MiCOM P111

Overcurrent Relay

P111/EN M/D11

Software Version 7D
Hardware Suffix AD

Technical Manual

Schneider Electric

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

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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 mm^2 (3.3 mm^2 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 µs, 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 IEC 60255-27:2005 EN 60255-27: 2006	Compliance is demonstrated by reference to safety standards.

IT

INTRODUCTION

Date:	**5th December 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

IT

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FIGURES

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1. MiCOM DOCUMENTATION STRUCTURE

The manual provides a functional and technical description of the MiCOM protection relay and a comprehensive set of instructions for the relay's use and application.

The section contents are summarized below:

P111/EN IT Introduction

A guide to the MiCOM range of relays and the documentation structure. Also a general functional overview of the relay and brief application summary is given.

P111/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.

P111/EN GS Getting Started

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

P111/EN ST Settings

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

P111/EN OP Operation

A comprehensive and detailed functional description of all protection and non-protection functions.

P111/EN AP Application Notes

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

P111/EN MR Measurements and Recording

Detailed description of the relays recording and measurements functions including the configuration of the event and disturbance recorder and measurement functions.

P111/EN CM Commissioning

Instructions on how to commission the relay, comprising checks on the calibration and functionality of the relay.

P111/EN MT Maintenance

A general maintenance policy for the relay is outlined.

P111/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.

P111/EN SC SCADA Communications

This section provides an overview regarding the SCADA communication interfaces of the relay. 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.

P111/EN SG Symbols and Glossary

List of common technical abbreviations found within the product documentation.

P111/EN IN Installation

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

P111/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 behavior of the power system using disturbance and fault records. They can also provide measurements of the system at regular intervals to a control center 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

The scope of P111 applications covers:

- industry and MV distribution networks;
- back-up protection in MV applications;
- LV applications.

The relay protects one, two or three-phase applications against earth fault and phase-to-phase short-circuit faults. It can control a circuit-breaker or contactor. Thanks to an implemented communication port, it can exchange information with a supervisory system in terms of measurements, relay state, switches control, etc.

3.1 Key for the manual

There are five hardware versions of P111 (look at ordering options). Model ‘A’ is a standard version. Inputs in this model are not marked as an option (Fig. 8). Model ‘B’ has additional earth-fault current input Io and communication port RS485. Model ‘F’ version, apart from ‘B’ features, has additional binary inputs V1, V2, and output relays P3, P4. Model ‘E’ has the some number of inputs/outputs but has increased measuring range and event record with time tag. Depending on a model chosen, there are different options for the relay configuration.

Therefore, the following key for the relay description was adopted in this manual: if no reference is made when describing a specific feature of the relay, then this feature is available for all relay versions; if (BE)* or (E)* references are used, then the described feature is available in models: B and E or E model only respectively.

See the commercial publication for further information on the product features and application arrangements.

3.2 Functional overview

The P111 feeder management relay contains a wide variety of protection functions. The protection features are summarized below:

PROTECTION FUNCTIONS OVERVIEW		Available in Model
50/51	Three overcurrent non-directional measuring stages are provided for each phase. Stages 1 and 2 may be set Inverse Definite Minimum Time (IDMT) or Definite Time (DT); stages 3 may be set DT only.	L, A, B, E, F
50N/51N	Two overcurrent non-directional measuring stages are provided. Stages 1 and 2 may be set Inverse Definite Minimum Time (IDMT) or Definite Time (DT)	L, B, E, F
38	Input for PTC sensor	A, B, E, F
	External protection (via Binary Inputs)	A, B, E, F
86	Output latching	L, A,B, E, F
	Outputs P1 (NO) and P2 (NO)	L, A, B, E, F
	Outputs P3 (NO) and P4 (C/O)	E, F
	Contact Input S (S1-S2 terminals)	A, B, E, F
	Contact Input T (T1-T2 terminals)	A, B, E, F
	Binary Inputs V1 (V1-C terminals) and V2 (V2-C terminals)	E, F
	Rear communication port (RS485)	L (option), B, E
	CB / contractor control (BI and RS485)	B, E

The P111 supports the following relay management functions in addition to the functions illustrated above.

- Measurement TRUE RMS values
- Circuit breaker control (BI & RS485)
- 2 Alternative setting groups
- Programmable allocation of digital inputs and outputs
- Sequence of event recording (E only)

Application overview

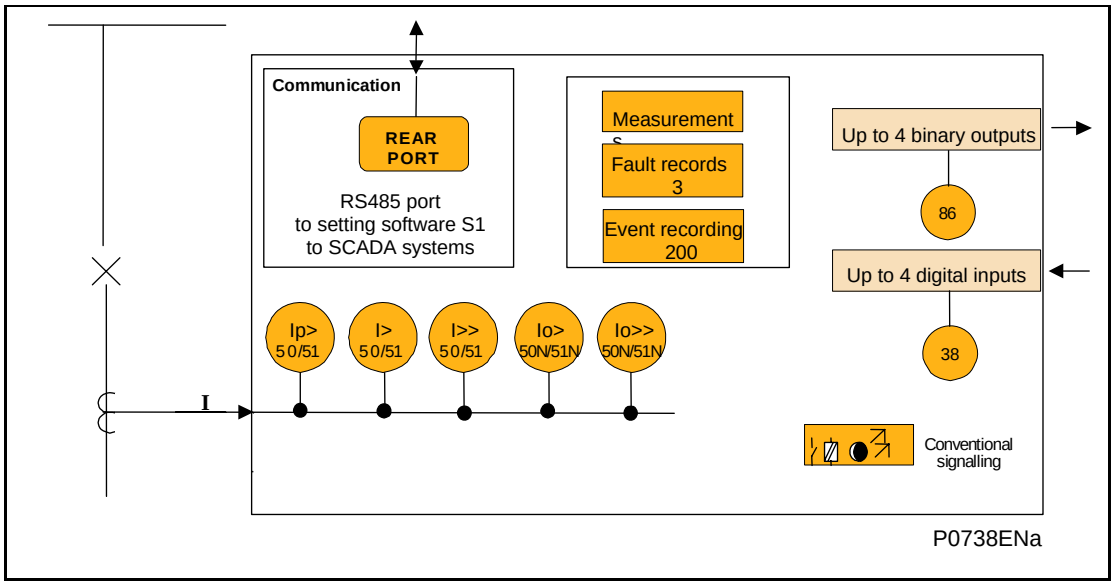

Figure 1: Functional diagram for model E

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3.3 Ordering options

Information Required with Order

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TECHNICAL DATA

Date:	**28th February 2008**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

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Technical Data

Mechanical Specifications

Design
Mounting is either flush mounting, or rail mounted (ordering options).

Enclosure Protection
Per EN 60529: 1991
IP 54 Protection (front panel) against dust and dripping water for the flush mounted model.
IP40 Protection for the front panel on the DIN rail mounted model.
IP 40 Protection for sides of the case.
IP 20 Protection for terminals.

Weight
approx. 0.5 kg

Terminals

AC Current Inputs (flush case only)

Flush mounted case:
Threaded M3 terminals, with wire protection for conductor cross-section
(i) 0.2…6mm^2 single-core
(ii) 0.2…4mm^2 finely stranded

DIN Rail case:
Phase current inputs

The current carrying conductors which pass through the phase CTs must be insulated.

Earth fault input:
Threaded M3 terminals, with wire protection for conductor cross-section
(i) 0.2…4mm^2 single-core
(ii) 0.2…2.5mm^2 finely stranded

General Input/Output Terminals
For power supply, opto and contact inputs, output contacts and COM for rear communications.

Threaded M3 terminals, with wire protection for conductor cross-section
(i) 0.2…4mm^2 single-core
(ii) 0.2…2.5 mm^2 finely stranded

For 'PTC' (T1-T2 terminals) and 'SIn' (S1-S2 terminals) inputs connection the screened cable should be used.

Rear Communications Port
EIA(RS)485 signal levels, two wire
Connections located on general purpose block, M3 screw.

For screened twisted pair cable, multi-drop, 1000m max.
For Modbus RTU protocol.
Isolation to SELV level.

Ratings

AC Measuring Inputs
Phase current
Nominal frequency: 50 to 60 Hz
Operating range: 10 to 250 Hz

Earth fault current
Nominal frequency: 50 to 60 Hz
Operating range:
Model B, E, F: 40 to 70 Hz
Model L: 10 to 250 Hz

AC Current
Nominal current (In): 1 and 5 A (ordering option)

Note: For rail mounting case nominal current In is defined as the maximum value of setting range (there are no terminals for phase current input and no primary wires of internal transformer I/U which have influence on nominal current value and thermal withstand). It is strongly recommended to use proper type of insulation and cross section of current wires to have thermal withstand given below.

Nominal burden per phase: < 0.3 VA at In
Thermal withstand:
continuous 4 In
for 10s: 30 In
for 1s; 100 In (exc. 7391xxxx5xx for Io: 50 In)

Power Supply

Auxiliary Voltage (Vx)
Two ordering options:
(i) Vx: 24 to 48 Vdc
(ii) Vx: 60 to 240 Vdc, and 60 to 240Vac (rms)

Operating Range
(i) 19 to 75V (dc), 19 to 53V (ac)
(ii) 48 to 300V (dc), 48 to 265V (ac)
With a tolerable ac ripple of up to 12% for a dc supply, per IEC 60255-11: 1979.

Nominal Burden

Power Supply:
Without energized outputs:
(i) 1.7W (60…240Vac/dc)
(ii) 2.5W (24…48Vac/dc).
Additions for energized binary inputs/outputs:
Per opto input: 0.03W

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Per energized output relay: 0.3W

For 4 energized output relays and 4 energized inputs: 3W (60-240Vac/dc)

Binary inputs:
Nominal burden for V1-C and V2-C inputs:
(i) for 240VDC: 0.6W

Power-up Time
Time to power up < 1s.

Power Supply Interruption
Per IEC 60255-11: 1979
The relay will withstand a 20ms interruption in the DC auxiliary supply, without de-energizing.
Per EN 61000-4-11: 1997
The relay will withstand a 20ms interruption in an AC auxiliary supply, without de-energizing.

Digital ("Opto") Inputs

Universal opto inputs: V1-C and V2-C.
May be energized from the external battery supply.
Rated nominal voltage: the same like Vx
Operating range: the same like Vx
Withstand: 300Vdc.
Nominal pick-up and reset thresholds:
(i) for DC:
Pick-up: approx. 50% minimum value of Auxiliary Voltage Operating Range,
Reset: approx. 45% minimum value of Auxiliary Voltage Operating Range.
(ii) for AC:
Pick-up: approx. 90% minimum value of Auxiliary Voltage Operating Range,
Reset: approx. 45% minimum value of Auxiliary Voltage Operating Range.

Recognition time: <20ms.

Universal opto inputs: S1-S2 and T1-T2, energized by shorting terminals
Note: It is not allowed to put any voltage on S1-S2 and T1-T2 terminal. It could damage P111.

Output Contacts

Standard Contacts
General purpose relay outputs for signaling, tripping and alarming:
Rated voltage: 250 V
Continuous current: 5 A
Short-duration current: 25 A for 3s
Making capacity: 150A for 30ms
Breaking capacity:
DC: 50W resistive
DC: 25W inductive (L/R = 40ms)
AC: 1250VA resistive (cos ϕ = unity)
AC: 1250VA inductive (cos ϕ = 0.7)
Response to command: < 10ms
Durability:
Loaded contact: 10 000 operations minimum,
Unloaded contact: 100 000 operations minimum.

Environmental Conditions

Ambient Temperature Range
EN 60255-6: 1994
Operating temperature range:
-20°C to +60°C (or -4°F to +140°F).
Storage and transit:
-25°C to +70°C (or -13°F to +158°F).

Ambient Humidity Range
IEC 60068-2-3: 1969:
56 days at 93% relative humidity and +40°C
Per EN 60068-2-30: 2005:
Damp heat cyclic, six (12 + 12) hour cycles, 93% RH, +25 to +55°C

Type Tests

Insulation
IEC 60255-5: 2000
Insulation resistance > 100MΩ at 500Vdc (Using only electronic/brushless insulation tester).

Creepage Distances and Clearances

IEC 60255-27:2005
Pollution degree 2,
Overvoltage category II,
Impulse test voltage 2.5 kV.

High Voltage (Dielectric) Withstand
IEC 60255-5:2000, 2 kV rmsAC, 1 minute:
Between all case terminals connected together, and the case earth simulated by a layer of metal foil surrounding the case.
Also, between all terminals of independent circuits.
1kV rms AC for 1 minute, across open watchdog contacts.
1kV rms AC for 1 minute, across open contacts of changeover output relays.

Impulse Voltage Withstand Test
IEC 60255-5:2000,
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
IEC 60255-22-1: 1988, Class III,
Common-mode test voltage: 2.5 kV,
Differential test voltage: 1.0 kV,
Test duration: 2s, Source impedance: 200Ω

Immunity to Electrostatic Discharge
IEC 60255-22-2: 1996, Class 3,
8kV discharge in air to all communication ports.
6kV point contact discharge to any part of the front of the product.

Electrical Fast Transient or Burst Requirements
EN 60255-22-4: 2002. Test severity Class III and IV:
Amplitude: 2 kV, burst frequency 5kHz (Class III),

Surge Immunity Test
EN60255-22-5:2002; EN 61000-4-5: 1995
Level 3,
Time to half-value: 1.2/50 µs,
Amplitude: 2kV between all groups and case earth,
Amplitude: 1kV between terminals of each group.

Immunity to Radiated Electromagnetic Energy
EN 60255-22-3: 2000, Class III:
Test field strength, frequency band 80 to 1000 MHz:
10 V/m,
Test using AM: 1 kHz / 80%,

Radiated Immunity from Digital Radio Telephones
EN 60255-22-3:2000
10 V/m, 900MHz.

Immunity to Conducted Disturbances Induced by Radio Frequency Fields
EN 61000-4-6: 1996, Level 3,
Disturbing test voltage: 10 V

Power Frequency Magnetic Field Immunity
IEC 61000-4-8: 1994, Level 4,
30A/m applied continuously,
300A/m applied for 3s.

Conducted Emissions
EN60255-25:2000:
0.15 - 0.5MHz, 79dBµV (quasi peak) 66dBµV (average)
0.5 - 30MHz, 73dBµV (quasi peak) 60dBµV (average).

Radiated Emissions
EN60255-25:2000
30 - 230MHz, 40dBµV/m at 10m measurement distance
230 - 1GHz, 47dBµV/m at 10m measurement distance.

EU Directives

EMC Compliance
89/336/EEC:
Compliance to the European Commission Directive on EMC is claimed via the Technical Construction File route. Product Specific Standards were used to establish conformity:
EN50263: 2000

Product Safety
73/23/EEC:
Compliance with European Commission Low Voltage Directive.
Compliance is demonstrated by reference to generic safety standards:

EN60255-27:2005

Mechanical Robustness

Vibration Test
EC 60255-21-1: 1995
Response Class 1
Endurance Class 1

Shock and Bump
EN 60255-21-2: 1995
Shock response Class 1
Shock withstand Class 1
Bump Class 1

TD

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Protection Functions

Three Phase Overcurrent Protection

Accuracy
Ip>, I>:
Pick-up: ±5%
Drop-off: 0.95 x setting ±5%
Minimum IDMT level:
1.05 x setting ±5%
IDMT shape: ±10% or 100ms whichever is greater *
DT operation: ±2% or 100ms, whichever is greater
DT reset: ±10%
I>>:
Pick-up: ±10%
Drop-off: 0.95 x setting ±5%
DT operation: ±2% or 100ms, whichever is greater
DT reset: ±10%
Instant operating time: <80ms

** Reference conditions TMS = 1, TD = 1 and I> setting of 1In operating range 0.5-30In*

Earth Fault Protection

Earth Fault Io> and Io>>
Pick-up: Setting ±10%
Drop-off: 1.05 x Setting ±5%
Trip level: 0.95 x Setting ±5%
IDMT shape:
±10% or 100ms whichever is greater *
DT operation:
±2% or 100ms whichever is greater (for current greater than 2 x Setting)
DT reset: ±10%
Repeatability: 2.5%
Instant operating time: <80ms

** Reference conditions TMS = 1, TD = 1 and IN> setting of 1A operating range 0.1-10In*

Measurements and Recording Facilities

Measurements
Phase current
Current: 0.1… 3In
Accuracy: ±5.0% of reading or 0.05In for In=5A and 0.1In for In=1A, whichever is greater
Earthfault current
Current: 0.1… 1In
Accuracy: ±10.0% of reading

Performance
Year 2000: Compliant
Real time clock accuracy: <±2% seconds/day (Model E only)

Timer Accuracy
Timers: ±2% or 40ms whichever is greater
Reset time: <30ms

Settings, Measurements and Records List

Settings List

Global Settings (System Data)

Setting Group:
Select via Menu
Select via Opto
Active Settings: Group 0/1
Overcurrent: Disabled/Enabled
Earth Fault: Disabled/Enabled

CT Ratios

Phase CT ratio: 1 to 9998; step 1
E/F CT ratio: 1 to 9998; step 1

Communications

Protocol: MODBUS RTU
Physical Link: Copper; RS485 half duplex
Comms. Mode:
Data Bit: 8
Stop bit: 1
Parity: none

Address: 0…255

Baud Rate*:*
1200 bits/s
2400 bits/s
4800 bits/s
9600 bits/s
19200 bits/s
Type of single 2-byte register:
- the most significant byte (MSB) is followed by the last significant byte (LSB)
- the last significant byte (LSB) is followed by the most significant byte (MSB)

Protection Functions

Phase Overcurrent

Stage: I>, Ip>

I>1 Function (toc):
DT (toc 0)
IEC S Inverse (toc 1)
IEC V Inverse (toc 2)
IEC E Inverse (toc 3)

Current Set for DT:
(hardware options)
- 0.40…40.00A (In=1A/5A, typical application 1A)
- 2…200A ((In=1A/5A, typical application 5A)

Current Set for IDMT characteristic [1] :
(hardware option)
- 0.40…4.00A (In=1A/5A, typical application 1A)
- 2.0…20.0A (In=1A/5A, typical application 5A)

[1] limitation to 0.1 x maximum setting range for IDMT, in comparison with DT, is recommended to have up to 10 times dependence of IDMT characteristic.
Note: firmware allows to set IDMT current stage up to maximum setting range for DT (0.4…40A or 2…200A)

Time Delay/TMS: 0.02…99.90
Recommended value of TMS: 0.025…1.200

Status:
Disabled (On 0)
Enabled on trip (On 1)
Enabled on alarm (On 2)

Stage: I>>
I>> Current Set: 0.40…40.00 In

I>> Time Delay: 0.02…99.90

I>> Status:
Disabled (On 0)
Enabled on trip (On 1)
Enabled on alarm (On 2)

Ground Overcurrent (Earth Fault Io> and Io>>)

Stage: Io>, Io>>

Function (toc):
DT (toc 0)
IEC S Inverse (toc 1)
IEC V Inverse (toc 2)
IEC E Inverse (toc 3)

Current Set for DT characteristic:
(hardware option):
- 0.01…1.00 A (In=1A)
- 0.05…5A (In=1…5A, typical application. 5A)
- 0.1…10.00 A (In=1…5A, typical applic. 5A)
- 0.5…40.0A (In=5A, typical application 5A)

flush mounting case only

Current Set for IDMT characteristic [1] :
(hardware option)
- 0.01…0.10 A (Ion=1A/5A, typical applic. 1A)
- 0.05…0.5A (Ion=1A/5A, typical applic. 5A)
- 0.1…1.00 A (Ion=1A/5A, typical applic. 5A)
- 0.5…4.0A (Ion=5A)

flush mounting case only

[1] limitation to 0.1 x maximum setting range for IDMT, in comparison with DT, is recommended to have up to 10 times dependence of IDMT characteristic.
Note: firmware allows to set IDMT current stage up to maximum setting range for DT

Time Delay/TMS: 0.02…99.90
Recommended value of TMS: 0.025…1.200

Status:
Disabled (On 0)
Enabled on trip (On 1)
Enabled on alarm (On 2)

External trip PTC (by binary input)

(not available in model L)
Status:
Disabled (On 0)
Enabled on trip (On 1)
Enabled on alarm (On 2)

External trip ZZ (by binary input)

(not available in model L)
Status:
Disabled (On 0)
Enabled on trip (On 1)
Enabled on alarm (On 2)

TD

Measurements List

Measurements

Iφ RMS

Per phase (φ = A, B, C) RMS current measurements

Io Magnitude

Fault Record Proforma

The following data is recorded for any relevant elements that operated during a fault, and can be viewed in each last 3 fault record.

Time & Date (via RS485 only)

Event Text

Event Value

Phase Overcurrent

Trip Ip>

Trip I>

Trip I>>

Earth Fault

Trip Io>

Trip Io>>

External trip (not available in model L)

PTC

ZZ

Per phase record of the current value during the fault.

Iφ

Io Measured

TD

GS

GETTING STARTED

Date:	**5th December 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

GS

CONTENTS

FIGURES

1. GETTING STARTED

1.1 User interfaces and menu structure

The settings and functions of the MiCOM protection relay can be accessed both from the front panel keypad and LED display, and via rear communication ports. Information on each of these methods is given in this section to describe how to start using the relay.

1.2 Introduction to the relay

1.2.1 Front panel

The front panel of the relay is shown in Figure 1.

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

- a 4 digit LED display
- a 5-key keypad comprising 4 arrow keys (),

  an enter key()
- 6 LEDs; 6 fixed function LEDs (I>>, I>, Ip>, Io>, PTC, ZZ)

1.2.1.1 LED indications

Fixed Function

The 6 fixed function LEDs on the left-hand side of the front panel are used to indicate the following conditions:

I>> - Trip (Red) indicates that the relay has issued a trip signal. It is reset when the associated fault record is cleared from the front display. (Alternatively the trip LED can be configured to be self-resetting)*.

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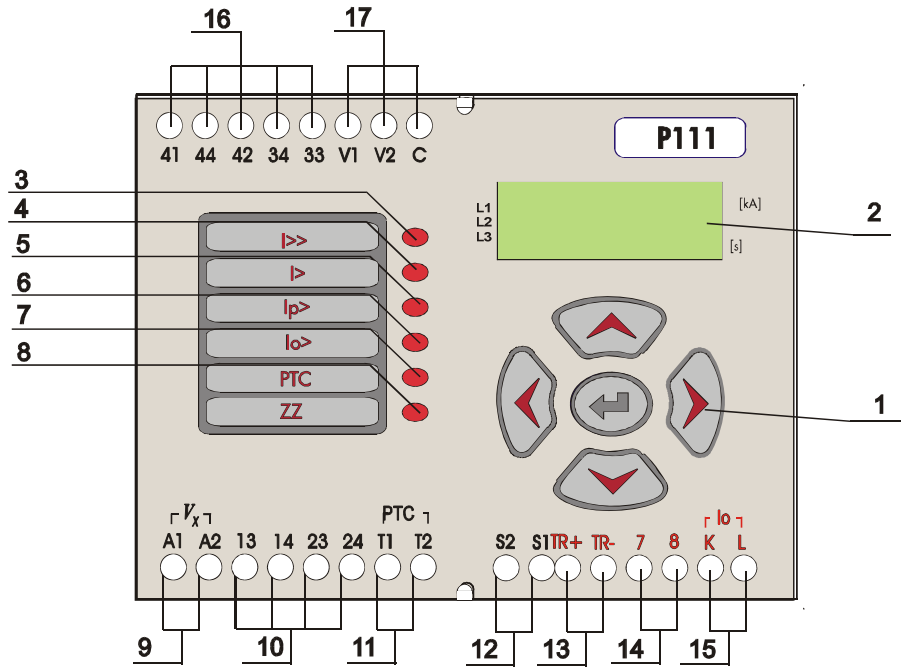

1- keypad,
2- LED display,
3-8- LED indicators:
3- trigger and trip of I>>,
4- trigger and trip of I>,
5- trigger and trip of Ip>,
6- trigger and trip of Io>,
7- excessive temperature of PTC sensors,
8- trip of external protection ZZ

9- auxiliary supply voltage terminals,
10- output relay contacts' terminals:
13- 14- relay P1,
23- 24- relay P2,
11- PTC sensors' terminals **(ABEF)**
12- control input terminals S1-S2 **(ABEF)**
13- RS485 terminals **(LBE)***

14- free,
15- Io input terminals **(LBEF)***
16- output relays' terminals **(EF)***
41- 42- 44- relay P4,
33- 34- relay P3,
17- control input terminals **(EF)***
V1- C and V2-C

P0739ENa

Figure 1: Relay front view for rail mounting case

On the front panel of P111 there are LED indicators : I>>, I>, Ip>, Io>, PTC, ZZ, L1, L2, L3, [kA], [s], as well as a 4 digit display. If a protection is configured to trip and it trips, then a respective LED lights on, and is kept this way until the trip is reset. If a protection is configured to send an alarm signal, then a respective LED lights off when a cause of fault, which triggered a protection, ceases.

LED's I>, I>>, Ip>, Io>:

- flashing LED indicates that the respective protection is triggered
- constant light of LED indicates tripping of the respective protection (triggering period exceeded a set time delay)

Note: If setting of programmable LED 5/LED 4 (d5; SEt1 column) is chosen:
(i) 'd5 0' - LED 4 (Io> LED) represents both Io> and Io>> (factory setting)
(ii) 'd5 1' - LED 4 (Io> LED) represents Io> only,

LED PTC:

- flashing LED indicates that the respective protection is triggered
- constant light of LED indicates tripping of the respective protection (triggering period exceeded a set time delay)

Note: If setting of programmable LED 5/LED 4 (d5; SEt1 column) is chosen:

(i) 'd5 0' – LED 5 (PTC) indicates that the resistance of a circuit connected to terminals T1-T2 has exceeded the PTC trip threshold (factory setting)

(ii) 'd5 1' - LED 5 (PTC) represents Io>> only,

LED ZZ:

- constant light of the LED indicates that an external protection ZZ has tripped.

LED's A (L1), B (L2), C (L3):

- they go on individually to indicate that a respective phase current is just displayed.

LED [kA]:

- LED lights on when current value is displayed in [kA]. If the LED if off, current value is displayed in [A].

LED [s]:

- LED lights on while setting the trip time values of I>, I>>, Ip>, Io>.

Simultaneous flashing of all the LEDs': I>, I>>, Ip>, Io>, PTC, ZZ indicates that the relay is currently in OFF-LINE mode of operation.

If neither LED nor display is on, it indicates that either auxiliary supply voltage is not applied or the device failed.

The default mappings for each of the programmable LEDs are as shown in the following table:

LED Number/disription	Flushing light	constant light
1/I>>	I>> Trigger	I>> Trip
2/I>	I> Trigger	I> Trip
3/Ip>	Ip> Trigger	Ip> Trip
4/Io>	Setting ‘d5’: - ‘0’: Io> or Io>> Trigger (factory set) - ‘1’: Io> Trigger	Setting ‘d5’: - ‘0’: Io> or Io>> Trip (factory setting) - ‘1’: Io> Trip
5/PTC	Setting ‘d5’: - ‘0’: PTC function Triggered (factory) - ‘1’: Io>> Triggered	Setting ‘d5’: - ‘0’: PTC function Trip (factory setting) - ‘1’: Io>> Trip
6/ZZ	ZZ function Trigger	ZZ function Trip

1.2.2 Relay rear panel

The rear panel for flush mounting case of the relay is shown in Figure 2. All current signals, digital logic input signals and output contacts are connected at the rear of the relay. Shown at the rear is the twisted pair wiring for the rear EIA(RS)485 communication port.

Figure 2: Relay rear panel for flush mounting case

For rail mounting case terminals are available on the front panel of relays (Figure 1)

Refer to the wiring diagram in the Installation section for complete connection details.

1.3 Relay connection and power-up

Before powering-up the relay, confirm that the relay power supply voltage and nominal ac signal magnitudes are appropriate for your application. The relay serial number, and the relay's current rating, power rating information can be viewed on the rear panel for flush mounting case or right side of rail mounting case. The relay is available in the following auxiliary voltage versions and these are specified in the table below:

Nominal Ranges	Operating dc Range	Operating ac Range
24 to 48 V ac/dc	19 to 75 V	19 to 53 V
60 to 240 V ac/dc	48 to 300 V	48 to 265 V

Please note that the label does not specify the logic input ratings. The P111 relay is fitted with universal opto isolated logic inputs: V1-C and V2-C which have the same nominal range as auxiliary power supply of P111.

Please note that binary inputs: S1-S2 and T1-T2 are energized by shorting terminals (for example by external switch). It is not allowed to connect voltage on terminals S1, S2, S3, S4. It could damage hardware of P111 (look at connection diagram).

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 relay familiarization procedures. Figure 1 and 2 indicates the location of the power supply terminals (A1 – A2) 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 relay has two user interfaces:

- The front panel user interface via the LCD and keypad
- The rear port which supports Modbus RTU protocol

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

	Keypad/ LCD	MODBUS
Display & modification of all settings	•	•
Digital I/O signal status		•
Display/extraction of measurements	•	•
Display/extraction of fault records	•	•
Reset of fault records		•
Clear event & fault records		•
Time synchronization		•
Control commands	•	•

Table 1

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1.5 Menu structure

The relay's menu is arranged in a tabular structure. The settings are arranged so that each column contains related settings, for example all of the Earth fault settings are contained within the same column. As shown in Figure 4, 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.

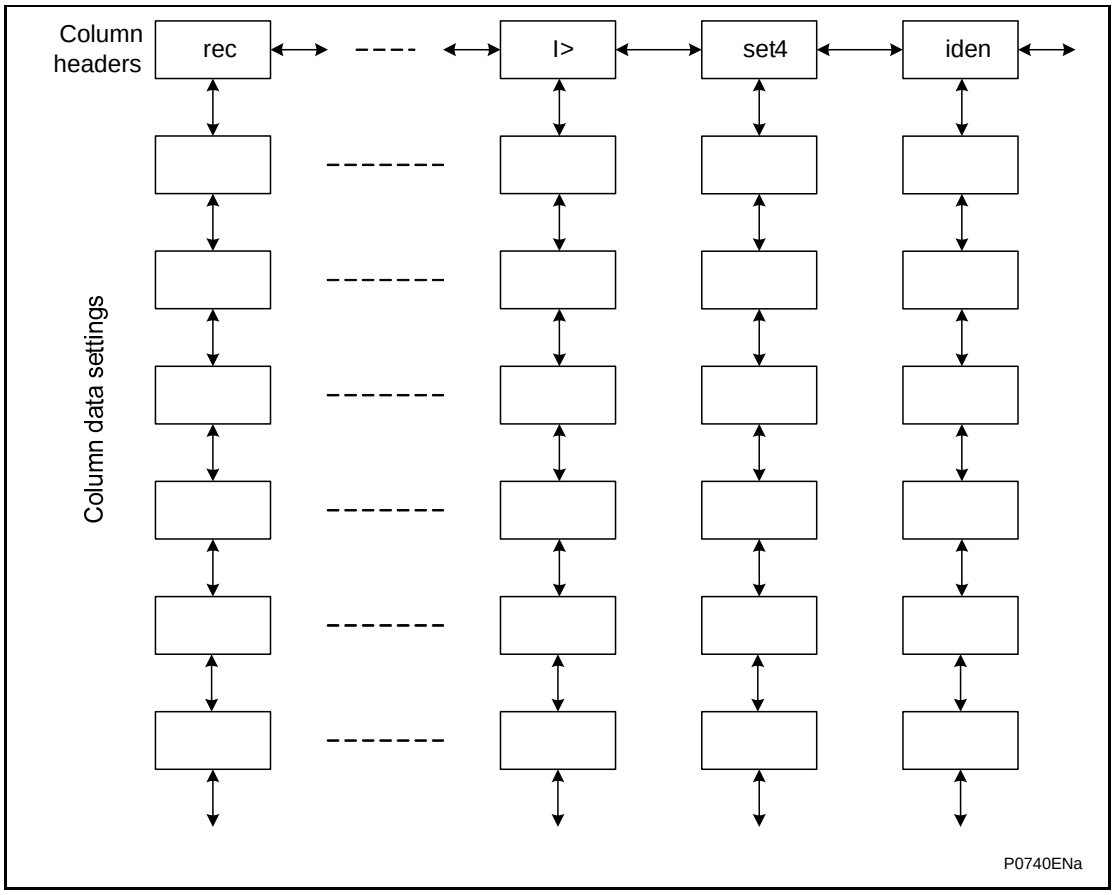


Figure 3: Menu structure

1.6 Password protection

The menu structure contains two level of access. The levels of access are summarized in Table 2.

Access level	Operations enabled
Level 0 No password required	Read access to all settings and fault records
Level 1 Password required	all settings can be changed

Table 2

Notes: - If access to settings and their modifying must be restricted, a three digit password should be set in the device. Then, without the password it is only possible to view the settings, but it is not possible to modify them.

- If the password is lost or forgotten, it is necessary to contact the manufacturer in order to obtain the factory password. In such case, please contact the Customer Care Centre:
http://www.schneider-electric.com/CCC

- If "000" is chosen as a password, it removes protection of the settings.

- Factory setting for the password is “000”.

1.7 Relay configuration

The relay is a multi-function device that supports numerous different protection, control and communication features. On the bottom of each protection column is possible to change protection function from enabled to disable. On the display is shown active setting group only. To configure second setting group, it is necessary to switch relay to second group (via menu or configured BI) or make setting via PC.

1.8 Front panel user interface (keypad and LCD)

When the keypad is exposed it provides full access to the menu options of the relay, with the information displayed on the LED display (Figure 4).

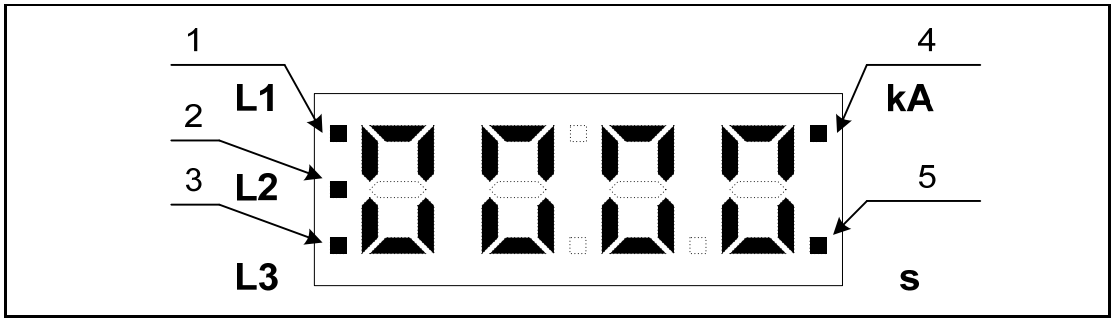


Figure 4: LED display

1 - LED lights on when L1 phase current is displayed

2 - LED lights on when L2 phase current is displayed

3 - LED lights on when L3 phase current is displayed

4 - LED indicates, that a value is displayed in [kA] unit

5 - LED indicates, that a value is displayed in [s] unit

Note: If no LEDs L1, L2, L3 lights on, then Io current is readout.

Fig. 5 shows the relay menu and the way to navigate through it. The information indicated on this figure applies to factory settings of the relay. The dark boxes denote, where a specific setting can be modified.

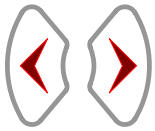
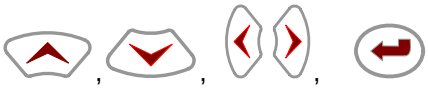
	moves cursor to a next menu item (upwards) or increases a setting value;
	moves cursor to a next menu item (downwards) or decreases a setting value;
	move cursor to a next menu item (left or right) or to a next password digit (left or right);
	enters edit mode / accepts a new setting;

Figure 5: Navigation keys

Note: „Right" and „down" keys, if pressed simultaneously, perform display and LEDs' test, during which all LEDs' and segments of the display illuminate for 3 s.

The  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.

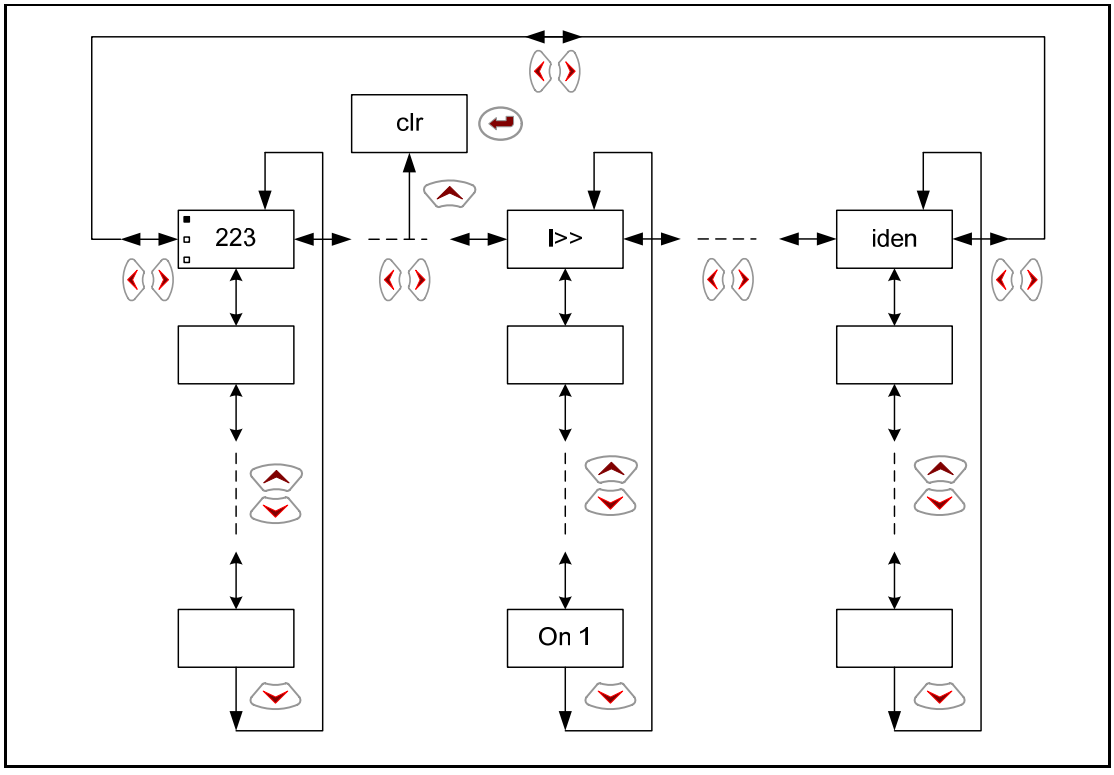


Figure 6: Front panel user interface

1.8.1 Default display and menu time-out

The front panel menu has a default display – actual value of current (in primary) in A (L1) phase. From the default display it is also possible to view the other default display options using the  and  keys. After power on default menu is displayed.

1.8.2 Menu navigation and setting browsing

The menu can be browsed using the four arrow keys, following the structure shown in Figure 6. Thus, starting at the default display the  key will display the first column heading.

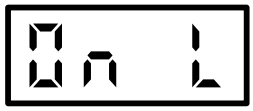
To select the required column heading use the  and  keys. The setting data contained in the column can then be viewed by using the  and  keys. It is possible to return to the column header by holding the  key down. It is only possible to move across columns at the column heading level (by pressing  or ). To return to the default display press the  or  key up to see default display or press the  key up to see  cell and after that press the  key (note that in such way, all latched LEDs and output will be reset).

Password entry

1.8.2.1 Entering a password for the first time (the factory setting is “000”)

Change mode of operation to OFF-LINE:

Note: changing the relay settings are possible in OFF-LINE mode only. When converting the relay operation to OFF-LINE mode, protection tripping states are reset, and latching of all protection features takes place. The relay status is kept that way until it is converted again into ON-LINE mode.

To change the relay mode into OFF-LINE, the menu item  should be selected,  and the key should be pressed. Then the letter "L" starts flashing. Press key  . Now, the menu displays  . Press  . All the LEDs' start flashing, which indicates OFF-LINE mode of operation.

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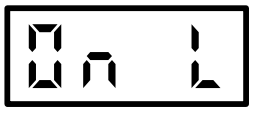
Notes: - Entering edit mode of the setting module will block all the protections, and reset their trip states.

- By pressing  in parallel and after that release in the same time, the jump to  cell will be done. It is hot key for ON-LINE cell jump .

Select the item  and press  .

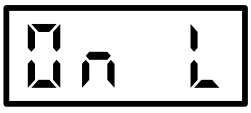
Using the keys  , change the displayed digit to the required value,

Press  to confirm the password.

Change mode of operation to ON-LINE

Once completing the above procedure, the password must be entered in order to modify settings or configuration of the relay.

1.8.2.2 Changing the password

Select the menu item  and press  , which will make the relay switch to menu item  .

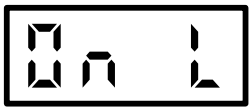
Enter a valid password. After entering the right string of digits press  and change mode of operation to OFF-LINE (see 6.2 b).

Select the menu item  and enter new password.

Change mode of operation to ON-LINE:

After all necessary changes have been done, select menu item  , press  , then  and, again  , in order to return to ON-LINE mode - the LEDs' stop flashing and the relay is activated with new settings.

1.8.2.3 Changing settings or configuration of the password protected device

Every attempt to change mode of operation to OFF-LINE in the password protected device, will automatically switch the menu to the password cell  . A valid password must be entered, and the key  must be pressed. Then the menu will automatically switch back to the cell  . If the entered password is not correct, any further attempt to change a mode of operation will again switch back to the password cell.

1.8.3 Resetting of latched LEDs and outputs

Note 1: If disconnection of the relay from supply voltage Vx or supply voltage interruption takes place after the relay has been tripped by one of its protections, then the relay status is recorded. When the supply voltage is restored, the LED corresponding to the protection tripped lights on, and output relays switch-over to the states from before voltage interruption (depending on the chosen configuration when setting the relay),
that is:

-P1 state is restored, if it is configured to 'protection-contactor' mode;

- P2/P3 states are restored if they are configured to latch on energising

Reset of LEDs': I>>, I>, Ip>, Io>, PTC, ZZ and output relays, which are configured to latch on energising, is only possible if a cause for their energising ceases.

Note 2: If a protection, which is set to alarm signal is activated, a respective LED lights on. If a cause for the alarm ceases, then the LED lights off automatically.

There are several ways of resetting the LEDs', which indicate protections' states set to trip, and relays' states, whose energised states are latched:

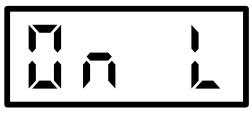
- close terminals S1-S2 for a short instant of time, if the input is assigned to reset function (S1-S2 input set to option '0'); (not available in Model L)

- manual reset from the device keypad.

If key the  is repeatedly pressed, the cell  appears. Then the key  should be pressed;

- remote reset via communication link RS485 (LBCE)*, if reset command is sent in MODBUS RTU protocol

1.8.4 Setting changes



To change the value of a setting, first navigate the menu to display the cell. Change mode of operation to OFF-LINE (see 10.8.3.1). Navigate the menu to display the relevant cell. To change the cell value press the enter key  , which will bring up a flashing digit to be changed. This will only happen if the OFF-LINE mode of operation is set, otherwise there is no any changes. The setting value can then be changed by pressing the  or  keys. When the desired new value has been reached it is confirmed as the new setting value by pressing  key. After that it is required to change mode of operation from OFF-LINE to ON-LINE

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1.9 Front communication port user interface

There are no front communication port. Settings are available by using rear communication port RS485. For local PC connection it is necessary to use RS485/RS232 CONVERTER (RS485 half duplex), available as separate Schneider Electric product (RS485/RS232 Converter ref. no:) or use third party product. This port supports the Modbus RTU according to MODICOM MODBUS protocol specification only. By using RS485/RS232 converter it is possible to make connection like for front port, by using the relay settings program MiCOM S1 that is a Windows 98, Windows NT4.0, Windows 2000 or Windows XP based software package.

1.10 MiCOM S1 relay communications basics

The front port is particularly designed for use with the relay settings program MiCOM S1 that is a Windows 98, Windows NT4.0, Windows 2000 or Windows XP based software package. MiCOM S1 is the universal MiCOM IED Support Software and provides users a direct and convenient access to all stored data in any MiCOM IED using the EIA(RS)232 communication port.

MiCOM S1 provides full access to:

- MiCOM Px10, Px20, Px30, Px40 relays
- MiCOM Mx20 measurements units

1.10.1 PC requirements

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

- IBM computer or 100% compatible,
- WindowsTM 98 or NT 4.0 (Not WindowsTM 95)
- Pentium II 300 Mhz minimum,
- Screen VGA 256 colours minimum,
- Resolution 640 x 400 minimum (1024 x 768 recommended),
- 48Mb RAM minimum,
- 500Mb free on computer hard-disk.

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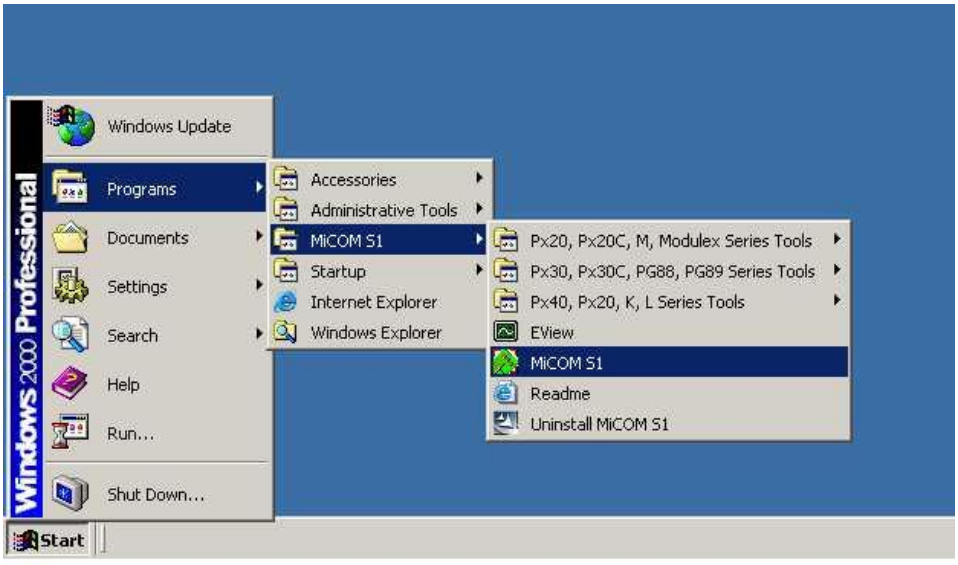
1.10.2 Connecting to the P111 relay using MiCOM S1

Before starting, verify that the RS485/RS232 converter (see point: 10.9) is properly connected to the RS485 port on the terminals of the relay and RS232 on PC. Please follow the instructions in section 1.9 to ensure a proper connection is made between the PC and the relay before attempting to communicate with the relay.

This section is intended as a quick start guide to using MiCOM S1 and assumes you have a copy of MiCOM S1 installed on your PC. Please refer to the MiCOM S1 User Manual for more detailed information.

To start MiCOM S1, click on the icon: 

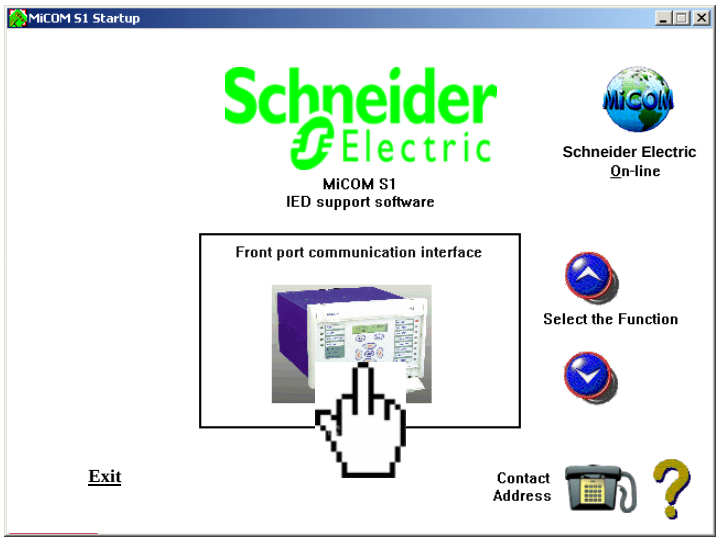
In the "Programs" menu, select "MiCOM S1" then "MiCOM S1 Start-up".



S0013ENb

WARNING: CLICKING ON "UNINSTALL MiCOM S1", WILL UNINSTALL MiCOM S1, AND ALL DATA AND RECORDS USED IN MiCOM S1.

You access the MiCOM S1 launcher screen.



The MiCOM S1 launcher is the software that gives access to the different application programs:

- MiCOM S1 for MiCOM M/Px20 & MiCOM Px10 IEDs
- MiCOM S1 for MiCOM Px30 IEDs
- MiCOM S1 for MiCOM Px40 IEDs
- MiCOM S1 disturbance application

To access these different programs, use the blue arrows, 

Click on the desired type of access

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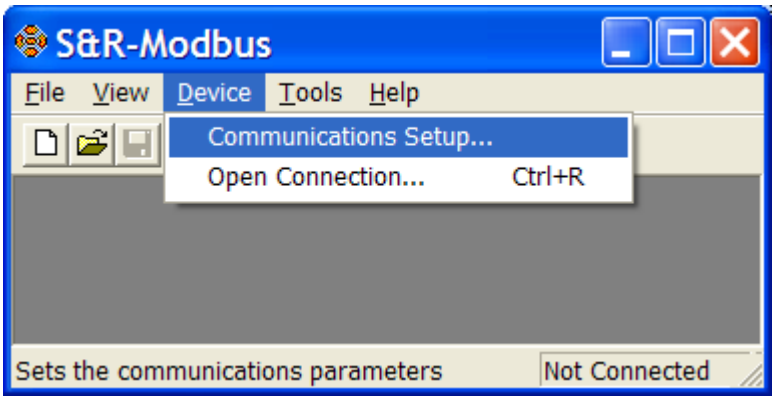
and click on the required MiCOM Px20 series

1.10.3 Open communication link with relay

To open the communications link from S1 to the P111 relay the following procedure must be followed:

First the communication setup must be adjusted if necessary. In the "Device" menu, select "Communications Setup…"



This brings up the following screen:

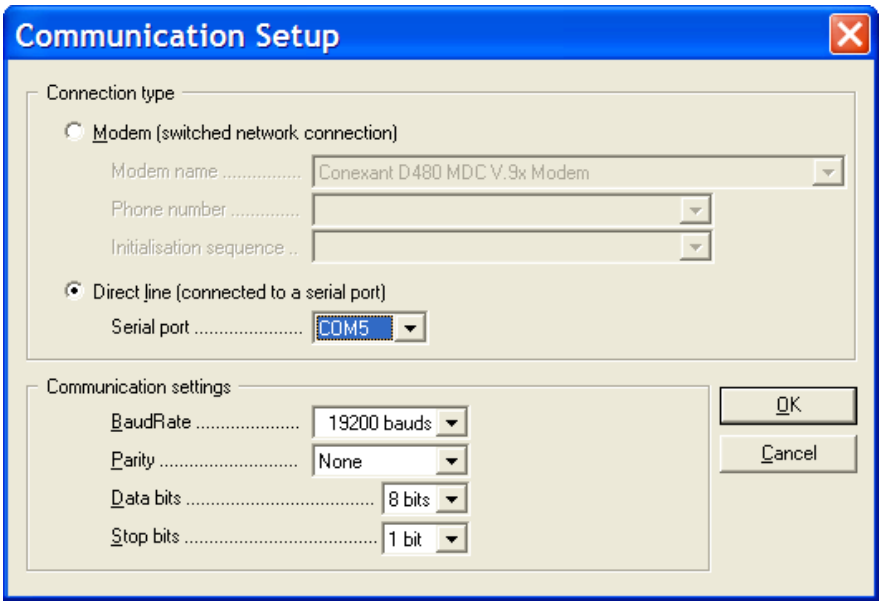


Figure 7: Communication set-up screen

Choose the proper com port (for example COM1)

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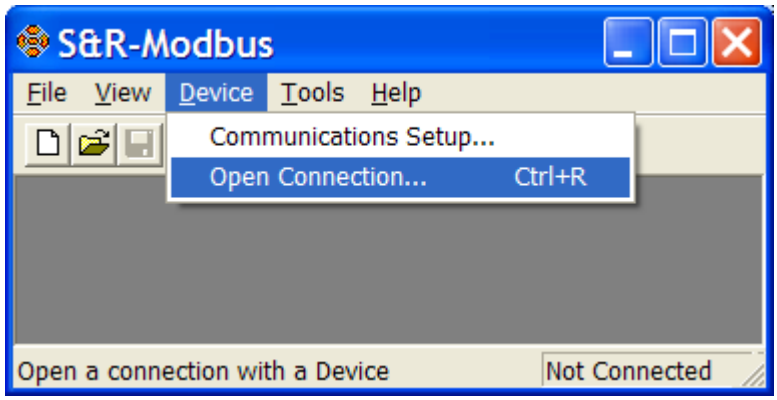
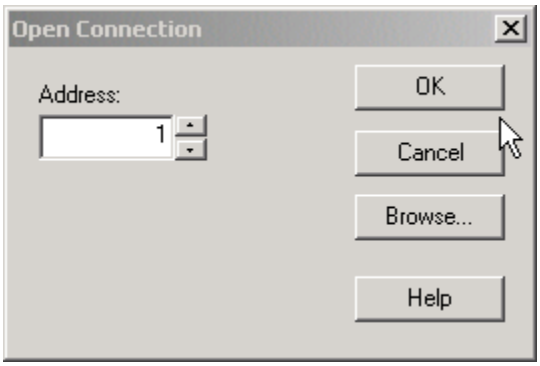
When the communications setup is correct the link with the relay can be initialized. In the "Device" menu, select "Open Connection…"



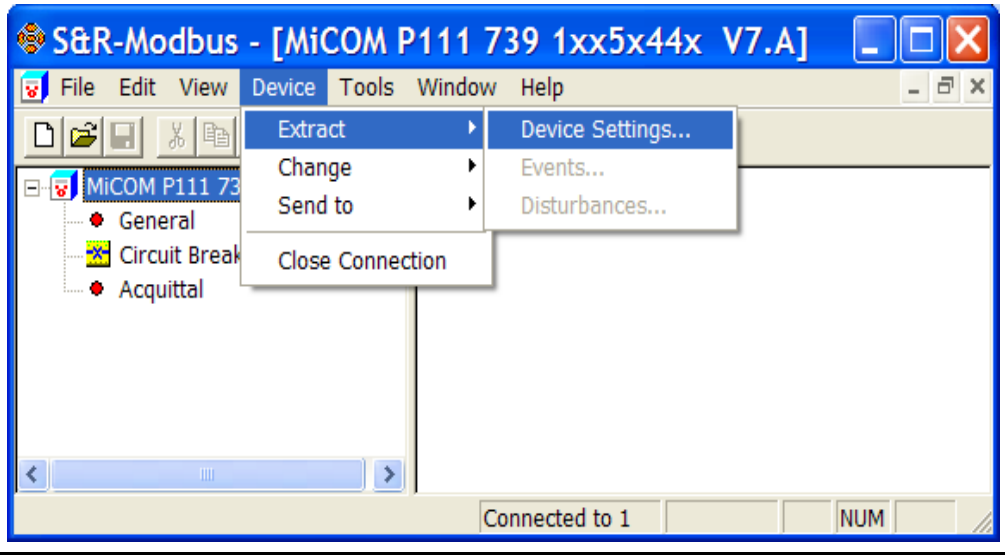
GS

This brings up a prompt for the address of the relay to be interrogated.



When this has been entered a prompt for the password appears.

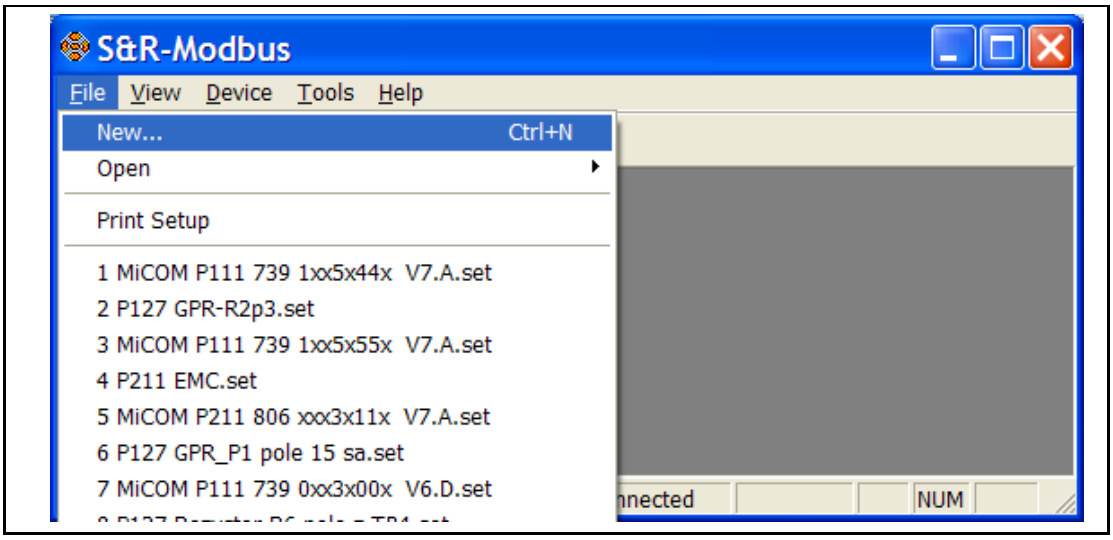
When these have been entered satisfactorily the relay is then able to communicate with MiCOM S1. When a communication link has been established between the PC and a MiCOM IED, both are said to be online. Data and information can be directly transferred from and to the IED using the menu available under the “DEVICE” menu.



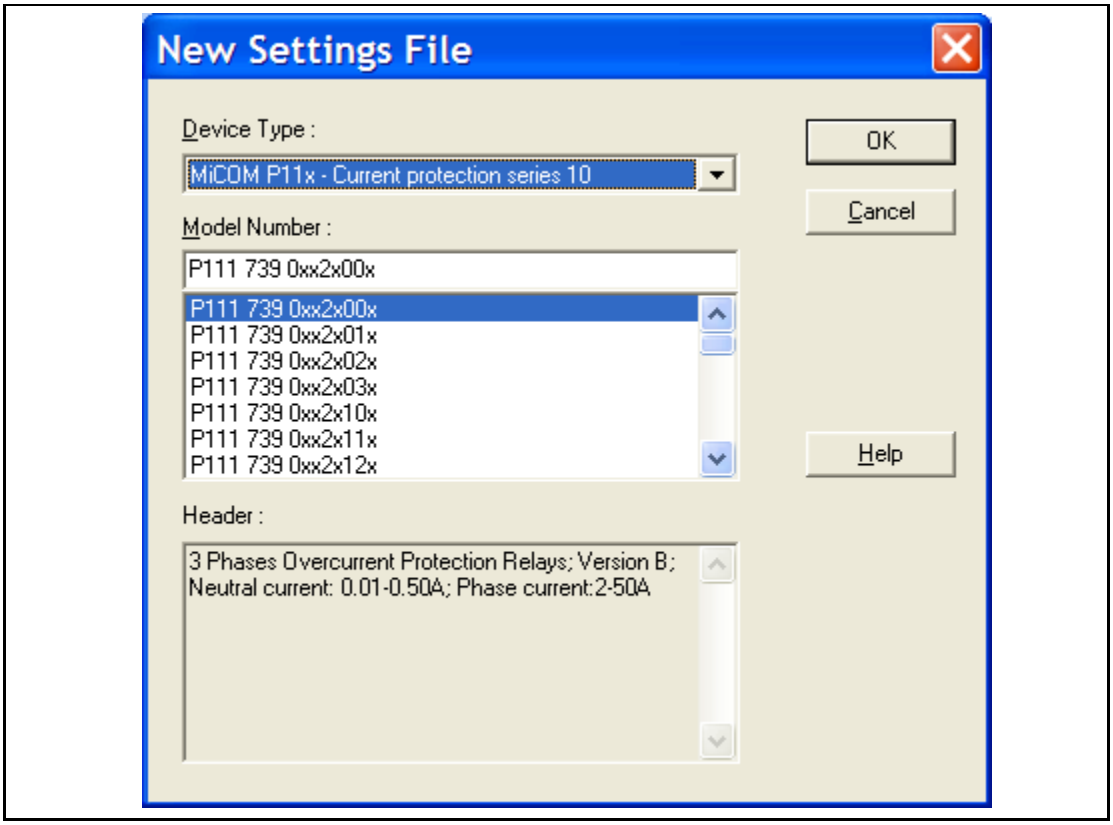
For further instruction on how to extract, download and modify settings files, please refer to the MiCOM S1 User Manual.

1.10.4 Off-line use of MiCOM S1

As well as being used for the on-line editing of settings, MiCOM S1 can also be used as an off-line tool to prepare settings without access to the relay. In order to open a default setting file for modification, in the “File” menu, select “New…”



This brings up a prompt for the relay model type where you can select the correct relay for your application:



Clicking on OK will open the default file and you can start to edit settings. For further instruction on how to extract, download and modify settings files, please refer to the MiCOM S1 User Manual.

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APPENDIX - RELAY MENU MAP (DEFAULT)

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

Fig. 5: Navigating menu

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SETTINGS

Date:	**5th December 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

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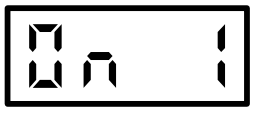
1. SETTINGS

The P111 must be configured to the system and application by means of appropriate settings. The relay is supplied with a factory-set configuration of default settings.

There are five hardware versions of P111. Model 'A' is a basic version. Inputs/outputs in this model are not marked as an option. Model 'B' has additional earth-fault current input Io and communication port RS485. Model 'E', apart from 'B' features, has additional binary inputs V1, V2, and output relays P3, P4 and event record with time tag. Model 'F', apart from 'E' features, has no RS485 (no any communication facilities: local or remote). Depending on a model chosen, there are different options for the relay configuration.

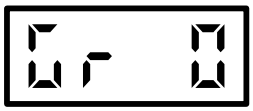
Therefore, the following key for the relay description was adopted in this manual: if no reference is made when describing a specific feature of the relay, then this feature is available for all relay versions; if (BEF)* or (E)* references are used, then the described feature is available in models: B, E and F or only E model respectively

1.1 Relay settings configuration

The relay is a multi-function device that supports numerous different protection, control and communication features To disable/enable a function change the relevant cell on the bottom of proper column (

).

In menu the active setting group is available only. To see or change any parameter of a second group during working on the first group, the best solution is make a setting via MiCOM. If there are no such possibility (changing via keyboard only), it is necessary to change the active group to the second group, change parameters and after that return to the first group again (as active group). Changing of setting group is possible via keyboard, proper configured binary input or RS485 communication. In 

column it is possible to see the active group (

cell; the first setting group is called '0', the second: '1') or change the active group to the second one.

1.2 Protection settings

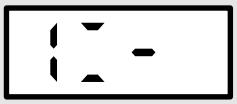
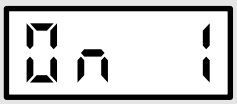
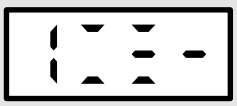
The protection settings include all the following items that become active once enabled in the column of protection function

There are two groups of protection settings ('0' and '1'), with each group containing the same setting cells. One group of protection settings is selected as the active group, and is used by the protection elements. The settings for group 0 is shown on the LED display. The settings are discussed in the same order in which they are displayed in the menu.

1.2.1 Phase overcurrrent protection

The overcurrent protection included in the P111 relay provides three stage (tIp> tI>, tI>>) non-directional three-phase overcurrent protection with independent time delay characteristics. All overcurrent settings apply to all three phases but are independent for each of the four stages.

The first two stages of overcurrent protection (tIp> and tI>) have time-delayed characteristics which are selectable between inverse definite minimum time (IDMT), or definite time (DT). The third stage have definite time characteristics only.

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
I> Function 				
'toc.' – type of time characteristic: 	0 (DT)	0 – DT, 1 - IEC S Inverse, 2 - IEC V Inverse, 3 - IEC E Inverse		
Setting for the tripping characteristic for the first stage overcurrent element.				
I> Current Set  Hardware options: - In =1A - In =5A	1.5 x In	0.4 x In	DT: 40.0 xIn IDMT: 4.0xIn (limitation to 3.0xIn is recommended to have up to 10 times dependence of IDMT characteristic. Firmware allows to set up to 40.0xIn)	0.1 A
Pick-up setting for first stage overcurrent element [A] in secondary value.				
I> Time Delay or TMS (depend on toc setting) 	1.00 s	0.02s	99.90s	0.01s
Setting for the time-delay for the definite time setting if selected for first stage element or time multiplier setting to adjust the operating time of the IEC IDMT characteristic if selected for first stage element				
'On' - Configuration of protection 	1 (trip)	0 – 'disable' – disabled, 1 – 'trip' - enabled to trip, 2 – 'alarm (warning signal)' - enabled to alarm only (no trip)		
Setting to determine the mode of action.				
I>> Function 				
I>> Current Set  Hardware options: - In =1A - In =5A	5 x In	0.4 x In	40.0 xIn	0.1 A
Pick-up setting for second stage overcurrent element [A] in secondary value.				

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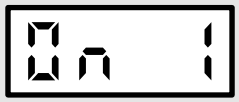
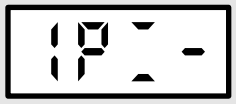
Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
I>> Time Delay 	0.20 s	0.02s	99.90s	0.01s
Setting for the time-delay for the definite time setting				
'On' - Configuration of protection 	1 (trip)	0 – 'disable' – disabled, 1 – 'trip' - enabled to trip, 2 – 'alarm (warning signal)' - enabled to alarm only (no trip)		
Setting to determine the mode of action.				
Ip> Function 				
'toc.' – type of time characteristic: 	0	0 – DT, 1 - IEC S Inverse, 2 - IEC V Inverse, 3 - IEC E Inverse		
Setting for the tripping characteristic for Ip> stage overcurrent element.				
Ip> Current Set  Hardware options: - In =1A - In =5A	1.2 x In	0.4 x In	DT: 40.0 xIn IDMT: 4.0xIn (limitation to 4.0xIn is recommended to have up to 10 times dependence of IDMT characteristic. Firmware allows to set up to 40.0xIn)	0.1 A
Pick-up setting for Ip> stage overcurrent element [A] in secondary value.				
Ip> Time Delay or TMS (depend on toc setting) 	1.00 s	0.02s	99.90s	0.01s
Setting for the time-delay for the definite time setting if selected for Ip> stage element or time multiplier setting to adjust the operating time of the IEC IDMT characteristic if selected for Ip> stage element				
'On' - Configuration of protection 	1 (trip)	0 – 'disable' – disabled, 1 – 'trip' - enabled to trip, 2 – 'alarm (warning signal)' - enabled to alarm only (no trip)		
Setting to determine the mode of action.				

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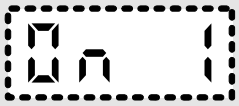
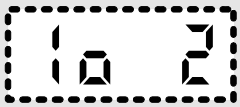
1.2.2 Earth fault

The first and second stages have selectable IDMT or DT characteristics.

The following table shows the relay menu for Earth Fault "Io>" and "Io>>" protection, including the available setting ranges and factory defaults :

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
'Io1' – Io> Function  **(LBEF)***				
'toc.' – type of time characteristic:  **(LBEF)***	0	0 – DT, 1 - IEC S Inverse, 2 - IEC V Inverse, 3 - IEC E Inverse		
Setting for the tripping characteristic for Io> stage overcurrent element.				
Io> Current Set  **(LBEF)*** Hardware options: - 0.01-1A: **Ion =1A[1];** - **Special** 0.05-5A: **Ion =5A[1];** - 0.1-10A: **Ion =5A[1];** - 0.5-40A: **Ion =5A[1]** [1] This nominal current is given for typical application. All hardware option can work with 1A or 5A nominal secondary value of CT	**Ion=1A[1]:** 0.05A; **Special 5A[1]** 0.1A **Ion=5A[1]:** 0.5A; **Ion=5A[1]:** 2.50A	**Ion=1A[1]:** 0.01A; **Special 5A[1]:** 0.05A **Ion=5A[1]:** 0.1A; **Ion=5A[1]:** 0.5A	**Ion=1A[1]:** DT: 1.0 A IDMT: 0.1A [2]; **Special 5A[1]:** DT: 5.0A IDMT: 0.5A [2]; **Ion=5A[1]:** DT: 10.00 A IDMT: 1.00A [2]; **Ion=5A[1]:** DT: 40.00A IDMT: 4.00A [2]; [2] limitation to 0.1 x maximum setting range for IDMT, in comparison with DT, is recommended to have up to 10 times dependence of IDMT characteristic. Note: firmware allows to set IDMT up to maximum setting range for DT	0.01 A
Pick-up setting for Io> stage overcurrent element [A] in secondary value.				
Io> Time Delay or TMS (depend on toc setting)  **(LBEF)***	2.00 s	0.02s	99.90s	0.01s
Setting for the time-delay for the definite time setting if selected for Io> stage element or time multiplier setting to adjust the operating time of the IEC IDMT characteristic if selected for Io> stage element				

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
'On' - Configuration of protection  **(LBEF)***	1 (trip)	0 – 'disable' – disabled, 1 – 'trip' - enabled to trip, 2 – 'alarm (warning signal)' - enabled to alarm only (no trip)		
Setting to determine the mode of action.				
'Io2' – Io>> Function  **(LBEF)***				
'toc.' – type of time characteristic:  **(BEF)***	0	0 – DT, 1 - IEC S Inverse, 2 - IEC V Inverse, 3 - IEC E Inverse		
Setting for the tripping characteristic for Io>> stage overcurrent element.				
Io>> Current Set  **(LBEF)*** Hardware options: - 0.01-1A: **Ion =1A**[1)]; - **Special** 0.05-5A: **Ion =5A**[1)]; - 0.1-10A: **Ion =5A**[1)]; - 0.5-40A: **Ion =5A**[1)] [1)] This nominal current is given for typical application. All hardware option can work with 1A or 5A nominal secondary value of CT	**Ion=1A**[1)]**:** 0.10A; **Special 5A**[1)] 0.50A **Ion=5A**[1)]**:** 1.00A; **Ion=5A**[1)]**:** 5.00A	**Ion=1A**[1)]**:** 0.01A; **Special 5A**[1)]**:** 0.05A **Ion=5A**[1)]**:** 0.1A; **Ion=5A**[1)]**:** 0.5A (flush case only)	**Ion=1A**[1)]**:** DT: 1.0 A IDMT: 0.1A [2)]; **Special 5A**[1)]**:** DT: 5.0A IDMT: 0.5A [2)]; **Ion=5A**[1)]**:** DT: 10.00 A IDMT: 1.00A [2)]; **Ion=5A**[1)]**:** DT: 40.00A IDMT: 4.00A [2)]; [2)] limitation to 0.1 x maximum setting range for IDMT, in comparison with DT, is recommended to have up to 10 times dependence of IDMT characteristic. Note: firmware allows to set IDMT up to maximum setting range for DT	0.01 A
Pick-up setting for Io>> stage overcurrent element [A] in secondary value.				
Io>> Time Delay or TMS (depend on toc setting)  **(LBEF)***	0.50 s	0.02s	99.90s	0.01s

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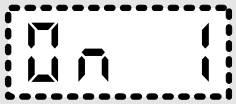
Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
Setting for the time-delay for the definite time setting if selected for Io> stage element or time multiplier setting to adjust the operating time of the IEC IDMT characteristic if selected for Io> stage element				
'On' - Configuration of protection  **(LBEF)***	1 (trip)	0 – 'disable' – disabled, 1 – 'trip' - enabled to trip, 2 – 'alarm (warning signal)' - enabled to alarm only (no trip)		
Setting to determine the mode of action.				

1.2.3 External trip via binary inputs PTC, ZZ (not available in Model L)

By using binary input it is possible to make trip via P111. Binary inputs can be configured to two external protection function:

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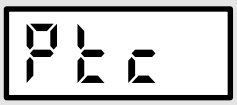
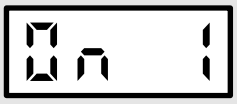
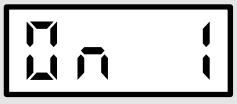
- PTC – this protection function is energized by low state of adequate programmed binary input
- ZZ - this protection function is energized by high state of adequate programmed binary input

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
'PTC' – External Trip Function  **(ABEF)***				
'On' - Configuration of protection 	1 (trip)	0 – 'disable' – disabled, 1 – 'trip' - enabled to trip, 2 – 'alarm (warning signal)' - enabled to alarm only (no trip)		
Setting to determine the mode of action.				
'ZZ' – External Trip Function  **(ABEF)***				
'On' - Configuration of protection 	1 (trip)	0 – 'disable' – disabled, 1 – 'trip' - enabled to trip, 2 – 'alarm (warning signal)' - enabled to alarm only (no trip)		
Setting to determine the mode of action.				

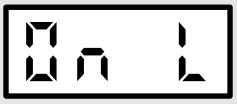
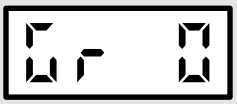
1.3 Control and support settings

The control and support settings are part of the main menu and are used to configure the relays global configuration:

- Generic parameters of P111
- Inputs and outputs configuration
- Identification relay

1.3.1 Generic parameters (SEt1)

This menu (SEt1) provides generic parameters of P111.

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
'Set1' – Generic parameters 				
'On L' - a current mode of relay operation 	On L	On L – all protection functions are on, OFFL – all protection functions are blocked and changing of the relay settings is possible		
Setting to determine the current mode of relay operation / allow to set relay				
'Gr' - Configuration of protection 	0	0 – an active setting group 0, 1 – an active setting group 1		
Setting to determine the mode of action.				
A time delay for changing an active setting group 	1.00s	0.00s	10.00s	0.01s
Setting to determine the time delay for changing an active setting group				
'P' – CT ratio for phase current 	1	0	9998	1
Setting to determine the CT ratio for phase current (measurements on LED display)				

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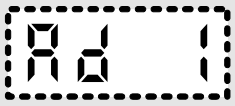
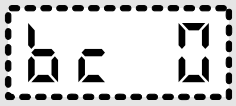
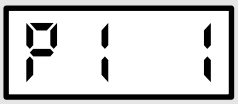
Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
'E' – CT ratio for earthfault current  **(LBEF)***	1	0	9998	1
Setting to determine the CT ratio for earthfault current (measurements on LED display)				
'Ad' – RS485 address  **(LBE)***	1	1	254	1
Setting to determine the system address to the device on RS485 port				
 **(LBE)***	19.2	1.2	19.2	x2
Setting to determine the baud rates to the device on RS485 port				
'bc' – frame format  **(LBE)***	0	0	1	1
Setting to determine the data frame format to the device on RS485 port				
'P' – Password 	000	000	999	1
In this cell of menu the a password can be activated and modified.				

1.3.2 Inputs and outputs configuration (SEt2)

This menu (Set2) provides configuration of binary inputs and binary outputs.

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
'Set2' – I/O configuration 				
'P1' - output relay P1 configuration (13-14 terminals) 	1	**0 – 'circuit breaker'** mode. Used for CB application. Tripping is done by closing the P1 contacts (minimum time of tripping signal is 0.5s). The output is not latched. **1 – 'protection-contactor'** mode in the basic scheme of application. This option does not allow to trip a contactor through communication link RS485. Once auxiliary supply voltage Vx is applied, the contacts of output relay P1 close. Trip of any protection will make the contacts of P1 open and remain in this state, until it is reset from the front panel keypad or through the adequately configured input S1-S2 **(ABEF)*** or RS485 link **(LBE)*.** **2 – 'bay terminal-contactor'** mode **(E)*.** Used for application where RS485 control is required. Applying auxiliary supply voltage Vx to the device does not change the state of output relay P1. High state of the input assigned to close function or close command via RS485, makes P1 contacts close with lathing, until trip command is sent via RS485 or the contactor opens (supervision on contact of contactor).		
Setting to determine the application: CB or contactor				
'P2' - output relay P2 configuration (23-24 terminals) 	1	**0 – 'trigger of any protection on trip'** - P2 is energised on start of current protection set to make a trip (PTC and ZZ are excluded); **1 – 'trip of any protection'** - P2 is energised, if tripping of any protection set for 'On 1' option (trip) takes place (PTC and ZZ included); **2 – 'alarm (warning) of any protection'** - P2 is energised, if the time delay of any protection set for 'On 2' option (alarm) is reached (PTC and ZZ have no time delay, from this reason start activate alarm); **3 - (LBE)* - 'remote or local CB close'** - The closing command of CB through communication link RS485 or an adequately configured device input, makes the P2 contacts closed for 0.5s (impulse).		
Setting to determine the mode of P2 output				

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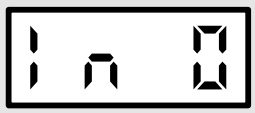
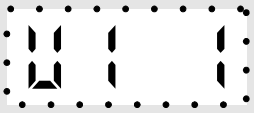
Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
'P2c' – latching of P2 configuration (23-24 terminals)  	1	**0 – 'without'** - no latching after energizing. The output is automatically reset, if a cause for its energising ceases; **1 – 'latching'** - latching of the energised relay, until it is reset from the device keypad or adequately configured input S1-S2, T1-T2 **(ABEF)*** or via RS485 communication link **(LBE)***		
Setting to determine the latching of P2 output				
'P3' - output relay P3 configuration (33-34 terminals)  **(EF)***	1	**0 – 'trigger of any protection on trip'** – P3 is energised on start of current protection set to make a trip (PTC and ZZ are excluded); **1 – 'trip of any protection'** – P3 is energised, if tripping of any protection set for 'On 1' option (trip) takes place (PTC and ZZ included); **2 – 'alarm (warning) of any protection'** – P3 is energised, if the time delay of any protection set for 'On 2' option (alarm) is reached (PTC and ZZ have no time delay, from this reason start activate alarm)		
Setting to determine the mode of P3 output				
'P3c' – latching of P3 configuration (33-34 terminals)  **(EF)***	0	**0 – 'without'** - no latching after energizing. The output is automatically reset, if a cause for its energising ceases; **1 – 'latching'** - latching of the energised relay, until it is reset from the device keypad or adequately configured input S1-S2, T1-T2 or via RS485 communication link **(E)***		
Setting to determine the latching of P3 output				

ST

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
‘P4’ - output relay P4 configuration (41-42-44 terminals)  **(EF)***	1	**0 – ‘trigger of any protection on trip’** – P3 is energised on start of current protection set to make a trip (PTC and ZZ are excluded); **1 – ‘trip of any protection’** – P3 is energised, if tripping of any protection set for ‘On 1’ option (trip) takes place (PTC and ZZ included); **2 – ‘no alarm (warning) of any protection and watchdog’** – P3 is energised, if no the time delay of any protection set for ‘On 2’ option (alarm) is reached or no watchdog detection appear. (PTC and ZZ have no time delay, from this reason start activate alarm); P4 output is energised on applying auxiliary supply voltage Vx to terminals A1 and A2 (41-44 closed, 41-42 opened). The output is deenergised (41-44 opened, 41-42 closed) if any alarm signal (On 2) or watchdog detection takes place; **3 – ‘watchdog’** - P4 output is energised on applying auxiliary supply voltage Vx to terminals A1 and A2 (41-44 closed, 41-42 opened). The output is deenergised (41-44 opened, 41-42 closed) if watchdog detection takes place; **4 - ‘I>> trip’** - P4 contacts are energised if tripping of tI>>takes place.		
Setting to determine the mode of P4 output				
‘P4c’ – latching of P4 configuration (41-42-44 terminals)  **(EF)***	0	**0 – ‘without’** - no latching after energizing. The output is automatically reset, if a cause for its energising ceases; **1 – ‘latching‘** - latching of the energised relay, until it is reset from the device keypad or adequately configured input S1-S2, T1-T2 or via RS485 communication link **(E)***		
Setting to determine the latching of P4 output				
‘In’ – Binary input ‘SIn’ (terminals: S1-S2). Energizing by shorting of terminals S1-S2.  **(ABEF)***	0	**0 – ‘reset of LEDs and latching’** - reset of the trip state; **1 – ’external trip ZZ’** – trip of an external tripping ZZ; **2 – ‘blocking of any remote controls (RS485)’** - block of control via RS485 **(BE)***; **3 – ‘switch setting group’** - change of active setting group: ‘0’ (S1-S2 open) - setting group 0; ‘1’ (S1-S2 closed) - setting group 1		
Setting to determine configuration of ‘SIn’ input (S1-S2 terminals)				

ST

Menu Text	Default Setting	Setting Range		Step Size
		Min.	Max.	
'Ptc' - Binary input 'tIn' (terminals: T1-T2). Energizing by shorting of terminals T1-T2.  **(ABEF)***	0	**0 – 'over temperature protection PTC'** - resistance of PTC serial loop exceeded the tripping threshold; Can be used for external trip too. Low state of Ptc input energizes external protection PTC; **1 - 'reset of LEDs and latching'** - reset of the trip state (LEDs and latched outputs); **2 - 'external trip ZZ'** - trip of an external protection ZZ; **3 - 'blocking of any remote controls (RS485)'** - block of control via RS485 **(BE)*** **4 - 'switch setting group'** - change of active setting group: '0' (T1-T2 open) - setting group 0; '1' (T1-T2 short) - setting group 1		
Setting to determine configuration of 'tIn' input (T1-T2 terminals)				
'V1' - Binary input 'tIn' (terminals: V1-C). Energizing by presence of Vx on terminals V1-C.  **(EF)***	1	**0 – 'local CB close'** - close circuit breaker; **1 - 'external trip ZZ'** - trip of an external protection ZZ; **2 – 'output in maintenance state'** - the output relays P1, P2, P3, P4 are set to their rest position (without Vx on terminals A1-A2)		
Setting to determine configuration of 'V1' input (V1-C terminals)				
'V2' - Binary input 'tIn' (terminals: V2-C). Energizing by presence of Vx on terminals V2-C.  **(EF)***	1	**0 – 'CB/contactor state'** - circuit-breaker or contactor closed state is represented by high state of the input. Enabling of this option is essential, if the contactor is intended to be controlled via RS485 (P1: 2); **1 - 'external trip ZZ'** - trip of an external protection ZZ; **2 - 'switch setting group'** - change of active setting group: '0' (V2-C - low) - setting group 0; '1' (V2-C - high) - setting group 1		
Setting to determine configuration of 'V2' input (V2-C terminals)				

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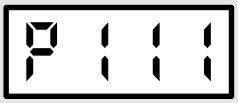
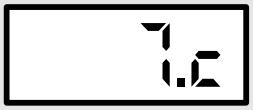
1.3.3 Relay identification

Menu Text
'IdEn' – identification of relay column 
The type of relay: 
The type of the relay is indicated
Hardware version: 
The model of the relay (e.g. A, B, E or F) and hardware version is indicated
Firmware version: 
The firmware version is indicated

ST

OP

OPERATION

Date:	**6th November 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

OP

CONTENTS

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FIGURES

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1. OPERATION OF INDIVIDUAL PROTECTION FUNCTIONS

The following sections detail the individual protection functions.

1.1 Overcurrent protection

The overcurrent protection included in the P111 relays provides three-stage non-directional three-phase overcurrent protection with independent time delay characteristics. All overcurrent settings apply to all three phases but are independent for each of the three stages. Each stage can be independently set to trip the main switch ("General Trip") or make alarm ("General Alarm") only (Set: 'On' in adequate column of menu).

Outputs can be configured to be energized from "General Trip", "General Alarm" , "General Start", or other signals available in menu.

The first two stages (Ip> and I>) of overcurrent protection have time-delayed characteristics which are selectable between inverse definite minimum time (IDMT), or definite time (DT). The third stage (I>>) has definite time characteristics only.

Various methods are available to achieve correct relay co-ordination on a system; by means of time alone, current alone or a combination of both time and current. Grading by means of current is only possible where there is an appreciable difference in fault level between the two relay locations. Grading by time is used by some utilities but can often lead to excessive fault clearance times at or near source substations where the fault level is highest. For these reasons the most commonly applied characteristic in co-ordinating overcurrent relays is the IDMT type.

The inverse time delayed characteristics indicated above, comply with the following formula:

IEC curves

$$t = T \cdot \frac{\beta}{M^{\alpha} - 1}$$

where:

t = Operation time

β = Constant

$$M = \frac{I}{Is}$$

I = Measured current

T = Time setting

Is = Current threshold setting

α = Constant

Curve Description	Standard	β Constant	α Constant
Standard Inverse	IEC	0.14	0.02
Very Inverse	IEC	13.5	1
Extremely Inverse	IEC	80	2

A time multiplier setting (T) is used to adjust the operating time of the IEC curves.

The functional logic diagram for non-directional overcurrent is shown below. The overcurrent block is a level detector that detects that the current magnitude is above the threshold. It provides a start and also initiates the IDMT/DT characteristic depending on the setting.

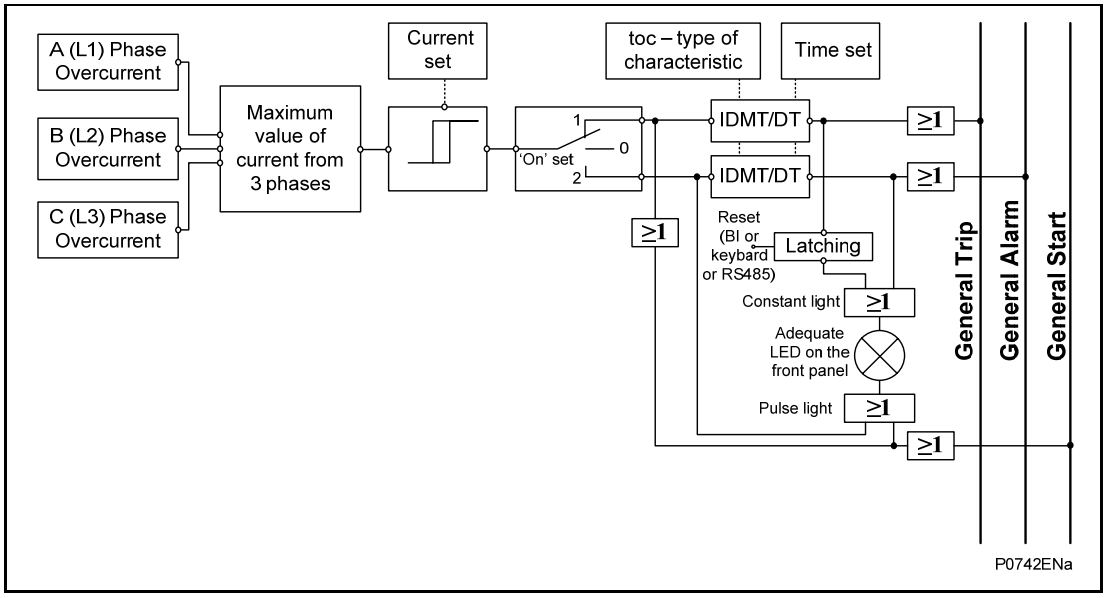

Figure 1: Non-directional overcurrent logic diagram

1.2 Earth fault protection

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Earth fault protection is based on analogue input (measured value) has two stages. The first and second stages have selectable IDMT or DT characteristics (the same as for phase protection)

The logic diagram for non-directional earth fault overcurrent is shown in Figure 2

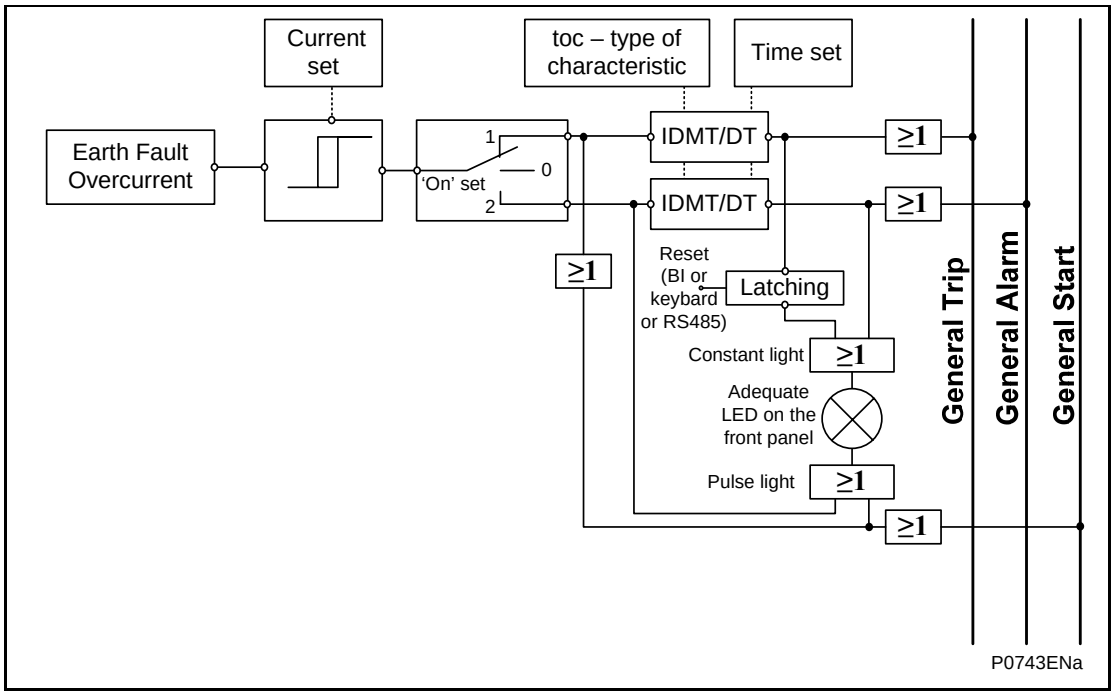

Figure 2: Non-directional earth fault overcurrent logic diagram

1.3 External trip PTC, ZZ via binary inputs (not available in Model L)

By using binary input it is possible to make trip of CB or contactor via P111. Binary inputs can be configured to two external protection function:

- PTC – this protection function is triggered by low state of appropriate programmed binary input (PTC input: T1-T2 terminals). The logic diagram for PTC external protection is shown in Figure 4
- ZZ - this protection function is triggered by high state of appropriate programmed binary input. The logic diagram for ZZ external protection is shown in Figure 3

Binary inputs: 'tIn' (T1-T2 terminals) and 'SIn' (S1-S2 terminals) measure resistance connected to appropriate terminals. From this reason T1-T2 terminals can be used as contact input or as input for PTC sensors (overload protection for small MV transformers) depending on setting in menu.

Note: For T1-T2 and S1-S2 terminals is not allowed to connect any source of voltage. Any source of voltage connected to T1-T2 and S1-S2 terminals can damage P111 relay.

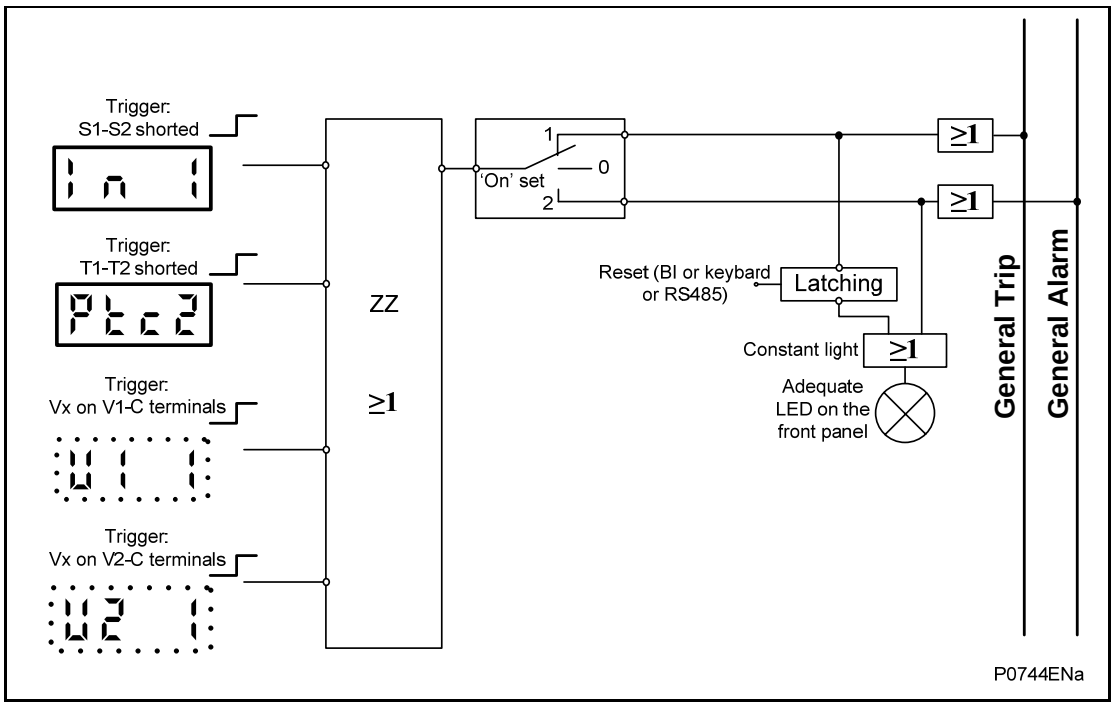

Figure 3: ZZ external protection logic diagram

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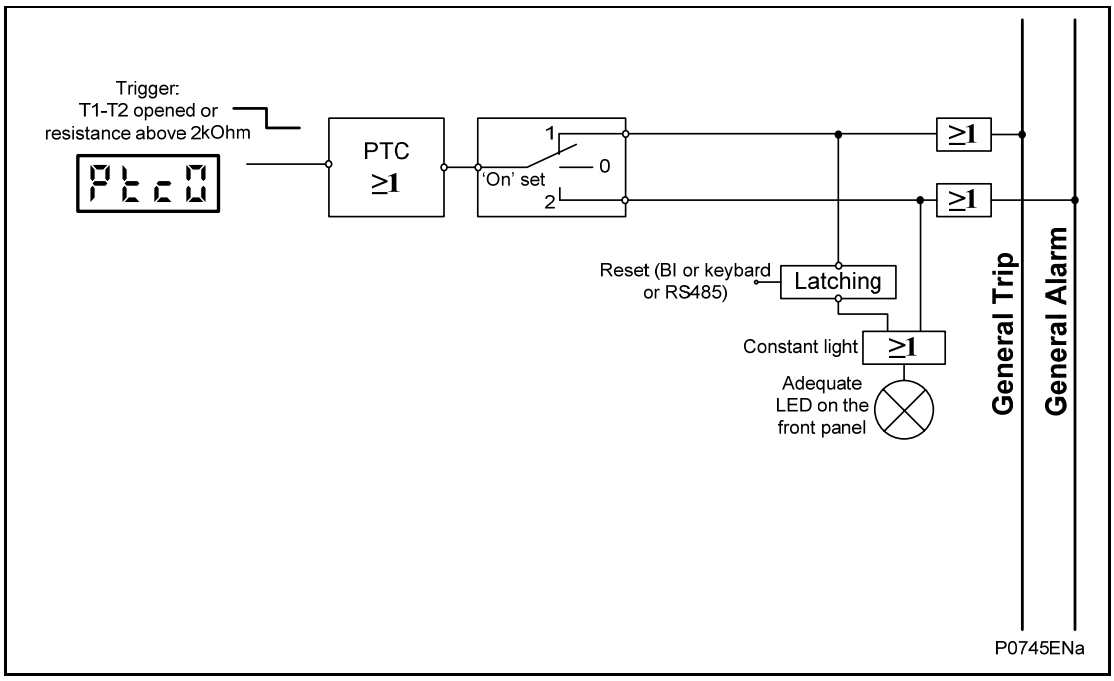

Figure 4: PTC external trip logic diagram

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2. OPERATION OF NON PROTECTION FUNCTIONS

2.1 Circuit breaker / contactor control

The relay includes the following options for control of a single circuit breaker / contactor:

- Protection tripping and local closing via relay opto-isolated inputs (model E only)
- Remote tripping and closing, using the relay communications (model: B, E only)

The same relay output contacts can be used for remote circuit breaker control and protection tripping. The control outputs to be selected via a local/remote selector switch as shown in Figure 5. PTC input (T1-T2 terminals) can be used for clocking any remote control via RS485. A local close command can be arranged via V1 binary input (V1-C terminals) (look Figure 5) or outside of P111 (directly to Close coil). If a local close command is arranged by P111, close command can be blocked by trip state (until reset of trip) and PTC input (if set 3) (blocking of remote control function).

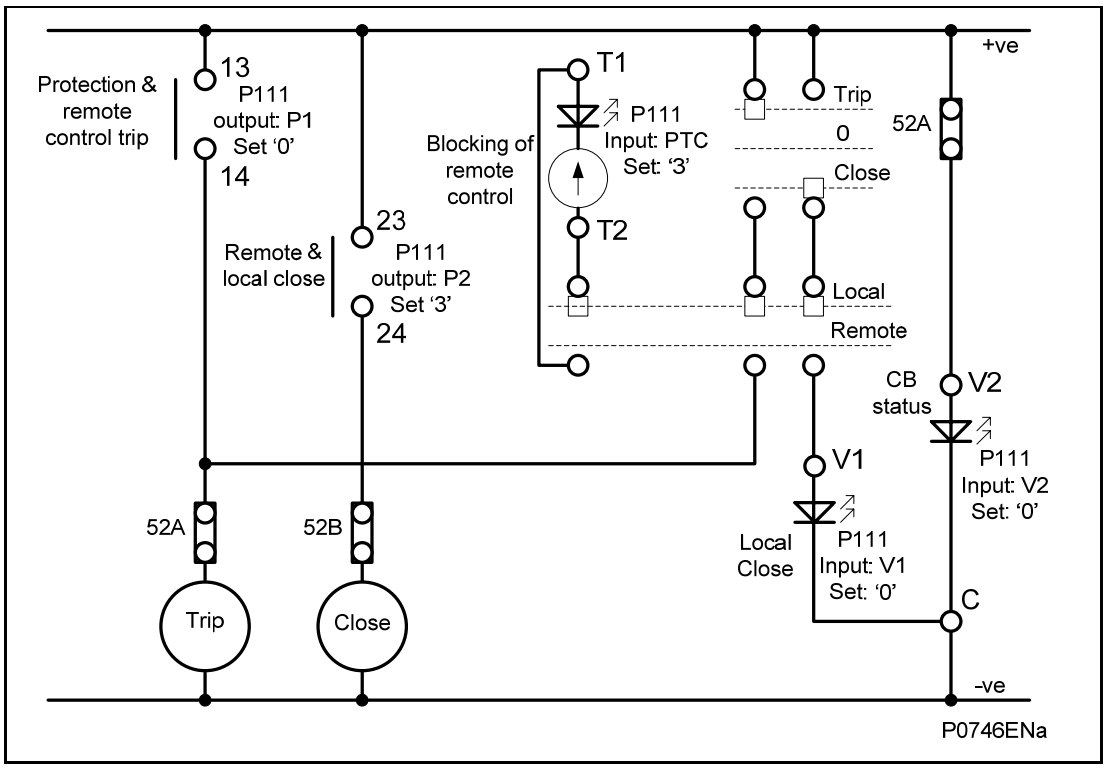

Figure 5: An example: Remote control of circuit breaker

A manual trip will be permitted provided that the circuit breaker is initially closed. Likewise, a close command can only be issued if the CB is initially open. To confirm these states it will be necessary to use the breaker 52A contact. If no CB auxiliary contacts are available then the cell V2 should not be set to 0. Under these circumstances no CB control (manual or auto) will be possible.

Once a CB Close command is initiated (Input V1 set to 0) the output contact (P2 set to 3) can be set to operate (0.5s pulse).

The length of the trip or close control pulse is unsettable and is equal 0.5s

If an attempt to close the breaker is being made, and a protection trip signal is generated, the protection trip command overrides the close command (if any protection - set to trip - LEDs is lit no close signal - via P111 - is issued).

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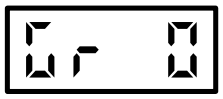
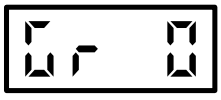
2.2 Setting groups selection

P111 has two setting group:

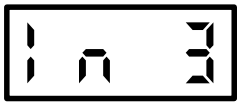
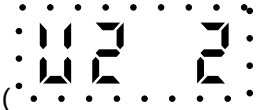
- the first group: ‘Gr 0’ (),
- the second group: ‘Gr 1’ ().

The active group is displayed in ‘Gr’ cell () in column ‘SEt1’ () column. ‘0’ means that the first setting group is displayed. ‘1’ means that the second setting group is displayed.

The setting groups can be changed either via opto inputs, via a menu selection, via RS485 (remote control). In menu is displayed active group only. The way to change a setting group via menu is the same as for every setting (look: “Getting Started; Setting changes”).

OP

The setting group can be changed via opto input, if configured in the proper way in SEt2 column ():

- SIn input (terminals: S1-S2) ‘In’ function: ‘3’: “switch setting group” () **(ABEF)***;. If the terminals S1-S2 are shorted the active group is the second group (1) otherwise the first group (0)
- PTC input (terminals: T1-T2) ‘Ptc’ function: ‘4’: “switch setting group” ()**(ABEF)***; If the terminals T1-T2 are shorted the active group is the second group (1) otherwise the first group (0);
- V2 input (terminals: V2-C)) function: ‘2’: “switch setting group” ( **(EF)***); If voltage Vx is present on the terminals V2-C the active group is the second group (1) otherwise the first group (0).

The relay starts the work on the new setting group after the set time delay (Setting:  [s] in ‘Set1’ () column)

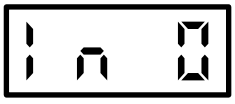
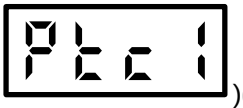
Each setting group includes protection configuration only. Input and output configuration (column: ‘SEt1’ () and ‘SEt2’ ()) is common for both groups.

2.3 Reset of LEDs and latched outputs

If any protection function is set for tripping of CB or contactor adequate LED is permanent lit after time delay of protection. The output relays P2, P3, P4 can be set to be permanent energized after instantaneous close of contacts:

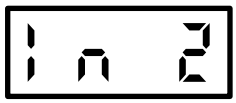
- P2: 'P2c' () cell in 'SEt2' () column,
- P3: 'P3c' () cell in 'SEt2' () column,
- P4: 'P4c'() cell in 'SEt2' () column,

The reset of latched LEDs and output contacts are possible via:

- menu 'Clr' hotkey
- Binary inputs if configured in the proper way in SEt2 column ():
  - SIn input (terminals: S1-S2) 'In' function: '0': "reset of LEDs and latching" ()**(ABEF)***;. The activation of function: changing from not shorted to shorted terminals S1-S2,
  - PTC input (terminals: T1-T2) 'Ptc' function: '1': "switch setting group" ()**(ABEF)***;. The activation of function: changing from not shorted to shorted terminals T1-T2,
- Remote reset command via RS485 (Modbus protocol)

2.4 Blocking of any remote control via RS485

During commissioning or local service of protection relays is necessary to blockade remote changing of any parameters or control of CB. Such function is possible via using of proper configured binary input 'SEt2' column ():

- SIn input (terminals: S1-S2) 'In' function: '2': "reset of LEDs and latching" ()**(ABEF)***.The activation of function: shorted terminals S1-S2,
- PTC input (terminals: T1-T2) 'Ptc' function: '3': "switch setting group" ()**(ABEF)***;. The activation of function: changing shorted terminals: T1-T2,

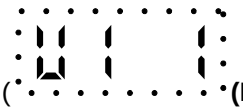
That function is useful for changing the way of control from remote to local (switch).

OP

Note: If that function is activated no any remote changing of setting is possible. A changing of setting requires write command, which are blockaded by that function too.

2.5 Outputs in maintenance state (model E, F only).

For fast switching protection relay to out of order state via binary input, 'Outputs in maintenance state' function can be used.

To apply this function it is necessary to set V1 input (terminals: V1-C) to function: '0': "output in maintenance state" (

(EF)*) in SEt2 column (

)

A presence of auxiliary voltage on V1-C terminals set the output relays P1, P2, P3, P4 to their rest position (like without Vx on A1-A2 terminals) (look at Figure 6).

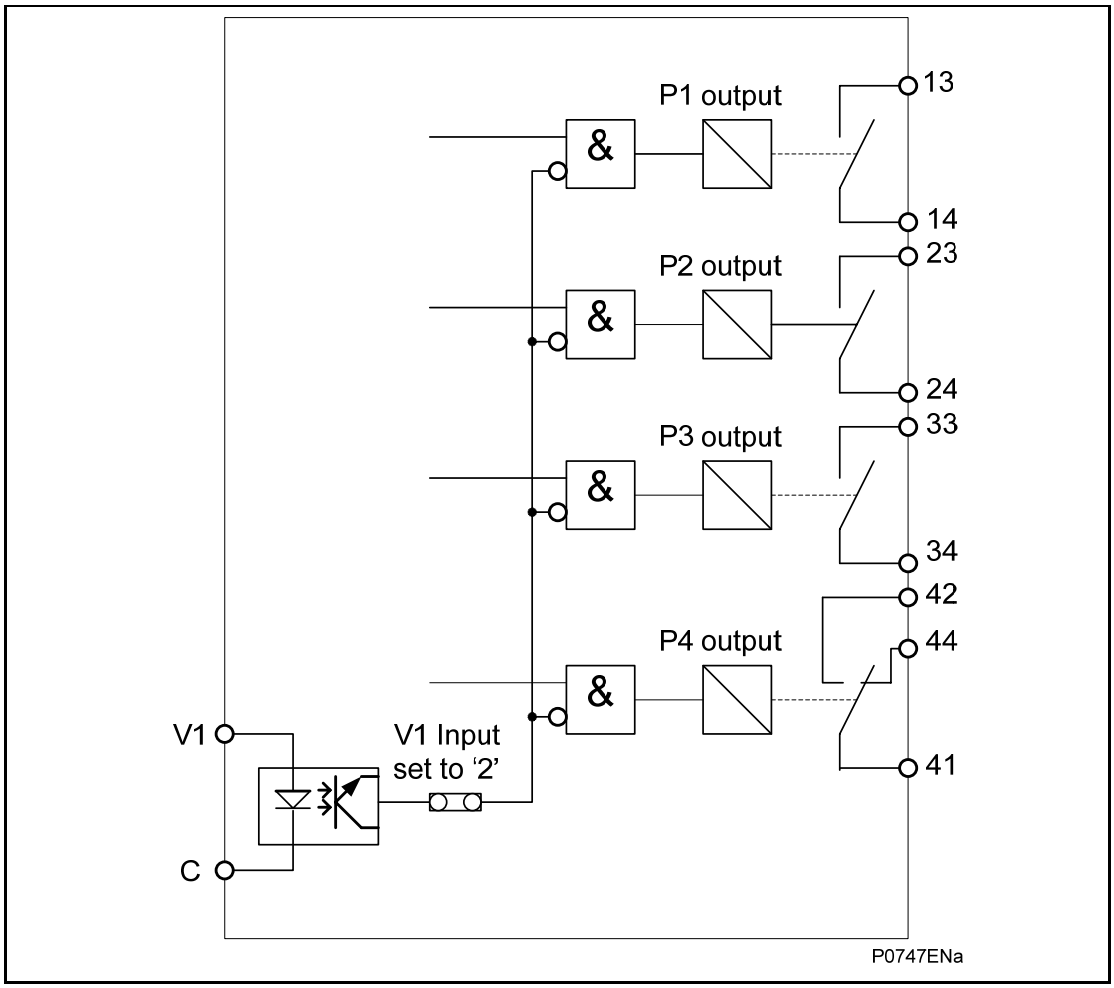


Figure 6: "Output in maintenance state" function

2.6 Outputs configuration

2.6.1 P1 output configuration

P1 output is dedicated to control the main switch (CB or contactor). The logic is shown on Figure 7.

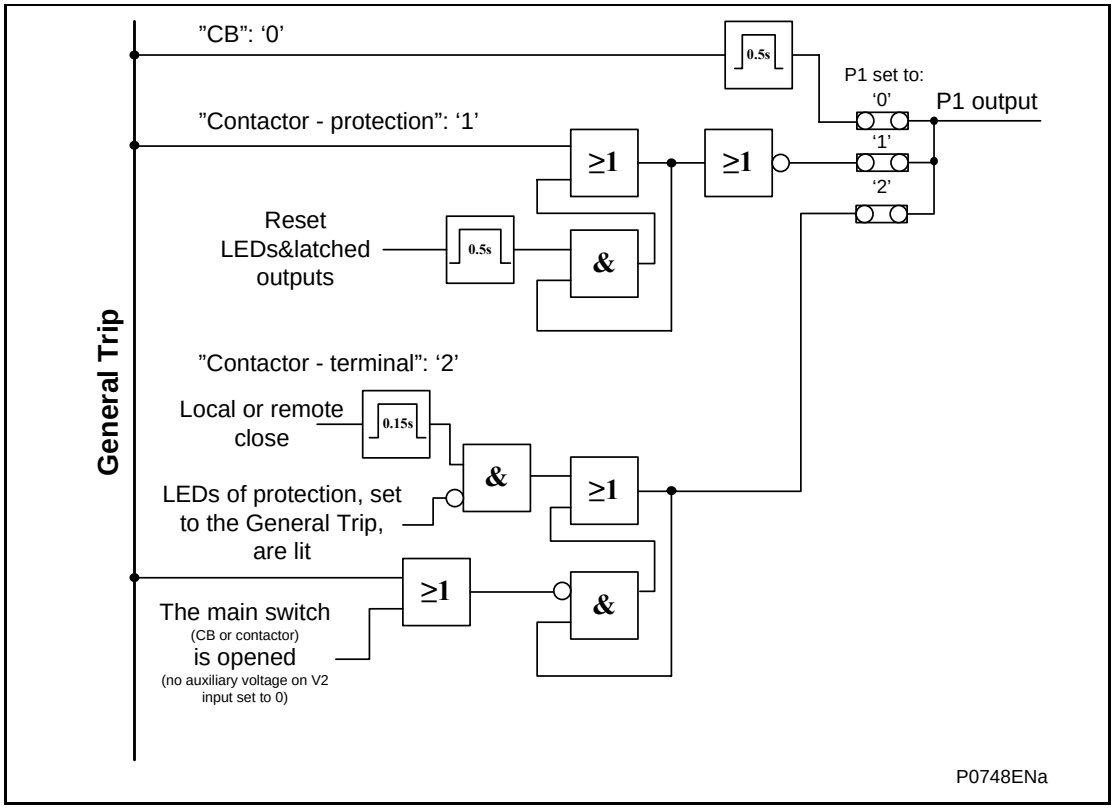
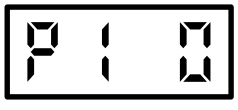


Figure 7: Configuration of P1 output

P1 output can be set to following function:

- "Circuit Breaker" (CB),
- "Contactor – Protection function only"
- "Contactor – Terminal for system"

2.6.1.1 "Circuit Breaker" mode

P1 should be set to 0 (cell: 

) in 

column of menu.

If P1 is configured to operate in "circuit breaker" mode, then tripping of any protection function, which is set to General Trip, the relay or a trip command sent via RS485 link will make the P1 output relay switch over for ≥ 0,5s (BE)*.

Closing of the circuit-breaker is performed via P2 output relay, therefore when closing is done via P111, then the output relay P2 should be configured to "remote or local CB close" mode.

(P2 set to 3 in 

cell).

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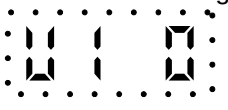
Closing of the circuit breaker is triggered via:

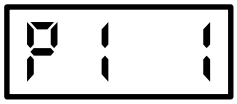
- input V1-C, if it is configured to “remote or local CB close” mode) (V1 set to 0 in  cell) **(EF)***,
- close command sent from a system via RS485 communication link **(BE)***

When closing of the circuit-breaker is commenced, then output relay P2 (terminals 23-24) is closed for a period of 0,5s.
It is only possible to close the circuit-breaker, if LED trip signaling is previously reset, which prevents from multiple attempts of the circuit-breaker closing when a fault is present.

Note: In "circuit breaker" mode, the option of P2 latching should be switched off (P2c set to 0 in  cell).

Otherwise it will remain closed until it is reset.

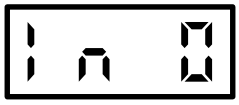
2.6.1.2 “Contactor - Protection function only” mode

(P1 set to 1 in  cell)

This mode of control is meant for applications, where a contactor is the control switch, and is not intended to be triggered via RS485.

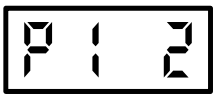
For this control mode it is recommended to use the standard arrangement of contactor control. On applying auxiliary supply voltage Vx the contacts of output relay P1 are closed. It allows closing of the contactor. Operation of any protection, which is configured to General Trip, makes the contacts of output relay P1 open, and so it does for the contactor. P1 is kept open until output relays' tripping states and indicating LED's are reset.

This can be done by means of:

- front panel keypad
- binary input S1-S2 (if configured to “reset of LEDs and latching” mode: the relevant value is set to 0 in  cell) **(ABEF)***;
- RS485 communication link **(BEL)***.

After the relay has been reset, the output contacts of P1 relay close again, thus allowing the contactor to be closed again.

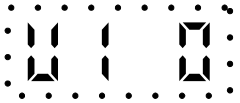
2.6.1.3 “Contactor – Terminal for system” mode

(P1 set to "2" in 

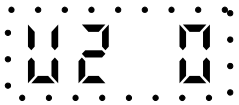
cell).

This mode is meant for applications, where control operations are to be performed through communication link RS485 or/and by means of an external switching contact.

Thus input V1-C must be configured to: “local CB close” mode.

(V1 set to 0 in 

cell) **(ABEF)***, and input V2-C must be configured to: "CB/contactor state" mode.

(V2 set to 0 in 

cell) **(ABEF)***;.

After auxiliary supply voltage Vx has been applied the state of output relay P1 (13-14) does not change (the contacts remain open), as it does when "contactor" mode is chosen.

Closing of the contactor (P1) is initiated by:

- applying auxiliary supply voltage to binary input V1-C;
- sending close command from the system, through communication link RS485.

It is only possible to close the contactor if LED trip signaling is previously reset, which prevents from unintended closing operation to be performed following a trip operation of any protection. Once closing operation is initiated, the contacts (13-14) of output relay P1 close for 150ms. Afterwards the status of the contactor, whose auxiliary contacts control the relay input V2-C is checked. If the contactor is closed (high state at V2-C input), then the output relay P1 remains closed.

Note: Tripping of any protection will instantaneously deenergise the output relay P1, regardless of a status of operation of the device (higher priority of trip over close command).

Contactor tripping can be performed through:

- opening of the contactor control circuit (external OFF switch). If the circuit is open, the contactor is de-energized. This process is monitored by the device input V2-C, which is configured to represent the switch state. If the input state changes from high to low, then the output relay P1 will instantaneously deenergize;
- trip command sent via communication link RS485, which makes the contacts of output relay P1 (13-14) open;
- trip of any protection which is set to General Trip mode.

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2.6.2 P2, P3, P4 output configuration

P3 and P4 are available in model E and F only.

The rest output: P2, P3, P4 can be set to logic functions shown on Figure 8.

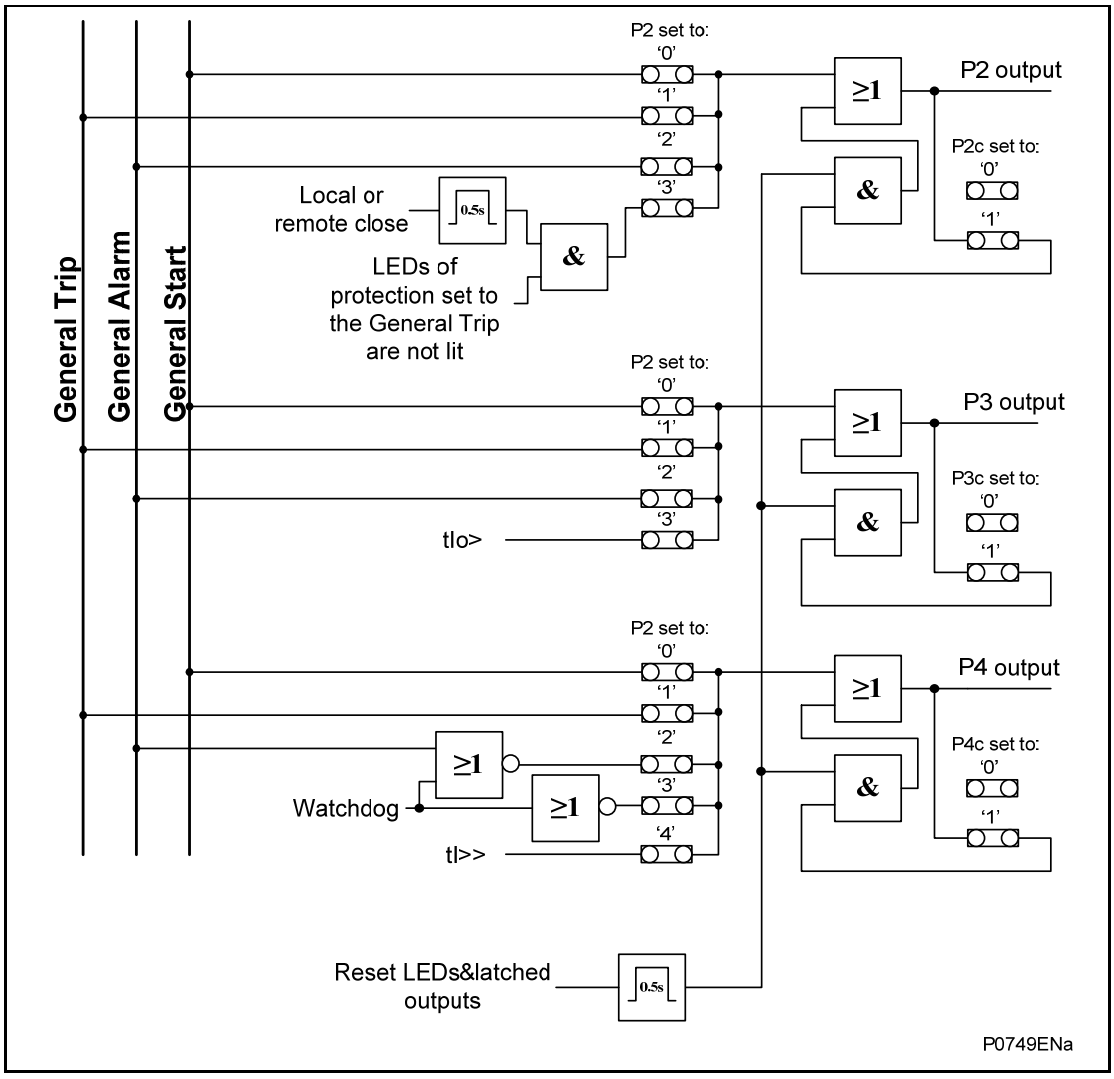

Figure 8: Configuration of P2, P3, P4 outputs

'P2c', 'P3c', 'P4c' switch is used for latching of output function until reset command.

AP

APPLICATION NOTES

Date:	**5th December 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

AP

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FIGURES

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1. INTRODUCTION

1.1 Protection of feeders

The secure and reliable distribution of power within a network is heavily dependent upon the integrity of underground cables which link the various sections of the network together. As such, the associated protection system must also provide both secure and reliable operation.

The most common fault conditions, on cables and MV/LV transformers, are short circuit faults. Such faults may occur between phases but will most often involve one or more phases becoming short circuit to earth. Faults of this nature require the fastest possible fault clearance times but at the same time allowing suitable co-ordination with other downstream protection devices.

The effect of fault resistance is more pronounced on lower voltage systems, resulting in potentially lower fault currents, which in turn increases the difficulty in the detection of high resistance faults. In addition, many distribution systems use earthing arrangements designed to limit the passage of earth fault current. Methods such as resistance earthing, Petersen Coil earthing or insulated systems makes the detection of earth faults difficult. Special protection requirements are often used to overcome these problems.

Damage to items of plant such as transformers and cables may also be incurred by excessive loading conditions, which leads directly to overheating of the equipment and subsequent degradation of the insulation. To protect against conditions of this nature, protective devices require characteristics, which closely match the thermal, withstand capability of the item of plant in question.

Uncleared faults, arising from either failure of the associated protection system or of the switchgear itself, must also be given due consideration. As such, the protection devices concerned may well be fitted with logic to deal with breaker failure conditions, in addition to the relays located upstream being required to provide adequate back-up protection for the condition.

2. APPLICATION OF INDIVIDUAL PROTECTION FUNCTIONS

The following sections detail individual protection functions in addition to where and how they may be applied. Each section provides some worked examples on how the settings are applied to the relay

2.1 Overcurrent protection

Overcurrent relays are the most commonly used protective devices in any industrial or distribution power system. They provide main protection to both feeders and busbars when unit protection is not used. They are also commonly applied to provide back-up protection when unit systems, such as pilot wire schemes, are used.

There are a few application considerations to make when applying overcurrent relays.

2.1.1 Transformer magnetizing inrush

When applying overcurrent protection to the MV side of a power transformer it is usual to apply a high set instantaneous overcurrent element in addition to the time delayed low-set, to reduce fault clearance times for MV fault conditions. Typically, this will be set to approximately 1.3 times the LV fault level, such that it will only operate for MV faults. A 30% safety margin is sufficient due to the low transient overreach of the third a overcurrent stage. Transient overreach defines the response of a relay to DC components of fault current and is quoted as a percentage.

The second requirement for this element is that it should remain inoperative during transformer energization, when a large primary current flows for a transient period. In most applications, the requirement to set the relay above the LV fault level will automatically result in settings that will be above the level of magnetizing inrush current.

All three overcurrent stages operate on the True RMS component in frequency range: 10-250Hz. This method of measurement reduces influence of transients (harmonics) but the setting should have a little bit bigger safety coefficient than for Fourier component measurement (Figure 1). TrueRMS component behaves similar to an electromechanical relay.

Definition of TrueRMS is given below:

$$I_{TrueRMS} = \sqrt{\sum_{k=0}^{N-1} (I_k)^2}$$

Where:

k - number of harmonic (0 - means DC component),

I_k - value of the k – harmonic in measured signal,

N - quantity of harmonic in measured signal,

$I_{TrueRMS}$ - TrueRMS value of measured signal.

An influence of harmonic on TrueRMS value is shown in Figure 1. 100% of the fundamental harmonic and 30% of the additional harmonic gives value less that 105% of fundamental harmonic. Two additional harmonics in fundamental signal, on the 20% level gives value less than 105% of fundamental harmonic.

An example of transients with non-periodical element in the current is shown in Figure 2. There are 35% of second harmonic and non periodical component included.

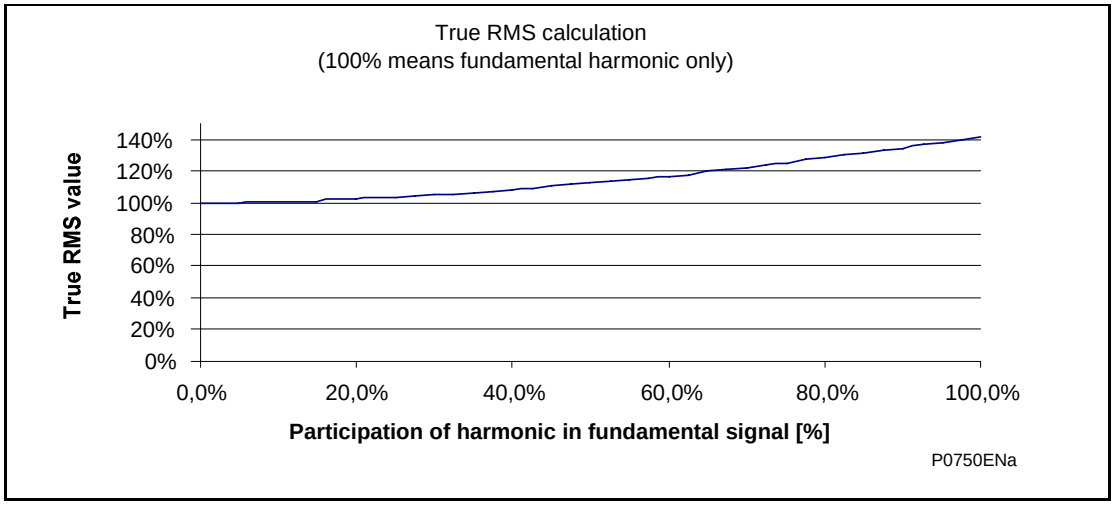

Figure 1: Influence of harmonics on True RMS value

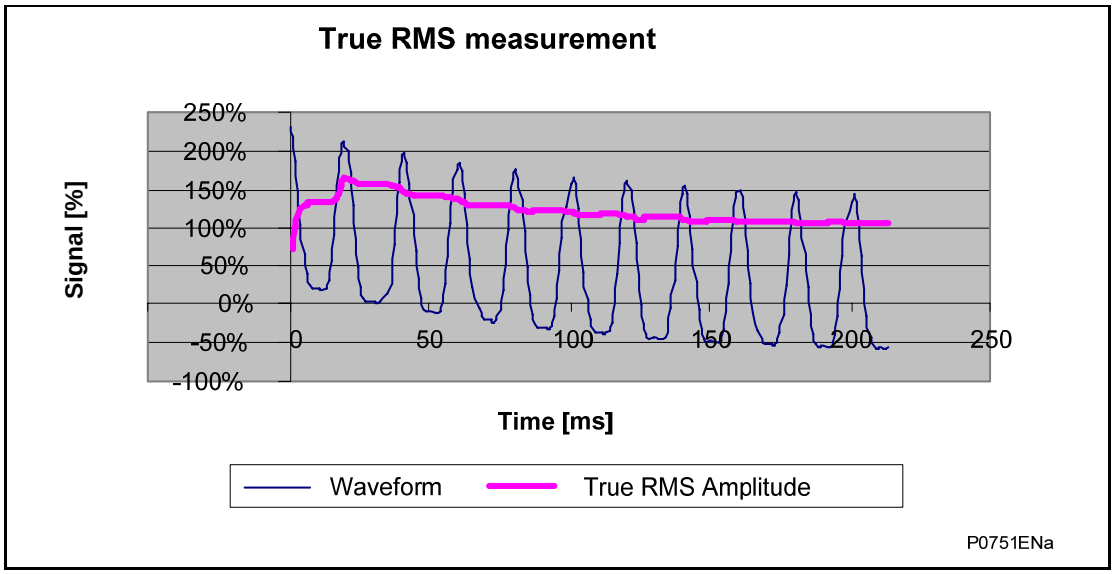

Figure 2: TrueRMS measurement with 35% of second harmonic and non periodical component

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2.1.2 Setting guidelines

When applying the overcurrent protection provided in the P111 relays, standard principles should be applied in calculating the necessary current and time settings for co-ordination The Network Protection and Automation Guide (NPAG) textbook offers further assistance. The example detailed below shows a typical setting calculation and describes how the settings are applied to the relay.

Assume the following parameters for a relay feeding an LV switchboard:

CT Ratio = 500/1

Full load current of circuit = 450A

Slowest downstream protection = 100A Fuse

The current setting employed on the P111 relay must account for both the maximum load current and the reset ratio of the relay itself:

I> must be greater than: 450/0.95 = 474A

In the P111 relay the current settings are in secondary quantities.

In this example, assuming primary currents are to be used, the ratio should be programmed as 500/1.

The required setting is therefore 0.95A in terms of secondary current.

A suitable time delayed characteristic will now need to be chosen. When co-ordinating with downstream fuses, the applied relay characteristic should be closely matched to the fuse characteristic. Therefore, assuming IDMT co-ordination is to be used, an Extremely Inverse (EI) characteristic would normally be chosen. As previously described, this is found under "I>1 Function" and should therefore be programmed as "IEC E Inverse".

Finally, a suitable time multiplier setting (TMS) must be calculated and entered in cell "I>1 TMS".

3. CT REQUIREMENTS

The current transformer requirements are based on a maximum prospective fault current of 50 times the relay rated current (In) and the relay having an instantaneous setting of 25 times rated current (In). The current transformer requirements are designed to provide operation of all protection elements.

Where the criteria for a specific application are in excess of those detailed above, or the actual lead resistance exceeds the limiting value quoted, the CT requirements may need to be increased according to the formulae in the following sections:

Nominal Rating	Nominal Output	Accuracy Class	Accuracy Limited Factor	Limiting Lead Resistance
1A	2.5VA	10P	20	1.3 ohms
5A	7.5VA	10P	20	0.11 ohms

3.1 Non-directional definite time/IDMT overcurrent & earth fault protection

3.1.1 Time-delayed phase overcurrent elements

$$V_K \geq I_{cp}/2 * (R_{CT} + R_L + R_{rp})$$

3.1.2 Time-delayed earth fault overcurrent elements

$$V_K \geq I_{cn}/2 * (R_{CT} + 2R_L + R_{rp} + R_{rn})$$

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3.2 Non-directional instantaneous overcurrent & earth fault protection

3.2.1 CT requirements for instantaneous phase overcurrent elements

$$V_K \geq I_{sp} \times (R_{CT} + R_L + R_{rp})$$

3.2.2 CT requirements for instantaneous earth fault overcurrent elements

$$V_K \geq I_{sn} \times (R_{CT} + 2R_L + R_{rp} + R_{rn})$$

3.3 Non-directional/directional definite time/IDMT sensitive earth fault (SEF) protection

3.3.1 Non-directional time delayed SEF protection (residually connected)

$$V_K \geq I_{cn}/2 * (R_{CT} + 2R_L + R_{rp} + R_{rn})$$

3.3.2 Non-directional instantaneous SEF protection (residually connected)

$$V_K \geq I_{sn} \times (R_{CT} + 2R_L + R_{rp} + R_{rn})$$

3.3.3 Directional time delayed SEF protection (residually connected)

$$V_K \geq I_{cn}/2 \times (R_{CT} + 2R_L + R_{rp} + R_{rn})$$

3.3.4 Directional instantaneous SEF protection (residually connected)

$$V_K \geq I_{fn}/2 * (R_{CT} + 2R_L + R_{rp} + R_{rn})$$

3.3.5 SEF protection - as fed from a core-balance CT

Core balance current transformers of metering class accuracy are required and should have a limiting secondary voltage satisfying the formulae given below:

Non-directional time delayed element:

$$V_K \geq I_{cn}/2 * (R_{CT} + 2R_L + R_{rn})$$

Non-directional instantaneous element:

$$V_K \geq I_{sn} \times (R_{CT} + 2R_L + R_{rn})$$

Note that, in addition, it should be ensured that the phase error of the applied core balance current transformer is less than 90 minutes at 10% of rated current and less than 150 minutes at 1% of rated current.

Abbreviations used in the previous formulae are explained below:

Where:

V_K = Required CT knee-point voltage (volts)

I_{fn} = Maximum prospective secondary earth fault current (amps)

I_{fp} = Maximum prospective secondary phase fault current (amps)

I_{cn} = Maximum prospective secondary earth fault current or 31 times I> setting (whichever is lower) (amps)

I_{cp} = Maximum prospective secondary phase fault current or 31 times I> setting (whichever is lower) (amps)

I_{sn} = Stage 2 earth fault setting (amps)

I_{sp} = Stage 2 setting (amps)

R_{CT} = Resistance of current transformer secondary winding (ohms)

R_L = Resistance of a single lead from relay to current transformer (ohms)

R_{rp} = Impedance of relay phase current input at 30In (ohms)

R_{rn} = Impedance of the relay neutral current input at 30In (ohms)

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3.4 Use of ANSI/IEEE “C” class CTs

Where American/IEEE standards are used to specify CTs, the C class voltage rating can be checked to determine the equivalent Vk (knee point voltage according to IEC). The equivalence formula is

$$V_K = [\text{(C rating in volts)} \times 1.05] + [100 \times R_{CT}]$$

4. AUXILIARY SUPPLY FUSE RATING

In the Safety section of this manual, the maximum allowable fuse rating of 16A is quoted. To allow time grading with fuses upstream, a lower fuse link current rating is often preferable. Use of standard ratings of between 6A and 16A is recommended. Low voltage fuse links, rated at 250V minimum and compliant with IEC60269-2 general application type gG are acceptable, with high rupturing capacity. This gives equivalent characteristics to HRC "red spot" fuses type NIT/TIA often specified historically.

The table below recommends advisory limits on relays connected per fused spur. This applies to MiCOM Px10 series devices**,** as these have inrush current limitation on switch-on, to conserve the fuse-link.

Maximum Number of MiCOM Px10 Relays Recommended Per Fuse				
Battery Nominal Voltage	6A	10A Fuse	15 or 16A Fuse	Fuse Rating > 16A
24 to 54V	2	4	6	Not permitted
60 to 125V	4	8	12	Not permitted
138 to 250V	6	10	16	Not permitted

Alternatively, miniature circuit breakers (MCB) may be used to protect the auxiliary supply circuits.

AP

MEASUREMENTS AND RECORDING

MR

Date: 5th December 2007

Hardware Suffix: AD

Software Version: 7D

Connection Diagrams: 10P11102

MR

CONTENTS

MR

1. MEASUREMENTS AND RECORDING

1.1 Introduction

The P111 is equipped with integral measurements, event (Model E only), fault recording facilities suitable for analysis of complex system disturbances.

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

1.2 Event records (available in E model only)

The relay records and time tags up to 150 events and stores them in non-volatile (FRAM) memory. This enables the system operator to establish the sequence of events that occurred within the relay 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 relay provides the time tag to each event, to a resolution of 10ms.

The event records are available for viewing via the communications RS485 ports only (for local communication with PC, RS232/RS485 converter is required. Could be ordered with P111).

For local downloading and viewing EventBrowser software should be used.

An event may be a change of state of a control input or output relay, an alarm condition, setting change, protection element trip etc.

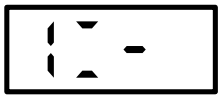
A complete list of the 'Events' is given in the Relay Menu Database (P111/EN MD), which is a separate document, available for downloaded from our website.

MR

1.3 Fault records

Each time a fault record is generated, with a corresponding time stamp.

Note that viewing of the actual fault record is carried out in the  column further down to see:

Type of cell	Displayed cell (an example)
The reason of trip (fault flag)	 tI> - trip
The value of current in phase L1 (A) on the beginning of trip command (fault measurements)	 5.5A (in primary value).
The value of current in phase L2 (A) on the beginning of trip command (fault measurements)	 5.5A (in primary value).
The value of current in phase L3 (A) on the beginning of trip command (fault measurements)	 5.5A (in primary value).
The value of earth fault current on the beginning of trip command (fault measurements)	 0.1A (in primary value).

These records () consist of fault flags and fault measurements. Also note that the time stamp given in the fault record will be available by using RS485 port.

Up to 3 last records are available in menu:

–  (the most recent),

–  (the previous one),

–  (the last one).

Fault records can be resetting via RS485 port.

1.4 Measurements

The relay produces a variety directly measured power system quantities. These measurement values are updated on a per second basis and can be viewed in the "Measurements" column of the relay or via MiCOM S1 Measurement viewer. The P111 relay is able to measure and display the following quantities as summarized.

– Phase Currents

– Earth Fault Current

MR

Measurement display quantities.

There is "Measurement" column available in the relay for viewing of measurement quantities. These can also be viewed with MiCOM S1 (see MiCOM Px10 – Monitoring section of the MiCOM S1 User Manual) and are shown below:

MEASUREMENTS	
IA RMS	0 A
IB RMS	0 A
IC RMS	0 A
IN Measured Mag.	0 A

All quantities are displayed in primary values (CT ratio settings is given in  column).

COMMISSIONING

CM

Date:	**5th December 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

CM

CONTENTS

1. INTRODUCTION

The MiCOM P111 feeder protection relays are fully numerical in their design, implementing all protection and non-protection functions in software. The relays employ 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 electro-mechanical relays.

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

- Extracting the settings applied to the relay using appropriate setting software (preferred method)
- Via the operator interface

Unless previously agreed to the contrary, the customer will be responsible for determining the application-specific settings to be applied to the relay and for testing of any scheme logic applied by external wiring and/or configuration of the relay'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 relay'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.

To simplify the specifying of menu cell locations in these Commissioning Instructions, they will be given in the form [courier reference: COLUMN HEADING, Cell Text]. For example, the cell for selecting the menu language (first cell under the column heading) is located in the System Data column (column 00) so it would be given as [0001: SYSTEM DATA, Language].

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

2. SETTING FAMILIARIZATION

When commissioning a MiCOM P111 relay 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 (P111/EN GS) contains a detailed description of the menu structure of P111 relays.

All settings can be changed by using key and LED display.However, menu cells that 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), 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 disk 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

Multifunctional dynamic current and voltage injection test set.

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 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).

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).

EIA(RS)RS485 to EIA(RS)232 protocol converter

A printer (for printing a setting record from the portable PC).

4. PRODUCT CHECKS

These product checks cover all aspects of the relay which should be checked to ensure that it has not been physically damaged prior to commissioning, is functioning correctly and all input quantity measurements are within the stated tolerances.

If the application-specific settings have been applied to the relay 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 diskette from the customer (this requires a portable PC with appropriate setting software for transferring the settings from the PC to the relay)
- Extracting the settings from the relay 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 relay's menu is sequentially stepped through via the front panel user interface

If password protection is enabled and the customer has changed password that prevents unauthorized changes to some of the settings, either the revised password 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 relay. The recovery password is unique to that relay and is unlikely to work on any other relay.

4.1 With the relay de-energized

The following group of tests should be carried out without the auxiliary supply being applied to the relay and with the trip circuit isolated.

The current transformer connections must be isolated from the relay for these checks. If a P991 test block is provided, the required isolation can easily be achieved by inserting test plug type P992 that effectively open-circuits all wiring routed through the test block.

If external test blocks are connected to the relay, great care should be taken when using the associated test plugs such as MMLB and MiCOM P992 since their use may make hazardous voltages accessible. *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.

Before inserting the test plug, reference should be made to the scheme (wiring) diagram to ensure that this will not potentially cause damage or a safety hazard. For example, the test block may be associated with protection current transformer circuits. It is essential that the sockets in the test plug, which correspond to the current transformer secondary windings, are linked before the test plug is inserted into the test block.

WARNING: NEVER OPEN CIRCUIT THE SECONDARY CIRCUIT OF A CURRENT TRANSFORMER SINCE THE HIGH VOLTAGE PRODUCED MAY BE LETHAL AND COULD DAMAGE INSULATION.

If a test block is not provided, the voltage transformer supply to the relay should be isolated by means of the panel links or connecting blocks. The line current transformers should be short-circuited and disconnected from the relay terminals. Where means of isolating the auxiliary supply and trip circuit (e.g. isolation links, fuses, MCB, etc.) are provided, these should be used. If this is not possible, the wiring to these circuits will have to be disconnected and the exposed ends suitably terminated to prevent them from being a safety hazard.

4.1.1 Visual inspection

The rating information given under the top access cover on the front of the relay should be checked. Check that the relay being tested is correct for the protected line/circuit. Ensure that the circuit reference and system details are entered onto the setting record sheet. Double-check the CT secondary current rating, and be sure to record the actual CT tap which is in use.

Carefully examine the relay to see that no physical damage has occurred since installation.

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 relay terminals are:

a) Current transformer circuits

b) Auxiliary voltage supply

c) Field voltage output and opto-isolated control inputs

d) Relay contacts

e) EIA(RS)485 communication port

The insulation resistance should be greater than 100MΩ at 500V.

On completion of the insulation resistance tests, ensure all external wiring is correctly reconnected to the relay.

4.1.3 External wiring

Check that the external wiring is correct to the relevant relay diagram and scheme diagram. Ensure as far as practical that phasing/phase rotation appears to be as expected. The relay diagram number appears on the rating label under the top access cover on the front of the relay.

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 colored 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 relay'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

P4 can be program to watchdog function. Using a continuity tester, check that the watchdog contacts are in the states given in Table 2 for a de-energized relay.

Terminals		Contact State	
		Relay De-energized	Relay Energized
41 - 42	(P111)	Closed	Open
41 - 44	(P111)	Open	Closed

Table 2: Watchdog contact status

4.1.5 Auxiliary supply

The relay can be operated from either a dc only or AC/DC auxiliary supply depending on the relay's nominal supply rating. The incoming voltage must be within the operating range specified in Table 3.

Without energizing the relay 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	[24 - 48]	19 to 75V	19 to 53V
60 - 240V	[60 - 240V]	48 to 300V	48 - 265V

Table 3: Operational range of auxiliary supply Vx

It should be noted that the relay can withstand an ac ripple of up to 12% of the upper rated voltage on the dc auxiliary supply.

Do not energize the relay or interface unit using the battery charger with the battery disconnected as this can irreparably damage the relay's power supply circuitry.

Energize the relay 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 relay.

4.2 With the relay energized

The following group of tests verify that the relay hardware and software is functioning correctly and should be carried out with the auxiliary supply applied to the relay.

The current transformer connections must remain isolated from the relay for these checks. The trip circuit should also remain isolated to prevent accidental operation of the associated circuit breaker.

CM

4.2.1 Watchdog contacts

Using a continuity tester, check the watchdog contacts are in the states given in Table 2 for an energized relay.

4.2.2 Date and time

The date and time should now be set to the correct values via RS485.

4.2.3 Light emitting diodes (LEDs)

Send command TEST via S1 software and look if all protection LED are lit

4.2.4 Input opto-isolators (not available in Model L)

This test checks that all the opto-isolated inputs on the relay are functioning correctly.

- The P111 with I/O option "A" (model no. begins: P111xxx1..) has 2 opto inputs
- The P111 with I/O option "B" (model no. begins: P111xxx2..) has 2 opto inputs
- The P111 with I/O option "E" (model no. begins: P111xxx5..) has 4 opto inputs
- The P111 with I/O option "F" (model no. begins: P111xxx6..) has 4 opto inputs

The opto-isolated inputs should be energized one at a time, see external connection diagrams (P111/EN IN) for terminal numbers.

Ensuring that the correct opto input nominal voltage is set in the 'Opto Config.' menu and correct polarity, connect the field supply voltage to the appropriate terminals for the input being tested. Each opto input also has selectable filtering. This allows use of a pre-set filter of ½ a cycle that renders the input immune to induced noise on the wiring.

Note 1: The opto-isolated V1 (V1-C terminals) and V2 (V2-C terminals) inputs may be energized from an eternal 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 relay may result. If an external 24-48V, 60-240V supply is being used it will be connected to the relays optically isolated inputs directly. If an external supply is being used than it must be energized for this test but only if it has been confirmed that it is suitably rated with less than 12% ac ripple.

Note 2: The opto-isolated inputs PTC (T1-T2 terminals) and SIn (S1-S2 terminals) are energized by shorting terminals only. No any voltage an terminals T1, T2, S1, S2 are allowed

4.2.5 Output relays

This test checks that all the output relays are functioning correctly.

- The P111 with I/O option “L” (model no. begins: P111xxx0..) has 2 relay outputs
- The P111 with I/O option “A” (model no. begins: P111xxx1..) has 2 relay outputs
- The P111 with I/O option “B” (model no. begins: P111xxx2..) has 2 relay outputs
- The P111 with I/O option “E” (model no. begins: P111xxx5..) has 4 opto outputs
- The P111 with I/O option “F” (model no. begins: P111xxx6..) has 4 opto outputs

Connect a continuity tester across the terminals corresponding to output relay 1 as given in external connection diagram (P111/EN IN).

4.2.6 Rear communications port

This test should only be performed where the relay is to be accessed from a remote location and for local setting of P111. For connection to PC RS232/RS485 should be applied.

4.2.6.1 MODBUS communications

Connect a portable PC running the appropriate MODBUS Master Station software to the relays first rear EIA(RS)485 port via an EIA(RS)485 to EIA(RS)232 interface converter. The terminal numbers for the relays EIA(RS)485 port are given in Table 8.

Ensure that the relay address, baud rate in the application software are set the same as those in cells of the relay.

Check that communications with this relay can be established.

4.2.7 Current inputs

This test verifies that the accuracy of current measurement is within the acceptable tolerances.

Apply current equal to the line current transformer secondary winding rating to each current transformer input of the corresponding rating in turn, see Table 1 or external connection diagram (P111/EN IN) for appropriate terminal numbers, checking its magnitude using a multimeter/test set readout. The corresponding reading can then be checked in the relay’s measurement column and value displayed recorded.

The measured current values displayed on the relay LED display or a portable PC connected to the front communication port will either be in primary or secondary Amperes. All values are in primary, the values displayed should be equal to the applied current multiplied by the corresponding current transformer ratio set in proper cell..

The measurement accuracy of the relay is ±10% (. However, an additional allowance must be made for the accuracy of the test equipment being used.

5. SETTING CHECKS

The setting checks ensure that all of the application-specific relay settings (i.e. the relay's function), for the particular installation, have been correctly applied to the relay.

Note: The trip circuit should remain isolated during these checks to prevent accidental operation of the associated circuit breaker.

5.1 Apply application-specific settings

There are two methods of applying the settings to the relay:

Transferring them from a pre-prepared setting file to the relay using a portable PC running the appropriate software via rear communications port (with a EIA(RS)232/EIA(RS)485 converter connected). This method is preferred for transferring function settings as it is much faster and there is less margin for error. .

If a setting file has been created for the particular application and provided on a diskette, this will further reduce the commissioning time and should always be the case where application-specific scheme logic is to be applied to the relay.

Enter them manually via the relay's operator interface.

5.2 Demonstrate correct relay operation

Tests have already demonstrated that the relay is within calibration, thus the purpose of these tests is as follows:

- To determine that the primary protection functions of the relay, overcurrent, earth-fault etc. can trip according to the correct application settings.
- To verify correct assignment of the trip contacts, by monitoring the response to a selection of fault injections.

5.2.1 Overcurrent protection testing

This test, performed on stage 1 of the overcurrent protection function in setting group 1, demonstrates that the relay is operating correctly at the application-specific settings.

5.2.1.1 Connection and preliminaries

Determine which output relay has been selected to operate when an I> trip occurs by viewing configuration cells.

The associated terminal numbers can be found from the external connection diagram (P111/EN IN)

Connect the output relay so that its operation will trip the test set and stop the timer.

Connect the current output of the test set to the 'A' phase current transformer input of the relay (terminals 1 and 2).

Ensure that the timer will start when the current is applied to the relay.

5.2.1.2 Perform the test

Ensure that the timer is reset.

Apply a current of twice the setting in cell I> to the relay and note the time displayed when the timer stops.

Check that the red I> LED has illuminated. Clear I> LED.

5.2.1.3 Check the operating time

Check that the operating time recorded by the timer is within the range shown in Table 9.

Note: Except for the definite time characteristic, the operating times given in Table 9 are for a time multiplier or time dial setting of 1. Therefore, to obtain the operating time at other time multiplier or time dial settings, the time given in Table 9 must be multiplied by the setting of t cell for IEC characteristics.

In addition, for definite time and inverse characteristics there is an additional delay of up to 0.1 second that may need to be added to the relay's acceptable range of operating times.

For all characteristics, allowance must be made for the accuracy of the test equipment being used.

Characteristic	Operating Time at Twice Current Setting and Time Multiplier/Time Dial Setting of 1.0	
	Nominal (Seconds)	Range (Seconds)
DT	[0404: I> Time Delay] Setting	Setting ±5%
IEC S Inverse	10.03	9.53 - 0.53
IEC V Inverse	13.50	12.83 - 14.18
IEC E Inverse	26.67	24.67 - 28.67

Table 9: Characteristic operating times for I>

Reconfigure to test a B phase fault. Repeat the test in section 5.2.1.2, this time ensuring that the breaker trip contacts relative to B phase operation close correctly. Record the phase B trip time. Repeat for C phase fault. Switch OFF the ac supply and reset the alarms.

CM

5.3 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 relay using a portable PC running the appropriate software via the front EIA(RS)232 port, located under the bottom access cover, or rear communications port (with a EIA(RS)232/EIA(RS)485 converter connected). Compare the settings transferred from the relay 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 relay's operator interface and compare them with the original application-specific setting record. Ensure that all protection elements required have been enabled in the configuration column.

6. ON-LOAD CHECKS

The objectives of the on-load checks are to:

- Confirm the external wiring to the current inputs is correct.

However, these checks can only be carried out if there are no restrictions preventing the energization of the plant being protected and the other P111 relays in the group have been commissioned.

If it has been necessary to disconnect any of the external wiring from the relay in order to perform any of the foregoing tests, it should be ensured that all connections are replaced in accordance with the relevant external connection or scheme diagram.

6.1 Confirm current transformer wiring

Measure the current transformer secondary values for each input using a multimeter connected in series with the corresponding relay current input.

Ensure the current flowing in the neutral circuit of the current transformers is negligible.

Compare the values of the secondary phase currents and phase angle with the relay's measured values, which can be found in the measurement menu column.

The currents displayed on the LCD or a portable PC connected to the front EIA(RS)485 communication port of the relay should be equal to the applied primary current. The values should be within 10% of the applied primary currents. However, an additional allowance must be made for the accuracy of the test equipment being used.

WARNING: NEVER OPEN CIRCUIT THE SECONDARY CIRCUIT OF A CURRENT TRANSFORMER SINCE THE HIGH VOLTAGE PRODUCED MAY BE LETHAL AND COULD DAMAGE INSULATION.

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 relay in order to perform the wiring verification tests, it should be ensured that all connections (wiring, fuses and links) are replaced in accordance with the relevant external connection or scheme diagram.

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 event records, fault records, LEDs have been reset before leaving the relay.

8. COMMISSIONING TEST RECORD

Date:		Engineer:	
Station:		Circuit:	
		System Frequency:	Hz
		CT Ratio (tap in use):	/ A

Front Plate Information

Overcurrent protection relay	**MiCOM P111**
Model number	
Serial number	
Rated current In	1A ☐ 5A ☐
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.

Injection test set	Model: Serial No:	
Insulation tester	Model: Serial No:	
Setting software:	Type: Version:	

*Delete as appropriate

Have all relevant safety instructions been followed? Yes* ☐ No* ☐

5. **Product Checks**

5.1 **With the relay de-energized**

5.1.1 Visual inspection

Relay damaged?	Yes* ☐ No* ☐
Rating information correct for installation?	Yes* ☐ No* ☐
Case earth installed?	Yes* ☐ No* ☐

5.1.3 Insulation resistance >100MΩ at 500V dc

Yes* ☐ No* ☐

Not Tested* ☐

5.1.4 External wiring

Wiring checked against diagram? Yes* ☐ No* ☐

5.1.5 Watchdog contacts (auxiliary supply off)

Terminals 41 and 42	Contact closed?	Yes* ☐ No* ☐
Terminals 41 and 44	Contact open?	Yes* ☐ No* ☐

5.1.6 Measured auxiliary supply _____ V ac/dc*

5.2 **With the relay energized (if P4 set to watchdog function)**

5.2.1 Watchdog contacts (auxiliary supply on)

Terminals 41 and 42	Contact open?	Yes* ☐ No* ☐
Terminals 41 and 44	Contact closed?	Yes* ☐ No* ☐

5.2.2 LED front panel display

Is the LED lit? (all digits are lit?) Yes* ☐ No* ☐

5.2.3 Date and time

Clock set to local time via setting software? Yes* ☐ No* ☐

Time maintained when auxiliary supply removed? Yes* ☐ No* ☐

CM

5.2.4 Light emitting diodes

5.2.4.1 All 6 protection LEDs working (command TEST via S1 software)? Yes* ☐ No* ☐

5.2.5 Field supply voltage

Value measured between terminals 8 and 9 _____ V dc

5.2.6 Input opto-isolators (checking via S1 software)

Opto input 1 (Ptc)	working?	Yes* ☐ No* ☐ N/A* ☐
Opto input 2 (Sin)	working?	Yes* ☐ No* ☐ N/A* ☐
Opto input 3 (V1)	working?	Yes* ☐ No* ☐ N/A* ☐
Opto input 4 (V2)	working?	Yes* ☐ No* ☐ N/A* ☐

5.2.7 Output relays

Relay 1 (P1)	working?	Yes* ☐ No* ☐
Relay 2 (P2)	working?	Yes* ☐ No* ☐
Relay 3 (P3)	working?	Yes* ☐ No* ☐ N/A* ☐
Relay 4 (P4)	working?	Yes* ☐ No* ☐ N/A* ☐

CM

5.2.8 Communication standard MODBUS

Communications established? Yes* ☐ No* ☐ N/A* ☐

Protocol converter tested? Yes* ☐ No* ☐ N/A* ☐

5.2.9 Current inputs

Displayed current Primary* ☐ Secondary* ☐

Phase CT ratio _____ N/A* ☐

Earth fault CT ratio _____ N/A* ☐

Input CT	Applied Value	Displayed Value
IA	_____ A	_____ A
IB	_____ A	_____ A
IC	_____ A	_____ A
IN	_____ A N/A* ☐	_____ A N/A* ☐

6. Setting Checks

6.1	Protection function timing tested?	Yes* ☐ No* ☐
	Overcurrent type (set in cell [I>)	Non-Directional* ☐
	Applied current	_____ A
	Expected operating time	_____ s
	Measured operating time	_____ s

8. Final Checks

All test equipment, leads, shorts and test blocks removed safely?	Yes* ☐ No* ☐
Disturbed customer wiring re-checked?	Yes* ☐ No* ☐ N/A* ☐
All commissioning tests disabled?	Yes* ☐ No* ☐
Event records reset (via S1 software)?	Yes* ☐ No* ☐
Fault records reset (via S1 software)?	Yes* ☐ No* ☐
LEDs reset?	Yes* ☐ No* ☐

COMMENTS #
(# Optional, for site observations or utility-specific notes).

Commissioning Engineer

Customer Witness

Date:

Date:

9. SETTING RECORD

Date:		Engineer:	
Station:		Circuit:	
		System Frequency:	Hz
		CT Ratio (tap in use):	/ A

Front Plate Information

Overcurrent protection relay	**MiCOM P111**
Model number	
Serial number	
Rated current In	1A ☐ 5A ☐
Auxiliary voltage Vx	

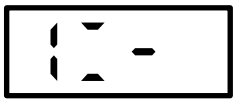
Setting Groups Used

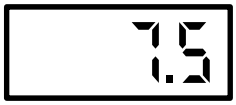
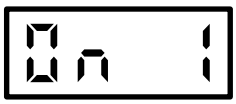
*Delete as appropriate

Group 1	Yes* ☐ No* ☐
Group 2	Yes* ☐ No* ☐

I> Function

0400

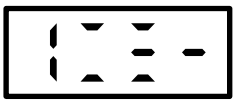


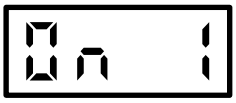
0402	'toc.' – type of time characteristic: 	
0403	I> Current Set 	
0404	I> Time Delay or TMS (depend on toc setting) 	
0405	'On' - Configuration of protection 	

CM

I>> Function

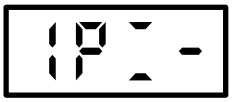
0500

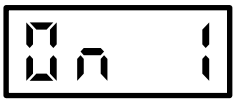


0501	I>> Current Set 	
0502	I>> Time Delay 	
0503	'On' - Configuration of protection 	

Ip> Function

0600

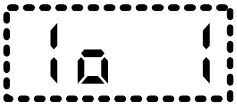


0601	'toc.' – type of time characteristic: 	
0602	Ip> Current Set 	
0603	Ip> Time Delay or TMS (depend on toc setting) 	
0604	'On' - Configuration of protection 	

CM

‘Io1’ – Io> Function

0700

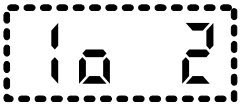


Note: Model B, E, F, L only

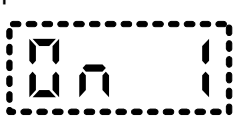
0701	‘toc.’ – type of time characteristic: 	
0702	Io> Current Set 	
0703	Io> Time Delay or TMS (depend on toc setting) 	
0704	‘On’ - Configuration of protection 	

‘Io2’ – Io>> Function

0800



Note: Model B, E, F, L only

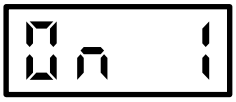
0801	‘toc.’ – type of time characteristic: 	
0802	Io>> Current Set 	
0803	Io>> Time Delay or TMS (depend on toc setting) 	
0804	‘On’ - Configuration of protection 	

CM

‘PTC’ – External Trip Function

0900

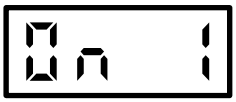
Note: Model A, B, E, F only

0901	‘On’ - Configuration of protection 	

‘ZZ’ – External Trip Function

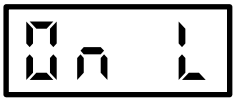
1000

Note: Model E, F only

1001	‘On’ - Configuration of protection 	

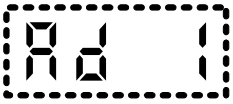
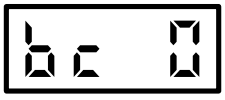
‘Set1’ – Generic parameters

1100

1101	‘On L’ - a current mode of relay operation 	
1102	‘Gr’ - Configuration of protection 	
1103	A time delay for changing an active setting group 	
1104	‘P’ – CT ratio for phase current	

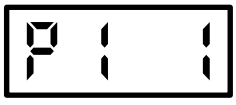
‘Set1’ – Generic parameters

1100

		
1105	‘E’ – CT ratio for earthfault current  Note: Model B, E, F, L only	
1106	‘Ad’ – RS485 address  Note: B, E, L (option) only	
1107	Baud Rate for RS485  Note: B, E, L (option) only	
1108	‘bc’ – frame format  Note: B, E, L (option) only	
1109	‘P’ – Password 	

‘Set2’ – I/O configuration

1200

1201	‘P1’ - output relay P1 configuration (13-14 terminals) 	
1202	‘P2’ - output relay P2 configuration (23-24 terminals) 	
1203	‘P2c’ – latching of P2 configuration	

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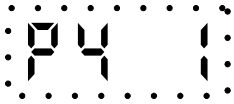
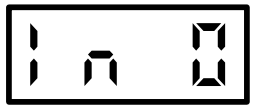
‘Set2’ – I/O configuration

1200

	(23-24 terminals) 	
1204	‘P3’ - output relay P3 configuration (33-34 terminals)  Note: Model E, F only	
1205	‘P3c’ – latching of P3 configuration (33-34 terminals)  Note: Model E, F only	
1206	‘P4’ - output relay P4 configuration (41-42-44 terminals)  Note: Model E, F only	
1207	‘P4c’ – latching of P4 configuration (41-42-44 terminals)  Note: Model E, F only	
1208	‘In’ – Binary input ‘SIn’ (terminals: S1-S2). Energizing by shorting of terminals S1-S2.  Note: Model A, B, E, F only	
1209	‘Ptc’ - Binary input ‘tIn’ (terminals: T1-T2). Energizing by shorting of terminals T1-T2.  Note: Model A, B, E, F only	

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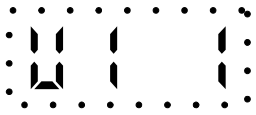
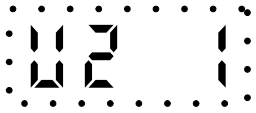
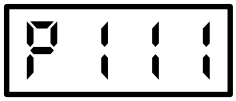
‘Set2’ – I/O configuration

1200

1209	‘V1’ - Binary input ‘tIn’ (terminals: V1-C). Energizing by presence of Vx on terminals V1-C.  Note: Model E, F only	
1209	‘V2’ - Binary input ‘tIn’ (terminals: V2-C). Energizing by presence of Vx on terminals V2-C.  Note: Model E, F only	

‘IdEn’ – identification of relay column

1300

1301	The type of relay:  	
1302	Hardware version:  	
1303	Firmware version:  	

CM

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Commissioning Engineer	Customer Witness
Date:	Date:

MAINTENANCE

MT

Date:	**5th December 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

MT

CONTENTS

MT

MT

1. MAINTENANCE

1.1 Maintenance period

It is recommended that products supplied by Schneider Electric receive periodic monitoring after installation. In view of the critical nature of protective relays 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 relays are self-supervising and so require less maintenance than earlier designs of relay. 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 relay is functioning correctly and the external wiring is intact.

1.2 Maintenance checks

Although some functionality checks can be performed from a remote location by utilizing the communications ability of the relays, these are predominantly restricted to checking that the relay is measuring the applied currents accurately. Therefore 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 GUIDE SFTY/4LM/E11 OR LATER ISSUE, OR THE SAFETY AND TECHNICAL DATA SECTION OF THE TECHNICAL MANUAL AND ALSO THE RATINGS ON THE EQUIPMENT RATING LABEL.

1.2.1 Opto-isolators (not available in Model L)

The opto-isolated inputs can be checked to ensure that the relay responds to their energization by repeating the commissioning test detailed in section 5.2.6 of the Commissioning section (P111/EN CM).

1.2.2 Output relays

The output relays can be checked to ensure that they operate by repeating the commissioning test detailed in section 5.2.7 of the Commissioning section (P111/EN CM).

1.2.3 Measurement accuracy

If the power system is energized, the values measured by the relay can be compared with known system values to check that they are in the approximate range that is expected. If they are then the analog/digital conversion and calculations are being performed correctly by the relay. Suitable test methods can be found in sections 7.1.1 and 7.1.2 of the Commissioning section (P111/EN CM).

Alternatively, the values measured by the relay can be checked against known values injected into the relay via the test block, if fitted, or injected directly into the relay terminals. Suitable test methods can be found in sections 5.2.10 and 5.2.11 of the Commissioning section (P111/EN CM). These tests will prove the calibration accuracy is being maintained.

1.3 Method of repair

It is recommended that the P111 relay is returned to an Schneider Electric service centre for repair.

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

1.4 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 moistened with clean water. The use of detergents, solvents or abrasive cleaners is not recommended as they may damage the relay's surface and leave a conductive residue.

TROUBLESHOOTING

TS

Date:	**12th December 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

TS

CONTENTS

TS

1. INTRODUCTION

Before carrying out any work on the equipment, the user should be familiar with the contents of the safety and technical data sections and the ratings on the equipment's rating label

The purpose of this section of the service manual is to allow an error condition on the relay to be identified so that appropriate corrective action can be taken.

In cases where a faulty relay is being returned to the manufacturer or one of their approved service centers, 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
Relay fails to power up	Section 3
Mal-operation of the relay during testing	Section 4

Table 1: Problem identification

3. POWER UP ERRORS

If the relay 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 relay or the relay front panel.

Test	Check	Action
1	Measure auxiliary voltage on terminals A1 and A2; verify voltage level and polarity against rating the label on front.	If auxiliary voltage is present and correct, then proceed to test 2. Otherwise the wiring/fuses in auxiliary supply should be checked.
2	LEDs/and LCD backlight illuminate on power-up, also check the N/O watchdog contact for closing.	If all protection LEDs illuminate but LED display is not illuminate then error is probably in the main processor board. If they do not illuminate and the contact does not close then proceed to test 3.
3	Make a shorting of T1 and T2 terminals via ampermeter (with 0-10mA measuring range). Check DC current. Note: Model L has no inputs so for this case this checking is not possible	If no any DC current (0.5mA-2mA) is present then the fault is probably in the relay power supply module.

Table 2: Failure of relay to power up

4. MAL-OPERATION OF THE RELAY DURING TESTING

4.1 Failure of output contacts

An apparent failure of the relay output contacts may be caused by the relay configuration; the following tests should be performed to identify the real cause of the failure.

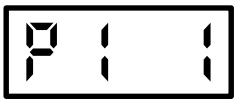
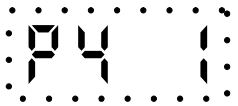
Test	Check	Action
1	Are protection LEDs flashing?	Flushing of protection LEDs may indicate that the relay is in test mode or that the protection has been disabled due to a setting mode.
2	Change settings of P111 to following configuration: in  column set: -  P1 output to '0' option (Circuit Breaker mode) -  P2 output to '1' option (trip of any protection) -  P3 output to '1' option (trip of any protection) -  P3 output to '1' option (trip of any protection) -  PTc input set to '0' (over temperature protection PTC) **(ABEF)*** Leave terminals T1 and T2 off (not shorted) 13-14 and 23-24 and 33-34 and 41-44 terminals should be closed (13-14 terminals – for 0.5s only). After that make a shorting of T1-T2 terminals: 13-14 and 23-24 and 33-34 and 41-44 terminals should be opened Note: This checking is not possible for Model B because has no binary inputs	If there is no any action of any contact output, after changing of PTC input (T1-T2 terminals) – it means that output relay is damaged.

Table 3: Failure of output contacts

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4.2 Failure of opto-isolated inputs (not applicable for Model L)

Note that 'In' (S1-S2 terminals) and 'PTC' (T1-T2 terminals) inputs are energized by shorting of adequate terminals. Applying of auxiliary voltage on such terminals will damage of binary inputs.

V1 (V1-C terminals) and V2 (V2-C terminals) are energized by auxiliary voltage.
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 relay 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 relay then the failure may be on the input card itself.

4.3 Incorrect analog signals

The measurements may be configured in primary or secondary to assist. If it is suspected that the analog quantities being measured by the relay are not correct then the measurement function of the relay can be used to verify the nature of the problem. The measured values displayed by the relay should be compared with the actual magnitudes at the relay terminals. Verify that the correct terminals are being used (in particular the dual rated CT inputs) and that the CT and VT ratios set on the relay are correct. The correct 120 degree displacement of the phase measurements should be used to confirm that the inputs have been correctly connected.

5. REPAIR AND MODIFICATION PROCEDURE

Please follow these 5 steps to return an Automation product to us:

1. Get the Repair and Modification Authorization Form (RMA)

Find a copy of the RMA form at the end of this section.

- To obtain an electronic version of the RMA form for e-mailing, please contact your local Schneider Electric service.

2. Fill

Fill in only the white part of the form.

Please ensure that all fields marked **(M)** are completed such as:

- Equipment model
- Model No. and Serial No.
- Description of failure or modification required (please be specific)
- Value for customs (in case the product requires export)
- Delivery and invoice addresses
- Contact details

3. Send RMA form to your local Schneider Electric contact

4. Receive from local service contact, the information required to ship the product

Your local service contact will provide you with all the information:

- Pricing details
- RMA n°
- Repair centre address

If required, an acceptance of the quote must be delivered before going to next stage.

5. Send the product to the repair centre

- Address the shipment to the repair centre specified by your local contact
- Ensure all items are protected by appropriate packaging: anti-static bag and foam protection
- Ensure a copy of the import invoice is attached with the unit being returned
- Ensure a copy of the RMA form is attached with the unit being returned
- E-mail or fax a copy of the import invoice and airway bill document to your local contact.

TS

SCADA COMMUNICATIONS

SC

Date:	**5th November 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

SC

CONTENTS

FIGURES

1. SCADA COMMUNICATIONS

1.1 Introduction

This section outlines the remote communications interfaces of the MiCOM relay. The relay supports Modbus RTU protocol via the rear communication interface (EIA(RS)485.

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 2-terminal screw connector located on the back of the relay. See section P111/EN IN for details of the connection terminals. The rear port provides EIA(RS)485 serial data communication and is intended for use with a permanently wired connection to a remote control center. Of the three connections, two are for the signal connection, and the other is for the earth shield of the cable. Care must be taken to observe the correct polarity.

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 (Figure 1)

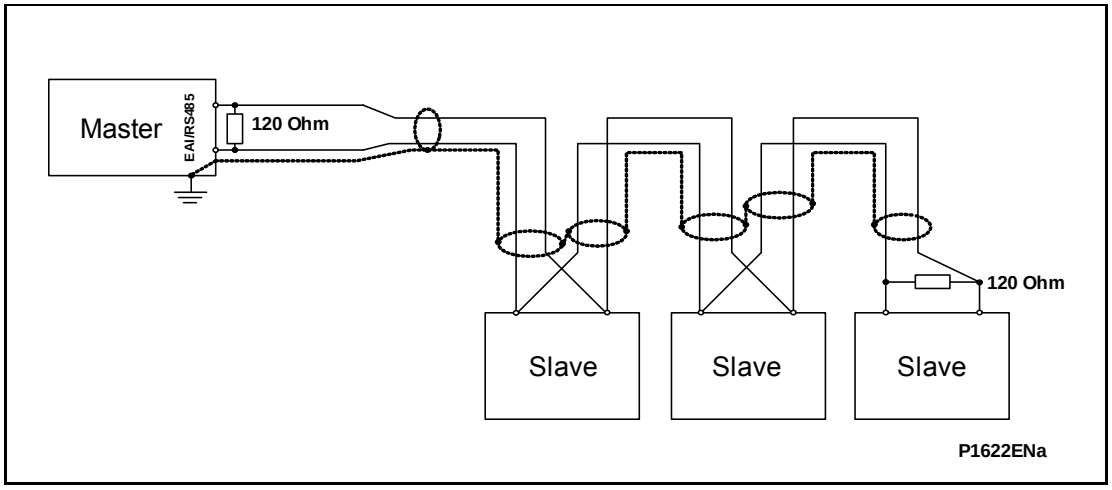


Figure 1: EIA(RS)485 bus connection arrangements

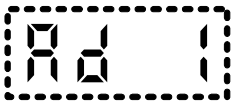
1.2.2 MODBUS communication

MODBUS is a master/slave communication protocol, which can be used for network control. 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.

To use the rear port with MODBUS communication, the relay's communication settings must be configured. To do this use the keypad and LED user interface. In the relay menu firstly check that the Communication settings in the 

column. Two settings apply to the rear port using MODBUS, which are described below. Move down the 

column from the column heading to the fifth cell down which indicates the MODBUS address of the relay:



Up to 32 relays can be connected to one MODBUS spur, and therefore 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. MODBUS uses an integer number between 1 and 255 for the relay address. It is important that no two relays have the same MODBUS address. The MODBUS address is then used by the master station to communicate with the relay.

The next cell down the column controls the baud rate to be used:

MODBUS communication is asynchronous. Three baud rates are supported by the relay, 1.2 kbits/s, 2.4 kbits/s, 4.8 kbits/s, 9.6 kbits/s and 19.2 kbits/s. It is important that whatever baud rate is selected on the relay is the same as that set on the MODBUS master station.

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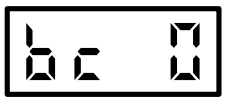
The next cell down controls the data frame format used in the data frames:



For communication with S1 software the setting should be ‘0’ – the format is the some as for P122, P123, P126, P127.

The parity format used in the data frames is not settable in P111: Parity None

2. 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

2.1 Communication link

This interface also uses the rear EIA(RS)485 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 and 1 stop bit (no parity). This gives 10 bits per character.

The following parameters can be configured for this port using either the front panel interface or the communication port:

- Baud rate
- Device address

2.2 Structure of the Modbus characters

2.2.1 Serial transmission mode

- The data rate speed varies between 1200 and 19200 baud.
- The structure of a character is: 1 start / 8 bits / 1 stop / no parity: total 10 bits

2.2.2 Synchronization of exchanged messages

Any character received after a silence on the line which is greater than or equal to the transmission time of 3 characters is considered as the start of a frame.

2.2.3 Error checking method

The validation of a frame is performed with a 16-bit cyclical redundancy check (CRC). The generator polynomial is:

1 + x2 + x15 + x16 = 1010 0000 0000 0001 binary =A001h.

2.3 Modbus protocol applied to the MiCOM P111 range

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2.3.1 Slave number of the MiCOM P111 relay

The MiCOM P111 address is situated between 1 and 254. This address can be configured through the operator.

2.3.2 MODBUS functions used by the MiCOM P111 relay

The MiCOM P111 relays feature the following MODBUS functions:

Function	MODBUS function supported	Application
3	Read Holding Registers	Reading of n words
4	Read Input Registers	Reading of n words
6	Force Single Coil	Writing of 1 word
7	Read Exception Status	Fast read of 8 bits
16	Preset Multiple Registers	Write of n words

2.3.3 Presentation of the MODBUS protocol

MODBUS is a master-slave protocol whereby every exchange involves a master query and a slave response.

2.3.4 Format of frames received by the MiCOM P111

Frame transmitted by the master (query):

Slave number	Function code	Information	Control Word
1 byte	1 byte	n bytes	2 bytes

Slave no.: the slave no. is situated between 1 and 254

Function code: requested MODBUS function (3, 4, 6, 7 or 16)

Information: contains the parameters of the selected function

Control word: value of the CRC16 calculated by the master

2.3.5 Format of frames sent by the MiCOM P111

Frame sent by the MiCOM P111 relay (response):

Slave number	Function code	Data	Control Word
1 byte	1 byte	n bytes	2 bytes

Slave no.: the slave no. is situated between 1 and 254

Function code: processed MODBUS function (3, 4, 6, 7 or 16)

Data: contains reply data to master query

Control word: value of the CRC16 calculated by the MiCOM P111 relay

2.3.6 Message validity check

When the relay receives a master query, it validates the frame:

- If the CRC is false, the frame is invalid. The MiCOM P111 relay does not reply. The master must retransmit its query.
- If the CRC is good but the MiCOM P111 relay can not process the query, it sends an exception response.

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Warning frame sent by the MiCOM P111 relay (response):

Slave number	Function code	Exception code	Control Word
1 byte	1 byte	1 byte	2 bytes (LSB MSB)

Slave no.: the slave number is situated between 1 and 254

Function code: 81h, 83h, 84h or 87h

The function code returned by the MiCOM P111 relay in the warning frame is the code in which the most significant bit (b7) is forced to 1.

Exception code: On of the 8 MODBUS protocol exception codes, the MiCOM P111 relay manages four of them:

- code 01: function code unauthorized or unknown,
- code 03: a value in the data field is unauthorized (incorrect data),
- code 04: device is busy (remote control during processing previous remote control),
- code 07: negative acknowledgement (writing can not be performed ex. device in maintenance state, off-line).

Control word: value of the CRC 16 calculated by the slave

2.3.7 MiCOM P111 database organization

Data in the MiCOM P111 relay database is organized in accordance with the mapping described in chapter 3.

2.4 Using MODBUS for accessing the MiCOM P111 data

2.4.1 MiCOM P111 relay data structure

Data field in response frame for function 3, 4 or 16 is organized by 2-byte (16-bits) registers, transmitted in ascending order of address. Order of the last and the most significant bytes in single 2-byte register is depended on **bc** parameter (device setting).

bc parameter is default set to zero for firmware version 6.A or higher.

When **bc=0**, the most significant byte (MSB) is followed by the last significant byte (LSB).

Slave number	Function code	Byte Count	Data	Control Word
1 byte	1 byte	1 byte	MSB LSB, MSB LSB, MSB LSB Reg 0 Reg 1 ... Reg n	LSB MSB 2 bytes

When **bc=1**, the last significant byte (LSB) is followed by the most significant byte (MSB)

Slave number	Function code	Byte Count	Data	Control Word
1 byte	1 byte	1 byte	LSB MSB, LSB MSB, LSB MSB Reg 0 Reg 1 ... Reg n	LSB MSB 2 bytes

2.4.2 Function 3 or 4 (reading of n words)

Example of reading settings:

Query:

Slave number	Function	Register address	Number of registers	Error check CRC
01	03	01 10	00 06	C5 F1

Reply when **bc=0**:

Slave number	Function	Byte count	Data	Error check CRC
01	03	0C	00 01 00 02 00 01 00 03 00 00 00 02	5B ED

Reply when **bc=1**:

Slave number	Function	Byte count	Data	Error check CRC
01	03	0C	01 00 02 00 01 00 03 00 00 00 02 00	0F E6

2.4.3 Function 6 (writing of 1 word)

Example of remote open command:

Query:

Slave number	Function	Register address	Preset data	Error check CRC
01	06	04 00	00 08	89 3C

Reply:

For function 6, the response frame is identical to the query frame.

2.4.4 Function 7 (fast read of 8 bits)

Example of reading relay status:

Query:

Slave number	Function	Error check CRC
01	07	41 E2

Reply:

Slave number	Function	Data	Error check CRC
01	07	C0	22 60

2.4.5 Function 16 (write of n words)

Example of writing settings:

Query:

Slave number	Function	Register address	Number of registers	Byte count	Data	Error check CRC
01	10	01 10	00 06	0C	00 01 00 03 00 01 00 02 00 00 00 02	AE 46

Reply:

Slave number	Function	Register address	Number of registers	Error check CRC
01	10	01 10	00 06	40 32

2.5 MiCOM P111 Database organisation.

2.5.1 Description of application mapping.

MiCOM P111 application mapping has 4 pages of parameters.

Page	Address range		Description	Allowed function	Note
0h	0000h	003Fh	Product information, remote signaling, measurements	3, 4	Can only be read through communication
1h	0100h	017Fh	Settings	3, 4, 6, 16	Can be read and write
4h	0400h	0400h	Remote controls	6	Can only be write
8h	0800h	0803h	Date time	3, 4, 6, 16	Can be read and write
10h	1000h	1004h	Events	3, 4	Can only be read
12h	1200h	121Ah	Fault record	3, 4	Can only be read

2.5.2 Limitations

Modbus queries and responses for MiCOM P111 have following limitations:

- Range of register addresses in single frame can not exceed single page address range.
- Maximum number of data registers in single frame is 59.
- To write MiCOM P111 settings, relay must be in OFF-Line mode.

The proper sequence is:

- Prepare P111 to writing - switch to OFF-Line mode by remote control (register 400h, function 6, control code 42)
- Write settings (page 1h, function 6 or 16)
- Activate new settings - switch P111 to ON-Line mode by remote control (register 400h, function 6, control code 41)

2.5.3 Database

Address		Description		Format code	Hardware			Note
Dec	Hex				L	B	E	
Read only		Product information		Function 3 or 4				
0	0	Relay description characters 1 and 2		F10	x	x	x	P1
1	1	Relay description characters 3 and 4		F10	x	x	x	11
2	2	Relay description characters 5 and 6		F10	x	x	x	
3	3	Unit reference characters 1 and 2		F10	x	x	x	AL
4	4	Unit reference characters 3 and 4		F10	x	x	x	ST
5	5	Firmware version		F26	x	x	x	
6	6	Hardware version		F28	x	x	x	
7	7	Phase current range		F21	x	x	x	
8	8	Neutral current range		F21	x	x	x	
9-16	0009-000F	Reserved						
Read only		Signalling		Function 3 or 4				
16	10	Logical inputs status		F12		x	x	
17	11	Protection disable status		F20	x	x	x	
18	12	Reserved						
19	13	Logical outputs status		F13	x	x	x	
20-21	0014-0015	Reserved						
22	16	Io2> protection status		F16	x	x	x	
23	17	Io1> protection status		F16	x	x	x	

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Address		Description		Format code	Hardware			Note
Dec	Hex				L	B	E	
24	18	Reserved						
25	19	Ip> protection status		F16	x	x	x	
26	001A	I> protection status		F16	x	x	x	
27	001B	I>> protection status		F16	x	x	x	
28	001C	Reserved						
29	001D	Externel trip ZZ status		F16		x	x	
30	001E	Over temperature PTC protection status		F16		x	x	
31-39	001F-0027	Reserved						
Read only		Measurements		Function 3 or 4				
40-47	0028-002F	Reserved		F21				
48	30	Phase L1 current		F21	x	x	x	[A] x fp / 256 x 0.1
49	31	Phase L1 current		F21	x	x	x	[A] x 0.1
50	32	Phase L2 current		F21	x	x	x	[A] x fp / 256 x 0.1
51	33	Phase L2 current		F21	x	x	x	[A] x 0.1
52	34	Phase L3 current		F21	x	x	x	[A] x fp / 256 x 0.1
53	35	Phase L3 current		F21	x	x	x	[A] x 0.1
54	36	Neutral current		F21	x	x	x	[A] x fe / 256 x 0.01
55	37	Neutral current		F21	x	x	x	[A] x 0.01
56-59	0038-003B	Reserved						
Read only		Scale factors		Function 3 or 4				
60	003C	Reserved		F21				
61	003D	Reserved		F21				

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Address		Description		Format code	Hardware			Note
Dec	Hex				L	B	E	
62	003E	Phase current scale factor		F21	x	x	x	fp
63	003F	Neutral current scale factor		F21	x	x	x	fe
Read/Write		Settings		Function 3,4,6 or 16				
256	100	Modbus address		F21	x	x	x	
257	101	Baud rate		F38	x	x	x	
258	102	Password		F21	x	x	x	
259	103	Back compatibility mode		F27	x	x	x	
260	104	On/Off Line		F35	x	x	x	
261	105	Settings group		F37	x	x	x	
262	106	Switch settings group time delay		F21	x	x	x	
263	107	Phase current ratio		F21	x	x	x	
264	108	Neutral current ratio		F21	x	x	x	
265	109	Reserved						
266	010A	Neutral current range		F59				
267-271	010B-010F	Reserved						
272	110	RL1 (P1) configuration		F40	x	x	x	
273	111	RL2 (P2) configuration		F51	x	x	x	
274	112	RL2 (P2) latching mode		F33	x	x	x	
275	113	RL3 (P3) configuration		F52			x	
276	114	RL3 (P3) latching mode		F33			x	
277	115	RL4 (P4) configuration		F53			x	
278	116	Input 1 (T1-T2) configuration		F55		x	x	
279	117	Input 2 (S1-S2)		F56		x	x	

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Address		Description		Format code	Hardware			Note
Dec	Hex				L	B	E	
		configuration						
280	118	Input 3 (V1-C) configuration		F47			x	
281	119	Input 4 (V2-C) configuration		F58			x	
282-287	011A-011F	Reserved						
288	120	I>> configuration	group 0	F31	x	x	x	
289	121	I>>	group 0	F21	x	x	x	[A] x 0.1
290	122	tI>>	group 0	F21	x	x	x	[s] x 0.01
291	123	Reserved	group 0					
292	124	I>> configuration	group 1	F21	x	x	x	
293	125	I>>	group 1	F21	x	x	x	[A] x 0.1
294	126	tI>>	group 1	F21	x	x	x	[s] x 0.01
295	127	Reserved	group 1					
296	128	I> configuration	group 0	F31	x	x	x	
297	129	I>	group 0	F21	x	x	x	[A] x 0.1
298	012A	tI>	group 0	F21	x	x	x	[s] x 0.01
299	012B	I> type of characteristic	group 0	F36	x	x	x	
300	012C	I> configuration	group 1	F21	x	x	x	
301	012D	I>	group 1	F21	x	x	x	[A] x 0.1
302	012E	tI>	group 1	F21	x	x	x	[s] x 0.01
303	012F	I> type of characteristic	group 1	F36	x	x	x	
304	130	Ip> configuration	group 0	F31	x	x	x	
305	131	Ip>	group 0	F21	x	x	x	[A] x 0.1
306	132	tIp>	group 0	F21	x	x	x	[s] x 0.01
307	133	Ip> type of characteristic	group 0	F36	x	x	x	
308	134	Ip> configuration	group 1	F21	x	x	x	
309	135	Ip>	group 1	F21	x	x	x	[A] x 0.1

Address		Description		Format code	Hardware			Note
Dec	Hex				L	B	E	
310	136	tIp>	group 1	F21	x	x	x	[s] x 0.01
311	137	Ip> type of characteristic	group 1	F36	x	x	x	
312	138	Io1> configuration	group 0	F31	x	x	x	
313	139	Io1>	group 0	F21	x	x	x	[A] x 0.01
314	013A	tIo1>	group 0	F21	x	x	x	[s] x 0.01
315	013B	Io1> type of characteristic	group 0	F36	x	x	x	
316	013C	Io1> configuration	group 1	F21	x	x	x	
317	013D	Io1>	group 1	F21	x	x	x	[A] x 0.01
318	013E	tIo1>	group 1	F21	x	x	x	[s] x 0.01
319	013F	Io1> type of characteristic	group 1	F36	x	x	x	
320	140	Io2> configuration	group 0	F31	x	x	x	
321	141	Io2>	group 0	F21	x	x	x	[A] x 0.01
322	142	tIo2>	group 0	F21	x	x	x	[s] x 0.01
323	143	Io2> type of characteristic	group 0	F36	x	x	x	
324	144	Io2> configuration	group 1	F21	x	x	x	
325	145	Io2>	group 1	F21	x	x	x	[A] x 0.01
326	146	tIo2>	group 1	F21	x	x	x	[s] x 0.01
327	147	Io2> type of characteristic	group 1	F36	x	x	x	
328	148	Over temperature PTC configuration	group 0	F31	x	x	x	
329	149	Over temperature PTC configuration	group 1	F31		x	x	
330	014A	External trip ZZ configuration	group 0	F31		x	x	

SC

Address		Description		Format code	Hardware			Note
Dec	Hex				L	B	E	
331	014B	External trip ZZ configuration	group 1	F31		x	x	
332-383	014C-017F	Reserved						
Write only		Remote control		Function 6				
1024	400	Remote control		F9	x	x	x	
Read/Write		Date time		Function 3,4,6 or 16				
2048	800	hundreds / seconds		F60			x	
2049	801	minutes / hours		F61			x	
2050	802	day / month		F62			x	
2051	803	year		F21			x	
Read only		The oldest event record		Function 3 or 4				
4096	1000	code / value		F80			x	
4097	1001	hundreds / seconds		F60			x	
4098	1002	minutes / hours		F61			x	
4099	1003	day / month		F62			x	
4100	1004	year		F21			x	
Read only		Fault records		Function 3 or 4				
4608	1200	Cause of fault	record 1	F22	x	x	x	
4609	1201	Phase L1 fault current	record 1	F21	x	x	x	[A] x fp / 256 x 0.1
4610	1202	Phase L2 fault current	record 1	F21	x	x	x	[A] x fp / 256 x 0.1
4611	1203	Phase L3 fault current	record 1	F21	x	x	x	[A] x fp / 256 x 0.1
4612	1204	Neutral fault current	record 1	F21	x	x	x	[A] x fe / 256 x 0.01
4613-4617	1205-1209	Reserved	record 1	F21				
4618	120A	hundreds / seconds	record 1	F60			x	
4619	120B	minutes / hours	record 1	F61			x	

Address		Description		Format code	Hardware			Note
Dec	Hex				L	B	E	
4620	120C	day / month	record 1	F62			x	
4621	120D	year	record 1	F21			x	
4622	120E	Cause of fault	record 2	F22	x	x	x	
4623	120F	Phase L1 fault current	record 2	F21	x	x	x	[A] x fp / 256 x 0.1
4624	1210	Phase L2 fault current	record 2	F21	x	x	x	[A] x fp / 256 x 0.1
4625	1211	Phase L3 fault current	record 2	F21	x	x	x	[A] x fp / 256 x 0.1
4626	1212	Neutral fault current	record 2	F21	x	x	x	[A] x fe / 256 x 0.01
4627-4631	1213-1217	Reserved		F21				
4632	1218	hundreds / seconds	record 2	F60			x	
4633	1219	minutes / hours	record 2	F61			x	
4634	121A	day / month	record 2	F62			x	
4635	121B	year	record 2	F21			x	
4636	121C	Cause of fault	record 3	F22	x	x	x	
4637	121D	Phase L1 fault current	record 3	F21	x	x	x	[A] x fp / 256 x 0.1
4638	121E	Phase L2 fault current	record 3	F21	x	x	x	[A] x fp / 256 x 0.1
4639	121F	Phase L3 fault current	record 3	F21	x	x	x	[A] x fp / 256 x 0.1
4640	1220	Neutral fault current	record 3	F21	x	x	x	[A] x fe / 256 x 0.01
4641-4645	1221-1225	Reserved	record 3	F21				
4646	1226	hundreds / seconds	record 3	F60			x	
4647	1227	minutes / hours	record 3	F61			x	
4648	1228	day / month	record 3	F62			x	
4649	1229	year	record 3	F21			x	
Read only		Relay status		Function 7				

Address		Description		Format code	Hardware			Note
Dec	Hex				L	B	E	
		Relay status		F50	x	x	x	

2.5.4 Data formats

Code	Description
F9	Unsigned integer - Remote control word
	1 - test
	4 - clear protection
	5 - clear fault recorder
	6 - clear event recorder (model E only)
	8 - CB open
	16 - CB close
	22 - switch to settings group 0
	23 - switch to settings group 1
	41 - switch to ON-Line mode
	42 - switch to OFF-Line mode
F10	Characters ASCII
	byte 1: ASCII character 32-127
	byte 2: ASCII character 32-127
F12	Unsigned integer - Logical input status
	bit 0: logic input 1 (T1-T2)
	bit 1: logic input 2 (S1-S2)
	bit 2: logic input 3 (V1-C)
	bit 3: logic input 4 (V2-C)
	bits 4 to 15 reserved
F13	Unsigned integer - Logical output status
	bit 0: logic output RL1 (P1)
	bit 1: logic output RL2 (P2)
	bit 2: logic output RL3 (P3)
	bit 3: logic output RL4 (P4)
F14	Unsigned char - I/O status afetr start
	bit 0: logic input 1 (T1-T2)
	bit 1: logic input 2 (S1-S2)
	bit 2: logic input 3 (V1-C)
	bit 3: logic input 4 (V2-C)
	bit 4: logic output RL1 (P1)
	bit 5: logic output RL2 (P2)
	bit 6: logic output RL3 (P3)
	bit 7: logic output RL4 (P4)

Code	Description
F16	Unsigned integer - Protection status
	bits 0 to 4 reserved
	bit 5: trigger of protection
	bit 6: protection TRIP
	bits 7 to 15 reserved
F20	Unsigned integer - Protection disable status
	bit 0: reserved
	bit 1: reserved
	bit 2: Io2> disable
	bit 3: CB position
	bit 4:reserved
	bit 5: I> disable
	bit 6: I>> disable
	bit 7: Io1> disable
	bit 8: Ip> disable
	bit 9: reserved
	bit 10:reserved
	bit 11: reserved
	bits 12 to 13 reserved
	bit 14: PTC disable
	bit 15: ZZ disable
F21	Unsigned integer
F22	Unsigned integer - Cause of fault
	bit 0: reserved
	bit 1: reserved
	bit 2: Io2>
	bit 3: reserved
	bit 4:reserved
	bit 5: I>
	bit 6: I>>
	bit 7: Io1>
	bit 8: Ip>
	bit 9: reserved
	bit 10: reserved
	bit 11:reserved
	bits 12 to 13 reserved
	bit 14: PTC
	bit 15: ZZ

Code	Description
F26	Two-digit decimal number - Firmware version
	1st digit - major version
	2nd digit - minor version
	60: 6.A
	61: 6.B
	62: 6.C
	etc...
F27	Unsigned integer - Configuration
	0: disable
	1: enable
F28	Unsigned integer - Hardware version
	0: A
	1: B
	2: C
	...
	19: U
F31	Unsigned integer - Protection configuration
	0: disable
	1: trip
	2: alarm (warning signal)
F33	Unsigned integer - Latching mode
	0: without
	1: latching
F35	Unsigned integer - ON/OFF Line mode
	0: OFF Line
	1: ON Line
F36	Unsigned integer - Type of characteristic
	0: Definite Time
	1: IEC Standard Inverse Definite Minimum Time
	2: IEC Very Inverse Definite Minimum Time
	3: IEC Extremely Inverse Definite Minimum Time
F37	Unsigned integer - Settings group
	0: Group 0
	1: Group 1

Code	Description
F38	Unsigned integer - Baud rate value
	12: 1200 baud
	24: 2400 baud
	48: 4800 baud
	96: 9600 baud
	192: 19200 baud
	other values reserved
F39	Unsigned integer - direction
	0: no direction
	1: forward (line side)
	2: reverse (busbar side)
F40	Unsigned integer - RL1 (P1) configuration
	0: circuit breaker
	1: contactor without remote control
	2: contactor with remote control (L, B, E only)
F47	Unsigned integer - Input 3 (V1-C) configuration
	for model E:
	0: local CB close
	1: external trip ZZ
	2: lock outputs
F50	Unsigned integer - Relay status
	bit 0: logic output RL1 (P1)
	bit 1: logic output RL2 (P2)
	bit 2: logic output RL3 (P3)
	bit 3: logic output RL4 (P4)
	bit 4: relay has unreaded event (version E only)
	bit 5: alarm (warning signal) of any protection
	bit 6: trip of any protection
	bit 7: relay in ON-Line mode
F51	Unsigned integer - RL2 (P2) configuration
	for model L, B, E:
	0: trigger of any protection on trip
	1: trip of any protection
	2: alarm (warning signal) of any protection
	3: remote or local CB close

Code	Description
F52	Unsigned integer - RL3 (P3) configuration
	for model E:
	0: trigger of any protection on trip
	1: trip of any protection
	2: alarm (warning signal) of any protection
	3: trip Io1> protection
F53	Unsigned integer - RL4 (P4) configuration
	for model E:
	0: trigger of any protection on trip
	1: trip of any protection
	2: alarm (warning signal) of any protection
	3: watchdog
	4: Io2> trip
F55	Unsigned integer - Input 1 (T1-T2) configuration
	for version B, E:
	0: over temperature protection PTC
	1: reset of LEDs and latchings
	2: external trip ZZ
	3: lock communication
	4: settings group
F56	Unsigned integer - Input 2 (S1-S2) configuration
	for model B, E:
	0: reset of LEDs and latchings
	1: external trip ZZ
	2: lock communication
	3: settings group

Code	Description
F58	Unsigned integer - Input 4 (V2-C) configuration
	for model E:
	0: CB state
	1: external trip ZZ
	2: settings group
F59	Unsigned Integer - Neutral current range
	0: low range
	1: high range
F60	Unsigned integer - hundreds / seconds
	byte 0: hundreds of second
	byte 1: seconds
F61	Unsigned integer - minutes / hours
	byte 0: minutes
	byte 1: hours
F62	Unsigned integer - day / month
	byte 0: day
	byte 1: month
F80	Unsigned integer - Event code / value
	byte 0: event code (see: Events Mapping)
	byte 1: associated value

2.5.5 Events mapping

Event code	Description	Associated value meaning
0	empty event	n/a
1	I> trip	0 = off; 1 = on
2	I>> trip	0 = off; 1 = on
3	Ip> trip	0 = off; 1 = on
4	PTC trip	0 = off; 1 = on
5	ZZ trip	0 = off; 1 = on
6	Io1> trip	0 = off; 1 = on
7	Io2> trip	0 = off; 1 = on
8	reserved	0 = off; 1 = on
9	reserved	0 = off; 1 = on
10	reserved	0 = off; 1 = on
11	reserved	0 = off; 1 = on
21	input 1	0 = off; 1 = on
22	input 2	0 = off; 1 = on
23	input 3	0 = off; 1 = on
24	input 4	0 = off; 1 = on
31	output 1	0 = off; 1 = on
32	output 2	0 = off; 1 = on
33	output 3	0 = off; 1 = on
34	output 4	0 = off; 1 = on
41	settings group	0 = group 0; 1 = group 1
42	clear	0 = protections; 1 = faults; 2 = events
45	on line	0 = off; 1 = on
46	reset	n/a
50	remote control	see format F9
254	system start	see format F14

SYMBOLS AND GLOSSARY

SG

Date:	**5th December 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

SG

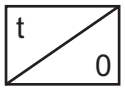
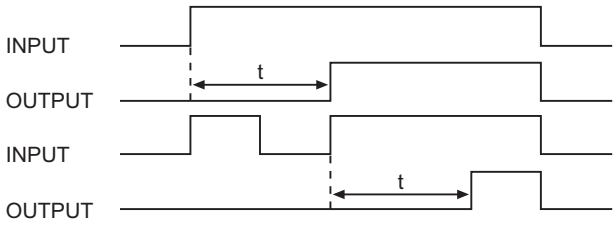
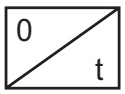
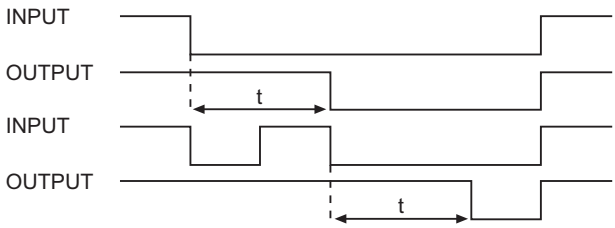
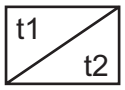
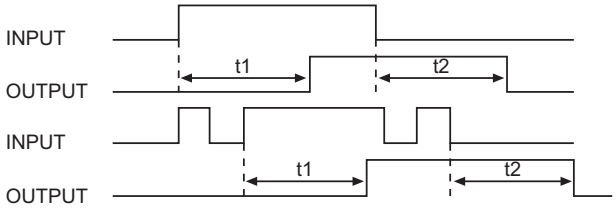
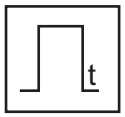
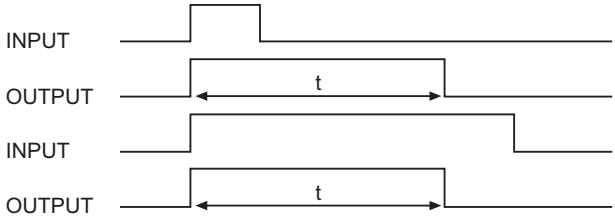
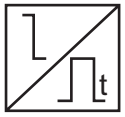
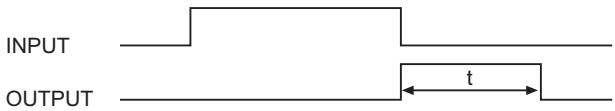
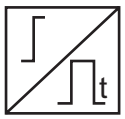
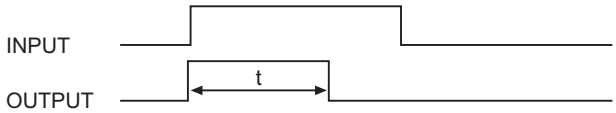
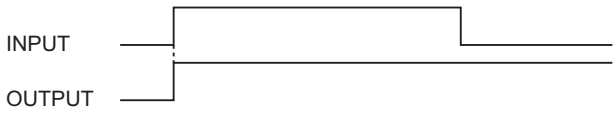
Logic Symbols

Symbols	Explanation
<	**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).
&	**Logical “AND”:** Used in logic diagrams to show an AND-gate function.
1	**Logical “OR”:** Used in logic diagrams to show an OR-gate function.
o	**A small circle on the input or output of a logic gate:** Indicates a NOT (invert) 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.
Σ	**“Sigma”:** Used to indicate a summation, such as cumulative current interrupted.
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.
CT	Current transformer.
Dly	Time delay.
DT	**Abbreviation of “Definite Time”:** An element which always responds with the same constant time delay on operation.
E/F	**Earth fault:** Directly equivalent to ground fault.
FLC	**Full load current:** The nominal rated current for the circuit.
Flt.	**Abbreviation of “Fault”:** Typically used to indicate faulted phase selection.
FN	Function.
Gnd.	**Abbreviation of “Ground”:** Used in distance settings to identify settings that relate to ground (earth) faults.
GRP.	**Abbreviation of “Group”:** Typically an alternative setting group.
I	Current.
Ip>	**First stage of phase overcurrent protection:** Could be labelled 51-1 in ANSI terminology.

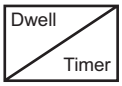
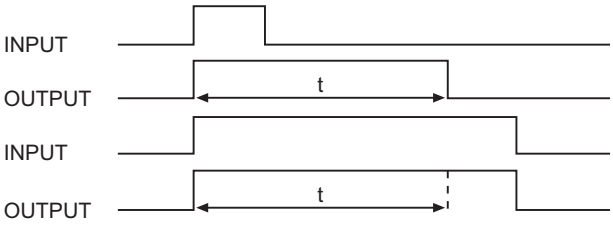
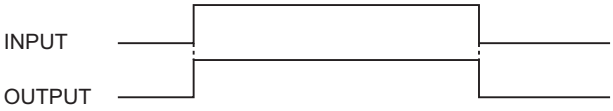
Symbols	Explanation
I>	**Second stage of phase overcurrent protection:** Could be labelled 51-2 in ANSI terminology.
I>>	**Third stage of phase overcurrent protection:** Could be labelled 51-3 in ANSI terminology.
I_0>	**Earth Fault current:** Equals the measured neutral/residual current.
IA	**Phase 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.
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.
IDMT	**Inverse definite minimum time:** A characteristic whose trip time depends on the measured input (e.g. current) according to an inverse-time curve.
In	**The rated nominal current of the relay:** Software selectable as 1 amp or 5 amp to match the line CT input.
IN	**Neutral current, or residual current:** This results from an external summation of the three measured phase currents.
Io1	**First stage of ground overcurrent protection:** Could be labelled 51N-1 in ANSI terminology.
Io2	**Second stage of ground overcurrent protection:** Could be labelled 51N-2 in ANSI terminology.
Inh	An inhibit signal.
Inst.	**An element with "instantaneous" operation:** i.e. having no deliberate time delay.
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".
LD	**Abbreviation of "Level Detector":** An element responding to a current or voltage below its set threshold.
LED	**Light emitting diode:** Red or green indicator on the relay front-panel.
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.

Symbols	Explanation
NXT	**Abbreviation of "Next":** In connection with hotkey menu navigation.
O/P	Abbreviation of "output".
Opto	**An optocoupled logic input:** Alternative terminology: binary input.
PCB	Printed circuit board.
Ph	**Abbreviation of "Phase":** Used in distance settings to identify settings that relate to phase-phase faults.
R	A resistance.
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.
t	A time delay.
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.
Vx	**An auxiliary supply voltage:** Typically the substation battery voltage used to power the relay.

Logic Timers

Logic Symbols	Explanation	Time Chart
	Delay on pick-up timer, t	
	Delay on drop-off timer, t	
	Delay on pick-up/drop-off timer	
	Pulse timer	
	Pulse pick-up falling edge	
	Pulse pick-up raising edge	
	Latch	

SG

Logic Symbols	Explanation	Time Chart
	Dwell timer	
	**Straight (non latching):** Hold value until input reset signal	

SG

INSTALLATION

Date:	**15th December 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

IN

CONTENTS

FIGURES

IN

1. RECEIPT OF RELAYS

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 P111/EN IN 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 that, although not always immediately apparent, will reduce the reliability of the circuit. The relay'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 relay has been designed and manufactured.

Before removing a printed circuit board, ensure that you are at the same electrostatic potential as the equipment by touching the case.

Handle analog 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.

Do not pass the module to another person without first ensuring you are both at the same electrostatic potential. Shaking hands achieves equipotential.

Place the module on an anti-static surface, or on a conducting surface that is at the same potential as you.

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 relay 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 500kΩ to 10MΩ. 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 British Standard document.

3. STORAGE

If relays 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.

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, relays should be stored at a temperature of between –25˚C to +70˚C (-13˚F to +158˚F).

4. UNPACKING

Care must be taken when unpacking and installing the relays so that none of the parts are damaged and additional components are not accidentally left in the packing or lost. Ensure that any User's CDROM or technical documentation is NOT discarded – this should accompany the relay to its destination substation.

Relays 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.

5. RELAY MOUNTING

MiCOM relays are dispatched either individually or as part of a panel/rack assembly.

Individual relays are normally supplied with an outline diagram showing the dimensions for panel cutouts and hole centers. This information can also be found in the product publication.

Secondary front covers can also be supplied as an option item to prevent unauthorized changing of settings and alarm status on DIN rail models.

The design of the relay 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 be positioned on the right-hand side of the relay (or relays) with which it is associated. This minimizes the wiring between the relay and test block, and allows the correct test block to be easily identified during commissioning and maintenance tests.

There are two housing types available: 35 mm DIN rail or flush mounted.

Rail mounted version:
Clip the relay onto a rail (no tool needed). In order to remove it from the rail use a narrow, flat screwdriver, put its tip in a special opening in the bottom part of the device's base and push the screwdriver handle upwards to release the spring bolt.

Flush mounted version:
Make a cut-out in mounting plate according to fig. 1. Then insert the relay into it. Fit fastening elements (see fig. 1) into the slots in the sides of the housing, and keep turning the fastening screws until the relay is securely fixed to the plate. To remove the relay undo the screws, so that the fastening element can be taken out, and then the relay can be withdrawn from the cut-out in the mounting plate.

6. RELAY WIRING

This section serves as a guide to selecting the appropriate cable and connector type for each terminal on the MiCOM relay.

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

6.1 Medium and heavy duty terminal block connections

Key:

Heavy duty terminal block: CT circuits, terminals 1-6

Medium duty: All other terminal blocks

The following minimum wire sizes are recommended:

Current Transformers	2.5mm^2
Auxiliary Supply, Vx	1.5mm^2
EIA(RS)485 Port	See separate section
S1-S2, T1-T2 terminals	Screened wires 1.0mm^2
Other Circuits	1.0mm^2

Heavy duty terminals in Flush case (1-6 terminals):

Threaded M3 terminals, with wire protection for conductor cross-section

- 0.2…6mm^2 single-core
- 0.2…4mm^2 finely stranded

Phase current inputs in rail mounting case:

The cables, which pass through the phase CT's built in P111must be insulated

Earth fault input (K-L terminals):

Threaded M3 terminals, with wire protection for conductor cross-section

- 0.2…4mm^2 single-core
- 0.2…2.5mm^2 finely stranded

General Input/Output Terminals

For power supply, opto and contact inputs, output contacts and COM rear communications.

Threaded M3 terminals, with wire protection for conductor cross-section

- (i) 0.2…4mm^2 single-core
- (ii) 0.2…2.5 mm^2 finely stranded

Connections to the equipment must only be made using single strand wire or stranded wire with the use of insulated crimp terminals.

For 'PTC' (T1-T2 terminals) and 'SIn' (S1-S2 terminals) inputs must used screened cable to connect these ports to other equipment .

The screen of each cable must be earthed at one end only and must be continuous. Multiple earthing of the screen can cause circulating currents to flow along the screen, which would induce the noise and also could be unsafe. To minimize noise pick-up it is recommended that low voltage cables are kept close to earthed metal casing and avoid areas of high electromagnetic and radio interference. The low voltage cables should not be routed adjacent to or in the same conduit as high voltage or current cables.

The wire used for all connections to the terminal blocks, except the EIA(RS)485 port, should have a minimum voltage rating of 300Vrms.

It is recommended that the auxiliary supply wiring should be protected by a 16A maximum rated 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 EIA(RS)485 port

Connections to the EIA(RS)485 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:	0.5mm^2 per core
Screen:	Overall braid, PVC sheathed

See SCADA Communications (P111/EN CT) for detailed discussion on setting up an EIA(RS)485 bus.

The RS485 communications port must used screened cable to connect this port to other equipment to maintain insulation requirements.

6.3 Watchdog contacts

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.

7. P111 CASE DIMENSIONS

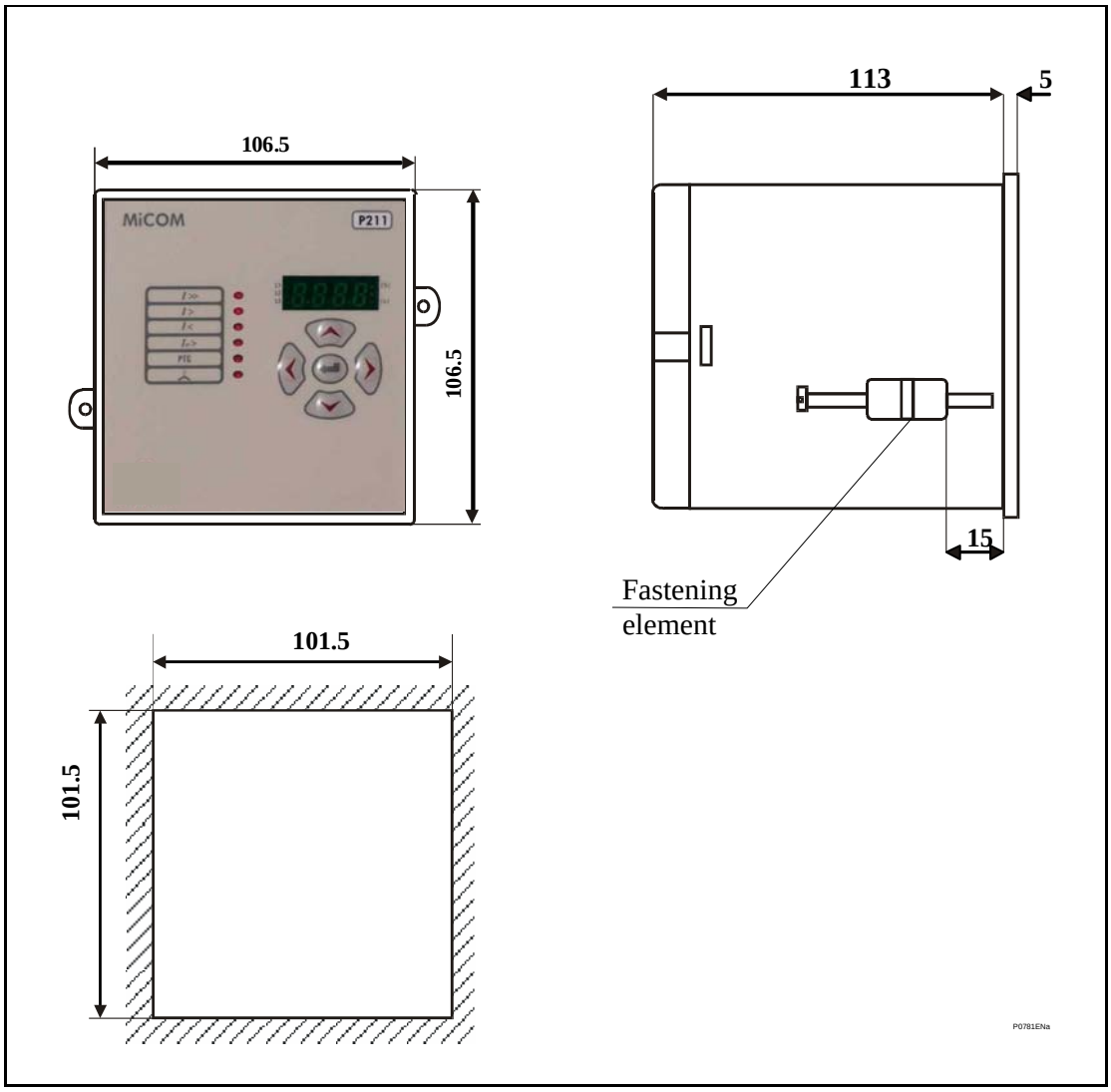


Figure 1: Case dimensions for flush mounting case

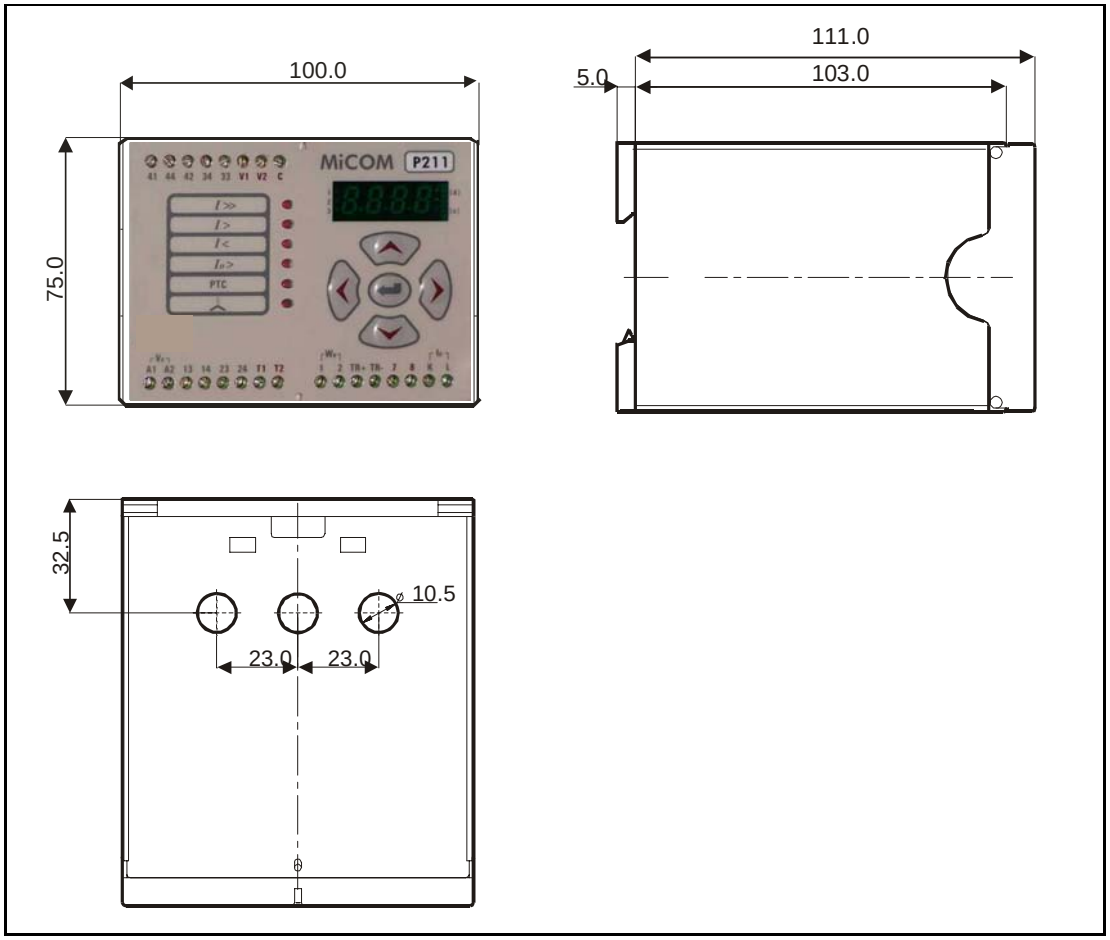


Figure 2: Case dimensions for rail mounting case (not available in Model L)

8. P111 EXTERNAL CONNECTION DIAGRAMS

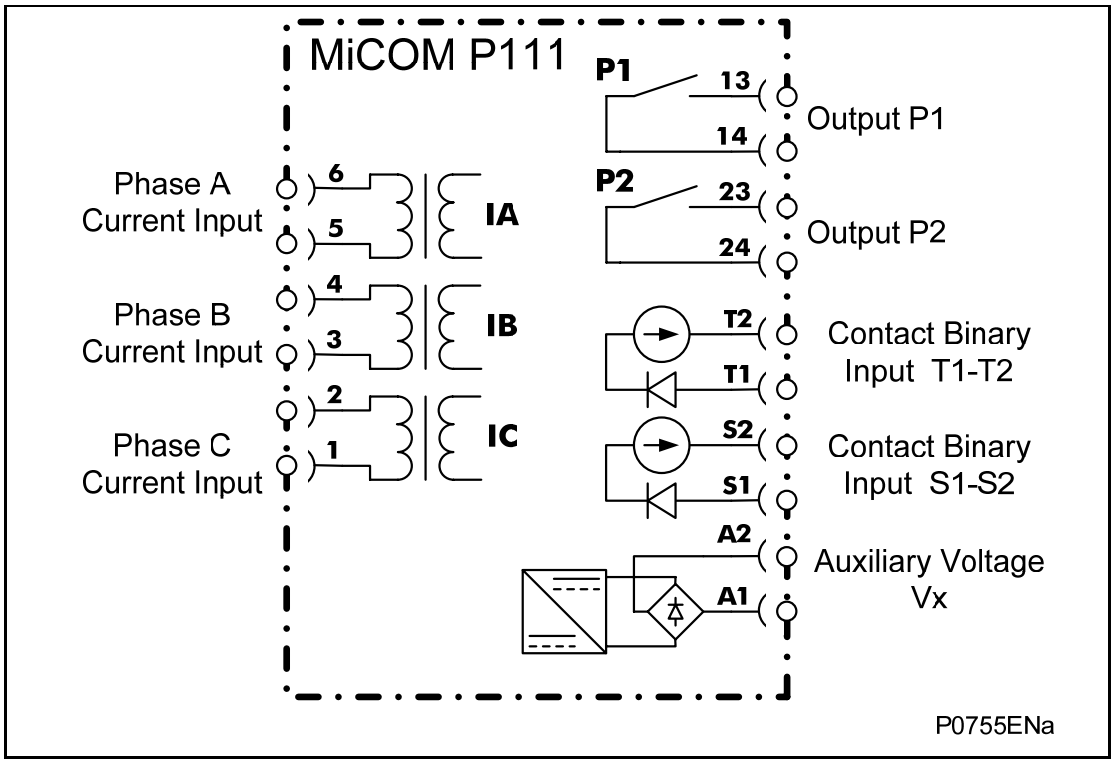


Figure 3: External connection diagram for model A, flush mounting case

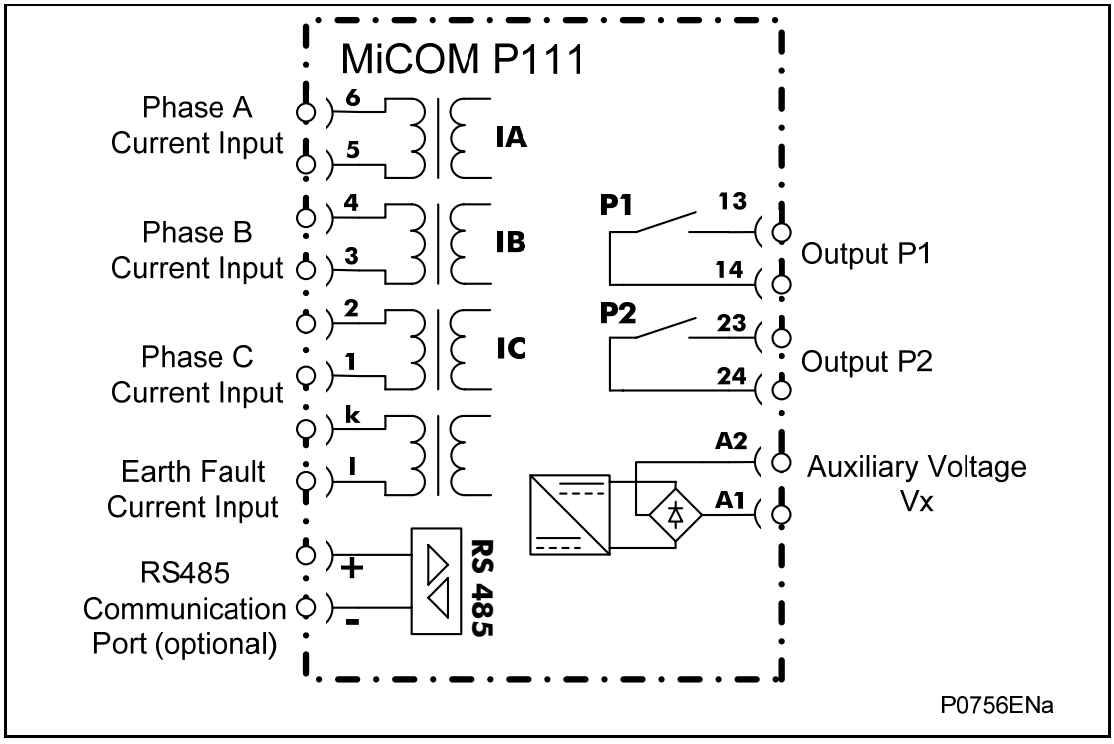


Figure 4: External connection diagram for model L, flush mounting case

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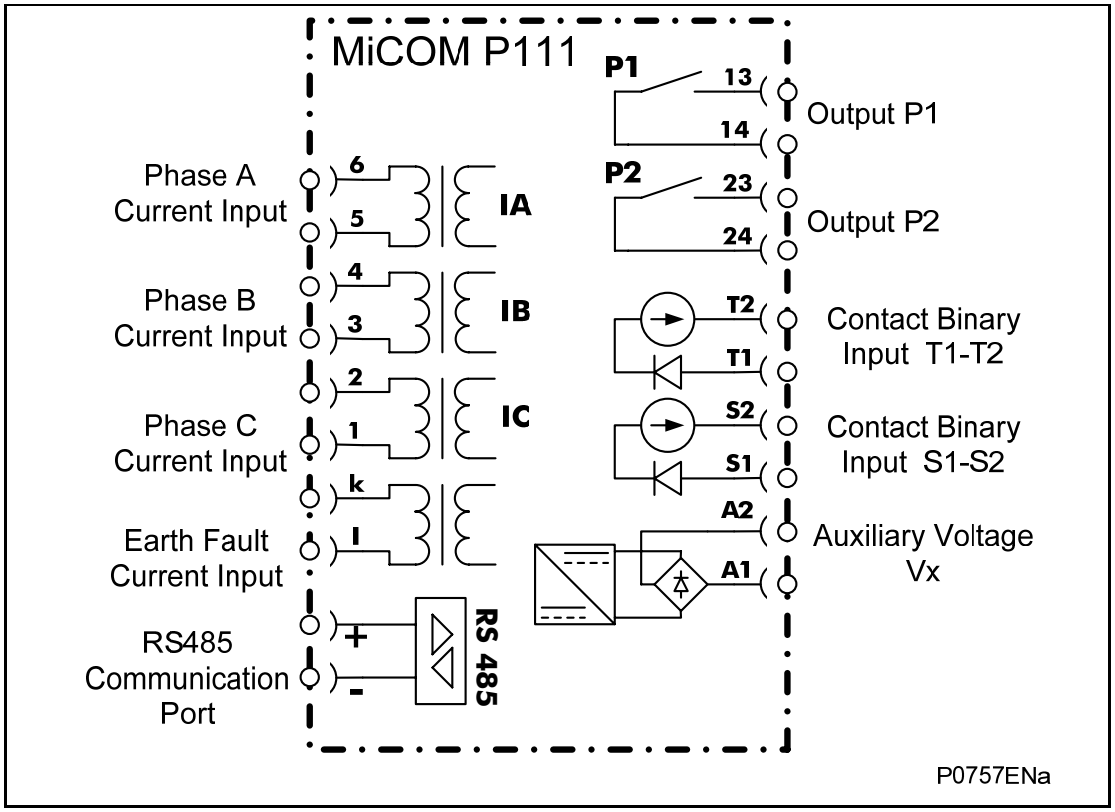

Figure 5: External connection diagram for model B, flush mounting case

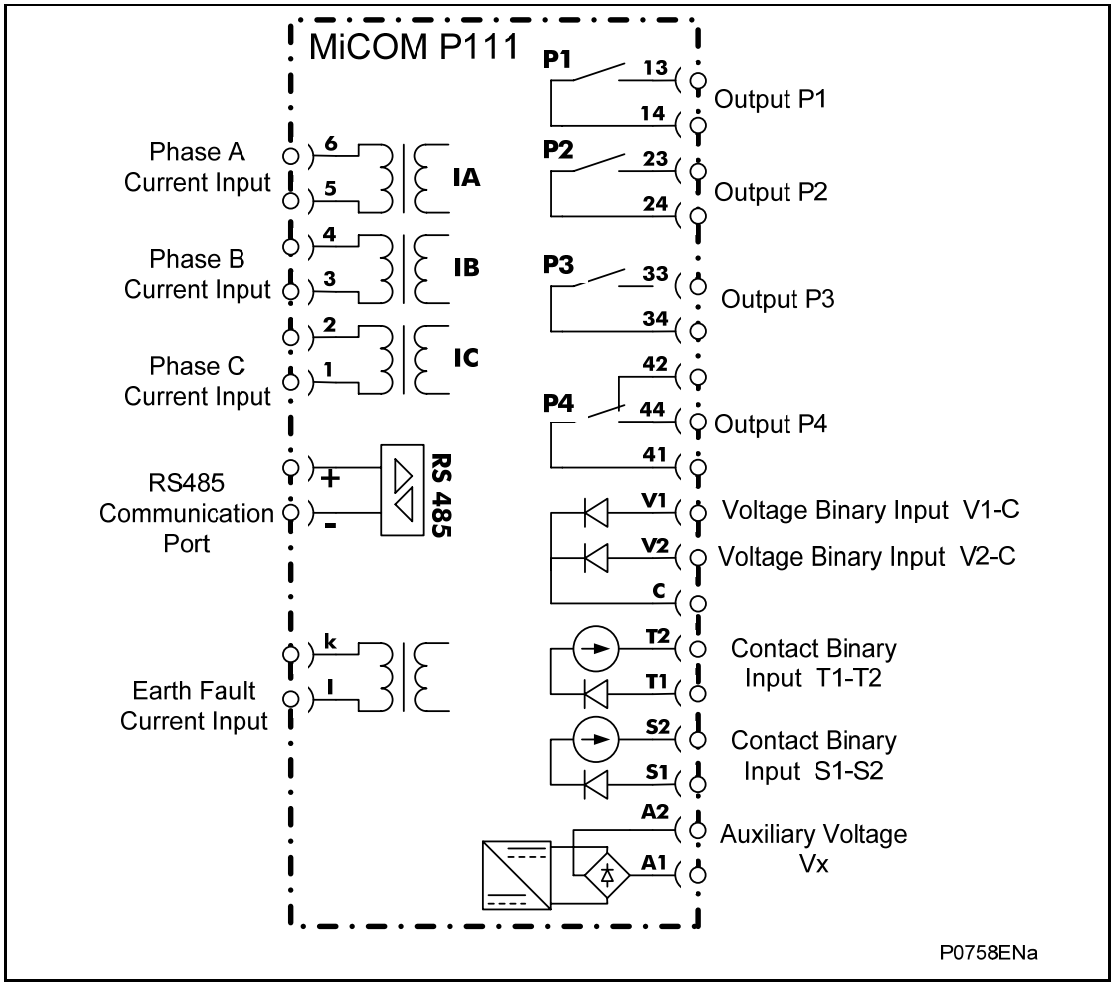

Figure 6: External connection diagram for model E, flush mounting case

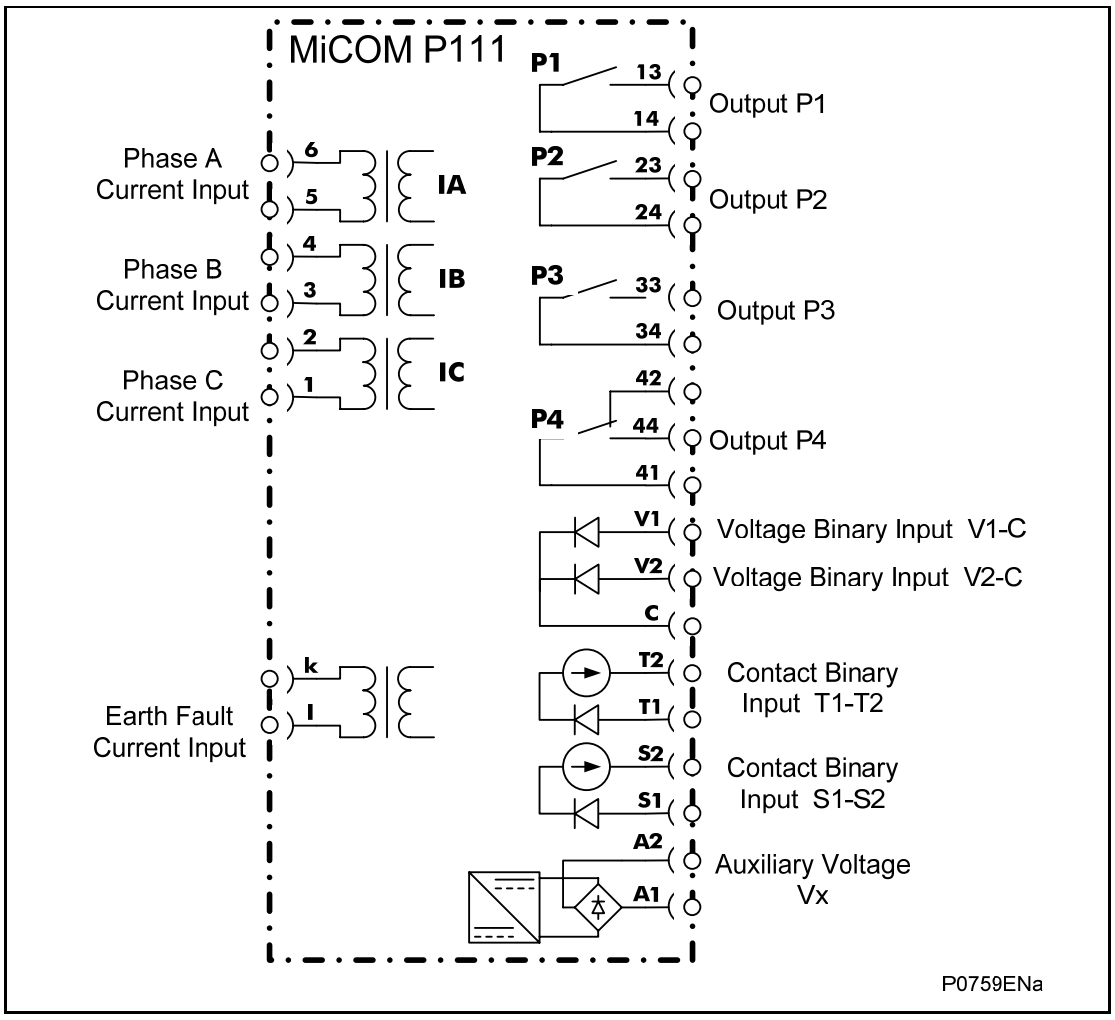

Figure 7: External connection diagram for model F, flush mounting case

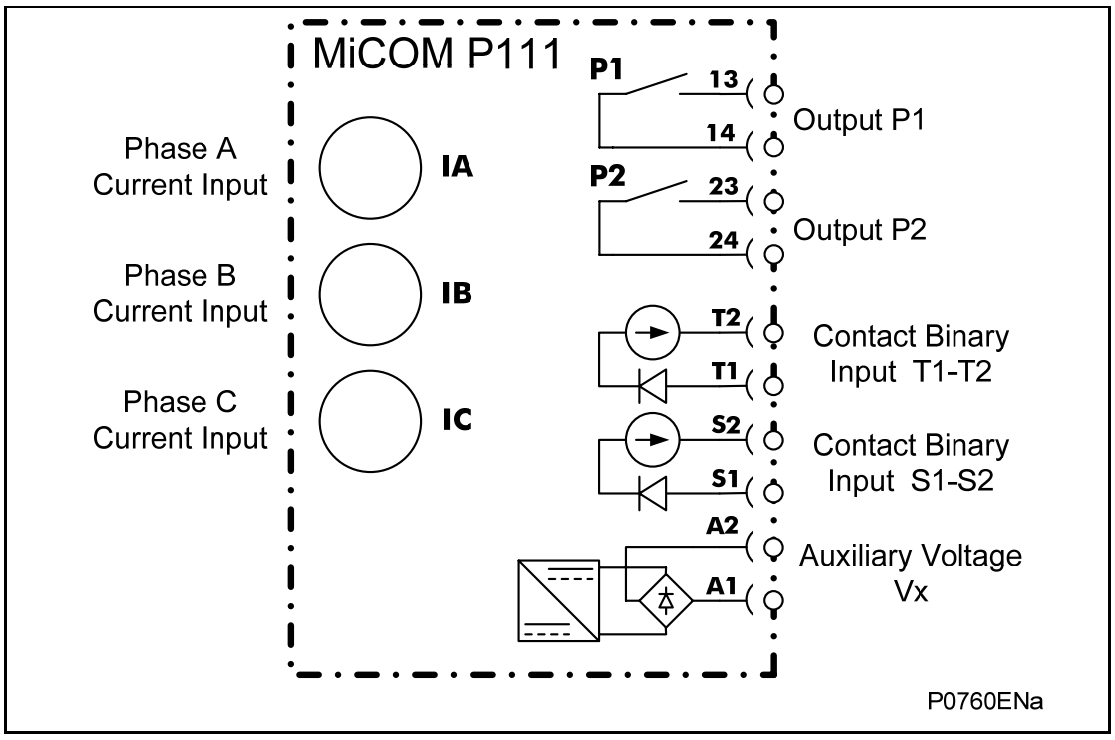

Figure 8: External connection diagram for model A, rail mounting case

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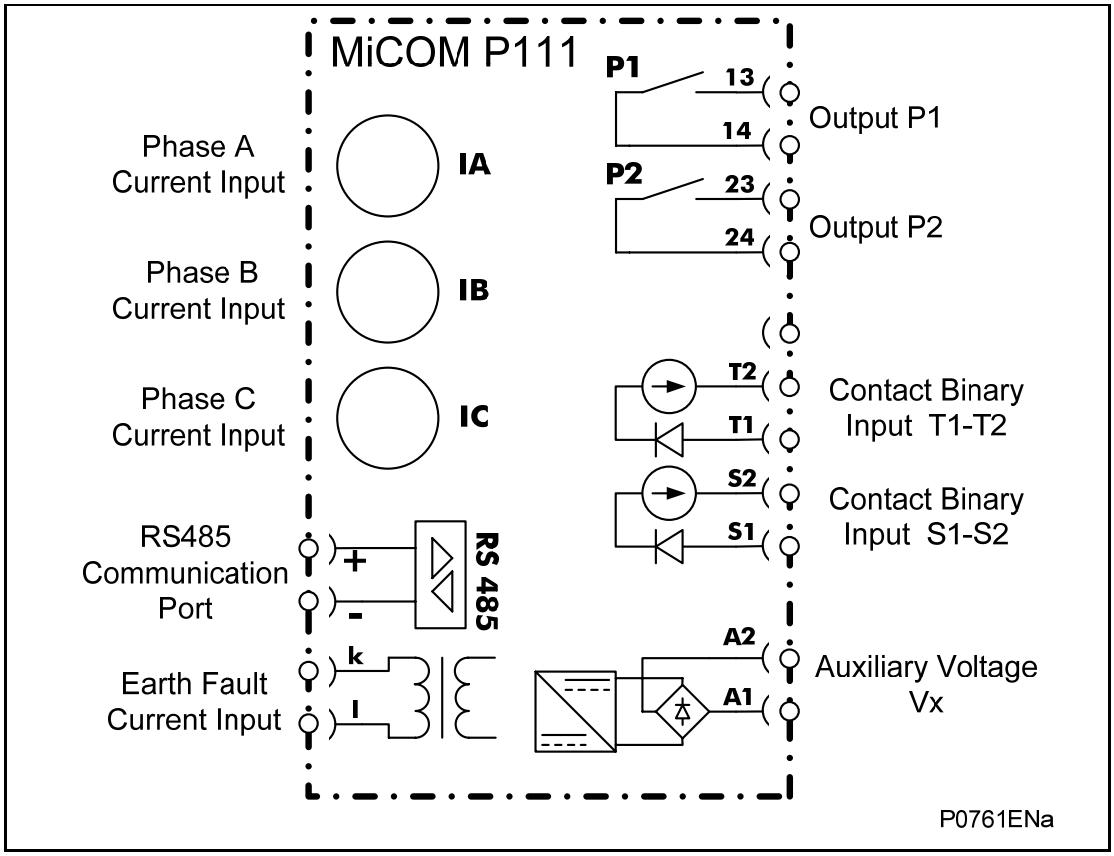

Figure 9: External connection diagram for model B, rail mounting case

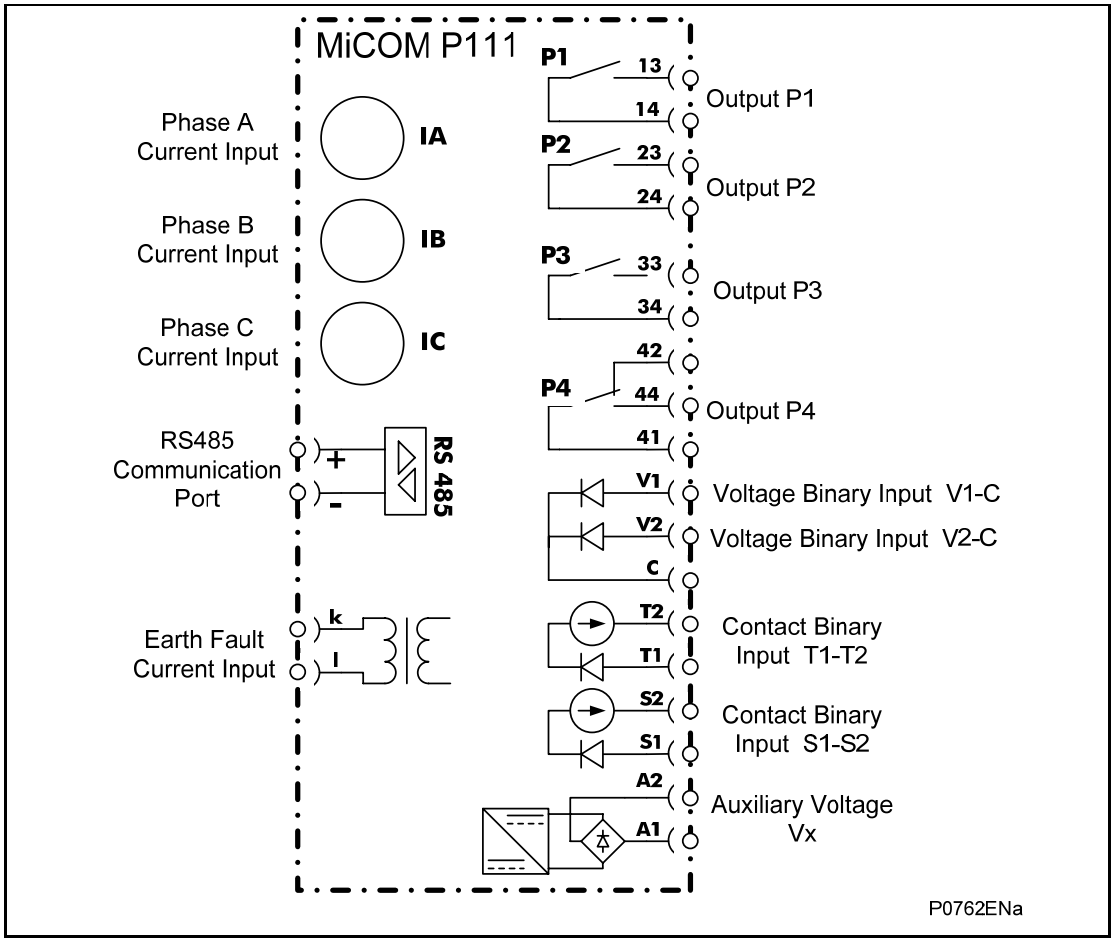

Figure 10: External connection diagram for model E, rail mounting case

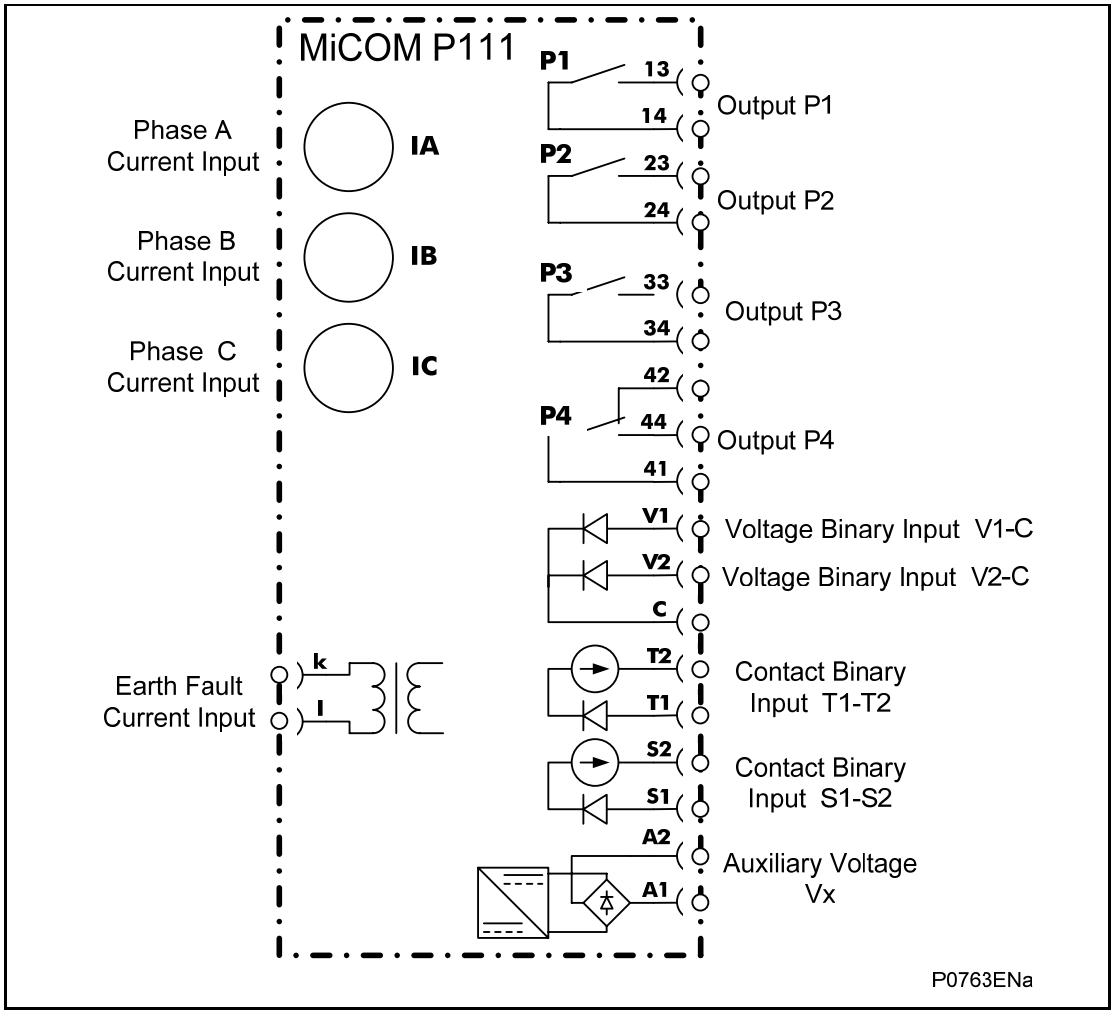

Figure 11: External connection diagram for model F, rail mounting case

FIRMWARE AND SERVICE MANUAL VERSION HISTORY

Date:	**7th December 2007**
Hardware Suffix:	**AD**
Software Version:	**7D**
Connection Diagrams:	**10P11102**

VH

Relay type: P111 …						
Software Version		**Hardware Suffix**	**Original Date of Issue**	**Description of Changes**	**S1 Compatibility**	**Technical Documentation**
Major	Minor					
7	A	AA	September 2005	✓ Original Issue	V2.12	P111/EN M/A11
7	B	AA	April 2006	✓ Changing in Modbus protocol: No response on broadcast massage (7A: P111 answers on broadcast massage)	V2.12	P111/EN M/A11
7	C	AC	January 2007	✓ Increased setting range	V2.14.3	P111/EN M/C11
7	D	AD	October 2007	✓ The new model L included	V2.14.3 for earlier version need patch	P111/EN M/D11

Setting File Software Version / Relay Software Version	7A	7B	7C	7D																						
7A	✓	✓	✓	✓																						
7B	✓	✓	✓	✓																						
7C			✓	✓																						
7D			✓	✓																						

Customer Care Centre

http://www.schneider-electric.com/CCC

Schneider Electric

35 rue Joseph Monier
92506 Rueil-Malmaison
FRANCE

Phone: +33 (0) 1 41 29 70 00
Fax: +33 (0) 1 41 29 71 00

www.schneider-electric.com

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