Altivar AFE

Active Front End
Option for Altivar 61 & Altivar 71

Operating instructions CANopen

09/2010

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General remarks

The following symbols should assist you in handling the instructions:

 Advice, tip !

 General information, note exactly !

The requirements for successful commissioning are correct selection of the device, proper planning and installation. If you have any further questions, please contact the supplier of the device.

Capacitor discharge !

Before performing any work on or in the device, disconnect it from the mains and wait at least 15 minutes until the capacitors have been fully discharged to ensure that there is no voltage on the device.

Automatic restart !

With certain parameter settings it may happen that the Active Front End restarts automatically when the mains supply returns after a power failure. Make sure that in this case neither persons nor equipment is in danger.

Commissioning and service !

Work on or in the device must be done only by duly qualified staff and in full compliance with the appropriate instructions and pertinent regulations. In case of a fault contacts which are normally potential-free and/or PCBs may carry dangerous voltages. To avoid any risk to humans, obey the regulations concerning "Work on Live Equipment" explicitly.

Terms of delivery

The latest edition "General Terms of Delivery of the Austrian Electrical and Electronics Industry Association" form the basis of our deliveries and services.

Specifications in this document

We are always anxious to improve our products and adapt them to the latest state of the art. Therefore, we reserve the right to modify the specifications given in this document at any time, particular those referring to weights and dimensions. All planning recommendations and connection examples are non-binding suggestions for which we cannot assume liability, particularly because the regulations to be complied depend on the type and place of installation and on the use of the devices.

All foreign-language translations result from the German or English version. Please consider those in case of unclarity.

Basis of contract

The specifications in text and drawings of this document are no subject of contract in the legal sense without explicit confirmation.

Regulations

The user is responsible to ensure that the device and its components are used in compliance with the applicable regulations. It is not permitted to use these devices in residential environments without special measures to suppress radio frequency interferences.

Trademark rights

Please note that we do not guarantee that the connections, devices and processes described herein are free from patent or trademark rights of third parties.

Copyright

Option CANopen for the Active Front End AFE

This instructions describe the functions software version APSatvr_R1.1IE02 and higher

☞ The instructions in hand cover the topics operation, parameterization and diagnostics of the CANopen interface of the Active Front End. Moreover, the principles of the CANopen architecture and their main components are explained in detail.

☞ Use this instructions additionally to the device documentation "Description of functions" and "Mounting instructions".

☞ The slave-specific configuration file SEAFE.eds is required for parameterization and configuration of the CANopen network. It is provided on the CD-ROM which is attached to each device as well as under www.schneider-electric-power-drives.com.

☞ In order to address an Active Front End via fieldbus also during mains cut-off (disconnecting switch, ...) the Active Front End AFE has to be supplied with an external 24 V buffer voltage.

Function CANopen

All Active Front End units AFE support the CANopen fieldbus system as standard. For the integration of the CANopen-typical Sub-D fieldbus connection, an optional CANopen adapter must be installed at the RJ45 interface next to the terminals of the Active Infeed Converter (see chapter "Mechanical construction", page 20).

In the CANopen network the Active Front End is operated as a slave. The used profile is designed on the basis of the Drivecom profile but it can be also switched to the Profidrive profile VDI/VDE 3689.

Principle function

CANopen is a higher transfer protocol according to CiA DS-301 based on the serial bus system "Controller Area Network" (CAN). It uses the multi-master capability to exchange data between the individual subscribers quickly and efficiently.

This data exchange takes place in an object-oriented manner in the form of "broadcasting". This means that a message is transferred to all bus subscribers and the subscriber itself decides whether the message is executed.

Typically the data is transferred only as required.

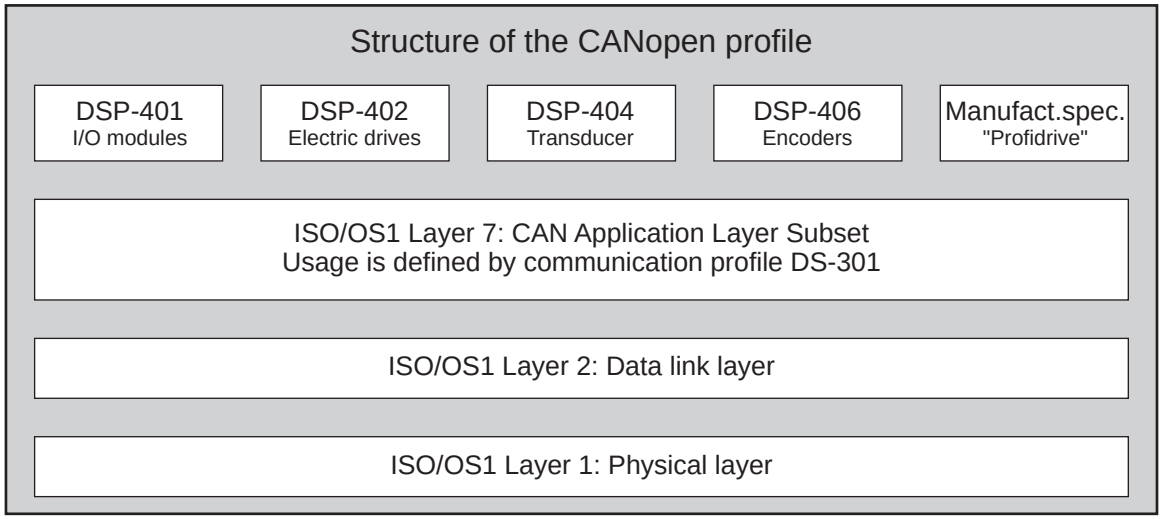
A bus access method must regulate conflict situations since several bus subscribers communicate via the same physical medium and the basic principle applies that only one transmitter, but several receivers may be active.

In the CANopen protocol, a stochastic (random) access method is used. In case of two or more simultaneous transmission accesses to the bus, the conflict is solved by bit-by-bit arbitration. Access thus automatically falls on the message with the highest priority.

The priority allocation corresponds with the identifier of the sent message (a low identifier corresponds with higher priority).

For error recognition during the data exchange, a combination of five different mechanisms is used (bit-level monitor, CRC, acknowledgement check, bit stuffing, and message frame monitoring).

The fieldbus interface implemented in the Active Front End is realized up to communication profile DS301 (ISO/OSI Layer 7). Based on this, the Drivecom or Profidrive profile (on the basis of VDI/VDE 3689) is used as the manufacturer-specific profile variant.



The object library is the main connecting link between the Active Front End AFE and the CANopen master (PLC). All communication and user objects are included in this object library. In the process, an object represents a parameter with an address and a subindex in the communication memory of the Active Infeed Converter AIC.

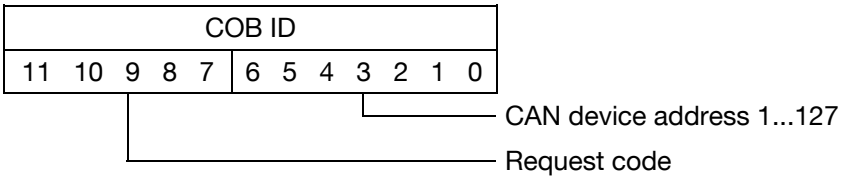
The CANopen communication profile DS301 describes permanently defined objects which are, for example, used to set the communication properties but also manufacturer-specific ranges like application-specific settings (parameters) of the Active Front End.

Structure of the CANopen object library

Object index	Use
0001...009F	Data types (static, complex,...)
00A0...0FFF	Reserved
1000...1FFF	CANopen communication profile
2000...5FFF	Manufacturer-specific range (parameters of the Active Front End)
6000...9FFF	Range for standardized device profiles
A000...AFFF	Process images of IEC61131 devices
B000...FFFF	Reserved

CANopen communication services

The communication services of the CANopen interface on the Active Front End are designed according to the CAN 2.A (DS301 V4.02) specification. In the process, every request is connected with the CANopen device address (node ID) and a telegram identifier for a COB ID (Communication Object Identifier). In this way, individual telegrams can be handled with priority during the transfer. The CANopen device address is transferred in bits 0...6 of the COB ID and the request code in bits 7...11.



Predefined connection set / Request code:

Object	Request code (bit 10 ... bit 7)		COB ID		Note
NMT	0000 bin	000 hex	000 hex	PLC → AFE	NMT (Network Management) services for the operation of the CANopen status machine
SYNC	0001 bin	080 hex	080 hex	PLC → AFE	SYNC service (also see object 1005 hex)
EMCY	0001 bin	080 hex	080 hex+ Node ID	PLC → AFE	Emergency service (also see object 1014 hex)
PDO1 transmit	0011 bin	180 hex	180 hex+ Node ID	AFE → PLC	Also see objects 1800 hex, 1600 hex
PDO1 receive	0100 bin	200 hex	200 hex+ Node ID	PLC → AFE	Also see objects 1400 hex, 1A00 hex
PDO2 transmit	0101 bin	280 hex	280 hex+ Node ID	AFE → PLC	Also see objects 1801 hex, 1A01 hex
PDO2 receive	0110 bin	300 hex	300 hex+ Node ID	PLC → AFE	Also see objects 1401 hex, 1601 hex
SDO transmit	1011 bin	580 hex	580 hex+ Node ID	AFE → PLC	Also see object 1200 hex
SDO receive	1100 bin	600 hex	600 hex+ Node ID	PLC → AFE	Also see object 1200 hex
Heartbeat	1110 bin	700 hex	700 hex+ Node ID	PLC → AFE	NMT, Node Guard, Heartbeat Also see objects 1016 hex, 1017 hex

☞ The Active Front End AFE supports the automatic formation of the COB ID (request code + node ID).

☞ The transfer direction and the definition of output/input should be seen from the viewpoint of the CANopen slave (AFE).

Communication objects

In the CANopen network, the following communication objects are differentiated:

- *Process data objects* (PDO) for the transport of control data
- *Service data objects* (SDO) for the parameterization of object library entries
- *Network management objects* for control of the CANopen status machine and for monitoring the subscribers
- Further objects, like synchronization objects, time stamps and fault messages

PDO (Process Data Object)

PDO telegrams are used for the fast transfer of control and status data, as well as reference and actual values. These are sent as unconfirmed telegrams (broadcast). In the Active Front End two PDO telegrams for transmitting and one telegram for receiving are available. Through the use of the method "static PDO mapping", the individual actual values are allocated in the respective PDO telegram using the parameterization.

The PDO telegrams can be prioritized over the SDO objects due to their low identifiers and are transferred in a cyclic, event-oriented or synchronized manner.

PDO 1 is processed device-internally in the 1.5 ms task, while PDO 2 is processed by the background task.

☞ Further information is given in chapter "Process Data Object PDO", page 24).

PDO type	Object	Word 1	Word 2	Word 3	Word 4
PDO1 - receive	200 hex	Control word (STW)	–	–	–
PDO1 - transmit	180 hex	Status word (ZTW)	Actual value 1 (4.6.40)	Actual value 2 (4.6.44)	Actual value 3 (4.6.48)
PDO2 - receive	300 hex	–	–	–	–
PDO2 - transmit	280 hex	Actual value 4 (4.6.52)			

SDO (Service Data Object)

SDO telegrams represent a service for direct access to the object library. The identifiers for the SDO transmit and SDO receive telegrams lie at 580/600 hex and thus lead to a lower-priority transfer within the CANopen network.

SDO	Object
SDO - transmit	600 hex
SDO - receive	580 hex

SDO telegrams are used for adjustment of the CANopen-specific communication settings during network configuration (objects 00 00 hex...1F FF hex), but can also be used to parameterize the Active Front End (objects 20 00 hex...5F FF hex).

☞ Parameter 6.1.03 "Parametrising station" must be set to "3 .. CANopen" in order to adjust parameters on the Active Front End via the CANopen interface.

Network management / CANopen state machine

NMT telegram PLC → Altivar AFE

By means of the NMT (network management) telegrams the CANopen state machine is operated. The telegram consists of a request code and the node ID of the desired subscriber.

If the node ID transferred in Byte 1 equals zero, the request transferred in the telegram applies for all subscribers operated in the network.

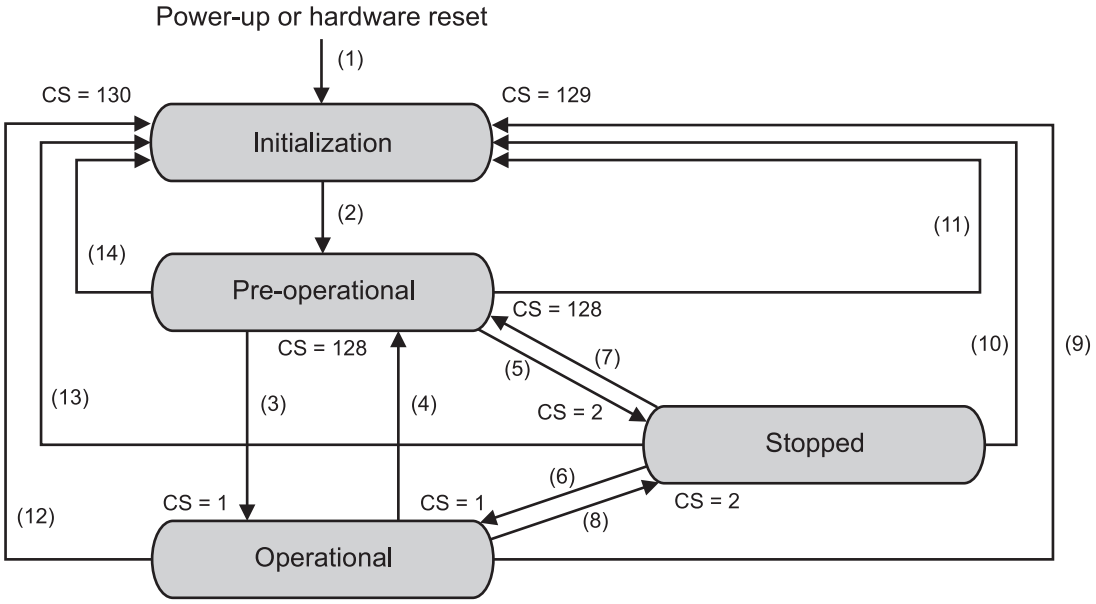
COB ID	Byte 0	Byte 1
00 hex	Command (CS)	Node ID

Command (CS)	Command
01 hex	Start_Remote_Node
02 hex	Stop_Remote_Node
80 hex	Enter_Pre-Operational_State
81 hex	Reset_Node
82 hex	Reset_Communication

Example: Start of the CANopen subscriber with address 5 (Start Remote Node)

00hex 01hex 05hex

CANopen state machine

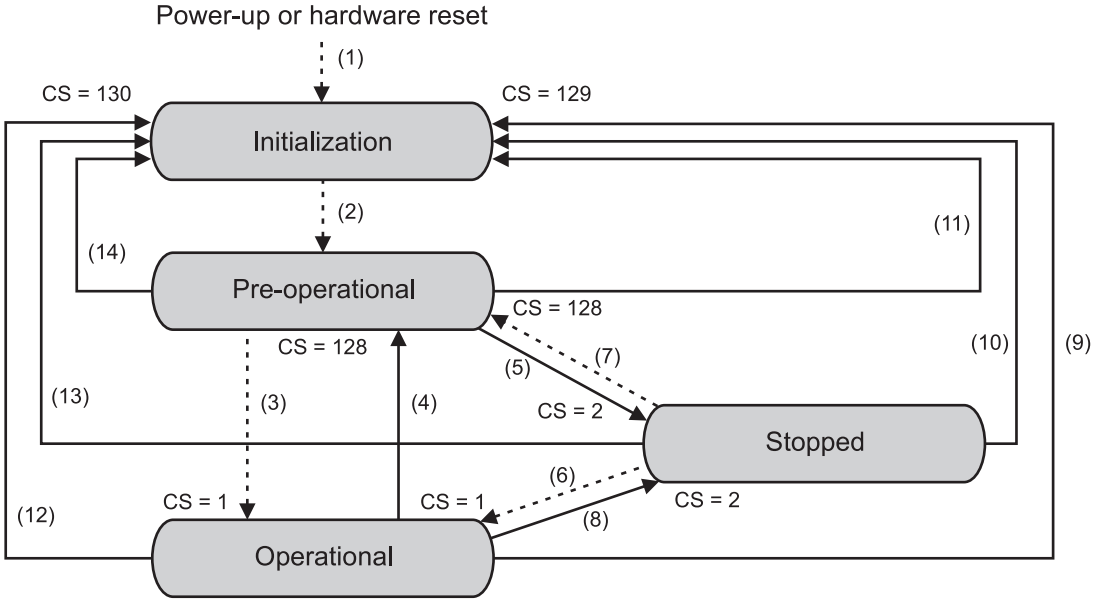


Change of state	Command		Description
(1)	–	–	When connecting to the mains the CANopen subscriber automatically switches to state "*Initialization*".
(2)	–	–	When the initialization has been completed successfully, the state automatically switches to "*Pre-operational*".
(3), (6)	Start_Remote_Node	01 hex	Change to state "*Operational*"; processing of PDO and SDO telegrams
(4), (7)	Enter_Pre_Operational_State	80 hex	Change to state "*Pre-Operational_State*". Only SDO telegrams are processed.
(5), (8)	Stop_Remote_Node	02 hex	Change to state "*Stopped*"
(9), (10), (11)	Reset_Node	81 hex	Change to state "*Initialization*"
(12), (13), (14)	Reset_Communication	82 hex	Change to state "*Initialization*"

The following services are possible depending on the communication status of the CANopen connection:

Service	Initialization	Pre-operational	Operational	Stopped
PDO			X	
SDO		X	X	
Synchronization (SYNC)		X	X	
Emergency (EMCY)		X	X	
Bootup service	X		X	
Network management (NMT)		X	X	X

Many changes of the state within the NMT status machine lead to CANopen communication faults. The following diagram and table list these states in detail.



Change of state	Command		Description
(4)	Enter_Pre_Operational_State	80 hex	No PDO services possible
(5)	Stop_Remote_Node	02 hex	No SDO services possible
(8)	Stop_Remote_Node	02 hex	No PDO and no SDO services possible
(9), (10), (11)	Reset_Node	81 hex	No PDO and no SDO services possible
(12), (13), (14)	Reset _Communication	82 hex	No PDO and no SDO services possible

☞ A fault message on the Active Front End can be reset using bit 7 in the control word (reset) only if the NMT state machine is in "*Operational*" state (PDO telegrams can be transferred only in this state).

If this is not the case, the CANopen master (PLC) must send an NMT telegram with a request code of 01 hex (Start_Remote_Node) to the corresponding subscriber.

☞ The active NMT state is transferred in the response telegram in case of active node guarding. Alternatively it can be read directly on the Active Front End under parameter 4.6.22 "".

Bootup service Altivar AFE → PLC

By means of this telegram, the CANopen subscriber indicates that it has switched to the "Pre-operational" state when initialization has been completed. The data byte sent in the process is always 00 hex.

COB ID	Byte 0
700 hex + Node ID	00 hex

Synchronization object –SYNC PLC → Altivar AFE

The SYNC object is sent cyclically to all subscribers from the CANopen master (PLC). It consists only of the identifier and is used by CANopen subscribers for cyclic communication modes.

COB ID
80 hex

Emergency object – EMCY Altivar AFE → PLC

Using the emergency telegram, the Active Front End indicates an active fault state as the CANopen slave. Both communication faults and general faults of the Active Front End are indicated in the process.

COB ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
80 hex + Node ID	Fault code *		Fault register					
	LSB	MSB	Bit 0 = 0 No fault Bit 0 = 1 Fault					

*) A detailed overview of the fault messages can be found in chapter "Device messages", page 63.

Node guarding

The "node guarding" function represents a monitoring of the bus subscribers initiated by the CANopen master. In the process, the master sends an RTR (Remote Transmit Request) telegram to the subscribers being monitored at cyclic intervals. This telegram triggers the lifetime counter in the CANopen slave. If the set time of the lifetime counter expires without a new RTS telegram being received, the drive reacts with the fault message "Life Guarding Fault" and sends an emergency telegram (EMCY).

The time of the lifetime counter is determined using the "Guard Time" (100C/00 hex) and "Lifetime Factor" (100D/00 hex) objects. These objects can be set using the SDO service during bus configuration. The time results from the multiplication of time [ms] and factor.

Example: 3 seconds monitoring time = 500 ms x 6

Parameter	Index	Subindex	Format	Unit
Guard time	100C hex	00 hex	Unsigned16	ms
Life time factor	100D hex	00 hex	Unsigned8	-

Node guarding (RTR) telegram PLC → Altivar AFE

COB ID
700 hex + Node ID

Node guarding telegram Altivar AFE → PLC

COB ID	Byte 0	
700 hex + Node ID	Bit 7	Bit 6 to 0
	Toggle bit	NMT state

NMT state: 00 hex Initialization
04 hex Stopped
05 hex Operational
7F hex Pre-operational

Toggle bit: The state of this bit is changing with every response.

☞ The "node guarding" and "heartbeat" functions cannot be used at the same time.

☞ The active NMT state can be read directly on the Active Front End under parameter 4.6.22.

☞ The setting of the node guarding parameters 100C and 100D is only possible at state "Pre-operational".

Heartbeat

The "Heartbeat" function represents an effective monitoring of the communication of any CANopen subscribers. The devices to be monitored are divided into heartbeat transmitters and receivers. The transmitter cyclically (Producer Heartbeat Time) transmits a heartbeat telegram with its actual NMT state.

This telegram triggers a timer in the heartbeat receiver. If the set time of the timer (Consumer Heartbeat Time) expires without a new heartbeat telegram being received, the subscriber defined as the heartbeat receiver reacts with the fault message "Heartbeat Fault" and sends an emergency telegram (EMCY).

Heartbeat telegram transmitter → receiver

COB ID	Byte 0	
700 hex + Node ID	Bit 7	Bit 6...0
	Zero	NMT state (transmitter)

NMT state: 00 hex Initialization
04 hex Stopped
05 hex Operational
7F hex Pre-operational

Bit 7 is reserved and always zero

Parameter	Index	Subindex	Format	Unit
Consumer heartbeat time	1016 hex	01 hex	Unsigned32	ms
Producer heartbeat time	1017 hex	00 hex	Unsigned16	ms

☞ The "node guarding" and "heartbeat" functions cannot be used at the same time.

Object library

Index	Subindex	R/W	Type	Factory setting	Comment
10 00 hex	00 hex	R	Unsigned32	00 00 00 00 hex	**Type of device:** Bits 24...31: Not used (0) Bits 16...23: Type of device (0) Bits 0...15: Device profile number (000)
1001 hex	00 hex	R	Unsigned8	00 hex	**Fault register:** Fault (bit 0 = 1) No fault (bit 0 = 0)
1003 hex	00 hex	R	Unsigned8	01 hex	**Number of faults**
	01 hex	R	Unsigned32	00 00 00 00 hex	**Standard fault field:** Bits 16...31: Always 0 Bits 0...15: For fault code parameters, also see Emergency Object / Fault Messages.
1005 hex	00 hex	R/W	Unsigned32	00 00 00 80 hex	**COB-ID entry for SYNC message**
1008 hex	00 hex	R	String	AIC-xVxxx	**Device name:** Read via segmented SDO services.
100B hex	00 hex	R	Unsigned32	00 00 00 00 hex	**Node-ID:** This object shows the CANopen address configured on the Altivar AFE.
100C hex	00 hex	R/W	Unsigned16	00 00 hex	**Guard time:** The node guarding function is deactivated (value: 0 ms) standard-like. The simultaneous use of the node guarding and heartbeat functions is not possible! (see 1017/00)
100D hex	00 hex	R/W	Unsigned8	00 hex	**Lifetime factor:** 100C/00 (guard time) * 100D/00 (lifetime factor) = lifetime A value of 0 deactivates the node guarding function on the respective Altivar AFE!
100E hex	00 hex	R	Unsigned32	00 00 07 00 hex +Node-ID	**Node guarding identifier:** COB ID entries are used for the node guarding protocol (configuration tool).
100F hex	00 hex	R	Unsigned32	00 00 00 01 hex	**Number of SDOs supported**
1014 hex	00 hex	R	Unsigned32	00 00 00 80 hex + Node-ID	**COB ID entry for emergency message**
1016 hex	00 hex	R	Unsigned8	01 hex	**Consumer heartbeat time:** Number of entries
	01 hex	R/W	Unsigned32	00 00 00 00 hex	**Consumer heartbeat time:** Bits 24...31: Not used (0) Bits 16...23: Node ID from heartbeat producer Bits 0...15: Max. heartbeat time (factor = 1 ms)
1017 hex	00 hex	R/W	Unsigned16	00 00 hex	**Producer heartbeat time**: The heartbeat function is deactivated (value: 0 ms) standard-like. The simultaneous use of the node guarding and heartbeat functions is not possible! (see 100C/00)

Index	Subindex	R/W	Type	Factory setting	Comment
1018 hex	00 hex	R	Unsigned8	03 hex	**ID object:** Number of entries
	01 hex	R	Unsigned32	00 00 01 D1 hex	**ID object:** Supplier ID: Schneider Electric Power Drives = 01D1
	02 hex	R	Unsigned32	4941 hex	**ID object:** Product Identification code AI = 4941 hex
	03 hex	R	Unsigned32	Depending on the used software	**ID object:** Product version: Bits 16...31 = Primary version ID Bits 0...15 = Secondary version ID
1400 hex	00 hex	R	Unsigned8	02 hex	**Receive PDO1:** Number of entries
	01 hex	R/W	Unsigned32	00 00 02 00 hex + Node-ID	**Receive PDO1:** COB ID entry Bits 0...10 can be changed in write mode to activate the slave-to-slave communication.
	02 hex	R/W	Unsigned8	FF hex	**Receive PDO1:** Transfer method "Asynchronous" (FE or FF) "Cyclically synchronous" (1...F0) "Acyclically synchronous" (0)
1600 hex	00 hex	R	Unsigned8	04 hex	**Receive PDO1 assignment:** Number of used process data Only one object is used
	01 hex	R	Unsigned32	30 00 01 10 hex	**Receive PDO1 assignment:** 1st Object Control word "STW"
	02 hex	R	Unsigned32	30 00 02 10 hex	**Receive PDO1 assignment:** Not used
	03 hex	R	Unsigned32	30 00 03 10 hex	**Receive PDO1 assignment:** Not used
	04 hex	R	Unsigned32	30 00 04 10 hex	**Receive PDO1 assignment:** Not used
1800 hex	00 hex	R	Unsigned8	05 hex	**Transmit PDO1:** Number of entries
	01 hex	R/W	Unsigned32	00 00 01 80 hex + Node-ID	**Transmit PDO1:** COB ID entry
	02 hex	R/W	Unsigned8	FF hex	**Transmit PDO1:** Transfer method "Asynchronous" (FE or FF) "Cyclically synchronous" (1...F0) "Acyclically synchronous" (0)
	03 hex	R/W	Unsigned16	12C (300 dec)	**Transmit PDO1:** Inhibit time Minimum time between two transfers. Factor: 10 ms Min. value: 100 (100 x 100 µs = 10 ms)
	05 hex	R/W	Unsigned16	3E8 hex (1000 dec)	**Transmit PDO1:** Event timer In "asynchronous" mode, this object defines the minimum transfer frequency. Factor: 1 ms Min. value:= 10 (10 ms) The run time of the event timer must be greater than the inhibit time (subindex: 1800/03).

Index	Subindex	R/W	Type	Factory setting	Comment
1801 hex	00 hex	R	Unsigned8	05 hex	**Transmit PDO2:** Number of entries
	01 hex	R/W	Unsigned32	00 00 02 80 hex + Node-ID	**Transmit PDO2:** COB ID entry
	02 hex	R/W	Unsigned8	FF hex	**Transmit PDO2:** Transfer method "Asynchronous" (254 or 255) "Cyclically synchronous" (1...240) "Acyclically synchronous" (0)
	03 hex	R/W	Unsigned16	12C (300 dec)	**Transmit PDO2:** Inhibit time Minimum time between two transfers. Factor: 10 ms Min. value: 100 (100 x 100 µs = 10 ms)
	05 hex	R/W	Unsigned16	3E8 hex (1000 dec)	**Transmit PDO2:** Event timer In "asynchronous" mode, this object defines the minimum transfer frequency. Factor: 1 ms Min. value:= 10 (10 ms) The run time of the event timer must be greater than the inhibit time (subindex: 1801/03).
1A 00 hex	00 hex	R	Unsigned8	04 hex	**Transmit PDO1 assignment:** Number of used process data 4 objects are used
	01 hex	R	Unsigned32	30 10 01 10 hex	**Transmit PDO1 assignment:** 1st Object Status word "ZTW"
	02 hex	R	Unsigned32	30 10 02 10 hex	**Transmit PDO1 assignment:** 2nd Object Act. value1 selection (see parameter 4.6.40)
	03 hex	R	Unsigned32	30 10 03 10 hex	**Transmit PDO1 assignment:** 3rd Object Act. value2 selection (see parameter 4.6.44)
	04 hex	R	Unsigned32	30 10 04 10 hex	**Transmit PDO1 assignment:** 4th Object Act. value3 selection (see parameter 4.6.48)
1A 01 hex	00 hex	R	Unsigned8	04 hex	**Transmit PDO2 assignment:** Number of used process data Only one object is used
	01 hex	R	Unsigned32	30 10 05 10 hex	**Transmit PDO2 assignment:** 1st Object Act. value4 selection (see parameter 4.6.52)
	02 hex	R	Unsigned32	30 10 06 10 hex	**Transmit PDO2 assignment:** Not used
	03 hex	R	Unsigned32	30 10 07 10 hex	**Transmit PDO2 assignment:** Not used
	04 hex	R	Unsigned32	30 10 08 10 hex	**Transmit PDO2 assignment:** Not used

Network configuration

Use the slave-specific EDS file (Electronic Data Sheet) for the network configuration of the CANopen master connection. For the Active Front End the configuration file **SEAFE.eds** has to be used. It is provided on the CD-ROM which is attached to each device as well as under www.schneider-electric-power-drives.com.

```
[Comments]
Lines=2
Line1=EDS file for AFE CANopen Slave
Line2=

[FileInfo]
FileName=E:\PROJEKT\CANOPEN_EDS\SEAFE.eds
FileVersion=1
FileRevision=0
EDSVersion=4.0
Description=EDS of the AFE
CreationTime=11:35AM
CreationDate=01-20-2004
CreatedBy=S.T.I.E.
ModificationTime=10:57AM
ModificationDate=04-02-2009
ModifiedBy=S.T.I.E.

[DeviceInfo]
Vendorname=Schneider Electric
VendorNumber=0x0200005A
ProductName=AFE_V1.0
ProductNumber=0x00414645
RevisionNumber=0x00010000
OrderCode=0
BaudRate_10=0
BaudRate_20=1
BaudRate_50=1
BaudRate_125=1
BaudRate_250=1
BaudRate_500=1
BaudRate_800=0
BaudRate_1000=1
SimpleBootUpMaster=0
SimpleBootUpSlave=1
Granularity=0
DynamicChannelsSupported=0
GroupMessaging=0
NrOfRXPDO=2
NrOfTXPDO=2
LSS_Supported=0
CompactPDO=0x00
.
.
.
```

The EDS file contains the whole information (according to the CANopen standard) which are required for coupling of the Active Front End to a CANopen network. The file is designed in such a manner that it can be read by means of a text editor.

Due to the reading of the EDS file using the bus configuration tool, all slave-specific bus data is available to the bus master according to the "predefined connection set". The address ranges are defined by means of configuration and the configuration setting is transmitted during boot up of the network from the PLC to the individual slaves using SDO telegrams.

In addition to the EDS file also three graphic files are available which can be optionally used in the configuration tool.

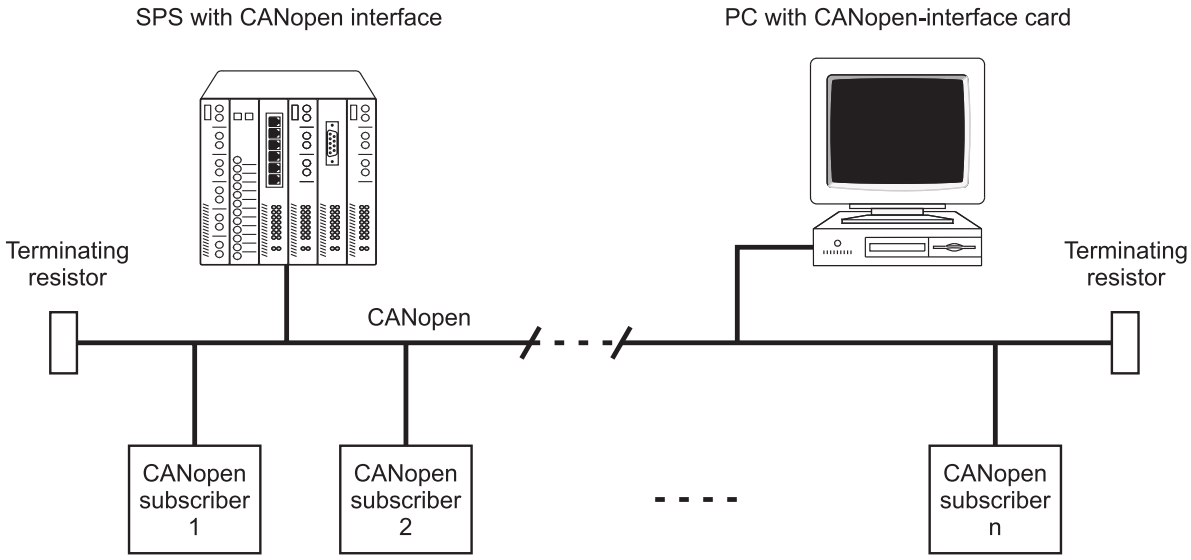
MX1D1_s.dib

MX1D1_r.dib

MX1D1_d.dib

Modifying the EDS-file leads to faulty action and is therefore not allowed!

Structure of the network



Due to the principle of bit-by-bit arbitration for the avoidance of bus access conflicts, the signal run time must be taken into consideration depending on the baud rate. Decreasing line lengths result at increasing bus speeds. Drop lines have a particularly negative influence on signal transmission. Generally, the drop lines should be kept as short as possible (max. 0.3 m drop line length at 1000 kBit/s).

Permissible line length depending on the baud rate:

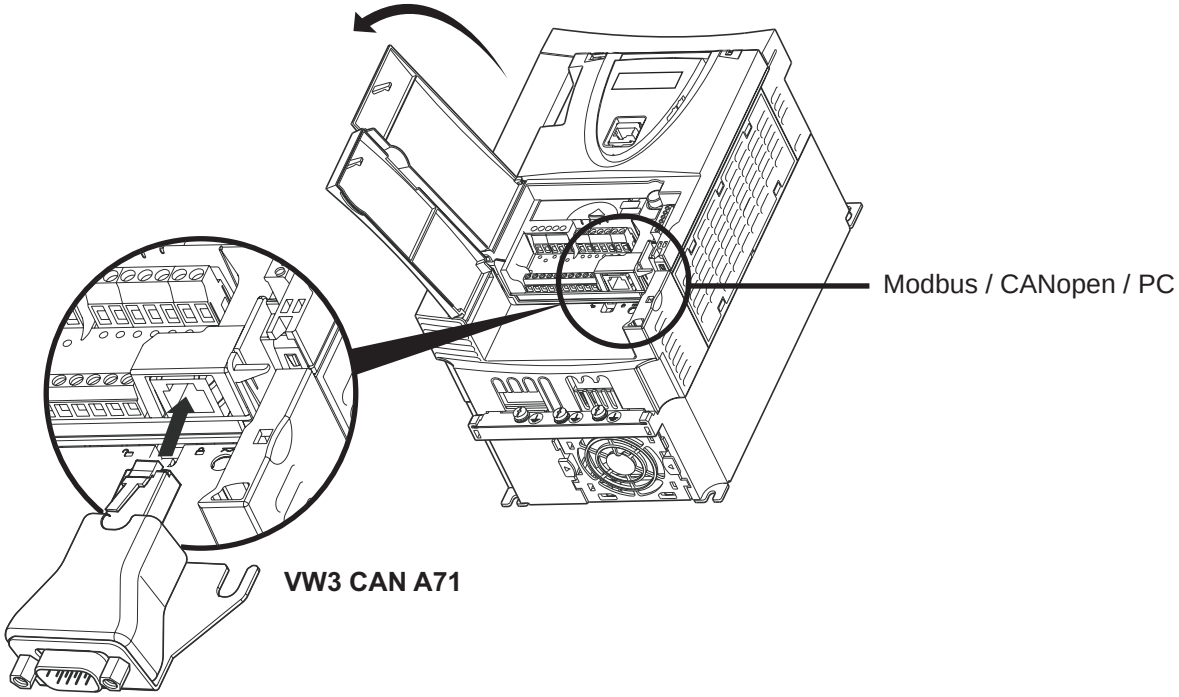
Baud rate [kBit/s]	20	50	125	250	500	1000
Length [m]	2500	1000	500	250	100	25

Technical key data of the CANopen network

Interface according to:	CiA DS 102
Maximum number of subscribers:	32...126 according to the CAN controller used
Bus cable:	Use a screened, twisted, two-wire line as bus cable (e.g. LAPPKABEL UNITRONIC® BUS CAN)
	Characteristic impedance: 120 Ω (108...132 Ω) Distributed capacitance: < 60 nF/km Loop resistance: < 186 Ω/km Wire cross-section: > 0.50 mm^2 Specific line lag: 5 ns/m
Terminating resistor:	The bus should be terminated on both ends using a 120 Ω (108...132 Ω) resistor. Terminating resistors are located in the bus plugs of the bus subscribers at both ends. The CANopen network functions only when the bus termination is properly installed!
Galvanic isolation:	No

Mechanical construction

Installation of the option



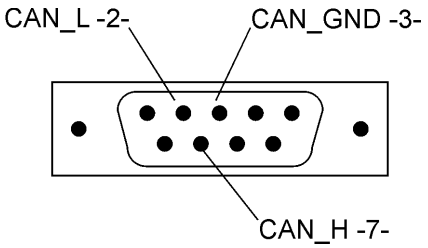
Plug assignment

Plug assignment of the CANopen communication interface (corresponding to ISO 11898)

Pin assignment: RJ45 plug Modbus/CANopen/PC
(at the AIC)

Pin	Signal
1	CAN_H
2	CAN_L
3	CAN_GND
4	D1 *)
5	D0 *)
6	Not used
7	VP **)
8	Common *)

Pin assignment: SUB-D plug CANopen
(at option VW3 CAN A71)



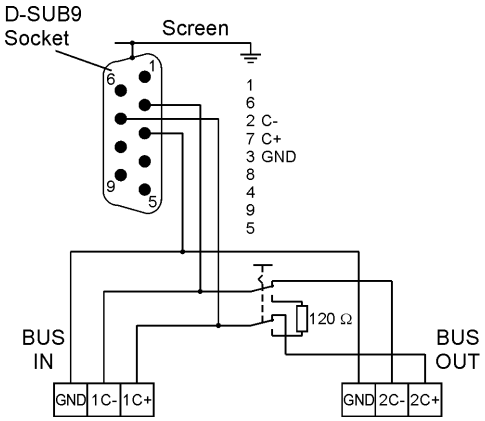
*) Modbus signal

**) Voltage supply for the RS232/RS485 interface converter (PC software MatriX 3)

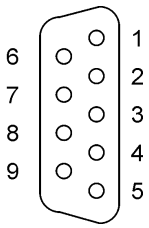
Plug connector:

The bus is connected via a 9-pole Sub-D plug connector. Female multipoint connector on the bus cable, male multipoint connector on the bus subscriber.

The bus plugs option CANopen connector (order number VW3 CAN KCDF 180T) are designed as T-pieces, whereby the bus line sections on the plug connector are permanently connected to each other. The terminating resistors are located in the bus plug and can be switched on and off.



Pin assignment of the option CANopen connector



9-pin Sub-D (female)

Pole	Signal	Meaning
1		
2	CAN-L	CANopen signal -
3	CAN-GND	CANopen ground
4		
5		
6		
7	CAN-H	CANopen signal +
8		
9		

Process Data Object PDO

Process Data Object PDO

PDO telegrams are used for the fast transfer of process data used for the control and monitoring of the drive. In the Active Front End one PDO receive telegram (PDO1) with one word is available. For transmitting the actual values two PDO transmit telegrams (PDO1 with 4 words, PDO2 with 1 word) are defined.

Receive PDO1 telegram PLC → Altivar AFE

COB ID	Byte 0	Byte 1
200 hex + Node ID	Control word (STW)	
	LSB	MSB

In the PDO receive telegram, the bus control word (STW) is transferred to the CANopen slave from the CAN open master (PLC). In the process, a PDO1 telegram received from the Altivar AFE is processed immediately (1.5 ms).

Because of using the method "*static PDO mapping*", the telegram structure of the PDO is permanently predefined. The transferred bus reference values are allocated by means of the parameterization in menu 4.6.

The PDO receive telegrams are sent as unconfirmed telegrams (broadcast) by the CANopen master and require no further settings on the Active Front End.

Transmit PDO1 telegram Altivar AFE → PLC

COB ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
180 hex + Node ID	Status word (ZTW)		Actual value 1 (4.6.40)		Actual value 2 (4.6.44)		Actual value 3 (4.6.48)	
	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB

Transmit PDO2 telegram Altivar AFE → PLC

COB ID	Byte 0	Byte 1
280 hex + Node ID	Actual value 4 (4.6.52)	
	LSB	MSB

In the PDO transmit telegram, the device status word (ZTW) and a maximum of 4 selectable actual values is transferred to the CANopen master (PLC) from the CANopen slave.

Because of using the method "static PDO mapping", the telegram structure of both PDOs is permanently predefined. The actual values being transferred are selected by means of parameterization in menu 4.6. Word 1 in the telegram "*PDO1 Transmit*" always contains the device status word.

The PDO transmit telegrams generated by Altivar AFE can be transferred using parameter groups 1800/1801 hex (PDO1, 2) cyclically or synchronized in event-oriented form.

Parameter	Index	Subindex	Format	Setting	Transfer mode
Transfer method	1800 hex 1801 hex	02 hex	Unsigned8	FE hex FF hex	Event-oriented transfer
				01...F0 hex	Cyclically (triggered by the SYNC telegram)
				00 hex	Event-oriented (triggered by SYNC)
				FC, FD hex	Triggered by RTR (not supported)

The selection of the transfer method is accepted only in the NMT state "Pre-operational".

Event-oriented transfer

In case of this transfer mode, a PDO transmit telegram is sent by the Altivar AFE only if a value is changed. When a PDO of a subscriber contains values that are constantly changing (such as current or controller values), this subscriber constantly tries to send PDOs. In order not to impair the data flow of other subscribers, the event-oriented transfer can be influenced as follows using two adjustable timers:

Parameter	Index	Subindex	Format	Factor	Function
Inhibit time	1800 hex	03 hex	Unsigned16	100 µs	Prevents the transfer of a PDO for a set period
Event timer	1800 hex	05 hex	Unsigned16	1 ms	Maximum time between 2 PDOs When this time is up, a PDO is transferred even if the value is not changed. The event timer must be set longer than the inhibit time!

Cyclic, synchronized transfer

In case of this transfer mode, the sending of a PDO telegram is triggered by the SYNC telegram sent by the CANopen master. In the process, it is possible to select whether the PDO should be sent with every SYNC telegram or after a certain number of SYNC telegrams have been received. The setting takes place using parameter 1800, 1801/02 hex (setting range 1...240).

Event-oriented, synchronized transfer

The PDO telegram is triggered depending on the received SYNC telegrams, as in case of the cyclically synchronous transfer. This occurs, however, only if the value has changed since the last transfer.

The setting takes place using parameter 1800, 1801/02 hex (setting range 1...240).

Control word

The Active Front End is controlled using the bus control word, which is designed on the basis of the Drivecom and Profidrive profile (VDE 3689). The standardized information of the control and status word (bit 0...10) is described subsequently and requires no internal settings at the Active Infeed Converter. The assignment of actual values has to be parameterized accordingly in menu "4.6 - Bus settings".

Assignment

Bit 15	–	
Bit 14	–	
Bit 13	–	
Bit 12	Trip request	
Bit 11	–	
Bit 10	Control O.K.	No control
Bit 9	–	–
Bit 8	–	–
Bit 7	Reset	–
Bit 6	–	–
Bit 5	–	–
Bit 4	–	–
Bit 3	Release operation	Lock operation
Bit 2	Operating condition	OFF 3
Bit 1	Operating condition	OFF 2
Bit 0	On	OFF 1
	High = 1	Low = 0

Description of control word bits

Bit	Value	Meaning	Note
0	1	ON	– Is accepted when the drive state is "*1 .. Ready to switch on*" and changes to drive state "*3 .. Ready to run*" when the DC link is already charged.
	0	OFF 1	– When the command has been accepted, the drive state changes to "*13 .. OFF1 active*" and thus the DC voltage is switched off.
1	1	Operating condition	"*OFF 2*" command canceled
	0	OFF 2	– When the command has been accepted, the Active Front End will be locked and the drive state changes to "*19 .. Lock switching on*". – When the basic state (bit 1 = 0, bit 2 = 1, bit 3 = 1 and bit 10 = 1) is given, the drive state changes to "*1 .. Ready to switch on* ". The OFF 2 command can also be triggered by means of the terminal function Impulse enable !
2	1	Operating condition	"*OFF 3*" command canceled
	0	OFF 3	– When the command has been accepted, the drive state changes to "*14 .. OFF3 active*".
3	1	Operation released	When the command has been accepted, the Active Front End is released (Impulse enable) in drive state "*3 .. Ready to run*" and afterwards the drive state changes to "*4 .. Operation released*".
	0	Lock operation	– When the command has been accepted, the Active Front End will be locked and the drive state changes to "*3 .. Ready to run*". – If the drive state is "*13 .. OFF1 active*", the Active Front End will be locked and the drive state changes to "*0 .. Not ready to switch on*". – When the basic state (bit 1 = 0, bit 2 = 1, bit 3 = 1 and bit 10 = 1) is given, the drive state changes to "*1 .. Ready to switch on*". – If the drive state is "*14 .. OFF 3 active*", the procedure is executed all the same !
4	x	Not used	
5	x	Not used	
6	x	Not used	
7	1	Reset	– The reset command is accepted at the positive edge when the drive state is "*20 .. Fault*". – When there is no fault anymore, the drive state changes to "*19 .. Lock switching-on*". – If a fault is still remaining the drive state is furthermore "*20 .. Fault*". The reset command can also be triggered by means of the terminal function "Ext. reset" as well as by means of the Stop/Reset key on the keypad.
	0	no meaning	
8	x	Not used	
9	x	Not used	

Bit	Value	Meaning	Note
10	1	Control O.K.	When the command has been accepted, the DP slave is controlled via the bus interface. The process data become valid. This bit must be set in order to accept control commands and/or the free bits as well as analog signals !
	0	No control	– When the command has been accepted, all data are processed depending in status bit 9 "*Control requested*". Control requested == 1 → Behaviour according to bus fault – If the DP slave requests control furthermore, the Active Front End switches over to fault state with the fault message BUS_COMM2 (depending on the setting of parameter 4.6.03 "Bus error reaction"). In this case an alarm message is always set ! Control requested == 0 → Data to 0 ! → only I/O or panel operation

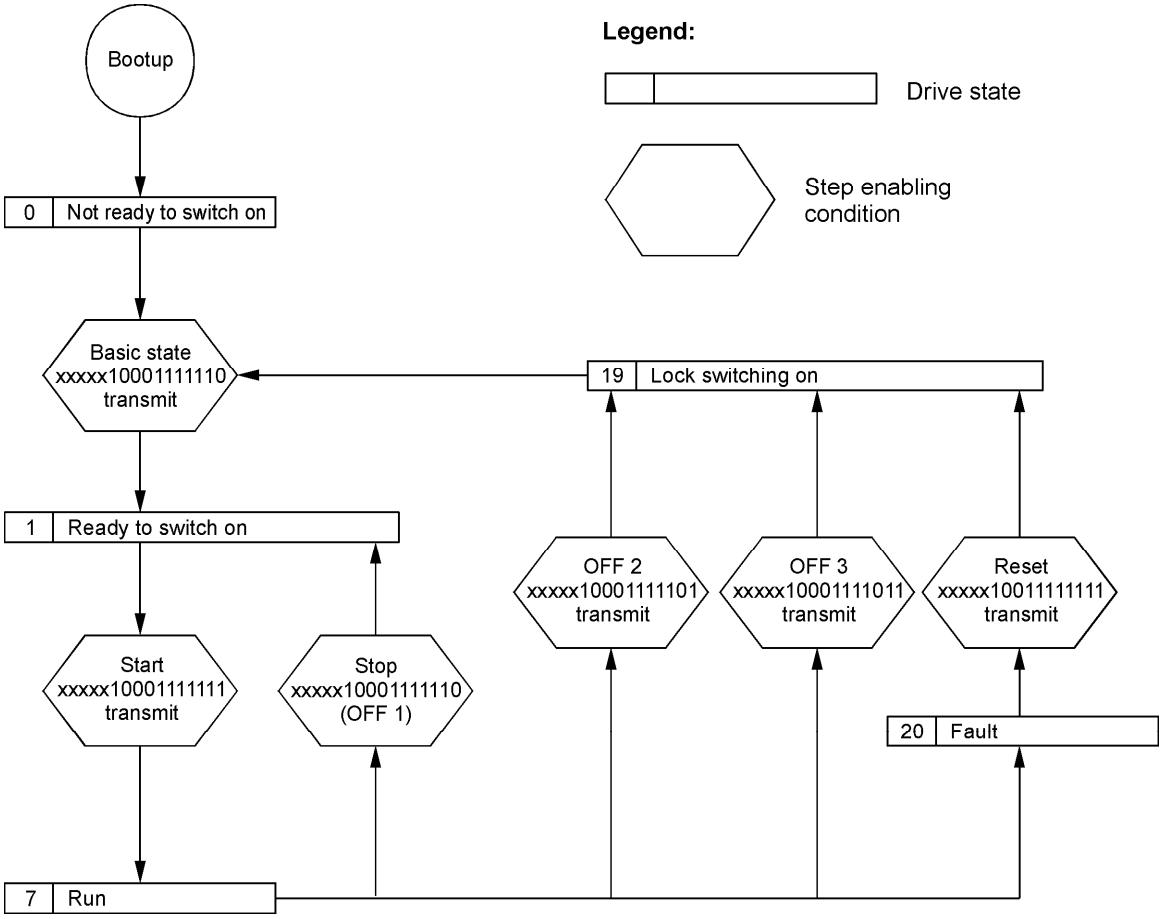
Summary of the most important control commands

Function	Control word	
	Binary	Hexadecimal
ON Start	0000010001111111	47F
OFF 1 Stop	0000010001111110 corresponds with the "basic state"	47E
OFF 2	0000010001111101 results in drive state Lock switching-on !	47D
OFF 3	0000010001111011 results in drive state Lock switching-on !	47B
Reset	xxxxx1xx1xxxxxxx	e.g. 480
Use of a free bit (e.g. 13) during operation	0000010001111111 +0010000000000000 0010010001111111	47F +2000 247F
Cancelling "Lock switching-on"	"*15 Lock switching-on*" 0000010001111110 0000010001111111	e.g.: 47E 47F

Simplified state machine

For standard control with the commands:

- Start / Stop
- OFF 2
- OFF 3
- Reset of a fault

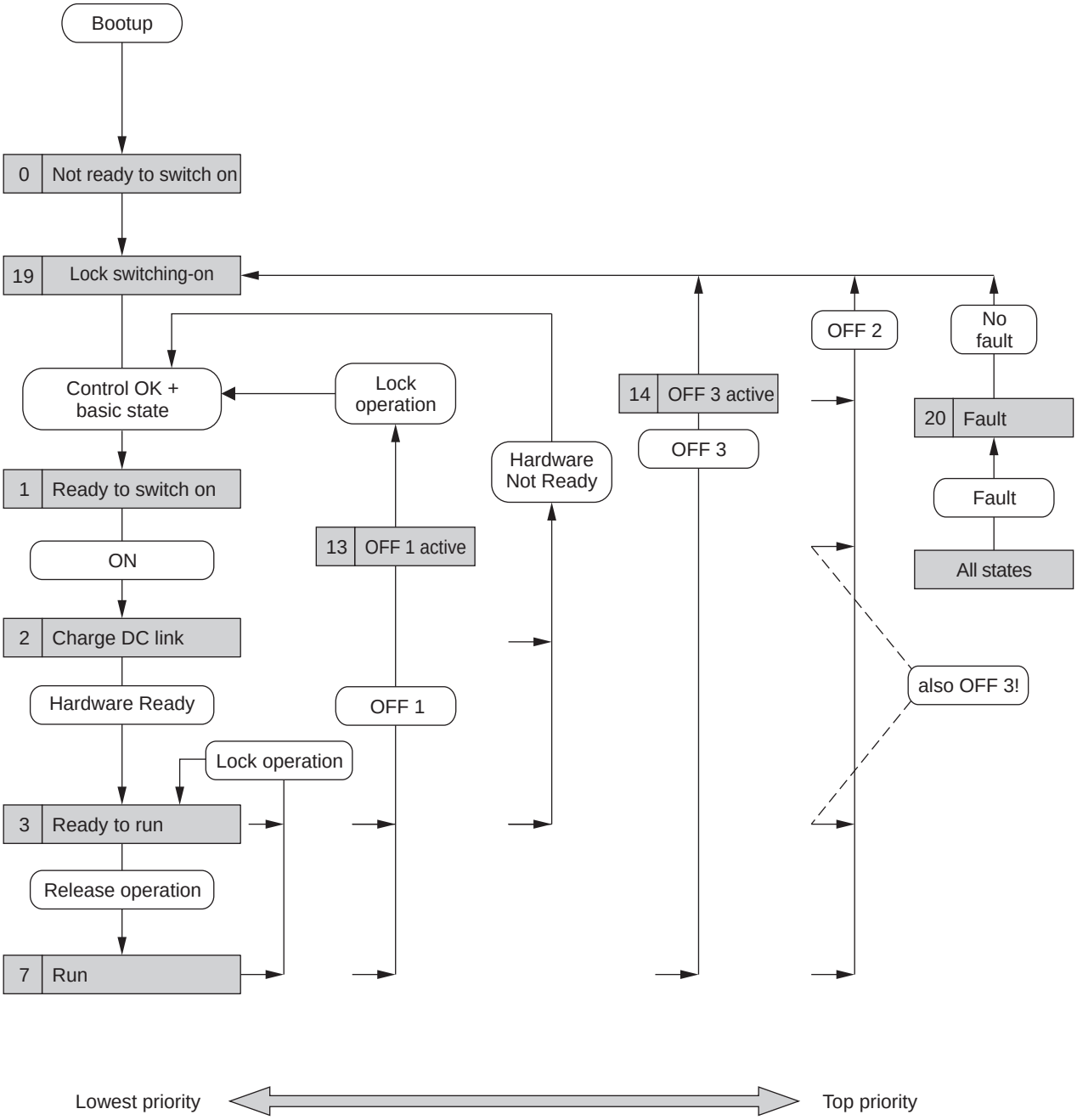


The commands OFF 2, OFF 3 as well as a fault which has been reset always result in drive state "*Lock switching-on*" !

In order to reach drive state "Run" it is necessary to send the basic state (bit 0 = 0, bit 1, 2 = 1) before transmitting the start command (bit 0 = 1).

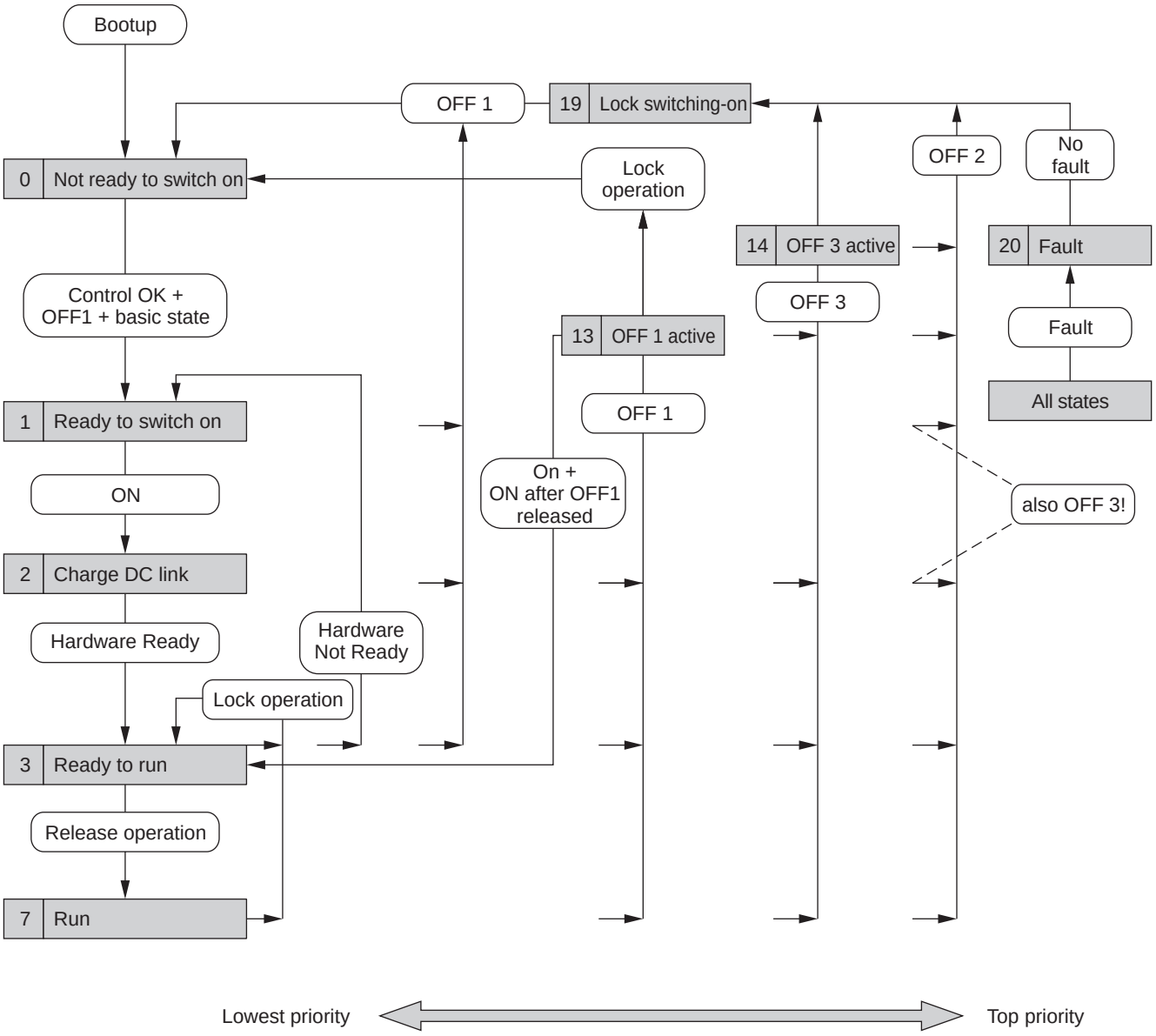
After connecting the mains (bootup of the drive) the basic state (bit 0 = 0, bit 1, 2 =1) must be provided in order to reach drive state "Ready to switch on".

Drivecom state machine



State machine Profidrive

At the Active Front End the Profidrive profile must be selected with parameter 4.6.04 Bus profile.



Status word

Assignment

Bit 15	–	
Bit 14	–	
Bit 13	–	
Bit 12	–	
Bit 11	–	
Bit 10	–	–
Bit 9	Control requested	No control authority requested
Bit 8	–	–
Bit 7	Alarm	No alarm
Bit 6	Lock switching-on	No lock switching-on
Bit 5	no OFF 3	OFF 3
Bit 4	no OFF 2	OFF 2
Bit 3	Fault	Failure-free
Bit 2	Operation released	Operation locked
Bit 1	Ready to run	Not ready to run
Bit 0	Ready to switch on	Not ready to switch on
	High = 1	Low = 0

Listing of the most important drive states	Status word bits										
	10	9	8	7	6	5	4	3	2	1	0
0 .. Not ready to switch on	x	1	x	x	0	x	x	0	0	0	0
1 .. Ready to switch on	x	1	x	x	0	x	1	0	0	0	1
3 .. Ready to run	x	1	x	x	0	x	1	0	0	1	1
7 .. Run	x	1	x	x	0	1	1	0	1	1	1
19 .. Lock switching on	x	1	x	x	1	x	x	0	0	0	0
20 .. Fault	x	1	x	x	0	x	x	1	0	0	0

0 .. Bit state zero

1 .. Bit state one

x .. Bit state is undefined

Description of status word bits

Bit	Value	Meaning	Note
0	1	Ready to switch on	The drive state is "*1 .. Ready to switch on*". The Active Front End is locked.
	0	Not ready to switch on	The drive state is "*0 .. Not ready to switch on*" or "*19 .. Lock switching-on*".
1	1	Ready to run	The drive state is "*3 .. Ready to run*". That means that there is voltage on the power part and there are no faults. But the Active Front End is still locked.
	0	Not ready to run	
2	1	Operation released	The drive state is "*7 .. Run*", "*13 .. OFF 1 active*" or "*14 .. OFF 3 active*". The Active Front End is operating with impulse enable and there is voltage on the output terminals.
	0	Operation locked	
3	1	Fault	The drive is not in operation due to a fault. The drive state is "*20 .. Fault*". After successful trouble shooting and reset of the fault the drive state changes to "*19 .. Lock switching-on*".
	0	Failure-free	
4	1	no OFF 2	
	0	OFF 2	An OFF 2 command is given.
5	1	no OFF 3	
	0	OFF 3	An OFF 3 command is given.
6	1	Lock switching-on	The inverter has drive state "*19 .. Lock switching-on*". This state occurs in consequence of the commands OFF 2 and OFF 3 as well as after successful resetting of a fault. This drive state is canceled by means of bit 0 STW = 0.
	0	No lock switching-on	
7	1	Alarm	There is an alarm message, resetting is not required.
	0	No alarm	
8	x	Not used	
9	1	Control requested	When the Active Front End is parameterized for bus operation by means of parameter 4.6.01 (control via bus), the Active Front End asks the DP master for assumption of control after mains connection or connecting an external 24 V buffer voltage. As long as the master does not assume control, an alarm message (ZTW bit 7) is given.
	0	No bus operation	If the Active Front End is disconnected from the bus communication because of switching to panel mode (key on the keypad), bit 9 is reset to zero. – If the master does not send "Control OK" (STW bit10 = 0), an alarm message is set. – When the drive is switched to remote mode = bus operation again, the automation system has to answer with "Control OK" within 2 seconds. Otherwise the drive is switched back to panel mode automatically.
10	x	Not used	

Main actual value (Auxiliary actual values)

In the PDO1 three actual values (each 16 bit) are available, in PDO2 one actual value. The meaning of the individual actual values is defined by parameterization of the Active Front End AFE using the operating panel.

The actual values can be used as internal actual values of the Active Infeed Converter like e.g. actual value of current, power a.s.o. (according to the analog outputs of the AFE).

The actual values are linear scaled values with 16 bit display.
That is 0 % = 0 (0 hex), 100 % = 2^{14} (4000 hex)

Therefrom a presentable data range of -200...+200 % with a resolution of 2^{-14} (0.0061 %) results.

%	Binary	Hexadecimal	Decimal
199.9939	01111111 11111111	7FFF	32767
100.000	01000000 00000000	4000	16384
0.0061	00000000 00000001	0001	1
0.000	00000000 00000000	0000	0
-0.0061	11111111 11111111	FFFF	-1
-100.000	11000000 00000000	C000	-16384
-200.000	10000000 00000000	8000	-32768

The scaling of the actual values is done by parameterization in parameter group 4.6. The scaling of the individual actual values is fixed for each output value. See parameter group 4.6.

Service Data Object SDO

Service Data Object SDO

SDO telegrams provide a service for direct access to the object library. On the one hand, they are used for adjustment of the CANopen-specific communication settings during network configuration (objects 00 00 hex...1F FF hex), while, on the other hand, they have read and write access to all parameters in the Altivar AFE (objects 20 00 hex...5F FF hex).

An SDO telegram is always executed as a confirmed telegram. When the Altivar AFE receives an SDO request telegram from the CANopen master, the request is processed internal and the response is returned to the master in form of an SDO response telegram.

Request SDO telegram PLC → Altivar AFE

COB ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
600 hex + Node ID	Request code	Object index		Object sub index	Request data			
		LSB	MSB		Bits 7...0	Bits 15...8	Bits 23...16	Bits 31...24

Response SDO telegram Altivar AFE → PLC

COB ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
580 hex + Node ID	Response code	Object index		Object sub index	Response data			
		LSB	MSB		Bits 7...0	Bits 15...8	Bits 23...16	Bits 31...24

Request code

Request code	Meaning	Byte 4	Byte 5	Byte 6	Byte 7
23 hex	Write 4 byte parameter	Bit 7...0	Bit 15...8	Bit 23...16	Bit 31...24
2B hex	Write 2 byte parameter	Bit 7...0	Bit 15...8	00 hex	00 hex
2F hex	Write 1 byte parameter	Bit 7...0	00 hex	00 hex	00 hex
40 hex	Read parameter (4/2/1 byte)	00 hex	00 hex	00 hex	00 hex
80 hex	Cancel request	00 hex	00 hex	00 hex	00 hex

Response code

Response code	Meaning	Byte 4	Byte 5	Byte 6	Byte 7
43 hex	Transfer 4 byte parameter	Bit 7...0	Bit 15...8	Bit 23...16	Bit 31...24
4B hex	Transfer 2 byte parameter	Bit 7...0	Bit 15...8	00 hex	00 hex
4F hex	Transfer 1 byte parameter	Bit 7...0	00 hex	00 hex	00 hex
60 hex	Parameter is written (4/2/1 Byte)	00 hex	00 hex	00 hex	00 hex
80 hex	Request not executed / fault code	00 hex	00 hex	00 hex	00 hex

If a request cannot be executed, response Code 80 hex is transferred together with the respective fault code as the response.

Fault code	Meaning
05 03 00 00 hex	Segmented transfer; the toggle bit was not changed
05 04 00 01 hex	Unknown request code
06 01 00 00 hex	Parameter cannot be adjusted (cannot be adjusted during operation, double assignment or active parameter lock)
06 01 00 02 hex	Parameter cannot be adjusted (actual value)
06 02 00 00 hex	Non-existent parameter index
06 09 00 11 hex	Non-existent parameter subindex
06 09 00 30 hex	Parameter value outside the permitted limits
06 09 00 31 hex	Parameter value too large
08 00 00 00 hex	General parameterization fault

General remarks regarding the use of the SDO parameterizing service

- For write requests, use a request that corresponds to the parameter type and enter the value to be transferred in the corresponding bytes (LSB before MSB).
- The master must recognize the response to a request made by evaluating the response code of the parameter index/subindex and the parameter value.
- If an SDO request cannot be executed, the Altivar AFE sends an SDO telegram with response code 80 hex (request not executed). The corresponding fault code is transferred in the data bytes (4...7).
- Parameter write requests are not permissible if they do not refer to objects that are assigned to a PDO.
- Read requests for parameter types greater than 4 bytes (multiple-byte data) are transferred using a segmented SDO routine. The transfer can be interrupted using request code 80 hex.

☞ Detailed information on the individual parameters, such as the index, subindex, setting range and data type can be found in the parameter list in the appendix.

☞ Parameter 6.1.03 "Parametrising station" (Index 200B/2F) must be set to "3 .. CANopen" in order to adjust parameters on the Altivar AFE via the CANopen interface.

Examples

☞ In the following examples, all COB IDs refer to slave address 1

☞ All values stated in the telegram structure are represented in hexadecimal form.

Reading of the operating hours (parameter 1.2.05)
→ 1.2.05 = Index: 2001 hex Subindex: 3B hex

SDO request

COB ID	Req	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
601	40	01	20	3B	00	00	00	00

SDO response

COB ID	Res	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
581	4B	01	20	3B	FE	01	00	00

01FE hex = 510 dec
Scaling: Real value = transferred value / factor (for factor, see chapter "List of parameters", page 58)
Operating hours = 510 / 1 = 510 h

Programming of the parameterizing station on CANopen (6.1.03 = setting "3 .. CANopen")
→ 6.1.03 = Index: 200B hex Subindex: 2F hex

SDO request

COB ID	Req	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
601	2B	0B	20	2F	03	00	00	00

SDO response

COB ID	Res	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
581	60	0B	20	2F	00	00	00	00

☞ It is necessary to set parameter 6.1.03 "Parametrising station" to setting "3 .. CANopen" (Index 200B/2F) in order to be qualified for adjusting other parameters.

Programming of relay output R1 to trip (3.4.01 = setting "3…Trip")
→ 3.4.01 = Index: 2007 hex Subindex: 62 hex

SDO request

COB ID	Req	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
601	2B	07	20	62	03	00	00	00

Positive SDO response

COB ID	Res	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
581	60	07	20	62	00	00	00	00

Negative SDO response (not assignable due to double assignment)

COB ID	Res	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
581	80	07	20	62	00	00	00	08

Response code 80 refers to a request that cannot be performed. The corresponding fault code is transferred in the value field (08 00 00 00 = general parameterizing error due to double assignment).

Adjustment of an analog value (3.3.04 "AO1 max. value" = 150 %)
→ 3.3.04 = Index: 2007 hex Subindex: 56 hex

SDO request

COB ID	Req	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
601	2B	07	20	56	98	3A	00	00

SDO response

COB ID	Res	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
581	60	07	20	56	00	00	00	00

Scaling: Value to be transferred = real value * factor (for factor, see chapter "List of parameters", page 58)

Setting 150 %, factor 100
Value to be transferred = 150 * 100 = 15000 dec = 3A98 hex

Reading of the drive reference (1.3.01 "Device type AFE")

→ 1.3.01 = Index: 2000 hex Subindex: 0C hex

The drive reference is a parameter of the type "Text". It is to be read in ASCII-coded form.

Corresponding to the expected length of text the start address and a certain number of ensuing parameters has to be read (see chapter "List of parameters", page 58).

1st SDO request

COB ID	Req	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
601	40	00	20	0C	00	00	00	00

1st SDO response

COB ID	Res	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
581	4B	00	20	0C	49	41	00	00

Transferred value = 41 49 → ASCII "A" "I"

2nd SDO request

COB ID	Req	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
601	40	00	20	0D	00	00	00	00

2nd SDO response

COB ID	Res	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
581	4B	00	20	0D	2D	43	00	00

Transferred value = 43 2D → ASCII "C" "-"

…….

8th SDO request

COB ID	Req	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
601	40	00	20	14	00	00	00	00

8th SDO response

COB ID	Res	Index		Sub	Byte 4	Byte 5	Byte 6	Byte 7
581	4B	00	20	14	00	00	00	00

Transferred value = 00 00 → ASCII "_" "_"

Summary: 46 49 43 2D 34 56 36 37 35 20 00 00 00 00 00 = AIC-4V675_

ASCII code table

ISO / IEC 10 367
Basic G0 Set
Latin Alphabet No. 1 supplementary set

hex	Char	hex	Char	hex	Char	hex	Char	hex	Char	hex	Char
20	Space	40	@	60	`	A1	¡	C1	Á	E1	á
21	!	41	A	61	a	A2	¢	C2	Â	E2	â
22	"	42	B	62	b	A3	£	C3	Ã	E3	ã
23	§	43	C	63	c	A4	¤	C4	Ä	E4	ä
24	$	44	D	64	d	A5	¥	C5	Å	E5	å
25	%	45	E	65	e	A6	¦	C6	Æ	E6	æ
26	&	46	F	66	f	A7	§	C7	Ç	E7	ç
27	´	47	G	67	g	A8	¨	C8	È	E8	è
28	(	48	H	68	h	A9	©	C9	É	E9	é
29	)	49	I	69	i	AA	ª	CA	Ê	EA	ê
2A	*	4A	J	6A	j	AB	«	CB	Ë	EB	ë
2B	+	4B	K	6B	k	AC	¬	CC	Ì	EC	ì
2C	,	4C	L	6C	l	AD		CD	Í	ED	í
2D	-	4D	M	6D	m	AE	®	CE	Î	EE	î
2E	.	4E	N	6E	n	AF	¯	CF	Ï	EF	ï
2F	/	4F	O	6F	o	B0	°	D0	Đ	F0	ð
30	0	50	P	70	p	B1	±	D1	Ñ	F1	ñ
31	1	51	Q	71	q	B2	²	D2	Ò	F2	ò
32	2	52	R	72	r	B3	³	D3	Ó	F3	ó
33	3	53	S	73	s	B4	´	D4	Ô	F4	ô
34	4	54	T	74	t	B5	µ	D5	Õ	F5	õ
35	5	55	U	75	u	B6	¶	D6	Ö	F6	ö
36	6	56	V	76	v	B7	·	D7	×	F7	÷
37	7	57	W	77	w	B8	¸	D8	Ø	F8	ø
38	8	58	X	78	x	B9	¹	D9	Ù	F9	ù
39	9	59	Y	79	y	BA	º	DA	Ú	FA	ú
3A	:	5A	Z	7A	z	BB	»	DB	Û	FB	û
3B	;	5B	[	7B	{	BC	¼	DC	Ü	FC	ü
3C	<	5C	\	7C	|	BD	½	DD	Ý	FD	ý
3D	=	5D	]	7D	}	BE	¾	DE	Þ	FE	þ
3E	>	5E	^	7E	~	BF	¿	DF	ß	FF	ÿ
3F	?	5F	_	7F	DEL	C0	À	E0	à	0	\n

AFE settings

General fieldbus settings

Parameter group 4.6 Bus settings is used for configuration of all fieldbus connections which are possible with the Active Front End. The two fieldbus connections CANopen and Modus are available as standard. Further fieldbuses like e.g. Profibus DP can be realized by means of optional PCBs which can be built-in.

According to the used bus which is selected with parameter 4.6.01 only parameters for this bus are displayed in parameter group 4.6 in order to guarantee clear parameterization.

4.6.01	Bus selection				0 .. No bus

0 ...No bus
1 ...Modbus
2 ...CANopen

The desired fieldbus system is activated by means of parameter 4.6.01 Bus selection. The activation influences the principle data exchange between the bus subscribers in respect of the transmitted process data (reference / actual values) and the parameterization service.

In order to use the bus control word of the respective bus profile for the control of the Active Front End, the control source (parameter 2.2.01) has to be set to "Fieldbus control".

See also parameter group 2.2 of the Description of functions for the Active Front End.

4.6.02	Control requested				0 .. Not active

0 ...Not active
1 ...Active

In order to recognize a communication problem at the serial fieldbus interface, two different monitoring routines are available.

Watch dog timing

The watch dog timing checks the fieldbus interface for a cyclical signal of the active bus master or scanner and therefrom it is a check of the bus hardware (cable break, malfunction of the master component, ...). The monitoring time depends on the existing network configuration like the number of subscribers, set baud rate a.s.o.. It is automatically transmitted from the master to the slave by means of the parameterization telegram or it has to be set at the Active Front End.

Loss of control

In contrast to the watch dog timing the control monitoring checks the data content of the serial data traffic. If a malfunction occurs at the fieldbus master or its respective PLC, all outgoing data are set to zero (Fail Save Mode). Therefore, the slave receives a telegram (with data content zero) periodically whereby the triggering of the watch dog timing is prevented.

In order to recognize this state and to take suitable measures, a monitoring of control can be activated with parameter 4.6.02 (typical for Profibus DP).

When parameter 4.6.02 Control requested is set to "1 .. Active" the Active Front End monitors bit 10 of the control word. If this bit equals state "Low", loss of control is detected.

4.6.03	Bus error reaction				4 .. -Δt- Trip

4 ...-Δt- Trip
5 ...-Δt- Alarm

4.6.04	Bus profile				1 .. DriveCom

1 ...DriveCom
2 ...Profidrive

Due to the bus profile a standardised communication is possible. The communication profile to be used can be selected with parameter 4.6.04.

☞ When the Active Front End is operated with a profibus card, parameter 4.6.04 has to be set to "2 .. Profidrive".

CANopen settings

4.6.20	CANopen address				0

0...127

Setting of the CANopen slave address. In this manual, the slave address is also called the node ID according to CiA □ DS301.

The setting of address 0 is not permissible!

4.6.21	CANopen baud rate				52 .. 125 kBaud

34...20 kBaud
38...50 kBaud
52...125 kBaud
60...250 kBaud
68...500 kBaud
76...1 Mbaud

The transmission rate must have the same setting in the whole CANopen network. Also see the chapter "Hardware" (for cable lengths). The setting of 20 kBaud is not supported by all CANopen devices and may lead to communication problems.

☞ The parameters "CANopen address" and "CANopen baud rate" do not become effective until after a boot procedure. For this purpose, the device should be completely disconnected (including the 24 V buffer voltage) or a software reset 5.1.01 should be performed.

Diagnostics of the configuration settings

4.6.22	CANopen state				

0 ...Boot-up
4 ...Stopped
5 ...Operational
127 .Pre-operational

Display of the active NMT state. This is also transferred in the response telegram to the CANopen master during active node guarding.

4.6.23	CANopen error register		0110		

0 .. No Error	☐ / ☑	4... Heartbeat	☐ / ☑
1 .. Bus Off	☐ / ☑	5... Invalid state	☐ / ☑
2 .. Node Guarding	☐ / ☑		
3 .. Overrun	☐ / ☑		

In the fault register, the corresponding fault is displayed during a CANopen communication problem.

No.	Fault	Required reaction
0	No fault	–
1	Bus OFF	Communication must be started.
2	Node Guarding	Return to the NMT state initialisation required
3	CAN overrun	–
4	Heartbeat	Return to the NMT state initialisation required
5	NMT state fault	Return to the NMT state initialisation required

4.6.24	CANopen Rx error count				

Counts all faulty received telegrams (SDO, PDO, etc.).

4.6.25	CANopen Tx error count				

Counts all incorrectly sent telegrams (SDO, PDO,....). (Hardware problems, bus overload,....)

Configuration of the fieldbus actual values

Corresponding to the configured telegram length there are four actual values available in addition to the digital status word.

Following process sizes can be transmitted as actual values:

Process size	Value	Unit	Scaling
1 .. load VSD	100.0	%	Nominal current AFE
2 .. Mains current	100.0	%	100 % = Nominal current AFE
3 .. Power	100.0	%	100 % = Nominal power
4 .. |Power|	100.0	%	100 % = Nominal power
5 .. Line filter voltage	100.0	%	100 % = Adjusted mains voltage
6 .. DC voltage	100.0	%	100 % = 1000 V
7 .. kWh meter mot.	1.0	kWh	Parameter 1.2.02
8 .. MWh meter mot.	1	MWh	Parameter 1.2.01
9 .. kWh meter gen.	1.0	kWh	Parameter 1.2.04
10 .. MWh meter gen.	1	MWh	Parameter 1.2.03
11 .. Act. Error Code	–	Integer	See table alarm index given in the appendix
12 .. Act. alarm Code	–	Integer	See table alarm index given in the appendix

4.6.40	Act. value1 selection				7 .. kWh meter mot.

0 ...Not used	5... Line filter voltage	10...MWh meter gen.
1 ...load VSD	6... DC voltage	11...Act. Error Code
2 ...Mains current	7... kWh meter mot.	12...Act. alarm Code
3 ...Power	8... MWh meter mot.	
4 ...|Power|	9... kWh meter gen.	

Selection of the size which should be transmitted at bus actual value 1.

4.6.41	Act. value1 min. value				0 %
	-300...300 %				

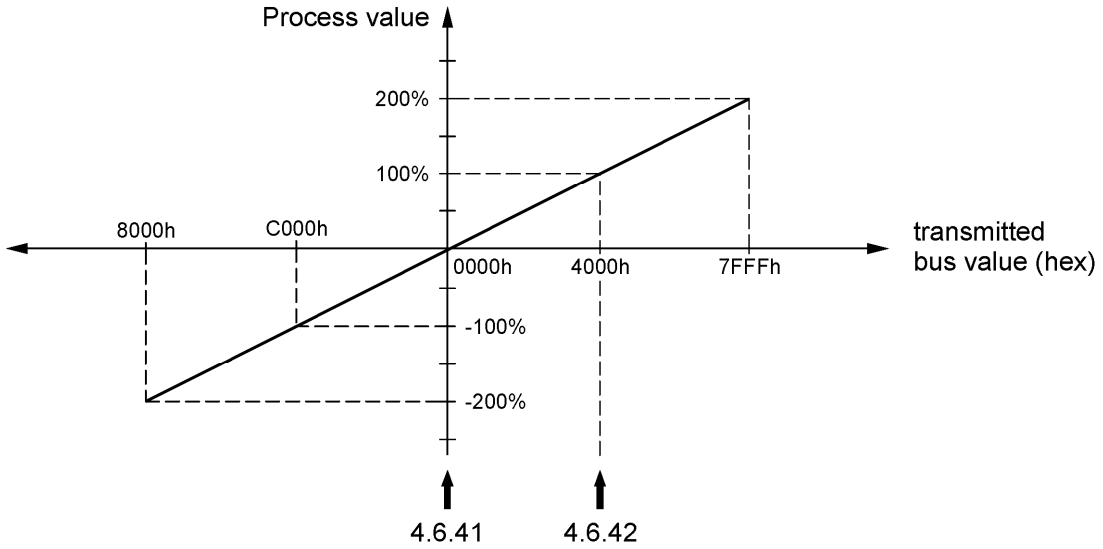
4.6.42	Act. value1 max. value				100 %
	-300...300 %				

The two parameters 4.6.41 "Act. value1 min. value" and 4.6.42 "Act. value1 max. value" are used for linear scaling of the transmitted bus actual value. 4.6.41 assigns the minimum value to the actual value point 0 % (0 dec = 0000 hex), 4.6.42 assigns the maximum value of a process size to the actual value point 100 % (16384 dec = 4000 hex).

The scaling of the process size and its unit can be seen from the table above.

Settings example for bus actual value 1

Process size	Scaling	4.6.41 "Act. value1 min. value"	4.6.42 "Act. value1 max. value"	Scaling of the output signal
3 .. Power	100 % = Nominal power AFE (e.g. 120 kW)	0 %	100 %	4000 hex (16384 dec) at 100 % Nominal power AFE (max. presentable range = 200 %)



4.6.43	Act. value1 filter-time				0 s
	0...30 s				

During the measurement of dynamically changing values, such as current or load, it may be a good idea to filter the actual value which should be transmitted already in the Active Front End. The measurement value can be stabilized before transmission by setting an appropriate filter time at the output filter.

At setting 0.0 seconds the filter is deactivated.

4.6.44	Act. value2 selection				8 .. MWh meter mot.
4.6.45	Act. value2 min. value				0 %
4.6.46	Act. value2 max. value				100 %
4.6.47	Act. value2 filter-time				0 s

4.6.48	Act. value3 selection				9 .. kWh meter gen.
4.6.49	Act. value3 min. value				0 %
4.6.50	Act. value3 max. value				100 %
4.6.51	Act. value3 filter-time				0 s

4.6.52	Act. value4 selection				10 .. MWh meter gen.
4.6.53	Act. value4 min. value				0 %
4.6.54	Act. value4 max. value				100 %
4.6.55	Act. value4 filter-time				0 s

The settings of the bus reference values 2...4 are logical identical with those of bus reference value 1 (see parameters 4.6.40...4.6.43).

Bus - Diagnostics

Diagnostics of the "Bus raw data"

4.6.100	PRx 01				hex
4.6.101	PRx 02				hex
4.6.102	PRx 03				hex
4.6.103	PRx 04				hex
4.6.104	PRx 05				hex
4.6.105	PRx 06				hex
4.6.106	PRx 07				hex
4.6.107	PRx 08				hex
4.6.108	PRx 09				hex
4.6.109	PRx 10				hex

Presentation of the incoming data words 1...10 at the bus.

4.6.110	PTx 01				hex
4.6.111	PTx 02				hex
4.6.112	PTx 03				hex
4.6.113	PTx 04				hex
4.6.114	PTx 05				hex
4.6.115	PTx 06				hex
4.6.116	PTx 07				hex
4.6.117	PTx 08				hex
4.6.118	PTx 09				hex
4.6.119	PTx 10				hex

Presentation of the outgoing data words 1...10 at the bus.

Bus coupling

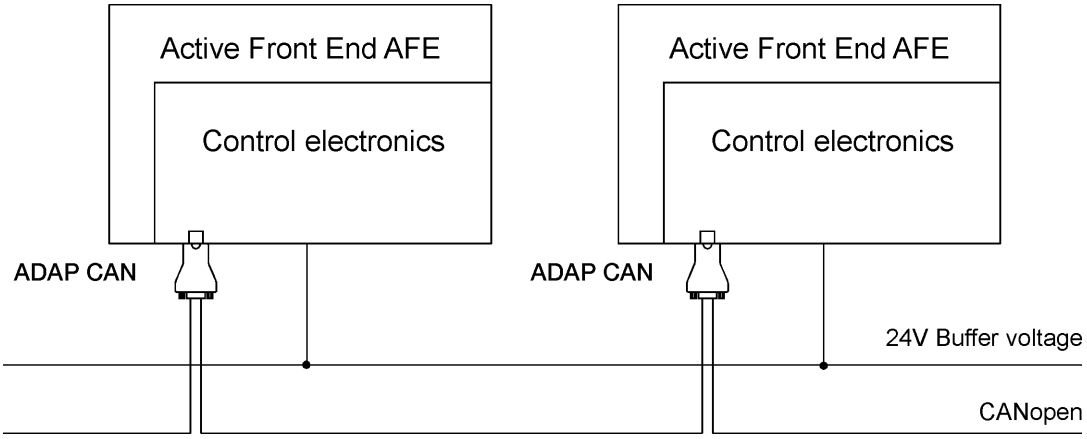
Design

The typical "Bus operation" (all Active Front End units are controlled via fieldbus) with simple configuration of the reference and actual values is available.

The whole control and diagnostics of the Active Front End is carried out by means of the bus coupling.

The possibility to implement conventional control elements is not used.

☞ In order to address an Active Front End via fieldbus also during mains cut-off (disconnecting switch, ...) the Active Front End AFE has to be supplied with an external 24 V buffer voltage.



Appendix

List of parameters

Parameter name		Index / Subindex	Type	Adjust-ability	Factor	Setting range min	Setting range max	Unit
1.2	**Counter**							
Operating hours meter								
1.2.01	MWh meter mot.	2001/40			1			MWh
1.2.02	kWh meter mot.	2001/41			10			kWh
1.2.03	MWh meter gen.	2001/42			1			MWh
1.2.04	kWh meter gen.	2001/43			10			kWh
1.2.05	Operating hours AFE	2001/3B			1			h
1.2.06	Interval operating hours	2004/47			1	0	60000	h
1.2.07	Interval counter	2001/3C			1			h
1.2.08	Clear interval counter	2001/3F						
1.3	**Device identification**							
Identification of the device								
1.3.01	Device type AFE	2000/0C	txt					
	Ensuing parameter	2000/0D	txt					
	Ensuing parameter	2000/0E	txt					
	Ensuing parameter	2000/0F	txt					
	Ensuing parameter	2000/10	txt					
	Ensuing parameter	2000/11	txt					
	Ensuing parameter	2000/12	txt					
	Ensuing parameter	2000/13	txt					
1.3.02	Nominal power AFE	2017/2A			1			kW
1.3.03	Nominal current AFE	2002/61			10			A
1.3.04	Nominal voltage AFE	2002/62						
1.3.05	Serial number AFE	2000/14			1			
1.3.06	Facility description	2000/18	txt					
	Ensuing parameter	2000/19	txt					
	Ensuing parameter	2000/1A	txt					
	Ensuing parameter	2000/1B	txt					
	Ensuing parameter	2000/1C	txt					
	Ensuing parameter	2000/1D	txt					
	Ensuing parameter	2000/1E	txt					
	Ensuing parameter	2000/1F	txt					
1.3.07	APP software AFE	2000/20	txt					
	Ensuing parameter	2000/21	txt					
	Ensuing parameter	2000/22	txt					
	Ensuing parameter	2000/23	txt					
	Ensuing parameter	2000/24	txt					
	Ensuing parameter	2000/25	txt					
	Ensuing parameter	2000/26	txt					
	Ensuing parameter	2000/27	txt					

Parameter name		Index / Subindex	Type	Adjust-ability	Factor	Setting range min	Setting range max	Unit
1.3.08	Service notice	2013/5E	txt					
	Ensuing parameter	2013/5F	txt					
	Ensuing parameter	2013/60	txt					
	Ensuing parameter	2013/61	txt					
	Ensuing parameter	2013/62	txt					
	Ensuing parameter	2013/63	txt					
	Ensuing parameter	2013/64	txt					
	Ensuing parameter	2014/01	txt					
	Ensuing parameter	2014/02	txt					
	Ensuing parameter	2014/03	txt					
	Ensuing parameter	2014/04	txt					
	Ensuing parameter	2014/05	txt					
1.4	**Display configuration**							
Configuration of the display								
1.4.01	Selection upper field	2004/49						
1.4.03	Selection lower field	2004/4B						
1.5	**Language selection**							
Language selection								
1.5.01	Language selection	2004/4E						
2.1	**AFE settings**							
AFE settings								
2.1.01	Mains voltage	2004/60						
Control logic								
2.1.02	Parallel operation	2010/58						
AFE settings								
2.1.10	Apparent power ref.value	2010/5D			1	0	32767	kVA
2.1.11	Reactive power factor	2010/5E			1	-100	100	%
2.2	**Control commands**							
Control logic								
2.2.01	Control source	2010/4E						
2.3	**Operating panel**							
Panel operation								
2.3.01	Operat.panel stop button	2009/32						
2.3.02	Operat.panel monitoring	201D/3F						
2.4	**External fault**							
External fault								
2.4.01	Ext. fault monitor	2009/0C						
2.4.02	Ext. fault response	2009/0D						
2.4.03	Start delay time	2009/0E			10	0	600	s
2.4.04	Time Δt	2009/0F			10	0	300	s
2.5	**Fault configuration**							
Behaviour in case of faults								
2.5.01	Autoreset	2008/5C						
2.5.02	Autoreset selection	2008/5D	0110					
2.5.03	Alarm	2010/4D	0110					

Parameter name		Index / Subindex	Type	Adjust-ability	Factor	Setting range min	Setting range max	Unit
3.2	**Logic inputs**							
Logic inputs								
3.2.01	LI inversion	201B/04	0110					
Service parameter								
3.2.02	LI at bus mode active	2007/52	0110					
3.3	**Analog output**							
Analog output								
3.3.01	AO1 selection	2007/53						
3.3.02	AO1 level	2007/54						
3.3.03	AO1 min. value	2007/55			100	-300	300	%
3.3.04	AO1 max. value	2007/56			100	-300	300	%
3.4	**Logic outputs**							
Logic outputs								
3.4.01	R1 selection	2007/62						
3.4.02	R3 selection	2007/64						
3.4.03	LO1 selection	2008/01						
3.4.04	LO2 selection	2008/02						
3.4.05	LO inversion	2008/06	0110					
3.4.06	Overload level	2010/51			1	0	120	%
4.1	**Process protection**							
Limitations								
4.1.01	I max 1 generator	2010/49			1	10	120	%
4.1.02	I max 2 generator	2010/4A			1	10	120	%
4.3	**Emergency operation**							
Emergency operation								
4.3.01	Enable emergency op.	2008/5F						
4.3.02	Emergency op. active	2002/4D						
4.6	**Bus settings**							
Fieldbus configuration								
4.6.01	Bus selection	200D/02						
4.6.02	Control requested	200D/03						
4.6.03	Bus error reaction	200D/04						
4.6.04	Bus profile	201B/3A						
4.6.10	Modbus address	200D/06			1	0	247	
4.6.11	Modbus baud rate	200D/07						
4.6.12	Modbus format	200D/08						
4.6.20	CANopen address	200D/14			1	0	127	
4.6.21	CANopen baud rate	200D/15						
4.6.22	CANopen state	2002/07						
4.6.23	CANopen error register	2002/08	0110					
4.6.24	CANopen Rx error count	2002/05			1			
4.6.25	CANopen Tx error count	2002/06			1			
4.6.30	DP slave address	200D/16			1			
4.6.31	DP baud rate	2002/09						
4.6.32	Slave state	2002/0A						
4.6.33	Master settings	2002/0B	0110					

4.6.34	DP diagnostic buffer 1	2002/10			1			hex
4.6.35	DP diagnostic buffer 2	2002/11			1			hex
4.6.40	Act. value1 selection	200D/3E						
4.6.41	Act. value1 min. value	200D/3F			100	-300	300	%
4.6.42	Act. value1 max. value	200D/40			100	-300	300	%
4.6.43	Act. value1 filter-time	200D/41			100	0	30	s
4.6.44	Act. value2 selection	200D/42						
4.6.45	Act. value2 min. value	200D/43			100	-300	300	%
4.6.46	Act. value2 max. value	200D/44			100	-300	300	%
4.6.47	Act. value2 filter-time	200D/45			100	0	30	s
4.6.48	Act. value3 selection	200D/46						
4.6.49	Act. value3 min. value	200D/47			100	-300	300	%
4.6.50	Act. value3 max. value	200D/48			100	-300	300	%
4.6.51	Act. value3 filter-time	200D/49			100	0	30	s
4.6.52	Act. value4 selection	200D/4A						
4.6.53	Act. value4 min. value	200D/4B			100	-300	300	%
4.6.54	Act. value4 max. value	200D/4C			100	-300	300	%
4.6.55	Act. value4 filter-time	200D/4D			100	0	30	s
Diagnosis								
4.6.100	PRx 01	2002/1F			1			hex
4.6.101	PRx 02	2002/20			1			hex
4.6.102	PRx 03	2002/21			1			hex
4.6.103	PRx 04	2002/22			1			hex
4.6.104	PRx 05	2002/23			1			hex
4.6.105	PRx 06	2002/24			1			hex
4.6.106	PRx 07	2002/25			1			hex
4.6.107	PRx 08	2002/26			1			hex
4.6.108	PRx 09	2002/27			1			hex
4.6.109	PRx 10	2002/28			1			hex
4.6.110	PTx 01	2002/33			1			hex
4.6.111	PTx 02	2002/34			1			hex
4.6.112	PTx 03	2002/35			1			hex
4.6.113	PTx 04	2002/36			1			hex
4.6.114	PTx 05	2002/37			1			hex
4.6.115	PTx 06	2002/38			1			hex
4.6.116	PTx 07	2002/39			1			hex
4.6.117	PTx 08	2002/3A			1			hex
4.6.118	PTx 09	2002/3B			1			hex
4.6.119	PTx 10	2002/3C			1			hex

5.1 Test function

Test routines							
5.1.01	Software reset	200A/60					
5.1.02	Simulation mode	200A/5F					

5.2 Fault memory

Fault memory

5.2.01	Number of faults AFE	2002/63			1			
5.2.02	Review AFE	200A/61						
5.2.03	Fault number AFE	2002/64			1			
5.2.04	Fault cause AFE	2003/01						
5.2.05	Operating hours AFE	2003/02			1			h
5.2.06	Min / sec	2003/03			100			m:s
5.2.07	Energy direction AFE	2010/56						
5.2.08	Line filter voltage AFE	2010/57			1			V
5.2.09	Mains current AFE	2003/06			1			A
5.2.10	DC voltage AFE	2003/07			1			V
5.2.11	AFE load	2003/08			1			%
5.2.12	Control mode AFE	2003/09						
5.2.13	Operating state AFE	2003/0A						
5.2.14	Alarm message AFE	2003/0B						
5.2.15	Device state AFE	2003/0D						
5.2.16	Bus STW AFE	2003/0C	0110					
5.2.17	Bus ZTW AFE	2003/0E	0110					

5.3 State

State logic inputs

5.3.01	LI state basic device	2003/0F	0110					
5.3.02	LI state option	2003/10	0110					
5.3.03	LO state basic device	2003/12	0110					
5.3.04	LO state option	2003/13	0110					

6.1 Code

Security settings

6.1.01	Code AFE	200B/2D			1	0	9999	
6.1.02	Code value AFE	200B/2E			1	0	9999	
6.1.03	Parametrising station	200B/2F						
6.1.04	Lock	200B/30						
6.1.05	Service code AFE	200B/31			1	0	59999	

System parameters

	Store parameter values	2000/29						

Device messages

Alarm/Info messages

Message	Alarm index (dec.)	Description
Emergency op. active	02	The Active Front End is switched over to the status "Emergency operation" via a logic input command. See parameter 4.3.02.
External fault	03	An external fault is signalized via a logic input command (see 2.4.01...2.4.04). It is processed as an alarm message corresponding to the setting of 2.4.02 Ext. fault response.
Undervoltage	05	There is an undervoltage situation.
Bus error	09	According to the setting of 4.6.03 Bus error reaction a bus fault caused by exceeded runtime or a loss of control leads to an alarm message.
Overload	21	The overload level set with parameter 3.4.06 has been exceeded.
Service AFE	26	The operating hours counter (1.2.05) for the power part of the device (device is supplied with mains voltage) has exceeded the set time interval (1.2.06).
Simulation active	28	The Simulation mode (5.1.02) is activated.
Download active	29	The PC program executes a parameter download. After transmission it is necessary to confirm or to deny the parameterization on the operating panel in order to return to the regular operating state. Alternatively confirmation is possibly by means of the service code 6.1.05 = 33.
IGBT ϑ >	38	IGBT overtemperature, determined by the thermal mathematical model.
Control requ. missing	46	Control bit (b10) of the bus control word is low.
I-limit active	51	The actual mains current is limited to the maximum operating current.
PTC/LI (SW2) wrong	58	Switch SW2 is not in position LI.
Sync-Alarm	59	If an fault occurs during the synchronisation of several Active Front End units connected in parallel, an alarm or a trip takes place depending on the setting of parameter 2.1.02.

Fault	Fault code		Description
	EMCY (hex)	Index (dec.)	
No fault	0000	00	
Overvoltage DC	3310	02	The DC link voltage has exceeded the protection level of 825 V. As the fault evaluation only occurs with impulse inhibit, a line overvoltage situation takes place !
Line overvoltage	3110	03	The mains voltage set with parameter 2.1.01 does not correspond with the existing mains situation.
MC not ready	3230	04	The line control is not ready after the charging process.
Precharging fault	FF01	06	Fuse of the charging DC link in the LFM defect
Line fault 1p	3130	08	Loss of one mains phase
Line fault 2-3p	3130	09	Loss of two or three mains phases
Overcurrent	2310	10	Overcurrent (mains current)
earth fault	2320	11	Earth fault at the output
Insulation fault	2330	12	The determined DC current is 25 % higher than the nominal current.
switching freq. >>	2310	13	Pulse frequency too high
AFE overload	4210	14	IGBT overtemperature caused by overload, determined by the thermal mathematical model.
AFE overtemp.	4210	19	Overtemperature (cooling problem, fan defect,...)
Unknown MC	6100	20	Unknown power part
PTC short circuit	7300	21	Monitoring of the internal temperature sensor (short-circuit at a thermistor sensor)
PTC open circuit	7300	22	Monitoring of the internal temperature sensor (a thermistor sensor is open)
ASIC Init fault	5000	23	ASIC on the line control cannot be initialized.
IGBT fault	5000	25	The desaturation protection of an IGBT has triggered.
Differential current >>	????	26	The current difference between the power parts connected in parallel is too high. The registration of this fault occurs only at devices with parallel IGBT power parts.
Current measure fault	5210	30	Fault of the current transformer, its voltage supply or the evaluation electronics.
MC E^2 zones invalid	6100	32	Line control EEProm defective
CPU fault	7400	33	Internal electronic fault
ISL fault	7500	34	Communication fault on the internal serial link
MTHA fault	FF08	35	Asic for time measurement defect (undervoltage time determination)
PWR fault	FF04	37	No 24 V at the logic input PWR
Opt. comm. fault	8200	39	Communication fault at an option card
Wrong option card	FF03	40	Defect or unknown option card used
Bus error	8100	41	A bus fault occurred due to exceeded run time or loss of control.
Param. config. fault	6320	42	Parameter settings invalid
Configuration fault	FF10	57	EEProm application software incompatible or changed power part
External fault	9001	58	An external fault is signalized via a logic input (see 2.4.01...2.4.04).
Precharging fault	1000	60	Error in the LFM, the control of the LFM or mains voltage missing

Fault	Fault code		Description
	EMCY (hex)	Index (dec.)	
Internal SW error	6100	64	Internal software bug
Power rating fault	1000	65	Unclear power part assignment
Incompatible MC	1000	66	Line control is not compatible with the application software
Flash fault APP	5500	67	Flash Eprom on the applicative defect
Indus zone fault	6100	68	Value for calibration on the applicative defect
Eprom fault APP	7600	69	EEProm on the applicative defect
24V fault	5112	73	Problem with the external 24 V buffer voltage
AFE overload		81	Protective shut-down due to exceeding the maximum current/time specification.
Sync-Error		86	Faulty parallel connection, fault during synchronisation of the line control or the applicative software

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