cdot \underline{I}_B + \underline{a} \cdot \underline{I}_C \right) \right|$$

Phase sequence A-C-B
(alternative terminology:
anti-clockwise rotary field)

$$\underline{I}_{neg} = \frac{1}{3} \cdot \left| \left(\underline{I}_A + \underline{a} \cdot \underline{I}_B + \underline{a}^2 \cdot \underline{I}_C \right) \right|$$

$$\underline{a} = e^{j120^\circ}$$

$$\underline{a}^2 = e^{j240^\circ}$$

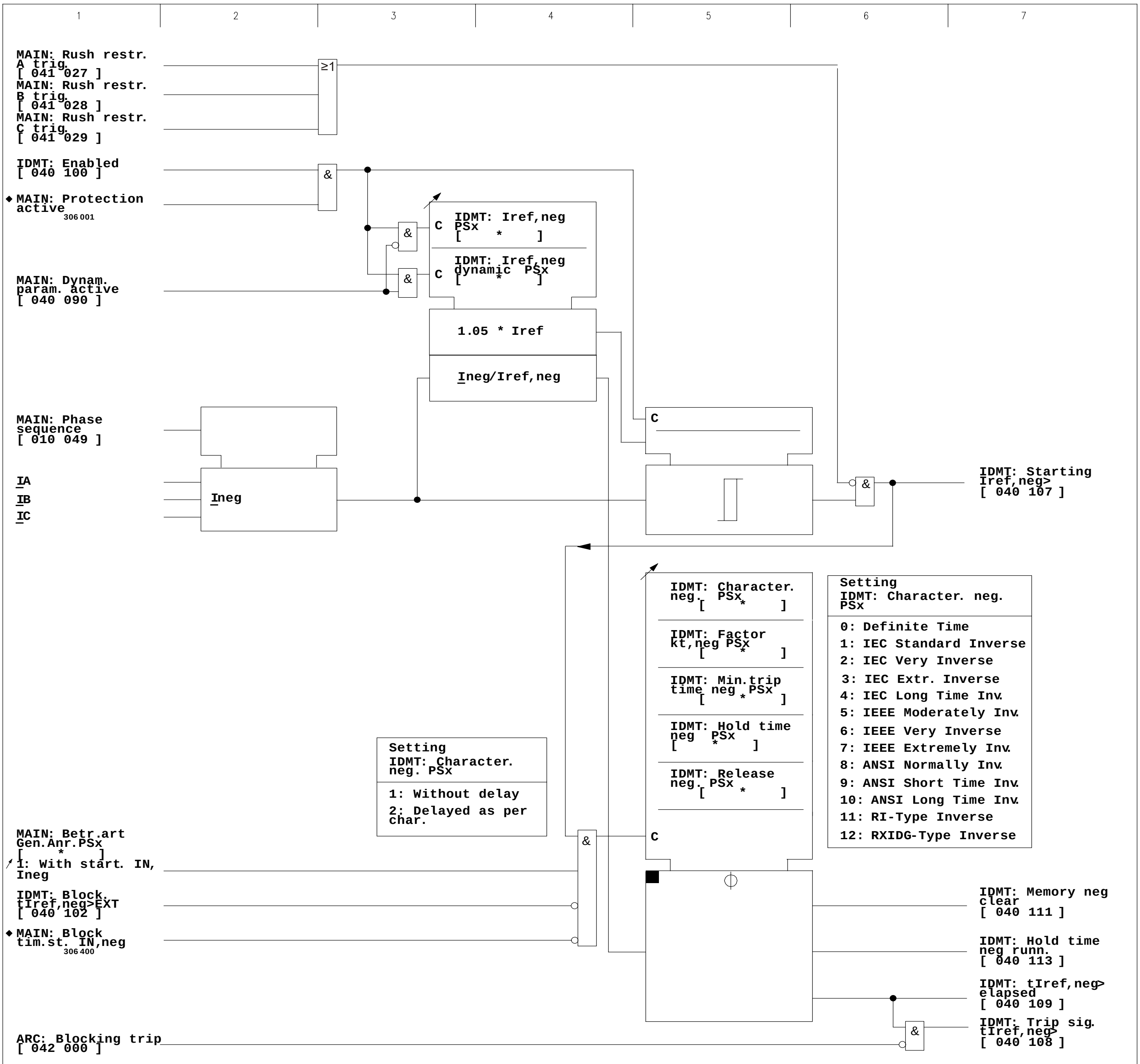
The negative-sequence current is monitored by the P132 to detect when it exceeds the set thresholds. Alternatively, two different thresholds can be active. The "dynamic" threshold is active for the set hold time for the "dynamic parameters" (see section ‘Activation of Dynamic Parameters’) and the "normal" threshold is active when no hold time is running. The IDMT protection will trigger when the 1.05-fold of the set reference current value is exceeded by the negative-sequence current. Depending on the characteristic selected and the residual current magnitude the P132 will determine the tripping time. Moreover the tripping time will under no circumstances fall below a settable minimum time threshold irrespective of the negative-sequence current flow magnitude.

When the inrush stabilization function (see section: ‘Main Functions of the P132’) is triggered, the negative-sequence current stage is blocked.

The inverse-time stage can be blocked by an appropriately configured binary signal input. In addition the inverse-time stage can also be automatically blocked by single-pole or multi-pole starting (depending on the setting).

When the short-circuit direction determination function (SCDD) is enabled, a trip signal from the IDMT negative-sequence current stage is always non-directional.

The trip signal from the negative-sequence current stage is blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.



* Parameter	IDMT: Iref,neg PSx	IDMT: Iref,neg dynamic PSx	IDMT: Character. neg. PSx	IDMT: Factor kt,neg PSx
set 1	072 051	072 004	072 057	072 054
set 2	073 051	073 004	073 057	073 054
set 3	074 051	074 004	074 057	074 054
set 4	075 051	075 004	075 057	075 054

* Parameter	IDMT: Min.trip time neg PSx	IDMT: Hold time neg PSx	IDMT: Release neg. PSx	MAIN: Gen. start. mode PSx
set 1	072 078	072 072	072 060	017 027
set 2	073 078	073 072	073 060	001 219
set 3	074 078	074 072	074 060	001 220
set 4	075 078	075 072	075 060	001 221

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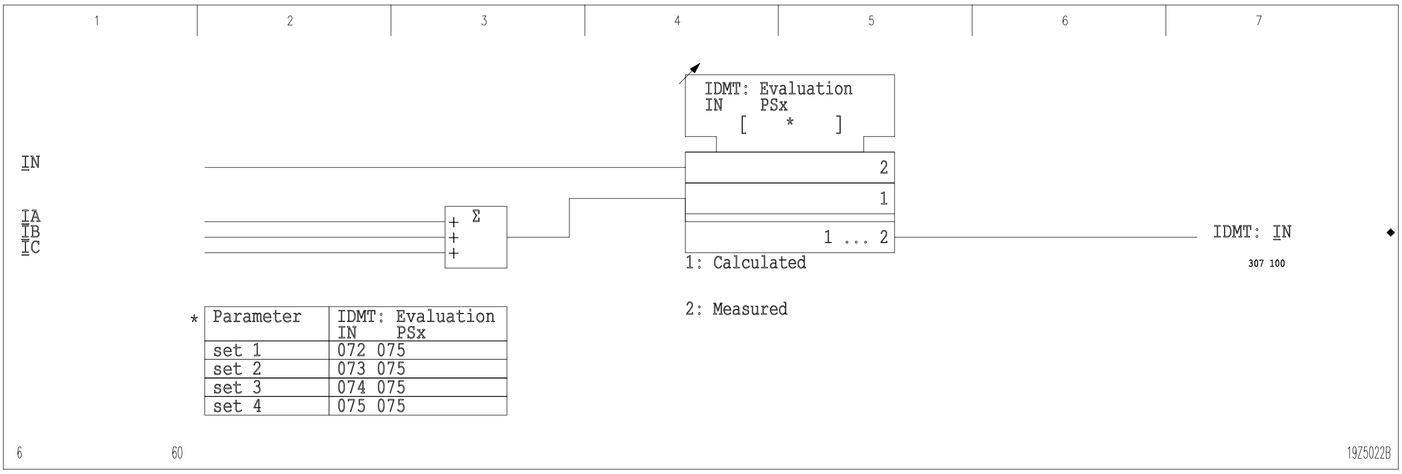
3-132 Negative-sequence current stage (IDMT represents IDMT1 and IDMT2; the addresses apply to IDMT1.)
(Note: Previous terminology of MAIN: Phase sequence was MAIN: Rotary field)

Selecting the measured variable for the residual current stage

A setting specifies which current will be used by the P132 as the residual current: either the residual current calculated from the three phase currents or the residual current directly measured at the fourth current transformer (T 4).



Parameter	IDMT: Evaluation IN PSx
set 1	072 075
set 2	073 075
set 3	074 075
set 4	075 075

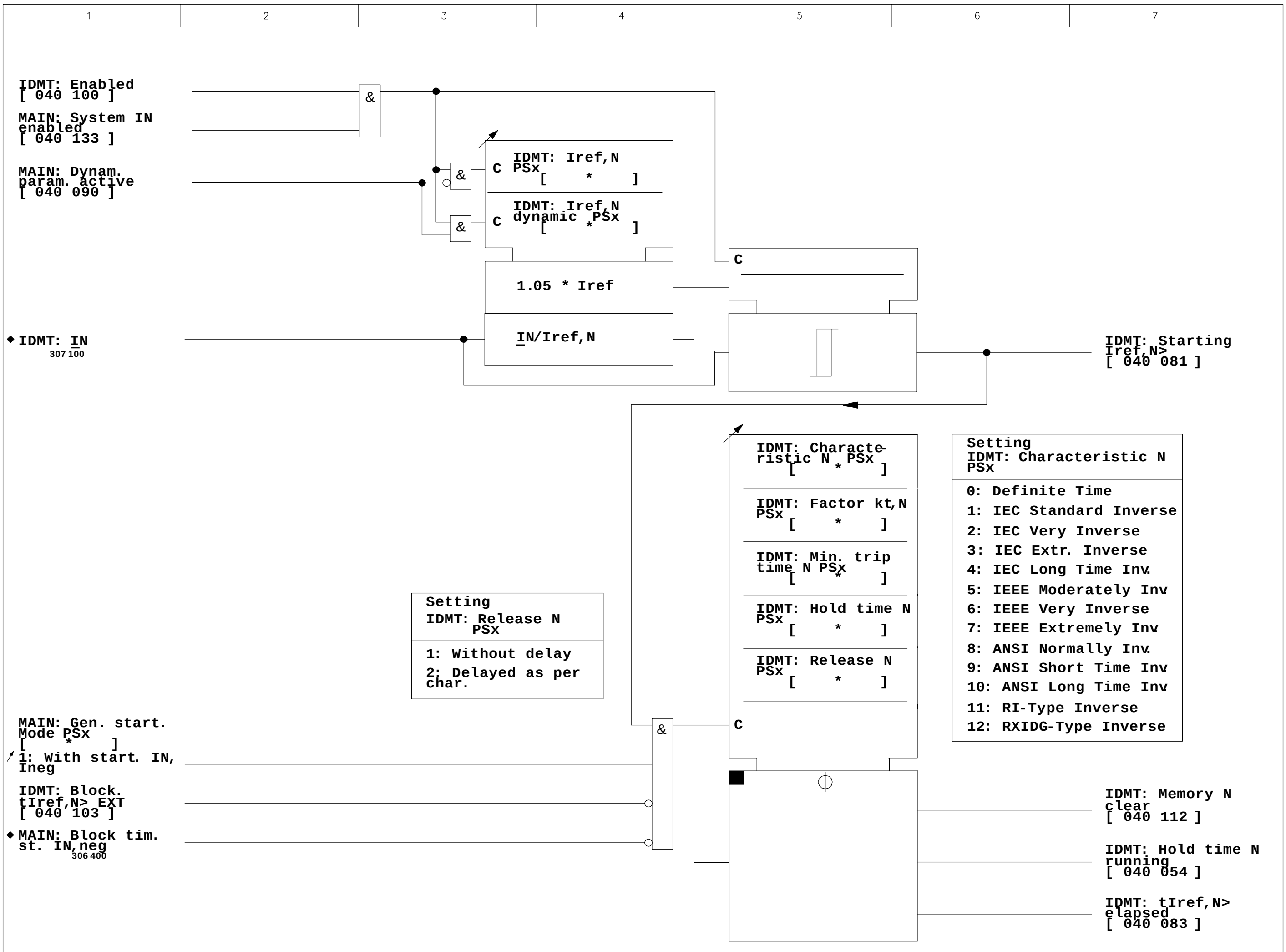
3-133 Selecting the measured variable (IDMT represents IDMT1 and IDMT2; the addresses apply to IDMT1.)

Residual current stage

The residual current is monitored by the P132 to detect when it exceeds the set thresholds. Alternatively, two different thresholds can be active. The "dynamic" threshold is active for the set hold time for the "dynamic parameters" (see section ‘Activation of Dynamic Parameters’) and the "normal" threshold is active when no hold time is running. The IDMT protection will trigger when the 1.05-fold of the set reference current value is exceeded by the residual current. Depending on the characteristic selected and the residual current magnitude the P132 will determine the tripping time. Moreover the tripping time will under no circumstances fall below a settable minimum time threshold irrespective of the residual current flow magnitude.

The inverse-time stage can be blocked by an appropriately configured binary signal input. In addition the inverse-time stage can also be automatically blocked by single-pole or multi-pole starting (depending on the setting).

The trip signal from the IDMT1 protection may also be blocked by the short-circuit direction determination or the auto-reclosing control function. Depending on the setting of the short-circuit direction determination the trip signal will be enabled. The trip signals of the residual current stages IDMT1 and IDMT2 are blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.



*

Parameter	MAIN: Gen. start. Mode PSx	IDMT: Iref,N PSx	IDMT: Iref,N dynamic PSx	IDMT: Characteristic N PSx
set 1	017 027	072 052	072 005	072 058
set 2	001 219	073 052	073 005	073 058
set 3	001 220	074 052	074 005	074 058
set 4	001 221	075 052	075 005	075 058

*

Parameter	IDMT: Factor kt,N PSx	IDMT: Min. trip time N PSx	IDMT: Hold time N PSx	IDMT: Release N PSx
set 1	072 055	072 079	072 073	072 061
set 2	073 055	073 079	073 073	073 061
set 3	074 055	074 079	074 073	074 061
set 4	075 055	075 079	075 073	075 061

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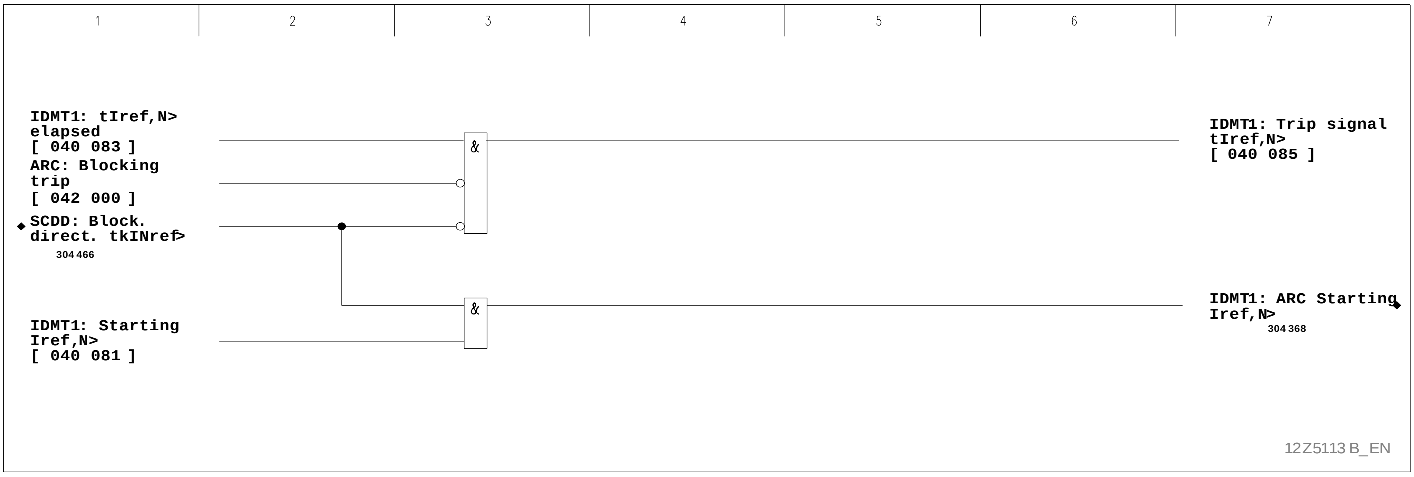
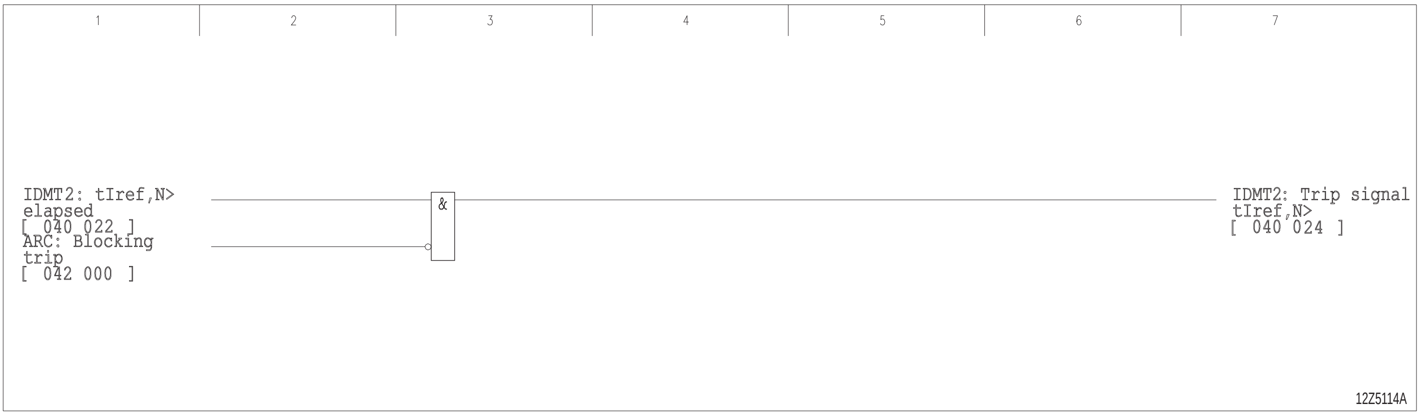
3-134 Residual current stage (IDMT represents IDMT1 and IDMT2; the addresses apply to IDMT1.) (Trip signal: see following figure)



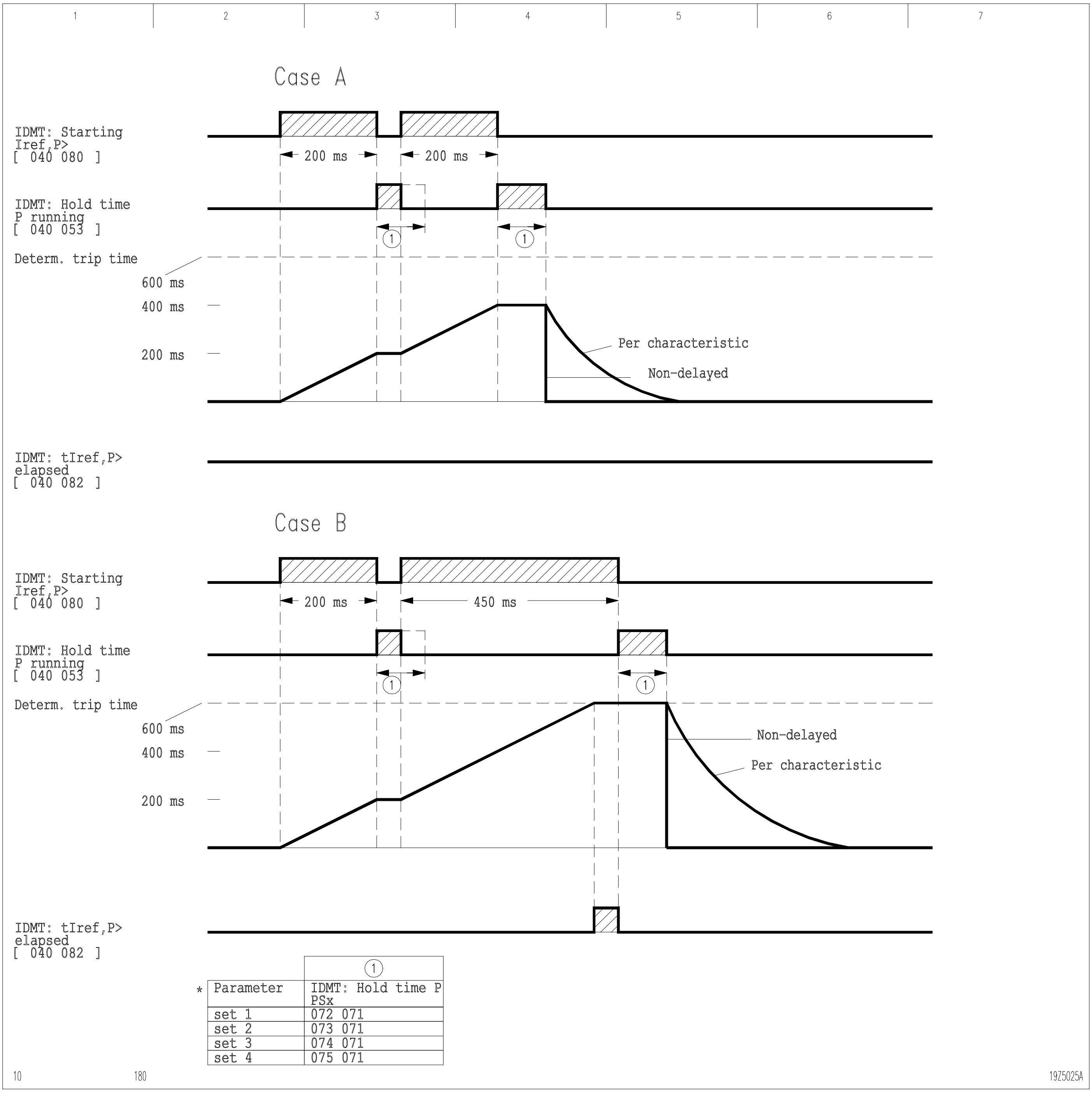
3-135a Trip signal of the residual current stage



3-135b Trip signal of the residual current stage

Holding time

Depending on the current flow the P132 will determine the tripping time and a timer stage is started. The setting of the hold time defines the time period during which the IDMT protection starting time is stored after the starting has dropped out. Should starting recur during the hold time period then the time of the renewed starting will be added to the time period stored. When the starting times sum reach the tripping time value determined by the P132 then the corresponding signal will be issued. Should starting not recur during the hold time period then, depending on the setting, the memory storing the accumulated starting times value will either be cleared without delay or according to the characteristic set. In figure 3-136 the effect of hold time is shown by the example of a phase current stage.



	①
* Parameter	IDMT: Hold time P PSx
set 1	072 071
set 2	073 071
set 3	074 071
set 4	075 071

3-136 *Effect of hold time shown with a phase current stage as an example*
Example A: Hold time determined is not reached.
Example B: Hold time determined is reached.

(IDMT represents IDMT1 and IDMT2; the addresses apply to IDMT1.)

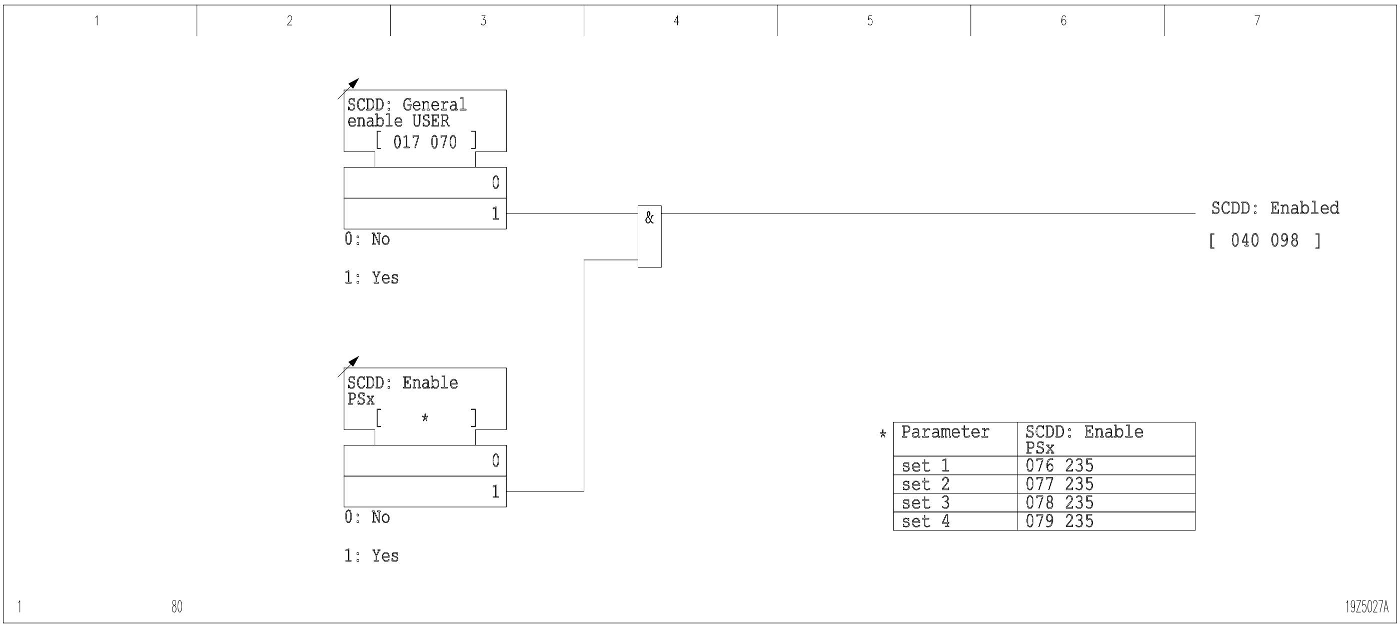
3.25 Short-Circuit Direction Determination (Function Group SCDD)

The P132 provides short circuit direction determination (SCDD). With this feature it is possible to apply the P132 for directional definite-time overcurrent protection and directional inverse-time overcurrent protection. Two separate measuring systems are available for this purpose for:

- ☐ Phase currents system
- ☐ Residual currents system

Enable/disable the short-circuit direction determination

The short-circuit direction determination can be disabled or enabled via setting parameters. Moreover, enabling can be carried out separately for each parameter subset.



* Parameter	SCDD: Enable PSx
set 1	076 235
set 2	077 235
set 3	078 235
set 4	079 235

3-137 *Enable/disable the short-circuit direction determination*

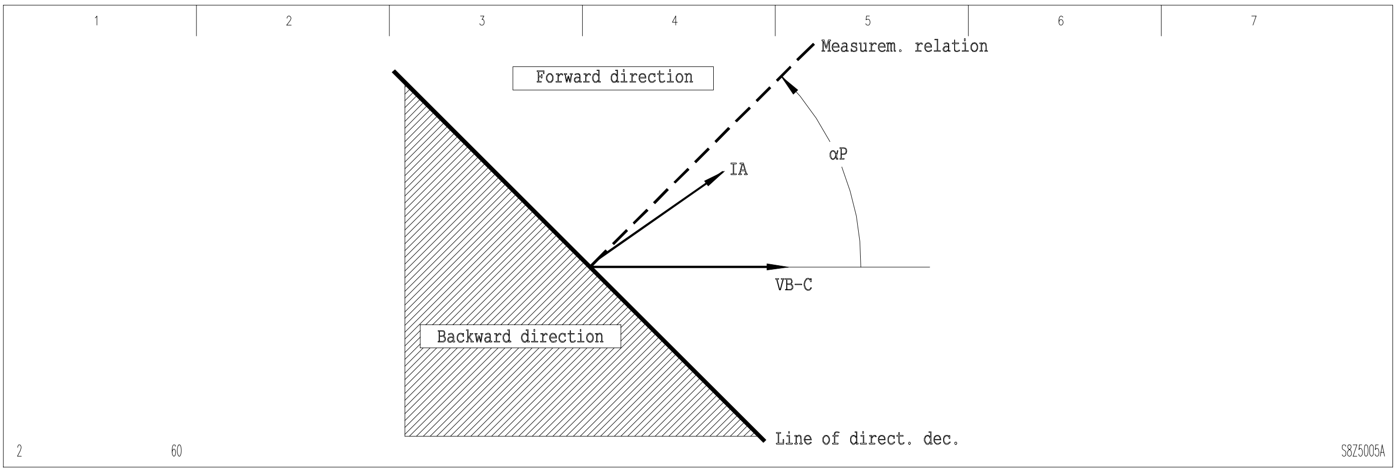
Phase current stages

To determine direction in the phase current stages and depending on the type of fault a phase current and the opposed phase-to-phase voltage as well as the respective optimum characteristic angle are used.

As an example for a single-pole fault in phase A to ground the phase A current value (I_A), the phase B to phase C voltage value ($V_{B\text{-}C}$) and the characteristic angle $\alpha_P = +45°$ are selected as measured variables (see figure 3-138).

The vector of the selected phase-to-phase voltage is the reference quantity. Beginning with the reference quantity the characteristic angle α_P will determine the measuring relation. Depending on the type of fault the P132 will present various characteristic angles. The measuring relation is defined as the angle bisector for the directional zone "Forward". Forward directional is apparent if the vector of the selected phase current lies in the range ≤ ± 90° of the measuring relation.

Backward directional is apparent if the vector of the selected phase current lies in the range > ± 90° of the measuring relation.



3-138 single-pole fault in phase A to ground (A-G) and with an inductive system and a phase sequence A-B-C (or clockwise rotary field direction)

Enabling for phase current stages (without voltage memory)

Direction determination for phase current stages is only enabled if the following conditions are met simultaneously:

☐ The short-circuit direction determination is enabled.

☐ Measuring-circuit monitoring has detected no faults in the voltage measuring loop (see section ‘Measuring Circuit Monitoring’).

☐ A phase current starting signal is present.

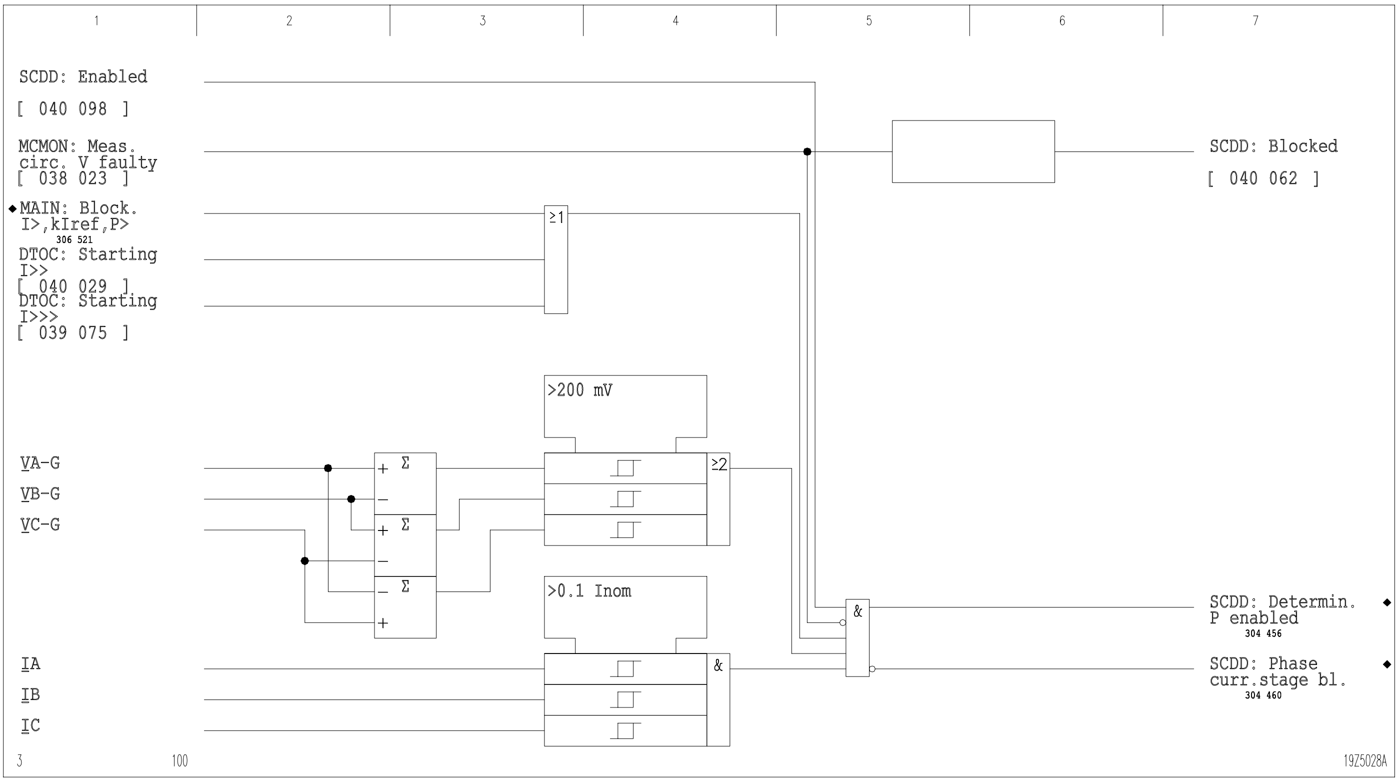
☐ At lease two phase-to-phase voltage values exceed 200 mV.

☐ All three phase current values exceed 0.1 I_{nom}.

☐ The external signal `MAIN: M.c.b. trip V EXT` is not present.

If the short-circuit direction determination is disabled the internal signal `SCDD: Phase curr.stage bl.` is generated.

As of variant –602 the voltage memory can be applied when 3-pole faults have occurred. (See description at the end of this section.)

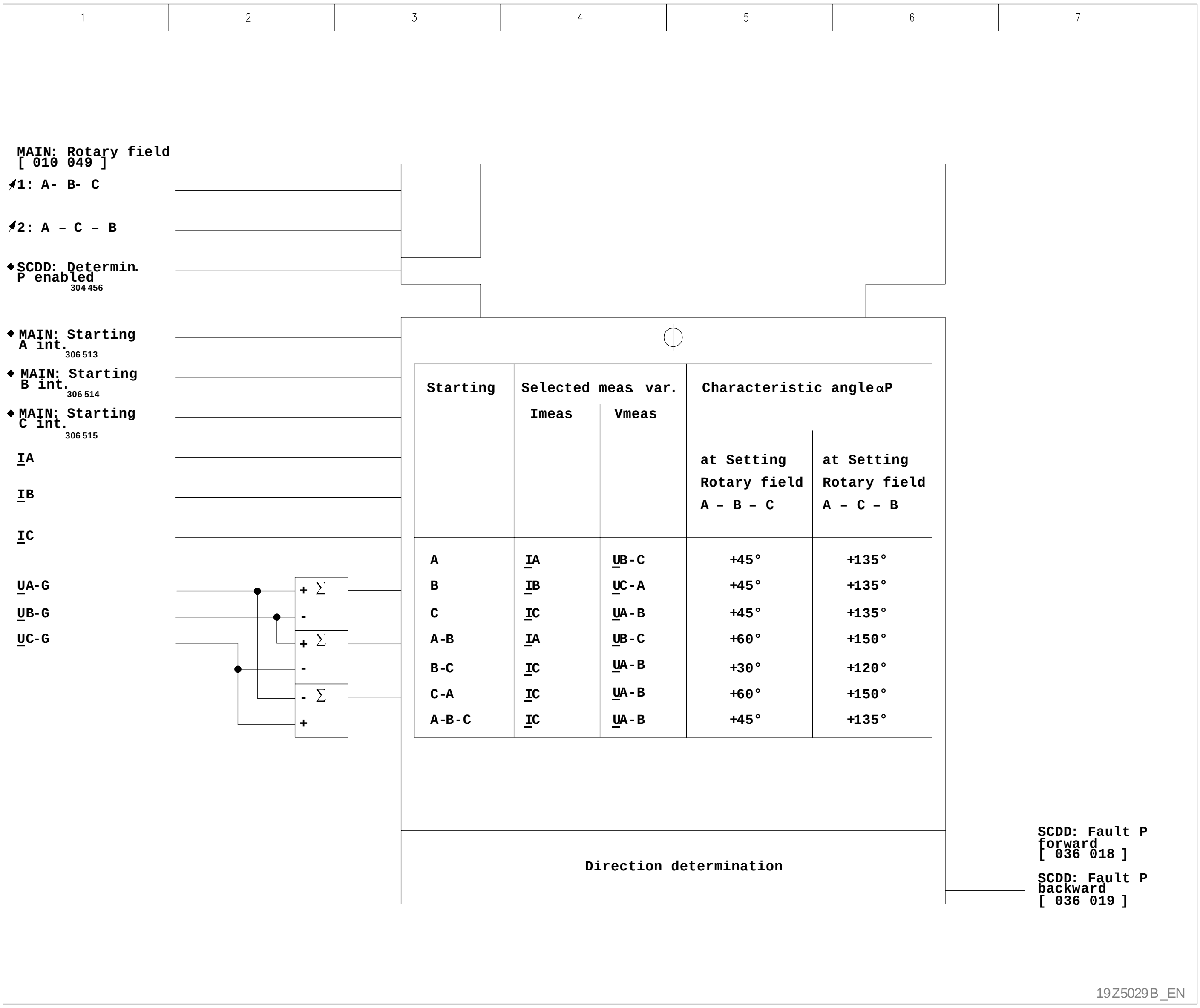


3-139 *Enabling direction determination for phase current stages*

After being enabled and depending on the direction determination decision one of the following signals will be issued:

- ☐ With a fault in forward direction,
  SCDD: Fault P forward
- ☐ With a fault in forward direction,
  SCDD: Fault P backward

To inhibit transient contention problems starting and dropping out of a direction determination decision in both directions is delayed for 30 ms.



Starting	Selected meas. var.		Characteristic angle αP	
	Imeas	Vmeas	at Setting Rotary field A – B – C	at Setting Rotary field A – C – B
A	IA	UB-C	+45°	+135°
B	IB	UC-A	+45°	+135°
C	IC	UA-B	+45°	+135°
A-B	IA	UB-C	+60°	+150°
B-C	IC	UA-B	+30°	+120°
C-A	IC	UA-B	+60°	+150°
A-B-C	IC	UA-B	+45°	+135°

3-140 Direction determination for phase current stages
(Note: Previous terminology of MAIN : Phase sequence was MAIN: Rotary field)

Forming the blocking signal for the phase current stages

To form the blocking signal for the two DTOC phase current stages and the IDMT phase current stage the fault direction to evaluate the measuring decision may be set separately for each of the stages to either 'Forward directional', 'Backward directional' or 'Non-directional'.

A blocking signal for the first DTOC phase current stage is formed when one of the following conditions is met:

☐ The direction for tI> is set to 'Forward directional' and the short-circuit direction determination detects a fault in backward direction.

☐ The direction for tI> is set to 'Backward directional' and the short-circuit direction determination detects a fault in forward direction.

A blocking signal for the second DTOC phase current stage is formed when one of the following conditions is met:

☐ The direction for tI>> is set to 'Forward directional' and the short-circuit direction determination detects a fault in backward direction.

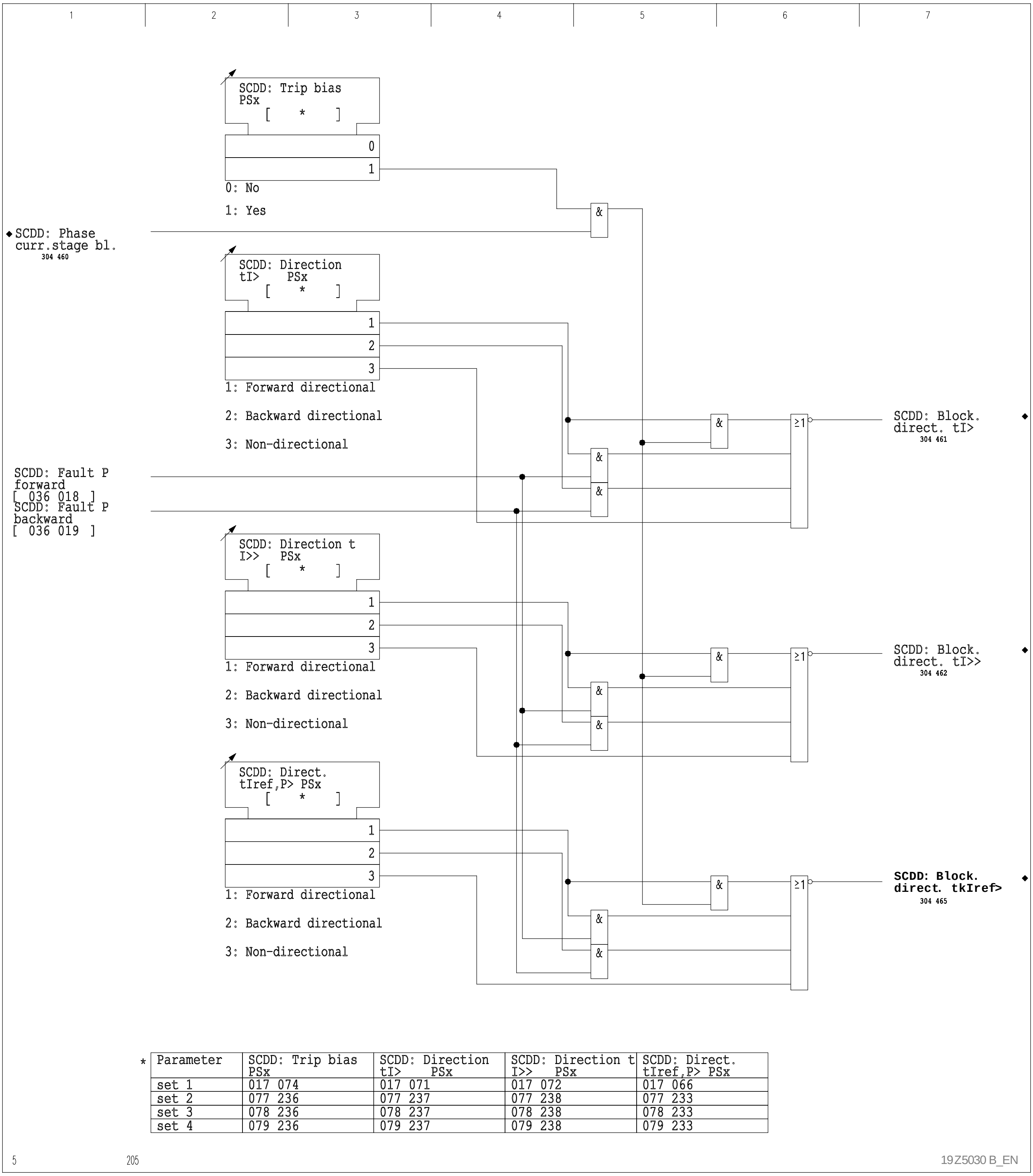
☐ The direction for tI>> is set to 'Backward directional' and the short-circuit direction determination detects a fault in forward direction.

A blocking signal for the IDMT phase current stage is formed when one of the following conditions is met:

☐ The direction for tIref,P> is set to 'Forward directional' and the short-circuit direction determination detects a fault in backward direction.

☐ The direction for tIref,P> is set to 'Backward directional' and the short-circuit direction determination detects a fault in forward direction.

In case the direction determination function is not enabled (e.g. with a M.c.b. trip) it is possible to select whether stages set to 'Forward directional' may be operated with biased tripping by enabling SCDD: Trip bias PSx.



Parameter	SCDD: Trip bias PSx	SCDD: Direction tI> PSx	SCDD: Direction t I>> PSx	SCDD: Direct. tIref,P> PSx
set 1	017 074	017 071	017 072	017 066
set 2	077 236	077 237	077 238	077 233
set 3	078 236	078 237	078 238	078 233
set 4	079 236	079 237	079 238	079 233

3-141 *Forming the blocking signals for the phase current stages*

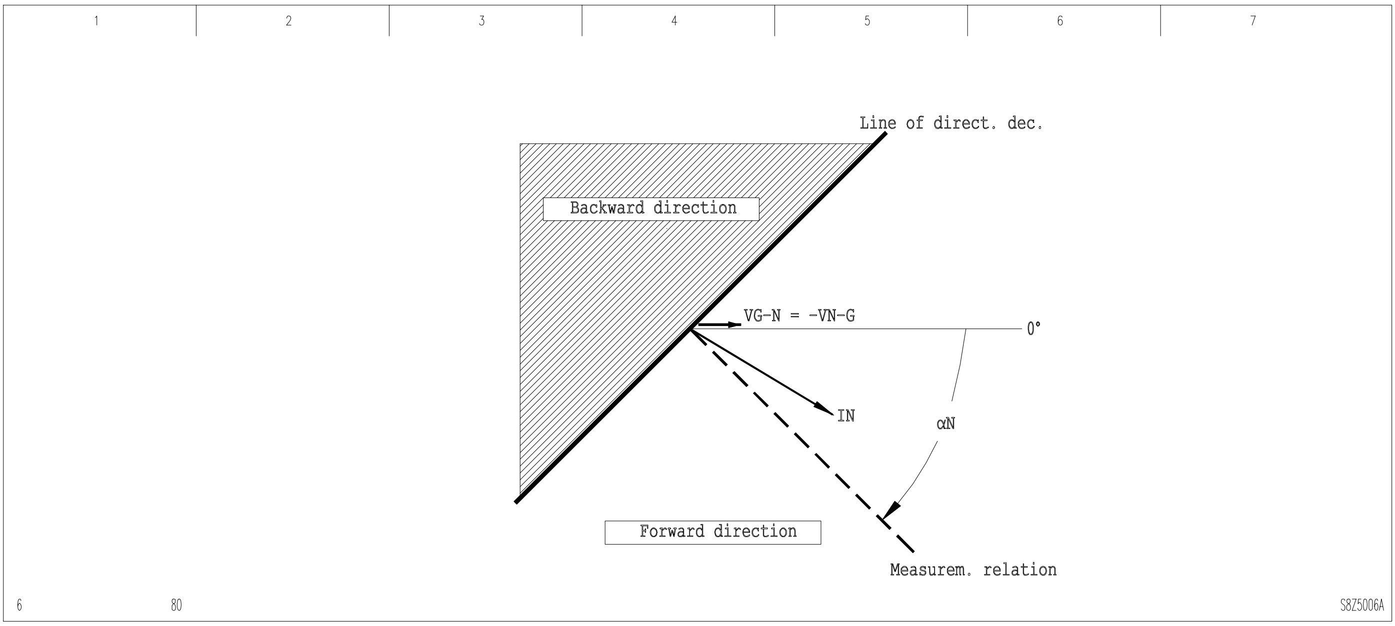
Residual current stages

To determine direction in the residual current stages the residual current measured ($\underline{I}_N$) and the neutral-point displacement voltage ($\underline{V}_{N-G} = -\underline{V}_{G-N}$) are used. The specification of a good characteristic angle is carried out by the user according to the neutral-point treatment of the system. The characteristic angle α_N may be set in
the range: - 90° to + 90°

The reference quantity is the neutral-point displacement vector. Beginning with the reference quantity the characteristic angle will determine the measuring relation. The measuring relation is defined as the angle bisector for the directional zone "Forward". Forward directional is apparent if the vector of the residual current lies in the range $\leq \pm 90°$ of the measuring relation.

Backward directional is apparent if the vector of the residual current lies in the range $> \pm 90°$ of the measuring relation.

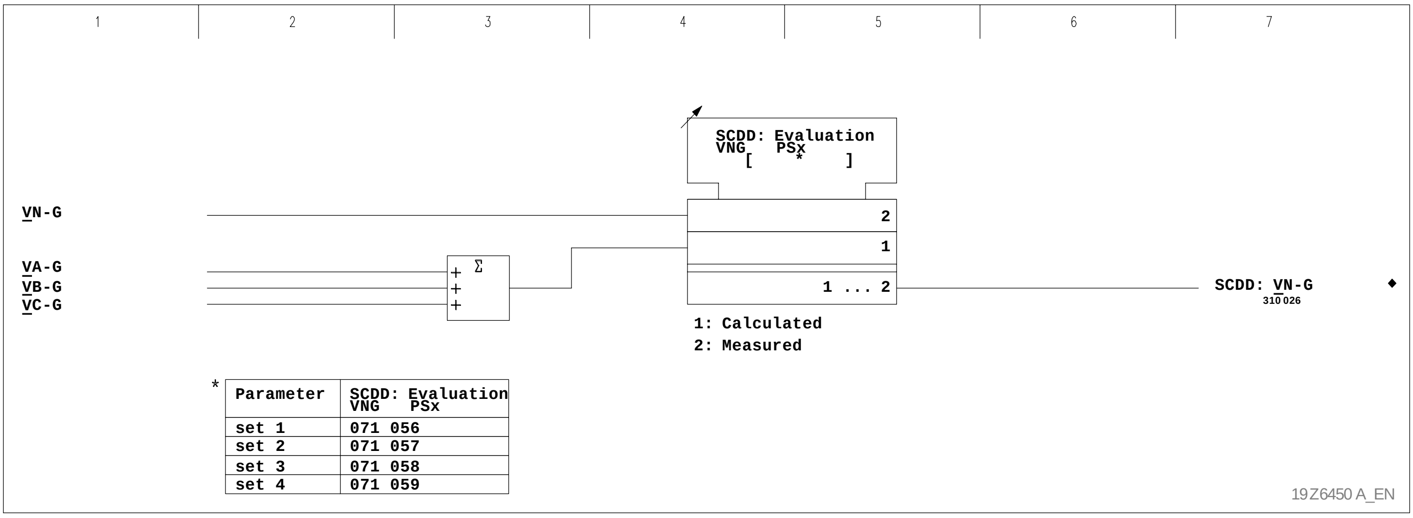
In the following example the system neutral is grounded with a relatively low resistance. Here the residual current apparent with a single-pole fault in phase A to ground (A-G) and a forward directional fault will take up the approximate position as shown in figure 3-142. With the characteristic angle $\alpha_N = -45°$ a forward directional decision will be issued.



3-142 *Example for forming a directional decision in the residual current stage*

Conditioning and selecting the measured variables

For the short-circuit direction determination it is possible to use either the neutral-point displacement voltage calculated by the P132 from the three phase-to-ground voltages or the displacement voltage measured at the T 90 transformer.

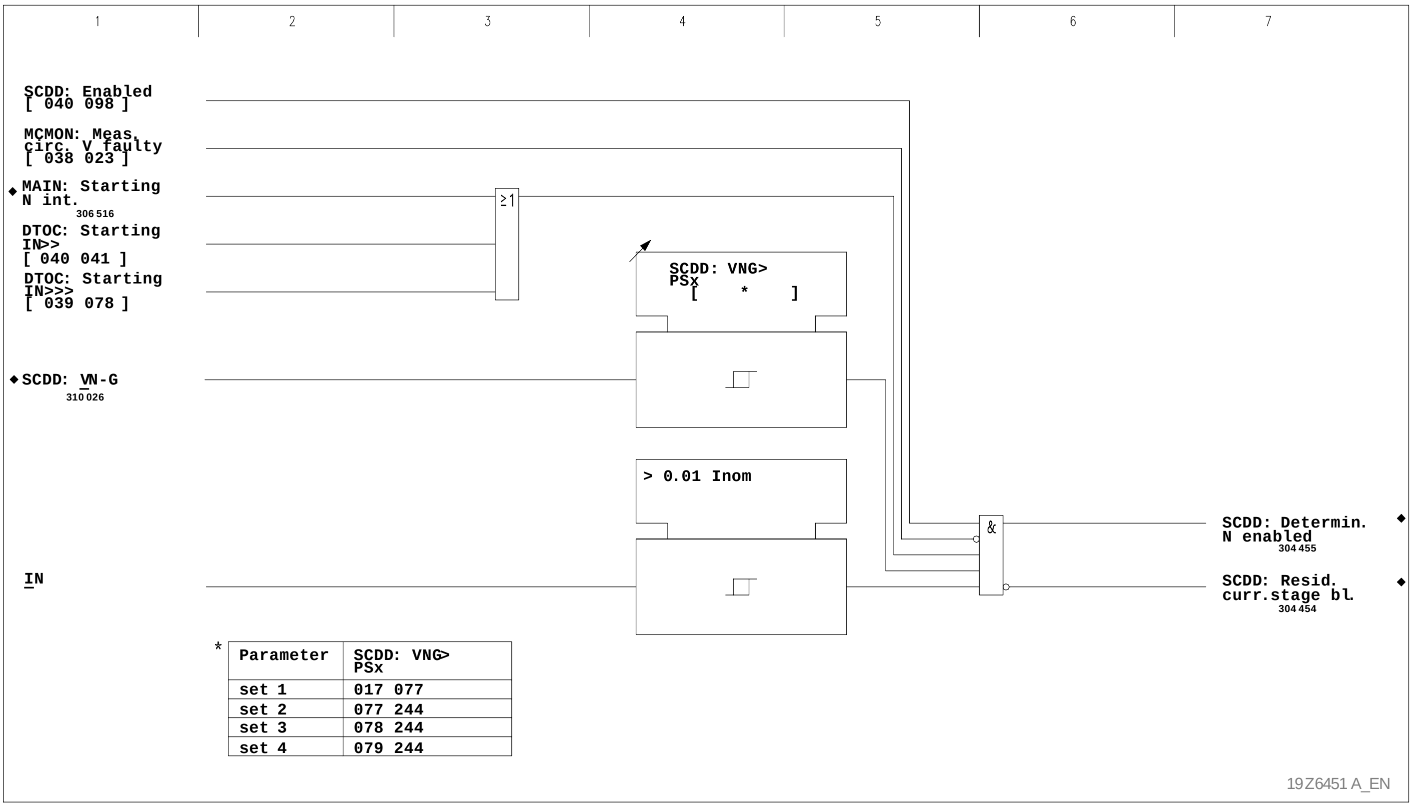


3-143b Selecting the measuring voltage

Enabling for residual current stages

Direction determination for residual current stages is only enabled if the following conditions are met simultaneously:

- ☐ The short-circuit direction determination is enabled
- ☐ The short-circuit direction determination is not blocked by the measuring-circuit monitoring (see section ‘Measuring Circuit Monitoring’)
- ☐ A residual current starting signal is present
- ☐ The residual current exceeds 0.01 I_{nom}
- ☐ The external signal `MAIN: M.c.b. trip V EXT` is not present.
- ☐ The neutral-point displacement voltage exceeds the threshold value set at `SCDD: VNG> PSx`.



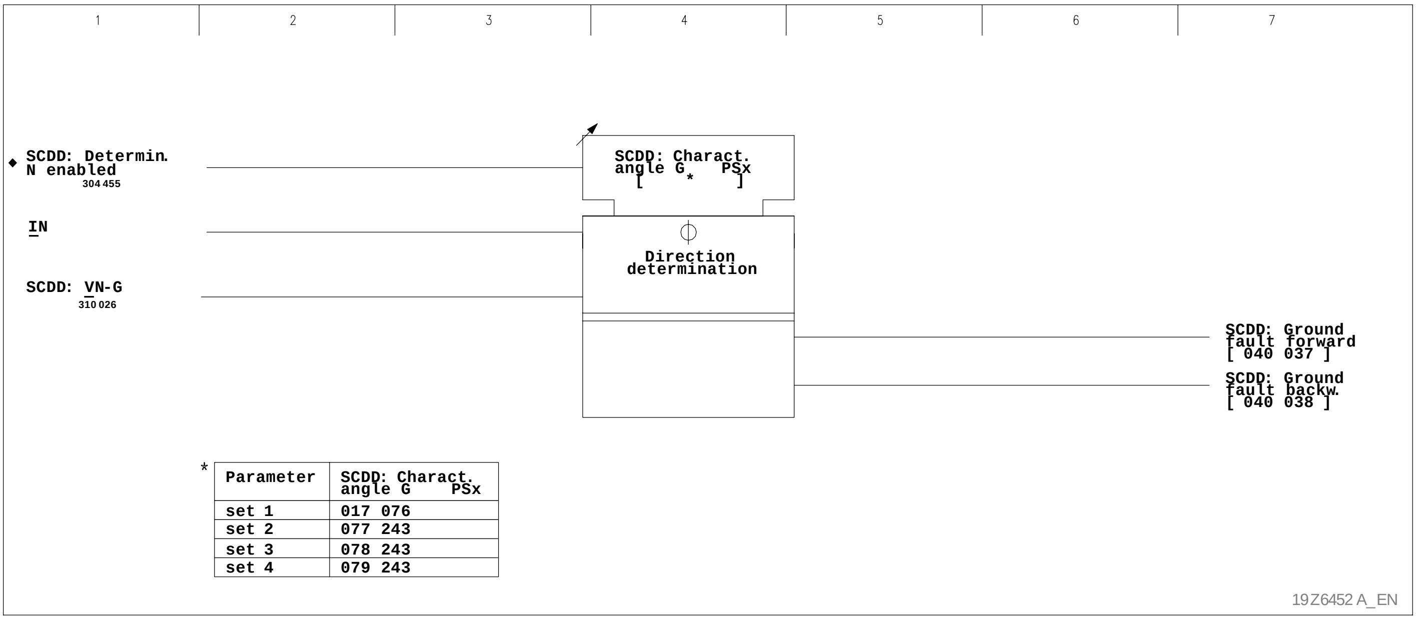
Parameter	SCDD: VNG> PSx
set 1	017 077
set 2	077 244
set 3	078 244
set 4	079 244

3-143a *Enabling direction determination for residual current stages*

After being enabled and depending on the direction determination decision one of the following signals will be issued:

- With a fault in forward direction,
  SCDD: Ground fault forward
- With a fault in backward direction,
  SCDD: Ground fault backward

To inhibit transient contention problems starting and dropping out of a direction determination decision in both directions is delayed for 30 ms.



Parameter	SCDD: Charact. angle G PSx
set 1	017 076
set 2	077 243
set 3	078 243
set 4	079 243

3-144 *Direction determination for residual current stages*

Forming the blocking signal for the residual current stages

To form the blocking signal for the two DTOC residual current stages and the IDMT residual current stage the fault direction to evaluate the measuring decision may be set separately for each of the stages to either 'Forward directional', 'Backward directional' or 'Non-directional'.

A blocking signal for the first DTOC residual current stage is formed when one of the following conditions is met:

- ☐ The direction for tI_N> is set to 'Forward directional' and the short-circuit direction determination detects a fault in backward direction.
- ☐ The direction for tI_N> is set to 'Backward directional' and the short-circuit direction determination detects a fault in forward direction.

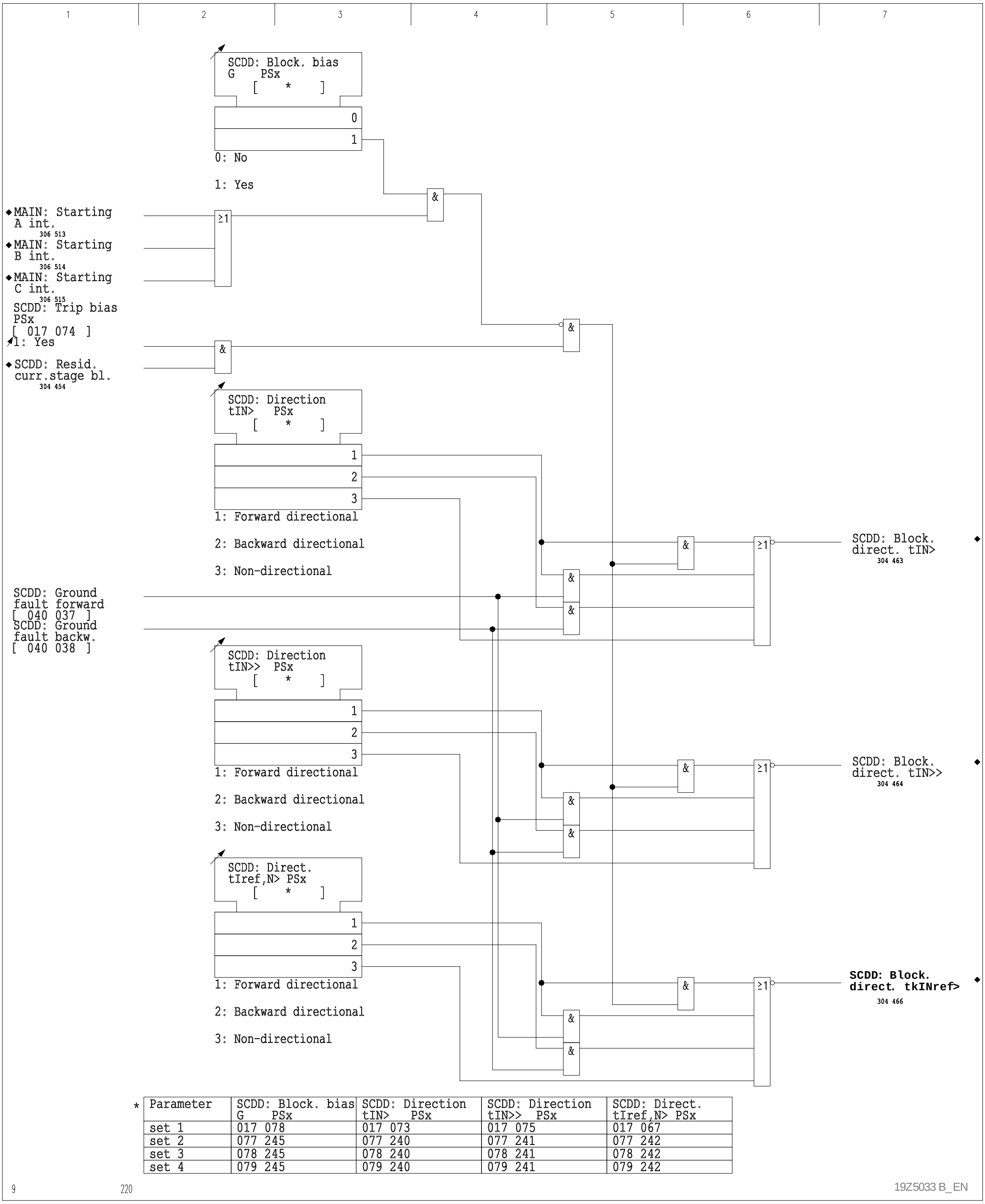
A blocking signal for the second DTOC residual current stage is formed when one of the following conditions is met:

- ☐ The direction for tI_N>> is set to 'Forward directional' and the short-circuit direction determination detects a fault in backward direction.
- ☐ The direction for tIN>> is set to 'Backward directional' and the short-circuit direction determination detects a fault in forward direction.

A blocking signal for the IDMT residual current stage is formed when one of the following conditions is met:

- ☐ The direction for $tI_{ref,N}$> is set to 'Forward directional' and the short-circuit direction determination detects a fault in backward direction.
- ☐ The direction for $tI_{ref,N}$> is set to 'Backward directional' and the short-circuit direction determination detects a fault in forward direction.

In case the direction determination function is not enabled (e.g. with a M.c.b. trip) it is possible to select whether stages set to 'Forward directional' may be operated with biased tripping by enabling `SCDD: Trip bias PSx`. In case of a phase current starting bias tripping in the residual current stage may be suppressed by enabling `SCDD: Block. Bias G PSx`.



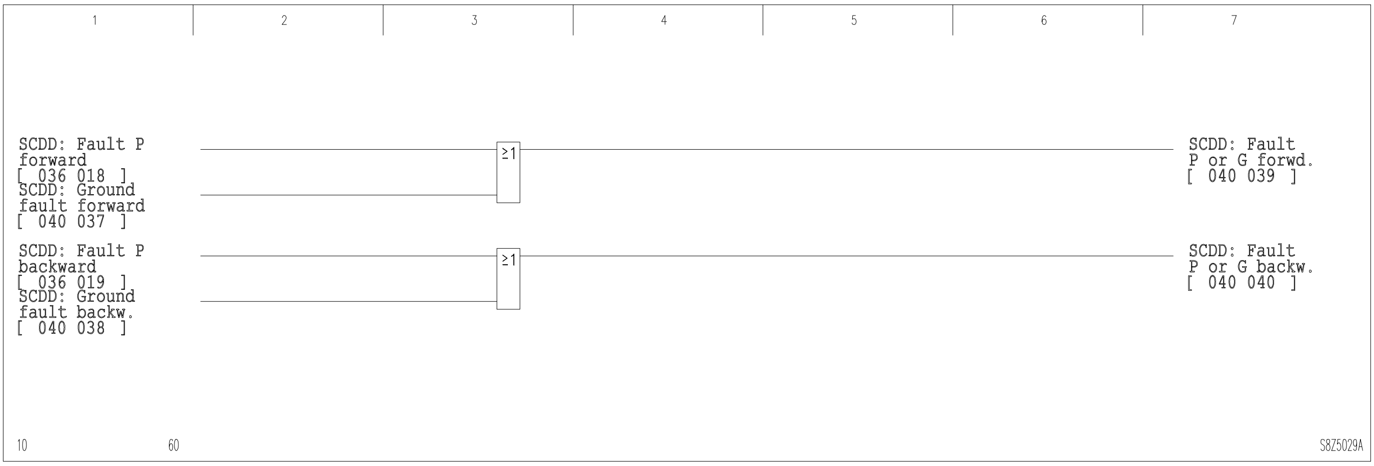
*

Parameter	SCDD: Block. bias G PSx	SCDD: Direction tIN> PSx	SCDD: Direction tIN>> PSx	SCDD: Direct. tIref,N> PSx
set 1	017 078	017 073	017 075	017 067
set 2	077 245	077 240	077 241	077 242
set 3	078 245	078 240	078 241	078 242
set 4	079 245	079 240	079 241	079 242

3-145 Forming the blocking signals for the residual current stages

Signaling logic

Fault directional signals generated by the directional determination function of the phase and residual current stages are grouped together to a combined function.



3-146 Fault signals from phase or residual current stages forward or backward directional

Short-circuit direction determination using voltage memory

The short-circuit direction determination (SCDD) function group is subdivided into two subsets.

<u>Direction determination in a residual current system</u>

For direction determination in a residual current system the measured residual current IN and the vector addition of the phase-ground voltages are applied.
In this case voltage memory is <u>not</u> used.

<u>Direction determination in a phase system</u>

For direction determination in a phase system the SCDD function uses the fault-dependent short-circuit current and – in general – the phase-to-phase, un-faulted voltages (not involved in the short-circuit) assigned to the type of fault. This ensures that with single-pole and two-pole faults there is always sufficient voltage available for direction determination.
This procedure can also be applied to three-pole faults with a phase-to-phase voltage > 200 mV.

Should a three-pole fault occur close to the point of measurement, there could be such a large 3-phase voltage drop, that direction determination on above basis is no longer possible. For such fault occurrences there is a voltage memory available from which the SCDD function can obtain the necessary voltage information for direction determination.

With a three-pole fault in the phase-current stage the measurement loop voltage (VABmeas) is compared to the selected operate value (Vop.Val.) of the voltage memory set by the user at SCDD: Oper.val.Vmemory PSx. If VABmeas < Vop.Val. then the SCDD function will not use VABmeas but will revert to the voltage memory, if it has been enabled. The following signal is issued:

SCDD: Direct. using memory

If the voltage memory has not been enabled (i.e. |Delta f| > 2.5 Hz) the SCDD function will check if VABmeas is sufficient for direction determination.
Should the result with a disabled voltage memory be VABmeas > 200 mV the direction will be determined on the basis of VABmeas. The following signal is issued:

SCDD: Direct. using Vmeas

If V12meas < 200 mV, a forward fault is detected if the voltage memory is disabled and if the pre-orientation is active (set under SCDD: Trip bias), otherwise the directional decision is blocked. The following signal is issued:

SCDD: Forw. w/o measurem.

These signals are additionally delivered to the following signals:

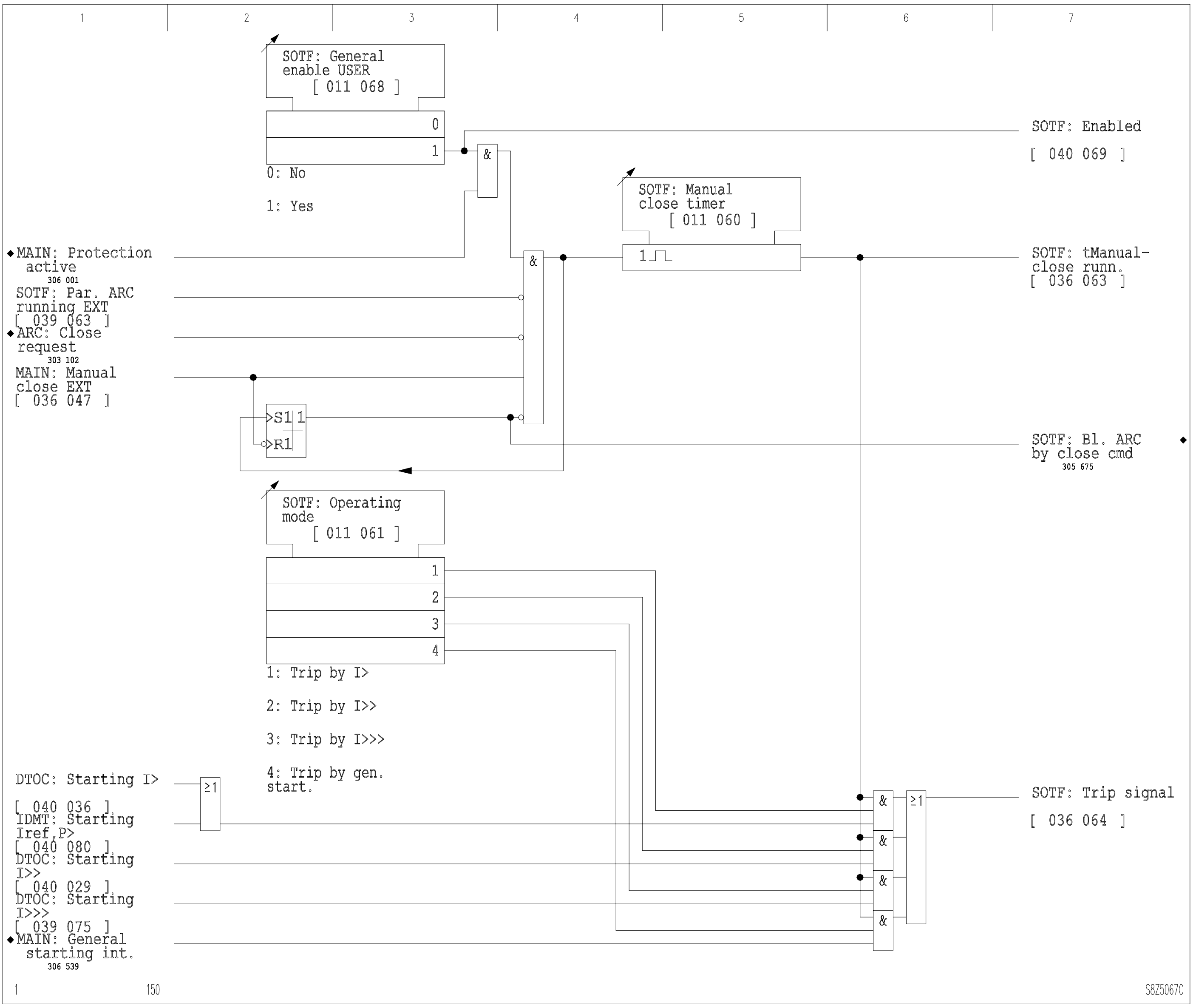
SCDD: Fault P forward
SCDD: Fault P backward
SCDD: Fault P Fault P or G forwd.
SCDD: Fault P Fault P or G backw.

3.26 Switch on to Fault Protection (Function Group SOTF)

When the circuit breaker is closed manually, it is possible to switch on to an existing fault. This is particularly critical since the time-overcurrent protection would not clear the fault until after the set operate delay had elapsed. In this situation, however, the fastest possible clearance is desired.

To ensure rapid clearing with manual closing, the manual close signal must be issued not only to the circuit breaker but also to the P132 at the same time. If there is no close request from the ARC and if no HSR cycle of an external auto-reclosure control is running, an adjustable timer stage is started with the manual close command. By setting a parameter, the user can choose which of the time-overcurrent protection starting decisions will generate a trip signal while the timer stage is elapsing:

An internal blocking signal is generated with the starting signal for the timer stage. This signal prevents the ARC from being activated when a manual close causes switching on to a fault.



3-147 *Switch on to fault protection. (IDMT stands for IDMT1 and IDMT2; the address applies to IDMT1.)*

3.27 Protective Signaling (Function Group PSIG)

Protective signaling

Protective signaling is used together with short-circuit direction determination in power systems with single-side infeed and a subsequent parallel line configuration (line section). Selective instantaneous clearing of the line section affected by the fault is initiated by this function, while the IDMT or DTOC tripping times are bypassed.

Disabling or enabling protective signaling

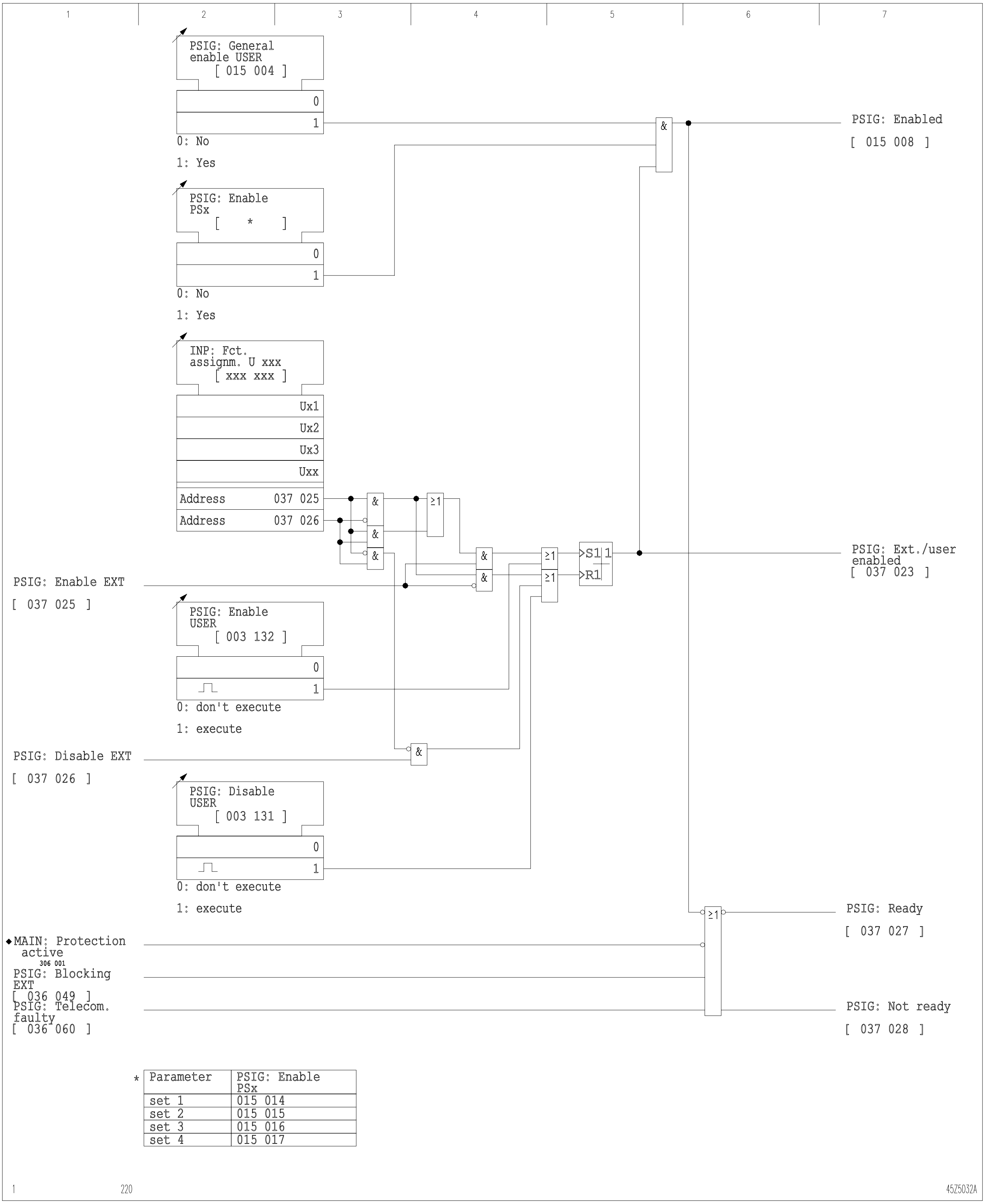
The function can be disabled or enabled by setting or through binary signal inputs.

Activation is enabled independent of parameter subset via PSIG: General enable USER. Activation is enabled for parameter subset PSx via PSIG: Enable PSx. Subsequently, protective signaling can be enabled by setting or through appropriately configured binary signal inputs. Enabling either by setting or through binary signal inputs is equally effective. If only PSIG: Enable EXT is assigned to a binary signal input then protective signaling will be enabled by a positive edge of the input signal; it will be disabled by a negative edge. If only PSIG: Disable EXT is assigned to a binary signal input then a signal present at the input will have no effect.

Readiness of the protective signaling function

In order for protective signaling (PSIG) to function, the following requirements must be satisfied:

- ☐ It must be activated.
- ☐ There is no external block
- ☐ There is no transmission fault.

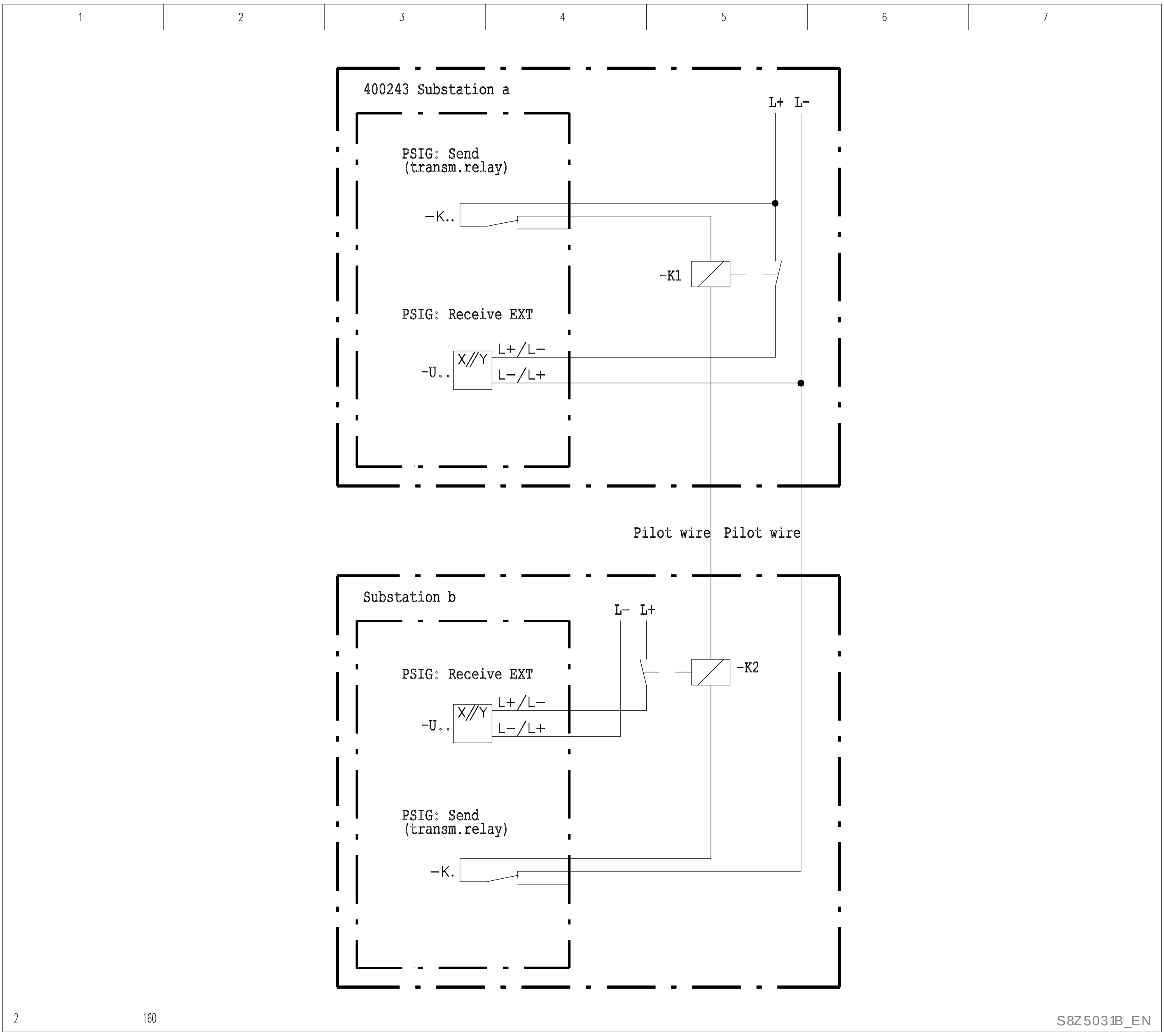


Parameter	PSIG: Enable PSx
set 1	015 014
set 2	015 015
set 3	015 016
set 4	015 017

3-148 *Protective signaling ready to operate*

Forming the communication link

To form the communication link it is necessary to connect either the break contact or the make contact of the transmitting relay, depending on the transmitting relay mode selected (‘*Transm. relay make contact*’ or ‘*Transm. relay break contact*’), to the PSIG: Receive EXT input of the remote station by means of pilot wires (see ‘Installation and Connection’ and Figure 3-148). With both operating modes, a receive signal (DC loop closed) is present in both protection devices in the idle state.



3-149 *Protective signaling using pilot wires, selected mode of operation: transmission relay break contact*

Operation of the protective signaling function

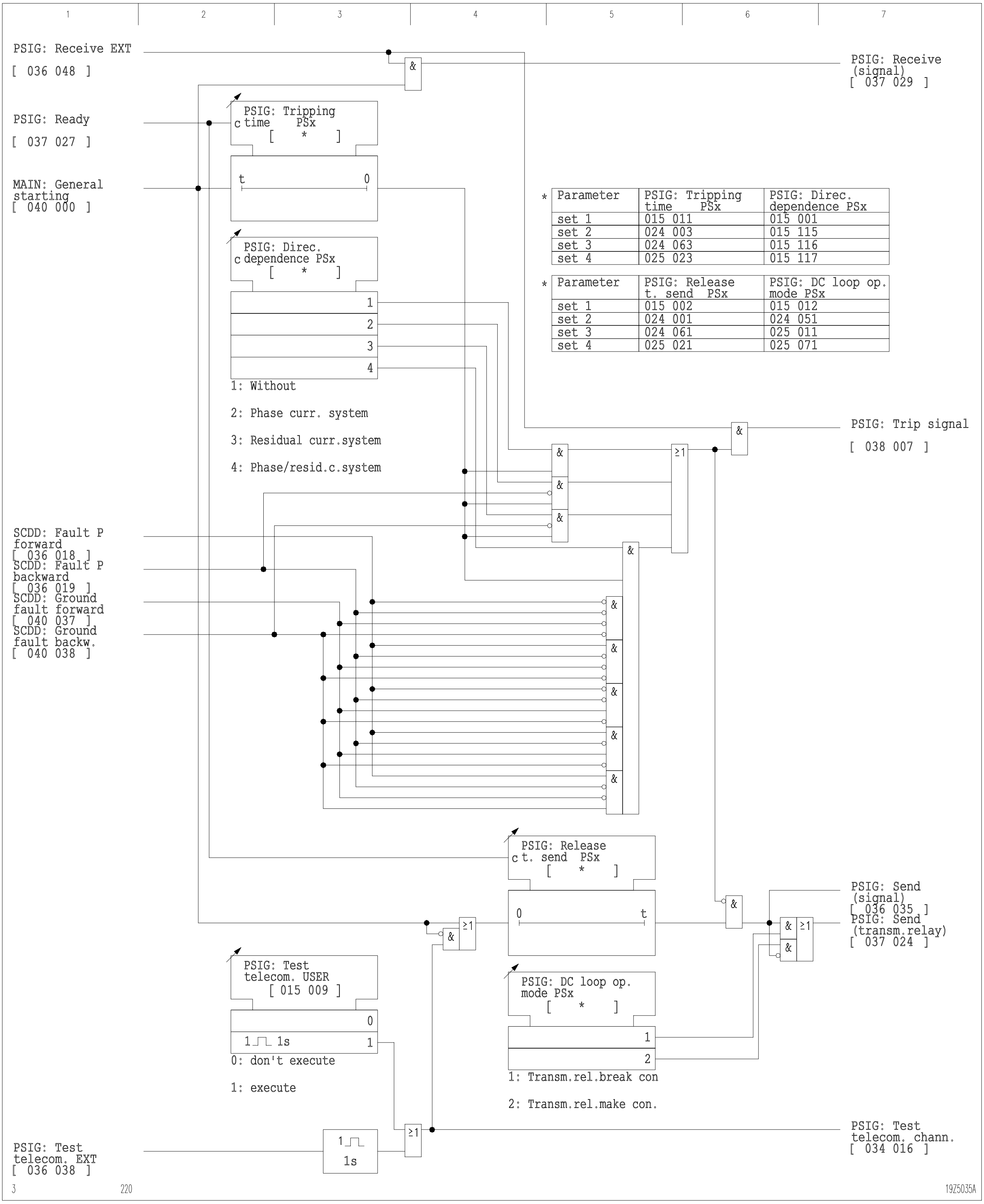
If a general starting condition begins, then the loop is opened without delay (transmitting). When a general starting signal is present and the set starting time has elapsed, loop reclosing takes place as follows in accordance with the mode selected at `PSIG: Direct. depend. PSx` and as a function of the direction decisions:

- ☐ Independently of any direction decision
- ☐ As a function of the condition that there not be any direction decision in the backward direction of the phase current stage
- ☐ As a function of the condition that there not be any direction decision in the backward direction of the residual current stage
- ☐ As a function of whether one of the following conditions in the table is satisfied (if one line of statements is true, then one condition is satisfied):

Fault Residual current stage Backwards	Fault Residual current stage Forwards	Fault Phase current stage Backwards	Fault Phase current stage Forwards
no	no	no	no
no	no	no	yes
no	yes	no	no
no	yes	no	yes
yes	no	no	yes

After the loop has reclosed and provided that both a general starting condition and a status signal through the `PSIG: Receive EXT` input of a closed loop are present, then the signal `PSIG: Trip by PSIG` is generated without delay. The loop recloses after dropout of the general starting condition and after a delay equal to the release time that can be set at `PSIG: Release t. send. PSx`.

If protective signaling is not ready, the DC loop will be open if *Transm. relay make contact* has been selected as operating mode for the transmitting relay or closed if *Transm. relay break contact* has been selected.



* Parameter	PSIG: Tripping time PSx	PSIG: Direc. dependence PSx
set 1	015 011	015 001
set 2	024 003	015 115
set 3	024 063	015 116
set 4	025 023	015 117

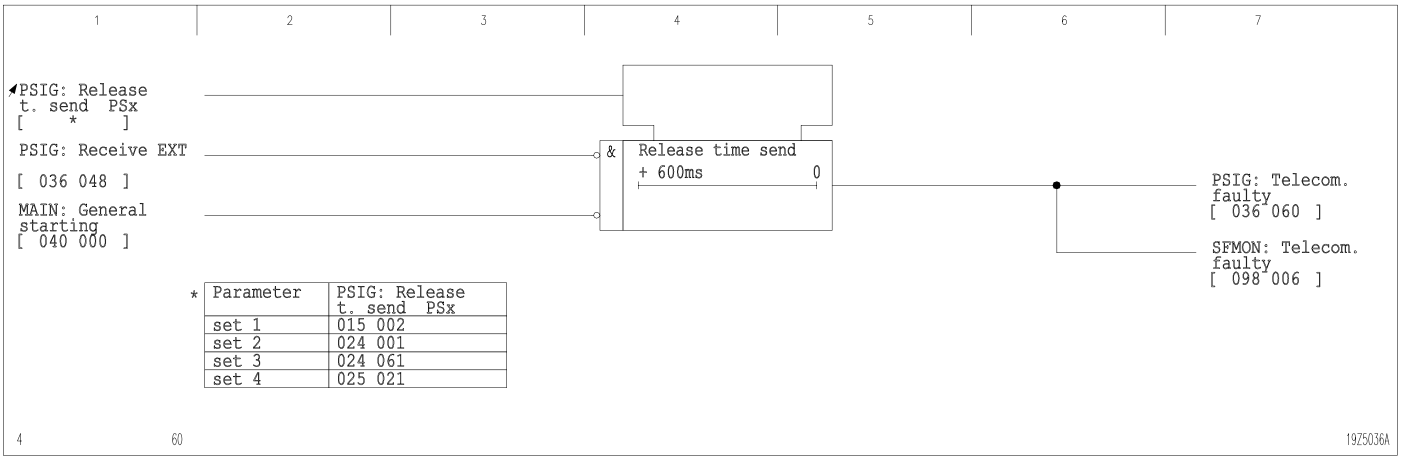
* Parameter	PSIG: Release t. send PSx	PSIG: DC loop op. mode PSx
set 1	015 002	015 012
set 2	024 001	024 051
set 3	024 061	025 011
set 4	025 021	025 071

3-150 Protective signaling logic

Protective signaling monitoring and loop check

The pilot wires are monitored for interruptions. If, in fault-free operation (i.e., in the absence of a general starting condition), no signal is received through the loop for a period longer than the set release time of the transmitting relay + 600 ms, then the signal PSIG: Telecom. faulty is issued (see Figure 3-150). A communication malfunction or failure leads to a protective signaling block.

To check the loop, the communications link can be opened via a user interface by means of the function PSIG: Test telecom. USER.



* Parameter	PSIG: Release t. send PSx
set 1	015 002
set 2	024 001
set 3	024 061
set 4	025 021

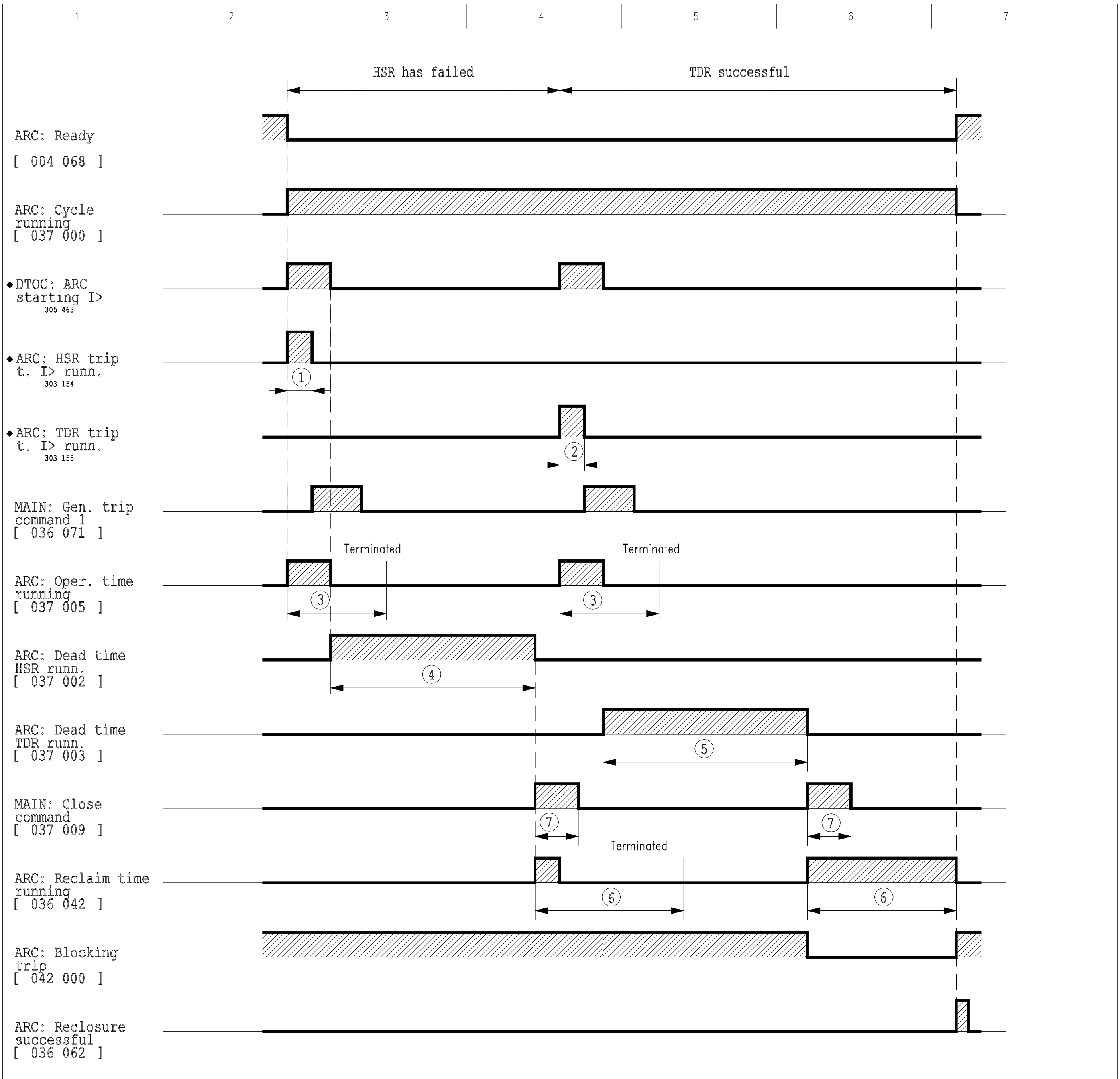
3-151 *Faulty transmission channel of protective signaling*

3.28 Auto-Reclosure Control (Function Group ARC)

Under certain conditions the automatic reclosure control function (ARC) will cause a line section to be cleared and then, when the dead time has elapsed, automatic reclosure of the line section will occur.

Figure 3-152 shows an example for the usual sequence of a failed high-speed reclosure (HSR) followed by a subsequent successful time-delay reclosure (TDR).

3 Operation
(continued)



	①	②	③	④	⑤	⑥
* Parameter	ARC: HSR trip. time I> PSx	ARC: TDR trip. time I> PSx	ARC: Operative time PSx	ARC: HSR dead time PSx	ARC: TDR dead time PSx	ARC: Reclaim time PSx
set 1	015 072	015 073	015 066	015 056	015 057	015 054
set 2	024 040	024 041	024 035	024 030	024 031	024 028
set 3	025 000	025 001	024 095	024 090	024 091	024 088
set 4	025 060	025 061	025 055	025 050	025 051	025 048

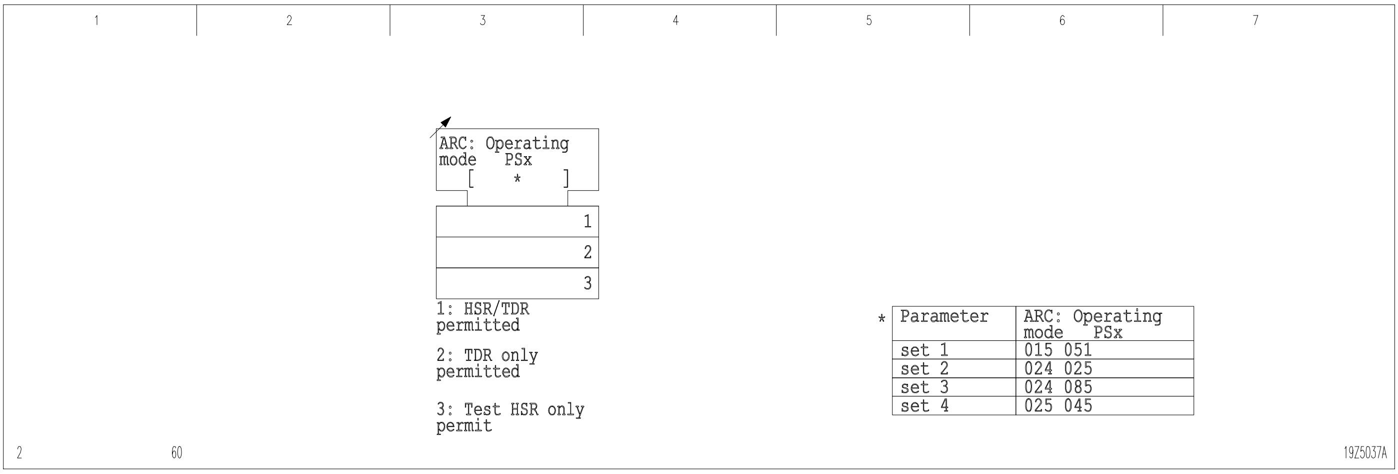
⑦ MAIN: Close cmd.pulse time [015 067]
ARC: No. permit. TDR PSx Setting: 1

1 205 19Z5041A

3-152 *Example for an ARC sequence*

ARC operating modes

The ARC function available in the P132 offers the possibility of triggering starting times with different starting signals. Once the starting times have elapsed, a trip signal is generated. Multiple reclosures are possible with the ARC function available in the P132. When the ARC operating mode has been set accordingly, multiple reclosures first begin with a high-speed reclosure (HSR). If the fault is not cleared after reclosure by a HSR, then another attempt can be made to clear the fault with a time-delay reclosure (TDR). Multiple reclosures using only TDRs are also possible if the ARC operating mode is set accordingly.



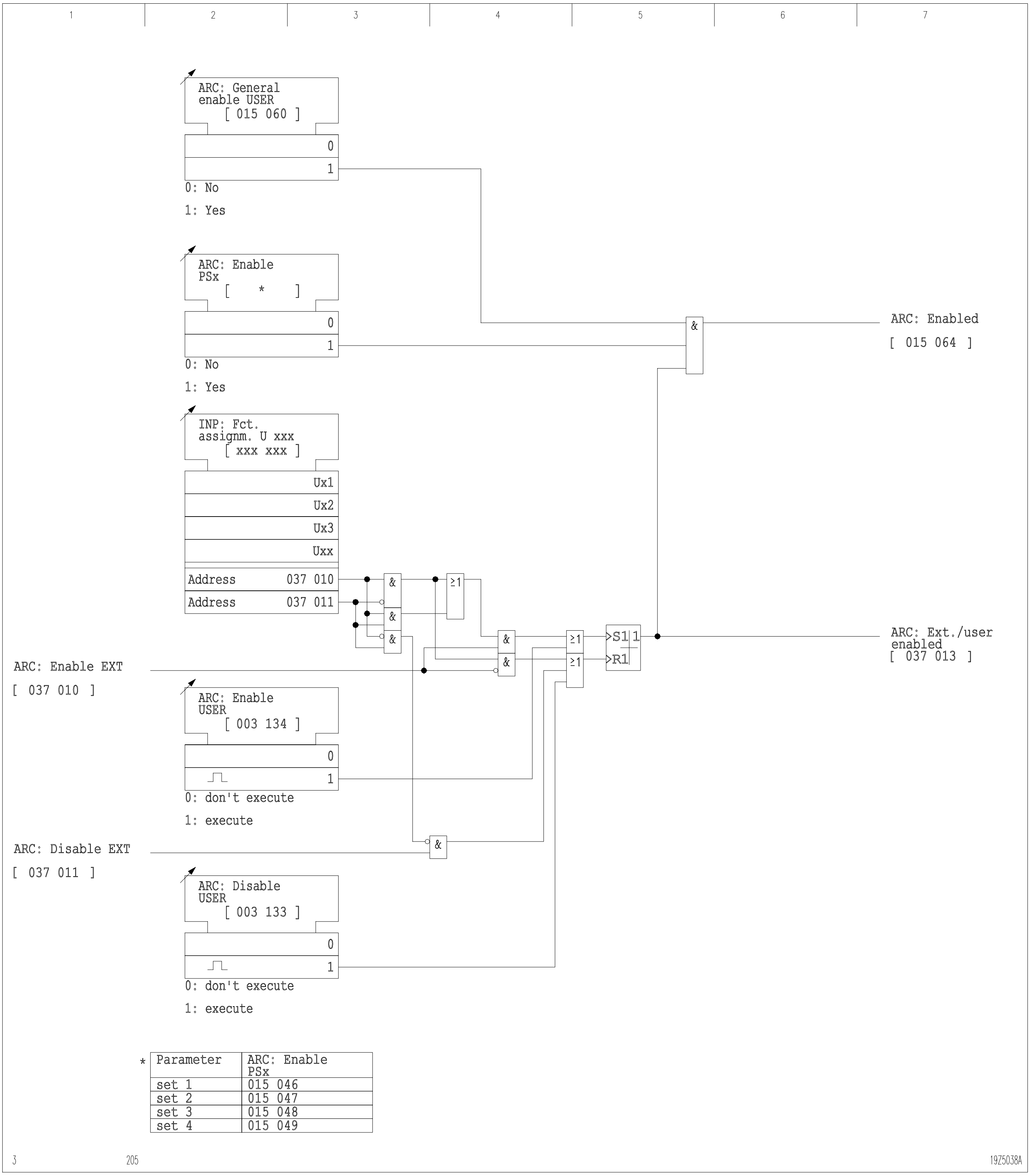
* Parameter	ARC: Operating mode PSx
set 1	015 051
set 2	024 025
set 3	024 085
set 4	025 045

3-153 Setting the operating mode of the ARC function

Enabling and disabling the ARC function

Disabling or enabling may be carried out with parameters or binary signal inputs.

The activation of the function is enabled generally (independent of parameter subsets) via ARC: General enable USER. It is enabled as a function of a parameter subset via ARC: Enable PSx. If these enabling functions have been activated, the Auto-reclose control function can be disabled or enabled by setting parameters or through appropriately configured binary signal inputs. Parameters and configured binary signal inputs have equal priority. If only the ARC: Enable EXT function is assigned to a binary signal input, then ARC will be enabled by a positive edge of the input signal and disabled by a negative edge. If only the parameter ARC: Disable EXT has been assigned to a binary signal input, then a signal at this input will have no effect.



Parameter	ARC: Enable PSx
set 1	015 046
set 2	015 047
set 3	015 048
set 4	015 049

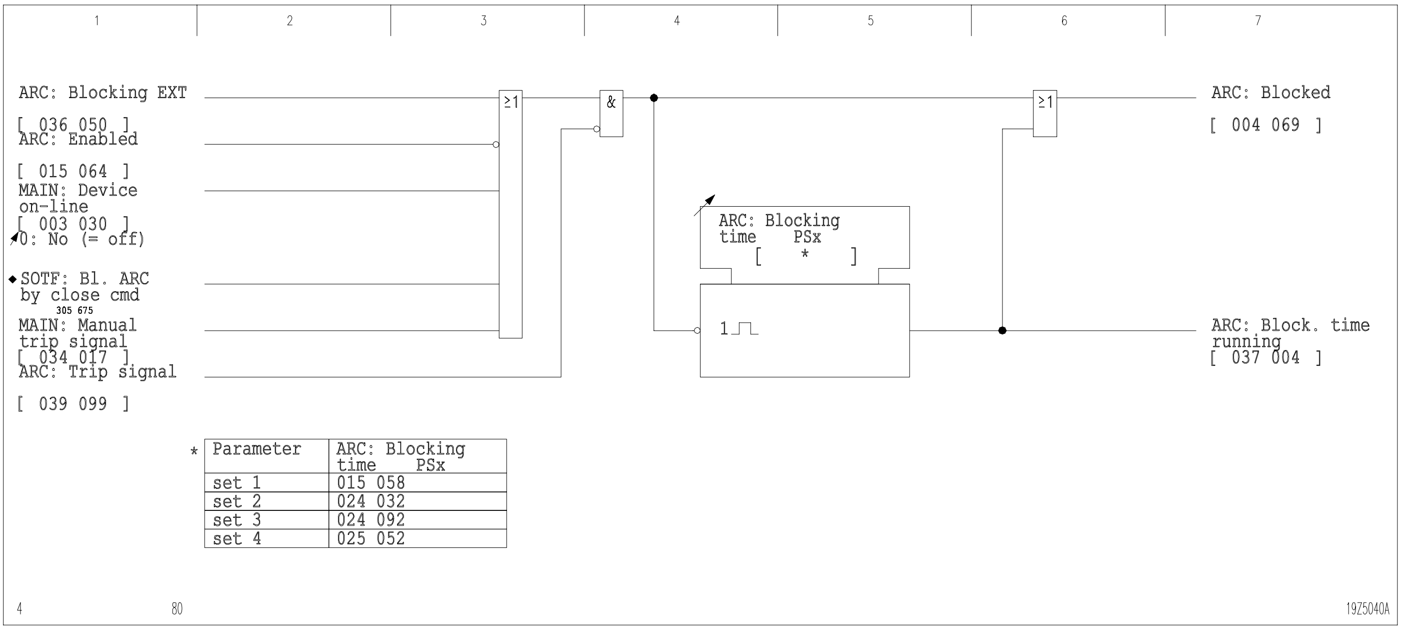
3-154 *Enabling or disabling auto-reclosure control*

ARC blocking

Under certain conditions the ARC will be blocked and the signal ARC: Blocked will be issued, provided that one of the following conditions is met:

- ☐ A blocking signal is present because of a manual close.
- ☐ An external signal ARC: Blocking EXT is present.
- ☐ ARC is disabled.
- ☐ Protection is disabled (off).
- ☐ A manual trip command is issued via setting parameter.

When all blocking conditions have been removed, the blocking time is started. When the blocking time has elapsed, ARC blocking is canceled.

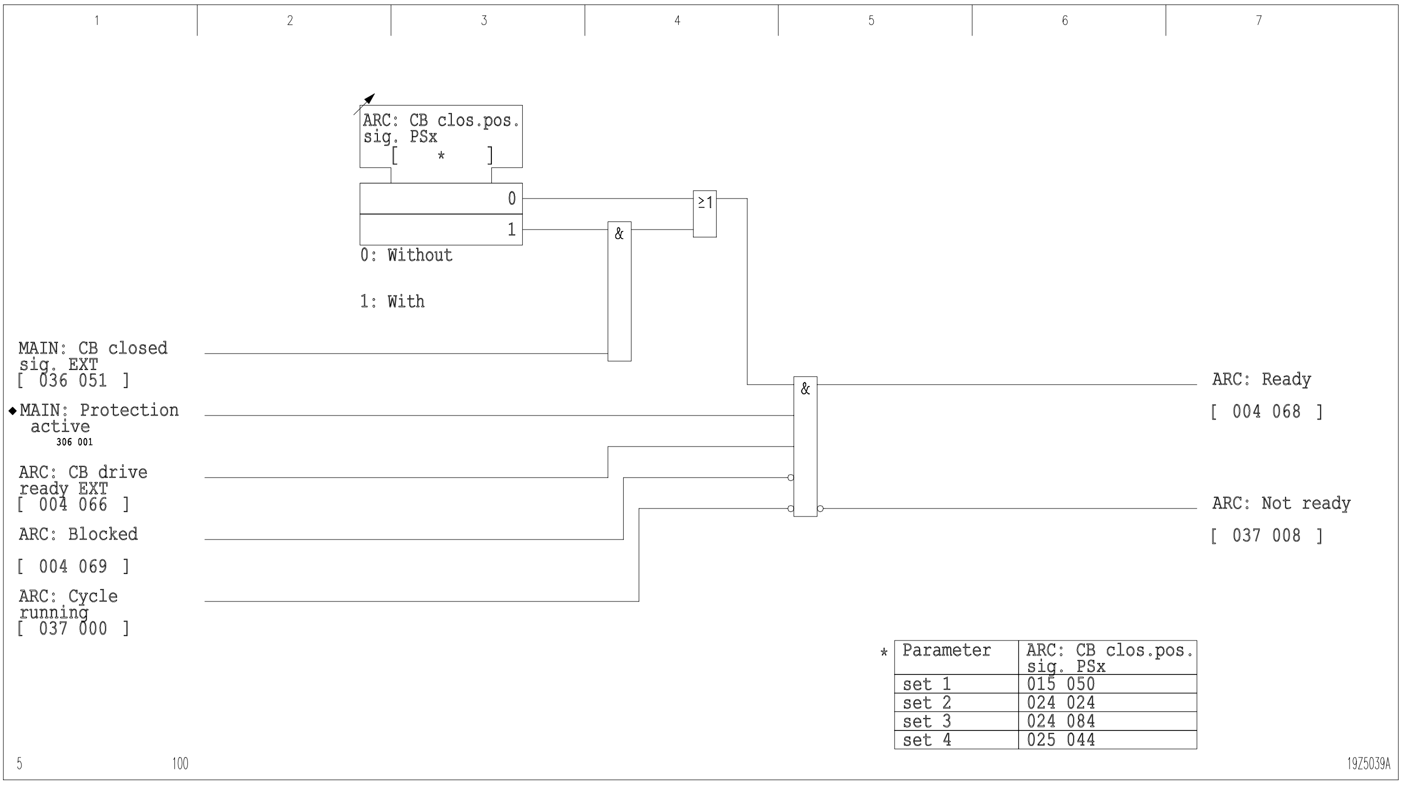


3-155 ARC blocking

ARC ready to operate

An ARC cycle can only start if the ARC is ready. For this purpose the following conditions need to be met simultaneously:

- ☐ Protection is activated (on).
- ☐ ARC is not blocked.
- ☐ The circuit breaker must be capable of opening and closing again (CB opening & closing drive is ready).
- ☐ The circuit breaker contacts must be in closed position (closed position scanning is optional).
- ☐ No ARC cycle is running.



* Parameter	ARC: CB clos.pos. sig. PSx
set 1	015 050
set 2	024 024
set 3	024 084
set 4	025 044

3-156 ARC ready to operate

Tripping times

When protection functions operating with auto-reclosure control are started, the tripping times (HSR or TDR) are started together with the operative time. If the tripping time has elapsed during an active ARC cycle while the operative time is still running, a trip signal is issued. The HSR or TDR trip time having caused the trip signal also determines which dead time (HSR or TDR) is to be triggered. Once the dead time commences, all tripping times already triggered and the operative time will be terminated.
The beginning of the following starts or input signals trigger the tripping times provided that the starting conditions are met and the respective tripping times are not "blocked".
If short-circuit direction determination (SCDD) is enabled, then some of the starting signals are directional:

☐	DTOC starting I>	(directional)
☐	DTOC starting I>>	(directional)
☐	DTOC Starting I>>>	
☐	DTOC starting I_N>	(directional)
☐	DTOC starting I_N>>	(directional)
☐	DTOC Starting I_N>>>	
☐	DTOC1 Starting Iref,P>	(directional)
☐	DTOC1 Starting Iref,N>	(directional)
☐	DTOC1 Starting Iref,neg>	
☐	Start by programmable logic	

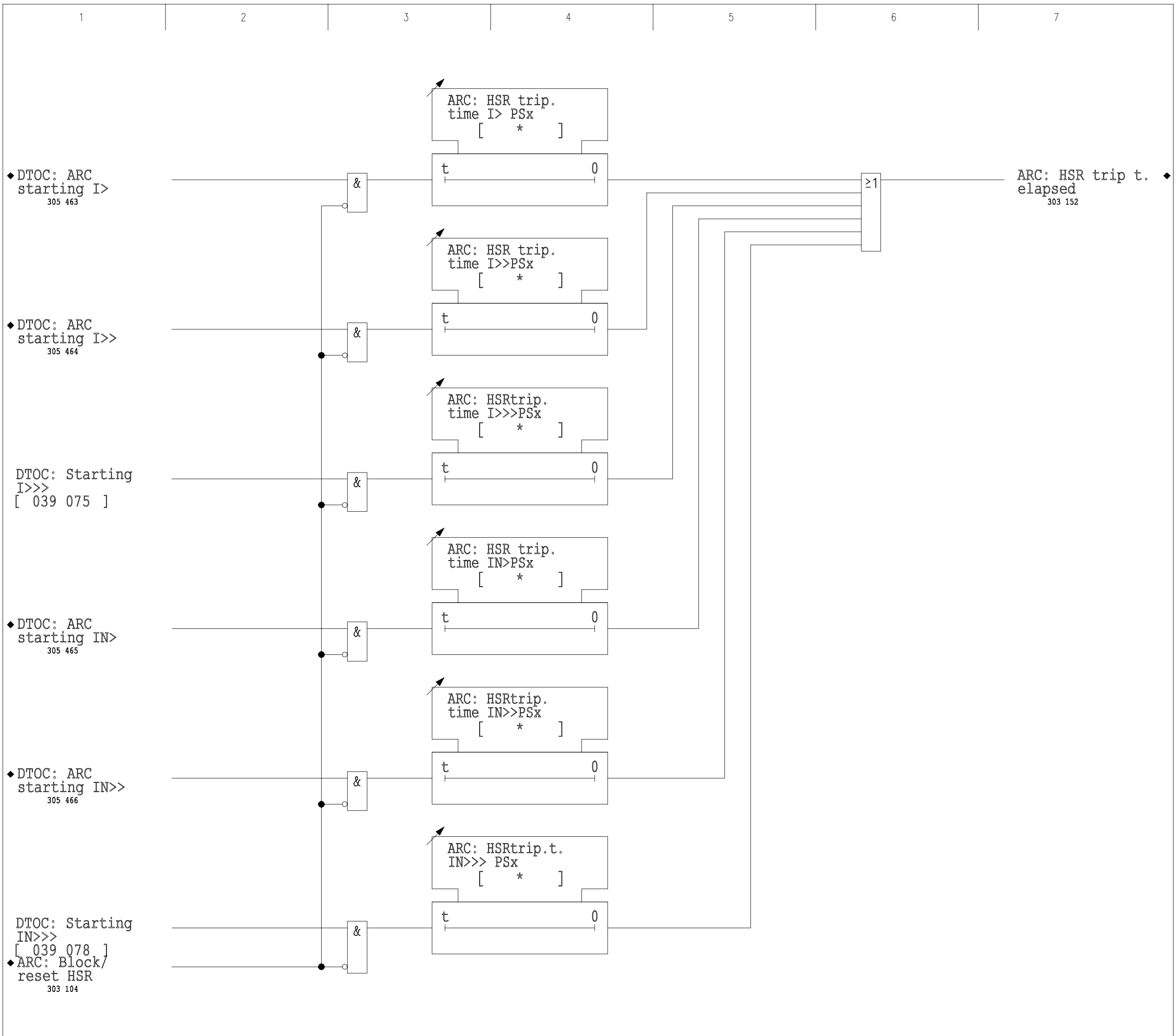
☐ General starting

☐ Ground fault direction determination by steady-state values (GFDSS) has operated and detected one of the following faults:
  - GFDSS starting fault 'forward/LS'
  - GFDSS starting Y(N)>
  - GFDSS starting fault 'forward/LS' or GFDSS starting Y(N)>

If - in the operating mode *"HSR/TDR permitted"* - only one of the starting conditions listed above applies, then the first trip signal is always generated by the HSR trip time stage, regardless of the duration of the HSR or TDR tripping time setting. HSR precedes TDR. If more than one starting is present then the trip signal will be issued after the HSR tripping time that has elapsed first. As an exception, a TDR will be triggered first after having elapsed first, if the associated HSR tripping time is set to *'Blocked'*.

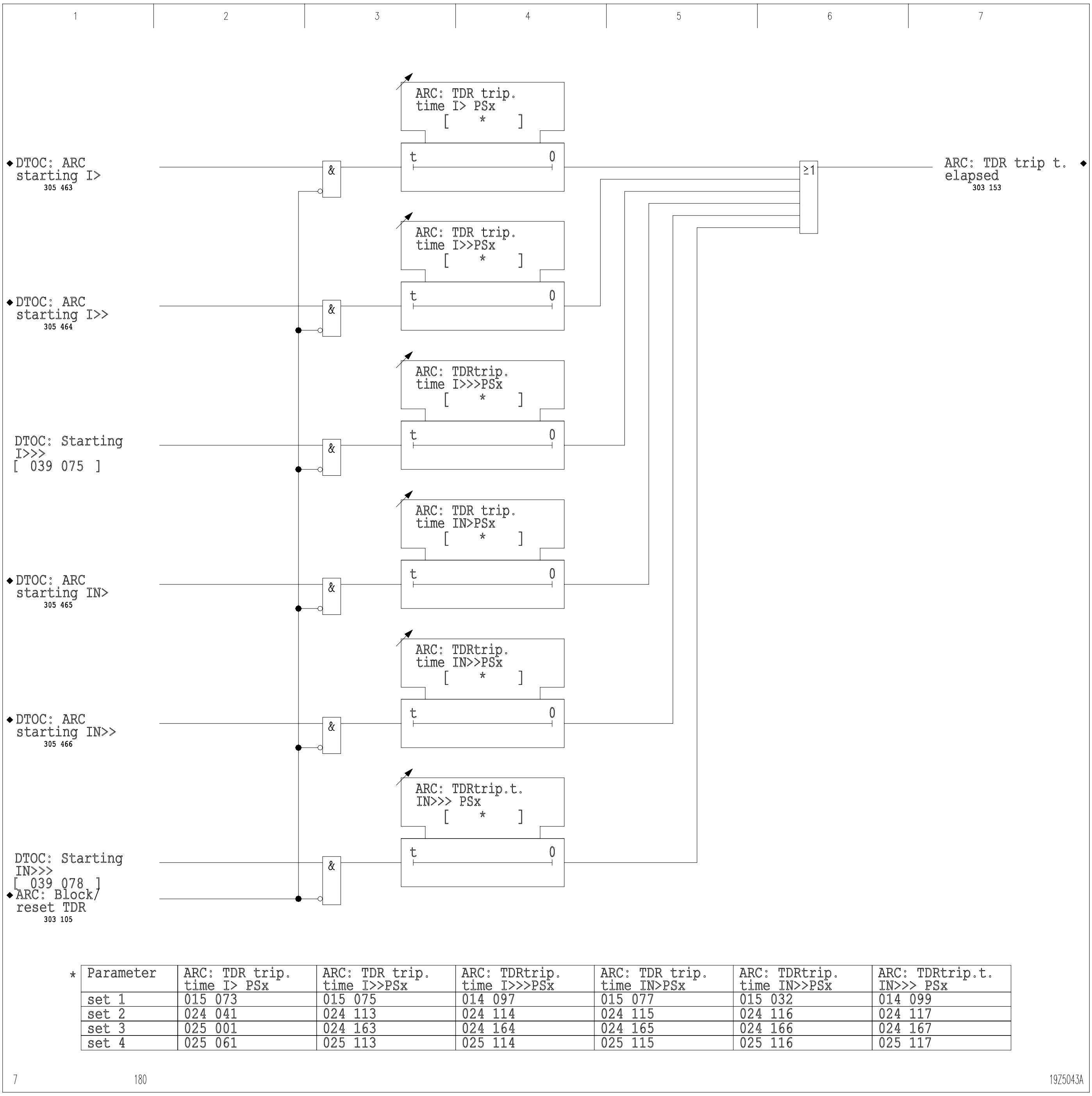
If the trip signal has been generated by a TDR tripping time stage, then no HSR will be initiated within the same ARC cycle.

The ARC trip signal must be included in the ‘m out of n’ selection of the trip commands.



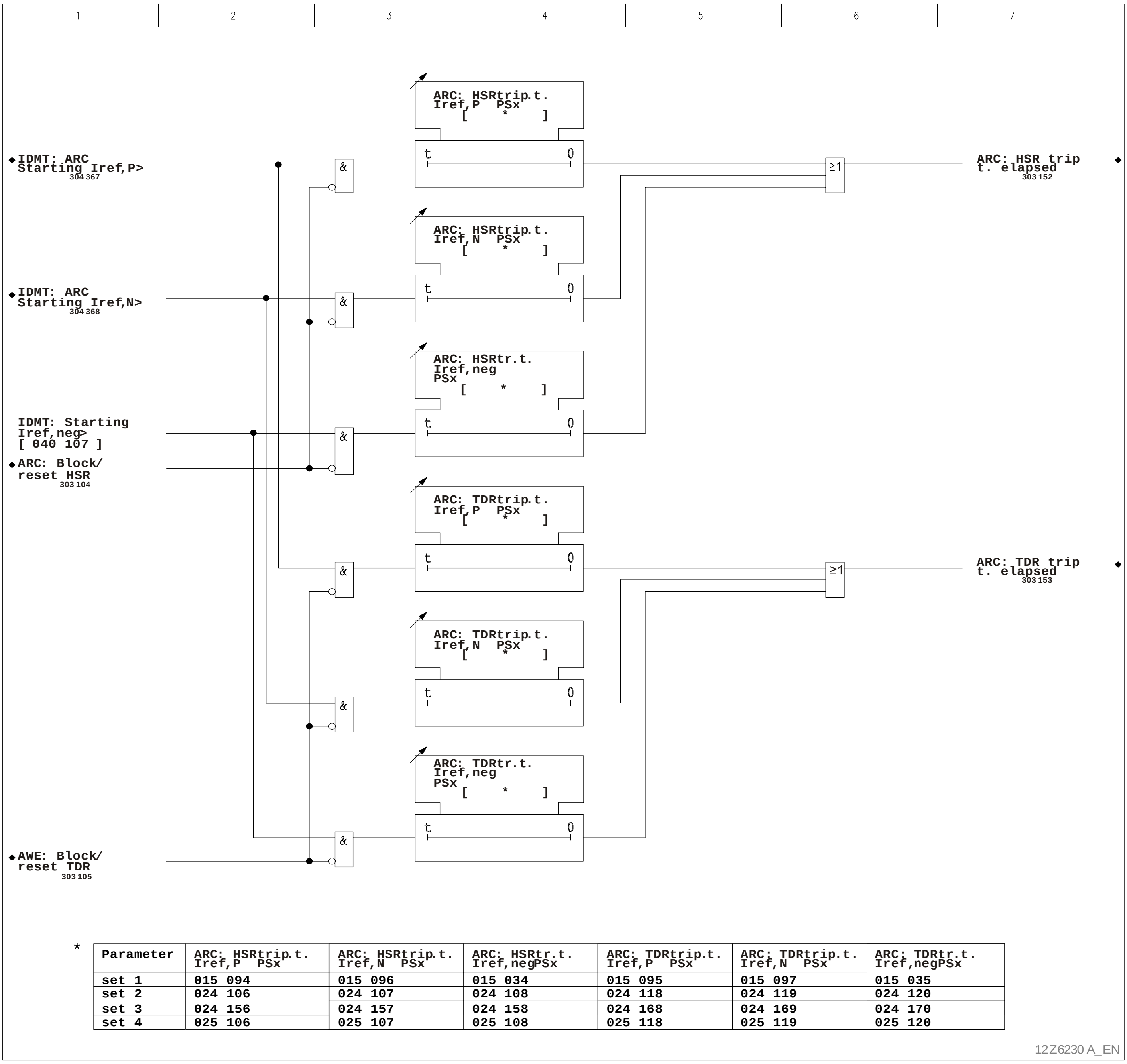
* Parameter	ARC: HSR trip. time I> PSx	ARC: HSR trip. time I>>PSx	ARC: HSRtrip. time I>>>PSx	ARC: HSR trip. time IN>PSx	ARC: HSRtrip. time IN>>PSx	ARC: HSRtrip.t. IN>>> PSx
set 1	015 072	015 074	014 096	015 076	015 031	014 098
set 2	024 040	024 101	024 102	024 103	024 104	024 105
set 3	025 000	024 151	024 152	024 153	024 154	024 155
set 4	025 060	025 101	025 102	025 103	025 104	025 105

3-157 Tripping time, part 1



Parameter	ARC: TDR trip. time I> PSx	ARC: TDR trip. time I>>PSx	ARC: TDRtrip. time I>>>PSx	ARC: TDR trip. time IN>PSx	ARC: TDRtrip. time IN>>PSx	ARC: TDRtrip.t. IN>>> PSx
set 1	015 073	015 075	014 097	015 077	015 032	014 099
set 2	024 041	024 113	024 114	024 115	024 116	024 117
set 3	025 001	024 163	024 164	024 165	024 166	024 167
set 4	025 061	025 113	025 114	025 115	025 116	025 117

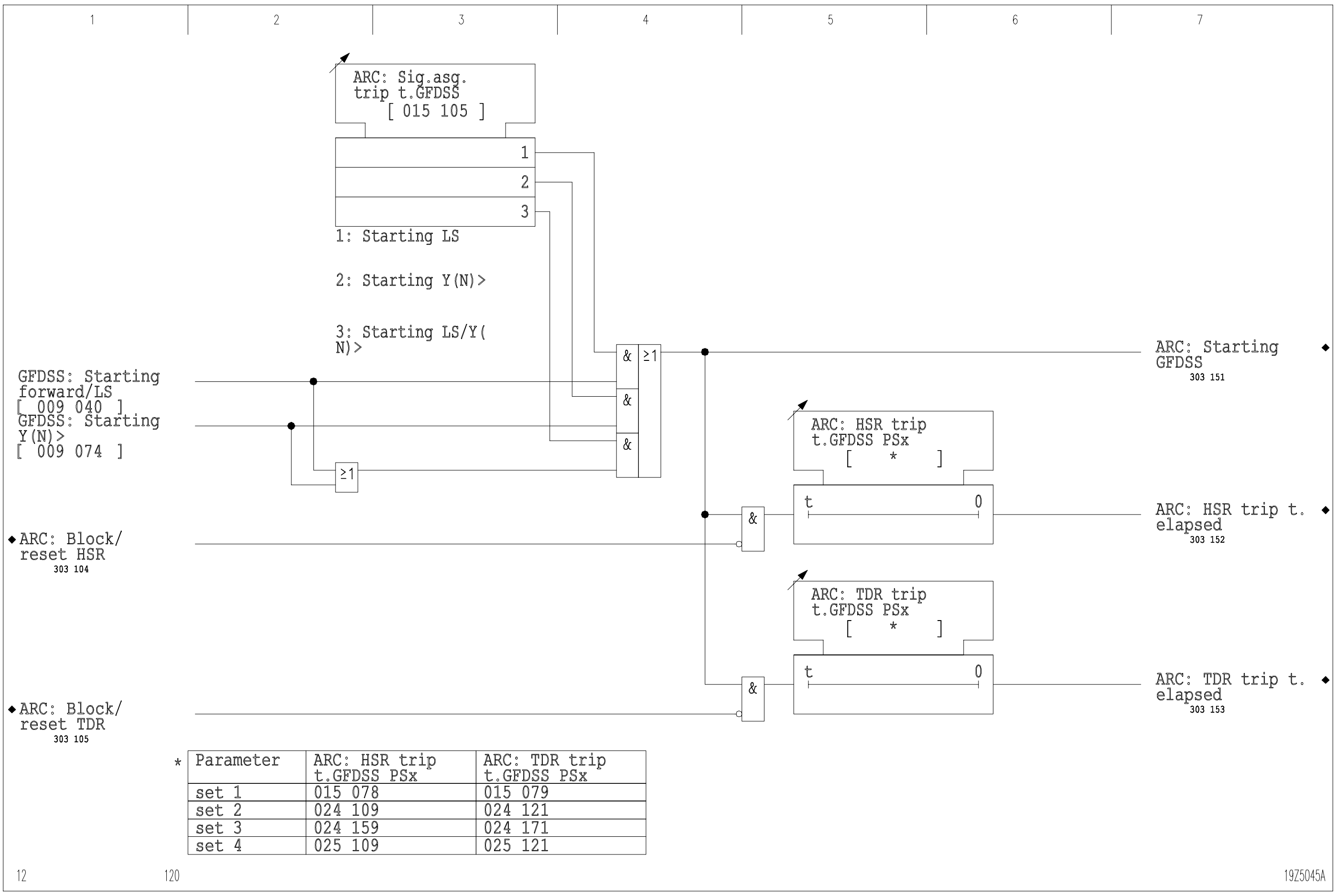
3-158 Tripping time, part 2



*

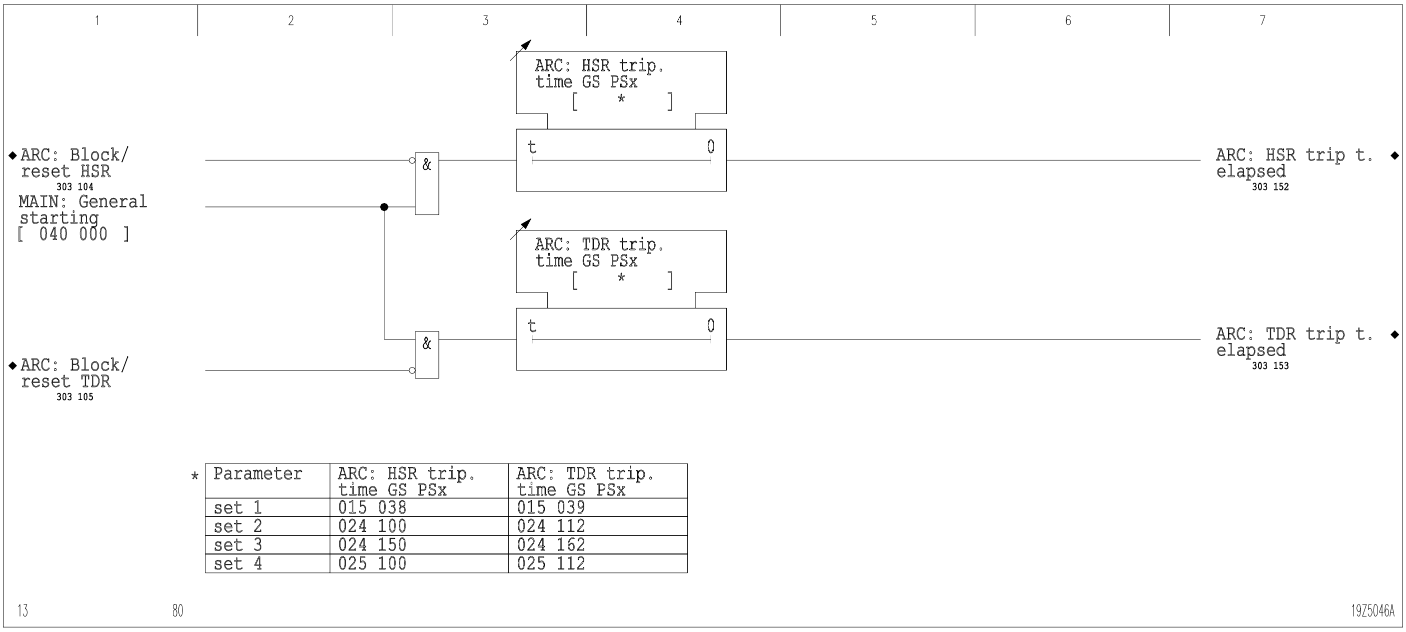
Parameter	ARC: HSRtrip.t. Iref,P PSx	ARC: HSRtrip.t. Iref,N PSx	ARC: HSRtr.t. Iref,negPSx	ARC: TDRtrip.t. Iref,P PSx	ARC: TDRtrip.t. Iref,N PSx	ARC: TDRtr.t. Iref,negPSx
set 1	015 094	015 096	015 034	015 095	015 097	015 035
set 2	024 106	024 107	024 108	024 118	024 119	024 120
set 3	024 156	024 157	024 158	024 168	024 169	024 170
set 4	025 106	025 107	025 108	025 118	025 119	025 120

3-159 Tripping time, part 3 (In this figure IDMT represents IDMT1)



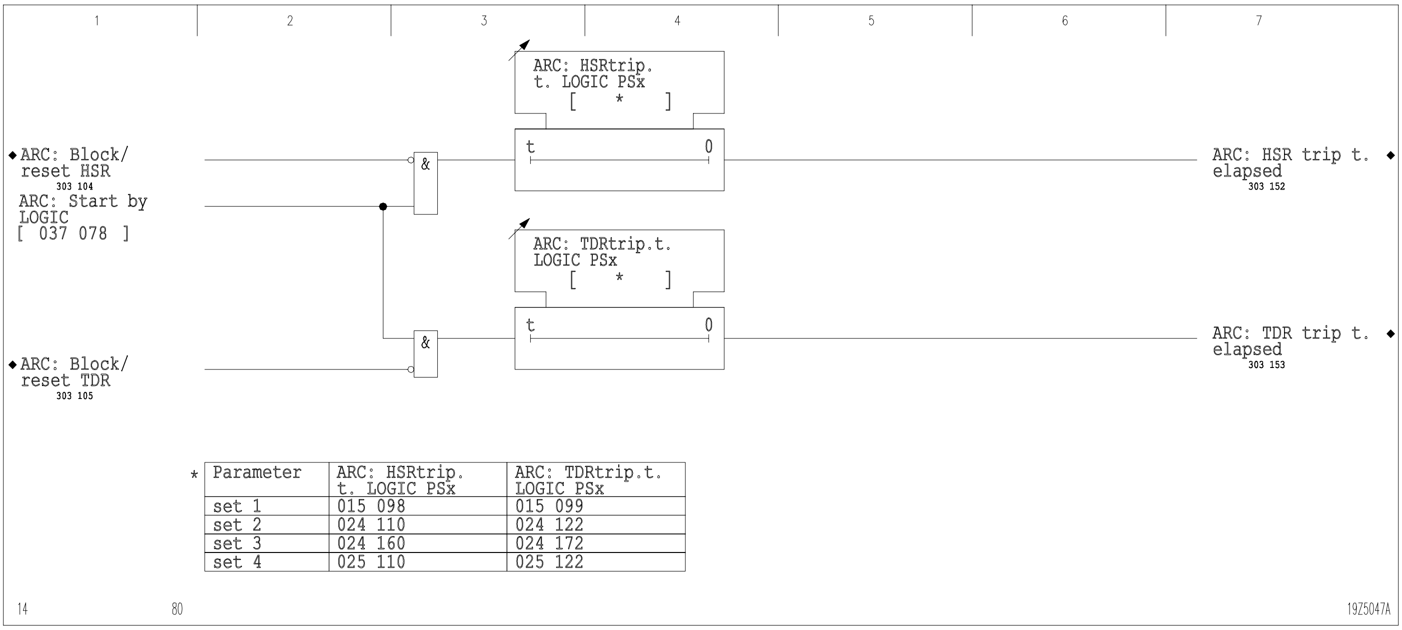
Parameter	ARC: HSR trip t.GFDSS PSx	ARC: TDR trip t.GFDSS PSx
set 1	015 078	015 079
set 2	024 109	024 121
set 3	024 159	024 171
set 4	025 109	025 121

3-160 Tripping time, part 4



Parameter	ARC: HSR trip. time GS PSx	ARC: TDR trip. time GS PSx
set 1	015 038	015 039
set 2	024 100	024 112
set 3	024 150	024 162
set 4	025 100	025 112

3-161 Tripping time, part 5



Parameter	ARC: HSRtrip. t. LOGIC PSx	ARC: TDRtrip.t. LOGIC PSx
set 1	015 098	015 099
set 2	024 110	024 122
set 3	024 160	024 172
set 4	025 110	025 122

3-162 Tripping time, part 6

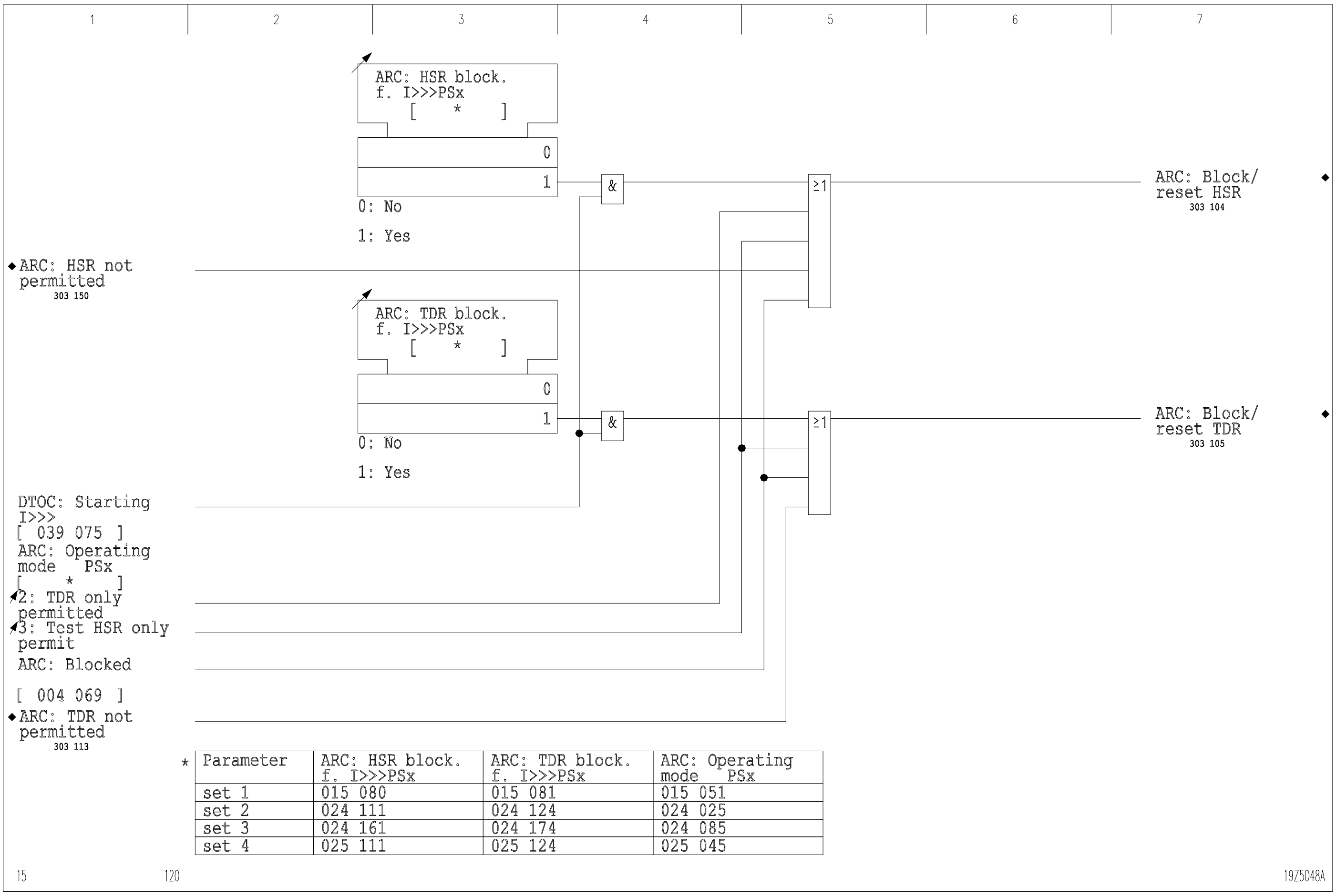
Blocking and resetting the tripping times

Except by the setting value *"Blocked"* the HSR tripping time stages are blocked or reset by one of the following conditions:

- ☐ With ARC: Operating mode PSx set to *"Test HSR only permitted"*
- ☐ I>>> starting is present and ARC: HSR blocking by I>>> PSx has been selected.
- ☐ With ARC: Operating mode PSx set to *'TDR only permitted'*.
- ☐ An HSR is not permitted because an HSR or TDR has already occurred within the current ARC cycle.
- ☐ The ARC is blocked.

Except by the setting value *"Blocked"* the TDR tripping time stages are blocked or reset by one of the following conditions:

- ☐ With ARC: Operating mode PSx set to *'Test HSR only permitted'*.
- ☐ I>>> starting is present and ARC: TDR blocking by I>>> PSx has been selected.
- ☐ The ARC is blocked.
- ☐ The number of permitted TDRs has been reached and thus no further TDRs are permitted.



* Parameter	ARC: HSR block. f. I>>>PSx	ARC: TDR block. f. I>>>PSx	ARC: Operating mode PSx
set 1	015 080	015 081	015 051
set 2	024 111	024 124	024 025
set 3	024 161	024 174	024 085
set 4	025 111	025 124	025 045

3-163 *Blocking and resetting the tripping time stages*

ARC cycle

An ARC cycle begins, provided that the starting condition is met, with the presence of a relevant starting option (DTOC/IDMT starting, starting via programmable logic, GFDSS, or start of a test HSR), as long as the signal ARC: Ready is present at this time. As the ARC cycle proceeds, the signal ARC: Ready is no longer taken into account.

An ARC cycle is running if the ARC is not blocked and one of the following conditions is met:

- ☐ The operative time is running.
- ☐ A dead time is running.
- ☐ The reclaim time is running.

Blocking the DTOC or IDMT protection function, the GFDSS function, and programmable logic

If the ARC is ready, it will block the trip signals of DTOC, IDMT1 and IDMT2 protection as well as the GFDSS function and the programmable logic via the signal ARC: Blocking trip. ARC permits the generation of a trip command by the other protection functions if one of the following conditions is met:

☐ ARC: Cycle running is not applicable, and ARC is not ready.

☐ The final reclaim time is running.

☐ Only an HSR test is permitted (*"Test HSR only permit"*).

☐ ARC is blocked.

☐ The operative time is running during a running tripping time.

☐ A relevant starting type begins while a dead time is running.

☐ One or more starts do not trigger a tripping time stage because the relevant tripping time stages are disabled (t set to *"Blocked"*). If a tripping time stage is started in this condition by an additional starting and as long as no final trip command has been issued, the ARC again generates a trip command.

Example of programmable logic in the ARC

This example (see figure 3-164) illustrates the possible interconnection and the binary signal output for starting the tripping time stage via a binary signal input.

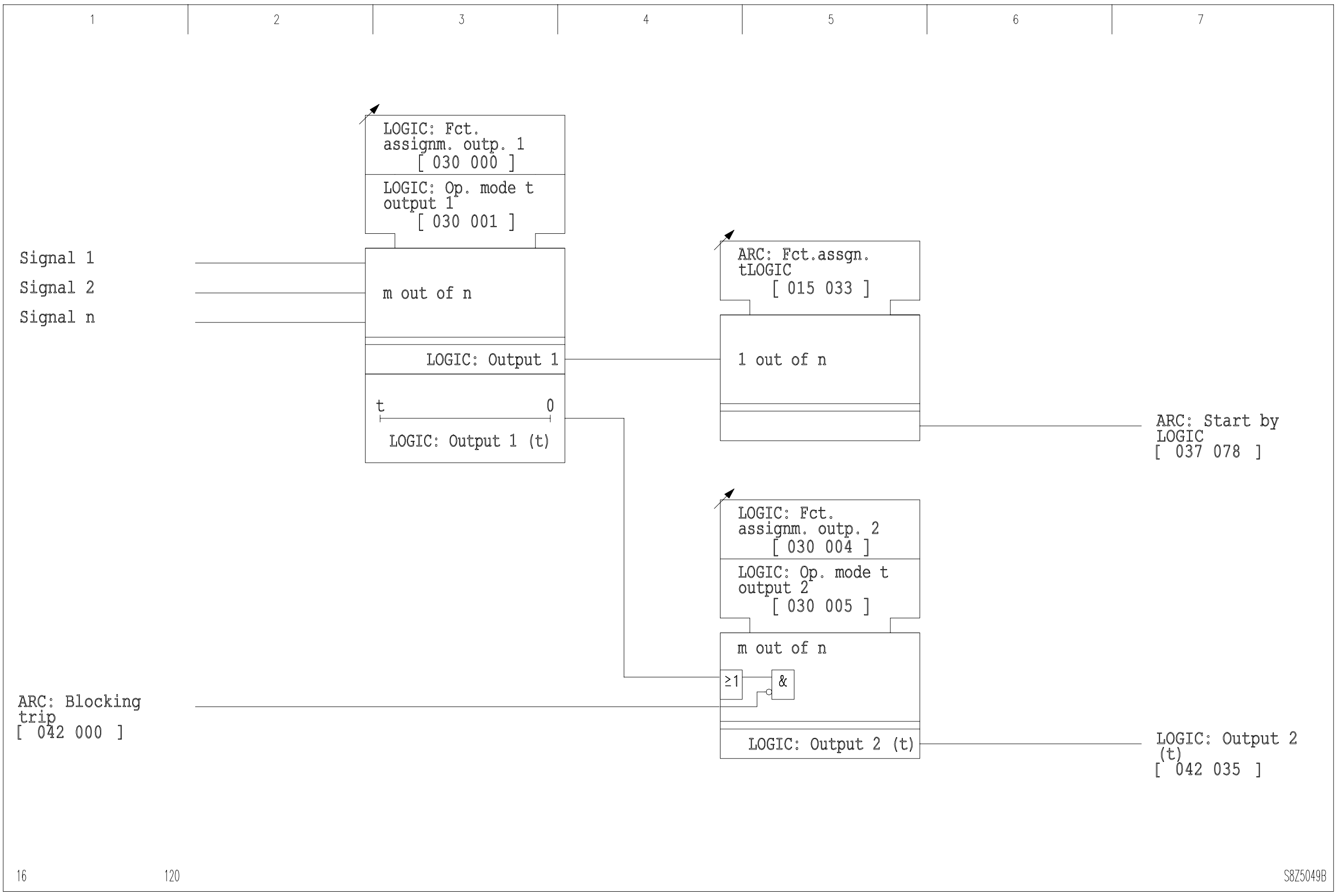
By using the programmable logic a binary signal input with serial operate delay and an AND element is implemented. The function ARC: Blocking trip *'NOT'* has been assigned to the second input on this AND element. The output from the AND element must be included in the configuration of the ‘m out of n’ selection for the general trip command. The tripping time can be started by the output signal ARC: Start by logic.

For this example the following list parameters need to be set from the local control panel (see section ‘Setting a List Parameter’ in Chapter “Local Control”).

	List Parameter	
LOGIC: Fct.assignm. output 1 (address 030 000)	OR	e.g. LOGIC: Input 4 EXT (address 034 003)
LOGIC: Fct.assignm. output 2	OR	LOGIC: Output 1 (t) (address 042 033)
	AND NOT	ARC: Blocking trip (address 042 000)

In general, any equation within the programmable logic function can be used to start the ARC tripping time.

One of the options offered by the programmable logic is the triggering of the ARC by an external protection device.

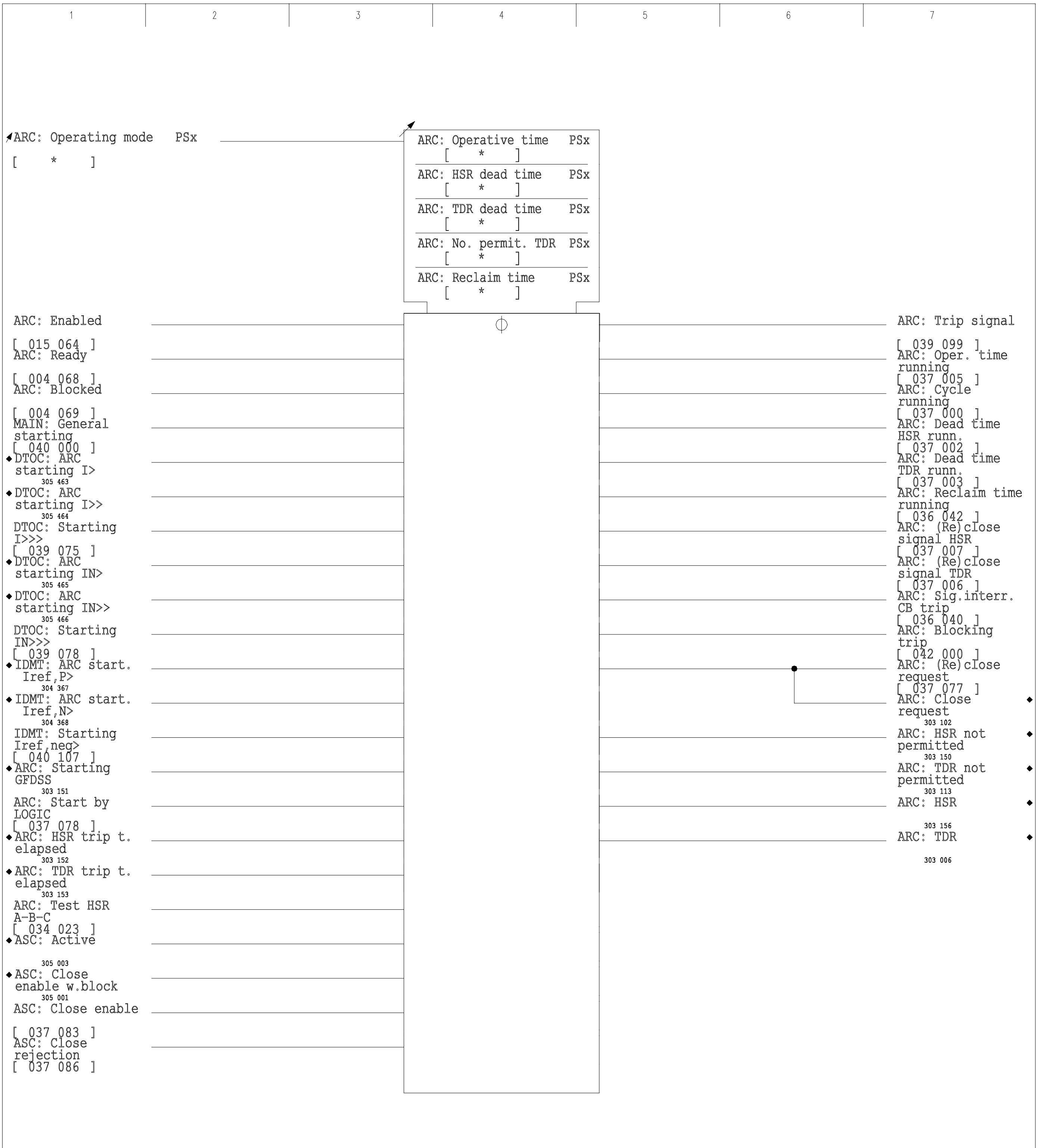


3-164 *Example of programmable logic in the ARC*

General control functions

The entire ARC sequence is monitored and controlled by a sequence control function.

While the ASC function is enabled, reclosure requires a close enable by the ASC function, which implements a check of the synchronism conditions.



* Parameter	ARC: Operating mode PSx	ARC: Operative time PSx	ARC: HSR dead time PSx	ARC: TDR dead time PSx	ARC: No. permit. TDR PSx	ARC: Reclaim time PSx
set 1	015 051	015 066	015 056	015 057	015 068	015 054
set 2	024 025	024 035	024 030	024 031	024 037	024 028
set 3	024 085	024 095	024 090	024 091	024 097	024 088
set 4	025 045	025 055	025 050	025 051	025 057	025 048

14 220 19Z5149A

3-165 *ARC sequence control (In this figure IDMT represents IDMT1.)*

3.28.1 High-Speed Reclosure (HSR)

If the starting conditions are met then any ARC-relevant protection startings will trigger an ARC cycle. The startings set off the associated tripping time stages and the operative time. If an HSR tripping time is running during the operative time then the signal ARC: Trip signal is issued and this signal can lead to a trip command if the function assignment for the trip commands is configured appropriately. With the release of the starting, the operative time is terminated and the HSR dead time begins. If there is no starting during the dead time, a reclosure command is issued once the dead time has elapsed. The reclaim time is started simultaneously. If during the reclaim time there is no starting with trip command, the signal ARC: Reclosure successful is issued and the ARC cycle is terminated once the reclaim time has elapsed.

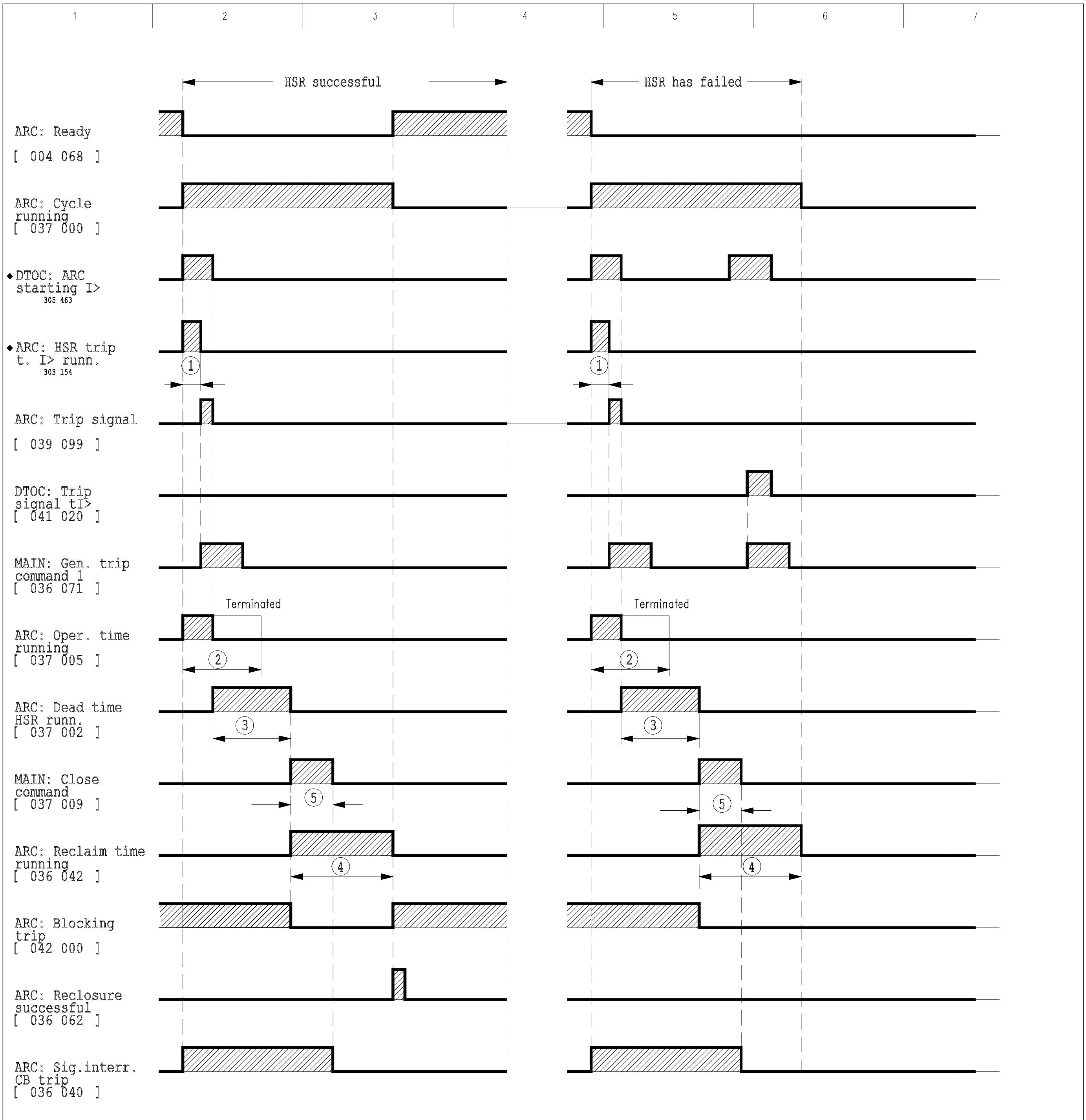
If the HSR does not succeed and another starting occurs then a TDR is started if at least one TDR is permitted. If TDR after HSR is not permitted then the current reclaim time will be the last reclaim time of the ARC cycle. If the last reclaim time has elapsed and another starting occurs then the tripping time stages are no longer started. Instead the signal ARC: Blocking trip is set to a logic value of ‘0’ and a trip by other protection functions is enabled. If a trip signal occurs during the last reclaim time then it will be regarded as a final trip. The ARC cycle is completed after the last reclaim time has elapsed.

When the signal ARC: Cycle running appears, the signal ARC: Sig.interr. CB trip. (interruption breaker trip signal) is issued and it is reset after the final HSR or TDR of the current ARC cycle, once the close command pulse time has elapsed. This signal is also reset immediately when the signal ARC: Blocked appears during an ARC cycle.

If the operative time has elapsed before the starting drops out, the last reclaim time will be started directly and the blocking of protection trip signals is cancelled.

During the dead time, the P132 keeps checking whether any ARC-relevant startings occur. If this is the case, the last reclaim time is started and the blocking of protection trip signals is cancelled.

While the ASC function is enabled, the procedures described in the following section "Joint Operation of the ARC and ASC Functions" are also applicable.



	①	②	③	④
* Parameter	ARC: HSR trip. time I> PSx	ARC: Operative time PSx	ARC: HSR dead time PSx	ARC: Reclaim time PSx
set 1	015 072	015 066	015 056	015 054
set 2	024 040	024 035	024 030	024 028
set 3	025 000	024 095	024 090	024 088
set 4	025 060	025 055	025 050	025 048

⑤ MAIN: Close cmd.pulse time

ARC: No. permit. TDR PSx Setting: 0

3-166 HSR signal sequence (example shown is with ASC disabled – see also next section "Joint Operation of the ARC and ASC Functions")

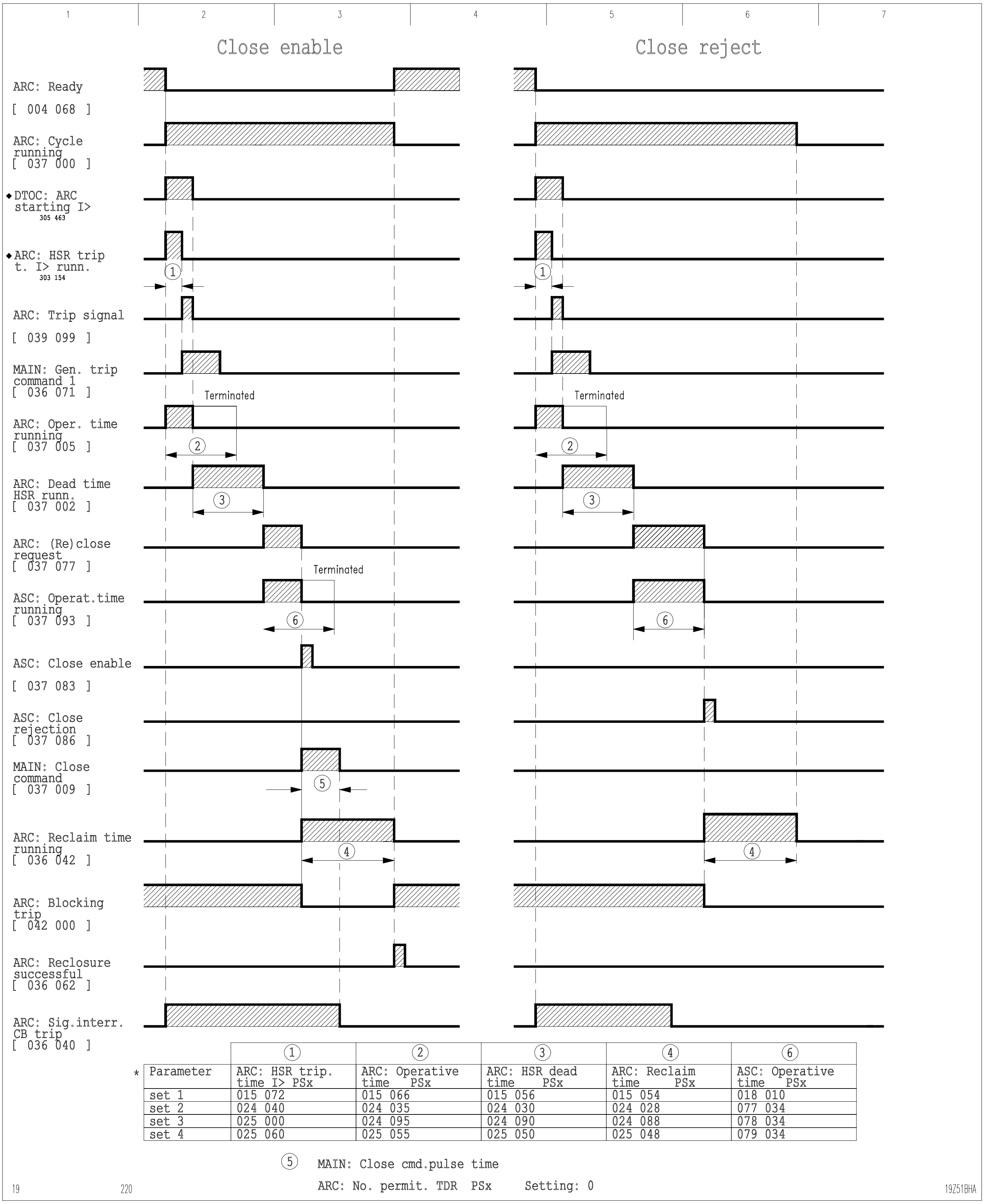
3.28.2 Joint Operation of the ARC and ASC Functions

Figure 3-167 shows the joint operation of the ARC and ASC functions, illustrated for a high-speed reclosure (HSR).

If the starting conditions are met then any ARC-relevant protection startings will trigger an ARC cycle. The startings set off the associated tripping time stages and the operative time. If a HSR tripping time is running during the operative time then the signal ARC: Trip signal is issued, and this signal can lead to a trip command if the function assignment for the trip commands is configured appropriately. With the release of the starting, the operative time is terminated and the HSR dead time begins. After the dead time has elapsed, a close request is sent to the ASC. The ASC checks to determine whether reclosure is possible. If a positive decision is reached during the ASC operative time, then there is a close enable, and the close command is issued.

If the ASC is disabled or deactivated, or if its decisions are to be ignored, then a close command is issued immediately. Moreover, the reclaim time is started. If during the reclaim time there is no starting with trip command, the signal ARC: Reclosure successful is issued and the ARC cycle is terminated once the reclaim time has elapsed.

If the ASC function decides against a reclosure then the reclaim time is started and the ARC cycle is completed after the reclaim time has elapsed.



*	①	②	③	④	⑥
Parameter	ARC: HSR trip. time I> PSx	ARC: Operative time PSx	ARC: HSR dead time PSx	ARC: Reclaim time PSx	ASC: Operative time PSx
set 1	015 072	015 066	015 056	015 054	018 010
set 2	024 040	024 035	024 030	024 028	077 034
set 3	025 000	024 095	024 090	024 088	078 034
set 4	025 060	025 055	025 050	025 048	079 034

⑤ MAIN: Close cmd.pulse time

ARC: No. permit. TDR PSx Setting: 0

3-167 *HSR signal sequence with ASC enabled*

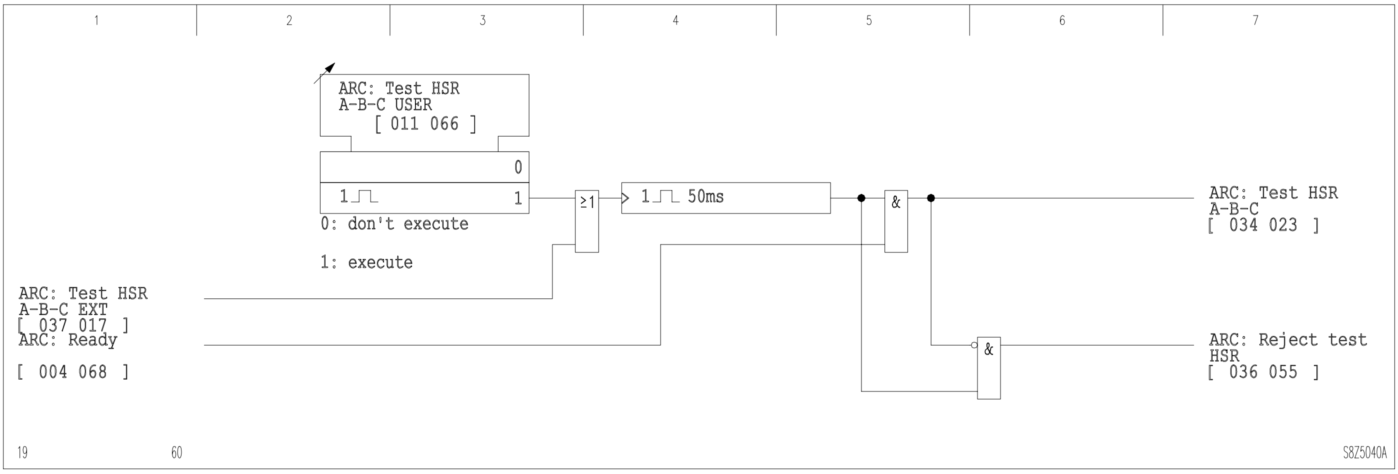
Test HSR

A test HSR can only be triggered when the ARC is ready to operate and if the operating mode has been set to *'Test HSR only permit.'*. In this operating mode, the blocking of the trip signals from the DTOC, IDMT and other protection functions is cancelled so that any system fault can be properly cleared.

Once a test HSR has been triggered, a trip signal of defined duration is issued. The subsequent sequence corresponds to a successful HSR (open and reclose command when the HSR dead time has elapsed). Once the close command pulse time has elapsed, further triggering during the reclaim time does not result in a further HSR.

A test HSR can be triggered either via setting parameter or via a binary signal input and adds an increment to the ARC: Number HSR counter.

Each 'Test HSR' request that does not result in a test HSR generates the signal ARC: Reject test HSR.



3-168 Test HSR

3.28.3 Time-Delay Reclosure (TDR)

Multiple reclosures using TDRs are possible if the operating mode is set accordingly. A TDR may occur after a HSR if reclosure has occurred as the result of the HSR or if the operating mode set for the ARC allows only TDRs. This is only possible if the setting for ARC: No. of permit. TDR PSx (number of permitted TDRs) is not zero.

If the starting conditions are met then any ARC-relevant protection startings will trigger the associated tripping times. The operative time is started simultaneously. If a TDR tripping time is running during the operative time then the signal ARC: Trip signal is issued and this signal can lead to a trip command if the function assignment for the trip commands is configured appropriately. With the release of the starting, the operative time is terminated and the TDR dead time begins. If there is no starting during the dead time, a reclosure command is issued once the dead time has elapsed. The reclaim time is started simultaneously. If no further TDR is permitted during the current ARC cycle then this will be the last reclaim time. If the last reclaim time has elapsed and another starting occurs then the tripping time stages are no longer started. Instead the signal ARC: Blocking trip is set to a logic value of ‘0’ and a final trip by other protection functions is enabled. If a trip signal occurs during the last reclaim time then it will be regarded as a final trip. The ARC cycle is completed after the last reclaim time has elapsed. If during the last reclaim time there is no starting with trip command, the signal ARC: Reclosure successful will be issued.

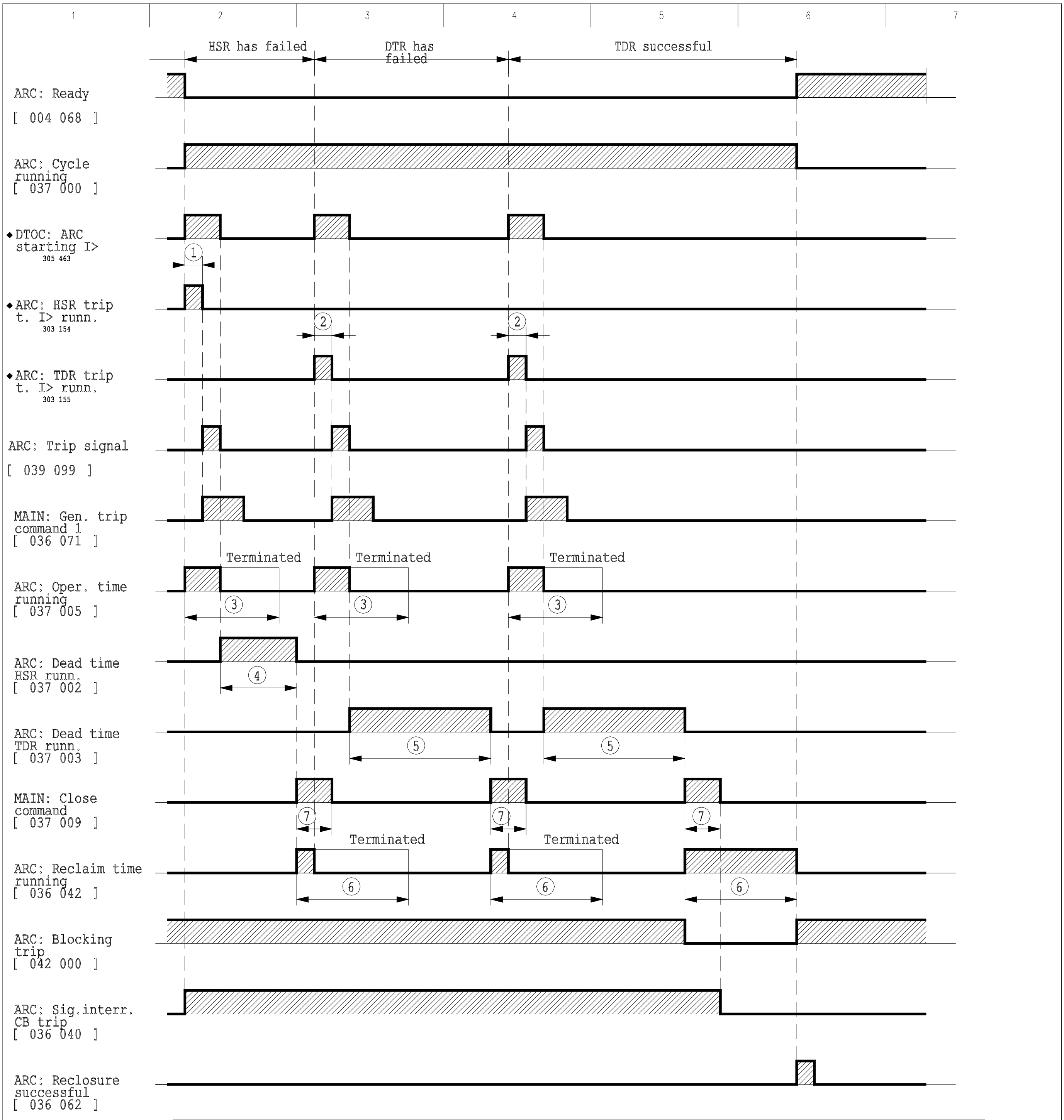
If there is a new starting during the reclaim time and at least one TDR is still permitted then the reclaim time is terminated and another trip is issued when the tripping time has elapsed. Once the dead time has elapsed, a further reclosure command is issued.

When the signal ARC: Cycle running appears, the signal ARC: Sig.interr. CB trip (interruption breaker trip signal) is issued automatically and it is reset after the final HSR or TDR of the current ARC cycle, once the close command pulse time has elapsed. This signal is also reset immediately when the signal ARC: Blocked appears during an ARC cycle.

If the operative time has elapsed before the starting drops out, the last reclaim time will be started directly and the blocking of protection trip signals is cancelled.

During the dead time, the P132 keeps checking whether any ARC-relevant startings occur. If this is the case, the last reclaim time is started and the blocking of protection trip signals is cancelled.

While the ASC function is enabled, the procedures described in the previous section "Joint Operation of the ARC and ASC Functions" are also applicable.



		①	②	③	④	⑤	⑥
*	Parameter	ARC: HSR trip. time I> PSx	ARC: TDR trip. time I> PSx	ARC: Operative time PSx	ARC: HSR dead time PSx	ARC: TDR dead time PSx	ARC: Reclaim time PSx
	set 1	015 072	015 073	015 066	015 056	015 057	015 054
	set 2	024 040	024 041	024 035	024 030	024 031	024 028
	set 3	025 000	025 001	024 095	024 090	024 091	024 088
	set 4	025 060	025 061	025 055	025 050	025 051	025 048

⑦ MAIN: Close cmd.pulse time

ARC: No. permit. TDR PSx Setting: 2

16 220 19Z5051A

3-169 *Signal sequence of a failed HSR followed by a failed TDR and then by a final successful TDR (example shown is with ASC disabled)*

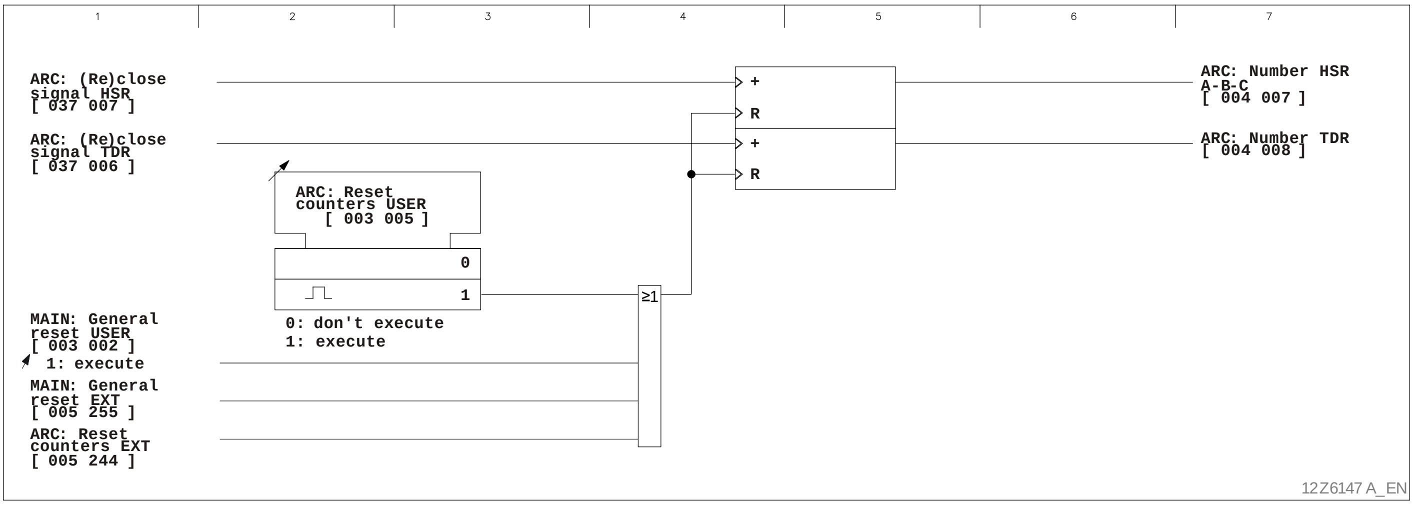
3.28.4 ARC counters

The following events are counted:

☐ Number of high-speed reclosures (HSR) that have been carried out

☐ Number of time-delay reclosures (TDR) that have been carried out.

The associated counters can be reset either individually or as a group.



3-170 ARC counters

3.28.5 Counter for Number of CB Operations

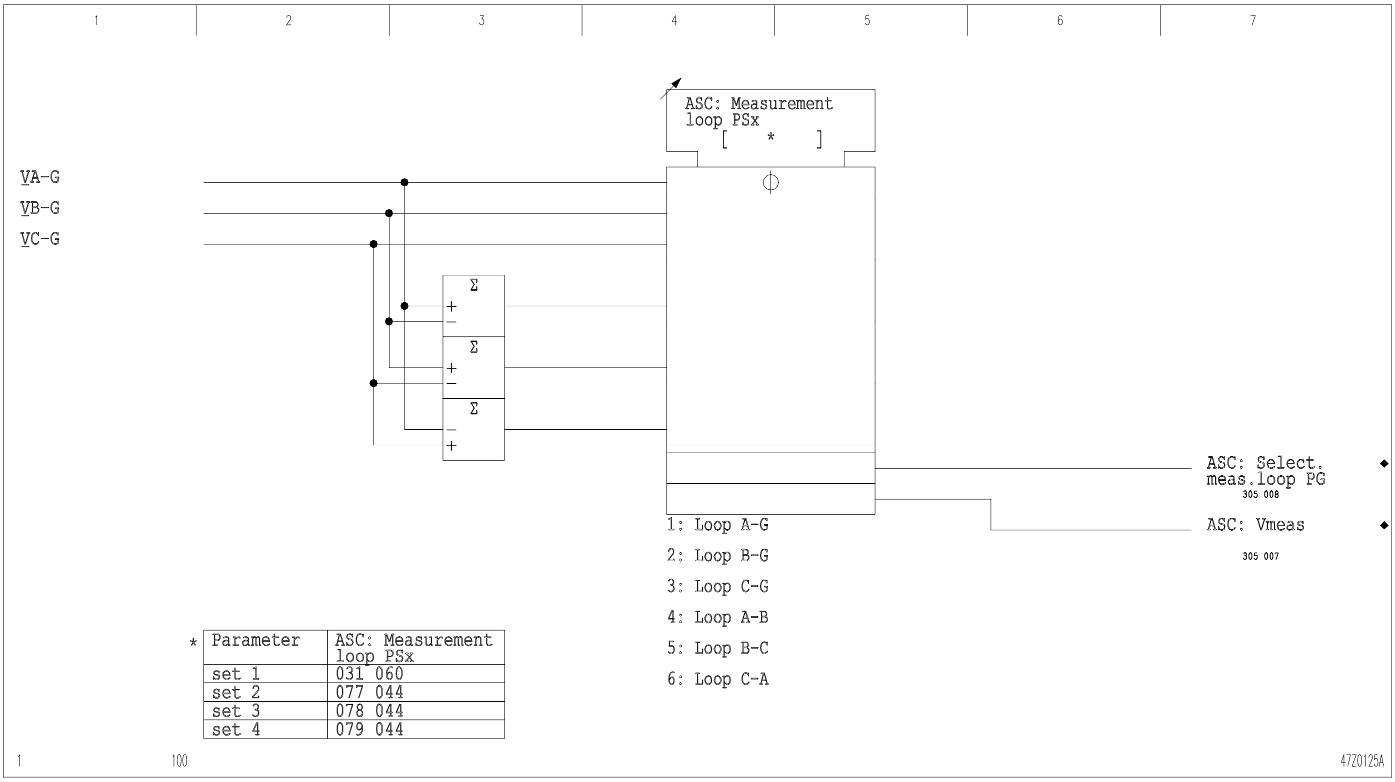
The maximum number of CB operations within an ARC cycle (or within a specific time period) may be set with parameter MAIN: CB1 max oper. cap. Associated with this parameter is the counter at MAIN: CB1 act. oper. cap. to which the maximum number of CB operations permitted is assigned as soon as the positive edge of an event is present that has been selected by a '1 out of n' parameter at MAIN: CB1 ready fct.assign

The number of CB operations permitted, set with the counter at MAIN: CB1 act. oper. cap. are then decremented by 1 with each CB operation. Operation of the CB is recognized from the contact position signals DEVxx: Switch. device open and DEVxx: Switch.device closed.

The counter at MAIN: CB1 act. oper. cap. may only be decremented to a value of 1. Reaching a value of 1 will in no way effect the protection or control functionality, in particular there will be no blocking of CB operation! When a CB fault has occurred (i.e. MAIN: CB1 faulty EXT is set to *Yes*) the counter MAIN: CB1 act. oper. cap. is immediately set to 1.

3.29 Automatic Synchronism Check (Function Group ASC)

The automatic synchronism check (ASC) function allows the device to verify that before a close or reclose command is issued synchronism exists between system sections that are to be synchronized (paralleled) or whether one of the system sections is de-energized. In order to check for synchronism, two voltages – generally the voltages on the line and busbar sides – are compared for differences in frequency, angle, and voltage. Connecting the reference voltage transformer will determine which of the system sections will provide the reference voltage (e.g. the line side or the busbar side). The measurement loop must be set to correspond to the reference voltage connection (ASC: Measurement loop PSx) so that the correct measuring voltage is selected for the comparison. In the connection example shown in the section 'Conditioning the Measured Variables' (see Chapter 3 section ‘Main Functions of the P132’), the busbar voltage $\underline{V}_{A-B}$ is the reference voltage.



Parameter	ASC: Measurement loop PSx
set 1	031 060
set 2	077 044
set 3	078 044
set 4	079 044

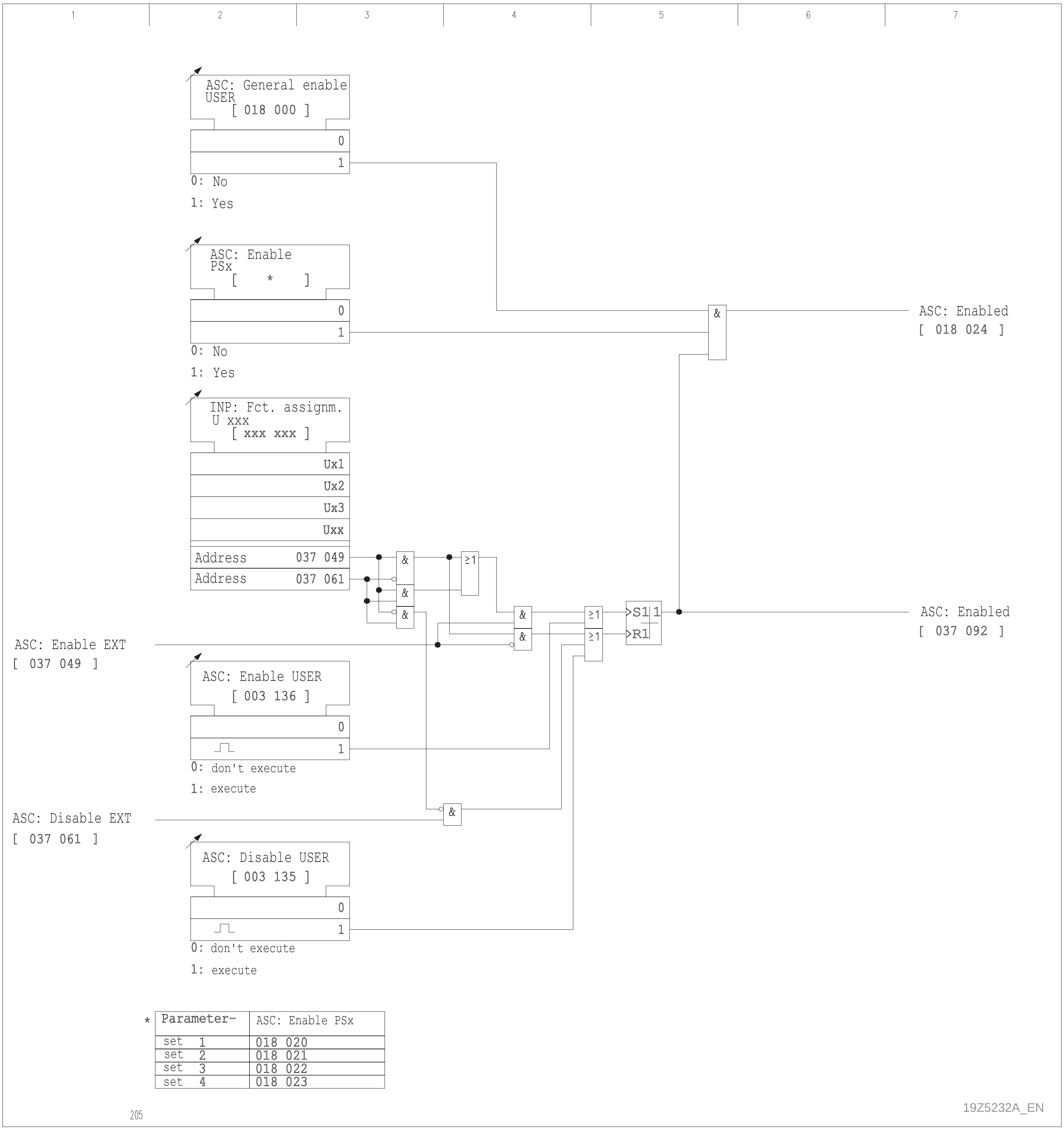
3-171 Selecting the measurement loop

Disabling and enabling the ASC function

Disabling or enabling may be carried out with parameters or binary signal inputs.

The activation of the function is enabled generally (independent of parameter subsets) via ASC: General enable USER. It is enabled as a function of a parameter subset via ASC: Enable PSx. If these enabling functions have been activated, ASC can be disabled or enabled via setting parameters or through appropriately configured binary signal inputs. Parameters and configured binary signal inputs have equal status. If only the ASC: Enable EXT function is assigned to a binary signal input, then ASC will be enabled by a positive edge of the input signal and disabled by a negative edge. If only the ASC: Disable EXT function has been assigned to a binary signal input, then a signal at this input will have no effect.

If the ASC function is disabled an activation enable will always be issued.



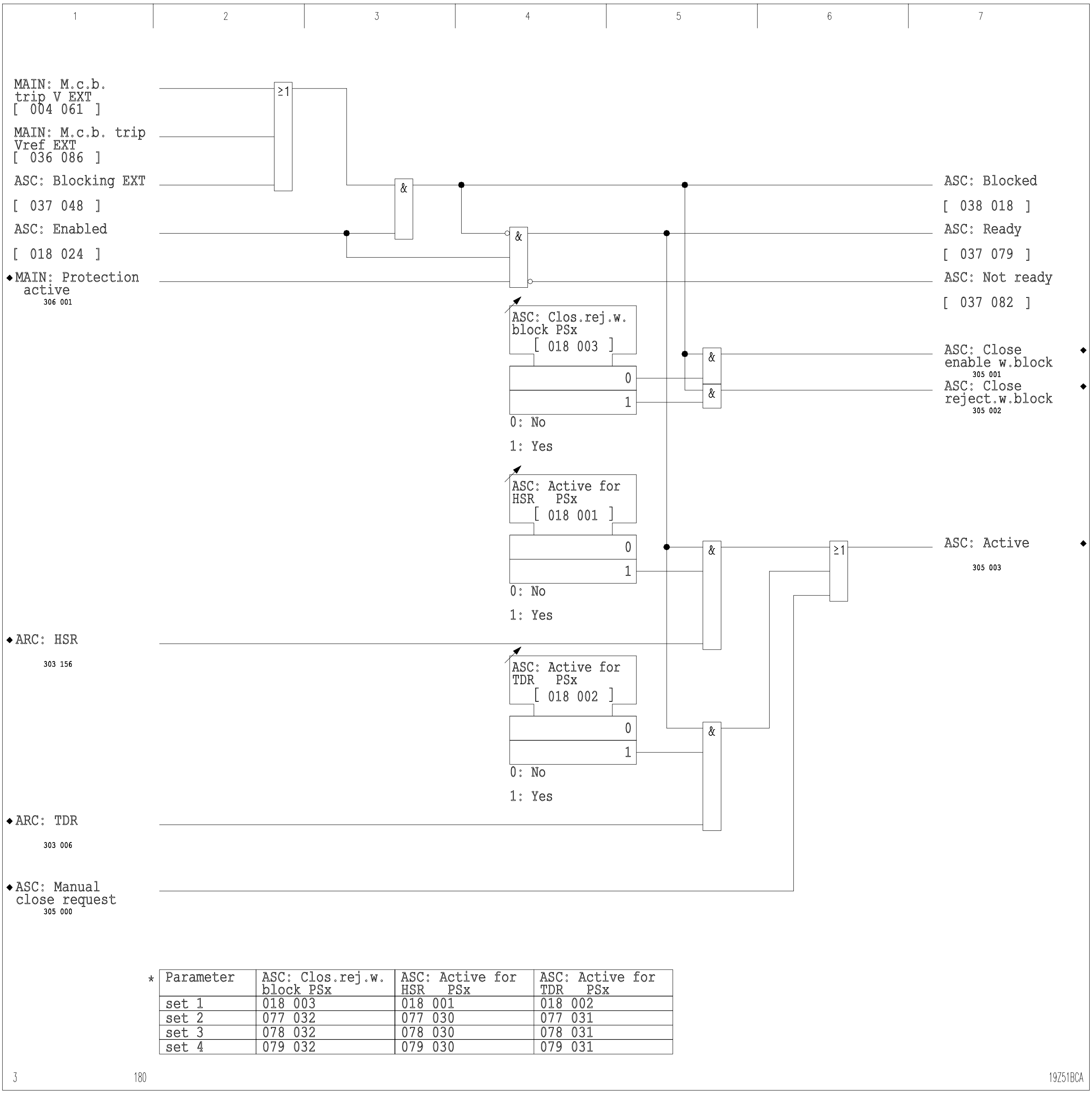
* Parameter-	ASC: Enable PSx
set 1	018 020
set 2	018 021
set 3	018 022
set 4	018 023

3-172 Enable/disable the automatic synchronism check function

ASC readiness and blocking

The ASC function is ready if it is activated and enabled and if there is no blocking. Blocking can be brought about if a voltage transformer M.c.b. was tripped or by an appropriately configured binary signal input. The user can specify whether closing or reclosing will always be enabled or not (reclosure with or without a check) when the ASC function is blocked.

The user can also specify separately for high-speed reclosures (HSR) and time-delay reclosures (TDR) whether reclosure will be carried out with or without a check.

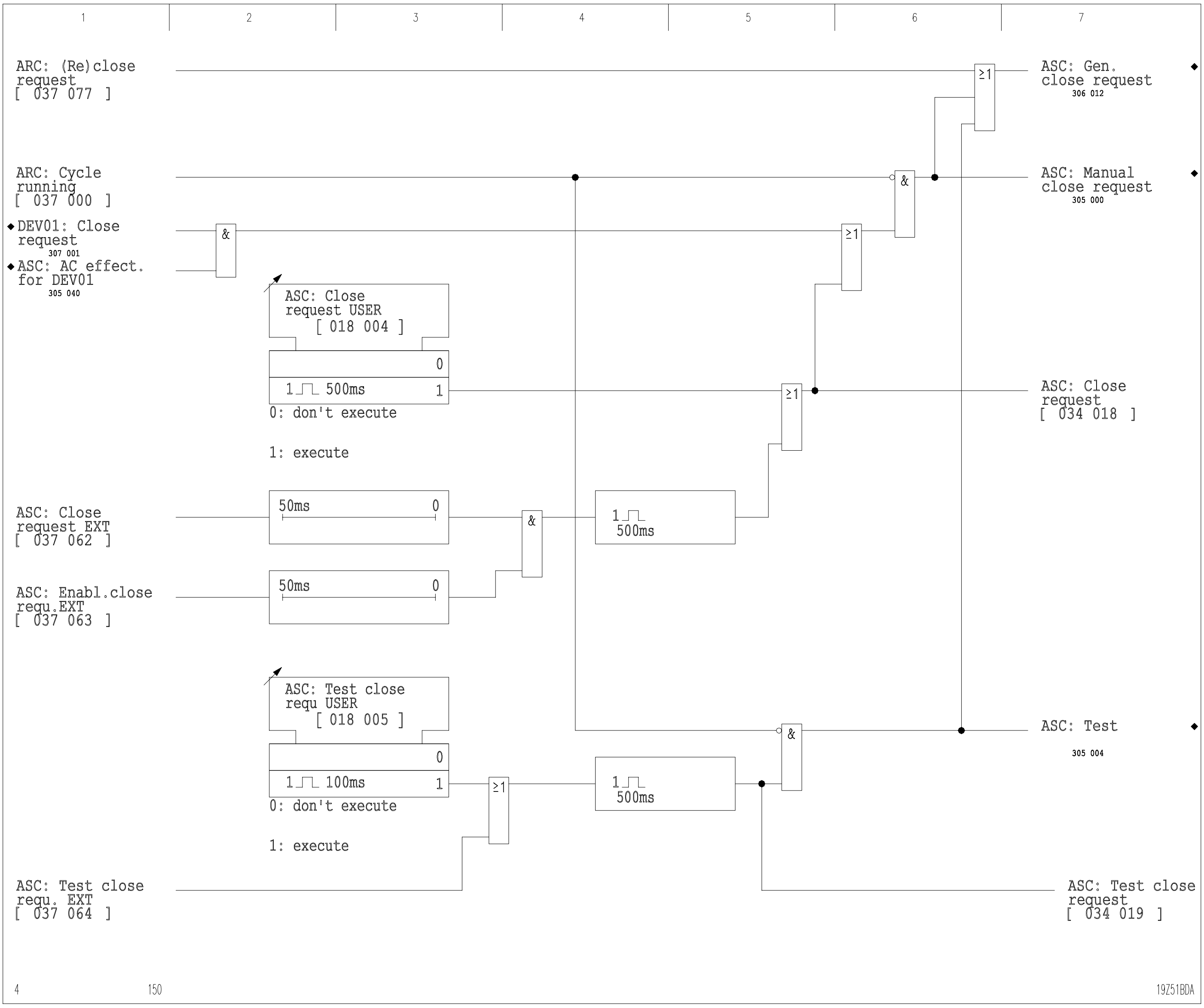


Parameter	ASC: Clos.rej.w. block PSx	ASC: Active for HSR PSx	ASC: Active for TDR PSx
set 1	018 003	018 001	018 002
set 2	077 032	077 030	077 031
set 3	078 032	078 030	078 031
set 4	079 032	079 030	079 031

3-173 *ASC readiness and blocking*

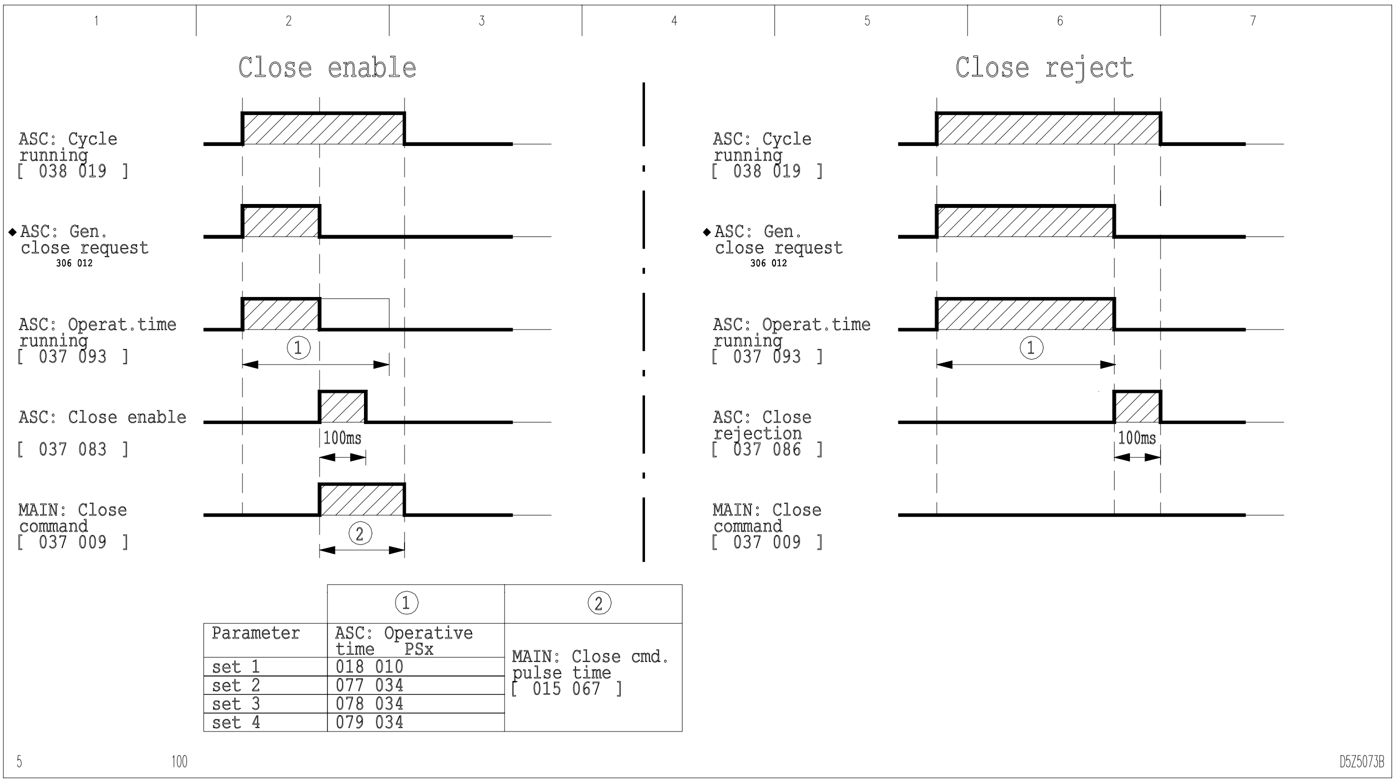
Close request

The ASC function can be triggered by ARC, via setting parameters, from an appropriately configured binary signal input (ASC: Close request EXT), or via a close request from the control function. Close requests via a setting parameter, the binary signal input or the control function are only accepted if no ARC cycle is running.



3-174 Close request

The ASC operative time is started with the close request. If the close enable is issued before the ASC operative time has elapsing, the close command is issued. Otherwise an ASC: Close rejection signal is generated for 100 ms.



	①	②
Parameter	ASC: Operative time PSx	MAIN: Close cmd. pulse time [015 067]
set 1	018 010	
set 2	077 034	
set 3	078 034	
set 4	079 034	

3-175 Signal flow for a close enable and a close rejection

ASC operating modes

The criteria for a close enable are determined by the ASC operating mode setting (see Figure 3-177). The following operating mode settings are possible:

☐ *Voltage-checked*

☐ *Synchronism-checked*

☐ *Voltage/synchronism-checked*

Voltage-checked

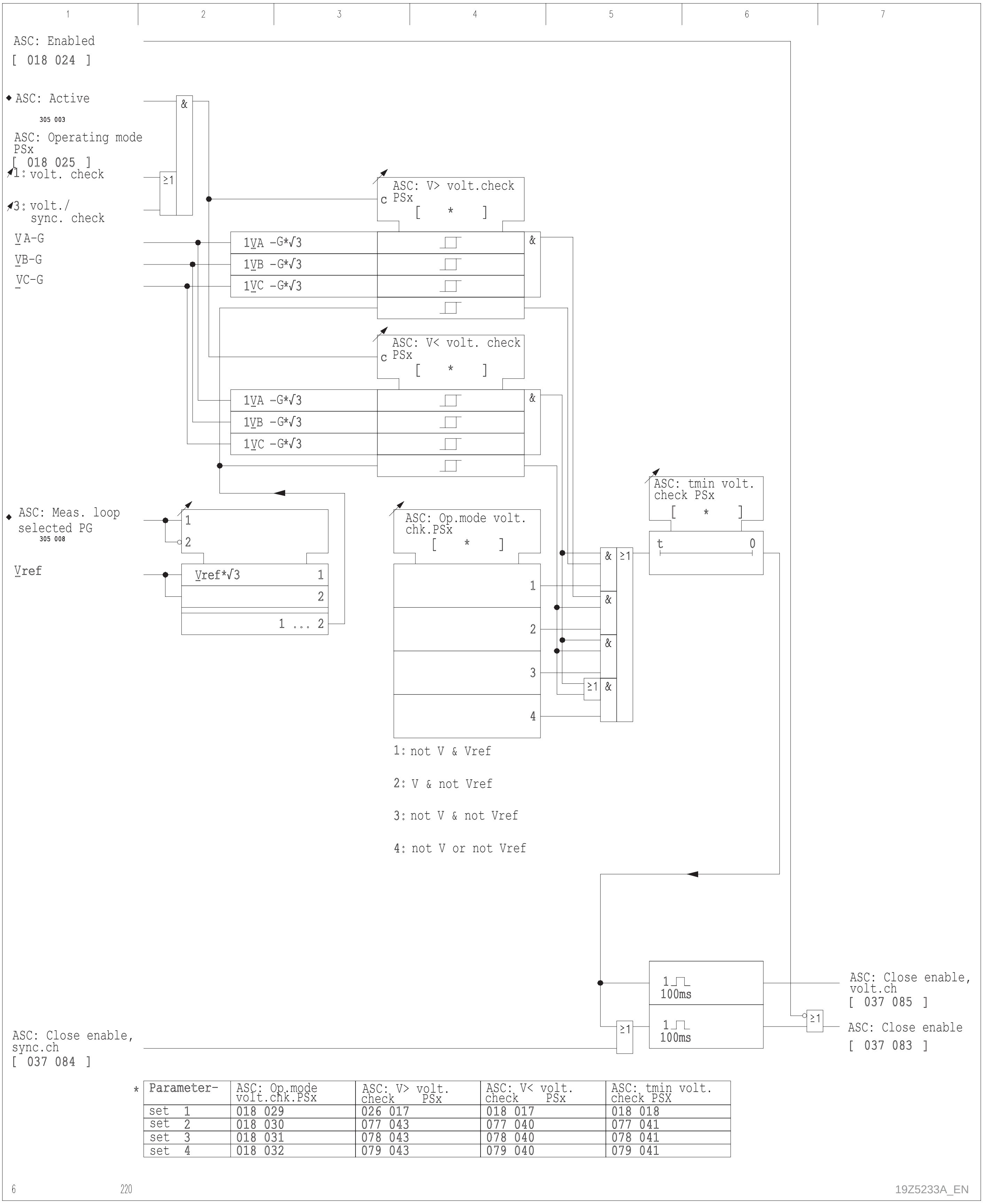
The synchronism-checked close enable can be bypassed using the voltage-checked close enable without affecting the former. For this purpose the three phase-to-ground voltages and the reference voltage $\underline{V}_{ref}$ are monitored to determine whether they exceed or fall below the set threshold values (ASC: V> volt. check and ASC: V< volt. check). Depending on the operating mode selected for the voltage check, all three phase-to-ground voltages need to exceed or fall below the set value in order to meet the condition for voltage-checked closing. If the conditions corresponding to the set operating mode for the voltage-checked synchronism check are met, then the close enable is issued after the set minimum time has elapsed (ASC: tmin volt. check). The following operating modes for voltage checking can be selected separately for each parameter subset:

☐ *Vref but not V*

☐ *V but not Vref*

☐ *Not V and not Vref*

☐ *Not V or not Vref*



Parameter-	ASC: Op.mode volt.chk.PSx	ASC: V> volt. check PSx	ASC: V< volt. check PSx	ASC: tmin volt. check PSX
set 1	018 029	026 017	018 017	018 018
set 2	018 030	077 043	077 040	077 041
set 3	018 031	078 043	078 040	078 041
set 4	018 032	079 043	079 040	079 041

3-176 Voltage-checked close enable

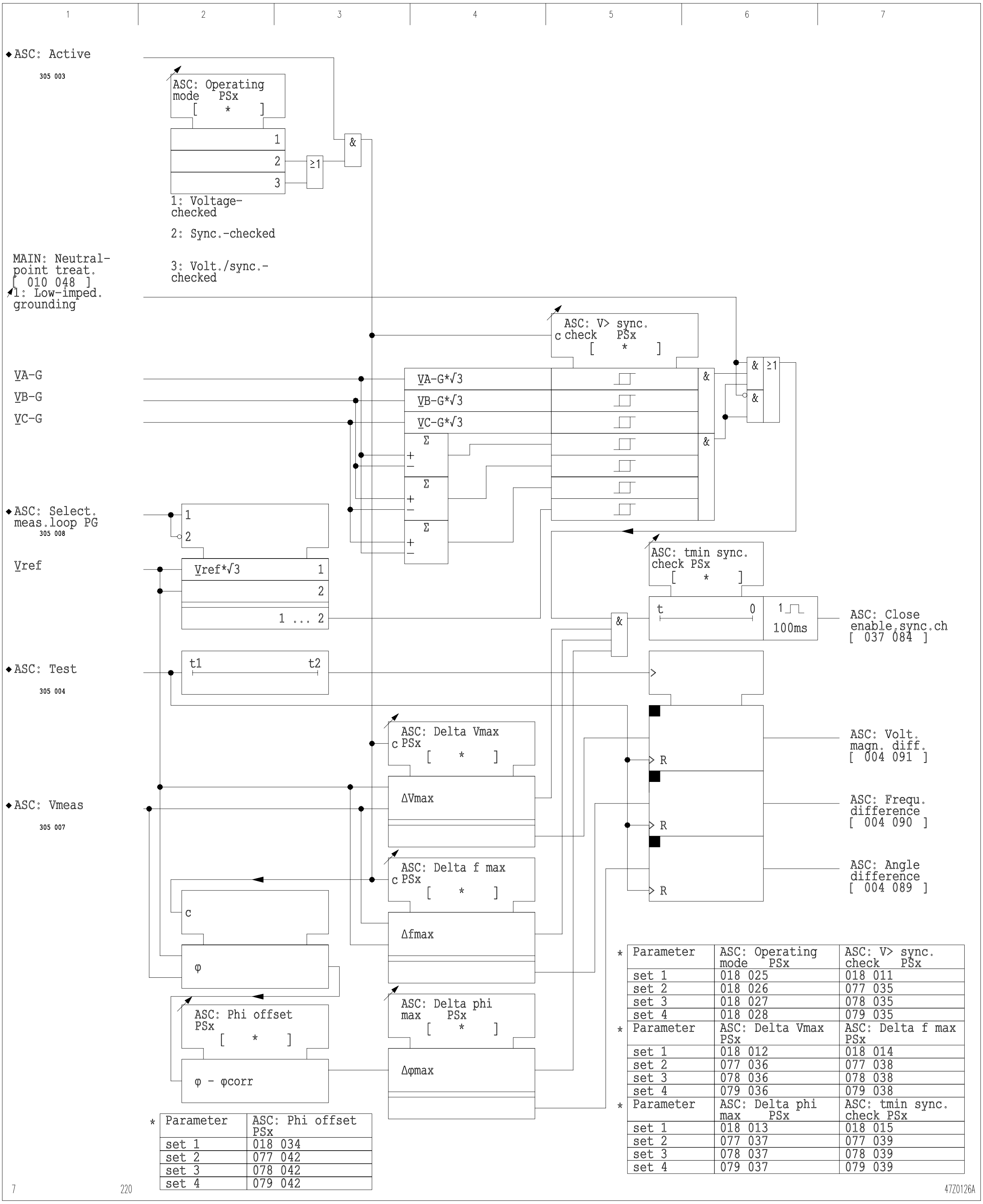
Synchronism-checked

Before a close enable is issued, the ASC checks the voltages for synchronism. Synchronism is recognized if the following conditions are met simultaneously:

- ☐ The three phase voltage and the reference voltage must exceed the set threshold value (ASC: V> sync. check). When with a three-phase voltage the setting of MAIN: Neutral-point treat. is *'Low-imped. grounding'* both the phase-to-ground and the phase-to-phase voltages are checked. If the setting is *'Isolated/res.ground.'* only the phase-to-phase voltages are checked.
- ☐ The difference in magnitude between measuring voltage and reference voltage must not exceed the set threshold value (ASC: Delta Vmax).
- ☐ The frequency difference between measuring voltage and reference voltage must not exceed the set threshold value (ASC: Delta f max).
- ☐ The angle difference between measuring voltage and reference voltage must not exceed the set threshold value (ASC: Delta phi max). In these comparisons the set offset angle ASC: Phi offset is taken into account.

If these conditions are met for at least the set time ASC: tmin sync. check, then a close enable is issued. The ASC operating time for determination of differences in voltage, angle, and frequency is approximately 100 ms.

The voltage magnitude difference, angle difference, and frequency difference are stored as measured synchronism data at the time the close request is issued. In the event of another close request, they are automatically overwritten by the new data.



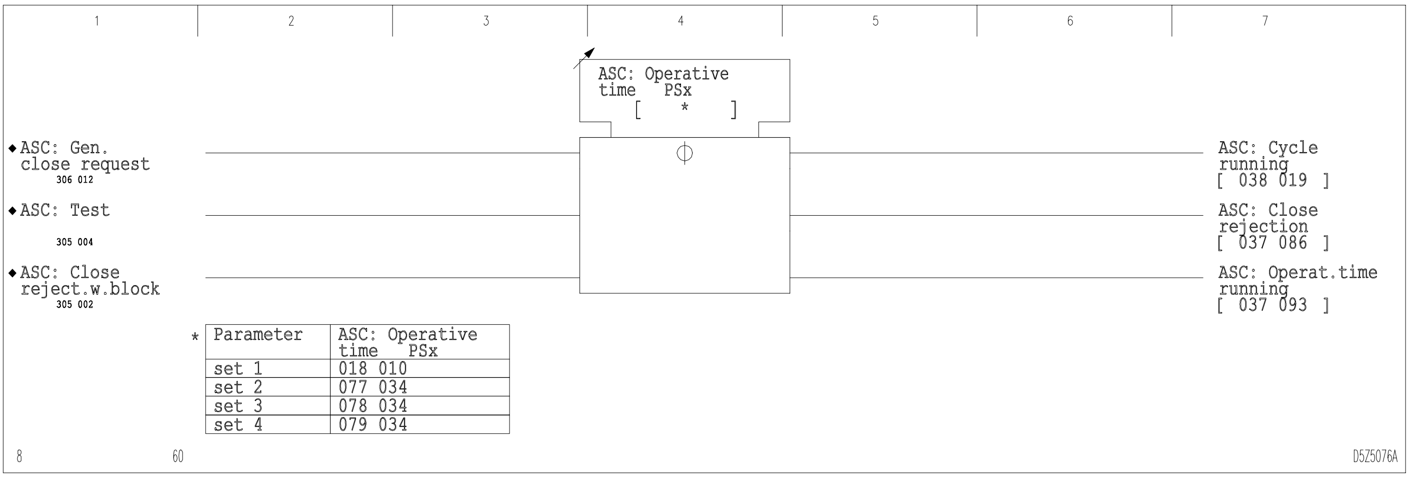
* Parameter	ASC: Phi offset PSx
set 1	018 034
set 2	077 042
set 3	078 042
set 4	079 042

* Parameter	ASC: Operating mode PSx	ASC: V> sync. check PSx
set 1	018 025	018 011
set 2	018 026	077 035
set 3	018 027	078 035
set 4	018 028	079 035
* Parameter	ASC: Delta Vmax PSx	ASC: Delta f max PSx
set 1	018 012	018 014
set 2	077 036	077 038
set 3	078 036	078 038
set 4	079 036	079 038
* Parameter	ASC: Delta phi max PSx	ASC: tmin sync. check PSx
set 1	018 013	018 015
set 2	077 037	077 039
set 3	078 037	078 039
set 4	079 037	079 039

3-177 Synchronism-checked close enable

Voltage/synchronism-checked

If this setting has been selected, then the close enable is issued if the conditions for voltage- or synchronism-checked closing are met.

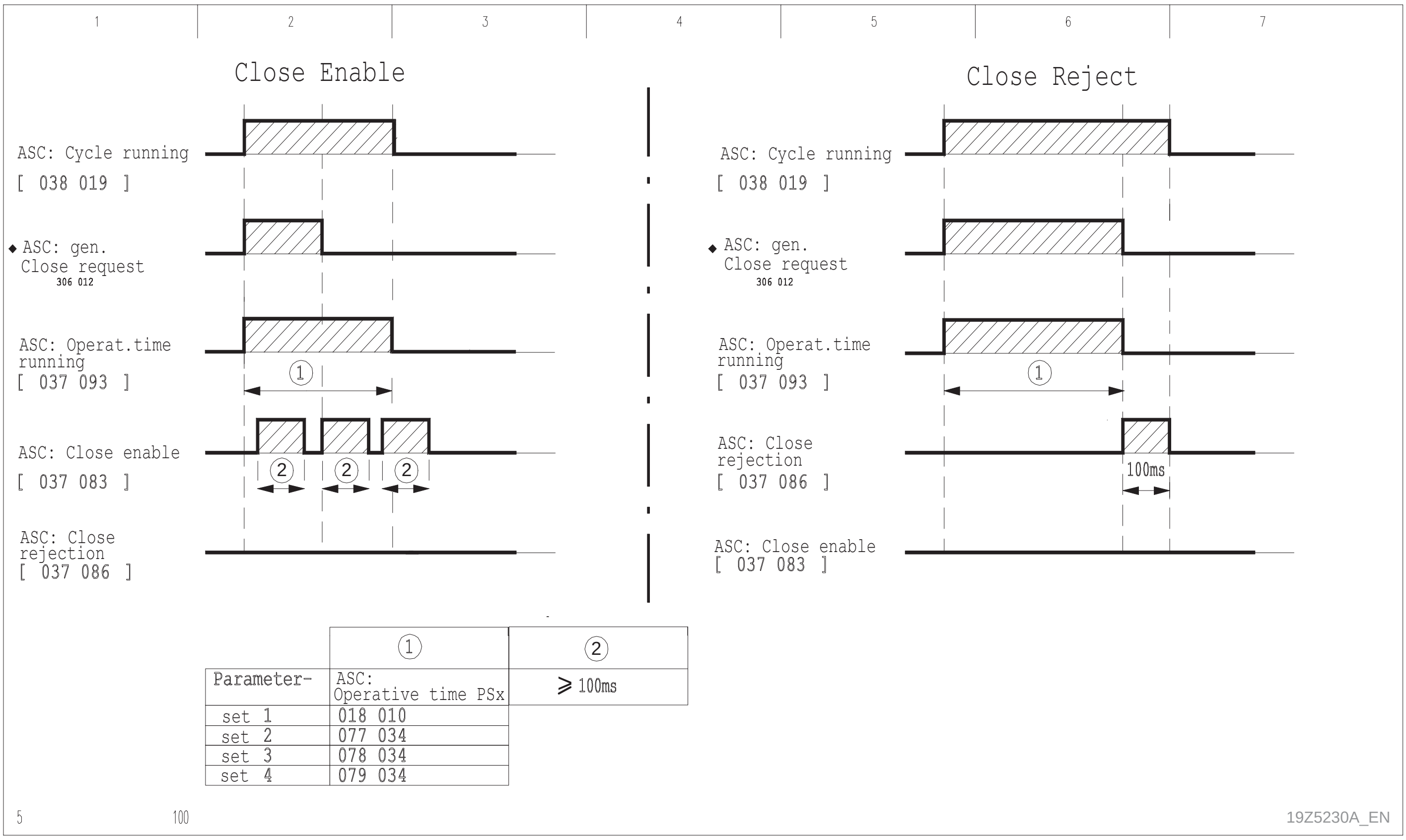


3-178 ASC sequence control

Testing the ASC function

For test purposes a close request can be issued via a setting parameters or an appropriately configured binary signal input (see Figure 3-179). In this case no close command is issued and it is not counted.

The ASC cycle and the operating time are started by the test close request. The network synchronism is checked during the whole operating time and `ASC: Close enable` is set accordingly. If at the end of the operate time no network synchronism is registered, a 100 ms signal `ASC: Close rejection` is issued.



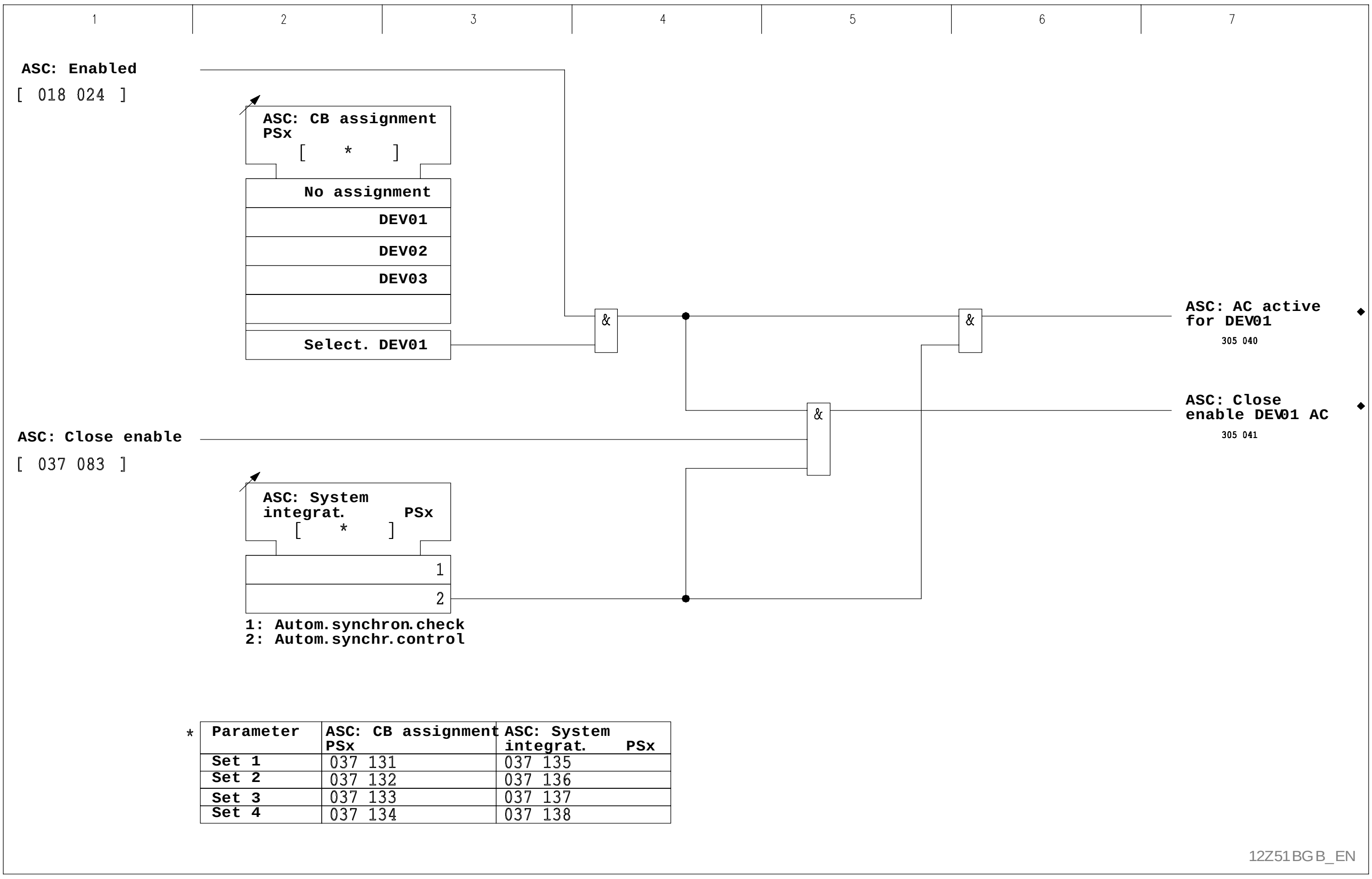
	①	②
Parameter-	ASC: Operative time PSx	⩾ 100ms
set 1	018 010	
set 2	077 034	
set 3	078 034	
set 4	079 034	

3-179 *ASC sequence during testing*

Integrating the ASC function into the control and monitoring of switchgear units

ASC triggering by a close request from the control functions is also possible.
This requires that the circuit breaker is assigned to an external device and that the ASC system integration is set to *'Autom. synchr. Control'.* If the control function issues a close request then the close command for the circuit breaker requires a *'close enable'* by the ASC function (see *'Issue of the switching commands'* in section 'Control and Monitoring of Switchgear Units').

However if ASC: System integrat. PSx is set to *'Autom. synchron. check'* ASC will not interfere with any switching commands. Data generated and continuously updated by the ASC function is transmitted – when configurations have been set accordingly – to the central control station, where operators may make decisions as to which external device is to be given a switching command.



Parameter	ASC: CB assignment PSx	ASC: System integrat. PSx
Set 1	037 131	037 135
Set 2	037 132	037 136
Set 3	037 133	037 137
Set 4	037 134	037 138

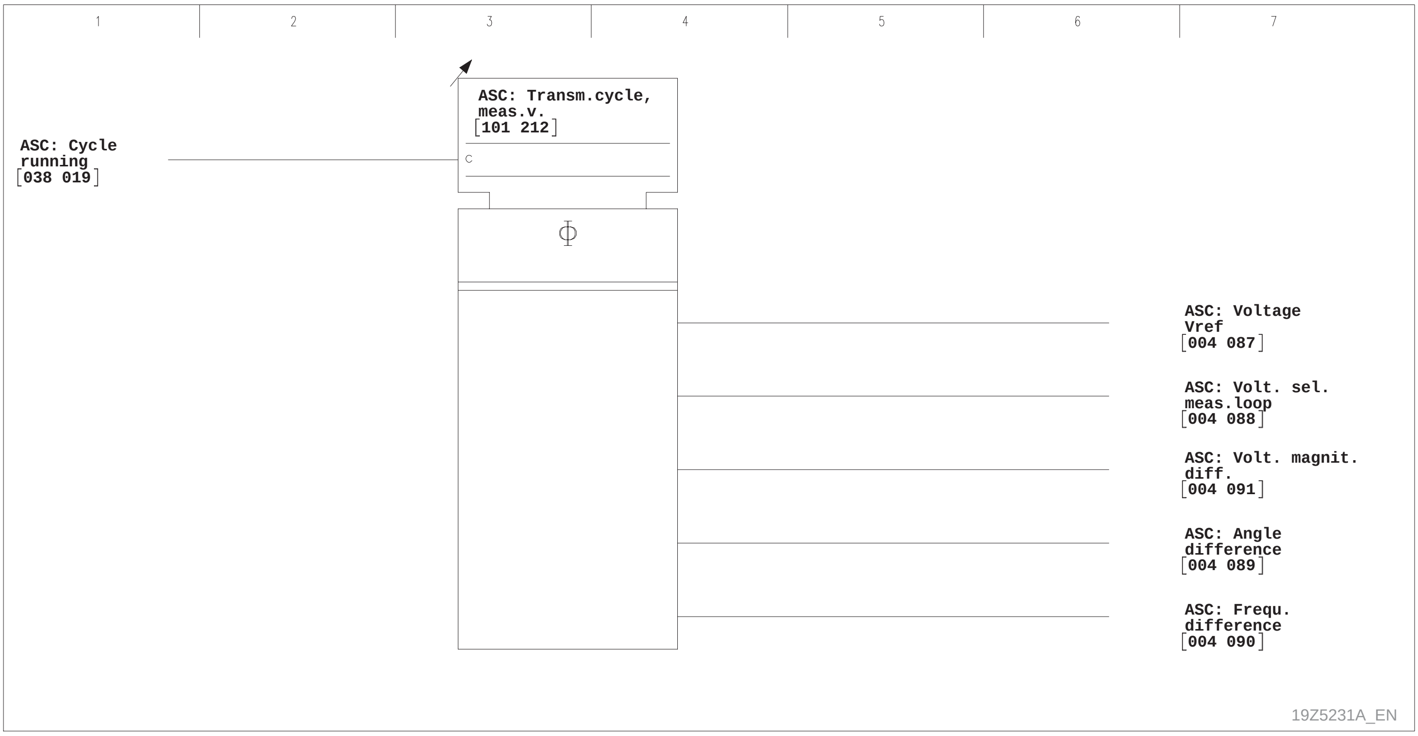
3-180 *Integrating the ASC function into the control and monitoring of switchgear units*

Measured values obtained by ASC

The following measured values are obtained and calculated during an ASC cycle and are transmitted during a set cycle time:

- ☐ Voltage from the reference voltage channel
- ☐ Voltage from the selected measuring loop
- ☐ Difference in phase voltage magnitudes
- ☐ Difference in phase angles
- ☐ Frequency difference

Outside of the ASC cycle the measured values have the status of "*not measured*".



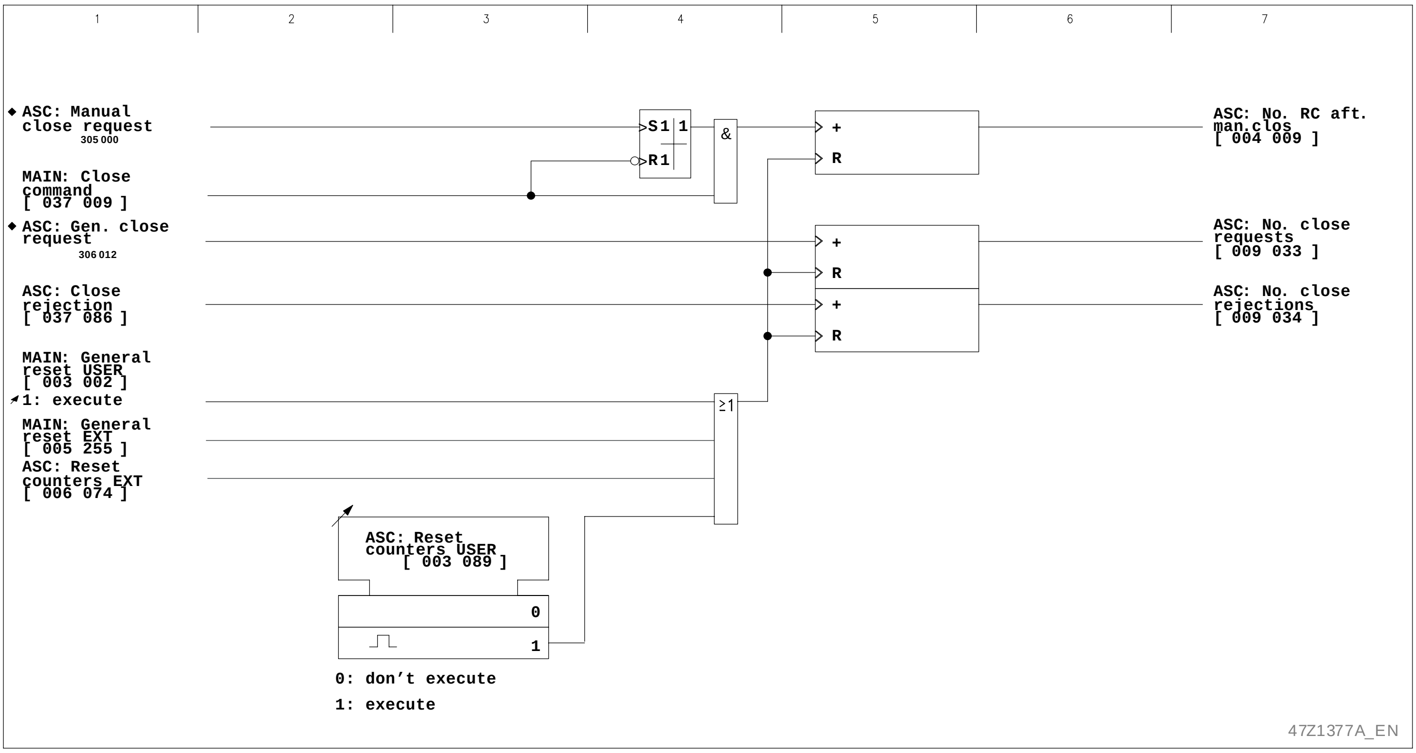
3-181 Measured values obtained by ASC

ASC counters

The following ASC signals are counted:

- Number of reclosures after a close request via setting parameters or an appropriately configured binary signal input.
- Number of close requests
- Number of close rejections

The counters can be reset individually (at the address at which they are displayed) or as a group.



3-182 ARC counters

3.30 Ground Fault Direction Determination Using Steady-State Values (Function Group GFDSS)

Ground fault direction determination is carried out by evaluating the neutral-point displacement voltage and the residual current using the steady-state power evaluation mode or, as an alternative, the admittance evaluation mode. Also possible is a steady-state current evaluation only. In this case only the filtered residual current is used as a criterion for a ground fault. Ground fault direction determination is then not possible.

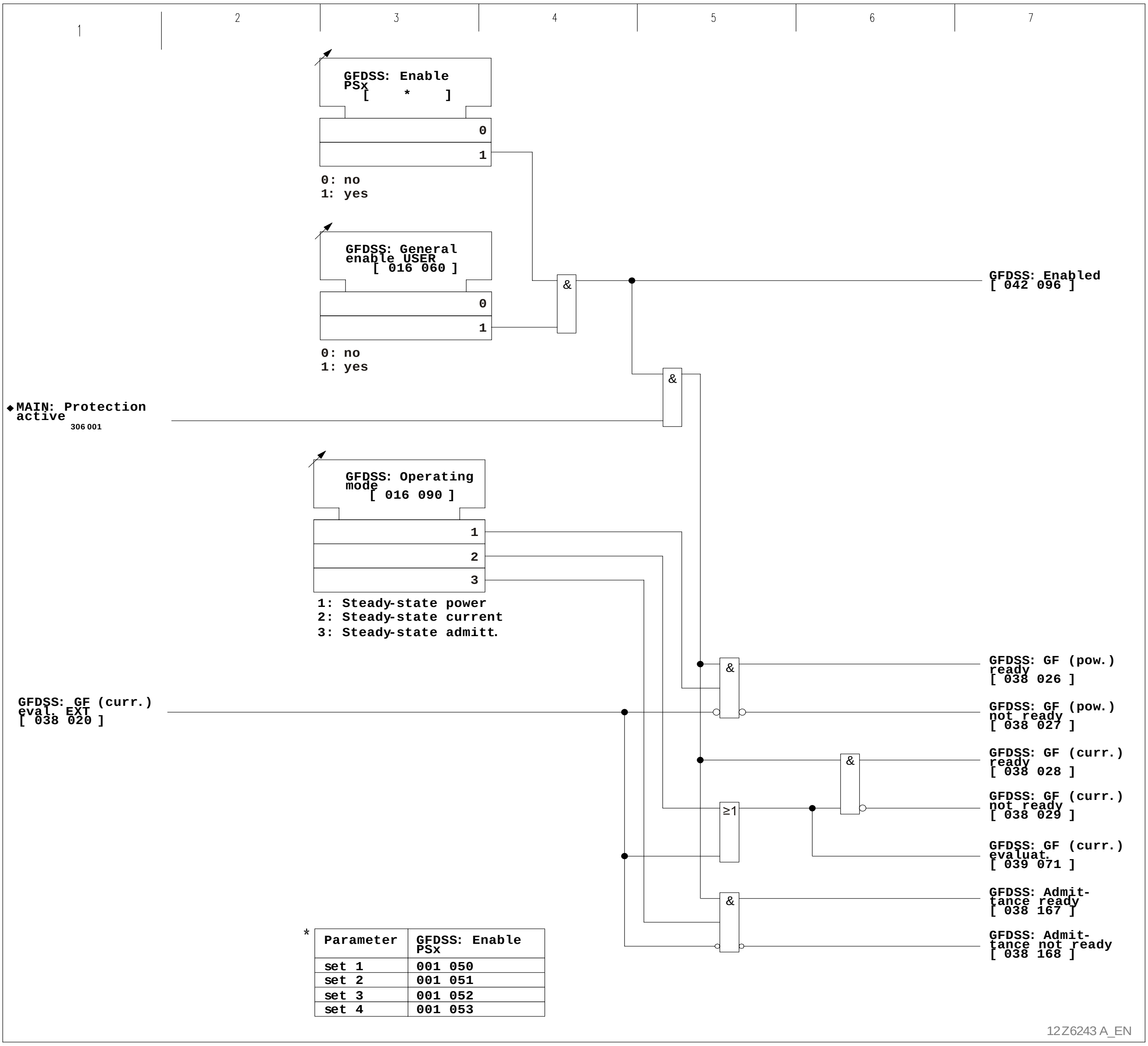
By using the ARC function it is possible to intervene in the functional sequence of ground fault direction determination using steady-state values.

Enable/disable the ground fault direction determination using steady-state values

The ground fault direction determination using steady-state values can be disabled or enabled via setting parameters. Switching over to *'Steady-state current'* evaluation is made by setting parameters or an appropriately configured binary signal input. Moreover, enabling can be carried out separately for each parameter set.

Ground fault direction determination using steady-state values is ready

A ready signal is issued for the evaluation mode selected if the protection and the ground fault direction determination using steady-state values are enabled.

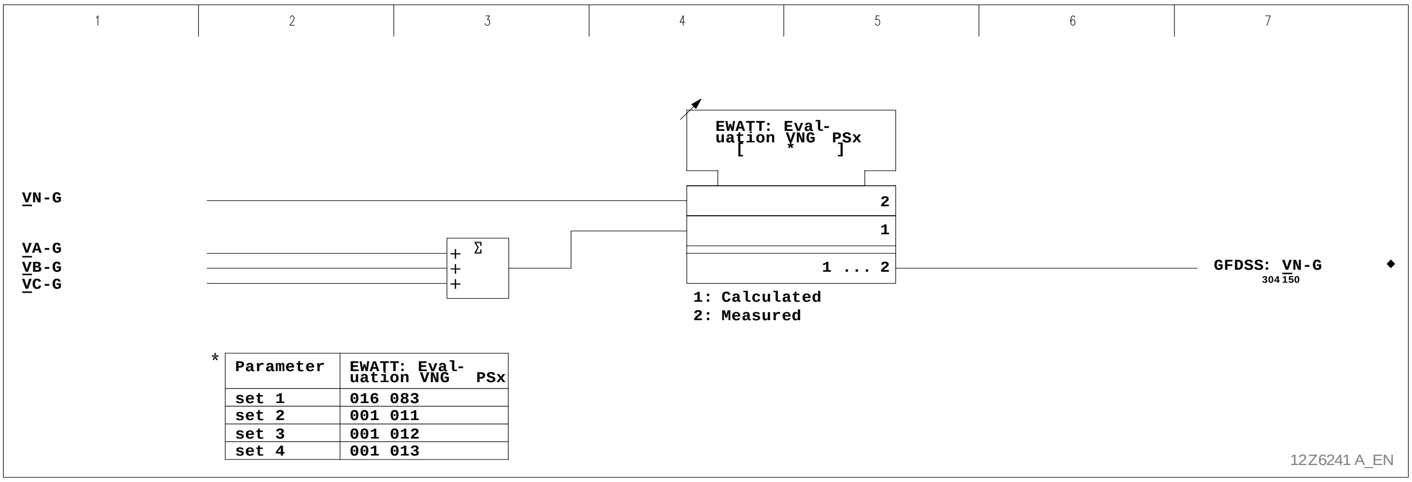


Parameter	GFDSS: Enable PSx
set 1	001 050
set 2	001 051
set 3	001 052
set 4	001 053

3-183 Enabling, disabling and readiness of the ground fault direction determination using steady-state values

Conditioning and selecting the measured variables

For the conditioning of measured variables the P132 is fitted with integrated transformers. As an alternative it is possible to use the neutral-point displacement voltage calculated by the P132 from the three phase-to-ground voltages or the displacement voltage measured at the T 90 transformer for steady-state power evaluation. The current transformer has been especially designed for this application so that it will perform with a very small phase-angle error.



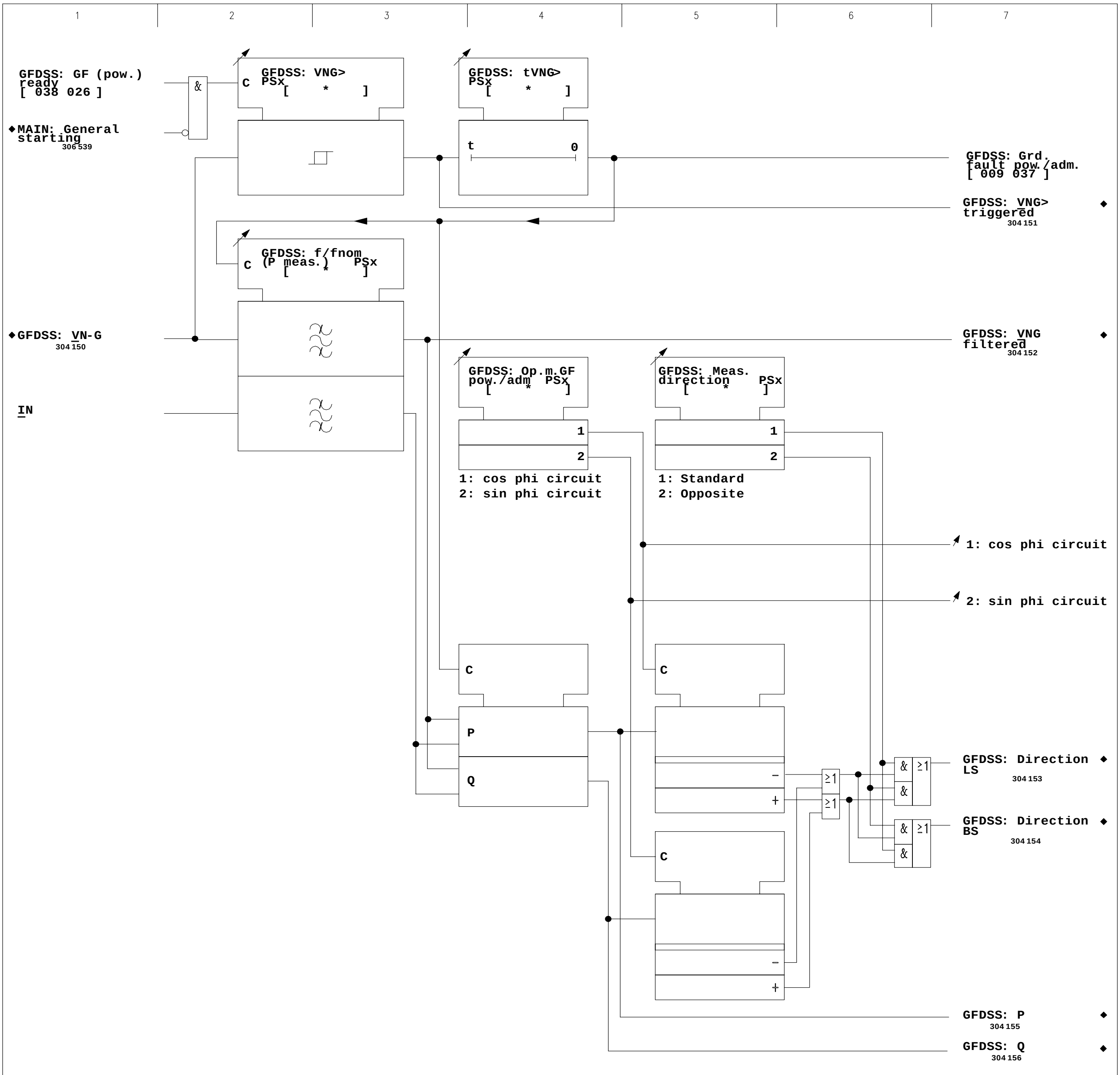
Parameter	EWATT: Evaluation VNG PSx
set 1	016 083
set 2	001 011
set 3	001 012
set 4	001 013

3-184 Selecting the measuring voltage

3.30.1 Steady-State Power Evaluation

The ground fault direction determination using steady-state values requires the neutral-point displacement voltage and the residual current values to be able to determine a ground fault direction. The frequency provided by the setting f/f_{nom} is filtered from these values by using a Fourier analysis. Three periods are used for evaluation if the time stage GFDSS: tVNG> has been set to a time period equal to or greater than 60 ms. This will result in the suppression of typical ripple-control frequencies in addition to all integer-frequency harmonics. If the time stage was set to a time period less than 60 ms only one period will be used for filtering.

The measurement is enabled when the time period set at GFDSS: tVNG> and which was triggered by VNG> has elapsed. Dependent on the operating mode selected (e.g. *'cos phi circuit'* or *'sin phi circuit'*) the sign of the active power (GFDSS: Op. mode GF pow./adm *'cos phi circuit'*) or of the reactive power (GFDSS: Op. mode GF pow./adm *'sin phi circuit'*) is used to determine the direction. Connection of the measuring circuits is taken into account by the setting at GFDSS: Measuring direction. When the connection *'Standard'* has been made a ground fault on the line side will issue the decision 'LS' and a ground fault on the busbar side will issue the decision 'BS'.



* Parameter	GFDSS: VNG> PSx	GFDSS: f/fnom (P meas.) PSx	GFDSS: tVNG> PSx	GFDSS: Op.m.GF pow./adm PSx	GFDSS: Meas. direction PSx
set 1	016 062	016 091	016 061	016 063	016 070
set 2	000 233	001 044	000 230	000 236	001 002
set 3	000 234	001 045	000 231	000 237	001 003
set 4	000 235	001 046	000 232	000 238	001 004

12Z6240 A_EN

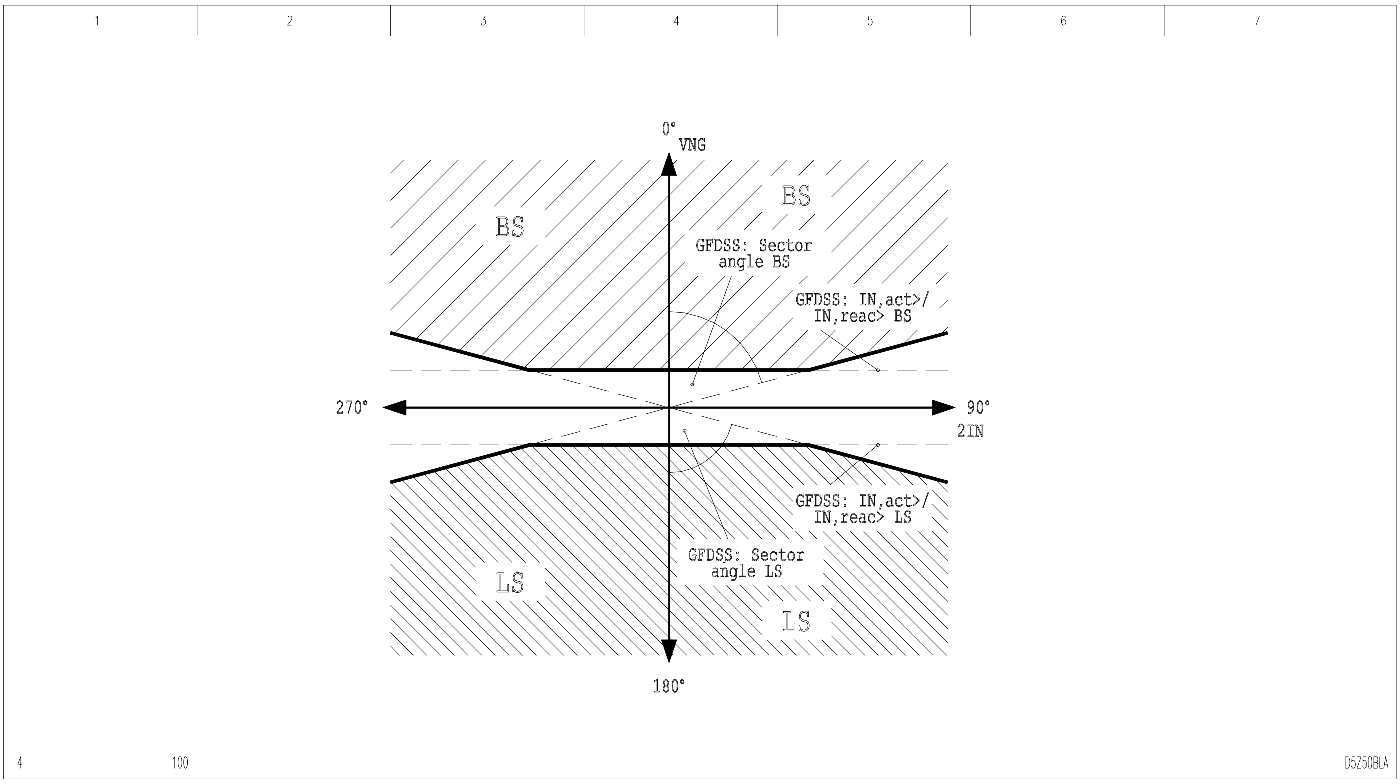
3-185 Direction determination with the operating mode 'steady-state power'

cos phi circuit

The directional decision is not enabled until the active component of the residual current exceeds the set threshold and the phase displacement between residual current and neutral-point displacement voltage is smaller than the set sector angle. The sector angle makes it possible to extend the "dead zone" to take into account the expected phase-angle errors of the measured variables. These settings make it possible to achieve the characteristic shown in Figure 3-186.

Output of the direction decisions is operate- and reset-delayed.

The trip signal *'forward directional'* issued by the ground fault direction determination using steady-state values (GFDSS) is blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.

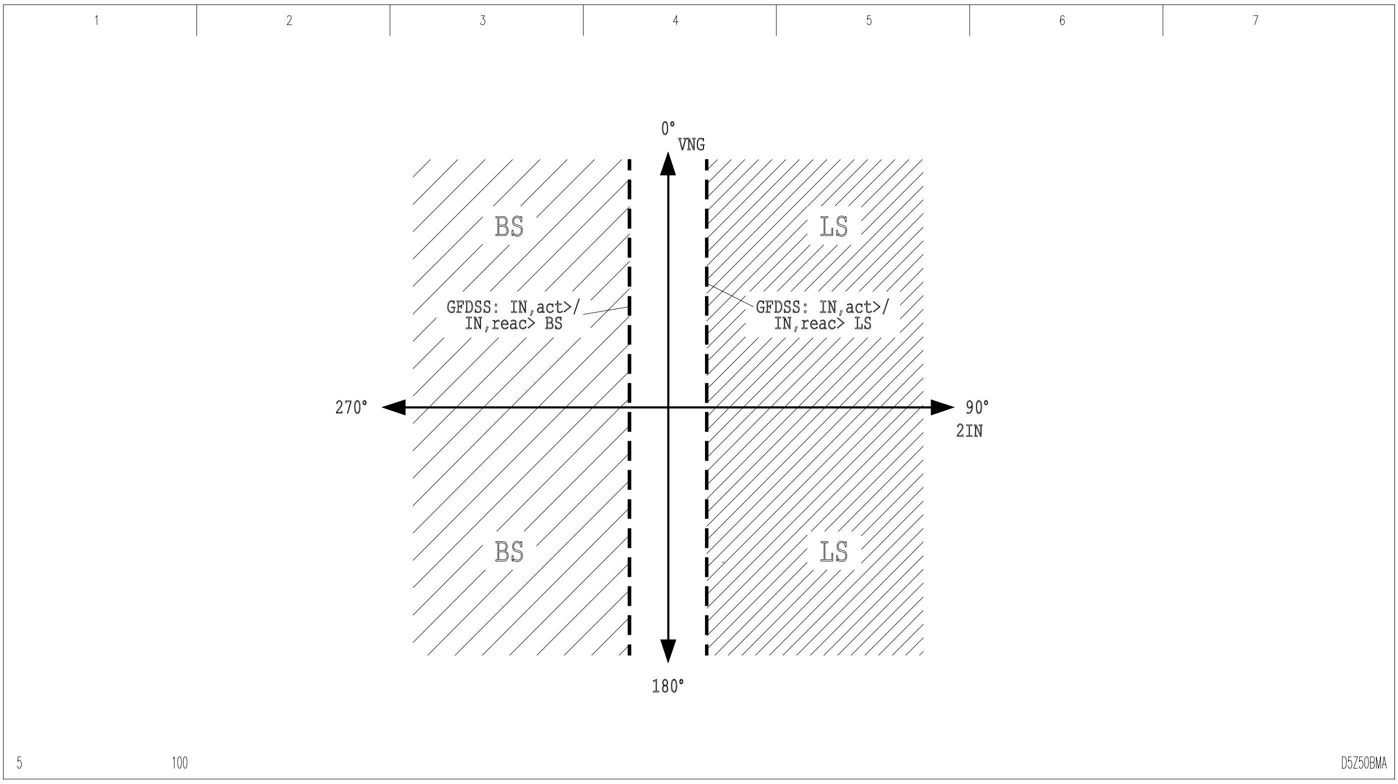


3-186 Characteristic of the ground fault direction determination using steady-state values, operating mode 'cos phi circuit' *sin phi circuit*

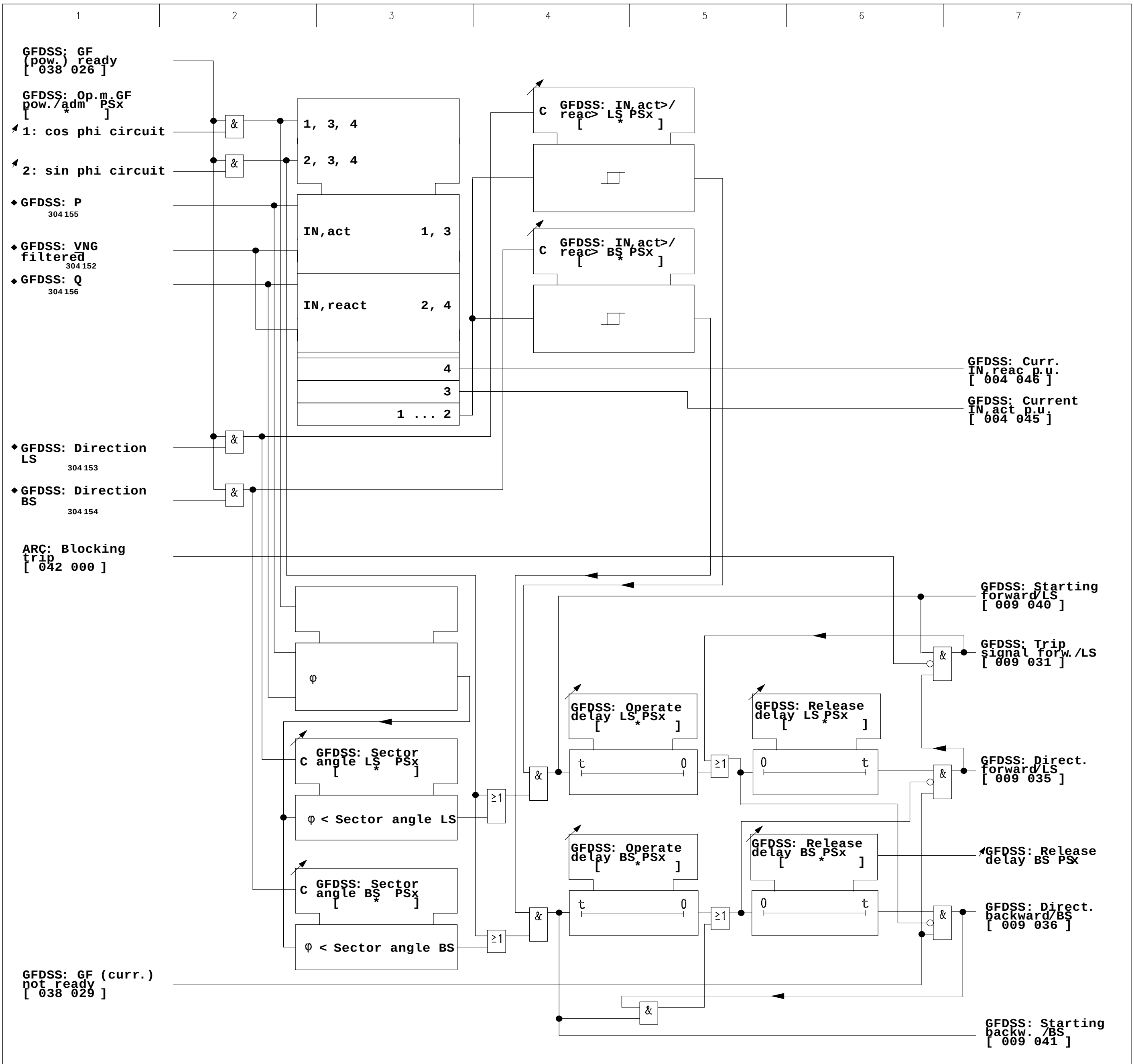
The direction decision is enabled if the reactive component of the residual current has exceeded the set threshold operate value. This setting makes it possible to achieve the characteristic shown in Figure 3-187.

Output of the direction decisions is operate- and reset-delayed.

The trip signal *'forward directional'* issued by the ground fault direction determination using steady-state values (GFDSS) is blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.



3-187 *Characteristic of the ground fault direction determination using steady-state values, operating mode 'sin phi circuit'*



* Parameter	GFDSS: Op.m.GF pow./adm PSx	GFDSS: Sector angle LS PSx	GFDSS: Sector angle BS PSx	GFDSS: IN,act>/ reac> LS PSx	GFDSS: IN,act>/ reac> BS PSx
set 1	016 063	016 065	016 068	016 064	016 067
set 2	000 236	000 242	000 248	000 239	000 251
set 3	000 237	000 243	000 249	000 240	000 252
set 4	000 238	000 244	000 250	000 241	000 253

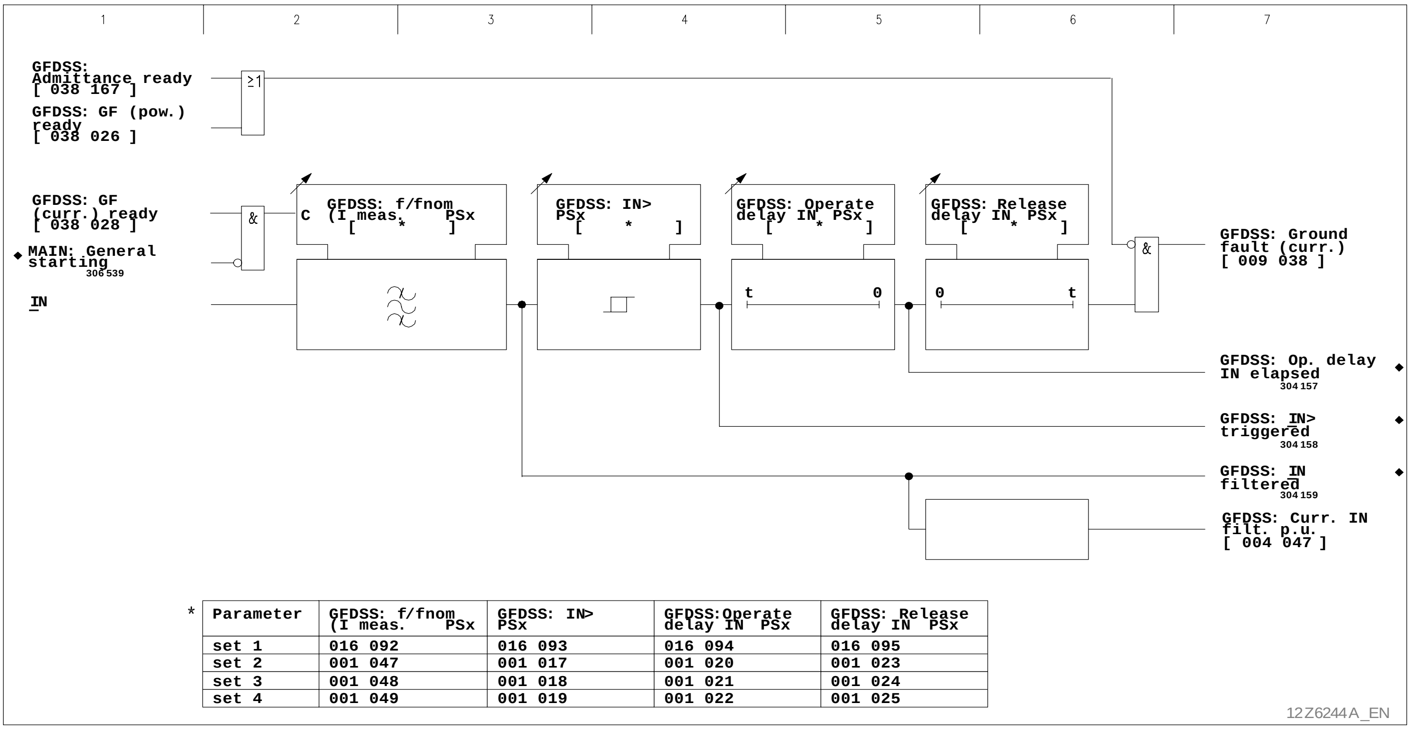
* Parameter	GFDSS: Operate delay LS PSx	GFDSS: Operate delay BS PSx	GFDSS: Release delay LS PSx	GFDSS: Release delay BS PSx
set 1	016 066	016 069	016 072	016 073
set 2	000 245	001 044	001 005	001 008
set 3	000 246	001 045	001 006	001 009
set 4	000 247	001 046	001 007	001 010

12Z6242 A_EN

3-188 *Output of the direction decisions with the operating mode 'steady-state power'*

3.30.2 Steady-State Current Evaluation

The frequency provided by the setting f/f_{nom} is filtered from the residual current value by using a Fourier analysis. Three periods are used for evaluation. If the residual current value exceeds the set threshold a ground fault signal is issued after the settable operate delay time period has elapsed.

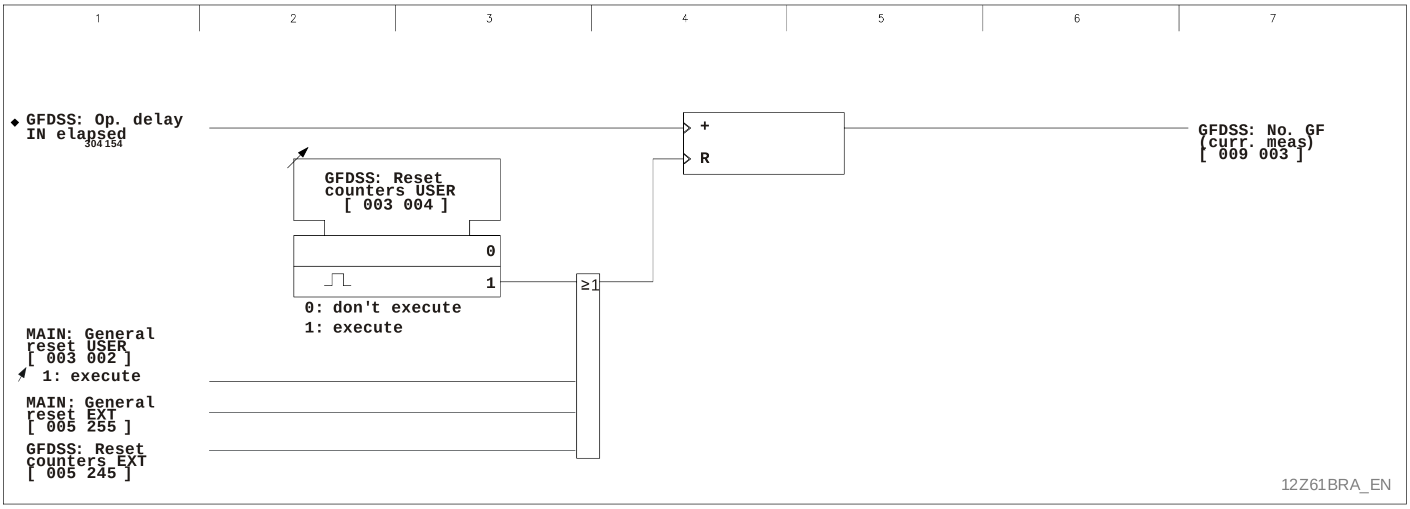


* Parameter	GFDSS: f/fnom (I meas. PSx	GFDSS: IN> PSx	GFDSS:Operate delay IN PSx	GFDSS: Release delay IN PSx
set 1	016 092	016 093	016 094	016 095
set 2	001 047	001 017	001 020	001 023
set 3	001 048	001 018	001 021	001 024
set 4	001 049	001 019	001 022	001 025

3-189 Evaluating residual current

Counting ground faults

The number of ground faults is counted. The counter may be reset either individually or together with other counters.

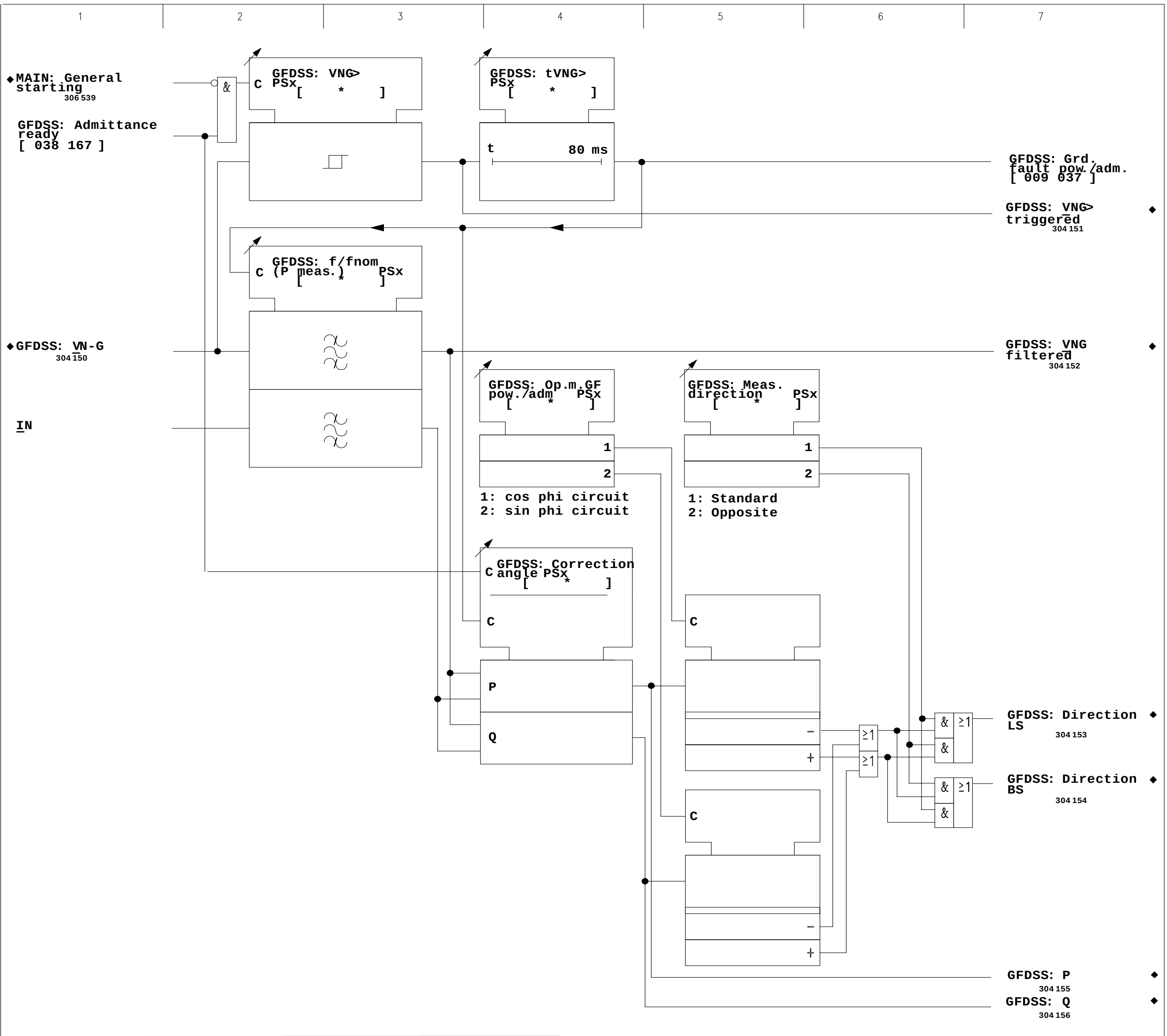


3-190 *Counting ground faults*

3.30.3 Steady-State Admittance Evaluation

To determine a ground fault direction the steady-state admittance evaluation requires the neutral-point displacement voltage and the residual current values. The frequency provided by the setting f/f_{nom} is filtered from these values by using a Fourier analysis.

The measurement is enabled when the time period set at GFDSS: tVNG> and which was triggered by VNG> has elapsed. Dependent on the operating mode selected (e.g. *'cos phi circuit'* or *'sin phi circuit'*) the sign of the active power (GFDSS: Op. mode GF pow./adm *'cos phi circuit'*) or of the reactive power (GFDSS: Op. mode GF pow./adm *'sin phi circuit'*) is used to determine the direction. Connection of the measuring circuits is taken into account by the setting at GFDSS: Measuring direction. When the connection *'Standard'* has been made a ground fault on the line side will issue the decision 'LS' and a ground fault on the busbar side will issue the decision 'BS'. Phase-angle errors of the system transformers can be compensated with the setting at GFDSS: Correction angle.



* Parameter	GFDSS: VNG> PSx	GFDSS: f/fnom (P meas.) PSx	GFDSS: tVNG> PSx	GFDSS: Op.m.GF pow./adm PSx	GFDSS: Correction angle PSx	GFDSS: Meas. direction PSx
set 1	016 062	016 091	016 061	016 063	016 110	016 070
set 2	000 233	001 044	000 230	000 236	001 026	001 002
set 3	000 234	001 045	000 231	000 237	001 027	001 003
set 4	000 235	001 046	000 232	000 238	001 028	001 004

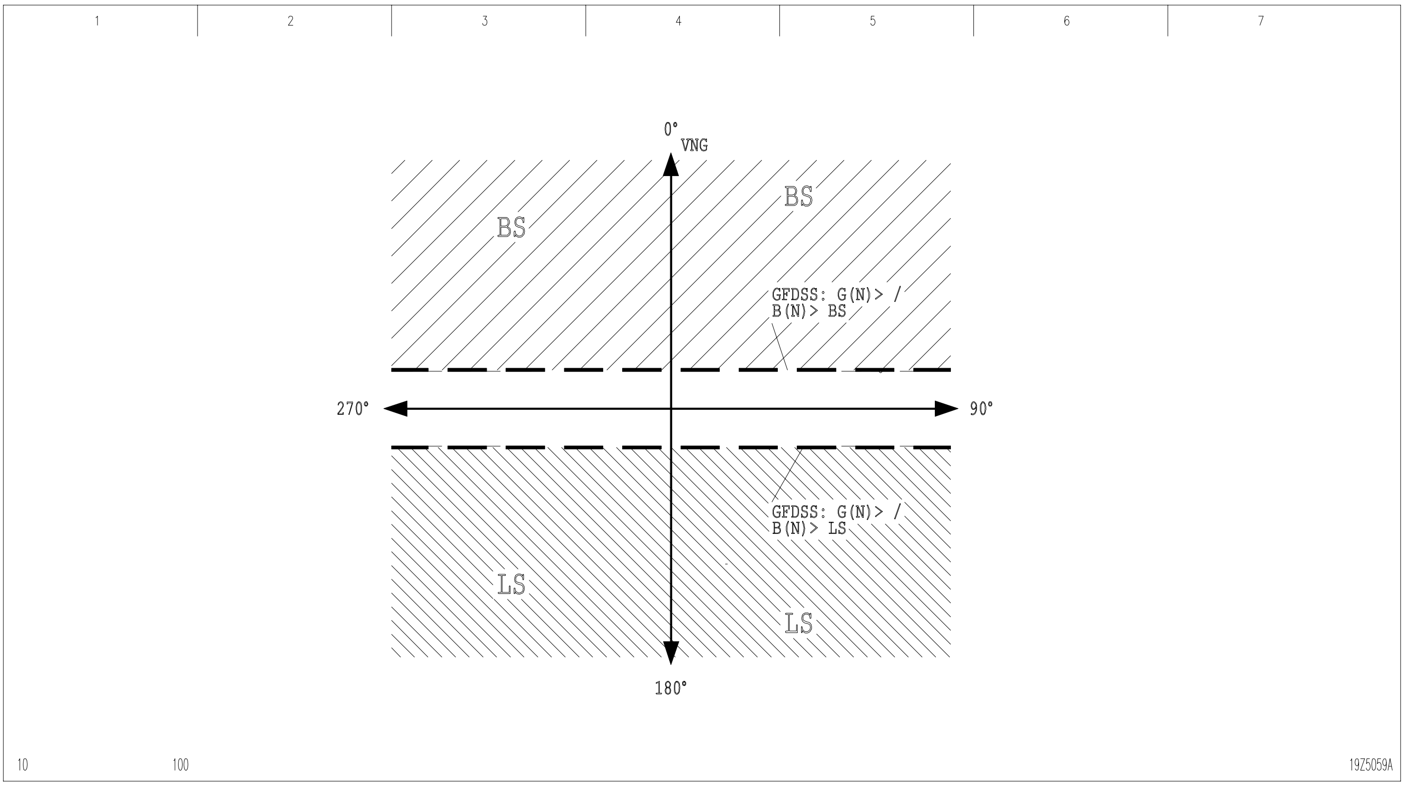
12Z6245 B_EN

3-191 *Direction determination with the operating mode 'steady-state admittance'* *cos phi circuit*

Direction determination is enabled when the conductance value (conductance G(N)) on the ground return exceeds the set threshold. This setting makes it possible to achieve the characteristic shown in Figure 3-192.

Output of the direction decisions is operate- and reset-delayed.

The trip signal in forward direction issued by the ground fault direction determination using steady-state values (GFDSS) is blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.

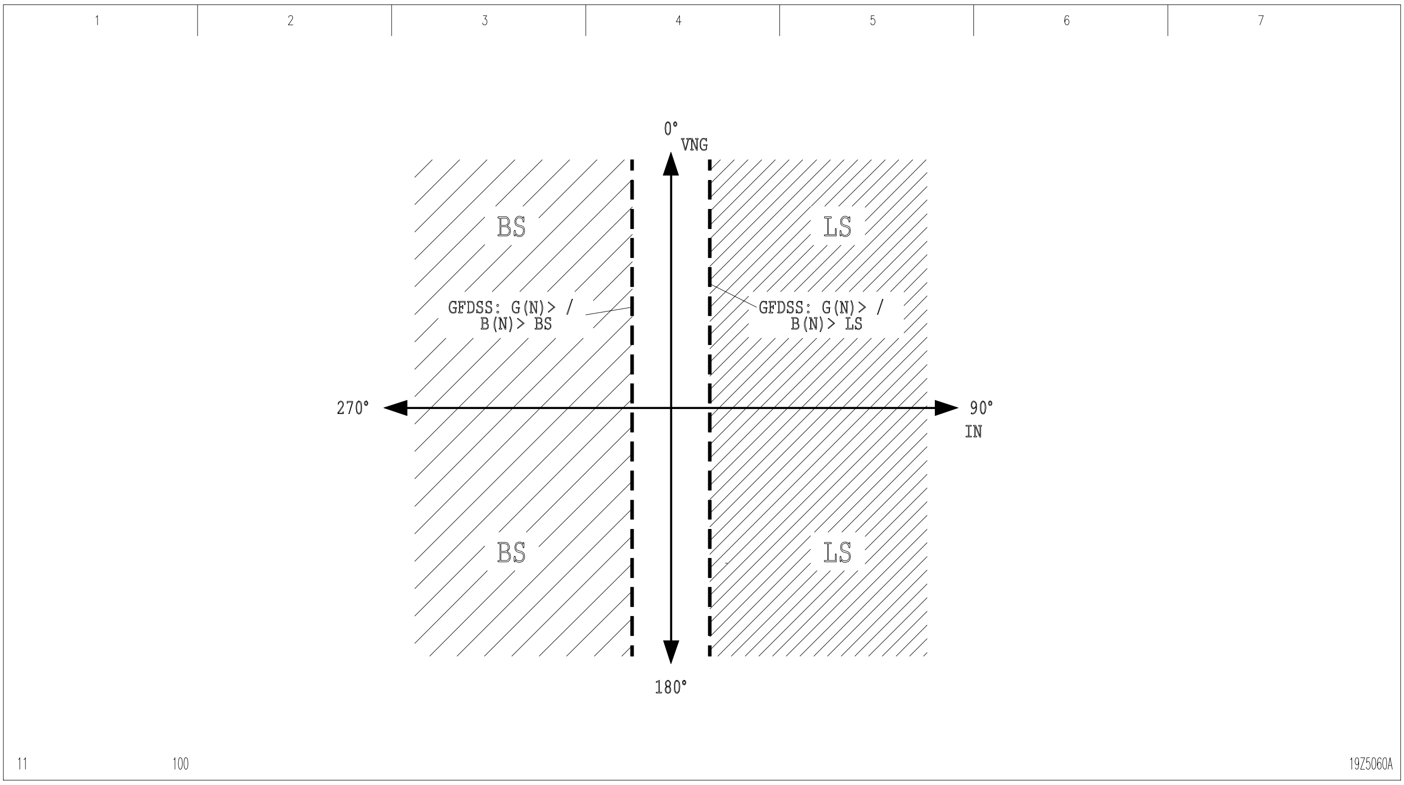


3-192 Characteristic of the ground fault direction determination using steady-state admittance, operating mode 'cos phi circuit' *sin phi circuit*

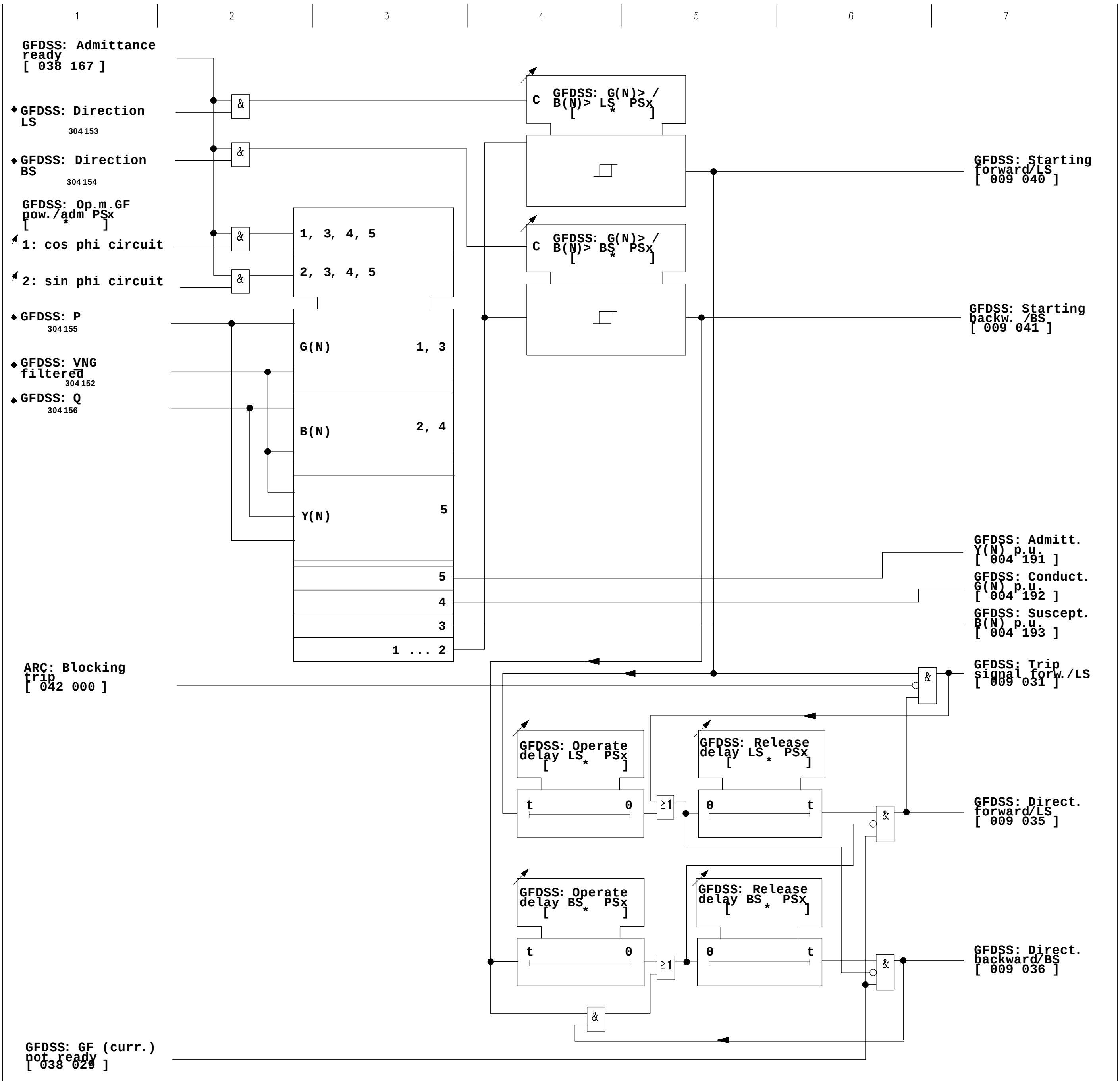
Direction determination is enabled when the conductance value (susceptance B(N)) on the ground return exceeds the set threshold. This setting makes it possible to achieve the characteristic shown in Figure 3-193.

Output of the direction decisions is operate- and reset-delayed.

The trip signal in forward direction issued by the ground fault direction determination using steady-state values (GFDSS) is blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.



3-193 Characteristic of the ground fault direction determination using steady-state admittance, operating mode 'sin phi circuit'



*

Parameter	GFDSS: Op.m.GF pow./adm PSx	GFDSS: G(N)> / B(N)> LS PSx	GFDSS: G(N)> / B(N)> BS PSx
set 1	016 063	016 111	016 112
set 2	000 236	001 029	001 032
set 3	000 237	001 030	001 033
set 4	000 238	001 031	001 034

*

Parameter	GFDSS: Operate delay LS PSx	GFDSS: Operate delay BS PSx	GFDSS: Release delay LS PSx	GFDSS: Release delay BS PSx
set 1	016 066	016 069	016 072	016 073
set 2	000 245	001 044	001 005	001 008
set 3	000 246	001 045	001 006	001 009
set 4	000 247	001 046	001 007	001 010

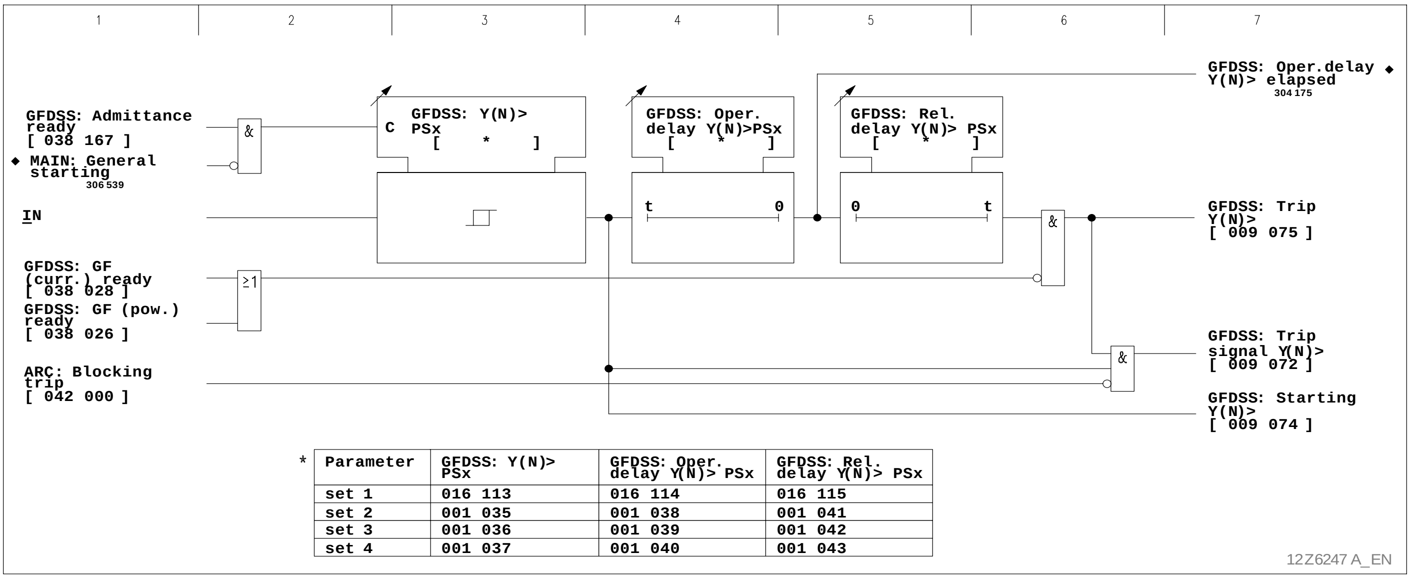
12Z6246 A_EN

3-194 Output of the direction decisions with the operating mode 'steady-state admittance'

Non-directional ground fault determination

The admittance value from the ground return is used for evaluation. If the admittance value exceeds the set threshold a ground fault signal is issued after the settable operate delay time period has elapsed.

The trip signal from the non-directional ground fault determination is blocked by the auto-reclosing control function (ARC) when this function is able to issue a trip command.



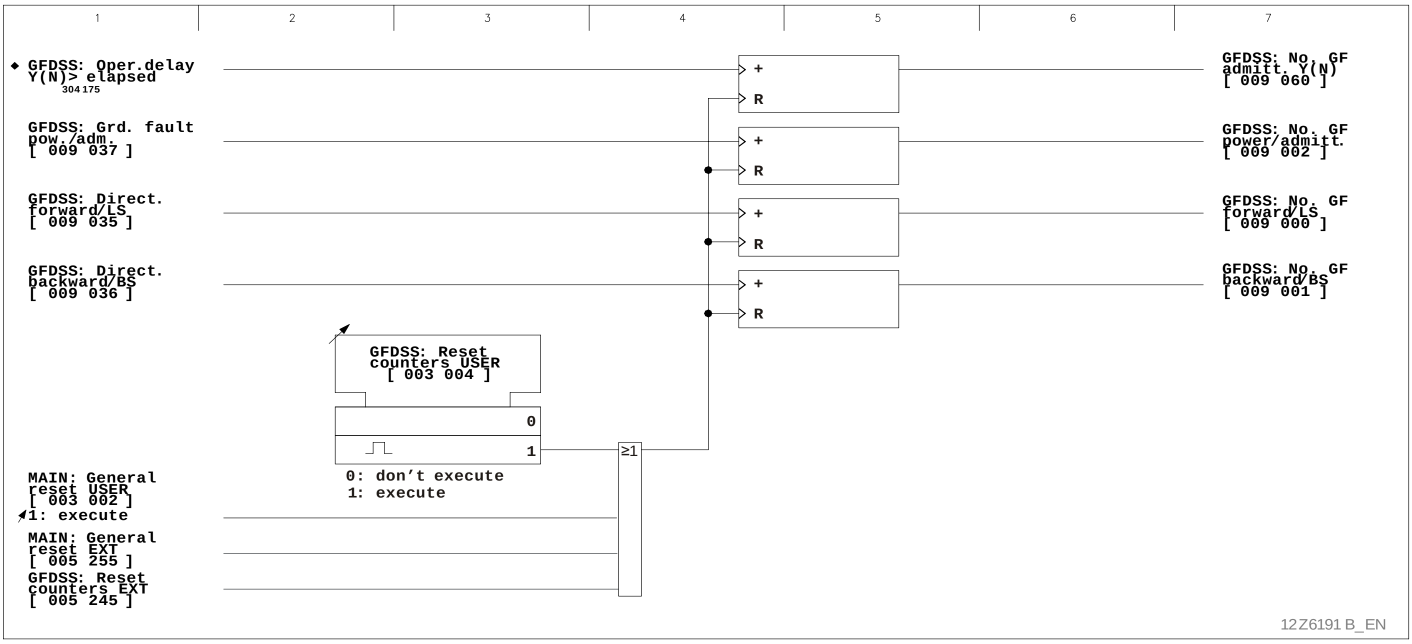
*

Parameter	GFDSS: Y(N)> PSx	GFDSS: Oper. delay Y(N)> PSx	GFDSS: Rel. delay Y(N)> PSx
set 1	016 113	016 114	016 115
set 2	001 035	001 038	001 041
set 3	001 036	001 039	001 042
set 4	001 037	001 040	001 043

3-195 Evaluating admittance

3.30.4 Counting the Ground Faults Detected by Steady-State Power and Admittance Evaluation

The number of ground faults and directional decisions are counted. The counters may be reset individually or together with other counters (see section 'Resetting Actions').



3-196 Counting ground faults

3.31 Transient Ground Fault Detection (Function Group TGFD)

By applying the transient ground fault measuring procedure the ground fault direction is determined by evaluating the neutral-point displacement voltage and the residual current.

Enable/disable the transient ground fault detection function.

The transient ground fault detection function (TGFD) can be disabled or enabled via setting parameters. Moreover, enabling can be carried out separately for each parameter set.

The transient ground fault detection function is ready

A ready signal is issued if the following conditions are met:

☐ The protection is enabled.

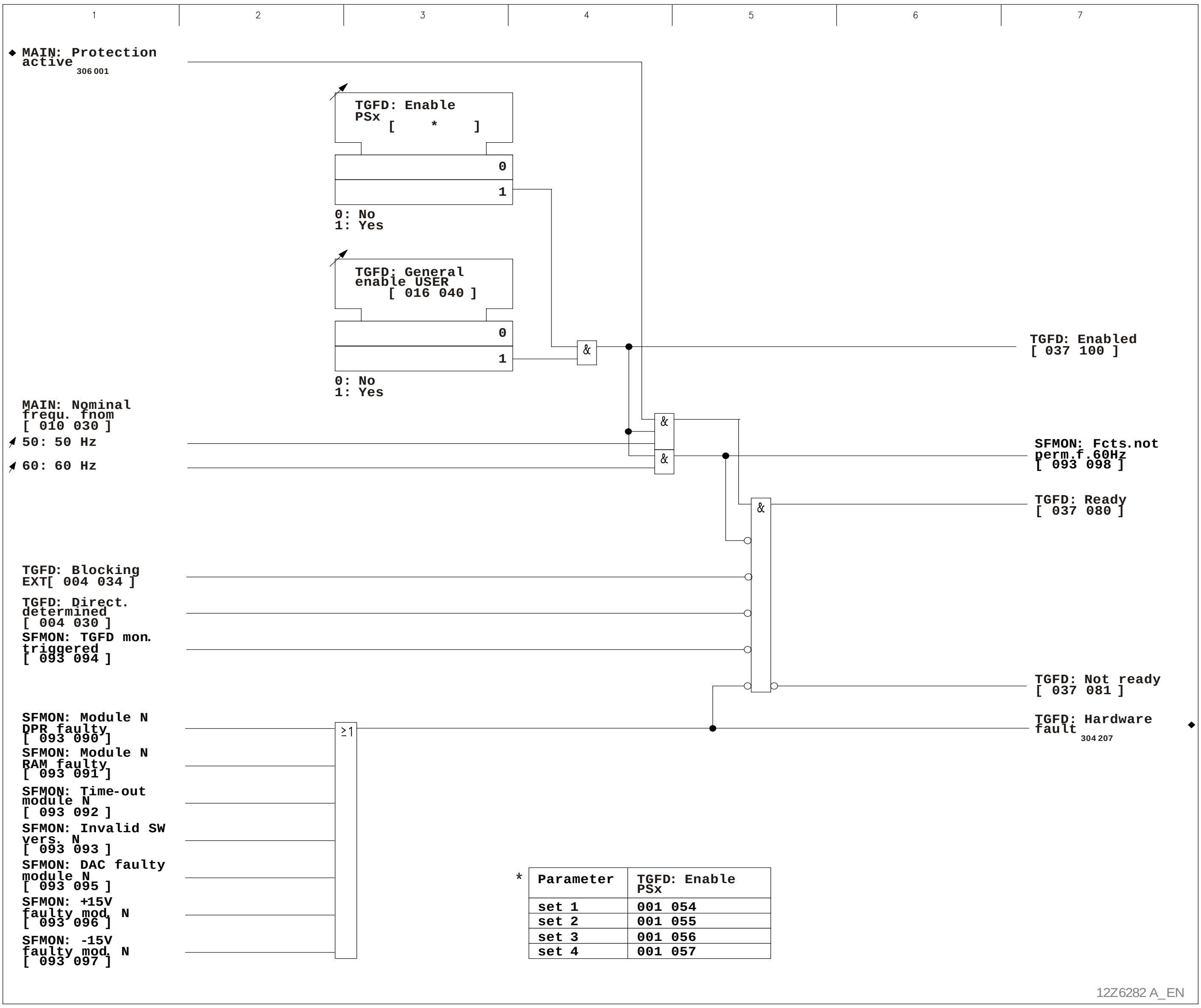
☐ The transient ground fault detection function is enabled.

☐ The nominal frequency is set to 50 Hz.

☐ There is no external blocking.

☐ Transient ground fault detection has issued no directional decisions.

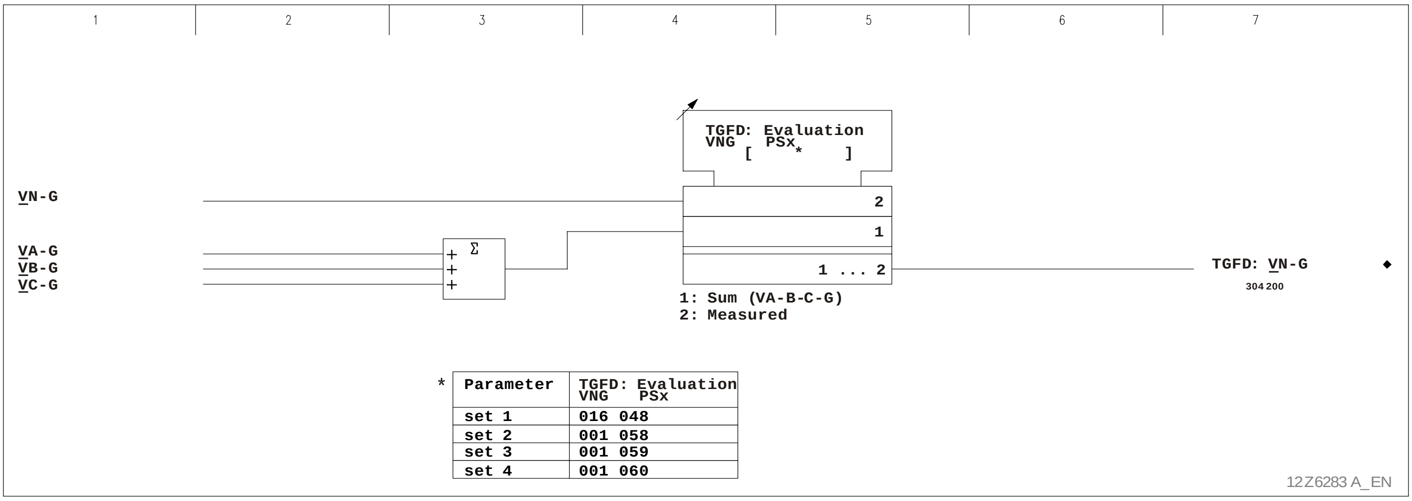
☐ Self-monitoring has detected no faults with transient ground fault detection.



3-197 *Enabling, disabling and readiness of the transient ground fault detection function*

Conditioning and selecting the measured variables

To condition measured variables VNG and IN the P132 is fitted with integrated transformers. As an alternative it is possible to use the neutral-point displacement voltage calculated by the P132 from the three phase-to-ground voltages. Connection of the measuring circuits is taken into account by the setting at TGFD: Measuring direction. A pole reversal of the residual current measuring circuit through the global setting at MAIN: Conn. meas. circ. IN will in no way influence direction determination by the transient ground fault detection function.



Parameter	TGFD: Evaluation VNG PSx
set 1	016 048
set 2	001 058
set 3	001 059
set 4	001 060

3-198 *Selecting the neutral-point displacement voltage*

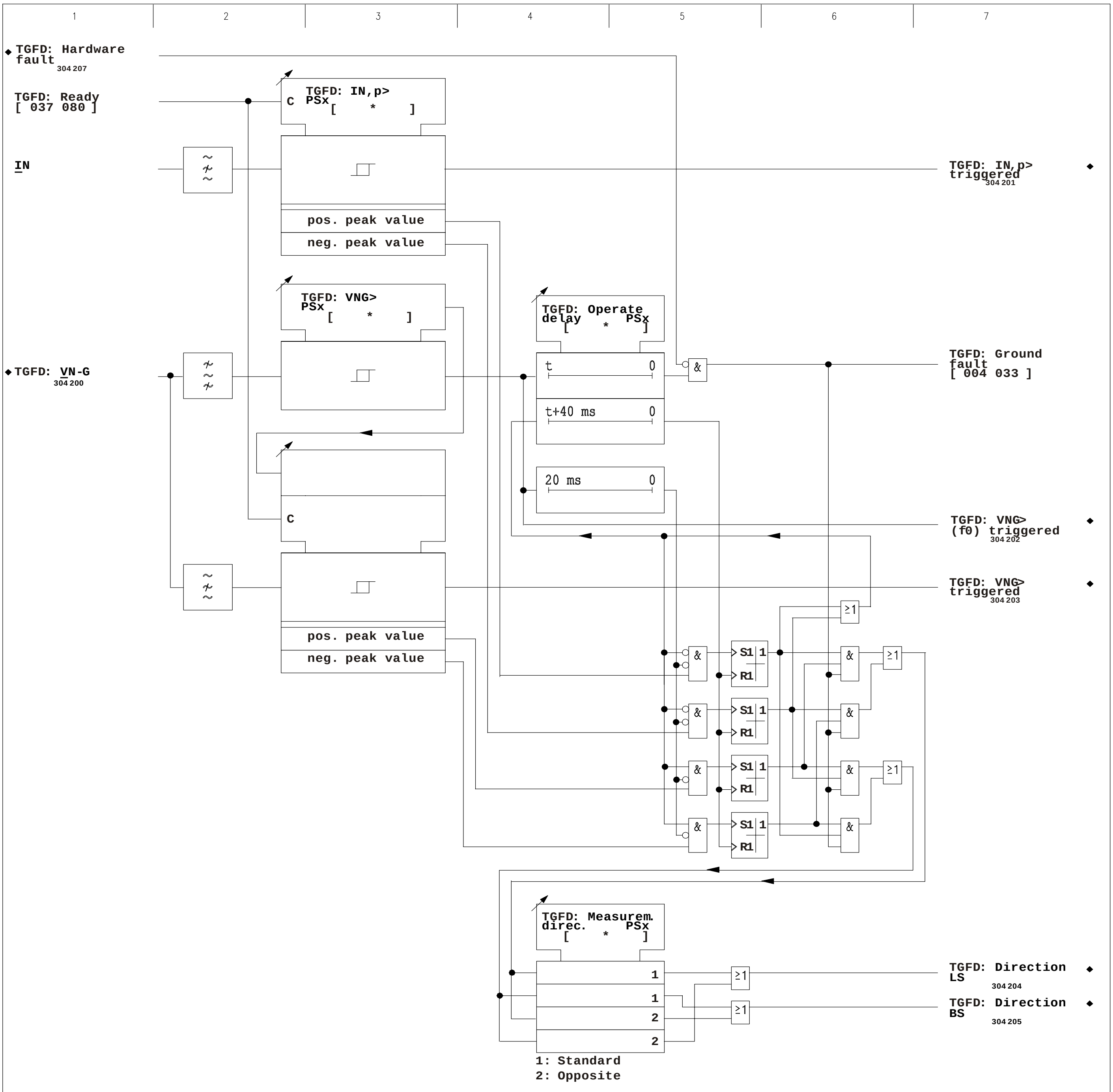
Determining the ground fault direction

A ground fault direction can only be determined if the TGFD function is ready.

The higher frequency content is filtered from the measured values for residual current and neutral-point displacement voltage. Settable triggers monitor the amplitudes of the residual current and neutral-point displacement voltage harmonics as well as the neutral-point displacement voltage fundamental. To determine the ground fault direction the P132 will evaluate trigger decisions by the harmonics monitoring function, separately for the positive and negative half-wave.

The sign of the neutral-point displacement voltage harmonic is determined immediately after the current harmonic has exceeded the positive or negative threshold value. Trigger decisions for current and voltage are compared to determine the ground fault direction where, as a rule, evaluation depends on the connection of the measuring circuits. Connection of the measuring circuits is taken into account by the setting at TGFD: Measuring direction. When the connection *'Standard'* has been made a ground fault on the line side will issue the decision 'LS' and a ground fault on the busbar side will issue the decision 'BS'. The directional decision is enabled after the operate delay period has elapsed, which follows monitoring of the neutral-point displacement voltage fundamental.

Furthermore the starting of a current trigger will start a timer stage that, after it has elapsed, will enable the TGFD function to detect further transient ground faults.
The time period after which a new transient ground fault may be detected is given by the setting of the operate delay +40 ms.



* Parameter	TGFD: IN,p> PSx	TGFD: VNG> PSx	TGFD: Operate delay PSx	Measurem. direc. PSx
set 1	016 042	016 041	016 044	016 045
set 2	001 064	001 061	001 067	001 073
set 3	001 065	001 062	001 068	001 074
set 4	001 066	001 063	001 069	001 075

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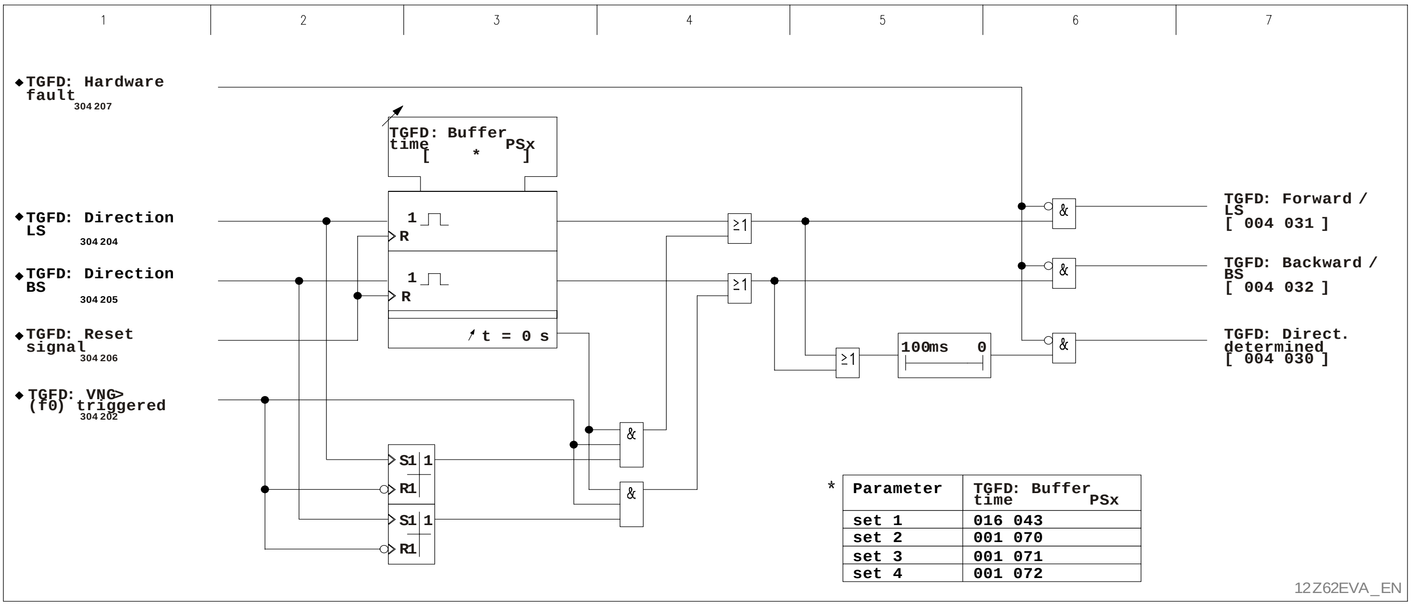
3-199 Direction determination

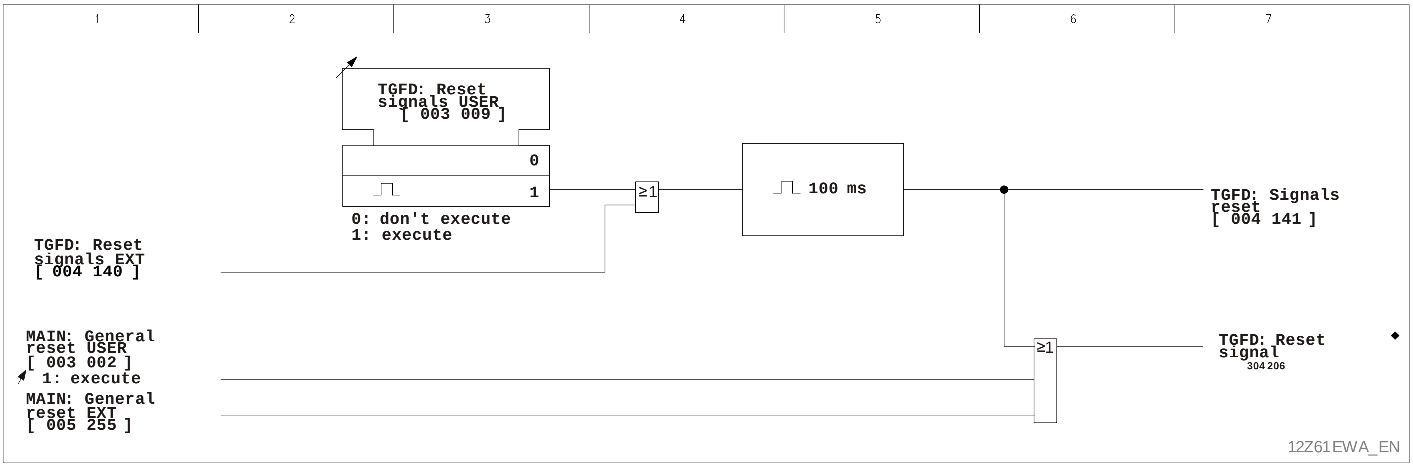
Directional decisions are issued for the duration of the set buffer time. If buffer time is set to 0 s directional decisions are issued for as long as the neutral-point displacement voltage fundamental exceeds the trigger threshold set at TGFD: VNG>.



3-200 Issuing directional decisions

Resetting a directional decision

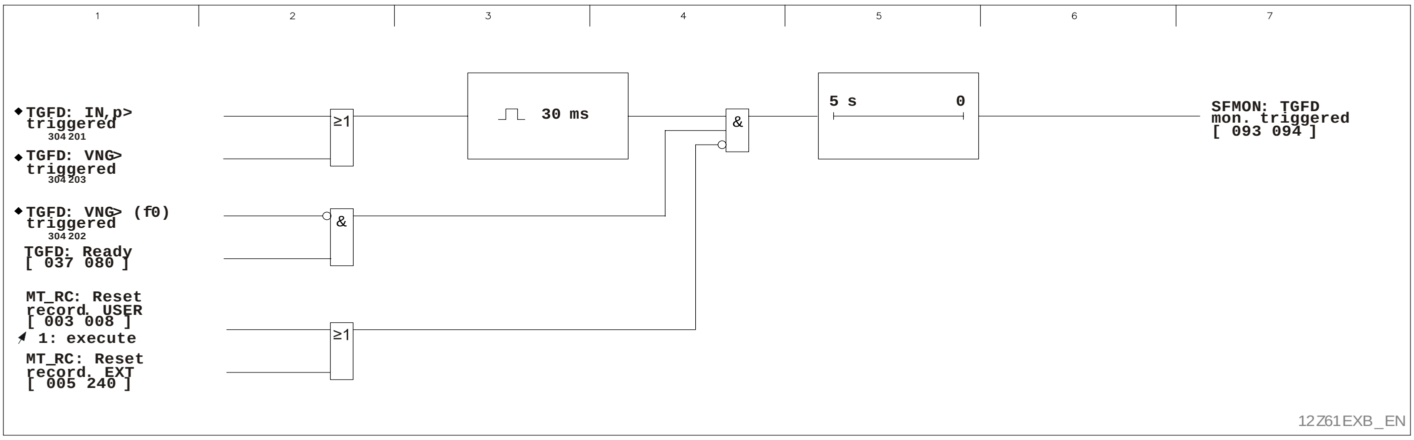
While the buffer time is elapsing the directional decisions can be reset from the integrated local control panel, a setting parameter or through an appropriately configured binary signal input. Should the buffer time be set to ∞ ("infinity") the directional decision must be reset so that a new transient ground fault can again be detected.



3-201 *Resetting directional decisions*

Monitoring the measured variables

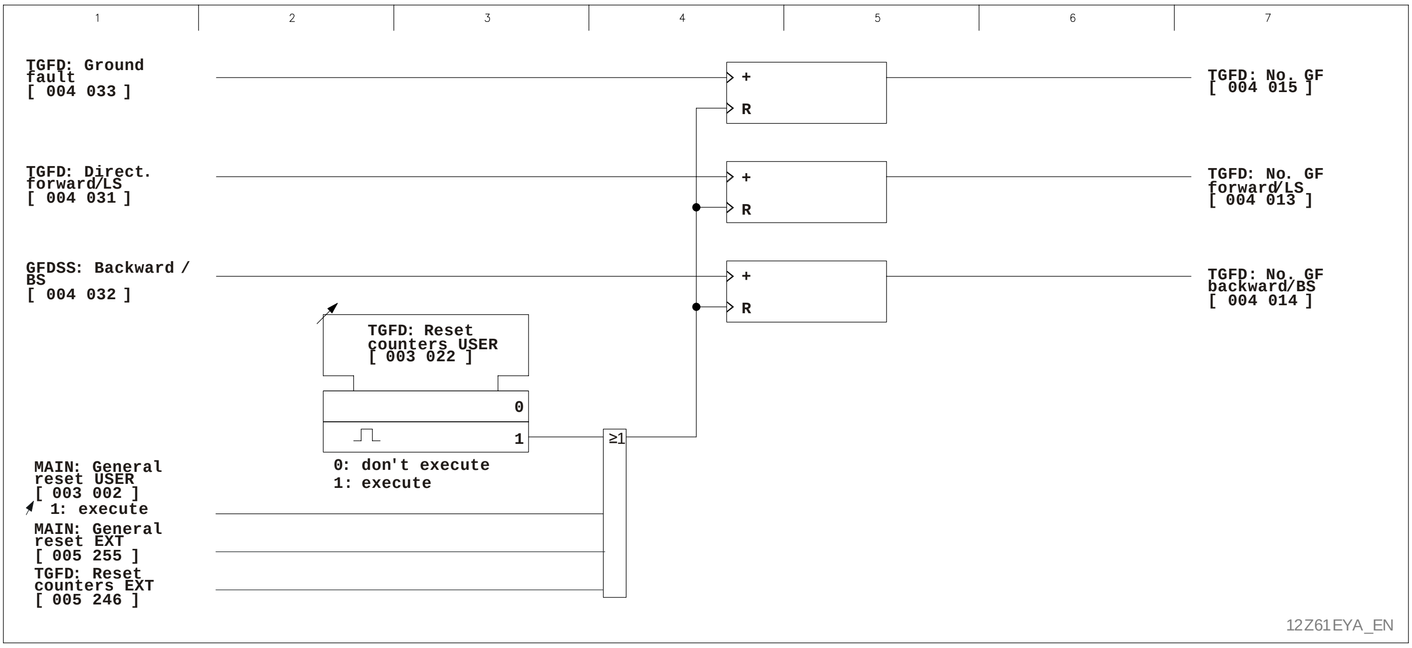
TGFD is blocked after 5s if the respective set threshold value is exceeded by the current or the higher frequency content of the neutral-point displacement voltage in the absence of a ground fault (that is while the neutral-point displacement voltage fundamental stays below the set trigger threshold).



3-202 *Monitoring measured variables*

Counting transient ground faults

The number of transient ground faults and directional decisions are counted. The counters can be reset either individually or as a group.



3-203 Counting transient ground faults

3.32 Motor Protection (Function Group MP)

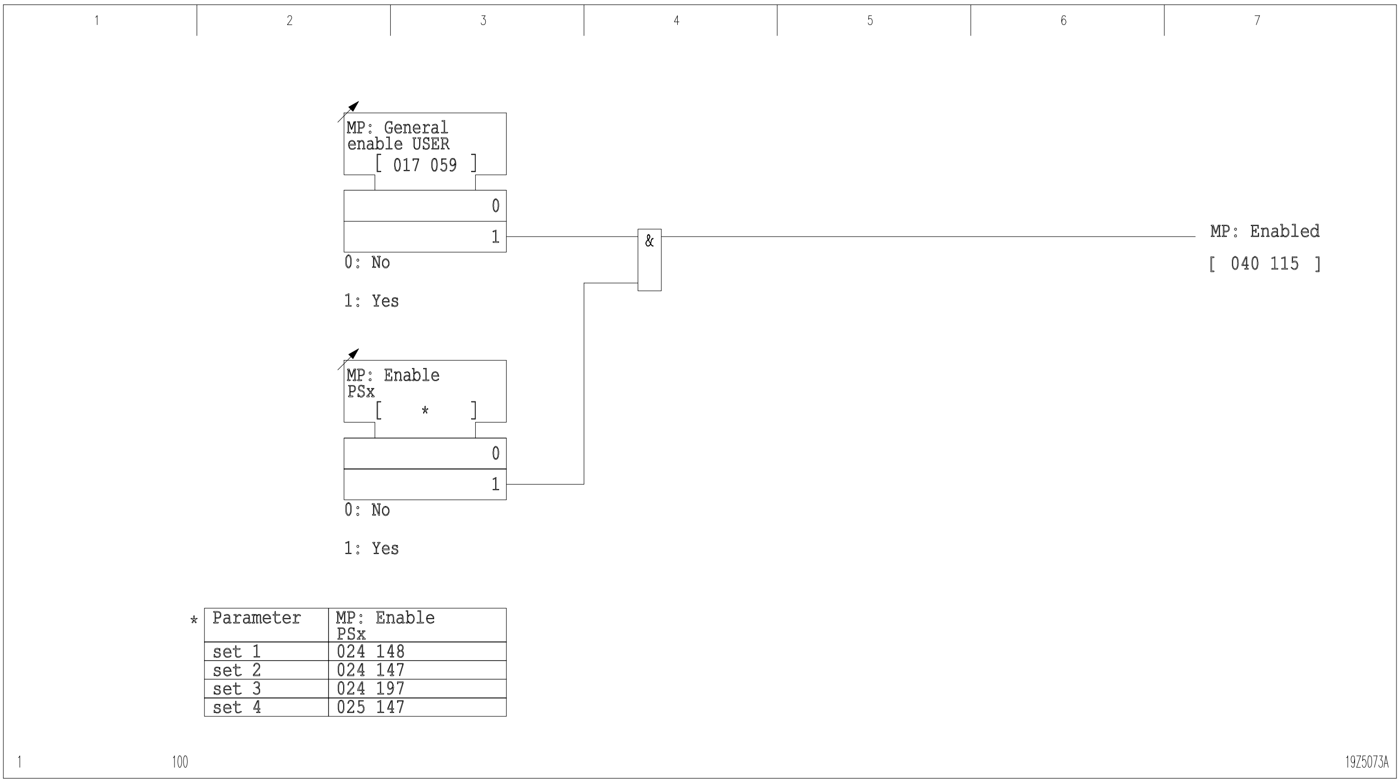
The P132 features a motor protection function (MP function). This motor protection function is specifically designed to protect directly switched high-voltage asynchronous motors with thermally critical rotors. Protection functions specially adapted for this application are available:

- ☐ Overload protection including a thermal replica of the motor (complete memory)
- ☐ Taking into account heat dispersion processes in the rotor after several startups
- ☐ Separate cooling time constants for running and stopped motors
- ☐ Monitoring of startup frequency including re-start blocking
- ☐ Heavy starting logic
- ☐ Locked rotor protection
- ☐ Logic function for the operating mode including thermal overload protection (THERM)
- ☐ Special startup measured values during commissioning
- ☐ Running time meter

The definite-time overcurrent protection stages required for global motor protection operation as well as the necessary unbalance protection are described in sections ‘DTOC Protection’ and ‘Unbalance Protection (I2>)’, respectively.

Enable/disable the motor protection function

The motor protection function can be enabled or disabled via a parameter setting. Moreover, enabling can be carried out separately for each parameter subset.



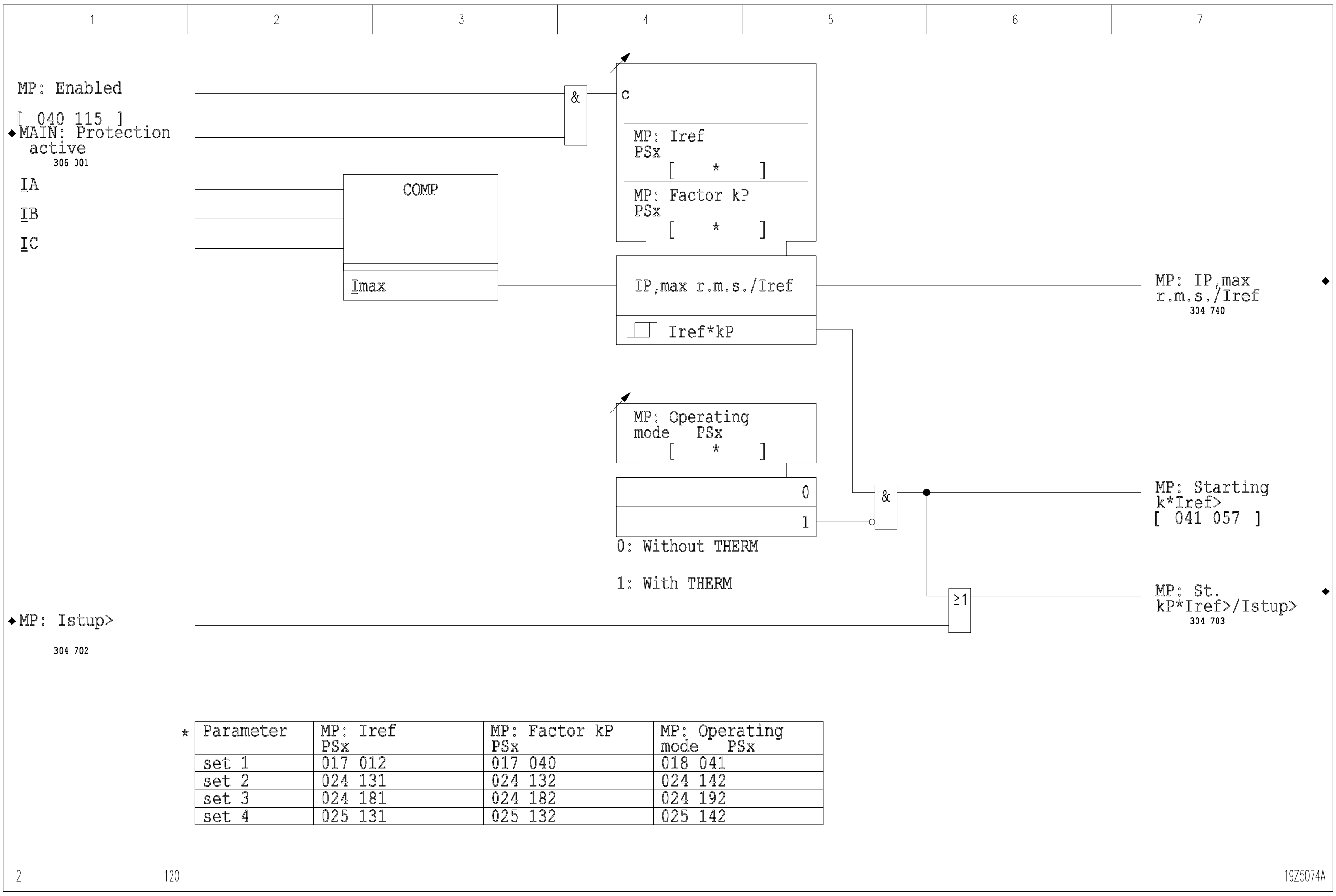
* Parameter	MP: Enable PSx
set 1	024 148
set 2	024 147
set 3	024 197
set 4	025 147

3-204 *Enable/disable the motor protection function*

Starting conditions

The overcurrent stage $I_{ref,P}$> is used as a starting stage for overload protection. For this the maximum value of the three phase currents is evaluated. The settable reference current I_{ref} is used as the reference quantity for the operate value and the tripping time. When the threshold $kP \cdot I_{ref}$ is exceeded then the current stage operates.

The output signal from the current stage $I_{ref,P}$> is used as the starting signal.



* Parameter	MP: Iref PSx	MP: Factor kP PSx	MP: Operating mode PSx
set 1	017 012	017 040	018 041
set 2	024 131	024 132	024 142
set 3	024 181	024 182	024 192
set 4	025 131	025 132	025 142

3-205 Starting conditions

3.32.1 Overload Protection

Operating state recognition

The P132 features an operating state recognition function with which the overload protection function is controlled, e.g. the thermal replica is plotted as precisely as possible. The possible individual operating states with a directly switched asynchronous motor are detected via various trigger stages as listed below:

☐ Machine stopped:
If the measured maximum RMS phase current value has dropped below the threshold of $0.1 \cdot I_{ref}$ the function will decide on 'machine stopped' (signaled by MP: Machine stopped). No-load currents for asynchronous motors lie significantly above the current threshold value of 0.1 I_{ref}.

☐ Machine running:
If the measured maximum RMS phase current value exceeds the threshold of 0.1 I_{ref} the function will decide on 'machine running' (signaled by MP: Machine running).

☐ Overload range:
For a machine the overload range starts with current values exceeding the maximum permissible continuous thermal current of the machine. The overload memory will be incremented if the measured maximum RMS phase current value exceeds the threshold value of $I_{ref,P}$>.

☐ Startup:
The onset of startup in a directly switched asynchronous motor is detected when the measured maximum RMS phase current value exceeds the threshold value set at MP: IStUp> PSx for a minimum time duration period set at MP: tIStUp>. The end of a startup process is detected when, after the onset of startup has been identified, the measured maximum RMS phase current value falls below the threshold value of $0.6 \cdot I_{StUp}$>.

Overload memory

The thermal overload protection function featured by the P132 is specifically suited for protection of high-voltage asynchronous motors with thermally critical rotors, a very common motor type. For this there is a specific overload memory available that presents a replica of the protected object’s relative over-temperature based on the coolant temperature and with a values range from 0 to 100%. The following values stored in the overload memory have particular significance within the range of this model:

☐ 0%:
The value 0% represents the cold state of a protected object, e.g. it has cooled down to ambient temperature.

☐ 20%:
The value 20% represents the minimum value stored by the overload memory when the protected object is at operating temperature or after initial startup. A running machine is always considered as being at operating temperature.

☐ 40%:
The value 40% temporarily represents the minimum value stored by the overload memory after two consecutive startups of the machine.

☐ 60%:
The value 60% temporarily represents the minimum value stored by the overload memory after three consecutive startups of the machine.

☐ 100%:
The instant when the overload memory reaches the value of 100% (trip threshold) an overload protection trip will be issued. The hysteresis for a defined release of the trip signal is 1%.

The overload memory mapping process that results in a replica of the actual thermal conditions existing in the protected object includes the following operations:

☐ Mapping of heating:
Basically the overload memory is continuously incremented when the maximum RMS phase current value measured will have exceeded the threshold value of kP I_{ref} (overload range). The rate of this increase of the storing value depends on the magnitude of the maximum RMS phase current value and, to a certain extent, on the selected tripping characteristic (MP: Characteristic P PSx).

☐ Mapping of heat transfer:
After a startup has been identified and the maximum RMS phase current value has fallen below the current threshold of 0.6 I_{StUp}> (load range), then the stored value is continuously and automatically pre-decreased, governed by the settable heat dispersion time constant MP: Tau after st.-up PSx of the overload memory. This time constant is used to map the heat transfer in the asynchronous motor from the copper of the rotor to the rotor’s iron core. This continuous pre-decreasing of the stored value is carried out linearly up to the minimum value stored after initial startup (mentioned above) and depending on the count of the startup frequency monitor. The rate for this pre-decreasing of the stored value is constant and ranges at about 40% of the discharge ($\tau_{\text{after startup}}$ = 20) within a time duration of 60 s, for example.

☐ Mapping of cooling:
When the measured maximum RMS phase current value has fallen below the current threshold of $I_{klref,P}$> and when the mapping of heat transfer, if applicable, has been completed, then cooling of the protected object is simulated by a continuous decreasing of the value stored in the overload memory. If the machine is running, decreasing of the stored value will be governed by the cooling time constant MP: Tau mach. running PSx and will continue until the minimum loading state of 20 % is reached. If the machine is stopped, decreasing of the stored value will be governed by the constant MP: Tau mach. stopped PSx and will continue until the minimum loading state of 0 % is reached. Decreasing of the stored value is an exponential function of time. The cooling time duration from an initial value m_0 to an interim value of m(t) can be determined as follows:

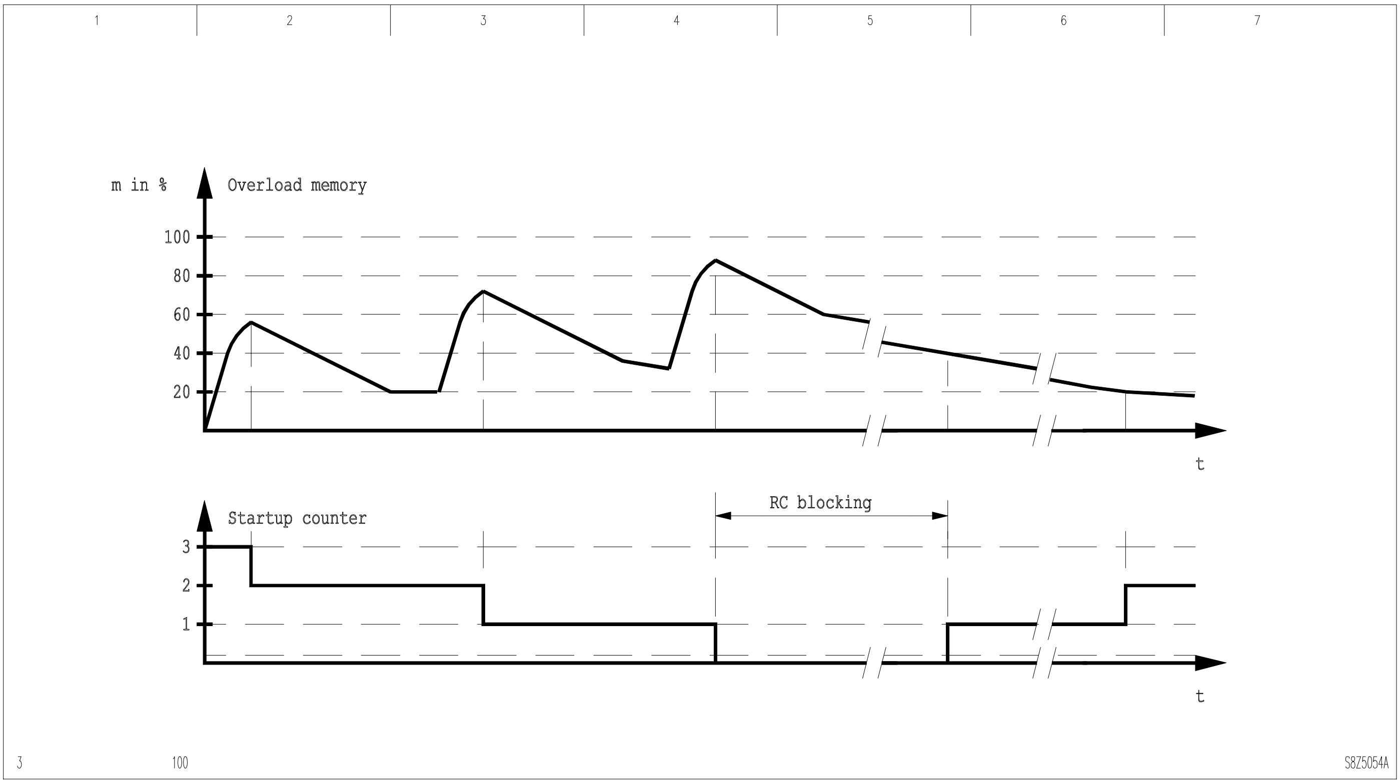
- ■ Machine running: $t = \tau_{machine \cdot running} \cdot \ln \frac{m_0 - 0.2}{m(t) - 0.2}$
- ■ Machine stopped: $t = \tau_{machine \cdot stooped} \cdot \ln \frac{m_0}{m(t)}$

Startup frequency monitoring

The P132 features a startup counter in 'count down' circuit configuration for startup frequency monitoring. Depending on the setting of MP: Perm. No. st.-ups PSx, the permissible number of consecutive startups is either 'three from cold or two from warm' or 'two from cold or one from warm'. The counter reading at any given time indicates the number of consecutive startups that are still permitted. The startup counter is controlled as follows (see Figure 3-206):

☐ Decrementing the startup counter (number of startups still permitted):
As the end of a startup is detected, the startup counter is decremented by ' 1 '. When the counter reading reaches its minimum value of ' 0 ', then the signal MP: RC blocking is issued and can - and indeed should - be configured to an output relay with which CB closure is blocked.

☐ Incrementing the startup counter (number of startups still permitted):
When the setting for the permissible number of consecutive startups is 'three from cold or two from warm' and the machine is running, then the startup counter is incremented by ' 1 ' if the stored value in the overload memory drops below a threshold value of 40% or 22%, respectively, in conjunction with 'mapping of cooling' of the protected object. When the machine is stopped then the startup counter will be incremented by ' 1 ' if the stored value in the overload memory drops below 40%, 20% or 2%, respectively, in conjunction with 'mapping of cooling' of the protected object.
When the setting for the maximum permissible number of consecutive startups is 'two from cold or one from warm' and the machine is running, then the startup counter will be incremented by the value ' 1 ' if the stored value in the overload memory drops below the threshold of 22%, in conjunction with 'mapping of cooling' of the protected object. When the machine is stopped then the startup counter will be incremented by ' 1 ' if the stored value in the overload memory drops below the threshold of 20% or 2%, respectively, in conjunction with 'mapping of cooling' of the protected object.
The signal MP: RC blocking is withdrawn if the stored value in the overload memory drops below the threshold of 40% (for 'three from cold or two from warm') or 22% (for 'two from cold or one from warm').



3-206 Overload memory and startup counter

Heavy starting logic

The heavy starting application involves a situation in which a machine’s startup time t_{StUp} exceeds its maximum possible blocking time t_E from operating temperature. For this application the P132 features a specific logic function that can be activated by the following two settings:

- ☐ The permissible number of consecutive startups is limited to 'two from cold or one from warm' (MP: Perm. No. st.-ups PSx)).
- ☐ For the permissible startup time t_{StUp} (MP: St.-up time tStUp PSx), a higher value is set than for the maximum permissible blocking time t_E from operating temperature (MP: Blocking time tE PSx). These two setting values are only relevant for this particular application; if both settings are identical, they have no effect on the protective function and the heavy starting logic is not active.

When this logic function has been activated, then the two timer stages t_E and t_{StUp} are triggered at the time when the onset of a startup is detected, corrected by the discrimination time t_{StUp} >. Once the set time t_E has elapsed, the logic function checks to see whether the machine is actually running. The presence of an external signal - from an overspeed monitor, for example - serves as the criterion for a running machine.

When a running machine is detected once the set time t_E has elapsed, then the stored value in the overload memory is automatically frozen and tracking is only restarted after the set startup time t_{StUp} has elapsed. When a locked rotor state is detected after the set time t_E has elapsed, the overload memory is automatically set to a value of 100%, which leads to an immediate trip decision.

Tripping time characteristics

The P132 user can choose between the following two tripping time characteristics:

☐ Reciprocally squared: $t = (1 - m_0) \cdot t_{6I_{ref}} \cdot \frac{36}{(I/I_{ref})^2}$

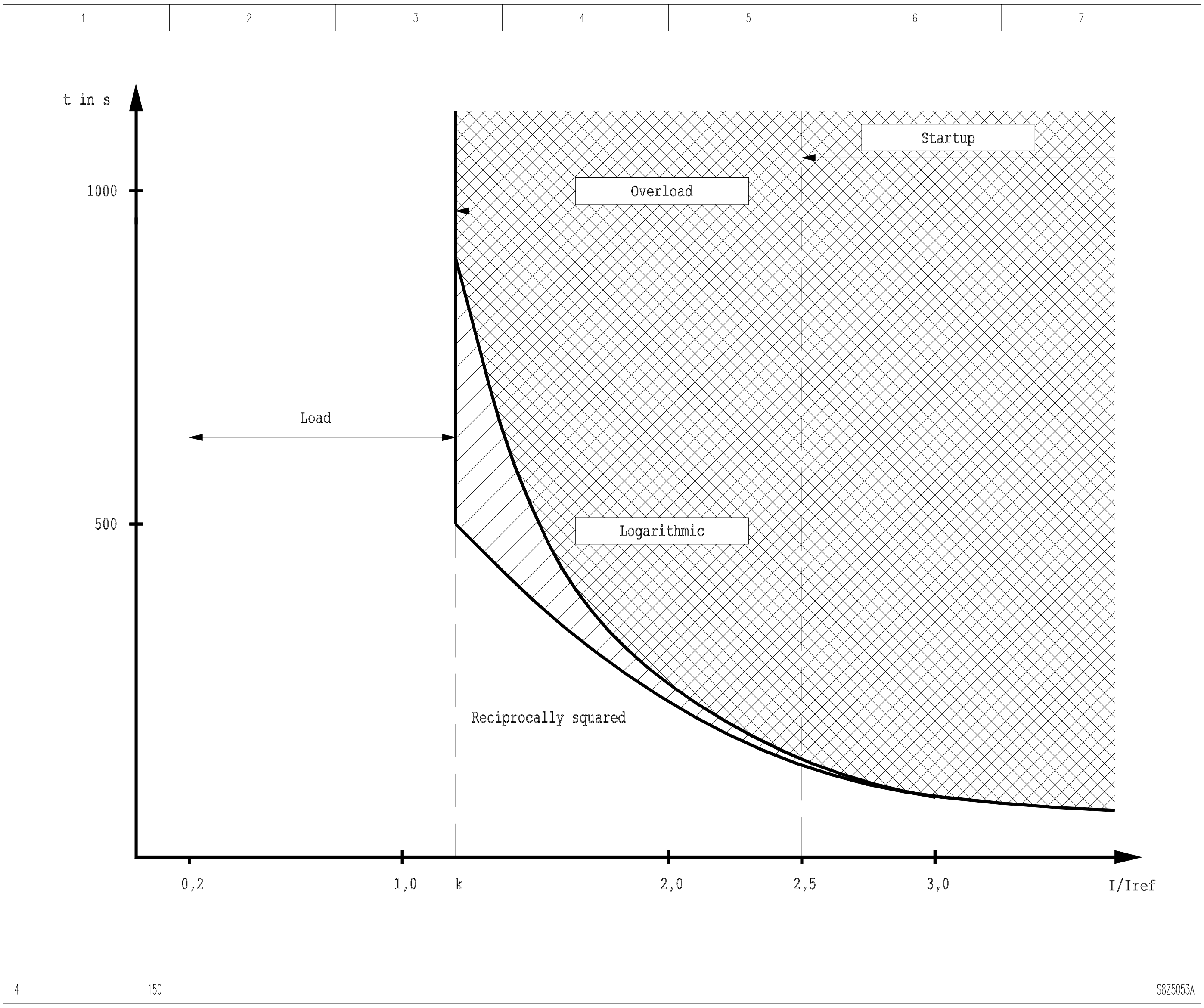
☐ Logarithmic: $t = (1 - m_0) \cdot t_{6I_{ref}} \cdot 36 \cdot \ln \frac{(I/I_{ref})^2}{(I/I_{ref})^2 - 1}$

where m_0 in each case signifies the pre-charging of the overload memory at time t = 0. With reference to the basic physical model (two-body model), the logarithmic characteristic in the overload range also takes into account heat transfer to the coolant, but this heat transfer becomes less significant as the overcurrent increases. At $I = 6 \cdot I_{ref}$, for example, the tripping time increase is only about 1.4% and is thus below the specified accuracy of the protection device. For a low overcurrent range, selection of the logarithmic characteristic provides significantly higher tripping times than selection of the reciprocally squared characteristic (see Figure 3-207), since the latter characteristic neglects any heat transfer to the cooling medium in the overload range. The possibility of choosing between two different tripping time characteristics takes into account the fact that the user or the application may require a more restrictive or a less restrictive type of protection. For currents in excess of 10 I_{ref}, the tripping times are limited in the direction of lower values.

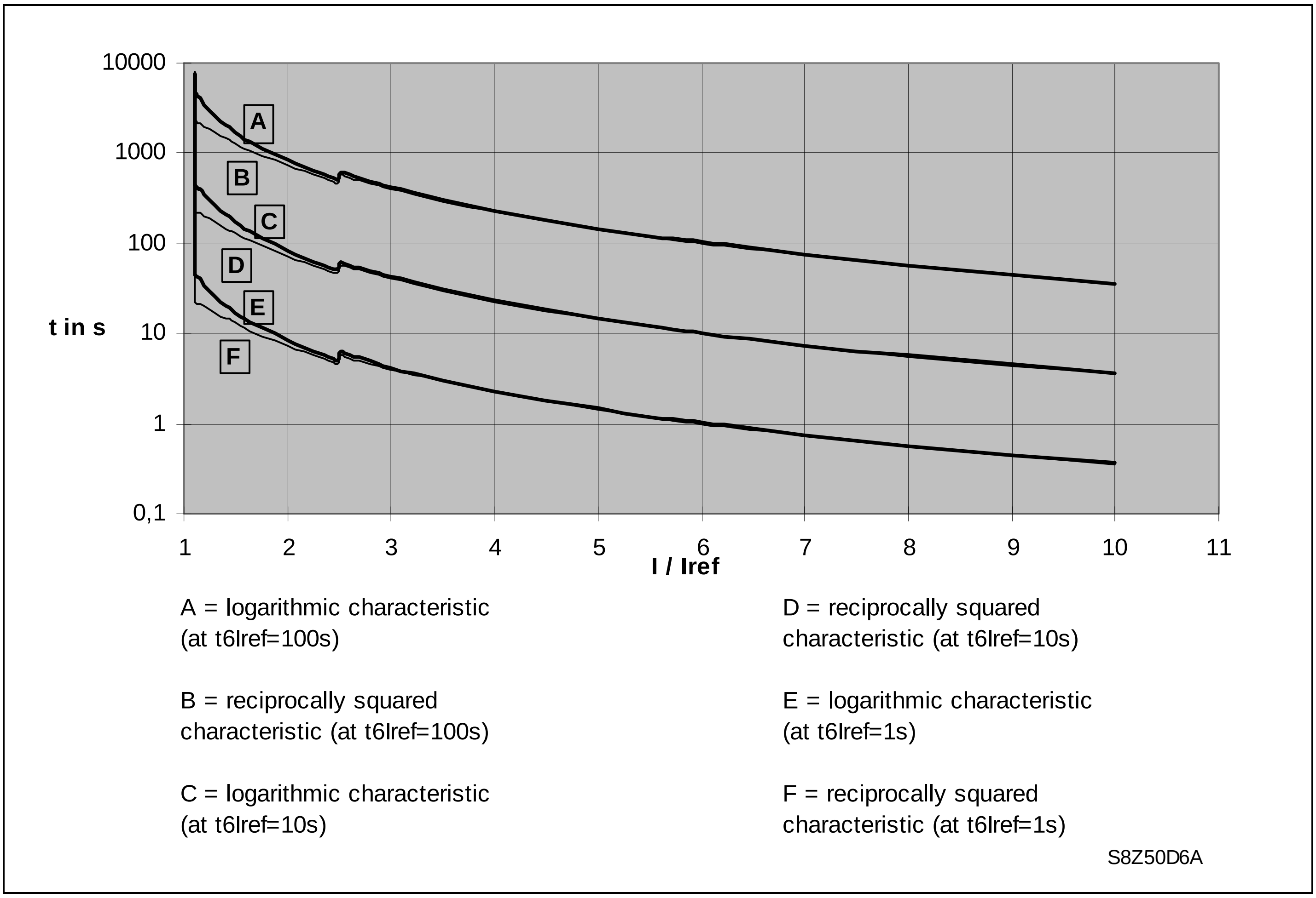
The equation for determining the setting value t_{6Iref} can be derived from the above equations for tripping time t. For this the startup current $I_{startup}$ and the maximum permissible blocking time from cold $t_{block,cold}$ for the asynchronous motor must be known. Setting the overload protection function on the basis of the 'cold' tripping time where m_0 = 0 % ('cold curve') is permitted since the conditions for a machine at operating temperature are automatically taken into account. The conditional equations for the setting value t_{6Iref} are therefore the following:

☐ Reciprocal squared: $t_{6I_{ref}} = t_{block,cold} \cdot \frac{(I_{startup}/I_{ref})^2}{36}$

☐ Logarithmic: $t_{6I_{ref}} = t_{block,cold} \cdot \frac{1}{36 \cdot \ln \frac{(I_{startup}/I_{ref})^2}{(I_{startup}/I_{ref})^2 - 1}}$



3-207 Tripping time characteristics



3-208 Tripping characteristic of motor protection (at I/Iref = 2.5 we have m=0.2, at I/Iref > 2.5 we have m=0)

Plausibility conditions

A number of plausibility conditions need to be observed in order to ensure that the protected object is given optimum protection and that unintended tripping is prevented.

☐ When the permissible number of consecutive startups is set for the sequence 'three from cold or two from warm' and if this set permissible number of consecutive startups is also intended to be used up during operation, then the heating during startup in the overload memory (OL_DA: Heat. dur. start-up,MP) must not exceed 60%. When the calculation is based on a constant startup current (OL_DA: Start-up current) over the entire startup period, then this will result in the plausibility condition $t_{startup} = 0.6 \cdot t_{block,cold}$. However, since the startup current decreases during the course of the startup time (OL_DA: Time taken f. startup), thereby causing the rate of value storing into the memory to decrease as well, it can therefore be assumed that there is a corresponding extra margin available.

☐ The setting value for the overload protection function is determined on the basis of the stated maximum permissible blocking time from the cold state $t_{block,cold}$. However, when a machine at operating temperature is connected, a protective trip during the t_E period must be guaranteed. Therefore, it is always necessary to check and ensure that the plausibility condition $t_{block,cold} = 1.25 \cdot t_E$ is met.

Initialization or plausibility check of the thermal replica

Under the following conditions, the P132 will not be able to track the thermal replica of the protected object, and re-initialization of the thermal replica will be triggered:

☐ The power supply has been interrupted

☐ Protection has been disabled (off)

☐ Motor protection has been disabled (off)

If the above conditions no longer apply, a plausibility check of the thermal replica is automatically performed prior to cyclic processing.

☐ Operation condition 'machine running' but not 'starting up':
A cyclic plausibility check of the thermal replica is carried out such that if the stored value in the overload memory is below 20% it is increased to the minimum value of 20% (= machine at operating temperature).

☐ Operation condition 'machine starting up':
Once the end of a startup is detected and the startup counter is decremented as a result, the stored value in the overload memory is increased, if appropriate, to the associated minimum value.

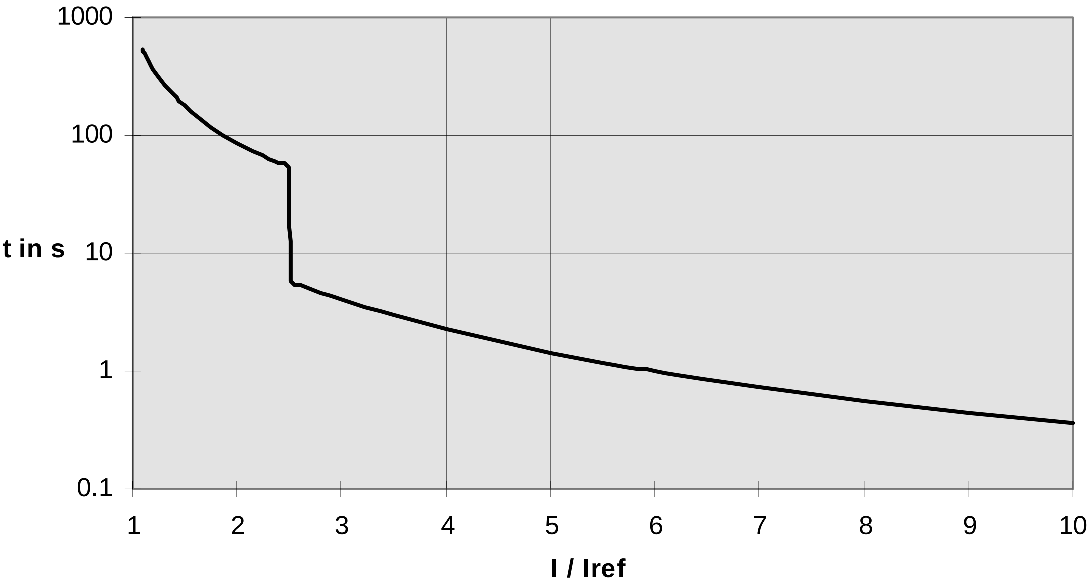
For each of the above procedures involving initialization or a plausibility check of the thermal replica, the stored value status in the overload memory is always coupled to the reading of the counter MP: St-ups still permitt. Therefore, if the value in the overload memory is set automatically, the counter reading is also changed to a plausible value as a function of the protection setting.

3.32.2 Exceptional Overload Protection Cases

Logic function for the operating mode with thermal overload protection (THERM)

For particular applications, the machine may be operated in the overload range for a longer period of time. In such cases the motor protection function (MP) is too restrictive. For such applications the MP and THERM protection functions are combined. The MP protection function then serves as rotor protection and the THERM protection function as stator protection.

When `MP: Operating mode PSx` is set to '*With THERM*', the overload memory will be incremented when the maximum RMS phase current is above the current threshold set at `MP: IStUp > PSx`. If this threshold is not exceeded, the stored value in the memory after a startup will initially be decremented until the mapping of the heat transfer from the copper of the rotor to the rotor core is complete. Thereafter, the value stored in the overload memory will remain constant and the thermal model of the thermal overload protection function (THERM) will become active. With the onset of another startup of the asynchronous motor (not the first startup), the thermal model of the THERM protection function will be temporarily blocked during the startup time.



MP protection: set reciprocally squared characteristic, t6Iref = 1 s

THERM protection: set time constant 1 = 300 s, trip limit value = 100 %

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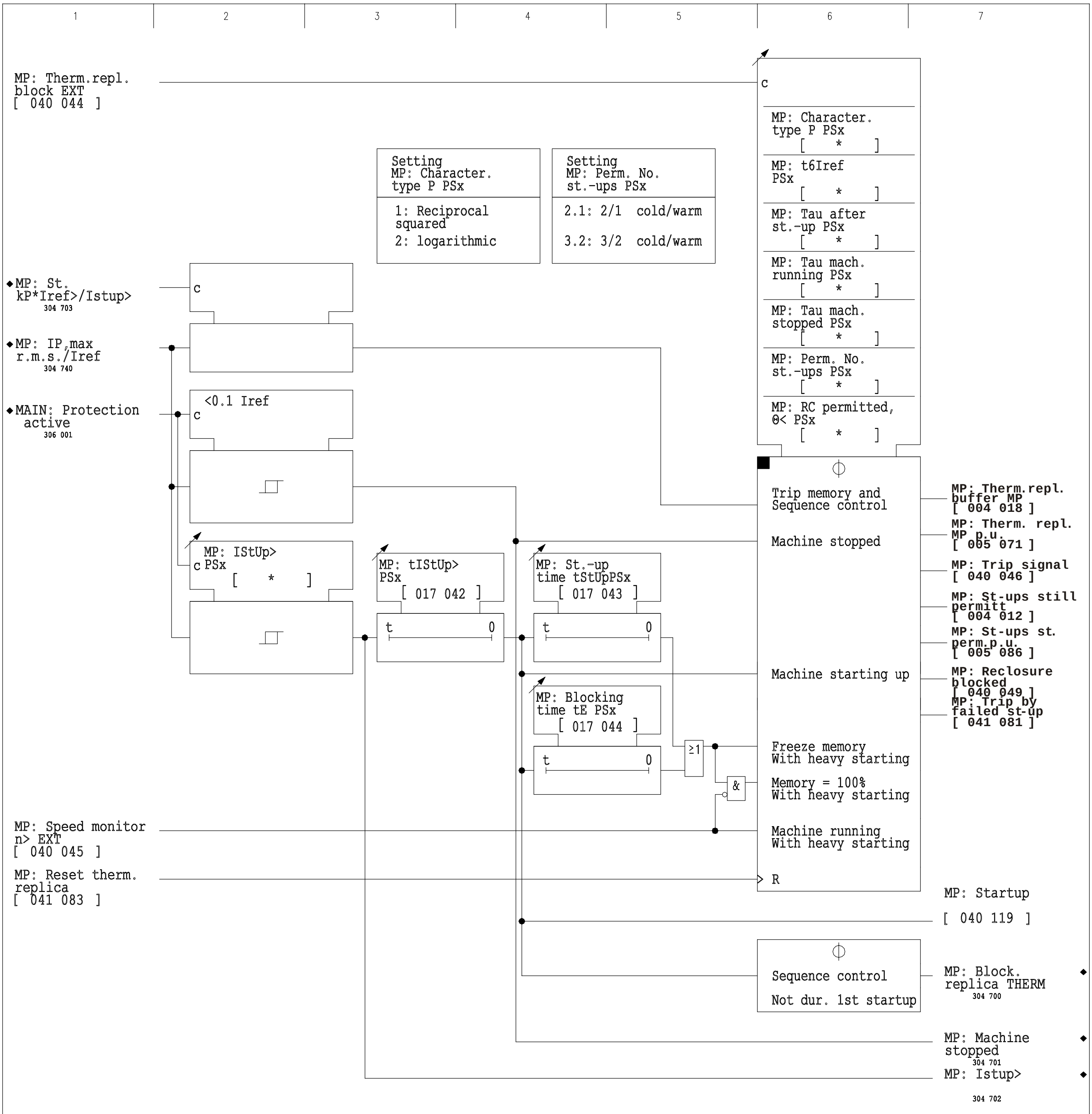
3-209 *Tripping characteristic of motor protection with operating mode 'With THERM' ('cold' characteristic)*

Change of threshold for 'reclosure permitted'

Depending on the particular application, it is possible to change the overload memory threshold value assumed for general use, when mapping protected object cooling, to either 40% (with 'three startups from cold or two from warm') or 22% (with 'two startups from cold or one from warm).' This threshold value set at `MP: RC permitted, T< PSx` can differ from these average values so as to be more restrictive or less restrictive.



*

Parameter	MP: Character. type P PSx	MP: t6Iref PSx	MP: Tau after st.-up PSx	MP: Tau mach. running PSx	MP: Tau mach. stopped PSx	MP: Perm. No. st.-ups PSx
set 1	017 029	017 041	018 042	017 088	017 089	017 047
set 2	024 135	024 136	024 137	024 138	024 139	024 140
set 3	024 185	025 186	024 187	024 188	024 189	024 190
set 4	025 135	025 136	025 137	025 138	025 139	025 140

*

Parameter	MP: RC permitted, Θ< PSx	MP: IStUp> PSx	MP: tIStUp> PSx	MP: St.-up time tStUpPSx	MP: Blocking time tE PSx
set 1	018 043	017 053	017 042	017 043	017 044
set 2	024 141	024 133	024 134	024 143	024 144
set 3	024 191	024 183	024 184	024 193	024 194
set 4	025 141	025 133	025 134	025 143	025 144

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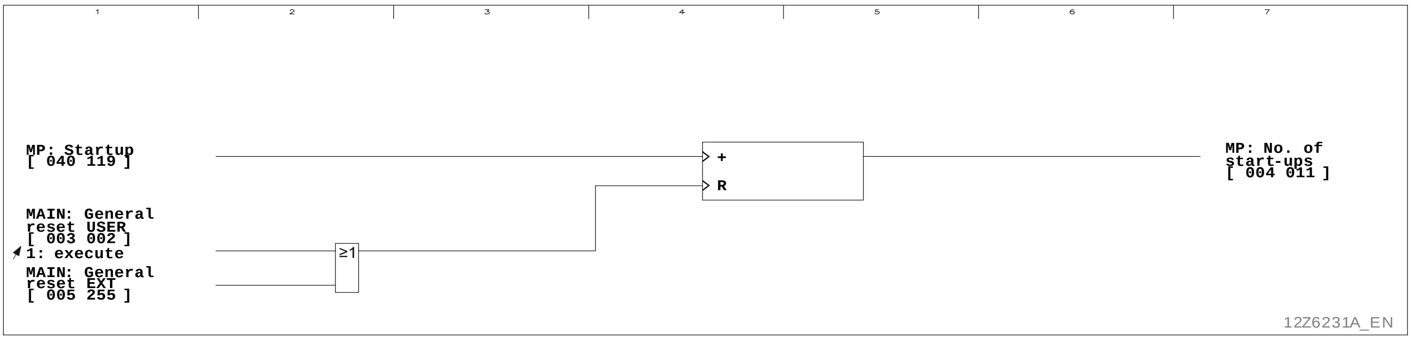
3-210 Overload protection in motor protection

Startup counter

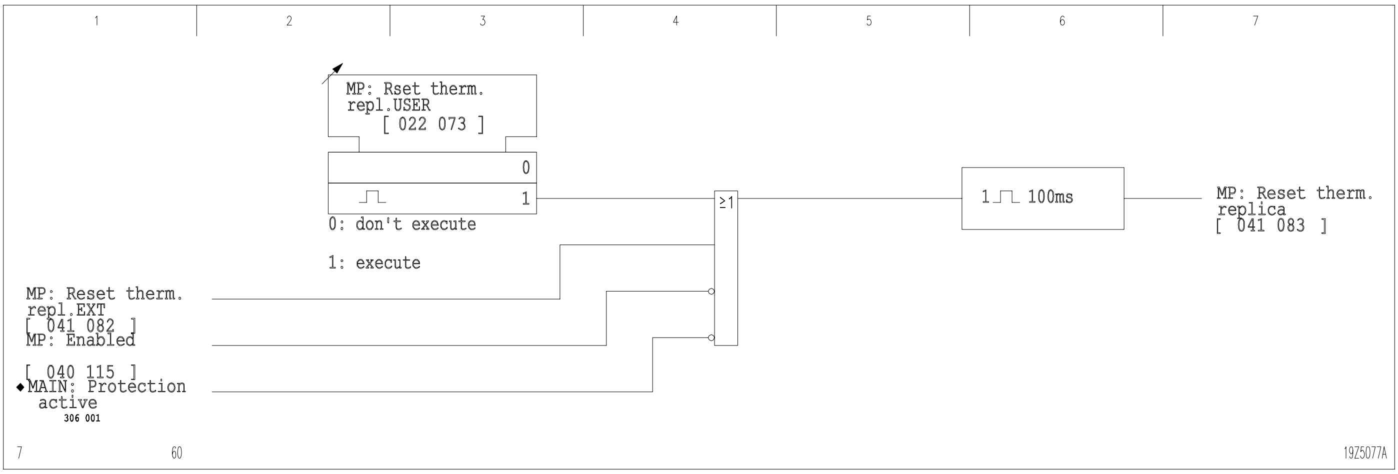
The motor startups are counted. The counter can be reset either individually or with others as a group.



3-211 ounter

Resetting the thermal replica

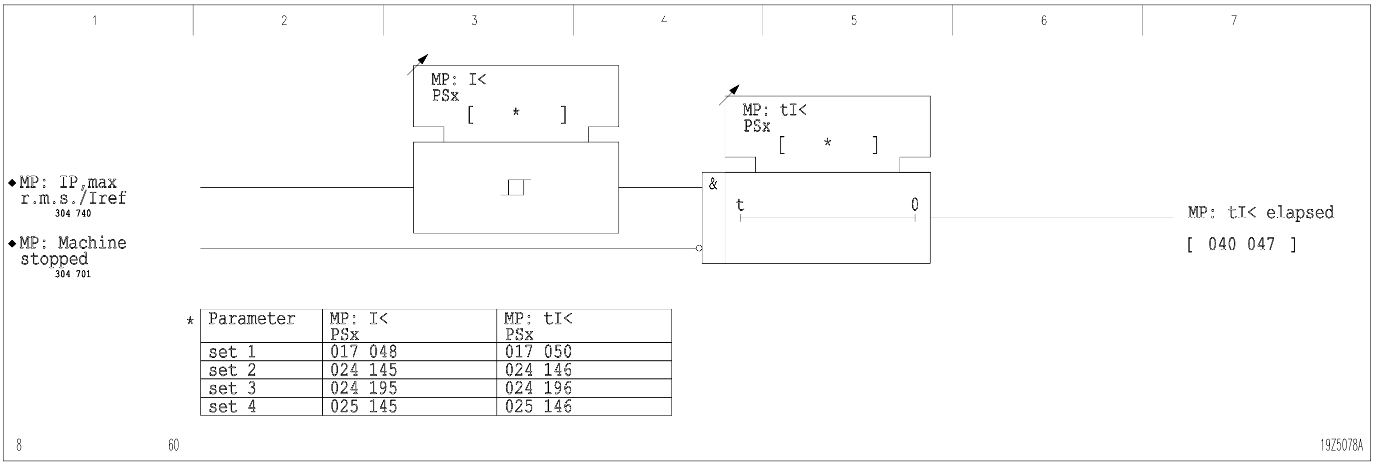
The thermal replica for motor heating can be reset at the local control panel or via an appropriately configured binary signal input.



3-212 Resetting the thermal replica

3.32.3 Low Load Protection

The low load protection function makes it possible to monitor the load torque of a motor drive for a minimum level. If the operating state recognition function detects a running machine and the measured maximum RMS phase current falls below the set operate value for a set time, then an appropriate signal is issued. The signal needs to be configured to a separate output relay, as it cannot be linked directly to either the general starting signal or the trip command.



Parameter	MP: I< PSx	MP: tI< PSx
set 1	017 048	017 050
set 2	024 145	024 146
set 3	024 195	024 196
set 4	025 145	025 146

3-213 Overload protection in motor protection

3.32.4 Protection of Increased-Safety Machines

Motors that are operated in hazardous areas must not reach a temperature level in the case of overload or blocking that would be critical for the existing air-gas mixture.

The P132 is suitable for this type of application, which requires increased-safety protection (type 'Ex e'.), but the device must be installed outside the hazardous area.

Please follow the setting information in chapter "Settings" ('Protection of Increased-Safety Machines').

3.32.5 Running Time Meter

The P132 features a running time meter to monitor the number of hours a protected machine has operated. The time period (in hours) is measured during which the P132 has detected 'Machine running' (compare with signal MP: Machine stopped) and this value is compared with the maximum number to be set at MP: Hours_Run >. When the time period value measured exceeds the set value at MP: Hours_Run > the value for MP: Sig. Hours_Run > is set to *'Yes'*.

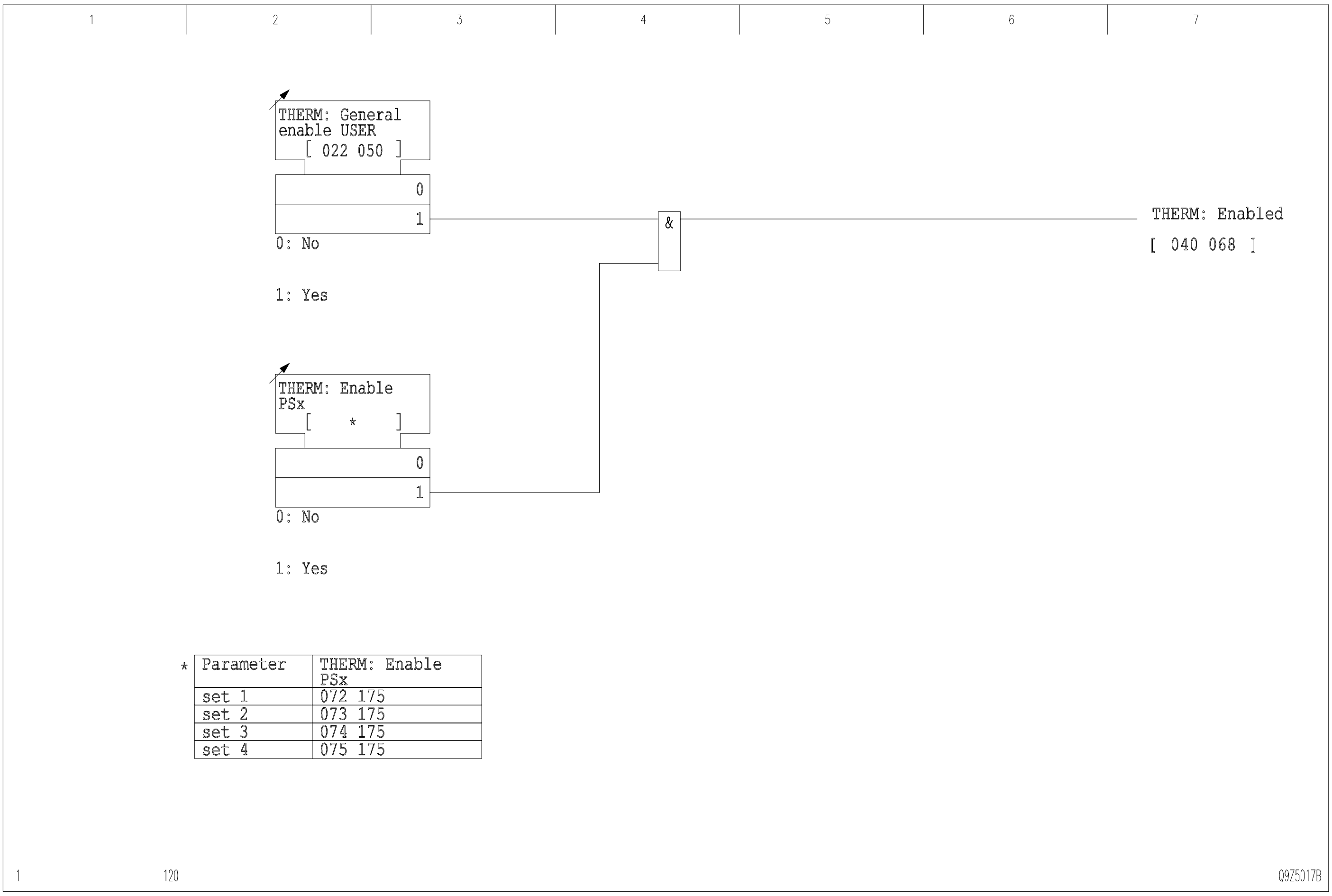
Additionally the number of hours run may be defaulted to any desired initial value ranging from *0* to *65000* hours. This value is defined at MP: Init. val. Hours_Run. The default is initialized by setting MP: Initialize Hours_Run to '*Execute*'.

3.33 Thermal Overload Protection (Function Group THERM)

Using this function, Thermal Overload Protection can be implemented. The Thermal Overload Protection function can be operated together with the Motor Protection function.

Disabling or enabling Thermal Overload Protection

The power thermal overload function can be disabled or enabled using a setting parameter. Moreover, enabling can be carried out separately for each parameter set.



Parameter	THERM: Enable PSx
set 1	072 175
set 2	073 175
set 3	074 175
set 4	075 175

3-214 Disabling or enabling Thermal Overload Protection

Tripping characteristics

The maximum r.m.s. phase current is used to track a first-order thermal replica as specified in IEC 255-8. The following parameters will govern the tripping parameters:

☐ The set thermal time constant (τ) of the protected object
THERM: Tim.const. 1(>Ibl)PSx

☐ The set tripping level THERM: Θ trip PSx

☐ The accumulated thermal load Θ_P.

☐ The updated measured coolant temperature Θ_c for the protected object.

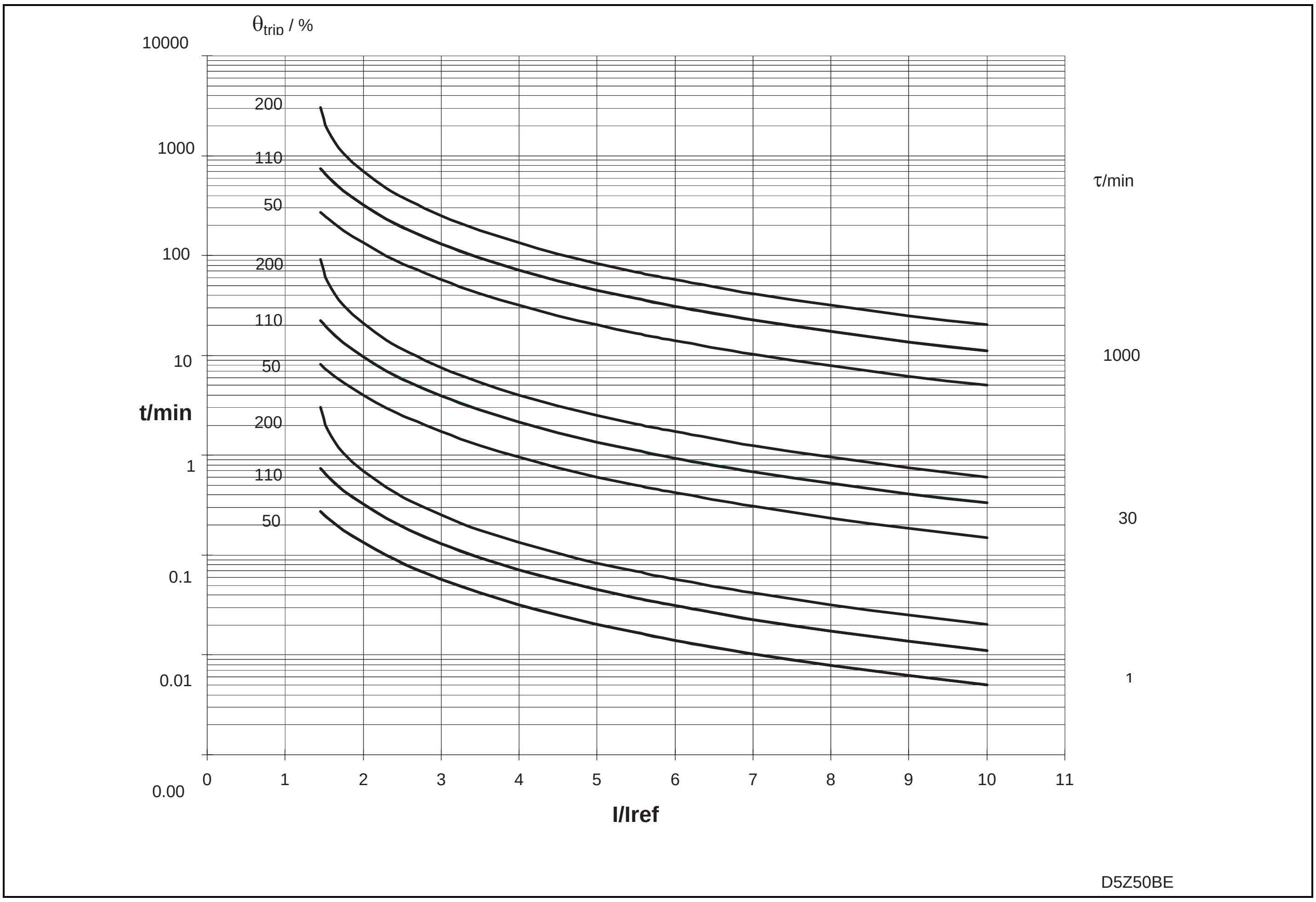
☐ The maximum permissible coolant temperature $\Theta_{c,max}$.

☐ The maximum permissible object temperature Θ_{max}

$$t = \tau \cdot \ln \frac{\left(\frac{I}{I_{ref}}\right)^2 - \Theta_P}{\left(\frac{I}{I_{ref}}\right)^2 - \Theta_{trip} \cdot \left(1 - \frac{\Theta_c - \Theta_{c,max}}{\Theta_{max} - \Theta_{c,max}}\right)}$$

Figure 3-214 shows the tripping characteristics for $\Theta_P = 0$ % and with a measured coolant temperature Θ_c identical to the maximum permissible coolant temperature.

The setting for the operating mode selects an ‘absolute’ or ‘relative’ replica. If the setting is for *Absolute replica*, the P132 will operate with a fixed trip threshold Θ_{trip} of 100 %.



3-215 Tripping characteristic of Thermal Overload Protection (tripping characteristics apply to Θ_P = 0 % and with a measured coolant temperature Θ_c identical to the setting for the maximum permissible coolant temperature $\Theta_{c,max}$)

To permit coolant temperature acquisition, one of the analog modules Y must be fitted – either the analog (I/O) module Y with a 20 mA current input and the “PT100” input or the temperature p/c board (the RTD module) with the temperature sensor inputs T1 to T9. If neither module is available in the P132 then the setting THERM: Coolant temp. PSx is used in the calculation of the tripping time. The setting THERM: Select meas.inputPSx will determine which of these 11 inputs ("PT100", 20 mA, T1 to T9) will influence the thermal replica.

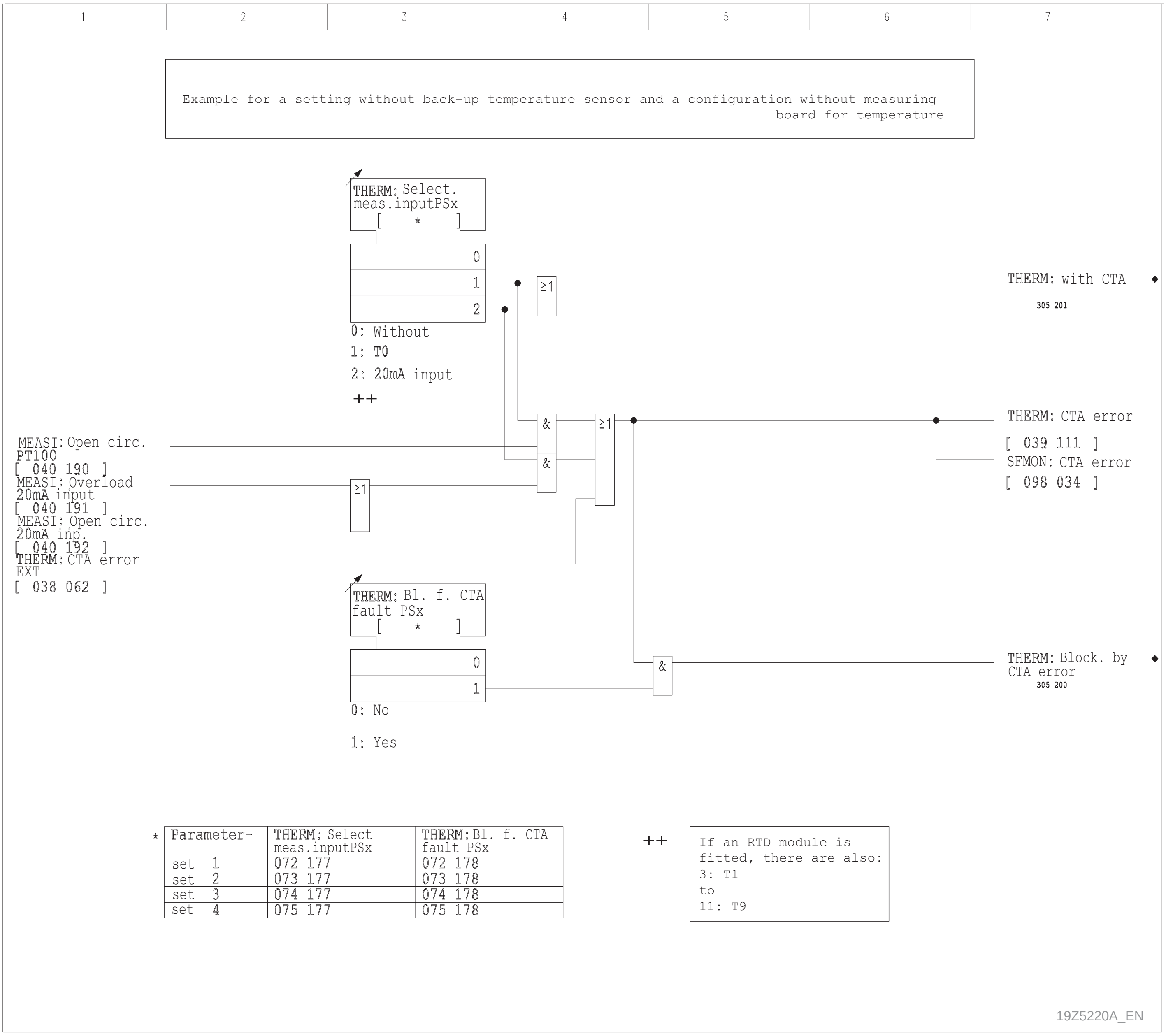
One of the following signals is issued when an open circuit to a sensor has ocurred on one of these analog inputs (see function description for 'Measured data input'):

MEASI: Open circ. 20mA inp.
MEASI: PT100 open circuit
MEASI: Open circ. T1
to
MEASI: Open circ. T9

The open circuit signal from the function group MEASI is forwarded to the Thermal Overload Protection function.

By setting the parameter THERM: Sel. backup th. PSx to one of the inputs ("PT100", 20 mA, T1 to T9) a temperature sensor with an open circuit can be replaced by one of these backup temperature sensors connected to the corresponding input.

The setting THERM: Bl. f. CTA fault PSx defines whether the Thermal Overload Protection function will be blocked in the event of a fault in the coolant temperature acquisition.



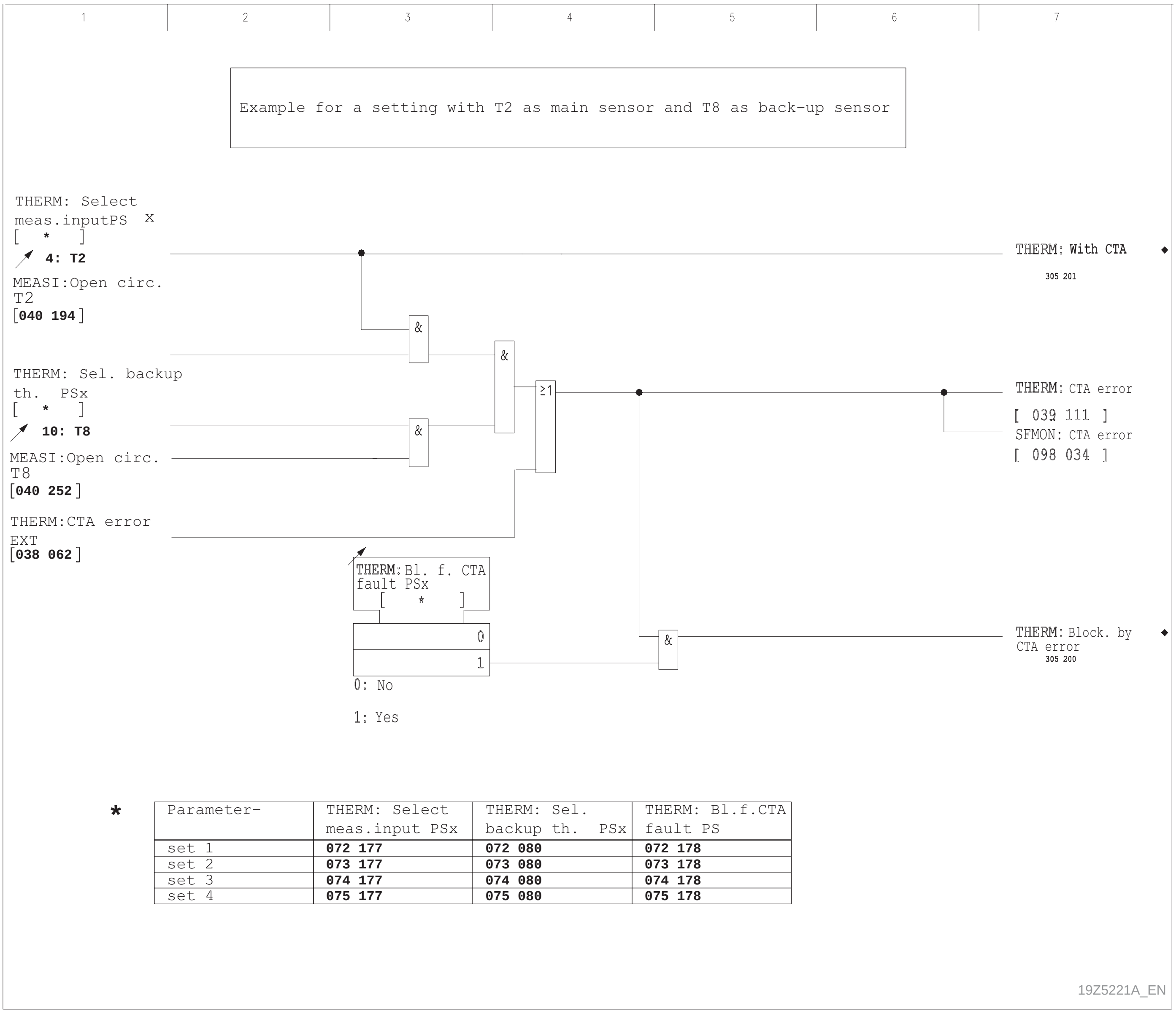
Parameter-	THERM: Select meas.inputPSx	THERM: Bl. f. CTA fault PSx
set 1	072 177	072 178
set 2	073 177	073 178
set 3	074 177	074 178
set 4	075 177	075 178

3-216 Monitoring the coolant temperature acquisition with an analog module (I/O) if the parameter THERM: Sel. backup th. PSx *is set to* 'Without'.

If the the temperature p/c board (the RTD module) is installed in addition to the analog (I/O) module y one of the temperature sensors T1 to T9 may be selected by setting THERM: Select meas.inputPSx. Depending on the setting one of these open circuit signals will be processed:

MEASI: Open circ. 20mA inp.
MEASI: PT100 open circuit
MEASI: Open circ. T1
to
MEASI: Open circ. T9

If one of the analog inputs (PT100, 20mA, T1 to T9) was selected as a backup by setting THERM: Sel. backup th. PSx the coolant temperature acquisition will continue to operate with the selected backup sensor input when an open circuit to the main sensor input has occurred. Only after the selected backup sensor has also become defective the coolant temperature can no longer be measured and the signal THERM: CTA fault is issued.



Parameter-	THERM: Select meas.input PSx	THERM: Sel. backup th. PSx	THERM: Bl.f.CTA fault PS
set 1	**072 177**	**072 080**	**072 178**
set 2	**073 177**	**073 080**	**073 178**
set 3	**074 177**	**074 080**	**074 178**
set 4	**075 177**	**075 080**	**075 178**

3-217 Monitoring the coolant temperature acquisition with main and backup sensors

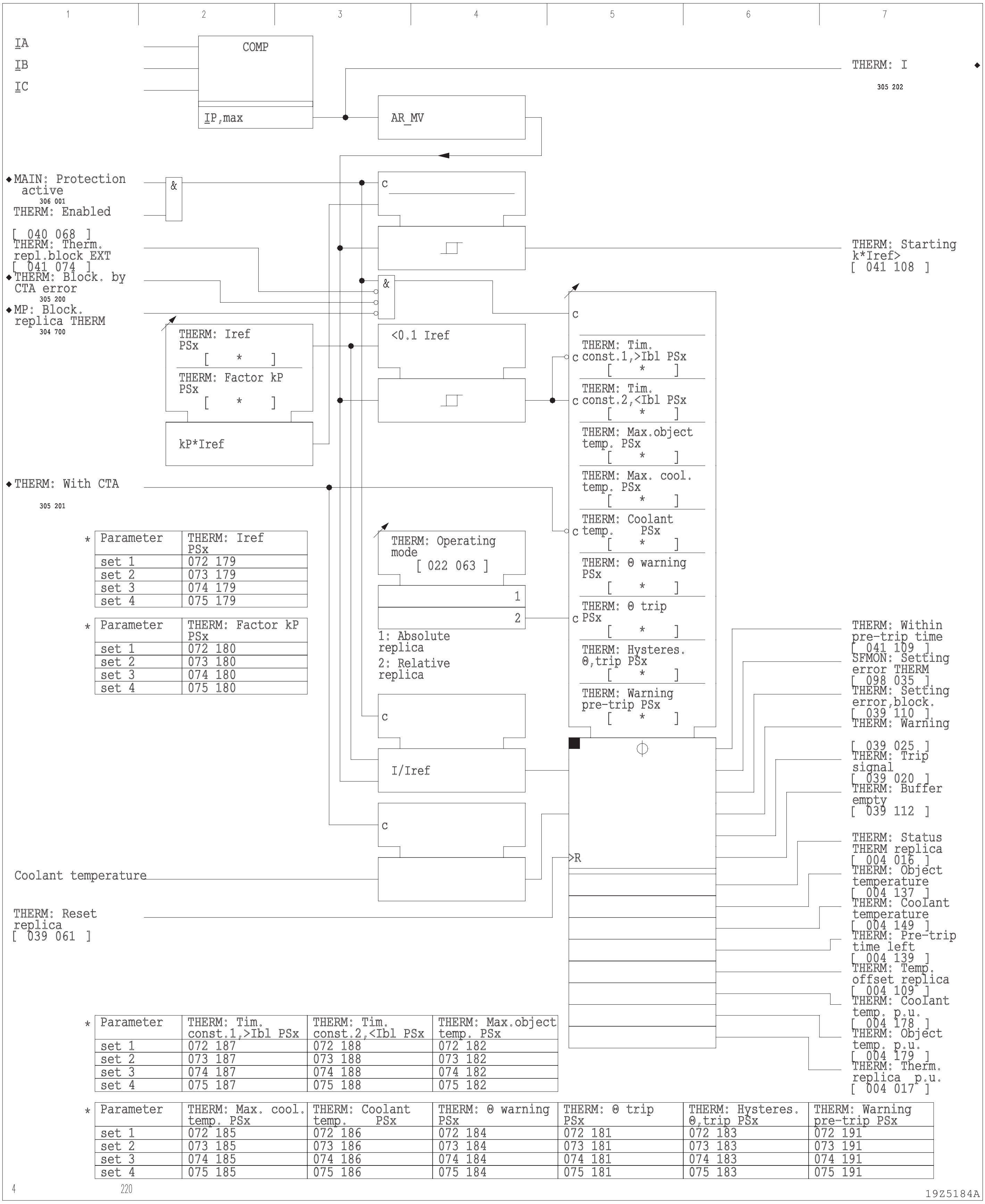
Warning

A warning signal can be set in accordance with the set operate value `THERM: Rel. O/T warning PSx` Additionally, a pre-trip time limit can be set, when the time left until tripping falls below this pre-trip limit, a warning will be issued.

If the current falls below the default threshold of 0.1 I_{ref}, the buffer is discharged with the set time constant `THERM: Tim.const.2,<Ibl PSx`. The thermal replica may be reset using a setting parameter or from an appropriately configured binary signal input. Resetting is possible even when Thermal Overload Protection is disabled. Thermal Overload Protection can be blocked via an appropriately configured binary signal input.

Operation together with the Motor Protection function

If the Thermal Overload Protection function is operated together with the Motor Protection function and if another startup of an asynchronous motor occurs (other than the first startup), then the Thermal Overload Protection function will be temporarily blocked during the startup time. If the Motor Protection function (MP) and the Thermal Overload Protection function (THERM) are used simultaneously, then MP will act on THERM protection and not vice versa.



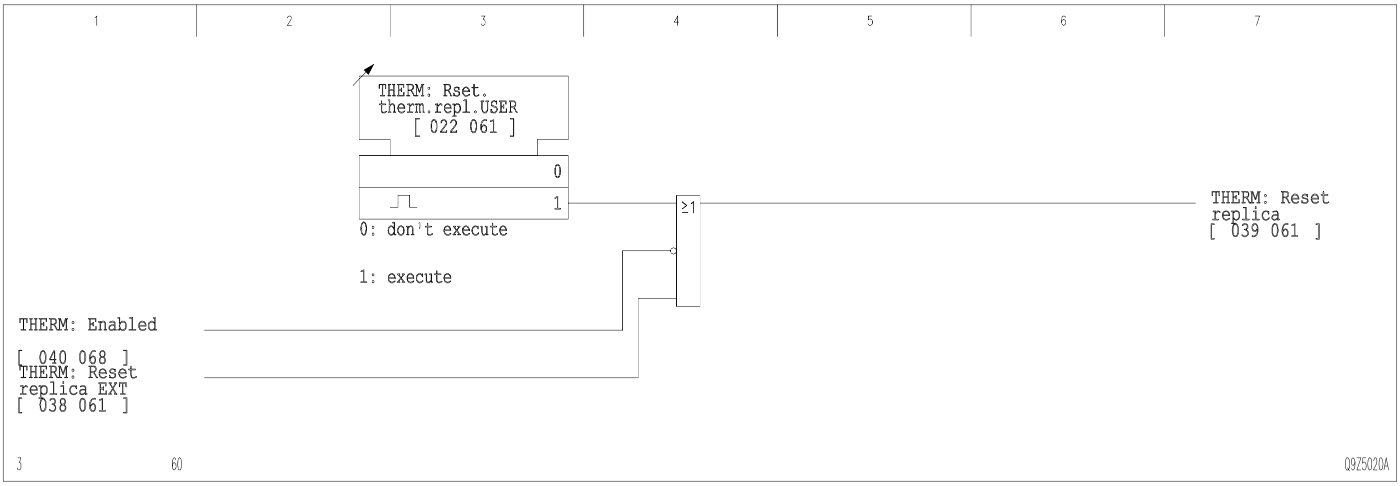
* Parameter	THERM: Iref PSx
set 1	072 179
set 2	073 179
set 3	074 179
set 4	075 179

* Parameter	THERM: Factor kP PSx
set 1	072 180
set 2	073 180
set 3	074 180
set 4	075 180

* Parameter	THERM: Tim. const.1,>Ibl PSx	THERM: Tim. const.2,<Ibl PSx	THERM: Max.object temp. PSx
set 1	072 187	072 188	072 182
set 2	073 187	073 188	073 182
set 3	074 187	074 188	074 182
set 4	075 187	075 188	075 182

* Parameter	THERM: Max. cool. temp. PSx	THERM: Coolant temp. PSx	THERM: Θ warning PSx	THERM: Θ trip PSx	THERM: Hysteres. Θ,trip PSx	THERM: Warning pre-trip PSx
set 1	072 185	072 186	072 184	072 181	072 183	072 191
set 2	073 185	073 186	073 184	073 181	073 183	073 191
set 3	074 185	074 186	074 184	074 181	074 183	074 191
set 4	075 185	075 186	075 184	075 181	075 183	075 191

3-218 Thermal Overload Protection



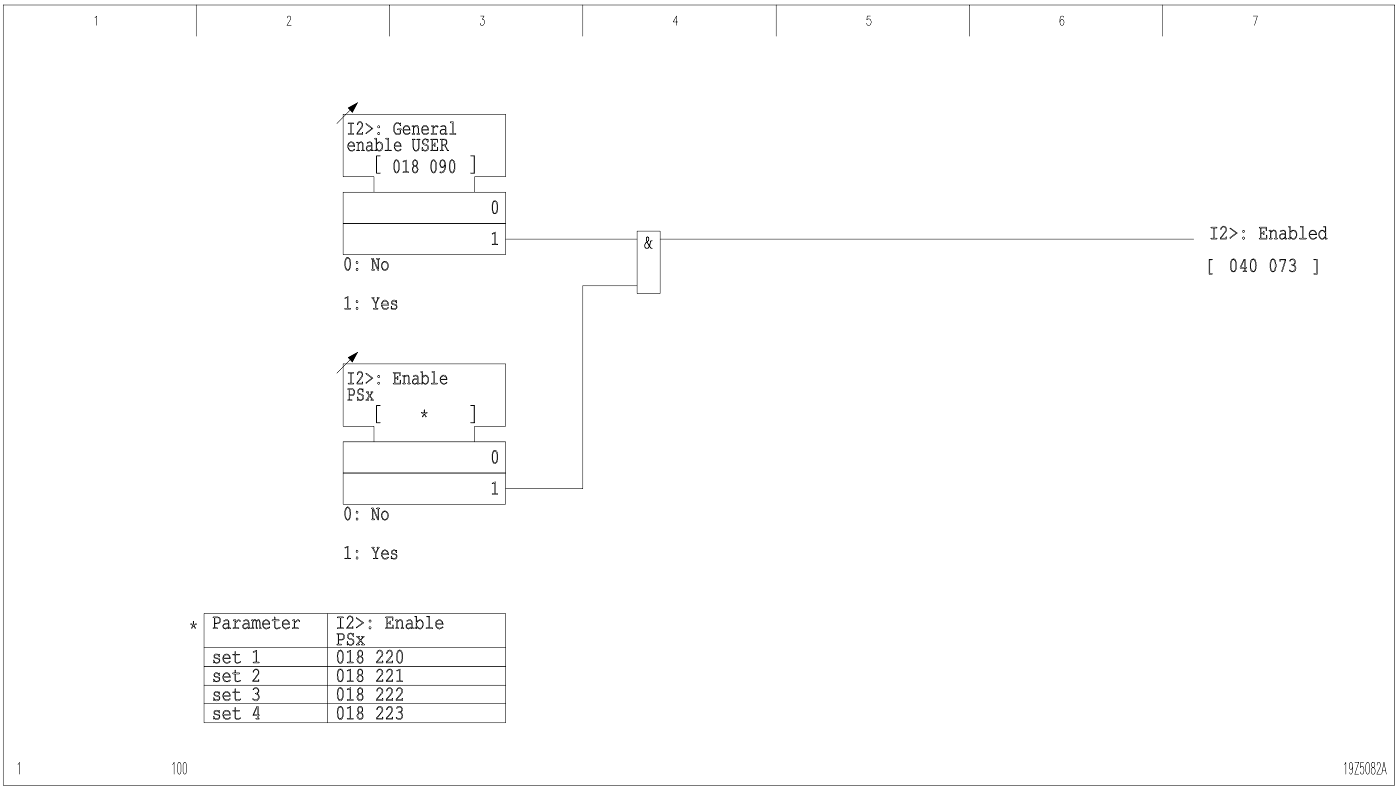
3-219 Resetting the thermal replica

3.34 Unbalance Protection (Function Group I2>)

A two-stage unbalance protection function (I2>) is implemented in the P132.

Enabling or disabling unbalance protection

Unbalance protection can be disabled or enabled by setting Moreover, enabling can be carried out separately for each parameter set.



Parameter	I2>: Enable PSx
set 1	018 220
set 2	018 221
set 3	018 222
set 4	018 223

3-220 *Enabling or disabling unbalance protection*

Operation

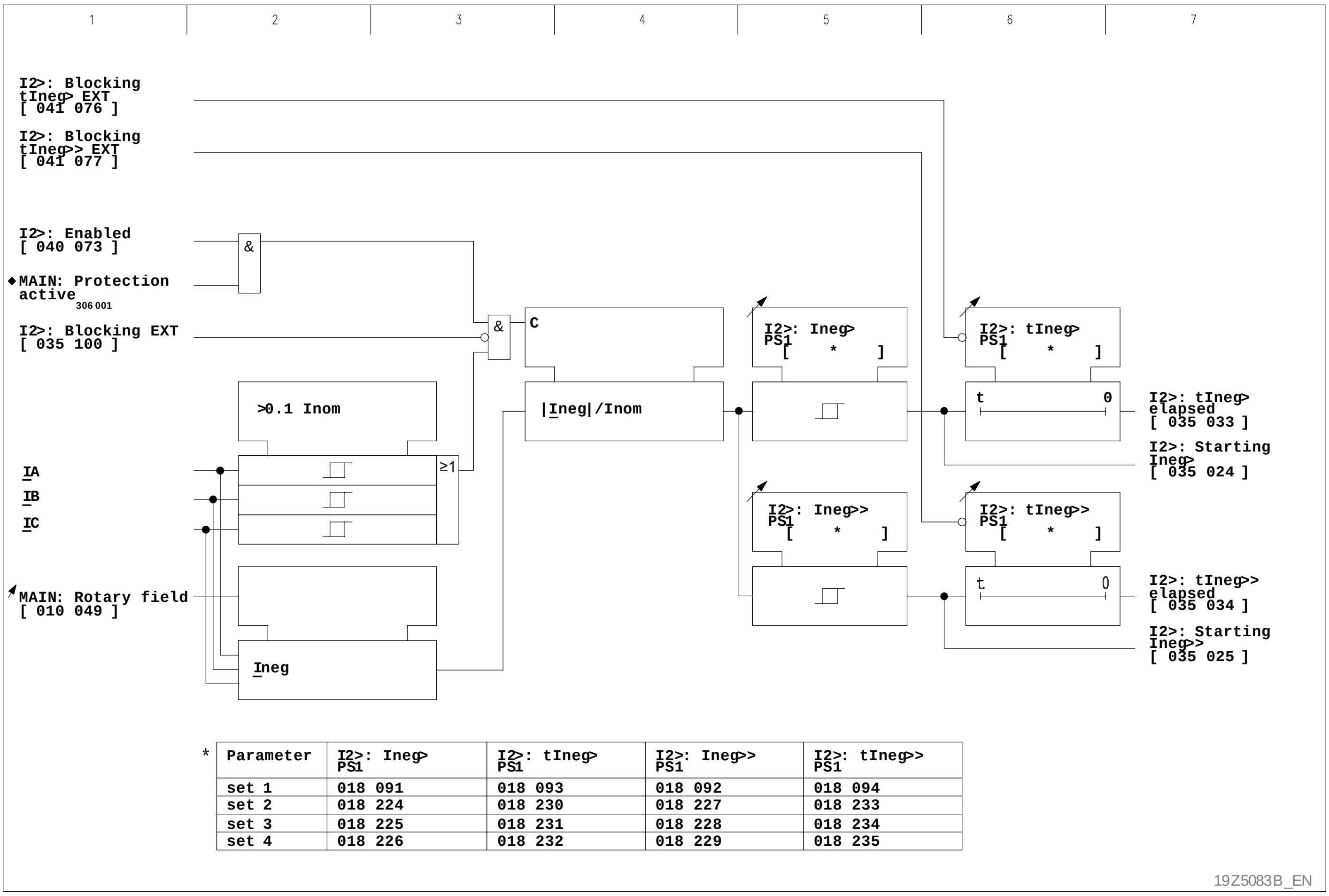
The presence or absence of unbalance is assessed on the basis of the negative-sequence system current. The negative-sequence current is monitored to determine whether it exceeds the set thresholds. After the set operate delay periods have elapsed, a signal is issued. The following stages are available for the negative-sequence current:

☐ Unbalance stage I_{neg}> with time delay t_{Ineg}>.

☐ Unbalance stage I_{neg}>> with time delay t_{Ineg}>>.

The elapsing of all operate delays may be blocked via appropriately configured binary signal inputs.

The unbalance protection signals can be configured to separate output relays. These signals cannot be linked to the general starting signal but can be configured to the trip command.



Parameter	I2>: Ineg> PS1	I2>: tIneg> PS1	I2>: Ineg>> PS1	I2>: tIneg>> PS1
set 1	018 091	018 093	018 092	018 094
set 2	018 224	018 230	018 227	018 233
set 3	018 225	018 231	018 228	018 234
set 4	018 226	018 232	018 229	018 235

3-221 Unbalance protection

3.35 Under and Overvoltage Protection (Function Group V<>)

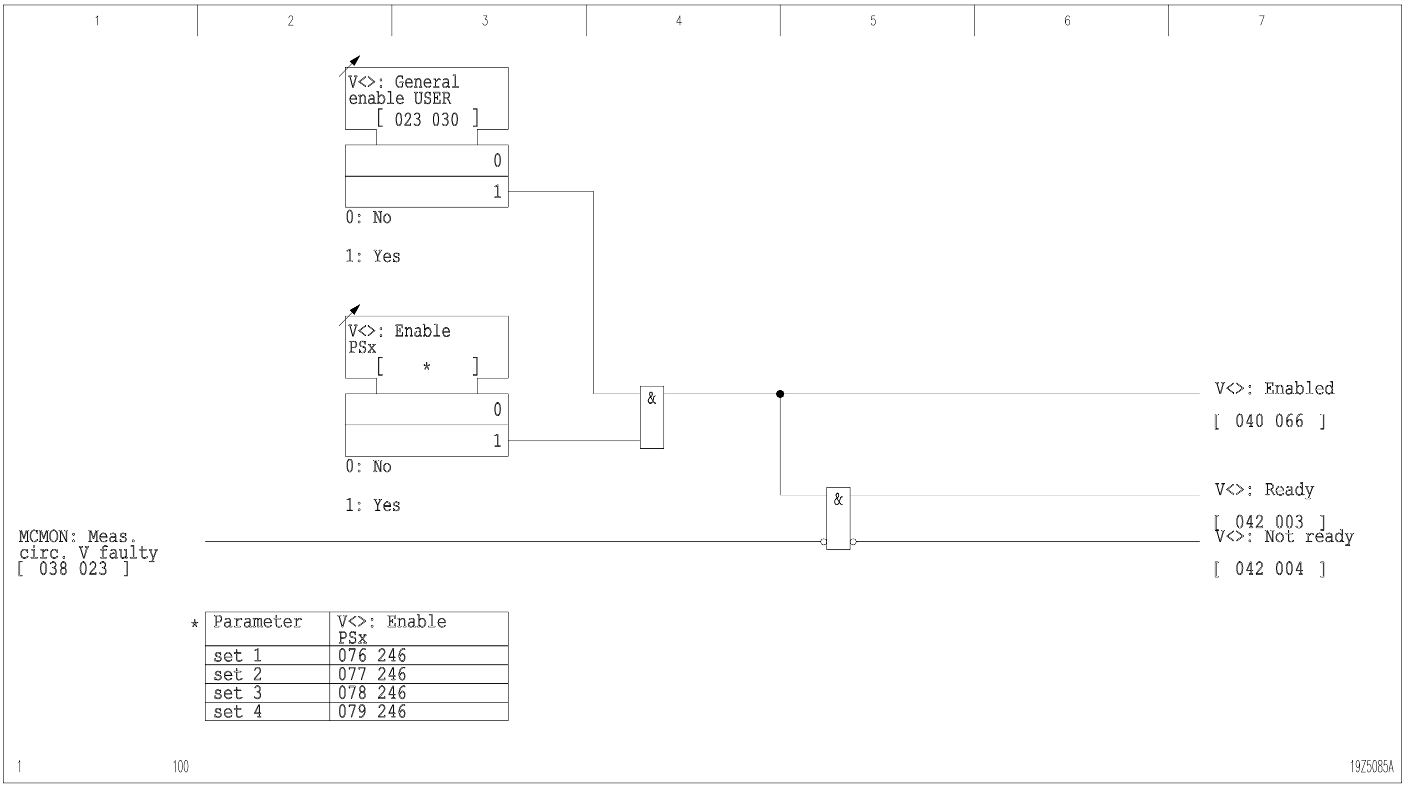
The time-voltage protection function evaluates the fundamental wave of the phase voltages and of the neutral-point displacement voltage as well as the positive-sequence voltage and negative-sequence voltage obtained from the fundamental waves of the three phase-to-ground voltages.

Disabling or enabling V<> protection

V<> protection can be disabled or enabled via setting parameters. Moreover, enabling can be carried out separately for each parameter subset.

V<> protection readiness

V<> protection is ready if it is enabled and no fault has been detected in the voltage-measuring circuit by measuring-circuit monitoring.



Parameter	V<>: Enable PSx
set 1	076 246
set 2	077 246
set 3	078 246
set 4	079 246

3-222 *Enabling, disabling and readiness of V<> protection*

Monitoring the phase voltages

The P132 checks the voltages to determine whether they exceed or fall below set thresholds. Dependent on the set operating mode of V<> protection, either the phase-to-ground voltages ('Star' operating mode) or the phase-to-phase voltages ('Delta' operating mode) are monitored. The triggers are followed by timer stages that can be blocked via appropriately configured binary signal inputs.

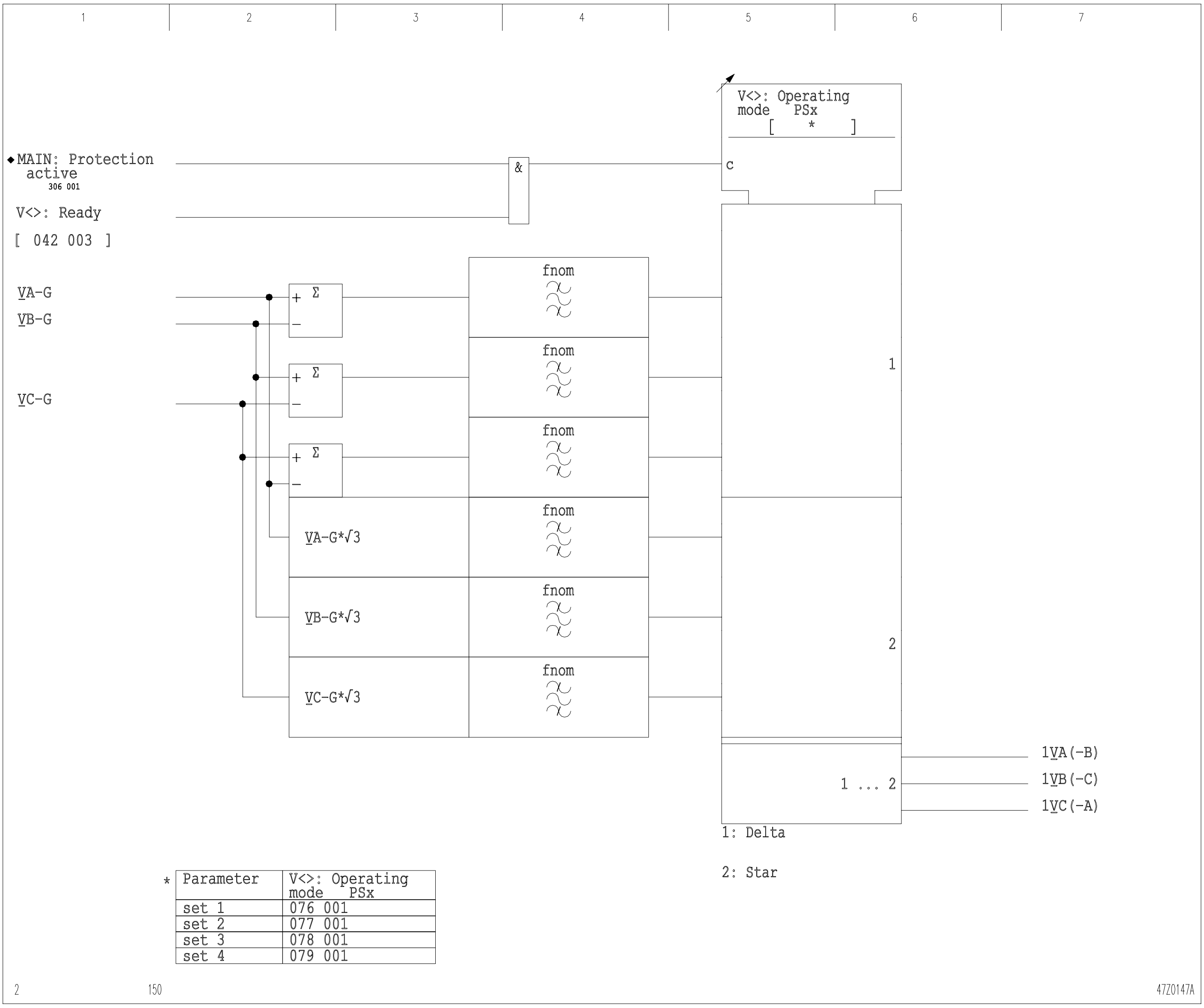
If the decisions of undervoltage monitoring are to be included in the trip commands, then it is recommended that transient signals be used. Otherwise the trip command would always be present when the system voltage was disconnected, and thus it would not be possible to close the circuit breaker again.

Minimum current monitoring

Furthermore there is an enabling threshold available with the V<> element which is based on minimum current monitoring for undervoltage stage V<. The following two settings may be used to activate the operating mode for minimum current monitoring and to set the enabling threshold:

☐ V<>: I enable V<   PSx

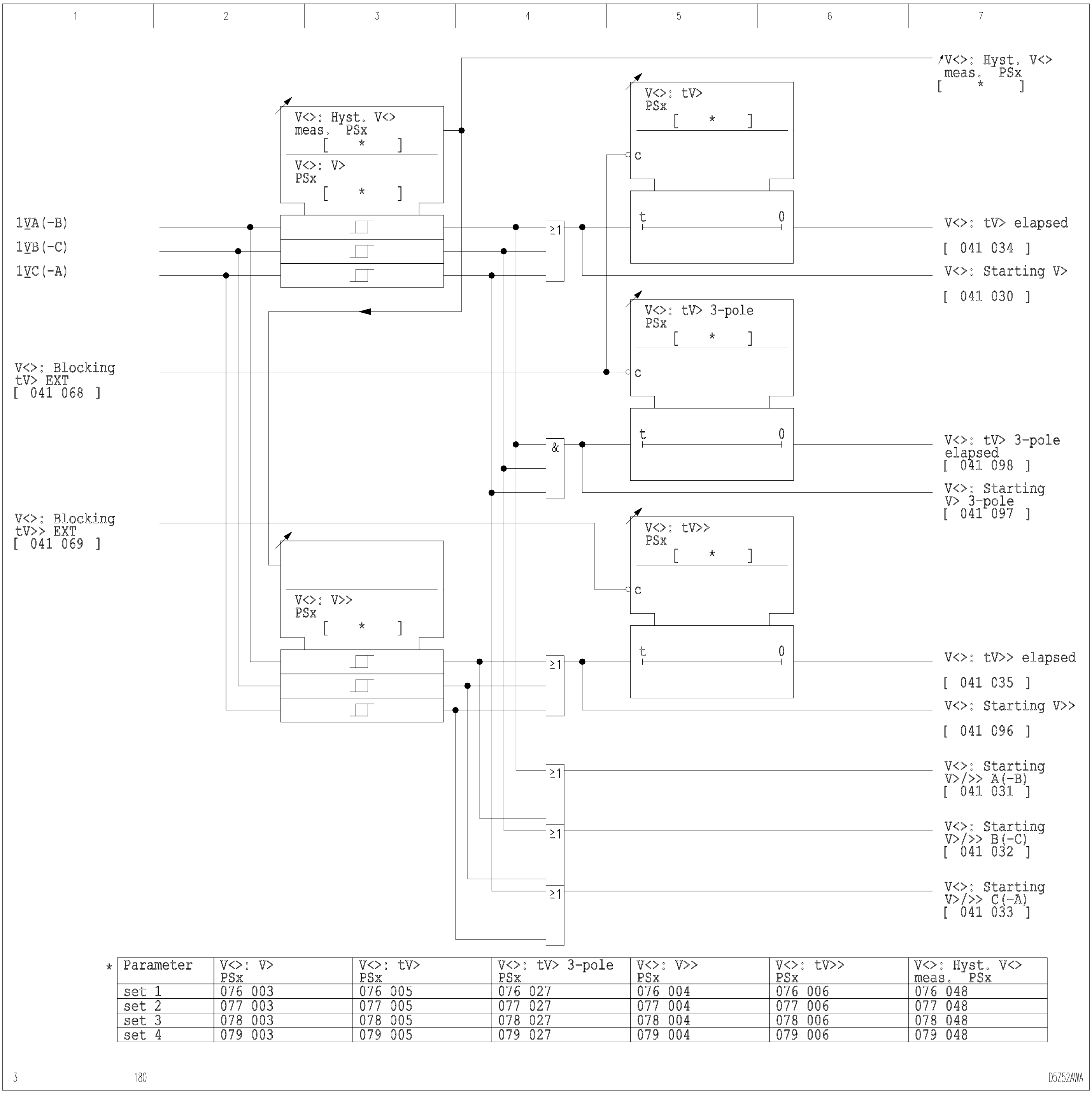
☐ V<>: Op. mode V< mon. PSx



*

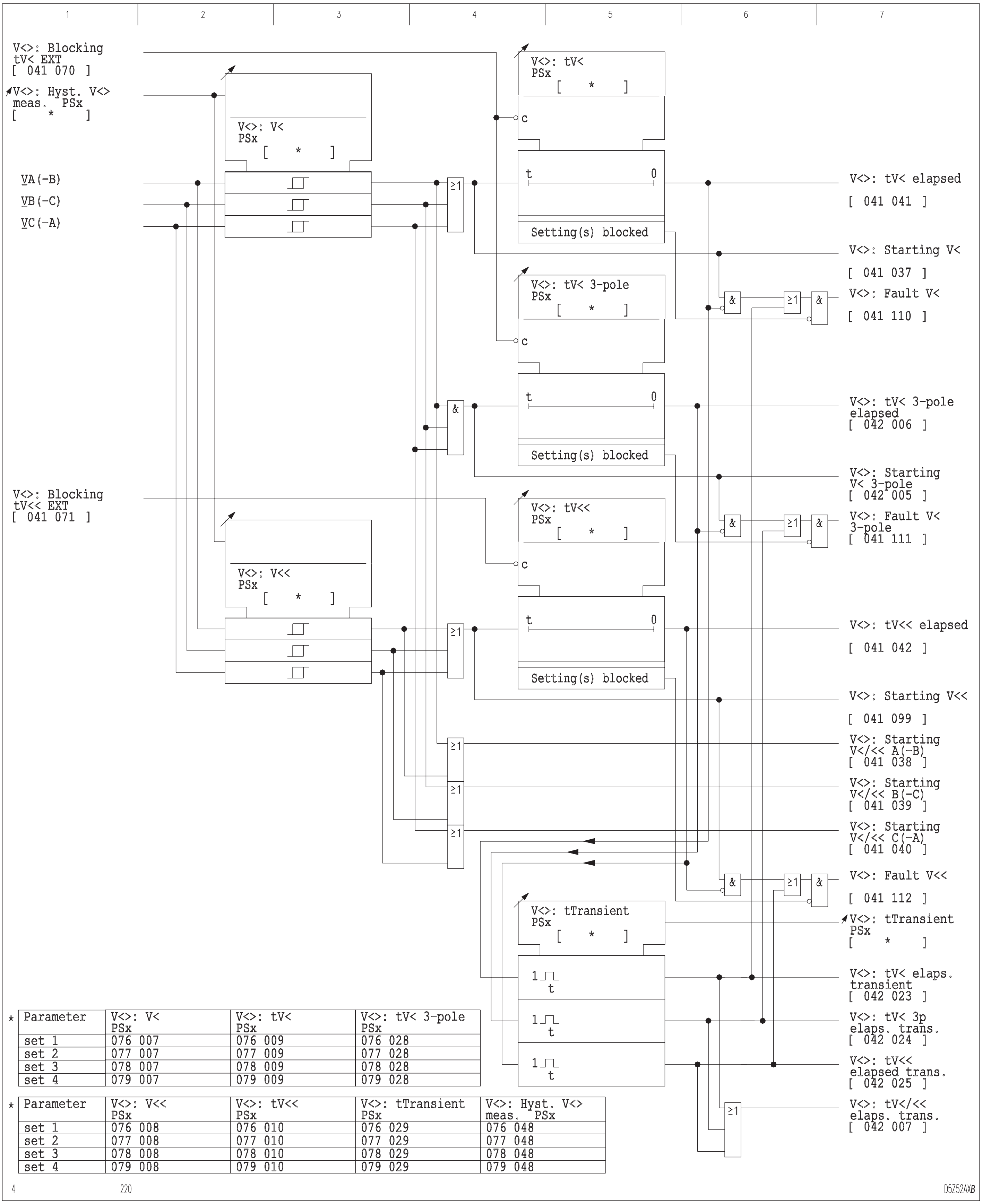
Parameter	V<>: Operating mode PSx
set 1	076 001
set 2	077 001
set 3	078 001
set 4	079 001

3-223 Selecting measured variables



Parameter	V<>: V> PSx	V<>: tV> PSx	V<>: tV> 3-pole PSx	V<>: V>> PSx	V<>: tV>> PSx	V<>: Hyst. V<> meas. PSx
set 1	076 003	076 005	076 027	076 004	076 006	076 048
set 2	077 003	077 005	077 027	077 004	077 006	077 048
set 3	078 003	078 005	078 027	078 004	078 006	078 048
set 4	079 003	079 005	079 027	079 004	079 006	079 048

3-224 *Overvoltage monitoring*



* Parameter	V<>: V< PSx	V<>: tV< PSx	V<>: tV< 3-pole PSx
set 1	076 007	076 009	076 028
set 2	077 007	077 009	077 028
set 3	078 007	078 009	078 028
set 4	079 007	079 009	079 028

* Parameter	V<>: V<< PSx	V<>: tV<< PSx	V<>: tTransient PSx	V<>: Hyst. V<> meas. PSx
set 1	076 008	076 010	076 029	076 048
set 2	077 008	077 010	077 029	077 048
set 3	078 008	078 010	078 029	078 048
set 4	079 008	079 010	079 029	079 048

3-225 Undervoltage monitoring

Monitoring the positive- and negative-sequence voltages

The P132 determines the positive-sequence and negative-sequence voltages from the fundamental components of the phase-to-ground voltages according to the formulas given below. This is based on the MAIN: Phase sequence setting (alternative terminology: Rotary field).

<u>Phase sequence A-B-C (alternative terminology: clockwise rotary field):</u>

Positive-sequence voltage:

$$\underline{V}_{pos} = \frac{1}{3} \cdot \left| \left(\underline{V}_{A-G} + \underline{a} \cdot \underline{V}_{B-G} + \underline{a}^{2} \cdot V_{C-G} \right) \right|$$

Negative-sequence voltage:

$$V_{neg} = \frac{1}{3} \cdot \left| \left(\underline{V}_{A-G} + \underline{a}^{2} \cdot \underline{V}_{B-G} + \underline{a} \cdot \underline{V}_{C-G} \right) \right|$$

<u>Phase sequence A-C-B (alternative terminology: anti-clockwise rotary field):</u>

Positive-sequence voltage:

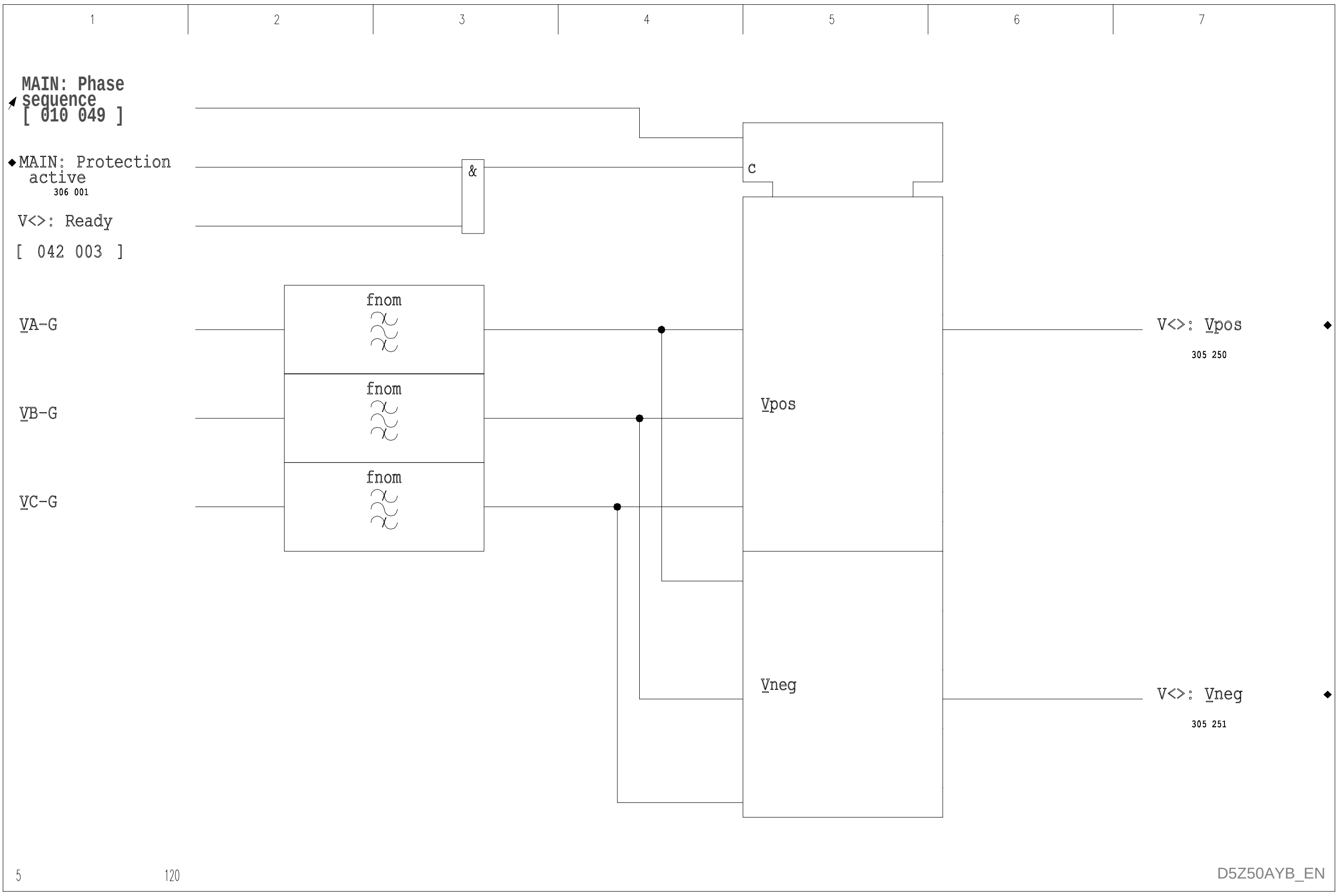
$$\underline{V}_{pos} = \frac{1}{3} \cdot \left| \left(\underline{V}_{A-G} + \underline{a}^{2} \cdot \underline{V}_{B-G} + \underline{a} \cdot \underline{V}_{C-G} \right) \right|$$

Negative-sequence voltage:

$$\underline{V}_{neg} = \frac{1}{3} \cdot \left| \left(\underline{V}_{A-G} + \underline{a} \cdot \underline{V}_{B-G} + \underline{a}^{2} \cdot \underline{V}_{C-G} \right) \right|$$

$\underline{a} = e^{j120°}$

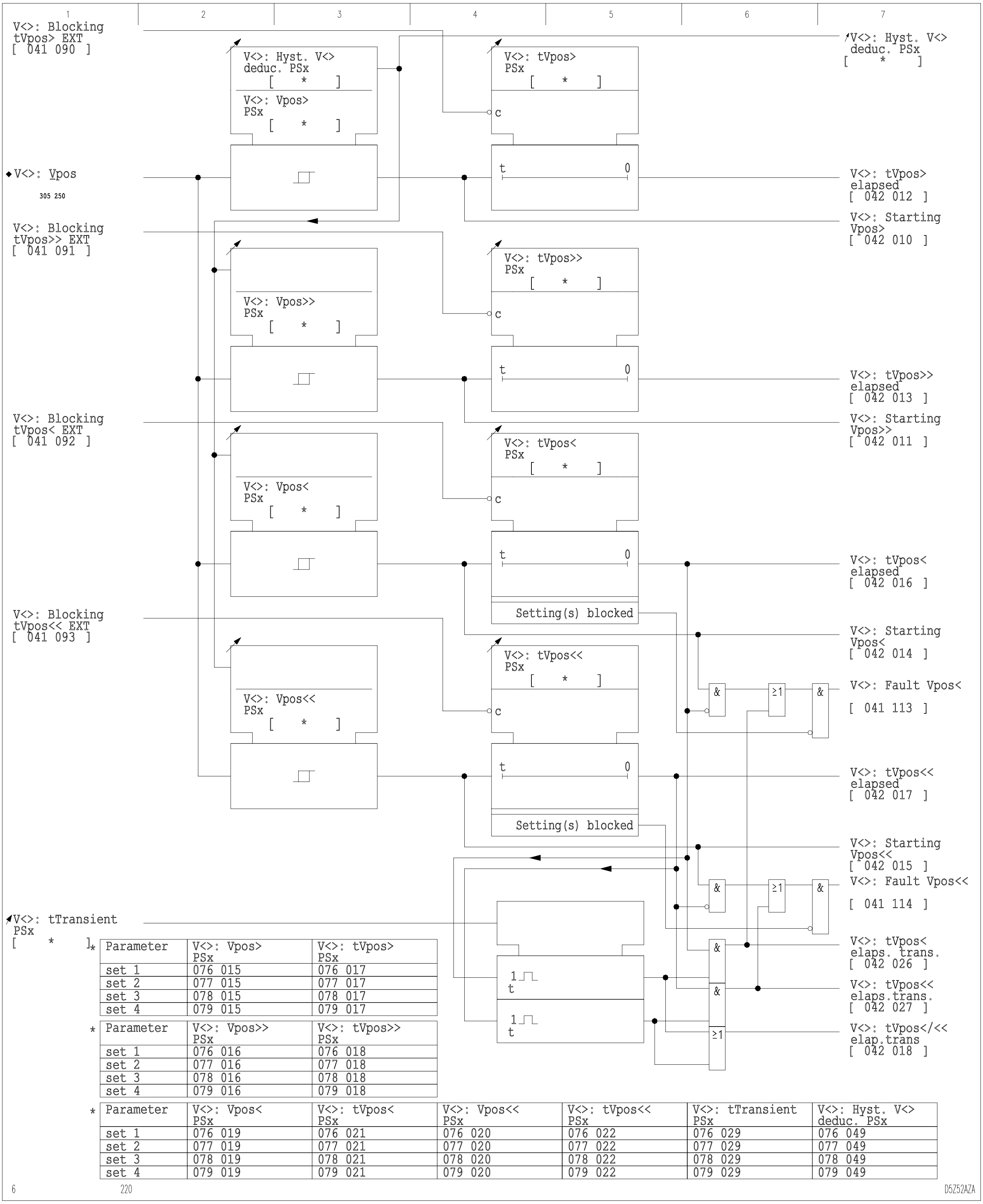
$\underline{a}^{2} = e^{j240°}$



3-226 Determination of positive- and negative-sequence voltages
(Note: Previous terminology of MAIN: Phase sequence was MAIN: Rotary field)

The positive-sequence voltage is monitored to determine whether it exceeds or falls below set thresholds, and the negative-sequence voltage is monitored to determine whether it exceeds set thresholds. If the voltage exceeds or falls below the set thresholds, then a signal is issued once the set operate delays have elapsed. The timer stages can be blocked by appropriately configured binary signal inputs.

If the decisions of undervoltage monitoring are to be included in the trip commands, then it is recommended that transient signals be used. Otherwise the trip command would always be present when the system voltage was disconnected, and thus it would not be possible to close the circuit breaker again.

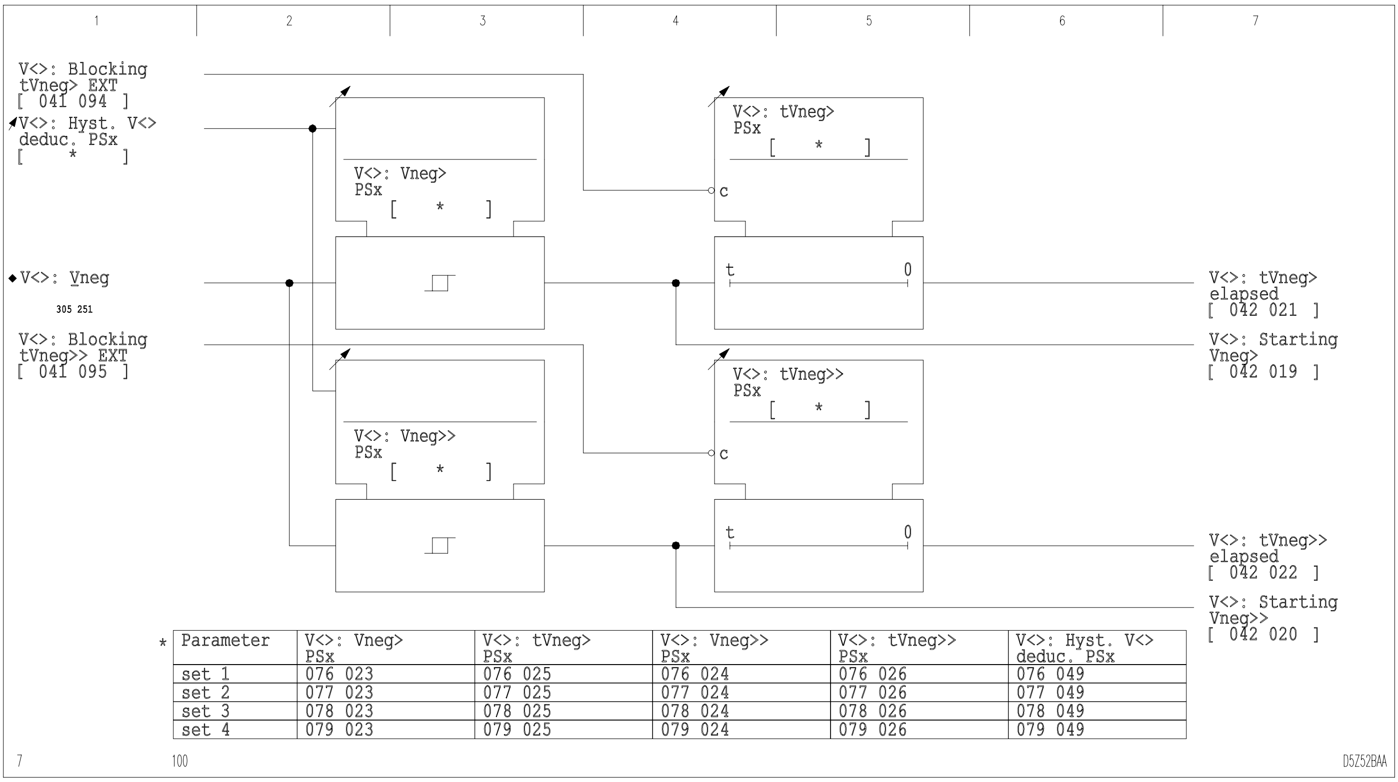


Parameter	V<>: Vpos> PSx	V<>: tVpos> PSx
set 1	076 015	076 017
set 2	077 015	077 017
set 3	078 015	078 017
set 4	079 015	079 017

Parameter	V<>: Vpos>> PSx	V<>: tVpos>> PSx
set 1	076 016	076 018
set 2	077 016	077 018
set 3	078 016	078 018
set 4	079 016	079 018

Parameter	V<>: Vpos< PSx	V<>: tVpos< PSx	V<>: Vpos<< PSx	V<>: tVpos<< PSx	V<>: tTransient PSx	V<>: Hyst. V<> deduc. PSx
set 1	076 019	076 021	076 020	076 022	076 029	076 049
set 2	077 019	077 021	077 020	077 022	077 029	077 049
set 3	078 019	078 021	078 020	078 022	078 029	078 049
set 4	079 019	079 021	079 020	079 022	079 029	079 049

3-227 *Monitoring the positive-sequence voltage*



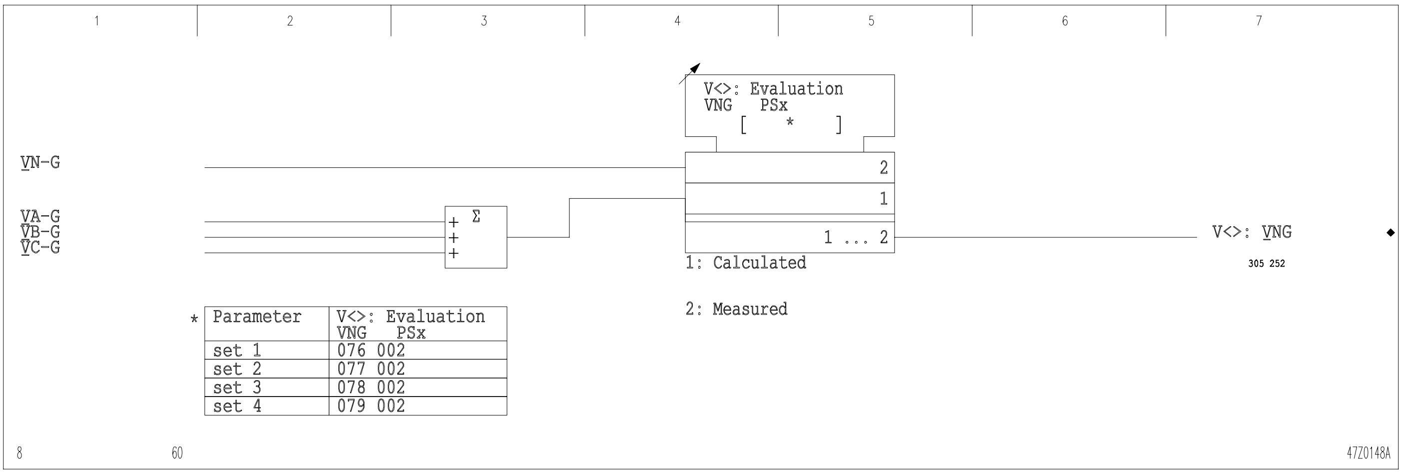
*

Parameter	V<>: Vneg> PSx	V<>: tVneg> PSx	V<>: Vneg>> PSx	V<>: tVneg>> PSx	V<>: Hyst. V<> deduc. PSx
set 1	076 023	076 025	076 024	076 026	076 049
set 2	077 023	077 025	077 024	077 026	077 049
set 3	078 023	078 025	078 024	078 026	078 049
set 4	079 023	079 025	079 024	079 026	079 049

3-228 Monitoring the negative-sequence voltage

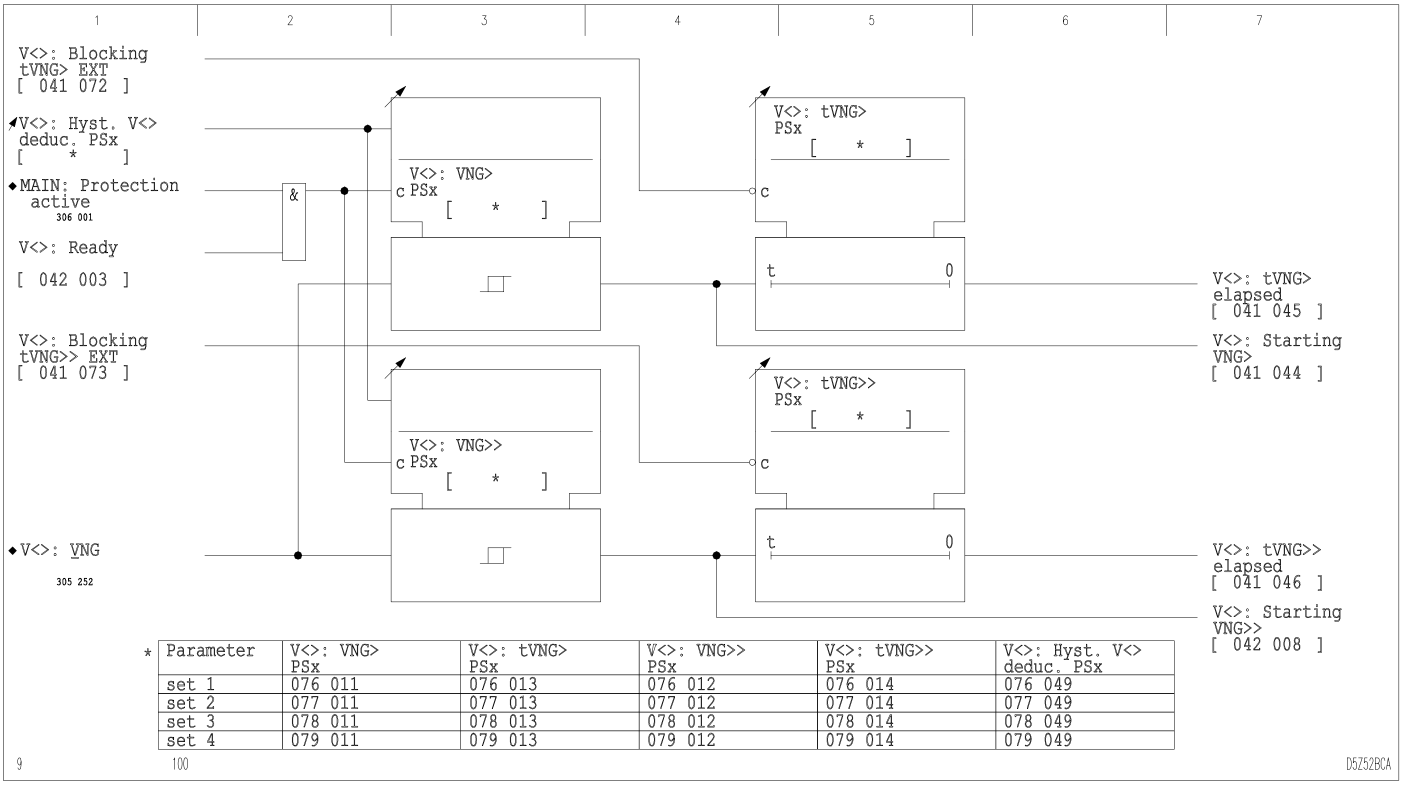
Monitoring the neutral-point displacement voltage

Dependent on the setting, the V<> function monitors either the neutral-point displacement voltage calculated by the P132 from the three phase-to-ground voltages or the neutral-point displacement voltage formed externally via the fourth voltage measuring input, for example the neutral-point displacement voltage from the open delta winding of the voltage transformers (see section 'Conditioning of Measured Variables'). The neutral-point displacement voltage is monitored to determine whether it exceeds set thresholds. The triggers are followed by timer stages that can be blocked via appropriately configured binary signal inputs.



Parameter	V<>: Evaluation VNG PSx
set 1	076 002
set 2	077 002
set 3	078 002
set 4	079 002

3-229 *Selecting the measured variable*



Parameter	V<>: VNG> PSx	V<>: tVNG> PSx	V<>: VNG>> PSx	V<>: tVNG>> PSx	V<>: Hyst. V<> deduc. PSx
set 1	076 011	076 013	076 012	076 014	076 049
set 2	077 011	077 013	077 012	077 014	077 049
set 3	078 011	078 013	078 012	078 014	078 049
set 4	079 011	079 013	079 012	079 014	079 049

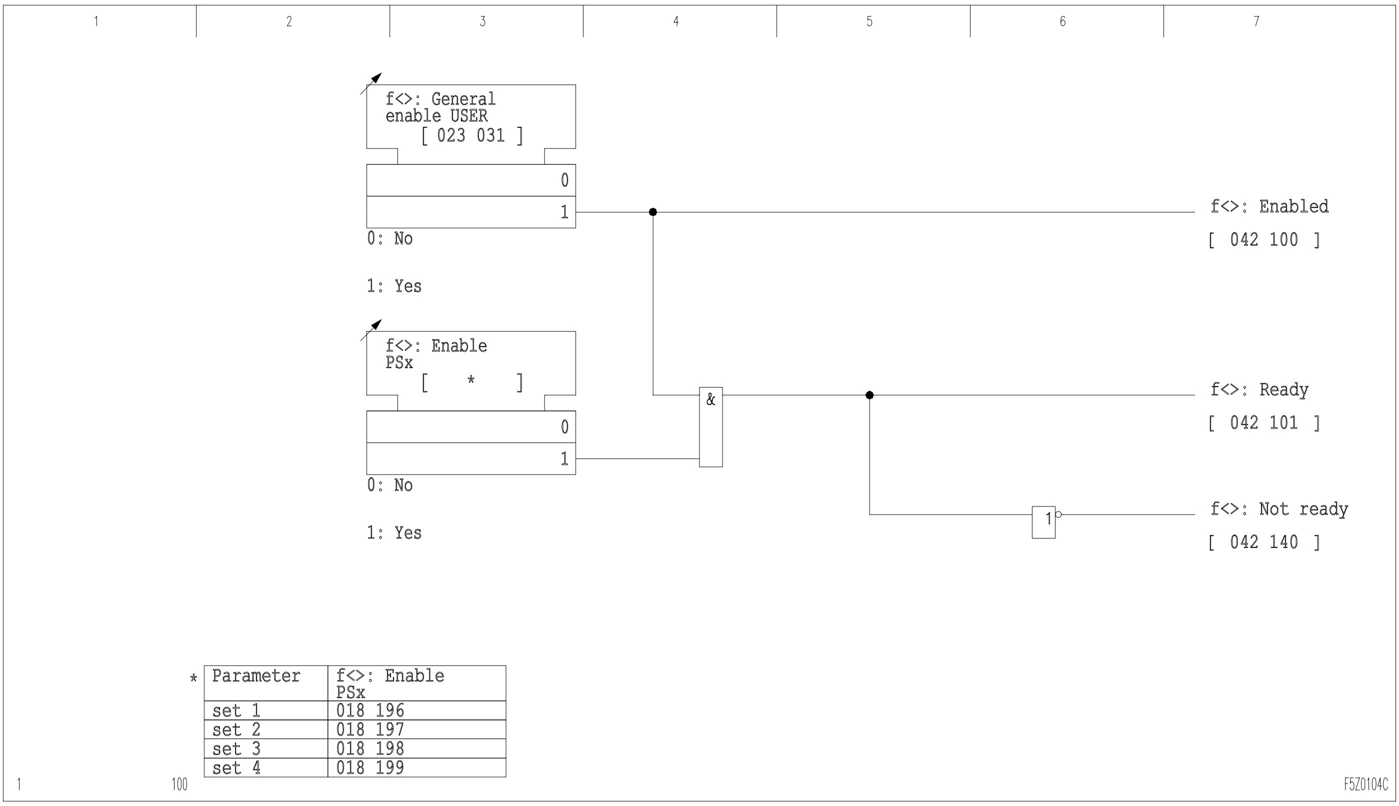
3-230 *Monitoring the neutral-point displacement voltage*

3.36 Over-/Underfrequency Protection (Function Group f<>)

The P132 monitors the selected voltage to determine whether it exceeds or falls below set frequencies. The frequency is determined from the difference in time between the zero crossings of the voltage (voltage zeroes). The over-/underfrequency protection function has four stages. The operation of over-/underfrequency protection will be explained below using the first stage as an example.

Disabling or enabling over-/underfrequency protection

Over-/underfrequency protection can be disabled or enabled via setting arameters. Moreover, enabling can be done separately for each parameter subset.

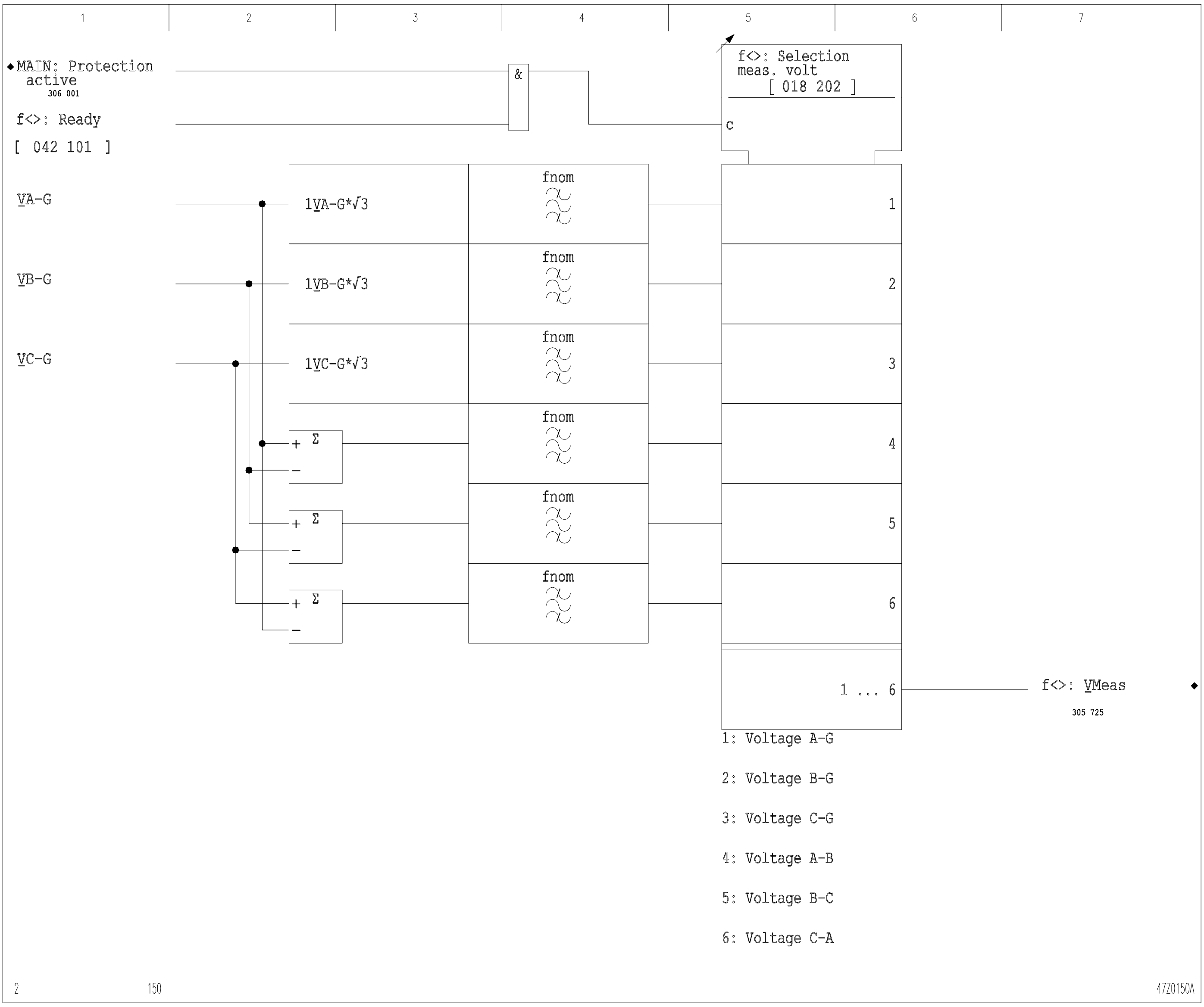


* Parameter	f<>: Enable PSx
set 1	018 196
set 2	018 197
set 3	018 198
set 4	018 199

3-231 *Disabling, enabling, and readiness of f<> protection*

Selecting the measuring voltage

By selecting a measuring voltage setting, the user defines the voltage that is used by the over-/underfrequency protection function for measurement purposes. This can be either a phase-to-ground voltage or a phase-to-phase voltage.

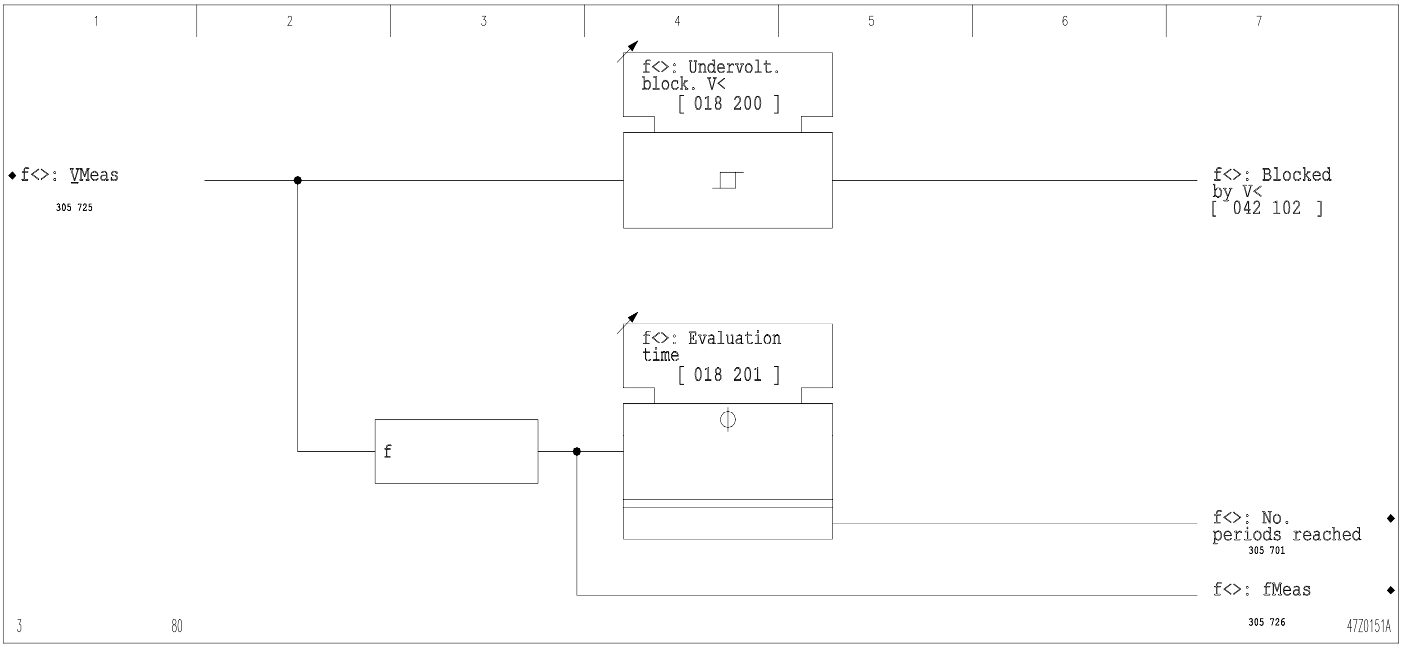


3-232 *Selecting the measuring voltage*

Undervoltage blocking and evaluation time

Over-/underfrequency protection requires a measuring voltage of sufficient magnitude. Over-/underfrequency protection will be blocked instantaneously if the measuring voltage falls below the set threshold of the undervoltage stage.

In order to avoid frequency stage starting caused by brief frequency fluctuations or interference, the evaluation time can be set by the user. The operate conditions must be satisfied for at least the duration of the set evaluation time in order for a signal to be issued.



3-233 *Undervoltage blocking and evaluation time setting*

Operating modes of over-/ underfrequency protection

For each stage of the over-/underfrequency protection function, the user can choose between the following operating modes:

☐ Frequency monitoring

☐ Frequency monitoring combined with differential frequency gradient monitoring (df/dt)

☐ Frequency monitoring combined with mean frequency gradient monitoring (Δf/Δt)

Frequency monitoring

Depending on the setting, the P132 monitors the frequency to determine whether it exceeds or falls below set thresholds. If an operate threshold in excess of the set nominal frequency is set, the P132 checks to determine whether the frequency exceeds the operate threshold. If an operate threshold below the set nominal frequency is set, the P132 checks to determine whether the frequency falls below the operate threshold. If it exceeds or falls below the set threshold, a set timer stage is started. The timer stage can be blocked by way of an appropriately configured binary signal input.

Frequency monitoring combined with differential frequency gradient monitoring (df/dt)

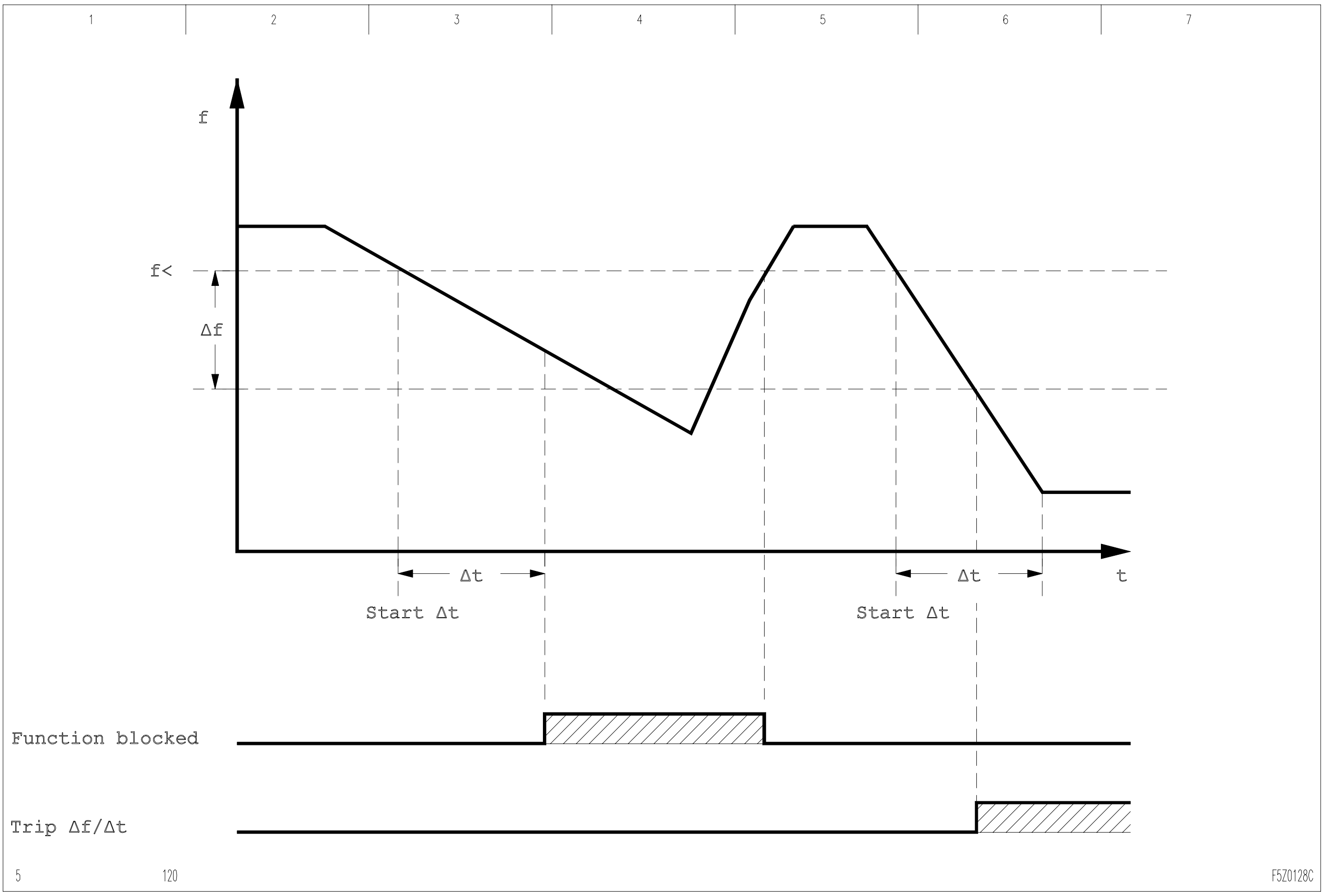
In this operating mode of the over-/ underfrequency protection function, the frequency is also checked to determine whether the set frequency gradient is reached (in addition to being monitored for exceeding or falling below the set threshold). Monitoring for overfrequency is combined with monitoring for a frequency increase; monitoring for underfrequency is combined with monitoring for a frequency decrease. If both operate conditions are satisfied, a set timer stage is started. The timer stage can be blocked by way of an appropriately configured binary signal input.

Frequency monitoring combined with mean frequency gradient monitoring (Δf/Δt)

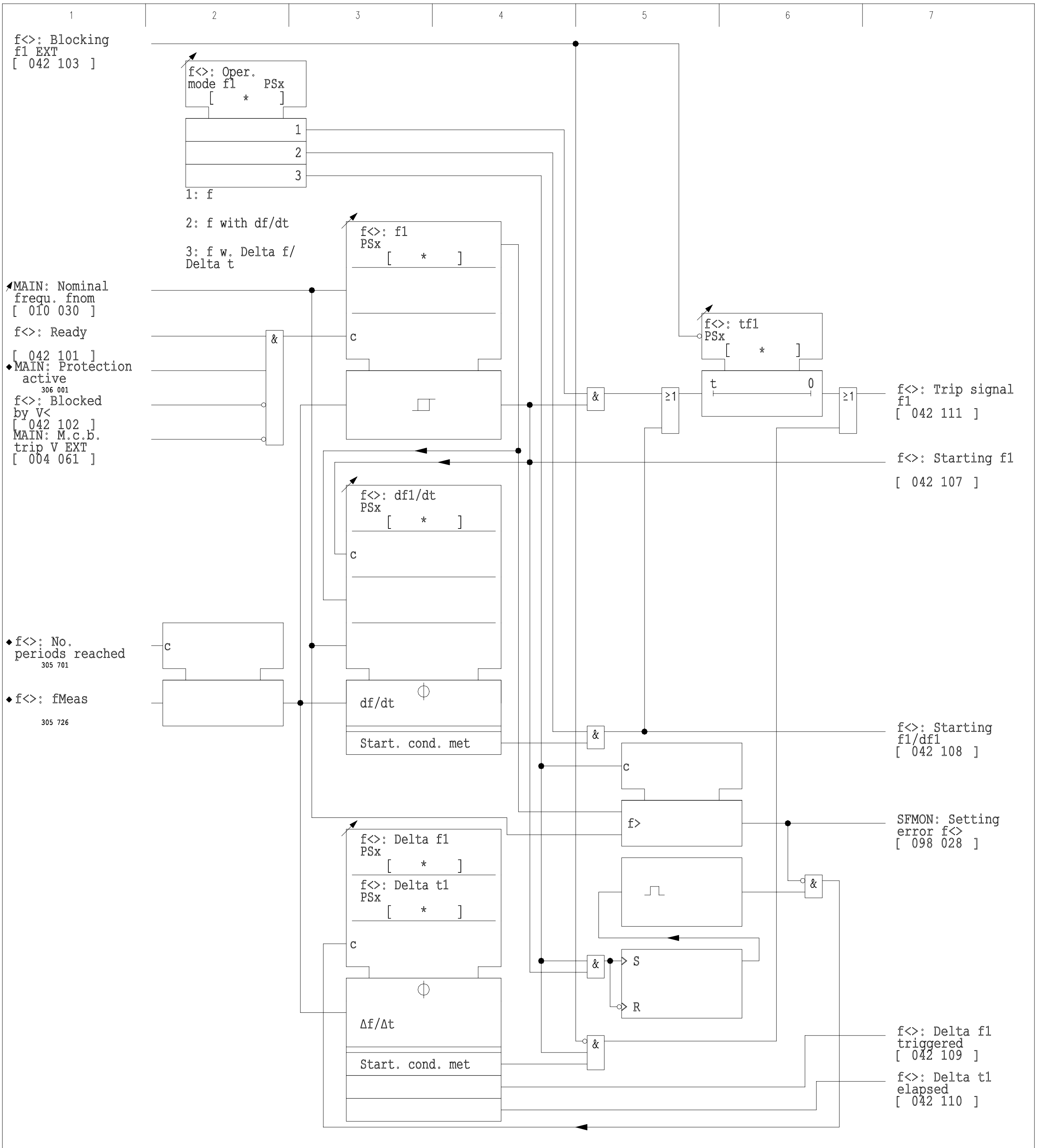
The frequency gradient can differ for system disturbances in individual substations and may vary over time due to power swings. Therefore it makes sense to take the mean value of the frequency gradient into account for load-shedding systems.

In this operating mode of over-/underfrequency protection, frequency monitoring must be set for 'underfrequency monitoring'.

Monitoring the mean value of the frequency gradient is started with the starting of frequency monitoring. If the frequency decreases by the set value Δf within the set time Δt, then the Δt/Δf monitoring function operates instantaneously and generates a trip signal. If a frequency change does not lead to an operate decision of the monitoring function, then the Δt/Δf monitoring function will be blocked until the underfrequency monitoring function drops out. The trip signal can be blocked by way of an appropriately configured binary signal input.



3-234 *Operation of frequency monitoring combined with Δf/Δt monitoring*



* Parameter	f<>: Oper. mode f1 PSx	f<>: f1 PSx	f<>: df1/dt PSx	f<>: Delta f1 PSx	f<>: Delta t1 PSx	f<>: tf1 PSx
set 1	018 120	018 100	018 108	018 112	018 116	018 104
set 2	018 121	018 101	018 109	018 113	018 117	018 105
set 3	018 122	018 102	018 110	018 114	018 118	018 106
set 4	018 123	018 103	018 111	018 115	018 119	018 107

4 220 47Z0152A

3-235 First stage of the over-/ underfrequency protection function

f_{min}-/f_{max} Acquisition

For the acquisition of the minimum frequency during an underfrequency condition and for the acquisition of the maximum frequency during an overfrequency condition, the two following measured event values are available:

f<>: max. frequ. for f>

f<>: min. frequ. for f<

At the beginning of a new over- and underfrequency condition the two measured event values are automatically reset. A manual reset is also possible:

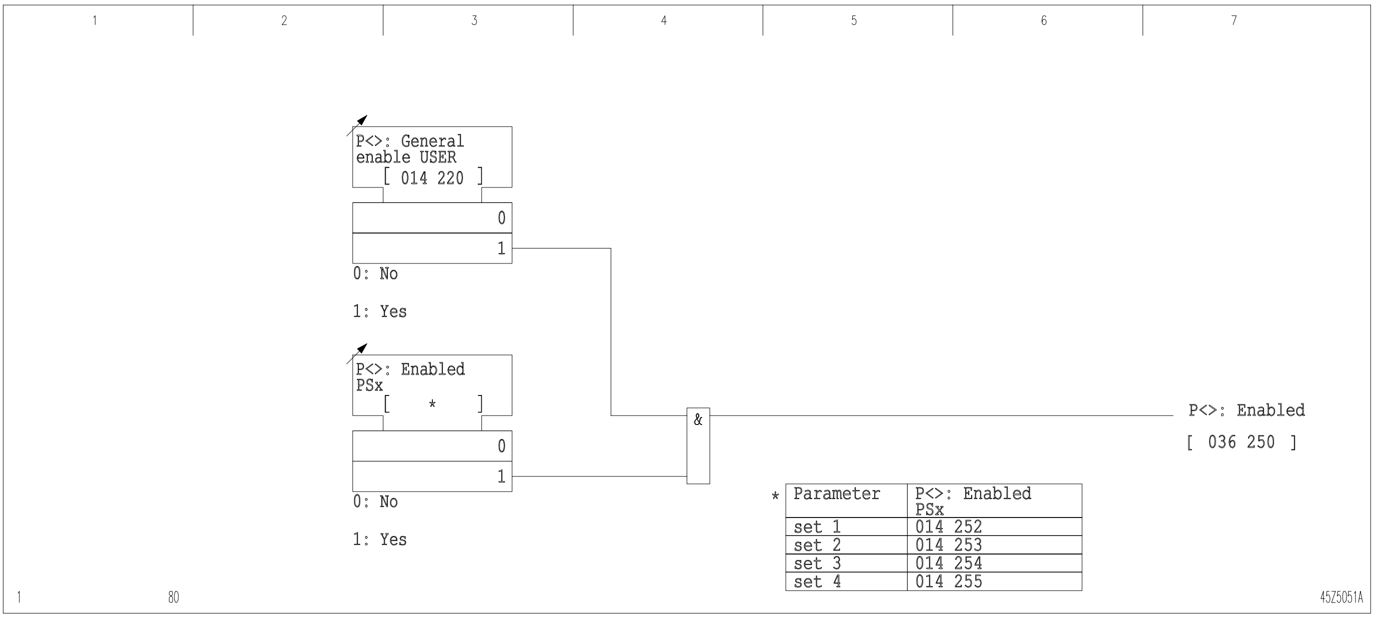
f<>: Reset meas.val. USER

3.37 Power Directional Protection (Function Group P<>)

The power directional protection function determines the active and reactive power from the fundamental currents and voltages. The sign of the active or the reactive power, respectively, is evaluated for direction determination

Disabling or enabling P<> protection

The power directional protection function can be disabled or enabled using a setting parameter. Moreover, enabling can be carried out separately for each parameter set.



Parameter	P<>: Enabled PSx
set 1	014 252
set 2	014 253
set 3	014 254
set 4	014 255

3-236 Enabling or disabling power directional protection

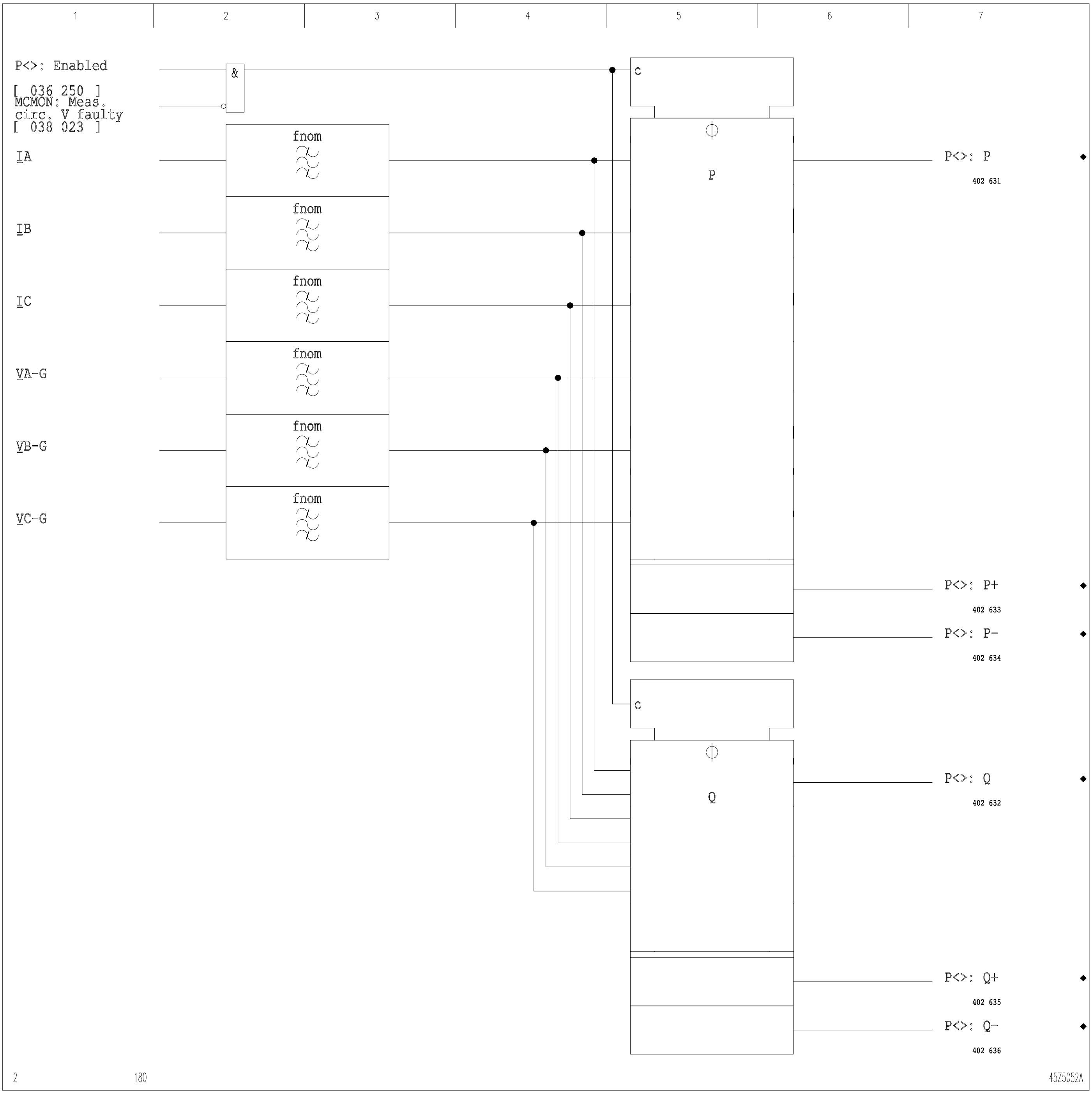
Power determination

The P132 determines the active and reactive power from the three phase and the phase-to-ground voltages. If the measuring-circuit monitoring function detects malfunctioning in the voltage measuring circuit, power determination will be blocked.

Power monitoring

The P132 checks the determined power values to detect whether they exceed or fall below set thresholds. The triggers are followed by timer stages that can be blocked via appropriately configured binary signal inputs.

If the decisions of power monitoring are to be included in the trip commands when values have fallen below set thresholds, then it is recommended that transient signals be used. Otherwise, the trip command would always be present when the system voltage was disconnected, and thus it would not be possible to close the circuit breaker again.

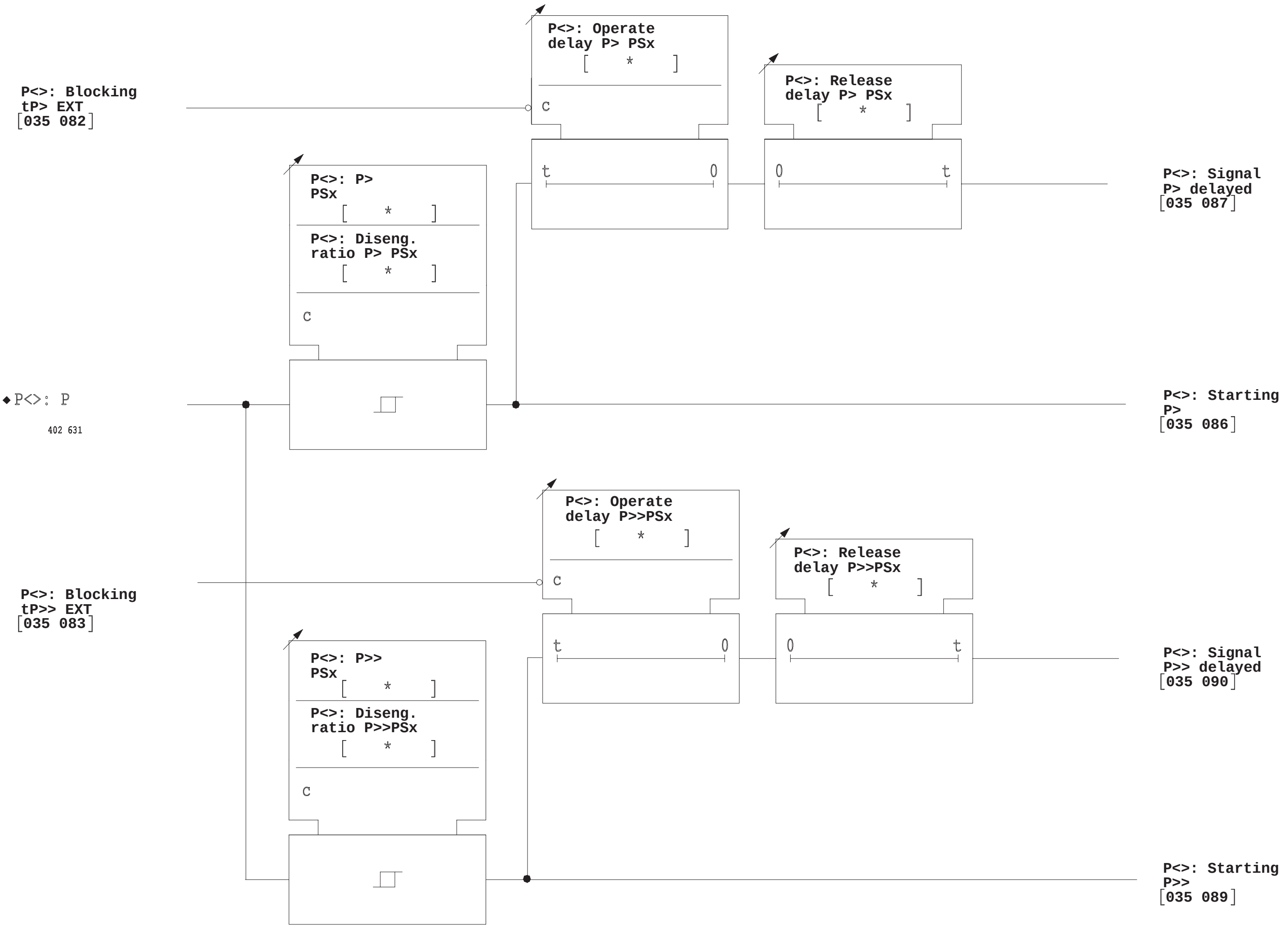


3-237 Power determination

Active power monitoring when set thresholds are exceeded

The P132 monitors the active power with two-stage functions to detect when it exceeds the set thresholds. The resetting ratio of the threshold stages can be set.

When the active power exceeds the set thresholds, a starting results. The starting signal is followed by the set operate and resetting delays.



*

Parameter	P<>: P> PSx	P<>: Diseng. ratio P> PSx	P<>: Operate delay P> PSx	P<>: Release delay P> PSx
set 1	017 120	017 124	017 128	017 132
set 2	017 200	017 125	017 129	017 133
set 3	017 201	017 126	017 130	017 134
set 4	017 202	017 127	017 131	017 135

*

Parameter	P<>: P>> PSx	P<>: Diseng. ratio P>>PSx	P<>: Operate delay P>>PSx	P<>: Release delay P>>PSx
set 1	017 140	017 144	017 148	017 152
set 2	017 141	017 145	017 149	017 153
set 3	017 142	017 146	017 150	017 154
set 4	017 143	017 147	017 151	017 155

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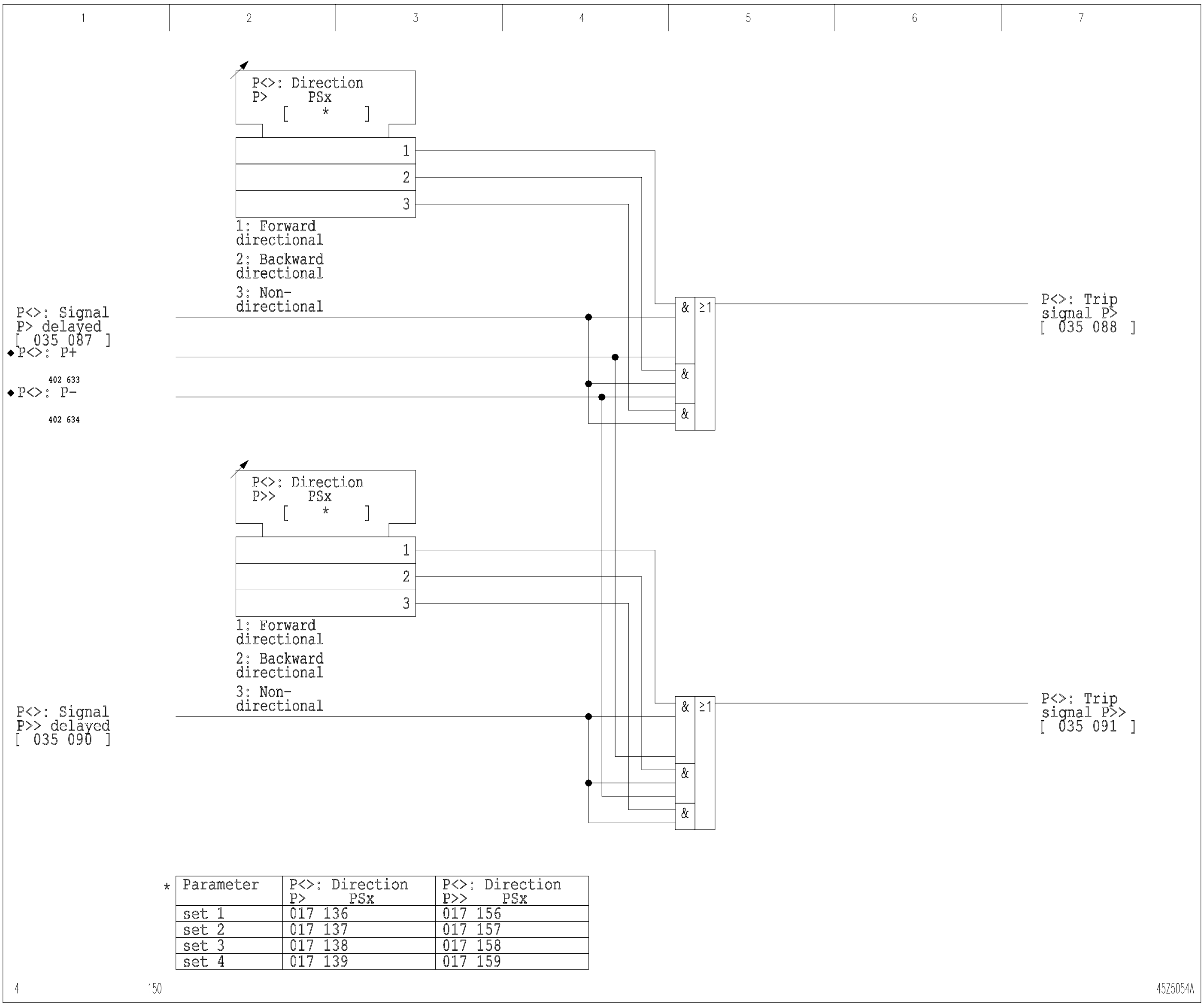
3-238 Active power monitoring when set thresholds are exceeded

Active power direction when set thresholds are exceeded

The P132 determines the sign of the active power. If the sign is positive, a forward-directional decision is issued; if it is negative, a backward-directional decision results. A setting determines whether a trip signal is triggered by a forward-directional, a backward-directional or a non-directional decision.



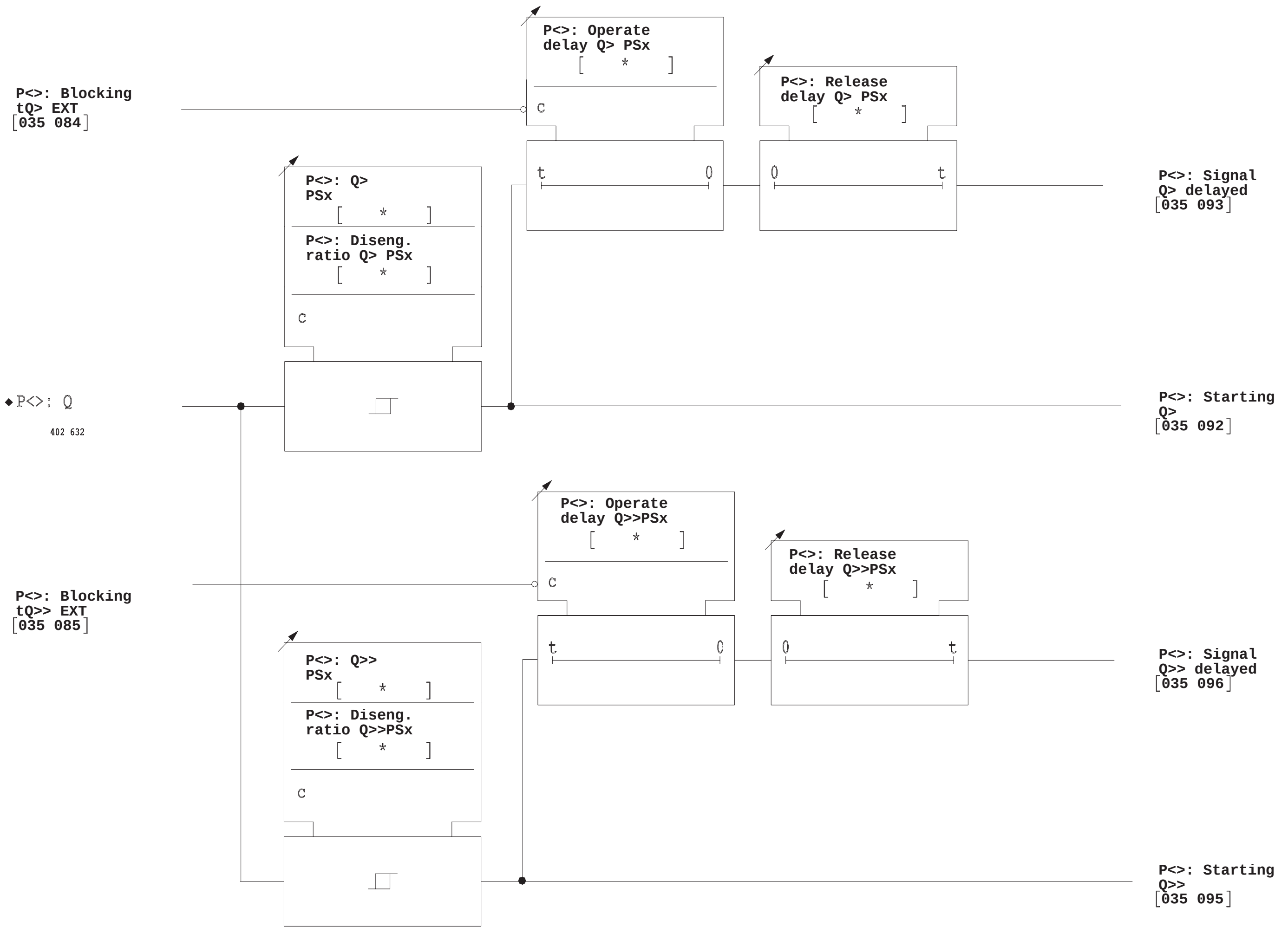
Parameter	P<>: Direction P> PSx	P<>: Direction P>> PSx
set 1	017 136	017 156
set 2	017 137	017 157
set 3	017 138	017 158
set 4	017 139	017 159

3-239 *The direction-dependent trip signal of the active power protection function when set thresholds are exceeded*

Reactive power monitoring when set thresholds are exceeded

The P132 monitors the reactive power with two-stage functions to detect when it exceeds the set thresholds. The resetting ratio of the threshold stages can be set.

When the reactive power exceeds the set thresholds, a starting results. The starting signal is followed by the set operate and resetting delays.



* Parameter	P<>: Q> PSx	P<>: Diseng. ratio Q> PSx	P<>: Operate delay Q> PSx	P<>: Release delay Q> PSx
set 1	017 160	017 164	017 168	017 172
set 2	017 161	017 165	017 169	017 173
set 3	017 162	017 166	017 170	017 174
set 4	017 163	017 167	017 171	017 175

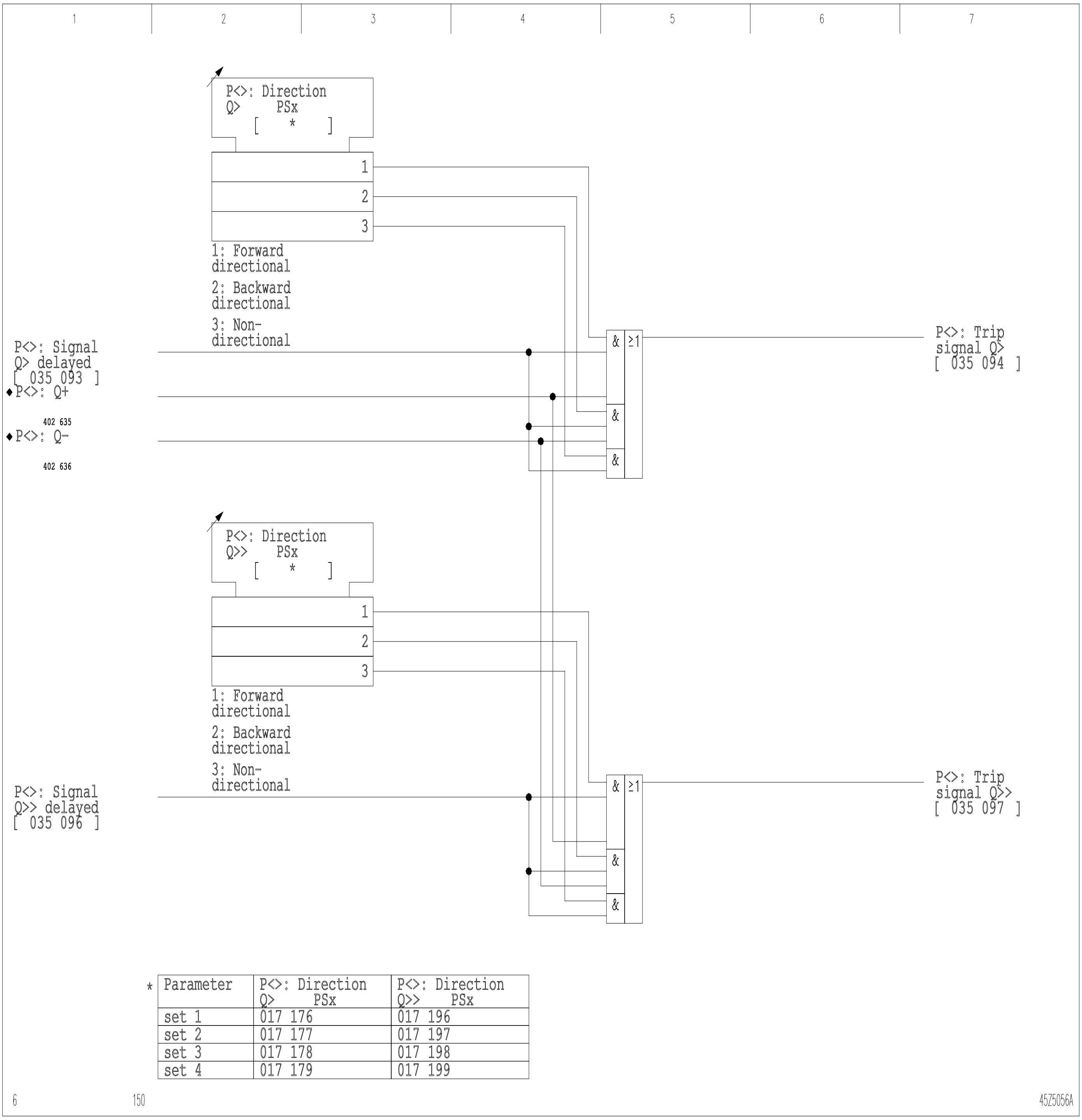
* Parameter	P<>: Q>> PSx	P<>: Diseng. ratio Q>>PSx	P<>: Operate delay Q>>PSx	P<>: Release delay Q>>PSx
set 1	017 180	017 184	017 188	017 192
set 2	017 181	017 185	017 189	017 193
set 3	017 182	017 186	017 190	017 194
set 4	017 183	017 187	017 191	017 195

19Z5270A_EN

3-240 *Reactive power monitoring when set thresholds are exceeded*

Reactive power direction when set thresholds are exceeded

The P132 determines the sign of the reactive power. If the sign is positive, a forward-directional decision is issued; if it is negative, a backward-directional decision results. A setting determines whether a trip signal is triggered by a forward-directional, a backward-directional or a non-directional decision.



Parameter	P<>: Direction Q> PSx	P<>: Direction Q>> PSx
set 1	017 176	017 196
set 2	017 177	017 197
set 3	017 178	017 198
set 4	017 179	017 199

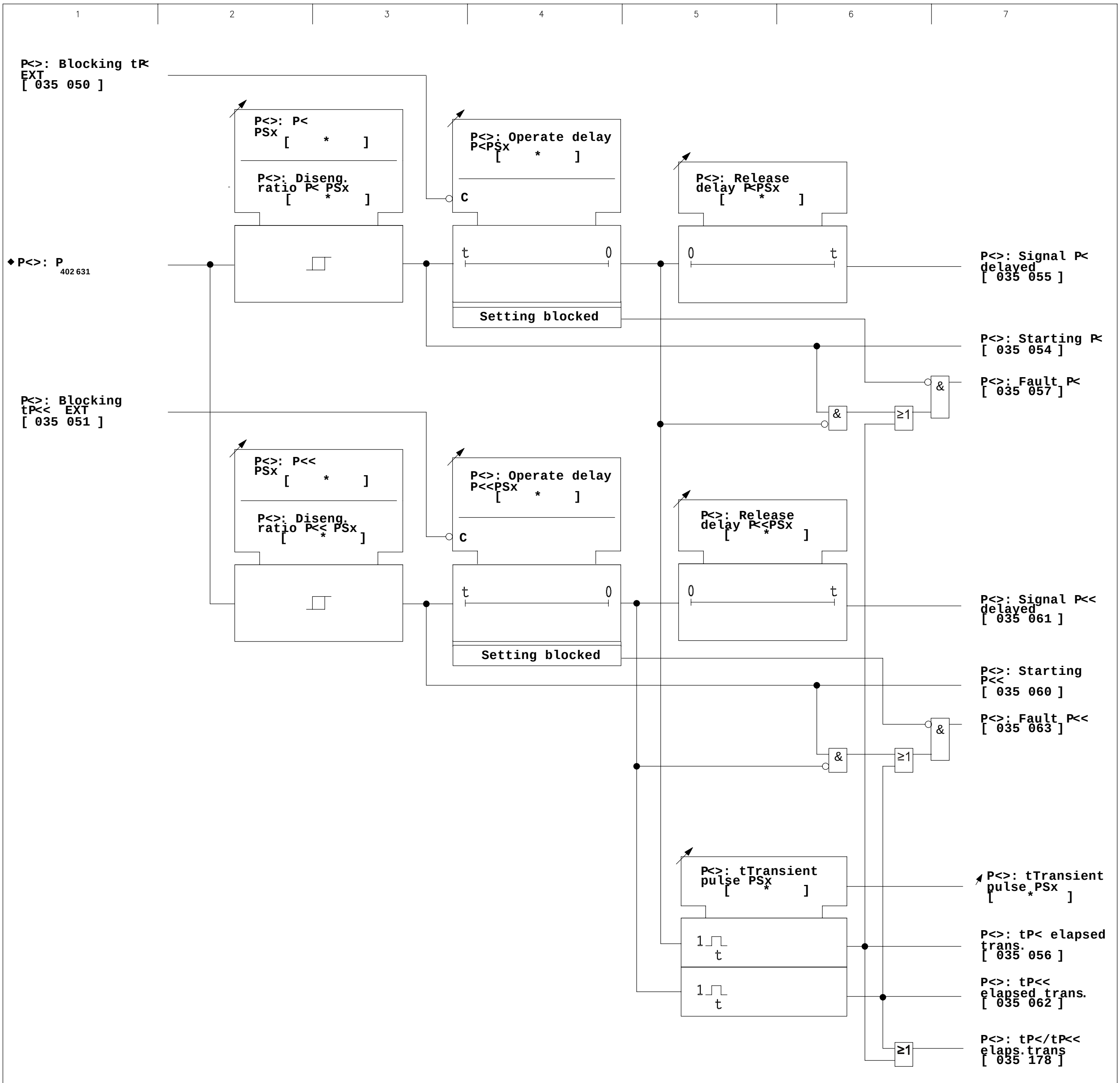
3-241 *The direction-dependent trip signal of the reactive power protection function when set thresholds are exceeded*

Active power monitoring when values fall below set thresholds

The P132 monitors the active power with two-stage functions to detect when it falls below the set thresholds. The resetting ratio of the threshold stages can be set.

When the active power falls below the set thresholds, a starting results. The starting signal is followed by the set operate and resetting delays.

3 Operation
(continued)



*

Parameter	P<>: P< PSx	P<>: Diseng. ratio P< PSx	P<>: Operate delay P<PSx	P<>: Release delay P<PSx
set 1	017 030	017 034	017 060	017 226
set 2	017 031	017 035	017 061	017 227
set 3	017 032	017 036	017 062	017 228
set 4	017 033	017 037	017 063	017 229

*

Parameter	P<>: P<< PSx	P<>: Diseng. ratio P<< PSx	P<>: Operate delay P<<PSx	P<>: Release delay P<<PSx	P<>: tTransient pulse PSx
set 1	017 234	017 238	017 242	017 246	018 246
set 2	017 235	017 239	017 243	017 247	018 247
set 3	017 236	017 240	017 244	017 248	018 248
set 4	017 237	017 241	017 245	017 249	018 249

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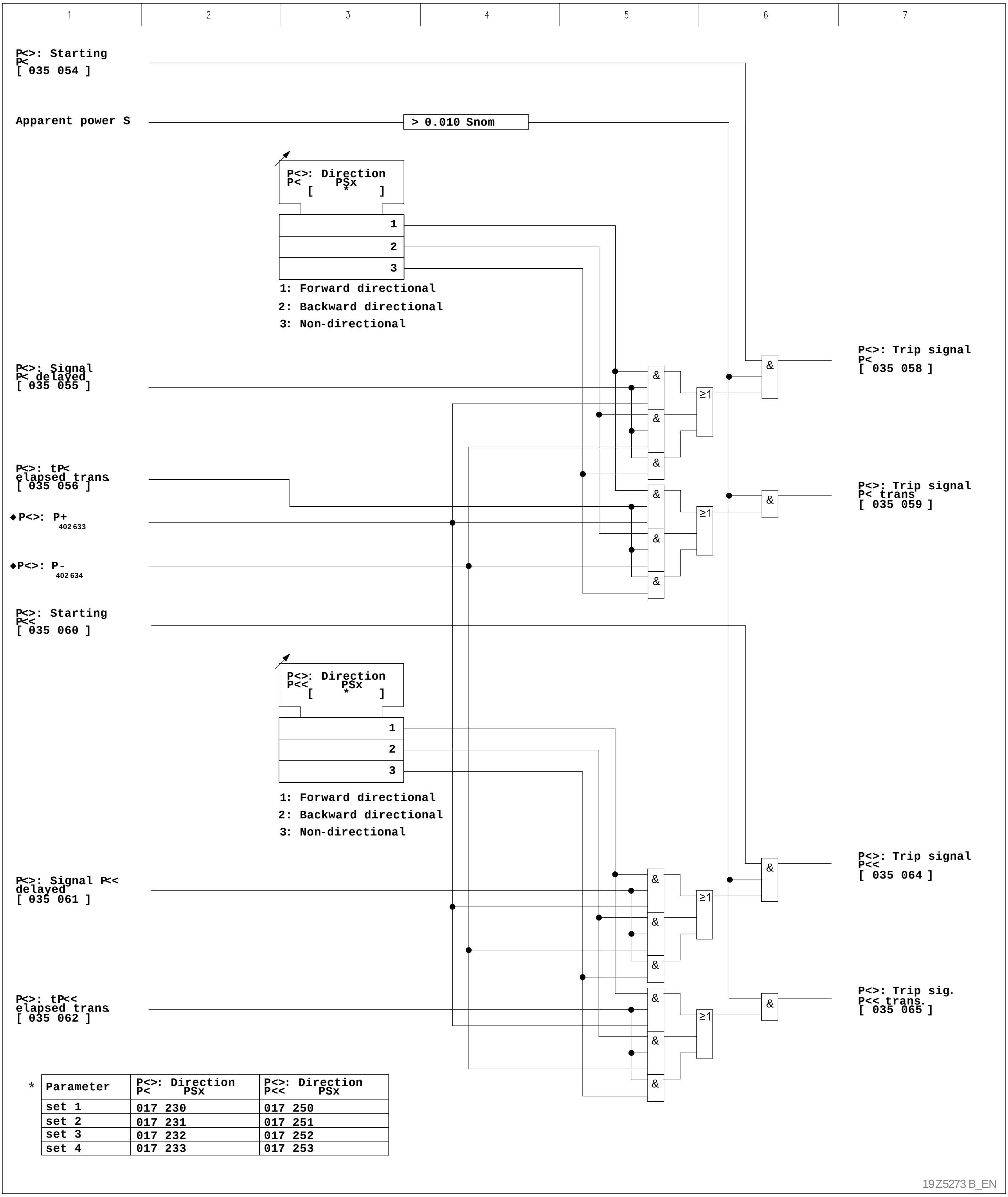
3-242 Active power monitoring when values fall below set thresholds

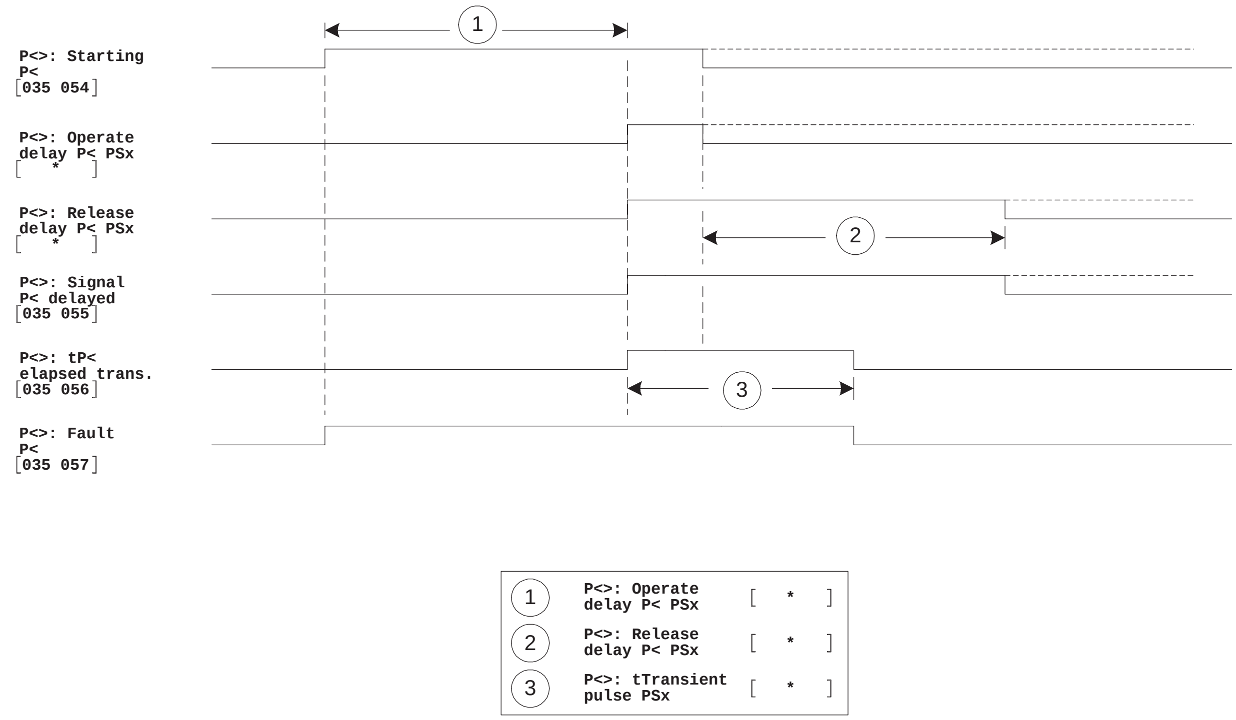
Active power direction when values fall below set thresholds

The P132 determines the sign of the active power. If the sign is positive, a forward-directional decision is issued; if it is negative, a backward-directional decision results. A setting determines whether a trip signal is triggered by a forward-directional, a backward-directional or a non-directional decision.



* Parameter	P<>: Direction P< PSx	P<>: Direction P<< PSx
set 1	017 230	017 250
set 2	017 231	017 251
set 3	017 232	017 252
set 4	017 233	017 253

3-243 The direction-dependent trip signal of the active power protection function when values fall below set thresholds



* Parameter	P<>: Operate delay P< PSx	P<>: Release delay P< PSx	P<>: tTransient pulse PSx
set 1	017 060	017 226	018 246
set 2	017 061	017 227	018 247
set 3	017 062	017 228	018 248
set 4	017 063	017 229	018 249

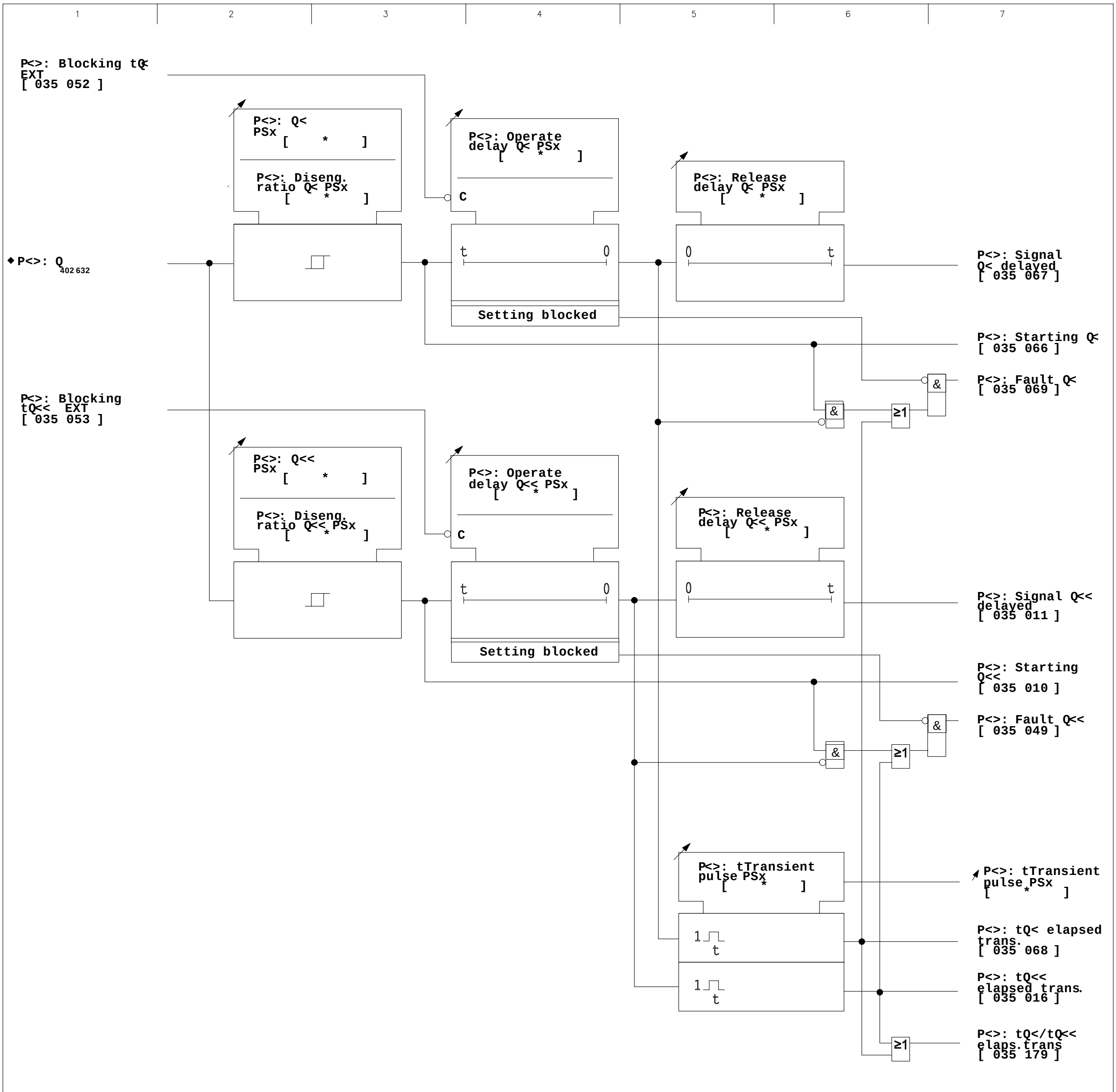
19Z5278A_EN

3-244 Performance of the transient signal and the fault signal issued by the active power monitoring

Reactive power monitoring when values fall below set thresholds

The P132 monitors the reactive power with two-stage functions to detect when it falls below the set thresholds. The resetting ratio of the threshold stages can be set.

When the reactive power falls below the set thresholds, a starting results. The starting signal is followed by the set operate and resetting delays.



* Parameter	P<>: Q< PSx	P<>: Diseng. ratio Q< PSx	P<>: Operate delay Q< PSx	P<>: Release delay Q< PSx
set 1	018 035	018 044	018 052	018 056
set 2	018 036	018 045	018 053	018 057
set 3	018 037	018 046	018 054	018 058
set 4	018 038	018 047	018 055	018 059

* Parameter	P<>: Q<< PSx	P<>: Diseng. ratio Q<< PSx	P<>: Operate delay Q<< PSx	P<>: Release delay Q<< PSx	P<>: tTransient pulse PSx
set 1	018 085	018 095	018 213	018 236	018 246
set 2	018 086	018 096	018 214	018 237	018 247
set 3	018 087	018 097	018 215	018 238	018 248
set 4	018 088	018 098	018 216	018 239	018 249

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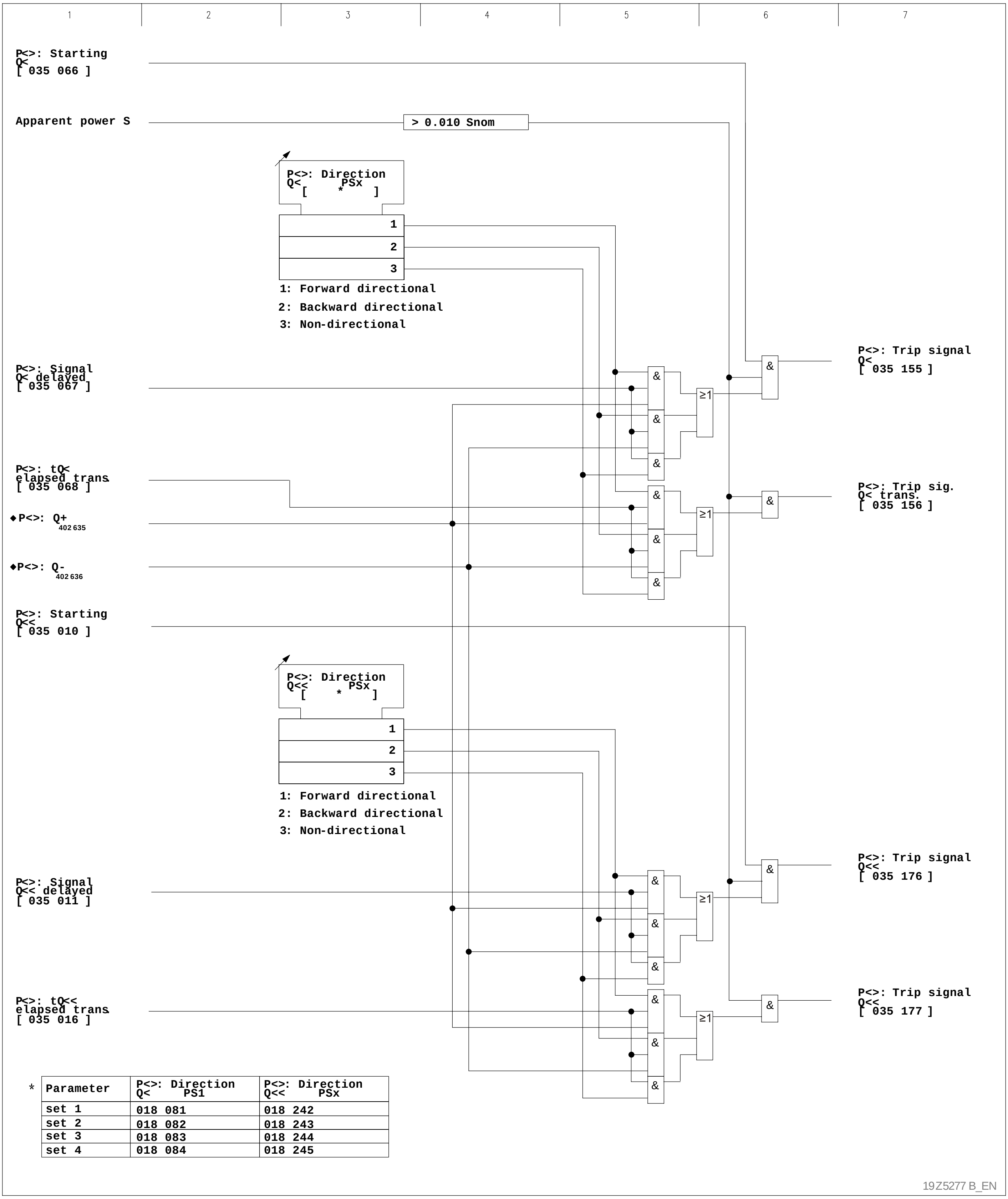
3-245 Reactive power monitoring when values fall below set thresholds

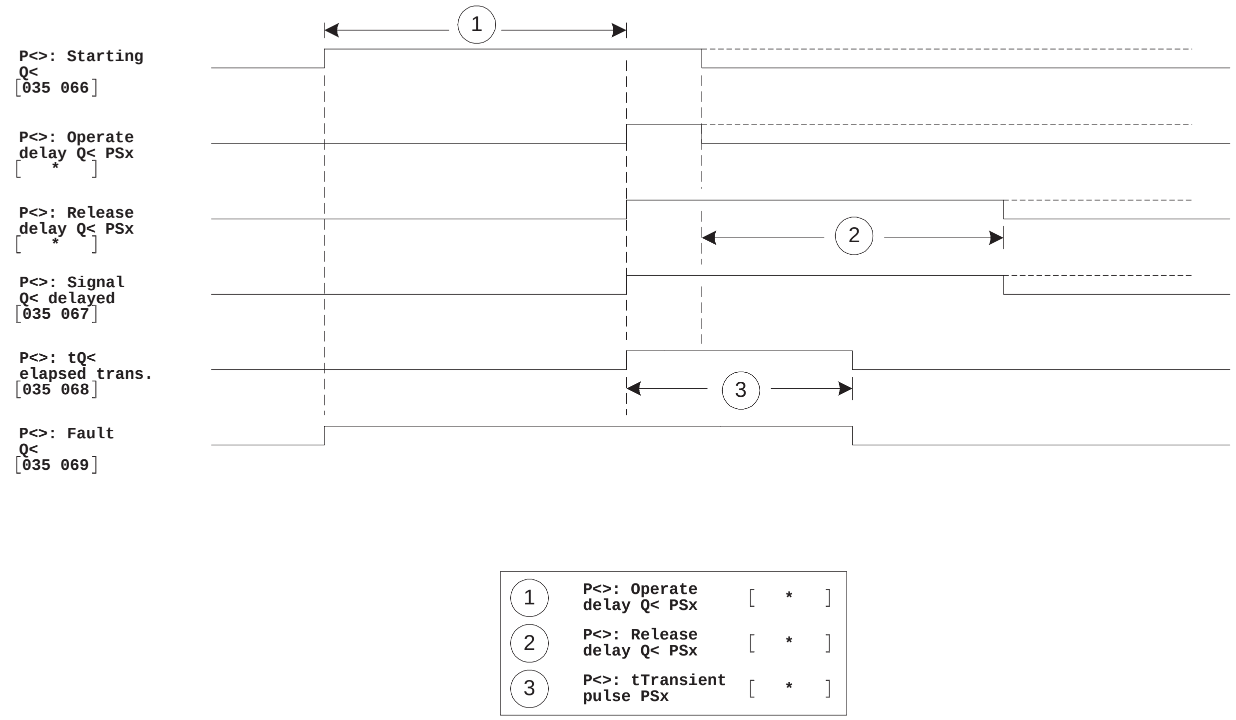
Reactive power direction when values fall below set thresholds

The P132 determines the sign of the reactive power. If the sign is positive, a forward-directional decision is issued; if it is negative, a backward-directional decision results. A setting determines whether a trip signal is triggered by a forward-directional, a backward-directional or a non-directional decision.



* Parameter	P<>: Direction Q< PS1	P<>: Direction Q<< PSx
set 1	018 081	018 242
set 2	018 082	018 243
set 3	018 083	018 244
set 4	018 084	018 245

3-246 The direction-dependent trip signal of the reactive power protection function when values fall below set thresholds



* Parameter	P<>: Operate delay Q< PSx	P<>: Release delay Q< PSx	P<>: tTransient pulse PSx
set 1	018 052	018 056	018 246
set 2	018 053	018 057	018 247
set 3	018 054	018 058	018 248
set 4	018 055	018 059	018 249

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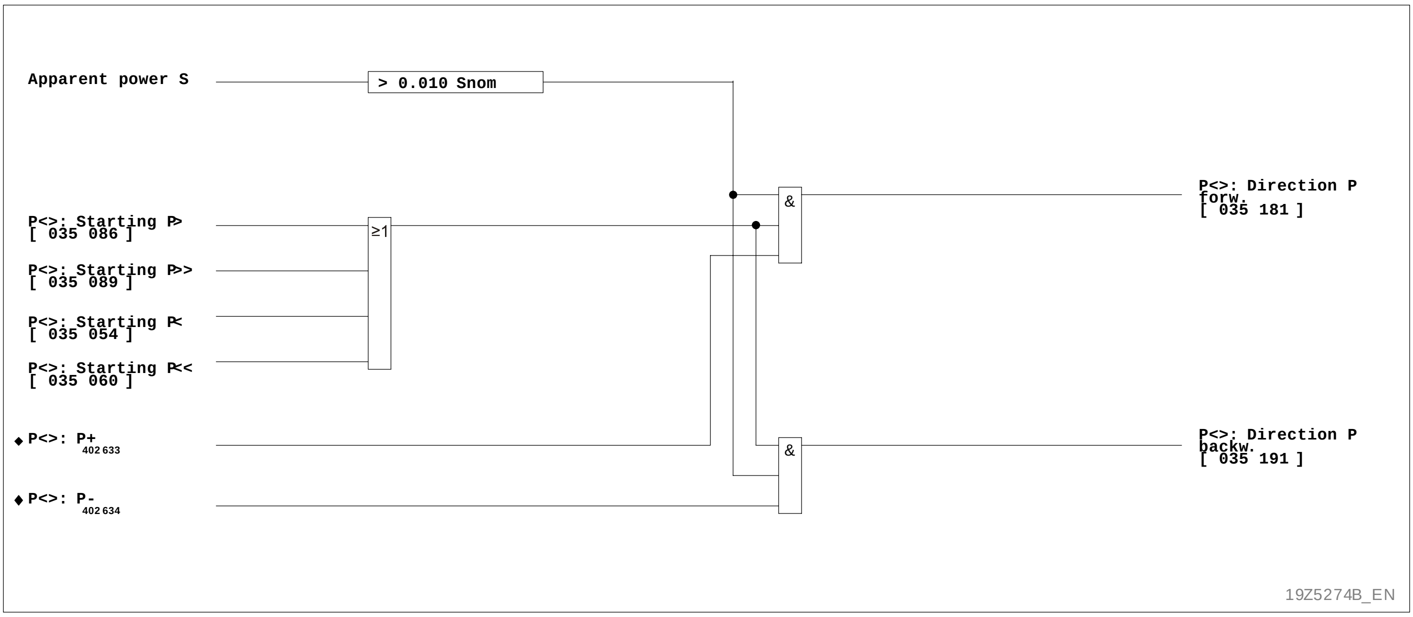
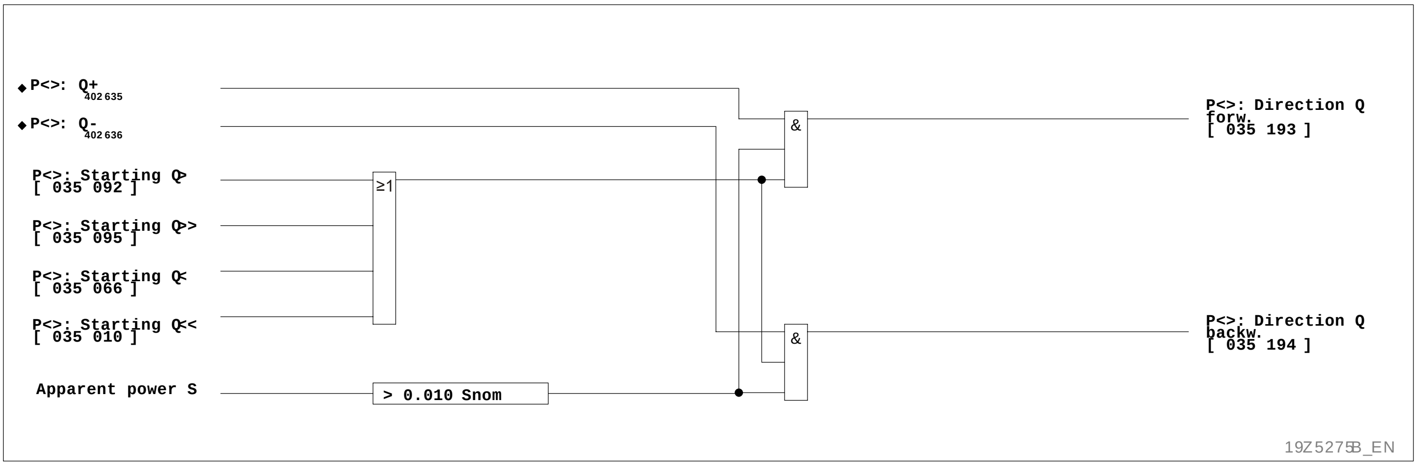
3-247 *Performance of the transient signal and the fault signal issued by the reactive power monitoring*

Starting signal with direction



3-248 Directional starting signal issued by the active power monitoring



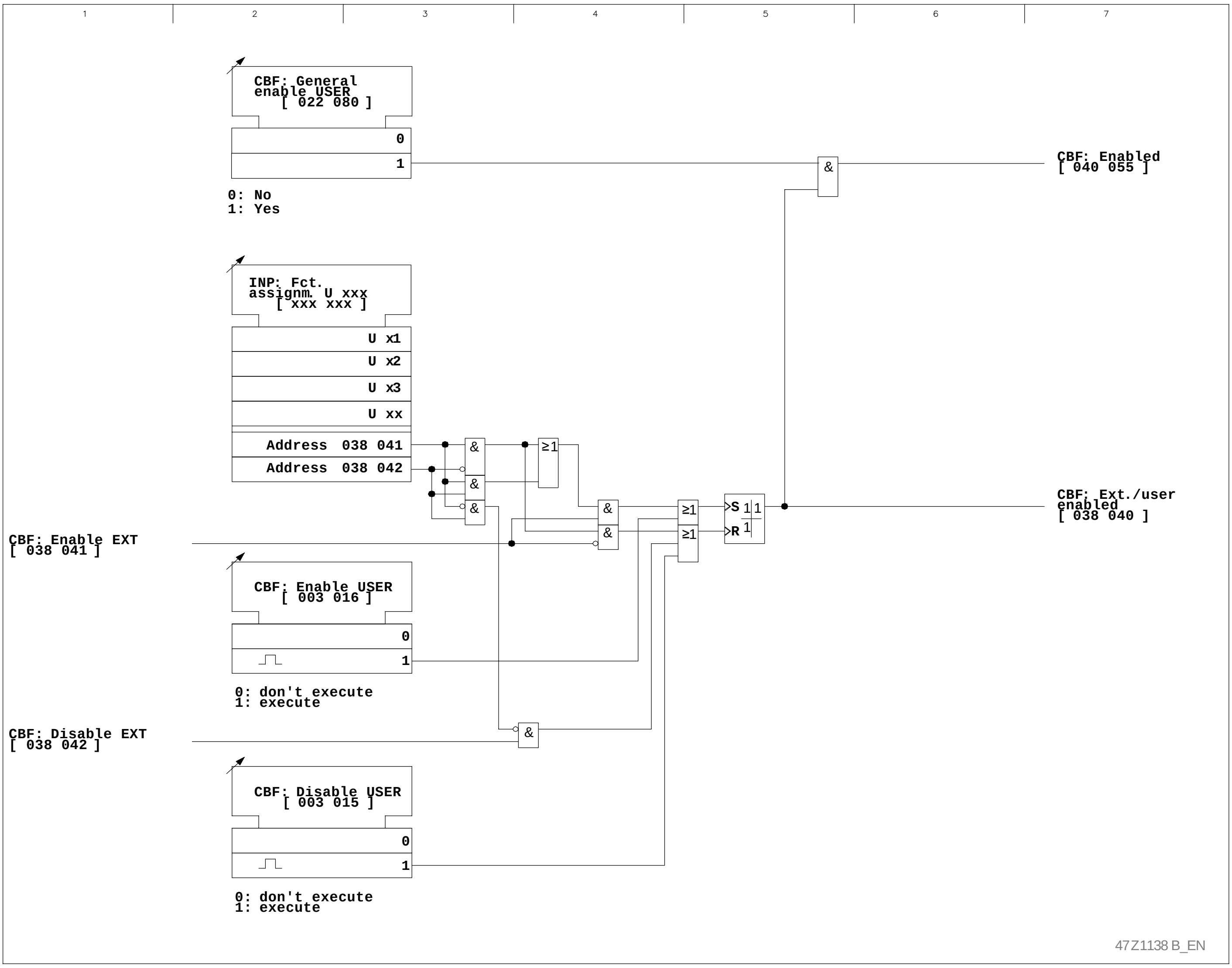
3-249 Directional starting signal issued by the reactive power monitoring

3.38 Circuit Breaker Failure Protection (Function Group CBF)

The P132 features the CB failure protection function. After a trip command has been issued the CBF function monitors that the circuit breaker has actually been triggered.

Enable/disable circuit breaker failure protection

The activation of the function is enabled at CBF: General enable USER. If this parameter has been activated the CBF function may be enabled or disabled by parameters or through appropriately configured binary signal inputs. Parameters and configured binary signal inputs have equal status. If only the function CBF: Enable EXT is assigned to a binary signal input, then circuit breaker protection will be enabled by a positive edge of the input signal and disabled by a negative edge. If only the function CBF: Disable EXT is assigned to a binary signal input, then a signal at this input will have no effect.

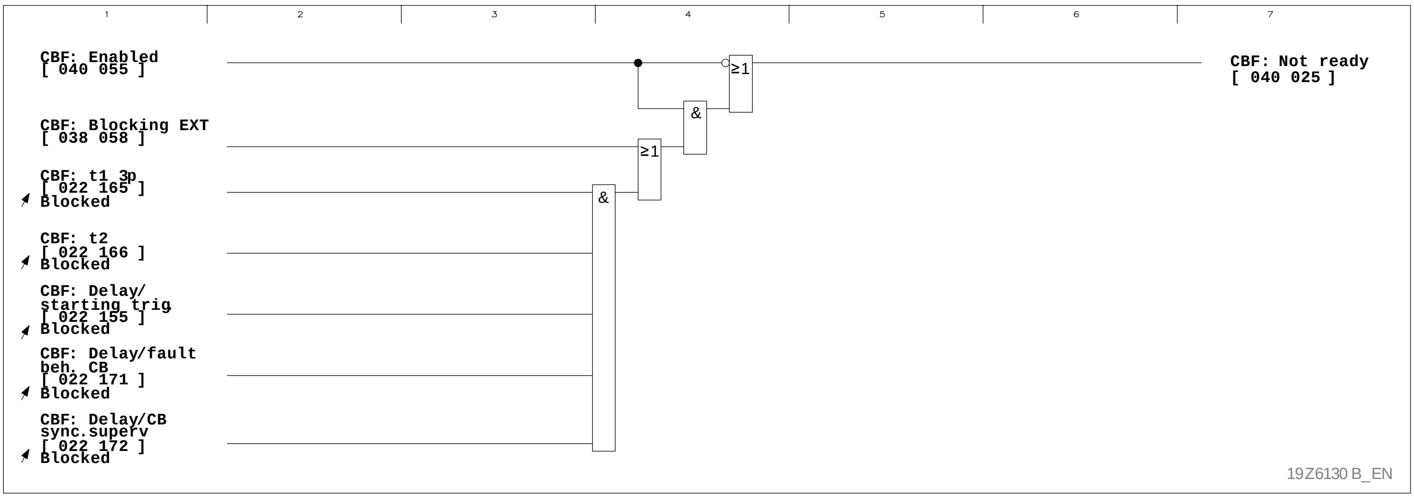


3-250 Disabling or enabling circuit breaker failure protection

Readiness of circuit breaker protection

Circuit breaker failure protection will not be available under the following conditions:

- ☐ The CBF function is not activated.
- ☐ Circuit breaker protection is being blocked by an appropriately configured binary signal input.
- ☐ All CBF timer stages have been set to '*blocked*'.



3-251 Signal CBF: Not ready

Detecting a CB tripping

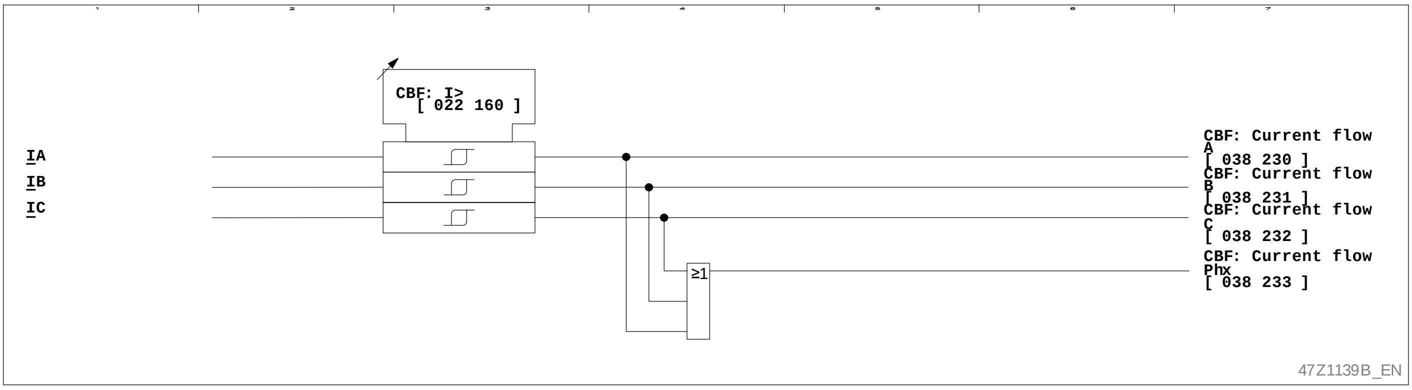
A break in current flow is the preferred criterion to detect a successful CB tripping.

Protection functions that have tripping criteria not directly dependent on current flow may additionally be provided with status signals from CB auxiliary contacts for evaluation.

Current flow monitoring

This function is used to detect a break in current flow safely, immediately and pole selectively. The CBF function continuously compares sampled current values with the set threshold value CBF: I>.

As long as current flow criteria are met the monitoring function will continuously issue the phase selective signals CBF: Current flow A, CBF: Current flow B, CBF: Current flow C and the multiple signal CBF: Current flow Phx.



3-252 Current flow monitoring
Note: CBF: I> represents an undercurrent criterion. As of version -613 the description text has been changed to CBF: I<.

Evaluation of CB status signals

Trip signals included in the Gen. Trip command 1, which use CB status signals in addition to current flow monitoring, can be selected with the parameter CBF: Fct.assignm. CBAux.

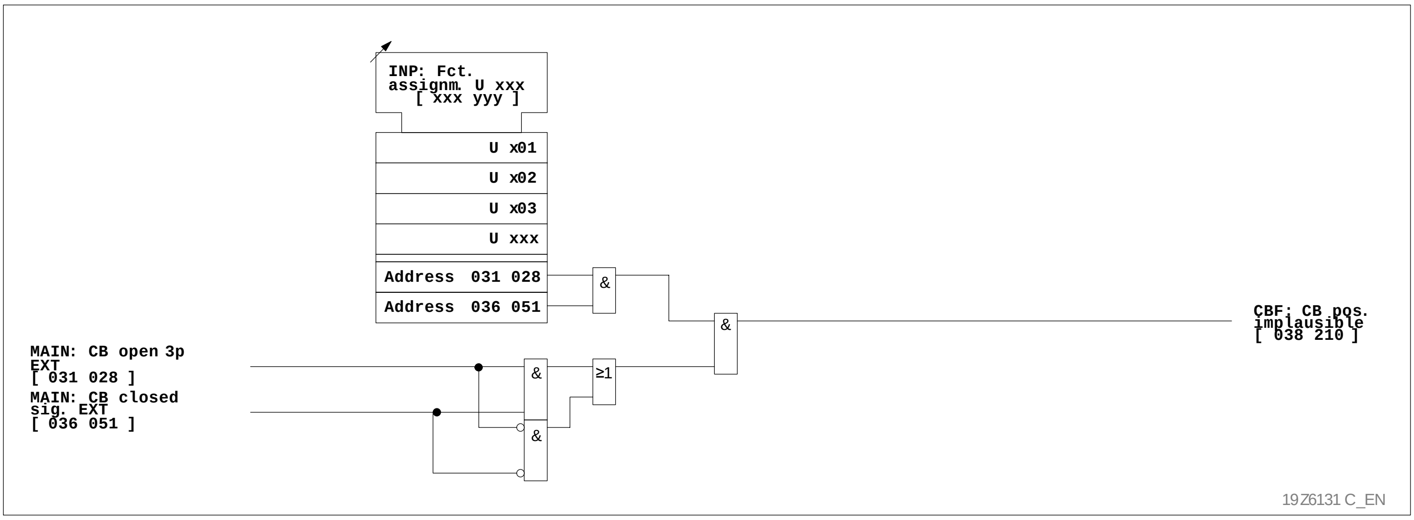
Applying CB status signals depends on the type of auxiliary contacts available. The P132 is capable of checking the following CB status signals for plausibility and evaluating them:

- ☐ The open signal from the circuit breaker, MAIN: CB1 open 3p EXT
- ☐ The closed signal from the circuit breaker, MAIN: CB closed sig. EXT

The evaluation of the CB status signals is blocked, if the configuration of the respective binary signal inputs or the signal levels are not plausible. This will result in the P132 issuing of the signal CBF: CB pos. implausible. Evaluation of current criteria is not affected by this blocking.

If only one of the two possible CB status signals has been configured, then this configured signal will always be considered plausible by the P132.

As an alternative the status signals from the external device may be used by the P132. Assigning necessary for this is made with the parameters MAIN: Sig. asg. CB open or MAIN: Sig. asg. CB closed. Status signals from external devices are processed similar to CB status signals MAIN: CB open 3p EXT and MAIN: CB closed sig. EXT.



3-253 Plausibility check of CB status signals

Startup criteria

The startup of the circuit breaker failure protection function will occur when the CB is recognized as closed during a start criterion. The following criteria are evaluated as a startup criterion:

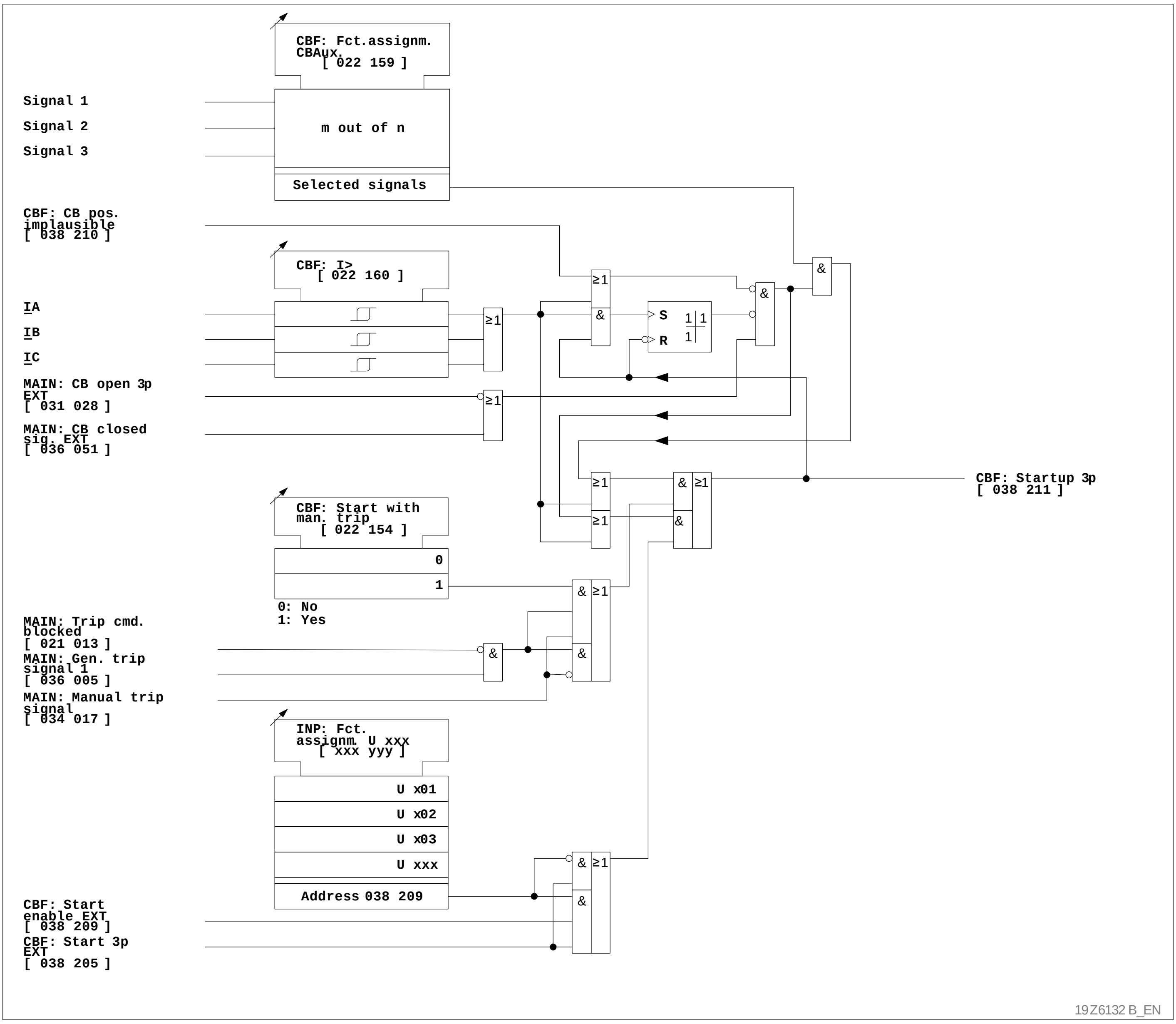
- ☐ Internal startup criterion:
  Generating the Gen. Trip signal 1 is considered a start criterion. In addition it may be selected, by setting the parameter CBF: Start for manual trip, that a manual trip signal will also be used as a start criterion.
  Current flow monitoring is the primary evaluation criterion. The CB auxiliary contacts are evaluated when no current flow is registered and the respective trip signal, included in the Gen. Trip command 1, has been selected from the protection function in parameter CBF: Fct.assignm. CBAux for the evaluation of the CB auxiliary contacts.
- ☐ External startup criterion:
  Triggering by a protection device operating in parallel (CBF: Start 3p EXT) may be used as a start criterion.
  To be on the safe side an additional two pole triggering may be implemented by applying the signal CBF: Start enable EXT.
  Current flow monitoring is the primary evaluation criterion. The CB auxiliary contacts are evaluated when no current flow is registered.

Timer stages and output logic

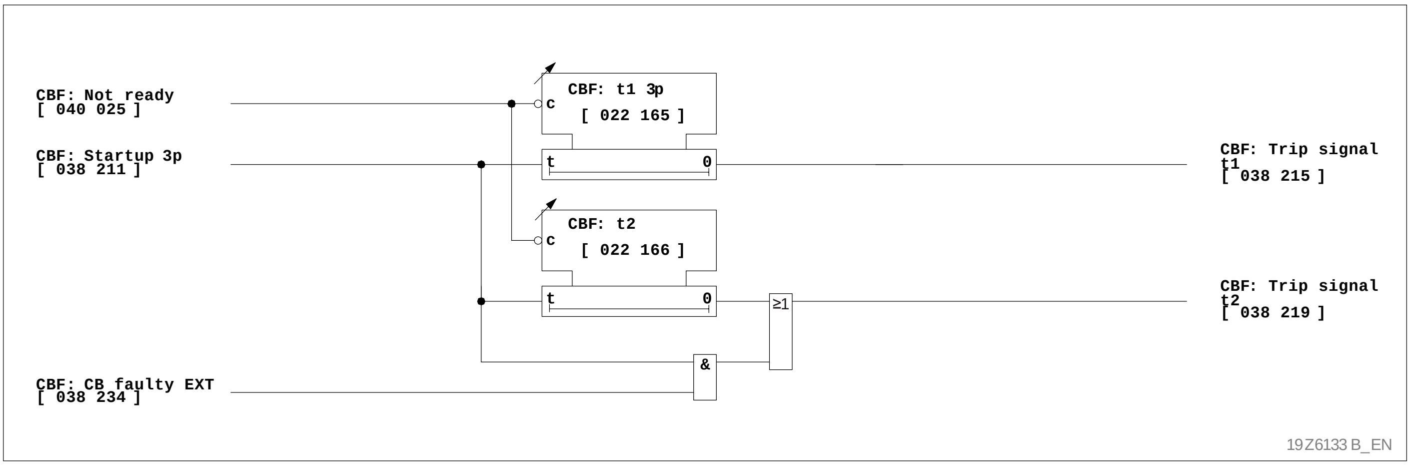
Associated timer stages are started when a startup criterion is met.

- ☐ The signal CBF: Trip signal t1 will be issued if the startup criterion is still present when the time period, set at timer stage CBF: t1 3p, has elapsed.
  The output command from this timer stage is intended for a second CB trip coil.
- ☐ The signal CBF: Trip signal t2 will be issued if the startup criterion is still present when the time period, set at timer stage CBF: t2, has elapsed.
  The output command from this timer stage is intended for a backup circuit breaker or protection system.

These trip signals will be issued as long as the startup criteria are met. Should a loss of gas pressure occur in the explosion chambers of installed type SF-6 circuit breakers then all surrounding circuit breakers must be immediately tripped without waiting for a reaction from the damaged switch. In case of an external CB fault the elapse of timer stage t2 may be interrupted by a signal to the binary signal input appropriately configured at CBF: CB faulty EXT.



3-254 Startup of the circuit breaker failure protection
Note: C B F : I > represents an undercurrent criterion. As of version -613 the description text has been changed to C B F : I < .

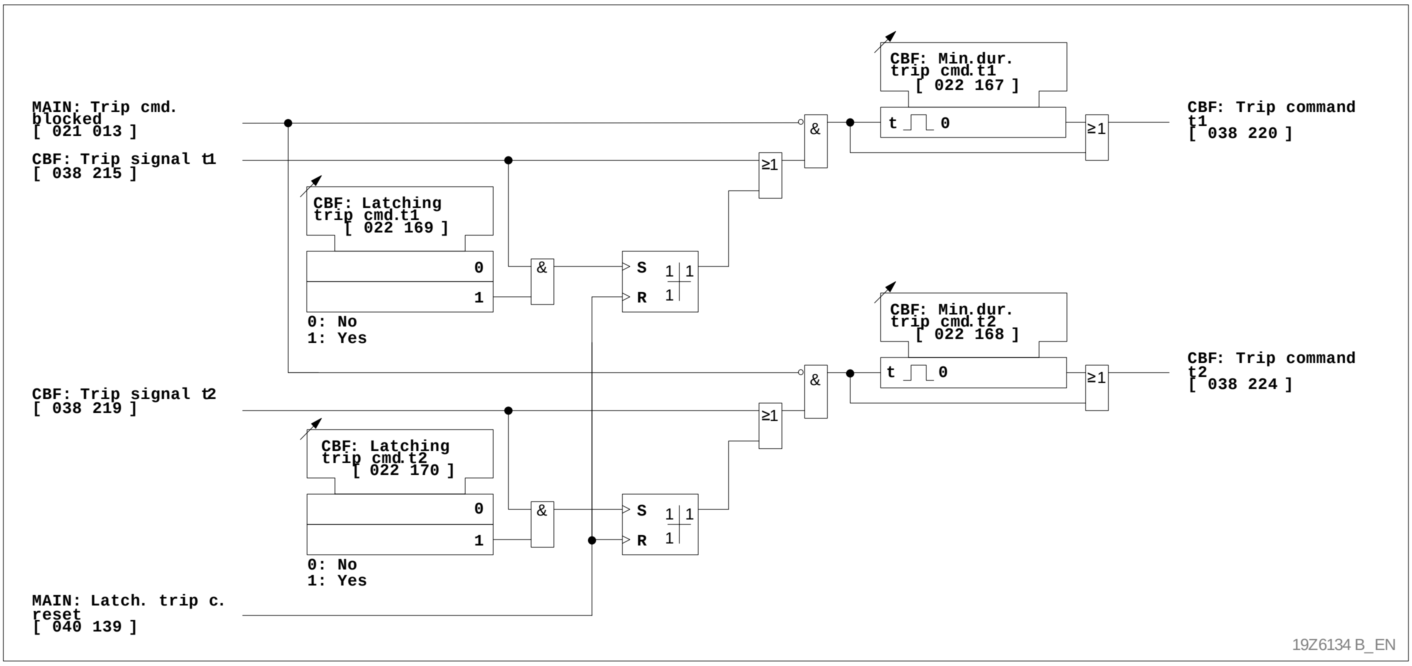


3-255 *Timer stages of the circuit breaker failure protection*

Trip commands

While trip signals issued by the CB failure protection have no timer stages available the user can set minimum time delay periods for trip commands.

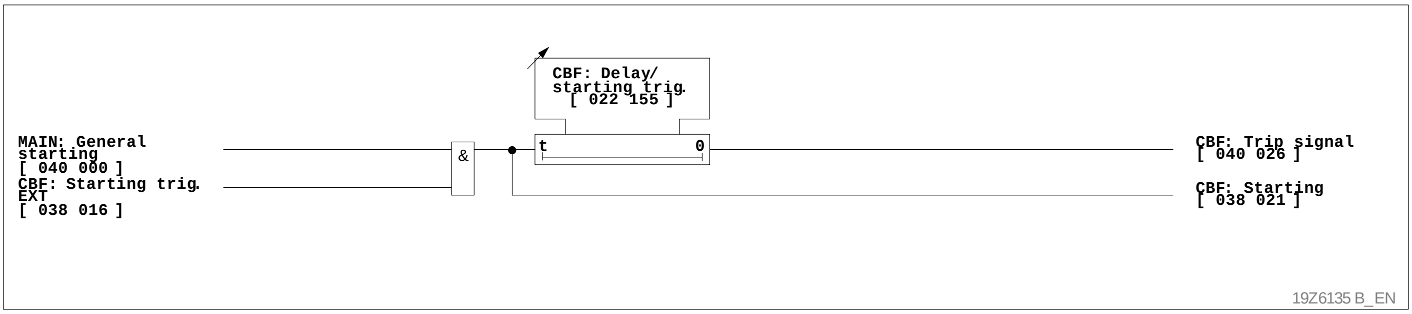
By appropriate setting it can be selected that trip commands, issued by the CB failure protection, will operate in latching mode. The respective trip command, set to latch mode, will remain active until reset by operating parameters or through an appropriately configured binary signal input.



3-256 *CBF trip commands*

Starting trigger

The signal CBF: Starting will be issued when the signal CBF: Starting trig. EXT is presented to an appropriately configured binary signal input and a general starting is present. The signal CBF: Trip signal will be issued after timer stage CBF: Delay/starting trig. has elapsed.



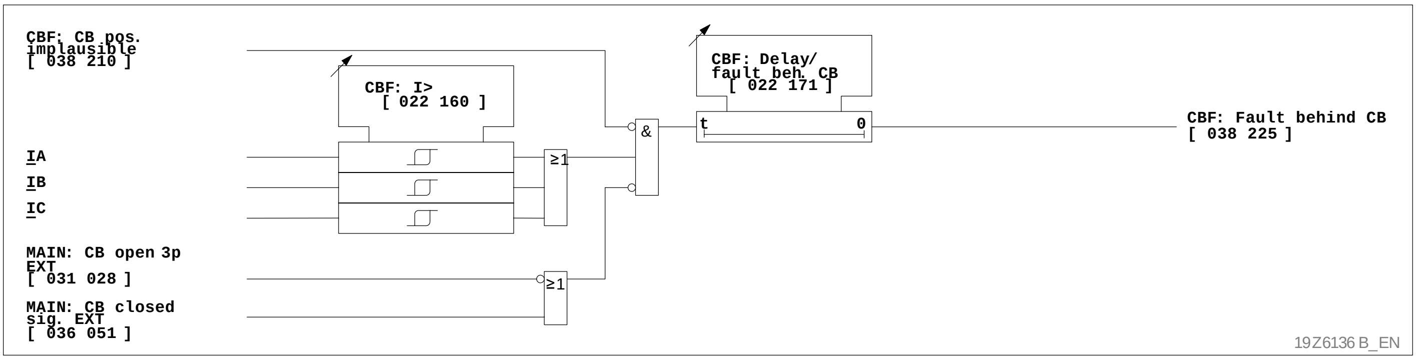
3-257 *Starting trigger*

Fault behind CB protection

A fault behind a CB (downstream) is a fault that may occur between a circuit breaker already open and a CT, which is fed from the remote end.

Fault behind CB protection recognizes such faults through the current criterion if the circuit breaker does not provide the information that it is closed after the time delay set at CBF: Delay/fault beh. CB has elapsed.

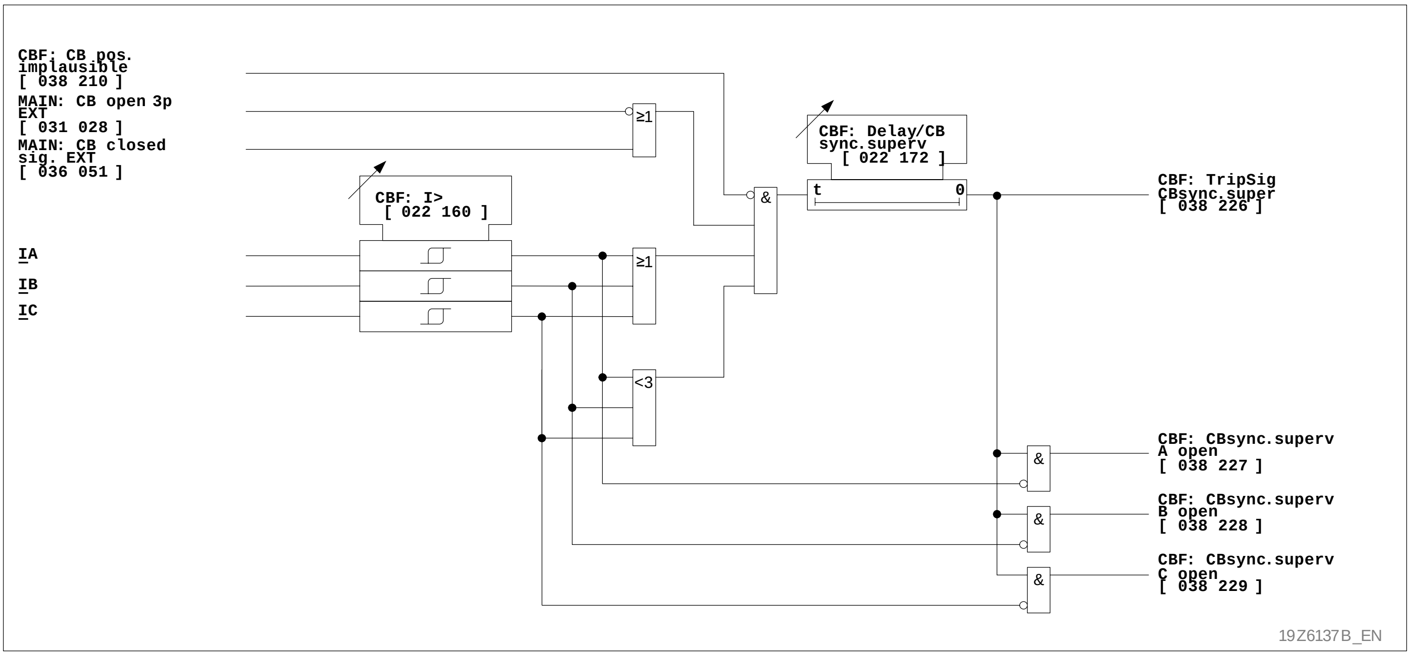
When such a fault behind CB is recognized the signal CBF: Fault beh. CB is issued. In such a case the far end circuit breaker may be triggered by an InterMiCOM protective interface. This may also prevent an unwanted triggering of the circuit breaker failure function.



3-258 *Fault behind CB protection*
Note: CBF: I> represents an undercurrent criterion. As of version -613 the description text has been changed to CBF: I<.

CB synchronization supervision

CB synchronization supervision recognizes states where not all circuit breaker contacts are open or closed. This function uses both current flow monitoring and evaluation of CB status signals to detect CB synchronization. In order to bridge CB operate times the time delay `CBF: Delay/CB synch.superv` can be used. When this time period has elapsed the signal `CBF: TripSig CB synch.super` is issued. Poles that are recognized as being *open* will still be signaled.



3-259 CB synchronization supervision
Note: `CBF: I>` represents an undercurrent criterion. As of version -613 the description text will be changed to `CBF: I<`.

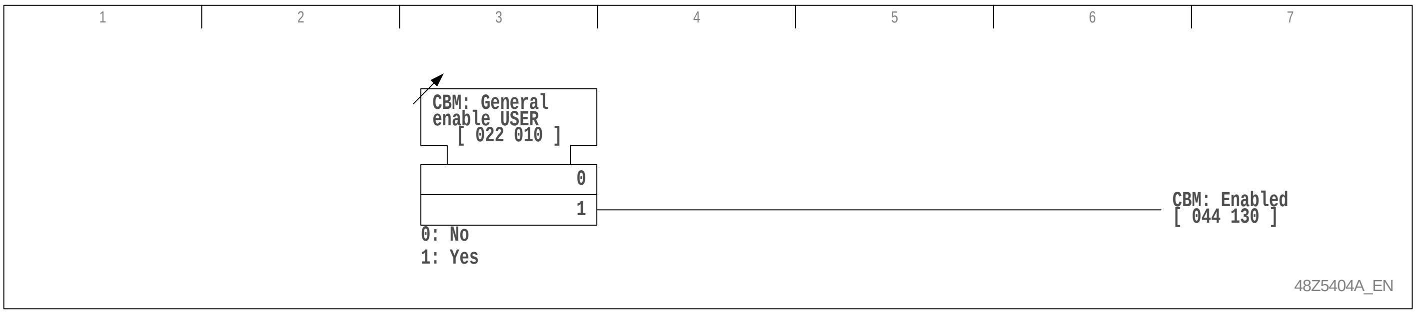
3.39 Circuit Breaker Monitoring (Function Group CBM)

3.39.1 Functional Description

The P132 features a circuit breaker monitoring function. This function supports state-controlled maintenance of circuit breakers.

Enable/disable circuit breaker monitoring

Circuit breaker monitoring may be disabled or enabled by setting parameters.



3-260 Enable/disable circuit breaker monitoring

Variants

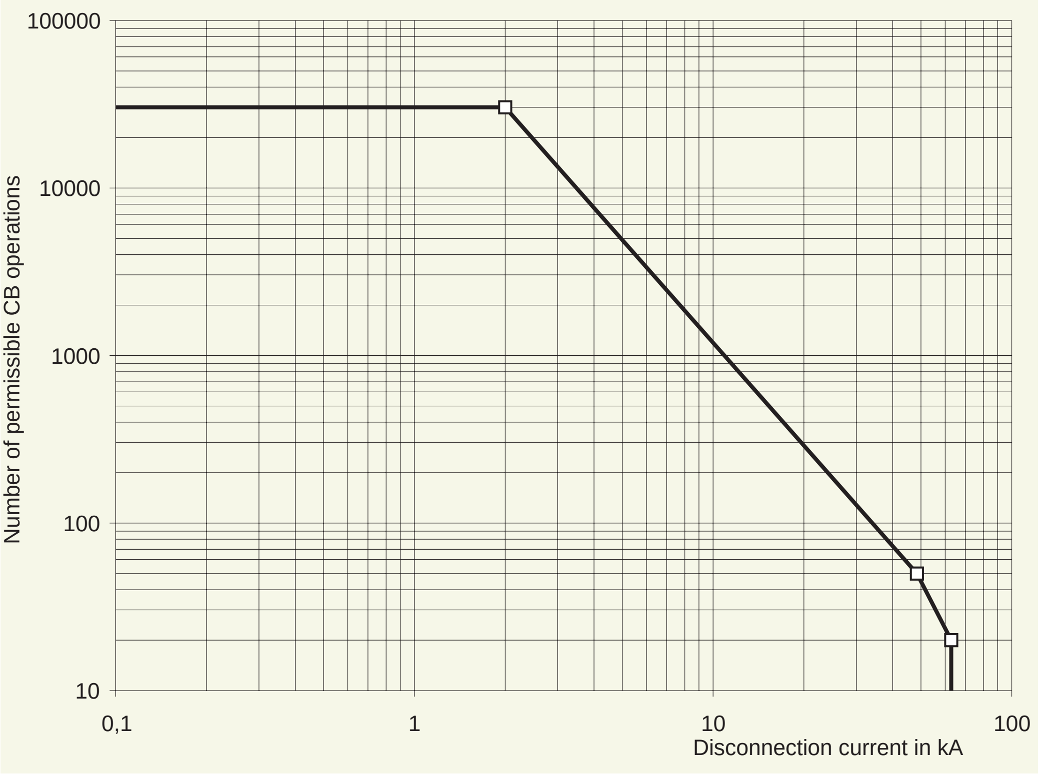
The wear condition of a circuit breaker may be determined by a variety of methods:

- ☐ Monitoring the mechanical switching operations
- ☐ Accumulating disconnection current values
- ☐ Accumulating the squared disconnection current values
- ☐ Calculating the current-time integral of disconnection and accumulation current values
- ☐ Calculating the remaining switching operations with reference to the CB wear characteristic.

CB wear characteristic

Manufacturers of circuit breakers usually provide wear characteristics displaying the maximum number of permissible CB operations in relation to the disconnection current.

Figure 3-261 displays the wear characteristics for a circuit breaker with a nominal current of 2000 A and a maximum cutoff current of 63 kA. The medium disconnection current is 48 kA.



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3-261 Wear characteristics for a circuit breaker

The knee points in figure 3-261 are necessary to set the wear characteristic for the circuit breaker:

- The nominal current CBM: Inom,CB for the circuit breaker and the permitted number of CB operations at nominal current CBM: Perm. CB op. Inom,CB
- The medium disconnection current CBM: Med. Curr. Itrip,CB for the circuit breaker and the permitted number of CB operations at medium disconnection current CBM: Perm. CB op. Imed,CB
- The maximum cutoff current CBM: Max. curr. Itrip,CB for the circuit breaker and the permitted number of CB operations at maximum cutoff current CBM: Perm. CB op. Imax,CB

Not all types of circuit breakers provide a value for the medium disconnection current. In such a case the parameters for this knee point are to be set to *'blocked'*. A knee point is not considered in the characteristic when at least one of the parameters for the knee point is set to *'blocked'*.

For proper performance of circuit breaker monitoring it should be observed that the knee points must be applied in a logically correct sequence (continuously descending). When setting currents and numbers of CB operations are not plausible according to the characteristic the P132 will issue an error message and block circuit breaker monitoring.

Calculating the CB wear state

The current wear state of the circuit breaker is given as the number of remaining CB operations at nominal current conditions. The number of remaining CB operations $n_{rem}(I_{nom,CB})$ is calculated and displayed phase selectively and after each disconnection by the P132. Calculation is per this equation:

$$n_{rem}\left(I_{nom,CB}\right) = n_{rem,0}\left(I_{nom,CB}\right) - \frac{n\left(I_{nom,CB}\right)}{n\left(I_{a,CB}\right)}$$

With:

- $I_{nom,CB}$: Nominal current for the CB
- $n(I_{nom,CB})$: Max permitted number of CB operations at $I_{nom,CB}$
- $I_{d,CB}$: Disconnection current
- $n(I_{d,CB})$: Permitted number of CB operations at $I_{d,CB}$ according to wear characteristics
- $n_{rem,0}(I_{nom,CB})$: Remaining permitted number of CB operations at $I_{nom,CB}$ <u>before</u> disconnection
- $n_{rem,}(I_{nom,CB})$: Remaining permitted number of CB operations at $I_{nom,CB}$ <u>after</u> disconnection

Operating modes

Setting the parameter CBM: Operating mode will select the condition under which the function will be triggered:

- ☐ *with trip cmd. only:*
  Function is triggered only by the general trip command 1
- ☐ *with CB sig. EXT only:*
  Function is triggered by the CB open signal generated by an auxiliary contact
- ☐ *CB sig. EXT or trip:*
  Function is triggered by the general trip command 1 or the CB open signal generated by an auxiliary contact

Measured values and counters are re-determined with each triggering and compared with set threshold values.

A correction value can be set in order to determine the trip time CBM: Corr. acquis. time. This enables proper evaluation of leading or lagging auxiliary contacts or the delay period between forming of the trip command and opening of the CB contacts.

Cycle for circuit breaker monitoring

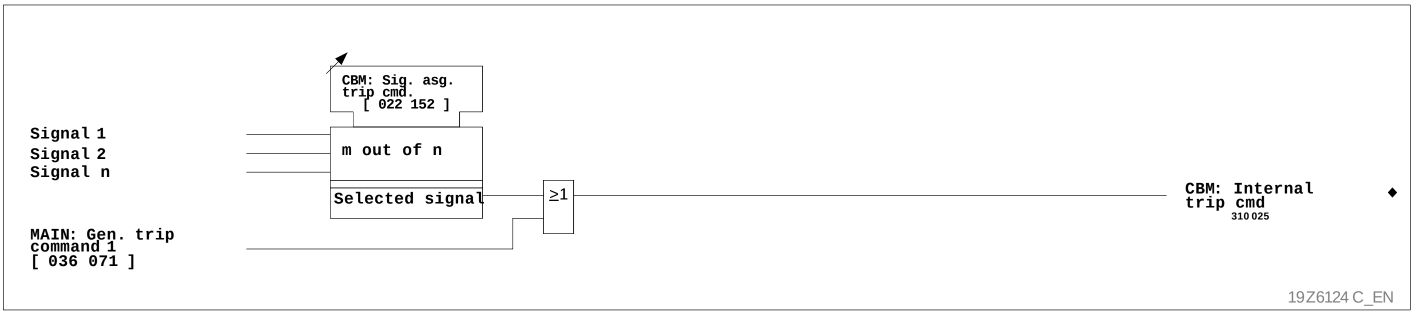
The cycle for circuit breaker monitoring is defined pole-selectively. During an active cycle the signals CBM: Cycle running X (X = A, B or C) are issued.

The cycle is started by a trigger criterion. Definition for the end of a cycle: The remaining time of a power cycle duration has elapsed after the last detected current zero crossing. The signal CBM: Curr. Flow ended X (X = A, B or C) is then issued.

The maximum cycle time duration is defined with 220 milliseconds. The start of the cycle time is corrected by the settable correction times. A fault on a CB pole is considered to be apparent if further current zero crossings are detected after the maximum cycle time has elapsed. Measured values from the respective CB tripping are canceled and the signal CBM: tmax>X (X = A, B or C) is issued.

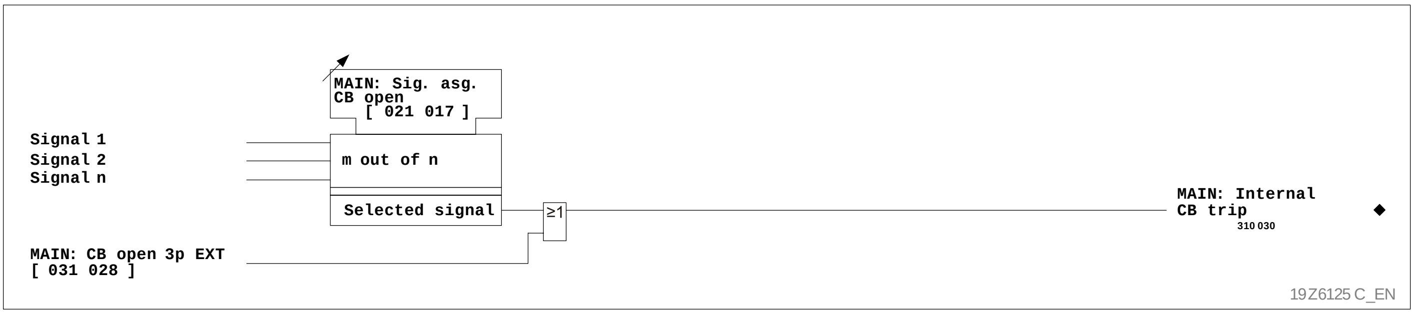
Linking control functions with the trip command

With the P132, the trip command from the optional control function can be linked with the general trip command 1 of the protection, when setting external devices. In such a case the trip command from the control function must be associated by the parameter CBM: Sig. asg. Trip cmd. so that operational trip commands, issued to the circuit breaker by the control function, are considered additionally to the general trip command 1.



3-262 *Forming the linked trip command*

The external devices state signal "open" may be linked to the control function state signal "open" by setting the parameter `CBM: Sig. asg. trip cmd.` so that the function in the P132 will be triggered by CB auxiliary contacts.



3-263 *Forming the linked "open" state signal*

Pole-selective counter values and measured values

The P132 separately evaluates each phase current and generates an individual wear presentation for each CB pole.

The following counter values are presented pole-selectively:

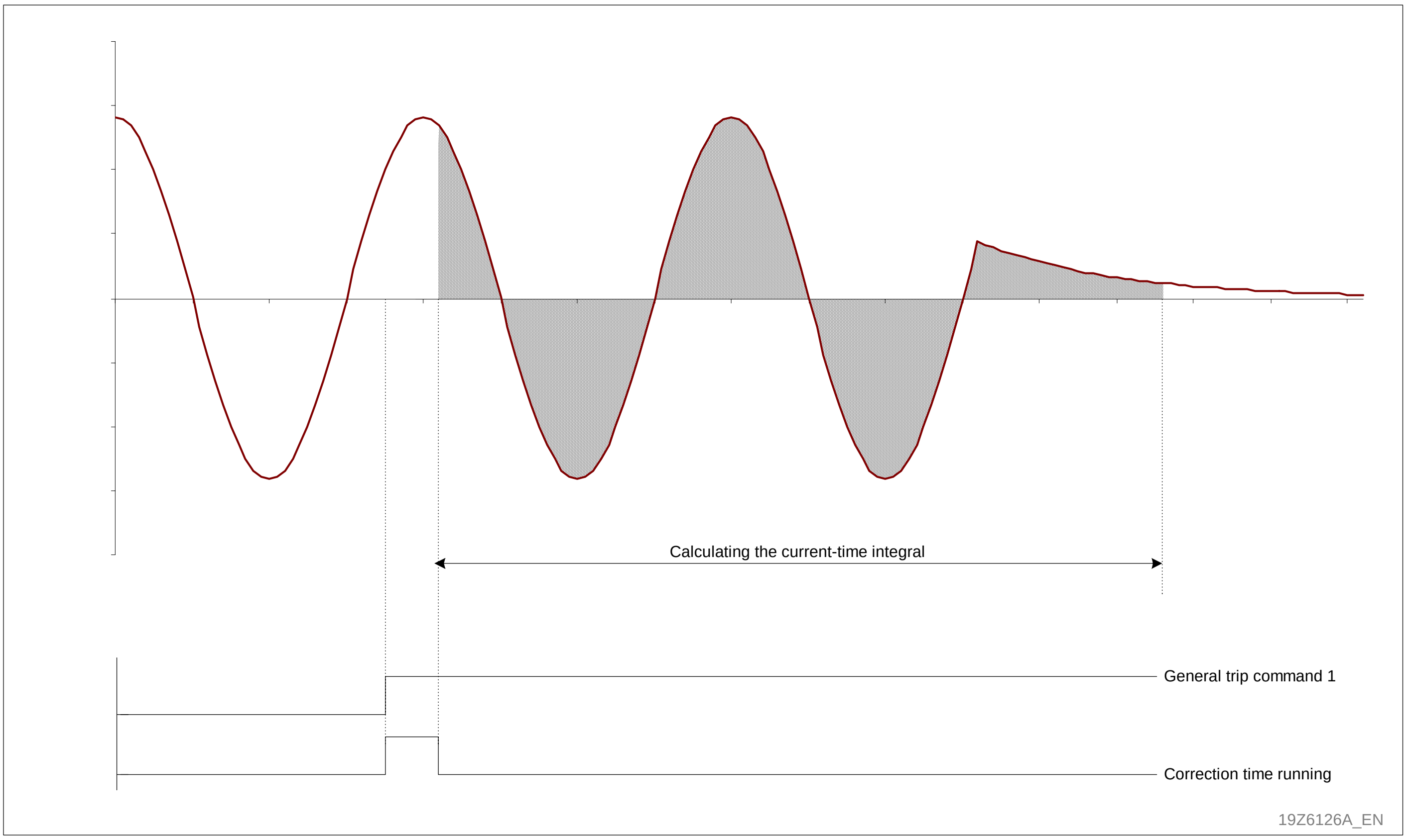
- The number of mechanical switching operations made
- The number of remaining CB operations at CB nominal current
  This value is derived by evaluating wear with reference to the CB wear characteristic.

The following measured values are presented pole-selectively, and per-unit values refer to CB nominal current:

- Primary disconnection current This value is applied to evaluate wear with reference to the CB wear characteristic.
- Per-unit disconnection current
- Second power of the per-unit disconnection current
- Sum of the per-unit disconnection currents
- Sum of the squares of the per-unit disconnection currents
- Current-time integral of the per-unit disconnection current
- Sum of the current-time integrals of the per-unit disconnection currents

The disconnection current is derived from the RMS current value detected before a last zero crossing.

The integral of the current-time area is calculated between the trip time and current disappearance. Current reset is recognized when there are no further current zero crossings detected. An example for calculation of the current-time integral is displayed in figure 3-264.



3-264 Calculation of the current-time integral when CBM is triggered by a general trip command 1

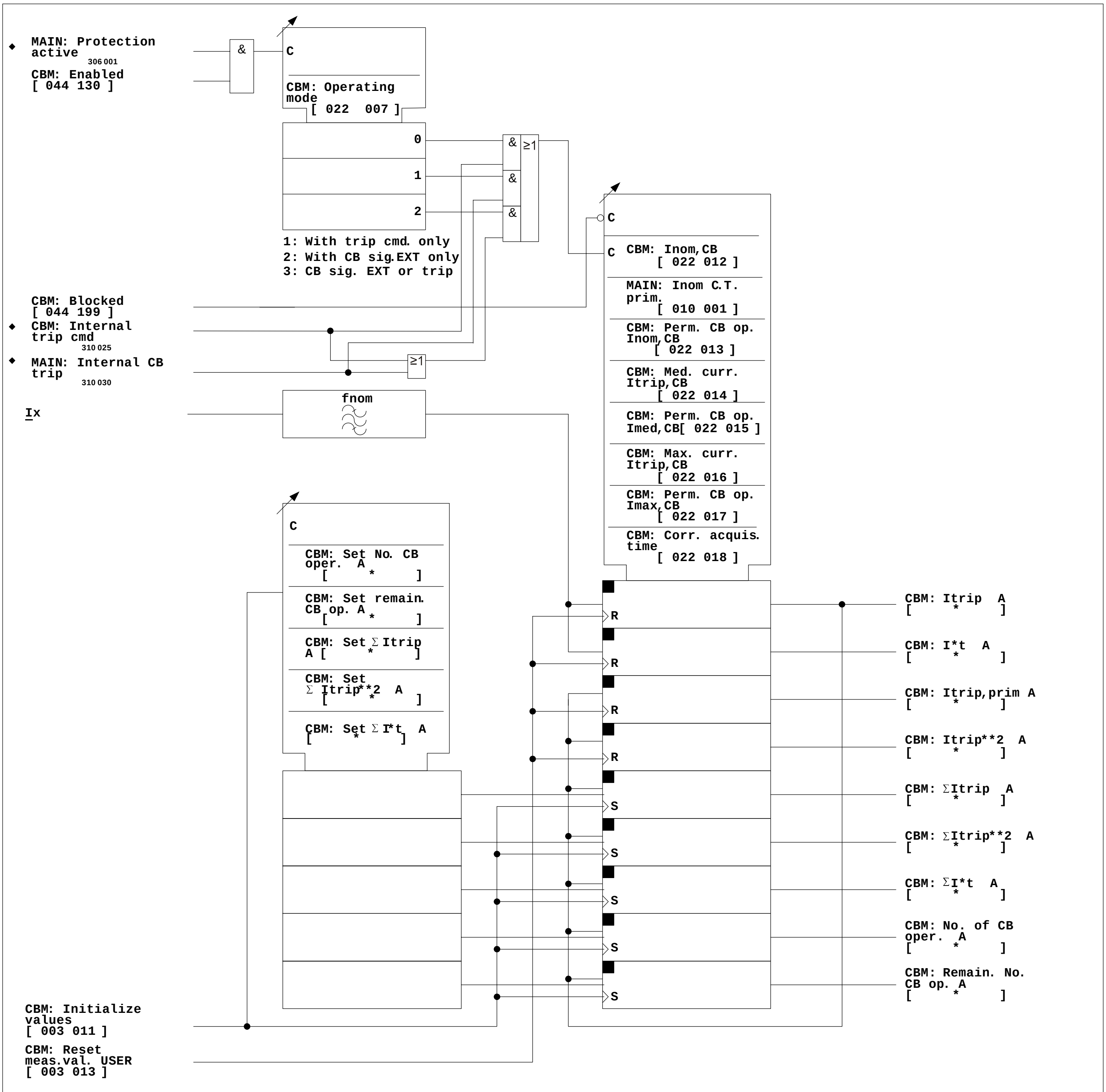
Resetting measured values

Measured values from the respective last CB tripping may be reset via the interfaces on the device. Accumulated measured values are not affected by such a reset operation.

Setting measured values

Setting measured values in the circuit breaker monitoring function is necessary when the respective CB has already been exposed to operating conditions or has been replaced. The available interfaces on the device may be used to set measured values in the circuit breaker monitoring function.

Note: Only such measured values and counter values in the P132 may be set to new values that do not have their default values set to *'blocked'*.
The stored value will remain unchanged if the default value is set to *'blocked'*.
Executing the set command results in initializing all default values in the P132 to *'blocked'*.



Phase x / Current Ix	CBM: Set No. CB oper. A	CBM: Set remain. CB op. A	CBM: Set Σ Itrip A	CBM: Set ΣItrip**2 A	CBM: Set Σ I*t A	CBM: No. of CB oper. A	CBM: Remain. No. CB op. A
A / IA	022 131	022 134	022 137	022 140	022 143	008 011	008 014
B / IB	022 132	022 135	022 138	022 141	022 144	008 012	008 015
C / IC	022 133	022 136	022 139	022 142	022 145	008 013	008 016

Phase x / Current Ix	CBM: Itrip A	CBM: I*t A	CBM: Itrip,prim A	CBM: Itrip**2 A	CBM: Itrip A	CBM: ΣItrip**2 A	CBM: ΣI*t A
A / IA	009 047	009 061	009 212	009 051	009 071	009 077	009 087
B / IB	009 048	009 062	009 213	009 052	009 073	009 078	009 088
C / IC	009 049	009 063	009 214	009 053	009 076	009 079	009 089

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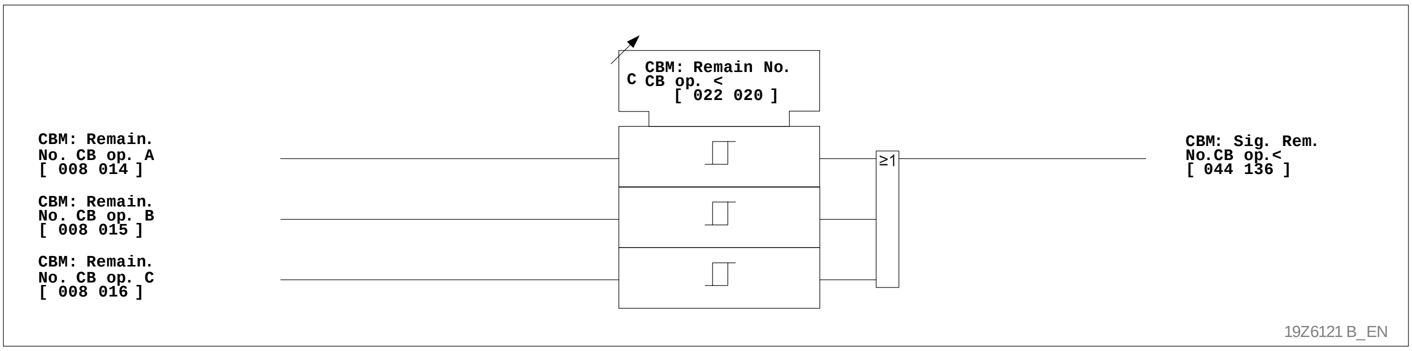
3-265 Triggering and calculating circuit breaker monitoring

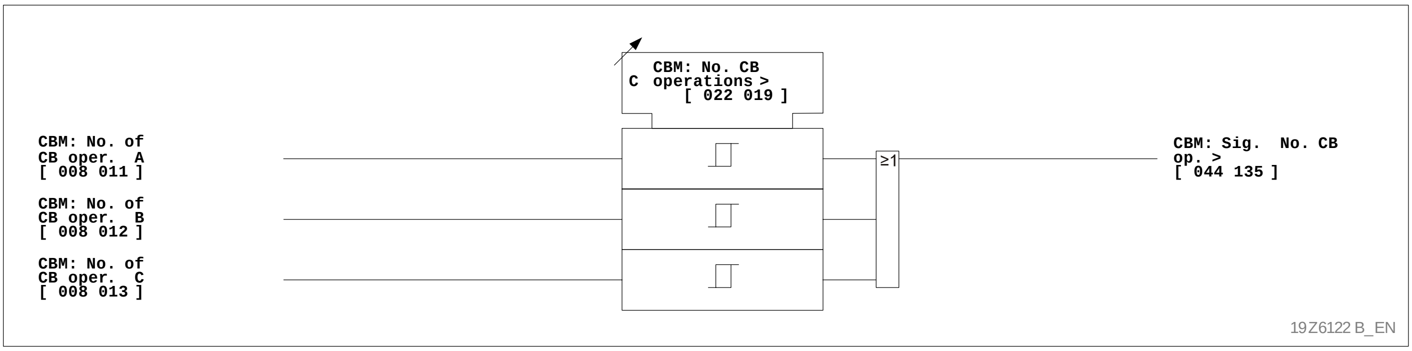
Monitoring the number of CB operations

Depending on the selected operating mode the P132 will calculate the current wear state of the circuit breaker after each disconnection. The number of remaining CB operations at CB nominal current are calculated and displayed. A threshold value can be set with the parameter CBM: No. CB operations <. An alarm is issued should the number of remaining CB operations drop below this threshold.



3-266 Monitoring the remaining number of CB operations at nominal current

At the same time each switching operation will increment the P132 counter for the number of CB operations The number of CB operations performed is displayed. A threshold value can be set with the parameter CBM: No. CB operations >. An alarm is issued should the number of CB operations performed exceed this threshold.



3-267 Monitoring the number of CB operations performed

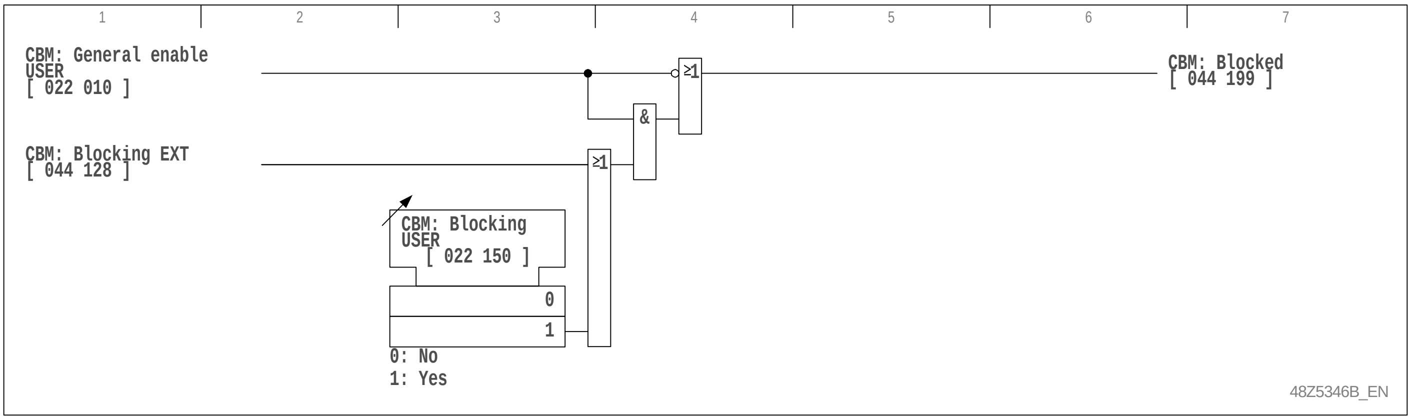
Monitoring disconnection currents

In addition to the evaluation of the CB wear state and monitoring of the number of CB operations performed, the P132 features the means to accumulate and display the disconnection current values and the squares of these values. Threshold values can be set with the parameters `CBM: ΣItrip >`, `CBM: ΣItrip**2 >` and `CBM: ΣI*t`. An alarm is issued should the accumulated current values exceed any of these thresholds.

Blocking circuit breaker monitoring

When protection injection testing is carried out the circuit breaker monitoring function should be blocked, so that such testing does not corrupt monitoring results. CBM protection is blocked if one of the following conditions is met:

- ☐ Circuit breaker monitoring is blocked by parameters.
- ☐ Circuit breaker monitoring is blocked by an appropriately configured binary signal input.

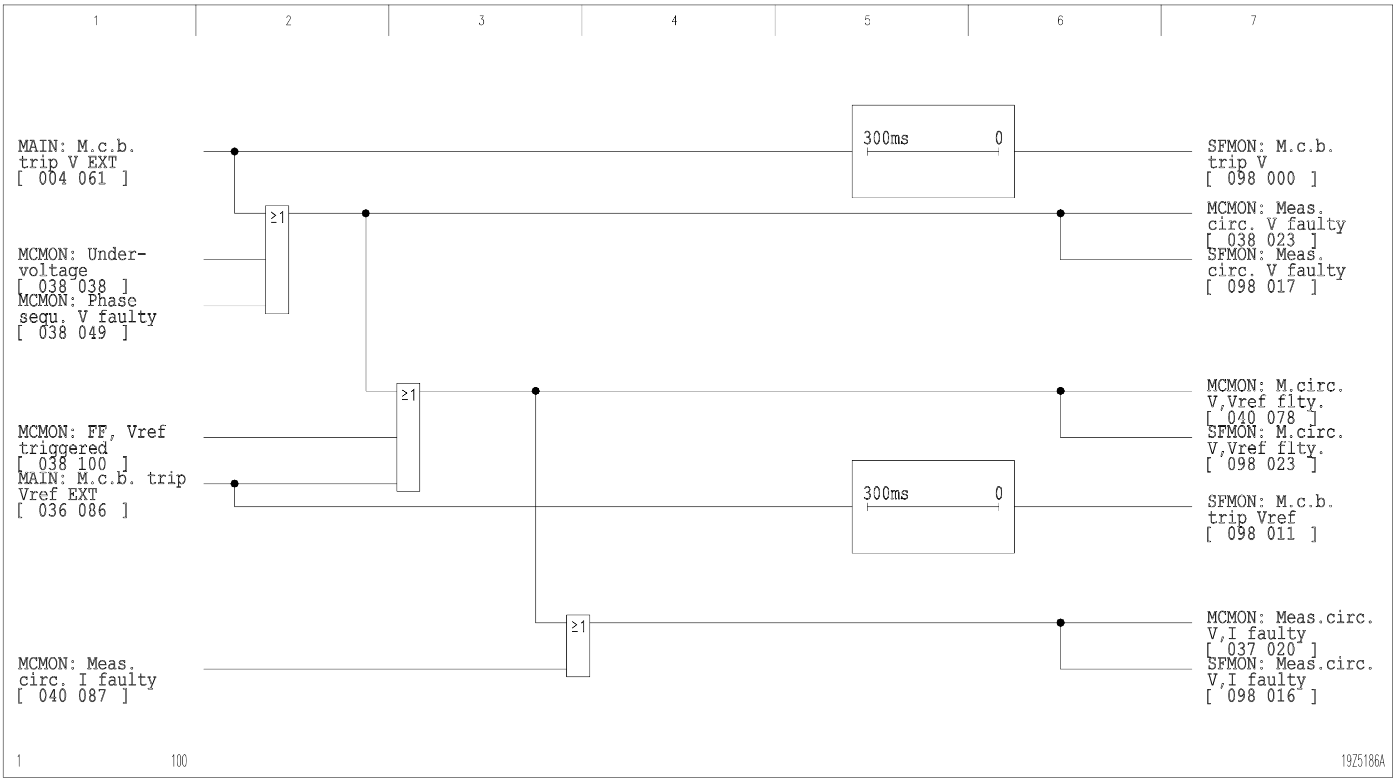


3-268 *Blocking circuit breaker monitoring*

3.40 Measuring-circuit Monitoring (Function Group MCMON)

Monitoring of the reference voltage has been added to the measuring-circuit monitoring function.

The P132 monitors the phase currents and voltages for balance during healthy system operation. If either unbalance or the lack of measuring voltage is detected, action is taken to prevent the unit from malfunctioning.



3-269 Monitoring signals

Measuring-circuit monitoring can be deactivated by the appropriate setting. In the event of a fault, measuring-circuit monitoring is blocked.

Current monitoring

Current monitoring is only enabled if the following conditions are met simultaneously:

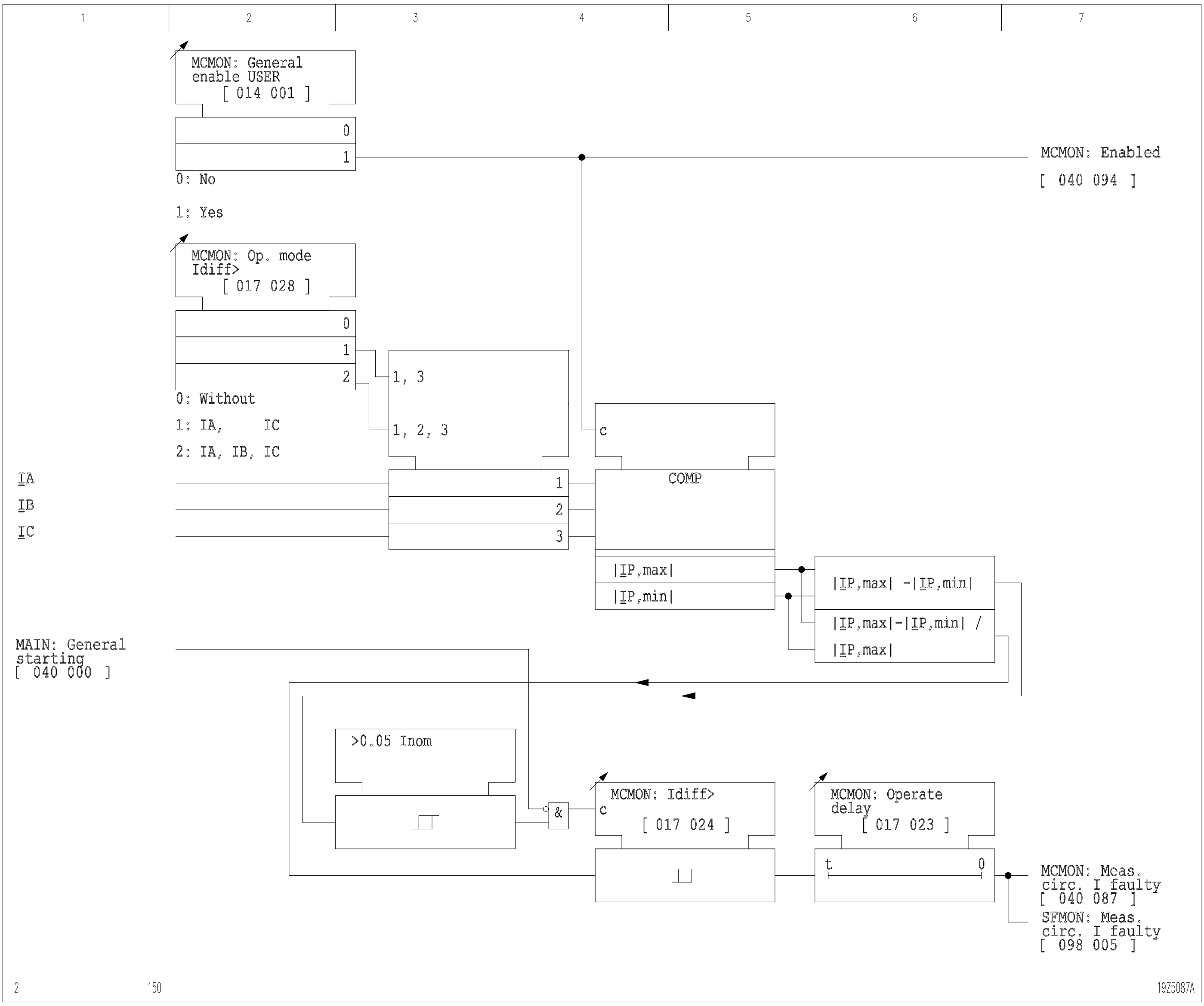
- ☐ Measuring-circuit monitoring is enabled.
- ☐ The difference between the maximum and the minimum phase current exceeds $0.05 \cdot I_{nom}$.
- ☐ A general starting signal is absent.

Current monitoring is based on checking the difference in the phase current magnitudes under the following operate condition:

$$\frac{I_{P,max} - I_{P,min}}{I_{P,max}} \geq \quad I_{diff} >$$

where $I_{P,max}$ is the highest of the three phase currents and $I_{P,min}$ is the lowest; I_{diff}> is the set operate value `MCMON: Idiff>`. In order to suppress short-term transients, the measuring stage *Idiff>* is followed by a set operate-delayed timer stage `MCMON: Operate delay`.

If connection is to two current transformers only (phase ANC connection only) evaluation of current I_{ref} can be disabled by an appropriate selection for the operating mode.



3-270 *Monitoring the current-measuring circuits*

Voltage monitoring

Voltage monitoring is only enabled if the following conditions are met simultaneously:

☐ Measuring-circuit monitoring is enabled.

☐ A general starting signal is absent.

In addition to these conditions, either a minimum current having the default threshold setting of $I > 0.05 \cdot I_{nom}$ or the closed position of the circuit breaker contacts can be used as enabling criteria. If at least one of the phase-to-phase voltages falls below the set trigger value MCMON: Vmin< for the period of the operate-delayed timer stage MCMON: Operate delay, then the MCMON: Undervoltage signal is issued.

The signal MCMON: Meas. voltage o.k. is generated if all three phase-to-phase voltages exceed the fixed threshold of 0.65 V_{nom} and there is no incorrect phase sequence.

Phase-sequence monitoring

Phase-sequence monitoring is only enabled if the following conditions are met simultaneously:

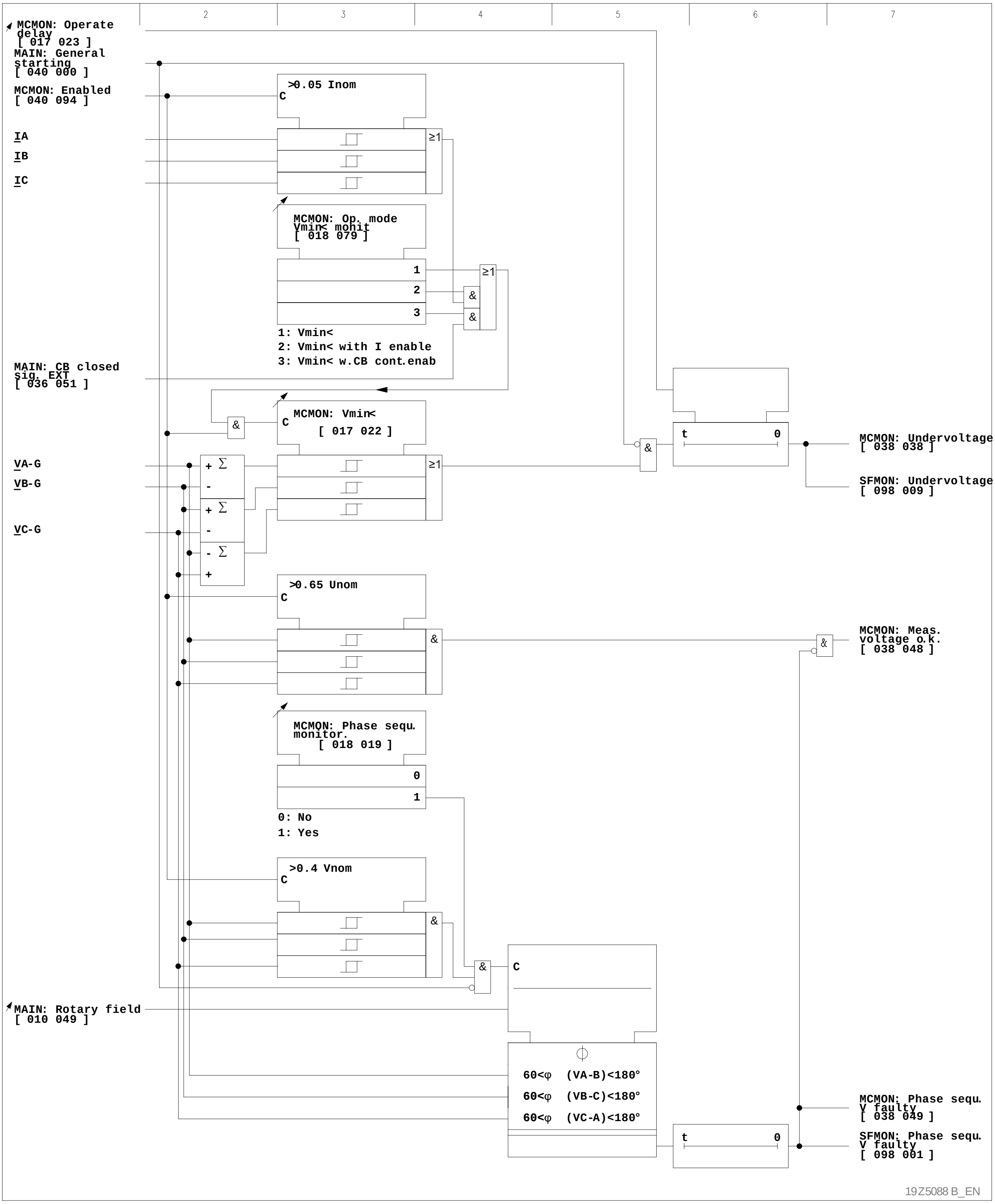
☐ Measuring circuit monitoring is enabled.

☐ Phase-sequence monitoring is enabled.

☐ All three phase-to-ground voltages exceed $0.4 \cdot V_{nom}$.

☐ A general starting signal is absent.

In order to suppress short-term transients, the phase-sequence monitoring trigger is followed by a set operate delay of 1 s. Once the operate delay has elapsed, the signal MCMON: Phase sequence faulty is issued.



3-271 Monitoring the voltage-measuring circuits (Note: Earlier terminology of MAIN: Phase sequence was MAIN: Rotary field)

"Fuse Failure" monitoring of the reference voltage

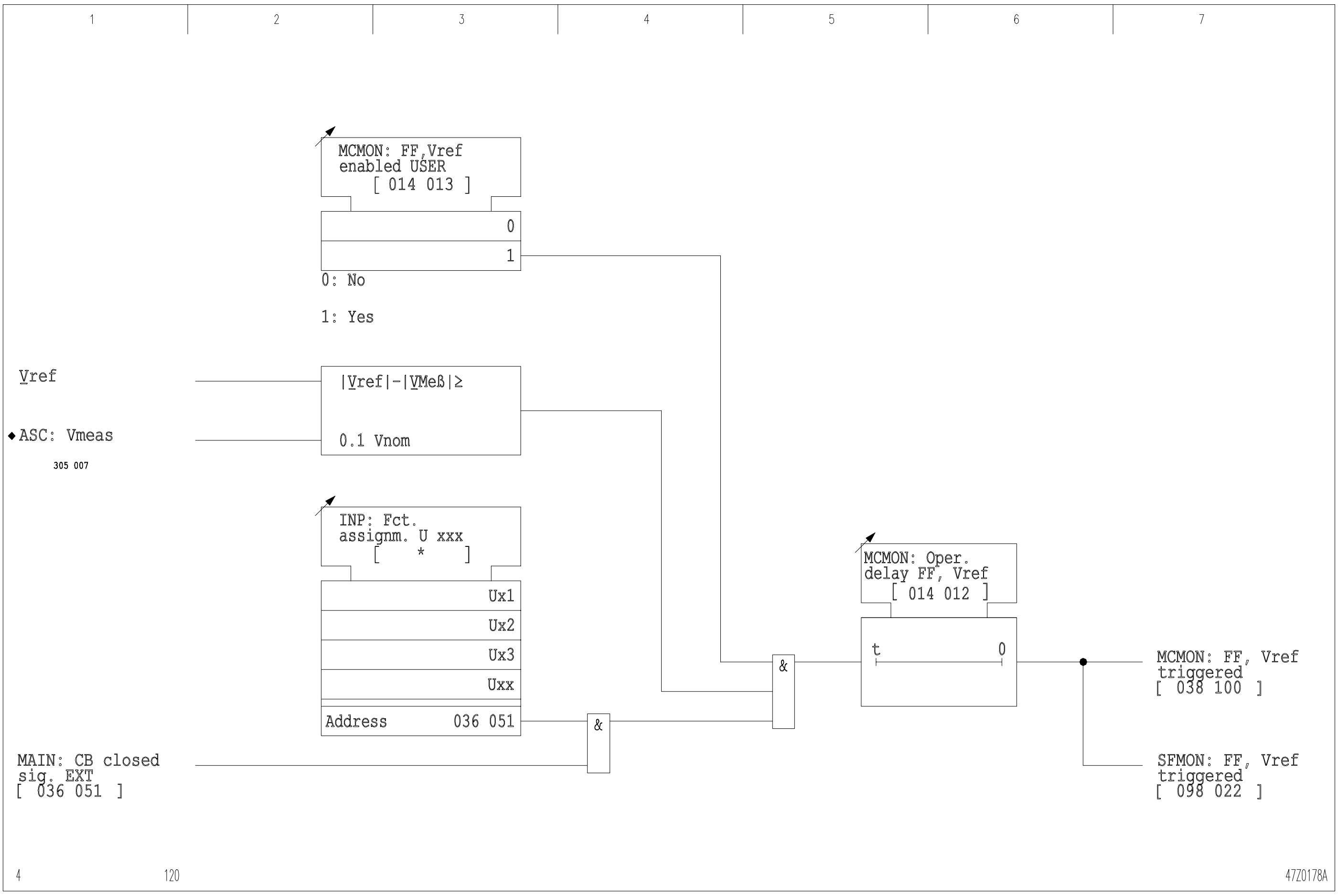
The P132 includes "Fuse Failure" monitoring of the reference voltage function, which is required by the 'Automatic Synchronism Check' (ASC).
Fuse Failure" monitoring is only possible if the ASC function has been configured. This is specifically applied when no auxiliary contact is available on the voltage transformer m.c.b. If "Fuse Failure" monitoring is not wanted it can be disabled from the local control panel.

"Fuse Failure" monitoring must be able to discriminate between a short circuit in the three-phase network being monitored and a reference voltage missing because of a short circuit or an open circuit in the secondary circuits of the reference voltage.

A short circuit or an open circuit in the secondary circuits of the reference voltage is present when the following conditions are met:

☐ The circuit breaker is closed.

☐ The difference in voltages on the line side and the busbar must exceed 0.1 V_{nom} .



3-272 "Fuse Failure" monitoring of the reference voltage

3.41 Limit Value Monitoring (Function Group LIMIT)

Limit Value Monitoring is not designed to be a high-speed protection function; it is only applied for monitoring and signaling purposes as well as to monitor temperature limits.

Enable/disable the Limit Value Monitoring function

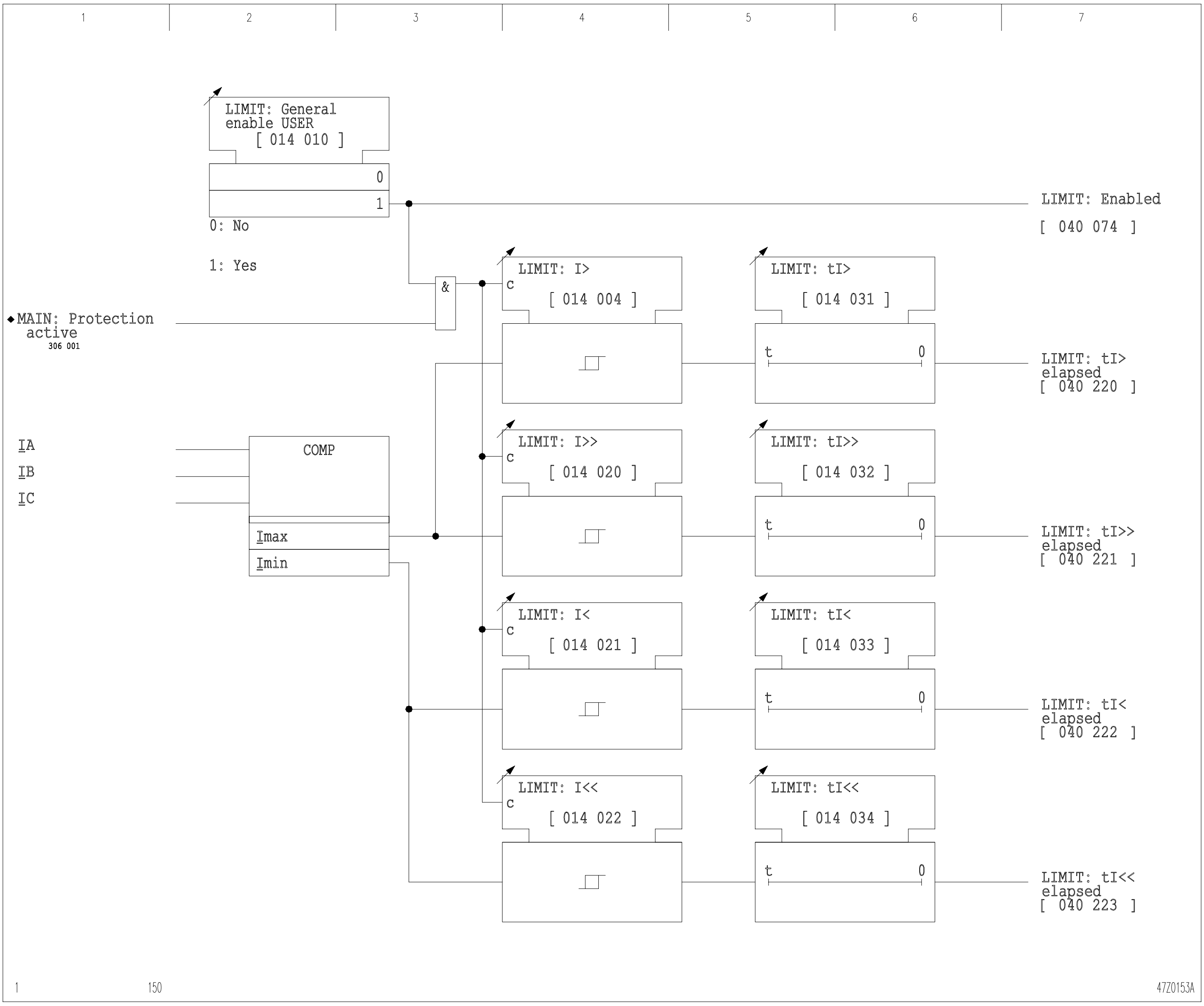
The Limit Value Monitoring function can be enabled or disabled using a setting parameter.

Monitoring phase currents and phase voltages

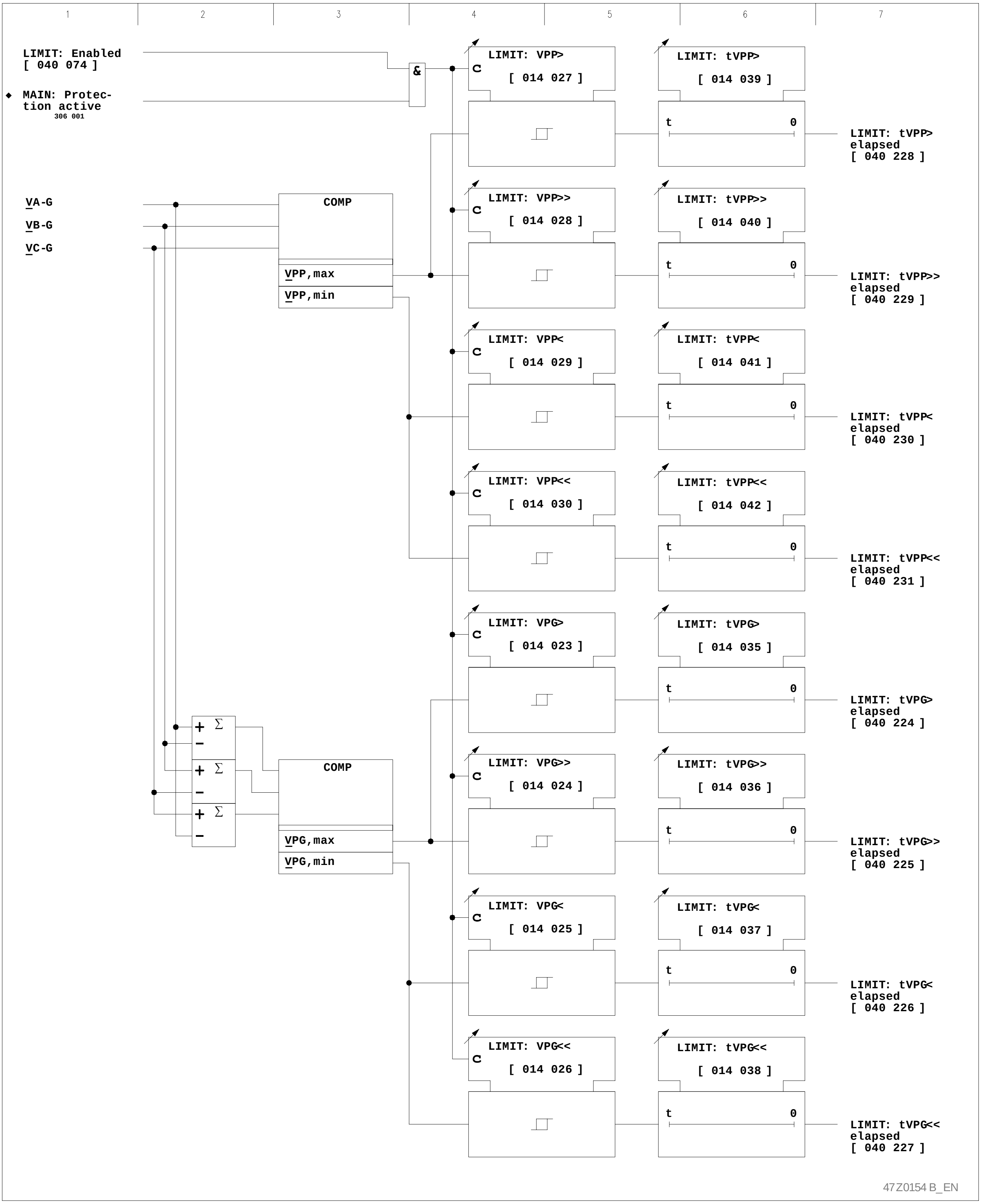
With the P132 monitoring of the following measured values is possible in order to determine if they exceed set upper limit values or fall below set lower limit values:

☐ Maximum phase current
☐ Minimum phase current
☐ Maximum phase-to-phase voltage
☐ Minimum phase-to-phase voltage
☐ Maximum phase-to-ground voltage
☐ Minimum phase-to-ground voltage

If any of the measured values exceeds or falls below the corresponding upper or lower limit values, then a signal is issued after the associated time period has elapsed.



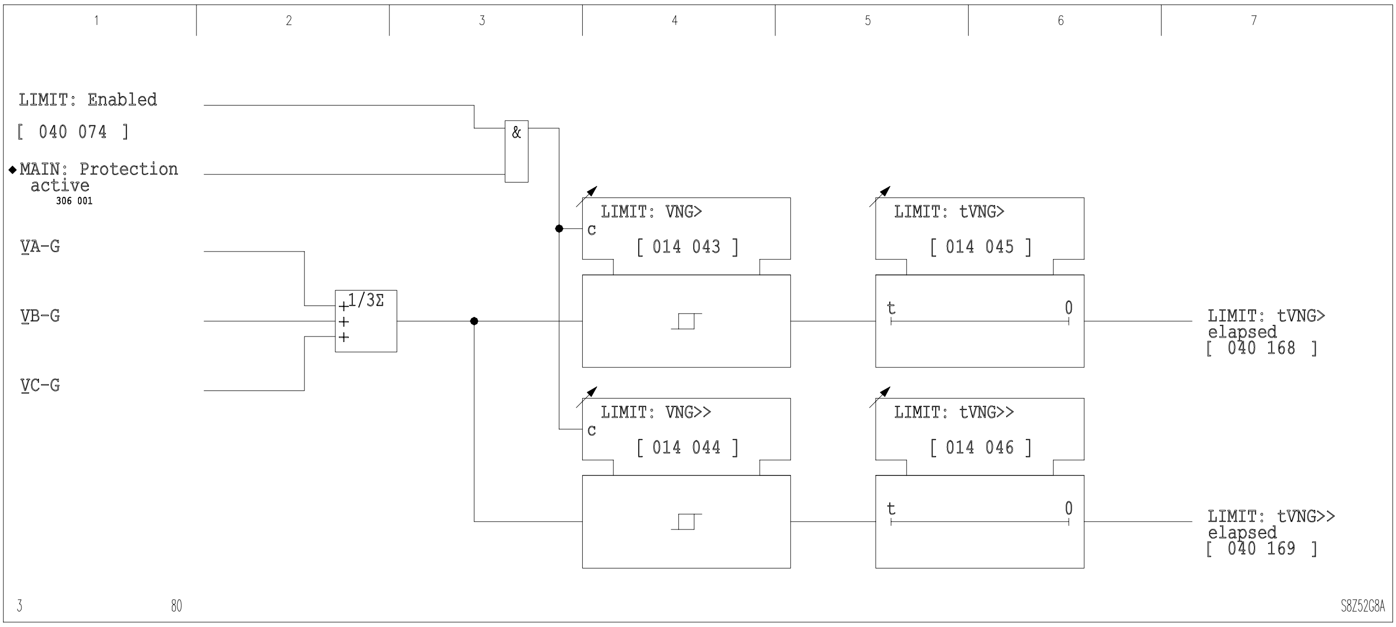
3-273 *Limit Value Monitoring of minimum and maximum phase current*



3-274 *Limit Value Monitoring of maximum and minimum phase-to-phase voltage and maximum and minimum phase-to-ground voltage*

Monitoring the neutral displacement voltage

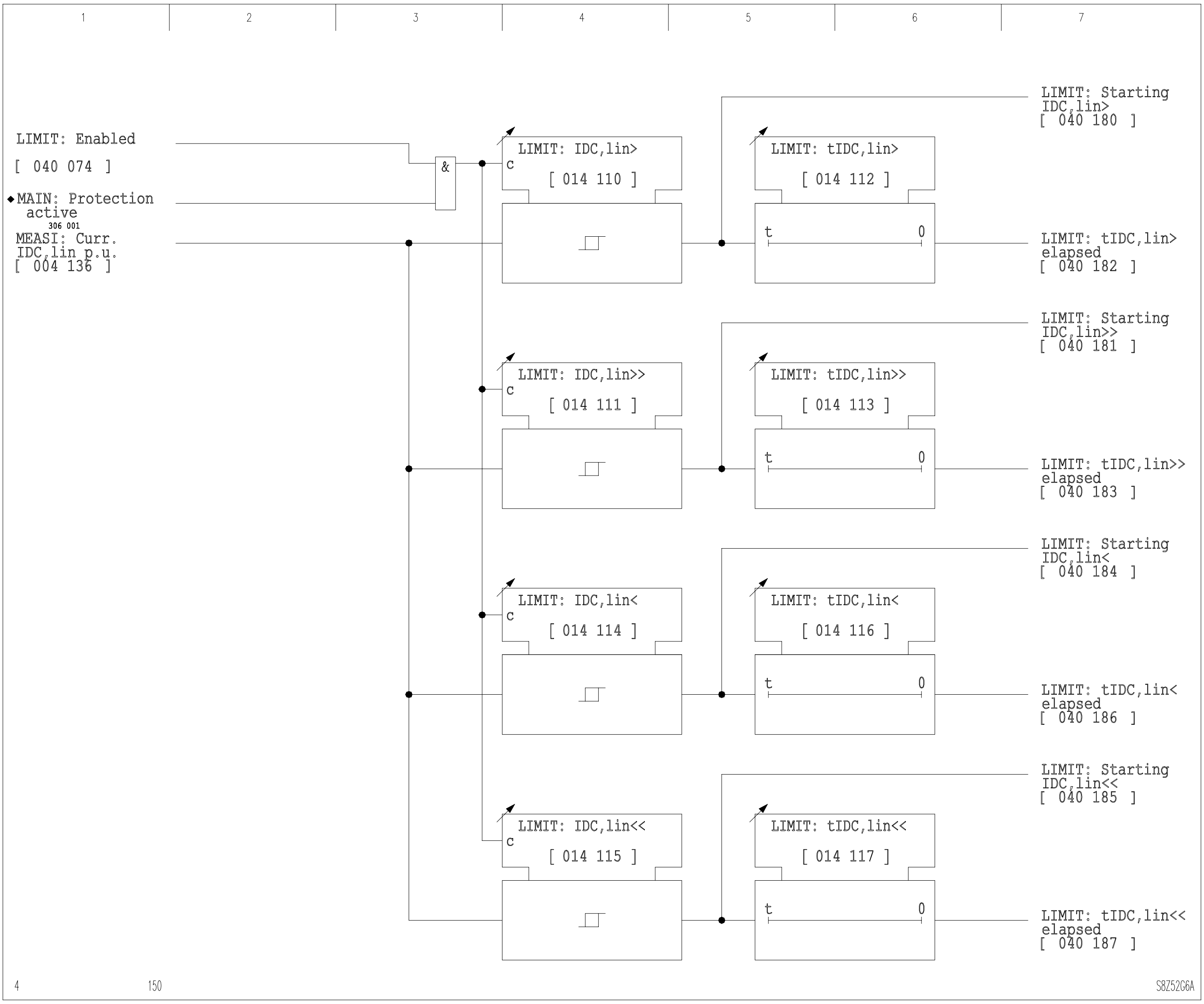
The neutral displacement voltage, calculated from the three phase-to-ground voltages, is monitored by two stages to determine whether it exceeds set thresholds. If any of the thresholds are exceeded, then a signal is issued after the associated time period has elapsed.



3-275 *Monitoring the neutral displacement voltage*

Monitoring the linearized measured DC values

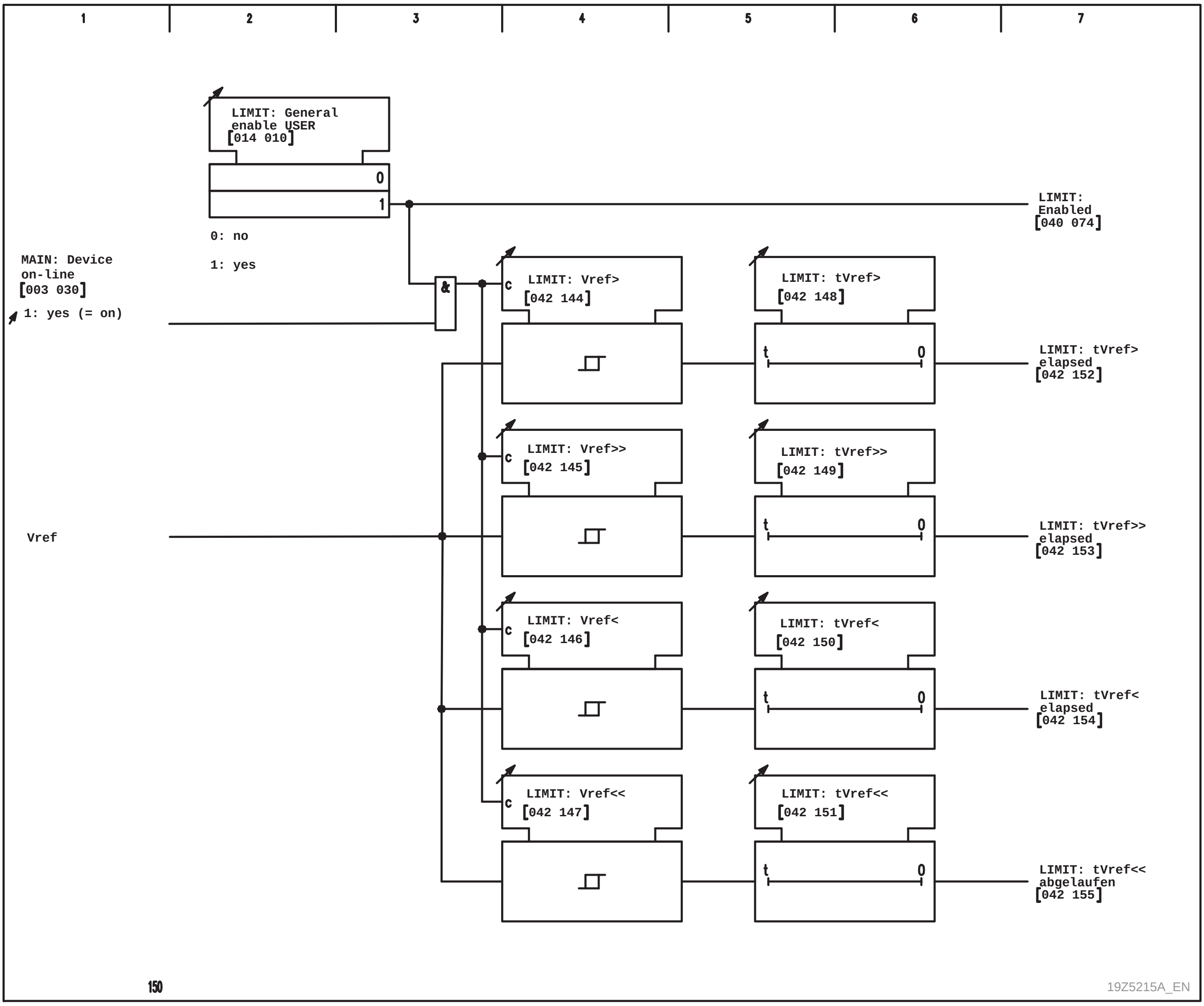
The direct current, linearized by the analog measured data input, is monitored by two stages to determine if it exceeds or falls below set thresholds. If the measured value exceeds or falls below the corresponding upper or lower limit values then a signal is issued after the associated time period has elapsed.



3-276 Monitoring the linearized measured DC values

Monitoring the reference voltage

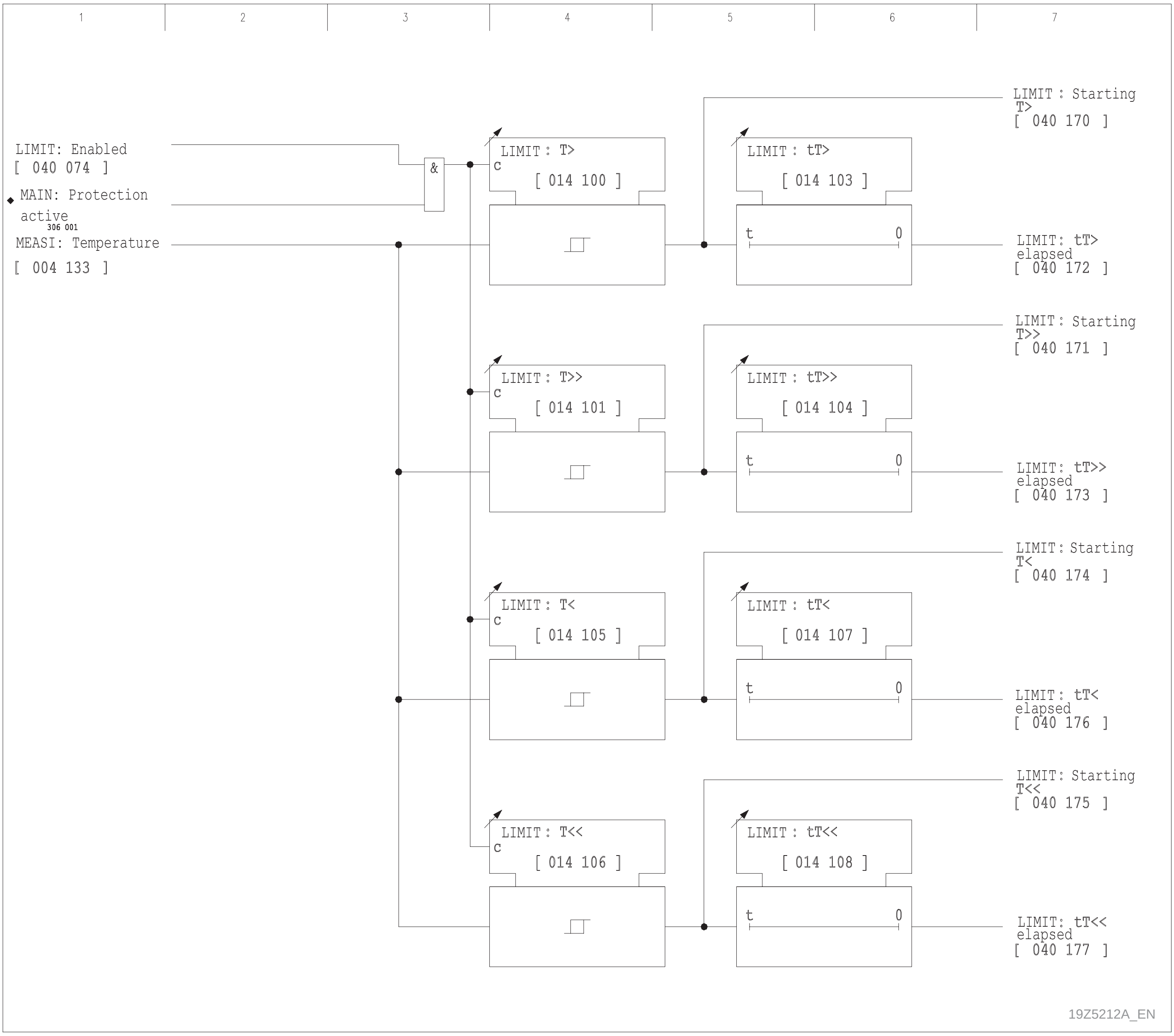
The reference voltage Vref (when synchrocheck VT is fitted) is monitored by two stages to determine whether it exceeds or falls below the corresponding upper or lower limit values. If the measured value exceeds or falls below the corresponding upper or lower limit values then a signal is issued after the associated time period has elapsed.



3-277 *Monitoring the reference voltage*

Monitoring the measured "PT 100" temperature value

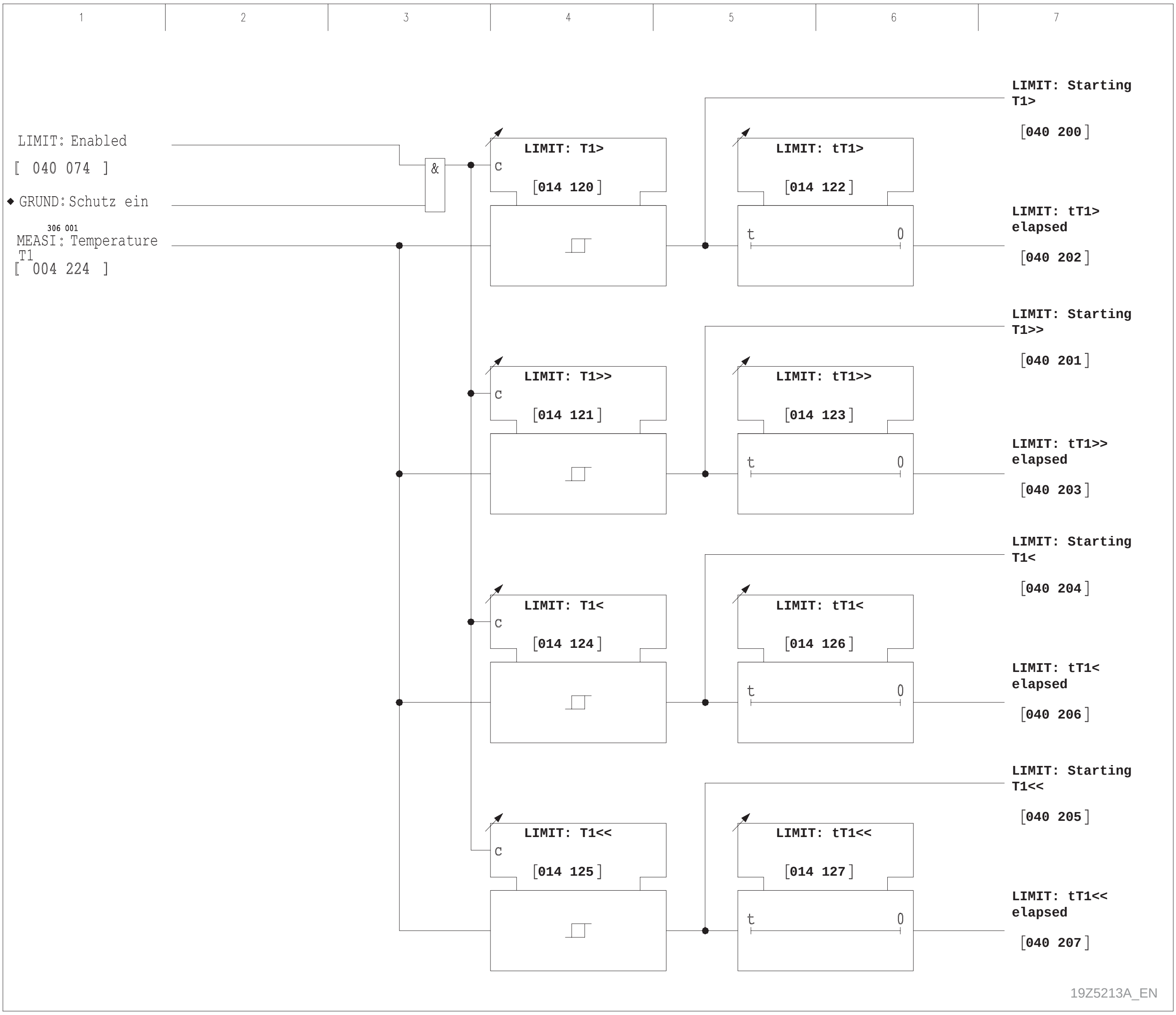
The temperature value that is measured by the P132 with a resistance thermometer (PT 100) connected to the analog (I/O) module Y, is monitored by two stages to determine whether it exceeds or falls below the corresponding upper or lower limit values. If the measured value exceeds or falls below the corresponding upper or lower limit values then a signal is issued after the associated time period has elapsed.



3-278 Monitoring the measured "PT 100" temperature value

Monitoring the measured temperature values T1 to T9

The temperatures that are measured by the P132 using temperature sensors connected to the temperature p/c board (RTD module) are each monitored by two stages to determine if they exceed or fall below set thresholds. If any of the measured values exceed or fall below the corresponding upper or lower limit values then a signal is issued after the associated time period has elapsed.



3-279 Monitoring the measured temperature value T1 as an example for measured temperature values T1 to T9

Open circuit PT100

The open circuit signals from the temperature sensors, issued by the function group MEASI (see function description for 'Measured data input') are forwarded to the Limit Value Monitoring function. An open circuit signal MEASI: Open circ. PT100 Tx (x = 1 to 9) will lead to blocking of these signals:

LIMIT: Starting Tx>, LIMIT: Starting Tx>>,
LIMIT: Starting Tx<, LIMIT: Starting Tx<<,
LIMIT: Starting Tx> elapsed, LIMIT: Starting Tx>> elapsed,
LIMIT: Starting Tx< elapsed, LIMIT: Starting Tx<< elapsed

Backup sensors

When an open circuit has occurred the 2-out-of-3-logic available with the Limit Value Monitoring function will revert to backup sensors.
The selection of such backup sensors for the Limit Value Monitoring function is made in the function group MEASI.

For this purpose the temperature sensors connected to the temperature p/c board (RTD module) are divided into three groups:

Group 1: T1, T2, T3
Group 2: T4, T5, T6
Group 3: T7, T8, T9

If MEASI: BackupTempSensor PSx is set to *'**Without**'* the Limit Value Monitoring function will operate without backup sensors.

If MEASI: BackupTempSensor PSx is set to ***Group 1 -2***, the defective temperature sensor from group 1 is replaced by the corresponding sensor from group 2.

If the backup temperature sensor from group 2 also fails it will be replaced by the corresponding sensor from group 3, under the assumption that MEASI: BackupTempSensor PSx is set to ***Group 1 –2/3***.

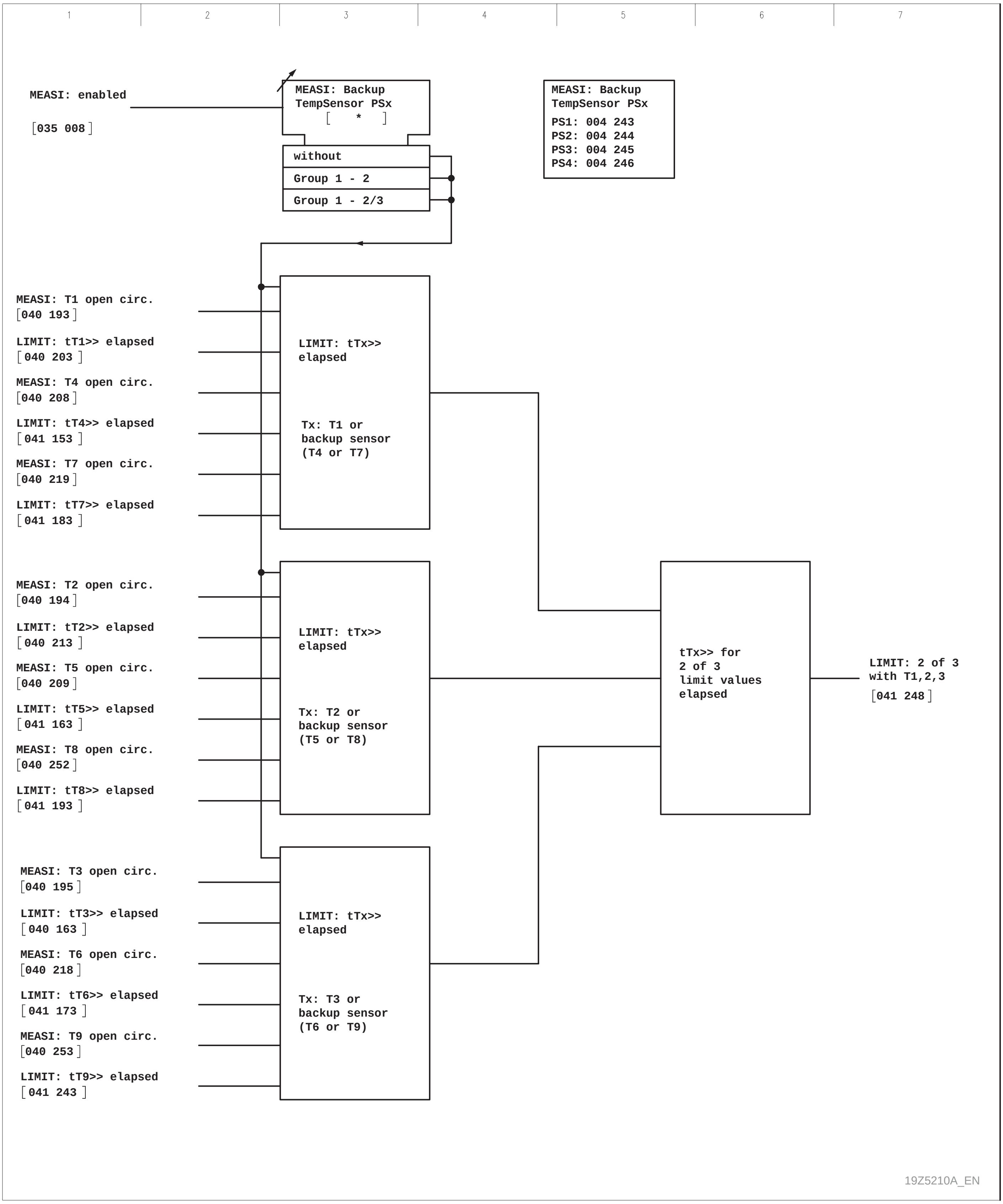
The association of backup temperature sensors is listed below:

Main sensor	Backup sensor from group 2	Backup sensor from group 3
	With setting: *Group 1 -2* or *Group 1 -2/3*	With setting: *Group 1 –2/3*
T1	T4	T7
T2	T5	T8
T3	T6	T9

Should temperature sensor T1 fail, with the setting *Group 1 –2/3*, it will replaced by T4. Should temperature sensor T4 also fail it will replaced by T7.

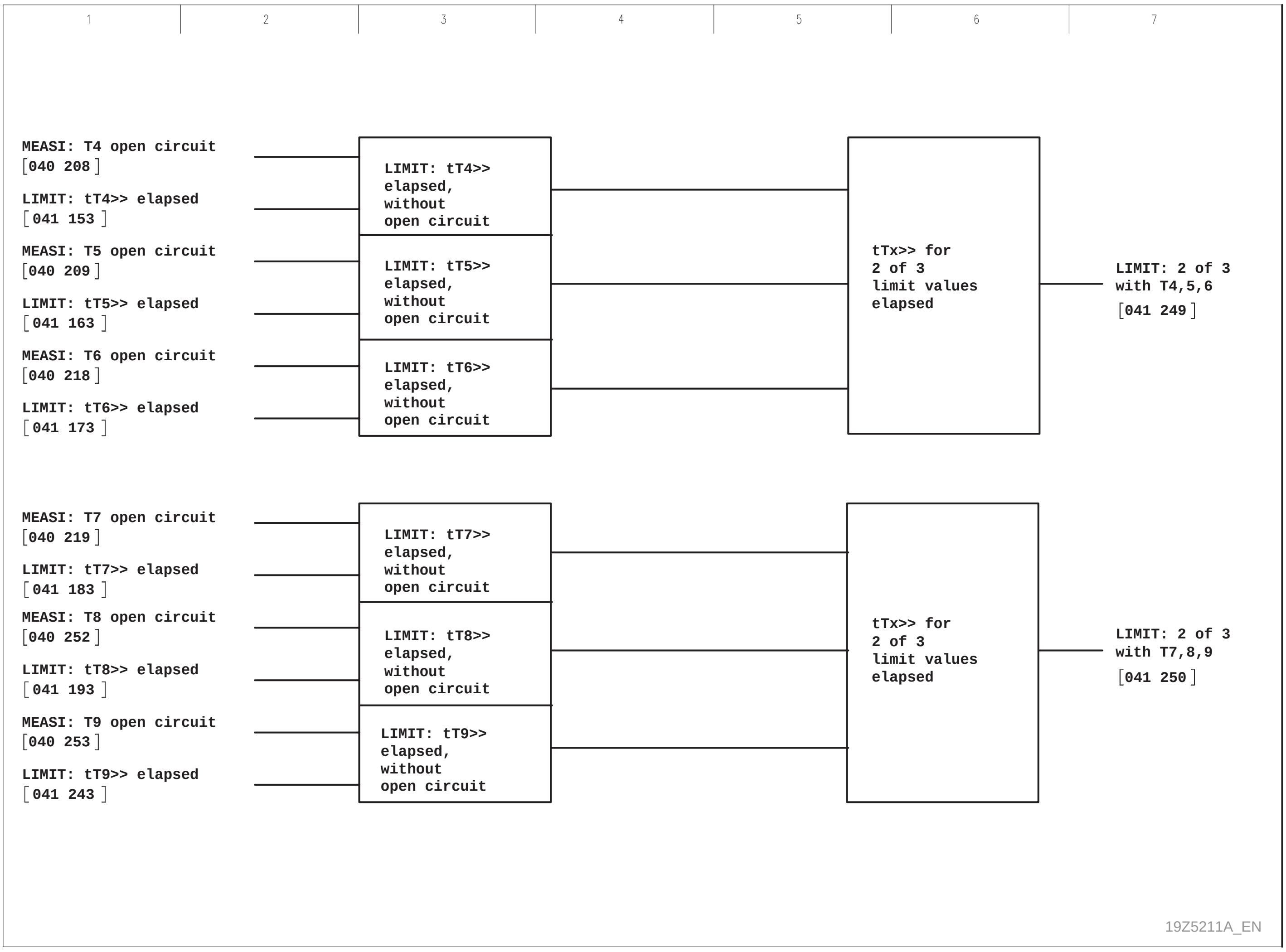
2-out-of-3 monitoring

Limit values resulting from temperature values measured by main sensors (from group 1) or their corresponding backup sensors are processed by the '2-out-of-3' Limit Value Monitoring function, LIMIT: 2out of3 with T1,2,3. This is displayed in the following figure.



3-280 *Using backup sensors ("BackupTempSensor") with the '2-out-of-3' Limit Value Monitoring function*

All functions associated with temperature sensors operate in a parallel mode. In this way the '2-out-of-3' Limit Value Monitoring function, LIMIT: 2out of3 with T4,5,6 may use temperature sensors from group 2 even though these backup sensors are configured to group 1.



*3-281 Limit Value Monitoring function '2-out-of-3' for temperature sensors T4 to T6 and T7 to T9. If MEASI: BackupTempSensor PSx is set to '**Without**' this scheme will also apply to temperature sensors T1 to T4.*

Application example

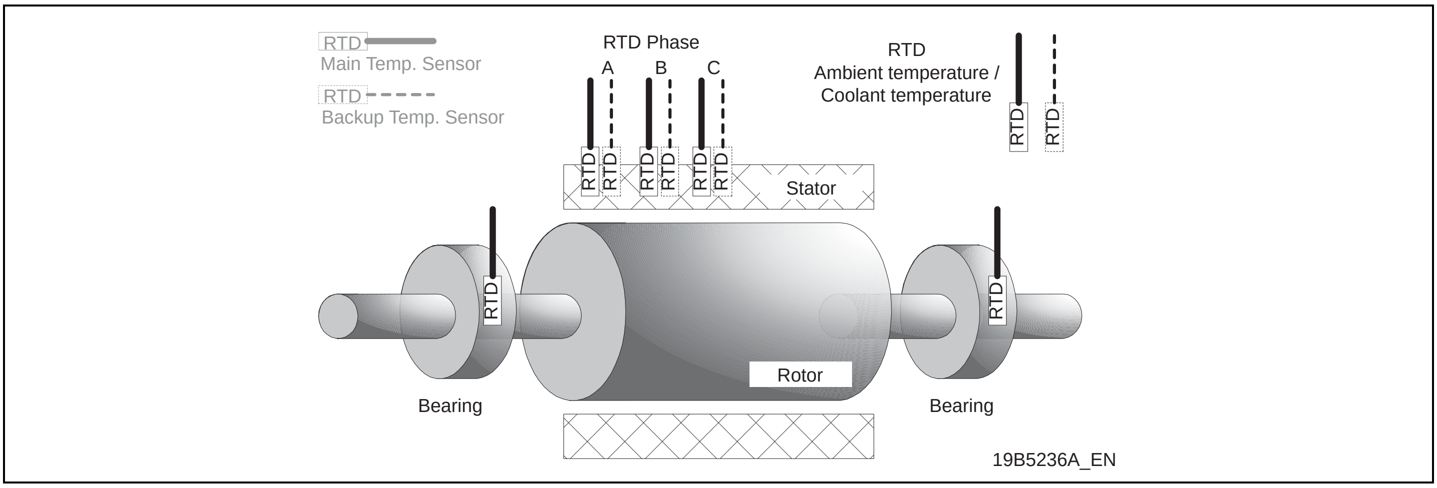
A motor protection application is shown in the figure below with temperature sensors T1 to T9 connected to the temperature p/c board (RTD module) and a "PT 100" resistance thermometer connected to the analog (I/O) module Y.

These temperature sensors, for example, can be distributed as follows:

☐ On the stator there are three temperature sensors as the main sensors (group 1: T1, T2, T3) and three backup sensors (group 2: T4, T5, T6) used by the '2-out-of-3' Limit Value Monitoring function

☐ One temperature sensor on each of the bearings is used for individual Limit Value signaling

☐ One main and one backup sensor inside the coolant are used by the thermal replica in the Thermal Overload protection



3-282 *Temperature measurements on a motor to be used with the Limit Value Monitoring function (L I M I T) and the Thermal Overload protection (THERM)*

3.42 Programmable Logic (Function Group LOGIC)

Programmable (or user-configurable) logic enables the user to link binary signals within a framework of Boolean equations.

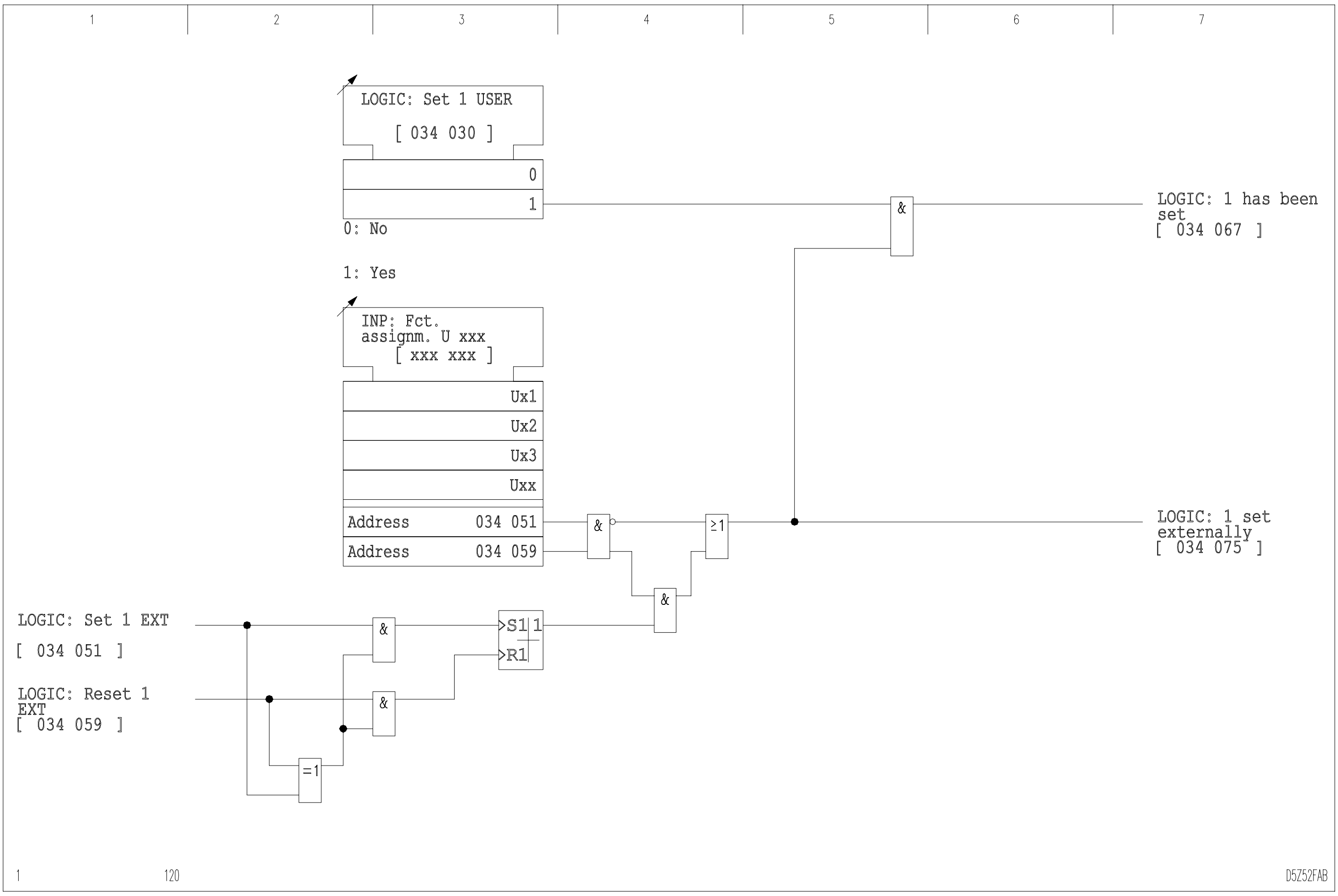
Binary signals in the P132 can be linked by logical ‘OR’ or ‘AND’ operations or by additional ‘NOT’ operations by setting LOGIC: Fct. assignm. outp. n, where n = 1 to 32. The Boolean equations need to be defined without the use of brackets. The following rule applies to the operators: ‘NOT’ before ‘AND’ before ‘OR’.

A maximum of 32 elements can be processed in one Boolean equation. In addition to the signals generated by the P132, initial conditions for governing the equations can be set using a setting parameter, through binary signal inputs, or through the serial interfaces.

Logical operations can be controlled through the binary signal inputs in different ways. The binary input signals LOGIC: Input n EXT (n = 1 to 16) have an updating function, whereas the input signals LOGIC: Set n EXT (n = 1 to 8) are stored. The logic can only be controlled from the binary signal inputs that are configured for LOGIC: Set n EXT if the corresponding reset input (LOGIC: Reset n EXT) has also been configured for a binary signal input. If only one or neither of the two functions is configured, then this is interpreted as ‘Logic externally set’. If the input signals of the two binary signal inputs are implausible (such as when they both have a logic value of ‘1’), then the last plausible state remains stored in memory.

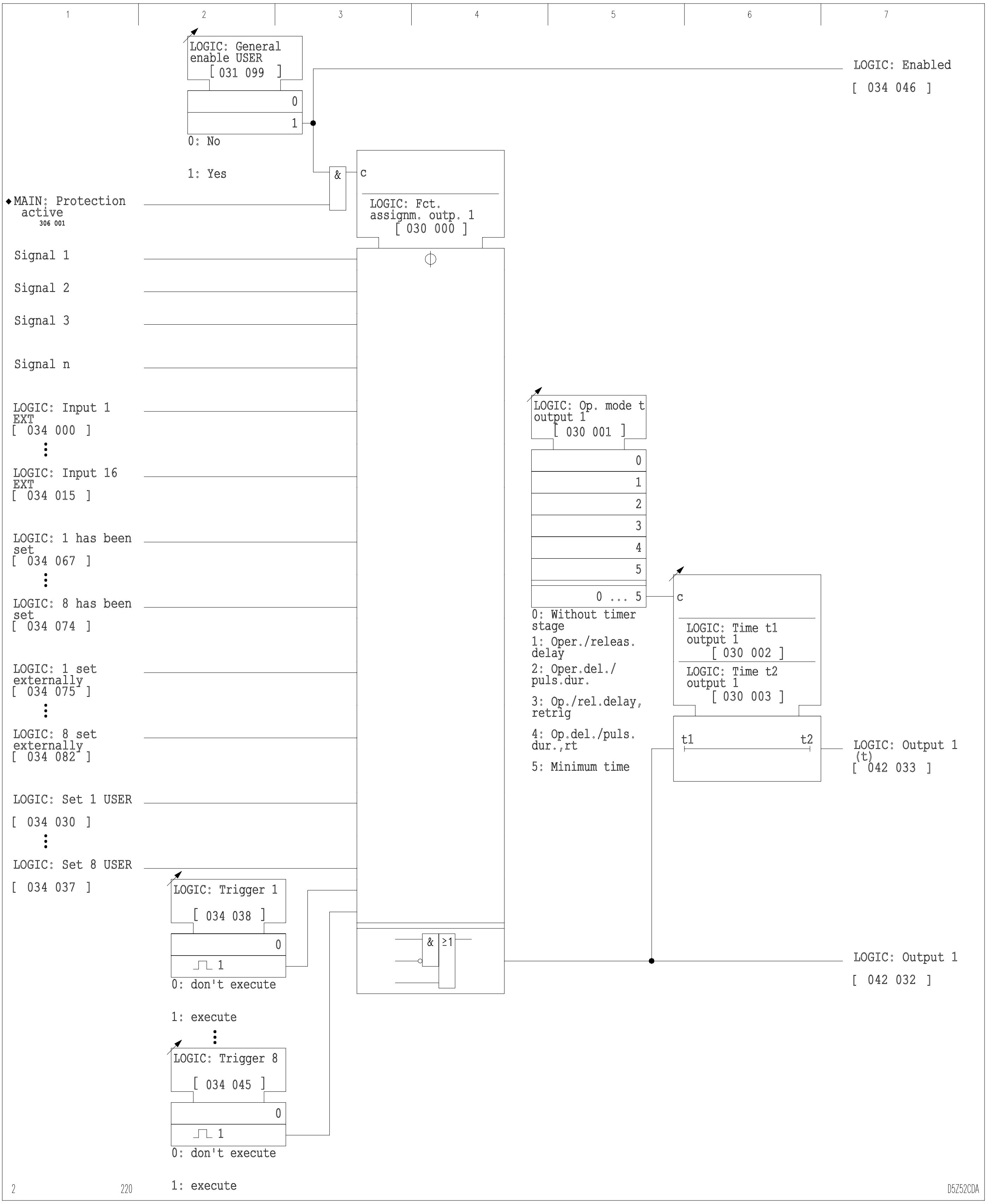
⚠

When using the programmable logic, the user must carry out a functional type test to conform to the requirements of the relevant protection/control application.
In particular, it is necessary to verify that the requirements for the implementation of logic linking (by setting) as well as the time performance during device startup, during operation and when there is a fault (device blocking) are fulfilled.



3-283 Control of logic operations via setting parameters or stored input signals

The `LOGIC: Trigger n` signal is a ‘triggering function’ that causes a 100 ms pulse to be issued.

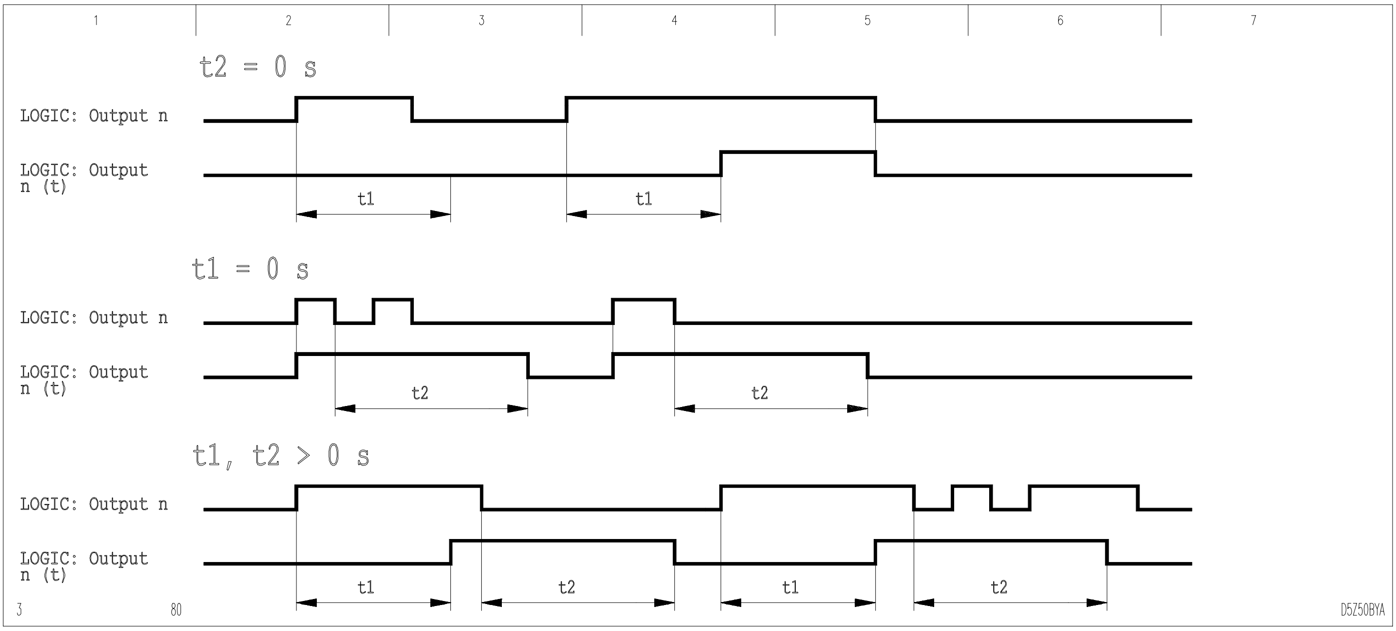


3-284 Setting options for programmable logic (shown here for output 1)

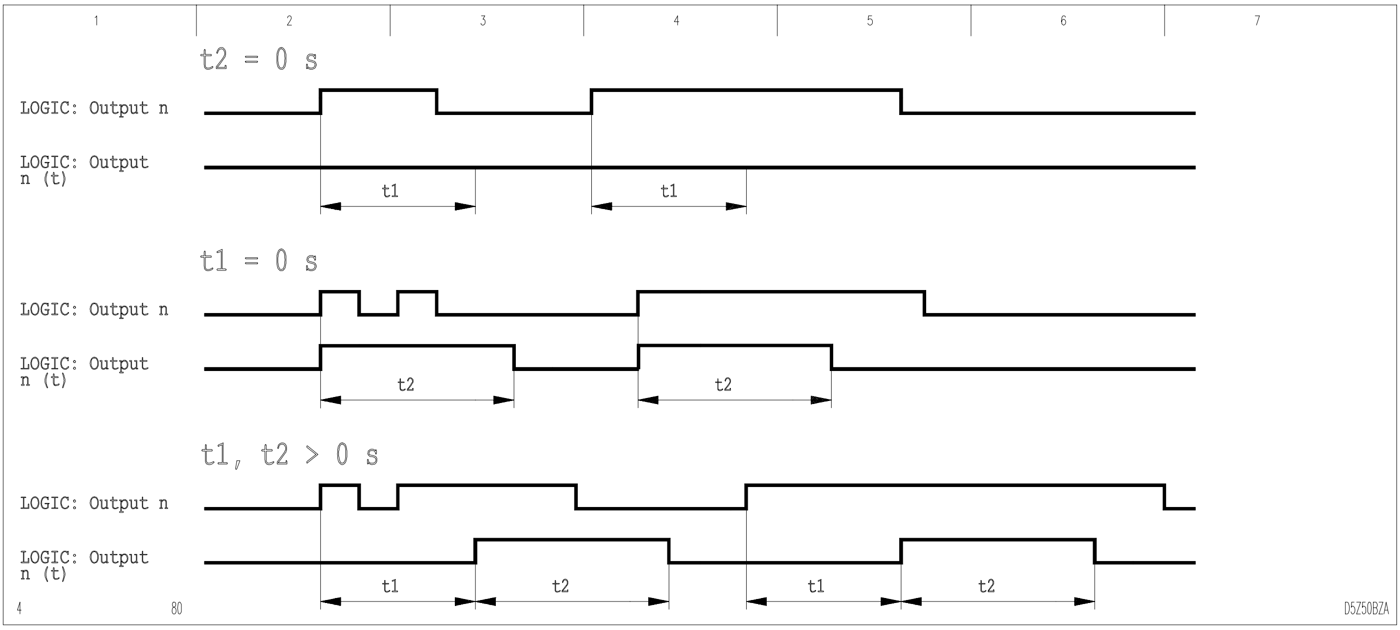
The output signal of one equation can be processed as the input signal for another higher-order equation, and this makes it possible to have a sequence of nested Boolean equations. The equations are processed in the sequence defined by the order of each equation so that the end result of a sequence of nested Boolean equations is given by the highest-order equation.

The output signal of each equation is fed to a separate timer stage that has two timer elements and a choice of operating modes. This offers the possibility of assigning a freely configurable time characteristic to the output signal of each Boolean equation. In the *Minimum time* operating mode, the setting of timer stage t2 has no effect. Figures 3-285 to 3-289 show the time characteristics for the various timer stage operating modes.

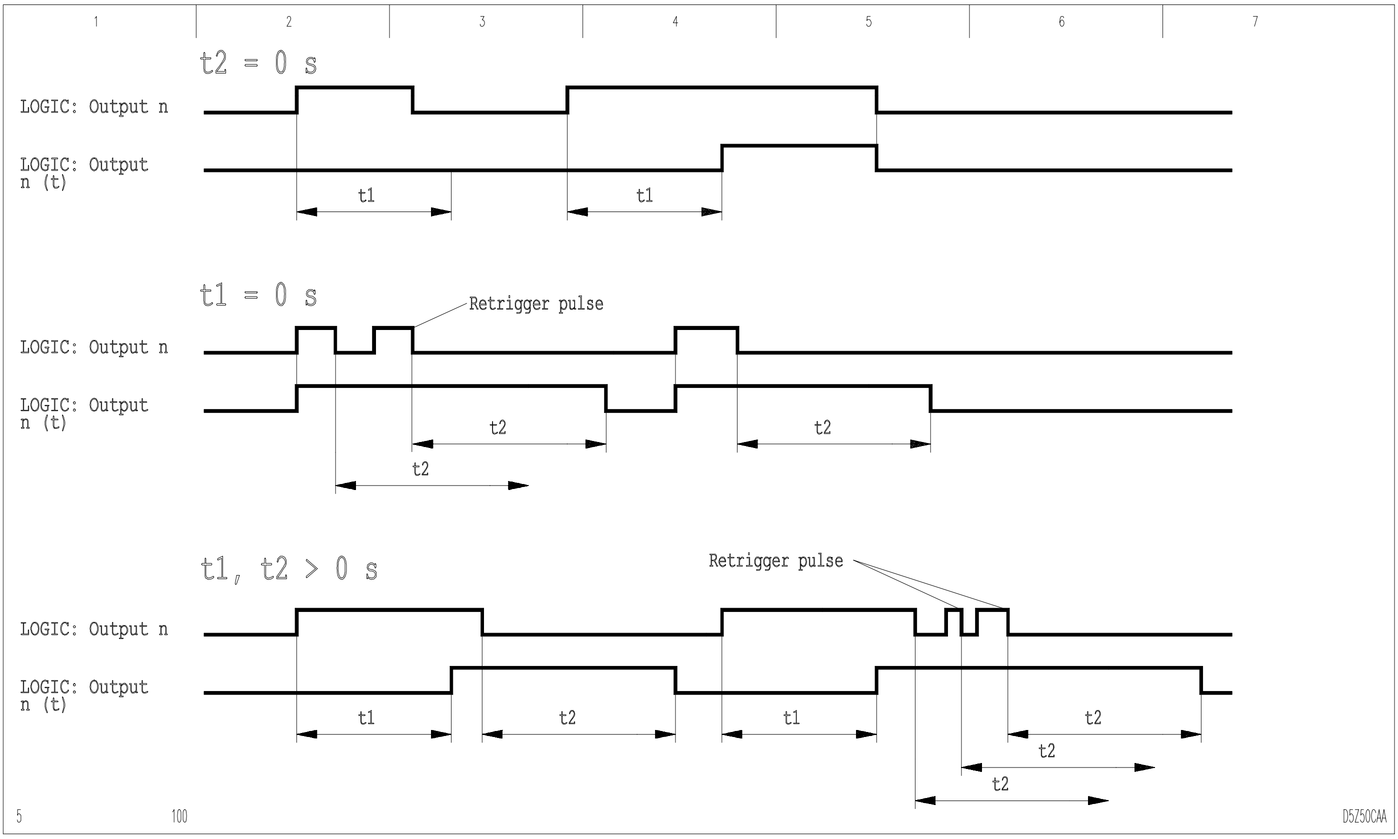
Note: If the unit is set to “off-line“, the equations are not processed and all outputs are set to a logic value of '0'.



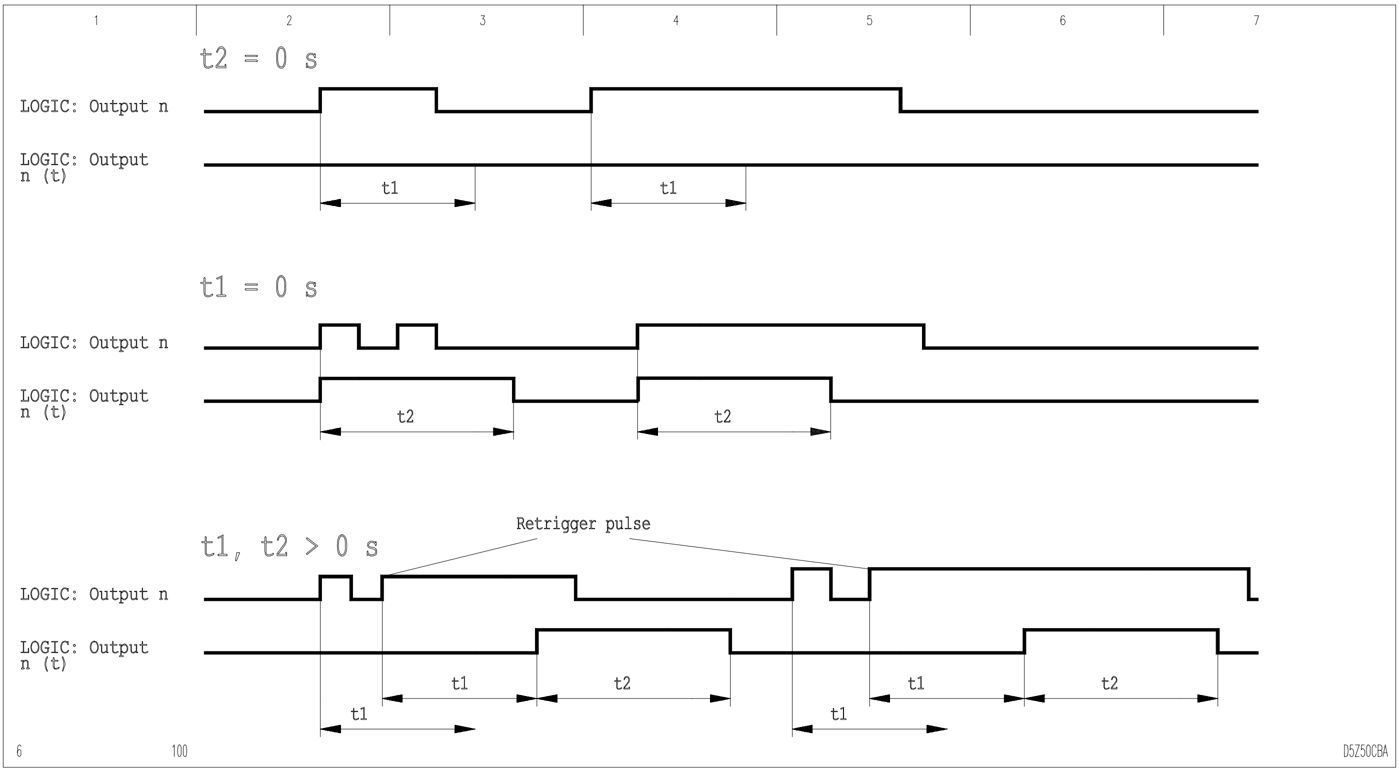
3-285 *Operating mode 1: Operate/release delay*



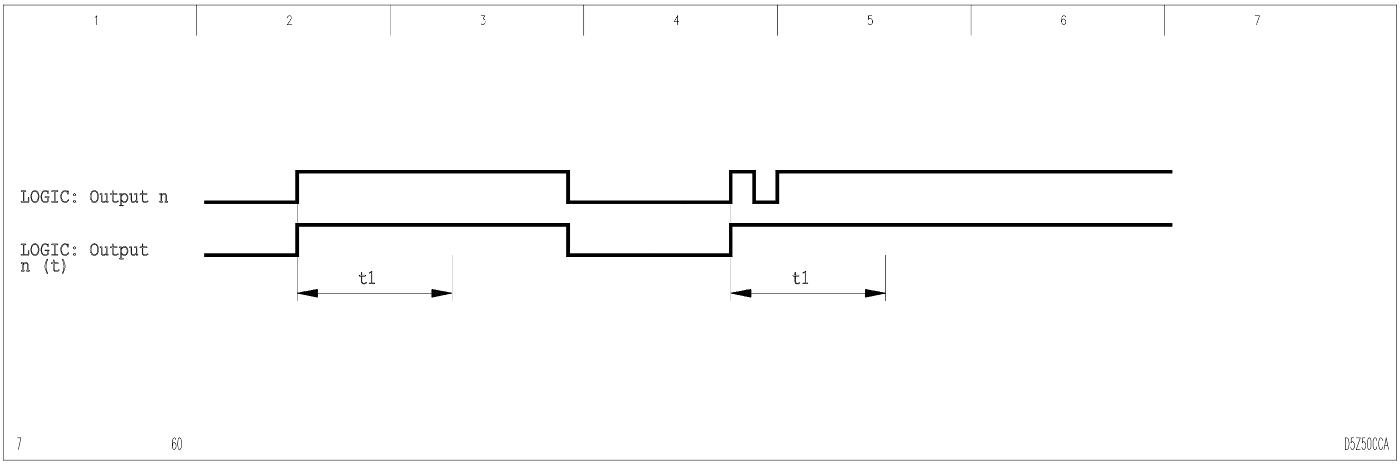
3-286 Operating mode 2: Operate-delay/pulse duration



3-287 Operating mode 3: Operate/release delay, retriggerable

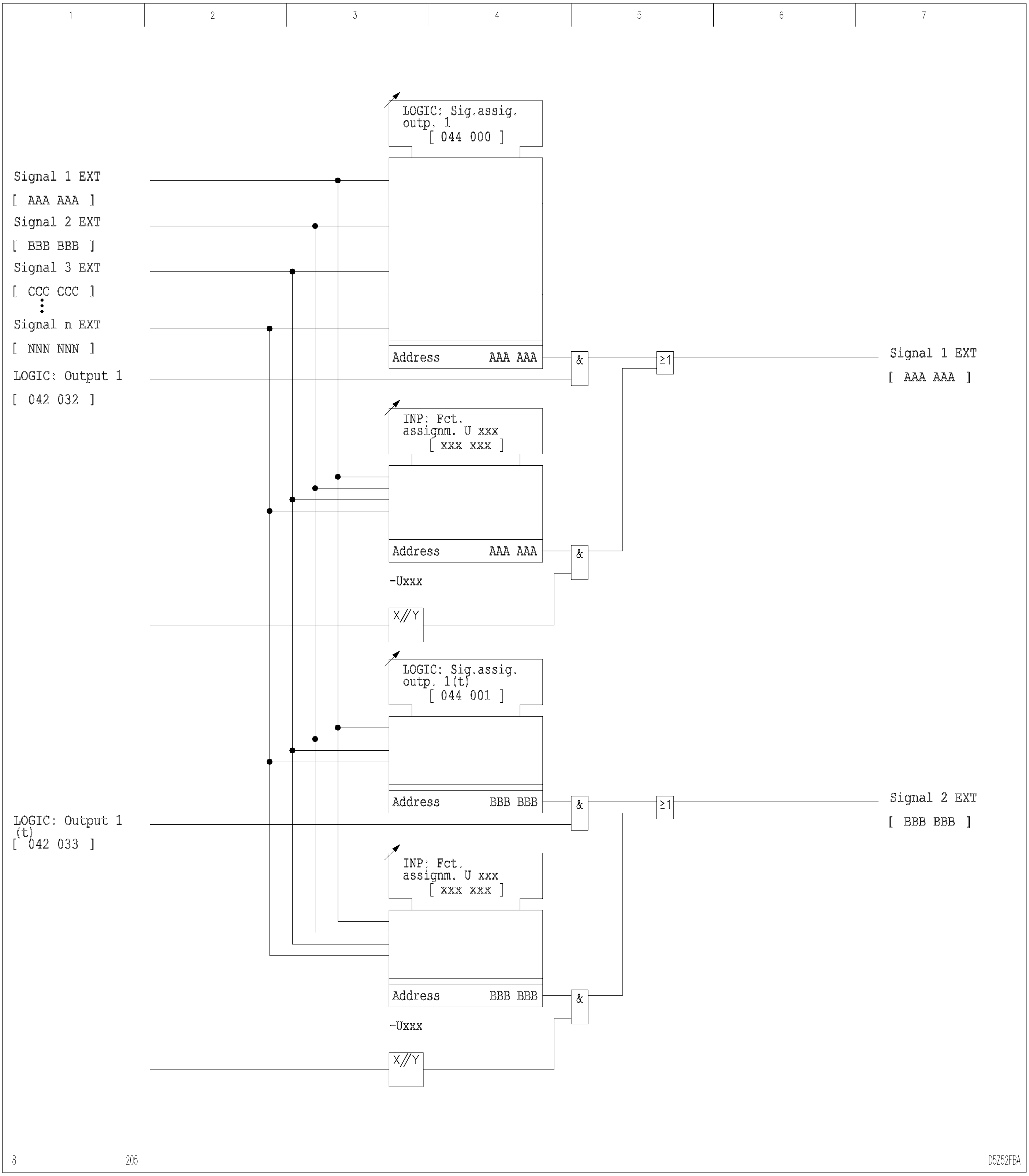


3-288 *Operating mode 4: Operate-delay/pulse duration, retriggerable*



3-289 *Operating mode 5: Minimum time*

Through appropriate configuration, it is possible to assign the function of a binary input signal to each output of a logic operation. The output of the logic operation then has the same effect as if the binary signal input to which this function has been assigned were triggered.



3-290 *Signal assignment to outputs of Boolean equations*

3.43 Control and Monitoring of Switchgear Units (Function Groups DEV01 to DEV03)

The P132 is designed to control up to 3 switchgear units. The Bay Panel type defines the layout of a bay with its switchgear units.

Defining a Bay Panel type

With the selection of a Bay Panel type, the following definitions are made:

☐ Manually operated switchgear units with status signals to be processed.

☐ Switchgear units to be controlled and signaled by the P132.

☐ The bay interlock conditions for the 'Open' / 'Close' command control of the switchgear units, for operation with or without the station interlock function.

When a Bay Panel type is selected, the binary inputs for switchgear status signals and the output relays for control commands are configured automatically if MAIN: Auto-assignment I/O is set to *'Yes'*. If set to '*No*', the user will need to carry out this configuration. The list of Bay Panel types in the Appendix shows which binary inputs and output relays have been assigned signals or commands for control of switchgear units in the case of automatic configuration.

Setting options for the P132 and the different possibilities to integrate a switchgear unit into the functional sequence of the P132 (processing of status signals only or controlling and signaling) will be explained below, using one switchgear unit as an example. Function group DEV01 will be used throughout in this example. If a signal is identified in the function diagrams by function group "COMM1:" with a blank address [--- ---], it will indicate that it is a signal to or from the communication interface and that it has not been assigned an address.

3.43.1 Processing Status Signals from Manually Operated Switchgear Units

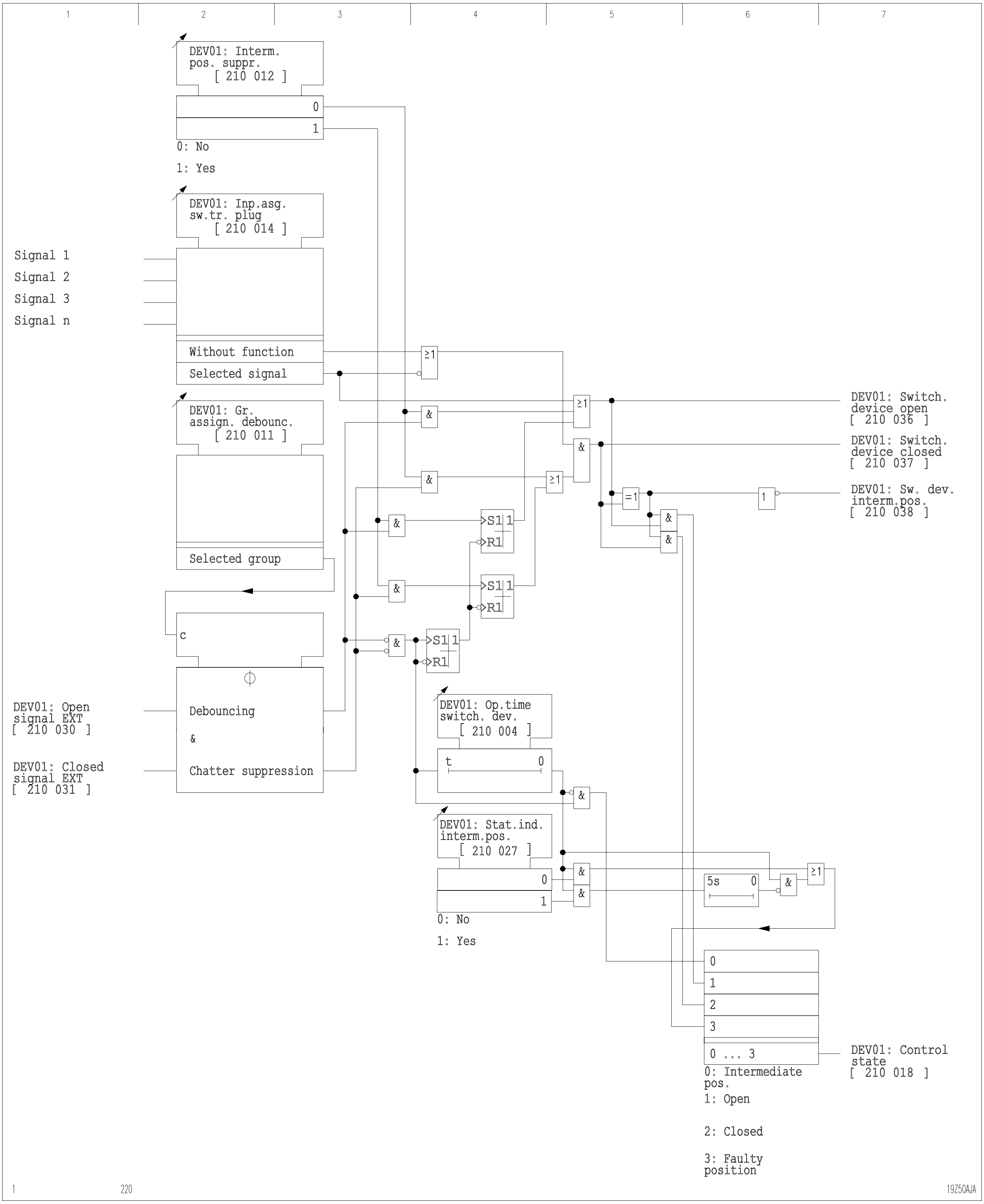
The status signals ‘Open’ and ‘Closed’ are assigned to binary signal inputs. The signals conditioned by debouncing and chatter suppression (see section ‘Main Functions of the P132’) are used for further processing. If no logic value of '1' is present at any of the two binary signal inputs, the running time monitoring function is started. For the duration of the set time period for running time monitoring or until the contacts on the switchgear unit are back to a defined position - either ‘Open’ or ‘Closed’ - the signal ‘Intermediate position’ is issued.

If `DEV01: Interm. pos. suppr.` is set to *'Yes'*, the previous switchgear unit status will continue to be signaled while the switchgear unit is operating. Once the contacts on the switchgear unit have reached their new position, the updated status is signaled.

The signal ‘Faulty position’ is issued if the contacts on the switchgear unit have not reached either their ’Open’ or ‘Closed’ position after the set time period for running time monitoring and the delay time set in `MAIN: Delay Man.Op.Superv.` have elapsed. If `DEV01: Stat.ind.interm.pos.` is set to '*Yes*', a delay time of 5 s is started. Once this time period has elapsed and there is no status signal for the position, the state actually present at the binary inputs will be signaled.

Switch truck

For switchgear units mounted on switch trucks with switch truck plugs, it is possible to configure a single-pole status signal from the switch truck plug. If such a configuration has been assigned, the status signal for the position of the associated switchgear unit is set to ‘Open’ while the input has a logic value of '1'.



3-291 *Processing status signals from a manually operated switchgear unit*

3.43.2 Functional Sequence for Controllable Switchgear Units

Local or remote control of external devices

Usually, remote control of external devices is carried out via the communication interface and local control via appropriately configured function keys on the local control panel. Moreover, switchgear units can be controlled via binary inputs configured appropriately (configuration via DEVxx: Inp.asg.el.ctrl.open or DEVxx: Inp.asg.el.ctr.close). The setting MAIN: Electrical control determines whether the inputs function as remote or local control points.

Dependent on the respective position of control the P132 will issue the following logic state signals:

☐ MAIN: Cmd. fr. comm.interf

or

☐ MAIN: Command from HMI

or

☐ MAIN: Cmd. fr. electr.ctrl

Additionally the following state signals are issued and entered into the operating data memory:

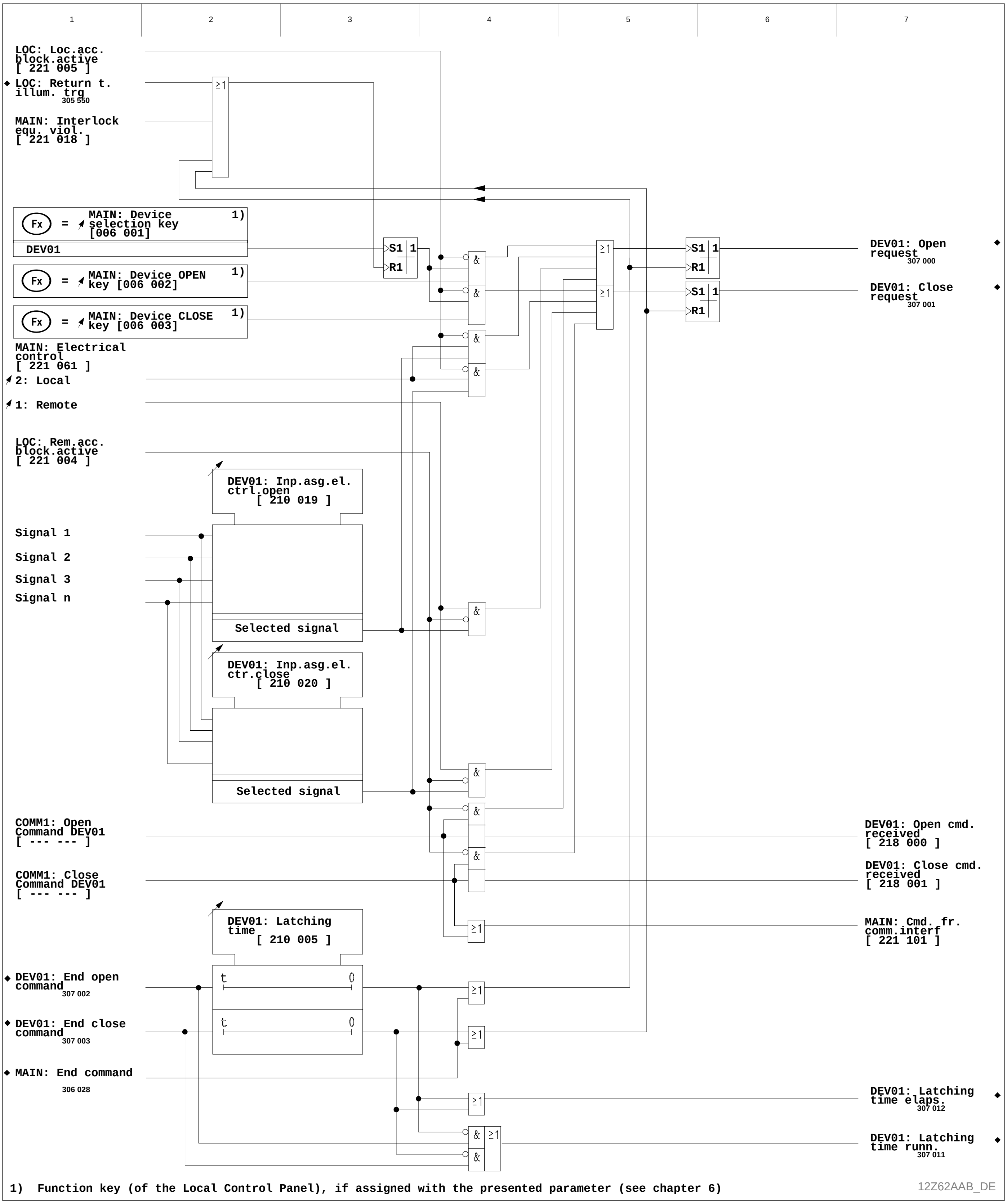
☐ DEVxx: Open cmd. received

☐ DEVxx: Close cmd. received

Selection of the switchgear unit to be controlled and generating a switching request

The switchgear unit to be controlled is selected and the switching command is sent to this selected switchgear unit. This can be carried out via the local control panel using the selection key and pressing the ‘Open’ or ‘Close’ key to generate the switching request. (It should be noted that the local control panel on the P132 does not feature specific keys for switching functions. If at this point mention of a “selection key” is made, then this would be a function key to which a specific function has been assigned – in this example MAIN: Device selection key. (See Chapter 6, section ‘Configurable Function Keys F1 to Fx, particularly as control keys'.)

For control via binary inputs, the appropriate control inputs need to be configured for switchgear units selected to be controlled. For control via the communication interface, the control commands ‘Open’ or ‘Close’ will also address the switchgear unit to be controlled.

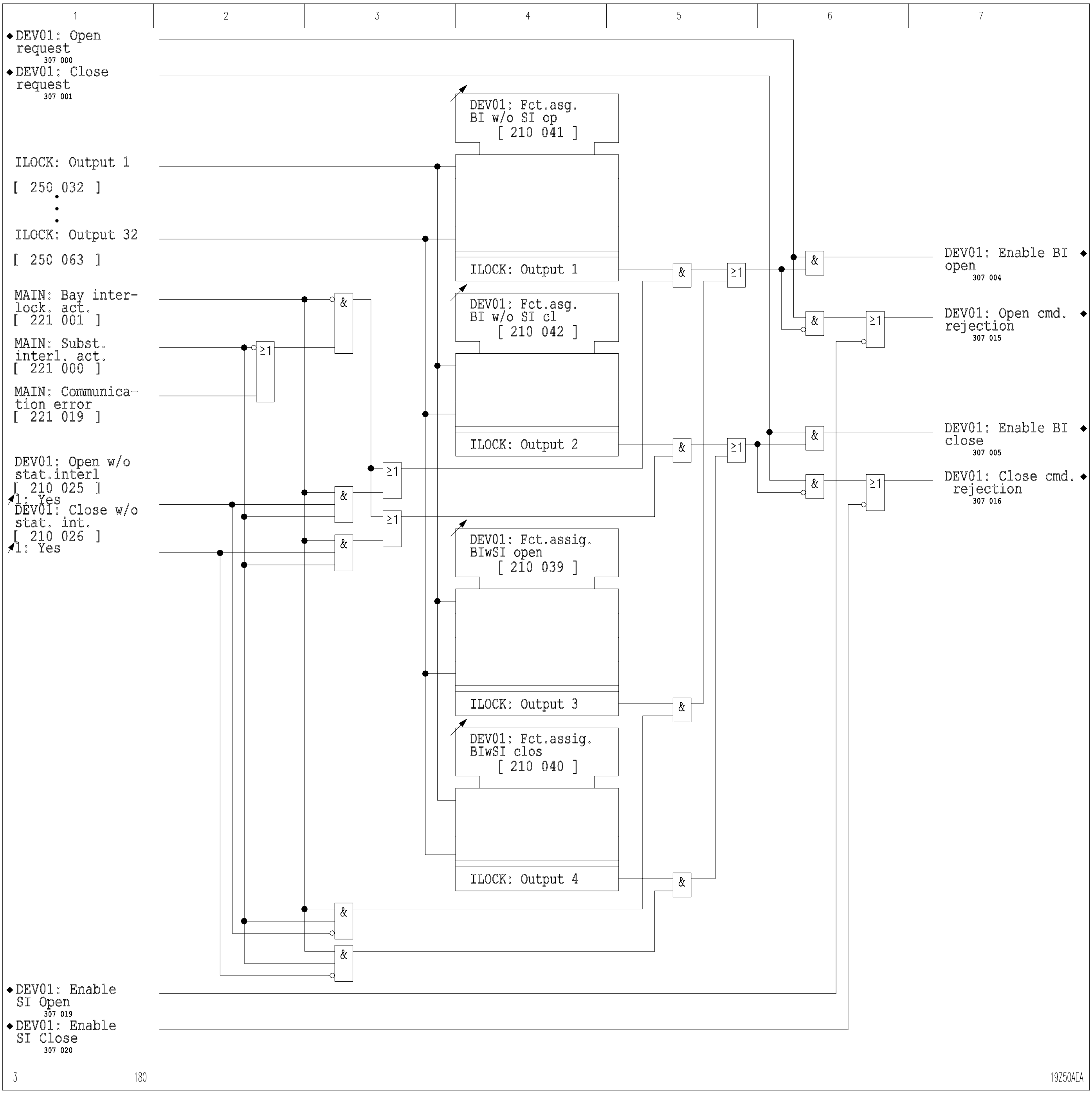


1) Function key (of the Local Control Panel), if assigned with the presented parameter (see chapter 6)

3-292 *Generating a switching request with remote control via the communication interface*

Enabling switching commands

Before a switching command is executed, the P132 checks the interlocking conditions defined in the interlocking logic to determine whether a switching command is permitted or not. Bay interlock conditions for operation with or without the station interlock function can be defined. The assignment of an output relay from the interlocking logic to a switching command determines the interlocking conditions that define, for example, the conditions for the 'Open' command for operation without the station interlock function.

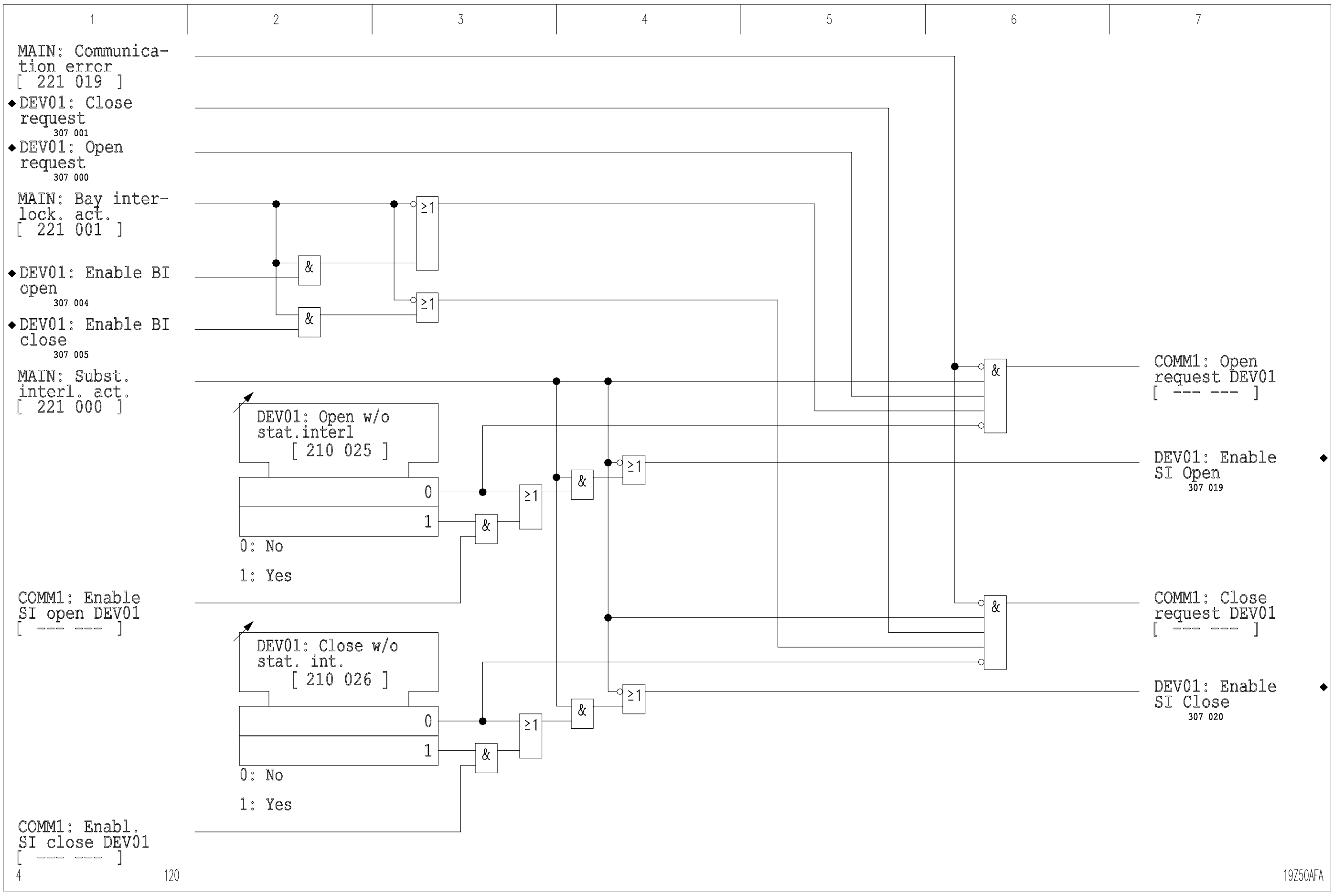


3-293 *Assignment of equations of the interlocking logic to the switching commands and enabling of switching commands by the bay interlock function*

Bay interlock for operation with the station interlock function

For the station interlock function conditions to be interrogated, there needs to be a communication link with the substation control level. If the P132 detects a communication error or if there is no communication interface available, there will be an automatic switch to bay interlock without the station interlock function.

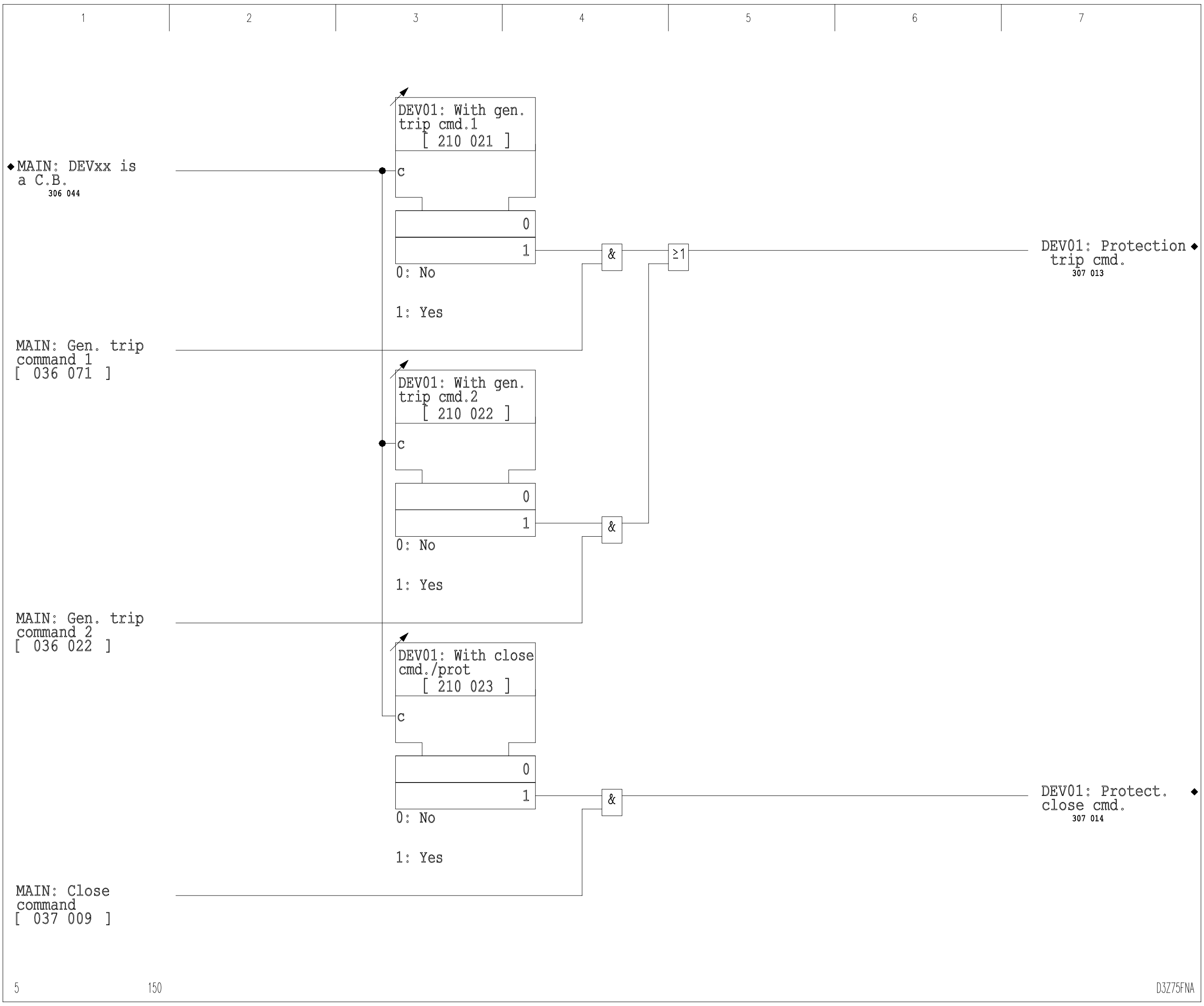
If there is to be a check on the bay interlock and the station interlock function, the bay interlock will be checked first. If bay interlocking issues a switching enable, a switching request will be sent to the substation control level. At substation control level, there will then be a check - taking into account the station interlock functions – as to whether switching is permitted or not. If the substation control level also issues an enabling command, the switching operation is carried out provided that the enable from the bay interlock is still present. Optionally, the ‘Open’ or ‘Close’ switching operation can be carried out without checking the station interlock function conditions. In this case, the bay interlock conditions defined for operation without station interlock functions will be considered.



3-294 *Enabling of switching commands by the station interlock*

Linking protection commands to switching commands

For circuit breakers, the ‘Open’ command can be linked to the protection trip signals. The 'Close' command can also be linked to the close command of the protection functions. The Bay Panel type defines which of the switchgear units are circuit breakers. The trip (open) or close commands of the protection functions are executed directly without a check of the interlocking conditions.



3-295 *Linking to the protection commands*

Issue of switching commands

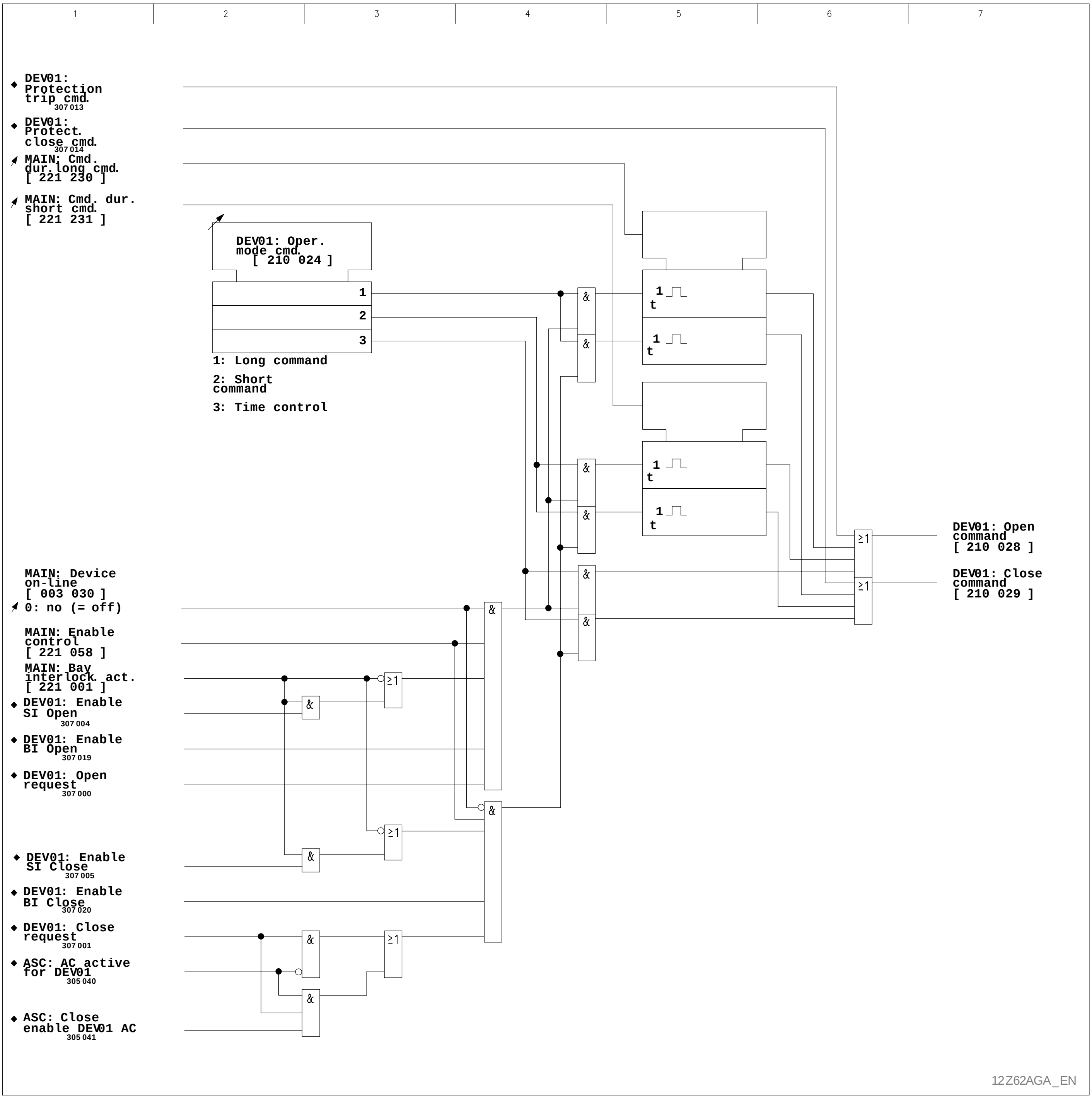
Dependent on the operating mode (set at DEVxx: Oper. Mode cmd.) set for commands, switching commands are issued for the set timer durations or according to time control.

When the automatic synchronism check (ASC) is active and the parameter ASC: System integrat. PSx is set to *'Autom. synchr. control'* a 'Close' request will automatically issue a 'Close' command for the circuit breaker after a *'close enable'* was issued by the ASC.

However if ASC: System integrat. PSx is set to *'Autom. synchron. checkl'* ASC will not interfere with any switching commands. Data generated and continuously updated by the ASC function is transmitted – when configurations have been set accordingly – to the central control station, where operators may make decisions as to which external device is to be given a switching command.

External termination control

If the operating mode time control was selected it is possible to intervene in the control process of external switchgear units by using external termination contacts. It will then be necessary to set the at MAIN: W. ext. cmd. termin. to *'Yes'* and binary signal inputs must be configured so they can be connected to the external termination contacts.



3-296 Issuing of switching commands

Time control of switching commands

As the switching command ends, running time monitoring for the switchgear unit is started. The P132 expects a status signal - ‘Open’ or ‘Closed’ to be issued by the switchgear unit within the duration of the set time period for running time monitoring. The status signal for the position of the contacts on the switchgear unit is present at appropriately configured binary inputs on the P132, which can be set to debouncing and chatter suppression mode (see description for Debouncing and Chatter Suppression in section 'Main Functions of the P132'). For the duration of the set time period for running time monitoring or until the contacts on the switchgear unit are back to a defined position - either ‘Open’ or ‘Closed’ - the signal ‘Intermediate position’ is issued.

If DEV01: Interm. pos. suppr. is set to *'Yes'*, the previous switchgear unit status will continue to be signaled while the switchgear unit is operating. Once the contacts on the switchgear unit have reached their new position, the updated status is signaled.

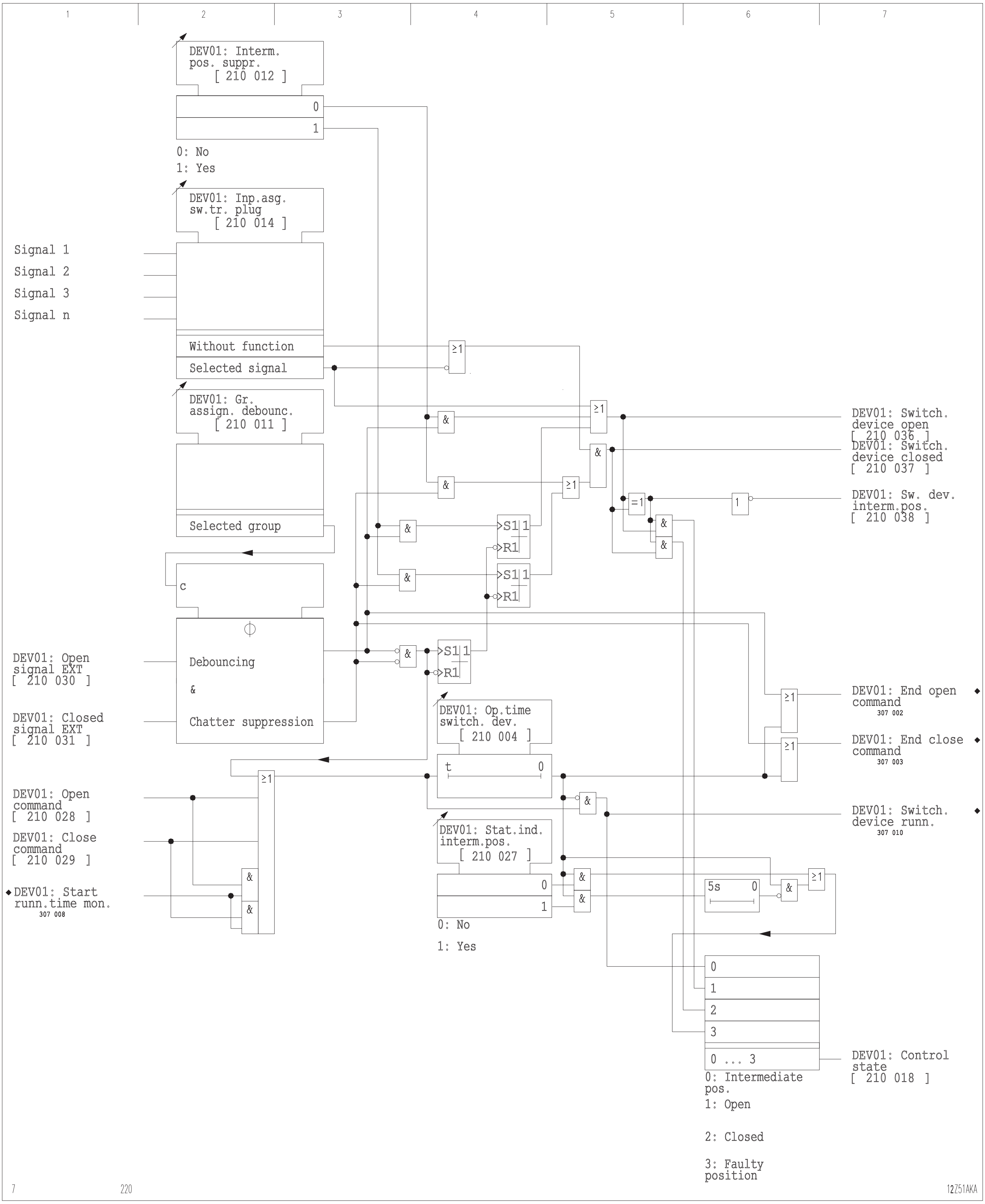
If the contacts on the switchgear unit have not reached either their ‘Open’ or ‘Closed’ position after the set time period for running time monitoring has elapsed the signal '*Faulty position'* is issued. If DEV01: Stat.ind.interm.pos. is set to '*Yes'*, a delay time of 5 s is started. Once this time period has elapsed and there is no status signal for the position, the state actually present at the binary inputs will be signaled.

If the operating mode without external termination contacts was selected (MAIN: W. ext. cmd. termin. is set to *'No'*) the switching command is terminated after the set latching time has elapsed, when either the ‘Open’ or ‘Closed’ position status signal is received or the set time period for running time monitoring has elapsed (see Figure 3-292).

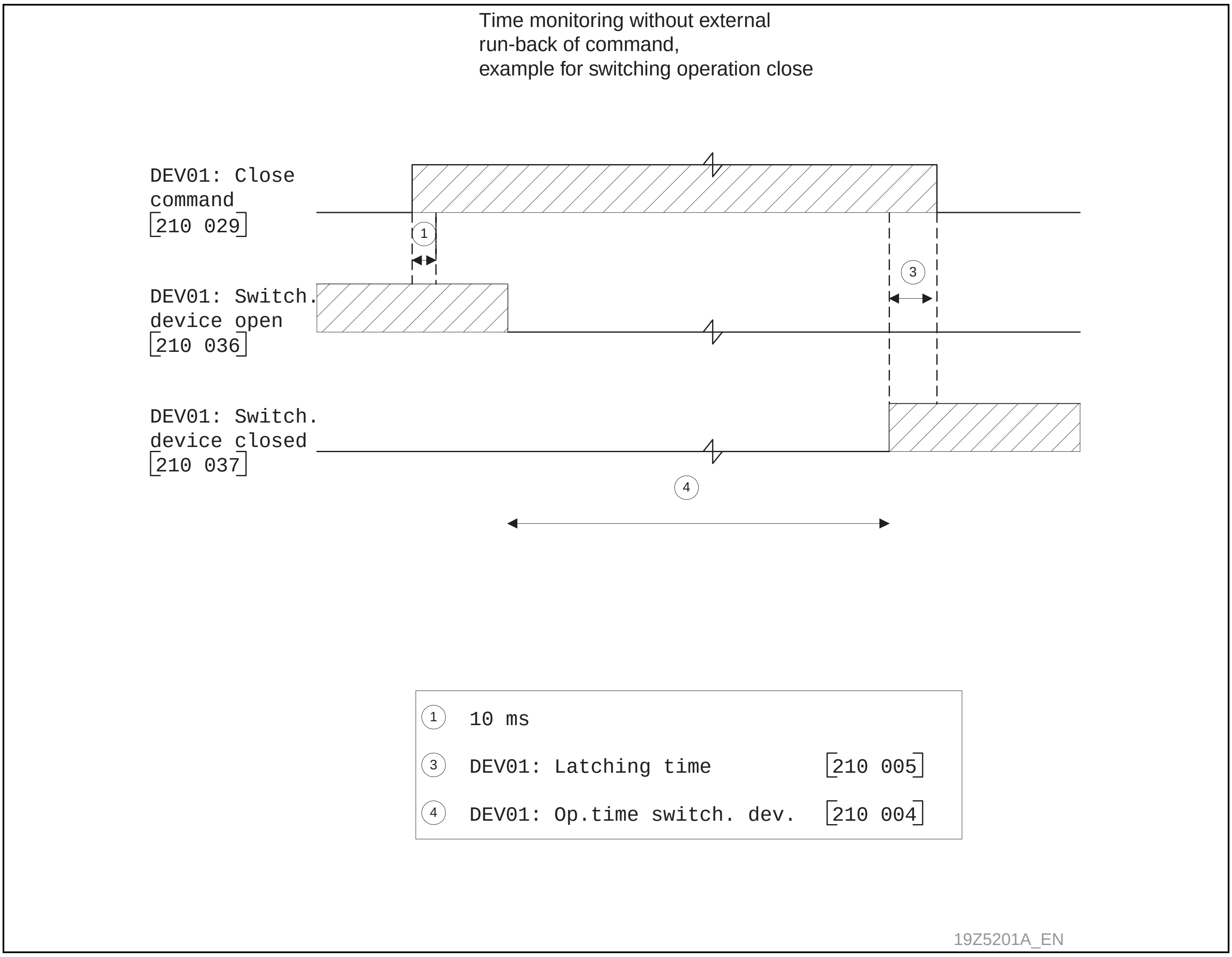
If the operating mode with external termination contacts was selected (MAIN: W. ext. cmd. termin. is set to *'Yes'*) the switching command is terminated, after the set latching time has elapsed, when a termination command is issued while the set time period for running time monitoring is active.

Switch truck

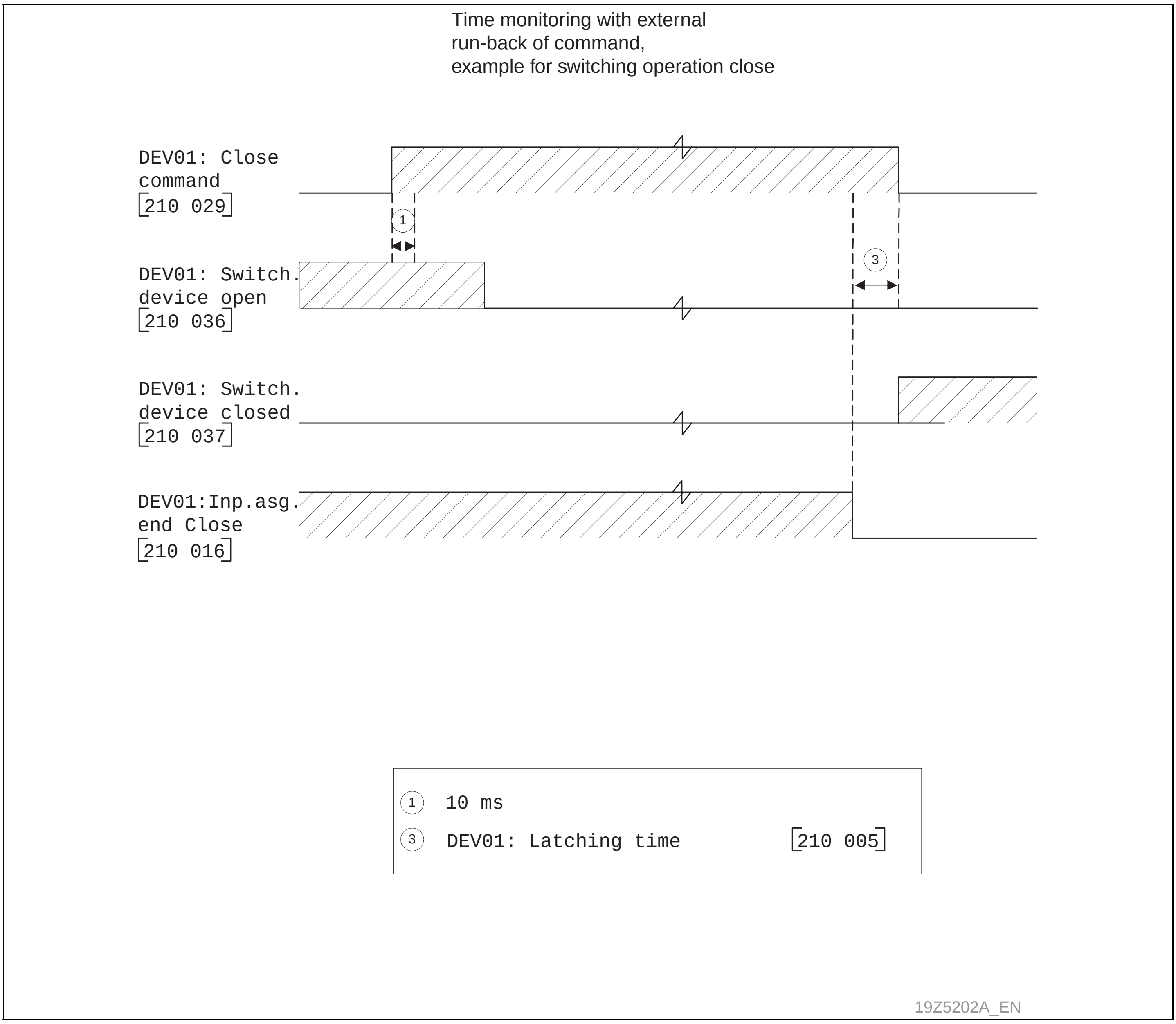
For switchgear units mounted on switch trucks with switch truck plugs, it is possible to configure a single-pole status signal from the switch truck plug. If such a configuration has been assigned, the status signal for the position of the associated switchgear unit is set to ‘Open’ while the input has a logic value of '1'.



3-297 *Monitoring of switching commands*



3-298 Sequence for time control of switching commands without external termination control



3-299 Sequence for time control of switching commands <u>with</u> external termination control

Monitoring the number of CB operations permitted

The maximum number of CB operations within an ARC cycle (or within a specific time period) may be set with parameter MAIN: CB1 max oper. cap. Associated with this parameter is the counter at MAIN: CB1 act. oper. cap. to which the maximum number of CB operations permitted is assigned as soon as the positive edge of an event is present that has been selected by a '1 out of n' parameter at MAIN: CB1 ready fct.assign.

The number of CB operations permitted, set with the counter at MAIN: CB1 act. oper. cap. are then decremented by 1 with each CB operation. Operation of the CB is recognized from the contact position signals DEVxx: Switch. device open and DEVxx: Switch.device closed.

The counter at MAIN: CB1 act. oper. cap. may only be decremented to a value of 1. Reaching a value of 1 will in no way effect the protection or control functionality, in particular there will be no blocking of CB operation! When a CB fault has occurred (i.e. MAIN: CB1 faulty EXT is set to *'Yes'*) the counter MAIN: CB1 act. oper. cap. is immediately set to 1.

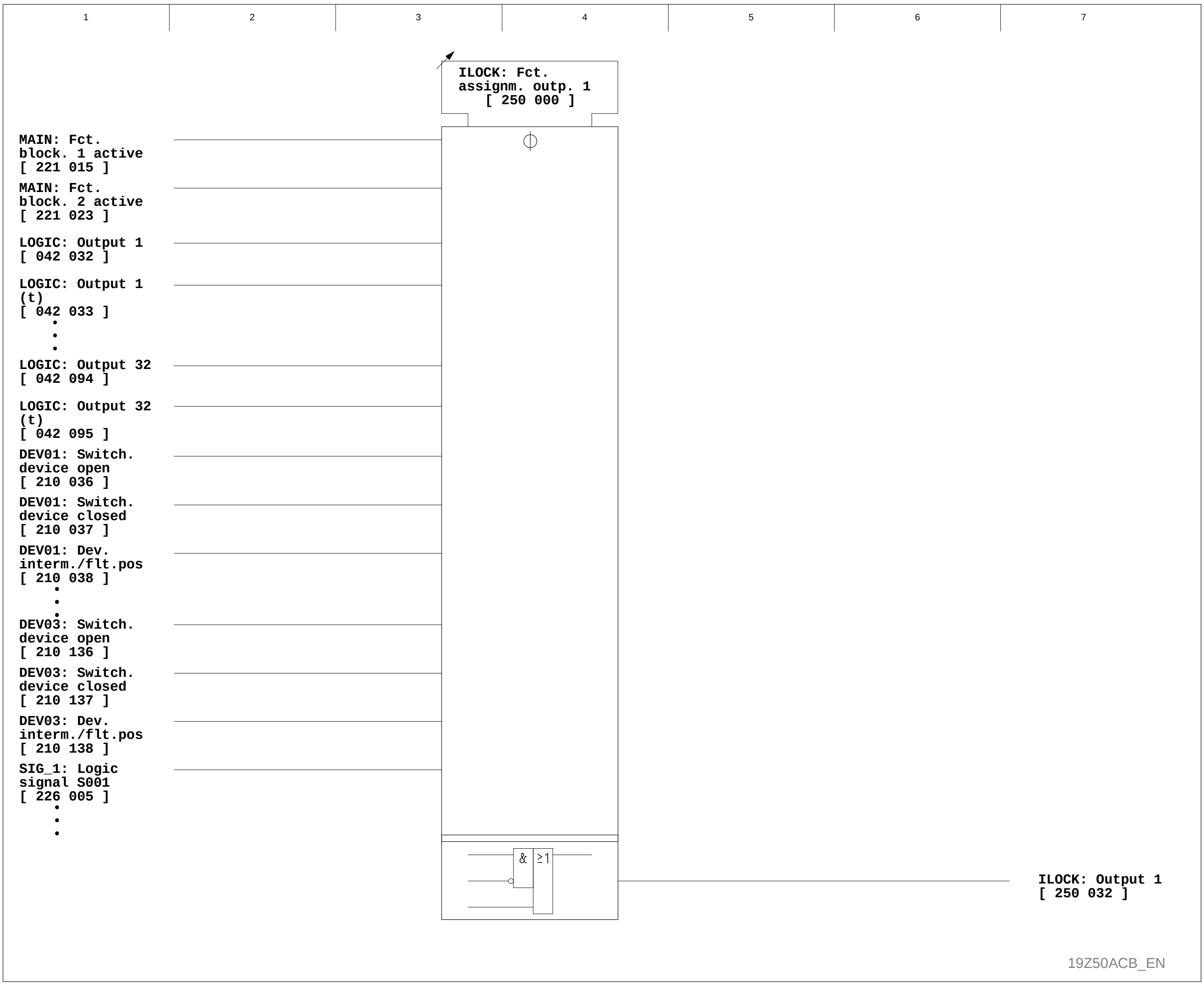
3.44 Interlocking Logic (Function Group ILOCK)

The switching commands to the controllable switchgear units of the bay are not enabled until the interlock conditions have been checked. The interlocks are defined in the form of Boolean equations in the interlocking logic function.

The choice of the bay type automatically defines the bay interlock conditions (or equations) for the ‘Open’ and ‘Close’ operations of the individual switchgear units in the bay. Different conditions are defined for the bay interlock equations for operation with or without station interlock (see the section entitled “List of Bay Types” in the Appendix). These automatically defined interlock conditions - determined by the choice of bay type - can be modified by the users at any time to fit their station requirements. For the bay interlock, the following signals acquired by the P132 are linked by logic operations:

- ☐ Function blocks 1 and 2
- ☐ The programmable logic outputs
- ☐ The signals from binary inputs after debouncing and chatter suppression
- ☐ The position signals of the switchgear units after debouncing and chatter suppression

A maximum of 32 equations with 32 equation elements each are available for definition of the interlock conditions. The Boolean equations need to be defined without the use of brackets. The following rule applies to the operators: ‘NOT’ before ‘AND’ before ‘OR’. The output signal of one equation can be processed as the input signal for another higher-order equation, and this makes it possible to have a sequence of nested Boolean equations.



3-300 Interlocking logic illustrated for equation 1

3.45 Single-pole Commands (Function Group CMD_1)

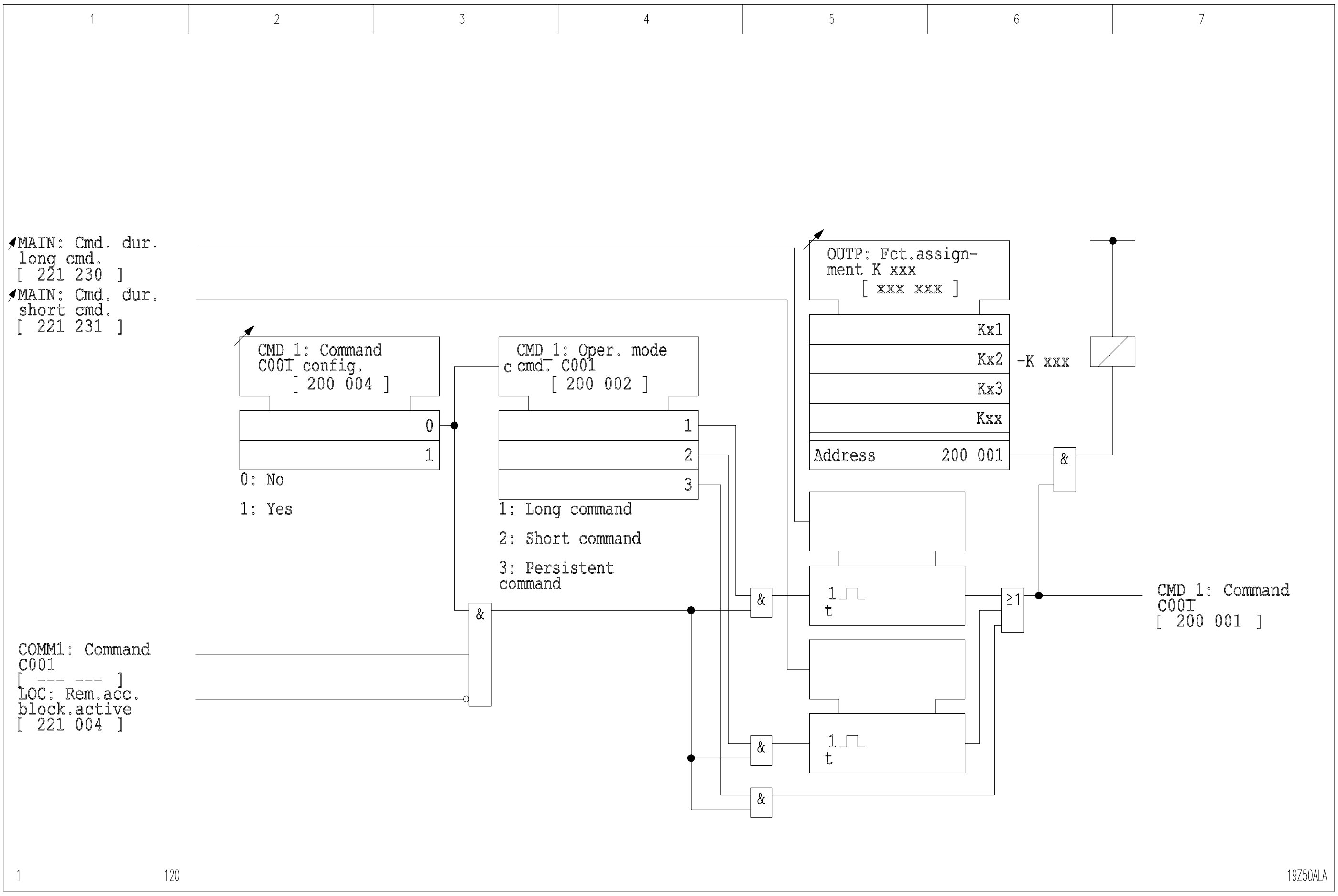
Commands may be transmitted to the P132 via the communications interface. When the P132 receives such a command, and the remote control mode is enabled, an appropriately configured output relay will be triggered and a signal is issued.

The operating mode may be selected individually for each single-pole command. The following settings are possible:

- ☐ Long command
- ☐ Short command
- ☐ Persistent command

If the operating mode long or short command has been selected the output relay will be triggered for the time period set at MAIN: Cmd. dur.long cmd. or MAIN: Cmd. dur. short cmd.

The setting possibilities and the functional sequence is displayed in the example for Command C001. This will apply accordingly to all other single-pole commands.



3-301 Functional sequence for single-pole commands in the example for Command C001

3.46 Single-Pole Signals (Function Group SIG_1)

Binary, single-pole signals from the station can be transmitted by the P132 to the control station through appropriately configured binary signal inputs.

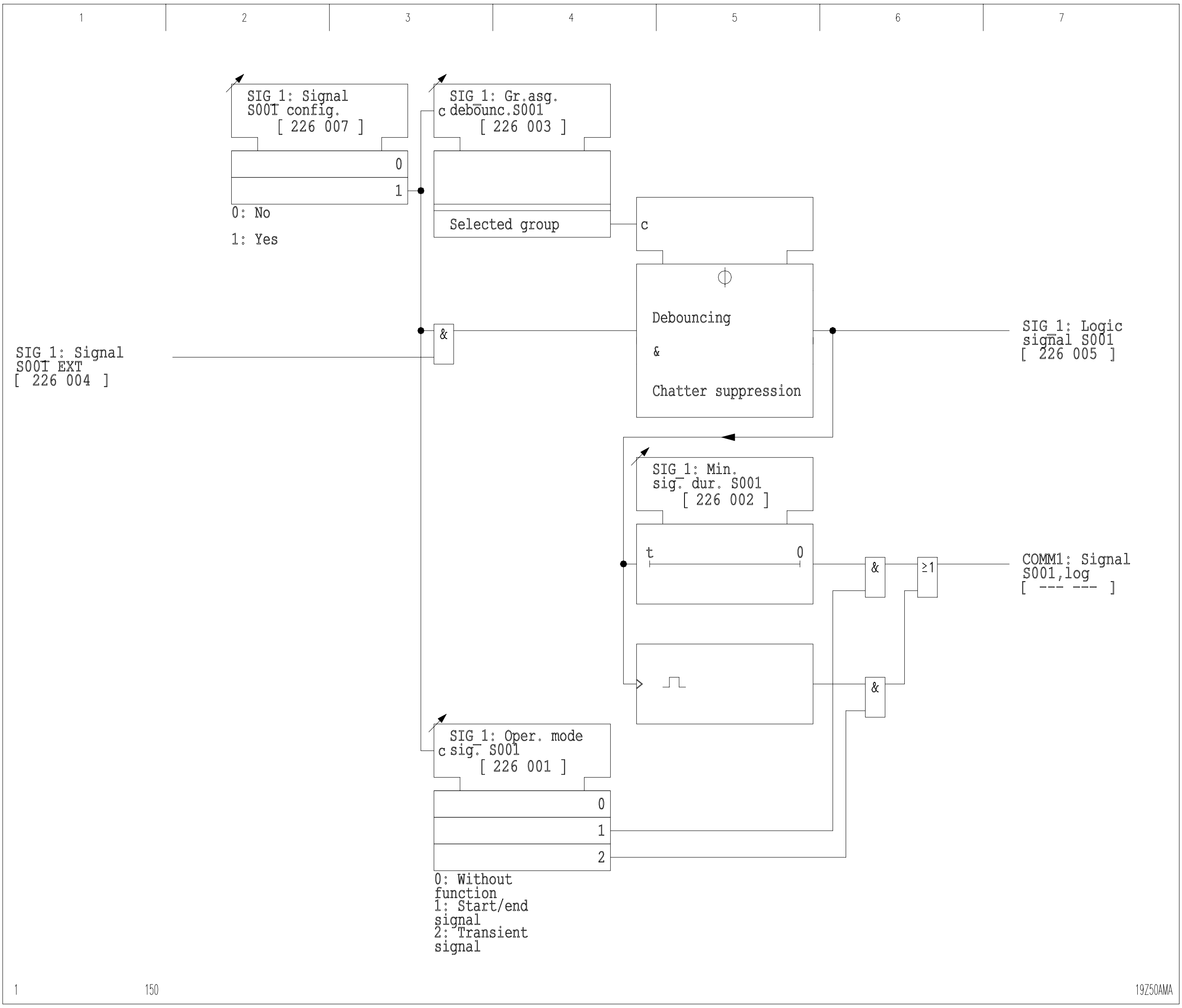
The input signal is conditioned by debouncing and chatter suppression (see: 'Main Functions of the P132). The conditioned signal is then available as `SIG_1: Logic signal xxx`.

Signaling characteristics can be defined through the communication interface by setting the operating mode. The following settings are possible:

- ☐ Without function:
- ☐ Start/end signal
- ☐ Transient signal

If the setting is *Without function*, then no telegram is sent when there is a state change at the binary input. If the setting is *Start/end signal* then a telegram is sent each time there is a state change. The requirement for sending the 'start' signal is that the logic '1' signal be available for the set minimum time. If the setting is *Transient signal,* telegrams are only sent if there is a state change from logic '0' to logic '1'.

The following figure shows the setting options and the functional sequence for signal S001. Equivalent considerations apply to all other single-pole signals.



3-302 *Functional sequence for single-pole signals, illustrated for signal S001*

4 Design

The P132 is available in different types of cases and with different combinations of modules.

Irrespective of the type a P132 is equipped with a detachable HMI or a fixed local control panel. (Exception: The case 24T is only available with a fixed local control panel.) The local control panel is covered with a tough film so that the specified degree of IP protection will be maintained. In addition to the essential control and display elements, a parallel display consisting of a total of 17 LED indicators is also incorporated. The meaning of the various LED indications is shown in plain text on a label strip.

The PC interface (9-pin D-Sub female connector) is located under the hinged cover at the bottom of the local control panel.

4.1 Designs

The P132 is available in a surface-mounted and a flush-mounted case.

Electrical connections are made via plug-in threaded terminal blocks. The threaded terminal blocks in the surface-mounted case are accessible from the front of the device after unscrewing the crosshead screws on the sides (see Figure 4-1, ①) and removing the local control panel. The local control panel can then be secured by inserting the tabs in the slots in the left side wall (see Figure 4-1, ②). The flush-mounted case is connected at the back of the case.

⚠

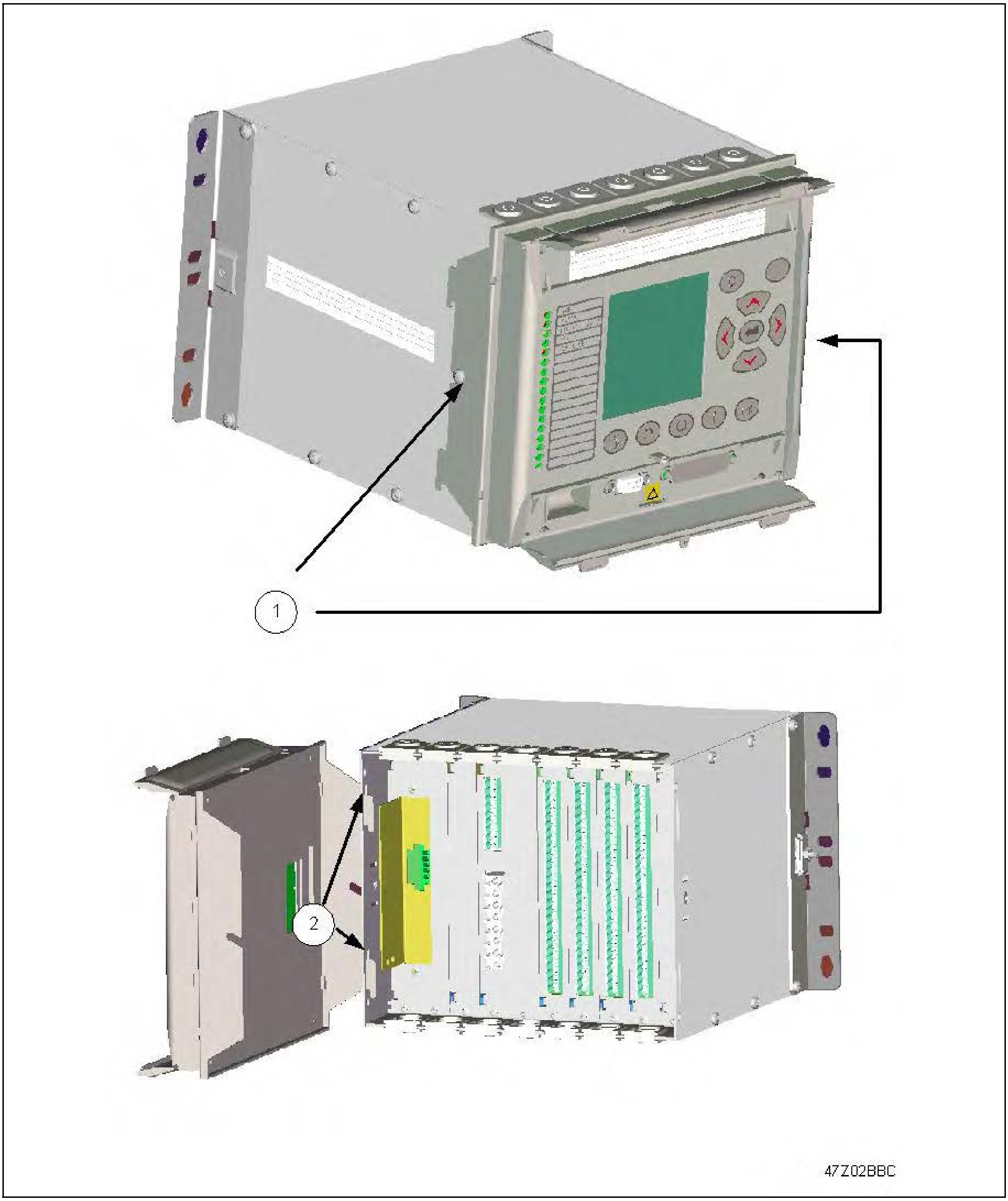
The local control panel is connected to processor module P by a plug-in connecting cable. Do not bend the connecting cable! Secure the local control panel by inserting it in the slots provided on the left.

⚠

The secondary circuit of live system current transformers must not be opened! If the secondary circuit of a live CT is opened, there is the danger that the resulting voltages will endanger personnel and damage the insulation.

⚠

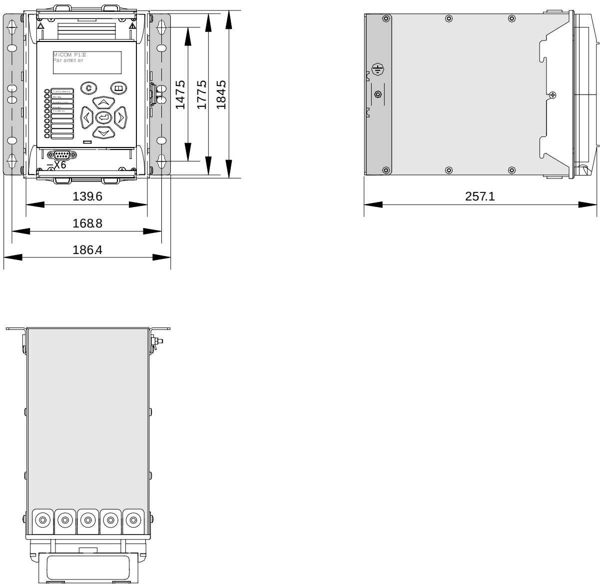
The threaded terminal block for system current transformer connection is not a shorting block! Therefore always short-circuit the system current transformers before loosening the threaded terminals.



4-1 Surface-mounted case, removal of local control panel (or - in case of a detachable HMI – the case front panel) illustration shows case 40T with (fixed) local control panel

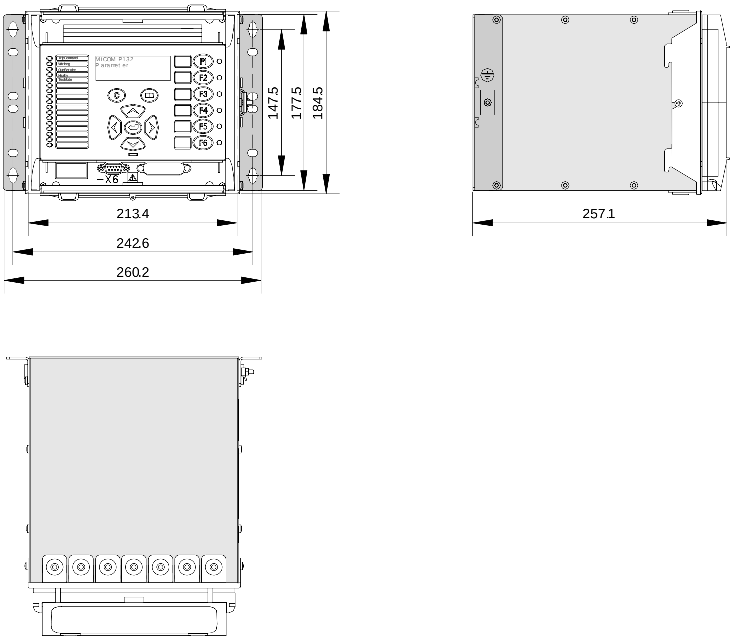
4.2 Dimensional Drawings

4.2.1 Surface-mounted case

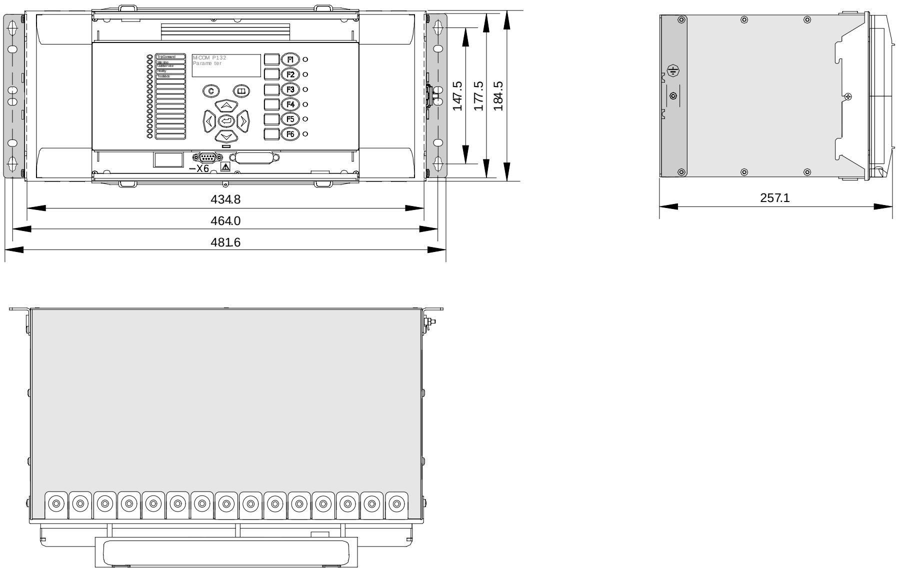


4-2 Dimensional drawing surface-mounted case 24T

4 Design
(continued)

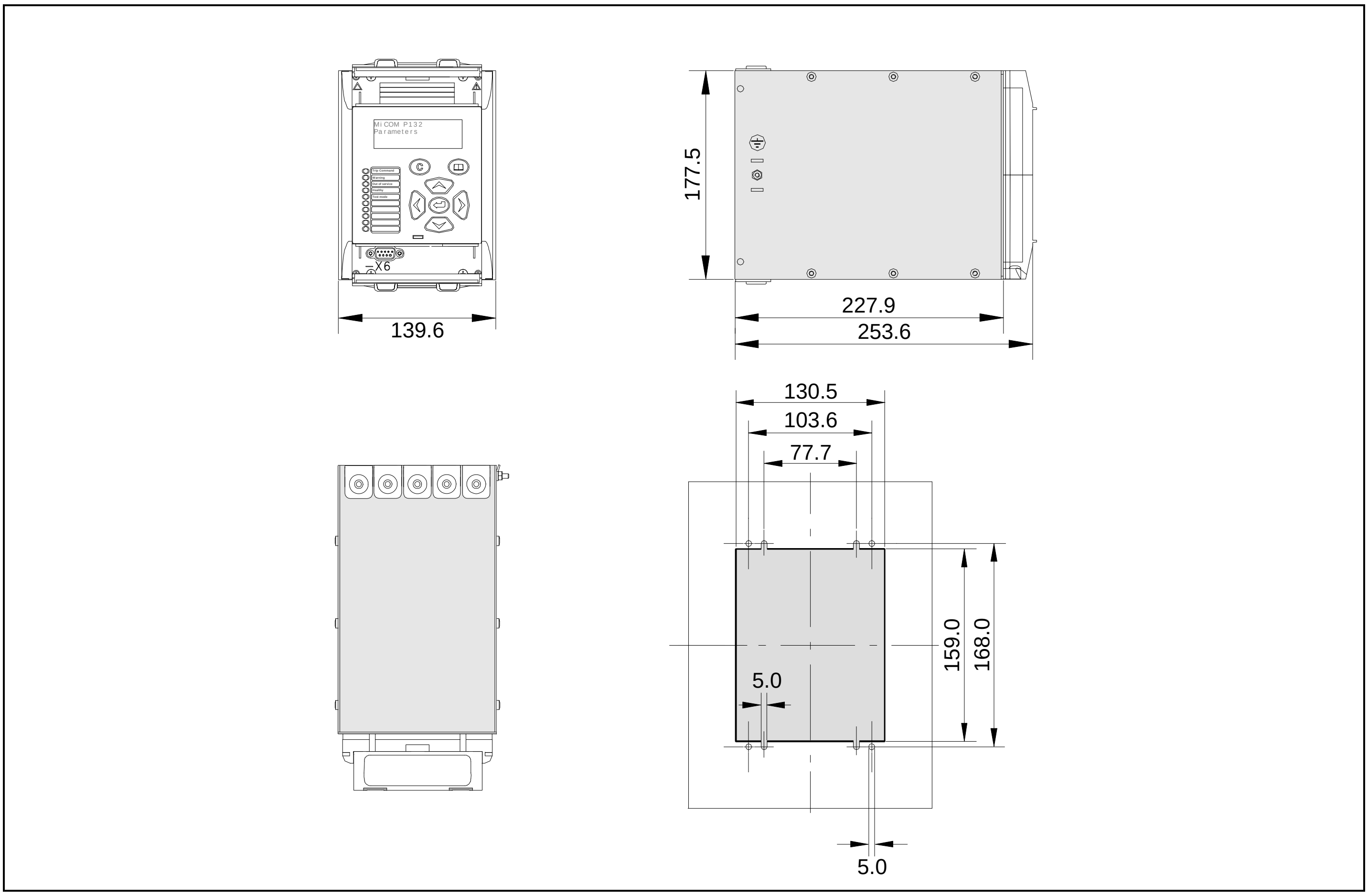


4-3 Dimensional drawing surface-mounted case 40T

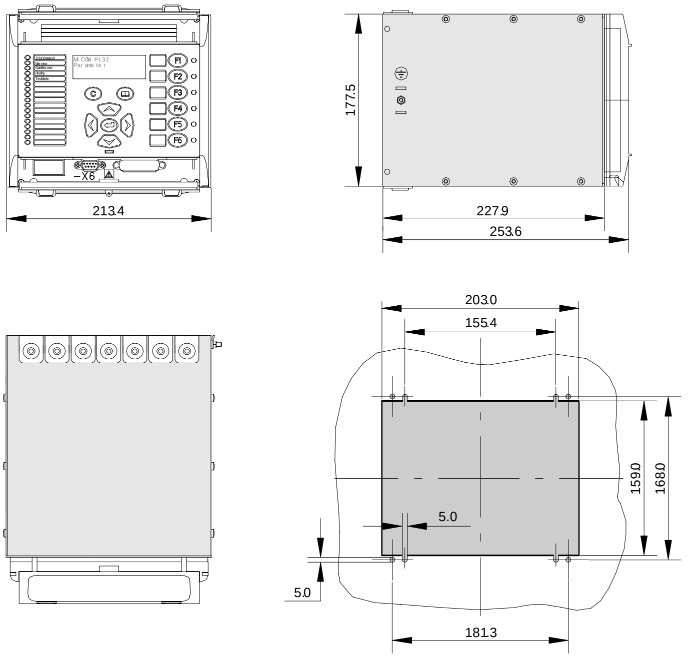


4-4 Dimensional drawing surface-mounted case 84T

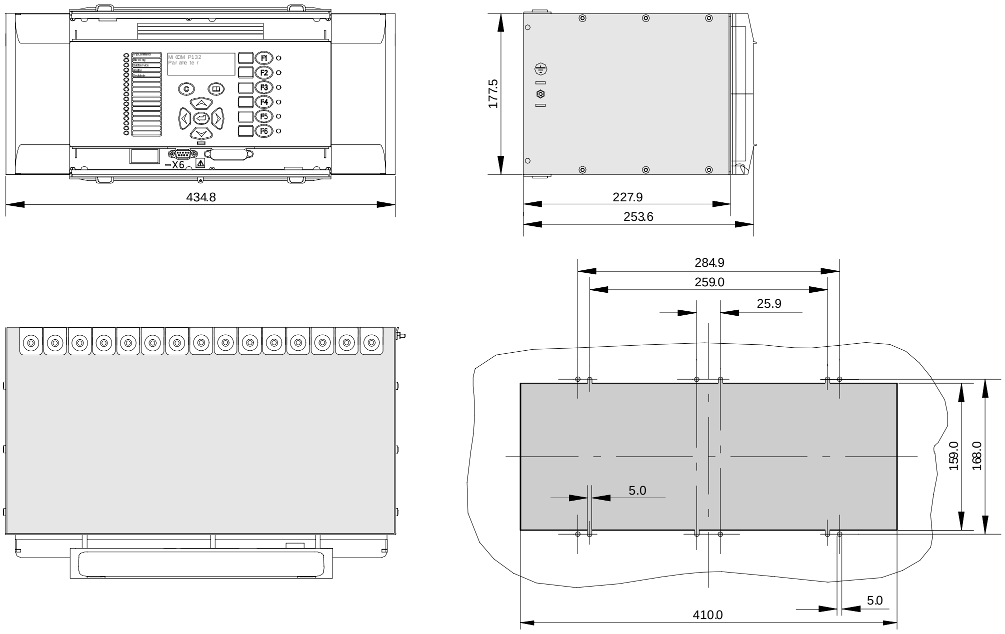
4.2.2 Flush-mounted case, flush-mount method 1 (without angle brackets)



4-5 *Flush-mounted case 24T with panel opening, flush-mount method 1 (without angle brackets)*
Note: The device has increased mechanical robustness if flush-mount method 2 (with angle brackets and frame, shown three drawings further) is used for the flush-mounted case.

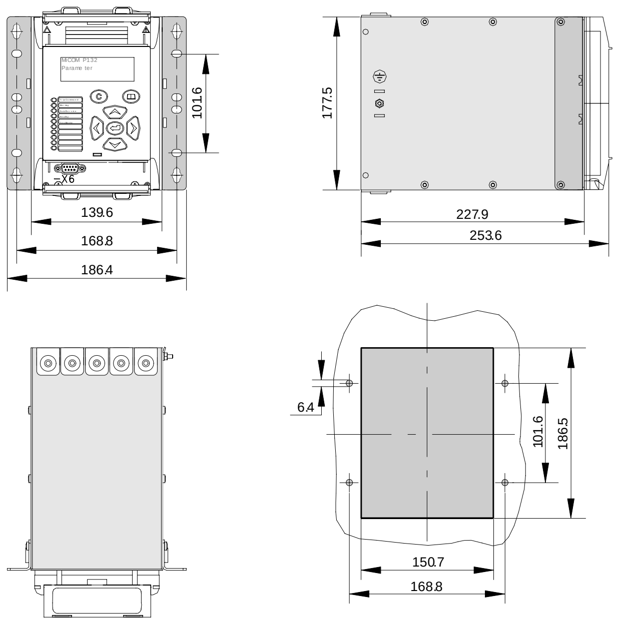


4-6 *Flush-mounted case 40T with panel opening, flush-mount method 1 (without angle brackets)*

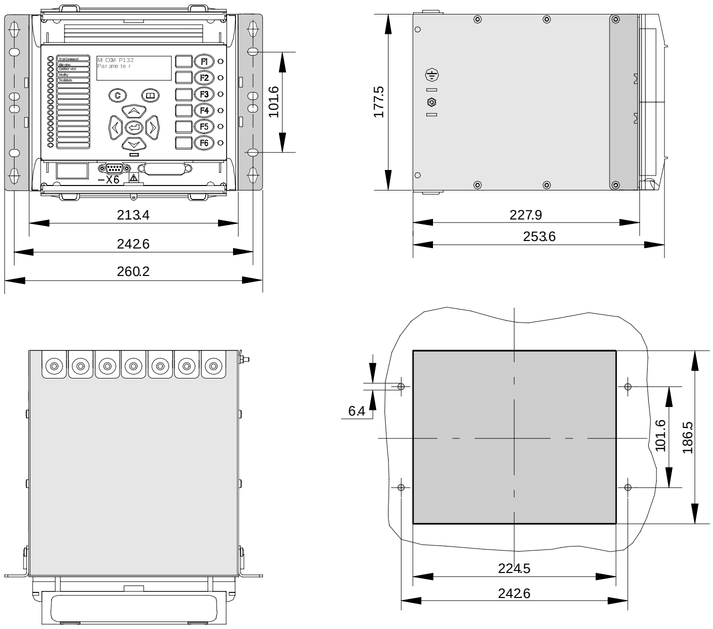


4-7 *Flush-mounted case 84T with panel opening, flush-mount method 1 (without angle brackets)*
Note: The device has increased mechanical robustness if flush-mount method 2 (with angle brackets and frame, shown in next drawing) is used for the flush-mounted case.

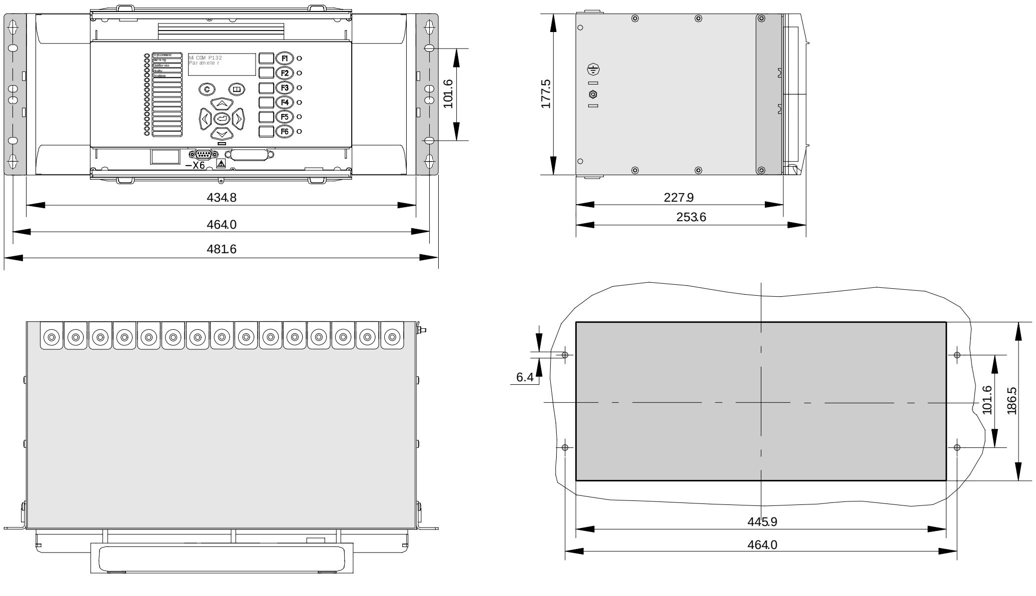
4.2.3 Flush mounted case, flush-mounting method 2 (with angle brackets and frame)



4-8 Flush-mounted case 24T with panel opening, flush-mount method 2 (with angle brackets and frame)



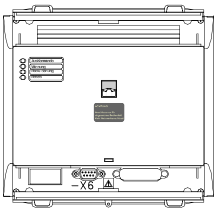
4-9 Flush-mounted case 40T with panel opening, flush-mount method 2 (with angle brackets and frame)
Note: The device has increased mechanical robustness if flush-mount method 2 (with angle brackets and frame, shown in this drawing) is used for the flush-mounted case.



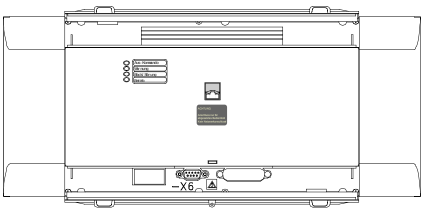
4-10 Flush-mounted case 84T with panel opening, flush-mount method 2 (with angle brackets and frame)
Note: The device has increased mechanical robustness if flush-mount method 2 (with angle brackets and frame, shown in this drawing) is used for the flush-mounted case.

4.2.4 Device views for connection of detachable HMI

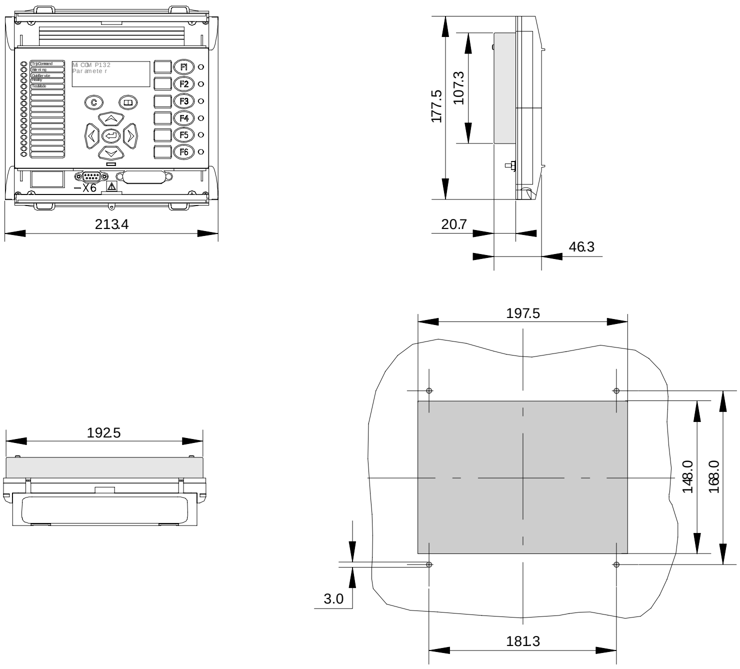
View of case 40T for connection of detachable HMI:



View of case 84T for connection of detachable HMI:



Detachable HMI with panel opening:



4-11 Device views for connection of detachable HMI
Note: Connection of protective grounding conductor: See section 5.5

4.3 Modules

The P132 is constructed from standard hardware modules. The following table gives an overview of the modules relevant for the P132.
(*: modules that are not shown in the location diagrams, ○: optional, ●: standard equipment, ☐: depending on order).

Type	Item number	Index	Description	Width	24 T	40 T	84 T
A	9650 356	A ff	Communication module (for RS 485 wire connection)	4T	○	○	○
A	9650 354	A ff	Communication module (for glass fiber, ST connector)	4T	○	○	○
A	9650 355	A ff	Communication module (for plastic fiber)	4T	○	○	○
A	9650 353	A ff	Communication module (IRIG-B only)	4T	○	○	○
A	9651 471	E ff	Ethernet module (for 100 Mbit/s Ethernet, glass fiber, ST connector and RJ45 wire)	4T	○	○	○
A	9651 427	E ff	Ethernet module (for 100 Mbit/s Ethernet, glass fiber, SC connector and RJ45 wire)	4T	○	○	○
A	9650 827	B ff	InterMiCOM Module COMM3 (RS 485)	4T	○	○	○
A	9650 828	B ff	InterMiCOM Module COMM3 (for glass fiber)	4T	○	○	○
A	9650 829	B ff	InterMiCOM Module COMM3 (for plastic fiber)	4T	○	○	○
A	9650 830	B ff	InterMiCOM Module COMM3 (RS 232)	4T	○	○	○
B	0336 186	B ff *	Bus module (digital)		●		
B	0336 187	D ff *	Bus module (digital)			●	
B	0336 188	C ff *	Bus module (digital)				●
B	0336 421	B ff *	Bus module (analog)		●	●	●
L	9650 194	C ff *	Local control module (Europ.)			☐	☐
L	9650 443	B ff *	Local control module (Cyrillic)			☐	☐
L	9651 473	B ff *	Local control module (Europ. for device version with DHMI)			☐	☐
L	9651 474	B ff *	Local control module (Cyrillic for device version with DHMI)			☐	☐
L	9650 563	B ff *	Front plate (for device version 40T with DHMI)			☐	
L	9650 563	B ff *	Front plate (for device version 84T with DHMI)				☐
L	9651 491	B ff *	Local control module (Europ.)		●		
L	9651 492	B ff *	Local control module (Cyrillic)		☐		
N	0337 086	B ff	Transient ground fault evaluation module	4T		○	○
			Processor module (up to hardware version -303)				
P	9651 472	B ff	Processor module (as of hardware version -304)	4T	●	●	●
T	9650 307	A ff	Transformer module 4 x I, 4 x V (pin connection)	8T	☐	☐	☐
T	9650 308	A ff	Transformer module 4 x I, 5 x V (pin connection)	8T	☐	☐	☐
T	9650 309	A ff	Transformer module 4 x I (pin connection)	8T	☐	☐	☐
T	9650 098	F ff	Transformer module 4 x V (pin connection)	8T	☐	☐	☐
T	9650 321	A ff	Transformer module 4 x I, 4 x V (ring connection)	8T	☐	☐	☐
T	9650 322	A ff	Transformer module 4 x I, 5 x V (ring connection)	8T	☐	☐	☐
T	9650 323	A ff	Transformer module 4 x I (ring connection)	8T	☐	☐	☐

Type	Item number	Index	Description	Width	24 T	40 T	84 T
T	9650 335	A ff	Transformer module 4 x V (ring connection)	8T	☐	☐	☐
V	0337 437	E ff	Power supply module 24 V DC Standard variant (switching threshold 18 V)	4T	☐	☐	☐
V	9651 300	A ff	Power supply module 24 V DC, switching threshold 73 V	4T	☐	☐	☐
V	9651 328	A ff	Power supply module 24 V DC, switching threshold 90 V	4T	☐	☐	☐
V	9651 439	A ff	Power supply module 24 V DC, switching threshold 146 V	4T	☐	☐	☐
V	9651 356	A ff	Power supply module 24 V DC, switching threshold 155 V	4T	☐	☐	☐
V	0337 191	M ff	Power supply module 48 to 250 V DC / 100 to 230 V AC, Standard variant (switching threshold 18 V)	4T	☐	☐	☐
V	9651 301	A ff	Power supply module 48 to 250 V DC / 100 to 230 V AC, switching threshold 73 V	4T	☐	☐	☐
V	9651 329	A ff	Power supply module 48 to 250 V DC / 100 to 230 V AC, switching threshold 90 V	4T	☐	☐	☐
V	9651 437	A ff	Power supply module 48 to 250 V DC / 100 to 230 V AC, switching threshold 146 V	4T	☐	☐	☐
V	9651 357	A ff	Power supply module 48 to 250 V DC / 100 to 230 V AC, switching threshold 155 V	4T	☐	☐	☐
X	0337 612	A ff	Binary I/O module (24 binary inputs), Standard variant (switching threshold 18 V)	4T		○	○
X	9651 304	A ff	Binary I/O module (24 binary inputs), switching threshold 73 V	4T		○	○
X	9651 332	A ff	Binary I/O module (24 binary inputs), switching threshold 90 V	4T		○	○
X	9651 443	A ff	Binary I/O module (24 binary inputs), switching threshold 146 V	4T		○	○
X	9651 360	A ff	Binary I/O module (24 binary inputs), switching threshold 155 V	4T		○	○
X	0337 377	E ff	Binary I/O module (6 binary inputs & 6 output relays), Standard variant (switching threshold 18 V)	4T		○	○
X	9651 305	A ff	Binary I/O module (6 binary inputs & 6 output relays), switching threshold 73 V	4T		○	○
X	9651 333	A ff	Binary I/O module (6 binary inputs & 6 output relays), switching threshold 90 V	4T		○	○
X	9651 444	A ff	Binary I/O module (6 binary inputs & 6 output relays), switching threshold 146 V	4T		○	○
X	9651 361	A ff	Binary I/O module (6 binary inputs & 6 output relays), switching threshold 155 V	4T		○	○
X	0336 971	D ff	Binary I/O module (6 binary inputs & 8 output relays), Standard variant (switching threshold 18 V)	4T		○	○
X	9651 306	A ff	Binary I/O module (6 binary inputs & 8 output relays), switching threshold 73 V	4T		○	○
X	9651 334	A ff	Binary I/O module (6 binary inputs & 8 output relays), switching threshold 90 V	4T		○	○

Type	Item number	Index	Description	Width	24 T	40 T	84 T
X	9651 445	A ff	Binary I/O module (6 binary inputs & 8 output relays), switching threshold 146 V	4T		○	○
X	9651 362	A ff	Binary I/O module (6 binary inputs & 8 output relays), switching threshold 155 V	4T		○	○
X	0336 973	B ff	Binary module (6 output relays)	4T	○	○	○
X	9650 341	B ff	Binary module (6 output relays, 4 of these with triacs)	4T	○	○	○
X	9651 493	B ff	Binary module (4 high-power contacts)	4T	○	○	○
Y	0337 406	D ff	Analog I/O module, Standard variant (switching threshold 18 V)	4T		○	○
Y	9651 307	A ff	Analog I/O module, switching threshold 73 V	4T		○	○
Y	9651 335	A ff	Analog I/O module, switching threshold 90 V	4T		○	○
Y	9651 446	A ff	Analog I/O module, switching threshold 146 V	4T		○	○
Y	9651 363	A ff	Analog I/O module, switching threshold 155 V	4T		○	○
Y	9650 735	C ff	Analog I/O module (RTD) / temperature p/c board	4T		○	○

The space available for the modules measures 4H in height by 24T, 40T or 84T in width (1H = 44.45 mm, 1T = 5.08 mm).

Location

The location of the individual modules and the position of the threaded terminal blocks in the P132 are shown in the location figures and terminal connection diagrams at the end of Chapter 5.

5 Installation and Connection

⚠

Only qualified personnel, familiar with the "Warning" page at the beginning of this manual, may work on or operate this device.

⚠

The instructions given in the "Protective and Operational Grounding" section should be noted. In particular, check that the protective ground connection is secured with a tooth lock washer, as per the diagram "Installing the protective grounding conductor terminal". If a cable screen is added to this connection or removed from it, then the protective grounding should be checked again.

⚠

The SC connector and RJ45 wire of the Ethernet module cannot be connected at the same time. (The selection for IEC: Ethernet Media should be noted.)

5.1 Unpacking and Packing

All P132 overcurrent and control devices are packaged separately into dedicated cartons and shipped with outer packaging. Use special care when opening cartons and unpacking devices, and do not use force. In addition, make sure to remove supporting documents and the type identification label supplied with each individual device from the inside carton. The design revision level of each module included in the device when shipped can be determined from the list of components (assembly list). This list of components should be filed carefully.

After unpacking, each device should be inspected visually to confirm it is in proper mechanical condition.

If the P132 needs to be shipped, both inner and outer packaging must be used. If the original packaging is no longer available, make sure that packaging conforms to DIN ISO 2248 specifications for a drop height ≤ 0.8 m.

5.2 Checking Nominal Data and Design Type

The nominal data and design type of the P132 can be determined by checking the type identification label (see Figure 5-1). One type identification label is located under the upper hinged cover on the front panel and a second label can be found on the inside of the device. Another copy of the type identification label is fixed to the outside of the P132 packaging.

<table>
<tr><td>P132</td><td colspan="4">P132-XXXXXXX-306-41x-612</td><td colspan="2">Diagram P132.41x</td><td>xx.yy</td></tr>
<tr><td colspan="2">$U_{nom / NE,nom}$ = 50 ... 130 V</td><td>I_{nom} = 1 / 5 A</td><td>$I_{N,nom}$ = 1 / 5 A</td><td>$I_{EP,nom}$ = A</td><td></td><td>f_{nom} = 50/60 Hz</td><td></td></tr>
<tr><td colspan="3">$U_{H,nom}$ =</td><td colspan="2">$U_{N,nom}$ = 24 … 250 V DC</td><td colspan="2"></td><td rowspan="2">CE</td></tr>
<tr><td>Schneider Electric</td><td colspan="3">Specification
EN 60255-6 / IEC 255-6</td><td colspan="3">F 6.xxxxxx.y</td></tr>
</table>

5-1 *Type identification label P132*

The P132 design version can be determined from the order number. A breakdown of the order number is given in Chapter 14 of this manual and in the supporting documents supplied with the unit.

5.3 Location Requirements

The P132 has been designed to conform to DIN 57 435 part 303. Therefore it is important when choosing the installation location to make certain that it provides the operating conditions as specified in above DIN norm sections 3.2 to 3.4. Several of these important operating conditions are listed below.

Environmental Conditions

Ambient temperature:	-5 °C to +55 °C [+23 °F to +131 °F]
Air pressure:	800 to 1100 hPa
Relative humidity:	The relative humidity must not result in the formation of either condensed water or ice in the P132.
Ambient air:	The ambient air must not be significantly polluted by dust, smoke, gases or vapors, or salt content.
Solar radiation:	Direct solar radiation on the front of the device must be avoided to ensure that the LC-Display remains readable.

Mechanical conditions

Vibration stress:	10 to 60 Hz, 0.035 mm and 60 to 150 Hz, 0.5 g
Earthquake resistance:	5 to 8 Hz, 3.5 mm / 1.5 mm, 8 to 35 Hz, 5 m/s^2, 3 x 1 cycle

Electrical conditions for auxiliary voltage of the power supply

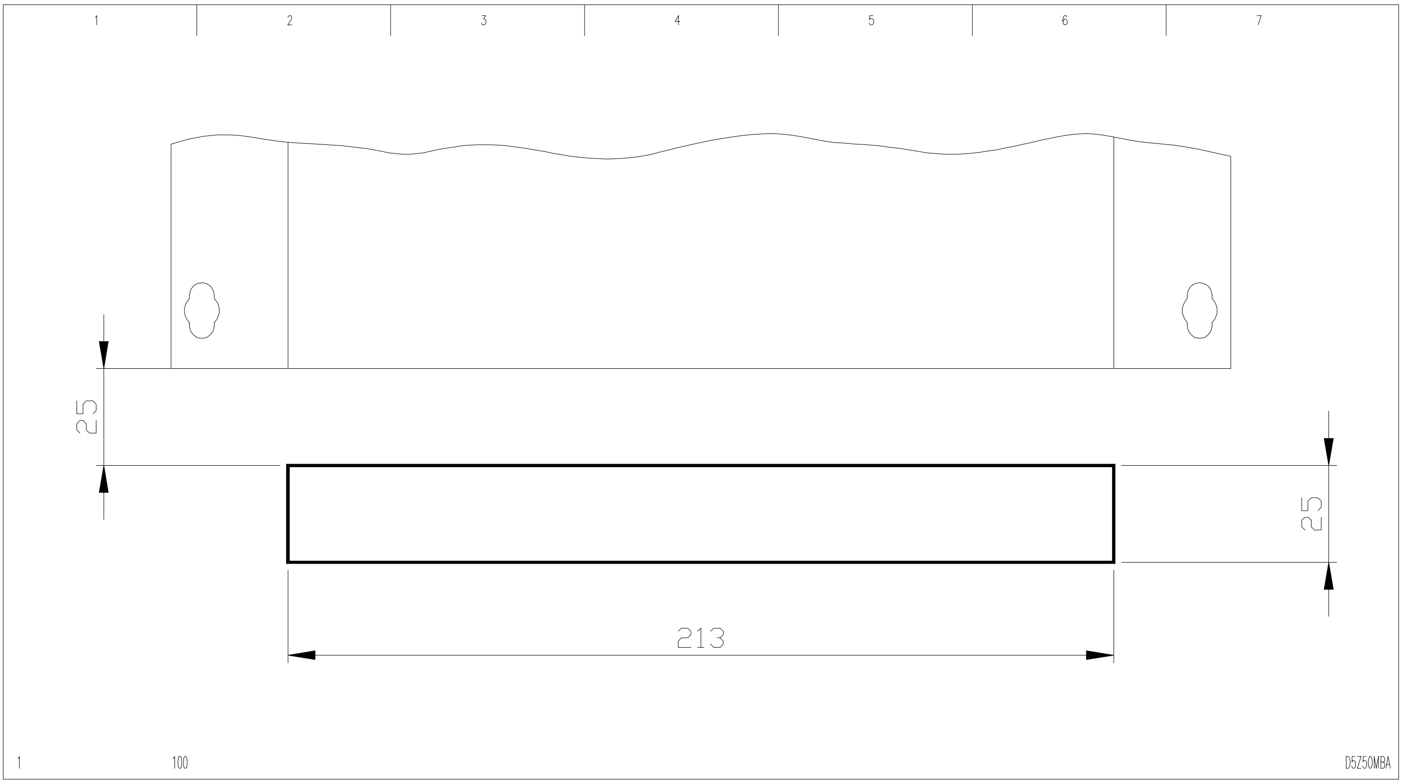
Operating range:	0.8 to 1.1 $V_{A,nom}$ with a residual ripple of up to 12 % $V_{A,nom}$

Electromagnetic conditions

Substation secondary system design must follow the best of modern practices, especially with respect to grounding and EMC.

5.4 Installation

The dimensions and mounting dimensions for surface-mounted cases are given in Chapter 4. When the P132 is surface-mounted on a panel, the wiring to the P132 is normally run along the front side of the mounting plane. If the wiring is to be at the back, an opening can be provided above or below the surface-mounted case. Figure 5-2 shows such an opening below the surface-mounted case.



5-2 Opening for running the wiring

The opening width
of the 24 T surface-mounted case is: 140 mm
of the 40 T surface-mounted case is: 213 mm (shown in this figure)
of the 84 T surface-mounted case is: 435 mm

The other dimensions are the same for all cases.

Flush-mounted cases are designed for control panels. The dimensions and mounting dimensions are given in Chapter 4. When the P132 is mounted on a cabinet door, special sealing measures are necessary to provide the degree of protection required for the cabinet (IP 51).

Connection of protective grounding conductor: See section 5.5

Instructions for selecting the flush-mount method:

The P132 has increased mechanical robustness if either the surface-mounted case or – for the flush-mounted case – flush-mount method 2 (with angle brackets and frame) is used. In this case, test severity class 2 of the vibration test, test severity class of the shock resistance test on operability as well as test severity class 1 of the shock resistance test on permanent shock are applied additionally.

Dimensions of the panel cutouts:

Dimensional drawings of the panel cutouts for all cases and for the detachable HMI can be found in section “Dimensional Drawings“ in chapter 4.

For flush-mount method 1 (without angle brackets and frame), the procedure is as follows:

Before the P132 can be installed into a control panel, the local control panel (or the front element of the case for devices with detachable display) must be taken down. The local control panel is removed as described below:

☐ Remove both top and bottom hinged flaps from the device. (Lift/lower both hinged flaps 180°up/down. Hold them in the middle and bend them slightly. The side mountings of both hinged flaps can then be disengaged.)

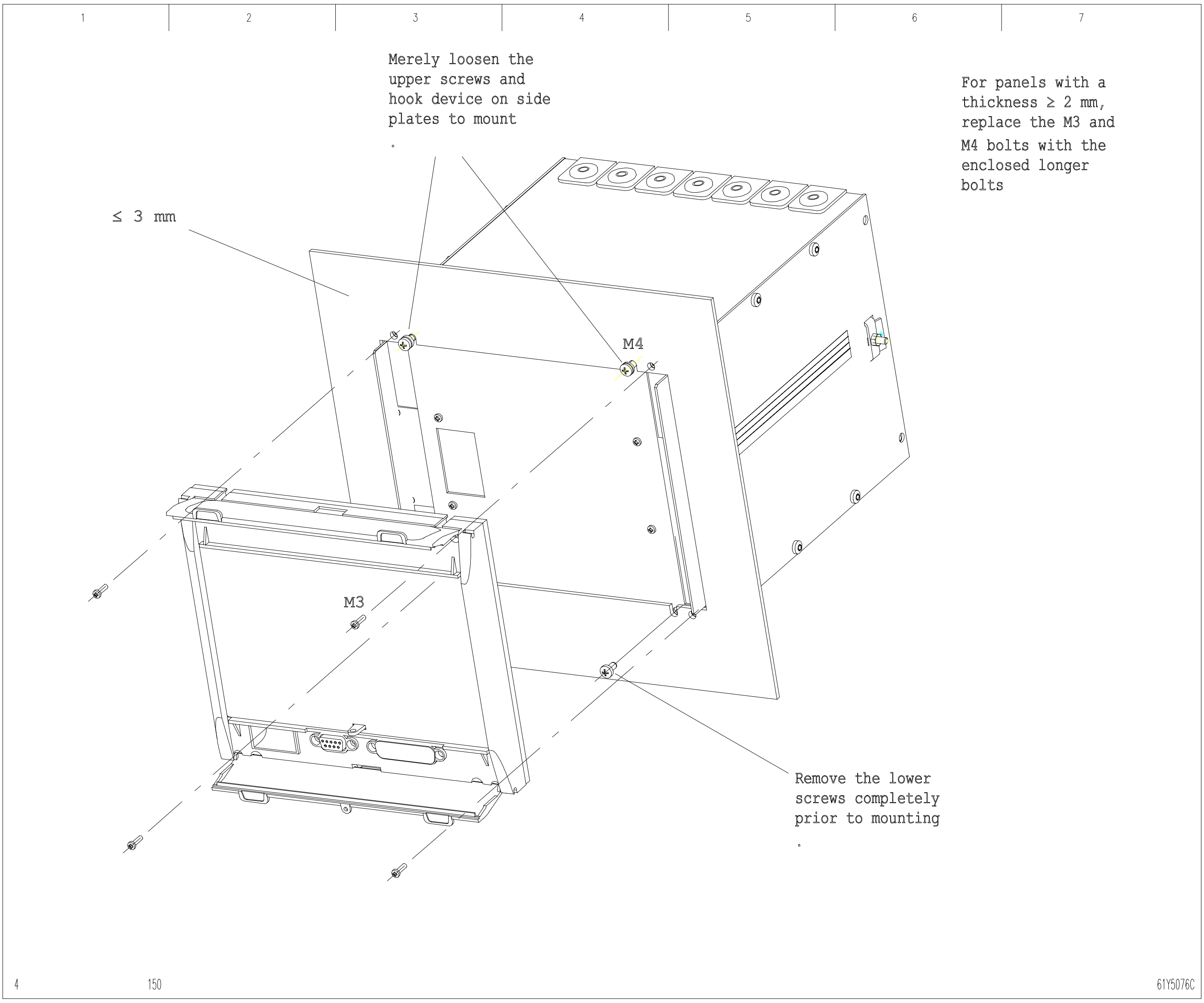
☐ Remove the M3 screws (see Figure 5-3).

☐ Then remove the local control panel.

The local control panel (or front element) is connected to processor module P by a plug-in connecting cable. Remember the connector position! Do not bend the connecting cable.

Then remove the lower M4 screws and only loosen the upper M4 screws (see Figure 5-3). Now insert the P132 into the panel opening from the rear so that the upper M4 screws fit into the corresponding holes. Then tighten all the M4 screws. After this, replace the local control panel.

Note: If the control panel thickness ≥ 2 mm, the longer M3 and M4 bolts must be used. Longer screws are enclosed within the device packing.



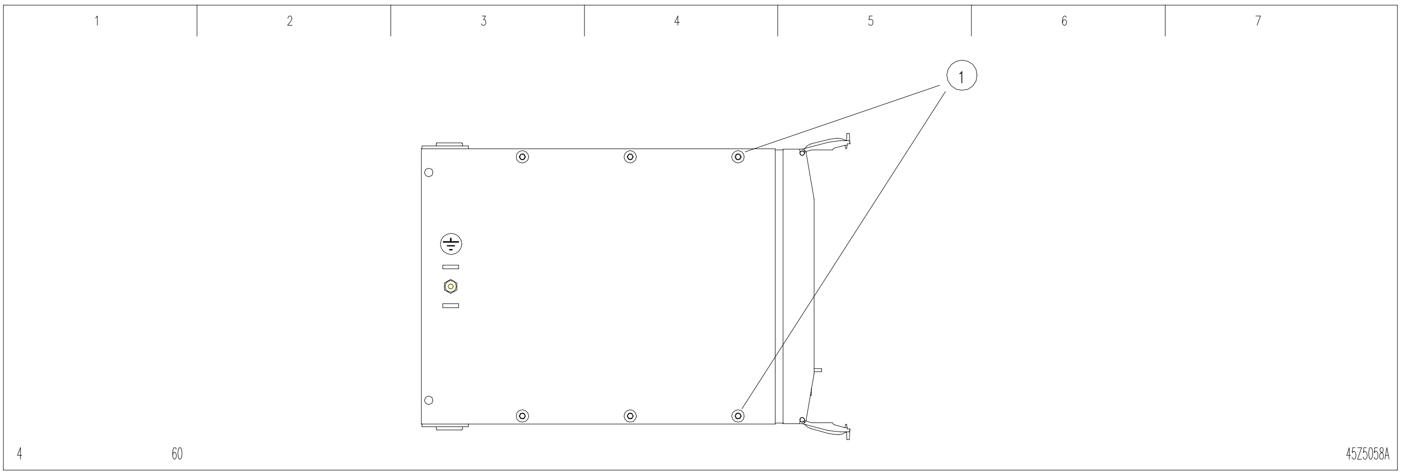
5-3 Installation of the case into a control panel, flush-mount method 1 (without angle brackets and frame). Example for a device in a 40 T case.

The P132 has increased mechanical robustness if either the surface-mounted case or for the flush-mounted case flush-mount method 2 (with angle brackets and frame, see figure 5-5.) is used.

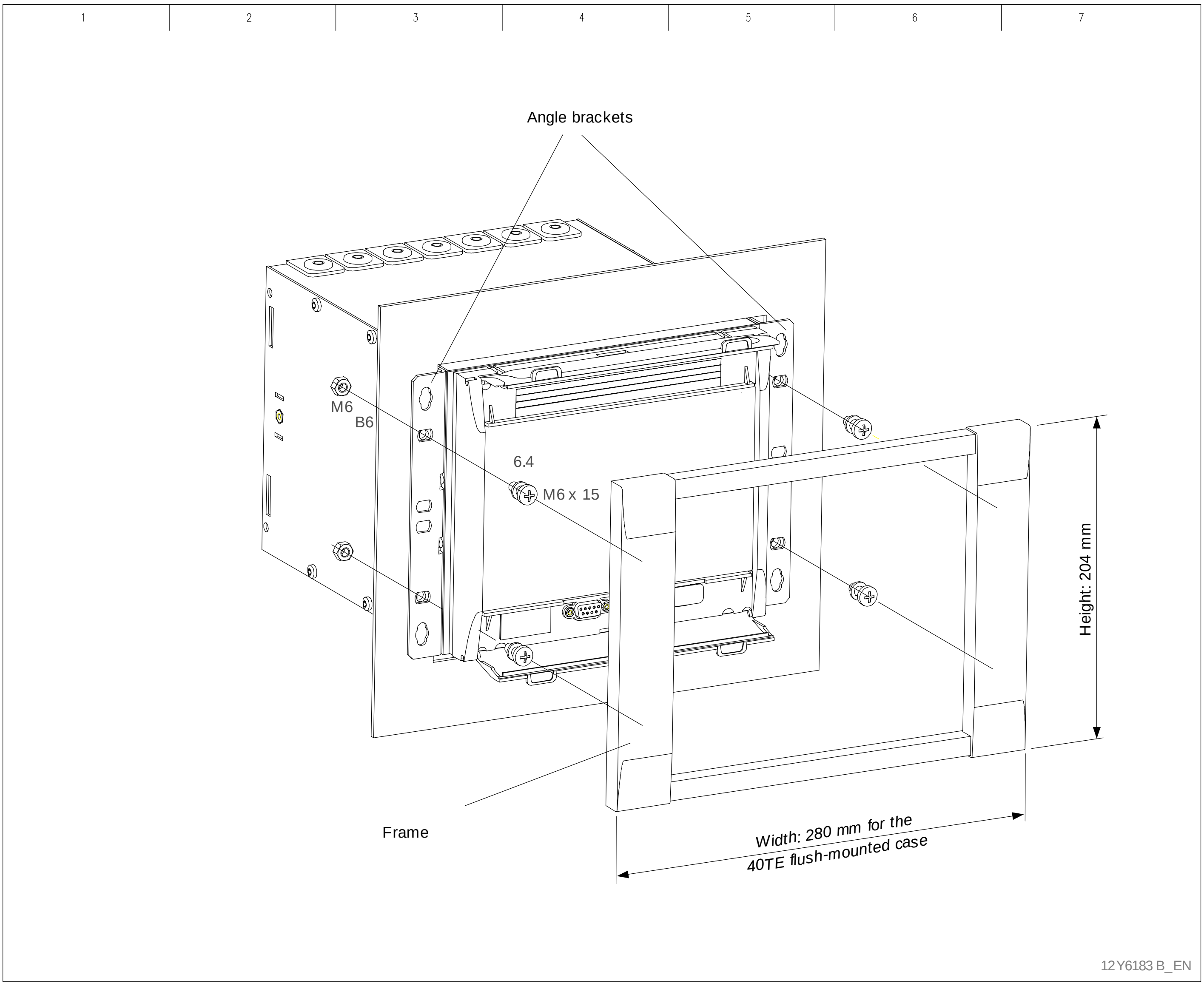
Connection of protective grounding conductor: See section 5.5

For flush-mount method 2 (using the angle brackets and frame), the procedure is as follows:

- ☐ Remove the screws as shown in Figure 5-4, ① and mount the enclosed angle brackets using these same screws.
- ☐ Then push the device into the control panel cutout from the front.
- ☐ Secure the device to the control panel by using the enclosed M6 screws (see Figure 5-5).
- ☐ Assemble the cover frame and snap-fasten onto the fixing screws.



5-4 Mounting the angle brackets



5-5 Installation of a case into a control panel, flush-mount method 2 (with angle brackets and frame)
Example for a device in a 40 T case.

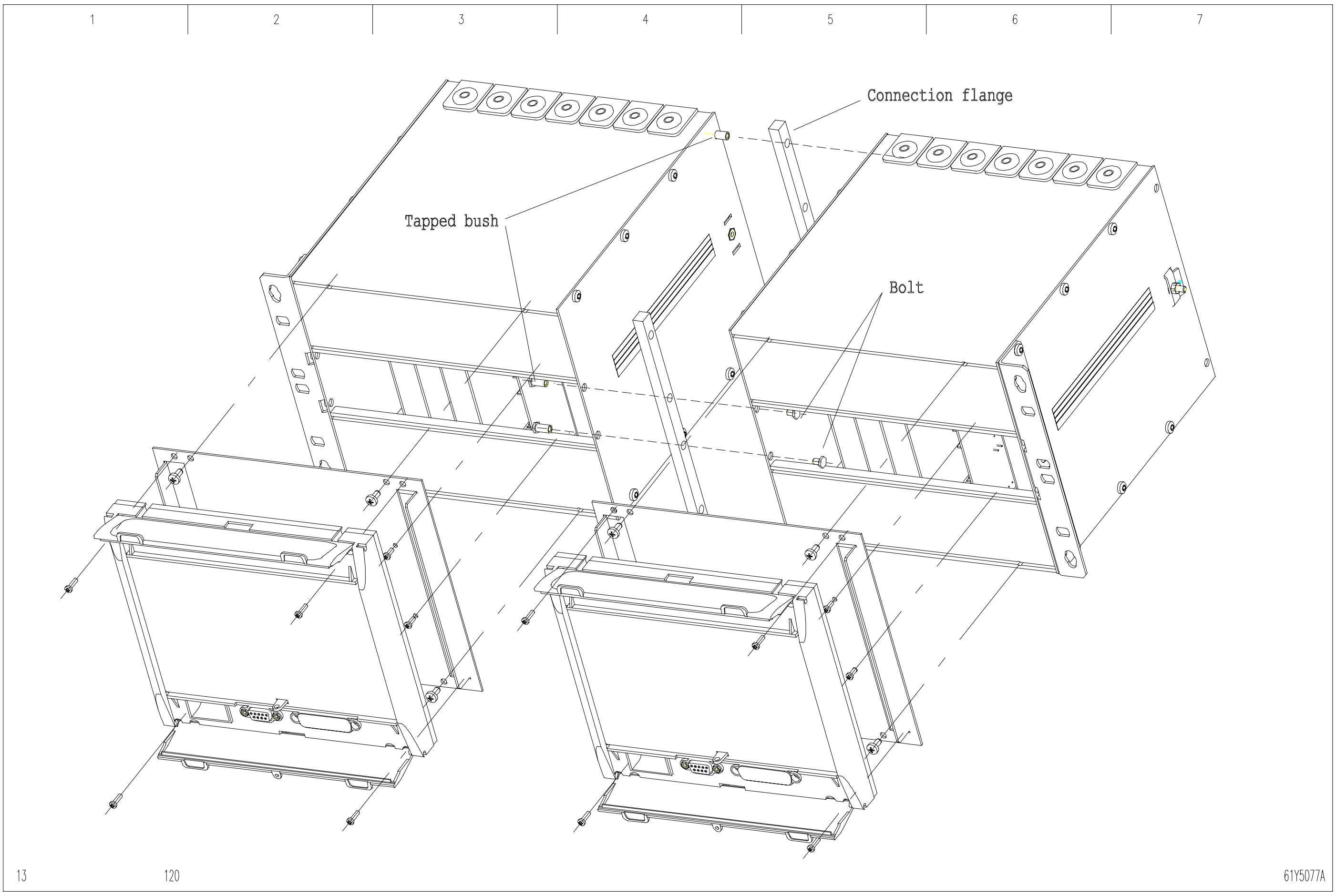
The cover frame width
of the 24 T case is: 210 mm
of the 40 T case is: 280 mm
of the 84 T case is: 486 mm

The cover frame height is
for all cases: 204 mm

The device has an increased mechanical robustness, if flush-mount method 2 (with angle brackets and frame, shown on this page) is used for the flush-mounted cases.

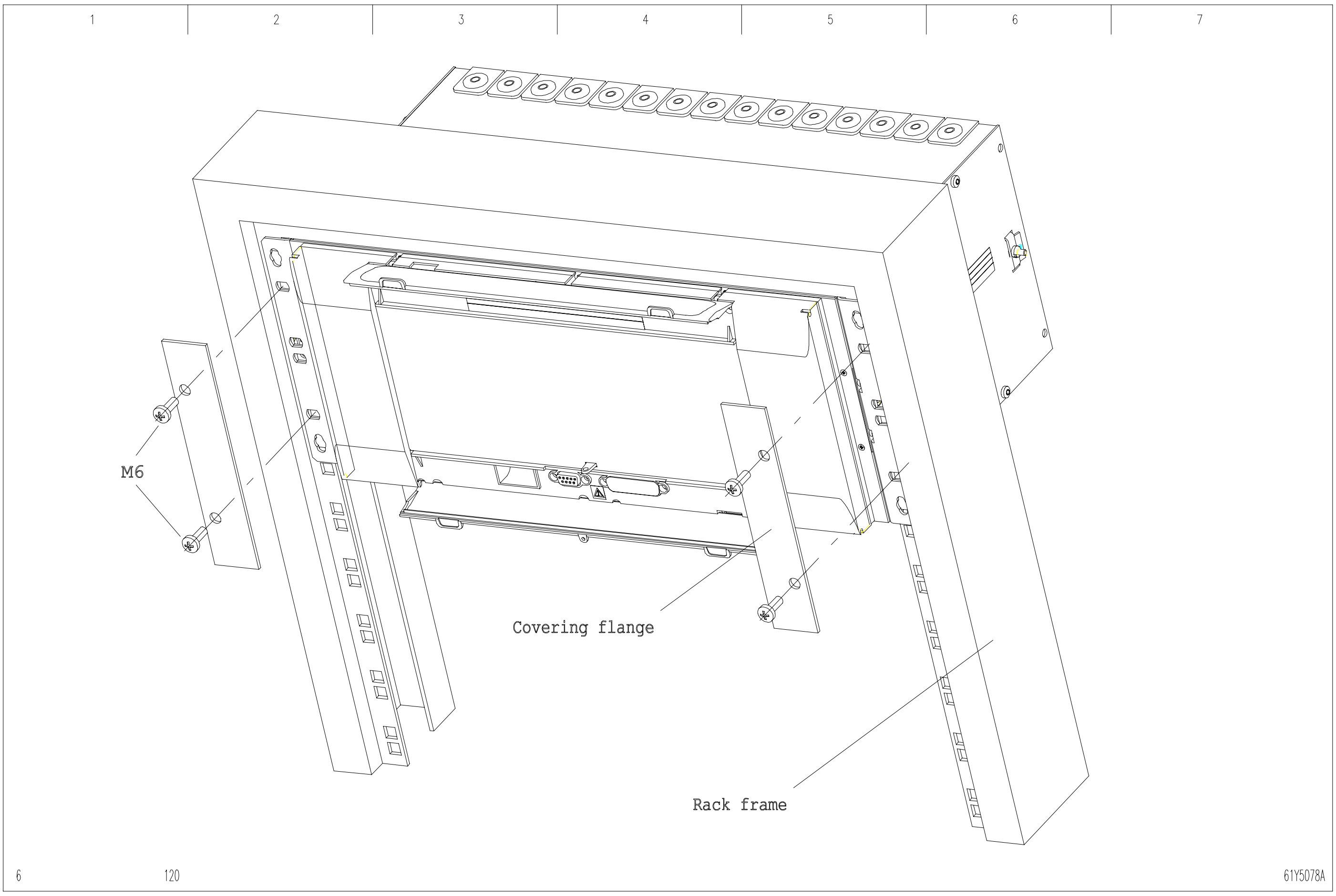
Connection of protective grounding conductor: See section 5.5

A rack mounting kit can be used to combine a flush-mounted 40 T case with a second sub-rack to form a 19" mounting rack (see Figure 5-6). The second sub-rack can be another device, for example, or an empty sub-rack with a blank front panel. Fit the 19" mounting rack to a cabinet as shown in Figure 5-7.



5-6 Combining 40 T flush-mounted cases to form a 19" mounting rack

Connection of protective grounding conductor: See section 5.5



5-7 *Installation of the P132 in a cabinet with a 19" mounting rack*

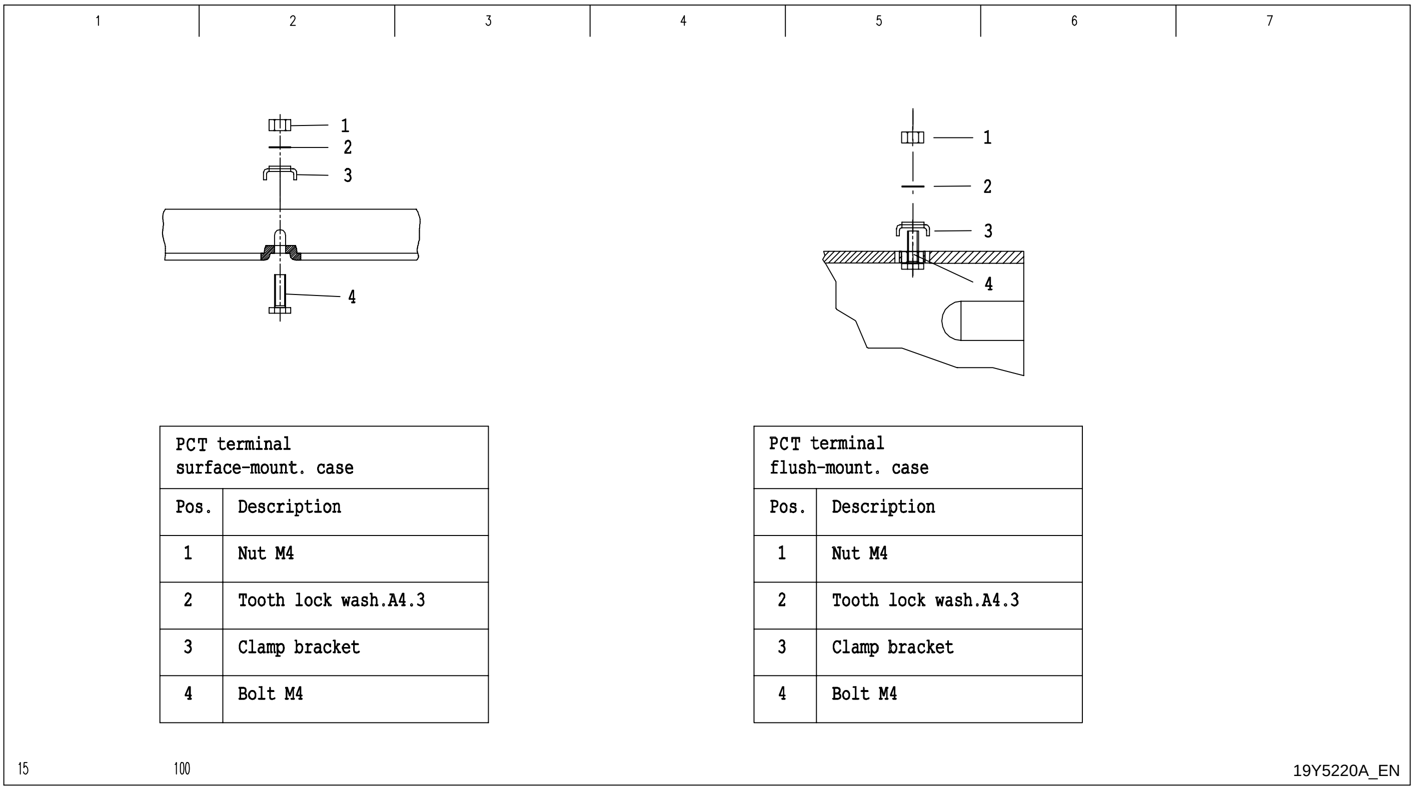
Connection of protective grounding conductor: See section 5.5

5.5 Protective and Operational Grounding

The device must be reliably grounded to meet protective equipment grounding requirements. The surface-mounted case is grounded using the bolt and nut, appropriately marked, as the ground connection. The flush-mounted case must be grounded in the area of the rear sidepieces at the location provided. The cross-section of the ground conductor must conform to applicable national standards. A minimum cross section of 2.5 mm^2 is required.

In addition, a protective ground connection at the terminal contact on the power supply module (identified by the letters "PE" on the terminal connection diagram) is also required for proper operation of the device. The cross-section of this ground conductor must also conform to applicable national standards. A minimum cross section of 1.5 mm^2 is required.

The grounding connection at both locations must be low-inductance, i.e. it must be kept as short as possible.



PCT terminal surface-mount. case	
Pos.	Description
1	Nut M4
2	Tooth lock wash.A4.3
3	Clamp bracket
4	Bolt M4

PCT terminal flush-mount. case	
Pos.	Description
1	Nut M4
2	Tooth lock wash.A4.3
3	Clamp bracket
4	Bolt M4

5-8 Installing the protective grounding conductor terminal

The protective conductor (earth) must always be connected to the protective grounding conductor terminal in order to guarantee the safety given by this set-up.

The bracket is marked with the protective ground symbol: ⏚

5.6 Connection

The P132 overcurrent and control device must be connected in accordance with the terminal connection diagram as indicated on the type identification label. The terminal connection diagram is included in the supporting documents supplied with the device. The terminal connection diagrams that apply to the P132 are also to be found at the end of this chapter.

In general copper conductors with a cross section of 2.5 mm^2 are sufficient to connect a system current transformer to a current input on the P132. To reduce CT knee-point voltage requirements, it may be necessary to install shorter copper conductors with a greater cross section between the system current transformers and the current inputs on the P132. Copper conductors having a cross section of 1.5 mm^2 are adequate to connect binary signal inputs, the output relays and the power supply input.

All connections run into the system must always have a defined potential. Connections that are pre-wired but not used should preferably be grounded when binary inputs and output relays are isolated. When binary inputs and output relays are connected to common potential, the pre-wired but unused connections should be connected to the common potential of the grouped connections.

5.6.1 Connecting Measuring and Auxiliary Circuits

Power supply

Before connecting the auxiliary voltage V_A for the P132 power supply, it must be ensured that the nominal value of the auxiliary device voltage corresponds with the nominal value of the auxiliary system voltage.

Current-measuring inputs

When connecting the system transformers, it must be ensured that the secondary nominal currents of the system and the device correspond.

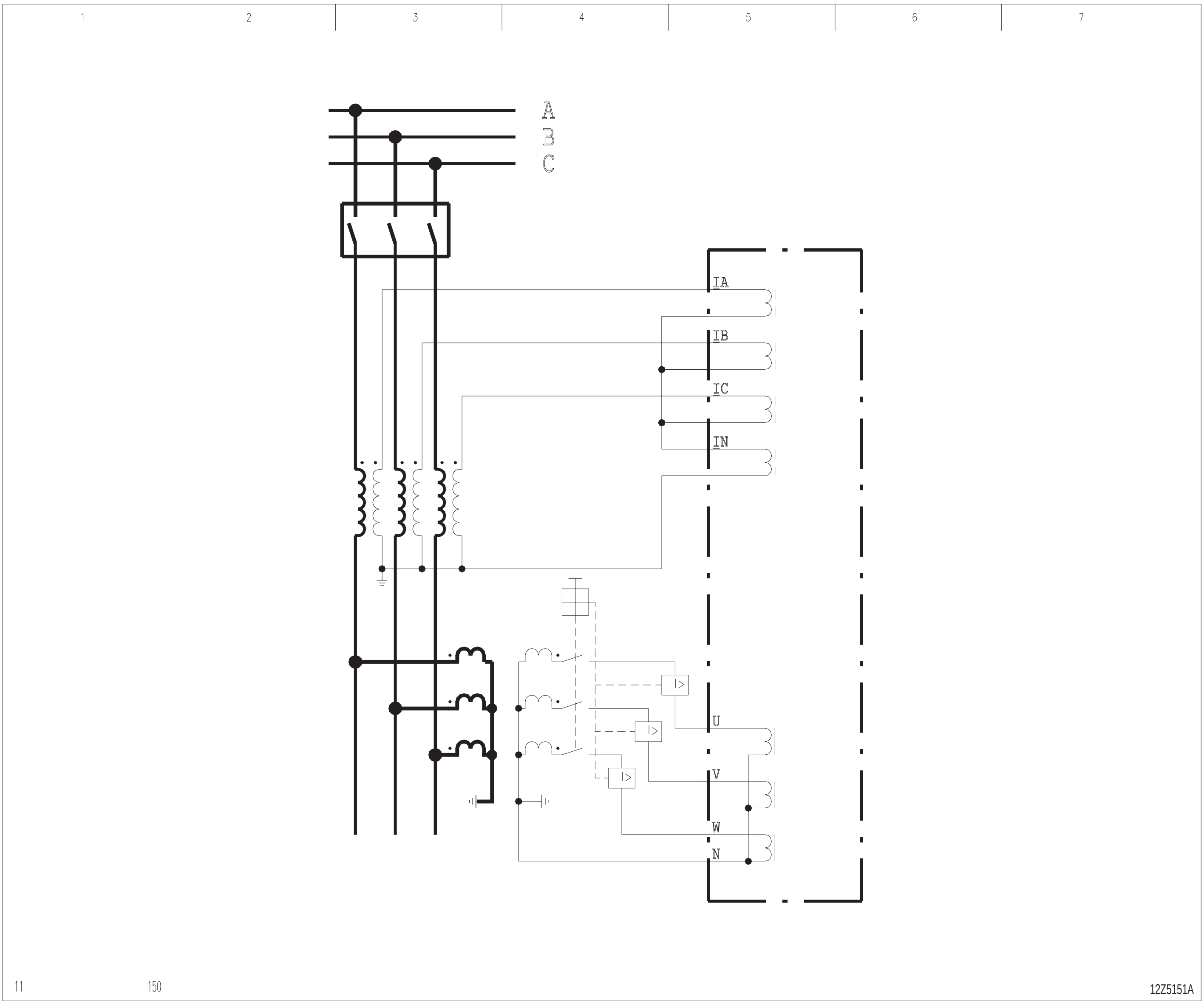
The secondary circuit of live system current transformers must not be opened! If the secondary circuit of a live CT is opened, there is the danger that the resulting voltages will endanger personnel and damage the insulation.

The threaded terminal block for system current transformer connection is not a shorting block! Therefore always short-circuit the system current transformers before loosening the threaded terminals.

Connecting the time-overcurrent protection measuring circuits

The system current and voltage transformers must be connected in accordance with the standard schematic diagram shown in Figure 5-9. It is essential that the grounding configuration shown in the diagram be followed. If the CT or VT connection is reversed, this can be taken into account when making settings (see Chapter 7).

The P132 is generally fitted with four current-measuring inputs. Three-pole or two-pole connection is possible to suit the individual power system and substation.



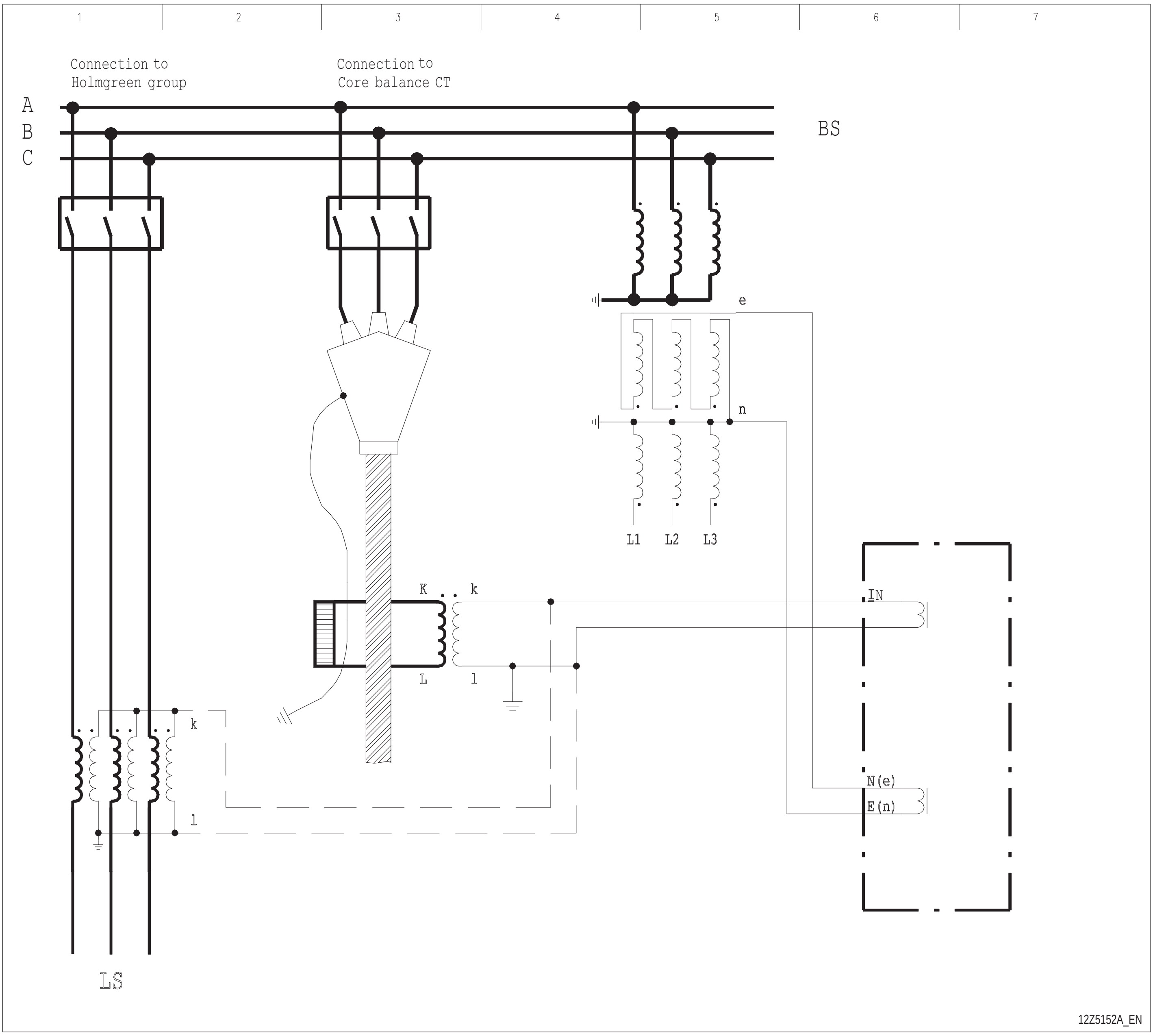
5-9 Standard schematic diagram for time-overcurrent protection

Connecting the measuring circuits for ground fault direction determination

If the P132 is to function using ground fault direction determination by steady-state values (the GFDSS function), then the T 4 current transformer must be connected to a core balance current transformer or a current transformer in Holmgreen configuration. If the metal shield of the cable is routed through the core balance transformer, the ground wire must be fed through the core again before it is connected to ground. The cable sealing end must be attached so that it is isolated from ground. This ensures that any currents flowing through the shield will not affect measurement.

The steady-state ground fault direction determination requires either the three phase-to-ground voltages or, alternatively, the neutral-point displacement voltage from the open delta winding of a voltage transformer assembly as the measured voltage. The phase voltages are drawn from the same transformers like the measured variables for the time voltage protection. An additional voltage transformer (T 90) is available in the P132 to connect an open delta winding. When setting the protection function, the selected voltage needs to be taken into account.

Figure 5-10 shows the standard connection for ground fault direction determination by steady-state values where the voltage measuring circuit is connected to an open delta winding. With this connection configuration, ‘forward/LS’ is displayed if a ground fault occurs on the line side. A reversed connection is possible for the system current or voltage transformer if the appropriate setting is configured (see Chapter 7).

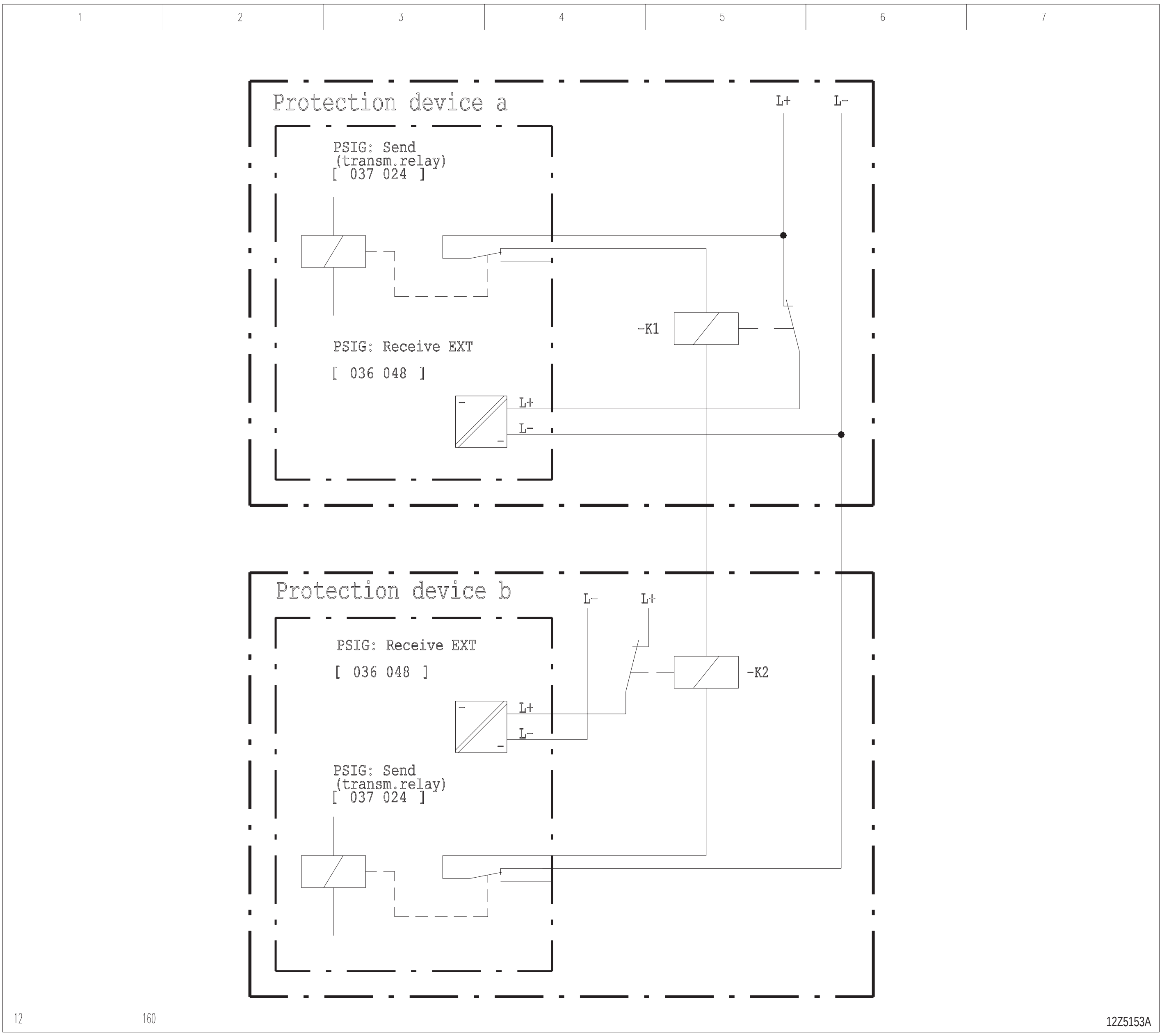


5-10 Connecting the steady-state ground fault direction determination function to Holmgreen-configuration and core balance transformers

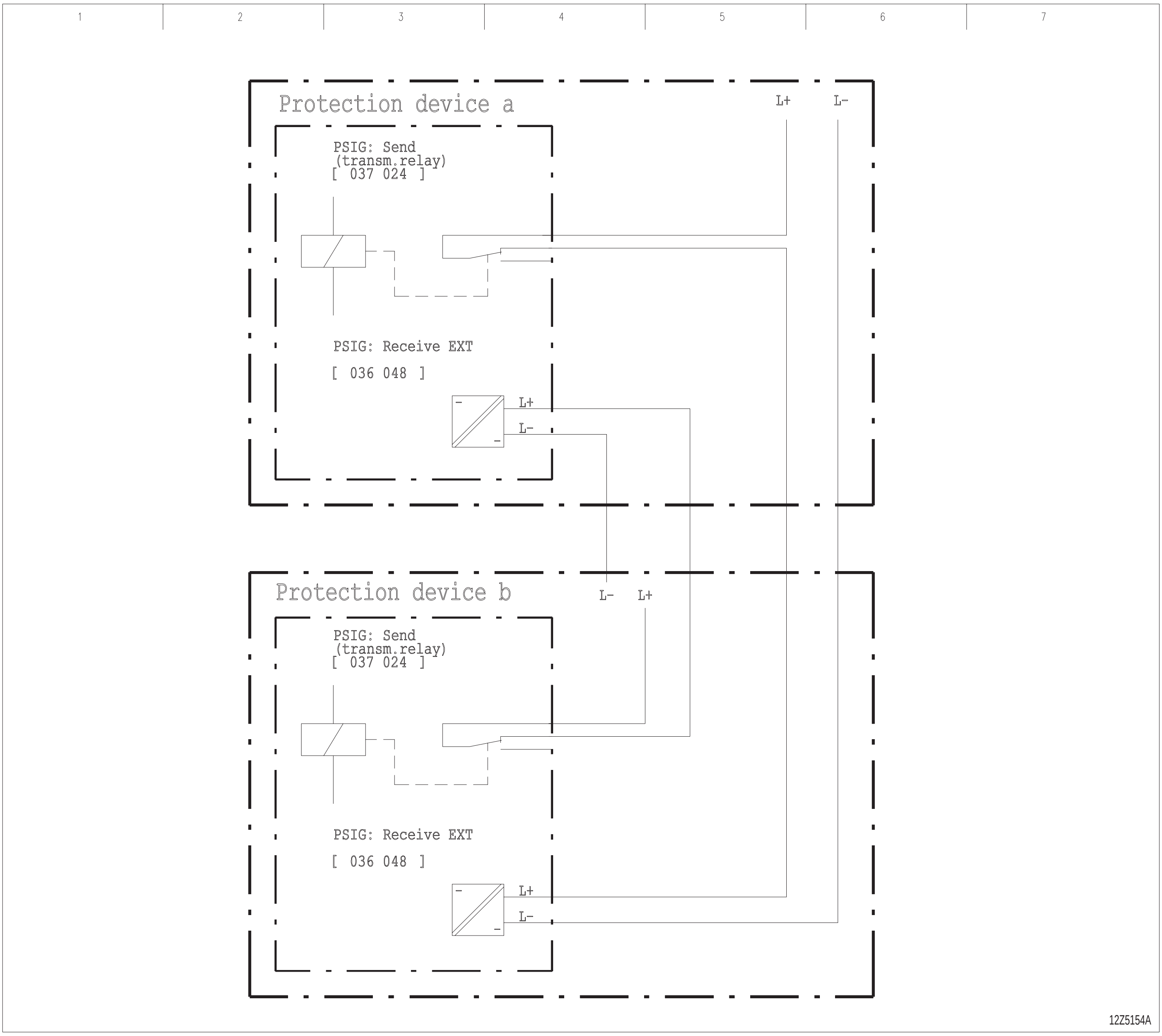
Connecting protective signaling

Either a transmission device or pilot wires are required for signal transmission, depending on the operating mode selected. Twisted pair cores should be used as pilot wires. Two or four cores are required. If only two cores are available, there must be an all-or-nothing relay in each station for coupling received and transmitted signals. The coils of the all-or-nothing relays must be designed for half the loop voltage. Figure 5-11 shows connection with two cores and Figure 5-12 with four cores.

The protective signaling transmitting relay can be set to either *Transm. rel. break con.* or *Transm. rel. make con.* In the first case the break contact of the transmitting relay must be wired, and in the second case the make contact must be wired. The figures show the connection for the setting *Transm. rel. break con*.



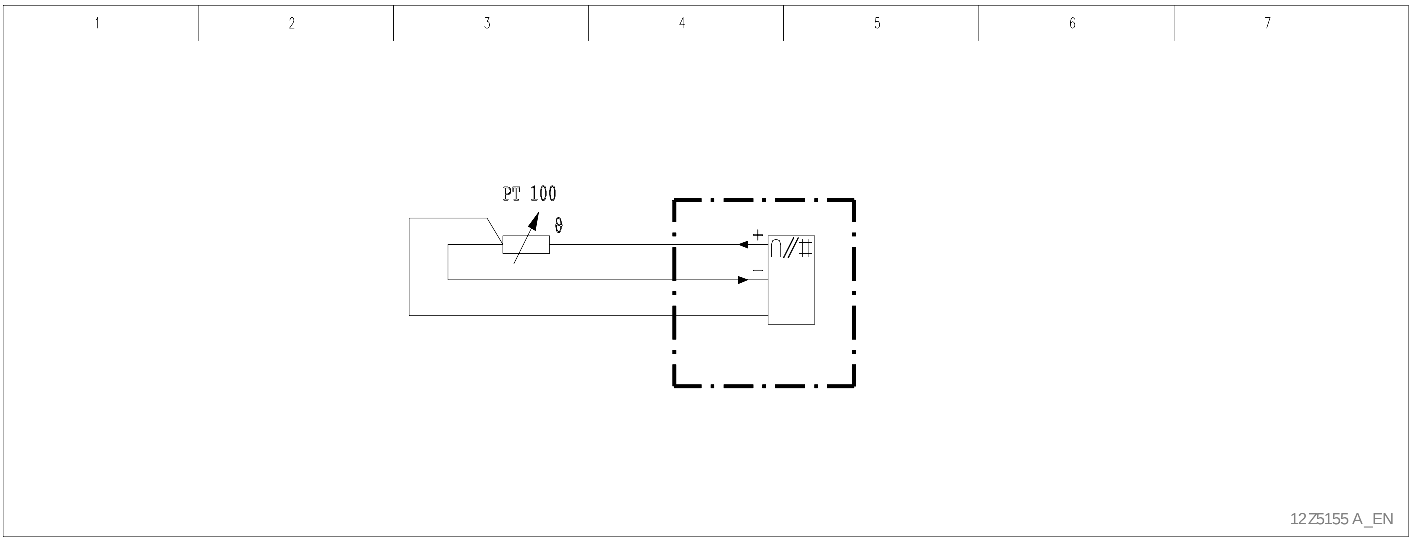
5-11 Connection of protective signaling with two cores



5-12 Connection of protective signaling with four cores

Connecting a resistance thermometer

A resistance thermometer can be connected if the device is fitted with analog module Y. This analog I/O module input is designed to connect a PT 100 resistance thermometer. The PT 100 should be connected using the 3-wire method (see Figure 5-13). No supply conductor compensation is required in this case.



5-13 Connecting a PT 100 using the 3-wire method

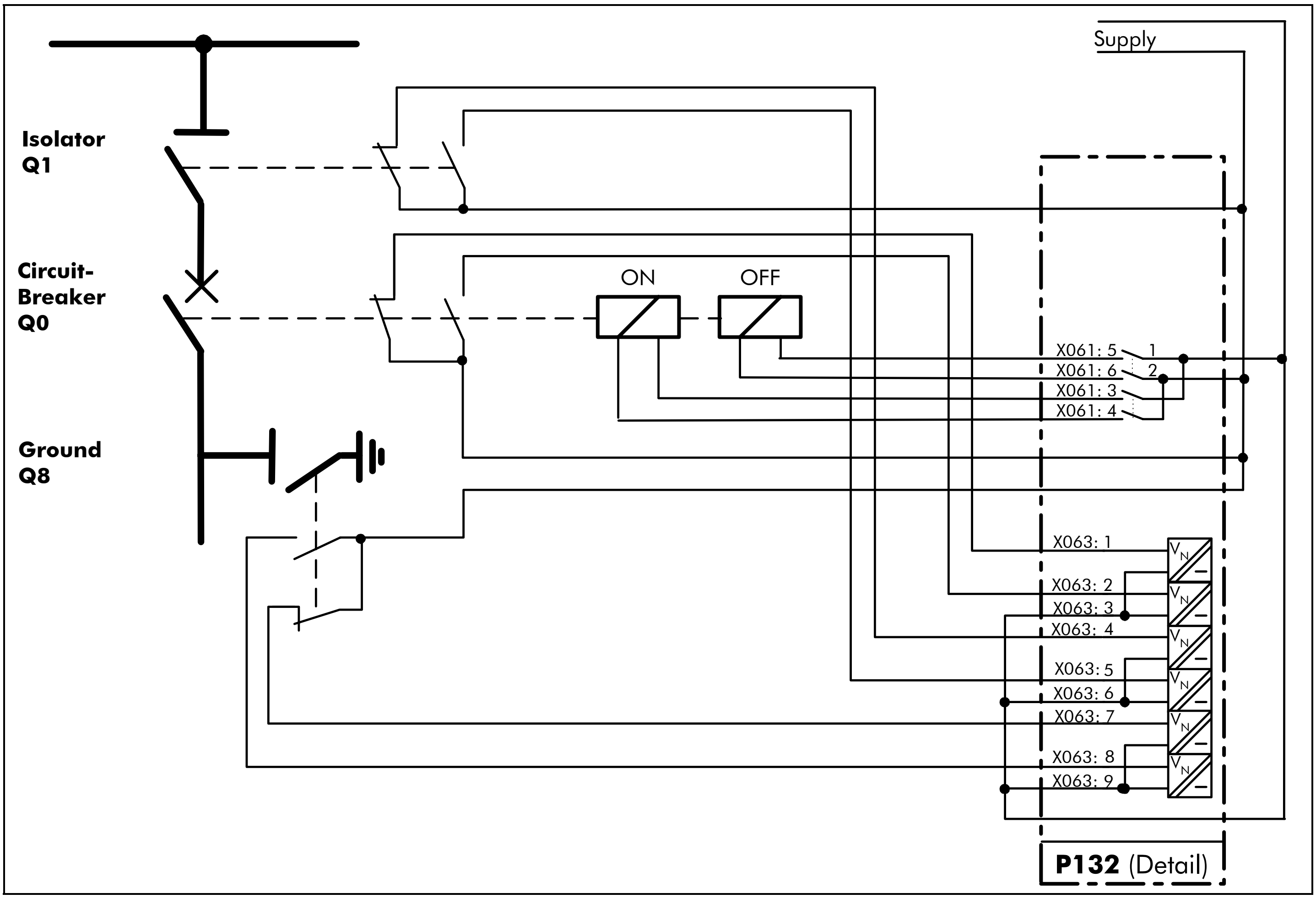
Connecting binary inputs and output relays

The binary inputs and output relays are freely configurable. When configuring these components it is important to note that the contact rating of the binary I/O modules (X) varies (see Chapter 2 “Technical Data”). Once the user has selected a bay type, the P132 can automatically configure the binary inputs and output relays with function assignments for the control of switchgear units. The standard configuration of binary inputs and output relays for each bay type is given in the list of bay types to be found in the Appendix to this operating manual.

The polarity for connected binary inputs is to be found in the terminal connection diagrams (see supporting documents supplied with the device or end of this chapter). This is to be understood as a recommendation only. Connection to binary inputs can be made as desired.

Connection example optional control

A connection example for P132 in case 40 TE for connection with pin-type cable terminals is shown in Figure 5-14.



5-14 *Connection example for optional control,*
bay type no. 33 (A13.205.R03), feeder bay with load disconnecting switches, single busbar

5.6.2 Connecting the IRIG-B interface.

An IRIG-B interface for time synchronization may be installed as an optional feature. It is connected by a BNC connector. A coaxial cable having a characteristic impedance of 50 Ω must be used as the connecting cable.

5.6.3 Connecting the Serial Interfaces

PC interface

The PC interface is provided so that personnel can operate the device from a personal computer (PC).

⚠

The PC interface is not designed as a permanent connection. Consequently, the female connector does not have the extra insulation from circuits connected to the system that is required per VDE 0106 Part 101.

Communication interface

The communication interface is provided as a permanent connection of the device to a control system for substations or to a central substation unit. Depending on the type, communication interface 1 on the device is connected either by a special fiber-optic connector or a RS 485 interface with twisted pair copper wires. Communication interface 2 is only available as a RS 485 interface.

The selection and assembly of a properly cut fiber-optic connecting cable requires special knowledge and expertise and is therefore not covered in this operating manual.

⚠

The fiber-optic interface may only be connected or disconnected when the supply voltage for the device is shut off.

An RS485 data transmission link between a master and several slave devices can be established by using the optional communication interface. The communication master could be, for instance, a central control station. Devices linked to the communication master, e.g. P132, are set-up as slave devices.

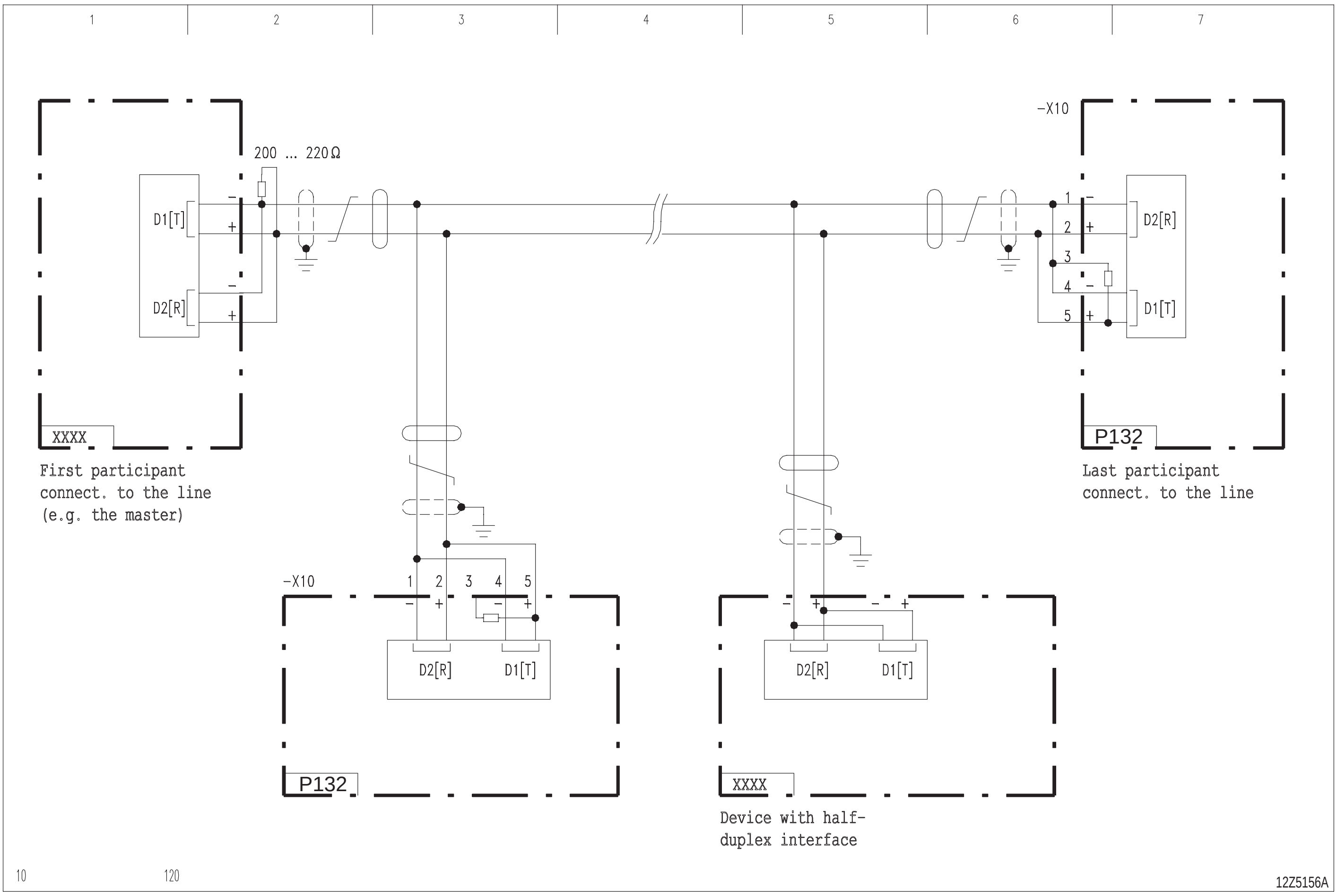
The RS 485 interface available on the P132 was designed so that data transfer in a full duplex transmission mode is possible using a 4-wire data link between devices. Data transfer between devices using the RS 485 interface is set up only for a half duplex transmission mode. To connect the RS485 communication interface the following must be observed:

- ☐ Only twisted pair shielded cables must be used, that are common in telecommunication installations.
- ☐ At least one symmetrical twisted pair of wires is necessary.
- ☐ Conductor insulation and shielding must only be removed from the core in the immediate vicinity of the terminal strips and connected according to national standards.
- ☐ All shielding must be connected to an effective protective ground surface at both ends.
- ☐ Unused conductors must all be grounded at one end.

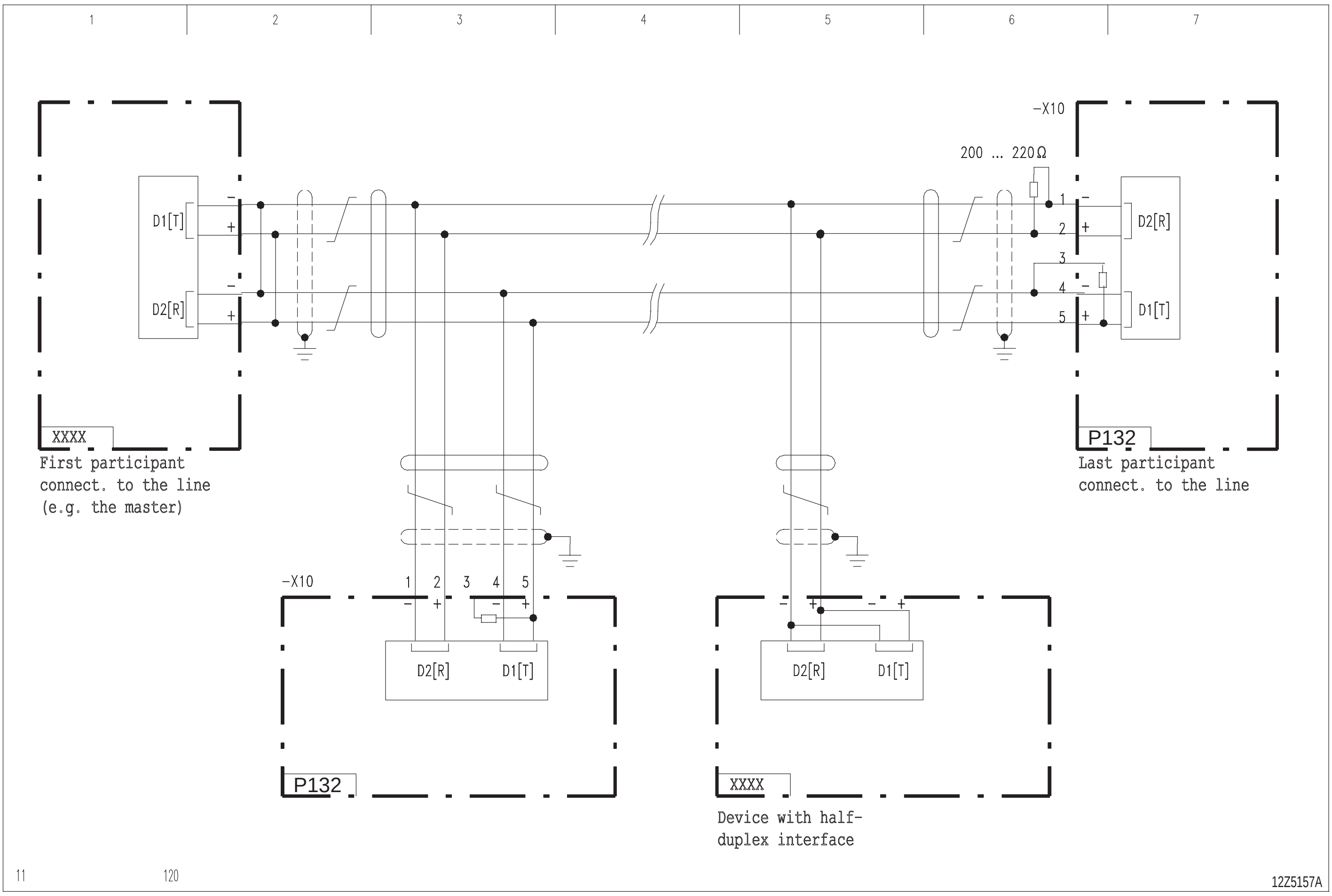
A 4-wire data link as an alternative to a 2-wire communications link is also possible. A cable with two symmetrical twisted pair wires is required for a 4-wire data link. A 2-wire data link is shown in Figure 5-15, and a 4-wire data link is shown in Figure 5-16 as an example for channel 2 on the communication module. The same is valid if channel 1 on the communication module is available as a RS 485 interface.

<u>2-wire data link</u>:
The transmitter must be bridged with the receiver on all devices equipped electrically with a full duplex communication interface, e.g. the P132. The two devices situated at either far end must have a 200 to 220 Ω resistor installed to terminate the data transmission conductor. In most Schneider Electric MiCOM Px3x devices, and also in the P132, a 220 Ω resistor is integrated into the RS485 interface hardware and can be connected with a wire jumper. An external resistor is therefore not necessary.

<u>4-wire data link</u>:
Transmitter and receiver must be bridged in the device situated on one far end of the data transmission conductor. The receivers of slave devices, that have an electrically full-duplex communication interface as part of their electrical system, e.g. the P132, are connected to the transmitter of the communication master device, and the transmitters of slave devices are connected to the receiver of the master device. Devices equipped electrically with only a half duplex RS485 communication interface are connected to the transmitter of the communication master device. The last device in line (master or slave device) on the data transmission conductor must have the transmitter and receiver terminated with a 200 to 220 Ω resistor each. In most Schneider Electric MiCOM Px3x devices, and also in the P132, a 220 Ω resistor is integrated into the RS485 interface hardware and can be connected with a wire jumper. An external resistor is therefore not necessary. The second resistor must be connected externally to the device (resistor order number see Chapter 13).

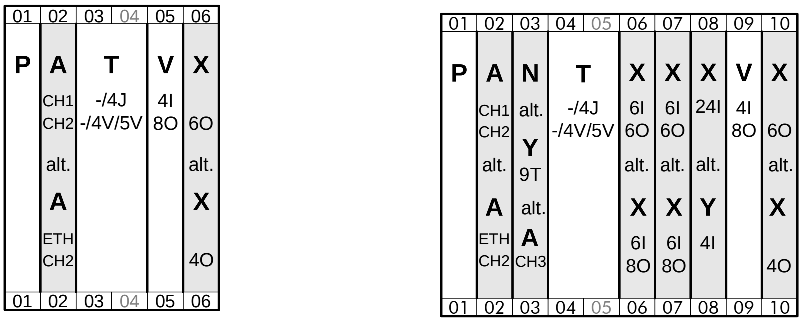


5-15 2-wire data link

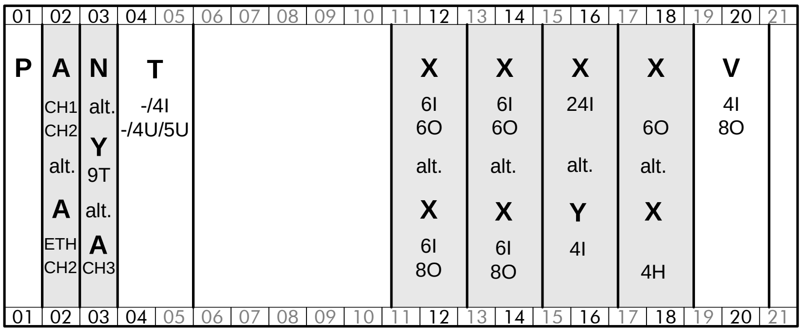


5-16 4-wire data link

5.7 Location diagrams

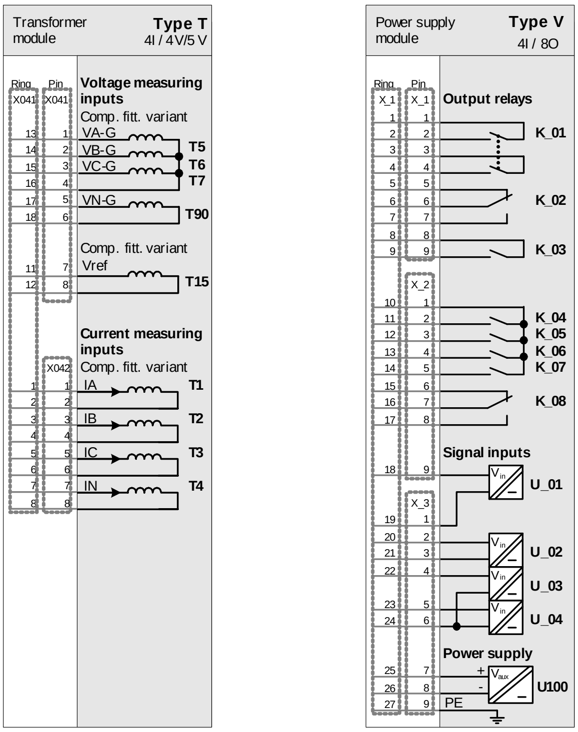


5-17 Location diagrams P132 in case 24 TE (on the left) or 40 TE (on the right)
Pin-terminal connection (24 TE: P132 -415, 40 TE: P132 -417)
Transformer module: Ring terminal connection, other modules pin-terminal connection (24 TE: P132 -416, 40 TE: P132 -418)

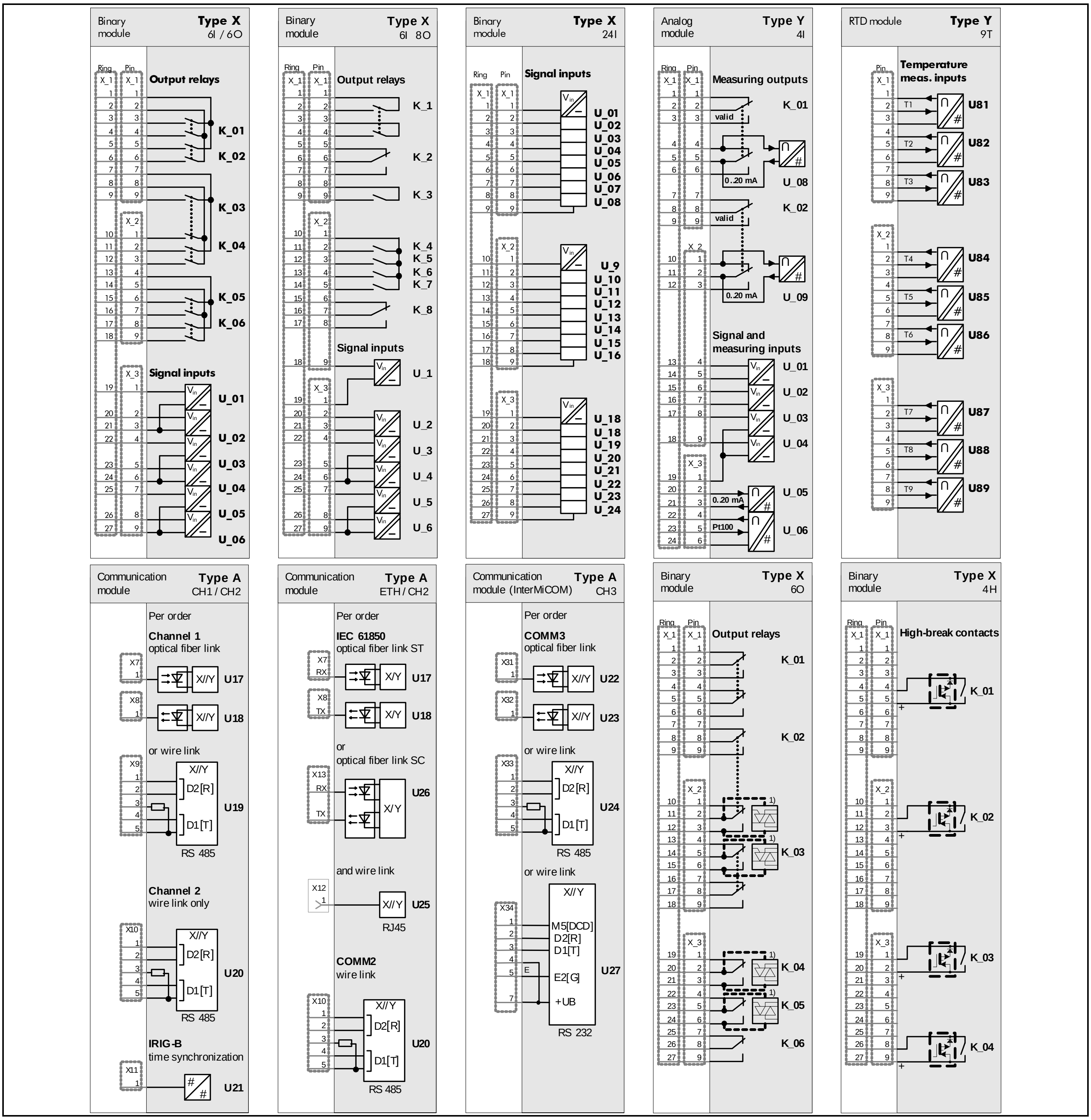


5-18 Location diagram for P132 in 84 TE case
Ring-terminal connection (P132 -419)

5.8 Terminal Connection Diagrams



5-19 Terminal connection diagrams P132 (part 1)
Note: '_' is a placeholder for the slot. See also section 5.5 for the Protective and Operational Grounding.



5-20 Terminal connection diagrams P132 (part 2)
Notes: '_' is a placeholder for the slot. See also section 5.5 for the Protective and Operational Grounding.
[1] The binary (I/O) module X (6xO) is now optionally available with 4 static outputs, parallel to the make contacts K_02.2, K_03.1, K_04, K_05.
The RTD module is equipped with a grounding bar providing connectors for the 9 cable shields.

6 Local Control Panel

6 Local Control Panel

Local control panel

All data required for operation of the protection device is entered from the local control panel, and the data important for system management is read out there as well. The following tasks can be handled from the local control panel:

- ☐ Readout and modification of settings
- ☐ Readout of cyclically updated measured operating data and logic status signals
- ☐ Readout of operating data logs and of monitoring signal logs
- ☐ Readout of event logs after overload situations, ground faults, or short circuits in the power system
- ☐ Device resetting and triggering of additional control functions used in testing and commissioning

Control is also possible through the PC interface. This requires a suitable PC and a specific operating program.

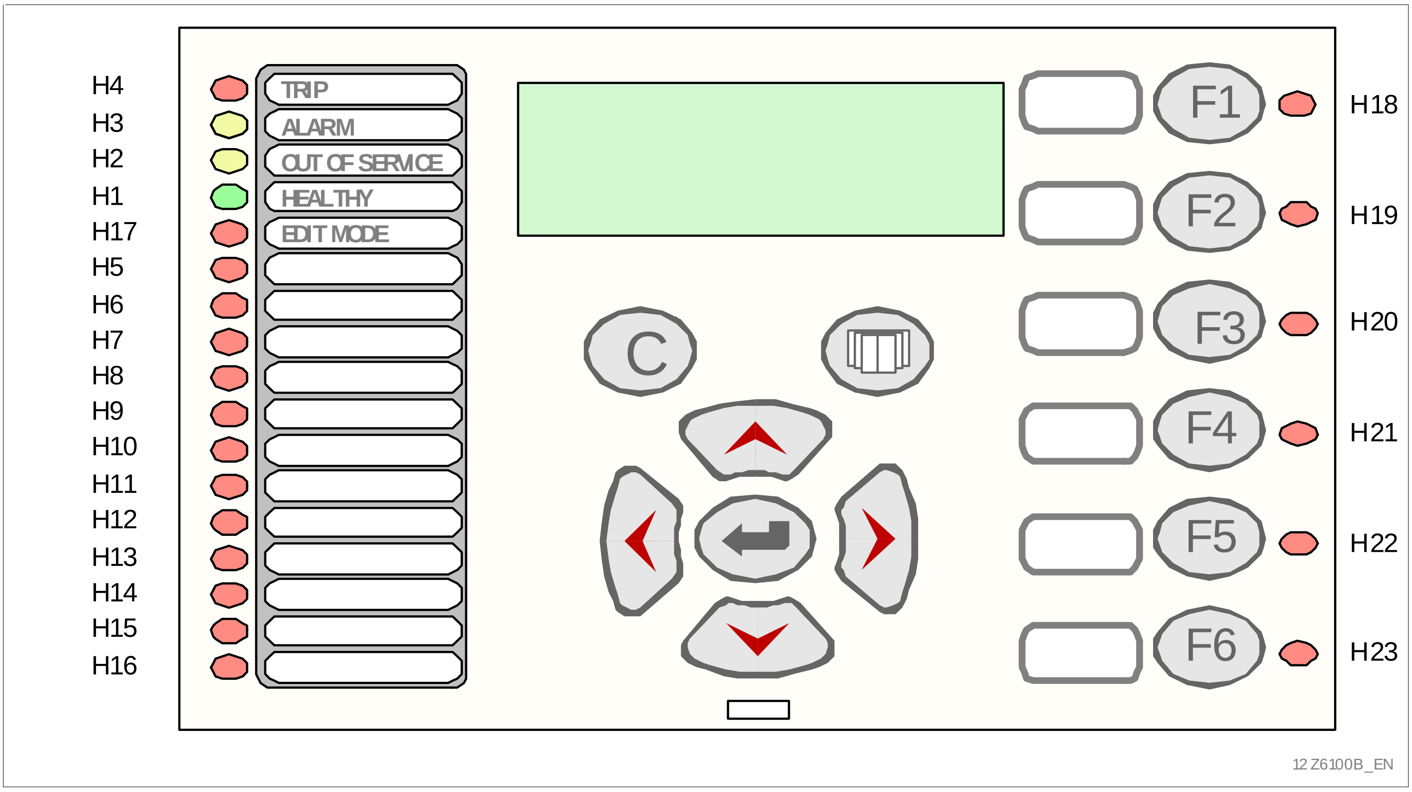
6.1 Display and Keypad

Display and Keypad

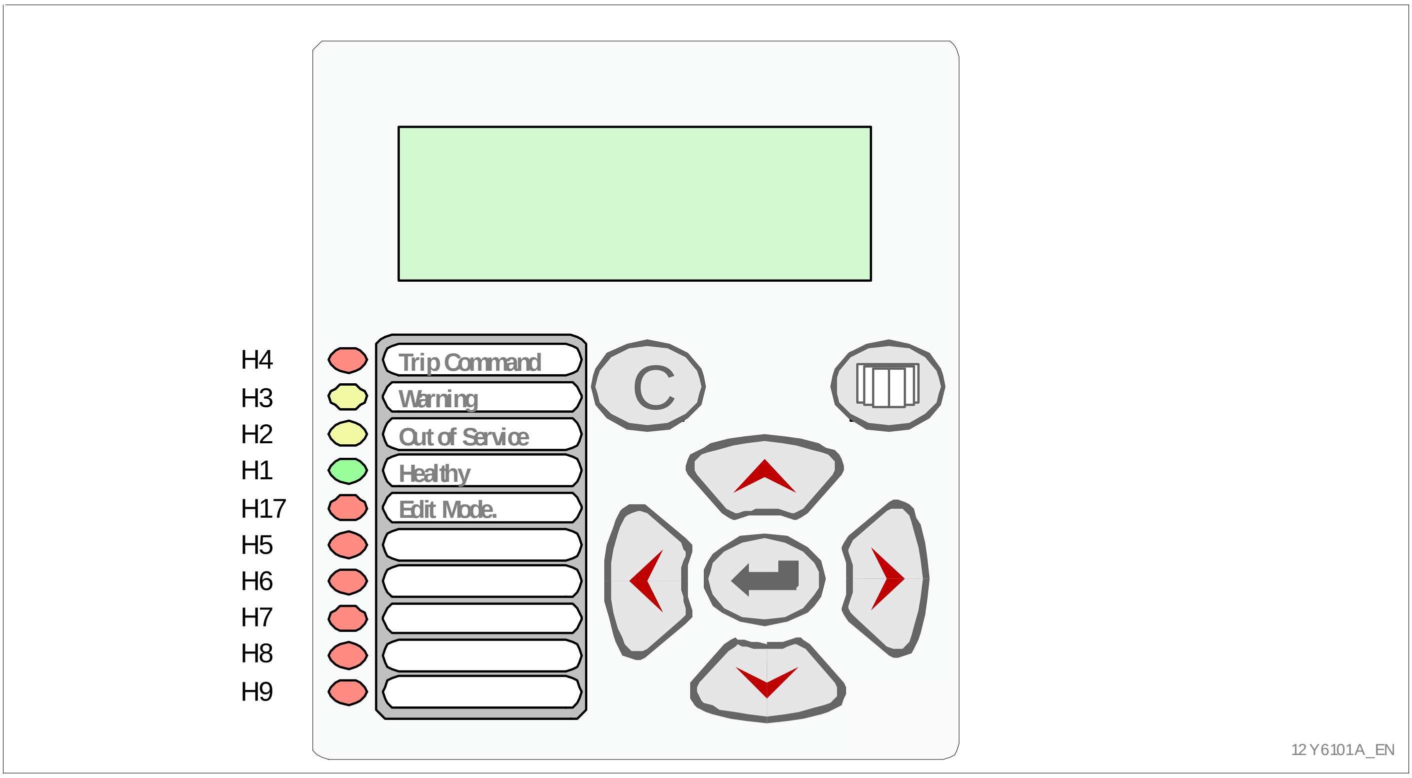
The local control panel is fitted with a LC display containing 4 x 20 alphanumeric characters.

Then there are seven keys with permanently assigned functions situated below the LCD and, with case 40T and case 84T devices, there are six additional freely configurable function keys on the right side of the LCD.

Furthermore the local control panel is provided with 17 LED indicators, mounted vertically, and situated on the left side of the LCD and, with case 40T and case 84T devices, there are six additional LED indicators situated on the right side of the six freely configurable function keys.



6-1 View of the local control panel on case 40T and case 84T devices



6-2 View of the local control panel on case 24T devices

Display levels

All data relevant for operation and all device settings are displayed on two levels. At the Panel level, data such as measurements are displayed in Panels that provide a quick overview of the current state of the bay. The *'menu tree'* level below the panel level allows the user to select all data points (settings, signals, measured variables, etc.) and to change them, if appropriate. To access a selected event recording from either the panel level or from any other point in the menu tree, press the "READ" key ▥.

Availability of the bay panel

The bay panel is only available under these conditions:

1. On the hardware side the protection unit has to have been upgraded with a control functionality. This requires that the optional binary I/O module to control switchgear units has been ordered and is fitted to a slot as listed below:
  - for a 40 T case: slot 6
  - for a 84 T case: slot 12

2. By selecting and sending a bay type (with parameter MAIN: Type of bay) a bay type has been generated.

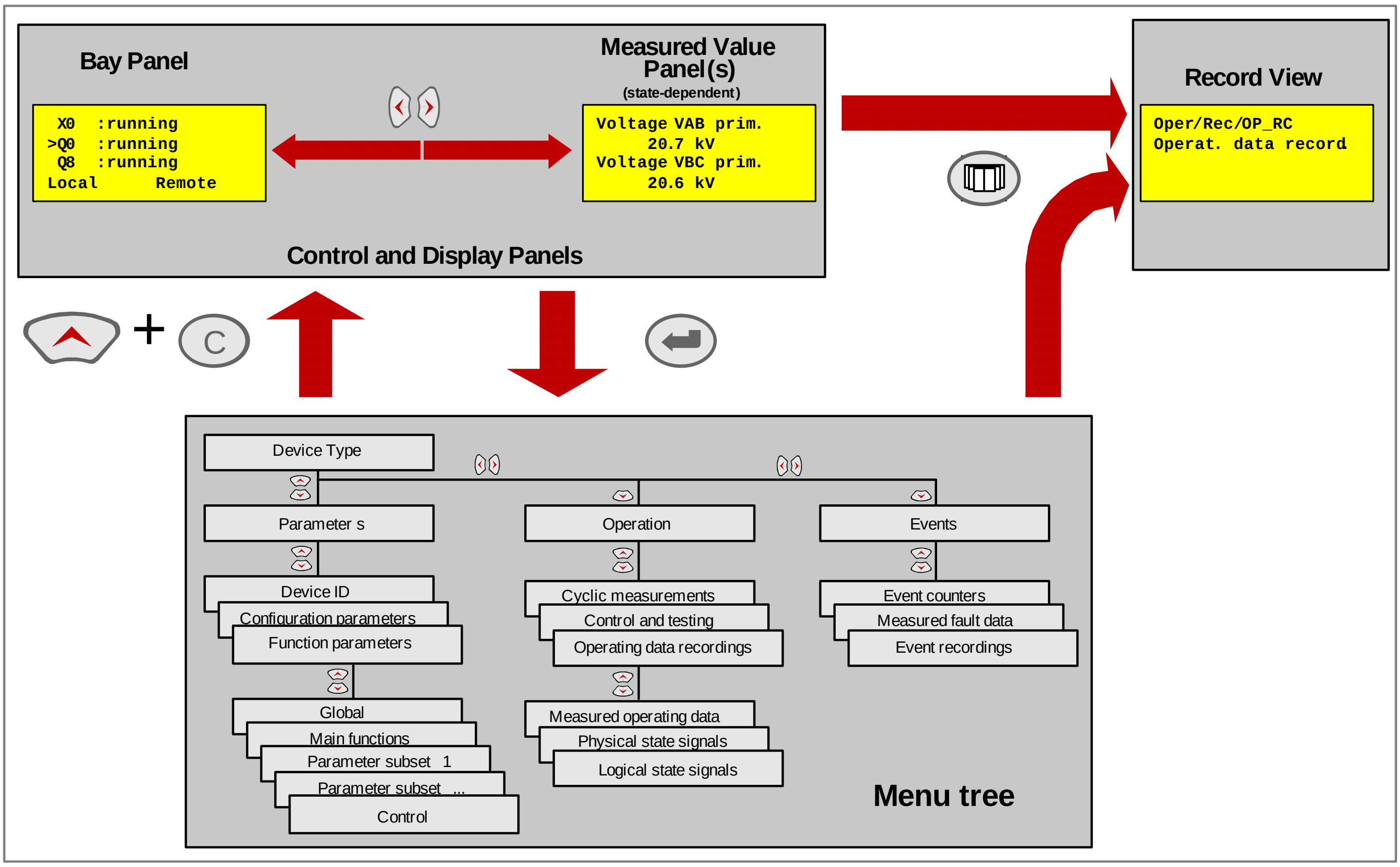
To access a selected event recording from either the panel level or from any other point in the menu tree, press the "READ" key ▥.

From the control and display panels (e.g. measured value panels or the bay panel) the user can access the menu tree level by pressing the "ENTER" key.

To return to the previously selected control and display panel from the menu tree level the user must simultaneously press the keys "Cursor up" and "RESET". (If previously no panel was selected, i.e. after a system restart, then the bay panel, if available, is accessed.)

After the set LOC: Autom. return time has elapsed the protection unit will also return automatically from the menu tree level to the control and display panel last selected.

The user can move from a bay panel to a measured value panel by pressing the key "Cursor left" and back again by pressing the key “Cursor right".



6-3 Display panels and menu tree

6 Local Control Panel

(continued)

Bay panels

If available the bay panel will display switching state signals from external devices (closed, open, intermediate position) and the active control site (local or remote). The text display will show up to 3 external devices, one per line, where the external device selected is marked with the flashing symbol "**>**" in front of the external devices' designation text.

```
   X0 :Running
 > Q0 :Running
   Q8 :Running
 Local     Remote
```

6-4 Example of a bay panel

The sequence for external devices is downwards in columns according to their numbering (DEV01, DEV02, DEV03). To designate these external devices there are up to four characters available, and next to these, separated by a colon, their current state is displayed ("running", "open", "closed" or "interm. pos.").

The active control unit (*"Remote"* or *"Local"*) is displayed in the fourth line and whether it is *"Locked"* or *"Unlocked"*.

Display panels

The P132 can display 'Measured Value Panels' which are selected automatically by the device according to system conditions.

Selected measured values are displayed on the Measured Value Panels. The system condition determines which Panel is called up (examples are the Operation Panel and the Fault Panel). Only the Measured Value Panels relevant for the particular design version of the given device and its associated range of functions are actually available. The Operation Panel is always provided.

Menu tree and data points

All *data points* (setting values, signals, measured values, etc.) are selected using a *menu tree*. When navigating through the *menu tree*, the first two lines of the LC-Display always show the branch of the *menu tree* that is active, as selected by the user. The *data points* are found at the lowest level of a *menu tree* branch and they are displayed either with their plain text description or in numerically encoded form, as selected by the user. The value associated with the selected *data point*, its meaning, and its unit of measurement are displayed in the line below.

List data points

List data points are a special category. In contrast to other data points, *list data points* generally have more than one associated value element. This category includes tripping matrices, programmable logic functions, and event logs. When a *list data point* is selected, the symbol ‘↓‘ is displayed in the bottom line of the LCD, indicating that a sub-level is situated below this displayed level. The individual value elements of a *list data point* are found at this sub-level. In the case of a list *parameter*, the individual value elements are linked by operators such as ‘OR’.

Short description of keys

☐ **‘Up’ and ‘Down’ Keys** ⌃ / ⌄

Panel Level:

The ‘up’/‘down’ keys switch between the pages of the Measured Value Panel.

Menu Tree Level:

Press the ‘up’ and ‘down’ keys to navigate up and down through the menu tree in a vertical direction. If the unit is in input mode, the ‘up’ and ‘down’ keys have a different function.

<u>Input mode</u>:

Settings can only be changed in the input mode, which is signaled by the LED indicator labeled EDIT MODE. Press the ‘up’ and ‘down’ keys in this mode to change the setting value.

(‘Up’ key: the next higher value is selected.
‘Down’ key: the next lower value is selected.)

With list settings, press the ‘up’ and ‘down’ key to change the logic operator of the value element.

☐ **‘Left’ and ‘Right’ Keys** ‹ / ›

Menu Tree Level:

Press the ‘left’ and ‘right’ keys to navigate through the menu tree in a horizontal direction. If the unit is in input mode, the ‘left’ and ‘right’ keys have a different function.

<u>Input mode</u>:

Settings can only be changed in the input mode, which is signaled by the LED indicator labeled EDIT MODE. When the ‘left’ and ‘right’ keys are pressed, the cursor positioned below one of the digits in the change-enabled value moves one digit to the right or left.

(‘Left’ key: the cursor moves to the next digit on the left.
‘Right’ key: the cursor moves to the next digit on the right.)

In the case of a list setting, press the ‘left’ and ‘right’ keys to navigate through the list of items available for selection.

☐ **ENTER Key** ↵

Panel Level:

Press the ENTER key at the Panel level to go to the menu tree.

Menu Tree Level:

Press the ENTER key to enter the input mode. Press the ENTER key a second time to accept the changes as entered and exit the input mode. The LED indicator labeled EDIT MODE signals that the input mode is active.

☐ **CLEAR Key** C

Press the CLEAR key to reset the LED indicators and clear all measured event data. The records in the recording memories are not affected by this action.

<u>Input mode</u>:

When the CLEAR key is pressed all changes entered are rejected and the input mode is exited.

- **READ Key**
  Press the READ key to access a selected event recording from either the Panel level or from any other point in the menu tree.

- **Function Keys (case 40T and 84T only)** F1 **to** F6
  By pressing a function key the assigned function is triggered. More details on assigning functions to function keys can be found in section "Configurable Function Keys (Function Group F_KEY)" in Chapter 3. More details on handling function keys can be found in this Chapter, in section 6.4 "Configurable Function Keys F1 to Fx (general)" and in section 6.5 " Configurable Function Keys F1 to Fx (particularly as control keys)".

The following presentation of the individual control steps shows which displays can be changed in each case by pressing keys. A small black square to the right of the enter key indicates that the LED indicator labeled EDIT MODE is illuminated. The examples used here are not necessarily valid for the device type described in this manual; they merely serve to illustrate the control principles involved.

6.2 Changing between Display Levels

After start-up of the device, the menu tree level is displayed.

Jumping from Menu Tree Level to Panel Level

Jumping from Panel Level to Menu Tree Level

Control Step / Description	Control Action	Display

0 From the Menu Tree Level, the user can jump to the Panel Level from any position within the menu tree.		`Par/Func/Glob/MAIN`
		`Device on-line`
		`No (=off)`

1 First press the 'up' key and hold it down while pressing the CLEAR key.
Note:
It is important to press the 'up' key first and release it last in order to avoid unintentional resetting of stored data.
	▲ + C	`Voltage U A-B prim.`
		`20.7 kV`
		`Voltage U B-C prim.`
		`20.6 kV`

0 Example of a Measured Value Panel.		`Voltage U A-B prim.`
		`20.7 kV`
		`Voltage U B-C prim.`
		`20.6 kV`

1 Press the ENTER key to go from the Panel Level to the Menu Tree Level.	↵	`XYYY`

After the set return time has elapsed (setting in menu tree: "Par/Conf/LOC"), the display will automatically switch to the Panel Level if a Measured Value Panel has been configured.

6.3 Display Illumination

If none of the control keys are pressed, the display illumination will switch off once the set ‘return time illumination’ (setting in menu tree: "Par/Conf/LOC") has elapsed. Pressing any of the control keys will turn the display illumination on again. In this case the control action that is normally triggered by that key will not be executed. Reactivation of the display illumination is also possible by using a binary input.

If continuous display illumination is required, the function ‘return time illumination’ is set to *blocked*.

6.4 Configurable Function Keys F1 to Fx (general)

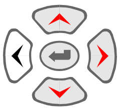
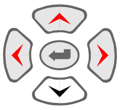
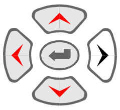
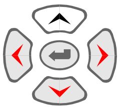
If not configured as control keys, function keys F1 to Fx (only available with case 40T and case 84T devices) are enabled only after the password for function keys has been entered.

Exception: If a function key has been configured at MAIN: Local/Remote key the function will only switch from *"Remote"* to *"Local"* control after the password has been entered, but switching from *"Local"* to *"Remote"* control will occur without checking the password (see also section 6.5).

It is assumed for the remainder of this section that the function key F1 is enabled only after the password (as assigned at F_KEY: Password funct.key 1) has been entered. After the password has been entered the function key will remain active for the time period set at F_KEY: Return time fct.keys. Thereafter, the function key is disabled until the password is entered again.

For this example it is further assumed that the password for the function keys is the factory-set password. If the user has changed the password (see the chapter entitled "Changing the Password"), the following description will apply accordingly.

6 Local Control Panel
(continued)

Control Step / Description	Control Action	Display
0 Example of a display.		Voltage VAB prim. 20.7 kV Voltage VBC prim. 20.6 kV
1 Function key F1 is pressed. Eight asterisks (*) appear in the fourth line as a prompt to enter the password.	F1	********
2a Press the following keys in sequence: 'Left'		*
'Down'		*
'Right'		*
'Up' The display will change as shown in the column on the right.		*
Now press the ENTER key. If the correct password has been entered, the active display will re-appear. Function keys F1 to Fx are active only during the set return time for function keys. If an invalid password has been entered, the display shown above in Step 1 will appear.		Voltage VAB prim. 20.7 kV Voltage VBC prim. 20.6 kV
2b This control step can be canceled at any time by pressing the CLEAR key before the ENTER key is pressed.	C	Voltage VAB prim. 20.7 kV Voltage VBC prim. 20.6 kV
3 Press F1 again. The function configured to this function key is carried out.	F1	Voltage VAB prim. 20.7 kV Voltage VBC prim. 20.6 kV
4 When function keys are pressed during the return time period, then the configured function is carried out directly, e.g. without again checking for the password.	Fx	Oper/CtrlTest/LOC Param.change enable Yes

6.5 Configurable Function Keys F1 to Fx (particularly as control keys)

As described in section "Configurable Function Keys (Function Group F_KEY)" in Chapter 3 function keys F1 to Fx may be configured as control keys at F_KEY: Fct. assignm. Fx (Fx: F1 to F6).

In this case different rules apply to checking the password (see the previous section) and the configuration to *"Key/Switch"* is ignored.

In case the control functionality is desired then each of the following four control commands, should be assigned to a function key. The particular selection of the four function keys out of the available six, however, does not matter.

- MAIN: Local/Remote Key
  The *"Local/Remote"* control command is effective only in the bay panel except where a binary signal input has been configured for this function.
  Depending on the functionality set at LOC: Fct. assign. L/R key, the *'Local/Remote'* command toggles either between *'Remote'* and *'Local'* control, or between *'Local/Remote'* and *'Local'* control. (The parameter LOC: Fct. assign. L/R key may be set either to *R* <-> *L* or to *R & L* <-> *L* and will then define which of the two switching modes is active.) If the *"Local/Remote"* command is configured such that it will switch from *"Remote"* control to *"Local"* control, then this can only occur if the password has first been entered at LOC: Password L/R. Switching from *"Local"* to *"Remote"* control will occur without checking the password. (See also section "Configuring the Measured Value Panels and Selection of the Control Point (Function Group LOC)" in Chapter 3.)

- MAIN: Device selection key
  This selection command is effective only in the bay panel and only if *"Local"* control is activated.
  If local control has been selected, pressing the selection key selects the switchgear unit to be controlled. This selected external device is marked on the text display with the flashing symbol "**>**" in front of the external devices' designation text.

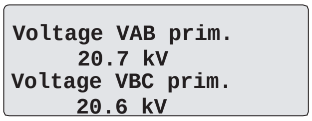
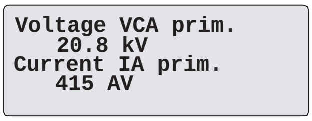
- MAIN: Device OPEN key
  The OPEN command is effective in the bay panel only.
  Pressing the key assigned to this function controls the selected switchgear unit – taking into account the interlock equation – to assume the 'open' status.

- MAIN: Device CLOSE key
  The CLOSE command is effective in the bay panel only.
  Pressing the key assigned to this function controls the selected switchgear unit – taking into account the interlock equation – to assume the 'closed' status.

6.6 Control at Panel Level

The measured values that will be displayed on the Measured Value Panels can first be selected in the menu tree under Par/Conf/LOC. The user can select different sets of measured values for the Operation Panel, the Overload Panel, the Ground Fault Panel, and the Fault Panel. Only the Measured Value Panels relevant for the particular design version of the given device and its associated range of functions are actually available. The selected set of values for the Operation Panel is always available. Please see the section entitled ‘Setting a List Parameter’ for instructions regarding selection. If the MAIN: Without function setting has been selected for a given panel, then that panel is disabled.

The Measured Value Panels are called up according to system conditions. If, for example, the device detects an overload or a ground fault, then the corresponding Measured Value Panel will be displayed as long as the overload or ground fault situation exists. Should the device detect a fault, then the Fault Panel is displayed and remains active until the measured fault values are reset, by pressing the CLEAR key, for example.

Control Step / Description	Control Action	Display
0 Up to six selected measured values can be displayed simultaneously on the Panel.		 Voltage VAB prim. 20.7 kV Voltage VBC prim. 20.6 kV
1 If more than two measured values have been selected, they can be viewed one page at a time by pressing the ‘up’ or ’down’ keys. The device will also show the next page of the Measured Value Panel after the set Hold-time for Panels (setting in menu tree: "Par/Conf/LOC") has elapsed.	▲ or ▼	 Voltage VCA prim. 20.8 kV Current IA prim. 415 AV

6.7 Control at the Menu Tree Level

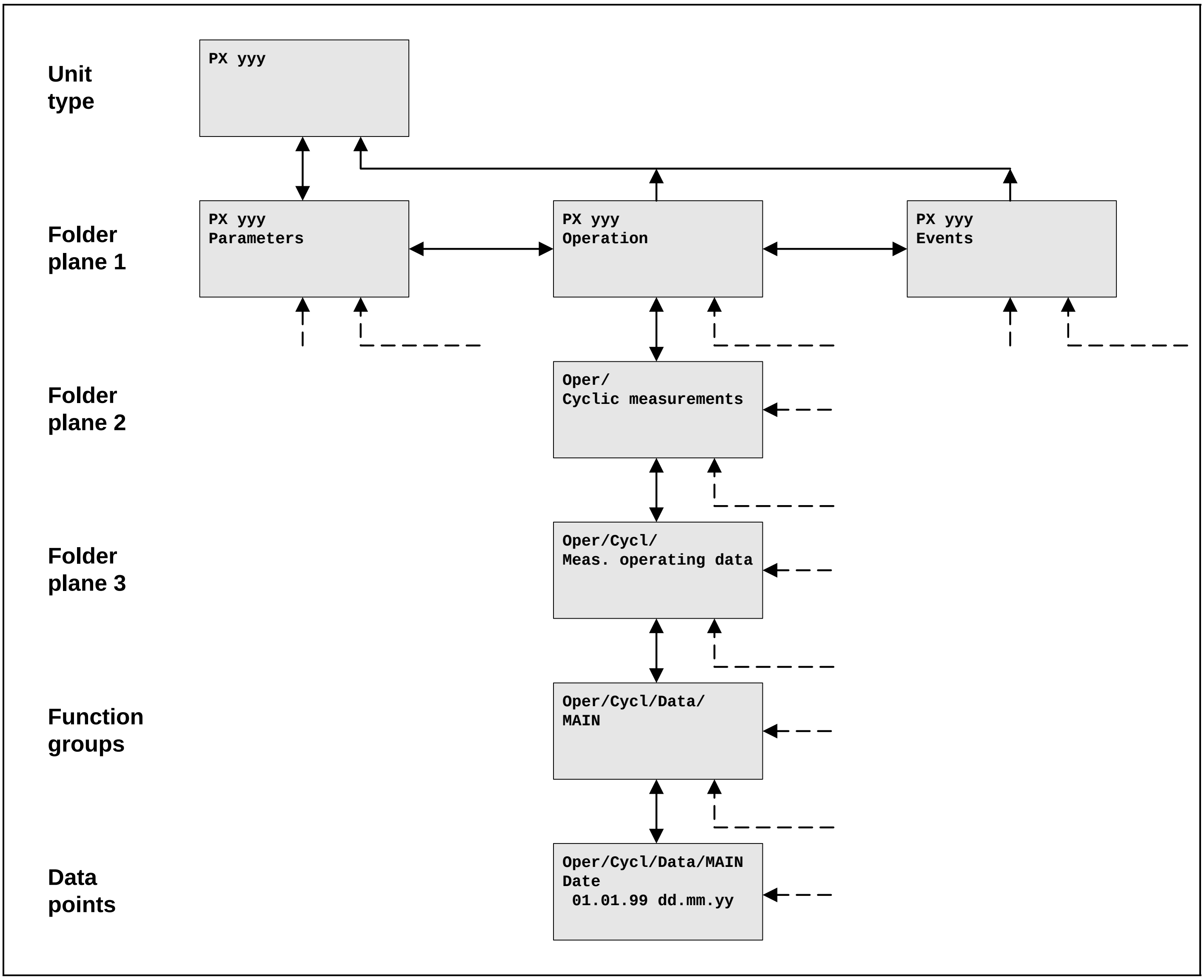
6.7.1 Navigation in the Menu Tree

Folders and function groups

All data points are organized in different folders based on practical control requirements.

At the root of the menu tree is the unit type; the tree branches into the three main folders 'Settings', 'Measurements & Tests' and 'Fault & Event Records', which form the first folder level. Up to two further folder levels follow so that the entire folder structure consists of three main branches and a maximum of three folder levels.

At the end of each branch of folders are the various function groups in which the individual data points (settings) are combined.



6-3 *Basic menu tree structure*

6.7.2 Switching Between Address Mode and Plain Text Mode

The display on the local control panel can be switched between address mode and plain text mode. In the address mode the display shows settings, signals, and measured values in numerically coded form, that is, as addresses. In plain text mode the settings, signals, and measured values are displayed in the form of plain text descriptions. In either case, control is guided by the menu tree. The active branch of the menu tree is displayed in plain text in both modes. In the following examples, the display is shown in plain text mode only.

Control Step / Description	Control Action	Display

0 In this example, the user switches from plain text mode to address mode.		`Par/Func/Glob/MAIN`
		`Device on-line`
		`No (=off)`

1 To switch from address mode to plain text mode or vice versa, press the CLEAR key and either the ‘left’ key or the ‘right’ key simultaneously. This can be done at any point in the menu tree.	C + ‹
	or
	C + ›
		`Par/Func/Glob/MAIN`
		`003.030`
		`0`

6.7.3 Change-Enabling Function

Although it is possible to select any data point in the menu tree and read the associated value by pressing the keys, it is not possible to switch directly to the input mode. This safeguard prevents unintended changes in the settings.

There are two ways to enter the input mode.

Global change-enabling function

- ☐ To activate the global change-enabling function, set the 'Param. change enabl.' parameter to 'Yes' (menu tree: 'Oper/CtrlTest/LOC').
  The change can only be made after the password has been entered. Thereafter, all further changes – with the exception of specially protected control actions (see section "Password-Protected Control Actions") – are enabled without entering the password.

Selective change-enabling function

- ☐ Password input prior to any setting change.

This setup is designed to prevent accidental output and applies even when the global change-enabling function has been activated. The following example is based on the factory-set password. If the password has been changed by the user (see section "Changing the Password"), the following description will apply accordingly.

Control Step / Description	Control Action	Display

0 In the menu tree 'Oper/CtrlTest/LOC', select the 'Param. change enabl.' parameter.		`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`

1 Press the ENTER key. Eight asterisks (*) appear in the fourth line of the display.	↵	`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`
		`********`

2 Press the following keys in sequence:
'Left'
	←	`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`
		` *`

'Right'	→	`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`
		` *`

'Up'	↑	`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`
		`  *`

'Down'
The display will change as shown in the column on the right.
	↓	`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`
		`   *`

Control Step / Description	**Control Action**	**Display**

Now press the ENTER key. The LED indicator labeled EDIT MODE will light up. This indicates that the setting can now be changed by pressing the ‘up’ or ’down’ keys.
If an invalid password has been entered, the display shown in Step 1 appears.
	↵	`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`No`

3 Change the setting to ‘*Yes*’.	▲
	◀ ↵ ▶
	▼
		`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`Yes`

4 Press the ENTER key again. The LED indicator will go out. The unit is enabled for further setting changes.	↵	`Oper/CtrlTest/LOC`
		`Param. change enabl.`
		`Yes`

The same procedure applies to any setting change unless the global change-enabling function has been activated. This method is recommended for a single setting change only. If several settings are to be changed, then the global change-enabling function is preferable. In the following examples, the global change-enabling function has been activated.

Automatic return

The automatic return function prevents the change-enabling function from remaining activated after a change of settings has been completed. Once the set return time (menu tree ‘Par/Conf/LOC’) has elapsed, the change-enabling function is automatically deactivated, and the display switches to a Measured Value Panel corresponding to the current system condition. The return time is restarted when any of the control keys is pressed.

Forced return

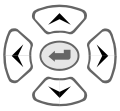
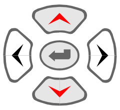
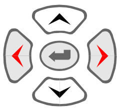
The return described above can be forced from the local control panel by first pressing the ‘up’ key and then holding it down while pressing the CLEAR key.

Note: It is important to press the ‘up’ key first and release it last in order to avoid unintentional deletion of stored data.

Even when the change-enabling function is activated, not all settings can be changed. For some settings it is also necessary to disable the protective function (menu tree: Par/Func/Glob/MAIN, 'Protection enabled'). Such settings include the configuration settings, by means of which the device interfaces can be adapted to the system.

6.7.4 Changing Parameters

If all the conditions for a value change are satisfied (see above), the desired setting can be entered.

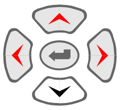
Control Step / Description	Control Action	Display
0 Example of a display. In this example, the change-enabling function is activated and the protective function is disabled, if necessary.		Oper/CtrlTest/LOC Param. change enabl. Yes
1 Select the desired setting by pressing the keys.		Par/Conf/LOC Autom. return time 50000 s
2 Press the ENTER key. The LED indicator labeled EDIT MODE will light up. The last digit of the value is highlighted by a cursor (underlined).		Par/Conf/LOC Autom. return time 50000 s
3 Press the ‘left’ or ’right’ keys to move the cursor to the left or right.		Par/Conf/LOC Autom. return time 50000 s
4 Change the value highlighted by the cursor by pressing the ‘up’ and ’down’ keys. In the meantime the device will continue to operate with the old value.		Par/Conf/LOC Autom. return time 50010 s
5 Press the ENTER key. The LED indicator labeled EDIT MODE will go out and the device will now operate with the new value. Press the keys to select another setting for a value change.		Par/Conf/LOC Autom. return time 50010 s
6 If you wish to reject the new setting while you are still entering it (LED indicator labeled EDIT MODE is on), press the CLEAR key. The LED indicator will go out and the device will continue to operate with the old value. A further setting can be selected for a value change by pressing the keys.		Par/Conf/LOC Autom. return time 50000 s

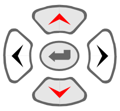
6.7.5 Setting a List Parameter

Using list settings, the user is able to select several elements from a list in order to perform tasks such as defining a trip command or defining the measurements that will be displayed on Measured Value Panels. As a rule, the selected elements are linked by an ‘OR’ operator. Other operators (NOT, OR, AND, NOT OR and NOT AND) are available in the LOGIC function group for linking the selected list items. In this way binary signals and binary input signals can be processed in a Boolean equation tailored to meet user requirements. For the DNP 3.0 communication protocol, the user defines the class of a setting instead of assigning operators. The definition of a trip command shall be used here as an illustration.

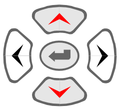
Control Step / Description	**Control Action**	**Display**

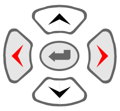
0 Select a list setting (in this example, the parameter 'Fct.assign.trip cmd.' at ‘Par/Func/Glob/ MAIN’ in the menu tree). The down arrow (↓) indicates that a list setting has been selected.		`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		↓

1 Press the ‘down’ key. The first function and the first selected signal will appear in the third and fourth lines, respectively. The symbol ‘#01’ in the display indicates the first item of the selection. If 'MAIN: Without function’ appears for the first item, then this means that no function assignment has yet been made.		`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		`#01 DIST`
		`Trip zone 1`

2 Scroll through the list of assigned functions by pressing the ‘right’ and ’left’ keys.
Once the end of the list is reached, the display shown on the right will appear.
		`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		`OR #02 DIST`
		`Trip zone 2`
		`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		`#05 MAIN`
		`?????`

3 Press the ENTER key at any position in the list. The LED indicator labeled EDIT MODE will light up.		`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		`#02 DIST`
		`Trip zone 2`

4 Scroll through the assignable functions by pressing the ‘right’ and ‘left’ keys in the input mode.		`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		`#02 DIST`
		`Trip zone 4`

5 Select the operator or the class using the ‘up’ and ’down’ keys. In this particular case, only the ‘OR’ operator can be selected. There is no limitation on the selection of classes.		`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		`OR #02 DIST`
		`Trip zone 4`

Control Step / Description	Control Action	Display

6 Press the ENTER key. The LED indicator will go out. The assignment has been made. The unit will now operate with the new settings.
If no operator has been selected, the 'OR' operator is always assigned automatically when the ENTER key is pressed. There is no automatic assignment of classes.
		`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		`OR          #02 DIST`
		`Trip zone 4`

7 Press the 'up' key to exit the list at any point in the list.		`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		↓

8 If you wish to reject the new setting while you are still entering it (LED indicator labeled EDIT MODE is on), press the CLEAR key. The LED indicator labeled EDIT MODE will be extinguished.		`Par/Func/Glob/MAIN`
		`Fct.assign.trip cmd.`
		`OR          #02 DIST`
		`Trip zone 2`

Deleting a list setting

If "MAIN: Without function" is assigned to a given item, then all the following items are deleted. If this occurs for item #01, everything is deleted.

6.7.6 Memory Readout

Memories can be read out after going to the corresponding entry point. This does not necessitate activating the change-enabling function or even disabling the protective functions. Inadvertent clearing of a memory at the entry point is not possible.

The following memories are available:

- In the menu tree 'Oper/Rec/OP_RC': Operating data memory
- In the menu tree 'Oper/Rec/MT_RC': Monitoring signal memory
- Event memories
  - In the menu tree 'Events/Rec/FT_RC': Fault memories 1 to 8
  - In the menu tree 'Events/Rec/OL_RC': Overload memories 1 to 8
  - In the menu tree 'Events/Rec/GF_RC': Ground fault memories 1 to 8

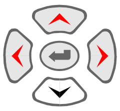
Not all of these event memories are present in each unit.

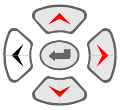
Readout of the operating data memory

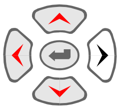
The operating data memory contains stored signals of actions that occur during operation, such as the enabling or disabling of a device function. A maximum of 100 entries is possible, after which the oldest entry is overwritten.

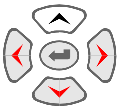
Control Step / Description	Control Action	Display

0 Select the entry point for the operating data memory.		`Oper/Rec/OP_RC`
		`Operat. data record.`
		↓

1 Press the 'down' key to enter the operating data memory. The latest entry is displayed.		`Oper/Rec/OP_RC`
		`01.01.97 11:33 ARC`
		`Enabled USER`
		`No`

2 Press the 'left' key repeatedly to display the entries one after the other in chronological order. Once the end of the operating data memory has been reached, pressing the 'left' key again will have no effect.		`Oper/Rec/OP_RC`
		`01.01.97 10:01 PSIG`
		`Enabled USER`
		`Yes`

3 Press the 'right' key to display the previous entry.		`Oper/Rec/OP_RC`
		`01.01.97 11:33 ARC`
		`Enabled USER`
		`No`

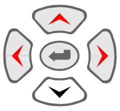
4 Press the 'up' key at any point within the operating data memory to return to the entry point.		`Oper/Rec/OP_RC`
		`Operat. data record.`
		↓

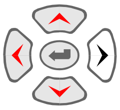
Readout of the monitoring signal memory

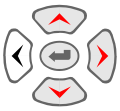
If the unit detects an internal fault in the course of internal self-monitoring routines or if it detects power system conditions that prevent flawless functioning of the unit, then an entry is made in the monitoring signal memory. A maximum of 30 entries is possible. After that an ‘overflow’ signal is issued.

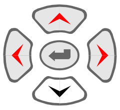
Control Step / Description	Control Action	Display

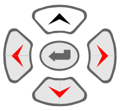
0 Select the entry point for the monitoring signal memory.		`Oper/Rec/MT_RC`
		`Mon. signal record.`
		↓

1 Press the ‘down’ key to enter the monitoring signal memory. The oldest entry is displayed.		`Mon. signal record.`
		`01.01.97 13:33 SFMON`
		`Checksum error param`

2 Press the ‘right’ key repeatedly to display the entries one after the other in chronological order. If more than 30 monitoring signals have been entered since the last reset, the ‘overflow’ signal is displayed as the last entry.		`Mon. signal record.`
		`01.01.97 10:01 SFMON`
		`Exception oper. syst.`

3 Press the ‘left’ key to display the previous entry.		`Mon. signal record.`
		`01.01.97 13:33 SFMON`
		`Checksum error param`

4 If the ‘down’ key is held down while a monitoring signal is being displayed, the following additional information will be displayed:
First: Time when the signal first occurred
Currently: The fault is still being detected (Yes) or is no longer detected (No) by the self-monitoring function.
Reset: The fault was no longer detected by the self-monitoring function and has been reset (Yes).
Number: The signal occurred x times.
		`Mon. signal record.`
		`01.01.97 13:33 SFMON`
		`Checksum error param`
		`First:   13:33:59.744`
		`Active: Yes`
		`Reset:   No`
		`Number:    5`

5 Press the ‘up’ key at any point within the monitoring signal memory to return to the entry point.		`Oper/Rec/MT_RC`
		`Mon. signal record.`
		↓

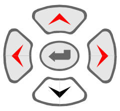
Readout of the event memories (records)

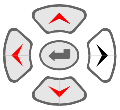
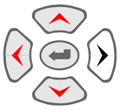
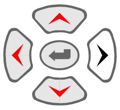
There are eight event memories for each type of event. The latest event is stored in event memory 1, the previous one in event memory 2, and so forth.

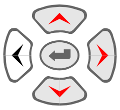
Readout of event memories is illustrated using the fault memory as an example.

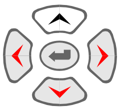
Control Step / Description	Control Action	Display

0 Select the entry point for the first fault memory, for example. If the memory contains entries, the third line of the display will show the date and time the fault began. If the third line is blank, then there are no entries in the fault memory.		`Events/Rec/FT_RC`
		`Fault recording 1`
		`01.01.99  10:00:33`
		↓

1 Press the ‘down’ key to enter the fault memory. First, the fault number is shown. In this example it is the 22nd fault since the last reset.		`Fault recording 1`
		`FT_RC`
		`Event`
		`22`

2 Press the ‘right’ key repeatedly to see first the measured fault data and then the binary signals in chronological order. The time shown in the second line is the time, measured from the onset of the fault, at which the value was measured or the binary signal started or ended.
Once the end of the fault has been reached (after the ‘right’ key has been pressed repeatedly), pressing the ‘right’ key again will have no effect.
	
	
	
		`Fault recording 1`
		`200 ms   FT_DA`
		`Running time`
		`0.17 s`
		
		`Fault recording 1`
		`0 ms   FT_RC`
		`Record. in progress`
		`Start`
		
		`Fault recording 1`
		`241 ms   FT_RC`
		`Record. in progress`
		`End`

3 Press the ‘left’ key to see the previous measured value or the previous signal.		`Fault recording 1`
		`0 ms   FT_RC`
		`Record. in progress`
		`Start`

4 Press the ‘up’ key at any point within the fault memory to return to the entry point.		`Events/Rec/FT_RC`
		`Fault recording 1`
		`01.01.99  10:00:33`
		↓

6.7.7 Reset

All information memories – including the event memories and the monitoring signal memory – as well as the LED indicators can be reset manually. In addition, the LED indicators are automatically cleared and initialized at the onset of a new fault – provided that the appropriate operating mode has been selected – so that they always indicate the latest fault.

The LED indicators can also be reset manually by pressing the CLEAR key, which is always possible in the standard control mode. This action also triggers an LED indicator test and an LCD display test. The event memories are not affected by this action, so that inadvertent deletion of the records associated with the reset signal pattern is reliably prevented.

Because of the ring structure of the event memories, the data for eight consecutive events are updated automatically so that manual resetting should not be necessary, in principle.

Deleting the event memories completely (e.g. after a function test), can be accomplished by various resetting actions including the configuration of a group resetting for several memories. An overview of all resetting actions can be found in section "Resetting Actions" in Chapter 3.

Resetting a single memory from the local control panel is described in the following with the example of a fault memory. In this example the global change-enabling function has already been activated.

Control Step / Description	Control Action	Display

0 Select the reset setting. Line 3 of the display shows the number of faults since the last reset, 10 in this example.		`Oper/CtrlTest/FT_RC`
		`Reset recording`
		`10`

1 Press the ENTER key. The LED indicator labeled EDIT MODE will light up.	↵	`Oper/CtrlTest/FT_RC`
		`Reset recording`
		`10`
		`Don't execute`

2 Press the 'Up' or 'Down' keys to change the setting to '*Execute*'.	▲ ◀ ↵ ▶ ▼	`Oper/CtrlTest/FT_RC`
		`Reset recording`
		`10`
		`Execute`

3 Press the ENTER key. The LED indicator labeled EDIT MODE will be extinguished. The value in line 3 is reset to '0'.	↵	`Oper/CtrlTest/FT_RC`
		`Reset recording`
		`0`

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(continued)

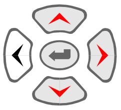
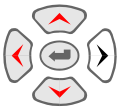
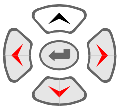
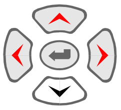
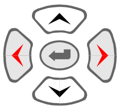
Control Step / Description	Control Action	Display

4 To cancel the intended clearing of the fault recordings after leaving the standard control mode (the LED indicator labeled EDIT MODE is on), press the CLEAR key. The LED indicator will be extinguished, and the fault recordings remain stored unchanged in the protection unit's memory. Any setting can be selected again for a value change by pressing the keys.	C	`Oper/CtrlTest/FT_RC`
		`Reset recording`
		`10`

6.7.8 Password-Protected Control Actions

Certain actions from the local control panel such as a manual trip command for testing purposes can only be carried out by entering a password so as to prevent unwanted output even though the global change-enabling function has been activated (see section "Change-Enabling Function").

This setup is designed to prevent accidental output and applies even when the global change-enabling function has been activated. The password consists of a pre-defined sequential key combination entered within a specific time interval. If the password has been changed by the user (see section "Changing the Password"), the following description will apply accordingly.

Control Step / Description	Control Action	Display
0 In the menu tree 'Oper/CtrlTest/MAIN', select the parameter 'Man. trip cmd. USER'.		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute
1 Press the ENTER key. Eight asterisks (*) appear in the fourth line of the display.		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute ********
2 Press the following keys in sequence: 'Left'		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute *
'Right'		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute *
'Up'		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute *
'Down' The display will change as shown in the column on the right.		Oper/CtrlTest/MAIN Man. trip cmd USER Don't execute *
Now press the ENTER key. The LED indicator labeled EDIT MODE will light up. This indicates that the setting can now be changed by pressing the 'up' or 'down' keys.		Oper/CtrlTest/MAIN Man. trip cmd. USER Don't execute
3 Change the setting to *'Execute'*.		Oper/CtrlTest/MAIN Man. trip cmd. USER Execute

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(continued)

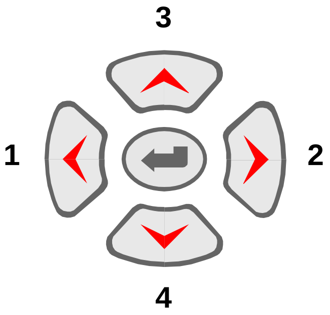
Control Step / Description	**Control Action**	**Display**

4 Press the ENTER key again. The LED indicator labeled EDIT MODE will go out. The unit will execute the command.	↵	`Oper/CtrlTest/MAIN`
		`Man. trip cmd. USER`
		`Don't execute`

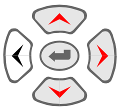
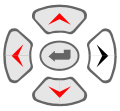
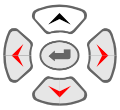
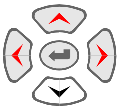
5 As long as the LED indicator labeled EDIT MODE is on, the control action can be terminated by pressing the CLEAR key. The LED indicator labeled EDIT MODE will be extinguished.	C	`Oper/CtrlTest/MAIN`
		`Man. trip cmd. USER`
		`Don't execute`

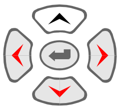
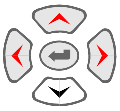
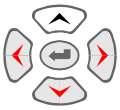
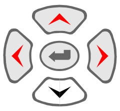
6.7.9 Changing the Password

The password consists of a combination of keys that must be entered sequentially within a specific time interval. The ‘left’, ’right’, ‘up’ and ‘down’ keys may be used to define the password and represent the numbers 1, 2, 3 and 4, respectively:



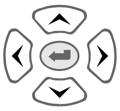
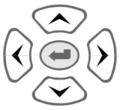
The password can be changed by the user at any time. The procedure for this change is described below. The starting point is the factory-set password.

Control Step / Description	Control Action	Display
0 In the menu tree ‘Par/Conf/LOC’, select the ‘Password’ setting.		Par/Conf/LOC Password ********
1 Press the ENTER key. Eight asterisks (*) appear in the fourth line of the display.		Par/Conf/LOC Password ******** ********
2 Press the ‘left’, ’right’, ‘up’ and ’down’ keys to enter the valid password. The display will change as shown in the column on the right.		Par/Conf/LOC Password ******** *
		Par/Conf/LOC Password ******** *
		Par/Conf/LOC Password ******** *
		Par/Conf/LOC Password ******** *
3 Now press the ENTER key. The LED indicator labeled EDIT MODE will light up. The third line shows an underscore character (_) as the prompt for entering a new password.		Par/Conf/LOC Password _

Control Step / Description	Control Action	Display
4 Enter the new password, which in this example is done by pressing the UP key followed by the DOWN key.	 	Par/Conf/LOC Password * Par/Conf/LOC Password **
5 Press the ENTER key again. Asterisks appear in the third line, and a cursor (underscore) in the fourth line prompts the user to enter the new password again.		Par/Conf/LOC Password ** _
6 Re-enter the password.	 	Par/Conf/LOC Password ** * Par/Conf/LOC Password ** **
7a Press the ENTER key again. If the password has been re-entered correctly, the LED indicator labeled EDIT MODE goes out and the display appears as shown on the right. The new password is now valid.		Par/Conf/LOC Password ********
7b If the password has been re-entered incorrectly, the LED indicator labeled EDIT MODE remains on and the display shown on the right appears. The password needs to be re-entered. It is also possible to cancel the change in password by pressing the CLEAR key (see Step 8).		Par/Conf/LOC Password ** _
8 The change in password can be canceled at any time before Step 7 by pressing the CLEAR key. If this is done, the original password continues to be valid.	 	Par/Conf/LOC Password ********

Operation from the local control panel without password protection is also possible. To select this option, immediately press the ENTER key a second time in steps 4 and 6 without entering anything else. This will configure the local control panel without password protection, and no control actions involving changes will be possible until the global change-enabling function has been activated (see section "Change-Enabling Function").

If the configured password has been forgotten, it can be called up on the LCD display as described below. The procedure involves turning the device off and then on again.

Control Step / Description	**Control Action**	**Display**
0 Turn off the device.		
1 Turn the device on again. At the very beginning of device startup, press the four directional keys (‘left’, ‘right’, ‘up’ and ‘down’) at the same time and hold them down.		`TEST`
2 When this condition is detected during startup, the password is displayed.		`Password` `1234`
3 After the four keys are released, startup will continue.		`TEST`

7 Settings

7 Settings

7.1 Parameter

The P132 must be adjusted to the system and to the protected equipment by appropriate settings. This chapter gives instructions for determining the settings, which are located in the folder titled ‘Parameters’ in the menu tree. The sequence in which the settings are listed and described in this chapter corresponds to their sequence in the menu tree.

The P132 devices are supplied with a factory-set standard configuration of settings that, in most cases, correspond to the default settings or become apparent after a "cold restart". The P132 is blocked in that case. All settings must be re-entered after a cold restart.

Note:

In the following tables (except for function group DVICE) an indication for the localization of the corresponding function description is shown in the right hand side column. "Figure: 3-xxx" refers to a logic diagram which displays the address, "Figure*: 3-xxx" to a figure subtitle or accompanying text, "Page: 3-xxx" to a page.

7.1.1 Device Identification

The device identification settings are used to record the ordering information and the design version of the P132. They have no effect on the device functions. These settings should only be changed if the design version of the P132 is modified.

Device

DVICE: Device type 000 000

The device type is displayed. This display cannot be altered.

DVICE: Software version 002 120

Software version for the device. This display cannot be altered.

DVICE: SW date 002 122

Date the software was created. This display cannot be altered.

DVICE: SW version communic. 002 103

Software version for the device's communication software. This display cannot be altered.

DVICE: DM IEC 61850 version 002 059

Software version of the communication software based on the device's protocol per IEC 61850. This display cannot be altered.

DVICE: Language version 002 123

Identification of the change level of the texts of the data model. This display cannot be altered.

DVICE: Text vers.data model 002 121

Using the ‘text replacement tool’ provided by the operating program, the user can change the parameter descriptors (plain text designations) and load them into the device. These customized data models contain an identifier defined by the user while preparing the data model. This identifier is displayed at this point in the menu tree. Standard data models have the identifier ‘0’ (factory-set default).

DVICE: F number 002 124

The F number is the serial number of the device. This display cannot be altered.

DVICE: AFS Order No. 001 000
DVICE: PCS Order No. 001 200

Order numbers for the device. The user cannot alter this number.

DVICE: Order ext. No. 1	000 003
DVICE: Order ext. No. 2	000 004
DVICE: Order ext. No. 3	000 005
DVICE: Order ext. No. 4	000 006
DVICE: Order ext. No. 5	000 007
DVICE: Order ext. No. 6	000 008
DVICE: Order ext. No. 7	000 009
DVICE: Order ext. No. 8	000 010
DVICE: Order ext. No. 9	000 011
DVICE: Order ext. No. 10	000 012
DVICE: Order ext. No. 11	000 013
DVICE: Order ext. No. 12	000 014
DVICE: Order ext. No. 13	000 015
DVICE: Order ext. No. 14	000 016
DVICE: Order ext. No. 15	000 017
DVICE: Order ext. No. 16	000 018
DVICE: Order ext. No. 17	000 019
DVICE: Order ext. No. 18	000 020
DVICE: Order ext. No. 19	000 021
DVICE: Order ext. No. 20	000 022
DVICE: Order ext. No. 21	000 023
DVICE: Order ext. No. 22	000 024
DVICE: Order ext. No. 23	000 025
DVICE: Order ext. No. 24	000 026
DVICE: Order ext. No. 25	000 027
DVICE: Order ext. No. 26	000 028
DVICE: Order ext. No. 27	000 029

Order extension numbers for the device.

DVICE: Module var. slot 1	086 050
DVICE: Module var. slot 2	086 051
DVICE: Module var. slot 3	086 052
DVICE: Module var. slot 4	086 053
DVICE: Module var. slot 5	086 054
DVICE: Module var. slot 6	086 055
DVICE: Module var. slot 7	086 056
DVICE: Module var. slot 8	086 057
DVICE: Module var. slot 9	086 058
DVICE: Module var. slot 10	086 059
DVICE: Module var. slot 11	086 060
DVICE: Module var. slot 12	086 061
DVICE: Module var. slot 13	086 062
DVICE: Module var. slot 14	086 063
DVICE: Module var. slot 15	086 064
DVICE: Module var. slot 16	086 065
DVICE: Module var. slot 17	086 066
DVICE: Module var. slot 18	086 067
DVICE: Module var. slot 19	086 068
DVICE: Module var. slot 20	086 069
DVICE: Module var. slot 21	086 070

Item number of the module inserted in the respective slot 1 to 21.
The display always shows the actual component configuration at any given time.

DVICE: Module vers. slot 1 086 193
DVICE: Module vers. slot 2 086 194
DVICE: Module vers. slot 3 086 195
DVICE: Module vers. slot 4 086 196
DVICE: Module vers. slot 5 086 197
DVICE: Module vers. slot 6 086 198
DVICE: Module vers. slot 7 086 199
DVICE: Module vers. slot 8 086 200
DVICE: Module vers. slot 9 086 201
DVICE: Module vers. slot 10 086 202
DVICE: Module vers. slot 11 086 203
DVICE: Module vers. slot 12 086 204
DVICE: Module vers. slot 13 086 205
DVICE: Module vers. slot 14 086 206
DVICE: Module vers. slot 15 086 207
DVICE: Module vers. slot 16 086 208
DVICE: Module vers. slot 17 086 209
DVICE: Module vers. slot 18 086 210
DVICE: Module vers. slot 19 086 211
DVICE: Module vers. slot 20 086 212
DVICE: Module vers. slot 21 086 213

Index letter specifying the version of the module fitted in the respective slot.

DVICE: Variant of module A 086 047

Item number of module A in this design version.

DVICE: Version of module A 086 190

Index letter specifying the version of module A.

DVICE: MAC address module A 104 061

MAC address for the network hardware of the Ethernet module. This address is introduced during manufacture and can only be read.

DVICE: Variant of module L 086 048

Item number of module L in this design version.

DVICE: Version of module L 086 191

Index letter specifying the version of module L.

DVICE: Variant of module B 086 049

Item number of module B in this design version.

DVICE: Version of module B 086 192

Index letter specifying the version of the digital bus module B.

DVICE: Variant module B (a) 086 046

Item number of analog bus module B.

DVICE: Version module B (a) 086 189

Index letter specifying the version of the digital bus module B.

DVICE: Customer ID data 1 000 040
DVICE: Customer ID data 2 000 041
DVICE: Customer ID data 3 000 042
DVICE: Customer ID data 4 000 043
DVICE: Customer ID data 5 000 044
DVICE: Customer ID data 6 000 045
DVICE: Customer ID data 7 000 046
DVICE: Customer ID data 8 000 047

Set your numerically coded user data here for your records.

DVICE: Location 001 201

Reference input for the device’s location as selected by user.

DVICE: Device ID 000 035

ID code used by the operating program for identification purposes. See description of the respective operating program for more detailed setting instructions.

DVICE: Substation ID 000 036

ID code used by the operating program for identification purposes. See description of the respective operating program for more detailed setting instructions.

DVICE: Feeder ID 000 037

ID code used by the operating program for identification purposes. See description of the respective operating program for more detailed setting instructions.

DVICE: Device password 1 000 048
DVICE: Device password 2 000 049

ID code used by the operating program for identification purposes. See description of the respective operating program for more detailed setting instructions.

DVICE: SW version DHMI 002 131
DVICE: SW version DHMI DM 002 132

Internal software version numbers.

LOC: Local HMI exists 221 099

When set to *'Yes'* it is apparent that the device is fitted with the local control panel (HMI).

7.1.2 Configuration Parameters

Local control panel

LOC: Language 003 020

Language in which texts will be displayed on the local control panel.

LOC: Decimal delimiter 003 021

Character to be used as decimal separator on the local control panel.

LOC: Password 003 035

The password to be used for changing settings from the local control panel can be defined here. Further information on changing the password is given in Chapter 6.

LOC: Password L/R 221 040

The password used to change the setting from *'Remote'* to *'Local'* control can be defined here. (Switching from *'Local'* to *'Remote'* control occurs without checking the password.)

LOC: Display L/R 221 070

This setting defines whether the control site – *'Local'* or *'Remote'* – shall be displayed on the bay panel.

LOC: Displ. interl. stat. 221 071

This setting defines whether the *'Locked'* or *'Unlocked'* status shall be displayed on the bay panel.

LOC: Fct. assign. L/R key 225 208 Fig: 3-6

This setting defines whether the (electric) key-operated switch switches between remote / local control (L↔R) or between *'Remote'* and *'Local'* control / *'Local'* control (R&L↔L).

LOC: Fct. reset key 005 251 Fig: 3-83

Selection of specified counters or event logs that are reset by pressing the RESET key on the local control panel.

LOC: Fct. read key 080 110

Selection of the event log that will be displayed when the READ key is pressed.

LOC: Fct. menu jmp list 1 030 238
LOC: Fct. menu jmp list 2 030 239

Selection of specified functions which will be sequentially displayed by repeated reading of the menu jump list 1 (or 2).

LOC: Fct. Operation Panel 053 007 Fig: 3-2

Definition of the values to be displayed on the Measured Value Panel also referred to as the Operation Panel.

LOC: Fct. Overload Panel 053 005 Fig: 3-5

Definition of the values to be displayed on the Overload Panel.

LOC: Fct. Grd.Fault Panel 053 004 Fig: 3-4

Definition of the values to be displayed on the Ground Fault Panel.

LOC: Fct. Fault Panel 053 003 Fig: 3-3

Definition of the values to be displayed on the Fault Panel.

LOC: Hold-time for Panels 031 075 Fig: 3-2

Setting for the time period during which a panel is displayed, before the unit switches to the next panel. This setting is only relevant if more values are selected than can be shown on the LC-Display.

	LOC: Autom. return time	003 014	Fig: 3-2
	If the user does not press a key on the local control panel during this set time period, the change-enabling function is deactivated.		
	LOC: Return time select.	221 030	
	If the user does not press a key on the local control panel during this set time period, then the selection of a switchgear unit is cancelled.		
	LOC: Return time illumin.	003 023	
	If the user does not press a key on the local control panel during this set time period, then the backlighting of the LCD display is switched off, and any switchgear selection that might have been made is cancelled.		
PC link	**PC: Name of manufacturer**	003 183	Fig: 3-7
	Setting the name of the manufacturer. **Note:** This setting can be changed to ensure compatibility.		
	PC: Bay address	003 068	Fig: 3-7
	PC: Device address	003 069	Fig: 3-7
	Bay and device addresses are used to address the device in communication via the PC interface. An identical setting must be selected for both addresses.		
	PC: Baud rate	003 081	Fig: 3-7
	Baud rate of the PC interface.		
	PC: Parity bit	003 181	Fig: 3-7
	Set the same parity that is set at the interface of the PC connected to the P132.		
	PC: Spontan. sig. enable	003 187	Fig: 3-7
	Enable for the transmission of spontaneous signals via the PC interface.		
	PC: Select. spontan.sig.	003 189	Fig: 3-7
	Selection of spontaneous signals for transmission via the PC interface.		
	PC: Transm.enab.cycl.dat	003 084	Fig: 3-7
	Enable for the cyclic transmission of measured values via the PC interface.		
	PC: Cycl. data ILS tel.	003 185	Fig: 3-7
	Selection of the measured values that are transmitted in a user-defined telegram via the PC interface.		
	PC: Delta V	003 055	Fig: 3-7
	A measured voltage value is transmitted via the PC interface if it differs by the set delta quantity from the last measured value transmitted.		
	PC: Delta I	003 056	Fig: 3-7
	A measured current value is transmitted via the PC interface if it differs by the set delta quantity from the last measured value transmitted.		
	PC: Delta P	003 059	Fig: 3-7
	The active power value is transmitted via the PC interface if it differs by the set delta quantity from the last measured value transmitted.		
	PC: Delta f	003 057	Fig: 3-7
	The measured frequency value is transmitted via the PC interface if it differs by the set delta from the last measured value transmitted.		

PC: Delta meas.v.ILS tel 003 155 Fig: 3-7

The telegram is transmitted if a measured value differs by the set delta quantity from the last measured value transmitted.

PC: Delta t 003 058 Fig: 3-7

All measured values are transmitted again via the PC interface after this time period has elapsed – provided that transmission has not been triggered by the other delta conditions.

PC: Time-out 003 188 Fig: 3-7

Setting for the time to elapse after the last telegram exchange via the PC interface before activating the second communication channel of communication module B.

Communication interface 1

COMM1: Function group COMM1 056 026

Cancelling function group COMM1 or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

COMM1: General enable USER 003 170 Fig: 3-14

Disabling or enabling communication interface 1.

COMM1: Basic IEC870-5enable 003 215 Fig: 3-8

Common settings for enabling all protocols based on IEC 870-5-xxx.

COMM1: Addit. -101 enable 003 216 Fig: 3-8

Enabling additional settings that are relevant for the protocol based on IEC 870-5-101.

COMM1: Addit. ILS enable 003 217 Fig: 3-8

Enabling additional settings that are relevant for the ILS protocol.

COMM1: MODBUS enable 003 220 Fig: 3-8

Enabling settings relevant for the MODBUS protocol.

COMM1: DNP3 enable 003 231 Fig: 3-8

Enabling settings relevant for the DNP 3.0 protocol.

COMM1: COURIER enable 103 040 Fig: 3-8

Enabling settings relevant for the COURIER protocol.

COMM1: Communicat. protocol 003 167 Fig: 3-8

Select the communication protocol that shall be used for the communication interface.

COMM1: -103 prot. variant 003 178 Fig: 3-9

The user may select between two variants of the 103 protocol.

Note: This setting is hidden unless the IEC 870-5-xxx protocol is enabled.

COMM1: MODBUS prot. variant 003 214 Fig: 3-12

The user may select between two variants of the MODBUS protocol.

Note: This setting is hidden unless the MODBUS protocol is enabled.

COMM1: Line idle state 003 165 Fig: 3-9, 3-10, 3-11, 3-12, 3-13, 3-14

Setting for the line idle state indication.

COMM1: Baud rate 003 071 Fig: 3-9, 3-10, 3-11, 3-12, 3-13, 3-14

Baud rate of the communication interface.

COMM1: Parity bit 003 171 Fig: 3-9, 3-10, 3-11, 3-12, 3-13, 3-14

Set the same parity that is set at the interface of the control system connected to the P132.

COMM1: Dead time monitoring 003 176 Fig: 3-9, 3-10, 3-11, 3-12, 3-13, 3-14

The P132 monitors telegram transmission to make sure that no excessive pause occurs within a telegram. This monitoring function can be disabled if it is not required.

Note: This setting is only necessary for modem transmission.

COMM1: Mon. time polling 003 202 Fig: 3-9, 3-10, 3-11, 3-12, 3-13, 3-14

The time between two polling calls from the communication master must be less than the time set here.

COMM1: Octet comm. address 003 072 Fig: 3-9, 3-10, 3-11, 3-12, 3-13, 3-14

The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses.

Note:
The former designation for COMM1: Octet comm. address was: ILSA: Bay address

"ASDU": Application Service Data Unit

COMM1: Oct.2 comm.addr.DNP3 003 240 Fig: 3-13

In the DNP 3.0 protocol, a 16-bit address is used to identify devices. The address that can be set here is the higher-order octet, whereas the address set at COMM1: Octet comm. address is the lower-order octet of the DNP address.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Test monitor on 003 166 Fig: 3-9, 3-10, 3-11, 3-12, 3-13, 3-14

Setting specifying whether data shall be recorded for service activities.

COMM1: Name of manufacturer 003 161 Fig: 3-9, 3-10, 3-11

Setting the name of the manufacturer.

Note: This setting can be changed to ensure compatibility.

This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Octet address ASDU 003 073 Fig: 3-9, 3-10, 3-11

The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses.

Note:

This setting is hidden unless an IEC 870-5 protocol is enabled.

The former designation for COMM1: Octet address ASDU:
ILSA: Device address.

"ASDU": Application Service Data Unit

COMM1: Spontan. sig. enable 003 177 Fig: 3-9, 3-10, 3-11

Enable for the transmission of spontaneous signals via the communication interface.

Note: This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Select. spontan.sig. 003 179 Fig: 3-9, 3-10, 3-11

Selection of spontaneous signals for transmission via communication interface 1.

COMM1: Transm.enab.cycl.dat 003 074 Fig: 3-9, 3-10, 3-11

Enable for the cyclic transmission of measured values via the communication interface.

Note: This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Cycl. data ILS tel. 003 175 Fig: 3-9, 3-10, 3-11

Selection of the measured values that are transmitted in a user-defined telegram via the communication interface.

Note: This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Delta V 003 050 Fig: 3-9, 3-10, 3-11

A measured voltage value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.

Note: This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Delta I 003 051 Fig: 3-9, 3-10, 3-11

A measured current value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.

Note: This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Delta P 003 054 Fig: 3-9, 3-10, 3-11

The active power value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.

Note: This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Delta f 003 052 Fig: 3-9, 3-10, 3-11

The measured frequency value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.

Note: This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Delta meas.v.ILS tel 003 150 Fig: 3-9, 3-10, 3-11

The telegram is transmitted if a measured value differs by the set delta quantity from the last measured value transmitted.

Note: This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Delta t 003 053 Fig: 3-9, 3-10, 3-11

All measured values are transmitted again via the communication interface after this time period has elapsed – provided that transmission has not been triggered by the other delta conditions.

Note: This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Delta t (energy) 003 151 Fig: 3-9, 3-10, 3-11

The measured values for active energy and reactive energy are transmitted via the communication interface after this time has elapsed.

Note: This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Contin. general scan 003 077 Fig: 3-9, 3-10, 3-11

A continuous or background general scan means that the P132 transmits all settings, signals, and monitoring signals through the communication interface during slow periods when there is not much activity. This ensures that there will be data consistency with a connected control system. The time to be set defines the minimum time difference between two telegrams.

Note: This setting is hidden unless an IEC 870-5 protocol is enabled.

COMM1: Comm. address length 003 201 Fig: 3-10

Setting the communication address length.

Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.

COMM1: Octet 2 comm. addr. 003 200 Fig: 3-10

Setting the length of the higher-order communication address.

Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.

COMM1: Cause transm. length 003 192 Fig: 3-10

Setting the length of the cause of transmission.

Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.

COMM1: Address length ASDU 003 193 Fig: 3-10

Setting the length of the common address for identification of telegram structures.

Note:

This setting is hidden unless the IEC 870-5-101 protocol is enabled.

"ASDU": Application Service Data Unit

COMM1: Octet 2 addr. ASDU 003 194 Fig: 3-10

Setting for the length of the common higher-order address for identification of telegram structures.

Note:

This setting is hidden unless the IEC 870-5-101 protocol is enabled.

"ASDU": Application Service Data Unit

COMM1: Addr.length inf.obj. 003 196 Fig: 3-10

Setting the length of the address for information objects.

Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.

COMM1: Oct.3 addr. inf.obj. 003 197 Fig: 3-10

Setting the length of the higher-order address for information objects.

Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.

COMM1: Inf.No.<->funct.type 003 195 Fig: 3-10

Setting specifying whether information numbers and function type shall be reversed in the object address.

Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.

COMM1: Time tag length 003 198 Fig: 3-10

Setting the time tag length.

Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.

COMM1: ASDU1 / ASDU20 conv. 003 190 Fig: 3-10

Setting specifying whether telegram structure 1 or 20 shall be converted as a single signal or double signal.

Note:

This setting is hidden unless the IEC 870-5-101 protocol is enabled.

"ASDU": Application Service Data Unit

COMM1: ASDU2 conversion 003 191 Fig: 3-10

Setting specifying whether telegram structure 2 shall be converted as a single signal or double signal.

Note:

This setting is hidden unless the IEC 870-5-101 protocol is enabled.

"ASDU": Application Service Data Unit

COMM1: Initializ. signal 003 199 Fig: 3-10

Setting specifying whether an initialization signal shall be issued.

Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.

COMM1: Balanced operation 003 226 Fig: 3-10

Setting that determines whether communication takes place on a balanced basis (full duplex operation).

Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.

COMM1: Direction bit 003 227 Fig: 3-10

Setting for the transmission direction. Normally this value will be set to '1' at the control center and to '0' at the substation.

Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.

COMM1: Time-out interval 003 228 Fig: 3-10

Setting the maximum time that will elapse until the status signal for the acknowledgment command is issued.

Note: This setting is hidden unless the IEC 870-5-101 protocol is enabled.

COMM1: Reg.asg. selec. cmds 003 210 Fig: 3-12

MODBUS registers in the range 00301 to 00400 are assigned to the selected commands. Assignment is made in the order of selection. This means that the first command is given to the register no. 00301, the second to the register no. 00302, etc.

Note: This setting is hidden unless the MODBUS protocol is enabled.

COMM1: Reg.asg. selec. sig. 003 211 Fig: 3-12

MODBUS registers in the range 10301 to 10400 are assigned to the selected signals. Assignment is made in the order of selection. This means that the first signal is given to the register no. 10301, the second to the register no. 10302, etc.

Note: This setting is hidden unless the MODBUS protocol is enabled.

COMM1: Reg.asg. sel. m.val. 003 212 Fig: 3-12

MODBUS registers in the range 30301 to 30400 are assigned to the selected measured values. Assignment is made in the order of selection. Assignment is made in the order of selection. This means that the first measured value is given to the register no. 30301, the second to the register no. 30302, etc.

Note: This setting is hidden unless the MODBUS protocol is enabled.

COMM1: Reg.asg. sel. param. 003 213 Fig: 3-12

MODBUS registers in the range 40301 to 40400 are assigned to the selected parameters. Assignment is made in the order of selection. This means that the first parameter is given to the register no. 40301, the second to the register no. 40302, etc.

Note: This setting is hidden unless the MODBUS protocol is enabled.

COMM1: Delta t (MODBUS) 003 152 Fig: 3-12

All MODBUS registers are transmitted again via the communication interface after this time has elapsed.

Note: This setting is hidden unless the MODBUS protocol is enabled.

COMM1: Autom.event confirm. 003 249 Fig: 3-12

Setting specifying whether an event must be confirmed by the master in order for an event to be deleted from the 'event queue'.

Note: This setting is hidden unless the MODBUS protocol is enabled.

COMM1: Phys. Charact. Delay 003 241 Fig: 3-13

Number of bits that must pass between the receipt of the 'request' and the start of sending the 'response'.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Phys. Char. Timeout 003 242 Fig: 3-13

Number of bits that may be missing from the telegram before receipt is terminated.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Link Confirm. Mode 003 243 Fig: 3-13

Setting the acknowledgment mode of the link layer.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Link Confirm.Timeout 003 244 Fig: 3-13

Setting the time period within which the master must acknowledge at the link layer.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Link Max. Retries 003 245 Fig: 3-13

Number of repetitions that are carried out on the link layer if errors have occurred during transmission (such as failure to acknowledge).

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Appl.Confirm.Timeout 003 246 Fig: 3-13

Setting the time period within which the master must acknowledge at the application layer.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Appl. Need Time Del. 003 247 Fig: 3-13

Time interval within which the slave cyclically requests time synchronization from the master.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Ind./cl. bin. inputs 003 232 Fig: 3-13

Selection of data points and data classes for object 1 – binary inputs. Assignment of indexes is made in the order of selection, beginning with 0.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Ind./cl. bin.outputs 003 233 Fig: 3-13

Selection of data points and data classes for object 10 – binary outputs. Assignment of indexes is made in the order of selection, beginning with 0.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Ind./cl. bin. count. 003 234 Fig: 3-13

Selection of data points and data classes for object 20 – binary counters. Assignment of indexes is made in the order of selection, beginning with 0.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Ind./cl. analog inp. 003 235 Fig: 3-13

Selection of data points and data classes for object 30 – analog inputs. Assignment of indices is made in the order of selection, beginning with 0.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Ind./cl. analog outp 003 236 Fig: 3-13

Selection of data points and data classes for object 40 – analog outputs. Assignment of indexes is made in the order of selection, beginning with 0.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Delta meas.v. (DNP3) 003 250 Fig: 3-13

Initialization value of threshold values for transmission of measured values in object 30. The threshold values can be changed separately by the master for each measured value by writing to object 34, 'analog input reporting deadband'.

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Delta t (DNP3) 003 248 Fig: 3-13

Cycle time for updating DNP object 30 (analog inputs).

Note: This setting is hidden unless the DNP 3.0 protocol is enabled.

COMM1: Command selection 103 042 Fig: 3-14

Selection of commands to be issued via the Courier protocol.

Note: This setting is hidden unless the Courier protocol is enabled.

COMM1: Signal selection 103 043 Fig: 3-14

Selection of signals to be transmitted via the Courier protocol.

Note: This setting is hidden unless the Courier protocol is enabled.

COMM1: Meas. val. selection 103 044 Fig: 3-14

Selection of measured values to be transmitted via the Courier protocol.

Note: This setting is hidden unless the Courier protocol is enabled.

COMM1: Parameter selection 103 045 Fig: 3-14

Selection of settings to be altered via the Courier protocol.

Note: This setting is hidden unless the Courier protocol is enabled.

COMM1: Delta t (COURIER) 103 046 Fig: 3-14

Cycle time at the conclusion of which the selected measured values are again transmitted.

Note: This setting is hidden unless the Courier protocol is enabled.

Communication interface 2

COMM2: Function group COMM2 056 057

Cancelling function group COMM2 or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

COMM2: General enable USER 103 170 Fig: 3-16

Disabling or enabling communication interface 2.

COMM2: Line idle state 103 165 Fig: 3-16

Setting for the line idle state indication.

COMM2: Baud rate 103 071 Fig: 3-16

Baud rate of the communication interface.

COMM2: Parity bit 103 171 Fig: 3-16

Set the same parity that is set at the interface of the control system connected to the P132.

COMM2: Dead time monitoring 103 176 Fig: 3-16

The P132 monitors telegram transmission to make sure that no excessive pause occurs within a telegram. This monitoring function can be disabled if it is not required.

Note: This setting is only necessary for modem transmission.

COMM2: Mon. time polling 103 202 Fig: 3-16

The time between two polling calls from the communication master must be less than the time set here.

COMM2: Positive ackn. fault 103 203

It is possible to set whether or not faults can be acknowledged positively after transmission (and consequently deleted from the fault overview at the COMM2/PC interface).

COMM2: Octet comm. address 103 072 Fig: 3-16

The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses.

"ASDU": Application Service Data Unit

COMM2: Name of manufacturer 103 161 Fig: 3-16

Setting the name of the manufacturer.

Note: This setting can be changed to ensure compatibility.

COMM2: Octet address ASDU 103 073 Fig: 3-16

The communication address and the ASDU address are used to identify the device in communication via the interface. An identical setting must be selected for both addresses.

"ASDU": Application Service Data Unit

COMM2: Spontan. sig. enable 103 177 Fig: 3-16

Enable for the transmission of spontaneous signals via the communication interface.

COMM2: Select. spontan.sig. 103 179 Fig: 3-16

Selection of spontaneous signals for transmission via communication interface 2.

COMM2: Transm.enab.cycl.dat 103 074 Fig: 3-16

Enable for the cyclic transmission of measured values via the communication interface.

COMM2: Cycl. data ILS tel. 103 175 Fig: 3-16

Selection of the measured values that are transmitted in a user-defined telegram via the communication interface.

COMM2: Delta V 103 050 Fig: 3-16

A measured voltage value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.

COMM2: Delta I 103 051 Fig: 3-16

A measured current value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.

COMM2: Delta P 103 054 Fig: 3-16

The active power value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.

COMM2: Delta f 103 052 Fig: 3-16

The measured frequency value is transmitted via the communication interface if it differs by the set delta quantity from the last measured value transmitted.

COMM2: Delta meas.v.ILS tel 103 150 Fig: 3-16

The telegram is transmitted if a measured value differs by the set delta quantity from the last measured value transmitted.

COMM2: Delta t 103 053 Fig: 3-16

All measured values are transmitted again via the communication interface after this time period has elapsed – provided that transmission has not been triggered by the other delta conditions.

Communication interface 3

COMM3: Function group COMM3 056 058

Cancelling function group COMM3 or including it in the configuration.

This setting parameter is only visible if the relevant optional communication module is fitted.

If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

COMM3: General enable USER 120 030 Page: 3-25

Disabling or enabling communication interface 3.

COMM3: Baud rate 120 038 Page: 3-25

Adjustment of the baud rate for telegram transmission via the teleprotection interface (InterMiCOM interface) so as to meet the requirements of the transmission carrier.

COMM3: Source address 120 031 Page: 3-25

Address for send signals.

COMM3: Receiving address 120 032 Page: 3-25

Address for receive signals.

COMM3: Fct. assignm. send 1	121 001	Page: 3-25
COMM3: Fct. assignm. send 2	121 003	
COMM3: Fct. assignm. send 3	121 005	
COMM3: Fct. assignm. send 4	121 007	
COMM3: Fct. assignm. send 5	121 009	
COMM3: Fct. assignm. send 6	121 011	
COMM3: Fct. assignm. send 7	121 013	
COMM3: Fct. assignm. send 8	121 015	
Assignment of functions for the 8 send signals.		
COMM3: Fct. assignm. rec. 1	120 001	Page: 3-25
COMM3: Fct. assignm. rec. 2	120 004	
COMM3: Fct. assignm. rec. 3	120 007	
COMM3: Fct. assignm. rec. 4	120 010	
COMM3: Fct. assignm. rec. 5	120 013	
COMM3: Fct. assignm. rec. 6	120 016	
COMM3: Fct. assignm. rec. 7	120 019	
COMM3: Fct. assignm. rec. 8	120 022	
Configuration (assignment of functions) for the 8 receive signals		
COMM3: Oper. mode receive 1	120 002	Page: 3-26
COMM3: Oper. mode receive 2	120 005	
COMM3: Oper. mode receive 3	120 008	
COMM3: Oper. mode receive 4	120 011	
Selection of *Blocking* or *Direct intertrip* for the operating mode of receive signals 1 to 4 (single-bit transmission).		
COMM3: Oper. mode receive 5	120 014	Page: 3-26
COMM3: Oper. mode receive 6	120 017	
COMM3: Oper. mode receive 7	120 020	
COMM3: Oper. mode receive 8	120 023	
Selection of *Permissive or Direct intertrip* for the operating mode of receive signals 5 to 8 (bit-pair transmission).		
COMM3: Default value rec. 1	120 060	Page: 3-27
COMM3: Default value rec. 2	120 061	
COMM3: Default value rec. 3	120 062	
COMM3: Default value rec. 4	120 063	
COMM3: Default value rec. 5	120 064	
COMM3: Default value rec. 6	120 065	
COMM3: Default value rec. 7	120 066	
COMM3: Default value rec. 8	120 067	
Definition of the default value for the 8 receive signals.		
COMM3: Time-out comm.fault	120 033	Fig: 3-19
This timer triggers the alarm signals COMM3: Communications fault and SFMON: Communic.fault COMM3 and sets the received signals to their user-defined default values. Time-out occurs when the set time has elapsed since the most recent 100% valid telegram was received.		
COMM3: Sig.asg. comm.fault	120 034	Page: 3-27
Using this setting, the alarm signal can be configured (assigned) to the corresponding PSIG input signal.		

COMM3: Time-out link fail. 120 035 Fig: 3-19

Time indicating a persistent failure of the transmission channel. After this timer stage has elapsed, alarm signals COMM3: Comm. link failure and SFMON: Comm.link fail.COMM3 are raised. These can be mapped to give the operator a warning LED or contact to indicate that maintenance attention is required.

COMM3: Limit telegr. errors 120 036 Page: 3-29

Percentage of corrupted messages compared to total messages transmitted before an alarm is raised (COMM3: Lim.exceed.,tel.err. and SFMON: Lim.exceed.,tel.err.). When this threshold is exceeded, the receive signals are set to their user-defined default values.

IEC 61850 Communication

IEC: Function group IEC 056 059

Cancelling function group IEC or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

IEC: General enable USER 104 000

Enabling and disabling function group IEC.

IEC: Enable configuration 104 058

This parameter can only be sent individually. In order to maintain consistency of all parameters in function groups IEC, GSSE and GOOSE, they are only enabled mutually by this parameter. After this command is sent to the device, the actual state of the previously changed parameter setting of the three function groups is enabled in the communication data model of the connected device. This function is carried out automatically with the off-line/on-line switching of the device.

IEC: Ethernet media 104 056

Selecting the physical communication channel on the Ethernet module from either wired (RJ45) or optical fiber (ST/SC connector depending on ordering option) connection.

IEC: IED name 104 057

Name of the device (IED has server function). This device name serves as device identification in the IEC 61850 system, it is included in the Logical Device Name in the IEC data model and must therefore be unambiguous. All devices logged-on to the network should have non-recurring IED names.

IEC: TCP keep-alive timer 104 062

This defines a "heart-beat" time interval used to actively monitor a communication link to a logged-on client.

IEC: IP address 104 001
IEC: IP address 1 104 002
IEC: IP address 2 104 003
IEC: IP address 3 104 004

IP address for the device (IED has server function).

Note:
In the S&R 103 operating program, the complete IP address is displayed at IEC: IP address. The device’s front panel display only displays the IP address distributed to these four data model addresses.

IEC: Subnet mask	104 005
IEC: Subnet mask 1	104 006
IEC: Subnet mask 2	104 007
IEC: Subnet mask 3	104 008

The subnet mask defines which part of the IP address is addressed by the sub-network and which part by the device that is logged-on to the network.

Note:
In the S&R 103 operating program, the complete IP address is displayed at IEC: Subnet mask. The device's front panel display only displays the IP address distributed to these four data model addresses.

IEC: Gateway address	104 011
IEC: Gateway address 1	104 012
IEC: Gateway address 2	104 013
IEC: Gateway address 3	104 014

This parameter defines the IPv4 address of the network gateway of a communication link to a client outside of the local network.

Note:
In the S&R 103 operating program, the complete IP address is displayed at IEC: Gateway address. The device's front panel display only displays the IP address distributed to these four data model addresses.

IEC: SNTP operating mode	104 200

Operating mode for the time synchronization telegram. When set to *Broadcast* synchronization occurs cyclically with the clock server transmitting a broadcast signal and, when set to *Request from Server* each device (IED has client function) individually requests a synchronization signal after its own cycle time.

IEC: SNTP poll cycle time	104 201

Device (IED) poll cycle time for time synchronization when operating mode is set to *Request from Server*.

IEC: SNTP server 1 IP	104 202
IEC: SNTP server 1 IP 1	104 203
IEC: SNTP server 1 IP 2	104 204
IEC: SNTP server 1 IP 3	104 205

IP address of the synchronizing clock server.

Note:
In the S&R 103 operating program, the complete IP address is displayed at IEC: SNTP server 1 IP. The device's front panel display only displays the IP address distributed to these four data model addresses.

IEC: SNTP server 2 IP	104 210
IEC: SNTP server 2 IP 1	104 211
IEC: SNTP server 2 IP 2	104 212
IEC: SNTP server 2 IP 3	104 213

IP address of the synchronizing clock server.

Note:
In the S&R 103 operating program, the complete IP address is displayed at IEC: SNTP server 2 IP. The device's front panel display only displays the IP address distributed to these four data model addresses.

IEC: Diff. local time 104 206

Time difference between UTC and local time at the devices' substation (IED).

IEC: Diff. dayl.sav. time 104 207

Time difference when changing to daylight saving time.

IEC: Switch.dayl.sav.time 104 219

This setting defines whether an automatic switching to daylight saving time is wanted.

IEC: Dayl.sav.time start 104 220
IEC: Dayl.sav.time st. d 104 221
IEC: Dayl.sav.time st. m 104 222

These three parameters define the date (e.g. at what day of the year) for switching from standard time over to daylight saving time. Available for IEC: Dayl.sav.time start are the values 'first', 'second', 'third', 'fourth', and 'last'. For IEC: Dayl.sav.time st. d the seven weekdays are available so that for example a setting like "on the last Sunday in March" may be used.

IEC: Dayl.sav.t.st.0:00 + 104 223

This defines the time difference and the time of day (on the specific changeover day) when the clock is to be switched to daylight saving time. The time is given in the number of minutes after midnight, e.g. when the clock changeover to 3:00 AM always occurs at 2:00 AM, then the value to be entered at IEC: Dayl.sav.t.st.0:00 + is *120* [minutes] and at IEC: Diff. dayl.sav. time it is *60* [minutes].

IEC: Dayl.sav.time end 104 225
IEC: Dayl.sav.time end d 104 226
IEC: Dayl.sav.time end m 104 227
IEC: Dayl.sav.t.end 0:00+ 104 228

This parameter defines the date and time of day for the clock changeover from daylight saving time to standard time. The setting is similar to that for the clock changeover to daylight saving time.

IEC: Update Measurements 104 229

Time period between two transmissions of all measured value Report Control Blocks (RCB) except the measured value for energy.

IEC: Dead band IP 104 230

Setting to calculate the filter value for all IP Report Control Blocks (RCB). Should a change occur in one of the IP measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting IEC: Dead band IP

IEC: Dead band IN 104 231

Setting to calculate the filter value for all IN Report Control Blocks (RCB). Should a change occur in one of the IN measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting IEC: Dead band IN

IEC: Dead band VPP 104 232

Setting to calculate the filter value for all VPP Report Control Blocks (RCB). Should a change occur in one of the VPP measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting IEC: Dead band VPP

IEC: Dead band VPG 104 233

Setting to calculate the filter value for all VPG Report Control Blocks (RCB). Should a change occur in one of the VPG measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting IEC: Dead band VPG

IEC: Dead band f 104 234

Setting to calculate the filter value for all f Report Control Blocks (RCB). Should a change occur in one of the f measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting IEC: Dead band f

IEC: Dead band P 104 235

Setting to calculate the filter value for all P Report Control Blocks (RCB). Should a change occur in one of the P measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting IEC: Dead band P

IEC: Dead band phi 104 236

Setting to calculate the filter value for all φ Report Control Blocks (RCB). Should a change occur in one of the φ measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting IEC: Dead band phi

IEC: Dead band Z 104 237

Setting to calculate the filter value for all Z Report Control Blocks (RCB). Should a change occur in one of the Z measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting IEC: Dead band Z

IEC: Dead band min/max 104 238

Setting to calculate the filter value for all min/max Report Control Blocks (RCB). Should a change occur in one of the min/max measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting IEC: Dead band min/max

IEC: Dead band ASC 104 239

Setting to calculate the filter value for all ASC Report Control Blocks (RCB). Should a change occur in one of the ASC measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting IEC: Dead band ASC

IEC: Dead band temp. 104 240

Setting to calculate the filter value for all temperature Report Control Blocks (RCB). Should a change occur in one of the temperature measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting `IEC: Dead band temp.`

IEC: Dead band 20mA 104 241

Setting to calculate the filter value for all 20mA Report Control Blocks (RCB). Should a change occur in one of the 20mA measured values, which is greater than the filter value, the RCB is again sent to all clients. The filter value for each measured value is calculated according to this formula:

step size measured value • setting `IEC: Dead band 20mA`

IEC: Update cycle energy 104 060

Cycle time to send energy value by Report Control Block (RCB). No RCB transmission with setting to *blocked*!

IEC: DEV control model 221 081

Setting of which control model is to be used to control all external devices. Suggested setting when performing switching operations at maximum safety is *SBO enh. Security* (SBO = Select-Before-Operate).

Generic Object Oriented Substation Event

GOOSE: Function group GOOSE 056 068

Cancelling function group GOOSE or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden. The parameters of this function group are only active if function group IEC has been configured and is activated, and if the parameters of this function group have been activated through the parameter `IEC: Enable configuration` or by switching the device off-line/on-line.

GOOSE: General enable USER 106 001

Enabling and disabling function group GOOSE.

GOOSE: Multic. MAC address 106 003

Multicast MAC address to provide identification of GOOSE to the receiving clients (IED). The default MAC address entered is suggested as a standard according to IEC 61850. The multicast MAC address entered in GOOSE may be modified so as to increase transmission security or to reduce the number of "GOOSE Messages" to be read by receiving clients (IED).

GOOSE: Application ID 106 004 Fig: 3-20

Application ID of GOOSE being sent by this device (IED).

GOOSE: Goose ID 106 002 Fig: 3-20

Goose ID being sent by this device (IED). GOOSE includes a Dataset with 32 binary and configurable virtual outputs and 10 two-pole states to the maximum of 10 monitored external devices

GOOSE: VLAN Identifier 106 006 Fig: 3-20

VLAN identifier of GOOSE being sent by this device (IED). The VLAN identifier makes it possible to have switches in the network filter messages, if the switches support such a function. Because so-called multicast MAC addresses are applied, switches are unable to filter messages in the network if they do not include a VLAN identifier.

GOOSE: VLAN Priority 106 007 Fig: 3-20

VLAN priority of GOOSE being sent by this device (IED).

GOOSE: DataSet Reference 106 008 Fig: 3-20

DataSet Reference of GOOSE being sent by this device (IED).

GOOSE: DataSet Cfg.Revision 106 009 Fig: 3-20

Display of the 'DataSet Configuration Revision' value of GOOSE, which is sent from this device (IED).

GOOSE: Output 1 fct.assig. 106 011 Fig: 3-20
GOOSE: Output 2 fct.assig. 106 013
GOOSE: Output 3 fct.assig. 106 015
GOOSE: Output 4 fct.assig. 106 017
GOOSE: Output 5 fct.assig. 106 019
GOOSE: Output 6 fct.assig. 106 021
GOOSE: Output 7 fct.assig. 106 023
GOOSE: Output 8 fct.assig. 106 025
GOOSE: Output 9 fct.assig. 106 027
GOOSE: Output 10 fct.assig. 106 029
GOOSE: Output 11 fct.assig. 106 031
GOOSE: Output 12 fct.assig. 106 033
GOOSE: Output 13 fct.assig. 106 035
GOOSE: Output 14 fct.assig. 106 037
GOOSE: Output 15 fct.assig. 106 039
GOOSE: Output 16 fct.assig. 106 041
GOOSE: Output 17 fct.assig. 106 043
GOOSE: Output 18 fct.assig. 106 045
GOOSE: Output 19 fct.assig. 106 047
GOOSE: Output 20 fct.assig. 106 049
GOOSE: Output 21 fct.assig. 106 051
GOOSE: Output 22 fct.assig. 106 053
GOOSE: Output 23 fct.assig. 106 055
GOOSE: Output 24 fct.assig. 106 057
GOOSE: Output 25 fct.assig. 106 059
GOOSE: Output 26 fct.assig. 106 061
GOOSE: Output 27 fct.assig. 106 063
GOOSE: Output 28 fct.assig. 106 065
GOOSE: Output 29 fct.assig. 106 067
GOOSE: Output 30 fct.assig. 106 069
GOOSE: Output 31 fct.assig. 106 071
GOOSE: Output 32 fct.assig. 106 073

Function assignment of a binary logical state signal to the virtual GOOSE outputs. The signal configured here is sent with the permanently configured Dataset of GOOSE.

GOOSE: Input 1 Applic. ID	107 000
GOOSE: Input 2 Applic. ID	107 010
GOOSE: Input 3 Applic. ID	107 020
GOOSE: Input 4 Applic. ID	107 030
GOOSE: Input 5 Applic. ID	107 040
GOOSE: Input 6 Applic. ID	107 050
GOOSE: Input 7 Applic. ID	107 060
GOOSE: Input 8 Applic. ID	107 070
GOOSE: Input 9 Applic. ID	107 080
GOOSE: Input 10 Applic. ID	107 090
GOOSE: Input 11 Applic. ID	107 100
GOOSE: Input 12 Applic. ID	107 110
GOOSE: Input 13 Applic. ID	107 120
GOOSE: Input 14 Applic. ID	107 130
GOOSE: Input 15 Applic. ID	107 140
GOOSE: Input 16 Applic. ID	107 150

Application ID for GOOSE, which is to be received by this device (IED) for the virtual binary GOOSE input.

GOOSE: Input 1 Goose ID	107 001
GOOSE: Input 2 Goose ID	107 011
GOOSE: Input 3 Goose ID	107 021
GOOSE: Input 4 Goose ID	107 031
GOOSE: Input 5 Goose ID	107 041
GOOSE: Input 6 Goose ID	107 051
GOOSE: Input 7 Goose ID	107 061
GOOSE: Input 8 Goose ID	107 071
GOOSE: Input 9 Goose ID	107 081
GOOSE: Input 10 Goose ID	107 091
GOOSE: Input 11 Goose ID	107 101
GOOSE: Input 12 Goose ID	107 111
GOOSE: Input 13 Goose ID	107 121
GOOSE: Input 14 Goose ID	107 131
GOOSE: Input 15 Goose ID	107 141
GOOSE: Input 16 Goose ID	107 151

Goose ID for GOOSE, which is to be received by this device (IED) for the virtual binary GOOSE input.

GOOSE: Input 1 DataSet Ref	107 002
GOOSE: Input 2 DataSet Ref	107 012
GOOSE: Input 3 DataSet Ref	107 022
GOOSE: Input 4 DataSet Ref	107 032
GOOSE: Input 5 DataSet Ref	107 042
GOOSE: Input 6 DataSet Ref	107 052
GOOSE: Input 7 DataSet Ref	107 062
GOOSE: Input 8 DataSet Ref	107 072
GOOSE: Input 9 DataSet Ref	107 082
GOOSE: Input 10 DataSet Ref	107 092
GOOSE: Input 11 DataSet Ref	107 102
GOOSE: Input 12 DataSet Ref	107 112
GOOSE: Input 13 DataSet Ref	107 122
GOOSE: Input 14 DataSet Ref	107 132
GOOSE: Input 15 DataSet Ref	107 142
GOOSE: Input 16 DataSet Ref	107 152

'Dataset Reference' for GOOSE, which is to be received by this device (IED) for the virtual binary GOOSE input. A 'Dataset Reference' consists of a chain of characters including the full path of the state value from the device (IED) situated on the opposite side with the logical device/logical node/data object/data attribute. If a path is made up of more than 20 characters, then only the first 20 characters are to be entered.

GOOSE: Input 1 DataObj Ind	107 003
GOOSE: Input 2 DataObj Ind	107 013
GOOSE: Input 3 DataObj Ind	107 023
GOOSE: Input 4 DataObj Ind	107 033
GOOSE: Input 5 DataObj Ind	107 043
GOOSE: Input 6 DataObj Ind	107 053
GOOSE: Input 7 DataObj Ind	107 063
GOOSE: Input 8 DataObj Ind	107 073
GOOSE: Input 9 DataObj Ind	107 083
GOOSE: Input 10 DataObj Ind	107 093
GOOSE: Input 11 DataObj Ind	107 103
GOOSE: Input 12 DataObj Ind	107 113
GOOSE: Input 13 DataObj Ind	107 123
GOOSE: Input 14 DataObj Ind	107 133
GOOSE: Input 15 DataObj Ind	107 143
GOOSE: Input 16 DataObj Ind	107 153

Data object index of a Dataset for GOOSE, which is to be received by this device (IED) for the virtual binary GOOSE input. A data object index indicates which data object element in the Dataset is to be evaluated.

GOOSE: Input 1 DatAttr Ind	107 004
GOOSE: Input 2 DatAttr Ind	107 014
GOOSE: Input 3 DatAttr Ind	107 024
GOOSE: Input 4 DatAttr Ind	107 034
GOOSE: Input 5 DatAttr Ind	107 044
GOOSE: Input 6 DatAttr Ind	107 054
GOOSE: Input 7 DatAttr Ind	107 064
GOOSE: Input 8 DatAttr Ind	107 074
GOOSE: Input 9 DatAttr Ind	107 084
GOOSE: Input 10 DatAttr Ind	107 094
GOOSE: Input 11 DatAttr Ind	107 104
GOOSE: Input 12 DatAttr Ind	107 114
GOOSE: Input 13 DatAttr Ind	107 124
GOOSE: Input 14 DatAttr Ind	107 134
GOOSE: Input 15 DatAttr Ind	107 144
GOOSE: Input 16 DatAttr Ind	107 154

Data attribute index of a Dataset for GOOSE, which is to be received by this device (IED) for the virtual binary GOOSE input. A data attribute index indicates which data attribute element in the data object is to be evaluated.

GOOSE: Input 1 default	107 005
GOOSE: Input 2 default	107 015
GOOSE: Input 3 default	107 025
GOOSE: Input 4 default	107 035
GOOSE: Input 5 default	107 045
GOOSE: Input 6 default	107 055
GOOSE: Input 7 default	107 065
GOOSE: Input 8 default	107 075
GOOSE: Input 9 default	107 085
GOOSE: Input 10 default	107 095
GOOSE: Input 11 default	107 105
GOOSE: Input 12 default	107 115
GOOSE: Input 13 default	107 125
GOOSE: Input 14 default	107 135
GOOSE: Input 15 default	107 145
GOOSE: Input 16 default	107 155

Default for the virtual binary GOOSE input. The state of a virtual two-pole GOOSE input will revert to default as soon as the continuously monitored communication link to a GOOSE sending device (IED situated on the opposite side) is in fault or has disappeared altogether.

GOOSE: Input 1 fct.assig.	107 006
GOOSE: Input 2 fct.assig.	107 016
GOOSE: Input 3 fct.assig.	107 026
GOOSE: Input 4 fct.assig.	107 036
GOOSE: Input 5 fct.assig.	107 046
GOOSE: Input 6 fct.assig.	107 056
GOOSE: Input 7 fct.assig.	107 066
GOOSE: Input 8 fct.assig.	107 076
GOOSE: Input 9 fct.assig.	107 086
GOOSE: Input 10 fct.assig.	107 096
GOOSE: Input 11 fct.assig.	107 106
GOOSE: Input 12 fct.assig.	107 116
GOOSE: Input 13 fct.assig.	107 126
GOOSE: Input 14 fct.assig.	107 136
GOOSE: Input 15 fct.assig.	107 146
GOOSE: Input 16 fct.assig.	107 156
Function assignment of the virtual binary GOOSE input to a binary logical state signal on the device (IED) so that it can be processed further by the protection, control or logic functions. The signal configured at this point will receive the state of the data attribute, as configured above, and which was received with the Dataset of GOOSE	
GOOSE: Ext.Dev01 Applic. ID	108 000
GOOSE: Ext.Dev02 Applic. ID	108 010
GOOSE: Ext.Dev03 Applic. ID	108 020
GOOSE: Ext.Dev04 Applic. ID	108 030
GOOSE: Ext.Dev05 Applic. ID	108 040
GOOSE: Ext.Dev06 Applic. ID	108 050
GOOSE: Ext.Dev07 Applic. ID	108 060
GOOSE: Ext.Dev08 Applic. ID	108 070
GOOSE: Ext.Dev09 Applic. ID	108 080
GOOSE: Ext.Dev10 Applic. ID	108 090
GOOSE: Ext.Dev11 Applic. ID	108 100
GOOSE: Ext.Dev12 Applic. ID	108 110
GOOSE: Ext.Dev13 Applic. ID	108 120
GOOSE: Ext.Dev14 Applic. ID	108 130
GOOSE: Ext.Dev15 Applic. ID	108 140
GOOSE: Ext.Dev16 Applic. ID	108 150
GOOSE: Ext.Dev17 Applic. ID	110 000
GOOSE: Ext.Dev18 Applic. ID	110 010
GOOSE: Ext.Dev19 Applic. ID	110 020
GOOSE: Ext.Dev20 Applic. ID	110 030
GOOSE: Ext.Dev21 Applic. ID	110 040
GOOSE: Ext.Dev22 Applic. ID	110 050
GOOSE: Ext.Dev23 Applic. ID	110 060
GOOSE: Ext.Dev24 Applic. ID	110 066
GOOSE: Ext.Dev25 Applic. ID	110 080
GOOSE: Ext.Dev26 Applic. ID	110 090
GOOSE: Ext.Dev27 Applic. ID	110 100
GOOSE: Ext.Dev28 Applic. ID	110 110
GOOSE: Ext.Dev29 Applic. ID	110 120
GOOSE: Ext.Dev30 Applic. ID	110 130
GOOSE: Ext.Dev31 Applic. ID	110 140

GOOSE: Ext.Dev32 Applic. ID	110 150

Application ID for GOOSE, which is to be received by this device (IED) for the virtual two-pole GOOSE input, representing the state of an external device.

GOOSE: Ext.Dev01 Goose ID	108 001
GOOSE: Ext.Dev02 Goose ID	108 011
GOOSE: Ext.Dev03 Goose ID	108 021
GOOSE: Ext.Dev04 Goose ID	108 031
GOOSE: Ext.Dev05 Goose ID	108 041
GOOSE: Ext.Dev06 Goose ID	108 051
GOOSE: Ext.Dev07 Goose ID	108 061
GOOSE: Ext.Dev08 Goose ID	108 071
GOOSE: Ext.Dev09 Goose ID	108 081
GOOSE: Ext.Dev10 Goose ID	108 091
GOOSE: Ext.Dev11 Goose ID	108 101
GOOSE: Ext.Dev12 Goose ID	108 111
GOOSE: Ext.Dev13 Goose ID	108 121
GOOSE: Ext.Dev14 Goose ID	108 131
GOOSE: Ext.Dev15 Goose ID	108 141
GOOSE: Ext.Dev16 Goose ID	108 151
GOOSE: Ext.Dev17 Goose ID	110 001
GOOSE: Ext.Dev18 Goose ID	110 011
GOOSE: Ext.Dev19 Goose ID	110 021
GOOSE: Ext.Dev20 Goose ID	110 031
GOOSE: Ext.Dev21 Goose ID	110 041
GOOSE: Ext.Dev22 Goose ID	110 051
GOOSE: Ext.Dev23 Goose ID	110 061
GOOSE: Ext.Dev24 Goose ID	110 071
GOOSE: Ext.Dev25 Goose ID	110 081
GOOSE: Ext.Dev26 Goose ID	110 091
GOOSE: Ext.Dev27 Goose ID	110 101
GOOSE: Ext.Dev28 Goose ID	110 111
GOOSE: Ext.Dev29 Goose ID	110 121
GOOSE: Ext.Dev30 Goose ID	110 131
GOOSE: Ext.Dev31 Goose ID	110 141
GOOSE: Ext.Dev32 Goose ID	110 151

Goose ID for GOOSE, which is to be received by this device (IED) for the virtual two-pole GOOSE input, representing the state of an external device. Virtual GOOSE inputs can be linked with interlocking equations of assigned external devices.

GOOSE: Ext.Dev01 DataSetRef	108 002
GOOSE: Ext.Dev02 DataSetRef	108 012
GOOSE: Ext.Dev03 DataSetRef	108 022
GOOSE: Ext.Dev04 DataSetRef	108 032
GOOSE: Ext.Dev05 DataSetRef	108 042
GOOSE: Ext.Dev06 DataSetRef	108 052
GOOSE: Ext.Dev07 DataSetRef	108 062
GOOSE: Ext.Dev08 DataSetRef	108 072
GOOSE: Ext.Dev09 DataSetRef	108 082
GOOSE: Ext.Dev10 DataSetRef	108 092
GOOSE: Ext.Dev11 DataSetRef	108 102
GOOSE: Ext.Dev12 DataSetRef	108 112

GOOSE: Ext.Dev13 DataSetRef	108 122
GOOSE: Ext.Dev14 DataSetRef	108 132
GOOSE: Ext.Dev15 DataSetRef	108 142
GOOSE: Ext.Dev16 DataSetRef	108 152
GOOSE: Ext.Dev17 DataSetRef	110 002
GOOSE: Ext.Dev18 DataSetRef	110 012
GOOSE: Ext.Dev19 DataSetRef	110 022
GOOSE: Ext.Dev20 DataSetRef	110 032
GOOSE: Ext.Dev21 DataSetRef	110 042
GOOSE: Ext.Dev22 DataSetRef	110 052
GOOSE: Ext.Dev23 DataSetRef	110 062
GOOSE: Ext.Dev24 DataSetRef	110 072
GOOSE: Ext.Dev25 DataSetRef	110 082
GOOSE: Ext.Dev26 DataSetRef	110 092
GOOSE: Ext.Dev27 DataSetRef	110 102
GOOSE: Ext.Dev28 DataSetRef	110 112
GOOSE: Ext.Dev29 DataSetRef	110 122
GOOSE: Ext.Dev30 DataSetRef	110 132
GOOSE: Ext.Dev31 DataSetRef	110 142
GOOSE: Ext.Dev32 DataSetRef	110 152

'Dataset Reference' for GOOSE, which is to be received by this device (IED) for the virtual two-pole GOOSE input, representing the state of an external device. A 'Dataset Reference' consists of a chain of characters including the full path of the state value from the device (IED) situated on the opposite side with the logical device/logical node/data object/data attribute. If a path is made up of more than 20 characters, then only the first 20 characters are to be entered.

GOOSE: Ext.Dev01 DataObjInd	108 003
GOOSE: Ext.Dev02 DataObjInd	108 013
GOOSE: Ext.Dev03 DataObjInd	108 023
GOOSE: Ext.Dev04 DataObjInd	108 033
GOOSE: Ext.Dev05 DataObjInd	108 043
GOOSE: Ext.Dev06 DataObjInd	108 053
GOOSE: Ext.Dev07 DataObjInd	108 063
GOOSE: Ext.Dev08 DataObjInd	108 073
GOOSE: Ext.Dev09 DataObjInd	108 083
GOOSE: Ext.Dev10 DataObjInd	108 093
GOOSE: Ext.Dev11 DataObjInd	108 103
GOOSE: Ext.Dev12 DataObjInd	108 113
GOOSE: Ext.Dev13 DataObjInd	108 123
GOOSE: Ext.Dev14 DataObjInd	108 133
GOOSE: Ext.Dev15 DataObjInd	108 143
GOOSE: Ext.Dev16 DataObjInd	108 153
GOOSE: Ext.Dev17 DataObjInd	110 003
GOOSE: Ext.Dev18 DataObjInd	110 013
GOOSE: Ext.Dev19 DataObjInd	110 023
GOOSE: Ext.Dev20 DataObjInd	110 033
GOOSE: Ext.Dev21 DataObjInd	110 043
GOOSE: Ext.Dev22 DataObjInd	110 053
GOOSE: Ext.Dev23 DataObjInd	110 063
GOOSE: Ext.Dev24 DataObjInd	110 073
GOOSE: Ext.Dev25 DataObjInd	110 083
GOOSE: Ext.Dev26 DataObjInd	110 093

GOOSE: Ext.Dev27 DataObjInd	110 103
GOOSE: Ext.Dev28 DataObjInd	110 113
GOOSE: Ext.Dev29 DataObjInd	110 123
GOOSE: Ext.Dev30 DataObjInd	110 133
GOOSE: Ext.Dev31 DataObjInd	110 143
GOOSE: Ext.Dev32 DataObjInd	110 153

Data object index of a Dataset for GOOSE, which is to be received by this device (IED) for the virtual two-pole GOOSE input, representing the state of an external device. A data object index indicates which data object element in the Dataset is to be evaluated.

GOOSE: Ext.Dev01 DatAttrInd	108 004
GOOSE: Ext.Dev02 DatAttrInd	108 014
GOOSE: Ext.Dev03 DatAttrInd	108 024
GOOSE: Ext.Dev04 DatAttrInd	108 034
GOOSE: Ext.Dev05 DatAttrInd	108 044
GOOSE: Ext.Dev06 DatAttrInd	108 054
GOOSE: Ext.Dev07 DatAttrInd	108 064
GOOSE: Ext.Dev08 DatAttrInd	108 074
GOOSE: Ext.Dev09 DatAttrInd	108 084
GOOSE: Ext.Dev10 DatAttrInd	108 094
GOOSE: Ext.Dev11 DatAttrInd	108 104
GOOSE: Ext.Dev12 DatAttrInd	108 114
GOOSE: Ext.Dev13 DatAttrInd	108 124
GOOSE: Ext.Dev14 DatAttrInd	108 134
GOOSE: Ext.Dev15 DatAttrInd	108 144
GOOSE: Ext.Dev16 DatAttrInd	108 154
GOOSE: Ext.Dev17 DatAttrInd	110 004
GOOSE: Ext.Dev18 DatAttrInd	110 014
GOOSE: Ext.Dev19 DatAttrInd	110 024
GOOSE: Ext.Dev20 DatAttrInd	110 034
GOOSE: Ext.Dev21 DatAttrInd	110 044
GOOSE: Ext.Dev22 DatAttrInd	110 054
GOOSE: Ext.Dev23 DatAttrInd	110 064
GOOSE: Ext.Dev24 DatAttrInd	110 074
GOOSE: Ext.Dev25 DatAttrInd	110 084
GOOSE: Ext.Dev26 DatAttrInd	110 094
GOOSE: Ext.Dev27 DatAttrInd	110 104
GOOSE: Ext.Dev28 DatAttrInd	110 114
GOOSE: Ext.Dev29 DatAttrInd	110 124
GOOSE: Ext.Dev30 DatAttrInd	110 134
GOOSE: Ext.Dev31 DatAttrInd	110 144
GOOSE: Ext.Dev32 DatAttrInd	110 154

Data attribute index of a Dataset for GOOSE, which is to be received by this device (IED) for the virtual two-pole GOOSE input, representing the state of an external device. A data object index indicates which data attribute element in the data object is to be evaluated.

GOOSE: Ext.Dev01 default	108 005
GOOSE: Ext.Dev02 default	108 015
GOOSE: Ext.Dev03 default	108 025
GOOSE: Ext.Dev04 default	108 035
GOOSE: Ext.Dev05 default	108 045
GOOSE: Ext.Dev06 default	108 055
GOOSE: Ext.Dev07 default	108 065
GOOSE: Ext.Dev08 default	108 075
GOOSE: Ext.Dev09 default	108 085
GOOSE: Ext.Dev10 default	108 095
GOOSE: Ext.Dev11 default	108 105
GOOSE: Ext.Dev12 default	108 115
GOOSE: Ext.Dev13 default	108 125
GOOSE: Ext.Dev14 default	108 135
GOOSE: Ext.Dev15 default	108 145
GOOSE: Ext.Dev16 default	108 155
GOOSE: Ext.Dev17 default	110 005
GOOSE: Ext.Dev18 default	110 015
GOOSE: Ext.Dev19 default	110 025
GOOSE: Ext.Dev20 default	110 035
GOOSE: Ext.Dev21 default	110 045
GOOSE: Ext.Dev22 default	110 055
GOOSE: Ext.Dev23 default	110 065
GOOSE: Ext.Dev24 default	110 075
GOOSE: Ext.Dev25 default	110 085
GOOSE: Ext.Dev26 default	110 095
GOOSE: Ext.Dev27 default	110 105
GOOSE: Ext.Dev28 default	110 115
GOOSE: Ext.Dev29 default	110 125
GOOSE: Ext.Dev30 default	110 135
GOOSE: Ext.Dev31 default	110 145
GOOSE: Ext.Dev32 default	110 155

Default for the virtual two-pole GOOSE input, representing the state of an external device. The state of a virtual two-pole GOOSE input will revert to default as soon as the continuously monitored communication link to a GOOSE sending device (IED situated on the opposite side) is in fault or has disappeared altogether.

IEC Generic Substation Status Events

GSSE: Function group GSSE 056 060

Cancelling function group GSSC or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden. The parameters of this function group are only active if function group IEC has been configured and is activated, and if the parameters of this function group have been activated through the parameter IEC: Enable configuration or by switching the device off-line/on-line.

GSSE: General enable USER 104 049

Enabling and disabling function group GSSE.

GSSE: Min. cycle 104 052

Minimum value for the GSSE repetition cycle time in ms. The repetition cycle time for a GSSE message is calculated, according to a standard, with this formula:

Repetition cycle time = Min. cycle + $(1 + (\text{increment}/1000))^{N-1}$ [ms]

The repetitions counter N will be restarted at count 1 after each state change of a GSSE bit pair.

GSSE: Max. cycle 104 053

Maximum value for the GSSE repetition cycle time in s. For the formula to calculate the repetition cycle time see *Min. cycle*. Should the calculated value for the repetition cycle time be equal to or greater than the set max. value then the GSSE message will be sent repeatedly at the set max. value time.

GSSE: Increment 104 054

Increment for the GSSE repetition cycle. For the formula to calculate the repetition cycle time see *Min. cycle*.

GSSE: Operating mode 104 055

In the operating mode *Broadcast* all GSSE, independent of their MAC address (network hardware characteristic), are always read and processed. In the operating mode *Promiscuous* and after all GSSE sending devices have logged-on, only messages with the MAC addresses of IEDs, that have logged-on successfully, are read and processed.

GSSE: Output 1 bit pair	104 101
GSSE: Output 2 bit pair	104 104
GSSE: Output 3 bit pair	104 107
GSSE: Output 4 bit pair	104 110
GSSE: Output 5 bit pair	104 113
GSSE: Output 6 bit pair	104 116
GSSE: Output 7 bit pair	104 119
GSSE: Output 8 bit pair	104 122
GSSE: Output 9 bit pair	104 125
GSSE: Output 10 bit pair	104 128
GSSE: Output 11 bit pair	104 131
GSSE: Output 12 bit pair	104 134
GSSE: Output 13 bit pair	104 137
GSSE: Output 14 bit pair	104 140
GSSE: Output 15 bit pair	104 143
GSSE: Output 16 bit pair	104 146
GSSE: Output 17 bit pair	104 149
GSSE: Output 18 bit pair	104 152
GSSE: Output 19 bit pair	104 155
GSSE: Output 20 bit pair	104 158
GSSE: Output 21 bit pair	104 161
GSSE: Output 22 bit pair	104 164
GSSE: Output 23 bit pair	104 167
GSSE: Output 24 bit pair	104 170
GSSE: Output 25 bit pair	104 173
GSSE: Output 26 bit pair	104 176
GSSE: Output 27 bit pair	104 179
GSSE: Output 28 bit pair	104 182
GSSE: Output 29 bit pair	104 185
GSSE: Output 30 bit pair	104 188
GSSE: Output 31 bit pair	104 191
GSSE: Output 32 bit pair	104 194

Setting with which GSSE bit pair the configured binary signal of the virtual GSSE outputs is to be transmitted. A GSSE is always transmitted consisting of a fixed number of 96 bit pairs, of which a maximum of 32 are used by this device (IED) during a send operation.

GSSE: Output 1 fct.assig.	104 102
GSSE: Output 2 fct.assig.	104 105
GSSE: Output 3 fct.assig.	104 108
GSSE: Output 4 fct.assig.	104 111
GSSE: Output 5 fct.assig.	104 114
GSSE: Output 6 fct.assig.	104 117
GSSE: Output 7 fct.assig.	104 120
GSSE: Output 8 fct.assig.	104 123
GSSE: Output 9 fct.assig.	104 126
GSSE: Output 10 fct.assig.	104 129
GSSE: Output 11 fct.assig.	104 132
GSSE: Output 12 fct.assig.	104 135
GSSE: Output 13 fct.assig.	104 138
GSSE: Output 14 fct.assig.	104 141
GSSE: Output 15 fct.assig.	104 144
GSSE: Output 16 fct.assig.	104 147
GSSE: Output 17 fct.assig.	104 150
GSSE: Output 18 fct.assig.	104 153
GSSE: Output 19 fct.assig.	104 156
GSSE: Output 20 fct.assig.	104 159
GSSE: Output 21 fct.assig.	104 162
GSSE: Output 22 fct.assig.	104 165
GSSE: Output 23 fct.assig.	104 168
GSSE: Output 24 fct.assig.	104 171
GSSE: Output 25 fct.assig.	104 174
GSSE: Output 26 fct.assig.	104 177
GSSE: Output 27 fct.assig.	104 180
GSSE: Output 28 fct.assig.	104 183
GSSE: Output 29 fct.assig.	104 186
GSSE: Output 30 fct.assig.	104 189
GSSE: Output 31 fct.assig.	104 192
GSSE: Output 32 fct.assig.	104 195

Function assignment of a binary logical state signal to the virtual GSSE outputs. The signal configured here is sent through the GSSE bit pair as configured above.

GSSE: Input 1 bit pair	105 001
GSSE: Input 2 bit pair	105 006
GSSE: Input 3 bit pair	105 011
GSSE: Input 4 bit pair	105 016
GSSE: Input 5 bit pair	105 021
GSSE: Input 6 bit pair	105 026
GSSE: Input 7 bit pair	105 031
GSSE: Input 8 bit pair	105 036
GSSE: Input 9 bit pair	105 041
GSSE: Input 10 bit pair	105 046
GSSE: Input 11 bit pair	105 051
GSSE: Input 12 bit pair	105 056
GSSE: Input 13 bit pair	105 061
GSSE: Input 14 bit pair	105 066
GSSE: Input 15 bit pair	105 071
GSSE: Input 16 bit pair	105 076
GSSE: Input 17 bit pair	105 081
GSSE: Input 18 bit pair	105 086
GSSE: Input 19 bit pair	105 091
GSSE: Input 20 bit pair	105 096
GSSE: Input 21 bit pair	105 101
GSSE: Input 22 bit pair	105 106
GSSE: Input 23 bit pair	105 111
GSSE: Input 24 bit pair	105 116
GSSE: Input 25 bit pair	105 121
GSSE: Input 26 bit pair	105 126
GSSE: Input 27 bit pair	105 131
GSSE: Input 28 bit pair	105 136
GSSE: Input 29 bit pair	105 141
GSSE: Input 30 bit pair	105 146
GSSE: Input 31 bit pair	105 151
GSSE: Input 32 bit pair	105 156

Setting which GSSE bit pair is assigned to which virtual GSSE input.
A GSSE is always received consisting of a fixed number of 96 bit pairs, of which a maximum of 32 are processed by this device (IED).

GSSE: Input 1 IED name	105 002
GSSE: Input 2 IED name	105 007
GSSE: Input 3 IED name	105 012
GSSE: Input 4 IED name	105 017
GSSE: Input 5 IED name	105 022
GSSE: Input 6 IED name	105 027
GSSE: Input 7 IED name	105 032
GSSE: Input 8 IED name	105 037
GSSE: Input 9 IED name	105 042
GSSE: Input 10 IED name	105 047
GSSE: Input 11 IED name	105 052
GSSE: Input 12 IED name	105 057
GSSE: Input 13 IED name	105 062
GSSE: Input 14 IED name	105 067
GSSE: Input 15 IED name	105 072
GSSE: Input 16 IED name	105 077
GSSE: Input 17 IED name	105 082
GSSE: Input 18 IED name	105 087
GSSE: Input 19 IED name	105 092
GSSE: Input 20 IED name	105 097
GSSE: Input 21 IED name	105 102
GSSE: Input 22 IED name	105 107
GSSE: Input 23 IED name	105 112
GSSE: Input 24 IED name	105 117
GSSE: Input 25 IED name	105 122
GSSE: Input 26 IED name	105 127
GSSE: Input 27 IED name	105 132
GSSE: Input 28 IED name	105 137
GSSE: Input 29 IED name	105 142
GSSE: Input 30 IED name	105 147
GSSE: Input 31 IED name	105 152
GSSE: Input 32 IED name	105 157

IED name for the virtual GSSE input used to identify a GSSE received.

GSSE: Input 1 default	105 003
GSSE: Input 2 default	105 008
GSSE: Input 3 default	105 013
GSSE: Input 4 default	105 018
GSSE: Input 5 default	105 023
GSSE: Input 6 default	105 028
GSSE: Input 7 default	105 033
GSSE: Input 8 default	105 038
GSSE: Input 9 default	105 043
GSSE: Input 10 default	105 048
GSSE: Input 11 default	105 053
GSSE: Input 12 default	105 058
GSSE: Input 13 default	105 063
GSSE: Input 14 default	105 068
GSSE: Input 15 default	105 073
GSSE: Input 16 default	105 078
GSSE: Input 17 default	105 083
GSSE: Input 18 default	105 088
GSSE: Input 19 default	105 093
GSSE: Input 20 default	105 098
GSSE: Input 21 default	105 103
GSSE: Input 22 default	105 108
GSSE: Input 23 default	105 113
GSSE: Input 24 default	105 118
GSSE: Input 25 default	105 123
GSSE: Input 26 default	105 128
GSSE: Input 27 default	105 133
GSSE: Input 28 default	105 138
GSSE: Input 29 default	105 143
GSSE: Input 30 default	105 148
GSSE: Input 31 default	105 153
GSSE: Input 32 default	105 158

Default for the virtual binary GSSE input. The state of a virtual two-pole GSSE input will revert to default as soon as the continuously monitored communication link to a GSSE sending device (IED situated on the opposite side) is in fault or has disappeared altogether.

GSSE: Input 1 fct.assig.	105 004
GSSE: Input 2 fct.assig.	105 009
GSSE: Input 3 fct.assig.	105 014
GSSE: Input 4 fct.assig.	105 019
GSSE: Input 5 fct.assig.	105 024
GSSE: Input 6 fct.assig.	105 029
GSSE: Input 7 fct.assig.	105 034
GSSE: Input 8 fct.assig.	105 039
GSSE: Input 9 fct.assig.	105 044
GSSE: Input 10 fct.assig.	105 049
GSSE: Input 11 fct.assig.	105 054
GSSE: Input 12 fct.assig.	105 059
GSSE: Input 13 fct.assig.	105 064
GSSE: Input 14 fct.assig.	105 069
GSSE: Input 15 fct.assig.	105 074
GSSE: Input 16 fct.assig.	105 079
GSSE: Input 17 fct.assig.	105 084
GSSE: Input 18 fct.assig.	105 089
GSSE: Input 19 fct.assig.	105 094
GSSE: Input 20 fct.assig.	105 099
GSSE: Input 21 fct.assig.	105 104
GSSE: Input 22 fct.assig.	105 109
GSSE: Input 23 fct.assig.	105 114
GSSE: Input 24 fct.assig.	105 119
GSSE: Input 25 fct.assig.	105 124
GSSE: Input 26 fct.assig.	105 129
GSSE: Input 27 fct.assig.	105 134
GSSE: Input 28 fct.assig.	105 139
GSSE: Input 29 fct.assig.	105 144
GSSE: Input 30 fct.assig.	105 149
GSSE: Input 31 fct.assig.	105 154
GSSE: Input 32 fct.assig.	105 159

Function assignment of the virtual GSSE input to a binary logical state signal on the device (IED) so that it can be processed further by the protection or logic functions. The signal configured at this point will receive the state of the bit pair, as configured above, and which was received with GSSE

IRIG_B

IRIGB: Function group IRIGB 056 072

Cancelling function group IRIGB or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

IRIGB: General enable USER 023 200 Fig: 3-21

Disabling or enabling the IRIG-B interface.

Function keys

F_KEY: Password funct.key 1 003 036
F_KEY: Password funct.key 2 030 242
F_KEY: Password funct.key 3 030 243
F_KEY: Password funct.key 4 030 244
F_KEY: Password funct.key 5 030 245
F_KEY: Password funct.key 6 030 246

These passwords enable the corresponding function key. Further information on assigning passwords is given in Chapter 6.

F_KEY: Fct. assignm. F1 080 112 Fig: 3-22
F_KEY: Fct. assignm. F2 080 113
F_KEY: Fct. assignm. F3 080 114
F_KEY: Fct. assignm. F4 080 115
F_KEY: Fct. assignm. F5 080 116
F_KEY: Fct. assignm. F6 080 117

Assignment of functions to the function keys. Either a single function or a menu jump list may be selected. Both menu jump lists are assembled at LOC: Fct. menu jmp list x (x: 1 or 2).

F_KEY: Operating mode F1 080 132 Fig: 3-22
F_KEY: Operating mode F2 080 133
F_KEY: Operating mode F3 080 134
F_KEY: Operating mode F4 080 135
F_KEY: Operating mode F5 080 136
F_KEY: Operating mode F6 080 137

Setting operating mode of the function key to push-button or to switch.

F_KEY: Return time fct.keys 003 037

Once the password has been entered, the function keys remain active for no longer than this time period. When this time period has elapsed the password must again be entered.

Binary input

The P132 has optical coupler inputs for processing binary signals from the system. The number and connection schemes for the available binary inputs are shown in the terminal connection diagrams.

The P132 identifies the installed modules during startup. If a given binary I/O module is not installed or has fewer binary signal inputs than the maximum number possible at this slot, then the configuration addresses for the missing binary signal inputs are automatically hidden in the menu tree.

When configuring binary inputs, one should keep in mind that the same function can be assigned to several signal inputs. Thus one function can be activated from several control points having different signal voltages.

The configuration in slots A and B and the configuration for the binary inputs U C01 to U C08 will be changed with the selection of a new bay type. (Whether automatic configuration occurs, is defined in the setting MAIN: Auto-assignment I/O.) Depending on the connection type chosen for the P132 – pin type or ring type cable socket terminals – the symbolic slots A, B and C refer to the following slots:

Symbolic slot	**Pin type cable socket terminals**	**Ring type cable socket terminals**
A	06	12
B	07	14
C	08	16

The configuration of binary inputs for each bay type – in the case of auto-assignment – is given in the List of Bay Types in the Appendix.

In the case of auto-assignment, the following notes apply:

Note: Before selecting a new bay type, make sure that the binary inputs at slots A and B as well as the binary inputs U C01 to U C08 are configured for functions from the DEVxx function groups only. Otherwise there will be an error message, and the new bay type will not be activated.

Note: Before selecting a new bay type, make sure that all binary inputs specified in the List of Bay types for the selected bay type are actually available in the device. Otherwise there will be an error message, and the new bay type will not be activated.

In order to ensure that the device will recognize the input signals, the triggering signals must persist for at least 30 ms.

The operating mode for each binary signal input can be defined. The user can specify whether the presence (*active ‘high’* mode) or absence (*active ‘low’* mode) of a voltage shall be interpreted as the logic ‘1’ signal.

INP: Filter	010 220	Fig: 3-23
Input filter which is activated when either the mode *"active 'high', filtered"* or *active 'low', filtered"* has been selected. In order to suppress transient interference peaks at the logic signal inputs it is suggested to set this parameter to *6 [steps]*. For further information see Chapter 3.		
INP: Fct. assignm. U 301	152 217	Fig: 3-23, 3-250, 3-253, 3-254
INP: Fct. assignm. U 302	152 220	
INP: Fct. assignm. U 303	152 223	
INP: Fct. assignm. U 304	152 226	
INP: Fct. assignm. U 501	152 073	
INP: Fct. assignm. U 502	152 076	
INP: Fct. assignm. U 503	152 079	
INP: Fct. assignm. U 504	152 082	
INP: Fct. assignm. U 601	152 091	
INP: Fct. assignm. U 602	152 094	
INP: Fct. assignm. U 603	152 097	
INP: Fct. assignm. U 604	152 100	
INP: Fct. assignm. U 605	152 103	
INP: Fct. assignm. U 606	152 106	
INP: Fct. assignm. U 701	152 109	
INP: Fct. assignm. U 702	152 112	
INP: Fct. assignm. U 703	152 115	
INP: Fct. assignm. U 704	152 118	
INP: Fct. assignm. U 705	152 121	
INP: Fct. assignm. U 706	152 124	
INP: Fct. assignm. U 801	184 002	
INP: Fct. assignm. U 802	184 006	
INP: Fct. assignm. U 803	184 010	
INP: Fct. assignm. U 804	184 014	
INP: Fct. assignm. U 805	184 018	
INP: Fct. assignm. U 806	184 022	
INP: Fct. assignm. U 807	184 026	
INP: Fct. assignm. U 808	184 030	
INP: Fct. assignm. U 809	184 034	
INP: Fct. assignm. U 810	184 038	
INP: Fct. assignm. U 811	184 042	
INP: Fct. assignm. U 812	184 046	
INP: Fct. assignm. U 813	184 050	
INP: Fct. assignm. U 814	184 054	
INP: Fct. assignm. U 815	184 058	
INP: Fct. assignm. U 816	184 062	
INP: Fct. assignm. U 817	184 066	
INP: Fct. assignm. U 818	184 070	
INP: Fct. assignm. U 819	184 074	
INP: Fct. assignm. U 820	184 078	
INP: Fct. assignm. U 821	184 082	
INP: Fct. assignm. U 822	184 086	
INP: Fct. assignm. U 823	184 090	
INP: Fct. assignm. U 824	184 094	
INP: Fct. assignm. U 901	152 145	
INP: Fct. assignm. U 902	152 148	

INP: Fct. assignm. U 903	152 151
INP: Fct. assignm. U 904	152 154
INP: Fct. assignm. U 1001	152 163
INP: Fct. assignm. U 1002	152 166
INP: Fct. assignm. U 1003	152 169
INP: Fct. assignm. U 1004	152 172
INP: Fct. assignm. U 1005	152 175
INP: Fct. assignm. U 1006	152 178
INP: Fct. assignm. U 1201	152 199
INP: Fct. assignm. U 1202	152 202
INP: Fct. assignm. U 1203	152 205
INP: Fct. assignm. U 1204	152 208
INP: Fct. assignm. U 1205	152 211
INP: Fct. assignm. U 1206	152 214
INP: Fct. assignm. U 1401	190 002
INP: Fct. assignm. U 1402	190 006
INP: Fct. assignm. U 1403	190 010
INP: Fct. assignm. U 1404	190 014
INP: Fct. assignm. U 1405	190 018
INP: Fct. assignm. U 1406	190 022
INP: Fct. assignm. U 1601	192 002
INP: Fct. assignm. U 1602	192 006
INP: Fct. assignm. U 1603	192 010
INP: Fct. assignm. U 1604	192 014
INP: Fct. assignm. U 1605	192 018
INP: Fct. assignm. U 1606	192 022
INP: Fct. assignm. U 1607	192 026
INP: Fct. assignm. U 1608	192 030
INP: Fct. assignm. U 1609	192 034
INP: Fct. assignm. U 1610	192 038
INP: Fct. assignm. U 1611	192 042
INP: Fct. assignm. U 1612	192 046
INP: Fct. assignm. U 1613	192 050
INP: Fct. assignm. U 1614	192 054
INP: Fct. assignm. U 1615	192 058
INP: Fct. assignm. U 1616	192 062
INP: Fct. assignm. U 1617	192 066
INP: Fct. assignm. U 1618	192 070
INP: Fct. assignm. U 1619	192 074
INP: Fct. assignm. U 1620	192 078
INP: Fct. assignm. U 1621	192 082
INP: Fct. assignm. U 1622	192 086
INP: Fct. assignm. U 1623	192 090
INP: Fct. assignm. U 1624	192 094
INP: Fct. assignm. U 2001	153 087
INP: Fct. assignm. U 2002	153 090
INP: Fct. assignm. U 2003	153 093
INP: Fct. assignm. U 2004	153 096

Assignment of functions to binary signal inputs.

INP: Oper. mode U 301	152 218	Fig: 3-23
INP: Oper. mode U 302	152 221	
INP: Oper. mode U 303	152 224	
INP: Oper. mode U 304	152 227	
INP: Oper. mode U 501	152 074	
INP: Oper. mode U 502	152 077	
INP: Oper. mode U 503	152 080	
INP: Oper. mode U 504	152 083	
INP: Oper. mode U 601	152 092	
INP: Oper. mode U 602	152 095	
INP: Oper. mode U 603	152 098	
INP: Oper. mode U 604	152 101	
INP: Oper. mode U 605	152 104	
INP: Oper. mode U 606	152 107	
INP: Oper. mode U 701	152 110	
INP: Oper. mode U 702	152 113	
INP: Oper. mode U 703	152 116	
INP: Oper. mode U 704	152 119	
INP: Oper. mode U 705	152 122	
INP: Oper. mode U 706	152 125	
INP: Oper. mode U 801	184 003	
INP: Oper. mode U 802	184 007	
INP: Oper. mode U 803	184 011	
INP: Oper. mode U 804	184 015	
INP: Oper. mode U 805	184 019	
INP: Oper. mode U 806	184 023	
INP: Oper. mode U 807	184 027	
INP: Oper. mode U 808	184 031	
INP: Oper. mode U 809	184 035	
INP: Oper. mode U 810	184 039	
INP: Oper. mode U 811	184 043	
INP: Oper. mode U 812	184 047	
INP: Oper. mode U 813	184 051	
INP: Oper. mode U 814	184 055	
INP: Oper. mode U 815	184 059	
INP: Oper. mode U 816	184 063	
INP: Oper. mode U 817	184 067	
INP: Oper. mode U 818	184 071	
INP: Oper. mode U 819	184 075	
INP: Oper. mode U 820	184 079	
INP: Oper. mode U 821	184 083	
INP: Oper. mode U 822	184 087	
INP: Oper. mode U 823	184 091	
INP: Oper. mode U 824	184 095	
INP: Oper. mode U 901	152 146	
INP: Oper. mode U 902	152 149	
INP: Oper. mode U 903	152 152	
INP: Oper. mode U 904	152 155	
INP: Oper. mode U 1001	152 164	
INP: Oper. mode U 1002	152 167	
INP: Oper. mode U 1003	152 170	
INP: Oper. mode U 1004	152 173	
INP: Oper. mode U 1005	152 176	

INP:	Oper. mode U 1006	152 179
INP:	Oper. mode U 1201	152 200
INP:	Oper. mode U 1202	152 203
INP:	Oper. mode U 1203	152 206
INP:	Oper. mode U 1204	152 209
INP:	Oper. mode U 1205	152 212
INP:	Oper. mode U 1206	152 215
INP:	Oper. mode U 1401	190 003
INP:	Oper. mode U 1402	190 007
INP:	Oper. mode U 1403	190 011
INP:	Oper. mode U 1404	190 015
INP:	Oper. mode U 1405	190 019
INP:	Oper. mode U 1406	190 023
INP:	Oper. mode U 1601	192 003
INP:	Oper. mode U 1602	192 007
INP:	Oper. mode U 1603	192 011
INP:	Oper. mode U 1604	192 015
INP:	Oper. mode U 1605	192 019
INP:	Oper. mode U 1606	192 023
INP:	Oper. mode U 1607	192 027
INP:	Oper. mode U 1608	192 031
INP:	Oper. mode U 1609	192 035
INP:	Oper. mode U 1610	192 039
INP:	Oper. Mode U 1611	192 043
INP:	Oper. Mode U 1612	192 047
INP:	Oper. Mode U 1613	192 051
INP:	Oper. Mode U 1614	192 055
INP:	Oper. Mode U 1615	192 059
INP:	Oper. Mode U 1616	192 063
INP:	Oper. Mode U 1617	192 067
INP:	Oper. Mode U 1618	192 071
INP:	Oper. Mode U 1619	192 075
INP:	Oper. Mode U 1620	192 079
INP:	Oper. mode U 1621	192 083
INP:	Oper. mode U 1622	192 087
INP:	Oper. mode U 1623	192 091
INP:	Oper. mode U 1624	192 095
INP:	Oper. mode U 2001	153 088
INP:	Oper. mode U 2002	153 091
INP:	Oper. mode U 2003	153 094
INP:	Oper. mode U 2004	153 097

Selection of operating mode for binary signal inputs.

Measured data input

MEASI: Function group MEASI 056 030

Cancelling function group MEASI or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

MEASI: General enable USER 011 100 Fig: 3-24

Disabling or enabling analog measured data input.

MEASI: Enable IDC p.u. 037 190 Fig: 3-27

Setting the minimum current that must flow in order for the P132 to display a measured value > 0 (zero suppression).

MEASI: IDC< open circuit 037 191 Fig: 3-27

If the input current falls below the set threshold, the P132 will issue an ‘open circuit’ signal.

MEASI: IDC 1	037 150	Fig: 3-27
MEASI: IDC 2	037 152	Fig: 3-27
MEASI: IDC 3	037 154	Fig: 3-27
MEASI: IDC 4	037 156	Fig: 3-27
MEASI: IDC 5	037 158	Fig: 3-27
MEASI: IDC 6	037 160	Fig: 3-27
MEASI: IDC 7	037 162	Fig: 3-27
MEASI: IDC 8	037 164	Fig: 3-27
MEASI: IDC 9	037 166	Fig: 3-27
MEASI: IDC 10	037 168	Fig: 3-27
MEASI: IDC 11	037 170	Fig: 3-27
MEASI: IDC 12	037 172	Fig: 3-27
MEASI: IDC 13	037 174	Fig: 3-27
MEASI: IDC 14	037 176	Fig: 3-27
MEASI: IDC 15	037 178	Fig: 3-27
MEASI: IDC 16	037 180	Fig: 3-27
MEASI: IDC 17	037 182	Fig: 3-27
MEASI: IDC 18	037 184	Fig: 3-27
MEASI: IDC 19	037 186	Fig: 3-27
MEASI: IDC 20	037 188	Fig: 3-27

Setting for the input current that will correspond to a linearized value that has been set accordingly.

MEASI: IDC,lin 1	037 151	Fig: 3-27
MEASI: IDC,lin 2	037 153	Fig: 3-27
MEASI: IDC,lin 3	037 155	Fig: 3-27
MEASI: IDC,lin 4	037 157	Fig: 3-27
MEASI: IDC,lin 5	037 159	Fig: 3-27
MEASI: IDC,lin 6	037 161	Fig: 3-27
MEASI: IDC,lin 7	037 163	Fig: 3-27
MEASI: IDC,lin 8	037 165	Fig: 3-27
MEASI: IDC,lin 9	037 167	Fig: 3-27
MEASI: IDC,lin 10	037 169	Fig: 3-27
MEASI: IDC,lin 11	037 171	Fig: 3-27
MEASI: IDC,lin 12	037 173	Fig: 3-27
MEASI: IDC,lin 13	037 175	Fig: 3-27
MEASI: IDC,lin 14	037 177	Fig: 3-27
MEASI: IDC,lin 15	037 179	Fig: 3-27
MEASI: IDC,lin 16	037 181	Fig: 3-27
MEASI: IDC,lin 17	037 183	Fig: 3-27
MEASI: IDC,lin 18	037 185	Fig: 3-27
MEASI: IDC,lin 19	037 187	Fig: 3-27
MEASI: IDC,lin 20	037 189	Fig: 3-27

Setting for the linearized current that will correspond to an input current that has been set accordingly.

MEASI: Scaled val. IDC,lin1	037 192	Fig: 3-28

Setting for the scaled value of IDC,lin1.

MEASI: Scaled val.IDC,lin20	037 193	Fig: 3-28

Setting for the scaled value of IDC,lin20.

MEASI: Type of TempSensors	004 254	

Selection of the temperature sensor type (PT 100, NI 100 or NI 120).

Binary outputs

The P132 has output relays for the output of binary signals. The number and connection schemes for the available output relays are shown in the terminal connection diagrams.

The P132 identifies the installed modules during startup. If a given binary I/O module is not installed or has fewer output relays than the maximum number possible at that slot, then the configuration addresses for the missing output relays are automatically hidden in the menu tree.

The contact data for the all-or-nothing relays permits them to be used either as command relays or as signal relays. It is important to note that the contact rating of the binary I/O modules (X) varies (see Chapter 'Technical Data'). One signal can also be assigned simultaneously to several output relays for the purpose of contact multiplication.

Selecting a new bay type can change the configuration for slots A and B! (Whether automatic configuration occurs, is defined in the setting MAIN: Auto-assignment I/O.) Depending on the connection type chosen for the P132 – pin type or ring type cable socket terminals – the symbolic slots A and B correspond to the following slots:

Symbolic slot	**Pin type cable socket terminals**	**Ring type cable socket terminals**
A	06	12
B	07	14

The configuration of output relays for each bay type – in the case of auto-assignment – is given in the List of Bay Types in the Appendix.

In the case of auto-assignment, the following notes apply:

Note: Before selecting a new bay type, make sure that the output relays at slots A and B are configured for functions from the DEVxx function groups only. Otherwise there will be an error message, and the new bay type will not be activated.

Note: Before selecting a new bay type, make sure that all output relays specified in the List of Bay types for the selected bay type are actually available in the device. Otherwise there will be an error message, and the new bay type will not be activated.

An operating mode can be defined for each output relay. Depending on the selected operating mode, the output relay will operate in either an energize-on-signal (ES) mode or a normally-energized (NE) mode and in either a latching or non-latching mode. For output relays operating in latching mode, the operating mode setting also determines when latching will be cancelled.

Fig: 3-32

OUTP: Fct. assignm. K 301	151 045
OUTP: Fct. assignm. K 302	151 048
OUTP: Fct. assignm. K 501	150 097
OUTP: Fct. assignm. K 502	150 100
OUTP: Fct. assignm. K 503	150 103
OUTP: Fct. assignm. K 504	150 106
OUTP: Fct. assignm. K 505	150 109
OUTP: Fct. assignm. K 506	150 112
OUTP: Fct. assignm. K 507	150 115
OUTP: Fct. assignm. K 508	150 118
OUTP: Fct. assignm. K 601	150 121
OUTP: Fct. assignm. K 602	150 124
OUTP: Fct. assignm. K 603	150 127
OUTP: Fct. assignm. K 604	150 130
OUTP: Fct. assignm. K 605	150 133
OUTP: Fct. assignm. K 606	150 136
OUTP: Fct. assignm. K 607	150 139
OUTP: Fct. assignm. K 608	150 142
OUTP: Fct. assignm. K 701	150 145
OUTP: Fct. assignm. K 702	150 148
OUTP: Fct. assignm. K 703	150 151
OUTP: Fct. assignm. K 704	150 154
OUTP: Fct. assignm. K 705	150 157
OUTP: Fct. assignm. K 706	150 160
OUTP: Fct. assignm. K 707	150 163
OUTP: Fct. assignm. K 708	150 166
OUTP: Fct. assignm. K 801	150 169
OUTP: Fct. assignm. K 802	150 172
OUTP: Fct. assignm. K 803	150 175
OUTP: Fct. assignm. K 804	150 178
OUTP: Fct. assignm. K 805	150 181
OUTP: Fct. assignm. K 806	150 184
OUTP: Fct. assignm. K 807	150 187
OUTP: Fct. assignm. K 808	150 190
OUTP: Fct. assignm. K 901	150 193
OUTP: Fct. assignm. K 902	150 196
OUTP: Fct. assignm. K 903	150 199
OUTP: Fct. assignm. K 904	150 202
OUTP: Fct. assignm. K 905	150 205
OUTP: Fct. assignm. K 906	150 208
OUTP: Fct. assignm. K 907	150 211
OUTP: Fct. assignm. K 908	150 214
OUTP: Fct. assignm. K 1001	150 217
OUTP: Fct. assignm. K 1002	150 220
OUTP: Fct. assignm. K 1003	150 223
OUTP: Fct. assignm. K 1004	150 226
OUTP: Fct. assignm. K 1005	150 229
OUTP: Fct. assignm. K 1006	150 232
OUTP: Fct. assignm. K 1007	150 235
OUTP: Fct. assignm. K 1008	150 238
OUTP: Fct. assignm. K 1201	151 009
OUTP: Fct. assignm. K 1202	151 012
OUTP: Fct. assignm. K 1203	151 015

OUTP: Fct. assignm. K 1204	151 018	
OUTP: Fct. assignm. K 1205	151 021	
OUTP: Fct. assignm. K 1206	151 024	
OUTP: Fct. assignm. K 1207	151 027	
OUTP: Fct. assignm. K 1208	151 030	
OUTP: Fct. assignm. K 1401	169 002	
OUTP: Fct. assignm. K 1402	169 006	
OUTP: Fct. assignm. K 1403	169 010	
OUTP: Fct. assignm. K 1404	169 014	
OUTP: Fct. assignm. K 1405	169 018	
OUTP: Fct. assignm. K 1406	169 022	
OUTP: Fct. assignm. K 1407	169 026	
OUTP: Fct. assignm. K 1408	169 030	
OUTP: Fct. assignm. K 1601	171 002	
OUTP: Fct. assignm. K 1602	171 006	
OUTP: Fct. assignm. K 1801	173 002	
OUTP: Fct. assignm. K 1802	173 006	
OUTP: Fct. assignm. K 1803	173 010	
OUTP: Fct. assignm. K 1804	173 014	
OUTP: Fct. assignm. K 1805	173 018	
OUTP: Fct. assignm. K 1806	173 022	
OUTP: Fct. assignm. K 2001	151 201	
OUTP: Fct. assignm. K 2002	151 204	
OUTP: Fct. assignm. K 2003	151 207	
OUTP: Fct. assignm. K 2004	151 210	
OUTP: Fct. assignm. K 2005	151 213	
OUTP: Fct. assignm. K 2006	151 216	
OUTP: Fct. assignm. K 2007	151 219	
OUTP: Fct. assignm. K 2008	151 222	
Assignment of functions to output relays.		
OUTP: Oper. mode K 301	151 046	Fig: 3-32
OUTP: Oper. mode K 302	151 049	
OUTP: Oper. mode K 501	150 098	
OUTP: Oper. mode K 502	150 101	
OUTP: Oper. mode K 503	150 104	
OUTP: Oper. mode K 504	150 107	
OUTP: Oper. mode K 505	150 110	
OUTP: Oper. mode K 506	150 113	
OUTP: Oper. mode K 507	150 116	
OUTP: Oper. mode K 508	150 119	
OUTP: Oper. mode K 601	150 122	
OUTP: Oper. mode K 602	150 125	
OUTP: Oper. mode K 603	150 128	
OUTP: Oper. mode K 604	150 131	
OUTP: Oper. mode K 605	150 134	
OUTP: Oper. mode K 606	150 137	
OUTP: Oper. mode K 607	150 140	
OUTP: Oper. mode K 608	150 143	
OUTP: Oper. mode K 701	150 146	
OUTP: Oper. mode K 702	150 149	
OUTP: Oper. mode K 703	150 152	
OUTP: Oper. mode K 704	150 155	

OUTP: Oper. mode K 705	150 158
OUTP: Oper. mode K 706	150 161
OUTP: Oper. mode K 707	150 164
OUTP: Oper. mode K 708	150 167
OUTP: Oper. mode K 801	150 170
OUTP: Oper. mode K 802	150 173
OUTP: Oper. mode K 803	150 176
OUTP: Oper. mode K 804	150 179
OUTP: Oper. mode K 805	150 182
OUTP: Oper. mode K 806	150 185
OUTP: Oper. mode K 807	150 188
OUTP: Oper. mode K 808	150 191
OUTP: Oper. mode K 901	150 194
OUTP: Oper. mode K 902	150 197
OUTP: Oper. mode K 903	150 200
OUTP: Oper. mode K 904	150 203
OUTP: Oper. mode K 905	150 206
OUTP: Oper. mode K 906	150 209
OUTP: Oper. mode K 907	150 212
OUTP: Oper. mode K 908	150 215
OUTP: Oper. mode K 1001	150 218
OUTP: Oper. mode K 1002	150 221
OUTP: Oper. mode K 1003	150 224
OUTP: Oper. mode K 1004	150 227
OUTP: Oper. mode K 1005	150 230
OUTP: Oper. mode K 1006	150 233
OUTP: Oper. mode K 1007	150 236
OUTP: Oper. mode K 1008	150 239
OUTP: Oper. mode K 1201	151 010
OUTP: Oper. mode K 1202	151 013
OUTP: Oper. mode K 1203	151 016
OUTP: Oper. mode K 1204	151 019
OUTP: Oper. mode K 1205	151 022
OUTP: Oper. mode K 1206	151 025
OUTP: Oper. mode K 1207	151 028
OUTP: Oper. mode K 1208	151 031
OUTP: Oper. mode K 1401	169 003
OUTP: Oper. mode K 1402	169 007
OUTP: Oper. mode K 1403	169 011
OUTP: Oper. mode K 1404	169 015
OUTP: Oper. mode K 1405	169 019
OUTP: Oper. mode K 1406	169 023
OUTP: Oper. mode K 1407	169 027
OUTP: Oper. mode K 1408	169 031
OUTP: Oper. mode K 1601	171 003
OUTP: Oper. mode K 1602	171 007
OUTP: Oper. mode K 1801	173 003
OUTP: Oper. mode K 1802	173 007
OUTP: Oper. mode K 1803	173 011
OUTP: Oper. mode K 1804	173 015
OUTP: Oper. mode K 1805	173 019
OUTP: Oper. mode K 1806	173 023
OUTP: Oper. mode K 2001	151 202

OUTP: Oper. mode K 2002 151 205
OUTP: Oper. mode K 2003 151 208
OUTP: Oper. mode K 2004 151 211
OUTP: Oper. mode K 2005 151 214
OUTP: Oper. mode K 2006 151 217
OUTP: Oper. mode K 2007 151 220
OUTP: Oper. mode K 2008 151 223

Selection of operating mode for output relays.

Measured data output

MEASO: Function group MEASO 056 020

Cancelling function group MEASI or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden. If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

MEASO: General enable USER 031 074 Fig: 3-34

Disabling or enabling the measured data output function.

MEASO: Fct. assignm. BCD 053 002 Fig: 3-38

Selection of the measured value to be transmitted in BCD form.

MEASO: Hold time output BCD 010 010 Fig: 3-38

Setting the time period for transmission of the selected measured value in BCD form.

MEASO: Scaled min. val. BCD 037 140 Fig: 3-38
MEASO: Scaled max. val. BCD 037 141 Fig: 3-38
MEASO: BCD-Out min. value 037 142 Fig: 3-38
MEASO: BCD-Out max. value 037 143 Fig: 3-38

The variable Mx is to be issued in BCD form.

For measured values in the range "measured values to be issued" the output value should change linearly with the measured value.

Measured values	**Range**
Measured values for the variable Mx	Mx,RL1 ... Mx,RL2
Associated scaled measured values	0 ... 1

Measured values to be issued	**Range**
Measured values to be issued	Mx,min. ... Mx,max.
Scaled measured values to be issued	Mx,scal,min. ... Mx,scal,max
Designation of the set values in the data model	"Scaled min. val. BCD" ... ... "Scaled max. val. BCD"

with:

Mx,scal,min = (Mx,min - Mx,RL1) / (Mx,RL2 - Mx,RL1

Mx,scal,max = (Mx,max - Mx,RL1) / (Mx,RL2 - Mx,RL1

Output values	**Range**
BCD display values for measured values in the range "measured values to be issued"	"BCD-Out min. value" ... ... "BCD-Out max. value"
BCD display values for measured values = Mx,min.	"BCD-Out min. value"
BCD display values for measured values = Mx,max.	"BCD-Out max. value" ...

MEASO: Fct. assignm. A-1 053 000 Fig: 3-40
MEASO: Fct. assignm. A-2 053 001

Selection of the measured value to be transmitted in analog form.

MEASO: Hold time output A-1 010 114 Fig: 3-40
MEASO: Hold time output A-2 010 115

Setting the time period for output of the selected measured value.

MEASO: Scaled min. val. A-1 037 104 Fig: 3-40
MEASO: Scaled min. val. A-2 037 110
MEASO: Scaled knee val. A-1 037 105 Fig: 3-40
MEASO: Scaled knee val. A-2 037 111
MEASO: Scaled max. val. A-1 037 106 Fig: 3-40
MEASO: Scaled max. val. A-2 037 112

After conversion via a characteristic the selected measured value Ax (x=1, 2) is to be issued as an output current. For this purpose a range "measured values to be issued" is defined. In this range the characteristic has two linear sections, which are separated by a knee point.

Measured values	**Range**
Measured values for the variable Mx	Mx,RL1 ... Mx,RL2
Associated scaled measured values	0 ... 1

Measured values to be issued	**Range**
Measured values to be issued	Mx,min. ... Mx,max.
Scaled measured values to be issued	Mx,scal,min. ... Mx,scal,max
Designation of the set values in the data model	"Scaled min. val. Ax" ... ... "Scaled max. val. Ax"

with:

Mx,scal,min = (Mx,min - Mx,RL1) / (Mx,RL2 - Mx,RL1

Mx,scal,max = (Mx,max - Mx,RL1) / (Mx,RL2 - Mx,RL1

Knee point for characteristic	**Designation**
Value for knee point	Mx,knee
Scaled knee point value	Mx,scaled,knee
Designation of this set value in the data model	"Scaled knee val. Ax" ...

with:

Mx,scaled,knee = (Mx,min - Mx,RL1) / (Mx,RL2 - Mx,RL1

MEASO: AnOut min. val. A-1	037 107	Fig: 3-40
MEASO: AnOut min. val. A-2	037 113	
MEASO: AnOut knee point A-1	037 108	Fig: 3-40
MEASO: AnOut knee point A-2	037 114	
MEASO: AnOut max. val. A-1	037 109	Fig: 3-40
MEASO: AnOut max. val. A-2	037 115	

Output values	**Designation in the data model**
Output current range for measured values in the range "measured values to be issued"	"An-Out min. val. Ax" ... ... "An-Out max. val. Ax"
Output current to be set for measured values = Mx,min.	"An-Out min. val. Ax"
Output current to be set for measured values = Mx,max.	"An-Out max. val. Ax" ...
Output current to be set for measured values = Mx,knee	"AnOut knee point Ax"

with:

Mx,min. ... Mx,max. : measured values to be issued

MEASO: Output value 1	037 120	Fig: 3-40
MEASO: Output value 2	037 121	Fig: 3-40
MEASO: Output value 3	037 122	Fig: 3-40

Measured values of external devices, which must be scaled to 0 to 100%, can be issued.

LED indicators

The P132 has a total of 23 LED indicators (for the case 40T and case 84T devices) for parallel display of binary signals. The case 24T device variant is fitted 10 LED indicators. LED indicator H 1 is not configurable. It is labeled "HEALTHY" and signals the operational readiness of the protection unit (supply voltage present). LED indicators H 2 and H 3 are not configurable either. H 2 is labeled "OUT OF SERVICE" and signals a blocking or malfunction; H 3 is labeled "ALARM" and signals a warning alarm.
LED indicator H 17 indicates that the user is in the "EDIT MODE".

Section 6.1 describes the layout of the LED indicators and the factory setting for LED indicator H 4. At this point it is specifically emphasized that for the case 40T and case 84T devices there is no permanent association between the freely configurable function keys and the LED indicators H 18 to H 23 situated directly next to these function keys.

An operating mode can be defined for each LED indicator. Depending on the set operating mode, the LED indicator will operate in either energize-on-signal (ES) mode ('open-circuit principle') or normally-energized (NE) mode ('closed-circuit principle') and in either latching or non-latching mode. For LED indicators operating in latching mode, the operating mode setting also determines when latching will be cancelled.

With the multi-color LED indicators (H 4 – H 16, H 18 – H 23 on the case 40T and case 84T devices) the colors red and green can be independently assigned with functions. The third color amber results as a mixture of red and green, i.e. when both functions assigned to the LED indicator are simultaneously present.

LED: Fct.assig. H 1 green 085 184

Display of the operational readiness of the protection device.
The function `MAIN: Healthy` is permanently assigned.

LED: Fct.assig. H 2 yell. 085 001

Display of the function assigned to LED indicator H 2.
The function `MAIN: Blocked/faulty` is permanently assigned.

LED: Fct.assig. H 3 yell. 085 004

Display of the function assigned to LED indicator H 3.
The function `SFMON: Warning (LED)` is permanently assigned.

LED: Fct.assig. H17 red 085 185

Display of the function assigned to LED indicator H 17.
The function `LOC: Edit mode` is permanently assigned.

LED: Fct.assig. H 4 red	085 007	
LED: Fct.assig. H 4 green	085 057	
LED: Fct.assig. H 5 red	085 010	
LED: Fct.assig. H 5 green	085 060	
LED: Fct.assig. H 6 red	085 013	
LED: Fct.assig. H 6 green	085 063	
LED: Fct.assig. H 7 red	085 016	
LED: Fct.assig. H 7 green	085 066	
LED: Fct.assig. H 8 red	085 019	
LED: Fct.assig. H 8 green	085 069	
LED: Fct.assig. H 9 red	085 022	
LED: Fct.assig. H 9 green	085 072	
LED: Fct.assig. H10 red	085 025	Fig: 3-41
LED: Fct.assig. H10 green	085 075	Fig: 3-41
LED: Fct.assig. H11 red	085 028	
LED: Fct.assig. H11 green	085 078	
LED: Fct.assig. H12 red	085 031	
LED: Fct.assig. H12 green	085 081	
LED: Fct.assig. H13 red	085 034	
LED: Fct.assig. H13 green	085 084	
LED: Fct.assig. H14 red	085 037	
LED: Fct.assig. H14 green	085 087	
LED: Fct.assig. H15 red	085 040	
LED: Fct.assig. H15 green	085 090	
LED: Fct.assig. H16 red	085 043	
LED: Fct.assig. H16 green	085 093	
LED: Fct.assig. H18 red	085 131	
LED: Fct.assig. H18 green	085 161	
LED: Fct.assig. H19 red	085 134	
LED: Fct.assig. H19 green	085 164	
LED: Fct.assig. H20 red	085 137	
LED: Fct.assig. H20 green	085 167	
LED: Fct.assig. H21 red	085 140	
LED: Fct.assig. H21 green	085 170	
LED: Fct.assig. H22 red	085 143	
LED: Fct.assig. H22 green	085 173	
LED: Fct.assig. H23 red	085 146	
LED: Fct.assig. H23 green	085 177	

Assignment of functions to LED indicators.

LED: Operating mode H 1	085 182	Fig: 3-41

The operating mode ES updating is permanently assigned.

LED: Operating mode H 2	085 002	

The operating mode ES updating is permanently assigned.

LED: Operating mode H 3	085 005	

The operating mode ES updating is permanently assigned.

LED: Operating mode H 17	085 183	

The operating mode ES updating is permanently assigned.

LED: Operating mode H 4	085 008	
LED: Operating mode H 5	085 011	
LED: Operating mode H 6	085 014	
LED: Operating mode H 7	085 017	
LED: Operating mode H 8	085 020	
LED: Operating mode H 9	085 023	
LED: Operating mode H 10	085 026	Fig: 3-41
LED: Operating mode H 11	085 029	
LED: Operating mode H 12	085 032	
LED: Operating mode H 13	085 035	
LED: Operating mode H 14	085 038	
LED: Operating mode H 15	085 041	
LED: Operating mode H 16	085 044	
LED: Operating mode H 18	085 132	
LED: Operating mode H 19	085 135	
LED: Operating mode H 20	085 138	
LED: Operating mode H 21	085 141	
LED: Operating mode H 22	085 144	
LED: Operating mode H 23	085 147	

Selection of operating mode for LED indicators.

Main function

MAIN: Chann.assign.COMM1/2 003 169 Fig: 3-84

Assignment of communication interfaces to physical communication channels.

MAIN: Type of bay 220 001 Fig: 3-45

Configuration of a bay type.

MAIN: Customized bay type 221 062 Fig: 3-45

If a user-specific (customized) bay type has been loaded, its bay type No. will be displayed. If no customized bay type has been loaded, the number '0' will be displayed.

MAIN: Prim.Source TimeSync 103 210 Fig.*: 3-81

Selection of the primary source for date and time synchronization. Available are COMM1, COMM2/PC, IRIG-B or a binary input for minute signal pulses.

MAIN: BackupSourceTimeSync 103 211 Fig.*: 3-81

Selection of the backup source for date and time synchronization. Available are COMM1, COMM2/PC, IRIG-B or a binary input for minute signal pulses. The backup source is used when there is no synchronization generated by the primary source after MAIN: Time sync. time-out has elapsed.

MAIN: Time sync. time-out 103 212 Fig.*: 3-81

Time-out setting for the time synchronization generated by the primary source.

Fault recording

FT_RC: Rec. analog chann. 1	035 160	Fig.*: 3-123
FT_RC: Rec. analog chann. 2	035 161	
FT_RC: Rec. analog chann. 3	035 162	
FT_RC: Rec. analog chann. 4	035 163	
FT_RC: Rec. analog chann. 5	035 164	
FT_RC: Rec. analog chann. 6	035 165	
FT_RC: Rec. analog chann. 7	035 166	
FT_RC: Rec. analog chann. 8	035 167	
FT_RC: Rec. analog chann. 9	035 168	

The user specifies the channel on which each physical variable is recorded. The figure shown illustrates an overview of the assignment.

Cancelling a protection or control function

The user can adapt the device to the requirements of a particular high-voltage system by including the relevant protection or control functions in the device configuration and cancelling all others (removing them from the device configuration).

The following conditions must be met before cancelling a protection or control function:

- ☐ The protection or control function in question must be disabled.
- ☐ None of the functions of the protection or control function to be cancelled may be assigned to a binary input.
- ☐ None of the signals of the protection or control function may be assigned to a binary output or an LED indicator.
- ☐ No functions of the device function being cancelled can be selected in a list setting.
- ☐ None of the signals of the protection or control function may be linked to other signals by way of an ‘m out of n’ parameter.

The protection or control function to which a parameter, a signal, or a measured value belongs is defined by the function group designation (example: ‘LIMIT’).

Definite-time overcurrent protection

DTOC: Function group DTOC 056 008

Cancelling function group DTOC or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Inverse-time overcurrent protection 1

IDMT1: Function group IDMT1 056 009

Cancelling function group IDMTx or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.

Inverse-time overcurrent protection 2

IDMT2: Function group IDMT2 056 013

Cancelling function group IDMT1 or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.

Short-circuit direction determination

SCDD: Function group SCDD 056 021

Cancelling function group SCDD or including it in the configuration.
If any function group is cancelled from the configuration, then all associated settings and signals are hidden.

Switch on to fault protection

SOTF: Function group SOTF 056 003

Cancelling function group SOTF or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Protective signaling

PSIG: Function group PSIG 056 004

Cancelling function group PSIG or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Auto-reclosing control

ARC: Function group ARC 056 005

Cancelling function group ARC or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Automatic synchronism check

ASC: Function group ASC 056 006

Cancelling function group ASC or including it in the configuration.
If any function group is cancelled from the configuration, then all associated settings and signals are hidden.

Ground fault direction determination using steady-state values

GFDSS: Function group GFDSS 056 012

Cancelling function group GFDSS or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Transient ground fault direction determination

TGFD: Function group TGFD 056 019

Cancelling function group TGFD or including it in the configuration.
If any function group is cancelled from the configuration, then all associated settings and signals are hidden.

Motor protection

MP: Function group MP 056 022

Cancelling function group MP or including it in the configuration.
If any function group is cancelled from the configuration, then all associated settings and signals are hidden.

Thermal overload protection

THERM: Function group THERM 056 023

Cancelling function group THERM or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Unbalance protection

I2>: Function group I2> 056 024

Cancelling function group I2> or including it in the configuration.
If any function group is cancelled from the configuration, then all associated settings and signals are hidden.

Time-voltage protection

V<>: Function group V<> 056 010

Cancelling function group V<> or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Over-/underfrequency protection

f<>: Function group f<> 056 033

Cancelling function group f<> or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Power directional protection

P<>: Function group P<> 056 045

Cancelling function group P<> or including it in the configuration.
If any function group is cancelled from the configuration, then all associated settings and signals are hidden.

Circuit breaker failure protection

CBF: Function group CBF 056 007

Cancelling function group CBF or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Circuit Breaker Monitoring

CBM: Function group CBM 056 062

Cancelling function group CBM or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Measuring-circuit monitoring

MCMON: Function group MCMON 056 015

Cancelling function group MCMON or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Limit value monitoring

LIMIT: Function group LIMIT 056 025

Cancelling function group LIMIT or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

Logic

LOGIC: Function group LOGIC 056 017

Cancelling function group LOGIC or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden.

External devices 01 to 03

DEV01: Function group DEV01	210 047
DEV02: Function group DEV02	210 097
DEV03: Function group DEV03	210 147

Cancelling function groups DEV01 to DEV03 or including them in the configuration. If any function group is cancelled from the configuration, then all associated settings and signals are hidden.

DEV01: Funct. type, signal	210 034
DEV02: Funct. type, signal	210 084
DEV03: Funct. type, signal	210 134

Setting the function type of the signal.

Note:

If the IEC 870-5-101 communication protocol has been set, then the 'low address' of the information object will be defined by this setting. If the ILS-C protocol has been set, then this setting will correspond to DN2.

DEV01: Inform. No., signal	210 035
DEV02: Inform. No., signal	210 085
DEV03: Inform. No., signal	210 135

Setting the information number of the signal.

Note:

If the IEC 870-5-101 communication protocol has been set, then the 'high address' of the information object will be defined by this setting. If the ILS-C protocol has been set, then this setting will correspond to DN3.

DEV01: Funct. type, command	210 032
DEV02: Funct. type, command	210 082
DEV03: Funct. type, command	210 132

Setting the function type of the command.

Note:

If the IEC 870-5-101 communication protocol has been set, then the 'low address' of the information object will be defined by this setting. If the ILS-C protocol has been set, then this setting will correspond to DN2.

DEV01: Inform. No., command	210 033
DEV02: Inform. No., command	210 083
DEV03: Inform. No., command	210 133

Setting the information number of the command.

Note:

If the IEC 870-5-101 communication protocol has been set, then the 'high address' of the information object will be defined by this setting. If the ILS-C protocol has been set, then this setting will correspond to DN3.

Interlocking logic

ILOCK: Function group ILOCK	250 102

Cancelling function group ILOCK or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.

Single-pole commands

CMD_1: Function group CMD_1	249 252	

Cancelling function group CMD_1 or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.

CMD_1: Command C001 config.	200 004	Fig: 3-301
CMD_1: Command C002 config.	200 009	
CMD_1: Command C003 config.	200 014	
CMD_1: Command C004 config.	200 019	
CMD_1: Command C005 config.	200 024	
CMD_1: Command C006 config.	200 029	
CMD_1: Command C007 config.	200 034	
CMD_1: Command C008 config.	200 039	
CMD_1: Command C009 config.	200 044	
CMD_1: Command C010 config.	200 049	
CMD_1: Command C011 config.	200 054	
CMD_1: Command C012 config.	200 059	

Cancelling commands C001 to C026 or including them in the configuration.
If any command is cancelled, then all associated settings and signals are hidden, with the exception of this setting.

Single-pole signals

SIG_1: Function group SIG_1	249 250	

Cancelling function group SIG_1 or including it in the configuration.
If the function group is cancelled from the configuration, then all associated settings and signals are hidden, with the exception of this setting.

SIG_1: Signal S001 config.	226 007	Fig: 3-302
SIG_1: Signal S002 config.	226 015	
SIG_1: Signal S003 config.	226 023	
SIG_1: Signal S004 config.	226 031	
SIG_1: Signal S005 config.	226 039	
SIG_1: Signal S006 config.	226 047	
SIG_1: Signal S007 config.	226 055	
SIG_1: Signal S008 config.	226 063	
SIG_1: Signal S009 config.	226 071	
SIG_1: Signal S010 config.	226 079	
SIG_1: Signal S011 config.	226 087	
SIG_1: Signal S012 config.	226 095	

Cancelling signals S001 to S012 or including them in the configuration.
If any signal is cancelled, then all associated settings and signals are hidden..

7.1.3 Function Parameters

7.1.3.1 Global

PC link

PC: Command blocking 003 182 Fig: 3-7

When command blocking is activated, commands are rejected from the PC interface.

PC: Sig./meas.val.block. 003 086 Fig: 3-7

When signal and measured value blocking is activated, no signals or measured data are transmitted through the PC interface.

Communication interface 1

COMM1: Command block. USER 003 172 Fig: 3-8

When command blocking user is activated, commands are rejected from communication interface 1.

COMM1: Sig./meas.block.USER 003 076 Fig: 3-9, 3-10,3-11

When signal and measured value blocking user is activated, no signals or measured data are transmitted through communication interface COMM1.

Communication interface 2

COMM2: Command block. USER 103 172 Fig: 3-16

When command blocking user is activated, commands are rejected from communication interface 2.

COMM2: Sig./meas.block.USER 103 076 Fig: 3-16

When signal and measured value blocking user is activated, no signals or measured data are transmitted through communication interface COMM2.

Binary outputs

OUTP: Outp.rel.block USER 021 014 Fig: 3-32

When this blocking is activated, all output relays are blocked.

Main function

MAIN: Device on-line 003 030 Fig: 3-59

Switching the device off-line or on-line. Some parameters can only be changed when protection is disabled.

MAIN: Test mode USER 003 012 Fig: 3-85

When the test mode user is activated, signals or measured data for PC and communication interfaces are labeled 'test mode'.

MAIN: Nominal frequ. fnom 010 030 Fig: 3-235

Setting for the nominal frequency of the protected system.

MAIN: Phase sequence 010 049 Fig: 3-132, 3-140, 3-221

Setting the phase sequence A-B-C or A-C-B.(Alternative terminology: Setting the rotary field direction, either clockwise or anticlockwise.)

MAIN: Time tag 221 098 Page: 3-77

For bay control function signals detected via binary signal inputs and conditioned with debouncing it is now possible to select whether the time tag for the signal is to be issued after debouncing or when the first pulse edge is detected. Furthermore it is defined whether entries in the operating data memory are made in chronological order or not.

MAIN: Inom C.T. prim.	010 001	Fig: 3-47, 3-108, 3-265
Setting for the primary nominal current of the main current transformers for measurement of phase currents.		
MAIN: IN,nom C.T. prim.	010 018	Fig: 3-48
Setting for the primary nominal current of the main current transformer for measurement of residual current.		
MAIN: Vnom V.T. prim.	010 002	Fig: 3-51, 3-108
Setting for the primary nominal voltage of the system transformer for measurement of phase-to-ground and phase-to-phase voltages.		
MAIN: VNG,nom V.T. prim.	010 027	Fig: 3-52
Setting for the primary nominal voltage of the system transformer for measurement of neutral-point displacement voltage.		
MAIN: Vref,nom V.T. prim.	010 100	Fig: 3-53
Setting for the primary nominal voltage of the system transformer for measurement of reference voltage for automatic synchronism check.		
MAIN: Inom prim. NCIT	010 037	
Setting the primary nominal current of the non-conventional instrument transformer (NCIT) for measurement of phase currents.		
MAIN: IN,nom prim. NCIT	010 039	
Setting the primary nominal current of the NCIT for measurement of residual current.		
MAIN: Vnom prim. NCIT	010 038	
Setting the primary nominal voltage of the NCIT for measurement of phase-to-ground and phase-to-phase voltages.		
MAIN: Ph. err. VAG,1 NCIT **MAIN: Ph. err. VBG,1 NCIT** **MAIN: Ph. err. VCG,1 NCIT**	010 180 010 181 010 182	
Setting the phase error of the system transformer for each phase-to-ground voltage in voltage measuring channel 1 of the NCIT.		
MAIN: Ph. err. VAG,2 NCIT **MAIN: Ph.e.VBG/Vref,2 NCIT** **MAIN: Ph. err. VAG,2 NCIT**	010 192 010 193 010 194	
Setting the phase error of the system transformer for each phase-to-ground voltage (or for the reference voltage Vref, with ASC activated) in voltage measuring channel 2 of the NCIT.		
MAIN: Channel select. NCIT	010 187	
Activating voltage measuring channel 1 or 2 of the NCIT. The setting '*Without*' (voltage measuring channel) is also possible.		
MAIN: Inom device	010 003	Fig: 3-46
Setting for the secondary nominal current of the system transformer for measurement of phase currents. This also corresponds to the nominal device current.		
MAIN: IN,nom device	010 026	Fig: 3-46
Setting for the secondary nominal current of the system transformer for measurement of residual current. This also corresponds to the nominal device current.		

MAIN: Vnom V.T. sec. 010 009 Fig: 3-46

Setting for the secondary nominal voltage of the system transformer for measurement of phase-to-ground and phase-to-phase voltages.

MAIN: VNG,nom V.T. sec. 010 028 Fig: 3-46

Setting for the secondary nominal voltage of the system transformer for measurement of neutral-point displacement voltage.

MAIN: Vref,nom V.T. sec. 031 052 Fig: 3-46

Setting for the secondary nominal voltage of the system transformer for measurement of reference voltage for automatic synchronism check.

MAIN: Conn. meas. circ. IP 010 004 Fig: 3-46

Short-circuit direction determination depends on the connection of the measuring circuits. If the connection is as shown in Chapter 5, then the setting must be *'Standard',* if the P132's 'Forward' decision is to be in the direction of the outgoing feeder. If the connection direction is reversed or – given a connection scheme according to Chapter 5 – if the *'Forward'* decision is to be in the busbar direction, then the setting must be *'Opposite'.*

MAIN: Conn. meas. circ. IN 010 019 Fig: 3-46

Direction determination of the ground fault measuring systems depends on the connection of the measuring circuits. If the connection is as shown in Chapter 5, then the setting must be *'Standard',* if the P132's 'Forward' decision is to be in the direction of the outgoing feeder. If the connection direction is reversed or – given a connection scheme according to Chapter 5 – if the *'Forward'* decision is to be in the busbar direction, then the setting must be *'Opposite'.*

MAIN: Meas. direction P,Q 006 096 Fig: 3-54

This parameter allows inverting the sign for the following measured operating values:

MAIN: Active power P prim. (004 050)
MAIN: Reac. power Q prim. (004 052)
MAIN: Active power P p.u. (004 051)
MAIN: Reac. power Q p.u. (004 053)

MAIN: Meas. value rel. IP 011 030 Fig: 3-47

Setting the minimum current that must be exceeded so that measured operating values of the phase currents and, if applicable, derived currents are displayed.

MAIN: Meas. value rel. IN 011 031 Fig: 3-48

Setting the minimum current that must be exceeded so that the measured operating value of the residual current is displayed.

MAIN: Meas. value rel. V 011 032 Fig: 3-51

Setting the minimum voltage that must be exceeded so that measured operating values of the phase-to-ground voltages, phase-to-phase voltages, and, if applicable, derived voltages are displayed.

MAIN: Meas. val. rel. VNG 011 033 Fig: 3-52

Setting the minimum voltage that must be exceeded so that the measured operating value of the neutral-point displacement voltage is displayed.

MAIN: Meas. val. rel. Vref 011 034 Fig: 3-53

Setting the minimum voltage that must be exceeded so that the measured operating value of the reference voltage for the automatic synchronism check is displayed.

MAIN: Op. mode energy cnt. 010 138

Selection of the procedure to determine the active and reactive energy output. 1st procedure: Data acquisition every 2s (approximately). 2nd procedure: Data acquisition every 100ms (approximately)

MAIN: Settl. t. IP,max,del 010 113 Fig: 3-47

Setting for the time after which the delayed maximum current display shall reach 95% of the maximum current $I_{P,max}$.

MAIN: Fct.assign. reset 1 005 248 Fig: 3-83

Assigning specific memories and counters which are to be reset jointly if MAIN: Group reset 1 USER is enabled.

MAIN: Fct.assign. reset 2 005 249 Fig: 3-83

Assigning specific memories and counters which are to be reset jointly if MAIN: Group reset 2 USER is enabled.

MAIN: Fct.assign. block. 1 021 021 Fig: 3-64

Assignment of functions that will be blocked simultaneously when blocking input 1 (MAIN: Blocking 1 EXT) is activated.

MAIN: Fct.assign. block. 2 021 022 Fig: 3-64

Assignment of functions that will be blocked simultaneously when blocking input 2 (MAIN: Blocking 2 EXT) is activated.

MAIN: Trip cmd.block. USER 021 012 Fig: 3-74

Blocking the trip commands from the local control panel.

MAIN: Fct.assig.trip cmd.1 021 001 Fig: 3-74

Assignment of signals that trigger trip command 1.

MAIN: Fct.assig.trip cmd.2 021 002 Fig: 3-74

Assignment of signals that trigger trip command 2.

MAIN: Min.dur. trip cmd. 1 021 003 Fig: 3-74

Setting for the minimum duration of trip command 1.

MAIN: Min.dur. trip cmd. 2 021 004 Fig: 3-74

Setting for the minimum duration of trip command 2.

MAIN: Latching trip cmd. 1 021 023 Fig: 3-74

Specification as to whether trip command 1 should latch.

MAIN: Latching trip cmd. 2 021 024 Fig: 3-74

Specification as to whether trip command 2 should latch.

MAIN: Close cmd.pulse time 015 067 Fig: 3-67

Setting for the duration of the close command.

MAIN: Sig. asg. CB open 021 017 Fig: 3-263

Definition of the binary signal used by the P132 to evaluate the 'CB open' position signal.

MAIN: Inp.asg. ctrl.enabl. 221 057 Fig: 3-78

Definition of the binary signal used to issue a general command output enable.

MAIN: Debounce time gr. 1 221 200 Fig: 3-42
MAIN: Debounce time gr. 2 221 203
MAIN: Debounce time gr. 3 221 206

Setting the debouncing time.

MAIN: Chatt.mon. time gr.1 221 201 Fig: 3-42
MAIN: Chatt.mon. time gr.2 221 204
MAIN: Chatt.mon. time gr.3 221 207

Setting the chatter monitoring time.

MAIN: Change of state gr.1 221 202 Fig: 3-42
MAIN: Change of state gr.2 221 205
MAIN: Change of state gr.3 221 208

Setting the number of signal changes allowed during the chatter monitoring time before chatter suppression operates.

MAIN: Cmd. dur.long cmd. 221 230 Fig: 3-301, 3-296

Setting the command duration for a long command.

MAIN: Cmd. dur. short cmd. 221 231 Fig: 3-301, 3-296

Setting the command duration for a short command.

MAIN: Inp.asg.interl.deact 221 007 Fig: 3-78

Definition of the binary signal used to deactivate interlocking of control commands for switchgear.

MAIN: Inp.asg. L/R key sw. 221 008 Fig: 3-6

Definition of the binary signal used to switch from remote control to local control.

MAIN: Auto-assignment I/O 221 065 Fig: 3-45

When a bay type is selected the binary inputs and outputs, required to control switchgear, are automatically configured with function assignments.

MAIN: Electrical control 221 061 Fig: 3-292

This setting determines whether the binary inputs, that are configured to control switchgear, will be active with remote control or local control

MAIN: Delay Man.Op.Superv. 221 079 Page: 3-408

After the delay time period, to be set in this window, has elapsed (with the signal "Sw. dev. interm. pos." already present and the status signal continuously absent), the actual switchgear status signal, as obtained from the respective binary inputs, will be issued. (See also "Processing status signals from manually operated switchgear")

MAIN: W. ext. cmd. termin. 221 063 Page: 3-415

This setting defines whether there is an intervention in the control process of external switchgear units by using external termination contacts.

MAIN: Inp.assign. tripping 221 010 Fig: 3-77

Definition of the binary signal used to signal the tripping of an external protection device. This signal is used to form the CB trip signal.

MAIN: Prot.trip>CB tripped 221 012 Fig: 3-77

Selection of the protection function trip command that will be used to form the CB trip signal.

MAIN: Inp. asg. CB trip 221 013 Fig: 3-77

Definition of the binary signal used by the P132 to signal the 'CB open' position signal.

MAIN: Sig. asg. CB closed 021 020 Fig: 3-66

Definition of the binary signal used by the P132 to evaluate the 'CB closed' position signal.

MAIN: Inp.asg.CB tr.en.ext 221 050 Fig: 3-77

Definition of the binary signal used to enable the CB trip signal of an external device.

MAIN: Inp.asg. CB trip ext 221 024 Fig: 3-77

Definition of the binary signal used to carry the CB trip signal of an external device.

MAIN: Inp.asg. mult.sig. 1 221 051 Fig: 3-68
MAIN: Inp.asg. mult.sig. 2 221 052 Fig: 3-68

Definition of the function that will be interpreted as a multiple signal (group signal).

MAIN: Fct. assign. fault 021 031 Fig: 3-65

Selection of signals whose appearance will result in a ‘Blocked/faulty’ signal and in the activation of the LED indicator labeled ‘OUT OF SERVICE’. Signals that lead to a blocking of the device are not configurable and always result in the above signal and indication.

Parameter subset selection

PSS: Control via USER 003 100 Fig: 3-86

If parameter subset selection is to be handled from the integrated local control panel rather than via binary signal inputs, choose the setting '*Yes*'.

PSS: Param.subs.sel. USER 003 060 Fig: 3-86

Selection of the parameter subset from the local control panel.

PSS: Keep time 003 063 Fig: 3-86

The setting of this timer stage is relevant only if parameter subset selection is carried out via binary signal inputs. Any voltage-free pause that may occur during selection is bridged. If, after this time period has elapsed, no binary signal input has yet been set, then the parameter subset selected from the local control panel shall apply.

Self-monitoring

SFMON: Fct. assign. warning 021 030 Fig: 3-87

Selection of the signals whose appearance shall result in the signals 'Warning (LED)' and 'Warning (relay)' and in the activation of the LED indicator labeled 'ALARM'. Signals caused by faulty hardware and leading to a blocking of the device are not configurable. They always result in the above signals and indication.

SFMON: Mon.sig. retention 021 018 Page: 3-139

This setting determines how long monitoring signals remain in the monitoring signal memory before a reset occurs.

Fault data acquisition

FT_DA: Line length 010 005 Fig: 3-109

This setting defines the distance in km that the fault locator interprets as 100 % when calculating the line distance to a fault.

FT_DA: Line reactance 010 012 Fig: 3-109

This setting defines the reactance X that the fault locator interprets as 100 % when calculating the line distance to a fault.

FT_DA: Angle kG 012 036 Fig: 3-106

Angle setting of the complex ground factor $\underline{k}_G$.

$$\underline{k}_G = \frac{\underline{Z}_0 - \underline{Z}_L}{3 \cdot \underline{Z}_L}$$

$\underline{Z}_0$: zero-sequence impedance
$\underline{Z}_L$: positive-sequence impedance

$$angle\ k_G = \arctan\frac{X_0 - X_L}{R_0 - R_L} - \arctan\frac{X_L}{R_L}$$

R_0: resistance component of zero-sequence impedance
R_L: resistance component of positive-sequence impedance
X_0: reactance component of zero-sequence impedance
X_L: reactance component of positive-sequence impedance

If the calculated value cannot be set exactly, then a next smaller value should be set.

FT_DA: Abs. value kG 012 037 Fig: 3-106

Setting the absolute value of the complex ground factor $\underline{k}_G$.

$$\underline{k}_G = \frac{\underline{Z}_0 - \underline{Z}_L}{3 \cdot \underline{Z}_L}$$

$\underline{Z}_0$: zero-sequence impedance
$\underline{Z}_L$: positive-sequence impedance

$$\left|\underline{k}_G\right| = \frac{\sqrt{(X_0 - X_L)^2 + (R_0 - R_L)^2}}{3 \cdot \sqrt{R_L{}^2 + X_L{}^2}}$$

R_0: resistance component of zero-sequence impedance
R_L: resistance component of positive-sequence impedance
X_0: reactance component of zero-sequence impedance
X_L: reactance component of positive-sequence impedance

If the calculated value cannot be set exactly, then a next smaller value should be set.

FT_DA: Start data acquisit. 010 011 Fig: 3-105

This setting determines at what point during a fault the acquisition of fault data should take place.

FT_DA: Output fault locat.	010 032	Fig: 3-105
Setting for the conditions under which a fault location output occurs.		

Fault recording

FT_RC: Fct. assig. trigger	003 085	Fig: 3-111
This setting defines the signals that will trigger fault recording and fault data acquisition.		
FT_RC: I>	017 065	Fig: 3-111
This setting defines the threshold value of the phase currents that will trigger fault recording and fault data acquisition.		
FT_RC: Pre-fault time	003 078	Fig: 3-113
Setting for the time during which data will be recorded before a fault occurs (pre-fault recording time).		
FT_RC: Post-fault time	003 079	Fig: 3-113
Setting for the time during which data will be recorded after the end of a fault (post-fault recording time).		
FT_RC: Max. recording time	003 075	Fig: 3-113
Setting for the maximum recording time per fault. This includes pre-fault and post-fault recording times.		

7.1.3.2 General Functions

Main function

MAIN: Syst.IN enabled USER 018 008 Fig: 3-60

Enable/disable the DTOC and IDMTx residual current stages.
(IDMTx: IDMT1, IDMT2)

Definite-time overcurrent protection

DTOC: General enable USER 022 075 Fig: 3-114

Enable/disable the definite-time overcurrent protection function.

Inverse-time overcurrent protection

IDMT1: General enable USER 017 096 Fig: 3-125
IDMT2: General enable USER 017 052

Enable/disable the inverse-time overcurrent protection function.

Short-circuit direction determination

SCDD: General enable USER 017 070 Fig: 3-137

Enable/disable the short-circuit direction determination.

Switch on to fault protection

SOTF: General enable USER 011 068 Fig: 3-147

Enable/disable the switch on to fault (short circuit) protection.

SOTF: Operating mode 011 061 Fig: 3-147

The setting of the operating mode defines whether, while the timer is running, a general starting will lead to a trip command ("trip with starting") or if the measuring range of the impedance zone 1 is extended by the set zone extension factor `DIST: kze HSR PSx` ("trip with extension").

SOTF: Manual close timer 011 060 Fig: 3-147

Setting for the timer stage that will be started by a manual close.

Protective signaling

PSIG: General enable USER 015 004 Fig: 3-148

Enable/disable the protective signaling.

Auto-reclosing control

ARC: General enable USER 015 060 Fig: 3-154

Enable/disable the auto-reclosing control.

ARC: Sig.asg.trip t.GFDSS 015 105 Fig: 3-160

Selection of the GFDSS starting to trigger the auto-reclosing control function.

ARC: Fct.assgn. tLOGIC 015 033 Fig: 3-164

Function assignment to tLOGIC.

Automatic synchronism check

ASC: General enable USER 018 000 Fig: 3-172

Enable/disable the automatic synchronism check.

ASC: Transm.cycle,meas.v. 101 212 Fig: 3-181

Cycle period for transmission of ASC measured values.

Ground fault direction determination using steady-state values

GFDSS: General enable USER 016 060 Fig: 3-183

Enable/disable the ground fault direction determination by steady-state values.

GFDSS: Operating mode 016 090 Fig: 3-183

This setting specifies whether steady-state power evaluation or steady-state current evaluation will be performed.

Transient ground fault direction determination

TGFD: General enable USER 016 040 Fig: 3-197

Enable/disable the transient ground fault direction determination.

Motor protection

MS: General enable USER 017 059 Fig: 3-204

Enable/disable the motor protection function.

MS: Hours_Run > 025 156

Setting the maximum hours for running time.

Thermal overload protection

THERM: General enable USER 022 050 Fig: 3-214

Enable/disable the thermal overload protection function.

THERM: Operating mode 022 063 Fig: 3-218

Setting the operating mode of thermal overload protection.

Unbalance protection

I2>: General enable USER 018 090 Fig: 3-220

Enable/disable the unbalance protection function.

Time-voltage protection

V<>: General enable USER 023 030 Fig: 3-222

Enable/disable the time-voltage protection function.

Over-/underfrequency protection

f<>: General enable USER 023 031 Fig: 3-231

Enable/disable the over-/underfrequency protection function.

f<>: Selection meas. volt 018 202 Fig: 3-232

Setting for the voltage that is used for frequency measurement.

f<>: Evaluation time 018 201 Fig: 3-233

Setting the evaluation time. The operate conditions must be met for the duration of the set evaluation time so that a signal is issued.

f<>: Undervolt. block. V< 018 200 Fig: 3-233

Setting for the threshold of undervoltage blocking. If the voltage falls below this threshold, the over-/underfrequency protection function will be blocked.

Power directional protection

P<>: General enable USER 014 220 Fig: 3-236

Enable/disable the power directional protection function.

Circuit breaker failure protection

CBF: General enable USER 022 080 Fig: 3-250

Enable/disable the circuit breaker failure protection function.

CBF: Start bei manu. Aus 022 154 Fig: 3-254

Setting that a manual trip signal will also be used as a start criterion.

CBF: Fct.assignm. CBAux. 022 159 Fig: 3-254

Selection of trip signals - assigned to Gen. trip command 1 - for which, in addition to current flow monitoring, status signals from CB auxiliary contacts are evaluated.

CBF: I> 022 160 Fig: 3-252, 3-254, 3-258, 3-259

Setting the threshold to detect a break in current flow.

CBF: t1 3p 022 165 Fig: 3-255

Setting 1st CBF timer stage to 3-pole operating mode.

CBF: t2 022 166 Fig: 3-255

Setting 2nd CBF timer stage.

CBF: Min.dur. trip cmd.t1 022 167 Fig: 3-256

Setting 1st timer stage for minimum duration of trip command.

CBF: Min.dur. trip cmd.t2 022 168 Fig: 3-256

Setting 2nd timer stage for minimum duration of trip command.

CBF: Latching trip cmd.t1 022 169 Fig: 3-256

The 1st timer stage trip command, set to latch mode, will remain active until reset by operating parameters or through an appropriately configured binary signal input.

CBF: Latching trip cmd.t2 022 170 Fig: 3-256

The 2nd timer stage trip command, set to latch mode, will remain active until reset by operating parameters or through an appropriately configured binary signal input.

CBF: Delay/starting trig. 022 155 Fig: 3-257

The signal `CBF: Trip signal` is issued when this timer stage’s time duration has elapsed.

CBF: Delay/fault beh. CB 022 171 Fig: 3-258

If during this delay time period the circuit breaker does not provide a signal from its auxiliary contacts that it is closed, then faults behind the CB are recognized through the current criterion (see section "Fault behind CB protection").

CBF: Delay/CB sync.superv 022 172 Fig: 3-259

Setting the delay time period to bridge circuit breaker operate times during CB synchronization supervision.

Circuit Breaker Monitoring

CBM: General enable USER 022 010 Fig: 3-260

Enable/disable circuit breaker monitoring.

CBM: Blocking USER 022 150 Fig: 3-268

Setting a temporary blocking of circuit breaker monitoring during protection injection testing.

CBM: Sig. asg. trip cmd. 022 152 Fig: 3-262

Using the setting for external devices the trip command issued by the control function may be linked to the trip command 1 issued by the protection by assigning the trip command issued by the control function by this parameter.

CBM: Operating mode 022 007 Fig: 3-265

This setting defines starting criteria for circuit breaker monitoring. To evaluate all trip commands issued by the protection device *"with Trip cmd. only"* must be selected. For further evaluation of operational trip commands the additional CB auxiliary contact *"CB sig.EXT or trip"* is used.

CBM: Inom,CB 022 012 Fig: 3-265

Setting the CB nominal current.

CBM: Perm. CB op. Inom,CB 022 013 Fig: 3-265

Setting the maximum number of CB operations at nominal current.

CBM: Med. curr. Itrip,CB 022 014 Fig: 3-265

Setting the average CB disconnection current.

Note: In general valid only for pneumatically operated CBs.

CBM: Perm. CB op. Imed,CB 022 015 Fig: 3-265

Setting the maximum number of CB operations at average disconnection current.

Note: In general valid only for pneumatically operated CBs.

CBM: Max. curr. Itrip,CB 022 016 Fig: 3-265

Setting the maximum CB disconnection current.

CBM: Perm. CB op. Imax,CB 022 017 Fig: 3-265

Setting the maximum number of CB operations permitted at maximum CB disconnection current.

CBM: No. CB operations > 022 019 Fig: 3-267

Setting the maximum number of mechanical CB switching operations.

CBM: Remain No. CB op. < 022 020 Fig: 3-266

Setting the warning stage with the number of remaining CB operations at CB nominal current.

CBM: ΣItrip> 022 022

Setting the warning stage with the accumulated CB disconnection current values.

CBM: ΣItrip2>** 022 081

Setting the warning stage with the accumulated CB disconnection current values to the second power.

CBM: ΣI*t> 022 096

Setting the warning stage with the sum of the current-time integrals of the CB disconnection current values

CBM: Corr. acquis. time 022 018 Fig: 3-265

Correction of the time tolerances permissible for leading or lagging CB auxiliary contacts.

Measuring-circuit monitoring

MCMON: General enable USER 014 001 Fig: 3-270

Enable/disable the measuring-circuit monitoring function.

MCMON: Op. mode Idiff> 017 028 Fig: 3-270

Adaptation of measuring-circuit monitoring to the system current transformers.

MCMON: Idiff> 017 024 Fig: 3-270

Setting the operate value of measuring-circuit monitoring.

MCMON: Op. mode Vmin< monit 018 079 Fig: 3-271

Selection of the monitoring mode in the voltage-measuring circuit.

MCMON: Vmin< 017 022 Fig: 3-271

Setting the operate value for the voltage trigger Vmin< of measuring circuit monitoring.

MCMON: Operate delay 017 023 Fig: 3-270

Setting the time delay for current and voltage monitoring.

MCMON: Phase sequ. monitor. 018 019 Fig: 3-271

Enable/disable the phase sequence monitoring function.

MCMON: FF,Vref enabled USER 014 013 Fig: 3-272

Enable/disable the "Fuse Failure" monitoring function of the reference voltage Vref.

MCMON: Oper. delay FF, Vref 014 012 Fig: 3-272

Setting for the time delay for "Fuse Failure" monitoring of the reference voltage Vref.

Limit value monitoring

LIMIT: General enable USER 014 010 Fig: 3-273

Enable/disable the limit value monitoring function.

LIMIT: I> 014 004 Fig: 3-273

Setting for the operate value of the first overcurrent stage for limit value monitoring.

LIMIT: I>> 014 020 Fig: 3-273

Setting for the operate value of the second overcurrent stage for limit value monitoring.

LIMIT: tI> 014 031 Fig: 3-273

Setting for the operate delay of the first overcurrent stage for limit value monitoring.

LIMIT: tI>> 014 032 Fig: 3-273

Setting for the operate delay of the second overcurrent stage for limit value monitoring.

LIMIT: I< 014 021 Fig: 3-273

Setting for the operate value of the first undercurrent stage for limit value monitoring.

LIMIT: I<< 014 022 Fig: 3-273

Setting for the operate value of the second undercurrent stage for limit value monitoring.

LIMIT: tI< 014 033 Fig: 3-273

Setting for the operate delay of the first undercurrent stage for limit value monitoring.

LIMIT: tI<< 014 034 Fig: 3-273

Setting for the operate delay of the second undercurrent stage for limit value monitoring.

LIMIT: VPG> 014 023 Fig: 3-274

Setting for the operate value of overvoltage stage VPG> for limit value monitoring.

LIMIT: VPG>> 014 024 Fig: 3-274

Setting for the operate value of overvoltage stage VPG>> for limit value monitoring.

LIMIT: tVPG> 014 035 Fig: 3-274

Setting for the operate delay of overvoltage stage VPG> for limit value monitoring.

LIMIT: tVPG>> 014 036 Fig: 3-274

Setting for the operate delay of overvoltage stage VPG>> for limit value monitoring.

LIMIT: VPG< 014 025 Fig: 3-274

Setting for the operate value of undervoltage stage VPG< for limit value monitoring.

LIMIT: VPG<< 014 026 Fig: 3-274

Setting for the operate value of undervoltage stage VPG<< for limit value monitoring.

LIMIT: tVPG< 014 037 Fig: 3-274

Setting for the operate delay of undervoltage stage VPG< for limit value monitoring.

LIMIT: tVPG<< 014 038 Fig: 3-274

Setting for the operate delay of undervoltage stage VPG<< for limit value monitoring.

LIMIT: VPP> 014 027 Fig: 3-274

Setting for the operate value of overvoltage stage VPP> for limit value monitoring.

LIMIT: VPP>> 014 028 Fig: 3-274

Setting for the operate value of overvoltage stage VPP>> for limit value monitoring.

LIMIT: tVPP> 014 039 Fig: 3-274

Setting for the operate delay of overvoltage stage VPP> for limit value monitoring.

LIMIT: tVPP>> 014 040 Fig: 3-274

Setting for the operate delay of overvoltage stage VPP>> for limit value monitoring.

LIMIT: VPP< 014 029 Fig: 3-274

Setting for the operate value of undervoltage stage VPP< for limit value monitoring.

LIMIT: VPP<< 014 030 Fig: 3-274

Setting for the operate value of undervoltage stage VPP<< for limit value monitoring.

LIMIT: tVPP< 014 041 Fig: 3-274

Setting for the operate delay of undervoltage stage VPP< for limit value monitoring.

LIMIT: tVPP<< 014 042 Fig: 3-274

Setting for the operate delay of undervoltage stage VPP<< for limit value monitoring.

LIMIT: VNG> 014 043 Fig: 3-275

Setting for the operate value of overvoltage stage VNG> for limit value monitoring.

LIMIT: VNG>> 014 044 Fig: 3-275

Setting for the operate value of overvoltage stage VNG>> for limit value monitoring.

LIMIT: tVNG> 014 045 Fig: 3-275

Setting for the operate delay of overvoltage stage VNG> for limit value monitoring.

LIMIT: tVNG>> 014 046 Fig: 3-275

Setting for the operate delay of overvoltage stage VNG>> for limit value monitoring.

LIMIT: Vref> 042 144 Fig: 3-277

Setting the operate value of overvoltage stage Vref> for limit value monitoring. (Relevant only with circuit board 5V, i.e. ordering option Vnom = 50 to 130 V {5 poles} for ASC).

LIMIT: Vref>> 042 145 Fig: 3-277

Setting the operate value of overvoltage stage Vref>> for limit value monitoring. (Relevant only with circuit board 5V).

LIMIT: tVref> 042 148 Fig: 3-277

Setting the operate delay of overvoltage stage Vref> for limit value monitoring. (Relevant only with circuit board 5V).

LIMIT: tVref>> 042 149 Fig: 3-277

Setting the operate delay of overvoltage stage Vref>> for limit value monitoring. (Relevant only with circuit board 5V).

LIMIT: Vref< 042 146 Fig: 3-277

Setting the operate value of undervoltage stage Vref< for limit value monitoring. (Relevant only with circuit board 5V).

LIMIT: Vref<< 042 147 Fig: 3-277

Setting the operate value of undervoltage stage Vref<< for limit value monitoring. (Relevant only with circuit board 5V).

LIMIT: tVref< 042 150 Fig: 3-277

Setting the operate delay of undervoltage stage Vref< for limit value monitoring. (Relevant only with circuit board 5V).

LIMIT: tVref<< 042 151 Fig: 3-277

Setting the operate delay of undervoltage stage Vref<< for limit value monitoring. (Relevant only with circuit board 5V).

LIMIT: IDC,lin> 014 110 Fig: 3-276

Setting for the operate value IDC,lin> for monitoring the linearized direct current.

LIMIT: IDC,lin>> 014 111 Fig: 3-276

Setting for the operate value IDC,lin>> for monitoring the linearized direct current.

LIMIT: tIDC,lin> 014 112 Fig: 3-276

Setting for the operate delay of overcurrent stage IDC,lin>.

LIMIT: tIDC,lin>> 014 113 Fig: 3-276

Setting for the operate delay of overcurrent stage IDC,lin>>.

LIMIT: IDC,lin< 014 114 Fig: 3-276

Setting for the operate value IDC,lin< for monitoring the linearized direct current.

LIMIT: IDC,lin<< 014 115 Fig: 3-276

Setting for the operate value IDC,lin<< for monitoring the linearized direct current.

LIMIT: tIDC,lin< 014 116 Fig: 3-276

Setting for the operate delay of undercurrent stage IDC,lin<.

LIMIT: tIDC,lin<< 014 117 Fig: 3-276

Setting for the operate delay of undercurrent stage IDC,lin<<.

LIMIT: T> 014 100 Fig: 3-278

Setting for the operate value of temperature monitoring T>.

LIMIT: T>> 014 101 Fig: 3-278

Setting for the operate value of temperature monitoring T>>.

LIMIT: tT> 014 103 Fig: 3-278

Setting for the operate delay of temperature monitoring T>.

LIMIT: tT>> 014 104 Fig: 3-278

Setting for the operate delay of temperature monitoring T>>.

LIMIT: T< 014 105 Fig: 3-278

Setting for the operate value of temperature monitoring T<.

LIMIT: T<< 014 106 Fig: 3-278

Setting for the operate value of temperature monitoring T<<.

LIMIT: tT< 014 107 Fig: 3-278

Setting for the operate delay of temperature monitoring T<.

LIMIT: tT<< 014 108 Fig: 3-278

Setting for the operate delay of temperature monitoring T<<.

LIMIT: T1>	014 120	Fig: 3-279
LIMIT: T2>	014 130	
LIMIT: T3>	014 140	
LIMIT: T4>	014 150	
LIMIT: T5>	014 160	
LIMIT: T6>	014 170	
LIMIT: T7>	014 180	
LIMIT: T8>	014 190	
LIMIT: T9>	015 130	

Setting the operate value of temperature monitoring Tn> for temperature sensor Tn.

LIMIT: T1>>	014 121	Fig: 3-279
LIMIT: T2>>	014 131	
LIMIT: T3>>	014 141	
LIMIT: T4>>	014 151	
LIMIT: T5>>	014 161	
LIMIT: T6>>	014 171	
LIMIT: T7>>	014 181	
LIMIT: T8>>	014 191	
LIMIT: T9>>	015 131	

Setting the operate value of temperature monitoring Tn>> for temperature sensor Tn.

LIMIT: tT1>	014 122	Fig: 3-279
LIMIT: tT2>	014 132	
LIMIT: tT3>	014 142	
LIMIT: tT4>	014 152	
LIMIT: tT5>	014 162	
LIMIT: tT6>	014 172	
LIMIT: tT7>	014 182	
LIMIT: tT8>	014 192	
LIMIT: tT9>	015 132	

Setting the operate delay of temperature monitoring Tn> for temperature sensor Tn.

LIMIT: tT1>>	014 123	Fig: 3-279
LIMIT: tT2>>	014 133	
LIMIT: tT3>>	014 143	
LIMIT: tT4>>	014 153	
LIMIT: tT5>>	014 163	
LIMIT: tT6>>	014 173	
LIMIT: tT7>>	014 183	
LIMIT: tT8>>	014 193	
LIMIT: tT9>>	015 133	

Setting the operate delay of temperature monitoring Tn>> for temperature sensor Tn.

LIMIT: T1<	014 124	Fig: 3-279
LIMIT: T2<	014 134	
LIMIT: T3<	014 144	
LIMIT: T4<	014 154	
LIMIT: T5<	014 164	
LIMIT: T6<	014 174	
LIMIT: T7<	014 184	
LIMIT: T8<	014 194	
LIMIT: T9<	015 134	
Setting the operate value of temperature monitoring Tn< for temperature sensor Tn.		
LIMIT: T1<<	014 125	Fig: 3-279
LIMIT: T2<<	014 135	
LIMIT: T3<<	014 145	
LIMIT: T4<<	014 155	
LIMIT: T5<<	014 165	
LIMIT: T6<<	014 175	
LIMIT: T7<<	014 185	
LIMIT: T8<<	014 195	
LIMIT: T9<<	015 135	
Setting the operate value of temperature monitoring Tn<< for temperature sensor Tn.		
LIMIT: tT1<	014 126	Fig: 3-279
LIMIT: tT2<	014 136	
LIMIT: tT3<	014 146	
LIMIT: tT4<	014 156	
LIMIT: tT5<	014 166	
LIMIT: tT6<	014 176	
LIMIT: tT7<	014 186	
LIMIT: tT8<	014 196	
LIMIT: tT9<	015 136	
Setting the operate delay of temperature monitoring Tn< for temperature sensor Tn.		
LIMIT: tT1<<	014 127	Fig: 3-279
LIMIT: tT2<<	014 137	
LIMIT: tT3<<	014 147	
LIMIT: tT4<<	014 157	
LIMIT: tT5<<	014 167	
LIMIT: tT6<<	014 177	
LIMIT: tT7<<	014 187	
LIMIT: tT8<<	014 197	
LIMIT: tT9<<	015 137	
Setting the operate delay of temperature monitoring Tn<< for temperature sensor Tn.		

Logic	LOGIC: General enable USER	031 099	Fig: 3-284
	Enable/disable the logic function.		
	LOGIC: Set 1 USER	034 030	Fig: 3-283, 3-290
	LOGIC: Set 2 USER	034 031	
	LOGIC: Set 3 USER	034 032	
	LOGIC: Set 4 USER	034 033	
	LOGIC: Set 5 USER	034 034	
	LOGIC: Set 6 USER	034 035	
	LOGIC: Set 7 USER	034 036	
	LOGIC: Set 8 USER	034 037	Fig: 3-290
	These settings define the static input conditions for the logic function.		
	LOGIC: Fct.assignm. outp. 1	030 000	Fig: 3-164, 3-284
	LOGIC: Fct.assignm. outp. 2	030 004	Fig: 3-164
	LOGIC: Fct.assignm. outp. 3	030 008	
	LOGIC: Fct.assignm. outp. 4	030 012	
	LOGIC: Fct.assignm. outp. 5	030 016	
	LOGIC: Fct.assignm. outp. 6	030 020	
	LOGIC: Fct.assignm. outp. 7	030 024	
	LOGIC: Fct.assignm. outp. 8	030 028	
	LOGIC: Fct.assignm. outp. 9	030 032	
	LOGIC: Fct.assignm. outp.10	030 036	
	LOGIC: Fct.assignm. outp.11	030 040	
	LOGIC: Fct.assignm. outp.12	030 044	
	LOGIC: Fct.assignm. outp.13	030 048	
	LOGIC: Fct.assignm. outp.14	030 052	
	LOGIC: Fct.assignm. outp.15	030 056	
	LOGIC: Fct.assignm. outp.16	030 060	
	LOGIC: Fct.assignm. outp.17	030 064	
	LOGIC: Fct.assignm. outp.18	030 068	
	LOGIC: Fct.assignm. outp.19	030 072	
	LOGIC: Fct.assignm. outp.20	030 076	
	LOGIC: Fct.assignm. outp.21	030 080	
	LOGIC: Fct.assignm. outp.22	030 084	
	LOGIC: Fct.assignm. outp.23	030 088	
	LOGIC: Fct.assignm. outp.24	030 092	
	LOGIC: Fct.assignm. outp.25	030 096	
	LOGIC: Fct.assignm. outp.26	031 000	
	LOGIC: Fct.assignm. outp.27	031 004	
	LOGIC: Fct.assignm. outp.28	031 008	
	LOGIC: Fct.assignm. outp.29	031 012	
	LOGIC: Fct.assignm. outp.30	031 016	
	LOGIC: Fct.assignm. outp.31	031 020	
	LOGIC: Fct.assignm. outp.32	031 024	
	These settings assign functions to the outputs.		

LOGIC: Op. mode t output 1	030 001	Fig: 3-164, 3-284
LOGIC: Op. mode t output 2	030 005	Fig: 3-164
LOGIC: Op. mode t output 3	030 009	
LOGIC: Op. mode t output 4	030 013	
LOGIC: Op. mode t output 5	030 017	
LOGIC: Op. mode t output 6	030 021	
LOGIC: Op. mode t output 7	030 025	
LOGIC: Op. mode t output 8	030 029	
LOGIC: Op. mode t output 9	030 033	
LOGIC: Op. mode t output 10	030 037	
LOGIC: Op. mode t output 11	030 041	
LOGIC: Op. mode t output 12	030 045	
LOGIC: Op. mode t output 13	030 049	
LOGIC: Op. mode t output 14	030 053	
LOGIC: Op. mode t output 15	030 057	
LOGIC: Op. mode t output 16	030 061	
LOGIC: Op. mode t output 17	030 065	
LOGIC: Op. mode t output 18	030 069	
LOGIC: Op. mode t output 19	030 073	
LOGIC: Op. mode t output 20	030 077	
LOGIC: Op. mode t output 21	030 081	
LOGIC: Op. mode t output 22	030 085	
LOGIC: Op. mode t output 23	030 089	
LOGIC: Op. mode t output 24	030 093	
LOGIC: Op. mode t output 25	030 097	
LOGIC: Op. mode t output 26	031 001	
LOGIC: Op. mode t output 27	031 005	
LOGIC: Op. mode t output 28	031 009	
LOGIC: Op. mode t output 29	031 013	
LOGIC: Op. mode t output 30	031 017	
LOGIC: Op. mode t output 31	031 021	
LOGIC: Op. mode t output 32	031 025	
LOGIC: Op. mode t output 32	031 025	

These settings define the operating modes for the output timer stages.

Fig: 3-284

LOGIC: Time t1 output 1	030 002
LOGIC: Time t1 output 2	030 006
LOGIC: Time t1 output 3	030 010
LOGIC: Time t1 output 4	030 014
LOGIC: Time t1 output 5	030 018
LOGIC: Time t1 output 6	030 022
LOGIC: Time t1 output 7	030 026
LOGIC: Time t1 output 8	030 030
LOGIC: Time t1 output 9	030 034
LOGIC: Time t1 output 10	030 038
LOGIC: Time t1 output 11	030 042
LOGIC: Time t1 output 12	030 046
LOGIC: Time t1 output 13	030 050
LOGIC: Time t1 output 14	030 054
LOGIC: Time t1 output 15	030 058
LOGIC: Time t1 output 16	030 062
LOGIC: Time t1 output 17	030 066
LOGIC: Time t1 output 18	030 070
LOGIC: Time t1 output 19	030 074
LOGIC: Time t1 output 20	030 078
LOGIC: Time t1 output 21	030 082
LOGIC: Time t1 output 22	030 086
LOGIC: Time t1 output 23	030 090
LOGIC: Time t1 output 24	030 094
LOGIC: Time t1 output 25	030 098
LOGIC: Time t1 output 26	031 002
LOGIC: Time t1 output 27	031 006
LOGIC: Time t1 output 28	031 010
LOGIC: Time t1 output 29	031 014
LOGIC: Time t1 output 30	031 018
LOGIC: Time t1 output 31	031 022
LOGIC: Time t1 output 32	031 026

Settings of timer stage t1 for the respective outputs.

LOGIC: Time t2 output 1	030 003	Fig: 3-284
LOGIC: Time t2 output 2	030 007	
LOGIC: Time t2 output 3	030 011	
LOGIC: Time t2 output 4	030 015	
LOGIC: Time t2 output 5	030 019	
LOGIC: Time t2 output 6	030 023	
LOGIC: Time t2 output 7	030 027	
LOGIC: Time t2 output 8	030 031	
LOGIC: Time t2 output 9	030 035	
LOGIC: Time t2 output 10	030 039	
LOGIC: Time t2 output 11	030 043	
LOGIC: Time t2 output 12	030 047	
LOGIC: Time t2 output 13	030 051	
LOGIC: Time t2 output 14	030 055	
LOGIC: Time t2 output 15	030 059	
LOGIC: Time t2 output 16	030 063	
LOGIC: Time t2 output 17	030 067	
LOGIC: Time t2 output 18	030 071	
LOGIC: Time t2 output 19	030 075	
LOGIC: Time t2 output 20	030 079	
LOGIC: Time t2 output 21	030 083	
LOGIC: Time t2 output 22	030 087	
LOGIC: Time t2 output 23	030 091	
LOGIC: Time t2 output 24	030 095	
LOGIC: Time t2 output 25	030 099	
LOGIC: Time t2 output 26	031 003	
LOGIC: Time t2 output 27	031 007	
LOGIC: Time t2 output 28	031 011	
LOGIC: Time t2 output 29	031 015	
LOGIC: Time t2 output 30	031 019	
LOGIC: Time t2 output 31	031 023	
LOGIC: Time t2 output 32	031 027	

Settings for timer stage t2 for the respective outputs.

Note: This setting has no effect in the ‘minimum time’ operating mode.

LOGIC: Sig.assig. outp. 1	044 000	Fig: 3-290
LOGIC: Sig.assig. outp. 2	044 002	
LOGIC: Sig.assig. outp. 3	044 004	
LOGIC: Sig.assig. outp. 4	044 006	
LOGIC: Sig.assig. outp. 5	044 008	
LOGIC: Sig.assig. outp. 6	044 010	
LOGIC: Sig.assig. outp. 7	044 012	
LOGIC: Sig.assig. outp. 8	044 014	
LOGIC: Sig.assig. outp. 9	044 016	
LOGIC: Sig.assig. outp. 10	044 018	
LOGIC: Sig.assig. outp. 11	044 020	
LOGIC: Sig.assig. outp. 12	044 022	
LOGIC: Sig.assig. outp. 13	044 024	
LOGIC: Sig.assig. outp. 14	044 026	
LOGIC: Sig.assig. outp. 15	044 028	
LOGIC: Sig.assig. outp. 16	044 030	
LOGIC: Sig.assig. outp. 17	044 032	
LOGIC: Sig.assig. outp. 18	044 034	
LOGIC: Sig.assig. outp. 19	044 036	
LOGIC: Sig.assig. outp. 20	044 038	
LOGIC: Sig.assig. outp. 21	044 040	
LOGIC: Sig.assig. outp. 22	044 042	
LOGIC: Sig.assig. outp. 23	044 044	
LOGIC: Sig.assig. outp. 24	044 046	
LOGIC: Sig.assig. outp. 25	044 048	
LOGIC: Sig.assig. outp. 26	044 050	
LOGIC: Sig.assig. outp. 27	044 052	
LOGIC: Sig.assig. outp. 28	044 054	
LOGIC: Sig.assig. outp. 29	044 056	
LOGIC: Sig.assig. outp. 30	044 058	
LOGIC: Sig.assig. outp. 31	044 060	
LOGIC: Sig.assig. outp. 32	044 062	

These settings assign the function of a binary input signal to the output of the logic equation.

LOGIC: Sig.assig.outp. 1(t)	044 001	Fig: 3-290
LOGIC: Sig.assig.outp. 2(t)	044 003	
LOGIC: Sig.assig.outp. 3(t)	044 005	
LOGIC: Sig.assig.outp. 4(t)	044 007	
LOGIC: Sig.assig.outp. 5(t)	044 009	
LOGIC: Sig.assig.outp. 6(t)	044 011	
LOGIC: Sig.assig.outp. 7(t)	044 013	
LOGIC: Sig.assig.outp. 8(t)	044 015	
LOGIC: Sig.assig.outp. 9(t)	044 017	
LOGIC: Sig.assig.outp.10(t)	044 019	
LOGIC: Sig.assig.outp.11(t)	044 021	
LOGIC: Sig.assig.outp.12(t)	044 023	
LOGIC: Sig.assig.outp.13(t)	044 025	
LOGIC: Sig.assig.outp.14(t)	044 027	
LOGIC: Sig.assig.outp.15(t)	044 029	
LOGIC: Sig.assig.outp.16(t)	044 031	
LOGIC: Sig.assig.outp.17(t)	044 033	
LOGIC: Sig.assig.outp.18(t)	044 035	
LOGIC: Sig.assig.outp.19(t)	044 037	
LOGIC: Sig.assig.outp.20(t)	044 039	
LOGIC: Sig.assig.outp.21(t)	044 041	
LOGIC: Sig.assig.outp.22(t)	044 043	
LOGIC: Sig.assig.outp.23(t)	044 045	
LOGIC: Sig.assig.outp.24(t)	044 047	
LOGIC: Sig.assig.outp.25(t)	044 049	
LOGIC: Sig.assig.outp.26(t)	044 051	
LOGIC: Sig.assig.outp.27(t)	044 053	
LOGIC: Sig.assig.outp.28(t)	044 055	
LOGIC: Sig.assig.outp.29(t)	044 057	
LOGIC: Sig.assig.outp.30(t)	044 059	
LOGIC: Sig.assig.outp.31(t)	044 061	
LOGIC: Sig.assig.outp.32(t)	044 063	

These settings assign the function of a binary input signal to the output of the logic equation.

Single-pole commands

CMD_1: Design. command C001	200 000	
CMD_1: Design. command C002	200 005	
CMD_1: Design. command C003	200 010	
CMD_1: Design. command C004	200 015	
CMD_1: Design. command C005	200 020	
CMD_1: Design. command C006	200 025	
CMD_1: Design. command C007	200 030	
CMD_1: Design. command C008	200 035	
CMD_1: Design. command C009	200 040	
CMD_1: Design. command C010	200 045	
CMD_1: Design. command C011	200 050	
CMD_1: Design. command C012	200 055	

Selection of the command designation.

CMD_1: Oper. mode cmd. C001	200 002	Fig: 3-301
CMD_1: Oper. mode cmd. C002	200 007	
CMD_1: Oper. mode cmd. C003	200 012	
CMD_1: Oper. mode cmd. C004	200 017	
CMD_1: Oper. mode cmd. C005	200 022	
CMD_1: Oper. mode cmd. C006	200 027	
CMD_1: Oper. mode cmd. C007	200 032	
CMD_1: Oper. mode cmd. C008	200 037	
CMD_1: Oper. mode cmd. C009	200 042	
CMD_1: Oper. mode cmd. C010	200 047	
CMD_1: Oper. mode cmd. C011	200 052	
CMD_1: Oper. mode cmd. C012	200 057	

Selection of the command operating mode.

Single-pole signals

SIG_1: Designat. sig. S001	226 000	
SIG_1: Designat. sig. S002	226 008	
SIG_1: Designat. sig. S003	226 016	
SIG_1: Designat. sig. S004	226 024	
SIG_1: Designat. sig. S005	226 032	
SIG_1: Designat. sig. S006	226 040	
SIG_1: Designat. sig. S007	226 048	
SIG_1: Designat. sig. S008	226 056	
SIG_1: Designat. sig. S009	226 064	
SIG_1: Designat. sig. S010	226 072	
SIG_1: Designat. sig. S011	226 080	
SIG_1: Designat. sig. S012	226 088	
Selection of the signal designation.		
SIG_1: Oper. mode sig. S001	226 001	Fig: 3-302
SIG_1: Oper. mode sig. S002	226 009	
SIG_1: Oper. mode sig. S003	226 017	
SIG_1: Oper. mode sig. S004	226 025	
SIG_1: Oper. mode sig. S005	226 033	
SIG_1: Oper. mode sig. S006	226 041	
SIG_1: Oper. mode sig. S007	226 049	
SIG_1: Oper. mode sig. S008	226 057	
SIG_1: Oper. mode sig. S009	226 065	
SIG_1: Oper. mode sig. S010	226 073	
SIG_1: Oper. mode sig. S011	226 081	
SIG_1: Oper. mode sig. S012	226 089	
Selection of the signal operating mode.		
SIG_1: Gr.asg. debounc.S001	226 003	Fig: 3-302
SIG_1: Gr.asg. debounc.S002	226 011	
SIG_1: Gr.asg. debounc.S003	226 019	
SIG_1: Gr.asg. debounc.S004	226 027	
SIG_1: Gr.asg. debounc.S005	226 035	
SIG_1: Gr.asg. debounc.S006	226 043	
SIG_1: Gr.asg. debounc.S007	226 051	
SIG_1: Gr.asg. debounc.S008	226 059	
SIG_1: Gr.asg. debounc.S009	226 067	
SIG_1: Gr.asg. debounc.S010	226 075	
SIG_1: Gr.asg. debounc.S011	226 083	
SIG_1: Gr.asg. debounc.S012	226 091	
Group assignment for the debouncing time and the chatter suppression.		

SIG_1: Min. sig. dur. S001	226 002	Fig: 3-302
SIG_1: Min. sig. dur. S002	226 010	
SIG_1: Min. sig. dur. S003	226 018	
SIG_1: Min. sig. dur. S004	226 026	
SIG_1: Min. sig. dur. S005	226 034	
SIG_1: Min. sig. dur. S006	226 042	
SIG_1: Min. sig. dur. S007	226 050	
SIG_1: Min. sig. dur. S008	226 058	
SIG_1: Min. sig. dur. S009	226 066	
SIG_1: Min. sig. dur. S010	226 074	
SIG_1: Min. sig. dur. S011	226 082	
SIG_1: Min. sig. dur. S012	226 090	

The logic '1' signal must be available for this minimum time setting so that a telegram can be sent in the "*Start/end signal*" mode.

7.1.3.3 Parameter Subsets

Measured data input

MEASI: BackupTempSensor PSx 004 243 004 244 004 245 004 246 Fig: 3-280

Selection of backup temperature sensor groups for parameter subset PSx.

Main function

MAIN: Neutr.pt. treat. PSx 010 048 001 076 001 077 001 078

The neutral-point treatment of the system must be set here.

MAIN: Hld time dyn.par.PSx 018 009 001 211 001 212 001 213 Fig: 3-61

Setting the hold time of the "dynamic parameters". After switching to the "dynamic" thresholds, the latter will remain active in place of the "normal" thresholds during this period.

MAIN: Bl.tim.st.IN,neg PSx 017 015 001 214 001 215 001 216 Fig: 3-71

This setting defines whether a blocking of the residual current stages should take place for single-pole or multi-pole phase current startings.

MAIN: Gen. start. mode PSx 017 027 001 219 001 220 001 221 Fig: 3-72, 3-118, 3-121, 3-132, 3-134

This setting defines whether the triggering of the residual current stages $I_N>$, $I_{ref,N}>$, $I_N>>$ or $I_N>>>$ as well as the negative-sequence current stage $I_{ref,neg}>$ should result in the formation of the general starting signal. If the setting is '*W/o start. IN, Ineg*' then the associated time delays $t_{IN>}$, $t_{Iref,N>}$, $t_{IN>>}$, $t_{IN>>>}$, $t_{Iref,neg>}$ are automatically excluded from the formation of the trip command.

MAIN: Op. rush restr. PSx 017 097 001 088 001 089 001 090 Fig: 3-62

Setting for the operating mode of the inrush stabilization function.

MAIN: Rush I(2fn)/I(fn)PSx 017 098 001 091 001 092 001 093 Fig: 3-62

Setting for the operate value of inrush stabilization.

MAIN: I>lift rush restrPSx 017 095 001 085 001 086 001 087 Fig: 3-62

Setting for the current threshold for deactivation of inrush stabilization.

MAIN: Suppr.start.sig. PSx 017 054 001 222 001 223 001 224 Fig: 3-71

Setting of the timer stage for the suppression of the phase-selective startings and of the residual and negative-sequence system starting.

MAIN: tGS PSx 017 005 001 225 001 226 001 227 Fig: 3-72

Setting the time delay of the general starting signal.

Definite-time overcurrent protection

DTOC: Enable PSx 072 098 073 098 074 098 075 098 Fig: 3-114

This setting defines the parameter subset in which definite-time overcurrent protection is enabled.

DTOC: I> PSx 017 000 073 007 074 007 075 007 Fig: 3-115

Setting the operate value of the first overcurrent stage (phase current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: I> dynamic PSx 017 080 073 032 074 032 075 032 Fig: 3-115

Setting the operate value of the first overcurrent stage in dynamic mode (phase current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: I>> PSx 017 001 073 008 074 008 075 008 Fig: 3-115

Setting the operate value of the second overcurrent stage (phase current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: I>> dynamic PSx 017 084 073 033 074 033 075 033 Fig: 3-115

Setting for the operate value of the second overcurrent stage in dynamic mode (phase current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: I>>> PSx 017 002 073 009 074 009 075 009 Fig: 3-115

Setting the operate value of the third overcurrent stage (phase current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: I>>> dynamic PSx 017 085 073 034 074 034 075 034 Fig: 3-115

Setting the operate value of the third overcurrent stage in dynamic mode (phase current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: tI> PSx 017 004 073 019 074 019 075 019 Fig: 3-115

Setting the operate delay of the first overcurrent stage.

DTOC: tI>> PSx 017 006 073 020 074 020 075 020 Fig: 3-115

Setting the operate delay of the second overcurrent stage.

DTOC: tI>>> PSx 017 007 073 021 074 021 075 021 Fig: 3-115

Setting the operate delay of the third overcurrent stage.

DTOC: Ineg> PSx 072 011 073 011 074 011 075 011 Fig: 3-117

Setting for the operate value Ineg> (I_{neg} = negative-sequence current).

DTOC: Ineg> dynamic PSx 076 200 077 200 078 200 079 200 Fig: 3-117

Setting the operate value Ineg> dynamic
(Ineg = negative-sequence current).

This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

DTOC: Ineg>> PSx 072 012 073 012 074 012 075 012 Fig: 3-117

Setting for the operate value Ineg>> (I_{neg} = negative-sequence current).

DTOC: Ineg>> dynamic PSx 076 201 077 201 078 201 079 201 Fig: 3-117

Setting the operate value Ineg>> dynamic
(Ineg = negative-sequence current).

This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

DTOC: Ineg>>> PSx 072 013 073 013 074 013 075 013 Fig: 3-117

Setting for the operate value Ineg>>> (Ineg = negative-sequence current).

DTOC: Ineg>>> dynamic PSx 076 202 077 202 078 202 079 202 Fig: 3-117

Setting the operate value Ineg>>> dynamic
(Ineg = negative-sequence current).

This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

DTOC: tIneg> PSx 072 023 073 023 074 023 075 023 Fig: 3-117

Setting for the operate delay of overcurrent stage Ineg> (I_{neg} = negative-sequence current).

DTOC: tIneg>> PSx 072 024 073 024 074 024 075 024 Fig: 3-117

Setting for the operate delay of overcurrent stage Ineg>>
(I_{neg} = negative-sequence current).

DTOC: tIneg>>> PSx 072 025 073 025 074 025 075 025 Fig: 3-117

Setting for the operate delay of overcurrent stage Ineg>>>
(I_{neg} = negative-sequence current).

DTOC: Eval. IN>,>>,>>> PSx 072 128 073 128 074 128 075 128 Fig: 3-119

As of software version -602. (SW -601: see next entry.)
This setting determines which current will be monitored: The current calculated by the P132 or the residual current IN>, IN>>, IN>>> measured at the T 4 current transformer. IN>>>> operates only with the calculated measured variables.

DTOC: IN> PSx 017 003 073 015 074 015 075 015 Fig: 3-120

Setting the operate value of the first overcurrent stage (residual current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: IN> dynamic PSx 017 081 073 035 074 035 075 035 Fig: 3-120

Setting the operate value of the dynamic first overcurrent stage (residual current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: IN>> PSx 017 009 073 016 074 016 075 016 Fig: 3-120

Setting the operate value of the second overcurrent stage (residual current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: IN>> dynamic PSx 017 086 073 036 074 036 075 036 Fig: 3-120

Setting the operate value of the second overcurrent stage in dynamic mode (residual current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: IN>>> PSx 017 018 073 017 074 017 075 017 Fig: 3-120

Setting the operate value of the third overcurrent stage (residual current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: IN>>> dynamic PSx 017 087 073 037 074 037 075 037 Fig: 3-120

Setting the operate value of the dynamic third overcurrent stage (residual current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: IN>>>> PSx 072 018 073 018 074 018 075 018 Fig: 3-120

Setting the operate value of the fourth overcurrent stage (residual current stage).

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: IN>>>> dyn. PSx 072 036 072 105 072 202 072 219 Fig: 3-120

Setting the operate value of the dynamic fourth overcurrent stage (residual current stage). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

Caution! The range of setting values includes operate values that are not permitted as continuous current values (see Chapter 'Technical Data').

DTOC: tIN> PSx 017 008 073 027 074 027 075 027 Fig: 3-120

Setting the operate delay of the first overcurrent stage (residual current stage).

DTOC: tIN>> PSx 017 010 073 028 074 028 075 028 Fig: 3-120

Setting the operate delay of the second overcurrent stage (residual current stage).

DTOC: tIN>>> PSx 017 019 073 029 074 029 075 029 Fig: 3-120

Setting the operate delay of the third overcurrent stage (residual current stage).

DTOC: tIN>>>> PSx 072 030 073 030 074 030 075 030 Fig: 3-120

Setting the operate delay of the fourth overcurrent stage (residual current stage).

DTOC: Puls.prol.IN>,intPSx 017 055 073 042 074 042 075 042 Fig: 3-122

Setting the pulse prolongation time of the hold-time logic for intermittent ground faults.

DTOC: tIN,interm. PSx 017 056 073 038 074 038 075 038 Fig: 3-122

Setting the tripping time of the hold-time logic for intermittent ground faults.

DTOC: Hold-t. tIN>,intmPSx 017 057 073 039 074 039 075 039 Fig: 3-122

Setting the hold-time for intermittent ground faults.

Inverse-time overcurrent protection

IDMT1: Enable PSx 072 070 073 070 074 070 075 070 Fig: 3-125
IDMT2: Enable PSx 076 042 076 043 076 044 076 045

This setting defines the parameter subset in which IDMTx protection is enabled.

IDMT1: Iref,P PSx 072 050 073 050 074 050 075 050 Fig: 3-130a
IDMT2: Iref,P PSx 076 236 076 237 076 238 076 239

Setting for the reference current (phase current system).

IDMT1: Iref,P dynamic PSx 072 003 073 003 074 003 075 003 Fig: 3-130a
IDMT2: Iref,P dynamic PSx 076 030 076 031 076 032 076 033

Setting the reference current in dynamic mode (phase current system). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

IDMT1: Characteristic P PSx 072 056 073 056 074 056 075 056 Fig: 3-130a
IDMT2: Characteristic P PSx 071 004 071 005 071 006 071 007

Setting for the tripping characteristic (phase current system).

IDMT1: Factor kt,P PSx 072 053 073 053 074 053 075 053 Fig: 3-130a
IDMT2: Factor kt,P PSx 078 250 078 251 078 252 078 253

Setting for the factor kt,P of the starting characteristic (phase current system).

IDMT1: Min. trip time P PSx 072 077 073 077 074 077 075 077 Fig: 3-130a
IDMT2: Min. trip time P PSx 071 044 071 045 071 046 071 047

Setting for the minimum trip time (phase current system). As a rule, this value should be set as for the first DTOC stage (I>).

IDMT1: Hold time P PSx 072 071 073 071 074 071 075 071 Fig: 3-130a
IDMT2: Hold time P PSx 071 028 071 029 071 030 071 031

Setting the holding time for intermittent short circuits (phase current system).

IDMT1: Release P PSx 072 059 073 059 074 059 075 059 Fig: 3-130a
IDMT2: Release P PSx 071 016 071 017 071 018 071 019

Setting for the release or reset characteristic (phase current system).

IDMT1: Iref,neg PSx 072 051 073 051 074 051 075 051 Fig: 3-130a
IDMT2: Iref,neg PSx 076 250 076 251 076 252 076 253

Setting for the reference current (negative-sequence current system).

IDMT1: Iref,neg dynamic PSx 072 004 073 004 074 004 075 004 Fig: 3-132
IDMT2: Iref,neg dynamic PSx 076 034 076 035 076 036 076 037

Setting the reference current in dynamic mode (negative-sequence current system). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

IDMT1: Character. neg. PSx 072 057 073 057 074 057 075 057 Fig: 3-132
IDMT2: Character. neg. PSx 071 008 071 009 071 010 071 011

Setting for the tripping characteristic (negative-sequence current system).

IDMT1: Factor kt,neg PSx 072 054 073 054 074 054 075 054 Fig: 3-132
IDMT2: Factor kt,neg PSx 079 250 079 251 079 252 079 253

Setting for the factor kt,neg of the starting characteristic (negative-sequence current system).

IDMT1: Min.trip time negPSx 072 078 073 078 074 078 075 078 Fig: 3-132
IDMT2: Min.trip time negPSx 071 048 071 049 071 050 071 051

Setting the minimum trip time (negative-sequence current system). As a rule, this value should be set as for the first DTOC stage (I>).

IDMT1: Hold time neg PSx 072 072 073 072 074 072 075 072 Fig: 3-132
IDMT2: Hold time neg PSx 071 032 071 033 071 034 071 035

Setting the holding time for intermittent short circuits (negative-sequence current system).

IDMT1: Release neg. PSx 072 060 073 060 074 060 075 060 Fig: 3-132
IDMT2: Release neg. PSx 071 020 071 021 071 022 071 023

Setting for the release or reset characteristic (negative-sequence current system).

IDMT1: Evaluation IN PSx 072 075 073 075 074 075 075 075 Fig: 3-133
IDMT2: Evaluation IN PSx 071 040 071 041 071 042 071 043

This setting determines which current will be monitored: The current calculated by the P132 or the residual current measured at the T 4 current transformer.

IDMT1: Iref,N PSx 072 052 073 052 074 052 075 052 Fig: 3-134
IDMT2: Iref,N PSx 077 250 077 251 077 252 077 253

Setting for the reference current (residual current system).

IDMT1: Iref,N dynamic PSx 072 005 073 005 074 005 075 005 Fig: 3-134
IDMT2: Iref,N dynamic PSx 076 038 076 039 076 040 076 041

Setting the reference current in dynamic mode (residual current system). This operate value is effective only while the timer stage MAIN: Hold-time dyn. param. is elapsing.

IDMT1: Characteristic N PSx 072 058 073 058 074 058 075 058 Fig: 3-134
IDMT2: Characteristic N PSx 071 012 071 013 071 014 071 015

Setting for the tripping characteristic (residual current system).

IDMT1: Factor kt,N PSx 072 055 073 055 074 055 075 055 Fig: 3-134
IDMT2: Factor kt,N PSx 071 000 071 001 071 002 071 003

Setting for the factor kt,N of the starting characteristic (residual current system).

IDMT1: Min. trip time N PSx 072 079 073 079 074 079 075 079 Fig: 3-134
IDMT2: Min. trip time N PSx 071 052 071 053 071 054 071 055

Setting the minimum trip time (residual current system). As a rule, this value should be set as for the first DTOC stage (IN>).

IDMT1: Hold time N PSx 072 073 073 073 074 073 075 073 Fig: 3-134
IDMT2: Hold time N PSx 071 036 071 037 071 038 071 039

Setting the holding time for intermittent short circuits (residual current system).

IDMT1: Release N PSx 072 061 073 061 074 061 075 061 Fig: 3-134
IDMT2: Release N PSx 071 024 071 025 071 026 071 027

Setting for the release characteristic (residual current system).

Short-circuit direction determination

SCDD: Enable PSx 076 235 077 235 078 235 079 235 Fig: 3-137

This setting defines the parameter subset in which short-circuit direction determination is enabled.

SCDD: Trip bias PSx 017 074 077 236 078 236 079 236 Fig: 3-141

This setting determines whether an overcurrent direction determination in forward direction shall be formed when the direction determination of the phase current and residual current stage is blocked.

SCDD: Direction tI> PSx 017 071 077 237 078 237 079 237 Fig: 3-141

This setting for the measuring direction determines whether a tI> trip signal in the DTOC phase current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.

SCDD: Direction tI>> PSx 017 072 077 238 078 238 079 238 Fig: 3-141

This setting for the measuring direction determines whether a tI>> trip signal in the DTOC phase current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.

SCDD: Direct. tIref,P> PSx 017 066 077 239 078 239 079 239 Fig: 3-141

This setting for the measuring direction determines whether a tIref,P> trip signal in the IDMT1 phase current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.

SCDD: Direction tIN> PSx 017 073 077 240 078 240 079 240 Fig: 3-145

This setting for the measuring direction determines whether a tIN> trip signal in the DTOC residual current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.

SCDD: Direction tIN>> PSx 017 075 077 241 078 241 079 241 Fig: 3-145

This setting for the measuring direction determines whether a tIN>> trip signal in the DTOC residual current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.

SCDD: Direct. tIref,N> PSx 017 067 077 242 078 242 079 242 Fig: 3-145

This setting for the measuring direction determines whether a tIref,N> trip signal in the IDMT1 residual current stage will be issued for forward, backward or non-directional fault decisions. If the ARC is enabled and has been set accordingly then a starting will trigger the associated ARC tripping time.

SCDD: Charact. angle G PSx 017 076 077 243 078 243 079 243 Fig: 3-144

Setting the characteristic angle for the residual current stage in correspondence to the measuring relation. Using this setting, a wide range of conditions in dependence of the system neutral grounding impedance can be accommodated, including the following examples:

☐ System neutral with relatively high resistance $\alpha_G = 0°$
☐ System neutral with relatively low resistance α_G - 45°
☐ System neutral effectively grounded α_G= - 75°
☐ System neutral reactance-grounded α_G= - 90°
☐ System with isolated neutral α_G= + 90°

SCDD: VNG> PSx 017 077 077 244 078 244 079 244 Fig: 3-143a

Setting the operate value VNG>. This setting value is an enabling criterion of the base point release of short-circuit direction determination.
In choosing this setting, the set nominal voltage `MAIN: VNG,nom V.T. sec.` should be taken into account.

SCDD: Evaluation VNG PSx 071 056 071 057 071 058 071 059 Fig: 3-143b

User may select between "measured" and "calculated" (standard default).

SCDD: Block. bias G PSx 017 078 077 245 078 245 079 245 Fig: 3-145

This setting defines whether the trip bias of the residual current stage should be blocked in the event of a phase current starting.

SCDD: Oper.val.Vmemory PSx 010 109 010 116 010 117 010 118

In the event of a three-phase fault in the phase current stage, the measured voltage VABmeas is compared with the selected operate value, Vop.Val., of the voltage memory. If VABmeas < Vop.Val. then the SCDD function will not use VABmeas but will revert to the voltage memory, if it has been enabled.

Protective signaling

PSIG: Enable PSx 015 014 015 015 015 016 015 017 Fig: 3-148

This setting defines the parameter subset in which protective signaling is enabled.

PSIG: Tripping time PSx 015 011 024 003 024 063 025 023 Fig: 3-150

Setting the time delay of protective signaling.

PSIG: Release t. send PSx 015 002 024 001 024 061 025 021 Fig: 3-150

This setting determines the duration of the send signal.

PSIG: DC loop op. mode PSx 015 012 024 051 025 011 025 071 Fig: 3-150

This setting defines whether the transmitting relay will be operated in energize-on-signal (ES) mode ('open-circuit principle') or normally-energized (NE) mode ('closed-circuit principle'), i.e., *Transm. rel. make con.* or *Transm. rel. break con.,* respectively.

PSIG: Direc.dependence PSx 015 001 015 115 015 116 015 117 Fig: 3-150

This setting governs the evaluation for the directional dependence of protective signaling. The following settings are possible:

Without
Phase curr. system
Residual curr. system
Phase/resid.c.system

Auto-reclosing control

ARC: Enable PSx 015 046 015 047 015 048 015 049 Fig: 3-154

This setting defines the parameter subset in which ARC is enabled.

ARC: CB clos.pos.sig. PSx 015 050 024 024 024 084 025 044 Fig: 3-156

This setting defines whether the CB closed position will be scanned or not. If the setting is '*With*', a binary signal input must be configured accordingly.

ARC: Operating mode PSx 015 051 024 025 024 085 025 045 Fig: 3-153, 3-163

The operating mode setting defines which of the following reclosure types is permitted.
☐ TDR only permitted
☐ HSR/TDR permitted
☐ Test HSR only permit

ARC: Operative time PSx 015 066 024 035 024 095 025 055 Fig: 3-165, 3-167

Setting for the operative time 1.

ARC: HSR trip.time GS PSx 015 038 024 100 024 150 025 100 Fig: 3-161

Setting the HSR tripping time and start via a general starting condition.

ARC: HSR trip.time I> PSx 015 072 024 040 025 000 025 060 Fig: 3-157, 3-167

Setting the HSR tripping time and start via a phase current starting in the first DTOC overcurrent stage.

ARC: HSR trip.time I>>PSx 015 074 024 101 024 151 025 101 Fig: 3-157

Setting the HSR tripping time and start via a phase current starting in the second DTOC overcurrent stage.

ARC: HSRtrip.time I>>>PSx 014 096 024 102 024 152 025 102 Fig: 3-157

Setting the HSR tripping time and start via a phase current starting in the third DTOC overcurrent stage.

ARC: HSR trip.time IN>PSx 015 076 024 103 024 153 025 103 Fig: 3-157

Setting the HSR tripping time and start via a residual current starting in the first DTOC overcurrent stage.

ARC: HSRtrip.time IN>>PSx 015 031 024 104 024 154 025 104 Fig: 3-157

Setting the HSR tripping time and start via a residual current starting in the second DTOC overcurrent stage.

ARC: HSRtrip.t. IN>>> PSx 014 098 024 105 024 155 025 105 Fig: 3-157

Setting the HSR tripping time and start via a residual current starting in the third DTOC overcurrent stage.

ARC: HSRtrip.t.Iref,P PSx 015 094 024 106 024 156 025 106 Fig: 3-159

Setting the HSR tripping time and start via a starting in the IDMT1 phase current system.

ARC: HSRtrip.t.Iref,N PSx 015 096 024 107 024 157 025 107 Fig: 3-159

Setting the HSR tripping time and start via a starting in the IDMT1 residual current system.

ARC: HSRtr.t.Iref,neg PSx 015 034 024 108 024 158 025 108 Fig: 3-159

Setting the HSR tripping time and start via a starting in the IDMT1 negative-sequence current system.

ARC: HSR trip t.GFDSS PSx 015 078 024 109 024 159 025 109 Fig: 3-160

Setting the HSR tripping time and start via ‘ground fault direction determination using steady-state values’.

ARC: HSRtrip.t. LOGIC PSx 015 098 024 110 024 160 025 110 Fig: 3-162

Setting the HSR tripping time and start via programmable logic.

ARC: HSR block.f. I>>>PSx 015 080 024 111 024 161 025 111 Fig: 3-163

The selection of the HSR blocking by I>>> defines whether an HSR is blocked during an I>>> starting.

ARC: HSR dead time PSx 015 056 024 030 024 090 025 050 Fig: 3-165, 3-167

Dead time setting for a three-pole HSR.

ARC: No. permit. TDR PSx 015 068 024 037 024 097 025 057 Fig: 3-165

Setting for the number of time-delayed reclosures permitted. With the ‘*0*’ setting, only one HSR is carried out.

ARC: TDR trip.time GS PSx 015 039 024 112 024 162 025 112 Fig: 3-161

Setting the TDR tripping time and start via a general starting condition.

ARC: TDR trip.time I> PSx 015 073 024 041 025 001 025 061 Fig: 3-158

Setting the TDR tripping time and start via a phase current starting in the first DTOC overcurrent stage.

ARC: TDR trip.time I>>PSx 015 075 024 113 024 163 025 113 Fig: 3-158

Setting the TDR tripping time and start via a phase current starting in the second DTOC overcurrent stage.

ARC: TDRtrip.time I>>>PSx 014 097 024 114 024 164 025 114 Fig: 3-158

Setting the TDR tripping time and start via a phase current starting in the third DTOC overcurrent stage.

ARC: TDR trip.time IN>PSx 015 077 024 115 024 165 025 115 Fig: 3-158

Setting the TDR tripping time and start via a residual current starting in the first DTOC overcurrent stage.

ARC: TDRtrip.time IN>>PSx 015 032 024 116 024 166 025 116 Fig: 3-158

Setting the TDR tripping time and start via a residual current starting in the second DTOC overcurrent stage.

ARC: TDRtrip.t. IN>>> PSx 014 099 024 117 024 167 025 117 Fig: 3-158

Setting the TDR tripping time and start via a residual current starting in the third DTOC overcurrent stage.

ARC: TDRtrip.t.Iref,P PSx 015 095 024 118 024 168 025 118 Fig: 3-159

Setting the TDR tripping time and start via a starting in the IDMT1 phase current system.

ARC: TDRtrip.t.Iref,N PSx 015 097 024 119 024 169 025 119 Fig: 3-159

Setting the TDR tripping time and start via a starting in the IDMT1 residual current system.

ARC: TDRtr.t.Iref,neg PSx 015 035 024 120 024 170 025 120 Fig: 3-159

Setting the TDR tripping time and start via a starting in the IDMT1 negative-sequence current system.

ARC: TDR trip t.GFDSS PSx 015 079 024 121 024 171 025 121 Fig: 3-160

Setting the TDR tripping time and start via ‘ground fault direction determination using steady-state values’.

ARC: TDRtrip.t. LOGIC PSx 015 099 024 122 024 172 025 122 Fig: 3-162

Setting the TDR tripping time and start via programmable logic.

ARC: TDR dead time PSx 015 057 024 031 024 091 025 051 Fig: 3-165

Setting for the TDR dead time.

ARC: TDR block.f. I>>>PSx 015 081 024 124 024 174 025 124 Fig: 3-163

The selection of the TDR blocking by I>>> defines whether a TDR is blocked during an I>>> starting.

ARC: Reclaim time PSx 015 054 024 028 024 088 025 048 Fig: 3-165, 3-167

Setting for the reclaim time.

ARC: Blocking time PSx 015 058 024 032 024 092 025 052 Fig: 3-155

Setting for the time that will elapse before the ARC will be ready again after blocking by a binary signal input.

Automatic synchronism check

ASC: Enable PSx 018 020 018 021 018 022 018 023 Fig: 3-172

This setting defines the parameter subset in which automatic synchronism check (ASC) is enabled.

ASC: CB assignment PSx 037 131 037 132 037 133 037 134 Fig: 3-180

This setting defines the function group DEVxx that will control the circuit breaker.

ASC: System integrat. PSx 037 135 037 136 037 137 037 138 Fig: 3-180

This setting defines whether ASC will operate in 'Autom. synchron. check' or 'Autom. synchr. control' mode.

ASC: Active for HSR PSx 018 001 077 030 078 030 079 030 Fig: 3-173

This setting defines whether reclosing after a three-pole HSR will occur only after being enabled by ASC.

ASC: Active for TDR PSx 018 002 077 031 078 031 079 031 Fig: 3-173

This setting defines whether reclosing after a three-pole TDR will occur only after being enabled by ASC.

ASC: Clos.rej.w.block PSx 018 003 077 032 078 032 079 032 Fig: 3-173

This setting defines whether reclosing is rejected after being blocked by ASC.

ASC: Operative time PSx 018 010 077 034 078 034 079 034 Fig: 3-167, 3-178

Setting for the operative time for ASC.

ASC: Operating mode PSx 018 025 018 026 018 027 018 028 Fig: 3-177

Criteria for a close enable are defined by setting for the operating mode.

ASC: Op.mode volt.chk.PSx 018 029 018 030 018 031 018 032 Fig: 3-176

This setting defines the logic linking of trigger decisions for a voltage controlled close enable.

ASC: V> volt.check PSx 026 017 077 043 078 043 079 043 Fig: 3-176

Setting the voltage threshold that the phase-to-ground voltages and the reference voltage must exceed so that they are recognized as "Voltage showing".

Note: The logic linking of trigger decisions is defined by setting ASC: Op.mode volt.chk. PSx.

ASC: V< volt. check PSx 018 017 077 040 078 040 079 040 Fig: 3-176

Setting the voltage threshold that the phase-to-ground voltages and the reference voltage must fall below so that they are recognized as "Voltage showing".

Note: The logic linking of trigger decisions is defined by setting ASC: Op.mode volt.chk. PSx.

ASC: tmin volt. check PSx 018 018 077 041 078 041 079 041 Fig: 3-176

Setting for the operate delay value to define the minimum time period during which voltage conditions must be met so that the close enable of the ASC is effected.

ASC: Measurement loop PSx 031 060 077 044 078 044 079 044 Fig: 3-171

The voltage measurement loop, corresponding to the reference voltage, must be selected so that determination of differential values is correct.

Example: Connect transformer T 15 to measure the reference voltage to phases A & B The measurement loop should be set to 'Loop A-B'.

ASC: V> sync. check PSx 018 011 077 035 078 035 079 035 Fig: 3-177

Setting for the threshold of the minimum voltage to obtain a synchronism checked close enable.

ASC: Delta Vmax PSx 018 012 077 036 078 036 079 036 Fig: 3-177

Setting the maximum differential voltage between measured and reference voltages to obtain a synchronism checked close enable.

ASC: Delta f max PSx 018 014 077 038 078 038 079 038 Fig: 3-177

Setting the maximum differential frequency between measured and reference voltages to obtain a synchronism checked close enable.

ASC: Delta phi max PSx 018 013 077 037 078 037 079 037 Fig: 3-177

Setting the maximum differential angle between measured and reference voltages to obtain a synchronism checked close enable.

ASC: Phi offset PSx 018 034 077 042 078 042 079 042 Fig: 3-177

Setting a Phi offset that may be necessary so that determination of the differential angle is correct.

ASC: tmin sync. check PSx 018 015 077 039 078 039 079 039 Fig: 3-177

Setting for the operate delay value to define the minimum time period during which synchronism conditions must be met so that the close enable of the ASC is effected.

Ground fault direction determination using steady-state values

GFDSS: Enable PSx 001 050 001 051 001 052 001 053 Fig: 3-183

This setting defines the parameter subset in which the GFDSS function is enabled.

GFDSS: Op.m.GF pow./adm PSx 016 063 000 236 000 237 000 238 Fig: 3-185, 3-191

Setting the operating mode of the ground fault direction determination by steady-state values. The following settings are possible: The following settings are possible:

☐ "*Cos* φ *circuit*" for resonant-grounded systems.

☐ "*Sin* φ *circuit*" for isolated neutral-point systems.

GFDSS: Evaluation VNG PSx 016 083 001 011 001 012 001 013 Fig: 3-184

This setting specifies which neutral-point displacement voltage will be used for direction determination: The displacement voltage calculated from the phase-to-ground voltages or the displacement voltage measured at the T 90 transformer of the P132.

GFDSS: Meas. direction PSx 016 070 001 002 001 003 001 004 Fig: 3-185, 3-191

This setting defines the measuring direction for the 'forward' or 'backward' decision.

GFDSS: VNG> PSx 016 062 000 233 000 234 000 235 Fig: 3-185, 3-191

Setting for the operate value of the neutral-point displacement voltage.

GFDSS: tVNG> PSx 016 061 000 230 000 231 000 232 Fig: 3-185, 3-191

Setting the operate delay of the VNG> trigger.

GFDSS: f/fnom (P meas.) PSx 016 091 001 044 001 045 001 046 Fig: 3-185, 3-191

Setting the frequency of the measured variables evaluated in steady-state power evaluation.

GFDSS: f/fnom (I meas.) PSx 016 092 001 047 001 048 001 049 Fig: 3-189

Setting the frequency of the measured variables evaluated in steady-state current evaluation.

GFDSS: IN,act>/reac> LS PSx 016 064 000 239 000 240 000 241 Fig: 3-188

Setting the threshold of the active or reactive power component of residual current that must be exceeded so that the ‘LS’ (line side) directional decision is enabled.

GFDSS: Sector angle LS PSx 016 065 000 242 000 243 000 244 Fig: 3-188

Setting of the sector angle for measurement in the line side direction.

Note: This setting is only effective in the "*cos* φ *circuit*" operating mode.

GFDSS: Operate delay LS PSx 016 066 000 245 000 246 000 247 Fig: 3-188, 3-194

Setting the operate delay of the direction decision in the forward direction.

GFDSS: Release delay LS PSx 016 072 001 005 001 006 001 007 Fig: 3-188, 3-194

Setting the release delay of the direction decision in the forward direction.

GFDSS: IN,act>/reac> BS PSx 016 067 000 251 000 252 000 253 Fig: 3-188

Setting the threshold of the active or reactive power component of residual current that must be exceeded so that the 'BS' (busbar side) directional decision is enabled.

GFDSS: Sector angle BS PSx 016 068 000 248 000 249 000 250 Fig: 3-188

Setting the sector angle for measurement in the direction of the busbar side.

Note: This setting is only effective in the "*cos* φ *circuit*" operating mode.

GFDSS: Operate delay BS PSx 016 069 000 254 000 255 001 001 Fig: 3-188, 3-194

Setting the operate delay of the direction decision in the backward direction.

GFDSS: Release delay BS PSx 016 073 001 008 001 009 001 010 Fig: 3-188, 3-194

Setting the release delay of the direction decision in the backward direction.

GFDSS: IN> PSx 016 093 001 017 001 018 001 019 Fig: 3-189

Setting the operate value of the steady-state current evaluation.

GFDSS: Operate delay IN PSx 016 094 001 020 001 021 001 022 Fig: 3-189

Setting the operate delay of steady-state current evaluation.

GFDSS: Release delay IN PSx 016 095 001 023 001 024 001 025 Fig: 3-189

Setting the release delay of steady-state current evaluation.

GFDSS: G(N)> / B(N)> LS PSx 016 111 001 029 001 030 001 031 Fig: 3-194

Setting the threshold of the active or reactive susceptance component of residual current that must be exceeded so that the ‘LS’ (line side) directional decision is enabled.

GFDSS: G(N)> / B(N)> BS PSx 016 112 001 032 001 033 001 034 Fig: 3-194

Setting the threshold of the active or reactive susceptance component of residual current that must be exceeded so that the ‘BS’ (busbar side) directional decision is enabled.

GFDSS: Y(N)> PSx 016 113 001 035 001 036 001 037 Fig: 3-195

Setting the operate value of the admittance for the non-directional ground fault determination (in the operating mode *"admittance evaluation"*).

GFDSS: Correction angle PSx 016 110 001 026 001 027 001 028 Fig: 3-191

This setting is provided to compensate for phase-angle errors of the system transformers (in the operating mode *"admittance evaluation"*).

GFDSS: Oper.delay Y(N)> PSx 016 114 001 038 001 039 001 040 Fig: 3-195

Setting the operate delay value of the admittance for the non-directional ground fault determination (in the operating mode *"admittance evaluation"*).

GFDSS: Rel. delay Y(N)> PSx 016 115 001 041 001 042 001 043 Fig: 3-195

Setting the release delay value of the admittance for the non-directional ground fault determination (in the operating mode *"admittance evaluation"*).

TGFD: Enable PSx 001 054 001 055 001 056 001 057 Fig: 3-197

This setting defines the parameter subset in which the TGFD function is enabled.

TGFD: Evaluation VNG PSx 016 048 001 058 001 059 001 060 Fig: 3-198

This setting specifies which neutral-point displacement voltage will be used for evaluation: The displacement voltage from the open delta winding of a voltage transformer assembly or the displacement voltage calculated from the three phase-to-ground voltages.

TGFD: Measurem. direc. PSx 016 045 001 073 001 074 001 075 Fig: 3-199

The direction measurement of the transient ground fault direction determination function depends on the connection of the measuring circuits. If the connection is as shown in Chapter 5, then the setting must be *'Standard',* if the P132's *'Forward'* decision is to be in the direction of the outgoing feeder. If the connection direction is reversed or – given a connection scheme according to Chapter 5 – if the 'forward' decision is to be in the busbar direction, then the setting must be *'Opposite'.*

Note: The global setting MAIN: Conn. meas. circ. IN does not affect the direction determination feature of the transient ground fault direction determination function.

TGFD: VNG> PSx 016 041 001 061 001 062 001 063 Fig: 3-199

Setting the neutral-point displacement voltage threshold.

TGFD: Operate delay PSx 016 044 001 067 001 068 001 069 Fig: 3-199

Setting for the operate delay.

TGFD: IN,p> PSx 016 042 001 064 001 065 001 066 Fig: 3-199

Setting the residual current threshold. A peak value is evaluated.

TGFD: Buffer time PSx 016 043 001 070 001 071 001 072 Fig: 3-200

Setting the signal buffer time for transient ground fault direction determination.

Motor protection

MP: Enable PSx 024 148 024 147 024 197 025 147 Fig: 3-204

This setting defines the parameter subset in which motor protection is enabled.

MP: Iref PSx 017 012 024 131 024 181 025 131 Fig: 3-205

For the determination of the reference current, the nominal motor current needs to be calculated first from the motor data.

$$I_{nom,motor} = \frac{P_{nom}}{\sqrt{3} \cdot V_{nom} \cdot \eta \cdot \cos\varphi}$$

The reference current is the nominal motor current as projected onto the transformer secondary side and is thus calculated as follows:

$$\frac{I_{ref}}{I_{nom,(relay)}} = \frac{I_{nom,motor} / T_{nom}}{I_{nom,(relay)}}$$

Example:

<u>Motor and System Data</u>:

Nominal motor voltage V_{nom}:	10 kV
Nominal motor power P_{nom}:	1500 kW
Efficiency η:	96.6 %
Active power factor cos φ:	0.86
Nominal transformation ratio T_{nom} of the main current transformer:	100 A

Determination of the Nominal Motor Current

$$I_{nom,motor} = \frac{1500\ kW}{\sqrt{3} \cdot 10\ kV \cdot 0.966 \cdot 0.86}$$
$$= 104\ A$$

Determination of the reference current:

$$\frac{I_{ref}}{I_{nom,(relay)}} = \frac{104\ A/100}{1\ A} = 1.04$$

MP: Factor kP PSx 017 040 024 132 024 182 025 132 Fig: 3-205

The starting factor k should be set according to the maximum permissible thermal continuous current:

$$k = \frac{I_{therm,motor}}{I_{nom,motor}}$$

Example:

<u>Motor Data</u>:

Maximum permissible continuous thermal motor current $I_{therm,motor}$:
1.1 $I_{nom,motor}$
<u>Determination of the Starting Factor</u>:

$$k = \frac{1.1\,I_{nom,motor}}{I_{nom,motor}} = 1.1$$

MP: IStUp> PSx 017 053 024 133 024 183 025 133 Fig: 3-210

Setting the current threshold for the operational status determination 'machine starting up'.

MP: tIStUp> PSx 017 042 024 134 024 184 025 134 Fig: 3-210

Setting the operate delay for the operational status determination 'machine starting up'. Usually, the default setting can be retained.

MP: Character.type P PSx 017 029 024 135 024 185 025 135 Fig: 3-210

The selection of the tripping characteristic defines the restrictiveness of the motor protection function. For low overcurrents, the logarithmic characteristic provides significantly higher tripping times than the reciprocally squared characteristic, since the latter neglects any heat transfer to the cooling medium in the overload range.

MP: t6Iref PSx 017 041 024 136 024 186 025 136 Fig: 3-210

This Setting the overload tripping time t_{6Iref} is determined from the cold machine data, using $I_{ref} = I_{nom,motor}$.

$$I_{ref} = I_{nom,motor}$$

For the reciprocally squared characteristic we set:

$$t_{6I_{ref}} = t_{block,cold} \cdot \frac{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2}{36}$$

For the logarithmic characteristic we set:

$$t_{6I_{ref}} = t_{block,cold} \cdot \frac{1}{36 \cdot \ln \frac{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2}{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2 - 1}}$$

Based on the setting value thus determined, the tripping time for a warm machine is now defined as follows.

For the reciprocally squared characteristic we set:

$$t = (1 - 0.2) \cdot t_{6I_{ref}} \cdot \frac{36}{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2}$$

For the logarithmic characteristic we set:

$$t = (1 - 0.2) \cdot t_{6I_{ref}} \cdot 36 \cdot \ln \frac{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2}{\left(\frac{I_{startup}}{I_{nom,motor}}\right)^2 - 1}$$

Example:

Motor Data:

Motor startup current $I_{startup}$:

5.7 $I_{nom,motor}$ at V_{nom}

Max. permissible locked-rotor time with cold machine $t_{block,cold}$:

18 s at V_{nom}

Max. permissible locked-rotor time with warm machine $t_{block,warm}$:

16 s at V_{nom}

MP: Tau after st.-up PSx	018 042	024 137	024 187	025 137	Fig: 3-210

Setting the heat dispersion time constant after startup. Usually, the default setting can be retained.

MP: Tau mach.running PSx	017 088	024 138	024 188	025 138	Fig: 3-210
MP: Tau mach.stopped PSx	017 089	024 139	024 189	025 139	Fig: 3-210

Setting the cooling time constant with a running or stopped machine, respectively.

If the thermal time constants of the motor are unknown, the cooling time constant with machine running is best set to the highest setting value and the cooling time with machine stopped to the five-fold value of that with machine running.

MP: Perm. No.st.-ups PSx	017 047	024 140	024 190	025 140	Fig: 3-210

Setting the startup sequence of the motor as permitted by thermal considerations.

Note:
The heavy starting logic (addresses 017 043 and 017 044) can only be activated if the permissible startup sequence is set to two startups from cold and one startup from warm.

MP: RC permitted, Θ< PSx	018 043	024 141	024 191	025 141	Fig: 3-210

Setting the threshold value of the overload memory for reclosure permission. Usually, the default setting can be retained.

MP: Operating mode PSx	018 041	024 142	024 192	025 142	Fig: 3-205

This setting defines whether motor protection will be operated together with thermal overload protection (THERM).

MP: St.-up time tStUpPSx	017 043	024 143	024 193	025 143	Fig: 3-210
MP: Blocking time tE PSx	017 044	024 144	024 194	025 144	Fig: 3-210

Using an overspeed monitor, the heavy starting logic can be activated if necessary. For this purpose, the load-torque-dependent operational startup time needs to be set for tStUp and the maximum permissible locked-rotor time (the ‘tE time’) with a machine at operating temperature needs to be set for tE.

If the heavy starting logic is not used then the set startup time tStUp and the tE-time should be set to the same value; the default values can be retained.

Note:
The heavy starting logic (address 017 047) can only be activated if the permissible startup sequence is set to two startups from cold and one startup from warm.

MP: I< PSx	017 048	024 145	024 195	025 145	Fig: 3-213

Setting the operate value of the minimum current stage of the underload protection function of motor protection.

MP: tI< PSx	017 050	024 146	024 196	025 146	Fig: 3-213

Setting the operate delay of the minimum current stage of the underload protection function of motor protection.

Thermal overload protection

THERM: Enable PSx 072 175 073 175 074 175 075 175 Fig: 3-214

This setting defines the parameter subset in which thermal overload protection is enabled.

THERM: Sel. backup th. PSx 072 080 073 080 074 080 075 080

Selecting the backup temperature sensor for the parameter subset PSx.

THERM: Iref PSx 072 179 073 179 074 179 075 179 Fig: 3-218

Setting the reference current.

THERM: Start.fact.OL_RC PSx 072 180 073 180 074 180 075 180 Fig: 3-218

Setting for the starting characteristic factor kP.

THERM: Tim.const.1,>Ibl PSx 072 187 073 187 074 187 075 187 Fig: 3-218

Setting for the thermal time constants of the protected object with current flow (Ibl: base line current).

THERM: Tim.const.2,<Ibl PSx 072 188 073 188 074 188 075 188 Fig: 3-218

Setting for the thermal time constants of the protected object without current flow (Ibl: base line current).

Note:
This setting option is only relevant when machines are running. In all other cases, time constant 2 must be set equal to time constant 1.

THERM: Max.perm.obj.tmp.PSx 072 182 073 182 074 182 075 182 Fig: 3-218

Setting the maximum permissible temperature of the protected object.

THERM: Max.perm.cool.tmpPSx 072 185 073 185 074 185 075 185 Fig: 3-218

Setting the maximum permissible coolant temperature.

THERM: Select meas.inputPSx 072 177 073 177 074 177 075 177 Fig: 3-216, 3-217

Selecting if and how the coolant temperature is measured: Via the PT100, the 20mA input or Tx (x = 1 to 9).

THERM: Default CTA PSx 072 186 073 186 074 186 075 186 Fig: 3-218

Setting the coolant temperature to be used for calculation of the trip time if coolant temperature is not measured.

THERM: Bl. f. CTA fault PSx 072 178 073 178 074 178 075 178 Fig: 3-216, 3-217

This setting specifies whether the thermal overload protection function will be blocked in the event of faulty coolant temperature acquisition.

THERM: Rel. O/T warning PSx 072 184 073 184 074 184 075 184 Fig: 3-218

Setting for the operate value of the warning stage.

THERM: Rel. O/T trip PSx 072 181 073 181 074 181 075 181 Fig: 3-218

Setting for the operate value of the trip stage.

Note:

If the operating mode has been set to '*Absolute replica*', the value here will be automatically set to 100% and this parameter is hidden as far as the local control panel is concerned.

THERM: Hysteresis trip PSx 072 183 073 183 074 183 075 183 Fig: 3-218

Setting for the hysteresis of the trip stage.

THERM: Warning pre-trip PSx 072 191 073 191 074 191 075 191 Fig: 3-218

A warning will be given in advance of the trip. The time difference between the warning time and the trip time is set here.

Unbalance protection

I2>: Enable PSx 018 220 018 221 018 222 018 223 — Fig: 3-220

This setting defines the parameter subset in which unbalance protection is enabled.

I2>: Ineg> PSx 018 091 018 224 018 225 018 226 — Fig: 3-221

Setting the operate value of the first overcurrent stage.

I2>: Ineg>> PSx 018 092 018 227 018 228 018 229 — Fig: 3-221

Setting the operate value of the second overcurrent stage.

I2>: tIneg> PSx 018 093 018 230 018 231 018 232 — Fig: 3-221

Setting the operate delay of the first overcurrent stage.

I2>: tIneg>> PSx 018 094 018 233 018 234 018 235 — Fig: 3-221

Setting the operate delay of the second overcurrent stage.

Time-voltage protection

V<>: Enable PSx 076 246 077 246 078 246 079 246 — Fig: 3-222

This setting defines the parameter subset in which time-voltage protection is enabled.

V<>: Operating mode PSx 076 001 077 001 078 001 079 001 — Fig: 3-223

This setting specifies whether the phase-to-ground voltages (operating mode *"Star"*) or the phase-to-phase voltages (operating mode *"Delta"*) will be monitored.

Note:

In the settings for the operate values of the time-voltage protection function, the reference quantity is V_{nom} in the *Delta* operating mode, but $V_{nom}/\sqrt{3}$ in the *Star* operating mode.

To work out the settings for the over/undervoltage stages, consider the following example for $V_{nom} = 100$ V:

Setting in the *Delta* operating mode for an operate value of 80 V (phase-to-phase):

$$\textit{Setting value} = \frac{\textit{operate value}}{V_{nom}} = \frac{80\,V}{100\,V} = 0.80$$

Setting in the *Star* operating mode for an operate value of 46.2 V (phase-to-phase):

$$\textit{Setting value} = \frac{\textit{operate value}}{V_{nom}/\sqrt{3}} = \frac{46.2\,V}{100\,V/\sqrt{3}} = \frac{46.2\,V \cdot \sqrt{3}}{100V} = 0.80$$

V<>: I enable V< PSx 001 155 001 159 001 160 001 161 — Page: 3-327

This setting defines the threshold value of the minimum current monitoring for undervoltage stage V<.

V<>: Op. mode V< mon. PSx 001 162 001 163 001 164 001 165 — Page: 3-327

Activation of the minimum current monitoring mode for undervoltage stage V<.

V<>: Evaluation VNG PSx 076 002 077 002 078 002 079 002 — Fig: 3-229

This setting determines which neutral-point displacement voltage will be monitored: The displacement voltage calculated by the P132 or the displacement voltage measured at the T 90 voltage transformer.

7 Settings
(continued)

V<>: V> PSx 076 003 077 003 078 003 079 003 Fig: 3-224

Setting for the operate value V>.

V<>: V>> PSx 076 004 077 004 078 004 079 004 Fig: 3-224

Setting for the operate value V>>.

V<>: tV> PSx 076 005 077 005 078 005 079 005 Fig: 3-224

Setting for the operate delay of overvoltage stage V>.

V<>: tV> 3-pole PSx 076 027 077 027 078 027 079 027 Fig: 3-224

Setting for the operate delay of overvoltage stage V> when all three trigger stages are activated.

V<>: tV>> PSx 076 006 077 006 078 006 079 006 Fig: 3-224

Setting for the operate delay of overvoltage stage V>>.

V<>: V< PSx 076 007 077 007 078 007 079 007 Fig: 3-225

Setting for the operate value V<.

V<>: V<< PSx 076 008 077 008 078 008 079 008 Fig: 3-225

Setting for the operate value V<<.

V<>: tV< PSx 076 009 077 009 078 009 079 009 Fig: 3-225

Setting for the operate delay of undervoltage stage V<.

V<>: tV< 3-pole PSx 076 028 077 028 078 028 079 028 Fig: 3-225

Setting for the operate delay of undervoltage stage V< when all three trigger stages are activated.

V<>: tV<< PSx 076 010 077 010 078 010 079 010 Fig: 3-225

Setting for the operate delay of undervoltage stage V<<.

V<>: Vpos> PSx 076 015 077 015 078 015 079 015 Fig: 3-227

Setting for the operate value Vpos>.

V<>: Vpos>> PSx 076 016 077 016 078 016 079 016 Fig: 3-227

Setting for the operate value Vpos>>.

V<>: tVpos> PSx 076 017 077 017 078 017 079 017 Fig: 3-227

Setting for the operate delay of overvoltage stage Vpos>.

V<>: tVpos>> PSx 076 018 077 018 078 018 079 018 Fig: 3-227

Setting for the operate delay of overvoltage stage Vpos>>.

V<>: Vpos< PSx 076 019 077 019 078 019 079 019 Fig: 3-227

Setting for the operate value Vpos<.

V<>: Vpos<< PSx 076 020 077 020 078 020 079 020 Fig: 3-227

Setting for the operate value Vpos<<.

V<>: tVpos< PSx 076 021 077 021 078 021 079 021 Fig: 3-227

Setting for the operate delay of undervoltage stage Vpos<.

V<>: tVpos<< PSx 076 022 077 022 078 022 079 022 Fig: 3-227

Setting for the operate delay of undervoltage stage Vpos<<.

V<>: Vneg> PSx 076 023 077 023 078 023 079 023 Fig: 3-228

Setting for the operate value Vneg>.

V<>: Vneg>> PSx 076 024 077 024 078 024 079 024 Fig: 3-228

Setting for the operate value Vneg>>.

V<>: tVneg> PSx 076 025 077 025 078 025 079 025 Fig: 3-228

Setting for the operate delay of overvoltage stage Vneg>.

V<>: tVneg>> PSx 076 026 077 026 078 026 079 026 Fig: 3-228

Setting for the operate delay of overvoltage stage Vneg>>.

V<>: VNG> PSx 076 011 077 011 078 011 079 011 Fig: 3-230

Setting for the operate value VNG>.

V<>: VNG>> PSx 076 012 077 012 078 012 079 012 Fig: 3-230

Setting for the operate value VNG>>.

V<>: tVNG> PSx 076 013 077 013 078 013 079 013 Fig: 3-230

Setting for the operate delay of overvoltage stage VNG>.

V<>: tVNG>> PSx 076 014 077 014 078 014 079 014 Fig: 3-230

Setting for the operate delay of overvoltage stage VNG>>.

V<>: tTransient PSx 076 029 077 029 078 029 079 029 Fig: 3-225

Setting for the time limit of the signals generated by the undervoltage stages.

V<>: Hyst. V<> meas. PSx 076 048 077 048 078 048 079 048 Fig: 3-224

Setting for the hysteresis of the trigger stages for monitoring measured voltages.

V<>: Hyst. V<> deduc. PSx 076 049 077 049 078 049 079 049 Fig: 3-227

Setting for the hysteresis of the trigger stages for monitoring derived voltages such as Vneg and VNG.

Over-/underfrequency protection

f<>: Enable	**PSx**	018 196	018 197	018 198	018 199	Fig: 3-231

This setting defines the parameter subset in which over-/underfrequency protection is enabled.

f<>: Oper. mode f1	**PSx**	018 120	018 121	018 122	018 123	Fig: 3-235
f<>: Oper. mode f2	**PSx**	018 144	018 145	018 146	018 147	
f<>: Oper. mode f3	**PSx**	018 168	018 169	018 170	018 171	
f<>: Oper. mode f4	**PSx**	018 192	018 193	018 194	018 195	

Setting for the operating mode of the timer stages of over-/underfrequency protection.

f<>: f1	**PSx**	018 100	018 101	018 102	018 103	Fig: 3-235
f<>: f2	**PSx**	018 124	018 125	018 126	018 127	
f<>: f3	**PSx**	018 148	018 149	018 150	018 151	
f<>: f4	**PSx**	018 172	018 173	018 174	018 175	

Setting the frequency threshold. The over-/underfrequency protection function will operate if one of the following two conditions applies: The threshold is higher than the set nominal frequency and the frequency exceeds this threshold. The threshold is lower than the set nominal frequency and the frequency falls below this threshold. Depending on the selected operating mode, a signal will be issued without further monitoring or, alternatively, further monitoring mechanisms will be triggered.

f<>: tf1	**PSx**	018 104	018 105	018 106	018 107	Fig: 3-235
f<>: tf2	**PSx**	018 128	018 129	018 130	018 131	
f<>: tf3	**PSx**	018 152	018 153	018 154	018 155	
f<>: tf4	**PSx**	018 176	018 177	018 178	018 179	

Setting for the operate delay of over-/underfrequency protection.

f<>: df1/dt	**PSx**	018 108	018 109	018 110	018 111	Fig: 3-235
f<>: df2/dt	**PSx**	018 132	018 133	018 134	018 135	
f<>: df3/dt	**PSx**	018 156	018 157	018 158	018 159	
f<>: df4/dt	**PSx**	018 180	018 181	018 182	018 183	

Setting for the frequency gradient to be monitored

Note: This setting is ineffective unless operating mode "*f with df/dt*" has been selected.

f<>: Delta f1	**PSx**	018 112	018 113	018 114	018 115	Fig: 3-235
f<>: Delta f2	**PSx**	018 136	018 137	018 138	018 139	
f<>: Delta f3	**PSx**	018 160	018 161	018 162	018 163	
f<>: Delta f4	**PSx**	018 184	018 185	018 186	018 187	

Setting for Delta f.

Note: This setting is ineffective unless operating mode "*f w. Delta f/Delta t*" has been selected.

f<>: Delta t1	**PSx**	018 116	018 117	018 118	018 119	Fig: 3-235
f<>: Delta t2	**PSx**	018 140	018 141	018 142	018 143	
f<>: Delta t3	**PSx**	018 164	018 165	018 166	018 167	
f<>: Delta t4	**PSx**	018 188	018 189	018 190	018 191	

Setting for Delta t.

Note: This setting is ineffective unless operating mode "*f w. Delta f/Delta t*" has been selected.

Power directional protection

P<>: Enabled PSx	014 252	014 253	014 254	014 255	Fig: 3-236
This setting defines the parameter subset in which power directional protection is enabled.					
P<>: P> PSx	017 120	017 200	017 201	017 202	Fig: 3-238
Setting the operate value P> for the active power.					
P<>: Operate delay P> PSx	017 128	017 129	017 130	017 131	Fig: 3-238
Setting the operate delay of stage P>.					
P<>: Release delay P> PSx	017 132	017 133	017 134	017 135	Fig: 3-238
Setting the release delay of stage P>.					
P<>: Direction P> PSx	017 136	017 137	017 138	017 139	Fig: 3-239
This setting of the measuring direction determines whether a P> trip signal will be issued for 'forward', 'backward' or 'non-directional' fault decisions.					
P<>: Diseng. ratio P> PSx	017 124	017 125	017 126	017 127	Fig: 3-238
Setting the disengaging ratio of the operate value P> for the active power.					
P<>: P>> PSx	017 140	017 141	017 142	017 143	Fig: 3-238
Setting the operate value P>> for the active power.					
P<>: Operate delay P>>PSx	017 148	017 149	017 150	017 151	Fig: 3-238
Setting the operate delay of stage P>>.					
P<>: Release delay P>>PSx	017 152	017 153	017 154	017 155	Fig: 3-238
Setting the release delay of stage P>>.					
P<>: Direction P>> PSx	017 156	017 157	017 158	017 159	Fig: 3-239
This setting of the measuring direction determines whether a P>> trip signal will be issued for 'forward', 'backward' or 'non-directional' fault decisions.					
P<>: Diseng. ratio P>>PSx	017 144	017 145	017 146	017 147	Fig: 3-238
Setting the disengaging ratio of the operate value P>> for the active power.					
P<>: Q> PSx	017 160	017 161	017 162	017 163	Fig: 3-240
Setting the operate value Q> of the reactive power.					
P<>: Operate delay Q> PSx	017 168	017 169	017 170	017 171	Fig: 3-240
Setting the operate delay of stage Q>.					
P<>: Release delay Q> PSx	017 172	017 173	017 174	017 175	Fig: 3-240
Setting the release delay of stage Q>.					
P<>: Direction Q> PSx	017 176	017 177	017 178	017 179	Fig: 3-241
This setting of the measuring direction determines whether a Q> trip signal will be issued for 'forward', 'backward' or 'non-directional' fault decisions.					
P<>: Diseng. ratio Q> PSx	017 164	017 165	017 166	017 167	Fig: 3-240
Setting the disengaging ratio of the operate value Q> of the reactive power.					
P<>: Q>> PSx	017 180	017 181	017 182	017 183	Fig: 3-240
Setting the operate value Q>> of the reactive power.					
P<>: Operate delay Q>>PSx	017 188	017 189	017 190	017 191	Fig: 3-240
Setting the operate delay of stage Q>>.					
P<>: Release delay Q>>PSx	017 192	017 193	017 194	017 195	Fig: 3-240
Setting the release delay of stage Q>>.					
P<>: Direction Q>> PSx	017 196	017 197	017 198	017 199	Fig: 3-241

This setting of the measuring direction determines whether a Q>> trip signal will be issued for 'forward', 'backward' or 'non-directional' fault decisions.

P<>: Diseng. ratio Q>>PSx	017 184	017 185	017 186	017 187		Fig: 3-240

Setting the disengaging ratio of the operate value Q>> of the reactive power.

P<>: P< PSx	017 030	017 031	017 032	017 033		Fig: 3-242

Setting the operate value P< for the active power.

P<>: Operate delay P< PSx	017 060	017 061	017 062	017 063		Fig: 3-242, 3-244

Setting the operate delay of stage P<.

P<>: Release delay P< PSx	017 226	017 227	017 228	017 229		Fig: 3-242, 3-244

Setting the release delay of stage P<.

P<>: Direction P< PSx	017 230	017 231	017 232	017 233		Fig: 3-243

This setting of the measuring direction determines whether a P< trip signal will be issued for 'forward', 'backward' or 'non-directional' fault decisions.

P<>: Diseng. ratio P< PSx	017 034	017 035	017 036	017 037		Fig: 3-242

Setting the disengaging ratio of the operate value P< for the active power.

P<>: P<< PSx	017 234	017 235	017 236	017 237		Fig: 3-242

Setting the operate value P<< for the active power.

P<>: Operate delay P<<PSx	017 242	017 243	017 244	017 245		Fig: 3-242

Setting the operate delay of stage P<<.

P<>: Release delay P<<PSx	017 246	017 247	017 248	017 249		Fig: 3-242

Setting the release delay of stage P<<.

P<>: Direction P<< PSx	017 250	017 251	017 252	017 253		Fig: 3-243

This setting of the measuring direction determines whether a P< trip signal will be issued for 'forward', 'backward' or 'non-directional' fault decisions.

P<>: Diseng.ratio P<< PSx	017 238	017 239	017 240	017 241		Fig: 3-242

Setting the disengaging ratio of the operate value P<< for the active power.

P<>: Q< PSx	018 035	018 036	018 037	018 038		Fig: 3-245

Setting the operate value Q< of the reactive power.

P<>: Operate delay Q< PSx	018 052	018 053	018 054	018 055		Fig: 3-245, 3-247

Setting the operate delay of stage Q<.

P<>: Release delay Q< PSx	018 056	018 057	018 058	018 059		Fig: 3-245, 3-247

Setting the release delay of stage Q<.

P<>: Direction Q< PSx	018 081	018 082	018 083	018 084		Fig: 3-246

This setting of the measuring direction determines whether a Q< trip signal will be issued for 'forward', 'backward' or 'non-directional' fault decisions.

P<>: Diseng. ratio Q< PSx	018 044	018 045	018 046	018 047		Fig: 3-245

Setting the disengaging ratio of the operate value Q< of the reactive power.

P<>: Q<< PSx	018 085	018 086	018 087	018 088		Fig: 3-245

Setting the operate value Q<< of the reactive power.

P<>: Operate delay Q<<PSx	018 213	018 214	018 215	018 216		Fig: 3-245

Setting the operate delay of stage Q<<.

P<>: Release delay Q<<PSx	018 236	018 237	018 238	018 239		Fig: 3-245
Setting the release delay of stage Q<<.						
P<>: Direction Q<< PSx	018 242	018 243	018 244	018 245		Fig: 3-246
This setting of the measuring direction determines whether a Q<< trip signal will be issued for 'forward', 'backward' or 'non-directional' fault decisions.						
P<>: Diseng.ratio Q<< PSx	018 095	018 096	018 097	018 098		Fig: 3-245
Setting the disengaging ratio of the operate value Q<< of the reactive power.						
P<>: tTransient pulse PSx	018 246	018 247	018 248	018 249		Fig: 3-242, 3-244, 3-245, 3-247
Setting the time limit of the signals generated by the stages P<, P<<, Q< and Q<< after the respective operate delay has elapsed.						

7.1.3.4 Control

Main function

MAIN: BI active USER 221 003 Fig: 3-78

Selecting the bay interlocking function from the local control panel.

MAIN: SI active USER 221 002 Fig: 3-78

Selecting the station interlocking function from the local control panel.

MAIN: Inp.asg. fct.block.1 221 014 Fig: 3-63
MAIN: Inp.asg. fct.block.2 221 022 Fig: 3-63

Definition of the binary signals assigned to function block 1 and 2.

MAIN: Op. delay fct. block 221 029 Fig: 3-63

Setting the operate delay of the function blocks.

MAIN: CB1 max. oper. cap. 221 084 Page: 3-421

Setting the maximum number of CB operations for an ARC cycle (or for a limited time period).

MAIN: CB1 ready fct.assign 221 085 Page: 3-421

Selecting the event which, when present, will initialize the counter at MAIN: CB1 act. oper. cap. with the value at MAIN: CB1 max. oper. cap.

External devices 01 to 03

DEV01: Designat. ext. dev. 210 000
DEV02: Designat. ext. dev. 210 050
DEV03: Designat. ext. dev. 210 100

Setting the designation of the respective external device.

DEV01: Op.time switch. dev. 210 004 Fig: 3-291, 3-297, 3-298
DEV02: Op.time switch. dev. 210 054
DEV03: Op.time switch. dev. 210 104

Setting the operating time for switchgear (switching device).

DEV01: Latching time 210 005 Fig: 3-292, 3-298, 3-299
DEV02: Latching time 210 055
DEV03: Latching time 210 105

Setting the time that a control command is sustained after a switchgear position signal – "Open" or "Closed" – has been received.

DEV01: Gr. assign. debounc. 210 011 Fig: 3-291, 3-297
DEV02: Gr. assign. debounc. 210 061
DEV03: Gr. assign. debounc. 210 111

Assigning the external device to one of eight groups for debouncing and chatter suppression.

DEV01: Interm. pos. suppr. 210 012 Fig: 3-291, 3-297
DEV02: Interm. pos. suppr. 210 062
DEV03: Interm. pos. suppr. 210 112

This setting determines whether the 'intermediate position’ signal will be suppressed or not, while the switchgear is operating.

DEV01: Stat.ind.interm.pos.	210 027	Fig: 3-291, 3-297
DEV02: Stat.ind.interm.pos.	210 077	
DEV03: Stat.ind.interm.pos.	210 127	

This setting determines whether the actual status will be signaled with a 5 s delay after the '*Faulty position'* signal is issued.

DEV01: Oper. mode cmd.	210 024	
DEV02: Oper. mode cmd.	210 074	
DEV03: Oper. mode cmd.	210 124	

Select the operating mode of the command from long command, short command or time control.

DEV01: Inp.asg. sw.tr. plug	210 014	Fig: 3-291, 3-297
DEV02: Inp.asg. sw.tr. plug	210 064	
DEV03: Inp.asg. sw.tr. plug	210 114	

Definition of the binary signal used to signal the position (*plugged-in* / *unplugged*) of the switch truck plug.

DEV01: With gen. trip cmd.1	210 021	Fig: 3-295
DEV02: With gen. trip cmd.1	210 071	
DEV03: With gen. trip cmd.1	210 121	

This setting specifies whether the circuit breaker will be opened by “general trip command 1” of the protection function.

Note: This setting is only visible (active) for external devices that are defined as ‘circuit breakers’. This definition is included in the bay type definitions.

DEV01: With gen. trip cmd.2	210 022	Fig: 3-295
DEV02: With gen. trip cmd.2	210 072	
DEV03: With gen. trip cmd.2	210 122	

This setting specifies whether the circuit breaker will be opened by “general trip command 2” of the protection function.

Note: This setting is only visible (active) for external devices that are defined as ‘circuit breakers’. This definition is included in the bay type definitions.

DEV01: With close cmd./prot	210 023	Fig: 3-295
DEV02: With close cmd./prot	210 073	
DEV03: With close cmd./prot	210 123	

This setting specifies whether the circuit breaker will be closed by the "close command" of the protection function.

Note: This setting is only visible (active) for external devices that are defined as ‘circuit breakers’. This definition is included in the bay type definitions.

DEV01: Inp.asg.el.ctrl.open	210 019	Fig: 3-292
DEV02: Inp.asg.el.ctrl.open	210 069	
DEV03: Inp.asg.el.ctrl.open	210 119	

This setting defines the binary signal that will be used as the control signal to move the switchgear unit to the open position.

Note: Only signals that are defined in the DEVxx function groups can be selected.

DEV01: Inp.asg.el.ctr.close 210 020 Fig: 3-292
DEV02: Inp.asg.el.ctr.close 210 070
DEV03: Inp.asg.el.ctr.close 210 120

This setting defines the binary signal that will be used as the control signal to move the switchgear unit to the 'Closed' position.

Note: Only signals that are defined in the DEVxx function groups can be selected.

DEV01: Inp. asg. end Open 210 015
DEV02: Inp. asg. end Open 210 065
DEV03: Inp. asg. end Open 210 115

This setting defines the binary signal that will be used to terminate the 'Open' command.

DEV01: Inp. asg. end Close 210 016 Fig: 3-299
DEV02: Inp. asg. end Close 210 066
DEV03: Inp. asg. end Close 210 116

This setting defines the binary signal that will be used to terminate the 'Close' command.

DEV01: Open w/o stat.interl 210 025 Fig: 3-294
DEV02: Open w/o stat.interl 210 075
DEV03: Open w/o stat.interl 210 125

This setting specifies whether switching to 'Open' position is permitted without a check by the station interlock function.

DEV01: Close w/o stat. int. 210 026 Fig: 3-294
DEV02: Close w/o stat. int. 210 076
DEV03: Close w/o stat. int. 210 126

This setting specifies whether switching to 'Closed' position is permitted without a check by the station interlock function.

DEV01: Fct.assig.BlwSI open 210 039 Fig: 3-293
DEV02: Fct.assig.BlwSI open 210 089
DEV03: Fct.assig.BlwSI open 210 139

This setting defines which output will issue the 'Open' enable to the interlocking logic when there is 'bay interlock with substation interlock'.

Note:

The interlock conditions for bay interlock with station interlock are included in the bay type definitions (see List of Bay Types in the Appendix).
If the interlock condition is to be modified, this is possible by modifying the corresponding Boolean equation in the interlocking logic or by defining a new interlocking logic equation. Only in the latter case is it necessary to change the function assignment.

DEV01: Fct.assig.BlwSI clos	210 040	Fig: 3-293
DEV02: Fct.assig.BlwSI clos	210 090	
DEV03: Fct.assig.BlwSI clos	210 140	

This setting defines which output will issue the 'Close' enable to the interlocking logic when there is 'bay interlock with substation interlock'.

Note:

The interlock conditions for bay interlock with station interlock are included in the bay type definitions (see List of Bay Types in the Appendix).
If the interlock condition is to be modified, this is possible by modifying the corresponding Boolean equation in the interlocking logic or by defining a new interlocking logic equation. Only in the latter case is it necessary to change the function assignment.

DEV01: Fct.asg.BI w/o SI op	210 041	Fig: 3-293
DEV02: Fct.asg.BI w/o SI op	210 091	
DEV03: Fct.asg.BI w/o SI op	210 141	

This setting defines which output will issue the 'Open' enable to the interlocking logic when there is 'bay interlock without substation interlock'.

Note:

The interlock conditions for bay interlock without station interlock are included in the bay type definitions (see List of Bay Types in the Appendix).
If the interlock condition is to be modified, this is possible by modifying the corresponding Boolean equation in the interlocking logic or by defining a new interlocking logic equation. Only in the latter case is it necessary to change the function assignment.

DEV01: Fct.asg.BI w/o SI cl	210 042	Fig: 3-293
DEV02: Fct.asg.BI w/o SI cl	210 092	
DEV03: Fct.asg.BI w/o SI cl	210 142	

This setting defines which output will issue the 'Close' enable to the interlocking logic when there is 'bay interlock without substation interlock'.

Note:

The interlock conditions for bay interlock without station interlock are included in the bay type definitions (see List of Bay Types in the Appendix).
If the interlock condition is to be modified, this is possible by modifying the corresponding Boolean equation in the interlocking logic or by defining a new interlocking logic equation. Only in the latter case is it necessary to change the function assignment.

Interlocking logic

ILOCK: Fct.assignm. outp. 1	250 000	Fig: 3-300
ILOCK: Fct.assignm. outp. 2	250 001	
ILOCK: Fct.assignm. outp. 3	250 002	
ILOCK: Fct.assignm. outp. 4	250 003	
ILOCK: Fct.assignm. outp. 5	250 004	
ILOCK: Fct.assignm. outp. 6	250 005	
ILOCK: Fct.assignm. outp. 7	250 006	
ILOCK: Fct.assignm. outp. 8	250 007	
ILOCK: Fct.assignm. outp. 9	250 008	
ILOCK: Fct.assignm. outp.10	250 009	
ILOCK: Fct.assignm. outp.11	250 010	
ILOCK: Fct.assignm. outp.12	250 011	
ILOCK: Fct.assignm. outp.13	250 012	
ILOCK: Fct.assignm. outp.14	250 013	
ILOCK: Fct.assignm. outp.15	250 014	
ILOCK: Fct.assignm. outp.16	250 015	
ILOCK: Fct.assignm. outp.17	250 016	
ILOCK: Fct.assignm. outp.18	250 017	
ILOCK: Fct.assignm. outp.19	250 018	
ILOCK: Fct.assignm. outp.20	250 019	
ILOCK: Fct.assignm. outp.21	250 020	
ILOCK: Fct.assignm. outp.22	250 021	
ILOCK: Fct.assignm. outp.23	250 022	
ILOCK: Fct.assignm. outp.24	250 023	
ILOCK: Fct.assignm. outp.25	250 024	
ILOCK: Fct.assignm. outp.26	250 025	
ILOCK: Fct.assignm. outp.27	250 026	
ILOCK: Fct.assignm. outp.28	250 027	
ILOCK: Fct.assignm. outp.29	250 028	
ILOCK: Fct.assignm. outp.30	250 029	
ILOCK: Fct.assignm. outp.31	250 030	
ILOCK: Fct.assignm. outp.32	250 031	

Definition of the interlock conditions.

7.2 Protection of Increased-Safety Machines

7.2.1 General

The P132 was subjected to risk analysis based on the DIN V 19 250 standard of May 1994 (on basic safety considerations for measuring and protection relays) as well as DIN V 19 251 of February 1995 (on measuring and protection relays, specifications and measures for their fail-safe functioning) and owing to a lack of more specific standards also based on DIN V VDE 0801 (on computers in safety systems).
Based on this risk analysis involving the examination of extensive measures for prevention and management of malfunction, the P132 has been classified in specifications class 3. According to NAMUR NE 31 (NAMUR: German committee on standards for measuring and control engineering), specifications class 3 corresponds to risk area 1. For this risk area, a protection device of single-channel design with alarm signal and/or normally-energized arrangement (‘closed-circuit principle’) will normally suffice. In special cases, a requirement for a higher specifications class can be met by a customized ‘1 out of 2’ or ‘2 out of 3’ circuit.

By connection and configuration of the output relay MAIN: Blocked/faulty , the increased-safety machine can be switched off immediately or, alternatively, an alarm signal can be given for delayed switch-off based on an assessment of the operational conditions by trained staff.

7.2.2 Restrictive Safety-Oriented Configuration

For the P132 to operate in a restrictive safety-oriented mode under all operational conditions, the output relays must be operated in a normally-energized arrangement ('closed-circuit principle'). In this arrangement, the relevant output relay is energized during normal operation and drops out in the event of an activation of the associated function or in the event of a malfunction.

On the configuration of functions, please see the Chapter 'Local Control'.

Essential General Configuration

Function	Address	Folder [1]	Setting
MAIN: Device on-line	003 030	Par/Func/Glob/’	Yes = on (1)
MAIN: Trip cmd.block. USER	021 012	Par/Func/Glob/’	No (0)
OUTP: Outp.rel.block USER	021 014	Par/Func/Glob/’	No (0)
DTOC: Function group DTOC	056 008	Par/Conf/	With (1)
MP: Function group MP	056 022	Par/Conf/	With (1)
I2>: Function group I2>	056 024	Par/Conf/	With (1)
DTOC: General enable USER	022 075	Par/Func/Gen/	Yes (1)
MP: General enable USER	017 059	Par/Func/Gen/	Yes (1)
I2>: General enable USER	018 090	Par/Func/Gen/	Yes (1)

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[1] siehe Kapitel ”Bedienung” dieser Betriebsanleitung.

In order to implement a restrictive safety-oriented configuration for the protection of electrical increased-safety machines, the configuration should be equivalent to the example shown in the table below:

Relay	Function	Address	Folder	Associated function
K 902	OUTP: Fct. assignm. K 902	150 196	Par/Conf/	MAIN: Gen. trip command 1
	OUTP: Oper. mode K 902	150 197	Par/Conf/	NE updating
	MAIN: Gen. trip command 1	021 001	Par/Func/Glob/’	MP: Trip signal
				DTOC: Trip signal
				I2>: tIneg> elapsed

During device startup and during P132 operation, cyclic self-monitoring tests are run. In the event of a positive test result, a specified monitoring signal will be issued and stored in a non-volatile (NV) memory – the monitoring signal memory (see chapter 'Troubleshooting'). Monitoring signals prompted by a serious hardware or software fault in the unit are always entered in the monitoring signal memory. The entry of monitoring signals of lesser significance into the monitoring signal memory is optional. The user can select this option by setting a 'm out of n' parameter.

The blocking of the protection device is governed by similar principles, that is, signals prompted by a serious hardware or software fault in the unit always lead to a blocking of the unit. The assignment of signals of lesser significance to the signal MAIN: Blocked/faulty by an ‘m out of n’ parameter (MAIN: Fct. assignm. Fault) is optional.

Relay	Function	Address	Folder	Associated function
K 908	OUTP: Fct. assignm. K 908	150 214	Par/Conf/	MAIN: Fct. assign. fault
	OUTP: Oper. mode K 908	150 215	Par/Conf/	NE updating
	MAIN: Fct. assign. fault	021 031	Par/Func/Glob/’	SFMON: Error K 902
				SFMON: Defect.module slot 1
				SFMON: Defect.module slot 4
				SFMON: Defect.module slot 9

For safety-oriented operation, the ‘Warning’ can be configured onto an output relay as in the following example.

Relay	Function	Address	Folder	Associated function
E.g. K 901	OUTP: Fct. assignm. K 901	150 193	Par/Conf/	SFMON: Warning (relay)
	SFMON: Fct. assign. warning	021 030	Par/Func/Glob/’	SFMON: Phase sequ. V faulty
				SFMON: Undervoltage

8 Information and Control Functions

8 Information and Control Functions

The P132 generates a large number of signals, processes binary input signals, and acquires measured data during fault-free operation of the protected object as well as fault-related data. A number of counters are available for statistical purposes.
This information can be read out from the integrated local control panel.
All this information can be found in the ‘Operation’ and ‘Events’ folders in the menu tree.

Note:

In the following tables the localization of the corresponding function description is indicated in the right hand side column. "Figure: 3-xxx" refers to a logic diagram which displays the address, "Figure*: 3-xxx" to a figure subtitle or figure report sheet, "Page: 3-xxx" to a page.

8.1 Healthy

8.1.1 Cyclic Values

8.1.1.1 Measured Operating Data

Communication interface 3

COMM3: No. tel. errors p.u.	120 040	Page: 3-29
Display of the updated measured operating value for the number of corrupted messages within the last 1000 received messages.		
COMM3: No.t.err.,max,stored	120 041	Page: 3-29
Display of the maximum value for the proportion of corrupted messages within the last 1000 received messages.		
COMM3: Loop back result	120 057	Page: 3-29
COMM3: Loop back receive	120 056	Page: 3-29
While the hold time is running, the loop back test results can be checked by reading out these values.		

Measured data input

MEASI: Temperature T1	004 224	Fig: 3-30, 3-279
MEASI: Temperature T2	004 225	
MEASI: Temperature T3	004 226	
MEASI: Temperature T4	004 227	
MEASI: Temperature T5	004 228	
MEASI: Temperature T6	004 229	
MEASI: Temperature T7	004 230	
MEASI: Temperature T8	004 231	
MEASI: Temperature T9	004 232	
Display of temperatures measured at inputs on the temperature p/c board.		

MEASI: Temperature T1 max. 004 234 Fig: 3-30
MEASI: Temperature T2 max. 004 235
MEASI: Temperature T3 max. 004 236
MEASI: Temperature T4 max. 004 237
MEASI: Temperature T5 max. 004 238
MEASI: Temperature T6 max. 004 239
MEASI: Temperature T7 max. 004 240
MEASI: Temperature T8 max. 004 241
MEASI: Temperature T9 max. 004 242

Display of maximum temperatures measured at inputs on the temperature p/c board.

MEASI: Current IDC 004 134 Fig: 3-27

Display of the input current.

MEASI: Current IDC p.u. 004 135 Fig: 3-27

Display of the input current referred to $I_{DC,nom}$.

MEASI: Curr. IDC,lin. p.u. 004 136 Fig: 3-27

Display of the linearized input current referred to $I_{DC,nom}$.

MEASI: Scaled value IDC,lin 004 180 Fig: 3-28

Display of the scaled linearized value.

MEASI: Temperature T 004 133 Fig: 3-29

Display of the temperature measured at the "PT 100" temperature input on the analog p/c board.

MEASI: Temperature Tmax 004 233 Fig: 3-29

Display of the maximum temperature measured at the "PT 100" temperature input on the analog p/c board.

MEASI: Temperature p.u. T 004 221 Fig: 3-29

Display of the temperature measured at the "PT 100" temperature input on the analog p/c board referred to 100°C.

MEASI: Temperature p.u. T1 004 081 Fig: 3-30
MEASI: Temperature p.u. T2 004 082
MEASI: Temperature p.u. T3 004 083
MEASI: Temperature p.u. T4 004 084
MEASI: Temperature p.u. T5 004 085
MEASI: Temperature p.u. T6 004 086
MEASI: Temperature p.u. T7 004 250
MEASI: Temperature p.u. T8 004 251
MEASI: Temperature p.u. T9 004 252

Display of temperatures measured at inputs on the temperature p/c board referred to 100°C.

MEASO: Current A-1 005 100 Fig: 3-40
MEASO: Current A-2 005 099

Display of the current on the analog measured data output
(A1: channel 1; A2: channel 2)

Main function

MAIN: Date 003 090 Fig: 3-81

Date display.

Note: The date can also be set here.

MAIN: Time of day 003 091 Fig: 3-81

Display of the time of day.

Note: The time can also be set here.

MAIN: Time switching 003 095 Fig: 3-81

Setting for standard time or daylight saving time.

This setting is necessary in order to avoid misinterpretation of the times assigned to signals and event data that can be read out through the PC or communication interfaces.

Note:
The time can be set here for standard time or daylight saving time.

In the case of clock synchronization via the clock synchronization telegram from a central control system or a central device, this setting will be overwritten each time a new clock synchronization telegram is received. With a free-running clock or synchronization by minute pulse through a binary input, the time of day setting and the time switching setting in the device must be plausible. The two settings do not affect each other.

MAIN: Frequency f 004 040 Fig: 3-56

Display of system frequency.

MAIN: Curr. IP,max prim. 005 050 Fig: 3-47

Display of the maximum phase current as a primary quantity.

MAIN: IP,max prim.,delay 005 036 Fig: 3-47

Display of the delayed maximum phase current as a primary quantity.

MAIN: IP,max prim.,stored 005 034 Fig: 3-47

Display of the delayed stored maximum phase current as a primary quantity.

MAIN: Curr. IP,min prim. 005 055 Fig: 3-47

Display of the minimum phase current as a primary quantity.

MAIN: Current A prim. 005 040 Fig: 3-47

Display of phase current A as a primary quantity.

MAIN: Current B prim. 006 040 Fig: 3-47

Display of phase current B as a primary quantity.

MAIN: Current C prim. 007 040 Fig: 3-47

Display of phase current C as a primary quantity.

MAIN: Current Σ(IP) prim. 005 010 Fig: 3-47

Display of the calculated resultant current as a primary quantity.

MAIN: Current IN prim. 004 043 Fig: 3-48

Display of the updated value for the residual current as a primary quantity.

MAIN: Volt. VPG,max prim. 008 042 Fig: 3-51

Display of the maximum phase-to-ground voltage as a primary quantity.

MAIN: Voltage A-G prim. 005 042 Fig: 3-51

Display of the updated value for phase-to-ground voltage A-G as a primary quantity.

MAIN: Voltage B-G prim. 006 042 Fig: 3-51

Display of the updated value for phase-to-ground voltage B-G as a primary quantity.

MAIN: Voltage C-G prim. 007 042 Fig: 3-51

Display of the updated value for phase-to-ground voltage C-G as a primary quantity.

MAIN: Volt. Σ(VPG)/3 prim. 005 012 Fig: 3-51

Display of the calculated neutral-point displacement voltage as a primary quantity.

MAIN: Voltage VNG prim. 004 041 Fig: 3-52

Display of the neutral-point displacement voltage measured at transformer T 90 as a primary quantity.

MAIN: Voltage Vref prim. 005 046 Fig: 3-53

Display of the reference voltage measured at transformer T 15 as a primary quantity.

MAIN: Volt. VPP,max prim. 008 044 Fig: 3-51

Display of the maximum phase-to-phase voltage as a primary quantity.

MAIN: Voltage VPP,min prim 009 044 Fig: 3-51

Display of the minimum phase-to-phase voltage as a primary quantity.

MAIN: Voltage A-B prim. 005 044 Fig: 3-51

Display of the updated value for phase-to-phase voltage A-B as a primary quantity.

MAIN: Voltage B-C prim. 006 044 Fig: 3-51

Display of the updated value for phase-to-phase voltage B-C as a primary quantity.

MAIN: Voltage C-A prim. 007 044 Fig: 3-51

Display of the updated value for phase-to-phase voltage C-A as a primary quantity.

MAIN: Volt. VPG,min prim. 009 042 Fig: 3-51

Display of the minimum phase-to-ground voltage as a primary quantity.

MAIN: Appar. power S prim. 005 025 Fig: 3-54

Display of the updated apparent power value as a primary quantity.

MAIN: Active power P prim. 004 050 Fig: 3-54

Display of the updated active power value as a primary quantity.

MAIN: Reac. power Q prim. 004 052 Fig: 3-54

Display of the updated reactive power value as a primary quantity.

MAIN: Act.energy outp.prim 005 061 Fig: 3-57

Display of the updated active energy output as a primary quantity.

MAIN: Act.energy inp. prim 005 062 Fig: 3-57

Display of the updated active energy input as a primary quantity.

MAIN: React.en. outp. prim 005 063 Fig: 3-57

Display of the updated reactive energy output as a primary quantity.

MAIN: React. en. inp. prim 005 064 Fig: 3-57

Display of the updated reactive energy input as a primary quantity.

MAIN: Frequency f p.u. 004 070 Fig: 3-56

Display of system frequency referred to f_{nom}.

MAIN: Current IP,max p.u. 005 051 Fig: 3-47

Display of the maximum phase current referred to I_{nom}.

MAIN: IP,max p.u.,delay 005 037 Fig: 3-47

Display of the delayed maximum phase current referred to I_{nom}.

MAIN: IP,max p.u.,stored 005 035 Fig: 3-47

Display of the delayed stored maximum phase current referred to I_{nom}.

MAIN: Current IP,min p.u. 005 056 Fig: 3-47

Display of the minimum phase current referred to I_{nom}.

MAIN: Current A p.u. 005 041 Fig: 3-47

Display of phase current A referred to I_{nom}.

MAIN: Current B p.u. 006 041 Fig: 3-47

Display of phase current B referred to I_{nom}.

MAIN: Current C p.u. 007 041 Fig: 3-47

Display of phase current C referred to I_{nom}.

MAIN: Current Σ(IP) p.u. 005 011 Fig: 3-47

Display of the calculated residual current referred to I_{nom}.

MAIN: Current IN p.u. 004 044 Fig: 3-48

Display of the updated residual current value referred to I_{nom}.

MAIN: Current Ipos p.u. 009 016

Display of the positive sequence current referred to I_{nom}.

MAIN: Current Ineg p.u. 009 015

Display of the negative-sequence current referred to I_{nom}.

MAIN: Voltage VPG,max p.u. 008 043 Fig: 3-51

Display of the maximum phase-to-ground voltage referred to V_{nom}.

MAIN: Voltage VPG,min p.u. 009 043 Fig: 3-51

Display of the minimum phase-to-ground voltage referred to V_{nom}.

MAIN: Voltage A-G p.u. 005 043 Fig: 3-51

Display of the updated value for phase-to-ground voltage A-G referred to V_{nom}.

MAIN: Voltage B-G p.u. 006 043 Fig: 3-51

Display of the updated value for phase-to-ground voltage B-G referred to V_{nom}.

MAIN: Voltage C-G p.u. 007 043 Fig: 3-51

Display of the updated value for phase-to-ground voltage C-G referred to V_{nom}.

MAIN: Volt. Σ(VPG)/√3 p.u. 005 013 Fig: 3-51

Display of the calculated neutral-point displacement voltage referred to V_{nom} .

MAIN: Voltage VNG p.u. 004 042 Fig: 3-52

Display of the neutral-point displacement voltage measured at transformer T 90 referred to V_{nom} .

MAIN: Voltage Vref p.u. 005 047 Fig: 3-53

Display of the reference voltage measured at transformer T 15 referred to V_{nom} .

MAIN: Voltage VPP,max p.u. 008 045 Fig: 3-51

Display of the maximum phase-to-phase voltage referred to V_{nom}.

MAIN: Voltage VPP,min p.u. 009 045 Fig: 3-51

Display of the minimum phase-to-phase voltage referred to V_{nom}.

MAIN: Voltage A-B p.u. 005 045 Fig: 3-51

Display of the updated value for phase-to-phase voltage A-B referred to V_{nom}.

MAIN: Voltage B-C p.u. 006 045 Fig: 3-51

Display of the updated value for phase-to-phase voltage B-C referred to V_{nom}.

MAIN: Voltage C-A p.u. 007 045 Fig: 3-51

Display of the updated value for phase-to-phase voltage C-A referred to V_{nom}.

MAIN: Voltage Vpos p.u. 009 018 Fig: 3-51

Display of the positive-sequence voltage referred to V_{nom}.

MAIN: Voltage Vneg p.u. 009 017 Fig: 3-51

Display of the negative-sequence voltage referred to V_{nom}.

MAIN: Appar. power S p.u. 005 026 Fig: 3-54

Display of the updated apparent power value referred to nominal apparent power Snom.

MAIN: Active power P p.u. 004 051 Fig: 3-54

Display of the updated active power value referred to nominal apparent power S_{nom}.

MAIN: Reac. power Q p.u. 004 053 Fig: 3-54

Display of the updated value for reactive power referred to nominal apparent power S_{nom}.

MAIN: Active power factor 004 054 Fig: 3-54

Display of the updated active power factor.

MAIN: Load angle phi A 004 055 Fig: 3-54

Display of the updated load angle value in phase A.

MAIN: Load angle phi B 004 056 Fig: 3-54

Display of the updated load angle value in phase B.

MAIN: Load angle phi C 004 057 Fig: 3-54

Display of the updated load angle value in phase C.

MAIN: Angle phi N 004 072 Fig: 3-54

Display of the angle between the measured residual current system quantities IN and VNG.

MAIN: Load angle phi A p.u 005 073 Fig: 3-54

Display of the updated load angle value in phase A (referred to 100°C).

MAIN: Load angle phi B p.u 005 074 Fig: 3-54

Display of the updated load angle value in phase B (referred to 100°C).

MAIN: Load angle phi C p.u 005 075 Fig: 3-54

Display of the updated load angle value in phase C (referred to 100°C).

MAIN: Angle phi N p.u. 005 076 Fig: 3-54

Display of the angle between the measured residual current system quantities IN and VNG (referred to 100°).

MAIN: Angle ΣVPG vs. IN 005 009 Fig: 3-54

Display of the angle between the calculated neutral-point displacement voltage and the measured residual current system quantities IN.

MAIN: Angle ΣVPG/IN p.u. 005 072 Fig: 3-54

Display of the angle between the calculated neutral-point displacement voltage and the measured residual current system quantities IN (referred to 100°).

MAIN: Phase rel.,IN vs ΣIP 004 073 Fig: 3-55

The phase relations of measured and calculated residual current are compared.

MAIN: Current ΣI unfilt. 004 074

Display of calculated unfiltered resultant current.

Ground fault direction determination using steady-state values

GFDSS: Current IN,act p.u. 004 045 Fig: 3-188

Display of the updated value for the active component of residual current referred to $I_{N,nom}$.

GFDSS: Curr. IN,reac p.u. 004 046 Fig: 3-188

Display of the updated value for the reactive component of residual current referred to $I_{N,nom}$.

GFDSS: Curr. IN filt. p.u. 004 047 Fig: 3-189

Display of the updated value for the harmonic content of residual current referred to $I_{N,nom}$. This display is only active when the steady-state current evaluation mode of the ground fault direction determination function (GFDSS) is enabled.

GFDSS: Admitt. Y(N) p.u. 004 191 Fig: 3-194

Display of the updated admittance value referred to $Y_{N,nom}$.With setting:
GFDSS: Evaluation VNG is set to "*Measured*":
$Y_{N,nom} = I_{N,nom} / V_{NGnom}$
With setting: GFDSS: Evaluation VNG is set to "*Calculated*":
$Y_{N,nom} = I_{N,nom} / V_{nom}$

GFDSS: Conduct. G(N) p.u. 004 192 Fig: 3-194

Display of the updated conductance value referred to $Y_{N,nom}$.With setting:
GFDSS: Evaluation VNG is set to "*Measured*":
$Y_{N,nom} = I_{N,nom} / V_{NGnom}$
With setting: GFDSS: Evaluation VNG is set to "*Calculated*":
$Y_{N,nom} = I_{N,nom} / V_{nom}$

GFDSS: Suscept. B(N) p.u. 004 193 Fig: 3-194

Display of the updated susceptance value referred to $Y_{N,nom}$.
With setting: GFDSS: Evaluation VNG is set to "*Measured*":
$Y_{N,nom} = I_{N,nom} / V_{NGnom}$
With setting: GFDSS: Evaluation VNG is set to "*Calculated*":
$Y_{N,nom} = I_{N,nom} / V_{nom}$

Motor protection

MP: Therm.repl.buffer MP 004 018 Fig: 3-210

Display of the buffer content of the motor protection function.

MP: St-ups still permitt 004 012 Fig: 3-210

Display of the current number of motor startups still permitted before RC blocking.

MP: Therm. repl. MP p.u. 005 071 Fig: 3-210

Display of the buffer content of the motor protection (referred to 100%).

MP: St-ups st. perm.p.u. 005 086 Fig: 3-210

Display of the current number of motor startups still permitted before RC blocking (referred to the factor 10).

Thermal overload protection

THERM: Status THERM replica 004 016 Fig: 3-218

Display of the buffer content of the thermal overload protection function.

THERM: Object temperature 004 137 Fig: 3-218

Display of the temperature of the protected object.

THERM: Coolant temperature 004 149 Fig: 3-218

Display of the coolant temperature depending on the setting at `THERM: Select CTA`.
When set to *"Default temp. value"* the set temperature value will be displayed. When set to "*From PT 100*" the temperature measured by the resistance thermometer will be displayed. When set to "*From 20 mA input*" the temperature measured via a 20 mA transducer will be displayed.

THERM: Pre-trip time left 004 139 Fig: 3-218

Display of the time remaining before the thermal overload protection function will reach the tripping threshold.

THERM: Therm. replica p.u. 004 017

Display of the buffer content of the thermal overload protection function referred to a buffer content of 100 %.

THERM: Object temp. p.u. 004 179

Display of the temperature of the protected object referred to 100 °C.

THERM: Coolant temp. p.u. 004 178

Display of the coolant temperature referred to 100 °C.

THERM: Temp. offset replica 004 109 Fig: 3-218

Display of the additional reserve if coolant temperature is taken into account and if the coolant temperature has been set to a value below the maximum permissible coolant temperature. (In this case, the thermal model has been shifted downwards.)

If, on the other hand, the coolant temperature and the maximum permissible coolant temperature have been set to the same value, then the coolant temperature is not taken into account and the characteristic is a function of the current only. The additional reserve amounts to zero in this case.

8.1.1.2 Physical State Signals

Communication interface 3

COMM3: State receive 1	120 000	Page: 3-29
COMM3: State receive 2	120 003	
COMM3: State receive 3	120 006	
COMM3: State receive 4	120 009	
COMM3: State receive 5	120 012	
COMM3: State receive 6	120 015	
COMM3: State receive 7	120 018	
COMM3: State receive 8	120 021	
Display of the relevant receive signal.		
COMM3: State send 1	121 000	Page: 3-29
COMM3: State send 2	121 002	
COMM3: State send 3	121 004	
COMM3: State send 4	121 006	
COMM3: State send 5	121 008	
COMM3: State send 6	121 010	
COMM3: State send 7	121 012	
COMM3: State send 8	121 014	
Display of the updated value for the relevant send signal.		

Generic Object Orientated Substation Events

GOOSE: Output 1 state	106 010
GOOSE: Output 2 state	106 012
GOOSE: Output 3 state	106 014
GOOSE: Output 4 state	106 016
GOOSE: Output 5 state	106 018
GOOSE: Output 6 state	106 020
GOOSE: Output 7 state	106 022
GOOSE: Output 8 state	106 024
GOOSE: Output 9 state	106 026
GOOSE: Output 10 state	106 028
GOOSE: Output 11 state	106 030
GOOSE: Output 12 state	106 032
GOOSE: Output 13 state	106 034
GOOSE: Output 14 state	106 036
GOOSE: Output 15 state	106 038
GOOSE: Output 16 state	106 040
GOOSE: Output 17 state	106 042
GOOSE: Output 18 state	106 044
GOOSE: Output 19 state	106 046
GOOSE: Output 20 state	106 048
GOOSE: Output 21 state	106 050
GOOSE: Output 22 state	106 052
GOOSE: Output 23 state	106 054
GOOSE: Output 24 state	106 056
GOOSE: Output 25 state	106 058
GOOSE: Output 26 state	106 060
GOOSE: Output 27 state	106 062
GOOSE: Output 28 state	106 064
GOOSE: Output 29 state	106 066
GOOSE: Output 30 state	106 068
GOOSE: Output 31 state	106 070
GOOSE: Output 32 state	106 072

Display of the virtual binary GOOSE output state.

GOOSE: Input 1 state	106 200
GOOSE: Input 2 state	106 201
GOOSE: Input 3 state	106 202
GOOSE: Input 4 state	106 203
GOOSE: Input 5 state	106 204
GOOSE: Input 6 state	106 205
GOOSE: Input 7 state	106 206
GOOSE: Input 8 state	106 207
GOOSE: Input 9 state	106 208
GOOSE: Input 10 state	106 209
GOOSE: Input 11 state	106 210
GOOSE: Input 12 state	106 211
GOOSE: Input 13 state	106 212
GOOSE: Input 14 state	106 213
GOOSE: Input 15 state	106 214
GOOSE: Input 16 state	106 215

Display of the virtual binary GOOSE input state.

8 Information and Control Functions

(continued)

IEC Generic Substation Status Events

GSSE: Output 1 state	104 100
GSSE: Output 2 state	104 103
GSSE: Output 3 state	104 106
GSSE: Output 4 state	104 109
GSSE: Output 5 state	104 112
GSSE: Output 6 state	104 115
GSSE: Output 7 state	104 118
GSSE: Output 8 state	104 121
GSSE: Output 9 state	104 124
GSSE: Output 10 state	104 127
GSSE: Output 11 state	104 130
GSSE: Output 12 state	104 133
GSSE: Output 13 state	104 136
GSSE: Output 14 state	104 139
GSSE: Output 15 state	104 142
GSSE: Output 16 state	104 145
GSSE: Output 17 state	104 148
GSSE: Output 18 state	104 151
GSSE: Output 19 state	104 154
GSSE: Output 20 state	104 157
GSSE: Output 21 state	104 160
GSSE: Output 22 state	104 163
GSSE: Output 23 state	104 166
GSSE: Output 24 state	104 169
GSSE: Output 25 state	104 172
GSSE: Output 26 state	104 175
GSSE: Output 27 state	104 178
GSSE: Output 28 state	104 181
GSSE: Output 29 state	104 184
GSSE: Output 30 state	104 187
GSSE: Output 31 state	104 190
GSSE: Output 32 state	104 193

Display of the virtual binary GSSE output state.

GSSE: Input 1 state	105 000
GSSE: Input 2 state	105 005
GSSE: Input 3 state	105 010
GSSE: Input 4 state	105 015
GSSE: Input 5 state	105 020
GSSE: Input 6 state	105 025
GSSE: Input 7 state	105 030
GSSE: Input 8 state	105 035
GSSE: Input 9 state	105 040
GSSE: Input 10 state	105 045
GSSE: Input 11 state	105 050
GSSE: Input 12 state	105 055
GSSE: Input 13 state	105 060
GSSE: Input 14 state	105 065
GSSE: Input 15 state	105 070
GSSE: Input 16 state	105 075
GSSE: Input 17 state	105 080
GSSE: Input 18 state	105 085
GSSE: Input 19 state	105 090

GSSE: Input 20 state	105 095
GSSE: Input 21 state	105 100
GSSE: Input 22 state	105 105
GSSE: Input 23 state	105 110
GSSE: Input 24 state	105 115
GSSE: Input 25 state	105 120
GSSE: Input 26 state	105 125
GSSE: Input 27 state	105 130
GSSE: Input 28 state	105 135
GSSE: Input 29 state	105 140
GSSE: Input 30 state	105 145
GSSE: Input 31 state	105 150
GSSE: Input 32 state	105 155

Display of the virtual binary GSSE input state.

Function keys

F_KEY: State F1	080 122	Fig: 3-22
F_KEY: State F2	080 123	
F_KEY: State F3	080 124	
F_KEY: State F4	080 125	
F_KEY: State F5	080 126	
F_KEY: State F6	080 127	

The state of the function keys is displayed as follows:

☐	"Without function":	No functions are assigned to the function key.
☐	"Off":	The function key is in the "Off" position.
☐	"On":	The function key is in the "On" position.

Binary input

INP: State U 301	152 216	Fig: 3-23
INP: State U 302	152 219	
INP: State U 303	152 222	
INP: State U 304	152 225	
INP: State U 501	152 072	
INP: State U 502	152 075	
INP: State U 503	152 078	
INP: State U 504	152 081	
INP: State U 601	152 090	
INP: State U 602	152 093	
INP: State U 603	152 096	
INP: State U 604	152 099	
INP: State U 605	152 102	
INP: State U 606	152 105	
INP: State U 701	152 108	
INP: State U 702	152 111	
INP: State U 703	152 114	
INP: State U 704	152 117	
INP: State U 705	152 120	
INP: State U 706	152 123	
INP: State U 801	184 001	
INP: State U 802	184 005	
INP: State U 803	184 009	
INP: State U 804	184 013	
INP: State U 805	184 017	
INP: State U 806	184 021	
INP: State U 807	184 025	
INP: State U 808	184 029	
INP: State U 809	184 033	
INP: State U 810	184 037	
INP: State U 811	184 041	
INP: State U 812	184 045	
INP: State U 813	184 049	
INP: State U 814	184 053	
INP: State U 815	184 057	
INP: State U 816	184 061	
INP: State U 817	184 065	
INP: State U 818	184 069	
INP: State U 819	184 073	
INP: State U 820	184 077	
INP: State U 821	184 081	
INP: State U 822	184 085	
INP: State U 823	184 089	
INP: State U 824	184 093	
INP: State U 901	152 144	
INP: State U 902	152 147	
INP: State U 903	152 150	
INP: State U 904	152 153	
INP: State U 1001	152 162	
INP: State U 1002	152 165	
INP: State U 1003	152 168	
INP: State U 1004	152 171	
INP: State U 1005	152 174	

INP: State U 1006	152 177
INP: State U 1201	152 198
INP: State U 1202	152 201
INP: State U 1203	152 204
INP: State U 1204	152 207
INP: State U 1205	152 210
INP: State U 1206	152 213
INP: State U 1401	190 001
INP: State U 1402	190 005
INP: State U 1403	190 009
INP: State U 1404	190 013
INP: State U 1405	190 017
INP: State U 1406	190 021
INP: State U 1601	192 001
INP: State U 1602	192 005
INP: State U 1603	192 009
INP: State U 1604	192 013
INP: State U 1605	192 017
INP: State U 1606	192 021
INP: State U 1607	192 025
INP: State U 1608	192 029
INP: State U 1609	192 033
INP: State U 1610	192 037
INP: State U 1611	192 041
INP: State U 1612	192 045
INP: State U 1613	192 049
INP: State U 1614	192 053
INP: State U 1615	192 057
INP: State U 1616	192 061
INP: State U 1617	192 065
INP: State U 1618	192 069
INP: State U 1619	192 073
INP: State U 1620	192 077
INP: State U 1621	192 081
INP: State U 1622	192 085
INP: State U 1623	192 089
INP: State U 1624	192 093
INP: State U 2001	153 086
INP: State U 2002	153 089
INP: State U 2003	153 092
INP: State U 2004	153 095

The state of the binary signal inputs is displayed as follows:

☐ "Without function": No functions are assigned to the binary signal input.

☐ "Low": Not energized.

☐ "High": Energized.

This display appears regardless of the setting for the binary signal input mode.

Binary outputs

OUTP: State K 301	151 044	
OUTP: State K 302	151 047	Fig: 3-32
OUTP: State K 501	150 096	
OUTP: State K 502	150 099	
OUTP: State K 503	150 102	
OUTP: State K 504	150 105	
OUTP: State K 505	150 108	
OUTP: State K 506	150 111	
OUTP: State K 507	150 114	
OUTP: State K 508	150 117	
OUTP: State K 601	150 120	
OUTP: State K 602	150 123	
OUTP: State K 603	150 126	
OUTP: State K 604	150 129	
OUTP: State K 605	150 132	
OUTP: State K 606	150 135	
OUTP: State K 607	150 138	
OUTP: State K 608	150 141	
OUTP: State K 701	150 144	
OUTP: State K 702	150 147	
OUTP: State K 703	150 150	
OUTP: State K 704	150 153	
OUTP: State K 705	150 156	
OUTP: State K 706	150 159	
OUTP: State K 707	150 162	
OUTP: State K 708	150 165	
OUTP: State K 801	150 168	
OUTP: State K 802	150 171	
OUTP: State K 803	150 174	
OUTP: State K 804	150 177	
OUTP: State K 805	150 180	
OUTP: State K 806	150 183	
OUTP: State K 807	150 186	
OUTP: State K 808	150 189	
OUTP: State K 901	150 192	
OUTP: State K 902	150 195	
OUTP: State K 903	150 198	
OUTP: State K 904	150 201	
OUTP: State K 905	150 204	
OUTP: State K 906	150 207	
OUTP: State K 907	150 210	
OUTP: State K 908	150 213	
OUTP: State K 1001	150 216	
OUTP: State K 1002	150 219	
OUTP: State K 1003	150 222	
OUTP: State K 1004	150 225	
OUTP: State K 1005	150 228	
OUTP: State K 1006	150 231	
OUTP: State K 1007	150 234	
OUTP: State K 1008	150 237	
OUTP: State K 1201	151 008	
OUTP: State K 1202	151 011	
OUTP: State K 1203	151 014	

OUTP: State K 1204	151 017
OUTP: State K 1205	151 020
OUTP: State K 1206	151 023
OUTP: State K 1207	151 026
OUTP: State K 1208	151 029
OUTP: State K 1401	169 001
OUTP: State K 1402	169 005
OUTP: State K 1403	169 009
OUTP: State K 1404	169 013
OUTP: State K 1405	169 017
OUTP: State K 1406	169 021
OUTP: State K 1407	169 025
OUTP: State K 1408	169 029
OUTP: State K 1601	171 001
OUTP: State K 1602	171 005
OUTP: State K 1801	173 001
OUTP: State K 1802	173 005
OUTP: State K 1803	173 009
OUTP: State K 1804	173 013
OUTP: State K 1805	173 017
OUTP: State K 1806	173 021
OUTP: State K 2001	151 200
OUTP: State K 2002	151 203
OUTP: State K 2003	151 206
OUTP: State K 2004	151 209
OUTP: State K 2005	151 212
OUTP: State K 2006	151 215
OUTP: State K 2007	151 218
OUTP: State K 2008	151 221

The state of the output relays is displayed as follows:

☐ "Without function": No functions are assigned to the output relay.

☐ "Low": The output relay is not energized.

☐ "High": The output relay is energized.

This display appears regardless of the operating mode set for the output relay.

LED indicators

LED: State H 1 green	085 180	
LED: State H 2 yell.	085 000	
LED: State H 3 yell.	085 003	
LED: State H 4 red	085 006	
LED: State H 5 red	085 009	
LED: State H 6 red	085 012	
LED: State H 7 red	085 015	
LED: State H 8 red	085 018	
LED: State H 9 red	085 021	
LED: State H10 red	085 024	Fig: 3-41
LED: State H11 red	085 027	
LED: State H12 red	085 030	
LED: State H13 red	085 033	
LED: State H14 red	085 036	
LED: State H15 red	085 039	
LED: State H16 red	085 042	
LED: State H17 red.	085 181	
LED: State H18 red	085 130	
LED: State H19 red	085 133	
LED: State H20 red	085 136	
LED: State H21 red	085 139	
LED: State H22 red	085 142	
LED: State H23 red	085 145	
LED: State H 4 green	085 056	
LED: State H 5 green	085 059	
LED: State H 6 green	085 062	
LED: State H 7 green	085 065	
LED: State H 8 green	085 068	
LED: State H 9 green	085 071	
LED: State H10 green	085 074	Fig: 3-41
LED: State H11 green	085 077	
LED: State H12 green	085 080	
LED: State H13 green	085 083	
LED: State H14 green	085 086	
LED: State H15 green	085 089	
LED: State H16 green	085 092	
LED: State H18 green	085 160	
LED: State H19 green	085 163	
LED: State H20 green	085 166	
LED: State H21 green	085 169	
LED: State H22 green	085 172	
LED: State H23 green	085 176	

The state of the LED indicators is displayed as follows:

- ☐ *"Inactive"*: The LED indicator is not energized.
- ☐ *"Active"*: The LED indicator is energized.

8.1.1.3 Logic State Signals

Local control panel

LOC: Edit mode	080 111	
LOC: Trig. menu jmp 1 EXT	030 230	
LOC: Trig. menu jmp 2 EXT	030 231	
LOC: Illumination on EXT	037 101	
LOC: Loc.acc.block.active	221 005	Fig: 3-6
LOC: Rem.acc.block.active	221 004	Fig: 3-6

Communication interface 1

COMM1: Command block. EXT	003 173	Fig: 3-8
COMM1: Sig./meas. block EXT	037 074	Fig: 3-9, 3-10, 3-11
COMM1: Command blocking	003 174	Fig: 3-8
COMM1: Buffer overrun	221 100	
COMM1: Sig./meas.val.block.	037 075	Fig: 3-9, 3-10, 3-11
COMM1: IEC 870-5-103	003 219	Fig: 3-9
COMM1: IEC 870-5-101	003 218	Fig: 3-10
COMM1: IEC 870-5,ILS	003 221	Fig: 3-11
COMM1: MODBUS	003 223	Fig: 3-12
COMM1: DNP3	003 230	Fig: 3-13
COMM1: COURIER	103 041	Fig: 3-14

Communication interface 3

COMM3: Reset No.tlg.err.EXT	006 054	Page: 3-29, Bild*: 3-83
COMM3: Communications fault	120 043	Fig: 3-19
COMM3: Comm. link failure	120 044	Fig: 3-19
COMM3: Lim.exceed.,tel.err.	120 045	Page: 3-29

IEC 61850 Communication

IEC: Comm. link faulty	105 180	
Display when an Ethernet module has not initiated properly, i.e. if the MAC address is missing or there is a non-plausible parameter setting!		
IEC: Control reservation	221 082	
Display if a client has made a reservation to control an external device ("select" for control by control mode "select before operate").		

Generic Object Orientated Substation Events

GOOSE: Ext.Dev01 position	109 000
GOOSE: Ext.Dev02 position	109 005
GOOSE: Ext.Dev03 position	109 010
GOOSE: Ext.Dev04 position	109 015
GOOSE: Ext.Dev05 position	109 020
GOOSE: Ext.Dev06 position	109 025
GOOSE: Ext.Dev07 position	109 030
GOOSE: Ext.Dev08 position	109 035
GOOSE: Ext.Dev09 position	109 040
GOOSE: Ext.Dev10 position	109 045
GOOSE: Ext.Dev11 position	109 050
GOOSE: Ext.Dev12 position	109 055
GOOSE: Ext.Dev13 position	109 060
GOOSE: Ext.Dev14 position	109 065
GOOSE: Ext.Dev15 position	109 070
GOOSE: Ext.Dev16 position	109 075
GOOSE: Ext.Dev17 position	109 100
GOOSE: Ext.Dev18 position	109 105
GOOSE: Ext.Dev19 position	109 110
GOOSE: Ext.Dev20 position	109 115
GOOSE: Ext.Dev21 position	109 120
GOOSE: Ext.Dev22 position	109 125
GOOSE: Ext.Dev23 position	109 130
GOOSE: Ext.Dev24 position	109 135
GOOSE: Ext.Dev25 position	109 140
GOOSE: Ext.Dev26 position	109 145
GOOSE: Ext.Dev27 position	109 150
GOOSE: Ext.Dev28 position	109 155
GOOSE: Ext.Dev29 position	109 160
GOOSE: Ext.Dev30 position	109 165
GOOSE: Ext.Dev31 position	109 170
GOOSE: Ext.Dev32 position	109 175

State of the virtual two-pole GOOSE input, representing the state of an external device.

GOOSE: Ext.Dev01 open	109 001
GOOSE: Ext.Dev02 open	109 006
GOOSE: Ext.Dev03 open	109 011
GOOSE: Ext.Dev04 open	109 016
GOOSE: Ext.Dev05 open	109 021
GOOSE: Ext.Dev06 open	109 026
GOOSE: Ext.Dev07 open	109 031
GOOSE: Ext.Dev08 open	109 036
GOOSE: Ext.Dev09 open	109 041
GOOSE: Ext.Dev10 open	109 046
GOOSE: Ext.Dev11 open	109 051
GOOSE: Ext.Dev12 open	109 056
GOOSE: Ext.Dev13 open	109 061
GOOSE: Ext.Dev14 open	109 066
GOOSE: Ext.Dev15 open	109 071
GOOSE: Ext.Dev16 open	109 076
GOOSE: Ext.Dev17 open	109 101
GOOSE: Ext.Dev18 open	109 106

GOOSE: Ext.Dev19 open	109 111
GOOSE: Ext.Dev20 open	109 116
GOOSE: Ext.Dev21 open	109 121
GOOSE: Ext.Dev22 open	109 126
GOOSE: Ext.Dev23 open	109 131
GOOSE: Ext.Dev24 open	109 136
GOOSE: Ext.Dev25 open	109 141
GOOSE: Ext.Dev26 open	109 146
GOOSE: Ext.Dev27 open	109 151
GOOSE: Ext.Dev28 open	109 156
GOOSE: Ext.Dev29 open	109 161
GOOSE: Ext.Dev30 open	109 166
GOOSE: Ext.Dev31 open	109 171
GOOSE: Ext.Dev32 open	109 176

Binary open state of the virtual two-pole GOOSE input, representing the state of an external device.

GOOSE: Ext.Dev01 closed	109 002
GOOSE: Ext.Dev02 closed	109 007
GOOSE: Ext.Dev03 closed	109 012
GOOSE: Ext.Dev04 closed	109 017
GOOSE: Ext.Dev05 closed	109 022
GOOSE: Ext.Dev06 closed	109 027
GOOSE: Ext.Dev07 closed	109 032
GOOSE: Ext.Dev08 closed	109 037
GOOSE: Ext.Dev09 closed	109 042
GOOSE: Ext.Dev10 closed	109 047
GOOSE: Ext.Dev11 closed	109 052
GOOSE: Ext.Dev12 closed	109 057
GOOSE: Ext.Dev13 closed	109 062
GOOSE: Ext.Dev14 closed	109 067
GOOSE: Ext.Dev15 closed	109 072
GOOSE: Ext.Dev16 closed	109 077
GOOSE: Ext.Dev17 closed	109 102
GOOSE: Ext.Dev18 closed	109 107
GOOSE: Ext.Dev19 closed	109 112
GOOSE: Ext.Dev20 closed	109 117
GOOSE: Ext.Dev21 closed	109 122
GOOSE: Ext.Dev22 closed	109 127
GOOSE: Ext.Dev23 closed	109 132
GOOSE: Ext.Dev24 closed	109 137
GOOSE: Ext.Dev25 closed	109 142
GOOSE: Ext.Dev26 closed	109 147
GOOSE: Ext.Dev27 closed	109 152
GOOSE: Ext.Dev28 closed	109 157
GOOSE: Ext.Dev29 closed	109 162
GOOSE: Ext.Dev30 closed	109 167
GOOSE: Ext.Dev31 closed	109 172
GOOSE: Ext.Dev32 closed	109 177

Binary closed state of the virtual two-pole GOOSE input, representing the state of an external device.

GOOSE: Ext.Dev01 interm.pos	109 003
GOOSE: Ext.Dev02 interm.pos	109 008

	GOOSE: Ext.Dev03 interm.pos	109 013	
	GOOSE: Ext.Dev04 interm.pos	109 018	
	GOOSE: Ext.Dev05 interm.pos	109 023	
	GOOSE: Ext.Dev06 interm.pos	109 028	
	GOOSE: Ext.Dev07 interm.pos	109 033	
	GOOSE: Ext.Dev08 interm.pos	109 038	
	GOOSE: Ext.Dev09 interm.pos	109 043	
	GOOSE: Ext.Dev10 interm.pos	109 048	
	GOOSE: Ext.Dev11 interm.pos	109 053	
	GOOSE: Ext.Dev12 interm.pos	109 058	
	GOOSE: Ext.Dev13 interm.pos	109 063	
	GOOSE: Ext.Dev14 interm.pos	109 068	
	GOOSE: Ext.Dev15 interm.pos	109 073	
	GOOSE: Ext.Dev16 interm.pos	109 078	
	GOOSE: Ext.Dev17 interm.pos	109 103	
	GOOSE: Ext.Dev18 interm.pos	109 108	
	GOOSE: Ext.Dev19 interm.pos	109 113	
	GOOSE: Ext.Dev20 interm.pos	109 118	
	GOOSE: Ext.Dev21 interm.pos	109 123	
	GOOSE: Ext.Dev22 interm.pos	109 128	
	GOOSE: Ext.Dev23 interm.pos	109 133	
	GOOSE: Ext.Dev24 interm.pos	109 138	
	GOOSE: Ext.Dev25 interm.pos	109 143	
	GOOSE: Ext.Dev26 interm.pos	109 148	
	GOOSE: Ext.Dev27 interm.pos	109 153	
	GOOSE: Ext.Dev28 interm.pos	109 158	
	GOOSE: Ext.Dev29 interm.pos	109 163	
	GOOSE: Ext.Dev30 interm.pos	109 168	
	GOOSE: Ext.Dev31 interm.pos	109 173	
	GOOSE: Ext.Dev32 interm.pos	109 178	
	GOOSE: IED link faulty	107 250	
	Binary intermediate position state of the virtual two-pole GOOSE input, representing the state of an external device.		
IEC Generic Substation Status Events	GSSE: IED link faulty	105 181	
	Display if the continuously monitored communication link to a GSSE sending device (IED situated on the opposite side) is in fault or has disappeared altogether. To each GSSE the GSSE sending device will attach a validity stamp, up to which a repetition of GSSE will be carried out independent of a change of state. Thus the device monitors the time period at which the next state signal must be received.		
IRIG-B interface	IRIGB: Enabled	023 201	Fig: 3-21
	IRIGB: Synchron. ready	023 202	Fig: 3-21

Measured data input

MEASI: Reset Tmax EXT	006 076	Fig.*: 3-83
MEASI: Enabled	035 008	Fig: 3-24
MEASI: Open circ. PT100	040 190	Fig: 3-29
MEASI: Open circ. T1	040 193	Fig: 3-30, 3-280
MEASI: Open circ. T2	040 194	Fig: 3-217, 3-280
MEASI: Open circ. T3	040 195	Fig: 3-280
MEASI: Open circ. T4	040 208	Fig: 3-280, 3-281
MEASI: Open circ. T5	040 209	Fig: 3-280, 3-281
MEASI: Open circ. T6	040 218	Fig: 3-280, 3-281
MEASI: Open circ. T7	040 219	Fig: 3-280, 3-281
MEASI: Open circ. T8	040 252	Fig: 3-217, 3-280, 3-281
MEASI: Open circ. T9	040 253	Fig: 3-280, 3-281
MEASI: Overload 20mA input	040 191	Fig: 3-27
MEASI: Open circ. 20mA inp.	040 192	Fig: 3-27

Binary outputs

OUTP: Block outp.rel. EXT	040 014	Fig: 3-32
OUTP: Reset latch. EXT	040 015	Fig: 3-32
OUTP: Outp. relays blocked	021 015	Fig: 3-32
OUTP: Latching reset	040 088	Fig: 3-32

Measured data output

MEASO: Enabled	037 102	Fig: 3-34
MEASO: Outp. enabled EXT	036 085	Fig: 3-35
MEASO: Reset output EXT	036 087	Fig: 3-36
MEASO: Output reset	037 117	Fig: 3-36
MEASO: Valid BCD value	037 050	Fig: 3-37, 3-38
MEASO: 1-digit bit 0 (BCD)	037 051	Fig: 3-38
MEASO: 1-digit bit 1 (BCD)	037 052	Fig: 3-38
MEASO: 1-digit bit 2 (BCD)	037 053	Fig: 3-38
MEASO: 1-digit bit 3 (BCD)	037 054	Fig: 3-38
MEASO: 10-digit bit 0 (BCD)	037 055	Fig: 3-38
MEASO: 10-digit bit 1 (BCD)	037 056	Fig: 3-38
MEASO: 10-digit bit 2 (BCD)	037 057	Fig: 3-38
MEASO: 10-digit bit 3 (BCD)	037 058	Fig: 3-38
MEASO: 100-dig. bit 0 (BCD)	037 059	Fig: 3-38
MEASO: 100-dig. bit 1 (BCD)	037 060	Fig: 3-38
MEASO: Value A-1 valid	069 014	Fig: 3-40
MEASO: Value A-1 output	037 118	Fig: 3-40
MEASO: Value A-2 valid	069 015	
MEASO: Value A-2 output	037 119	

Main function

MAIN: Healthy	060 001	
Signal that the protection unit is operational. As a standard this signal is linked to `LED: Fct.assig. H 1 green.`		
MAIN: Enable protect. EXT	003 027	Fig: 3-59
MAIN: Group reset 1 EXT	005 209	Fig: 3-83
MAIN: Reset c. cl/tr.c EXT	005 210	Fig.*: 3-83
MAIN: Reset IP,max,st. EXT	005 211	Fig: 3-49

8 Information and Control Functions
(continued)

MAIN: Reset meas.v.en. EXT	005 212	Fig.*: 3-83
MAIN: Group reset 2 EXT	005 252	Fig: 3-83
MAIN: General reset EXT	005 255	Fig: 3-2
MAIN: Parallel trip EXT	037 019	Fig: 3-67
MAIN: Disable protect. EXT	003 026	Fig: 3-59
MAIN: Time switching EXT	003 096	
MAIN: System IN enable EXT	040 130	Fig: 3-60
MAIN: CB1 faulty EXT	221 086	Page: 3-421
MAIN: Syst. IN disable EXT	040 131	Fig: 3-60
MAIN: Test mode EXT	037 070	Fig: 3-85
MAIN: Blocking 1 EXT	040 060	Fig: 3-64
MAIN: Blocking 2 EXT	040 061	Fig: 3-64
MAIN: Reset latch.trip EXT	040 138	Fig: 3-74
MAIN: Trip cmd. block. EXT	036 045	Fig: 3-74
MAIN: M.c.b. trip V EXT	004 061	Fig: 3-173
MAIN: M.c.b. trip Vref EXT	036 086	Fig: 3-173
MAIN: Switch dyn.param.EXT	036 033	Fig: 3-61
MAIN: CB closed sig. EXT	036 051	Fig: 3-66, 3-67, 3-156, 3-271, 3-272
MAIN: Manual close EXT	036 047	Fig: 3-147
MAIN: Man. trip cmd. EXT	037 018	Fig: 3-75
MAIN: Man.cl.cmd.enabl.EXT	041 023	Fig: 3-67
MAIN: Man. close cmd. EXT	041 022	Fig: 3-67
MAIN: CB open 3p EXT	031 028	Fig: 3-253, 3-254, 3-258, 3-259, 3-263
MAIN: Reset indicat. EXT	065 001	Fig: 3-82
MAIN: Min-pulse clock EXT	060 060	Fig: 3-81
MAIN: Ch.1 an. NCIT on EXT	010 188	
MAIN: Ch.2 an. NCIT on EXT	010 190	
MAIN: Prot. ext. enabled	003 028	Fig: 3-59
MAIN: Prot. ext. disabled	038 046	Fig: 3-59
MAIN: Syst.IN ext/user en.	040 132	Fig: 3-60
MAIN: System IN enabled	040 133	Fig: 3-60
MAIN: System IN disabled	040 134	Fig: 3-60
MAIN: Device not ready	004 060	Fig: 3-65
MAIN: Enable control	221 058	Fig: 3-78
MAIN: Test mode	037 071	Fig: 3-85
MAIN: Blocked/faulty	004 065	Fig: 3-65
MAIN: Trip cmd. blocked	021 013	Fig: 3-74
MAIN: Latch. trip c. reset	040 139	Fig: 3-74
MAIN: Manual trip signal	034 017	Fig: 3-75
MAIN: Man. close command	037 068	Fig: 3-67
MAIN: Gen. trip signal	036 251	Fig: 3-74
MAIN: Gen. trip signal 1	036 005	Fig: 3-74
MAIN: Gen. trip signal 2	036 023	Fig: 3-74
MAIN: Gen. trip command	035 071	Fig: 3-74
MAIN: Gen. trip command 1	036 071	Fig: 3-74
MAIN: Gen. trip command 2	036 022	Fig: 3-74
MAIN: Close command	037 009	Fig: 3-175, 3-182
MAIN: Close aft.man.cl.rqu	037 012	Fig: 3-67
MAIN: Dynam. param. active	040 090	Fig: 3-61

MAIN: CB open 3p	031 040	
MAIN: CB closed 3p	031 042	
MAIN: CB pos.sig. implaus.	031 041	
MAIN: General starting	040 000	Fig: 3-72
MAIN: tGS elapsed	040 009	Fig: 3-72
MAIN: Starting A	040 005	Fig: 3-71
MAIN: Starting B	040 006	Fig: 3-71
MAIN: Starting C	040 007	Fig: 3-71
MAIN: Starting GF	040 008	Fig: 3-71
MAIN: Starting Ineg	040 105	Fig: 3-71
MAIN: Rush restr. A trig.	041 027	Fig: 3-62
MAIN: Rush restr. B trig.	041 028	Fig: 3-62
MAIN: Rush restr. C trig.	041 029	Fig: 3-62
MAIN: Timer stage P elaps.	040 031	Fig: 3-73
MAIN: Timer st. Ineg elaps	040 050	Fig: 3-73
MAIN: Timer stage N elaps.	040 032	Fig: 3-73
MAIN: TripSig. tI>/tIrefP>	040 042	Fig: 3-73
MAIN: TrSg.tIneg>/Iref,neg	040 051	Fig: 3-73
MAIN: TripSig tIN>/tIrefN>	040 043	Fig: 3-73
MAIN: Ground fault	041 087	Fig: 3-70
MAIN: Ground fault A	041 054	Fig: 3-69
MAIN: Ground fault B	041 055	Fig: 3-69
MAIN: Ground fault C	041 056	Fig: 3-69
MAIN: Gnd. fault forw./LS	041 088	Fig: 3-70
MAIN: Gnd. fault backw./BS	041 089	Fig: 3-70
MAIN: Bay interlock. act.	221 001	Fig: 3-78
MAIN: Subst. interl. act.	221 000	Fig: 3-78
MAIN: Fct. block. 1 active	221 015	Fig: 3-63
MAIN: Fct. block. 2 active	221 023	Fig: 3-63
MAIN: Interlock equ. viol.	221 018	Fig: 3-79
MAIN: CB trip internal	221 006	Fig: 3-77
MAIN: CB tripped	221 016	Fig: 3-77
MAIN: Mult. sig. 1 active	221 017	Fig: 3-68
MAIN: Mult. sig. 1 stored	221 054	Fig: 3-68
MAIN: Mult. sig. 2 active	221 053	Fig: 3-68
MAIN: Mult. sig. 2 stored	221 055	Fig: 3-68
MAIN: Communication error	221 019	Fig: 3-80
MAIN: Auxiliary address	038 005	
MAIN: Dummy entry	004 129	
MAIN: Without function	060 000	
MAIN: Without function	061 000	
MAIN: Ch.1 analog NCIT on	010 189	
MAIN: Ch.2 analog NCIT on	010 191	
MAIN: Device selection key	006 001	
MAIN: Device OPEN key	006 002	
MAIN: Cmd. fr. comm.interf	221 101	Fig: 3-292
MAIN: Device CLOSE key	006 003	
MAIN: Command from HMI	221 102	
MAIN: Local/Remote key	006 004	Fig: 3-6
MAIN: Cmd. fr. electr.ctrl	221 103	

Parameter subset selection

PSS: Control via user EXT	036 101	Fig: 3-86
PSS: Activate PS 1 EXT	065 002	Fig: 3-86
PSS: Activate PS 2 EXT	065 003	Fig: 3-86
PSS: Activate PS 3 EXT	065 004	Fig: 3-86
PSS: Activate PS 4 EXT	065 005	Fig: 3-86
PSS: Control via user	036 102	Fig: 3-86
PSS: Ext.sel.param.subset	003 061	Fig: 3-86
PSS: PS 1 activated ext.	036 094	Fig: 3-86
PSS: PS 2 activated ext.	036 095	Fig: 3-86
PSS: PS 3 activated ext.	036 096	Fig: 3-86
PSS: PS 4 activated ext.	036 097	Fig: 3-86
PSS: Actual param. subset	003 062	Fig: 3-86
PSS: PS 1 active	036 090	Fig: 3-86
PSS: PS 2 active	036 091	Fig: 3-86
PSS: PS 3 active	036 092	Fig: 3-86
PSS: PS 4 active	036 093	Fig: 3-86

Self-monitoring

SFMON: faulty DSP	093 127	
SFMON: Invalid SW vers. DSP	093 128	
SFMON: CB faulty EXT	098 072	
SFMON: Warning (LED)	036 070	Fig: 3-87
SFMON: Warning (relay)	036 100	Fig: 3-87
SFMON: Warm restart exec.	041 202	
SFMON: Cold restart exec.	041 201	
SFMON: Cold restart	093 024	
SFMON: Cold rest./SW update	093 025	
SFMON: Blocking/ HW failure	090 019	
SFMON: Relay Kxx faulty	041 200	
SFMON: Hardware clock fail.	093 040	
SFMON: Battery failure	090 010	
SFMON: Invalid SW d.loaded	096 121	
SFMON: Invalid type of bay	096 122	
SFMON: +15V supply faulty	093 081	
SFMON: +24V supply faulty	093 082	
SFMON: -15V supply faulty	093 080	
SFMON: Wrong module slot 1	096 100	
SFMON: Wrong module slot 2	096 101	
SFMON: Wrong module slot 3	096 102	
SFMON: Wrong module slot 4	096 103	
SFMON: Wrong module slot 5	096 104	
SFMON: Wrong module slot 6	096 105	
SFMON: Wrong module slot 7	096 106	
SFMON: Wrong module slot 8	096 107	
SFMON: Wrong module slot 9	096 108	
SFMON: Wrong module slot 10	096 109	
SFMON: Wrong module slot 11	096 110	
SFMON: Wrong module slot 12	096 111	
SFMON: Wrong module slot 13	096 112	
SFMON: Wrong module slot 14	096 113	
SFMON: Wrong module slot 15	096 114	
SFMON: Wrong module slot 16	096 115	
SFMON: Wrong module slot 17	096 116	
SFMON: Wrong module slot 18	096 117	

SFMON: Wrong module slot 19	096 118
SFMON: Wrong module slot 20	096 119
SFMON: Wrong module slot 21	096 120
SFMON: Defect.module slot 1	097 000
SFMON: Defect.module slot 2	097 001
SFMON: Defect.module slot 3	097 002
SFMON: Defect.module slot 4	097 003
SFMON: Defect.module slot 5	097 004
SFMON: Defect.module slot 6	097 005
SFMON: Defect.module slot 7	097 006
SFMON: Defect.module slot 8	097 007
SFMON: Defect.module slot 9	097 008
SFMON: Defect.module slot10	097 009
SFMON: Defect.module slot11	097 010
SFMON: Defect.module slot12	097 011
SFMON: Defect.module slot13	097 012
SFMON: Defect.module slot14	097 013
SFMON: Defect.module slot15	097 014
SFMON: Defect.module slot16	097 015
SFMON: Defect.module slot17	097 016
SFMON: Defect.module slot18	097 017
SFMON: Defect.module slot19	097 018
SFMON: Defect.module slot20	097 019
SFMON: Defect.module slot21	097 020
SFMON: +15V faulty mod. N	093 096
SFMON: -15V faulty mod. N	093 097
SFMON: DAC faulty module N	093 095
SFMON: Module N DPR faulty	093 090
SFMON: Module N RAM faulty	093 091
SFMON: Module Y DPR faulty	093 110
SFMON: Module Y RAM faulty	093 111
SFMON: Mod.Y RTD DPR faulty	093 108
SFMON: Mod.Y RTD RAM faulty	093 109
SFMON: Error K 501	097 062
SFMON: Error K 502	097 063
SFMON: Error K 503	097 064
SFMON: Error K 504	097 065
SFMON: Error K 505	097 066
SFMON: Error K 506	097 067
SFMON: Error K 507	097 068
SFMON: Error K 508	097 069
SFMON: Error K 301	097 021
SFMON: Error K 302	097 022
SFMON: Error K 601	097 070
SFMON: Error K 602	097 071
SFMON: Error K 603	097 072
SFMON: Error K 604	097 073
SFMON: Error K 605	097 074
SFMON: Error K 606	097 075
SFMON: Error K 607	097 076
SFMON: Error K 608	097 077
SFMON: Error K 701	097 078
SFMON: Error K 702	097 079

SFMON: Error K 703	097 080
SFMON: Error K 704	097 081
SFMON: Error K 705	097 082
SFMON: Error K 706	097 083
SFMON: Error K 707	097 084
SFMON: Error K 708	097 085
SFMON: Error K 801	097 086
SFMON: Error K 802	097 087
SFMON: Error K 803	097 088
SFMON: Error K 804	097 089
SFMON: Error K 805	097 090
SFMON: Error K 806	097 091
SFMON: Error K 807	097 092
SFMON: Error K 808	097 093
SFMON: Error K 901	097 094
SFMON: Error K 902	097 095
SFMON: Error K 903	097 096
SFMON: Error K 904	097 097
SFMON: Error K 905	097 098
SFMON: Error K 906	097 099
SFMON: Error K 907	097 100
SFMON: Error K 908	097 101
SFMON: Error K 1001	097 102
SFMON: Error K 1002	097 103
SFMON: Error K 1003	097 104
SFMON: Error K 1004	097 105
SFMON: Error K 1005	097 106
SFMON: Error K 1006	097 107
SFMON: Error K 1007	097 108
SFMON: Error K 1008	097 109
SFMON: Error K 1201	097 118
SFMON: Error K 1202	097 119
SFMON: Error K 1203	097 120
SFMON: Error K 1204	097 121
SFMON: Error K 1205	097 122
SFMON: Error K 1206	097 123
SFMON: Error K 1207	097 124
SFMON: Error K 1208	097 125
SFMON: Error K 1401	097 134
SFMON: Error K 1402	097 135
SFMON: Error K 1403	097 136
SFMON: Error K 1404	097 137
SFMON: Error K 1405	097 138
SFMON: Error K 1406	097 139
SFMON: Error K 1407	097 140
SFMON: Error K 1408	097 141
SFMON: Error K 1601	097 150
SFMON: Error K 1602	097 151
SFMON: Error K 1801	097 166
SFMON: Error K 1802	097 167
SFMON: Error K 1803	097 168
SFMON: Error K 1804	097 169
SFMON: Error K 1805	097 170

SFMON: Error K 1806	097 171	
SFMON: Error K 2001	097 182	
SFMON: Error K 2002	097 183	
SFMON: Error K 2003	097 184	
SFMON: Error K 2004	097 185	
SFMON: Error K 2005	097 186	
SFMON: Error K 2006	097 187	
SFMON: Error K 2007	097 188	
SFMON: Error K 2008	097 189	
SFMON: Undef. operat. code	093 010	
SFMON: Invalid arithm. op.	093 011	
SFMON: Undefined interrupt	093 012	
SFMON: Exception oper.syst.	093 013	
SFMON: Protection failure	090 021	
SFMON: Checksum error param	090 003	
SFMON: Clock sync. error	093 041	
SFMON: Interm.volt.fail.RAM	093 026	
SFMON: Overflow MT_RC	090 012	Fig: 3-89
SFMON: Semaph. MT_RC block.	093 015	
SFMON: Inval. SW COMM1/IEC	093 075	
SFMON: Invalid SW vers. N	093 093	
SFMON: Time-out module N	093 092	
SFMON: Invalid SW vers. Y	093 113	
SFMON: Invalid SW vers YRTD	093 123	
SFMON: Time-out module Y	093 112	
SFMON: Time-out module YRTD	093 119	
SFMON: IRIGB faulty	093 117	
SFMON: M.c.b. trip V	098 000	Fig: 3-269
SFMON: M.c.b. trip Vref	098 011	
SFMON: Phase sequ. V faulty	098 001	Fig: 3-271
SFMON: Undervoltage	098 009	Fig: 3-271
SFMON: FF, Vref triggered	098 022	Fig: 3-272
SFMON: M.circ. V,Vref flty.	098 023	
SFMON: Meas. circ. V faulty	098 017	Fig: 3-269
SFMON: Meas. circ. I faulty	098 005	Fig: 3-270
SFMON: Meas.circ.V,I faulty	098 016	Fig: 3-269
SFMON: Communic.fault COMM3	093 140	
SFMON: Hardware error COMM3	093 143	
SFMON: Invalid SW vers DHMI	093 145	
SFMON: Comm.link fail.COMM3	093 142	
SFMON: Lim.exceed.,tel.err.	093 141	
SFMON: Telecom. faulty	098 006	Fig: 3-151
SFMON: Setting error THERM	098 035	Fig: 3-218
SFMON: Setting error CBM	098 020	
SFMON: CTA error	098 034	Fig: 3-216, 3-217
SFMON: TGFD mon. triggered	093 094	Fig: 3-202
SFMON: CB No. CB op. >	098 066	
SFMON: Fcts.not perm.f.60Hz	093 098	Fig: 3-197
SFMON: CB rem. No. CB op. <	098 067	
SFMON: CB ΣItrip >	098 068	
SFMON: CB ΣItrip**2 >	098 069	
SFMON: Invalid scaling BCD	093 124	

	SFMON: CB tmax> A	098 070	
	SFMON: Invalid scaling A-1	093 114	Fig: 3-40
	SFMON: CB tmax> B	098 071	
	SFMON: Invalid scaling A-2	093 115	
	SFMON: CB tmax> C	098 077	
	SFMON: Invalid scaling IDC	093 116	Fig: 3-27
	SFMON: PT100 open circuit	098 024	Fig: 3-29
	SFMON: T1 open circ.	098 029	Fig: 3-30
	SFMON: T2 open circ.	098 030	
	SFMON: T3 open circ.	098 040	
	SFMON: T4 open circ.	098 041	
	SFMON: T5 open circ.	098 042	
	SFMON: T6 open circ.	098 043	
	SFMON: T7 open circ.	098 044	
	SFMON: T8 open circ.	098 045	
	SFMON: T9 open circ.	098 052	
	SFMON: Overload 20 mA input	098 025	Fig: 3-27
	SFMON: Open circ. 20mA inp.	098 026	Fig: 3-27
	SFMON: Setting error f<>	098 028	Fig: 3-235
	SFMON: Inv.inp.f.clock sync	093 120	
	SFMON: Output 30	098 053	
	SFMON: Output 30 (t)	098 054	
	SFMON: Output 31	098 055	
	SFMON: Output 31 (t)	098 056	
	SFMON: Output 32	098 057	
	SFMON: Output 32 (t)	098 058	
	SFMON: CB pos.sig. implaus.	098 124	
Operating data recording	OP_RC: Reset record. EXT	005 213	Fig: 3-83
Monitoring signal recording	MT_RC: Reset record. EXT	005 240	Fig.*: 3-83
Overload recording	OL_RC: Reset record. EXT	005 241	Fig.*: 3-83
	OL_RC: Record. in progress	035 003	Fig: 3-93
	OL_RC: Overl. mem. overflow	035 007	Fig: 3-94
Ground fault recording	GF_RC: Reset record. EXT	005 242	Fig.*: 3-83
	GF_RC: Record. in progress	035 005	Fig: 3-102
	GF_RC: GF memory overflow	035 006	Fig: 3-103
Fault data acquisition	FT_DA: Trigger EXT	036 088	Fig: 3-105
Fault recording	FT_RC: Record.trig active	002 002	Fig: 3-111
	FT_RC: Reset record. EXT	005 243	Fig.*: 3-83
	FT_RC: Trigger EXT	036 089	Fig: 3-111
	FT_RC: Trigger	037 076	Fig: 3-111
	FT_RC: I> triggered	040 063	Fig: 3-111
	FT_RC: Record. in progress	035 000	Fig: 3-111
	FT_RC: Fault mem. overflow	035 001	Fig: 3-112
	FT_RC: System disturb. runn	035 004	Fig: 3-111
	FT_RC: Faulty time tag	035 002	

Definite-time overcurrent protection

DTOC: Blocking tI> EXT	041 060	Fig: 3-115
DTOC: Blocking tI>> EXT	041 061	Fig: 3-115
DTOC: Blocking tI>>> EXT	041 062	Fig: 3-115
DTOC: Block. tIneg> EXT	036 141	Fig: 3-117
DTOC: Block. tIneg>> EXT	036 142	Fig: 3-117
DTOC: Block. tIneg>>> EXT	036 143	Fig: 3-117
DTOC: Blocking tIN> EXT	041 063	Fig: 3-120
DTOC: Blocking tIN>> EXT	041 064	Fig: 3-120
DTOC: Blocking tIN>>> EXT	041 065	Fig: 3-120
DTOC: Blocking tIN>>>> EXT	041 101	Fig: 3-120
DTOC: Enabled	040 120	Fig: 3-114
DTOC: Starting I>	040 036	Fig: 3-115
DTOC: Starting I>>	040 029	Fig: 3-115
DTOC: Starting I>>>	039 075	Fig: 3-115
DTOC: Starting Ineg>	036 145	Fig: 3-71, 3-72, 3_117
DTOC: Starting Ineg>>	036 146	Fig: 3-71, 3-72, 3-117
DTOC: Starting Ineg>>>	036 147	Fig: 3-71, 3-72, 3-117
DTOC: Starting IN>	040 077	Fig: 3-120
DTOC: Starting IN>>	040 041	Fig: 3-120
DTOC: Starting IN>>>	039 078	Fig: 3-120
DTOC: Starting IN>>>>	035 031	Fig: 3-120
DTOC: tI> elapsed	040 010	Fig: 3-115
DTOC: tI>> elapsed	040 033	Fig: 3-115
DTOC: tI>>> elapsed	040 012	Fig: 3-115
DTOC: Trip signal tI>	041 020	Fig: 3-116
DTOC: Trip signal tI>>	040 011	Fig: 3-116
DTOC: Trip signal tI>>>	040 076	Fig: 3-116
DTOC: tIneg> elapsed	036 148	Fig: 3-73, 3-91, 3-117
DTOC: tIneg>> elapsed	036 149	Fig: 3-73, 3-91, 3-117
DTOC: tIneg>>> elapsed	036 150	Fig: 3-73, 3-91, 3-117
DTOC: Trip signal tIneg>	036 151	Fig: 3-73, 3-91, 3-117
DTOC: Trip signal tIneg>>	036 152	Fig: 3-91, 3-117
DTOC: Trip signal tIneg>>>	036 153	Fig: 3-91, 3-117
DTOC: tIN> elapsed	040 013	Fig: 3-120
DTOC: tIN>> elapsed	040 121	Fig: 3-120
DTOC: tIN>>> elapsed	039 079	Fig: 3-120
DTOC: tIN>>>> elapsed	035 040	Fig: 3-120
DTOC: Trip signal tIN>	041 021	Fig: 3-121
DTOC: Trip signal tIN>>	040 028	Fig: 3-121
DTOC: Trip signal tIN>>>	040 079	Fig: 3-121
DTOC: Trip sign. tIN>>>>	035 046	Fig: 3-121
DTOC: H.-time tIN>,i. runn	040 086	Fig: 3-122
DTOC: tIN>,interm. elapsed	040 099	Fig: 3-122
DTOC: Trip sig. tIN>,intm.	039 073	Fig: 3-122

Inverse-time overcurrent protection

IDMT1: Block. tIref,P> EXT	040 101	Fig: 3-130a
IDMT1: Block. tIref,neg>EXT	040 102	Fig: 3-132
IDMT1: Block. tIref,N> EXT	040 103	Fig: 3-134
IDMT1: Enabled	040 100	Fig: 3-125
IDMT1: Starting Iref,P>	040 080	Fig: 3-130a
IDMT1: tIref,P> elapsed	040 082	Fig: 3-130a
IDMT1: Trip signal tIref,P>	040 084	Fig: 3-131a
IDMT1: Hold time P running	040 053	Fig: 3-130a
IDMT1: Memory P clear	040 110	Fig: 3-130a
IDMT1: Starting Iref,neg>	040 107	Fig: 3-132
IDMT1: tIref,neg> elapsed	040 109	Fig: 3-132
IDMT1: Trip sig. tIref,neg>	040 108	Fig: 3-132
IDMT1: Hold time neg runn.	040 113	Fig: 3-132
IDMT1: Memory neg clear	040 111	Fig: 3-132
IDMT1: Starting Iref,N>	040 081	Fig: 3-134
IDMT1: tIref,N> elapsed	040 083	Fig: 3-134
IDMT1: Trip signal tIref,N>	040 085	Fig: 3-135a
IDMT1: Hold time N running	040 054	Fig: 3-134
IDMT1: Memory N clear	040 112	Fig: 3-134
IDMT2: Block. tIref,P> EXT	040 136	
IDMT2: Block. tIref,neg>EXT	040 149	
IDMT2: Block. tIref,N> EXT	040 150	
IDMT2: Enabled	040 135	
IDMT2: Starting Iref,P>	040 018	
IDMT2: tIref,P> elapsed	040 021	Fig: 3-131b
IDMT2: Trip signal tIref,P>	040 023	Fig: 3-131b
IDMT2: Hold time P running	040 016	
IDMT2: Memory P clear	040 178	
IDMT2: Starting Iref,neg>	040 156	
IDMT2: tIref,neg> elapsed	040 159	
IDMT2: Trip sig. tIref,neg>	040 158	
IDMT2: Hold time neg runn.	040 189	
IDMT2: Memory neg clear	040 179	
IDMT2: Starting Iref,N>	040 019	
IDMT2: tIref,N> elapsed	040 022	Fig: 3-135b
IDMT2: Trip signal tIref,N>	040 024	Fig: 3-135b
IDMT2: Hold time N running	040 017	
IDMT2: Memory N clear	040 188	

Short-circuit direction determination

SCDD: Enabled	040 098	Fig: 3-137
SCDD: Blocked	040 062	Fig: 3-139
SCDD: Fault P forward	036 018	Fig: 3-140
SCDD: Fault P backward	036 019	Fig: 3-140
SCDD: Ground fault forward	040 037	Fig: 3-144
SCDD: Ground fault backw.	040 038	Fig: 3-144
SCDD: Fault P or G forwd.	040 039	Fig: 3-146
SCDD: Fault P or G backw.	040 040	Fig: 3-146
SCDD: Forw. w/o measurem.	038 044	
SCDD: Direct. using Vmeas	038 045	
SCDD: Direct. using memory	038 047	
SCDD: tVmemory running	040 034	

Switch on to fault protection

SOTF: Par. ARC running EXT	039 063	Fig: 3-147
SOTF: Enabled	040 069	Fig: 3-147
SOTF: tManual-close runn.	036 063	Fig: 3-147
SOTF: Trip signal	036 064	Fig: 3-147

Protective signaling

PSIG: Enable EXT	037 025	Fig: 3-148
PSIG: Disable EXT	037 026	Fig: 3-148
PSIG: Test telecom. EXT	036 038	Fig: 3-150
PSIG: Blocking EXT	036 049	Fig: 3-148
PSIG: Receive EXT	036 048	Fig: 3-150, 3-151
PSIG: Ext./user enabled	037 023	Fig: 3-148
PSIG: Enabled	015 008	Fig: 3-148
PSIG: Ready	037 027	Fig: 3-148
PSIG: Not ready	037 028	Fig: 3-148
PSIG: Test telecom. chann.	034 016	Fig: 3-150
PSIG: Telecom. faulty	036 060	Fig: 3-151
PSIG: Send (signal)	036 035	Fig: 3-150
PSIG: Send (transm.relay)	037 024	Fig: 3-150
PSIG: Receive (signal)	037 029	Fig: 3-150
PSIG: Trip signal	038 007	Fig: 3-150

Auto-reclosing control

ARC: Reset counters EXT	005 244	Fig: 3-170
ARC: Enable EXT	037 010	Fig: 3-154
ARC: Disable EXT	037 011	Fig: 3-154
ARC: Test HSR A-B-C EXT	037 017	Fig: 3-168
ARC: Blocking EXT	036 050	Fig: 3-155
ARC: CB drive ready EXT	004 066	Fig: 3-156
ARC: Ext./user enabled	037 013	Fig: 3-154
ARC: Enabled	015 064	Fig: 3-154
ARC: Test HSR A-B-C	034 023	Fig: 3-168
ARC: Blocked	004 069	Fig: 3-155
ARC: Blocking trip	042 000	Fig: 3-165
ARC: Ready	004 068	Fig: 3-156
ARC: Not ready	037 008	Fig: 3-156
ARC: Reject test HSR	036 055	Fig: 3-168
ARC: Block. time running	037 004	Fig: 3-155
ARC: Cycle running	037 000	Fig: 3-165
ARC: Oper. time running	037 005	Fig: 3-165
ARC: Start by LOGIC	037 078	Fig: 3-164
ARC: Dead time HSR runn.	037 002	Fig: 3-165
ARC: Dead time TDR runn.	037 003	Fig: 3-165
ARC: Reclaim time running	036 042	Fig: 3-165
ARC: Trip signal	039 099	Fig: 3-165
ARC: (Re)close request	037 077	Fig: 3-67, 3-165, 3-174
ARC: (Re)close signal HSR	037 007	Fig: 3-165
ARC: (Re)close signal TDR	037 006	Fig: 3-165
ARC: Reclosure successful	036 062	Fig: 3-165
ARC: Sig.interr. CB trip	036 040	Fig: 3-165

Automatic synchronism check

ASC: Ext./user enabled	037 092	Fig: 3-172
ASC: Reset counters EXT	006 074	Fig.*: 3-83
ASC: Enable EXT	037 049	Fig: 3-172
ASC: Disable EXT	037 061	Fig: 3-172
ASC: Blocking EXT	037 048	Fig: 3-173
ASC: Test close requ. EXT	037 064	Fig: 3-174
ASC: Enabl.close requ.EXT	037 063	Fig: 3-174
ASC: Close request EXT	037 062	Fig: 3-174
ASC: Enabled	018 024	Fig: 3-172
ASC: Blocked	038 018	Fig: 3-173
ASC: Ready	037 079	Fig: 3-173
ASC: Not ready	037 082	Fig: 3-173
ASC: Test close request	034 019	Fig: 3-174
ASC: Close request	034 018	Fig: 3-174
ASC: Cycle running	038 019	Fig: 3-178
ASC: Operat.time running	037 093	Fig: 3-178
ASC: Close enable	037 083	Fig: 3-67, 3-176
ASC: Close enable,volt.ch	037 085	Fig: 3-176
ASC: Close enable,sync.ch	037 084	Fig: 3-177
ASC: Close rejection	037 086	Fig: 3-178

Ground fault direction determination using steady-state values

GFDSS: Reset counters EXT	005 245	Fig.*: 3-83
GFDSS: GF (curr.) eval. EXT	038 020	Fig: 3-183
GFDSS: Enabled	042 096	Fig: 3-183
GFDSS: GF (pow.) ready	038 026	Fig: 3-183
GFDSS: GF (pow.) not ready	038 027	Fig: 3-183
GFDSS: GF (curr.) evaluat.	039 071	Fig: 3-183
GFDSS: GF (curr.) ready	038 028	Fig: 3-183
GFDSS: GF (curr.) not ready	038 029	Fig: 3-183
GFDSS: Admittance ready	038 167	Fig: 3-183
GFDSS: Admittance not ready	038 168	Fig: 3-183
GFDSS: Grd. fault pow./adm.	009 037	Fig: 3-185, 3-191
GFDSS: Direct. forward/LS	009 035	Fig: 3-188, 3-194
GFDSS: Direct. backward/BS	009 036	Fig: 3-188, 3-194
GFDSS: Starting forward/LS	009 040	Fig: 3-188, 3-194
GFDSS: Starting backw. /BS	009 041	Fig: 3-188, 3-194
GFDSS: Trip signal forw./LS	009 031	Fig: 3-188, 3-194
GFDSS: Ground fault (curr.)	009 038	Fig: 3-189
GFDSS: Starting Y(N)>	009 074	Fig: 3-195
GFDSS: Trip Y(N)>	009 075	Fig: 3-195
GFDSS: Trip signal Y(N)>	009 072	Fig: 3-195

Transient ground fault direction determination

TGFD: Blocking EXT	004 034	Fig: 3-197
TGFD: Reset counters EXT	005 246	Fig: 3-203
TGFD: Reset signal EXT	004 140	Fig: 3-201
TGFD: Enabled	037 100	Fig: 3-197
TGFD: Ready	037 080	Fig: 3-197
TGFD: Not ready	037 081	Fig: 3-197
TGFD: Ground fault	004 033	Fig: 3-199
TGFD: Direct. determined	004 030	Fig: 3-200
TGFD: Forward / LS	004 031	Fig: 3-200
TGFD: Backward / BS	004 032	Fig: 3-200
TGFD: Signals reset	004 141	Fig: 3-201

Motor protection

MP: Therm.repl.block EXT	040 044	Fig: 3-210
MP: Reset replica EXT	041 082	Fig: 3-212
MP: Speed monitor n> EXT	040 045	Fig: 3-210
MP: Sig. Hours_Run >	025 155	
MP: Machine stopped	025 158	
MP: Machine running	025 159	
MP: Enabled	040 115	Fig: 3-204
MP: Reset therm. replica	041 083	Fig: 3-212
MP: Reclosure blocked	040 049	Fig: 3-210
MP: Starting k*Iref>	041 057	Fig: 3-205
MP: Startup	040 119	Fig: 3-210
MP: Trip by failed st-up	041 081	Fig: 3-210
MP: Trip signal	040 046	Fig: 3-210
MP: tI< elapsed	040 047	Fig: 3-213

Thermal overload protection

THERM: Therm.repl.block EXT	041 074	Fig: 3-218
THERM: Reset replica EXT	038 061	Fig: 3-219
THERM: Enabled	040 068	Fig: 3-214
THERM: Reset replica	039 061	Fig: 3-219
THERM: Starting k*Iref>	041 108	Fig: 3-218
THERM: CTA error EXT	038 062	Fig: 3-216, 3-217
THERM: Warning	039 025	Fig: 3-218
THERM: Trip signal	039 020	Fig: 3-218
THERM: Buffer empty	039 112	Fig: 3-218
THERM: CTA error	039 111	Fig: 3-216, 3-217
THERM: Within pre-trip time	041 109	Fig: 3-218
THERM: Setting error,block.	039 110	Fig: 3-218

Unbalance protection

I2>: Blocking EXT	035 100	Fig: 3-221
I2>: Blocking tIneg> EXT	041 076	Fig: 3-221
I2>: Blocking tIneg>> EXT	041 077	Fig: 3-221
I2>: Enabled	040 073	Fig: 3-220
I2>: Starting Ineg>	035 024	Fig: 3-221
I2>: Starting Ineg>>	035 025	Fig: 3-221
I2>: tIneg> elapsed	035 033	Fig: 3-221
I2>: tIneg>> elapsed	035 034	Fig: 3-221

Time-voltage protection

V<>: Blocking tV> EXT	041 068	Fig: 3-224
V<>: Blocking tV>> EXT	041 069	Fig: 3-224
V<>: Blocking tV< EXT	041 070	Fig: 3-225
V<>: Blocking tV<< EXT	041 071	Fig: 3-225
V<>: Blocking tVpos> EXT	041 090	Fig: 3-227
V<>: Blocking tVpos>> EXT	041 091	Fig: 3-227
V<>: Blocking tVpos< EXT	041 092	Fig: 3-227
V<>: Blocking tVpos<< EXT	041 093	Fig: 3-227
V<>: Blocking tVneg> EXT	041 094	Fig: 3-228
V<>: Blocking tVneg>> EXT	041 095	Fig: 3-228
V<>: Blocking tVNG> EXT	041 072	Fig: 3-230
V<>: Blocking tVNG>> EXT	041 073	Fig: 3-230
V<>: Enabled	040 066	Fig: 3-222
V<>: Ready	042 003	Fig: 3-222
V<>: Not ready	042 004	Fig: 3-222
V<>: Starting V>/>> A(-B)	041 031	Fig: 3-224
V<>: Starting V>/>> B(-C)	041 032	Fig: 3-224
V<>: Starting V>/>> C(-A)	041 033	Fig: 3-224
V<>: Starting V>	041 030	Fig: 3-224
V<>: Starting V> 3-pole	041 097	Fig: 3-224
V<>: Starting V>>	041 096	Fig: 3-224
V<>: tV> elapsed	041 034	Fig: 3-224
V<>: tV> 3-pole elapsed	041 098	Fig: 3-224
V<>: tV>> elapsed	041 035	Fig: 3-224
V<>: Starting V</<< A(-B)	041 038	Fig: 3-225
V<>: Starting V</<< B(-C)	041 039	Fig: 3-225
V<>: Starting V</<< C(-A)	041 040	Fig: 3-225
V<>: Starting V<	041 037	Fig: 3-225
V<>: Starting V< 3-pole	042 005	Fig: 3-225
V<>: Starting V<<	041 099	Fig: 3-225
V<>: tV< elapsed	041 041	Fig: 3-225
V<>: tV< elaps. transient	042 023	Fig: 3-225
V<>: Fault V<	041 110	Fig: 3-225
V<>: tV< 3-pole elapsed	042 006	Fig: 3-225
V<>: tV< 3p elaps. trans.	042 024	Fig: 3-225
V<>: Fault V< 3-pole	041 111	Fig: 3-225
V<>: tV<< elapsed	041 042	Fig: 3-225
V<>: tV<< elapsed trans.	042 025	Fig: 3-225
V<>: tV</<< elaps. trans.	042 007	Fig: 3-225
V<>: Fault V<<	041 112	Fig: 3-225
V<>: Starting Vpos>	042 010	Fig: 3-227
V<>: Starting Vpos>>	042 011	Fig: 3-227
V<>: tVpos> elapsed	042 012	Fig: 3-227
V<>: tVpos>> elapsed	042 013	Fig: 3-227
V<>: Starting Vpos<	042 014	Fig: 3-227
V<>: Starting Vpos<<	042 015	Fig: 3-227
V<>: tVpos< elapsed	042 016	Fig: 3-227
V<>: tVpos< elaps. trans.	042 026	Fig: 3-227
V<>: Fault Vpos<	041 113	Fig: 3-227
V<>: tVpos<< elapsed	042 017	Fig: 3-227
V<>: tVpos<< elaps.trans.	042 027	Fig: 3-227
V<>: Fault Vpos<<	041 114	Fig: 3-227
V<>: tVpos</<< elap.trans	042 018	Fig: 3-227

V<>: Starting Vneg>	042 019	Fig: 3-228
V<>: Starting Vneg>>	042 020	Fig: 3-228
V<>: tVneg> elapsed	042 021	Fig: 3-228
V<>: tVneg>> elapsed	042 022	Fig: 3-228
V<>: Starting VNG>	041 044	Fig: 3-230
V<>: Starting VNG>>	042 008	Fig: 3-230
V<>: tVNG> elapsed	041 045	Fig: 3-230
V<>: tVNG>> elapsed	041 046	Fig: 3-230

Over-/underfrequency protection

f<>: Reset meas.val. EXT	006 075	Fig.*: 3-83
f<>: Blocking f1 EXT	042 103	Fig: 3-235
f<>: Blocking f2 EXT	042 104	
f<>: Blocking f3 EXT	042 105	
f<>: Blocking f4 EXT	042 106	
f<>: Enabled	042 100	Fig: 3-231
f<>: Ready	042 101	Fig: 3-231
f<>: Not ready	042 140	Fig: 3-231
f<>: Blocked by V<	042 102	Fig: 3-233
f<>: Starting f1	042 107	Fig: 3-235
f<>: Starting f1/df1	042 108	Fig: 3-235
f<>: Delta f1 triggered	042 109	Fig: 3-235
f<>: Delta t1 elapsed	042 110	Fig: 3-235
f<>: Trip signal f1	042 111	Fig: 3-235
f<>: Starting f2	042 115	
f<>: Starting f2/df2	042 116	
f<>: Delta f2 triggered	042 117	
f<>: Delta t2 elapsed	042 118	
f<>: Trip signal f2	042 119	
f<>: Starting f3	042 123	
f<>: Starting f3/df3	042 124	
f<>: Delta f3 triggered	042 125	
f<>: Delta t3 elapsed	042 126	
f<>: Trip signal f3	042 127	
f<>: Starting f4	042 131	
f<>: Starting f4/df4	042 132	
f<>: Delta f4 triggered	042 133	
f<>: Delta t4 elapsed	042 134	
f<>: Trip signal f4	042 135	

Power directional protection

P<>: Blocking tP> EXT	035 082	Fig: 3-238
P<>: Blocking tP>> EXT	035 083	Fig: 3-238
P<>: Blocking tQ> EXT	035 084	Fig: 3-240
P<>: Blocking tQ>> EXT	035 085	Fig: 3-240
P<>: Blocking tP< EXT	035 050	Fig: 3-242
P<>: Blocking tP<< EXT	035 051	Fig: 3-242
P<>: Blocking tQ< EXT	035 052	Fig: 3-245
P<>: Blocking tQ<< EXT	035 053	Fig: 3-245
P<>: Enabled	036 250	Fig: 3-236
P<>: Starting P>	035 086	Fig: 3-238, 3-248
P<>: Starting P>>	035 089	Fig: 3-238, 3-248
P<>: Signal P> delayed	035 087	Fig: 3-238
P<>: Signal P>> delayed	035 090	Fig: 3-238
P<>: Trip signal P>	035 088	Fig: 3-239
P<>: Trip signal P>>	035 091	Fig: 3-239
P<>: Starting Q>	035 092	Fig: 3-240, 3-249
P<>: Starting Q>>	035 095	Fig: 3-240, 3-249
P<>: Signal Q> delayed	035 093	Fig: 3-240
P<>: Signal Q>> delayed	035 096	Fig: 3-240
P<>: Trip signal Q>	035 094	Fig: 3-241
P<>: Trip signal Q>>	035 097	Fig: 3-241
P<>: Starting P<	035 054	Fig: 3-242, 3-243, 3-248
P<>: Starting P<<	035 060	Fig: 3-242, 3-243, 3-248
P<>: Signal P< delayed	035 055	Fig: 3-242, 3-243
P<>: Signal P<< delayed	035 061	Fig: 3-242, 3-243
P<>: tP< elapsed trans.	035 056	Fig: 3-242, 3-243
P<>: tP<< elapsed trans.	035 062	Fig: 3-242, 3-243
P<>: tP</tP<< elaps.trans	035 178	Fig: 3-242
P<>: Fault P<	035 057	Fig: 3-242, 3-244
P<>: Fault P<<	035 063	Fig: 3-242
P<>: Trip signal P<	035 058	Fig: 3-243
P<>: Trip signal P<<	035 064	Fig: 3-243
P<>: Trip signal P< trans	035 059	Fig: 3-243
P<>: Trip sig. P<< trans.	035 065	Fig: 3-243
P<>: Starting Q<	035 066	Fig: 3-245, 3-246, 3-249
P<>: Starting Q<<	035 010	Fig: 3-245, 3-246, 3-249
P<>: Signal Q< delayed	035 067	Fig: 3-245, 3-246
P<>: Signal Q<< delayed	035 011	Fig: 3-245, 3-246
P<>: tQ< elapsed trans.	035 068	Fig: 3-245, 3-246
P<>: tQ<< elapsed trans.	035 016	Fig: 3-245, 3-246
P<>: tQ</tQ<< elaps.trans	035 179	Fig: 3-245
P<>: Fault Q<	035 069	Fig: 3-245, 3-247
P<>: Fault Q<<	035 049	Fig: 3-245

P<>: Trip signal Q<	035 155	Fig: 3-246
P<>: Trip signal Q<<	035 176	Fig: 3-246
P<>: Trip sig. Q< trans.	035 156	Fig: 3-246
P<>: Trip sig. Q<< trans.	035 177	Fig: 3-246
P<>: Direction P forw.	035 181	Fig: 3-248
P<>: Direction P backw.	035 191	Fig: 3-248
P<>: Direction Q forw.	035 193	Fig: 3-249
P<>: Direction Q backw.	035 194	Fig: 3-249

Circuit Breaker Failure Protection

CBF: Ready	038 009	
CBF: Startup 3p	038 211	Fig: 3-254
CBF: Starting trig. EXT	038 016	Fig: 3-250
CBF: Blocking EXT	038 058	
CBF: Enable EXT	038 041	
CBF: Disable EXT	038 042	
CBF: Enabled	040 055	Fig: 3-250
CBF: Not ready	040 025	Fig: 3-251
CBF: Trip signal	040 026	Fig: 3-257
CBF: Starting	038 021	Fig: 3-257
CBF: Ext./user enabled	038 040	Fig: 3-250
CBF: CB failure	036 017	
CBF: Start 3p EXT	038 205	Fig: 3-254
CBF: Start enable EXT	038 209	Fig: 3-254
CBF: CB pos. implausible	038 210	Fig: 3-253
CBF: Trip signal t1	038 215	Fig: 3-255
CBF: Trip signal t2	038 219	Fig: 3-255
CBF: Trip command t1	038 220	Fig: 3-256
CBF: Trip command t2	038 224	Fig: 3-256
CBF: Fault behind CB	038 225	Fig: 3-258
CBF: TripSig CBsync.super	038 226	Fig: 3-259
CBF: CBsync.superv A open	038 227	Fig: 3-259
CBF: CBsync.superv B open	038 228	Fig: 3-259
CBF: CBsync.superv C open	038 229	Fig: 3-259
CBF: Current flow A	038 230	Fig: 3-252
CBF: Current flow B	038 231	Fig: 3-252
CBF: Current flow C	038 232	Fig: 3-252
CBF: Current flow Phx	038 233	Fig: 3-252
CBF: CB faulty EXT	038 234	Fig: 3-255

Circuit Breaker Monitoring

CBM: Reset meas.val. EXT	005 247	Fig.*: 3-83
CBM: Blocking EXT	044 128	Fig: 3-268
CBM: Enabled	044 130	Fig: 3-260
CBM: Cycle running A	044 205	
CBM: Cycle running B	044 206	
CBM: Cycle running C	044 207	
CBM: Blocked	044 199	Fig: 3-268
CBM: Sig. No. CB op. >	044 135	Fig: 3-267
CBM: Sig. Rem. No.CB op.<	044 136	Fig: 3-266
CBM: Signal ΣItrip>	044 137	
CBM: Signal ΣItrip**2>	044 138	
CBM: Signal ΣI*t>	044 139	
CBM: tmax> A	044 177	
CBM: tmax> B	044 178	

CBM: tmax> C	044 179	
CBM: Curr. flow ended A	044 201	
CBM: Curr. flow ended B	044 202	
CBM: Curr. flow ended C	044 203	
CBM: Setting error CBM	044 204	

Measuring-circuit monitoring

MCMON: Enabled	040 094	Fig: 3-270
MCMON: Meas. circ. I faulty	040 087	Fig: 3-270
MCMON: Undervoltage	038 038	Fig: 3-271
MCMON: Phase sequ. V faulty	038 049	Fig: 3-271
MCMON: Meas. circ. V faulty	038 023	Fig: 3-269
MCMON: Meas.circ.V,I faulty	037 020	Fig: 3-269
MCMON: FF, Vref triggered	038 100	Fig: 3-272
MCMON: Meas. voltage o.k.	038 048	Fig: 3-271
MCMON: M.circ. V,Vref flty.	040 078	

Limit value monitoring

LIMIT: Enabled	040 074	Fig: 3-273, 3-277
LIMIT: tI> elapsed	040 220	Fig: 3-273
LIMIT: tI>> elapsed	040 221	Fig: 3-273
LIMIT: tI< elapsed	040 222	Fig: 3-273
LIMIT: tI<< elapsed	040 223	Fig: 3-273
LIMIT: tVPG> elapsed	040 224	Fig: 3-274
LIMIT: tVPG>> elapsed	040 225	Fig: 3-274
LIMIT: tVPG< elapsed	040 226	Fig: 3-274
LIMIT: tVPG<< elapsed	040 227	Fig: 3-274
LIMIT: tVPP> elapsed	040 228	Fig: 3-274
LIMIT: tVPP>> elapsed	040 229	Fig: 3-274
LIMIT: tVPP< elapsed	040 230	Fig: 3-274
LIMIT: tVPP<< elapsed	040 231	Fig: 3-274
LIMIT: tVNG> elapsed	040 168	Fig: 3-275
LIMIT: tVNG>> elapsed	040 169	Fig: 3-275
LIMIT: tVref> elapsed	042 152	Fig: 3-277
LIMIT: tVref>> elapsed	042 153	Fig: 3-277
LIMIT: tVref< elapsed	042 154	Fig: 3-277
LIMIT: tVref<< elapsed	042 155	Fig: 3-277
LIMIT: Starting IDC,lin>	040 180	Fig: 3-276
LIMIT: Starting IDC,lin>>	040 181	Fig: 3-276
LIMIT: tIDC,lin> elapsed	040 182	Fig: 3-276
LIMIT: tIDC,lin>> elapsed	040 183	Fig: 3-276
LIMIT: Starting IDC,lin<	040 184	Fig: 3-276
LIMIT: Starting IDC,lin<<	040 185	Fig: 3-276
LIMIT: tIDC,lin< elapsed	040 186	Fig: 3-276
LIMIT: tIDC,lin<< elapsed	040 187	Fig: 3-276
LIMIT: Starting T>	040 170	Fig: 3-278
LIMIT: Starting T>>	040 171	Fig: 3-278
LIMIT: tT> elapsed	040 172	Fig: 3-278
LIMIT: tT>> elapsed	040 173	Fig: 3-278
LIMIT: Starting T<	040 174	Fig: 3-278
LIMIT: Starting T<<	040 175	Fig: 3-278
LIMIT: tT< elapsed	040 176	Fig: 3-278
LIMIT: tT<< elapsed	040 177	Fig: 3-278
LIMIT: Starting T1>	040 200	Fig: 3-279

LIMIT: Starting T1>>	040 201	Fig: 3-279
LIMIT: tT1> elapsed	040 202	Fig: 3-279
LIMIT: tT1>> elapsed	040 203	Fig: 3-279, 3-280
LIMIT: Starting T1<	040 204	Fig: 3-279
LIMIT: Starting T1<<	040 205	Fig: 3-279
LIMIT: tT1< elapsed	040 206	Fig: 3-279
LIMIT: tT1<< elapsed	040 207	Fig: 3-279
LIMIT: Starting T2>	040 210	
LIMIT: Starting T2>>	040 211	
LIMIT: tT2> elapsed	040 212	
LIMIT: tT2>> elapsed	040 213	Fig: 3-280
LIMIT: Starting T2<	040 214	
LIMIT: Starting T2<<	040 215	
LIMIT: tT2< elapsed	040 216	
LIMIT: tT2<< elapsed	040 217	
LIMIT: Starting T3>	040 160	
LIMIT: Starting T3>>	040 161	
LIMIT: tT3> elapsed	040 162	
LIMIT: tT3>> elapsed	040 163	Fig: 3-280
LIMIT: Starting T3<	040 164	
LIMIT: Starting T3<<	040 165	
LIMIT: tT3< elapsed	040 166	
LIMIT: tT3<< elapsed	040 167	
LIMIT: Starting T4>	041 150	
LIMIT: Starting T4>>	041 151	
LIMIT: tT4> elapsed	041 152	
LIMIT: tT4>> elapsed	041 153	Fig: 3-280, 3-281
LIMIT: Starting T4<	041 154	
LIMIT: Starting T4<<	041 155	
LIMIT: tT4< elapsed	041 156	
LIMIT: tT4<< elapsed	041 157	
LIMIT: Starting T5>	041 160	
LIMIT: Starting T5>>	041 161	
LIMIT: tT5> elapsed	041 162	
LIMIT: tT5>> elapsed	041 163	Fig: 3-280, 3-281
LIMIT: Starting T5<	041 164	
LIMIT: Starting T5<<	041 165	
LIMIT: tT5< elapsed	041 166	
LIMIT: tT5<< elapsed	041 167	
LIMIT: Starting T6>	041 170	
LIMIT: Starting T6>>	041 171	
LIMIT: tT6> elapsed	041 172	
LIMIT: tT6>> elapsed	041 173	Fig: 3-280, 3-281
LIMIT: Starting T6<	041 174	
LIMIT: Starting T6<<	041 175	
LIMIT: tT6< elapsed	041 176	
LIMIT: tT6<< elapsed	041 177	
LIMIT: Starting T7>	041 180	
LIMIT: Starting T7>>	041 181	
LIMIT: tT7> elapsed	041 182	

LIMIT: tT7>> elapsed	041 183	Fig: 3-280, 3-281
LIMIT: Starting T7<	041 184	
LIMIT: Starting T7<<	041 185	
LIMIT: tT7< elapsed	041 186	
LIMIT: tT7<< elapsed	041 187	
LIMIT: Starting T8>	041 190	
LIMIT: Starting T8>>	041 191	
LIMIT: tT8> elapsed	041 192	
LIMIT: tT8>> elapsed	041 193	Fig: 3-280, 3-281
LIMIT: Starting T8<	041 194	
LIMIT: Starting T8<<	041 195	
LIMIT: tT8< elapsed	041 196	
LIMIT: tT8<< elapsed	041 197	
LIMIT: Starting T9>	041 240	
LIMIT: Starting T9>>	041 241	
LIMIT: tT9> elapsed	041 242	
LIMIT: tT9>> elapsed	041 243	Fig: 3-280, 3-281
LIMIT: Starting T9<	041 244	
LIMIT: Starting T9<<	041 245	
LIMIT: tT9< elapsed	041 246	
LIMIT: tT9<< elapsed	041 247	
LIMIT: 2out of3 with T1,2,3	041 248	Fig: 3-280
LIMIT: 2out of3 with T4,5,6	041 249	Fig: 3-281
LIMIT: 2out of3 with T7,8,9	041 250	Fig: 3-281
LIMIT: tIPxx triggered	221 232	
LIMIT: tVPGxx triggered	221 233	
LIMIT: tVPPxx triggered	221 234	
LIMIT: tVNGxx triggered	221 235	
LIMIT: tVrefxx triggered	221 237	

Logic

LOGIC: Input 1 EXT	034 000	Fig: 3-284
LOGIC: Input 2 EXT	034 001	
LOGIC: Input 3 EXT	034 002	
LOGIC: Input 4 EXT	034 003	
LOGIC: Input 5 EXT	034 004	
LOGIC: Input 6 EXT	034 005	
LOGIC: Input 7 EXT	034 006	
LOGIC: Input 8 EXT	034 007	
LOGIC: Input 9 EXT	034 008	
LOGIC: Input 10 EXT	034 009	
LOGIC: Input 11 EXT	034 010	
LOGIC: Input 12 EXT	034 011	
LOGIC: Input 13 EXT	034 012	
LOGIC: Input 14 EXT	034 013	
LOGIC: Input 15 EXT	034 014	
LOGIC: Input 16 EXT	034 015	Fig: 3-284
LOGIC: Set 1 EXT	034 051	Fig: 3-283
LOGIC: Set 2 EXT	034 052	
LOGIC: Set 3 EXT	034 053	
LOGIC: Set 4 EXT	034 054	
LOGIC: Set 5 EXT	034 055	

LOGIC: Set 6 EXT	034 056	
LOGIC: Set 7 EXT	034 057	
LOGIC: Set 8 EXT	034 058	
LOGIC: Reset 1 EXT	034 059	Fig: 3-283
LOGIC: Reset 2 EXT	034 060	
LOGIC: Reset 3 EXT	034 061	
LOGIC: Reset 4 EXT	034 062	
LOGIC: Reset 5 EXT	034 063	
LOGIC: Reset 6 EXT	034 064	
LOGIC: Reset 7 EXT	034 065	
LOGIC: Reset 8 EXT	034 066	
LOGIC: 1 has been set	034 067	Fig: 3-283
LOGIC: 2 has been set	034 068	
LOGIC: 3 has been set	034 069	
LOGIC: 4 has been set	034 070	
LOGIC: 5 has been set	034 071	
LOGIC: 6 has been set	034 072	
LOGIC: 7 has been set	034 073	
LOGIC: 8 has been set	034 074	
LOGIC: 1 set externally	034 075	Fig: 3-283
LOGIC: 2 set externally	034 076	
LOGIC: 3 set externally	034 077	
LOGIC: 4 set externally	034 078	
LOGIC: 5 set externally	034 079	
LOGIC: 6 set externally	034 080	
LOGIC: 7 set externally	034 081	
LOGIC: 8 set externally	034 082	
LOGIC: Enabled	034 046	Fig: 3-284
LOGIC: Output 1	042 032	Fig: 3-284
LOGIC: Output 1 (t)	042 033	Fig: 3-284
LOGIC: Output 2	042 034	
LOGIC: Output 2 (t)	042 035	Fig: 3-164
LOGIC: Output 3	042 036	
LOGIC: Output 3 (t)	042 037	
LOGIC: Output 4	042 038	
LOGIC: Output 4 (t)	042 039	
LOGIC: Output 5	042 040	
LOGIC: Output 5 (t)	042 041	
LOGIC: Output 6	042 042	
LOGIC: Output 6 (t)	042 043	
LOGIC: Output 7	042 044	
LOGIC: Output 7 (t)	042 045	
LOGIC: Output 8	042 046	
LOGIC: Output 8 (t)	042 047	
LOGIC: Output 9	042 048	
LOGIC: Output 9 (t)	042 049	
LOGIC: Output 10	042 050	
LOGIC: Output 10 (t)	042 051	
LOGIC: Output 11	042 052	
LOGIC: Output 11 (t)	042 053	
LOGIC: Output 12	042 054	
LOGIC: Output 12 (t)	042 055	
LOGIC: Output 13	042 056	

LOGIC: Output 13 (t)					042 057	
LOGIC: Output 14					042 058	
LOGIC: Output 14 (t)					042 059	
LOGIC: Output 15					042 060	
LOGIC: Output 15 (t)					042 061	
LOGIC: Output 16					042 062	
LOGIC: Output 16 (t)					042 063	
LOGIC: Output 17					042 064	
LOGIC: Output 17 (t)					042 065	
LOGIC: Output 18					042 066	
LOGIC: Output 18 (t)					042 067	
LOGIC: Output 19					042 068	
LOGIC: Output 19 (t)					042 069	
LOGIC: Output 20					042 070	
LOGIC: Output 20 (t)					042 071	
LOGIC: Output 21					042 072	
LOGIC: Output 21 (t)					042 073	
LOGIC: Output 22					042 074	
LOGIC: Output 22 (t)					042 075	
LOGIC: Output 23					042 076	
LOGIC: Output 23 (t)					042 077	
LOGIC: Output 24					042 078	
LOGIC: Output 24 (t)					042 079	
LOGIC: Output 25					042 080	
LOGIC: Output 25 (t)					042 081	
LOGIC: Output 26					042 082	
LOGIC: Output 26 (t)					042 083	
LOGIC: Output 27					042 084	
LOGIC: Output 27 (t)					042 085	
LOGIC: Output 28					042 086	
LOGIC: Output 28 (t)					042 087	
LOGIC: Output 29					042 088	
LOGIC: Output 29 (t)					042 089	
LOGIC: Output 30					042 090	
LOGIC: Output 30 (t)					042 091	
LOGIC: Output 31					042 092	
LOGIC: Output 31 (t)					042 093	
LOGIC: Output 32					042 094	Fig: 3-300
LOGIC: Output 32 (t)					042 095	Fig: 3-300

External devices 01 to 03

DEV01: Open signal EXT					210 030	Fig: 3-291, 3-297
DEV01: Closed signal EXT					210 031	Fig: 3-291, 3-297
DEV01: Control state					210 018	Fig: 3-20, 3-291, 3-297
DEV01: Switch. device open					210 036	Fig: 3-291, 3-297,3-298, 3-299
DEV01: Switch.device closed					210 037	Fig: 3-291, 3-297, 3-298, 3-299
DEV01: Dev. interm./flt.pos					210 038	Fig: 3-291, 3-297
DEV01: Open command					210 028	

	DEV01: Close command	210 029	Fig: 3-298, 3-299
	DEV01: Open cmd. received	218 000	Fig: 3-292
	DEV01: Close cmd. received	218 001	Fig: 3-292
	DEV02: Open signal EXT	210 080	
	DEV02: Closed signal EXT	210 081	Fig: 3-66
	DEV02: Control state	210 068	
	DEV02: Switch. device open	210 086	
	DEV02: Switch.device closed	210 087	
	DEV02: Dev. interm./flt.pos	210 088	
	DEV02: Open command	210 078	
	DEV02: Close command	210 079	
	DEV02: Open cmd. received	218 002	
	DEV02: Close cmd. received	218 003	
	DEV03: Open signal EXT	210 130	
	DEV03: Closed signal EXT	210 131	
	DEV03: Control state	210 118	
	DEV03: Switch. device open	210 136	
	DEV03: Switch.device closed	210 137	
	DEV03: Dev. interm./flt.pos	210 138	
	DEV03: Open command	210 128	
	DEV03: Close command	210 129	
	DEV03: Open cmd. received	218 004	
	DEV03: Close cmd. received	218 005	

Interlocking logic	ILOCK: Output 1	250 032	Fig: 3-300
	ILOCK: Output 2	250 033	
	ILOCK: Output 3	250 034	
	ILOCK: Output 4	250 035	
	ILOCK: Output 5	250 036	
	ILOCK: Output 6	250 037	
	ILOCK: Output 7	250 038	
	ILOCK: Output 8	250 039	
	ILOCK: Output 9	250 040	
	ILOCK: Output 10	250 041	
	ILOCK: Output 11	250 042	
	ILOCK: Output 12	250 043	
	ILOCK: Output 13	250 044	
	ILOCK: Output 14	250 045	
	ILOCK: Output 15	250 046	
	ILOCK: Output 16	250 047	
	ILOCK: Output 17	250 048	
	ILOCK: Output 18	250 049	
	ILOCK: Output 19	250 050	
	ILOCK: Output 20	250 051	
	ILOCK: Output 21	250 052	
	ILOCK: Output 22	250 053	
	ILOCK: Output 23	250 054	
	ILOCK: Output 24	250 055	
	ILOCK: Output 25	250 056	
	ILOCK: Output 26	250 057	
	ILOCK: Output 27	250 058	
	ILOCK: Output 28	250 059	


ILOCK: Output 29
250 060
ILOCK: Output 30
250 061
ILOCK: Output 31
250 062
ILOCK: Output 32
250 063

Fig: 3-293

Single-pole commands

CMD_1: Command C001	200 001	Fig: 3-301
CMD_1: Command C002	200 006	
CMD_1: Command C003	200 011	
CMD_1: Command C004	200 016	
CMD_1: Command C005	200 021	
CMD_1: Command C006	200 026	
CMD_1: Command C007	200 031	
CMD_1: Command C008	200 036	
CMD_1: Command C009	200 041	
CMD_1: Command C010	200 046	
CMD_1: Command C011	200 051	
CMD_1: Command C012	200 056	

Single-pole signals

SIG_1: Signal S001 EXT	226 004	Fig: 3-302
SIG_1: Logic signal S001	226 005	Fig: 3-302
SIG_1: Signal S002 EXT	226 012	
SIG_1: Logic signal S002	226 013	
SIG_1: Signal S003 EXT	226 020	
SIG_1: Logic signal S003	226 021	
SIG_1: Signal S004 EXT	226 028	
SIG_1: Logic signal S004	226 029	
SIG_1: Signal S005 EXT	226 036	
SIG_1: Logic signal S005	226 037	
SIG_1: Signal S006 EXT	226 044	
SIG_1: Logic signal S006	226 045	
SIG_1: Signal S007 EXT	226 052	
SIG_1: Logic signal S007	226 053	
SIG_1: Signal S008 EXT	226 060	
SIG_1: Logic signal S008	226 061	
SIG_1: Signal S009 EXT	226 068	
SIG_1: Logic signal S009	226 069	
SIG_1: Signal S010 EXT	226 076	
SIG_1: Logic signal S010	226 077	
SIG_1: Signal S011 EXT	226 084	
SIG_1: Logic signal S011	226 085	
SIG_1: Signal S012 EXT	226 092	
SIG_1: Logic signal S012	226 093	

8.1.2 Control and Testing

Device

DVICE: Service info 031 080	031 080	

Local control panel

LOC: Param. change enabl.	003 010	
Setting the enable for changing values from the local control panel.		

Communication interface 1

COMM1: Sel.spontan.sig.test	003 180	Fig: 3-15
Signal selection for testing purposes.		
COMM1: Test spont.sig.start	003 184	Fig: 3-15
Triggering of transmission of a selected signal as "starting".		
COMM1: Test spont.sig. end	003 186	Fig: 3-15
Triggering of transmission of a selected signal as "ending".		

Communication interface 2

COMM2: Sel.spontan.sig.test	103 180	Fig: 3-17
Signal selection for testing purposes.		
COMM2: Test spont.sig.start	103 184	Fig: 3-17
Triggering of transmission of a selected signal as "starting".		
COMM2: Test spont.sig. end	103 186	Fig: 3-17
Triggering of transmission of a selected signal as "ending".		

Communication interface 3

COMM3: Rset.No.tlg.err.USER	120 037	Page: 3-29
COMM3: Send signal for test	120 050	Page: 3-29
COMM3: Log. state for test	120 051	Page: 3-29
COMM3: Send signal, test	120 053	Page: 3-29
COMM3: Loop back send	120 055	Page: 3-29
COMM3: Loop back test	120 054	Page: 3-29
COMM3: Hold time for test	120 052	Page: 3-29

IEC Generic Substation Status Events

GSSE: Reset statistics	105 171	
Command to reset monitoring counters as listed below.		
GSSE: Enroll. IEDs flags L	105 160	
Bar with state bits for all GSSE inputs, showing if the respective GSSE sending device has logged-on and is transmitting free of fault (input 1 to 16).		
GSSE: Enroll. IEDs flags H	105 161	
Bar with state bits for all GSSE inputs, showing if the respective GSSE sending device has logged-on and is transmitting free of fault (input 17 to 32).		
GSSE: Tx message counter	105 162	
Shows the number of GSSE messages sent. This counter is reset by GSSE: Reset counters.		
GSSE: Rx message counter	105 163	
Shows the number of GSSE messages received. This counter is reset by GSSE: Reset counters.		

GSSE: No. bin.state chang. 105 164

Number of state changes included in a GSSE sent. This counter is reset by GSSE: Reset counters.

GSSE: Tx last sequence 105 165

State of the continuous counter sequence for the message counter sent with each GSSE.

GSSE: Tx last message 105 166

State of the continuous counter sequence for state changes sent with each GSSE.

GSSE: No. reject. messages 105 167

Number of telegram rejections having occurred because of non-plausible message content. This counter is reset by GSSE: Reset counters.

GSSE: IED view selection 105 170

Setting for which GSSE sending device the following statistics information is to be displayed.

GSSE: IED receiv. messages 105 172

Counter of the received GSSE telegrams.

GSSE: IED Rx last sequence 105 173

State of the continuous counter sequence for the message counter received with each GSSE.

GSSE: IED Rx last message 105 174

State of the continuous counter sequence for state changes received with each GSSE.

GSSE: IED missed messages 105 175

Number of missing GSSE messages (gaps in the continuous sequence numbering). This counter is reset by GSSE: Reset counters.

GSSE: IED missed changes 105 176

Number of missing state changes (gaps in the continuous sequence numbering). This counter is reset by GSSE: Reset counters.

GSSE: IED time-outs 105 177

Number of GSSE received after the validity time period has elapsed. This counter is reset by GSSE: Reset counters.

Measured data input

MEASI: Reset Tmax USER 003 045

Resetting of measured maximum temperatures Tmax and Tmax Tx (x=1...9) to the updated measured values.

Binary outputs

OUTP: Reset latch. USER 021 009 Fig: 3-32

Reset of latched output relays from the local control panel.

OUTP: Relay assign. f.test 003 042 Fig: 3-33

Selection of an output relay to be tested.

OUTP: Relay test 003 043 Fig: 3-33

The output relay selected for testing is triggered for the duration of the set time (OUTP: Hold-time for test).

This control action is password-protected (see section entitled 'Password-Protected Control Operations' in Chapter 6).

OUTP: Hold-time for test 003 044 Fig: 3-33

Setting the time period for which the selected output relay is triggered during functional testing.

Measured data output

MEASO: Reset output USER 037 116 Fig: 3-36

Resetting the measured data output function.

Main function

MAIN: Enable syst. IN USER 003 142 Fig: 3-60

Enabling the residual current stages of the DTOC/IDMT_x protection.

MAIN: Disable syst.IN USER 003 141 Fig: 3-60

Disabling the residual current stages of the DTOC/IDMT_x protection.

MAIN: General reset USER 003 002 Fig: 3-82

Reset of the following memories:

☐ All counters
☐ LED indicators
☐ Operating data memory
☐ All event memories
☐ Event counters
☐ Fault data
☐ Measured overload data
☐ Recorded fault values

This control action is password-protected (see section entitled 'Password-Protected Control Operations' in Chapter 6).

MAIN: Reset indicat. USER 021 010 Fig: 3-82

Reset of the following displays:

☐ LED indicators

☐ Fault data

MAIN: Rset.latch.trip USER 021 005 Fig: 3-74

Reset of latched trip commands from the local control panel.

MAIN: Reset c. cl/tr.cUSER 003 007 Fig: 3-76

The counters for counting close and trip commands are reset.

MAIN: Reset IP,max,st.USER 003 033 Fig: 3-47

The display of the stored maximum phase current is reset.

MAIN: Reset meas.v.en.USER 003 032 Fig: 3-57

The display of active and reactive energy output and input is reset.

MAIN: Group reset 1 USER 005 253 Fig: 3-83
MAIN: Group reset 2 USER 005 254 Fig: 3-83

Group of resetting commands.

MAIN: Man. trip cmd. USER 003 040 Fig: 3-75

A 100 ms trip command is issued from the local control panel. This setting is password-protected (see section entitled 'Password-Protected Control Operations' in Chapter 6).

Note:
The command is only executed if the manual trip command has been configured as trip command 1 or 2.

MAIN: Man. close cmd. USER 018 033 Fig: 3-67

A close command is issued from the local control panel for the set reclose command time. This setting is password-protected (see section entitled 'Password-Protected Control Operations' in Chapter 6).

MAIN: Warm restart 003 039

A warm restart is carried out. The device functions as it does when the power supply is turned on.

MAIN: Cold restart 000 085

A cold restart is carried out. This setting is password-protected (see section entitled 'Password-Protected Control Operations' in Chapter 6). A cold restart means that all settings and recordings are cleared. The values with which the device operates after a cold restart are selected so as to block the device after a cold restart.

Operating data recording

OP_RC: Reset record. USER 100 001 Fig: 3-88

The operating data memory and the counter for operation signals are reset.

Monitoring signal recording

MT_RC: Reset record. USER 003 008 Fig: 3-89

Reset of the monitoring signal memory.

Overload recording

OL_RC: Reset record. USER 100 003 Fig: 3-94

Reset of the overload memory.

Ground fault recording

GF_RC: Reset record. USER 100 000 Fig: 3-103

Reset of the ground fault memory.

8 Information and Control Functions

(continued)

Fault recording

FT_RC: Trigger USER 003 041 Fig: 3-111

Fault recording is enabled from the local control panel for 500 ms.

FT_RC: Reset record. USER 003 006 Fig: 3-112

Reset of the following memories:

☐ LED indicators

☐ Fault memory

☐ Fault counter

☐ Fault data

☐ Recorded fault values

Protective signaling

PSIG: Enable USER 003 132 Fig: 3-148

Protective signaling is enabled from the local control panel.

PSIG: Disable USER 003 131 Fig: 3-148

Protective signaling is disabled from the local control panel.

PSIG: Test telecom. USER 015 009 Fig: 3-150

A send signal is issued for 500 ms.

Auto-reclosing control

ARC: Enable USER 003 134 Fig: 3-154

The auto-reclosing control function is enabled from the local control panel.

ARC: Disable USER 003 133 Fig: 3-154

The auto-reclosing control function is disabled from the local control panel.

ARC: Test HSR A-B-C USER 011 066 Fig: 3-168

A three-pole test HSR is triggered.

ARC: Reset counters USER 003 005 Fig: 3-170

The ARC counters are reset.

Automatic synchronism check

ASC: Enable USER 003 136 Fig: 3-172

Automatic synchronism check is enabled from the local control panel.

ASC: Disable USER 003 135 Fig: 3-172

Automatic synchronism check is disabled from the local control panel.

ASC: Reset counters USER 003 089 Fig: 3-182

The ASC counters are reset.

ASC: Test close requ.USER 018 005 Fig: 3-174

A close request is issued from the integrated local control panel. This will trigger the ASC functional operation. No close command is transmitted to the CB if the check of the ASC is positive. Only a signal is issued.

ASC: Close request USER 018 004 Fig: 3-174

A close request is issued from the integrated local control panel. This will trigger the ASC functional operation. A close command is transmitted to the CB if the ASC check is positive.

This control action is password-protected (see section entitled 'Password-Protected Control Operations' in Chapter 6).

Ground fault direction determination using steady-state values

GFDSS: Reset counters USER 003 004 Fig: 3-190, 3-196

The counters for the ground fault direction determination function using steady-state values are reset.

Transient ground fault direction determination

TGFD: Reset signal USER 003 009 Fig: 3-201

The direction decisions can be reset while the buffer time is elapsing.

TGFD: Reset counters USER 003 022 Fig: 3-203

The counters for the transient ground fault direction determination function are reset.

Motor protection

MP: Reset replica USER 022 073 Fig: 3-212

Resetting the thermal replica of the motor protection function.

MP: Initialize Hours_Run 025 151

In order to set the default value for the operating hours, this parameter should be set to 'execute'.

MP: Init. val. Hours_Run 025 154

Setting for the default value of the operating hours counter.

Thermal overload protection

THERM: Reset replica USER 022 061 Fig: 3-219

Resetting the thermal replica of the thermal overload protection function.

Over-/underfrequency protection

f<>: Reset meas.val. USER 003 080

Resetting the measured event values `f<>: max. frequ. for f>` and `f<>: min. frequ. for f<`.

Circuit Breaker Failure Protection

CBF: Enable USER 003 016

Circuit breaker failure protection is enabled from the local control panel.

CBF: Disable USER 003 015 Fig: 3-250

Circuit breaker failure protection is disabled from the local control panel.

Circuit Breaker Monitoring

CBM: Initialize values	003 011	Fig: 3-265
Setting default values.		
CBM: Reset meas.val. USER	003 013	Fig: 3-265
Resetting the measured value memories.		
CBM: Set No. CB oper. A	022 131	Fig: 3-265
CBM: Set No. CB oper. B	022 132	
CBM: Set No. CB oper. C	022 133	
Set the number of CB operations.		
CBM: Set remain. CB op. A	022 134	Fig: 3-265
CBM: Set remain. CB op. B	022 135	
CBM: Set remain. CB op. C	022 136	
Set the remaining CB operations.		
CBM: Set ΣItrip A	022 137	Fig: 3-265
CBM: Set ΣItrip B	022 138	
CBM: Set ΣItrip C	022 139	
CBM: Set ΣItrip**2 A	022 140	Fig: 3-265
CBM: Set ΣItrip**2 B	022 141	
CBM: Set ΣItrip**2 C	022 142	
CBM: Set ΣI*t A	022 143	Fig: 3-265
CBM: Set ΣI*t B	022 144	
CBM: Set ΣI*t C	022 145	
Set the limit values for the ruptured currents and their squares. (An alarm is displayed if these limit values are exceeded.)		

Logic

LOGIC: Trigger 1	034 038	Fig: 3-284
LOGIC: Trigger 2	034 039	
LOGIC: Trigger 3	034 040	
LOGIC: Trigger 4	034 041	
LOGIC: Trigger 5	034 042	
LOGIC: Trigger 6	034 043	
LOGIC: Trigger 7	034 044	
LOGIC: Trigger 8	034 045	Fig: 3-284
Intervention in the logic at the appropriate point of a 100 ms pulse.		

8.1.3 Operating data recording

Operating data recording

OP_RC: Operat. data record.	003 024	Fig: 3-88
Point of entry into the operating data log.		

Monitoring signal recording

MT_RC: Mon. signal record.	003 001	Fig: 3-89
Point of entry into the monitoring signal log.		

8.2 Events

8.2.1 Event counters

Communication interface 3

COMM3: No. telegram errors 120 042 Page: 3-29

Main function

MAIN: No. general start. 004 000 Fig: 3-72

Number of general starting signals.

MAIN: CB1 act. oper. cap. 221 087 Page: 3-421

Setting for the maximum number of switching operations within an ARC cycle (or within a limited period).

MAIN: No. gen.trip cmds. 1 004 006 Fig: 3-76

Number of general trip commands 1.

MAIN: No. gen.trip cmds. 2 009 050 Fig: 3-76

Number of general trip commands 2.

MAIN: No. close commands 009 055 Fig: 3-67

Number of close commands.

MAIN: No.overfl.act.en.out 009 090 Fig: 3-57

Counter for the number of times the measuring range of the active energy output was exceeded.

MAIN: No.overfl.act.en.inp 009 091 Fig: 3-57

Counter for the number of times the measuring range of the active energy input was exceeded.

MAIN: No.ov/fl.reac.en.out 009 092 Fig: 3-57

Counter for the number of times the measuring range of the reactive energy output was exceeded.

MAIN: No.ov/fl.reac.en.inp 009 093 Fig: 3-57

Counter for the number of times the measuring range of the reactive energy input was exceeded.

Operating data recording

OP_RC: No. oper. data sig. 100 002 Fig: 3-88

Number of signals stored in the operating data memory.

Monitoring signal recording

MT_RC: No. monit. signals 004 019 Fig: 3-89

Number of signals stored in the monitoring signal memory.

Overload recording

OL_RC: No. overload 004 101 Fig: 3-93

Number of overload events.

Ground fault recording

GF_RC: No. ground faults 004 100 Fig: 3-102

Number of ground faults.

Fault recording

FT_RC: No. of faults 004 020 Fig: 3-111

Number of faults.

FT_RC: No. system disturb. 004 010 Fig: 3-111

Number of system disturbances.

Auto-reclosing control

ARC: Number HSR A-B-C 004 007 Fig: 3-170

Number of high-speed reclosures.

ARC: Number TDR 004 008 Fig: 3-170

Number of time-delay reclosures.

Automatic synchronism check

ASC: No. RC aft. man.clos 004 009 Fig: 3-182

Number of reclosures after a manual close request.

ASC: No. close requests 009 033 Fig: 3-182

Number of close requests.

ASC: No. close rejections 009 034 Fig: 3-182

Number of close rejections.

Ground fault direction determination using steady-state values

GFDSS: No. GF power/admitt. 009 002 Fig: 3-196

Number of ground faults detected by steady-state power evaluation.

GFDSS: No. GF (curr. meas) 009 003 Fig: 3-190

Number of ground faults detected by steady-state current evaluation.

GFDSS: No. GF admitt. Y(N) 009 060 Fig: 3-196

Number of ground faults (non-directional) detected by the admittance evaluation method.

GFDSS: No. GF forward/LS 009 000 Fig: 3-196

Number of ground faults in the forward direction.

GFDSS: No. GF backward/BS 009 001 Fig: 3-196

Number of ground faults in the backward direction.

Transient ground fault direction determination

TGFD: No. GF 004 015 Fig: 3-203

Number of transient ground faults.

TGFD: No. GF forward/LS 004 013 Fig: 3-203

Number of transient ground faults in the forward direction.

TGFD: No. GF backward/BS 004 014 Fig: 3-203

Number of ground faults in the backward direction.

Motor protection

MP: No. of start-ups 004 011 Fig: 3-211

Number of motor startups since the last reset.

MP: No. of hours run 025 150

Number of operating hours since the last reset.

Circuit Breaker Monitoring

CBM: No. of CB oper. A **CBM: No. of CB oper. B** **CBM: No. of CB oper. C**	008 011 008 012 008 013	Fig: 3-265 Fig: 3-267 Fig: 3-267
Number of mechanical switching operations made.		
CBM: Remain. No. CB op. A **CBM: Remain. No. CB op. B** **CBM: Remain. No. CB op. C**	008 014 008 015 008 016	Fig: 3-265 Fig: 3-266 Fig: 3-266
Number of remaining switching operations (as shown by evaluating wear with reference to the CB wear characteristic).		

8.2.2 Measured event data

Overload data acquisition

OL_DA: Overload duration 004 102 Fig: 3-90

Duration of the overload event.

OL_DA: T.taken f.startup,MP 005 096 Fig: 3-91

Display of the motor startup time.

OL_DA: Start-up current, MP 005 098 Fig: 3-91

Display of the motor startup current.

OL_DA: Heat.dur.start-up,MP 005 097 Fig: 3-91

Display of startup heating in motor protection.

OL_DA: Status THERM replica 004 147 Fig: 3-92

Display of the buffer content of the thermal overload protection function.

OL_DA: Load current THERM 004 058 Fig: 3-92

Display of the load current used by the thermal overload protection function to calculate the tripping time.

OL_DA: Object temp. THERM 004 035 Fig: 3-92

Display of the temperature of the protected object.

OL_DA: Coolant temp. THERM 004 036 Fig: 3-92

Display of the coolant temperature depending on the setting at THERM: Select CTA.
When set to *"Default temp. value"* the set temperature value will be displayed. When set to "*From PT 100*" the temperature measured by the resistance thermometer will be displayed. When set to "*From 20 mA input*" the temperature measured via a 20 mA transducer will be displayed.

OL_DA: Pre-trip t.leftTHERM 004 148 Fig: 3-92

Display of the time remaining before the thermal overload protection function will reach the tripping threshold.

OL_DA: Offset THERM replica 004 154 Fig: 3-92

Display of the additional reserve if the coolant temperature is taken into account. This display is relevant if the coolant temperature has been set to a value below the maximum permissible coolant temperature or, in other words, if the thermal model has been shifted downwards.

If the coolant temperature and the maximum permissible coolant temperature have been set to the same value, then the coolant temperature is not taken into account and the characteristic is a function of the current only. The additional reserve amounts to 0 in this case.

Ground fault data acquisition

GF_DA: Ground flt. duration 009 100 Fig: 3-95

Display of the ground fault duration of the most recent ground fault.

GF_DA: GF duration pow.meas 009 024 Fig: 3-96

Display of the ground fault duration of the most recent ground fault as determined by the steady-state power evaluation feature of the ground fault direction determination function.

GF_DA: Voltage VNG p.u. 009 020 Fig: 3-97, 3-101

Display of the neutral-point displacement voltage of the most recent ground fault referred to V_{nom}.

Note:
This display is only active when the steady-state power evaluation mode of the GFDSS ground fault direction determination function is enabled.

GF_DA: Current IN p.u. 009 021 Fig: 3-97, 3-99, 3-101

Display of the residual current of the most recent ground fault referred to $I_{N,nom}$.

Note:
This display is only active when the ground fault direction determination function using steady state values (GFDSS) is enabled.

GF_DA: Curr. IN,act p.u. 009 022 Fig: 3-97

Display of the active component of the residual current of the most recent ground fault referred to $I_{N,nom}$.

Note:
This display is only active when the steady-state power evaluation mode of the GFDSS ground fault direction determination function is enabled.

GF_DA: Curr. IN,reac p.u. 009 023 Fig: 3-97

Display of the reactive component of the residual current of the most recent ground fault referred to $I_{N,nom}$.

Note:
This display is only active when the steady-state power evaluation mode of the GFDSS ground fault direction determination function is enabled.

GF_DA: GF durat. curr.meas. 009 026 Fig: 3-98

Display of the ground fault duration of the most recent ground fault as determined by the steady-state current evaluation feature of the ground fault direction determination function.

GF_DA: Curr. IN filt. p.u. 009 025 Fig: 3-99

Display of the residual current component having the set filter frequency for the most recent ground fault (referred to $I_{N,nom}$).

GF_DA: GF duration admitt. 009 068 Fig: 3-100

Display of the ground fault duration of the most recent ground fault as determined by the admittance evaluation mode of the ground fault direction determination function.

GF_DA: Admittance Y(N) p.u. 009 065 Fig: 3-101

Display of the admittance value referred to $Y_{N,nom}$.
With setting: GFDSS: Evaluation VNG is set to ”*Measured*”:
$Y_{N,nom} = I_{N,nom} / V_{NGnom}$
With setting: GFDSS: Evaluation VNG is set to ”*Calculated*”:
$Y_{N,nom} = I_{N,nom} / V_{nom}$

GF_DA: Conduct. G(N) p.u. 009 066 Fig: 3-101

Display of the conductance value referred to $Y_{N,nom}$.
With setting: GFDSS: Evaluation VNG is set to "*Measured*":
$Y_{N,nom} = I_{N,nom} / V_{NGnom}$
With setting: GFDSS: Evaluation VNG is set to "*Calculated*":
$Y_{N,nom} = I_{N,nom} / V_{nom}$

GF_DA: Suscept. B(N) p.u. 009 067 Fig: 3-101

Display of the susceptance value referred to $Y_{N,nom}$.
With setting: GFDSS: Evaluation VNG is set to "*Measured*":
$Y_{N,nom} = I_{N,nom} / V_{NGnom}$
With setting: GFDSS: Evaluation VNG is set to "*Calculated*":
$Y_{N,nom} = I_{N,nom} / V_{nom}$

Fault data acquisition

FT_DA: Fault duration 008 010 Fig: 3-104

Display of the fault duration.

FT_DA: Running time 004 021 Fig: 3-104

Display of the running time.

FT_DA: Fault current P p.u. 004 025 Fig: 3-108

Display of phase current A referred to I_{nom}.

FT_DA: Flt.volt. PG/PP p.u. 004 026 Fig: 3-108

Display of the calculated neutral-point displacement voltage referred to V_{nom} .

FT_DA: Fault loop angle P 004 024 Fig: 3-108

Display of the fault angle.

FT_DA: Fault curr. N p.u. 004 049 Fig: 3-108

Display of the ground fault current referred to $I_{N,nom}$.

FT_DA: Fault loop angle N 004 048 Fig: 3-108

Display of the ground fault angle.

FT_DA: Meas. loop selected 004 079 Fig: 3-108

Display of the measuring loop selected for determination of fault data.

FT_DA: Fault react., prim. 004 029 Fig: 3-108

Display of the fault reactance as a primary quantity.

FT_DA: Fault reactance,sec. 004 028 Fig: 3-108

Display of the fault reactance as a secondary quantity.

FT_DA: Fault impedance, sec 004 023 Fig: 3-108

Display of the fault impedance as a secondary quantity.

FT_DA: Fault locat. percent 004 027 Fig: 3-37, 3-109

Display of the fault location of the last fault (in %) referred to the setting FT_DA: Line reactance PSx.

FT_DA: Fault location 004 022 Fig: 3-109

Display of the fault location of the last fault in km.

FT_DA: Load imped.post-flt. 004 037 Fig: 3-110

Display of the load impedance (in Ω) after the general starting condition of time-overcurrent protection has ended.
The display only appears if the fault has been detected by the fault data acquisition function of the P132.

FT_DA: Load angle post-flt. 004 038 Fig: 3-110

Display of the load angle (in degrees) after the general starting condition of time-overcurrent protection has ended.
The display only appears if the fault has been detected by the fault data acquisition function of the P132.

FT_DA: Resid.curr. post-flt 004 039 Fig: 3-110

Display of the residual current referred to I_{nom} after the general starting condition of time-overcurrent protection has ended.
The display only appears if the fault has been detected by the fault data acquisition function of the P132.

Automatic synchronism check

ASC: Voltage Vref 004 087 Fig: 3-181
ASC: Volt. sel. meas.loop 004 088 Fig: 3-181
ASC: Volt. magnit. diff. 004 091 Fig: 3-177, 3-181

Display of the difference between amplitudes of the measurement loop voltage and the reference voltage during a close request, referred to V_{nom}.
The display only appears if ASC is operating.

ASC: Angle difference 004 089 Fig: 3-177, 3-181

Display of the difference between angles (in degrees) of the measurement loop voltage and the reference voltage during a close request.
The display only appears if ASC is operating.

ASC: Frequ. difference 004 090 Fig: 3-177, 3-181

Display of the difference between frequencies (in Hz) of the measurement loop voltage and the reference voltage during a close request.

The display only appears if ASC is operating.

Over-/underfrequency protection

f<>: Max. frequ. for f> 005 002

Maximum frequency during an overfrequency condition.

f<>: Min. frequ. for f< 005 001

Minimum frequency during an underfrequency condition.

Circuit Breaker Monitoring	CBM: Itrip,prim A	009 212	Fig: 3-265
	CBM: Itrip,prim B	009 213	
	CBM: Itrip,prim C	009 214	
	CBM: Itrip A	009 047	Fig: 3-265
	CBM: Itrip B	009 048	
	CBM: Itrip C	009 049	
	CBM: Itrip**2 A	009 051	Fig: 3-265
	CBM: Itrip**2 B	009 052	
	CBM: Itrip**2 C	009 053	
	Ruptured currents and their squared values.		
	CBM: ΣItrip A	009 071	Fig: 3-265
	CBM: ΣItrip B	009 073	
	CBM: ΣItrip C	009 076	
	CBM: ΣItrip**2 A	009 077	Fig: 3-265
	CBM: ΣItrip**2 B	009 078	
	CBM: ΣItrip**2 C	009 079	
	CBM: I*t A	009 061	Fig: 3-265
	CBM: I*t B	009 062	
	CBM: I*t C	009 063	
	CBM: ΣI*t A	009 087	Fig: 3-265
	CBM: ΣI*t B	009 088	
	CBM: ΣI*t C	009 089	
	Sum of the ruptured currents and of their squared values.		

8.2.3 Event recording

Overload recording

OL_RC: Overload recording 1	033 020	Fig: 3-94
OL_RC: Overload recording 2	033 021	Fig: 3-94
OL_RC: Overload recording 3	033 022	Fig: 3-94
OL_RC: Overload recording 4	033 023	Fig: 3-94
OL_RC: Overload recording 5	033 024	Fig: 3-94
OL_RC: Overload recording 6	033 025	Fig: 3-94
OL_RC: Overload recording 7	033 026	Fig: 3-94
OL_RC: Overload recording 8	033 027	Fig: 3-94

Point of entry into the overload log.

Ground fault recording

GF_RC: Ground flt.record. 1	033 010	Fig: 3-103
GF_RC: Ground flt.record. 2	033 011	Fig: 3-103
GF_RC: Ground flt.record. 3	033 012	Fig: 3-103
GF_RC: Ground flt.record. 4	033 013	Fig: 3-103
GF_RC: Ground flt.record. 5	033 014	Fig: 3-103
GF_RC: Ground flt.record. 6	033 015	Fig: 3-103
GF_RC: Ground flt.record. 7	033 016	Fig: 3-103
GF_RC: Ground flt.record. 8	033 017	Fig: 3-103

Point of entry into the ground fault log.

Fault recording

FT_RC: Fault recording 1	003 000	Fig: 3-112
FT_RC: Fault recording 2	033 001	Fig: 3-112
FT_RC: Fault recording 3	033 002	Fig: 3-112
FT_RC: Fault recording 4	033 003	Fig: 3-112
FT_RC: Fault recording 5	033 004	Fig: 3-112
FT_RC: Fault recording 6	033 005	Fig: 3-112
FT_RC: Fault recording 7	033 006	Fig: 3-112
FT_RC: Fault recording 8	033 007	Fig: 3-112

Point of entry into the fault log.

9 Commissioning

9 Commissioning

9.1 Safety Instructions

Only qualified personnel, familiar with the "Warning" page at the beginning of this manual, may work on or operate this device.

The device must be reliably grounded before auxiliary voltage is turned on.

The surface-mounted case is grounded using the bolt and nut, appropriately marked, as the ground connection. The flush-mounted case must be grounded in the area of the rear sidepieces at the location provided. The cross-section of the ground conductor must conform to applicable national standards. A minimum cross section of 2.5 mm^2 is required.

In addition, a protective ground connection at the terminal contact on the power supply module (identified by the letters "PE" on the terminal connection diagram) is also required for proper operation of the device. The cross-section of this ground conductor must also conform to applicable national standards. A minimum cross section of 1.5 mm^2 is required.

Before working on the device itself or in the space where the device is connected, always disconnect the device from the supply.

The secondary circuit of live system current transformers must not be opened! If the secondary circuit of a live CT is opened, there is the danger that the resulting voltages will endanger personnel and damage the insulation.

The threaded terminal block for connection to the current transformers is not a shorting block. Therefore always short-circuit current transformers before loosening the threaded terminals.

The power supply must be turned off for at least 5 s before power supply module V is removed. Otherwise there is the danger of an electric shock.

When increased-safety machinery is located in a hazardous area the P132 must always be installed outside of this hazardous area.

⚠

The fiber-optic interface may only be connected or disconnected when the supply voltage for the device is shut off.

⚠

The PC interface is not designed for permanent connection. Consequently, the female connector does not have the extra insulation from circuits connected to the system that is required per VDE 0106 Part 101. Therefore, when connecting the prescribed connecting cable be careful not to touch the socket contacts.

⚠

Application of analog signals to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see chapter entitled 'Technical Data')

⚠

When using the programmable logic (function group LOGIC), the user must carry out a functional type test to conform to the requirements of the relevant protection/control application. In particular, it is necessary to verify that the requirements for the implementation of logic linking (by setting) as well as the time performance during device startup, during operation and when there is a fault (device blocking) are fulfilled.

9.2 Commissioning Tests

Preparation

After the P132 has been installed and connected as described in Chapter 5, the commissioning procedure can begin.

Before turning on the power supply voltage, the following items must be checked again:

☐ Is the device connected to the protective ground at the specified location?

☐ Does the nominal voltage of the battery agree with the nominal auxiliary voltage of the device?

☐ Are the current and voltage transformer connections, grounding, and phase sequences correct?

After the wiring work is completed, check the system to make sure it is properly isolated. The conditions given in VDE 0100 must be satisfied.

Once all checks have been made, the power supply voltage may be turned on. After voltage has been applied, the device starts up. During startup, various startup tests are carried out (see Chapter 3, ‘Self-Monitoring’). The LED indicators for ‘Operation’ (H1) and ‘Blocked/Faulty’ (H2) will light up. After approximately 15 s, the P132 is ready for operation. By default (factory setting) or after a cold restart, the device type "P132" and the time are displayed on the first line of the LCD after the device has started up.

Once the change enabling command has been issued (see Chapter 6, ‘Enabling parameter changes’), all settings can be entered. The procedure for entering settings from the integrated local control panel is described in Chapter 6.

Note: **For devices with control functions (Order option):**
First the type of bay wanted is to be set at MAIN: Type of bay, 'Par/Conf/' folder. When the automatic assignment has been enabled at MAIN: Auto-assignment I/O then selecting the type of bay will automatically configure binary signal inputs and output relays according to the definitions corresponding to the bay type (see 'List of Bay Types' in the Appendix).

After pressing the ENTER key to confirm the setting parameter 'Type of bay' the signal 'Bay initialization' is displayed on the LCD for a time duration of 20 s. The LED indicator labeled EDIT MODE will light up. A control action is not possible during this time period.

If either the PC interface or the communication interface will be used for setting the P132 and reading out event records, then the following settings must first be made from the integrated local control panel.

- ☐ 'Par/DvID/' folder:
  - DVICE: Device password 1
  - DVICE: Device password 2
- ☐ 'Par/Conf/' folder:
  - PC: Name of manufacturer
  - PC: Bay address
  - PC: Device address
  - PC: Baud rate
  - PC: Parity bit
  - COMM1: Function group COMM1
  - COMM1: General enable USER
  - COMM1: Name of manufacturer
  - COMM1: Line idle state
  - COMM1: Baud rate
  - COMM1: Parity bit
  - COMM1: Communicat. protocol
  - COMM1: Octet comm. address
  - COMM1: Octet address ASDU
  - COMM2: Function group COMM2
  - COMM2: General enable USER
  - COMM2: Name of manufacturer
  - COMM2: Line idle state
  - COMM2: Baud rate
  - COMM2: Parity bit
  - COMM2: Octet comm. address
  - COMM2: Octet address ASDU
  - COMM3: Function group COMM3
  - COMM3: General enable USER
  - COMM3: Baud rate

- ☐ ‘Par/Func/Glob/’ folder:
  - PC: Command blocking
  - PC: Sig./meas.val.block.
  - COMM1: Command block. USER
  - COMM1: Sig./meas.block.USER
  - COMM2: Command block. USER
  - COMM2: Sig./meas.block.USER

Instructions on these settings are given in Chapters 7 and 8.

Note: The settings given above apply to the IEC 60870-5-103 communication protocol. If another protocol is being used for the communication interface, additional settings may be necessary. See Chapter 7 for further details.

After the settings have been made, the following checks should be carried out again before the blocking is cancelled:

☐ For devices with control functions (Order option):
Is the correct type of bay type configured?

☐ Does the function assignment of the binary signal inputs agree with the terminal connection diagram?

☐ Has the correct operating mode been selected for the binary signal inputs?

☐ Does the function assignment of the output relays agree with the terminal connection diagram?

☐ Has the correct operating mode been selected for the output relays?

☐ For devices with control functions (Order option):
Are the interlocking conditions and the external interlock inputs correctly configured?

☐ Have all settings been made correctly?

Now blocking can be cleared as follows (‘Par/Func/Glob/’ folder):

☐ MAIN: Device on-line *'Yes' (on)'*

Tests

By using the signals and displays generated by the P132, it is possible to determine whether the P132 is correctly set and properly interconnected with the station. Signals are signaled by output relays and LED indicators and entered into the event memory. In addition, the signals can be checked by selecting the appropriate signal in the menu tree.

If the user does not wish the circuit breaker to operate during protection testing, the trip commands can be blocked through MAIN: Trip cmd. block. USER ('Par/Func/Glob' folder) or an appropriately configured binary signal input. If circuit breaker testing is desired, it is possible to issue a trip command for 100 ms through MAIN: Man. Trip cmd. USER (‘Oper/CtrlTest’ folder) or an appropriately configured binary signal input. Selection of the trip command from the integrated local control panel is password-protected (see Chapter 6, "Password-Protected Control Operations").

Note: The manual trip command is only executed if it has been configured for trip command 1 or trip command 2.

If the P132 is connected at substation control level, the user is advised to activate the test mode via MAIN: Test mode USER (folder ‘Par/Func/Glob’) or an appropriately configured binary signal input. The telegrams are then identified accordingly (reason for transmission: test mode).

Checking the binary signal inputs

By selecting the corresponding state signal (‘Oper/Cycl/Phys’ folder), it is possible to determine whether the input signal that is present is recognized correctly by the device. The values displayed have the following meanings:

- "*Low*": Not energized.
- "*High*": Energized.
- "*Without function*": No functions are assigned to the binary signal input.

This display appears regardless of the binary signal input mode selected.

Checking the output relays

It is possible to trigger the output relays for a settable time period for test purposes (time setting at OUTP: Hold-time for test in ‘Oper/CtrlTest/’ folder). First select the output relay to be tested (OUTP: Relay assign. f. test, ‘Oper/CtrlTest/’ folder). Test triggering then occurs via OUTP: Relay test (‘Oper/CtrlTest/’ folder).
It is password-protected (see Chapter 6, ‘Password-Protected Control Operations’).

Before starting the test, open any triggering circuits for external devices so that no inadvertent switching operations will take place.

Checking the current-measuring inputs

By injecting appropriate analog test values at the measuring inputs it is possible to check, by taking a readout from the operating data display (see Chapter 8 "Information and Control Functions”), whether the Time-Overcurrent Protection and Control Unit will detect such analog signals within the required class accuracy (‘Oper/Cycl/Meas’ folder).

- MAIN: Current A p.u.: Display of the updated phase A current in reference to the nominal device current I_{nom}
- MAIN: Current B p.u.: Display of the updated phase B current in reference to the nominal device current I_{nom}
- MAIN: Current C p.u.: Display of the updated phase C current in reference to the nominal device current I_{nom}
- MAIN: Current IN p.u.: Display of the updated residual current I_N in reference to the nominal device current I_{nom}

Application of analog test values to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see Chapter 'Technical Data').

Checking the protection function

Four parameter subsets are stored in the P132, one of which is activated. Before checking the protective function, the user should determine which parameter subset is activated. The active parameter subset is displayed at PSS: Actual param. subset (‘Oper/Cycl/Log/' folder).
When checking the time-overcurrent protection function with a testing device the measuring-circuit monitoring function must be disabled at (MCMON: General enable USER, ‘Par/Func/Main’ folder), as this protection will always be triggered – depending on the setting – and error messages will be issued.

Checking the correct phase connection of current and voltage transformers with load current

The user can check that the connection to the system’s current and voltage transformers involves the correct phase by consulting the operating data displays for load angle (MAIN: Load angle phi A, MAIN: Load angle phi B, and MAIN: Load angle phi C in the ‘Oper/Cycl/Meas/’ folder). In this test it is required that the connection *'Standard'* has been made according to the standard schematic connection diagram shown in Chapter 'Installation and Connection' and that the parameter at MAIN: Conn. meas. circ. IP (‘Par/Funk/Glob’ folder) is set to *'Standard'.* If there is only an ohmic (resistive) load then the load angles for all three phases toward the line must come to approximately 0°. The load angles are only determined if at least 5% of the nominal device current is flowing.

Checking the correct phase connection of the residual current transformer with load current

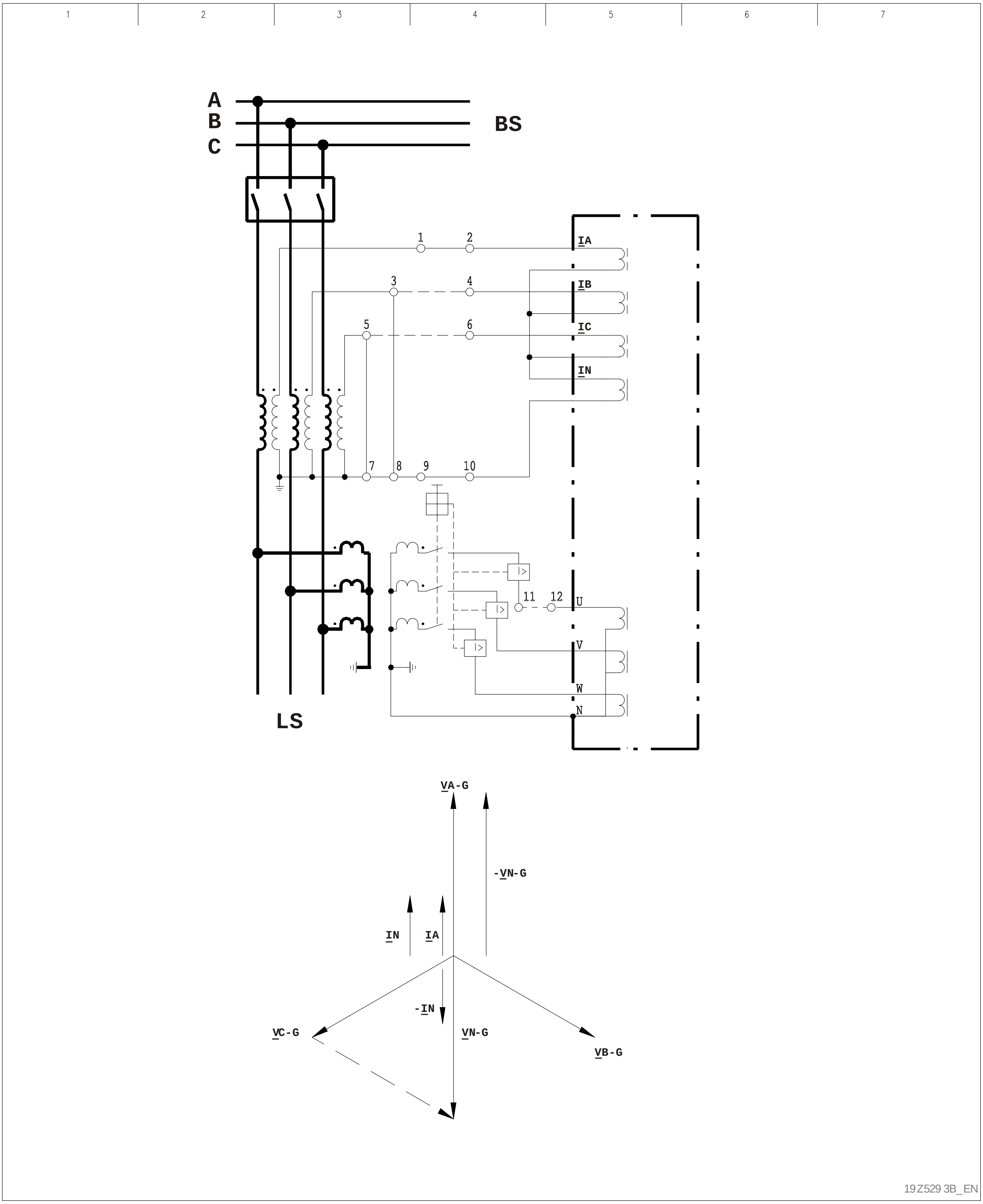
The user can check that the P132 connection to the system's residual current transformer involves the correct phase by consulting the operating data display at MAIN: Load angle phi N ('Oper/Cycl/Meas/' folder). For this the required measured variables V_{N-G} and I_N must be generated. When the connection *'Standard'* has been made according to the standard schematic connection diagram shown in Chapter 'Installation and Connection' and the parameter at MAIN: Conn. meas. circ. IN ('Par/Func/Glob' folder) is set to *'Standard'*, then one phase-to-ground voltage must be opened and the phase currents of the other two phases must be shorted at the same time (see figure 9-1).

The selected phase sequence (alternative terminology: Rotary field) must match the actual phase sequence. If there is only an ohmic (resistive) load then angle φ_N must take on the following values (depending whether the energy flow is towards the line or towards the busbar):

Display	Energy flow towards the line	Energy flow towards the busbar
MAIN: Angle phi N ('Oper/Cycl/Meas' folder)	Approx. 0°	Approx. 180°

Simple check of the correct phase connection of the residual current transformer with load current

In case no system current transformer (e.g. a core balance CT) is available to supply a residual current value then a simple check may be carried out. After a positive check of the correct phase connection of current and voltage transformers and after one of the phase currents has been short-circuited, a phase comparison of the measured residual current value with the total value of all phase currents is carried out. In the event of phase congruence or a positive directional check, the operating panel MAIN: Phase rel.,IN vs ΣIP ('Oper/Cycl/Meas' folder) will display the value '1'. A check of the phase relation will only be carried out if the calculated residual current exceeds the value 0.1 I_{nom}.



9-1 Connection example to generate measured variables

Checking the definite-time overcurrent protection function

A test of the definite-time overcurrent protection can only be carried out when the following conditions are met:

- The DTOC function is activated. This can be determined by checking logic state signal DTOC: Enabled (‘Oper/Cycl/Log/’ folder).
- The function at MAIN: Block tim.st. IN,neg must be set to '*No*' (‘Par/Func/Main/’ folder).
- The function at MAIN: Gen. starting mode is to be set to *'with start. IN, Ineg*' (‘Par/Func/Main/’ folder).
- The short-circuit direction determination function must be disabled. SCDD: General enable USER is to be set to ‘*No*’ (‘Par/Func/Main/’ folder).

By injecting appropriate analog test values at the current measuring inputs it is possible to check the overcurrent stages and their associated timer stages.

Application of analog test values to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see Chapter 'Technical Data').

Checking the inverse-time overcurrent protection function

A test of the inverse-time overcurrent protection can only be carried out when the following conditions are met:

- The IDMT function is activated. This can be determined by checking logic state signal IDMT: Enabled (‘Oper/Cycl/Log/’ folder).
- The function at MAIN: Block tim.st. IN,neg must be set to '*No*' (‘Par/Func/Main/’ folder).
- The function at MAIN: Gen. starting mode is to be set to *'with start. IN, Ineg*' (‘Par/Func/Main/’ folder).
- The short-circuit direction determination function must be disabled. SCDD: General enable USER is to be set to ‘*No*’ (‘Par/Func/Main/’ folder).

By injecting appropriate analog test values at the current measuring inputs it is possible to check the overcurrent stages and their associated timer stages.

Application of analog test values to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see Chapter 'Technical Data').

Tripping times issued by the inverse-time maximum current protection, and dependant on the tripping characteristic selected, are given in the following table:

No.	Tripping Characteristic	Formula for the Tripping Characteristic	Constants			Formula for the Reset Characteristic	
	Characteristic settable factor: $k = 0.05\,to\,10.00$		a	b	c		R
0	Definite Time	$t = k$					
	Per IEC 255-3	$t = k \cdot \frac{a}{\left(\frac{I}{I_{ref}}\right)^{b} - 1}$					
1	Standard Inverse		0.14	0.02			
2	Very Inverse		13.50	1.00			
3	Extremely Inverse		80.00	2.00			
4	Long Time Inverse		120.00	1.00			
	Per IEEE C37.112	$t = k \cdot \frac{a}{\left(\frac{I}{I_{ref}}\right)^{b} - 1} + c$				$t_r = k \cdot \frac{k \cdot R}{\left(\frac{I}{I_{ref}}\right)^{2} - 1}$	
5	Moderately Inverse		0.0515	0.0200	0.1140		4,85
6	Very Inverse		19.6100	2.0000	0.4910		21,60
7	Extremely Inverse		28.2000	2.0000	0.1217		29,10
	Per ANSI	$t = k \cdot \frac{a}{\left(\frac{I}{I_{ref}}\right)^{b} - 1} + c$				$t_r = k \cdot \frac{k \cdot R}{\left(\frac{I}{I_{ref}}\right)^{2} - 1}$	
8	Normally Inverse		8.9341	2.0938	0.17966		9,00
9	Short Time Inverse		0.2663	1.2969	0.03393		0,50
10	Long Time Inverse		5.6143	1.0000	2.18592		15,75
11	RI-Type Inverse	$t = k \cdot \frac{1}{0.339 - \frac{0.236}{\left(\frac{I}{I_{ref}}\right)}}$					
12	RXIDG-Type Inverse	$t = k \cdot \left(5.8 - 1.35 \cdot In \frac{I}{I_{ref}}\right)$					

Checking the short-circuit direction determination: direction of the phase current stages

A system's current and voltage transformers must be simulated by an appropriate testing device. A test of the phase current stages, used with short-circuit direction determination, can only be carried out when the following conditions are met:

☐ The short-circuit direction determination function must be activated (see Chapter 3).

☐ All phase currents exceed 0.1 I_{nom}.

☐ At least two phase-to-phase voltages exceed 200 mV.

☐ The directions for short-circuit direction determination are set to '*forward*'.

When the connection *'Standard'* has been made according to the standard schematic connection diagram shown in Chapter 'Installation and Connection' and the parameter at MAIN: Conn. meas. circ. IP is also set to *'Standard'*, then measurement of the short-circuit direction determination is towards the line. The selected phase sequence (alternative terminology: Rotary field) must match the actual phase sequence. Now the various fault types may simulated with the appropriate starting by the DTOC and IDMT protection by connecting different short-circuit wiring (e.g. Phase A to N). Trip signals issued by the phase current stages are now directional.

Short-Circuit Direction Determination: Checking the direction of the residual current stages

A test of the residual current stages, used with short-circuit direction determination, can only be carried out when the following conditions are met:

☐ The short-circuit direction determination function must be activated (see Chapter 3).

☐ The residual current calculated must exceed 0.01 I_{nom}.

☐ The neutral-point displacement voltage must exceed the trigger value set at SCDD: V_{NG}>.

When the connection *'Standard'* has been made according to the standard schematic connection diagram shown in Chapter 'Installation and Connection' and the parameter at MAIN: Conn. meas. circ. IN is also set to *'Standard'*, then measurement of the short-circuit direction determination is towards the line. The selected phase sequence (alternative terminology: Rotary field) must match the actual phase sequence. Now the various fault types may simulated as described above in the paragraph 'Checking direction of the phase current stages'. Trip signals issued by the residual current stages are now directional.

Checking protective signaling

The protective signaling function can only be tested if protective signaling is ready. Check at the logic state signal PSIG: Ready (‘Oper/Cycl/Log/’ folder).

If protective signaling is not ready, this may be due to the following reasons:

☐ Protective signaling is not enabled.
PSIG: General enable USER is set to *'No'*.

☐ Protective signaling is being blocked by triggering a correspondingly configured binary signal input (PSIG: Blocking EXT).

☐ A fault in the data transmission channel was detected (PSIG: Telecom. faulty).

If conditions for a test are met it is possible to generate, for testing purposes, a 'test send' signal from the integrated local control panel (PSIG: Test telecom. USER) This pulse will be present for 1 s and is extended for the set reset time. The generated 'test send' signal may be checked at the logic state signal
PSIG: Send (transm.relay) .

Checking the auto-reclosing function

The auto-reclosing function (ARC) can only be checked if it is ready. Check at the logic state signal ARC: Ready ('Oper/Cycl/Log/' folder).

If the ARC function is not ready, this may be due to the following reasons:

- ☐ The ARC function is not enabled
  (check at ARC: Enabled ('Oper/Cycl/Log/' folder). This may be due to the following reasons:
  - ■ ARC: General enable USER ('Par/Func/Main/' folder) has been set to '*No*'.
  - ■ ARC was disabled from an appropriately configured binary signal input (check at the logic state signal ARC: Ext./user enabled ('Oper/Cycl/Log/' folder).
- ☐ ARC is blocked (check at the logic state signal ARC: Blocked, 'Oper/Cycl/Log/' folder).
- ☐ There is no signal with a logic value of '1' at the binary signal input configured for ARC: CB drive ready EXT.
- ☐ There is no signal with a logic value of '1' at the binary signal input configured for MAIN: CB closed sig. EXT. The circuit breaker position signal is only necessary if the setting at ARC: CB clos. pos. sig. PSx is '*Yes*'.
- ☐ An ARC cycle is in progress. (Check at the logic state signal ARC: Cycle running in the 'Oper/Cycl/Log/' folder.)

A test HSR can be executed for testing purposes from the integrated local control panel or by triggering a binary signal input. The test HSR function first issues a trip command and then issues a reclose command after the set dead time has elapsed.

Checking the motor protection function

By injecting appropriate analog test values it is possible to check the overcurrent stage and the associated time delay.

Application of analog test values to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see Chapter 'Technical Data').

Before the motor protection can be tested the thermal replica must always be cleared. Clearing the thermal replica is done by short term disabling of the protection by setting MAIN: Device on-line to *'No'* (off) ('Par/FuncGlob/' folder). The actual status of the thermal replica may be read out from the operating data display at MP: Therm.repl.buffer MP ('Oper/Cycl/Meas/' folder). Because the characteristic curve is settable, there can be different tripping times:
With the thermal replica cleared an applied test current is abruptly changed from 0 (≡ machine stopped) to a value ≥ to the setting of MP: tIStUp> PSx, in the 'Par/Func/Main/' folder (≡ machine starting up):

☐ reciprocally squared characteristic curve: $t = t_{6I_{ref}} \cdot \frac{36}{\left(I/I_{ref}\right)^2}$

☐ logarithmic characteristic curve: $t = t_{6I_{ref}} \cdot 36 \cdot \ln \frac{\left(I/I_{ref}\right)^2}{\left(I/I_{ref}\right)^2 - 1}$

Checking the thermal overload protection function

By injecting appropriate analog test values it is possible to check the reference current setting and the associated time delay.

Application of analog test values to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see Chapter 'Technical Data').

Before the thermal overload protection can be tested the thermal replica must always be cleared. Clearing the thermal replica is done by short term disabling of the protection by setting MAIN: Device on-line to *'No'* (off) ('Par/FuncGlob/' folder). The actual status of the thermal replica may be read out from the operating data display at THERM: Status THERM replica ('Oper/Cycl/Meas/' folder). The tripping time may be checked:

With the thermal replica cleared an applied test current is abruptly changed from 0 to the value $\geq 0.1\ I_{ref}$

$$t = \tau \cdot \ln \frac{\left(\frac{I}{I_{ref}}\right)^2 - \Theta_P}{\left(\frac{I}{I_{ref}}\right)^2 - \Theta_{trip} \cdot \left(1 - \frac{\Theta_a - \Theta_{a,\max}}{\Theta_{\max} - \Theta_{a,\max}}\right)}$$

Checking the time-voltage protection function

By injecting appropriate analog test values at the measuring inputs it is possible to check, by taking a readout from the operating data display (see Chapter 8 "Information and Control Functions”), whether the device will detect such analog signals within the required class accuracy (‘Oper/Cycl/Meas’ folder).

☐ MAIN: Voltage A-G p.u.: Display of the updated value for phase A to ground voltage referred to V_{nom}.

☐ MAIN: Voltage B-G p.u.: Display of the updated value for phase B to ground voltage referred to V_{nom}.

☐ MAIN: Voltage C-G p.u.: Display of the updated value for phase C to ground voltage referred to V_{nom}.

☐ MAIN: Voltage VPG,max p.u.: Display of the updated value for max phase to ground voltage referred to V_{nom}.

☐ MAIN: Voltage VPG,min p.u.: Display of the updated value for min phase to ground voltage referred to V_{nom}.

☐ MAIN: Voltage A-B p.u.: Display of the updated value for phase A to phase B voltage referred to V_{nom}.

☐ MAIN: Voltage B-C p.u.: Display of the updated value for phase B to phase C voltage referred to V_{nom}.

☐ MAIN: Voltage C-A p.u.: Display of the updated value for phase C to phase A voltage referred to V_{nom}.

☐ MAIN: Voltage VPP,max p.u.: Display of the updated value for max phase to phase voltage referred to V_{nom}.

☐ MAIN: Voltage VPP,min p.u.: Display of the updated value for min phase to phase voltage referred to V_{nom}.

☐ MAIN: Voltage VPP,min p.u.: Display of the updated value for min phase to phase voltage referred to V_{nom}.

☐ MAIN: Volt. Σ(VPG)/ √3 p.u.: Display of the calculated neutral-point displacement voltage referred to V_{nom}.

Application of analog test values to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see Chapter 'Technical Data').

By injecting appropriate analog test values at the voltage measuring inputs it is possible to check the overvoltage and undervoltage stages as well as their associated timer stages.

The P132 calculates the neutral-point displacement voltage from the analog test values at the voltage measuring inputs according to below formula:

$$\left|\underline{V}_{N-G}\right| = \frac{1}{3}\cdot\left|\underline{V}_{A-G}+\underline{V}_{B-G}+\underline{V}_{C-G}\right|$$

In the case of a single-phase test setup using $|\underline{V}_{B\text{-}G}| = |\underline{V}_{C\text{-}G}| = 0$, the result of the calculation formula for $\underline{V}_{N\text{-}G}$ given above is that the triggers VNG> and VNG>> operate when the test voltage exceeds the following value:

$$\left|\underline{V}_{test}\right| = 3\cdot V_{N-G}> \cdot\frac{V_{nom}}{\sqrt{3}}$$

$V_{N\text{-}G}$: Setting V<>: VNG> and U<>: VNG>>

Application of analog test values to the measuring inputs must be in compliance with the maximum permissible rating of the measuring inputs (see Chapter 'Technical Data').

Checking the steady-state-power ground fault direction detection

If values for both residual current and neutral-point displacement voltage are available as measuring quantities the P132, when set to operating mode *'Steady-state power'* or *'Steady-state admittance'*, will determine the direction of a ground fault by steady-state power evaluation of the measuring values. Depending on the setting either the value calculated by the P132 or the value measured at the transformer T 90 will be evaluated as the neutral-point displacement voltage. If current values only can be measured the P132 will decide on "ground fault" (*'Steady-state current'* evaluation) because of the residual current value level. Switching to *'Steady-state current'* evaluation is made via the integrated local control panel or by triggering an appropriately configured binary signal input.

Should the system permit such operation a ground fault on the busbar side (BS) or on the line side (LS) may be simulated by wiring a short circuit. Then the P132 must issue the respective signal. With the operating mode for ground faults set to *'Steady-state power'* it is assumed that threshold values for residual current (set at GFDSS: IN,act>/IN,reac> BS and GFDSS: IN,act>/IN,reac> LS) and the neutral-point displacement voltage with *'Steady-state admittance'* evaluation (set at GFDSS: VNG> and GFDSS: IN>) are exceeded. With the operating mode set to *'Steady-state admittance'* the set threshold values for conductance / susceptance (set at GFDSS: G(N)> / B(N)> BS and GFDSS: G(N)> / B(N)> LS) and the neutral-point displacement voltage (GFDSS: VNG>) or the admittance (GFDSS: Y(N)>) must be exceeded.

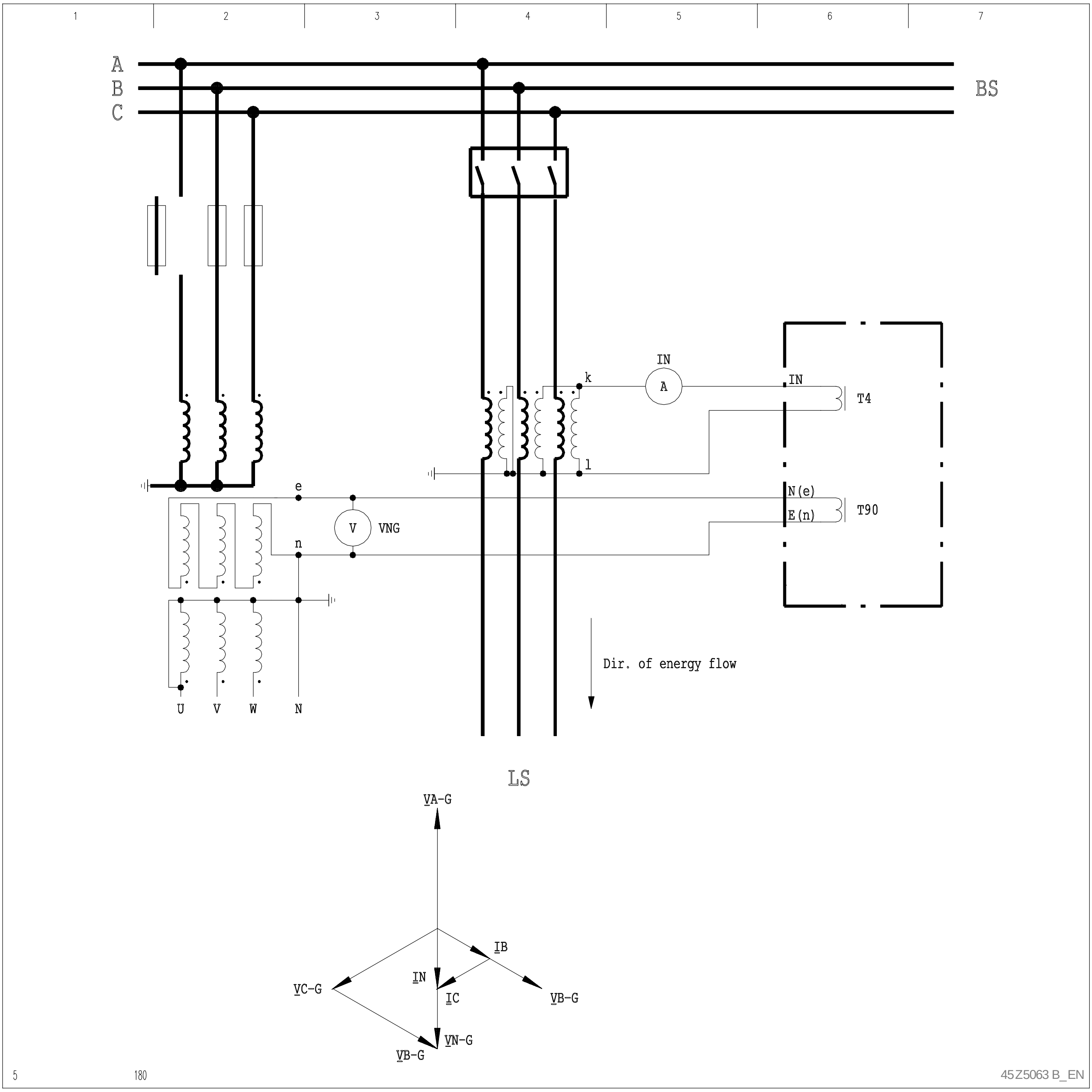
A ground fault functional test by wiring a short circuit is, in most cases, not possible as there is the danger of a double ground fault occurring. As an alternative it is possible to wire the system’s CTs and VTs such that a functional test is possible without causing a ground fault.

The residual current and the neutral-point displacement voltage measured by the P132 are displayed as measured operating values in primary quantities referred to the nominal quantities of the Protection & Control device.

Ancillary circuit for systems with ground fault compensation

First the fuse in the phase A line to the voltage transformer is removed and the associated secondary VT line is short circuited (see figures 9-2 and 9-3). This will produce a neutral-point displacement voltage $\underline{V}_{N-G}$ with an amplitude which is smaller by the factor √3 than with a saturated ground fault.

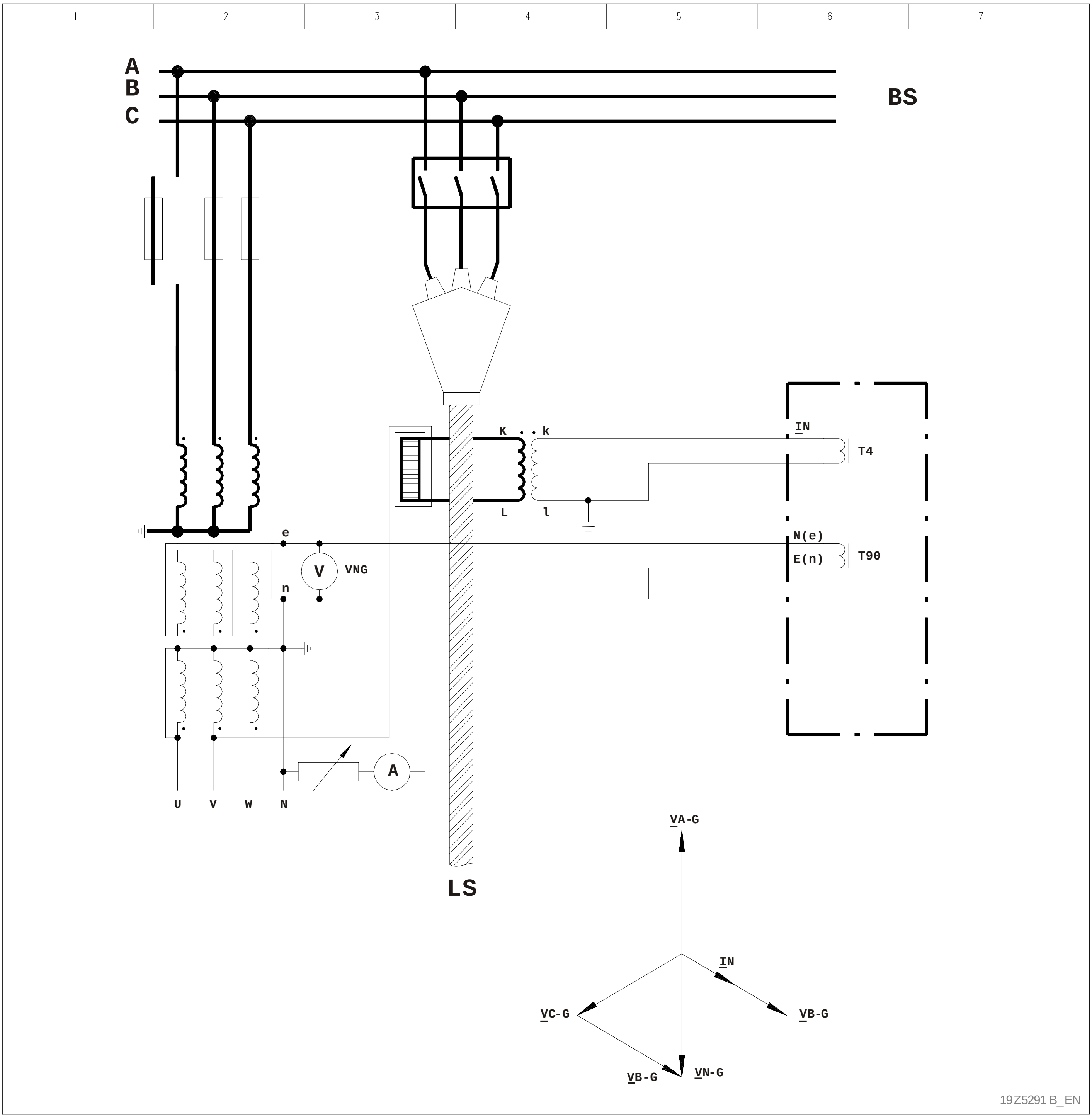
If current is measured at a Holmgreen group the secondary side of the phase A line current transformer must be disconnected and shorted (see figure 9-2).



9-2 *Ancillary circuit for systems with ground fault compensation and Holmgreen group, ground fault towards BS*

A test-wire is inserted through the core balance current transformer to obtain a current flow from the phase B line (see figure 9-3). The ancillary circuit figures include vector diagrams displaying the position of current and voltage vectors.

A simulated ground fault on the busbar is displayed in the example. The current connections or the voltage connections must be exchanged to test a ground fault on the line side.

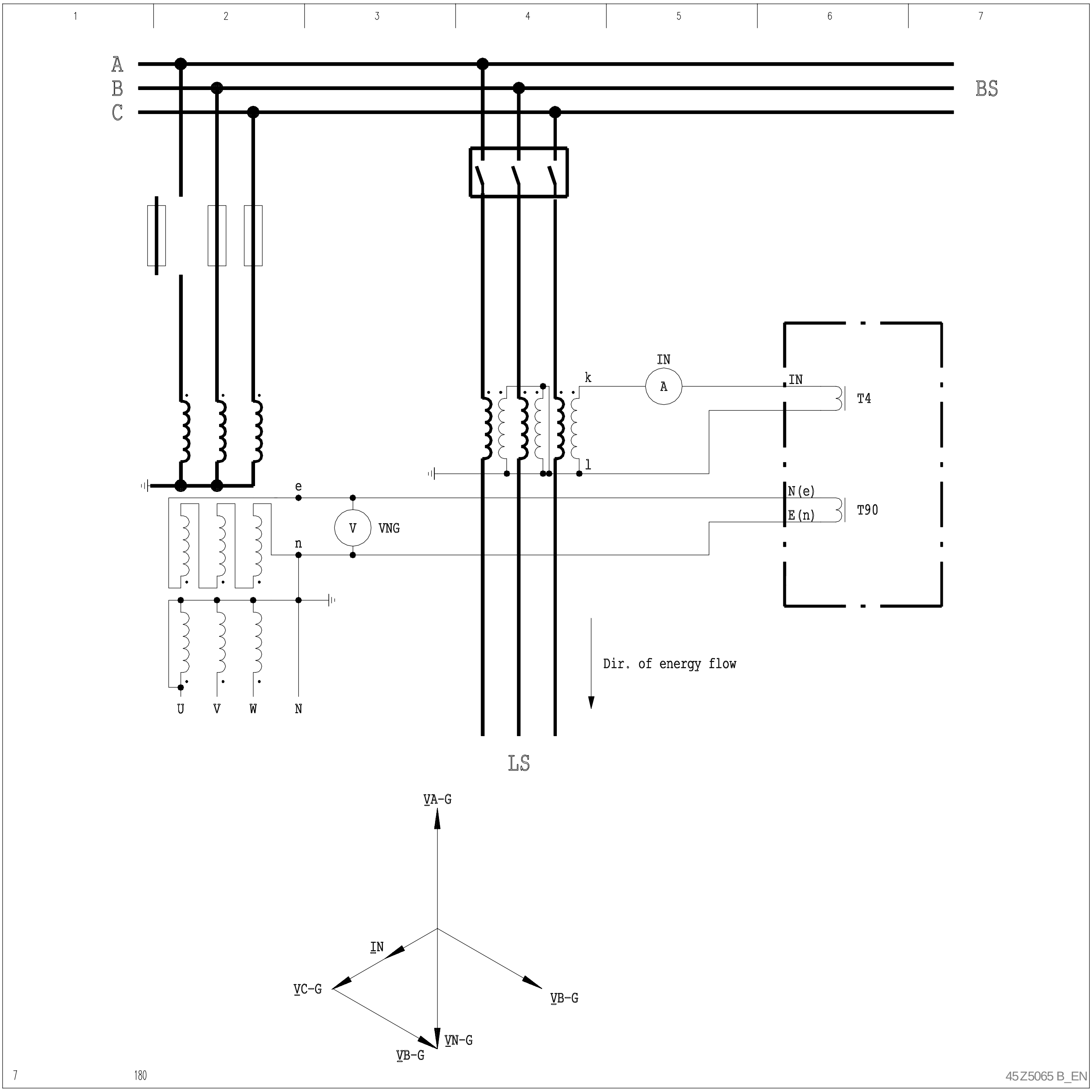


9-3 *Ancillary circuit for systems with ground fault compensation and core balance current transformer, ground fault towards BS*

Ancillary circuit for isolated neutral-point systems

First the fuse in the phase A line to the voltage transformer’s primary side is removed and the associated secondary VT line is short circuited (see figures 9-4 and 9-5). This will produce a neutral-point displacement voltage $\underline{V}_{N\text{-}G}$ with an amplitude which is smaller by the factor $\sqrt{3}$ than with a saturated ground fault.

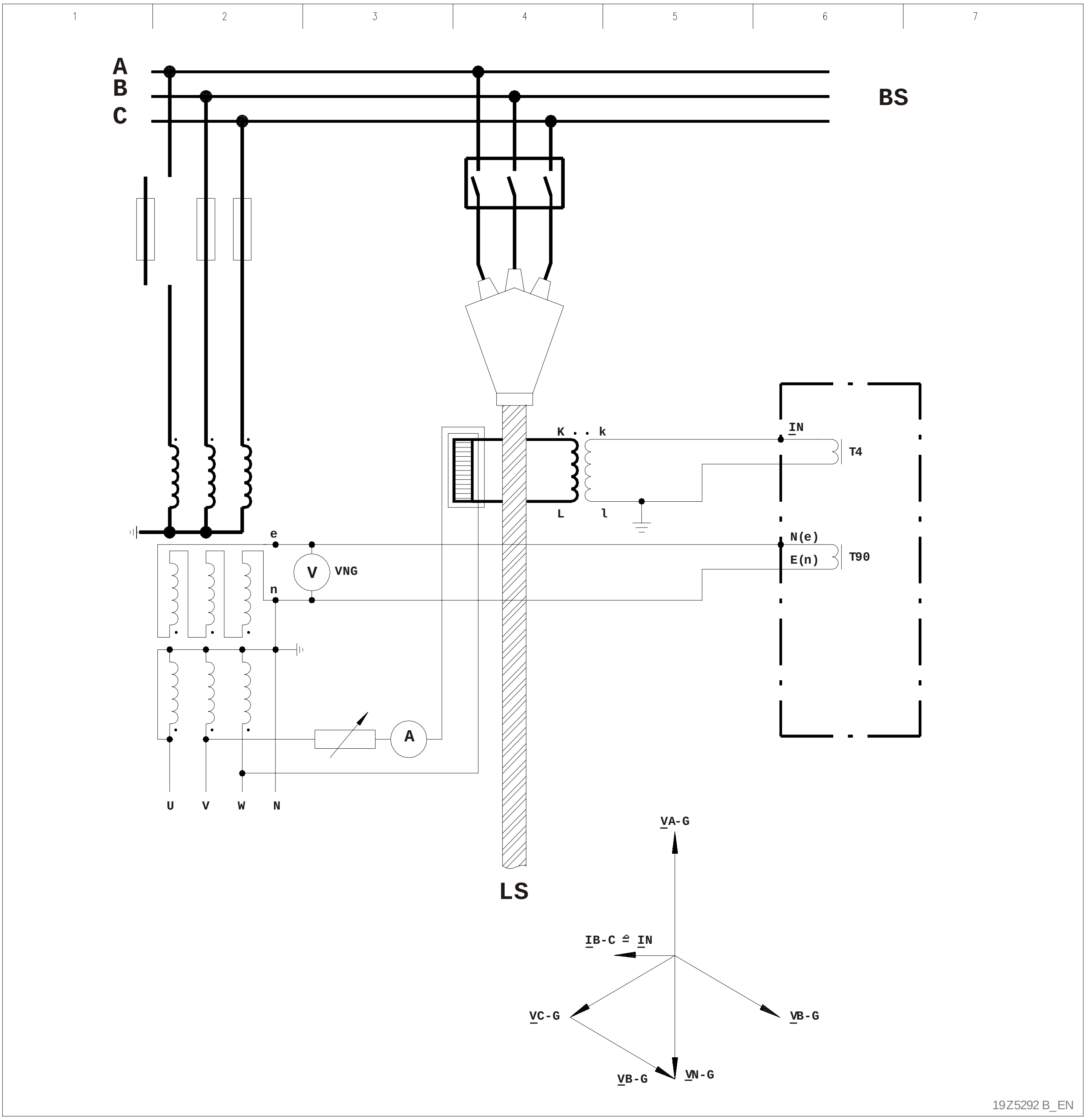
If current is measured at a Holmgreen group the secondary side of the phase A and B line current transformers must be disconnected and shorted (see figure 9-4).



9-4 *Ancillary circuit for isolated neutral-point systems and Holmgreen group, ground fault towards LS*

A test-wire is inserted through the core balance current transformer to obtain current flow from the phase B and C lines (see figure 9-5). The ancillary circuit figures include vector diagrams displaying the position of current and voltage vectors.

A simulated ground fault on the line side is displayed in the example. The current connections or the voltage connections must be exchanged to test a ground fault on the busbar side.



9-5 *Ancillary circuit for isolated neutral-point systems and core balance current transformers, ground fault towards LS*

Checking the transient ground fault direction determination

A secondary check of the transient ground fault direction determination is only possible by applying *a* testing device which is capable of simulating the transient pulse with sufficient accuracy. Otherwise it is possible that the transient ground fault direction determination will not operate as the logic has been designed specifically to detect such transient pulses.

Checking Control Functions
For devices with control functions (Order option):

Local/Remote selection

Control of switchgear units may be carried out by keys on the local control panel (for appropriate configuration, see Chapter 3, section 'Configurable Function Keys F_KEY') or remotely via the communications interface or with appropriately configured binary signal inputs. The control site – *Local* or *Remote* – is selected by the L/R key on the local control panel or by an appropriately configured binary signal input. The L/R key has no effect when a binary signal input has been configured. Using the L/R key on the local control panel to switch from '*Remote*' to '*Local*' is only possible after the 'Password L/R' was entered (see Chapter 6 for further information).

Local control

The switchgear unit to be controlled is selected by pressing the selection key on the local control panel, and pressing the 'Open' or 'Close' key will generate a switching request. (It should be noted that the local control panel on the P132 does not feature specific keys for switching functions. If at this point mention of a "selection key" is made, then this would be a function key to which a specific function has been assigned – in this example MAIN: Device selection key. (See Chapter 6, section 'Configurable Function Keys F1 to Fx, particularly as control keys'.)

When control is carried out with binary signal inputs the respective binary signal input is to be triggered.

Remote control

Remote control of switchgear units may be carried out via the communications interface or with appropriately configured binary signal inputs.

Switchgear unit cannot be controlled

Should a switchgear unit refuse to be controlled, then this may be due to the following reasons:

- ☐ General enable for switch commands has not been set.
  (Configuration at MAIN: Inp.asg. ctrl.enabl., 'Par/Func/Glob/' folder)
- ☐ Interlocking has operated.
  (Check at MAIN: Interlock equ. viol., 'Oper/Cycl/Log' folder).

To determine which interlocks are activated, check as follows:

☐ For bay interlock (BI) check:
MAIN: Bay interlock. act., 'Oper/Cycl/Log/' folder

☐ For substation interlock (SI) check:
MAIN: Subst. interl. act., 'Oper/Cycl/Log/' folder

☐ For local control:
It is possible to deactivate the interlock through an appropriately configured binary signal input.
Configuration through MAIN: Inp.asg.interl.deact, 'Oper/Func/Glob' folder)

Note: Substation interlocking is only active when there is communication with the substation control level through the communication interface. In the event of a communication error, the unit will switch automatically to ‘bay interlock without station interlock’. To determine if there is a communication error, check at MAIN: Communication error, ‘Oper/Cycl/Log/’ folder.

Substation interlocking can be deactivated selectively for each switchgear unit and each control direction – Open or Close.
(This can be checked at DEVxx: Open w/o stat.interl or DEVxx: Close w/o stat. int., 'Oper/Cycl/Log/' folder.)

Completing commissioning

Before the P132 is released for operation, the user should make sure that the following steps have been taken:

☐ All memories have been reset.
(Reset at MAIN: General reset (password-protected) and MT_RC: Reset recording, both in ‘Oper/CtrlTest/’ folder.)

☐ Blocking of output relays has been cancelled.
(OUTP: Outp.rel.block USER, 'Par/Func/Glob/' folder, setting '*No*'.)

☐ Blocking of the trip command has been cancelled.
(MAIN: Trip cmd.block. USER, 'Par/Func/Glob/' folder, setting '*No*'.)

☐ The device is on-line
(MAIN: Device on-line, 'Par/Func/Glob/' folder, setting '*Yes*' *(on)*.)

☐ The residual current stages are enabled (on).
(MAIN: Syst.IN enabled USER, 'Par/Func/Main/' folder, setting *'Yes' (on)*)

☐ Measuring-circuit monitoring is enabled – if it was previously cancelled for testing purposes.
(MCMON: General enable USER, 'Par/Func/Main/' folder, setting *'Yes' (on)*)

☐ The correct control point - '*Local*' or '*Remote*' – has been activated.

☐ The required interlock equations have been activated.

After completion of commissioning, only the green LED indicator signaling ‘Operation’ (H1) should be illuminated.

10 Troubleshooting

This chapter describes problems that might be encountered, their causes, and possible methods for eliminating them. It is intended as a general orientation only, and in cases of doubt it is better to return the P132 to the manufacturer. Please follow the packaging instructions in the section entitled "Unpacking and Packing" in Chapter 5 when returning equipment to the manufacturer.

Problem:

☐ Lines of text are not displayed on the local control panel.

- Check to see whether there is supply voltage at the device connection points.
- Check to see whether the magnitude of the auxiliary voltage is correct. The P132 is protected against damage resulting from polarity reversal.

Only qualified personnel, familiar with the "Warning" page at the beginning of this manual, may work on or operate this device.

Before checking further, disconnect the P132 from the power supply.

The following instructions apply to surface-mounted cases:

The local control panel is connected to processor module P by a plug-in connecting cable. Remember the connector position! Do not bend the connecting cable.

- Check to make sure that fuse F1 on power supply module V is not fused.

  If the fuse is defective, it should not be replaced without determining the cause of failure. If a fuse is replaced without eliminating the problem, there is the danger that the damage will spread.

  Required fuses:

  $V_{A,nom}$ = 24 V DC: Type M3.5-250V
  $V_{A,nom}$ = 48 to 250 V DC and 100 to 230 V AC: Type M2-250V

☐ The P132 issues an ‘Alarm’ signal on LED H3.

Identify the specific problem by reading out the monitoring signal memory (see section "Monitoring Signal Memory Readout" in Chapter 6). The table below lists possible monitoring or warning indications (provided that a configuration setting has been entered at `SFMON: Fct. assign. warning`), the faulty area, the P132 response, and the mode of the output relay configured for 'Warning' and 'Blocked/faulty'.

SFMON: Warning (LED) 036 070

Warning configured for LED H3.

SFMON: Warning (relay) 036 100

Warning configured for an output relay.

Key:

- :	No reaction and/or no output relay triggered.
Yes:	The corresponding output relay is triggered.
Updating:	The output relay configured for 'Warning' starts only if the monitoring signal is still present.
1) :	The 'Blocked/faulty' output relay only operates if the signal has been configured at `MAIN: Fct. assignm. warning`.
2) :	The 'Warning' output relay only operates if the signal has been configured at `SFMON: Fct. assign. warning`.

SFMON: Cold restart 093 024

A cold restart has been carried out on account of a checksum error in the memory (NOVRAM).

1st device reaction / 2nd device reaction:		Warm restart / Device blocking
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	Yes / Yes	

SFMON: Cold rest./SW update 093 025

A cold restart has been carried out following a software update.

1st device reaction / 2nd device reaction:		Warm restart / Device blocking
'Warning' output relay:	Yes / Yes	
'Blocked/faulty' output relay:	Yes / Yes	

SFMON: Blocking/ HW failure 090 019

Supplementary warning that this device is blocked.

'Warning' output relay:	Updating / Updating

SFMON: Relay Kxx faulty
041 200

Multiple signal: Output relay defective.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Updating / Updating
'Blocked/faulty' output relay: Yes / Yes 1)

SFMON: Hardware clock fail.
093 040

The hardware clock has failed.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Battery failure
090 010

Battery voltage too low. Replace battery.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Updating / Updating
'Blocked/faulty' output relay: - / -

SFMON: Invalid SW d.loaded
096 121

Wrong or invalid software has been downloaded.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: Invalid type of bay
096 122

If the user has selected a bay type that requires a P132 hardware configuration that is not actually fitted, then this signal is generated.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: - / -
'Blocked/faulty' output relay: - / -

SFMON: +15V supply faulty
093 081

The +15 V internal supply voltage has dropped below a minimum value.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: +24V supply faulty
093 082

The +24 V internal supply voltage has dropped below a minimum value.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: -15V supply faulty 093 080

The - 15 V internal supply voltage has dropped below a minimum value.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: Wrong module slot 1 096 100
SFMON: Wrong module slot 2 096 101
SFMON: Wrong module slot 3 096 102
SFMON: Wrong module slot 4 096 103
SFMON: Wrong module slot 5 096 104
SFMON: Wrong module slot 6 096 105
SFMON: Wrong module slot 7 096 106
SFMON: Wrong module slot 8 096 107
SFMON: Wrong module slot 9 096 108
SFMON: Wrong module slot 10 096 109
SFMON: Wrong module slot 11 096 110
SFMON: Wrong module slot 12 096 111
SFMON: Wrong module slot 13 096 112
SFMON: Wrong module slot 14 096 113
SFMON: Wrong module slot 15 096 114
SFMON: Wrong module slot 16 096 115
SFMON: Wrong module slot 17 096 116
SFMON: Wrong module slot 18 096 117
SFMON: Wrong module slot 19 096 118
SFMON: Wrong module slot 20 096 119
SFMON: Wrong module slot 21 096 120

Module in wrong slot.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: Defect.module slot 1 097 000
SFMON: Defect.module slot 2 097 001
SFMON: Defect.module slot 3 097 002
SFMON: Defect.module slot 4 097 003
SFMON: Defect.module slot 5 097 004
SFMON: Defect.module slot 6 097 005
SFMON: Defect.module slot 7 097 006
SFMON: Defect.module slot 8 097 007
SFMON: Defect.module slot 9 097 008
SFMON: Defect.module slot10 097 009
SFMON: Defect.module slot11 097 010
SFMON: Defect.module slot12 097 011
SFMON: Defect.module slot13 097 012
SFMON: Defect.module slot14 097 013
SFMON: Defect.module slot15 097 014
SFMON: Defect.module slot16 097 015
SFMON: Defect.module slot17 097 016
SFMON: Defect.module slot18 097 017

SFMON: Defect.module slot19 097 018
SFMON: Defect.module slot20 097 019
SFMON: Defect.module slot21 097 020

Defective module in slot x.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Updating / Updating
'Blocked/faulty' output relay: Yes / Yes [1)]

SFMON: +15V faulty mod. N 093 096

The +15 V internal supply voltage of the transient ground fault evaluation module has dropped below a minimum value.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: -15V faulty mod. N 093 097

The –15 V internal supply voltage of the transient ground fault evaluation module has dropped below a minimum value.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: DAC faulty module N 093 095

The digital-to-analog converter of the transient ground fault evaluation module is defective.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Module N DPR faulty 093 090

The checksum feature of the transient ground fault evaluation module has detected a fault in the data transmission of the Dual-Port-RAM.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Module N RAM faulty 093 091

Fault in the program or data memory of the transient ground fault evaluation module.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Module Y DPR faulty 093 110

The checksum feature of analog I/O module Y has detected a fault in the data transmission of the Dual-Port-RAM.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Module Y RAM faulty 093 111

Fault in the program or data memory of the analog I/O module.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Mod.Y RTD DPR faulty 093 108

The checksum feature of analog module (RTD) has detected a fault in the data transmission of the Dual-Port-RAM.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Mod.Y RTD RAM faulty 093 109

Fault in the program or data memory of the analog module (RTD).

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Error K 301	097 021
SFMON: Error K 302	097 022
SFMON: Error K 501	097 062
SFMON: Error K 502	097 063
SFMON: Error K 503	097 064
SFMON: Error K 504	097 065
SFMON: Error K 505	097 066
SFMON: Error K 506	097 067
SFMON: Error K 507	097 068
SFMON: Error K 508	097 069
SFMON: Error K 601	097 070
SFMON: Error K 602	097 071
SFMON: Error K 603	097 072
SFMON: Error K 604	097 073
SFMON: Error K 605	097 074
SFMON: Error K 606	097 075
SFMON: Error K 607	097 076
SFMON: Error K 608	097 077
SFMON: Error K 701	097 078
SFMON: Error K 702	097 079
SFMON: Error K 703	097 080
SFMON: Error K 704	097 081
SFMON: Error K 705	097 082
SFMON: Error K 706	097 083
SFMON: Error K 707	097 084
SFMON: Error K 708	097 085
SFMON: Error K 801	097 086
SFMON: Error K 802	097 087
SFMON: Error K 803	097 088
SFMON: Error K 804	097 089
SFMON: Error K 805	097 090
SFMON: Error K 806	097 091
SFMON: Error K 807	097 092

SFMON: Error K 808	097 093
SFMON: Error K 901	097 094
SFMON: Error K 902	097 095
SFMON: Error K 903	097 096
SFMON: Error K 904	097 097
SFMON: Error K 905	097 098
SFMON: Error K 906	097 099
SFMON: Error K 907	097 100
SFMON: Error K 908	097 101
SFMON: Error K 1001	097 102
SFMON: Error K 1002	097 103
SFMON: Error K 1003	097 104
SFMON: Error K 1004	097 105
SFMON: Error K 1005	097 106
SFMON: Error K 1006	097 107
SFMON: Error K 1007	097 108
SFMON: Error K 1008	097 109
SFMON: Error K 1201	097 118
SFMON: Error K 1202	097 119
SFMON: Error K 1203	097 120
SFMON: Error K 1204	097 121
SFMON: Error K 1205	097 122
SFMON: Error K 1206	097 123
SFMON: Error K 1207	097 124
SFMON: Error K 1208	097 125
SFMON: Error K 1401	097 134
SFMON: Error K 1402	097 135
SFMON: Error K 1403	097 136
SFMON: Error K 1404	097 137
SFMON: Error K 1405	097 138
SFMON: Error K 1406	097 139
SFMON: Error K 1407	097 140
SFMON: Error K 1408	097 141
SFMON: Error K 1601	097 150
SFMON: Error K 1602	097 151
SFMON: Error K 1801	097 166
SFMON: Error K 1802	097 167
SFMON: Error K 1803	097 168
SFMON: Error K 1804	097 169
SFMON: Error K 1805	097 170
SFMON: Error K 1806	097 171
SFMON: Error K 2001	097 182
SFMON: Error K 2002	097 183
SFMON: Error K 2003	097 184
SFMON: Error K 2004	097 185
SFMON: Error K 2005	097 186
SFMON: Error K 2006	097 187
SFMON: Error K 2007	097 188

SFMON: Error K 2008 097 189

Output relay K xxx defective.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Updating / Updating
'Blocked/faulty' output relay: Yes / Yes [1)]

SFMON: Undef. operat. code 093 010

Undefined operation code.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: Invalid arithm. op. 093 011

Invalid arithmetic operation.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: Undefined interrupt 093 012

Undefined interrupt.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: Exception oper.syst. 093 013

Interrupt of the operating system.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: Protection failure 090 021

Watchdog is monitoring the periodic start of protection routines. It has detected an error.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: Checksum error param 090 003

A checksum error involving the parameters in the memory (NOVRAM) has been detected.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: Clock sync. error 093 041

In 10 consecutive clock synchronization telegrams, the difference between the time of day given in the telegram and that of the hardware clock is greater than 10 ms.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Interm.volt.fail.RAM 093 026

Faulty test pattern in the RAM. This can occur, for example, if the processor module or the power supply module is removed from the bus module (digital). This fault is only detected during device startup. After the fault is detected, the software initializes the RAM. This means that all records are deleted.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Overflow MT_RC 090 012

Last entry in the monitoring signal memory in the event of overflow.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Semaph. MT_RC block. 093 015

Software overloaded.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Inval. SW COMM1/IEC 093 075

Incorrect or invalid communication software has been downloaded.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Invalid SW vers. N 093 093

Incorrect or invalid software for transient ground fault evaluation module has been downloaded.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Time-out module N 093 092

Watchdog is monitoring the periodic status signal of the transient ground fault evaluation module. It has detected an error.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Invalid SW vers. Y 093 113

Incorrect or invalid software for analog I/O module Y has been downloaded.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Invalid SW vers YRTD 093 123

Incorrect or invalid software for analog module (RTD) has been downloaded.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Time-out module Y 093 112

Watchdog is monitoring the periodic status signal of the analog I/O module Y. It has detected an error.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Time-out module YRTD 093 119

Watchdog is monitoring the periodic status signal of the analog module (RTD). It has detected an error.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: IRIGB faulty 093 117

The IRIGB interface is enabled but there is no plausible input signal.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: M.c.b. trip V 098 000

The line-side voltage transformer m.c.b. has tripped.

1st device reaction / 2nd device reaction: Blocking of the short-circuit direction determination

'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: M.c.b. trip Vref 098 011

The m.c.b. monitoring the reference voltage transformer has tripped.

1st device reaction / 2nd device reaction: Blocking of automatic synchronism check (ASC)
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Phase sequ. V faulty 098 001

Measuring-circuit monitoring has detected a fault in the phase sequence of the phase-to-ground voltages.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Undervoltage 098 009

The measuring-circuit monitoring function has detected an undervoltage.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: FF, Vref triggered 098 022

The fuse failure monitoring function has detected a fault in the reference voltage-measuring circuit.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: M.circ. V,Vref flty. 098 023

Multiple signal: Voltage-measuring circuits for phase-to-ground voltages or the reference voltage faulty.

1st device reaction / 2nd device reaction: Depends on type of fault detected.

'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Meas. circ. V faulty 098 017

Multiple signal: Voltage-measuring circuits faulty.

1st device reaction / 2nd device reaction: Depends on type of fault detected.

'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Meas. circ. I faulty 098 005

The measuring-circuit monitoring function has detected a fault in the current-measuring circuits.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Meas.circ.V,I faulty 098 016

Multiple signal: Multiple signaling: Current- or voltage-measuring circuits faulty.

1st device reaction / 2nd device reaction: Depends on type of fault detected.

'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Communic.fault COMM3 098 140

Since the last complete valid message was transmitted the time set at COMM3: Time-out comm.fault has elapsed and the receive signals are set to their user-defined default values.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Hardware error COMM3 093 143

The device has detected a hardware error in the effective connection InterMiCOM (communication interface 3).

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Comm.link fail.COMM3 098 142

Timer stage COMM3: Time-out link fail. has elapsed indicating a persistent failure of the transmission channel. The receive signals are set to their user-defined default values.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Lim.exceed.,tel.err. 098 141

The threshold set for timer stage COMM3: Limit telegr. errors was exceeded and the receive signals are set to their user-defined default values.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Telecom. faulty 098 006

The transmission channel of protective signaling is faulty.

1st device reaction / 2nd device reaction: Blocking of protective signaling
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Setting error THERM 098 035

Invalid parameters in the setting for the thermal replica.

1st device reaction / 2nd device reaction: Blocking of thermal overload protection.
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Setting error CBM 098 020

An invalid characteristic has been set for circuit breaker monitoring.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: CB No. CB op. > 098 066

The maximum number of CB operations performed has been exceeded.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: CB rem. No. CB op. < 098 067

The minimum number of CB operations performed at nominal current has fallen below the threshold.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: CB ΣItrip > 098 068

The maximum sum of disconnection current values has been exceeded.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: CB ΣItrip2 >** 098 069

The maximum sum of the disconnection current values to the second power has been exceeded.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: CB tmax> A 098 070
SFMON: CB tmax> B 098 071
SFMON: CB tmax> C 098 077

The maximum duration for the opening of a CB pole has been exceeded. Disconnection is not determined for this CB pole.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: CB pos.sig. implaus. 098 124

The plausibility logic was triggered during the acquisition of the circuit breaker's (CB) status signals.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: CTA error 098 034

Measurement of the coolant temperature via the analog module is faulty.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: TGFD mon. triggered 093 094

The monitoring function for transient ground fault direction determination has operated.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: faulty DSP 093 127

The DSP Coprocessor has detected an error.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: Invalid SW vers. DSP 093 128

Incorrect or invalid software has been downloaded for the DSP co-processor.

1st device reaction / 2nd device reaction: Warm restart / Device blocking
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: Yes / Yes

SFMON: Fcts.not perm.f.60Hz 093 098

A protective function has been activated that is not permitted for operation at a system frequency of 60 Hz.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Invalid scaling BCD 093 124

An invalid characteristic has been set for the BCD output channel of analog I/O module Y.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Invalid scaling A-1 093 114
SFMON: Invalid scaling A-2 093 115

An invalid characteristic has been set for one of the analog output channels of analog I/O module Y.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Invalid scaling IDC 093 116

An invalid characteristic has been set for the analog input channel of analog I/O module Y.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: PT100 open circuit 098 024

The P132 has detected an open circuit in the connection of the resistance thermometer "PT100" to the analog I/O module Y.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: PT100 T1 open circ. 098 029
SFMON: PT100 T2 open circ. 098 030
SFMON: PT100 T3 open circ. 098 040
SFMON: PT100 T4 open circ. 098 041
SFMON: PT100 T5 open circ. 098 042
SFMON: PT100 T6 open circ. 098 043
SFMON: PT100 Open circ.T7 098 044
SFMON: PT100 T8 open circ. 098 045
SFMON: PT100 T9 open circ. 098 052

The P132 has detected an open circuit in the connection of a resistance thermometer Tx (x = 1 ... 9) to the analog module (RTD).

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Overload 20 mA input 098 025

The 20 mA input of analog I/O module Y is overloaded.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Open circ. 20mA inp. 098 026

The P132 has detected an open circuit in the connection of the 20 mA input.

1st device reaction / 2nd device reaction: Depends on type of fault detected.
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Setting error f<> 098 028

The over-/underfrequency protection function has been set for 'overfrequency' monitoring (based on the settings for operate value and nominal frequency). This setting is not valid in the *f w. Delta f / Delta t* operating mode.

1st device reaction / 2nd device reaction: Blocking of the over-/under frequency protection function
'Warning' output relay: Yes / Yes 2)
'Blocked/faulty' output relay: - / -

SFMON: Inv.inp.f.clock sync 093 120

The function was configured to a binary signal input on the analog I/O module Y. Such a configuration is not permitted for this function.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

SFMON: Output 30	098 053
SFMON: Output 30 (t)	098 054
SFMON: Output 31	098 055
SFMON: Output 31 (t)	098 056
SFMON: Output 32	098 057
SFMON: Output 32 (t)	098 058

These LOGIC outputs can be included in the list of warning signals by selection at SFMON: Fct. assign. warning. The warning signals are also recorded in the monitoring signal memory.

1st device reaction / 2nd device reaction: - / -
'Warning' output relay: Yes / Yes
'Blocked/faulty' output relay: - / -

11 Maintenance

11 Maintenance

Only qualified personnel, familiar with the "Warning" page at the beginning of this manual, may work on or operate this device.

The P132 is a low-maintenance device. The components used in the units are selected to meet exacting requirements. Recalibration is not necessary.

Maintenance procedures in the power supply area

Electrolytic capacitors are installed in the power supply area because of dimensioning requirements. The useful life of these capacitors is significant from a maintenance standpoint. When the equipment is operated continuously at the upper limit of the recommended temperature range (+55°C or 131°F), the useful life of these components is 80,000 hours, or more than 9 years. Under these conditions, replacement of the electrolytic capacitors is recommended after a period of 8 to 10 years. When the operating temperatures are approx. +45°C inside the devices, the required maintenance interval can be increased by about 1 year.

The P132 is equipped with a lithium battery for non-volatile storage of fault data and for keeping the internal clock running in the event of failure of the auxiliary power supply. Loss of capacity due to module-internal self-discharging amounts to less than 1% per year over a period of availability of 10 years. Since the terminal voltage remains virtually constant until capacity is exhausted, usefulness is maintained until a very low residual capacity is reached. With a nominal capacity of 850 mAh and discharge currents of only a few µA during device storage or in the range of the self-discharge current during device operation, the result is a correspondingly long service life. It is therefore recommended that the lithium battery only be replaced after the maintenance interval cited above.

Replacement of the maintenance-related components named above is not possible without soldering. Maintenance work must be carried out by trained personnel, and the auxiliary voltage must be turned off while the work is being performed.

Always turn off the power (supply voltage) before removing a hardware module.

The power supply must be turned off for at least 5 s before power supply module V is removed. Otherwise there is the danger of an electric shock.

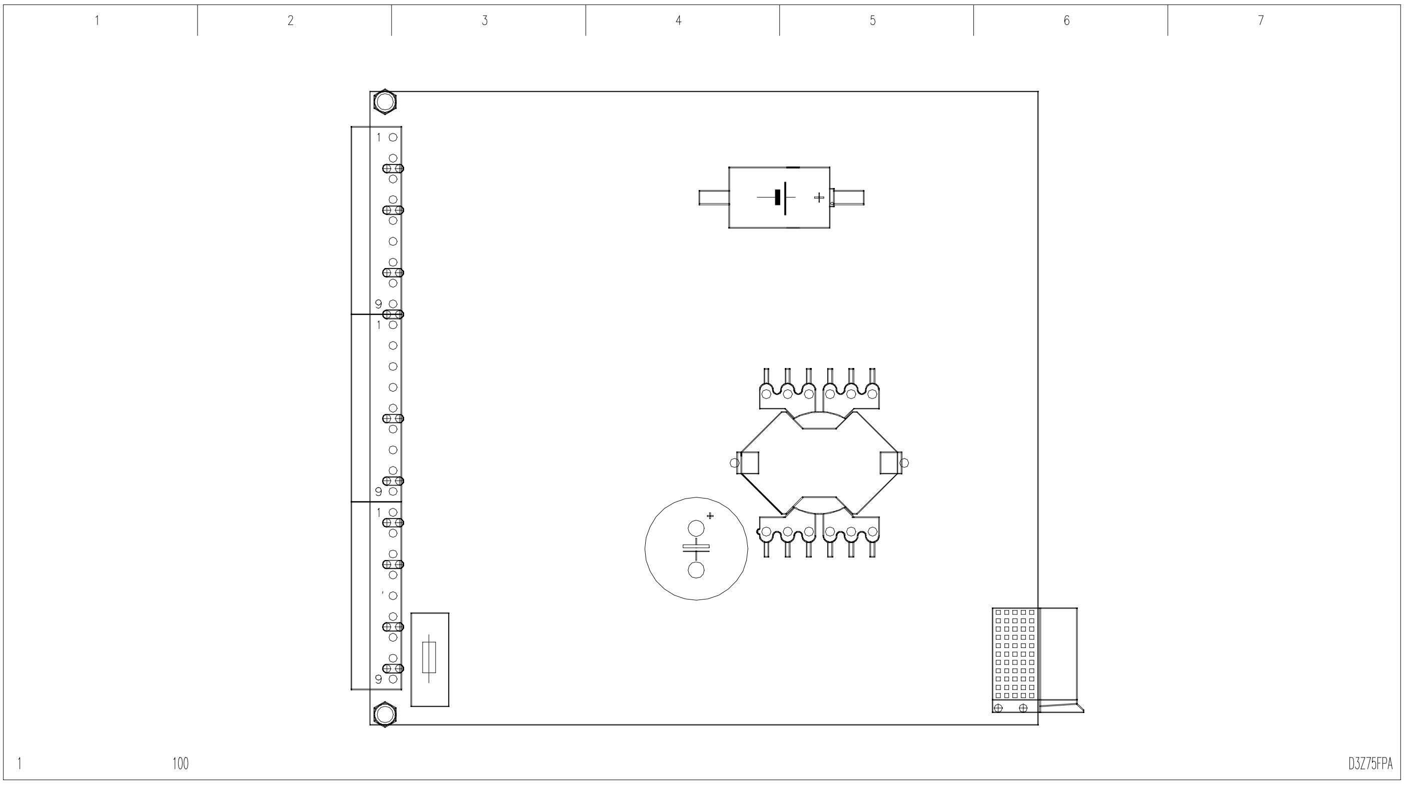
The relevant components are located on the following modules:

☐ Electrolytic capacitor:
on power supply module V.

☐ Lithium battery:
on power supply module V.

Note: Only Schneider Electric-approved components may be used (see Chapter 13).

Capacitor capacitance must be checked before installation.



11-1 Component drawing for power supply module V.

⚠

There is a danger of explosion if the electrolytic capacitor and battery are not properly replaced. Always check to make sure that the polarity of the electrolytic capacitor and the battery is correct.

The following instructions apply to surface-mounted cases:

⚠

The local control panel is connected to processor module P by a plug-in connecting cable. Remember the connector position! Do not bend the connecting cable.

Note: The replaced components (electrolytic capacitor and battery) must be disposed of in compliance with applicable national regulations.

After the maintenance procedures described above have been completed, new commissioning tests as described in Chapter 9 must be carried out.

Routine functional testing

The P132 is used as a safety device and must therefore be routinely injection tested for proper operation. The first functional tests should be carried out approximately 6 to 12 months after commissioning. Functional tests should be performed at intervals of 2 to 3 years – 4 years at the maximum.

The P132 incorporates in its system a very extensive self-monitoring function for hardware and software. The internal structure guarantees, for example, that communication within the processor system will be checked on a continuing basis.

Nonetheless, there are a number of subfunctions that cannot be checked by the self-monitoring feature without injection testing from the device terminals. The respective device-specific properties and settings must be observed in such cases.

In particular, none of the control and signaling circuits that are run to the device from the outside are checked by the self-monitoring function.

Analog input circuits

The analog inputs are fed through an analog preprocessing feature (anti-aliasing filtering) to a common analog-to-digital converter. In conjunction with the self-monitoring function, the CT/VT supervision function that is available for the device’s general functions can detect deviations in many cases. However, it is still necessary to test from the device terminals in order to make sure that the analog measuring circuits are functioning correctly.

The best way to carry out a static test of the analog input circuits is to check the primary measured operating data using the operating data measurement function or to use a suitable testing instrument. A "small" measured value (such as the nominal current in the current path) and a "large" measured value (such as the nominal voltage in the voltage path) should be used to check the measuring range of the A/D converter. This makes it possible to check the entire dynamic range.

The accuracy of operating data measurement is <1 %. An important factor in evaluating device performance is long-term performance based on comparison with previous measurements.

In addition, a dynamic test can be used to check transmission performance and the phase relation of the current transformers and the anti-aliasing filter. This can best be done by measuring the trigger point of the first zone when there is a two-phase ungrounded fault. For this test, the value of the short-circuit current should be such that a loop voltage of approximately 2 V is obtained at the device's terminals with the set impedance. Furthermore, a suitable testing instrument that correctly replicates the two-phase ungrounded fault should be used for this purpose.

This dynamic test is not absolutely necessary, since it only checks the stability of a few less passive components. Based on reliability analysis, the statistical expectation is that only <u>one</u> component in 10 years in 1000 devices will be outside the tolerance range.

Additional analog testing of such factors as the impedance characteristic or the starting characteristic is not necessary, in our opinion, since information processing is completely digital and is based on the measured analog current and voltage values. Proper operation was checked in conjunction with type testing.

Binary opto inputs

The binary inputs are not checked by the self-monitoring function. However, a testing function is integrated into the software so that the trigger state of each input can be read out (‘Oper/Cycl/Phys’ folder). This check should be performed for each input being used and can be done, if necessary, without disconnecting any device wiring.

Binary outputs

With respect to binary outputs, the integrated self-monitoring function includes even two-phase triggering of the relay coils of <u>all</u> the relays. There is no monitoring function for the external contact circuit. In this case, the all-or-nothing relays must be triggered by way of device functions or integrated test functions. For these testing purposes, triggering of the output circuits is integrated into the software through a special control function (‘Oper/CtrlTest/’ folder).

⚠

Before starting the test, open any triggering circuits for external devices so that no inadvertent switching operations will take place.

Serial Interfaces

The integrated self-monitoring function for the PC or communication interface also includes the communication module. The complete communication system, including connecting link and fiber-optic module (if applicable), is always totally monitored as long as a link is established through the control program or the communication protocol.

12 Storage

Devices must be stored in a dry and clean environment. A temperature range of -25°C to +70°C (-13°F to +158°F) must be maintained during storage (see the Chapter on Technical Data). The relative humidity must be controlled so that neither condensation nor ice formation will result.

If the units are stored without being connected to auxiliary voltage, then the electrolytic capacitors in the power supply area need to be recharged every 4 years. Recharge the capacitors by connecting auxiliary voltage to the P132 for approximately 10 minutes.

If the units are stored during a longer time, the battery of the power supply module is used for the continuous buffering of the event data in the working memory of the processor module. Therefore the battery is permanently required and discharges rapidly. In order to avoid this continuous discharge, it is recommended to remove the power supply module from the mounting rack during long storage periods. The contents of the event memory should be previously read out and stored separately!

13 Accessories and Spare Parts

The P132 is supplied with standard labeling for the LED indicators. User-specific labeling for non-standard configurations of the LED's can be printed on the blank label strips packed with the device. The label strip can then be glued to the front panel area reserved for this purpose.

The label strip can be filled in using an overhead projector pen, waterproof type.
Example: Stabilo brand pen, OH Pen 196 PS.

Description	**Order No.**
Cable bushings	88512-4-0337414-301
Lithium battery, type 1/2 AA 3.6 V	
Electrolytic capacitor 100 µF, 385 V DC Only the following brands of capacitor are permitted: Philips, type PUL-SI/159/222215946101 Panasonic, type TS-HA/ECOS 2GA 101 Nichicon, type LGQ 2G 101 MHSZ Nichicon, type LGU 2G 101 MHLZ	
Fuse for $V_{A,nom}$ = 24 V DC: M3.5-250V	
Fuse for $V_{A,nom}$ = 48 to 250 V DC and 100 to 230 V AC: M2-250V	
Resistance 200 Ω	255.002.696
Cover frame 84 T	88512-4-9650723-301
S&R-103 operating program (for Windows)	On request

14 Order Information

14.1 Order Information for P132

MiCOM P132

Feeder Management and Bay Control P132	**P 1 3 2 -**			**9**	**0**					**-306**	**-4xx**	**-612**	**-7xx**	**-46x**	**-9x x**	**-9x x**	**-8xx**
Basic device:																	
Basic device 24TE, pin-terminal connection,		1									-415						
Basic device 24TE, CT/VT ring-, I/O pin-terminal connection,		2									-416						
Basic device 40TE, pin-terminal connection,		3									-417						
Basic device 40TE, CT/VT ring-, I/O pin-terminal connection,		5									-418						
Basic device 84TE, ring-terminal connection,		8									-419						
basic complement with 4 binary inputs and 8 output relays; 6 function keys (40TE and 84TE only)																	
Mounting option and display:																	
Surface-mounted, local control panel with text display			3														
Flush-mounted, local control panel with text display			4														
Surface-mounted, with detachable HMI 16)			7														
Flush-mounted, with detachable HMI 16)			9														
Current transformer:																	
Without 11)				0													
Inom = 1 A / 5 A (T1...T4) 2)				9													
Voltage transformer:																	
Without 11)						0											
Vnom = 50 ... 130 V (4-pole)						4											
Vnom = 50 ... 130 V (5-pole) f. Automatic Synchronism Check 12)						5											
Additional binary I/O options: 16)																	
Without							0										
With 1 binary module (add. 6 binary inputs and 8 output relays)							1										
With 2 binary modules (add. 12 binary inputs and 16 output relays)							2										
With 1 binary module (add. 6 binary inputs and 6 output relays) for the control of up to 3 switchgear units							5										
With 1 binary module (add. 6 binary inputs and 6 output relays) and 1 binary module (add. 6 binary inputs and 6 output relays) for the control of up to 3 switchgear units							6										
With 1 binary module (add. 6 binary inputs and 8 output relays) and 1 binary module (add. 6 binary inputs and 6 output relays) for the control of up to 3 switchgear units							8										
Power supply and additional outputs:																	
VA,nom = 24 VDC								3									
VA,nom = 48 ... 250 VDC / 100 ... 230 VAC								4									
VA,nom = 24 VDC and 6 output relays, 4 with thyristor								6									
VA,nom = 48 ... 250 VDC / 100 ... 230 VAC and 6 output relays, 4 with thyristor								7									
VA,nom = 24 VDC and 6 output relays								8									
VA,nom = 48 ... 250 VDC / 100 ... 230 VAC and 6 output relays								9									
VA,nom = 24 VDC and 4 high break contacts								C									
VA,nom = 48 ... 250 VDC / 100 ... 230 VAC and 4 high break contacts								D									
Further add. options: 16)																	
Without									0								
With TGF (transient ground fault direction determination) module 3) 10)									1								
With analogue module									2								
With TGF and analogue module 3) 10)									3								
With binary module (add. 24 binary inputs)									4								
With TGF and binary module (add. 24 binary inputs) 3) 10)									5								
With RTD module 3) 12)									7								
With RTD and analogue module 3) 12)									8								
With RTD module and binary module (add. 24 binary inputs) 3) 12)									9								
Switching threshold on binary inputs:																	
>18 V (standard variant)	Without order extension no.																
>90 V (60...70% of VA,nom = 125...150 V) 8)														-461			
>155 V (60...70% of VA,nom = 220...250 V) 8)														-462			
>73 V (67% of VA,nom = 110 V) 8)														-463			
>146 V (67% of VA,nom = 220 V) 8)														-464			
With communication / information interface:																	
Only IRIG-B input for clock synchronization															-90 0		
Protocol can be switched between: IEC 60870-5-101/-103, Modbus, DNP3, Courier and IRIG-B input for clock synchronization and 2nd interface (RS485, IEC 60870-5-103)															-92 ☐		
For connection to wire, RS485, isolated															1		
For connection to plastic fiber, FSMA connector															2		
For connection to glass fiber, ST connector															4		
Protocol IEC61850:															-94 ☐		
For connection to 100 Mbit/s Ethernet, glass fiber SC and wire RJ45 and 2nd interface (RS485, IEC 60870-5-103)															6		
For connection to 100 Mbit/s Ethernet, glass fiber ST and wire RJ45 and 2nd interface (RS485, IEC 60870-5-103)															7		
With guidance / protection interface: 16)																	
Protocol InterMiCOM																-95 ☐	
For connection to wire, RS485, isolated																1	
For connection to plastic fiber, FSMA connector																2	
For connection to glass fiber, ST connector																4	
For connection to wire, RS232, isolated																5	
Language:																	
English (German) 4)	Without order extension no.																
Px40 English (English) 4)	On request																-800
German (English) 4)																	-801
French (English) 4)	On request																-802
Spanish (English) 4)	On request																-803
Polish (English) 4)	On request																-804
Russian (English) 4) 7)	On request																-805

2) Switching via parameter, default setting is underlined!
3) This option is excluded if the InterMiCOM (-95x) is ordered
4) Second included language in brackets
7) Hardware option, supports cyrillic letters instead of special West. Europe characters
8) Standard variant recommended, if higher pickup threshold not explicitly required by the application
10) Transient ground fault option for variants with current and voltage transformers only
11) Option without current transformers and without voltage transformers not possible
12) Option without current transformer not possible
16) Options for basic device 24 TE not possible

Information about ordering options

Language version

In order to display the Russian data model, the corresponding order extension number (-805) must be added upon ordering so that the hardware option supporting Cyrillic characters is integrated. With this ordering option, reference menu texts (English) will be available for display. However, other Western European languages containing extra characters will not be fully supported. Consequently, selecting the "Russian / English" ordering option means that it will not be possible to download Western European data models into the device.

Binary inputs' switching threshold

The standard version of binary signal inputs (opto-couplers) is recommended in most applications, as these inputs operate with any voltage from 18V. Special versions with higher pick-up/drop-off thresholds (see also "Technical Data" chapter) are provided for applications where a higher switching threshold is expressly required.

Customer Care Centre

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