

MiCOM P849

Input & Output Extension Device

P849/EN M/B12

Software Version A0
Hardware Version K

Technical Manual

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IT**TD****GS****ST****OP****AP****PL****MR****FD****CM****MT****TS****SC****SG****IN****VH**

SAFETY SECTION

STANDARD SAFETY STATEMENTS AND EXTERNAL LABEL INFORMATION FOR SCHNEIDER ELECTRIC EQUIPMENT

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1. INTRODUCTION

This guide and the relevant equipment documentation provide full information on safe handling, commissioning and testing of this equipment. This Safety Guide also includes descriptions of equipment label markings.

Documentation for equipment ordered from Schneider Electric is despatched separately from manufactured goods and may not be received at the same time. Therefore this guide is provided to ensure that printed information which may be present on the equipment is fully understood by the recipient.

The technical data in this safety guide is typical only, see the technical data section of the relevant product publication(s) for data specific to a particular equipment.



Before carrying out any work on the equipment the user should be familiar with the contents of this Safety Guide and the ratings on the equipment's rating label.

Reference should be made to the external connection diagram before the equipment is installed, commissioned or serviced.

Language specific, self-adhesive User Interface labels are provided in a bag for some equipment.

2. HEALTH AND SAFETY

The information in the Safety Section of the equipment documentation is intended to ensure that equipment is properly installed and handled in order to maintain it in a safe condition.

It is assumed that everyone who will be associated with the equipment will be familiar with the contents of that Safety Section, or this Safety Guide.

When electrical equipment is in operation, dangerous voltages 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 also cause personal injury or physical damage.

Before working in the terminal strip area, the equipment must be isolated.

Proper and safe operation of the equipment 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 the equipment.

Qualified personnel are individuals who:





- Are familiar with the installation, commissioning, and operation of the equipment and of the system to which it is being connected;
- Are able to safely perform switching operations in accordance with accepted safety engineering practices and are authorised 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 practices;
- Are trained in emergency procedures (first aid).

The equipment documentation 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.

3. SYMBOLS AND EXTERNAL LABELS ON THE EQUIPMENT

For safety reasons the following symbols and external labels, which may be used on the equipment or referred to in the equipment documentation, should be understood before the equipment is installed or commissioned.

3.1 Symbols

	
Caution: refer to equipment documentation	Caution: risk of electric shock
	
Protective Conductor (*Earth) terminal	Functional/Protective Conductor (*Earth) terminal. Note: This symbol may also be used for a Protective Conductor (Earth) Terminal if that terminal is part of a terminal block or sub-assembly e.g. power supply.

*NOTE: THE TERM EARTH USED THROUGHOUT THIS GUIDE IS THE DIRECT EQUIVALENT OF THE NORTH AMERICAN TERM GROUND.

3.2 Labels

See Safety Guide (SFTY/4L M/G11) for equipment labelling information.

4. INSTALLING, COMMISSIONING AND SERVICING



Equipment connections

Personnel undertaking installation, commissioning or servicing work for this equipment should be aware of the correct working procedures to ensure safety.

The equipment documentation should be consulted before installing, commissioning, or servicing the equipment.

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

The clamping screws of all terminal block connectors, for field wiring, using M4 screws shall be tightened to a nominal torque of 1.3 Nm.

Equipment intended for rack or panel mounting is for use on a flat surface of a Type 1 enclosure, as defined by Underwriters Laboratories (UL).

Any disassembly of the equipment may expose parts at hazardous voltage, also electronic parts may be damaged if suitable electrostatic voltage discharge (ESD) precautions are not taken.

If there is unlocked access to the rear of the equipment, care should be taken by all personnel to avoid electric shock or energy hazards.

Voltage and current connections shall be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety.

Watchdog (self-monitoring) contacts are provided in numerical relays to indicate the health of the device. Schneider Electric strongly recommends that these contacts are hardwired into the substation's automation system, for alarm purposes.

To ensure that wires are correctly terminated the correct crimp terminal and tool for the wire size should be used.

The equipment must be connected in accordance with the appropriate connection diagram.

Protection Class I Equipment

- Before energizing the equipment it must be earthed using the protective conductor terminal, if provided, or the appropriate termination of the supply plug in the case of plug connected equipment.
- The protective conductor (earth) connection must not be removed since the protection against electric shock provided by the equipment would be lost.
- When the protective (earth) conductor terminal (PCT) is also used to terminate cable screens, etc., it is essential that the integrity of the protective (earth) conductor is checked after the addition or removal of such functional earth connections. For M4 stud PCTs the integrity of the protective (earth) connections should be ensured by use of a locknut or similar.

The recommended minimum protective conductor (earth) wire size is 2.5 mm² (3.3 mm² for North America) unless otherwise stated in the technical data section of the equipment documentation, or otherwise required by local or country wiring regulations.

The protective conductor (earth) connection must be low-inductance and as short as possible.

All connections to the equipment must 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.

Before energizing the equipment, the following should be checked:

- Voltage rating/polarity (rating label/equipment documentation),
- CT circuit rating (rating label) and integrity of connections,
- Protective fuse rating,
- Integrity of the protective conductor (earth) connection (where applicable),
- Voltage and current rating of external wiring, applicable to the application.



Accidental touching of exposed terminals

If working in an area of restricted space, such as a cubicle, where there is a risk of electric shock due to accidental touching of terminals which do not comply with IP20 rating, then a suitable protective barrier should be provided.



Equipment use

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



Removal of the equipment front panel/cover

Removal of the equipment front panel/cover may expose hazardous live parts, which must not be touched until the electrical power is removed.

**UL and CSA/CUL Listed or Recognized equipment**

To maintain UL and CSA/CUL Listing/Recognized status for North America the equipment should be installed using UL or CSA Listed or Recognized parts for the following items: connection cables, protective fuses/fuseholders or circuit breakers, insulation crimp terminals and replacement internal battery, as specified in the equipment documentation.

For external protective fuses a UL or CSA Listed fuse shall be used. The Listed type shall be a Class J time delay fuse, with a maximum current rating of 15 A and a minimum d.c. rating of 250 Vd.c., for example type AJT15.

Where UL or CSA Listing of the equipment is not required, a high rupture capacity (HRC) fuse type with a maximum current rating of 16 Amps and a minimum d.c. rating of 250 Vd.c. may be used, for example Red Spot type NIT or TIA.

**Equipment operating conditions**

The equipment should be operated within the specified electrical and environmental limits.

**Current transformer circuits**

Do not open the secondary circuit of a live CT since the high voltage produced may be lethal to personnel and could damage insulation. Generally, for safety, the secondary of the line CT must be shorted before opening any connections to it.

For most equipment with ring-terminal connections, the threaded terminal block for current transformer termination has automatic CT shorting on removal of the module. Therefore external shorting of the CTs may not be required, the equipment documentation should be checked to see if this applies.

For equipment with pin-terminal connections, the threaded terminal block for current transformer termination does NOT have automatic CT shorting on removal of the module.

**External resistors, including voltage dependent resistors (VDRs)**

Where external resistors, including voltage dependent resistors (VDRs), are fitted to the equipment, these may present a risk of electric shock or burns, if touched.

**Battery replacement**

Where internal batteries are fitted they should be replaced with the recommended type and be installed with the correct polarity to avoid possible damage to the equipment, buildings and persons.

**Insulation and dielectric strength testing**

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part of the test, the voltage should be gradually reduced to zero, to discharge capacitors, before the test leads are disconnected.

**Insertion of modules and pcb cards**

Modules and PCB cards must not be inserted into or withdrawn from the equipment whilst it is energized, since this may result in damage.

**Insertion and withdrawal of extender cards**

Extender cards are available for some equipment. If an extender card is used, this should not be inserted or withdrawn from the equipment whilst it is energized. This is to avoid possible shock or damage hazards. Hazardous live voltages may be accessible on the extender card.

**External test blocks and test plugs**

Great care should be taken when using external test blocks and test plugs such as the MMLG, MMLB and MiCOM P990 types, hazardous voltages may be accessible when using these. *CT shorting links must be in place before the insertion or removal of MMLB test plugs, to avoid potentially lethal voltages.

*Note: When a MiCOM P992 Test Plug is inserted into the MiCOM P991 Test Block, the secondaries of the line CTs are automatically shorted, making them safe.

**Fiber optic communication**

Where fiber optic communication devices are fitted, these should not be viewed directly. Optical power meters should be used to determine the operation or signal level of the device.

**Cleaning**

The equipment may be cleaned using a lint free cloth dampened with clean water, when no connections are energized. Contact fingers of test plugs are normally protected by petroleum jelly, which should not be removed.

5. DECOMMISSIONING AND DISPOSAL**De-commissioning**

The supply input (auxiliary) for the equipment may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the equipment (both poles of any dc supply), the capacitors should be safely discharged via the external terminals prior to de-commissioning.

**Disposal**

It is recommended that incineration and disposal to water courses is avoided. The equipment should be disposed of in a safe manner. Any equipment containing batteries should have them removed before disposal, taking precautions to avoid short circuits. Particular regulations within the country of operation, may apply to the disposal of the equipment.

6. TECHNICAL SPECIFICATIONS FOR SAFETY

Unless otherwise stated in the equipment technical manual, the following data is applicable.

6.1 Protective fuse rating

The recommended maximum rating of the external protective fuse for equipments is 16A, high rupture capacity (HRC) Red Spot type NIT, or TIA, or equivalent. Unless otherwise stated in equipment technical manual, the following data is applicable. The protective fuse should be located as close to the unit as possible.



CAUTION - CTs must NOT be fused since open circuiting them may produce lethal hazardous voltages.

6.2 Protective Class

IEC 60255-27: 2005
EN 60255-27: 2006

Class I (unless otherwise specified in the equipment documentation). This equipment requires a protective conductor (earth) connection to ensure user safety.

6.3 Installation Category

IEC 60255-27: 2005
EN 60255-27: 2006

Installation Category III (Overvoltage Category III):
Distribution level, fixed installation.

Equipment in this category is qualification tested at 5 kV peak, 1.2/50 μ s, 500 Ω , 0.5 J, between all supply circuits and earth and also between independent circuits.

6.4 Environment

The equipment is intended for indoor installation and use only. If it is required for use in an outdoor environment then it must be mounted in a specific cabinet or housing which will enable it to meet the requirements of IEC 60529 with the classification of degree of protection IP54 (dust and splashing water protected).

Pollution Degree - Pollution Degree 2
Altitude - Operation up to 2000m

Compliance is demonstrated by reference to safety standards.

IEC 60255-27:2005
EN 60255-27: 2006

INTRODUCTION

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

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1. MiCOM DOCUMENTATION STRUCTURE

The manual provides a functional and technical description of the MiCOM P849 Input & Output extension device and a comprehensive set of instructions for the device's use and application.

The section contents are summarized below:

P849/EN IT Introduction

A guide to the MiCOM range of relays and the documentation structure. General safety aspects of handling Electronic Equipment is discussed with particular reference to safety symbols. Also a general functional overview of the device and brief application summary is given.

P849/EN TD Technical Data

Technical data including setting ranges, accuracy limits, recommended operating conditions, ratings and performance data. Compliance with norms and international standards is quoted where appropriate.

P849/EN GS Getting Started

A guide to the different user interfaces of the device describing how to start using it. This section provides detailed information regarding the communication interfaces of the device, including a detailed description of how to access the settings database stored within the device.

P849/EN ST Settings

List of all device settings, including ranges, step sizes and defaults, together with a brief explanation of each setting.

P849/EN OP Operation

A comprehensive and detailed functional description.

P849/EN AP Application Notes

This section includes a description of common power system applications of the device, calculation of suitable settings, some typical worked examples, and how to apply the settings to the device.

P849/EN PL Programmable Logic

Overview of the programmable scheme logic and a description of each logical node. This section includes the factory default (PSL) and an explanation of typical applications.

P849/EN MR Recording

Detailed description of the devices recording functions including the configuration of the standard event recording and precise event recording.

P849/EN FD Firmware Design

Overview of the operation of the device's hardware and software. This section includes information on the self-checking features and diagnostics of the device.

P849/EN CM Commissioning

Instructions on how to commission the device.

P849/EN MT Maintenance

A general maintenance policy for the device is outlined.

P849/EN TS Troubleshooting

Advice on how to recognize failure modes and the recommended course of action. Includes guidance on whom within Schneider Electric to contact for advice.

P849/EN SC SCADA Communications

This section provides an overview regarding the SCADA communication interfaces of the device. Detailed protocol mappings, semantics, profiles and interoperability tables are not provided within this manual. Separate documents are available per protocol, available for download from our website.

P849/EN SG Symbols and Glossary

List of common technical abbreviations found within the product documentation.

P849/EN IN Installation

Recommendations on unpacking, handling, inspection and storage of the device. A guide to the mechanical and electrical installation of the device is provided, incorporating earthing recommendations. All external wiring connections to the device are indicated.

P849/EN VH Firmware and Service Manual Version History

History of all hardware and software releases for the product.

2. INTRODUCTION TO MiCOM

MiCOM is a comprehensive solution capable of meeting all electricity supply requirements. It comprises a range of components, systems and services from Schneider Electric.

Central to the MiCOM concept is flexibility.

MiCOM provides the ability to define an application solution and, through extensive communication capabilities, integrate it with your power supply control system.

The components within MiCOM are:

- P range protection relays;
- C range control products;
- M range measurement products for accurate metering and monitoring;
- S range versatile PC support and substation control packages.

MiCOM products include extensive facilities for recording information on the state and behaviour of the power system using disturbance and fault records. They can also provide measurements of the system at regular intervals to a control centre enabling remote monitoring and control to take place.

For up-to-date information on any MiCOM product, visit our website:

www.schneider-electric.com

3. PRODUCT SCOPE

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3.1 Functional overview

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P849 Overview		
Input / Output (I/O) arrangements available:	Digital inputs	Relay outputs
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Rating options

Auxiliary Voltage Rating Options	
Features	P849
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Communication protocol options

Communication Protocol Options	
Features	849
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3.2 Ordering Options

Information Required with Order

Input & Output Extension Device	P849	0									
Auxiliary Voltage Rating											
24 – 48V dc		1									
48 – 110V dc		2									
110 – 250V dc (100 – 240Vac)		3									
Hardware options											
Nothing		1									
IRIG-B modulated only		2									
Fibre Optic Converter only		3									
IRIG-B modulated + Fibre optic converter		4									
Ethernet with 100Mbps fibre optic port		6									
2nd Rear Comms port		7									
2nd Rear comms port + IRIG-B (modulated)		8									
Ethernet (100Mbps) + IRIG-B (modulated)		A									
Ethernet (100Mbps) + IRIG-B (demodulated)		B									
IRIG-B demodulated only		C									
InterMiCOM + Courier rear port		E									
InterMiCOM + Courier rear port + IRIG-B (modulated)		F									
Redundant Ethernet (SHR) 2 multi-mode fibre ports + IRIG-B (modulated)		G									
Redundant Ethernet (SHR) 2 multi-mode fibre ports + IRIG-B (un-modul.)		H									
Redundant Ethernet (RSTP) 2 multi-mode fibre ports + IRIG-B (modulated)		J									
Redundant Ethernet (RSTP) 2 multi-mode fibre ports + IRIG-B (un-modul.)		K									
Redundant Ethernet (DHS) 2 multi-mode fibre ports + IRIG-B (modulated)		L									
Redundant Ethernet (DHS) 2 multi-mode fibre ports + IRIG-B (un-modul.)		M									
Product Specific											
32 optos + 16 Relays										A	
48 optos + 24 Relays										B	
32 optos + 14 Relays + 16 High Break Relays										C	
16 optos + 60 Relays										D	
64 optos + 16 Relays										E	
32 optos + 46 Relays										F	
Protocol Options											
K-Bus/Courier											1
Modbus											2
IEC60870-5-103											3
DNP3.0											4
IEC 61850 + Courier via rear RS485 port											6
IEC 61850 + IEC60870-5-103 via rear RS485 port											7
DNP3.0 over Ethernet											8
Mounting											
Panel / flush Mounting											M
Rack mounting											N
Language											
English, French, German, Spanish											0
English, French, German, Russian											5
Chinese, English or French via HMI, with English or French only via Communications port											C
Software Version											
Unless specified the latest version will be delivered											* *
Settings File											
Default											8
Customer Specific											9
Hardware Suffix											
Original											K



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TECHNICAL DATA

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

Technical Data

MiCOM P849 Input & Output extension device
Input / Output (I/O)

- * 32I/16O,
- * 48I/24O,
- * 32I/30O (16 high speed high break relays),
- * 16I/60O,
- * 64I/16O,
- * 32I/46O.

Protocol options:

- * K-Bus
- * Modbus,
- * VDEW (IEC 60870-5-103)
- * DNP3.0
- * IEC61850 + Courier via rear RS485 port
- * IEC61850 + IEC 60870-5-103 via rear RS485 port
- * DNP3 over Ethernet with Courier rear port K-Bus/RS485 protocol

Hardware options:

- * IRIG-B input
- * Fibre optic converter (IEC60870-5-103)
- * IRIG-B input and Fibre optic converter (IEC60870-5-103)
- * Single Ethernet 100Mbit/s
- * Rear Comms + InterMiCOM
- * Rear Comms + IRIB-B + InterMiCOM
- * Single Ethernet (100Mbit/s) plus IRIG-B (Modulated)
- * Single Ethernet (100Mbit/s) plus IRIG-B (De-modulated)
- * IRIG-B (De-modulated)
- * InterMiCOM + Courier Rear Port *
- * InterMiCOM + Courier Rear Port + IRIG-B modulated *
- * Redundant Ethernet Self-Healing Ring, 2 multi-mode fibre ports + Modulated IRIG-B
- * Redundant Ethernet Self-Healing Ring, 2 multi-mode fibre ports + Un-modulated IRIG-B
- * Redundant Ethernet RSTP, 2 multi-mode fibre ports + Modulated IRIG-B
- * Redundant Ethernet RSTP, 2 multi-mode fibre ports + Un-modulated IRIG-B
- * Redundant Ethernet Dual-Homing Star, 2 multi-mode fibre ports + Modulated IRIG-B
- * Redundant Ethernet Dual-Homing Star, 2 multi-mode fibre ports + Un-modulated IRIG-B

Mechanical Specification

Design

Modular MiCOM Px40 platform relay, Size 16" case (80TE)
Mounting is front of panel flush mounting.

Enclosure Protection

Per IEC 60529: 1992

IP 52 Protection (front panel) against dust and dripping water,

IP 50 Protection for the rear and sides of the case against dust,

IP 10 Product safety protection for the rear due to live connections on the terminal block.

Weight

MiCOM P849: 10.5 kg

Terminals

General Input/Output Terminals

For power supply, opto inputs, output contacts and COM1 & optional COM2 rear communications.

Located on general purpose (grey) blocks:
Threaded M4 terminals, for ring lug connection.

Case Protective Earth Connection

Two rear stud connections, threaded M4.

Must be earthed (grounded) using the protective (earth) conductor for safety, minimum earth wire size 2.5mm².

Front Port Serial PC Interface

EIA RS232 DTE, 9 pin D-type female connector.

Courier protocol for interface to MiCOM S1 software.

PEB* rated Maximum cable length 15m.

Front Download/Monitor Port

EIA RS232, 25 pin D-type female connector.

For firmware downloads. PEB* rated circuit.

Rear Communications Port

K-Bus/EIA(RS485) signal levels, two wire Connections located on general purpose block, M4 screw.

For screened twisted pair cable, multidrop, 1000m max. Courier protocol. SELV* rated circuit.

Ethernet (copper & fibre)

Optional Second Rear Communication

PortEIA(RS)232, 9 pin D-type female connector, socket SK4. Courier protocol: K-Bus, or EIA(RS)485 or EIA(RS)232. Maximum cable length: 15m.

Optional Rear Ethernet Connection for IEC 61850**10 Base T / 100 Base TX Communications**

Interface in accordance with IEEE802.3 and IEC61850

Isolation: 1.5kV. Connector type: RJ45
Cable type: Screened Twisted Pair (STP)
Max. cable length: 100m

100 Base FX Interface

Interface in accordance with IEEE802.3 and IEC61850

Wavelength: 1300nm

Fiber: multi-mode 50/125µm or 62.5/125µm

Connector style: BFOC 2.5 - (ST®)

Optional Rear IRIG-B Interface modulated or un-modulated

BNC socket

SELV* rated circuit.

50 ohms coaxial cable.

*: PEB = Protective equipotential bonded

*: SELV = Safety/Separated extra low voltage

Both PEB and SELV circuits are safe to touch after a single fault condition.

Optional Rear redundant Ethernet connection for IEC 61850**100 Base FX Interface**

Interface in accordance with IEEE802.3 and IEC61850

Wavelength: 1300nm

Fiber: multi-mode 50/125µm or 62.5/125µm

Connector style: BFOC 2.5 -(ST®)

Transmitter optical characteristics 100 base FX interface

Transmitter Optical Characteristics – 100 base FX interface

(TA = 0°C to 70°C, VCC = 4.75 V to 5.25 V)

Parameter	Sym	Min.	Typ.	Max	Unit
Output Optical Power BOL: 62.5/125 µm, NA = 0.275 Fiber EOL	P _{OUT}	-19 -20	-16.8	-14	dBm avg.
Output Optical Power BOL: 50/125 µm, NA = 0.20 Fiber EOL	P _{OUT}	-22.5 -23.5	-20.3	-14	dBm avg.
Optical Extinction Ratio				10 -10	% dB
Output Optical Power at Logic "0" State	P _{OUT} ("0")			-45	dBm avg.

BOL – Beginning of life

EOL – End of life

Receiver Optical Characteristics – 100 base FX interface

(TA = 0°C to 70°C, VCC = 4.75 V to 5.25 V)

Parameter	Sym	Min.	Typ.	Max.	Unit
Input Optical Power Minimum at Window Edge	P _{IN} Min. (W)		-33.5	-31	dBm avg.
Input Optical Power Minimum at Eye Center	P _{IN} Min. (C)		-34.5	-31.8	dBm avg.
Input Optical Power Maximum	P _{IN} Max.	-14	-11.8		dBm avg.

Fiber defect connector (watchdog relay) –

Redundant Ethernet board

Connector (3 terminals): 2NC contacts

Rated voltage: 250 V

Continuous current: 5 A

Short duration current: 30 A for 3 s

Breaking capacity

DC: 50 W resistive

DC: 25 W resistive

AC: 1500 VA resistive (cos φ = unity)

AC: 1500 VA inductive (cos φ = unity)

Subject to maxima of 5 A and 250 V

Ratings**Power supply****Auxiliary Voltage (Vx)**

Three ordering options:

(i) Vx: 24 to 48 Vdc

(ii) Vx: 48 to 110 Vdc,

(iii) Vx: 110 to 250 Vdc, and 100 to 240Vac (rms)

Operating Range

(i) 19 to 65V (dc only for this variant)

(ii) 37 to 150V (dc),

(iii) 87 to 300V (dc), 80 to 265V (ac)

With a tolerable ac ripple of up to 15% for a dc supply, per IEC 60255-11: 2008.

Nominal Burden

Quiescent burden: 12W

Additions for energized binary inputs/outputs:

Per opto input:

* 0.09W...(24 to 54V),

* 0.12W...(110/125V),

* 0.19W...(220/250V).

Per energized output relay: 0.13W

Per energized high break output relay:0.73W

Power-up Time

Time to power up < 8s.

Power Supply Interruption

Per IEC 60255-11: 2008 / EN 60255-11: 2010

The device will withstand a 20ms interruption in the DC auxiliary supply, without de-energizing.

Per IEC 61000-4-11: 2004

The device will withstand a 20ms interruption in an AC auxiliary supply, without de-energizing.

Note: the use of a E124 extends these limits

In addition to IEC 60255-11 compliance, MiCOM P849 withstands:

DC Power supply voltage	DC Power supply interruption
24V	20ms
48V	100ms with Vx ordering option (i), 20ms with Vx ordering option (ii)
110V	200ms with Vx ordering option (ii), 50ms with Vx ordering option (iii)
220V	200ms

Battery Backup

Front panel mounted Type ½ AA, 3.6V

Field Voltage Output

Regulated 48Vdc

Current limited at 112mA maximum output

Digital (“Opto”) Inputs

Universal opto inputs with programmable voltage thresholds. May be energized from the 48V field voltage, or the external battery supply.

Rated nominal voltage: 24 to 250Vdc

Operating range: 19 to 265Vdc

Withstand: 300Vdc.

Nominal pick-up and reset thresholds:

- * Pick-up: approx. 70% of battery nominal set,
- * Reset: approx. 66% of battery nominal set.

Recognition time: 7ms

Output Contacts

Standard Contacts

General purpose relay outputs for signalling, tripping and alarming:

Rated voltage:

- * 300 V

Continuous current:

- * 10 A

Short-duration current:

- * 30 A for 3 s

Making capacity:

- * 250A for 30 ms

Breaking capacity:

- * DC: 50W resistive
- * DC: 62.5W inductive (L/R = 50ms)
- * AC: 2500VA resistive (cos φ = unity)
- * AC: 2500VA inductive (cos φ = 0.7)

Response to command:

- * < 5ms

Durability:

- * Loaded contact: 10000 operations minimum,
- * Unloaded contact: 100000 operations minimum.

Fast operation and High Break Contacts

Dedicated purpose relay outputs for tripping:

- * Uses IGBT technology

Make and Carry:

- * 30 Amps for 3 sec, 30A @ 250V resistive

Carry:

- * 250 Amps dc for 30ms

Continuous Carry:

- * 10 Amps dc

Break Capacity:

- * 10 Amps @ 250V resistive (10,000 operations) 10 Amps @ 250V L/R=40ms

Operating time:

- * <200us & Reset time: 7.5ms

Watchdog Contacts

Non-programmable contacts for device healthy/device fail indication:

Breaking capacity:

- * DC: 30W resistive
- * DC: 15W inductive (L/R = 40ms)
- * AC: 375VA inductive (cos φ = 0.7)

IRIG-B 12X Interface (Modulated)

External clock synchronization per IRIG standard 200-98, format B12X.

Input impedance 6kΩ at 1000Hz

Modulation ratio:

- * 3:1 to 6:1

Input signal, peak-peak:

- * 200mV to 20V

IRIG-B 00X Interface (Un-modulated)

External clock synchronization per IRIG standard 200-98, format B00X.

Input signal TTL level

Input impedance at dc 10kΩ

Environmental Conditions

Ambient Temperature Range

Ambient temperature range

Operating temperature range

–25°C to +55°C (or –13°F to +131°F)

Storage and transit

–25°C to +70°C (or –13°F to +158°F)

Tested as per

IEC 60068-2-1: 2007

–25°C (–13°F) operation (96 hours)

–25°C (–13°F) storage (96 hours)

IEC 60068-2-2: 2007

+55°C (+131°F) operation (96 hours)

+70°C (+158°F) storage (96 hours)

Ambient Humidity Range

Per IEC 60068-2-78: 2002:

- * 56 days at 93% relative humidity and +40 °C

Per IEC 60068-2-30: 2005:

- * Damp heat cyclic, six (12 + 12) hour cycles, 93% RH, +25 to +55 °C

Corrosive Environments

Per IEC 60068-2-60: 1995, Part 2, Test Ke, Method (class) 3

Industrial corrosive environment/poor

environmental control, mixed gas flow test.

21 days at 75% relative humidity and +30°C

Exposure to elevated concentrations of H2S, NO2, Cl2 and SO2.



Type Tests

Insulation

Per IEC 60255-27: 2005,
 * Insulation resistance > 100MΩ at 500Vdc
 (Using only electronic/brushless insulation tester).

Creepage Distances and Clearances

Per IEC 60255-27: 2005
 * Pollution degree 3,
 * overvoltage category III,
 * impulse test voltage 5 kV.

High Voltage (Dielectric) Withstand

(EIA RS232 ports excepted).

(i) Per IEC 60255-27: 2005, 2 kV rms, AC, 1 minute:

Between all case terminals connected together and the case earth.

Also, between all terminals of independent circuits.

* 1kV rms AC for 1 minute, across open watchdog contacts and across open contacts of changeover output relays.

(ii) Per ANSI/IEEE C37.90-1989 (reaffirmed 1994):

* 1.5 kV rms AC for 1 minute, across open contacts of changeover output relays.

Impulse Voltage Withstand Test

Per IEC 60255-27: 2005

Front time: 1.2 μs, Time to half-value: 50 μs,
 Peak value: 5 kV, 0.5J

Between all terminals, and all terminals and case earth.

Electromagnetic Compatibility (EMC)

1 MHz Burst High Frequency Disturbance Test

Per IEC 60255-22-1: 2008, Class III,

Common-mode test voltage: 2.5 kV,

Differential test voltage: 1.0 kV,

Test duration: 2 s, Source impedance: 200 Ω
 (EIA RS232 ports excepted).

100 kHz Damped oscillatory Test

Per EN 61000-4-18: 2007, Level 3,

Common-mode test voltage: 2.5 kV,

Differential test voltage: 1.0 kV,

Immunity to Electrostatic Discharge

Per IEC 60255-22-2: 1997, Class 4,
 15kV Air discharge, 8kV Contact Discharge

Per IEC 60255-22-2: 1997, Class 3,
 8kV Air discharge, 6kV Contact Discharge

6kV point contact discharge to any part of the front of the product.

Electrical Fast Transient or Burst Requirements

Per IEC 60255-22-4: 2008 and
 EN 61000-4-4: 2004+A1:2010.

Test severity:

* Class III and IV:

Amplitude:

* 2 kV, burst frequency 5kHz (Class III),

Amplitude:

* 4 kV, burst frequency 2.5kHz (Class IV).

Applied directly to auxiliary supply, and applied to all other inputs. (EIA RS232 ports excepted).

Amplitude:

* 4 kV, burst frequency 5kHz (Class IV).

Applied directly to auxiliary supply.

Surge Withstand Capability

Per IEEE/ANSI C37.90.1: 2002:

4kV fast transient and 2.5kV oscillatory applied directly across each output contact, optically isolated input, and power supply circuit.

Surge Immunity Test

(EIA RS232 ports excepted).

Per IEC 61000-4-5: 2006 Level 4,

Time to half-value: 1.2 / 50 μs,

* Amplitude: 4kV between all groups and case earth,

* Amplitude: 2kV between terminals of each group.

Immunity to Radiated Electromagnetic Energy

Per IEC 60255-22-3: 2008, Class III:

Test field strength, frequency band 80 to 1000 MHz:

* 10 V/m,

* Test using AM: 1 kHz / 80%,

* Spot tests at 80, 160, 450, 900 MHz

Per IEEE/ANSI C37.90.2: 2004:

25MHz to 1000MHz, zero and 100% square wave modulated.

Field strength of 35V/m.

Radiated Immunity from Digital Communications

Per EN61000-4-3: 2006: A2:2010, Level 4:

Test field strength, frequency band 800 to 960 MHz, and 1.4 to 2.0 GHz:

* 30 V/m,

Test using AM:

* 1 kHz / 80%.

Radiated Immunity from Digital Radio Telephones

Per EN 61000-4-3: 2002

* 10 V/m, 900MHz and 1.89GHz.

Immunity to Conducted Disturbances Induced by Radio Frequency Fields

Per IEC 61000-4-6: 2008, Level 3,

Disturbing test voltage: 10 V

Power Frequency Magnetic Field Immunity

Per IEC 61000-4-8: 2009, Level 5,

* 100A/m applied continuously,

* 1000A/m applied for 3s.

Per IEC 61000-4-9: 2001, Level 5,

* 1000A/m applied in all planes.

Per IEC 61000-4-10: 2001, Level 5,

* 100A/m applied in all planes at

100kHz/1MHz with a burst duration of 2s.

Conducted Emissions

- Per EN 55022:2006+A1:2007 and EN 60255-25:2000:
- * 0.15 – 0.5MHz, 79dB μ V (quasi peak) 66dB μ V (average)
- * 0.5 – 30MHz, 73dB μ V (quasi peak) 60dB μ V (average).

Radiated Emissions

- Per EN 55022:2006+A1:2007 and EN 60255-25:2000:
- * 30 - 230MHz, 40dB μ V/m at 10m measurement distance
- * 230 – 1GHz, 47dB μ V/m at 10m measurement distance.

EU Directives

EMC Compliance

Per 2004/108/EC:
 Compliance to the European Commission Directive on EMC is claimed via the Technical Construction File route. Product Specific Standards were used to establish conformity:
 * EN 60255-26:2009

Product Safety

Per 2006/95/EC:
 Compliance with European Commission Low Voltage Directive. Compliance is demonstrated by reference to generic safety standards:
 * IEC 60255-27:2005

CE

R&TTE compliance

Radio and telecommunication terminal equipment (R&TTE) directive 99/5/EC. Compliance demonstrated by compliance to both the EMC directives on low voltage directive down to 0V.
 Applicable to rear communication ports.

Mechanical Robustness

Vibration Test

Per IEC 60255-21-1:1988 / EN 60255-21-1:1996 Response Class 2
 Endurance Class 2

Shock and Bump

Per IEC 60255-21-2:1988 / EN 60255-21-2:1996 Shock response Class 2
 Shock withstand Class 1
 Bump Class 1

Seismic Test

Per IEC 60255-21-3:1993 / EN 60255-21-3:1995 Class 2

Timing and Accuracy

IRIG-B and Real Time Clock

Modulated IRIG-B:

- Modulation ratio:
- * 1/3 or 1/6
- Input signal peak-peak amplitude:
- * 200 mV to 20 V
- Input impedance at 1000Hz: 6000 Ω
- External clock synchronization:
- * Conforms to IRIG standard 200-98, format B

Un-modulated IRIG-B:

- Input signal TTL level
- Input impedance at dc 10k Ω
- External clock synchronization per IRIG standard 200-98, format B00X.

Performance Accuracy (for modulated and un-modulated versions)

Real time clock accuracy: < \pm 2 seconds/day

Precise events recording, Standard events recording

Accuracy

- Waveshape:
- * Comparable with applied quantities
- Duration:
- * \pm 2%
- Trigger position:
- * \pm 2% (minimum trigger 100ms)

Reference conditions

- Ambient temperature:
- * 20 $^{\circ}$ C

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IEC 61850 Ethernet data

10 Base T /100 Base TX Communications

Interface in accordance with IEEE802.3 and IEC61850

Isolation 1.5kV

Cable type: Screened twisted pair STP

Max length: 100m

100 Base FX Interface

Interface in accordance with IEEE802.3 and IEC61850

Wavelength: 1300nm

Fibre: multi-mode 50/125µm or 62.5/125µm

Connector style: ST

Transmitter Optical Characteristics

(TA = 0°C to 70°C, VCC = 4.75 V to 5.25 V)

Parameter	Sym	Min.	Typ.	Max	Unit
Output Optical Power BOL 62.5/125 µm, NA = 0.275 Fiber EOL	PO	-19 -20	-16.8	-14	dBm avg.
Output Optical Power BOL 50/125 µm, NA = 0.20 Fiber EOL	PO	-22.5 -23.5	-20.3	-14	dBm avg.
Optical Extinction Ratio				10 -10	% dB
Output Optical Power at Logic "0" State	PO ("0")			-45	dBm avg.

BOL – Beginning of life

EOL – End of life

Receive Optical Characteristics

(TA = 0°C to 70°C, VCC = 4.75 V to 5.25 V)

Parameter	Sym	Min.	Typ.	Max.	Unit
Input Optical Power Minimum at Window Edge	PIN Min. (W)		-33.5	-31	dBm avg.
Input Optical Power Minimum at Eye Center	PIN Min. (C)		-34.5	-31.8	Bm avg.
Input Optical Power Maximum	PIN Max.	-14	-11.8		dBm avg.

GOOSE performances

P849 as a GOOSE publisher:

- * Time to process one opto input⁽¹⁾ change into one Virtual Output < 15ms
 - * Time to process one or several opto input⁽¹⁾ change into 18 Virtual Output into One GOOSE < 20ms
- ⁽¹⁾ un-filtered opto-isolated inputs

P849 as a GOOSE subscriber:

- * Time to process one Virtual Input to close one output relay < 10ms
- * Time to process one Virtual Input to close one High Speed High Break relay < 5ms
- * Time to process 18 Virtual Inputs (in one GOOSE) to close all output relays < 13ms
- * Time to process 18 Virtual Inputs (in one GOOSE) to close all High Speed High Break relays < 8ms
- * Time to process 3 GOOSE messages (with one Virtual Input change in each GOOSE) to close one output relay < 15ms
- * Time to process 3 GOOSE messages (with one Virtual Input change in each GOOSE) to close one High Speed High Break relay < 10ms
- * Time to process 3 GOOSE messages (with 18 Virtual Input changes in each GOOSE) to close all output relays < 20ms
- * Time to process 3 GOOSE messages (with 18 Virtual Input changes in each GOOSE) to close all High Speed High Break relays < 15ms

Settings and Records List

Global Settings (System Data):

Language:
 * English/French/German/Spanish
 Frequency:
 * 50/60Hz

Date and Time

IRIG-B Sync:
 * Disabled/Enabled
 Battery Alarm:
 * Disabled/Enabled

Configuration

Setting Group:
 . Select via Menu
 . Select via Opto
 Active Settings: Group 1/2/3/4
 Setting Group 1: Disabled/Enabled
 Setting Group 2: Disabled/Enabled
 Setting Group 3: Disabled/Enabled
 Setting Group 4: Disabled/Enabled
 Input Labels: Visible/Invisible
 Output Labels: Visible/Invisible
 Record Control: Visible/Invisible
 Disturb recorder: Visible/Invisible
 Measur't setup: Visible/Invisible
 Comms setting: Visible/Invisible
 Commission tests: Visible/Invisible
 Control inputs: Visible/Invisible
 Ctrl I/P Config: Visible/Invisible
 Direct Acces: Enabled/Disabled
 hotkey only/
 CB cntrl only
 InterMiCOM: Enabled/Disabled
 IEC Goose: Visible/Invisible
 Function key: Visible/Invisible
 RP1 read only: Enabled/Disabled
 RP2 read only: Enabled/Disabled
 NIC read only: Enabled/Disabled
 LCD Contrast: (Factory pre-set)

Record Control

Records for the last 512 events

Disturb. Recording

Duration:
 * Settable from 0.1 to 10.5s
 Trigger Position:
 * 0...100% (step 0.1%)
 Trigger Mode:
 * Single/Extended
 32 Digital Inputs
 Selected binary channel assignment from any
 DDB status point within the device (opto input,
 output contact, alarms, starts, trips, controls,
 logic...)
 Sampling frequency:
 * 1000Hz

Communications

Courier protocol:
 Protocol indicated
 RP1 Address:
 * Courier: 0 to 255 (step 1)
 * Modbus: 1 to 247 (step 1)
 * IEC60870-5-103: 0 to 254 (step 1)
 * DNP3.0: 0 to 65534 (step 1)
 RP1 Inactiv timer: 1mn to 30 mn (step 1mn)
 Physical link: RS485, Fibre optic
 RP1 Status
 RP1 Port configuration: Kbus/EIA(RS)485
 RP1 comms mode:
 * IEC60870 FT1.2
 * 10-Bit no parity
 RP1 Baud Rate: 9600/19200/38400 bits/s

IEC60870-5-103 protocol:

Protocol indicated
 RP1 Address: 7 to 34 (step 1)
 RP1 Inactiv timer: 1mn to 30 mn (step 1mn)
 Baud Rate: 9600/19200/38400 bits/s
 Measurement period: 1 to 60s (step 1s)
 CS103 blocking:
 * Disabled,
 * Monitor blocking,
 * Command blocking.
 RP1 Status
 RP1 Port configuration: Kbus/EIA(RS)485
 RP1 comms mode:
 * IEC60870 FT1.2
 * 10-Bit no parity
 RP1 Baud Rate: 9600/19200/38400 bits/s
 IEC 103 over Ethernet should also be available

Modbus protocol:

Protocol indicated
 RP1 Address: 7 to 34 (step 1)
 RP1 Inactiv timer: 1mn to 30 mn (step 1mn)
 Baud Rate: 9600/19200/38400 bits/s
 Parity: Odd/Even/None
 Physical link: RS485/Fibre optic
 Date/Time Format: Enabled/Disabled
 RP1 Status
 RP1 Port configuration: Kbus/EIA(RS)485
 RP1 comms mode:
 * IEC60870 FT1.2
 * 10-Bit no parity
 RP1 Baud Rate: 9600/19200/38400 bits/s

DNP3.0 protocol:

Protocol indicated
 RP1 Address: 7 to 34 (step 1)
 RP1 Inactiv timer: 1mn to 30 mn (step 1mn)
 Baud Rate: 9600/19200/38400 bits/s
 Parity: Odd/Even/None
 Measurement period: 1 to 60s (step 1s)
 Physical link: RS485/Fibre optic
 Time Synchronization: Enabled/Disabled
 Date/Time Format: Enabled/Disabled
 RP1 Status
 RP1 Port configuration: Kbus/EIA(RS)485
 RP1 comms mode:
 IEC60870 FT1.2/10-Bit no parity
 * RP1 Baud Rate: 9600/19200/38400 bits/s



(TD) 2-8

MiCOM P849

Scale Value indicated

Message Gap: 0 to 50ms (step 1ms)
 DNP Need Time: 1 to 30 (step 1)
 DNP Application fragment size:
 100 to 2048 (step 1)
 DNP Application fragment timeout:
 1s to 120s (step 1s)
 DNB SBO timeout: 1s to 10s (step 1s)
 DNP link timeout: 0 to 120s (step 1s)

Ethernet port, IEC61850 protocol:

Protocol indicated
 Protocol & Scale value indicated,
 Network Interface Card (NIC) protocol:
 Courier/IEC60870-5-103/Modbus/DNP3.0
 NIC MAC Adress indicated,
 NIC tunnel timeout: 1 to 30mn (step 1mn)
 NIC Link Report: Alarm/Even/None

Ethernet port, DNP3.0 protocol:

Protocol, IP address, subnet mask, NIC MAC
 address and Gateway address indicated,
 Ethernet port, IEC60870-5-103 protocol:
 Protocol, Scale value, NIC protocol & NIC
 MAC address indicated, NIC tunnel timeout
 & Link report
 DNP time synchro: Enabled/Disabled
 DNP Meas scaling:
 Primary/Secondary/Normalized
 RP1 Address: 7 to 34 (step 1)
 RP1 Inactiv timer: 1mn to 30 mn (step 1mn)
 Baud Rate: 9600/19200/38400 bits/s
 Parity: Odd/Even/None
 NIC tunnel timeout: 1 to 30mn (step 1mn)
 NIC Link Report: Alarm/Even/None
 SNTP parameters:
 Primary and Secondary SNTP addresses
 displayed
 SNTP poll rate: 64 to 1024s (step 1s)
 SNTP need time: 1 to 30mn (step 1mn)
 SNTP Application Fragment size:100 to 2048
 (step 1)
 SNTP Application fragment timeout:1s to 120s
 (step 1s)
 SNTP SBO timeout: 1s to 10s (step 1s)

Second rear port connection setting:

Protocol and Status indicated
 RP2 Port configuration:
 Kbus/EIA(RS)485/EIA RS232
 RP2 comms mode:
 IEC60870 FT1.2/10-Bit no parity
 RP2 Address: 0 to 255 (step 1)
 RP2 Inactivity timer: 1 to 30mn (step 1mn)
 RP2 Baud Rate: 9600/19200/38400 bits/s

COMMISSION TESTS

Status of opto-isolated inputs indication,
 Status of output relays indication,
 Status of test port indication,
 Status of LEDs indication,
 Monitor Bit 1 (*up to 8*):
 Binary function link strings, selecting which
 DDB signals have their status visible in the
 Commissioning menu, for test purposes
 Test Pattern:
 Configuration of which output contacts are
 to be energized when the contact test is
 applied.
 Contact test:
 No operation/Apply test/Remove test
 LEDs test,
 Autoreclose test:
 No operation/ 3-pole test/
 Pole A, B or C test
 Red or Green LED status visible,
 DDB31-0 to DDB 2047-2016 status visible.

OPTO CONFIGURATION

Opto input voltage range:
 * 24-27V
 * 30-34V
 * 48-54V
 * 110-125V
 * 220-250V
 Custom
 Opto Input 1
 (up to # = max. opto no. fitted)

Custom options allow independent thresholds
 to be set per opto, from the same range as
 above

HOTKEYS AND CONTROL INPUTS

Control Inputs operation (CTRL inputs
 menu)menu:
 Status of control inputs indication,
 Control inputs operation:
 Set/Reset/No operation

Control Inputs configuration (CTRL I/P config.
 Menu):
 The control inputs can be individually assigned
 to the hotkeys by stetting,
 Control input configuration: Latched/Pulsed
 Following text displayed in the hotkey menu
 can be set: Set/Reset / In/Out /
 Enabled/Disabled / On/Off

Opto Input Labels (Opto I/P Labels menu)

User defined text string to describe the
 function of the particular opto input.

Teleprotection (InterMiCOM comms)

Source Address: 0 to 10 (step 1)

Received Address: 0 to 10 (step 1)

Baud rate:

- * 600 Baud
- * 1200 Baud
- * 2400 Baud
- * 4800 Baud
- * 9600 Baud
- * 19200 Baud

Channels statistics: Visible/Invisible

- * Nbr of tripping messages received
- * Nbr blocking messages received,
- * Number of messages received: tripping, blocking, total and incorrect,
- * Lost messages,
- * Elapsed time,
- * Reset statistics: Yes/No

Channel diagnostics: Visible/Invisible

- * "Data carrier detect" status,
- * Frame synchronization status,
- * Message status,
- * Channel status,
- * InterMiCOM hardware status.

Loopback Mode: Internal/External/Disabled
 Configuration of which InterMiCOM signals are to be energized when the loopback test is applied.

- * User defined test pattern,
- * Loopback status

InterMiCOM configuration

IM Msg Alarm Level: 0 to 100.0% (step 1%)

InterMiCOM command Types:

- * IM1, IM2, IM3 and IM4 Command types: Disabled/Direct/Blocking
- * IM5 Cmd Type: Disabled/Permissive/Direct
- * IM6, IM7 and IM8 Command types: Disabled/Permissive/Direct

Fallback mode:

Default/Latched

Default value: 0/1

Frame Synchronization Time: 10ms to 1.50s (step 10ms)

Function keys

10 function keys:

- * Status: Disabled/Locked/Unlocked
- * Mode: toggled/Normal
- * Label: User defined

Opto Input Labels

Opto Input 1 up to 64* (depending on the model)

User defined text string to describe the function of the particular opto input.

Outputs Labels

Relay 1 up to 60 (depending on the model).

User defined text string to describe the function of the particular relay output contact.

IED configurator (IEC61850)

Switch between active or inactive configuration banks,

MiCOM Configuration Language (MCL) files restoration.

IEC 61850 configuration data displayed:

- * Active / inactive Memory banks,
- * Configuration revision number of Active or inactive Memory bank,
- * IP address, mask and Gateway connected,
- * SNTP: IP address of the primary and secondary servers,
- * IED name,
- *

IEC61850 GOOSE

- * test mode,
- * Ignore test flag option

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GETTING STARTED

Date:	2012
Hardware Suffix:	K
Software Version:	
Connection Diagrams:	10P849xx (xx = 01 to 06)

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1. GETTING STARTED



BEFORE CARRYING OUT ANY WORK ON THE EQUIPMENT, THE USER SHOULD BE FAMILIAR WITH THE CONTENTS OF THE SAFETY SECTION/SAFETY GUIDE SFTY/4LM/E11 OR LATER ISSUE, THE TECHNICAL DATA SECTION AND THE RATINGS ON THE EQUIPMENT RATING LABEL.

1.1 User interfaces and menu structure

The settings and functions of the MiCOM P849 input & output extension device can be accessed both from the front panel keypad and LCD, and via the front and rear communication ports. Information on each of these methods is given in this section to describe how to start using the device.

1.2 Introduction

1.2.1 Front panel

The front panel of the MiCOM P849 is shown in Figure 1, with the hinged covers at the top and bottom of the device shown open. Extra physical protection for the front panel can be provided by an optional transparent front cover. With the cover in place read only access to the user interface is possible. Removal of the cover does not compromise the environmental withstand capability of the product, but allows access to the settings. When full access to the keypad is required, for editing the settings, the transparent cover can be unclipped and removed when the top and bottom covers are open. If the lower cover is secured with a wire seal, this will need to be removed. Using the side flanges of the transparent cover, pull the bottom edge away from the front panel until it is clear of the seal tab. The cover can then be moved vertically down to release the two fixing lugs from their recesses in the front panel.

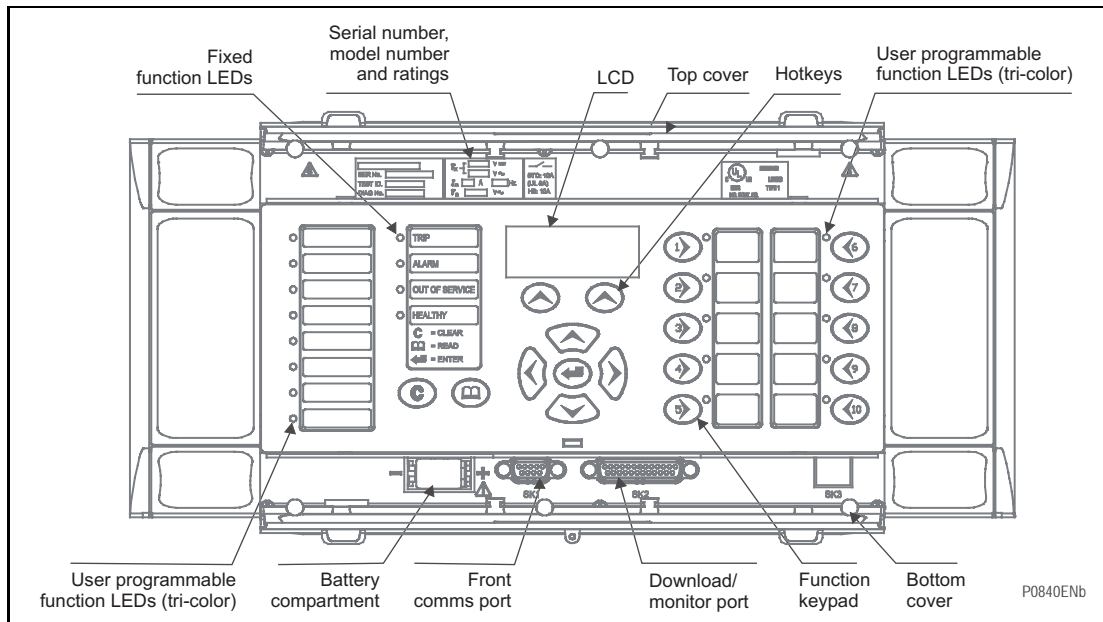


FIGURE 1: MICOM P849 FRONT VIEW

The front panel of the MiCOM P849 includes the following, as indicated in Figure 1:

- a 16-character by 3-line alphanumeric liquid crystal display (LCD)
- a 19-key keypad comprising 4 arrow keys (⬅, ➡, ⬆, ⬇), an enter key (↵), a clear key (⊙), a read key (Ⓜ), 2 additive hotkeys (⊕).
- 12 LEDs; 8 programmable function LEDs and 4 fixed function LEDs on the left hand side.

- 10 tri-color programmable function LEDs associated with the function keys (⏪) – (⏩) on the right hand side.

Hotkey functionality:

- SCROLL: Starts scrolling through the various default displays,
- STOP: Stops scrolling the default display,
for control of setting groups, control inputs and circuit breaker operation.

Function key functionality:

- The front panel features control pushbutton switches with programmable LEDs that facilitate local control. Factory default settings associate specific functions with these 10 direct-action pushbuttons and LEDs e.g. reset indications. Using programmable scheme logic, the user can readily change the default direct-action pushbutton functions and LED indications to fit specific control and operational needs.

The front panel includes two covers with:

- Under the top hinged cover: The serial number, and the device's current and voltage rating information
- Under the bottom hinged cover:
 - Battery compartment to hold the 1/2 AA size battery which is used for memory back-up for the real time clock, event and records,
 - A 9-pin female D-type front port for communication with a PC locally to the device (up to 15m distance) via an EIA(RS)232 serial data connection
 - A 25-pin female D-type port providing internal signal monitoring and high speed local downloading of software and language text via a parallel data connection

The 4 fixed function LEDs on the left-hand side of the front panel are used to indicate the following conditions:

- Trip (Red) indicates that the device has issued a trip signal from an external relay. It is reset when the associated record is cleared from the front display.
- Alarm (Yellow) flashes to indicate that the device has registered an alarm. This may be triggered by an event or maintenance record. The LED will flash until the alarms have been accepted (read), after which the LED will change to constant illumination, and will extinguish, when the alarms have been cleared.
- Out of service (Yellow) indicates that the device's function is unavailable or a test mode is selected.
- Healthy (Green) indicates that the device is in correct working order, and should be on at all times. It will be extinguished if the device's self-test facilities indicate that there is an error with the device's hardware or software. The state of the healthy LED is reflected by the watchdog contact at the back of the device.

To improve the visibility of the settings via the front panel, the LCD contrast can be adjusted using the "LCD Contrast" setting in the CONFIGURATION column. This should only be necessary in very hot or cold ambient temperatures.

Programmable LEDs

All the programmable LEDs are tri-colour and can be programmed to indicate RED, YELLOW or GREEN depending on the requirements. The 8 programmable LEDs on the left are suitable for programming alarm indications and the default indications and functions are indicated in the table below. The 10 programmable LEDs physically associated with the function keys, are used to indicate the status of the associated pushbutton's function and the default indications are shown below:

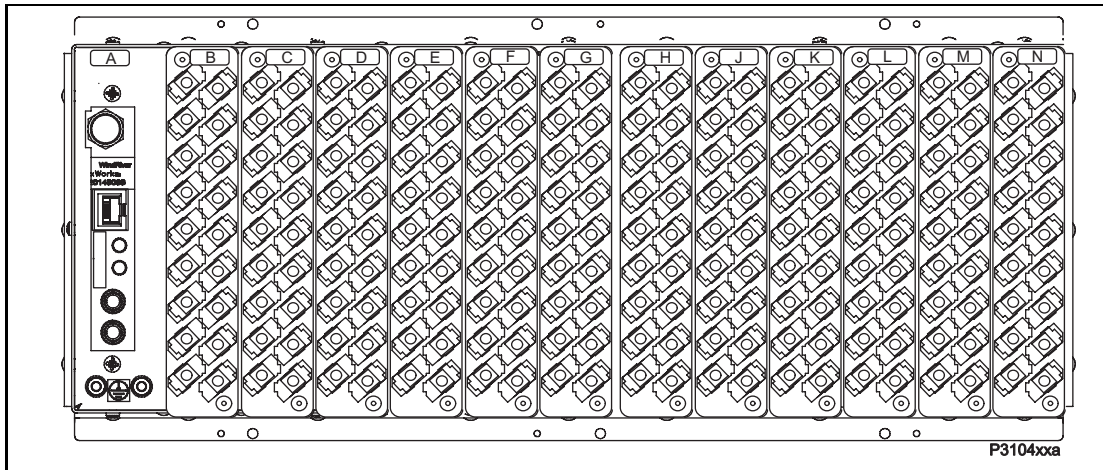
The default functions for the function keys are:

- Function key 1: GOOSE testing mode (toggled mode. The yellow LED lit when ON)
- Function key 6: send testing mode message (toggled mode. LED is controlled by other DDB)
- Function key 10: Trigger precise event recorder

The other Function keys are not assigned in the default configuration.

1.2.2 Device rear panel

An example of the rear panel of the device is shown in Figure 2. All current signals, digital logic input signals and output contacts are connected at the rear of the device. Also connected at the rear is the twisted pair wiring for the rear EIA(RS)485 communication port; the IRIG-B time synchronising input is optional, the Ethernet rear communication board with copper and fiber optic connections or the second communication are optional.



- A – IRIG B / Ethernet / COMMS
- B – Opto
- C – Opto
- D – Opto
- E – Relay \ Opto
- F – Relay \ Opto
- G – Relay \ Opto \ high break
- H – Relay \ Opto \ high break
- J – Relay \ Opto \ high break
- K – Relay \ Opto \ high break
- L – Relay board
- M – Relay board
- N – Power supply board

FIGURE 2: MiCOM P849 – REAR VIEW 80TE

Refer to the wiring diagram in ‘Installation Chapter’ (P849/EN IN) for complete connection details.

1.3 Device connection and power-up

Before powering-up the device, confirm that the device power supply voltage and nominal ac signal magnitudes are appropriate for your application. The device serial number, and the device’s current and voltage rating, power rating information can be viewed under the top hinged cover. The device is available in the following auxiliary voltage versions and these are specified in the table below:

Nominal Ranges	Operative dc Range	Operative ac Range
24 - 48V dc	19 to 65V	-
48 - 110V dc	37 to 150V	
110 - 250V dc (100 - 240V ac rms) **	87 to 300V	80 to 265V

** rated for ac or dc operation

Please note that the label does not specify the logic input ratings. The MiCOM P849 devices are fitted with universal opto isolated logic inputs that can be programmed for the nominal battery voltage of the circuit of which they are a part. See ‘Universal Opto input’ in the Firmware section for more information on logic input specifications. Please note that the opto inputs have a maximum input voltage rating of 300V dc at any setting.

Once the ratings have been verified for the application, connect external power capable of delivering the power requirements specified on the label to perform the device familiarization procedures. Figure 2 and 3 indicates the location of the power supply terminals but please refer to the wiring diagrams in the Installation section for complete installation details ensuring that the correct polarities are observed in the case of dc supply.

1.4 Introduction to the user interfaces and settings options

The device has three user interfaces:

- The front panel user interface via the LCD and keypad
- The front port which supports Courier communication
- The rear port which supports five protocols:
 - Courier
 - DNP3
 - IEC 60870-5-103
 - IEC 61850-8-1
 - MODBUS..
- The optional Ethernet port supports IEC 61850

The information and settings that can be accessed from the four interfaces are summarized in Table 1.

	Keypad/ LCD	Courier	Modbus	IEC870-5-103	DNP3.0	IEC61850
Display & modification of all settings	●	●	●	●		
Digital I/O signal status	●	●	●	●	●	●
Display/extraction of measurements	●	●	●	●	●	●
Display/extraction of records	●	●	●	●	●	●
Extraction of precise event records		●	●	●	●	●
Programmable scheme logic settings		●				
Reset of alarm records	●	●	●	●	●	
Clear standard event records	●	●	●	●	●	
Time synchronisation		●	●	●	●	●
Control commands	●	●	●	●	●	●

Table 1

1.5 Menu structure

The device's menu is arranged in a tabular structure. Each setting in the menu is referred to as a cell, and each cell in the menu may be accessed by reference to a row and column address. The settings are arranged so that each column contains related settings, for example all of the precise event recording are contained within the same column. As shown in Figure 3, the top row of each column contains the heading that describes the settings contained within that column. Movement between the columns of the menu can only be made at the column heading level. A complete list of all of the menu settings is given in the Menu Content Map at the end of this section.

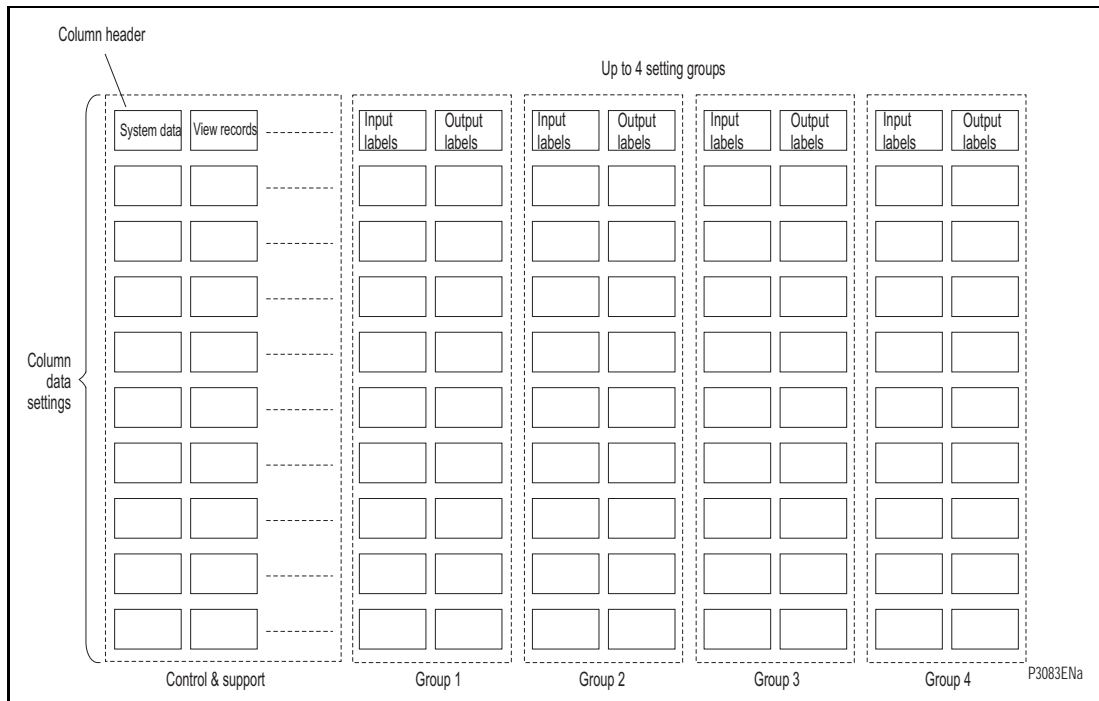


FIGURE 3: MENU STRUCTURE

All of the settings in the menu fall into one of three categories; settings, precise event recording, or control and support (C&S) settings. One of two different methods is used to change a setting depending on which category the setting falls into. Control and support settings are stored and used by the device immediately after they are entered. For either settings or precise event recording, the device stores the new setting values in a temporary 'scratchpad'. It activates all the new settings together, but only after it has been confirmed that the new settings are to be adopted. This technique is employed to provide extra security, and so that several setting changes that are made within a group of settings will all take effect at the same time.

1.5.1 Settings

The settings include the following items:

- Input and Output element settings
- Scheme logic settings

There are four groups of settings, with each group containing the same setting cells. One group of settings is selected as the active group, and is used by the configuration elements.

1.5.2 Precise event recording

The precise event recording include the record duration and trigger position, selection of digital signals to record, and the signal sources that trigger the recording.

1.5.3 Control and support settings

The control and support settings include:

- Configuration settings,
- Active setting group,
- Password & language settings,
- Communications settings,
- Event & maintenance record settings,
- User interface settings,
- Commissioning settings.

1.6 Password protection

The menu structure contains three levels of access. The level of access that is enabled determines which of the device's settings can be changed and is controlled by entry of two different passwords. The levels of access are summarized in Table 2.

Access level	Operations enabled
Level 0 No password required	Read access to all settings, alarms, event records and maintenance records
Level 1 Password 1 or 2	As level 0 plus: Control commands, e.g. circuit breaker open/close. Reset of maintenance and alarm conditions. Reset LEDs. Clearing of event and maintenance records.
Level 2 As level 1 plus:	Password 2 required All other settings.

Table 2

Each of the passwords is 4 characters of upper case text. The factory default for both passwords is AAAA. Each password is user-changeable once it has been correctly entered. Entry of the password is achieved either by a prompt when a setting change is attempted, or by moving to the 'Password' cell in the 'System data' column of the menu. The level of access is independently enabled for each interface, that is to say if level 2 access is enabled for the rear communication port, the front panel access will remain at level 0 unless the relevant password is entered at the front panel. The access level enabled by the password entry will time-out independently for each interface after a period of inactivity and revert to the default level. If the passwords are lost an emergency password can be supplied - contact Schneider Electric with the device's serial number and security code. The current level of access enabled for an interface can be determined by examining the 'Access level' cell in the 'System data' column, the access level for the front panel user interface, can also be found as one of the default display options.

The device is supplied with a default access level of 2 such that no password is required to change any of the device settings. It is also possible to set the default menu access level to either level 0 or level 1, preventing write access to the device settings without the correct password. The default menu access level is set in the 'Password control' cell which is found in the 'System data' column of the menu (note that this setting can only be changed when level 2 access is enabled).

1.7 Device configuration

The device is a multi-function device that supports numerous different functions, control and communication features. In order to simplify the setting of the device, there is a configuration settings column which can be used to enable or disable many of the functions of the device. The settings associated with any function that is disabled are made invisible, i.e. they are not shown in the menu. To disable a function change the relevant cell in the 'Configuration' column from 'Enabled' to 'Disabled'.

The configuration column controls which of the four settings groups is selected as active through the 'Active settings' cell. A setting group can also be disabled in the configuration column, provided it is not the present active group. Similarly, a disabled setting group cannot be set as the active group.





The column also allows all of the setting values in one group of settings to be copied to another group.

To do this firstly set the 'Copy from' cell to the setting group to be copied, then set the 'Copy to' cell to the group where the copy is to be placed. The copied settings are initially placed in the temporary scratchpad, and will only be used by the device following confirmation.

To restore the default values to the settings in any settings group, set the 'Restore defaults' cell to the relevant group number. Alternatively it is possible to set the 'Restore defaults' cell to 'All settings' to restore the default values to all of the device's settings, not just the groups' settings. The default settings will initially be placed in the scratchpad and will only be used by the device after they have been confirmed. Note that restoring defaults to all settings includes the rear communication port settings, which may result in communication via the rear port being disrupted if the new (default) settings do not match those of the master station.

1.8 Front panel user interface (keypad and LCD)

When the keypad is exposed it provides full access to the menu options of the device, with the information displayed on the LCD.

The , ,  and  keys which are used for menu navigation and setting value changes include an auto-repeat function that comes into operation if any of these keys are held continually pressed. This can be used to speed up both setting value changes and menu navigation; the longer the key is held depressed, the faster the rate of change or movement becomes.

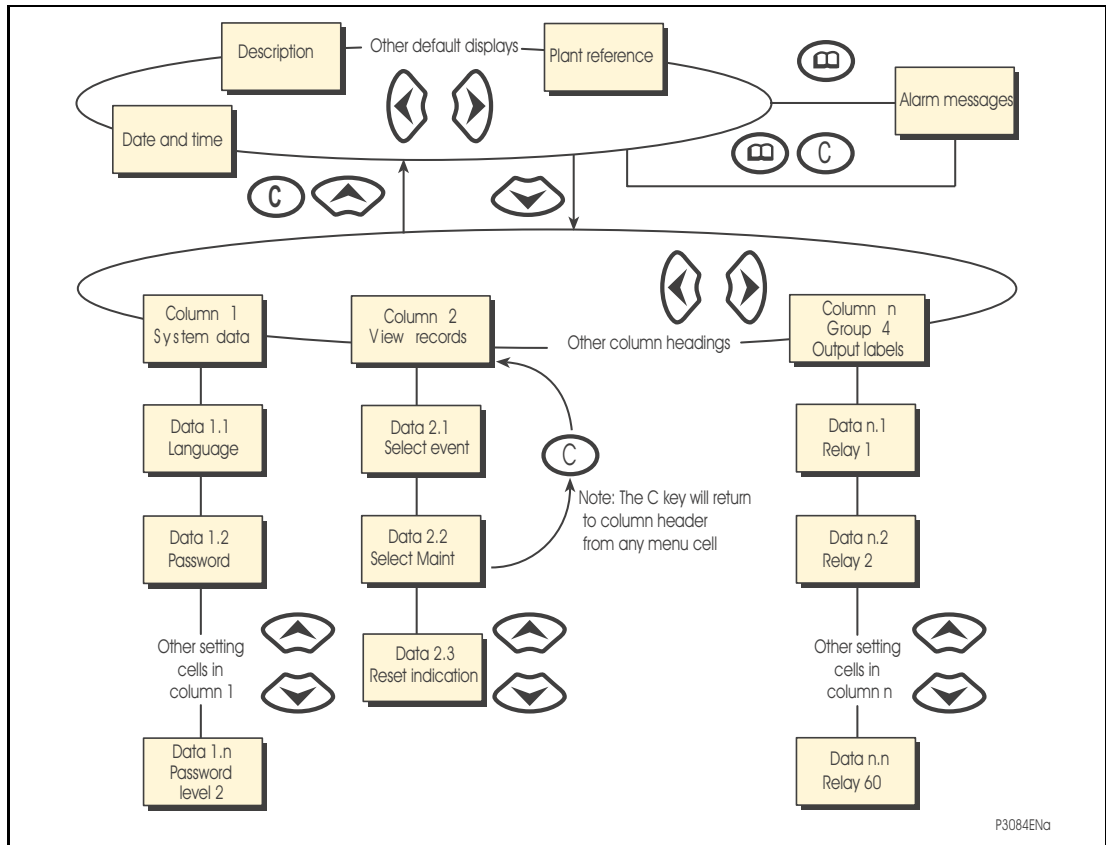


FIGURE 4: FRONT PANEL USER INTERFACE

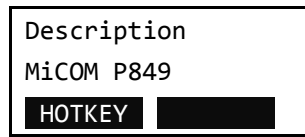
1.8.1 Default display and menu time-out

The front panel menu has a default display, the contents of which can be selected from the following options in the 'default display' cell of the 'Measure't. setup' column:

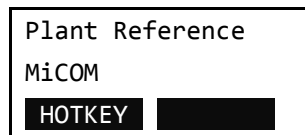
- Date and time
For example:



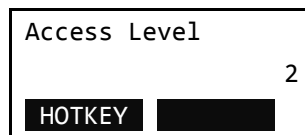
- Device description (user defined)
For example:



- Plant reference (user defined)
For example:



- Access Level
For example:



From the default display it is also possible to view the other default display options using the \leftarrow and \rightarrow keys. However, if there is no keypad activity for the 15 minute timeout period, the default display will revert to that selected by the setting and the LCD backlight will turn off. If this happens any setting changes that have not been confirmed will be lost and the original setting values maintained.

1.8.2 Menu navigation and setting browsing

The menu can be browsed using the four arrow keys, following the structure shown in Figure 5. Thus, starting at the default display the \leftarrow key will display the first column heading. To select the required column heading use the \leftarrow and \rightarrow keys. The setting data contained in the column can then be viewed by using the \downarrow and \uparrow keys. It is possible to return to the column header either by holding the [up arrow symbol] key down or by a single press of the clear key C . It is only possible to move across columns at the column heading level. To return to the default display, press the \leftarrow key or the clear key C from any of the column headings. It is not possible to go straight to the default display from within one of the column cells using the auto-repeat facility of the \leftarrow key, as the auto-repeat will stop at the column heading. To move to the default display, the \leftarrow key must be released and pressed again.

1.8.3 Hotkey menu navigation

The hotkey menu can be browsed using the two keys directly below the LCD. These are known as direct access keys. The direct access keys perform the function that is displayed directly above them on the LCD. Thus, to access the hotkey menu from the default display the direct access key below the "HOTKEY" text must be pressed. Once in the hotkey menu the \leftarrow and \rightarrow keys can be used to scroll between the available options and the direct access keys can be used to control the function currently displayed. If neither the \leftarrow or \rightarrow keys are pressed with 20 seconds of entering a hotkey sub menu, the device will revert to the default display. The clear key C will also act to return to the default menu from any page of the hotkey menu. The layout of a typical page of the hotkey menu is described below:

- The top line shows the contents of the previous and next cells for easy menu navigation
- The centre line shows the function
- The bottom line shows the options assigned to the direct access keys

The functions available in the hotkey menu are listed below:

1.8.3.1 Setting group selection

The user can either scroll using $\ll\text{NXT GRP}\gg$ through the available setting groups or $\ll\text{SELECT}\gg$ the setting group that is currently displayed.

When the SELECT button is pressed a screen confirming the current setting group is displayed for 2 seconds before the user is prompted with the $\ll\text{NXT GRP}\gg$ or $\ll\text{SELECT}\gg$ options again. The user can exit the sub menu by using the left and right arrow keys.

For more information on setting group selection refer to "setting groups selection" section in the Operation section (P849/EN OP).

1.8.3.2 Control inputs – user assignable functions

The number of control inputs (user assignable functions – USR ASS) represented in the hotkey menu is user configurable in the "CTRL I/P CONFIG" column. The chosen inputs can be SET/RESET using the hotkey menu.

For more information refer to the "Control Inputs" section in the Operation section (P849/EN OP).

1.8.3.3 Hotkey menu navigation

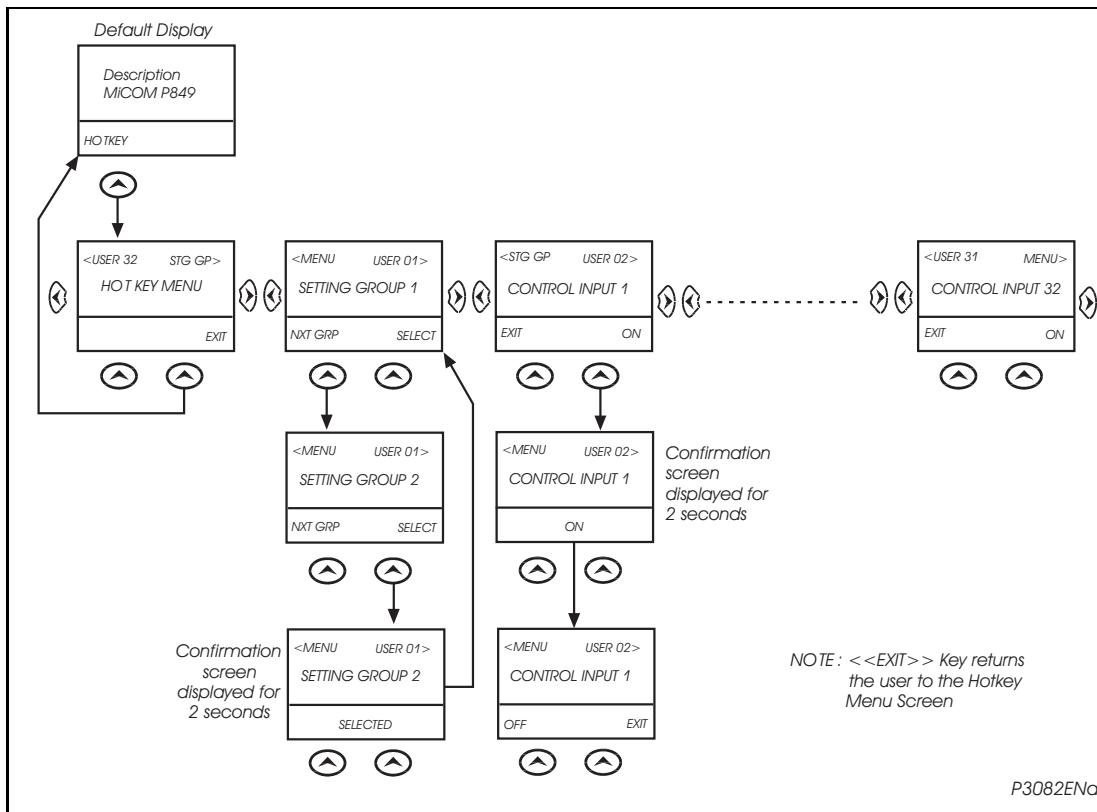


FIGURE 5: HOTKEY MENU NAVIGATION

1.8.4 Password entry

When entry of a password is required the following prompt will appear (default password is AAAA).

```

Enter Password
**** Level 1
  
```

1. A flashing cursor shows which character field of the password can be changed. Press the up or down cursor keys to change each character (tip: pressing the up arrow once will return an upper case "A" as required by the default level 3 password).
2. Use the left and right cursor keys to move between the character fields of the password.
3. Press the **Enter** key to confirm the password. If you enter an incorrect password, an invalid password message is displayed then the display reverts to **Enter password**. Upon entering a valid password a message appears indicating that the password is correct and if so what level of access has been unlocked. If this level is sufficient to edit the selected setting, the display returns to the setting page to allow the edit to continue. If the correct level of password has not been entered, the password prompt page appears again.
4. To escape from this prompt press the Clear key. Alternatively, enter the password using System data > Password. If the keypad is inactive for 15 minutes, the password protection of the front panel user interface reverts to the default access level.
5. To manually reset the password protection to the default level, select **System data > Password**, then press the clear key instead of entering a password.

1.8.5 Reading and clearing of alarm messages and records

The presence of one or more alarm messages will be indicated by the default display and by the yellow alarm LED flashing. The alarm messages can either be self-resetting or latched, in which case they must be cleared manually. To view the alarm messages press the read key ⏏ . When all alarms have been viewed, but not cleared, the alarm LED will change from flashing to constant illumination and the latest record will be displayed (if there is one). To scroll through the pages of this use the ⏏ key. When all pages of the record have been viewed, the following prompt will appear:

Press clear to
Reset alarm

To clear all alarm messages press ⏏ ; to return to the alarms/faults present display and leave the alarms uncleared, press ⏏ . Depending on the password configuration settings, it may be necessary to enter a password before the alarm messages can be cleared (see section on password entry). When the alarms have been cleared the yellow alarm LED will extinguish, as will the red trip LED if it was illuminated following a trip from an external relay.

Alternatively it is possible to accelerate the procedure, once the alarm viewer has been entered using the ⏏ key, the ⏏ key can be pressed, and this will move the display straight to the record. Pressing ⏏ again will move straight to the alarm reset prompt where pressing ⏏ once more will clear all alarms.

1.8.6 Setting changes

To change the value of a setting, first navigate the menu to display the relevant cell. To change the cell value press the enter key ⏏ , which will bring up a flashing cursor on the LCD to indicate that the value can be changed. This will only happen if the appropriate password has been entered, otherwise the prompt to enter a password will appear. The setting value can then be changed by pressing the ⏏ or ⏏ keys. If the setting to be changed is a binary value or a text string, the required bit or character to be changed must first be selected using the ⏏ and ⏏ keys. When the desired new value has been reached it is confirmed as the new setting value by pressing ⏏ . Alternatively, the new value will be discarded either if the clear button ⏏ is pressed or if the menu time-out occurs.

For group settings and precise event recording, the changes must be confirmed before they are used by the device. To do this, when all required changes have been entered, return to the column heading level and press the ⏏ key. Prior to returning to the default display the following prompt will be given:

Update settings?
Enter or clear

Pressing ⏏ will result in the new settings being adopted, pressing ⏏ will cause the device to discard the newly entered values. It should be noted that, the setting values will also be discarded if the menu time out occurs before the setting changes have been confirmed. Control and support settings will be updated immediately after they are entered, without the 'Update settings?' prompt.

1.9 Front communication port user interface

The front communication port is provided by a 9-pin female D-type connector located under the bottom hinged cover. It provides EIA(RS)232 serial data communication and is intended for use with a PC locally to the device (up to 15m distance) as shown in Figure 7. This port supports the Courier communication protocol only. Courier is the communication language developed by Schneider Electric to allow communication with its range of protection relays. The front port is particularly designed for use with the relay settings program MiCOM S1 Studio (Windows 2000, Windows XP or Windows Vista based software package).

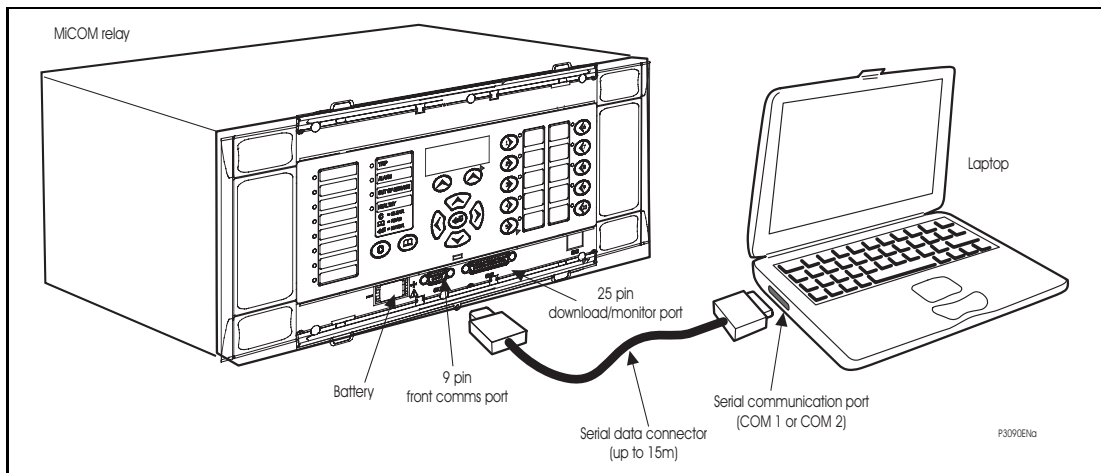


FIGURE 6: FRONT PORT CONNECTION

The device is a Data Communication Equipment (DCE) device. Thus the pin connections of the device's 9-pin front port are as follows:

Pin no. 2	Tx Transmit data
Pin no. 3	Rx Receive data
Pin no. 5	0V Zero volts common

None of the other pins are connected in the device. The device should be connected to the serial port of a PC, usually called COM1 or COM2. PCs are normally Data Terminal Equipment (DTE) devices which have a serial port pin connection as below (if in doubt check your PC manual):

	25 Way	9 Way	
Pin no. 2	3	2	Rx Receive data
Pin no. 3	2	3	Tx Transmit data
Pin no. 5	7	5	0V Zero volts common

For successful data communication, the Tx pin on the device must be connected to the Rx pin on the PC, and the Rx pin on the device must be connected to the Tx pin on the PC, as shown in Figure 7. Therefore, providing that the PC is a DTE with pin connections as given above, a 'straight through' serial connector is required, i.e. one that connects pin 2 to pin 2, pin 3 to pin 3, and pin 5 to pin 5. Note that a common cause of difficulty with serial data communication is connecting Tx to Tx and Rx to Rx. This could happen if a 'cross-over' serial connector is used, i.e. one that connects pin 2 to pin 3, and pin 3 to pin 2, or if the PC has the same pin configuration as the device.

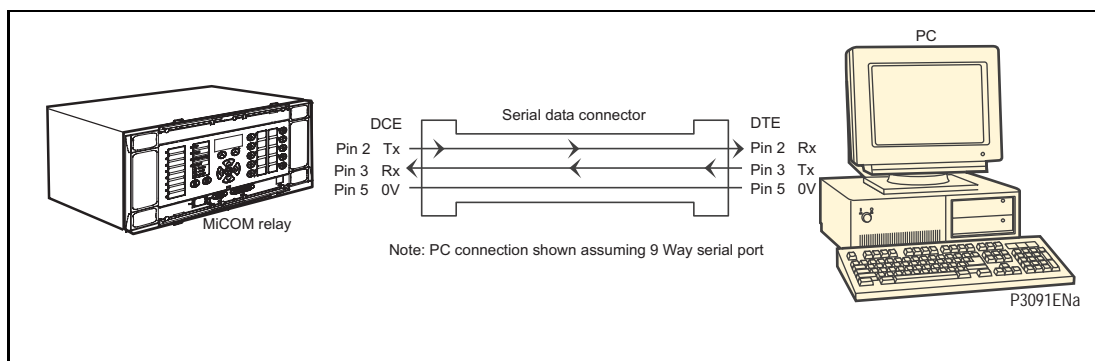


FIGURE 7: PC – DEVICE SIGNAL CONNECTION

Having made the physical connection from the device to the PC, the PC's communication settings must be configured to match those of the device. The device's communication settings for the front port are fixed as shown in the table below:

Protocol	Courier
Baud rate	19,200 bits/s
Courier address	1
Message format	11 bit - 1 start bit, 8 data bits, 1 parity bit (even parity), 1 stop bit

The inactivity timer for the front port is set at 15 minutes. This controls how long the device will maintain its level of password access on the front port. If no messages are received on the front port for 15 minutes then any password access level that has been enabled will be revoked.

1.9.1 Front courier port

The front EIA(RS)232¹ 9 pin port supports the Courier protocol for one to one communication. It is designed for use during installation and commissioning/maintenance and is not suitable for permanent connection. Since this interface will not be used to link the device to a substation communication system, some of the features of Courier are not implemented. These are as follows:

Automatic Extraction of standard Event Records:

- Courier Status byte does not support the Event flag
- Send Event/Accept Event commands are not implemented

Automatic Extraction of precise event records:

- Courier Status byte does not support the precise event flag

Busy Response Layer:

- Courier Status byte does not support the Busy flag, the only response to a request will be the final data

Fixed Address:

- The address of the front courier port is always 1, the Change Device address command is not supported.

Fixed Baud Rate:

- 19200 bps

It should be noted that although automatic extraction of event and precise event records is not supported it is possible to manually access this data via the front port.

¹ This port is actually compliant to EIA(RS)574; the 9-pin version of EIA(RS)232, see www.tiaonline.org.

1.10 MiCOM S1 Studio relay communications basics

The front port is particularly designed for use with the device settings program MiCOM S1 Studio. MiCOM S1 Studio is the universal MiCOM IED Support Software and provide users a direct and convenient access to all stored data in any MiCOM IED using the EIA(RS)232 front communication port.

MiCOM S1 Studio provides full access to MiCOM Px20, Px30, Px40 relays and other protection devices.

1.10.1 PC requirements

The following minimum requirements must be met for the MiCOM S1 Studio software to properly work on a PC.

- Minimum:
 - Processor: 1 GHz,
 - Memory: 256 MB,
 - Operating system: Windows 2000,
 - Screen resolution: 800 x 600.
- Recommended:
 - Processor: 2 GHz,
 - Memory: 1 GB,
 - Operating system: Windows XP,
 - Screen resolution: 1024 x 768.
- Microsoft Vista:
 - Processor: 2 GHz,
 - Memory: 2 GB,

1.10.2 Connecting to the MiCOM P849 device using MiCOM S1 Studio

1.10.2.1 “Quick Connection” to the device

To start MiCOM S1 Studio, click on the icon: 

In the "Programs" menu, select "MiCOM S1 Studio".

The MiCOM S1 Studio launcher screen is displayed:



GS

- Click on the “Quick Connect” button at the top left of the application:



Quick Connect is used to connect directly to an IED, for example to send configuration parameters to an IED or perform commissioning tests. This may be a connection to the front or rear port of a single device, or a link to a multi-drop system of many devices.

- Click on the Quick Connect button at the top left of the application.
- Select a device type from the presented options.
- Select a port from the presented options.
- Upon a successful connection a dialog will be displayed showing device type, model number and plant reference. Options for language, device name and comment are also available.
- The device will be displayed in the Studio Explorer panel.

1.10.2.2 Create a system

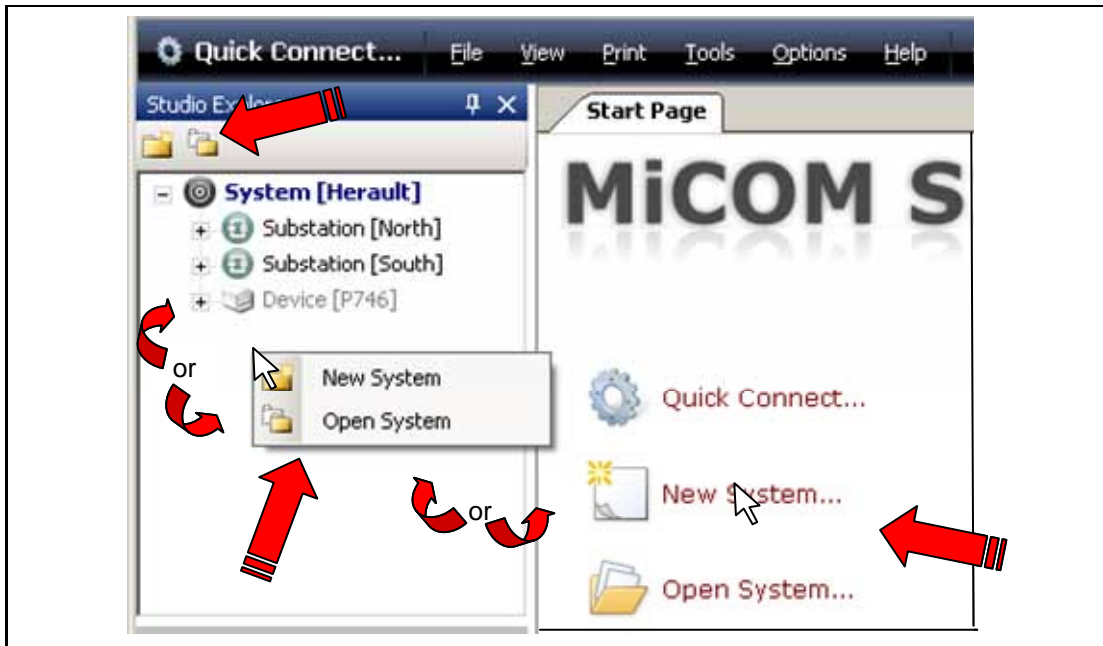
In MiCOM S1 Studio, a System provides a root node in the Studio Explorer from which all subsequent nodes are created.

You may add substations, bays, voltage levels and devices to the system. If a system is no longer needed, It can be deleted using the delete command.

The use of Quick Connect will automatically create a default system, if one does not already exist. Systems are not opened automatically, unless "Reopen last System at start-up" is selected in "Options / Preferences..." menu.

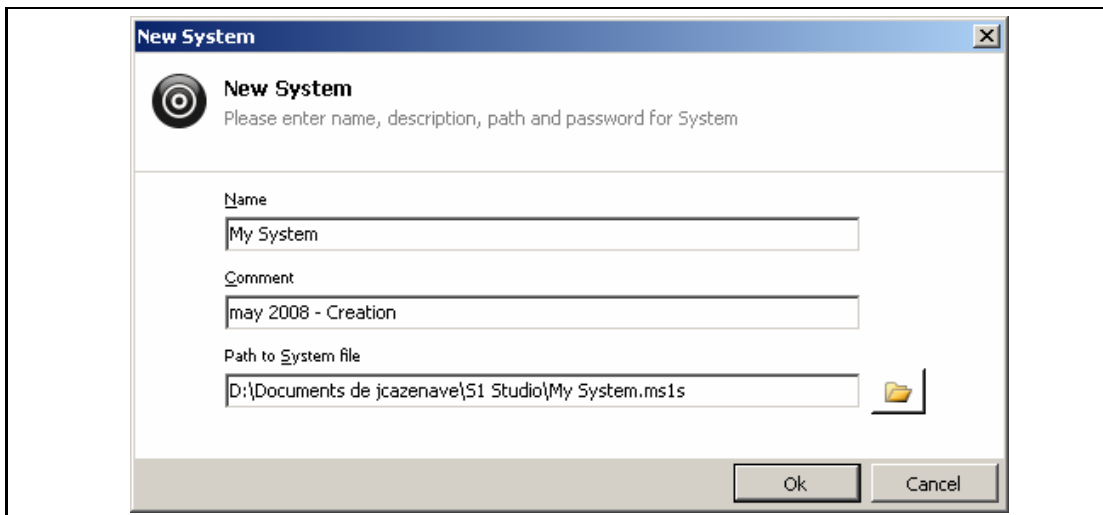
To create or open a new system: Right-click on the Studio Explorer panel background and select New System.

Note: This can also be done using the icons on Studio Explorer's toolbar

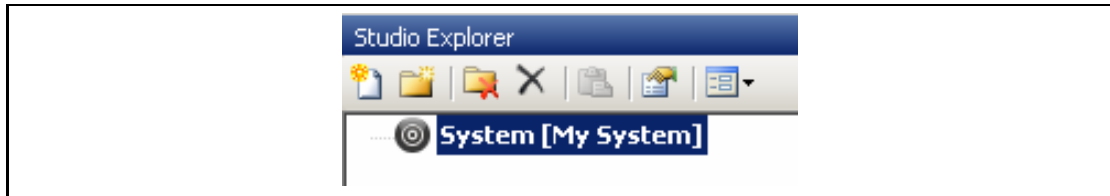


- In the New System window (or Open System window), select the path for the system file and provide a system name and description (new system).
- Click OK to open the system

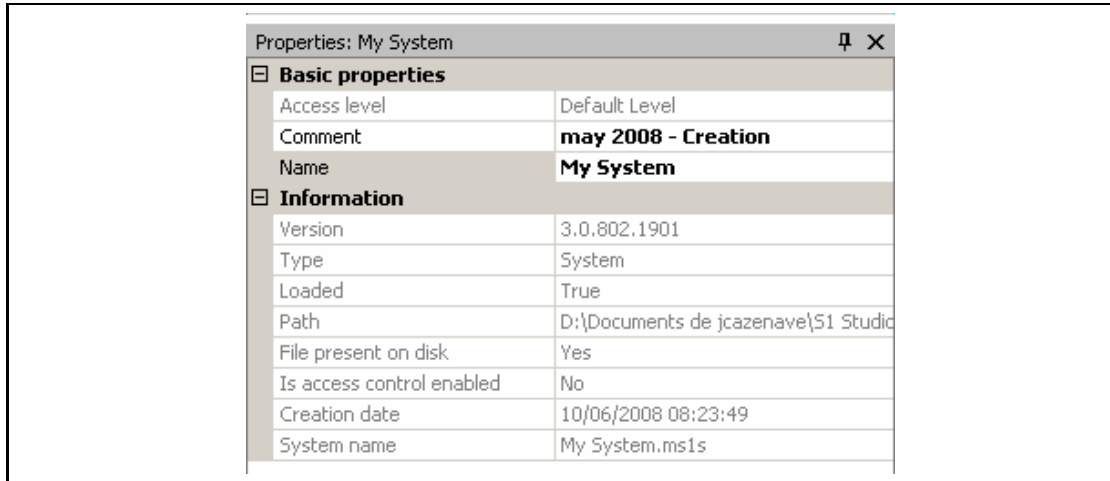
The following window is displayed: Enter the name of the system, and the path to save the system file.



The new System is displayed in the Studio Explorer panel:



Note: In the Studio Explorer panel, if an item is selected, its properties are displayed in the "Properties" panel



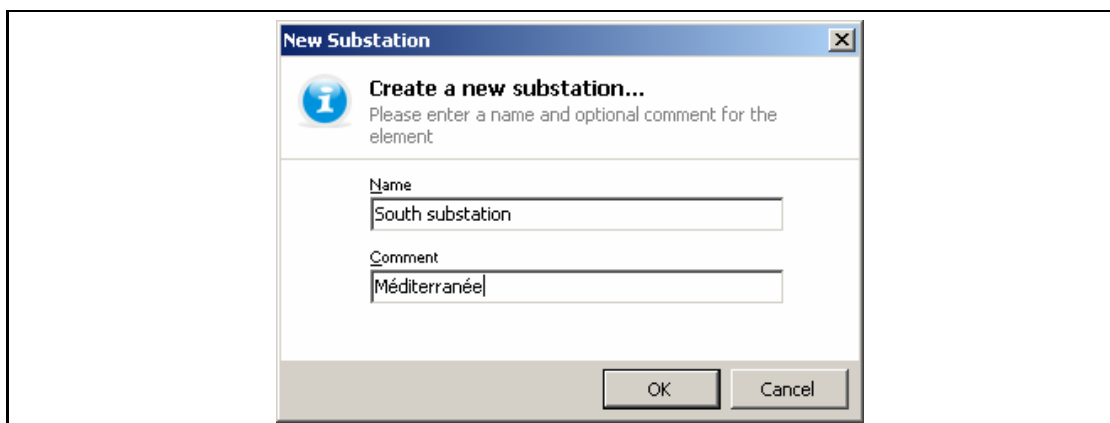
GS

1.10.2.3 Create a new substation

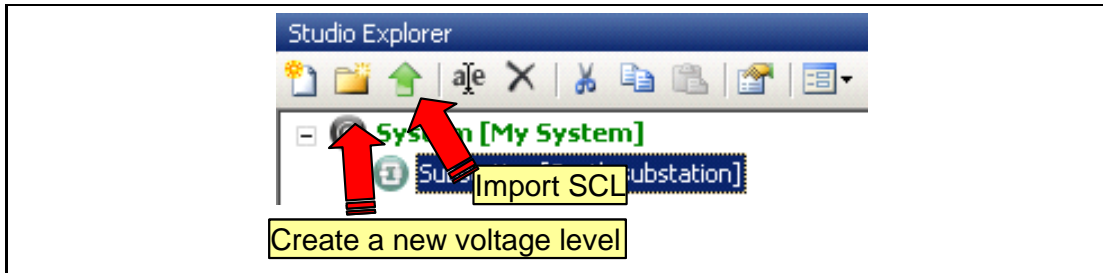
Select the system: the menu bar is updated with "new device", "new substation", "close", "delete", "paste", "properties" and "options" icons.



Click on "new substation" icon (or select the menu using right-click). The following window is displayed:



The new substation is displayed and the menu bar is updated when a substation is selected:



Click on “Import SCL” button to import a Substation Configuration File.

To create a substation configuration, click on “new voltage level” button.

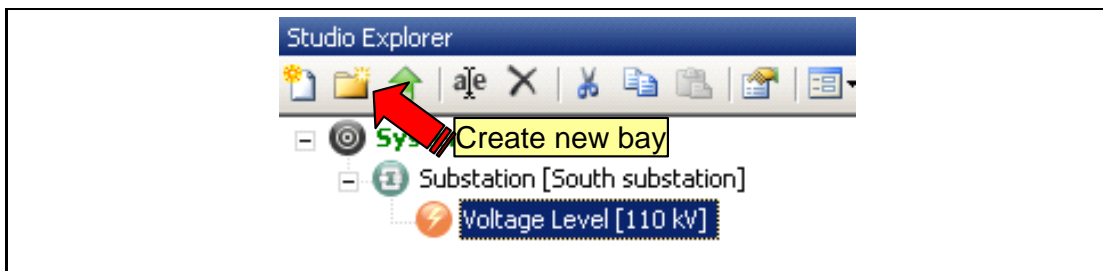
GS

1.10.2.4 Create a new voltage level

Select the substation and click on “new station level” button (or select the menu using right-click).

In the “Create a new voltage level”, enter the voltage level of the station.

The “new voltage level” is displayed and the “new bay” icon is displayed.

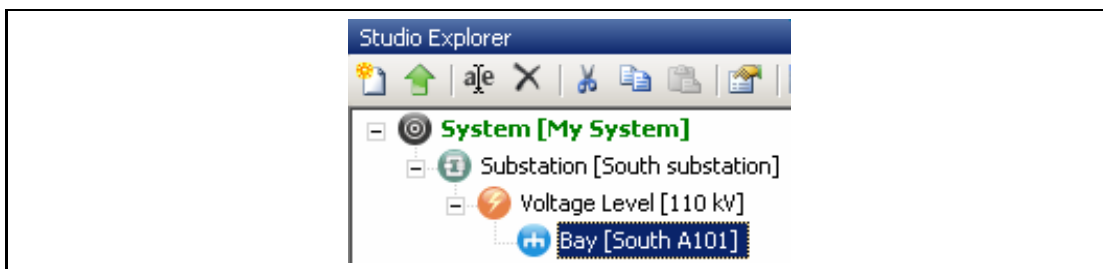


1.10.2.5 Create a new bay

Select the substation and click on “new bay” button (or select the menu using right-click).

In the “Create new bay...” window, enter the bay indication,

The new bay is displayed.



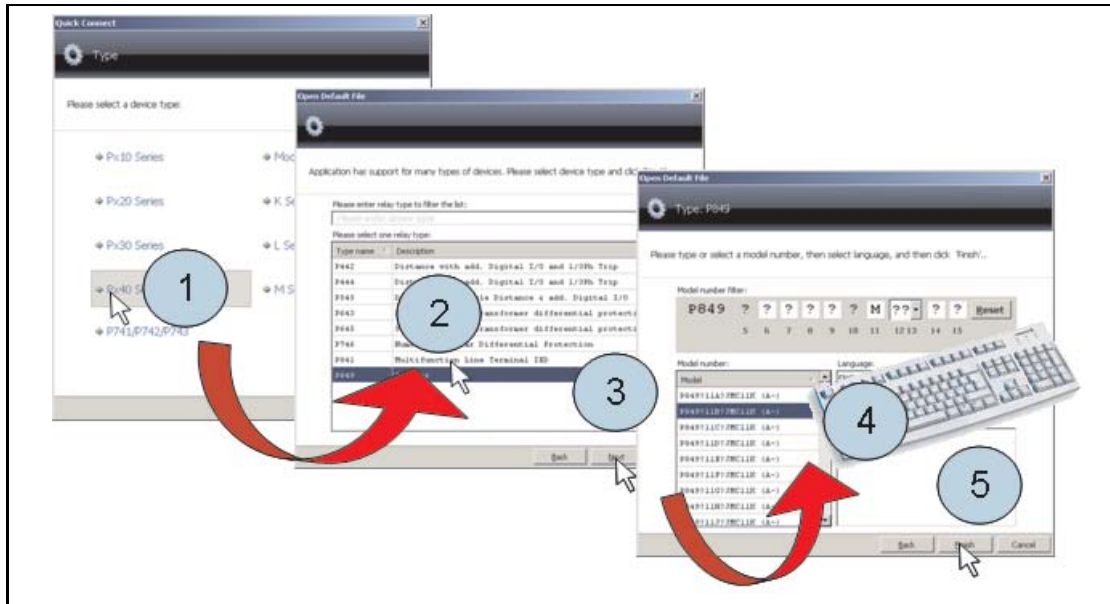
1.10.2.6 Create a new device

Click on “new device” button (or select the menu using right-click). The “Device Type” panel is displayed.

In the “Select device” panel, select the device type (1). The “Type” panel is displayed.

Select the MiCOM P849 device (2) and click the “next” button (3). The “Model Number” panel is displayed.

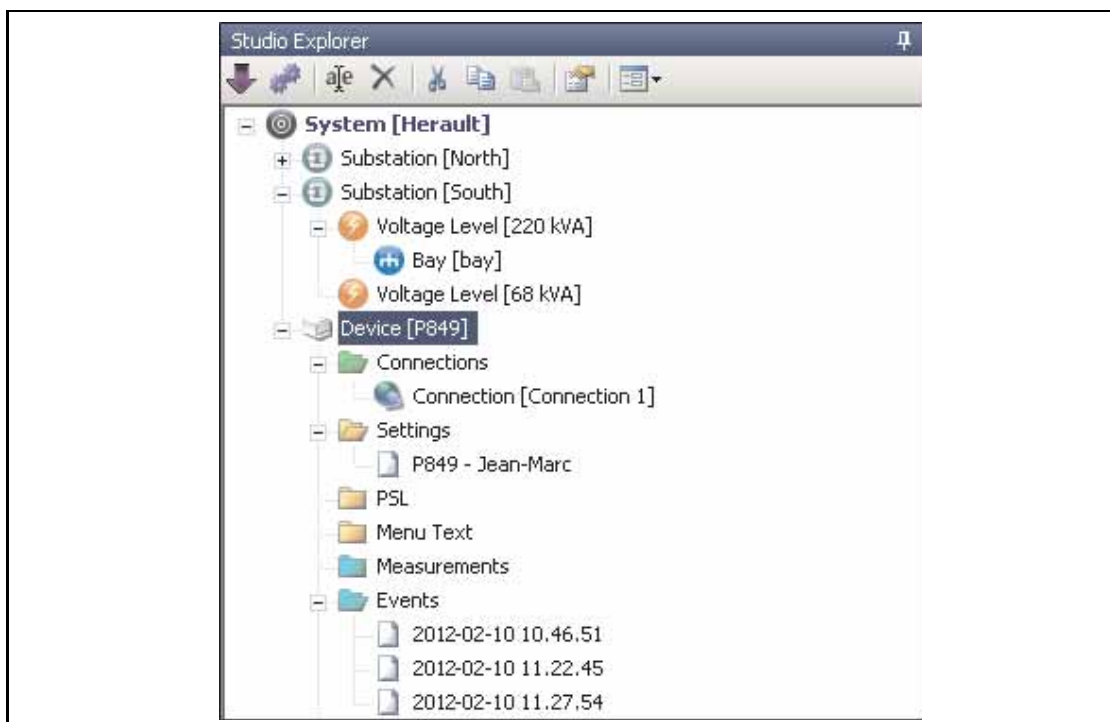
Enter the model number (4) (this number is noted on the front label of the device) and click the “next” button (5) to display the “Model” panel.



Select the model in the list and click in the “Next” button. The “Device Name” panel is displayed.

Enter the name and description of the device and click on the “Next” button.

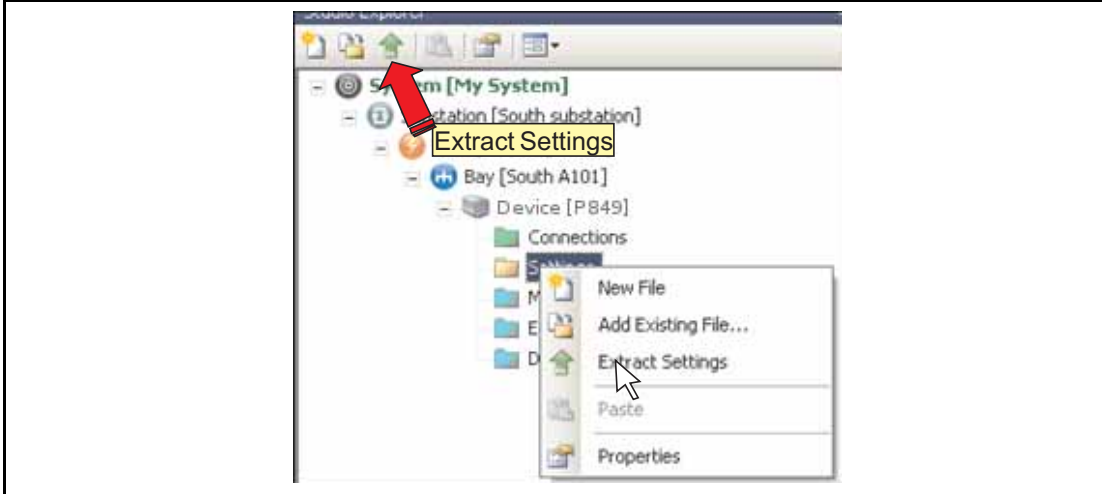
The new device is created and displayed.



1.10.2.7 Open Settings File

To open an existing file:

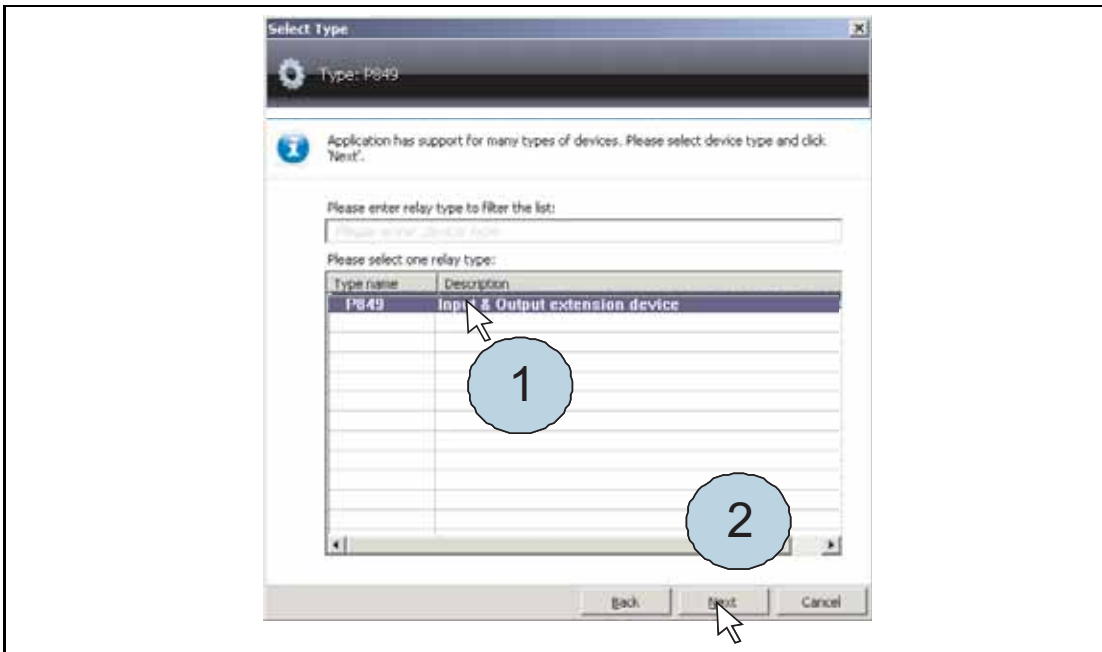
- If the file is saved or if the device is not connected: open the Settings folder and open the Settings file,
- If the device is connected, extract the settings from the device: click on the “Extract Settings” command or right click on the Settings folder.



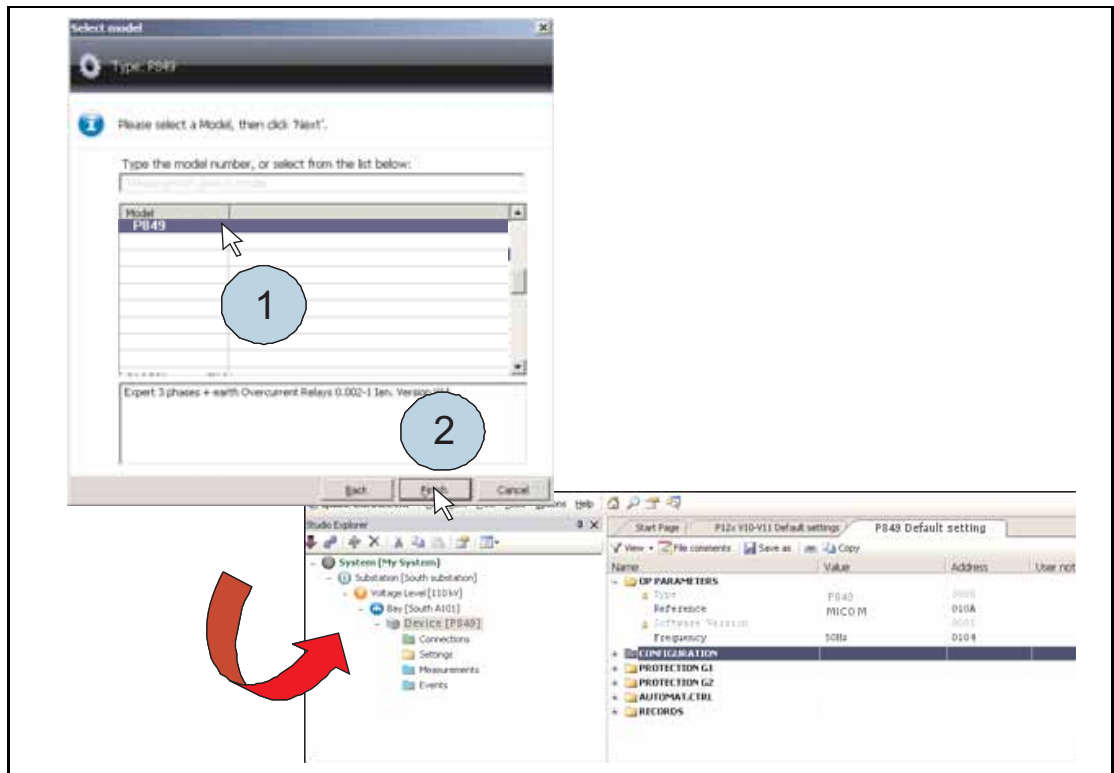
GS

To open default settings:

- Click on “Open Default Settings File” Option in the File menu.
- Select the device type then the communication protocol.
- Select the device type and click on the “Next” button:

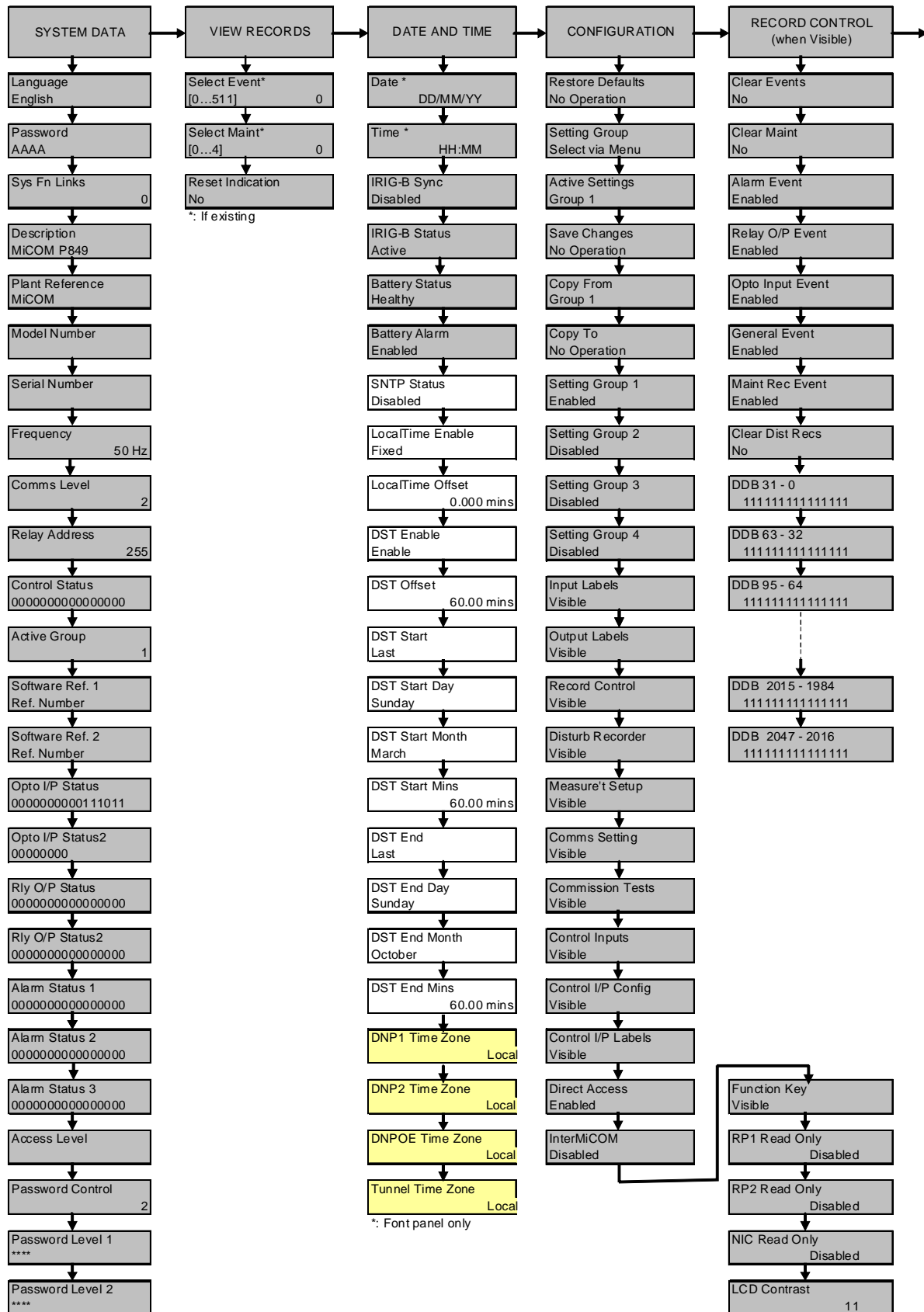


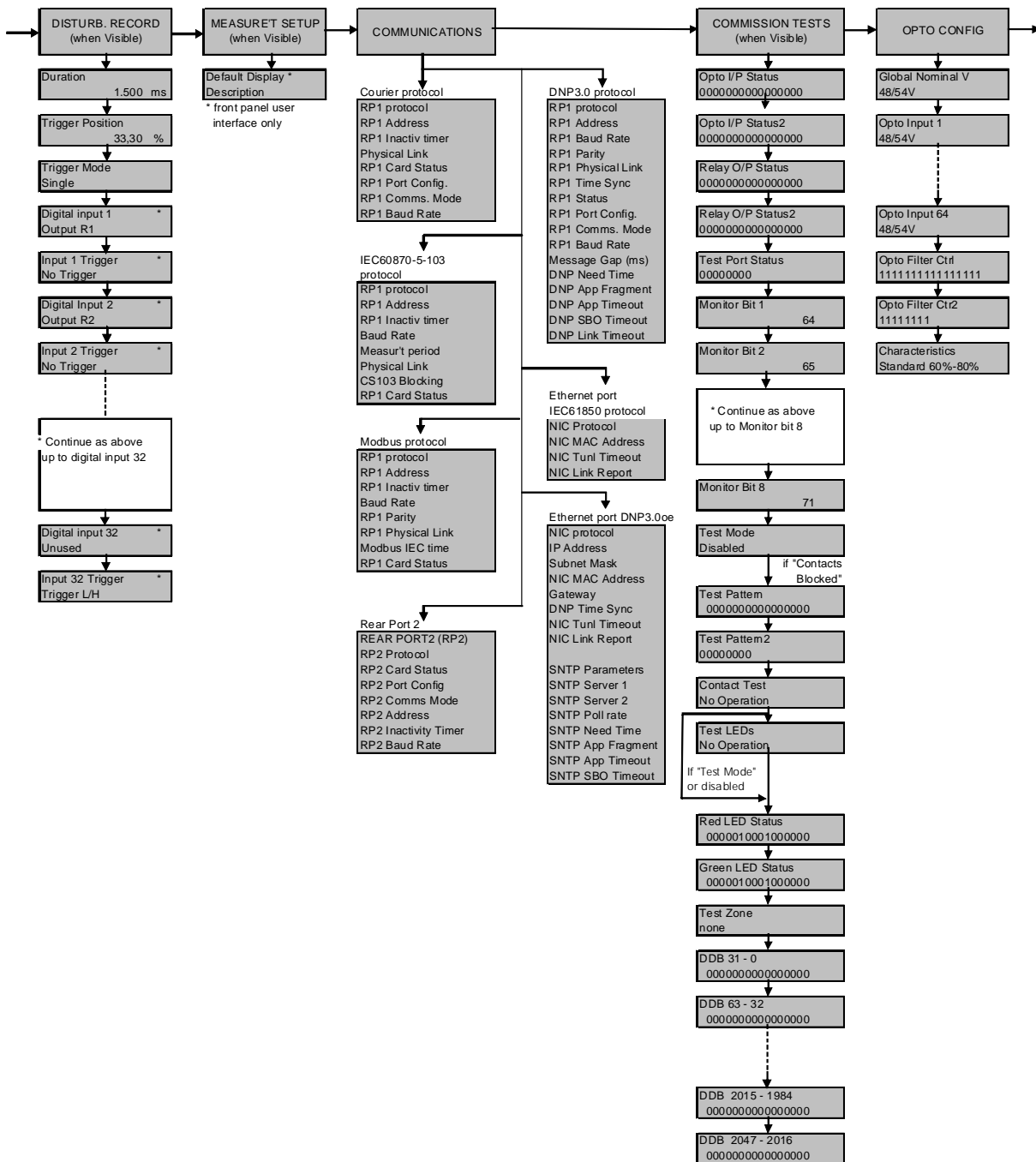
- Select the Model and click on the “Finish” button. The default settings are displayed.



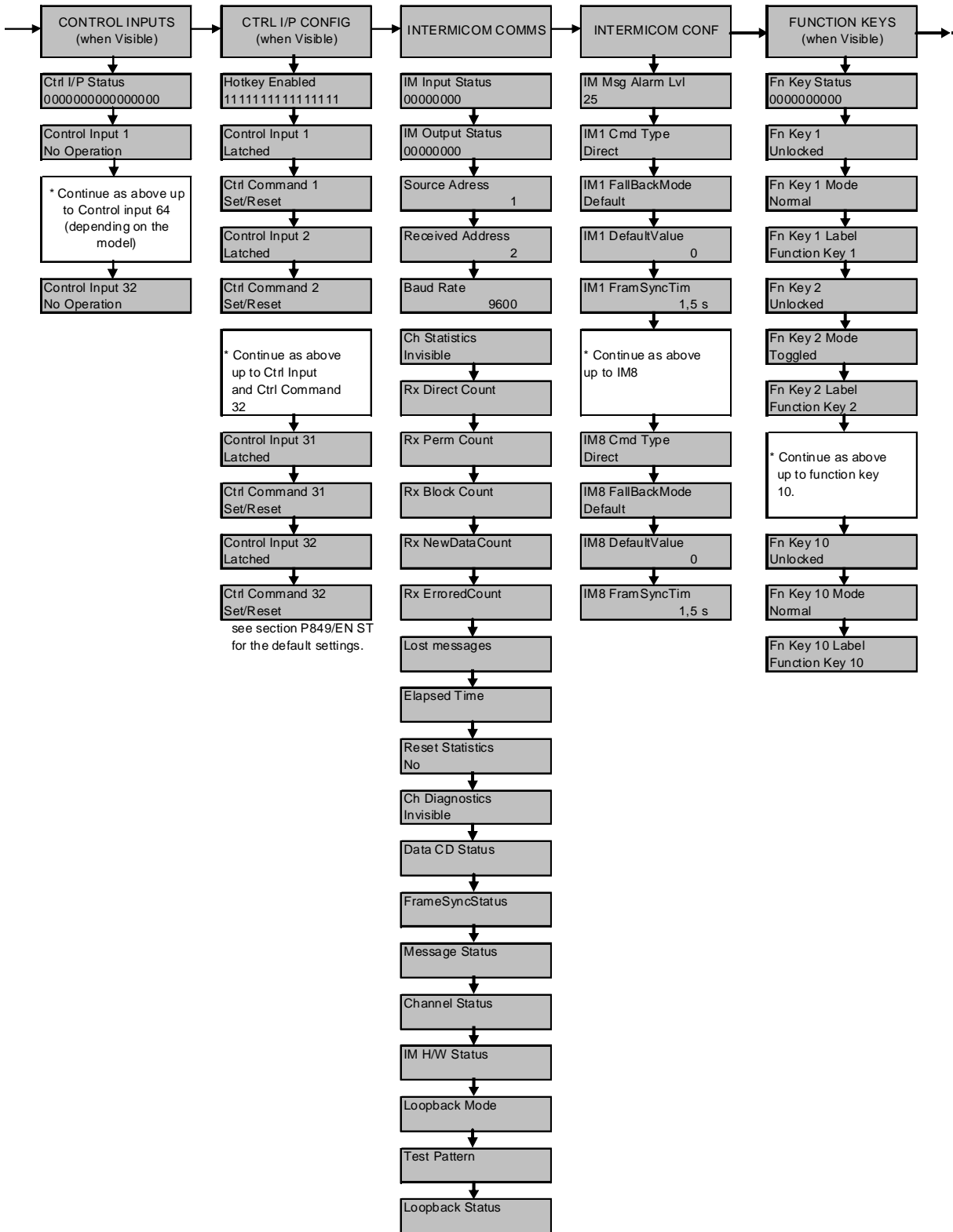
Appendix – MiCOM P849 device Menu Map (Default)

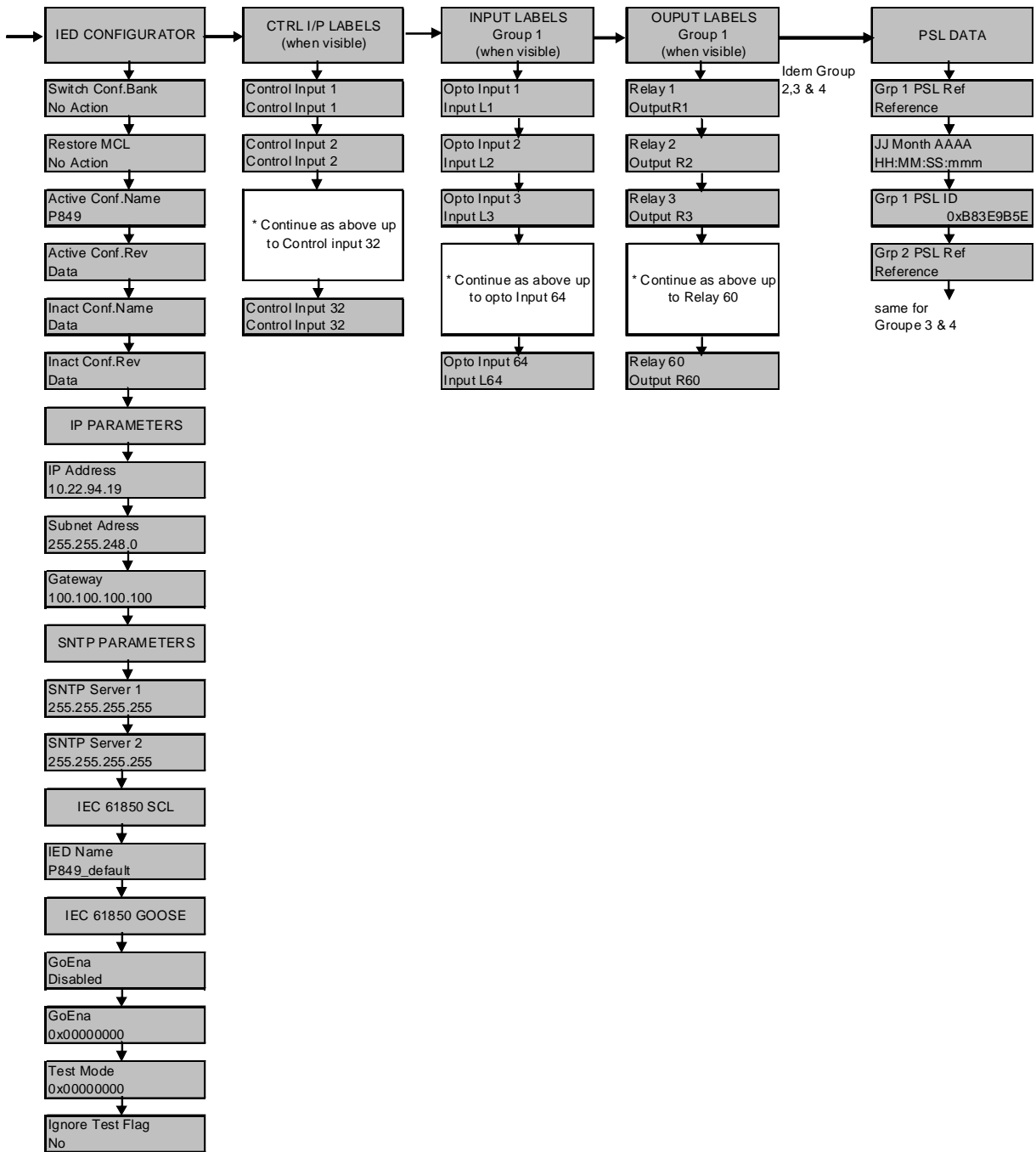
Note: This menu map is annotated with the factory default settings.





GS





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SETTINGS

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

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1. SETTINGS

The MiCOM P849 must be configured to the system and application by means of appropriate settings. The sequence in which the settings are listed and described in this chapter will be the control and configuration settings and the recorder settings (see section P849/EN GS for the detailed menu maps). The device is supplied with a factory-set configuration of default settings.

1.1 Device settings configuration (“System Data column”)

This menu provides information for the device and general status of the device.

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
SYSTEM DATA				
Language	English			
The default language used by the device. Selectable as English, French, German, Russian, Spanish or Chinese.				
Password	AAAA			
Device default password.				
Sys. Fn. Links	0			1
Setting to allow the fixed function trip LED to be self resetting.				
Description	MiCOM P849			
16 character device description. Can be edited.				
Plant Reference	MiCOM			
Associated plant description and can be edited.				
Model Number	P849?????????K			
Device model number. This display cannot be altered.				
Serial Number	6 digits + 1 letter			
Model number. This display cannot be altered.				
Frequency	50 Hz	50 or 60 Hz		
Relay set frequency. Settable between 50 and 60Hz				
Comms Level	2			
Displays the conformance of the device to the Courier Level 2 comms.				
Relay Address	1 or 255*	0	255*	1
First rear port relay address. * depending on protocol				
Control Status	0000000000000000			
Not used.				
Active Group	1			
Displays the active settings group.				
Software Ref. 1				
Software Ref. 2				
Displays the device software version including protocol and device model.				

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
SYSTEM DATA				
Opto I/P Status	00000000000000000000000000000000			
Duplicate. Displays the status of opto-isolated inputs (L1 to L16 or L32).				
Opto I/P Status2	00000000			
Duplicate. Displays the status of opto inputs (L33 to L48 or L64).				
Plant Status	01010101010101			
Displays the circuit breaker plant status for up to 6 circuit breakers (from CB1 to CB6 and Bus CB coupler).				
Rly O/P Status Rly O/P Status2	00000000			
Duplicate. Displays the status of output relays (number of output relays depending on the model)				
Alarm Status 1	00000000000000000000000000000000			
32 bits field give status of first 32 alarms.				
Alarm Status 2	00000000000000000000000000000000			
Next 32 alarm status defined				
Alarm Status 3	00000000000000000000000000000000			
Next 32 alarm status defined. Assigned specifically for platform alarms.				
Access Level				
Displays the current access level (see section P849/EN GS for level description and access): – Level 0 (No password required) = Read access to all settings, alarms, event records records – Level 1 (Password 1 or 2 required) = As level 0 plus: Control commands, e.g. circuit breaker open/close + Reset of alarm conditions + Reset LEDs, Clearing of event and – Level 2 (Password 2 required) = as level 1 plus all other settings				
Password Control	2			
Sets the menu access level for the device. This setting can only be changed when level 2 access is enabled.				
Password Level 1	****			
Allows user to change password level 1.				
Password Level 2	****			
Allows user to change password level 2.				



1.2 Configuration column (“Configuration” menu)

The MiCOM P849 is a device that supports numerous different control and communication features. The settings associated with any function that is disabled are made invisible; i.e. they are not shown in the menu. To disable a function change the relevant cell in the ‘Configuration’ column from ‘Enabled’ to ‘Disabled’.

The configuration column controls which of the four settings groups is selected as active through the ‘Active settings’ cell. A setting group can also be disabled in the configuration column, provided it is not the present active group. Similarly, a disabled setting group cannot be set as the active group.

The column also allows all of the setting values in one group of settings to be copied to another group.

To do this firstly set the ‘Copy from’ cell to the setting group to be copied, then set the ‘copy to’ cell to the group where the copy is to be placed. The copied settings are initially placed in the temporary scratchpad, and will only be used by the device following confirmation.

The aim of the configuration column is to allow general configuration from a single point in the menu. Items that are disabled or made invisible do not appear in the main menu.

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Menu Text	Default Setting	Available Settings
CONFIGURATION		
Restore Defaults	No Operation	No Operation All Settings Setting Group 1 Setting Group 2 Setting Group 3 Setting Group 4
Setting to restore a setting group to factory default settings.		
Setting Group	Select via Menu	Select via Menu Select via PSL
Allows setting group changes to be initiated via Opto Input or via Menu.		
Active Settings	Group 1	Group 1, Group 2, Group 3, Group 4
Selects the active setting group.		
Save Changes	No Operation	No Operation, Save, Abort
Saves all settings.		
Copy from	Group 1	Group 1, 2, 3 or 4
Allows displayed settings to be copied from a selected setting group.		
Copy to	No Operation	No Operation Group 1, 2, 3 or 4
Allows displayed settings to be copied to a selected setting group (ready to paste).		
Setting Group 1	Enabled	Enabled or Disabled
If the setting group is disabled from the configuration, then all associated settings and signals are hidden, with the exception of this setting (paste).		

Menu Text	Default Setting	Available Settings
CONFIGURATION		
Setting Group 2 (as above)	Disabled	Enabled or Disabled
Setting Group 3 (as above)	Disabled	Enabled or Disabled
Setting Group 4 (as above)	Disabled	Enabled or Disabled
Input Labels	Visible	Invisible or Visible
Sets the Input Labels menu visible further on in the settings menu.		
Output Labels	Visible	Invisible or Visible
Sets the Output Labels menu visible further on in the settings menu.		
Record Control	Visible	Invisible or Visible
Sets the Record Control menu visible further on in the settings menu.		
Disturb Recorder	Visible	Invisible or Visible
Sets the "Disturb recorder" menu (Precise events recorder) visible further on in the settings menu.		
Measure't. Set-up	Visible	Invisible or Visible
Sets the Measurement Setup menu visible further on in the settings menu.		
Comms. Settings	Visible	Invisible or Visible
Sets the Communications Settings menu visible further on in the settings menu. These are the settings associated with the 1 st and 2 nd rear communications ports.		
Commission Tests	Visible	Invisible or Visible
Sets the Commissioning Tests menu visible further on in the settings menu.		
Control Inputs	Visible	Invisible or Visible
Activates the Control Input status and operation menu further on in the setting menu.		
Ctrl I/P Config.	Visible	Invisible or Visible
Sets the Control Input Configuration menu visible further on in the setting menu.		
Ctrl I/P Labels	Visible	Invisible or Visible
Sets the Control Input Labels menu visible further on in the setting menu.		
Direct Access	Enabled	Enabled/Disabled/Hotkey only/CB Cntrl. only
Defines what CB control direct access is allowed. Enabled implies control via menu, hotkeys etc.		
InterMiCOM	Disabled	Enabled/Disabled
To enable (activate) or disable (turn off) EIA (RS) 232 InterMiCOM (integrated teleprotection).		
Function Key	Visible	Invisible or Visible
Sets the Function Key menu visible further on in the setting menu.		
RP1 Read Only	Disabled	Enabled or Disabled
Enable Remote Read Only Mode on RP1 courier or IEC60870-5-103 communication protocol.		
RP2 Read Only	Disabled	Enabled or Disabled
Enable Remote Read Only Mode on RP2 courier communication protocol.		

Menu Text	Default Setting	Available Settings
CONFIGURATION		
NIC Read Only	Disabled	Enabled or Disabled
Enable Remote Read Only Mode on the Network Interface card (IEC 61850 tunneled courier).		
LCD Contrast	11	0...31
Sets the LCD contrast.		

1.2.1 Default settings restore

To restore the default values to the settings in any settings group, set the 'restore defaults' cell to the relevant group number. Alternatively it is possible to set the 'restore defaults' cell to 'all settings' to restore the default values to all of the device's settings, not just the groups' settings. The default settings will initially be placed in the scratchpad and will only be used by the device after they have been confirmed. Note that restoring defaults to all settings includes the rear communication port settings, which may result in communication via the rear port being disrupted if the new (default) settings do not match those of the master station.

2. CONTROL AND SUPPORT SETTINGS

The control and support settings are part of the main menu and are used to configure the devices global configuration. It includes submenu settings as below and is discussed in more detail below:

- Function configuration settings,
- Reset LEDs,
- Active setting group,
- Password & language settings,
- Communications settings,
- Record settings,
- User interface settings,
- Commissioning settings.

a) Date and time

Displays the date and time as well as the battery condition.

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
DATE AND TIME				
Date	Data			
Displays the device's current date (front panel).				
Time	Data			
Displays the device's current time (front panel).				
IRIG-B Sync	Disabled	Disabled or Enabled		
Enable IRIG-B time synchronization (with Irig-B option).				
IRIG-B Status	Data	Card not fitted/Card failed/ Signal healthy/No signal		
Displays the status of IRIG-B (with Irig-B option).				
Battery Status	Data			
Displays whether the battery is healthy or not.				
Battery Alarm	Enabled	Disabled or Enabled		
Setting that determines whether an unhealthy device battery condition is alarmed or not.				
SNTP Status	Data	Disabled, Trying Server 1, Trying Server 2, Server 1 OK, Server 2 OK, No response, No valid clock		
For Ethernet option only: Displays information about the SNTP time synchronization status				

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
DATE AND TIME				
LocalTime Enable	Disabled	Disabled/Fixed/Flexible		
<p>Setting to turn on/off local time adjustments.</p> <p>Disabled - No local time zone will be maintained. Time synchronization from any interface will be used to directly set the master clock and all displayed (or read) times on all interfaces will be based on the master clock with no adjustment.</p> <p>Fixed - A local time zone adjustment can be defined using the LocalTime offset setting and all interfaces will use local time except SNTP time synchronization and IEC61850 timestamps.</p> <p>Flexible - A local time zone adjustment can be defined using the LocalTime offset setting and each interface can be assigned to the UTC zone or local time zone with the exception of the local interfaces which will always be in the local time zone and IEC61850/SNTP which will always be in the UTC zone.</p>				
LocalTime Offset	0	-720	720	15
Setting to specify an offset of -12 to +12 hrs in 15 minute intervals for local time zone. This adjustment is applied to the time based on the master clock which is UTC/GMT				
DST Enable	Disabled	Disabled or Enabled		
Setting to turn on/off daylight saving time adjustment to local time.				
DST Offset	60mins	30	60	30min
Setting to specify daylight saving offset which will be used for the time adjustment to local time.				
DST Start	Last	First, Second, Third, Fourth, Last		
Setting to specify the week of the month in which daylight saving time adjustment starts				
DST Start Day	Sunday	Monday, Tuesday, Wednesday, Thursday, Friday, Saturday		
Setting to specify the day of the week in which daylight saving time adjustment starts				
DST Start Month	March	January, February, March, April, May, June, July, August, September, October, November, December		
Setting to specify the month in which daylight saving time adjustment starts				
DST Start Mins	60min	0	1425	15min
Setting to specify the time of day in which daylight saving time adjustment starts. This is set relative to 00:00 hrs on the selected day when time adjustment is to start.				
DST End	Last	First, Second, Third, Fourth, Last		
Setting to specify the week of the month in which daylight saving time adjustment ends.				
DST End Day	Sunday	Monday, Tuesday, Wednesday, Thursday, Friday, Saturday		
Setting to specify the day of the week in which daylight saving time adjustment ends				
DST End Month	October	January, February, March, April, May, June, July, August, September, October, November, December		
Setting to specify the month in which daylight saving time adjustment ends				

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
DATE AND TIME				
DST End Mins	60	0	1425	15min
Setting to specify the time of day in which daylight saving time adjustment ends. This is set relative to 00:00 hrs on the selected day when time adjustment is to end.				
RP1 Time Zone	Local	UTC or Local		
Setting for the rear port 1 interface to specify if time synchronization received will be local or universal time coordinated				
RP2 Time Zone	Local	UTC or Local		
Setting for the rear port 2 interface to specify if time synchronization received will be local or universal time coordinated				
DNPOE Time Zone	Local	UTC or Local		
Setting for the DNP3.0 Over Ethernet interface to specify if time synchronization received will be local or universal time coordinated				
Tunnel Time Zone	Local	UTC or Local		
With Ethernet option only: Setting to specify if time synchronisation received will be local or universal time co-ordinate when 'tunnelling' courier protocol over Ethernet.				

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2.1 Record control

It is possible to disable the reporting of events from all interfaces that supports setting changes. The settings that control the various types of events are in the Record Control column. The effect of setting each to disabled is as follows:

Menu Text	Default Setting	Available Settings
RECORD CONTROL		
Clear Events	No	No or Yes
Selecting "Yes" will cause the existing event log to be cleared and an event will be generated indicating that the events have been erased.		
Clear Maint	No	No or Yes
Selecting "Yes" will cause the existing maintenance records to be erased from the device.		
Alarm Event	Enabled	Enabled or Disabled
Disabling this setting means that all the occurrences that produce an alarm will result in no event being generated.		
Relay O/P Event	Enabled	Enabled or Disabled
Disabling this setting means that no event will be generated for any change in logic input state.		
Opto Input Event	Enabled	Enabled or Disabled
Disabling this setting means that no event will be generated for any change in logic input state.		
General Event	Enabled	Enabled or Disabled
Disabling this setting means that no General Events will be generated		

Menu Text	Default Setting	Available Settings
RECORD CONTROL		
Maint. Rec Event	Enabled	Enabled or Disabled
Disabling this setting means that no event will be generated for any occurrence that produces a maintenance record.		
Clear Dist Recs	No	No or Yes
Selecting "Yes" will cause the existing precise event records to be cleared and an event will be generated indicating that the precise event records have been erased.		
DDB 31 - 0	11111111111111111111111111111111	
Displays the status of DDB signals 0 – 31.		
DDB 2047 - 2016	11111111111111111111111111111111	
Displays the status of DDB signals 2047 – 2016.		

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2.2 Precise event recorder settings ('Disturb. Recorder' column)

The precise event recorder settings include the record duration and trigger position, selection of digital signals to record, and the signal sources that trigger the recording. The precise event recorder column ("Disturb. Recorder" menu) is visible when the "Disturb recorder" setting ("Configuration" column) = "visible".

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
DISTURB. RECORDER				
Duration	1.5 s	0.1 s	10.5 s	10.00 ms
This sets the overall recording time.				
Trigger Position	33.3%	0.0%	100.0%	0.10 %
This sets the trigger point as a percentage of the duration. For example, the default settings show that the overall recording time is set to 1.5s with the trigger point being at 33.3% of this, giving 0.5 s pre-fault and 1.0 s post event recording times.				
Trigger Mode	Single	Single / Extended		
When set to single mode, if a further trigger occurs whilst a recording is taking place, the recorder will ignore the trigger.				
Digital Input 1	Relay 1	Any O/P Contacts or Any Opto Inputs or Internal Digital Signals		
The relay 1 output digital channel is assigned to this channel. The digital channel will trigger the precise event recorder when the corresponding assigned precise event will occur. In this case, the digital recorder will trigger when the output R1 will change. Following lines indicate default signals for the 32 channels.				
Input 1 Trigger	No Trigger	No Trigger, Trigger L/H, Trigger H/L		
This digital channel will not trigger the precise event recorder. When "Trigger L/H" is selected, the channel will trigger the precise event recorder when changing from '0' (low Level) to '1' (High level). If "Trigger H/L" is selected, it will trigger when changing from '1' (high level) to '0' (low level). Following lines give default settings up to channel 32.				

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
DISTURB. RECORDER				
Digital Input 2	Relay 2	As above		
The relay 2 output digital channel is assigned to this channel.				
Input 2 Trigger	No Trigger	No Trigger, Trigger L/H, Trigger H/L		
Digital Input 3	Relay 3	As above		
Input 3 Trigger	No Trigger	No Trigger, Trigger L/H, Trigger H/L		
As above up to 'Digital Input 12' = Relay 12				
Digital Input 12	Relay 12	As above		
Input 12 Trigger	No Trigger	No Trigger, Trigger L/H, Trigger H/L		
Digital Input 13	Opto 1	As above		
Input 13 Trigger	No Trigger	No Trigger, Trigger L/H, Trigger H/L		
Digital Input 14	Opto 2	As above		
Input 14 Trigger	No Trigger	No Trigger, Trigger L/H, Trigger H/L		
As above up to 'Digital Input 24' = Opto 12				
Digital Input 24	Opto 12	As above		
Input 24 Trigger	No Trigger	No Trigger, Trigger L/H, Trigger H/L		
'Digital Input 25' up to 'Digital Input 32', default setting = Unused 'Input 25 Trigger' up to 'Input 32 Trigger', default setting = No Trigger				
Digital Input 32	Unused	As above		
Input 32 Trigger	No Trigger	No Trigger, Trigger L/H, Trigger H/L		

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2.3 Communications

The communications settings are available in the menu 'Communications' column and are displayed when the "Comms Settings" setting ("Configuration" column) = "visible".

2.3.1 Communications settings for courier protocol

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
RP1 Protocol	Courier			
Indicates the communications protocol that will be used on the rear communications port.				
RP1 Address	255	0	255	1
This cell sets the unique address for the device such that only one relay is accessed by master station software.				
RP1 Inactiv Timer	15 mins.	1 mins.	30 mins.	1 min.
This cell controls how long the device will wait without receiving any messages on the rear port before it reverts to its default state, including resetting any password access that was enabled.				

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
Physical Link	Copper	Copper, (RS485), Fibre optic		
This cell defines whether an electrical connection ("Copper" or "RS485" according to software version) or fiber optic connection is being used for communication between the master station and device. The optional fiber optic communications board will be required if 'Fiber optic' is to be selected.				
RP1 Card Status	Data			
This cell indicates the status of the rear communication board.				
RP1 Port Config.	KBus	KBus or EIA(RS)485		
This cell defines whether an electrical KBus or EIA(RS)485 is being used for communication between the master station and device.				
RP1 Comms. Mode	IEC60870 FT1.2	IEC60870 FT1.2 or 10-Bit No Parity		
The choice is either IEC60870 FT1.2 for normal operation with 11-bit modems, or 10-bit no parity.				
RP1 Baud Rate	19200 bits/s	9600 bits/s, 19200 bits/s or 38400 bits/s		
This cell controls the communication speed between device and master station. It is important that both device and master station are set at the same speed setting.				

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2.3.2 Communication settings for IEC60870-5-103

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
RP1 Protocol	IEC60870-5-103			
Indicates the communications protocol that will be used on the rear communications port.				
RP1 Address	1	0	254	1
This cell sets the unique address for the device such that only one device is accessed by master station software.				
RP1 Inactiv Timer	15 mins.	1 mins.	30 mins.	1 min.
This cell controls how long the device will wait without receiving any messages on the rear port before it reverts to its default state, including resetting any password access that was enabled.				
Baud Rate	19200 bits/s	9600 bits/s or 19200 bits/s		
This cell controls the communication speed between device and master station. It is important that both device and master station are set at the same speed setting.				
Measur't period	15s	1s	60s	1s
This cell controls the time interval that the device will use between sending measurement data to the master station.				
Physical Link	RS485	RS485, Fibre optic		
This cell defines whether an electrical connection ("Copper") or fiber optic connection is being used for communication between the master station and device. The optional fiber optic communications board will be required if 'Fiber optic' is to be selected.				

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
CS103 Blocking	Disabled	Disabled, Monitor blocking, Command blocking		
<p>There are three settings associated with this cell:</p> <p>Disabled – No blocking selected.</p> <p>Monitor Blocking – When the monitor blocking DDB Signal is active high, either by energizing an opto input or control input, reading of the status information and precise event records is not permitted. When in this mode the device returns a “termination of general interrogation” message to the master station.</p> <p>Command Blocking – When the command blocking DDB signal is active high, either by energizing an opto input or control input, all remote commands will be ignored (i.e. change setting group etc.). When in this mode the device returns a “negative acknowledgement of command” message to the master station.</p>				
RP1 Card Status	Data			
This cell indicates the status of the rear communication board.				

ST

2.3.3 Communication settings for Modbus protocol

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
RP1 Protocol	Modbus			
Indicates the communications protocol that will be used on the rear communications port.				
RP1 Address	1	1	247	1
This cell sets the unique address for the device such that only one device is accessed by master station software.				
RP1 Inactiv Timer	15 mins.	1 mins.	30 mins.	1 min.
This cell controls how long the device will wait without receiving any messages on the rear port before it reverts to its default state, including resetting any password access that was enabled.				
Baud Rate	19200 bits/s	9600 bits/s, 19200 bits/s or 38400 bits/s		
This cell controls the communication speed between device and master station. It is important that both device and master station are set at the same speed setting.				
RP1 Parity	None	Odd, Even or None		
This cell controls the parity format used in the data frames. It is important that both device and master station are set with the same parity setting.				
RP1 Physical Link	RS485	RS485, Fibre optic		
This cell defines whether an electrical connection (“Copper”) or fiber optic connection is being used for communication between the master station and device. The optional fiber optic communications board will be required if ‘Fiber optic’ is to be selected.				

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
Modbus IEC Time	Disabled	Disabled, Enabled		
<p>This cell allows the user to set the “Modbus IEC Time and Date format” at the user interface and front/2nd port besides the Modbus 1st rear port.</p> <p>When ‘Disabled’ is selected, the “Standard IEC” time format complies with IEC 60870-5-4 requirements such that byte 1 of the information is transmitted first, followed by bytes 2 through 7.</p> <p>When ‘Enabled’ is selected, the transmission of information is reversed (Reverse IEC time format).</p>				
RP1 Card Status	Data			
This cell indicates the status of the rear communication board.				

ST

2.3.4 Communication settings for DNP3.0 protocol

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
RP1 Protocol	DNP3.0			
Indicates the communications protocol that will be used on the rear communications port.				
RP1 Address	1	0	65534	1
This cell sets the unique address for the device such that only one device is accessed by master station software.				
RP1 Baud Rate	19200 bits/s	1200 bit/s, 2400 bits/s, 4800 bits/s, 9600 bits/s, 19200 bits/s or 38400 bits/s		
This cell controls the communication speed between device and master station. It is important that both device and master station are set at the same speed setting.				
RP1 Parity	None	Odd, Even or None		
This cell controls the parity format used in the data frames. It is important that both device and master station are set with the same parity setting.				
RP1 PhysicalLink	RS485	RS485, Fibre optic		
This cell defines whether an electrical connection (“Copper”) or fiber optic connection is being used for communication between the master station and device. The optional fiber optic communications board will be required if ‘Fiber optic’ is to be selected.				
RP1 Time Sync	Disabled	Disabled, Enabled		
This setting enables or disables time synchronization with master Clock.				
RP1 Card Status	Data			
This cell indicates the status of the rear communication board.				
Message Gap (ms)	0	0	50	1
This setting allows the master station to have an interframe gap.				
DNP Need Time	10	1	30	1
Sets the time duration before next time synchronization request from the master.				
DNP App Fragment	2048	100	2048	1
Maximum message length (application fragment size) transmitted by the device.				

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
DNP App Timeout	2	1	120	1
Duration of time waited, after sending a message fragment and awaiting a confirmation from the master.				
DNP SBO Timeout	10s	1s	10s	1s
Duration of time waited (Select Before Operate mode), after receiving a select command and awaiting an operate confirmation from the master.				
DNP Link Timeout	0s	0s	120s	1s
Duration of time that the device will wait for a Data Link Confirm from the master. A value of 0 means data link support disabled and 1 to 120 seconds is the timeout setting.				

ST

2.3.5 Communications for Ethernet port – IEC61850 protocol

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
NIC Protocol	DNP3.0	Courier, IEC60870-5-103, Modbus or DNP 3.0		
The NIC (Network Interface Cards) protocol cell Indicates that IEC 61850 will be used on the rear Ethernet port.				
NIC MAC Address	<i>Ethernet MAC Address</i>			
Indicates the MAC (Media Access Control) address of the rear Ethernet port. This address is formatted as a six-byte hexadecimal number, and is unique.				
NIC Tunl Timeout	5 mins	1 min	30 mins	1 min
Duration of time waited before an inactive tunnel to MiCOM S1 Studio is reset.				
NIC Link Report	Alarm	Alarm, Event, None		
Configures how a failed/unfitted network link (copper or fiber) is reported: Alarm - an alarm is raised for a failed link Event - an event is logged for a failed link None - nothing reported for a failed link				

2.3.5.1 Communications settings for Ethernet port – DNP3.0 Over Ethernet

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
NIC Protocol	DNP3.0			
The NIC (Network Interface Cards) protocol cell Indicates that IEC 61850 will be used on the rear Ethernet port.				

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
IP Address	<i>IP Address</i>			
Indicates the IP (Internet Protocol) address of the rear Ethernet port. This address is formatted as a six-byte hexadecimal number, and is unique.				
Subnet mask	<i>Subnet mask</i>			
Displays the sub-network that the device is connected to.				
NIC MAC Address	<i>Ethernet MAC Address</i>			
Indicates the MAC (Media Access Control) address of the rear Ethernet port. This address is formatted as a six-byte hexadecimal number, and is unique.				
Gateway	<i>Gateway Address</i>			
Displays the IP address of the gateway (proxy) that the device is connected to, if any.				
DNP Time Sync	Disabled	Disabled, Enabled		
If set to 'Enabled', the DNP3.0 master station can be used to synchronize the time on the device. If set to 'Disabled' either the internal free running clock, or IRIG+B input are used.				
NIC Tuntl Timeout	5 mins	1 min	30 mins	1 min
Duration of time waited before an inactive tunnel to MiCOM S1 is reset.				
NIC Link Report	Alarm	Alarm, Event, None		
Configures how a failed/unfitted network link (copper or fiber) is reported: Alarm - an alarm is raised for a failed link Event - an event is logged for a failed link None - nothing reported for a failed link				
SNTP Parameters				
SNTP Server 1	<i>SNTP server 1 Address</i>			
Time synchronization is supported using SNTP (Simple Network Time Protocol); this protocol is used to synchronize the internal real time clock of the device s. This cell displays the IP address of the primary SNTP server.				
SNTP Server 2	<i>SNTP server 21 Address</i>			
Displays the IP address of the secondary SNTP server.				
SNTP Poll rate	64s	64s	1024s	1s
Duration of SNTP poll rate in seconds.				
SNTP Need Time	10 mins	1 min	30 mins	1 min
Sets the time duration before next time synchronization request from the master.				
SNTP App Fragment	2048	100	2048	1
Maximum message length (application fragment size) transmitted by the device.				
SNTP App Timeout	2s	1s	120s	1s
Duration of time waited, after sending a message fragment and awaiting a confirmation from the master.				
SNTP SBO Timeout	10s	1s	10s	1s
Duration of time waited (Select Before Operate mode), after receiving a select command and awaiting an operate confirmation from the master.				

2.3.5.2 Rear port 2 connection settings

The settings shown are those configurable for the second rear port which is only available with the courier protocol.

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
COMMUNICATIONS				
REAR PORT2 (RP2)				
RP2 Protocol	data			
Indicates the communications protocol that will be used on the rear communications port.				
RP2 Card Status.	data			
This cell indicates the status of the rear communication board.				
RP2 Port Config.	EIA RS232	EIA RS232, EIA RS485 or KBus		
This cell defines whether an electrical EIA(RS)232, EIA(RS)485 or KBus is being used for communication.				
RP2 Comms. Mode	IEC60870 FT1.2	IEC60870 FT1.2 or 10-bit		
The choice is either IEC60870 FT1.2 for normal operation with 11-bit modems, or 10-bit no parity.				
RP2 Address	255	0	255	1
This cell sets the unique address for the device such that only one relay is accessed by master station software.				
RP2 Inactivity Timer	15 mins.	1 mins.	30 mins.	1 min.
This cell controls how long the device will wait without receiving any messages on the rear port before it reverts to its default state, including resetting any password access that was enabled.				
RP2 Baud Rate	19200 bits/s	9600 bits/s, 19200 bits/s or 38400 bits/s		
This cell controls the communication speed between device and master station. It is important that both device and master station are set at the same speed setting.				

2.4 Commissioning tests

To help minimising the time required to test MiCOM relays, the device provides several test facilities under the 'COMMISSION TESTS' menu heading.

There are menu cells which allow the status of the opto-isolated inputs, output relay contacts, internal digital data bus (DDB) signals and user-programmable LEDs to be monitored. Additionally there are cells to test the operation of the output contacts, user-programmable LEDs.

This column is visible when the "Commission tests" setting ("Configuration" column) = "visible".

Menu Text	Default Setting	Available Settings
COMMISSION TESTS		
Opto I/P Status	00000000000000000000000000000000	
This menu cell displays the status of the device's opto-isolated inputs (L01 to L32) as a binary string, a '1' indicating an energized opto-isolated input and a '0' a de-energized one		
Opto I/P Status2	00000000000000000000000000000000	
As above for opto-isolated inputs (L33 to L64).		
Relay O/P Status	00000000000000000000000000000000	
This menu cell displays the status of the digital data bus (DDB) signals that result in energization of the output relays (R01 to R32) as a binary string, a '1' indicating an operated state and '0' a non-operated state. When the 'Test Mode' cell is set to 'Enabled' the 'Relay O/P Status' cell does not show the current status of the output relays and hence can not be used to confirm operation of the output relays. Therefore it will be necessary to monitor the state of each contact in turn.		
Relay O/P Status2	00000000000000000000000000000000	
As above for output relays (R33 to R60).		
Test Port Status	00000000	
This menu cell displays the status of the eight digital data bus (DDB) signals that have been allocated in the 'Monitor Bit' cells.		
Monitor Bit 1	Relay Label 01	0 to 2047 See section P849/EN PL for details of digital data bus signals
The eight 'Monitor Bit' cells allow the user to select the status of which digital data bus signals can be observed in the 'Test Port Status' cell or via the monitor/download port.		
Monitor Bit 8	Relay Label 08	0 to 2047
The eight 'Monitor Bit' cells allow the user to select the status of which digital data bus signals can be observed in the 'Test Port Status' cell or via the monitor/download port.		
Test Mode	Disabled	Disabled / Contacts blocked / Test Mode
The Test Mode menu cell enables a facility to directly test the output contacts by applying menu controlled test signals. To select test mode the Test Mode menu cell should be set to 'Contact blocked', which takes the relay out of service. It also causes an alarm condition to be recorded and the yellow 'Out of Service' LED to illuminate and an alarm message 'Out of Service' is given. Once testing is complete the cell must be set back to 'Disabled' to restore the device back to service.		

Menu Text	Default Setting	Available Settings
COMMISSION TESTS		
Test Pattern	0000000000000000	0 = Not Operated 1 = Operated
This cell is used to select the output relay contacts (R01 to R32) that will be tested when the 'Contact Test' cell is set to 'Apply Test'.		
Test Pattern2	00000000	
This cell is used to select the output relay contacts (R33 to R60) that will be tested when the 'Contact Test' cell is set to 'Apply Test'.		
Contact Test	No Operation	No Operation, Apply Test, Remove Test
<p>When the 'Apply Test' command in this cell is issued the contacts set for operation (set to '1') in the 'Test Pattern' cell change state. After the test has been applied the command text on the LCD will change to 'No Operation' and the contacts will remain in the Test State until reset issuing the 'Remove Test' command. The command text on the LCD will again revert to 'No Operation' after the 'Remove Test' command has been issued.</p> <p>Note: When the 'Test Mode' cell is set to 'Enabled' the 'Relay O/P Status' cell does not show the current status of the output relays and hence can not be used to confirm operation of the output relays. Therefore it will be necessary to monitor the state of each contact in turn.</p>		
Test LEDs	No Operation	No Operation Apply Test
When the 'Apply Test' command in this cell is issued the eighteen user-programmable LEDs will illuminate for approximately 2 seconds before they extinguish and the command text on the LCD reverts to 'No Operation'.		
Red LED Status	0000100010000000	
This cell is an eighteen bit binary string that indicates which of the user-programmable LEDs on the device are illuminated with the Red LED input active when accessing the device from a remote location, a '1' indicating a particular LED is lit and a '0' not lit.		
Green LED Status	0000100010000000	
This cell is an eighteen bit binary string that indicates which of the user-programmable LEDs on the device are illuminated with the Green LED input active when accessing the device from a remote location, a '1' indicating a particular LED is lit and a '0' not lit.		
DDB 31 - 0	00000000000000000000000000000000	
Displays the status of DDB signals 0 – 31.		
DDB 2047 - 2016	00000000000000000000000000000000	
Displays the status of DDB signals 2047 – 2016.		



2.5 Opto configuration

This menu is used to set the opto-isolated inputs.

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
OPTO CONFIG.				
Global Nominal V	48/54V	24/27V, 30/34V, 48/54V, 110/125V, 220/250V, Custom		
Sets the nominal battery voltage for all opto inputs by selecting one of the five standard ratings in the Global Nominal V settings. If Custom is selected then each opto input can individually be set to a nominal voltage value.				
Opto input 1 to Opto Input 64	48/54V	24/27V, 30/34V, 48/54V, 110/125V, 220/250V		
Sets the nominal battery voltage for the relevant opto input by selecting one of the five standard ratings in the Global Nominal V settings.				
Opto Filter Ctrl	11111111111111111111111111111111			
This menu is used to control the device's opto-isolated inputs L1 to L32. A '1' indicates an energized and operating device, a '0' indicates a de-energized				
Opto Filter Ctrl2	11111111			
Controls the next device's opto-isolated inputs.				
Characteristics	Standard 60%-80%	50% - 70 % / Standard 60%-80%		
Controls the changement of state of opto-isolated inputs, according to the nominal voltage value.				

2.6 "Control inputs" menu

The control inputs column displays the control inputs status. It can be used to set, or reset individually each control input.

The "CTRL INPUTS" column is visible when the "Commission tests" setting ("Configuration" column) = "visible".

Menu Text	Default Setting	Available Setting
CTRL INPUTS		
Ctrl I/P Status	00000000000000000000000000000000	
Displays the status of the opto-isolated inputs from L1 (last digit) to L32 (first digit): "0" = Reset and "1" = Set. The control inputs can also be set and reset by setting a "1" to set or "0" to reset a control input.		
Control Input 1	No Operation	Set / Reset / No Operation
Sets or resets control input 1.		
Control Input 2 to 32	No Operation	Set / Reset / No Operation
Sets or resets control inputs 2 to 32 individually.		

Menu Text	Default Setting	Setting Range		Step Size
		Min	Max	
INTERMICOM COMMS				
Source Address	1	1	10	1
Received Address	2	1	10	1
The “source” and “receive” addresses are used to synchronize remote and local devices. Both relays must be programmed with a unique pair of addresses that correspond with each other in the “Source Address” and “Receive Address” cells				
Baud Rate	9600	600 / 1200 / 2400 / 4800 / 9600 / 19200		
This cell controls the communication speed between device and master station. It is important that both device and master station are set at the same speed setting.				
Ch Statistics	Invisible	Invisible / Visible		
Activates or hides the channel statistics. When visible is selected, the following menus are displayed. Otherwise, next menu is “Ch Diagnostics”.				
Rx Direct count	Data			
Number of Permissive messages received with the correct message structure.				
Rx Perm Count	Data			
Number of Blocking messages received with the correct message structure.				
Rx Block Count	Data			
Number of Blocking messages received with the correct message structure.				
Rx NewdataCount	Data			
Number of different messages received.				
Rx ErroredCount	Data			
Number of incomplete or incorrectly formatted messages received.				
Lost Messages	Data			
Number of messages lost within the previous time period set in “Alarm Window” cell.				
Elapsed Time	Data			
Time in seconds since the InterMiCOM channel statistics were reset.				
Reset Statistics	No	No / Yes		
Reset channel statistics command.				
Ch Diagnostics	Invisible	Invisible / Visible		
Activates or hides the channel diagnostics. When visible is selected, the following menus are displayed. Otherwise, next menu is “loopback mode”.				
Data CD Status	OK / Fail / Card Not Fitted / Unavailable			
Indicates when the “Data Carrier Detect” (DCD) line (pin 1) is energised. OK = DCD is energised, FAIL = DCD is de-energised, Absent = InterMiCOM board is not fitted, Unavailable = hardware error present				
FrameSyncStatus	OK / Fail / Card Not Fitted / Unavailable			
Indicates when the message structure and synchronisation is valid. OK = valid message structure and synchronisation ,FAIL = synchronisation has been lost, Card Not Fitted = InterMiCOM board is not fitted, Unavailable = hardware error present				

Menu Text	Default Setting	Setting Range		Step Size
		Min	Max	
INTERMICOM COMMS				
Message Status	OK / Fail / Card Not Fitted / Unavailable			
Indicates when the percentage of received valid messages has fallen below the "IM Msg Alarm Lvl" setting within the alarm time period. OK = acceptable ratio of lost messages, FAIL = unacceptable ratio of lost messages, Card Not Fitted = InterMiCOM board is not fitted, Unavailable = hardware error present				
Channel Status	OK / Fail / Card Not Fitted / Unavailable			
Indicates the state of the InterMiCOM communication channel OK = channel healthy, FAIL = channel failure, Card Not Fitted = InterMiCOM board is not fitted, Unavailable = hardware error present				
IM H/W Status	OK / Fail / Card Not Fitted / Unavailable			
Indicates the state of the InterMiCOM hardware OK = InterMiCOM hardware healthy, Read Error = InterMiCOM hardware failure, Write Error = InterMiCOM hardware failure, Card Not Fitted = InterMiCOM board is either not fitted or failed to initialise				
Loopback Mode	Disabled	Disabled / Internal / External		
By selecting "Loopback Mode" to "Internal", only the internal software of the device is checked whereas "External" will check both the software and hardware used by InterMiCOM (In the latter case, it is necessary to connect the transmit and receive pins together and ensure that the DCD signal is held high).				
Test pattern	11111111	00000000	11111111	-
A test pattern can be entered which is then transmitted through the software and/or hardware.				
Loopback Status	OK / Fail / Card Not Fitted / Unavailable			
Providing all connections are correct and the software is working correctly, the "Loopback Status" cell will display "OK". An unsuccessful test would be indicated by "FAIL", whereas a hardware error will be indicated by "UNAVAILABLE".				

2.8.2 InterMiCOM configuration

The "INTERMICOM CONF" column selects the format of each signal and its fallback operation mode.

InterMiCOM provides 8 commands over a single communications link, with the mode of operation of each command being individually selectable within the "IM# Cmd Type" cell (# = 1 to 8).

Menu Text	Default Setting	Setting Range		Step Size
		Min	Max	
INTERMICOM CONF				
IM Msg Alarm Lvl	25%	0%	100%	1%
The "IM "Msg Alam Lvl" sets the level of invalid messages received compared to the total number of messages that should have been received. If this value exceeds the selected level, an alarm will be raised.				

Menu Text	Default Setting	Setting Range		Step Size
		Min	Max	
INTERMICOM CONF				
IM1 Cmd Type	Blocking	Disabled/ Blocking/ Direct		
<p>“Blocking” mode provides the fastest signalling speed (available on commands 1 – 4), “Direct Intertrip” mode provides the most secure signalling (available on commands 1 – 8) and “Permissive” mode provides the most dependable signalling (available on commands 5 – 8).</p> <p>Each command can be disabled so that it has no effect in the logic of the device.</p>				
IM1 Fallback Mode	Default	Default/ Latched		
<p>Visible if “IM1 Cmd type” ≠ “Disabled”</p> <p>When “Latched”, during periods of extreme where the synchronization of a message structure is lost or is cannot be decoded, the last good command can be maintained until a new valid message is received</p> <p>When “Default”: if the synchronisation is lost, after a time period, a known fallback state can be assigned to the command.</p> <p>In this latter case, the time period will need to be set in the “IM# FrameSynTim” cell and the default value will need to be set in “IM# DefaultValue” cell. As soon as a full valid message is seen by the device all the timer periods are reset and the new valid command states are used. An alarm is provided if the noise on the channel becomes excessive</p>				
IM1 DefaultValue	0	0	1	1
<p>Visible if “IM1 Fallback Mode” = “Default”</p> <p>Sets the default value to assign to the command after a time period.</p>				
IM1 FrameSynTim	1.5s	10ms	1500ms	10ms
<p>Visible if “IM1 Fallback Mode” = “Default”</p> <p>Sets the time period to assign the known default value to the device.</p>				
<i>IM2 to IM4</i>	<i>(Cells as for IM1 above)</i>			
IM5 Cmd Type	Direct	Disabled/ Permissive/ Direct		
IM5 Fallback Mode	Default	Default/ Latched		
IM5 DefaultValue	0	0	1	1
IM5 FrameSynTim	1.5s	10ms	1500ms	10ms
<i>IM6 to IM8</i>	<i>(Cells as for IM5 above)</i>			
<p>As IM1 Cmd Type.</p> <p>Note: Setting choices are different from IM2 to IM8 (see IM1 Cmd type).</p> <p>When Cmd Type is enabled, Fallback Mode is enabled.</p> <p>Default values and frameSync type are settable when fallback mode selection is “latched”.</p>				

2.9 Programmable function keys and tricolour LEDs (“Function keys” menu)

The lock setting allows a function key output that is set to toggle mode to be locked in its current active state. In toggle mode a single key press will set/latch the function key output as high or low in programmable scheme logic. This feature can be used to enable/disable device functions. In the normal mode the function key output will remain high as long as the key is pressed. The Fn. Key label allows the text of the function key to be changed to something more suitable for the application.

The “Function keys” column is visible when the “Function key” setting (“Configuration” column) = “visible”.

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
FUNCTION KEYS				
Fn. Key Status	0000000000			
Displays the status of each function key.				
Fn. Key 1	Unlocked	Disabled, Locked, Unlock		
Setting to activate function key. The 'Lock' setting allows a function key output that is set to toggle mode to be locked in its current active state.				
Fn. Key 1 Mode	Toggled	Toggled, Normal		
Sets the function key in toggle or normal mode. In 'Toggle' mode, a single key press will set/latch the function key output as 'high' or 'low' in programmable scheme logic. This feature can be used to enable/disable device functions. In the 'Normal' mode the function key output will remain 'high' as long as key is pressed.				
Fn. Key 1 Label	Function Key 1			
Allows the text of the function key to be changed to something more suitable for the application.				
Fn. Key 2 to 10	Unlocked	Disabled, Locked, Unlock		
Setting to activate function key. The 'Lock' setting allows a function key output that is set to toggle mode to be locked in its current active position.				
Fn. Key 2 to 10 Mode	Normal	Toggled, Normal		
Sets the function key in toggle or normal mode. In 'Toggle' mode, a single key press will set/latch the function key output as 'high' or 'low' in programmable scheme logic. This feature can be used to enable/disable device functions. In the 'Normal' mode the function key output will remain 'high' as long as key is pressed.				
Fn. Key 2 to 10 Label	Function Key 2 to 10			
Allows the text of the function key to be changed to something more suitable for the application.				

2.10 “IED Configurator” column

The contents of the IED CONFIGURATOR column (for IEC 61850 configuration) are mostly data cells, displayed for information but not editable. In order to edit the configuration, it is necessary to use the IED (Intelligent Electronic Device) configurator tool within MiCOM S1.

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
IED CONFIGURATOR				
Switch Conf.Bank	No Action	No Action, Switch Banks		
Setting which allows the user to switch between the current configuration, held in the Active Memory Bank (and partly displayed below), to the configuration sent to and held in the Inactive Memory Bank.				
Restore MCL	No action	No action / Restore MCL		
Used to restore data from MCL binary file. MCL (MiCOM Configuration Language) files are specific, containing a single devices IEC61850 configuration information, and used for transferring data to/from the MiCOM IED.				
Active Conf.Name	Data			
The name of the configuration in the Active Memory Bank, usually taken from the SCL file.				

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Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
IED CONFIGURATOR				
Active Conf.Rev	Data			
Configuration Revision number of the Active Memory Bank, used for version management.				
Inact.Conf.Name	Data			
The name of the configuration in the Inactive Memory Bank, usually taken from the SCL file.				
Inact.Conf.Rev	Data			
Configuration Revision number of the Inactive Memory Bank, used for version management.				
IP PARAMETERS				
IP Address	Data			
Displays the unique network IP address that identifies the device.				
Subnet Mask	Data			
Displays the sub-network that the device is connected to.				
Gateway	Data			
Displays the IP address of the gateway (proxy) that the device is connected to.				
SNTP PARAMETERS				
SNTP Server 1	Data			
Displays the IP address of the primary SNTP server.				
SNTP Server 2	Data			
Displays the IP address of the secondary SNTP server.				
IEC61850 SCL				
IED Name	Data			
8 character IED name, which is the unique name on the IEC 61850 network for the IED, usually taken from the SCL (Substation Configuration Language for XML) file.				
IEC61850 GOOSE				
GoEna	00000000	00000000	11111111	1
GoEna (GOOSE ENABLE) is a setting to enable GOOSE (Generic Object Orientated Substation Event, for high-speed inter-device messaging) publisher settings. This setting enables ("1") or disables ("0") GOOSE control blocks from 08 (1 st digit) to 01 (last digit).				
Test Mode	00000000	00000000	11111111	1
The Test Mode cell allows the test pattern to be sent in the GOOSE message, for example for testing or commissioning. The setting enables ("1") or disables ("0") test mode for GOOSE control block from 08 (1 st digit) to 01 (last digit). Once testing is complete the cell must be set back to 'Disabled' to restore the GOOSE scheme back to normal service.				
Ignore Test Flag	No	No, Yes		
When set to 'Yes', the test flag in the subscribed GOOSE message is ignored, and the data treated as normal.				

2.11 Control input labels

The “CTRL I/P Labels” column is visible when the “Control I/P Labels” setting (“Configuration” column) = “visible”.

Menu Text	Default Setting	Setting Range	Step Size
CTRL I/P LABELS			
Control Input 1	Control Input 1	16 Character Text	
Setting to change the text associated with each individual control input. This text will be displayed when a control input is accessed by the hotkey menu, or it can be displayed in the programmable scheme logic.			
Control Input 2 to 32	Control Input 2 to 32	16 Character Text	
Setting to change the text associated with each individual control input. This text will be displayed when a control input is accessed by the hotkey menu, or it can be displayed in the programmable scheme logic.			

2.12 Input Labels

The “Input Labels” column is visible when the “Input Labels” setting (“Configuration” column) = “visible”.

Menu Text	Default Setting	Setting Range	Step Size
INPUT LABELS			
Opto Input 1	Input L1	16 Character Text	
Setting to change the text associated with the first opto-isolated input. This text will be displayed in the programmable scheme logic and event record description of the opto-isolated input.			
Opto Input 2 to 64*	Input L2 to L64	16 Character Text	
Setting to change the text associated with each individual opto-isolated input. This text will be displayed in the programmable scheme logic and event record description of the opto-isolated input.			

2.13 Output labels

The “Output Labels” column is visible when the “Output Labels” setting (“Configuration” column) = “visible”.

Menu Text	Default Setting	Setting Range	Step Size
OUTPUT LABELS			
Relay 1	Output R1	16 Character Text	
Setting to change the text associated with each individual control input. This text will be displayed in the programmable scheme logic and event record description of the device output contact			
Relay 2 to 60	Output R3 to R60	16 Character Text	
Setting to change the text associated with each individual control input. This text will be displayed in the programmable scheme logic and event record description of the device output contact			

OPERATION

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

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1. OPERATION OF FUNCTIONS

1.1 Programmable scheme logic

1.1.1 Level settings

Name	Range	Step Size
Time delay t	0-14400000ms	1ms

1.1.2 Accuracy

Output conditioner timer	Setting $\pm 2\%$ or 50ms whichever is greater
Dwell conditioner timer	Setting $\pm 2\%$ or 50ms whichever is greater
Pulse conditioner timer	Setting $\pm 2\%$ or 50ms whichever is greater

1.2 IRIG-B signal only

If a satellite time clock signal conforming to IRIG-B is provided and the relay has the optional IRIG-B port fitted, the satellite clock equipment should be energised.

In the event of the auxiliary supply failing, with a battery fitted in the compartment behind the bottom access cover, the time and date will be maintained. Therefore, when the auxiliary supply is restored, the time and date will be correct and not need to be set again.

OP

1.3 Trip LED logic

The trip LED can be reset when the flags for the last record are displayed or via dedicated ddb's. The flags are displayed automatically after a trip (from an external relay) occurs, or can be selected in the standard event record menu. The reset of trip LED and the records is performed by pressing the \odot key once the fault record has been read.

1.4 Function keys

The MiCOM P849 relay offers users 10 function keys for programming any operator control functionality via PSL. Each function key has an associated programmable tri-colour LED that can be programmed to give the desired indication on function key activation.

These function keys can be used to trigger any function that they are connected to as part of the PSL. The function key commands can be found in the 'Function Keys' menu (see Settings section, P849/EN ST). In the 'Fn. Key Status' menu cell there is a 10 bit word which represent the 10 function key commands and their status can be read from this 10 bit word.

In the programmable scheme logic editor 10 function key signals, which can be set to a logic 1 or On state, as described above, are available to perform control functions defined by the user.

The "Function Keys" column has 'Fn. Key n Mode' cell which allows the user to configure the function key as either 'Toggled' or 'Normal'. In the 'Toggle' mode the function key DDB signal output will remain in the set state until a reset command is given, by activating the function key on the next key press. In the 'Normal' mode, the function key DDB signal will remain energized for as long as the function key is pressed and will then reset automatically. A minimum pulse duration can be programmed for a function key by adding a minimum pulse timer to the function key DDB output signal.

The "Fn. Key n Status" cell is used to enable/unlock or disable the function key signals in PSL. The 'Lock' setting has been specifically provided to allow the locking of a function key thus preventing further activation of the key on consequent key presses. This allows function keys that are set to 'Toggled' mode and their DDB signal active 'high', to be locked in their active state thus preventing any further key presses from deactivating the associated function. Locking a function key that is set to the "Normal" mode causes the associated DDB signals to be permanently off. This safety feature prevents any inadvertent function key presses from activating or deactivating critical relay functions.

The “Fn. Key Labels” cell makes it possible to change the text associated with each individual function key. This text will be displayed when a function key is accessed in the function key menu, or it can be displayed in the PSL.

The status of the function keys is stored in battery backed memory. In the event that the auxiliary supply is interrupted the status of all the function keys will be recorded. Following the restoration of the auxiliary supply the status of the function keys, prior to supply failure, will be reinstated. If the battery is missing or flat the function key DDB signals will set to logic 0 once the auxiliary supply is restored. Please also note the relay will only recognize a single function key press at a time and that a minimum key press duration of approximately 200msec. is required before the key press is recognized in PSL. This deglitching feature avoids accidental double presses.

1.5 Setting groups selection

The setting groups can be changed either via opto inputs, via a menu selection, via the hotkey menu or via function keys. In the Configuration column if 'Setting Group - select via optos' is selected then any opto input or function key can be programmed in PSL to select the setting group as shown in the table below. If 'Setting Group - select via menu' is selected then in the Configuration column the 'Active Settings - Group1/2/3/4' can be used to select the setting group.

The setting group can be changed via the hotkey menu providing 'Setting Group select via menu' is chosen.

Two DDB signals are available in PSL for selecting a setting group via an opto input or function key selection. The following table illustrates the setting group that is active on activation of the relevant DDB signals.

DDB 1122 'SG Select x1'	DDB 1123 'SG Select 1x'	Selected setting group
0	0	1
1	0	2
0	1	3
1	1	4

1.6 Control inputs

The control inputs function as software switches that can be set or reset either locally or remotely. These inputs can be used to trigger any function that they are connected to as part of the PSL. There are three setting columns associated with the control inputs that are: “CONTROL INPUTS”, “CTRL. I/P CONFIG.” and “CTRL. I/P LABELS”. The function of these columns is described below:

Menu Text	Default Setting	Setting Range	Step Size
CONTROL INPUTS			
Ctrl I/P Status	00000000000000000000000000000000		
Control Input 1	No Operation	No Operation, Set, Reset	
Control Input 2 to 32	No Operation	No Operation, Set, Reset	

The Control Input commands can be found in the 'Control Input' menu. In the 'Ctrl. I/P status' menu cell there is a 32 bit word which represent the 32 control input commands. The status of the 32 control inputs can be read from this 32-bit word. The 32 control inputs can also be set and reset from this cell by setting a 1 to set or 0 to reset a particular control input. Alternatively, each of the 32 Control Inputs can be set and reset using the individual menu setting cells 'Control Input 1, 2, 3' etc. The Control Inputs are available through the relay menu as described above and also via the rear communications.

In the programmable scheme logic editor 32 Control Input signals, DDB 800 – 831, which can be set to a logic 1 or On state, as described above, are available to perform control functions defined by the user.



Menu Text	Default Setting	Setting Range	Step Size
CTRL. I/P CONFIG.			
Hotkey Enabled	11111111111111111111111111111111		
Control Input 1	Latched	Latched, Pulsed	
Ctrl Command 1	SET/RESET	SET/RESET, IN/OUT, ENABLED/DISABLED, ON/OFF	
Control Input 2 to 32	Latched	Latched, Pulsed	
Ctrl Command 2 to 32	SET/RESET	SET/RESET, IN/OUT, ENABLED/DISABLED, ON/OFF	
Menu Text	Default Setting	Setting Range	Step Size
CTRL. I/P LABELS			
Control Input 1	Control Input 1	16 character text	
Control Input 2 to 32	Control Input 2 to 32	16 character text	



The “CTRL. I/P CONFIG.” column has several functions one of which allows the user to configure the control inputs as either ‘latched’ or ‘pulsed’. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energized for 10ms after the set command is given and will then reset automatically (i.e. no reset command required).

In addition to the latched/pulsed option this column also allows the control inputs to be individually assigned to the “Hotkey” menu by setting ‘1’ in the appropriate bit in the “Hotkey Enabled” cell. The hotkey menu allows the control inputs to be set, reset or pulsed without the need to enter the “CONTROL INPUTS” column. The “Ctrl. Command” cell also allows the SET/RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as “ON/OFF”, “IN/OUT” etc.

The “CTRL. I/P LABELS” column makes it possible to change the text associated with each individual control input. This text will be displayed when a control input is accessed by the hotkey menu, or it can be displayed in the PSL.

Note: With the exception of pulsed operation, the status of the control inputs is stored in battery backed memory. In the event that the auxiliary supply is interrupted the status of all the inputs will be recorded. Following the restoration of the auxiliary supply the status of the control inputs, prior to supply failure, will be reinstated. If the battery is missing or flat the control inputs will set to logic 0 once the auxiliary supply is restored.

1.7 Real time clock synchronization via opto-inputs

In modern protective schemes it is often desirable to synchronize the relays real time clock so that events from different relays can be placed in chronological order. This can be done using the IRIG-B input, if fitted, or via the communication interface connected to the substation control system. In addition to these methods the Px4x range offers the facility to synchronize via an opto-input by routing it in PSL to DDB 1131 ('Time Sync.'). Pulsing this input will result in the real time clock snapping to the nearest minute. The recommended pulse duration is 20ms to be repeated no more than once per minute. An example of the time sync. function is shown.

Time of “Sync.	Pulse” Corrected Time
19:47:00 to 19:47:29	19:47:00
19:47:30 to 19:47:59	19:48:00

Note: The above assumes a time format of hh:mm:ss

To avoid the event buffer from being filled with unnecessary time sync. events, it is possible to ignore any event that is generated by the time sync. opto input. This can be done by applying the following settings:

Menu Text	Value
RECORD CONTROL	
Opto Input Event	Enabled
DDB 63 – 32 (Opto Inputs)	Set " Time Sync. " associated opto to 0

To improve the recognition time of the time sync. opto input by approximately 10ms, the opto input filtering could be disabled. This is achieved by setting the appropriate bit to 0 in the "**Opto Filter Cntl.**" cell (OPTO CONFIG. column). Disabling the filtering may make the opto input more susceptible to induced noise. Fortunately the effects of induced noise can be minimized by using the methods described in section "Universal opto isolated logic inputs" of Firmware Design (P849/EN FD) section.

1.8 Enhanced opto time stamping

Each opto-input sample are time stamped with respect to the relay's Real Time Clock. These time stamps are utilized for the opto event logs and for the Precise event recorder. The relay needs to be synchronized accurately to an external clock source such as the GPS clock and the synchronization shall consist of IRIG-B and SNTP through Ethernet communication.

For both the filtered and unfiltered opto inputs, the time stamp of an opto change event is the sampling time at which the opto change of state has occurred. If a mixture of filtered and unfiltered optos changes state at the same sampling interval, these state changes is reported as a single event. The enhanced opto event time stamping is consistent across all the implemented protocols. The GOOSE messages is published in a timely manner and is not delayed by any event filtering mechanisms that is used to align the event time stamps.

1.9 InterMiCOM Teleprotection

InterMiCOM is a protection signalling system that is an optional feature of MiCOM Px40 relays and provides a cost-effective alternative to discrete carrier equipment. InterMiCOM sends eight signals between the two relays in the scheme, with each signal having a selectable operation mode to provide an optimal combination of speed, security and dependability in accordance with the application. Once the information is received, it may be assigned in the Programmable Scheme Logic to any function as specified by the user's application.

1.9.1 Protection Signalling

In order to achieve fast fault clearance and correct discrimination for faults anywhere within a high voltage power network, it is necessary to signal between the points at which protection relays are connected. Two distinct types of protection signalling can be identified:

1.9.1.1 Communications Media

InterMiCOM is capable of transferring up to 8 commands over one communication channel. Due to recent expansions in communication networks, most signalling channels are now digital schemes utilising multiplexed fibre optics and for this reason, InterMiCOM provides a standard EIA(RS)232 output using digital signalling techniques. This digital signal can then be converted using suitable devices to any communications media as required.

Note: The MiCOM P849 devices only use electrical connections (EIA(RS)232, port SK5)

The EIA(RS)232 output may alternatively be connected to a MODEM link.

Regardless of whether analogue or digital systems are being used, all the requirements of teleprotection commands are governed by an international standard IEC60834-1:1999 and InterMiCOM is compliant with the essential requirements of this standard. This standard governs the speed requirements of the commands as well as the probability of unwanted commands being received (security) and the probability of missing commands (dependability).

1.9.1.2 General Features & Implementation

InterMiCOM provides 8 commands over a single communications link, with the mode of operation of each command being individually selectable within the “IM# Cmd Type” cell. “Blocking” mode provides the fastest signalling speed (available on commands 1 – 4), “Direct Intertrip” mode provides the most secure signalling (available on commands 1 – 8) and “Permissive” mode provides the most dependable signalling (available on commands 5 – 8). Each command can also be disabled so that it has no effect in the logic of the relay.

Since many applications will involve the commands being sent over a multiplexed communications channel, it is necessary to ensure that only data from the correct relay is used. Both relays in the scheme must be programmed with a unique pair of addresses that correspond with each other in the “Source Address” and “Receive Address” cells. For example, at the local end relay if we set the “Source Address” to 1, the “Receive Address” at the remote end relay must also be set to 1. Similarly, if the remote end relay has a “Source Address” set to 2, the “Receive Address” at the local end must also be set to 2. All four addresses must not be set identical in any given relay scheme if the possibility of incorrect signalling is to be avoided.

It must be ensured that the presence of noise in the communications channel isn't interpreted as valid messages by the relay. For this reason, InterMiCOM uses a combination of unique pair addressing described above, basic signal format checking and for “Direct Intertrip” commands an 8-bit Cyclic Redundancy Check (CRC) is also performed. This CRC calculation is performed at both the sending and receiving end relay for each message and then compared in order to maximise the security of the “Direct Intertrip” commands.

Most of the time the communications will perform adequately and the presence of the various checking algorithms in the message structure will ensure that InterMiCOM signals are processed correctly. However, careful consideration is also required for the periods of extreme noise pollution or the unlikely situation of total communications failure and how the relay should react.

During periods of extreme noise, it is possible that the synchronization of the message structure will be lost and it may become impossible to decode the full message accurately. During this noisy period, the last good command can be maintained until a new valid message is received by setting the “IM# FallBackMode” cell to “Latched”. Alternatively, if the synchronisation is lost for a period of time, a known fallback state can be assigned to the command by setting the “IM# FallBackMode” cell to “Default”. In this latter case, the time period will need to be set in the “IM# FrameSynTim” cell and the default value will need to be set in “IM# DefaultValue” cell. As soon as a full valid message is seen by the relay all the timer periods are reset and the new valid command states are used. An alarm is provided if the noise on the channel becomes excessive.

When there is a total communications failure, the relay will use the fallback (failsafe) strategy as described above. Total failure of the channel is considered when no message data is received for four power system cycles or if there is a loss of the DCD line.

1.9.1.3 Physical Connections

InterMiCOM on the Px40 relays is implemented using a 9-pin ‘D’ type female connector (labelled SK5) located at the bottom of the second Rear communication board. This connector on the Px40 relay is wired in DTE (Data Terminating Equipment) mode, as indicated below:

Pin	Acronym	InterMiCOM Usage
1	DCD	“Data Carrier Detect” is only used when connecting to modems otherwise this should be tied high by connecting to terminal 4.
2	RxD	“Receive Data”
3	TxD	“Transmit Data”
4	DTR	“Data Terminal Ready” is permanently tied high by the hardware since InterMiCOM requires a permanently open communication channel.
5	GND	“Signal Ground”
6	Not used	-

Pin	Acronym	InterMiCOM Usage
7	RTS	"Ready To Send" is permanently tied high by the hardware since InterMiCOM requires a permanently open communication channel.
8	Not used	-
9	Not used	-

Figure 1: table 1: InterMiCOM D9 port pin-out connections

Depending upon whether a direct or modem connection between the two relays in the scheme is being used, the required pin connections are described below.

1.9.1.4 Direct Connection

The EIA(RS)232 protocol only allows for short transmission distances due to the signalling levels used and therefore the connection shown below is limited to less than 15m. However, this may be extended by introducing suitable EIA(RS)232 to fiber optic convertors, such as the CILI 204. Depending upon the type of convertor and fiber used, direct communication over a few kilometres can easily be achieved.

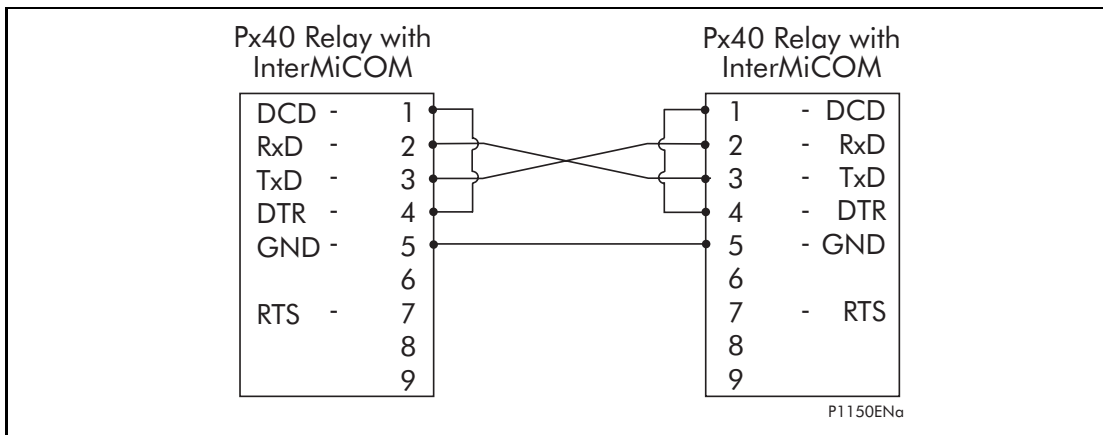


Figure 2: Direct connection within the local substation

This type of connection should also be used when connecting to multiplexers which have no ability to control the DCD line.

1.9.1.5 Modem Connection

For long distance communication, modems may be used in which the case the following connections should be made.

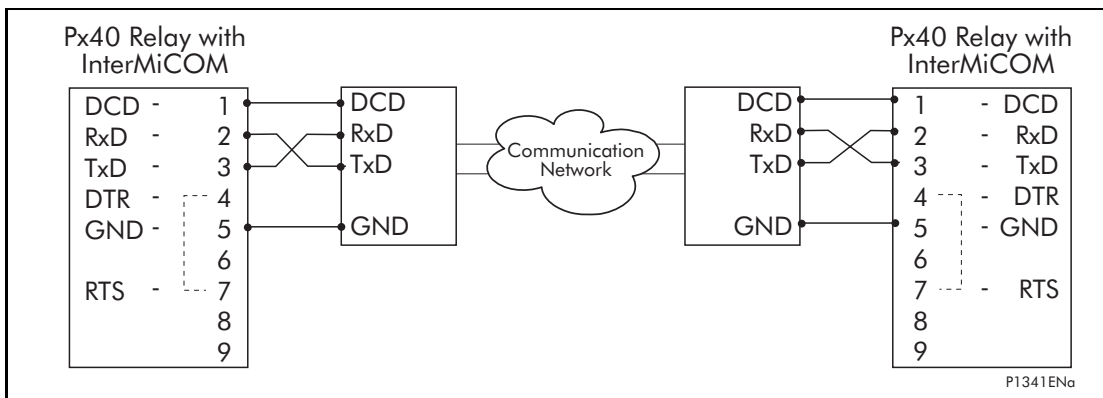


Figure 3: InterMiCOM teleprotection via a MODEM link

This type of connection should also be used when connecting to multiplexers which have the ability to control the DCD line.

With this type of connection it should be noted that the maximum distance between the Px40 relay and the modem should be 15m, and that a baud rate suitable for the communications path used should be selected.

1.9.2 Functional Assignment

Even though settings are made on the relay to control the mode of the intertrip signals, it is necessary to assign interMiCOM input and output signals in the relay Programmable Scheme Logic (PSL) if InterMiCOM is to be successfully implemented.

It should be noted that when an InterMiCOM signal is sent from the local relay, only the remote end relay will react to this command. The local end relay will only react to InterMiCOM commands initiated at the remote end.

1.9.3 InterMiCOM Settings

The settings necessary for the implementation of InterMiCOM are contained within two columns of the relay menu structure. The first column entitled "INTERMICOM COMMS" contains all the information to configure the communication channel and also contains the channel statistics and diagnostic facilities. The second column entitled "INTERMICOM CONF" selects the format of each signal and its fallback operation mode. The following tables show the relay menus including the available setting ranges and factory defaults.

Once the relay operation has been confirmed using the loopback test facilities, it will be necessary to ensure that the communications between the two relays in the scheme are reliable. To facilitate this, a list of channel statistics and diagnostics are available in the InterMiCOM COMMS column:

1.9.3.1 Setting Guidelines

The settings required for the InterMiCOM signalling are largely dependant upon whether a direct or indirect (modem/multiplexed) connection between the scheme ends is used.

Direct connections will either be short metallic based and hence can be set to have the highest signalling speed of 19200b/s. Due to this high signalling rate, the difference in operating speed between the direct, permissive and blocking type signals is so small that the most secure signalling (direct intertrip) can be selected without any significant loss of speed. In turn, since the direct intertrip signalling requires the full checking of the message frame structure and CRC checks, it would seem prudent that the "IM# Fallback Mode" be set to "Default" with a minimal intentional delay by setting "IM# FrameSyncTim" to 10msecs. In other words, whenever two consecutive messages have an invalid structure, the relay will immediately revert to the default value until a new valid message is received.

For indirect connections, the settings that should be applied will become more application and communication media dependent. As for the direct connections, it may be appealing to consider only the fastest baud rate but this will usually increase the cost of the necessary modem/multiplexer.

In addition, devices operating at these high baud rates may suffer from "data jams" during periods of interference and in the event of communication interruptions, may require longer re-synchronization periods.

Both of these factors will reduce the effective communication speed thereby leading to a recommended baud rate setting of 9600b/s. It should be noted that as the baud rate decreases, the communications become more robust with fewer interruptions, but that overall signalling times will increase.

Since it is likely that slower baud rates will be selected, the choice of signalling mode becomes significant. However, once the signalling mode has been chosen it is necessary to consider what should happen during periods of noise when message structure and content can be lost.

If "Blocking" mode is selected, only a small amount of the total message is actually used to provide the signal, which means that in a noisy environment there is still a good likelihood of receiving a valid message. In this case, it is recommended that the "IM# Fallback Mode" is set to "Default" with a reasonably long "IM# FrameSyncTim".

If "Direct Intertrip" mode is selected, the whole message structure must be valid and checked to provide the signal, which means that in a very noisy environment the chances of receiving a valid message are quite small. In this case, it is recommended that the "IM# Fallback

Mode” is set to “Default” with a minimum “IM# FrameSyncTim” setting i.e. whenever a non-valid message is received, InterMiCOM will use the set default value.

If “Permissive” mode is selected, the chances of receiving a valid message is between that of the “Blocking” and “Direct Intertrip” modes. In this case, it is possible that the “IM# Fallback Mode” is set to “Latched”. The table below highlights the recommended “IM# FrameSyncTim” settings for the different signalling modes and baud rates:

Baud Rate	Minimum Recommended “IM# FrameSyncTim” Setting		Minimum Setting	Maximum Setting
	Direct Intertrip Mode	Blocking Mode		
600	100	250	100	1500
1200	50	130	50	1500
2400	30	70	30	1500
4800	20	40	20	1500
9600	10	20	10	1500
19200	10	10	10	1500

Table 2: Recommended Frame Synchronism Time settings

NOTA: No recommended setting is given for the Permissive mode since it is anticipated that “Latched” operation will be selected. However, if “Default mode” is selected, the “IM# FrameSyncTim” setting should be set greater than the minimum settings listed above. If the “IM# FrameSyncTim” setting is set lower than the minimum setting listed above, there is a danger that the relay will monitor a correct change in message as a corrupted message. A setting of 25% is recommended for the communications failure alarm.

1.9.3.2 InterMiCOM Statistics & Diagnostics

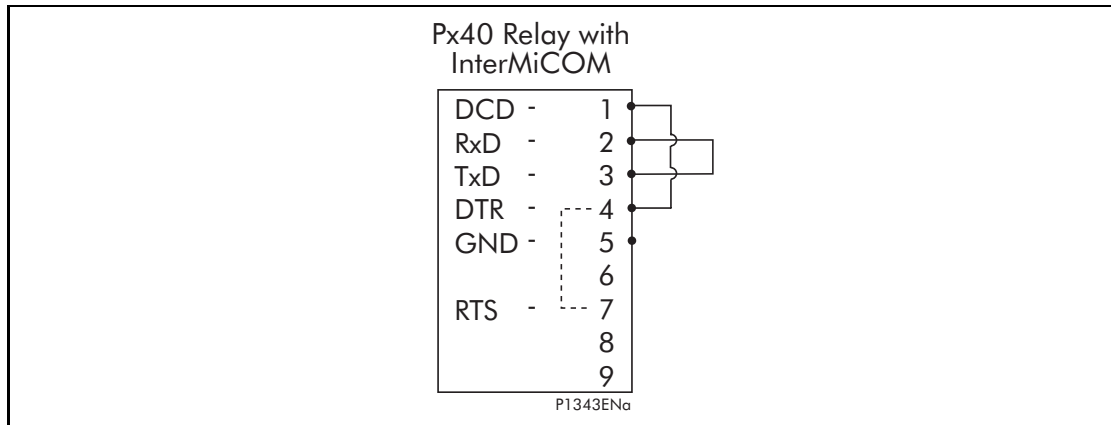
It is possible to hide the channel diagnostics and statistics from view by setting the “Ch Statistics” and/or “Ch Diagnostics” cells to “Invisible”. All channel statistics are reset when the relay is powered up, or by user selection using the “Reset Statistics” cell.

1.9.4 Testing InterMiCOM

1.9.4.1 InterMiCOM Loopback Testing & Diagnostics

A number of features are included within the InterMiCOM function to assist a user in commissioning and diagnosing any problems that may exist in the communications link.

“Loopback” test facilities, located within the INTERMICOM COMMS column of the relay menu, provide a user with the ability to check the software and hardware of the InterMiCOM signalling. By selecting “Loopback Mode” to “Internal”, only the internal software of the relay is checked whereas “External” will check both the software and hardware used by InterMiCOM. In the latter case, it is necessary to connect the transmit and receive pins together (pins 2 and 3) and ensure that the DCD signal is held high (connect pin 1 and pin 4 together). When the relay is switched into “Loopback Mode” the relay will automatically use generic addresses and will inhibit the InterMiCOM messages to the PSL by setting all eight InterMiCOM message states to zero. The loopback mode will be indicated on the relay frontplate by the amber Alarm LED being illuminated and a LCD alarm message, “IM Loopback”.



Connections for External Loopback mode

Once the relay is switched into either of the Loopback modes, a test pattern can be entered in the “Test Pattern” cell which is then transmitted through the software and/or hardware. Providing all connections are correct and the software is working correctly, the “Loopback Status” cell will display “OK”. An unsuccessful test would be indicated by “FAIL”, whereas a hardware error will be indicated by “UNAVAILABLE”. Whilst the relay is in loopback test mode, the “IM Output Status” cell will only show the “Test Pattern” settings, whilst the “IM Input Status” cell will indicate that all inputs to the PSL have been forced to zero.

Care should be taken to ensure that once the loopback testing is complete, the “Loopback Mode” is set to “Disabled” thereby switching the InterMiCOM channel back in to service. With the loopback mode disabled, the “IM Output Status” cell will show the InterMiCOM messages being sent from the local relay, whilst the “IM Input Status” cell will show the received InterMiCOM messages (received from the remote end relay) being used by the PSL.

Once the relay operation has been confirmed using the loopback test facilities, it will be necessary to ensure that the communications between the two relays in the scheme are reliable. To facilitate this, a list of channel statistics and diagnostics are available in the InterMiCOM COMMS column – see section 10.2. It is possible to hide the channel diagnostics and statistics from view by setting the “Ch Statistics” and/or “Ch Diagnostics” cells to “Invisible”. All channel statistics are reset when the relay is powered up, or by user selection using the “Reset Statistics” cell.

Another indication of the amount of noise on the channel is provided by the communications failure alarm. Within a fixed 1.6 second time period the relay calculates the percentage of invalid messages received compared to the total number of messages that should have been received based upon the “Baud Rate” setting. If this percentage falls below the threshold set in the “IM Msg Alarm Lvl” cell, a “Message Fail” alarm will be raised.

1.10 Read only mode

With IEC61850 and Ethernet/Internet communication capabilities, security has become a pressing issue. The Px40 relay provides a facility to allow the user to enable or disable the change in configuration remotely. This feature is available only in relays with Courier, Courier with IEC 60870-5-103, Courier with IEC 61850 and Courier with IEC 60870-5-103 and IEC 61850 protocol options. It has to be noted that in IEC 60870-5-103 protocol, Read Only Mode function is different from the existing Command block feature.

1.10.1 Protocol/port implementation

1.10.1.1 IEC 60870-5-103 protocol on rear port 1

The protocol does not support settings but the indications, measurands and records commands are available at the interface.

Allowed:

- Poll Class 1 (read spontaneous events)
- Poll Class 2 (read measurands)

- GI sequence (ASDU7 '**Start GI**', Poll Class 1)
- Transmission of Records sequence (ASDU24, ASDU25, Poll Class 1)
- Time Synchronization (ASDU6)
 - General Commands (ASDU20), namely:
 - INF23 activate characteristic 1
 - INF24 activate characteristic 2
 - INF25 activate characteristic 3
 - INF26 activate characteristic 4

Blocked:

- Write parameter (=change setting) (private ASDUs)
 - General Commands (ASDU20), namely:
 - INF16 auto-recloser on/off
 - INF19 LED reset
 - Private INFs (e.g. CB open/close, control inputs)

1.10.1.2 Courier protocol on rear port 1/2 and Ethernet

Allowed:

- Read settings, statuses, measurands
- Read standard or precise event records
- Time Synchronization
- Change active setting group

Blocked:

- Write settings
- All controls, including:
 - Reset Indication (Trip LED)
 - Operate control inputs
 - CB operations
 - Auto-reclose operations
 - Reset demands
 - Clear event/maintenance/ records
 - Test LEDs & contacts

1.10.1.3 IEC 61850

Allowed:

- Read statuses,
- Generate reports
- Extract precise event records
- Time synchronization

- Change active setting group

Blocked:

- All controls, including:
- Operate control inputs
- Reset LEDs

1.10.2 Courier database support

Three settings, one for each remote communications port at the back of the relay are created to support the enabling and disabling of the read only mode at each port.

The '**NIC Read Only**' setting will apply to all the communications protocols (including the Tunnelled Courier) that are transmitted via the Ethernet Port. Their default values are '**Disabled**'.

The MODBUS and DNP3 communications interfaces that do not support the feature will ignore these settings.

The remote read only mode is also available in the PSL via three dedicated DDB signals:

- • RP1 Read Only
- • RP2 Read Only
- • NIC Read Only

Through careful scheme logic design, the activations of these read only signals can be facilitated via Opto Inputs, Control Inputs and Function Keys.

These DDBs are available in every build, however they are effective only in Courier, IEC 60870-5-103 build and in latest IEC 61850. The setting cells are not available in MODBUS and DNP3.0.

2. OPERATION OF RECORDING FACILITIES

The MiCOM P849 contains the following recording facilities:

- Real time clock for time synchronization
- Standard and precise event recording facilities.

2.1 Real time clock, time synchronization

The MiCOM P849 provides real time clock and time synchronisation.

The time synchronisation is available through:

- IRIG-B port,
- Serial communication port,
- Ethernet port,
- Opto (opto time synchr)

Time synchronization uses Courier, Modbus, IEC60850-5-103, DNP3 or IEC61850 protocols.

Publishing GOOSE does not contain time stamp. Events are time stamped at reception at the other end (for example when it is received by P746).

2.2 Standard Event recording facilities

A sequence of time-tagged events is available. The product provides up to 512 non-volatile event records.

The following list items are stored as events:

- Recognition of change of state of logic (optically isolated) inputs,
- Recognition of change of state of output relays,
- Alarms,
- Maintenance records,
- Settings changes (local and remote).

2.3 Precise event recording

The product stores precise events in non-volatile memory. Each precise event recording contains 32 digital data channels.

APPLICATION NOTES

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

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1. INTRODUCTION

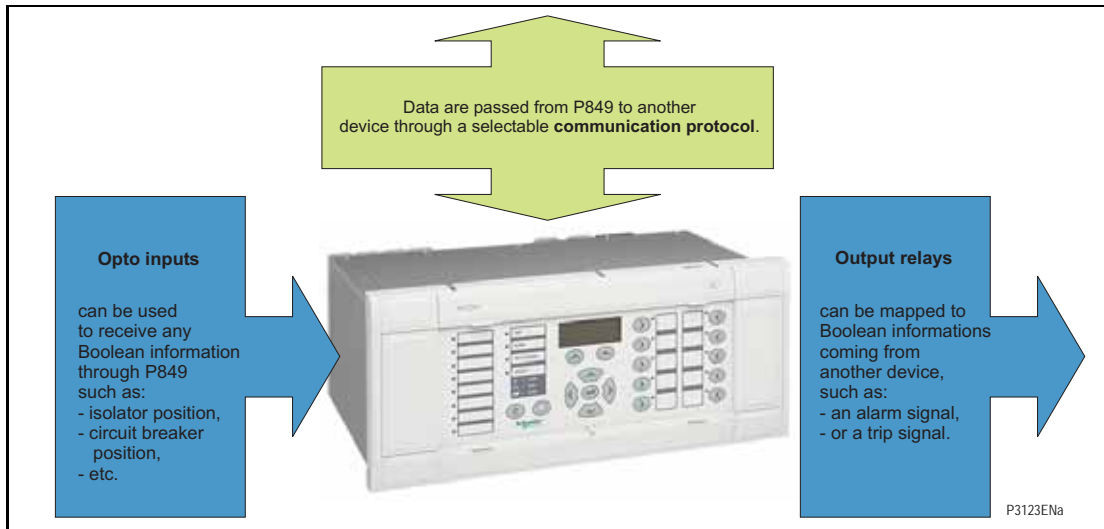


Before carrying out any work on the equipment, the user should be familiar with the contents of the safety section/safety guide SFTY/4LM/C11 or later issue, the technical data section and the ratings on the equipment rating label.

2. APPLICATION OF THE MiCOM P849 INPUT AND OUTPUT EXTENSION DEVICE

MiCOM P849 Input & Output Extension device combines solutions to provide 'Protection Application' (section 2.1) and 'Control Application' (section 2.2) with the standard benefits of the MiCOM Px40 platform.

This section describes how MiCOM P849 can be used within 'Protection application' and 'Control Application'



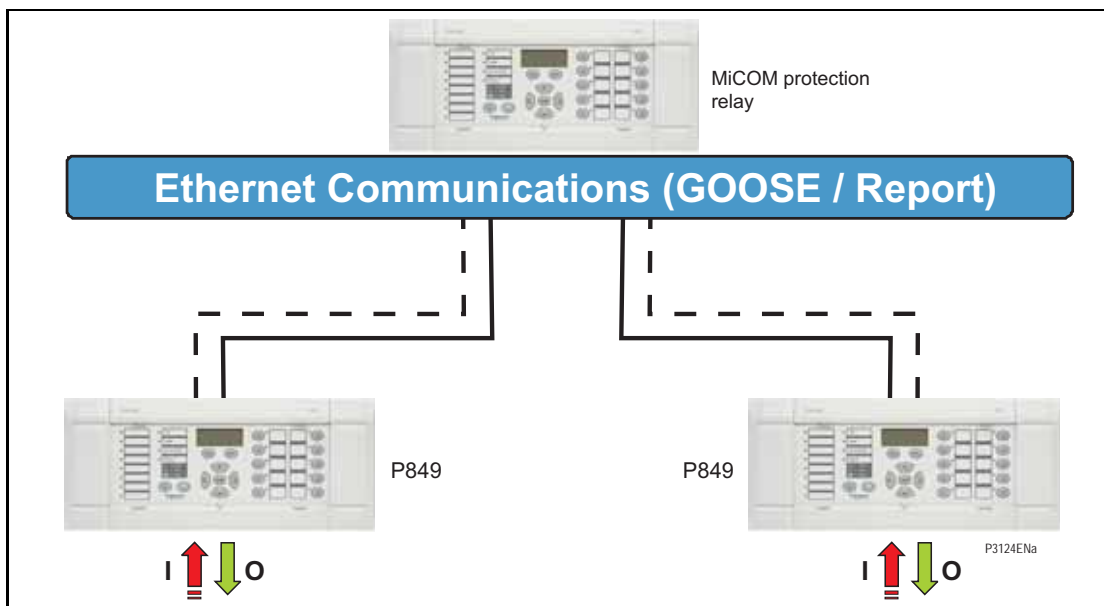
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2.1 Protection Application

2.1.1 Definition

The protection application is characterised by the ability of the device to communicate IEC61850-8.1 over either a single Ethernet network or a redundant Ethernet network.

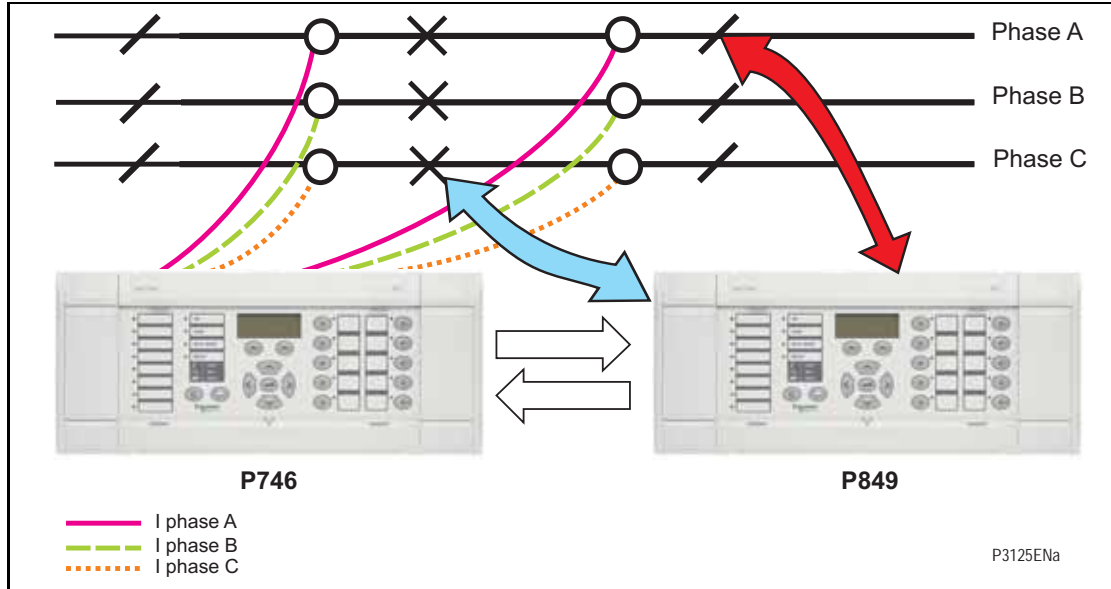
The MiCOM P849 is enabled to extend the number of IO of any device at all voltage levels (from MV up to HV transmission), regardless of manufacturer (IEC61850 communication through GOOSEs and Reports).



2.1.2 MiCOM P746 & P849 Use Cases

P849 is an opportunity to increase the number of inputs and outputs of MiCOM P746 in one box mode as well as in three box mode.

P746 One Box and P849 Use Case

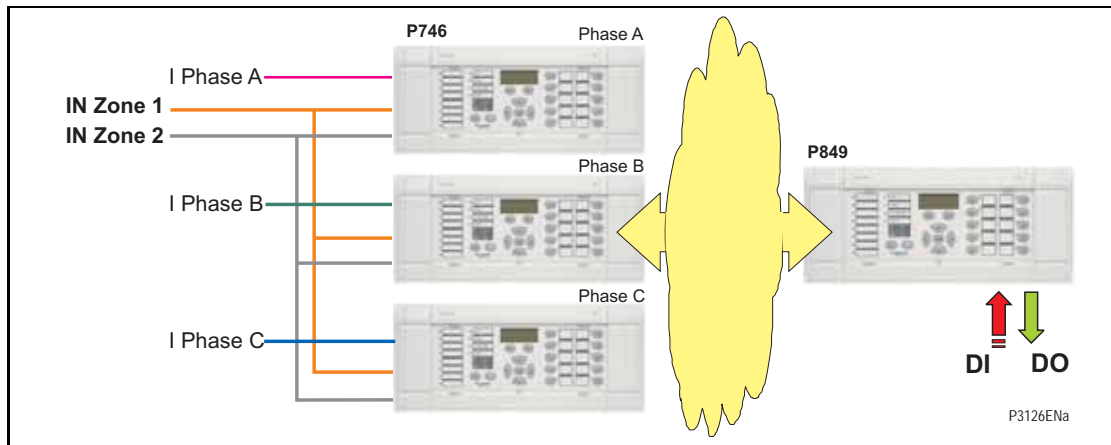


In this use case, the P849 can be used to transmit the status of switchgear to the P746 through GOOSE messages.

P849 can also be used to open a Circuit Breaker based on a command sent from P746 through GOOSE messages.

The inter-device communication can also be done through InterMiCOM proprietary protocol.

P746 Three Box and P849 use case



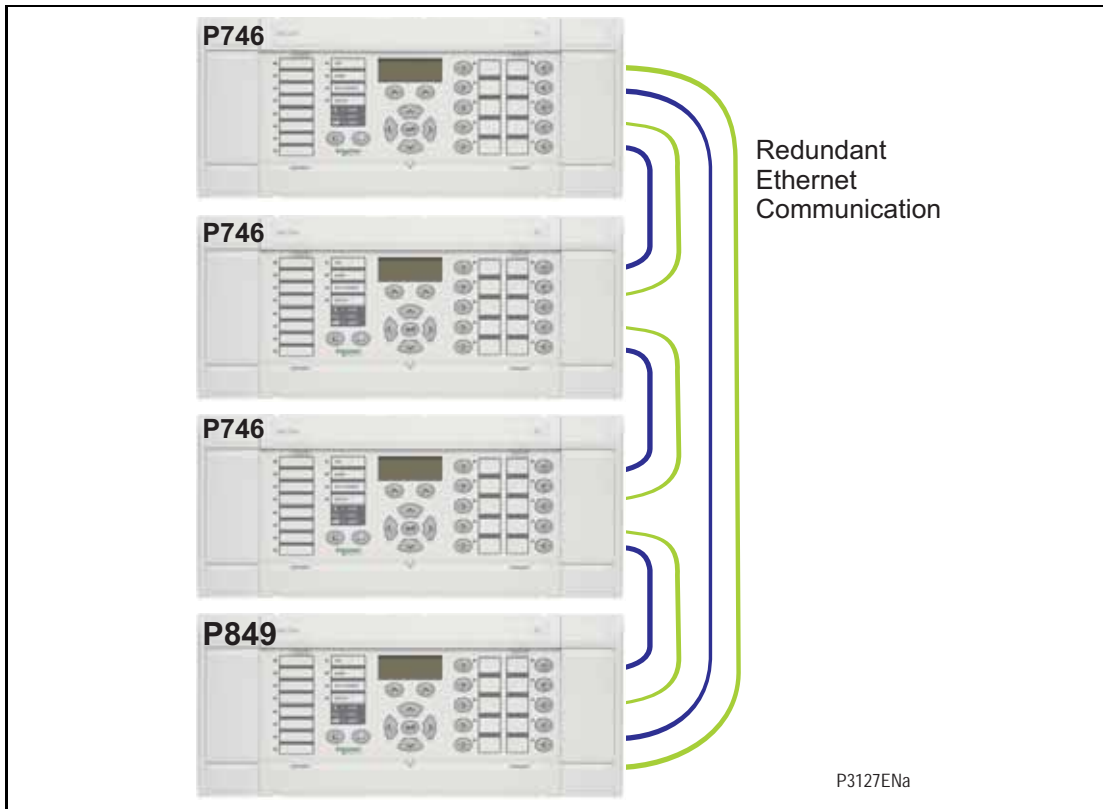
In this use case, the P849 can be used to transmit the status of switchgear to the P746 through GOOSE messages.

P849 can also be used to open a Circuit Breaker based on a command sent from P746 through GOOSE messages.

Note: The inter-device network is also used for inter-P746 communications.

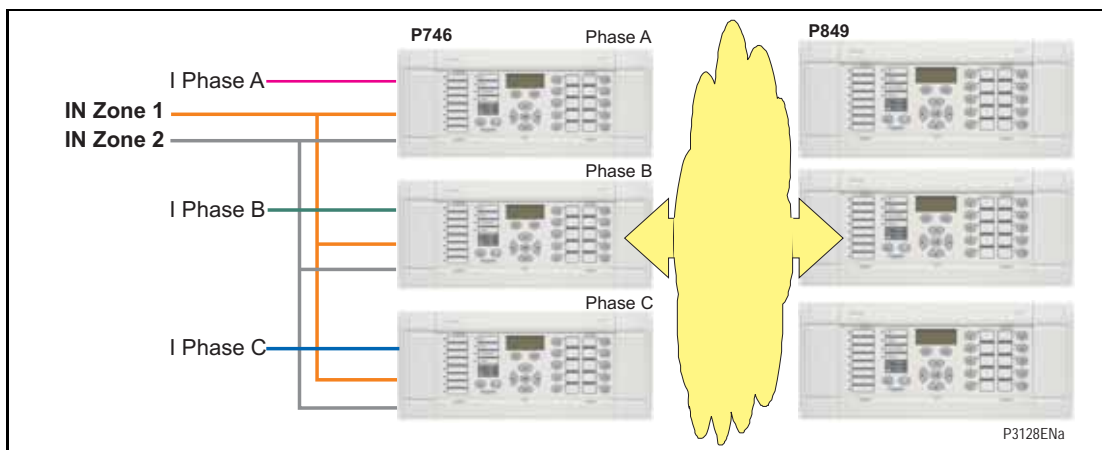
The most recommended architecture for this use case is to use a redundant Ethernet network as described hereafter.

It is recommended that GOOSE messages are exchanged between P746 protection relays and P849 over a Redundant Ethernet network.



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P746 3 Box and several P849 use case



The number of P849 that can be connected to device or a system of devices is not limited.

The number of P849 used will depend of customer application and more precisely on the corresponding required number of digital inputs and digital outputs by the application.

2.1.3 GOOSE Testing Mode

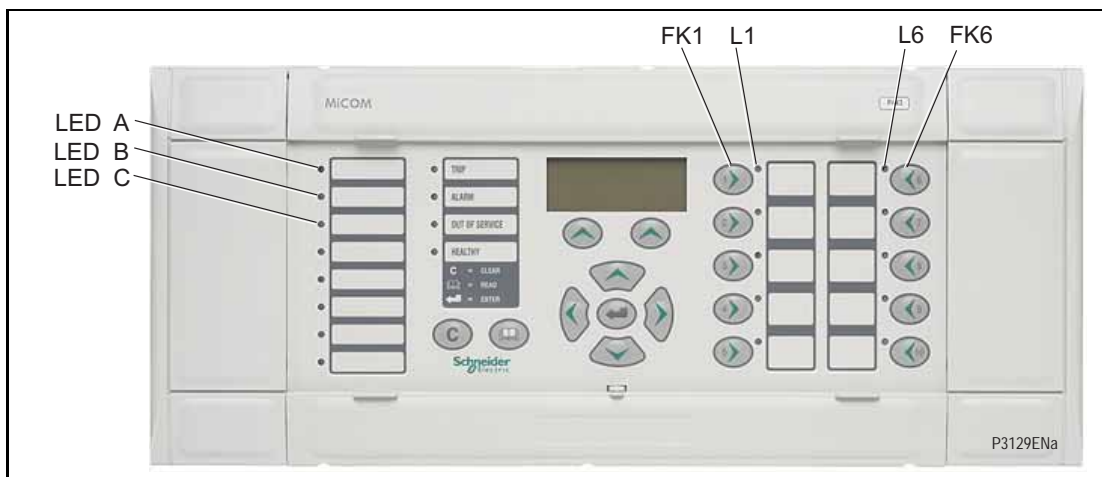
An inbuilt GOOSE Testing Mode is provided to facilitate IEC61850 commissioning.

From front panel of the device the user will be able to process GOOSE Testing mode.

This function is performed through PSL and can be customized to some particular application cases if required. The demonstration example below is based on P746.

It is supposed that the connected P746 is also in GOOSE Testing Mode or has got adequate PSL to answer P849 GOOSEs.

It consists in sending and receiving Test GOOSEs and check that they are correctly sent and received.

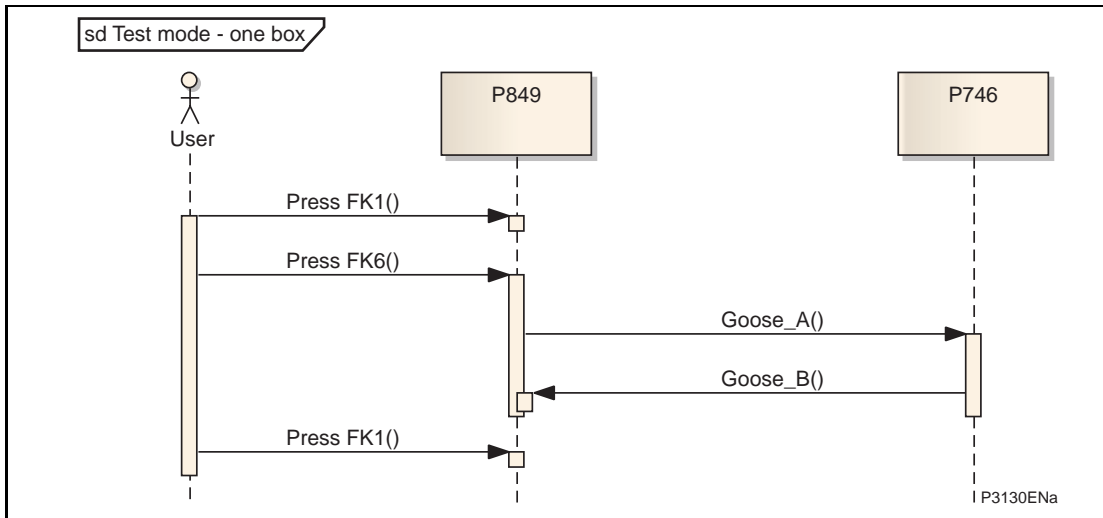


To activate GOOSE Testing Mode press Function key 1

To send a testing GOOSE message press Function key 6.

LED A, B and C are used to check that the P849 receives correctly GOOSEs.

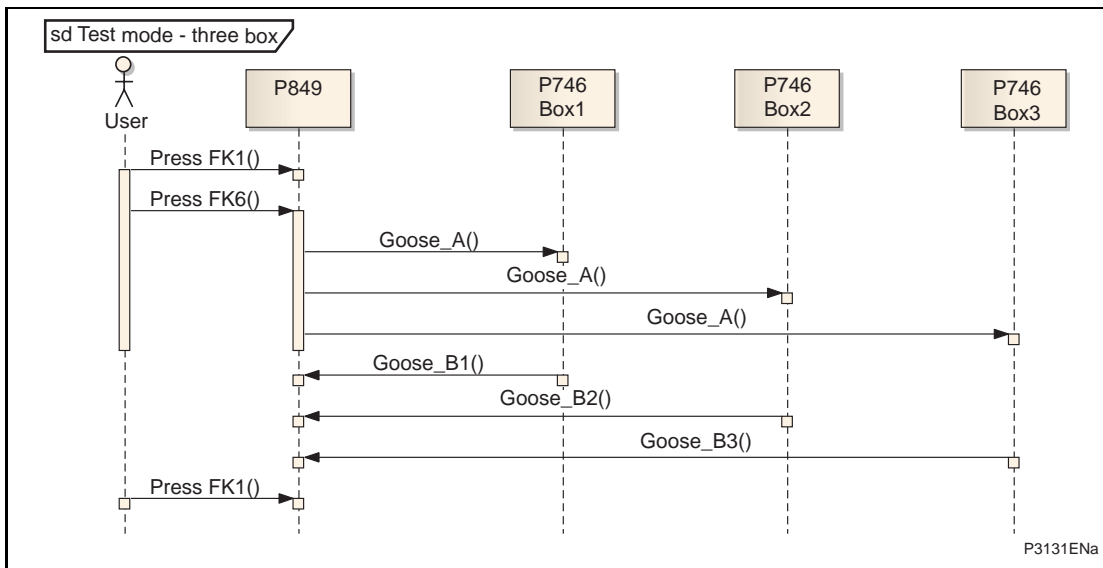
GOOSE Testing mode in case of P746 one box mode:



GOOSE_A and GOOSE_B are test GOOSE messages (please refer to default PSL for more detail)

LED A on the relay lights on as soon as GOOSE_B is received by P849

GOOSE Testing mode in case of P746 three box mode:



GOOSE_A and GOOSE_B are test GOOSE messages (please refer to default PSL for more detail)

LED A on the P849 lights on as soon as GOOSE_B1 is received by P849. It proves that GOOSEs are correctly exchanged between P849 and P746-Box1.

In the same manner LED B on the P849 lights on as soon as GOOSE_B2 is received by P849.

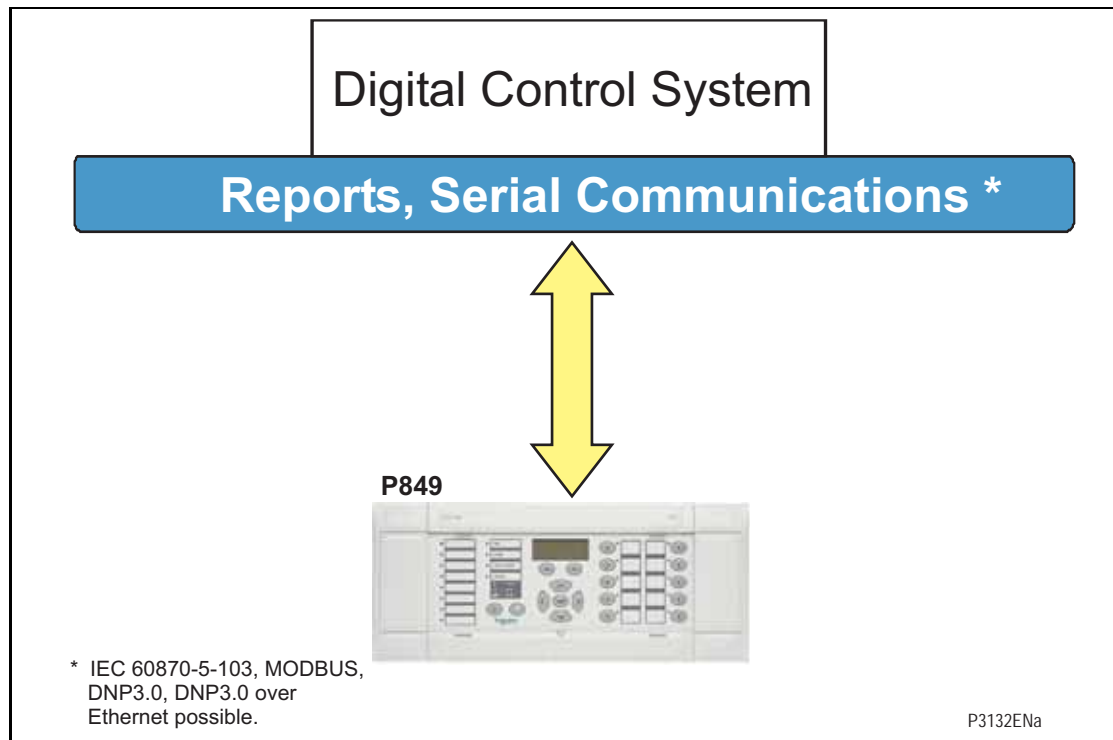
In the same manner LED C on the P849 lights on as soon as GOOSE_B3 is received by P849.



2.2 Control Application

2.2.1 Definition

MiCOM P849 will be able to communicate with usual legacy protocols and thus will behave as Remote Terminal Unit (Communication to Digital Control System).



3. APPLICATION OF MiCOM P849 FUNCTIONS

The non-protection features for the scheme are summarised below:

- Standard event and precise event recording – Comprehensive analysis available via standard event lists, and precise event records which can be accessed locally via the relay LCD or remotely via the serial communication link.
- Real time clock/time synchronisation – Time synchronisation available via IRIG-B input.
- Four settings groups – Independent remotely selectable setting groups to allow for customer specific applications.
- Commissioning test facilities.
- Continuous self monitoring – extensive self checking routines to ensure maximum reliability.
- Graphical programmable scheme logic – allowing user control logic to be tailored to the specific application.

3.1 Function keys

These function keys can be used to trigger any function that they are connected to as part of the PSL. The function key commands can be found in the 'Function Keys' menu. In the 'Fn. Key Status' menu cell there is a 10 bit word which represent the 10 function key commands and their status can be read from this 10 bit word. In the programmable scheme logic editor 10 function key signals, DDB 676 – 685, which can be set to a logic 1 or On state are available to perform control functions defined by the user.

The "Function Keys" column has 'Fn. Key n Mode' cell which allows the user to configure the function key as either 'Toggled' or 'Normal'. In the 'Toggle' mode the function key DDB signal output will remain in the set state until a reset command is given, by activating the function key on the next key press. In the 'Normal' mode, the function key DDB signal will remain energized for as long as the function key is pressed and will then reset automatically.

A minimum pulse duration can be programmed for a function key by adding a minimum pulse timer to the function key DDB output signal. The "Fn. Key n Status" cell is used to enable/unlock or disable the function key signals in PSL. The 'Lock' setting has been specifically provided to allow the locking of a function key thus preventing further activation of the key on consequent key presses. This allows function keys that are set to 'Toggled' mode and their DDB signal active 'high', to be locked in their active state thus preventing any further key presses from deactivating the associated function. Locking a function key that is set to the "Normal" mode causes the associated DDB signals to be permanently off. This safety feature prevents any inadvertent function key presses from activating or deactivating critical relay functions. The "Fn. Key Labels" cell makes it possible to change the text associated with each individual function key. This text will be displayed when a function key is accessed in the function key menu, or it can be displayed in the PSL.

The status of the function keys is stored in battery backed memory. In the event that the auxiliary supply is interrupted the status of all the function keys will be recorded. Following the restoration of the auxiliary supply the status of the function keys, prior to supply failure, will be reinstated. If the battery is missing or flat the function key DDB signals will set to logic 0 once the auxiliary supply is restored. The relay will only recognise a single function key press at a time and that a minimum key press duration of approximately 200msec. is required before the key press is recognised in PSL. This deglitching feature avoids accidental double presses.

DDB: '**Function Key 1**' (see P849/EN PL)

The activation of one of the ten function key will drive an associated DDB signal. The DDB signal will remain active depending on the programmed setting i.e. toggled or normal. Toggled mode means the DDB signal will remain latched or unlatched on key press and normal means the DDB will only be active for the duration of the key press.

DDB: 'FnKey LED 1 Red'

Ten programmable tri-colour LEDs associated with each function key are used to indicate the status of the associated pushbutton's function. Each LED can be programmed to indicate red, yellow or green as required. The green LED is configured by driving the green DDB input. The red LED is configured by driving the red DDB input. The yellow LED is configured by driving the red and green DDB inputs simultaneously. When the LED is activated the associated DDB signal will be asserted. For example, if FnKey Led 1 Red is activated, DDB will be asserted.

DDB 'FnKey LED 1 Grn'

The same explanation as for Fnkey 1 Red applies.

DDB 'LED 1 Red'

Eight programmable tri-colour LEDs that can be programmed to indicate red, yellow or green as required. The green LED is configured by driving the green DDB input. The red LED is configured by driving the red DDB input. The yellow LED is configured by driving the red and green DDB inputs simultaneously. When the LED is activated the associated DDB signal will be asserted. For example, if Led 1 Red is activated, DDB #640 will be asserted.

DDB 'LED 1 Grn'

The same explanation as for LED 1 Red applies.

3.2 Opto inputs configuration

The MiCOM P849 is fitted with universal opto-isolated logic inputs (opto inputs) that can be programmed for the nominal battery voltage of the circuit of which they are a part i.e. thereby allowing different voltages for different circuits e.g. signalling. They can also be programmed as Standard 60% - 80% or **50% - 70%** to satisfy different operating constraints (**Dual Opto**).

Threshold levels are as follows:

Nominal Battery Voltage (Vdc)	Standard 60% - 80%		50% - 70%	
	No Operation (logic 0) Vdc	Operation (logic 1) Vdc	No Operation (logic 0) Vdc	Operation (logic 1) Vdc
24 / 27	<16.2	>19.2	<12.0	>16.8
30 / 34	<20.4	>24.0	<15.0	>21.0
48 / 54	<32.4	>38.4	<24.0	>33.6
110 / 125	<75.0	>88.0	<55.0	>77.0
220 / 250	<150.0	>176.0	<110	>154

Table 1 – opto-config Threshold levels

This lower value eliminates fleeting pickups that may occur during a battery earth fault, when stray capacitance may present up to 50% of battery voltage across an input.

Each input also has selectable filtering which can be utilised. This allows use of a pre-set filter of ½ cycle which renders the input immune to induced noise on the wiring: although this method is secure it can be slow. This can be improved by switching off the ½ cycle filter in which case one of the following methods to reduce ac noise should be considered. The first method is to use double pole switching on the input, the second is to use screened twisted cable on the input circuit.

3.3 HOTKEYS / Control inputs

3.3.1 Control inputs

The control inputs function as software switches that can be set or reset either locally or remotely. These inputs can be used to trigger any function that they are connected to as part of the PSL. There are three setting columns associated with the control inputs which are: "CONTROL INPUTS", "CTRL I/P CONFIG" and "CTRL I/P LABELS". The function of these columns is described below.

The Control Input commands can be found in the 'Control Input' menu. In the 'Ctrl I/P status' menu cell there is a 32 bit word which represent the 32 control input commands. The status of the 32 control inputs can be read from this 32 bit word. The 32 control inputs can also be set and reset from this cell by setting a 1 to set or 0 to reset a particular control input. Alternatively, each of the 32 Control Inputs can be set and reset using the individual menu setting cells 'Control Input 1, 2, 3' etc. The Control Inputs are available through the relay menu as described above and also via the rear communications.

The control inputs function as software switches that can be set or reset either locally or remotely. These inputs can be used to trigger any function that they are connected to as part of the PSL.

The two hotkeys in the front panel can perform a direct command if a dedicated PSL has been previously created using DDB: **'CONTROL INPUT'** cells (see P849/EN PL). The MiCOM P849 offers 32 control inputs which can be activated by the Hotkey manually or by the IEC 103 remote communication.

3.3.2 Control I/P Configuration

The "CTRL I/P CONFIG" column has several functions one of which allows the user to configure the control inputs as either 'latched' or 'pulsed'. A latched control input will remain in the set state until a reset command is given, either by the menu or the serial communications. A pulsed control input, however, will remain energised for 10ms after the set command is given and will then reset automatically (i.e. no reset command required).

In addition to the latched / pulsed option this column also allows the control inputs to be individually assigned to the "Hotkey" menu by setting '1' in the appropriate bit in the "Hotkey Enabled" cell. The hotkey menu allows the control inputs to be set, reset or pulsed without the need to enter the "CONTROL INPUTS" column. The "Ctrl Command" cell also allows the SET / RESET text, displayed in the hotkey menu, to be changed to something more suitable for the application of an individual control input, such as "ON / OFF", "IN / OUT" etc.

3.3.3 Control I/P Labels

The "CTRL I/P LABELS" column makes it possible to change the text associated with each individual control input. This text will be displayed when a control input is accessed by the hotkey menu, or it can be displayed in the PSL.

Note: With the exception of pulsed operation, the status of the control inputs is stored in battery backed memory. In the event that the auxiliary supply is interrupted the status of all the inputs will be recorded. Following the restoration of the auxiliary supply the status of the control inputs, prior to supply failure, will be reinstated. If the battery is missing or flat the control inputs will set to logic 0 once the auxiliary supply is restored

PROGRAMMABLE LOGIC

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

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MiCOM P849

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2.	MiCOM P849 PROGRAMMABLE SCHEME LOGIC	20

1. PROGRAMMABLE LOGIC

1.1 Overview

The purpose of the programmable scheme logic (PSL) is to allow the user to configure an individual logical scheme to suit their own particular application. This is achieved through the use of programmable logic gates and delay timers.

The input to the PSL is any combination of the status of opto inputs. It is also used to assign the mapping of functions to the opto inputs and output contacts. The fixed scheme logic provides the device's standard configuration schemes. The PSL itself consists of software logic gates and timers. The logic gates can be programmed to perform a range of different logic functions and can accept any number of inputs. The timers are used either to create a programmable delay, and/or to condition the logic outputs, e.g. to create a pulse of fixed duration on the output regardless of the length of the pulse on the input. The outputs of the PSL are the LEDs on the front panel and the output contacts at the rear.

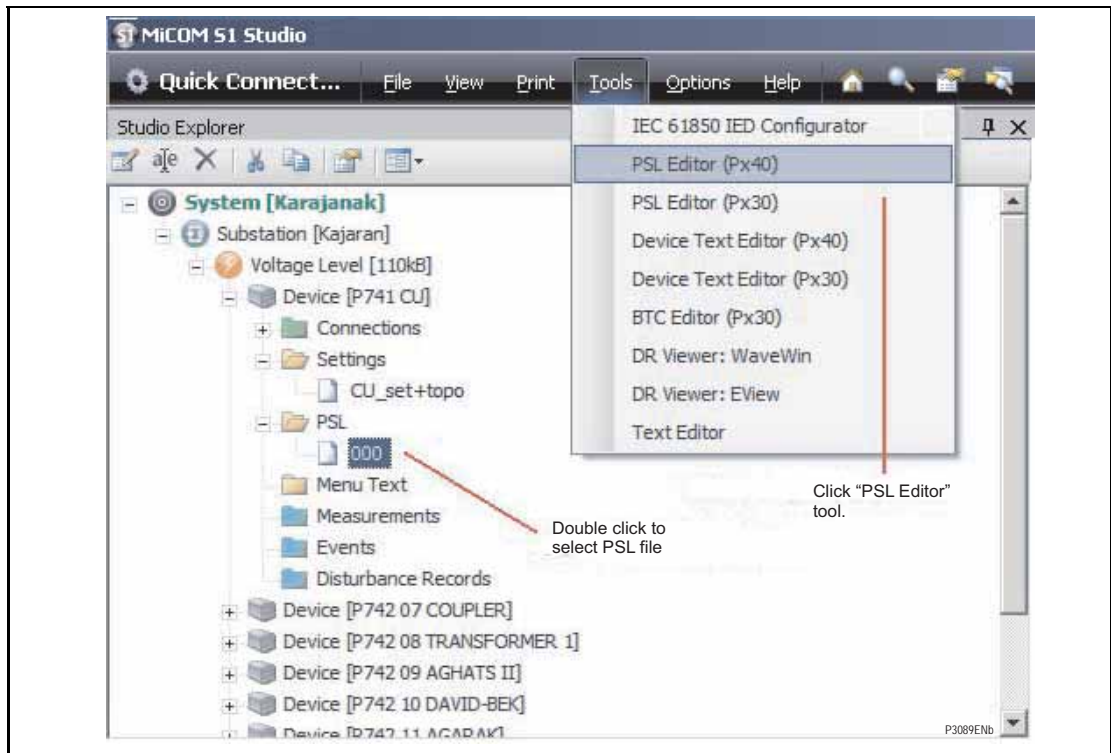
The execution of the PSL logic is event driven; the logic is processed whenever any of its inputs change, for example as a result of a change in one of the digital input signals. Also, only the part of the PSL logic that is affected by the particular input change that has occurred is processed. This reduces the amount of processing time that is used by the PSL; even with large, complex PSL schemes the device trip time will not lengthen.

This system provides flexibility for the user to create their own scheme logic design. However, it also means that the PSL can be configured into a very complex system, hence setting of the PSL is implemented through the PC support package MiCOM S1 Studio.

1.2 MiCOM S1 Studio Px40 PSL editor

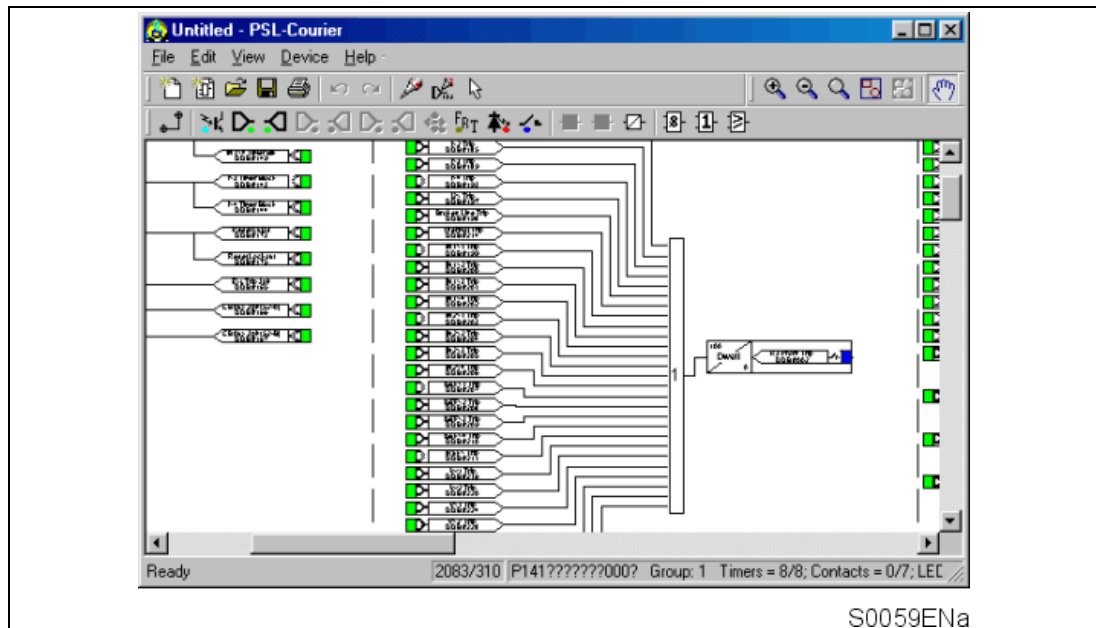
1.2.1 MiCOM S1 Studio

To access the MiCOM S1 Studio V3 Px40 PSL Editor double click on the PSL file on the Explorer or click PSL Editor (Px40) from Tools Menu



1.2.2 PSL Editor

The PSL Editor module enables you to connect to any MiCOM device front port, Rear port with courier protocol and Ethernet port with tunnelled courier protocol, retrieve and edit its Programmable Scheme Logic files and send the modified file back to a MiCOM Px40 device.



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1.3 How to use MiCOM Px40 PSL editor

With the MiCOM Px40 PSL Module you can:

- Start a new PSL diagram
- Extract a PSL file from a MiCOM Px40 IED
- Open a diagram from a PSL file
- Add logic components to a PSL file
- Move components in a PSL file
- Edit link of a PSL file
- Add link to a PSL file
- Highlight path in a PSL file
- Use a conditioner output to control logic
- Download PSL file to a MiCOM Px40 IED
- Print PSL files
- View DDB numbering for the signals

For a detailed discussion on how to use these functions, please refer to PSL Editor online help or S1 Users manual.

1.4 Warnings

Before the scheme is sent to the device checks are done. Various warning messages may be displayed as a result of these checks.

The Editor first reads in the model number of the connected device, and then compares it with the stored model number. A "wildcard" comparison is employed. If a model mismatch occurs then a warning will be generated before sending commences. Both the stored model number and that read-in from the device are displayed along with the warning; the onus is on you to decide if the settings to be sent are compatible with the connected device. Wrongly ignoring the warning could lead to undesired behaviour in the device.

If there are any potential problems of an obvious nature then a list will be generated. The types of potential problems that the program attempts to detect are:

- One or more gates, LED signals, contact signals, and/or timers have their outputs linked directly back to their inputs. An erroneous link of this sort could lock up the device, or cause other more subtle problems to arise.
- Inputs to Trigger (ITT) exceed the number of inputs. A programmable gate has its ITT value set to greater than the number of actual inputs; the gate can never activate. Note that there is no lower ITT value check. A 0-value does not generate a warning.
- Too many gates. There is a theoretical upper limit of 256 gates in a scheme, but the practical limit is determined by the complexity of the logic. In practice the scheme would have to be very complex, and this error is unlikely to occur.
- Too many links. There is no fixed upper limit to the number of links in a scheme. However, as with the maximum number of gates, the practical limit is determined by the complexity of the logic. In practice the scheme would have to be very complex, and this error is unlikely to occur.

1.5 Toolbar and commands

There are a number of toolbars available for easy navigation and editing of PSL.

1.5.1 Standard tools

- For file management and printing.



1.5.2 Alignment tools

- To snap logic elements into horizontally or vertically aligned groupings.



1.5.3 Drawing Tools

- To add text comments and other annotations, for easier reading of PSL schemes.



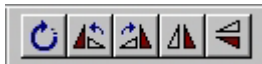
1.5.4 Nudge tools

- To move logic elements.



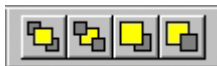
1.5.5 Rotation tools

- Tools to spin, mirror and flip.



1.5.6 Structure tools

- To change the stacking order of logic components.



1.5.7 Zoom and pan tools

- For scaling the displayed screen size, viewing the entire PSL, or zooming to a selection.



1.5.8 Logic symbols



This toolbar provides icons to place each type of logic element into the scheme diagram. Not all elements are available in all devices. Icons will only be displayed for those elements available in the selected device.

Link



Create a link between two logic symbols.

Opto Signal



Create an opto signal.

Input Signal



Create an input signal.

Output Signal



Create an output signal.

GOOSE In



Create an input signal to logic to receive a GOOSE message transmitted from another IED. Used in IEC 61850 GOOSE applications only.

GOOSE Out



Create an output signal from logic to transmit a GOOSE message to another IED. Used in IEC 61850 GOOSE applications only.

Control In



Create an input signal to logic that can be operated from an external command.

Function Key



Create a function key input signal.

Trigger Signal



Create a fault record trigger.

LED Signal



Create an LED input signal that repeats the status of tri-colour LED.

Contact Signal



Create a contact signal.

LED Conditioner



Create an LED conditioner.

Contact Conditioner



Create a contact conditioner.

Timer



Create a timer.

AND Gate



Create an AND Gate.

OR Gate



Create an OR Gate.

Programmable Gate



Create a programmable gate.

SR latch Gate



Create an SR latch Gate.

1.6 PSL logic signals properties

The logic signal toolbar is used for the selection of logic signals.

Performing a right-mouse click on any logic signal will open a context sensitive menu and one of the options for certain logic elements is the **Properties...** command. Selecting the Properties option will open a Component Properties window, the format of which will vary according to the logic signal selected.

Properties of each logic signal, including the Component Properties windows, are shown in the following sub-sections:

Signal properties menu

The **Signals List** tab is used for the selection of logic signals.

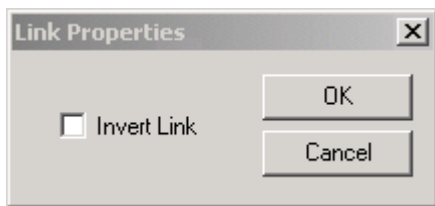
The signals listed will be appropriate to the type of logic symbol being added to the diagram. They will be of one of the following types:

1.6.1 Link properties



Links form the logical link between the output of a signal, gate or condition and the input to any element.

Any link that is connected to the input of a gate can be inverted via its properties window. An inverted link is indicated with a “bubble” on the input to the gate. It is not possible to invert a link that is not connected to the input of a gate.



Links can only be started from the output of a signal, gate, or conditioner, and can only be ended on an input to any element.

Since signals can only be either an input or an output then the concept is somewhat different. In order to follow the convention adopted for gates and conditioners, input signals are connected from the left and output signals to the right. The Editor will automatically enforce this convention.

A link attempt will be refused where one or more rules would otherwise be broken. A link will be refused for the following reasons:

- An attempt to connect to a signal that is already driven. The cause of the refusal may not be obvious, since the signal symbol may appear elsewhere in the diagram. Use “Highlight a Path” to find the other signal.
- An attempt is made to repeat a link between two symbols. The cause of the refusal may not be obvious, since the existing link may be represented elsewhere in the diagram.

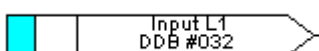
1.6.2 Opto signal properties

Opto Signal



Each opto input can be selected and used for programming in PSL. Activation of the opto input will drive an associated DDB signal.

For example activating opto input L1 will assert DDB 032 in the PSL.



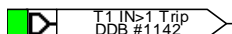
1.6.3 Input signal properties

Input Signal



device logic functions provide logic output signals that can be used for programming in PSL. Depending on the device functionality, operation of an active device function will drive an associated DDB signal in PSL.

For example DDB 1142 will be asserted in the PSL should the active terminal1 earth fault, stage 1 protection operate/trip.



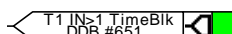
1.6.4 Output signal properties

Output Signal



Device logic functions provide logic input signals that can be used for programming in PSL. Depending on the device functionality, activation of the output signal will drive an associated DDB signal in PSL and cause an associated response to the device function

For example, if DDB 651 is asserted in the PSL, it will block the terminal1 earth function stage 1 timer.



1.6.5 GOOSE input signal properties

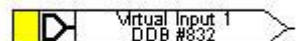
GOOSE In



The Programmable Scheme Logic interfaces with the GOOSE Scheme Logic (see PSL Editor online help or S1 Users manual for more details) by means of 32 Virtual inputs. The Virtual Inputs can be used in much the same way as the Opto Input signals.

The logic that drives each of the Virtual Inputs is contained within the device's GOOSE Scheme Logic file. It is possible to map any number of bit-pairs, from any subscribed device, using logic gates onto a Virtual Input (see S1 Users manual for more details).

For example DDB 832 will be asserted in PSL should virtual input 1 operate.



1.6.6 GOOSE output signal properties

GOOSE Out



The Programmable Scheme Logic interfaces with the GOOSE Scheme Logic by means of 32 Virtual outputs.

The structure (dataset) of any publishing Goose is fixed. The dataset is as follow:

Virtual output number	Virtual output Structure
Virtual output 1	Ind 1 └── Ind1.StVal └── Ind1.q
Virtual output 2	Ind 2 └── Ind2.StVal └── Ind2.q
...	...
Virtual output 32	Ind 32 └── Ind32.StVal └── Ind32.q



Note: Dataset is described in a “*.icd” file. This file is accessible under “Program files\MiCOM S1 Studio\IED Configurator\Templates\P84x\” folder, “P849xxxxx.icd” file.

The definitions of all used Logical Nodes and their associated Common Data Classes are described in the PICS & MICS user document (P849/EN PM).

It is possible to map virtual outputs to bit-pairs for transmitting to any **published** devices (see PSL Editor online help or S1 Users manual for more details).

For example if DDB 865 is asserted in PSL, Virtual Output 32 and its associated mappings will operate.



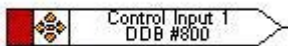
1.6.7 Control in signal properties

Control In



There are 32 control inputs which can be activated via the device menu, ‘hotkeys’ or via rear communications. Depending on the programmed setting i.e. latched or pulsed, an associated DDB signal will be activated in PSL when a control input is operated.

For example operate control input 1 to assert DDB 800 in the PSL.



1.6.8 Function key properties

Function Key



Each function key can be selected and used for programming in PSL. Activation of the function key will drive an associated DDB signal and the DDB signal will remain active depending on the programmed setting i.e. toggled or normal. Toggled mode means the DDB signal will remain latched or unlatched on key press and normal means the DDB will only be active for the duration of the key press.

For example operate function key 1 to assert DDB 712 in the PSL.



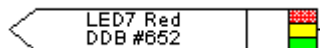
1.6.9 LED signal properties

LED



All programmable LEDs will drive associated DDB signal when the LED is activated.

For example DDB 652 will be asserted when LED 7 is activated.



1.6.10 Contact signal properties

Contact Signal



All device output contacts will drive associated DDB signal when the output contact is activated.

For example DDB 009 will be asserted when output R10 is activated.



PL

1.6.11 LED conditioner properties

LED Conditioner

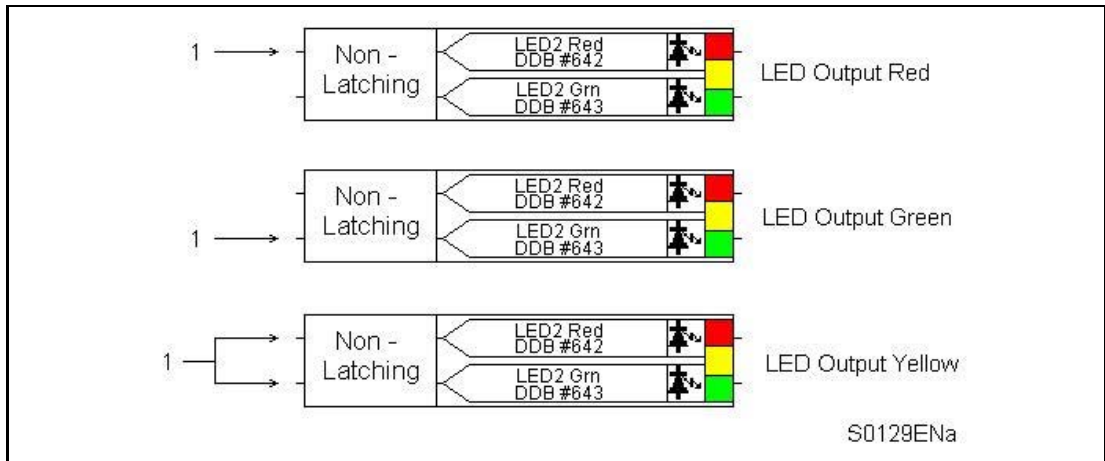


1. Select the **LED name** from the list (only shown when inserting a new symbol).
2. Configure the LED output to be Red, Yellow or Green.

Configure a Green LED by driving the Green DDB input.

Configure a RED LED by driving the RED DDB input.

Configure a Yellow LED by driving the RED and GREEN DDB inputs simultaneously.

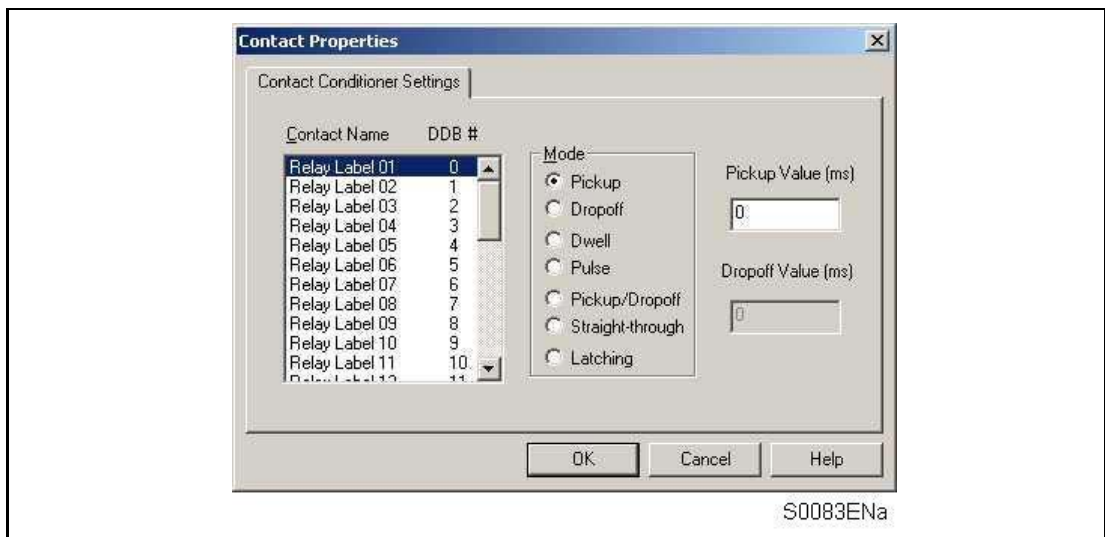


3. Configure the LED output to be latching or non-latching.

1.6.12 Contact conditioner properties



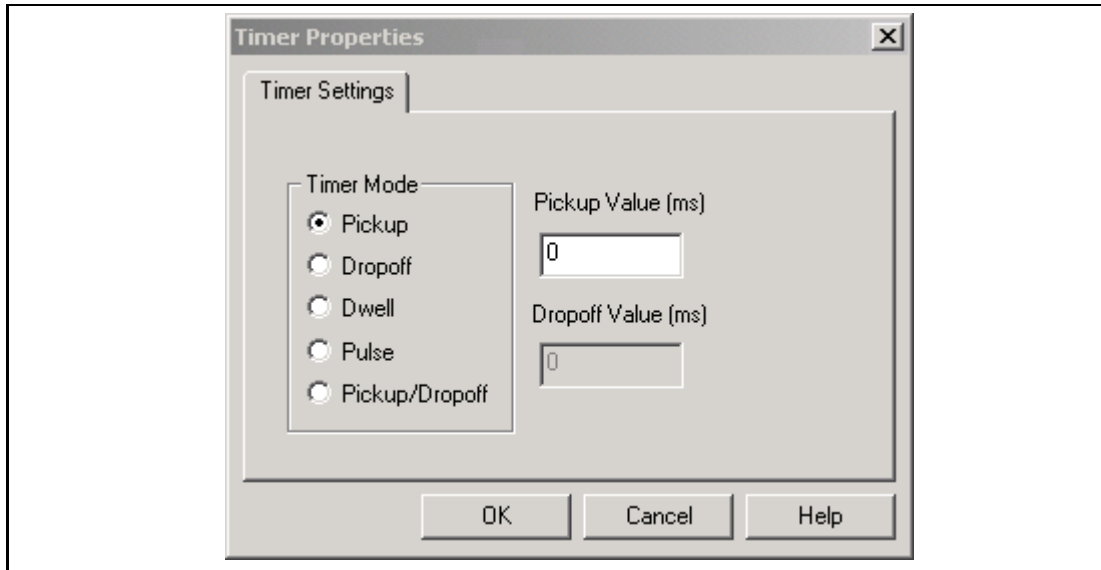
Each contact can be conditioned with an associated timer that can be selected for pick up, drop off, dwell, pulse, pick-up/drop-off, straight-through, or latching operation. "Straight-through" means it is not conditioned in any way whereas "latching" is used to create a sealed-in or lockout type function.



1. Select the contact **name** from the **Contact Name** list (only shown when inserting a new symbol).
2. Choose the conditioner type required in the **Mode** tick list.
3. Set the **Pick-up** Time (in milliseconds), if required.
4. Set the **Drop-off** Time (in milliseconds), if required.

1.6.13 Timer properties 

Each timer can be selected for pick up, drop off, dwell, pulse or pick-up/drop-off operation.





1. Choose the operation mode from the **Timer Mode** tick list.
2. Set the Pick-up Time (in milliseconds), if required.
3. Set the Drop-off Time (in milliseconds), if required.


PL


1.6.14 Gate properties   

A Gate may be an AND, OR, programmable gate or SR Latch .

An **AND** gate  requires that all inputs are TRUE for the output to be TRUE.

An **OR** gate  requires that one or more input is TRUE for the output to be TRUE.

A **Programmable** gate  requires that the number of inputs that are TRUE is equal to or greater than its 'Inputs to Trigger' setting for the output to be TRUE.

Three variants of the SR latch gate  are available. They are:

- Standard – no input dominant
- Set Input Dominant
- Reset Input Dominant

The output of the gate, Q is latched, i.e. its state is non-volatile upon power cycle.

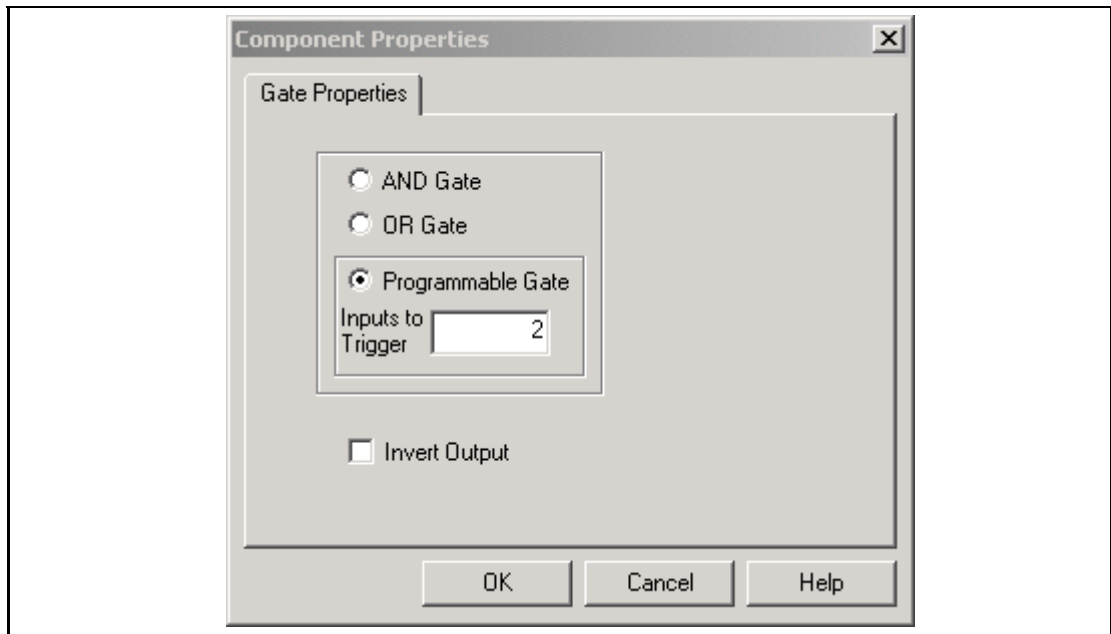
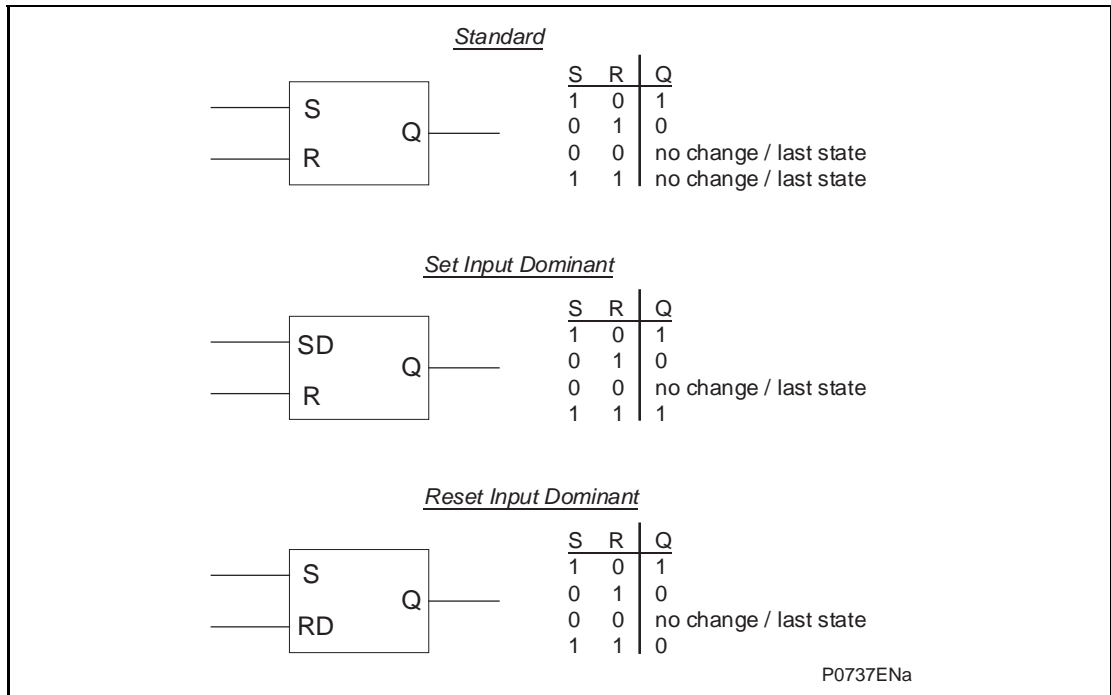
The inversions of the input and output signals are supported.

The state of Q is reset when a new PSL is downloaded to the device or when the active setting group is changed. The maximum number of SR Latch gates is 64.

The evaluation of the Q state is carried out after all the DDB changes have completed, i.e. at the end of the protection cycle and synchronised with protection task. Hence there is an inherent delay of a protection cycle in processing every one of the SR gates and the delay increases if the SR gates are connected one after another.

The user has to be aware that if there is a timer before the SR gate, then an additional delay of a protection cycle will be incurred before the Q state is changed.

The logic operations of the three variants of the gate are depicted in the diagram below:



PL

1. Select the Gate type AND, OR, or Programmable.
2. Set the number of inputs to trigger when Programmable is selected.
3. Select if the output of the gate should be inverted using the Invert Output check box. An inverted output is indicated with a "bubble" on the gate output.

1.7 Description of the MiCOM P849 logic nodes

1.7.1 Sorted by DDB number

DDB No.	English Text	Source	Description
0 to 59	Relay 1 to Relay 60	Relay Conditioner 1 to Relay Conditioner 60	Output Relay 1 to Output Relay 60 High level when a DDB cell (linked by PSL logic) is at 1. State depends on the logic set in the PSL (MiCOM S1) These programmable relays are assigned in the default PSL, with the following logic conditions: - Pulse time-delay - Pick Up/Drop Off Time-delay - Dwell Time-delay - Pick Up Time-delay - Drop Off Time-delay - Latching - Straight (used in default PSL)
60 to 63	--	Unused	
64	Opto Input 1	Opto Isolator Input 1	OPTO ISOLATOR 1 Set to 1 when the opto input is energised for a minimum time: 7ms (48Vdc), 10ms (universal) to be validated by internal logic To enable the selection of a setting group by state change of the opto isolated logic inputs 1 and 2, disconnect Opto inputs 01 and 02 in the PSL (Opto inputs 01 and 02 must not be connected to any output signal)
65	Opto Input 2	Opto Isolator Input 2	OPTO ISOLATOR 2 Set to 1 when the opto input is energised for a minimum time: 7ms (48Vdc), 10ms (universal) to be validated by internal logic To enable the selection of a setting group by state change of the opto isolated logic inputs 1 and 2, disconnect Opto inputs 01 and 02 in the PSL (Opto inputs 01 and 02 must not be connected to any output signal)
66 to 127	Opto Input 3 to Opto Input 64	Opto Isolator Input 3 to Opto Isolator Input 64	OPTO ISOLATOR 3 to OPTO ISOLATOR 32 Set to 1 when the opto input is energised for a minimum time: 7ms (48Vdc), 10ms (universal) to be validated by internal logic
128 to 187	Relay Cond 1 to Relay Cond 60	PSL	Relay Conditioner 1 to Relay Conditioner 60
188 to 191	Unused	--	--
192	LED1 Red	PSL	Programmable Tri-LED 1 Red is energized:
193	LED1 Grn	PSL	Programmable Tri-LED 1 Green is energized
194 to 205	Programmable Tri-LEDs 2 to 7
206	LED8 Red	PSL	Programmable Tri-LED 8 Red energized
207	LED8 Grn	PSL	Programmable Tri-LED 8 Green energized
208	FnKey LED1 Red	PSL	Programmable function key Tri-LED 1 Red energized
209	FnKey LED1 Grn	PSL	Programmable function key Tri-LED 1 Green energized
210 to 226	FnKey LED2 Red to FnKey LED10 Red to FnKey LED10 Grn	...	Programmable function key Tri-LED 2 Red / Green to Programmable function key Tri-LED 10 Red / Green
228 to 255	--	Unused	--
256	LED1 Con R	PSL	Assignment of signal to drive output Tri-LED 1 Red
257	LED1 Con G	PSL	Assignment of signal to drive output Tri-LED 1 Green
258 to 271	LED 2 Con R to LED 8 Con G	PS	Tri-LED conditioners 2 (Red) to 8 (Green)
272	FnKey LED1 ConR	PSL	Assignment of signal to drive output FnKey Tri-LED 1 Red. This LED is associated with Function Key 1 - To drive function key LED yellow, DDB 272 and DDB 273 must be active at the same time

DDB No.	English Text	Source	Description
273	FnKey LED1 ConG	PSL	Function key tri LED conditioner Green. Assignment of signal to drive output FnKey Tri-LED 1 Green. This LED is associated with Function Key 1 - To drive function key LED yellow, DDB 272 and DDB 273 must be active at the same time
274 to 291	FnKey LED2 ConR to FnKey LED10 ConG	PSL	Function key tri LED conditioner Red. Assignment of signals to drive output FnKey Tri-LED 2 Red to FnKey Tri-LED 9 Green
292 to 319	--	Unused	--
320	Function Key 1	User Control	Function Key 1 is activated. In 'Normal' mode it is high on keypress and in 'Toggle' mode remains high/low on single keypress
321 to 329	Function Key 2 to Function Key 10	User Control	Function Keys 2 to 10 are activated.
330 to 351	--	Unused	--
352	Timer out 1	Auxiliary Timer 1	Auxiliary Timer out 1
353 to 383	Timer out 2 to Timer out 16	Auxiliary Timer 2 to Auxiliary Timer 16	Auxiliary Timer out 2 to Auxiliary Timer out 16.
384-385	--	Unused	--
386	SG-opto Invalid	Group Selection	Setting Group (selected via opto inputs 1 & 2) invalid
387	Prot'n Disabled	OOS ALARM	Protection is disabled and test mode enabled
388-408	--	Unused	--
409	SR User Alarm 1	PFSI	Self reset alarm 1 (user programming)
410 to 425	SR User Alarm 2 to SR User Alarm 17	PFSI	Self reset alarms 2 to 17 (user programming)
426	MR User Alarm 18	PFSI	Manual reset alarm 18 (user programming)
427 to 443	MR User Alarm 19 to MR User Alarm 35	PFSI	Manual reset alarms 19 to 35 (user programming)
444 to 447	--	Unused	--
448	Battery Fail	Self Monitoring	Battery Fail alarm indication
449	Field Volts Fail	Self Monitoring	Relay 48V output Voltage Failure
450	Rear Comm2 FAIL	PSL(OUT)	Alarm second rear port
451	GOOSE IED Absent	PSL(OUT)	The IED has not subscribed to a publishing IED
452	NIC Not Fitted	PSL(OUT)	Network Interface Card not fitted/failed alarm
453	NIC No Response	PSL(OUT)	Network Interface Card not responding alarm
454	NIC Fatal Error	PSL(OUT)	Network Interface Card fatal error alarm indication
455	NIC Soft. Reload	PSL(OUT)	Network Interface Card software reload alarm
456	Bad TCP/IP Cfg.	PSL(OUT)	Bad TCP/IP Configuration Alarm
457	Bad OSI Config.	PSL(OUT)	Bad OSI Configuration Alarm
458	NIC Link Fail	PSL(OUT)	Network Interface Card link fail alarm indication
459	NIC SW Mis-Match	PSL(OUT)	Main card/NIC software mismatch alarm indication
460	IP Addr Conflict	PSL(OUT)	IP address conflict alarm indication
461	IM Loopback	PSL(OUT)	InterMiCOM indication that loopback testing is in progress
462	IM Msg Fail	PSL(OUT)	InterMiCOM message failure alarm
463	IM DCD Fail	PSL(OUT)	InterMiCOM data channel detect fail
464	IM Chan Fail	PSL(OUT)	InterMiCOM message channel fail
465	Backup Setting	PSL(OUT)	Back up setting alarm
466 to 511	--	Unused	--
512	Control Input 1	User Control 1	Control Input 1 - for SCADA and menu commands into PSL
513 to 543	Control input 2 to Control input 32	User Control 2 to User Control 32	Control input 2 to Control input 32
544 to 575	--	Unused	--
576	InterMiCOM in 1	Interin	InterMiCOM IM1 Signal Input - is driven by a message from the remote line end
577 to 583	InterMiCOM in 2 to InterMiCOM in 8	Interin	InterMiCOM IM2 Signal Input to InterMiCOM IM8 Signal Input
584	InterMiCOM out 1	Interout	InterMiCOM IM1 Signal output - mapping what will be sent to the remote line end



DDB No.	English Text	Source	Description
585 to 591	InterMiCOM out 2 to InterMiCOM out 8	Interout	InterMiCOM IM2 Signal output to InterMiCOM IM8 Signal output
592 to 607	--	Unused	--
608	Virtual Output1	PSL	GOOSE Output 01 - Allows binary signals to send to other devices
609 to 671	Virtual Output2 to Virtual Output64	PSL	GOOSE Output 02 to GOOSE Output 64 Allows binary signals to send to other devices
672 to 735	--	Unused	--
736	Virtual Input 1	UCA2 GOOSE	GOOSE Input 01 - Allows binary signals to be mapped to interface into PSL
737 to 863	Virtual Input 01 to Virtual Input 128	UCA2 GOOSE	GOOSE Input 01 to GOOSE Input 128 Allows binary signals to be mapped to interface into PSL
864 to 991	PubPres VIP 1 to PubPres VIP 128	PSL	Publishing presence of virtual input 1 (to 128): indicates virtual input 1 (to 128) presence.
992 to 1119	Quality VIP 1 to Quality VIP 128	PSL	Validation of the GOOSE virtual input 1 (to 64) (signal correct).
1122	SG Select x1	PSL	Setting Group Selector x1 (bit 0). See section P849/EN OP: setting groups selection
1123	SG Select 1x	PSL	Setting Group Selector 1x (bit 1). See section P849/EN OP: setting groups selection
1124	RP1 Read Only	PSL	Rear Port 1 in read only mode
1125	RP2 Read Only	PSL	Rear Port 2 in read only mode
1126	NIC Read Only	PSL	Remote Network Interface Card in read only mode
1127	103 MonitorBlock	PSL	Monitor Blocking
1128	103 Command Block	PSL	Command Blocking
1129	--	Unused	--
1130	Reset Relays/LED	PSL	Reset Latched Relays & LEDs
1131	Time Synch	PSL	Time synchronise to nearest minute on 0-1 change
1132	Logic 0 Ref.	--	Low logic level for for PSL requirements (this level never changes).
1133 to 1215	--	Unused	--
1216 to 1515	PSL	PSLINT	PSL Internal connection
1516 to 2047	--	Unused	--

1.7.2 Sorted by DDB name

DDB No.	English Text	Source	Description
1128	103 Command Block	PSL	Command Blocking
1127	103 MonitorBlock	PSL	Monitor Blocking
465	Backup Setting	PSL(OUT)	Back up setting alarm
457	Bad OSI Config.	PSL(OUT)	Bad OSI Configuration Alarm
456	Bad TCP/IP Cfg.	PSL(OUT)	Bad TCP/IP Configuration Alarm
448	Battery Fail	Self Monitoring	Battery Fail alarm indication
512	Control Input 1	User Control 1	Control Input 1 - for SCADA and menu commands into PSL
513 to 543	Control input 2 to Control input 32	User Control 2 to User Control 32	Control input 2 to Control input 32
449	Field Volts Fail	Self Monitoring	Relay 48V output Voltage Failure
273	FnKey LED1 ConG	PSL	Function key tri LED conditioner Green. Assignment of signal to drive output FnKey Tri-LED 1 Green. This LED is associated with Function Key 1 - To drive function key LED yellow, DDB 272 and DDB 273 must be active at the same time
272	FnKey LED1 ConR	PSL	Function key tri LED conditioner Red. Assignment of signals to drive output FnKey Tri-LED 2 Red to FnKey Tri-LED 9 Green
209	FnKey LED1 Grn	PSL	Programmable function key Tri-LED 1 Green energized
208	FnKey LED1 Red	PSL	Programmable function key Tri-LED 1 Red energized
274 to 291	FnKey LED2 ConR to FnKey LED10 ConG	PSL	Assignment of signals to drive output FnKey Tri-LED 2 Red to FnKey Tri-LED 9 Green
210 to 226 to 227	FnKey LED2 Red to FnKey LED2 Grn to FnKey LED10 Red to FnKey LED10 Grn	...	Programmable function key Tri-LED 2 Red / Green to Programmable function key Tri-LED 10 Red / Green
320	Function Key 1	User Control	Function Key 1 is activated. In 'Normal' mode it is high on keypress and in 'Toggle' mode remains high/low on single keypress
321 to 329	Function Key 2 to Function Key 10	User Control	Function Keys 2 to 10 are activated.
451	GOOSE IED Absent	PSL(OUT)	The IED has not subscribed to a publishing IED
464	IM Chan Fail	PSL(OUT)	InterMiCOM message channel fail
463	IM DCD Fail	PSL(OUT)	InterMiCOM data channel detect fail
461	IM Loopback	PSL(OUT)	InterMiCOM indication that loopback testing is in progress
462	IM Msg Fail	PSL(OUT)	InterMiCOM message failure alarm
576	InterMiCOM in 1	Interin	InterMiCOM IM1 Signal Input - is driven by a message from the remote line end
577 to 583	InterMiCOM in 2 to InterMiCOM in 8	Interin	InterMiCOM IM2 Signal Input to InterMiCOM IM8 Signal Input
584	InterMiCOM out 1	Interout	InterMiCOM IM1 Signal output - mapping what will be sent to the remote line end
585 to 591	InterMiCOM out 2 to InterMiCOM out 8	Interout	InterMiCOM IM2 Signal output to InterMiCOM IM8 Signal output
460	IP Addr Conflict	PSL(OUT)	IP address conflict alarm indication
258 to 271	LED 2 Con R to LED 8 Con G	PS	Tri-LED conditioners 2 (Red) to 8 (Green)
257	LED1 Con G	PSL	Assignment of signal to drive output Tri-LED 1 Green
256	LED1 Con R	PSL	Assignment of signal to drive output Tri-LED 1 Red
193	LED1 Grn	PSL	Programmable Tri-LED 1 Green is energized
192	LED1 Red	PSL	Programmable Tri-LED 1 Red is energized:
207	LED8 Grn	PSL	Programmable Tri-LED 8 Green energized
206	LED8 Red	PSL	Programmable Tri-LED 8 Red energized
1132	Logic 0 Ref.	--	Low logic level for for PSL requirements (this level never changes).
426	MR User Alarm 18	PFSI	Manual reset alarm 18 (user programming)



DDB No.	English Text	Source	Description
427 to 443	MR User Alarm 19 to MR User Alarm 35	PFSI	Manual reset alarms 19 to 35 (user programming)
454	NIC Fatal Error	PSL(OUT)	Network Interface Card fatal error alarm indication
458	NIC Link Fail	PSL(OUT)	Network Interface Card link fail alarm indication
453	NIC No Response	PSL(OUT)	Network Interface Card not responding alarm
452	NIC Not Fitted	PSL(OUT)	Network Interface Card not fitted/failed alarm
1126	NIC Read Only	PSL	Remote Network Interface Card in read only mode
455	NIC Soft. Reload	PSL(OUT)	Network Interface Card software reload alarm
459	NIC SW Mis-Match	PSL(OUT)	Main card/NIC software mismatch alarm indication
64	Opto Input 1	Opto Isolator Input 1	OPTO ISOLATOR 1 Set to 1 when the opto input is energised for a minimum time: 7ms (48Vdc), 10ms (universal) to be validated by internal logic To enable the selection of a setting group by state change of the opto isolated logic inputs 1 and 2, disconnect Opto inputs 01 and 02 in the PSL (Opto inputs 01 and 02 must not be connected to any output signal)
65	Opto Input 2	Opto Isolator Input 2	OPTO ISOLATOR 2 Set to 1 when the opto input is energised for a minimum time: 7ms (48Vdc), 10ms (universal) to be validated by internal logic To enable the selection of a setting group by state change of the opto isolated logic inputs 1 and 2, disconnect Opto inputs 01 and 02 in the PSL (Opto inputs 01 and 02 must not be connected to any output signal)
66 to 127	Opto Input 3 to Opto Input 64	Opto Isolator Input 3 to Opto Isolator Input 64	OPTO ISOLATOR 3 to OPTO ISOLATOR 32 Set to 1 when the opto input is energised for a minimum time: 7ms (48Vdc), 10ms (universal) to be validated by internal logic
387	Prot'n Disabled	OOS ALARM	Protection is disabled and test mode enabled
1216 to 1515	PSL	PSLINT	PSL Internal connection
864 to 991	PubPres VIP 1 to PubPres VIP 128	PSL	Publishing presence of virtual input 1 (to 128): indicates virtual input 1 (to 128) presence.
992 to 1119	Quality VIP 1 to Quality VIP 128	PSL	Validation of the GOOSE virtual input 1 (to 64) (signal correct).
450	Rear Comm2 FAIL	PSL(OUT)	Alarm second rear port
0 to 59	Relay 1 to Relay 60	Relay Conditioner 1 to Relay Conditioner 60	Output Relay 1 to Output Relay 60 High level when a DDB cell (linked by PSL logic) is at 1. State depends on the logic set in the PSL (MiCOM S1) These programmable relays are assigned in the default PSL, with the following logic conditions: - Pulse time-delay - Pick Up/Drop Off Time-delay - Dwell Time-delay - Pick Up Time-delay - Drop Off Time-delay - Latching - Straight (used in default PSL)
128 to 187	Relay Cond 1 to Relay Cond 60	PSL	Relay Conditioner 1 to Relay Conditioner 60
1130	Reset Relays/LED	PSL	Reset Latched Relays & LEDs
1124	RP1 Read Only	PSL	Rear Port 1 in read only mode
1125	RP2 Read Only	PSL	Rear Port 2 in read only mode
1123	SG Select 1x	PSL	Setting Group Selector 1x (bit 1)
1122	SG Select x1	PSL	Setting Group Selector x1 (bit 0)
386	SG-opto Invalid	Group Selection	Setting Group (selected via opto inputs 1 & 2) invalid
409	SR User Alarm 1	PFSI	Self reset alarm 1 (user programming)
410 to 425	SR User Alarm 2 to SR User Alarm 17	PFSI	Self reset alarms 2 to 17 (user programming)
1131	Time Synch	PSL	Time synchronise to nearest minute on 0-1 change
352	Timer out 1	Auxiliary Timer 1	Auxiliary Timer out 1
353 to 383	Timer out 2 to Timer out 16	Auxiliary Timer 2 to Auxiliary Timer 16	Auxiliary Timer out 2 to Auxiliary Timer out 16.

DDB No.	English Text	Source	Description
188 to 191	Unused	--	--
737 to 863	Virtual Input 01 to Virtual Input 128	UCA2 GOOSE	GOOSE Input 01 to GOOSE Input 128 Allows binary signals to be mapped to interface into PSL
736	Virtual Input 1	UCA2 GOOSE	GOOSE Input 01 - Allows binary signals to be mapped to interface into PSL
608	Virtual Output1	PSL	GOOSE Output 01 - Allows binary signals to send to other devices
609 to 671	Virtual Output2 to Virtual Output64	PSL	GOOSE Output 02 to GOOSE Output 64 Allows binary signals to send to other devices

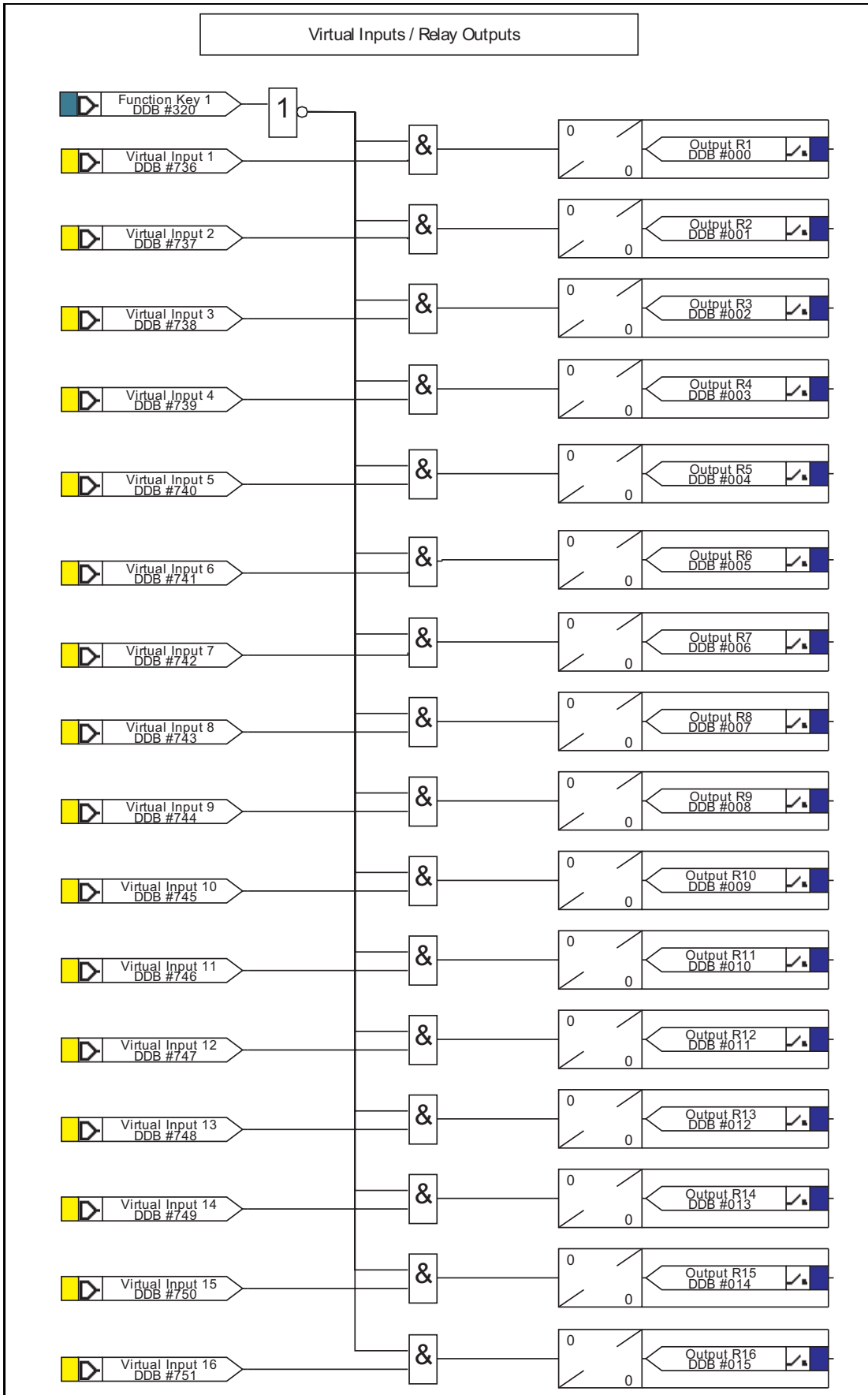
1.8 Factory default programmable scheme logic

The following section details the default settings of the PSL. The MiCOM P849 models are as follows:

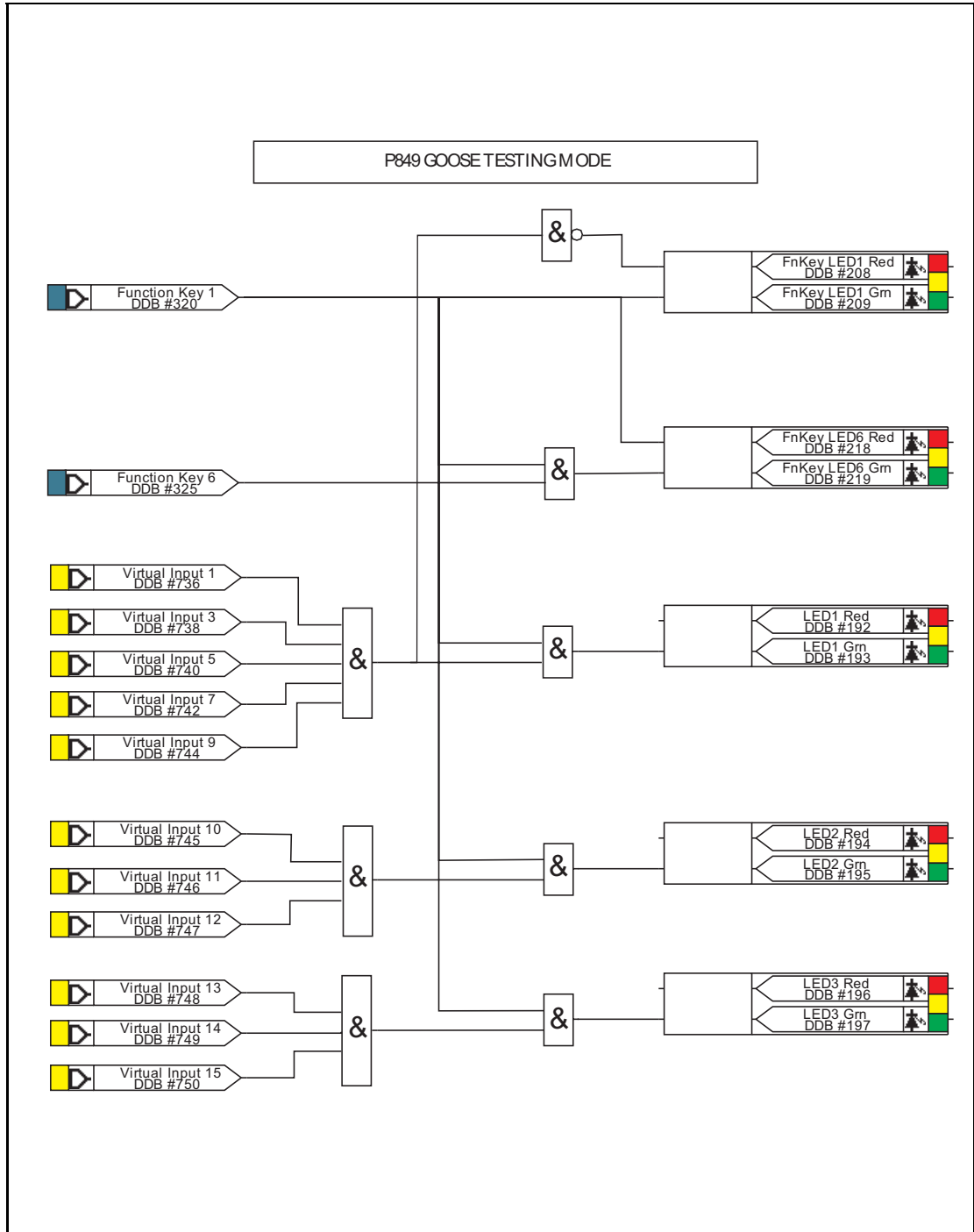
Model	Logic Inputs	Relay Outputs		
		Total	relays	High break relays
P849xxxA	32	16	16	--
P849xxxB	48	24	24	--
P849xxxC	32	30	14	16
P849xxxD	16	60	60	--
P849xxxE	64	16	16	--
P849xxxF	32	46	46	--

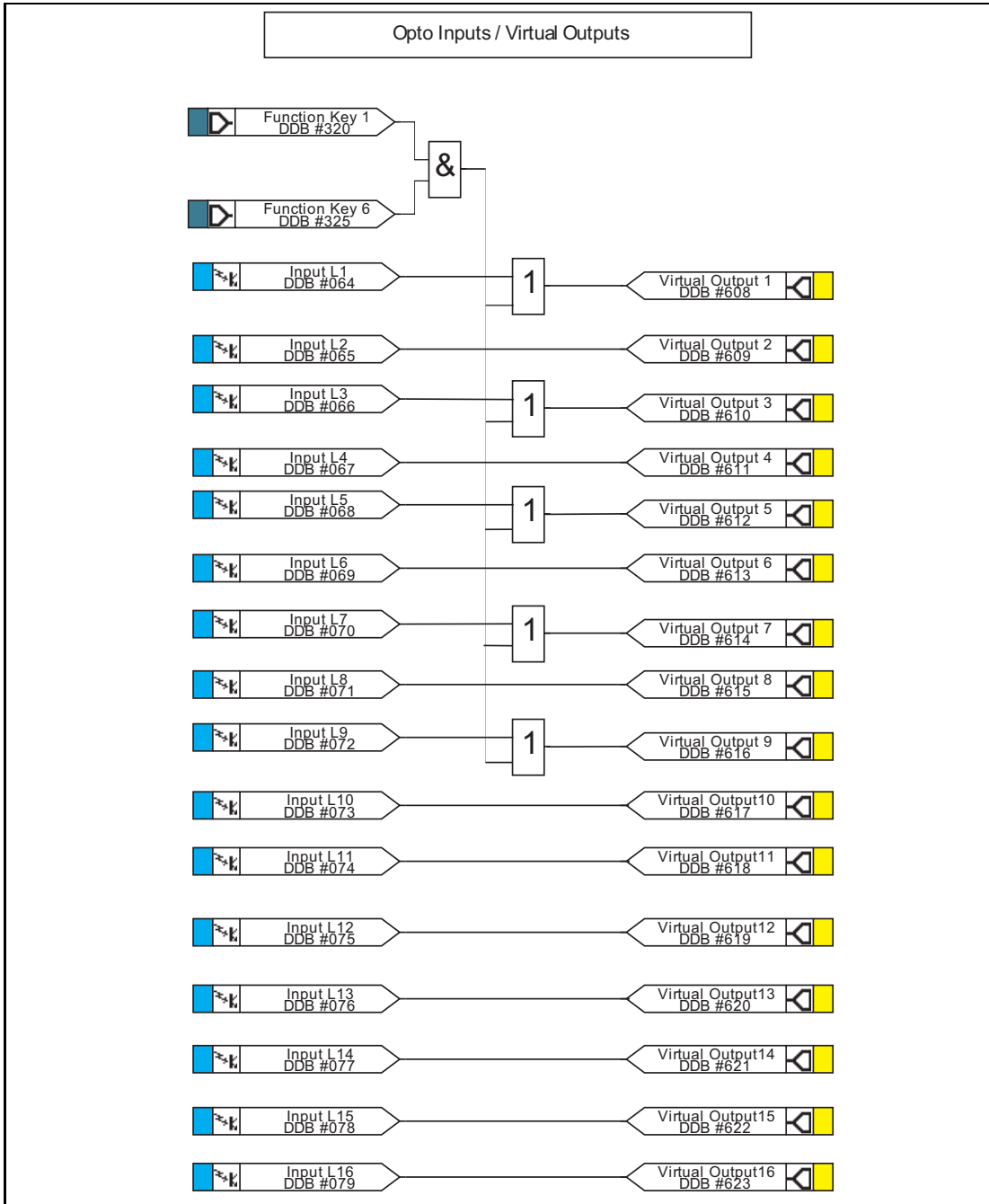


2. MiCOM P849 PROGRAMMABLE SCHEME LOGIC



PL





PL

RECORDING

MR

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

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1. RECORDING

1.1 Introduction

The MiCOM P849 is equipped with integral standard and precise event recording facilities suitable for analysis of complex system records.

The device is flexible enough to allow for the programming of these facilities to specific user application requirements and are discussed below.

Note: The MiCOM P849 does not produce measurements.

1.2 Standard Event recorder

The records and time tags up to 512 events and stores them in non-volatile (battery backed up) memory. This enables the system operator to establish the sequence of events that occurred within the device following a particular power system condition, switching sequence etc. When the available space is exhausted, the oldest event is automatically overwritten by the new one.

The real time clock within the device provides the time tag to each event, to a resolution of 1ms.

The event records are available for viewing either via the front plate LCD or remotely, via the communications port or via MiCOM S1 Studio with a PC connected to the device (event extracted from device & loaded in PC):

Right-click on a device's Events folder in Studio Explorer and select Extract Events,

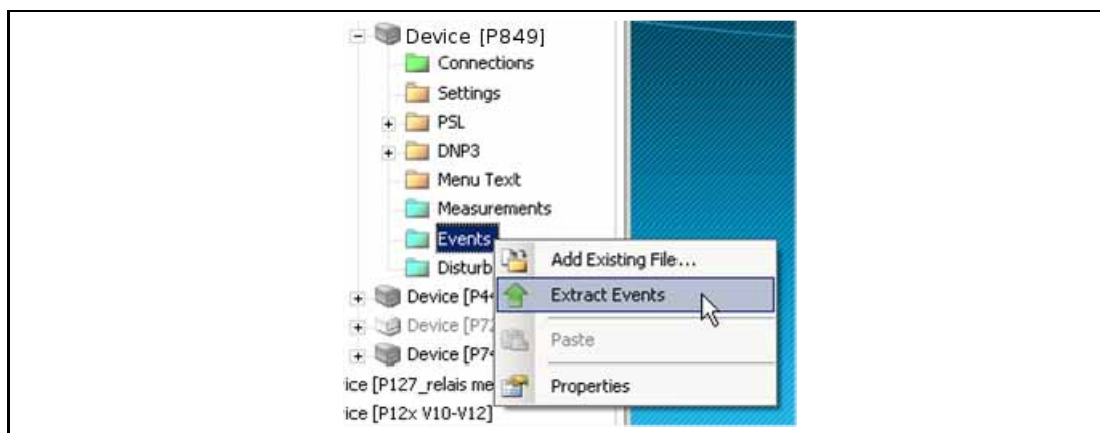


Figure 1:

Local viewing on the LCD is achieved in the menu column entitled "VIEW RECORDS". This column allows viewing of event records.

VIEW RECORDS	
LCD Reference	Description
Select Event	Setting range from 0 to 511. This selects the required event record from the possible 512 that may be stored. A value of 0 corresponds to the latest event and so on.
Menu Cell Ref	Self reset alarm active Self reset alarm inactive Relay event Opto event Protection event Platform event Fault logged event Maintenance Record logged event

VIEW RECORDS	
LCD Reference	Description
Time & Date	Time & Date Stamp for the event given by the internal Real Time Clock.
Record Text	Up to 32 Character description of the Event (refer to following sections).
Record Value	Up to 32 Bit Binary Flag or integer representative of the Event (refer to following sections).
Select Maint	Setting range from 0 to 4. This selects the required maintenance record from the possible 5 that may be stored. A value of 0 corresponds to the latest event and so on.
Maint Text Maint Type Maint Data	The following cells show all the starts etc. associated with the event.
Reset Indication	Either Yes or No. This serves to reset the trip LED indications provided that the relevant element has reset, to reset all LED and relays latched in the PSL, and to reset the latched alarms.

For extraction from a remote source via communications, refer to the SCADA Communications section (P849/EN CT), where the procedure is fully explained.

1.2.1.1 Types of event

An event may be a change of state of a control input or output relay, an alarm condition, setting change etc. The following sections show the various items that constitute an event:

1.2.1.2 Change of state of opto-isolated inputs

If one or more of the opto (logic) inputs has changed state since the last time that the algorithm ran, the new status is logged as an event. When this event is selected to be viewed on the LCD, three applicable cells will become visible as shown below:

Time & date of event
“LOGIC INPUTS1”
“Event Value 0101010101010101”

The Event Value is a 32-bit word showing the status of the opto inputs, where the least significant bit (extreme right) corresponds to opto input 1 etc. The same information is present if the event is extracted and viewed via PC.

1.2.1.3 Change of state of one or more output relay contacts

If one or more of the output relay contacts have changed state since the last time that the algorithm ran, then the new status is logged as an event. When this event is selected to be viewed on the LCD, three applicable cells will become visible as shown below:

Time & date of event
“OUTPUT CONTACTS 1”
“Event Value 1010101010101010”

The Event Value is a 24 bit word showing the status of the output contacts, where the least significant bit (extreme right) corresponds to output contact 1 etc. The same information is present if the event is extracted and viewed via PC.

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1.2.1.4 Device alarm conditions

Any alarm conditions generated by the device will also be logged as individual events. The following table shows examples of some of the alarm conditions and how they appear in the event list:

Alarm Condition	Event Text ('System Data / Alarms Status 1" menu)	Event Value
Setting group via optos invalid	SG-opto Invalid	Bit position 3 in 32 bit field
Protection disabled	Prot'n Disabled	Bit position 4 in 32 bit field

The previous table shows the abbreviated description that is given to the various alarm conditions and also a corresponding value between 0 and 31. This value is appended to each alarm event in a similar way as for the input and output events previously described. It is used by the event extraction software, such as MiCOM S1 Studio, to identify the alarm and is therefore invisible if the event is viewed on the LCD. Either ON or OFF is shown after the description to signify whether the particular condition has become operated or has reset.

Bit	Texte	Bit	Texte
Alarm Status 1		Alarm Status 3	
1	Unused	1	Battery Fail
2	Unused	2	Field Volt Fail
3	SG-opto Invalid	3	Comm2 H/W FAIL
4	Prot'n Disabled	4	GOOSE IED Absent
5 to 25	Unused	5	NIC Not Fitted
26 to 32	SR User Alarm 1 (to 7)	6	NIC No Response
		8	NIC Soft. Reload
Alarm Status 2		9	Bad TCP/IP Config.
1 to 4	Unused	10	Bad OSI Config.
5 to 14	SR User Alarm 8 tp 17	12	NIC SW Mis-Match
15 to 32	MR User Alarm 18 to 35	13	IP Addr Conflict
		14	IM Loopback
		15	IM Message Fail
		16	IM Data CD Fail
		17	IM Channel Fail
		18	Backup Setting
		19	Bad DNP Setting
		20 to 32	Unused

1.2.1.5 General events

A number of events come under the heading of 'General Events'. The following list items are stored as events.

- Recognition of change of state of logic (optically isolated) inputs;
- Recognition of change of state of output relays;
- Alarms;
- Maintenance records;
- Settings changes (local and remote);

A complete list of the 'General Events' is given in the Device Menu Database (P849/EN MD), which is a separate document.

1.2.1.6 Setting changes

Changes to any setting within the device are logged as an event.

Note: Control/Support settings are settings which are not duplicated within the four setting groups. When any of these settings are changed, the event record is created simultaneously. However, changes to precise or standard event recorder settings will only generate an event once the settings have been confirmed at the 'setting trap'.

1.2.2 Resetting of precise event records

If it is required to delete either the precise event or maintenance reports, this may be done from within the "RECORD CONTROL" column (displayed when enabled in the "CONFIGURATION" column).

1.2.3 Viewing event records via MiCOM S1 Studio support software

When the event records are extracted and viewed on a PC they look slightly different than when viewed on the LCD.

The various events appear when displayed using MiCOM S1 Studio with:

- the description and time stamp for the event, whilst the additional information that is displayed below may be collapsed via the +/- symbol.
- For further information regarding events and their specific meaning, refer to device menu database document (P849/EN MD). This is a standalone document not included in this manual.

1.2.4 Event filtering

It is possible to disable the reporting of events from all interfaces that supports setting changes. The settings that control the various types of events are in the "RECORD CONTROL" column. The following changes are stored as events:

- change of state logic (opto-isolated) inputs,
- change of state of output relays,
- Alarms,
- Maintenance records.
- Settings changes (local and remote);

The effect of setting each to disabled is as follows:

Menu text	action
Clear Events	To clear the existing event log. An event will be generated indicating that the events have been erased
Clear Maint	To erase the existing maintenance.
Alarm Event	Disabled = all the occurrences that produce an alarm will result in no event being generated.
Relay O/P Event	Disabled = no event generated for any change in logic input state.
Opto Input Event	Disabled = no event generated for any change in logic input state.
General Event	Disabled = no General Events generated
Maint. Rec Event	Disabled = no event generated for any occurrence that produces a maintenance record.
Clear Dist Recs	To clear the existing records. An event will be generated indicating that the records have been erased.

Note that some occurrences will result in more than one type of event, e.g. a battery failure will produce an alarm event and a maintenance record event.

For further information regarding events and their specific meaning, refer to device menu database document (P849/EN MD).

1.3 Precise event recorder (menu 'Disturb recorder')

The integral precise event recorder has an area of memory specifically set aside for record storage. The number of records that may be stored by the device is dependent upon the selected recording duration. The device can typically store a minimum of 50 records, each of 1.5 seconds duration. Precise event records continue to be recorded until the available memory is exhausted, at which time the oldest record(s) are overwritten to make space for the newest one.

Each precise event record consists of up to 32 digital data channels.

Menu text	action
Duration	This sets the overall recording time
Trigger Position	This sets the trigger point as a percentage of the duration
Trigger Mode	Sets Single or Extended trigger mode.
Digital input xx (with xx = 1 to 32)	Any relay output digital channel, any Opto-isolated inputs or Internal digital signals can be assigned to this channel. The digital channel will trigger the precise event recorder when the corresponding assigned event will occur.
Digital trigger xx (with xx = 1 to 32)	When "Trigger L/H" is selected, the channel will trigger the precise event recorder when changing from '0' (low Level) to '1' (High level). If "Trigger H/L" is selected, it will trigger when changing from '1' (high level) to '0' (low level).

The pre and post event recording times are set by a combination of the "Duration" and "Trigger Position" cells. "Duration" sets the overall recording time and the "Trigger Position" sets the trigger point as a percentage of the duration. For example, the default settings show that the overall recording time is set to 1.5s with the trigger point being at 33.3% of this, giving 0.5s pre-event and 1.0s post event recording times.

If a further trigger occurs whilst a recording is taking place, the recorder will ignore the trigger if the "Trigger Mode" has been set to "Single". However, if this has been set to "Extended", the post trigger timer will be reset to zero, thereby extending the recording time.

The digital channels may be mapped to any of the opto isolated inputs or output contacts, in addition to a number of internal device digital signals, LEDs etc. The complete list of these signals may be found by viewing the available settings in the device menu or via a setting file in MiCOM S1 Studio. Any of the digital channels may be selected to trigger the precise event recorder on either a low to high or a high to low transition, via the "Input Trigger" cell.

It is not possible to view the precise event records locally via the LCD; they must be extracted using suitable software such as MiCOM S1 Studio. This process is fully explained in the SCADA Communications section (P849/EN SC).

1.4 Measurements

The MiCOM P849 device does not acquire any analogue value. The "Measurements SETUP" (when visible) does not display measurements.

FIRMWARE DESIGN

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Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

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1. SYSTEM OVERVIEW

1.1 Hardware overview

The hardware is based on a modular design whereby the device is made up of an assemblage of several modules that are drawn from a standard range. Some modules are essential while others are optional depending on the user's requirements.

The modules and the processor boards form a network. A data bus, used for data exchange and address selection, links this network. The processor controls and drives the input/output boards and the other modules of the device. The following figure illustrates the data exchange.

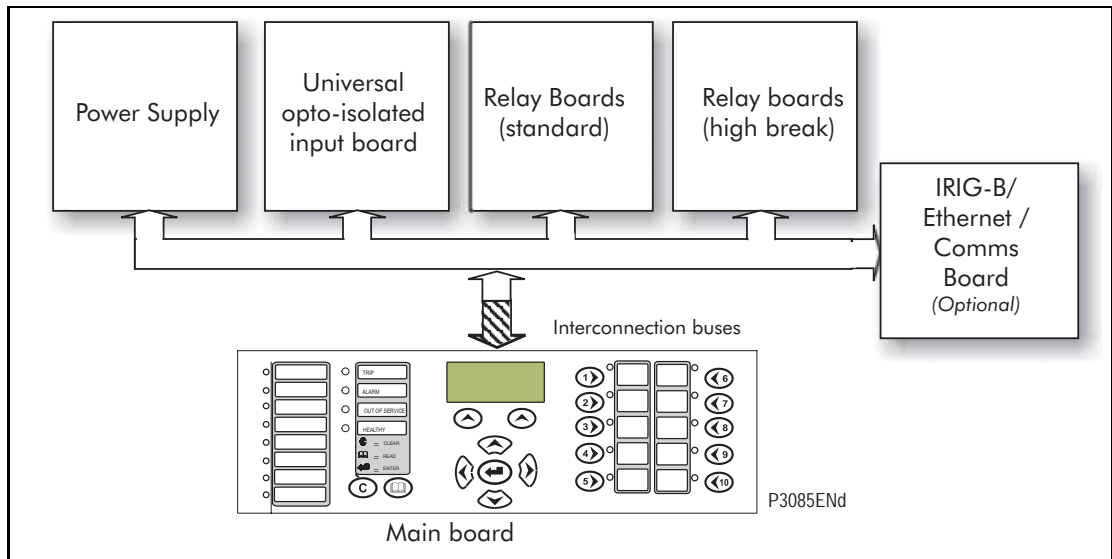


FIGURE 1: MICOM P849 ARCHITECTURE

The different modules that can be present in the device are as follows:

1.1.1 Processor board (Main board)

The main board performs some functions for the device (fixed and programmable scheme logic...) and controls the operation of modules which are on its interconnection bus within the device. The main board also contains and controls the user interfaces (LCD, LEDs, keypad and communication interfaces).

1.1.2 Universal opto-isolated Input module

The standard opto-isolated input module consists of a main input board which provides isolated digital inputs.

1.1.3 Input and output boards

Model	Opto-inputs	Device outputs
P849xxxA	32 x UNI ⁽¹⁾	16 (12 N/O, 4 C/O)
P849xxxB	48 x UNI ⁽¹⁾	24 (18 N/O, 6 C/O)
P849xxxC	32 x UNI ⁽¹⁾	14 (6 N/O, 8 C/O) + 16 high break devices
P849xxxD	16 x UNI ⁽¹⁾	60 (36 N/O, 24 C/O)
P849xxxE	64 x UNI ⁽¹⁾	16 (12 N/O, 4 C/O)
P849xxxF	32 x UNI ⁽¹⁾	46 (30 N/O, 16 C/O)

⁽¹⁾ Universal voltage range opto inputs N/O – normally open
C/O – change over

1.1.4 Power supply module

The power supply module provides a power supply to all of the other modules in the device, at three different voltage levels. The power supply board also provides the EIA(RS)485 electrical connection for the rear communication port.

The power supply module also provides a 48V external field supply output to drive the opto isolated digital inputs (or the substation battery may be used to drive the optos).

1.1.5 IRIG-B modulated or unmodulated board

The modulated or unmodulated IRIG-B board, which is optional, can be used where an IRIG-B signal is available to provide an accurate time reference for the device. There is also an option on this board to specify:

- a fibre optic rear communication port, for use with IEC60870 communication only.
- A second rear port designed typically for dial-up modem access by engineers/operators (see section 1.1.6).

All modules are connected by a parallel data and address bus which allows the processor board to send and receive information to and from the other modules as required. There is also a separate serial data bus for conveying data from the input module to the processor. The section “Software overview” (section 1.2) shows the modules of the device and the flow of information between them.

The IRIG-B board is controlled by the main board.

1.1.6 Second rear comms and InterMiCOM board board (optional)

The optional second rear port is designed typically for dial-up modem access by engineers/operators, when the main port is reserved for SCADA traffic. Communication is via one of three physical links; K-Bus, EIA(RS)485 or EIA(RS)232. The port supports full local or remote control access by MiCOM S1 V2 or MiCOM S1 Studio software. The second rear port is also available with an on board IRIG-B input.

The optional board also houses port “SK5”, the InterMiCOM teleprotection port. InterMiCOM permits end-to-end signalling with a remote device. Port SK5 has an EIA(RS)232 connection, allowing connection to a MODEM, or compatible multiplexers.

1.1.7 Ethernet or Redundant Ethernet board

Ethernet or redundant Ethernet boards are mandatory boards for IEC 61850 enabled devices. The boards provide network connectivity through either copper or fiber media at rates of 10Mb/s (copper only) or 100Mb/s. There is also an option on the Ethernet board to specify IRIG-B board port (modulated or un-modulated). This board and the second rear comms. board are mutually exclusive as they both utilize the same slot within the device case.

All modules are connected by a parallel data and address bus that allows the processor board to send and receive information to and from the other modules as required. There is also a separate serial data bus for conveying data from the input module to the processor.

Note: It is possible to connect to the Ethernet network any of the MiCOM P849 without the embedded Ethernet board using the RS485 to Ethernet converter MiCOM I4X (Courier protocol)

1.2 Software overview

The device is a centralised system.

The software for the device can be conceptually split into four elements; the real-time operating system, the system services software, the platform software and the control software. These four elements are not distinguishable to the user, and are all processed. The distinction between the four parts of the software is made purely for the purpose of explanation here:

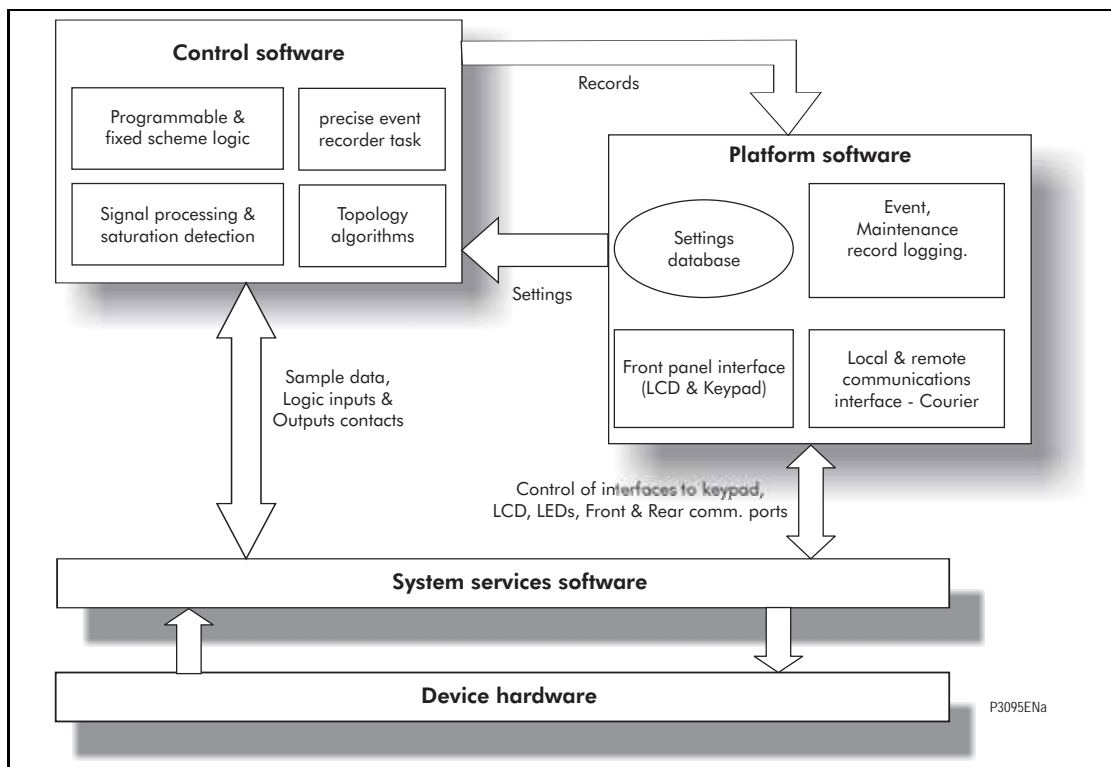


FIGURE 2: SOFTWARE OVERVIEW

1.2.1 Real-time operating system

As explain in the hardware overview, each device contains one main board. A real time operating system is used to provide a framework for the different parts of the device's software to operate within. To this end the software is split into tasks. The real-time operating system is responsible for scheduling the processing of these tasks such that they are carried out in the time available and in the desired order of priority.

The real-time operating system is responsible for scheduling the processing of these tasks such that they are carried out in the time available and in the desired order of priority. The operating system is also responsible for the exchange of information between tasks, in the form of messages.

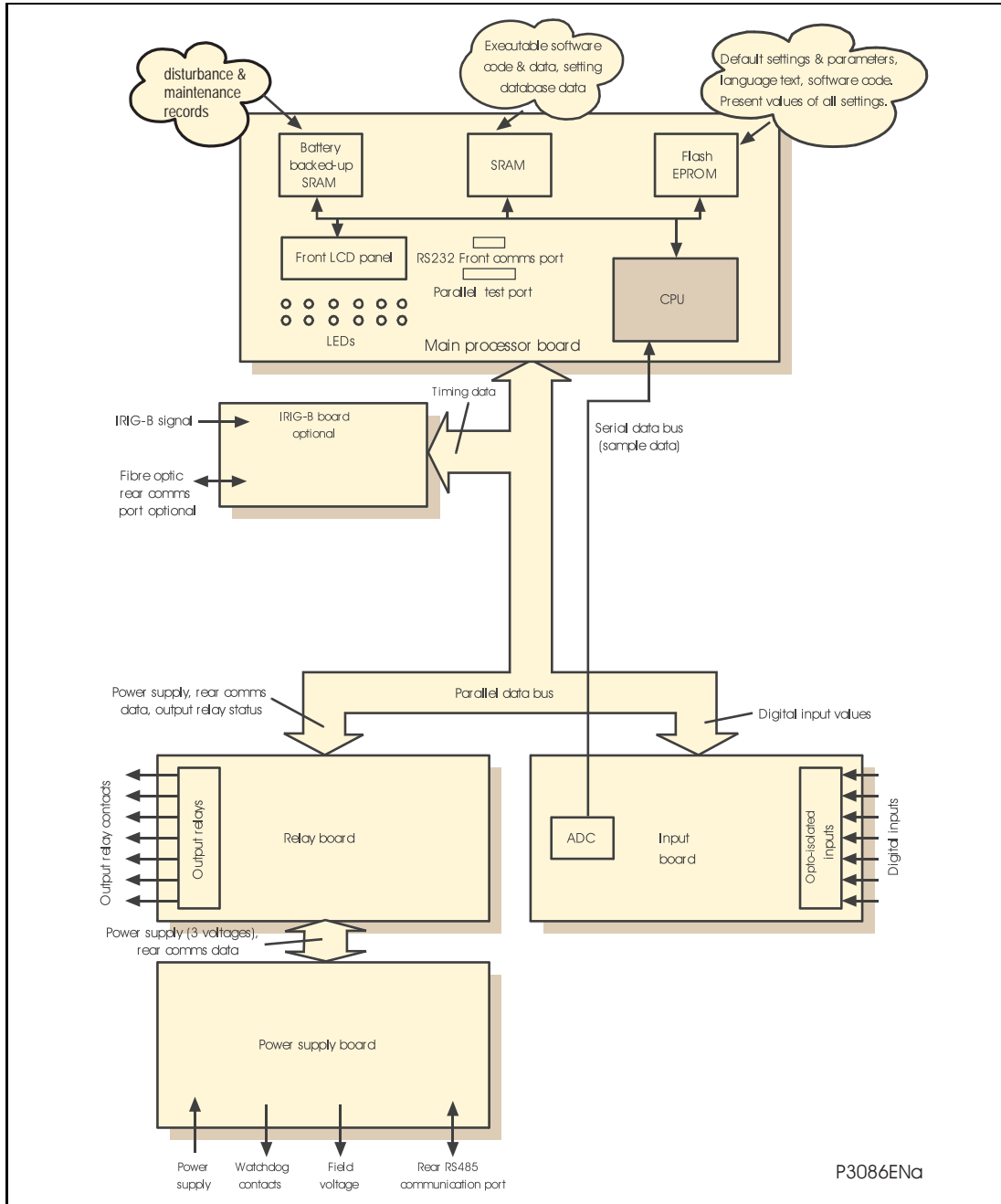


FIGURE 3: DEVICE MODULES AND INFORMATION FLOW

1.2.2 System services software

The system services software provides the low-level control of the device hardware. For example, the system services software controls the boot of the device's software from the non-volatile flash EPROM memory at power-on, and provides driver software for the user interface via the LCD and keypad, and via the serial communication ports. The system services software provides an interface layer between the control of the device's hardware and the rest of the device software.

1.2.3 Platform software

The platform software deals with the management of the device settings, the user interfaces and logging of event, alarm and maintenance records. All of the device settings are stored in a database within the device that provides direct compatibility with Courier communications. For all other interfaces (i.e. the front panel keypad, LCD interface and IEC 61850) the platform software converts the information from the database into the format required. The platform software notifies the control software of all settings changes and logs data as specified by the control software.

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1.2.4 Control software

The control software performs the calculations for all of the algorithms of the device. This includes digital signal processing and ancillary tasks. The control software interfaces with the platform software for settings changes and logging of records, and with the system services software for acquisition of data and access to output devices and digital opto-isolated inputs.

1.2.5 Precise event recorder

The logic signals are routed from the control software to the precise event recorder software. The platform software interfaces to the precise event recorder to allow extraction of the stored records.

2. HARDWARE MODULES

The device is based on a modular hardware design where each module performs a separate function within the operation. This section describes the functional operation of the various hardware modules.

2.1 Processor board

The device is based around a TMS320VC33 floating point, 32-bit digital signal processor (DSP) operating at a clock frequency of 75MHz. This processor performs all of the calculations for the device, control of the data communication and user interfaces including the operation of the LCD, keypad and LEDs.

The processor board is located directly behind the front panel which allows the LCD, function keys and LEDs to be mounted on the processor board along with the front panel communication ports. These comprise the 9-pin D-connector for EIA(RS)232 serial communications (e.g. using MiCOM S1 Studio and Courier communications) and the 25-pin D-connector device test port for parallel communication. All serial communication is handled using a field programmable gate array (FPGA).

All serial communication is handled using a two-channel 85C30 serial communications controller (SCC).

The memory provided on the main processor board is split into two categories, volatile and non-volatile; the volatile memory is fast access SRAM which is used for the storage and execution of the processor software, and data storage as required during the processor's calculations. The non-volatile memory is sub-divided into 2 groups; 4MB of flash memory for non-volatile storage of software code, present setting values, text, configuration data, latched data signals (from control inputs, function keys, LEDs, device outputs) and 4MB of battery backed-up SRAM for the storage of precise event, standard event and maintenance record data.

2.2 Internal communication bus

The internal interconnexion bus is controlled by the main board. Via its interconnection bus the main board controls also the IRIG-B board (if present).

This interconnection bus is based on a 64-way ribbon cable. The ribbon cable carries the data and address bus signals in addition to control signals and all power supply lines. Operation of the bus is driven by the main processor board that operates as a master while all other modules within the device are slaves.

The DSP processor has a built-in serial port that is used to read the data from the serial bus. The serial bus is also carried on the 64-way ribbon cable.

The main part of the bus is a parallel link with 6 address lines for board selection, 16 data lines and control lines. On the main controlled bus, main board drive address and control lines.

Other parts of the buses are:

- Power supply which are directly wired between the two interconnection buses.
- Serial lines for rear RS485 communication. So in any way main board keeps control of the rear RS485 communication.

2.3 Input board

The input module provides the interface between the processor board and the digital signals coming into the device.

The input board is shown as a block diagram in Figure 4. It provides the circuitry for the digital input signals. The digital input signals are opto isolated on this board to prevent excessive voltages on these inputs causing damage to the device's internal circuitry.

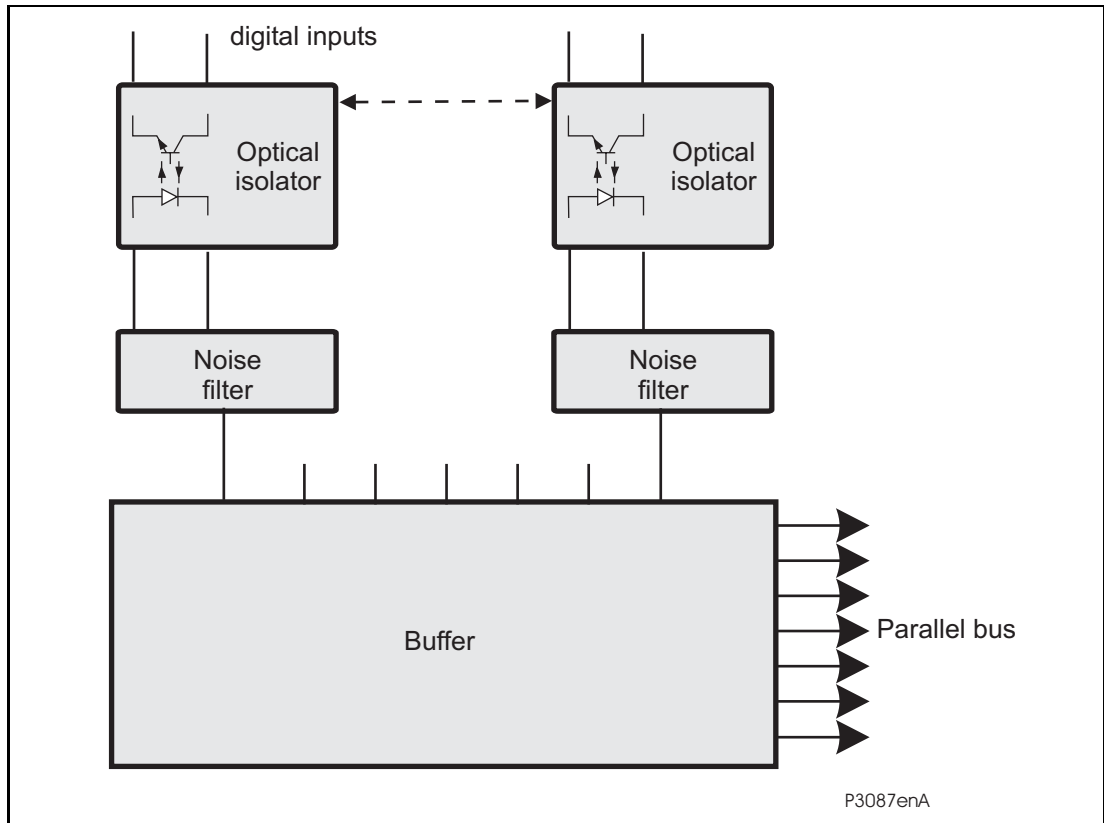


FIGURE 4: MAIN INPUT BOARD

The function of the input board is to read the state of the signals present on the digital inputs and present this to the parallel data bus for processing. One input board holds 8 optical isolators for the connection of up to eight digital input signals. The opto-isolators are used with the digital signals to isolate the device's electronics from the power system environment. The input board provides some hardware filtering of the digital signals to remove unwanted noise before buffering the signals for reading on the parallel data bus.

2.3.1 Universal opto isolated logic inputs

The MiCOM P849 device is fitted with universal opto isolated logic inputs that can be programmed for the nominal battery voltage of the circuit of which they are a part. i.e. thereby allowing different voltages for different circuits e.g. signalling, tripping. They nominally provide a Logic 1 or "ON" value for Voltages 80% of the set voltage and a Logic 0 or "OFF" value for the voltages 60% of the set voltage. This lower value eliminates fleeting pickups that may occur during a battery earth fault, when stray capacitance may present up to 50% of battery voltage across an input. Each input has filtering of 7ms. This renders the input immune to induced noise on the wiring: although this method is secure it can be slow.

In the 'Opto Config.' Menu, the nominal battery voltage can be selected for all opto inputs by selecting one of the five standard ratings in the Global Nominal V settings. If Custom is selected then each opto input can individually be set to a nominal voltage value.

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
OPTO CONFIG.				
Global Nominal V	48/54V	24/27V, 30/34V, 48/54V, 110/125V, 220/250V, Custom		
Opto Input x	48/54V	24/27V, 30/34V, 48/54V, 110/125V, 220/250V, Custom		

2.4 Power supply module (including output devices)

The power supply module contains two PCBs, one for the power supply unit itself and the other for the output devices. The power supply board also contains the input and output hardware for the rear communication port which provides an EIA(RS)485 communication interface.

2.4.1 Power supply board (including EIA(RS)485 communication interface)

One of three different configurations of the power supply board can be fitted to the device. This will be specified at the time of order and depends on the nature of the supply voltage that will be connected to the device. The three options are shown in table 1 below:

Nominal dc Range	Nominal ac Range
24/54 V	DC only
48/125 V	DC only
110/250 V	100/240 Vrms

Table 1: Power supply options

The outputs from all versions of the power supply module are used to provide isolated power supply rails to all of the other modules within the device. Three voltage levels are used within the device, 5.1V for all of the digital circuits, ±16V for the analogue electronics, e.g. on the input board, and 22V for driving the output device coils and communication boards 3.3V power supply (through on board DC-DC converter).

All power supply voltages including the 0V ground line are distributed around the device via the 64-way ribbon cables. One further voltage level is provided by the power supply board which is the field voltage of 48V. This is brought out to terminals on the back of the device so that it can be used to drive the optically isolated digital inputs.

The two other functions provided by the power supply board are the RS485 communications interface and the watchdog contacts for the device. The RS485 interface is used with the device's rear communication port to provide communication using K Bus Courier. The RS485 hardware supports half-duplex communication and provides optical isolation of the serial data being transmitted and received.

All internal communication of data from the power supply board is conducted via the output relay board which is connected to the parallel bus.

The watchdog facility provides two output device contacts, one normally open and one normally closed that are driven by the processor board. These are provided to give an indication that the device is in a healthy state.

The power supply board incorporates inrush current limiting. This limits the peak inrush current, during energization, to approximately 10A.



2.4.2 Output relay board (standard)

The output relay board holds eight devices, six with normally open contacts and two with changeover contacts. The devices are driven from the 22V power supply line. The devices' state is written to or read from using the parallel data bus.

2.4.3 Output relay board (High speed / High break)

The high speed / high break output relay board holds four devices, all normally open. The devices are driven from the 22V power supply line. The devices' state is written to or read from using the parallel data bus.

A high speed output relay board contains a hybrid of MOSFET solid state devices (SSD) in parallel with high capacity device output contacts. The MOSFET has a varistor across it to provide protection which is required when switching off inductive loads as the stored energy in the inductor causes a reverse high voltage which could damage the MOSFET.

When there is a control input command to operate an output contact, the miniature device is operated at the same time as the SSD. The miniature device contact closes in nominally 3.5ms and is used to carry the continuous load current; the SSD operates in <0.2ms and is switched off after 7.5ms. When the control input resets to open the contacts, the SSD is again turned on for 7.5ms. The miniature device resets in nominally 3.5ms before the SSD and so the SSD is used to break the load. The SSD absorbs the energy when breaking inductive loads and so limits the resulting voltage surge. This contact arrangement is for switching dc circuits only. As the SSD comes on very fast (<0.2ms) then these high break output contacts have the added advantage of being very fast operating.

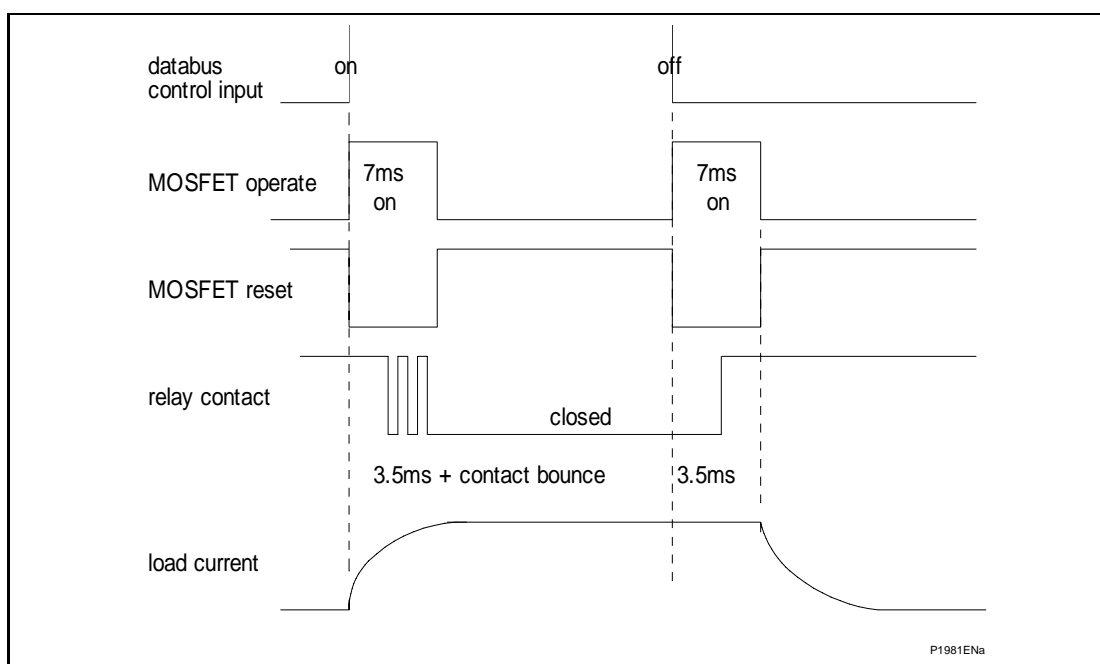


FIGURE 5: HIGH BREAK CONTACT OPERATION

2.4.4 Auxiliary power supply

The three input voltage options are the same as for main supply. The relay board is provided as an alone board.

2.4.5 IRIG-B board

The IRIG-B board is an order option that can be fitted in the MiCOM P849 to provide an accurate timing reference for the device. This is available as a modulated or de-modulated option depending on the requirements. The IRIG-B signal is connected to the board via a BNC connector on the back of the device. The timing information is used to synchronize the device's internal real-time clock to an accuracy of 1ms in the case of modulated. The internal clock is then used for the time tagging of the event, maintenance and precise event records.

2.5 Second rear communications

On ordering this board within a device, both 2nd rear communications will become connection and setting options. The user may then enable either one, or both, as demanded by the installation.

There is a hardware option of a second rear communications port, which will run the Courier language. This can be used over one of three physical links: twisted pair K-Bus (non-polarity sensitive), twisted pair EIA(RS)485 (connection polarity sensitive) or EIA(RS)232.

The second rear comms. board and Ethernet board are mutually exclusive since they use the same hardware slot. For this reason two versions of second rear comms. board are available; one with an IRIG-B input and one without. The physical layout of the second rear comms. board is shown in Figure 6.

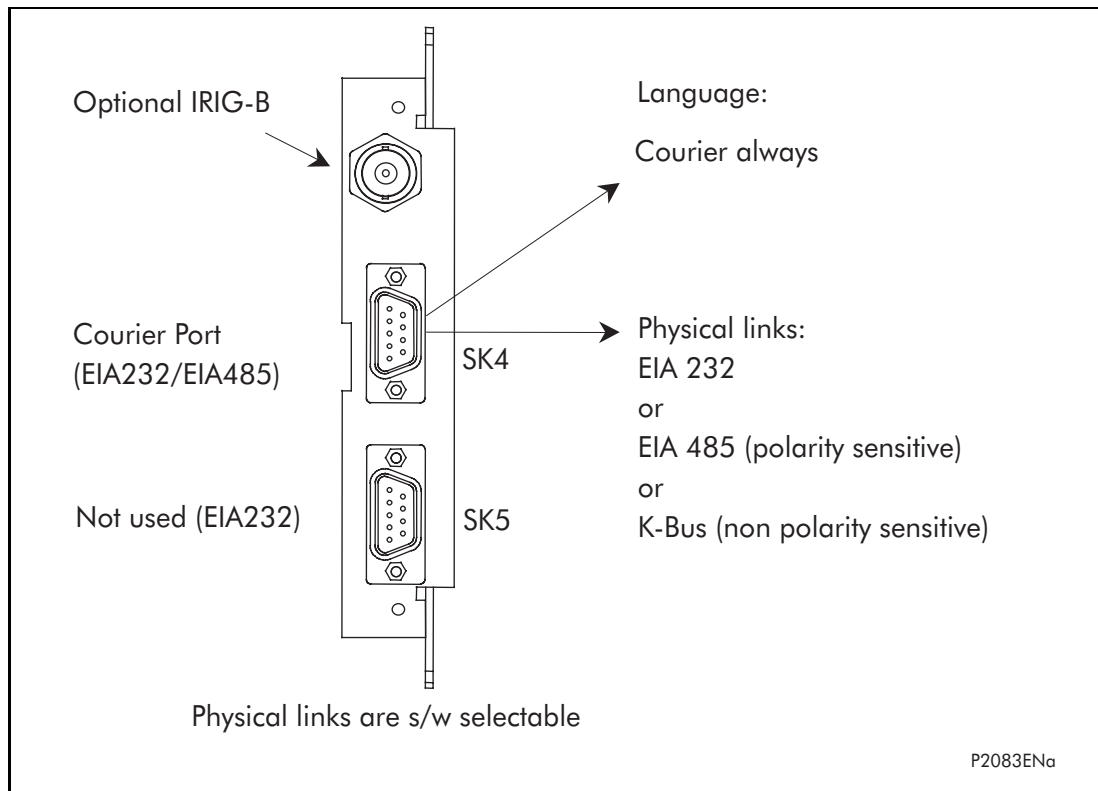


FIGURE 6: REAR COMMS. PORT

2.6 Ethernet and redundant Ethernet boards

The optional Ethernet board (ZN0049) has 3 variants which support the IEC 61850 implementation:

- 100 Mbits/s Fiber Optic + 10/100 Mbits/s Copper
- 100 Mbits/s Fiber Optic + 10/100 Mbits/s Copper + modulated IRIG-B
- 100 Mbits/s Fiber Optic + 10/100 Mbits/s Copper + demodulated IRIG-B

The optional Redundant Ethernet board (ZN0071) has 6 variants (refer to Px4x/EN REB user guide):

- redundant Ethernet (SHR protocol) with modulated or un-modulated IRIG-B,
- redundant Ethernet (RSTP protocol) with modulated or un-modulated IRIG-B,
- redundant Ethernet (DHS protocol) with modulated or un-modulated IRIG-B.

This card is fitted into Slot A of the device, which is the optional communications slot. Each Ethernet card has a unique MAC address used for Ethernet communications. This is printed on the rear of the card, alongside the Ethernet sockets.

The 100 Mbits/s Fiber Optic ports use ST® type connectors and are suitable for 1300nm multi-mode fiber type.

Copper ports use RJ45 type connectors. When using copper Ethernet, it is important to use Shielded Twisted Pair (STP) or Foil Twisted Pair (FTP) cables, to shield the IEC 61850 communications against electromagnetic interference. The RJ45 connector at each end of the cable must be shielded, and the cable shield must be connected to this RJ45 connector shield, so that the shield is grounded to the device case. Both the cable and the RJ45 connector at each end of the cable must be Category 5 minimum, as specified by the IEC 61850 standard. It is recommended that each copper Ethernet cable is limited to a maximum length of 3 meters and confined within one bay/cubicle.

When using IEC 61850 communications through the Ethernet card, the rear EIA(RS)485 and front EIA(RS)232 ports are also available for simultaneous use, both using the Courier protocol.

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2.7 Mechanical layout

The case materials of the device are constructed from pre-finished steel that has a conductive covering of aluminium and zinc. This provides good earthing at all joints giving a low impedance path to earth that is essential for performance in the presence of external noise. The boards and modules use a multi-point earthing strategy to improve the immunity to external noise and minimize the effect of circuit noise. Ground planes are used on boards to reduce impedance paths and spring clips are used to ground the module metalwork.

Heavy duty terminal blocks are used at the rear of the device for the current and voltage signal connections. Medium duty terminal blocks are used for the digital logic input signals, the output device contacts, the power supply and the rear communication port. A BNC connector is used for the optional IRIG-B signal. 9-pin and 25-pin female D-connectors are used at the front of the device for data communication.

Inside the device the PCBs plug into the connector blocks at the rear, and can be removed from the front of the device only. The connector blocks to the device's CT inputs are provided with internal shorting links inside the device which will automatically short the current transformer circuits before they are broken when the board is removed.

The front panel consists of a membrane keypad with tactile dome keys, an LCD and LEDs mounted on an aluminium backing plate.

3. DEVICE SOFTWARE

The software was introduced in the overview of the device at the start of this manual. The software can be considered to be made up of four sections:

- The real-time operating system,
- The system services software,
- The platform software,
- The control software.

This section describes in detail the latter two of these, the platform software and the control software, which between them control the functional behaviour of the device. The figure below shows the structure of the software.

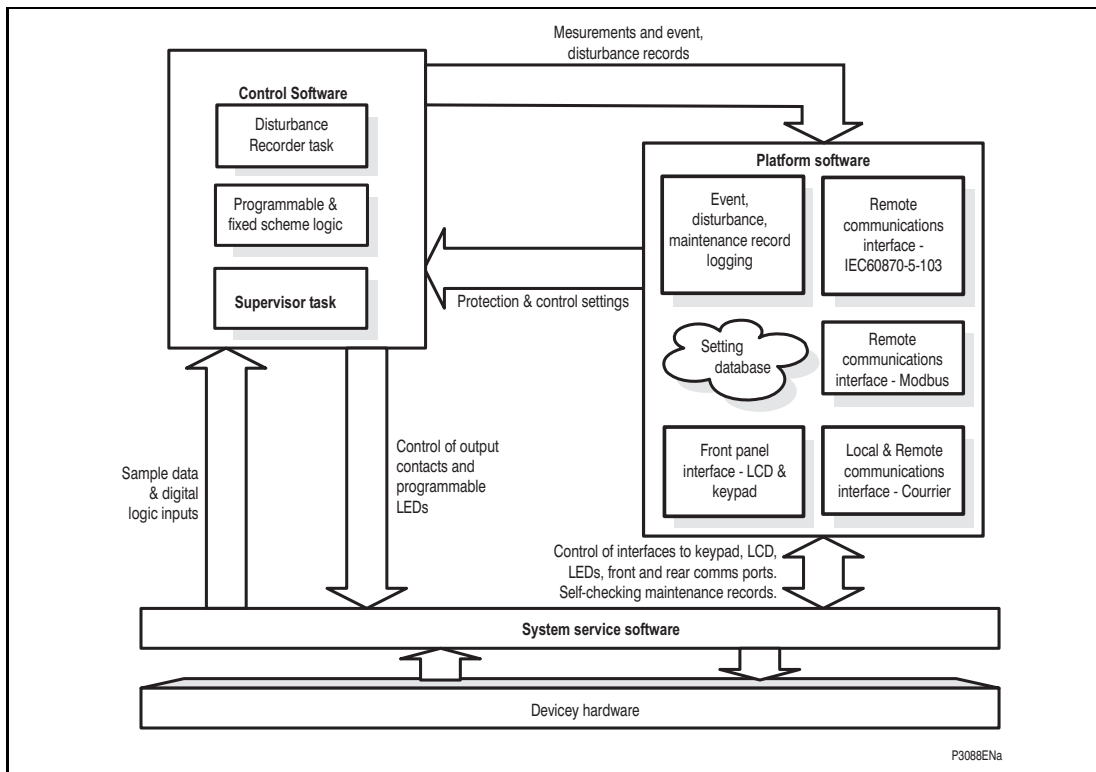


FIGURE 7: DEVICE SOFTWARE STRUCTURE

3.1 Real-time operating system

Real-time operating system for main board: the real-time operating system is used to schedule the processing of the tasks to ensure that they are processed in the time available and in the desired order of priority. The operating system is also responsible in part for controlling the communication between the software tasks through the use of operating system messages.

The software is split into tasks; the real-time operating system is used to schedule the processing of the tasks to ensure that they are processed in the time available and in the desired order of priority. The operating system is also responsible in part for controlling the communication between the software tasks through the use of operating system messages.

FD

3.2 System services software

As shown in Figure 7, the system services software provides the interface between the device's hardware and the higher-level functionality of the platform software and the control software. For example, the system services software provides drivers for items such as the LCD display, the keypad and the remote communication ports, and controls the boot of the processor and downloading of the processor code into SRAM from flash EPROM at power up.

3.3 Platform software

The platform software has three main functions:

- To control the logging of records that are generated by the software, including alarms and event, and maintenance records.
- To store and maintain a database of all of the device's settings in non-volatile memory.
- To provide the internal interface between the settings database and each of the device's user interfaces, i.e. the front panel interface and the front and rear communication ports, using whichever communication protocol has been specified (Courier or IEC 60870-5-103).

3.3.1 Record logging

The logging function is provided to store all alarms, events and maintenance records. The records for all of these incidents are logged in battery backed-up SRAM in order to provide a non-volatile log of what has happened. The device maintains four logs: one each for up to 32 alarms, 512 standard event records and 5 maintenance records. The logs are maintained such that the oldest record is overwritten with the newest record. The logging function can be initiated from the internal software or the platform software is responsible for logging of a maintenance record in the event of a device failure. This includes errors that have been detected by the platform software itself or error that are detected by either the system services or the software function. See also the section on supervision and diagnostics later in this section.

3.3.2 Settings database

The settings database contains all of the settings and data for the device, including precise event recorder and control & support settings. The settings are maintained in non-volatile memory. The platform software's management of the settings database includes the responsibility of ensuring that only one user interface modifies the settings of the database at any one time. This feature is employed to avoid conflict between different parts of the software during a setting change. For changes to precise event recorder settings, the platform software operates a 'scratchpad' in SRAM memory. This allows a number of setting changes to be applied, precise event recorder and saved in the database in non-volatile memory. If a setting change affects the control task, the database advises it of the new values.

3.3.3 Database interface

The other function of the platform software is to implement the device's internal interface between the database and each of the device's user interfaces. The database of settings and records must be accessible from all of the device's user interfaces to allow read and modify operations. The platform software presents the data in the appropriate format for each user interface.

3.4 Control software

The control software task is responsible for processing all of device. To achieve this, it has to communicate with both the system services software and the platform software as well as organize its own operations. The control software has the highest priority of any of the software tasks in the device in order to provide the fastest possible control response. The control software has a supervisor task that controls the start-up of the task and deals with the exchange of messages between the task and the platform software.

3.4.1 Overview - control scheduling

The Figure 7 shows the parts of Schneider Electric software and their allocation on the different boards.

3.4.2 Signal processing

The sampling function provides filtering of the digital input signals from the opto-isolators. The digital inputs are checked against their previous value over a period of half a cycle.

3.4.3 Programmable scheme logic

The purpose of the programmable scheme logic (PSL) is to allow the device user to configure an individual scheme to suit their own particular application. This is achieved through the use of programmable logic gates and delay timers.

The input to the PSL is any combination of the status of the digital input signals from the opto-isolators on the input board, control inputs, function keys and the outputs of the fixed scheme logic. The fixed scheme logic provides the device's standard schemes. The PSL itself consists of software logic gates and timers. The logic gates can be programmed to perform a range of different logic functions and can accept any number of inputs. The timers are used either to create a programmable delay, and/or to condition the logic outputs, e.g. to create a pulse of fixed duration on the output regardless of the length of the pulse on the input. The outputs of the PSL are the LEDs on the front panel of the device and the output contacts at the rear.

The execution of the PSL logic is event driven; the logic is processed whenever any of its inputs change, for example as a result of a change in one of the digital input signals. Also, only the part of the PSL logic that is affected by the particular input change that has occurred is processed. This reduces the amount of processing time that is used by the PSL. The control software updates the logic delay timers and checks for a change in the PSL input signals every time it runs.

This system provides flexibility for the user to create their own scheme logic design. However, it also means that the PSL can be configured into a very complex system, and because of this setting of the PSL is implemented through the PC support package MiCOM S1 Studio.

3.4.4 Function key interface

The ten function keys interface directly into the PSL as digital input signals and are processed based on the PSL's event driven execution. However, a change of state is only recognized when a key press is executed on average for longer than 200 ms. The time to register a change of state depends on whether the function key press is executed at the start or the end of a task cycle, with the additional hardware and software scan time included. A function key press can provide a latched (toggled mode) or output on key press only (normal mode) depending on how it is programmed and can be configured to individual scheme requirements. The latched state signal for each function key is written to non-volatile memory and read from non-volatile memory during device power up thus allowing the function Key state to be reinstated after power-up should device power be inadvertently lost.

3.4.5 Event and maintenance recording

A change in any digital input signal or output signal causes a standard event record to be created. When this happens, the control task sends a message to the supervisor task to indicate that an event is available to be processed and writes the event data to a fast buffer in SRAM which is controlled by the supervisor task. When the supervisor task receives a standard event record message, it instructs the platform software to create the appropriate log in battery backed-up SRAM. The operation of the record logging to battery backed-up SRAM is slower than the supervisor's buffer. This means that the software is not delayed waiting for the records to be logged by the platform software. However, in the rare case when a large number of records to be logged are created in a short period of time, it is possible that some will be lost if the supervisor's buffer is full before the platform software is able to create a new log in battery backed-up SRAM. If this occurs then an event is logged to indicate this loss of information.

3.4.6 Precise event recorder

The precise event recorder operates as a separate task from the control task. It can record the values of up to 32 digital signals. The recording time is user selectable up to a maximum of 10.5 seconds. The precise event recorder is supplied with data by the control task once per cycle. The precise event recorder collates the data that it receives into the required length precise event record. The precise event records can be extracted by MiCOM S1 Studio that can also store the data in COMTRADE format, thus allowing the use of other packages to view the recorded data.

4. SELF TESTING & DIAGNOSTICS

The device includes a number of self-monitoring functions to check the operation of its hardware and software when it is in service. These are included so that if an error or fault occurs within the device's hardware or software, the device is able to detect and report the problem and attempt to resolve it by performing a re-boot. This involves the device being out of service for a short period of time which is indicated by the 'Healthy' LED on the front of the device being extinguished and the watchdog contact at the rear operating. If the restart fails to resolve the problem, then the device will take itself permanently out of service. Again this will be indicated by the LED and watchdog contact.

If a problem is detected by the self-monitoring functions, the device attempts to store a maintenance record in battery backed-up SRAM to allow the nature of the problem to be notified to the user.

The self-monitoring is implemented in two stages: firstly a thorough diagnostic check which is performed when the device is booted-up, e.g. at power-on, and secondly a continuous self-checking operation which checks the operation of the device's critical functions whilst it is in service.

4.1 Start-up self-testing

The self-testing which is carried out when the device is started takes a few seconds to complete, during which time the device is unavailable. This is signalled by the 'Healthy' LED on the front of the device which will illuminate when the device has passed all of the tests and entered operation. If the testing detects a problem, the device will remain out of service until it is manually restored to working order.

The operations that are performed at start-up are as follows:

4.1.1 System boot

The integrity of the flash memory is verified using a checksum before the program code and data stored in it is copied into SRAM to be used for execution by the processor. When the copy has been completed the data then held in SRAM is compared to that in the flash to ensure that the two are the same and that no errors have occurred in the transfer of data from flash to SRAM. The entry point of the software code in SRAM is then called which is the device initialization code.

4.1.2 Initialization software

The initialization process includes the operations of initializing the processor registers and interrupts, starting the watchdog timers (used by the hardware to determine whether the software is still running), starting the real-time operating system and creating and starting the supervisor task. In the course of the initialization process the device checks:

- The status of the battery
- The integrity of the battery backed-up SRAM that is used to store standard and precise event records
- The voltage level of the field voltage supply which is used to drive the opto-isolated inputs
- The operation of the LCD controller
- The watchdog operation

At the conclusion of the initialization software the supervisor task begins the process of starting the platform software.

4.1.3 Platform software initialization & monitoring

In starting the platform software, the device checks the integrity of the data held in non-volatile memory with a checksum, the operation of the real-time clock, and the IRIG-B board if fitted. The final test that is made concerns the input and output of data; the presence and healthy condition of the input board is checked.

At the successful conclusion of all of these tests the device is entered into service.

4.2 Continuous self-testing

When the device is in service, it continually checks the operation of the critical parts of its hardware and software. The checking is carried out by the system services software (see section on device software earlier in this section) and the results reported to the platform software. The functions that are checked are as follows:

- The flash containing all program code setting values and language text is verified by a checksum
- The code and constant data held in SRAM is checked against the corresponding data in flash to check for data corruption
- The SRAM containing all data other than the code and constant data is verified with a checksum
- The battery status
- The level of the field voltage
- The integrity of the digital signal I/O data from the opto-isolated inputs and the device contacts is checked by the data acquisition function every time it is executed.
- The operation of the IRIG-B board is checked, where it is fitted, by the software that reads the time and date from the board
- The operation of the Ethernet board is checked, where it is fitted, by the software on the main processor card. If the Ethernet board fails to respond an alarm is raised and the card is reset in an attempt to resolve the problem

In the unlikely event that one of the checks detects an error within the device's subsystems, the platform software is notified and it will attempt to log a maintenance record in battery backed-up SRAM. If the problem is with the battery status or the IRIG-B board, the device will continue in operation. However, for problems detected in any other area the device will initiate a shutdown and re-boot. This will result in a period of up to 5 seconds when the device is unavailable, but the complete restart of the device including all initializations should clear most problems that could occur. As described above, an integral part of the start-up procedure is a thorough diagnostic self-check. If this detects the same problem that caused the device to restart, i.e. the restart has not cleared the problem, then the device will take itself permanently out of service. This is indicated by the 'Healthy' LED on the front of the device, which will extinguish, and the watchdog contact that will operate.

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COMMISSIONING

CM

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

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1. INTRODUCTION

The MiCOM P849 input & output extension device is fully numerical in its design, implementing all functions in software. The device employs a high degree of self-checking and, in the unlikely event of a failure, will give an alarm. As a result of this, the commissioning tests do not need to be as extensive as with non-numeric electronic or electromechanical relays.

To commission numerical devices, it is only necessary to verify that the hardware is functioning correctly and the application-specific software settings have been applied to the device. It is considered unnecessary to test every function of the device if the settings have been verified by one of the following methods:

- Extracting the settings applied to the device using appropriate setting software (preferred method) such as MiCOM S1 Studio.
- Via the operator interface (HMI).

Unless previously agreed to the contrary, the customer will be responsible for determining the application-specific settings to be applied to the device and for testing of any scheme logic applied by external wiring and/or configuration of the device's internal programmable scheme logic.

Blank commissioning test and setting records are provided at the end of this chapter for completion as required.

As the device's menu language is user-selectable, it is acceptable for the Commissioning Engineer to change it to allow accurate testing as long as the menu is restored to the customer's preferred language on completion.




Before carrying out any work on the equipment, the user should be familiar with the contents of the safety section/safety guide SFTY/4LM/E11 or later issue, the technical data section and the ratings on the equipment rating label.

2. SETTING FAMILIARISATION

When commissioning a MiCOM P849 input & output extension device for the first time, sufficient time should be allowed to become familiar with the method by which the settings are applied.

The Getting Started section (P849/EN GS) contains a detailed description of the menu structure of MCOM P849 device.

With the secondary front cover in place all keys except the  key are accessible. All menu cells can be read. LED's and alarms can be reset. However, no setting can be changed, or event records cleared.

Removing the secondary front cover allows access to all keys so that settings can be changed, LED's and alarms reset, and event records cleared. However, menu cells those have access levels higher than the default level will require the appropriate password to be entered before changes can be made.

Alternatively, if a portable PC is available together with suitable setting software (such as MiCOM S1 Studio), the menu can be viewed a page at a time to display a full column of data and text. This PC software also allows settings to be entered more easily, saved to a file on a digital medium for future reference or printed to produce a setting record. Refer to the PC software user manual for details. If the software is being used for the first time, allow sufficient time to become familiar with its operation.

3. EQUIPMENT REQUIRED FOR COMMISSIONING

3.1 Minimum equipment required

Multimeter with suitable ac current range, and ac and dc voltage ranges of 0 – 440V and 0 – 250V respectively

Continuity tester (if not included in the multimeter)

Note: Modern test equipment may contain many of the above features in one unit.

3.2 Optional equipment

Multi-finger test plug type P992 (if test block type P991 installed) or MMLB (if using MMLG blocks)

An electronic or brushless insulation tester with a dc output not exceeding 500V (for insulation resistance testing when required). This equipment will be required only if the dielectric test has not been done during the manufacturing process.

A portable PC, with appropriate software (this enables the rear communications port to be tested, if this is to be used, and will also save considerable time during commissioning).

A printer (for printing a setting record from the portable PC).

4. PRODUCT CHECKS

These product checks cover all aspects of the device which should be checked to ensure that it has not been physically damaged prior to commissioning and is functioning correctly.

If the application-specific settings have been applied to the device prior to commissioning, it is advisable to make a copy of the settings so as to allow their restoration later. This could be done by:

- Obtaining a setting file on a digital medium from the customer (this requires a portable PC with appropriate setting software for transferring the settings from the PC to the device).
- Extracting the settings from the device itself (this again requires a portable PC with appropriate setting software).
- Manually creating a setting record. This could be done using a copy of the setting record located at the end of this chapter to record the settings as the menu is sequentially stepped through via the front panel user interface.

If password protection is enabled and the customer has changed password 2 that prevents unauthorised changes to some of the settings, either the revised password 2 should be provided, or the customer should restore the original password prior to commencement of testing.

Note: In the event that the password has been lost, a recovery password can be obtained from Schneider Electric by quoting the serial number of the device. The recovery password is unique to that device and is unlikely to work on any other device.

4.1 With the device de-energised

4.1.1 Visual inspection

Carefully examine the device to see that no physical damage has occurred since installation.

The rating information given under the top access cover on the front of the device should be checked to ensure it is correct for the particular installation.

Ensure that the case earthing connections, bottom left-hand corner at the rear of the device case, are used to connect the device to a local earth bar using an adequate conductor.

4.1.2 Insulation

Insulation resistance tests are only necessary during commissioning if it is required for them to be done and they have not been performed during installation.

Isolate all wiring from the earth and test the insulation with an electronic or brushless insulation tester at a dc voltage not exceeding 500V. Terminals of the same circuits should be temporarily connected together.

The main groups of device terminals are:

- a) Auxiliary voltage supply.
- b) Field voltage output and opto-isolated control inputs.
- c) device contacts.
- d) Case earth.

The insulation resistance should be greater than 100M Ω at 500V.

On completion of the insulation resistance tests, ensure all external wiring is correctly reconnected to the device.

4.1.3 External wiring

Check that the external wiring is correct to the relevant device diagram or scheme diagram. The diagram number appears on the rating label under the top access cover on the front of the device. The corresponding connection diagram will have been supplied with the Schneider Electric order acknowledgement.

If a P991 test block is provided, the connections should be checked against the scheme (wiring) diagram. It is recommended that the supply connections are to the live side of the test block [coloured orange with the odd numbered terminals (1, 3, 5, 7 etc.)]. The auxiliary supply is normally routed via terminals 13 (supply positive) and 15 (supply negative), with terminals 14 and 16 connected to the device's positive and negative auxiliary supply terminals respectively. However, check the wiring against the schematic diagram for the installation to ensure compliance with the customer's normal practice.

4.1.4 Watchdog contacts

Using a continuity tester, check that the watchdog contacts are in the states given in Table 1 for a de-energised device.

Terminals	Contact state	
	Device de-energised	Device energised
N11 – N12	Closed	Open
N13 – N14	Open	Closed

TABLE 1: WATCHDOG CONTACT STATUS

4.1.5 Auxiliary supply

The MiCOM P849 input & output extension device can be operated from either a dc only or an ac/dc auxiliary supply depending on the device's nominal supply rating. The incoming voltage must be within the operating range specified in Table 2.

Without energising the device, measure the auxiliary supply to ensure it is within the operating range.

Nominal supply rating DC [AC rms]	DC operating range	AC operating range
24 – 48V [-]	19 to 65V	-
48 – 110V [-]	37 to 150V	-
110 – 250V [100 – 240V]	87 to 300V	80 to 265V

TABLE 2: OPERATIONAL RANGE OF AUXILIARY SUPPLY VX.

It should be noted that the MiCOM P849 can withstand an ac ripple of up to 12% of the upper rated voltage on the dc auxiliary supply.



Do not energise the device or interface unit using the battery charger with the battery disconnected as this can irreparably damage the device's power supply circuitry.

Energise the device only if the auxiliary supply is within the specified operating ranges. If a test block is provided, it may be necessary to link across the front of the test plug to connect the auxiliary supply to the device.

4.2 With the device energised

The following group of tests verifies that the hardware and software is functioning correctly and should be carried out with the auxiliary supply applied to the device.

4.2.1 Watchdog contacts

Using a continuity tester, check the watchdog contacts are in the states given in Table 1 for an energised device.

4.2.2 Date and time

Before setting the date and time, ensure that the factory-fitted battery isolation strip, that prevents battery drain during transportation and storage, has been removed. With the lower access cover open, presence of the battery isolation strip can be checked by a red tab protruding from the positive side of the battery compartment. Whilst lightly pressing the battery, to prevent it from falling out of the battery compartment, pull the red tab to remove the isolation strip.

The date and time should now be set to the correct values. The method of setting will depend on whether accuracy is being maintained via the optional Inter-Range Instrumentation Group standard B (IRIG-B) port on the rear of the MiCOM P849 device.

4.2.2.1 With an IRIG-B signal

If a satellite time clock signal conforming to IRIG-B is provided and the MiCOM P849 device has the optional IRIG-B port fitted, the satellite clock equipment should be energised.

To allow the device's time and date to be maintained from an external IRIG-B source cell [DATE and TIME, IRIG-B Sync] must be set to 'Enabled'.

Ensure the device is receiving the IRIG-B signal by checking that cell [DATE and TIME, IRIG-B Status] reads 'Active'.

Once the IRIG-B signal is active, adjust the time offset of the universal co-ordinated time (satellite clock time) on the satellite clock equipment so that local time is displayed.

Check the time, date and month are correct in cell [DATE and TIME, Date/Time]. The IRIG-B signal does not contain the current year so it will need to be set manually in this cell.

In the event of the auxiliary supply failing, with a battery fitted in the compartment behind the bottom access cover, the time and date will be maintained. Therefore, when the auxiliary supply is restored, the time and date will be correct and not need to be set again.

To test this, remove the IRIG-B signal, then remove the auxiliary supply from the device. Leave the device de-energised for approximately 30 seconds. On re-energisation, the time in cell [DATE and TIME, Date/Time] should be correct.

Reconnect the IRIG-B signal.

4.2.2.2 Without an IRIG-B signal

If the time and date is not being maintained by an IRIG-B signal, ensure that cell [DATE and TIME, IRIG-B Sync] is set to 'Disabled'.

Set the date and time to the correct local time and date using cell [DATE and TIME, Date/Time].

In the event of the auxiliary supply failing, with a battery fitted in the compartment behind the bottom access cover, the time and date will be maintained. Therefore when the auxiliary supply is restored the time and date will be correct and not need to be set again.

To test this, remove the auxiliary supply from the device for approximately 30 seconds. On re-energisation, the time in cell [DATE and TIME, Date/Time] should be correct.

4.2.3 Light Emitting Diodes (LED's)

On power up the green LED should have illuminated and stayed on indicating that the device is healthy. The device has non-volatile memory which remembers the state (on or off) of the alarm, trip and, if configured to latch, user-programmable LED indicators when the device was last energised from an auxiliary supply. Therefore these indicators may also illuminate when the auxiliary supply is applied.

If any of these LED's are on then they should be reset before proceeding with further testing. If the LED's successfully reset (the LED goes out), there is no testing required for that LED because it is known to be operational.

Note: It is likely that alarms related to the communications channels will not reset at this stage.

4.2.3.1 Testing the alarm and out of service LED's

The alarm and out of service LED's can be tested using the COMMISSION TESTS menu column. Set cell [COMMISSION TESTS, Test Mode] to 'Out Of Service' on the MiCOM P849. Check that the out of service LED illuminates continuously and the alarm LED flashes.

It is not necessary to return cell [COMMISSION TESTS, Test Mode] to 'Disabled' at this stage because the test mode will be required for later tests.

4.2.3.2 Testing the Trip LED

The trip LED can be tested by initiating a manual circuit breaker trip from the device. However, the trip LED will operate during the setting checks performed later. Therefore no further testing of the trip LED is required at this stage.

4.2.3.3 Testing the user-programmable LEDs

To test the user-programmable LED's set cell [COMMISSION TESTS, Test LEDs] to 'Apply Test'. Check that all the LED's of the device illuminate.

In the MiCOM P849:

- The 'Red LED Status' cell is an eighteen bit binary string that indicates which of the user-programmable LEDs on the device are illuminated when accessing the device from a remote location, a '1' indicating a particular Red LED is lit.
- The 'Green LED Status' cell is an eighteen bit binary string that indicates which of the user-programmable LEDs on the device are illuminated when accessing the device from a remote location, a '1' indicating a particular Green LED is lit.
- If a 'Red LED Status' cell AND the same 'Green LED Status' cell are at '1' the particular LED is lit Orange
- If a 'Red LED Status' cell AND the same 'Green LED Status' cell are at '0' the particular LED is not lit.

4.2.4 Field voltage supply

The device generates a field voltage of nominally 48V dc that can be used to energise the opto-isolated inputs (alternatively the substation battery may be used).

Measure the field voltage across the terminals 7 and 9 on the terminal block given in Table 3. Check that the field voltage is within the range 40V to 60V when no load is connected and that the polarity is correct.

Repeat for terminals 8 and 10.

Supply rail	Terminals
+ve	N7 & N8
-ve	N9 & N10

TABLE 3: FIELD VOLTAGE TERMINALS

4.2.5 Input opto-isolators

This test checks that all the opto-isolated inputs on the device are functioning correctly.

The opto-isolated inputs should be energised one at a time, see external connection diagrams (P849/EN IN) for terminal numbers. Ensuring correct polarity, connect the field supply voltage to the appropriate terminals for the input being tested.

Note: The opto-isolated inputs may be energised from an external dc auxiliary supply (e.g. the station battery) in some installations. Check that this is not the case before connecting the field voltage otherwise damage to the device may result.

The status of each opto-isolated input can be viewed using either cell [SYSTEM DATA, Opto I/P Status] or [COMMISSION TESTS, Opto I/P Status], a '1' indicating an energised

input and a '0' indicating a de-energised input. When each opto-isolated input is energised one of the characters on the bottom line of the display will change to indicate the new state of the inputs.

4.2.6 Output relays

This test checks that all the output relays are functioning correctly.

See external Connection Diagrams Chapter (P849/EN IN) for terminal numbers.

Ensure that the relay is still in test mode by viewing cell [COMMISSION TESTS, Test Mode] to ensure that it is set to 'Blocked'.

The output relays should be energised one at a time. To select output relay 1 for testing, set cell [COMMISSION TESTS, Test Pattern] as appropriate.

Connect a continuity tester across the terminals corresponding to output relay 1 as given in external connection diagram (P849/EN IN).

To operate the output relay set cell [COMMISSION TESTS, Contact Test] to 'Apply Test'. Operation will be confirmed by the continuity tester operating for a normally open contact and ceasing to operate for a normally closed contact. Measure the resistance of the contacts in the closed state.

Reset the output relay by setting cell [COMMISSION TESTS, Contact Test] to 'Remove Test'.

Note: It should be ensured that thermal ratings of anything connected to the output relays during the contact test procedure is not exceeded by the associated output relay being operated for too long. It is therefore advised that the time between application and removal of contact test is kept to the minimum.

Return the device to service by setting cell [COMMISSION TESTS, Test Mode] to 'Disabled'.

4.2.7 Rear communications port

This test should only be performed where the device is to be accessed from a remote location and will vary depending on the communications standard being adopted. It is not the intention of the test to verify the operation of the complete system from the device to the remote location, just the device's rear communications port and any protocol converter necessary.

4.2.7.1 Courier communications

If a K-Bus to EIA(RS)232 KITZ protocol converter is installed, connect a portable PC running the appropriate software to the incoming (remote from device) side of the protocol converter. Ensure that the communications baud rate and parity settings in the application software are set the same as those on the protocol converter (usually a KITZ but could be a SCADA RTU). The devices courier address in cell [COMMUNICATIONS, Remote Access] must be set to a value between 1 and 254. Check that communications can be established with this device using the portable PC.

Check that, using the Master Station, communications with the device can be established.

Note: The first rear communication port (terminal N17-18) can be either K-Bus or EIA(RS)485.

4.2.8 Second rear communications port

This test should only be performed where the device is to be accessed from a remote location and will vary depending on the communications standard being adopted. It is not the intention of the test to verify the operation of the complete system from the device to the remote location, just the devices rear communications port and any protocol converter necessary.

4.2.8.1 K-Bus configuration

If a K-Bus to EIA(RS)232 KITZ protocol converter is installed, connect a portable PC running the appropriate software (e.g. MiCOM S1 Studio) to the incoming (remote from device) side of the protocol converter.

If a KITZ protocol converter is not installed, it may not be possible to connect the PC to the device installed. In this case a KITZ protocol converter and portable PC running appropriate software should be temporarily connected to the devices second rear communications port configured for K-Bus. However, as the installed protocol converter is not being used in the test, only the correct operation of the devices K-Bus port will be confirmed.

Ensure that the communications baud rate and parity settings in the application software are set the same as those on the protocol converter (usually a KITZ but could be a SCADA RTU). The devices courier address in cell [COMMUNICATIONS, RP2 Address] must be set to a value between 1 and 254. The second rear communications port configuration [COMMUNICATIONS, RP2 Port Config] must be set to K-Bus.

Check that communications can be established with this device using the portable PC.

4.2.8.2 EIA(RS)485 configuration

If an EIA(RS)485 to EIA(RS)232 converter (Schneider Electric CK222) is installed, connect a portable PC running the appropriate software (e.g. MiCOM S1 Studio) to the EIA(RS)232 side of the converter and the second rear communications port of the device to the EIA(RS)485 side of the converter.

Ensure that the communications baud rate and parity settings in the application software are set the same as those in the device. The relays courier address in cell [COMMUNICATIONS, RP2 Address] must be set to a value between 1 and 254. The second rear communications port configuration [COMMUNICATIONS, RP2 Port Config.] must be set to EIA(RS)485.

Check that communications can be established with this device using the portable PC.

4.2.8.3 EIA(RS)232 configuration

Connect a portable PC running the appropriate software (e.g. MiCOM S1 Studio) to the rear EIA(RS)2321 port of the device.

The second rear communications port connects via the 9-way female D-type connector (SK4). The connection is compliant to EIA(RS)574.

Connections to the second rear port configured for EIA(RS)232 operation can be made using a screened multi-core communication cable up to 15m long, or a total capacitance of 2500pF. The cable should be terminated at the device end with a 9-way, metal shelled, D-type male plug.

Ensure that the communications baud rate and parity settings in the application software are set the same as those in the device. The devices courier address in cell [COMMUNICATIONS, RP2 Address] must be set to a value between 1 and 254. The second rear communications port configuration [COMMUNICATIONS, RP2 Port Config.] must be set to EIA(RS)232.

Check that communications can be established with this device using the portable PC.

5. COMMISSIONING TEST MENU

5.1 Test mode

The "COMMISSION TEST" cell is used to allow commissioning of the MiCOM P849 device. It also enables a facility to directly test the output contacts by applying menu controlled tests signals. During the test mode, opto inputs and outputs contacts remain in last known state before the test mode is selected.

To select test mode the "COMMISSION TEST" cell in the "CONFIGURATION" menu should be set to 'Enabled' which takes the device out of service causing an alarm condition to be recorded and the yellow 'Out of Service' LED to illuminate. Once testing is complete the cell must be set back to 'Disabled' to restore the device back to service.



WHEN THE 'TEST MODE' CELL IS SET TO 'ENABLED', THE device SCHEME LOGIC DOES NOT DRIVE THE OUTPUT RELAYS.

HOWEVER, THE COMMUNICATIONS CHANNELS WITH REMOTE RELAYS REMAIN ACTIVE.

6. SETTING CHECKS

The setting checks ensure that all of the application-specific device settings (i.e. both the device's function and programmable scheme logic settings), for the particular installation, have been correctly applied to the device.

Note 1: The trip circuits should remain isolated during these checks to prevent accidental operation of the associated circuit breaker.

6.1 Apply application-specific settings

There are two methods of applying the settings to the device:

- Transferring them from a pre-prepared setting file to the device using a portable PC running the appropriate software via the device's front EIA(RS)232 port, located under the bottom access cover. This method is preferred for transferring function settings as it is much faster and there is less margin for error. If the programmable scheme logic other than the default settings with which the device is supplied is to be used then this is the only way of changing the settings.
If a setting file has been created for the particular application and provided on a digital medium, this will further reduce the commissioning time and should always be the case where application-specific programmable scheme logic is to be applied to the device.
- Enter them manually via the device's operator interface. This method is not suitable for changing the programmable scheme logic.

Note: It is essential that where the installation needs application-specific Programmable Scheme Logic, that the appropriate .psl file is downloaded (sent) to the device, for each and every setting group that will be used. If the user fails to download the required .psl file to any setting group that may be brought into service, then factory default PSL will still be resident. This may have severe operational and safety consequences.

6.2 Check Application Settings

The settings applied should be carefully checked against the required application-specific settings to ensure that they are correct, and have not been mistakenly altered during the injection test.

There are two methods of checking the settings:

- Extract the settings from the device using a portable PC running the appropriate software via the front EIA(RS)232 port, located under the bottom access cover. Compare the settings transferred from the device with the original written application-specific setting record. (For cases where the customer has only provided a printed copy of the required settings but a portable PC is available).
- Step through the settings using the device's operator interface and compare them with the original application-specific setting record.

Unless previously agreed to the contrary, the application-specific programmable scheme logic will not be checked as part of the commissioning tests.

Due to the versatility and possible complexity of the programmable scheme logic, it is beyond the scope of these commissioning instructions to detail suitable test procedures. Therefore, when programmable scheme logic tests must be performed, written tests which will satisfactorily demonstrate the correct operation of the application-specific scheme logic should be devised by the Engineer who created it. These should be provided to the Commissioning Engineer together with the digital medium containing the programmable scheme logic setting file.

7. FINAL CHECKS

The tests are now complete.



Remove all test or temporary shorting leads, etc. If it has been necessary to disconnect any of the external wiring from the device in order to perform the wiring verification tests, it should be ensured that all connections are replaced in accordance with the relevant external connection or scheme diagram.

Ensure that the device has been restored to service by checking that cell [COMMISSION TESTS, Test Mode] is set to 'Disabled'.

If the menu language has been changed to allow accurate testing it should be restored to the customer's preferred language.

If a P991/MMLG test block is installed, remove the P992/MMLB test plug and replace the cover so that the protection is put into service.

Ensure that all records, alarms and LED's have been reset before leaving the device.

If applicable, replace the secondary front cover on the device.

8. COMMISSIONING TEST RECORD

Date: _____ Engineer: _____
 Station: _____ Circuit: _____
 System Frequency: _____

Front Plate Information

Device Type	P849
Model number	
Serial number	
Auxiliary voltage Vx	

Test Equipment Used

This section should be completed to allow future identification of protective devices that have been commissioned using equipment that is later found to be defective or incompatible but may not be detected during the commissioning procedure.

Optical power meter	Model: Serial No:	
Insulation tester	Model: Serial No:	
Setting software:	Type: Version:	

* Delete as appropriate
na = not applicable



Have all relevant safety instructions been followed?

Yes/No*

4 Product Checks

4.1 With the device de-energised

4.1.1 Visual inspection

Device damaged?

Yes/No*

Rating information correct for installation?

Yes/No*

Case earth installed?

Yes/No*

4.1.2 Current transformer shorting contacts close?

Yes/No/Not checked*

4.1.3 Insulation resistance >100MΩ at 500V dc

Yes/No/Not tested*

4.1.4 External Wiring

Wiring checked against diagram?

Yes/No*

Test block connections checked?

Yes/No/na*

4.1.5 Watchdog Contacts (auxiliary supply off)

Terminals 11 and 12 Contact closed?

Yes/No*

Contact resistance

____Ω/Not measured*

Terminals 13 and 14 Contact open?

Yes/No*

4.1.6 Measured auxiliary supply

____ V ac/dc*

4.2 With the device energised

4.2.1 Watchdog Contacts (auxiliary supply on)

Terminals 11 and 12 Contact open?

Yes/No*

Terminals 13 and 14 Contact closed?

Yes/No*

Contact resistance

____Ω/Not measured*

4.2.2 Date and time

Clock set to local time?

Yes/No*

Time maintained when auxiliary supply removed?

Yes/No*

4.2.3 Light Emitting Diodes

4.2.3.1 Alarm (yellow) LED working?

Yes/No*

Out of service (yellow) LED working?

Yes/No*



* Delete as appropriate
na = not applicable

4.2.3.2 Trip (red) LED working? Yes/No*

4.2.3.3 All 8 programmable LED's working? Yes/No*

4.2.4 Field supply voltage

Value measured between terminals 7 and 9 _____ V dc

Value measured between terminals 8 and 10 _____ V dc

4.2.5 Input opto-isolators

Opto input 1 working?	Yes/No*
Opto input 2 working?	Yes/No*
Opto input 3 working?	Yes/No*
Opto input 4 working?	Yes/No*
Opto input 5 working?	Yes/No*
Opto input 6 working?	Yes/No*
Opto input 7 working?	Yes/No*
Opto input 8 working?	Yes/No*
Opto input 9 working?	Yes/No*
Opto input 10 working?	Yes/No*
Opto input 11 working?	Yes/No*
Opto input 12 working?	Yes/No*
Opto input 13 working?	Yes/No*
Opto input 14 working?	Yes/No*
Opto input 15 working?	Yes/No*
Opto input 16 working?	Yes/No*
Opto input 17 working?	Yes/No/na*
Opto input 18 working?	Yes/No/na*
Opto input 19 working?	Yes/No/na*
Opto input 20 working?	Yes/No/na*
Opto input 21 working?	Yes/No/na*
Opto input 22 working?	Yes/No/na*
Opto input 23 working?	Yes/No/na*
Opto input 24 working?	Yes/No/na*
Opto input 25 working?	Yes/No/na*
Opto input 26 working?	Yes/No/na*
Opto input 27 working?	Yes/No/na*
Opto input 28 working?	Yes/No/na*
Opto input 29 working?	Yes/No/na*
Opto input 30 working?	Yes/No/na*
Opto input 31 working?	Yes/No/na*
Opto input 32 working?	Yes/No/na*
Opto input 33 working?	Yes/No/na*
Opto input 34 working?	Yes/No/na*
Opto input 35 working?	Yes/No/na*
Opto input 36 working?	Yes/No/na*
Opto input 37 working?	Yes/No/na*
Opto input 38 working?	Yes/No/na*
Opto input 39 working?	Yes/No/na*
Opto input 40 working?	Yes/No/na*
Opto input 41 working?	Yes/No/na*
Opto input 42 working?	Yes/No/na*
Opto input 43 working?	Yes/No/na*
Opto input 44 working?	Yes/No/na*
Opto input 45 working?	Yes/No/na*



* Delete as appropriate
na = not applicable

Opto input 46 working?	Yes/No/na*
Opto input 47 working?	Yes/No/na*
Opto input 48 working?	Yes/No/na*
Opto input 49 working?	Yes/No/na*
Opto input 50 working?	Yes/No/na*
Opto input 51 working?	Yes/No/na*
Opto input 52 working?	Yes/No/na*
Opto input 53 working?	Yes/No/na*
Opto input 54 working?	Yes/No/na*
Opto input 55 working?	Yes/No/na*
Opto input 16 working?	Yes/No/na*
Opto input 57 working?	Yes/No/na*
Opto input 58 working?	Yes/No/na*
Opto input 59 working?	Yes/No/na*
Opto input 60 working?	Yes/No/na*
Opto input 61 working?	Yes/No/na*
Opto input 62 working?	Yes/No/na*
Opto input 63 working?	Yes/No/na*
Opto input 64 working?	Yes/No/na*

Refer to the connection diagrams (section P849/EN IN) for "Normally open" and "Change over" output relays location

* Delete as appropriate
na = not applicable

4.2.6 Output relays

Relay 1	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 2	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 3	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 4	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 5	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 6	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 7	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured*
Relay 8	Working?		Yes/No/na*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/ na*
Relay 9	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 10	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 11	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*



Relay 12	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 13	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 14	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Next output relays are only present in the models with with options A, B, D, E and F			
Relay 15	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 16	Working?		Yes/No*
	Contact resistance	(N/C)	___Ω/Not measured*
		(N/O)	___Ω/Not measured/na*
Next output relays are only present in the models with options B, D and F			
Relay 17	Working?		Yes/No/na*
	Contact resistance		___Ω/Not measured*
Relay 18	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 19	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 20	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 21	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 22	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 23	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 24	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Next output relays are only present in the models with options D and F			
Relay 25	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 26	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 27	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 28	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 29	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 30	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*



Relay 31	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 32	Working?		Yes/No/na*
	Contact resistance		___Ω/Not measured*
Relay 33	Working?		Yes/No/na*
	Contact resistance		___Ω/Not measured*
Relay 34	Working?		Yes/No/na*
	Contact resistance		___Ω/Not measured*
Relay 35	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 36	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 37	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 38	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 39	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 40	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 41	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 42	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 43	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 44	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 45	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*
Relay 46	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured/na*

Next output relays are only present in the model with option D.

Relay 47	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 48	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 49	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 50	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 51	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured
Relay 52	Working?		Yes/No*
	Contact resistance	(N/O)	___Ω/Not measured*
		(N/C)	___Ω/Not measured*
Relay 53	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*
Relay 54	Working?		Yes/No*
	Contact resistance		___Ω/Not measured*



Relay 55	Working?		Yes/No *
	Contact resistance		_____Ω/Not measured*
Relay 56	Working?		Yes/No *
	Contact resistance		_____Ω/Not measured*
Relay 57	Working?		Yes/No *
	Contact resistance		_____Ω/Not measured*
Relay 58	Working?		Yes/No *
	Contact resistance		_____Ω/Not measured*
Relay 59	Working?		Yes/No*
	Contact resistance	(N/O)	_____Ω/Not measured*
		(N/C)	_____Ω/Not measured
Relay 60	Working?		Yes/No*
	Contact resistance	(N/O)	_____Ω/Not measured*
		(N/C)	_____Ω/Not measured*

Note:



Commissioning Engineer:

Customer Witness:

Date:

Date:

9. SETTING RECORD

Date: _____ Engineer: _____
 Station: _____ Circuit: _____

Front Plate Information

Type:	P849
Model Number	
Serial Number	
Rated Current In	
Auxiliary Voltage Vx	

Setting Groups Used

* Delete as appropriate

Group 1	Yes/No*
Group 2	Yes/No*
Group 3	Yes/No*
Group 4	Yes/No*

SYSTEM DATA

	Language	
	Description	
	Plant Reference	
	Model Number	
	Serial Number	
	Frequency	
	Comms Level	
	Relay Address	
	Plant Status	
	Control Status	
	Active Group	
	Software Ref 1 number	
	Software Ref 2 number	
	Opto input Status 1	
	Opto input Status 2	
	Relay Output Status	
	Relay Output Status 2	
	Alarm Status 1	
	Alarm Status 2	
	Alarm Status 3	
	Access level	
	Password Control	



DATE AND TIME

	IRIG-B Sync	Disabled/Enabled*
	IRIG-B Status	Inactive/Active*
	Battery Status	Dead/Healthy*
	Battery Alarm	Disabled/Enabled*

CONFIGURATION

* Delete as appropriate

	Setting Group	Select via Menu/Select via Optos*
	Active Settings	Group 1/Group 2/Group 3/Group 4*
	Setting Group 1	Disabled/Enabled*
	Setting Group 2	Disabled/Enabled*
	Setting Group 3	Disabled/Enabled*
	Setting Group 4	Disabled/Enabled*
	Input Labels	Invisible/Visible*
	Output Labels	Invisible/Visible*
	Record Control	Invisible/Visible*
	Disturb Recorder	Invisible/Visible*
	Measur't Setup	Invisible/Visible*
	Comms Setting	Invisible/Visible*
	Commission Tests	Invisible/Visible*
	Control inputs	Invisible/Visible*
	Control I/P Config	Invisible/Visible*
	Control I/P Labels	Invisible/Visible*
	Direct Access	Disabled/Enabled*
	InterMiCOM	Disabled/Enabled*
	IEC GOOSE	Invisible/Visible*
	Function key	Invisible/Visible*
	RP1 Read Only	Disabled/Enabled*
	RP2 Read Only	Disabled/Enabled*
	NIC Read Only	Disabled/Enabled*
	LCD Contrast	

CM**RECORD CONTROL**

* Delete as appropriate

	Alarm Event	Enabled/Disabled*
	Relay O/P Event	Enabled/Disabled*
	Opto Input Event	Enabled/Disabled*
	General Event	Enabled/Disabled*
	Maint Rec Event	Enabled/Disabled*
	Event	Enabled/Disabled*
	DDB 31 – 0	

RECORD CONTROL

* Delete as appropriate

	DDB 63 – 32	
	DDB 95 – 64	
	DDB 127 – 96	
	DDB 159 - 128	
	DDB 191 - 160	
	DDB 223 - 192	
	DDB 255 - 224	
	DDB 287 - 256	
	DDB 319 - 288	
	DDB 351 - 320	
	DDB 383 - 352	
	DDB 415 - 384	
	DDB 447 - 416	
	DDB 479 - 448	
	DDB 511 - 480	
	DDB 543 - 512	
	DDB 575 - 544	
	DDB 607 - 576	
	DDB 639 - 608	
	DDB 671 - 640	
	DDB 703 - 672	
	DDB 735 - 704	
	DDB 767 - 736	
	DDB 799 - 768	
	DDB 831 - 800	
	DDB 863 - 832	
	DDB 895 - 864	
	DDB 927 - 896	
	DDB 959 - 928	
	DDB 991 - 960	
	DDB 1022 - 992	
	DDB 1055 - 1024	
	DDB 1087 - 1056	
	DDB 1119 - 1088	
	DDB 1151 - 1120	
	DDB 1183 - 1152	
	DDB 1215 - 1184	
	DDB 1247 - 1216	
	DDB 1279 - 1248	

RECORD CONTROL

* Delete as appropriate

	DDB 1311 - 1280	
	DDB 1343 - 1312	
	DDB 1375 - 1344	
	DDB 1407 - 1376	
	DDB 1439 - 1408	
	DDB 1471 - 1440	
	DDB 1503 - 1472	
	DDB 1535 - 1504	
	DDB 1567 - 1536	
	DDB 1599 - 1568	
	DDB 1631 - 1600	
	DDB 1663 - 1632	
	DDB 1695 - 1664	
	DDB 1727 - 1696	
	DDB 1759 - 1728	
	DDB 1791 - 1760	
	DDB 1823 - 1792	
	DDB 1855 - 1824	
	DDB 1887 - 1856	
	DDB 1919 - 1888	
	DDB 1951 - 1920	
	DDB 1983 - 1952	
	DDB 2015 - 1984	
	DDB 2047 - 2016	

CM**DISTURB RECORDER**

* Delete as appropriate

	Duration	
	Trigger Position	
	Trigger Mode	Single
	Digital Input 1	
	Input 1 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 2	
	Input 2 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 3	
	Input 3 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 4	
	Input 4 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 5	
	Input 5 trigger	No trigger / Trigger L/H / Trigger H/L*

DISTURB RECORDER

* Delete as appropriate

	Digital Input 6	
	Input 6 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 7	
	Input 7 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 8	
	Input 8 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 9	
	Input 9 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 10	
	Input 10 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 11	
	Input 11 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 12	
	Input 12 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 13	
	Input 13 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 14	
	Input 14 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 15	
	Input 15 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 16	
	Input 16 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 17	
	Input 17 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 18	
	Input 18 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 19	
	Input 19 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 20	
	Input 20 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 21	
	Input 21 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 22	
	Input 22 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 23	
	Input 23 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 24	
	Input 24 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 25	
	Input 25 trigger	No trigger / Trigger L/H / Trigger H/L*

DISTURB RECORDER

* Delete as appropriate

	Digital Input 26	
	Input 26 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 27	
	Input 27 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 28	
	Input 28 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 29	
	Input 29 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 30	
	Input 30 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 31	
	Input 31 trigger	No trigger / Trigger L/H / Trigger H/L*
	Digital Input 32	
	Input 32 trigger	No trigger / Trigger L/H / Trigger H/L*

0E00 COMMUNICATIONS

	RP1 Protocol	Courier* <input type="checkbox"/>	IEC870-5-103* <input type="checkbox"/>
		MODBUS* <input type="checkbox"/>	DNP3.0* <input type="checkbox"/>
	RP1 Address		
	RP1 InactivTimer		
	RP1 Baud Rate	1200* <input type="checkbox"/>	2400* <input type="checkbox"/>
		4800* <input type="checkbox"/>	9600* <input type="checkbox"/>
		19200* <input type="checkbox"/>	38400* <input type="checkbox"/>
	RP1 Parity	Odd* <input type="checkbox"/>	Even* <input type="checkbox"/>
		None* <input type="checkbox"/>	
	RP1 Meas. Period		
	RP1 PhysicalLink	EIA(RS)485* <input type="checkbox"/>	Fiber Optic* <input type="checkbox"/>
	RP1 Time Sync.	Disabled* <input type="checkbox"/>	Enabled* <input type="checkbox"/>
	NIC Tunl Timeout		
	NIC Link Report	Alarm* <input type="checkbox"/>	Event* <input type="checkbox"/>
		None* <input type="checkbox"/>	
	NIC Link Timeout		

CM**COMMISSION TESTS**

* Delete as appropriate

	Opto I/P Status	
	Opto I/P Status 2	
	Rly O/P Status	
	Rly O/P Status 2	
	Test Port Status	
	Monitor Bit 1	
	Monitor Bit 2	
	Monitor Bit 3	

COMMISSION TESTS

* Delete as appropriate

	Monitor Bit 4	
	Monitor Bit 5	
	Monitor Bit 6	
	Monitor Bit 7	
	Monitor Bit 8	
	Test Mode	Disabled/Test Mode/Contacts Blocked *
	Test Pattern	
	Contact Test	No Operation, Apply Test, Remove Test *
	DDB 31 – 0	
	DDB 63 – 32	
	DDB 95 – 64	
	DDB 127 – 96	
	DDB 159 - 128	
	DDB 191 - 160	
	DDB 223 - 192	
	DDB 255 - 224	
	DDB 287 - 256	
	DDB 319 - 288	
	DDB 351 - 320	
	DDB 383 - 352	
	DDB 415 - 384	
	DDB 447 - 416	
	DDB 479 - 448	
	DDB 511 - 480	
	DDB 543 - 512	
	DDB 575 - 544	
	DDB 607 - 576	
	DDB 639 - 608	
	DDB 671 - 640	
	DDB 703 - 672	
	DDB 735 - 704	
	DDB 767 - 736	
	DDB 799 - 768	
	DDB 831 - 800	
	DDB 863 - 832	
	DDB 895 - 864	
	DDB 927 - 896	
	DDB 959 - 928	
	DDB 991 - 960	
	DDB 1022 - 992	

CM

COMMISSION TESTS

* Delete as appropriate

	DDB 1055 - 1024	
	DDB 1087 - 1056	
	DDB 1119 - 1088	
	DDB 1151 - 1120	
	DDB 1183 - 1152	
	DDB 1215 - 1184	
	DDB 1247 - 1216	
	DDB 1279 - 1248	
	DDB 1311 - 1280	
	DDB 1343 - 1312	
	DDB 1375 - 1344	
	DDB 1407 - 1376	
	DDB 1439 - 1408	
	DDB 1471 - 1440	
	DDB 1503 - 1472	
	DDB 1535 - 1504	
	DDB 1567 - 1536	
	DDB 1599 - 1568	
	DDB 1631 - 1600	
	DDB 1663 - 1632	
	DDB 1695 - 1664	
	DDB 1727 - 1696	
	DDB 1759 - 1728	
	DDB 1791 - 1760	
	DDB 1823 - 1792	
	DDB 1855 - 1824	
	DDB 1887 - 1856	
	DDB 1919 - 1888	
	DDB 1951 - 1920	
	DDB 1983 - 1952	
	DDB 2015 - 1984	
	DDB 2047 - 2016	

1100 OPTOS CONFIG

	Global Nominal V	
	Opto Filter Ctrl	
	Opto Filter Ctr2	

OUTPUT LABELS

Group Settings		Group 1 Settings	Group 2 Settings	Group 3 Settings	Group 4 Settings
	Relay 1				
	Relay 2				
	Relay 3				
	Relay 4				
	Relay 5				
	Relay 6				
	Relay 7				
	Relay 8				
	Relay 9				
	Relay 10				
	Relay 11				
	Relay 12				
	Relay 13				
	Relay 14				
	Relay 15				
	Relay 16				
	Relay 17				
	Relay 18				
	Relay 19				
	Relay 20				
	Relay 21				
	Relay 22				
	Relay 23				
	Relay 24				
	Relay 25				
	Relay 26				
	Relay 27				
	Relay 28				
	Relay 29				
	Relay 30				
	Relay 31				
	Relay 32				
	Relay 33				
	Relay 34				

CM

OUTPUT LABELS

Group Settings		Group 1 Settings	Group 2 Settings	Group 3 Settings	Group 4 Settings
	Relay 35				
	Relay 36				
	Relay 37				
	Relay 38				
	Relay 39				
	Relay 40				
	Relay 41				
	Relay 42				
	Relay 43				
	Relay 44				
	Relay 45				
	Relay 46				
	Relay 47				
	Relay 48				
	Relay 49				
	Relay 50				
	Relay 51				
	Relay 52				
	Relay 53				
	Relay 54				
	Relay 55				
	Relay 56				
	Relay 57				
	Relay 58				
	Relay 59				
	Relay 60				
	Relay 61				
	Relay 62				
	Relay 63				
	Relay 64				

GROUP SETTINGS

INPUT LABELS

Group 1 Settings		Group 1 Settings	Group 2 Settings	Group 3 Settings	Group 4 Settings
	Opto Input 1				
	Opto Input 2				
	Opto Input 3				
	Opto Input 4				
	Opto Input 5				
	Opto Input 6				
	Opto Input 7				
	Opto Input 8				
	Opto Input 9				
	Opto Input 10				
	Opto Input 11				
	Opto Input 12				
	Opto Input 13				
	Opto Input 14				
	Opto Input 15				
	Opto Input 16				
	Opto Input 17				
	Opto Input 18				
	Opto Input 19				
	Opto Input 20				
	Opto Input 21				
	Opto Input 22				
	Opto Input 23				
	Opto Input 24				
	Opto Input 25				
	Opto Input 26				
	Opto Input 27				
	Opto Input 28				
	Opto Input 29				
	Opto Input 30				
	Opto Input 31				
	Opto Input 32				
	Opto Input 33				
	Opto Input 34				
	Opto Input 35				
	Opto Input 36				



Group 1 Settings		Group 1 Settings	Group 2 Settings	Group 3 Settings	Group 4 Settings
	Opto Input 37				
	Opto Input 38				
	Opto Input 39				
	Opto Input 40				
	Opto Input 41				
	Opto Input 42				
	Opto Input 43				
	Opto Input 44				
	Opto Input 45				
	Opto Input 46				
	Opto Input 47				
	Opto Input 48				
	Opto Input 49				
	Opto Input 50				
	Opto Input 61				
	Opto Input 62				
	Opto Input 63				
	Opto Input 64				

4B00 OUTPUT LABELS

Group 1 Settings		Group 1 Settings	Group 2 Settings	Group 3 Settings	Group 4 Settings
	Relay 1				
	Relay 2				
	Relay 3				
	Relay 4				
	Relay 5				
	Relay 6				
	Relay 7				
	Relay 8				
	Relay 9				
	Relay 10				
	Relay 11				
	Relay 12				
	Relay 13				
	Relay 14				
	Relay 15				
	Relay 16				
	Relay 17				



Group 1 Settings		Group 1 Settings	Group 2 Settings	Group 3 Settings	Group 4 Settings
	Relay 18				
	Relay 19				
	Relay 20				
	Relay 21				
	Relay 22				
	Relay 23				
	Relay 24				
	Relay 25				
	Relay 26				
	Relay 27				
	Relay 28				
	Relay 29				
	Relay 30				
	Relay 31				
	Relay 32				
	Relay 41				
	Relay 42				
	Relay 43				
	Relay 44				
	Relay 45				
	Relay 46				
	Relay 47				
	Relay 48				
	Relay 49				
	Relay 50				
	Relay 51				
	Relay 52				
	Relay 53				
	Relay 54				
	Relay 55				
	Relay 56				
	Relay 57				
	Relay 58				
	Relay 59				
	Relay 60				
	Relay 61				
	Relay 62				
	Relay 63				
	Relay 64				

CM

Note:



Commissioning Engineer:

Customer Witness:

Date:

Date:

1100 OPTOS SETUP**1300 CTRL. I/P CONFIG.**

	Ctrl I/P Status	
	Control Input 1	Latched / Pulsed *
	Ctrl Command 1	
	Control Input 2	Latched / Pulsed *
	Ctrl Command 2	
	Control Input 3	Latched / Pulsed *
	Ctrl Command 3	
	Control Input 4	Latched / Pulsed *
	Ctrl Command 4	
	Control Input 5	Latched / Pulsed *
	Ctrl Command 5	
	Control Input 6	Latched / Pulsed *
	Ctrl Command 6	
	Control Input 7	Latched / Pulsed *
	Ctrl Command 7	
	Control Input 8	Latched / Pulsed *
	Ctrl Command 8	
	Control Input 9	Latched / Pulsed *
	Ctrl Command 9	
	Control Input 10	Latched / Pulsed *
	Ctrl Command 10	
	Control Input 11	Latched / Pulsed *
	Ctrl Command 11	
	Control Input 12	Latched / Pulsed *
	Ctrl Command 12	
	Control Input 13	Latched / Pulsed *
	Ctrl Command 13	
	Control Input 14	Latched / Pulsed *
	Ctrl Command 14	
	Control Input 15	Latched / Pulsed *
	Ctrl Command 15	
	Control Input 16	Latched / Pulsed *
	Ctrl Command 16	
	Control Input 17	Latched / Pulsed *
	Ctrl Command 17	
	Control Input 18	Latched / Pulsed *
	Ctrl Command 18	
	Control Input 19	Latched / Pulsed *

1300 CTRL. I/P CONFIG.

	Ctrl Command 19	
	Control Input 20	Latched / Pulsed *
	Ctrl Command 20	
	Control Input 21	Latched / Pulsed *
	Ctrl Command 21	
	Control Input 22	Latched / Pulsed *
	Ctrl Command 22	
	Control Input 23	Latched / Pulsed *
	Ctrl Command 23	
	Control Input 24	Latched / Pulsed *
	Ctrl Command 24	
	Control Input 25	Latched / Pulsed *
	Ctrl Command 25	
	Control Input 26	Latched / Pulsed *
	Ctrl Command 26	
	Control Input 27	Latched / Pulsed *
	Ctrl Command 27	
	Control Input 28	Latched / Pulsed *
	Ctrl Command 28	
	Control Input 29	Latched / Pulsed *
	Ctrl Command 29	
	Control Input 30	Latched / Pulsed *
	Ctrl Command 30	
	Control Input 31	Latched / Pulsed *
	Ctrl Command 31	
	Control Input 32	Latched / Pulsed *
	Ctrl Command 32	

1700 FUNCTION KEYS

	Fn Key Status	
	Fn. Key 1	Disabled / Locked / Unlock *
	Fn. Key 1 Mode	Toggled / Normal *
	Fn. Key 1 Label	
	Fn. Key 2	Disabled / Locked / Unlock *
	Fn. Key 2 Mode	Toggled / Normal *
	Fn. Key 2 Label	
	Fn. Key 3	Disabled / Locked / Unlock *
	Fn. Key 3 Mode	Toggled / Normal *
	Fn. Key 3 Label	

1700 FUNCTION KEYS

	Fn. Key 4	Disabled / Locked / Unlock *
	Fn. Key 4 Mode	Toggled / Normal *
	Fn. Key 4 Label	
	Fn. Key 5	Disabled / Locked / Unlock *
	Fn. Key 5 Mode	Toggled / Normal *
	Fn. Key 5 Label	
	Fn. Key 6	Disabled / Locked / Unlock *
	Fn. Key 6 Mode	Toggled / Normal *
	Fn. Key 6 Label	
	Fn. Key 7	Disabled / Locked / Unlock *
	Fn. Key 7 Mode	Toggled / Normal *
	Fn. Key 7 Label	
	Fn. Key 8	Disabled / Locked / Unlock *
	Fn. Key 8 Mode	Toggled / Normal *
	Fn. Key 8 Label	
	Fn. Key 9	Disabled / Locked / Unlock *
	Fn. Key 9 Mode	Toggled / Normal *
	Fn. Key 9 Label	
	Fn. Key 10	Disabled / Locked / Unlock *
	Fn. Key 10 Mode	Toggled / Normal *
	Fn. Key 0 Label	

1900 IED CONFIGURATOR

	Switch Conf.Bank	No Action* <input type="checkbox"/>	Switch Banks* <input type="checkbox"/>
	GoEna	Disabled* <input type="checkbox"/>	Enabled* <input type="checkbox"/>
	Test Mode	Disabled* <input type="checkbox"/>	Pass Through* <input type="checkbox"/>
		Forced* <input type="checkbox"/>	
	VOP Test Pattern		
	Ignore Test Flag	No* <input type="checkbox"/>	Yes* <input type="checkbox"/>

2900 CTRL. I/P LABELS

	Control Input 1	
	Control Input 2	
	Control Input 3	
	Control Input 4	
	Control Input 5	
	Control Input 6	
	Control Input 7	
	Control Input 8	



2900 CTRL. I/P LABELS

	Control Input 9	
	Control Input 10	
	Control Input11	
	Control Input 12	
	Control Input 13	
	Control Input 14	
	Control Input 15	
	Control Input 16	
	Control Input 17	
	Control Input 18	
	Control Input 19	
	Control Input 20	
	Control Input 21	
	Control Input 22	
	Control Input 23	
	Control Input 24	
	Control Input 25	
	Control Input 26	
	Control Input 27	
	Control Input 28	
	Control Input 29	
	Control Input 30	
	Control Input 31	
	Control Input 32	



Commissioning Engineer:

Customer Witness:

Date:

Date:

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CM

MAINTENANCE

MT

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

CONTENTS

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1. MAINTENANCE

1.1 Maintenance period

It is recommended that products supplied by Schneider Electric receive periodic monitoring after installation. As with all products some deterioration with time is inevitable. In view of the critical nature of devices and their infrequent operation, it is desirable to confirm that they are operating correctly at regular intervals.

Schneider Electric protective relays are designed for a life in excess of 20 years.

MiCOM P849 input and output extension device is self-supervising and so require less maintenance than earlier designs of device. Most problems will result in an alarm so that remedial action can be taken. However, some periodic tests should be done to ensure that the device is functioning correctly and the external wiring is intact.

If a Preventive Maintenance Policy exists within the customer's organisation then the recommended product checks should be included in the regular programme. Maintenance periods will depend on many factors, such as:

- operating environment
- accessibility of the site
- amount of available manpower
- importance of the installation in the power system
- consequences of failure


1.2 Maintenance checks

It is recommended that maintenance checks are performed locally (i.e. at the substation itself).



Before carrying out any work on the equipment, the user should be familiar with the contents of the safety section/safety guide SFTY/4LM/E11 or later issue, the technical data section and the ratings on the equipment rating label

1.2.1 Alarms

The alarm status LED should first be checked to identify if any alarm conditions exist. If so, press the read key  repeatedly to step through the alarms.

Clear the alarms to extinguish the LED.

1.2.2 Opto-isolators

The opto-isolated inputs can be checked to ensure that the device responds to their energisation by repeating the commissioning test.

1.2.3 Output relays

The output relays can be checked to ensure that they operate by repeating the commissioning test.

1.3 Method of repair

If the device should develop a fault whilst in service, depending on the nature of the fault, the watchdog contacts will change state and an alarm condition will be flagged. Due to the extensive use of surface-mount components faulty PCBs should be replaced as it is not possible to perform repairs on damaged circuits. Thus either the complete device or just the faulty PCB, identified by the in-built diagnostic software, can be replaced. Advice about identifying the faulty PCB can be found in the Problem Analysis.

The preferred method is to replace the complete device as it ensures that the internal circuitry is protected against electrostatic discharge and physical damage at all times and overcomes the possibility of incompatibility between replacement PCBs. However, it may be difficult to remove an installed device due to limited access in the back of the cubicle and rigidity of the scheme wiring.

Replacing PCBs can reduce transport costs but requires clean, dry conditions on site and higher skills from the person performing the repair. However, if the repair is not performed by an approved service centre, the warranty will be invalidated.



Before carrying out any work on the equipment, the user should be familiar with the contents of the safety section/safety guide SFTY/4LM/E11 or later issue, the technical data section and the ratings on the equipment rating label

1.3.1 Replacing the complete device

The case and rear terminal blocks have been designed to facilitate removal of the complete device should replacement or repair become necessary without having to disconnect the scheme wiring.

Before working at the rear of the device, isolate all voltage supplies to the device.

Disconnect the earth, IRIG-B (Central unit only) and fibre optic connections, as appropriate, from the rear of the device.

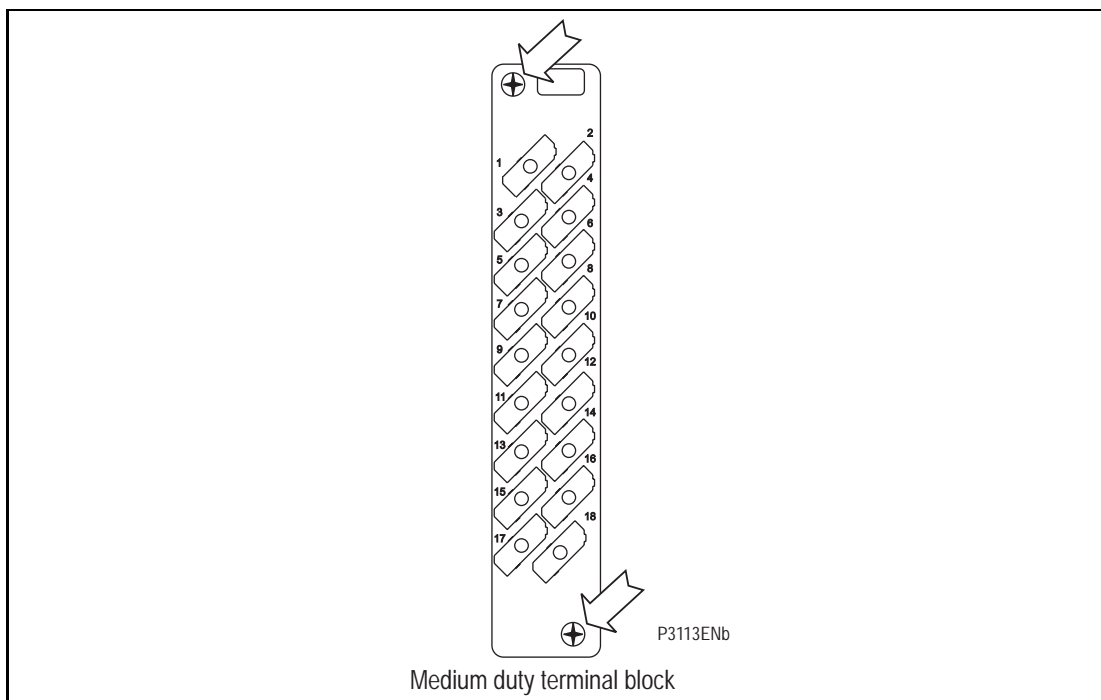


FIGURE 1: LOCATION OF SECURING SCREWS FOR TERMINAL BLOCK

Note: The use of a magnetic bladed screwdriver is recommended to minimise the risk of the screws being left in the terminal block or lost

Without exerting excessive force or damaging the scheme wiring, pull the terminal blocks away from their internal connectors.

Remove the screws used to fasten the device to the panel, rack, etc. These are the screws with the larger diameter heads that are accessible when the access covers are fitted and open.



If the top and bottom access covers have been removed, do not remove the screws with the smaller diameter heads which are accessible. These screws secure the front panel to the device.

Withdraw the device carefully from the panel, rack, etc. because it will be heavy due to the internal transformers.

To reinstall the repaired or replacement device, follow the above instructions in reverse, ensuring that each terminal block is relocated in the correct position and the case earth, IRIG-B (Central Unit only) and fibre optic connections are replaced. To facilitate easy identification of each terminal block, they are labeled alphabetically with 'A' on the left hand side when viewed from the rear.

Once reinstallation is complete the device should be recommissioned using the instructions in sections 1 to 8 inclusive of this chapter.

1.3.2 Replacing a PCB

If the device fails to operate correctly refer to the Problem Analysis chapter, to help determine which PCB has become faulty.

To replace any of the device's PCBs it is necessary to first remove the front panel.



Before removing the front panel to replace a PCB the auxiliary supply must be removed. It is also strongly recommended that the voltage and current transformer connections and trip circuit are isolated.

Open the top and bottom access covers. With size 80TE cases the access covers have two hinge-assistance T-pieces which clear the front panel moulding when the access covers are opened by more than 90°, thus allowing their removal.

If fitted, remove the transparent secondary front cover. A description of how to do this is given in the 'Introduction'.

By applying outward pressure to the middle of the access covers, they can be bowed sufficiently so as to disengage the hinge lug allowing the access cover to be removed. The screws that fasten the front panel to the case are now accessible.

The size 80TE case has an additional two screws, one midway along each of the top and bottom edges of the front plate. Undo and remove the screws.



Do not remove the screws with the larger diameter heads which are accessible when the access covers are fitted and open. These screws hold the device in its mounting (panel or cubicle).

When the screws have been removed, the complete front panel can be pulled forward and separated from the metal case.

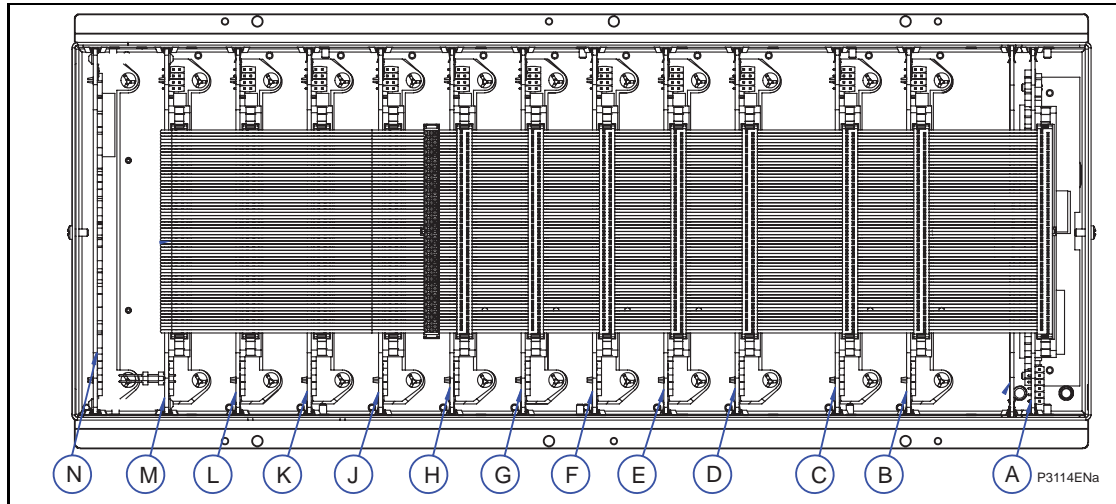
Caution should be observed at this stage because the front panel is connected to the rest of the device circuitry by a 64-way ribbon cable.

Additionally, from here on, the internal circuitry of the device is exposed and not protected against electrostatic discharges, dust ingress, etc. Therefore ESD precautions and clean working conditions should be maintained at all times.

The ribbon cable is fastened to the front panel using an IDC connector; a socket on the cable itself and a plug with locking latches on the front panel. Gently push the two locking latches outwards which will eject the connector socket slightly. Remove the socket from the plug to disconnect the front panel.

The PCBs within the device are now accessible.

Note: The numbers above the case outline identify the guide slot reference for each printed circuit board. Each printed circuit board has a label stating the corresponding guide slot number to ensure correct re-location after removal. To serve as a reminder of the slot numbering there is a label on the rear of the front panel metallic screen.



REF	DESCRIPTION	Reference
N	Assy Power Supply (24-48Vdc) Assy Power Supply (24-110Vdc) Assy Power Supply (110-250Vdc)	2071964A01 2071964A02 2071964A03
B to M (see next table)	Opto Input board Output relay board (7 relays) Output relay board (8 relays) High Break output relay board	2071960A22 2071966A01 2071962A01 ZN0042-001
A	No Option Assy IRIG-B modulated only Fibre Optic converter IRIG-B Modulated + Fibre Optic Converter Assy IRIG-B demodulated only Assy Ethernet (100Mbps) only Assy Ethernet (100Mbps) + IRIG-B (mod) Assy Ethernet (100Mbps) IRIG-B (demod) Assy 2nd rear port + IRIG-B (mod) Assy 2nd rear port only Assy Redundant Ethernet (SHR) Modulated IRIG-B Assy Redundant Ethernet (SHR) non Modulated IRIG-B Assy Redundant Ethernet (RSTP) Modulated IRIG-B Assy Redundant Ethernet (RSTP) non Modulated IRIG-B Assy Redundant Ethernet (DHS) Modulated IRIG-B Assy Redundant Ethernet (DHS) non Modulated IRIG-B	-- ZN0007 001 ZN0007 002 ZN0007 003 ZN0049 004 ZN0049 001 ZN0049 002 ZN0049 003 ZN0025 001 ZN0025 002 ZN0071 001 ZN0071 002 ZN0071 005 ZN0071 006 ZN0071 007 ZN0071 008

FIGURE 2: MiCOM P849 – PCB/MODULE LOCATIONS (VIEWED FROM FRONT)



The next table summarizes PCBs location for Slots B to M per Model:

		Model (P849xxxA ... P849xxxF)					
REF	DESCRIPTION	A	B	C	D	E	F
M	Relay board (7 relays)			✓			✓
	Relay board (8 relays)	✓	✓		✓	✓	
L	Relay board (7 relays)			✓			✓
	Relay board (8 relays)	✓	✓		✓	✓	
K	Opto input board					✓	
	Relay board (7 relays)						
	Relay board (8 relays)		✓		✓		✓
	High Break output relay board			✓			
J	Opto input board					✓	
	Relay board (7 relays)						
	Relay board (8 relays)				✓		✓
	High Break output relay board			✓			
H	Opto input board		✓			✓	
	Relay board (7 relays)				✓		
	Relay board (8 relays)						✓
	High Break output relay board			✓			
G	Opto input board		✓			✓	
	Relay board (7 relays)				✓		
	Relay board (8 relays)						✓
	High Break output relay board			✓			
F	Opto input board	✓	✓			✓	✓
	Relay board (7 relays)				✓		
E	Opto input board	✓	✓	✓		✓	✓
	Relay board (7 relays)				✓		
D	Opto input board	✓	✓	✓	✓	✓	✓
C	Opto input board	✓	✓	✓	✓	✓	✓
B	Opto input board			✓			



After replacing the PCB, set and/or check jumpers position.

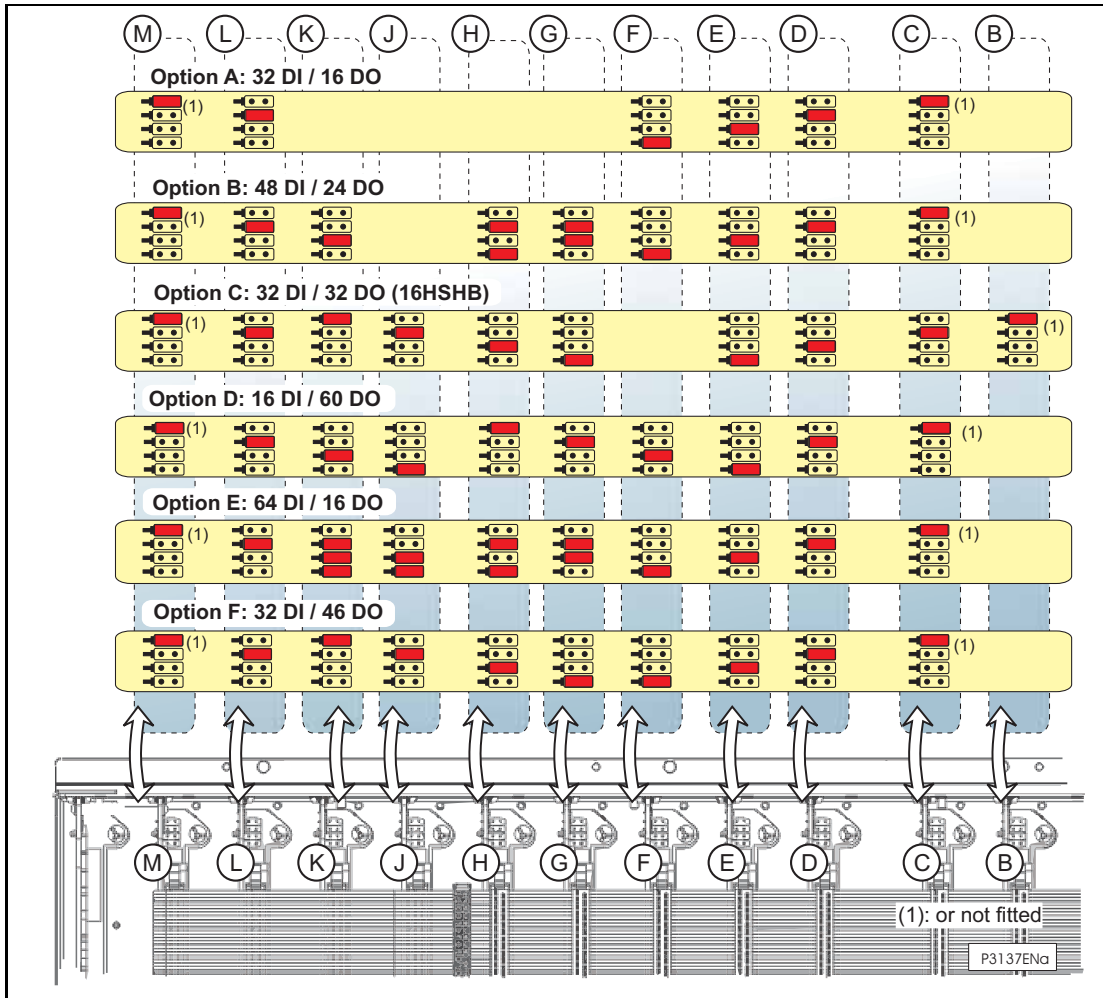


FIGURE 3: MiCOM P849 – JUMPERS POSITION (VIEWED FROM FRONT)

1.3.2.1 Replacement of the main processor board



ESD precautions should be taken to avoid damage to the microprocessor based circuits.

The main processor board is located in the front panel, not within the case as with all the other PCBs. Place the front panel with the user interface face-down and remove the six screws from the metallic screen, as shown in figure 4. Remove the metal plate.

There are two further screws, one each side of the rear of the battery compartment recess, that hold the main processor PCB in position. Remove these screws.

The user interface keypad is connected to the main processor board via a flex-strip ribbon cable. Carefully disconnect the ribbon cable at the PCB-mounted connector as it could easily be damaged by excessive twisting.

The front panel can then be re-assembled with a replacement PCB using the reverse procedure. Ensure that the ribbon cable is reconnected to the main processor board and all eight screws are re-fitted.

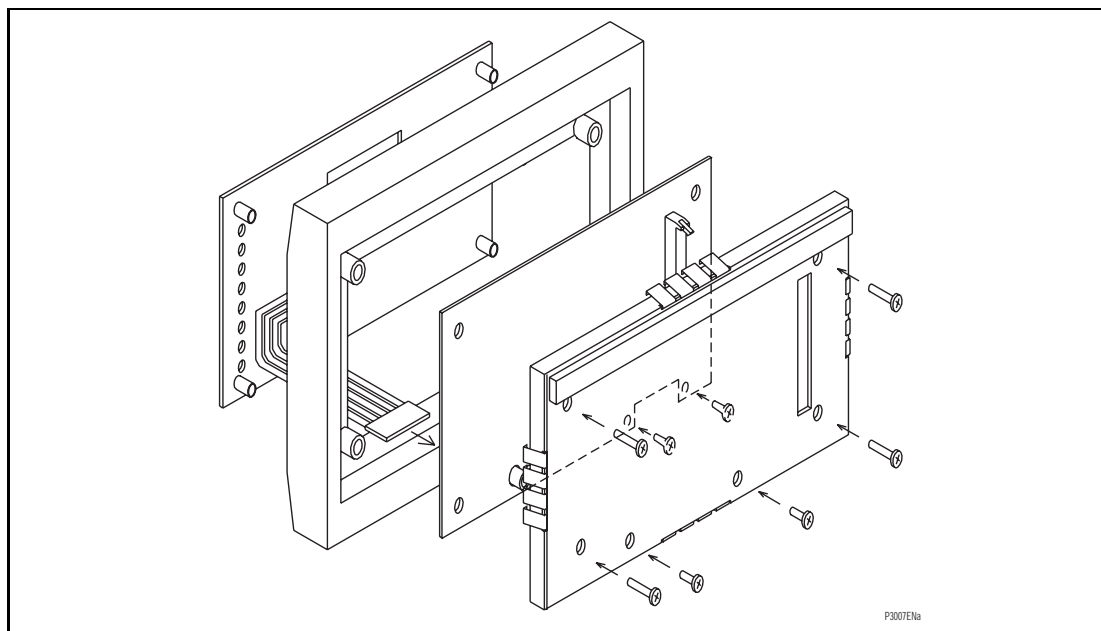


FIGURE 4: FRONT PANEL ASSEMBLY

Refit the front panel using the reverse procedure to that given before. After refitting and closing the access covers on size 80TE cases, press at the location of the hinge-assistance T-pieces so that they click back into the front panel moulding.

After replacement of the main processor board, all the settings required for the application will need to be re-entered. Therefore, it is useful if an electronic copy of the application-specific settings is available on a digital medium. Although this is not essential, it can reduce the time taken to re-enter the settings and hence the time the device is out of service.

Once the device has been reassembled after repair, it should be recommissioned in accordance with the instructions in sections 1 to 8 inclusive (commissioning and maintenance section P849/EN CM).

1.3.2.2 Replacement of the optional board in MiCOM P849

To replace a faulty board, disconnect all connections at the rear of the device.

The board is secured in the case by two screws accessible from the rear of the device, one at the top and another at the bottom, as shown in Figure 6. Remove these screws carefully as they are not captive in the rear panel of the device.

Gently pull the optional board forward and out of the case.

To help identify that the correct board has been removed, Figure 5 illustrates the layout of the IRIG-B board with IRIG-B (ZN0007-001 or ZN0049-004) or Ethernet (ZN0049-001) or Ethernet and IRIG-B (ZN0049 002 or ZN0049 003) or second rear port (ZN0025-001 or ZN0025-002) or Redundant Ethernet Board ((ZN0071 001 to ZN0071 008).

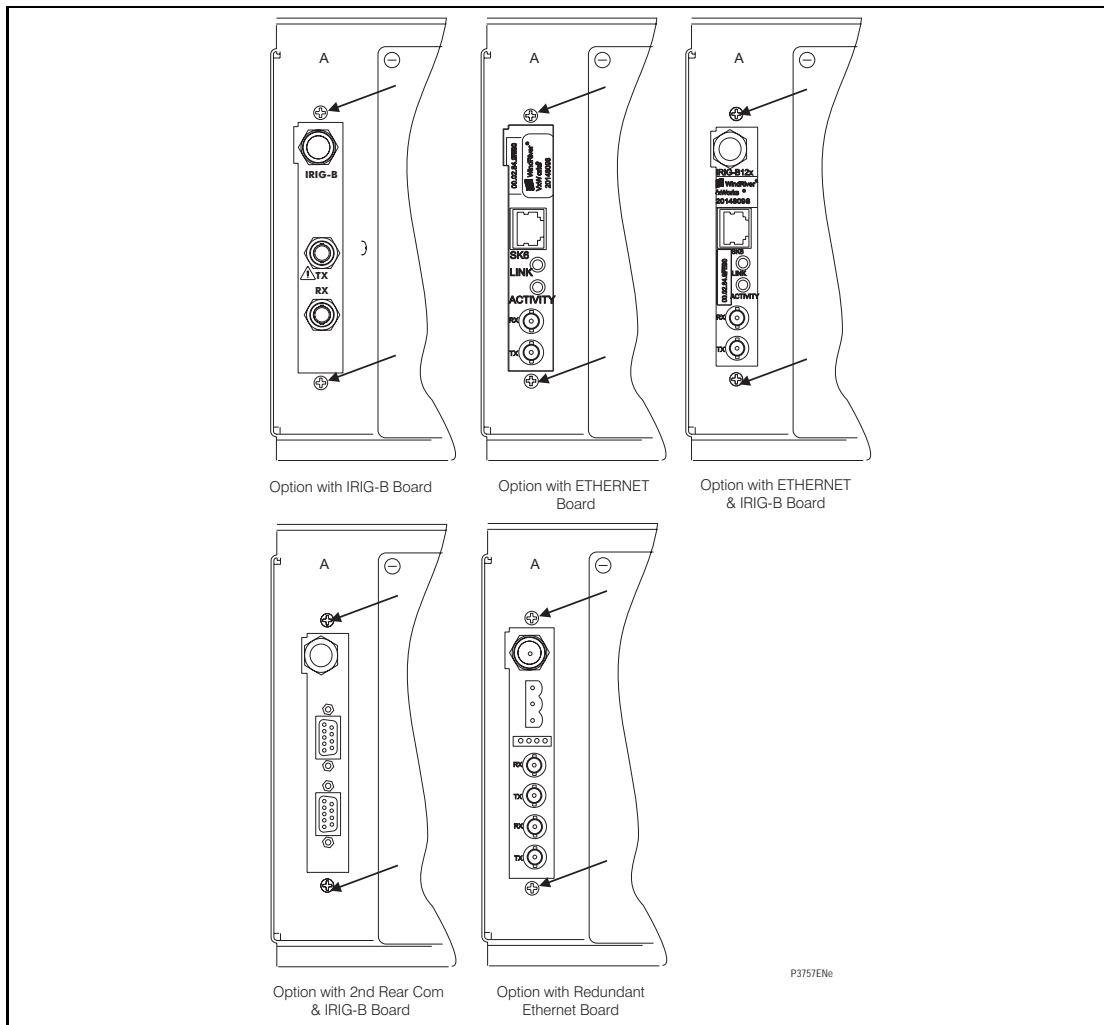


FIGURE 5: LOCATION OF SECURING SCREWS FOR OPTIONAL BOARD

MT

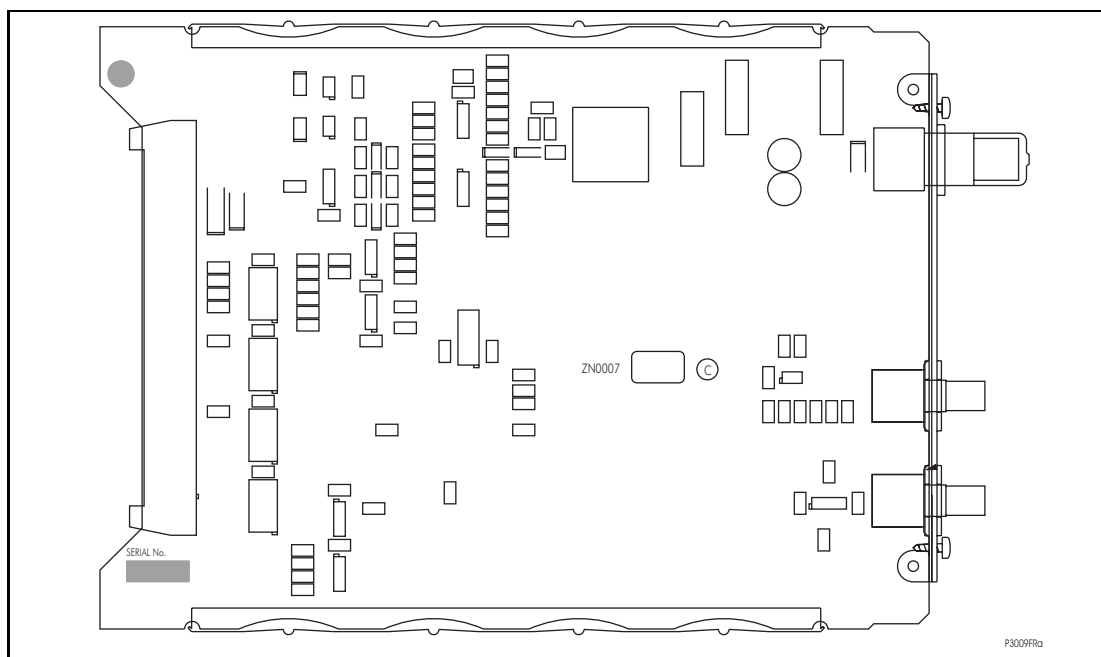


FIGURE 6: TYPICAL IRIG-B BOARD

Before fitting the replacement PCB check that the number on the round label adjacent to the front edge of the PCB matches the slot number into which it will be fitted. If the slot number is missing or incorrect write the correct slot number on the label.

The replacement PCB should be carefully slotted into the appropriate slot, ensuring that it is pushed fully back on to the rear terminal blocks and the securing screws are re-fitted.

Reconnect the connections at the rear of the device.

Refit the front panel using the reverse procedure to that given in section 1.3.2.1. After refitting and closing the access covers on size 80TE cases, press at the location of the hinge-assistance T-pieces so that they click back into the front panel moulding.

Once the device has been reassembled after repair, it should be recommissioned in accordance with the instructions in sections 1 to 8 inclusive (commissioning and maintenance section P849/EN CM).

1.3.2.3 Replacement of the power supply board

The power supply board is fastened to a relay board to form the power supply module and is located on the extreme left-hand side of all MiCOM P849 devices.

Pull the power supply module forward, away from the rear terminal blocks and out of the case. A reasonable amount of force will be required to achieve this due to the friction between the contacts of the two medium duty terminal blocks.

The two boards are held together with push-fit nylon pillars and can be separated by pulling them apart. Care should be taken when separating the boards to avoid damaging the inter-board connectors located near the lower edge of the PCBs towards the front of the power supply module.

The power supply board is the one with two large electrolytic capacitors on it that protrude through the other board that forms the power supply module. To help identify that the correct board has been removed, Figure 7 illustrates the layout of the power supply board for all voltage ratings.

Before re-assembling the module with a replacement PCB check that the number on the round label adjacent to the front edge of the PCB matches the slot number into which it will be fitted. If the slot number is missing or incorrect write the correct slot number on the label.

Re-assemble the module with a replacement PCB ensuring the inter-board connectors are firmly pushed together and the four push-fit nylon pillars are securely located in their respective holes in each PCB.

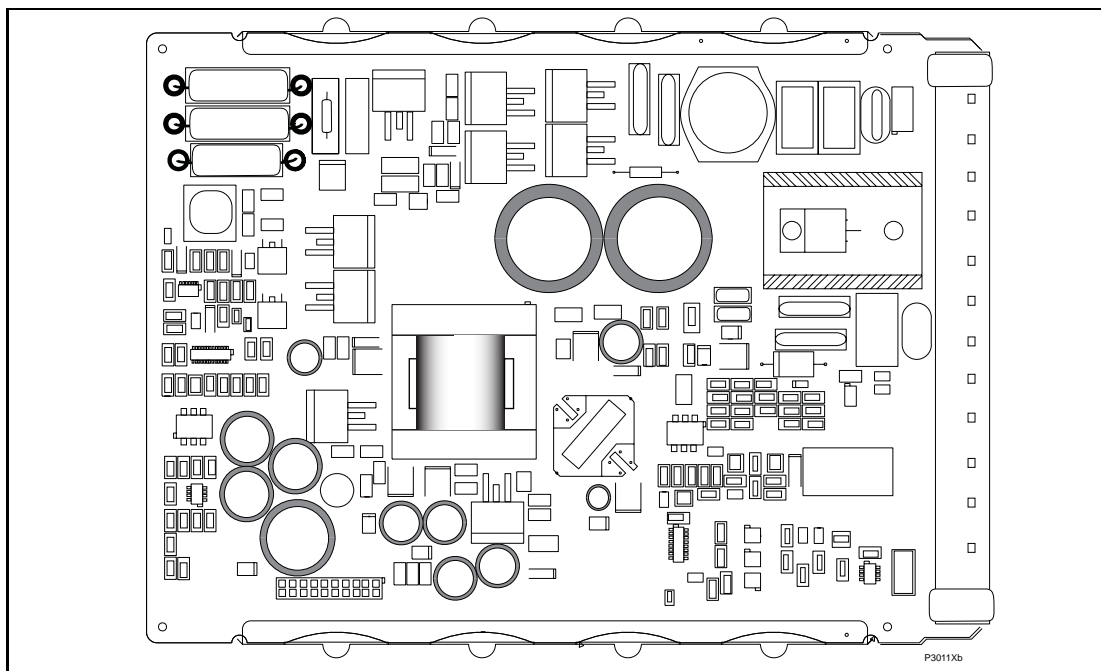


FIGURE 7: TYPICAL POWER SUPPLY BOARD

Slot the power supply module back into the device case, ensuring that it is pushed fully back on to the rear terminal blocks.

Refit the front panel using the reverse procedure to that given in section. After refitting and closing the access covers on size 80TE cases, press at the location of the hinge-assistance T-pieces so that they click back into the front panel moulding.

Once the device has been reassembled after repair, it should be recommissioned in accordance with the instructions in in sections 1 to 8 inclusive (commissioning and maintenance section P849/EN CM).

1.3.2.4 Replacement of the relay board in the power supply module

Remove and replace the relay board in the power supply module as described in above.

The relay board is the one with holes cut in it to allow the transformer and two large electrolytic capacitors of the power supply board to protrude through. To help identify that the correct board has been removed, Figure 8 illustrates the layout of the relay board.

Before re-assembling the module with a replacement relay board check that the number on the round label adjacent to the front edge of the PCB matches the slot number into which it will be fitted. If the slot number is missing or incorrect write the correct slot number on the label.

Ensure the setting of the link (located above IDC connector) on the replacement relay board is the same as the one being replaced before replacing the module in the device case.

Once the device has been reassembled after repair, it should be recommissioned in accordance with the instructions in sections 1 to 8 inclusive (commissioning and maintenance section P849/EN CM).

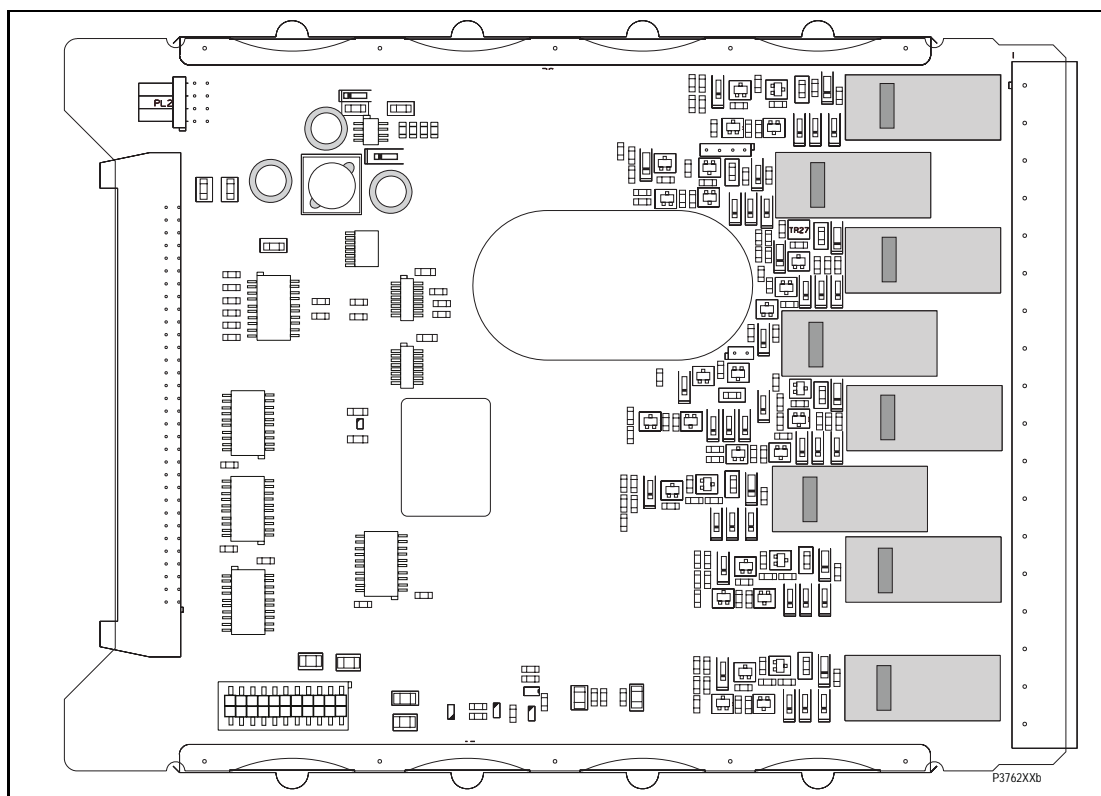


FIGURE 8: TYPICAL RELAY BOARD

1.3.2.5 Replacement of the opto and separate relay boards

To remove either, gently pull the faulty PCB forward and out of the case.

If the relay board is being replaced, ensure the setting of the link (located above IDC connector) on the replacement relay board is the same as the one being replaced. To help identify that the correct board has been removed, Figure 9 illustrates the layout of the opto board.

Before fitting the replacement PCB check that the number on the round label adjacent to the front edge of the PCB matches the slot number into which it will be fitted. If the slot number is missing or incorrect write the correct slot number on the label.

The replacement PCB should be carefully slid into the appropriate slot, ensuring that it is pushed fully back on to the rear terminal blocks.

Refit the front panel using the reverse procedure to that given in section. After refitting and closing the access covers on size 80TE cases, press at the location of the hinge-assistance T-pieces so that they click back into the front panel moulding.

Once the device has been reassembled after repair, it should be recommissioned in accordance with the instructions in sections 1 to 8 inclusive (commissioning and maintenance section P849/EN CM).

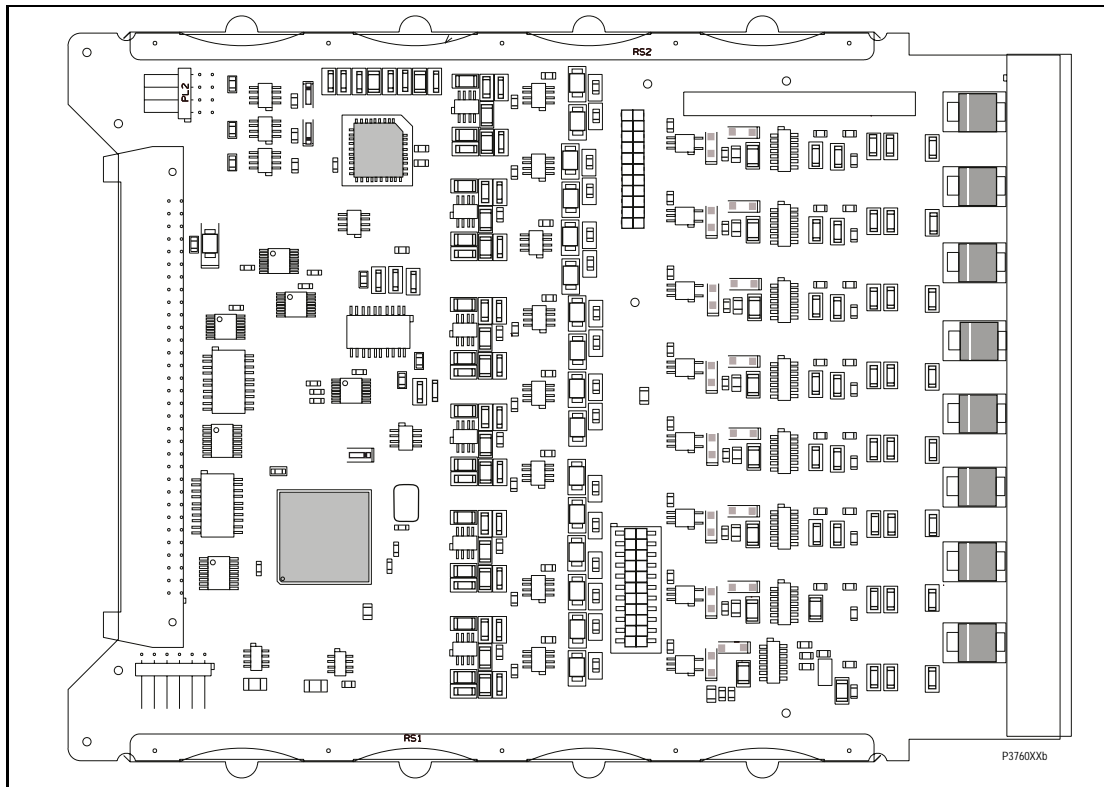


FIGURE 9: TYPICAL OPTO INPUT BOARD

1.4 Changing the device battery

Each device has a battery to maintain status data and the correct time when the auxiliary supply voltage fails. The data maintained includes event records and the thermal state at the time of failure.

This battery will periodically need changing, although an alarm will be given as part of the device's continuous self-monitoring in the event of a low battery condition.

If the battery-backed facilities are not required to be maintained during an interruption of the auxiliary supply, the steps below can be followed to remove the battery, but do not replace with a new battery.

Before carrying out any work on the equipment, the user should be familiar with the contents of the safety section/safety guide SFTY/4LM/E11 or later issue, the technical data section and the ratings on the equipment rating label.



1.4.1 Instructions for replacing the battery.

Open the bottom access cover on the front of the device.

Gently extract the battery from its socket. If necessary, use a small insulated screwdriver to prize the battery free.

Ensure that the metal terminals in the battery socket are free from corrosion, grease and dust.

The replacement battery should be removed from its packaging and placed into the battery holder, taking care to ensure that the polarity markings on the battery agree with those adjacent to the socket.

Note: Only use a type ½AA Lithium battery with a nominal voltage of 3.6V and safety approvals such as UL (Underwriters Laboratory), CSA (Canadian Standards Association) or VDE (Vereinigung Deutscher Elektrizitätswerke).



Ensure that the battery is securely held in its socket and that the battery terminals are making good contact with the metal terminals of the socket.

Close the bottom access cover.

1.4.2 Post modification tests

To ensure that the replacement battery will maintain the time and status data if the auxiliary supply fails, check cell [0806: DATE and TIME, Battery Status] reads 'Healthy'.

Additionally, if further confirmation that the replacement battery is installed correctly is required, the commissioning test described in chapter, 'Date and Time', can be performed.

1.4.3 Battery disposal

The battery that has been removed should be disposed of in accordance with the disposal procedure for Lithium batteries in the country in which the device is installed.

1.5 Cleaning



Before cleaning the equipment ensure that all ac and dc supplies, current transformer and voltage transformer connections are isolated to prevent any chance of an electric shock whilst cleaning.

The equipment may be cleaned using a lint-free cloth dampened with clean water. The use of detergents, solvents or abrasive cleaners is not recommended as they may damage the device's surface and leave a conductive residue.

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TROUBLESHOOTING

TS

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

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1. INTRODUCTION



Before carrying out any work on the equipment, the user should be familiar with the contents of the safety section/safety guide SFTY/4LM/E11 or later issue, the technical data section and the ratings on the equipment rating label

The purpose of this section of the service manual is to allow an error condition on the device to be identified so that appropriate corrective action can be taken.

Should the device have developed a fault, it should be possible in most cases to identify which device module requires attention. The Maintenance section (P849/EN MT), advises on the recommended method of repair where faulty modules need replacing. It is not possible to perform an on-site repair to a faulted module.

In cases where a faulty device/module is being returned to the manufacturer or one of their approved service centres, completed copy of the Repair/Modification Return Authorization Form located at the end of this section should be included.

2. INITIAL PROBLEM IDENTIFICATION

Consult the table below to find the description that best matches the problem experienced, then consult the section referenced to perform a more detailed analysis of the problem.

Symptom	Refer To
Device fails to power up	Section 4
Device powers up - but indicates error and halts during power-up sequence	Section 5
Device Powers up but Out of Service LED is illuminated	Section 6
Error during normal operation	Section 7
Mal-operation of the device during testing	Section 8

Table 1: Problem identification

3. POWER UP ERRORS

If the device does not appear to power up then the following procedure can be used to determine whether the fault is in the external wiring, auxiliary fuse, power supply module of the device or the device front panel.

Test	Check	Action
1	Measure auxiliary voltage on terminals 1 and 2; verify voltage level and polarity against rating the label on front. Terminal 1 is -dc, 2 is +dc	If auxiliary voltage is present and correct, then proceed to test 2. Otherwise the wiring/fuses in auxiliary supply should be checked.
2	Do LEDs/and LCD backlight illuminate on power-up, also check the N/O watchdog contact for closing.	If they illuminate or the contact closes and no error code is displayed then error is probably in the main processor board (front panel). If they do not illuminate and the contact does not close then proceed to test 3.
3	Check Field voltage output (nominally 48V DC)	If field voltage is not present then the fault is probably in the device power supply module.

Table 2: Failure of device to power up

4. ERROR MESSAGE/CODE ON POWER-UP

During the power-up sequence of the device self-testing is performed as indicated by the messages displayed on the LCD. If an error is detected by the device during these self-tests then an error message will be displayed and the power-up sequence will be halted. If the error occurs when the device application software is executing then a maintenance record will be created and the device will reboot.

Test	Check	Action
1	Is an error message or code permanently displayed during power up?	If device locks up and displays an error code permanently then proceed to test 2. If the device prompts for input by the user proceed to test 4. If the device re-boots automatically then proceed to test 5
2	Record displayed error, then remove and re-apply device auxiliary supply.	Record whether the same error code is displayed when the device is rebooted. If no error code is displayed then contact the local service centre stating the error code and device information. If the same code is displayed proceed to test 3.
3	<p>Error code Identification</p> <p>Following text messages (in English) will be displayed if a fundamental problem is detected preventing the system from booting:</p> <p>Bus Fail – address lines SRAM Fail – data lines FLASH Fail format error FLASH Fail checksum Code Verify Fail</p> <p>The following hex error codes relate to errors detected in specific device modules:</p> <p>0c140005/0c0d0000 0c140006/0c0e0000</p> <p>Last 4 digits provide details on the actual error.</p>	<p>These messages indicate that a problem has been detected on the main processor board of the device (located in the front panel).</p> <p>Input Module (inc. Opto-isolated inputs) Output device Cards</p> <p>Other error codes relate to problems within the main processor board hardware or software. It will be necessary to contact Schneider Electric with details of the problem for a full analysis.</p>
4	Device displays message for corrupt settings and prompts for restoration of defaults to the affected settings.	The power up tests have detected corrupted device settings, it is possible to restore defaults to allow the power-up to be completed. It will then be necessary to re-apply the application-specific settings.
5	Device resets on completion of power up - record error code displayed	Error 0x0E080000, programmable scheme logic error due to excessive execution time. Restore default settings by performing a power up with ⇐ and ⇒ keys depressed, confirm restoration of defaults at prompt using ↵ key. If device powers up successfully, check programmable logic for feedback paths. Other error codes will relate to software errors on the main processor board, contact Schneider Electric.

Table 3: Power-up self-test error

5. OUT OF SERVICE LED ILLUMINATED ON POWER UP

Test	Check	Action
1	Using the device menu confirm whether the Commission Test/Test Mode setting is Enabled. Otherwise proceed to test 2.	If the setting is Enabled then disable the test mode and, verify that the Out of Service LED is extinguished.
2	Select and view the last maintenance record from the menu (in the View Records).	<p>Check for H/W Verify Fail this indicates a discrepancy between the device model number and the hardware; examine the "Maint. Data", this indicates the causes of the failure using bit fields:</p> <p>Bit Meaning</p> <ul style="list-style-type: none"> 0 The application type field in the model number does not match the software ID 1 The application field in the model number does not match the software ID 2 The variant 1 field in the model number does not match the software ID 3 The variant 2 field in the model number does not match the software ID 4 The protocol field in the model number does not match the software ID 5 The language field in the model number does not match the software ID 6 The VT type field in the model number is incorrect (110V VTs fitted) 7 The VT type field in the model number is incorrect (440V VTs fitted) 8 The VT type field in the model number is incorrect (no VTs fitted)

Table 4: Out of service LED illuminated



6. ERROR CODE DURING OPERATION

The device performs continuous self-checking, if an error is detected then an error message will be displayed, a maintenance record will be logged and the device will reset (after a 1.6 second delay). A permanent problem (for example due to a hardware fault) will generally be detected on the power up sequence, following which the device will display an error code and halt. If the problem was transient in nature then the device should reboot correctly and continue in operation. The nature of the detected fault can be determined by examination of the maintenance record logged.

There are also two cases where a maintenance record will be logged due to a detected error where the device will not reset. These are detection of a failure of either the field voltage or the lithium battery, in these cases the failure is indicated by an alarm message, however the device will continue to operate.

If the field voltage is detected to have failed (the voltage level has dropped below threshold), then a scheme logic signal is also set. This allows the scheme logic to be adapted in the case of this failure (for example if a blocking scheme is being used).

In the case of a battery failure it is possible to prevent the device from issuing an alarm using the setting under the Date and Time section of the menu. This setting 'Battery Alarm' can be set to 'Disabled' to allow the device to be used without a battery, without an alarm message being displayed.

Error codes (as reported by the device via the front panel or in the Maintenance Records) can offer a considerable amount of information about the source of the error.

The Hex Code is reported on the front user interface of the device immediately prior to a reboot sequence. If this code could not be observed, use the Maintenance Records section of the View Records column to display the corresponding Decimal Code.

Hex Code	Decimal Code	Meaning
0x0C140001	202637313	The serial driver failed to initialise properly. Check the serial port hardware on the power supply board and the main processor board.
0x0C140002	202637314	The LCD driver failed to initialise properly. Check the LCD on the main processor board.
0x0C140003	202637315	The Flash memory driver failed to initialise properly. Check the Flash memory on the main processor board.
0x0C140004	202637316	The date and time driver failed to initialise properly. Check the real-time clock and battery-backed SRAM on the main processor board.
0x0C140008	202637320	The database failed to initialise properly. Check the EEPROM on the main processor board.
0x0C140009	202637321	The database took too long to commit a change. Check the EEPROM on the main processor board.
0x0C14000A	202637322	The IRIG-B driver failed to initialise properly. Check the IRIG-B interface hardware on the IRIG-B board.
0x0C160010	202768400	The continuous self-checks have found an error in the RAM bus. Check the RAM on the main processor board.
0x0C160011	202768401	The continuous self-checks have found an error in the RAM block. Check the RAM on the main processor board.
0x0C160012	202768402	The continuous self-checks have found an error in the Flash EPROM checksum. Check the Flash EPROM on the main processor board, and then try downloading a new program.

Hex Code	Decimal Code	Meaning
0x0C160013	202768403	The continuous self-checks have found an error in the code comparison. Check the Flash EPROM on the main processor board, and then try downloading a new program.
0x0C160014	202768404	The continuous self-checks have found an error in the battery backed SRAM. Check the battery, then the RAM on the main processor board.
0x0C160015	202768405	The continuous self-checks have found an error in the EEPROM. Check the EEPROM on the main processor board.
0x0C1600A0	202768544	The continuous self-checks have found an error on the acquisition board. Check the input board.
0x0C170016	202833942	Secondary initialisation tests detected a fast watchdog failure. Check the Flash EPROM on the main processor board.
0x0C170017	202833943	Secondary initialisation tests detected a battery backed SRAM failure. Check the battery backed SRAM on the main processor board.
0x0C170018	202833944	Secondary initialisation tests detected a bus reset test failure. Check the main processor board.
0x0C170019	202833945	Secondary initialisation tests detected a slow watchdog failure.

Table 5: Error Codes

Other error codes relate to problems within the main processor board software. It will be necessary to contact Schneider Electric through the Customer Care Centre at <http://www.schneider-electric.com>, with details of the problem for a full analysis.

7. MAL-OPERATION OF THE DEVICE DURING TESTING

7.1 Failure of output contacts

An apparent failure of the device output contacts may be caused by the device configuration; the following tests should be performed to identify the real cause of the failure. Note that the device self-tests verify that the coil of the contact has been energized, an error will be displayed if there is a fault in the output relay board.

Test	Check	Action
1	Is the Out of Service LED illuminated?	Illumination of this LED may indicate that the device is in test mode or that the device has been disabled due to a hardware verify error (see Table 4).
2	Examine the Contact status in the Commissioning section of the menu.	If the relevant bits of the contact status are operated then proceed to test 4, if not proceed to test 3.
3	Verify by examination of the fault record or by using the test port whether the device element is operating correctly.	If the device element does not operate verify whether the test is being correctly applied. If the device element does operate then it will be necessary to check the programmable logic, to ensure that the mapping of the device element to the contacts is correct.
4	Using the Commissioning/Test mode function apply a test pattern to the relevant relay output contacts and verify whether they operate (note the correct external connection diagram should be consulted). A continuity tester can be used at the rear of the device for this purpose.	If the output relay does operate then the problem must be in the external wiring to the device. If the output relay does not operate this could indicate a failure of the output relay contacts (note that the self-tests verify that the relay coil is being energized). Ensure that the closed resistance is not too high for the continuity tester to detect.

Table 6: Failure of output contacts

7.2 Failure of opto-isolated inputs

The opto-isolated inputs are mapped onto the device internal signals using the programmable scheme logic. If an input does not appear to be recognized by the device scheme logic the Commission Tests/Opto Status menu option can be used to verify whether the problem is in the opto-isolated input itself or the mapping of its signal to the scheme logic functions. If the opto-isolated input does appear to be read correctly then it will be necessary to examine its mapping within the programmable logic.

Ensure the voltage rating for the opto inputs has been configured correctly with applied voltage. If the opto-isolated input state is not being correctly read by the device the applied signal should be tested. Verify the connections to the opto-isolated input using the correct wiring diagram. Next, using a voltmeter verify that 80% opto setting voltage is present on the terminals of the opto-isolated input in the energized state. If the signal is being correctly applied to the device then the failure may be on the input card itself.

7.3 PSL editor troubleshooting

A failure to open a connection could be because of one or more of the following:

- The device address is not valid (note: this address is always 1 for the front port)
- Password is not valid
- Communication Set-up - COM port, Baud rate, or Framing - is not correct
- Transaction values are not suitable for the device and/or the type of connection
- Modem configuration is not valid. Changes may be necessary when using a modem
- The connection cable is not wired correctly or broken. See MiCOM S1 connection configurations

7.3.1 Diagram reconstruction after recover from device

Although the extraction of a scheme from a device is supported, the facility is provided as a way of recovering a scheme in the event that the original file is unobtainable.

The recovered scheme will be logically correct, but much of the original graphical information is lost. Many signals will be drawn in a vertical line down the left side of the canvas. Links are drawn orthogonally using the shortest path from A to B.

Any annotation added to the original diagram (titles, notes, etc.) are lost.

Sometimes a gate type may not be what was expected, e.g. a 1-input AND gate in the original scheme will appear as an OR gate when uploaded. Programmable gates with an inputs-to-trigger value of 1 will also appear as OR gates.

7.3.2 PSL version check

The PSL is saved with a version reference, time stamp and CRC check. This gives a visual check whether the default PSL is in place or whether a new application has been downloaded.

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SCADA COMMUNICATIONS

SC

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

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1. SCADA COMMUNICATIONS

1.1 Introduction

This section outlines the remote communications interfaces of the MiCOM relay. The relay supports a choice of one of five protocols via the rear communication interface, selected via the model number when ordering. This is in addition to the front serial interface and 2nd rear communications port, which supports the Courier protocol only.

The rear EIA(RS)485 interface is isolated and is suitable for permanent connection whichever protocol is selected. The advantage of this type of connection is that up to 32 relays can be 'daisy chained' together using a simple twisted pair electrical connection.

It should be noted that the descriptions contained within this section do not aim to fully detail the protocol itself. The relevant documentation for the protocol should be referred to for this information. This section serves to describe the specific implementation of the protocol in the relay.

1.2 Rear port information and connection advice – EIA(RS)485 protocols

1.2.1 Rear communication port EIA(RS)485 interface

The rear EIA(RS)485 communication port is provided by a 3-terminal screw connector located on the back of the relay. See section P849/EN IN for details of the connection terminals. The rear port provides K-Bus/EIA(RS)485 serial data communication and is intended for use with a permanently wired connection to a remote control centre. Of the three connections, two are for the signal connection, and the other is for the earth shield of the cable. When the K-Bus option is selected for the rear port, the two signal connections are not polarity conscious, however for MODBUS, IEC60870-5-103 and DNP3.0 care must be taken to observe the correct polarity.

The protocol provided by the relay is indicated in the relay menu in the 'Communications' column. Using the keypad and LCD, firstly check that the 'Comms. settings' cell in the 'Configuration' column is set to 'Visible', then move to the 'Communications' column. The first cell down the column shows the communication protocol being used by the rear port.

1.2.1.1 EIA(RS)485 bus

The EIA(RS)485 two-wire connection provides a half-duplex fully isolated serial connection to the product. The connection is polarized and whilst the product's connection diagrams indicate the polarization of the connection terminals it should be borne in mind that there is no agreed definition of which terminal is which. If the master is unable to communicate with the product, and the communication parameters match, then it is possible that the two-wire connection is reversed.

1.2.1.2 Bus termination

The EIA(RS)485 bus must have 120Ω (Ohm) ½ Watt terminating resistors fitted at either end across the signal wires – see Figure 1. Some devices may be able to provide the bus terminating resistors by different connection or configuration arrangements, in which case separate external components will not be required. However, this product does not provide such a facility, so if it is located at the bus terminus then an external termination resistor will be required.

1.2.1.3 Bus connections & topologies

The EIA(RS)485 standard requires that each device be directly connected to the physical cable that is the communications bus. Stubs and tees are expressly forbidden, as are star topologies. Loop bus topologies are not part of the EIA(RS)485 standard and are forbidden by it.

Two-core screened cable is recommended. The specification of the cable will be dependent on the application, although a multi-strand 0.5mm^2 per core is normally adequate. Total cable length must not exceed 1000m. The screen must be continuous and connected to ground at one end, normally at the master connection point; it is important to avoid circulating currents, especially when the cable runs between buildings, for both safety and noise reasons.

This product does not provide a signal ground connection. If a signal ground connection is present in the bus cable then it must be ignored, although it must have continuity for the benefit of other devices connected to the bus. At no stage must the signal ground be connected to the cables screen or to the product's chassis. This is for both safety and noise reasons.

1.2.1.4 Biasing

It may also be necessary to bias the signal wires to prevent jabber. Jabber occurs when the signal level has an indeterminate state because the bus is not being actively driven. This can occur when all the slaves are in receive mode and the master is slow to turn from receive mode to transmit mode. This may be because the master purposefully waits in receive mode, or even in a high impedance state, until it has something to transmit. Jabber causes the receiving device(s) to miss the first bits of the first character in the packet, which results in the slave rejecting the message and consequentially not responding. Symptoms of this are poor response times (due to retries), increasing message error counters, erratic communications, and even a complete failure to communicate.

Biasing requires that the signal lines be weakly pulled to a defined voltage level of about 1V. There should only be one bias point on the bus, which is best situated at the master connection point. The DC source used for the bias must be clean; otherwise noise will be injected. Note that some devices may (optionally) be able to provide the bus bias, in which case external components will not be required.

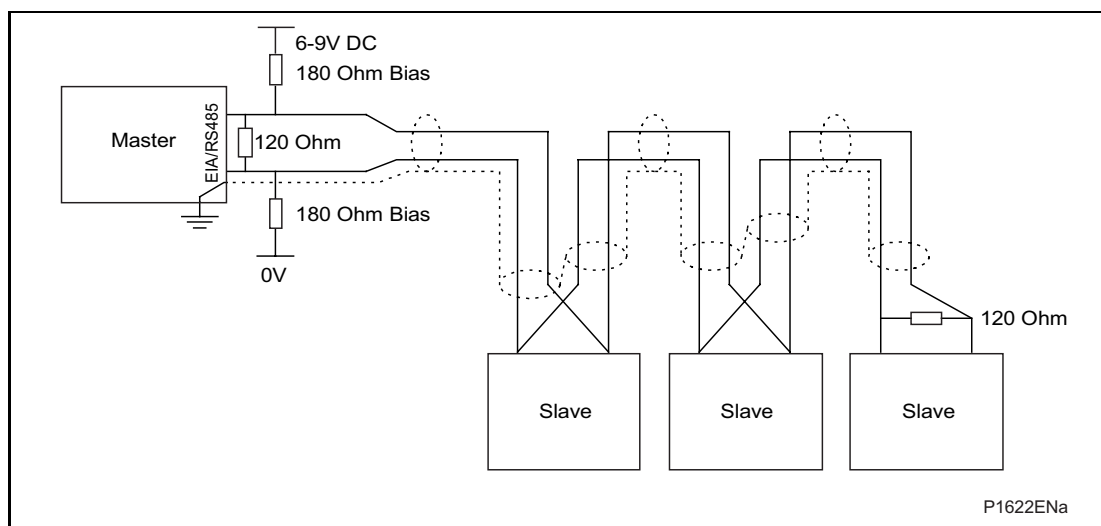


FIGURE 1: EIA(RS)485 BUS CONNECTION ARRANGEMENTS

It is possible to use the products field voltage output (48V DC) to bias the bus using values of $2.2k\Omega$ ($\frac{1}{2}W$) as bias resistors instead of the 180Ω resistors shown in the above diagram.

Note the following warnings apply:

- It is extremely important that the 120Ω termination resistors are fitted. Failure to do so will result in an excessive bias voltage that may damage the devices connected to the bus.
- As the field voltage is much higher than that required, Schneider Electric cannot assume responsibility for any damage that may occur to a device connected to the network as a result of incorrect application of this voltage.
- Ensure that the field voltage is not being used for other purposes (i.e. powering logic inputs) as this may cause noise to be passed to the communication network.

1.2.2 Courier communication

Courier works on a master/slave basis where the slave units contain information in the form of a database, and respond with information from the database when it is requested by a master unit.

The relay is a slave unit that is designed to be used with a Courier master unit such as MiCOM S1 Studio or a SCADA system.

To use the K-Bus rear port to communicate with a PC-based master station using Courier, a KITZ K-Bus to EIA(RS)232 protocol converter is required. This unit is available from Schneider Electric. A typical connection arrangement is shown in Figure 2. For more detailed information on other possible connection arrangements refer to the manual for the Courier master station software and the manual for the KITZ protocol converter. Each spur of the K-Bus twisted pair wiring can be up to 1000m in length and have up to 32 relays connected to it.

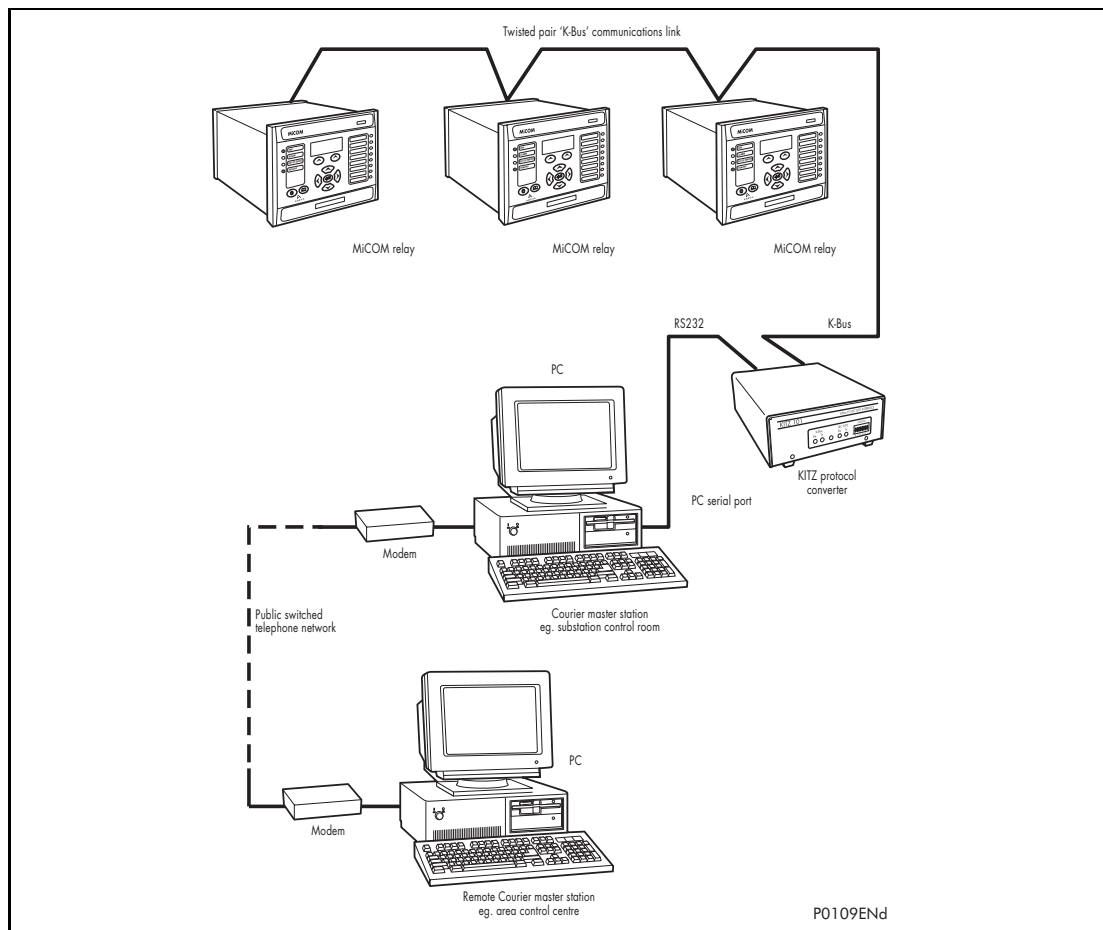
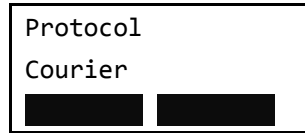


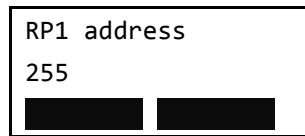
FIGURE 2: REMOTE COMMUNICATION CONNECTION ARRANGEMENTS

Having made the physical connection to the relay, the relay's communication settings must be configured. To do this use the keypad and LCD user interface. In the relay menu firstly check that the 'Comms. settings' cell in the 'Configuration' column is set to 'Visible', then move to the 'Communications' column. Only two settings apply to the rear port using Courier, the relay's address and the inactivity timer. Synchronous communication is used at a fixed baud rate of 64kbits/s.

Move down the 'Communications' column from the column heading to the first cell down which indicates the communication protocol:

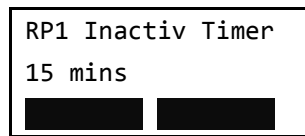


The next cell down the column controls the address of the relay:



Since up to 32 relays can be connected to one K-bus spur, as indicated in Figure 2, it is necessary for each relay to have a unique address so that messages from the master control station are accepted by one relay only. Courier uses an integer number between 0 and 254 for the relay address, which is set with this cell. It is important that no two relays have the same Courier address. The Courier address is then used by the master station to communicate with the relay. Default value of remote address is 255 and must be changed.

The next cell down controls the inactivity timer:



The inactivity timer controls how long the relay will wait without receiving any messages on the rear port before it reverts to its default state, including revoking any password access that was enabled. For the rear port this can be set between 1 and 30 minutes.

Note that precise event recorder settings that are modified using an on-line editor must be confirmed with a write to the 'Save changes' cell of the 'Configuration' column. Off-line editors such as MiCOM S1 Studio do not require this action for the setting changes to take effect.

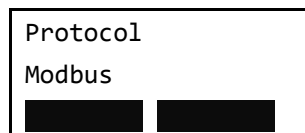
For K-Bus, the baud rate is fixed at 64kbit/second between the relay and the KITZ interface at the end of the relay spur. Courier communications is asynchronous.

1.2.3 MODBUS communication

MODBUS is a master/slave communication protocol, which can be used for network control, in a similar fashion to Courier (section 1.2.2), the system works by the master device initiating all actions and the slave devices (the relays), responding to the master by supplying the requested data or by taking the requested action. MODBUS communication is achieved via a twisted pair EIA(RS)485 connection to the rear port and can be used over a distance of 1000m with up to 32 slave devices.

The protocol specifications are in the public domain. They are managed by the MODBUS organization (www.modbus.org)

Move down the 'Communications' column from the column heading to the first cell down which indicates the communication protocol:



The next cells ('RP1 Address' and RP1 Inactiv timer') are similar to Courier protocol (see section 1.2.2):

- The MODBUS slave nodes must have an address. This address must be unique on a MODBUS communication network,
- The duration of the inactivity timer depends on the request processing time needed for the slave application.

The next cell controls the communication speed:

RP1 Baud Rate
19200
<input type="checkbox"/> <input type="checkbox"/>

Three baud rates are supported by the relay, '9600 bits/s', '19200 bits/s' and '38400 bits/s'.

The next cell controls the Parity format:

Parity
None
<input type="checkbox"/> <input type="checkbox"/>

'Parity' cell is used to configure devices for Even or Odd parity checking, or for No Parity checking. This will determine how the parity bit will be set in each character. If either Even or Odd Parity is specified, the quantity of '1' bits will be counted in the data portion of each character. The parity bit will then be set to a 0 or 1 to result in an Even or Odd total of 1 bits. When the message is transmitted, the parity bit is calculated and applied to the frame of each character. The device that receives counts the quantity of 1 bits and sets an error if they are not the same as configured for that device.

The next cell defines the electrical interface ('Physical Link'). The setting choice (cable connection type) depends on the MiCOM P849 option.

The next cell controls the date and time format ('Standard IEC' or 'Reverse IEC'):

Modbus IEC Time
Standard IEC
<input type="checkbox"/> <input type="checkbox"/>

1.2.4 IEC60870-5 CS 103 communication

The IEC specification IEC60870-5-103: Telecontrol Equipment and Systems, Part 5: Transmission Protocols Section 103 defines the use of standards IEC60870-5-1 to IEC60870-5-5 to perform communication with protection equipment. The standard configuration for the IEC60870-5-103 protocol is to use a twisted pair EIA(RS)485 connection over distances up to 1000m. The relay operates as a slave in the system, responding to commands from a master station.

IEC60870-5 CS 103 communication protocol can be set in a similar fashion to MODBUS communication (section 1.2.3).

1.2.5 DNP3.0 communication

The DNP 3.0 protocol is defined and administered by the DNP User Group. Information about the user group, DNP 3.0 in general and protocol specifications can be found on their website: www.dnp.org.

DNP3.0 communication protocol can be set in a similar fashion to MODBUS communication (section 1.2.3).

1.3 Second rear communication port (SK4)

There is a hardware option of a second rear communications port, which will run the Courier language. This can be used over one of three physical links: twisted pair K-Bus (non-polarity sensitive), twisted pair EIA(RS)485 (connection polarity sensitive) or EIA(RS)232.

The settings for this port are located immediately below the ones for the first port as described in previous sections of P849/EN GS. Move down the settings until the following sub heading is displayed.

```

REAR PORT2 (RP2)
██████████ ██████████

```

The next cell down indicates the language, which is fixed at Courier for RP2.

```

RP2 Protocol
Courier
██████████ ██████████

```

The next cell down indicates the status of the hardware, e.g.

```

RP2 card status
EIA(RS)232 OK
██████████ ██████████

```

The next cell allows for selection of the port configuration.

```

RP2 Port Config
EIA(RS)232
██████████ ██████████

```

The port can be configured for EIA(RS)232, EIA(RS)485 or K-Bus.

In the case of EIA(RS)232 and EIA(RS)485 the next cell selects the communication mode.

```

RP2 Comms Mode
IEC60870 FT1.2
██████████ ██████████

```

The choice is either IEC60870 FT1.2 for normal operation with 11-bit modems, or 10-bit no parity.

The next cell down controls the comms. port address.

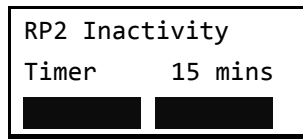
```

RP2 Address
255
██████████ ██████████

```

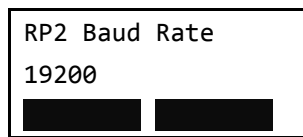
Since up to 32 relays can be connected to one K-bus spur, as indicated in Figure 2, it is necessary for each relay to have a unique address so that messages from the master control station are accepted by one relay only. Courier uses an integer number between 0 and 254 for the relay address that is set with this cell. It is important that no two relays have the same Courier address. The Courier address is then used by the master station to communicate with the relay. The default value is 255 and must be changed in the range 0 to 254 before use.

The next cell down controls the inactivity timer.



The inactivity timer controls how long the relay will wait without receiving any messages on the rear port before it reverts to its default state, including revoking any password access that was enabled. For the rear port this can be set between 1 and 30 minutes.

In the case of EIA(RS)232 and EIA(RS)485 the next cell down controls the baud rate. For K-Bus the baud rate is fixed at 64kbit/second between the relay and the KITZ interface at the end of the relay spur.



Courier communications is asynchronous. Three baud rates are supported by the relay, '9600 bits/s', '19200 bits/s' and '38400 bits/s'.

1.4 Ethernet communication

It is possible to communicate through an Ethernet network using a Schneider Electric I4XS4UE.

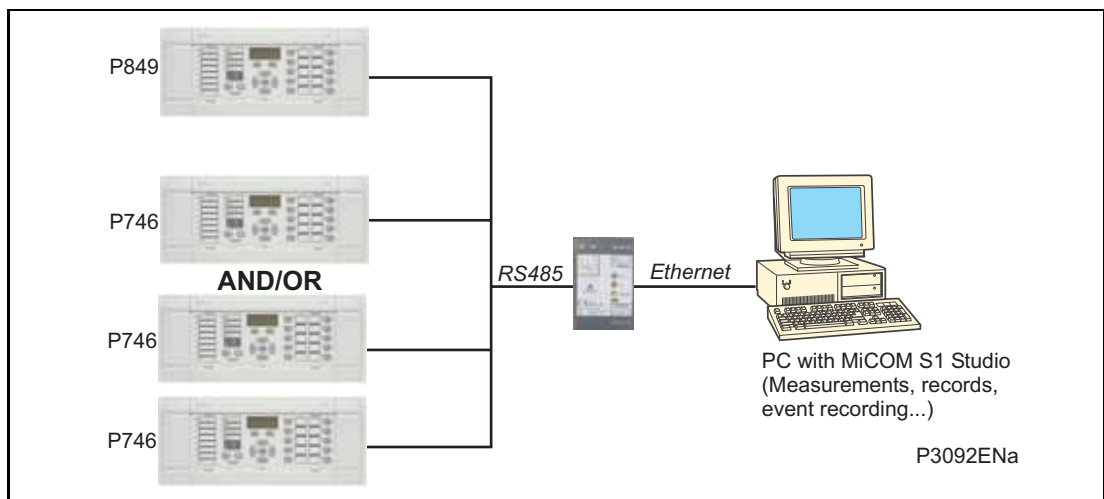


FIGURE 3: ETHERNET CONNECTION EXAMPLE

Using Ethernet hardware options, high-speed communication exchanges are possible through an Ethernet network.

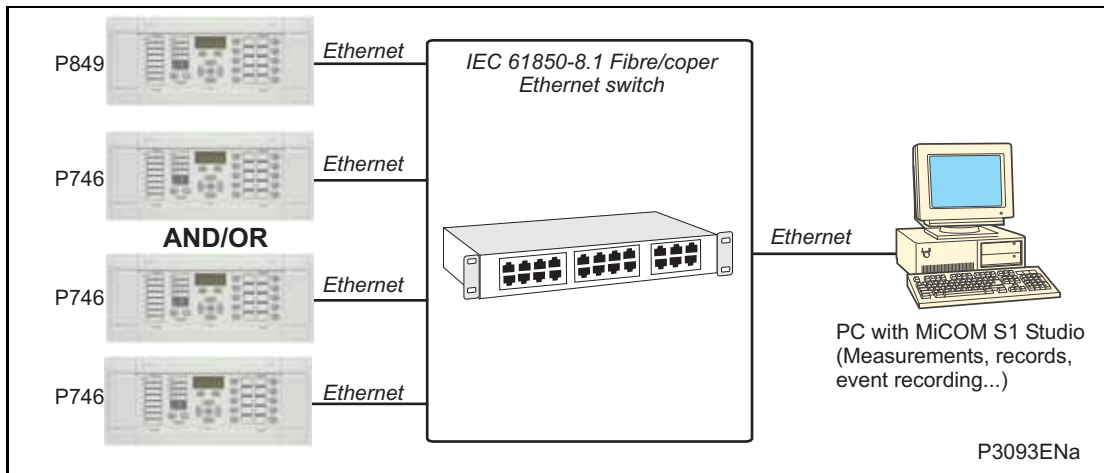


FIGURE 4: ETHERNET CONNECTION

Redundant Ethernet connections are performed with Redundant Ethernet (Self Healing, Dual homing or Rapid Spanning Tree Protocol) options (refer to Px4x/EN REB user guide).

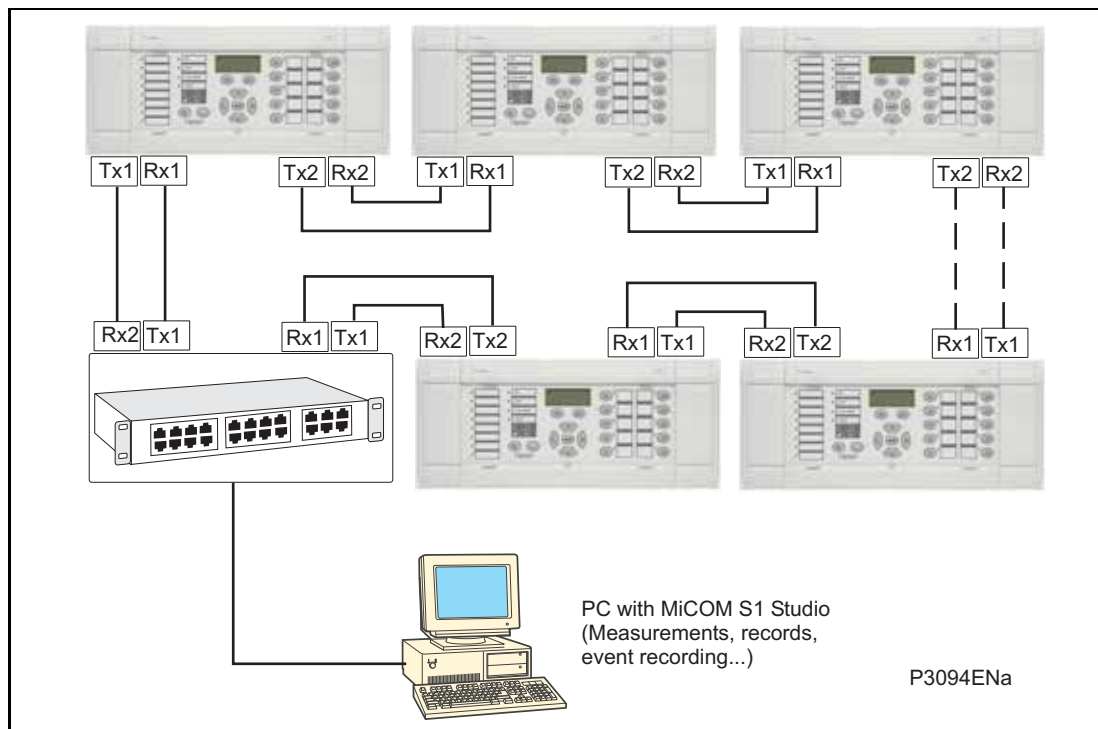


FIGURE 5: REDUNDANT ETHERNET BOARD CONNECTION

2. COURIER INTERFACE

2.1 Courier protocol

K-Bus is based on EIA(RS)485 voltage levels with HDLC FM0 encoded synchronous signalling and its own frame format. The K-Bus twisted pair connection is unpolarized, whereas the EIA(RS)485 and EIA(RS)232 interfaces are polarized.

The EIA(RS)232 interface uses the IEC60870-5 FT1.2 frame format.

The relay supports an IEC60870-5 FT1.2 connection on the front-port. This is intended for temporary local connection and is not suitable for permanent connection. This interface uses a fixed baud rate, 11-bit frame, and a fixed device address.

The rear interface is used to provide a permanent connection for K-Bus and allows multi-drop connection. It should be noted that although K-Bus is based on EIA(RS)485 voltage levels it is a synchronous HDLC protocol using FM0 encoding. It is not possible to use a standard EIA(RS)232 to EIA(RS)485 converter to convert IEC60870-5 FT1.2 frames to K-Bus. Nor is it possible to connect K-Bus to an EIA(RS)485 computer port. A protocol converter, such as the KITZ101, should be employed for this purpose.

Alternatively for direct connections, the fibre optic converter card may be used to convert the rear EIA(RS)485 port into a fibre optic (ST) port.

2.2 Supported command set

The following Courier commands are supported by the relay:

Protocol Layer

- Reset Remote Link

- Poll Status

- Poll Buffer*

Low Level Commands

- Send Event*

- Accept Event*

- Send Block

- Store Block Identifier

- Store Block Footer

Menu Browsing

- Get Column Headings

- Get Column Text

- Get Column Values

- Get Strings

- Get Text

- Get Value

- Get Column Setting Limits

Setting Changes

Enter Setting Mode

Preload Setting

Abort Setting

Execute Setting

Reset Menu Cell

Set Value

Control Commands

Select Setting Group

Change Device Address*

Set Real Time

Note: Commands indicated with a * are not supported via the front Courier port.

2.3 Relay courier database

The Courier database is a two dimensional structure with each cell in the database being referenced by a row and column address. Both the column and the row can take a range from 0 to 255. Addresses in the database are specified as hexadecimal values; e.g. 0A02 is column 0A (10 decimal) row 02. Associated settings/data will be part of the same column, row zero of the column contains a text string to identify the contents of the column, i.e. a column heading.

P849/EN MD contains the complete database definition for the relay. For each cell location the following information is stated:

- Cell text
- Cell datatype
- Cell value
- Whether the cell is settable, if so
- Minimum value
- Maximum value
- Step size
- Password level required to allow setting changes
- String information (for Indexed String or Binary flag cells)

2.4 Setting changes

(See R6512, Courier User Guide - Chapter 9)

There are three categories of settings within the relay database:

- Control and support
- Recorder
- settings group

Setting changes made to the control and support settings are implemented immediately and stored in non-volatile memory. Changes made to either the recorder settings or the settings groups are stored in a 'scratchpad' memory and are not immediately implemented by the relay.

To action setting changes stored in the scratchpad the save changes cell in the configuration column must be written to. This allows the changes to either be confirmed and stored in non-volatile memory, or the setting changes to be aborted.

2.4.1 Setting transfer mode

If it is necessary to transfer all of the relay settings to or from the relay a cell within the communication system data column can be used. This cell (location BF03) when set to 1 makes all of the relay settings visible. Any setting changes made, with the relay set in this mode, are stored in scratchpad memory (including control and support settings). When the value of BF03 is set back to 0 any setting changes are verified and stored in non-volatile memory.

2.5 Event extraction

Events can be extracted either automatically (rear port only) or manually (either Courier port). For automatic extraction all events are extracted in sequential order using the standard Courier event mechanism, this includes maintenance data if appropriate. The manual approach allows the user to select events, or maintenance data at random from the stored records.

2.5.1 Automatic event extraction

(See Chapter 7 Courier User Guide, publication R6512)

This method is intended for continuous extraction of event information as it is produced. It is only supported via the rear Courier port.

When new event information is created the event bit is set within the status byte, this indicates to the master device that event information is available. The oldest, unextracted event can be extracted from the relay using the send event command. The relay will respond with the event data, which will be either a Courier Type 0 or Type 3 event. The Type 3 event is used for records.

Once an event has been extracted from the relay, the accept event can be used to confirm that the event has been successfully extracted. If all events have been extracted then the event bit will reset, if there are more events still to be extracted the next event can be accessed using the send event command as before.

2.5.2 Event types

Events will be created by the relay under the following circumstances:

- Change of state of output contact
- Change of state of opto input
- Alarm condition
- Setting change
- Password entered/timed-out
- Fault record (Type 3 Courier Event)
- Maintenance record (Type 3 Courier Event)

2.5.3 Event format

The send event command results in the following fields being returned by the relay:

- Cell reference
- Timestamp
- Cell text
- Cell value

The menu database, P849/EN MD, contains a table of the events created by the relay and indicates how the contents of the above fields are interpreted. Records will return a Courier Type 3 event, which contains the above fields together with two additional fields:

- Event extraction column
- Event number

These events contain additional information that is extracted from the relay using the referenced extraction column. Row 01 of the extraction column contains a setting that allows the maintenance record to be selected. This setting should be set to the event number value returned within the record; the extended data can be extracted from the relay by uploading the text and data from the column.

2.5.4 Manual event record extraction

Column 01 of the database can be used for manual viewing of event and maintenance records. The contents of this column will depend on the nature of the record selected. It is possible to select events by event number and to directly select a records by number.

Standard Event Record Selection (Row 01) - This cell can be set to a value between 0 to 511 to select which of the 512 stored events is selected, 0 will select the most recent record; 511 the oldest stored record. For simple event records, (Type 0) cells 0102 to 0105 contain the event details. A single cell is used to represent each of the event fields. If the event selected is a records (Type 3) then the remainder of the column will contain the additional information.

Maintenance Record Selection (Row F0) – This cell can be used to select a maintenance record using a value between 0 and 4 and operates in a similar way to the record selection.

It should be noted that if this column is used to extract event information from the relay the number associated with a particular record will change when a new event occurs.

2.6 Record extraction

Select Record Number (Row 01) - This cell can be used to select the record to be extracted. Record 0 will be the oldest unextracted record, already extracted older records will be assigned positive values, and negative values will be used for more recent records.

Once a record has been selected, using the above cell, the time and date of the record can be read from cell 02. The record itself can be extracted using the block transfer mechanism from cell B00B.

As has been stated, the rear Courier port can be used to automatically extract records as they occur. This operates using the standard Courier mechanism defined in Chapter 8 of the Courier User Guide. The front Courier port does not support automatic extraction although record data can be extracted manually from this port.

2.7 Programmable scheme logic settings

The programmable scheme logic (PSL) settings can be uploaded from and downloaded to the relay using the block transfer mechanism.

The following cells are used to perform the extraction:

- B204 Domain: Used to select either PSL settings (Upload or download) or PSL configuration data (Upload only)
- B208 Sub-Domain: Used to select the Setting Group to be uploaded/downloaded.
- B20C Version: Used on a download to check the compatibility of the file to be downloaded with the relay.
- B21C Transfer Mode: Used to set-up the transfer process.
- B120 Data Transfer Cell: Used to perform upload/download.

The programmable scheme logic settings can be uploaded and downloaded to and from the relay using this mechanism. If it is necessary to edit the settings MiCOM S1 Studio must be used as the data format is compressed. MiCOM S1 Studio also performs checks on the validity of the settings before they are downloaded to the relay.

3. MODBUS INTERFACE

The MODBUS interface is a master/slave protocol and it is defined by MODBUS.org: See www.modbus.org

MODBUS Serial Protocol Reference Guide: PI-MBUS-300 Rev. E

3.1 Communication link

This interface also uses the rear EIA(RS)485 port (or converted fiber optic port) for communication using 'RTU' mode communication rather than 'ASCII' mode as this provides more efficient use of the communication bandwidth. This mode of communication is defined by the MODBUS standard.

In summary, the character framing is 1 start bit, 8 bit data, either 1 parity bit and 1 stop bit, or two stop bits. This gives 11 bits per character.

The following parameters can be configured for this port using either the front panel interface or the front Courier port:

- Baud rate
- Device address
- Parity
- Inactivity time

3.2 MODBUS functions

The following MODBUS function codes are supported by the relay:

- | | |
|----|-----------------------------------|
| 01 | Read Coil Status |
| 02 | Read Input Status |
| 03 | Read Holding Registers |
| 04 | Read Input Registers |
| 06 | Preset Single Register |
| 08 | Diagnostics |
| 11 | Fetch Communication Event Counter |
| 12 | Fetch Communication Event Log |
| 16 | Preset Multiple Registers 127 max |

These are interpreted by the MiCOM relay in the following way:

- | | | |
|----|--------------------------------|-------------------|
| 01 | Read status of output contacts | (0xxxx addresses) |
| 02 | Read status of opto inputs | (1xxxx addresses) |
| 03 | Read setting values | (4xxxx addresses) |
| 04 | Read measured values | (3xxxx addresses) |
| 06 | Write single setting value | (4xxxx addresses) |
| 16 | Write multiple setting values | (4xxxx addresses) |

3.3 Response codes

Code	MODBUS Description	MiCOM Interpretation
01	Illegal Function Code	The function code transmitted is not supported by the slave.
02	Illegal Data Address	The start data address in the request is not an allowable value. If any of the addresses in the range cannot be accessed due to password protection then all changes within the request are discarded and this error response will be returned. Note: If the start address is correct but the range includes non-implemented addresses this response is not produced.
03	Illegal Value	A value referenced in the data field transmitted by the master is not within range. Other values transmitted within the same packet will be executed if inside range.
06	Slave Device Busy	The write command cannot be implemented due to the database being locked by another interface. This response is also produced if the relay software is busy executing a previous request.

3.4 Register mapping

The relay supports the following memory page references:

Memory Page	Interpretation
0xxxx	Read and write access of the output relays
1xxxx	Read only access of the opto inputs
3xxxx	Read only access of data
4xxxx	Read and write access of settings

Where xxxx represents the addresses available in the page (0 to 9999).

Note that the “extended memory file” (6xxxx) is not supported.

A complete map of the MODBUS addresses supported by the relay is contained in menu database, P849/EN MD, of this service manual.

Note that MODBUS convention is to document register addresses as ordinal values whereas the actual protocol addresses are literal values. The MiCOM relays begin their register addresses at zero. Thus, the first register in a memory page is register address zero. The second register is register address 1 and so on. Note that the page number notation is not part of the address.

3.5 Event extraction

The relay supports two methods of event extraction providing either automatic or manual extraction of the stored event and maintenance records.

3.5.1 Manual selection

There are three registers available to manually select stored records, there are also three read only registers allowing the number of stored records to be determined.

40100 - Select Event, 0 to 249

40102 - Select Maintenance Record, 0 to 4

For each of the above registers a value of 0 represents the most recent stored record. The following registers can be read to indicate the numbers of the various types of record stored.

30100 - Number of stored records

30102 - Number of stored maintenance records

Each maintenance record logged causes an event record to be created by the relay. If this event record is selected the additional registers allowing the maintenance record details will also become populated.

3.5.2 Automatic extraction

The automatic extraction facilities allow all types of record to be extracted as they occur. Event records are extracted in sequential order including any maintenance data that may be associated with the event.

The MODBUS master can determine whether the relay has any events stored that have not yet been extracted. This is performed by reading the relay status register 30001 (G26 data type). If the event bit of this register is set then the relay has unextracted events available. To select the next event for sequential extraction the master station writes a value of 1 to the record selection register 40400 (G18 data type). The event data together with any maintenance data can be read from the registers specified below. Once the data has been read the event record can be marked as having been read by writing a value of 2 to register 40400.

3.5.3 Record data

The location and format of the registers used to access the record data is the same whether they have been selected using either of the two mechanisms detailed above.

Event Description	MODBUS Address	Length	Comments
Time and Date	30103	4	See G12 data type description in section 3.8.
Event Type	30107	1	See G13 data type. Indicates type of event.
Event Value	30108	2	Nature of value depends on event type. This will contain the status as a binary flag for contact, opto, alarm, and events.
MODBUS Address	30110	1	This indicates the MODBUS register address where the change occurred. Alarm 30011 Relays 30723 Optos 30725 events – like the relay and opto addresses this will map onto the MODBUS address of the appropriate DDB status register depending on which bit of the DDB the change occurred. These will range from 30727 to 30785. For platform events and maintenance events the default is 0.

Event Description	MODBUS Address	Length	Comments
Event Index	30111	1	This register will contain the DDB ordinal for events or the bit number for alarm events. The direction of the change will be indicated by the most significant bit; 1 for 0 – 1 change and 0 for 1 – 0 change.
Additional Data Present	30112	1	0 means that there is no additional data. 1 means record data can be read from 30113 to 30199 (number of registers depends on the product). 2 means maintenance record data can be read from 30036 to 30039.

If a maintenance record is directly selected using the manual mechanism then the data can be read from the register ranges specified above. The event record data in registers 30103 to 30111 will not be available.

It is possible using register 40401(G6 data type) to clear independently the stored relay event/fault and maintenance records. This register also provides an option to reset the relay indications, which has the same effect on the relay as pressing the clear key within the alarm viewer using the front panel menu.

3.6 Precise event record extraction

The relay provides facilities for both manual and automatic extraction of Precise event records. The extraction mechanisms are explained below:

3.6.1 Extraction mechanism

Records extracted over MODBUS from Px40 platform relays will be presented in COMTRADE format. This involves extracting an ASCII text configuration file and then extracting a binary data file.

Each file is extracted by reading a series of data pages from the relay. The data page is made up of 127 registers, giving a maximum transfer of 254 bytes per page.

3.6.1.1 Interface registers

The following set of registers is presented to the master station to support the extraction of uncompressed Precise event records:

MODBUS Register	Name	Description
3x00001	Status register	Provides the status of the relay as bit flags: b0 – Out of service b1 – Minor self test failure b2 – Event b3 – Time synchronization b4 – Precise event b5 – standard event b6 – b7 – Alarm b8 to b15 – Unused A '1' on b4 indicates the presence of a precise event.



MODBUS Register	Name	Description
3x00800	N ^o of stored precise event	Indicates the total number of precise event records currently stored in the relay, both extracted and unextracted.
3x00801	Unique identifier of the oldest precise event record	Indicates the unique identifier value for the oldest precise event record stored in the relay. This is an integer value used in conjunction with the 'N ^o of stored precise event' value to calculate a value for manually selecting records.
4x00250	Manual precise event record selection register	This register is used to manually select precise event records. The values written to this cell are an offset of the unique identifier value for the oldest record. The offset value, which ranges from 0 to the N ^o of stored precise event – 1, is added to the identifier of the oldest record to generate the identifier of the required record.
4x00400	Record selection command register	This register is used during the extraction process and has a number of commands. These are: b0 – Select next event b1 – Accept event b2 – Select next precise event b3 – Accept precise event record b4 – Select next page of precise event data b5 – Select data file
3x00930 – 3x00933	Record time stamp	These registers return the timestamp of the precise event record.
3x00802	N ^o of registers in data page	This register informs the master station of the number of registers in the data page that are populated.
3x00803 – 3x00929	Data page registers	These 127 registers are used to transfer data from the relay to the master station. They are 16-bit unsigned integers.
3x00934	precise event record status register	The precise event record status register is used during the extraction process to indicate to the master station when data is ready for extraction. See next table.
4x00251	Data file format selection	This is used to select the required data file format. This is reserved for future use.

Note: Register addresses are provided in reference code + address format. E.g. 4x00001 is reference code 4x, address 1 (which is specified as function code 03, address 0x0000 in the MODBUS specification).

The precise event record status register will report one of the following values:

State	Description
Idle	This will be the state reported when no record is selected; such as after power on or after a record has been marked as extracted.
Busy	The relay is currently processing data.
Page ready	The data page has been populated and the master station can now safely read the data.
Configuration complete	All of the configuration data has been read without error.
Record complete	All of the precise event data has been extracted.
precise event overwritten	An error occurred during the extraction process where the precise event being extracted was overwritten by a new record.
No unextracted precise events	An attempt was made by the master station to automatically select the next oldest unextracted precise event when all records have been extracted.
Not a valid precise event	An attempt was made by the master station to manually select a record that did not exist in the relay.
Command out of sequence	The master station issued a command to the relay that was not expected during the extraction process.

3.6.2 Extraction procedure

The following procedure will be used to extract precise events from the relay. The procedure is split into four sections:

1. Selection of a precise event – either manually or automatically
2. Extraction of the configuration file
3. Extraction of the data file
4. Accepting the extracted record (automatic extraction only)

3.6.2.1 Manual extraction procedure

The procedure used to extract a precise event manually is shown in the following figure. The manual method of extraction does not allow for the acceptance of precise event records.

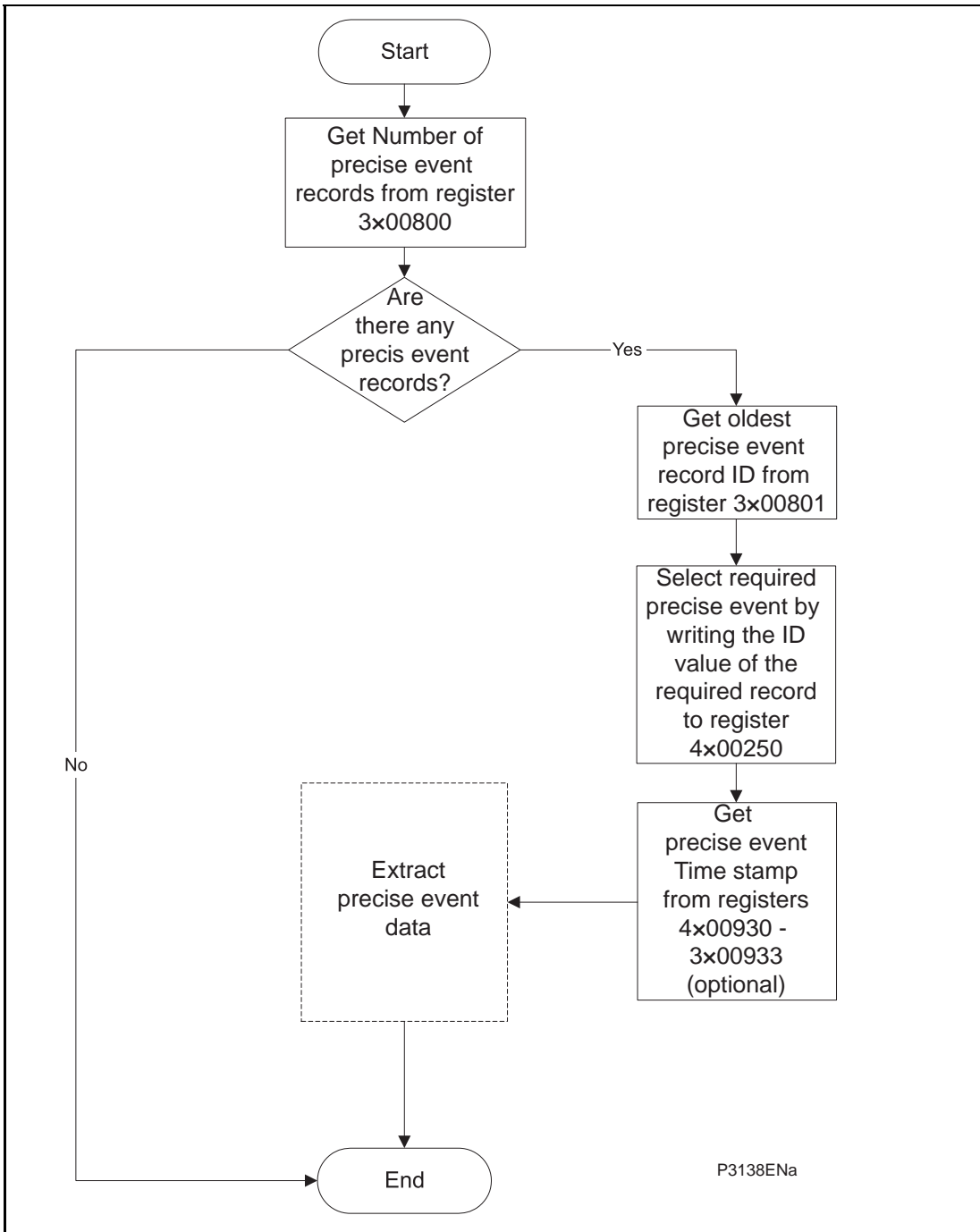


FIGURE 6: MANUAL SELECTION OF A PRECISE EVENT RECORD

3.6.2.2 Automatic extraction procedure

There are two methods that can be used for automatically extracting precise events. Option 1 is simpler and is better at extracting single precise event records, i.e. when the precise event recorder is polled regularly. Option 2, however, is more complex to implement but is more efficient at extracting large quantities of precise event records. This may be useful when the precise event recorder is polled only occasionally and hence may have many stored records.



3.6.2.3 Automatic extraction procedure – option 1

The procedure for the first method is shown in the following figure. This also shows the acceptance of the precise event record once the extraction is complete.

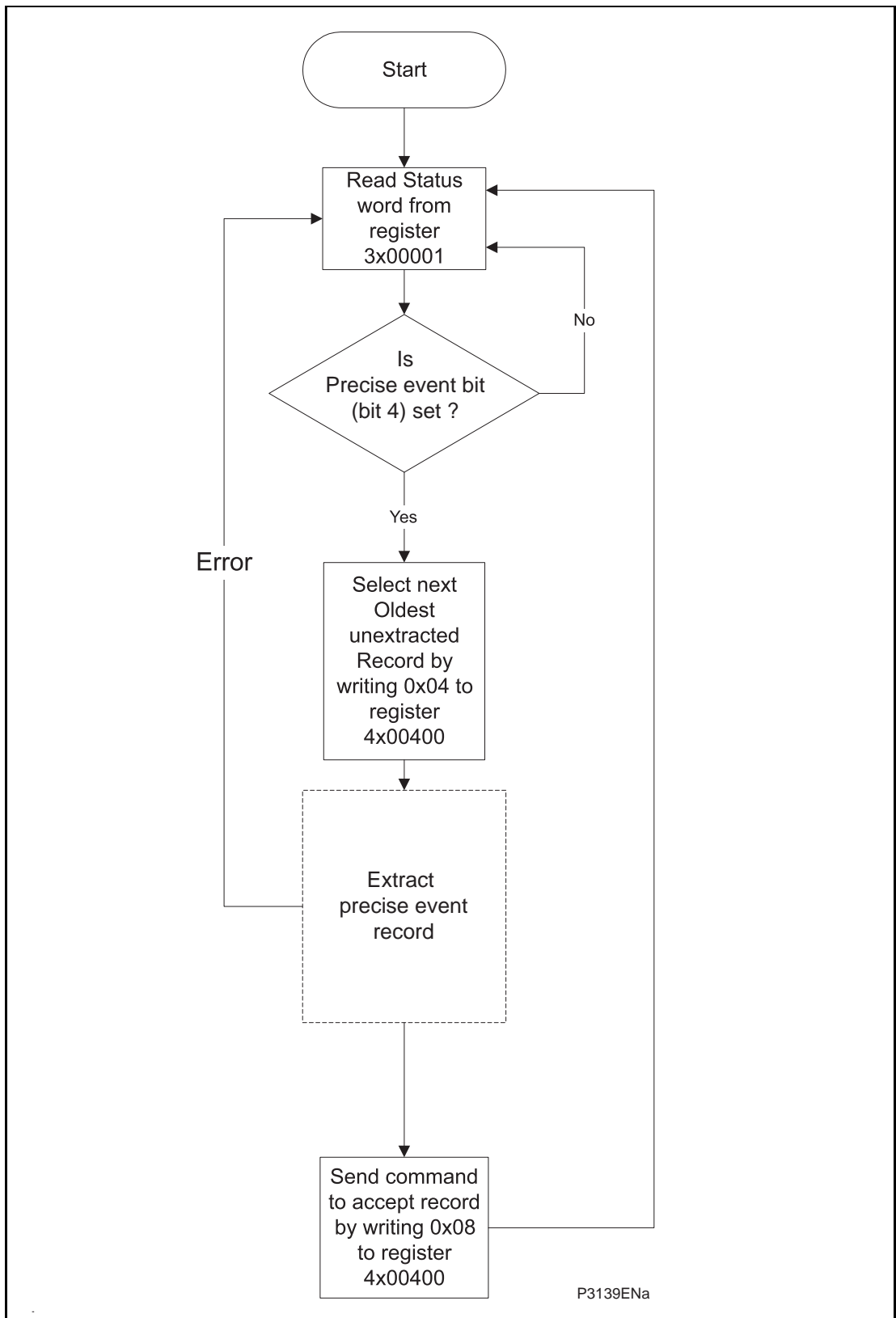


FIGURE 7: AUTOMATIC SELECTION OF A PRECISE EVENT – OPTION 1

3.6.2.4 Automatic extraction procedure – option 2

The second method that can be used for automatic extraction is shown in the following figure. This also shows the acceptance of the precise event record once the extraction is complete:

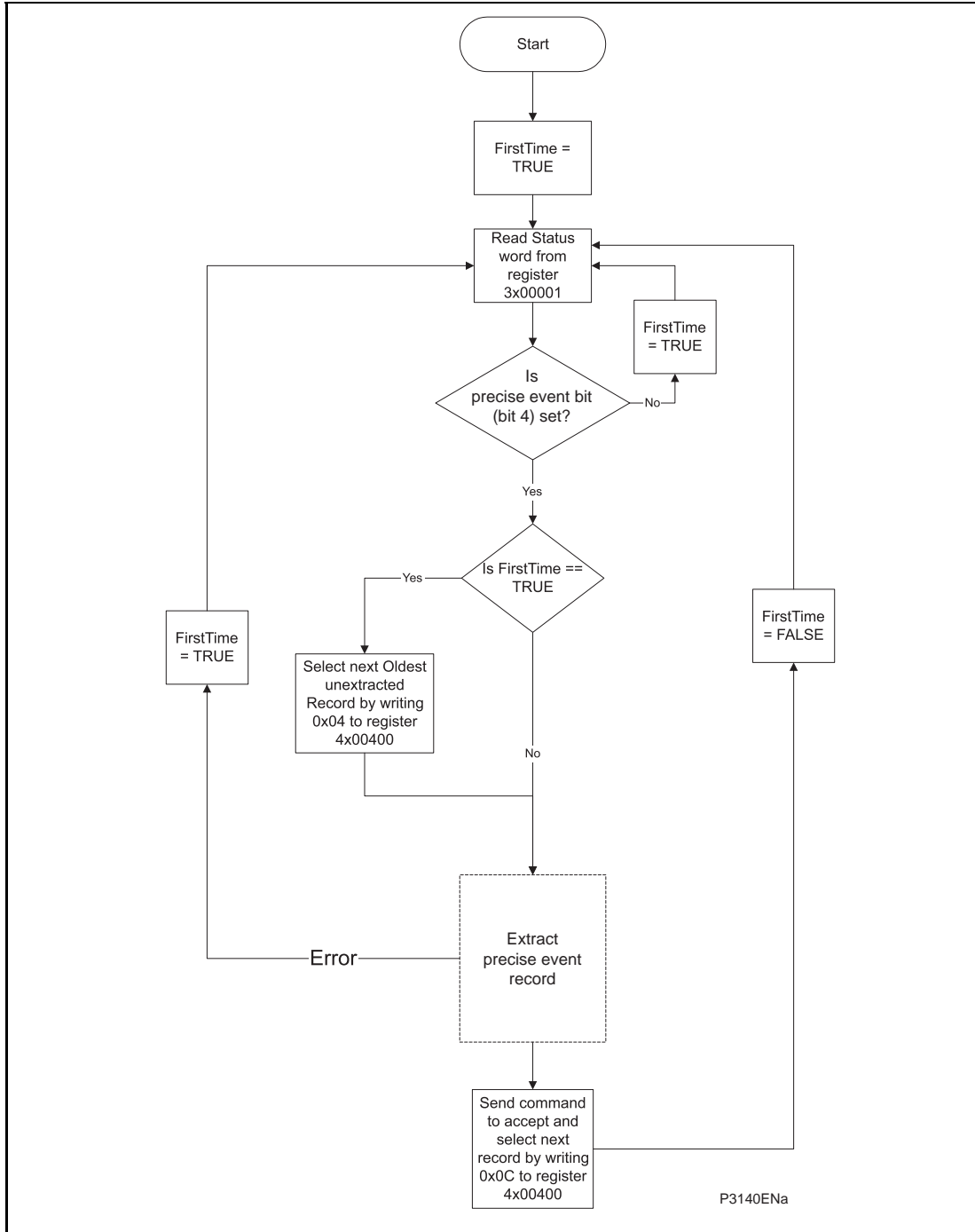
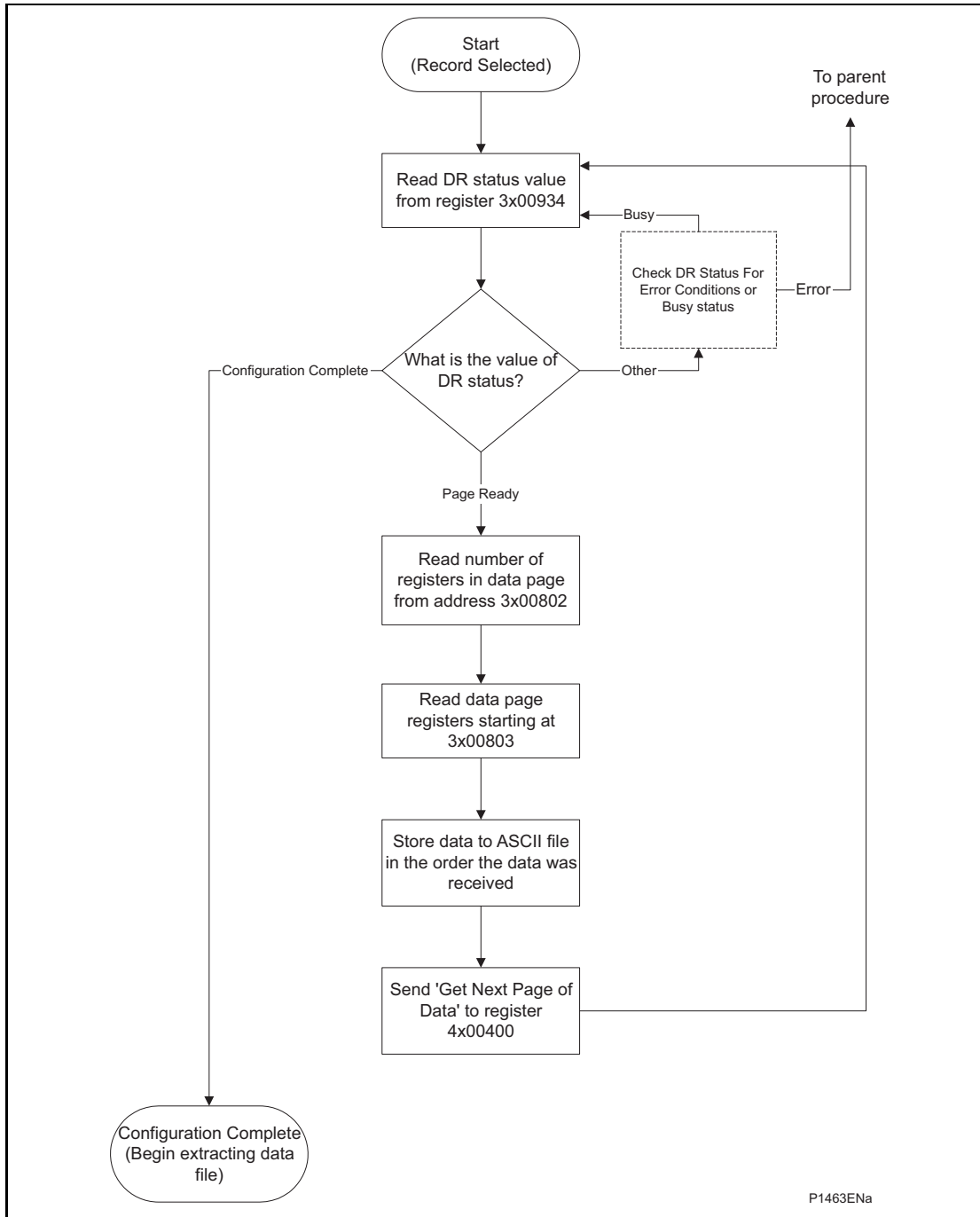


FIGURE 8: AUTOMATIC SELECTION OF A PRECISE EVENT – OPTION 2

3.6.3 Extracting the precise event data

The extraction of the precise event record, as shown in the three figures above, is a two-stage process that involves extracting the configuration file first and then the data file.

The following figure shows how the configuration file is extracted from the relay:



P1463ENa



FIGURE 9: EXTRACTING THE COMTRADE CONFIGURATION FILE

The following figure shows how the data file is extracted:

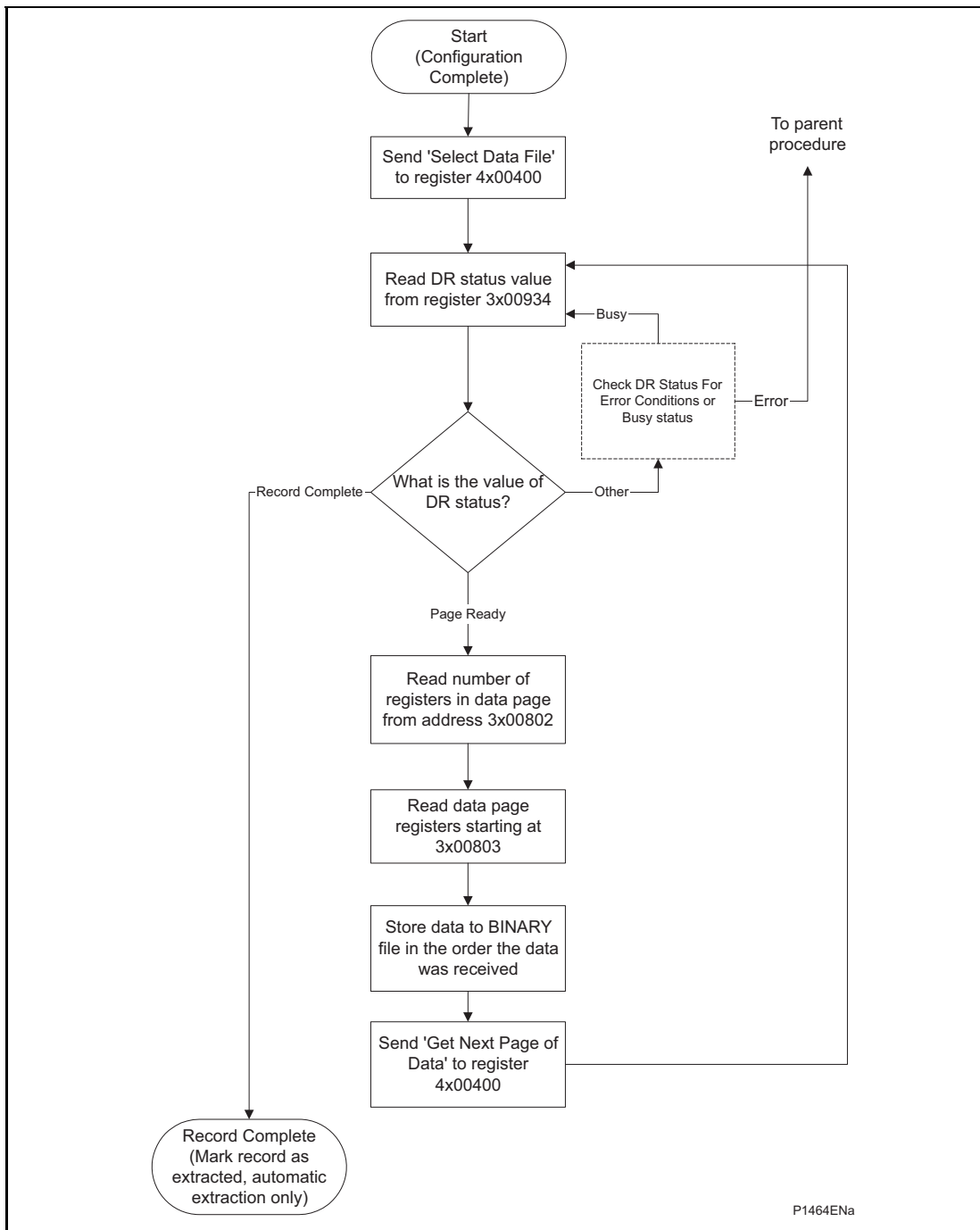


FIGURE 10: EXTRACTING THE COMTRADE BINARY DATA FILE

During the extraction of the COMTRADE files, an error may occur that will be reported on the DR Status register 3x00934. This can be caused by the relay overwriting the record being extracted or due to the master station issuing a command that is not within the bounds of the extraction procedure.

3.7 Setting changes

The relay settings can be split into two categories:

- Control and support settings
- Record settings and setting groups

Changes to settings within the control and support area are executed immediately. Changes to the setting groups or the recorder settings are stored in a temporary 'scratchpad' area and must be confirmed before they are implemented. All the relay settings are 4xxxx page addresses. The following points should be noted when changing settings:

- Settings implemented using multiple registers must be written to using a multi-register write operation.
- The first address for a multi-register write must be a valid address, if there are unmapped addresses within the range being written to then the data associated with these addresses will be discarded.
- If a write operation is performed with values that are out of range then the illegal data response will be produced. Valid setting values within the same write operation will be executed.
- If a write operation is performed attempting to change registers that require a higher level of password access than is currently enabled then all setting changes in the write operation will be discarded.

3.7.1 Password protection

As described in the introduction to this service manual, the relay settings can be subject to password protection. The level of password protection required to change a setting is indicated in the relay setting database (P849/EN MD). Level 2 is the highest level of password access, level 0 indicates that no password is required.

The following registers are available to control password protection:

40001 & 40002	Password entry
40022	Default password level
40023 & 40024	Setting to change password level 1
40025 & 40026	Setting to change password level 2
30010	Can be read to indicate current access level

3.7.2 Control and support settings

Control and support settings are executed immediately on the write operation.

3.7.3 Recorder settings

Setting changes to either of these areas are stored in a scratchpad area and will not be used by the relay unless a confirm or an abort operation is performed. Register 40405 can be used either to confirm or abort the setting changes within the scratchpad area. It should be noted that the relay supports four groups of settings. The MODBUS addresses for each of the four groups are repeated within the following address ranges:

Group 1	41000 - 42999
Group 2	43000 - 44999
Group 3	45000 - 46999
Group 4	47000 - 48999

In addition to the basic editing of the setting groups, the following functions are provided:

- Default values can be restored to a setting group or to all of the relay settings by writing to register 40402.
- It is possible to copy the contents of one setting group to another by writing the source group to register 40406 and the target group to 40407.

It should be noted that the setting changes performed by either of the two operations defined above are made to the scratchpad area. These changes must be confirmed by writing to register 40405.

The active setting groups can be selected by writing to register 40404. An illegal data response will be returned if an attempt is made to set the active group to one that has been disabled.

3.8 Date and time format (data type G12)

The date-time data type G12 allows *real* date and time information to be conveyed down to a resolution of 1ms. The structure of the data type is shown in

Table 3-1 and is compliant with the IEC60870-5-4 “Binary Time 2a” format.

The seven bytes of the structure are packed into four 16-bit registers, such that byte 1 is transmitted first, followed by byte 2 through to byte 7, followed by a null (zero) byte to make eight bytes in total. Since register data is usually transmitted in big-endian format (high order byte followed by low order byte), byte 1 will be in the high-order byte position followed by byte 2 in the low-order position for the first register. The last register will contain just byte 7 in the high order position and the low order byte will have a value of zero.

Byte	Bit Position							
	7	6	5	4	3	2	1	0
1	m ⁷	m ⁶	m ⁵	m ⁴	m ³	m ²	m ¹	m ⁰
2	m ¹⁵	m ¹⁴	m ¹³	m ¹²	m ¹¹	m ¹⁰	m ⁹	m ⁸
3	IV	R	I ⁵	I ⁴	I ³	I ²	I ¹	I ⁰
4	SU	R	R	H ⁴	H ³	H ²	H ¹	H ⁰
5	W ²	W ¹	W ⁰	D ⁴	D ³	D ²	D ¹	D ⁰
6	R	R	R	R	M ³	M ²	M ¹	M ⁰
7	R	Y ⁶	Y ⁵	Y ⁴	Y ³	Y ²	Y ¹	Y ⁰

Table 3-1 G12 date & time data type structure

Where:

- m = 0...59,999ms
- I = 0...59 minutes
- H = 0...23 Hours
- W = 1...7 Day of week; Monday to Sunday, 0 for not calculated
- D = 1...31 Day of Month
- M = 1...12 Month of year; January to December
- Y = 0...99 Years (year of century)
- R = Reserved bit = 0
- SU = summertime: 0 = standard time, 1 = summer time
- IV = invalid value: 0 = valid, 1 = invalid
- range = 0ms...99 years

Since the range of the data type is only 100 years, the century must be deduced. The century is calculated as the one that will produce the nearest time value to the current date. For example: 30-12-99 is 30-12-1999 when received in 1999 & 2000, but is 30-12-2099 when received in 2050. This technique allows 2 digit years to be accurately converted to 4 digits in a ± 50 year window around the current datum.

The invalid bit has two applications:

5. It can indicate that the date-time information is considered inaccurate, but is the best information available.
6. Date-time information is not available.

The summertime bit is used to indicate that summertime (day light saving) is being used and, more importantly, to resolve the alias and time discontinuity which occurs when summertime starts and ends. This is important for the correct time correlation of time stamped records.

The day of the week field is optional and if not calculated will be set to zero.

The concept of time zone is not catered for by this data type and hence by the relay. It is up to the end user to determine the time zone utilized by the relay. Normal practice is to use UTC (universal co-ordinated time), which avoids the complications with day light saving time-stamp correlation's.

3.9 Power & energy measurement data formats (G29 & G125)

The power and energy measurements are available in two data formats; G29 integer format and G125 IEEE754 floating point format.

3.9.1 Data type G29

Data type G29 consists of three registers. The first register is the per unit power or energy measurement and is of type G28, which is a signed 16 bit quantity. The second and third registers contain a multiplier to convert the per unit value to a real value. The multiplier is of type G27, which is an unsigned 32-bit quantity. Thus, the overall value conveyed by the G29 data type must be calculated as $G29 = G28 \times G27$.

The relay calculates the G28 per unit power or energy value as $G28 = ((\text{measured secondary quantity}) / (\text{CT secondary}) \times (110\text{V} / (\text{VT secondary})))$. Since data type G28 is a signed 16-bit integer, its dynamic range is constrained to ± 32768 . This limitation should be borne in mind for the energy measurements, as the G29 value will saturate a long time before the equivalent G125 does.

The associated G27 multiplier is calculated as $G27 = (\text{CT primary}) \times (\text{VT primary} / 110\text{V})$ when primary value measurements are selected, and as $G27 = (\text{CT secondary}) \times (\text{VT secondary} / 110\text{V})$ when secondary value measurements are selected.

Due to the required truncations from floating point values to integer values in the calculations of the G29 component parts and its limited dynamic range, the use of the G29 values is only recommended when the MODBUS master cannot deal with the G125 IEEE754 floating point equivalents.

Note that the G29 values must be read in whole multiples of three registers. It is not possible to read the G28 and G27 parts with separate read commands.

Example:

For A-Phase Power (Watts) (registers 30300 - 30302) for a 110V relay, $I_n = 1\text{A}$, VT ratio = 110V:110V and CT ratio = 1A:1A.

Applying A-phase 1A @ 63.51V

A-phase Watts = $((63.51\text{V} \times 1\text{A}) / I_n = 1\text{A}) \times (110\text{V} / V_n = 110\text{V}) = 63.51\text{ Watts}$

The G28 part of the value is the truncated per unit quantity, which will be equal to 64 (40h).

The multiplier is derived from the VT and CT ratios set in the relay, with the equation $((\text{CT Primary}) \times (\text{VT Primary}) / 110\text{V})$. Thus, the G27 part of the value will equal 1. Hence the overall value of the G29 register set is $64 \times 1 = 64\text{W}$

The registers would contain:

30300 - 0040h

30301 - 0000h

30302 - 0001h

Using the previous example with a VT ratio = 110,000V; 110V and CT ratio = 10,000A:1A the G27 multiplier would be $10,000A \times 110,000V/110 = 10,000,000$. The overall value of the G29 register set is $64 \times 10,000,000 = 640MW$. (Note that there is an actual error of 49MW in this calculation due to loss of resolution.)

The registers would contain:

30300 - 0040h

30301 - 0098h

30302 - 9680h

3.9.2 Data type G125

Data type G125 is a short float IEEE754 floating point format, which occupies 32 bits in two consecutive registers. The high order byte of the format is in the first (low order) register and the low order byte in the second register.

The value of the G125 measurement is as accurate as the relay's ability to resolve the measurement after it has applied the secondary or primary scaling factors as require. It does not suffer from the truncation errors or dynamic range limitations associated with the G29 data format.

4. IEC60870-5-103 INTERFACE

The IEC60870-5-103 interface is a master/slave interface with the relay as the slave device. The relay conforms to compatibility level 2; compatibility level 3 is not supported.

The following IEC60870-5-103 facilities are supported by this interface:

- Initialization (reset)
- Time synchronization
- Event record extraction
- General interrogation
- Cyclic measurements
- General commands
- precise event record extraction
- Private codes

4.1 Physical connection and link layer

Two connection options are available for IEC60870-5-103, either the rear EIA(RS)485 port or an optional rear fiber optic port. Should the fiber optic port be fitted the selection of the active port can be made via the front panel menu or the front Courier port, however the selection will only be effective following the next relay power up.

For either of the two modes of connection it is possible to select both the relay address and baud rate using the front panel menu/front Courier. Following a change to either of these two settings a reset command is required to re-establish communications, see reset command description below.

4.2 Initialization

Whenever the relay has been powered up, or if the communication parameters have been changed a reset command is required to initialize the communications. The relay will respond to either of the two reset commands (Reset CU or Reset FCB), the difference being that the Reset CU will clear any unsent messages in the relay's transmit buffer.

The relay will respond to the reset command with an identification message ASDU 5, the Cause Of Transmission COT of this response will be either Reset CU or Reset FCB depending on the nature of the reset command. The content of ASDU 5 is described in the IEC60870-5-103 section of the menu database, P849/EN MD.

In addition to the above identification message, if the relay has been powered up it will also produce a power up event.

4.3 Time synchronization

The relay time and date can be set using the time synchronization feature of the IEC60870-5-103 protocol. The relay will correct for the transmission delay as specified in IEC60870-5-103. If the time synchronization message is sent as a send/confirm message then the relay will respond with a confirm. Whether the time-synchronization message is sent as a send confirm or a broadcast (send/no reply) message, a time synchronization Class 1 event will be generated/produced.

If the relay clock is being synchronized using the IRIG-B input then it will not be possible to set the relay time using the IEC60870-5-103 interface. An attempt to set the time via the interface will cause the relay to create an event with the current date and time taken from the IRIG-B synchronized internal clock.

4.4 Spontaneous events

Events are categorized using the following information:

- Function type
- Information number

The IEC60870-5-103 profile in the menu database, P849/EN MD, contains a complete listing of all events produced by the relay.

4.5 General interrogation

The GI request can be used to read the status of the relay, the function numbers, and information numbers that will be returned during the GI cycle are indicated in the IEC60870-5-103 profile in the menu database, P849/EN MD.

4.6 Cyclic measurements

The relay will produce measured values using ASDU 9 on a cyclical basis, this can be read from the relay using a Class 2 poll (note ADSU 3 is not used). The rate at which the relay produces new measured values can be controlled using the measurement period setting. This setting can be edited from the front panel menu/front Courier port and is active immediately following a change.

It should be noted that the measurands transmitted by the relay are sent as a proportion of 2.4 times the rated value of the analog value.

4.7 Commands

A list of the supported commands is contained in the menu database, P849/EN MD. The relay will respond to other commands with an ASDU 1, with a cause of transmission (COT) indicating 'negative acknowledgement'.

4.8 Test mode

It is possible using either the front panel menu or the front Courier port to disable the relay output contacts to allow secondary injection testing to be performed. This is interpreted as 'test mode' by the IEC60870-5-103 standard. An event will be produced to indicate both entry to and exit from test mode. Spontaneous events and cyclic measured data transmitted whilst the relay is in test mode will have a COT of 'test mode'.

4.9 Precise event records

The precise event records are stored in uncompressed format and can be extracted using the standard mechanisms described in IEC60870-5-103.

Note: IEC60870-5-103 only supports up to 8 records.

4.10 Blocking of monitor direction

The relay supports a facility to block messages in the monitor direction and also in the command direction. Messages can be blocked in the monitor and command directions using the menu commands, Communications – CS103 Blocking – Disabled/Monitor Blocking/Command Blocking or DDB signals Monitor Blocked and Command Blocked.

5. DNP3.0 INTERFACE

5.1 DNP3.0 protocol

The descriptions given here are intended to accompany the device profile document that is included in the menu database, P849/EN MD. The DNP3.0 protocol is not described here, please refer to the documentation available from the user group. The device profile document specifies the full details of the DNP3.0 implementation for the relay. This is the standard format DNP3.0 document that specifies which objects, variations and qualifiers are supported. The device profile document also specifies what data is available from the relay via DNP3.0. The relay operates as a DNP3.0 slave and supports subset level 2 of the protocol, plus some of the features from level 3.

DNP3.0 communication uses the EIA(RS)485 or fiber optic communication port at the rear of the relay. The data format is 1 start bit, 8 data bits, an optional parity bit and 1 stop bit. Parity is configurable.

5.2 DNP3.0 menu setting

The settings shown below are available in the menu for DNP3.0 in the 'Communications' column.

Setting	Range	Description
RP1 Address	0 – 65534	DNP3.0 address of relay (decimal)
RP1 Baud Rate	1200, 2400, 4800, 9600, 19200, 38400	Selectable baud rate for DNP3.0 communication
RP1 Parity	None, Odd, Even	Parity setting
RP1 Physicallink	RS485, Fibre optic	Type of connection for communication between master station and relay (Fibre optic only present with optional board)
RP1 Time Sync.	Enabled, Disabled	Enables or disables the relay requesting time sync. from the master via IIN bit 4 word 1
Message Gap	0 – 50 ms	Setting to allow the master station to have an interframe gap.
DNP need time	1 – 30 mn	Time duration before requesting another time synchronization from the master
DNP App Fragment	100 – 2048 bytes	Maximum message length (application fragment size) transmitted by the relay
DNP App Timeout	1 – 120 s	Duration of time waited, after sending a message fragment and awaiting a confirmation from the master.
DNP SBO Timeout	1 – 10 s	Duration of time waited (Select Before Operate mode), after receiving a select command and awaiting an operate confirmation from the master.
DNP Link Timeout	0 – 120 s	Duration of time that the relay will wait for a Data Link Confirm from the master. A value of 0 means data link support disabled and 1 to 120 seconds is the timeout setting.

In addition, if the DNP3.0 over Ethernet option has been chosen, further settings as shown in the following table, are presented:

Setting	Range	Description
IP Address	--	Indicates the IP (Internet Protocol) address of the rear Ethernet port. This address is formatted as a six-byte hexadecimal number, and is unique.
Subnet mask	--	Displays the sub-network that the relay is connected to.
NIC MAC Address	--	Indicates the MAC (Media Access Control) address of the rear Ethernet port. This address is formatted as a six-byte hexadecimal number, and is unique.
Gateway	--	Displays the IP address of the gateway (proxy) that the relay is connected to, if any.
DNP Time Sync	Disabled, Enabled	If set to 'Enabled', the DNP3.0 master station can be used to synchronize the time on the relay. If set to 'Disabled' either the internal free running clock, or IRIG+B input are used.
NIC Tunl Timeout	1 – 30 mn	Duration of time waited before an inactive tunnel to a master station is reset.
NIC Link Report	Alarm, Event, None	Configures how a failed/unfitted network link (copper or fiber) is reported: Alarm - an alarm is raised for a failed link Event - an event is logged for a failed link None - nothing reported for a failed link

5.3 Object 1 binary inputs

Object 1, binary inputs, contains information describing the state of signals within the relay which mostly form part of the digital data bus (DDB). In general these include the state of the output contacts and input optos and alarm signals. The 'DDB number' column in the device profile document provides the DDB numbers for the DNP3.0 point data. These can be used to cross-reference to the DDB definition list that is also found in the menu database, P849/EN MD. The binary input points can also be read as change events via object 2 and object 60 for class 1-3 event data.

5.4 Object 10 binary outputs

Object 10, binary outputs, contains commands that can be operated via DNP3.0. As such the points accept commands of type pulse on [null, close] and latch on/off as detailed in the device profile in the menu database, P849/EN MD and execute the command once for either command. The other fields are ignored (queue, clear, close, in time and off time).

Due to that fact that many of the relay's functions are configurable, it may be the case that some of the object 10 commands described below are not available for operation. In the case of a read from object 10 this will result in the point being reported as off-line and an operate command to object 12 will generate an error response.

Examples of object 10 points that maybe reported as off-line are:

- Activate setting groups - Ensure setting groups are enabled
- CB close - Ensure remote CB control is enabled
- Reset RTD flags - Ensure RTD Inputs is enabled
- Control Inputs - Ensure control inputs are enabled

5.5 Object 20 binary counters

Object 20, binary counters, contains cumulative counters and measurements. The binary counters can be read as their present 'running' value from object 20, or as a 'frozen' value from object 21. The running counters of object 20 accept the read, freeze and clear functions. The freeze function takes the current value of the object 20 running counter and stores it in the corresponding object 21 frozen counter. The freeze and clear function resets the object 20 running counter to zero after freezing its value.

5.6 Object 30 analog input

Object 30, analog inputs, contains information from the relay's measurements columns in the menu. All object 30 points are reported as fixed-point values although they are stored inside the relay in a floating-point format. The conversion to fixed-point format requires the use of a scaling factor, which differs for the various types of data within the relay e.g. current, voltage, phase angle etc. The data types supported are listed at the end of the device profile document with each type allocated a 'D number', i.e. D1, D2, etc. In the object 30 point list each data point has a D number data type assigned to it which defines the scaling factor, default deadband setting and the range and resolution of the deadband setting. The deadband is the setting used to determine whether a change event should be generated for each point. The change events can be read via object 32 or object 60 and will be generated for any point whose value has changed by more than the deadband setting since the last time the data value was reported.

Any analog measurement that is unavailable at the time it is read will be reported as offline, e.g. the frequency when the current and voltage frequency is outside the tracking range of the relay. Note that all object 30 points are reported as secondary values in DNP3.0 (with respect to CT and VT ratios).

5.7 DNP3.0 configuration using MiCOM S1 Studio

A PC support package for DNP3.0 is available as part of the settings and records module of MiCOM S1 Studio. The S1 module allows configuration of the relay's DNP3.0 response. The PC is connected to the relay via a serial cable to the 9-pin front part of the relay – see section Getting Started (P849/EN GS). The configuration data is uploaded from the relay to the PC in a block of compressed format data and downloaded to the relay in a similar manner after modification. The new DNP3.0 configuration takes effect in the relay after the download is complete. The default configuration can be restored at any time by choosing 'All Settings' from the 'Restore Defaults' cell in the menu 'Configuration' column. In S1, the DNP3.0 data is displayed on a three-tabbed screen, one screen each for object 1, 20 and 30. Object 10 is not configurable.

5.7.1 Object 1

For every point included in the device profile document there is a check box for membership of class 0 and radio buttons for class 1, 2 or 3 membership. Any point that is in class 0 must be a member of one of the change event classes 1, 2 or 3.

Points that are configured out of class 0 are by default not capable of generating change events. Furthermore, points that are not part of class 0 are effectively removed from the DNP3.0 response by renumbering the points that are in class 0 into a contiguous list starting at point number 0. The renumbered point numbers are shown at the left-hand side of the screen in S1 and can be printed out to form a revised device profile for the relay. This mechanism allows best use of available bandwidth by only reporting the data points required by the user when a poll for all points is made.

5.7.2 Object 20

The running counter value of object 20 points can be configured to be in or out of class 0. Any running counter that is in class 0 can have its frozen value selected to be in or out of the DNP3.0 response, but a frozen counter cannot be included without the corresponding running counter. As with object 1, the class 0 response will be renumbered into a contiguous list of points based on the selection of running counters. The frozen counters will also be renumbered based on the selection; note that if some of the counters that are selected as running are not also selected as frozen then the renumbering will result in the frozen counters having different point numbers to their running counterparts. For example, object 20 point 3 (running counter) might have its frozen value reported as object 21 point 1.

5.7.3 Object 30

For the analog inputs, object 30, the same selection options for classes 0, 1, 2 and 3 are available as for object 1. In addition to these options, which behave in exactly the same way as for object 1, it is possible to change the deadband setting for each point. The minimum and maximum values and the resolution of the deadband settings are defined in the device profile document; MiCOM S1 Studio will allow the deadband to be set to any value within these constraints.

6. IEC 61850 ETHERNET INTERFACE

6.1 Introduction

IEC 61850 is the international standard for Ethernet-based communication in substations. It enables integration of all protection, control, measurement and monitoring functions within a substation, and additionally provides the means for interlocking and inter-tripping. It combines the convenience of Ethernet with the security which is essential in substations today.

The MiCOM protection relays can integrate with the PACiS substation control systems, to complete Schneider Electric offers of a full IEC 61850 solution for the substation. The majority of MiCOM Px3x and Px4x relay types can be supplied with Ethernet, in addition to traditional serial protocols. Relays which have already been delivered with UCA2.0 on Ethernet can be easily upgraded to IEC 61850.

6.2 What is IEC 61850?

IEC 61850 is an international standard, comprising 14 parts, which defines a communication architecture for substations.

The standard defines and offers much more than just a protocol. It provides:

- Standardized models for IEDs and other equipment within the substation
- Standardized communication services (the methods used to access and exchange data)
- Standardized formats for configuration files
- Peer-to-peer (e.g. relay to relay) communication

The standard includes mapping of data onto Ethernet. Using Ethernet in the substation offers many advantages, most significantly including:

- High-speed data rates (currently 100 Mbits/s, rather than 10's of kbits/s or less used by most serial protocols)
- Multiple masters (called "clients")
- Ethernet is an open standard in every-day use

Schneider Electric has been involved in the Working Groups which formed the standard, building on experience gained with UCA2.0, the predecessor of IEC 61850.

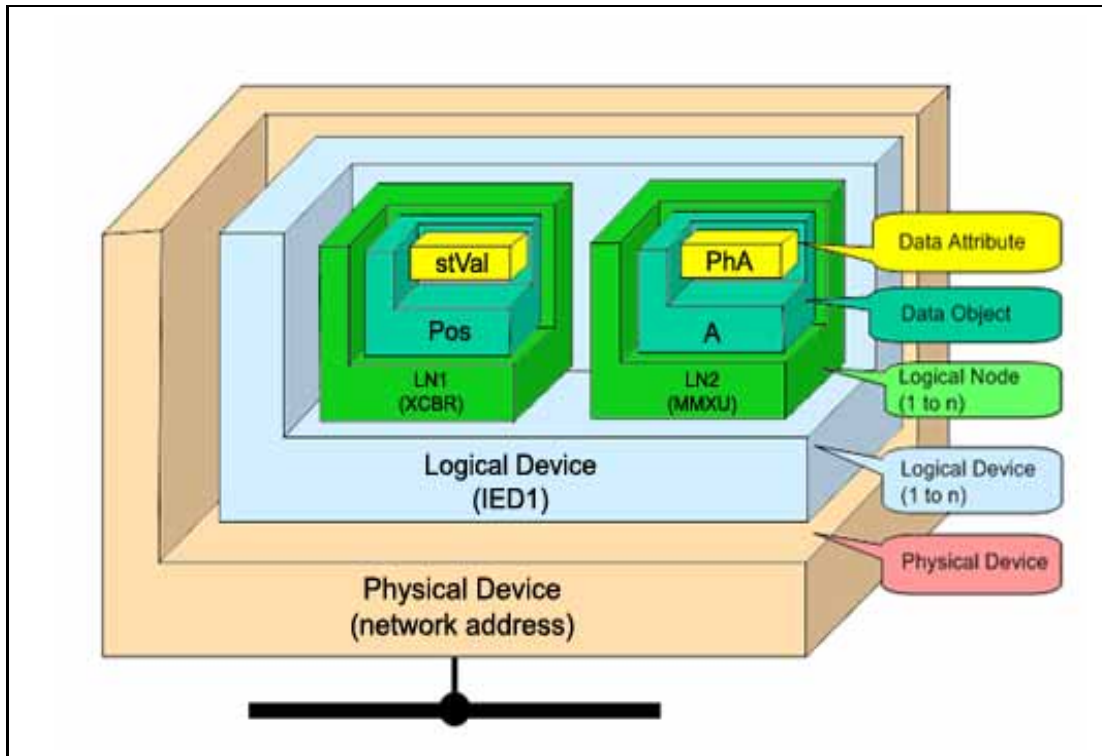
6.2.1 Interoperability

A major benefit of IEC 61850 is interoperability. IEC 61850 standardizes the data model of substation IEDs. This responds to the utilities' desire of having easier integration for different vendors' products, i.e. interoperability. It means that data is accessed in the same manner in different IEDs from either the same or different IED vendors, even though, for example, the protection algorithms of different vendors' relay types remain different.

When a device is described as IEC 61850-compliant, this does not mean that it is interchangeable, but does mean that it is interoperable. You cannot simply replace one product with another, however the terminology is pre-defined and anyone with prior knowledge of IEC 61850 should be able very quickly integrate a new device without the need for mapping of all of the new data. IEC 61850 will inevitably bring improved substation communications and interoperability, at a lower cost to the end user.

6.2.2 The data model

To ease understanding, the data model of any IEC 61850 IED can be viewed as a hierarchy of information. The categories and naming of this information is standardized in the IEC 61850 specification.



The levels of this hierarchy can be described as follows:

- Physical Device
 - Identifies the actual IED within a system. Typically the device's name or IP address can be used (for example **Feeder_1** or **10.0.0.2**).
- Logical Device
 - Identifies groups of related Logical Nodes within the Physical Device. For the MiCOM relays, 5 Logical Devices exist: **Control, Measurements, Protection, Records, System**.
- Wrapper/Logical Node Instance
 - Identifies the major functional areas within the IEC 61850 data model. Either 3 or 6 characters are used as a prefix to define the functional group (wrapper) while the actual functionality is identified by a 4 character Logical Node name suffixed by an instance number. For example, XCBR1 (circuit breaker), MMXU1 (measurements), FrqPTOF2 (overfrequency protection, stage 2).
- Data Object
 - This next layer is used to identify the type of data you will be presented with. For example, **Pos** (position) of Logical Node type **XCBR**.
- Data Attribute
 - This is the actual data (measurement value, status, description, etc.). For example, **stVal** (status value) indicating actual position of circuit breaker for Data Object type **Pos** of Logical Node type **XCBR**.

6.3 IEC 61850 in MiCOM relays

IEC 61850 is implemented in MiCOM relays by use of a separate Ethernet card. This card manages the majority of the IEC 61850 implementation and data transfer to avoid any impact on the performance of the protection.

In order to communicate with an IEC 61850 IED on Ethernet, it is necessary only to know its IP address. This can then be configured into either:

- An IEC 61850 “**client**” (or master), for example a PACiS computer (MiCOM C264) or HMI, or
- An “**MMS browser**”, with which the full data model can be retrieved from the IED, without any prior knowledge

6.3.1 Capability

The IEC 61850 interface provides the following capabilities:

1. Read access to measurements
All measurands are presented using the measurement Logical Nodes, in the ‘**Measurements**’ Logical Device. Reported measurement values are refreshed by the relay once per second, in line with the relay user interface.
2. Generation of unbuffered reports on change of status/measurement
Unbuffered reports, when enabled, report any change of state in statuses and/or measurements (according to deadband settings).
3. Support for time synchronization over an Ethernet link
Time synchronization is supported using SNTP (Simple Network Time Protocol); this protocol is used to synchronize the internal real time clock of the relays.
4. GOOSE peer-to-peer communication
GOOSE communications of statuses are included as part of the IEC 61850 implementation. Please see section 6.6 for more details.
5. Disturbance record extraction
Extraction of disturbance records, by file transfer, is supported by the MiCOM relays. The record is extracted as an ASCII format COMTRADE file.
6. Controls
The following control services are available:
 - Direct Control
 - Direct Control with enhanced security
 - Select Before Operate (SBO) with enhanced security

Controls shall be applied to open and close circuit breakers via XCBR.Pos and DDB signals ‘**Control Trip**’ and ‘**Control Close**’.

System/LLN0.LLN0.LEDRs shall be used to reset any trip LED indications.
7. Reports
Reports only include data objects that have changed and not the complete dataset. The exceptions to this are a General Interrogation request and integrity reports.
 - Buffered Reports
Eight Buffered Report Control Blocks, (BRCB), are provided in SYSTEM/LLN0 in Logical Device ‘**System**’

Buffered reports are configurable to use any configurable dataset located in the same Logical device as the BRCB (i.e. SYSTEM/LLN0)

– Unbuffered Reports

Sixteen Unbuffered Report Control Blocks, (URCB) are provided in SYSTEM/LLN0 in Logical Device '**System**'

Unbuffered reports are configurable to use any configurable dataset located in the same Logical device as the URCB (i.e. SYSTEM/LLN0)

8. Configurable data sets

It is possible to create and configure datasets in any Logical Node using the IED Configurator. The maximum number of datasets will be specified in an IED's ICD file. An IED is capable of handling 100 datasets.

9. Published GOOSE message

Eight GOCBs are provided in SYSTEM/LLN0.

10. Uniqueness of control

Uniqueness of control mechanism is implemented in the Px4x to have consistency with the PACiS mechanism. This requires the relay to subscribe to the OrdRun signal from all devices in the system and be able to publish such a signal in a GOOSE message.

11. Select active setting group

Functional protection groups can be enabled/disabled via private mod/beh attributes in Protection/LLN0.OcpMod object. Setting groups are selectable using the Setting Group Control Block class, (SGCB). The Active Setting Group can be selected using the System/LLN0.SP.SGCB.ActSG data attribute in Logical Device '**System**'.

12. Quality for GOOSE

It is possible to process the quality attributes of any Data Object in an incoming GOOSE message. Devices that do not support IEC 61850 quality flags shall send quality attributes as all zeros.

13. Address List

An Address List document (to be titled ADL) is produced for each IED which shows the mapping between the IEC 61850 data model and the internal data model of the IED. It includes a mapping in the reverse direction, which may be more useful. This document is separate from the PICS/MICS document.

14. Originator of control

Originator of control mechanism is implemented for operate response message and in the data model on the ST of the related control object, consistent with the PACiS mechanism.

15. Metering

MMTR (metering) logical node is implemented in Px4x. All metered values in the MMTR logical node are of type BCR. The actVal attribute of the BCR class is of type INT128, but this type is not supported by the SISCO MMSLite library. Instead, an INT64 value will be encoded for transmission.

A SPC data object named MTTRs has been included in the MMTR logical node. This control will reset the demand measurements. A SPC data object named MTTRs is also included in the PTTR logical node. This control will reset the thermal measurements.

16. Scaled measurements

The Unit definition, as per IEC specifies an SI unit and an optional multiplier for each measurement. This allows a magnitude of measurement to be specified e.g. mA, A, kA, MA.

The multiplier will always be included in the Unit definition and will be configurable in SCL, but not settable at runtime. It will apply to the magnitude, rangeC.min & rangeC.max attributes. rangeC.min & rangeC.max will not be settable at runtime to be more consistent with Px30 and to reduce configuration problems regarding deadbands.

Setting changes (e.g. of protection settings) are not supported in the current IEC 61850 implementation. In order to keep this process as simple as possible, such setting changes are done using MiCOM S1 Studio Settings & Records program. This can be done as previously using the front port serial connection of the relay, or now optionally over the Ethernet link if preferred (this is known as “**tunneling**”).

6.3.2 IEC 61850 configuration

One of the main objectives of IEC 61850 is to allow IEDs to be directly configured from a configuration file generated at system configuration time. At the system configuration level, the capabilities of the IED are determined from an IED capability description file (ICD) which is provided with the product. Using a collection of these ICD files from varying products, the entire protection of a substation can be designed, configured and tested (using simulation tools) before the product is even installed into the substation.

To aid in this process, the MiCOM S1 Studio Support Software provides an IED Configurator tool which allows the pre-configured IEC 61850 configuration file (an SCD file or CID file) to be imported and transferred to the IED. Alongside this, the requirements of manual configuration are satisfied by allowing the manual creation of configuration files for MiCOM relays based on their original IED capability description (ICD file).

Other features include the extraction of configuration data for viewing and editing, and a sophisticated error checking sequence which ensures that the configuration data is valid for sending to the IED and that the IED will function within the context of the substation.

To aid the user, some configuration data is available in the ‘**IED CONFIGURATOR**’ column of the relay user interface, allowing read-only access to basic configuration data.

6.3.2.1 Configuration banks

To promote version management and minimize down-time during system upgrades and maintenance, the MiCOM relays have incorporated a mechanism consisting of multiple configuration banks. These configuration banks are categorized as:

- Active Configuration Bank
- Inactive Configuration Bank

Any new configuration sent to the relay is automatically stored into the inactive configuration bank, therefore not immediately affecting the current configuration. Both active and inactive configuration banks can be extracted at anytime.

When the upgrade or maintenance stage is complete, the IED Configurator tool can be used to transmit a command (to a single IED) authorizing the activation of the new configuration contained in the inactive configuration bank, by switching the active and inactive configuration banks. This technique ensures that the system down-time is minimized to the start-up time of the new configuration. The capability to switch the configuration banks is also available via the ‘**IED CONFIGURATOR**’ column.

For version management, data is available in the ‘**IED CONFIGURATOR**’ column in the relay user interface, displaying the SCL Name and Revision attributes of both configuration banks.

6.3.2.2 Network connectivity

Note: This section presumes a prior knowledge of IP addressing and related topics. Further details on this topic may be found on the Internet (search for IP Configuration) and in numerous relevant books.

Configuration of the relay IP parameters (IP Address, Subnet Mask, Gateway) and SNTP time synchronization parameters (SNTP Server 1, SNTP Server 2) is performed by the IED Configurator tool, so if these parameters are not available via an SCL file, they must be configured manually.

If the assigned IP address is duplicated elsewhere on the same network, the remote communications will operate in an indeterminate way. However, the relay will check for a conflict on every IP configuration change and at power up. An alarm will be raised if an IP conflict is detected. The relay can be configured to accept data from networks other than the local network by using the '**Gateway**' setting.

6.4 The data model of MiCOM relays

The data model naming adopted in the Px30 and Px40 relays has been standardized for consistency. Hence the Logical Nodes are allocated to one of the five Logical Devices, as appropriate, and the wrapper names used to instantiate Logical Nodes are consistent between Px30 and Px40 relays.

The data model is described in the Model Implementation Conformance Statement (MICS) document, which is available separately. The MICS document provides lists of Logical Device definitions, Logical Node definitions, Common Data Class and Attribute definitions, Enumeration definitions, and MMS data type conversions. It generally follows the format used in Parts 7-3 and 7-4 of the IEC 61850 standard.

6.5 The communication services of MiCOM relays

The IEC 61850 communication services which are implemented in the Px30 and Px40 relays are described in the Protocol Implementation Conformance Statement (PICS) document, which is available separately. The PICS document provides the Abstract Communication Service Interface (ACSI) conformance statements as defined in Annex A of Part 7-2 of the IEC 61850 standard.

6.6 Peer-to-peer (GSE) communications

The implementation of IEC 61850 Generic Substation Event (GSE) sets the way for cheaper and faster inter-relay communications. The generic substation event model provides the possibility for a fast and reliable system-wide distribution of input and output data values. The generic substation event model is based on the concept of an autonomous decentralization, providing an efficient method allowing the simultaneous delivery of the same generic substation event information to more than one physical device through the use of multicast services.

The use of multicast messaging means that IEC 61850 GOOSE uses a publisher-subscriber system to transfer information around the network*. When a device detects a change in one of its monitored status points it publishes (i.e. sends) a new message. Any device that is interested in the information subscribes (i.e. listens) to the data it contains.

Note: * Multicast messages cannot be routed across networks without specialized equipment.

Each new message is re-transmitted at user-configurable intervals until the maximum interval is reached, in order to overcome possible corruption due to interference, and collisions. In practice, the parameters which control the message transmission cannot be calculated. Time must be allocated to the testing of GSE schemes before or during commissioning, in just the same way a hardwired scheme must be tested.

6.6.1 Scope

A maximum of 64 virtual inputs are available within the PSL which can be mapped directly to a published dataset in a GOOSE message (Configurable dataset is supported).

Each GOOSE signal contained in a subscribed GOOSE message can be mapped to any of the 64 virtual inputs within the PSL. The virtual inputs allow the mapping to internal logic functions for protection control, directly to output contacts or LEDs for monitoring.

The MiCOM relay can subscribe to all GOOSE messages but only the following data types can be decoded and mapped to a virtual input:

- BOOLEAN
- BSTR2
- INT16
- INT32
- INT8
- UINT16
- UINT32
- UINT8

6.6.2 IEC 61850 GOOSE configuration

All GOOSE configuration is performed via the IED Configurator tool available within the MiCOM S1 Studio Support Software.

All GOOSE publishing configuration can be found under the '**GOOSE Publishing**' tab in the configuration editor window. All GOOSE subscription configuration can be found under the '**GOOSE SUBSCRIBE**' tab in the configuration editor window. Care should be taken to ensure that the configuration is correct, to ensure efficient GOOSE scheme operation.

CONFIGURATION NOTE:

It should be noted that whilst the GOOSE messaging allows for fast and efficient passing of data between devices the performance will be dependent on the configuration of the device; in particular the published dataset. The IED Configurator tool provides a warning bar that indicates the size of a defined dataset relative to the maximum size that can be published within a GOOSE message. As the size of the message approaches this maximum size the performance may be impacted.

In addition the Px40 device is designed to provide maximum performance through an optimised publishing mechanism. This optimised mechanism is enabled if the published GOOSE message is mapped using only the data attributes of the model rather than mapping a complete data object (see section 6.6.1). If data objects are mapped the GOOSE messaging will operate correctly; however without the benefit of the optimised mechanism.

Settings to enable GOOSE signalling and to apply Test Mode are available via the relay user interface.

6.7 Ethernet functionality

Settings relating to a failed Ethernet link are available in the '**COMMUNICATIONS**' column of the relay user interface.

6.7.1 Ethernet disconnection

IEC 61850 '**associations**' are unique and made to the relay between the client (master) and server (IEC 61850 device). In the event that the Ethernet is disconnected, such associations are lost, and will need to be re-established by the client. The TCP_KEEPALIVE function is implemented in the relay to monitor each association, and terminate any which are no longer active.

6.7.2 Loss of power

The relay allows the re-establishment of associations by the client without a negative impact on the relay's operation after having its power removed. As the relay acts as a server in this process, the client must request the association. Uncommitted settings are cancelled when power is lost, and reports requested by connected clients are reset and must be re-enabled by the client when it next creates the new association to the relay.

SYMBOLS AND GLOSSARY

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

Logic Symbols used

Symbols	Explanation
&	Logical “AND”: Used in logic diagrams to show an AND-gate function.
Σ	“Sigma”: Used to indicate a summation, such as cumulative current interrupted.
τ	“Tau”: Used to indicate a time constant, often associated with thermal characteristics.
<	Less than: Used to indicate an “under” threshold, such as undercurrent (current dropout).
>	Greater than: Used to indicate an “over” threshold, such as overcurrent (current overload).
1	Logical “OR”: Used in logic diagrams to show an OR-gate function.
52a	A circuit breaker closed auxiliary contact: The contact is in the same state as the breaker primary contacts.
52b	A circuit breaker open auxiliary contact: The contact is in the opposite state to the breaker primary contacts.
89a	An Isolator closed auxiliary contact: The contact is in the same state as the breaker primary contacts.
89b	An Isolator open auxiliary contact: The contact is in the opposite state to the breaker primary contacts.
ACSI	Abstract Communication Service Interface: In IEC 61850, the ACSI provides abstract definitions of a hierarchical data model and the services that operate on the data.
BAR	Block auto-reclose signal.
BN>	Neutral over susceptance protection element: Reactive component of admittance calculation from neutral current and residual voltage.
BU	Backup: Typically a back-up protection element.
C/O	A changeover contact having normally closed and normally open connections: Often called a “form C” contact.
CB	Circuit breaker.
CB Aux.	Circuit breaker auxiliary contacts: Indication of the breaker open/closed status.
CBF	Circuit breaker failure protection.
CLP	Cold load pick-up.
CS	Check synchronism.
CT	Current transformer.
CTRL.	Abbreviation of “Control”: As used for the Control Inputs function.

Symbols	Explanation
CTS	Current transformer supervision: To detect CT input failure.
CZ	Abbreviation of “Check Zone”: Zone taking into account only the feeders.
DDB	Digital data bus within the programmable scheme logic: A logic point that has a zero or 1 status. DDB signals are mapped in logic to customize the relay's operation.
DEF	Directional earth fault protection: A directionalised ground fault aided scheme.
Df/dt	Rate of change of frequency protection (ROCOF).
Dly	Time delay.
DR	Abbreviation of “Disturbance Record”
DT	Abbreviation of “Definite Time”: An element which always responds with the same constant time delay on operation.
DZ	Abbreviation of “Dead Zone”: Area between a CT and an open breaker or an open isolator.
E/F	Earth fault: Directly equivalent to ground fault.
F<	An underfrequency element: Could be labelled 81U in ANSI terminology.
F>	An overfrequency element: Could be labelled 81O in ANSI terminology.
FLC	Full load current: The nominal rated current for the circuit.
Fit.	Abbreviation of “Fault”: Typically used to indicate faulted phase selection.
FN	Function.
Fwd.	Indicates an element responding to a flow in the “Forward” direction.
GN>	Neutral over conductance protection element: Real component of admittance calculation from neutral current and residual voltage.
Gnd.	Abbreviation of “Ground”: Used in distance settings to identify settings that relate to ground (earth) faults.
GOOSE	Generic Object Oriented Substation Event: In IEC 61850, a specific definition of a type of generic substation event, for peer-peer communication.
GRP.	Abbreviation of “Group”: Typically an alternative setting group.
GSE	Generic Substation Event: In IEC 61850, the generic substation event model provides the possibility for a fast and reliable system-wide distribution of input and output data values (peer-peer communication).

Symbols	Explanation
HMI	Human Machine Interface: The graphical user interface of the control system.
I	Current.
I[^]	Current raised to a power: Such as when breaker statistics monitor the square of ruptured current squared (^ power = 2).
I/O	Abbreviation of “Inputs and Outputs”: Used in connection with the number of optocoupled inputs and output contacts within the relay.
I/P	Abbreviation of “Input”.
I<	An undercurrent element: Responds to current dropout.
I>	An overcurrent element: Detects phase faults; Optionally used by the 50BF protection.
I>1	First stage of phase overcurrent protection: Could be labelled 51-1 in ANSI terminology.
I>2	Second stage of phase overcurrent protection: Could be labelled 51-2 in ANSI terminology.
I>3	Third stage of phase overcurrent protection: Could be labelled 51-3 in ANSI terminology.
I>4	Fourth stage of phase overcurrent protection: Could be labelled 51-4 in ANSI terminology.
I>BB	Minimum pick-up phase threshold for the local trip order confirmation.
I>DZ	Minimum pick-up phase threshold for the Dead Zone protection.
I₀	Zero sequence current: Equals one third of the measured neutral/residual current.
I₁	Positive sequence current.
I₂	Negative sequence current.
I2>	Negative sequence overcurrent protection (NPS element).
I2pol	Negative sequence polarizing current.
IA	Phase A current: Might be phase L1, red phase. or other, in customer terminology.
IB	Phase B current: Might be phase L2, yellow phase. or other, in customer terminology.
IbiasPh> Cur.	SDEF blocking bias current threshold.
IC	Phase C current: Might be phase L3, blue phase. or other, in customer terminology.
ID	Abbreviation of “Identifier”: Often a label used to track a software version installed.
ID>1	Minimum pick-up phase circuitry fault threshold.
ID>2	Minimum pick-up differential phase element for all the zones.
IDCZ>2	Minimum pick-up differential phase element for the Check Zone.


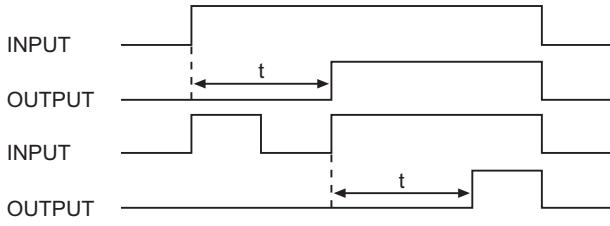
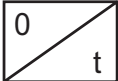
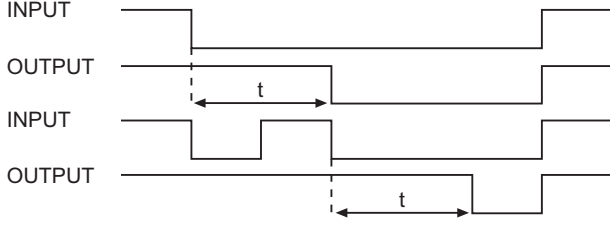
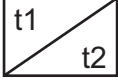
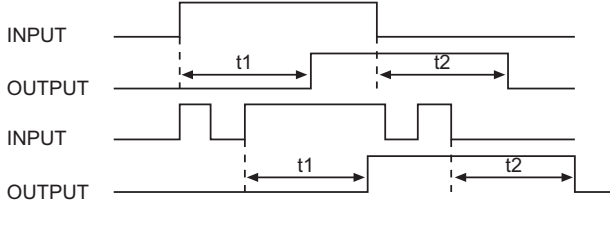
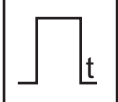
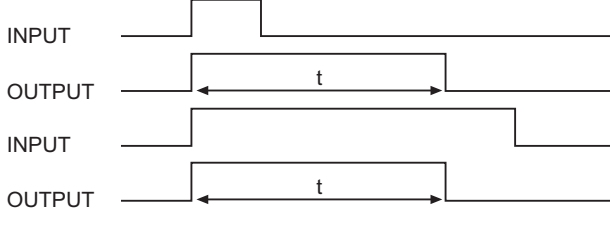
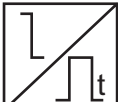

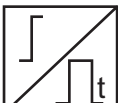
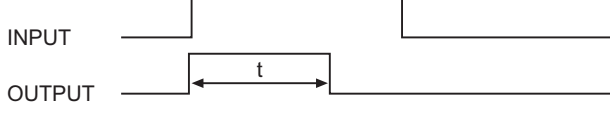

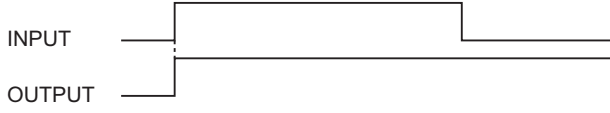
Symbols	Explanation
IDMT	Inverse definite minimum time: A characteristic whose trip time depends on the measured input (e.g. current) according to an inverse-time curve.
IDN>1	Minimum pick-up neutral circuitry fault threshold.
IDN>2	Minimum pick-up differential neutral element for all the zones.
IDNCZ>2	Minimum pick-up differential neutral element for the Check Zone.
IDZ	Minimum pick-up differential neutral element for the Check Zone.
IED	Intelligent Electronic Device: For example a MiCOM relay
In	The rated nominal current of the relay: Software selectable as 1 amp or 5 amps to match the line CT input.
IN	Neutral current, or residual current: This results from an internal summation of the three measured phase currents.
IN>	A neutral (residual) overcurrent element: Detects earth/ground faults.
IN>1	First stage of ground overcurrent protection: Could be labelled 51N-1 in ANSI terminology.
IN>2	Second stage of ground overcurrent protection: Could be labelled 51N-2 in ANSI terminology.
IN>BB	Minimum pick-up neutral threshold for the local trip order confirmation.
IN>DZ	Minimum pick-up neutral threshold for the Dead Zone protection.
Inh	An inhibit signal.
Inst.	An element with “instantaneous” operation: i.e. having no deliberate time delay.
ISEF>	Sensitive earth fault overcurrent element.
K1	Slope of the phase circuitry fault function.
K2	Slope of the differential phase element for all the zones.
KCZ	Slope of the differential phase element for the Check Zone.
KN1	Slope of the neutral circuitry fault function.
KN2	Slope of the differential neutral element for all the zones.
KNCZ	Slope of the differential neutral element for the Check Zone.
KZN	The residual compensation factor: Ensuring correct reach for ground distance elements.
LCD	Liquid crystal display: The front-panel text display on the relay.
LD	Abbreviation of “Level Detector”: An element responding to a current or voltage below its set threshold.
LED	Light emitting diode: Bicolour: Red/black or green/black or orange/black indicator on the relay front-panel. Tricolour: Red/orange/green/black indicator on the relay front-panel.
MCB	A “miniature circuit breaker”: Used instead of a fuse to protect VT secondary circuits.

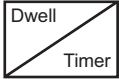
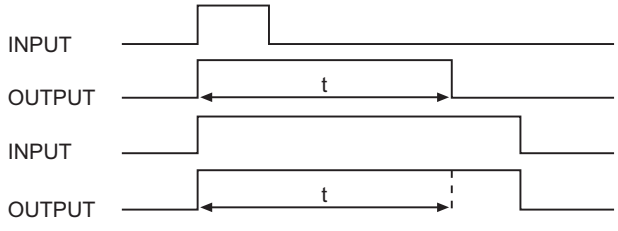

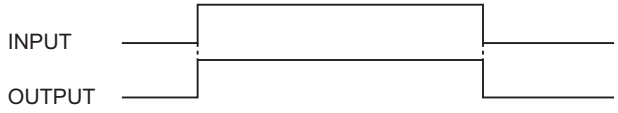
Symbols	Explanation
MICS	Model Implementation Conformance Specification: Defines the IEC 61850 data model implemented in an IED.
MMS	Manufacturing Message Specification: A protocol used to transport the data of IEC 61850 across an Ethernet network.
N	Indication of “Neutral” involvement in a fault: i.e. a ground (earth) fault.
N/A	Not applicable.
N/C	A normally closed or “break” contact: Often called a “form B” contact.
N/O	A normally open or “make” contact: Often called a “form A” contact.
NIC	Network Interface Card: i.e. the Ethernet card of the IED
NPS	Negative phase sequence.
NVD	Neutral voltage displacement: Equivalent to residual overvoltage protection.
NXT	Abbreviation of “Next”: In connection with hotkey menu navigation.
◦	A small circle on the input or output of a logic gate: Indicates a NOT (invert) function.
O/P	Abbreviation of “output”.
Opto	An optocoupled logic input: Alternative terminology: binary input.
P1	Used in IEC terminology to identify the primary CT terminal polarity: Replace by a dot when using ANSI standards.
P2	Used in IEC terminology to identify the primary CT terminal polarity: The non-dot terminal.
PCB	Printed circuit board.
Ph	Abbreviation of “Phase”: Used in distance settings to identify settings that relate to phase-phase faults.
PICS	Protocol Implementation Conformance Specification: Defines the IEC 61850 services implemented in an IED, with reference to the ACSI.
PN>	Wattmetric earth fault protection: Calculated using residual voltage and current quantities.
Pol	Abbreviation of “Polarizing”: Typically the polarizing voltage used in making directional decisions.
PSL	Programmable scheme logic: The part of the relay’s logic configuration that can be modified by the user, using the graphical editor within MiCOM S1 Studio software.
Qx	Isolator number x (from 1 to 6).
R	A resistance.

Symbols	Explanation
R Gnd.	A distance zone resistive reach setting: Used for ground (earth) faults.
RBN	Lead burden for the neutral.
RBPh	Lead burden for the phases.
RCA	Abbreviation of “Relay Characteristic Angle”: The centre of the directional characteristic.
RCT	Current Transformer secondary resistance.
REF	Restricted earth fault protection.
Rev.	Indicates an element responding to a flow in the “reverse” direction.
RMS	The equivalent a.c. current: Taking into account the fundamental, plus the equivalent heating effect of any harmonics. Abbreviation of “root mean square”.
RP	Abbreviation of “Rear Port”: The communication ports on the rear of the relay.
Rx	Abbreviation of “Receive”: Typically used to indicate a communication receive line/pin.
S1	Used in IEC terminology to identify the secondary CT terminal polarity: Replace by a dot when using ANSI standards.
S2	Used in IEC terminology to identify the secondary CT terminal polarity: The non-dot terminal.
SCL	Substation Configuration Language: In IEC 61850, the definition of the configuration files.
SCSM	Specific Communication Service Mappings: In IEC 61850, the SCSMs define the actual information exchange mechanisms currently used (e.g. MMS).
SDEF	Sensitive Differential Earth Fault Protection.
SEF	Sensitive Earth Fault Protection.
SSD	Solid State Device
T	A time delay.
TCS	Trip circuit supervision.
TD	The time dial multiplier setting: Applied to inverse-time curves (ANSI/IEEE).
TE	A standard for measuring the width of a relay case: One inch = 5TE units.
TMS	The time multiplier setting applied to inverse-time curves (IEC).
Tx	Abbreviation of “Transmit”: Typically used to indicate a communication transmit line/pin.
V	Voltage.
V<	An undervoltage element.
V<1	First stage of undervoltage protection: Could be labelled 27-1 in ANSI terminology.

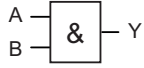
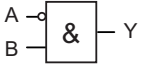
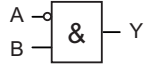
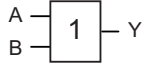
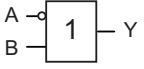
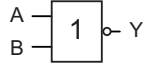
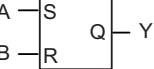
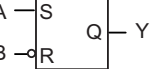
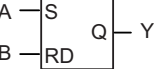



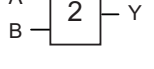
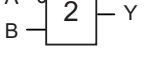
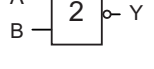
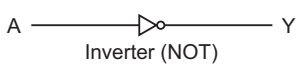
Symbols	Explanation
V<2	Second stage of undervoltage protection: Could be labelled 27-2 in ANSI terminology.
V>	An overvoltage element.
V>1	First stage of overvoltage protection: Could be labelled 59-1 in ANSI terminology.
V>2	Second stage of overvoltage protection: Could be labelled 59-2 in ANSI terminology.
V₀	Zero sequence voltage: Equals one third of the measured neutral/residual voltage.
V₁	Positive sequence voltage.
V₂	Negative sequence voltage.
V2pol	Negative sequence polarizing voltage.
VA	Phase A voltage: Might be phase L1, red phase. or other, in customer terminology.
VB	Phase B voltage: Might be phase L2, yellow phase. or other, in customer terminology.
VC	Phase C voltage: Might be phase L3, blue phase. or other, in customer terminology.
VCO	Voltage controlled overcurrent element.
Vk	IEC knee point voltage of a current transformer.
Vn	The rated nominal voltage of the relay: To match the line VT input.
VN	Neutral voltage displacement or residual voltage.
VN>1	First stage of residual (neutral) overvoltage protection.
VN>2	Second stage of residual (neutral) overvoltage protection.
Vres.	Neutral voltage displacement or residual voltage.
VT	Voltage transformer.
VTS	Voltage transformer supervision: To detect VT input failure.
Vx	An auxiliary supply voltage: Typically the substation battery voltage used to power the relay.
YN>	Neutral overadmittance protection element: Non-directional neutral admittance protection calculated from neutral current and residual voltage.
Z₀	Zero sequence impedance.
Z₁	Positive sequence impedance.
Z₂	Negative sequence impedance.

Logic Timers

Logic Symbols	Explanation	Time Chart
	<p>Delay on pick-up timer, t</p>	
	<p>Delay on drop-off timer, t</p>	
	<p>Delay on pick-up/drop-off timer</p>	
	<p>Pulse timer</p>	
	<p>Pulse pick-up falling edge</p>	
	<p>Pulse pick-up raising edge</p>	
	<p>Latch</p>	

Logic Symbols	Explanation	Time Chart
	<p>Dwell timer</p>	
	<p>Straight (non latching): Hold value until input reset signal</p>	

Logic Gates

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INSTALLATION

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

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1. RECEIPT OF MICOM P849 DEVICE

MiCOM P849 devices and MiCOM relays, although generally of robust construction, require careful treatment prior to installation on site. Upon receipt, relays should be examined immediately to ensure no external damage has been sustained in transit.

If damage has been sustained, a claim should be made to the transport contractor and Schneider Electric should be promptly notified.

Relays that are supplied unmounted and not intended for immediate installation should be returned to their protective polythene bags and delivery carton.

Section 3 of this chapter gives more information about the storage of relays.

2. HANDLING OF ELECTRONIC EQUIPMENT

A person's normal movements can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semiconductor devices when handling electronic circuits can cause serious damage which, although not always immediately apparent, will reduce the reliability of the circuit. This is particularly important to consider where the circuits use complementary metal oxide semiconductors (CMOS), as is the case with these devices.

The device's electronic circuits are protected from electrostatic discharge when housed in the case. Do not expose them to risk by removing the front panel or printed circuit boards unnecessarily.

Each printed circuit board incorporates the highest practicable protection for its semiconductor devices. However, if it becomes necessary to remove a printed circuit board, the following precautions should be taken to preserve the high reliability and long life for which the device has been designed and manufactured.

1. Before removing a printed circuit board, ensure that you are at the same electrostatic potential as the equipment by touching the case.
2. Handle analogue input modules by the front panel, frame or edges of the circuit boards. Printed circuit boards should only be handled by their edges. Avoid touching the electronic components, printed circuit tracks or connectors.
3. Do not pass the module to another person without first ensuring you are both at the same electrostatic potential. Shaking hands achieves equipotential.
4. Place the module on an anti-static surface, or on a conducting surface which is at the same potential as yourself.
5. If it is necessary to store or transport printed circuit boards removed from the case, place them individually in electrically conducting anti-static bags.

In the unlikely event that you are making measurements on the internal electronic circuitry of a device in service, it is preferable that you are earthed to the case with a conductive wrist strap. Wrist straps should have a resistance to ground between 500k Ω to 10M Ω . If a wrist strap is not available you should maintain regular contact with the case to prevent a build-up of electrostatic potential. Instrumentation which may be used for making measurements should also be earthed to the case whenever possible.

More information on safe working procedures for all electronic equipment can be found in BS EN 100015: Part 1:1992. It is strongly recommended that detailed investigations on electronic circuitry or modification work should be carried out in a special handling area such as described in the aforementioned British Standard document.

3. STORAGE

If devices are not to be installed immediately upon receipt, they should be stored in a place free from dust and moisture in their original cartons. Where de-humidifier bags have been included in the packing they should be retained. The action of the de-humidifier crystals will be impaired if the bag is exposed to ambient conditions and may be restored by gently heating the bag for about an hour prior to replacing it in the carton.

To prevent battery drain during transportation and storage a battery isolation strip is fitted during manufacture. With the lower access cover open, presence of the battery isolation strip can be checked by a red tab protruding from the positive side.

Care should be taken on subsequent unpacking that any dust which has collected on the carton does not fall inside. In locations of high humidity the carton and packing may become impregnated with moisture and the de-humidifier crystals will lose their efficiency.

Prior to installation, devices should be stored at a temperature of between -40°C to $+70^{\circ}\text{C}$.

4. UNPACKING

Care must be taken when unpacking and installing the devices so that none of the parts are damaged and additional components are not accidentally left in the packing or lost.

Note: With the lower access cover open, the red tab of the battery isolation strip will be seen protruding from the positive side of the battery compartment. Do not remove this strip because it prevents battery drain during transportation and storage and will be removed as part of the commissioning tests.

Devices must only be handled by skilled persons.

The site should be well lit to facilitate inspection, clean, dry and reasonably free from dust and excessive vibration. This particularly applies to installations which are being carried out at the same time as construction work.

5. DEVICE MOUNTING

MiCOM devices are dispatched either individually or as part of a panel/rack assembly.

Individual devices are normally supplied with an outline diagram showing the dimensions for panel cut-outs and hole centres. This information can also be found in the product publication.

Secondary front covers can also be supplied as an option item to prevent unauthorised changing of settings and alarm status. They are available in sizes 40TE (GN0037 001) and 60TE (GN0038 001). Note that the 60TE cover also fits the 80TE case size of the device.

The design of the device is such that the fixing holes in the mounting flanges are only accessible when the access covers are open and hidden from sight when the covers are closed.

If a P991 or MMLG test block is to be included, it is recommended that, when viewed from the front, it is positioned on the right-hand side of the device (or devices) with which it is associated. This minimises the wiring between the device and test block, and allows the correct test block to be easily identified during commissioning and maintenance tests.

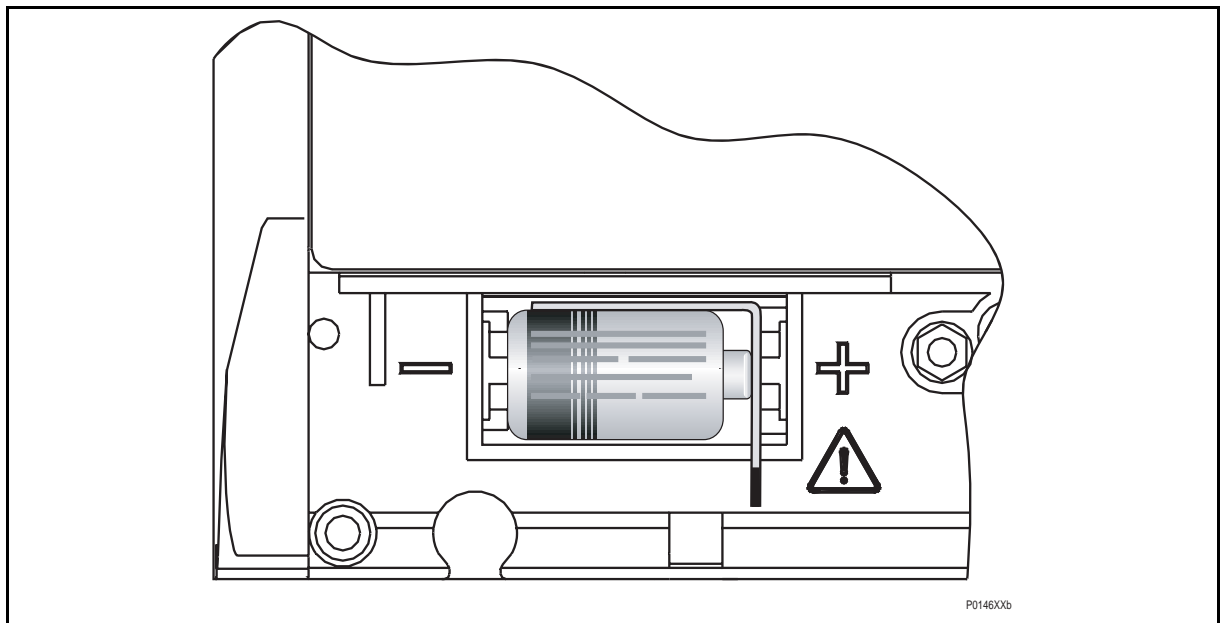


FIGURE 1: LOCATION OF BATTERY ISOLATION STRIP

If it is necessary to test correct device operation during the installation, the battery isolation strip can be removed but should be replaced if commissioning of the scheme is not imminent. This will prevent unnecessary battery drain during transportation to site and installation. The red tab of the isolation strip can be seen protruding from the positive side of the battery compartment when the lower access cover is open. To remove the isolation strip, pull the red tab whilst lightly pressing the battery to prevent it falling out of the compartment. When replacing the battery isolation strip, ensure that the strip is refitted as shown in Figure 1, i.e. with the strip behind the battery with the red tab protruding.

5.1 Rack mounting

MiCOM P849 devices and MiCOM relays may be rack mounted using single tier rack frames (our part number FX0121 001), as illustrated in Figure 2. These frames have been designed to have dimensions in accordance with IEC60297 and are supplied pre-assembled ready to use. On a standard 483mm (19") rack system this enables combinations of widths of case up to a total equivalent of size 80TE to be mounted side by side.

The two horizontal rails of the rack frame have holes drilled at approximately 26mm intervals and the relays are attached via their mounting flanges using M4 Taptite self-tapping screws with captive 3mm thick washers (also known as a SEMS unit). These fastenings are available in packs of 5 (our part number ZA0005 104).

Note: Conventional self-tapping screws, including those supplied for mounting MIDOS relays, have marginally larger heads which can damage the front cover moulding if used.

Once the tier is complete, the frames are fastened into the racks using mounting angles at each end of the tier.

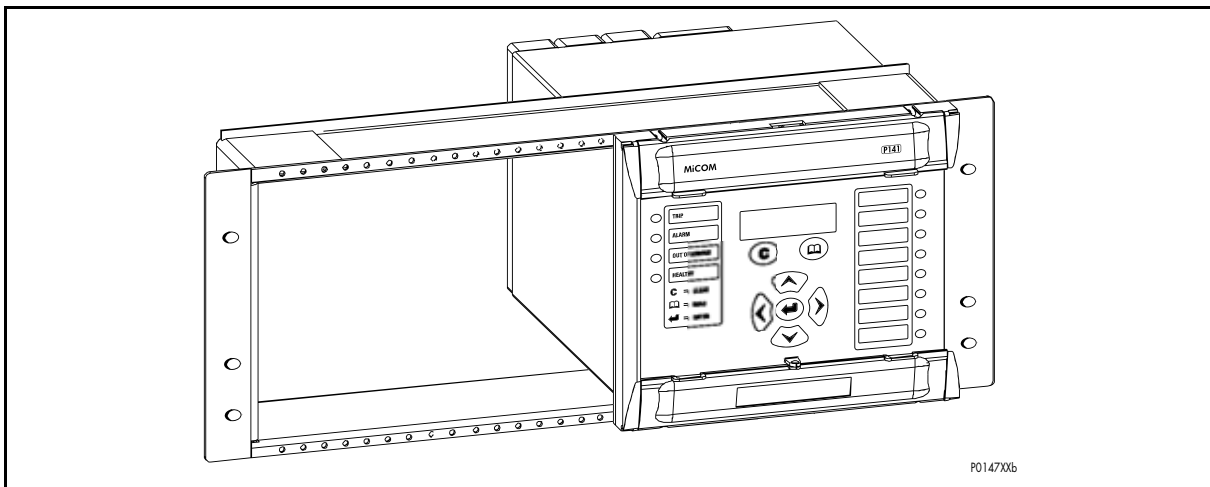


FIGURE 2: RACK MOUNTING OF RELAYS (EXAMPLE)

Relays can be mechanically grouped into single tier (4U) or multi-tier arrangements by means of the rack frame. This enables schemes using products from the MiCOM and MiDOS product ranges to be pre-wired together prior to mounting.

Where the case size summation is less than 80TE on any tier, or space is to be left for installation of future relays, blanking plates may be used. These plates can also be used to mount ancillary components. Table 1 shows the sizes that can be ordered.

Further details on mounting MiDOS relays can be found in publication R7012, "MiDOS Parts Catalogue and Assembly Instructions".

Case size summation	Blanking plate part number
5TE	GJ2128 001
10TE	GJ2128 002
15TE	GJ2128 003
20TE	GJ2128 004
25TE	GJ2128 005
30TE	GJ2128 006
35TE	GJ2128 007
40TE	GJ2128 008

TABLE 1: BLANKING PLATES

5.2 Panel mounting

The relays can be flush mounted into panels using M4 SEMS Taptite self-tapping screws with captive 3mm thick washers (also known as a SEMS unit).

These fastenings are available in packs of 5 (our part number ZA0005 104).

Note: Conventional self-tapping screws, including those supplied for mounting MIDOS relays, have marginally larger heads which can damage the front cover moulding if used.

Alternatively tapped holes can be used if the panel has a minimum thickness of 2.5mm.

For applications where relays need to be semi-projection or projection mounted, a range of collars are available.

Where several relays are to be mounted in a single cut-out in the panel, it is advised that they are mechanically grouped together horizontally and/or vertically to form rigid assemblies prior to mounting in the panel.

Note: It is not advised that MiCOM relays are fastened using pop rivets as this will not allow the relay to be easily removed from the panel in the future if repair is necessary.

If it is required to mount a relay assembly on a panel complying to BS EN60529 IP52, it will be necessary to fit a metallic sealing strip between adjoining relays (Part no GN2044 001) and a sealing ring selected from Table 2 around the complete assembly.

Width	Single tier	Double tier
10TE	GJ9018 002	GJ9018 018
15TE	GJ9018 003	GJ9018 019
20TE	GJ9018 004	GJ9018 020
25TE	GJ9018 005	GJ9018 021
30TE	GJ9018 006	GJ9018 022
35TE	GJ9018 007	GJ9018 023
40TE	GJ9018 008	GJ9018 024
45TE	GJ9018 009	GJ9018 025
50TE	GJ9018 010	GJ9018 026
55TE	GJ9018 011	GJ9018 027
60TE	GJ9018 012	GJ9018 028
65TE	GJ9018 013	GJ9018 029
70TE	GJ9018 014	GJ9018 030
75TE	GJ9018 015	GJ9018 031
80TE	GJ9018 016	GJ9018 032

TABLE 2: IP52 SEALING RINGS

Further details on mounting MiDOS relays can be found in publication R7012, "MiDOS Parts Catalogue and Assembly Instructions".

6. RELAY WIRING



Before carrying out any work on the equipment, the user should be familiar with the contents of the safety section/safety guide SFTY/4LM/E11 or later issue, the technical data section and the ratings on the equipment rating label.”

6.1 Medium and heavy duty terminal block connections

Loose relays are supplied with sufficient M4 screws for making connections to the rear mounted terminal blocks using ring terminals, with a recommended maximum of two ring terminals per relay terminal.

If required, Schneider Electric can supply M4 90° crimp ring terminals in three different sizes depending on wire size (see Table 3). Each type is available in bags of 100.

Part number	Wire size	Insulation colour
ZB9124 901	0.25 – 1.65mm ² (22 – 16AWG)	Red
ZB9124 900	1.04 – 2.63mm ² (16 – 14AWG)	Blue
ZB9124 904	2.53 – 6.64mm ² (12 – 10AWG)	Uninsulated*

TABLE 3: M4 90° CRIMP RING TERMINALS

* To maintain the terminal block insulation requirements for safety, an insulating sleeve should be fitted over the ring terminal after crimping.

The following minimum wire sizes are recommended:

- Current Transformers 2.5mm²
- Auxiliary Supply, Vx 1.5mm²
- RS485 Port See separate section
- Other circuits 1.0mm²

Due to the limitations of the ring terminal, the maximum wire size that can be used for any of the medium or heavy duty terminals is 6.0mm² using ring terminals that are not pre-insulated. Where it required to only use pre-insulated ring terminals, the maximum wire size that can be used is reduced to 2.63mm² per ring terminal. If a larger wire size is required, two wires should be used in parallel, each terminated in a separate ring terminal at the relay.

The wire used for all connections to the medium and heavy duty terminal blocks, except the RS485 port, should have a minimum voltage rating of 300Vrms.

It is recommended that the auxiliary supply wiring should be protected by a 16A high rupture capacity (HRC) fuse of type NIT or TIA. For safety reasons, current transformer circuits must never be fused. Other circuits should be appropriately fused to protect the wire used.

6.2 RS485 port

Connections to the RS485 port are made using ring terminals. It is recommended that a 2 core screened cable is used with a maximum total length of 1000m or 200nF total cable capacitance. A typical cable specification would be:

- Each core: 16/0.2mm copper conductors
 PVC insulated
- Nominal conductor area: 0.5mm² per core
- Screen (SCN): Overall braid, PVC sheathed

6.3 IRIG-B connections

The IRIG-B input and BNC connector have a characteristic impedance of 50Ω . It is recommended that connections between the IRIG-B equipment and the relay are made using coaxial cable of type RG59LSF with a halogen free, fire retardant sheath.

6.4 RS232 port

Short term connections to the RS232 port, located behind the bottom access cover, can be made using a screened multi-core communication cable up to 15m long, or a total capacitance of 2500pF. The cable should be terminated at the relay end with a 9-way, metal shelled, D-type male plug.

6.5 Optical fiber connectors (when applicable)

WARNING ABOUT LASER RAYS: Where fibre optic communication devices are fitted, never look into the end of a fiber optic due to the risk of causing serious damage to the eye. Optical power meters should be used to determine the operation or signal level of the device. Non-observance of this rule could possibly result in personal injury.

If electrical to optical converters are used, they must have management of character idle state capability (for when the fibre optic cable interface is "Light off").

Specific care should be taken with the bend radius of the fibres, and the use of optical shunts is not recommended as these can degrade the transmission path over time.

The relay uses 1300nm multi mode 100BaseFx and BFOC 2.5 - (ST)[®] connectors (one Tx – optical emitter, one Rx – optical receiver).

6.6 Download/monitor port

Short term connections to the download/monitor port, located behind the bottom access cover, can be made using a screened 25-core communication cable up to 4m long. The cable should be terminated at the relay end with a 25-way, metal shelled, D-type male plug.

6.7 Earth connection

Every relay must be connected to the local earth bar using the M4 earth studs in the bottom left hand corner of the relay case. The minimum recommended wire size is 2.5mm^2 and should have a ring terminal at the relay end. Due to the limitations of the ring terminal, the maximum wire size that can be used for any of the medium or heavy duty terminals is 6.0mm^2 per wire. If a greater cross-sectional area is required, two parallel connected wires, each terminated in a separate ring terminal at the relay, or a metal earth bar could be used.

Note: To prevent any possibility of electrolytic action between brass or copper earth conductors and the rear panel of the relay, precautions should be taken to isolate them from one another. This could be achieved in a number of ways, including placing a nickel-plated or insulating washer between the conductor and the relay case, or using tinned ring terminals.



Before carrying out any work on the equipment, the user should be familiar with the contents of the safety section/safety guide SFTY/4LM/E11 or later issue, the technical data section and the ratings on the equipment rating label.”

7. MiCOM P849

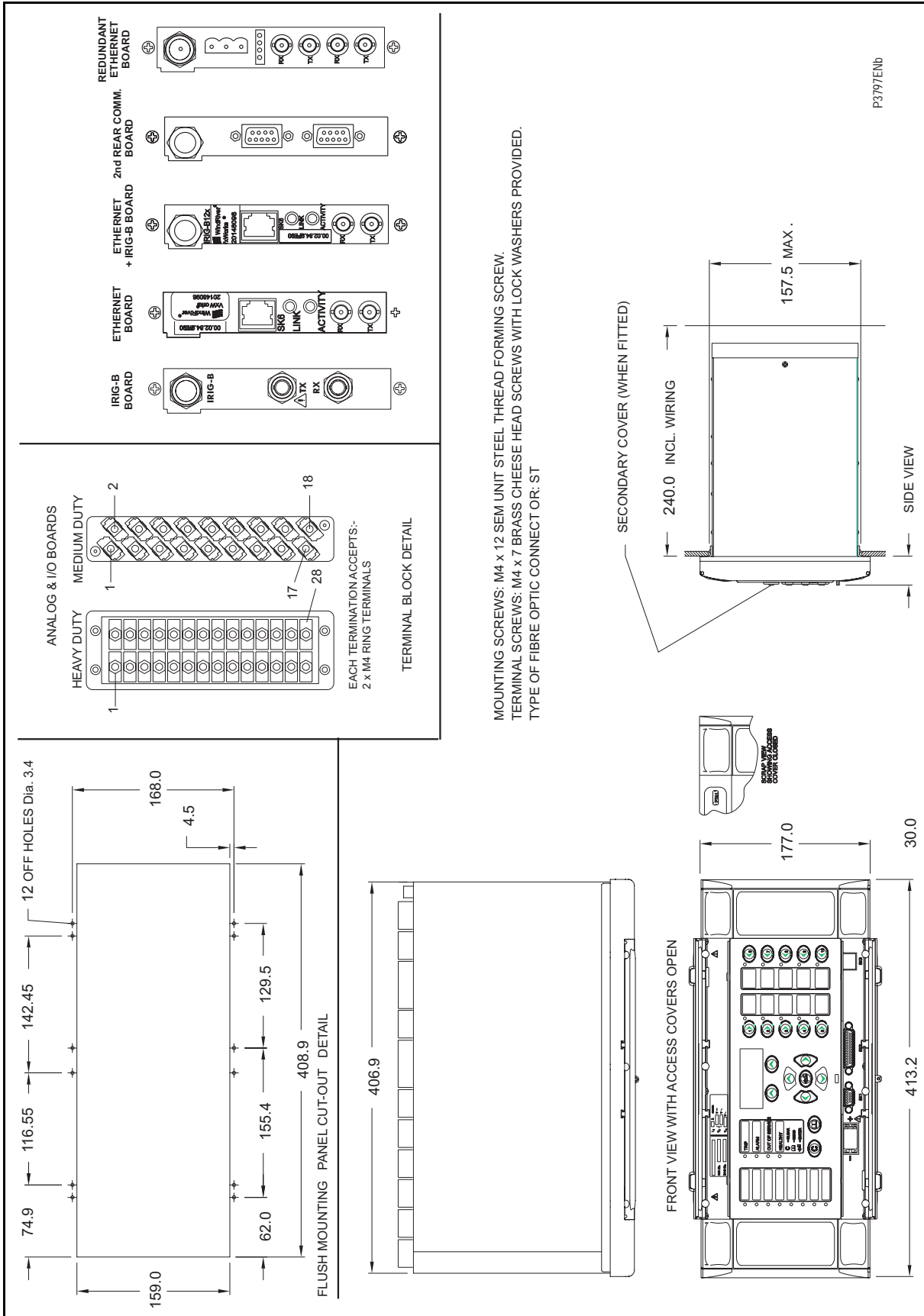
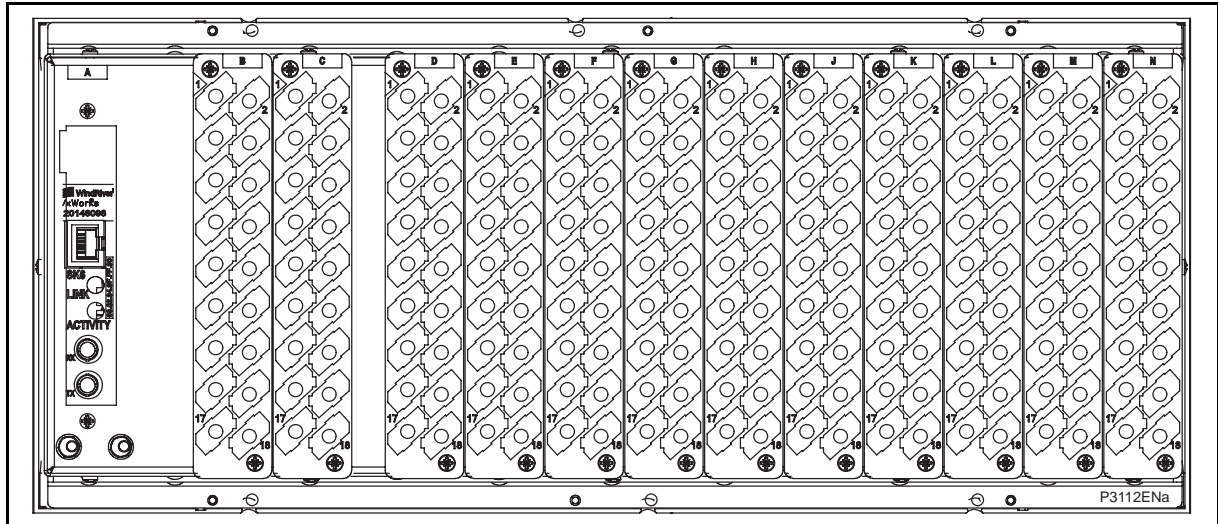


FIGURE 3: MiCOM P849 (80TE) – HARDWARE DESCRIPTION



- A – IRIG B / Ethernet / COMMS ⁽¹⁾
- B – Opto input board ⁽²⁾
- C – Opto input board ⁽²⁾
- D – Opto input board ⁽²⁾
- E – Relay \ Opto ⁽²⁾
- F – Relay \ Opto ⁽²⁾
- G – Relay \ Opto \ High Break ⁽²⁾
- H – Relay \ Opto \ high break ⁽²⁾
- J – Relay \ Opto \ high break ⁽²⁾
- K – Relay \ Opto \ high break ⁽²⁾
- L – Relay board ⁽²⁾
- M – Relay board ⁽²⁾
- N – Power supply board

FIGURE 4: MiCOM P849 (80TE) – REAR VIEW

⁽¹⁾ Hardware options:

- Standard version P849xx1
- IRIG-B Only (Modulated) P849xx2
- Single Ethernet 100Mbit/s fibre optic port P849xx6
- Second Rear Comms (Courier EIA232 / EIA485 / KBUS) P849xx7
- Second Rear Comms (Courier EIA232 / EIA485 / KBUS) + IRIG-B modulated P849xx8
- Single Ethernet (100Mbit/s) plus IRIG-B (Modulated) P849xxA
- Single Ethernet (100Mbit/s) plus IRIG-B (De-modulated) P849xxB
- IRIG-B (De-modulated) P849xxC
- InterMiCOM + Courier Rear Port P849xxE
- InterMiCOM + Courier Rear Port + IRIG-B modulated P849xxF
- Redundant Ethernet Self-Healing Ring, 2 multi-mode fibre ports + Modulated IRIG-B P849xxG
- Redundant Ethernet Self-Healing Ring, 2 multi-mode fibre ports + Un-modulated IRIG-B P849xxH
- Redundant Ethernet RSTP, 2 multi-mode fibre ports + Modulated IRIG-B P849xxJ
- Redundant Ethernet RSTP, 2 multi-mode fibre ports + Un-modulated IRIG-B P849xxK
- Redundant Ethernet Dual-Homing Star, 2 multi-mode fibre ports + Modulated IRIG-B P849xxL
- Redundant Ethernet Dual-Homing Star, 2 multi-mode fibre ports + Un-modulated IRIG-B P849xxM

⁽²⁾ Models:

- P849xxxA – (32 Opto-inputs, 16 output relays)
- B: empty
- C: Opto input board (2071960A22)
- D: Opto input board (2071960A22)
- E: Opto input board (2071960A22)
- F: Opto input board (2071960A22)
- G: empty
- H: empty
- J: empty
- K: empty
- L: Relay board (8 relays – 2071962A01)
- M: Relay board (8 relays – 2071962A01)

- P849xxxB – (32 Opto-inputs, 16 output relays)
 - B: empty
 - C: Opto input board (2071960A22)
 - D: Opto input board (2071960A22)
 - E: Opto input board (2071960A22)
 - F: Opto input board (2071960A22)
 - G: Opto input board (2071960A22)
 - H: Opto input board (2071960A22)
 - J: empty
 - K: Relay board (8 relays – 2071962A01)
 - L: Relay board (8 relays – 2071962A01)
 - M: Relay board (8 relays – 2071962A01)

- P849xxxC – (32 Opto-inputs, 30 output relays (16 high break relays))
 - B: Opto input board (2071960A22)
 - C: Opto input board (2071960A22)
 - D: Opto input board (2071960A22)
 - E: Opto input board (2071960A22)
 - F: empty
 - G: High break relay board (ZN0042-001)
 - H: High break relay board (ZN0042-001)
 - J: High break relay board (ZN0042-001)
 - K: High break relay board (ZN0042-001)
 - L: Relay board (7 relays – ZN0031-001)
 - M: Relay board (7 relays – ZN0031-001)

- P849xxxD – (16 Opto-inputs, 60 output relays)
 - B: empty
 - C: Opto input board (2071960A22)
 - D: Opto input board (2071960A22)
 - E: Relay board (7 relays – ZN0031-001)
 - F: Relay board (7 relays – ZN0031-001)
 - G: Relay board (7 relays – ZN0031-001)
 - H: Relay board (7 relays – ZN0031-001)
 - J: Relay board (8 relays – 2071962A01)
 - K: Relay board (8 relays – 2071962A01)
 - L: Relay board (8 relays – 2071962A01)
 - M: Relay board (8 relays – 2071962A01)

- P849xxxE – (32 Opto-inputs, 16 output relays)
 - B: empty
 - C: Opto input board (2071960A22)
 - D: Opto input board (2071960A22)
 - E: Opto input board (2071960A22)
 - F: Opto input board (2071960A22)
 - G: Opto input board (2071960A22)
 - H: Opto input board (2071960A22)
 - J: Opto input board (2071960A22)
 - K: Opto input board (2071960A22)
 - L: Relay board (8 relays – 2071962A01)
 - M: Relay board (8 relays – 2071962A01)

- P849xxxF – (32 Opto-inputs, 16 output relays)
 - B: empty
 - C: Opto input board (2071960A22)
 - D: Opto input board (2071960A22)
 - E: Opto input board (2071960A22)
 - F: Opto input board (2071960A22)
 - G: Relay board (8 relays – 2071962A01)
 - H: Relay board (8 relays – 2071962A01)
 - J: Relay board (8 relays – 2071962A01)
 - K: Relay board (8 relays – 2071962A01)
 - L: Relay board (7 relays – ZN0031-001)
 - M: Relay board (7 relays – ZN0031-001)

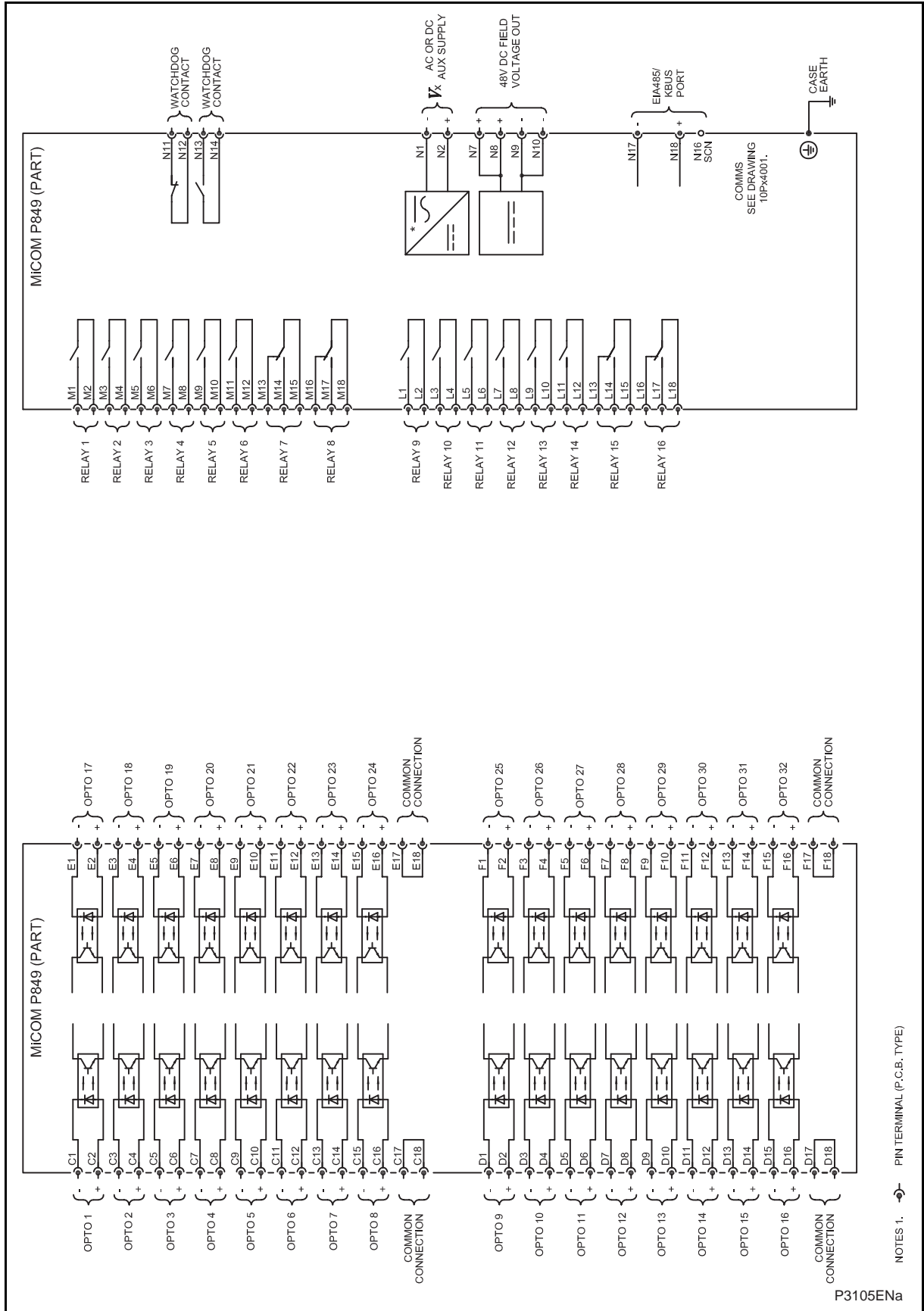


FIGURE 5: MiCOM P849 – CONNECTION DIAGRAM FOR MiCOM P849xxxA (connection diagram n° P84901)

P3105ENa



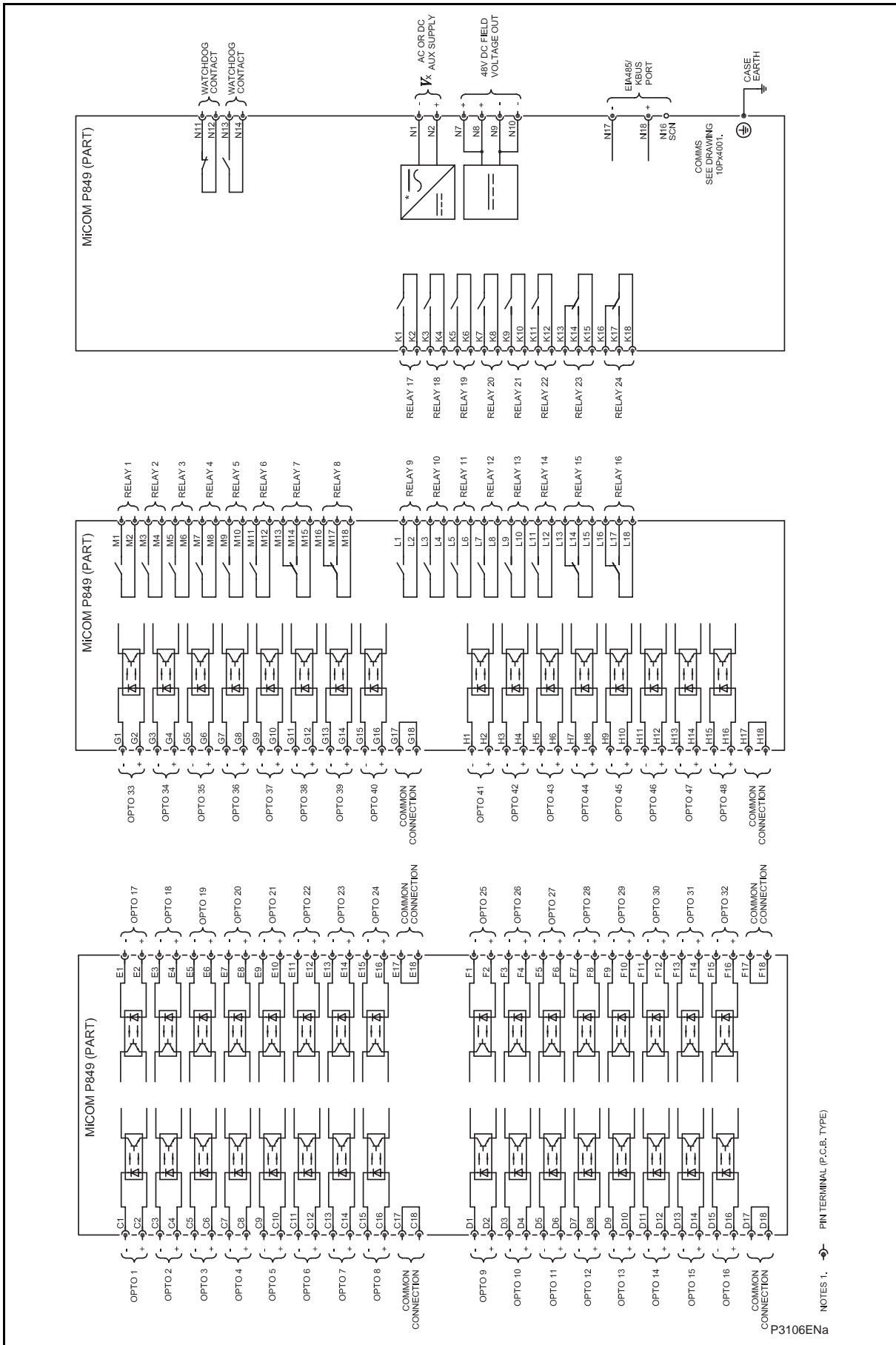
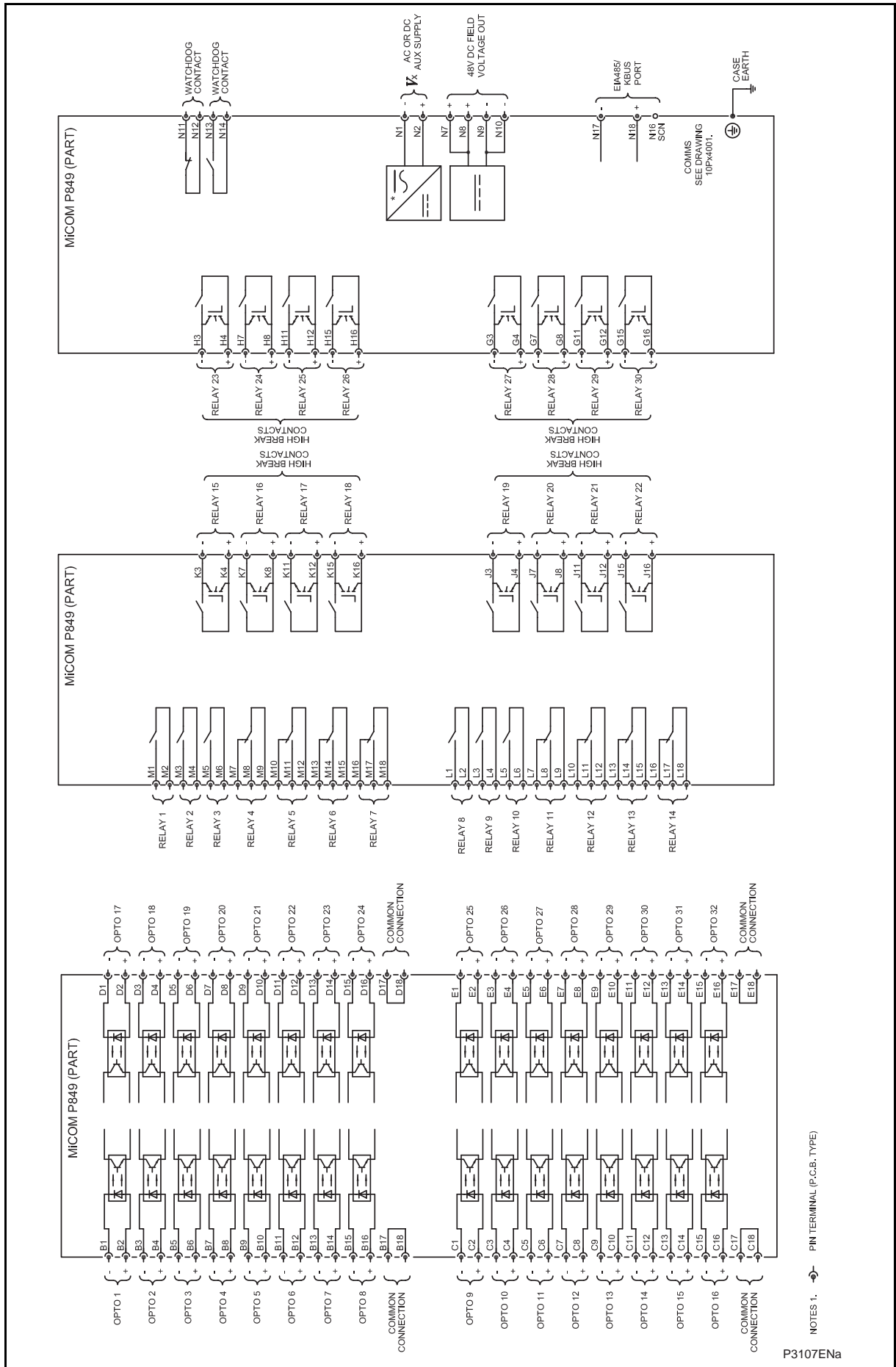


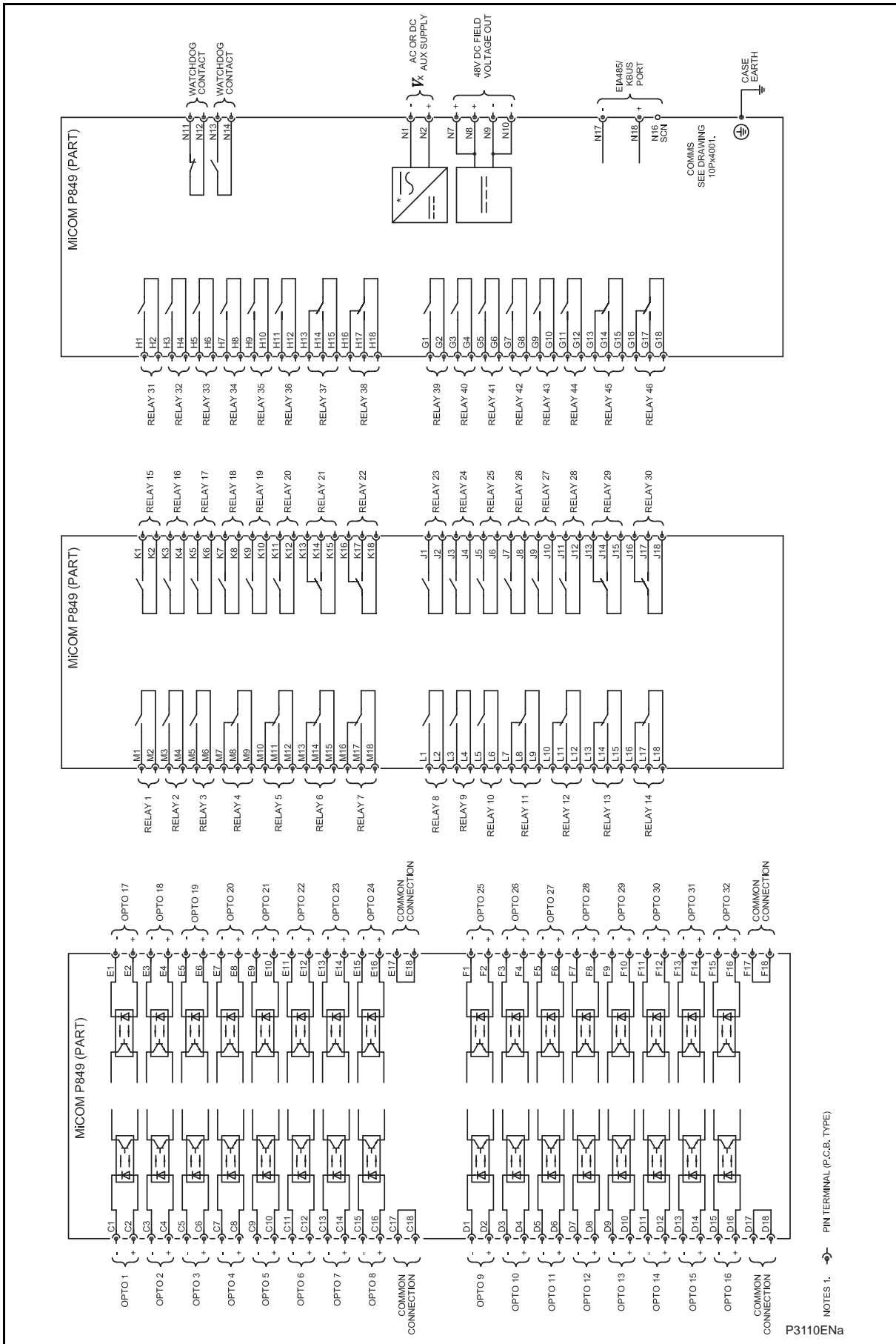
FIGURE 6: MiCOM P849 – CONNECTION DIAGRAM FOR MiCOM P849xxxB (connection diagram n° P84902)



P3107ENa

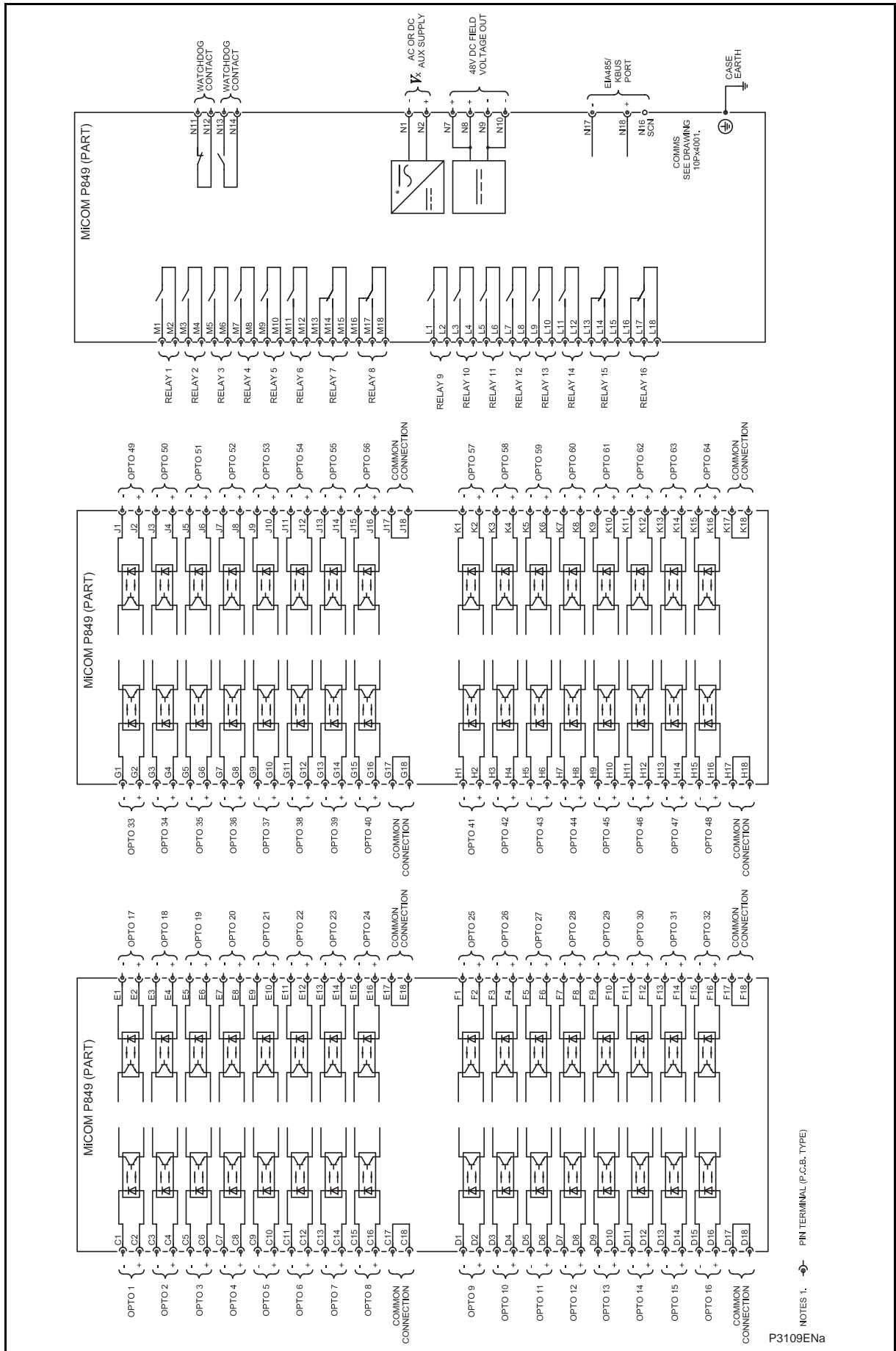
FIGURE 7: MiCOM P849 – CONNECTION DIAGRAM FOR MiCOM P849xxxC (connection diagram n° P84903)





P3110ENa

FIGURE 8: MiCOM P849 – CONNECTION DIAGRAM FOR MiCOM P849xxxD (connection diagram n° P84904)



NOTES 1. → PIN TERMINAL (P.C.B. TYPE)
P3109ENa

FIGURE 9: MiCOM P849 – CONNECTION DIAGRAM FOR MiCOM P849xxxE (connection diagram n° P84905)



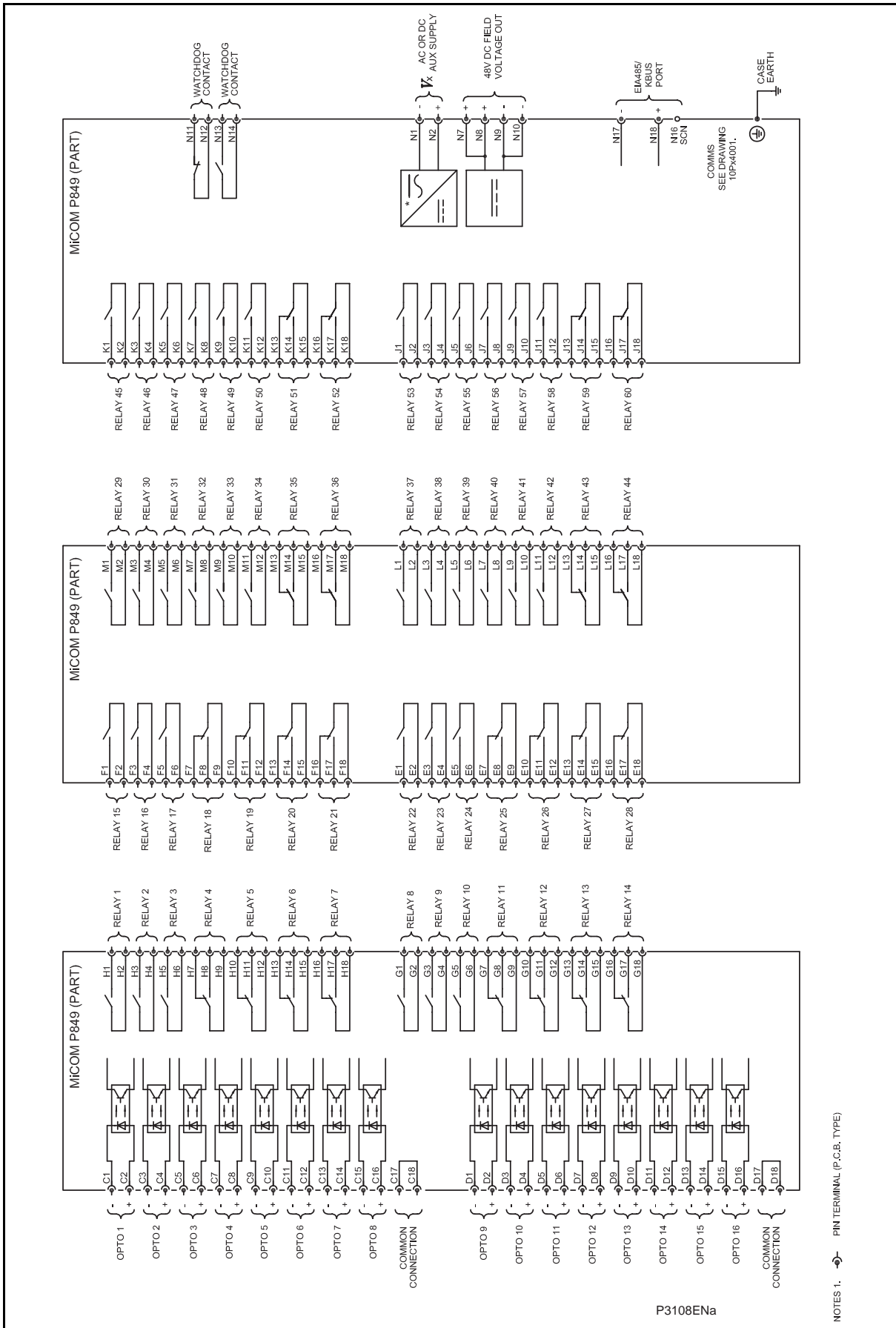


FIGURE 10: MiCOM P849 – CONNECTION DIAGRAM FOR MiCOM P849xxxF (connection diagram n° P84906)

8. COMMUNICATION OPTIONS

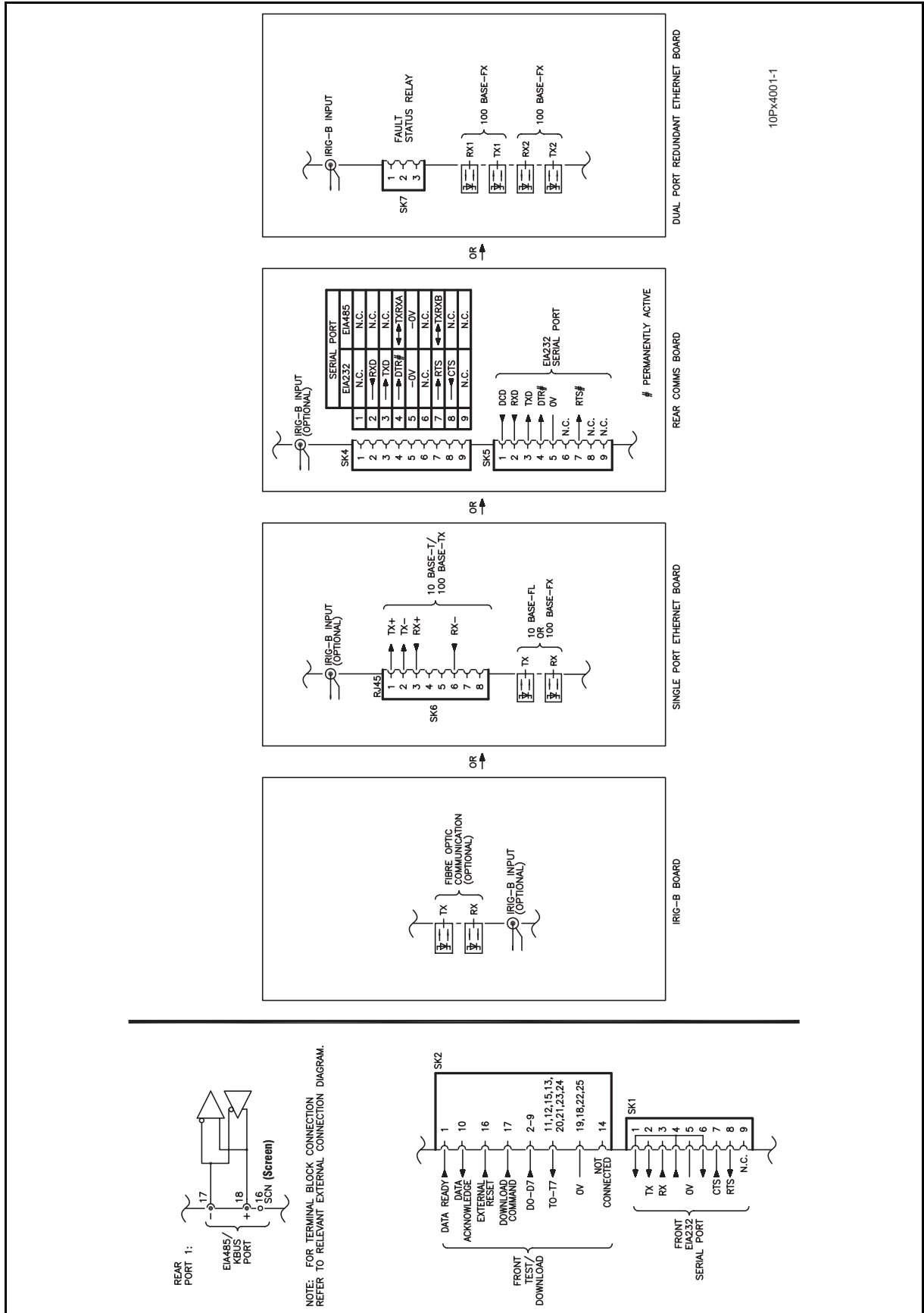


FIGURE 11: MiCOM P849 (80TE) – COMMUNICATION OPTIONS



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FIRMWARE AND SERVICE MANUAL VERSION HISTORY

Date:	2012
Hardware Suffix:	K
Software Version:	A0
Connection Diagrams:	10P849xx (xx = 01 to 06)

Relay type: MiCOM P849 ...						
Software Version		Hardware Suffix	Original Date of Issue	Description of Changes	S1 Compatibility	Technical Documentation
Major	Minor					
A0		K	Jan 2012	<ul style="list-style-type: none"> ✓ Original Issue ✓ First release to production 	V3.4	P849/EN xx/A11
A0		K	Sept 2012	<ul style="list-style-type: none"> ✓ New Assembly power supplies: 2071964A01, 2071964A02 and 2071964A03 ✓ New opto input board: 2071960A22 ✓ New Output relay boards: (2071966A01, 2071966A01) 	V3.4	P849/EN xx/B12



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Publication: P849/EN M/B12

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