##  <br> AREVA

# MiCOM P125/P126 \& P127 

Directional/Non-directional Relay

V6D

## Technical Guide

P12Y/EN T/H42

## MiCOM P125/P126 \& P127 <br> Directional/Non-directional Relay CONTENT

| Safety Section | Pxxxx/EN SS/B11 |
| :--- | ---: |
| Getting Started | P12y/EN GS/E42 |
| Handling, Installation and Case Dimensions | P12y/EN IN/C22 |
| User Guide | P12y/EN FT/E42 |
| Technical Data and Curve Characteristics | P12y/EN AP/F42 |
| Application Guide | P12y/EN CT/E42 |
| Communication Database | P12y/EN CO/C22 |
| Commissioning and Maintenance Guide | P12y/EN RS/E42 |

## BLANK PAGE

## SAFETY SECTION

## CONTENTS

1. INTRODUCTION ..... 3
2. HEALTH AND SAFETY ..... 3
3. SYMBOLS AND EXTERNAL LABELS ON THE EQUIPMENT ..... 4
3.1 Symbols ..... 4
3.2 Labels ..... 4
4. INSTALLING, COMMISSIONING AND SERVICING ..... 4
5. DECOMMISSIONING AND DISPOSAL ..... 7
6. EQUIPMENT WHICH INCLUDES ELECTROMECHANICAL ELEMENTS ..... 7
7. TECHNICAL SPECIFICATIONS FOR SAFETY ..... 7
7.1 Protective fuse rating ..... 7
7.2 Protective Class ..... 7
7.3 Installation Category ..... 7
7.4 Environment ..... 8
8. CE MARKING ..... 8
9. RECOGNIZED AND LISTED MARKS FOR NORTH AMERICA ..... 9

## 1. INTRODUCTION

This guide and the relevant operating or service manual documentation for the equipment provide full information on safe handling, commissioning and testing of this equipment and also includes descriptions of equipment label markings.

Documentation for equipment ordered from AREVA Energy Automation \& Information 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 normally present on equipment is fully understood by the recipient.


Before carrying out any work on the equipment the user should be familiar with the contents of this Safety Guide.

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 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 operating manual for the equipment 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 AREVA 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


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) 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.

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 should be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety.
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 energising 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.

The recommended minimum protective conductor (earth) wire size is $2.5 \mathrm{~mm}^{2}$ ( $3.3 \mathrm{~mm}^{2}$ 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 energising 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.


## 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 Listed or Recognized Equipment

To maintain UL and CSA approvals the equipment should be installed using UL and/or CSA Listed or Recognized parts of the following type: connection cables, protective fuses/fuseholders or circuit breakers, insulation crimp terminals, and replacement internal battery, as specified in the equipment documentation.


## 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 energised, 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 energised. This is to avoid possible shock or damage hazards. Hazardous live voltages may be accessible on the extender card.

## Insertion and withdrawal of integral heavy current test plugs

It is possible to use an integral heavy current test plug with some equipment. CT shorting links must be in place before insertion or removal of heavy current test plugs, to avoid potentially lethal voltages.


## 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.

## Fibre optic communication

Where fibre 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 energised. Contact fingers of test plugs are normally protected by petroleum jelly which should not be removed.
5. DECOMMISSIONING AND DISPOSAL


## Decommissioning:

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 decommissioning.

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 batteries.
6. EQUIPMENT WHICH INCLUDES ELECTROMECHANICAL ELEMENTS


## Electrical adjustments

It is possible to change current or voltage settings on some equipment by direct physical adjustment e.g. adjustment of a plug-bridge setting. The electrical power should be removed before making any change, to avoid the risk of electric shock.


## Exposure of live parts

Removal of the cover may expose hazardous live parts such as relay contacts, these should not be touched before removing the electrical power.

## 7. TECHNICAL SPECIFICATIONS FOR SAFETY

### 7.1 Protective fuse rating

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


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

### 7.2 Protective Class

IEC 61010-1: 2001
EN 61010-1: 2001

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

### 7.3 Installation Category

IEC 61010-1: 2001
EN 61010-1: 2001

Installation Category III (Overvoltage Category III):
Distribution level, fixed installation.
Equipment in this category is qualification tested at 5 kV peak, $1.2 / 50 \mu \mathrm{~s}, 500 \Omega, 0.5 \mathrm{~J}$, between all supply circuits and earth and also between independent circuits

### 7.4 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 | Compliance is demonstrated by reference to safety |
| :--- | :--- |
| Degree 2 | standards. |

Altitude - operation up to
2000 m
IEC 61010-1: 2001
EN 61010-1: 2001

## 8. CE MARKING

C Marking

Product safety:
Low Voltage Directive - 73/23/EEC
amended by 93/68/EEC
EN 61010-1: 2001
EN 60950-1: 2001
EN 60255-5: 2001
IEC 60664-1: 2001

Compliance with all relevant European Community directives:

Compliance demonstrated by reference to safety standards.

Electromagnetic Compatibility Directive (EMC) 89/336/EEC amended by 93/68/EEC.

The following Product Specific Standard was used to establish conformity:

EN 50263: 2000

Where applicable :


ATEX Potentially Explosive Atmospheres directive 94/9/EC, for equipment.

The equipment is compliant with Article 1(2) of European directive 94/9/EC. It is approved for operation outside an ATEX hazardous area. It is however approved for connection to Increased Safety, "Ex e", motors with rated ATEX protection, Equipment Category 2 , to ensure their safe operation in gas Zones 1 and 2 hazardous areas.

CAUTION - Equipment with this marking is not itself suitable for operation within a potentially explosive atmosphere.

Compliance demonstrated by Notified Body certificates of compliance.

Radio and
Telecommunications Terminal Equipment (R \& TTE) directive 95/5/EC.

Compliance demonstrated via the Technical Construction File route.

## 9. RECOGNIZED AND LISTED MARKS FOR NORTH AMERICA

## CSA - Canadian Standards Association

UL - Underwriters Laboratory of America- UL Recognized to UL (USA) requirements

- UL Recognized to UL (USA) and CSA (Canada) requirements
- UL Listed to UL (USA) requirements
- UL Listed to UL (USA) and CSA (Canada) requirements

LISTED
Prooucurwernm

- Certified to CSA (Canada) requirements


## GETTING STARTED

## CONTENT

1. GENERAL CONSIDERATIONS ..... 3
1.1 Receipt of Relays ..... 3
1.2 Electrostatic Discharge (ESD) ..... 3
2. HANDLING OF ELECTRONIC EQUIPMENT ..... 4
3. RELAY MOUNTING ..... 5
4. UNPACKING ..... 5
5. STORAGE ..... 5
6. USE OF THIS SECTION ..... 5
7. INTRODUCTION TO THE MICOM RANGE ..... 6
8. GENERAL ON MICOM P125, P126 \& P127 ..... 7
8.1 MiCOM P125, P126 \& P127 ..... 7
9. RELAY DESCRIPTION ..... 8
9.1 Relay Overview ..... 8
9.2 Front Panel Description ..... 9
9.2.1 Relay Identification ..... 10
9.2.2 Battery and Communication Port ..... 11
9.3 Withdrawing Module from Case ..... 12
9.4 Main Functions ..... 13
10. OVERWIEW DIRECTIONAL PROTECTION FUNCTIONS ..... 14
11. ENERGISING THE RELAY ..... 15
11.1 System Connections ..... 15
11.2 Auxiliary Power Supply Connections ..... 15
12. MENU STRUCTURE ..... 16
12.1 P125 Menu Structure ..... 16
$12.2 \quad$ P126 \& P127 Menu Structure ..... 16
12.3 Access to the Menu ..... 16
12.3.1 Password Protection ..... 16
12.3.2 Password Entry ..... 17
13. DEFAULT SETTINGS AND SETTING RANGE ..... 18
14. DESCRIPTION REAR TERMINAL BLOCK FOR P125, P126 \& P127 ..... 38
14.1 Description Rear Terminal Block for P125 ..... 38
14.2 Description Rear Terminal Block for P126 \& P127 ..... 39
15. LOCAL CONNECTION TO A PC ..... 40
15.1 Configuration ..... 40
16. REMOTE CONNECTION ..... 40
17. WIRING DIAGRAMS FOR P125, P126 \& P127 ..... 43
17.1 P125 Wiring Diagram ..... 43
17.2 P126 Wiring Diagram ..... 44
17.3 P127 Wiring Diagram ..... 45
18. CASE DIMENSIONS ..... 46
18.1 P126 \& P127 Case Dimension ..... 46
18.2 P125 Case Dimension ..... 46
19. COMPANY CONTACT INFORMATION ..... 47

## 1. GENERAL CONSIDERATIONS

### 1.1 Receipt of Relays

Protection relays, although generally of robust construction, require careful treatment prior to installation at a site. Upon receipt, relays should be examined immediately to ensure no damage has been sustained in transit. If damage has been sustained during transit a claim should be made to the transport contractor and AREVA T\&D Protection \& Control should be promptly notified.

Relays that are supplied unpacked and not intended for immediate installation should be returned to their protective polythene bags.

### 1.2 Electrostatic Discharge (ESD)

The relays use components that are sensitive to electrostatic discharges.
The electronic circuits are well protected by the metal case and the internal module should not be withdrawn unnecessarily. When handling the module outside its case, care should be taken to avoid contact with components and electrical connections. If removed from the case for storage, the module should be placed in an electrically conductive antistatic bag.
There are no hardware setting adjustments possible within the module and it is advised that it is not necessary to withdraw the module from its case. Although the printed circuit boards are plugged together, the connectors are only a manufacturing aid and not intended for frequent dismantling; in fact considerable effort may be required to separate them. Touching the printed circuit board (PCB) should be avoided, since complementary metal oxide semiconductors (CMOS) are used, which can be damaged by static electricity discharged from the person handling the PCB.

## 2. HANDLING OF ELECTRONIC EQUIPMENT

The normal movements of a person can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semiconductor devices when handling electronic circuits can cause serious damage, which often may not be immediately apparent but the reliability of the circuit will have been reduced.

These electronic circuits are completely safe from electrostatic discharge when housed within the case. Do not expose them to risk of damage by withdrawing modules unnecessarily.

Each module incorporates the highest practicable protection for its semiconductor components. However, if it becomes necessary to withdraw a module, the following precautions should be taken to preserve the high reliability and long life for which the equipment has been designed and manufactured.

1. Before removing a module, ensure that you are at the same electrostatic potential as the equipment by touching the case.
2. Handle the module by its front plate, frame or edges of the printed circuit board. Avoid touching the electronic components, printed circuit tracks or connectors.
3. Do not pass the module to another person without first ensuring you are both at the same electrostatic potential. Both persons must achieve equipotential for instance by wearing antistatic belts.
4. Place the module on an antistatic surface, or on a conducting surface which is at the same potential as yourself.
5. Store or transport the module only in a conductive bag.

If you are making measurements on the internal electronic circuitry of any equipment in service, it is preferable that you are earthed to the case with a conductive wrist strap. Wrist straps should have a resistance to ground between 500k - 10M .

If a wrist strap is not available you should maintain regular contact with the case to prevent a build-up of static electricity. Instrumentation which may be used for making measurements should be earthed to the case whenever possible.

More information on safe working procedures for all electronic equipment can be found in standards BS5783 and IEC 147-OF. It is strongly recommended that detailed investigations on electronic circuitry or modification work should only be carried out in a special handling area such as described in the above-mentioned BS and IEC documents.

## 3. RELAY MOUNTING

Relays are dispatched either individually or as part of a panel or rack assembly.
If a MMLG test block is to be included it should be positioned at the right-hand side of the assembly (viewed from the front). Modules should remain protected by their metal case during assembly into a panel or rack.

For individually mounted relays an outline diagram is supplied in in the P12y/EN IN/xxx document showing the panel dimensions and hole centres.

When you install the relay remove the film applied on the LCD window for a better visualisation, this is a protection against scratches.

## 4. UNPACKING

Care must be taken when unpacking and installing the relays so that none of the parts are damaged or the settings altered. Only skilled personnel must handle the relays.

The installation site should be clean, dry and reasonably free from dust and excessive vibration; moreover it should be well lit to facilitate inspection.

Relays removed from their cases should not be left in dusty or damp situations. This applies especially to such installation sites that are undergoing construction work.

## 5. STORAGE

If relays are not to be installed immediately upon receipt they should be stored in their original cartons in a place free from dust and moisture. Where de-humidifier bags have been included in the packing they should be retained. The action of the de-humidifier crystals will be impaired if the bag has been exposed to ambient conditions. It may be restored by gently heating the bag for about an hour, prior to replacing it in the carton.

Dust, which collects on a carton, may find its way into the relay on subsequent unpacking. In damp conditions the carton and packing may become impregnated with moisture and the dehumidifier bags will lose its efficiency.

Storage temperature: $-25^{\circ} \mathrm{C}$ to $+70^{\circ} \mathrm{C}$.

## 6. USE OF THIS SECTION

This section includes, information on installing the relay and first operation.
A correct use of this information helps the user to a successful first operation of this MiCOM directional overcurrent and directional earth fault relay.

## 7. INTRODUCTION TO THE MiCOM RANGE

MiCOM is a comprehensive solution capable of meeting all electricity supply requirements. It comprises of a range of components, systems and services from AREVA T\&D. Flexibility is central to the MiCOM concept.

MiCOM provides the ability to define an application solution and, through extensive communication capabilities, to integrate this solution with your power supply control system.
The components within MiCOM are:

- $\quad \mathbf{P}$ range protection relays;
- $\quad$ C range control products;
- $\quad$ M range measurement products for accurate metering and monitoring;
- $\quad$ S range versatile PC support and substation control packages.

MiCOM products include extensive facilities for recording information on the state and behaviour of a power system, using disturbance and fault records.

They can also provide measurements of the power system at regular intervals to a control centre enabling remote monitoring and control to take place.
For up-to-date information on any MiCOM product, refer to the technical publications, which can be obtained from: AREVA or your local sales office; alternatively visit our web site.

## 8. GENERAL ON MiCOM P125, P126 \& P127

The MiCOM P125, P126 \& P127 relays have been designed for controlling, protecting and monitoring industrial installations, public distribution networks and substations. They can also be used as part of a protection scheme for transformers and generator transformers. The P125, P126 \& P127 relays can also provide back-up protection for HV and EHV transmission systems.

### 8.1 MiCOM P125, P126 \& P127

The MiCOM P125, P126 \& P127 relays are based on the successful K, MODN and MX3 range.

Each relay includes a large number of protection and control functions for most demanding applications.

On the front panel the relays are equipped with a liquid crystal display (LCD) with $2 \times 16$ backlit alphanumeric characters, a tactile 7 -button keypad (to gain access to all parameters, alarms and measurements) and 8 LEDs to display the status of the MiCOM P125, P126 \& P127.

A dedicated AREVA setting software package is available that allows the user to read, initialise and change the relay parameter settings via the RS485 rear communications port and/or the RS232 front port.
The MiCOM P125, P126 \& P127 relays provide comprehensive directional overcurrent protection for utilities networks, industrial plants and networks in addition to other applications where directional or non-directional overcurrent protection is required.

The directional earth fault element is sensitive enough to be used in impedance-earthed systems (such as resistance or Peterson Coil) or insulated systems.

The models available are:
MiCOM P125: Directional earth fault relay with earth fault wattmetric element.
MiCOM P126: Three phase overcurrent and directional earth fault relay with earth fault wattmetric element and autoreclose function.

MiCOM P127: Directional overcurrent and directional earth fault relay with earth fault wattmetric element, overvoltage/undervoltage protection and autoreclose function.

## 9. RELAY DESCRIPTION

### 9.1 Relay Overview

The next figures show the P125 and P127 (P126) relays.


As can be seen in above figures the case width dimensions differ between the P125 and the P127 (P126).

The table shows the case size for the relays.

| Version | Height | Depth | Width |
| :--- | :--- | :--- | :--- |
| Type P125 | $4 \mathrm{U}(177 \mathrm{~mm})$ | 230 mm | 20 TE |
| Type P126 \& P127 | $4 \mathrm{U}(177 \mathrm{~mm})$ | 230 mm | 30 TE |

The hinged covers at the top and bottom of the relay are shown closed. Extra physical protection for the front panel can be provided by an optional transparent front cover; this allows read only access to the relays settings and data but does not affect the relays IP rating. When full access to the relay keypad is required to edit the settings, the transparent cover can be unclipped and removed when the top and bottom hinged covers are open.

### 9.2 Front Panel Description

The front panel components are shown below. The front panel functionality is identical for the P125, P126 \& P127 relays.

Liquid Crystal Display (LCD):
A 16-character by 2-line alphanumeric liquid crystal display (LCD).

When you install the relay remove the film applied on the LCD window for a better visualisation, this is a protection against scratches.

Keypad: A keypad with 7 keys comprising a clear key a read key, 4 arrow keys and an enter key.

8 LEDs: 4 fixed function LEDs and 4 programmable function LEDs on the left hand side of the front panel. The LED labels are in English by default.
Trip LED: Red LED L1, labelled Trip, indicates when a trip command has been issued by the relay to the cut-off element (circuit breaker, protection trip). This LED copies the trip command issued to the trip output relay contact (RL1). In its normal state the LED is not lit. It is illuminated as soon as a trip order is issued. It is reset when the associated alarm is acknowledged.

Alarm LED: Orange LED L2, labelled Alarm, indicates that an alarm has been registered by MiCOM P125, P126 \& P127 relays. The alarms are either threshold crossings (instantaneous) or tripping orders (time delayed). The LED will flash until the alarms have been accepted (read key), after which the LED will change to constant illumination. It will extinguish when the alarms have been cleared (clear key) and the trip cause is reset.


Warning LED: Orange LED L3, labelled Warning, is dedicated to the internal alarms of MiCOM P125, P126 \& P127 relays.
When a "non critical" internal alarm (i.e. a communication fault) is detected, the LED flashes continuously. When the fault is classed as "critical", the LED is illuminated continuously. The LED only extinguishes after the cause that provoked this fault has been removed (i.e. repair of the module, disappearance of the fault).
Auxiliary Supply LED: Green LED L4, labelled Healthy (Vaux). Supply, indicates that MiCOM P125, P126 and P127 relays are in correct working order and the auxiliary power supply is present.
Programmable LEDs: L5 to L8 with label printed by user. These LEDs can be programmed by the user on the basis of information on available thresholds (instantaneous and time-delayed). The user selects the information he wishes to see associates with each LED from the menu element (Logic OR). Each LED illuminates when the associated information is valid. The extinguishing of each LED is linked to the acknowledgement of the associated alarms.

### 9.2.1 Relay Identification

Under the top hinged cover there is an adhesive paper label that contains the relay model number, serial number, sensitive earth current range, rating information and the Cortec code for ordering etc.

Each item on the label is described below:

P127CAF11: CORTEC code
This code allows the user to identify the features of the relay.
No.: 0000000: Serial number
Cde: 00000/000: Reference to the purchasing order.
These numbers are needed when contacting ALSTON in case of problems.
Un = 57-130V: Voltage input range. Modbus: Communication protocol of the RS485 communication port situated on the rear of the relay.
0.002 len: Sensitivity of the earth fault current (available are three sensitivity levels).
$\mathrm{Ua}=48-150 \mathrm{~V}$ DC: Auxiliary power supply range. In this example, the power supply must be a DC voltage.

### 9.2.2 Battery and Communication Port

Under the bottom hinged cover of the relay there is a battery compartment to hold the $1 / 2 A A$ size battery, which is used for memory back-up to store event, fault and disturbance records (P126 \& P127 only). Next to the battery compartment there is a 9-pin female D-type socket, which can be used to communicate with a local PC (up to 15 m distance) via a RS232 serial data link cable (SK1 port).


ATTENTION !!
WHEN YOU INSTALLED THE RELAY REMOVE THE FILM APPLIED BETWEEN THE POSITIVE TERMINAL OF THE BATTERY AND THE RELEVANT CONTACT TO MAKE THE BATTERY OPERATIVE.


FIGURE 1 : BATTERY BOX MiCOM E1
The battery box performs the two following functions:
6. Temporary powering of the relay in order to allow the user to view or modify data when the auxiliary power supply has failed. The battery used is a 6LR61 type (9V) which can power the relay up to 3 hours.
When the battery is flat it is possible to power the battery box with an external dc supply. The dc voltage value must be comprised between 12 Vdc and 24 Vdc .
7. RS232 interface between the MiCOM relay and the PC equipped with the setting software MiCOM S1.

### 9.3 Withdrawing Module from Case

The withdrawal of the MiCOM module active part (chassis) from its case is achieved by inserting a 3 mm screwdriver into a hole situated under the upper hinged cover above the LCD, and turning the lock pin $90^{\circ}$ to the left. Then the screwdriver is inserted into a second hole situated under the lower hinged cover, and the lower lock pin is turned $90^{\circ}$ to the right.

By this turning action the module is pushed slightly forward in its case and can be easily extracted by pulling on both sides of the front panel.


### 9.4 Main Functions

The following table shows the functions available with the models.

| MODELS and FUNCTIONS |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| FUNCTIONS | ANSI CODE | $\begin{gathered} \text { MiCOM } \\ \text { P125 } \end{gathered}$ | $\begin{gathered} \text { MiCOM } \\ \text { P126 } \end{gathered}$ | $\begin{gathered} \text { MiCOM } \\ \text { P127 } \end{gathered}$ |
| Directional/non-directional earth fault | 67N/50N/51N | 0 | 0 | 0 |
| Directional/non-directional three phase overcurrent | 67/50/51 |  |  | 0 |
| Three phase overcurrent | 50/51 |  | 0 |  |
| Wattmetric protection (Pe or leCos) | 32N/leCos (*) | 0 | 0 | 0 |
| Broken conductor detector |  |  | 0 | 0 |
| Undercurrent | 37 |  | 0 | 0 |
| Negative phase sequence overcurrent | 46 |  | 0 | 0 |
| Thermal overload | 49 |  | 0 | 0 |
| Undervoltage | 27 |  |  | 0 |
| Overvoltage | 59 |  |  | 0 |
| Residual overvoltage | 59N | 0 | 0 | 0 |
| Auto-reclose (4 shots) with TOR | 79 |  | 0 | 0 |
| Circuit breaker failure | 50BF |  | 0 | 0 |
| Circuit breaker monitoring and control |  |  | 0 | 0 |
| Blocking logic |  | 0 | 0 | 0 |
| Cold load pickup |  |  | 0 | 0 |
| Selective relay scheme logic |  |  | 0 | 0 |
| Start contact |  | 0 | 0 | 0 |
| SOTF-Switch on to Fault |  |  | 0 | 0 |
| Programmable AND logic |  |  | 0 | 0 |
| Setting group |  | 2 | 2 | 2 |
| Measurements |  | 0 | 0 | 0 |
| Fault records |  |  | 0 | 0 |
| Istantaneous record |  |  | 0 | 0 |
| Rolling Demand |  |  | 0 | 0 |
| Event records |  |  | 0 | 0 |
| Disturbance records |  |  | 0 | 0 |
| Test facilities (Maintenance mode) |  | 0 | 0 | 0 |
| Diagnostic/self monitoring |  | 0 | 0 | 0 |
| Network communication |  | 0 | 0 | 0 |
| RS232 front port |  | 0 | 0 | 0 |

*NOTE: $\mathrm{Pe} \quad=\quad \mathrm{Vr} \times \mathrm{le} \times \operatorname{Cos} \varphi$
$\mathrm{leCos}=\quad \mathrm{le} \times \operatorname{Cos} \varphi$

## 10. OVERWIEW DIRECTIONAL PROTECTION FUNCTIONS

The directional overcurrent and directional earth fault protection functions provide the setting current thresholds, torque angle and tripping zone.

The tripping zone for the directional protection function is shown in the drawing.


The directional earth fault protection also provides a non-sensitive area to avoid instability due to small dissymetries and unbalances that can generally be present in the systems. This condition is represented by the characteristic reproduced below, where the hatched area is the tripping zone. The tripping zone is limited by the equation: le $+5 \times \mathrm{Ue}<90$ in case of len=5A; le+Ue<18 in case of len=1A.


## 11. ENERGISING THE RELAY

To energise the relay correctly, follow the following instructions carefully.

### 11.1 System Connections

1. Check the wiring scheme of your installation.
2. Check that the contacts of output relay RL1 are included in your trip circuit.

### 11.2 Auxiliary Power Supply Connections

Connect a DC or AC (according to nominal supply rating Ua) voltage power supply.
POSITIVE Vaux TO TERMINAL 33 NEGATIVE Vaux TO TERMINAL 34 DO NOT FORGET TO CONNECT THE EARTH REFERENCE TO TERMINAL 29!

Turn on the auxiliary power supply and set to approximately rated voltage as shown on the front panel of the relay.

The display should show:
IA 1.00 A

Displays the A phase current (true RMS value) taking into account the phase CT ratio (CONFIGURATION/CT RATIO submenu).

LEDs should be in the following configuration:

- Green LED L3 "Healthy" (Vaux) is iluminated
- All the other LEDs should be off.


## 12. MENU STRUCTURE

A simple menu structure allows setting and reading of parameters and functionality.
The menu structure is shown below.
12.1 P125 Menu Structure


NOTE : To reach the default display from any menu item press $\otimes$

### 12.2 P126 \& P127 Menu Structure



### 12.3 Access to the Menu

Before the initial operation of the MiCOM P125, P126 or P127 relay, some of the parameter settings must be checked or modified.

Lift the upper and lower hinged covers and remove the transparent cover over the front panel. When the keypad is exposed, it provides full access to the menu options of the relay. The relevant information is displayed on the LCD.

### 12.3.1 Password Protection

Password protection is applicable to most of the relay parameter settings, especially to the selection of the various thresholds, time delays, communication parameters, allocation of logic inputs and logic outputs.

The password consists of four capital characters. When leaving the factory, the password is set to AAAA. The user can define any combination of four characters.

Should the password be lost or forgotten, the modification of stored parameters is blocked. It is then necessary to contact the manufacturer or his agent and by specifying the serial number of the relay, a stand-by password specific to the relay concerned may be obtained.

NOTE: The programming mode is indicated with the letter " P " on the right hand side of the display on each menu heading. The letter "P" remains present as long as the password is active ( 5 minutes if there is no action on the keypad).

### 12.3.2 Password Entry

When entry of a password is required the following prompt will appear:
A flashing cursor will indicate which character field of the password may be entered.

| Password | The password entry is made character by character using <br> $\Theta \leftrightarrow \leftrightarrow$ to go up or down in the alphabet. After each |
| :--- | :--- |
| character, press $\theta$ to enter the following character. At the |  |
| end press $\Theta$ to validate the password. If the password is |  |
| correct, the following message is displayed on the LCD : |  |
| PASSWORD OK |  |

As soon as the password has been entered, no setting change will be accepted via the remote or local communication port (RS485 or RS232).

Alternatively, the password can be entered by using the Password window in the OP.PARAMETERS menu. This password entry procedure is the same as above.

NOTE: In case of lacking of owner password a rescue password is available contacting the site sale office or the factory.

## 13. DEFAULT SETTINGS AND SETTING RANGE

When the relay is delivered from the factory, the parameter are set to default values and stored in the non-volatile memory.

Following tables show default setting values for functions and protection elements of the P125, P126 \& P127 directional relays.


|  | DEFAULT VALUE |  |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Mode | Min | Max | Step |
| tIA> | N.A | No | No | R/W | No | Yes | Yes/No |
| tIB> | N.A | No | No | R/W | No | Yes | Yes/No |
| tIC> | N.A | No | No | R/W | No | Yes | Yes/No |
| le> | No | No | No | R/W | No | Yes | Yes/No |
| tle> | No | No | No | R/W | No | Yes | Yes/No |
| le>> | No | No | No | R/W | No | Yes | Yes/No |
| tle>> | No | No | No | R/W | No | Yes | Yes/No |
| le>>> | No | No | No | R/W | No | Yes | Yes/No |
| tle>>> | No | No | No | R/W | No | Yes | Yes/No |
| $\mathrm{Pe} / \mathrm{leCos}>$ | No | No | No | R/W | No | Yes | Yes/No |
| tPe/leCos> | No | No | No | R/W | No | Yes | Yes/No |
| $\mathrm{Pe} / \mathrm{leCos} \gg$ | No | No | No | R/W | No | Yes | Yes/No |
| tPe/leCos>> | No | No | No | R/W | No | Yes | Yes/No |
| 12> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl2> | N.A | No | No | R/W | No | Yes | Yes/No |
| 12>> | N.A | No | No | R/W | No | Yes | Yes/No |
| t12>> | N.A | No | No | R/W | No | Yes | Yes/No |
| 12>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| t12>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| Thermal Trip | N.A | No | No | R/W | No | Yes | Yes/No |
| K | N.A | No | No | R/W | No | Yes | Yes/No |
| $\mathrm{tl}<$ | N.A | No | No | R/W | No | Yes | Yes/No |
| U> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| tU> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| U>> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| tU>> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| $\mathrm{U}<$ | N.A | N.A | No | R/W | No | Yes | Yes/No |
| $t \cup<$ | N.A | N.A | No | R/W | No | Yes | Yes/No |
| $\mathrm{U} \ll$ | N.A | N.A | No | R/W | No | Yes | Yes/No |
| tU<< | N.A | N.A | No | R/W | No | Yes | Yes/No |
| Ue>>>> | No | No | No | R/W | No | Yes | Yes/No |
| tUe>>>> | No | No | No | R/W | No | Yes | Yes/No |
| Brkn. Cond | N.A | No | No | R/W | No | Yes | Yes/No |
| CB Fail | N.A | No | No | R/W | No | Yes | Yes/No |
| Input1 | No | No | No | R/W | No | Yes | Yes/No |
| Input2 | No | No | No | R/W | No | Yes | Yes/No |
| Input3 | No | No | No | R/W | No | Yes | Yes/No |
| Input4 | No | No | No | R/W | No | Yes | Yes/No |
| Input5 | N.A | No | No | R/W | No | Yes | Yes/No |
| Input6 | N.A | No | No | R/W | No | Yes | Yes/No |
| Input7 | N.A | No | No | R/W | No | Yes | Yes/No |
| Recloser Run | N.A | No | No | R/W | No | Yes | Yes/No |
| Recl. Blocked | N.A | No | No | R/W | No | Yes | Yes/No |
| tAux1 | N.A | No | No | R/W | No | Yes | Yes/No |

Page 20/48
MiCOM P125/P126 \& P127

|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| tAux2 | N.A | No | No | R/W | No | Yes | Yes/No |
| t SOTF | N.A | No | No | R/W | No | Yes | Yes/No |
| Led 6 |  |  |  | R/W |  |  |  |
| I> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl> | N.A | No | No | R/W | No | Yes | Yes/No |
| l>> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl>> | N.A | No | No | R/W | No | Yes | Yes/No |
| l>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| tIA> | N.A | No | No | R/W | No | Yes | Yes/No |
| tIB> | N.A | No | No | R/W | No | Yes | Yes/No |
| tIC> | N.A | No | No | R/W | No | Yes | Yes/No |
| le> | No | No | No | R/W | No | Yes | Yes/No |
| tle> | No | No | No | R/W | No | Yes | Yes/No |
| le>> | No | No | No | R/W | No | Yes | Yes/No |
| tle>> | No | No | No | R/W | No | Yes | Yes/No |
| le>>> | No | No | No | R/W | No | Yes | Yes/No |
| tle>>> | No | No | No | R/W | No | Yes | Yes/No |
| Pe/leCos> | No | No | No | R/W | No | Yes | Yes/No |
| tPe/leCos> | No | No | No | R/W | No | Yes | Yes/No |
| Pe/leCos>> | No | No | No | R/W | No | Yes | Yes/No |
| tPe/leCos>> | No | No | No | R/W | No | Yes | Yes/No |
| 12> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl2> | N.A | No | No | R/W | No | Yes | Yes/No |
| 12>> | N.A | No | No | R/W | No | Yes | Yes/No |
| t12>> | N.A | No | No | R/W | No | Yes | Yes/No |
| 12>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl2>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| Therm Trip | N.A | No | No | R/W | No | Yes | Yes/No |
| l< | N.A | No | No | R/W | No | Yes | Yes/No |
| $\mathrm{tl}<$ | N.A | No | No | R/W | No | Yes | Yes/No |
| U> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| tU> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| U>> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| tU>> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| U< | N.A | N.A | No | R/W | No | Yes | Yes/No |
| $t U<$ | N.A | N.A | No | R/W | No | Yes | Yes/No |
| $\mathrm{U} \ll$ | N.A | N.A | No | R/W | No | Yes | Yes/No |
| tU<< | N.A | N.A | No | R/W | No | Yes | Yes/No |
| Ue>>>> | No | No | No | R/W | No | Yes | Yes/No |
| tUe>>>> | No | No | No | R/W | No | Yes | Yes/No |
| Brkn. Cond | N.A | No | No | R/W | No | Yes | Yes/No |
| CB Fail | N.A | No | No | R/W | No | Yes | Yes/No |
| Input1 | No | No | No | R/W | No | Yes | Yes/No |


|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| Input2 | No | No | No | R/W | No | Yes | Yes/No |
| Input3 | No | No | No | R/W | No | Yes | Yes/No |
| Input4 | No | No | No | R/W | No | Yes | Yes/No |
| Input5 | N.A | No | No | R/W | No | Yes | Yes/No |
| Input6 | N.A | No | No | R/W | No | Yes | Yes/No |
| Input7 | N.A | No | No | R/W | No | Yes | Yes/No |
| Recloser Run | N.A | No | No | R/W | No | Yes | Yes/No |
| Recl. Blocked | N.A | No | No | R/W | No | Yes | Yes/No |
| tAux1 | N.A | No | No | R/W | No | Yes | Yes/No |
| tAux2 | N.A | No | No | R/W | No | Yes | Yes/No |
| t SOTF | N.A | No | No | R/W | No | Yes | Yes/No |
| Led 7 |  |  |  | R/W |  |  |  |
| 1> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl> | N.A | No | No | R/W | No | Yes | Yes/No |
| I>> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl>> | N.A | No | No | R/W | No | Yes | Yes/No |
| l>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| tIA> | N.A | No | No | R/W | No | Yes | Yes/No |
| tIB> | N.A | No | No | R/W | No | Yes | Yes/No |
| tIC> | N.A | No | No | R/W | No | Yes | Yes/No |
| le> | No | No | No | R/W | No | Yes | Yes/No |
| tle> | No | No | No | R/W | No | Yes | Yes/No |
| le>> | No | No | No | R/W | No | Yes | Yes/No |
| tle>> | No | No | No | R/W | No | Yes | Yes/No |
| le>>> | No | No | No | R/W | No | Yes | Yes/No |
| tle>>> | No | No | No | R/W | No | Yes | Yes/No |
| $\mathrm{Pe} / \mathrm{leCos}>$ | No | No | No | R/W | No | Yes | Yes/No |
| tPe/leCos> | No | No | No | R/W | No | Yes | Yes/No |
| Pe/leCos>> | No | No | No | R/W | No | Yes | Yes/No |
| tPe/leCos>> | No | No | No | R/W | No | Yes | Yes/No |
| 12> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl2> | N.A | No | No | R/W | No | Yes | Yes/No |
| 12>> | N.A | No | No | R/W | No | Yes | Yes/No |
| t12>> | N.A | No | No | R/W | No | Yes | Yes/No |
| 12>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| t12>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| Therm Trip | N.A | No | No | R/W | No | Yes | Yes/No |
| 1< | N.A | No | No | R/W | No | Yes | Yes/No |
| tl< | N.A | No | No | R/W | No | Yes | Yes/No |
| U> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| tU> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| U>> | N.A | N.A | No | R/W | No | Yes | Yes/No |

Page 22/48
MiCOM P125/P126 \& P127

|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| tU>> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| $\mathrm{U}<$ | N.A | N.A | No | R/W | No | Yes | Yes/No |
| $t \cup<$ | N.A | N.A | No | R/W | No | Yes | Yes/No |
| U<< | N.A | N.A | No | R/W | No | Yes | Yes/No |
| tU<< | N.A | N.A | No | R/W | No | Yes | Yes/No |
| Ue>>>> | No | No | No | R/W | No | Yes | Yes/No |
| tUe>>>> | No | No | No | R/W | No | Yes | Yes/No |
| Brkn. Cond | N.A | No | No | R/W | No | Yes | Yes/No |
| CB Fail | N.A | No | No | R/W | No | Yes | Yes/No |
| Input1 | No | No | No | R/W | No | Yes | Yes/No |
| Input2 | No | No | No | R/W | No | Yes | Yes/No |
| Input3 | No | No | No | R/W | No | Yes | Yes/No |
| Input4 | No | No | No | R/W | No | Yes | Yes/No |
| Input5 | N.A | No | No | R/W | No | Yes | Yes/No |
| Input6 | N.A | No | No | R/W | No | Yes | Yes/No |
| Input7 | N.A | No | No | R/W | No | Yes | Yes/No |
| Recloser Run | N.A | No | No | R/W | No | Yes | Yes/No |
| Recl. Blocked | N.A | No | No | R/W | No | Yes | Yes/No |
| tAux1 | N.A | No | No | R/W | No | Yes | Yes/No |
| tAux2 | N.A | No | No | R/W | No | Yes | Yes/No |
| t SOTF | N.A | No | No | R/W | No | Yes | Yes/No |
| Led 8 |  |  |  | R/W |  |  |  |
| I> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl> | N.A | No | No | R/W | No | Yes | Yes/No |
| l>> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl>> | N.A | No | No | R/W | No | Yes | Yes/No |
| l>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| tIA> | N.A | No | No | R/W | No | Yes | Yes/No |
| tIB> | N.A | No | No | R/W | No | Yes | Yes/No |
| tIC> | N.A | No | No | R/W | No | Yes | Yes/No |
| le> | No | No | No | R/W | No | Yes | Yes/No |
| tle> | No | No | No | R/W | No | Yes | Yes/No |
| le>> | No | No | No | R/W | No | Yes | Yes/No |
| tle>> | No | No | No | R/W | No | Yes | Yes/No |
| le>>> | No | No | No | R/W | No | Yes | Yes/No |
| tle>>> | No | No | No | R/W | No | Yes | Yes/No |
| Pe/leCos> | No | No | No | R/W | No | Yes | Yes/No |
| tPe/leCos> | No | No | No | R/W | No | Yes | Yes/No |
| Pe/leCos>> | No | No | No | R/W | No | Yes | Yes/No |
| tPe/leCos>> | No | No | No | R/W | No | Yes | Yes/No |
| 12> | N.A | No | No | R/W | No | Yes | Yes/No |
| tl2> | N.A | No | No | R/W | No | Yes | Yes/No |
| I2>> | N.A | No | No | R/W | No | Yes | Yes/No |

Page 23/48

|  | DEFAULT VALUE |  |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Mode | Min | Max | Step |
| t12>> | N.A | No | No | R/W | No | Yes | Yes/No |
| 12>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| t12>>> | N.A | No | No | R/W | No | Yes | Yes/No |
| Therm Trip | N.A | No | No | R/W | No | Yes | Yes/No |
| 1< | N.A | No | No | R/W | No | Yes | Yes/No |
| tl< | N.A | No | No | R/W | No | Yes | Yes/No |
| U> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| tU> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| U>> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| tU>> | N.A | N.A | No | R/W | No | Yes | Yes/No |
| $U_{<}$ | N.A | N.A | No | R/W | No | Yes | Yes/No |
| $t U<$ | N.A | N.A | No | R/W | No | Yes | Yes/No |
| U<< | N.A | N.A | No | R/W | No | Yes | Yes/No |
| tU<< | N.A | N.A | No | R/W | No | Yes | Yes/No |
| Ue>>>> | No | No | No | R/W | No | Yes | Yes/No |
| tUe>>>> | No | No | No | R/W | No | Yes | Yes/No |
| Brkn. Cond | N.A | No | No | R/W | No | Yes | Yes/No |
| CB Fail | N.A | No | No | R/W | No | Yes | Yes/No |
| Input1 | No | No | No | R/W | No | Yes | Yes/No |
| Input2 | No | No | No | R/W | No | Yes | Yes/No |
| Input3 | No | No | No | R/W | No | Yes | Yes/No |
| Input4 | No | No | No | R/W | No | Yes | Yes/No |
| Input5 | N.A | No | No | R/W | No | Yes | Yes/No |
| Input6 | N.A | No | No | R/W | No | Yes | Yes/No |
| Input7 | N.A | No | No | R/W | No | Yes | Yes/No |
| Recloser Run | N.A | No | No | R/W | No | Yes | Yes/No |
| Recl. Blocked | N.A | No | No | R/W | No | Yes | Yes/No |
| tAux1 | N.A | No | No | R/W | No | Yes | Yes/No |
| tAux2 | N.A | No | No | R/W | No | Yes | Yes/No |
| t SOTF | N.A | No | No | R/W | No | Yes | Yes/No |
| Inputs Configuration |  |  |  |  |  |  |  |
| Inputs | $\uparrow \uparrow \uparrow \uparrow$ | $\uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow$ | $\uparrow \uparrow \uparrow \uparrow \uparrow \uparrow \uparrow$ | R/W | Active Low $\downarrow$ or active High $\uparrow$ |  |  |
| Voltage Input | DC | DC | DC | R/W | DC | AC | DC/AC |
| Start /Stop tAUX1 by input | LEVEL | LEVEL | LEVEL | R/W | LEVEL | EDGE | LEVEL/EDGE |
| Start /Stop tAUX2 by input | LEVEL | LEVEL | LEVEL | R/W | LEVEL | EDGE | LEVEL/EDGE |
| Start /Stop tAUX3 by input | LEVEL | LEVEL | LEVEL | R/W | LEVEL | EDGE | LEVEL/EDGE |
| Start /Stop tAUX4 by input | LEVEL | LEVEL | LEVEL | R/W | LEVEL | EDGE | LEVEL/EDGE |
| RL1 Output relay |  |  |  |  | 1 | 2 | 1 |
| Fail safe relay | No | No | No | R/W | No | Yes | No/Yes |
| Group select | 1 | 1 | 1 | R/W | 1 | 2 | 1 |
| Change Group By input | LEVEL | LEVEL | LEVEL |  | LEVEL | EDGE | LEVEL/EDGE |

Page 24/48
MiCOM P125/P126 \& P127

|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| Alarms | 1 | 1 | 1 | R/W | 1 | 2 | 1 |
| Inst. Self-reset | No | No | No | R/W | Yes | No | Yes/No |
| Reset Led on Fault. | No | No | No | R/W | Yes | No | Yes/No |
| Battery Alarm. | No | No | No | R/W | Yes | No | Yes/No |
| Rel. Maintenance . |  |  |  |  |  |  |  |
| Rel. Maintenance . | No | No | No | R/W | Yes | No | Yes/No |
| Relays Cmd. | $\begin{aligned} & \text { 65W4321 } \\ & 0000000 \end{aligned}$ | $\begin{aligned} & \text { 876W54321 } \\ & 000000000 \end{aligned}$ | $\begin{aligned} & \text { 876W54321 } \\ & 000000000 \end{aligned}$ | R/W | 0 | 1 | 1 |
| Date |  |  |  |  |  |  |  |
| Date Format | Private | Private | Private |  | Private | IEC | Private/IEC |
| COMMUNICATION |  |  |  |  |  |  |  |
| Communication? | No | No | No | R/W | Yes/No |  |  |
| Baud Rate | 19200 | 19200 | 19200 | R/W | 300, 600, 1200, 2400, 9600, 19200, 38400 |  |  |
| Parity | None | None | None | R/W | None-Even-Odd |  |  |
| Stop Bit | 1 | 1 | 1 | R/W | 1 or 2 |  |  |
| Relay Address | 1 | 1 | 1 | R/W | 1 | 255 | 1 |
| PROTECTION G1-G2 |  |  |  |  |  |  |  |
| [67] Phase OC | N.A | N.A |  |  |  |  |  |
| $1>$ ? | N.A | N.A | No | R/W | No or DIR or Yes |  |  |
| I> | N.A | N.A | 25 ln | R/W | 0.1 ln | 25 ln | 0.01 ln |
| Delay Type | N.A | N.A | DMT | R/W | DMT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tl> | N.A | N.A | Os | R/W | 0 s | 150s | 0.01s |
| I> TMS | N.A | N.A | 1 | R/W | 0.025 | 1.5 | 0.025 |
| K | N.A | N.A | 0.100 | R/W | 0.100 | 10.000 | 0.005 |
| I> Reset Delay Type | N.A | N.A | DMT | R/W | DMT or IDMT |  |  |
| I $>$ RTMS | N.A | N.A | 0.025 | R/W | 0.025 | 3.2 | 0.025 |
| I $>$ tReset | N.A | N.A | 0.04 s | R/W | 0 s | 100 s | 0.01 s |
| Interlock l> by l>>...l>>>? | N.A | N.A | No | R/W | No or Yes |  |  |
| $1>$ Torque angle | N.A | N.A | $0^{\circ}$ | R/W | $0^{\circ}$ | $359{ }^{\circ}$ | $1^{\circ}$ |
| I> Trip zone | N.A | N.A | $\pm 85^{\circ}$ | R/W | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| $1 \gg$ ? | N.A | N.A | No | R/W | No or Yes or DIR |  |  |
| l>> | N.A | N.A | 40 ln | R/W | 0.5 In | 40 ln | 0.01 ln |
| Delay Type | N.A | N.A | DMT | R/W | DMT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tl>> | N.A | N.A | Os | R/W | 0 s | 150s | 0.01s |
| l>> TMS | N.A | N.A | 1 | R/W | 0.025 | 1.5 | 0.025 |
| K | N.A | N.A | 0.100 | R/W | 0.100 | 10.000 | 0.005 |
| I>> Reset Delay Type | N.A | N.A | DMT | R/W | DMT or IDMT |  |  |
| l>> RTMS | N.A | N.A | 0.025 | R/W | 0.025 | 3.2 | 0.025 |
| l>> tReset | N.A | N.A | 0.04 s | R/W | 0 s | 100 s | 0.01 s |
| l>> Torque angle | N.A | N.A | $0^{\circ}$ | R/W | $0^{\circ}$ | $359{ }^{\circ}$ | $1^{\circ}$ |
| 1>> Trip zone | N.A | N.A | $\pm 85^{\circ}$ | R/W | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |


|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| l>>> ? | N.A | N.A | No | R/W | No or Yes or DIR or Peak |  |  |
| l>>> | N.A | N.A | 40 ln | R/W | 0.5 ln | 40 ln | 0.01 ln |
| tl>>> | N.A | N.A | 0 s | R/W | 0 s | 150s | 0.01s |
| l>>> Torque angle | N.A | N.A | $0^{\circ}$ | R/W | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| l>>> Trip zone | N.A | N.A | $\pm 85^{\circ}$ | R/W | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| [50/51] Phase OC | N.A |  | N.A |  |  |  |  |
| $1>$ ? | N.A | No | N.A | R/W | No/Yes |  |  |
| 1> | N.A | 25 ln | N.A | R/W | 0.1 ln | 25 ln | 0.01 ln |
| Delay Type | N.A | DMT | N.A | R/W | DMT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC EI, IEC LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tl> | N.A | 0 | N.A | R/W | 0 s | 150s | 0.01s |
| I> TMS | N.A | 1 | N.A | R/W | 0.025 | 1.5 | 0.025 |
| K | N.A | 0.100 | N.A | R/W | 0.100 | 10.000 | 0.005 |
| I> Reset Delay Type | N.A | DMT | N.A | R/W | DMT or IDMT |  |  |
| I> RTMS | N.A | 0.025 | N.A | R/W | 0.025 | 1.5 | 0.025 |
| $1>$ tReset | N.A | Os | N.A | R/W | 0.04 s | 100 s | 0.01 s |
| Interlock l> by l>>...\|>>> | N.A | No | N.A | R/W | No/Yes |  |  |
| $1 \gg$ ? | N.A | No | N.A | R/W | No or Yes or DIR |  |  |
| l>> | N.A | 40 ln | N.A | R/W | 0.5 ln | 40 ln | 0.01 ln |
| Delay Type | N.A | DMT | N.A | R/W | DMT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tl>> | N.A | 0 | N.A | R/W | 0 s | 150s | 0.01s |
| l>> TMS | N.A | 1 | N.A | R/W | 0.025 | 1.5 | 0.025 |
| K | N.A | 0.100 | N.A | R/W | 0.100 | 10.000 | 0.005 |
| l>> Reset Delay Type | N.A | DMT | N.A | R/W | DMT or IDMT |  |  |
| l>> RTMS | N.A | 0.025 | N.A | R/W | 0.025 | 1.5 | 0.025 |
| l>> tReset | N.A | Os | N.A | R/W | 0.04 s | 100 s | 0.01 s |
| $1 \ggg$ ? | N.A | No | N.A | R/W | No or Yes or Peak |  |  |
| l>>> | N.A | 40 In | N.A | R/W | 0.5 ln | 40 ln | 0.01 ln |
| tl>>> | N.A | 0 s | N.A | R/W | 0 s | 150s | 0.01 s |
| [67N] E/Gnd |  |  |  |  |  |  |  |
| Sensitivity Ranges |  |  |  |  |  |  |  |
| High sensitivity: Current input from 0.002 to 1 len | Cortec code P12-C-X---X |  |  |  |  |  |  |
| le> | 1 Ien | 1 Ien | 1 Ien | R/W | 0.002 len | 1 Ien | 0.001 Ien |
| le>> | 1 Ien | 1 Ien | 1 Ien | R/W | 0.002 len | 1 Ien | 0.001 Ien |
| le>>> | 1 Ien | 1 len | 1 Ien | R/W | 0.002 len | 1 Ien | 0.001 Ien |
| Med. sensitivity Current input from 0.01 to 8 len | Cortec code P12-B-X---X |  |  |  |  |  |  |
| le> | 8 len | 8 len | 8 Ien | R/W | 0.01 len | 8 Ien | 0.005 len |
| le>> | 8 Ien | 8 Ien | 8 Ien | R/W | 0.01 Ien | 8 Ien | 0.005 Ien |
| le>>> | 8 Ien | 8 Ien | 8 Ien | R/W | 0.01 len | 8 Ien | 0.005 len |

Page 26/48
MiCOM P125/P126 \& P127


|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| le>>> Trip zone | $\pm 85^{\circ}$ | $\pm 85^{\circ}$ | $\pm 85^{\circ}$ | R/W | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1{ }^{\circ}$ |
| le>>> tReset | 0.04 s | 0.04 s | 0.04 s | R/W | 0.0 s | 100 s | 0.01 s |
| 57-130V Input voltage | Cortec code: P12-XAX---X |  |  |  |  |  |  |
| Ue>>> | 260V | 260V | 260V | R/W | 1 V | 260 V | 0.1 V |
| 220-480V Input voltage | Cortec code: P12-XBX---X |  |  |  |  |  |  |
| Ue>>> | 960 V | 960 V | 960 V | R/W | 4 V | 960 V | 0.5 V |
| [32N] Earth Wattmetric |  |  |  |  |  |  |  |
| [32N] Mode : | Pe | Pe | Pe | R/W | Pe or leCos |  |  |
| Sensitivity Ranges |  |  |  |  |  |  |  |
| High sensitivity: Current input from 0.002 to 1 len |  |  |  |  |  |  |  |
| 57-130V Input voltage | Cortec code: P12-CAX---X |  |  |  |  |  |  |
| Pe> | $20 \times \mathrm{KW}$ (*) | $20 \times \mathrm{KW}$ (*) | $20 \times \mathrm{KW}$ (*) | R/W | $0.2 \times \mathrm{KW}$ (*) | $20 \times \mathrm{KW}$ (*) | $0.02 \times \mathrm{K}$ W (*) |
| Pe>> | $20 \times \mathrm{KW}$ (*) | $20 \times \mathrm{KW}$ (*) | $20 \times \mathrm{KW}$ (*) | R/W | $0.2 \times \mathrm{KW}$ (*) | $20 \times \mathrm{KW}$ (*) | $0.02 \times \mathrm{KW}$ (*) |
| 220-480V Input voltage | Cortec code: P12-CBX---X |  |  |  |  |  |  |
| Pe> | $80 \times \mathrm{KW}$ (*) | $80 \times \mathrm{KW}$ (*) | $80 \times \mathrm{KW}$ (*) | R/W | $1 \times \mathrm{KW}$ (*) | $80 \times \mathrm{KW}$ (*) | $0.1 \times \mathrm{K} \mathrm{W}\left({ }^{*}\right)$ |
| Pe>> | $80 \times \mathrm{KW}$ (*) | $80 \times \mathrm{KW}$ (*) | $80 \times \mathrm{KW}$ (*) | R/W | $1 \times \mathrm{KW}$ (*) | $80 \times \mathrm{KW}$ (*) | $0.1 \times \mathrm{KW}\left({ }^{*}\right)$ |
| Med. sensitivity | Current input from 0.01 to 8 len |  |  |  |  |  |  |
| 57-130V Input voltage | Cortec code: P12-BAX---X |  |  |  |  |  |  |
| Pe> | $160 \times \mathrm{KW}$ (*) | $160 \times \mathrm{KW}$ (*) | $160 \times \mathrm{KW}$ (*) | R/W | 1. x K W(*) | $160 \times \mathrm{KW}$ (*) | $0.1 \times \mathrm{K}$ W(*) |
| Pe>> | $160 \times \mathrm{KW}\left({ }^{*}\right)$ | $160 \times \mathrm{KW}$ (*) | $160 \times \mathrm{KW}$ (*) | R/W | 1. x K W(*) | $160 \times \mathrm{KW}\left({ }^{*}\right)$ | $0.1 \times \mathrm{KW}$ (*) |
| 220-480V Input voltage | Cortec code: P12-BBX---X |  |  |  |  |  |  |
| Pe> | $640 \times \mathrm{KW}$ (*) | $640 \times \mathrm{KW}$ (*) | $640 \times \mathrm{KW}$ (*) | R/W | $4 \times \mathrm{KW}{ }^{*}$ ) | $640 \times \mathrm{KW}$ * $^{*}$ ) | $0.5 \times \mathrm{KW}\left({ }^{*}\right)$ |
| Pe>> | $640 \times \mathrm{KW}\left({ }^{*}\right)$ | $640 \times \mathrm{KW}\left(^{*}\right)$ | $640 \times \mathrm{KW}$ (*) | R/W | $4 \times \mathrm{KW}$ (*) | $640 \times \mathrm{KW}\left({ }^{*}\right)$ | $0.5 \times \mathrm{KW}\left({ }^{*}\right)$ |
| Low sensitivity | Current input from 0.1 to 40 len |  |  |  |  |  |  |
| 57-130V Input voltage | Cortec code: P12-AAX---X |  |  |  |  |  |  |
| Pe> | $800 \times \mathrm{KW}\left({ }^{*}\right)$ | $800 \times \mathrm{KW}$ (*) | $800 \times \mathrm{KW}$ (*) | R/W | $10 \times \mathrm{K}$ W (*) | $800 \times \mathrm{KW}\left({ }^{*}\right)$ | $1 \times \mathrm{KW}{ }^{*}$ ) |
| Pe>> | $800 \times \mathrm{KW}$ (*) | $800 \times \mathrm{KW}$ (*) | $800 \times \mathrm{KW}$ (*) | R/W | $10 \times \mathrm{KW}{ }^{*}$ ) | $800 \times \mathrm{KW}\left({ }^{*}\right)$ | $1 \times \mathrm{KW}$ (*) |
| 220-480V Input voltage |  |  |  |  |  |  |  |
| Pe> | 3200 x K W (*) | $3200 \times \mathrm{K} \mathrm{W}$ (*) | $3200 \times \mathrm{K} \mathrm{W}$ (*) | R/W | $40 \times \mathrm{K}$ W (*) | 3200 x K W (*) | $5 \times \mathrm{KW}$ (*) |
| Pe>> | 3200 x K W (*) | $3200 \times \mathrm{KW}$ (*) | $3200 \times \mathrm{KW}$ (*) | R/W | $40 \times \mathrm{K}$ W(*) | 3200 x K W (*) | $5 \times \mathrm{KW}$ (*) |
| Pe> ? | No | No | No | R/W | No/Yes |  |  |
| Delay Type | DMT | DMT | DMT | R/W | DMT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MII, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tPe> | 0s | 0s | 0s | R/W | 0 s | 150s | 0.01s |
| Pe> TMS | 1 | 1 | 1 | R/W | 0.025 | 1.5 | 0.025 |
| Pe> Reset Delay Type | DMT | DMT | DMT | R/W | DMT or IDMT |  |  |
| Pe> RTMS | 1 | 1 | 1 | R/W | 0.025 | 1.5 | 0.025 |

Page 28/48
MiCOM P125/P126 \& P127

|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| Pe>tReset | 0 s | 0 s | 0 s | R/W | 0.0 s | 100 s | 0.01 s |
| Pe>> ? | No | No | No | R/W | No/Yes |  |  |
| tPe>> | 1s | 1s | 1s | R/W | 0 s | 150s | 0.01s |
| Pe>> tReset | 0 s | 0 s | 0 s | R/W | 0.0 s | 100 s | 0.01 s |
| High sensitivity leCos set | Cortec code P12-C-X---X |  |  |  |  |  |  |
| leCos> | 1 Ien | 1 Ien | 1 len | R/W | 0.002 len | 1 Ien | 0.001 len |
| leCos>> | 1 Ien | 1 Ien | 1 Ien | R/W | 0.002 len | 1 Ien | 0.001 Ien |
| Med. sensitivity lecos set | Cortec code P12-B-X---X |  |  |  |  |  |  |
| leCos> | 8 len | 8 len | 8 len | R/W | 0.01 len | 8 len | 0.005 len |
| leCos>> | 8 Ien | 8 Ien | 8 Ien | R/W | 0.01 len | 8 Ien | 0.005 Ien |
| Low sensitivity lecos set | Cortec code P12-A-X---X |  |  |  |  |  |  |
| leCos> | 25 len | 25 Ien | 25 Ien | R/W | 0.1 len | 25 Ien | 0.01 len |
| leCos>> | 40 len | 40 Ien | 40 len | R/W | 0.5 len | 40 len | 0.01 len |
| leCos> ? | No | No | No | R/W | Yes or No | Yes or No | Yes/No |
| Delay Type | DMT | DMT | DMT | R/W | DMT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tleCos> | Os | Os | Os | R/W | 0 s | 150s | 0.01s |
| leCos> TMS | 1 | 1 | 1 | R/W | 0.025 | 1.5 | 0.025 |
| leCos> Reset Delay Type | DMT | DMT | DMT | R/W | DMT or IDMT |  |  |
| leCos> RTMS | 0.025 | 0.025 | 0.025 | R/W | 0.025 | 1.5 | 0.025 |
| leCos> tReset | 0.04 s | 0.04 s | 0.04 s | R/W | 0.0 s | 100 s | 0.01 s |
| leCos>> ? | No | No | No | R/W | Yes or No | Yes or No | Yes/No |
| tleCos>> | 1s | 1s | 1s | R/W | 0 s | 150s | 0.01s |
| leCos>> tReset | 0.04 s | 0.04 s | 0.04 s | R/W | 0.0 s | 100 s | 0.01 s |
| $\mathrm{Pe} / \mathrm{leCos}$ Angle | $0^{\circ}$ | $0^{\circ}$ | $0^{\circ}$ | R/W | $0^{\circ}$ | $359{ }^{\circ}$ | $1^{\circ}$ |
| [46] Neg Seq. OC | N.A |  |  |  |  |  |  |
| I2>? | N.A | No | No | R/W | No/Yes |  |  |
| 12> | N.A | 25 ln | 25 ln | R/W | 0.1 ln | 25 ln | 0.01 ln |
| Delay Type | N.A | DMT |  | R/W | DMT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tl2> | N.A | Os | Os | R/W | 0 s | 150s | 0.01s |
| I2> TMS | N.A | 1 | 1 | R/W | 0.025 | 1.5 | 0.025 |
| I2> Reset Delay Type | N.A | DMT | DMT | R/W | DMT or IDMT |  |  |
| 12> RTMS | N.A | 0.025 | 0.025 | R/W | 0.025 | 1.5 | 0.025 |
| 12> tReset | N.A | 0.04 s | 0.04 s | R/W | 0.0 s | 100 s | 0.01 s |
| 12>> ? | N.A | No | No | R/W | No/Yes |  |  |
| 12>> | N.A | 40 ln | 40 ln | R/W | 0.5 ln | 40 ln | 0.01 ln |
| t12>> | N.A | 0 s | 0 s | R/W | 0 s | 150s | 0.01s |
| 12>>> ? | N.A | No | No | R/W | No/Yes |  |  |
| 12>>> | N.A | 40 ln | 40 ln | R/W | 0.5 ln | 40 ln | 0.01 ln |
| tl2>>> | N.A | 0 s | 0 s | R/W | 0 s | 150s | 0.01s |


|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| [49] Therm OL | N.A |  |  |  |  |  |  |
| Therm OL ? | N.A | No | No | R/W | No/Yes |  |  |
| $1 \theta>$ | N.A | 0.1 | 0.1 | R/W | 0.1 ln | 3.2 ln | 0.01 |
| Te | N.A | 1 | 1 | R/W | 1 mn | 200 mn | 1 mn |
| K | N.A | 1.05 | 1.05 | R/W | 1 | 1,5 | 0.01 |
| $\theta$ Trip | N.A | 100\% | 100\% | R/W | 50\% | 200\% | 1\% |
| $\theta$ Alarm ? | N.A | No | No | R/W | No/Yes |  |  |
| $\theta$ Alarm | N.A | 90\% | 90\% | R/W | 50\% | 200\% | 1\% |
| [37] Under Current | N.A |  |  |  |  |  |  |
| K? | N.A | No | No | R/W | No/Yes |  |  |
| 1< | N.A | 0.1 ln | 0.1 In | R/W | 0.1 ln | 1 ln | 0.01 ln |
| tl< | N.A | Os | Os | R/W | 0 s | 150 s | 0.01 s |
| [59] Phase Over Voltage | N.A | N.A |  |  |  |  |  |
| $U>$ ? | N.A | N.A | No | R/W | No or AND or OR |  |  |
| 57-130V Input voltage. | Cortec code: P127-AX---X |  |  |  |  |  |  |
| U> | N.A | N.A | 260V | R/W | 2 V | 260 V | 0.1 V |
| 220-480V Input voltage. | Cortec code: P127-BX---X |  |  |  |  |  |  |
| U> | N.A | N.A | 720V | R/W | 10 V | 720 V | 0.5 V |
| tU> | N.A | N.A | 0 s | R/W | 0 s | 600 s | 0.01 s |
| U>> ? | N.A | N.A | No | R/W | No or A |  |  |
| 57-130V Input voltage. | Cortec code: P127-AX---X |  |  |  |  |  |  |
| U>> | N.A | N.A | 260 V | R/W | 2 V | 260 V | 0.1 V |
| 220-480V Input voltage. | Cortec code: P127-BX---X |  |  |  |  |  |  |
| U>> | N.A | N.A | 960 V | R/W | 10 V | 960 V | 0.5 V |
| tU>> | N.A | N.A | 0 s | R/W | 0 s | 600 s | 0.01 s |
| [27] Phase Under Voltage | N.A | N.A |  |  |  |  |  |
| $\mathrm{U}<$ ? | N.A | N.A | No | R/W | No or A |  |  |
| 57-130V Input voltage. | Cortec code: P127-AX---X |  |  |  |  |  |  |
| $\mathrm{U}<$ | N.A | N.A | 5 V | R/W | 2 V | 130 V | 0.1V |
| 220-480V Input voltage. | Cortec code: P127-BX---X |  |  |  |  |  |  |
| $\mathrm{U}<$ | N.A | N.A | 20 V | R/W | 10 V | 480 V | 0.5 V |
| $t \mathrm{U}<$ | N.A | N.A | 0 s | R/W | 0 s | 600 s | 0.01 s |
| $\mathrm{U} \ll$ ? | N.A | N.A | No | R/W | No or A |  |  |
| 57-130V Input voltage. | Cortec code: P127-AX---X |  |  |  |  |  |  |
| U<< | N.A | N.A | 5 V | R/W | 2 V | 130 V | 0.1 V |
| 220-480V Input voltage. | Cortec code: P127-BX---X |  |  |  |  |  |  |
| U<< | N.A | N.A | 20V | R/W | 10 V | 480 V | 0.5V |
| t $\mathrm{U} \ll$ | N.A | N.A | 0.5 s | R/W | 0 s | 600 s | 0.01 s |

Page 30/48
MiCOM P125/P126 \& P127

|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| [59N] Residual Over Voltage |  |  |  |  |  |  |  |
| Ue>>>> ? | No | No | No | R/W |  |  |  |
| 57-130V Input voltage. | Cortec code: P12--AX---X |  |  |  |  |  |  |
| Ue>>>> | 260 V | 260 V | 260 V | R/W | 1 V | 260 V | 0.1V |
| 220-480V Input voltage. | Cortec code: P12--BX---X |  |  |  |  |  |  |
| Ue>>>> | 960 V | 960 V | 960 V | R/W | 5 V | 960 V | 0.5 V |
| tUe>>>> | 0 s | 0 s | 0 s | R/W | 0 s | 600 s | 0.01 s |
| [79] Autoreclose | N.A |  |  |  |  |  |  |
| Autoreclose? | N.A | No | No | R/W | Yes/No |  |  |
| Ext. CB Fail? | N.A | No | No | R/W | Yes/No |  |  |
| Ext. CB Fail Time | N.A | 0.01s | 0.01s |  | 0.01s | 600s | 0.01 s |
| Aux1 ( ${ }^{\text {l }}$ ) | N.A | No | No | R/W | Yes/No |  |  |
| Aux2 (le>) | N.A | No | No | R/W | Yes/No |  |  |
| Ext. Block ? | N.A | No | No | R/W | Yes/No |  |  |
| Dead Time | N.A |  |  |  |  |  |  |
| td1 | N.A | 0.01 s | 0.01 s | R/W | 0.01 s | 300 s | 0.01 s |
| td2 | N.A | 0.01 s | 0.01 s | R/W | 0.01 s | 300 s | 0.01 s |
| td3 | N.A | 0.01 s | 0.01 s | R/W | 0.01 s | 600 s | 0.01 s |
| td4 | N.A | 0.01 s | 0.01 s | R/W | 0.01 s | 600 s | 0.01 s |
| Reclaim Time | N.A |  |  |  |  |  |  |
| tR | N.A | 0.02 s | 0.02 s | R/W | 0.02 s | 600 s | 0.01 s |
| Inhib Time | N.A |  |  |  |  |  |  |
| tl | N.A | 0.02 s | 0.02 s | R/W | 0.02 s | 600 s | 0.01 s |
| Phase Cycles | N.A | 0 | 0 | R/W | 0 | 4 | 1 |
| E/Gnd Cycles | N.A | 0 | 0 | R/W | 0 | 4 | 1 |
| Cycles | N.A | 4321 | 4321 |  |  |  |  |
| tl> | N.A | 0000 | 0000 |  | 0 | 2 | 1 |
| tl>> | N.A | 0000 | 0000 |  | 0 | 2 | 1 |
| tl>>> | N.A | 0000 | 0000 |  | 0 | 2 | 1 |
| tle> | N.A | 0000 | 0000 |  | 0 | 2 | 1 |
| tle>> | N.A | 0000 | 0000 |  | 0 | 2 | 1 |
| tle>>> | N.A | 0000 | 0000 |  | 0 | 2 | 1 |
| tPle/lecos> | N.A | 0000 | 0000 |  | 0 | 2 | 1 |
| tIPe/lecos>> | N.A | 0000 | 0000 |  | 0 | 2 | 1 |
| tAux1 | N.A | 0000 | 0000 |  | 0 | 2 | 1 |
| tAux2 | N.A | 0000 | 0000 |  | 0 | 2 | 1 |
| AUTOMAT. CTRL |  |  |  |  |  |  |  |
| Trip Commands |  |  |  |  |  |  |  |
| Trip tl> ? | N.A | No | No | R/W | No | Yes | Yes or No |
| Trip tl>> ? | N.A | No | No | R/W | No | Yes | Yes/No |
| Trip tl>>> ? | N.A | No | No | R/W | No | Yes | Yes/No |
| Trip tle>? | No | No | No | R/W | No | Yes | Yes/No |


|  | DEFAULT VALUE |  |  |  |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 |  | P126 |  | P127 |  |  | Min | Max | Step |
| Trip tle>> ? | No |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tle>>> ? | No |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tPe/leCos> ? | No |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tPe/leCos>> | No |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tl2> ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tl2>> ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tl2>>> ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Thermal Trip ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip $\mathrm{t}<$ ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip $\mathrm{tU}>$ ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tU>> ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip t < ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip t <<< ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tUe>>>> ? | No |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip Brkn. Cond? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tAux1? | No |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tAux2? | No |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tAux3? | No |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip tAux4 ? | No |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Trip SOTF | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Ctrl Trip | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Equation A ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Equation B ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Equation C ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Equation D ? | N.A |  | No |  | No |  | R/W | No | Yes | Yes/No |
| Latch Relays |  |  |  |  |  |  |  |  |  |  |
| Relay | 654321 |  | 87654321 |  | 87654321 |  |  |  |  |  |
| Latch: | 000000 |  | 00000000 |  | 00000000 |  | R/W | 0 | 1 | 1 |
| Blocking Logic 1 / 2 | 1 | N.A. | 1 | 2 | 1 | 2 |  |  |  |  |
| Block tl> ? |  | N.A. | No | No | No | No | R/W | No | Yes | Yes / No |
| Block tl>> ? | N.A. | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block tl>>> ? | N.A. | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block tle> ? | No | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block tle>> ? | No | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block tle>>> ? | No | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block tPe/leCos> ? | No | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block tPe/leCos>> ? | No | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block tl2> ? | N.A. | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block tl2>> ? | N.A. | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block tl2>>> ? | N.A. | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block tThermal $\theta$ ? | N.A. | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block $\mathrm{tl}<$ ? | N.A. | N.A. | No | No | No | No | R/W | No | Yes | Yes/No |
| Block tU> ? | N.A. | N.A. | N.A. | N.A. | No | No | R/W | No | Yes | Yes/No |

Page 32/48
MiCOM P125/P126 \& P127


Page 33/48

|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| 12>> | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| t12>> | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| 12>>> | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| t12>>> | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| Therm Alarm | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| Therm Trip | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| 1< | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| t $<$ | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| U> | N.A. |  | 0000000 | R/W | 0 | 1 | 1 |
| tU> | N.A. |  | 0000000 | R/W | 0 | 1 | 1 |
| U>> | N.A. |  | 0000000 | R/W | 0 | 1 | 1 |
| tU>> | N.A. |  | 0000000 | R/W | 0 | 1 | 1 |
| U< | N.A. |  | 0000000 | R/W | 0 | 1 | 1 |
| $t \cup<$ | N.A. |  | 0000000 | R/W | 0 | 1 | 1 |
| U<< | N.A. |  | 0000000 | R/W | 0 | 1 | 1 |
| tU<< | N.A. |  | 0000000 | R/W | 0 | 1 | 1 |
| Ue>>>> | 00000 | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| tUe>>>> | 00000 | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| Brkn. Cond | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| CB Alarm | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| 52 Fail | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| CB Fail | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| CB Close | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| tAux1 | 00000 | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| tAux2 | 00000 | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| tAux3 | 00000 | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| tAux4 | 00000 | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| 79 Run | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| 79 Trip | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| SOTF | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| Control Trip | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| Control Close | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| Active Group | 00000 | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| t EQU A | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| t EQU B | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| t EQU C | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| t EQU D | N.A. | 0000000 | 0000000 | R/W | 0 | 1 | 1 |
| Inputs | 4 | 7 | 7 |  |  |  |  |
| Input 1 | None | None | None | R/W | None b, Au Rese L PU Main | Blk L <br> , Aux set, Block Close | og 2, CB FL Log S Circ, |

Page 34/48

|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| Input 2 | None | None | None | R/W | None, Unlatch, Blk Log 1, Blk Log 2, 52 a, 52 b, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block_79, Trip Circ, Start t BF, Maint. M, Man. Close, Local |  |  |
| Input 3 | None | None | None | R/W | None, Unlatch, Blk Log 1, Blk Log 2, 52 a, 52 b, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block_79, Trip Circ, Start t BF, Maint. M, Man. Close, Local |  |  |
| Input 4 | None | None | None | R/W | None, Unlatch, Blk Log 1, Blk Log 2, 52 a, 52 b, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block_79, Trip Circ, Start t BF, Maint. M, Man. Close, Local |  |  |
| Input 5 | N.A | None | None | R/W | None, Unlatch, Blk Log 1, Blk Log 2, 52 a, 52 b, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block_79, Trip Circ, Start t BF, Maint. M, Man. Close, Local |  |  |
| Input 6 | N.A | None | None | R/W | None, Unlatch, Blk Log 1, Blk Log 2, 52 a, 52 b, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block_79, Trip Circ, Start t BF, Maint. M, Man. Close, Local |  |  |
| Input 7 | N.A | None | None | R/W | None, Unlatch, Blk Log 1, Blk Log 2, 52 a, 52 b, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block_79, Trip Circ, Start t BF, Maint. M, Man. Close, Local |  |  |
| tAux1 time | 0 | 0 | 0 | R/W | 0 | 200s | 0.01s |
| tAux2 time | 0 | 0 | 0 | R/W | 0 | 200s | 0.01s |
| tAux3 time | 0 | 0 | 0 | R/W | 0 | 200s | 0.01s |
| tAux4 time | 0 | 0 | 0 | R/W | 0 | 200s | 0.01s |
| Broken Conductor | N.A. |  |  |  |  |  |  |
| Brkn.Cond? | N.A. | No | No | R/W | Yes/No |  |  |
| Brkn.Cond | N.A. | 20\% | 20\% | R/W | 20\% | 100\% | 1\% |
| Brkn.Cond Time | N.A. | 0 s | 0 s | R/W | 0 s | 14400 s | 1 s |
| Cold Load Pick Up | N.A. |  |  |  |  |  |  |
| Cold Load PU ? | N.A. | No | No | R/W | Yes/No |  |  |
| Cold Load PU tl> ? | N.A. | No | No | R/W | Yes/No |  |  |
| Cold Load PU tl>> ? | N.A. | No | No | R/W | Yes/No |  |  |
| Cold Load PU tl>>> ? | N.A. | No | No | R/W | Yes/No |  |  |
| Cold Load PU tle> ? | N.A. | No | No | R/W | Yes/No |  |  |
| Cold Load PU tle>> ? | N.A. | No | No | R/W | Yes/No |  |  |
| Cold Load PU tle>>>? | N.A. | No | No | R/W | Yes/No |  |  |
| Cold Load PU tl2> ? | N.A. | No | No | R/W | Yes/No |  |  |
| Cold Load PU tl2>> ? | N.A. | No | No | R/W | Yes/No |  |  |
| Cold Load PU tl2>>>? | N.A. | No | No | R/W | Yes/No |  |  |
| Cold Load PU tTherm>? | N.A. | No | No | R/W | Yes/No |  |  |
| Level | N.A. | 100\% | 100\% | R/W | 100\% | 500\% | 1\% |
| tCL | N.A. | 0.1 s | 0.1 s | R/W | 0.1 s | 3600 s | 0.1 s |


|  | DEFAULT VALUE |  |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Mode | Min | Max | Step |
| 51 V (57-130V) | N.A. | N.A. |  |  |  |  |  |
| (U<ORV2>)\&1>>? | N.A. | N.A. | No | R/W | No | Yes | Yes/No |
| V2> | N.A. | N.A. | 130 V | R/W | 3V | 200V | 0.1 V |
| ( $\mathrm{U} \ll$ ORV2>>)\&1>>>? | N.A. | N.A. | No | R/W | No | Yes | Yes/No |
| V2>> | N.A. | N.A. | 130 V | R/W | 3 V | 200V | 0.1 V |
| 51V (220-480V) | N.A. | N.A. |  |  |  |  |  |
| ( $\mathrm{U}<\mathrm{ORV} 2>$ ) \& $1 \gg$ ? | N.A. | N.A. | No | R/W | No | Yes | Yes/No |
| V2> | N.A. | N.A. | 480 V | R/W | 20 V | 720V | 0.5 V |
| ( $\mathrm{U} \ll$ ORV2>>)\&1>>>? | N.A. | N.A. | No | R/W | No | Yes | Yes/No |
| V2>> | N.A. | N.A. | 480V | R/W | 20V | 720V | 0.5 V |
| VTS Blocks 51V? | N.A. | N.A. | No | R/W | No | Yes | Yes/No |
| VTS Alarm? | N.A. | N.A. | No | R/W | No | Yes | Yes/No |
| CB Fail | N.A. |  |  |  |  |  |  |
| CB Fail ? | N.A. | No | No | R/W | Yes/No |  |  |
| CB Fail Time tBF | N.A. | 0.10 s | 0.10.s | R/W | 0 s | 10 s | 0.01 s |
| $1<B F$ | N.A. | 0.1 ln | 0.1 ln | R/W | 0.02 In | 1 ln | 0.01 ln |
| Block l>? | N.A. | No | No | R/W | Yes | No | Yes/No |
| Block le>? | N.A. | No | No | R/W | Yes | No | Yes/no |
| CB Supervision |  |  |  |  |  |  |  |
| TC Supervision? | N.A. | No | No | R/W | No | Yes | Yes/No |
| t trip circuit tSUP | N.A. | 0.1 s | 0.1 s | R/W | 0.1 s | 10 s | 0.1 s |
| CB Open S'vision | N.A. | No | No | R/W | Yes/No |  |  |
| CB Open Time | N.A. | 0.05 s | 0.05 s | R/W | 0.05 s | 1 s | 0.01 s |
| CB Close S'vision | N.A. | No | No | R/W | No | Yes | Yes/No |
| CB Close Time | N.A. | 0.05 s | 0.05 s | R/W | 0.05 s | 1 s | 0.01 s |
| CB Open Alarm? | N.A. | No | No | R/W | No | Yes | Yes/No |
| CB Open NB | N.A. | 0 | 0 | R/W | 0 | 50000 | 1 |
| $\Sigma \operatorname{Amps}(\mathrm{n})$ | N.A. | No | No | R/W | No | Yes | Yes/No |
| $\Sigma \operatorname{Amps}(\mathrm{n})$ | N.A. | 0 | 0 | R/W | 0 Exp6 A | 4000 Exp6 A | 1 Exp6 A |
| n | N.A. | 1 | 1 | R/W | 1 | 2 | 1 |
| tOpen Pulse | 0.1 s | 0.1 s | 0.1 s | R/W | 0.1 s | 5 s | 0.01 s |
| tClose Pulse | 0.1 s | 0.1 s | 0.1 s | R/W | 0.1 s | 5 s | 0.01 s |
| SOTF | N.A. |  |  |  |  |  |  |
| Sotf? | N.A. | No | No | R/W | No | Yes | Yes/No |
| tSotf | N.A. | 500 ms | 500 ms | R/W | 0 ms | 500 ms | 10 ms |
| l>> | N.A. | No | No | R/W | No | Yes | Yes/No |
| l>>> | N.A. | No | No | R/W | No | Yes | Yes/No |

Page 36/48
MiCOM P125/P126 \& P127

|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| AND LOGIC EQUAT | N.A. | DCBA | DCBA |  |  |  |  |
| I> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tl> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| l>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tl>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| l>>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tl>>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| le> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tle> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| le>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tle>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| le>>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tle>>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| Pe/leCos> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tPe/leCos> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| Pe/leCos>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tPe/leCos>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| I2> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| t12> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| I2>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tl2>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| 12>>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tl2>>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| Thermal Alarm | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| Thermal Trip | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| l< | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| $\mathrm{t}<$ | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| U> | N.A. | N.A. | 0000 | R/W | 0 | 1 | 1 |
| tU> | N.A. | N.A. | 0000 | R/W | 0 | 1 | 1 |
| U>> | N.A. | N.A. | 0000 | R/W | 0 | 1 | 1 |
| tU>> | N.A. | N.A. | 0000 | R/W | 0 | 1 | 1 |
| $\mathrm{U}<$ | N.A. | N.A. | 0000 | R/W | 0 | 1 | 1 |
| $t \mathrm{U}<$ | N.A. | N.A. | 0000 | R/W | 0 | 1 | 1 |
| $\mathrm{U} \ll$ | N.A. | N.A. | 0000 | R/W | 0 | 1 | 1 |
| tU<< | N.A. | N.A. | 0000 | R/W | 0 | 1 | 1 |
| Ue>>>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tUe>>>> | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| Brkn. Cond | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| 79 Trip | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tAux1 | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tAux2 | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tAux3 | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |
| tAux4 | N.A. | 0000 | 0000 | R/W | 0 | 1 | 1 |


|  | DEFAULT VALUE |  |  | Mode | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 |  | Min | Max | Step |
| AND LOGIC EQUAT T delay | N.A. |  |  |  |  |  |  |
| EQU. A Toperat | N.A. | 0.0 | 0.0 | R/W | 0 s | 600 s | 0.01 s |
| EQU. A Treset | N.A. | 0.0 | 0.0 | R/W | 0 s | 600 s | 0.01 s |
| EQU. B Toperat | N.A. | 0.0 | 0.0 | R/W | 0 s | 600 s | 0.01 s |
| EQU. B Treset | N.A. | 0.0 | 0.0 | R/W | 0 s | 600 s | 0.01 s |
| EQU. C Toperat | N.A. | 0.0 | 0.0 | R/W | 0 s | 600 s | 0.01 s |
| EQU. C Treset | N.A. | 0.0 | 0.0 | R/W | 0 s | 600 s | 0.01 s |
| EQU. D Toperat | N.A. | 0.0 | 0.0 | R/W | 0 s | 600 s | 0.01 s |
| EQU. D Treset | N.A. | 0.0 | 0.0 | R/W | 0 s | 600 s | 0.01 s |
| RECORDS | N.A. |  |  |  |  |  |  |
| Fault Record | N.A. |  |  |  |  |  |  |
| Record Number | N.A. | 5 | 5 | R/W | 1 | 5 | 1 |
| Istantaneous | N.A. |  |  |  |  |  |  |
| Number | N.A. | 5 | 5 | R/W | 1 | 5 | 1 |
| Disturb Record | N.A. |  |  |  |  |  |  |
| Pre-Time | N.A. | 0.1 | 0.1 | R/W | 0.1 | 3 | 0.1 |
| Post-Time | N.A. | 0.1 | 0.1 | R/W | 0.1 | 3 | 0.1 |
| Disturb rec Trig | N.A. | ON INST | ON INST | R/W | ON TRIP or ON INST. |  |  |
| Time Peak Value | N.A. |  |  |  |  |  |  |
| Time Window | N.A. | 5 mn | 5 mn | R/W | $5 \mathrm{mn}, 10 \mathrm{mn}, 15 \mathrm{mn}, 30 \mathrm{mn}, 60 \mathrm{mn}$ |  |  |

## (*) Please note

The Pe thresholds are displayed in the format: \#\#.\#\# x len W
The threshold value is in Watt [W] secondary.
If len $=1 \mathrm{~A}$, the shownrelay setting value will be equal to $20 \times 1=20 \mathrm{~W}$. If len $=5 A$, the shown relay setting value will be equal to $20 \times 5=100 \mathrm{~W}$.

## 14. DESCRIPTION REAR TERMINAL BLOCK FOR P125, P126 \& P127

### 14.1 Description Rear Terminal Block for P125



| Output 5 | 1 | 2 | Common output 1 |
| :---: | :---: | :---: | :---: |
| Common output 5 | 3 | 4 | Output 1 (NC) |
| Output 6 | 5 | 6 | Output1 (NO) |
| Common output 6 | 7 | 8 | Common output 2 |
|  | 9 | 10 | Output 2 (NC) |
|  | 11 | 12 | Output 2 (NO) |
|  | 13 | 14 | Output 3 |
|  | 15 | 16 | Common output 3 |
| Input 3 <br> + terminal | 17 | 18 | Output 4 |
| Input 3 <br> - terminal | 19 | 20 | Common output 4 |
| Input 4 + terminal | 21 | 22 | Input 1 + terminal |
| Input 4 - terminal | 23 | 24 | Input 1 - terminal |
|  | 25 | 26 | Input 2 <br> + terminal |
|  | 27 | 28 | Input 2 <br> - terminal |


| Case earth connection | 29 | 30 | Terminal RS485 |
| :---: | :---: | :---: | :---: |
| RS485 <br> + terminal | 31 | 32 | RS485 |
| Vaux <br> + terminal | 33 | 34 | Vaux <br> - terminal |
| Relay failed (WD) | 35 | 36 | Common "Watchdog " |
| Relay healthy (WD) | 37 | 38 |  |
| Residual volt. input | 39 | 40 | Residual volt. input |
|  | 41 | 42 |  |
|  | 43 | 44 |  |
|  | 45 | 46 |  |
| Current input (5A) | 47 | 48 | Current input (5A) |
|  | 49 | 50 |  |
|  | 51 | 52 |  |
|  | 53 | 54 |  |
| Current input (1A) | 55 | 56 | Current input (1A) |

### 14.2 Description Rear Terminal Block for P126 \& P127



| Input 7 + terminal | 57 | 58 | Input 6 + terminal |
| :---: | :---: | :---: | :---: |
| Input 7 <br> - terminal | 59 | 60 | Input 6 <br> - terminal |
|  | 61 | 62 |  |
|  | 63 | 64 |  |
|  | 65 | 66 |  |
|  | 67 | 68 |  |
| (•) Voltage input VA | 69 | 70 | Voltage input VA |
| (•) Voltage input VB | 71 | 72 | Voltage input VB |
| (•) Voltage input VC/Vr | 73 | 74 | Voltage input VC/Vr |
|  | 75 | 76 |  |
|  | 77 | 78 |  |
|  | 79 | 80 |  |
|  | 81 | 82 |  |
|  | 83 | 84 |  |


| Output 5 | 1 | 2 | Common output 1 | Case earth connection | 29 | 30 | Terminal RS485 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Common output 5 | 3 | 4 | Output 1 (NC) | RS485 <br> + terminal | 31 | 32 | RS485 |
| Output 6 | 5 | 6 | Output1 (NO) | Vaux <br> + terminal | 33 | 34 | Vaux <br> - terminal |
| Common output 6 | 7 | 8 | Common output 2 | Relay failed (WD) | 35 | 36 | Common "Watchdog" |
| Common output 7 | 9 | 10 | Output 2 <br> (NC) | Relay healthy (WD) | 37 | 38 |  |
| Output 7 | 11 | 12 | Output 2 <br> (NO) |  | 39 | 40 |  |
| Common output 8 | 13 | 14 | Output 3 | (•) Current input IA (5A) | 41 | 42 | Current input IA (5A) |
| Output 8 | 15 | 16 | Common output 3 | (•) Current input IB (5A) | 43 | 44 | Current input IB (5A) |
| Input 3 <br> + terminal | 17 | 18 | Output 4 | (•) Current input IC(5A) | 45 | 46 | Current input IC(5A) |
| Input 3 <br> - terminal | 19 | 20 | Common output 4 | (•) Current input le (5A) | 47 | 48 | Current input le(5A) |
| Input 4 + terminal | 21 | 22 | Input 1 + terminal | (•) Current input IA (1A) | 49 | 50 | Current input IA (1A) |
| Input 4 <br> - terminal | 23 | 24 | Input 1 <br> - terminal | (•) Current input IB (1A) | 51 | 52 | Current input IB (1A) |
| Input 5 + terminal | 25 | 26 | Input 2 <br> + terminal | (•) Current input IC (1A) | 53 | 54 | Current input IC (1A) |
| Input 5 <br> - terminal | 27 | 28 | Input 2 <br> - terminal | (•) Current input le (1A) | 55 | 56 | Current input le (1A) |

NOTE: (•) shows primary transformer polarity.
Voltage inputs VA, VB and VC only for P127 relay.
Vr (residual voltage), internally derived value for P126 and P127 relays
15. LOCAL CONNECTION TO A PC
15.1 Configuration


For a local connection between a PC and the relay a serial cable with metallic shield should be used.

The wiring of the RS232 cable must be as shown in the following drawing.


## 16. REMOTE CONNECTION

The figures show the advise connection for a local network by the RS485 cable


17. WIRING DIAGRAMS FOR P125, P126 \& P127

### 17.1 P125 Wiring Diagram



### 17.2 P126 Wiring Diagram



### 17.3 P127 Wiring Diagram


18. CASE DIMENSIONS
18.1 P126 \& P127 Case Dimension

18.2

P125 Case Dimension


## 19. COMPANY CONTACT INFORMATION

If you need information pertaining to the operation of this MiCOM product that you have purchased, please contact your local AREVA T\&D agent or the After Sales Service Department of AREVA T\&D. Do not forget to give the serial number and reference of the MiCOM product.

The MiCOM product reference and serial numbers are documented under the upper hinged cover on the front of the relay. For more precise information, refer to the section "Relay Identification" in this chapter.

PLEASE GIVE THE FOLLOWING DATA WHEN MAKING A CALL TO AREVA :

- CORTEC code of the MiCOM relay
- $\quad$ Serial number of the MiCOM relay
- AREVAs order reference
- AREVAs operator reference

AREVA After Sales Service department address, phone and fax number:
Service Après Vente/After Sales Service
AREVA T\&D EAI
95 avenue de la Figuières - BP75
F-34975 Lattes Cedex
FRANCE
Phone: +33 (0)467205558 or +33(0)467205555
Fax: +33 (0)467 205600
E-mail: www.areva-td.com

## HANDLING, INSTALLATION AND CASE DIMENSIONS

## CONTENT

1. GENERAL CONSIDERATIONS ..... 3
1.1 Receipt of relays ..... 3
1.2 Electrostatic discharge (ESD) ..... 3
2. HANDLING OF ELECTRONIC EQUIPMENT ..... 4
3. RELAY MOUNTING ..... 5
4. UNPACKING ..... 6
5. STORAGE ..... 7
6. CASE DIMENSIONS ..... 8
6.1 MiCOM P126 \& P127 ..... 9
6.2 MiCOM P125 ..... 9

## 1. GENERAL CONSIDERATIONS

### 1.1 Receipt of relays

Protective relays, although generally of robust construction, require careful treatment prior to installation on site. Upon receipt, relays should be examined immediately to ensure no damage has been sustained in transit. If damage has been sustained during transit a claim should be made to the transport contractor and AREVA should be promptly notified.

Relays that are supplied unmounted and not intended for immediate installation should be returned to their protective polythene bags.

### 1.2 Electrostatic discharge (ESD)

The relays use components that are sensitive to electrostatic discharges.
The electronic circuits are well protected by the metal case and the internal module should not be withdrawn unnecessarily. When handling the module outside its case, care should be taken to avoid contact with components and electrical connections. If removed from the case for storage, the module should be placed in an electrically conducting antistatic bag.

There are no setting adjustments within the module and it is advised that it is not unnecessarily disassembled. Although the printed circuit boards are plugged together, the connectors are a manufacturing aid and not intended for frequent dismantling; in fact considerable effort may be required to separate them. Touching the printed circuit board should be avoided, since complementary metal oxide semiconductors (CMOS) are used, which can be damaged by static electricity discharged from the body.

## 2. HANDLING OF ELECTRONIC EQUIPMENT

A person's normal movements can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semiconductor devices when handling electronic circuits can cause serious damage, which often may not be immediately apparent but the reliability of the circuit will have been reduced.

The electronic circuits are completely safe from electrostatic discharge when housed in the case. Do not expose them to risk of damage by withdrawing modules unnecessarily.

Each module incorporates the highest practicable protection for its semiconductor devices. However, if it becomes necessary to withdraw a module, the following precautions should be taken to preserve the high reliability and long life for which the equipment has been designed and manufactured.

1. Before removing a module, ensure that you are at the same electrostatic potential as the equipment by touching the case.
2. Handle the module by its front-plate, frame or edges of the printed circuit board. Avoid touching the electronic components, printed circuit track or connectors.
3. Do not pass the module to another person without first ensuring you are both at the same electrostatic potential. Shaking hands achieves equipotential.
4. Place the module on an antistatic surface, or on a conducting surface which is at the same potential as yourself.
5. Store or transport the module in a conductive bag.

If you are making measurements on the internal electronic circuitry of an equipment 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 $500 \mathrm{k} \Omega-10 \mathrm{M} \Omega$.
If a wrist strap is not available you should maintain regular contact with the case to prevent a build-up of static. Instrumentation which may be used for making measurements should be earthed to the case whenever possible.

More information on safe working procedures for all electronic equipment can be found in BS5783 and IEC 147-OF. 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 above-mentioned BS and IEC documents.

## 3. RELAY MOUNTING

Relays are dispatched either individually or as part of a panel/rack assembly.
If an MMLG test block is to be included it should be positioned at the right-hand side of the assembly (viewed from the front). Modules should remain protected by their metal case during assembly into a panel or rack.

For individually mounted relays an outline diagram is supplied in section 6 of this chapter showing the panel cut-outs and hole centres.

## 4. UNPACKING

Care must be taken when unpacking and installing the relays so that none of the parts is damaged or the settings altered. Relays must only be handled by skilled persons. The installation should be clean, dry and reasonably free from dust and excessive vibration. The site should be well lit to facilitate inspection. Relays that have been removed from their cases should not be left in situations where they are exposed to dust or damp. This particularly applies to installations which are being carried out at the same time as construction work.

## 5. 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. The action of the de-humidifier crystals will be impaired if the bag has been exposed to ambient conditions and may be restored by gently heating the bag for about an hour, prior to replacing it in the carton.

Dust which collects on a carton may, on subsequent unpacking, find its way into the relay; in damp conditions the carton and packing may become impregnated with moisture and the dehumifier will lose its efficiency.

Storage temperature : $-25^{\circ} \mathrm{C}$ to $+70^{\circ} \mathrm{C}$.

## 6. CASE DIMENSIONS

MiCOM P125, P126 and P127 relays are available in a 4 U metal case for panel or flush mounting.

### 6.1 MiCOM P126 \& P127


6.2 MiCOM P125


## USER GUIDE

## CONTENT

1. INTRODUCTION ..... 3
2. PASSWORD ..... 4
2.1 Password Protection ..... 4
2.2 Password Entry ..... 4
2.3 Changing the Password ..... 4
2.4 Change of Setting Invalidation ..... 4
2.5 Displays of Alarm \& Warning Messages ..... 4
2.5.1 Electrical Network Alarms ..... 5
2.5.2 Relay Hardware or Software Warning Messages ..... 5
3. GENERAL CHARACTERISITCS ..... 9
3.1 Analogue Inputs ..... 9
4. MENU ..... 11
4.1 Menu OP PARAMETERS ..... 11
4.1.1 Additional OP PARAMETERS Menu Points for P126 \& P127 ..... 12
4.2 Menu CONFIGURATION ..... 13
4.2.1 Submenu General Options ..... 14
4.2.2 Submenu Transfo. Ratio ..... 14
4.2.3 Submenus to Configure LEDs 5 to 8 ..... 15
4.2.4 Example: Setting LED 5 for P126: ..... 18
4.2.5 Submenu Logic Inputs Choice: Active High/Low (P125) ..... 21
4.2.6 Submenu Logic Inputs Choice: Active High/Low (P126 \& P127) ..... 21
4.2.7 Submenu Output Relay 1 in Fail Safe mode ..... 23
4.2.8 Submenu Selecting Active Protection Group (P125, P126 \& P127) ..... 23
4.3 Menu MEASUREMENTS ..... 24
4.4 Voltage Connections ..... 25
4.4.1 $\quad \mathrm{Vpn}$ (Three phase-neutral connection) : ..... 25
4.4.2 $2 \mathrm{Vpn}+\operatorname{Vr}$ (Two phase-neutral plus an Open Delta connection) : ..... 25
4.4.3 $\quad \mathrm{Vpp}+\mathrm{Vr}$ (Two phase-phase plus an Open Delta connection) : ..... 25
4.4.4 Menu MEASUREMENTS for P125 ..... 26
4.4.5 MEASUREMENTS Menu Points for P126 ..... 27
4.4.6 Additional Measurements Menu Points for P127 ..... 29
4.5 Menu COMMUNICATION ..... 32
4.5.1 Menu ModBus COMMUNICATION ..... 32
4.5.2 Menu Courier COMMUNICATION ..... 32
4.5.3 Menu IEC 60870-5-103 COMMUNICATION ..... 33
4.5.4 Menu DNP3.0 COMMUNICATION ..... 33
4.6 Menu PROTECTION ..... 33
4.6.1 Submenu [67/50/51] Directional Three Phase Overcurrent (P127) ..... 34
4.6.2 Submenu [67N/50N/51N] Directional Earth Overcurrent ..... 38
4.6.3 Submenu [50/51] Three Phase Overcurrent (P126) ..... 43
4.6.4 Submenu [32N] Earth Wattmetric Protection ..... 46
4.6.5 Submenu [46] Negative Phase Sequence Overcurrent (P126 \& P127) ..... 49
4.6.6 Submenu [49] Thermal Replica Overload (P126 \& P127) ..... 51
4.6.7 Submenu [37] Undercurrent Protection (P126 \& P127) ..... 52
4.6.8 Submenu [59] Over-voltage Protection (P127) ..... 52
4.6.9 Submenu [27] Under-voltage Protection (P127) ..... 53
4.6.10 Submenu [59N] Earth Over-voltage Protection ..... 53
4.6.11 Submenu [79] AUTORECLOSE (P126 \& P127) ..... 54
4.7 Menu AUTOMAT. CTRL ..... 56
4.7.1 Submenu Trip Commands ..... 56
4.7.2 Submenu Latch Relays ..... 59
4.7.3 Submenu Blocking Logic ..... 60
4.7.4 Submenu Logic Select ..... 62
4.7.5 Submenu Outputs Relays ..... 62
4.7.6 Submenu Inputs ..... 69
4.7.7 Setting auxiliary timers at the end of submenu Inputs ..... 70
4.7.8 Submenu Broken Conductor (P126 \& P127) ..... 71
4.7.9 Submenu Cold Load PU (P126 \& P127) ..... 71
4.7.10 Submenu 51V and VTS control (Overcurrent controlled by voltage voltage transformer control (P127)) ..... 72
4.7.11 Submenu Circuit Breaker Fail (P126 \& P127) ..... 73
4.7.12 Submenu Circuit Breaker Supervision (P126 \& P127) ..... 73
4.7.13 Submenu SOTF (Switch on to fault) (P126 \& P127) ..... 74
4.8 Menu RECORDS (P126 \& P127) ..... 80
4.8.1 $\quad$ Submenu CB Monitoring (P126 \& P127) ..... 80
4.8.2 Submenu Disturb Record ..... 83
5. WIRING ..... 84
5.1 Auxiliary Power Supply ..... 84
5.2 Current Measurement Inputs ..... 84
5.3 Logic Inputs ..... 84
5.4 Output Relays ..... 84
5.5 Communication ..... 85
5.5.1 RS485 Rear Communication Port ..... 85
5.5.2 RS232 Front Communication Port ..... 85

## 1. INTRODUCTION

MiCOM P125, P126 \& P127 are fully numerical relays designed to perform electrical protection and control functions.

The following sections describe content and structure of the menu.
The five keys situated in the middle of the MiCOM relay front panel are dedicated to set parameters.

With the keys $\Delta \Leftrightarrow \theta(1)$ it is possible to move in the direction indicated to the various levels of the menus.

The key $\oplus$ validates the settings modification.
The two keys © and () are dedicated to acknowledging/clearing and displaying/reading of data. For example if successive alarms are to be displayed, press on key (1).

The alarms are presented in reverse order of their detection (the most recent alarm first, the oldest last). The user can either acknowledge and clear each alarm from the LCD by using © or go to the end of the ALARM menu and carry out a general acknowledgement.

## 2. PASSWORD

### 2.1 Password Protection

Password protection is applicable to most of the relay settings, especially to the selection of the various alarm thresholds, trip thresholds, communication parameters, allocation of logic inputs and outputs.

The password consists of four capital characters. When leaving the factory, the password is set to AAAA. The user can define any combination of four characters.

Should the password be lost or forgotten, modification of the stored parameters is blocked. It is then necessary to contact the manufacturer or his agent and a stand-by password specific to the relay concerned may be obtained.

The programming mode is indicated with the letter "P" on the right hand side of the display on each menu heading. The letter "P" remains present as long as the password is active ( 5 minutes if there is no action on the keypad).

### 2.2 Password Entry

The input of the password is requested as soon as a modification of a parameter is made for any one of the six/eight menus and the submenus. The user enters each of the 4 characters and then validates the entire password with $\Theta$.

After 5 seconds, the display returns to the point of the preceding menu.
If no key is pressed inside of 5 minutes, the password is deactivated. A new password request is associated with any subsequent parameter modification.

### 2.3 Changing the Password

To change an active password, go to the OP. PARAMETERS menu and then to the Password submenu. Enter the current password and validate. Then press $\oplus$ and enter the new password character by character and validate the new password using $\oplus$.

The message NEW PASSWORD OK is displayed to indicate that the new password has been accepted.

### 2.4 Change of Setting Invalidation

The procedure to modify a setting is shown in the next part of this document.
If during this action it occurs the need to get back to the old setting it is necessary push the © key before validating the setting change. After this action the following message will appear on the LCD for some seconds and the old setting will be maintained.

## UPGRADE CANCEL

### 2.5 Displays of Alarm \& Warning Messages

Alarm messages are displayed directly on the front panel LCD. They have priority over the default current value. As soon as an alarm situation is detected by the relay (threshold crossing for example), the associated message is displayed on the MiCOM relay front panel LCD and the LED Alarm (LED 2) lights up.

The alarm and warning messages are classed as follows:
Alarm messages generated by the electrical power network.
Warning messages caused by hardware or software faults from the relay.

### 2.5.1 Electrical Network Alarms

Any crossing of a threshold (instantaneous or time delay) generates an "electrical network alarm". The involved threshold is indicated. Regarding the phase thresholds, the phase designation ( $\mathrm{A}, \mathrm{B}$ or C ) is also displayed.

If several alarms are triggered, they are all stored in their order of appearance and presented on the LCD in reverse order of their detection (the most recent alarm first, the oldest alarm last). Each alarm message is numbered and the total stored is shown.

The user can read all the alarm messages by using (a).
The user acknowledges and clears the alarm messages from the LCD by using ©.
The user can acknowledge each alarm message one by one or all by going to the end of the list to acknowledge, and clear, all the alarm messages by using ©.

The control of the ALARM LED (LED 2) is directly assigned to the status of the alarm messages stored in the memory.
If one or several messages are NOT READ and NOT ACKNOWLEDGED, the ALARM LED (LED 2) flashes.

If all the messages have been READ but NOT ACKNOWLEDGED, the ALARM LED (LED 2) lights up continuously.
If all the messages have been ACKNOWLEDGED, and cleared, if the cause was reset, the ALARM LED (LED 2) is extinguished.

### 2.5.2 Relay Hardware or Software Warning Messages

Any software or hardware fault of the MiCOM relay generates a "hardware/software alarm" that is stored in memory as a "Hardware Alarm". If several hardware alarms are acquired they are all stored in their order of appearance. The warning messages are presented on the LCD in reverse order of their detection (the most recent first and the oldest last). Each warning message is numbered and the total stored is shown.
The user can read all warning messages by using $)$, without entering the password.
The acknowledgement, and clearing, of warning messages caused by internal relay hardware or software faults is not possible. A warning message can only be made to disappear if the cause of the fault has been removed.
The control of the WARNING LED (LED 3) is directly assigned to the status of the warning messages stored in the memory.

If the internal hardware or software fault is major (i.e. the relay cannot perform protection functions), the WARNING LED (LED 3) lights up continuously.

If the internal hardware or software fault is minor (i.e. a communication failure that has no influence on the protection and automation functions), the WARNING LED (LED 3) will flash.

Warning messages caused by internal hardware or software faults are:

```
<< EEPROM ERROR CALIBRATION >>
<< CLOCK ERROR >>
<< BATTERY FAIL >>
<< DEFAULT SETTINGS (*) >>
<< SETTING ERROR (**) >>
<< CT ERROR >>
<< COMMUNIC. ERROR >>
<< WATCH DOG >>
<< RAM ERROR >>
```

(*) DEFAULT SETTINGS: Each time the relay is powered ON it will check its memory contents to determine whether the settings are set to the factory defaults. If the relay detects
that the default settings are loaded an alarm is raised. The ALARM LED (YELLOW) will light up and the Watch Dog contact will be activated.

Only one parameter in the relay's menu needs to be changed to suppress these messages and to reset the watch dog. This alarm is only an indication to the user that the relay has its default settings applied.
(**) SETTING ERROR: Should the CPU fails to get correctly store data to the EEPROM during a setting change, a "HARDWARE" ALARM will appear on the LCD display followed by "SETTING ERROR" message (when pushing on the button). In addition, the ALARM LED (YELLOW) will light up and the Watch Dog contact will be activated To reset this alarm it is necessary to power ON and OFF the relay. Following this, the last unsuccessful setting change will then need to be re-applied. If the alarm persists, i.e. the "SETTING ERROR" alarm is still displayed, please contact AREVA After Sales Services for advice and assistance.

Possible software alarm messages are:

| $\mathrm{l}>$ | instantaneous $1^{\text {st }}$ threshold directional/non directional overcurrent |
| :--- | :--- |
| $\mathrm{tl}>$ | time delayed $1^{\text {st }}$ threshold directional/non directional overcurrent |

For the $\mathrm{l}>$ and $\mathrm{tl}>$ a particular attention has to be taken.
The P126 \& P127 are able to identify the phase where the fault occurs, and the relevant alarm messages are shown in the below listed table.

| Menu' ALARMS |  |
| :---: | :---: |
| $\mathrm{l}>$ PHASE | $\mathrm{tl}>$ PHASE |
| A | A |
| A | A |
| B | B |
| B | B |
| C | C |
| C | C |
| A | A |
| A | AB |
| A | AB |
| A | AB |
| A | ABC |
| A | ABC |
| A | ABC |
| A | ABC |
| A | ABC |
| ABC | ABC |

tl>>> $\quad 3^{\text {rd }}$ trip threshold directional/non directional overcurrent
le> $\quad 1^{\text {st }}$ alarm threshold directional/non directional earth fault
le>> $\quad 2^{\text {nd }}$ alarm threshold directional/non directional earth fault

1>>
l>>>
tl>
tl>>
le>>>
$2^{\text {nd }}$ alarm threshold directional/non directional overcurrent
>> $\quad 3^{\text {rd }}$ alarm threshold directional/non directional overcurrent
$\quad 1^{\text {st }}$ trip threshold directional/non directional overcurrent
>> $\quad 2^{\text {nd }}$ trip threshold directional/non directional overcurrent
$3^{\text {rd }}$ alarm threshold directional/non directional earth fault

| tle> | $1^{\text {st }}$ trip threshold directional/non directional earth fault |
| :---: | :---: |
| tle>> | $2^{\text {nd }}$ trip threshold directional/non directional earth fault |
| tle>>> | $3{ }^{\text {rd }}$ trip threshold directional/non directional earth fault |
| Pe/leCos> | $1^{\text {st }}$ alarm threshold wattmetric/leCos earth fault |
| Pe/leCos>> | $2^{\text {nd }}$ alarm threshold wattmetric/leCos earth fault |
| tPe/leCos> | $1{ }^{\text {st }}$ trip threshold wattmetric/leCos earth fault |
| tPe/leCos>> | $2^{\text {nd }}$ trip threshold wattmetric/leCos earth fault |
| Thermal Alarm | threshold thermal alarm |
| Thermal Overload | thermal overload trip |
| l< | alarm threshold undercurrent fault |
| $\mathrm{tl}<$ | trip threshold undercurrent fault |
| 12> | $1^{\text {st }}$ alarm threshold negative sequence overcurrent |
| tl2> | $1^{\text {st }}$ trip threshold negative sequence overcurrent |
| I2>> | $2^{\text {nd }}$ alarm threshold negative sequence overcurrent |
| t12>> | $2^{\text {nd }}$ trip threshold negative sequence current |
| 12>>> | $3{ }^{\text {rd }}$ alarm threshold negative sequence current |
| tl2>>> | $3{ }^{\text {rd }}$ trip threshold negative sequence current |
| Brkn.Cond. | broken conductor signal. I2/I1 element threshold exceeded for longer than tBC ; tBC is settable in the AUTOMAT. CTRL/Broken Conductor menu. |
| U> | $1^{\text {st }}$ alarm threshold overvoltage |
| U>> | $2{ }^{\text {nd }}$ alarm threshold overvoltage |
| tU> | $1^{\text {st }}$ trip threshold overvoltage |
| tU>> | $2^{\text {nd }}$ trip threshold overvoltage |
| U< | $1^{\text {st }}$ alarm threshold undervoltage |
| $\mathrm{U} \ll$ | $2^{\text {nd }}$ alarm threshold undervoltage |
| $t \cup<$ | $1^{\text {st }}$ trip threshold undervoltage |
| $t$ U<< | $2^{\text {nd }}$ trip threshold undervoltage |
| Ue>>>> | alarm threshold residual overvoltage |
| tUe>>>> | trip threshold residual overvoltage |
| tAUX 1 | timer t AUX1 associated with logic input Aux1 <br> Alarm occurs when the timer is expired and for any output relay assignement |
| tAUX 2 | timer t AUX2 associated with logic input Aux2 <br> Alarm occurs when the timer is expired and for any output relay assignement |
| tAUX 3 | timer t AUX3 associated with logic input Aux3 <br> Alarm occurs when the timer is expired is assignment to relay 1 (Trip Command) only. |
| tAUX 4 | timer t AUX4 associated with logic input Aux4 <br> Alarm occurs when the timer is expired is assignment to relay 1 (Trip Command) only. |


| CB Fail | circuit breaker failure signal; the CB does not trip on Tbf <br> (time-out). tBF is settable in the AUTOMAT. CTRL/CB Fail menu. <br> faulty circuit breaker signal at assignable logic input <br> (set in AUTOMAT. CTRL/Inputs menu). |
| :--- | :--- |
| SF6 Low |  |
| Toperating CB | operating (or tripping) time of the circuit breaker longer than the value <br> set in the AUTOMAT. CTRL/CB Supervision menu. |
| Trip Circuit Super. | Circuit breaker trip circuit failure for longer than the supervision timer t |
| SUP settable in the AUTOMAT.CTRL/CB Supervision menu. |  |

## 3. GENERAL CHARACTERISITCS

### 3.1 Analogue Inputs

The analogue inputs for each relay are shown in the following table:

| Type of Analogue Inputs | MiCOM <br> $\mathbf{P 1 2 5}$ | MiCOM <br> $\mathbf{P 1 2 6}$ | MiCOM <br> $\mathbf{P 1 2 7}$ |
| :--- | :---: | :---: | :---: |
| Phase current inputs |  | $\mathbf{3}$ | $\mathbf{3}$ |
| Earth current inputs (high, medium, low <br> sensitivity by Cortec code) | $\mathbf{1}$ | $\mathbf{1}$ | $\mathbf{1}$ |
| Residual voltage input | $\mathbf{1}$ | $\mathbf{1}$ | $\mathbf{1 / 0}$ |
| Phase to neutral or phase to phase voltage <br> inputs |  | $2 / 3$ |  |
| Total analogue inputs | 2 | 5 | 7 |

Following is a description of the voltage inputs connection for the P 127 relay.

## Case A

2 phase to neutral voltage inputs
1 residual voltage input
$V C$ is then calculated as $V C=V A+V B+V e$
To obtain a correct reading of the input voltage the exact voltage transformer ratio for Ve has to be set.

Case B
2 phase to phase voltage inputs
VCA is then calculated as $\mathrm{VCA}=\mathrm{VAB}+\mathrm{VBC}$

## Case C

3 phase to phase voltage inputs
No residual voltage input

$$
\text { Ve can be calculated as } \mathrm{Ve}=(\mathrm{VA}+\mathrm{VB}+\mathrm{VC}) / 3
$$

- On the MiCOM P125 relays rear terminals there is one current input rated 1A and one current input rated 5A available and one voltage input. On the MiCOM P126 relay rear terminals there are four current inputs rated 1A and four current inputs rated 5A available and one voltage input. On the MiCOM P127 relay rear terminals there are four current inputs rated 1 A and four current inputs rated 5 A available and three voltages input.
- By using the Cortec code (see the appropriate section) the user can choose the voltage range for voltage inputs for the MiCOM P125 \& P126 (one input) and P127 (three inputs).

All logic outputs can be programmed to respond to any of the available control or protection functions. Logic inputs can be assigned to various control functions.

All logic digital inputs can be programmed to respond to any of the available control or protection functions. Their supply level is the same as the power supply selected of the relay by Cortec. They can be supplied in A.C or D.C current by Cortec choice.

The MiCOM relays are powered either from a DC (3 voltage ranges) or an AC auxiliary power supply.

Any short time voltage interruption ( $<50 \mathrm{~ms}$ ) is filtered and regulated through the auxiliary power supply.

The front panel enables the user to navigate through the menu to access data, change settings, read measurements etc.

Eight LEDs on the front panel allow a clear and simple presentation of events. The various detected alarms are stored and can be displayed on the back-lit LCD.

No Password is required to read and acknowledge (clear) these alarm messages.
On their rear terminals the MiCOM P125, P126 \& P127 relays have a standard RS485 port available. The user can choose, by ordering, the communication protocol ModBus RTU, IEC 60870-5-103, Courier (when available), or DNP3 (when available).

Using the communication channel RS485, all stored information (measurements, alarms, and parameters) can be read and the settings can be modified if this functionality is allowed by the chosen protocol.

Evaluation and modification of this data can be carried out on site with a normal PC and the appropriate AREVA software.

RS485 based communication allows MiCOM P125, P126 \& P127 relays to be directly linked to a digital control system (e.g. MiCOM S10).

All the available data is then placed at the disposal of the supervisor and can be processed either local or remotely.

## 4. MENU

The menu of the MiCOM P125, P126 \& P127 relays is organised into main menus and submenus. The available content depends on the MiCOM model.

The menu for the MiCOM P125 relay is divided into 7 sections and for the MiCOM P126 \& P127 relays into 8 sections:
$\Rightarrow$ OP PARAMETERS
$\Rightarrow$ CONFIGURATION
$\Rightarrow$ MEASUREMENTS
$\Rightarrow$ COMMUNICATION
$\Rightarrow \quad$ PROTECTION G1 / G2
$\Rightarrow$ AUTOMAT. CTRL
$\Rightarrow \quad$ RECORDS (P126 \& P127 only)
To access these menus from the default display press $\Theta$.
To return to the default display from these menus or submenus press $\otimes$.

### 4.1 Menu OP PARAMETERS

To gain access to the OP PARAMETERS menu from the default display, press $\Theta$.



### 4.2 Menu CONFIGURATION

The following parameters can be set in the CONFIGURATION menu:

- labels used to display currents and voltages
- ratios for the earth and phase current transformers (CT)
- ratios for the residual voltage and phase voltage transformers (VT)
- LEDs 5 to 8 assigned to several functions.
- The setting group change by a dedicated digital input working on the level or on the edge.
- The polarisation of the digital inputs by voltage present or lacking
- The possibility to have the trip relay normally ON or OFF
- The choice to enable alarms functionality as well as battery alarm, self reset on trip or instantaneous protection or other function.
- By the maintenance way to drive the output relays.
- To set the management date for the network in using

The submenus are:

- General Options
- CT Ratio
- Led 5
- Led 6
- Led 7
- Led 8
- Inputs Configuration
- RL1 Output relay
- Group Select
- Alalrms
- Rel. maintenance
- Date

To gain access to the CONFIGURATION menu from the default display, press $\Leftrightarrow$ followed by $)$ until the desired submenu header is displayed.

### 4.2.1 Submenu General Options

The following submenu displays the connection mode only for the P127 and the default display only for the P126.

The General Options submenu is not available for the P125 relay. The default display is fixed to IN and there is no VT connection setting choice.

| CONFIGURATION | Heading of CONFIGURATION menu. <br> To gain access to the General Options submenu, press $\Theta$ and (B) until the submenu is reached. |
| :---: | :---: |
| General Options | Heading of General Options submenu. <br> To navigate within submenu points, press $\otimes \Leftrightarrow$. To modify setting, press $\Theta$. Use $\otimes \Leftrightarrow \otimes(1)$ to scroll and set available selections. Press $\Theta$ to confirm choice. |
| VT Connection 2Vpp+Vr | Displays the type of VT connection. <br> Select choice using the above instructions. <br> The available options are: $3 \mathrm{Vpn}, 2 \mathrm{Vpp}+\mathrm{Vr}, 2 \mathrm{Vpn}+\mathrm{Vr}$. To gain access to the next window press $\Theta$. To gain access to the previous window press $\otimes$. |
| Default Displays RMS I A | Displays the default current value (by selecting either Phase A, Phase B, Phase C, or Earth N). <br> To modify this default value, follow the above instructions. <br> To gain access to the next window press $\Theta$. To gain access to the previous window press $\otimes$. |

4.2.2 Submenu Transfo. Ratio

| CONFIGURATION | Heading of CONFIGURATION menu. <br> To gain access to the Transfo. Ratio submenu, press $\otimes$ and 8$)$ until the submenu is reached. |
| :---: | :---: |
| Transfo. Ratio | Heading of Transfo. Ratio submenu. <br> To navigate within submenu points, press $\otimes \Theta$. To modify setting, press $\Theta$. Use $\otimes \Leftrightarrow \otimes(1)$ to scroll and set available selections. Press $\oplus$ to confirm choice. <br> To gain access to the next window press $\Theta$. To gain access to the previous window press $\otimes$. |
| Line CT primary $5 \mathrm{~A}$ | Displays the rated primary current of the line CT. <br> The setting range is from 1 to 9999. <br> This setting is only available in P 126 and P 127 relays. |
| Line CT sec 5 A | Displays the rated secondary current of the line CT. <br> The setting value is either 1 or 5 . <br> This setting is only available in P126 and P127 relays. |
| E/Gnd CT primary $5 \mathrm{~A}$ | Displays the rated primary current of the earth CT. The setting range is from 1 to 9999. |
| E/Gnd CT sec 5 A | Displays the rated secondary current of the earth CT. The setting value is either 1 or 5 . |

The following displays and settings are only shown and applicable with the P127 relay.


Displays the rated primary voltage of the line VT. The rated voltage input range is given by relay Cortec code.
The setting range is from 0.1 to 1000 kV , in steps of 0.01 kV . For the $220-480 \mathrm{~V}$ model the setting range is from 220 to 480 V , in steps of 1 V .

## Line VT sec

Displays the rated secondary voltage of the line VT. The rated voltage input range is given by relay Cortec code. The setting range is from 57 to 130 V , in steps of 0.1 V This window is not available for the $220-480 \mathrm{~V}$ model.

The following displays are only shown if the connection mode $2 \mathrm{Vpp}+\mathrm{Vr}$ or $2 \mathrm{Vpn}+\mathrm{Vr}$ is selected.


## E/Gnd VT sec 100.0 V

Displays the rated primary voltage of the earth VT. The rated voltage input range is given by relay Cortec code. The setting range is from 0.1 to 1000 kV , in steps of 0.01 kV . For the $220-480 \mathrm{~V}$ model the setting range is from 220 to 480 V , in steps of 1 V .

Displays the rated secondary voltage of the earth VT. The rated voltage input range is given by relay Cortec code. The setting range is from 57 to 130 V , in steps of 0.1 V . This window is not available for the $220-480 \mathrm{~V}$ model.

WARNING: WITH THE P127 RELAY, NOT ALL MEASUREMENTS CAN BE READ IN the direct mode. these measurements must be read in the INDIRECT MODE.

These measurement values are called derived measurements.
They depend on the selected electrical voltage connection mode.
4.2.3 Submenus to Configure LEDs 5 to 8

To gain access to the CONFIGURATION menu from the default display press $\Theta$. Then press ()) until the submenu Led is reached.

To reach the LED configuration submenu press $\Leftrightarrow$ for Led 5 . Press © to reach Led 6, again to reach Led 7 and again to reach Led 8.

The following table lists the protection functions that can be assigned to the LEDs (5 to 8) for each MiCOM relay model.

Directional overcurrent protection.

| TEXT | P125 | P126 | P127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| l> |  |  | X | Instantaneous 1st threshold phase overcurrent |
| tl> |  |  | X | Time delayed 1st threshold phase overcurrent |
| t\|A> |  |  | X | Time delayed first threshold trip on phase A |
| t\|B> |  |  | X | Time delayed first threshold trip on phase B |
| t\|C> |  |  | X | Time delayed first threshold trip on phase C |
| l>> |  |  | X | Instantaneous 2nd threshold phase overcurrent |
| tl>> |  |  | X | Time delayed 2nd threshold phase overcurrent |
| l>>> |  |  | X | Instantaneous 3rd threshold phase overcurrent |
| tl>>> |  |  | X | Time delayed 3rd threshold phase overcurrent |

Three phase overcurrent protection

| TEXT | P125 | P126 | P127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| l> |  | X |  | Instantaneous 1st threshold overcurrent |
| t $\mid>$ |  | X |  | Time delayed 1st threshold overcurrent |
| t\|A> |  | X |  | Time delayed first threshold trip on phase A |
| t\|B> |  | X |  | Time delayed first threshold trip on phase B |
| t $\gg$ |  | X |  | Time delayed first threshold trip on phase C |
| l>> |  | X |  | Instantaneous 2nd threshold overcurrent |
| tl>> |  | X |  | Time delayed 2nd threshold overcurrent |
| l>> |  | X |  | Instantaneous 3rd threshold overcurrent |
| tl>>> |  | X |  | Time delayed 3rd overcurrent threshold |

Directional earth fault protection

| TEXT | P 125 | P 126 | P 127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| le> | X | X | X | Instantaneous 1st threshold earth overcurrent |
| tle> | X | X | X | Time delayed 1st threshold earth overcurrent |
| le>> | X | X | X | Instantaneous 2nd threshold earth overcurrent |
| tle>> | X | X | X | Time delayed 2nd threshold earth overcurrent |
| le>>> | X | X | X | Instantaneous 3rd threshold earth overcurrent |
| tle>>> | X | X | X | Time delayed 3rd threshold earth overcurrent |

Wattmetric Pe/leCOS protection

| TEXT | P125 | P126 | P127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| Pe/leCos $>$ | X | X | X | $1^{\text {st }}$ alarm threshold earth fault overpower/leCos <br> (wattmetric) |
| tPe/leCos> | X | X | X | $1^{\text {st }}$ trip threshold earth fault overpower/leCos <br> (wattmetric) |
| Pe/leCos>> | X | X | X | $2^{\text {nd }}$ alarm threshold earth fault overpower/leCos <br> (wattmetric) |
| tPe/leCos>> | X | X | X | $2^{\text {nd }}$ trip threshold earth fault overpower/leCos <br> (wattmetric) |

Negative phase sequence overcurrent protection

| TEXT | P125 | P126 | P127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| I2> |  | X | X | $1^{\text {st }}$ alarm threshold negative sequence overcurrent |
| t12> |  | X | X | $1^{\text {s }}$ trip threshold negative sequence overcurrent |
| I2>> |  | X | X | $2^{\text {nd }}$ alarm threshold negative sequence overcurrent |
| t\|2>> |  | X | X | $2^{\text {nd }}$ trip threshold negative sequence overcurrent |
| \|2>>> |  | X | X | $3^{\text {rd }}$ alarm threshold negative sequence overcurrent |
| tl2>>> |  | X | X | $3^{\text {rd }}$ trip threshold negative sequence overcurrent |

Thermal protection

| TEXT | P125 | P126 | P127 | Information |
| :---: | :---: | :---: | :---: | :--- |
| Therm Trip |  | X | X | Thermal trip overload threshold |

Three phase undercurrent protection

| TEXT | P 125 | P 126 | P 127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| $\mathrm{l}<$ |  | X | X | Alarm threshold undercurrent |
| $\mathrm{tl}<$ |  | X | X | Trip threshold undercurrent |

Overvoltage protection

| TEXT | P125 | P126 | P127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| U $>$ |  |  | X | $1^{\text {st }}$ alarm threshold overvoltage |
| tU $>$ |  |  | X | $1^{\text {st }}$ trip threshold overvoltage |
| U $\gg$ |  |  | X | $2^{\text {nd }}$ alarm threshold overvoltage |
| tU>> |  |  | X | $2^{\text {nd }}$ trip threshold overvoltage |

Undervoltage protection

| TEXT | P125 | P126 | P127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| $\mathrm{U}<$ |  |  | X | $1^{\text {st }}$ alarm threshold undervoltage |
| $\mathrm{t} U<$ |  |  | X | $1^{\text {st }}$ trip threshold undervoltage |
| $\mathrm{U} \lll$ |  |  | X | $2^{\text {nd }}$ alarm threshold undervoltage |
| $\mathrm{t} U \ll$ |  |  | X | $2^{\text {nd }}$ trip threshold undervoltage |

Residual overvoltage protection

| TEXT | P125 | P126 | P127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| Ue>>>> | X | X | X | Alarm threshold residual overvoltage |
| tUe>>>> | X | X | X | Trip threshold residual overvoltage |

Broken conductor protection

| TEXT | P125 | P126 | P127 | Information |
| :---: | :---: | :---: | :---: | :--- |
| Brkn. Cond |  | X | X | Broken conductor detection trip |

CB Fail

| TEXT | P125 | P126 | P127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| CB Fail |  | X | X | Circuit breaker failure trip |

Logic inputs

| TEXT | P125 | P126 | P127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| Input1 | X | X | X | Copy of the status of logic input no 1 |
| Input2 | X | X | X | Copy of the status of logic input no 2 |
| Input3 | X | X | X | Copy of the status of logic input no 3 |
| Input4 | X | X | X | Copy of the status of logic input no 4 |
| Input5 |  | X | X | Copy of the status of logic input no 5 |
| Input6 |  | X | X | Copy of the status of logic input no 6 |
| Input7 |  | X | X | Copy of the status of logic input no 7 |

Autoreclose function

| TEXT | P125 | P126 | P127 | Information |
| :---: | :---: | :---: | :---: | :--- |
| Recloser Run |  | X | X | Signal that Autoreclose cycle is working |
| Recl. Blocked |  | X | X | Signal for Autoreclose cycle end |

Auxiliary timers

| TEXT | P125 | P126 | P127 | Information |
| :--- | :---: | :---: | :---: | :--- |
| tAux1 | X | X | X | Copy of the status of logic input delayed by tAux 1 |
| tAux2 | X | X | X | Copy of the status of logic input delayed by tAux 2 |

t SOTF FUNCTION

| TEXT | P125 | P126 | P127 | Information |
| :---: | :---: | :---: | :---: | :--- |
| t SOTF |  | X | X | Switch on to fault timer expired |

NOTES : Each parameter can be assigned to one or more LEDs.
One or more parameters (OR logic) can light each LED.

### 4.2.4 Example: Setting LED 5 for P126:



Heading of CONFIGURATION menu.
To gain access to the LED submenu, press $\Leftrightarrow$ and (1) until the submenu is reached.


Heading Led submenu.
To gain access to Led 5 submenu, press $\Theta$. To set the led assignment press $\Theta$ and $\Theta \Leftrightarrow$ to scroll available selections. Press $\oplus$ to confirm choice.


Setting choice Yes: LED 5 lights up when le> threshold is exceeded.
Setting choice No: No operation when le> threshold is exceeded.


Setting choice Yes: LED 5 lights up when tle> delay time has elapsed.
Setting choice No: No operation when tle> delay time has elapsed.


Setting choice Yes: LED 5 lights up when le>> threshold is exceeded.
Setting choice No: No operation when le>> threshold is exceeded.


Setting choice Yes: LED 5 lights up when tle>> delay time has elapsed.
Setting choice No: No operation when tle>> delay time has elapsed.


Setting choice Yes: LED 5 lights up when le>>> threshold is exceeded.
Setting choice No: No operation when le>>> threshold is exceeded.

| Led 5  <br> tle>>>  | No |
| :--- | :--- |

Setting choice Yes: LED 5 lights up when tle>>> delay time has elapsed.
Setting choice No: No operation when tle>>> delay time has elapsed.

| Led 5 |  |
| :--- | :--- |
| Pe/leCos $>$ | No |

Setting choice Yes: LED 5 lights up when Pe> or leCos> threshold is exceeded.
Setting choice No: No operation when Pe> or leCos> threshold is exceeded.

| Led 5 |  |
| :--- | :--- |
| tPe/leCos $>$ | No |

Setting choice Yes: LED 5 lights up when tPe> or leCos> delay time has elapsed.
Setting choice No: No operation when tPe> or leCos> delay time has elapsed.


Setting choice Yes: LED 5 lights up when Pe>> or leCos>> threshold is exceeded.
Setting choice No: No operation when Pe>> or leCos>> threshold is exceeded.


Setting choice Yes: LED 5 lights up when tPe>> or leCos>> delay time has elapsed.
Setting choice No: No operation when tPe>> or leCos>> delay time has elapsed.


Setting choice Yes: LED 5 lights up when I> threshold is exceeded.
Setting choice No: No operation when I> threshold is exceeded.


Setting choice Yes: LED 5 lights up when tl> delay time has elapsed.
Setting choice No: No operation when tl> delay time has elapsed.

| $\begin{aligned} & \text { Led } 5 \\ & \text { l>> } \end{aligned}$ | No | Setting choice Yes: LED 5 lights up when l>> threshold is exceeded. <br> Setting choice No: No operation when I>> threshold is exceeded. |
| :---: | :---: | :---: |
| Led 5 tl>> | No | Setting choice Yes: LED 5 lights up when tl>> delay time has elapsed. <br> Setting choice No: No operation when tl>> delay time has elapsed. |
| Led 5 l>>> | No | Setting choice Yes: LED 5 lights up when l>>> threshold is exceeded. <br> Setting choice No: No operation when l>>> threshold is exceeded. |
| Led 5 tll>> | No | Setting choice Yes: LED 5 lights up when tl>>> delay time has elapsed. <br> Setting choice No: No operation when tl>>> delay time has elapsed. |
| Led 5 l< | No | Setting choice Yes: LED 5 lights up when I < threshold is exceeded. <br> Setting choice No: No operation when I < threshold is exceeded. |
| $\begin{aligned} & \hline \text { Led } 5 \\ & \text { t\|2> } \end{aligned}$ | No | Setting choice Yes: LED 5 lights up when tl2> delay time has elapsed. <br> Setting choice No: No operation when tl2> delay time has elapsed. |
| Led 5 <br> Brkn. Cond | No | Setting choice Yes: LED 5 lights up when Brkn. Cond is detected. <br> Setting choice No: No operation when Brkn. Cond is detected. |
| Led 5 Therm Trip | No | Setting choice Yes: LED 5 lights up when Thermal Trip occurs. <br> Setting choice No: No operation when Thermal Trip occurs. |
| Led 5 Ue>>>> | No | Setting choice Yes: LED 5 lights up when Ue>>>> threshold is exceeded. <br> Setting choice No: No operation when Ue>>>> threshold is exceeded. |
| Led 5 tUe>>>> | No | Setting choice Yes: LED 5 lights up when tUe>>>> delay time has elapsed. <br> Setting choice No: No operation when tUe>>>> delay time has elapsed. |
| Led 5 CB Fail | No | Setting choice Yes: LED 5 lights up when CB failure occurs. Setting choice No: No operation when CB failure occurs. |
| Led 5 Input 1 | No | Setting choice Yes: LED 5 lights up with signal present at logic input 1. <br> Setting choice No: No operation with signal present at logic input 1. |
| Led 5 Input 2 | No | Setting choice Yes: LED 5 lights up with signal present at logic input 2. <br> Setting choice No: No operation with signal present at logic input 2. |
| Led 5 Input 3 | No | Setting choice Yes: LED 5 lights up with signal present at logic input 3. <br> Setting choice No: No operation with signal present at logic input 3. |


| Led 5 Input 4 | No | Setting choice Yes: LED 5 lights up with signal present at logic input 4. <br> Setting choice No: No operation with signal present at logic input 4. |
| :---: | :---: | :---: |
| Led 5 Input 5 | No | Setting choice Yes: LED 5 lights up with signal present at logic input 5. <br> Setting choice No: No operation with signal present at logic input 5. |
| Led 5 Input 6 | No | Setting choice Yes: LED 5 lights up with signal present at logic input 6. <br> Setting choice No: No operation with signal present at logic input 6. |
| Led 5 Input 7 | No | Setting choice Yes: LED 5 lights up with signal present at logic input 7. <br> Setting choice No: No operation with signal present at logic input 7. |
| Led 5 <br> Recloser Run | No | Setting choice Yes: LED 5 lights up when Recloser Run cycle is active. <br> Setting choice No: No operation when Recloser Run cycle is active. |
| Led 5 <br> Recl. Blocked | No | Setting choice Yes: LED 5 lights up when Recl. Blocked function is active. <br> Setting choice No: No operation when Recl. Blocked function is active. |
| Led 5 tAux1 | No | Setting choice Yes: LED 5 lights up when time Aux1 has elapsed. <br> Setting choice No: No operation when time Aux1 has elapsed. |
| Led 5 tAux2 | No | Setting choice Yes: LED 5 lights up when time Aux2 has elapsed. <br> Setting choice No: No operation when time Aux2 has elapsed. |
| Led 5 tSOTF | No | Setting choice Yes: LED 5 lights up when time tSOTF has expired. <br> Setting choice No: No operation when time tSOTF has expired. |

### 4.2.5 Submenu Logic Inputs Choice: Active High/Low (P125)



Heading of CONFIGURATION menu. To gain access to the Inputs submenu, press $\Leftrightarrow$ and () until the submenu is reached.

Heading Inputs submenu. To gain access to the submenu content, press $\Theta$.

Press $\oplus$ to modify and use $\otimes \Theta \Leftrightarrow(1)$ to assign active high or low functionality to each logic input. Press $\oplus$ to confirm choice.
Note: $\uparrow=$ active high
$\downarrow=$ active low
Voltage Input DC

To modify press $\Theta$ and using $\otimes \otimes$ keys to select the AC or DC power supply for the digital input. Press $\oplus$ to confirm the setting. The power supply for any input is the same one as much as the power supply for the relay.

| Start/Stop | tAUX1 |
| :--- | :--- |
| By Input | LEVEL |

To modify press $\Theta$ and using $\otimes \Theta$ keys to select if the control of the timer is on the change of the LEVEL of the relevant input or on the EDGE of the relevant input. Press $\Theta$ to confirm the setting.

| Start/Stop | tAUX2 |
| :--- | :--- |
| By Input | LEVEL |

To modify press $\Theta$ and using $\otimes \Theta$ keys to select if the control of the timer is on the change of the LEVEL of the relevant input or on the EDGE of the relevant input. Press $\Theta$ to confirm the setting.

| Start/Stop | tAUX3 |
| :--- | :--- |
| By Input | LEVEL |

To modify press $\Theta$ and using $\Theta \Theta$ keys to select if the control of the timer is on the change of the LEVEL of the relevant input or on the EDGE of the relevant input. Press $\oplus$ to confirm the setting.

| Start/Stop | tAUX4 |
| :--- | :--- |
| By Input | LEVEL |

To modify press $\Theta$ and using $\omega \Theta$ keys to select if the control of the timer is on the change of the LEVEL of the relevant input or on the EDGE of the relevant input Press $\oplus$ to confirm the setting.
4.2.6 Submenu Logic Inputs Choice: Active High/Low (P126 \& P127)

| Inputs | $: 7654321$ |
| :--- | :--- |
|  | $\uparrow \downarrow \downarrow \downarrow \uparrow \uparrow \uparrow$ |

Heading of CONFIGURATION menu.
To gain access to the Inputs submenu, press $\Theta,()$ until the submenu is reached.

Heading INPUT submenu.
To gain access to the submenu content, press $\Theta$.
Press $\Theta$ to modify and use $\Delta \Leftrightarrow \theta(2)$ to assign active high or low functionality to each logic input. Press $\Theta$ to confirm choice.
Note: $\uparrow=$ active high
$\downarrow=$ active low

| Voltage Input |
| :--- |
|  |

To modify press $\Theta$ and using $\otimes \Leftrightarrow$ keys to select the AC or DC power supply for the digital input. Press $\oplus$ to confirm the setting. The power supply for any input is the same one as much as the power supply for the relay.

| Start/Stop | tAUX1 |
| :--- | :---: |
| By Input | LEVEL |

To modify press $\Theta$ and using $\Theta \Leftrightarrow$ keys to select if the control of the timer is on the change of the LEVEL of the relevant input or on the EDGE of the relevant input.
Press $\oplus$ to confirm the setting.

| Start/Stop <br> By Input | tAUX2 |
| :--- | :--- | :--- |
| LEVEL |  |$\quad$| To modify press $\Theta$ and using $\Theta \Theta$ keys to select if the |
| :--- |
| control of the timer is on the change of the LEVEL of the |
| relevant input or on the EDGE of the relevant input. |
| Press $\Theta$ to confirm the setting. |

It is possible to configure the operation of the digital input, either on falling edge/low level, or on rising edge/high level.

Falling edge or low level (idem for rising edge or high level) depends of the application of the digital inputs.

Example : a digital input configured "blocking logic" will operate on level, on the other hand a digital input configured "Cold load pick up" will operate on edge.

ONLY a digital input configured "change of setting group" can operate either on edge or on level.

| Function allocated to the Digital Input | Operation of the Digital Input |
| :--- | :--- |
| Unlatch of the output relays | On level |
| Position of the CB, 52a or 52b | On level |
| Blocking logic 1 \& 2 | On level |
| Logic Selectivity 1 \& 2 | On level |
| Aux 1, Aux 2, Aux3 \& Aux4 | On level / On Edge |
| CB Fault | On level |
| Reset of the thermal state | On edge |
| Cold load Pick Up | On edge |
| Start of disturbance record | On edge |
| Trip circuit supervision | On level |
| Change of setting group | On edge, or on level |
| CB Fail timer start | On edge |
| Block 79 | On level |
| Maintenace Mode | On level |
| Man. close | On edge |
| Local | On level |

The user has to set in the CONFIGURATION Menu the auxiliary voltage (AC or DC) for the operation of the digital inputs. This setting is necessary due to the time filtering different in DC and AC.

### 4.2.7 Submenu Output Relay 1 in Fail Safe mode

| CONFIGURATION | Heading of CONFIGURATION menu. <br> To gain access to the RL1 Output relay submenu, press $\Theta$, (3) until the submenu is reached. |
| :---: | :---: |
| RL1 Output relay | Heading of the RL1 Output relay submenu. To gain access to the submenu content, press $\Theta$. |
| Fail Safe Relay <br> Yes | Fail safe Relay $=$ No means that the RL1 output relay is normally de-energized and picks-up in case of trip (standard configuration). <br> Fail-safe Relay = Yes means that the RL1 output relay is normally energized and drops in case of trip (or in case of fail of auxiliary voltage, or coil interruption, etc.). To modify press $\Theta$ and using $\otimes \Theta$ keys Press $\Theta$ to confirm the setting. |

4.2.8 Submenu Selecting Active Protection Group (P125, P126 \& P127)

| CONFIGURATION | Heading of CONFIGURATION menu. <br> To gain access to the Group Select menu, press $\Theta$ and (3) until the submenu is reached. |
| :---: | :---: |
| Group Select | Heading Group Select submenu. To gain access to the submenu content press $\Theta$. |
| Change Group By Input LEVEL | To select the way to active the setting group 1or 2 press $\odot$ and $\otimes \Theta$ to choose on the LEVEL or on the EDGE. Press $\oplus$ to confirm your choice. |
| Setting Group 1 | To select active setting protection group 1 or 2 press $\Theta$ and $\Leftrightarrow$ or $\Theta$. <br> Press $\oplus$ to confirm choice. |

The following table shows the possible combinations by using on "Level" or on "Edge".

|  | Setting configuration |  |  |  | Input status |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Active setting <br> group | Input active <br> High | Input active <br> Low | Change group <br> on Level | Change group <br> on Fall Edge | Input non <br> powered | Input <br> powered |
| Setting Group 1 | X |  | X |  | X |  |
| Setting Group 2 | X |  | X |  |  | X |
| Setting Group 1 |  | X | X |  |  | X |
| Setting Group 2 |  | X | X | X |  |  |
| Setting Group 1 | X |  |  | X | L to H |  |
| Setting Group 2 | X |  |  | X | L to H |  |
| Setting Group 1 |  | X |  | X |  | H to L |
| Setting Group 2 |  | X |  | X |  | H to L |



Heading of CONFIGURATION menu.
To gain access to the Alarm submenu, press $\Theta$, (1) until the submenu is reached.

Heading Alarm submenu. To gain access to the submenu content, press $\Theta$.

To enable/ disable the auto acknowledge of the instantaneous alarms.
To modify press $\Theta$ and using $\Theta \Leftrightarrow$ keys Press $\Theta$ to confirm the setting.

| Reset Led on <br> Fault | Yes |
| :--- | :--- |
| Battery Alarm |  |

Displays the reset mode of the alarms concerning the instantaneous :reset led on a new fault Yes or No.
To modify press $\Theta$ and using $\Theta \Leftrightarrow$ keys Press $\Theta$ to confirm the setting.
(ONLY P126 \& P127)
Displays the possibility Yes or No to display the alarm "RAM ERROR" or "BATTERY FAIL" in case of ram error or battery failure.
To modify press $\Theta$ and using $\Theta \Theta$ keys Press $\Theta$ to confirm the setting.


Heading of CONFIGURATION menu.
To gain access to the Inputs submenu, press $\Theta,(1)$ until the submenu is reached.


Heading of the CONFIGURATION RELAYS MAINTENANCE sub-menu. To gain access to the submenu content, press $\Theta$,

| Rel. Maintenance |
| :--- |
| Mode $\quad$ Yes |

Displays the MAINTENANCE MODE of the MiCOM relay. If the user chooses Yes, the protection and automation functions are disconnected of the output relays.

| Relay | 8765W4321 |
| :--- | ---: |
| Status | 010111101 |

In MAINTENANCE MODE Yes, this menu ables the user to activate each output relay $1=$ relay actived $0=$ relay. to active / deactivate press $(1)$ and $\otimes \Theta$

## CONFIGURATION

Heading of CONFIGURATION menu.
To gain access to the Inputs submenu, press $\Theta$, (1) until the submenu is reached.


Heading type date submenu. To gain access to the submenu content, press $\Theta$.

Date Format
PRIVATE

Press $\Theta$ to modify and use $\Delta \Leftrightarrow$ to assign free format date or IEC format date. Press $\Theta$ to confirm choice. (This operation is seen from remote)

### 4.3 Menu MEASUREMENTS

By going to the MEASUREMENTS menu various system measurement values can be shown on the LCD.

The displayed voltage measures depend on which wiring scheme is choose.
The direct measure is the signal wires to the terminal.
The derived measure is the calculated.
The RMS value is provided for the direct measures.
The fundamental value is provided for the derived (calculated) measures.

### 4.4 Voltage Connections

For the P127, it is important to select the VTs configuration in the Configuration/General Options/ VT Connection submenu in according to the relay wiring for a corrected functionality of the voltage protections, of the three phase and earth fault directional protections.

In the above mentioned menu you will find that for the P127 there are three connection schemes for the VTs.
4.4.1 Vpn (Three phase-neutral connection) :

In this configuration, the relay directly measures Ua, Ub, and Uc and calculates internally the zero sequence voltage $\mathrm{Ue}=(1 / 3)[\mathrm{Ua}+\mathrm{Ub}+\mathrm{Uc}]$. This internal value Ue will be used to be compared to the threshold of Ue (the Earth Overvoltage Protection threshold and to evaluate the angle with the earth current for the earth fault directional protection). However, the Ue is displayed in the measurement Menu as well as the earth fault current and the relevant angle between them as $\mathrm{IN}, \mathrm{IN}^{\wedge} \mathrm{UN}$.
4.4.2 $2 \mathrm{Vpn}+\mathrm{Vr}$ (Two phase-neutral plus an Open Delta connection) :

In this configuration, the relay directly measures Ua and Ub. The input voltage of phase $C$ of the relay (terminals $73-74$ ) which is connected to the summation of the three voltage phases is used to be compared to the Ue (The earth Overvoltage Protection function threshold). This voltage at C input is considered as Ur and it is displayed in the measurement menu as UN.

Moreover for the phase Overvoltage and Undervoltage protection functions, the phase C voltage value Uc is internally reconstituted using the equation:
$\mathrm{Uc}=\mathrm{Ua}+\mathrm{Ub}+\mathrm{Ur}$. This value will be compared to the U/V or O/V threshold in case of a fault in phase C. Uc is not displayed in the measurement menu.

The reconstruction is valid if the Ur is measured from a transformer with 5 limb; two used for the phase voltage Ua and Uc and the others used in Open delta configuration for the Ur.

## be Careful: IF the Ur is measured from a separate transformer the ABOVERECONSTRUCTION IS NOT VALID AND CAN NOT BE USED.

4.4.3 $\quad \mathrm{Vpp}+\mathrm{Vr}$ (Two phase-phase plus an Open Delta connection) :

The relay directly measures Uab and Ubc, the phase to phase (A-C) voltage value Uca is internally reconstituted using the equation Uca=Uab+Ubc.

The third input of voltage of the relay (terminals 73-74) can be connected to the output of a delta transformer or to a dedicated voltage transformer, the measured value can be used to compare to the earth overvoltage threshold.

This voltage is displayed in the measurement menu as UN and it is designed as the earth voltage.

The shown measurements are functions of system voltages taken at the relay inputs.

The following table lists the shown voltage measurements

|  | Configuration <br> $\mathbf{3 V p n}$ | Displayed <br> on HMI | Configuration <br> $\mathbf{2 V p n + V r}$ | Displayed on <br> HMI | Configuration <br> $\mathbf{2 V p p}+\mathbf{V r}$ | Displayed <br> on HMI |
| :--- | :--- | :---: | :--- | :--- | :--- | :--- |
| Ua | Direct <br> measurement | Yes | Direct <br> measurement | Yes | N.A | ------------- |
| Ub | Direct <br> measurement | Yes | Direct <br> measurement | Yes | N.A | ------------- |
| Uc | Direct <br> measurement | Yes | Derived <br> measurement | Yes | N.A | ------------ |
| Uab | Derived <br> measurement | Yes | Derived <br> measurement | Yes | Direct <br> measurement | Yes |
| Ubc | Derived <br> measurement | Yes | Derived <br> measurement | Yes | Direct <br> measurement | Yes |
| Uac | Derived <br> measurement | Yes | Derived <br> measurement | Yes | Derived <br> measurement | No |
| UN | Derived <br> measurement | Yes | Direct <br> measurement | Yes | Direct <br> measurement | Yes |

To gain access to the MEASUREMENTS menu from the default display, press $\Leftrightarrow$ then () until the header of menu is reached.

The following windows list the items available in the measurements menu for the P125, P126 \& P127 relays.

### 4.4.4 Menu MEASUREMENTS for P125

| IN |
| :--- |

Heading of MEASUREMENTS menu. To gain access to the submenu contents, press $\Theta$.

Displays the network frequency taken from analogue inputs having a reliable signal level. In case of no reliable analogue signal input level present the display shows XX. XX Hz.

Displays the earth current (true RMS value) taking in account the earth CT ratio (CONFIGURATION/Transfo. Ratio submenu).

| I N - fn |  |
| :--- | :--- |
| RST $=[\mathrm{C}]$ | 0.00 A |

Displays the earth current I N (true RMS value) minus the earth current value at the fundamental frequency (value of the harmonic).


Displays the earth voltage taking in account the earth VT connection mode and ratio (General Options and Transfo. Ratio submenu).

| Pe |
| :--- |

Displays the neutral power based on neutral current value, neutral voltage value and the relevant angle.


Displays the active earth fault current value.


Displays the angle value between the Zero sequence voltage and earth fault current.relevant.

### 4.4.5 MEASUREMENTS Menu Points for P126



Displays the earth current (true RMS value) taking in account the earth CT ratio (CONFIGURATION/Transfo. Ratio submenu).
Displays the positive sequence component.


Displays the earth voltage taking in account the earth VT connection mode and ratio (General Options and Transfo. Ratio submenu).

| Pe | 0.00 W |
| :--- | :--- |

Displays the neutral power based on neutral current value, neutral voltage and the relevant angle.

| leCos | 0.00 A |
| :--- | :--- |

Displays the active neutral current value.

| IN ^ UN | $0.0^{\circ}$ |
| :--- | :--- |
| I N - fn  <br> RST $=[\mathrm{C}]$ 0.00 A |  |

## THERMAL STATUS <br> RST $=[\mathrm{C}] \quad 0$ \%

```
MAX & AVERAGE
RST = [C]
```

| Max | IA Rms <br> 600.00 A |
| :--- | :---: |
| Max | IB Rms |
|  | 600.00 A |

Displays the angle value between the Zero sequence voltage and earth fault current.relevant.

Displays the earth current I N (true RMS value) minus the earth current value at the fundamental frequency (value of the harmonic).

Displays the \% thermal state based on true RMS current phase values.
To clear the \% values, press © .
Allows the user to clear the maximum (peak) and average (rolling) memorised values of the current.
To clear these values, press ©.
Displays the true RMS maximum current value for phase A.

Displays the true RMS maximum current value for phase $B$.


Displays the true RMS average current value for phase C.


| ROLLING AVERAGE |
| :--- | ---: |
| IC Rms $\quad 600.00 \mathrm{~A}$ |



| Total recloses | 0 |
| :--- | :--- |


| Cycle1 Recloses | 0 |
| :--- | :--- |


| Cycle2 Recloses | 0 |
| :--- | :--- |


| Cycle3 Recloses |  |
| :--- | :--- |


| Cycle4 Recloses |  |
| :--- | :--- |
|  | 0 |


|  <br> Lockout | 0 |
| :--- | :--- |

Displays the total number of definitive trips issued by the autoreclose function.

### 4.4.6 Additional Measurements Menu Points for P127

Following is the display of voltages when a $\mathbf{3 V}$ pn connection mode is chosen (three phases neutral).

| UA |  | Displays the RMS voltage value of phase A. |
| :---: | :---: | :---: |
|  | 57.00V |  |
| UB |  | Displays the RMS voltage value of phase B. |
|  | 57.00 V |  |
| UC |  | Displays the RMS voltage value of phase C. |
|  | 57.00 V |  |


| UAB |  |
| :--- | :--- |
|  | 100.00 V |

splays the calculated fondamental value of the line voltage UAB. (vector calculus)

| UBC |  |
| :--- | :--- |
|  | 100.00 V |

Displays the calculated fondamental value of the line

| UCA |
| :--- |
|  |

Displays the calculated fondamental value of the line
UN 0.00 V

Displays the calculated neutral voltage value. $U N=(U A+U B+U C) / 3$ (vector calculus)

| Max | UA Rms |
| :--- | :--- |
|  | 101.23 V |

Displays the true RMS maximum voltage value for phase $A$.

| Max | UB Rms |
| :--- | :--- |
|  | 101.28 V |

Displays the true RMS maximum voltage value for phase $B$.

| Max | $\begin{aligned} & \text { UC Rms } \\ & 100.00 \mathrm{~V} \end{aligned}$ | Displays the true RMS maximum voltage value for phase C |
| :---: | :---: | :---: |
| Average | $\begin{aligned} & \text { UA Rms } \\ & 100.00 \mathrm{~V} \end{aligned}$ | Displays the true RMS average voltage value for phase A. |
| Average | $\begin{aligned} & \text { UB Rms } \\ & 100.00 \mathrm{~V} \end{aligned}$ | Displays the true RMS average voltage value for phase B. |
| Average | $\begin{aligned} & \text { UC Rms } \\ & 100.00 \mathrm{~V} \end{aligned}$ | Displays the true RMS average voltage value for phase C. |

Following is the display of voltages when a $\mathbf{2 V p n + V r}$ connection mode is chosen (two phases - neutral plus earth voltage). The visualisation depends on connection mode.

| UA | Displays the RMS voltage value of phase $A$. |
| :--- | :--- |


| UB | Displays the RMS voltage value of phase $B$. |
| :--- | :--- |

UC Displays the Fondamental voltage value of phase C. (vector
57.00 V calculus)

| UAB |  |
| :--- | :--- |
|  | 100.00 V |

Displays the calculated fondamental value of the line voltage UAB. (vector calculus)

| UBC |  |
| :--- | :--- |
|  | 100.00 V |

Displays the calculated fondamental value of the line voltage UBC. (vector calculus)

| UCA |
| :--- |
|  |

Displays the calculated fondamental value of the line voltage UCA. (vector calculus)

| UN |  | Displays the neutral voltage value. |
| :---: | :---: | :---: |
|  | 0.00V |  |
| Max | UA Rms 127.23 V | Displays the true RMS maximum voltage value for phase A. |
| Max | UB Rms 136.28 V | Displays the true RMS maximum voltage value for phase B. |
| Average | UA Rms 98.25 V | Displays the true RMS average voltage value for phase A. |
| Average | UB Rms 97.88 V | Displays the true RMS average voltage value for phase B. |

Following is the display of voltages when a $\mathbf{2 V p p + V r}$ connection mode is chosen (two phase - phase plus earth voltage).

| UAB |  |
| :--- | :--- |
| UBC | 100.00 V |
|  | 100.00 V |
| UCA | 100.00 V |

Displays the RMS line voltage value UAB. Displays the RMS line voltage value UBC. Displays the fondamental line voltage value UCA.
UN 3.15 V

Displays the neutral voltage value.

| Max | UAB Rms |
| :--- | ---: |
|  | 127.23 V |

Displays the true RMS maximum line voltage value. UAB

| Max | UBC Rms |
| :--- | ---: |
|  | 127.28 V |

Displays the true RMS maximum line voltage valueUBC.

| Average | UAB Rms <br> $127.25 ~ V$ |
| :--- | :---: |
| Average | UBC Rms <br> $97.88 ~ V$ |
| $P$ | 0.00 kW |

Displays the true RMS average line voltage value for UAB.

Displays the true RMS average line voltage value for UB C.

Displays the positive \& negative active power; only negative sign is shown.
The maximum measured value displayed is 9999MW. If the measured value is above 9999MW this display remains on the LCD.

Displays the positive \& negative reactive power; only the negative sign is shown.
The maximum measured value displayed is 9999MVAr. If the measured value is above 9999MVAr this display remains on the LCD.

| $\operatorname{Cos}$ (Phi) | 1.00 |
| :--- | :--- |

Displays the three phases power factor.

| Energy |
| :--- |
| RST $=[\mathrm{C}]$ |

Header for energy measurements.
Allows the user to reset the measured energy value. To clear these values, press © Note: Password is requested to clear the display.

Displays the three phase active energy forward.

## 3Ph WHours Fwd <br> 4200 GWh

## 3Ph WHours Rev <br> 4200 GWh

## 3Ph VArHours Fwd 4200 GVArh

## 3Ph VArHours Rev 4200 GVArh

NOTE: The number "4200" shown on the LCD is the maximum value for energy measurements. If the measured energy value is higher than 4200 G...h then the display shows XXXX G.. h.

### 4.5 Menu COMMUNICATION

The COMMUNICATION menu depends on the type of communications protocol: ModBus, Courier, IEC 60870-5-103 or DNP3.

To gain access to the COMMUNICATION menu from the default display, press $\Theta$ then $\theta$ until the menu is reached.

### 4.5.1 Menu ModBus COMMUNICATION

| COMMUNICATION | Heading COMMUNICATION menu. To gain access to submenu, press $\Theta$. To modify setting press $\Theta$ and $\Theta \otimes$ to scroll available selections. Press $\Theta$ to confirm choice. |
| :---: | :---: |
| Communication? <br> Yes | Use ModBus RTU communication via the RS485 port on the rear terminals of the relay. To activate the parameter communication, press $\Theta$ and use $\otimes$ to select Yes. Press $\oplus$ to enable choice. |
| Baud Rate $9600 \text { bd }$ | Displays the baud rate of ModBus transmission. Select from: 300, 600, 1200, 2400, 4800, 9600, 19200 or 38400 bd. |
| Parity None | Displays the parity in the ModBus data frame. Select parity: Even, Odd or None |
| Data Bits 8 | Displays the number of data bits in the ModBus data frame. Select 7 or 8 bit data frame. |
| Stop Bits 1 | Displays the number of stop bits in the ModBus data frame. Select stop bit: 0 or 1 |
| Relay Address 1 | Displays the network address of the MiCOM relay in the ModBus network. <br> Select an address from 1 to 255. |
| WARNING: $\begin{array}{ll}\text { A MODB } \\ & \text { ON THE }\end{array}$ | TWORK CAN ONLY COMPRISE 32 RELAY ADDRESSES MODBUS SUB-LAN. |

### 4.5.2 Menu Courier COMMUNICATION

This communication protocol is not yet available.

| COMMUNICATION | Heading COMMUNICATION menu. To gain access to submenu, press $\Theta$. To modify setting press $\Theta$ and $\Theta \otimes$ to scroll available selections. Press $\oplus$ to confirm choice. |
| :---: | :---: |
| Communication? <br> Yes | Use Courier communication via the RS485 port on the rear terminals of the relay. To activate the parameter communication, press $\oplus$ and use $\Leftrightarrow$ to select Yes. Press © to enable choice. |
| Relay Address | Displays the network address of the MiCOM relay in the Courier network. <br> Select an address from 1 to 255. |

### 4.5.3 Menu IEC 60870-5-103 COMMUNICATION

| COMMUNICATION | Heading COMMUNICATION menu. To gain access to submenu, press $\Theta$. To modify setting press $\Theta$ and $\Theta \otimes$ to scroll available selections. Press $\Theta$ to confirm choice. |
| :---: | :---: |
| Communication? <br> Yes | Use VDEW communication via the RS485 port on the rear terminals of the relay. To activate the parameter communication, press $\Theta$ and use $\otimes$ to select Yes. Press $\oplus$ to enable choice. |
| Baud Rate $9600 \text { bd }$ | Displays the baud rate of VDEW transmission. Select from: 300, 600, 1200, 2400, 4800, 9600, 19200 or 38400 bd. |
| Relay Address 1 | Displays of the network address of the MiCOM relay in the VDEW network. <br> Select an address from 1 to 255. |

4.5.4 Menu DNP3.0 COMMUNICATION

## To be defined

### 4.6 Menu PROTECTION

There are two protection menus they are designated as PROTECTION G1 and PROTECTION G2 menu and are available for the MiCOM P125, P126 \& P127 relays. By opening the PROTECTION menu the user can program the parameters of various protection functions and settings (thresholds, time delay, logic) associated with each of the phase or earth protection functions.

The following table shows the protection functions available with each relay.
When Setting Group is set to 1 in the submenu Group Select the function PROTECTION G1 is activated in the relays.

When Setting Group is set to 2 in the submenu Group Select the function PROTECTION G2 is activated in the relays.

The main protection functions are listed in the table:

| PROTECTION FUNCTIONS | ANSI CODE | P125 | P126 | P127 |
| :--- | :---: | :---: | :---: | :---: |
| Directional/non directional phase overcurrent | $67 / 50 / 51$ |  |  | $\mathbf{X}$ |
| Directional/non directional earth fault | $67 \mathrm{~N} / 50 \mathrm{~N} / 51 \mathrm{~N}$ | $\mathbf{X}$ | $\mathbf{X}$ | $\mathbf{X}$ |
| Three phase overcurrent | $50 / 51$ |  | $\mathbf{X}$ |  |
| Wattmetric protection Pe/leCos | 32 N | $\mathbf{X}$ | $\mathbf{X}$ | $\mathbf{X}$ |
| Undercurrent | 37 |  | $\mathbf{X}$ | $\mathbf{X}$ |
| Negative phase sequence overcurrent | 46 |  | $\mathbf{X}$ | $\mathbf{X}$ |
| Thermal overload | 49 |  | $\mathbf{X}$ | $\mathbf{X}$ |
| Undervoltage | 27 |  |  | $\mathbf{X}$ |
| Overvoltage | 59 |  |  | $\mathbf{X}$ |
| Residual overvoltage | 59 N | $\mathbf{X}$ | $\mathbf{X}$ | $\mathbf{X}$ |
| Autoreclose (4 shots) | 79 |  | $\mathbf{X}$ | $\mathbf{X}$ |

The various submenus are shown below.

### 4.6.1 Submenu [67/50/51] Directional Three Phase Overcurrent (P127)



By pushing $\Leftrightarrow$ the next window will show the Delay type menu

| $\mathbf{l >}$ ? | DIR | Selection of the first alarm threshold function for phase OC <br> (l>). Setting choice: No, Yes, DIR <br> If the user selects DIR, the following window is shown: <br> If the user selects No, the next window will show the |
| :--- | :--- | :--- |
| threshold menu l>>. |  |  |

By pushing $\Theta$ the next window will show the Delay type menu

### 4.6.1.1 Threshold Menu I> DMT

| Delay Type | Displays threshold delay time type. Setting choices are: <br> DMT (definite time), RI for the electromechanical inverse <br> (ime curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay |
| :--- | :--- |
|  | curve and RECT curve. <br> If the user selects DMT the following menu is displayed: |
| $\mathbf{t l >}$ | Displays setting value for the trip threshold. <br> The setting range is from 0 to 150 s, in steps of 10 ms. |

### 4.6.1.2 Threshold Menu I> RI



By pushing $\Leftrightarrow$ the next window will display the threshold menu l>>

### 4.6.1.3 Threshold Menu I> IEC-XX



By pushing $\Leftrightarrow$ the next window will display the threshold menu l>>.

### 4.6.1.4 Threshold Menu I> Rectifier Curve



Displays threshold delay time type. Setting choices are: DMT (definite time), RI for the electromechanical inverse time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay curve and RECT curve.
If the user selects RECT curve the following menu is displayed:

| TMS | 1.000 |
| :--- | :--- |

Displays TMS value for the curve: The setting range is from 0.025 to 1.5 in steps of 0.025 .
tReset 0.10 s

Displays setting value for the reset time. The setting range is from 0 to 100 s , in steps of 10 ms .

Interlock of first threshold by the second and third thresholds, but only if first threshold trip is set to IDMT. Setting choice: No, Yes

By pushing $\Leftrightarrow$ the next window will display the threshold menu l>>.

### 4.6.1.5 Threshold Menu I> ANSI/IEEE



Displays threshold delay time type. Setting choices are: DMT (definite time) RI for the electromechanical inverse time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay curve and RECT curve. If the user selects IEEE/ANSI curve, the following menu is displayed:

| TMS | Displays TMS value for the curve. <br> The setting range is from 0.025 to 1.5, in steps of 0.025 |
| :--- | :--- |

4.6.1.6 Reset Threshold Menu I> DMT/IDMT IEEE/ANSI

| Reset Delay Type <br> DMT | Displays the reset delay time type. <br> Select between DMT (Definitive Time) and IDMT (Inverse <br> Time). |
| :--- | :--- |
| If the user selects DMT delay type, the following menu is <br> displayed: |  |
| tReset | Displays the reset time setting value. <br> The setting range is from 0 to 100 s, in steps of 10 ms. |
| $\mathbf{0 . 0 0 \mathrm { s }}$ | The |

By pushing $\Theta$ the next window will display the threshold menu l>>.

| Reset Delay Type <br> IDMT | Displays the reset delay time type. <br> Select between DMT (Definitive Time) and IDMT (Inverse <br> Time) |
| :--- | :--- |
| If the user selects IDMT delay type, the following menu is <br> displayed: |  |
| RTMS | Displays the RTMS value associated with the IDMT reset <br> time choice. |
| The setting range is from 0.025 to 3.200, in steps of 0.025 |  |

By pushing $\Theta$ the next window will display the threshold menu l>>.

### 4.6.1.7 Threshold Menu l>>

For the IDMT delay time choice all the parameters are indentical to first threshold l> excluding the interlock choice.


Selection of the second alarm threshold function for phase OC (l>>). Setting choice: No, Yes, DIR.
If the user selects Yes, the following window is shown:
If the user selects DIR, the directional choice window is shown.
If the user selects No, the next window will show the threshold menu l>>>.


Displays setting value for the alarm threshold. The threshold setting range is from 0.5 to 40 In , in steps of 0.01 In .


Displays threshold delay time type. Setting choices are: DMT (definite time), RI for the electromechanical inverse time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay curve and RECT curve.
If the user selects DMT the following menu is displayed:


Displays setting value for the trip threshold. The setting range is from 0 to 150 s , in steps of 10 ms .

By pushing $\Leftrightarrow$ the next window will display the threshold menu l>>>.


Selection of the second alarm threshold function for phase OC (l>>). Setting choice: No, Yes, DIR.
If the user selects DIR, the following window is shown: If the user selects Yes, the non-directional choice window is shown.
If the user selects No, the next window will show the threshold menu l>>>.

| $l \gg$ |
| :--- |
|  |

Displays setting value for the alarm threshold.
The threshold setting range is from 0.5 to 40 In , in steps of 0.01 In .

| $l \gg$ |  |
| :--- | :--- |
| Torque | $90^{\circ}$ |


| l>> |  |
| :--- | :--- |
| Trip Zone $\quad \pm 10^{\circ}$ |  |



Displays setting value for the torque angle.
Torque angle setting range is from $0^{\circ}$ to $359^{\circ}$, in steps of $1^{\circ}$.
Displays angle value for the Trip Zone.
This defines the operating region to either side of the torque angle. Setting range is from $\pm 10^{\circ}$ to $170^{\circ}$, in steps of $1^{\circ}$.
Displays threshold delay time type. Setting choices are: DMT (definite time), RI for the electromechanical inverse time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay curve and RECT curve. If the user selects DMT the following menu is displayed:

| $t l \gg$ |  |
| :--- | :--- |
|  |  |

Displays setting value for the trip threshold.
The setting range is from 0 to 150 s , in steps of 10 ms .

By pushing $\Leftrightarrow$ the next window will display the threshold menu l>>>.

### 4.6.1.8 Threshold Menu l>>>

| $l \ggg$ ? $\quad$ Yes | Selection of the third threshold function for phase OC (l>>>). Setting choice: No, Yes, PEAK, DIR. <br> If the user selects Yes, the following window is shown and |
| :---: | :---: |
|  | l>>> threshold operates on Fast Fourier transformation base. |
|  | If the user selects DIR, the directional windows are shown and l>>> thethreshold operates on Fast Fourier transformation base.. |
|  | If the user selects PEAK the operation mode of the third threshold. l>>> is on current sample base, If the user selects No, next window will show the submenu [67] Phase OC. |
| l>>> | Displays setting value for the alarm threshold. |
| 10.00 In | The threshold setting range is from 0.5 to 40 In , in steps of 0.01 In . |
| t ll>> | Displays setting value for the trip threshold. <br> The setting range is from 0 to 150 s , in steps of 10 ms . |
| 150.00 s |  |

By pushing $\Leftrightarrow$ the next window will display the [67] Phase OC, the header of the menu.

| l>>> ? | DIR | Selection of the third alarm threshold function for phase OC (l>>>). Setting choice: No, Yes, DIR. <br> If the user selects DIR, the following window is shown: If the user selects Yes, the non-directional choice window is shown. <br> If the user selects No, next window will show the submenu [67] Phase OC. |
| :---: | :---: | :---: |
|  |  |  |
| l>>> | 10.00 In | Displays setting value for the alarm threshold. <br> The threshold setting range is from 0.5 to 40 In , in steps of 0.01 In . |
| \|>>> <br> Torque | $90^{\circ}$ | Displays setting value for the torque angle. <br> Torque angle setting range is from $0^{\circ}$ to $359^{\circ}$, in steps of $1^{\circ}$ |


| l>>> |  |
| :--- | :--- |
| Trip Zone | $\pm 10^{\circ}$ |

Displays angle value for the Trip Zone.
This defines the operating region to either side of the torque angle. Setting range is from $\pm 10^{\circ}$ to $170^{\circ}$, in steps of $1^{\circ}$.
$t l \ggg 150.00 \mathrm{~s}$

Displays setting value for the trip threshold. The setting range is from 0 to 150 s , in steps of 10 ms .

By pushing $\Leftrightarrow$ the next window will display the [67] Phase OC, the header of the menu.

### 4.6.2 Submenu [67N/50N/51N] Directional Earth Overcurrent



Heading of Protection menu.
To gain access to menu for P125 relay, press $\Leftrightarrow$. To gain access to menu (Protection G1 \& G2) for P126 and P127 relays press $\otimes$ and $(1)$ until the submenu is reached.

Heading of [67N/50N/51N] submenu.
To navigate within submenu points, press $\otimes \Theta$. To modify setting, press $\Theta$. Use $\Delta \Leftrightarrow \theta(1)$ to scroll and set available selections. Press $\oplus$ to confirm choice.

Selection of the first alarm threshold function for earth fault current (le>). Setting choice: No, Yes, DIR.
If the user selects Yes the following window is shown: If the user selects DIR the directional choice window is shown.
If the user selects No, the next window will show the threshold menu le>>.


Displays setting values for the alarm threshold. Three earth fault current ranges are available:
from 0.002 to 1 len, in steps of 0.001 len. Cortec code $C$ from 0.01 to 8 len, in steps of 0.005 len. Cortec code B from 0.1 to 25 len, in steps of 0.01len. Cortec code A

By pushing $\Leftrightarrow$ the next window will display the Delay Type


Selection of the first alarm threshold function for earth fault current (le>). Setting choice: No, Yes, DIR
If the user selects DIR the following window is shown: If the user selects No, the next window will show the threshold menu le>>.


Displays setting values for the alarm threshold. Three earth fault current ranges are available:
from 0.002 to 1 len, in steps of 0.001 len. Cortec code C from 0.010 to 8 len, in steps of 0.005 len. Cortec code B from 0.1 to 25 len, in steps of 0.01 Ien. Cortec code A
Ue> 5.0 V

Displays setting values for the alarm threshold Ue>. Input voltage range 57-130V: The threshold setting range is from 1 to 260 V , in steps of 0.1 V . Input voltage range $220-480 \mathrm{~V}$ : The threshold setting range is from 4 to 960 V , in steps of 0.5 V .

| le> | $0^{\circ}$ |
| :--- | :--- |
| Torque |  |

Displays setting value for the torque angle.
Torque angle setting range is from $0^{\circ}$ to $359^{\circ}$, in steps of $1^{\circ}$.

| le> |
| :--- | :--- |
| Trip Zone $\quad \pm 10^{\circ}$ |

Displays angle value for the Trip Zone.
This defines the operating region to either side of the torque angle. Setting range is from $\pm 10^{\circ}$ to $\pm 170^{\circ}$, in steps of $1^{\circ}$.

By pushing $\Leftrightarrow$ the next window will display the Delay Type

### 4.6.2.1 Threshold Menu le> DMT



Displays threshold delay time type. Setting choices are: DMT (definite time), RI for the electromechanical inverse time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay curve and RECT curve.
If the user selects DMT the following menu is displayed:


Displays setting value for the trip threshold.
The setting range is from 0 to 150 s , in steps of 10 ms .
tReset Displays setting value for the reset time. The setting range is from 0 to 100 s , in steps of 10 ms .

By pushing $\otimes$ the next window will display the le>>?

### 4.6.2.2 Threshold Menu le> RI

| Delay Type | RI | Displays threshold delay time type. Setting choices are: DMT (definite time), RI for the electromechanical inverse time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay curve and RECT curve. If the user selects RI the following menu is displayed. |
| :---: | :---: | :---: |
|  |  |  |
|  |  |  |
|  |  |  |
| K | 1.000 | Selection of K value for the RI curve. <br> The setting range is from 0.100 to 10 in steps of 0.005 . |
|  |  |  |
| tReset | 0.10 s | Displays setting value for the reset time. The setting range is from 0 to 100 s , in steps of 10 ms . |
|  |  |  |
| le\gg\gg>> <br> Interlock <br> Yes |  | Interlock of first threshold by the second and third thresholds, but only if first threshold trip is set to IDMT. Setting choice: No, Yes |
|  |  |  |  |

By pushing $\Leftrightarrow$ the next window will display the le>>?

### 4.6.2.3 Threshold Menu le> IEC-XX



By pushing $\Theta$ the next window will display the le>>?

### 4.6.2.4 Threshold Menu le> Redtifier curve



Displays threshold delay time type. Setting choices are: DMT (definite time) RI for the electromechanical inverse time curve, IEC-XX, CO2, CO8, IEEE-XX, RECT inverse time delay curve.
If the user selects RECT curve the following menu is displayed:

| TMS |  | Displays TMS value for the curve. <br> The setting range is from 0.025 to 1.5 , in steps of 0.025 . |
| :---: | :---: | :---: |
|  | 1.000 |  |
| tReset |  | Displays setting value for the reset time. |
|  | 0.10 s | The setting range is from 0 to 100 s , in steps of 10 ms . |
| le\gg\gg>> Interlock |  | Interlock of first threshold by the second and third thresholds, but only if first threshold trip is set to IDMT. Setting choice: No, Yes |
|  | Yes |  |

By pushing $\Theta$ the next window will display the le>>?
4.6.2.5 Threshold Menu le> ANSI/IEEE

| Delay Type | Displays threshold delay time type. Setting choices are: <br> DMT (definite time) RI for the electromechanical inverse <br> IEEE-EI <br> time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay <br> curve. <br> If the user selects IEEE/ANSI curve, the following menu is <br> displayed: |
| :--- | :--- |
| TMS | Displays TMS value for the curve. <br> The setting range is from 0.025 to 1.5, in steps of 0.025. |

4.6.2.6 Reset Threshold Menu le> DMT/IDMT IEEE/ANSI

| Reset Delay Type | Displays the reset delay time type. <br> DMT |
| :--- | :--- |
| Select between DMT (Definitive Time) and IDMT (Inverse <br> Time). <br> If the user selects DMT delay type, the following menu is <br> displayed: |  |
| tReset | Displays setting value for the reset time. |
| The setting range is from 0 to 100 s, in steps of 10 ms. |  |

By pushing $\Theta$ the next window will display the le>>?

| Reset Delay Type IDMT | Displays the reset delay time type. <br> Select between DMT (Definitive Time) and IDMT (Inverse |
| :---: | :---: |
|  | Time). <br> If the user selects IDMT delay type, the following menu is displayed: |
| RTMS 0.025 | Displays the RTMS value associated with the IDMT reset time choice. <br> The setting range is from 0.025 to 3.200 , in steps of 0.025 |
| le\gg\gg>> <br> Interlock <br> Yes | Interlock of first threshold by the second and third thresholds, but only if first threshold trip is set to IDMT. Setting choice: No, Yes |

By pushing $\Theta$ the next window will display the le>>?

### 4.6.2.7 Threshold Menu le>>

For the IDMT delay time choice all the parameters follow the first threshold le> excluding the interlock choice.


By pressing $\Theta$ the next window will display the le>>>?


By pressing $\Theta$ the next window will display the le>>>?

### 4.6.2.8 Threshold Menu le>>>



Selection of the third threshold function for earth fault current (le>>>). Setting choice: No, Yes, PEAK, DIR. If the user selects Yes, the following window is shown and l>>> thethreshold operates on Fast Fourier transformation base.
If the user selects DIR, the directional windows are shown and l>>> thethreshold operates on Fast Fourier transformation base..
If the user selects PEAK the operation mode of the third threshold. l>>> is on current sample base, If the user selects No, next window will show the submenu [67N] E/GND.


Displays setting value for the alarm threshold. Three earth fault current ranges are available:
from 0.002 to 1 len, in steps of 0.001 len. Cortec code $C$ from 0.01 to 8 len, in steps of 0.005 Ien. Cortec code B from 0.1 to 40 len, in steps of 0.01 len. Cortec code A


Displays setting value for the trip threshold. The setting range is from 0 to 150 s , in steps of 10 ms .

| tReset | 0.10 s |
| :--- | :--- |

Displays setting value for the reset time.
The setting range is from 0 to 100 s , in steps of 10 ms .
By pressing $\Leftrightarrow$ the next window will display [67N] E/GND


Selection of the third threshold function for earth fault current (le>>>). Setting choice: No, Yes, DIR.
If the user selects DIR, the following window is shown: If the user selects Yes, the non-directional choice window is shown.
If the user selects No, the next window will show the submenu [67N] E/GND.


Displays setting values for the alarm threshold. Three earth fault current ranges are available:
from 0.002 to 1 len, in steps of 0.001 len. Cortec code C from 0.01 to 8 len, in steps of 0.005 len. Cortec code B from 0.1 to 40 len, in steps of 0.01 len. Cortec code A


Displays setting values for the alarm threshold Ue>>>. Input voltage range 57-130V: The threshold setting range is from 1 to 260 V , in steps of 0.1 V . Input voltage range 220-480V: The threshold setting range is from 4 to 960 V , in steps of 0.5 V .


Displays setting value for the torque angle.
Torque angle setting range is from $0^{\circ}$ to $359^{\circ}$, in steps of $1^{\circ}$.


Displays angle value for the Trip Zone.
This defines the operating region to either side of the torque angle. Setting range is from $\pm 10^{\circ}$ to $\pm 170^{\circ}$, in steps of $1^{\circ}$.

| $t$ le>>> | 150.00 s |
| :--- | :--- |

Displays setting value for the trip threshold.
The setting range is from 0 to 150 s , in steps of 10 ms .

| tReset | 0.10 s |
| :--- | :--- |

Displays setting value for the reset time.
The setting range is from 0 to 100 s , in steps of 10 ms .
By pressing $\Leftrightarrow$ the next window will display [67N] E/GND

### 4.6.3 Submenu [50/51] Three Phase Overcurrent (P126)

| PROTECTION G1 | Heading of Protection G1 menu. <br> To gain access to menu, press $\Leftrightarrow$ and ()) until the submenu is reached. |
| :---: | :---: |
| [50/51] PHASE OC | Heading of [50/51] submenu. <br> To navigate within submenu points, press $\otimes \otimes$. To modify setting, press $\Theta$. Use $\otimes \Leftrightarrow \otimes(>)$ to scroll and set available selections. Press $\Theta$ to confirm choice. |
| $\mathrm{l}>$ ? | Selection of the first alarm threshold function for phase OC (l>). Setting choice: No, Yes <br> If the user selects Yes, the following window is shown: If the user selects No, the next window will show the threshold menu l>>. |
| l> $\quad 10.00 \mathrm{ln}$ | Displays setting value for the alarm threshold. <br> The threshold setting range is from 0.1 to 25 In , in steps of 0.01 In . |

By pressing $\Theta$ the next window will display the Delay type
4.6.3.1 Threshold Menu I> DMT


Displays threshold delay time type. Setting choices are:
DMT (definite time) RI for the electromechanical inverse time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay curve and RECT curve.
If the user selects DMT the following menu is displayed:

## t l>

Displays setting value for the trip threshold.
The setting range is from 0 to 150 s , in steps of 10 ms .
By pressing $\Theta$ the next window will display the $l \gg$ ?

### 4.6.3.2 Threshold Menu I>RI



By pushing $\Leftrightarrow$ the next window will display the $l \gg$ ?

### 4.6.3.3 Threshold Menu I> IEC-XX

| Delay Type |  |
| :---: | :---: |
|  | IEC-STI |

Displays threshold delay time type. Setting choices are: DMT (definite time) RI for the electromechanical inverse time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay curve and RECT curve. If the user selects IEC curve the following menu is displayed:

| TMS |  |
| :--- | :--- |
| tReset | 1.000 |
|  | 0.10 s |

Displays TMS value for the curve.
The setting range is from 0.025 to 1.5 , in steps of 0.025 .
Displays setting value for the reset time.
The setting range is from 0 to 100 s , in steps of 10 ms .
By pushing $\Theta$ the next window will display the $1 \gg$ ?
4.6.3.4 Threshold Menu I> RECT


By pushing $\Leftrightarrow$ the next window will display the $1 \gg$ ?
4.6.3.5 Threshold Menu I> ANSI/IEEE

| Delay Type | Displays threshold delay time type. Setting choices are: <br> DMT (definite time) RI for the electromechanical inverse <br> time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay <br> curve and RECT curve. |
| :--- | :--- |
| If the user selects IEEE/ANSI curve, the following menu is <br> displayed: |  |
| TMS | Displays TMS value for the IEEE/ANSI curve. <br> The setting range is from 0.025 to 1.5, in steps of 0.025. |

By pushing $\Leftrightarrow$ the next window will display the $1 \gg$ ?
4.6.3.6 Reset Threshold Menu I> DMT/IDMT IEEE/ANSI

| Reset Delay Type |
| :---: |
| DMT |

Displays the reset delay time type.
Select between DMT (Definitive Time) and IDMT (Inverse Time).
If the user selects DMT delay type, the following menu is displayed:

| tReset | $\mathbf{0 . 1 0} \mathbf{s}$ |
| :--- | :--- | | Displays setting value for the reset time. |
| :--- |
| The setting range is from 0 to 100 s , in steps of 10 ms. |

By pushing $\Theta$ the next window will display the $1 \gg$ ?


By pushing $\Leftrightarrow$ the next window will display the $1 \gg$ ?

### 4.6.3.7 Threshold Menu l>>

For the IDMT delay time choice all the parameters follow the first threshold l> excluding the interlock choice.


By pushing $\Theta$ the next window will display the l>>>?
4.6.3.8 Threshold Menu l>>>


By pushing $\Leftrightarrow$ the next window will display the [50/51] PHASE OC

### 4.6.4 Submenu [32N] Earth Wattmetric Protection



Heading of Protection menu.
To gain access to menu for P125 relay, press $\Theta$. To gain access to menu (Protection G1 \& G2) for P126 and P127 relays press $\Leftrightarrow$ and $(\rightarrow)$ until the submenu is reached.


Heading of [32N] submenu.
To navigate within submenu points, press $\otimes \otimes$. To modify setting, press $\Theta$. Use $\otimes \Leftrightarrow \otimes$ to scroll and set available selections. Press $\oplus$ to confirm choice..

Selection of the function mode.
If the user selects Pe the following menu is displayed: If the user selects leCos the next window will change to leCos>. Each Pe and leCos threshold has its own setting (time delay, threshold value etc).


Selection of the first alarm threshold function for Pe>. These instructions are also valid for leCos>.
Setting choice: No, Yes
If the user selects Yes the following window is shown: If the user selects No, the next window will show the threshold menu Pe>> (leCos>>).
Pe> $20 \times 1 \mathrm{~W}$

Displays setting values for the alarm threshold Pe>.
High sensitivity current: 0.001 to 1 In
Input voltage range $57-130 \mathrm{~V}$ : The setting range is from 0.2 to $20 \times$ len $W$, in steps of $0.02 \times$ len $W$.
Input voltage range $220-480 \mathrm{~V}$ : The setting range is from 1 to $80 \times$ len $W$, in steps of $0.1 \times$ len $W$.
The setting range for leCos> is from 0.002 to 1 len, in steps of 0.001.
Medium sensitivity current: 0.01 to 8 In
Input voltage range 57-130V: The setting range is from 1 to $160 \times$ len $W$, in steps of $0.1 \times$ len $W$.
Input voltage range $220-480 \mathrm{~V}$ : The setting range is from 4 to $640 \times$ len W, in steps of $0.5 \times$ len W.
The setting range for leCos> is from 0.01 to 8 len, in steps of 0.005 .
Low sensitivity current: 0.1 to 40 In
For range $57-130 \mathrm{~V}$ from 10 to 800 x len W , in steps of 1 x len W.
For range $220-480 \mathrm{~V}$ from 40 to $3200 \times$ len W , in steps of 5 $x$ len W.
The setting range for leCos> is from 0.1 to 40 len, in steps of 0.01.


Displays threshold delay time type. Setting choices are: DMT (definite time) RI for the electromechanical inverse time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay curve and RECT curve. If the user selects DMT the following menu is displayed:

| t Pe> | 150.00 s |
| :--- | :--- |

Displays setting value for the trip threshold.
The setting range is from 0 to 150 s , in steps of 10 ms .
Displays setting value for the reset time.
The setting range is from 0 to 100 s , in steps of 10 ms .

By pushing $\Leftrightarrow$ the next window will display the Pe>>?

### 4.6.4.1 Threshold Menu Pe/leCos> RI



Displays threshold delay time type. Setting choices are: DMT (definite time) RI for the electromechanical inverse time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay curve and RECT curve.
If the user selects RI the following menu is displayed:

| $K$ | 1.000 |
| :--- | :--- |

Selection of $K$ value for the RI curve. The setting range is from 0.100 to 10 , in steps of 0.005 .
tReset
0.04 s Displays setting value for the reset time. The setting range is from 0 to 100 s , in steps of 10 ms .

By pushing $\Leftrightarrow$ the next window will display the Pe>>?
4.6.4.2 Threshold Menu Pe/leCos> IEC-XX

| Delay Type | Displays threshold delay time type. Setting choices are: <br> DMT (definite time) RI for the electromechanical inverse <br> time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay <br> curve and RECT curve. |
| :--- | :--- | :--- |
| If the user selects IEC curve the following menu is |  |
| displayed: |  |

By pushing $\Theta$ the next window will display the Pe>>?

### 4.6.4.3 Threshold Menu Pe/leCos> RECT

| Delay Type | Displays threshold delay time type. Setting choices are: <br> DMT (definite time) RI for the electromechanical inverse <br> time curve, IEC-XX, RECT, CO2, CO8, IEEE-XX inverse <br> time delay curve and RECT curve. <br> If the user selects IEC curve the following menu is <br> displayed: |
| :--- | :--- |
| TMS | Displays TMS value for the curve. <br> The setting range is from 0.025 to 1.5, in steps of 0.025. |
| tReset | Displays setting value for the reset time. |

By pushing $\Leftrightarrow$ the next window will display the Pe>>?

### 4.6.4.4 Threshold Menu Pe/leCos> ANSI/IEEE

| Delay Type | Displays threshold delay time type. Setting choices are: <br> DMT (definite time) RI for the electromechanical inverse <br> time curve, IEC-XX, CO2, CO8, IEEE-XX inverse time delay <br> curve and RECT curve. |  |
| :--- | :--- | :--- |
|  | If the user selects IEEE/ANSI curve, the following menu is <br> displayed: |  |
| TMS | Displays TMS value for the curve. |  |
|  | $\mathbf{1 . 0 0 0}$ | The setting range is from 0.025 to 1.5 , in steps of 0.025. |

### 4.6.4.5 Reset Threshold Menu Pe/leCos> DMT/IDMT IEEE/ANSI



Displays the reset delay time type.
Select between DMT (Definitive Time) and IDMT (Inverse Time).
If the user selects DMT delay type, the following menu is displayed:

| tReset |
| :---: |

Displays setting value for the reset time. The setting range is from 0 to 100 s , in steps of 10 ms .

By pushing $\Theta$ the next window will display the Pe>>?

| Reset Delay Type |
| :--- | :--- |
| IDMT | | Displays the reset delay time type. |
| :--- |
| Select between DMT (Definitive Time) and IDMT (Inverse |
| Time). |
| If the user selects IDMT delay type, the following menu is |
| displayed: |

By pushing $\Theta$ the next window will display the Pe>>?


Selection of the second alarm threshold function for Pe>>. Setting choice: No, Yes
If the user selects Yes the following menu is shown:
If the user selects No, the next window will show the submenu [32N] Earth Wattmetric.
Pe>> $20 \times 1 \mathrm{~W}$

Displays setting values for the alarm threshold Pe>>.
High sensitivity current: 0.001 to 1 In
Input voltage range $57-130 \mathrm{~V}$ : The setting range is from 0.2 to $20 \times$ len W , in steps of 0.02 x len W .
Input voltage range $220-480 \mathrm{~V}$ : The setting range is from 1 to $80 \times$ len $W$, in steps of $0.1 \times$ len $W$.
The setting range for leCos>> is from 0.002 to 1 ln , in steps of 0.001.
Medium sensitivity current: 0.01 to 8 In Input voltage range $57-130 \mathrm{~V}$ : The setting range is from 1 to $160 \times$ len $W$, in steps of $0.1 \times$ len $W$.
Input voltage range $220-480 \mathrm{~V}$ : The setting range is from 4 to $640 \times$ len $W$, in steps of $0.5 x$ len W.
The setting range for leCos>> is from 0.01 to 8 ln , in steps of 0.005 .
Low sensitivity current: 0,1 to 40 In
Input voltage range 57-130V: The setting range is from 10 to $800 \times$ len W, in steps of $1 x$ len W.
Input voltage range $220-480 \mathrm{~V}$ : The setting range is from 40 to $3200 \times$ len W, in steps of $5 \times$ len W.
The setting range for leCos>> is from 0.5 to 40 ln , in steps of 0.01.


Displays setting value for the trip threshold.
The setting range is from 0 to 150 s , in steps of 10 ms .
Displays setting value for the reset time.
The setting range is from 0 to 100 s , in steps of 10 ms .

| Pe> Pe>> |  |
| :--- | :--- |
| ANGLE | $90^{\circ}$ |

Displays the setting angle for $\mathrm{Pe} / \mathrm{leCos}$. This item is only activated if at least one of the $\mathrm{Pe} / \mathrm{leCos}$ thresholds is enabled.
The setting range is from $0^{\circ}$ to $359^{\circ}$, in steps of $1^{\circ}$. This angle is the RCA angle for the directional earth fault power.

By pushing $\Leftrightarrow$ the next window will display the [32N] Earth Wattmetric

### 4.6.5 Submenu [46] Negative Phase Sequence Overcurrent (P126 \& P127)

| PROTECTION G1 | Heading of Protection G1 menu. <br> To gain access to menu, press $\Leftrightarrow$ and ) until the submenu is reached. |
| :---: | :---: |
| [46] Neg Seq OC | Heading of [46] submenu. <br> To navigate within submenu points, press $\otimes \otimes$. To modify setting, press $\Theta$. Use $\otimes \Leftrightarrow \otimes\left(\begin{array}{l}\text { to scroll and set available }\end{array}\right.$ selections. Press $\Theta$ to confirm choice. |
| 12> ? Yes | Selection of the first alarm threshold function for Negative Phase Sequence OC (I2>). <br> Setting choice: No, Yes <br> If the user selects Yes the following window is shown: <br> If the user selects No, the next window will show the threshold menu l2>>. |
| 12> 1.00 ln | Displays setting value for the alarm threshold. <br> The threshold setting range is from 0.1 to 25 In , in steps of 0.01 In . |
| Delay Type ${ }^{\text {DMT }}$ | Displays threshold delay time type. Setting choices are: DMT for definite delay time, IDMT for Inverse time curve, RI for the electromechanical inverse time curve. |
| t l2> $\quad 150.00 \mathrm{~s}$ | Displays setting value for the trip threshold. The setting range is from 0 to 150 s , in steps of 10 ms . |

By pushing $\Leftrightarrow$ the next window will display the $12 \gg$ ?

### 4.6.5.1 Threshold Menu I2> RI

| Delay Type | RI |
| :--- | :--- |

Displays the I2> RI electromechanical inverse curve.

| $K$ | 1.000 |
| :--- | :--- |

Selection of K value for the RI curve.
The setting range is from 0.100 to 10 , in steps of 0.005 .


Displays setting value for the reset time. The setting range is from 0 to 100 s , in steps of 10 ms .

By pushing $\Leftrightarrow$ the next window will display the $12 \gg$ ?
4.6.5.2 Threshold Menu I2> IDMT - IEC or IEEE/ANSI curves

| Delay Type | Displays the type of IEC XX curves for I2> delay time. |
| :---: | :---: |
| TMS 1.00 | Displays the TMS value associated to IEC family of curves. The setting range is from 0.025 to 1.5 , in steps of 0.025 . |
| tReset 0.00 s | Displays setting value for the reset time. <br> The setting range is from 0 to 100 s , in steps of 10 ms . |

By pushing $\Leftrightarrow$ the next window will display the $12 \gg$ ?

### 4.6.5.3 Threshold Menu I2> RECT curve

| Delay Type |  |
| :--- | :--- |
|  | RECT |

Displays the type of RECT curve for I2> delay time.

| TMS |
| :--- |
|  |

Displays the TMS value associated to IEC family of curves. The setting range is from 0.025 to 1.5 , in steps of 0.025 .
 Displays setting value for the reset time. The setting range is from 0 to 100 s , in steps of 10 ms .

By pushing $\Theta$ the next window will display the $12 \gg$ ?

### 4.6.5.4 Threshold Menu I2> ANSI/IEEE

| Delay Type <br> ANSI/IEEE Displays the type of ANSI/IEEE curves for I2> delay time. <br> TMS Displays the TMS factor associated to ANSI/IEEE family of <br> curves. <br> The setting range is from 0.025 to 1.5, in steps of 0.025.  |
| :--- | :--- | :--- |

### 4.6.5.5 Reset Threshold Menu I2> DMT/IDMT IEEE/ANSI



Displays the reset delay time type for ANSI/IEEE definite delay time curves.


Displays setting value for the reset time. The setting range is from 0 to 100 s , in steps of 10 ms .

By pushing $\Theta$ the next window will display the $12 \gg$ ?

| Reset Delay Type IDMT | Displays the selected reset delay type for ANSI/IEEE inverse delay time curves. |
| :---: | :---: |
| RTMS 1.000 | Displays the RTMS factor associated to IDMT delay type reset. |

By pushing $\Theta$ the next window will display the $12 \gg$ ?
4.6.5.6 Threshold Menu I2>>


By pushing $\Theta$ the next window will display the $12 \ggg$ ?

### 4.6.5.7 Threshold Menu I2>>>



By pushing $\otimes$ the next window will display the [46] Neg Seq OC
4.6.6 Submenu [49] Thermal Replica Overload (P126 \& P127)


Heading of Protection G1 menu. To gain access to menu, press $\Leftrightarrow$ and $\geqslant$ until the submenu is reached.

Heading of [49] submenu.
To navigate within submenu points, press $\Delta \Leftrightarrow$. To modify setting, press $\Theta$. Use $\otimes \otimes \otimes(1)$ to scroll and set available selections. Press $\oplus$ to confirm choice.


Selection of the thermal overload alarm function. Setting choice: No, Yes If the user selects Yes the following window is shown: If the user selects No, no new window will be shown.


Displays setting value for the alarm threshold. The threshold setting range is from 0.1 to 3.2 In , in steps of 0.01 In .

Displays the Te thermal constant associated with the thermal formula. The Te setting range is from 1 to 200 min , in steps of 1 min .


Displays the K factor associated with the thermal overload function.
The K setting range is from 1 to 1.50 , in steps of 0.01 .


Displays the percentage applicable to the thermal overload trip threshold.
The $\theta$ Trip setting range is from 50 to $200 \%$, in steps of 0.01 .


Selection of the thermal overload alarm function.
Setting choice: No, Yes
If the user selects Yes, the following window is shown: If the user selects No, no new window will be shown.


Displays the percentage applicable to the thermal overload alarm threshold.
The $\theta$ Alarm setting range is from 50 to $200 \%$, in steps of 0.01 .

By pushing $\Leftrightarrow$ the next window will display the [49] Therm OL

### 4.6.7 Submenu [37] Undercurrent Protection (P126 \& P127)

| PROTECTION G1 | Heading of Protection G1 menu. <br> To gain access to menu, press $\Leftrightarrow$ and (1) until the submenu is reached. |
| :---: | :---: |
| [37] Under Current | Heading of [37] submenu. <br> To navigate within submenu points, press $\otimes \Theta$. To modify setting, press $\oplus$. Use $\Delta \Leftrightarrow \otimes \mid$ to scroll and set available selections. Press $\oplus$ to confirm choice. |
| l ? ? $\quad$ Yes | Selection of the first alarm threshold function for phase undercurrent ( $\mathrm{l}<$ ). Setting choice: No, Yes If the user selects Yes the following window is shown: If the user selects No, the next window will show the submenu [37] Under Current. |
| I< | Displays setting value for the alarm threshold. The threshold setting range is from 0.1 to 1 ln , in steps of 0.01 In . |
| 0.10 ln |  |
| t $1<$ | Displays setting value for the trip threshold. The setting range is from 0 to 150 s , in steps of 10 ms . |
| 150.00 s |  |

By pushing $\Leftrightarrow$ the next window will display the [37] Under Current
4.6.8 Submenu [59] Over-voltage Protection (P127)


Heading of Protection menu. To gain access to menu, press $\Theta$ and $(1)$ until the submenu is reached.

Heading of [59] submenu.
To navigate within submenu points, press $\otimes \Leftrightarrow$. To modify setting, press $\Theta$. Use $\otimes \otimes \otimes$ to scroll and set available selections. Press $\Theta$ to confirm choice.

Selection of the first alarm threshold function for phase overvoltage (U>). Setting choice: No, AND, OR.
If the user selects AND or OR, the following window is shown:
If the user selects No, the next windows will show the threshold menu U>>.


Displays setting value for the alarm threshold.
Input voltage range 57-130V: from 1 to 260 V , in steps of 0.1 V .

Input voltage range $220-480 \mathrm{~V}$ : from 10 to 960 V , in steps of 0.5 V .
t U> 600.00 s

Displays setting value for the trip threshold.
The setting range is from 0 to 600 s , in steps of 10 ms


Selection of the second alarm threshold function for phase overvoltage (U>>).
Setting choice: No, AND, OR
If the user selects AND or OR, the following window is shown:
If the user selects No, next window will show the submenu [59] Phase Over Voltage.


Displays setting value for the alarm threshold.
Input voltage range 57-130V: from 2 to 260 V , in steps of 0.1 V .

Input voltage range 220-480V: from 10 to 960 V , in steps of 0.5 V .

| $\mathbf{t}$ U>> | Displays setting value for the trip threshold. <br> The setting range is from 0 to 600 s , in steps of 10 ms |
| :--- | :--- |

By pushing $\Leftrightarrow$ the next window will display the [59] Phase Over Voltage

### 4.6.9 Submenu [27] Under-voltage Protection (P127)

| PROTECTION G1 | Heading of Protection G1 menu. <br> To gain access to menu, press $\Leftrightarrow$ and (8) until the submenu is reached. |
| :---: | :---: |
| [27] Phase Under Voltage | Heading of [27] submenu. <br> To navigate within submenu points, press $\otimes \otimes$. To modify setting, press $\Theta$. Use $\otimes \Leftrightarrow \Leftrightarrow(1)$ to scroll and set available selections. Press $\Theta$ to confirm choice. |
| $\mathrm{U}<$ ? $\quad$ Yes | Selection of the first alarm threshold function for phase undervoltage ( $\mathrm{U}<$ ). Setting choice: No, Yes If the user selects Yes, the following window is shown: If the user selects No, the next window will show the threshold menu $\mathrm{U} \ll$. |
| $\mathrm{U}<2.0 \mathrm{~V}$ | Displays setting value for the alarm threshold. Input voltage range 57-130V: from 2 to 130 V , in steps of 0.1 V. <br> Input voltage range $220-480 \mathrm{~V}$ : from 10 to 480 V , in steps of 0.5 V . |
| $t \mathrm{U}<\quad 150.00 \mathrm{~s}$ | Displays setting value for the trip threshold. <br> The setting range is from 0 to 600 s , in steps of 10 ms |
| $\mathrm{U} \ll$ ? | Selection of the second alarm threshold function for phase undervoltage ( $\mathrm{U} \ll$ ). Setting choice: No, Yes If the user selects Yes, the following window is shown: If the user selects No, next window will show the submenu [27] Phase Under Voltage. |
| $\mathrm{U} \lll 2.0 \mathrm{~V}$ | Displays setting value for the alarm threshold. Input voltage range 57-130V: from 2 to 260 V , in steps of 0.1 V . <br> Input voltage range 220-480V: from 10 to 960 V , in steps of 0.5 V . |
| $t \mathrm{U} \ll \quad 600.00 \mathrm{~s}$ | Displays setting value for the trip threshold. <br> The setting range is from 0 to 600 s , in steps of 10 ms |

By pushing $\otimes$ the next window will display the [27] Phase Under Voltage
4.6.10 Submenu [59N] Earth Over-voltage Protection


## [59N] Residual Over Voltage

## Ue>>>>?

Yes

Heading of Protection menu. To gain access to menu for P125 relay, press $\Leftrightarrow$. To gain access to menu (Protection G1 \& G2) for P126 and P127 relays press $\Leftrightarrow$ and $(1)$ until the submenu is reached.

Heading of [59N] submenu.
To navigate within submenu points, press $\otimes \Leftrightarrow$. To modify setting, press $\Theta$. Use $\Delta \Leftrightarrow \otimes(1)$ to scroll and set available selections. Press $\Theta$ to confirm choice.

Selection of the alarm threshold function for residual overvoltage (Ue>>>>). Setting choice: No, Yes If the user selects Yes, the following window is shown: If the user selects No, next window will show the submenu [59N] Residual Over Voltage.

| Ue>>>> 5.0 V | Displays setting value for the alarm threshold. Input voltage range $57-130 \mathrm{~V}$ : from 1 to 260 V , in steps of 0.1 V . |
| :---: | :---: |
|  |  |
|  | Input voltage range $220-480 \mathrm{~V}$ : from 10 to 960 V , in steps |
|  | 0.5 V . |
| t Ue>>>>> | Displays setting value for the trip threshold. |
| 600.00 s | The setting range is from 0 to 600 s , in steps of 10 ms . |

By pushing $\Leftrightarrow$ the next window will display the [59N] Residual Over Voltage
4.6.11 Submenu [79] AUTORECLOSE (P126 \& P127)

| PROTECTION G1 | Heading of PROTECTION menu. <br> To gain access to the Autoreclose menu, press $\Theta,(1)$ until the submenu is reached. |
| :---: | :---: |
| [79] Autoreclose | Heading of [79] AUTORECLOSE submenu. <br> To navigate within submenu points, press $\otimes \Theta$. To modify setting, press $\oplus$. Use $\otimes \Theta \otimes(1)$ to scroll and set available selections. Press $\Theta$ to confirm choice. |
| Autoreclose ? <br> Yes | Selection of autoreclose function. <br> Setting choice: No, Yes <br> If the user selects Yes the following menu is shown: <br> If the user selects No, no new window will be shown. |

### 4.6.11.1 Selection Menu [79] EXTERNAL CB FAILURE

| Ext CB Fail ? Yes | Selection of external CB failure alarm function. A binary <br> status signal from the CB sent to the logic input CB FLT can <br> be assigned to Autoreclose. Setting choice: No, Yes <br> If the user selects Yes the following window is shown: |
| :--- | :--- |
|  | If the user selects No, next window will show the submenu <br> Ext Block ?. |
| Ext CB Fail Time | Displays the external CB failure trip threshold. |
| 1.00 s | The setting range is from 0 to 600 s , in steps of 10 ms. |

### 4.6.11.2 Selection Menu [79] EXTERNAL BLOCKING



Selection of external blocking function. A binary signal sent to a logic input (Block_79) can be used to block the autoreclose function.
Setting choice: No, Yes
4.6.11.3 [79] Dead and Reclaim Time


Displays setting value of the first cycle dead time (tD1) for the autoreclose function.
The setting range is from 0.01 to 300 s , in steps of 10 ms .

| Dead Time <br> tD2 | 180.00 s |
| :--- | :--- |

Displays setting value of the second cycle dead time (tD2) for the autoreclose function.
The setting range is from 0.01 to 300 s , in steps of 10 ms .

| Dead Time <br> tD3 |  |
| :--- | :--- |

Displays setting value of the third cycle dead time (tD3) for the autoreclose function. The setting range is from 0.01 to 600 s , in steps of 10 ms .

| Dead Time <br> tD4 | 180.00 s |
| :--- | :--- |

Displays setting value of the forth cycle dead time (tD4) for the autoreclose function.
The setting range is from 0.01 to 600 s , in steps of 10 ms .
Reclaim Time
tR $\quad 180.00 \mathrm{~s}$

Displays setting value of the reclaim time (tR) for the autoreclose function.
The setting range is from 0.01 to 600 s , in steps of 10 ms .

| Inhib Time |  |
| :--- | :--- |
| tl | 5.00 s |

Displays setting value of the inhibit time (tl) for the autoreclose function (following a manual CB closure). Setting range from 0.01 s to 600 s , in steps of 10 ms .

### 4.6.11.4 [79] Phase and Earth Re-closing Cycles

| Phase Cycles | $\mathbf{4}$ | Displays setting of autoreclose cycles externally started by <br> a phase protection trip signal. <br> Setting choice is from 0 to 4 cycles. |
| :--- | :--- | :--- |
| E/Gnd Cycles | 4 | Displays setting of autoreclose cycles externally started by <br> an earth protection trip signal. <br> Setting choice is from 0 to 4 cycles. |

By pushing $\Theta$ the next window will display the [79] cycles allocation
4.6.11.5 [79] Cycles allocation

| CYCLES | 4321 |
| :--- | :--- |
| tl> | 1101 |


| CYCLES | 4321 |
| :--- | :--- |
| tl>> | 1101 |

$0=$ no action on autorecloser : definitive trip
$1=$ trip on tl> pick-up, followed by reclosing cycle
$2=$ no trip on tl> pick-up
2 = no trip on tl> pick-up
$0=$ no action on autorecloser : definitive trip
$1=$ trip on tl>> pick-up, followed by reclosing cycle
2 = no trip on tl>> pick-up

| CYCLES | 4321 |
| :--- | :--- |
| tl>>> | 1101 |

$0=$ no action on autorecloser : definitive trip 1 = trip on tl>>> pick-up, followed by reclosing cycle 2 = no trip on tl>>> pick-up

| CYCLES | 4321 |
| :--- | :--- |
| tle> | 1101 |

$0=$ no action on autorecloser : definitive trip
$1=$ trip on tle> pick-up, followed by reclosing cycle
$2=$ no trip on tle> pick-up

| CYCLES | 4321 |
| :--- | :--- |
| tle>> | 1101 |

$0=$ no action on autorecloser : definitive trip
1 = trip on tle>> pick-up, followed by reclosing cycle
2 = no trip on tle>> pick-up

| CYCLES | 4321 | $0=$ no action on autorecloser : definitive trip <br> tle>>> |
| :--- | :--- | :--- |
|  | 1101 | $2=$ trip on tle>>> pick-up, followed by reclosing cycle |
| 2 |  |  |


| CYCLES tPe/lecos> | $\begin{aligned} & 4321 \\ & 1101 \end{aligned}$ | $0=$ no action on autorecloser : definitive trip <br> 1 = trip on tPe/lecos> pick-up, followed by reclosing cycle <br> $2=$ no trip on tPe/lecos> pick-up |
| :---: | :---: | :---: |
| CYCLES | 4321 | $0=$ no action on autorecloser : definitive trip |
| tPe/lecos>> | 1101 | $1=$ trip on tPe/lecos>> pick-up, followed by reclosing cycle 2 = no trip on tPe/lecos>>pick-up |


| CYCLES | 4321 |
| :--- | :--- |
| tAux1 | 1101 |

$0=$ no action on autorecloser : definitive trip
$1=$ trip on tAux1 pick-up, followed by reclosing cycle
$2=$ no trip on tAux1 pick-up

| CYCLES | 4321 | 1101 |
| :--- | :--- | :--- |$\quad$| $0=$ no action on autorecloser : definitive trip |
| :--- |
| 1 $=$ trip on tAux2 pick-up, followed by reclosing cycle |
| 2 |

By pushing $\Leftrightarrow$ the next window will display the [79] Autoreclose.

### 4.7 Menu AUTOMAT. CTRL

The AUTOMAT. CTRL Menu makes it possible to programme the various automation functions included in the MiCOM P125, P126 \& P127 relays.

The various submenus are:

- Trip Commands
- Latch Functions
- Blocking Logic (P125)
- Blocking Logic 1 \& 2 (P126 \& P127)
- Logic Select. 1 \& 2 (P126 \& P127)
- Outputs Relays
- Inputs
- Broken Conductor (P126 \& P127)
- Cold load Pick Up (P126 \& P127)
- CB Fail (P126 \& P127)
- $\quad$ CB Supervision (P126 \& P127)
- SOTF Switch on to fault and trip on reclose
- AND Logic Equation
- $\quad$ AND logic equation timers

To gain access to the AUTOMAT. CTRL menu from the default display press $\Leftrightarrow$ and $\beta$ until AUTOMAT.CTRL is reached.
4.7.1 Submenu Trip Commands

This submenu makes it possible to assign some or all the selected thresholds to the trip logic output (RL1).

### 4.7.1.1 Submenu Trip Commands for P125

| AUTOMAT. CTRL | Heading of AUTOMAT. CTRL menu. <br> To gain access to the Trip Commands menu, press $\Leftrightarrow$ and (3) until the submenu is reached. |
| :---: | :---: |
| Trip Commands | Heading of Trip Commands submenu. <br> To navigate within submenu points, press $\otimes \Theta$. To modify setting, press $\oplus$. Use $\otimes \otimes(1)$ to scroll and set available selections. Press $\oplus$ to confirm choice. |
| Trip tle> No | Assigning the first trip threshold for earth overcurrent to trip output (RL1). <br> Setting choice: Yes, No |
| Trip tle>> No | Assigning the second trip threshold for earth overcurrent to trip output (RL1). <br> Setting choice: Yes, No |
| Trip tle>>> No | Assigning the third trip threshold for earth overcurrent to trip output (RL1). <br> Setting choice: Yes, No |
| Trip tPe/leCos> No | Assigning the first earth wattmetric trip threshold to trip output (RL1). <br> Setting choice: Yes, No |


| Trip tPe/leCos>> <br> No | Assigning the second earth wattmetric trip threshold to trip output (RL1). <br> Setting choice: Yes, No |
| :---: | :---: |
| Trip tUe>>>> No | Assigning the trip threshold for residual overvoltage to trip output (RL1). <br> Setting choice: Yes, No |
| Trip tAux 1 No | Assigning the delayed auxiliary input Aux1 to trip output (RL1). <br> Setting choice: Yes, No |
| Trip tAux 2 No | Assigning the delayed auxiliary input Aux2 to trip output (RL1). <br> Setting choice: Yes, No |
| Trip tAux 3 No | Assigning the delayed auxiliary input Aux3 to trip output (RL1). <br> Setting choice: Yes, No |
| Trip tAux 4 No | Assigning the delayed auxiliary input Aux4 to trip output (RL1). |

### 4.7.1.2 Trip Commands Menu Points for P126 \& P127

| Trip tl> No | Assigning the first three-phase OC trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| :---: | :---: |
| Trip tl>> No | Assigning the second three-phase OC trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip tl>>> No | Assigning the third three-phase OC trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip tle> No | Assigning the first earth fault overcurrent trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip tle>> No | Assigning the second earth fault overcurrent trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip tle>>> No | Assigning the third earth fault overcurrent trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip tPe/leCos> No | Assigning the first earth wattmetric trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip tPe/leCos>> <br> No | Assigning the second earth wattmetric trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip tl2> No | Assigning the first negative sequence overcurrent trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip tl2>> No | Assigning the second negative sequence overcurrent trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip tl2>>> No | Assigning the third negative sequence overcurrent trip threshold to output relay RL1. <br> Setting choice: Yes, No |


| Trip Thermal $\theta$ <br> No | Assigning the thermal overload trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| :---: | :---: |
| Trip tUe>>>> No | Assigning the residual overvoltage trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip Brkn. Cond ${ }^{\text {No }}$ | Assigning the broken conductor detection signal to output relay RL1. <br> Setting choice: Yes, No |
| Trip tAux 1 No | Assigning the delayed auxiliary input Aux1 to trip output (RL1). <br> Setting choice: Yes, No |
| Trip tAux 2 No | Assigning the delayed auxiliary input Aux2 to trip output (RL1). <br> Setting choice: Yes, No |
| Trip tAux 3 No | Assigning the delayed auxiliary input Aux3 to trip output (RL1). <br> Setting choice: Yes, No |
| Trip tAux 4 No | Assigning the delayed auxiliary input Aux4 to trip output (RL1). <br> Setting choice: Yes, No |
| Trip SOTF <br>  No | Assigning the SOTF functionality to the trip output (RL1). Setting choice: Yes, No |
| Ctrl Trip No | Assigning the control by remote to the trip output (RL1). Setting choice: Yes, No |
| EQUATION A ? | Assigning the Boolean AND logic equation A result to output relay RL1. <br> Setting choice: Yes, No |
| EQUATION B ? | Assigning the Boolean AND logic equation A result to output relay RL1. <br> Setting choice: Yes, No |
| EQUATION C ? | Assigning the Boolean AND logic equation A result to output relay RL1. <br> Setting choice: Yes, No |
| EQUATION D? <br> No | Assigning the Boolean AND logic equation A result to output relay RL1. <br> Setting choice: Yes, No |
| Additional Trip Commands Menu Points for P127 |  |
| Trip tU> No | Assigning the first overvoltage trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip tU>> No | Assigning the second overvoltage trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip $\mathrm{tU}<\mathrm{U}^{\text {a }}$ | Assigning the first undervoltage trip threshold to output relay RL1. <br> Setting choice: Yes, No |
| Trip $\mathrm{tU} \lll$ | Assigning the second undervoltage trip threshold to output relay RL1. <br> Setting choice: Yes, No |

### 4.7.2 Submenu Latch Relays

With this submenu the user can program trip functions so that the resulting output signal will remain latched after the cause for exceeding the threshold has disappeared.

### 4.7.2.1 Submenu Latch Relays for P125

With the following menu the user can set each output relay as latched or not latched.
A " 0 " assigned to an output relay means that the relay is not latched. The output relay will be active when the relevant command will be active; the relay will not be active when the relevant command will reset.

A " 1 " setting assigned to an output relay means that the relay is latched. The output relay will be active when the relevant command will be active; the relay will remain active, if the relevant command will reset.

The active latched output relays can be reset by a logic input assigned to this function.
Further, the active latched output relays can be reset from the front panel by pushing © This action is available if the window status Output Relays in OP. PARAMETERS submenu is displayed.

The alarm string "Latched Relays" appears on LCD and the yellow LED is lighted.


Heading of AUTOMAT. CTRL menu.
To gain access to the Latch Relays menu, press $\Leftrightarrow$ and $(\theta)$ until the submenu is reached.

Heading of submenu.
To modify setting press $\oplus$.
To select output relay press (1). To confirm choice for setting press $\Theta$. Then press $\Theta$ or $\otimes$ to select 0 or 1. Press $\Theta$ to confirm setting choice.

NOTE: In the above window the output relays set to Latch function are number 4 and 7 (RL4 \& RL7).

The window for the P 125 relay is shown below:

Latch $\quad$| $: 654321$ |
| ---: |
|  |
|  |
|  |

### 4.7.3 Submenu Blocking Logic

The MiCOM P125 relay has the submenu Blocking Logic available for setting. MiCOM P126 \& P127 relays have the submenu Blocking Logic 1 and Blocking Logic 2 available for setting. By opening the Blocking Logic submenu the user can assign each delayed threshold to the "Blk Log" input (refer to Inputs menu).

It is possible to enable or disable the "blocking" of most protection functions even if a logic input has been assigned to that function. Blocking of a protection function can be prevented if "No" is selected in the relevant window (see below). Blocking of a protection function can be enabled if "Yes" is selected in the relevant window.

### 4.7.3.1 Submenu Blocking Logic for P125



Heading of AUTOMAT. CTRL menu. To gain access to the Blocking Logic submenu, press $\Leftrightarrow$ and () until the submenu Blocking Logic is reached.
Heading of Blocking Logic submenu.
To navigate within submenu points, press $\otimes \otimes$. To modify setting, press $\Theta$. Use $\Delta \otimes \otimes(1)$ to scroll and set available selections. Press $\oplus$ to confirm choice.

Enables/disables Blocking Logic of the first trip threshold for earth overcurrent from locking on the level (logic state = 1) of logic input "Blk Log".

Setting choice: Yes, No


Enables/disables Blocking Logic of the second trip threshold for earth overcurrent from locking on the level (logic state $=1$ ) of logic input "BIk Log".
Setting choice: Yes, No


Enables/disables Blocking Logic of the third trip threshold for earth overcurrent from locking on the level (logic state = 1) of logic input "Blk Log". Setting choice: Yes, No

| Block <br> tPe/leCos> | No |
| :--- | :--- |

Enables/disables Blocking Logic of the first earth wattmetric trip threshold from locking on the level (logic state 1) of logic input "Blk Log".
Setting choice: Yes, No


Enables/disables Blocking Logic of the second earth wattmetric trip threshold from locking on the level (logic state 1) of logic input "Blk Log". Setting choice: Yes, No


Enables/disables Blocking Logic of the trip threshold for residual overvoltage from locking on the level (logic state 1) of logic input "Blk log".
Setting choice: Yes, No


Enables/disables Blocking Logic of time delay of auxiliary input Aux1.
Setting choice: Yes, No
Enables/disables Blocking Logic of time delay of auxiliary input Aux2.
Setting choice: Yes, No


Enables/disables Blocking Logic of time delay of auxiliary input Aux 3.
Setting choice: Yes, No


Enables/disables Blocking Logic of time delay of auxiliary input Aux 4.
Setting choice: Yes, No

### 4.7.3.2 Additional Blocking Logic Menu Points for P126 \& P127

| Block1 tl> No | Enables/disables Blocking Logic 1 of the first trip threshold for phase OC from locking on the level (logic state $=1$ ) of logic input "Blk Log". <br> Setting choice: Yes, No |
| :---: | :---: |
| Block1 tl>> No | Enables/disables Blocking Logic 1 of the second trip threshold for phase OC from locking on the level (logic state = 1) of logic input "BIk Log". <br> Setting choice: Yes, No |
| Block1 tl>>> No | Enables/disables Blocking Logic 1 of the third trip threshold for phase OC from locking on the level (logic state $=1$ ) of logic input "Blk Log". <br> Setting choice: Yes, No |
| Block1 tl< No | Enables/disables Blocking Logic 1 of the trip threshold for phase undercurrent from locking on the level (logic state $=$ 1) of logic input "Blk Log". <br> Setting choice: Yes, No |
| Block1 tl2> No | Enables/disables Blocking Logic 1 of the first trip threshold for Negative Sequence overcurrent from locking on the level (logic state 1) of logic input "Blk Log". <br> Setting choice: Yes, No |
| Block1 tl2>> No | Enables/disables Blocking Logic 1 of the second trip threshold for Negative Sequence overcurrent from locking on the level (logic state 1) of logic input "Blk Log". Setting choice: Yes, No |
| Block1 tl2>>> No | Enables/disables Blocking Logic 1 of the third trip threshold for Negative Sequence overcurrent from locking on the level (logic state 1) of logic input "BIk Log". <br> Setting choice: Yes, No |
| Block1 tThermal $\theta$ No | Enables/disables Blocking Logic 1 of the trip threshold for thermal overload from locking on the level (logic state 1) of logic input "Blk Log". <br> Setting choice: Yes, No |
| Block1 tBrk. Cond No | Enables/disables Blocking Logic 1 of the Broken Conductor trip signal from locking on the level (logic state 1) of logic input "Blk log". <br> Setting choice: Yes, No |

4.7.3.3 Additional Blocking Logic Menu Points for P127

| Block1 tU> | No | Enables/disables Blocking Logic 1 of the first trip threshold <br> for overvoltage from locking on the level (logic state 1) of <br> logic input "Blk Log". <br> Setting choice: Yes, No |
| :--- | :--- | :--- |
| Block1 tU>> | No |  |
|  | Enables/disables Blocking Logic 1 of the second trip <br> threshold for overvoltage from locking on the level (logic <br> state 1) of logic input "Blk Log". <br> Setting choice: Yes, No |  |
| Block1 tU< | Enables/disables Blocking Logic 1 of the first trip threshold <br> for undervoltage from locking on the level (logic state 1) of <br> logic input "Blk Log". <br> Setting choice: Yes, No |  |
| Block1 tU<< | Enables/disables Blocking Logic 1 of the second trip <br> threshold undervoltage from locking on the level (logic state <br> 1) of logic input "Blk Log". <br> Setting choice: Yes, No |  |

### 4.7.4 Submenu Logic Select

With the submenu Logic Select. 1 or Logic Select. 2 the user can assign each trip threshold to the "Log Sel" input (refer to Inputs menu). To access the submenu Logic Select. 1 or Logic Select. 2, press $\Leftrightarrow$ and () until the submenu is reached.

The submenu Logic Select. 1 / Logic Select. 2 is only available in the software of the P126 \& P127 relays. The thresholds l>>, l>>> are from the protection function [67/50/51] and le>>, le>>> from the protection function [67N/50N/51N].

| AUTOMAT. CTRL | Heading of AUTOMAT. CTRL menu. <br> To gain access to the Logic Select menu, press $\Leftrightarrow$ and ( $)$ until the submenu Logic Select. 1 or Logic Select. 2 is reached. |
| :---: | :---: |
| Logic Select. 1 | Heading of Logic Select submenu. <br> To navigate within submenu points, press $\Theta \otimes$. To modify setting, press $\oplus$. Use $\Delta \Leftrightarrow \otimes(1)$ to scroll and set available selections. Press $\oplus$ to confirm choice. |
| Sel1 tl>> No | Enables/disables Logic Select 1 of the second trip threshold for phase overcurrent ( $\mathrm{tl} \gg$ ). <br> Setting choice: Yes, No |
| Sel1 tl>>> No | Enables/disables Logic Select 1 of the third trip threshold for phase overcurrent threshold (tl>>>). <br> Setting choice: Yes, No |
| Sel1 tle>> No | Enables/disables Logic Select 1 of the second trip threshold for earth fault overcurrent (tle>>). <br> Setting: Yes or No. |
| Sel1 tle>>> No | Enables/disables Logic Select 1 of the third trip threshold for earth fault overcurrent (tle>>>). <br> Setting choice: Yes, No |
| t Sel1 150.00 s | Displays time delay t Sel1 for Logic Select 1. <br> The setting range for t Sel 1 is from 0 s to 150 s , in steps of 10 ms . |

### 4.7.5 Submenu Outputs Relays

This submenu makes it possible to assign various alarm and trip thresholds (instantaneous and/or time delay) to a logic output. Excepted from this option are the Watchdog (RLO) and the Tripping (RL1) outputs (refer to Trip Commands submenu).
The total number of programmable logic outputs for the three relay models is listed in the table:

| Model | P125 | P126 | P127 |
| :--- | :---: | :---: | :---: |
| Output relays | 6 | 8 | 8 |

### 4.7.5.1 Submenu Outputs Relays for P125

Output Relays

Heading of AUTOMAT. CTRL menu. To gain access to the Output Relays submenu, press $\Theta$ and ()) until the submenu is reached.

Heading of Output Relays submenu. To navigate within submenu points, press $\Theta \Leftrightarrow$. To modify setting, press $\Theta$. Use $\otimes \otimes \theta(1)$ to scroll and set available selections. Press $\oplus$ to confirm choice.

| Trip | $: 65432$ |
| :--- | ---: |
|  | 00010 |

Assigning output signal Trip (RL1) to other output relays; i.e. to output 3 (RL3). Setting choice: 1 assigns the output relay; 0 no assignment.

| le> | :65432 |
| :--- | ---: |
|  | 00010 |
|  |  |
| tle> | $: 65432$ |
|  | 00010 |
|  |  |
| le_R $>$ | $: 65432$ |
|  | 00010 |


| le>> | 65432 <br> 00010 |
| :--- | ---: |
|  |  |
| tle>> | $: 65432$ |
|  | 00010 |
|  |  |
| le_R>> | $: 65432$ |
|  | 00010 |

Assigning second alrm threshold for earth fault overcurrent (le>>) to the output relays; i.e. to output 3 (RL3). Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning second trip threshold for earth fault overcurrent (tle>>) to the output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning second trip threshold for directional earth fault overcurrent from the inverse trip zone (le_R>>) to the output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.

| le>>> | 65432 <br> 00010 |
| :--- | ---: |
|  |  |
| tle>>> | $: 65432$ |
|  | 00010 |


| le_R>>> | $: 65432$ |
| :--- | ---: |
|  | 00010 |


| $\mathrm{Pe} /$ | $: 65432$ |
| :--- | ---: |
| $\mathrm{leCos}>$ | 00010 |


| $\mathrm{tPe} /$ | $: 65432$ |
| :--- | ---: |
| $\mathrm{leCos}>$ | 00010 |


| Pe/ | $: 65432$ |
| :--- | ---: |
| $\mathrm{leCos} \gg$ | 00010 |


| $\mathrm{tPe} /$ | $: 65432$ |
| :--- | ---: |
| $\mathrm{leCos} \gg$ | 00010 |

Assigning third alarm threshold for earth fault overcurrent (le>>>) to the output relays; i.e. to output 3 (RL3). Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning third trip threshold for earth fault overcurrent (tle>>>) to the output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning third trip threshold for directional earth fault overcurrent from the inverse trip zone (le_R>>>) to the output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning first earth wattmetric alarm threshold (Pe/leCos>) to the output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning first earth wattmetric trip threshold (tPe/leCos>) to the output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning second earth wattmetric alarm threshold ( $\mathrm{Pe} / \mathrm{leCos} \gg$ ) to the output relays; i.e. to output 3 (RL3). Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning second earth wattmetric trip threshold (tPe/leCos>>) to the output relays; i.e. to output 3 (RL3). Setting choice: 1 assigns the output relay; 0 no assignment.

| Ue>>>> | $\begin{array}{r} 65432 \\ 00010 \end{array}$ | Assigning the alarm threshold for residual overvoltage (Ue>>>>) to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| :---: | :---: | :---: |
| tUe>>>> | $\begin{array}{r} 65432 \\ 00010 \end{array}$ | Assigning trip threshold for residual overvoltage (tUe>>>>) to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| tAUX1 | $\begin{array}{r} : 65432 \\ 00010 \end{array}$ | Assigning delayed auxiliary input Aux 1 to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| t AUX2 | $\begin{array}{r} \text { :65432 } \\ 00010 \end{array}$ | Assigning delayed auxiliary input Aux 2 to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| tAUX3 | $\begin{array}{r} : 65432 \\ 00010 \end{array}$ | Assigning delayed auxiliary input Aux 3 to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| t AUX4 | $\begin{array}{r} 65432 \\ 00010 \end{array}$ | Assigning delayed auxiliary input Aux 4 to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| Active Group | $\begin{array}{r} \hline 65432 \\ 00010 \end{array}$ | Assigning the active setting group to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |

### 4.7.5.2 Submenu Outputs Relays for P126 and P127

| AUTOMAT. CTRL | Heading of AUTOMAT. CTRL menu. <br> To gain access to the Output Relays submenu, press $\Theta$ and $(8)$ until the submenu is reached. |
| :---: | :---: |
| Output Relays | Heading of Output Relays submenu. <br> To navigate within submenu points, press $\otimes \Theta$. To modify setting, press $\oplus$. Use $\otimes \Leftrightarrow \Leftrightarrow\left(\begin{array}{l}\text { to } \\ \text { to scroll and set available }\end{array}\right.$ selections. Press $\oplus$ to confirm choice. |
| Trip $\begin{array}{r}: 8765432 \\ 0000010\end{array}$ | Assigning output signal Trip (RL1) to other output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| l> $: 8765432$ <br>  0100010 | Assigning first alarm threshold for phase OC (l>) to the output relays; i.e. to output 3 \& 7 (RL3 \& RL7). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| tl> $: 8765432$ <br>  1100010 | Assigning first trip threshold for phase OC (tl>) to the output relays; i.e. to output 3,7 \& 8 (RL3, RL7 \& RL8). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| I_R> $\begin{array}{r}: 8765432 \\ 0000010\end{array}$ | Assigning first trip threshold for directional phase OC from the inverse trip zone (I_R>) to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| $l \gg$ $: 8765432$ <br> 0100010  | Assigning second alarm threshold for phase OC (l>>) to other output relays; i.e. to output 3 \& 7 (RL3 \& RL7). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| tl>> $: 8765432$ <br>  1100010 | Assigning second trip threshold for phase OC (tl>>) to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| I_R>> 8765432 <br>  0000010 | Assigning second trip threshold for directional phase OC from the inverse trip zone (I_R>>) to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |


| I_R>>> | $: 8765432$ <br>  <br>  |
| :--- | ---: |

Assigning third alarm threshold for phase OC (l>>>) to the output relays; i.e. to output 3 \& 7 (RL3 \& RL7).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning third trip threshold for phase OC (tl>>>) to the output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.

| tIA $>$ | $: 8765432$ |
| :--- | ---: |
|  | 1100010 |
|  |  |
| tIB $>$ | $: 8765432$ |
|  | 1100010 |


| tIC $>$ | $: 8765432$ |
| :--- | :---: |
|  | 1100010 |
|  |  |
| le> | $: 8765432$ |
|  | 0000010 |
|  |  |
| tle $>$ | $: 8765432$ |
|  | 0000010 |


| le_R $>$ | $: 8765432$ |
| :--- | ---: |
|  | 0000010 |


| le>> | $: 8765432$ |
| :--- | ---: |
|  | 1100010 |


| tle $\gg$ | $: 8765432$ |
| :--- | ---: |
|  | 1100010 |


| le_R $\ggg$ | $: 8765432$ |
| :--- | ---: |
|  | 0000010 |


| $l e \ggg$ | $: 8765432$ |
| ---: | ---: |
|  | 1100010 |


| tle $\ggg$ | $: 8765432$ |
| ---: | ---: |
|  | 1000010 |


| le_R |
| ---: |
|  |
|  |
|  |

Assigning third trip threshold for directional phase OC from the inverse trip zone (I_R>>>) to the output relays; i.e. to output 3 (RL3). Setting choice: 1 assigns the output relay; 0 no assignment.

Linking first delayed threshold for phase A (tIA>) to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8). Setting choice: 1 assigns the output relay; 0 no assignment. Linking first delayed threshold for phase $B$ (tIB>) to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8). Setting choice: 1 assigns the output relay; 0 no assignment. Linking first delayed threshold for phase C ( $\mathrm{tCl}>$ ) to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8). Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning of the first alarm threshold for earth fault overcurrent (le>) to the output relays; i.e. to output 3 (RL3). Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning first trip threshold for earth fault overcurrent (tle>) to other output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning first trip threshold for directional earth fault overcurrent from the inverse trip zone (le_R>) to the output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning second alarm threshold for earth fault overcurrent (le>>) to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning second trip threshold for earth fault overcurrent (tle>>) to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning second trip threshold for directional earth fault
overcurrent from the inverse trip zone (le_R>>) to the
output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning third alarm threshold for earth fault overcurrent (le>>>) to the output relays; i.e. to output 3, $7 \& 8$ (RL3, RL7 \& RL8).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning third trip threshold for earth fault overcurrent (tle>>>) to the output relays; i.e. to output 3 \& 8 (RL3 \& RL8).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning third trip threshold for directional earth fault overcurrent from the inverse trip zone (le_R>>>) to the output relays; i.e. to output 3,7 \& 8 (RL3, RL7 \& RL8). Setting choice: 1 assigns the output relay; 0 no assignment.

| Pe/ $: 8765432$ <br> leCos $>$ 1100010 |
| :--- | ---: |
| tPe/ $: 8765432$ <br> leCos 0000010 <br>   <br> Pe/ $: 8765432$ <br> leCos $\gg$ 1100010 |

Assigning first earth wattmetric alarm threshold (Pe/leCos>) to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning first earth wattmetric trip threshold (tPe/leCos>) to the output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning second earth wattmetric alarm threshold (Pe/leCos>>) to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8).
Setting choice: 1 assigning to the output relay; 0 no assignment.

| $\mathrm{tPe} /$ | $: 8765432$ |
| :--- | ---: |
| $\mathrm{leCos} \gg$ | 1100010 |

Assigning second earth wattmetric trip threshold (tPe/leCos>>) to the output relays; i.e. to output $3,7 \& 8$ (RL3, RL7 \& RL8).
Setting choice: 1 assigns the output relay; 0 no assignment.

| I2> | :8765432 |
| :--- | ---: |
|  | 0100010 |

Assigning first alarm threshold for negative sequence overcurrent (I2>) to the output relays; i.e. to output $3 \& 7$ (RL3 \& RL7).
Setting choice: 1 assigns the output relay; 0 no assignment.

| $t \mid 2>$ | $: 8765432$ |
| :--- | ---: |
|  | 0100010 | Assigning of the first trip threshold for negative sequence overcurrent (I2>) to the output relays; i.e. to output 3 \& 7 (RL3 \& RL7).

Setting choice: 1 assigns the output relay; 0 no assignment.

| l2>> | :8765432 |
| :--- | ---: |
|  | 0100010 |

Assigning second alarm threshold for negative sequence overcurrent (12>>) to the output relays; i.e. to output 3 \& 7 (RL3 \& RL7).
Setting choice: 1 assigns the output relay; 0 no assignment.

| tl2>> | $: 8765432$ |
| ---: | ---: |
|  | 0100010 |

Assigning second trip threshold for negative sequence overcurrent (12>>) to the output relays; i.e. to output 3 \& 7 (RL3 \& RL7).
Setting choice: 1 assigns the output relay; 0 no assignment.

| l2>>> | 8765432 <br>  <br>  |
| :--- | ---: |

Assigning of the third alarm threshold for negative sequence overcurrent (I2>>>) to the output relays; i.e. to output 3 \& 7 (RL3 \& RL7).
Setting choice: 1 assigns the output relay; 0 no assignment.

| tl2>>> | $: 8765432$ |
| ---: | ---: |
|  | 0100010 |

Assigning of the third trip threshold for negative sequence overcurrent (tl2>>>) to the output relays; i.e. to output 3 \& 7 (RL3 \& RL7). Setting choice: 1 assigns the output relay; 0 no assignment.

| Therm <br> Alarm | $: 8765432$ |
| :--- | ---: |
|  |  |

Assigning thermal alarm to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8).
Setting choice: 1 assigns the output relay; 0 no assignment.


Assigning thermal trip threshold to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning threshold for undercurrent ( $\mathrm{l}<$ ) to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8).
Setting choice: 1 assigns the output relay; 0 no assignment.

| $\mathrm{tl}<$ | $: 8765432$ |
| ---: | ---: |
|  | 1100010 |

Assigning trip threshold for undercurrent ( $\mathrm{t} \mid<$ ) to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8).
Setting choice: 1 assigns the output relay; 0 no assignment.

| Ue>>>> | $: 8765432$ |
| ---: | ---: |
|  | 1100010 |

Assigning alarm threshold for residual overvoltage to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8). Setting choice: 1 assigns the output relay; 0 no assignment.


| 52 Fail | $: 8765432$ |
| ---: | ---: |
|  | 1100010 |

Assigning circuit breaker trip supervision failure function signal to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8). Setting choice: 1 assigns the output relay; 0 no assignment.

| CB  <br> Fail $: 8765432$ <br> 0001010  <br>   <br> CB $: 8765432$ <br> Close 0100010 <br>   <br> tAux1 $: 8765432$ <br>  1100010 |
| :--- | ---: |

Assigning circuit breaker failure function timer signal (tBF) to the output relays; i.e. to output 3 \& 5 (RL3 \& RL5). Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning circuit breaker closing order signal to the output relays; i.e. to output 3 \& 7 (RL3 \& RL7).
Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning delayed auxiliary input Aux 1 to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8).

Setting choice: 1 assigns the output relay; 0 no assignment.

| tAau2 | $: 8765432$ |
| ---: | ---: |
|  | 1100010 |


| tAUX3 | $: 8765432$ <br> 0000010 |
| :--- | ---: |
|  |  |
| t AUX4 | $: 8765432$ <br> 0000010 |
|  |  |
| 79 Run | $: 8765432$ |
|  | 1100010 |
|  |  |
| 79 Trip | $: 8765432$ |
|  | 1100010 |
|  |  |
| SOTF | $: 8765432$ |
|  | 0000010 |


| tAUX3 | 8765432 <br> 0000010 |
| :--- | ---: |
|  |  |
| t AUX4 | $: 8765432$ <br> 0000010 |
|  |  |
| 79 Run | $: 8765432$ |
|  | 1100010 |
|  |  |
| 79 Trip | $: 8765432$ |
|  | 1100010 |
|  |  |
| SOTF | $: 8765432$ |
|  | 0000010 |



| CONTROL | :8765432 |
| :--- | ---: |
| CLOSE | 0000010 |


| Active | $: 8765432$ |
| :--- | ---: |
| Group | 0000010 |

Assigning trip threshold for residual overvoltage to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8). Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning Broken Conductor alarm signal to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8). Setting choice: 1 assigns the output relay; 0 no assignment.

Assigning circuit breaker alarm function signal (CB Open NB, ©Amps(n), CB Open Time and CB Close Time) to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8). Setting choice: 1 assigns the output relay; 0 no assignment.

Assigning delayed auxiliary input Aux 2 to the output relays; i.e. to output 3,7 \& 8 (RL3, RL7 \& RL8).

Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning delayed auxiliary input Aux 3 to the output relays; i.e. to output 3 (RL3).

Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning delayed auxiliary input Aux 4 to the output relays; i.e. to output 3 (RL3).

Setting choice: 1 assigns the output relay; 0 no assignment.

Assigning the "autoreclose in progress" information to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8). Setting choice: 1 assigns the output relay; 0 no assignment.

Assigning the autoreclose final trip signal to the output relays; i.e. to output 3, 7 \& 8 (RL3, RL7 \& RL8). Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning the SOTF functionality to the output relays; i.e. to output 3 (RL3). When the tSOTF is expired the assigned relay works. Setting choice 1 assigns the output relay, 0 none assignment.

Assigning the Control Trip command to the output relays; i.e. to output 3 (RL3).

Setting choice 1 assigns the output relay; 0 none assignment.

Assigning the Control Close command to the output relays; i.e. to output 3 (RL3).

Setting choice: 1 assigns the output relay; 0 no assignment.
Assigning the active setting group to the output relays; i.e. to output 3 (RL3).
Setting choice: 1 assigns the output relay; 0 no assignment.

| t EQU.A | $\begin{array}{r} 8765432 \\ 1000000 \end{array}$ | Assigning the logic AND equation A result trip signal to the output relays; i.e. to output 8 (RL8). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| :---: | :---: | :---: |
| t EQU.B | $\begin{array}{r} 8765432 \\ 1000000 \end{array}$ | Assigning the logic AND equation B result trip signal to the output relays; i.e. to output 8 (RL8). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| t EQU.C: | $\begin{aligned} & 8765432 \\ & 1000000 \end{aligned}$ | Assigning the logic AND equation $C$ result trip signal to the output relays; i.e. to output 8 (RL8). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| t EQU.D: | $\begin{aligned} & \hline 8765432 \\ & 1000000 \end{aligned}$ | Assigning the logic AND equation D result trip signal to the output relays; i.e. to output 8 (RL8). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |

### 4.7.5.2.1 Additional Output Relay Menu Points for P127

| U> | $\begin{array}{r} 8765432 \\ 0100010 \end{array}$ | Assigning first alarm threshold for overvoltage ( $U>$ ) to the output relays; i.e. to output 3 \& 7 (RL3 \& RL7). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| :---: | :---: | :---: |
| tU> | $\begin{array}{r} 8765432 \\ 0000010 \end{array}$ | Assigning first trip threshold for overvoltage ( $\mathrm{tU}>$ ) to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| U>> | $\begin{array}{r} 8765432 \\ 0100010 \end{array}$ | Assigning second alarm threshold for overvoltage (U>>) to output relays; i.e. to output 3 \& 7 (RL3 \& RL7). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| tU>> | $\begin{array}{r} 8765432 \\ 0000010 \end{array}$ | Assigning second trip threshold for overvoltage (tU>>) to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| $U_{<}$ | $\begin{array}{r} 8765432 \\ 0100010 \end{array}$ | Assigning first alarm threshold for undervoltage ( $\mathrm{U}<$ ) to the output relays; i.e. to output 3 \& 7 (RL3 \& RL7). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| tU< | $\begin{array}{r} \hline 8765432 \\ 0000010 \end{array}$ | Assigning of the first trip threshold for undervoltage ( $\mathrm{t} \mathbf{U}$ ) to the output relays; i.e. output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| U<< | $\begin{array}{r} 8765432 \\ 0100010 \end{array}$ | Assigning second alarm threshold for undervoltage ( $\mathrm{U} \ll$ ) to the output relays; i.e. to output 3 \& 7 (RL3 \& RL7). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |
| tU<< | $\begin{array}{r} 8765432 \\ 0000010 \end{array}$ | Assigning second trip threshold for undervoltage (tU<<) to the output relays; i.e. to output 3 (RL3). <br> Setting choice: 1 assigns the output relay; 0 no assignment. |

### 4.7.6 Submenu Inputs

Each relay model has a fixed number of opto-isolated logic inputs.
Logic inputs:

| Model | P125 | P126 | P127 |
| :--- | :---: | :---: | :---: |
| Logic Input | 4 | 7 | 7 |

With the submenu Inputs it is possible to assign a label or an automation function to each logic input (see the following table):

| Label designation | Label description | P125 | P126 | P127 |
| :---: | :---: | :---: | :---: | :---: |
| None | No link/assignment | X | X | X |
| Unlatch | Unlocks latched output relays | X | X | X |
| Blk Log 1 | Blocking logic 1 | X | X | X |
| Blk Log 2 | Blocking logic 2 |  | X | X |
| 52 a | Position of the circuit breaker (open) |  | X | X |
| 52 b | Position of the circuit breaker (close) |  | X | X |
| Aux 1 | Assigning external information to input Aux1 | X | X | X |
| Aux 2 | Assigning external information to input Aux2 | X | X | X |
| Aux 3 | Assigning external information to input Aux3 | X | X | X |
| Aux 4 | Assigning external information to input Aux4 | X | X | X |
| CB FLT | External failure information from the CB |  | X | X |
| $\theta$ Reset | Reset of the thermal state |  | X | X |
| Change set | Change of setting group (default setting group 1) |  | X | X |
| Log Sel 2 | Logic selectivity 2 |  | X | X |
| Log Sel 1 | Logic selectivity 1 |  |  |  |
| Cold L PU | Cold load pick up assignment |  | X | X |
| Strt Dist | Starting of the disturbance recording function |  | X | X |
| Block_79 | Blocking of the autoreclose function [79] |  | X | X |
| Trip Circ | Trip circuit supervision input |  | X | X |
| Start t BF | Start CB fail timer from external input |  | X | X |
| Maint. M | Maintenance Mode ON/OFF change | X | X | X |
| Man. Close | Manual control close CB | X | X | X |
| Local | Local mode condition (if active, any remote operation involving the output relays is forbidden) | X | X | X |

### 4.7.7 Setting auxiliary timers at the end of submenu Inputs



Inputs

## Input 1

## 52a

Input 2

## 52b

Input 3
Aux1
Input 5
Log Sel 1
Input 6
Block_79
Input 7
Cold L PU
 tAux2 200.00 s

## Aux 3 Time tAux $3 \quad 200.00$ s

Heading of AUTOMAT. CTRL menu.
To gain access to the Inputs menu, press $\Theta$ and $(1)$ until the submenu is reached.

Heading of Inputs submenu. To navigate within submenu points, press $\otimes \otimes$. To modify setting, press $\Theta$. Use $\otimes \Leftrightarrow \otimes$ to scroll and set available selections. Press $\Theta$ to confirm choice.

Assigning label 52a to logic input 1. To modify see above windows.

Assigning label 52b to logic input 2. To modify see above windows.

Assigning label Aux1 to logic input 3. To modify see above windows.

Assigning label Log Sel 1 to logic input 5. To modify see above windows.

Assigning label Block_79 to logic input 6. To modify see above windows.

Assigning label Cold L PU to logic input 7. To modify see above windows.

Displays setting value of timer assigned to logic input Aux1. The setting range for tAux1 is from 0 ms to 200 s , in steps of 10 ms .

Displays setting value of timer assigned to input Aux2. The setting range for tAux2 is from 0 ms to 200 s , in steps of 10 ms .

Displays setting value of timer assigned to logic input Aux 3. The setting range for tAux3 is from 0 ms to 200 s , in steps of 10 ms .


Displays setting value of timer assigned to input Aux4. The setting range for tAux 4 is from 0 ms to 200 s , in steps of 10 ms .

### 4.7.8 Submenu Broken Conductor (P126 \& P127)

| AUTOMAT. CTRL | Heading of AUTOMAT. CTRL menu. To gain access to the Broken Conductor detector menu, press $\Leftrightarrow$ and $(1)$ until the submenu is reached. |
| :---: | :---: |
| Broken Conductor | Heading of Broken Conductor detector submenu. To navigate within submenu points, press $\otimes \Leftrightarrow$. To modify setting, press $\Theta$. Use $\otimes \Leftrightarrow \otimes\rangle$ to scroll and set available selections. Press $\Theta$ to confirm choice. |
| Brkn. Cond ? No | Selection of the Broken Conductor function. <br> Setting choice: Yes, No <br> If Yes is selected, the following menu is displayed: <br> If No is selected, the Broken Conductor function is inactive. |
| Brkn.Cond Time tBC $\quad 14400 \mathrm{~s}$ | Displays delay timer setting ( tBC ) for the Broken Conductor function. <br> The setting range for tBC is from 0 to 14400 s, in steps of 1 s . |
| Ratio I2/11 20 \% | Displays value, in percent, for the Broken Conductor threshold. This threshold is the ratio between negative and positive phase sequence current. <br> Setting range is from 20 to $100 \%$ by, in steps of $1 \%$. |

### 4.7.9 Submenu Cold Load PU (P126 \& P127)

The Cold Load PU submenu allows enabling of the cold load pick-up function and the associated settings.


| $\begin{aligned} & \text { Cold Load PU } \\ & \text { tl2>? } \end{aligned}$ | Assigning the first trip threshold for negative sequence overcurrent (I2>) to cold load pick up function. <br> Setting choice: Yes, No |
| :---: | :---: |
| $\begin{aligned} & \text { Cold Load PU } \\ & \text { t12>>? } \\ & \hline \end{aligned}$ | Assigning the second trip threshold for negative sequence overcurrent (l2>>) to cold load pick up function. <br> Setting choice: Yes, No |
| $\begin{aligned} & \text { Cold Load PU } \\ & \text { tl2>>>? } \end{aligned}$ | Assigning the third trip threshold for negative sequence overcurrent (l2>>>) to cold load pick up function. <br> Setting choice: Yes, No |
| Cold Load PU tTherm>? <br> No | Assigning the trip threshold for thermal overload (tTherm>?) to cold load pick up function. <br> Setting choice: Yes, No |
| Cold Load PU <br> Level $200 \%$ | Displays scaling value, in percent, for the cold load pick up assigned to the selected thresholds. <br> Setting range is from $100 \%$ to $500 \%$, in steps of $1 \%$. |
| $\begin{aligned} & \text { Cold Load PU } \\ & \text { tCL } \quad 3600.0 \mathrm{~s} \end{aligned}$ | Displays delay timer setting (tCL) for the Cold Load Pick-up function. <br> Setting range is from 0.1 to 3600 s , in steps of 100 ms . |

4.7.10 Submenu 51V and VTS control (Overcurrent controlled by voltage transformer control (P127))

| 51V | Heading of 51V submenu. <br> To navigate within submenu points, press $\otimes \Theta$. To modify setting, press $\oplus$. Use $\otimes \otimes \bigotimes(1)$ to scroll and set available selections. Press 5 to confirm choice. |
| :---: | :---: |
| $(\mathrm{U}<\mathrm{OR} \mathrm{~V} 2>) \& \mid \gg ?$ <br> No | Enable or disable the control of the start of the l>> by $U<$ and $\mathrm{V} 2>$ stages value. <br> Setting choice: Yes, No |
| V2>? 130V | Assigning the V2> threshold value for the inverse voltage 47 for the l>> control. <br> Select from 3 V to 200 V by step of 0.1 V . |
| $\begin{gathered} (\mathrm{U} \ll \text { OR V2>>) \& l>>>? } \\ \text { No } \end{gathered}$ | Enable or disable the control of the start of the l>>> by $U \ll$ and $\mathrm{V} 2 \gg$ stages value. <br> Setting choice: Yes, No |
| V2>>? 130V | Assigning the V2>> threshold value for the inverse voltage 47 for the l>>> control. <br> Select from 3V to 200 V by step of 0.1 V . |
| VTS Blocks 51V? <br> No | The VTS function can block the 51 V function. Setting choice: Yes, No |
| VTS Alarm? No | Assigning the first trip threshold for negative sequence overcurrent (I2>) to cold load pick up function. Setting choice: Yes, No |

### 4.7.11 Submenu Circuit Breaker Fail (P126 \& P127)

With the CB Fail submenu circuit breaker failure can be detected and associated parameters can be set. This protection feature is only available for P126 \& P127 relays.

4.7.12 Submenu Circuit Breaker Supervision (P126 \& P127)

With the CB Supervision submenu circuit breakers can be supervised and monitored, and associated parameters can be set.


| CB Close Time $0.05 \mathrm{~s}$ | Displays monitoring time for CB close operations. Setting range from 0.050 to 1.0 s , in steps of 10 ms . |
| :---: | :---: |
| CB Open Alarm ? <br> No | Selection of the monitor function for maximum count of $C B$ operations. <br> Setting choice: Yes, No <br> If Yes is selected, the following window is displayed: <br> If No is selected, the next window is $\Sigma \operatorname{Amps}(\mathrm{n})$. |
| CB Open NB 0 | Displays alarm threshold for CB open count. Setting range is from 0 to 50000, in steps of 1. |
| EAmps(n) ? No | Selection of the monitoring function that continuously sums the current (in Amps or square Amps) interrupted by the CB. <br> Setting choice: Yes, No <br> If Yes is selected, the following window is displayed: <br> If No is selected, the next window is tOpen Pulse. |
| זAmps(n) 0 E6 | Displays alarm threshold for the summation of the current (in Amps or square Amps) interrupted by the CB. Setting range is from 0 to 4000 E6 A (or A ${ }^{2}$ ), in steps of 1 E6. $(E 6=106)$ |
| n 1 | Displays the exponent for the summation (IA or $I^{2} A^{2}$ ). Setting choice for n : 1 or 2 |

The below two settings are also available in the P125 for the Local/remote functionality

| tOpen Pulse |  |
| :--- | :--- |
|  | 1.00 s |

Displays and sets the tripping pulse time.
Setting range is from 0.1 to 5 s , in steps of 10 ms .


Displays and sets the closing pulse time. This time is also associated to the during of the closing pulse time of the autoreclose function after dead time in case of lacking of the 52a signal the closing control stays for the setting value. Setting range is from 0.1 to 5 s , in steps of 10 ms .
4.7.13 Submenu SOTF (Switch on to fault) (P126 \& P127)

## AUTOMAT. CTRL

Heading of AUTOMAT. CTRL menu.
To gain access to the SOTF-menu, press $\Leftrightarrow$ and $(>)$ until the submenu is reached.


Heading of SOTF sub menu. To navigate within submenu points, press $\otimes \otimes$. To modify setting, press $\Theta$. Use $\otimes \otimes \otimes(1)$ to scroll and set available selections. Press $\oplus$ to confirm choice.


Selection of the Sotf function. Setting choice: Yes, No If Yes is selected, the following menu is displayed: If No is selected, the Sotf sub menu is inactive.


Displays the delay timer setting (tSotf) for Sotf function. The setting range for tSotf is from 0 to 500 ms , in steps of 10 ms .


Selection if the Sotf function is triggered from l>>. Setting choice: Yes, No

## l>>>?

No

Selection if the Sotf function is triggered from l>>>. Setting choice: Yes, No

### 4.7.13.1 Submenu AND Logic Equat (P126 \& P127)



Assigning first alarm threshold for phase OC (l>) to one (or more) of the logic equations $A, B, C$ and $D$.
Setting choice: 1 assigns the logic equation; 0 no assignment.

Assigning first trip threshold for phase $\mathrm{OC}(\mathrm{tl}>)$ to one (or more) of the logic equations $A, B, C$ and $D$.
Setting choice: 1 assigns the logic equation; 0 no assignment.

| $l \gg$ | :DCBA |
| ---: | ---: |
|  | 0000 |

Assigning second alarm threshold for phase OC (l>>) to one (or more) of the logic equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D . Setting choice: 1 assigns the logic equation; 0 no assignment.


Assigning second trip threshold for phase OC (tl>>) to one (or more) of the logic equations $A, B, C$ and $D$. Setting choice: 1 assigns the logic equation; 0 no assignment.
Assigning third alarm threshold for phase OC (l>>>) to one (or more) of the logic equations $A, B, C$ and $D$.
Setting choice: 1 assigns the logic equation; 0 no assignment.
Assigning third trip threshold for phase OC (tl>>>) to one (or more) of the logic equations $A, B, C$ and $D$.
Setting choice: 1 assigns the logic equation; 0 no assignment.
Assigning first alarm threshold for earth fault overcurrent (le>) to one (or more) of the logic equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D . Setting choice: 1 assigns the logic equation; 0 no assignment.

| tle> | :DCBA <br> 0000 |
| :--- | ---: |
|  |  |
| le>> | :DCBA <br> 0000 |

Assigning first trip threshold for earth fault overcurrent (tle>) to one (or more) of the logic equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D . Setting choice: 1 assigns the logic equation; 0 no assignment.
Assigning second alarm threshold for earth fault overcurrent (le>>) to one (or more) of the logic equations A, B, C and D. Setting choice: 1 assigns the logic equation; 0 no assignment.


Assigning second trip threshold for earth fault overcurrent (tle>>) to one (or more) of the logic equations A, B, C and D.

Setting choice: 1 assigns the logic equation; 0 no assignment.

| $l e \ggg$ | :DCBA |
| :--- | ---: |
|  | 0000 |

Assigning third alarm threshold for earth fault overcurrent (le>>>) to one (or more) of the logic equations A, B, C and D.

Setting choice: 1 assigns the logic equation; 0 no assignment.

| t le>>> | $\begin{array}{r} \hline \text { :DCBA } \\ 0000 \end{array}$ | Assigning third trip threshold for earth fault overcurrent (tle>>>) to one (or more) of the logic equations A, B, C and D. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| :---: | :---: | :---: |
| Pe leCos> | $\begin{array}{r} \hline \text { DCBA } \\ 0000 \\ \hline \end{array}$ | Assigning first earth wattmetric alarm threshold ( $\mathrm{Pe} / \mathrm{leCos}>$ ) to one (or more) of the logic equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D . <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| tPe/ leCos> | $\begin{array}{r} \hline \text { DCBA } \\ 0000 \\ \hline \end{array}$ | Assigning first earth wattmetric trip threshold (tPe/leCos>) to one (or more) of the equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D . Setting choice: 1 assigns the logic equation; 0 no assignment. |
| Pe/ leCos>> | $\begin{array}{r} \hline \text { DCBA } \\ \hline 0000 \\ \hline \end{array}$ | Assigning second earth wattmetric alarm threshold (Pe/leCos>>) to one (or more) of the equations A, B, C and D. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| tPe/ leCos>> | $\begin{array}{r} \hline \text { DCBA } \\ 0000 \\ \hline \end{array}$ | Assigning second earth wattmetric trip threshold (tPe/leCos>>) to one (or more) of the equations A, B, C and D. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| 12> | $\begin{array}{r} \hline \text { DCBA } \\ 0000 \\ \hline \end{array}$ | Assigning first alarm threshold for negative sequence overcurrent (I2>) to one (or more) of the equations A, B, C and D . <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| t12> | $\begin{array}{r} \hline \text { DCBA } \\ 0000 \\ \hline \end{array}$ | Assigning of the first trip threshold for negative sequence overcurrent (tl2>) to one (or more) of the equations A, B, C and D . <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| 12>> | $\begin{array}{r} \hline \text { DCBA } \\ 0000 \\ \hline \end{array}$ | Assigning second alarm threshold for negative sequence overcurrent (I2>>) to one (or more) of the equations A, B, C and $D$. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| t12>> | $\begin{array}{r} \hline \text { DCBA } \\ 0000 \end{array}$ | Assigning second trip threshold for negative sequence overcurrent (tl2>>) to one (or more) of the equations A, B, C and D . <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| 12>>> | $\begin{array}{r} \hline \text { DCBA } \\ 0000 \\ \hline \end{array}$ | Assigning third alarm threshold for negative sequence overcurrent (l2>>>) to one (or more) of the equations $A, B$, C and D. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| t12>>> | $\begin{array}{r} \hline \text { :DCBA } \\ 0000 \\ \hline \end{array}$ | Assigning third trip threshold for negative sequence overcurrent (tl2>>>) to one (or more) of the equations A, B, C and D. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| Therm Alarm | $\begin{aligned} & \hline \text { :DCBA } \\ & 0000 \end{aligned}$ | Assigning thermal alarm to one (or more) of the equations A, B, C and D. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |


| Therm Trip | $\begin{array}{r} \text { :DCBA } \\ 0000 \end{array}$ | Assigning threshold for thermal overload trip to one (or more) of the equations $A, B, C$ and $D$ <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| :---: | :---: | :---: |
| Brkn Cond | $\begin{array}{r} \text { :DCBA } \\ 0000 \end{array}$ | Assigning Broken Conductor alarm signal to one (or more) of the equations $A, B, C$ and $D$. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| I< | $\begin{array}{r} \text { :DCBA } \\ 0000 \end{array}$ | Assigning alarm threshold for undercurrent ( $\mathrm{l}<$ ) to one (or more) of the equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D . <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| tl< | $\begin{array}{r} \text { :DCBA } \\ 0000 \end{array}$ | Assigning trip threshold for undercurrent ( $\mathrm{tl}<$ ) to one (or more) of the equations $A, B, C$ and $D$. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| 79 Trip | $\begin{array}{r} \text { :DCBA } \\ 0000 \end{array}$ | Assigning the autoreclose final trip signal (79 Trip) to one (or more) of the equations A, B, C and D. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| Ue>>>> | $\begin{array}{r} \hline \text { DCBA } \\ 0000 \end{array}$ | Assigning alarm threshold for residual overvoltage (Ue>>>>) to one (or more) of the equations A, B, C and D. Setting choice: 1 assigns the logic equation; 0 no assignment. |
| tUe>>>> | $\begin{array}{r} \text { :DCBA } \\ 0000 \\ \hline \end{array}$ | Assigning trip threshold for residual overvoltage (Ute>>>>) to one (or more) of the equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D . Setting choice: 1 assigns the logic equation; 0 no assignment. |
| tBF | $\begin{array}{r} \text { :DCBA } \\ 0000 \end{array}$ | Assigning circuit breaker failure function timer signal (tBF) to one (or more) of the equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D . Setting choice: 1 assigns the logic equation; 0 no assignment. |
| tAux1 | $\begin{array}{r} \text { :DCBA } \\ 0000 \end{array}$ | Assigning delayed auxiliary input Aux 1 to one (or more) of the equations $A, B, C$ and $D$. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| tAux2 | $\begin{array}{r} \text { :DCBA } \\ 0000 \end{array}$ | Assigning delayed auxiliary input Aux 2 to one (or more) of the equations $A, B, C$ and $D$. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| tAux3 | $\begin{array}{r} \text { :DCBA } \\ 0000 \end{array}$ | Assigning delayed auxiliary input Aux 3 to one (or more) of the equations $A, B, C$ and $D$. <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |
| tAux4 | $\begin{array}{r} \text { :DCBA } \\ 0000 \end{array}$ | Assigning delayed auxiliary input Aux 4 to one (or more) of the equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D . <br> Setting choice: 1 assigns the logic equation; 0 no assignment. |

### 4.7.13.2 Additional AND Logic Submenu Points for P127

| $U>$ | $:$ DCBA |
| :--- | ---: |
| 0000 |  |

Assigning first alarm threshold for overvoltage (U>) to one (or more) of the equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D .
Setting choice: 1 assigns the logic equation; 0 no assignment.

| tU> | :DCBA <br> 0000 |
| :--- | :---: |
| $U \gg$ |  |
|  | :DCBA |
| 0000 |  |

Assigning first trip threshold for overvoltage (tU>) to one (or more) of the equations $A, B, C$ and $D$.
Setting choice: 1 assigns the logic equation; 0 no assignment.
Assigning second alarm threshold for overvoltage (U>>) to one (or more) of the equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D .
Setting choice: 1 assigns the logic equation; 0 no assignment.

| $t U \gg$ | :DCBA <br> 0000 |
| :--- | :---: |
| $U<$ | :DCBA |
|  | 0000 |

Assigning second trip threshold for overvoltage (tU>>) to one (or more) of the equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D .
Setting choice: 1 assigns the logic equation; 0 no assignment.
Assigning first alarm threshold for undervoltage $(\mathrm{U}<)$ to one (or more) of the equations $A, B, C$ and $D$.
Setting choice: 1 assigns the logic equation; 0 no assignment.

| $\mathbf{t} \mathbf{U}<$ | :DCBA |
| :---: | :---: |
|  | 0000 |

Assigning first trip threshold for undervoltage ( $\mathrm{t} \mathrm{U}<$ ) to one (or more) of the equations $A, B, C$ and $D$.
Setting choice: 1 assigns the logic equation; 0 no assignment.

| $U \ll$ | :DCBA |
| :---: | :---: |
|  | 0000 |

Assigning second alarm threshold for undervoltage $(\mathrm{U} \ll)$ to one (or more) of the equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D .
Setting choice: 1 assigns the logic equation; 0 no assignment.

| $\mathbf{t} \mathbf{U} \ll \quad$:DCBA <br> 0000 |
| :---: | :---: | Assigning second trip threshold for undervoltage ( $\mathrm{t} \mathrm{U} \ll$ ) to one (or more) of the equations $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D .

Setting choice: 1 assigns the logic equation; 0 no assignment.

### 4.7.13.3 Submenu AND Logic Equat. T Delay

| AUTOMAT. CTRL | Heading of AUTOMAT. CTRL menu. To gain access to the AND logic equat submenu, press $\Theta$ and $(1)$ until the submenu is reached. |
| :---: | :---: |
| AND logic equat T delay | Heading of submenu. <br> To navigate within submenu points, press $\otimes \otimes$. To modify setting, press $\Theta$. Use $\Delta \otimes \theta\left(\begin{array}{l}\text { B }\end{array}\right.$ to scroll and set available selections. Press $\oplus$ to confirm choice. |
| EQU. A Toperat 600.00 s | Displays setting value of operating delay time (Toperat) for logic equation $A$. <br> Setting range is from 0 to 600s, in steps of 10 ms . |
| EQU. A Treset 600.00 s | Displays setting value of reset delay time (Treset) for logic equation $A$. <br> Setting range is from 0 to 600 s , in steps of 10 ms . |
| EQU. B Toperat 600.00 s | Displays setting value of operating delay time (Toperat) for logic equation B. <br> Setting range is from 0 to 600s, in steps of 10 ms . |
| EQU. B Treset 600.00 s | Displays setting value of reset delay time (Treset) for logic equation $B$. <br> Setting range is from 0 to 600s, in steps of 10 ms . |
| EQU. C Toperat 600.00 s | Displays setting value of operating delay time (Toperat) for logic equation C . <br> Setting range is from 0 to 600s, in steps of 10 ms . |
| $\begin{array}{ll}\text { EQU. C } & \text { Treset } \\ & 600.00 \mathrm{~s}\end{array}$ | Displays setting value of reset delay time (Treset) for logic equation C. <br> Setting range: from 0 to 600s, in steps of 10 ms . |
| EQU. D Toperat 600.00 s | Displays setting value of operating delay time (Toperat) for logic equation D. <br> Setting range: from 0 to 600 s , in steps of 10 ms . |
| EQU. D Treset 600.00 s | Displays setting value of reset delay time (Treset) for logic equation D. <br> Setting range: from 0 to 600 s , in steps of 10 ms . |

### 4.8 Menu RECORDS (P126 \& P127)

With the RECORDS menu stored data, events, disturbances and monitoring signals from various submenus can be displayed and read:

- CB Monitoring
- Fault record
- Istantaneous record
- Disturbance record
- Time peak value
- Rolling Demand


### 4.8.1 Submenu CB Monitoring (P126 \& P127)

With the CB Monitoring submenu it is possible to read and clear counter values associated with the circuit breaker.

| RECORD | Heading the RECORD menu. |
| :---: | :---: |
| CB Monitoring | Heading the CB Monitoring submenu. To gain access to the submenu points, press $\Theta$. |
| CB Opening Time 0.05 s | Displays the circuit breaker opening time. |
| CB Closing Time 0.05 s | Displays the circuit breaker closing time. |
| CB Operations $\text { RST }=[C]$ | Displays the number of opening commands executed by the circuit breaker. To clear these values, press ©. |
| $\begin{aligned} & \text { E Amps (n) } \\ & \text { RST }=[C] \\ & \hline \end{aligned}$ | Displays the summation of the current (in Amps or square Amps) interrupted by the CB. Stored current values for all 3 phases are cleared together. To clear these values, press ©. |
| $\begin{array}{\|ll} \hline \text { I Amps (n) IA } & \\ & 2 \text { E04 } \end{array}$ | Displays the summation value of the current (in Amps or square Amps) for phase A interrupted by the circuit breaker. |
| $\begin{array}{\|cc\|} \hline \Sigma \text { Amps (n) IB } & \\ & 2 \text { E04 } \\ \hline \end{array}$ | Displays the summation value of the current (in Amps or square Amps) for phase B interrupted by the circuit breaker. |
| $\begin{array}{\|ll} \hline \text { Amps (n) IC } \\ 2 \text { E04 } \end{array}$ | Displays the summation value of the current (in Amps or square Amps) for phase C interrupted by the circuit breaker |

### 4.8.1.1 Submenu Fault Record for P126 \& P127

The Fault Record submenu makes it possible to read up to five stored fault records, that occurred when programmed thresholds where exceeded.

The fault records are generated by the operation of trip relay RL1.
NOTE: All measurement magnitude values refer to the transformer primary side.

| Record Number |
| :--- | :--- |

Heading of RECORD menu.

Heading of Fault Record submenu To gain access to the submenu points, press $\Theta$.

Selection of the Fault Record number 5 to be displayed (selection: 1, 2, 3, 4 or 5). To modify this fault record number, press © then using $\otimes$ the required number is entered. Press $\oplus$ to confirm choice.

| Fault Time |  |
| :--- | :--- |
|  | 13:05:23 |
|  |  |
| Fault Date |  |
|  | $12 / 11 / 01$ |



Displays the time when the fault was recorded. The format of the time is hh:mm:ss.
In this example the fault was recorded at 1:05:23 pm.
Displays the date when the fault was recorded. The format of the Date is DD/MM/YY.
In this example, the fault was recorded on November 12th 2001.

Displays the active setting group (1 or 2).

Displays the phase, where a fault occurred, for the chosen fault record. (NONE, PHASE A, B, C, EARTH)

Displays the origin of the fault that generated the trip order. Common for P126 \& P127 are:
tle>, tle>>, tle>>>, tPe/leCos>, tPe/leCos>>, Trip tUe>>>>, tl>, tl>>, tl>>>, tl<, tl2>, t|2>>, tl2>>>, Thermal $\theta$, Brkn. Cond, tAux 1, tAux 2, tAux 3, tAux 4, EQU A, EQU B, EQU C, EQU D
Only valid for P127:
$t U>, t U \gg, t U<, t U \ll$

| Magnitude |  |
| :--- | :--- |
|  |  |

## IA Magnitude

1200 A
IB Magnitude 1200 A

Displays the magnitude value of the fault: Voltage, current, earth power. The value is based on the amplitude at 50 or 60 Hz .
Displays the magnitude value of the phase A current at the time of the fault.

Displays the magnitude value of the phase $B$ current at the time of the fault.

Displays the magnitude value of the phase $C$ current at the time of the fault.

Displays the magnitude value of the earth current at the time of the fault.

Only P127
Displays the magnitude value of the phase $A$ to phase $B$ voltage at the time of the fault.

## VBC Magnitude

10 KV

Only P127
Displays the magnitude value of the phase $B$ to phase $C$ voltage at the time of the fault.


Only P127
Displays the magnitude value of the phase $C$ to phase $A$ voltage at the time of the fault.

Displays the magnitude value of the residual voltage at the time of the fault.

Only P127
Displays the angle between phase A current and phase B to phase $C$ voltage at the time of the fault. The indication is $---{ }^{\circ}$ if the angle cannot be measured.

Only P127
Displays the angle between phase B current and phase C to phase A voltage at the time of the fault. The indication is ----ㅇ if the angle cannot be measured.

Only P127
Displays the angle between phase C current and phase A to phase B voltage at the time of the fault. The indication is $---^{\circ}$ if the angle cannot be measured.
Displays the angle between earth current and voltage at the time of the fault.
The indication is $---{ }^{\circ}$ if the angle cannot be measured.

### 4.8.1.2 INSTANTANEOUS sub-menu available in the P126 \& P127

The instantaneous sub-menu makes possible to read the various parameters for each of the last five starting information.

NOTE: All measurement magnitude values refer to the transformer primary side.


### 4.8.2 Submenu Disturb Record

The Disturb Record submenu makes it possible to open and read up to 4 disturbance records of 3 seconds each. Each disturbance record consists of analogue and digital data.

| RECORD | Heading of RECORD menu. |
| :---: | :---: |
| Disturb Record | Heading of Disturb Record submenu. To gain access to the submenu points, press $\Theta$. |
| Pre-Time 0.2 s | Selection of the disturbance record pre-time. Select from 100 ms to 3 s in steps of 100 ms by using $\Theta$. Press $\Theta$ to confirm choice. |
| Post-Time 0.2 s | Selection of the disturbance record post-time. Select from 100 ms to 3 s in steps of 100 ms by using $\Theta$. Press $\Theta$ to confirm choice. |

## WARNING : THE TOTAL DISTURBANCE RECORDING TIME IS 3 SECONDS (PRE TIME + POST TIME).



Selection of start criteria for the disturbance recording function. Select between ON INST. (start on instantaneous thresholds) and ON TRIP (start on trip conditions) by pressing $\Leftrightarrow$ or $\otimes$. Press $\Theta$ to confirm choice.

### 4.8.2.1 Submenu Time Peak Value

The Time Peak Value submenu makes it possible to set parameters associated to this function. (Peak and average values displayed in the Measurements menu).

| RECORD | Heading of RECORD menu. |
| :---: | :---: |
| Time Peak Value | Heading of Time Peak Value submenu. To gain access to the submenu points, press $\Theta$. |
| Time Window $5 \mathrm{mn}$ | Selection of the time window during which peak and average values are stored. To select the time window between $5 \mathrm{mn}, 10 \mathrm{mn}, 15 \mathrm{mn}, 30 \mathrm{mn}$, or 60 mn press $\oplus$ and then $\Theta$ or $\otimes$. <br> Press $\oplus$ to confirm choice. |

### 4.8.2.2 ROLLING DEMAND sub-menu

The Rolling Demand sub-menu makes possible to set the rolling sub-period and the number of the sub-period for the calculation of the 3 phase Rolling Average and peak demand values, available in the Measurement menu.

| RECORD | Heading of RECORDS |
| :---: | :---: |
| Rolling Demand | Rolling Demand Heading of the Rolling Demand sub-menu. To gain access to the sub-menu points, press $\Theta$. |
| Sub Period 1 mn | Selection of the width of the sub-period during the rolling average values are calculated. Select from 1 mn to 60 mn in steps of 1 mn using $\Theta$ or $\otimes$ and validate your choice using $\Theta$. |
| Num of Sub Per | Selection of number of sub-period for the calculation of the average of these average values.. Select from 1 to 24 in steps of 1 using $\Theta$ or $\otimes$ and validate your choice using $\Theta$ |
| 1 |  |

## 5. WIRING

The MiCOM P125, P126 \& P127 relays have the same terminal layout for common elements. The wiring diagram for each model is provided in Appendix 1 of the Technical Guide.

### 5.1 Auxiliary Power Supply

The auxiliary power supply for the MiCOM P125, P126 \& P127 relays can be either direct current with a voltage range of 24-60 VDC, 48-150 VDC, 130-250 VDC, or alternating current with a voltage of $110-250 \mathrm{VAC} / 50-60 \mathrm{~Hz}$. The voltage range (Ua) is specified on the adhesive paper label under the top hinged cover on the front of the relay.

The auxiliary power supply must only be connected to terminals 33 and 34.

### 5.2 Current Measurement Inputs

The MiCOM P125, P126 \& P127 relays comprise up to eight current inputs (2 times 4 earth and phase current inputs).

The nominal current value of the measuring inputs is either 1 Ampere or 5 Ampere (refer to wiring diagram). For the same relay, the user can mix the 1 and 5 Ampere inputs between phases and earth.

NOTE: All phase inputs must have the same rating (1 or 5 Amps ).

### 5.3 Logic Inputs

The number of logic inputs depends on the relay model. The relays have programmable opto-isolated logic inputs, which may be assigned to any available label or function.

Logic inputs for each relay model:

| Model | P125 | P126 | P127 |
| :--- | :---: | :---: | :---: |
| Logic outputs | 4 | 7 | 7 |

The voltage range of the inputs is identical to the DC auxiliary supply range of the MiCOM relay (e.g. Ua $=48-150$ VDC, logic input voltage range $=48-150$ VDC).

On the same MiCOM P12x relay, the user can mix different voltage levels for the logic inputs (e.g. Ua $=48-150 \mathrm{VDC}$, logic input $1=48 \mathrm{VDC}$, logic inputs 2 to $5=110$ VDC).

If the user set the supply of the logic input in AC way, they are active from 24 to 220 Vac .
The automation operations and signalling functions to which these logic inputs respond can be selected from the AUTOMAT. CTRL. menu.

### 5.4 Output Relays

The number of logic outputs depends on the relay model. The relays have configurable logic outputs, which may be assigned to any available function.

The normally closed (NC) contact of the Watchdog (RLO) is not configurable. The other contacts are configurable to functions available in the relay. A basic output matrix is included in the relay. Some logic outputs have changeover contacts.

Logic outputs for each relay model:

| Model | P125 | P126 | P127 |
| :--- | :---: | :---: | :---: |
| Logic outputs | 6 | 8 | 8 |

The first logic output (RLO) is allocated to signalling a relay fault (Watchdog, WD) and is not counted in the above table .

### 5.5 Communication

5.5.1 RS485 Rear Communication Port

All MiCOM relays have a RS485 rear communication port.
The terminals 29-30-31-32 are dedicated to the RS485 communication port. See wiring diagrams in chapter P12y/EN CO of the Technical Guide.
5.5.2 RS232 Front Communication Port

MiCOM P125, P126 \& P127 relays provide the user with a RS232 communication port on the front panel. This link is dedicated to MiCOM setting software.

The cable between the relays and the PC is a standard RS 232 shielded cable.
The relay requires a RS232 cable with a 9-pin male connector.
The wiring of the RS232 cable must be as follows:

| RS232 PC PORT |
| :---: | :---: | :---: | :---: | :---: |
| 9 pin male connector |

FRONT PANEL PORT COMMUNICATION RS232 CABLE WIRING

## BLANK PAGE

## TECHNICAL DATA AND CHARACTERISTIC CURVES

## CONTENT

1. RATINGS ..... 3
$1.1 \quad$ Power Supply ..... 3
1.2 Frequency ..... 3
1.3 Current Inputs ..... 3
$1.4 \quad$ Voltage Inputs ..... 4
1.5 Logic Inputs ..... 4
1.5.1 Supply ..... 4
1.6 Output Relay Characteristic ..... 5
2. HIGH VOLTAGE WITHSTAND ..... 6
3. ELECTRICAL ENVIRONMENT ..... 7
4. ENVIRONMENT ..... 8
5. GENERAL INFORMATION AND DEVIATION OF THE PROTECTION ELEMENTS ..... 9
6. DEVIATION OF AUTOMATION FUNCTIONS TIMERS ..... 11
7. DEVIATION OF MEASUREMENTS ..... 12
8. PROTECTION SETTING RANGES ..... 13
8.1 [67/50/51] Directional/Non-Directional Phase Overcurrent (P127) ..... 13
8.1.1 Synchronous Polarisation ..... 13
8.1.2 Protection Setting Ranges (P127) ..... 13
$8.2 \quad[50 / 51]$ Phase Overcurrent Protection (P126) ..... 14
8.2.1 Protection Setting Ranges (P126) ..... 14
8.3 [67N/50N/51N] Dir./Non-Dir. Earth fault protection (P125, P126 \& P127) ..... 15
8.3.1 Protection Setting Ranges ..... 15
8.4 Earth Wattmetric Protection ..... 17
8.5 Functionality Mode ..... 18
8.5.1 Protection Setting Ranges ..... 18
8.6 Undercurrent Protection (P126 \& P127) ..... 20
8.6.1 Protection Setting Ranges ..... 20
8.7 Negative Sequence Overcurrent Protection (P126 \& P127) ..... 20
8.7.1 Protection Setting Ranges ..... 20
8.8 Thermal Overload Protection (P126 \& P127) ..... 21
8.8.1 Protection Setting Ranges ..... 21
8.9 Undervoltage Protection (P127) ..... 21
8.9.1 Protection Setting Ranges (P127) ..... 21
8.10 Overvoltage Protection (P127) ..... 22
8.10.1 Protection Setting Ranges (P127) ..... 22
8.11 Residual Overvoltage Protection ..... 23
8.11.1 Protection Setting Ranges ..... 23
8.12 Multishot Autoreclose Function (P126 \& P127) ..... 23
8.12.1 Multishot Autoreclose Settings ..... 24
9. AUTOMATION AND ANCILLARY FUNCTIONS ..... 25
$9.1 \quad$ Cold Load Pickup (P126 \& P127) ..... 25
9.2 51V function ..... 25
9.3 Auxiliary Timers (P126 \& P127) ..... 25
9.4 Broken Conductor Detection (P126 \& P127) ..... 26
9.4.1 Broken Conductor Detection Setting Ranges ..... 26
$9.5 \quad$ Circuit Breaker Failure (P126 \& P127) ..... 26
9.5.1 CB Fail Setting Ranges ..... 26
9.6 Trip Circuit Supervision (P126 \& P127) ..... 26
9.6.1 Trip Circuit Supervision Setting Ranges ..... 26
$9.7 \quad$ Circuit Breaker Control and Monitoring (P126 \& P127) ..... 27
9.7.1 Setting Ranges ..... 27
9.8 SOTF/TOR Switch on to fault / Trip on reclose (P126 \& P127) ..... 27
9.8.1 Setting Ranges ..... 27
$9.9 \quad$ AND Logic Equation (P126 \& P127) ..... 27
9.9.1 Timer Setting Ranges ..... 27
10. RECORDING FUNCTIONS (P126 \& P127) ..... 28
10.1 Event Records ..... 28
10.2 Fault Records ..... 28
10.3 Instantaneous recorder ..... 28
10.4 Disturbance Records ..... 28
10.4.1 Triggers; Data; Setting Ranges ..... 28
11. COMMUNICATION ..... 29
12. CURVES ..... 30
12.1 General ..... 30
12.1.1 Inverse Time Curves: ..... 30
12.1.2 Reset Timer ..... 31
12.2 Thermal Overload Curves ..... 32

## 1. RATINGS

### 1.1 Power Supply

| Nominal auxiliary voltage Vx | 24-60Vdc; 48-150Vdc; <br> $130-250 \mathrm{Vdc}$ <br> $100-250 \mathrm{Vac} 50 / 60 \mathrm{~Hz}$ <br> $125-250 \mathrm{Vdc} / 100-250 \mathrm{Vac}$ <br> (special application) |
| :---: | :---: |
| Operating range | $\begin{array}{\|l\|} \hline \mathrm{DC} \pm 20 \% \text { of } \mathrm{Ua} \\ \mathrm{AC}-20 \%,+10 \% \text { of } \mathrm{Ua} \end{array}$ |
| Residual ripple | Up to 12\% |
| Stored energy time | $\geq 50 \mathrm{~ms}$ for interruption of Ua |
| Burden P125 | $\begin{array}{ll}\text { Stand by: } & <3 W \text { DC or }<8 \text { VA AC } \\ \text { Max: } & <5 W \text { DC or }<12 V A \text { AC }\end{array}$ |
| Burden P126 | Stand by: $<3 W$ DC or $<8 V A$ AC <br> Max: $\quad<6 W$ DC or $<14 V A$ AC |
| Burden P127 | Stand by: $<3 W$ DC or $<8$ VA AC <br> Max: $\quad<6 W$ DC or $<14 \mathrm{VA}$ AC |

## $1.2 \quad$ Frequency

| Frequency protection functions | From 45 to 65 Hz |
| :--- | :--- |
| Nominal frequency | $50 / 60 \mathrm{~Hz}$ |

### 1.3 Current Inputs

| Phase current inputs | 1 and 5A by connection |
| :---: | :---: |
| Earth current inputs | 1 and 5A by connection |
| Operating range | Selection by ordering code (Cortec) |
| Burden Phase Current | $\begin{array}{ll} \hline<0.025 \mathrm{VA} & (1 \mathrm{~A}) \\ <0.3 \mathrm{VA} & (5 \mathrm{~A}) \end{array}$ |
| Burden Earth Current | $\begin{array}{ll} \hline<0.008 \mathrm{VA} & (1 \mathrm{~A}) \\ <0.010 \mathrm{VA} & (5 \mathrm{~A}) \end{array}$ |
| Thermal withstand | 1s @ $100 \times$ rated current 2s @ $40 \times$ rated current continuous @ $4 \times$ rated current |

### 1.4 Voltage Inputs

| Voltage input range Un | 57 to 130 V |
| :--- | :--- |
| Operating range | 0 to 260 V (measuring range) |$|$| Besistive $44 \mathrm{k} \Omega:$$0.074 \mathrm{~W} / 57 \mathrm{~V}$ <br> $0.38 \mathrm{~W} / 130 \mathrm{~V}$ <br> $1.54 \mathrm{~W} / 260 \mathrm{~V}$ |  |
| :--- | :--- |
| Burden | $0.1102 \mathrm{~W} / 220 \mathrm{~V}$ <br> $0.525 \mathrm{~W} / 480 \mathrm{~V}$ <br> $2.1 \mathrm{~W} / 960 \mathrm{~V}$ |
| Continuous | 300 V ph-ph |
| 10 seconds | 220 to 480 V |
| Voltage input range | 0 to 960 V (measuring range) |
| Operating range | $438 \mathrm{k} \Omega:$ |
| Burden |  |
| Thermal Withstand | 960 V ph-ph |
| Continuous | 1300 V ph-ph |
| 10 seconds |  |

### 1.5 Logic Inputs

| Logic input type | Independent optically insulated |
| :--- | :--- |
| Logic input burden | $<10 \mathrm{mAmps}$ per input |
| Logic input recognition time | $<5 \mathrm{~ms}$ |

### 1.5.1 Supply

The logic inputs shall be powered with a DC voltage, excepted the $M$ auxiliary voltage range which acccepts both DC and AC voltage as logic input control voltage.

|  |  | Logic input electrical functionality |  |  |
| :--- | :--- | :--- | :--- | :--- |
| Ordering <br> Code <br> (Cortec) | Relay ausiliary power <br> supply range | Auxiliary voltage <br> range for the logic <br> inputs(*) | Minimum <br> polarisation <br> voltage level <br> (Volt) | Minimum <br> polarisation <br> current level <br> (mAmps) |
| A | $24-60 \mathrm{Vdc}$ | $19-60 \mathrm{Vdc}$ | 15 Vdc | 3.35 mA |
| F | $48-150 \mathrm{Vdc}$ | $32-150 \mathrm{Vdc}$ | 25 Vdc | 3.35 mA |
| M | $130-250 \mathrm{Vdc}$ <br> $100-250 \mathrm{Vdc}$ | $48-250 \mathrm{Vdc}$ <br> $48-250 \mathrm{Vac}$ | 38 Vdc <br> 38 Vdc | 2.20 mA <br> 1.90 mA |
| T | $48-150 \mathrm{Vdc}$ <br> Special EA (**) | $32-150 \mathrm{Vdc}$ | 25 Vdc | 3.35 mA |
| U | $130-250 \mathrm{Vdc}$ <br> Special EA (**) | $48-250 \mathrm{Vdc}$ | 38 Vdc | 2.20 mA |
| H | $125-250 \mathrm{Vdc}$ <br> $100-250 \mathrm{Vdc}$ | $105-145 \mathrm{Vdc}$ | 96 Vdc | 1.8 mA |

$\left(^{*}\right)$ The tolerance on the auxiliary voltage variations for the logic inputs is $\pm 20 \%$ in DC voltage and $-20 \%,+10 \%$ in AC voltage.
${ }^{(* *)}$ Logic input recognition time for EA approval. Dedicated filtering on 24 samples ( 15 ms at 50 Hz )

### 1.6 Output Relay Characteristic

| Contact rating |  |
| :--- | :--- |
| Contact relay | Dry contact Ag CdO |
| Make current | Max. 30A and carrry for 3s |
| Carry capacity | 5 A continuous |
| Rated Voltage | 250 Vac |
| Breaking characteristic | 1250 VA resistive <br> 1250 VA inductive (P.F. $=0.5)$ <br> $220 \mathrm{Vac}, 5 \mathrm{~A}(\cos \varphi=0.6)$ |
| Breaking capacity AC | $135 \mathrm{Vdc}, 0.3 \mathrm{~A}(\mathrm{~L} / \mathrm{R}=30 \mathrm{~ms})$ <br>  <br> Breaking capacity DC <br>  <br> Operation time <br> Durability <br> Loaded contact <br> Unloaded contact |

2. HIGH VOLTAGE WITHSTAND

| Dielectric withstand | IEC 60-255-5 | 2 kV common mode <br> 1 kV differential mode |
| :--- | :--- | :--- |
|  |  | 5 kV common mode |
| Impulse voltage | IEC 60-255-5 | 1 kV differential mode |
|  |  | $>1000 \mathrm{M} \Omega$ |

## 3. ELECTRICAL ENVIRONMENT

| High frequency <br> disturbance | IEC 61000-4-1 | 2.5 kV common mode, class 3 <br> 1 kV differential mode, class 3 |
| :--- | :--- | :--- |
| Fast transient | IEC 61000-4-4 | 4 kV auxiliary voltage, class 4 <br>  <br>  <br> ANSI C37.90.1 |
| Electrostatic <br> discharge | IEC $61000-4-2$ | 8 kV , class 4 |

## 4. ENVIRONMENT

| Temperature | IEC 60-255-6 | Storage $-25^{\circ} \mathrm{C}$ to $+70^{\circ} \mathrm{C}$ <br> Operation $-25^{\circ} \mathrm{C}$ to $+55^{\circ} \mathrm{C}$ |
| :--- | :--- | :--- |
| Humidity | IEC 600-68-2-3 | 56 days at $93 \%$ RH and $40^{\circ} \mathrm{C}$ |
| Enclosure protection | IEC 60-529 | IP 52, IK 07 |
| Sinusoidal Vibrations | IEC 60-255-21-1 | Response and endurance, class 2 |
| Shocks | IEC 60-255-21-2 | Response and withstand, class $1 \& 2$ |
| Bump | IEC 60-255-21-2 | Response and withstand, class 1 |
| Seismic | IEC 60-255-21-3 | Class 2 |

5. GENERAL INFORMATION AND DEVIATION OF THE PROTECTION ELEMENTS

## Glossary

| I | $:$ | Phase current |
| :--- | :--- | :--- |
| Is | $:$ | l>, l>>, l>>> \& l< |
| l2s | $:$ | l2>, l2>> \& l2>>> |
| les | $:$ | le>, le>> \& le>>> |
| lesCos $:$ | leCos> \& leCos>> |  |

$\mathrm{Pe} \quad$ : Earth fault (wattmetric)
Pes : Pe> \& Pe>>
Us : U>, U>>, U<\& U<<
Urs : Ue>, Ue>>, Ue>>> \& Ue>>>>
DT : Definite time
IDMT : Inverse definite minimum time

| Element | Range | Deviation | Trigger | Reset | Time deviation |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Phase overcurrent elements \|> \& |>> \& |>>> | 0.1 to 40 In | $\pm 2 \%$ | DT: Is $\pm 2 \%$ IDMT: 1.1ls $\pm 2 \%$ | $\begin{aligned} & 0.95 \text { Is } \pm 2 \% \\ & 1.05 \text { Is } \pm 2 \% \end{aligned}$ | $\begin{aligned} & \pm 2 \%+30 \ldots 50 \mathrm{~ms} \\ & \pm 5 \%+30 \ldots 50 \mathrm{~ms} \end{aligned}$ |
| Relay characteristic angle RCA <br> (RCA-Torque angle) | $0^{\circ}$ to $359^{\circ}$ | $\leq 3^{\circ}$ |  |  |  |
| Trip zone | $\pm 10^{\circ}$ to $\pm 170^{\circ}$ | $\leq 3^{\circ}$ |  |  |  |
| Earth fault overcurrent elements le> \& le>> \& le>>> | 0.002 to 1 len 0.01 to 8 len 0.1 to 40 len | $\pm 2 \%$ | DT: les $\pm 2 \%$ <br> IDMT: 1.1 les $\pm 2 \%$ | $\begin{aligned} & 0.95 \text { les } \pm 2 \% \\ & 1.05 \text { les } \pm 2 \% \end{aligned}$ | $\begin{aligned} & \pm 2 \%+30 \ldots 50 \mathrm{~ms} \\ & \pm 5 \%+30 \ldots 50 \mathrm{~ms} \end{aligned}$ |
| Wattmetric earth fault elements | $\begin{aligned} & 57 \text { to } 130 \mathrm{~V} \\ & 0.2 \text { to } 20 \mathrm{~W} \\ & 1 \text { to } 160 \mathrm{~W} \\ & 10 \text { to } 800 \mathrm{~W} \end{aligned}$ | $\pm 4 \% \pm$ error on $\cos \varphi$ | DT: Pes $\pm$ accuracy IDMT: 1.1Pes $\pm$ accuracy | 0.95 Pes <br> $\pm$ accuracy <br> 1.05 Pes <br> $\pm$ accuracy | $\begin{aligned} & \pm 2 \%+30 \ldots 50 \mathrm{~ms} \\ & \pm 5 \%+30 \ldots 50 \mathrm{~ms} \end{aligned}$ |
| Wattmetric earth fault elements $\mathrm{Pe}>\& \mathrm{Pe} \gg$ | $\begin{aligned} & 220 \text { to } 480 \mathrm{~V} \\ & 1 \text { to } 80 \mathrm{~W} \\ & 4 \text { to } 640 \mathrm{~W} \\ & 40 \text { to } 3200 \mathrm{~W} \end{aligned}$ | $\pm 4 \% \pm$ error on $\cos \varphi$ | DT: Pes $\pm$ accuracy IDMT: 1.1Pes $\pm$ accuracy | $\begin{aligned} & \text { 0.95 Pes } \\ & \pm \text { accuracy } \\ & 1.05 \text { Pes } \\ & \pm \text { accuracy } \end{aligned}$ | $\begin{aligned} & \pm 2 \%+30 \ldots 50 \mathrm{~ms} \\ & \pm 5 \%+30 \ldots 50 \mathrm{~ms} \end{aligned}$ |
| Active earth fault overcurrent elements $\operatorname{leCos} \varphi>$ \& leCos $\varphi \gg$ | 0.002 to 1 len 0.01 to 8 len 0.1 to 40 len | $\begin{array}{\|l}  \pm 2 \% \pm \text { error } \\ \text { on } \cos \varphi \end{array}$ | DT: lesCos $\pm$ accuracy IDMT: 1.1 lesCos $\pm$ accuracy | $\begin{aligned} & 0.95 \text { lesCos } \\ & \pm \text { accuracy } \\ & 1.05 \text { lesCos } \\ & \pm \text { accuracy } \end{aligned}$ | $\begin{aligned} & \pm 2 \%+30 \ldots 50 \mathrm{~ms} \\ & \pm 5 \%+30 \ldots 50 \mathrm{~ms} \end{aligned}$ |
| Negative sequence phase overcurrent elements 12>, \|2>> \& |2>>> | 0.1 to 40 In | $\pm 2 \%$ | DT: $12 \mathrm{~s} \pm 2 \%$ IDMT: $1.112 \mathrm{~s} \pm 2 \%$ | $\begin{aligned} & 0.95 \mathrm{I} 2 \mathrm{~s} \pm 2 \% \\ & 1.05 \mathrm{l} 2 \mathrm{~s} \pm 2 \% \end{aligned}$ | $\begin{aligned} & \pm 2 \%+30 \ldots 50 \mathrm{~ms} \\ & \pm 5 \%+30 \ldots 50 \mathrm{~ms} \end{aligned}$ |
| Phase undercurrent element l< | 0.1 to 1 ln | $\pm 2 \%$ | DT: $1< \pm 2 \%$ | $1.05 \mathrm{l}< \pm 2 \%$ | $\pm 2 \%+30 . . .50 \mathrm{~ms}$ |
| Broken conductor [I2/I1]. | 20 to 100\% | $\pm 3 \%$ | DT: $12 / 11 \pm 3 \%$ | $0.95 \mathrm{I} / \mathrm{IL} 1 \pm 3 \%$ | $\pm 2 \%+30 \ldots 50 \mathrm{~ms}$ |
| Thermal overload I $\theta>, \theta$ Alarm, $\theta$ Trip | 0.10 to 3.2 ln | $\pm 3 \%$ | IDMT: $1 \theta> \pm 3 \%$ | $0.97 \mathrm{l} \theta> \pm 3 \%$ | $\begin{aligned} & \hline-5 \%+30 \ldots 50 \mathrm{~ms} \\ & \text { (ref. IEC 60255-8) } \end{aligned}$ |
| Overvoltage U> \& U>> | $\begin{aligned} & 57 \text { to } 130 \mathrm{~V} \\ & 2 \text { to } 260 \mathrm{~V} \end{aligned}$ | $\pm 2 \%$ | DT: Us $\pm 2 \%$ | 0.95 Us $\pm 2 \%$ | $\pm 2 \%+20 . .40 \mathrm{~ms}$ |


| Element | Range | Deviation | Trigger | Reset | Time deviation |
| :--- | :--- | :--- | :--- | :--- | :---: |
| Overvoltage <br> U> \& U>> | 220 to 480 V <br> 10 to 960 V | $\pm 2 \%$ | DT: Us $\pm 2 \%$ | 0.95 Us $\pm 2 \%$ | $\pm 2 \%+20 \ldots 40 \mathrm{~ms}$ |
| Undervoltage <br> U< \& U<< | 57 to 130 V <br> 2 to 130 V | $\pm 2 \%$ | DT: Us $\pm 2 \%$ | 1.05 Us $\pm 2 \%$ | $\pm 2 \%+20 \ldots 40 \mathrm{~ms}$ |
| Undervoltage <br> U< \& U<< | 220 to 480 V <br> 10 to 480 V | $\pm 2 \%$ | DT: Us $\pm 2 \%$ | 1.05 Us $\pm 2 \%$ | $\pm 2 \%+20 \ldots 40 \mathrm{~ms}$ |
| Residual overvoltage <br> (Direct input) <br> Ue>, Ue>>, Ue>>>, <br> Ue>>>> | 57 to 130 V <br> 1 to 260 V <br> 1 to 260 V | $\pm 2 \%$ | DT: Urs $\pm 2 \%$ | 0.95 Urs $\pm 2 \%$ | $\pm 2 \%+20 \ldots 40 \mathrm{~ms}$ |
| Residual overvoltage <br> (Direct input) <br> Ue>, Ue>>, Ue>>>, <br> Ue>>>> | 220 to 480 V <br> 4 to 960 V <br> 5 to 960 V | $\pm 2 \%$ | DT: Urs $\pm 2 \%$ | 0.95 Urs $\pm 2 \%$ | $\pm 2 \%+20 \ldots 40 \mathrm{~ms}$ |
| Derived residual <br> overvoltage <br> Ue>, Ue>>, Ue>>>, <br> Ue>>>> | 57 to 130 V <br> 1 to 260 V <br> 1 to 260 V | $\pm 2 \%$ <br> or 0.2V | DT: Urs $\pm 2 \%$ | 0.95 Urs $\pm 2 \%$ | $\pm 2 \%+20 \ldots 40 \mathrm{~ms}$ |
| Derived residual <br> overvoltage <br> Ue>, Ue>>, Ue>>>, <br> Ue>>>> | 220 to 480 V <br> 4 to 960 V <br> 5 to 960 V | $\pm 2 \%$ <br> or 1 V | DT: Urs $\pm 2 \%$ | 0.95 Urs $\pm 2 \%$ | $\pm 2 \%+20 \ldots 40 \mathrm{~ms}$ |

## 6. DEVIATION OF AUTOMATION FUNCTIONS TIMERS

| Autoreclose timers tDs, tR, tl | $\pm 2 \%+10 \ldots 30 \mathrm{~ms}$ |
| :--- | :--- |
| CB fail \& CB monitoring timers | $\pm 2 \%+10 \ldots 30 \mathrm{~ms}$ |
| Auxiliary timers tAUX1, tAUX2, tAUX3, tAUX4 | $\pm 2 \%+10 \ldots 30 \mathrm{~ms}$ |
| Cold load pickup | $\pm 2 \%+20 \ldots 40 \mathrm{~ms}$ |
| SOTF/TOR | $\pm 2 \%+20 \ldots .40 \mathrm{~ms}$ |
| Programmable AND logic | $\pm 2 \%+10 \ldots 30 \mathrm{~ms}$ |

## 7. DEVIATION OF MEASUREMENTS

| Measurement | Range | Deviation |
| :--- | :--- | :--- |
| Phase current | 0.1 to 40 In | Typical $\pm 0.5 \%$ at In |
| Earth current | 0.002 to 1 len | Typical $\pm 0.5 \%$ at len |
|  | 0.01 to 8 len | Typical $\pm 0.5 \%$ at len |
|  | 0.1 to 40 len | Typical $\pm 0.5 \%$ at len |
| Voltage | 57 to 260 V | Typical $\pm 0.5 \%$ at Un |
|  | 220 to 960 V | Typical $\pm 0.5 \%$ at Un |


| Active Power and Active Energy |  | Reactive Power and Reactive Energy |  |
| :--- | :--- | :--- | :--- |
| $\operatorname{Cos} \varphi$ | Deviation | $\operatorname{Sin} \varphi$ | Deviation |
| 0.866 | $<1.5 \%$ | 0.866 | $<3 \%$ |
| 0.5 | $<3 \%$ | 0.5 | $<1.5 \%$ |

## 8. PROTECTION SETTING RANGES

## 8.1 [67/50/51] Directional/Non-Directional Phase Overcurrent (P127)

| - | Phase current | Fundamental only |
| :--- | :--- | :--- |
| - | Phase or phase to phase voltage | Fundamental only |
| - | Minimum voltage operation | 0.6 V (Un: 57 to 130 V$)$ |
| - | Minimum voltage operation | 3.0 V (Un: 220 to 480V) |

8.1.1 Synchronous Polarisation

- Minimum phase voltage fixed threshold enabling synchronous polarising: 0.6V
- Synchronous polarising permanence time phase voltage thresholds: 5 s

NOTE: When $\mathrm{l}>$ is associated to an IDMT curve, the maximum setting recommended should be 2 In.
8.1.2 Protection Setting Ranges (P127)

|  | Setting Range |  |  |
| :---: | :---: | :---: | :---: |
| [67] Phase OC | Min | Max | Step |
| $1>$ ? | No or Yes or DIR |  |  |
| I> | 0.1 In | 25 In | 0.01 ln |
| Delay type | DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tl> | 0 s | 150 s | 0.01 s |
| $1>$ TMS | 0.025 | 1.5 | 0.025 |
| I> Reset Delay Type | DT or IDMT |  |  |
| I> RTMS | 0.025 | 3.2 | 0.025 |
| I $>$ tReset | 0.00 s | 100 s | 0.01 s |
| \|> |>> l>>> Interlock | No or Yes |  |  |
| l> Torque angle | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| I> Trip zone | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| $1 \gg$ ? | No or Yes or DIR |  |  |
| l>> | 0.5 ln | 40 ln | 0.01 ln |
| Delay type | DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tl>> | 0 s | 150 s | 0.01 s |
| $1 \gg$ TMS | 0.025 | 1.5 | 0.025 |
| l>> Reset Delay Type | DT or IDMT |  |  |
| l>> RTMS | 0.025 | 3,2 | 0.025 |
| l>> tReset | 0.00 s | 100 s | 0.01 s |
| l>> Torque angle | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| $1 \gg$ Trip zone | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| l>>> ? | No or Yes or DIR or Peak |  |  |


|  | Setting Range |  |  |
| :--- | :--- | :--- | :--- |
| [67] Phase OC | Min |  | Max |

## $8.2 \quad$ [50/51] Phase Overcurrent Protection (P126)

- Phase current

Fundamental only
NOTE: When $l>$ and $l \gg$ is associated to an IDMT curve, the maximum setting recommended should be 2 In .
8.2.1 Protection Setting Ranges (P126)

|  | Setting Range |  |  |
| :---: | :---: | :---: | :---: |
| [51] Phase OC | Min | Max | Step |
| $1>$ ? | No or Yes |  |  |
| $1>$ | 0.1 In | 25 In | 0.01 ln |
| Delay type | DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tl> | 0 s | 150 s | 0.01 s |
| l> TMS | 0.025 | 1.5 | 0.025 |
| I> Reset Delay Type | DT or IDMT |  |  |
| I> RTMS | 0.025 | 3.2 | 0.025 |
| l> tReset | 0.00 s | 100 s | 0.01 s |
| \|> |>> |>>> Interlock | No or Yes |  |  |
| $1 \gg$ ? | No or Yes |  |  |
| l>> | 0.5 In | 40 ln | 0.01 ln |
| Delay type | DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tl>> | 0 s | 150 s | 0.01 s |
| l>> TMS | 0.025 | 1.5 | 0.025 |
| l>> Reset Delay Type | DT or IDMT |  |  |
| $1 \gg$ RTMS | 0.025 | 3.2 | 0.025 |
| l>> tReset | 0.00 s | 100 s | 0.01 s |
| $1 \ggg$ ? | No or Yes or Peak |  |  |
| l>>> | 0.5 ln | 40 ln | 0.01 ln |
| tl>>> | 0 s | 150 s | 0.01 s |

## 8.3 [67N/50N/51N] Dir./Non-Dir. Earth fault protection (P125, P126 \& P127)

- Earth fault current
- Earth fault current ranges
- Residual voltage
- Residual voltage range
- Minimum residual voltage operation
- Minimum residual voltage operation

Fundamental only
See following table
Fundamental only
See following table
0.7V (Uen: 57 to 130V)
3.0V (Uen: 220 to 480V)

NOTE: When le> or le>> are associated to an IDMT curve, the maximum setting recommended should be the maximum of the range divided by 20.
8.3.1 Protection Setting Ranges

|  | Setting Range |  |  |
| :---: | :---: | :---: | :---: |
| [67N] Earth OC | Min | Max | Step |
| High sensitivity current set | Cortec code P12-C-X---X |  |  |
| le> | 0.002 len | 1 Ien | 0.001 len |
| le>> | 0.002 len | 1 Ien | 0.001 Ien |
| le>>> | 0.002 len | 1 Ien | 0.001 Ien |
| Med. sensitivity current set | Cortec code P12-B-X---X |  |  |
| le> | 0.01 Ien | 1 Ien | 0.005 len |
| le>> | 0.01 Ien | 8 len | 0.005 Ien |
| le>>> | 0.01 Ien | 8 Ien | 0.005 Ien |
| Low sensitivity current set | Cortec code P12-A-X---X |  |  |
| le> | 0.1 len | 25 len | 0.1 len |
| le>> | 0.5 len | 40 len | 0.1 Ien |
| le>>> | 0.5 len | 40 len | 0.1 Ien |
| $l e>$ ? | No or Yes or DIR |  |  |
| Delay type | DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tle> | 0 s | 150 s | 0.01 s |
| le> TMS | 0.025 | 1.5 | 0.025 |
| le> Reset Delay Type | DT or IDMT |  |  |
| le> RTMS | 0.025 | 3.2 | 0.025 |
| le> tReset | 0.00 s | 100 s | 0.01 s |
| $\begin{aligned} & \text { le> le>> le>>> } \\ & \text { Interlock } \end{aligned}$ | No or Yes |  |  |
| le> Torque angle | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| le> Trip zone | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| Input residual voltage with range from 57 to 130V |  |  |  |
| Ue> | 1 V | 260 V | 0.1 V |
| Input residual voltage with range from 220 to 480V |  |  |  |
| Ue> | 4 V | 960 V | 0.5 V |



## ATTENTION: THE Ue THRESHOLD SETTINGS DEPEND ON THE ADOPTED CONNECTION OPTION. IN CONFIGURATION/GENERAL OPTIONS MENU OF THE P127 RELAY THE Ve INPUT CAN BE SET DIRECTLY FROM A VT (I.E. FROM A DELTA VT) OR CAN BE DERIVED FROM THE MEASUREMENT OF THE THREE PHASE TO NEUTRAL VOLTAGES (3VPN). IN THIS CASE THE Ue IS CALCULATED AS: <br> $\mathrm{Ue}=\frac{1}{3} x(\overrightarrow{\mathrm{UA}}+\overrightarrow{\mathrm{UB}}+\overrightarrow{\mathrm{UC}})$ <br> THE SETTING OF THE Ue THRESHOLDS MUST TAKE THE ABOVE FORMULA IN ACCOUNT.

### 8.4 Earth Wattmetric Protection

- Earth fault current Fundamental only
- Residual voltage Fundamental only
- Minimum Operating Voltage
- Range from 57 to $130 \mathrm{~V} \quad 0.7 \mathrm{~V}$
- Range from 220 to 480 V 3.0 V
- Minimum Operating Current with len=1A and len=5A
- Range from 0.002 to 1 len 1 mA
- Range from 0.01 to 8 len 5 mA
- Range from 0.1 to 40 len 50 mA

NOTE : When Pe> or lecos> is associated to an IDMT curve, the maximum setting recommended should be the maximum of the range divided by 20.

### 8.5 Functionality Mode

This protection element can operate in Pe or leCos mode.

### 8.5.1 Protection Setting Ranges

|  | Setting range |  |  |
| :---: | :---: | :---: | :---: |
| [32N] Earth Wattmetric | Min | Max | Step |
| Mode | Pe or leCos |  |  |
| High sensitivity: | Current input from 0.002 to 1 len |  |  |
| 57-130V Input voltage | Cortec code: P12-CAX---X |  |  |
| Pe> (*) | $0.2 \times \mathrm{kW}$ | $20 \times \mathrm{k}$ W | $0.02 \times \mathrm{kW}$ |
| Pe>> (*) | $0.2 \times \mathrm{kW}$ | $20 \times \mathrm{k}$ W | 0.02 x k W |
| 220-480V Input voltage | Cortec code: P12-CBX---X |  |  |
| Pe> (*) | $1 \times \mathrm{kW}$ | $80 \times \mathrm{k}$ W | $0.1 \times \mathrm{kW}$ |
| Pe>> (*) | $1 \times \mathrm{kW}$ | $80 \times \mathrm{k}$ W | $0.1 \times \mathrm{kW}$ |
| Med. Sensitivity: | Current input from 0.01 to 8 len |  |  |
| 57-130V Input voltage | Cortec code: P12-BAX---X |  |  |
| Pe> (*) | $1 \times \mathrm{kW}$ | $160 \times \mathrm{k}$ W | $0.1 \times \mathrm{kW}$ |
| Pe>> (*) | $1 \times \mathrm{kW}$ | $160 \times \mathrm{k}$ W | $0.1 \times \mathrm{kW}$ |
| 220-480V Input voltage | Cortec code: P12-BBX---X |  |  |
| Pe> (*) | $4 \times \mathrm{kW}$ | $640 \times \mathrm{k} \mathrm{W}$ | $0.5 \times \mathrm{kW}$ |
| Pe>> (*) | $4 \times \mathrm{kW}$ | $640 \times \mathrm{k} \mathrm{W}$ | $0.5 \times \mathrm{kW}$ |
| Low sensitivity: | Current input from 0.1 to 40 len |  |  |
| 57-130V Input voltage | Cortec code: P12-AAX---X |  |  |
| Pe> (*) | $10 \times \mathrm{kW}$ | $800 \times \mathrm{kW}$ | $1 \times \mathrm{kW}$ |
| Pe>> (*) | $10 \times \mathrm{kW}$ | $800 \times \mathrm{kW}$ | 1 xkW |
| 220-480V Input voltage | Cortec code: P12-ABX---X |  |  |
| Pe> (*) | $40 \times \mathrm{k}$ W | 3200 x k W | $5 \times \mathrm{kW}$ |
| Pe>> (*) | $40 \times \mathrm{kW}$ | 3200 x k W | $5 \times \mathrm{kW}$ |
| Pe> ? | No or Yes |  |  |
| Delay Type | DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI,RI, RECT curve) |  |  |
| tPe> | 0 s | 150 s | 0.01 s |
| Pe> TMS | 0.025 | 1.5 | 0.025 |
| Pe> Reset Delay Type | DT or IDMT |  |  |
| Pe> RTMS | 0.025 | 1.5 | 0.025 |
| Pe>tReset | 0.00 s | 100 s | 0.01 s |
| Pe>> ? | No or Yes |  |  |
| tPe>> | 0 s | 150 s | 0.01 s |
| Pe>> tReset | 0.00 s | 100 s | 0.01 s |


|  | Setting range |  |  |
| :---: | :---: | :---: | :---: |
| [32N] Earth Wattmetric | Min | Max | Step |
| High sensitivity leCos | Cortec code P12-C-X---X |  |  |
| leCos> | 0.002 Ien | 1 Ien | 0.001 Ien |
| leCos>> | 0.002 len | 1 Ien | 0.001 Ien |
| Med. sensitivity leCos | Cortec code P12-B-X---X |  |  |
| leCos> | 0.01 len | 8 Ien | 0.005 len |
| leCos>> | 0.01 len | 8 len | 0.005 len |
| Low sensitivity leCos | Cortec code P12-A-X---X |  |  |
| leCos> | 0.1 len | 25 len | 0.01 len |
| leCos>> | 0.5 Ien | 40 len | 0.01 Ien |
| leCos> ? | Yes or No |  |  |
| Delay Type | DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tleCos> | 0 s | 150 s | 0.01 s |
| leCos> TMS | 0.025 | 1.5 | 0.025 |
| leCos> Reset Delay Type | DT or IDMT |  |  |
| leCos> RTMS | 0.025 | 1.5 | 0.025 |
| leCos> tReset | 0.00 s | 100 s | 0.01 s |
| leCos>> ? | Yes or No |  |  |
| tleCos>> | 0 s | 150 s | 0.01 s |
| leCos> tReset | 0.00 s | 100 s | 0.01 s |
| Pe/leCos Torque angle | $0^{\circ}$ | $359{ }^{\circ}$ | $1^{\circ}$ |

(*) ATTENTION: THE Pe THRESHOLDS ARE DISPLAYED IN THE FORMAT: \#\#.\#\# x len W THE THRESHOLD VALUE IS IN WATT [W] SECONDARY.
THE Pe> THRESHOLD SETTING VALUE IS 20 W AND IS TO BE SET FROM THE FRONT PANEL KEYPAD:
IF len $=1 \mathrm{~A}$, THE INTERNAL RELAY SETTING VALUE WILL BE EQUAL TO $1 \times 20=20 \mathrm{~W}$.
IF len $=5$ A, THE INTERNAL RELAY SETTING VALUE WILL BE EQUAL TO $5 \times 20=100 \mathrm{~W}$.

### 8.6 Undercurrent Protection (P126 \& P127)

- Undercurrent
- Phase current: Fundamental only
8.6.1 Protection Setting Ranges

|  | Setting ranges |  |  |
| :--- | :--- | :--- | :--- |
| [37] Under Current | Min | Max | Step |
| $\mathrm{l}<?$ | Yes or No |  |  |
| $\mathrm{l}<$ | 0.1 ln | 1 ln | 0.01 ln |
| $\mathrm{tl}<$ | 0 s | 150 s | 0.01 s |

8.7 Negative Sequence Overcurrent Protection (P126 \& P127)

- Phase current:

Fundamental only
NOTE: When $12>$ is associated to an IDMT curve, the maximum setting recommended should be 21 n.
8.7.1 Protection Setting Ranges

|  | Setting ranges |  |  |
| :---: | :---: | :---: | :---: |
| [46] Neg.Seq. OC | Min | Max | Step |
| $12>$ ? | No or Yes |  |  |
| 12> | 0.1 ln | 25 In | 0.01 ln |
| Delay Type | DT or IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tl2> | 0 s | 150s | 0.01s |
| I2> TMS | 0.025 | 1.5 | 0.025 |
| I2> Reset Delay Type | DT or IDMT |  |  |
| I2> RTMS | 0.025 | 1.5 | 0.025 |
| 12> tReset | 0.04 s | 100 s | 0.01 s |
| 12>> ? | No or Yes |  |  |
| 12>> | 0.5 ln | 40 ln | 0.01 ln |
| t12>> | 0 s | 150s | 0.01s |
| l2>>> ? | No or Yes |  |  |
| $12 \ggg$ | 0.5 In | 40 ln | 0.01 ln |
| tl2>>> | 0 s | 150s | 0.01s |

### 8.8 Thermal Overload Protection (P126 \& P127)

- Phase Current:

RMS
8.8.1 Protection Setting Ranges

| [49] Therm. OL |  |  |  |
| :--- | :--- | :--- | :--- |
| Therm. OL ? | Setting ranges |  |  |
| I $\theta$ | 0.1 In | 3.2 In | 0.01 |
| Te | 1 mn | 200 mn | 1 mn |
| k | 1 | 1,5 | 0.01 |
| $\theta$ Trip | $50 \%$ | $200 \%$ | $1 \%$ |
| $\theta$ Alarm ? | No or Yes |  |  |
| $\theta$ Alarm | $50 \%$ | $200 \%$ | $1 \%$ |

### 8.9 Undervoltage Protection (P127)

- Phase or phase to phase voltage Fundamental only
- Thresholds selection mode AND or OR (*)
8.9.1 Protection Setting Ranges (P127)

|  | Setting ranges |  |  |
| :---: | :---: | :---: | :---: |
| [27] Phase Undervoltage | Min | Max | Step |
| 57-130V Input voltage | Cortec code: P127-AX---X |  |  |
| $\mathrm{U}<$ ? | No or AND or OR |  |  |
| U< tU< | $\begin{aligned} & 2 \mathrm{~V} \\ & 0 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 130 \mathrm{~V} \\ & 600 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 0.1 \mathrm{~V} \\ & 0.01 \mathrm{~s} \end{aligned}$ |
| $\mathrm{U} \ll$ ? | No or AND or OR |  |  |
| U<< tU<< | $\begin{aligned} & 2 \mathrm{~V} \\ & 0 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 130 \mathrm{~V} \\ & 600 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 0.1 \mathrm{~V} \\ & 0.01 \mathrm{~s} \end{aligned}$ |
| 220-480V Input voltage. | Cortec code: P127-BX---X |  |  |
| $\mathrm{U}<$ ? | No or AND or OR |  |  |
| $U_{<}$ tU< | $\begin{aligned} & 10 \mathrm{~V} \\ & 0 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 480 \mathrm{~V} \\ & 600 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 0.5 \mathrm{~V} \\ & 0.01 \mathrm{~s} \end{aligned}$ |
| $\mathrm{U} \ll$ ? | No or AND or OR |  |  |
| $\mathrm{U} \ll$ $\mathrm{t} \mathrm{U} \ll$ | $\begin{aligned} & 10 \mathrm{~V} \\ & 0 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 480 \mathrm{~V} \\ & 600 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 0.5 \mathrm{~V} \\ & 0.01 \mathrm{~s} \end{aligned}$ |

### 8.10 Overvoltage Protection (P127)

- Phase or phase to phase voltage
- Thresholds selection mode

Fundamental only
AND or OR (*)
8.10.1 Protection Setting Ranges (P127)

|  | Setting ranges |  |  |
| :---: | :---: | :---: | :---: |
| [59] Phase Overvoltage | Min | Max | Step |
| 57-130V Input voltage | Cortec code: P127-AX---X |  |  |
| U> ? | No or AND or OR |  |  |
| U> <br> tU> | $\begin{aligned} & 2 \mathrm{~V} \\ & 0 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 260 \mathrm{~V} \\ & 260 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 0.1 \mathrm{~V} \\ & 0.01 \mathrm{~s} \end{aligned}$ |
| U>> ? | No or AND or OR |  |  |
| $\begin{aligned} & U \gg \\ & t U \gg \end{aligned}$ | $\begin{aligned} & 2 \mathrm{~V} \\ & 0 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 260 \mathrm{~V} \\ & 600 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 0.1 \mathrm{~V} \\ & 0.01 \mathrm{~s} \end{aligned}$ |
| 220-480V Input voltage. | Cortec code: P127-BX---X |  |  |
| U> ? | No or AND or OR |  |  |
| U> <br> tU> | $\begin{aligned} & 10 \mathrm{~V} \\ & 0 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 960 \mathrm{~V} \\ & 600 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 0.5 \mathrm{~V} \\ & 0.01 \mathrm{~s} \end{aligned}$ |
| U>> ? | No or AND or OR |  |  |
| $\begin{aligned} & U \gg \\ & t U \gg \end{aligned}$ | $\begin{aligned} & 10 \mathrm{~V} \\ & 0 \mathrm{~s} \end{aligned}$ | $960 \mathrm{~V}$ | $\begin{array}{\|l} 0.5 \mathrm{~V} \\ 0.01 \mathrm{~s} \end{array}$ |

(*) OR trip caused by one or two or three phase values exceeding the threshold.
AND trip caused by three phase values exceeding the threshold.

### 8.11 Residual Overvoltage Protection

- Residual voltage: Fundamental only


### 8.11.1 Protection Setting Ranges

|  | Setting range |  |  |
| :---: | :---: | :---: | :---: |
| [59] Residual Overvoltage | Min | Max | Step |
| 57-130V Input voltage. | Cortec code: P127-AX---X |  |  |
| Ue>>>> ? | No or Yes |  |  |
| $\begin{aligned} & \text { Ue>>>> } \\ & \text { tUe>>>> } \end{aligned}$ | $\begin{aligned} & 1 \mathrm{~V} \\ & 0 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 260 \mathrm{~V} \\ & 600 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 0.1 \mathrm{~V} \\ & 0.01 \mathrm{~s} \end{aligned}$ |
| 220-480V Input voltage. | Cortec code: P127-BX---X |  |  |
| Ue>>>> ? | No or Yes |  |  |
| Ue>>>> <br> tUe>>>> | $\begin{aligned} & 5 \mathrm{~V} \\ & 0 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 960 \mathrm{~V} \\ & 600 \mathrm{~s} \end{aligned}$ | $\begin{aligned} & 0.5 \mathrm{~V} \\ & 0.01 \mathrm{~s} \end{aligned}$ |

ATTENTION: THE Ue THRESHOLD SETTINGS DEPEND ON THE ADOPTED CONNECTION OPTION. IN CONFIGURATION/GENERAL OPTIONS MENU OF THE P127 RELAY THE Ve INPUT CAN BE SET DIRECTLY FROM A VT (I.E. FROM A DELTA VT) OR CAN BE DERIVED FROM THE MEASUREMENT OF THE THREE PHASE TO NEUTRAL VOLTAGES (3VPN). IN THIS CASE THE Ue IS CALCULATED AS:
$\mathrm{Ue}=\frac{1}{3} x(\overrightarrow{\mathrm{UA}}+\overrightarrow{\mathrm{UB}}+\overrightarrow{\mathrm{UC}})$
THE SETTING OF THE Ue THRESHOLDS MUST TAKE THE ABOVE FORMULA IN ACCOUNT.

### 8.12 Multishot Autoreclose Function (P126 \& P127)

Main shots: 4 independent shots.
External logic inputs: 6 inputs (CB opened signal, CB closed signal, manual opening command, manual closing command, blocking order, cycle activation).

Internal programmable trigger from phase and earth fault on all re-closing cycles.
External trigger from logic input.
Inhibit time on manual closing.
Programmable dead times and reclaim time setting.
Maximum CB closing control equal to 5s (+t_Pulse setting)

### 8.12.1 Multishot Autoreclose Settings

|  | Setting range |  |  |
| :---: | :---: | :---: | :---: |
| [79] Autoreclose | Min | Max | Step |
| Autoreclose? | Yes or No |  |  |
| Ext. CB Fail? | Yes or No |  |  |
| Ext. CB Fail time | 0.01 s | 600 s | 0.01 s |
| Aux1 ((l>) ? | Yes or No |  |  |
| Aux2 (le>) ? | Yes or No |  |  |
| Ext Block? | Yes or No |  |  |
| Dead time |  |  |  |
| tD1 | 0.01 s | 300 s | 0.01 s |
| tD2 | 0.01 s | 300 s | 0.01 s |
| tD3 | 0.01 s | 600 s | 0.01 s |
| tD4 | 0.01 s | 600 s | 0.01 s |
| Reclaim time |  |  |  |
| tR | 0.02 s | 600 s | 0.01 s |
| Inhib time |  |  |  |
| tl | 0.02 s | 600 s | 0.01 s |
| Phase Cycles | 0 | 4 | 1 |
| E/Gnd Cycles | 0 | 4 | 1 |
| Cycles | 4321 | Settings |  |
| tl> | 1111 | 0 or 1 or 2 |  |
| tl>> | 1111 | 0 or 1 or 2 |  |
| tl>>> | 1111 | 0 or 1 or 2 |  |
| tle> | 1111 | 0 or 1 or 2 |  |
| tle>> | 1111 | 0 or 1 or 2 |  |
| tle>>> | 1111 | 0 or 1 or 2 |  |
| tPe/lecos> | 1111 | 0 or 1 or 2 |  |
| tPe/lecos>> | 1111 | 0 or 1 or 2 |  |
| tAux1 | 1111 | 0 or 1 or 2 |  |
| tAux2 | 1111 | 0 or 1 or 2 |  |

$0=$ no action on autorecloser : definitive trip
$1=$ trip on pick up of the protection element, followed by reclosing cycle
$2=$ no trip on pick up of the protection element also if this has been set in the CRTL/Trip commands/Trip menu.
8.12.1.1 Further timing

Fixed time out for lacking of CB opening signal on trip protection: $\quad 2.00 \mathrm{~s}$ at 50 Hz
1.67 s at 60 Hz

Time out for lacking of CB closing signal on close control after dead time :
tClose Pulse(*): from 0.1 to 5.00 s in stepds of 0.01 s
$\left(^{*}\right)$ Setting available in CB monitoring menu.

## 9. AUTOMATION AND ANCILLARY FUNCTIONS

### 9.1 Cold Load Pickup (P126 \& P127)

|  | Setting range |  |  |
| :--- | :--- | :--- | :--- |
| Cold Load PU | Min | Max | Step |
| Cold Load PU ? | Yes or No |  |  |
| Level | $100 \%$ | $500 \%$ | $1 \%$ |
| tCL | 0.1 s | 3600 s | 0.1 s |

### 9.2 51V function

The 51 V function means the control of the overcurrent elements by the monitoring of the phase voltage the involved setting are listed below. The VTS function can also block the 51 V .

Settings

| 51 V |  |  | Max |
| :--- | :--- | :--- | :--- |
| Voltage range 57-130V | Min | No | Yes/No |
| $($ U<OR V2>) \& l>> | Yes | 200 V | 0.1 V |
| V2> | 3 V | No | Yes/No |
| $(\mathrm{U} \ll$ OR V2>>) \& l>>> | Yes | 200 V | 0.1 V |
| V2> | 3 V | Max | Step |
| Voltage range 220-480V | Min | No | Yes/No |
| (U<OR V2>) \& l>> | Yes | 720 V | 0.5 V |
| V2> | 20 V | No | Yes/No |
| (U<<OR V2>>) \& l>>> | Yes | 720 V | 0.5 V |
| V2> | 20 V | No | Yes/No |
| VTS Blocks 51V | Yes | No | Yes/No |
| VTS Alarm | Yes |  |  |

### 9.3 Auxiliary Timers (P126 \& P127)

Auxiliary timers: 4 assigned to the logic inputs
Aux1, Aux2,Aux3, Aux4

|  | Setting range |  |  |
| :--- | :--- | :--- | :--- |
| Auxiliary timers | Min | Max | Step |
| tAux1 | 0 | 200 s | 0.01 s |
| tAux2 | 0 | 200 s | 0.01 s |
| tAux3 | 0 | 200 s | 0.01 s |
| tAux4 | 0 | 200 s | 0.01 s |

### 9.4 Broken Conductor Detection (P126 \& P127)

Principle used:
Functionality available for: $\quad$ (IA or IB or IC) $>10 \%$ In
9.4.1 Broken Conductor Detection Setting Ranges

|  | Setting range |  |  |
| :--- | :--- | :--- | :--- |
| Broken Conductor | Min | Max | Step |
| Brkn.Cond? | Yes or No |  |  |
| Ratio I2/I1 | $20 \%$ | $100 \%$ | $1 \%$ |
| Brkn.Cond Time tBC | 0 s | 14400 s | 1 s |

### 9.5 Circuit Breaker Failure (P126 \& P127)

9.5.1 CB Fail Setting Ranges

|  | Setting range |  |  |
| :--- | :--- | :--- | :--- |
| CB Fail | Min | Max | Step |
| CB Fail ? | Yes or No |  |  |
| l< BF | 0.02 In | 1 In | 0.01 In |
| CB Fail Time tBF | 0 s | 10 s | 0.01 s |
| Block l> | No | Yes | Yes or No |
| Block le> | No | Yes | Yes or No |

9.6 Trip Circuit Supervision (P126 \& P127)
9.6.1 Trip Circuit Supervision Setting Ranges

|  | Setting range |  |  |
| :--- | :--- | :--- | :--- |
| TC Supervision | Min | Max | Step |
| TC Supervision? | Yes or No |  |  |
| t trip circuit tSUP | 0.1 s | 10 s | 0.1 s |

### 9.7 Circuit Breaker Control and Monitoring (P126 \& P127)

9.7.1 Setting Ranges

| CB Supervision | Setting range |  |  |
| :---: | :---: | :---: | :---: |
|  | Min | Max | Step |
| CB Open S'vision? | Yes or No |  |  |
| CB Open time | 0.05 s | 1 s | 0.01 s |
| CB Close S'vision? | Yes or No |  |  |
| CB Close time | 0.05 s | 1 s | 0.01 s |
| CB Open Alarm ? | Yes or No |  |  |
| CB Open NB | 0 | 50000 | 1 |
| $\Sigma \operatorname{Amps}(\mathrm{n})$ ? | Yes or No |  |  |
| £Amps(n) | 0 E6 A | 4000 E6 A | 1E6 A |
| n | 1 | 2 | 1 |
| tOpen Pulse(*) | 0.10 s | 5 s | 0.01 s |
| tClose Pulse(*) | 0.10 s | 5 s | 0.01 s |

${ }^{*}$ (*)Note: The tOpen/Close Pulse is available in the P125 for the Local /Remote functionality
9.8 SOTF/TOR Switch on to fault / Trip on reclose (P126 \& P127)
9.8.1 Setting Ranges

| SOTF | Setting range |  |  |
| :--- | :--- | :--- | :--- |
|  | Min | Max | Step |
| SOTF? | Yes or No |  |  |
| t SOTF | 0 ms | 500 ms | 10 ms |
| l>> | Yes or No |  |  |
| l>>> | Yes or No |  |  |

### 9.9 AND Logic Equation (P126 \& P127)

For the AND logic equations (A, B, C or D), a setting value 1 shows the assignment of a logic output to the equation; a setting value 0 shows no assignment of a logic output to the equation.
9.9.1 Timer Setting Ranges

|  | Setting range |  |  |
| :--- | :--- | :--- | :--- |
| AND logic equat <br> T delay | Min | Max | Step |
| EQU. A Toperat | 0 s | 600 s | 0.01 s |
| EQU. A Treset | 0 s | 600 s | 0.01 s |
| EQU. B Toperat | 0 s | 600 s | 0.01 s |
| EQU. B Treset | 0 s | 600 s | 0.01 s |
| EQU. C Toperat | 0 s | 600 s | 0.01 s |
| EQU. C Treset | 0 s | 600 s | 0.01 s |
| EQU. D Toperat | 0 s | 600 s | 0.01 s |
| EQU. D Treset | 0 s | 600 s | 0.01 s |

## 10. RECORDING FUNCTIONS (P126 \& P127)

### 10.1 Event Records

| Capacity | 75 events |
| :--- | :--- |
| Time-tag | 1 millisecond |
| Triggers | Any selected protection alarm and threshold <br> Logic input change of state <br> Setting changes <br> Self test events |

### 10.2 Fault Records

| Capacity | 5 faults |
| :--- | :--- |
| Time-tag | 1 millisecond |
| Triggers | Any selected protection alarm and threshold |
| Data | Fault date <br> Protection thresholds <br> Setting Group <br> AC inputs measurements (RMS) <br> Fault measurements |

10.3 Instantaneous recorder

| Capacity | 5 starting informations (instantaneous |
| :--- | :--- |
| Time-tag | 1 millisecond |
| Triggers | Any selected protection alarm and threshold |
| Data | date, hour <br> origin (any protection alarm) <br> length (duration of the instantaneous trip yes or no |

### 10.4 Disturbance Records

10.4.1 Triggers; Data; Setting Ranges

| Disturbance Records | P126 |  |  | P127 |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Triggers | Any selected protection alarm and threshold, logic input, remote command |  |  |  |  |
| Data | AC input channels digital input and output states frequency value |  |  |  |  |
|  | Default value |  | Setting range |  |  |
|  | P126 | P127 | Min | Max | Step |
| Pre-Time | 2.5 | 2.5 | 0.1 | 3 | 0.1 |
| Post-Time | 0.5 | 0.5 | 0.1 | 3 | 0.1 |
| Disturb rec Trig | ON TRIP | ON TRIP | ON TRIP or ON INST. |  |  |
| Trigger | Any selected protection alarm and threshold Logic input Remote command |  |  |  |  |

## 11. COMMUNICATION

| Type <br> Port | Relay <br> position | Physical Link | Connectors | Data Rate | Protocol |
| :--- | :--- | :--- | :--- | :--- | :--- |
| RS485 | Rear port | Screened twister <br> pair | Screws or <br> snap-on | 300 to 38400 baud <br> (programmable) | ModBus RTU, Courier, <br> IEC60870-5-103, <br> DNP3 |
| RS232 | Front port | Screened twister <br> pair | Sub-D 9 pin <br> female <br> connector | 300 to 38400 baud <br> (programmable) | ModBus RTU |

NOTE: The availablity of the Courier and DNP3 protocols has to be defined.

## 12. CURVES

### 12.1 General

Although the curves tend towards infinite when the current approaches is (general threshold), the minimum guaranteed value of the operating current for all the curves with the inverse time characteristic is 1.1 Is (with a tolerance of $\pm 0.05 \mathrm{Is}$ ).
12.1.1 Inverse Time Curves:

The first stage thresholds for phase (earth) overcurrent can be selected with an inverse definite minimum time (IDMT) characteristic. The time delay is calculated with a mathematical formula.

In all, there are eleven IDMT characteristics available.
The mathematical formula applicable to the first ten curves is:
$t=T \times\left(\frac{K}{\left(I / I_{S}\right)^{\alpha}-1}+L\right)$
Where:
t Operation time
K Factor (see table)
I Value of measured current
Is Value of the programmed threshold (pick-up value)
$\alpha \quad$ Factor (see table)
L ANSI/IEEE constant (zero for IEC and RECT curves)
T Time multiplier setting from 0.025 to 1.5

| Type of curve | Standard | K factor | $\alpha$ factor | L factor |
| :--- | :--- | :--- | :--- | :--- |
| Short time inverse | AREVA | 0.05 | 0.04 | 0 |
| Standard inverse | IEC | 0.14 | 0.02 | 0 |
| Very inverse | IEC | 13.5 | 1 | 0 |
| Extremely inverse | IEC | 80 | 2 | 0 |
| Long time inverse | AREVA | 120 | 1 | 0 |
| Short time inverse | C02 | 0.02394 | 0.02 | 0.01694 |
| Moderately Inverse | ANSI/IEEE | 0.0515 | 0.02 | 0.114 |
| Long time inverse | C08 | 5.95 | 2 | 0.18 |
| Very inverse | ANSI/IEEE | 19.61 | 2 | 0.491 |
| Extremely inverse | ANSI/IEEE | 28.2 | 2 | 0.1217 |
| Rectifier protection | RECT | 45900 | 5.6 | 0 |

The RI curve has the following definition:

$$
t=K \cdot \frac{1}{\left.0.339-\frac{0.236}{(I / I S}\right)}
$$

K setting is from 0.10 to 10 in steps of 0.05 .
The equation is valid for $1.1 \leq \mathrm{l} / \mathrm{ls} \leq 20$.

### 12.1.2 Reset Timer

The first stage thresholds for phase and earth overcurrent protection, negative sequence overcurrent and wattmetric/leCos are provided with a timer hold facility "t Reset".

It may be set to a definite time value or to an inverse definite minimum time characteristic (IEEE/ANSI curves only). This may be useful in certain applications, for example when grading with upstream electromechanical overcurrent relays that have inherent reset time delays.

The second and third stage thresholds for the wattmetric/leCos protection and earth fault overcurrent protection only have a definite time reset.

A possible situation where the reset timer may be used is to reduce fault clearance times where intermittent faults occur.

An example may occur in a cable with plastic insulation. In this application it is possible that the fault energy melts the cable insulation, which then reseals after clearance, thereby eliminating the cause for the fault. This process repeats itself to give a succession of fault current pulses, each of increasing duration with reducing intervals between the pulses, until the fault becomes permanent.

When the reset time of the overcurrent relay is set to minimum the P125, P126 and P127 relays will be repeatedly reset and will not be able to trip until the fault becomes permanent. By using the reset timer hold function the relay will integrate the fault current pulses, thereby reducing fault clearance time.

The mathematical formula applicable to the five curves is:

$$
t=T \times\left(\frac{K}{1-\left(I / I_{S}\right)^{\alpha}}\right)
$$

Where:
t Reset time
K Factor (see table)
I Value of the measured current
Is Value of the programmed threshold (pick-up value)
$\alpha \quad$ Factor (see table)
T Reset time multiplier (RTMS) setting between 0.025 and 1.5.

| Type of curve | Standard | K factor | $\alpha$ factor |
| :--- | :--- | :--- | :--- |
| Short time inverse | C02 | 2.261 | 2 |
| Moderately inverse | ANSI/IEEE | 4.850 | 2 |
| Long time inverse | C08 | 5.950 | 2 |
| Very inverse | ANSI/IEEE | 21.600 | 2 |
| Extremely Inverse | ANSI/IEEE | 29.100 | 2 |

### 12.2 Thermal Overload Curves

The thermal time characteristic is given by:

$$
e^{\left(\frac{-t}{\tau}\right)}=\frac{\left(I^{2}-(k x I F L C)^{2}\right)}{\left(I^{2}-I_{p}^{2}\right)}
$$

## Where:

$\mathrm{t}=$ Time to trip, following application of the overload current, I
$\tau \quad=$ Heating and cooling time constant of the protected plant equipment
I = Largest phase current
$\mathrm{I}_{\mathrm{FLC}} \quad=$ Full load current rating (relay setting 'Thermal Trip')
$\mathrm{k}=1.05$ constant, allows continuous operation up to $<1.05 \mathrm{I}_{\text {FLC }}$
$\mathrm{I}_{\mathrm{P}} \quad=$ Steady state pre-loading current before application of the overload
The time to trip varies depending on the load current carried before application of the overload, i.e. whether the overload was applied from "hot" or "cold".

Curves of the thermal overload time characteristic are given in Technical Data.
The mathematical formula applicable to MiCOM Relays is the following
$\dagger$ Trip $=\operatorname{Te} \ln \left(\frac{\left|K^{2}-\theta^{2}\right|}{\mid K^{2}-\theta \text { trip }{ }^{2} \mid}\right)$
Where :
t Trip $=$ Time to trip (in seconds)
Te $\quad=$ Thermal time constant of the equipment to be protected (in seconds)
$\mathrm{K} \quad=$ Thermal overload equal to leq $/ \mathrm{k} I \theta>$ with:
leq = Equivalent current corresponding to the RMS value of the largest phase current

I $\gg \quad=$ Full load current rating given by the national standard or by the supplier
$\mathrm{k} \quad=$ Factor associated to the thermal state formula
$\theta$ alarm $=$ Initial thermal state .
$\theta$ trip $=$ Trip thermal state
The settings of these parameters are available in the various menus. The calculation of the thermal state is given by the following formula:
$\Theta_{\tau+1}=\left(\frac{l_{\text {eq }}}{k x \mid \Theta>}\right)^{2}\left[1-e^{\left(\frac{-t}{T e}\right)}\right]+\Theta_{\tau} e^{\left(\frac{-t}{T e}\right)}$
$\theta$ being calculated every 100 ms .

## APPLICATION GUIDE

## CONTENT

1. INTRODUCTION ..... 5
1.1 Protection of Underground and Overhead Lines ..... 5
1.2 MiCOM Directional Relays ..... 6
2. CURRENT PROTECTIONS \& AUTOMATION FUNCTIONS ..... 8
2.1 [67/50/51] Directional/non Directional Three Phase Overcurrent Protection (P127) ..... 8
2.2 [67] Directional Overcurrent protection ..... 8
2.2.1 Description ..... 8
2.2.2 Synchronous Polarisation ..... 12
2.2.3 l>...l>>...l>>> Interlock ..... 12
2.2.4 Setting Guidelines ..... 13
2.2.5 Directional three phase overcurrent applications ..... 14
$2.3 \quad$ [50/51] Three phase Overcurrent protection (P126 - P127) ..... 16
2.3.1 Instantaneous Function [50/51] ..... 16
2.3.2 l>...l>>...l>>> Interlock ..... 16
2.3.3 Three phase overcurrent protection applications ..... 17
$2.4 \quad$ Directional Earth Fault Protection (P125, P126 \& P127) ..... 19
2.4.1 General Setting Guidelines ..... 20
2.4.2 An application of 67 N in an Insulated Systems ..... 21
2.4.3 Wattmetric (Pe) Characteristic ..... 23
2.4.4 Application Considerations ..... 25
2.4.5 lecos protection ..... 25
2.4.6 Where use lecos and where use Pe . ..... 25
2.5 Application of a MiCOM P125 relay as a Single Element Power Relay ..... 26
2.5.1 Overview ..... 26
2.5.2 Relay Connection ..... 26
2.5.3 Relay Characteristic Angle Setting ..... 27
2.5.4 Replacing an MWTU11 Reverse Power / Forward Power Relay. ..... 28
2.5.5 Application of the Power Function ..... 28
2.6 Thermal Overload Protection (P126 \& P127) ..... 29
2.6.1 Time Constant Characteristic ..... 29
2.6.2 Mathematical Formula Applicable to MiCOM Relays: ..... 30
2.6.3 Setting Guidelines ..... 30
$2.7 \quad$ Undercurrent Protection (P126 \& P127) ..... 31
$2.8 \quad$ Negative Sequence Overcurrent Protection (P126 \& P127) ..... 32
2.8.1 12 Thresholds Setting Guidelines ..... 32
3. VOLTAGE PROTECTIONS ..... 34
3.1 Setting for the Voltage Connections ..... 34
3.2 Voltage Measurement displayed ..... 35
3.3 Consideration on the measurement menu ..... 35
3.4 (59N) Zero Sequence Overvoltage Protection (P125, P126 \& P127) ..... 35
3.4.1 Setting Guidelines ..... 36
3.5 (27) Undervoltage Protection (P127) ..... 36
3.5.1 Setting Guidelines ..... 36
3.6 (59) Overvoltage Protection (P127) ..... 37
3.6.1 Setting Guidelines ..... 37
4. DESCRIPTION AND SETTING GUIDE OF THE AUTORECLOSE FUNCTION (P126 \& P127) ..... 38
4.1 Available Settings ..... 40
4.2 Functionality ..... 41
4.2.1 Activation ..... 41
4.2.2 ARC setting and functionality ..... 41
4.2.3 Re-closer Lockout ..... 45
4.2.4 Inputs setting ..... 45
4.2.5 Output realys for the ARC (Output relays submenu) ..... 45
4.2.6 Leds for the ARC (Led submenu) ..... 46
4.2.7 ARC Measurements ..... 46
4.2.8 Autoreclose Setting Guidelines ..... 46
4.2.9 Number Of Shots ..... 47
4.2.10 Dead Timer Setting ..... 47
4.2.11 Fuse application ..... 49
5. AUTOMATIC CONTROL FUNCTIONS ..... 51
5.1 Trip Commands ..... 51
5.2 Latch relays ..... 51
5.3 Broken Conductor Detection (P126 \& P127) ..... 51
5.3.1 Setting Guidelines ..... 51
5.3.2 Example Setting ..... 52
5.4 Cold Load Pick-up (P126 \& P127) ..... 52
5.4.1 Air Conditioning / Resistive Heating Loads ..... 52
5.4.2 Motor Feeders ..... 53
5.4.3 Earth Fault Protection Applied to Transformers ..... 53
$5.5 \quad 51 \mathrm{~V}$ and VTS features ..... 53
$5.6 \quad$ Auxiliary Timers (P125, P126 \& P127) ..... 54
5.7 Selective Scheme Logic (P126 \& P127) ..... 55
5.8 Blocking logic function (Blocked directional/non directional overcurrent protection) ..... 56
5.9 Circuit Breaker State Monitoring ..... 57
5.10 Circuit Breaker Condition Monitoring (P126 \& P127) ..... 57
5.11 Circuit Breaker Condition Monitoring Features (P126 \& P127) ..... 57
5.11.1 Setting Guidelines ..... 58
5.12 Circuit Breaker Failure (P126 \& P127) ..... 58
5.12.1 Circuit Breaker Failure Protection Mechanism ..... 59
5.12.2 Breaker Fail Settings ..... 59
5.13 Trip Circuit Supervision (P126 \& P127) ..... 60
5.13.1 MiCOM P126 \& P127 Trip Circuit Supervision Mechanism ..... 60
5.13.2 External Resistor R1 Calculation ..... 63
5.14 Switch onto Fault Protection \& Trip on Reclose (SOTF/TOR) (P126 \& P127) ..... 64
5.14.1 General ..... 64
5.14.2 SOTF/TOR description ..... 64
5.15 Local/Remote conditioning (P125, P126 \& P127) ..... 66
5.15.1 General ..... 66
5.15.2 Local/remote conditioning by logical input ..... 66
5.15.3 Settings ..... 66
5.16 AND Logic Functions (P126 \& P127) ..... 68
6. RECORDS (P126 \& P127) ..... 69
6.1 Event Records ..... 69
6.2 Fault Records ..... 69
6.3 Instantaneous Recorder ..... 69
6.4 Disturbance Records ..... 69
7. ROLLING AND PEAK VALUE DEMANDS (P126 \& P127 ..... 70
7.1 Rolling demand ..... 70
7.2 Peak value demand ..... 71
8. SETTING GROUP SELECTION (P125, P126 \& P127) ..... 72
8.1.1 Setting group change by digital input ..... 72
8.1.2 Priority ..... 72
9. MEASUREMENTS ..... 73
9.1 Power and Energy Measurements (P127) ..... 73
10. LOGIC INPUTS AND LOGIC OUTPUTS ..... 75
10.1 Logic Inputs ..... 75
10.2 Logic Outputs ..... 75
11. MAINTENANCE MODE ..... 76
12. CT REQUIREMENTS ..... 77
12.1 Definite time / IDMT overcurrent \& earth fault protection ..... 77
12.2 Instantaneous overcurrent \& earth fault protection ..... 77
12.3 Definite time / IDMT sensitive earth fault (SEF) protection ..... 77

## BLANK PAGE

## 1. INTRODUCTION

### 1.1 Protection of Underground and Overhead Lines

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

The most common fault conditions, on underground cables and overhead lines, are short circuit faults. These faults may occur between the phase conductors but will most often involve one or more phase conductor becoming short-circuited to earth.

Faults caused by short circuits require the fastest faulted conductor clearance times but at the same time allowing for suitable co-ordination with other downstream protection devices.

Fault sensitivity is an issue common to all voltage levels. For transmission systems, towerfooting resistance can be high. Also, high resistance faults might be prevalent where lines pass over sandy or rocky terrain. Fast, discriminative faulted conductor clearance is required for these fault conditions.

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.

Earthed methods as such as using resistance, Petersen coil or insulated systems make the detection of earth faults arduous. Special protection equipment is often used to overcome these problems.

Nowadays, the supply continuity in the energy distribution is of paramount importance.
On overhead lines most of faults are transient or semi-permanent in nature.
In order to increase system availability multi-shot autoreclose cycles are commonly used in conjunction with instantaneous tripping elements. For permanent faults it is essential that only the faulted section of the network is isolated. High-speed, discriminative fault clearance is therefore a fundamental requirement of any protection scheme on a distribution network.

Power transformers are installed at all system voltage levels and have their own specific requirements with regard to protection. In order to limit the damage incurred by a transformer under fault conditions, fast clearance of the windings with phase to phase and phase to earth faults is a primary requirement.

Damage to electrical plant equipment such as transformers, cables and lines may also be incurred by excessive loading conditions, which leads directly to overheating of the equipment and subsequent degradation of their insulation. To protect against such fault conditions, protective devices require thermal characteristics too.

Uncleared faults, arising either from the failure of the associated protection system or of the switchgear itself, must also be considered. The protection devices concerned should be fitted with logic to deal with breaker failure and relays located upstream must be able to provide adequate back-up protection for such fault conditions.

Other situations may arise on overhead lines, such as broken phase conductors. Traditionally, a series fault has been difficult to detect.

With today's digital technology, it is now possible to design elements, which are responsive to such unbalanced system, conditions and to subsequently issue alarm and trip signals.

On large networks, time co-ordination of the overcurrent and earth fault protection relays can often lead to problematic grading situations or, as is often the case, excessive fault clearance times. Such problems can be overcome by relays operating in blocked overcurrent schemes.

### 1.2 MiCOM Directional Relays

MiCOM relays are a range of products from AREVA T\&D Protection \& Control using the latest digital technology the range includes devices designed for application to a wide range of power system plant equipment such as motors, generators, feeders, overhead lines and cables.

Each relay is designed around a common hardware and software platform in order to achieve a high degree of conformity between products. One such product in the range is the directional overcurrent and directional earth fault relay. Using a wide variety of protection and automatic control functions, the MiCOM directional overcurrent relays can provide protection for many applications, including overhead lines and underground cables at transmission and distribution voltages levels.

The relay also includes a comprehensive range of non-protection features to aid with power system diagnosis and fault analysis. All these features are accessible to the user.

There are 3 available separate models: P125, P126, and P127.
Since they cover a wide range of applications, they optimise installation costs.
The protection and additional features of each model are summarised in the listed table below.

| FUNCTIONS | ANSI CODE | MiCOM <br> P125 | $\begin{array}{\|c} \hline \text { MiCOM } \\ \text { P1 } 26 \end{array}$ | $\begin{array}{\|c} \hline \text { MiCOM } \\ \text { P127 } \end{array}$ |
| :---: | :---: | :---: | :---: | :---: |
| Three phase overcurrent | 50/51 |  | - |  |
| Directional/non directional three phase overcurrent | 67/50/51 |  |  | - |
| Thermal overload | 49 |  | - | $\bigcirc$ |
| Undercurrent | 37 |  | 0 | $\bigcirc$ |
| Negative phase sequence overcurrent | 46 |  | $\bigcirc$ | $\bigcirc$ |
| Broken conductor detection | 46BC |  | $\bigcirc$ | $\bigcirc$ |
| Directional/non directional earth fault | 67N/50N/51N | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
| Wattmetric protection (W or leCos) | 32N/leCos | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
| Undervoltage | 27 |  |  | $\bigcirc$ |
| Overvoltage | 59 |  |  | $\bigcirc$ |
| Residual overvoltage | 59N | - | $\bigcirc$ | $\bigcirc$ |
| Autoreclose (4 shots) | 79 |  | $\bigcirc$ | $\bigcirc$ |
| Circuit breaker failure | 50BF |  | $\bigcirc$ | - |
| Circuit breaker monitoring and control |  |  | $\bigcirc$ | $\bigcirc$ |
| Trip circuit supervision [TCS] |  |  | - | $\bigcirc$ |
| SOTF/TOR (switch on to fault) |  |  | $\bigcirc$ | $\bigcirc$ |
| Blocking logic |  | - | $\bigcirc$ | $\bigcirc$ |
| Cold load pick up |  |  | $\bigcirc$ | $\bigcirc$ |
| Output relay latching | 86 | - | $\bigcirc$ | $\bigcirc$ |
| Selective relay scheme logic |  |  | - | $\bigcirc$ |
| Start contact |  | - | $\bigcirc$ | $\bigcirc$ |
| Programmable AND logic |  |  | $\bigcirc$ | $\bigcirc$ |
| Setting group |  | 2 | 2 | 2 |
| Measurements |  | - | - | $\bigcirc$ |
| Fault records |  |  | $\bigcirc$ | - |
| Event records |  |  | $\bigcirc$ | $\bigcirc$ |
| Disturbance records |  |  | $\bigcirc$ | $\bigcirc$ |
| Diagnostic/self monitoring |  | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |
| Network communication |  | - | - | $\bigcirc$ |
| RS232 front port |  | 0 | $\bigcirc$ | $\bigcirc$ |
| Support software (MiCOM S1) |  | $\bigcirc$ | $\bigcirc$ | $\bigcirc$ |

The directional relays have been designed to provide more functionality in terms of protections, measuring, automatic operation and order control in any medium voltage electric network.

The specific nature of these directional relays makes it possible to apply them to various applications, such as: medium voltage subscriber, cable line, overhead line etc. The earth and phase protection functions include instantaneous information and time delay information.

They can operate in networks with neutral earthed by impedance, by resonant system as such as Petersen coil, in insulated system and in system with neutral earthed.

The protection functions can be used in conjunction with blocking so as to optimise the performance of the protection schemes, thus reducing operating times.

The delay time for the first and second stage for directional/non directional phase and earth fault protections can be chosen to be in definite or inverse delay time (IEC, ANSI/IEEE, CO, RI and RECT).

Instead for the wattmetric / leCos and inverse sequence overcurrent protection, the delay time can be chosen in definite or inverse delay time (IEC, ANSI/IEEE, CO, RI and RECT) for the first threshold only.

This wide choice of characteristics of triggering times makes it possible to easily adapt these directional relays to an existing protection scheme, irrespective of other relays already installed on the network.

## 2. CURRENT PROTECTIONS \& AUTOMATION FUNCTIONS

## $2.1 \quad[67 / 50 / 51]$ Directional/non Directional Three Phase Overcurrent Protection (P127)

The directional/non directional overcurrent protection has three thresholds.
Each threshold can operate in directional or non-directional mode; if the setting is [Yes] it operates like a typical three-phase overcurrent protection.

With the setting [DIR] the relay operates like a three-phase directional overcurrent protection (only for the P127 relay), when the setting is [NO] it can not operate.

The third threshold can be set to operate on the peak of the measured phase current.
It compares the biggest peak value of the measured current against the setting.
The peak detection is applied where a CT saturation condition occurs and the measure is not more trustworthy.

## 2.2 [67] Directional Overcurrent protection

### 2.2.1 Description

If a fault current can flow in both directions through a relay location, it is necessary to add directionality to the overcurrent relays in order to obtain correct co-ordination. Typical systems that require such protection are parallel feeders (both plain and transformer) and ring main systems, each of which are relatively common in distribution networks.

In order to give directionality to an overcurrent relay, it is necessary to provide it with a suitable reference, or polarising signal. The reference generally used is the system voltage, as its angle remains relatively constant under fault conditions. The phase fault elements of the directional relay are internally polarised by the quadrature phase-phase voltages, as listed in the table below:

| Protected Phase | Operating Current | Polarising Voltage |
| :--- | :--- | :--- |
| A Phase | IA | VBC |
| B Phase | IB | VCA |
| C Phase | IC | VAB |



Under system fault conditions, the fault current vector will generally lag its nominal phase voltage by an angle dependent on the system X/R ratio.

It is important that the relay operates with maximum sensitivity for currents lying in this region.
 $\pm 10^{\circ}$ to $\pm 170^{\circ}$ in step of $1^{\circ}$ with reference to RCA (Torque angle) RCA (Torque angle) is settable from $0^{\circ}$ to $359^{\circ}$ in step of $1^{\circ}$

P0079ENa


This is achieved by means of the relay characteristic angle (RCA) setting (also referred to as torque angle). RCA defines the angle by which the current applied to the relay must be displaced from the voltage applied to the relay to obtain maximum relay sensitivity.

A programmable tripping zone with reference to relay characteristic angle (RCA) or torque angle is available.

The calculation of the angle between phase voltage and phase current depends on the values for voltage and current.

The close figure shows the calculation zone.

Each directional threshold consists of:

- Current threshold
- RCA angle /Torque angle and Trip boundary zone

The system voltage provides the polarisation signal, the minimum voltage operating value is 0.6 V secondary for the voltage input range $57-130 \mathrm{~V}$ and 3 V for the voltage input range $220-$ 480V.

The first and second thresholds can be set as definite delay time or inverse delay time using the IEC, IEEE/ANSI, CO, RI and RECT curves where their parameters are shown in the Technical Data of this Technical Guide.

The third threshold can be set as definite delay time only, but can be set to work on the peak of the current measured in non-directional way.

The protection elements trip when the following conditions occur:

- The phase current exceeds the set overcurrent threshold.
- The current vector lies within the trip boundary zone.

The following diagrams show the functionality for each threshold

LOGIC OF THE FIRST THRESHOLD I> FOR THE 67 PROTECTION


Fwd: forward
Rev: reverse


Fwd: forward
Rev: reverse

LOGIC OF THE THIRD THRESHOLD I>>> FOR THE 67 PROTECTION


```
Fwd: forward
Rev: reverse
```

The following figures show the windows where the first phase trip forward and instantaneous reverse trip can be assigned to an output relay. The same one is for the 2nd and 3rd stages.

| tl> | $\begin{aligned} & 8765432 \\ & 0000100 \end{aligned}$ | Assigning the first phase delayed forward directional overcurrent threshold (tl>) to output 4 (RL4). <br> Setting choice: 1 is assigning an output relay; 0 no assignment. |
| :---: | :---: | :---: |
| I_R> | $\begin{aligned} & 8765432 \\ & 0100010 \end{aligned}$ | Assigning the first phase instantaneous reverse directional overcurrent (I_R>) to output 3 \& 7 (RL3 \& RL7). <br> Setting choice: 1 is assigning an output relay; 0 no assignment. |

### 2.2.2 Synchronous Polarisation

The directional overcurrent elements are polarised by the line voltage (phase to phase) in quadrature to the considered phase current.

The absolute phase angle of line voltages is measured every cycle and the last value is stored in the relay memory.

When with close-up three phase faults the polarisation voltage is collapsed, the synchronous polarisation is switched on.

The polarisation discrimination voltage value is 0.6 V (fixed value) for relays with a system voltage of 57 to 130 V and 3 V (fixed value) for relays with a system voltage of 220 to 480V.

Over this value the directional relay uses standard polarisation (the measured voltage), under this value the synchronous polarisation (stored vector) is used. The synchronous polarisation is maintained up to the restoration of an input voltage value.
If the input voltage loss continues longer than $5 s$ the directional overcurrent protection is blocked.
2.2.3 |>...l>>...|>>> Interlock

The choice of this functionality is available when the IDMT delay trip time is chosen on the first threshold.

The following figures show the window where the functionality can be or not to be assigned

| l $\ggg \ggg$ <br> Interlock$\quad$ Yes | Interlock of first threshold by the second and third <br> thresholds, but only if first threshold trip is set to IDMT. <br> Setting choice: No, Yes |
| :--- | :--- |

The $2^{\text {nd }}$ and $3^{\text {rd }}$ threshold pickup can suspend $1^{\text {st }}$ threshold output control to save selectivity
Below it is shown the trend of the delay trip time of the first threshold in the both cases Yes or No.


### 2.2.4 Setting Guidelines

The applied current settings for directional overcurrent relays depend on the specific application. In a parallel feeder arrangement, load current is always flowing in the nonoperating direction. Consequently the relay current setting may be less than the full load rating of the circuit, typically $50 \%$ of In.

Note that the minimum setting that may be applied has to take into account the thermal rating of the relay. Some electro-mechanical directional overcurrent relays have continuous withstand ratings of only twice the applied current setting. Therefore $50 \%$ of rating was the minimum setting that had to be applied.

With the latest generation relays the continuous current rating is 4 x rated current. If required it is now possible to apply much more sensitive settings.

In a ring main arrangement, it is possible for load current to flow in either direction through the point where the relay is located. Consequently the current setting must be above the maximum load current, as in a standard non-directional application.

The required relay characteristic angle (RCA) settings for directional relays will depend on the exact application in which they are used.

For instance for plain feeders where the zero sequence source is behind the relay, a RCA of $30^{\circ}$ should be set.

The following picture shows the above examples.


On the P 127 relay, it is possible to set the relay characteristic angle (RCA) or torque angle, as it is also called, in the range of $0^{\circ}$ to $+359^{\circ}$ in steps of $1^{\circ}$. The trip boundary zone associated to the RCA is settable in the range from $\pm 10^{\circ}$ to $\pm 170^{\circ}$ in steps of $1^{\circ}$.

Further information about the setting range for the directional overcurrent protection are available in the Technical Data document.

### 2.2.5 Directional three phase overcurrent applications

### 2.2.5.1 Parallel Feeders



TYPICAL DISTRIBUTION SYSTEM USING PARALLEL TRANSFORMERS
The above figure shows a typical distribution system using parallel power transformers.
In such an application, a fault at ' $F$ ' could result in the tripping of both relays R3 and R4, and the subsequent loss of supply to the 11 kV busbar.

Consequently with this system configuration, it is necessary to apply directional relays at these locations set to 'look into' their respective upstream transformers.

These relays should co-ordinate with the relays R1 and R2, so that discriminative relay operation during such fault conditions is ensured.

In such an application, relays R3 and R4 may commonly require non-directional overcurrent protection elements to provide protection to the 11 kV busbar, in addition to providing a backup function to the overcurrent relays on the outgoing feeders (R5).

Note that the above requirements outlined for parallel transformer arrangements are equally applicable for plain feeders, which are operating in parallel.

### 2.2.5.2 Ring Main Arrangement

A particularly common arrangement within distribution networks is the ring main circuit. The primary reason for its use is to maintain supplies to consumers in the event of fault conditions occurring on the interconnecting feeders.

A typical ring main with associated overcurrent protection is shown in the following figure.


TYPICAL RING MAIN WITH ASSOCIATED OVERCURRENT PROTECTION
As with the previously described parallel feeder arrangement, it can be seen here that current may flow in either direction through the various relay locations.

Therefore, directional overcurrent relays are again required in order to provide a discriminative protection system.

The normal grading procedure for overcurrent relays protecting a ring main circuit is to open the ring at the supply point and to grade the relays first clockwise and then counterclockwise. The arrows shown at the various relay locations in above figure depict the direction for forward operation of the respective relays, i.e. in the same way as for parallel feeders, the directional relays are set to 'look into' the feeder that they are protecting. The above figure shows typical relay time settings (if definite delay time co-ordination was set), from which it can be seen that faults on the interconnections between stations are cleared without any discrimination by the relays at each end of the feeder.

Again, any of the three overcurrent stages may be configured to be directional and coordinated as per the previously outlined grading procedure, noting that IDMT characteristics are selectable on the first and second stage.

Note that the above requirements outlined for the parallel transformer arrangements are equally applicable for plain feeders, which are operating in parallel.

## $2.3 \quad$ [50/51] Three phase Overcurrent protection (P126 - P127)

The three phase overcurrent protection has three independent thresholds.
The first and second threshold can be set as definite delay time or inverse delay time using the IEC, IEEE/ANSI, CO, RI and RECT curves where their parameters are shown in the Technical Data of this Application Guide.

The third threshold can be set to operate on the peak of the measured phase current. It compares the biggest peak value of the measured current against the setting.

The peak detection is applied where a CT saturation condition occurs and the measure is not more trustworthy.

The logical current over-threshold functionality is defined below.
2.3.1 Instantaneous Function [50/51]

As soon as a phase threshold is running, the instantaneous output associated with this threshold is activated. This output indicates that the protection element has detected a phase fault and that the time delay associated with the threshold has started.
2.3.2 |>...l>>...l>>> Interlock

The choice of this functionality is available when the IDMT delay trip time is selected.
The following figures show the window where this functionality can be or not to be actived.

| $l \ggg \ggg$ <br> Interlock$\quad$ Yes | Interlock of first threshold by the second and third <br> thresholds, but only if first threshold trip is set to IDMT. |
| :--- | :--- | :--- |

Setting choice: No, Yes
The $2^{\text {nd }}$ and $3^{\text {rd }}$ threshold pickup can suspend $1^{\text {st }}$ threshold output control to save selectivity
Below it is shown the trend of the delay trip time of the first threshold in the both cases Yes or No.

l\gg\gg>>Interlock NO


### 2.3.3 Three phase overcurrent protection applications

Being P127 a three phase directional/non directional relay an overcurrent protection involves the P127 used as non directional relay and the P126.

Some applications can be considered, but for indicative applications it is better to involve the blocking logic and selective functions, so an overcurrent application will be shown in the part of this TG regarding the blocking logic and selective function.
The following diagrams show the functionality for each thresholds


## LOGIC OF THE SECOND THRESHOLD I>> FOR THE 50/51 PROTECTION




### 2.4 Directional Earth Fault Protection (P125, P126 \& P127)

The MiCOM P125, P126, P127 relays have a directional/non directional earth fault protection.

It provides three directional/non directional earth overcurrent thresholds and two wattmetric and active earth fault current thresholds.

The first and second threshold can be set as definite or inverse delay time using the IEC, IEEE/ANSI, CO2-8, RI and RECT curves as shown in the Technical Data of the relays; for the wattmetric protection ( $\mathrm{Pe} / \mathrm{leCos}$ ) only the first threshold can be set as definite or inverse delay time, always using IEC, IEEE/ANSI, CO, RI and RECT curves.

The directional earth fault overcurrent protection element compares the earth fault current, residual voltage with the set thresholds le>, Ue>, le>>, Ue>>, le>>>, Ue>>> and the relevant angle between the le and Ue for each threshold. Once all the following listed requirements are met the tripping command is set:

- $\quad$ thresholds for le and Ue are exceeded (earth fault OC protection element)
- le current vector is in the tripping area (le^Ue)
$-\quad$ le $[\mathrm{mA}]+\mathrm{Ue}[\mathrm{V}]>18(\mathrm{len}=1 \mathrm{~A})$ or le $[\mathrm{mA}]+5 x \mathrm{Ue}[\mathrm{V}]>90(\mathrm{len}=5 A)$
- the tripping timer expires.

The protection's tripping area is defined by a tripping zone settable form $\pm 10^{\circ}$ to $\pm 170^{\circ}$ in steps of $1^{\circ}$ for each tripping threshold and a settable angle from $0^{\circ}$ to $359^{\circ}$ in steps of $1^{\circ}$ named torque/RCA angle (le^Ue), which can be separately set for each tripping threshold and

The same threshold can be set as non-directional with definite or inverse delay time.
The third current threshold can be set as directional or non-directional but with only definite delay time setting. The same applies to the Pe or leCos second threshold.

The third threshold can work on the measured peak by an opportune choice in the dedicated submenu. (See the FT part of the TG)

The peak detection is applied where a CT saturation condition occurs and the measure is not more trustworthy.

The reset delay time for each threshold provides protection against intermittent faults.


The close figure shows the forward and reverse tripping zone for the directional earth fault protection.

The protection element also provides a non-sensitive area to avoid instability due to small asymmetries and unbalances that can generally be present in the network system. This condition is represented by the characteristic reproduced below, where the hatched area is the tripping zone.

The tripping zone is limited by the equation le $+(\mathrm{kx} \mathrm{Ue})<(\mathrm{kx} 18)$. (18 is a value derived experimentally where stability is guaranteed).

The $K$ factor is 1 , if len=1A, 5 if len=5A.


The directional earth fault element needs a suitable voltage supply to provide the necessary polarisation. (See the Technical data for further information)

The polarising signal must be representative of the earth fault condition. As residual voltage is generated during earth fault conditions, and this quantity is used to polarise directional earth fault elements. The P127 relay can derive this voltage internally from the 3 phase voltage inputs when the VT connection option 3 Vpn is set. It can also be measured directly by a VT transformer when the VT connection option $2 \mathrm{Vpp}+\mathrm{Vr}$ (two phase to phase) or $2 \mathrm{Vpn}+\mathrm{Vr}$ (two phase to neutral) is set.

The P125 and P126 measures this voltage directly from a broken delta or single VT.

### 2.4.1 General Setting Guidelines

When setting the relay characteristic/torque angle for the three phase directional overcurrent element, a positive angle setting was specified. This was due to the fact that we consider as polarising voltage, the phase voltage value in quadrature of the current under fault conditions. With directional earth fault protection, the residual current under fault conditions lies at an angle lagging the polarising residual earth fault voltage.

The following listed angle settings are recommended to fix the right direction of the earth fault for the various earthed systems.

| Resistance earthed systems | $180^{\circ}$ |
| :--- | :--- |
| Insulated systems | $270^{\circ}$ |
| Petersen Coil system | $200^{\circ}$ |
| Transmission Systems (solidly earthed) | $90^{\circ}-120^{\circ}$ |

The setting ranges for directional/non-directional earth fault and wattmetric protection ( $\mathrm{Pe} / \mathrm{leCos}$ ) can be found in the FT and TD chapters of the technical guide.

### 2.4.2 An application of 67N in an Insulated Systems

The advantage with an insulated power system is that during a single phase to earth fault condition, no high earth fault current will flow. Consequently, it is possible to maintain power flow on the system even with an earth fault condition present. However, this advantage is offset by the fact that the resultant steady state and transient over-voltages on the healthy phases can be very high. In general insulated systems will only be used in low or medium voltage networks where it does not prove too costly to provide the necessary insulation against such over-voltages.

Higher system voltages would normally be solidly earthed or earthed via a low impedance.
Operational advantages may be obtained by the use of insulated systems.
However, it is still essential that detection of the earth fault condition is achieved. This is not possible if standard current operated earth fault protection equipment is used. One possibility for earth fault detection is by applying a residual over-voltage protection device. This functionality is provided by the MiCOM P125, P126 and P127 relays.

However, fully discriminative earth fault protection on this type of system can only be achieved by earth fault protection element. This protection element is included in directional relays MiCOM P125, P126 \& P127.

It is essential that a core balance CT is used for high sensitive earth fault detection. This eliminates the possibility of spill current that may arise from slight mismatches between residually connected line CTs. It also enables a much lower CT ratio to be applied, thereby allowing the required protection sensitivity to be more easily achieved.


From above figure and the vector diagram below it can be seen that the relays on the healthy feeders see the unbalance in the charging currents on their own feeder. The relay on the faulted feeder, however, sees the charging current from the rest of the system [ IH 1 and IH 2 in this case], with it's own feeders charging current [IH3] being cancelled out.


A setting of Torque(RCA) angle of $270^{\circ}$
shifts the center of the characteristic to here

Referring to the vector diagram, it can be seen that the $C$ phase to earth fault causes the phase voltages on the healthy phases to rise by a factor of $\sqrt{3}$.

The A phase charging current (la), is then shown to be leading the resultant A phase voltage by $90^{\circ}$. Likewise, the IB phase charging current leads the resultant voltage Vb by $90^{\circ}$.

The unbalance current detected by a core balance current transformer on the healthy feeders can be seen as the vector addition of la1 and lb1 (la2 and Ib2), giving a residual current which lies at exactly $90^{\circ}$ anticipating the polarising voltage ( $\mathrm{Vr}=3 \mathrm{Ve}$ ).

The vector diagram indicates that the residual currents on the healthy and faulted feeders, IH1\& IH2 and IR3 respectively, are in opposite direction to each other ( $180^{\circ}$ ). A directional element could therefore be used to provide discriminative earth fault protection.

If the polarising voltage of this element, equal to 3 Ve , is shifted through $+270^{\circ}$, the residual current seen by the relay on the faulted feeder will lie within the operate region (Trip Zone) of the directional characteristic. As previously stated, the required RCA setting for the sensitive earth fault protection when applied to insulated systems, is $270^{\circ}$.

### 2.4.3 Wattmetric (Pe) Characteristic

The P125, P126 and P127 relays include the zero sequence power measurement function.
They also offer the possibility to choose between a Wattmetric ( Pe ) protection and leCos (active component of the earth fault current) protection functionality mode.

The following figure shows the characteristic tripping zone for the wattmetric protection.


In the following formula the power thresholds in the relay menu are called $\mathrm{Pe}>$ \& $\mathrm{Pe} \gg$.
The Pe> and Pe>> settings are calculated as:
Vres $x \operatorname{Ires} x \operatorname{Cos}(f-f c)=9 x \operatorname{Vex} \times \operatorname{le} \operatorname{Cos}(f-f c)$
Where:
f $\quad=$ angle between the polarising voltage (Vres) and the residual current
fc = relay characteristic angle (RCA/torque angle)
Vres = residual voltage
Ires = residual current
Ve = zero sequence voltage
le = zero sequence current

### 2.4.3.1 Setting Guidelines for Pe Thresholds

The Pe thresholds are displayed in the format: \#\#.\#\# x len W
In this formula the \#\#.\#\# setting value is multiplied by the setting value of the len.
The threshold value is expressed in Watt secondary.
Example: The $\mathrm{Pe}>$ threshold is to be set from the relay front panel and the setting value is 20W.
len $=1 \mathrm{~A}$, the internal relay setting value will be equal to $20 \times 1=20 \mathrm{~W}$.
To set the thresholds for the Pe (Wattmetric/leCos) protection the relay will display the following menu windows.


The same procedure is to be applied for setting the second Pe>> threshold.
For the settings of the trip delay time see the FT chapter of the TG)

### 2.4.4 Application Considerations

The protection $\mathrm{Pe}>$ and $\mathrm{Pe} \gg$ require relay current and voltage connections to be actived. The measurement of the Pe depends on the voltage wiring of the relay. In case of 3 Vpn wiring the Ve will be equal to $\mathrm{Ve}=1 / 3(\mathrm{Va}+\mathrm{VB}+\mathrm{VC})$ in the other insertions way the applied voltage to the relay is directly used to calculate the Pe.

Referring to the relevant application diagram for the P125, P126 and P127 relays, it should be installed such that its direction for forward operation is 'looking into' the protected feeder i.e. away from the busbar, with the appropriate RCA .

| Resistance earthed systems | $180^{\circ}$ |
| :--- | :--- |
| Insulated systems | $270^{\circ}$ |
| Petersen Coil system | $200^{\circ}$ |
| Transmission Systems (solidly earthed) | $90^{\circ}-120^{\circ}$ |

As illustrated in the relay application diagram, it is usual for the earth fault element to be driven from a core balance current transformer. This eliminates the possibility of spill current that may arise from slight mismatches between residually connected line CTs. It also enables a much lower CT ratio to be applied, thereby allowing the required protection sensitivity to be more easily achieved.

### 2.4.5 lecos protection

The lecos protection follows the same concepts of the Pe protection.
The difference is that the thresholds take in account the active component of the earth fault current.

The setting of the RCA follows the above listed table.
2.4.6 Where use lecos and where use Pe.

The wattmetric protection $\mathrm{Pe} / \mathrm{lecos}$ is almost used in the Petersen Coil systems.
In a Petersen Coil scheme during a fault we have a resistive current and an inductive current.

The resistive current is constant because the residual voltage is always present; the inductive current is the summation of the capacitive contribution of the healthy line and the reactive contribution of the fault line.

In this situation is difficult to discriminate the line and detect the fault current value because the capacitive and reactive are of opposite sign.

Since the residual voltage is present to the parallel between the coil and resistance a wattmetric protection is used to be sure to open the fault line.

The unique resistive present component depends on the fault line.
The discriminative for the using of Pe or lecos protection is the fault current value and the relative fault operating boundary.

In some applications, the residual current on the healthy feeder can lie just inside the operating boundary following a fault condition. The residual current for the faulted feeder lies close to the operating boundary.

In this case, a correct discrimination is achieved by means of an lecos characteristic, as the faulted feeder will have a large active component of residual current, whilst the healthy feeder will have a small value.

For insulated earth applications, it is common to use the lesin characteristic that can be obtained by the setting of the characteristic angle to $90^{\circ}$ or $270^{\circ}$.

### 2.5 Application of a MiCOM P125 relay as a Single Element Power Relay

### 2.5.1 Overview

The MiCOM P125 relay is a single phase relay designed for stand alone directional earth fault protection. This relay incorporates both an leCosø and a Zero Sequence Power element. These elements can be configured to provide a single phase power measurement or alternatively a sensitive directional overcurrent characteristic similar to that of the MWTU11 Reverse Power relay.

Using a MiCOM P125 relay as a stand alone power relay provides a wide setting range, the setting range available is dependent on the CT range ordered. The table below outlines the settings available for each of the voltage and CT input ranges.

|  | Analogue Input |  |  | Setting Range (p.u.) |  |
| :--- | :--- | :--- | :--- | :--- | :---: |
|  | CT Range | VT Range | Pe | le Cos $\varnothing$ |  |
| P125AA | $0.1-40$ | $57-130$ | $10-800 \mathrm{~W}$ | $0.1-40$ |  |
| P125AB |  | $220-480$ | $40-3200 \mathrm{~W}$ |  |  |
| P125BA | $0.01-8$ | $57-130$ | $1-60 \mathrm{~W}$ | $0.01-8$ |  |
| P125BB |  | $220-480$ | $4-640 \mathrm{~W}$ |  |  |
| P125CA | $0.002-1$ | $57-130$ | $0.2-20 \mathrm{~W}$ | $0.002-1$ |  |
| P125CB |  | $220-480$ | $1-80 \mathrm{~W}$ |  |  |

Flexible connection arrangements allow for phase to phase or phase to ground connection of the polarising voltage, a wide range of angle settings allows the relay to operate for Watts or Vars, Import or export.

The VT inputs for the MiCOM P125 relay are rated 57 to 130 Vac or $220-480$ Vac (Selected at time of order) these ranges make the relay suitable for connection to a VT secondary or direct connection to a 415 V systems.

### 2.5.2 Relay Connection

The relay setting angle which is discussed in further detail below allows the user to customise the VT connection to suit the primary plant, available VT secondaries and the protection philosophy of the customer.

The VT connection can be made phase to phase or phase to ground using the connection table below

For simplicity the connection has been made so as a reverse power setting will require an angle of 180 degrees.

| Polarising Voltage | Terminals |  |
| :--- | :---: | :---: |
|  | Leading Subscript <br> (Eg Va-n) | Laging Subscript <br> (Eg Va-n) |
| Va-n |  |  |
| Vb-n | 40 | 39 |
| Vc-n |  |  |
| Va-b |  |  |
| Vb-c |  |  |
| Vc-a |  |  |



One of the possible line CT connection is shown below, The CT input can be connected to any available phase CT, (A, B or C).

### 2.5.3 Relay Characteristic Angle Setting

Below is a table of some of the possible settings to achieve various protection functions for different CT and VT connections, the settings below are with reference to the connections outlined above.

| Function | Voltage | Current | Angle Setting |
| :---: | :---: | :---: | :---: |
| Active Power Import | Va-n | la | 180 |
|  | Vb-n | lb |  |
|  | Vc-n | Ic |  |
|  | Va-b | Ic | 270 |
|  | Vb-c | la |  |
|  | Vc-a | lb |  |
| Reactive Power Import* | Va-n | la | 90 |
|  | Vb-n | lb |  |
|  | Vc-n | Ic |  |
|  | Va-b | Ic | 180 |
|  | Vb-c | la |  |
|  | Vc-a | lb |  |
| Active Power Export | Va-n | la | 0 |
|  | $\mathrm{Vb}-\mathrm{n}$ | lb |  |
|  | Vc-n | Ic |  |
|  | Va-b | Ic | 90 |
|  | Vb-c | la |  |
|  | Vc-a | lb |  |


| Reactive Power Export* | Va-n | la | 20 |
| :--- | :---: | :---: | :---: |
|  | Vb-n | lb |  |
|  | Vc-n | Ic |  |
|  | Va-b | Ic |  |
|  | Vb-c | la |  |
|  | Vc-a | lb |  |

*Refers to lagging Vars import and export

2.5.4 Replacing an MWTU11 Reverse Power / Forward Power Relay.

The MWTU11 was not strictly a power measuring relay. The relay operated using an Icosø characteristic. Provided enough voltage was present to polarise the measuring element, a $1 \%$ setting on a 1 A relay would pickup at 10 mA independent of the voltage magnitude applied.

By selecting the 0.01 to 8len, model number MiCOM P125B, A setting range of 1 to $100 \%$ of the nominal current in $0.1 \%$ steps is available.

### 2.5.5 Application of the Power Function

The standard configuration of the MiCOM P125 when set to use the wattmetric earth fault protection can measure the zero sequence power, the connection for this can be found in the sales publication and service manual. By adopting the connection above the relay can measure the phase current and phase to phase, or phase to ground voltage, the operate quantity when using these connections is a single phase power. As power protection is generally required to operate for balanced three phase conditions basing the protection on a single phase measured quantity is of no consequence.

When using the Power Function of the relay ( Pe ) care must be taken when selecting the relay range. If the MiCOM P125CA relay is considered and is connected phase to ground with 1A CT secondaries. A 0.2 W setting would be equivalent to $0.2 / 63.5$ Watts, $0.3 \%$ of the nominal load.

### 2.6 Thermal Overload Protection (P126 \& P127)

Thermal overload protection can be applied to prevent damages to the electrical plant equipment when operating at temperatures in excess of the designed maximum withstand. A prolonged overloading causes excessive heating, which may result in premature deterioration of the insulation, or in extreme cases, insulation failure.

MiCOM P126 \& P127 relays incorporate a current based thermal replica, using load current to reproduce the heating and cooling of the equipment to be protected. The element thermal overload protection can be set with both alarm and trip stages.

The heating within any plant equipment, such as cables or transformers, is of resistive type ( $\left.I^{2} R x t\right)$. Thus, the quantity of heat generated is directly proportional to current squared $\left(I^{2}\right)$. The thermal time characteristic used in the relay is based on current squared, integrated over time.

The MiCOM P126 \& P127 relays automatically use the highest phase current as input information for the thermal model.

Protection equipment is designed to operate continuously at a temperature corresponding to its full load rating, where heat generated is balanced with heat dissipated by radiation etc. Over-temperature conditions therefore occur when currents in excess of rating are allowed to flow for a certain period of time. It can be shown that temperatures during heating follow exponential time constants and a similar exponential decrease of temperature occurs during cooling.

In order to apply this protection element, the thermal time constant ( Te ) of the plant equipment to be protected is therefore required.

The following sections will show that different plant equipment possesses different thermal characteristics, due to the nature of their construction.

### 2.6.1 Time Constant Characteristic

This characteristic is used to protect cables, dry type transformers (e.g. type AN), and capacitor banks.

The thermal time characteristic is given by:

$$
\mathrm{e}^{\left(\frac{-\mathrm{t}}{\tau}\right)}=\frac{\left(\mathrm{I}^{2}-\left(\mathrm{k} \times \mathrm{I}_{\mathrm{FLC}}\right)^{2}\right)}{\left(\mathrm{I}^{2}-\mathrm{I}_{\mathrm{p}}^{2}\right)}
$$

Where:

$$
\begin{array}{ll}
\mathrm{t} & =\text { Time to trip, following application of the overload current, } \mathrm{I} \\
\tau & =\text { Heating and cooling time constant of the protected plant equipment } \\
\mathrm{I} & =\text { Largest phase current } \\
\mathrm{I}_{\mathrm{FLC}}=\text { Full load current rating (relay setting 'Thermal Trip') } \\
\mathrm{k} & =1.05 \text { constant, allows continuous operation up to }<1.05 \mathrm{I}_{\text {FLC }} \\
\mathrm{I}_{\mathrm{P}} & =\text { Steady state pre-loading current before application of the overload }
\end{array}
$$

The time to trip varies depending on the load current carried before application of the overload, i.e. whether the overload was applied from "hot" or "cold".

Curves of the thermal overload time characteristic are given in Technical Data.

### 2.6.2 Mathematical Formula Applicable to MiCOM Relays:

The calculation of the Time to Trip is given by:
t Trip $=\operatorname{Te} \ln \left(\frac{\left|I x^{2}-\theta^{2}\right|}{\left|I x^{2}-\theta t r i p^{2}\right|}\right)$
With :

$$
\begin{aligned}
& \mathrm{t} \text { Trip }=\text { Time to trip (in seconds) } \\
& \mathrm{Te}=\text { Thermal time constant of the equipment to be protected (in seconds) } \\
& \mathrm{Ix}=\text { Thermal overload equal to leq/kI } \theta> \\
& \mathrm{leq}=\text { Equivalent current corresponding to the RMS value of the largest } \\
& \\
& \mathrm{I} \theta>\text { phase current } \\
& \mathrm{k}=\text { Full load current rating given by the national standard or by the supplier } \\
& \theta=\text { Factor associated to the thermal state formula } \\
& \theta \text { Inip }=\text { Initial thermal state. }
\end{aligned}
$$

The settings of these parameters are available in the various menus.
The calculation of the thermal state is given by the following formula:

$$
\Theta_{\tau+1}=\left(\frac{\mathrm{I}_{\mathrm{eq}}}{\mathrm{k} \times \mathrm{I} \Theta>}\right)^{2}\left[1-\mathrm{e}^{\left(\frac{-\mathrm{t}}{\mathrm{~T}_{\mathrm{e}}}\right)}\right]+\Theta_{\tau} \mathrm{e}^{\left(\frac{-\mathrm{t}}{\mathrm{~T}_{\mathrm{e}}}\right)}
$$

$\theta$ being calculated every 100 ms .

### 2.6.3 Setting Guidelines

The current setting is calculated as:
Thermal Trip ( $\theta$ trip ) = Permissible continuous loading of the plant equipment / CT ratio. Typical time constant values are given in the following tables.

The relay setting, 'Time Constant', is in minutes.
Paper insulated lead sheathed cables or polyethylene insulated cables, placed above ground or in conduits. The table shows $\tau$ in minutes, for different cable rated voltages and conductor cross-sectional areas:

| CSA mm |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
|  | $\mathbf{6}-\mathbf{- 1 1} \mathbf{~ k V}$ | $\mathbf{2 2} \mathbf{~ k V}$ | $\mathbf{3 3} \mathbf{~ k V}$ | $\mathbf{6 6} \mathbf{~ k V}$ |
| $25-50$ | 10 | 15 | 40 | - |
| $70-120$ | 15 | 25 | 40 | 60 |
| 150 | 25 | 40 | 40 | 60 |
| 185 | 25 | 40 | 60 | 60 |
| 240 | 40 | 40 | 60 | 60 |
| 300 | 40 | 60 | 60 | 90 |
|  |  |  |  |  |

Other plant equipment:

|  | Time constant $\tau$ (minutes) | Limits |
| :--- | :--- | :--- |
| Dry-type transformers | 40 | Rating $<400 \mathrm{kVA}$ <br> Rating $400-800 \mathrm{kVA}$ |
| Air-core reactors | 40 |  |
| Capacitor banks | 10 |  |
| Overhead lines | 10 | Cross section $\geq 100 \mathrm{~mm}^{2} \mathrm{Cu}$ <br> or $150 \mathrm{~mm}^{2} \mathrm{Al}$ |
| Busbars | 60 |  |

An alarm can be raised on reaching a thermal state corresponding to a percentage of the trip threshold. A typical setting might be 'Thermal Trip' = 70\% of thermal capacity.

### 2.7 Undercurrent Protection (P126 \& P127)

The undercurrent function [37] makes it possible to detect a loss of load (for example the draining of a pump or breakage of a conveyor belt). It uses definite delay time undercurrent protection.

The user can set the following parameters:

- undercurrent threshold $\mathrm{I}<$
- time delayed undercurrent threshold $\mathrm{tl}<$


## $2.8 \quad$ Negative Sequence Overcurrent Protection (P126 \& P127)

When applying traditional phase overcurrent protection, the overcurrent elements must be set higher than maximum load current, thereby limiting the sensitivity of the element. Most protection techniques also use an earth fault element operating from residual current, which improves sensitivity for earth faults. However, certain faults may arise which can remain undetected by such techniques.

Any unbalanced fault condition will produce negative sequence current of some magnitude. Thus, a negative phase sequence overcurrent element can operate for both phase-to-phase and phase to earth faults.
This section describes how negative phase sequence overcurrent protection may be applied in conjunction with standard overcurrent and earth fault protection in order to alleviate some less common application difficulties.

- Negative phase sequence overcurrent elements give greater sensitivity to resistive phase-to-phase faults, where phase overcurrent elements may not operate.
- In certain applications, residual current may not be detected by an earth fault relay due to the system configuration. For example, an earth fault relay applied on the delta side of a delta-star transformer is unable to detect earth faults on the star side. However, negative sequence current will be present on both sides of the transformer for any fault condition, irrespective of the transformer configuration. Therefore, a negative phase sequence overcurrent element may be employed to provide timedelayed back-up protection for any un-cleared asymmetrical fault.
- Where fuses protect motors on rotating machines, a blown fuse produces a large amount of negative sequence current. This is a dangerous condition for the motor due to the heating effects of negative phase sequence current at double frequency. A negative phase sequence overcurrent element may be applied to provide efficient back-up protection for dedicated motor protection relays.
- It may also be required to simply set an alarm at the presence of negative phase sequence currents on the system. Operators are then prompted to investigate the cause of the unbalance.

The negative phase sequence overcurrent elements have a current pick up settings $12>$, l2>>, l2>>>, and are time delayed in operation by the adjustable timers tl2>, tl2>>, tl2>>>.

### 2.8.1 I2 Thresholds Setting Guidelines

This protection element includes three thresholds.
The first threshold can be set as DT or IDMT trip delay time.
The curves are the same as for the [50/51], [50N/51N] protection.
The current pick-up threshold (settable in the menu PROTECTION G1/[46] Neg. Seg. OC) must be set higher than the normal negative phase sequence current due to the normal load unbalance that is always present on the system. This can be set at the commissioning stage, making use of the relay measurement function to display the standing negative phase sequence current, and apply a setting at least $20 \%$ above.

Where the negative phase sequence element is required to operate for specific un-cleared asymmetric faults, a precise threshold setting has to be based on an individual fault analysis for that particular system due to the complexities involved. However, to ensure operation of the protection element, the current pick-up setting must be set approximately $20 \%$ below the lowest calculated negative phase sequence fault current for a specific remote fault condition.

The correct setting of the time delay is vital for this protection element. It should be also seen that this element is applied primarily to provide back-up protection to other protective devices or to provide an alarm. Therefore, it would be associated with a long delay time.

It must be ensured that the time delay is set longer than the operating time of any other protective device (at minimum fault level) on the system, which may respond to unbalanced faults, such as:

- Phase overcurrent protection elements
- Earth fault protection elements
- Broken conductor protection elements
- $\quad$ Negative phase sequence influenced thermal protection elements


## 3. VOLTAGE PROTECTIONS

### 3.1 Setting for the Voltage Connections

For the P 127 , it is important to select the VTs configuration in the Configuration/ General Options/ VT Connection submenu in according to the relay wiring for a corrected functionality of the voltage protections.

In the above mentioned is menu you will find that for the P127 relay there are three configurations of VTs.

## 1. 3Vpn (Three phase-neutral connection) :

In this configuration, the relay directly measures Ua, Ub, and Uc and calculates internally the zero sequence voltage $\mathrm{Ue}=(1 / 3)[\mathrm{Ua}+\mathrm{Ub}+\mathrm{Uc}]$. This internal value Ue will be used to be compared to the threshold of Ue (the Earth Overvoltage Protection threshold and to evaluate the angle with the earth current for the earth fault directional protection). However, none UN is displayed in the measurement Menu.

## 2. 2Vpn + Vr (Two phase-neutral plus an Open Delta connection) :

In this configuration, the relay directly measures Ua and Ub. The input voltage of phase C of the relay (terminals 73-74) which is connected to the summation of the three voltage phases is used to be compared to the Ue (The earth Overvoltage Protection function threshold). This voltage at C input is considered as Ur and it is displayed in the measurement menu as UN.

Moreover for the phase Overvoltage and Undervoltage protection functions, the phase C voltage value Uc is internally reconstituted using the equation:

- $\quad U c=U a+U b+U r$. This value will be compared to the U/V or O/V threshold in case of a fault in phase C . Uc is not displayed in the measurement menu.
- The reconstruction is valid if the Ur is measured from a transformer with 5 limb;
- two used for the phase voltage Ua and Uc and the others used in Open delta configuration for the Ur.

BE CAREFUL: IF THE Ur IS MEASURED FROM A SEPARATE TRANSFORMER THE ABOVE RECONSTRUCTION IS NOT VALID AND CAN NOT BE USED.

## 3. 2Vpp + Vr (Two phase-phase plus an Open Delta connection) :

The relay directly measures Uab and Ubc, the phase to phase (A-C) voltage value Uca is internally reconstituted using the equation Uca=Uab+Ubc.

The third input of voltage of the relay (terminals 73-74) can be connected to the output of a delta transformer or to a dedicated voltage transformer, the measured value can be used to compare to the earth overvoltage threshold.

This voltage is displayed in the measurement menu as UN and it is designed as the earth voltage.

### 3.2 Voltage Measurement displayed

Here is a summary table of the measured parameters in according to the configuration scheme:

|  | Configuration <br> 3 Vpn | Displayed <br> on HMI | Configuration <br> $2 \mathrm{Vpn}+\mathrm{Vr}$ | Displayed on <br> HMI | Configuration <br> $2 \mathrm{Vpp}+\mathrm{Vr}$ | Displayed on <br> HMI |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Ua | Direct <br> measurement | Yes | Direct <br> measurement | Yes | N.A | N.A |
| Ub | Direct <br> measurement | Yes | Direct <br> measurement | Yes | N.A | N.A |
| Uc | Direct <br> measurement | Yes | Derived <br> measurement | Yes | N.A | N.A |
| Uab | Derived <br> measurement | Yes | Derived <br> measurement | Yes | Direct <br> measurement | Yes |
| Ubc | Derived <br> measurement | Yes | Derived <br> measurement | Yes | Direct <br> measurement | Yes |
| Uac | Derived <br> measurement | Yes | Derived <br> measurement | Yes | Derived <br> measurement | Yes |
| UN | Derived <br> measurement | Yes | Direct <br> measurement | Yes | Direct <br> measurement | Yes |

### 3.3 Consideration on the measurement menu

Why UN for the earth voltage measurement?
The neutral, earth or residual or zero sequence voltage are considered a single voltage and because it is not possible to modify the label in the display we have used the following terminology:

- Ue for the thresholds.
- UN for the measurement menu.
- UN in the fault recorder.

UN for the measurement and fault record menu is to intend residual, zero sequence voltage earth voltage etc.

## 3.4 (59N) Zero Sequence Overvoltage Protection (P125, P126 \& P127)

On a healthy three phase power system, the addition of each of the three phase to earth voltages is nominally zero, as this results from the vector addition of three balanced vectors set at $120^{\circ}$ to one another. However, when an earth fault occurs on the primary system this balance is upset and a 'residual' voltage is produced. This can be measured, for example, at the secondary terminals of a voltage transformer having a "broken delta" secondary connection. Hence, a residual voltage-measuring relay can be used to offer earth fault protection on such a system. Note that this condition causes a rise in the neutral voltage with respect to earth, which is commonly referred to as "neutral voltage displacement".

### 3.4.1 Setting Guidelines

The voltage setting applied to the protection elements is dependent upon the magnitude of residual voltage that is expected to occur during an earth fault condition.

This in turn is dependent upon the method of system earthing employed. It must also be ensured that the relay is set above any standing level of residual voltage that is present on the system.

The protection element has one programmable element with delay time tUe>>>>.
The setting range and the functionality limits for the residual over-voltage are described in the TD chapter, the setting menu is described in the User Guide chapter.

## 3.5 (27) Undervoltage Protection (P127)

Under-voltage conditions may occur on a power system for a variety of reasons, some of which are outlined below:

## Increased system loading

Generally, some corrective action would be taken by voltage regulating equipment such as AVRs or On Load Tap Changers, in order to bring the system voltage back to its nominal value. If this voltage regulating equipment is unsuccessful in restoring healthy system voltage, then tripping by means of ander-voltage relay will be required following a suitable time delay.

Faults occurring on the power system result in a reduction in voltage of the phases involved in a fault. The proportion by which the voltage decreases is directly dependent upon the type of fault, method of system earthing and it's location with respect to the relay installation point. Consequently, co-ordination with other voltage and current-based protection devices is essential in order to achieve sufficient discrimination.

## Complete loss of bus-bar voltage

This may occur due to fault conditions present on the incomer or busbar itself, resulting in total isolation of the incoming power supply. For this condition, it may be a requirement for each of the feeders to be isolated, so that when supply voltage is restored, the load is not connected. Hence, the automatic tripping of a CB on a feeder upon detection of complete loss of voltage on the busbar may be required. This may be achieved by a three-phase undervoltage protection element.

### 3.5.1 Setting Guidelines

In the majority of applications, undervoltage protection is not required to operate during system earth fault conditions. If this is the case, the protection element should be selected in the menu to operate from a phase-to-phase voltage measurement, as this quantity is less affected by the decrease of a single-phase voltage due to an earth fault.

The voltage threshold setting for the undervoltage protection element should be set at some value below the voltage decreases which may be expected under normal system operating conditions. This threshold is dependent upon the system in question but typical healthy system voltage decreases may be in the order of $-10 \%$ of nominal value.

The undervoltage protection element has two programmable thresholds with delay timers: $\mathrm{tU}<, \mathrm{tU} \ll$

After a trip command the thresholds will be reset when all phase voltages have risen above $105 \%$ of setting values.

The undervoltage protection element, which can be set as OR or AND logic, operates by comparing each UAB, UBC and UCA voltage input with the $\mathrm{U}<, \mathrm{U} \ll$ thresholds.

The relay continuously monitors the phase-to-phase voltages.
NOTE: If the relay is connected in the mode 3 Vpn to control the phase to neutral voltages, the thresholds must be multiplied by $\sqrt{3}$.

When OR operating logic is set and one or more voltage values fall below the threshold value, the tripping command is sent after the tripping timer has reached the set overtime condition.

When AND operating logic is set and all of the voltage values have fallen below the threshold value, the tripping command is sent after the tripping timer has reached the set overtime condition.

The protection element under-voltage has two programmable thresholds with definite delay time tU < and tU <<.

Information as to the thresholds setting range can be found in the FT and TD parts of the technical guide.

## $3.6 \quad$ (59) Overvoltage Protection (P127)

As previously discussed, under-voltage conditions are relatively common, as they are related to fault conditions etc. However, over-voltage conditions are also a possibility and are generally related to loss of load conditions as described below.

Under load shedding conditions, the supply voltage will increase in magnitude. This situation would normally be rectified by voltage regulating equipment such as AVRs or on-load tap changers. However, failure of this equipment to bring the system voltage back within prescribed limits, leaving the system with an over-voltage condition which must be cleared in order to preserve the life of the system insulation. Hence, over-voltage protection, which is suitably time delayed to allow for normal regulator action, may be applied. During earth fault conditions on a power system there may be an increase in the healthy phase voltages.
Ideally, the system should be designed to withstand such over-voltages for a defined period of time.

Normally, there will be a relay with a primary protection element employed to detect the earth fault condition and to issue a trip command if the fault is non-cleared after a nominal time. However, in this instance it would be possible to use a relay with an over-voltage protection element as back-up protection. Sufficient would be a single stage of protection, having a definite delay time.

### 3.6.1 Setting Guidelines

The relay with this type of protection element must be co-ordinated with any other overvoltage relay at other locations on the system. This should be carried out in a similar manner to that used for grading current operated protection devices.

The protection element over-voltage has two programmable thresholds and two delay timers, tU>, tU>>.
After a trip command the thresholds will be reset when all phase voltages have fallen below $95 \%$ of setting values.

The overvoltage protection element, which can be set as OR or AND logic, operates by comparing each UAB, UBC and UCA voltage input with the U>, U>> thresholds.

NOTE: If the relay is connected in the mode 3 Vpn to control the phase to neutral voltages, the thresholds must be multiplied by $\sqrt{3}$.

When OR operating logic is set and one or more voltage has risen above the threshold value, the tripping command is sent after the tripping timer has reached the set overtime condition.

When AND operating logic is set and all of the voltage values have risen above the threshold value, the tripping command is sent after the tripping timer has reached the set overtime condition.
Information as to the thresholds setting range can be found in the FT and TD parts of the technical guide.

## 4. DESCRIPTION AND SETTING GUIDE OF THE AUTORECLOSE FUNCTION (P126 \& P127)

An analysis of faults on any overhead line network has shown that $80-90 \%$ are transient in nature. A transient fault, such as an insulator flashover, is a self-clearing 'non-damage' fault. This type of fault can be cleared by the immediate tripping of one or more circuit breakers to isolate the fault, and does not recur when the line is re-energised. Lightning is the most common cause of transient faults, other possible causes being clashing conductors and wind blown debris. The remaining $10-20 \%$ of faults are either non-permanent (arcing fault) or permanent.

A small tree branch falling on the line could cause a non-permanent fault. Here the cause of the fault would not be removed by the immediate tripping of the circuit, but could be burnt away during a time-delayed trip.

Permanent faults could be broken conductors, transformer faults, cable faults or machine faults that must be located and repaired before the supply can be restored.

In the majority of fault incidents, if the faulty line is immediately tripped out, and time is allowed for the fault arc to de-ionise, re-closure of the circuit breakers will result in the line being successfully re-energised. Autoreclose approaches are employed to automatically reclose a switching device at a set time after it has been opened due to operation of protection where transient and non-permanent faults are prevalent.

On HV and MV distribution networks, the autoreclose function is applied mainly to radial feeders where system stability problems do not generally arise. The main advantages to be derived from using autoreclose can be summarised as follows:

- Minimises interruptions in supply to the consumer.
- Reduces operating costs - less man-hours in repairing fault damage and the possibility of running substations unattended. With autoreclose instantaneous protection can be used which means shorter fault durations which gives rise to less fault damage and fewer permanent faults.

As $80 \%$ of overhead line faults are transient, elimination of loss of supply from such faults, by the introduction of the autoreclose function gives obvious benefits. Furthermore, autoreclose may allow a particular substation to operate unattended. In the case of unattended substations, the number of visits by personnel to re-close a circuit breaker manually after a fault can be substantially reduced, which is an important consideration for substations in remote areas.

The autoreclose function gives an important benefit on circuits using time-graded protection, in that it allows the use of instantaneous protection to give a high-speed first trip. With fast tripping, the duration of the power arc resulting from an overhead line fault is reduced to a minimum, thus lessening the chance of damage to the line, which might otherwise cause a transient fault to develop into a permanent fault.

Using short time delay protection also prevents blowing of fuses and reduces circuit breaker maintenance by eliminating pre-arc heating when clearing transient faults.

The next figure shows an example of 4 autoreclose cycles (maximum numbers of allowed cycles) to the final trip:
tD1, tD2, tD3, tD4 = dead time 1, 2, 3 and 4 timers
tR = Reclaim time
$\mathrm{O}=\mathrm{CB}$ open
$C=C B$ closed


TYPICAL AUTORECLOSE CYCLES
It should be noted that when short time delay protection is used with autoreclose, the scheme is normally arranged to block the instantaneous protection after the first trip. Therefore, if the fault persists after re-closing, the time-graded protection will give discriminative tripping with fuses or other protection devices, resulting in the isolation of the faulted section. However, for certain applications, where the majority of the faults are likely to be transient, it is not uncommon to allow more than one instantaneous trip before the instantaneous protection is blocked. Some schemes allow a number of re-closings and time graded trips after the first instantaneous trip, which may result in the burning out and clearance of non-permanent faults. Such an approach may also be used to allow fuses to operate in teed feeders where the fault current is low.

When considering feeders which consist partly of overhead lines and partly of underground cables, any decision to apply the autoreclose function would be influenced by all data known on the frequency of transient faults. When a significant proportion of the faults are permanent, the advantages of autoreclose are small, particularly since re-closing on to a faulty cable is likely to aggravate the damage.

For the autoreclose function relay settings, see FT (User Guide, tree autoreclose menu) and the TD (Technical Data).

The Autoreclose function provided by the P126 \& P127 relays presents the typical functionality of an autoreclose function plus auxiliary functionality.

The setting for the ARC and all the functionality are listed below too.

### 4.1 Available Settings

The setting parameters are listed in the table below.

| MENU TEXT | SETTING RANGE |  | STEP SIZE |
| :---: | :---: | :---: | :---: |
| PROTECTION G1 | MIN | MAX |  |
| Autoreclose? | NO | YES | YES/NO |
| Ext CB Fail? | NO | YES |  |
| Ext CB Fail Time | 000.01 ms | 600, 00 sec | 0.01 sec |
| Ext Block? | NO | YES |  |
| tD1 | 000.01 sec | 300, 00 sec | 0.01 sec |
| tD2 | 000.01 sec | 300, 00 sec | 0.01 sec |
| tD3 | 000.01 sec | 600, 00 sec | 0.01 sec |
| tD4 | 000.01 sec | 600, 00 sec | 0.01 sec |
| Reclaim Time tR | 000.02 sec | 600, 00 sec | 0.01 sec |
| Inhibit Time tl | 000.02 sec | 600, 00 sec | 0.01 sec |
| Phase Cycles | 0 | 4 | 1 |
| E/Gnd Cycles | 0 | 4 | 1 |
| Cycles tl> | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ | $\begin{aligned} & 4321 \\ & 2222 \end{aligned}$ | 0/1/2 |
| Cycles tl>> | $\begin{aligned} & 4321 \\ & 0000 \\ & \hline \end{aligned}$ | $\begin{aligned} & 4321 \\ & 2222 \end{aligned}$ | 0/1/2 |
| Cycles tl>>> | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ | $\begin{aligned} & 4321 \\ & 2222 \end{aligned}$ | 0/1/2 |
| Cycles tle> | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ | $\begin{aligned} & 4321 \\ & 2222 \end{aligned}$ | 0/1/2 |
| Cycles tle>> | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ | $\begin{aligned} & 4321 \\ & 2222 \end{aligned}$ | 0/1/2 |
| Cycles tle>>> | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ | $\begin{aligned} & 4321 \\ & 2222 \end{aligned}$ | 0/1/2 |
| Cycles tPe/lecos>, | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ | $\begin{aligned} & 4321 \\ & 2222 \end{aligned}$ | 0/1/2 |
| Cycles tPe/lecos>> | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ | $\begin{aligned} & 4321 \\ & 2222 \end{aligned}$ | 0/1/2 |
| Cycles tAux1 | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ | $\begin{aligned} & 4321 \\ & 2222 \end{aligned}$ | 0/1/2 |
| Cycles tAux2 | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ | $\begin{aligned} & 4321 \\ & 2222 \end{aligned}$ | 0/1/2 |

### 4.2 Functionality

### 4.2.1 Activation

Firstly if you want to utilise the ARC (Autoreclose) you have to set the parameters in correct way.
If you do not execute correctly the setting, on the LCD of the relay an Alarm Message appears indicating:"Conflict Recloser".
4.2.2 $\quad$ ARC setting and functionality

The sequence below is the sequence of setting using the keys on the front panel.

## 1. Enable the Autoreclose

Set the Autoreclose to Yes .
Immediately could appear the message:"Conflict Recloser".
Do not worry, you are hardly beginning to set your ARC and some settings must be worked out.
2. Ext CB Fail

It is possible to consider the possibility to detect a CB fail during the autoreclosing cycles. This signal is provided by the CB equipment (for instance low SF6) and it has to be assigned to a digital input by the Automatic Control inputs submenu.
If you decide to use this feature sets Yes, than you also have to set the Ext.CB Fail time. The CB will be declared fault and the autoreclose will move in the locked status when the Ext. CB Fail time will be elapsed and the Ext CB Fail will stand active. The Ext. CB Fail timer will start when the tD will be expired. If during this time the signal Ext CB Fail will disappear the ARC will continue with its programmed cycles. If your setting is No, the Ext. CB Fail function won't be actived
3. Ext. Block

The Ext. Block means that it is possible to lock the autoreclose by an external command. If you set this item to Yes to make it active you have to assign to a digital input the function Block 79 by the inputs submenu in Automatic control function. With the Ext. Block actived (the relevant digital input supplied) the autoreclose will move to the locked status after a protection trip involved in the sequences matrix of the ARC.
4. Dead Time (tD1, tD2, tD3, tD4) and 50 ms time window

An autoreclose cycle can be initiated by the trip of a protection element (phase, earth or external input) with the CB closed (52a input signal energised). The dead time (tD1, tD2, tD3 and tD4) starts when the digital input connected to the 52a, auxiliary contact of the CB, is de-energised and the involved protection threshold reset. It means that CB has tripped. If on trip protection the CB opening signal (52a) is lacking, after a fixed time out of 2.00 s at 50 Hz or 1.67 s at 60 Hz , the ARC resets to the initial status. If on trip protection the 52a signal changes status but the protection threshold trip stands the tD timer will start when the protection trip threshold will disappear.
In the above case NONE TIME OUT IS FORECASTED.
The 52a signal has to assigned to a digital input by by the inputs submenu in
Automatic control function. The 52a signal is in accordance with the CB status

| Auxiliary Contact status |  | CB Status |
| :---: | :---: | :---: |
| 52 A | 52 B | ----------------- |
| Open | Closed | Circuit Breaker open |
| Closed | Open | Circuit Breaker closed |

Within the tD a further time window is active. This time window starts together to the td.It expires after 50 ms .

If within this time window a threshold involved in the trip of the $C B$ and in the ARC cycle is intermittent the ARC will be lock.

## 5. Reclaim Time tR

When the tD timer is expired, a close command is launched to the CB by an output relay, the reclaim time ( $\dagger \mathbf{R}$ ) will begin to count when the 52 a input will be energized. It will mean that the $C B$ is closed.
When the close command is launched the tClose Pulse timer begins to count too. This timer takes a look to the change of the 52a status from low to high, if the timer expired before changing of the 52a, a time out condition has occurred and the ARC function will move to the locked status. Otherwise the timer will be reset and the ARC will continue with the setting cycles.
The setting for the t Close Pulse timer is available in the Automatic Control CB Supervision submenu.
If during the tR the 52a will change status from high to low (CB from close to open status), the ARC will move to the lock status.
If none phase or earth current threshold, earth power threshold or external digital input will trip within the reclaim time, at the expiring of $t R$, the autoreclose function resets to the initial status ready to re-start for a new cycles sequence.

## 6. Inhibit Time tI

The Inhibit time starts when an intentional closing action is executed on the CB. Any trip opening the CB within the tl timer will move the ARC in the lock status. The setting value of the Inhibit Time ( $\mathbf{t l}$ ) can be used to prevent autoreclose being initiated when the CB is manually closed onto a fault.
7. Phase and earth fault cycles number

The maximum available auto-recloser cycles in the ARC in the P126 and P127 are 4. The user can set 4 cycles for the earth faults and 4 cycles for the phase faults or other. The auto-recloser algorithm will execute a maximum of 4 cycles.
What does it mean?
It means, for instance, we have set 4 auto-recloser cycles for earth fault and 4 autorecloser cycles for phase fault.
During a fault situation we have already executed 2 autoreclose cycles for a phase fault, if the next fault will be an earth fault the ARC will be able to execute the remaining ones. The number of set cycles, earth and/or phase, must be in accordance with the set of the ARC configuration matrix setting. The setting to 0 of the phase cycles and/or the earth cycles means that any trip of phase or earth are considered final trip. The autoreclose will move in the lock status.
8. ARC configuration matrix

From the 6A software version it has been implemented the possibility to assign to any phase current threshold, to any earth fault current/power threshold and to the tAux1 and tAux2 the cycle where to have a recloser action or a definitive trip or a trip without the relevant activation of the relay 1 . The listed table below shows the involved thresholds and the relevant setting way.

| Cycles <br> tl> | 4321 <br> 0000 | 2321 <br> 2222 | $0 / 1 / 2$ |
| :--- | :--- | :--- | :---: |
| Cycles <br> tl>> | 4321 | 4321 | $0 / 1 / 2$ |
| Cycles <br> tl>>> | 4321 <br> 0000 | 2222 <br> 2221 | $0 / 1 / 2$ |
| Cycles <br> tle> | 4321 <br> 0000 | 4321 <br> 2222 | $0 / 1 / 2$ |
| Cycles <br> tle>> | 4321 <br> 0000 | 4321 <br> 2222 | $0 / 1 / 2$ |
| Cycles <br> tle>>> | 4321 | 4321 | $0 / 1 / 2$ |
| Cycles <br> tPe/lecos>, | 0000 | 2222 | $0 / 1221$ |
| 0000 | 4321 | $0 / 1 / 2$ |  |
| Cycles <br> tPe/lecos>> | 2222 |  |  |
| Cycles <br> tAux1 (phase) | 0000 | 4321 <br> 2222 | $0 / 1 / 2$ |
| Cycles <br> tAux2 (earth) | 4321 <br> 0000 | 4321 <br> 2222 | $0 / 1 / 2$ |

The settings 0,1 and 2 means:
$\mathbf{0}=$ means that any trip of the threshold is considered final trip.
The autoreclose will move in the lock status.
1 = trip on threshold pick up, followed by the programmed reclosing activity
$\mathbf{2}=$ none trip on threshold pick up, and this one whatever in AUTOMAT.CRTL/Trip Command submenu is set to ON. With this setting after that the tR is expired a "Recloser Successful" message is displayed on the LCD. The autoreclose is ready for a new cycles sequence.

It can occur that instead of 0,1 or 2 reading the setting on the LCD we find the symbol means that the download setting regarding the configuration matrix by a remote program (S1 or other) was wrong.
In the above case none message is provided but the autoreclose does not operate for the setting threshold error, if tl (inhibit time) is greater of the trip delay of the involved threshold the ARC will move to the lock status. The ARC executes the normal cycles for the other corrected settings.

## NOTE: Pay attention to the ARC setting both in local and remote.

The set of the cycles number, phase or earth and the setting of the configuration matrix are related each other strictly.
Below a setting example to define the ARC cycles number. The rule to define the available cycles number is listed below.

It is valid both for the phase and earth thresholds using the thresholds le>, le>>, le>>>, Pe/lecos>, $\mathrm{Pe} / \mathrm{lecos>>}$, tAux2.

1. To have at least an ARC cycle the right item must be equal to 1 .
2. The presence of one has to be counted starting from right.

|  | A | B | C | D |
| :---: | :---: | :---: | :---: | :---: |
| Cycles | 4321 | 4321 | 4321 | 4321 |
| tl> | 0000 | 0011 | 0011 | 0010 |
| Cycles | 4321 | 4321 | 4321 | 4321 |
| tl>> | 0000 | 0200 | 1200 | 1000 |
| Cycles | 4321 | 4321 | 4321 | 4321 |
| tl>>> | 0010 | 0002 | 2010 | 0021 |
| Cycles | 4321 | 4321 | 4321 | 4321 |
| tAux1 (phase) | 1110 | 0100 | 0000 | 0020 |
| Counting of the ones | 1110 | 0111 | 1011 | 1011 |
| Setting of the ARC number cycles | 0 | 3 | 2 | 2 |

Two examples of setting are listed below.

## Example 1

We suppose to set the ARC as following.
$\mathrm{tl}=0.5 \mathrm{~s}, \mathrm{tD} 1=\mathrm{tD} 2=\mathrm{tD} 3=\mathrm{tD} 4=1 \mathrm{~s} ; \mathrm{tR}=2 \mathrm{~s}$
Phase cycles number equal to 2 .

| CYCLES | 4321 |
| :--- | :--- |
| tl> | 0211 |

The tl> = ON in Automat. CTRL/Trip Command menu
With the above setting we will have two autoreclose cycles. The third will be executed without any trip command and when the tR will be elapsed a "Recloser Successful" message will be provided on the LCD.
An end of third cycle (setting item $=2$ ) the ARC will move to the initial status. If the $\mathrm{tl}>\mathrm{is}$ present a new ARC cycles will begin again.

## Example 2

We suppose to set the ARC as following. $\mathrm{tl}=0.5 \mathrm{~s}, \mathrm{tD} 1=\mathrm{tD} 2=\mathrm{tD} 3=\mathrm{tD} 4=1 \mathrm{~s} ; \mathrm{tR}=2 \mathrm{~s}$.
Phase cycles number equal to 4 .

| CYCLES | 4321 |
| :--- | :--- |
| tl> | 0211 |


| CYCLES | 4321 |
| :--- | :--- |
| tl>> | 1111 |

The $\mathrm{tl}>$ and $\mathrm{tl} \gg=\mathrm{ON}$ in Automat. CTRL / Trip Command menu
If there is only a trip of the tl> the functionality of the ARC will be the same as above(example 1), if during the third cycle of the tl> a trip of the tl>> will occur, the autoreclose will operate in accordance with the setting of the tl>>.(example 2)

### 4.2.3 Re-closer Lockout

If protection operates during the reclaim time, following the final re-close attempt, the relay will lockout and the autoreclose function is disabled until the lockout condition is removed.

The ARC is locked for a trip during the $t D+t R$ time by:

- Any opening command launched to the CB
- Residual Over-voltage trip (59N)
- $\quad$ Negative sequence overcurrent trip (46)
- Thermal overload trip (49)
- Maximum setting number of autoreclose cycles achieved.
- $\quad$ Setting for any protection $=0$
- Trip of CB fail (52BF)
- TCS (Trip circuit supervision)
- Diagnostic of the CB
- Close/Open CB operating time over the threshold set.

If the auxiliary supply is lost during an autoreclose cycle, the autoreclose function is totally reset.

The lockout ARC condition can be removed by:

- CB manual closing command,
- The acknowledge of the message displayed on the LCD by pressing the © key on front panel of the relay,
- By acquisition of the alarms by local (S1) or by remote.


### 4.2.4 Inputs setting

For the configuration the only involved digital input is the CB status 52a.
This setting is necessary for the ARC functionality. The lacking of this setting generates the alarm "Conflict Recloser".

This signal follows the rule:

| Auxiliary Contact status | CB Status |
| :---: | :---: |
| 52A | ----------------- |
| Open (Low) | Circuit Breaker open |
| Closed (High) | Circuit Breaker closed |

4.2.5 Output realys for the ARC (Output relays submenu)

The ARC function provides the following information 79 Run and 79 Trip.
The ARC provides the command for the closing of the CB (CB Close).
The CB close setting must be assigned to an output relay controlling the closing of the CB.
This setting is necessary for the ARC functionality. The lacking of this setting generates the alarm "Conflict Recloser". No other functionality, excluding CTRL Close assignment, can be associated to this relay, otherwise a "Conflict Recloser" alarm is provided.

The 79 Run provides the information that the timer tD or the timer tR is in progress, when the $t R$ expires to the last cycle programmed or a 79 locked occurs, the 79 Run information is reset.

The 79 Trip provides the information that the ARC has been moved in the lock status.

### 4.2.6 Leds for the ARC (Led submenu)

The ARC function provides a signal light information by the leds from 5 to 8 on the front panel of the relay the following information: Recloser Run equivalent to 79 Run and Recloser Blocked equivalent to 79 Trip.

### 4.2.7 ARC Measurements

In the measurement menu are available the counters relevant to the number of operations execute All counters can be reset to 0 by pressing the (c) key on the front panel of the relay or by local (S1) or remote command.

The available counters are

- Reclosers number,
- Number of Reclosers on the Cycle1
- Number of Reclosers on the Cycle2
- Number of Reclosers on the Cycle3
- Number of Reclosers on the Cycle4
- Number of Total 79 Trip and Lockout
4.2.8 Autoreclose Setting Guidelines

Below there are listed the fundamental settings to enable the ARC to operate.
Again. it is important to consider the congruence between the number of programmed cycles and the configuration matrix.

A non-valid configuration provides a recloser configuration alarm (Conflict Recloser).

| SETTING CONDITION FOR THE ARC FUNCTIONALITY |  |  |
| :--- | :---: | :--- |
| Autoreclose | On |  |
| Phase Cycles or/and E/GND Cycles | At least 1 | If the cycle = 0 none ARC available |
| Congruence between the number of <br> forecasted cycles and the settings of the <br> trip matrix | 1234 <br> 0111 | Max number available cycle equal to <= 3 |
| Trip Command | At least a trip <br> command. | Overcurrent and/or earth fault overcurrent <br> trip thresholds One of them is enough |
| One of the digital inputs from 1 to 7. The <br> relevant input must be configured as <br> Active High | $52 a$ | This input must be in accordance with the <br> CB position: HIGH with CB close, LOW <br> with CB opened. |
| One of the relays from 2 to 8 | CB Close | This relay must be only assigned to this <br> function. |

### 4.2.9 Number Of Shots

There are no clear-cut rules for defining the number of shots for a particular application. Generally medium voltage systems utilize only two or three shot autoreclose schemes. However, in certain countries, for specific applications, four shot approaches are not uncommon. Four shots have the advantage that the final dead time can be set sufficiently long to allow any thunderstorms to pass before re-closing for the final time. This approach will prevent unnecessary lockout for consecutive transient faults.

Typically, the first trip, and sometimes the second, will result from short time protection. Since $80 \%$ of faults are transient, the subsequent trips will be time delayed, all with increasing dead times to clear non-permanent faults.

In order to determine the required number of shots the following factors must be taken into account:

An important consideration is the ability of the circuit breaker to perform several trip-close operations in quick succession and the effect of these operations on the maintenance period.

If statistical information on a particular system shows a moderate percentage of nonpermanent faults, which could be burned out, two or more shots are justified. In addition to this, if fused 'tees' are used and the fault level is low, the fusing time may not discriminate with the main IDMT relay and it would then be useful to have several shots. This would warm up the fuse to such an extent that it would eventually blow before the main protection operated.

### 4.2.10 Dead Timer Setting

The following factors can influence the choice of dead timer setting. Due to the great diversity of load, which may exist on a system it may prove very difficult to arrive at an optimum dead time. However, it is possible to address each type of load individually and thereby arrive at a typical dead time. The most common types of load are addressed below.

Synchronous motors are only capable of tolerating extremely short interruptions of supply without loss of synchronism. In practice it is desirable to disconnect the motor from the supply in the event of a fault. The dead time should be sufficient to allow the motor no-volt device to operate. Typically, a minimum dead time of $0.2-0.3$ seconds has been suggested to allow this device to operate. Induction motors, on the other hand, can withstand supply interruptions, up to a maximum of 0.5 seconds and then re-accelerate successfully. In general dead times of 3-10 seconds are normally satisfactory, but there may be special cases for which additional time is required to permit the resetting of manual controls and safety devices.

Loss of supply to lighting circuits, such as street lighting may be important for safety reasons as intervals of 10 seconds or more may be dangerous for traffic. The main considerations of supply interruptions for domestic customers are those of inconvenience.

An important measurement criterion for many power utilities is the number of minutes lost per year to customers, which will be reduced on feeders using autoreclose and will also be affected by the dead time settings used.

For high-speed autoreclose the minimum dead time of the power system will depend on the minimum time delays imposed by the circuit breaker during a tripping and re-closing operation.

Since a circuit breaker is a mechanical device, it will have an inherent contact separation time. The operating time for a modern circuit breaker is usually within the range of 50-100 ms , but could be longer with older designs.

After tripping, time must be allowed for the mechanism to reset before applying a closing pulse. This resetting time will vary depending on the circuit breaker, but is typically 0.1 seconds.

Once the circuit breaker has reset, it can begin to close. The time interval between the energizing of the closing mechanism and the making of the contacts is termed the closing time. Owing to the time constant of a solenoid closing mechanism and the inertia of the plunger, a solenoid closing mechanism may take 0.3 s . A spring-operated breaker, on the other hand, can close in less than 0.2 seconds.

Where high-speed re-closing is required, which is true for the majority of medium voltage applications, the circuit breaker mechanism itself dictates the minimum dead time. However, the fault de-ionizing time may also have to be considered. High-speed autoreclose may be required to maintain stability on a network with two or more power sources. For high-speed autoreclose the system disturbance time should be minimized by using fast protection, <50 ms , such as distance or feeder differential protection and fast circuit breakers $<100 \mathrm{~ms}$. Fast fault clearances can reduce the required fault arc de-ionizing time.

For stability between two sources a dead time of $<300 \mathrm{~ms}$ may typically be required. When only considering the $C B$ the minimum system dead time is given by the mechanism reset time plus the CB closing time. Thus, a solenoid mechanism will not be suitable for highspeed autoreclose as the closing time is generally too long.

For high-speed autoreclose the fault de-ionizing time may be the most important factor when considering the dead time. This is the time required for ionized air to disperse around the fault position so that the insulation level of the air is restored. This can be approximated from the following formula:

De-ionizing time $=\left(10.5+\frac{\text { Vsys }}{34.5}\right) \times \frac{1}{\text { frequency }}[\mathrm{s}] \quad($ Vsys $=$ System voltage in kV$)$
For $66 \mathrm{kV}=0.25 \mathrm{~s}(50 \mathrm{~Hz})$
For $132 \mathrm{kV}=0.29 \mathrm{~s}(50 \mathrm{~Hz})$
It is essential that the protection fully resets during the dead time, so that correct time discrimination will be maintained after re-closing on to a fault. For high-speed autoreclose instantaneous reset of protection is required.

Typical $11 / 33 \mathrm{kV}$ dead time settings in the UK are as follows:
1st dead time $=5-10$ seconds
2nd dead time $=30$ seconds
3rd dead time $=60-100$ seconds
4th dead time (uncommon in the UK, however used in South Africa) =60-100 seconds

### 4.2.10.1 Reclaim Timer Setting

A number of factors influence the choice of the reclaim timer, such as:

- Supply continuity - long reclaim times can result in unnecessary lockout for transient faults.
- Fault incidence and past experience - short reclaim times may be required where there is a high incidence of lightning strikes to prevent unnecessary lockout for transient faults.
- $\quad$ Spring charging time - for high-speed autoreclose the reclaim time may be set longer than the spring charging time to ensure there is sufficient energy in the circuit breaker to perform a trip-close-trip cycle. For delayed autoreclose there is no need to set the reclaim time longer than the spring charging time as the dead time can be extended by an extra CB healthy check window time if there is insufficient energy in the CB. If there is insufficient energy after the check window time has elapsed the relay will lockout.
- Switchgear maintenance - excessive operation resulting from short reclaim times can mean shorter maintenance periods. A minimum reclaim time of $>5 \mathrm{~s}$ may be needed to allow the CB time to recover after a trip and close operation before it can perform another trip-close-trip cycle. This time will depend on the duty (rating) of the CB.
- The reclaim time must be long enough to allow any time-delayed protection initiating autoreclose to operate. Failure to do so would result in premature resetting of the autoreclose scheme and re-enabling of instantaneous protection.
- If this condition arose, a permanent fault would effectively look like a number of transient faults, resulting in continuous autoreclose operations unless additional measures were taken to overcome this, such as excessive fault frequency lockout protection.
- A sensitive earth fault protection is usually applied to detect high resistance earth faults
Usually, a long trip delay time is set, typically 10-15 s. This longer time may be taken into consideration, if autoreclose is started by an earth fault protection, and when deciding on a reclaim time, if the reclaim time is not blocked by a SEF protection start signal. Sensitive earth faults, for example, a broken overhead conductor in contact with dry ground or a wood fence, is rarely transient and presents great danger to persons and animals. It is therefore common practice to block autoreclose by operation of sensitive earth fault protection and lockout the circuit breaker.
- Where motor-wound spring closed circuit breakers are used, the reclaim time must be at least as long as the spring winding time for high-speed autoreclose to ensure that the breaker can perform a trip-close-trip cycle.
- A typical $11 / 33 \mathrm{kV}$ reclaim time is $3-10$ seconds; this prevents unnecessary lockout during thunderstorms. However, reclaim times up to 60-180 seconds maybe used.


### 4.2.11 Fuse application

An application of the ARC is the coordination with a fuse. This application is typical in rural areas where derived lines are protected by a fuse.


We suppose to have the following settings for the protection and the ARC narrow to the configuration matrix. All the others have to be compliance with the rules above.

| 67 protection |  |
| :---: | :---: |
| $1>\mathrm{ON}$ | $1 \gg \mathrm{ON}$ |
| $1>8 \mathrm{ln}$ | $1 \gg 10 \mathrm{ln}$ |
| $\mathrm{tl}>5 \mathrm{sec}$. | tl>> 0 sec |
| AUTORECLOSE (only the matrix) |  |
| ARC cycles AR init tl> | $\begin{array}{lll} 4 & 3 & 1 \\ 0 & 1 & 1 \end{array}$ |
| ARC cycles AR init tl>> | $\begin{aligned} & 4321 \\ & 0021 \end{aligned}$ |
| ARC cycles AR init tl>>> | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ |
| ARC cycles AR init tAux1 | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ |
| Number of phase cycles | 1 |

The sequence is the following.

1. Fault on the line protected by the fuse.

2. Istantaneous trip of the $I \gg$ and opening of the $C B$.

3. tD1 in progress;
4. tD 1 is expired
5. Closing of the CB and start of the tR.

Due to the setting of the ARC the l>> will start but won't generate a trip. During the delay trip time of the l> the fault will be cleared for the breaking of the fuse or for the auto-extintion of the fault.

Breaker of the fuse


Auto-extintion of the fault


The above one is an example to show a basic using of the " 2 " setting in the ARC function.

## 5. AUTOMATIC CONTROL FUNCTIONS

### 5.1 Trip Commands

This menu is used to assign the trip of the protection and the automatic control function to the relay 1. See the P12y/EN FT (User Guide).

The relay 1 is usually used for the trip of the CB and the logic output is used to start all the functionality relevant to the CB control.

### 5.2 Latch relays

Sometimes it occurs to memorise trips or alarms.
By this menu it is possible the latching of the relay from 1 to 8 .
the relevant relays to the 79 function must not be assigned latched.

### 5.3 Broken Conductor Detection (P126 \& P127)

The majority of faults on a power system occur between one phase and ground or two phases and ground. These are known as shunt faults and arise from lightning discharges and other overvoltages, which initiate flashover. Alternatively, they may arise from other causes such as birds on overhead lines or mechanical damage to cables etc.

Such faults induce an appreciable current increase and are easily detectable in most applications.

Another type of unbalanced system condition is the series or open circuit fault. This fault can arise from broken conductors, mal-operation of single-phase switchgear, or the operation of fuses.

Series faults will not induce an increase in phase current on the system and hence are not easily detectable by standard overcurrent protection elements available with common relays. However, they will produce an unbalance and an important level of negative phase sequence current, which can be detected.

It is possible to apply a negative phase sequence overcurrent relay to detect a series fault condition as described. However, on a lightly loaded line, the negative sequence current resulting from a series fault condition may be very close to, or less than, the full load steady state unbalance arising from CT errors, load unbalance etc. A negative sequence protection element therefore would not operate at low load levels.

The MiCOM P126 and P127 relays incorporate a protection element, which measures the ratio of negative to positive phase sequence current (I2/I1). This protection element will be affected to a lesser extent than the measurement of negative sequence current alone, since the ratio is approximately constant with variations in load current. Hence, a more sensitive setting may be achieved.

### 5.3.1 Setting Guidelines

In the case of a single point earthed power system, there will be little zero sequence current flow and the ratio of $\mathrm{I} / \mathrm{I} 1$ that flows in the protected circuit will approach $100 \%$. In the case of a multiple earthed power system (assuming equal impedance in each sequence network), the ratio $\mathrm{I} / \mathrm{I} 11$ will be $50 \%$.

The setting for the broken conductor protection element is described in Technical Data and the menu is described in User Guide.

### 5.3.2 Example Setting

The following information was recorded by the relay during commissioning:

$$
\text { full load }=500 \mathrm{~A}
$$

$$
\mathrm{I} 2=50 \mathrm{~A}
$$

therefore the quiescent ratio for $\mathrm{I} / \mathrm{I} 1$ is given by:

$$
I 2 / I 1=50 / 500=0.1
$$

To allow for tolerances and load variations a setting of $200 \%$ of this value may be typical: Therefore set RATIO I2/I1 = 20\%

Set $\mathbf{t B C}=60 \mathrm{~s}$ to allow adequate time for short circuit fault clearance by time delayed protections.

### 5.4 Cold Load Pick-up (P126 \& P127)

The Cold Load Pick-up feature enables the selected settings of the MiCOM P126 and P127 relays to be changed to react to temporary overload conditions that may occur during cold starts.

This condition may occur by switching on large heating loads after a sufficient cooling period, or loads that draw high initial starting currents.

When a feeder is energised, the current levels that flow for a period of time following energising may differ greatly from the normal load levels. Consequently, overcurrent settings that have been applied to give short circuit protection may not be suitable during this period.

The Cold Load Pick-up (CLP) logic included in the MiCOM P126 \& P127 relays raises the settings of selected stages for a set duration. This allows the protection settings to be set closer to the load profile by automatically increasing them after energising. The CLP logic provides stability, without compromising protection performance during starting.
Cold Load Pick-up (CLP) setting is described in the Technical Data (TD), the CLP menu in the User Guide (FT).

The timer tCL in the CLP menu controls the time for which the relevant protections elements in CLP menu (\%) are altered following an external input signal (e.g. circuit breaker closure. When the set tCL time has elapsed, all of the relevant settings revert back to their original values or become unblocked.
tCL is initiated via a dedicated logic input signal (refer to AUTOMAT. CTRL/INPUTS menu), generated by connecting an auxiliary contact from the circuit breaker ( 52 a or 52 b ) or starting device to the logic relevant inputs of the relay.

The following sections describe applications where the CLP logic may be useful and the settings that need to be applied.

### 5.4.1 Air Conditioning / Resistive Heating Loads

Where a feeder is used to supply air conditioning or resistive heating loads there may be a conflict between the "steady state" overcurrent settings and those required following energizing. This is due to the temporary increase in load current that may arise during starting.
With the Cold Load Pick-up function enabled, the affected thresholds are selected to be adjusted for the required time to allow the start condition to subside. A percentage value is selected as the amount by which the selected threshold is increased or decreased.

The time for which the adjusted thresholds are valid is defined by the tCL setting. After this time, the settings return to normal.
It may not be necessary to alter the protection settings following a short supply interruption. In this case the CLP function is not activated.

### 5.4.2 Motor Feeders

In general, a dedicated motor protection device, such as the MiCOM P220, P225 or P241 relays should protect feeders supplying motor loads. However, if no specific protection has been applied (possibly due to economic reasons) then the CLP function in the MiCOM P126 or P127 relay may be used to modify the overcurrent settings accordingly during starting.
Depending upon the magnitude and duration of the motor starting current, it may be sufficient to simply block operation of instantaneous elements or, if the start duration is long, the time delayed protection settings may also need to be raised. Hence, a combination of both blocking and raising of settings of the relevant overcurrent stages may be adopted. The CLP overcurrent settings in this case must be chosen with regard to the motor starting characteristic.

As previously described, the CLP logic includes the option of raising the settings of the first stage of the earth fault protection. This may be useful where instantaneous earth fault protection is required to be applied to the motor. During conditions of motor starting, it is likely that incorrect operation of the earth fault element would occur due to asymmetric CT saturation. This is a result of the high level of starting current causing saturation of one or more of the line CTs feeding the overcurrent and/or earth fault protection. The resultant transient imbalance in the secondary line current quantities is thus detected by the residually connected earth fault element. For this reason, it is normal to either apply a nominal time delay to the element, or to utilise a series stabilising resistor.

The CLP logic may be used to allow reduced operating times or current settings to be applied to the earth fault element under normal running conditions. These settings could then be raised prior to motor starting, via the logic.

### 5.4.3 Earth Fault Protection Applied to Transformers

Where an earth fault relay is residually connected on the primary side of a delta-star transformer, no time delay is required for co-ordination purposes, due to the presence of the delta winding. However, a nominal time delay or stabilising resistor is recommended, to ensure transient stability during transformer energising.

The CLP logic may be used in a similar manner to that previously described for the motor application.

It should be noted that this method should not provide stability in the event of asymmetric CT saturation that occurs as a result of an unbalanced fault condition. If problems of this nature are encountered, the best solution would still be the using of a stabilising resistor.

### 5.5 51V and VTS features

The main feature for this version is the $\mathrm{V} 2>+\mathrm{V}<$ logic controlled overcurrent protection with VTS.

The logic functionality is below.


VTS condition is: $\mathrm{VTS}=(\mathrm{V} 2>0.3 \mathrm{Vn}$ AND $\mathrm{I}<\mathbf{< 0 . 5 \mathrm { In } )} \mathrm{OR}(\mathrm{V} 1<0.1 \mathrm{Vn}$ AND $1>0.1 \mathrm{In})$

### 5.6 Auxiliary Timers (P125, P126 \& P127)

Four auxiliary timers tAux1, tAux2, tAux3 and tAux4 are available associated to Aux1, Aux2, Aux3 and Aux4 logic inputs (refer to AUTOMAT. CRTLINPUTS menu). When these inputs are energised, the associated timers start and, after the set time, the output relays close (refer to AUTOMAT. CRTL/OUTPUTS menu). The time delays are independently settable.

The tAux1 and tAux2 timers always provide an alarm when their set time is expired; the tAux3 and tAux4 provide an alarm only when they are assigned to the trip relay in the Automatic Ctrl Trip Command menu

### 5.7 Selective Scheme Logic (P126 \& P127)

The following figure describes the use of non-cascade protection schemes using the start contacts from downstream relays to block operation of upstream relays.

In the case of Selective Overcurrent Logic (SOL), the start contacts are used to increase the time delays of upstream relays, instead of blocking them. This provides an alternative approach to achieving a non-cascade type of overcurrent scheme. It may be more familiar to some utilities than the blocked overcurrent arrangement.


TYPICAL SELECTIVE SCHEME LOGIC
The SOL function temporarily increases the time delay settings of the second and third stages of phase overcurrent. This logic is initiated by energising the appropriate logic input (Log Sel1 or Log Sel2) as selected in AUTOMAT. CRTL/INPUTS menu.

To allow time for a start contact to initiate a change of setting, the time settings of the second and third stages should include a nominal delay. Guidelines for minimum
time settings are identical to those given for blocked overcurrent schemes.
The tSel1 and tSel2 timers are independently settable.
See the TD (Technical Data) for the setting values and FT (User Guide) for the selective scheme logic menu.

### 5.8 Blocking logic function (Blocked directional/non directional overcurrent protection)

The directional non directional overcurrent and overcurrent protection are applicable for radial feeder circuits where there is small or no back feed.

This application shows that the upstream IDMT relay being blocked by the start output from a downstream relay that has detected the presence of a fault current, which is above its threshold settings. Thus both the upstream and downstream relays can then have the same current and the blocking feature will automatically provide time settings and grading. If the CB failure protection function is active, the blocking order on the upstream relay will be removed if the downstream circuit breaker fails to trip.

Thus for a fault downstream from relay $C$, the start output from relay $C$ will block operation of relay $B$, the start output of relay $B$ will block operation of relay $A$. All the 3 relays could have the same time and current threshold settings and the grading would be obtained by the blocking signal received from a relay closer to the fault. This gives a constant, close time grading, but there will be no back-up protection in the event of the pilots being short circuited.

However, in practice it is recommended that the upstream relay should be set greater (plus $10 \%$ ) than the downstream relay setting. This ensures that the downstream relay successfully blocks the upstream relay when required to do so.


## BLOCKING LOGIC

The allocations of the "Blocking Logic1 and 2" functions are available in the menu AUTOMAT. CTRL/Blocking Logic1 / Blocking Logic2; this logic is initiated by energizing the appropriate logic input (Blk Log1 or Blk Log2) selecting in the AUTOMAT. CRTLINPUTS menu.

This functionality involves all the current and voltage protections available in the relays.

### 5.9 Circuit Breaker State Monitoring

An operator at a remote location requires a reliable indication of the state of the switchgear. Without an indication that each circuit breaker is either open or closed, the operator has insufficient information to decide on switching operations. The MiCOM P126 and P127 relays incorporate a circuit breaker state monitoring function, giving an indication of the position of the circuit breaker contacts.

This indication is available either on the relay front panel or via the communications network.
The circuit breaker state monitoring function is selectable in the AUTOMAT. CTRL/Inputs and CONFIGURATION/Led menu.

Further, the MiCOM P126 and P127 relays are able to inform the operator that the CB has not opened following a remote trip command.
$5.10 \quad$ Circuit Breaker Condition Monitoring (P126 \& P127)
Periodic maintenance of circuit breakers is necessary to ensure that the trip circuit and mechanism operate correctly, and also that the breaking capability has not been compromised due to previous fault interruptions. Generally, such maintenance is based on a fixed time interval, or a fixed number of fault current interruptions. These methods of monitoring circuit breaker condition give a rough guide only and can lead to excessive maintenance.

The relays record various statistics related to each circuit breaker trip operation, allowing a more accurate assessment of the circuit breaker condition to be determined. These CB condition monitoring features are discussed in the following section.
5.11 Circuit Breaker Condition Monitoring Features (P126 \& P127)

For each circuit breaker trip operation the relay records statistics as shown in the following table taken from the relay menu. The RECORDS/CB Monitoring menu cells shown are counter values only.

These cells can only be read:

| MENU TEXT |  |
| :--- | :--- |
| CB Monitoring |  |
| CB Opening Time | Displays the CB opening time |
| CB Closing Time | Displays the CB closing time |
| CB Operations | Displays the number of opening commands executed by the CB |
| $\Sigma$ Amps(n) I1 | Displays the summation of the Amps (or square Amps) interrupted by <br> the CB phase A |
| $\Sigma$ Amps(n) I2 | Displays the summation of the Amps (or square Amps) interrupted by <br> the CB phase B |
| $\Sigma$ Amps(n) I3 | Displays the summation of the Amps (or square Amps) interrupted by <br> the CB phase C |

The above counters in the CB condition monitoring function may be reset to zero, for example, following a maintenance inspection and overhaul.

The circuit breaker condition monitoring counters will be updated every time the relay issues a trip command. In cases where the breaker is tripped by an external protection device it is also possible to update the CB condition monitoring. This is achieved by allocating one of the logic inputs or via the communications to accept a trigger from an external device.

The options available for the CB condition monitoring function include the set-up of the broken conductor protection element and those features, which can be set to raise an alarm, or to lockout the CB.

All the settings are available in the AUTOMAT. CTRL/CB Supervision menu.

### 5.11.1 Setting Guidelines

5.11.1.1 Setting the $\Sigma I^{n}$ Thresholds

Where overhead lines are prone to frequent faults and are protected by oil circuit breakers (OCB), oil changes account for a large proportion of the life cycle cost for the switchgear. Generally, oil changes are performed at a fixed interval of circuit breaker fault operations. However, this may result in premature maintenance where fault currents tend to be low, and hence oil degradation is slower than expected.

The $\Sigma \mathrm{I}^{n}$ counter monitors the cumulative severity of the duty placed on the interrupter allowing a more accurate assessment of the circuit breaker condition to be made.

For OCBs, the dielectric withstand of the oil generally decreases as a function of $\Sigma I^{2} t$. This is where ' $l$ ' is the fault current broken, and ' t ' is the arcing time within the interrupter tank (not the breaking time). As the arcing time cannot be determined accurately, the relay would normally be set to monitor the sum of the broken current squared, by setting $\mathrm{n}=2$.

For other types of circuit breaker, especially those operating on higher voltage systems, practical evidence suggests that the value of $\mathbf{n}=2$ may be inappropriate. In such applications $\mathbf{n}$ may be set to 1 .

An alarm in this instance for example may be indicative of the need for gas/vacuum interrupter HV pressure testing.

It is imperative that any maintenance programme must be fully compliant with the switchgear manufacturer's instructions.
5.11.1.2 Setting the Number of Operations Thresholds

Every operation of a circuit breaker results in some degree of wear for its components. Thus, routine maintenance, such as oiling of mechanisms, may be based upon the number of operations. Suitable setting of the maintenance threshold will allow an alarm to be raised, indicating when preventative maintenance is due.

Should maintenance not be carried out, the relay can be set to lockout the autoreclose function on reaching an operations threshold. This prevents further re-closing when the circuit breaker has not been maintained to the standard demanded by the maintenance instructions supplied by the switchgear manufacturer.

Certain circuit breakers, such as oil circuit breakers (OCB) can only perform a specific number of fault interruptions before requiring maintenance attention. This is because each fault interruption causes carbonising of the oil, degrading its dielectric properties.

### 5.11.1.3 Setting the Operating Time Thresholds

Slow CB operation is also indicative of the need for mechanism maintenance. Therefore, an alarm is provided and is settable in the range of 100 ms to 5 s . This time is set in relation to the specified breaking time of the circuit breaker.

### 5.12 Circuit Breaker Failure (P126 \& P127)

Following the inception of a fault one or more main protection devices will operate and issue a trip output to the circuit breaker(s) associated with the faulted circuit. Operation of the circuit breaker is essential to isolate the fault, and prevent damage or further damage to the power system.

For transmission and sub-transmission systems, slow fault clearance can also threaten system stability. It is therefore common practice to install circuit breaker failure protection [50BF], which monitors that the circuit breaker has opened within a reasonable time. If the fault current has not been interrupted following a set time delay from circuit breaker trip initiation, breaker failure protection (CBF) will operate.

CBF operation can be used to back-trip upstream circuit breakers to ensure that the fault is isolated correctly. CBF can also operate to reset all start output contacts, by external logic, ensuring that any blocks asserted on upstream protection are removed.

### 5.12.1 Circuit Breaker Failure Protection Mechanism

The CB failure protection included in both MiCOM P126 \& P127 relays is performed as follows.

The tBF timer is initiated when a trip order is issued through the logic output RL1 or by an assigned digital input (start tBFI).

The trip order can be emitted from a protection element or auxiliary function associated to the logic output RL1, the logic digital input can be energised from an external device.

In case of command from external device the start of the tBF is active by the change of status of the relevant digital input (edge), when the tBF is expired a CBF signal is issued. The tBF is reset when the relevant $\mathrm{I}<\mathrm{BF}$ is verified for each phase. ( $(\mathrm{la}<\& \& \mathrm{lb}<\& \&$ lc<)==TRUE)

In case of a trip by a RL1 the MiCOM P126 \& P127 relays monitor the current signal of each phase and they compare each phase current signal with the undercurrent $\mathrm{I}<\mathrm{BF}$ threshold settable its menu. If the undercurrent $\mathrm{I}<\mathrm{BF}$ is FALSE (( $\mathrm{I} \ll \& \& \mathrm{Ib}<\& \& \mathrm{Ic}<$ )==FALSE) when the tBF timer is expired a CBF signal is issued, if it is TRUE ((( $\mathrm{I}=\& \& \mathrm{lb}<\& \& \mathrm{Ic}<)==$ TRUE $)$ the tBF timer is reset. A TRUE condition of the $1<B F$ resets the tBF always.

In the CB fail menu it is also possible to choose if to lock the instantaneous l> and le> thresholds when a CBF signal is emitted. This one allows more flexibility in the fault localisation and isolation.

5.12.2 Breaker Fail Settings

A typical timer setting used with a $21 / 2$ cycle circuit breaker is around 150 ms .
The phase undercurrent settings ( $\mathrm{l}<$ ) must be set less than load current, to ensure that $\mathrm{l}<$ operation indicates that the circuit breaker pole is open. A typical setting for overhead line or cable circuits is $20 \% \mathrm{In}$, with $5 \%$ In common for generator circuit breaker CBF.

### 5.13 Trip Circuit Supervision (P126 \& P127)

The trip circuit extends beyond the relay enclosure and passes through more components, such as fuses, links, relay contacts, auxiliary switch contacts and so on.

This complexity, coupled with the importance of the trip circuit, has directed attention to its supervision.

The simplest arrangement for trip circuit supervision contains a healthy trip lamp in series with a resistance placed in parallel with a trip output relay contacts of the protection device.
5.13.1 MiCOM P126 \& P127 Trip Circuit Supervision Mechanism

The Trip Circuit Supervision function included in the MiCOM P126 and P127 relays is described below:

A logic input is programmed to the AUTOMAT. CTRL/CB Supervision/TC Supervision function. The logic input is associated to the label Trip Circ within the AUTOMAT. CTRL/Inputs menu. Then, this logic input is wired in the trip circuit according to one of the typical application diagrams shown in the following example. The method of connecting the logic input to provide TC supervision, is shown later.

When the function TC Supervision is set "Yes" within CB Supervision sub-menu, the relay checks continuously on trip circuit continuity whatever the CB status - CB opened or CB closed. The function TC Supervision is enabled when the trip logic output (RL1) is not energised. The function TC Supervision is not enabled when the trip logic output (RL1) is energised.

A 52 Fail (trip circuit failure) signal is generated if the logic input detects no voltage signal during a time longer than the settable timer tSUP. See Chapter P12y/EN FT (User Guide) and Chapter P12y/EN TD (Technical Data) for the settings.

As this function is disabled when the trip logic output (RL1) is energised, this function is suitable for use with the enabled relay latching logic.


TRIP CIRCUIT SUPERVISION PRINCIPLE DIAGRAM
Three examples of application are given below.
NOTE : It is considered that the CB is fitted with its own safety device.

## Example 1

In this example only the 52a auxiliary contact is available, the MiCOM P126 \& P127 relays monitor the trip coil whatever the CB status (CB open or CB closed ).


## TRIP COIL MONITORING

## Example 2

In this example both 52a and 52b auxiliary contacts are available; the MiCOM P126 and P127 relays monitor the complete trip circuit when the CB is closed and a part of the trip circuit when the CB is open.

In this case it is necessary to insert a resistor R1 in series with 52 b , if either the output (RL1) trip is latched or it stays involuntarily closed, or a long time trip pulse is programmed.


## Example 3

In this example both 52a and 52b auxiliary contacts are available, the MiCOM P126 \& P127 relays monitor the complete trip circuit whatever the CB status ( $C B$ open or $C B$ closed).

In this case it is necessary to insert a R1, if either the output (RL1) trip is latched, or it stays involuntarily closed, or a long time trip pulse is programmed.


TRIP COIL AND AUXILIARY CONTACTS MONITORING WHATEVER THE POSITION OF THE CB

### 5.13.2 External Resistor R1 Calculation

The calculation of the R1 resistor value will take into account that a minimum current is flowing through the logic input. This minimum current value is a function of the relay auxiliary voltage range (Ua).

## 1 - Case of example no 2 :

The R1 resistor maximum value (in Ohm) is defined by the following formula:

$$
\mathrm{R} 1<\frac{0,8 \times \mathrm{U}_{\mathrm{a}}-\mathrm{U}_{\min }}{\mathrm{I}_{\min }}[\mathrm{Ohm}]
$$

Where:
$\mathrm{Ua}=\quad$ auxiliary voltage value (in this case a DC voltage; range is given on label under the top hinged cover. See table below).
Umin $=$ internal minimum voltage value needed for the opto logic input to operate.
Imin $=\quad$ minimum current value needed for the opto logic input to operate.

| Relay auxiliary voltage range (Ua) |  |  |
| :--- | :--- | :--- |
| $24-60 \mathrm{VDC}$ | $48-150 \mathrm{VDC}$ | $130-250 \mathrm{VDC} / 110-250 \mathrm{VAC}$ |
| $\mathrm{R} 1<(0,8 \times \mathrm{Ua}-15) / 0.0035$ | $\mathrm{R} 1<(0,8 \times \mathrm{Ua}-25) / 0.0035$ | $\mathrm{R} 1<(0,8 \times \mathrm{Ua}-38) / 0.0022$ |

The R1 resistor withstand value (in Watt) is defined below:

$$
\mathrm{P}_{\mathrm{R} 1}>2 \times \frac{\left(1,2 \times \mathrm{U}_{\mathrm{a}}\right)^{2}}{\mathrm{R} 1}[\mathrm{~W}]
$$

## 2 - Case of example no 3:

The R1 resistor maximum value (in Ohm) is defined by the following formula:

$$
\mathrm{R} 1<\frac{0,8 \times \mathrm{U}_{\mathrm{a}}-\mathrm{U}_{\min }}{\mathrm{I}_{\min }}-\mathrm{R}_{\mathrm{Coil}}[\mathrm{Ohm}]
$$

Where:
Ua $=\quad$ auxiliary voltage value (in this case a DC voltage; range is given on label under the top hinged cover. See table below).
Umin $=\quad$ internal minimum voltage value needed for the opto logic input to operate.
Imin = minimum current value needed for the opto logic input to operate.
$R_{\text {coil }}=\quad$ Trip coil resistance value.

| Relay auxiliary voltage range (Ua) |  |  |
| :--- | :--- | :--- |
| $24-60 \mathrm{VDC}$ | $48-150 \mathrm{VDC}$ | $130-250 \mathrm{VDC} / 110-250 \mathrm{VAC}$ |
| $\mathrm{R} 1<(0,8 \times \mathrm{Ua}-15) / 0.0035-\mathrm{R}_{\text {coil }}$ | $\mathrm{R} 1<(0,8 \times \mathrm{Ua}-25) / 0,0035-\mathrm{R}_{\text {coil }}$ | $\mathrm{R} 1<(0,8 \times \mathrm{Ua}-38) / 0,0022-\mathrm{R}_{\text {coil }}$ |

The R1 resistor withstand value (in Watt) is defined below:

$$
\mathrm{P}_{\mathrm{R} 1}>2 \times{\frac{\left(1,2 \times \mathrm{U}_{\mathrm{a}}\right)^{2}}{\left(\mathrm{R} 1+\mathrm{R}_{\text {Coil }}\right)}}^{2}[\mathrm{~W}]
$$

Remarks: - The presence of auxiliary relays, such an anti-pumping system for instance, in the trip circuit must be taken into account for the R1 resistance values specification.

- It is assumed the maximum variations of the auxiliary voltage value are $\pm 20 \%$.


### 5.14 Switch onto Fault Protection \& Trip on Reclose (SOTF/TOR) (P126 \& P127)

### 5.14.1 General

Under particular conditions, it can happen,that when the feeder is supplied by the closing of the CB a fast trip command may be required if a fault is present. (Closing on to fault)

Some faults may be caused by conditions not removed from the feeder after a reclosing cycle or a manual trip, or due to earthed clamps left on after maintenance works. In these cases, it may be desirable to clear the fault condition in fast time, rather than waiting for the trip time delay DMT or IDMT associated with the involved protection.

In case of manually closing of the CB it can happen to switch on to an existing fault. This is a particularly critical situation, because the overcurrent protection would not clear the fault until the set operate delay had elapsed. This is another typical case of closing on to fault. Hence it is desirable to clear the fault as fast as possible.

The P126 and P127 relays provide the SOTF/TOR functionality.
The SOTF acronym means switch on to fault.
The TOR acronym means trip on recloser.
The available setting to enable/disable/set the SOTF/TOR function is written in a submenu of the AUTOMATIC CTRL menu.

The setting regarding the $l \gg$ and $l \ggg$ is provided to initiate the Sotf function.
5.14.2 SOTF/TOR description

When the SOTF/TOR function is enable, it can be initiated by a local manual CB control close command detected by the digital input labelled Man.Close, or by a TC (closing command by remote via network: Modbus, IEC 60870) or by an automatic reclosing cycle.
When CB has been closed on some faults caused by lightning or something else, the fault detection needs a time period. This is the reason why a 500 ms fixed time window after initiatialization of the SOTF/TOR function is included.

When this fixed timer is elapsed and the l>> or l>>> is detected, the settable timer $t$ Sotf starts.

The existence of this settable timer is justified because in some applications selectivity for fault occurring in stage two or three is requested.

Another justification of the SOTF/TOR tripping time delay is for cases where serious transient happen and the three poles of the CB do not close at the same time and for those cases where the CB may not be closed instantaneously.

Furthermore, the t SOFT can also be considered a trip delay time that substitutes the trip timer of the started threshold such to accelerate the tripping.
If a trip due to switch on to fault occurs during the reclaim time of the ARC, the trip will be definitive and the ARC will move in the blocked status.

If the l>> and l>>> reset during the settable timer t Sotf the SOTF/TOR function resets.

The SOTF/TOR functionality diagram is shown below.


The trip by SOTF is settable in the AUTOMATIC CTRL/TRIP COMMAND submenu and in the AUTOMATIC CTRL/Output relays submenu.

Below are the involved settings.


## AUTOMATIC CTRL / TRIP COMMAND SUBMENU



Assigning the SOTF functionality to the trip output.
When the t SOTF is elapsed the trip command is launched
Setting choice: Yes, No

## AUTOMATIC CTRL / OUTPUT RELAYS SUBMENU

| SOTF | $: 8765432$ <br> 0000010 |
| :--- | ---: |

Assigning the SOTF functionality to the output relays; i.e. to output 3 (RL3). The assigned relay trips when the t SOTF has expired. Setting choice 1 assigns the output relay, 0 is for no assignment.

AUTOMATIC CTRL / INPUTS

```
Input 1...7
    Man. Close
```

Assigning the Manual control close (Signal from external close command by push button) to the selected digital input labelled Man. Close.

### 5.15 Local/Remote conditioning (P125, P126 \& P127)

5.15.1 General

The choice to work in local or remote mode for the P126 and P127 is set by the status of a digital input labeled LOCAL MODE. If this input is powered and set as active high the local mode is activated otherwise the remote mode is activated.

In local mode trips protection and the Auto-recloser command to the CB are always sent, any command done remotely is inhibited.
5.15.2 Local/remote conditioning by logical input

When the assigned logic input is polarized, all the writing commanded through communication (setting parameters, control command ..) will be forbidden to avoid any interference and accident during the local mode operation. The synchronization time by network stays active because it doesn't affect the output relays and neither the operation of the circuit breaker.

If the logic input is not polarized, all writing commands done remotely will be authorized.
This feature has been implemented in existing and available communication protocols of relays P125, P126 \& P127.
5.15.3 Settings

In the AUTOMATIC CTRL/TRIP COMMAND submenu TC (opening command done in remote via network:) item uses the CTRL TRIP to open the CB.

In the AUTOMATIC CTRL/Output relays the CTRL TRIP and CTRL CLOSE items can be used to open and close the CB from remote control order.

The CB CLOSE relay can be used for the close command.
In order to keep the normal functionality, the customer will have to assign both information TRIP by protection and Ctrl Trip on (RL1), and to assign both information CLOSE CTRL and CB CLOSE on the same auxiliary relay.

Below are the involved settings for the Local/Remote functionality

## AUTOMATIC CTRL / TRIP COMMAND SUBMENU

| Ctrl Trip | Yes |
| :--- | :--- |
| Assignes the control by remote to the trip output. |  |
| Setting choice: Yes, No |  |

AUTOMATIC CTRL / OUTPUT RELAYS SUBMENU


Assigns the Control Trip command to the output relays; i.e. to output 2 (RL2).

Setting choice 1 assigns the output relay; 0 none assignment.

| CONTROL | $: 8765432$ |
| :--- | ---: |
| CLOSE | 0000010 |


| CB | $: 8765432$ |
| :--- | ---: |
| Close | 0000010 |

Assigns circuit breaker closing order signal to the output relays; i.e. to output 3 (RL3).

Setting choice: 1 assigns the output relay; 0 no assignment.
AUTOMATIC CTRL / INPUTS

An application of the subject mentioned above is presented below.
In the following schematic, the customer will have to assign the TRIP and CTRL TRIP to the TRIP RELAY, the CB CLOSE and the CTRL CLOSE to the auxiliary relay number two, in accordance with setting above.

If the Local input is energised any remote command will be ignored if the Local input is deenergised all the remote control will be considered.


### 5.16 AND Logic Functions (P126 \& P127)

AND logic functions are included in MiCOM P126 and P127 relays.
They can be used to combine trip or start protection conditions to obtain dedicated functionality and combined output thresholds.

The AND logic can be used to allocate input and output signals to time delay.
Following is an example of their application.
The time delayed output $\mathrm{tl}>$ is combined with the output $U>$.
When both thresholds are crossed a trip output command is to be issued.
A possible parameter setting is shown below.


The trip characteristic is shown in the diagram:


The timer allocation to the AND logic is set as shown below:


The logic output is set as shown below:


## 6. RECORDS (P126 \& P127)

### 6.1 Event Records

The relay records and time tags up to 75 events and stores them in a non-volatile (battery back-up) memory. This enables the system operator to analyse the sequence of events that occurred within the relay following a particular power system condition, switching sequence etc. When the available memory space is exhausted, the new fault automatically overwrites the oldest fault.

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

The event records are available for viewing either on the front panel, or via the front panel EIA RS232 port or remotely, via the rear EIA RS485 port.

### 6.2 Fault Records

Each time any of the programmed thresholds are crossed a fault record is created and stored in a memory. The fault record tags up to 5 faults and stores them in a non-volatile (battery back-up) memory. This enables the system operator to identify and analyse network failures. When the available memory space is exhausted, the new fault automatically overwrites the oldest fault.

Note that viewing of the actual fault record is carried out in the RECORD/Fault Record menu, which is selectable from up to 5 stored records. These records consist of fault flags, fault measurements etc. Also note that the time stamp given in the fault record itself will be more accurate than the corresponding stamp given in the event record as the event is logged some time after the actual fault record is generated.

The fault records are available for viewing either on the display, or via the front panel EIA RS232 port or remotely, via the rear EIA RS485 port.

### 6.3 Instantaneous Recorder

Each time any of programmed threshold is crossed an instantaneous record is created and displayed in the RECORDS/Instantaneous menu. The last five starting information with the duration of the information are available. The number of the fault, hour, date, origin (voltage, current and wattmetric protection thresholds), length (duration of the instantaneous), trip (a trip is appeared, yes or no) are displayed in the RECORDS/Fault Record menu.

### 6.4 Disturbance Records

The integral disturbance recorder has an area of memory specifically set aside for disturbance record storage. The number of disturbance records that may be stored is 5 disturbance records of 3 seconds length each. Disturbance records continue to be recorded until the available memory space is exhausted, at which time the oldest disturbance record(s) is (are) overwritten to make space for the newest disturbance record(s).
The recorder stores actual samples, which are taken at a rate of 32 samples per cycle. Each disturbance record consists of analogue data channels and digital data channels. Note that the relevant VTs and CTs ratios for the analogue channels are also extracted to enable scaling to primary quantities.
The total recording time is set by a combination of the pre and post fault recording times. The total disturbance recording time is 3.0 s (pre-trigger plus post-trigger).

For the settings of the parameters see FT (User Guide) and TD (Technical Data) chapters of this TG.

## 7. ROLLING AND PEAK VALUE DEMANDS (P126 \& P127

The MiCOM P126 and P127 relays are able to store the 3 phases rolling average and maximum subperiod values. The description and principle of calculation are given bellow.

### 7.1 Rolling demand

The principle of the calculation of the rolling demand value for IA, IB and IC currents is following:

- Calculation of the average of the RMS values on a "Rolling Sub Period" period.

The setting of the width of the period "Rolling Sub Period" is in the "RECORDS/Rolling Demand/Sub Period" menu.

Setting range: from 1 to 60 minutes.

- $\quad$ Storage of these values in a sliding window
- Calculation of the average of these average values (sliding window values) on the number of "Num. of Sub Periods" periods

The setting of the number of Sub Period "Num of Sub Periods" in the "RECORDS/Rolling Demand/Num of Sub Per" menu.

Setting range : from 1 to 24.
Display of the first result in the MEASUREMENTS menu only after the storage of "Num of Sub Periods" periods. The 3 phases Rolling average value are
displayed:

- $\quad$ Rolling Average IA RMS

Rolling Average IB RMS
Rolling Average IC RMS
The calculation is reset by either "hand Reset" (by key _ ) without use of password, or a remote command.

NOTE: In case of loss of power supply the rolling demand are not stored.
A modification of the settings (either "Rolling Sub Period" or "Num of Sub Periods" parameter) reset the calculation.

Example:
Sub Period $=5 \mathrm{mn}$
Num of Sub Period = 2


At the end of the Sub Period 2 :
Rolling average value $=($ average value $1+$ average value 2$) / 2$
At the end of the Sub Period 3 :
New Rolling average value $=($ average value $2+$ average value 3$) / 2$

### 7.2 Peak value demand

The principle of the calculation of the Peak value demand for IA, IB and IC currents is following:

Every "Rolling Sub Period", a new average value is compared with the previous value calculated at the previous "Rolling Sub Period". If this new value is greater than the previous value already stored, then this new value is stored instead of the previous one.

In the opposite if this new value is lower than the previous value already stored, then the previous value is kept stored.

In this way, a average peak vale will be refreshed each Sub Period; There is no dedicated setting for this calculation. The setting of the Sub Period in the RECORDS menu is used.

The 3 phase Peak value demand are displayed in the MEASUREMENTS menu :
MAX SUBPERIOD IA RMS
MAX SUBPERIOD IB RMS
MAX SUBPERIOD IC RMS

- The calculation is reset by either "hand Reset" (by key _) without use of password, or a remote command.

NOTE: In case of loss of power supply the Peak average values are stored.
A modification of the setting "Rolling Sub Period" parameter reset the calculation.
8. SETTING GROUP SELECTION (P125, P126 \& P127)

The MiCOM P125, P126 and P127 relays have two protection related setting groups named PROTECTION G1 and PROTECTION G2. Only one of two setting groups is active.

Changes between the two groups are executed via the front interface (CONFIGURATION/GROUP SELECT/SETTING GROUP 1 or 2), a dedicated logic input (AUTOMAT CTRLINPUT X/CHANGE SET) where $X$ is the chosen logic input, or through the communication port (refer to Mapping Data Base for more detailed information).

To avoid any undesirable tripping, the setting group change is only executed when none protection function is running excepted than for thermal overload function

If a setting group change is received during any protection or automation function, it is stored and executed after the last timer has elapsed.

The active group is displayed in the OP PARAMETER menu.
The active group can also be assigned to an output relay: with a normally open contact.

- a contact open will indicate Group 1
- a contact closed will indicate Group 2
8.1.1 Setting group change by digital input

It is possible to configure the change of the setting group by a digital input, either on falling edge/ low level or on rising edge/ high level. The choice can be done in the CONFIGURATION/Inputs menu.

Falling edge or low level (idem for rising edge or high level) depending of the
application is selectable in the CONFIGURATION/Group Select/Change Group/Input menu.
if the digital input assigned to the change of setting group operates on level (low or high), it is not possible to change of setting group via either remote communication or front panel.
Switching between the groups can be done via:

- the relay front panel interface (CONFIGURATION/GROUP SELECT/ SETTING GROUP 1 or 2),
- a dedicated logic input (AUTOMAT. CTRL/INPUT X/CHANGE SET) where $X$ is the chosen logic input,
- through the communications port.


### 8.1.2 Priority

The front panel is priority level maximum due the fact when the user takes the hand on front panel and enters a password, it is not possible to change of setting group via remote communication as long as the password is active (5mn).

Below are listed the priorities in the different ways to switch between setting groups.

| ORIGIN OF THE ORDER | PRIORITY LEVEL |
| :--- | :--- |
| FRONT PANEL | MAXIMUM |
| LOGIC INPUT | MEDIUM |
| REMOTE COMMUNICATIONS | MINIMUM |

## 9. MEASUREMENTS

The measurement functions on MiCOM P125, P126 and P127 relays are described in chapter User Guide of this Technical Guide.

Particular attention is to be given to the power and energy measurement.

## $9.1 \quad$ Power and Energy Measurements (P127)

The MiCOM P127 relay provides the measurements function for active and reactive power and for active and reactive energy.
The value for power is calculated in accordance with the following listed table.

| VTs connection | Active Reactive power calculation method |  |
| :--- | :--- | :--- |
| $3 V p n$ | Sum of each power phase | $\mathrm{P}=\mathrm{PA}+\mathrm{PB}+\mathrm{PC}$ <br> $\mathrm{Q}=\mathrm{QA}+\mathrm{QB}+\mathrm{QC}$ |
| $2 \mathrm{Vpn+Vr}$ | Sum of each power phase | $\mathrm{P}=\mathrm{PA}+\mathrm{PB}+\mathrm{PC}$ <br> $\mathrm{Q}=\mathrm{QA}+\mathrm{QB}+\mathrm{QC}$ |
| $2 \mathrm{Vpp+Vr}$ | Aron insertion |  |

The value for energy is calculated by multiplying the calculated power value by time.
The calculated energy value is stored in a non-volatile memory ( $E^{2} P R O M$ ) every second, so that in case of temporary power supply fault, the previous values calculated can be recalled.

The MiCOM P127 relay provides, on the display, the measurements of the power and of the energy. Both refer to primary values and rely on the CT and VT ratio.

The maximum active and reactive power value displayed is 9999MW and 9999MVAr.
The maximum active and reactive energy value displayed is 4200GWh and 4200GVArh.
The sign of the active and reactive power/energy values is taken according to the diagram below.

They are in accordance with the wiring diagrams in the chapter P12y/EN CO in this Technical Guide.


Following is the MiCOM P127 relay measurement menu for the power and energy.


## 10. LOGIC INPUTS AND LOGIC OUTPUTS

### 10.1 Logic Inputs

In the logic input submenu can be set the digital inputs as active high or active low, can be chosen the supply type DC or AC and it is possible to set the start/stop of the relevant auxiliary timers assigned to the inputs by front or edge..

By the ordering code it is possible to select the relay with the digital inputs with EA approval regulation.

See the technical data for further information.
The setting menu for this functionality is in the CONFIGURATION menu. For more details see FT (User Guide).

### 10.2 Logic Outputs

A dedicated output relay is assigned to each logic output. It is possible to set the relays as self reset or latching.

The setting menu for the functionality of the logic outputs is available in the AUTOMAT. CTRL menu.

It is possible to assign a specific function to each output relay except RL1.
For more details see the chapter User Guide.

## 11. MAINTENANCE MODE

This menu allows the user to verify the operation of the protection functions without sending any external order (Tripping or signalling).

The selection of the maintenance mode is possible by logic input, control command (rear or front port), or by front display. The end of maintenance mode is done by logic input, by control command or on the front display time out (5minutes) and by turning off the power supply.

## Maintenance Mode YES

When activating this menu (YES), the Alarm led will start flashing and an alarm message will appear "MAINTENANCE MODE". In this case, all output contacts are blocked, no operation will take place on these contacts even if a protection threshold associated to one of these output contacts is exceeded.
(If protection threshold is exceeded, all the associated leds will become ON, even the TRIP LED, if the threshold is associated to the RL1).


This window allows the user to verify the external wiring to the relay output contacts, to do this, it is sufficient to assign a 1 to any of the output contacts, this will close the contact and the wiring continuity could be verified.

## 12. CT REQUIREMENTS

The CT requirements for the MiCOM P12y relays are given below.
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 <br> Output | Accuracy <br> Class | Accuracy Limit <br> Factor | Limiting lead <br> resistance |
| :--- | :--- | :--- | :--- | :--- |
| 1 A | 2.5 VA | 10 P | 20 | 1.3 ohms |
| 5 A | 7.5 VA | 10 P | 20 | 0.11 ohms |

12.1 Definite time / IDMT overcurrent \& earth fault protection

Time-delayed Phase overcurrent elements :

$$
\mathrm{V}_{\mathrm{k}} \quad \geq \quad \mathrm{I}_{\mathrm{cp}} / 2 *\left(R_{\mathrm{ct}}+R_{\mathrm{L}}+\mathrm{R}_{\mathrm{rp}}\right)
$$

Time-delayed Earth Fault overcurrent elements :

$$
V_{\mathrm{K}} \quad \geq \quad \mathrm{I}_{\mathrm{cn}} / 2 *\left(\mathrm{R}_{\mathrm{ct}}+2 R_{\mathrm{L}}+\mathrm{R}_{\mathrm{tp}}+\mathrm{R}_{\mathrm{m}}\right)
$$

### 12.2 Instantaneous overcurrent \& earth fault protection

CT requirements for instantaneous phase overcurrent elements :

$$
V_{k} \quad \geq \quad I_{\mathrm{sp}} / 2 *\left(R_{\mathrm{ct}}+R_{L}+R_{\mathrm{rp}}\right)
$$

CT requirements for instantaneous earth fault overcurrent elements :

$$
V_{\mathrm{K}} \quad \geq \quad \mathrm{I}_{\mathrm{sn}} / 2^{*}\left(R_{\mathrm{ct}}+2 R_{\mathrm{L}}+R_{\mathrm{tp}}+R_{\mathrm{rt}}\right)
$$

12.3 Definite time / IDMT sensitive earth fault (SEF) protection

Time delay SEF protection :

$$
V_{\mathrm{K}} \quad \geq \quad \mathrm{I}_{\mathrm{cn}} / 2 *\left(R_{\mathrm{ct}}+2 R_{\mathrm{L}}+R_{\mathrm{tp}}+R_{\mathrm{rm}}\right)
$$

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:

Time Delayed element:

$$
V_{\mathrm{k}} \quad \geq \quad I_{c \mathrm{c}} / 2 *\left(R_{\mathrm{ct}}+2 R_{L}+R_{\mathrm{tp}}+R_{\mathrm{m}}\right)
$$

Instantaneous element:

$$
V_{\mathrm{K}} \quad \geq \quad \mathrm{I}_{\mathrm{f}} / 2 *\left(R_{\mathrm{CT}}+2 R_{L}+R_{\mathrm{tp}}+R_{\mathrm{m}}\right)
$$

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 :
VK = Required CT knee-point voltage (volts),
Ifn $=$ Maximum prospective secondary earth fault current (amps),
Ifp = Maximum prospective secondary phase fault current (amps),
Icn = Maximum prospective secondary earth fault current or 31 times I> setting (whichever is lower) (amps),
Icp = Maximum prospective secondary phase fault current or 31 times l> setting (whichever is lower) (amps),
Isn $=$ Stage $2 \& 3$ Earth Fault setting (amps),
Isp $=$ Stage 2 and 3 setting (amps),
RCT = Resistance of current transformer secondary winding (ohms)
RL = Resistance of a single lead from relay to current transformer (ohms),
Rrp $=\quad$ Impedance of relay phase current input at 30In (ohms),
Rrn $=$ Impedance of the relay neutral current input at 30In (ohms).

# MODBUS DATABASE IEC 60870-5-103 <br> MiCOM P1 25-P1 26 - P1 27 VERSION VG.F SOFTWARE VERSION 

# MODBUS DATABASE IEC 60870-5-103 

## CONTENT

## 1. INTRODUCTION 3

1.1 Purpose of this document ..... 3
1.2 Glossary ..... 3
2. MODBUS PROTOCOL ..... 4
2.1 MODBUS connection technical characteristics ..... 4
2.1.1 MODBUS connection parameters ..... 4
2.1.2 Exchanges messages synchronisation ..... 4
2.1.3 Message validity check ..... 4
2.1.4 Address ..... 4
2.2 MODBUS functions available in the protection device ..... 5
2.3 Presentation of the MODBUS protocol ..... 5
2.3.1 Frame size received by the protection device (slave) ..... 5
2.3.2 Format of frames transmitted by the protection device ..... 6
2.3.3 Messages validity check ..... 6
2.4 Database organisation ..... 7
2.4.1 Description of the application mapping ..... 7
2.4.1.1 Settings ..... 7
2.4.1.2 Page OH ..... 8
2.4.1.3 Page 1H ..... 11
2.4.1.4 Page 2H ..... 15
2.4.1.5 Page 3H ..... 18
2.4.1.6 Page 4H ..... 18
2.4.1.7 Page 7H ..... 18
2.4.1.8 Reserved pages ..... 18
2.4.1.9 Mapping access characteristics ..... 19
2.4.2 Mapping format description ..... 20
3. IEC 60870-5-103 PROTOCOL ..... 28
3.1 General information ..... 28
3.2 System state ..... 28
3.3 Processed commands ..... 29
3.3.1 System commands ..... 29
3.3.2 General commands ..... 29
3.4 Relay reinitialisation ..... 30
3.5 Cyclic Messages ..... 30

## 1. INTRODUCTION

### 1.1 Purpose of this document

This document describes the characteristics of the different communication protocols of MiCOM P125 relay.

The available communication protocols on the relay are listed below:

- MODBUS
- IEC 60870-5-103
- K-BUS/Courier (not available)
- DNP3 (not available)


### 1.2 Glossary

le : earth fault current measured
Ue : residual voltage measured directly by the input terminals on rear panel
$\mathrm{Pe} \quad$ : earth fault power (Calculated)
leCosPhi : active component of the earth fault current
pf : soft weight of a word of 16 bits
PF : heavy weight of a word of 16 bits
Dec : decimal representation value
Hex : hexadecimal representation value
DNP3. 0 \& COURIER are not available yet (in grey colour)
2. MODBUS PROTOCOL

MiCOM P125 relay can communicate by a RS 485 link. The terminals are placed on the rear panel (terminals 31 and 32). See the GS document for further information on the wiring. The applied ModBus protocol is compliance with the MODBUS RTU.
2.1 MODBUS connection technical characteristics
2.1.1 MODBUS connection parameters

The different parameters of the MODBUS connection are as follows:

- Isolated two-point RS485 connection ( 2 kV 50 Hz ),
- MODBUS line protocol in RTU mode

Communication speed can be configured by an operator dialog in the front panel of the relay:

| Baud rate |
| :--- |
| 300 |
| 600 |
| 1200 |
| 2400 |
| 4800 |
| 9600 |
| 19200 |
| 38400 |

Transmission mode of the configured characters by operator dialog:

| Mode |
| :--- |
| 1 start / 8 bits / 1 stop : total 10 bits |
| 1 start / 8 bits / even parity / 1 stop : total 11 bits |
| 1 start / 8 bits / odd parity / 1 stop : total 11 bits |
| 1 start / 8 bits / 2 stop : total 11 bits |
| 1 start / 7 bits / 2 stop : total 10 bits |
| 1 start / 7 bits / 1 stop : total 9 bits |
| 1 start / 7 bits / even parity / 1 stop : total 10 bits |
| 1 start / 7 bits / odd parity / 1 stop : total 10 bits |

2.1.2 Exchanges messages synchronisation

Any character received after a silence on the line of more than or equal to a transmission time of 3 bytes is considered as a frame start.
2.1.3 Message validity check

The validation of a frame is performed with a 16-bit cyclical redundancy check (CRC).
The generator polynomial is:
$1+x^{2}+x^{15}+x^{16}=1010000000000001$ binary $=$ A001h

### 2.1.4 Address

In order to integrate a protection device into a control and monitoring system, the address must be set from the local control panel. The address may be selected from the range of 1 to 255. The address 0 is reserved for broadcast messages.

### 2.2 MODBUS functions available in the protection device

Protection device data may be read or modified by using function codes. Following are the available function codes. Function codes to read from or write into parameter cells in the protection device are described in the listed following table.

| Function Nr. | Data Read | Data Write | Data Format \& Type |
| :--- | :--- | :--- | :--- |
| 1 | X |  | N bits |
| 2 | X |  | N bits |
| 3 | X |  | N words |
| 4 | X |  | N words |
| 5 |  | X | 1 bit |
| 6 | X | X | 1 word |
| 7 | X |  | 8 bits |
| 8 |  |  | Diagnostics counter |
| 11 |  | X | Event counter |
| 15 | X | N bits |  |
| 16 |  | N words |  |

### 2.3 Presentation of the MODBUS protocol

MODBUS is a master-slave protocol where every exchange involves a master devices request for data and a slave devices response with data.
2.3.1 Frame size received by the protection device (slave)

Frame transmitted by the master (query):

| Slave number | Function code | Information | CRC16 |
| :--- | :--- | :--- | :--- |
| 1 byte | 1 byte | $n$ bytes | 2 bytes |
| 0 à FFh | 1 à 10h |  |  |

## Slave address:

The slave address is in the range from 1 to 255. A transmitted frame with a slave address equal to 0 is a globally addressed to all installed equipment (broadcast frame)

## Function code:

The function code returned by the slave in the exception response frame is the code in which the most significant bit (bit 7 ) is forced to 1.

## Error code:

Among the 8 exception codes of the MODBUS protocol, the protection device manages two:

- Code 01: Function code unauthorised or unknown.
- $\quad$ Code 03: A value from the data field is unauthorised (incorrect code).
- Control of data being read.
- Control of data being written.
- Control of data address.
- Length of request for data message.


## CRC16:

The CRC16 value is calculated by the slave.
NOTE: The protection device does not respond to globally broadcast frames sent out by the master.
2.3.2 Format of frames transmitted by the protection device

Frame transmitted (response):

| Slave number | Function code | Data | CRC16 |
| :--- | :--- | :--- | :--- |
| 1 byte | 1 byte | $n$ bytes | 2 bytes |
| 1 à FFh | 1 à 10 h |  |  |

## Slave address:

The slave address is in the range from 1 to 255 .
Function code:
Processed MODBUS function (1 to 16).
Data:
Contains the response data to the masters request for data.

## CRC16:

CRC16 value calculated by the slave.
2.3.3 Messages validity check

When the slave ( $\mathbf{P} 125$ ) receives a request for data from the master, it validates the frame:

- If the CRC is incorrect, the frame is discarded as invalid. The slave does not reply to the request for data. The master must retransmit its request for data. With the exception of a broadcast message, this is the only case where the slave does not reply to a request for data from the master.
- If the CRC is correct but the slave can not process the request for data, it sends an exception response to the master.

Warning frame sent by the MiCOM relay (response)

| Slave number | Function code | Warning code | CRC16 |
| :--- | :--- | :--- | :--- |
| 1 byte | 1 byte | 1 byte | 2 bytes |
| 1 to FFh | 81 h or 83 h or 8 Ah or 8 Bh |  | pf $\ldots$ PF |

Slave number:
The slave number is situated between 1 and 255 .

## Function code:

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

Warning code:
On the 8 warning codes of the MODBUS protocol, the relay manages two of them:

- code 01 : function code unauthorised or unknown.
- code 03 : a value in the data field is unauthorised (incorrect data).
- Control of pages being read
- Control of pages being written
- Control of addresses in pages
- Length of request messages

CRC16:
Value of the CRC16 calculated by the slave.

### 2.4 Database organisation

2.4.1 Description of the application mapping

### 2.4.1.1 Settings

Parameters are organized in pages.
MiCOM P125 application mapping has 6 pages of parameters.
The characteristics are the following:

| Page | Data type | Read <br> permission | Write <br> permission |
| :--- | :--- | :--- | :--- |
| 0 | Product information, remote signalling, <br> measurements | Through <br> communication |  |
| 1 | General remote parameters | X | X |
| 2 | Setting group 1 remote parameters | X | X |
| 3 | Setting group 2 remote parameters | X | X |
| 4 | Remote controls |  | X |
| 7 | P125 Relay status | Fast |  |

They are described more precisely in the following pages.

MiCOM P125
Page 8/30

### 2.4.1.2 Page OH

| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0000 | Product Information | Relay description characters 1 and 2 | $32 . . .127$ | 1 |  | F10 |  |
| 0001 |  | Relay description characters 3 and 4 | $32 . . .127$ | 1 |  | F10 | P1 |
| 0002 |  | Relay description characters 5 and 6 | $32 . . .127$ | 1 |  | F10 | 20 |
| 0003 |  | Unit reference characters 1 and 2 | $32 . . .127$ | 1 |  | F10 | AL |
| 0004 |  | Unit reference characters 3 and 4 | $32 \ldots .127$ | 1 |  | F10 | ST |
| 0005 |  | Software version | $10 \ldots .$. xx | 1 |  | F21 |  |
| 0006 |  | Front \& rear port available communication protocols | 0-3 |  |  | F41 |  |
| 0007 |  | Internal ratio phase current |  |  |  | F1 |  |
| 0008 |  | Internal ratio earth current |  |  |  | F1 |  |
| 0009 |  | Internal ratio rated tension |  |  |  | F1 |  |
| 000A |  | Internal ratio numeric tension |  |  |  | F1 |  |
| 000B |  | Info General Start (only if IEC 60870-5-103 version) |  |  |  | F1 |  |
| OOOC |  | Reserved |  |  |  |  |  |
| 000D |  | Configured digital inputs status, part 2/2 |  |  |  | F20A |  |
| 000E |  | Password status | 0-1 |  |  | F24 | 0 |
| 000F |  | HW alarm status |  |  |  | F45 |  |
| 0010 | Remote signals | Digital inputs status |  |  |  | F12 |  |
| 0011 |  | Configured digital inputs status |  |  |  | F20 |  |
| 0012 |  | RL1: output status | 0-1 |  |  | F22 |  |
| 0013 |  | Output relays operation command |  |  |  | F13 |  |
| $\begin{aligned} & 0014- \\ & 0016 \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 0017 | Protection 67n | Information of overshooting of the threshold le> |  |  |  | F16 |  |
| 0018 |  | Information of overshooting of the threshold le>> |  |  |  | F16 |  |
| 0019 |  | Information of overshooting of the threshold le>>> |  |  |  | F16 |  |
| 001A-0024 |  | Reserved |  |  |  |  |  |
| 0025 | Alarms 1 | Non acknowledged alarms <br> - part 1/4 |  |  |  | F36 |  |
| 0026 |  | Reserved |  |  |  |  |  |
| 0027 | RL1 Relay status | Information on the starting origin of the RL1 trip relay | 0-28 |  |  | F61 |  |
| 0028 |  | Reserved |  |  |  |  |  |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0029 | Alarms 2 | Non acknowledged alarms - part 2/4 |  |  |  | F36A |  |
| 002A | Alarms 3 | Non acknowledged alarms - part 3/4 |  |  |  | F36B |  |
| 002B | Alarms 4 | Non acknowledged alarms - part 4/4 |  |  |  | F36C |  |
| $\begin{aligned} & \text { OO2C- } \\ & \text { OO2D } \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 002E | Relays latch | RL1 ... RL6 latched relays status |  |  |  | F27 |  |
| 002F |  | Reserved |  |  |  |  |  |
| 0030-0035 | Remote measurements |  |  |  |  |  |  |
| 0036-0037 |  | Earth RMS current |  |  | A/100 | F18 |  |
| 0038-003D |  | Reserved |  |  |  |  |  |
| 003E |  | Frequency | 4500-6500 |  | $1 / 100 \mathrm{~Hz}$ | F1 |  |
| 003F-004A |  | Reserved |  |  |  |  |  |
| $\begin{aligned} & \text { 004B- } \\ & 004 \mathrm{C} \end{aligned}$ |  | le harmonic |  |  | A/100 | F18 |  |
| 004D-0052 |  | Reserved |  |  |  |  |  |
| 0053 |  | Module of le |  |  |  | F1 |  |
| 0054-0056 |  | Reserved |  |  |  |  |  |
| 0057 |  | Argument (phase-angle) of le |  |  |  | F1 |  |
| 0058-0071 |  | Reserved |  |  |  |  |  |
| 0072 | Protection 32n | Information of overshooting of the threshold Pe>or leCos> |  |  |  | F16 |  |
| 0073 |  | Information of overshooting of the threshold $\mathrm{Pe} \gg$ or leCos>> |  |  |  | F16 |  |
| 0074 |  | Reserved |  |  |  |  |  |
| 0075 |  | Angle between le^Ue |  |  |  | F1 |  |
| $\begin{aligned} & 0076- \\ & 0079 \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 007A | Protection 59n | Information of overshooting of the threshold Ue>>>> |  |  |  | F16 |  |
| 007B-007F |  | Reserved |  |  |  |  |  |
| 0080-0085 | Voltage measurement | Reserved |  |  |  |  |  |
| 0086-0087 |  | Earth RMS voltage |  | 1 | V/100 | F18 |  |
| 0088-008A |  | Reserved |  |  |  |  |  |
| 008B |  | Module of Ue |  |  |  | F1 |  |
| $\begin{aligned} & \text { 008C- } \\ & \text { 008E } \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 008F |  | Argument (phase-angle) of Ue |  |  |  | F1 |  |
| 0090-009B |  | Reserved |  |  |  |  |  |

MiCOM P125
Page 10/30

| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 009C- <br> 009D | Power <br> measurements | Module Pe |  |  |  | F18A |  |
| 009E- <br> 00A8 |  | Reserved |  |  |  |  |  |
| O0A9- <br> O0AA |  | Module leCos |  |  |  | F18A |  |

### 2.4.1.3 Page 1H

| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0100 | Remote setting | Address | $1 . . .255$ | 1 |  | F1 | 1 |
| 0101 |  | Reserved |  |  |  |  |  |
| 0102 |  | Password, ASCII digits 1 and 2 | $32 . .127$ | 1 |  | F10 | AA |
| 0103 |  | Password, ASCII digits 3 and 4 | $32 . . .127$ | 1 |  | F10 | AA |
| 0104 |  | Rated frequency | $50 \ldots .60$ | 10 | Hz | F1 | 50 |
| 0105-0109 |  | Reserved |  |  |  |  |  |
| 010A |  | User reference, ASCII digits 1 and 2 | $32 . .127$ | 1 |  | F10 | AL |
| 010B |  | User reference, ASCII digits 3 and 4 | $32 . . .127$ | 1 |  | F10 | ST |
| O10C |  | Reserved |  |  |  |  |  |
| 010D |  | Inputs mode configuration (edge or level), part2/2 |  | 1 |  | F54A |  |
| 010E |  | Maintenance Mode | 0-1 | 1 |  | F24 | 0 |
| 010F |  | Digital inputs signal type: $A C-D C$ | 1-2 | 1 |  | F51 | 1 |
| $\begin{aligned} & 0110- \\ & 0118 \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 0119 |  | Digital input 1 config. part 2/2 |  | 1 |  | F15A |  |
| 011A |  | Digital input 2 config. part 2/2 |  | 1 |  | F15A |  |
| 011B |  | Digital input 3 config. part 2/2 |  | 1 |  | F15A |  |
| 011C |  | Digital input 4 config. part 2/2 |  | 1 |  | F15A |  |
| $\begin{aligned} & \text { 011D- } \\ & 0129 \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 012A |  | Secondary earth VT | 570.... 1300 | 1 | V/10 | F1 | 100V |
| 012B |  | Maintenance mode relays command |  |  |  | F13 |  |
| $\begin{aligned} & \text { O12C- } \\ & \text { O12D } \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 012E | Communication | Speed (IEC 60870-5-103 only) | $0 \ldots .7$ | 1 | - | F53 |  |
| 012F |  | Reserved |  |  |  |  |  |
| 0130 |  | UART Baud rate | $0 \ldots .7$ | 1 | - | F4 |  |
| 0131 |  | Parity | $0 \ldots .2$ | 1 | - | F5 | 0 |
| 0132 |  | Data bits | 0-1 | 1 | - | F28 | 1 |
| 0133 |  | Stop bits | 0-1 | 1 | - | F29 | 0 |
| 0134 |  | Communication available | 0-3 | 1 | - | F30 | 1 |
| 0135 | Configuration setting group | Parameters configuration active setting group | 1-2 | 1 | - | F55 | 1 |
| 0136 | LEDs configuration | Led 5 |  | 1 | - | F19 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0137 |  | Led 6 |  | 1 | - | F19 | 0 |
| 0138 |  | Led 7 |  | 1 | - | F19 | 0 |
| 0139 |  | Led 8 |  | 1 |  | F19 | 0 |
| 013A |  | Led PF 5 |  | 1 | - | F19A | 0 |
| 013B |  | Led PF 6 |  | 1 | - | F19A | 0 |
| 013C |  | Led PF 7 |  | 1 | - | F19A | 0 |
| 013D |  | Led PF 8 |  | 1 |  | F19A | 0 |
| $\begin{aligned} & 013 E- \\ & 0141 \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 0142 | Digital inputs configuration | Inputs operating mode configuration (edge or level) |  |  |  | F54 |  |
| 0143 |  | Inputs sense configuration (High or Low) | - | 1 | - | F47 | 0 |
| 0144-0145 |  | Reserved |  |  |  |  |  |
| 0146 |  | Digital input 1 | VTA |  | - | F15 | 0 |
| 0147 |  | Digital input 2 | VTA |  | - | F15 | 0 |
| 0148 |  | Digital input 3 | VTA |  | - | F15 | 0 |
| 0149 |  | Digital input 4 | VTA |  | - | F15 | 0 |
| $\begin{aligned} & \text { O14A- } \\ & \text { O14D } \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 014E | Alarm | Config. of Self-reset or non tor the start protection alarms | 0-1 | 1 |  | F24 |  |
| 014F-0151 |  | Reserved |  |  |  |  |  |
| 0152 |  | Conf. tripping tAUX 1 |  | 1 | - | F14 | 0 |
| 0153 |  | Conf. tripping tAUX 2 |  | 1 | - | F14 | 0 |
| 0154-0155 |  | Reserved |  |  |  |  |  |
| 0156 | Output Relays | RL1 relay operating mode | 0-1 | 1 | - | F56 | 0 |
| 0157-015B |  | Reserved |  |  |  |  |  |
| 015C |  | RL1 ... RL6 relays configuration and latch |  | 1 | - | F27 | 0 |
| 015D |  | RL1 relay configuration on RL2 ... RL6 |  | 1 | - | F14 | 0 |
| $\begin{aligned} & 015 E- \\ & 0160 \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 0161 | Protection 67n | Conf. tripping le> |  | 1 | - | F14 | 0 |
| 0162 |  | Conf. tripping le>> |  | 1 | - | F14 | 0 |
| 0163 |  | Conf. tripping le>>> |  | 1 | - | F14 | 0 |
| $\begin{aligned} & 0164- \\ & 0166 \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 0167 | Protection 67n | Conf. start le> |  | 1 | - | F14 | 0 |
| 0168 |  | Conf. start le>> |  | 1 | - | F14 | 0 |
| 0169 |  | Conf. start le>>> |  | 1 | - | F14 | 0 |
| $\begin{aligned} & 016 A- \\ & 016 B \end{aligned}$ |  | Reserved |  |  |  |  |  |

\(\left.$$
\begin{array}{|l|l|l|l|l|l|l|l|}\hline \begin{array}{l}\text { Address } \\
\text { (hex) }\end{array} & \text { Group } & \text { Description } & \begin{array}{l}\text { Values } \\
\text { range }\end{array} & \text { Step } & \text { Unit } & \text { Format } & \begin{array}{l}\text { Def. } \\
\text { Value }\end{array} \\
\hline \text { 016C } & \text { Automatism } & \text { Conf. tripping on relay RL1 } & & 1 & - & \text { F6 } & 1 \\
\hline \text { 016D } & & \text { Reserved } & & & & & \\
\hline \text { 016E } & & \text { Blocking logic } & & 1 & - & \text { F8 } & 0 \\
\hline \begin{array}{l}\text { 016F...018 } \\
\text { Aeserved }\end{array} & & \text { CB open pulse duration } & 10 \ldots 500 & 1 & \begin{array}{l}1 / 100 \\
\text { sec }\end{array}
$$ \& F1 \& 10 <br>
\hline 018B \& CB monitoring \& CB close pulse duration \& 10 ··· 500 \& 1 \& 1 / 100 <br>

sec\end{array}\right)\) F1 | 10 |
| :--- |
| 018C |

MiCOM P125
Page 14/30

| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 01EC |  | Conf. tripping Control Trip <br> \& Control Close |  | 1 | - | F14C | 0 |
| 01ED |  | Reserved |  |  |  |  |  |
| 01EE |  | Relay config. on Group 2 <br> active |  |  |  | F14 |  |
| 01EF - <br> 01F4 | Reserved |  |  |  |  |  |  |
| 01F5 |  | Autoreset LEDs on fault | $0 / 1$ | 1 |  | F24 | 1 |

Communications

MiCOM P125/P126/P127

### 2.4.1.4 Page 2 H

| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0200-0215 |  | Reserved |  |  |  |  |  |
| 0216 | Protection 67n | le> operating mode | 0-1-2 | 1 | - | F24A | 0 |
| 0217 |  | 0.002... 1 Ien | 2 .... 1000 | 1 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 Ien | $10 . .1000$ | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ |  |  |
|  |  | 0.1 ... 40 len | 10.... 2500 | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ |  |  |
| 0218 |  | Trip time type le> |  | - | - | F3 | 0 |
| 0219 |  | DMT Trip time le> | $0 . . .15000$ | 1 | 1/100 s | F1 | 0 |
| 021A |  | TMS: le> trip time multiplier | $25 \ldots .1500$ | 25 | 1/1000 | F1 | 25 |
| 021B |  | K: le> trip time multiplier for RI type curve | $100 . .10000$ | 5 | 1/1000 | F1 | 100 |
| 021C |  | le> reset time type DMT or IDMT | 0-1 | 1 |  | F34 |  |
| 021D |  | DMT Reset time le> | $0 \ldots .10000$ | 1 | 1/100 s | F1 | 4 |
| 021E |  | TMS: le> reset time multiplier | $25 \ldots .1500$ | 25 | 1/1000 | F1 | 0 |
| 021F | Ue> value | $57 \ldots 130 \mathrm{~V}$ | $10 \ldots 2600$ | 1 | V/10 | F1 | 2600 |
|  |  | 220 ... 480V | 40 .... 7200 | 5 | V/10 | F1 | 7200 |
| 0220 |  | Torque angle le^Ue> | 0.... 359 | 1 | Deg. | F1 | 0 |
| 0221 |  | Trip angle le^Ue> | 10 .... 170 | 1 | Deg. | F1 | 10 |
| 0222 |  | Interlock le> | 0-1 | 1 |  | F24 | 0 |
| 0223 |  | le>> operating mode | 0-1-2 | 1 | - | F24A | 0 |
| 0224 | le>> value | 0.002... 1 len | $2 \ldots .1000$ | 1 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 Ien | $10 \ldots .8000$ | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ |  |  |
|  |  | $0.1 \ldots 40$ len | $40 . . .4000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ |  |  |
| 0225 |  | Trip time le>> | 0 ..... 15000 | 1 | 1/100 s | F1 | 0 |
| 0226 | Ue>> value | 57 .... 130V | $10 . . .2600$ | 1 | V/10 | F1 | 2600 |
|  |  | 220 .... 480V | $40 \ldots 9600$ | 5 | V/10 | F1 | 9600 |
| 0227 |  | Torque angle le^Ue>> | $0 \ldots 359$ | 1 | Deg. | F1 | 0 |
| 0228 |  | Trip angle le^Ue>> | $10 \ldots .170$ | 1 | Deg. | F1 | 10 |
| 0229 |  | le>>> operating mode | 0-1-2-3 | 1 | - | F24A | 0 |
| 022A | le>>> value | 0.002... 1 len | 2 ... 1000 | 1 | $\begin{aligned} & \hline 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 Ien | $10 . . .8000$ | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { len } \end{aligned}$ |  |  |
|  |  | $0.1 \ldots 40$ len | $40 . . .4000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ |  |  |
| 022B |  | Trip time le>>> | 0 ... 15000 | 1 | 1/100 s | F1 | 0 |
| 022C | Ue>>> value | 57 .... 130V | $10 \ldots 2600$ | 1 | V/10 | F1 | 2600 |
|  |  | 220 ....480V | $40 \ldots .9600$ | 5 | V/10 | F1 | 9600 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 022D |  | Torque angle le^Ue>>> | $0 \ldots .359$ | 1 | Deg. | F1 | 0 |
| 022E |  | Trip angle le^Ue>>> | $10 . . .170$ | 1 | Deg. | F1 | 10 |
| $\begin{aligned} & \text { 022F- } \\ & \text { 024D } \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 024E | Protection 32n | Pe> trip angle | $0 . . . .359$ | 1 |  | F1 | 0 |
| 024F |  | $32 n$ operating mode: Pe or leCos | 0-1 | 1 | - | F24C | 0 |
| 0250 |  | Pe> operating mode | 0-1 | 1 | - | F24 | 0 |
| 0251 | $\mathrm{Pe}>$ value | 0.002... 1 len current operating range with version 57...130V | 20... 2000 | 2 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 2000 |
|  |  | 0.002... 1 len current operating range with version 220 ... 480V | 100... 8000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 8000 |
|  |  | 0.01 ... 8 len current operating range with version 57 ... 130V | 400... 16000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 16000 |
|  |  | 0.01 ... 8 len current operating range with version 220...480V | 400... 64000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 64000 |
|  |  | $0.1 \ldots 40$ len current operating range with version 57 ... 130V | 10..... 800 | 1 | 1 lenW | F1 | 800 |
|  |  | $0.1 \ldots 40$ len current operating range with version 220...480V | 40... 3200 | 5 | 1 IenW | F1 | 3200 |
| 0252 |  | Trip time type Pe> |  | - | - | F3 | 0 |
| 0253 |  | Trip time Pe> | $0 . . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0254 |  | TMS: Pe> trip time multiplier | $25 \ldots .1500$ | 25 | 1/1000 | F1 | 25 |
| 0255 |  | K: Pe> trip time multiplier for RI type curve | $100 . .10000$ | 5 | 1/1000 | F1 | 100 |
| 0256 |  | Reset time type Pe>: DMT or IDMT | 0-1 | 1 | - | F34 | 0 |
| 0257 |  | DMT reset time Pe> | $0 \ldots .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 0258 |  | TMS reset time Pe> | $25 \ldots .3200$ | 25 | 1/1000 | F1 | 100 |
| 0259 |  | Pe>> operating mode | 0-1 | 1 | - | F24 | 0 |
| 025A | Pe>> value | 0.002... 1 len current operating range with version 57...130V | 20... 2000 | 2 | $\begin{aligned} & 1 / 100 \\ & \text { IenW } \end{aligned}$ | F1 | 2000 |
|  |  | $0.002 . . .1$ len current operating range with version 220 ... 480V | 100... 8000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 8000 |
|  |  | 0.01 ... 8 len current operating range with version 57 ... 130V | 400... 16000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 16000 |
|  |  | 0.01 ... 8 len current operating range with version 220...480V | 400... 64000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 64000 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 0.1 ... 40 len current operating range with version 57 ... 130V | 10..... 800 | 1 | 1 lenW | F1 | 800 |
|  |  | 0.1 ... 40 len current operating range with version 220...480V | 40... 3200 | 5 | 1 lenW | F1 | 3200 |
| 025B |  | Trip time Pe>> | $0 . . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 025C |  | leCos> operating mode | 0-1 | 1 | - | F24 | 0 |
| 025D | leCos> value | 0.002... 1 len | $2 \ldots . .1000$ | 1 | $\begin{aligned} & \hline 1 / 1000 \\ & \text { len } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 len | 10... 8000 | 5 | $\begin{aligned} & \hline 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 |  |
|  |  | 0.1 ... 40 len | $10 \ldots 2500$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ | F1 |  |
| 025E |  | Trip time type leCos> |  | - | - | F3 | 0 |
| 025F |  | DMT Trip time leCos> | 0..... 15000 | 1 | 1/100 s | F1 | 0 |
| 0260 |  | TMS: leCos> trip time multiplier | 25 .... 1500 | 25 | 1/1000 | F1 | 25 |
| 0261 |  | K: leCos> trip time multiplier for RI type curve | $\begin{aligned} & 100 \ldots . . \\ & 10000 \end{aligned}$ | 5 | 1/1000 | F1 | 100 |
| 0262 |  | Reset time type leCos>: DMT or IDMT | 0-1 | 1 | - | F34 | 0 |
| 0263 |  | DMT Reset time leCos> | 0 ..... 10000 | 1 | 1/100 s | F1 | 4 |
| 0264 |  | TMS reset time leCos> | $25 \ldots . .1500$ | 25 | 1/1000 | F1 | 25 |
| 0265 |  | leCos>> mode | 0-1 | 1 | - | F24 | 0 |
| 0266 | leCos>> value | 0.002... 1 Ien | 2 ..... 1000 | 1 | $\begin{aligned} & 1 / 1000 \\ & \text { len } \\ & \hline \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 len | 10... 8000 | 5 | $\begin{aligned} & \hline 1 / 1000 \\ & \text { len } \end{aligned}$ | F1 |  |
|  |  | 0.1 ... 40 len | $50 \ldots 4000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { Ien } \end{aligned}$ | F1 |  |
| 0267 |  | Trip time leCos>> | $0 \ldots . .15000$ | 1 | 1/100 s | F1 | 0 |
| 0268-026D |  | Reserved |  |  |  |  |  |
| 026E | Protection 59n | Ue>>>> operating mode | 0-1 | 1 | - | F24 | 0 |
| 026F | Ue>>>> value | $57 . . .130 \mathrm{~V}$ | $10 \ldots . .2600$ | 1 | V/10 | F1 | 2600 |
|  |  | 220 ... 480V | 50 ..... 9600 | 5 | V/10 | F1 | 9600 |
| 0270 |  | Trip time Ue>>>> | $0 \ldots .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0271-0283 |  | Reserved |  |  |  |  |  |
| 0284 | Reset time 67N | DMT Reset time le>> | $0 \ldots . .10000$ | 1 | $1 / 100$ | F1 | 4 |
| 0285 |  | DMT Reset time le>>> | $0 \ldots .10000$ | 1 | 1/100 s | F1 | 4 |
| 0286 | Reset time 32N | DMT Reset time leCos>> | 0 ..... 10000 | 1 | 1/100 s | F1 | 4 |
| 0287 |  | DMT Reset time Pe>> | $0 \ldots . .10000$ | 1 | 1/100 s | F1 | 4 |
| 0288-028D |  | Reserved |  |  |  |  |  |
| 028E | Protection 67n | Trip time type le>> |  | - | - | F3 | 0 |

MiCOM P125
Page 18/30

| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 028 F |  | TMS: le>> trip time <br> multiplier | $25 \ldots .1500$ | 25 | $1 / 1000$ | F1 | 25 |
| 0290 |  | K: le>> trip time multiplier <br> for RI type curve | $100 \ldots$. <br> 10000 | 5 | $1 / 1000$ | F1 | 100 |
| 0291 | Reset time type: DMT / <br> IDMT | $0-1$ | 1 |  | F34 |  |  |
| 0292 |  | TMS: le>> reset time <br> multiplier | $25 \ldots .1500$ | 25 | $1 / 1000$ | F1 | 25 |

### 2.4.1.5 Page 3H

The same as page 2 H except addresses are 03XX instead of 02XX.

### 2.4.1.6 Page 4H

| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0400 | Remote control | Remote control word 1 | $0 \ldots . .31$ | 1 | - | F9 | 0 |
| 0401 |  | Calibration mode |  |  | - |  | 0 |
| 0402 |  | Remote control word 2 <br> (single output command) | $0 \ldots .511$ | 1 | - | F39 | 0 |
| 0403 |  | Remote control word 3 | $0-3$ | 1 |  | F50 | 0 |

### 2.4.1.7 Page 7H

| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0700 | Fast reading <br> byte | Fast reading byte |  | 1 | - | F23 | 0 |

### 2.4.1.8 Reserved pages

The following pages are reserved for further expansions:

- Page 5H.
- Page 6H.


### 2.4.1.9 Mapping access characteristics

- Description of accessible addresses in reading of words (function 03 and 04).

PAGE 00: 0000h ..... 00A4h
PAGE 01: 0100h ...... 01F2h
PAGE 02: 0200h ...... 0283h
PAGE 05: 0500h ...... 0539h

- Definition of accessible addresses in writing of 1 word (function 06).

PAGE 01: 0100h ...... 01F2h
PAGE 02: 0200h ...... 0283h
PAGE 04: 0400h ...... 0403h
PAGE 05: 0500h ...... 0539h

- Definition of accessible addresses in writing of n words (function 16).

PAGE 01: 0100h ...... 01F2h
PAGE 02: 0200h ...... 0283h
PAGE 05: 0500h ...... 0539h

- Definition of accessible addresses in reading of bits (function 01 and 02).

WARNING: BITS NUMBER MUST NOT BE HIGHER THAN 16. ADDRESSES ARE GIVEN IN BIT ADDRESSES.
PAGE 00: 0100H ...... 0250H
PAGE 01: 1500H ...... 1830H

- Definition of accessible addresses in writing of 1 bit (function 05).

WARNING: BITS NUMBER MUST NOT BE HIGHER THAN 16.
PAGE 04: 4000H ...... 400FH

- Definition of accessible addresses in writing of $n$ bits (function 15).

WARNING: BITS NUMBER MUST NOT BE HIGHER THAN 16.
PAGE 01: 1500H ...... 1830H
PAGE 04: 4000H ...... 400BH

### 2.4.2 Mapping format description

| CODE | DESCRIPTION |
| :---: | :---: |
| F1 | Unsigned integer: numerical data 1..... 65535 |
| F2 | Signed integer: numerical data -32768 ....... 32767 |
| F3 | Unsigned integer: TRIP / RESET curves type (hex values) <br> 0 : DMT <br> 10 : STI (CEI) <br> 11 : SI (CEI) <br> 12 : VI (CEI) <br> 13 : El (CEI) <br> 14 : LTI (CEI) <br> 115 : STI (C02) <br> 116 : MI (ANSI) <br> 117 : LTI (CO8) <br> 118: VI (ANSI) <br> 119 : El (ANSI) <br> 1A : RECT <br> 20 : RI |
| F4 | Unsigned integer: UART Baud rate <br> 0: 300 <br> 1: 600 <br> 2: 1200 <br> 3: 2400 <br> 4: 4800 <br> 5: 9600 <br> 6: 19200 <br> 7: 38400 |
| F5 | Unsigned integer: Modbus parity bit 0: none <br> 1: even <br> 2: odd |
| F6 | Unsigned integer: relay X1 configuration - part $1 / 2$ <br> Bits 0 to 2: Reserved <br> Bit 3: tle> <br> Bit 4: tle>> <br> Bit 5: tle>>> <br> Bits 6 to 8: Reserved <br> Bit 9: tAUX 1 trip <br> Bit 10: tAUX 2 trip <br> Bit 11: Reserved <br> Bit 12: tPe/lecos> <br> Bit 13: tPe/lecos >> <br> Bit 14: tUe>>>> <br> Bit 15: Control trip |
| F6A | Unsigned integer: relay X1 configuration - part 2/2 <br> Bits 0 to 12: Reserved <br> Bit 13: tAUX 3 trip <br> Bit 14: tAUX 4 trip <br> Bit 15: Reserved |
| F7 | Reserved |


| CODE | DESCRIPTION |
| :--- | :--- |
| F8 | Unsigned integer: blocking logic configuration - part 1/2 <br> Bits 0 to 2: Reserved <br> Bit 3: tle> <br>  <br> Bit 4: te>> <br> Bit 5: tle>>> <br> Bits 6 to 9: Reserved <br> Bit 9: taux1 trip <br> Bit 10: taux trip <br> Bit 11: Reserved <br> Bit 12: PPe/lecos> <br> Bit 13: tPe/lecos>> <br> Bit 14: tUe>>>> <br> Bit 15: Reserved |
| F8A | Unsigned integer: blocking logic configuration - part 2/2 <br> Bit 0 to 3: Reserved |
|  | Bit 4: taux3 trip |
|  | Bit 5: taux4 trip |
| Bits 6 to 15: Reserved |  |


| CODE | DESCRIPTION |
| :---: | :---: |
| F14B | Unsigned integer: RI2 ... RL6 output configuration for tAux3 \& tAux4 Bit 0: logic output number RL2 selection (tAux3) <br> Bit 1: logic output number RL3 selection (tAux3) <br> Bit 2: logic output number RL4 selection (tAux3) <br> Bit 3: logic output number RL5 selection (tAux3) <br> Bit 4: logic output number RL6 selection (tAux3) <br> Bits 5 to 7: Reserved <br> Bit 8: logic output number RL2 selection (tAux4) <br> Bit 9: logic output number RL3 selection (tAux4) <br> Bit 10: logic output number RL4 selection (tAux4) <br> Bit 11: logic output number RL5 selection (tAux4) <br> Bit 12: logic output number RL6 selection (tAux4) <br> Bits 13 to 15: Reserved |
| F14C | Unsigned integer: RI2 ... RL6 output configuration for Control Trip \& Close <br> Bit 0: logic output number RL2 selection (Control Trip) <br> Bit 1: logic output number RL3 selection (Control Trip) <br> Bit 2: logic output number RL4 selection (Control Trip) <br> Bit 3: logic output number RL5 selection (Control Trip) <br> Bit 4: logic output number RL6 selection (Control Trip) <br> Bits 5 to 7: Reserved <br> Bit 8: logic output number RL2 selection (Control Close) <br> Bit 9: logic output number RL3 selection (Control Close) <br> Bit 10: logic output number RL4 selection (Control Close) <br> Bit 11: logic output number RL5 selection (Control Close) <br> Bit 12: logic output number RL6 selection (Control Close) <br> Bits 13 to 15: Reserved |
| F15 | Unsigned integer: digital inputs configuration, part 1/2 <br> Bit 0 : auxuliary relays de-latching command <br> Bits 1 to 3: Reserved <br> Bit 4: aux 1 <br> Bit 5: aux 2 <br> Bit 6: blocking logic <br> Bits 7 to 9: Reserved <br> Bit 10: digital selection <br> Bit 11: Reserved <br> Bit 12: settings group change (configuration must be equal to INPUT) <br> Bits 13 to 15: Reserved |
| F15A | Unsigned integer: digital inputs configuration, part 2/2 <br> Bit 0: Reserved <br> Bit 1: maintenance mode <br> Bit 2: aux 3 <br> Bit 3: aux 4 <br> Bits 4 to 15: Reserved |
| F16 | Unsigned integer: earth threshold (current, voltage) information status Bit 0: overshooting of the earth thresholds <br> Bits 1 to 3: Reserved <br> Bit 4: le> Interlock activated <br> Bit 5: information start <br> Bit 6: tripping information of the earth thresholds <br> Bit 7: overshooting of the earth threshold reverse. <br> Bits 8 to 15: Reserved |
| F17 | Reserved |
| F18 | Signed long integer: numeric data: $-2^{31} \ldots . .2^{31}$ |
| F18A | Unsigned long integer: numeric data: $1 \ldots \ldots . .2^{32}$ |


| CODE | DESCRIPTION |
| :---: | :---: |
| F19 | Unsigned integer: LEDS configuration mask - part 1/2 <br> Bits 0 to 5: Reserved <br> Bit 6: le> <br> Bit 7: tle> <br> Bit 8: le>> <br> Bit 9: tle>> <br> Bit 10: le>>> <br> Bit 11: tle>>> <br> Bits 12 to 15: Reserved |
| F19A | Unsigned integer: LEDS configuration mask - part 2/2 <br> Bit 0: digital input 1 <br> Bit 1: digital input 2 <br> Bit 2: digital input 3 <br> Bit 3: digital input 4 <br> Bits 4 to 6: Reserved <br> Bit 7: tAUX1 trip <br> Bit 8: tAUX2 trip <br> Bit 9: Pe/lecos> <br> Bit 10: tPe/lecos> <br> Bit 11: Pe/lecos>> <br> Bit 12: tPe/lecos>> <br> Bit 13: Ue>>>> <br> Bit 14: tUe>>>> <br> Bit 15: Reserved |
| F19B | Reserved |
| F19C | Reserved |
| F20 | Unsigned integer: logic inputs data status <br> Bit 0: logic selection <br> Bit 1: Reserved <br> Bit 2: relays de-latching <br> Bits 3 to 5: Reserved <br> Bit 6: aux 1 <br> Bit 7: aux 2 <br> Bit 8: blocking logic <br> Bits 9 to 11: Reserved <br> Bit 12: settings group change <br> Bits 13 to 15: Reserved |
| F20A | Unsigned integer: logic inputs data status, part 2/2 <br> Bit 0: Reserved <br> Bit 1: maintenance mode <br> Bit 2: aux 3 <br> Bit 3: aux 4 <br> Bits 4 to 15: Reserved |
| F21 | Unsigned integer: software version (Dec value) : 00-99 (XY) <br> $X$ digit $=$ Version number 0-9 <br> Y digit = Revision number 0 (A)-9 (J) |
| F22 | Unsigned integer : internal logic data Bit 0: RL1 trip relay status <br> Bits 1 to 15: Reserved |
| F23 | Unsigned integer: machine status <br> Bit 0 : heavy alarm <br> Bit 1 : non heavy alarm <br> Bit 2 : presence of a non-acknowledged event <br> Bit 3 : synchronisation state <br> Bit 4:38 $\rightarrow$ version 6.A <br> Bit 5 : presence of a non-acknowledged fault record <br> Bits 6 to 15: Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F24 | Unsigned integer: generic info operating mode 0 : out of service / not active <br> 1: in service / active |
| F24A | Unsigned integer: 67N operating mode <br> 0: NO <br> 1: YES <br> 2: DIR <br> 3: PEAK |
| F24B | Reserved |
| F24C | Unsigned integer: 32 N protection operating mode <br> 0: Pe threshold mode <br> 1: leCos threshold mode |
| F25 | Unsigned integer: 2 ASCII characters |
| F26 | Unsigned integer: default display configuration 4 : IN measurement display (True RMS) |
| F27 | Unsigned integer: RL1 ... RL6 output relays latch configuration and status <br> Bit 0: relay number 1 (RL1) <br> Bit 1: relay number 2 (RL2) <br> Bit 2: relay number 3 (RL3) <br> Bit 3: relay number 4 (RL4) <br> Bit 4: relay number 5 (RL5) <br> Bit 5: relay number 6 (RL6) <br> Bits 6 to15: Reserved |
| F28 | Unsigned integer: Modbus parameters - data bits number. 0: 7 data bits <br> 1: 8 data bits |
| F29 | Unsigned integer: Modbus and DNP3 stop bits number <br> 0 : one stop bit <br> 1: two stop bits |
| F30 | Unsigned integer: communication status + Private telegram option (IEC870-5-103 only) Bit 0 : communication available if $=1$ <br> Bit 1: IEC870-5-103 private telegrams used if $=1$, else IEC870-5-103 telegrams in public range only. |
| F31 | Reserved |
| F32 | Reserved |
| F33 | Unsigned integer: cold load start thresholds <br> Bits 0 to 2: Reserved <br> Bit 3: tle> <br> Bit 4: tle>> <br> Bit 5: tle>>> <br> Bits 6 to 15: Reserved |
| F34 | Unsigned integer: threshold reset timer type <br> 0: DMT <br> 1: IDMT |
| F35 | Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F36 | Unsigned integer: non acknowledged memorised alarms flags - part 1/4 <br> Bit 0: le> <br> Bit 1: tle> <br> Bit 2: le>> <br> Bit 3: tle>> <br> Bit 4: le>>> <br> Bit 5: tle>>> <br> Bit 6: le>REV <br> Bit 7: le>> REV <br> Bit 8: le>>>REV <br> Bits 9 to 13: Reserved <br> Bit 14: AUX1 trip <br> Bit 15: AUX2 trip |
| F36A | Unsigned integer: non acknowledged memorised alarms flags - part $2 / 4$ Bits 0 to 9 : Reserved <br> Bit 9: Pe/lecos> <br> Bit 10: tPe/lecos > <br> Bit 11: Pe/lecos >> <br> Bit 12: tPe/lecos >> <br> Bits 13 to 15: Reserved |
| F36B | Unsigned integer: non acknowledged memorised alarms flags - part 3/4 <br> Bits 0 to 7: Reserved <br> Bit 8: Ue>>>> <br> Bit 9: tUe>>>> <br> Bits 10 to 15: Reserved |
| F36C | Unsigned integer: non acknowledged memorised alarms flags - part 4/4 <br> Bit 0: AUX3 trip <br> Bit 1: AUX4 trip <br> Bits 2 to 15 : Reserved |
| F37 | Reserved |
| F38 | Unsigned integer: accessory functions <br> Bits 0 to 5: Reserved <br> Bit 6: AUX 1 trip <br> Bit 7: AUX 2 trip <br> Bits 8 to 11: Reserved <br> Bit 12: AUX 3 trip <br> Bit 13: AUX 4 trip <br> Bits 14-15: Reserved |
| F39 | Unsigned integer : output relay remote word in maintenance mode <br> Bit 0: RL1 (trip) <br> Bit 1: RL2 <br> Bit 2: RL3 <br> Bit 3 : RLO (watch-dog) <br> Bit 4: RL4 <br> Bit 5: RL5 <br> Bit 6: RL6 <br> Bits 7 to15: Reserved |
| F40 | Reserved |
| F41 | Unsigned integer: remote communication configuration <br> 0 : front and rear MODBUS <br> 1 : front MODBUS rear IEC 60870-5-103 <br> 2 : front MODBUS rear COURIER <br> 3 : front MODBUS rear DNP3.0 |
| F42 | Reserved |
| F43 | Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F44 | Reserved |
| F45 | Unsigned integer : HW alarm relay status <br> Bit 0: Watch-Dog operating <br> Bit 1: communication failure <br> Bit 2: EEPROM data failure <br> Bit 3: analogue failure <br> Bit 4: Reserved <br> Bit 5: EEPROM calibration failure <br> Bits 6 to 8: Reserved <br> Bit 9: factory alarm (default factory configuration reloaded) <br> Bits 10 to 15: Reserved |
| F46 | Unsigned integer: : le harmonic content extraction Bit 0: calculation active Bits 1 to 15: Reserved |
| F47 | Unsigned integer: digital inputs operating mode, part 1/2 Bit $\mathrm{x}=$ <br> $0 \rightarrow$ active when de-energized; <br> $1 \rightarrow$ active when energized <br> Bit 0 : input 1 <br> Bit 1 : input 2 <br> Bit 2 : input 3 <br> Bit 3 : input 4 <br> Bit 4 : input 5 <br> Bit 5 : input 6 <br> Bit 6 : input 7 <br> Bits 2 to 15: Reserved |
| F49 | Unsigned integer: calibration status flag <br> 0: calibration KO <br> 1: calibration OK |
| F50 | Unsigned integer: remote control word number 3 Bit 0: flag sync. earth current harmonic Bits 1 to 15: Reserved |
| F51 | Unsigned integer: digital inputs signal type <br> 1: AC <br> 2: DC |
| F52 | Reserved |
| F53 | Unsigned integer: IEC 60870-5-103 and DNP3.0 communication speed (Baud) $\frac{\text { INTERNAL USE ONLY }}{\frac{\text { IEC 60870-5-103: }}{0: 9600}} \begin{aligned} & 1: 19200 \end{aligned}$ |
| F54 | Unsigned integer: Digital inputs configuration mode, part 1/2: <br> Bit $x=0 \rightarrow$ level / $1 \rightarrow$ edge <br> Bit 0 : logic selection; operating only on level; not configurable (0) <br> Bit 1: Reserved <br> Bit 2: relays de-latching; operating only on level; not configurable (0) <br> Bits 3 to 5: Reserved <br> Bit 6: t Aux 1; operating only on level; not configurable (0) <br> Bit 7: t Aux 2; operating only on level; not configurable (0) <br> Bit 8: blocking logic; operating only on level; not configurable (0) <br> Bits 9 to 11: Reserved <br> Bit 12: settings group change ; Attention: $\mathbf{0} \boldsymbol{\rightarrow}$ Input / $\mathbf{1 \rightarrow}$ Menu <br> Bits 13 to 15: Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F54A | Unsigned integer: Digital inputs configuration mode, part2/2: <br> Bit $\mathrm{x}=0 \rightarrow$ level $/ 1 \rightarrow$ edge <br> Bit 0: Reserved <br> Bit 1: maintenance mode; operating only on level; not configurable (0) <br> Bit 2: t aux 3; operating only on level; not configurable (0) <br> Bit 3: t aux 4; operating only on level; not configurable (0) <br> Bits 4,5: Reserved <br> Bit 6: Local mode; operating only on level; not configurable (0) <br> Bits 7 to 15: Reserved |
| F55 | Unsigned integer: active group <br> 1: settings group 1 <br> 2: settings group 2 |
| F56 | Reserved |
| F57 | Reserved |
| F58 | Reserved |
| F59 | Reserved |
| F60 | Reserved |
| F61 | Unsigned integer: Information on the starting origin of the RL1 trip relay <br> 01 - Remote X1 trip <br> 02 - Reserved <br> 03 - Reserved <br> 04-Reserved <br> 05 - Reserved <br> 06 - le> trip <br> 07 - le>> trip <br> 08 - le>>> trip <br> 09 - Reserved <br> 10 - Reserved <br> 11-Reserved <br> 12 - Reserved <br> 13 - Pe/lecos> trip <br> 14 - $\mathrm{Pe} / \mathrm{lecos} \gg$ trip <br> 15-Reserved <br> 16-Reserved <br> 17 - Reserved <br> 18 - Reserved <br> 19-Reserved <br> 20-Ue>>>> trip <br> 21-Aux 1 trip <br> 22-Aux 2 trip <br> 23 - Reserved <br> 24-Reserved <br> 25 - Reserved <br> 26-Reserved <br> 27-Aux 3 trip <br> 28-Aux 4 trip <br> 29-Reserved |

## 3. IEC 60870-5-103 PROTOCOL

### 3.1 General information

Messages representation is expressed with the associated :

- INFORMATION NUMBER: INF
- ASDU TYPE: TYP
- CAUSE OF TRANSMISSION: COT
- FUNCTION NUMBER: FUN .


### 3.2 System state

It is given in the answer to the General Interrogation (GI).
Relay state informations are Class 1 data, they are systematically sent to the master station, during a General Interrogation.

The list of processed data, following a General Interrogation, is given below ; it is a subassembly of the spontaneous messages list, so like spontaneous messages, these data are generated on rising and falling edge.

The following list of processed events is the list with the private messages option active, where FUNCTION NUMBERS (FUN) 160 is used for Public range for current protection data, and FUNCTION NUMBERS (FUN) 168 is used for Private range. The corresponding event numbers with private messages option inactive are given just below.

Status indications (monitor direction):

- Local parameter Setting active:
- $\quad$ Setting group number 1 active:
- $\quad$ Setting group number 2 active:
- Auxiliary input 1 :
- Auxiliary input 2 :
- Auxiliary input 3 :
- Auxiliary input 4:
- Logical input 1:
with private option inactive:
- Logical input 2 :
with private option inactive:
- Logical input 3:
with private option inactive:
- Logical input 4:
with private option inactive:
- Logical output 1:
with private option inactive:
- Logical output 2:
with private option inactive:

$$
\begin{aligned}
& \text { FUN <160>; INF <22>; TYP <1>; COT<9> } \\
& \text { FUN<160>; INF <23>; TYP <1>; COT<9> } \\
& \text { FUN<160>;INF <24>; TYP <1>; COT<9> } \\
& \text { FUN<160>;INF <27>; TYP <1>; COT<9> } \\
& \text { FUN<160>;INF <28>; TYP <1>; COT<9> } \\
& \text { FUN<160>;INF <29>; TYP <1>; COT<9> } \\
& \text { FUN<160>;INF <30>; TYP <1>; COT<9> } \\
& \text { FUN<168>;INF <160>; TYP <1>; COT<9> } \\
& \text { FUN<160>;INF <161>; TYP <1>; COT<9> } \\
& \text { FUN<168>;INF <161>; TYP <1>; COT<9> } \\
& \text { FUN<160>;INF <162>; TYP <1>; COT<9> } \\
& \text { FUN<168>;INF <162>; TYP <1>; COT<9> } \\
& \text { FUN<160>;INF <163>; TYP <1>; COT<9> } \\
& \text { FUN<168>;INF <163>; TYP <1>; COT<9> } \\
& \text { FUN<160>;INF <164>; TYP <1>; COT<9> } \\
& \text { FUN<168>;INF <176>; TYP <1>; COT<9> } \\
& \text { FUN<160>;INF <176>; TYP <1>; COT<9> } \\
& \text { FUN<168>;INF <177>; TYP <1>; COT<9> } \\
& \text { FUN<160>;INF <177>; TYP <1>; COT<9> }
\end{aligned}
$$

- Logical output 3:
with private option inactive:
- Logical output 4:
with private option inactive:
- Watch Dog output:
with private option inactive:
- Logical output 5 :
with private option inactive:
- Logical output 6:

Fault Indications (monitor direction):

- Start / pick-up N:

FUN<168>;INF <178>; TYP <1>; COT<9>
FUN<160>; INF <178>; TYP <1>; COT<9>
FUN<168>;INF <179>; TYP <1>; COT<9>
FUN<160>;INF <179>; TYP <1>; COT<9>
FUN<168>;INF <180>; TYP <1>; COT<9>
FUN<160>;INF <180>; TYP <1>; COT<9>
FUN<168>;INF <181>; TYP <1>; COT<9>
FUN<160>;INF <181>; TYP <1>; COT<9>
FUN<168>;INF <182>; TYP <1>; COT<9>

FUN<160>;INF <67>; TYP <2>; COT<9>

### 3.3 Processed commands

3.3.1 System commands

## General Interrogation Initialisation command: ASDU 7

FUN<255>;INF <0>; TYP <7>; COT<9>

This command starts the relay interrogation.
The relay then sends a list of data containing the relay state (see the list described in the above paragraph).
The GI command contains a scan number which will be included in the answers of the Gl cycle generated by the GI command.

If a data has just changed before extracted by the GI, the new state is sent to the master station.

The end of a GI consists in sending an ASDU 8 to the master station.
If, during a General Interrogation cycle, another GI Initialisation command is received, the previous answer is stopped, and the new Gl cycle is started.
3.3.2 General commands

Control direction: ASDU 20

- LEDS Reset : this command acknowledges all alarms on Front Panel:
- Trip TC
with private option inactive:
- Close TC:
with private option inactive:

FUN<160>;INF<19>; TYP<20>; COT<20>
FUN<168>;INF<1>; TYP<20>; COT<20>
FUN<160>;INF <142>; TYP <20>; COT<20>
FUN<168>;INF<2>; TYP<20>; COT<20>
FUN<160>;INF <143>; TYP <20>; COT<20>

After executing one of these commands, the relay sends an acknowledgement message, which contains the result of command execution.

If a state change is the consequence of the command, it must be sent in a ASDU 1 with COT 12 (remote operation).

If the relay receives another command message from the master station before sending the acknowledgement message, it will be discarded.

Commands which are not processed by the relay are rejected with a negative acknowledgement message.

### 3.4 Relay reinitialisation

In case of relay reinitialisation, the relay sends to the master station the following messages , ASDU 5:

- relay's power on FUN<160>; INF <5>; TYP <5> ; COT <5>

In case of Communication reinitialisation, the relay sends to the master station the following messages, ASDU 5:

- Reset CU FUN<160>; INF <5>; TYP <3> ; COT <4>

In case of Communication reinitialisation by Reset FCB, the relay sends to the master station the following messages, ASDU 5:

- Reset FCB FUN<160>; INF <5>; TYP <2> ; COT <3>

Each ASDU 5 message (identification of the relay) contains the manufacturer's name in 8 ASCII characters and 4 ASCII characters containing the relay model («P125»).

### 3.5 Cyclic Messages

Only measurands can be stored in these messages.
Measurands values are stored in lower levels of communication, before polling by master station.

In ASDU $9 \quad$ FUN<160>;INF <148>; TYP <9>; COT<2>
The following value is stored (with a rate such as: 2,4 * nominal value $=4096$ ) :

- Frequency (lf frequency is out of bounds, the value is set to « unvalid».

In ASDU $3 \quad$ FUN<160>;INF <147>; TYP <3>; COT<2>
The following values are stored (with a rate such as: 2,4 * nominal value $=4096$ ) :

- RMS IN,
- RMS Un.


# MODBUS DATABASE IEC 60870-5-103 

## CONTENT

## 1. INTRODUCTION 3

1.1 Purpose of this document3
1.2 Glossary ..... 3
2. MODBUS PROTOCOL ..... 4
2.1 MODBUS connection technical characteristics ..... 4
2.1.1 MODBUS connection parameters ..... 4
2.1.2 Exchanges messages synchronisation ..... 4
2.1.3 Message validity check ..... 4
2.1.4 Address ..... 4
2.2 MODBUS functions available in the protection device ..... 5
2.3 Presentation of the MODBUS protocol ..... 5
2.3.1 Frame size received by the protection device (slave) ..... 5
2.3.2 Format of frames transmitted by the protection device ..... 6
2.3.3 Messages validity check ..... 6
2.4 Database organisation ..... 7
2.4.1 Description of the application mapping ..... 7
2.4.2 Mapping format description ..... 42
2.4.3 Disturbance record additional information ..... 55
2.4.4 Request to retrieve the oldest non-acknowledge event ..... 56
2.4.5 Request to retrieve a dedicated event ..... 56
2.4.6 Modbus request definition used to retrieve the fault records ..... 56
3. IEC 60870-5-103 PROTOCOL ..... 58
3.1 General information ..... 58
3.2 Spontaneous messages ..... 58
3.2.1 Time Tagged Message ..... 58
3.2.2 Status Indications ..... 58
3.3 System state ..... 62
3.4 Processed commands ..... 64
3.4.1 System commands ..... 64
3.4.2 General commands ..... 64
3.5 Relay reinitialisation ..... 65
3.6 Cyclic Messages ..... 65
3.7 Disturbance record extraction ..... 66

## 1. INTRODUCTION

### 1.1 Purpose of this document

This document describes the characteristics of the different communication protocols of MiCOM P126 relay.

The available communication protocols on the relay are listed below:

- MODBUS
- IEC 60870-5-103
- K-BUS/Courier (not available)
- DNP3 (not available)
1.2 Glossary
le : earth fault current measured
Ue : residual voltage measured directly by the input terminals on rear panel
$\mathrm{Pe} \quad$ : earth fault power (Calculated)
leCosPhi : active component of the earth fault current
pf : soft weight of a word of 16 bits
PF : heavy weight of a word of 16 bits
Dec : decimal representation value
Hex : hexadecimal representation value
DNP3. 0 \& COURIER are not available yet (in grey colour)

2. MODBUS PROTOCOL

MiCOM P126 relay can communicate by a RS 485 link. The terminals are placed on the rear panel (terminals 31 and 32). See the GS document for further information on the wiring. The applied ModBus protocol is compliance with the MODBUS RTU.
2.1 MODBUS connection technical characteristics
2.1.1 MODBUS connection parameters

The different parameters of the MODBUS connection are listed belows:

- Isolated two-point RS485 connection (2kV 50Hz),
- MODBUS line protocol in RTU mode

Communication speed can be configured by an operator dialog in the front panel of the relay:

| Baud rate |
| :--- |
| 300 |
| 600 |
| 1200 |
| 2400 |
| 4800 |
| 9600 |
| 19200 |
| 38400 |

Transmission mode of the configured characters by operator dialog:

| Mode |
| :--- |
| 1 start / 8 bits / 1 stop : total 10 bits |
| 1 start / 8 bits / even parity / 1 stop : total 11 bits |
| 1 start / 8 bits / odd parity / 1 stop : total 11 bits |
| 1 start / 8 bits / 2 stop : total 11 bits |
| 1 start / 7 bits / 2 stop : total 10 bits |
| 1 start / 7 bits / 1 stop : total 9 bits |
| 1 start / 7 bits / even parity / 1 stop : total 10 bits |
| 1 start / 7 bits / odd parity / 1 stop : total 10 bits |

2.1.2 Exchanges messages synchronisation

Any character received after a silence on the line of more than or equal to a transmission time of 3 bytes is considered as a frame start.
2.1.3 Message validity check

The validation of a frame is performed with a 16-bit cyclical redundancy check (CRC).
The generator polynomial is:
$1+x^{2}+x^{15}+x^{16}=1010000000000001$ binary $=$ A001h

### 2.1.4 Address

In order to integrate a protection device into a control and monitoring system, the address must be set from the local control panel. The address may be selected from the range of 1 to 255. The address 0 is reserved for broadcast messages.

### 2.2 MODBUS functions available in the protection device

Protection device data may be read or modified by using function codes. Following are the available function codes. Function codes to read from or write into parameter cells in the protection device are described in the listed following table.

| Function Nr. | Data Read | Data Write | Data Format \& Type |
| :--- | :--- | :--- | :--- |
| 1 | X |  | N bits |
| 2 | X |  | N bits |
| 3 | X |  | N words |
| 4 | X |  | N words |
| 5 |  | X | 1 bit |
| 6 | X | X | 1 word |
| 7 | X |  | 8 bits |
| 8 |  |  | Diagnostics counter |
| 11 |  | X | Event counter |
| 15 | X | N bits |  |
| 16 |  | N words |  |

### 2.3 Presentation of the MODBUS protocol

MODBUS is a master-slave protocol where every exchange involves a master devices request for data and a slave devices response with data.
2.3.1 Frame size received by the protection device (slave)

Frame transmitted by the master (query):

| Slave number | Function code | Information | CRC16 |
| :--- | :--- | :--- | :--- |
| 1 byte | 1 byte | $n$ bytes | 2 bytes |
| 0 à FFh | 1 à 10h |  |  |

## Slave address:

The slave address is in the range from 1 to 255. A transmitted frame with a slave address equal to 0 is a globally addressed to all installed equipment (broadcast frame)

## Function code:

The function code returned by the slave in the exception response frame is the code in which the most significant bit (bit 7) is forced to 1.

## Error code:

Among the 8 exception codes of the MODBUS protocol, the protection device manages two:

- Code 01: Function code unauthorised or unknown.
- $\quad$ Code 03: A value from the data field is unauthorised (incorrect code).
- Control of data being read.
- Control of data being written.
- Control of data address.
- Length of request for data message.


## CRC16:

The CRC16 value is calculated by the slave.
NOTE: The protection device does not respond to globally broadcast frames sent out by the master.
2.3.2 Format of frames transmitted by the protection device

Frame transmitted (response):

| Slave number | Function code | Data | CRC16 |
| :--- | :--- | :--- | :--- |
| 1 byte | 1 byte | $n$ bytes | 2 bytes |
| 1 à FFh | 1 à 10 h |  |  |

## Slave address:

The slave address is in the range from 1 to 255 .
Function code:
Processed MODBUS function (1 to 16).
Data:
Contains the response data to the masters request for data.

## CRC16:

CRC16 value calculated by the slave.
2.3.3 Messages validity check

When MiCOM P126 relay receives a request for data from the master, it validates the frame:

- If the CRC is incorrect, the frame is discarded as invalid. The slave does not reply to the request for data. The master must retransmit its request for data. With the exception of a broadcast message, this is the only case where the slave does not reply to a request for data from the master.
- If the CRC is correct but the slave can not process the request for data, it sends an exception response to the master.


## Warning frame sent (response)

| Slave number | Function code | Warning code | CRC16 |
| :--- | :--- | :--- | :--- |
| 1 byte | 1 byte | 1 byte | 2 bytes |
| 1 to FFh | 81 h or 83 h or 8 Ah or 8 Bh |  | pf $\ldots$ PF |

Slave number:
The slave number is situated between 1 and 255 .

## Function code:

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

Warning code:
On the 8 warning codes of the MODBUS protocol, the relay manages two of them:

- code 01 : function code unauthorised or unknown.
- code 03 : a value in the data field is unauthorised (incorrect data).
- Control of pages being read
- Control of pages being written
- Control of addresses in pages
- Length of request messages

CRC16:
Value of the CRC16 calculated by the slave.

### 2.4 Database organisation

2.4.1 Description of the application mapping
2.4.1.1 Settings

Parameters are organized in pages.
MiCOM P126 application mapping has 7 pages of parameters.
The characteristics are the following:

| Page | Data type | Read <br> permission | Write <br> permission |
| :--- | :--- | :--- | :--- |
| 0 | Product information, remote signalling, <br> measurements | Through <br> communication |  |
| 1 | General remote parameters | X | X |
| 2 | Setting group 1 remote parameters | X | X |
| 3 | Setting group 2 remote parameters | X | X |
| 4 | Remote controls |  | X |
| 7 | P126 Relay status | Fast |  |
| 8 | Data and time | X | X |

They are completely listed below.

MiCOM P126
Page 8/66

### 2.4.1.2 Page 0 H

| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0000 | Product Information | Relay description characters 1 and 2 | $32 . . .127$ | 1 | - | F10 |  |
| 0001 |  | Relay description characters 3 and 4 | $32 . . .127$ | 1 | - | F10 | P1 |
| 0002 |  | Relay description characters 5 and 6 | $32 . . .127$ | 1 | - | F10 | 20 |
| 0003 |  | Unit reference characters 1 and 2 | $32 . . .127$ | 1 | - | F10 | AL |
| 0004 |  | Unit reference characters 3 and 4 | $32 . . .127$ | 1 | - | F10 | ST |
| 0005 |  | Software version | $10 \ldots . \mathrm{xx}$ | 1 | - | F21 |  |
| 0006 |  | Front \& rear port available communication protocols | 0-3 |  |  | F41 |  |
| 0007 |  | Internal ratio phase current |  |  |  | F1 |  |
| 0008 |  | Internal ratio earth current |  |  |  | F1 |  |
| 0009 |  | Internal ratio rated voltage |  |  |  | F1 |  |
| 000A |  | Internal ratio voltage |  |  |  | F1 |  |
| 000B |  | Info General Start (only if IEC 60870-5-103 version) |  |  |  | F1 |  |
| 000C |  | Reserved |  |  |  |  |  |
| 000D |  | Configuration status of the digital inputs part 2/2 |  |  |  | F20A |  |
| 000E |  | Password status | 0-1 |  | - | F24 | 0 |
| 000F |  | HW alarm status |  |  |  | F45 |  |
| 0010 | Remote signals | Digital inputs status |  |  | - | F12 |  |
| 0011 |  | Status of the digital inputs configuration; part 1/2 |  |  | - | F20 |  |
| 0012 |  | RL1: output status | 0-1 |  | - | F22 |  |
| 0013 |  | Output relays operation command |  |  | - | F13 |  |
| 0014 | Protection 50/51 | Information of the threshold status l> |  |  | - | F17 |  |
| 0015 |  | Information of the threshold status l>> |  |  | - | F17 |  |
| 0016 |  | Information of the threshold status l>>> |  |  | - | F17 |  |
| 0017 | Protection 67n | Information of the threshold status le> |  |  | - | F16 |  |
| 0018 |  | Information of the threshold status le>> |  |  | - | F16 |  |
| 0019 |  | Information of the threshold status le>>> |  |  | - | F16 |  |
| 001A-001F |  | Reserved ${ }^{1}$ |  |  |  |  |  |

${ }^{1}$ Informations of instantaneous and temporised mémorised $1>,|\gg,| \ggg$ and l < have different address Modbus from release V3/V4/V5 to V6. This old address Modbus V5 aren't used (001Bh to 001Fh and 0024 h ) and all are integrated in the new one address 002Bh (see format description F36C).

| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0020 | Protection 49 | Information of the thermal protection status |  |  | - | F37 |  |
| 0021 | Protection 37 | Information of the undercurrent threshold status $1<$ |  |  | - | F17 |  |
| 0022 |  | Reserved |  |  |  |  |  |
| 0023 | Accessory function | Information of the status of the accessory functions (look to the F38 meaning in the Mapping format description chapter) |  |  | - | F38 |  |
| 0024 |  | Reserved ${ }^{2}$ |  |  | - |  |  |
| 0025 | Alarms 1 | Non acknowledged alarms <br> - part 1/4 |  |  |  | F36 |  |
| 0026 | Disturbance | Numbers of available disturbance fault records | $0 \ldots .5$ |  | - | F31 |  |
| 0027 | Relay RL1 status | Information on the starting origin of the RL1 trip relay | 0 .. 29 |  |  | F61 |  |
| 0028 | Circuit Breaker | CB Supervision status |  |  |  | F43 |  |
| 0029 | Alarms 2 | Non acknowledged alarms <br> - part 2/4 |  |  |  | F36A |  |
| 002A | Alarms 3 | Non acknowledged alarms <br> - part 3/4 |  |  |  | F36B |  |
| 002B | Alarms 4 | Non acknowledged alarms <br> - part 4/4 |  |  |  | F36C |  |
| $\begin{aligned} & \text { 002C- } \\ & \text { 002D } \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 002E | Relays | RL1...RL8 output relays, latch configuration and status |  |  |  | F27 |  |
| 002F |  | Reserved |  |  |  |  |  |
| 0030-0031 | Remote measurements | Phase A RMS current |  | 1 | A/100 | F18 |  |
| 0032-0033 |  | Phase B RMS current |  | 1 | A/100 | F18 |  |
| 0034-0035 |  | Phase C RMS current |  | 1 | A/100 | F18 |  |
| 0036-0037 |  | Earth RMS current |  | 1 | A/100 | F18 |  |
| 0038-0039 |  | Inverse current I2 (fundamental) |  | 1 | A/100 | F18 |  |
| $\begin{aligned} & \text { 003A- } \\ & 003 B \end{aligned}$ |  | Direct current I1 (fundamental) |  | 1 | A/100 | F18 |  |
| 003C |  | Ratio I2 / I1 | $0 \ldots 999$ | 1 | - | F1 |  |
| 003D |  | Thermal status (protected) | $0 \ldots 999$ | 1 | \% | F1 |  |
| 003E |  | Frequency | 4500-6500 | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{~Hz} \end{aligned}$ | F1 |  |
| 003F-0040 |  | Phase A RMS max current |  | 1 | A/100 | F18 |  |
| 0041-0042 |  | Phase B RMS max current |  | 1 | A/100 | F18 |  |

${ }^{2}$ Informations of instantaneous and temporised mémorised $|>,|\gg,| \ggg$ and l < have different address Modbus from release V3/V4/V5 to V6. This old address Modbus V5 aren't used (001Bh to 001Fh and 0024h) and all are integrated in the new one address 002Bh (see format description F36C).

MiCOM P126
Page 10/66

| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0043-0044 |  | Phase C RMS max current |  | 1 | A/100 | F18 |  |
| 0045-0046 |  | Phase A RMS average urrent |  | 1 | A/100 | F18 |  |
| 0047-0048 |  | Phase B RMS average current |  | 1 | A/100 | F18 |  |
| 0049-004A |  | Phase C RMS average current |  | 1 | A/100 | F18 |  |
| $\begin{aligned} & \text { 004B- } \\ & 004 \mathrm{C} \end{aligned}$ |  | le harmonic |  | 1 | A/100 | F18 |  |
| $\begin{aligned} & 004 \mathrm{D} \\ & 004 \mathrm{~F} \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 0050 |  | Module IA |  |  | - | F1 |  |
| 0051 |  | Module IB |  |  | - | F1 |  |
| 0052 |  | Module IC |  |  | - | F1 |  |
| 0053 |  | Module le |  |  | - | F1 |  |
| 0054 |  | Argument IA |  |  | - | F1 |  |
| 0055 |  | Argument IB |  |  | - | F1 |  |
| 0056 |  | Argument IC |  |  | - | F1 |  |
| 0057 |  | Argument le |  |  | - | F1 |  |
| 0058 |  | Inverse current module I2 |  |  | - | F1 |  |
| 0059 |  | Direct current module I1 |  |  | - | F1 |  |
| 005A | Recloser 79 | Nr . of total cycles |  |  |  | F1 |  |
| 005B |  | Nr. of cycles 1 |  |  |  | F1 |  |
| 005C |  | Nr. of cycles 2 |  |  |  | F1 |  |
| 005D |  | Nr . of cycles 3 |  |  |  | F1 |  |
| 005E |  | Nr. of cycles 4 |  |  |  | F1 |  |
| 005F |  | Nr. of definitive trips |  |  |  | F1 |  |
| 0060 |  | Nr. of tripping orders |  |  |  | F1 |  |
| $\begin{aligned} & 0061- \\ & 0068 \end{aligned}$ |  | Reserved |  |  |  |  |  |
| $\begin{aligned} & 0069- \\ & 006 A \end{aligned}$ |  | Rolling demand max RMS IA value |  | 1 | A/100 | F18 |  |
| $\begin{aligned} & \text { 006B- } \\ & 006 \mathrm{C} \end{aligned}$ |  | Rolling demand max RMS IB value |  | 1 | A/100 | F18 |  |
| $\begin{aligned} & \text { 006D- } \\ & \text { OO6E } \end{aligned}$ |  | Rolling demand max RMS IC value |  | 1 | A/100 | F18 |  |
| 006F-0071 |  | Reserved |  |  |  |  |  |
| 0072 | Protection 32n | Information of the threshold status $\mathrm{Pe} / \mathrm{leCos}>$ |  |  |  | F16 |  |
| 0073 |  | Information of the threshold status $\mathrm{Pe} / \mathrm{leCos} \gg$ |  |  |  | F16 |  |
| 0074 |  | Reserved |  |  |  |  |  |
| 0075 |  | Angle between le^Ue |  |  |  | F1 |  |
| $\begin{aligned} & 0076- \\ & 0079 \end{aligned}$ |  | Reserved |  |  |  |  |  |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. <br> Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 007A | Protection 59n | Information of the threshold status Ue>>>> |  |  |  | F16 |  |
| 007B |  | Reserved |  |  |  |  |  |
| 007C | Protection 46 | Information of the threshold status I2> |  |  | - | F17 |  |
| 007D |  | Information of the threshold status I2>> |  |  | - | F17 |  |
| 007E |  | Information of the threshold status I2>>> |  |  | - | F17 |  |
| 007F | AND equations | Logic AND equations information status |  |  |  | F48 |  |
| 0080-0085 | Voltage measurement | Reserved |  |  |  |  |  |
| 0086-0087 |  | RMS Earth voltage |  | 1 | V/100 | F18 |  |
| 0008-008A |  | Reserved |  |  |  |  |  |
| 008B |  | Module Ue |  |  |  | F1 |  |
| $\begin{aligned} & \text { 008C- } \\ & \text { 008E } \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 008F |  | Argument Ue |  |  |  | F1 |  |
| 0090-009B |  | Reserved |  |  |  |  |  |
| $\begin{aligned} & \text { 009C- } \\ & \text { 009D } \end{aligned}$ | Power measures | Module Pe |  |  |  | F18A |  |
| $\begin{aligned} & \text { OO9E- } \\ & \text { OOA2 } \end{aligned}$ |  | Reserved |  |  |  |  |  |
| $\begin{aligned} & \text { 00A3- } \\ & \text { 00A4 } \end{aligned}$ |  | Rolling demand average RMS IA value |  | 1 | A/100 | F18A |  |
| $\begin{aligned} & \text { 00A5- } \\ & \text { 00A6 } \end{aligned}$ |  | Rolling demand average RMS IB value |  | 1 | A/100 | F18A |  |
| $\begin{aligned} & \text { 00A7- } \\ & \text { 00A8 } \end{aligned}$ |  | Rolling demand average RMS IC value |  | 1 | A/100 | F18A |  |
| $\begin{aligned} & \text { 00A9- } \\ & \text { 00AA } \end{aligned}$ | Power measures | Module leCos |  |  |  | F18A |  |

### 2.4.1.3 Page 1 H

| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0100 | Remote setting | Address | $1 . . .255$ | 1 |  | F1 | 1 |
| 0101 |  | Reserved |  |  |  |  |  |
| 0102 |  | Password, ASCII digits 1 and 2 | $32 . . .127$ | 1 |  | F10 | AA |
| 0103 |  | Password, ASCII digits 3 and 4 | $32 . . .127$ | 1 |  | F10 | AA |
| 0104 |  | Rated frequency | $50 \ldots \ldots .60$ | 10 | Hz | F1 | 50 |
| 0105-0108 |  | Reserved |  |  |  |  |  |
| 0109 |  | Default display | $0 \ldots .3$ | 1 |  | F26 | 1 |
| 010A |  | User reference, ASCII digits 1 and 2 | $32 . . .127$ | 1 |  | F10 | AL |
| 010B |  | User reference, ASCII digits 3 and 4 | $32 . . .127$ | 1 |  | F10 | ST |
| 010C |  | Number of the record to be displayed | 1-5 | 1 |  | F31 | 5 |
| 010D |  | Inputs mode configuration (edge or level) |  | 1 |  | F54A |  |
| 010E |  | Maintenance Mode | 0-1 | 1 |  | F24 | 0 |
| 010F |  | Digital inputs signal type: $A C-D C$ | 1-2 | 1 |  | F51 | 1 |
| 0110 | CB monitoring measurements | CB operations number |  | 1 |  | F1 |  |
| 0111 |  | CB operating time |  | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 |  |
| 0112-0113 |  | Switched square Amps phase A sum |  |  | An | F18 |  |
| 0114-0114 |  | Switched square Amps phase B sum |  |  | An | F18 |  |
| 0116-0117 |  | Switched square Amps phase C sum |  |  | An | F18 |  |
| 0118 |  | Circuit breakerClosure time |  | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 |  |
| 0119 |  | Digital input 1 config. part 2/2 |  | 1 |  | F15A |  |
| 011A |  | Digital input 2 config. part 2/2 |  | 1 |  | F15A |  |
| 011B |  | Digital input 3 config. part 2/2 |  | 1 |  | F15A |  |
| 011C |  | Digital input 4 config. part 2/2 |  | 1 |  | F15A |  |
| 011D |  | Digital input 5 config. part 2/2 |  | 1 |  | F15A |  |
| 011E |  | Digital input 6 config. part 2/2 |  | 1 |  | F15A |  |
| 011F |  | Digital input 7 config. part 2/2 |  | 1 |  | F15A |  |
| 0120 | Ratios CT | Primary phase CT | 1.... 9999 | 1 | A | F1 | 1 |
| 0121 |  | Secondary phase CT | 1 or 5 | - | A | F1 | 1 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0122 |  | Primary earth CT | 1 .... 9999 | 1 | A | F1 | 1 |
| 0123 |  | Secondary earth CT | 1 or 5 | - | A | F1 | 1 |
| 0124-0127 | Ratios VT | Reserved |  |  |  |  |  |
| 0128-0129 |  | Primary earth VT 57....130V version | 10-100000 | 1 | 100V | F18A | 100V |
|  |  | Primary earth VT 220....480V version | 220-480 | 1 | 1V | F18A | 220 V |
| 012A |  | Secondary earth VT | 570-1300 | 1 | V/10 | F1 | 100V |
| 012B |  | Maintenance mode relays command |  |  |  | F13 |  |
| 012C |  | Battery Alarm | 0-1 | 1 | - | F24 | 1 |
| 012D |  | Number of available Istantaneous record to be displayed | 1-5 | 1 |  | F31 | 5 |
| 012E | Communication | Speed (IEC870-5-103) | $0 \ldots .7$ | 1 | - | F53 |  |
| 012F |  | Date format | 0-1 | 1 | - | F52 | 0 |
| 0130 |  | UART Baud rate | $0 \ldots .7$ | 1 | - | F4 |  |
| 0131 |  | Parity | $0 \ldots .2$ | 1 | - | F5 | 0 |
| 0132 |  | Data bits | 0-1 | 1 | - | F28 | 1 |
| 0133 |  | Stop bits | 0-1 | 1 | - | F29 | 0 |
| 0134 |  | COM available info | 0-3 | 1 | - | F30 | 1 |
| 0135 | Configuration group | Parameters configuration group | 1-2 | 1 | - | F55 | 1 |
| 0136 | LEDS configuration | Led 5 |  | 1 | - | F19 | 0 |
| 0137 |  | Led 6 |  | 1 | - | F19 | 0 |
| 0138 |  | Led 7 |  | 1 | - | F19 | 0 |
| 0139 |  | Led 8 |  | 1 |  | F19 | 0 |
| 013A |  | Led PF 5 |  | 1 | - | F19A | 0 |
| 013B |  | Led PF 6 |  | 1 | - | F19A | 0 |
| 013C |  | Led PF 7 |  | 1 | - | F19A | 0 |
| 013D |  | Led PF 8 |  | 1 |  | F19A | 0 |
| 013E |  | Led PF15 |  | 1 | - | F19B | 0 |
| 013F |  | Led PF16 |  | 1 | - | F19B | 0 |
| 0140 |  | Led PF17 |  | 1 | - | F19B | 0 |
| 0141 |  | Led PF18 |  | 1 |  | F19B | 0 |
| 0142 | Digital inputs configuration | Inputs mode configuration (edge or level) |  |  |  | F54 |  |
| 0143 |  | Inputs sense configuration (High or Low) | - | 1 | - | F47 | 0 |
| 0144 |  | Digital input 6, part 1/2 | VTA |  | - | F15 | 0 |
| 0145 |  | Digital input 7, part 1/2 | VTA |  | - | F15 | 0 |
| 0146 |  | Digital input 1, part 1/2 | VTA |  | - | F15 | 0 |
| 0147 |  | Digital input 2, part 1/2 | VTA |  | - | F15 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0148 |  | Digital input 3, part 1/2 | VTA |  | - | F15 | 0 |
| 0149 |  | Digital input 4, part 1/2 | VTA |  | - | F15 | 0 |
| 014A |  | Digital input 5, part 1/2 | VTA |  | - | F15 | 0 |
| 014B | Output relays assignement to | Broken conductor configuration |  | 1 | - | F14 | 0 |
| 014C |  | Breaker failure config. |  | 1 | - | F14 | 0 |
| 014D | Protection 37 | Conf. tripping l |  | 1 | - | F14 | 0 |
| 014E | Alarm | Selfreset start protection alarms enable / disable |  | 1 |  | F24 |  |
| 014F | Protection 49 | Conf. Thermal overload alarm( $\theta$ alarm) |  | 1 | - | F14 | 0 |
| 0150 |  | Conf. Thermal overload tripping ( $\theta$ trip) |  | 1 | - | F14 | 0 |
| 0151 | Circuit breaker | Conf. Switch on to fault, circuit breaker tripping \& SOTF/TOR |  | 1 | - | F14A | 0 |
| 0152 |  | Conf. tripping AUX 1 |  | 1 | - | F14 | 0 |
| 0153 |  | Conf. tripping AUX 2 |  | 1 | - | F14 | 0 |
| 0154 |  | Conf. circuit breakers alarms |  | 1 | - | F14 | 0 |
| 0155 |  | Conf. Tripping circuit |  | 1 | - | F14 | 0 |
| 0156 | Output Relays | RL1 relay operating mode | 0-1 | 1 | - | F56 | 0 |
| 0157 |  | Conf. Block relay on l> start | 0-1 | 1 |  | F24 |  |
| 0158 |  | Conf. Block relay on le> start | 0-1 | 1 |  | F24 |  |
| 0159 |  | Conf. tripping on Phase A |  | 1 | - | F14 | 0 |
| 015A |  | Conf. tripping on Phase B |  | 1 | - | F14 | 0 |
| 015B |  | Conf. tripping on Phase C |  | 1 | - | F14 | 0 |
| 015C |  | RL1 ... RL8: configuration and latch |  | 1 | - | F27 | 0 |
| 015D |  | Conf. relay RL1 on RL2 ... RL8 |  | 1 | - | F14 | 0 |
| 015E | Protection 50/51 | Conf. tripping l> |  | 1 | - | F14 | 0 |
| 015F |  | Conf. tripping l>> |  | 1 | - | F14 | 0 |
| 0160 |  | Conf. tripping l>>> |  | 1 | - | F14 | 0 |
| 0161 | Protection 67n | Conf. tripping le> |  | 1 | - | F14 | 0 |
| 0162 |  | Conf. tripping le>> |  | 1 | - | F14 | 0 |
| 0163 |  | Conf. tripping le>>> |  | 1 | - | F14 | 0 |
| 0164 | Protection 50/51 | Conf. start l> |  | 1 | - | F14 | 0 |
| 0165 |  | Conf. start l>> |  | 1 | - | F14 | 0 |
| 0166 |  | Conf. start l>>> |  | 1 | - | F14 | 0 |
| 0167 | Protection 67n | Conf. start le> |  | 1 | - | F14 | 0 |
| 0168 |  | Conf. start le>> |  | 1 | - | F14 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0169 |  | Conf. start le>>> |  | 1 | - | F14 | 0 |
| 016A | Recloser 79 | Conf. re-closer running |  | 1 | - | F14 | 0 |
| 016B |  | Conf. definitive tripping \& Conf. recloser locked |  | 1 | - | F14D | 0 |
| 016C | Automatic control | Conf. tripping on relay RL1-part 1/2 |  | 1 | - | F6 | 1 |
| 016D | Breaker Failure | Current Threshold | $10 \ldots 100$ | 1 | In/100 | F1 | 2 |
| 016E | Blocking Logic | Blocking logic 1 - part 1/2 |  | 1 | - | F8 | 0 |
| 016F |  | Blocking logic 2 - part 1/2 |  | 1 | - | F8 | 0 |
| 0170 | Broken Conductor | Brkn. Cond. operating mode | 0-1 | 1 | - | F24 | 0 |
| 0171 |  | Brkn. Cond trip time | $0 \ldots .14400$ | 1 | 1 sec | F1 | 1 |
| 0172 |  | Brkn. C ond. limit | 20... 100 | 1 | - | F1 | 20 |
| 0173 | Cold Load PU | Operating mode | 0-1 | 1 | - | F24 | 0 |
| 0174 |  | Configuration desensitising limits |  | 1 | - | F33 | 0 |
| 0175 |  | Percentage of desensitisation | $100 . . .500$ | 1 | \% | F1 | 50 |
| 0176 |  | Desensitising timer | $1 \ldots .36000$ | 1 | $\begin{aligned} & 1 / 10 \\ & \mathrm{sec} \end{aligned}$ | F1 | 1 |
| 0177 | Breaker failure | BF operating mode | 0-1 | 1 | - | F24 | 0 |
| 0178 |  | BF time | $0 \ldots .1000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0179 | Selectivity | Digital selectivity 1 |  | 1 | - | F40 | 0 |
| 017A |  | Digital selectivity 2 |  | 1 | - | F40 | 0 |
| 017B |  | tsel1 | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 017C |  | tsel2 | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 017D | Disturbance | Pre-trigger ime | 1.... 30 | 1 | - | F1 | 1 |
| 017E |  | Post-trigger time | $1 \ldots . .30$ | 1 | - | F1 | 1 |
| 017F |  | Config. Disturbance start | 0-1 | 1 | - | F32 | 0 |
| 0180 | CB monitoring | CB operating time | 0-1 | 1 | - | F24 | 0 |
| 0181 |  | CB operating time thereshold | 5... 100 | 5 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 5 |
| 0182 |  | Operations number | 0-1 | 1 | - | F24 | 0 |
| 0183 |  | CB opening operations number threshold. | $0 \ldots .50000$ | 1 | - | F1 | 0 |
| 0184 |  | CB switched Amps sum | 0-1 | 1 | - | F24 | 0 |
| 0185 |  | CB switched Amps sum threshold |  |  | $\begin{aligned} & 10^{\mathrm{E}} 6 \\ & \mathrm{~A}^{\mathrm{n}} \end{aligned}$ | F1 |  |
| 0186 |  | Amps or square Amps | 1-2 | 1 |  | F1 | 1 |
| 0187 |  | Closing time threshold | $5 \ldots .100$ | 5 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 5 |
| 0188 |  | Auxiliary timer 1 | $0 \ldots .20000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0189 |  | Auxiliary timer 2 | $0 \ldots .20000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 018A |  | Max \& average (current + voltage) time window selection | $\begin{aligned} & 5-10-15- \\ & 30-60 \end{aligned}$ | VTA | min | F42 | 5 |
| 018B |  | CB open pulse duration | $10 \ldots . .500$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 10 |
| 018C |  | CB close pulse duration | $10 \ldots .500$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 10 |
| 018D |  | Validation of the limit of closing time | 0-1 | 1 | - | F24 | 0 |
| 018E |  | Validation of protection of the closing circuit | 0-1 | 1 | - | F24 | 0 |
| 018F |  | Trip circuit time | $10 . . .1000$ | 1 |  | F1 |  |
| 0190 |  | Blocking logic 1 - part 2/2 |  | 1 | - | F8A | 0 |
| 0191 |  | Blocking logic 2 - part 2/2 |  | 1 | - | F8A | 0 |
| 0192 |  | Conf. tripping on relay RL1 - part 2/2 |  | 1 | - | F6A | 0 |
| 0193 |  | Auxiliary timer 3 | $0 \ldots .20000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 0194 |  | Auxiliary timer 4 | $0 \ldots .20000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0195 |  | Description for COURIER: ASCII digits 1 and 2 | $32 . . .127$ | 1 | - | F10 |  |
| 0196 |  | Description for COURIER: ASCII digits 3 and 4 | $32 \ldots .127$ | 1 | - | F10 |  |
| 0197 |  | Description for COURIER: ASCII digits 5 and 6 | $32 \ldots 127$ | 1 | - | F10 |  |
| 0198 |  | Description for COURIER: ASCII digits 7 and 8 | $32 . . .127$ | 1 | - | F10 |  |
| 0199 |  | Description for COURIER: ASCII digits 9 and 10 | $32 . . .127$ | 1 | - | F10 |  |
| 019A |  | Description for COURIER: ASCII digits 11 and 12 | $32 . . .127$ | 1 | - | F10 |  |
| 019B |  | Description for COURIER: ASCII digits 13 and 14 | $32 . . .127$ | 1 | - | F10 |  |
| 019C |  | Description for COURIER: ASCII digits 15 and 16 | $32 . . .127$ | 1 | - | F10 |  |
| 019D | Protection 67n | Istant.Tripping le> reverse |  | 1 | - | F14 | 0 |
| 019E |  | Istant.Tripping le>> reverse |  | 1 | - | F14 | 0 |
| 019F |  | Istant.Tripping le>>> reverse |  | 1 | - | F14 | 0 |
| 01A0 | Protection 32n | Start Pe> |  | 1 | - | F14 | 0 |
| 01A1 |  | Tripping Pe> |  | 1 | - | F14 | 0 |
| 01A2 |  | Start Pe>> |  | 1 | - | F14 | 0 |
| 01A3 |  | Tripping Pe>> |  | 1 | - | F14 | 0 |
| $\begin{aligned} & \text { 01A4- } \\ & \text { 01A7 } \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 01A8 | Protection 59N | Start Ue>>>> |  | 1 | - | F14 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 01A9 |  | Tripping Ue>>>> |  | 1 | - | F14 | 0 |
| $\begin{aligned} & \text { 01AA- } \\ & 01 \mathrm{BO} \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 01B1 | Protection 46 | Start 12> |  | 1 | - | F14 | 0 |
| 01B2 |  | Tripping 12> |  | 1 | - | F14 | 0 |
| 01B3 |  | Start l2>> |  | 1 | - | F14 | 0 |
| 01B4 |  | Tripping l2>> |  | 1 | - | F14 | 0 |
| 01B5 |  | Start l2>>> |  | 1 | - | F14 | 0 |
| 01B6 |  | Tripping l2>>> |  | 1 | - | F14 | 0 |
| $\begin{aligned} & \text { 01B7- } \\ & \text { 01BA } \end{aligned}$ | AND Logic Equations | Reserved |  |  |  |  |  |
| 01BB |  | Start Pe> |  | 1 | - | F11 | 0 |
| 01BC |  | Tripping Pe> |  | 1 | - | F11 | 0 |
| 01BD |  | Start Pe>> |  | 1 | - | F11 | 0 |
| 01BE |  | Tripping Pe>> |  | 1 | - | F11 | 0 |
| 01BF |  | Start l |  | 1 | - | F11 | 0 |
| 01C0 |  | Tripping l< |  | 1 | - | F11 | 0 |
| 01C1 |  | Start I2> |  | 1 | - | F11 | 0 |
| 01C2 |  | Tripping 12> |  | 1 | - | F11 | 0 |
| 01C3 |  | Start l2>> |  | 1 | - | F11 | 0 |
| 01C4 |  | Tripping l2>> |  | 1 | - | F11 | 0 |
| 01C5 |  | Start 12>>> |  | 1 | - | F11 | 0 |
| $01 \mathrm{C6}$ |  | Tripping l2>>> |  | 1 | - | F11 | 0 |
| 01C7 |  | Thermal alarm (lth>) |  | 1 | - | F11 | 0 |
| 01C8 |  | Thermal tripping (Ith>>) |  | 1 | - | F11 | 0 |
| $\begin{aligned} & \text { 01C9- } \\ & \text { 01CB } \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 01CD |  | Start Ue>>>> |  | 1 | - | F11 | 0 |
| 01CE |  | Tripping Ue>>>> |  | 1 | - | F11 | 0 |
| 01CF |  | Start l> |  | 1 | - | F11 | 0 |
| 01D0 |  | Tripping l> |  | 1 | - | F11 | 0 |
| 01D1 |  | Start l>> |  | 1 | - | F11 | 0 |
| 01D2 |  | Tripping l>> |  | 1 | - | F11 | 0 |
| 01D3 |  | Start l>>> |  | 1 | - | F11 | 0 |
| 01D4 |  | Tripping l>>> |  | 1 | - | F11 | 0 |
| 01D5 |  | Start le> |  | 1 | - | F11 | 0 |
| 01D6 |  | Tripping le> |  | 1 | - | F11 | 0 |
| 01D7 |  | Start le>> |  | 1 | - | F11 | 0 |
| 01D8 |  | Tripping le>> |  | 1 | - | F11 | 0 |
| 01D9 |  | Start le>>> |  | 1 | - | F11 | 0 |
| 01DA |  | Tripping le>>> |  | 1 | - | F11 | 0 |
| 01DB |  | Tripping 79 |  | 1 | - | F11 | 0 |
| 01DC |  | Tripping BRK |  | 1 | - | F11 | 0 |


| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 01DD |  | Conf. AUX 1 |  | 1 | - | F11 | 0 |
| 01DE |  | Conf. AUX 2 |  | 1 | - | F11 | 0 |
| 01DF | AND logic <br> Equations time <br> delay | Tripping delay time <br> equation A | $0 \ldots .60000$ | 1 | $1 / 100$ <br> sec | F1 | 0 |
| 01E0 |  | Reset delay time equation <br> A | $0 \ldots .60000$ | 1 | $1 / 100$ <br> sec | F1 | 0 |
| 01E1 |  | Tripping equation A on <br> relays configuration |  |  |  |  | F14 |
| 01E2 | Tripping delay time <br> equation B | $0 \ldots .60000$ | 1 | $1 / 100$ |  |  |  |
| sec |  |  |  |  |  |  |  |$\quad$ F1 | 0 |
| :--- |
| 01E3 |

### 2.4.1.4 Page 2 H

| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0200 | Protection 50/51 | I> operating mode | 0-1 | 1 | - | F24B | 0 |
| 0201 |  | I> value | $10 . . .2500$ | 1 | In/100 | F1 | 2500 |
| 0202 |  | Trip time type l> |  | - | - | F3 | 0 |
| 0203 |  | DMT Trip time I> | $0 . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0204 |  | TMS: I> trip time multiplier | $25 . . .1500$ | 25 | 1/1000 | F1 | 25 |
| 0205 |  | K: I> trip time multiplier for RI type curve | $100 . .10000$ | 5 | $\begin{aligned} & 1 / 100 \\ & 0 \end{aligned}$ | F1 | 100 |
| 0206 |  | Reset time type: DMT / IDMT | 0-1 | 1 |  | F34 |  |
| 0207 |  | DMT reset time I> | $4 \ldots .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 4 |
| 0208 |  | TMS: I> reset time multiplier | $25 \ldots .1500$ | 25 | 1/1000 | F1 | 25 |
| $\begin{aligned} & 0209- \\ & 020 A \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 020B |  | Interlock 1> | 0-1 |  |  | F24 | 0 |
| 020C |  | l>> operating mode | 0-1 | 1 | - | F24B | 0 |
| 020D |  | 1>> value | $50 \ldots .4000$ | 1 | In/100 | F1 | 4000 |
| 020E |  | Trip time l>> | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| $\begin{aligned} & \text { 020F - } \\ & 0210 \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 0211 |  | l>>> operating mode | 0-1-2 | 1 | - | F24B | 0 |
| 0212 |  | l>>> value | $50 \ldots 4000$ | 1 | In/100 | F1 | 4000 |
| 0213 |  | Trip time l>>> | $0 \ldots 15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| $\begin{aligned} & \hline 0214- \\ & 0215 \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 0216 | Protection 67n | le> operating mode | 0-1-2 | 1 | - | F24A | 0 |
| 0217 | le> value | 0.002... 1 len operating range | 2 .... 1000 | 1 | $\begin{aligned} & \hline 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 len operating range | $10 \ldots .1000$ | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { len } \end{aligned}$ |  |  |
|  |  | 0.1 ... 40 len operating range | 10... 2500 | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ |  |  |
| 0218 |  | Trip time type le> |  | - | - | F3 | 0 |
| 0219 |  | DMT Trip time le> | $0 . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 021A |  | TMS: le> trip time multiplier | $25 \ldots .1500$ | 25 | 1/1000 | F1 | 25 |
| 021B |  | K: le> trip time multiplier for RI type curve | 100.... 10000 | 5 | 1/1000 | F1 | 100 |
| 021C |  | le> reset time type DMT or IDMT | 0-1 | 1 |  | F34 |  |
| 021D |  | DMT Reset time le> | $0 \ldots .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 021E |  | TMS: le> reset time multiplier | $25 . . .1500$ | 25 | 1/1000 | F1 | 0 |
| 021F | Ue> value | $57 . .130 \mathrm{~V}$ operating range | $10 \ldots 2600$ | 1 | V/10 | F1 | 2600 |
|  |  | 220 ... 480V operating range | $40 \ldots 7200$ | 5 | V/10 | F1 | 7200 |
| 0220 |  | Torque (RCA) angle (le^Ue)> | $0 \ldots .359$ | 1 | Deg. | F1 | 0 |
| 0221 |  | Trip angle (le^Ue)> | $10 . . .170$ | 1 | Deg. | F1 | 10 |
| 0222 |  | Interlock le> | 0-1 | 1 |  | F24 | 0 |
| 0223 |  | le>> operating mode | 0-1-2 | 1 | - | F24A | 0 |
| 0224 | le>> value | $0.002 \ldots 1$ len operating range | $2 . . .1000$ | 1 | $\begin{aligned} & 1 / 1000 \\ & \text { len } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 len operating range | $10 . . .8000$ | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ |  |  |
|  |  | 0.1 ... 40 len operating range | $40 \ldots .4000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ |  |  |
| 0225 |  | Trip time le>> | $0 . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 0226 | Ue>> value | 57 .... 130V operating range | $10 \ldots .2600$ | 1 | V/10 | F1 | 2600 |
|  |  | 220 .... 480V operating range | $40 \ldots .9600$ | 5 | V/10 | F1 | 9600 |
| 0227 |  | Torque (RCA) angle (le^Ue)>> | $0 \ldots 359$ | 1 | Deg. | F1 | 0 |
| 0228 |  | Trip angle (le^Ue)>> | $10 \ldots .170$ | 1 | Deg. | F1 | 10 |
| 0229 |  | le>>> operating mode | 0-1-2-3 | 1 | - | F24A | 0 |
| 022A | le>>> value | $0.002 \ldots 1$ len operating range | 2 ... 1000 | 1 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 len operating range | $10 . . .8000$ | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ |  |  |
|  |  | 0.1 ... 40 len operating range | $40 . . .4000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ |  |  |
| 022B |  | Trip time le>>> | 0 ... 15000 | 1 | 1/100 s | F1 | 0 |
| 022C | Ue>>> value | 57 .... 130V operating range | $10 \ldots 2600$ | 1 | V/10 | F1 | 2600 |
|  |  | 220 .... 480V operating range | $40 \ldots .9600$ | 5 | V/10 | F1 | 9600 |
| 022D |  | Torque (RCA) angle (le^Ue)>>> | $0 \ldots .359$ | 1 | Deg. | F1 | 0 |
| 022E |  | Trip angle (le^Ue)>>> | $10 . . .170$ | 1 | Deg. | F1 | 10 |
| 022F | Protection 49 | $\theta$ alarm operating mode | 0-1 | 1 | - | F24 | 0 |
| 0230 |  | $\theta$ alarm value | $50 \ldots 200$ | 1 | \% | F1 | 90 |
| 0231 |  | I $\theta>$ (nominal current thermal) | $10 \ldots .320$ | 1 | 1/100 | F1 | 10 |
| 0232 |  | K | $100 \ldots 150$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { In } \end{aligned}$ | F1 | 105 |
| 0233 |  | Thermal overload time constant | $1 . . .200$ | 1 | Minute | F1 | 1 |
| 0234 |  | $\theta$ trip operating mode | 0-1 | 1 | - | F24 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0235 |  | $\theta$ trip value | $50 . . .200$ | 1 | \% | F1 | 100 |
| 0236 | Protection 37 | I< operating mode | 0-1 | 1 | - | F24 | 0 |
| 0237 |  | I< value | $10 \ldots .100$ | 1 | In/100 | F1 | 2 |
| 0238 |  | Trip time l | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0239 | Protection 46 | 12> operating mode | 0-1 | 1 | - | F24 | 0 |
| 023A |  | I2> value | $10 . . .2500$ | 1 | $\begin{aligned} & \text { 1/100 } \\ & \text { In } \end{aligned}$ | F1 | 2500 |
| 023B |  | Trip time type 12> |  | - | - | F3 | 0 |
| 023C |  | DMT trip time I2> | $0 . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 023D |  | TMS: I2> trip time multiplier | $25 \ldots . .1500$ | 25 | 1/1000 | F1 | 25 |
| 023E |  | K: I2> trip time multiplier for RI type curve | 100... 10000 | 5 | 1/1000 | F1 | 100 |
| 023F |  | I2 reset time type: DMT or IDMT | 0-1 | 1 | - | F34 | 0 |
| 0240 |  | DMT reset time 12> | 4 .... 10000 | 1 | 1/100 s | F1 | 4 |
| 0241 |  | TMS: I2> reset time multiplier | $25 \ldots .1500$ | 25 | 1/1000 | F1 | 100 |
| 0242 |  | I2>> operating mode | 0-1 | 1 | - | F24 | 0 |
| 0243 |  | I2>> value | $50 \ldots .4000$ | 1 | $\begin{aligned} & \text { 1/100 } \\ & \text { In } \end{aligned}$ | F1 | 4000 |
| 0244 |  | Trip time 12>> | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 0245 |  | I2>>> operating mode | 0-1 | 1 | - | F24 | 0 |
| 0246 |  | I2>>> value | $50 \ldots .4000$ | 1 | $\begin{aligned} & \text { 1/100 } \\ & \text { In } \end{aligned}$ | F1 | 4000 |
| 0247 |  | Trip time 12>>> | $0 \ldots . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| $\begin{aligned} & 0248- \\ & 024 E \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 024E | Protection 32n | Pe/lecos Torque (RCA) angle | $0 \ldots . .359$ | 1 |  | F1 | 0 |
| 024F |  | 32n operating mode: Pe or leCos | 0-1 | 1 | - | F24C | 0 |
| 0250 |  | Pe> operating mode | 0-1 | 1 | - | F24 | 0 |
| 0251 | Pe> value | 0.002... 1 len current operating with range 57 ... 130 V version | 20... 2000 | 2 | $\begin{aligned} & \text { 1/100 } \\ & \text { IenW } \end{aligned}$ | F1 | 2000 |
|  |  | 0.002... 1 len current operating with range 220 .. 480 V version | 100.... 8000 | 10 | $\begin{aligned} & \text { 1/100 } \\ & \text { IenW } \end{aligned}$ | F1 | 8000 |
|  |  | 0.01 ... 8 len current operating with range $57 \ldots$ 130 V version | 400... 16000 | 10 | $\begin{aligned} & \text { 1/100 } \\ & \text { IenW } \end{aligned}$ | F1 | 16000 |
|  |  | 0.01 ... 8 len current operating with range 220...480V version | 400... 64000 | 10 | $\begin{aligned} & \text { 1/100 } \\ & \text { lenW } \end{aligned}$ | F1 | 64000 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 0.1 ... 40 len current operating with range 57 ... 130 V version | 10..... 800 | 1 | $\begin{aligned} & 1 \\ & \text { lenW } \end{aligned}$ | F1 | 800 |
|  |  | $0.1 \ldots 40$ len current operating with range 220... 480 V version | 40... 3200 | 5 | $\begin{aligned} & 1 \\ & \text { lenW } \end{aligned}$ | F1 | 3200 |
| 0252 |  | Trip time type Pe> |  | - | - | F3 | 0 |
| 0253 |  | Trip time Pe> | 0 ..... 15000 | 1 | 1/100 s | F1 | 0 |
| 0254 |  | TMS: Pe> trip time multiplier | $25 \ldots .1500$ | 25 | 1/1000 | F1 | 25 |
| 0255 |  | K: Pe> trip time multiplier for RI type curve | $\begin{aligned} & 100 \ldots . \\ & 10000 \end{aligned}$ | 5 | 1/1000 | F1 | 100 |
| 0256 |  | Reset time type Pe>: DMT or IDMT | 0-1 | 1 | - | F34 | 0 |
| 0257 |  | DMT reset time Pe> | $0 \ldots 10000$ | 1 | 1/100 s | F1 | 4 |
| 0258 |  | TMS reset time Pe> | $25 \ldots .1500$ | 25 | 1/1000 | F1 | 100 |
| 0259 |  | Pe>> operating mode | 0-1 | 1 | - | F24 | 0 |
| 025A | Pe>> value | 0.002... 1 len current operating with range 57 ... 130 V version | 20... 2000 | 2 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 2000 |
|  |  | 0.002... 1 len current operating with range 220 ... 480 V version | 100... 8000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 8000 |
|  |  | 0.01 ... 8 len current operating with range 57 ... 130 V version | 400... 16000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 16000 |
|  |  | 0.01 ... 8 len current operating with range 220... 480 V version | 400... 64000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 64000 |
|  |  | 0.1 ... 40 len current operating with range 57 ... 130 V version | 10..... 800 | 1 | $\begin{aligned} & \hline 1 \\ & \text { lenW } \end{aligned}$ | F1 | 800 |
|  |  | 0.1 ... 40 len current operating with range 220... 480 V version | 40... 3200 | 5 | $\begin{aligned} & \hline 1 \\ & \text { lenW } \end{aligned}$ | F1 | 3200 |
| 025B |  | Trip time Pe>> | $0 \ldots . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 025C |  | leCos> operating mode | 0-1 | 1 | - | F24 | 0 |
| 025D | leCos> value | 0.002... 1 len range current operating | $2 \ldots .1000$ | 1 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 len range current operating | 10... 8000 | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 | 8000 |
|  |  | $0.1 \ldots 25$ len range current operating | $10 \ldots 2500$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ | F1 | 2500 |
| 025E |  | Trip time type leCos> |  | - | - | F3 | 0 |
| 025F |  | DMT Trip time leCos> | $0 . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 0260 |  | TMS: leCos> trip time multiplier | $25 . . . .1500$ | 25 | 1/1000 | F1 | 25 |
| 0261 |  | K: leCos> trip time multiplier for RI type curve | $100 . .10000$ | 5 | 1/1000 | F1 | 100 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0262 |  | Reset time type leCos>: DMT or IDMT | 0-1 | 1 | - | F34 | 0 |
| 0263 |  | DMT Reset time leCos> | $0 \ldots . .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 0264 |  | TMS reset time leCos> | $25 . . . .1500$ | 25 | 1/1000 | F1 | 25 |
| 0265 |  | leCos>> mode | 0-1 | 1 | - | F24 | 0 |
| 0266 | leCos>> value | 0.002... 1 len range current operating | $2 \ldots . .1000$ | 1 | $\begin{aligned} & 1 / 1000 \\ & \text { len } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 len range current operating | 10.... 8000 | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { len } \end{aligned}$ | F1 | 8000 |
|  |  | $0.1 \ldots 40$ len range current operating | 50... 4000 | 1 | $\begin{aligned} & \text { 1/100 } \\ & \text { Ien } \end{aligned}$ | F1 | 4000 |
| 0267 |  | Trip time leCos>> | $0 . . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| $\begin{aligned} & 0268- \\ & 026 D \end{aligned}$ |  | Reserved |  |  |  |  |  |
| 026E | Protection 59n | Ue>>>> operating mode | 0-1 | 1 | - | F24 | 0 |
| 026F | Ue>>>> value | 57...130V operating range | $10 . .2600$ | 1 | V/10 | F1 | 2600 |
|  |  | 220 ...480V operating range | $50 \ldots . .9600$ | 5 | V/10 | F1 | 9600 |
| 0270 |  | Trip time Ue>>>> | $0 \ldots .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0271 | Recloser 79 | Recloser info | 0-1 | 1 |  | F24 | 0 |
| 0272 |  | CB position active | 0-1 | 1 |  | F24 | 0 |
| $\begin{aligned} & 0273 \text { - } \\ & 0274 \end{aligned}$ |  | Supervision window | $1 . . . .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F18A | 1 |
| 0275 |  | External blocking input | 0-1 | 1 |  | F24 | 0 |
| 0276 |  | TAux1 cycle configuration | 0 .... 2222 | 1 |  | F57 | 1111 |
| 0277 |  | TAux2 cycle configuration | 0 .... 2222 | 1 |  | F57 | 1111 |
| 0278 |  | Dead time 1 | $1 \ldots . .30000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 1 |
| 0279 |  | Dead time 2 | $1 . . . .30000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 1 |
| $\begin{aligned} & \text { 027A- } \\ & \text { 027B } \end{aligned}$ |  | Dead time 3 | $1 . . . .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F18A | 1 |
| $\begin{aligned} & \text { 027C- } \\ & \text { 027D } \end{aligned}$ |  | Dead time 4 | $1 . . . .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F18A | 1 |
| 027E-027F |  | Reclaim time | 2 .... 60000 | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F18A | 2 |
| 0280-0281 |  | Inhibit time | 2 .... 60000 | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F18A | 2 |
| 0282 |  | Recloser cycles for phase faults | $0 \ldots .4$ | 1 |  | F1 | 0 |
| 0283 |  | Recloser cycles for earth faults | $0 \ldots .4$ | 1 |  | F1 | 0 |
| 0284 | Reset time 67N | DMT Reset time le>> | $0 \ldots . .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 0285 |  | DMT Reset time le>>> | $0 \ldots . .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 4 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0286 | Reset time 32N | DMT Reset time leCos>> | $0 \ldots . .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 0287 |  | DMT Reset time Pe>> | $0 \ldots . .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 4 |
| 0288 | Protection 67 | Trip time type l>> |  | - | - | F3 | 0 |
| 0289 |  | TMS: I>> trip time multiplier | $25 \ldots .1500$ | 25 | 1/1000 | F1 | 25 |
| 028A |  | K: I>> trip time multiplier for RI type curve | 100... 10000 | 5 | 1/1000 | F1 | 100 |
| 028B |  | Reset time type: DMT / IDMT | 0-1 | 1 |  | F34 |  |
| 028C |  | DMT reset time l>> | $4 \ldots .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 4 |
| 028D |  | TMS: l>> reset time multiplier | $25 \ldots .1500$ | 25 | $\begin{aligned} & 1 / 100 \\ & 0 \end{aligned}$ | F1 | 25 |
| 028E | Protection 67n | Trip time type le>> |  | - | - | F3 | 0 |
| 028F |  | TMS: le>> trip time multiplier | $25 \ldots .1500$ | 25 | $\begin{aligned} & 1 / 100 \\ & 0 \end{aligned}$ | F1 | 25 |
| 0290 |  | K: le>> trip time multiplier for RI type curve | 100... 10000 | 5 | 1/1000 | F1 | 100 |
| 0291 |  | Reset time type: DMT / IDMT | 0-1 | 1 |  | F34 |  |
| 0292 |  | TMS: le>> reset time multiplier | $25 \ldots .1500$ | 25 | 1/1000 | F1 | 25 |
| 0293 | Recloser 79 | $1>$ cycle configuration | 0 .... 2222 | 1 |  | F57 | 1111 |
| 0294 |  | l>> cycle configuration | 0 .... 2222 | 1 |  | F57 | 1111 |
| 0295 |  | l>>> cycle configuration | 0 .... 2222 | 1 |  | F57 | 1111 |
| 0296 |  | le> cycle configuration | $0 \ldots 2222$ | 1 |  | F57 | 1111 |
| 0297 |  | le>> cycle configuration | 0 .... 2222 | 1 |  | F57 | 1111 |
| 0298 |  | le>>> cycle configuration | 0 .... 2222 | 1 |  | F57 | 1111 |
| 0299 |  | Pe/leCos> cycle configuration | $0 \ldots 2222$ | 1 |  | F57 | 1111 |
| 029A |  | Pe/leCos>> cycle configurat. | 0 .... 2222 | 1 |  | F57 | 1111 |

### 2.4.1.5 Page 3 H

The same as page 2 H except addresses are 03XX instead of 02XX.

### 2.4.1.6 Page 4H

| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0400 | Remote control | Remote control word 1 | $0 \ldots .65535$ | 1 | - | F9 | 0 |
| 0401 |  | Calibration mode |  |  | - |  | 0 |
| 0402 |  | Remote control word 2 <br> $($ single output command) | $0 \ldots . \ldots 511$ | 1 | - | F39 | 0 |
| 0403 |  | Remote control word 3 | $0-53$ | 1 |  | F50 | 0 |

### 2.4.1.7 Page 7H

| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0700 |  | Relays status |  | 1 | - | F23 | 0 |

### 2.4.1.8 Page 8 H

Time synchronisation: access only in writing or reading 4 words (function 16 or 3 ).
The time synchronisation format is based on 8 bytes ( 4 words).
If date Format (012Fh) is private date then format is:

| Timer | Address (hex) | Nb bytes | Mask <br> (hex) | Values range | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Year | 0800 | 2 | FFFF | 1994-2093 | Years |
| Month | 0801 | 1 (Hi) | FF | 1-12 | Months |
| Day |  | 1 (Lo) | FF | 1-31 | Days |
| Hour | 0802 | 1 (Hi) | FF | 0-23 | Hours |
| Minute |  | 1 (Lo) | FF | 0-59 | Minutes |
| Milliseconds | 0803 | 2 | FFFF | 0-59999 | ms |

Else format is IEC 60870-5-103:

| Timer | Address (hex) | Nb bytes | Mask (hex) | Values range | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 0800 | 1 (Hi) |  |  |  |
| Year |  | 1 (Lo) | 7F | $\begin{aligned} & 94-99(1994-1999) \\ & 0-93(2000-2093) \end{aligned}$ | Years |
| Month | 0801 | 1 (Hi) | OF | 1-12 | Months |
| Day of the week |  | 1 (Lo) | E0 | 1-7 (Monday - Sunday) | Days |
| Day of the month |  | 1 (Lo) | 1F | 1-31 | Days |
| Season | 0802 | 1 (Hi) | 80 | 0-1 (summer - winter) |  |
| Hour |  | 1 (Hi) | 1F | 0-23 | Hours |
| Date validity |  | 1 (Lo) | 80 | 0-1 (valid - invalid) |  |
| Minute |  | 1 (Lo) | 3F | 0-59 | Minutes |
| Milliseconds | 0803 | 2 | FFFF | 0-59999 | ms |

Reserved pages
The following pages are Reserved:

- Page 5.
- Page 6.


### 2.4.1.9 Disturbance records

Pages $\mathbf{3 8}$ to $\mathbf{3 C h}$ : mapping pages used to send a service request to select the record number to be uploaded before uploading any disturbance record.

The answer following this request contains the following information:

1. Numbers of samples (pre and post time)
2. Phase CT ratio
3. Earth CT ratio
4. Internal phase and earth current ratios
5. Phase VT ratio
6. Earth VT ratio
7. Internal phase and earth voltage ratios
8. Number of the last disturbance mapping page
9. Number of samples in this last disturbance mapping page

Pages 9 h to $\mathbf{2 1 h}$ : contain the disturbance data ( 25 pages)
A disturbance mapping page contains 250 words:
0900 to 09FAh: 250 disturbance data words
OA00 to OAFAh: 250 disturbance data words OB00 to OBFAh: 250 disturbance data words

2100 to 21FAh: $\quad 250$ disturbance data words
The disturbance data pages contain the sample of a single channel from a record.
Page 22h : contains the index of the disturbance
Page 38h to 3Ch : selection of the disturbance record and channel
Page 3Dh : a dedicated request allows to know the number of disturbance records stored in SRAM.
2.4.1.10 Events records

To upload the event records two requests are allowed:
Page 35h: request to upload an event record without acknowledge of this event.
Used addresses:
3500h :
EVENT 1

354Ah :
EVENT 75
Page 36h: request to upload the non-acknowledged oldest stored event record.
Two modes are available for the acknowledgement: automatic acknowledgement or manual acknowledgement

The way depends on the state of the bit 12 of the remote control word (address 400 h ).
If this bit is set, then the acknowledgement is manual else the acknowledgement is in automatic way.
In automatic way, the reading of on event acknowledges itself.

In manual way, it is necessary to write a specific command to acknowledge the oldest event. (setting the bit 13 of control word at the address 400 h )

### 2.4.1.11 Fault records

Page 37h: Page dedicated to upload fault record
Used addresses:

| $3700 \mathrm{~h}:$ | FAULT 1 |
| :--- | :--- |
| $3701 \mathrm{~h}:$ | FAULT 2 |
| $\ldots .$. |  |
| $3704 \mathrm{~h}:$ | FAULT 5 |

Page 3Eh: Request to upload the non-acknowledged oldest stored fault record.
Two modes are available for the acknowledgement: automatic acknowledgement or manual acknowledgement

The mode depends on the state of the bit 12 of the remote control word (address 400 h ).
If this bit is set, then the acknowledgement is manual else the acknowledgement is automatic.

In automatic mode, the reading of the fault acknowledges automatically the event.
In manual mode, it is necessary to write a specific command to acknowledge the oldest fault.
(set the bit 14 of control word to the address 400 h )

### 2.4.1.12 Mapping access characteristics

- Description of accessible addresses in reading of words (function 03 and 04).

| PAGE 00: | $0000 \mathrm{~h} \ldots . .00044 \mathrm{~h}$ |
| :--- | :--- |
| PAGE 01: | $0100 \mathrm{~h} \ldots . .01 \mathrm{~F} 2 \mathrm{~h}$ |
| PAGE 02: | $0200 \mathrm{~h} \ldots . .0283 \mathrm{~h}$ |
| PAGE 03: | $0300 \mathrm{~h} \ldots . .0383 \mathrm{~h}$ |

- Definition of accessible addresses in writing of 1 word (function 06).

| PAGE 01: | $0100 \mathrm{~h} \ldots . .01$ 01F2h |
| :--- | :--- |
| PAGE 02: | $0200 \mathrm{~h} \ldots . .0283 \mathrm{~h}$ |
| PAGE 03: | $0300 \mathrm{~h} \ldots .0383 \mathrm{~h}$ |
| PAGE 04: | $0400 \mathrm{~h} \ldots . .0403 \mathrm{~h}$ |

- Definition of accessible addresses in writing of n words (function 16).

| PAGE 01: | $0100 \mathrm{~h} . . . .001$ 012h |
| :--- | :--- |
| PAGE 02: | $0200 \mathrm{~h} \ldots . .0283 \mathrm{~h}$ |
| PAGE 03: | $0300 \mathrm{~h} \ldots . .0383 \mathrm{~h}$ |
| PAGE 08: | $0800 \mathrm{~h} . . . .0803 \mathrm{~h}$ |

- Definition of accessible addresses in reading of bits (function 01 and 02).

WARNING: BITS NUMBER MUST NOT BE HIGHER THAN 16. ADDRESSES ARE GIVEN IN BIT ADDRESSES. PAGE 00: 0100H 0250H PAGE 01: 1500 H ...... 1830H

- Definition of accessible addresses in writing of 1 bit (function 05).

WARNING: BITS NUMBER MUST NOT BE HIGHER THAN 16. PAGE 04: 4000H 400FH

- Definition of accessible addresses in writing of $n$ bits (function 15).

WARNING: BITS NUMBER MUST NOT BE HIGHER THAN 16.
PAGE 01: 1500H
1830H
PAGE 04: 4000 H ...... 400BH

### 2.4.1.13 Pages 9 H to 21 H

Disturbance record data (25 pages).
Writing access in words (function 03)
Each disturbance mapping page contains 250 words.

| Addresses (hex) | Contents |
| :--- | :--- |
| 0900h to 09FAh | 250 disturbance data words |
| 0A00h to 0AFAh | 250 disturbance data words |
| 0B00h to 0BFAh | 250 disturbance data words |
| 0C00h to 0CFAh | 250 disturbance data words |
| 0D00h to 0DFAh | 250 disturbance data words |
| 0E00h to 0DFAh | 250 disturbance data words |
| 0F00h to 0FFAh | 250 disturbance data words |
| 1000h to 10FAh | 250 disturbance data words |
| 1100h to 11FAh | 250 disturbance data words |
| 1200h to 12FAh | 250 disturbance data words |
| 1300h to 13FAh | 250 disturbance data words |
| 1400h to 14FAh | 250 disturbance data words |
| 1500h to 15FAh | 250 disturbance data words |
| 1600h to 16FAh | 250 disturbance data words |
| 1700h to 17FAh | 250 disturbance data words |
| 1800h to 18FAh | 250 disturbance data words |
| 1900h to 19FAh | 250 disturbance data words |
| 1A00h to 1AFAh | 250 disturbance data words |
| 1B00h to 1BFAh | 250 disturbance data words |
| 1C00h to 1CFAh | 250 disturbance data words |
| 1D00h to 1DFAh | 250 disturbance data words |
| 1E00h to 1EFAh | 250 disturbance data words |
| 1F00h to 1FFAh | disturbance data words |
| 2000h to 20FAh | 2100h to 21FAh words |
|  |  |

NOTE: The disturbance data pages contain the values of one channel from one given disturbance record.

### 2.4.1.13.1 Meaning of each channel value

- IA, IB, IC, le channels.

The values are signed 16 bits words equivalent to the ADC value.

## Phase current values calculation formula

Line phase current value (primary value) = phase sampled value * phase primary CT ratio/ phase internal CT ratio (mapping address 0007) * $\sqrt{2}$

## Earth current value calculation formula

The formula depends on the nominal earth current :
0.1 to 40 len range

Line earth current value (primary value) = earth sampled value * earth primary CT ratio/ earth internal CT ratio (mapping address 0008=800) * $\sqrt{2}$
0.01 to 8 len range

Line earth current value (primary value) = earth sampled value * earth primary CT ratio/ earth internal CT ratio (mapping address 0008=3277) * 2

### 0.002 to 1 len range

Line earth current value (primary value) = earth sampled value * earth primary CT ratio/ earth internal CT ratio (mapping address 0008=32700) * $\sqrt{2}$

- Ue channel.

The values are signed 16 bits words equivalent to the ADC value.

## Earth voltage value calculation formula

The formula depends on nominal earth voltage:
Line earth voltage value (primary value) = earth primary VT ratio / earth secondary VT ratio

- Frequency channel:

Time between two samples in microseconds

- Logic channels:

| Logic channel | Contents |
| :--- | :--- |
| Bit 0 | Trip relay (RL1) |
| Bit 1 | Output relay 2 (RL2) |
| Bit 2 | Output relay 3 (RL3) |
| Bit 3 | Output relay 4 (RL4) |
| Bit 4 | Watch-Dog relay (RL0) |
| Bit 5 | Output relay 5 (RL5) |
| Bit 6 | Output relay 6 (RL6) |
| Bit 7 | Output relay 7 (RL7) |
| Bit 8 | Output relay 8 (RL8) |
| Bit 9 | Logic input 1 (EL1) |
| Bit 10 | Logic input 2 (EL2) |
| Bit 11 | Logic input 3 (EL3) |
| Bit 12 | Logic input 4 (EL4) |
| Bit 13 | Logic input 5 (EL5) |
| Bit 14 | Logic input 6 (EL6) |
| Bit 15 | Logic input 7 (EL7) |

### 2.4.1.14 Page 22H

Disturbance record index frame
Reading access in word (function 03)

| Logic channel | Contents |
| :--- | :--- |
| 2200 h | Disturbance data index frame |

Disturbance record index frame

| Word Nr. | Contents |
| :--- | :--- |
| 1 | Disturbance record number |
| 2 | Disturbance record finish date (second) |
| 3 | Disturbance record finish date (second) |
| 4 | Disturbance record finish date (millisecond) |
| 5 | Disturbance record finish date (millisecond) |
| 6 | Disturbance record starting condition: <br> $1 \rightarrow$ tripping command (RL1) <br> $2 \rightarrow$ instantaneous <br> $3 \rightarrow$ remote command <br> $4 \rightarrow$ logic input |
| 7 | Frequency at the post-time beginning |

2.4.1.15 Page 35H

Event record data (9 words).
Addresses 3500h to 354Ah.

| Word Nr. | Contents |
| :--- | :--- |
| 1 | Event meaning (see table below) |
| 2 | MODBUS address |
| 3 | MODBUS associated value |
| 4 | Reserved |
| PRIVATE FORMAT: $5 \& 6$ | Event date (number of seconds since 01/01/1994) |
| PRIVATE FORMAT: $7 \& 8$ | Event date (millisecond) |
| IEC FORMAT: 5 to 8 | Event date (see format of time synchronisation, address <br> 0800h) |
| 9 | Acknowledgement: <br> $0=$ event non acknowledged <br> $1=$ event acknowledged |

Word n .1 event meaning and relative codes

| Code (Dec) | Event meaning | Type | MODBUS address |
| :---: | :---: | :---: | :---: |
| 01 | Remote closing | F9 | 013h |
| 02 | Remote tripping | F9 | 013h |
| 03 | Disturbance recording start | F9 | - |
| 04 | Trip output unlatch | F9 | 013h |
| 05 | Settings change | Address | - |
| 06 | Remote thermal reset | F9 | - |
| 07 | Maintenance Mode | F9 $\uparrow \downarrow$ | 0402h |
| 08 | Control relay in maintenance mode | F39 $\uparrow \downarrow$ | 013h |
| 09 | Reserved | - | - |
| 10 | Reserved | - | - |
| 11 | Pe> | F16 $\uparrow \downarrow$ | 72h |
| 12 | Pe>> | F16 $\uparrow \downarrow$ | 73h |
| 13 | 1< | F17 $\uparrow \downarrow$ | 21h |
| 14 | 12> | F17 $\uparrow \downarrow$ | 7Ch |
| 15 | 12>> | F17 $\uparrow \downarrow$ | 7Dh |
| 16 | 12>>> | F17 $\uparrow \downarrow$ | 7Eh |
| 17 | Thermal overload alarm | F37 $\uparrow \downarrow$ | 020h |
| 18 | Reserved | - | - |
| 19 | Reserved | - | - |
| 20 | Ue>>>> | F16 $\uparrow \downarrow$ | 77h |
| 21 | I> | F17 $\uparrow \downarrow$ | 14h |
| 22 | l>> | F17¢ $\downarrow$ | 15h |
| 23 | l>>> | F17¢ $\downarrow$ | 16h |
| 24 | le> | F16 $\uparrow \downarrow$ | 17h |
| 25 | le>> | F16 $\uparrow \downarrow$ | 18h |
| 26 | le>>> | F16 $\uparrow \downarrow$ | 19h |
| 27 | Reserved | - | - |
| 28 | Reserved | - | - |
| 29 | Pe> trip | F16 | 72h |
| 30 | Pe>> trip | F16 | 73h |
| 31 | $1<$ trip | F17 | 21h |
| 32 | 12> trip | F17 | 7Ch |
| 33 | 12>> trip | F17 | 7Dh |
| 34 | 12>>> trip | F17 | 7Eh |
| 35 | $\theta$ trip | F37 | 20h |
| 36 | Reserved | - | - |
| 37 | Reserved | - | - |


| Code (Dec) | Event meaning | Type | MODBUS address |
| :---: | :---: | :---: | :---: |
| 38 | Ue>>>> trip | F16 | 7Ah |
| 39 | Reserved | - | - |
| 40 | Reserved | - | - |
| 41 | Reserved | - | - |
| 42 | $1>$ trip | F17 | 14h |
| 43 | 1>> trip | F17 | 15h |
| 44 | l>>> trip | F17 | 16h |
| 45 | le> trip | F16 | 17h |
| 46 | le>> trip | F16 | 18h |
| 47 | le>>> trip | F16 | 19h |
| 48 | Trip SOTF | F38 | 23h |
| 49 | X1 trip: t AUX3 | F13 | 13h |
| 50 | X1 trip: t AUX4 | F13 | 13h |
| 51 | EQU LOG A trip | F48 | 7Fh |
| 52 | EQU LOG B trip | F48 | 7Fh |
| 53 | EQU LOG C trip | F48 | 7Fh |
| 54 | EQU LOG D trip | F48 | 7Fh |
| 55 | Broken conductor trip | F38 | 23h |
| 56 | t AUX1 trip | F38 | 23h |
| 57 | t AUX2 trip | F38 | 23h |
| 58 | SF6 fault | F20 | 11h |
| 59 | Working time | F43 $\uparrow \downarrow$ | 28h |
| 60 | Operation numbers | F43 $\uparrow \downarrow$ | 28h |
| 61 | Sum of switched square amps | F43 $\uparrow \downarrow$ | 28h |
| 62 | Trip circuit supervision | F43 $\uparrow \downarrow$ | 28h |
| 63 | Closing time | F43 $\uparrow \downarrow$ | 28h |
| 64 | Reclose successful | F43 $\uparrow \downarrow$ | 28h |
| 65 | Recloser final trip | F43 $\uparrow \downarrow$ | 28h |
| 66 | Recloser settings error | F43 $\uparrow \downarrow$ | 28h |
| 67 | Broken conductor | F38 $\uparrow \downarrow$ | 23h |
| 68 | Selective scheme logic 1 | F20 $\uparrow \downarrow$ | 11h |
| 69 | Selective scheme logic 2 | F20 $\uparrow \downarrow$ | 11h |
| 70 | Blocking logic 1 | F20 $\uparrow \downarrow$ | 11h |
| 71 | Blocking logic 2 | F20 $\uparrow \downarrow$ | 11h |
| 72 | Settings group change | F20 | 11h |
| 73 | O/O | F20 $\uparrow \downarrow$ | 11h |
| 74 | F/O | F20 $\uparrow \downarrow$ | 11h |
| 75 | All alarms acknowledgement by logic | F20^ $\downarrow$ | 11h |


| Code (Dec) | Event meaning | Type | MODBUS address |
| :---: | :---: | :---: | :---: |
|  | input |  |  |
| 76 | Cold load pick up active | F20 $\uparrow \downarrow$ | 11h |
| 77 | Input logic state change | F12 $\uparrow \downarrow$ | 10h |
| 78 | X1 trip: $\theta$ trip | F13 | 13h |
| 79 | X1 trip: tl > | F13 | 13h |
| 80 | X1 trip: $\mathrm{tl} \gg$ | F13 | 13h |
| 81 | X1 trip: $\mathrm{tl} \ggg$ | F13 | 13h |
| 82 | X1 trip: t le> | F13 | 13h |
| 83 | X1 trip: t le>> | F13 | 13h |
| 84 | X1 trip: t le>>> | F13 | 13h |
| 85 | X1 trip: $\mathrm{t} \mathrm{Pe/lecos>}$ | F13 | 13h |
| 86 | X1 trip: t Pe/lecos>> | F13 | 13h |
| 87 | Reserved | - | - |
| 88 | Reserved | - | - |
| 89 | X1 trip: tl < | F13 | 13h |
| 90 | Reserved | - | - |
| 91 | Reserved | - | - |
| 92 | X1 trip: t l2> | F13 | 13h |
| 93 | X1 trip: t l2>> | F13 | 13h |
| 94 | X1 trip: t l2>>> | F13 | 13h |
| 95 | X1 trip: t Ue>>>> | F13 | 13h |
| 96 | X1 trip: Broken Conductor | F13 | 13h |
| 97 | X1 trip: EQU LOG A | F13 | 13h |
| 98 | X1 trip: EQU LOG B | F13 | 13h |
| 99 | X1 trip: EQU LOG C | F13 | 13h |
| 100 | X1 trip: EQU LOG D | F13 | 13h |
| 101 | X1 trip: t AUX1 | F13 | 13h |
| 102 | X1 trip: t AUX2 | F13 | 13h |
| 103 | Output relays command | F39 $\uparrow \downarrow$ | 402h |
| 104 | Front panel single alarm acknowledge | - | - |
| 105 | All alarms front panel acknowledgement | - | - |
| 106 | Single alarm remote acknowledgement |  | - |
| 107 | All alarms remote acknowledgement | - | - |
| 108 | heavy alarm | F45 $\uparrow \downarrow$ | 0Fh |
| 109 | non heavy alarm | F45 $\uparrow \downarrow$ | OFh |
| 110 | Operating Latched Relays status | F27 $\uparrow \downarrow$ | 2Eh |
| 111 | General "Start" protection (IEC 60870-5103 only) | F1 $\uparrow \downarrow$ | OBh |


| Code (Dec) | Event meaning | Type | MODBUS <br> address |
| :--- | :--- | :--- | :--- |
| 112 | Recloser in "Service" (IEC 60870-5-103 <br> only) | F43 $\uparrow \downarrow$ | 28 h |
| 113 | 52a by recloser (IEC 60870-5-103 only) | Cycle | - |
| 114 | Local parameter setting (password <br> active) - (IEC 60870-5-103 only) | $\uparrow \downarrow$ | - |
| 115 | Start timer Breaker failure from digital <br> input | F20A $\uparrow \downarrow$ | 0Dh |
| 116 | t AUX3 trip | F38 | 23 h |
| 117 | t AUX4 trip | F38 | 23 h |
| 118 | Manual Close | F20A | 0Dh |
| 119 | X1 trip: SOTF | F38 | 23 h |
| 120 | Local Mode | F20A $\downarrow \downarrow$ | 0Dh |
| 121 | Reserved |  |  |
| 122 | Reserved | F43 $\uparrow \downarrow$ | 28 h |
| 123 | Reserved | F43 $\downarrow$ | 28 h |
| 124 | Reserved | Reserved | Recloser locked |
| 125 | Recloser in progress |  |  |
| 126 |  |  |  |
| 127 |  |  |  |

NOTE: The double arrow $\uparrow \downarrow$ means the event is generated on event occurrence ( $\uparrow$ ) and on event disappearance ( $\downarrow$ ).

On event occurrence, the corresponding bit of the associated format is set to « 1 ».

On event disappearance, the corresponding bit of the associated format is set to « $0 »$.

### 2.4.1.16 Page 36H

Oldest event data.
Reading access in word (function 03)

| Address (hex) | Contents |
| :--- | :--- |
| 3600 h | Oldest event data |

2.4.1.17 Page 37H

Fault record value data
Reading access in word (function 03)

| Address (hex) | Contents |
| :--- | :--- |
| 3700 h | Fault value record $\mathrm{n}^{\circ} 1$ |
| 3701 h | Fault value record $\mathrm{n}^{\circ} 2$ |
| 3702 h | Fault value record $\mathrm{n}^{\circ} 3$ |
| 3703 h | Fault value record $\mathrm{n}^{\circ} 4$ |
| 3704 h | Fault value record $\mathrm{n}^{\circ} 5$ |

Each record is made up of 24 words:

| Word Nr. | Contents |
| :---: | :---: |
| 1 | Fault number |
| PRIVATE FORMAT: 2 \& 3 | Fault date (number of seconds since 01/01/94) |
| PRIVATE FORMAT: 4 \& 5 | Fault date (milli-seconds) |
| IEC FORMAT: 2 to 5 | Fault date (see format of time synchronisation, address 0800h) |
| 6 | Fault date (season) <br> $0=$ winter <br> 1 = summer <br> $2=$ undefined |
| 7 | Active setting group during the fault (1 or 2) |
| 8 | Fault origin <br> $0=$ none <br> $1=$ phase A <br> 2= phase B <br> 3= phase C <br> 4= Reserved <br> 5= Reserved <br> 6= Reserved <br> 7= Reserved <br> $8=$ earth |
| 9 | Fault recording starting origin (see format F61) |
| 10 \& 11 | Fault value |
| 12 | Phase A current value (nominal value) |
| 13 | Phase B current value (nominal value) |
| 14 | Phase C current value (nominal value) |
| 15 | Earth current value (nominal value) |
| 16 | Reserved |
| 17 | Reserved |
| 18 | Reserved |
| 19 | Earth voltage value (nominal value) |
| 20 | Reserved |
| 21 | Reserved |
| 22 | Reserved |
| 23 | Angle between earth current and earth voltage values |
| 24 | Acknowledgement: $\begin{aligned} & 0=\text { fault not acknowledged } \\ & 1=\text { fault acknowledged } \end{aligned}$ |

Phase current values calculation formula
Line phase current value (primary value) = phase sampled value (e.g. word 10, 11, 12 or 13 )

* phase primary CT ratio / phase internal CT ratio (mapping address 0007)

Earth current values calculation formula
The formula depends on nominal earth fault current :
0.1 to 40 len range

Earth fault current value (primary value) = earth sampled value (e.g. word 10 or 14) * earth primary CT ratio / earth internal CT ratio (mapping address 0008=800)

### 0.01 to 8 len range

Earth fault current value (primary value) = earth sampled value (e.g. word 10 or 14) * earth primary CT ratio / earth internal CT ratio (mapping address 0008=3277)
0.002 to 1 len range

Earth fault current value (primary value) = earth sampled value (e.g. word 10 or 14) * earth primary CT ratio / earth internal CT ratio (mapping address 0008=32700)

Earth voltage values calculation formula
Line earth voltage value (primary value) = earth sampled value (e.g. word 10 or 18) * earth primary VT ratio / earth internal VT ratio

### 2.4.1.18 Pages 38 H to 3 CH

Selection of the disturbance record and channel (19 words are uploaded for each address reading)

Access in word reading (function 03)

| Address (hex) | Disturbance record number | Channel |
| :---: | :---: | :---: |
| 3800h | 1 | IA |
| 3801h | 1 | IB |
| 3802h | 1 | IC |
| 3803h | 1 | le |
| 3804h | 1 | Reserved |
| 3805h | 1 | Reserved |
| 3806h | 1 | Ue |
| 3807h | 1 | Frequency |
| 3808h | 1 | Logic inputs and outputs |
| 3900h | 2 | IA |
| 3901h | 2 | IB |
| 3902h | 2 | IC |
| 3903h | 2 | le |
| 3904h | 2 | Reserved |
| 3905h | 2 | Reserved |
| 3906h | 2 | Ue |
| 3907h | 2 | Frequency |
| 3908h | 2 | Logic inputs and outputs |
| 3A00h | 3 | IA |
| 3A01h | 3 | IB |
| 3A02h | 3 | IC |
| 3A03h | 3 | le |
| 3A04h | 3 | Reserved |


| Address (hex) | Disturbance record number | Channel |
| :--- | :--- | :--- |
| 3A05h | 3 | Reserved |
| 3A06h | 3 | Ue |
| 3A07h | 3 | Frequency |
| 3A08h | 3 | Logic inputs and outputs |
| 3B00h | 4 | IA |
| 3B01h | 4 | IB |
| 3B02h | 4 | IC |
| 3B03h | 4 | Ie |
| 3B04h | 4 | Reserved |
| 3B05h | 4 | Reserved |
| 3B06h | 4 | Ue |
| 3B07h | 4 | Frequency |
| 3B08h | 4 | Logic inputs and outputs |
| 3C00h | 5 | IA |
| 3C01h | 5 | IB |
| 3C02h | 5 | IC |
| 3C03h | 5 | Ie |
| 3C04h | 5 | Reserved |
| 3C05h | 5 | Reserved |
| 3C06h | 5 | Ue |
| $3 C 07 \mathrm{~h}$ | 5 | Frequency |
| 3C08h | 5 | Logic inputs and outputs |
|  |  |  |


| Word Nr. | Contents |
| :--- | :--- |
| 1 | Number of samples included in the mapping |
| 2 | Sample number in pre-time |
| 3 | Sample number in post-time |
| 4 | Phase primary CT ratio |
| 5 | Phase secondary CT ratio |
| 6 | Earth primary CT ratio |
| 7 | Earth secondary CT ratio |
| 8 | Phase internal CT ratio |
| 9 | Earth internal CT ratio |
| 10 | Reserved |
| 11 | Reserved |
| 12 | Reserved |
| 13 | Earth primary VT ratio - byte low |
| 14 | Earth primary VT ratio - byte high |
| 15 | Earth secondary VT ratio |


| Word Nr. | Contents |
| :--- | :--- |
| 16 | Internal VT ratio - numerator: 100 |
| 17 | Internal VT ratio - denominator: 6300 or 1700 |
| 18 | Last mapping page |
| 19 | Last mapping page words number |

Phase current values calculation formula
Line phase current value (primary value) = phase sampled value (e.g. adress 3800h, 3801h or 3802 h ) * phase primary CT ratio * (1/internal phase ratio) * $\sqrt{2}$

Earth current value calculation formula
Line earth current value (primary value) = earth sampled value (e.g. adress 3803h) * earth primary CT ratio * (1 / internal earth ratio) * $\sqrt{2}$

Earth voltage values calculation formula
Line earth voltage value (primary value) = earth sampled value (e.g. address 3806h) * earth primary VT ratio / earth internal VT ratio * $\sqrt{ } 2$
2.4.1.19 Page 3DH

Number of disturbance records available
Access in word reading (function 03)

| Address (hex) | Contains |
| :--- | :--- |
| 3D00h | Number of disturbance records available |

Words description:

| Word Nr. | Contents |
| :--- | :--- |
| 1 | Number of disturbance records available |
| 2 | Oldest disturbance record number (n) |
| PRIVATE FORMAT: $3 \& 4$ | Oldest disturbance record date (seconds) |
| PRIVATE FORMAT: $5 \& 6$ | Oldest disturbance record date (milli-seconds) |
| IEC FORMAT: 3 to 6 | Oldest disturbance record date (see format of time <br> synchronisation, address 0800h) |
| 7 | Disturbance record starting origin <br> 1= trip relay (RL1) <br> $3=$ instantaneous threshold <br> $4=$ logic input |
| 8 | Acknowledge |
| 9 | Disturbance record previous number (n+1) |


| Word Nr. | Contents |
| :---: | :---: |
| 15 | Acknowledge |
| 16 | Disturbance record previous number ( $\mathrm{n}+2$ ) |
| PRIVATE FORMAT: 17 \& 18 | Previous disturbance record date (second) |
| PRIVATE FORMAT: 19 \& 20 | Previous disturbance record date (millisecond) |
| IEC FORMAT: 17 to 20 | Previous disturbance record date (see format of time synchronisation, address 0800h) |
| 21 | Disturbance record starting origin $1=$ trip relay (RL1) <br> 2= instantaneous threshold <br> $3=$ remote command <br> $4=$ logic input |
| 22 | Acknowledge |
| 23 | Disturbance record previous number ( $\mathrm{n}+3$ ) |
| PRIVATE FORMAT: 24 \& 25 | Previous disturbance record date (seconds) |
| PRIVATE FORMAT: 26 \& 27 | Previous disturbance record date (milli-seconds) |
| IEC FORMAT: 24 to 27 | Previous disturbance record date (see format of time synchronisation, address 0800h) |
| 28 | $\begin{array}{\|l} \text { Disturbance record starting origin } \\ 1=\text { trip relay (RL1) } \\ 2=\text { instantaneous threshold } \\ 3=\text { remote command } \\ 4=\text { logic input } \end{array}$ |
| 29 | Acknowledge |
| 30 | Disturbance record previous number ( $\mathrm{n}+4$ ) |
| PRIVATE FORMAT: 31 \& 32 | Previous disturbance record date (second) |
| PRIVATE FORMAT: 33 \& 34 | Previous disturbance record date (millisecond) |
| IEC FORMAT: 31 to 34 | Previous disturbance record date (see format of time synchronisation, address 0800h) |
| 35 | Disturbance record starting origin $1=$ trip relay (RL1) <br> 2= instantaneous threshold <br> $3=$ remote command <br> $4=$ logic input |
| 36 | Acknowledge |

### 2.4.1.20 Page 3EH

Oldest fault record value data.
Access in word reading (function 03).

| Address (hex) | Contents |
| :--- | :--- |
| 3E00h | Oldest fault record |

### 2.4.1.21 Page 5AH

Eeprom error counters.
Access in word reading (function 03).

| Address (hex) | Contents |
| :--- | :--- |
| 5A00h | E2prom error counters |

Words description:

| Word Nr. | Contents |
| :--- | :--- |
| 1 | Number of errors in page 1 |
| 2 | Last error address of page 1 |
| 3 | Number of errors in page 2 |
| 4 | Last error address of page 2 |
| 5 | Number of errors in page 3 |
| 6 | Last error address of page 3 |
| 7 | Number of errors in calibration page |
| 8 | Last error address of calibration page |
| 9 | Number of data checksum errors |
| 10 | Number of calibration checksum errors |

### 2.4.2 Mapping format description

Values are decimal except when differently specified.

| CODE | DESCRIPTION |
| :---: | :---: |
| F1 | Unsigned integer: numerical data 1..... 65535 |
| F2 | Signed integer: numerical data -32768....... 32767 |
| F3 | Unsigned integer: trip / reset curves type (hex values) <br> 0 : DMT <br> 10 : STI (CEI) <br> 11 : SI (CEI) <br> 12 : VI (CEI) <br> 13 : El (CEI) <br> 14 : LTI (CEI) <br> 115 : STI (C02) <br> 116 : MI (ANSI) <br> 117 : LTI (CO8) <br> 118 : VI (ANSI) <br> 119 : El (ANSI) <br> 1A : RECT <br> 20 : RI |
| F4 | Unsigned integer: UART Baud rate <br> 0: 300 <br> 1: 600 <br> 2: 1200 <br> 3: 2400 <br> 4: 4800 <br> 5: 9600 <br> 6: 19200 <br> 7: 38400 |
| F5 | Unsigned integer: Modbus and DNP3.0 parity bit 0 : none <br> 1 : even <br> 2 : odd |
| F6 | Unsigned integer: relay X1 configuration - part 1/2 <br> Bit 0: tl> <br> Bit 1: tl>> <br> Bit 2: tl>>> <br> Bit 3: tle> <br> Bit 4: tle>> <br> Bit 5: tle>>> <br> Bit 6: $\mathrm{tl}<$ <br> Bit 7: tlth>> <br> Bit 8: broken conductor trip <br> Bit 9: AUX 1 trip <br> Bit 10: AUX 2 trip <br> Bit 11: tl2> <br> Bit 12: tPe> <br> Bit 13: tPe>> <br> Bit 14: tUe>>>> <br> Bit 15: Control trip |


| CODE | DESCRIPTION |
| :---: | :---: |
| F6A | Unsigned integer: configuration du déclenchement du X1 part 2/2 <br> Bits 0 to 3: Reserved <br> Bit 4: AND logic equation A trip <br> Bit 5: AND logic equation B trip <br> Bit 6: AND logic equation C trip <br> Bit 7: AND logic equation D trip <br> Bit 8: tl2>> <br> Bit 9: tl2>>> <br> Bit 10: Reserved <br> Bit 11: Reserved <br> Bit 12: Reserved <br> Bit 13: AUX 3 trip <br> Bit 14: AUX 4 trip <br> Bit 15: SOTF/TOR |
| F7 | Reserved |
| F8 | Unsigned integer: blocking logic configuration - part 1/2 <br> Bit 0: tl> <br> Bit 1: tl>> <br> Bit 2: tl>>> <br> Bit 3: tle> + le>REV <br> Bit 4: tle>>+le>>REV <br> Bit 5: tle>>> + le>>>REV <br> Bit 6: $\mathrm{t}<$ <br> Bit 7: Ith>> trip <br> Bit 8: broken conductor trip <br> Bit 9: aux1 trip <br> Bit 10: aux2 trip <br> Bit 11: tl2> <br> Bit 12: tPe> <br> Bit 13: tPe>> <br> Bit 14: tUe>>>> <br> Bit 15: Reserved |
| F8A | Unsigned integer: blocking logic configuration - part 2/2 <br> Bits 0 to 3: Reserved <br> Bit 4: AUX3 trip <br> Bit 5: AUX4 trip <br> Bits 6-7: Reserved <br> Bit 8: tl2>> <br> Bit 9: tl2>>> <br> Bits 10 to 15: Reserved |
| F9 | Unsigned integer: remote control 1 <br> Bit 0: relays de-latching <br> Bit 1: 1st alarm acknowledge <br> Bit 2: all alarms acknowledge <br> Bit 3: remote tripping (CONTROL trip) <br> Bit 4: remote closing (CONTROL close) <br> Bit 5 : settings group change <br> Bit 6: thermal state reset <br> Bit 7: max \& average values reset <br> Bit 8: disturbance record remote start <br> Bit 9: maintenance mode <br> Bit 10: recloser counters reset <br> Bit 11: recloser reset <br> Bit 12: manual acknowledge mode <br> Bit 13: oldest event acknowledge <br> Bit 14: oldest fault acknowledge <br> Bit 15: hardware Sram alarm acknowledge |


| CODE | DESCRIPTION |
| :---: | :---: |
| F10 | Unsigned integer: 2 ASCII characters 32-127 = ASCII character1 32-127 = ASCII character 2 |
| F11 | Unsigned integer: AND logic equations configuration Bit 0: AND logic equation A association <br> Bit 1: AND logic equation $B$ association <br> Bit 2: AND logic equation A association <br> Bit 3: AND logic equation D association <br> Bits 4 to 15: Reserved |
| F12 | Unsigned integer: logic input status Bit 0: logic input number 1 <br> Bit 1: logic input number 2 <br> Bit 2: logic input number 3 <br> Bit 3 logic input number 4 <br> Bit 4 logic input number 5 <br> Bit 5 logic input number 6 <br> Bit 6 logic input number 7 <br> Bits 7 to 15: Reserved |
| F13 | Unsigned integer: : logic outputs status <br> Bit 0: logic output number RL1 (X1 tripping) <br> Bit 1: logic output number RL2 <br> Bit 2: logic output number RL3 <br> Bit 3: logic output number RL4 <br> Bit 4: logic output number RLO (Watch-Dog) <br> Bit 5: logic output number RL5 <br> Bit 6: logic output number RL6 <br> Bit 7: logic output number RL7 <br> Bit 8: logic output number RL8 <br> Bits 9 to 15: Reserved |
| F14 | Unsigned integer: RI2 ... RL8 output configuration Bit 0: logic output number RL2 selection Bit 1: logic output number RL3 selection Bit 2: logic output number RL4 selection Bit 3: logic output number RL5 selection Bit 4: logic output number RL6 selection Bit 5: logic output number RL7 selection Bit 6: logic output number RL8 selection Bits 7 to 15: Reserved |
| F14A | Unsigned integer: RI2 ... RL8 output configuration for CB \& SOTF Bit 0: logic output number RL2 selection (Recloser) <br> Bit 1: logic output number RL3 selection (Recloser) <br> Bit 2: logic output number RL4 selection (Recloser) <br> Bit 3: logic output number RL5 selection (Recloser) <br> Bit 4: logic output number RL6 selection (Recloser) <br> Bit 5: logic output number RL7 selection (Recloser) <br> Bit 6: logic output number RL8 selection (Recloser) <br> Bit 7: Reserved <br> Bit 8: logic output number RL2 selection (SOTF) <br> Bit 9: logic output number RL3 selection (SOTF) <br> Bit 10: logic output number RL4 selection (SOTF) <br> Bit 11: logic output number RL5 selection (SOTF) <br> Bit 12: logic output number RL6 selection (SOTF) <br> Bit 13: logic output number RL7 selection (SOTF) <br> Bit 14: logic output number RL8 selection (SOTF) <br> Bit 15: Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F14B | Unsigned integer: RI2 ... RL8 output configuration for tAux3 \& tAux4 Bit 0: logic output number RL2 selection (tAux3) <br> Bit 1: logic output number RL3 selection (tAux3) <br> Bit 2: logic output number RL4 selection (tAux3) <br> Bit 3: logic output number RL5 selection (tAux3) <br> Bit 4: logic output number RL6 selection (tAux3) <br> Bit 5: logic output number RL7 selection (tAux3) <br> Bit 6: logic output number RL8 selection (tAux3) <br> Bit 7: Reserved <br> Bit 8: logic output number RL2 selection (tAux4) <br> Bit 9: logic output number RL3 selection (tAux4) <br> Bit 10: logic output number RL4 selection (tAux4) <br> Bit 11: logic output number RL5 selection (tAux4) <br> Bit 12: logic output number RL6 selection (tAux4) <br> Bit 13: logic output number RL7 selection (tAux4) <br> Bit 14: logic output number RL8 selection (tAux4) <br> Bit 15: Reserved |
| F14C | Unsigned integer: RI2 ... RL8 output configuration for Control Trip \& Close Bit 0: logic output number RL2 selection (Control Trip) Bit 1: logic output number RL3 selection (Control Trip) Bit 2: logic output number RL4 selection (Control Trip) Bit 3: logic output number RL5 selection (Control Trip) Bit 4: logic output number RL6 selection (Control Trip) Bit 5: logic output number RL7 selection (Control Trip) Bit 6: logic output number RL8 selection (Control Trip) Bit 7: Reserved <br> Bit 8: logic output number RL2 selection (Control Close) Bit 9: logic output number RL3 selection (Control Close) Bit 10: logic output number RL4 selection (Control Close) Bit 11: logic output number RL5 selection (Control Close) Bit 12: logic output number RL6 selection (Control Close) Bit 13: logic output number RL7 selection (Control Close) Bit 14: logic output number RL8 selection (Control Close) Bit 15: Reserved |
| F14D | Unsigned integer: RI2 ... RL8 output configuration for recloser trip final \& locked Bit 0: logic output number RL2 selection (recloser trip final) Bit 1: logic output number RL3 selection (recloser trip final) Bit 2: logic output number RL4 selection (recloser trip final) Bit 3: logic output number RL5 selection (recloser trip final) Bit 4: logic output number RL6 selection (recloser trip final) Bit 5: logic output number RL7 selection (recloser trip final) Bit 6: logic output number RL8 selection (recloser trip final) Bit 7: Reserved <br> Bit 8: logic output number RL2 selection (recloser locked) Bit 9: logic output number RL3 selection (recloser locked) Bit 10: logic output number RL4 selection (recloser locked) Bit 11: logic output number RL5 selection (recloser locked) Bit 12: logic output number RL6 selection (recloser locked) Bit 13: logic output number RL7 selection (recloser locked) Bit 14: logic output number RL8 selection (recloser locked) Bit 15: Reserved |


| CODE | DESCRIPTION |
| :--- | :--- |
| F15 | Unsigned integer: digital inputs configuration <br> Bit 0: auxuliary relays de-latching command <br> Bit 1: O/O <br> Bit 2: F/O <br>  <br>  <br> Bit 3: missing SF6 <br> Bit 4: aux 1 <br> Bi 5: aux 2 <br> Bit 6: blocking logic 1 <br> Bit 7: blocking logic 2 <br> Bit 8: disturbance start <br> Bit 9: cold load start <br> Bit 10: digital selection 1 <br> Bit 11: digital selection 2 <br> Bit 21: settings group change (configuration must be equal to INPUT) <br> Bit 13: recloser latched <br> Bit 14: reset thermal status <br> Bit 15: control tripping circuit |
| F15A | Unsigned integer: digital inputs configuration, part 2/2 <br> Bit 0: start Breaker Failure timer <br> Bit 1: maintenance mode |
|  | Bit 2: aux 3 |
| Bit 3: aux 4 |  |
| Bits 4 to 15: Reserved |  |


| CODE | DESCRIPTION |
| :---: | :---: |
| F19 | Unsigned integer: leds configuration mask - part 1/4 <br> Bit 0: 1> <br> Bit 1: tl> <br> Bit 2: l>> <br> Bit 3: tl>> <br> Bit 4: l>>> <br> Bit 5: tl>>> <br> Bit 6: le> <br> Bit 7: tle> <br> Bit 8: le>> <br> Bit 9: tle>> <br> Bit 10: le>>> <br> Bit 11: tle>>> <br> Bit 12: Ith>> <br> Bit 13: tl2> <br> Bit 14: broken conductor trip <br> Bit 15: breaker failure trip |
| F19A | Unsigned integer: leds configuration mask - part 2/4 <br> Bit 0: digital input 1 <br> Bit 1: digital input 2 <br> Bit 2: digital input 3 <br> Bit 3: digital input 4 <br> Bit 4: digital input 5 <br> Bit 5: recloser running <br> Bit 6: recloser latched <br> Bit 7: aux1 trip <br> Bit 8: aux2 trip <br> Bit 9: Pe> <br> Bit 10: tPe> <br> Bit 11: Pe>> <br> Bit 12: tPe>> <br> Bit 13: Ue>>>> <br> Bit 14: tUe>>>> <br> Bit 15: SOTF |
| F19B | Unsigned integer: leds configuration mask - part 3/4 <br> Bits 0 to 7: Reserved <br> Bit 8: tl2>> <br> Bit 9: tl< <br> Bit 10: $\mathrm{tl}>$ phase A <br> Bit 11: $\mathrm{tl}>$ phase B <br> Bit 12: $\mathrm{tl}>$ phase C <br> Bit 13: digital input 6 <br> Bit 14: digital input 7 <br> Bit 15: tl2>>> |
| F19C | Unsigned integer: leds configuration mask - part 4/4 <br> Bit 0: I2> <br> Bit 1: 12>> <br> Bit 2: l2>>> <br> Bit 3: 1< <br> Bits 4 to 15: Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F20 | Unsigned integer: logic inputs data status, part 1/2 <br> Bit 0: logic selection 1 <br> Bit 1: logic selection 2 <br> Bit 2: relays de-latching <br> Bit 3: CB position (52a) <br> Bit 4: CB position (52b) <br> Bit 5: external CB failure <br> Bit 6: aux 1 <br> Bit 7: aux 2 <br> Bit 8: blocking logic 1 <br> Bit 9: blocking logic 2 <br> Bit 10: disturbance recording start <br> Bit 11: cold load start <br> Bit 12: settings group change <br> Bit 13: recloser locked <br> Bit 14: thermal status reset <br> Bit 15: trip circuit supervision |
| F20A | Unsigned integer: logic inputs data status, part 2/2 <br> Bit 0: start Breaker Failure timer <br> Bit 1: maintenance mode <br> Bit 2: aux 3 <br> Bit 3: aux 4 <br> Bit 4: SOTF/TOR <br> Bit 5: Local Mode <br> Bits 6 to 15: Reserved |
| F21 | Unsigned integer: software version (Dec value) : 00-99 (XY) <br> X digit $=$ Version number 0-9 <br> Y digit = Revision number 0 (A) - 9 ( J ) |
| F22 | Unsigned intege: internal logic data Bit 0: RL1 trip relay status Bits 1 to 15: Reserved |
| F23 | Unsigned integer : machine status <br> Bit 0 : major material alarm <br> Bit 1 : minor material alarm <br> Bit 2 : presence of a non-acknowledged event <br> Bit 3 : synchronisation state <br> bit 4 : presence of a non-acknowledged disturbance recording <br> Bit 5 : presence of a non-acknowledged fault record <br> Bits 6 to 15: Reserved |
| F24 | Unsigned integer: generic info operating mode 0 : out of service / not active <br> 1: in service / active |
| F24A | Unsigned integer: 67 N operating mode <br> 0: NO <br> 1: YES <br> 2: DIR <br> 3: PEAK |
| F24B | Unsigned integer: 50/51 operating mode <br> 0: NO <br> 1: YES <br> 2: PEAK |
| F24C | Unsigned integer: 32N protection operating mode <br> 0 : Pe type mode seuil <br> 1: leCos type mode seuil |
| F25 | Unsigned integer: 2 ASCII characters |


| CODE | DESCRIPTION |
| :---: | :---: |
| F26 | Unsigned integer: default display configuration <br> 1 : IA measurement display (True RMS) <br> 2 : IB measurement display (True RMS) <br> 3 : IC measurement display (True RMS) <br> 4 : IN measurement display (True RMS) |
| F27 | Unsigned integer: RL1 ... RL8 output relays latch configuration and status <br> Bit 0: relay number 1 (RL1) <br> Bit 1: relay number 2 (RL2) <br> Bit 2: relay number 3 (RL3) <br> Bit 3: relay number 4 (RL4) <br> Bit 4: relay number 5 (RL5) <br> Bit 5: relay number 6 (RL6) <br> Bit 6: relay number 7 (RL7) <br> Bit 7: relay number 8 (RL8) <br> Bits 8 to15: Reserved |
| F28 | Unsigned integer: Modbus parameters - data bits number. <br> 0: 7 data bits <br> 1: 8 data bits |
| F29 | Unsigned integer: Modbus and DNP3 stop bits number. <br> 0 : one stop bit <br> 1: two stop bits |
| F30 | Unsigned integer: communication status + Private telegram option (IEC870-5-103 only) Bit 0 : communication available if $=1$ <br> Bit 1: IEC870-5-103 private telegrams used if $=1$, else IEC870-5-103 telegrams in public range only. |
| F31 | Unsigned integer : number of available events records <br> 0: no event records available <br> 1: one events record available <br> 2: two events records available <br> 3: three events records available <br> 4: four events records available <br> 5: five events records available |
| F32 | Unsigned integer: disturbance recording configuration <br> 0: disturbance recording start condition on protection START <br> 1: disturbance recording start condition on protection TRIPPING |
| F33 | Unsigned integer: cold load start thresholds Bit 0: tl> <br> Bit 1: tl>> <br> Bit 2: tl>>> <br> Bit 3: tle> <br> Bit 4: tle>> <br> Bit 5: tle>>> <br> Bit 6: Ith>> trip <br> Bit 7: tl2> <br> Bit 8: tl2>> <br> Bit 9: tl2>>> <br> Bits 10 to 15: Reserved |
| F34 | Unsigned integer: threshold reset timer type <br> 0: DMT <br> 1: IDMT |
| F35 | Unsigned integer: disturbance recording status <br> 0 : no disturbance recording uploaded <br> 1: disturbance recording upload running |


| CODE | DESCRIPTION |
| :---: | :---: |
| F36 | Unsigned integer: non acknowledged memorised alarms flags - part 1/4 <br> Bit 0: le> <br> Bit 1: tle> <br> Bit 2: le>> <br> Bit 3: tle>> <br> Bit 4: le>>> <br> Bit 5: tle>>> <br> Bit 6: le>REV <br> Bit 7: le>> REV <br> Bit 8: le>>>REV <br> Bit 9: thermal alarm (tlth>) <br> Bit 10: thermal trip (tlth>>) <br> Bit 11: broken conductor trip <br> Bit 12: breaker failure trip <br> Bit 13: Reserved <br> Bit 14: AUX1 trip <br> Bit 15: AUX2 trip |
| F36A | Unsigned integer: non acknowledged memorised alarms flags - part 2/4 <br> bit 0 : CB operating time overreach <br> bit 1 : CB operation number overreach <br> bit 2 : square Amps sum overreach <br> bit 3 : trip circuit supervision <br> bit 4 : CB closing time overreach <br> Bit 5: AND logic equation A trip <br> Bit 6: AND logic equation $B$ trip <br> Bit 7: AND logic equation C trip <br> Bit 8: AND logic equation $D$ trip <br> Bit 9: Pe> <br> Bit 10: tPe> <br> Bit 11: Pe>> <br> Bit 12: tPe>> <br> Bit 13: 12> <br> Bit 14: tl2> <br> Bit 15: SOTF |
| F36B | Unsigned integer: non acknowledged memorised alarms flags - part 3/4 <br> Bits 0 to 7: Reserved <br> Bit 8: Ue>>>> <br> Bit 9: tUe>>>> <br> Bit 10 : recloser locked <br> Bit 11 : recloser successful <br> Bit 12: 12>> <br> Bit 13: tl2>> <br> Bit 14: 12>>> <br> Bit 15: tl2>>> |
| F36C ${ }^{3}$ | Unsigned integer: non acknowledged memorised alarms flags - part 4/4 Bit 0: AUX3 trip <br> Bit 1: AUX4 trip <br> Bit 2: l> (old format before release V6: address 001Ah bit 5) <br> Bit 3: tl> (old format before release V6: address 001Dh bit 6) <br> Bit 4: l>> (old format before release V6: address 001Bh bit 5) <br> Bit 5: tl>> (old format before release V6: address 001Eh bit 6) <br> Bit 6: l>>> (old format before release V6: address 001Ch bit 5) <br> Bit 7: tl>>> (old format before release V6: address 001Fh bit 6) <br> Bit 8: $\mathrm{l} \quad$ (old format before release V6: address 0024h bit 5) <br> Bit 9: tl< (old format before release V6: address 0024h bit 6) <br> Bits 10 to 15: Reserved |

[^0]| CODE | DESCRIPTION |
| :---: | :---: |
| F37 | Unsigned integer: thermal overload information Bit 0 : thermal overload alarm (tth $>$ ) <br> Bit 1 : thermal overload trip (tth>>) <br> Bits 2 to 15: Reserved |
| F38 | Unsigned integer: accessory functions <br> Bit 0: SOTF running <br> Bit 1: CB failure <br> Bit 2: pole A opening <br> Bit 3: pole B opening <br> Bit 4: pole C opening <br> Bit 5: broken conductor <br> Bit 6: Aux 1 trip <br> Bit 7: Aux 2 trip <br> Bit 8: broken conductor time delay <br> Bit 9: CB failure time delay <br> Bit 10: cold load pick up time delay <br> Bit 11: CB alarms or bits $0,1,4$ of F43 <br> Bit 12: Aux 3 trip <br> Bit 13: Aux 4 trip <br> Bit 14: Start SOTF <br> Bit 15: Trip SOTF |
| F39 | Unsigned integer : output relay remote word in maintenance mode <br> Bit 0: RL1 (trip) <br> Bit 1: RL2 <br> Bit 2: RL3 <br> Bit 3 : RLO (watch-dog) <br> Bit 4: RL4 <br> Bit 5: RL5 <br> Bit 6: RL6 <br> Bit 7: RL7 <br> Bit 8: RL8 <br> Bits 9 to15: Reserved |
| F40 | Unsigned integer: selective scheme logic configuration Bit 0: tl>> <br> Bit 1: tl>>> <br> Bit 2: tle>> <br> Bit 3: tle>>> <br> Bits 4 to 15: Reserved |
| F41 | Unsigned integer: remote communication configuration <br> 0 : front and rear MODBUS <br> 1 : front MODBUS rear IEC 60870-5-103 <br> 2 : front MODBUS rear COURIER <br> 3 : front MODBUS rear DNP3.0 |
| F42 | ```Unsigned integer: max \& average current + voltage time window selection (dec. values) 05: 5 min 10: 10 min 15: 15 min 30: 30 min 60: 60 min``` |


| CODE | DESCRIPTION |
| :---: | :---: |
| F43 | Unsigned integer <br> Bit 0: CB operating time overreach <br> Bit 1: CB operation number overreach <br> Bit 2: square Amps sum overreach <br> Bit 3: trip circuit supervision <br> Bit 4: CB closing time overreach <br> Bit 5: recloser locked <br> Bit 6: recloser successful <br> Bit 7: recloser in progress <br> Bit 8: closing command issued from recloser cycle <br> Bit 9: recloser configuration error <br> Bit 10: recloser in service (IEC 60870-5-103 only) <br> Bits 11: recloser final trip <br> Bits 12 to 15: Reserved |
| F44 | Reserved |
| F45 | Unsigned integer : HW alarm relay status <br> Bit 0: Watch-Dog operating <br> Bit 1: communication failure <br> Bit 2: E2PROM data failure <br> Bit 3: analogue failure <br> Bit 4: dating failure <br> Bit 5: E2PROM calibration failure <br> Bit 6: SRAM failure <br> Bit 7: battery failure <br> Bit 8: Reserved <br> Bit 9: factory alarm (default factory configuration and setting active) <br> Bits 10 to 15: Reserved |
| F46 | Unsigned integer: Calculation for the extraction of the le harmonic content Bit 0: calculation active <br> Bits 1 to 15: Reserved |
| F47 | Unsigned integer: digital inputs operating mode Bit $\mathrm{x}=$ <br> $0 \rightarrow$ active when de-energised; <br> $1 \rightarrow$ active when energised <br> Bit 0 : input 1 <br> Bit 1 : input 2 <br> Bit 2 : input 3 <br> Bit 3 : input 4 <br> Bit 4 : input 5 <br> Bit 5 : input 6 <br> Bit 6 : input 7 |
| F48 | Unsigned integer: AND logic equations status Bit 0: Reserved <br> Bit 1: AND logic equation A trip <br> Bit 2: AND logic equation B trip <br> Bit 3: AND logic equation C trip <br> Bit 4: AND logic equation D trip <br> Bits 5 to 15: Reserved |
| F49 | Unsigned integer: calibration status flag <br> 0: calibration KO <br> 1: calibration OK |


| CODE | DESCRIPTION |
| :---: | :---: |
| F50 | Unsigned integer: remote control word number 3 <br> Bit 0: flag sync. harmonic earth current <br> Bit 1: Reserved <br> Bit 2: energy reset <br> Bit 3: Reserved <br> Bit 4: rolling average values reset <br> Bit 5: rolling max sub-period values reset <br> Bits 6 to 15: Reserved |
| F51 | Unsigned integer: digital inputs signal type <br> 1: AC <br> 2: DC |
| F52 | Unsigned integer: date and time format (IEC 60870-5-103 only) <br> 0 : internal format (see « page 8 H » description) <br> 1: IEC |
| F53 | Unsigned integer: IEC 60870-5-103 and DNP3.0 communication speed (Baud) INTERNAL USE ONLY $\begin{gathered} \text { IEC } 60870-5-103: \\ 0: 9600 \\ 1: 19200 \\ \text { DNP3.0: } \\ 1: 600 \\ 0: 1200 \\ 1: 2400 \\ \text { 2: } 4800 \\ \text { 3: } 9600 \\ 4: 19200 \\ \text { 5: } 38400 \end{gathered}$ |
| F54 | Unsigned integer: Digital inputs configuration mode, part 1/2: <br> Bit $x=0 \rightarrow$ level / $1 \rightarrow$ edge <br> Bit 0: logic selection 1 ; operating only on level; not configurable (0) <br> Bit 1: logic selection 2; operating only on level; not configurable (0) <br> Bit 2: relays de-latching; operating only on level; not configurable (0) <br> Bit 3: CB position (52a) ; operating only on level; not configurable (0) <br> Bit 4: CB position (52b) ; operating only on level; not configurable (0) <br> Bit 5: external CB failure; operating only on level; not configurable (0) <br> Bit 6: tAux 1; operating only on level; not configurable (0) <br> Bit 7: tAux 2; operating only on level; not configurable (0) <br> Bit 8: blocking logic 1; operating only on level; not configurable (0) <br> Bit 9: blocking logic 2; operating only on level; not configurable (0) <br> Bit 10: disturbance recording start; operating only on edge; not configurable (1) <br> Bit 11: cold load start; operating only on level; not configurable (0) <br> Bit 12: settings group change ; Attention: $0 \rightarrow$ Input / $1 \rightarrow$ Menu <br> Bit 13: recloser locked; operating only on level; not configurable (0) <br> Bit 14: thermal status reset; operating only on edge; not configurable (1) <br> Bit 15: trip circuit supervision; operating only on level; not configurable (0) |
| F54A | Unsigned integer: Digital inputs configuration mode, part2/2: <br> Bit $x=0 \rightarrow$ level $/ 1 \rightarrow$ edge <br> Bit 0: start Breaker Failure timer; operating only on edge; not configurable (1) <br> Bit 1: maintenance mode; operating only on level; not configurable (0) <br> Bit 2: tAux 3; operating only on level; not configurable (0) <br> Bit 3: tAux 4; operating only on level; not configurable (0) <br> Bit 4: Reserved <br> Bit 5: Manual close; operating only on level; not configurable (0) <br> Bit 6: Local mode; operating only on level; not configurable (0) <br> Bits 7 to 15: Reserved |
| F55 | Unsigned integer: active group <br> 1: settings group 1 <br> 2: settings group 2 |


| CODE | DESCRIPTION |
| :---: | :---: |
| F56 | Unsigned integer: RL1 digital output operating mode $0 \rightarrow$ normally de-energised; <br> $1 \rightarrow$ active when energised |
| F57 | Unsigned integer: auto reclosing cycles configuration <br> Bit 0: Cycle 1 configuration (trip and initialise the recloser) <br> Bit 1: Cycle 1 configuration (block the tripping on cycle) <br> Bit 2, Bit 3: Reserved <br> Bit 4: Cycle 2 configuration (trip and initialise the recloser) <br> Bit 5: Cycle 2 configuration (block the tripping on cycle) <br> Bit 6, Bit 7: Reserved <br> Bit 8: Cycle 3 configuration (trip and initialise the recloser) <br> Bit 9: Cycle 3 configuration (block the tripping on cycle) <br> Bit 10, Bit 11: Reserved <br> Bit 12: Cycle 4 configuration (trip and initialise the reclosure) <br> Bit 13: Cycle 4 configuration (block the tripping on cycle) <br> Bit 14, Bit 15: Reserved |
| F58 | Unsigned integer: Switch onto fault configuration <br> Bit 0: Start l>> <br> Bit 1: Start l>>> <br> Bits 2 to 14: Reserved <br> Bit 15: SOTF on/off |
| F59 | Reserved |
| F60 | Reserved |
| F61 | Unsigned integer: Information on the starting origin of the RL1 trip relay 01 - Remote X1 trip <br> 02- $\theta$ trip (Thermal overload) <br> 03 - I> trip <br> 04 - l>> trip <br> 05-l>>> trip <br> 06 - le> trip <br> 07 - le>> trip <br> 08 - le>>> trip <br> 09 - 1< trip <br> 10 - Broken conductor trip <br> 11 - Reserved <br> 12 - Reserved <br> 13 - Pe/lecos> trip <br> 14 - $\mathrm{Pe} / \mathrm{lecos} \gg$ trip <br> 15-12> trip <br> 16-12>> trip <br> 17-12>>> trip <br> 18 - Reserved <br> 19-Reserved <br> 20 - Ue>>>> trip <br> 21-Aux 1 trip <br> 22-Aux 2 trip <br> 23 - AND Logic equate A trip <br> 24 - AND Logic equate B trip <br> 25 - AND Logic equate C trip <br> 26 - AND Logic equate D trip <br> 27-Aux 3 trip <br> 28-Aux 4 trip <br> 29 - SOTF |

### 2.4.3 Disturbance record additional information

2.4.3.1 MODBUS request definition used for disturbance record

To upload a disturbance record, the following requests must be done in the exact given order :

1. (optional) : send a request to know the number of disturbance records available in SRAM.
2. (compulsory) : send a request with the record number and the channel number.
3. (compulsory) : send one or several requests to upload the disturbance record data; It depends of the number of samples.
4. (compulsory) : send a request to upload the index frame.
2.4.3.2 Request to know the number of disturbance records in SRAM

| Slave number | Function code | Word address | Word number | CRC |  |  |  |
| :--- | :--- | :--- | :---: | :--- | :---: | :--- | :--- |
| $x x$ | 03 h | $3 D h$ | 00 | 00 | 24 h | xx | xx |

This request may generate an error message with the error code :

## EVT_NOK(OF): No record available

NOTE: If there are less than 5 records available, the answer will contain zero in non-used words.

### 2.4.3.3 Service requests

This request must be sent before uploading the disturbance record channel samples. It allows to know the record number and the channel number to upload. It allows also to know the number of samples in the channel.

| Slave number | Function code | Word address | Word number | CRC |  |  |
| :--- | :--- | :--- | :--- | :---: | :--- | :--- |
| $x x$ | 03 h | Refer to mapping | 00 | 13 h | $x x$ | $x x$ |

This request may generate an error message with two different error codes :
CODE_DEF_RAM(02) : SRAM failure
CODE_EVT_NOK(03) : no disturbance record available in SRAM
2.4.3.4 Disturbance record upload request

| Slave number | Function code | Word address | Word number | CRC |
| :--- | :--- | :--- | :--- | :--- | :--- |
| xx | 03 h | Refer to mapping | 01 to 7Dh | $\mathrm{xx} \quad \mathrm{xx}$ |

This request may generate an error message with two different error codes:
CODE_DEP_DATA(04) : The required disturbance data number is greater than the memorised number.

CODE_SERV_NOK(05) : The service request for disturbance record and channel number has not been sent
2.4.3.5 Index frame upload request

| Slave number | Function code | Word address | Word number | CRC |  |  |  |
| :--- | :--- | :--- | :---: | :--- | :---: | :--- | :--- |
| $x x$ | 03 h | 22 h | 00 | 00 | 07 h | xx | xx |

This request may generate an error message with an error code :
CODE_SERV_NOK(05): The service request for disturbance record and channel number has not been sent.

### 2.4.4 Request to retrieve the oldest non-acknowledge event

Two ways can be followed to retrieve an event record:
Send a request to retrieve the oldest non-acknowledge event.
Send a request to retrieve a dedicated event.

| Slave number | Function code | Word address | Word number | CRC |  |  |  |
| :--- | :--- | :--- | :---: | :--- | ---: | :--- | :--- |
| $x x$ | 03 h | 36 h | 00 | 00 | 09 h | xx | xx |

This event request may generate an error message with the error code :
EVT_EN_COURS_ECRIT (5) : An event is being written into the saved RAM.
NOTE: On event retrieval, two possibilities exist regarding the event record acknowledgement:

- Automatic event record acknowledgement on event retrieval
- Bit12 of the remote order frame (format F9 - mapping address 0400 h ) shall be set to 0 . On event retrieval, this event record is acknowledged.
- Non automatic event record acknowledgement on event retrieval:
- Bit12 of the remote order frame (format F9 - mapping address 0400 h ) shall be set to 1 . On event retrieval, this event record is not acknowledged.
- To acknowledge this event, an other remote order shall be sent to the relay. Bit 13 of this frame (format F9 - mapping address 0400h) shall be set to 1 .
2.4.5 Request to retrieve a dedicated event

| Slave number | Function code | Word address | Word number | CRC |  |  |
| :--- | :--- | :--- | :--- | ---: | :--- | :--- |
| $x \mathrm{xx}$ | 03 h | Refer to mapping | 00 | 09 h | xx | xx |

This event request may generate an error message with the error code :
EVT_EN_COURS_ECRIT (5) : An event is being written into the saved RAM.
NOTE: This event retrieval does not acknowledge this event.
2.4.6 Modbus request definition used to retrieve the fault records

Two ways can be followed to retrieve a fault record:

1. Send a request to retrieve the oldest non-acknowledge fault record.
2. Send a request to retrieve a dedicated fault record.
2.4.6.1 Request to retrieve the oldest non-acknowledge fault record

| Slave number | Function code | Word address | Word number | CRC |  |  |  |
| :--- | :--- | :--- | :---: | :--- | :---: | :--- | :--- |
| $x x$ | 03 h | $3 E h$ | 00 | 00 | 18 h | xx | xx |

NOTE: On fault retrieval, two possibilities exist regarding the fault record acknowledgement:

1. Automatic fault record acknowledgement on event retrieval.
2. The bit12 of the remote order frame (format F9 - mapping address 0400h) shall be set to 0 . On fault retrieval, this fault record is acknowledged.
3. Non automatic fault record acknowledgement on fault retrieval :

- Bit12 of the remote order frame (format F9 - mapping address 0400h) shall be set to 1. On fault retrieval, this fault record is not acknowledged.
- To acknowledge this fault, an other remote order shall be sent to the relay. Bit 14 of this frame (format F9 - mapping address 0400h) shall be set to 1 .
2.4.6.2 Request to retrieve a dedicated fault record

| Slave number | Function code | Word address | Word number | CRC |  |  |
| :--- | :--- | :--- | :--- | ---: | :--- | :--- |
| xx | 03 h | Refer to mapping | 00 | 18 h | xx | xx |

NOTE : This fault value retrieval does not acknowledge this fault record.
3. IEC 60870-5-103 PROTOCOL

### 3.1 General information

Messages representation is expressed with the associated :

- INFORMATION NUMBER: INF
- ASDU TYPE: TYP
- CAUSE OF TRANSMISSION: COT
- FUNCTION NUMBER: FUN


### 3.2 Spontaneous messages

These messages include a sub-assembly of the events, which are generated on the relay.
The messages considered are concerning highest priority events.
An event is always generated on the rising edge of the information; some can be generated also on falling edge.
In the list below, events generated only on rising edge will be tagged with a '*'.
3.2.1 Time Tagged Message

Two types of ASDU can be generated for events:

- ASDU 1 : time-tagged message
- ASDU 2 : time-tagged message with relative time

The following list of processed events is the list with the private messages option active, where FUNCTION NUMBERS (FUN) 160 and 161 are used for Public range, respectively for current and voltage protections data, and FUNCTION NUMBERS (FUN) 168 and 169 are used for Private range, respectively for current and voltage protections data. The corresponding event numbers with private messages option inactive are given just below.
3.2.2 Status Indications

Status indications (monitor direction) :

- Autorecloser active:
- LEDS reset:
- Local parameter Setting active:
- $\quad$ Setting group number 1 active:
- $\quad$ Setting group number 2 active:
- Auxiliary input 1 :
- Auxiliary input 2 :
- Auxiliary input 3 :
- Auxiliary input 4:
- Logical input 1:
with private option inactive:
- Logical input 2 :
with private option inactive:

FUN<160>; INF <16>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <19>; TYP <1>; COT<1>,*
FUN<160>; INF <22>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <23>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <24>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <27>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <28>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <29>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <30>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <160>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN <160>;INF <161>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <161>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <162>; TYP <1>; COT<1> $\uparrow \downarrow$

- Logical input 3:
with private option inactive:
- Logical input 4:
with private option inactive:
- Logical input 5 :
with private option inactive:
Logical input 6:
with private option inactive:
- Logical input 7:
with private option inactive:
- Logical output 1:
with private option inactive:
- Logical output 2:
with private option inactive:
- Logical output 3 :
with private option inactive:
- Logical output 4:
with private option inactive:
- Watch Dog:
with private option inactive:
- Logical output 5:
with private option inactive:
- Logical output 6:
with private option inactive:
Logical output 7:
with private option inactive:
- Logical output 8:
with private option inactive:
Fault Indications (monitor direction):
- Trip Circuit Supervision :

Start Indications (monitor direction) :

- Start l>:
with private option inactive:
- $\quad$ Start l>>:
with private option inactive:
- $\quad$ Start l>>>:

|  |  |
| :---: | :---: |
| $\begin{aligned} & \text { FUN <160>;INF <163>; TYP <1>; COT<1> } \downarrow \downarrow \\ & \text { FUN<168>;INF <163>; TYP <1>; COT<1> } \uparrow \downarrow \end{aligned}$ |  |
|  |  |
| FUN<160>; INF <164>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<168>; INF <164>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<160>; INF <165>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<168>;INF <165>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| N |  |
| FUN<168>; INF <166>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<160>;INF <167>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<168>;INF <176>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<160>;INF <176>; TYP <1>; COT<1> $\downarrow \downarrow$ |  |
| 168 |  |
| FUN<160>; INF <177>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| N<168>; INF <178>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<160>;INF <178>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| $\uparrow \downarrow$ |  |
| FUN<160>;INF <179>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<168>;INF <180>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<160>; INF <180>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<168>; INF <181>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<160>; INF <181>; TYP <1>; COT<1> $\downarrow \downarrow$ |  |
| FUN<168>;INF <182>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<160>;INF <182>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<168>;INF <183>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<160>;INF <183>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
| FUN<168>; INF <184>; TYP <1>; COT<1> $\uparrow \downarrow$ |  |
|  |  |

FUN<160>;INF <36>; TYP <1>; COT<1> $\uparrow \downarrow$

FUN<168>;INF <9>; TYP <2>; COT<1> $\downarrow \downarrow$
FUN<160>;INF <64>; TYP <2>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <10>; TYP <2>; COT<1> $\downarrow$
FUN<160>;INF <65>; TYP <2>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <11>; TYP <2>; COT<1> $\uparrow \downarrow$

with private option inactive:

- $\quad$ Start IN>:
with private option inactive:
- $\quad$ Start IN>>:
with private option inactive:
with private option inactive:
- $\quad$ Start / pick-up N :
- $\quad$ Start $\mathrm{l}<$ :
with private option inactive:
with private option inactive:
with private option inactive:
with private option inactive:
- General Start / pick-up :
- $\quad$ Start UN>>>>:
with private option inactive:
with private option inactive:
with private option inactive:
Start Therm:
with private option inactive:

Indications (monitor direction):

- General Trip:
- Trip L1:
- $\quad$ Trip L2:
- Trip L3:
- Trip l>:
- Trip l>>:
- Trip l>>>:
with private option inactive:
with private option inactive:

FUN<160>;INF <66>; TYP <2>; COT<1> $\downarrow \downarrow$ FUN < 168>; INF <12>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<160>;INF <96>; TYP <2>; COT<1> $\downarrow \downarrow$ FUN<168>; INF <13>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<160>; INF <97>; TYP <2>; COT<1> $\downarrow \downarrow$ FUN<168>;INF <14>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<160>;INF <98>; TYP <2>; COT<1> $\downarrow$ FUN < 160>; INF <67>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<168>; INF <73>; TYP <2>; COT<1> $\downarrow \downarrow$ FUN<160>;INF <100>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<168>; INF <57>; TYP <2>; COT<1> $\downarrow \downarrow$ FUN<160>;INF <104>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<168>;INF <74>; TYP <2>; COT<1> $\downarrow \downarrow$ FUN<160>;INF <106>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<168>; INF <76>; TYP <2>; COT<1> $\downarrow \downarrow$ FUN<160>;INF <108>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<160>;INF <84>; TYP <2>; COT<1> $\downarrow \downarrow$ FUN<169>; INF <14>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<161>;INF <97>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<169>; INF <84>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN < 161>; INF <78>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<169>;INF <85>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<161>;INF <80>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<168>;INF <15>; TYP <2>; COT<1> $\downarrow$ FUN<160>;INF <110>; TYP <2>; COT<1> $\uparrow \downarrow$

FUN<160>;INF <68>; TYP <2>; COT<1>,* FUN<160>;INF <69>; TYP <2>; COT<1>,* FUN<160>;INF <70>; TYP <2>; COT<1>,* FUN<160>;INF <71>; TYP <2>; COT<1>,* FUN<160>;INF <90>; TYP <2>; COT<1>,* FUN<160>;INF <91>; TYP <2>; COT<1>,* FUN<168>;INF <19>; TYP <2>; COT<1>,* FUN<160>;INF <94>; TYP <2>; COT<1>,* FUN<168>;INF <23>; TYP <2>; COT<1>,* FUN<160>;INF <101>; TYP <2>; COT<1>,*

- Trip IN>:
- Trip IN>>:
- Trip IN>>> :
with private option inactive:
Trip I2>:
with private option inactive:
Trip 12>>:
with private option inactive:
- Trip l2>>>
with private option inactive:
- Trip UN>>>>:
with private option inactive:
- Trip PN>:
with private option inactive:
- Trip PN>:
with private option inactive:
- Trip Therm:
with private option inactive:
- Breaker failure trip:
- Broken conductor trip:
with private option inactive:
- Local Mode (input):
- Manual Close (input):
- SOTF trip:
- AND Logic Equate A trip:
with private option inactive:
- $\quad$ AND Logic Equate B trip:
with private option inactive:
- $\quad$ AND Logic Equate C trip:
with private option inactive:
- $\quad$ AND Logic Equate D trip:
with private option inactive:

FUN<160>;INF <92>; TYP <2>; COT<1>,* FUN<160>;INF <93>; TYP <2>; COT<1>,* FUN<168>;INF <22>; TYP <2>; COT<1>,* FUN<160>;INF <95>; TYP <2>; COT<1>,* FUN<168>;INF <58>; TYP <2>;COT<1>,* FUN<160>;INF <105>; TYP <2>; COT<1>,* FUN<168>;INF <75>; TYP <2>; COT<1>,* FUN<160>;INF <107>; TYP <2>; COT<1>,* FUN<168>;INF <77>; TYP <2>; COT<1>,* FUN<160>;INF <109>; TYP <2>; COT<1>,* FUN<169>;INF <22>; TYP <2>; COT<1>,* FUN<161>;INF <95>; TYP <2>; COT<1>,* FUN<169>;INF <86>; TYP <2>; COT<1>,* FUN<161>;INF <79>; TYP <2>; COT<1>,* FUN<169>;INF <87>; TYP <2>; COT<1>,* FUN<161>;INF <81>; TYP <2>; COT<1>,* FUN<168>;INF <16>; TYP <2>; COT<1>,* FUN<160>;INF <111>; TYP <2>; COT<1>,* FUN<160>;INF <85>; TYP <2>; COT<1>,* FUN<168>;INF <39>; TYP <2>; COT<1>,* FUN<160>;INF <114>; TYP <2>; COT<1>,* FUN<168>;INF <40>; TYP <2>; COT<1>,* FUN<168>;INF <238>; TYP <2>; COT<1>,* FUN<168>;INF <239>; TYP <2>; COT<1>,* FUN<168>;INF <144>; TYP <2>; COT<1>,* FUN<161>;INF <86>; TYP <2>; COT<1>,* FUN<168>;INF <145>; TYP <2>; COT<1>,* FUN<161>;INF <87>; TYP <2>; COT<1>,* FUN<168>;INF <146>; TYP <2>; COT<1>,* FUN<161>;INF <88>; TYP <2>; COT<1>,* FUN<168>;INF <147>; TYP <2>; COT<1>,* FUN<161>;INF <89>; TYP <2>; COT<1>,*

- Circuit Breaker 'ON' by short-time autorecloser:

FUN<160>;INF <128>; TYP <1>; COT<1>,*

- Circuit Breaker 'ON’ by long-time autorecloser:
- FUN<160>;INF <129>; TYP <1>; COT<1>,*
- Autorecloser blocked:
- $\quad \mathrm{CB}$ in $\mathrm{O} / \mathrm{O}$ (« closed ») position: with private option inactive:
- $\quad \mathrm{CB}$ in $\mathrm{F} / \mathrm{O}$ (« open ») position: with private option inactive:
- Trip TC:
with private option inactive:
- Close TC:
with private option inactive:

$$
\begin{aligned}
& \text { FUN<160>;INF <129>; TYP <1>; COT<1>,* } \\
& \text { FUN<160>;INF <130>; TYP <1>; COT<1> } \uparrow \downarrow \\
& \text { FUN<168>;INF <33>; TYP <1>; COT<1> } \uparrow \downarrow \\
& \text { FUN<160>;INF <140>; TYP <1>; COT<1> } \uparrow \downarrow \\
& \text { FUN<168>;INF <34>; TYP <1>; COT<1> } \uparrow \downarrow \\
& \text { FUN<160>;INF <141>; TYP <1>; COT<1> } \downarrow \downarrow \\
& \text { FUN<168>;INF <1>; TYP <1>; COT<1> } \uparrow \downarrow \\
& \text { FUN<160>;INF <142>; TYP <1>; COT<1> } \downarrow \downarrow \\
& \text { FUN<168>;INF <2>; TYP <1>; COT<1> } \downarrow \downarrow \\
& \text { FUN<160>;INF <143>; TYP <1>; COT<1> } \downarrow \downarrow
\end{aligned}
$$

### 3.3 System state

It is given in the answer to the General Interrogation (GI).
Relay state information is Class 1 data, they are systematically sent to the master station, during a General Interrogation.

The list of processed data, following a General Interrogation, is given below; it is a subassembly of the spontaneous messages list, so like spontaneous messages, these data are generated on rising and falling edge.

Status indications (monitor direction) :

- Autorecloser active:
- Local parameter Setting active:
- $\quad$ Setting group number 1 active:
- $\quad$ Setting group number 2 active:
- Auxiliary input 1 :
- Auxiliary input 2 :
- Auxiliary input 3:
- Auxiliary input 4:
- Logical input 1:
with private option inactive:
- Logical input 2:
with private option inactive:
- Logical input 3:
with private option inactive:
- Logical input 4:
with private option inactive:
- Logical input 5:
with private option inactive:

FUN<160>;INF <16>; TYP <1>; COT<9>
FUN<160>;INF <22>; TYP <1>; COT<9>
FUN<160>;INF <23>; TYP <1>; COT<9>
FUN<160>;INF <24>; TYP <1>; COT<9>
FUN<160>;INF <27>; TYP <1>; COT<9>
FUN<160>;INF <28>; TYP <1>; COT<9>
FUN<160>;INF <29>; TYP <1>; COT<9>
FUN<160>;INF <30>; TYP <1>; COT<9>
FUN<168>;INF <160>; TYP <1>; COT<9>
FUN<160>;INF <161>; TYP <1>; COT<9>
FUN<168>;INF <161>; TYP <1>; COT<9>
FUN<160>; INF <162>; TYP <1>; COT<9>
FUN<168>;INF <162>; TYP <1>; COT<9>
FUN<160>;INF <163>; TYP <1>; COT<9>
FUN<168>;INF <163>; TYP <1>; COT<9>
FUN<160>;INF <164>; TYP <1>; COT<9>
FUN<168>;INF <164>; TYP <1>; COT<9>
FUN<160>;INF <165>; TYP <1>; COT<9>

- Logical input 6: with private option inactive:
- Logical input 7: with private option inactive:
- Logical output 1: with private option inactive:
- Logical output 2:
with private option inactive:
- Logical output 3:
with private option inactive:
- Logical output 4:
with private option inactive:
- Watch Dog output:
with private option inactive:
- Logical output 5:
with private option inactive:
- Logical output 6:
with private option inactive:
- Logical output 7:
with private option inactive:
- Logical output 8:
with private option inactive:
Supervision Indications (monitor direction):
- Trip Circuit Supervision :

Fault Indications (monitor direction):

- Start / pick-up N:
- General Start / pick-up:

Auto-recloser Indications (monitor direction):

- Autorecloser blocked:
- $\quad \mathrm{CB}$ in $\mathrm{O} / \mathrm{O}$ (《 closed ») position:
with private option inactive:
- $\quad$ CB in F/O (« open ») position:
with private option inactive:

FUN<168>;INF <165>; TYP <1>; COT<9> FUN<160>; INF <166>; TYP <1>; COT<9> FUN<168>;INF <166>; TYP <1>; COT<9> FUN<160>;INF <167>; TYP <1>; COT<9> FUN<168>;INF <176>; TYP <1>; COT<9> FUN<160>;INF <176>; TYP <1>; COT<9> FUN<168>;INF <177>; TYP <1>; COT<9> FUN<160>;INF <177>; TYP <1>; COT<9> FUN<168>;INF <178>; TYP <1>; COT<9> FUN<160>;INF <178>; TYP <1>; COT<9> FUN<168>;INF <179>; TYP <1>; COT<9> FUN<160>;INF <179>; TYP <1>; COT<9> FUN<168>;INF <180>; TYP <1>; COT<9> FUN<160>;INF <180>; TYP <1>; COT<9> FUN<168>;INF <181>; TYP <1>; COT<9> FUN<160>;INF <181>; TYP <1>; COT<9> FUN<168>;INF <182>; TYP <1>; COT<9> FUN<160>;INF <182>; TYP <1>; COT<9> FUN<168>;INF <183>; TYP <1>; COT<9> FUN<160>;INF <183>; TYP <1>; COT<9> FUN<168>;INF <184>; TYP <1>; COT<9> FUN<160>;INF <184>; TYP <1>; COT<9>

FUN<160>;INF <36>; TYP <1>; COT<9>

FUN<160>;INF <67>; TYP <2>; COT<9>
FUN<160>;INF <84>; TYP <2>; COT<9>

FUN<160>;INF <130>; TYP <1>; COT<9> FUN<168>;INF <33>; TYP <1>; COT<9> FUN<160>;INF <140>; TYP <1>; COT<9> FUN<168>;INF <34>; TYP <1>; COT<9> FUN<160>;INF <141>; TYP <1>; COT<9>

### 3.4 Processed commands

### 3.4.1 System commands

## Synchronisation Command: ASDU 6

> FUN<255>;INF <0>; TYP <6>; COT<8>

This command can be sent to a specific relay, or global.
The time sent by master is the time of the first bit of the frame. The relay synchronises with this time, corrected by the frame transmission delay. After updating its time, the relay sends back acknowledgement info to the master, by giving its new current time. This acknowledgement message will be an event of ASDU 6 type.

General Interrogation Initialisation command: ASDU 7
FUN<255>;INF <0>; TYP <7>; COT<9>

This command starts the relay interrogation.
The relay then sends a list of data containing the relay state (see the list described above). The GI command contains a scan number which will be included in the answers of the GI cycle generated by the GI command.

If a data has just changed before extracted by the GI, the new state is sent to the master station.

When an event is generated during the Gl cycle, the event is sent in priority, and the Gl cycle is temporarily interrupted. The end of a Gl consists in sending an ASDU 8 to the master station.

If, during a General Interrogation cycle, another GI Initialisation command is received, the previous answer is stopped, and the new GI cycle is started.

### 3.4.2 General commands

Control direction: ASDU 20

- Auto-recloser On / Off: FUN<160>;INF<16>; TYP<20>; COT<20>
- LEDS Reset : this command acknowledges all alarms on Front Panel:
- $\quad$ Setting group number 1 :

$$
\begin{aligned}
& \text { FUN<160>;INF<19>; TYP<20>; COT<20> } \\
& \text { FUN<160>;INF<23>; TYP<20>; COT<20> } \\
& \text { FUN<160>;INF<24>; TYP<20>; COT<20> } \\
& \text { FUN<168>;INF<1>; TYP<20>; COT<20> } \\
& \text { FUN<160>;INF <142>; TYP <20>; COT<20> } \\
& \text { FUN<168>;INF<2>; TYP<20>; COT<20> } \\
& \text { FUN<160>;INF <143>; TYP <20>; COT<20> }
\end{aligned}
$$

- $\quad$ Setting group number 2 :
- Trip TC:
with private option inactive:
- Close TC:
with private option inactive:

After executing one of these commands, the relay sends an acknowledgement message, which contains the result of command execution.

If a state change is the consequence of the command, it must be sent in a ASDU 1 with COT 12 (remote operation).

If the relay receives another command message from the master station before sending the acknowledgement message, it will be discarded.

Commands which are not processed by the relay are rejected with a negative acknowledgement message.

### 3.5 Relay reinitialisation

In case of relay reinitialisation, the relay sends to the master station the following messages , ASDU 5:

- relay's power on $\quad$ FUN<160>; INF <5>; TYP <5> ; COT <5>

In case of Communication reinitialisation, the relay sends to the master station the following messages, ASDU 5:

- Reset CU FUN<160>; INF <5>; TYP <3> ; COT <4>

In case of Communication reinitialisation by Reset FCB, the relay sends to the master station the following messages, ASDU 5:

- Reset FCB FUN<160>; INF <5>; TYP <2> ; COT <3>

Each ASDU 5 message (identification of the relay) contains the manufacturer's name in 8 ASCII characters and 4 ASCII characters containing the relay model ("P126») .

### 3.6 Cyclic Messages

Only measurands can be stored in these messages.
Measurands values are stored in lower levels of communication, before polling by master station.

In ASDU $9 \quad$ FUN<160>;INF <148>; TYP <9>; COT<2>
the following values are stored (with a rate such as: 2,4 * nominal value $=4096$ ) :

- RMS la,
- RMS lb,
- RMS Ic,
- Frequency (If frequency is out of bounds, the value is set to « unvalid».

In ASDU 3
FUN<160>;INF <147>; TYP <3>; COT<2>
the following values are stored (with a rate such as: 2,4 * nominal value $=4096$ ) :

- RMS IN,
- RMS Un.

In ASDU 77 which is a private ASDU, $\quad$ FUN<168>; INF <209>; TYP <77>; COT<2> the following values are stored (in IEEE 32 bits floating-point format):

- I1,
- I2,
- $\quad$ Thermal state (in \%).

These values are not rated.
with private option inactive:
FUN<160>,INF <149>; TYP <77>; COT<2>

### 3.7 Disturbance record extraction

The disturbance extraction procedure with IEC870-5-103 in MiCOM Px2x relays is in conformance with IEC870-5-103 standard definition.
The maximum disturbance record number stored in a P126/P127 is 5.
The disturbance record mapping for P126 is the following:
Number of analog channels transmitted: 6, which are:
$0 \quad$ Channel 1: la current (Phase L1).
1 Channel 2: lb current (Phase L2).
2 Channel 3: Ic current (Phase L3).
3 Channel 4: IN current (Earth).
4 Channel 5: Uc/U0 voltage.
$5 \quad$ Channel 6: Frequency.
Identifiers of tags (16) transmitted in ASDU 29 (logical informations) for P126:
$0 \quad$ Tag number 1: General start:
1 Tag number 2: General Trip:
2 Tag number 3: CB Failure:
3 Tag number 4: tl>:
4 Tag number 5: tl>>:
5 Tag number 6: tIN> (Earth):
6 Tag number 7: tIN>> (Earth):
7 Tag number 8: PN>: with private option inactive:

8 Tag number 9: PN>>: with private option inactive:

9 Tag number 10: Log input 1: with private option inactive:

15 Tag number 16: Log input 7: with private option inactive:

FUN <160> INF <84>
FUN <160> INF <68>
FUN <160> INF <85>
FUN <160> INF <90>
FUN <160> INF <91>
FUN <160> INF <92>
FUN <160> INF <93>
FUN <168> INF <86>
FUN <160>,INF <79>
FUN <168> INF <87>
FUN <160>,INF <81>
FUN < 168> INF < 160>
FUN < 160>,INF < 161>
FUN < 168> INF < 161>
FUN < 160>,INF <162>
FUN <168> INF <162>
FUN < 160>,INF < 163>
FUN < 168> INF <163>
FUN < 160>,INF <164>
FUN < 168> INF < 164>
FUN < 160>,INF <165>
FUN < 168> INF <165>
FUN < 160>,INF < 166>
FUN < 168> INF < 166>
FUN < 160>, INF < 167>

# MODBUS DATABASE IEC 60870-5-103 

## CONTENTS

1. INTRODUCTION ..... 3
1.1 Purpose of this document ..... 3
1.2 Glossary ..... 3
2. MODBUS PROTOCOL ..... 4
2.1 MODBUS connection technical characteristics ..... 4
2.1.1 MODBUS connection parameters ..... 4
2.1.2 Exchanges messages synchronisation ..... 4
2.1.3 Message validity check ..... 4
2.1.4 Address ..... 4
2.2 MODBUS functions available in the protection device ..... 5
2.3 Description of the ModBus protocol ..... 5
2.3.1 Frame size received from the protection device (slave) ..... 5
2.3.2 Format of frames sent from the relay ..... 6
2.3.3 Messages validity check ..... 6
2.4 Database organisation ..... 7
2.4.1 Description of the application mapping ..... 7
2.4.2 Mapping format description ..... 44
2.4.3 Disturbance record additional information ..... 59
2.4.4 Request to retrieve the oldest non-acknowledge event ..... 60
2.4.5 Request to retrieve a dedicated event ..... 60
2.4.6 Modbus request definition used to retrieve the fault records ..... 60
3. IEC 60870-5-103 PROTOCOL ..... 62
3.1 General information ..... 62
3.2 Spontaneous messages ..... 62
3.2.1 Time Tagged Message ..... 62
3.2.2 Status Indications ..... 62
$3.3 \quad$ System state ..... 67
3.4 Processed commands ..... 69
3.4.1 System commands ..... 69
3.4.2 General commands ..... 69
3.5 Relay reinitialisation ..... 70
3.6 Cyclic Messages ..... 70
3.7 Disturbance record extraction ..... 71

## BLANK PAGE

## 1. INTRODUCTION

### 1.1 Purpose of this document

This document describes the characteristics of the different communication protocols of MiCOM P127 relay.

The available communication protocols on the relay are listed below:

- MODBUS
- IEC 60870-5-103
- K-BUS/COURIER (not available)
- DNP3 (not available)


### 1.2 Glossary

le : earth fault current measured
Ue $\quad$ : residual voltage measured directly by the input terminals on rear panel
$\mathrm{Pe} \quad$ : earth fault power (Calculated)
leCosPhi : active component of the earth fault current
MWh+ : positive active energy
MWh- : negative active energy
MVARh+ : positive re-active energy
MVARh- : negative re-active energy
pf : soft weight of a 16 bits word
PF : heavy weight of a 16 bits word
Dec : decimal representation value
Hex : hexadecimal representation value
DNP3.0 \& COURIER are not available yet (in grey colour)
2. MODBUS PROTOCOL

MiCOM P127 relay can communicate by a RS 485 link. The terminals are placed on the rear panel (terminals 31 and 32). See the GS document for further information on the wiring. The applied ModBus protocol is compliance with the MODBUS RTU.
2.1 MODBUS connection technical characteristics
2.1.1 MODBUS connection parameters

The different parameters of the MODBUS connection are listed below :

- Isolated two-point RS485 connection ( 2 kV 50 Hz ),
- MODBUS line protocol in RTU mode

Communication speed can be configured by an operator dialog in the front panel of the relay:

| Baud rate |
| :--- |
| 300 |
| 600 |
| 1200 |
| 2400 |
| 4800 |
| 9600 |
| 19200 |
| 38400 |

Transmission mode of the configured characters by operator dialog:

| Mode |
| :--- |
| 1 start / 8 bits / 1 stop : total 10 bits |
| 1 start / 8 bits / even parity / 1 stop : total 11 bits |
| 1 start / 8 bits / odd parity / 1 stop : total 11 bits |
| 1 start / 8 bits / 2 stop : total 11 bits |
| 1 start / 7 bits / 2 stop : total 10 bits |
| 1 start / 7 bits / 1 stop : total 9 bits |
| 1 start / 7 bits / even parity / 1 stop : total 10 bits |
| 1 start / 7 bits / odd parity / 1 stop : total 10 bits |

2.1.2 Exchanges messages synchronisation

Any character received after a silence on the line of more than or equal to a transmission time of 3 bytes is considered as a frame start.
2.1.3 Message validity check

The validation of a frame is performed with a 16-bit cyclical redundancy check (CRC).
The generator polynomial is:
$1+x^{2}+x^{15}+x^{16}=1010000000000001$ binary $=A 001 \mathrm{~h}$

### 2.1.4 Address

In order to integrate a protection device into a control and monitoring system, the address must be set from the local control panel. The address may be selected from the range of 1 to 255. The address 0 is reserved for broadcast messages.

### 2.2 MODBUS functions available in the protection device

Protection device data may be read or modified by using function codes. Following are the available function codes. Function codes to read from or write into parameter cells in the protection device are described in the listed following table.

| Function Nr. | Data Read | Data Write | Data Format \& Type |
| :---: | :---: | :---: | :---: |
| 1 | X |  | $N$ bits |
| 2 | X |  | $N$ bits |
| 3 | X |  | N words |
| 4 | X |  | N words |
| 5 |  | X | 1 bit |
| 6 |  | X | 1 word |
| 7 | Fast |  | 8 bits |
| 8 | X |  | Diagnostics counter |
| 11 | X |  | Event counter |
| 15 |  | X | $N$ bits |
| 16 |  | X | N words |

### 2.3 Description of the ModBus protocol

MODBUS is a master-slave protocol where every exchange involves a master device request for data and a slave devices response with data.
2.3.1 Frame size received from the protection device (slave)

Frame transmitted from the master (query):

| Slave number | Function code | Information | CRC16 |
| :--- | :--- | :--- | :--- |
| 1 byte | 1 byte | $n$ bytes | 2 bytes |
| 0 à FFh | 1 à 10h |  |  |

Slave address:
The slave address is in the range from 1 to 255 . A transmitted frame with a slave address equal to 0 is a globally addressed to all installed equipment (broadcast frame)

## Function code:

The function code returned from the slave in the exception response frame is the code in which the most significant bit (bit 7) is forced to 1.

## Error code:

Among the 8 exception codes of the MODBUS protocol, the protection device manages two:

- Code 01: Function code unauthorised or unknown.
- $\quad$ Code 03: A value from the data field is unauthorised (incorrect code).
- Control of data being read.
- Control of data being written.
- Control of data address.
- Length of request for data message.


## CRC16:

The slave calculates the CRC16 value.
NOTE: The slave device does not respond to globally broadcast frames sent out from the master.
2.3.2 Format of frames sent from the relay

Frame sent (response)

| Slave number | Function code | Data | CRC16 |
| :--- | :--- | :--- | :--- |
| 1 byte | 1 byte | $n$ bytes | 2 bytes |
| 1 à FFh | 1 à 10h |  |  |

## Slave address:

The slave address is in the range from 1 to 255 .
Function code:
Processed MODBUS function (1 to 16).
Data:
Contains reply data to master query.
CRC 16:
CRC16 value calculated by the slave.
2.3.3 Messages validity check

When MiCOM P127 relay ( slave) receives a master query, it validates the frame:

- If the CRC is incorrect, the frame is discarded as invalid. The slave does not reply to the request for data. The master must retransmit its request for data. With the exception of a broadcast message, this is the only case where the slave does not reply to a request for data from the master.
- If the CRC is correct but the slave can not process the request for data, it sends an exception response to the master.

Warning frame sent (response)

| Slave number | Function code | Warning code | CRC16 |
| :--- | :--- | :--- | :--- |
| 1 byte | 1 byte | 1 byte | 2 bytes |
| 1 to FFh | 81 h or 83 h or 8 Ah or 8 Bh |  | pf $\ldots$ PF |

## Slave number:

The address range of the slave device is between 1 and 255 .

## Function code:

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

Warning code :
On the 8 warning codes of the MODBUS protocol, the relay manages two of them:

- code 01: function code unauthorised or unknown.
- code 03: a value in the data field is unauthorised (incorrect data).
- Control of pages being read
- Control of pages being written
- Control of addresses in pages
- Length of request messages

CRC16:
Value of the CRC16 calculated by the slave.

### 2.4 Database organisation

2.4.1 Description of the application mapping

### 2.4.1.1 Settings

Parameters are organised in pages.
MiCOM P127 application mapping has 7 pages of parameters..
The characteristics are the following:

| Page | Data type | Read <br> permission | Write <br> permission |
| :--- | :--- | :--- | :--- |
| Oh | Product information, remote signalling, <br> measurements | Through <br> communication |  |
| 1h | General remote parameters | X | X |
| 2 h | Setting group 1 remote parameters | X | X |
| 3 h | Setting group 2 remote parameters | X | X |
| 4 h | Remote controls |  | X |
| 7 h | P127 Relay status | Fast |  |
| 8 h | Data and time | X | X |

They are completely listed below.

### 2.4.1.2 Page OH

Informations of instantaneous and temporised mémorised $|>,|\gg,| \ggg$ and l < have different address Modbus from release V3/V4/V5 to V6. But the old address Modbus V5 aren't used. This address are 001Bh to 001Fh and 0024h that all are integrated in one address 002Bh.

| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0000 | Product <br> Information | Relay description <br> characters 1 and 2 | $32 . .127$ | 1 | - | F10 |  |
| 0001 |  | Relay description <br> characters 3 and 4 | $32 . .127$ | 1 | - | F10 | P1 |
| 0002 |  | Relay description <br> characters 5 and 6 | $32 \ldots .127$ | 1 | - | F10 | 20 |
| 0003 |  | Unit reference characters 1 <br> and 2 | $32 \ldots .127$ | 1 | - | F10 | AL |
| 0004 |  | Unit reference characters 3 <br> and 4 | $32 \ldots .127$ | 1 | - | F10 | ST |
| 0005 |  | Software version | $10 \ldots$. xx | 1 | - | F21 |  |
| 0006 |  | Front \& rear port available <br> communication protocols | $0-3$ |  |  | F41 |  |
| 0007 |  | Internal ratio phase current |  |  |  |  |  |


| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0019 |  | Information of the threshold <br> status le>>> |  |  | - | F16 |  |
| 001A-001F |  | Reserved ${ }^{\text {R }}$ |  |  |  |  |  |

${ }^{1}$ Informations of instantaneous and temporised memorised $\mathrm{l}>$, $|\gg,| \ggg$ and $\mathrm{I}<$ have different address Modbus from release V3/V4/V5 to V6. This old address Modbus V5 aren't used (001Bh to 001Fh and 0024h) and all are integrated in the new one address 002Bh (see format description F36C).
${ }^{2}$ Informations of instantaneous and temporised memorised $\mathrm{l} \mid$, $1 \gg, \mid \ggg$ and I < have different address Modbus from release V3/V4/V5 to V6. This old address Modbus V5 aren't used (001Bh to 001Fh and 0024h) and all are integrated in the new one address 002Bh (see format description F36C).

| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 003E |  | Frequency | 4500-6500 | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{~Hz} \end{aligned}$ | F1 |  |
| 003F-0040 |  | Phase A RMS max current |  | 1 | A/100 | F18 |  |
| 0041-0042 |  | Phase B RMS max current |  | 1 | A/100 | F18 |  |
| 0043-0044 |  | Phase C RMS max current |  | 1 | A/100 | F18 |  |
| 0045-0046 |  | Phase A RMS average current |  | 1 | A/100 | F18 |  |
| 0047-0048 |  | Phase B RMS average current |  | 1 | A/100 | F18 |  |
| 0049-004A |  | Phase C RMS average current |  | 1 | A/100 | F18 |  |
| $\begin{aligned} & \text { 004B- } \\ & 004 \mathrm{C} \end{aligned}$ |  | le harmonic |  | 1 | A/100 | F18 |  |
| 004D |  | Reserved |  |  |  |  |  |
| 004E |  | Module V1 |  |  | - | F1 |  |
| 004F |  | Module V2 |  |  | - | F1 |  |
| 0050 |  | Module IA |  |  | - | F1 |  |
| 0051 |  | Module IB |  |  | - | F1 |  |
| 0052 |  | Module IC |  |  | - | F1 |  |
| 0053 |  | Module le |  |  | - | F1 |  |
| 0054 |  | Argument IA |  |  | - | F1 |  |
| 0055 |  | Argument IB |  |  | - | F1 |  |
| 0056 |  | Argument IC |  |  | - | F1 |  |
| 0057 |  | Argument le |  |  | - | F1 |  |
| 0058 |  | Inverse current module I2 |  |  | - | F1 |  |
| 0059 |  | Direct current module 11 |  |  | - | F1 |  |
| 005A | Recloser 79 | Nr. of total cycles |  |  |  | F1 |  |
| 005B |  | Nr. of cycles 1 |  |  |  | F1 |  |
| 005C |  | Nr. of cycles 2 |  |  |  | F1 |  |
| 005D |  | Nr. of cycles 3 |  |  |  | F1 |  |
| 005E |  | Nr. of cycles 4 |  |  |  | F1 |  |
| 005F |  | Nr. of definitive trips |  |  |  | F1 |  |
| 0060 |  | Nr. of tripping orders |  |  |  | F1 |  |
| 0061-0062 | Energy measures | Positive active energy | $\begin{aligned} & \text { from } 1 \text { to } \\ & 4.294 \times 10^{9} \end{aligned}$ | 1 | $\begin{aligned} & 1000 \\ & \text { Wh } \end{aligned}$ | F18A |  |
| 0063-0064 |  | Negative active energy | $\begin{aligned} & \text { from } 1 \text { to } \\ & 4.294 \times 10^{9} \end{aligned}$ | 1 | $\begin{aligned} & 1000 \\ & \text { Wh } \end{aligned}$ | F18A |  |
| 0065-0066 |  | Positive reactive energy | $\begin{aligned} & \text { from } 1 \text { to } \\ & 4.294 \times 10^{9} \end{aligned}$ | 1 | 1000 <br> WARh | F18A |  |
| 0067-0068 |  | Negative reactive energy | $\begin{aligned} & \text { from } 1 \text { to } \\ & 4.294 \times 10^{9} \end{aligned}$ | 1 | 1000 WARh | F18A |  |
| 0069-006A |  | Rolling demand max RMS IA value |  | 1 | A/100 | F18 |  |
| $\begin{aligned} & \text { 006B- } \\ & 006 \mathrm{C} \end{aligned}$ |  | Rolling demand max RMS IB value |  | 1 | A/100 | F18 |  |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { 006D- } \\ & \text { 006E } \end{aligned}$ |  | Rolling demand max RMS IC value |  | 1 | A/100 | F18 |  |
| 006F |  | Reserved |  |  |  |  |  |
| 0070 | Protection 27 | Information of the threshold status U< |  |  |  | F17 |  |
| 0071 |  | Information of the threshold status U<< |  |  |  | F17 |  |
| 0072 | Protection 32n | Information of the threshold status $\mathrm{Pe} / \mathrm{leCos}>$ |  |  |  | F16 |  |
| 0073 |  | Information of the threshold status $\mathrm{Pe} / \mathrm{leCos} \gg$ |  |  |  | F16 |  |
| 0074 |  | Reserved |  |  |  |  |  |
| 0075 |  | Angle between le^Ue |  |  |  | F1 |  |
| 0076 | Protection 59 | Information of the threshold status U> |  |  |  | F17 |  |
| 0077 |  | Information of the threshold status U>> |  |  |  | F17 |  |
| 0078-0079 |  | Reserved |  |  |  |  |  |
| 007A | Protection 59n | Information of the threshold status Ue>>>> |  |  |  | F16 |  |
| 007B |  | Reserved |  |  |  |  |  |
| 007C | Protection 46 | Information of the threshold status I2> |  |  | - | F17 |  |
| 007D |  | Information of the threshold status I2>> |  |  | - | F17 |  |
| 007E |  | Information of the threshold status I2>>> |  |  | - | F17 |  |
| 007F | AND equations | Logic AND equations information status |  |  |  | F48 |  |
| 0080-0081 | Voltage measurement | Phase A RMS voltage |  | 1 | V/100 | F18A |  |
| 0082-0083 |  | Phase B RMS voltage |  | 1 | V/100 | F18A |  |
| 0084-0085 |  | Phase C RMS voltage |  | 1 | V/100 | F18A |  |
| 0086-0087 |  | Earth RMS voltage |  | 1 | V/100 | F18A |  |
| 0088 |  | Module UAB |  |  |  | F1 |  |
| 0089 |  | Module UBC |  |  |  | F1 |  |
| 008A |  | Module UCA |  |  |  | F1 |  |
| 008B |  | Module Ue |  |  |  | F1 |  |
| 008C |  | Argument UAB |  |  |  | F1 |  |
| 008D |  | Argument UBC |  |  |  | F1 |  |
| 008E |  | Argument UCA |  |  |  | F1 |  |
| 008F |  | Argument Ue |  |  |  | F1 |  |
| 0090-0091 |  | Max phase A RMS voltage |  | 1 | V/100 | F18 |  |
| 0092-0093 |  | Max phase B RMS voltage |  | 1 | V/100 | F18 |  |
| 0094-0095 |  | Max phase C RMS voltage |  | 1 | V/100 | F18 |  |
| 0096-0097 |  | Average phase A RMS voltage |  | 1 | V/100 | F18 |  |


| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0098-0099 |  | Average phase B RMS <br> voltage |  | 1 | V/100 | F18 |  |
| 009A- <br> 009B |  | Average phase C RMS <br> voltage |  | 1 | V/100 | F18 |  |
| 009C- <br> 009D | Power <br> measures | Module Pe |  |  | F18A |  |  |
| 009E-009F |  | 3-Phase Active Power | From 1 to <br> 2.147483648 <br> $\times 10^{9}$ | 1 | Watt <br> ${ }^{*} 10$ | F18 |  |
| 00A0- <br> 00A1 | 3-Phase Re-active Power | From 1 to <br> 2.147483648 <br> $\times 10^{9}$ | 1 | VAR <br> $*$ | F18 |  |  |
| 00A2 |  | 3-Phase CosPHI | $-100 \ldots 100$ | 1 | $1 / 100$ | F2 |  |
| 00A3- <br> 00A4 |  | Rolling demand average <br> RMS IA value |  | 1 | A/100 | F18A |  |
| 00A5- <br> 00A6 |  | Rolling demand average <br> RMS IB value |  | 1 | A/100 | F18A |  |
| 00A7- <br> 00A8 |  | Rolling demand average <br> RMS IC value |  | 1 | A/100 | F18A |  |
| 00A9- <br> 00AA | Power <br> measures | Module leCos | F18A |  |  |  |  |

### 2.4.1.3 Page 1H

| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0100 | Remote setting | Address | $1 . . .255$ | 1 |  | F1 | 1 |
| 0101 |  | Reserved |  |  |  |  |  |
| 0102 |  | Password, ASCII digits 1 and 2 | $32 . . .127$ | 1 |  | F10 | AA |
| 0103 |  | Password, ASCII digits 3 and 4 | $32 \ldots .127$ | 1 |  | F10 | AA |
| 0104 |  | Rated frequency | $50 \ldots .60$ | 10 | Hz | F1 | 50 |
| 0105-0108 |  | Reserved |  |  |  |  |  |
| 0109 |  | Default display | $0 \ldots .3$ | 1 |  | F26 | 1 |
| 010A |  | User reference, ASCII digits 1 and 2 | $32 . . .127$ | 1 |  | F10 | AL |
| 010B |  | User reference, ASCII digits 3 and 4 | $32 . . .127$ | 1 |  | F10 | ST |
| 010C |  | Number of the record to be displayed | 1-5 | 1 |  | F31 | 5 |
| 010D |  | Inputs mode configuration (edge or level), part2/2 |  | 1 |  | F54A |  |
| 010E |  | Maintenance Mode | 0-1 | 1 |  | F24 | 0 |
| 010F |  | Digital inputs signal type: $A C-D C$ | 0-1 | 1 |  | F51 | 1 |
| 0110 | CB monitoring measurements | CB operations number |  | 1 |  | F1 |  |
| 0111 |  | CB operating time |  | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 |  |
| 0112-0113 |  | Switched square Amps phase A summation |  |  | An | F18 |  |
| 0114-0115 |  | Switched square Amps phase B summation |  |  | An | F18 |  |
| 0116-0117 |  | Switched square Amps phase C summation |  |  | An | F18 |  |
| 0118 |  | Circuit breaker closing time |  | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 |  |
| 0119 |  | Digital input 1 config. part 2/2 |  | 1 |  | F15A |  |
| 011A |  | Digital input 2 config. part 2/2 |  | 1 |  | F15A |  |
| 011B |  | Digital input 3 config. part 2/2 |  | 1 |  | F15A |  |
| 011C |  | Digital input 4 config. part 2/2 |  | 1 |  | F15A |  |
| 011D |  | Digital input 5 config. part 2/2 |  | 1 |  | F15A |  |
| 011E |  | Digital input 6 config. part 2/2 |  | 1 |  | F15A |  |
| 011F |  | Digital input 7 config. part 2/2 |  | 1 |  | F15A |  |
| 0120 | Ratios CT | Primary phase CT | 1.... 9999 | 1 | A | F1 | 1 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0121 |  | Secondary phase CT | 1 or 5 | - | A | F1 | 1 |
| 0122 |  | Primary earth CT | 1 .... 9999 | 1 | A | F1 | 1 |
| 0123 |  | Secondary earth CT | 1 or 5 | - | A | F1 | 1 |
|  | Ratios VT |  |  |  |  |  |  |
| 0124-0125 | Primary phase VT | $57-130 \mathrm{~V}$ version | 10-100000 | 1 | 10V | F18A | 100V |
|  |  | $220-480 \mathrm{~V}$ version | 220-480 | 1 | 1 V | F18A | 220 V |
| 0126 |  | Secondary phase VT | 570 ... 1300 | 1 | V/10 | F1 | 100V |
| 0127 | Scheme VTs connection | VTs connection mode : $3 \mathrm{Vpn}, 2 \mathrm{Vpp}+\mathrm{Vr}$, 2Vpn+Vr | 0, 2, 4 |  |  | F7 | 0 |
| $\begin{aligned} & 0128- \\ & 0129 \end{aligned}$ | Primary earth VT | $57-130 \mathrm{~V}$ version | $10 . .100000$ | 1 | 10 V | F18A | 100V |
|  |  | $220-480 \mathrm{~V}$ version | 220-480 | 1 | 1V | F18A | 220 V |
| 012A |  | Secondary earth VT | $570 \ldots 1300$ | 1 | V/10 | F1 | 100V |
| 012B |  | Maintenance mode relays command |  |  |  | F13 |  |
| 012C |  | Battery Alarm | 0-1 | 1 | - | F24 | 1 |
| 012D |  | Number of available Instantaneous record to be displayed | 1-5 | 1 |  | F31 | 5 |
| 012E | Communication | Speed (IEC870-5-103) | 0.... 7 | 1 | - | F53 |  |
| 012F |  | Date format | 0-1 | 1 | - | F52 | 0 |
| 0130 |  | UART Baud rate | $0 \ldots .7$ | 1 | - | F4 |  |
| 0131 |  | Parity | $0 . . .2$ | 1 | - | F5 | 0 |
| 0132 |  | Data bits | 0-1 | 1 | - | F28 | 1 |
| 0133 |  | Stop bits | 0-1 | 1 | - | F29 | 0 |
| 0134 |  | COM available info | 0-3 | 1 | - | F30 | 1 |
| 0135 | Configuration group | Parameters configuration group | 1-2 | 1 | - | F55 | 1 |
| 0136 | LEDS configuration | Led 5 |  | 1 | - | F19 | 0 |
| 0137 |  | Led 6 |  | 1 | - | F19 | 0 |
| 0138 |  | Led 7 |  | 1 | - | F19 | 0 |
| 0139 |  | Led 8 |  | 1 |  | F19 | 0 |
| 013A |  | Led PF 5 |  | 1 | - | F19A | 0 |
| 013B |  | Led PF 6 |  | 1 | - | F19A | 0 |
| 013C |  | Led PF 7 |  | 1 | - | F19A | 0 |
| 013D |  | Led PF 8 |  | 1 |  | F19A | 0 |
| 013E |  | Led PF1 5 |  | 1 | - | F19B | 0 |
| 013F |  | Led PF1 6 |  | 1 | - | F19B | 0 |
| 0140 |  | Led PF1 7 |  | 1 | - | F19B | 0 |
| 0141 |  | Led PF1 8 |  | 1 |  | F19B | 0 |
| 0142 | Digital inputs configuration | Inputs mode configuration (edge or level) |  |  |  | F54 |  |
| 0143 |  | Inputs sense configuration (High or Low) | - | 1 | - | F47 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0144 |  | Digital input 6, part 1/2 | VTA |  | - | F15 | 0 |
| 0145 |  | Digital input 7, part 1/2 | VTA |  | - | F15 | 0 |
| 0146 |  | Digital input 1, part 1/2 | VTA |  | - | F15 | 0 |
| 0147 |  | Digital input 2, part 1/2 | VTA |  | - | F15 | 0 |
| 0148 |  | Digital input 3, part 1/2 | VTA |  | - | F15 | 0 |
| 0149 |  | Digital input 4, part 1/2 | VTA |  | - | F15 | 0 |
| 014A |  | Digital input 5, part 1/2 | VTA |  | - | F15 | 0 |
| 014B | Output relays assignement to | Broken conductor configuration |  | 1 | - | F14 | 0 |
| 014C |  | Breaker failure config. |  | 1 | - | F14 | 0 |
| 014D | Protection 37 | Conf. tripping l< |  | 1 | - | F14 | 0 |
| 014E | Alarm | Self reset start protection alarms enable / disable |  | 1 |  | F24 |  |
| 014F | Protection 49 | Conf. Thermal overload alarm( $\theta$ alarm) |  | 1 | - | F14 | 0 |
| 0150 |  | Conf. Thermal overload tripping ( $\theta$ trip) |  | 1 | - | F14 | 0 |
| 0151 | Circuit breaker | Conf. Switch on to fault, circuit breaker tripping \& SOTF/TOR |  | 1 | - | F14A | 0 |
| 0152 |  | Conf. tripping AUX 1 |  | 1 | - | F14 | 0 |
| 0153 |  | Conf. tripping AUX 2 |  | 1 | - | F14 | 0 |
| 0154 |  | Conf. circuit breakers alarms |  | 1 | - | F14 | 0 |
| 0155 |  | Conf. Tripping circuit |  | 1 | - | F14 | 0 |
| 0156 | Output Relays | Relay X1 self safe operating mode | 0-1 | 1 | - | F56 | 0 |
| 0157 |  | Conf. Block relay on I> start | 0-1 | 1 | - | F24 | 0 |
| 0158 |  | Conf. Block relay on le> start | 0-1 | 1 | - | F24 | 0 |
| 0159 |  | Conf. tripping on Phase A |  | 1 | - | F14 | 0 |
| 015A |  | Conf. tripping on Phase B |  | 1 | - | F14 | 0 |
| 015B |  | Conf. tripping on Phase C |  | 1 | - | F14 | 0 |
| 015C |  | RL1...RL8: configuration and latch |  | 1 | - | F27 | 0 |
| 015D |  | Conf. relay RL1 on RL2 ... RL8 |  | 1 | - | F14 | 0 |
| 015E | Protection 67 | Conf. tripping l> |  | 1 | - | F14 | 0 |
| 015F |  | Conf. tripping l>> |  | 1 | - | F14 | 0 |
| 0160 |  | Conf. tripping l>>> |  | 1 | - | F14 | 0 |
| 0161 | Protection 67n | Conf. tripping le> |  | 1 | - | F14 | 0 |
| 0162 |  | Conf. tripping le>> |  | 1 | - | F14 | 0 |
| 0163 |  | Conf. tripping le>>> |  | 1 | - | F14 | 0 |
| 0164 | Protection 67 | Conf. start l> |  | 1 | - | F14 | 0 |
| 0165 |  | Conf. start l>> |  | 1 | - | F14 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0166 |  | Conf. start l>>> |  | 1 | - | F14 | 0 |
| 0167 | Protection 67n | Conf. start le> |  | 1 | - | F14 | 0 |
| 0168 |  | Conf. start le>> |  | 1 | - | F14 | 0 |
| 0169 |  | Conf. start le>>> |  | 1 | - | F14 | 0 |
| 016A | Recloser 79 | Conf. recloser running |  | 1 | - | F14 | 0 |
| 016B |  | Conf. definitive tripping \& Conf. recloser locked |  | 1 | - | F14D | 0 |
| 016C | Automatism | Conf. tripping on relay RL1-part 1/2 |  | 1 | - | F6 | 1 |
| 016D | Breaker Failure | Current Threshold | $2 . . .100$ | 1 | $\mathrm{ln} / 100$ | F1 | 2 |
| 016E | Blocking Logic | Blocking logic 1 - part 1/2 |  | 1 | - | F8 | 0 |
| 016F |  | Blocking logic 2 - part 1/2 |  | 1 | - | F8 | 0 |
| 0170 | Broken Conductor | Brkn. Cond. operating mode | 0-1 | 1 | - | F24 | 0 |
| 0171 |  | Brkn. Cond. trip delay time | $0 \ldots .14400$ | 1 | 1sec | F1 | 1 |
| 0172 |  | Brkn. Cond. limit | 20... 100 | 1 | - | F1 | 100 |
| 0173 | Cold Load PU | Operating mode | 0-1 | 1 | - | F24 | 0 |
| 0174 |  | Configuration desensitising limits |  | 1 | - | F33 | 0 |
| 0175 |  | Percentage of desensitisation | $100 \ldots . .500$ | 1 | \% | F1 | 50 |
| 0176 |  | Desensitising timer | $1 \ldots .36000$ | 1 | $\begin{aligned} & 1 / 10 \\ & \mathrm{sec} \end{aligned}$ | F1 | 1 |
| 0177 | Breaker failure | Breaker Failure operating mode | 0-1 | 1 | - | F24 | 0 |
| 0178 |  | Breaker failure delay time | $0 \ldots .1000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 0179 | Selectivity | Digital selectivity 1 |  | 1 | - | F40 | 0 |
| 017A |  | Digital selectivity 2 |  | 1 | - | F40 | 0 |
| 017B |  | tsel1 | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 017C |  | tsel2 | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 017D | Disturbance | Pre-trigger time | $1 \ldots . .30$ | 1 | - | F1 | 1 |
| 017E |  | Post-trigger time | 1 ..... 30 | 1 | - | F1 | 1 |
| 017F |  | Config. Disturbance start | 0-1 | 1 | - | F32 | 0 |
| 0180 | CB monitoring | CB open operating mode | 0-1 | 1 | - | F24 | 0 |
| 0181 |  | CB open time thereshold | 5... 100 | 5 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 5 |
| 0182 |  | Operations number | 0-1 | 1 | - | F24 | 0 |
| 0183 |  | CB opening operations number threshold. | $0 \ldots . .50000$ | 1 | - | F1 | 0 |
| 0184 |  | CB switched Amps sum | 0-1 | 1 | - | F24 | 0 |
| 0185 |  | CB switched Amps sum threshold |  |  | $\begin{aligned} & 10^{\mathrm{E}} 6 \\ & A^{\wedge} \end{aligned}$ | F1 |  |
| 0186 |  | Amps or square Amps | 1-2 | 1 |  | F1 | 1 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0187 |  | Closing time threshold | 5.... 100 | 5 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 5 |
| 0188 |  | Auxiliary timer 1 | $0 \ldots .20000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0189 |  | Auxiliary timer 2 | $0 \ldots .20000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 018A |  | Max \& average (current + voltage) time window selection | $\begin{aligned} & 5-10-15- \\ & 30-60 \end{aligned}$ | VTA | min | F42 | 5 |
| 018B |  | CB open pulse duration | $10 \ldots 500$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 10 |
| 018C |  | CB close pulse duration | $10 \ldots 500$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 10 |
| 018D |  | CB close operating mode | 0-1 | 1 | - | F24 | 0 |
| 018E |  | CB supervision operating mode | 0-1 | 1 | - | F24 | 0 |
| 018F |  | Trip circuit time | $10 . . .1000$ | 1 |  | F1 |  |
| 0190 |  | Blocking logic 1 - part 2/2 |  | 1 | - | F8A | 0 |
| 0191 |  | Blocking logic 2 - part 2/2 |  | 1 | - | F8A | 0 |
| 0192 |  | Conf. tripping on relay RL1 - part 2/2 |  | 1 | - | F6A | 0 |
| 0193 |  | Auxiliary timer 3 | $0 \ldots .20000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0194 |  | Auxiliary timer 4 | $0 . . .20000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 0195 |  | Description for Courier: ASCII digits 1 and 2 | $32 . . .127$ | 1 | - | F10 |  |
| 0196 |  | Description for Courier: ASCII digits 3 and 4 | $32 . . .127$ | 1 | - | F10 |  |
| 0197 |  | Description for Courier: ASCII digits 5 and 6 | $32 . . .127$ | 1 | - | F10 |  |
| 0198 |  | Description for Courier: ASCII digits 7 and 8 | $32 . . .127$ | 1 | - | F10 |  |
| 0199 |  | Description for Courier: ASCII digits 9 and 10 | $32 . . .127$ | 1 | - | F10 |  |
| 019A |  | Description for Courier: ASCII digits 11 and 12 | $32 . . .127$ | 1 | - | F10 |  |
| 019B |  | Description for Courier: ASCII digits 13 and 14 | $32 . . .127$ | 1 | - | F10 |  |
| 019C |  | Description for Courier: ASCII digits 15 and 16 | $32 . . .127$ | 1 | - | F10 |  |
| 019D | Protection 67n | Istant.Tripping le> reverse |  | 1 | - | F14 | 0 |
| 019E |  | Istant.Tripping le>> reverse |  | 1 | - | F14 | 0 |
| 019F |  | Istant.Tripping le>>> reverse |  | 1 | - | F14 | 0 |
| 01A0 | Protection 32n | Start Pe/lecos> |  | 1 | - | F14 | 0 |
| 01A1 |  | Tripping Pe/lecos> |  | 1 | - | F14 | 0 |
| 01A2 |  | Start Pe/lecos>> |  | 1 | - | F14 | 0 |
| 01A3 |  | Tripping Pe/lecos>> |  | 1 | - | F14 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 01A4 | Protection 59 | Start U> |  | 1 | - | F14 | 0 |
| 01A5 |  | Tripping U> |  | 1 | - | F14 | 0 |
| 01A6 |  | Start U>> |  | 1 | - | F14 | 0 |
| 01A7 |  | Tripping U>> |  | 1 | - | F14 | 0 |
| 01A8 | Protection 59N | Start Ue>>>> |  | 1 | - | F14 | 0 |
| 01A9 |  | Tripping Ue>>>> |  | 1 | - | F14 | 0 |
| 01AA | Protection 67 | Istant.Tripping \|> reverse |  | 1 | - | F14 | 0 |
| 01AB |  | Istant.Tripping l>> reverse |  | 1 | - | F14 | 0 |
| 01AC |  | Istant.Tripping l>>> reverse |  | 1 | - | F14 | 0 |
| 01AD | Protection 27 | Start U< |  | 1 | - | F14 | 0 |
| 01AE |  | Tripping U< |  | 1 | - | F14 | 0 |
| 01AF |  | Start U<< |  | 1 | - | F14 | 0 |
| 01B0 |  | Tripping U<< |  | 1 | - | F14 | 0 |
| 01B1 | Protection 46 | Start 12> |  | 1 | - | F14 | 0 |
| 01B2 |  | Tripping 12> |  | 1 | - | F14 | 0 |
| 01B3 |  | Start l2>> |  | 1 | - | F14 | 0 |
| 01B4 |  | Tripping l2>> |  | 1 | - | F14 | 0 |
| 01B5 |  | Start 12>>> |  | 1 | - | F14 | 0 |
| 01B6 |  | Tripping l2>>> |  | 1 | - | F14 | 0 |
| 01B7 | AND Logic equations | Start U< |  | 1 | - | F11 | 0 |
| 01B8 |  | Tripping U< |  | 1 | - | F11 | 0 |
| 01B9 |  | Start U<< |  | 1 | - | F11 | 0 |
| 01BA |  | Tripping U<< |  | 1 | - | F11 | 0 |
| 01BB |  | Start Pe/lecos> |  | 1 | - | F11 | 0 |
| 01BC |  | Tripping Pe/lecos> |  | 1 | - | F11 | 0 |
| 01BD |  | Start Pe/lecos>> |  | 1 | - | F11 | 0 |
| 01BE |  | Tripping Pe/lecos>> |  | 1 | - | F11 | 0 |
| 01BF |  | Start $\mathrm{<}$ |  | 1 | - | F11 | 0 |
| 01C0 |  | Tripping l< |  | 1 | - | F11 | 0 |
| 01C1 |  | Start 12> |  | 1 | - | F11 | 0 |
| 01C2 |  | Tripping 12> |  | 1 | - | F11 | 0 |
| 01C3 |  | Start l2>> |  | 1 | - | F11 | 0 |
| 01C4 |  | Tripping l2>> |  | 1 | - | F11 | 0 |
| 01C5 |  | Start 12>>> |  | 1 | - | F11 | 0 |
| 01C6 |  | Tripping l2>>> |  | 1 | - | F11 | 0 |
| $01 \mathrm{C7}$ |  | Thermal alarm ( $\theta$ alarm) |  | 1 | - | F11 | 0 |
| 01C8 |  | Thermal tripping ( $\theta$ trip) |  | 1 | - | F11 | 0 |
| 01C9 |  | Start U> |  | 1 | - | F11 | 0 |
| 01CA |  | Tripping U> |  | 1 | - | F11 | 0 |
| 01CB |  | Start U>> |  | 1 | - | F11 | 0 |
| 01CC |  | Tripping U>> |  | 1 | - | F11 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 01CD |  | Start Ue>>>> |  | 1 | - | F11 | 0 |
| 01CE |  | Tripping Ue>>>> |  | 1 | - | F11 | 0 |
| 01CF |  | Start l> |  | 1 | - | F11 | 0 |
| 01D0 |  | Tripping l> |  | 1 | - | F11 | 0 |
| 01D1 |  | Start l>> |  | 1 | - | F11 | 0 |
| 01D2 |  | Tripping l>> |  | 1 | - | F11 | 0 |
| 01D3 |  | Start l>>> |  | 1 | - | F11 | 0 |
| 01D4 |  | Tripping l>>> |  | 1 | - | F11 | 0 |
| 01D5 |  | Start le> |  | 1 | - | F11 | 0 |
| 01D6 |  | Tripping le> |  | 1 | - | F11 | 0 |
| 01D7 |  | Start le>> |  | 1 | - | F11 | 0 |
| 01D8 |  | Tripping le>> |  | 1 | - | F11 | 0 |
| 01D9 |  | Start le>>> |  | 1 | - | F11 | 0 |
| 01DA |  | Tripping le>>> |  | 1 | - | F11 | 0 |
| 01DB |  | Tripping 79 |  | 1 | - | F11 | 0 |
| 01DC |  | Tripping Brkn. Cond. |  | 1 | - | F11 | 0 |
| 01DD |  | Conf. Aux1 |  | 1 | - | F11 | 0 |
| 01DE |  | Conf. Aux2 |  | 1 | - | F11 | 0 |
| 01DF | AND Logic Equations T delay | Tripping equation A time | $0 \ldots .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 01E0 |  | Reset equation A time | $0 \ldots .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 01E1 |  | Tripping equation A on relays configuration |  |  |  | F14 | 0 |
| 01E2 |  | Tripping equation B time | $0 \ldots .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 01E3 |  | Time reset equation B time | $0 \ldots .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 01E4 |  | Tripping equation $B$ on relays configuration |  |  |  | F14 | 0 |
| 01E5 |  | Tripping equation C time | $0 \ldots .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 01E6 |  | Reset equation C time | $0 \ldots .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 01E7 |  | Tripping equation C on relays configuration |  |  |  | F14 | 0 |
| 01E8 |  | Tripping equation D time | $0 \ldots .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 01E9 |  | Reset equation D time | $0 \ldots .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 01EA |  | Tripping equation D on relays configuration |  |  |  | F14 | 0 |
| 01EB |  | Conf. tripping AUX 3 \& AUX 4 |  | 1 | - | F14B | 0 |
| 01EC |  | Conf. tripping Control Trip \& Control Close |  | 1 | - | F14C | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 01ED |  | Config. start $\mathrm{l}<$ |  |  |  | F14 | 0 |
| 01EE |  | Relay config. on Group 2 active |  |  |  | F14 |  |
| 01EF |  | Led PF2 5 |  | 1 | - | F19C | 0 |
| 01F0 |  | Led PF2 6 |  | 1 | - | F19C | 0 |
| 01F1 |  | Led PF2 7 |  | 1 | - | F19C | 0 |
| 01F2 |  | Led PF2 8 |  | 1 |  | F19C | 0 |
| 01F3 |  | Conf. Aux 3 |  | 1 | - | F11 | 0 |
| 01F4 |  | Conf. Aux 4 |  | 1 | - | F11 | 0 |
| 01F5 |  | Self-reset LEDs on fault | 0/1 | 1 | - | F24 | 1 |
| 01F6 |  | Temporal opening for Rolling Subperiod | 1-60 | 1 | Minute | F1 | 1 |
| 01F7 |  | Number of Subperiods considered | 1-24 | 1 | - | F1 | 1 |
| 01F8 |  | Switch onto Fault (SOTF) | 0-32771 | 1 | - | F58 | 1 |
| 01F9 |  | SOTF time | 0-500 | 1 | $\begin{aligned} & 1 / 1000 \\ & \mathrm{sec} \end{aligned}$ | F1 | 100 |
| 01FA | 51V function | 51 V configuration | 0-3 | 1 |  | F59 | 0 |
| 01FB | V2> value | $57-130 \mathrm{~V}$ operating range | $30 . .2000$ | 1 | V/10 | F1 | 1300 |
|  |  | $220-480 \mathrm{~V}$ operating range | $200 . .7200$ | 5 | V/10 | F1 | 4800 |
| 01FC | V2>> value | $57-130 \mathrm{~V}$ operating range | $30 . . .2000$ | 1 | V/10 | F1 | 1300 |
|  |  | $220-480 \mathrm{~V}$ operating range | 200 ...7200 | 5 | V/10 | F1 | 4800 |
| 01FD | VTS function | VTS configuration | 0-3 | 1 |  | F60 | 0 |

### 2.4.1.4 Page 2 H

| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0200 | Protection 67 | I> operating mode | 0-1-2 | 1 | - | F24A | 0 |
| 0201 |  | $1>$ value | $10 \ldots .2500$ | 1 | $\mathrm{ln} / 100$ | F1 | 2500 |
| 0202 |  | Trip time type l> |  | - | - | F3 | 0 |
| 0203 |  | DMT Trip time I> | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0204 |  | TMS: I> trip time multiplier | $25 . . .1500$ | 25 | 1/1000 | F1 | 25 |
| 0205 |  | K: I>trip time multiplier for RI type curve | 100-10000 | 5 | 1/1000 | F1 | 100 |
| 0206 |  | Reset time type: DMT / IDMT | 0-1 | 1 |  | F34 |  |
| 0207 |  | DMT reset time l> | $4 \ldots .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 4 |
| 0208 |  | TMS: I> reset time multiplier | $25 \ldots .3200$ | 25 | 1/1000 | F1 | 25 |
| 0209 |  | Torque (RCA) angle $\wedge^{\wedge} \mathrm{U}$ > | 0.... 359 | 1 | Deg. | F1 | 0 |
| 020A |  | Trip angle $\ \wedge \cup>$ | $10 . .170$ | 1 | Deg | F1 | 10 |
| 020B |  | Interlock l> | 0-1 |  |  | F24 | 0 |
| 020C |  | l>> operating mode | 0-1-2 | 1 | - | F24A | 0 |
| 020D |  | $1 \gg$ value | 50 .... 4000 | 1 | $\mathrm{ln} / 100$ | F1 | 4000 |
| 020E |  | Trip time l>> | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 020F |  | Torque (RCA) angle $\ \wedge$ U $\gg$ | $0 \ldots .359$ | 1 | Deg. | F1 | 0 |
| 0210 |  | Trip angle \^U>> | 10 ... 170 | 1 | Deg. | F1 | 80 |
| 0211 |  | l>>> operating mode | 0-1-2-3 | 1 | - | F24A | 0 |
| 0212 |  | l>>> value | $50 \ldots 4000$ | 1 | $\mathrm{ln} / 100$ | F1 | 4000 |
| 0213 |  | Trip time l>>> | $0 \ldots 15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0214 |  | Torque (RCA) angle \|^U>>> | $0 \ldots .359$ | 1 | Deg. | F1 | 0 |
| 0215 |  | Trip angle $\ \wedge U \ggg$ | $10 \ldots .170$ | 1 | Deg. | F1 | 10 |
| 0216 | Protection 67n | le> operating mode | 0-1-2 | 1 | - | F24A | 0 |
| 0217 | le> value | 0.002 ... 1 len operating range | 2 .... 1000 | 1 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \\ & \hline \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 1 len operating range | $10 \ldots .1000$ | 5 | $\begin{aligned} & \hline 1 / 1000 \\ & \text { Ien } \\ & \hline \end{aligned}$ | F1 | 1000 |
|  |  | $0.1 \ldots 25$ len operating range | 10... 2500 | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ | F1 | 2500 |
| 0218 |  | Trip time type le> |  | - | - | F3 | 0 |
| 0219 |  | DMT Trip time le> | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 021A |  | TMS : le> trip time multiplier | $25 \ldots .1500$ | 25 | 1/1000 | F1 | 25 |
| 021B |  | K: le> trip time multiplier for RI type curve | $100 . .10000$ | 5 | 1/1000 | F1 | 100 |
| 021C |  | le> reset time type DMT or IDMT | 0-1 | 1 |  | F34 |  |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 021D |  | DMT Reset time le> | $0 \ldots .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 021E |  | TMS: le> reset time multiplier | $25 . . .3200$ | 25 | 1/1000 | F1 | 0 |
| 021F | Ue> value | $57 . .130 \mathrm{~V}$ operating range | $10 \ldots 2600$ | 1 | V/10 | F1 | 1000 |
|  |  | 220 ... 480V operating range | 40 ... 7200 | 5 | V/10 | F1 | 4000 |
| 0220 |  | Torque (RCA) angle le^Ue> | $0 \ldots .359$ | 1 | Deg. | F1 | 0 |
| 0221 |  | Trip angle le^Ue> | $10 \ldots .170$ | 1 | Deg. | F1 | 10 |
| 0222 |  | Interlock le> | 0-1 | 1 |  | F24 | 0 |
| 0223 |  | le>> operating mode | 0-1-2 | 1 | - | F24A | 0 |
| 0224 | le>> value | 0.002... 1 len operating range | 2 .... 1000 | 1 | $1 / 1000$ Ien | F1 | 1000 |
|  |  | 0.01 ... 8 len operating range | $10 . . .8000$ | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 | 8000 |
|  |  | $0.1 \ldots 40$ len operating range | $40 \ldots .4000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ | F1 | 4000 |
| 0225 |  | Trip time le>> | $0 . . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 0226 | Ue>> value | $57 \ldots .130 \mathrm{~V}$ operating range | $10 \ldots .2600$ | 1 | V/10 | F1 | 1000 |
|  |  | 220 .... 480V operating range | $40 \ldots .9600$ | 5 | V/10 | F1 | 4000 |
| 0227 |  | Torque (RCA) angle le^Ue>> | $0 \ldots .359$ | 1 | Deg. | F1 | 0 |
| 0228 |  | Trip angle le^Ue>> | $10 . . .170$ | 1 | Deg. | F1 | 10 |
| 0229 |  | le>>> operating mode | 0-1-2-3 | 1 | - | F24A | 0 |
| 022A | le>>> value | 0.002... 1 len operating range | 2 ... 1000 | 1 | $\begin{aligned} & 1 / 1000 \\ & \text { len } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 len operating range | $10 . . .8000$ | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 | 1000 |
|  |  | $0.1 \ldots 40$ len operating range | $40 . . .4000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ | F1 | 4000 |
| 022B |  | Trip time le>>> | 0 ... 15000 | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 022C | Ue>>> value | 57 .... 130V operating range | $10 \ldots 2600$ | 1 | V/10 | F1 | 1000 |
|  |  | 220 .... 480V operating range | $40 . . .9600$ | 5 | V/10 | F1 | 4000 |
| 022D |  | Torque (RCA) angle (le^Ue)>>> | $0 \ldots .359$ | 1 | Deg. | F1 | 0 |
| 022E |  | Trip angle (le^Ue)>>> | $10 . . .170$ | 1 | Deg. | F1 | 80 |
| 022F | Protection 49 | $\theta$ alarm operating mode | 0-1 | 1 | - | F24 | 0 |
| 0230 |  | $\theta$ alarm value | $50 . . .200$ | 1 | \% | F1 | 90 |
| 0231 |  | I $\theta>$ (nominal current thermal) | $10 \ldots .320$ | 1 | 1/100 | F1 | 10 |
| 0232 |  | K | $100 \ldots 150$ | 1 | $\begin{aligned} & \text { 1/100 } \\ & \text { In } \end{aligned}$ | F1 | 105 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0233 |  | Thermal overload time constant | $1 . . .200$ | 1 | Minute | F1 | 1 |
| 0234 |  | $\theta$ trip operating mode | 0-1 | 1 | - | F24 | 0 |
| 0235 |  | $\theta$ trip value | $50 \ldots .200$ | 1 | \% | F1 | 100 |
| 0236 | Protection 37 | I< operating mode | 0-1 | 1 | - | F24 | 0 |
| 0237 |  | I< value | $10 \ldots .100$ | 1 | In/100 | F1 | 2 |
| 0238 |  | Trip time $\mathrm{<}$ | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 0239 | Protection 46 | 12> operating mode | 0-1 | 1 | - | F24 | 0 |
| 023A |  | I2> value | $10 . . .2500$ | 1 | $\begin{aligned} & \text { 1/100 } \\ & \text { ln } \end{aligned}$ | F1 | 2500 |
| 023B |  | Trip time type 12> |  | - | - | F3 | 0 |
| 023C |  | DMT trip time 12> | $0 . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 023D |  | TMS: 12> trip time multiplier | $25 . . . .1500$ | 25 | 1/1000 | F1 | 25 |
| 023E |  | K: I2> trip time multiplier for RI type curve | 100... 10000 | 5 | 1/1000 | F1 | 100 |
| 023F |  | I2 reset time type: DMT or IDMT | 0-1 | 1 | - | F34 | 0 |
| 0240 |  | DMT reset time I2> | $4 . . .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 0241 |  | TMS: I2> reset time multiplier | $25 \ldots .1500$ | 25 | $\begin{aligned} & 1 / 100 \\ & 0 \end{aligned}$ | F1 | 100 |
| 0242 |  | I2>> operating mode | 0-1 | 1 | - | F24 | 0 |
| 0243 |  | I2>> value | $50 \ldots .4000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { In } \end{aligned}$ | F1 | 4000 |
| 0244 |  | Trip time 12>> | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 0245 |  | 12>>> operating mode | 0-1 | 1 | - | F24 | 0 |
| 0246 |  | l2>>> value | $50 \ldots .4000$ | 1 | $\begin{aligned} & \text { 1/100 } \\ & \text { ln } \end{aligned}$ | F1 | 4000 |
| 0247 |  | Trip time 12>>> | $0 . . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 0248 | Protection 27 | U< operating mode | 0-1-2 | 1 | - | F24B | 0 |
| 0249 | U< value | 57 .... 130V operating range | $20 . .1300$ | 1 | V/10 | F1 | 20 |
|  |  | 220 .... 480V operating range | $100 \ldots 4800$ | 5 | V/10 | F1 | 100 |
| 024A |  | Trip time $\mathrm{U}<$ | $0 . . . .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 024B |  | U<< operating mode | 0-1 | 1 | - | F24 | 0 |
| 024C | U<< value | 57 .... 130V operating range | $20 . .1300$ | 1 | V/10 | F1 | 20 |
|  |  | 220 ..... 480V | $100 \ldots 4800$ | 5 | V/10 | F1 | 100 |
| 024D |  | Trip time U<< operating range | $0 . . . .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 024E | Protection 32n | Pe> trip angle | $0 \ldots . .359$ | 1 |  | F1 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 024F |  | 32n operating mode: Pe or leCos | 0-1 | 1 | - | F24C | 0 |
| 0250 |  | $\mathrm{Pe}>$ operating mode | 0-1 | 1 | - | F24 | 0 |
| 0251 | $\mathrm{Pe}>$ value | 0.002... 1 len current operating range with version 57...130V | 20... 2000 | 2 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | 2000 |
|  |  | 0.002... 1 len current operating range with version 220 ... 480V | 100... 8000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { IenW } \end{aligned}$ | F1 | 8000 |
|  |  | 0.01 ... 8 len current operating range with version 57 ... 130V | 400... 16000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | $\begin{aligned} & 1600 \\ & 0 \end{aligned}$ |
|  |  | 0.01 ... 8 len current operating range with version 220...480V | 400... 64000 | 10 | $\begin{aligned} & \text { 1/100 } \\ & \text { lenW } \end{aligned}$ | F1 | $\begin{aligned} & 6400 \\ & 0 \end{aligned}$ |
|  |  | $0.1 \ldots 40$ len current operating range with version 57 ... 130V | 10..... 800 | 1 | $\begin{aligned} & 1 \\ & \text { lenW } \end{aligned}$ | F1 | 800 |
|  |  | 0.1 ... 40 len current operating range with version 220...480V | 40... 3200 | 5 | $\begin{aligned} & 1 \\ & \text { lenW } \end{aligned}$ | F1 | 3200 |
| 0252 |  | Trip time type Pe> |  | - | - | F3 | 0 |
| 0253 |  | Trip time Pe> | $0 . . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0254 |  | TMS: Pe> trip time multiplier | $25 \ldots .1500$ | 25 | $\begin{aligned} & 1 / 100 \\ & 0 \end{aligned}$ | F1 | 25 |
| 0255 |  | K: Pe> trip time multiplier for RI type curve | $100 \ldots 10000$ | 5 | $\begin{aligned} & 1 / 100 \\ & 0 \end{aligned}$ | F1 | 100 |
| 0256 |  | Reset time type Pe>: DMT or IDMT | 0-1 | 1 | - | F34 | 0 |
| 0257 |  | DMT reset time Pe> | $0 \ldots .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 0258 |  | TMS reset time Pe> | $25 \ldots .3200$ | 25 | $\begin{aligned} & 1 / 100 \\ & 0 \end{aligned}$ | F1 | 100 |
| 0259 |  | Pe>> operating mode | 0-1 | 1 | - | F24 | 0 |
| 025A | Pe>> value | 0.002... 1 len current operating range with version 57...130V | 20.... 2000 | 2 | $\begin{aligned} & 1 / 100 \\ & \text { IenW } \end{aligned}$ | F1 | 2000 |
|  |  | 0.002... 1 len current operating range with version 220 ... 480V | 100... 8000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { IenW } \end{aligned}$ | F1 | 8000 |
|  |  | 0.01 ... 8 len current operating range with version 57 ... 130V | 400... 16000 | 10 | $\begin{aligned} & \text { 1/100 } \\ & \text { lenW } \end{aligned}$ | F1 | $\begin{aligned} & 1600 \\ & 0 \end{aligned}$ |
|  |  | 0.01 ... 8 len current operating range with version 220...480V | 400... 64000 | 10 | $\begin{aligned} & 1 / 100 \\ & \text { lenW } \end{aligned}$ | F1 | $\begin{aligned} & 6400 \\ & 0 \end{aligned}$ |
|  |  | $0.1 \ldots 40$ len current operating range with version $57 \ldots$... 130V | 10..... 800 | 1 | $\begin{aligned} & 1 \\ & \text { lenW } \end{aligned}$ | F1 | 800 |
|  |  | $0.1 \ldots 40$ len current operating range with version 220...480V | 40... 3200 | 5 | $\begin{aligned} & 1 \\ & \text { lenW } \end{aligned}$ | F1 | 3200 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 025B |  | Trip time Pe>> | $0 . . . .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { sec } \end{aligned}$ | F1 | 0 |
| 025C |  | leCos> operating mode | 0-1 | 1 | - | F24 | 0 |
| 025D | leCos> value | 0.002... 1 len range current operating | $2 \ldots .1000$ | 1 | $\begin{aligned} & 1 / 1000 \\ & \text { len } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 len range current operating | 10... 8000 | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { len } \end{aligned}$ | F1 | 8000 |
|  |  | $0.1 \ldots 25$ len range current operating | $10 \ldots 2500$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ | F1 | 2500 |
| 025E |  | Trip time type leCos> |  | - | - | F3 | 0 |
| 025F |  | DMT Trip time leCos> | $0 \ldots 15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0260 |  | TMS: leCos> trip time multiplier | $25 . . . .1500$ | 25 | 1/1000 | F1 | 25 |
| 0261 |  | K: leCos> trip time multiplier for RI type curve | $100 \ldots 10000$ | 5 | $\begin{aligned} & 1 / 100 \\ & 0 \end{aligned}$ | F1 | 100 |
| 0262 |  | Reset time type leCos>: DMT or IDMT | 0-1 | 1 | - | F34 | 0 |
| 0263 |  | DMT Reset time leCos> | $0 . . . .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 0264 |  | TMS reset time leCos> | $25 . . . .3200$ | 25 | 1/1000 | F1 | 25 |
| 0265 |  | leCos>> mode | 0-1 | 1 | - | F24 | 0 |
| 0266 | leCos>> value | 0.002... 1 len range current operating | $2 \ldots . .1000$ | 1 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 | 1000 |
|  |  | 0.01 ... 8 len range current operating | 10... 8000 | 5 | $\begin{aligned} & 1 / 1000 \\ & \text { Ien } \end{aligned}$ | F1 |  |
|  |  | $0.1 \ldots 25$ len range current operating | $50 \ldots 4000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \text { len } \end{aligned}$ | F1 |  |
| 0267 |  | Trip time leCos>> | $0 \ldots .15000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0268 | Protection 59 | U> operating mode | 0-1-2 | 1 | - | F24B | 0 |
| 0269 | U> value | $57-130 \mathrm{~V}$ operating range | $20 . .2600$ | 1 | V/10 | F1 | 1000 |
|  |  | 220 - 480V operating range | 100 ... 9600 | 1 | V/10 | F1 | 4000 |
| 026A |  | Trip time U> | $0 . . .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 026B |  | U>> operating mode | 0-1-2 | 1 | - | F24B | 0 |
| 026C | U>> value | $57-130 \mathrm{~V}$ operating range | $20 . .2600$ | 1 | V/10 | F1 | 1000 |
|  |  | $220-480 \mathrm{~V}$ operating range | 100 ... 9600 | 1 | V/10 | F1 | 4000 |
| 026D |  | Trip time U>> | $0 . . . .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 026E | Protection 59n | Ue>>>> operating mode | 0-1 | 1 | - | F24 | 0 |
| 026F | Ue>>>> value | 57 - 130V operating range | 10 ... 2600 | 1 | V/10 | F1 | 1000 |
|  |  | 220 - 480V operating range | 50 ..... 9600 | 5 | V/10 | F1 | 4000 |
| 0270 |  | Trip time Ue>>>> | $0 \ldots .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 0 |
| 0271 | Recloser 79 | Recloser info | 0-1 | 1 |  | F24 | 0 |


| Address (hex) | Group | Description | Values range | Step | Unit | Format | Def. Value |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 0272 |  | CB position active | 0-1 | 1 |  | F24 | 0 |
| 0273-0274 |  | Supervision window | $1 . . . .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F18A | 1 |
| 0275 |  | External blocking input | 0-1 | 1 |  | F24 | 0 |
| 0276 |  | tAux1 cycle configuration | 0 .... 2222 | 1 |  | F57 | 1111 |
| 0277 |  | tAux2 cycle configuration | 0 .... 2222 | 1 |  | F57 | 1111 |
| 0278 |  | Dead time 1 | 1 .... 30000 | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 1 |
| 0279 |  | Dead time 2 | $1 . . . .30000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 1 |
| $\begin{aligned} & \text { 027A- } \\ & \text { 027B } \end{aligned}$ |  | Dead time 3 | $1 . . . .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F18A | 1 |
| $\begin{aligned} & \text { 027C- } \\ & \text { 027D } \end{aligned}$ |  | Dead time 4 | 1 .... 60000 | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F18A | 1 |
| 027E-027F |  | Reclaim time | $2 . . . .60000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F18A | 2 |
| 0280-0281 |  | Inhibit time | 2 ..... 60000 | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F18A | 2 |
| 0282 |  | Recloser cycles for phase faults | $0 \ldots .4$ | 1 |  | F1 | 0 |
| 0283 |  | Recloser cycles for earth faults | $0 \ldots .4$ | 1 |  | F1 | 0 |
| 0284 | Reset time 67N | DMT Reset time le>> | $0 . . . .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 0285 |  | DMT Reset time le>>> | $0 . . . .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 0286 | Reset time 32N | DMT Reset time leCos>> | $0 . . . .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 0287 |  | DMT Reset time Pe>> | $0 . . . .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 0288 | Protection 67 | Trip time type l>> |  | - | - | F3 | 0 |
| 0289 |  | TMS: I>> trip time multiplier | 25... 1500 | 25 | 1/1000 | F1 | 25 |
| 028A |  | K: I>> trip time multiplier for RI type curve | $100 \ldots 10000$ | 5 | 1/1000 | F1 | 100 |
| 028B |  | Reset time type: DMT / IDMT | 0-1 | 1 |  | F34 |  |
| 028C |  | DMT reset time l>> | $4 \ldots .10000$ | 1 | $\begin{aligned} & 1 / 100 \\ & \mathrm{sec} \end{aligned}$ | F1 | 4 |
| 028D |  | TMS: l>> reset time multiplier | $25 \ldots .3200$ | 25 | $\begin{aligned} & 1 / 100 \\ & 0 \end{aligned}$ | F1 | 25 |
| 028E | Protection 67n | Trip time type le>> |  | - | - | F3 | 0 |
| 028F |  | TMS: le>> trip time multiplier | $25 . . .1500$ | 25 | 1/1000 | F1 | 25 |
| 0290 |  | K: le>> trip time multiplier for type curve | $\begin{aligned} & 100 \\ & \ldots .10000 \\ & \hline \end{aligned}$ | 5 | 1/1000 | F1 | 100 |
| 0291 |  | Reset time type: DMT / IDMT | 0-1 | 1 |  | F34 |  |
| 0292 |  | TMS: le>> reset time multiplier | $25 \ldots .3200$ | 25 | 1/1000 | F1 | 25 |


| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0293 | Recloser 79 | l> cycle configuration | $0 \ldots .2222$ | 1 |  | F57 | 1111 |
| 0294 |  | I>> cycle configuration | $0 \ldots . \ldots 222$ | 1 |  | F57 | 1111 |
| 0295 |  | I>>> cycle configuration | $0 \ldots .2222$ | 1 |  | F57 | 1111 |
| 0296 |  | le> cycle configuration | $0 \ldots . \ldots 222$ | 1 |  | F57 | 1111 |
| 0297 |  | le>> cycle configuration | $0 \ldots .2222$ | 1 |  | F57 | 1111 |
| 0298 |  | le>>> cycle configuration | $0 \ldots .2222$ | 1 |  | F57 | 1111 |
| 0299 |  | Pe/leCos> cycle <br> configuration | $0 \ldots .2222$ | 1 |  | F57 | 1111 |
| 029A |  | Pe/leCos>> cycle <br> configurat. | $0 \ldots 2222$ | 1 |  | F57 | 1111 |

### 2.4.1.5 Page 3H

The same as page 2 H except addresses are 03XX instead of 02XX.
2.4.1.6 Page 4H

| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0400 | Remote control | Remote control word 1 | $0 \ldots .65535$ | 1 | - | F9 | 0 |
| 0401 |  | Calibration mode |  |  | - |  | 0 |
| 0402 |  | Remote control word 2 <br> (single output command) | $0 \ldots . .511$ | 1 | - | F39 | 0 |
| 0403 |  | Remote control word 3 | $0-53$ | 1 |  | F50 | 0 |

### 2.4.1.7 Page 7H

| Address <br> (hex) | Group | Description | Values <br> range | Step | Unit | Format | Def. <br> Value |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 0700 |  | Relays status |  | 1 | - | F23 | 0 |

### 2.4.1.8 Page 8 H

Time synchronisation: access only in writing or reading 4 words (function 16 or 3 ).
The time synchronisation format is based on 8 bytes ( 4 words).
If date Format ( 012 Fh ) is private date then format is:

| Timer | Address <br> (hex) | Nb <br> bytes | Mask <br> $(\mathbf{h e x})$ | Values range | Unit |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Year | 0800 | 2 | FFFF | $1994-2093$ | Years |
| Month | 0801 | $1(\mathrm{Hi})$ | FF | $1-12$ | Months |
| Day |  | $1(\mathrm{Lo})$ | FF | $1-31$ | Days |
| Hour | 0802 | $1(\mathrm{Hi})$ | FF | $0-23$ | Hours |
| Minute |  | $1(\mathrm{Lo})$ | FF | $0-59$ | Minutes |
| Milliseconds | 0803 | 2 | FFFF | $0-59999$ | ms |

Else format is IEC 60870-5-103:

| Timer | Address (hex) | Nb bytes | Mask (hex) | Values range | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 0800 | 1 (Hi) |  |  |  |
| Year |  | 1 (Lo) | 7F | $\begin{aligned} & 94-99(1994-1999) \\ & 0-93(2000-2093) \end{aligned}$ | Years |
| Month | 0801 | 1 (Hi) | OF | 1-12 | Months |
| Day of the week |  | 1 (Lo) | E0 | 1-7 (Monday - Sunday) | Days |
| Day of the month |  | 1 (Lo) | 1F | 1-31 | Days |
| Season | 0802 | 1 (Hi) | 80 | 0-1 (summer - winter) |  |
| Hour |  | 1 (Hi) | 1F | 0-23 | Hours |
| Date validity |  | 1 (Lo) | 80 | 0-1 (valid - invalid) |  |
| Minute |  | 1 (Lo) | 3F | 0-59 | Minutes |
| Milliseconds | 0803 | 2 | FFFF | 0-59999 | ms |

### 2.4.1.9 Reserved pages

Page 5.
Page 6.
2.4.1.10 Disturbance records

Pages 38 h to $\mathbf{3 C h}$ : mapping pages used to send a service request to select the record number to be uploaded before uploading any disturbance record.
The answer following this request contain the following information:

1. Numbers of samples (pre and post time)
2. Phase CT ratio
3. Earth CT ratio
4. Internal phase and earth current ratios
5. Phase VT ratio
6. Earth VT ratio
7. Internal phase and earth voltage ratios
8. Number of the last disturbance mapping page
9. Number of samples in this last disturbance mapping page

Pages 9 h to $\mathbf{2 1 h}$ : contain the disturbance data ( 25 pages)
A disturbance mapping page contains 250 words:
0900 to 09FAh: 250 disturbance data words
OA00 to OAFAh: 250 disturbance data words
OBOO to OBFAh: 250 disturbance data words

2100 to 21FAh: 250 disturbance data words

The disturbance data pages contain the sample of a single channel from a record.
Page 22h: contains the index of the disturbance
Page 38h to 3Ch: selection of the disturbance record and channel
Page 3Dh: a dedicated request allows to know the number of disturbance records stored in SRAM.

### 2.4.1.11 Events records

To upload the events records two requests are allowed:
Page 35h: request to upload an event record without acknowledges of this event.
Used addresses:
3500h :
EVENT 1

354Ah :
EVENT 75
Page 36h: request to upload the non-acknowledged oldest stored event record.
Two modes are available for the acknowledgement: automatic acknowledgement or manual acknowledgement

The mode depends of the state of bit 12 of remote control word (address 400 h ).
If this bit is set, then the acknowledgement is manual else the acknowledgement is automatic.

In automatic mode, the reading of the event acknowledges the event.
In manual mode, it is necessary to write a specific command to acknowledge the oldest event
(set the bit 13 of control word addressed to 400 h )
2.4.1.12 Fault records

Page 37h: Page dedicated to upload fault record
Used addresses:

| $3700 \mathrm{~h}:$ | FAULT 1 |
| :--- | :--- |
| $3701 \mathrm{~h}:$ | FAULT 2 |
| $\ldots .$. |  |
| $3704 \mathrm{~h}:$ | FAULT 5 |

Page 3Eh: Request to upload the non-acknowledged oldest stored fault record.
Two modes are available for the acknowledgement: automatic acknowledgement or manual acknowledgement

The mode depends of the state of bit 12 of remote control word (address $400 \mathbf{h}$ ).
If this bit is set, then the acknowledgement is manual else the acknowledgement is automatic.

In automatic mode, the reading of the fault acknowledges automatically the event.
In manual mode, it is necessary to write a specific command to acknowledge the oldest fault.
(set the bit 14 of control word addressed to 400 h )

### 2.4.1.13 Mapping access characteristics

- Description of accessible addresses in reading of words (function 03 and 04).
PAGE 00: 0000h ...... 00AA h

PAGE 01: 0100h ...... 01F9h
PAGE 02: 0200h ...... 029Ah
PAGE 03: 0300h ...... 039Ah

- Definition of accessible addresses in writing of 1 word (function 06).

PAGE 01: 0100h ...... 01F9h
PAGE 02: 0200h ...... 029Ah
PAGE 03: 0300h ...... 039Ah
PAGE 04: 0400h ...... 0403h

- Definition of accessible addresses in writing of n words (function 16).

PAGE 01: 0100h ...... 01F9h
PAGE 02: 0200h ...... 029Ah
PAGE 03: 0300h ...... 039Ah
PAGE 08: 0800h ...... 0803h

- Definition of accessible addresses in reading of bits (function 01 and 02).

WARNING: THE BITS NUMBER MUST NOT BE HIGHER THAN 16. ADDRESSES ARE GIVEN IN BIT ADDRESSES. PAGE 00: 0100H ...... 0250H
PAGE 01: 1500 H ...... 01830H

- Definition of accessible addresses in writing of 1 bit (function 05).

WARNING: THE BITS NUMBER MUST NOT BE HIGHER THAN 16. PAGE 04: $4000 \mathrm{H} . . . . .400 \mathrm{FH}$

- Definition of accessible addresses in writing of $n$ bits (function 15).

WARNING: BITS NUMBER MUST NOT BE HIGHER THAN 16.
PAGE 01: 1500H ...... 1830H
PAGE 04: 4000 H ...... 400BH

### 2.4.1.14 Pages 9 H to 21 H

Disturbance record data (25 pages).
Writing access in words (function 03)
Each disturbance mapping page contains 250 words.

| Addresses (hex) | Contents |
| :--- | :--- |
| 0900h to 09FAh | 250 disturbance data words |
| 0A00h to 0AFAh | 250 disturbance data words |
| 0B00h to 0BFAh | 250 disturbance data words |
| 0C00h to 0CFAh | 250 disturbance data words |
| 0D00h to 0DFAh | 250 disturbance data words |
| 0E00h to 0DFAh | 250 disturbance data words |
| 0F00h to 0FFAh | 250 disturbance data words |
| 1000h to 10FAh | 250 disturbance data words |
| 1100h to 11FAh | 250 disturbance data words |
| 1200h to 12FAh | 250 disturbance data words |
| 1300h to 13FAh | 250 disturbance data words |
| 1400h to 14FAh | 250 disturbance data words |
| 1500h to 15FAh | 250 disturbance data words |
| 1600h to 16FAh | 250 disturbance data words |
| 1700h to 17FAh | 250 disturbance data words |
| 1800h to 18FAh | 250 disturbance data words |
| 1900h to 19FAh | 250 disturbance data words |
| 1A00h to 1AFAh | 250 disturbance data words |
| 1B00h to 1BFAh | 250 disturbance data words |
| 1C00h to 1CFAh | 250 disturbance data words |
| 1D00h to 1DFAh | 250 disturbance data words |
| 1E00h to 1EFAh | 250 disturbance data words |
| 1F00h to 1FFAh | disturbance data words |
| 2000h to 20FAh | 2100h to 21FAh words |
|  |  |

NOTE: The disturbance data pages contain the values of one channel from one given disturbance record.

### 2.4.1.14.1 Meaning of each channel value

- IA, IB, IC, le channels.

The values are signed 16 bits words equivalent to the ADC value.

## Phase current values calculation formula

Line phase current value (primary value) = phase sampled value * phase primary CT ratio/ phase internal CT ratio (mapping address 0007)

Earth current value calculation formula
The formula depends on the nominal earth current :
0.1 to 40 len range

Line earth current value (primary value) = earth sampled value * earth primary CT ratio/ earth internal CT ratio (mapping address 0008=800)

### 0.01 to 8 len range

Line earth current value (primary value) = earth sampled value * earth primary CT ratio/ earth internal CT ratio (mapping address 0008=3277)

### 0.002 to 1 len range

Line earth current value (primary value) = earth sampled value * earth primary CT ratio/ earth internal CT ratio (mapping address 0008=32700)

- UA, UB, UC/Ue channels.

The values are signed 16 bits words equivalent to the ADC value.

## Phase voltage values calculation formula

The formula depends on nominal phase voltage:
Line phase voltage value (primary value) = phase sampled value * phase primary VT ratio / phase secondary VT ratio

## Earth voltage value calculation formula

The formula depends on nominal earth voltage:
Line earth voltage value (primary value) = earth primary VT ratio / earth secondary VT ratio

- Frequency channel:

Time between two samples in microseconds

- Logic channels:

| Logic channel | Contents |
| :--- | :--- |
| Bit 0 | Trip relay (RL1) |
| Bit 1 | Output relay 2 (RL2) |
| Bit 2 | Output relay 3 (RL3) |
| Bit 3 | Output relay 4 (RL4) |
| Bit 4 | Watch-Dog relay (RL0) |
| Bit 5 | Output relay 5 (RL5) |
| Bit 6 | Output relay 6 (RL6) |
| Bit 7 | Output relay 7 (RL7) |
| Bit 8 | Output relay 8 (RL8) |
| Bit 9 | Logic input 1 (EL1) |
| Bit 10 | Logic input 2 (EL2) |


| Logic channel | Contents |
| :--- | :--- |
| Bit 11 | Logic input 3 (EL3) |
| Bit 12 | Logic input 4 (EL4) |
| Bit 13 | Logic input 5 (EL5) |
| Bit 14 | Logic input 6 (EL6) |
| Bit 15 | Logic input 7 (EL7) |

### 2.4.1.15 Page 22H

Disturbance record index frame
Reading access in word (function 03)

| Addresses (hex) | Contents |
| :--- | :--- |
| 2200 h | Disturbance data index frame |

Disturbance record index frame

| Word Nr. | Contents |
| :--- | :--- |
| 1 | Disturbance record number |
| 2 | Disturbance record finish date (second) |
| 3 | Disturbance record finish date (second) |
| 4 | Disturbance record finish date (millisecond) |
| 5 | Disturbance record finish date (millisecond) |
| 6 | Disturbance record starting condition: <br> $1 \rightarrow$ tripping command (RL1) <br> $2 \rightarrow$ instantaneous <br> $3 \rightarrow$ remote command <br> $4 \rightarrow$ logic input |
| 7 | Frequency at the post-time beginning |

### 2.4.1.16 Page 35H

Event record data (9 words).
Addresses 3500h to 354Ah.

| Word Nr. | Contents |
| :--- | :--- |
| 1 | Event meaning (see table below) |
| 2 | MODBUS address |
| 3 | MODBUS associated value |
| 4 | Reserved |
| PRIVATE FORMAT: $5 \& 6$ | Event date (number of seconds since 01/01/1994) |
| PRIVATE FORMAT: $7 \& 8$ | Event date (millisecond) |
| IEC FORMAT: 5 to 8 | Event date (see format of time synchronisation, address <br> $0800 h)$ |
| 9 | Acknowledgement: <br> $0=$ event non acknowledged <br> $1=$ event acknowledged |

Word n .1 event meaning and relative codes

| Code (Dec) | Event meaning | Type | MODBUS address |
| :---: | :---: | :---: | :---: |
| 01 | Remote closing | F9 | 013h |
| 02 | Remote tripping | F9 | 013h |
| 03 | Disturbance recording start | F9 |  |
| 04 | Trip output unlatch | F9 | 013h |
| 05 | Settings change | Address |  |
| 06 | Remote thermal reset | F9 |  |
| 07 | Maintenance Mode | F9 $\uparrow \downarrow$ | 0402h |
| 08 | Control relay in maintenance mode | F39 $\uparrow \downarrow$ | 013h |
| 09 | $\mathrm{U}<$ | F17 $\uparrow \downarrow$ | 70h |
| 10 | U<< | F17 $\uparrow \downarrow$ | 71h |
| 11 | Pe/lecos> | F16 $\uparrow \downarrow$ | 72h |
| 12 | Pe/lecos>> | F16 $\uparrow \downarrow$ | 73h |
| 13 | I< | F17 $\uparrow \downarrow$ | 21h |
| 14 | 12> | F17 $\uparrow \downarrow$ | 7Ch |
| 15 | I2>> | F17 $\uparrow \downarrow$ | 7Dh |
| 16 | 12>>> | F17 $\uparrow \downarrow$ | 7Eh |
| 17 | Thermal overload alarm | F37 $\uparrow \downarrow$ | 020h |
| 18 | U> | F17 $\downarrow \downarrow$ | 76h |
| 19 | U>> | F17 $\uparrow \downarrow$ | 77h |
| 20 | Ue>>>> | F16 $\uparrow \downarrow$ | 77h |
| 21 | $1>$ | F17 $\uparrow \downarrow$ | 14h |
| 22 | 1>> | F17¢ $\downarrow$ | 15h |
| 23 | l>>> | F17¢ $\downarrow$ | 16h |
| 24 | $l e>$ | F16 $\uparrow \downarrow$ | 17h |
| 25 | le>> | F16 $\uparrow \downarrow$ | 18h |
| 26 | le>>> | F16 $\uparrow \downarrow$ | 19h |
| 27 | $U<$ trip | F17 | 70h |
| 28 | U<<trip | F17 | 71h |
| 29 | Pe/lecos> trip | F16 | 72h |
| 30 | $\mathrm{Pe} / \mathrm{lecos} \gg$ trip | F16 | 73h |
| 31 | I< trip | F17 | 21h |
| 32 | $12>$ trip | F17 | 7Ch |
| 33 | 12>> trip | F17 | 7Dh |
| 34 | I2>>> trip | F17 | 7Eh |
| 35 | $\theta$ trip | F37 | 20h |
| 36 | $U>$ trip | F17 | 76h |


| Code (Dec) | Event meaning | Type | MODBUS address |
| :---: | :---: | :---: | :---: |
| 37 | U>> trip | F17 | 77h |
| 38 | Ue>>>> trip | F16 | 7Ah |
| 39 | Reserved |  |  |
| 40 | Reserved |  |  |
| 41 | Reserved |  |  |
| 42 | $1>$ trip | F17 | 14h |
| 43 | 1>> trip | F17 | 15h |
| 44 | l>>> trip | F17 | 16h |
| 45 | le> trip | F16 | 17h |
| 46 | le>> trip | F16 | 18h |
| 47 | le>>> trip | F16 | 19h |
| 48 | Trip SOTF | F38 | 23h |
| 49 | X1 trip: t AUX3 | F13 | 13h |
| 50 | X1 trip: t AUX4 | F13 | 13h |
| 51 | EQU LOG A trip | F48 | 7Fh |
| 52 | EQU LOG B trip | F48 | 7Fh |
| 53 | EQU LOG C trip | F48 | 7Fh |
| 54 | EQU LOG D trip | F48 | 7Fh |
| 55 | Broken conductor trip | F38 | 23h |
| 56 | t AUX1 trip | F38 | 23h |
| 57 | t AUX2 trip | F38 | 23h |
| 58 | SF6 fault | F20 | 11h |
| 59 | Working time | F43 $\uparrow \downarrow$ | 28h |
| 60 | Operation numbers | F43^ $\downarrow$ | 28h |
| 61 | Sum of switched square amps | F43 $\uparrow \downarrow$ | 28h |
| 62 | Trip circuit supervision | F43^ $\downarrow$ | 28h |
| 63 | Closing time | F43^ $\downarrow$ | 28h |
| 64 | Reclose successful | F43^ $\downarrow$ | 28h |
| 65 | Recloser final trip | F43^ $\downarrow$ | 28h |
| 66 | Recloser settings error | F43^ $\downarrow$ | 28h |
| 67 | Broken conductor | F38 $\uparrow \downarrow$ | 23h |
| 68 | Selective scheme logic 1 | F20^ $\downarrow$ | 11h |
| 69 | Selective scheme logic 2 | F20^ $\downarrow$ | 11h |
| 70 | Blocking logic 1 | F20^ $\downarrow$ | 11h |
| 71 | Blocking logic 2 | F20^ $\downarrow$ | 11h |
| 72 | Setting group change | F20 | 11h |
| 73 | O/O | F20^ $\downarrow$ | 11h |
| 74 | F/O | F20^ $\downarrow$ | 11h |


| Code (Dec) | Event meaning | Type | MODBUS address |
| :---: | :---: | :---: | :---: |
| 75 | All alarms acknowledgement by logic input | F20^ $\downarrow$ | 11h |
| 76 | Cold load pick up active | F20^ $\downarrow$ | 11h |
| 77 | Input logic state change | F12¢ $\downarrow$ | 10h |
| 78 | X1 trip: $\theta$ trip | F13 | 13h |
| 79 | X1 trip: $\mathrm{tl}>$ | F13 | 13h |
| 80 | X1 trip: t l>> | F13 | 13h |
| 81 | X1 trip: $\mathrm{tl} \ggg$ | F13 | 13h |
| 82 | X1 trip: t le> | F13 | 13h |
| 83 | X1 trip: t le>> | F13 | 13h |
| 84 | X1 trip: t le>>> | F13 | 13h |
| 85 | X1 trip: t Pe/lecos> | F13 | 13h |
| 86 | X1 trip: $\mathrm{t} \mathrm{Pe/lecos>>}$ | F13 | 13h |
| 87 | X1 trip: t U < | F13 | 13h |
| 88 | X1 trip: t U<< | F13 | 13h |
| 89 | X1 trip: $\mathrm{tl}<$ | F13 | 13h |
| 90 | X1 trip: t U> | F13 | 13h |
| 91 | X1 trip: t U>> | F13 | 13h |
| 92 | X1 trip: t l2> | F13 | 13h |
| 93 | X1 trip: t l2>> | F13 | 13h |
| 94 | X1 trip: t l2>>> | F13 | 13h |
| 95 | X1 trip: t Ue>>>> | F13 | 13h |
| 96 | X1 trip: Broken Conductor | F13 | 13h |
| 97 | X1 trip: EQU LOG A | F13 | 13h |
| 98 | X1 trip: EQU LOG B | F13 | 13h |
| 99 | X1 trip: EQU LOG C | F13 | 13h |
| 100 | X1 trip: EQU LOG D | F13 | 13h |
| 101 | X1 trip: t AUX1 | F13 | 13h |
| 102 | X1 trip: t AUX2 | F13 | 13h |
| 103 | Output relays command | F39^ $\downarrow$ | 402h |
| 104 | Front panel single alarm acknowledge | - | - |
| 105 | All alarms front panel acknowledgement | - | - |
| 106 | Single alarm remote acknowledgement | - | - |
| 107 | All alarms remote acknowledgement | - | - |
| 108 | Major material alarm | F45 $\uparrow \downarrow$ | Fh |
| 109 | Minor material alarm | F45 $\uparrow \downarrow$ | Fh |
| 110 | Operating Latched Relays status | F27^ $\downarrow$ | 2Eh |
| 111 | General "Start" protection (IEC 60870-5103 only) | F1 $\uparrow \downarrow$ | OBh |


| Code (Dec) | Event meaning | Type | MODBUS <br> address |
| :--- | :--- | :--- | :--- |
| 112 | Recloser in "Service" (IEC 60870-5-103 <br> only | F43 $\uparrow \downarrow$ | 28 h |
| 113 | 52a by recloser (IEC 60870-5-103 only) | Cycle | - |
| 114 | Local parameter setting (password <br> active) - (IEC 60870-5-103 only) | $\uparrow \downarrow$ | - |
| 115 | Start timer Breaker failure from digital <br> input | F20A $\uparrow \downarrow$ | 0Dh |
| 116 | t AUX3 trip | F38 | 23 h |
| 117 | t AUX4 trip | F38 | 23 h |
| 118 | Manual Close | F20A | 0Dh |
| 119 | X1 trip: SOTF | F38 | 23 h |
| 120 | Local Mode | F20A $\uparrow \downarrow$ | 0Dh |
| 121 | l>> Blocked | F38A $\uparrow \downarrow$ | 24 h |
| 122 | l>>> Blocked | F38A $\uparrow \downarrow$ | 24 h |
| 123 | VTS | F38A $\uparrow \downarrow$ | 24 h |
| 124 | V2> | F38A $\uparrow \downarrow$ | 24 h |
| 125 | V2>> | F38A $\downarrow \downarrow$ | 24 h |
| 126 | Recloser locked | F43 $\uparrow \downarrow$ | 28 h |
| 127 | Recloser in progress | F43 $\uparrow \downarrow$ | 28 h |

NOTE: $\quad$ The double arrow $\uparrow \downarrow$ means the event is generated on event occurrence $(\uparrow)$ and on event disappearance $(\downarrow)$.

On event occurrence, the corresponding bit of the associated format is set to « 1 ».
On event disappearance, the corresponding bit of the associated format is set to « $0 »$.

### 2.4.1.17 Page 36H

Oldest event data.
Reading access in word (function 03)

| Address (hex) | Contents |
| :--- | :--- |
| 3600 h | Oldest event data |

2.4.1.18 Page 37H

Fault record value data
Reading access in word (function 03)

| Address (hex) | Contents |
| :--- | :--- |
| 3700 h | Fault value record $\mathrm{n}^{\circ} 1$ |
| 3701 h | Fault value record $\mathrm{n}^{\circ} 2$ |
| 3702 h | Fault value record $\mathrm{n}^{\circ} 3$ |
| 3703 h | Fault value record $\mathrm{n}^{\circ} 4$ |
| 3704 h | Fault value record $\mathrm{n}^{\circ} 5$ |

Each record is made up of 24 words:

| Word Nr. | Contents |
| :---: | :---: |
| 1 | Fault number |
| PRIVATE FORMAT: 2 \& 3 | Fault date (number of seconds since 01/01/94) |
| PRIVATE FORMAT: 4 \& 5 | Fault date (milli-seconds) |
| IEC FORMAT: 2 to 5 | Fault date (see format of time synchronisation, address 0800h) |
| 6 | Fault date (season) $0=$ winter 1 = summer $2=$ undefined |
| 7 | Active setting group during the fault (1 or 2) |
| 8 | Fault origin $\begin{aligned} & 0=\text { none } \\ & 1=\text { phase } A \\ & 2=\text { phase B } \\ & 3=\text { phase C } \\ & 4=\text { phases A-B } \\ & 5=\text { phases } A-C \\ & 6=\text { phases } B-C \\ & 7=\text { phase } A-B-C \\ & 8=\text { earth } \end{aligned}$ |
| 9 | Fault recording starting origin (see format F61) |
| 10 \& 11 | Fault value |
| 12 | Phase A current value (nominal value) |
| 13 | Phase B current value (nominal value) |
| 14 | Phase C current value (nominal value) |
| 15 | Earth current value (nominal value) |
| 16 | Phase A voltage value (nominal value) |
| 17 | Phase B voltage value (nominal value) |
| 18 | Phase C voltage value (nominal value) |
| 19 | Earth voltage value (nominal value) |
| 20 | Angle between phase A current and phase B-C voltage values |
| 21 | Angle between phase B current and phase C-A voltage values |
| 22 | Angle between phase C current and phase A-B voltage values |
| 23 | Angle between earth current and earth voltage values |
| 24 | Acknowledgement: $\begin{aligned} & 0=\text { fault not acknowledged } \\ & 1=\text { fault acknowledged } \end{aligned}$ |

Phase current values calculation formula

Line phase current value (primary value) = phase sampled value (e.g. word 10, 11, 12 or 13)

* phase primary CT ratio / phase internal CT ratio (mapping address 0007)


## Earth current values calculation formula

The formula depends of nominal earth current :

## 0.1 to 40 len range

Line earth current value (primary value) = earth sampled value (e.g. word 10 or 14) * earth primary CT ratio / earth internal CT ratio (mapping address 0008=800)

### 0.01 to 8 len range

Line earth current value (primary value) = earth sampled value (e.g. word 10 or 14) * earth primary CT ratio / earth internal CT ratio (mapping address 0008=3277)
0.002 to 1 len range

Line earth current value (primary value) = earth sampled value (e.g. word 10 or 14) * earth primary CT ratio / earth internal CT ratio (mapping address 0008=32700)

Phase voltage values calculation formula
Line phase voltage value (primary value) = phase sampled value (e.g. word 10 or 15 or 16 or 17) * phase primary CT ratio / phase internal CT ratio

Earth voltage values calculation formula
Line earth voltage value (primary value) = earth sampled value (e.g. word 10 or 18) * earth primary CT ratio / earth internal CT ratio
2.4.1.19 Pages 38 H to 3 CH

Selection of the disturbance record and channel (19 words are uploaded for each address reading)

Access in word reading (function 03)

| Address (hex) | Disturbance record number | Channel |
| :--- | :--- | :--- |
| 3800 h | 1 | I A |
| 3801 h | 1 | I B |
| 3802 h | 1 | I C |
| 3803 h | 1 | Ie |
| 3804 h | 1 | UA |
| 3805 h | 1 | UB |
| 3806 h | 1 | UC / Ue |
| 3807 h | 1 | Frequency |
| 3808 h | 1 | Logic inputs and outputs |
| 3900 h | 2 | I A |
| 3901 h | 2 | IB |
| 3902 h | 2 | I C |
| 3903 h | 2 | Ie |
| 3904 h | 2 | UA |
| 3905 h | 2 | UB |
| 3906 h | 2 | UC / Ue |
| 3907 h | 2 | Frequency |
| 3908 h | 2 | Logic inputs and outputs |


| Address (hex) | Disturbance record number | Channel |
| :--- | :--- | :--- |
| 3A00h | 3 | I A |
| 3A01h | 3 | I B |
| 3A02h | 3 | I C |
| 3A03h | 3 | Ie |
| 3A04h | 3 | UA |
| 3A05h | 3 | UB |
| 3A06h | 3 | UC / Ue |
| 3A07h | 3 | Frequency |
| 3A08h | 3 | Logic inputs and outputs |
| 3B00h | 4 | I A |
| 3B01h | 4 | I B |
| 3B02h | 4 | I C |
| 3B03h | 4 | Ie |
| 3B04h | 4 | UA |
| 3B05h | 4 | UB |
| 3B06h | 4 | UC / Ue |
| 3B07h | 4 | Frequency |
| 3B08h | 4 | Logic inputs and outputs |
| 3C00h | 5 | I A |
| 3C01h | 5 | I B |
| 3C02h | 5 | I C |
| 3C03h | 5 | Ie |
| 3C04h | 5 | UA |
| 3C05h | 5 | UB |
| 3C06h | 5 | Frequency |
| 3C07h | 5 | Inputs and outputs |
| 3C08h | 5 |  |
|  | 3 |  |


| Word Nr. | Contents |
| :--- | :--- |
| $n^{\circ} 1$ | Number of samples included in the mapping |
| $n^{\circ} 2$ | Sample number in pre-time |
| $n^{\circ} 3$ | Sample number in post-time |
| $n^{\circ} 4$ | Phase primary CT ratio |
| $n^{\circ} 5$ | Phase secondary CT ratio |
| $n^{\circ} 6$ | Earth primary CT ratio |
| $n^{\circ} 7$ | Earth secondary CT ratio |
| $n^{\circ} 8$ | Phase internal CT ratio |
| $n^{\circ} 9$ | Earth internal CT ratio |
| $n^{\circ} 10$ | Phase primary VT ratio - byte low |


| Word Nr. | Contents |
| :--- | :--- |
| $\mathrm{n}^{\circ} 11$ | Phase primary VT ratio - byte high |
| $\mathrm{n}^{\circ} 12$ | Phase secondary VT ratio |
| $\mathrm{n}^{\circ} 13$ | Earth primary VT ratio - byte low |
| $\mathrm{n}^{\circ} 14$ | Earth primary VT ratio - byte high |
| $\mathrm{n}^{\circ} 15$ | Earth secondary VT ratio |
| $\mathrm{n}^{\circ} 16$ | Internal VT ratio - numerator: 100 |
| $\mathrm{n}^{\circ} 17$ | Internal VT ratio - denominator: 6300 or 1700 |
| $\mathrm{n}^{\circ} 18$ | Last mapping page |
| $\mathrm{n}^{\circ} 19$ | Last mapping page words number |

Calculation formula for phase current values
Line phase current value (primary value) = phase sampled value (e.g. adress 3800h, 3801h or 3802h) * phase primary CT ratio * (1 / internal phase ratio) * $\sqrt{2}$

Calculation formula for earth current values
Line earth current value (primary value) = earth sampled value (e.g. adress 3803h) * earth primary CT ratio * (1 / internal earth ratio) * $\sqrt{ } 2$

Phase voltage values calculation formula
Line phase voltage value (primary value) = phase sampled value (e.g. address 3804h or 3805 h or 3806 h if Uc) * phase primary VT ratio / phase internal VT ratio * $\sqrt{2}$

Earth voltage values calculation formula
Line earth voltage value (primary value) = earth sampled value (e.g. address 3806h if Ue) * earth primary VT ratio / earth internal VT ratio * $\sqrt{ } 2$
2.4.1.20 Page 3DH

Number of disturbance records available
Access in word reading (function 03)

| Address (hex) | Contains |
| :--- | :--- |
| 3D00h | Number of disturbance records available |

## Words description:

| Word Nr. | Contents |
| :---: | :---: |
| 1 | Number of disturbance records available |
| 2 | Oldest disturbance record number ( n ) |
| PRIVATE FORMAT: 3 \& 4 | Oldest disturbance record date (seconds) |
| PRIVATE FORMAT: 5 \& 6 | Oldest disturbance record date (milli-seconds) |
| IEC FORMAT: 3 to 6 | Oldest disturbance record date (see format of time synchronisation, address 0800h) |
| 7 | Disturbance record starting origin <br> $1=$ trip relay (RL1) <br> $2=$ instantaneous threshold <br> $3=$ remote command <br> $4=$ logic input |
| 8 | Acknowledge |


| Word Nr. | Contents |
| :---: | :---: |
| 9 | Disturbance record previous number ( $\mathrm{n}+1$ ) |
| PRIVATE FORMAT: 10 \& 11 | Previous disturbance record date (seconds) |
| PRIVATE FORMAT: 12 \& 13 | Previous disturbance record date (milli-seconds) |
| IEC FORMAT: 10 to 13 | Previous disturbance record date (see format of time synchronisation, address 0800h) |
| 14 | Disturbance record starting origin $1=$ trip relay (RL1) <br> 2= instantaneous threshold <br> $3=$ remote command <br> $4=$ logic input |
| 15 | Acknowledge |
| 16 | Disturbance record previous number ( $\mathrm{n}+2$ ) |
| PRIVATE FORMAT: 17 \& 18 | Previous disturbance record date (second) |
| PRIVATE FORMAT: 19 \& 20 | Previous disturbance record date (millisecond) |
| IEC FORMAT: 17 to 20 | Previous disturbance record date (see format of time synchronisation, address 0800h) |
| 21 | Disturbance record starting origin <br> $1=$ trip relay (RL1) <br> 2= instantaneous threshold <br> $3=$ remote command <br> $4=$ logic input |
| 22 | Acknowledge |
| 23 | Disturbance record previous number ( $\mathrm{n}+3$ ) |
| PRIVATE FORMAT: 24 \& 25 | Previous disturbance record date (seconds) |
| PRIVATE FORMAT: 26 \& 27 | Previous disturbance record date (milli-seconds) |
| IEC FORMAT: 24 to 27 | Previous disturbance record date (see format of time synchronisation, address 0800h) |
| 28 | Disturbance record starting origin $1=$ trip relay (RL1) <br> 2= instantaneous threshold <br> $3=$ remote command <br> $4=$ logic input |
| 29 | Acknowledge |
| 30 | Disturbance record previous number ( $\mathrm{n}+4$ ) |
| PRIVATE FORMAT: 31 \& 32 | Previous disturbance record date (second) |
| PRIVATE FORMAT: 33 \& 34 | Previous disturbance record date (millisecond) |
| IEC FORMAT: 33 to 36 | Previous disturbance record date (see format of time synchronisation, address 0800h) |
| 35 | Disturbance record starting origin <br> $1=$ trip relay (RL1) <br> 2= instantaneous threshold <br> $3=$ remote command <br> $4=$ logic input |
| 36 | Acknowledge |

### 2.4.1.21 Page 3EH

Oldest fault record value data.
Access in word reading (function 03).

| Address (hex) | Contents |
| :--- | :--- |
| 3 E00h | Oldest fault record |

### 2.4.1.22 Page 5AH

Eeprom error counters.
Access in word reading (function 03).

| Address (hex) | Contents |
| :--- | :--- |
| 5A00h | E2prom error counters |

Words description:

| Word Nr. | Contents |
| :--- | :--- |
| 1 | Number of errors in page 1 |
| 2 | Last error address of page 1 |
| 3 | Number of errors in page 2 |
| 4 | Last error address of page 2 |
| 5 | Number of errors in page 3 |
| 6 | Last error address of page 3 |
| 7 | Number of errors in calibration page |
| 8 | Last error address of calibration page |
| 9 | Number of data checksum errors |
| 10 | Number of calibration checksum errors |

### 2.4.2 Mapping format description

Values are decimal except when differently specified.

| CODE | DESCRIPTION |
| :---: | :---: |
| F1 | Unsigned integer: numerical data $1 \ldots 65535$ |
| F2 | Signed integer: numerical data -32768 ... 32767 |
| F3 | ```Unsigned integer: trip / reset curves type (hex values) 0 : DMT 10 : STI (CEI) 11 : SI (CEI) 12 : VI (CEI) 13 : El (CEI) 14 : LTI (CEI) 115 : STI (C02) 116 : MI (ANSI) 117 : LTI (CO8) 118 : VI (ANSI) 119 : El (ANSI) 1A : RECT 20 : RI``` |
| F4 | Unsigned integer: UART Baud rate <br> 0: 300 <br> 1: 600 <br> 2: 1200 <br> 3: 2400 <br> 4: 4800 <br> 5: 9600 <br> 6: 19200 <br> 7: 38400 |
| F5 | Unsigned integer: Modbus and DNP3 parity bit 0 : none <br> 1 : even <br> 2 : odd |
| F6 | Unsigned integer: relay X1 configuration - part 1/2 <br> Bit 0: tl> <br> Bit 1: tl>> <br> Bit 2: tl>>> <br> Bit 3: tle> <br> Bit 4: tle>> <br> Bit 5: tle>>> <br> Bit 6: $\mathrm{tl}<$ <br> Bit 7: $\theta$ trip <br> Bit 8: broken conductor trip <br> Bit 9: AUX 1 trip <br> Bit 10: AUX 2 trip <br> Bit 11: tl2> <br> Bit 12: $\mathrm{tPe} / \mathrm{lecos}>$ <br> Bit 13: tPe/lecos>> <br> Bit 14: tUe>>>> <br> Bit 15: Control trip |


| CODE | DESCRIPTION |
| :---: | :---: |
| F6A | Unsigned integer: configuration du déclenchement du X1 part 2/2 <br> Bit 0: tU> <br> Bit 1: tU>> <br> Bit 2: $\mathrm{tU}<$ <br> Bit 3: tU<< <br> Bit 4: AND logic equation A trip <br> Bit 5: AND logic equation B trip <br> Bit 6: AND logic equation C trip <br> Bit 7: AND logic equation D trip <br> Bit 8: tl2>> <br> Bit 9: tl2>>> <br> Bit 10: Reserved <br> Bit 11: Reserved <br> Bit 12: Reserved <br> Bit 13: AUX 3 trip <br> Bit 14: AUX 4 trip <br> Bit 15: SOTF/TOR |
| F7 | Unsigned integer: U connection mode 0 : 3Vpn $2: 2 \mathrm{Vpp}+\mathrm{Vr}$ $4: 2 \mathrm{Vpn}+\mathrm{Vr}$ |
| F8 | Unsigned integer: blocking logic configuration - part 1/2 <br> Bit 0: tl>+ tl>REV <br> Bit 1: tl>> + tl>>REV <br> Bit 2: tl>>> + tl>>>REV <br> Bit 3: tle> + tle>REV <br> Bit 4: tle>> + tle>>REV <br> Bit 5: tle>>> + tle>>>REV <br> Bit 6: t < <br> Bit 7: $\theta$ trip <br> Bit 8: broken conductor trip <br> Bit 9: aux1 trip <br> Bit 10: aux2 trip <br> Bit 11: t\|2> <br> Bit 12: tPe/lecos> <br> Bit 13: tPe/lecos>> <br> Bit 14: tUe>>>> <br> Bit 15: Reserved |
| F8A | Unsigned integer: blocking logic configuration - part 2/2 <br> Bit 0: tU> <br> Bit 1: tU>> <br> Bit 2: $\mathrm{tU}<$ <br> Bit 3: tU<< <br> Bit 4: aux3 trip <br> Bit 5: aux4 trip <br> Bits 6-7: Reserved <br> Bit 8: tl2>> <br> Bit 9: tl2>>> <br> Bits 10 to 15: Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F9 | Unsigned integer: remote control 1 <br> Bit 0: relays de-latching <br> Bit 1: 1st alarm acknowledge <br> Bit 2: all alarms acknowledge <br> Bit 3: remote tripping (CONTROL trip) <br> Bit 4: remote closing (CONTROL close) <br> Bit 5: settings group change <br> Bit 6: thermal state reset <br> Bit 7: max \& average values reset <br> Bit 8: disturbance record remote start <br> Bit 9: maintenance mode <br> Bit 10: recloser counter reset <br> Bit 11: recloser reset <br> Bit 12: manual acknowledge mode <br> Bit 13: oldest event acknowledge <br> Bit 14: oldest fault acknowledge <br> Bit 15: hardware Sram alarm acknowledge |
| F10 | Unsigned integer: 2 ASCII characters 32-127 = ASCII character1 32-127 = ASCII character 2 |
| F11 | Unsigned integer: AND logic equations configuration Bit 0: AND logic equation A association <br> Bit 1: AND logic equation B association Bit 2: AND logic equation $A$ association Bit 3: AND logic equation D association Bits 4 to 15: Reserved |
| F12 | Unsigned integer: logic input status Bit 0: logic input number 1 Bit 1: logic input number 2 Bit 2: logic input number 3 Bit 3 logic input number 4 Bit 4 logic input number 5 Bit 5 logic input number 6 Bit 6 logic input number 7 Bits 7 to 15: Reserved |
| F13 | Unsigned integer: logic outputs status <br> Bit 0: logic output number RL1 (X1 tripping) <br> Bit 1: logic output number RL2 <br> Bit 2: logic output number RL3 <br> Bit 3: logic output number RL4 <br> Bit 4: logic output number RL0 (Watch-Dog) <br> Bit 5: logic output number RL5 <br> Bit 6: logic output number RL6 <br> Bit 7: logic output number RL7 <br> Bit 8: logic output number RL8 <br> Bits 9 to 15: Reserved |
| F14 | Unsigned integer: RI2 ... RL8 output configuration Bit 0: logic output number RL2 selection Bit 1: logic output number RL3 selection Bit 2: logic output number RL4 selection Bit 3: logic output number RL5 selection Bit 4: logic output number RL6 selection Bit 5: logic output number RL7 selection Bit 6: logic output number RL8 selection Bits 7 to 15: Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F14A | Unsigned integer: R12 ... RL8 output configuration for CB \& SOTF Bit 0: logic output number RL2 selection (Recloser) Bit 1: logic output number RL3 selection (Recloser) Bit 2: logic output number RL4 selection (Recloser) Bit 3: logic output number RL5 selection (Recloser) Bit 4: logic output number RL6 selection (Recloser) Bit 5: logic output number RL7 selection (Recloser) Bit 6: logic output number RL8 selection (Recloser) Bit 7: Reserved <br> Bit 8: logic output number RL2 selection (SOTF) Bit 9: logic output number RL3 selection (SOTF) Bit 10: logic output number RL4 selection (SOTF) Bit 11: logic output number RL5 selection (SOTF) Bit 12: logic output number RL6 selection (SOTF) Bit 13: logic output number RL7 selection (SOTF) Bit 14: logic output number RL8 selection (SOTF) Bit 15: Reserved |
| F14B | Unsigned integer: RI2 ... RL8 output configuration for tAux3 \& tAux4 Bit 0: logic output number RL2 selection (tAux3) <br> Bit 1: logic output number RL3 selection (tAux3) <br> Bit 2: logic output number RL4 selection (tAux3) <br> Bit 3: logic output number RL5 selection (tAux3) <br> Bit 4: logic output number RL6 selection (tAux3) <br> Bit 5: logic output number RL7 selection (tAux3) <br> Bit 6: logic output number RL8 selection (tAux3) <br> Bit 7: Reserved <br> Bit 8: logic output number RL2 selection (tAux4) <br> Bit 9: logic output number RL3 selection (tAux4) <br> Bit 10: logic output number RL4 selection (tAux4) <br> Bit 11: logic output number RL5 selection (tAux4) <br> Bit 12: logic output number RL6 selection (tAux4) <br> Bit 13: logic output number RL7 selection (tAux4) <br> Bit 14: logic output number RL8 selection (tAux4) <br> Bit 15: Reserved |
| F14C | Unsigned integer: RI2 ... RL8 output configuration for Control Trip \& Close Bit 0: logic output number RL2 selection (Control Trip) Bit 1: logic output number RL3 selection (Control Trip) Bit 2: logic output number RL4 selection (Control Trip) Bit 3: logic output number RL5 selection (Control Trip) Bit 4: logic output number RL6 selection (Control Trip) Bit 5: logic output number RL7 selection (Control Trip) Bit 6: logic output number RL8 selection (Control Trip) Bit 7: Reserved <br> Bit 8: logic output number RL2 selection (Control Close) Bit 9: logic output number RL3 selection (Control Close) Bit 10: logic output number RL4 selection (Control Close) Bit 11: logic output number RL5 selection (Control Close) Bit 12: logic output number RL6 selection (Control Close) Bit 13: logic output number RL7 selection (Control Close) Bit 14: logic output number RL8 selection (Control Close) Bit 15: Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F14D | Unsigned integer: R12 ... RL8 output configuration for recloser trip final \& locked Bit 0: logic output number RL2 selection (recloser trip final) Bit 1: logic output number RL3 selection (recloser trip final) Bit 2: logic output number RL4 selection (recloser trip final) Bit 3: logic output number RL5 selection (recloser trip final) Bit 4: logic output number RL6 selection (recloser trip final) Bit 5: logic output number RL7 selection (recloser trip final) Bit 6: logic output number RL8 selection (recloser trip final) Bit 7: Reserved <br> Bit 8: logic output number RL2 selection (recloser locked) Bit 9: logic output number RL3 selection (recloser locked) Bit 10: logic output number RL4 selection (recloser locked) Bit 11: logic output number RL5 selection (recloser locked) Bit 12: logic output number RL6 selection (recloser locked) Bit 13: logic output number RL7 selection (recloser locked) Bit 14: logic output number RL8 selection (recloser locked) Bit 15: Reserved |
| F15 | Unsigned integer: digital inputs configuration, part 1/2 <br> Bit 0: auxuliary relays de-latching command <br> Bit 1: O/O <br> Bit 2: F/O <br> Bit 3: missing SF6 <br> Bit 4: aux 1 <br> Bit 5: aux 2 <br> Bit 6: blocking logic 1 <br> Bit 7: blocking logic 2 <br> Bit 8: disturbance start <br> Bit 9: cold load start <br> Bit 10: digital selection 1 <br> Bit 11: digital selection 2 <br> Bit 12: settings group change (configuration must be equal to INPUT) <br> Bit 13: recloser latched <br> Bit 14: reset thermal status <br> Bit 15: control tripping circuit |
| F15A | Unsigned integer: digital inputs configuration, part 2/2 <br> Bit 0: start Breaker Failure timer <br> Bit 1: maintenance mode <br> Bit 2: aux 3 <br> Bit 3: aux 4 <br> Bit 4: Reserved <br> Bit 5: Manual close <br> Bit 6: Local mode <br> Bits 7 to 15: Reserved |
| F16 | Unsigned integer: earth threshold (current, voltage \& power) information status Bit 0 : info limit exceeding <br> Bits 1 to 3: Reserved <br> Bit 4: le> Interlock activated <br> Bit 5: info start <br> Bit 6: info tripping <br> Bit 7: info tripping reverse mode <br> Bits 8 to 15: Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F17 | Unsigned integer: phase threshold (current, voltage \& power) information status Bit 0: info limit exceeding <br> Bit 1: phase A trip <br> Bit 2: phase B trip <br> Bit 3: phase C trip <br> Bit 4: l> Interlock activated <br> Bit 5: info start <br> Bit 6: info tripping <br> Bit 7: info tripping reverse mode <br> Bits 8 to 15: Reserved |
| F18 | Signed long integer: numeric data : -231 ..... 231 |
| F18A | Unsigned long integer: numeric data : $1 . . . . .232$ |
| F19 | Unsigned integer: leds configuration mask - part 1/4 <br> Bit 0: l> <br> Bit 1: tl> <br> Bit 2: l>> <br> Bit 3: tl>> <br> Bit 4: l>>> <br> Bit 5: tl>>> <br> Bit 6: le> <br> Bit 7: tle> <br> Bit 8: le>> <br> Bit 9: tle>> <br> Bit 10: le>>> <br> Bit 11: tle>>> <br> Bit 12: $\theta$ trip <br> Bit 13: tl2> <br> Bit 14: broken conductor trip <br> Bit 15: breaker failure trip |
| F19A | Unsigned integer: leds configuration mask - part 2/4 <br> Bit 0: digital input 1 <br> Bit 1: digital input 2 <br> Bit 2: digital input 3 <br> Bit 3: digital input 4 <br> Bit 4: digital input 5 <br> Bit 5: recloser running <br> Bit 6: recloser latched <br> Bit 7: aux1 trip <br> Bit 8: aux2 trip <br> Bit 9: Pe/lecos> <br> Bit 10: tPe/lecos> <br> Bit 11: Pe/lecos>> <br> Bit 12: tPe/lecos>> <br> Bit 13: Ue>>>> <br> Bit 14: tUe>>>> <br> Bit 15: SOTF |


| CODE | DESCRIPTION |
| :---: | :---: |
| F19B | Unsigned integer: leds configuration mask - part 3/4 <br> Bit 0: U> <br> Bit 1: tU> <br> Bit 2: U>> <br> Bit 3: tU>> <br> Bit 4: U< <br> Bit 5: $\mathrm{tU}<$ <br> Bit 6: $U \ll$ <br> Bit 7: tU<< <br> Bit 8: tl2>> <br> Bit 9: $\mathrm{tl}<$ <br> Bit 10: tl> phase A <br> Bit 11: tl> phase B <br> Bit 12: tl> phase C <br> Bit 13: digital input 6 <br> Bit 14: digital input 7 <br> Bit 15: tl2>>> |
| F19C | Unsigned integer: leds configuration mask - part 4/4 <br> Bit 0: 12> <br> Bit 1: 12>> <br> Bit 2: 12>>> <br> Bit 3: < <br> Bits 4 to 15: Reserved |
| F20 | Unsigned integer: logic inputs data status, part 1/2 <br> Bit 0: logic selection 1 <br> Bit 1: logic selection 2 <br> Bit 2: relays de-latching <br> Bit 3: CB position (52a) <br> Bit 4: CB position (52b) <br> Bit 5: external CB failure <br> Bit 6: aux 1 <br> Bit 7: aux 2 <br> Bit 8: blocking logic 1 <br> Bit 9: blocking logic 2 <br> Bit 10: disturbance recording start <br> Bit 11: cold load start <br> Bit 12: settings group change <br> Bit 13: recloser locked <br> Bit 14: thermal status reset <br> Bit 15: trip circuit supervision |
| F20A | Unsigned integer: logic inputs data status, part 2/2 <br> Bit 0: start Breaker Failure timer <br> Bit 1: maintenance mode <br> Bit 2: aux 3 <br> Bit 3: aux 4 <br> Bit 4: Reserved <br> Bit 5: Manual close <br> Bit 6: Local mode <br> Bits 7 to 15: Reserved |
| F21 | Unsigned integer: software version (Dec value) : 00-99 (XY) <br> $X$ digit $=$ Version number 0-9 <br> Y digit = Revision number 0 (A) - 9 (J) |
| F22 | Unsigned integer : internal logic data Bit 0: RL1 trip relay status Bits 1 to 15: Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F23 | Unsigned integer : machine status <br> Bit 0 : major material alarm <br> Bit 1 : minor material alarm <br> Bit 2 : presence of a non-acknowledged event <br> Bit 3 : synchronisation state <br> bit 4 : presence of a non-acknowledged disturbance recording <br> Bit 5 : presence of a non-acknowledged fault record <br> Bits 6 to 15: Reserved |
| F24 | Unsigned integer: generic info operating mode 0 : out of service / not active <br> 1: in service / active |
| F24A | Unsigned integer: 67 and 67 N operating mode 0 : NO <br> 1: YES <br> 2: DIR <br> 3: PEAK |
| F24B | Unsigned integer: threshold operating mode 0: NO <br> 1: AND <br> 2: OR |
| F24C | Unsigned integer: 32N protection operating mode <br> 0 : Pe type mode seuil <br> 1: leCos type mode seuil |
| F25 | Unsigned integer: 2 ASCII characters |
| F26 | Unsigned integer: default display configuration <br> 1 : IA measurement display (True RMS) <br> 2 : IB measurement display (True RMS) <br> 3 : IC measurement display (True RMS) <br> 4 : IN measurement display (True RMS) |
| F27 | Unsigned integer: RL1 ... RL8 output relays latch configuration and status <br> Bit 0: relay number 1 (RL1) <br> Bit 1: relay number 2 (RL2) <br> Bit 2: relay number 3 (RL3) <br> Bit 3: relay number 4 (RL4) <br> Bit 4: relay number 5 (RL5) <br> Bit 5: relay number 6 (RL6) <br> Bit 6: relay number 7 (RL7) <br> Bit 7: relay number 8 (RL8) <br> Bits 8 to15: Reserved |
| F28 | Unsigned integer: Modbus parameters - data bits number. <br> 0: 7 data bits <br> 1: 8 data bits |
| F29 | Unsigned integer: Modbus and DNP3 stop bits number 0 : one stop bit <br> 1: two stop bits |
| F30 | Unsigned integer: communication status + Private telegram option (IEC870-5-103 only) Bit 0 : communication available if $=1$ <br> Bit 1: IEC870-5-103 private telegrams used if $=1$, else IEC870-5-103 telegrams in public range only. |


| CODE | DESCRIPTION |
| :---: | :---: |
| F31 | Unsigned integer: number of available events records 0: no event records available <br> 1: one events record available <br> 2: two events records available <br> 3: three events records available <br> 4: four events records available <br> 5: five events records available |
| F32 | Unsigned integer: disturbance recording configuration <br> 0: disturbance recording start condition on protection START <br> 1: disturbance recording start condition on protection TRIPPING |
| F33 | Unsigned integer: cold load start thresholds Bit 0: tl> <br> Bit 1: tl>> <br> Bit 2: tl>>> <br> Bit 3: tle> <br> Bit 4: tle>> <br> Bit 5: tle>>> <br> Bit 6: $\theta$ trip <br> Bit 7: tl2> <br> Bit 8: tl2>> <br> Bit 9: tl2>>> <br> Bits 10 to 15: Reserved |
| F34 | Unsigned integer: threshold reset timer type <br> 0: DMT <br> 1: IDMT |
| F35 | Unsigned integer: disturbance recording status <br> 0 : no disturbance recording uploaded <br> 1: disturbance recording upload running |
| F36 | Unsigned integer: non acknowledged memorised alarms flags - part 1/4 <br> Bit 0: le> <br> Bit 1: tle> <br> Bit 2: le>> <br> Bit 3: tle>> <br> Bit 4: le>>> <br> Bit 5: tle>>> <br> Bit 6: tle>REV <br> Bit 7: tle>> REV <br> Bit 8: tle>>>REV <br> Bit 9: thermal alarm ( $\theta$ alarm) <br> Bit 10: thermal trip ( $\theta$ trip) <br> Bit 11: broken conductor trip <br> Bit 12: breaker failure trip <br> Bit 13: Reserved <br> Bit 14: AUX1 trip <br> Bit 15: AUX2 trip |


| CODE | DESCRIPTION |
| :---: | :---: |
| F36A | Unsigned integer: non acknowledged memorised alarms flags - part 2/4 <br> Bit 0 : CB operating time overreach <br> Bit 1 : CB operation number overreach <br> Bit 2 : square Amps sum overreach <br> Bit 3 : trip circuit supervision <br> Bit 4 : CB closing time overreach <br> Bit 5: AND logic equation A trip <br> Bit 6: AND logic equation $B$ trip <br> Bit 7: AND logic equation C trip <br> Bit 8: AND logic equation D trip <br> Bit 9: Pe/lecos> <br> Bit 10: $\mathrm{tPe} / \mathrm{lecos}>$ <br> Bit 11: Pe/lecos>> <br> Bit 12: tPe/lecos>> <br> Bit 13: 12> <br> Bit 14: tl2> <br> Bit 15: SOTF |
| F36B | Unsigned integer: non acknowledged memorised alarms flags - part 3/4 <br> Bit 0: U< <br> Bit 1: $\mathrm{tU}<$ <br> Bit 2: $U \ll$ <br> Bit 3: $\mathrm{UU} \ll$ <br> Bit 4: U> <br> Bit 5: tU> <br> Bit 6: U>> <br> Bit 7: tU>> <br> Bit 8: Ue>>>> <br> Bit 9: tUe>>>> <br> Bit 10 : recloser locked <br> Bit 11 : recloser successful <br> Bit 12: 12>> <br> Bit 13: tl2>> <br> Bit 14: $12 \ggg$ <br> Bit 15: tl2>>> |
| F36C ${ }^{3}$ | Unsigned integer: non acknowledged memorised alarms flags - part 4/4 <br> Bit 0: AUX3 trip <br> Bit 1: AUX4 trip <br> Bit 2: l> (old format before release V6: address 001Ah bit 5) <br> Bit 3: tl> (old format before release V6: address 001Dh bit 6)Bit 4: l>> (old format before release V6: address 001Bh bit 5)Bit 5: tl>> (old format before release V6: address 001Eh bit 6)Bit 6: l>>> (old format before release V6: address 001Ch bit 5)Bit 7: tl>>>(old format before release V6: address 001Fh bit 6)Bit 8: l< (old format before release V6: address 0024h bit 5) <br> Bit 9: $\mathrm{tl} \quad$ (old format before release V6: address 0024h bit 6)Bit 10: VTS <br> Bits 11 to 15: Reserved |
| F37 | Unsigned integer: thermal overload information Bit 0 : thermal overload alarm <br> Bit 1 : thermal overload trip <br> Bits 2 to 15: Reserved |

[^1]| CODE | DESCRIPTION |
| :---: | :---: |
| F38 | Unsigned integer: accessory functions - part 1/2 <br> Bit 0: SOTF running <br> Bit 1: CB failure <br> Bit 2: pole A opening <br> Bit 3: pole B opening <br> Bit 4: pole C opening <br> Bit 5: broken conductor <br> Bit 6: Aux 1 trip <br> Bit 7: Aux 2 trip <br> Bit 8: broken conductor time delay <br> Bit 9: CB failure time delay <br> Bit 10: cold load pick up time delay <br> Bit 11: CB alarms or bits 0, 1, 4 of F43 <br> Bit 12: Aux 3 trip <br> Bit 13: Aux 4 trip <br> Bit 14: Start SOTF <br> Bit 15: Trip SOTF |
| F38A | Unsigned integer: accessory functions - part 2/2 <br> Bit 0: l>> Blocked <br> Bit 1: l>>> Blocked <br> Bit 2: VTS <br> Bit 3: V2> <br> Bit 4: V2>> <br> Bits 5 to 15: Reserved |
| F39 | Unsigned integer : output relay remote word in maintenance mode Bit 0: RL1 (trip) <br> Bit 1: RL2 <br> Bit 2: RL3 <br> Bit 3 : RLO (watch-dog) <br> Bit 4: RL4 <br> Bit 5: RL5 <br> Bit 6: RL6 <br> Bit 7: RL7 <br> Bit 8: RL8 <br> Bits 9 to15: Reserved |
| F40 | Unsigned integer: selective scheme logic configuration <br> Bit 0: tl>> <br> Bit 1: tl>>> <br> Bit 2: tle>> <br> Bit 3: tle>>> <br> Bits 4 to 15: Reserved |
| F41 | Unsigned integer: remote communication configuration <br> 0 : front and rear MODBUS <br> 1 : front MODBUS rear IEC 60870-5-103 <br> 2 : front MODBUS rear COURIER <br> 3 : front MODBUS rear DNP3. 0 |
| F42 | ```Unsigned integer: max \& average current + voltage time window selection (dec values) 5: 5 min 10: 10 min 15: 15 min 30: 30 min 60: 60 min``` |


| CODE | DESCRIPTION |
| :---: | :---: |
| F43 | Unsigned integer <br> Bit 0: CB operating time overreach <br> Bit 1: CB operation number overreach <br> Bit 2: square Amps sum overreach <br> Bit 3: trip circuit supervision <br> Bit 4: CB closing time overreach <br> Bit 5: recloser locked <br> Bit 6: recloser successful <br> Bit 7: recloser in progress <br> Bit 8: closing command issued from recloser cycle <br> Bit 9: recloser configuration error <br> Bit 10: recloser in service (IEC 60870-5-103 only) <br> Bits 11: recloser final trip <br> Bits 12 to 15: Reserved |
| F44 | Reserved |
| F45 | Unsigned integer: HW alarm relay status <br> Bit 0: Watch-Dog operating <br> Bit 1: communication failure <br> Bit 2: EEPROM data failure <br> Bit 3: analogue failure <br> Bit 4: datation failure <br> Bit 5: EEPROM calibration failure <br> Bit 6: SRAM failure <br> Bit 7: battery failure <br> Bit 8: Reserved <br> Bit 9: factory alarm (default factory configuration reloaded) <br> Bits 10 to 15: Reserved |
| F46 | Unsigned integer: le harmonic content extraction Bit 0: calculation active Bits 1 to 15: Reserved |
| F47 | Unsigned integer: digital inputs operating mode Bit $\mathrm{x}=$ <br> $0 \rightarrow$ active when de-energized <br> $1 \rightarrow$ active when energized; <br> Bit 0 : input 1 <br> Bit 1 : input 2 <br> Bit 2 : input 3 <br> Bit 3 : input 4 <br> Bit 4 : input 5 <br> Bit 5 : input 6 <br> Bit 6 : input 7 |
| F48 | Unsigned integer: AND logic equations status Bit 0: Reserved <br> Bit 1: AND logic equation A trip <br> Bit 2: AND logic equation B trip <br> Bit 3: AND logic equation C trip <br> Bit 4: AND logic equation D trip <br> Bits 5 to 15: Reserved |
| F49 | Unsigned integer: calibration status flag 0: calibration KO <br> 1: calibration OK |


| CODE | DESCRIPTION |
| :---: | :---: |
| F50 | Unsigned integer: remote control word number 3 <br> Bit 0: flag sync. harmonic earth current <br> Bit 1: Reserved <br> Bit 2: energy reset <br> Bit 3: Reserved <br> Bit 4: rolling average values reset <br> Bit 5: rolling max subperiod values reset <br> Bits 6 to 15: Reserved |
| F51 | Unsigned integer: digital inputs signal type $\begin{aligned} & \text { 0: DC } \\ & \text { 1: AC } \end{aligned}$ |
| F52 | Unsigned integer: date and time format (IEC 60870-5-103 only) 0: internal format (see «page 8H" description) <br> 1: IEC |
| F53 | Unsigned integer: IEC 60870-5-103 and DNP3.0 communication speed (Baud) INTERNAL USE ONLY <br> IEC 60870-5-103: $0: 9600$ $\text { 1: } 19200$ <br> DNP3.0: <br> 1: 600 <br> 0: 1200 <br> 1: 2400 <br> 2: 4800 <br> 3: 9600 <br> 4: 19200 <br> 5: 38400 |
| F54 | Unsigned integer: Digital inputs configuration mode, part 1/2: <br> Bit $x=0 \rightarrow$ level $/ 1 \rightarrow$ edge <br> Bit 0: logic selection 1; operating only on level; not configurable (0) <br> Bit 1: logic selection 2; operating only on level; not configurable (0) <br> Bit 2: relays de-latching; operating only on level; not configurable (0) <br> Bit 3: CB position (52a) ; operating only on level; not configurable (0) <br> Bit 4: CB position (52b) ; operating only on level; not configurable (0) <br> Bit 5: external CB failure; operating only on level; not configurable (0) <br> Bit 6: tAux 1; operating only on level; not configurable (0) <br> Bit 7: tAux 2; operating only on level; not configurable (0) <br> Bit 8: blocking logic 1; operating only on level; not configurable (0) <br> Bit 9: blocking logic 2; operating only on level; not configurable (0) <br> Bit 10: disturbance recording start; operating only on edge; not configurable (1) <br> Bit 11: cold load start; operating only on level; not configurable (0) <br> Bit 12: settings group change ; Attention: $0 \rightarrow$ Input / $1 \rightarrow$ Menu <br> Bit 13: recloser locked; operating only on level; not configurable (0) <br> Bit 14: thermal status reset; operating only on edge; not configurable (1) <br> Bit 15: trip circuit supervision; operating only on level; not configurable (0) |
| F54A | Unsigned integer: Digital inputs configuration mode, part2/2: <br> Bit $x=0 \rightarrow$ level $/ 1 \rightarrow$ edge <br> Bit 0: start Breaker Failure timer; operating only on edge; not configurable (1) <br> Bit 1: maintenance mode; operating only on level; not configurable (0) <br> Bit 2: tAux 3; operating only on level; not configurable (0) <br> Bit 3: tAux 4; operating only on level; not configurable (0) <br> Bit 4: Reserved <br> Bit 5: Manual close; operating only on level; not configurable (0) <br> Bit 6: Local mode; operating only on level; not configurable (0) <br> Bits 7 to 15: Reserved |


| CODE | DESCRIPTION |
| :--- | :--- |
| F55 | Unsigned integer: active group <br> 1: settings group 1 <br> 2: settings group 2 |
| F56 | Unsigned integer: RL1 digital ouput operating mode <br> o $\rightarrow$ normally de-energized; <br> 1 $\rightarrow$ normally energized |
| F57 | Unsigned integer: recloser cycles configuration <br> Bit 0: Cycle 1 configuration (trip and initialize the reclosure) <br> Bit 1: Cycle 1 configuration (block the tripping on cycle) <br> Bit 2, Bit 3: Reserved <br> Bit 4: Cycle 2 configuration (trip and initialize the reclosure) <br> Bit 5: Cycle 2 configuration (block the tripping on cycle) <br> Bit 6, Bit 7: Reserved <br> Bit 8: Cycle 3 configuration (trip and initialize the reclosure) <br> Bit 9: Cycle 3 configuration (block the tripping on cycle) <br> Bit 10, Bit 11: Reserved <br> Bit 12: Cycle 4 configuration (trip and initialize the reclosure) <br> Bit 13: Cycle 4 configuration (block the tripping on cycle) <br> Bit 14, Bit 15: Reserved |
| F58 | Unsigned integer: Switch onto fault configuration <br> Bit 0: Start t>> <br> Bit 1: Start l>>> <br> Bits 2 to 14: Reserved <br> Bit 15: SOTF on/off |
| F59 | Unsigned integer: 51V configuration <br> Bit 0: (U< OR V2>) \& I>> ? yes/no <br> Bit 1: (U<< OR V2>>) \& I>> ? yes/no <br> Bits 3 to 15: Reserved |
| F60 | Unsigned integer: VTS configuration <br> Bit 0: VTS Alarm ? yes/no <br> Bit 1: VTS Blocks 51V ? yes/no <br> Bits 2 to 15: Reserved |


| CODE | DESCRIPTION |
| :---: | :---: |
| F61 | Unsigned integer: Information on the starting origin of the RL1 trip relay 01 - Remote X1 trip <br> 02- $\theta$ trip (Thermal overload) <br> 03 - l> trip <br> 04 - l>> trip <br> 05-l>>> trip <br> 06 - le> trip <br> 07 - le>> trip <br> 08 - le>>> trip <br> 09 - 1< trip <br> 10 - Broken conductor trip <br> 11-U<trip <br> 12-U<<trip <br> 13-Pe/lecos> trip <br> 14 - $\mathrm{Pe} / \mathrm{lecos} \gg$ trip <br> 15-12> trip <br> 16-12>> trip <br> 17-12>>> trip <br> $18-U>$ trip <br> 19 - U>> trip <br> 20-Ue>>>> trip <br> 21-Aux 1 trip <br> 22-Aux 2 trip <br> 23 - AND Logic equate A trip <br> 24 - AND Logic equate B trip <br> 25 - AND Logic equate C trip <br> 26-AND Logic equate D trip <br> 27-Aux 3 trip <br> 28-Aux 4 trip <br> 29-SOTF |

### 2.4.3 Disturbance record additional information

2.4.3.1 MODBUS request definition used for disturbance record

To upload a disturbance record, the following requests must be done in the exact given order:

1. (optional): Send a request to know the number of disturbance records available in SRAM.
2. (compulsory): Send a request with the record number and the channel number.
3. (compulsory): Send one or several requests to upload the disturbance record data. It depends of the number of samples.
4. (compulsory): Send a request to upload the index frame.
2.4.3.2 Request to know the number of disturbance records in SRAM

| Slave number | Function code | Word address | Word number | CRC |  |  |  |
| :--- | :--- | :--- | :---: | :--- | :---: | :--- | :--- |
| Xx | 03 h | 3 Dh | 00 | 00 | 24 h | xx | xx |

This request may generate an error message with the error code :
EVT_NOK(OF): No record available
NOTE: If there are less than 5 records available, the answer will contain zero in non-used words.

### 2.4.3.3 Service requests

This request must be sent before uploading the disturbance record channel samples. It allows knowing the record number and the channel number to upload.

It allows also knowing the number of samples in the channel.

| Slave number | Function code | Word address | Word number | CRC |  |  |
| :--- | :--- | :--- | :--- | :---: | :--- | :--- |
| $x x$ | 03 h | Refer to mapping | 00 | 13 h | xx | xx |

This request may generate an error message with two different error codes:

| CODE_DEF_RAM(02) : | SRAM failure |
| :--- | :--- |
| CODE_EVT_NOK(03) : | no disturbance record available in SRAM |

2.4.3.4 Disturbance record upload request

| Slave number | Function code | Word address | Word number | CRC |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| xx | 03 h | Refer to mapping | 01 to 7Dh | xx | xx |

This request may geberate an error message with two different error codes :
CODE_DEP_DATA(04) : The required disturbance data number is greater than the memorised number.

CODE_SERV_NOK(05) : The service request for disturbance record and channel number has not been sent.
2.4.3.5 Index frame upload request

| Slave number | Function code | Word address | Word number | CRC |  |  |  |
| :--- | :--- | :--- | :---: | :--- | :---: | :--- | :--- |
| $x \mathrm{xx}$ | 03 h | 22 h | 00 | 00 | 07 h | xx | xx |

This request may generate an error message with an error code:
CODE_SERV_NOK(05): The service request for disturbance record and channel number has not been sent.

### 2.4.4 Request to retrieve the oldest non-acknowledge event

Two ways can be followed to retrieve an event record:
Send a request to retrieve the oldest non-acknowledged event.
Send a request to retrieve a dedicated event.

| Slave number | Function code | Word address | Word number | CRC |  |  |  |
| :--- | :--- | :--- | :---: | :--- | ---: | :--- | :--- |
| xx | 03 h | 36 h | 00 | 00 | 09 h | xx | xx |

This event request may generate an error message with the error code :
EVT_EN_COURS_ECRIT (5) : An event is being written into the saved RAM.
NOTE: On event retrieval, two possibilities exist regarding the event record acknowledgement:

- Automatic event record acknowledgement on event retrieval: Bit12 of the remote order frame (format F9 - mapping address 0400 h ) shall be set to 0 . On event retrieval, this event record is acknowledged.
- Non automatic event record acknowledgement on event retrieval: Bit12 of the remote order frame (format F9 - mapping address 0400 h ) shall be set to 1 . On event retrieval, this event record is not acknowledged.
To acknowledge this event, another remote order shall be sent to the relay. Bit 13 of this frame (format F9 - mapping address 0400h) shall be set to 1 .
2.4.5 Request to retrieve a dedicated event

| Slave number | Function code | Word address | Word number | CRC |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| xx | 03 h | Refer to mapping | 00 | 09 h | xx |
| xx | xx |  |  |  |  |

This event request may generate an error message with the error code :
EVT_EN_COURS_ECRIT (5) : An event is being written into the saved RAM.
NOTE: This event retrieval does not acknowledge this event.
2.4.6 Modbus request definition used to retrieve the fault records

Two ways can be followed to retrieve a fault record:

1. Send a request to retrieve the oldest non-acknowledge fault record.
2. Send a request to retrieve a dedicated fault record.
2.4.6.1 Request to retrieve the oldest non-acknowledge fault record

| Slave number | Function code | Word address | Word number | CRC |  |  |  |
| :--- | :--- | :--- | :---: | :--- | :---: | :--- | :--- |
| xx | 03 h | 3 Eh | 00 | 00 | 18 h | xx | xx |

NOTE: On fault retrieval, two possibilities exist regarding the fault record acknowledgement:

- Automatic fault record acknowledgement on event retrieval: Bit12 of the remote order frame (format F9 - mapping address 0400h) shall be set to 0 . On fault retrieval, this fault record is acknowledged.
- Non automatic fault record acknowledgement on fault retrieval: Bit12 of the remote order frame (format F9 - mapping address 0400 h ) shall be set to 1 . On fault retrieval, this fault record is not acknowledged.
To acknowledge this fault, another remote order shall be sent to the relay. Bit 14 of this frame (format F9 - mapping address 0400h) shall be set to 1 .
2.4.6.2 Request to retrieve a dedicated fault record

| Slave number | Function code | Word address | Word number | CRC |  |  |
| :--- | :--- | :--- | :--- | :---: | :--- | :--- |
| xx | 03 h | Refer to mapping | 00 | 18 h | xx | xx |

NOTE: This fault value retrieval does not acknowledge this fault record.

## 3. IEC 60870-5-103 PROTOCOL

### 3.1 General information

Messages representation is expressed with the associated :

```
- INFORMATION NUMBER:
INF
```

- ASDU TYPE:

TYP

- CAUSE OF TRANSMISSION:

COT

- FUNCTION NUMBER: FUN


### 3.2 Spontaneous messages

These messages include a sub-assembly of the events, which are generated on the relay.
The messages considered are concerning highest priority events.
An event is always generated on the rising edge of the information; some can be generated also on falling edge.

In the list below, events generated only on rising edge will be tagged with a '*'.
3.2.1 Time Tagged Message

Two types of ASDU can be generated for events:

- ASDU 1 : time-tagged message
- ASDU 2 : time-tagged message with relative time

The following list of processed events is the list with the private messages option active, where FUNCTION NUMBERS (FUN) 160 and 161 are used for Public range, respectively for current and voltage protections data, and FUNCTION NUMBERS (FUN) 168 and 169 are used for Private range, respectively for current and voltage protections data. The corresponding event numbers with private messages option inactive are given just below.
3.2.2 Status Indications

Status indications (monitor direction) :

- Autorecloser active:
- LEDS reset:
- Local parameter Setting active:
- $\quad$ Setting group number 1 active:
- $\quad$ Setting group number 2 active:
- Auxiliary input 1 :
- Auxiliary input 2 :
- Auxiliary input 3 :
- Auxiliary input 4:
- Logical input 1:
with private option inactive:
- Logical input 2:
with private option inactive:

FUN<160>; INF <16>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <19>; TYP <1>; COT<1>,*
FUN<160>; INF <22>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <23>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <24>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <27>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <28>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <29>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <30>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <160>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <161>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <161>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <162>; TYP <1>; COT<1> $\uparrow \downarrow$

- Logical input 3:
with private option inactive:
- Logical input 4:
with private option inactive:
- Logical input 5 :
with private option inactive:
Logical input 6:
with private option inactive:
- Logical input 7:
with private option inactive:
- Logical output 1:
with private option inactive:
- Logical output 2:
with private option inactive:
- Logical output 3 :
with private option inactive:
- Logical output 4:
with private option inactive:
- Watch Dog:
with private option inactive:
- Logical output 5:
with private option inactive:
- Logical output 6:
with private option inactive:
- Logical output 7:
with private option inactive:
- Logical output 8:
with private option inactive:
Supervision Indications (monitor direction)
- Trip Circuit Supervision :

Start Indications (monitor direction) :

- Start l>
with private option inactive:
- $\quad$ Start l>>:
with private option inactive:

FUN<168>;INF <162>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <163>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <163>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <164>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <164>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <165>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <165>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <166>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <166>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <167>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <176>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <176>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <177>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <177>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <178>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <178>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <179>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <179>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <180>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <180>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <181>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <181>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <182>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <182>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <183>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <183>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <184>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <184>; TYP <1>; COT<1> $\uparrow \downarrow$

FUN<160>;INF <36>; TYP <1>; COT<1> $\downarrow \downarrow$

FUN<168>;INF <9>; TYP <2>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <64>; TYP <2>; COT<1> $\downarrow \downarrow$
FUN<168>;INF <10>; TYP <2>; COT<1> $\downarrow$
FUN<160>;INF <65>; TYP <2>; COT<1> $\downarrow$

- Start l>>>:
- $\quad$ Start $\operatorname{IN}>$ :
with private option inactive:
- Start IN>>:
with private option inactive:
- $\quad$ Start $\operatorname{IN} \ggg$ :
with private option inactive:
- Start / pick-up N :
- Start l <:
with private option inactive:
- Start 12>:
with private option inactive:
- Start l2>>:
with private option inactive:
- Start 12>>>:
with private option inactive:
- General Start / pick-up :
- $\quad$ Start U<:
with private option inactive:
- $\quad$ Start U<<:
with private option inactive:
- Start U>:
with private option inactive:
- Start U>>:
with private option inactive:
- Start UN>>>>:
with private option inactive:
- Start PN>:
with private option inactive:
- Start PN>:
with private option inactive:
- $\quad 51 \mathrm{~V}$ : l>> blocked:
- 51 V : l>>> blocked:
- Start VTS:
- Start V2>:

FUN<168>;INF <11>; TYP <2>; COT<1> $\downarrow$ FUN < 160 ; INF <66>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<168>;INF <12>; TYP <2>; COT<1> $\downarrow$ FUN < 160>; INF <96>; TYP <2>; COT<1> $\downarrow$ FUN<168>;INF <13>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<160>;INF <97>; TYP <2>; COT<1> $\downarrow$ FUN<168>;INF <14>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<160>;INF <98>; TYP <2>; COT<1> $\downarrow$ FUN<160>;INF <67>; TYP <2>; COT<1> $\downarrow$ FUN<168>;INF <73>; TYP <2>; COT<1> $\downarrow$ FUN<160>;INF <100>; TYP <2>; COT<1> $\uparrow$ FUN<168>;INF <57>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<160>;INF <104>; TYP <2>; COT<1> $\downarrow$ FUN<168>;INF <74>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<160>;INF <106>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<168>;INF <76>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<160>;INF <108>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<160>;INF <84>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<169>;INF <73>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<161>;INF <98>; TYP <2>; COT<1> $\downarrow$ FUN<169>;INF <100>; TYP <2>; COT<1> $\downarrow$ FUN<161>;INF <100>; TYP <2>; COT<1> $\uparrow$ FUN<169>;INF <9>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN <161>;INF <64>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<169>;INF <10>; TYP <2>; COT<1> $\downarrow$ FUN<161>;INF <65>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<169>;INF <14>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<161>;INF <97>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<169>;INF <84>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<161>;INF <78>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<169>;INF <85>; TYP <2>; COT<1> $\downarrow$ FUN < 161>;INF <80>; TYP <2>; COT<1> $\downarrow$ FUN<169>;INF <134>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<169>;INF <135>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<169>;INF <136>; TYP <2>; COT<1> $\uparrow \downarrow$ FUN<169>;INF <137>; TYP <2>; COT<1> $\downarrow$

- $\quad$ Start V2>>:
- Start Therm:
with private option inactive:
Fault Indications (monitor direction):
- General Trip:
- Trip L1:
- Trip L2:
- Trip L3:
- Trip l>:
- Trip l>>:
- Trip l>>>:
with private option inactive:
- $\quad$ Trip l :
with private option inactive:
- Trip IN>:
- Trip IN>>:
- Trip $\operatorname{IN} \ggg$ :
with private option inactive:
- Trip I2>:
with private option inactive:
- Trip l2>>
with private option inactive:
- Trip 12>>>:
with private option inactive:
- Trip U<:
with private option inactive:
- Trip U<<:
with private option inactive:
- Trip U>:
with private option inactive:
- Trip U>>:
with private option inactive:
- Trip UN>>>>:
with private option inactive:
- Trip PN $>$
with private option inactive:

FUN<169>;INF <138>; TYP <2>; COT<1> $\uparrow \downarrow$
FUN < 168>;INF <15>; TYP <2>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <110>; TYP <2>; COT<1> $\downarrow$

FUN <160>;INF <68>; TYP <2>; COT<1>,* FUN<160>;INF <69>; TYP <2>; COT<1>,* FUN<160>;INF <70>; TYP <2>; COT<1>,* FUN <160>;INF <71>; TYP <2>; COT<1>,* FUN<160>;INF <90>; TYP <2>; COT<1>,* FUN<160>;INF <91>; TYP <2>; COT<1>,* FUN <168>;INF <19>; TYP <2>; COT<1>,* FUN<160>;INF <94>; TYP <2>; COT<1>,* FUN <168>;INF <23>; TYP <2>; COT<1>,* FUN<160>;INF <101>; TYP <2>; COT<1>,* FUN<160>;INF <92>; TYP <2>; COT<1>,* FUN<160>;INF <93>; TYP <2>; COT<1>,* FUN<168>;INF <22>; TYP <2>; COT<1>,* FUN<160>;INF <95>; TYP <2>; COT<1>,* FUN <168>;INF <58>; TYP <2>;COT<1>,* FUN<160>;INF <105>; TYP <2>; COT<1>,* FUN<168>;INF <75>; TYP <2>; COT<1>,* FUN $<160$; INF <107>; TYP <2>; COT<1>,* FUN<168>;INF <77>; TYP <2>; COT<1>,* FUN<160>;INF <109>; TYP <2>; COT<1>,* FUN <169>;INF <23>; TYP <2>; COT<1>,* FUN <161>;INF <99>; TYP <2>; COT<1>,* FUN<169>;INF <101>; TYP <2>; COT<1>,* FUN <161>;INF <101>; TYP <2>; COT<1>,* FUN <169>;INF <90>; TYP <2>; COT<1>,* FUN<161>;INF <90>; TYP <2>; COT<1>,* FUN<169>;INF <91>; TYP <2>; COT<1>,* FUN<161>;INF <91>; TYP <2>; COT<1>,* FUN<169>;INF <22>; TYP <2>; COT<1>,* FUN<161>;INF <95>; TYP <2>; COT<1>,* FUN<169>;INF <86>; TYP <2>; COT<1>,* FUN<161>;INF <79>; TYP <2>; COT<1>,*

- Trip PN>:
with private option inactive:
- Trip Therm:
with private option inactive:
- Breaker failure trip:
- Broken conductor trip:
with private option inactive:
- Local Mode (input):
- Manual Close (SOTF, input):
- SOTF trip:
- AND Logic Equate A trip:
with private option inactive:
- AND Logic Equate B trip:
with private option inactive:
- AND Logic Equate C trip:
with private option inactive:
- AND Logic Equate D trip:
with private option inactive:

FUN<169>;INF <87>; TYP <2>; COT<1>,* FUN<161>;INF <81>; TYP <2>; COT<1>,* FUN<168>;INF <16>; TYP <2>; COT<1>,* FUN<160>;INF <111>; TYP <2>; COT<1>,* FUN <160>;INF <85>; TYP <2>; COT<1>,* FUN<168>;INF <39>; TYP <2>; COT<1>,* FUN<160>;INF <114>; TYP <2>; COT<1>,* FUN<168>;INF <40>; TYP <2>; COT<1>,* FUN<168>;INF <238>; TYP <2>; COT<1>,* FUN < 168>; INF <239>; TYP <2>; COT<1>,* FUN < 168>;INF <144>; TYP <2>; COT<1>,* FUN<161>;INF <86>; TYP <2>; COT<1>,* FUN < 168>;INF <145>; TYP <2>; COT<1>,* FUN<161>;INF <87>; TYP <2>; COT<1>,* FUN<168>;INF <146>; TYP <2>; COT<1>,* FUN <161>;INF <88>; TYP <2>; COT<1>,* FUN < 168>; INF <147>; TYP <2>; COT<1>,* FUN<161>;INF <89>; TYP <2>; COT<1>,*

Auto-recloser Indications (monitor direction):

- Circuit Breaker 'ON' by short-time autorecloser:

FUN<160>;INF <128>; TYP <1>; COT<1>,*

- Circuit Breaker 'ON’ by long-time autorecloser:

FUN<160>;INF <129>; TYP <1>; COT<1>,*

- Autorecloser blocked:
- CB in O/O (« closed ») position: with private option inactive:
- $\quad \mathrm{CB}$ in $\mathrm{F} / \mathrm{O}$ (" open ») position: with private option inactive:
- Trip TC:
with private option inactive:
- Close TC:
with private option inactive:

FUN<160>;INF <130>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <33>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <140>; TYP <1>; COT<1> $\downarrow$
FUN<168>;INF <34>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <141>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <1>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>; INF <142>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<168>;INF <2>; TYP <1>; COT<1> $\uparrow \downarrow$
FUN<160>;INF <143>; TYP <1>; COT<1> $\uparrow \downarrow$

### 3.3 System state

It is given in the answer to the General Interrogation (GI).
Relay state information is Class 1 data, they are systematically sent to the master station, during a General Interrogation.

The list of processed data, following a General Interrogation, is given below; it is a subassembly of the spontaneous messages list, so like spontaneous messages, these data are generated on rising and falling edge.

Status indications (monitor direction) :

- Autorecloser active:
- Local parameter Setting active:
- $\quad$ Setting group number 1 active:
- $\quad$ Setting group number 2 active:
- Auxiliary input 1 :
- $\quad$ Auxiliary input 2 :
- $\quad$ Auxiliary input 3 :
- Auxiliary input 4:
- Logical input 1:
with private option inactive:
- Logical input 2:
with private option inactive:
- Logical input 3:
with private option inactive:
- Logical input 4:
with private option inactive:
- Logical input 5:
with private option inactive:
- Logical input 6:
with private option inactive:
- Logical input 7:
with private option inactive:
- Logical output 1:
with private option inactive:
- Logical output 2:
with private option inactive:
- Logical output 3:
with private option inactive:
- Logical output 4:
with private option inactive:

FUN<160>;INF <16>; TYP <1>; COT<9>
FUN<160>; INF <22>; TYP <1>; COT<9>
FUN<160>;INF <23>; TYP <1>; COT<9>
FUN<160>;INF <24>; TYP <1>; COT<9>
FUN<160>;INF <27>; TYP <1>; COT<9>
FUN<160>;INF <28>; TYP <1>; COT<9>
FUN<160>;INF <29>; TYP <1>; COT<9>
FUN<160>;INF <30>; TYP <1>; COT<9>
FUN<168>;INF <160>; TYP <1>; COT<9>
FUN<160>;INF <161>; TYP <1>; COT<9>
FUN<168>;INF <161>; TYP <1>; COT<9>
FUN<160>;INF <162>; TYP <1>; COT<9>
FUN<168>;INF <162>; TYP <1>; COT<9>
FUN<160>;INF <163>; TYP <1>; COT<9>
FUN<168>;INF <163>; TYP <1>; COT<9>
FUN<160>;INF <164>; TYP <1>; COT<9>
FUN<168>;INF <164>; TYP <1>; COT<9>
FUN<160>;INF <165>; TYP <1>; COT<9>
FUN<168>;INF <165>; TYP <1>; COT<9>
FUN<160>;INF <166>; TYP <1>; COT<9>
FUN<168>;INF <166>; TYP <1>; COT<9>
FUN<160>;INF <167>; TYP <1>; COT<9>
FUN<168>;INF <176>; TYP <1>; COT<9>
FUN<160>;INF <176>; TYP <1>; COT<9>
FUN<168>;INF <177>; TYP <1>; COT<9>
FUN<160>;INF <177>; TYP <1>; COT<9>
FUN<168>;INF <178>; TYP <1>; COT<9>
FUN<160>;INF <178>; TYP <1>; COT<9>
FUN<168>;INF <179>; TYP <1>; COT<9>
FUN<160>;INF <179>; TYP <1>; COT<9>


Supervision Indications (monitor direction):

- Trip Circuit Supervision :

FUN<160>;INF <36>; TYP <1>; COT<9>
Fault Indications (monitor direction):

- Start / pick-up N:
- General Start / pick-up:

FUN<160>;INF <67>; TYP <2>; COT<9>
FUN<160>;INF <84>; TYP <2>; COT<9>
Auto-recloser Indications (monitor direction):

- Autorecloser blocked:
- $\quad \mathrm{CB}$ in $\mathrm{O} / \mathrm{O}$ (《 closed ») position: with private option inactive:
- $\quad \mathrm{CB}$ in F/O (« open ») position:
with private option inactive:
FUN<160>;INF <130>; TYP <1>; COT<9>
FUN<168>;INF <33>; TYP <1>; COT<9>
FUN<160>;INF <140>; TYP <1>; COT<9>
FUN<168>;INF <34>; TYP <1>; COT<9>
FUN<160>;INF <141>; TYP <1>; COT<9>


### 3.4 Processed commands

### 3.4.1 System commands

Synchronisation Command: ASDU 6
FUN<255>;INF <0>; TYP <6>; COT<8>
This command can be sent to a specific relay, or global.
The time sent by master is the time of the first bit of the frame. The relay synchronises with this time, corrected by the frame transmission delay. After updating its time, the relay sends back acknowledgement info to the master, by giving its new current time. This acknowledgement message will be an event of ASDU 6 type.

General Interrogation Initialisation command: ASDU 7
FUN<255>;INF <0>; TYP <7>; COT<9>

This command starts the relay interrogation.
The relay then sends a list of data containing the relay state (see the list described above). The GI command contains a scan number which will be included in the answers of the GI cycle generated by the GI command.

If a data has just changed before extracted by the GI, the new state is sent to the master station.

When an event is generated during the Gl cycle, the event is sent in priority, and the Gl cycle is temporarily interrupted. The end of a Gl consists in sending an ASDU 8 to the master station.

If, during a General Interrogation cycle, another GI Initialisation command is received, the previous answer is stopped, and the new Gl cycle is started.
3.4.2 General commands

Control direction: ASDU 20

- Auto-recloser On / Off: FUN<160>;INF<16>; TYP<20>; COT<20>
- LEDS Reset : this command acknowledges all alarms on Front Panel:
- $\quad$ Setting group number $1:$

FUN<160>; INF<19>; TYP<20>; COT<20>

- $\quad$ Setting group number 2

FUN<160>;INF<23>; TYP<20>; COT<20>

- Trip TC:

FUN<160>; INF<24>; TYP<20>; COT<20>
with private option inactive:
FUN<168>;INF<1>; TYP<20>; COT<20>
FUN<160>;INF <142>; TYP <20>; COT<20>

- Close TC:

FUN<168>;INF<2>; TYP<20>; COT<20>
with private option inactive:
FUN<160>;INF <143>; TYP <20>; COT<20>
After executing one of these commands, the relay sends an acknowledgement message, which contains the result of command execution.

If a state change is the consequence of the command, it must be sent in a ASDU 1 with COT 12 (remote operation).

If the relay receives another command message from the master station before sending the acknowledgement message, it will be discarded.

Commands which are not processed by the relay are rejected with a negative acknowledgement message.

### 3.5 Relay reinitialisation

In case of relay reinitialisation, the relay sends to the master station the following messages, ASDU 5 :

- relay's power on $\quad$ FUN<160>; INF <5>; TYP <5> ; COT <5>

In case of Communication reinitialisation, the relay sends to the master station the following messages, ASDU 5:

- Reset CU FUN<160>; INF <5>; TYP <3> ; COT <4>

In case of Communication reinitialisation by Reset FCB, the relay sends to the master station the following messages, ASDU 5:

- Reset FCB $\quad$ FUN<160>; INF <5>; TYP <2> ; COT <3>

Each ASDU 5 message (identification of the relay) contains the manufacturer's name in 8 ASCII characters and 4 ASCII characters containing the relay model («P127»).

### 3.6 Cyclic Messages

Only measurands can be stored in these messages.
Measurands values are stored in lower levels of communication, before polling by master station.

In ASDU $9 \quad$ FUN<160>;INF <148>; TYP <9>; COT<2>
the following values are stored (with a rate such as: 2,4 * nominal value $=4096$ ) :

- RMS la,
- RMS lb,
- RMS Ic,
- RMS Ua,
- RMS Ub,
- RMS Uc,
- $\quad \mathrm{P}$,
- $\quad$,
- Frequency (If frequency is out of bounds, the value is set to « unvalid».

In ASDU 3
FUN<160>;INF <147>; TYP <3>; COT<2>

- RMS IN,
- RMS Un.
- 
- I1,
- I2,
- $\quad$ Thermal state (in \%).


### 3.7 Disturbance record extraction

$0 \quad$ Channel 1: la current (Phase L1).
1 Channel 2: lb current (Phase L2).
2 Channel 3: Ic current (Phase L3).
3 Channel 4: IN current (Earth).
4 Channel 5: Ua voltage.
5 Channel 6: Ub voltage.
$6 \quad$ Channel 7: Uc/U0 voltage.
7 Channel 8: Frequency.
Identifiers of tags (16) transmitted in ASDU 29 (logical information) for P127:
0 Tag number 1: General start: $\quad$ FUN < 160> INF <84>
1 Tag number 2: General Trip: $\quad$ FUN <160> INF <68>
2 Tag number 3: CB Failure: $\quad$ FUN <160> INF <85>
3 Tag number 4: tl>: FUN <160> INF <90>
4 Tag number 5: tl>>: $\quad$ FUN <160> INF <91>
5 Tag number 6: tIN> (Earth): $\quad$ FUN <160> INF <92>
6 Tag number 7: tIN>> (Earth): $\quad$ FUN <160> INF <93>
7 Tag number 8: PN>: $\quad$ FUN <168> INF <86>
with private option inactive: $\quad$ FUN <160>,INF <79>
8 Tag number 9: PN>>:
with private option inactive:
9 Tag number 10: Log input 1:
with private option inactive:
10 Tag number 11: Log input 2:
with private option inactive:
11 Tag number 12: Log input 3:
with private option inactive:
12 Tag number 13: Log input 4:
with private option inactive:
13Tag number 14: Log input 5:
with private option inactive:
14 Tag number 15: Log input 6:
with private option inactive:
15 Tag number 16: Log input 7:
with private option inactive:
FUN <168> INF <87>
FUN <160>,INF <81>
FUN < 168> INF < 160>
FUN < 160>,INF <161>
FUN < 168> INF < 161>
FUN <160>,INF <162>
FUN < 168> INF < 162>
FUN < 160>,INF <163>
FUN < 168> INF < 163>
FUN <160>,INF <164>
FUN < 168> INF < 164>
FUN < 160>,INF <165>
FUN < 168> INF < 165>
FUN < 160>,INF < 166>
FUN < 168> INF < 166>
FUN < 160>,INF < 167>

## BLANK PAGE

## COMMISSIONING AND MAINTENANCE GUIDE

## CONTENT

1. REQUIREMENTS PRIOR TO COMMISSIONING ..... 3
2. COMMISSIONING TEST ENVIRONMENT ..... 4
2.1 Important notes ..... 4
2.1.1 Injection test sets ..... 4
2.1.2 Communication ..... 4
2.2 Commissioning test sheets ..... 5
3. PRODUCT VERIFICATION TESTS ..... 6
3.1 Allocation of terminals ..... 6
3.2 Electrostatic discharge (ESD) ..... 6
3.3 Visual inspection ..... 6
3.4 Earthing ..... 6
3.5 Current transformers (CT's) ..... 6
3.6 Use of a Core Balance CT for earth faults ..... 7
3.6.1 Cable shields and core CT ..... 7
3.6.2 Core CT polarity ..... 7
3.7 Auxiliary supply ..... 8
$3.8 \quad$ Logic inputs ..... 8
3.9 Logic outputs ..... 9
3.10 RS 485 rear communication ..... 9
4. SETTING CHECK ..... 10
4.1 Settings ..... 10
4.2 Measurements ..... 10
4.2.1 MiCOM P125 ..... 10
4.2.2 MiCOM P126 ..... 11
4.2.3 MiCOM P127 ..... 11
4.3 Thresholds validation ..... 12
4.3.1 MiCOM settings ..... 12
4.3.2 MiCOM P125 Settings ..... 12
4.3.3 MiCOM P126 Settings ..... 13
4.3.4 MiCOM P127 settings ..... 14
4.3.5 Earth current and neutral voltage test ..... 15
4.4 Final checks ..... 19
5. MAINTENANCE ..... 20
5.1 Equipment failure ..... 20
5.1.1 Minor fault ..... 20
5.1.2 Major fault ..... 20
5.1.3 Hardware and software faults ..... 20
5.2 Method of repair ..... 21
5.2.1 Replacing the active part ..... 21
5.2.2 Replacing the complete relay ..... 21
5.2.3 Changing the battery (MiCOM P126 \& P127 only) ..... 21
5.3 Problem solving ..... 22
5.3.1 Password lost or not accepted ..... 22
5.3.2 Communication ..... 22
5.4 MiCOM relay no longer responds ..... 22
5.4.1 A remote command is not taken in account ..... 23

## 1. REQUIREMENTS PRIOR TO COMMISSIONING

The MiCOM P125 P126 and P127 relays are fully numerical in their design, implementing all protection and non-protection functions in software. The MiCOM relays employ a high degree of self-checking and, in the unlikely event of a failure, will provide an alarm. As a result of this, the commissioning test does not need to be as extensive as with non-numerical relays (static or electromechanical).

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

- Extracting the settings applied to the relay using the appropriate setting software (preferred method)
- Via the front panel user interface.

To confirm that the product is operating correctly once the application-specific settings have been applied, a test should be performed on a single protection element.

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

Blank commissioning test and setting records are provided at the chapter P12y/EN RS of this Technical Guide for completion as required.

WARNING: BEFORE COMMISSIONING THE RELAY, THE SAFETY SECTION OF THIS TECHNICAL GUIDE MUST BE READ.

## 2. COMMISSIONING TEST ENVIRONMENT

### 2.1 Important notes

All the commissioning tests of the MiCOM P125, P126, and P127 relays are carried out by injecting currents and voltages to the secondary of the earth and/or phases CTs and VTs using appropriate injection test sets provided for this purpose.

### 2.1.1 Injection test sets

The test of directional protection within P125, P126 and P127 requires at least a phase current, phase to phase and residual voltage injection.

The test equipment must provide tools to change the phase between voltage and current.
For reasons of convenience (weight, spatial requirement, transportation), a single-phased current injection and single voltage test set is more suitable for commissioning and is able to perform all commissioning tests regarding overcurrent directional/non directional protection of MiCOM P125, P126 \& P127 relays.

Thus, the following descriptions indicate how to conduct the commissioning tests with a single-phase injection test set.
However, for certain commissioning tests, the three-phase wiring diagrams are easier to understand and in this case the description is also given in three-phase format.

## Single-phase injection test set:

- $\quad 1$ current ( 0 to 50 A ), timer (precision 1 ms ).
- 1 voltage ( 30 to 130 V ), timer (precision 1 ms )


## Three-phase injection test set:

- $\quad 3$ currents ( 0 to 50 A ), timer (precision 1 ms ).
- $\quad 3$ voltage ( 30 to 130 V ), timer (precision 1 ms )

Possibility to lag the current respect to voltage injection.

## Additional commissioning test equipment:

- 1 multimeter (precision $1 \%$ ),
- 1 connecting terminal to measure the currents exceeding 10 A (precision $2 \%$ ),

Test plugs and wires to carry out injections to the CT's secondary (dimension according to the currents injected).

### 2.1.2 Communication

Using the RS 485 communication on the rear connector of the MiCOM P125, P126 \& P127 relays or using the RS232 front port can make all commissioning test records.
All above in according to each RS 485 communication protocol (MODBUS, Courier, IEC 60870-5-103, DNP3).

### 2.2 Commissioning test sheets

Commissioning test sheets are available in the chapter P12y/EN RS of this Technical Guide.
The presentation of the Commissioning test sheets follows the description of the tests of this chapter.

The contents of these Commissioning test sheets enable you to log:

- $\quad$ The name of the relay, station and circuit
- $\quad$ The characteristics of the MiCOM P125, P126 and P127 relays
- The various settings
- The results of the protection and automation checks
- $\quad$ The result of the test records after commissioning.


## 3. PRODUCT VERIFICATION TESTS

### 3.1 Allocation of terminals

It is necessary to consult the appropriate wiring diagram provided in the chapter P12y/EN CO of this Technical Guide whilst observing the various polarities and ground/earth connection.

### 3.2 Electrostatic discharge (ESD)

Before any handling of the module (active part of the relay), please refer to the recommendations in Safety Section of this Technical Guide.

### 3.3 Visual inspection

Carefully examine the relay to see if there has been any possible deterioration following installation.

Check if the external wiring corresponds to the appropriate relay diagram or the assembly diagram. The reference number of the relay diagram is indicated on a label situated under the upper flap of the front panel.

When the relay is outside from its case, use a continuity tester to test that the current shortcircuits (phases and earth CT's) between the terminals indicated on the wiring diagram are closed.

### 3.4 Earthing

Check if the earth connection of the case situated above the rear terminal block is used to connect the relay to a local earth bar. With several relays present, make sure that the copper earth bar is properly installed for solidly connecting the earthing terminals of each case.

### 3.5 Current transformers (CT's)



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

### 3.6 Use of a Core Balance CT for earth faults

If a core balance CT is used to detect earth faults, prior to any test, the user must check the following points:

- MV or HV cable screens and core CT,
- No current flow through the MV or HV cables,
- Orientation of the core CT (P1-S1, P2-S2)
3.6.1 Cable shields and core CT

When mounting a core balance CT around electric cables, check the connection to the earth of the cable shields. It is vital that the earth cable of the shield moves in the opposite direction through the core CT . This cancels the currents carried by the cable shields through the core CT.


SCREEN SHIELDS AND CT CORE

### 3.6.2 Core CT polarity

It is necessary to check the polarity of the core CT by following the figure below :
Momentarily connect the battery + to P1 and - to P2. The centre zero ammeter connected with + to S1 and - to S2 will deflect in the positive direction if the wiring is correct.

The phase CT may be tested using the same method.


CORE CT ORIENTATION TEST
NOTE : De-magnetise the CT after polarity test. Inject an ac current starting from zero and increase to slowly exceed the CT nominal value and then decrease slowly to zero.

### 3.7 Auxiliary supply

Check the value of the auxiliary supply voltage (terminals 33 and 34). The value measured shall be between 0.8 and 1.2 times the nominal auxiliary supply voltage indicated on the MiCOM P125, P126 and P127.

You can read the Uax range of the relay under the flap on the top of front relay.

| Uaux range (Volts) | Uaux nominal zone (Volts) |
| :--- | :--- |
| $24-60 \mathrm{Vdc}$ | $19-72 \mathrm{Vdc}$ |
| $48-150 \mathrm{Vdc}$ | $38-180 \mathrm{Vdc}$ |
| $130-250 \mathrm{Vdc}$ | $100-300 \mathrm{Vdc}$ |

### 3.8 Logic inputs

This test checks that all the opto-isolated inputs are functioning correctly. The P125 has 4 opto-isolated inputs while P126 and P127 have 7 logic opto-isolated inputs.

The opto inputs should be energised a time. The status of the input can be viewed using menu OP. PARAMETERS/Input Status, a 1 indicating an energised input and a 0 indicating a de-energised input. When each logic input is energised one of the characters on the bottom line of the menu display will change to the value show in the following table to indicate the new state of the inputs.

| Input | MiCOM P12x models | OP. PARAMETERS/Inputs <br> Satuts. cell value |
| :---: | :---: | :---: |
| Opto input 1 <br> 22-24 Terminals | $\mathrm{P} 125, \mathrm{P} 126, \mathrm{P} 127$ | 0000001 |
| Opto input 2 <br> 26-28 Terminals | $\mathrm{P} 125, \mathrm{P} 126, \mathrm{P} 127$ | 0000010 |
| Opto input 3 <br> 17-19 Terminals | $\mathrm{P} 125, \mathrm{P} 126, \mathrm{P} 127$ | 0000100 |
| Opto input 4 <br> 21-23 Terminals | $\mathrm{P} 125, \mathrm{P} 126, \mathrm{P} 127$ | 0001000 |
| Opto input 5 <br> 25-27 Terminals | $\mathrm{P} 126, \mathrm{P} 127$ | 0010000 |
| Opto input 6 <br> $58-60$ Terminals | $\mathrm{P} 126, \mathrm{P} 127$ | $\mathrm{P} 126, \mathrm{P} 127$ |
| Opto input 7 <br> $57-59$ Terminals | 10000000 |  |

### 3.9 Logic outputs

This test checks that all output relays are functioning correctly. The P126 and P127 relays have 8 outputs, P125 relay has 6 outputs.

The watch dog relay is always on. In case of relay failure the watch dog relay moves to the off and the terminals 35-36 are opened.
The status of the outputs can be viewed using menu OP. PARAMETERS/ Relay Status, an indicating 1 means relay supplied and a 0 indicating means relay non-supplied. When each output relay is closed one of the characters on the bottom line of the menu display will change to the value show in the following table to indicate the new state of the output relays.

Each output contact may have its own and independent power supply (refer to wiring schemes).

| OUTPUT RELAYS | MiCOM P125 range | OP. PARAMETERS/Relay <br> Status. cell value |
| :--- | :---: | :---: |
| WD Relay Terminals 35-37 | P125, P126 and P127 | Normal close |
| RL 1 Change over type. <br> Terminals : <br> 2 Common -4 NC-6 NO | P125, P126 and P127 | 00000001 |
| RL 2 Change over type. <br> Terminals : <br> 8 Common -10 NC-12 NO | P125, P126 and P127 | 00000010 |
| RL 3 Terminals 14-16 | $\mathrm{P} 125, \mathrm{P} 126$ and P127 | 00000100 |
| RL 4 Terminals 18-20 | $\mathrm{P} 125, \mathrm{P} 126$ and P127 | 00001000 |
| RL 5 Terminals 1-3 | $\mathrm{P} 125, \mathrm{P} 126$ and P127 | 00010000 |
| RL 6 Terminals 7-8 | $\mathrm{P} 125, \mathrm{P} 126$ and P127 | 00100000 |
| RL 7 Terminals 9-11 | P126 and P127 | 01000000 |
| RL 8 Terminals 13-15 | P126 and P127 | 10000000 |

### 3.10 RS 485 rear communication

This test should only be performed where the relay is to be accessed from a remote location and will vary depending on the communication protocol being adopted (refer to label under the upper flap).

It is not the intention of the test to verify the operation of the complete system from the relay to the remote location, just the relay's rear communication port and any protocol converter necessary.

Connect a laptop PC to the RS485 rear port (via a KITZ for Courier communication) and check the communication with the appropriate command.

## 4. SETTING CHECK

The setting checks must ensure that all relay settings have been correctly applied to the relay for the specific application.

Transfer the setting file to the relay using a laptop PC running the appropriate software via the RS232 front port or the RS485 rear port.

This is the preferred setting transfer method, because it is faster and there are fewer margins for errors.

If the setting software is not used, the relay settings must be checked manually via the relay front panel interface.

## The commissioning checks are as follows:

1. Settings verify and delivery to customer
2. Validation of the measurements
3. Validation of the thresholds and associated timers.

### 4.1 Settings

Log the settings on the commissioning test sheets.

### 4.2 Measurements

The MiCOM P125 P126 P127 relays measure phase and earth currents, phase (phase to phase) voltage, zero sequence voltage as a True RMS value up to the $10^{\text {th }}$ harmonics. The value(s) indicated take account of the phase and/or earth CT ratio and VT ratio.

WARNING : MiCOM P125 P126 P127 RELAYS HAVE 1 AND 5 A CURRENT INPUTS, AND 57 -130V OR 220 - 480V VOLTAGE INPUT. CHECK THAT THE INJECTED CURRENT AND VOLTAGE ARE COMPATIBLE WITH THE SELECTED RANGE.

### 4.2.1 MiCOM P125

- $\quad$ Note the CT and neutral VT ratio.
- Energise the MiCOM P125 relay.
- Apply current to input terminals 55-56 (len=1A) or 47-48 (len=5A) and verify the IN value shown on the LCD taking in account the relevant nominal current.
- Apply earth voltage to 39-40 terminals and verify in measurements menu the UN value shown on LCD.
- Log the results to the Commissioning test sheets (Applied value and relay value displayed).


### 4.2.2 MiCOM P126

- Note the select phase and earth CTs ratio and neutral VT ratio.
- Energise the MiCOM P126 relay.
- Apply current to input terminals 49-50 $(\ln =1 A)$ or 41-42 ( $\ln =5 \mathrm{~A})$ and verify the IA value shown on the LCD.
- Apply current to input terminals 51-52 $(\ln =1 A)$ or $43-44(\ln =5 A)$ and verify the IB value shown on the LCD.
- Apply current to input terminals $53-54(\ln =1 A)$ or $45-46(\ln =5 A)$ and verify the $I C$ value shown on the LCD.
- Apply current to input terminals 55-56 (len=1A) or 47-48 (len=5A) and verify the IN values on the LCD in relay measurement menu.
- Apply earth voltage to 73-74 terminals and verify the UN values on the LCD in relay measurement menu.
- Log the results to the Commissioning test sheets (Applied values and relay values displayed).


### 4.2.3 MiCOM P127

- $\quad$ Configure the relay in CONFIGURATION-General Options item menu as: $2 \mathrm{Vph}-\mathrm{ph}+\mathrm{Vr}$ VT connection mode. (See User Guide, chapter P12y/EN FT, of this Technical Guide)
- Note the select phase and earth CTs ratio, phase voltage VTs ratio and neutral voltage VTs ratio.
- Energise the MiCOM P127 relay.
- Apply current to input terminals 49-50 $(\ln =1 A)$ or $41-42(\ln =5 A)$ and verify the $I A$ value shown on the LCD.
- Apply current to input terminals 51-52 $(\ln =1 A)$ or $43-44(\ln =5 A)$ and verify the IB value shown on the LCD.
- Apply current to input terminals $53-54(\ln =1 A)$ or $45-46(\ln =5 A)$ and verify the $I C$ value shown on the LCD.
- Apply current to input terminals 55-56 (len=1A) or 47-48 (len=5A) and verify the IN values on the LCD in relay measurement menu.
- Apply voltage to inputs terminals 69-70 and 71-72 and verify the UAB and UBC values in relay measurement menu on the LCD.
- Apply current to input terminals 55-56 (len=1A) or 47-48 (len=5A) and verify the $I N$ value in relay measurement menu on the LCD.
- Apply voltage to inputs terminals 73-74 and verify the UN value in relay measurement menu on the LCD.

Log the results to the Commissioning test sheets (Applied values and relay values displayed).

### 4.3 Thresholds validation

This test type demonstrates that the relay is operating correctly at the application specific settings.
4.3.1 MiCOM settings

Set the following thresholds for the relay-
Applying the voltage and current to terminals as in wiring diagrams in chapter P12y/EN CO of this Technical Guide.

The applied current and voltage must be great than setting value.
4.3.2 MiCOM P125 Settings

| Configuration Menu |  |  |  |
| :--- | :--- | :---: | :---: |
| Transfo. Ratio |  |  |  |
| E/Gnd CT primary | 1 A |  |  |
| E/Gnd CT Sec | 1 A |  |  |
| E/Gnd VT primary | 0.100 kV |  |  |
| E/Gnd VT Sec | 100.0 V |  |  |
| Protection Menu |  |  |  |
| le> | Yes |  |  |
| le> | 1 len |  |  |
| tle> | DT or IDMT or RI |  |  |
| tle> (if DT) | 10 s |  |  |
| Curve (if IDMT) | IEC VI or IEEE VI |  |  |
| TMS value (if IDMT) | 1 |  |  |
| K value (if RI) | 1 |  |  |
| Ue>>>> | 10 V |  |  |
| tUe>>>> | 10 s |  |  |
| Automation Menu |  |  |  |
| TRIP tle> | YES |  |  |
| TRIP tUe>>>> | YES |  |  |

### 4.3.3 MiCOM P126 Settings

| Configuration menu |  |
| :---: | :---: |
| Transfo. Ratio |  |
| Line CT primary | 1 A |
| Line CT Sec | 1 A |
| E/Gnd CT primary | 1 A |
| E/Gnd CT Sec | 1 A |
| E/Gnd VT primary | 0.100 kV |
| E/Gnd VT Sec | 100.0 V |
| Protection Menu G1 |  |
| I> | Yes |
| I> | 1 ln |
| tl> | DT or IDMT or RI |
| tl> | (if DT) 10 s |
| Curve (if IDMT) | IEC VI or IEEE VI |
| TMS value (if IDMT) | 1 |
| K value (if RI) | 1 |
| le> | Yes |
| le> | 1 ln |
| tle> | DT or IDMT or RI |
| tle> (if DT) | 20 s |
| Curve (if IDMT) | IEC VI or IEEE VI |
| TMS value (if IDMT)1 | K value (if RI) 1 |
| Ue>>>> | 10V |
| tUe>>>> | 10 s |
| Automation Menu |  |
| TRIP tl> | YES |
| TRIP tle> | YES |
| TRIP tUe>>>> | YES |

### 4.3.4 MiCOM P127 settings

| CONFIGURATION |  |
| :---: | :---: |
| General Options |  |
| $2 \mathrm{Vpp}+\mathrm{Vr}$ |  |
| Transfo. Ratio |  |
| Line CT primary | 1 A |
| Line CT Sec | 1 A |
| E/Gnd CT primary | 1 A |
| E/Gnd CT Sec | 1 A |
| Line VT primary | 0.100 kV |
| Line VT Sec | 100.0 V |
| E/Gnd VT primary | 0.100 kV |
| E/Gnd VT Sec | 100.0 V |
| Protection Menu G1 |  |
| I> | Yes |
| I> | 1 ln |
| tl> | DT or IDMT or RI |
| tl> (if DT) | 10 s |
| Curve (if IDMT) | IEC VI or IEEE VI |
| TMS value (if IDMT) | 1 |
| K value (if RI) | 1 |
| U> | Yes |
| U> | 20V |
| tU> | 10 s |
| le> | Yes |
| le> | 1 ln |
| tle> | DT or IDMT or RI |
| tle> (if DT) | 20 s |
| Curve (if IDMT) | IEC VI or IEEE VI |
| TMS value (if IDMT)1 | K value (if Rl ) $=1$ |
| Ue>>>> | 10 V |
| tUe>>>> | 10 s |
| Automation Menu |  |
| TRIP tl> | YES |
| TRIP tU> | YES |
| TRIP tle> | YES |
| TRIP Ue>>>> | YES |

4.3.5 Earth current and neutral voltage test

This test can be executed on the P125, P126 and P127 relay and the operating sequence is the same for all three relays.

After the setting is completed connect the relay using the wiring diagram in chapter P12y/EN CO.
4.3.5.1 Earth fault overcurrent and residual over voltage test.

Delay type: Definite time
Used thresholds for this test:

- le>, tle>, Ue >>>>, tUe>>>>.
- Supply the relay, inject current and voltage with magnitude greater then le> and Ue>>>> setting value.
- If the time delay tle> is short, gradually increases injection current up to the value of the le> threshold.
- If the time delay tle> is long, inject $0.95 \times \mathrm{I}$ threshold and check that there is no tripping. Then inject $1,1 \times$ le threshold and check the trip.
- Gradually decreases the injected current and record the value of the drop out le> threshold.
- The same procedure above for Ue>>>>.
- Checks:
- Alarm message on the LCD display.
- Alarm LED flashes.
- Trip LED on
- le>, Ue>>>> threshold LED on (if programmed).
- Trip output closes.
- le>, Ue>>>> threshold output closes (if programmed).


## Delay type: Inverse time (IDMT)

Used thresholds for this test:

- le>, tle>
- $\quad$ Supply the relay inject a current equal to $2 x$ le> threshold into one of the earth current inputs. Repeat the operation for various current values ( $\mathrm{n} x$ le threshold with n ranging from 4 to 10, for example). Check that the values measured correspond to those indicated in the table below (for TMS=1).


## IEC curves

| Type of curve | Tripping time (in seconds) for TMS $=1$ |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
| IEC | $2 \times$ I threshold | $10 \times$ I threshold |  |  |
|  | Nominal | Min - Max | Nominal | Min - Max |
| STI | 1.78 | $1.62-1.98$ | 0.5 | $0.45-0.55$ |
| SI | 10.1 | $9.1-11.1$ | 3 | $2.7-3.3$ |
| VI | 13.5 | $12.2-14.9$ | 1.5 | $1.35-1.65$ |
| EI | 26.7 | $24-29.5$ | 0.8 | $0.72-0.88$ |
| LTI | 120 | $108-132$ | 13.3 | $12-14.6$ |

## IEEE/ANSI curves

| Type of curve | Tripping time (in seconds) for TMS $=1$ |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
| IEEE/ANSI | $2 \times$ I threshold |  |  | $10 \times$ I threshold |
|  | Nominal | Min - Max | Nominal | Min - Max |
| STI | 0.25 | $0.22-0.28$ | 0.08 | $0.07-0.09$ |
| MI | 3.8 | $3.4-4.2$ | 1.2 | $1.08-1.32$ |
| I | 2.2 | $1.9-2.4$ | 0.3 | $0.27-0.33$ |
| VI | 7.2 | $6.5-8$ | 0.7 | $0.63-0.77$ |
| EI | 9.5 | $8.5-10.5$ | 0.4 | $0.36-0.44$ |

## Checks:

- le> Alarm message on the LCD display.
- Alarm LED flashes.
- Trip LED on
- le> threshold LED on (if programmed).
- Trip output closes.
- le> threshold output closes (if programmed).


### 4.3.5.2 Phase overcurrent l> threshold test (P126 \& P127)

## Phase overcurrent threshold check:

- If the time delay tl> is short, gradually increase the injection current up to the value of the $\mathrm{l}>$ threshold.
- If the time delay $\mathrm{tl}>$ is long, inject $0.95 \times \mathrm{I}$ threshold and check that there is no tripping. Then inject $1,1 \times \mathrm{I}$ threshold and check the trip.
- Gradually decrease the injected current and record the value of the drop out off (l> threshold).


## Checks:

- Alarm message on the LCD display.
- Alarm LED flashes.
- Trip LED on
- $\quad \mathrm{l}>$ threshold LED on (if programmed).
- Trip output closes.
- $\quad$ l> threshold output closes (if programmed).


## Delay type: Definite time tl>

- Apply a current into one of the phases and measure the time delay tl> by pre-setting the current above the $I>$ threshold (I injected $>2 \times I$ threshold).
- Apply a current onto one of the phases and measure the time delay tl> by pre-setting the current above the $l>$ threshold (I injected $>10 \times I$ threshold).


## Checks:

- Alarm message on the LCD display for l> after that the setting trip delay time is expired.
- Alarm LED flashes > after that the setting trip delay time is expired.
- Trip LED on after that the setting trip delay time is expired.
- $\quad \mathrm{l}>$ threshold LED on (if programmed) $>$ after that the setting trip delay time is expired.
- Trip output closes > after that the setting trip delay time is expired..
- $\quad$ l> threshold output closes (if programmed) $>$ after that the setting trip delay time is expired.


## Delay type: Inverse time (IDMT)

Used threshold for this test:

- l>, tl>
- $\quad$ Supply the relay, inject a current equal to $2 x I>$ threshold into one of the earth current inputs. Repeat the operation for various current values ( $\mathrm{n} \times$ le threshold with n ranging from 4 to 10, for example). Check that the values measured correspond to those indicated in the table below (for TMS=1).


## IEC curves

| Type of curve | Tripping time (in seconds) for TMS $=1$ |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
| IEC | $2 \times$ I threshold | $10 \times$ I threshold |  |  |
|  | Nominal | Min - Max | Nominal | Min - Max |
| STI | 1.78 | $1.62-1.98$ | 0.5 | $0.45-0.55$ |
| SI | 10.1 | $9.1-11.1$ | 3 | $2.7-3.3$ |
| VI | 13.5 | $12.2-14.9$ | 1.5 | $1.35-1.65$ |
| EI | 26.7 | $24-29.5$ | 0.8 | $0.72-0.88$ |
| LTI | 120 | $108-132$ | 13.3 | $12-14.6$ |

## IEEE/ANSI curves

| Type of curve | Tripping time (in seconds) for TMS $=1$ |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
| IEEE/ANSI | $2 \times$ I threshold |  |  | $10 \times$ I threshold |
|  | Nominal | Min - Max | Nominal | Min - Max |
| STI | 0.25 | $0.22-0.28$ | 0.08 | $0.07-0.09$ |
| MI | 3.8 | $3.4-4.2$ | 1.2 | $1.08-1.32$ |
| I | 2.2 | $1.9-2.4$ | 0.3 | $0.27-0.33$ |
| VI | 7.2 | $6.5-8$ | 0.7 | $0.63-0.77$ |
| EI | 9.5 | $8.5-10.5$ | 0.4 | $0.36-0.44$ |

RI electromechanical curve

| Type of curve | Tripping time (in seconds) for K=1 |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
| Electromechanical | $2 \times$ I threshold |  |  | $10 \times$ I threshold |
|  | Nominal | Min - Max | Nominal | Min - Max |
| RI | 4.5 | $4-5$ | 3.2 | $2.8-3.6$ |

For other injected current values, compare the values found with the theoretical values calculated according to the formula of the curves.

NOTE: Equations of IEC, IEEE/ANSI and RI curves are given in chapter P12y/EN TD of this Technical Guide.

## Checks:

- I> Alarm message on the LCD display.
- Alarm LED flashes.
- Trip LED on
- $\quad \mathrm{l}>$ threshold LED on (if programmed).
- Trip output closes.
- $\quad$ l> threshold output closes (if programmed).
4.3.5.3 Phase to phase (phase to neutral) over-voltage U> threshold (P127)


## Phase overcurrent threshold check:

- If $\mathrm{t} \mathbf{>}$ time delay is short, gradually raise the injection voltage up to the value of $U>$ threshold.
- If $U>$ time delay is long, inject $0.95 \times U>$ threshold setting and check there is no trip. Then inject $1.1 \times \mathrm{U}>$ threshold setting and check the trip output is close.
- Gradually lower the injected current and note the value of the drop out $U>$ threshold.


## Checks:

- Alarm message on the LCD display for U> after that the setting trip delay time is expired.
- Alarm LED flashes after that the setting trip delay time is expired.
- Trip LED on, after that the setting trip delay time is expired.
- $\quad U>$ threshold LED on (if programmed) $>$ after that the setting trip delay time is expired.
- Trip output closes $U>$ after that the setting trip delay time is expired..
- U> threshold output closes (if programmed) after that the setting trip delay time is expired.


### 4.4 Final checks

1. Remove all test or temporary shorting leads, etc... If it is 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 are replace in accordance with the relevant external connection or scheme diagram.
2. If a MMLG test block is installed, remove the MMLB01 test plug and replace the MMLG cover so that the protection is put into service.
3. For MiCOM P126 and P127 models, ensure that all event, fault and disturbance records, alarm and LEDs have been reset before leaving the relay.
4. If the relays are in a new installation or the circuit breaker has been just maintained, the circuit breaker maintenance and current counters should be zero. These counters (only P126 \& P127) have to be reset using relevant command in RECORD/CB Monitoring menu (refer to User Guide).

## 5. MAINTENANCE

### 5.1 Equipment failure

MiCOM P125, P126 and P127 relays are full digital and permanent self-diagnosing. Any failure of software or hardware elements is instantly detected. As soon as an internal fault is detected, depending on its type (minor or major), an alarm message is displayed as a priority on the front panel LCD before the fault LED is illuminated (fixed or flashing) and the watchdog relay is closed (if the fault is a major one).

An equipment failure (major or minor) cannot be acknowledged on the front panel (using the dedicated tactile button keypad). Only the disappearance of the cause will acknowledge the fault and hence reset the fault LED.

### 5.1.1 Minor fault

Regarded by the MiCOM P125, P126 and P127 relays as a minor fault is a communication failure. If the communication is in fault, MiCOM P125, P126 and P127 protection and automation modules are not affected.

## Message :

"COMM.ERROR" : Communication fault

## Cause :

Hardware or software failure of the communication module

## Action :

Withdraw the active part and return it to the factory for repair.

## Alternative :

If communication is not used, disable communication in the COMMUNICATION menu (Communication ? = No).

### 5.1.2 Major fault

Major fault for MiCOM P125, P126 and P127 relays are all software and hardware failures except the communication faults. As soon as this type of failure is detected, the watchdog (WD) is closed and all operations are stopped (protection, automation, communication).
5.1.3 Hardware and software faults

## Messages :

"EEPROM ERROR DATA" : Data zone in fault
"EEPROM ERROR CALIBR." : Calibration zone in fault
"CT ERROR" : Analogue channel in fault
"RAM ERROR" : Ram supplied by battery in fault (see below of this Commissioning and Maintenance Guide)

## Cause :

Hardware or software failure

## Action :

Restart the protection software.
If the software fault still remain after restart, withdraw the active part and return the module to the factory for repair.

### 5.2 Method of repair

5.2.1 Replacing the active part

The case and the rear terminals blocks have been designed to facilitate removal of the MiCOM P12x relay should replacement or repair become necessary without disconnect the scheme wiring.

NOTE : The MiCOM relays have integral current transformer shorting switches which will close when the active part is removed from the case.

Remove the upper and lower flap without exerting excessive force. Remove the external screws. Under the upper flap, turn the extractor with a 3 mm screwdriver and extract the active part of the relay by pulling from the upper and lower notches on the front panel of the MiCOM relay.
The reinstall the repaired or replacement relay follow the above instruction in reverse, ensuring that no modification has been done on the scheme wiring.

### 5.2.2 Replacing the complete relay

To remove the complete relay (active part and case) the entire wiring must be removed from the rear connector.

Before working at the rear of the relay, isolate all current supplies to the MiCOM relay and ensure that the relay is no more powered.


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

Remove all wiring (communication, logic inputs, outputs, auxiliary voltage, current inputs). Disconnect the relay earth connection from the rear of the relay.

Remove the screws used to fasten the relay to the panel, rack, etc... .These are the screws with the larger diameter heads that are accessible when the upper and lower flaps are open.

Withdraw the relay from the panel, rack, etc... carefully because it will be heavy due to the internal transformers.

To reinstall the repaired or replacement relay follow the above instructions in reverse, ensuring that each terminal block is relocated in the correct position and case earth, communication are replaced.

Once reinstallation is complete the relay should be recommissioned using the instruction in sections 1 to 4 inclusive of this chapter.
5.2.3 Changing the battery (MiCOM P126 \& P127 only)

Each MiCOM P126 and P127 relay has a battery to maintain recording data and the correct time when the auxiliary voltage fails. The data maintained include event, fault and disturbance records and the thermal state at the time failure.

The battery is designed for a life of 10 years in standard atmospheric conditions.
"RAM ERROR" message could be the result of a battery failure.
To replace the battery follow the following instructions :

- Open the lower flap on the front of the relay
- Gently extract the battery from its socket. If necessary, use a small screwdriver.
- Ensure that metal terminals in the battery socket are free from corrosion, grease and dust.
- The replacement battery should be removed from its packaging and placed into the battery holder, ensure that the polarity markings on the battery agree with those adjacent to the socket.

NOTE: Only use a type 1/2AA lithium battery with a nominal voltage of 3.6 V.

- Ensure that the battery is securely held in its socket and that the battery terminals are making good contact with the metal terminals of the socket.
- Close the lower flap on the front of the relay.

NOTE: The battery that has been removed should be disposed of in accordance with the disposal procedure for Lithium batteries in the country in which the relay is installed.

### 5.3 Problem solving

5.3.1 Password lost or not accepted

Problem:
Password lost or not accepted

## Cause:

MiCOM P125, P126 and P127 relays are supplied with the password set to AAAA. This password can be changed by the user (refer OP PARAMETERS menu).

## Action:

There is an additional unique recovery password associated to the relay which can be supplied by the factory or service agent, if given details of its serial number (under the upper flap of the front panel). With this serial number, contact your AREVA local dealer or AREVA T\&D P\&C After Sales Dept.
5.3.2 Communication
5.3.2.1 Values measured locally and remotely

## Problem:

The measurements noted remotely and locally (via RS485 communication) differ.

## Cause :

The values accessible on the front face via the Measurement menu are refreshed every second. Those fed back via the communication and accessible by the AREVA T\&D Setting software generally have skeletal refreshing frequencies. If the refreshing frequency of the supervision software differs from that of MiCOM P125, P126 and P127 relays (1s), there may be a difference between indicated values.

## Action:

Adjust the frequency for refreshing the measurements of the supervision software or of the setting software to 1 second.

### 5.4 MiCOM relay no longer responds <br> Problem:

No response from MiCOM P125, P126 and P127 relays when asked by the supervision software without any communication fault message.

## Cause:

Mainly, this type of problem is linked to an error in the MiCOM P125, P126 and P127 communication parameters.

## Action:

Check MiCOM P125, P126 and P127 communication parameters (data rate, parity, etc.) are in accordance with the supervision settings.
Check MiCOM P125, P126 and P127 network address.
Check that this address is not used by another device connected on the same LAN.
Check that the other devices on the same LAN answer to supervision requests.

## MiCOM P125/P126 \& P127

### 5.4.1 A remote command is not taken in account

## Problem :

The communication between the relay and the PC is correct, but the relay does not accept any remote command or file downloading.

## Cause :

Generally this is due to the fact that the relay is in programming situation. This means that the password is active.

## Action :

Check that the password is not active in the relay since the last 5 minutes.

## CONNECTIONS AND WIRING DIAGRAMS

## CONTENT

1. P125 REAR DESCRIPTION ..... 3
1.1 P125 wiring diagram ..... 4
2. P126/P127 REAR DESCRIPTION ..... 5
2.1 Scheme representing MiCOM P126 ..... 6
2.2 Scheme representing MiCOM P127 ..... 7
3. $\mathrm{P} 126 \& \mathrm{P} 127$ CURRENT INSERTION SCHEMES ..... 8
3.1 P126 \& P127 Holmgreen CT's insertion ..... 8
$3.2 \quad$ P126 \& P127 Two phases CT's insertion ..... 9

## 1. P125 REAR DESCRIPTION



| Output 5 | 1 | 2 | Common output <br> 1 |
| :--- | :--- | :--- | :--- |
| Common <br> output 5 | 3 | 4 | Output 1 (NC) |
| Output 6 | 5 | 6 | Output1 (NO) |
| Common <br> output 6 | 7 | 8 | Common output <br> 2 |
|  | 9 | 10 | Output 2 (NC) |
|  | 11 | 12 | Output 2 (NO) |
|  | 13 | 14 | Output 3 |
|  | 17 | 16 | Common output <br> 3 |
| Input3 + | 19 | 20 | Common output <br> 4 |
| Input3 - | 21 | 22 | Input1 + |
| Input4 + | 23 | 24 | Input1 - |
| Input4 - | 25 | 26 | Input2 + |
|  | 27 | 28 | Input2 - |
|  |  | 18 |  |


| Case earth connection | 29 | 30 | Terminal RS485 |
| :---: | :---: | :---: | :---: |
| RS485 + | 31 | 32 | RS485 - |
| Vaux + | 33 | 34 | Vaux - |
| Relay faulty | 35 | 36 | Common "Watchdog" |
| Relay healthy | 37 | 38 |  |
| Residual volt. input | 39 | 40 | Residual volt. input |
|  | 41 | 42 |  |
|  | 43 | 44 |  |
|  | 45 | 46 |  |
| Current input (5A) | 47 | 48 | Current input $(5 A)$ |
|  | 49 | 50 |  |
|  | 51 | 52 |  |
|  | 53 | 54 |  |
| Current input (1A) | 55 | 56 | Current input (1A) |

### 1.1 P125 wiring diagram

Scheme shows output relays off


## 2. P126/P127 REAR DESCRIPTION



| Input 7 + | 57 | 58 | Input 6 + |
| :--- | :--- | :--- | :--- |
| Input 7 - | 59 | 60 | Input 6 - |
|  | 61 | 62 |  |
|  | 63 | 64 |  |
|  | 65 | 66 |  |
|  | 67 | 68 |  |
| Voltage <br> input VA | $\bullet 69$ | 70 | Voltage <br> input VA |
| Voltage ( (•) <br> input VB | 71 | 72 | Voltage <br> input VB |
| Voltage ( ( $)$ <br> input VC/Vr | 73 | 74 | Voltage <br> input VC/Vr |
|  | 75 | 76 |  |
| 77 | 78 |  |  |
| 79 | 80 |  |  |
| 81 | 82 | 84 |  |
|  | 83 |  |  |


| Output 5 | $\mathbf{1}$ | $\mathbf{2}$ | Common <br> output 1 |
| :--- | :---: | :--- | :--- |
| Common <br> output 5 | $\mathbf{3}$ | $\mathbf{4}$ | Output 1 <br> (NC) |
| Output 6 | $\mathbf{5}$ | $\mathbf{6}$ | Output1 <br> (NO) |
| Common <br> output 6 | $\mathbf{7}$ | $\mathbf{8}$ | Common <br> output 2 |
| Common <br> output 7 | $\mathbf{9}$ | $\mathbf{1 0}$ | Output 2 <br> (NC) |
| Output 7 | $\mathbf{1 1}$ | $\mathbf{1 2}$ | Output 2 <br> (NO) |
| Common <br> output 8 | $\mathbf{1 3}$ | $\mathbf{1 4}$ | Output 3 <br> Output 8 |
| $\mathbf{1 5}$ | $\mathbf{1 6}$ | Common <br> output 3 |  |
| Input 3 + | $\mathbf{1 7}$ | $\mathbf{1 8}$ | Output 4 |
| Input 3 - | $\mathbf{1 9}$ | $\mathbf{2 0}$ | Common <br> output 4 |
| Input 4 + | $\mathbf{2 1}$ | $\mathbf{2 2}$ | Input 1 + |
| Input 4 - | $\mathbf{2 3}$ | $\mathbf{2 4}$ | Input 1 - |
| Input 5 + | $\mathbf{2 5}$ | $\mathbf{2 6}$ | Input 2 + |
| Input 5 - | $\mathbf{2 7}$ | $\mathbf{2 8}$ | Input 2 - |


| Case earth <br> connection | $\mathbf{2 9}$ | $\mathbf{3 0}$ | Terminal <br> RS485 |
| :--- | :--- | :--- | :--- |
| RS485 + | $\mathbf{3 1}$ | $\mathbf{3 2}$ | RS485- |
| Vaux + | $\mathbf{3 3}$ | $\mathbf{3 4}$ | Vaux - |
| Relay failed | $\mathbf{3 5}$ | $\mathbf{3 6}$ | Common <br> "Watchdog" |
| Relay <br> healthy | $\mathbf{3 7}$ | $\mathbf{3 8}$ |  |
|  | $\mathbf{3 9}$ | $\mathbf{4 0}$ |  |
| Current (•) <br> input IA (5A) | $\mathbf{4 1}$ | $\mathbf{4 2}$ | Current input <br> IA (5A) |
| Current (•) <br> input IB (5A) | $\mathbf{4 3}$ | $\mathbf{4 4}$ | Current input <br> IB (5A) |
| Current (•) <br> input IC(5A) | $\mathbf{4 5}$ | $\mathbf{4 6}$ | Current input <br> IC(5A) |
| Current (•) <br> input Ie (5A) | $\mathbf{4 7}$ | $\mathbf{4 8}$ | Current input <br> Ie(5A) |
| Current (•) <br> input IA (1A) | $\mathbf{4 9}$ | $\mathbf{5 0}$ | Current input <br> IA (1A) |
| Current (•) <br> input IB (1A) | $\mathbf{5 1}$ | $\mathbf{5 2}$ | Current input <br> IB (1A) |
| Current (•) <br> input IC(1A) | $\mathbf{5 3}$ | $\mathbf{5 4}$ | Current input <br> IC(1A) |
| Current (• <br> input le (1A) | $\mathbf{5 5}$ | $\mathbf{5 6}$ | Current input <br> Ie(1A) |

NOTE: (•) means primary transformer polarity.
VA, VB and VC voltage inputs only stay in P127 relay
Vr (residual voltage) stays in P 126 and P 127 relays

### 2.1 Scheme representing MiCOM P126

Scheme represents relays off


### 2.2 Scheme representing MiCOM P127

Scheme represents relays off

3. P126 \& P127 CURRENT INSERTION SCHEMES
3.1 P126 \& P127 Holmgreen CT's insertion


### 3.2 P126 \& P127 Two phases CT's insertion



## COMMISSIONING TEST AND RECORD SHEET

## MiCOM P125/P126 \& P127

Page 1/48

## CONTENT

1. COMMISSIONING TEST ..... 3
1.1 Relay identification ..... 3
1.2 Commissioning test record ..... 3
1.3 Auxiliary supply control ..... 3
1.4 Measurements and analogue inputs control ..... 4
1.5 Introduction ..... 4
1.6 Phase overcurrent protection test ..... 5
1.7 Phase under current protection test ..... 5
1.8 Earth over current protection test ..... 6
1.9 Directional earth fault overcurrent ..... 6
1.10 Earth Fault Wattmetric protection test ..... 7
1.11 Over/Under Phase voltage protection test ..... 8
1.12 Residual voltage protection test ..... 8
1.13 Autoreclose basic test ..... 9
1.13.1 ARC test procedure with tl> ..... 11
1.13.2 ARC test procedure with tle> ..... 11
2. COMMISSIONING RECORD SHEET ..... 12
3. P126 \& P127 FURTHER TESTS ..... 38
3.1 Introduction ..... 38
3.2 Test equipment ..... 38
$3.3 \quad$ Type used relay ..... 38
3.4 Test configuration ..... 38
3.5 Connections to test equipment ..... 38
3.6 Test Overcurrent Protection ..... 38
3.7 Non-directional overcurrent protection ..... 39
3.7.1 Overcurrent sensitivity tests ..... 39
3.7.2 Overcurrent characteristic tests ..... 39
3.7.3 Non-directional earth fault overcurrent protection ..... 40
3.7.4 Neutral characteristic tests ..... 40
3.7.5 Directional earth fault overcurrent protection ..... 41
3.7.6 Reset time test ..... 42
3.7.7 Directional earth fault operating boundary ..... 42
3.7.8 Neutral characteristic tests ..... 43
3.7.9 Directionaloperating boundary - PHASE overcurrent (only P127) ..... 43
3.7.10 Earth directional wattmetric test ..... 44
3.7.11 Negative sequence overcurrent ..... 45
3.7.12 Thermal overload ..... 45
3.8 Voltage Protection (only P127) ..... 45
3.8.1 Under voltage ..... 45
3.8.2 Phase to neutral under voltage element ..... 46
3.8.3 Over voltage ..... 46
3.8.4 Phase to neutral over voltage element ..... 46
3.8.5 Residual over voltage ..... 46
3.9 Automatic control functions ..... 47
3.9.1 Trip circuit supervision ..... 47
3.9.2 Circuit breaker failure ..... 47
3.9.3 Cold load pick-up ..... 48
3.9.4 Broken Conductor ..... 48

## 1. COMMISSIONING TEST

### 1.1 Relay identification

| Commissioning date : |  |  |  |
| :---: | :---: | :---: | :---: |
| Engineer : |  |  |  |
| Substation : |  |  |  |
| Circuit : |  |  |  |
| Network nominal frequency: |  |  |  |
| MiCOM relay model: | $\square \mathrm{P} 125$ | $\square^{\mathrm{P} 126}$ | $\square \mathrm{P} 127$ |
| Serial number: |  |  |  |
| Rated current ln : |  |  |  |
| Rated current len : |  |  |  |
| Rated Voltage primary : |  |  |  |
| Rated Voltage secondary: |  |  |  |
| Auxiliary voltage Uaux : |  |  |  |
| Communication protocol : |  |  |  |
| Language : |  |  |  |

### 1.2 Commissioning test record

(write OK or No after each checked stage where there is $\square$ )
Serial number check ?
All current transformer shorting switches closed?
Wiring checked against diagram (if available)?
Case earth installed?
Test block connections checked (if installed) ?
Insulation tested?

### 1.3 Auxiliary supply control

(write Yes or No after each checked stage where there is $\square$ )
Auxiliary voltage to relay
Auxiliary voltage value

Watchdog contacts

With auxiliary supply off
With auxiliary supply on

Terminals 35 and 36
Terminals 36 and 37
)

### 1.4 Measurements and analogue inputs control

- $\quad$ Set the voltage wiring mode in CONFIGURATION/General options menu as $2 \mathrm{Vpn}+\mathrm{Vr}$ (See User Guide ref. P12y/EN FT/XXX of this T.G.)
- Set in the configuration menu in the submenu Transfo Ratio as shown below. (See User Guide ref. P12y/EN FT/XXX of this T.G.)

| Line CT <br> primary | Line CT <br> secondary | E/Gnd CT <br> primary | E/Gnd CT <br> Secondary | Line VT <br> Primary | Line VT <br> secondary | E/Gnd VT <br> Primary | E/Gnd VT <br> Secondary |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 1 | 1 | 1 | 1 | 0.10 kV | 100 V | 0.10 kV | 100 V |


| Phase Applied Current | Measured value |
| :--- | :--- |
| Phase A: | IA: |
| Phase B: | IB: |
| Phase C: | IC: |


| Earth Current Applied | Measured value |
| :--- | :--- |
| Earth current: | $\mathrm{IN}:$ |


| Phase Voltage Applied | Measured value |
| :--- | :--- |
| Phase A: | UA: |
| Phase B: | UB: |


| Residual Voltage Applied | Measured value |
| :--- | :--- |
| Residual Voltage: | UN: |

NOTE: The measured values are displayed in the Measurement submenu of the involved relay.

### 1.5 Introduction

Any involved stage before beginning the test must be enable by the setting "Yes".
Above it is the first operation to do having so the parameters to disposal.
To realise this operation you can use or S1 software interface or acting on the keys on the relay front panel directly.

To have the trip on relay 1 to measure trip time drop off etc. it is necessary to assign the involved stage in the test to the trip relay.

Ypu have to set "Yes" in the AUTOMATIC CTRL/Trip Command submen where the stage stays.

It is possible to assign some led (from 5 to 8) to any function operating in the CONFIGURATION/LED submenu and output relays operating in the AUTOMATIC CTRL/Output relays.

### 1.6 Phase overcurrent protection test

| Type and setting threshold <br> in In | Value <br> applied in <br> In | Delay Time <br> Seetting | Trip value in <br> In | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| $\mid>:$ | $0.2 \times 1>$ | 1s |  |  |


| Type and setting threshold <br> in In | Value <br> applied in <br> In | Delay Time <br> Setting | Measured <br> Trip Delay <br> time | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| $\backslash:$ | $2 \times 1>$ | 1s |  |  |


| Type and setting threshold <br> in In | Value <br> applied in <br> In | Delay Time <br> Setting | Trip value in <br> In | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| $l \gg:$ | $0.5 \times \mathrm{l>>}$ | 1s |  |  |


| Type and setting threshold <br> in In | Value <br> applied in <br> In | Delay Time <br> Seetting | Measured <br> Trip Delay <br> time | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| $\mid \gg:$ | $2.5 x \mid \gg$ | 1s |  |  |


| Type and setting threshold <br> in In | Value <br> applied in <br> In | Delay Time <br> Setting | Trip value in <br> In | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| $\mid \ggg$ | $0.5 x \mid \ggg$ | 1s |  |  |


| Type and setting threshold <br> in In | Value <br> applied in <br> In | Delay Time <br> Setting | Measured <br> Trip Delay <br> time | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| $1 \ggg$ | $2.5 x \mid \ggg$ | 1s |  |  |

### 1.7 Phase under current protection test

| Type and setting threshold <br> in In | Value <br> applied in <br> In | Delay Time <br> Setting | Trip value in <br> In | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| $\mathrm{K}:$ | $0.2 \times \mathrm{K}<$ | 1s |  |  |


| Type and setting threshold <br> in In | Value <br> applied in <br> In | Delay Time <br> Setting | Measured <br> Trip Delay <br> time | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| $\mathrm{K}<:$ | $0.2 \times \mathrm{l}<$ | 1s |  |  |

### 1.8 Earth over current protection test

| Type and setting threshold <br> in len | Value <br> applied in len | Delay Time <br> Setting | Trip value in <br> In | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| le>: | $0.2 \times$ le> | 1 s |  |  |


| Type and setting threshold <br> in len | Value <br> applied in len | Delay Time <br> Setting | Measured <br> Trip Delay <br> time | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| le>: | $2 \times$ le> | 1 s |  |  |


| Type and setting threshold <br> in len | Value <br> applied in len | Delay Time <br> Setting | Trip value in <br> In | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| le>>: | $0.2 x$ le>> | 1 s |  |  |


| Type and setting threshold <br> in len | Value <br> applied in len | Delay Time <br> Setting | Measured <br> Trip Delay <br> time | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| le>>: | $2 \times$ le>> | 1 s |  |  |


| Type and setting threshold <br> in len | Value <br> applied in len | Delay Time <br> Setting | Trip value in <br> In | Drop value in <br> In |
| :--- | :--- | :--- | :--- | :--- |
| le>>>: | $0.5 \times$ le>>> | 1 s |  |  |


| Type and setting threshold <br> in len | Value <br> applied in len | Delay Time <br> Setting | Measured <br> Trip Delay <br> time | Drop value in <br> len, Ue, $R$ |
| :--- | :--- | :--- | :--- | :--- |
| le>>>: | $2 \times$ le>>> | 1 s |  |  |

### 1.9 Directional earth fault overcurrent

The setting range depends on the sensitivity of the relay type.
However the setting value is expressed in len and this one bypasses the problem.
The test is proposed for the first stage, but using the same values can be executed for the others stages two stages.

Below it is listed the guide table.

| Type and setting current stage in len, Ue> in Volt, in degrees for the torque angle and the trip zone | Value applied in In, in Volt and the angles in degrees | Delay Time Setting | Measured Trip Delay time | Drop value for Ien, Ue, Torque angle, and trip zone |
| :---: | :---: | :---: | :---: | :---: |
| le>: | $0.5 \times \mathrm{le}>$ | 1s |  |  |
| Ue>:10V | $2 \times 10 \mathrm{~V}$ |  |  |  |
| Torque angle : $0^{\circ}$ | $0^{\circ}$ |  |  |  |
| Trip Zone : +/- $90^{\circ}$ | +/-85 ${ }^{\circ}$ |  |  |  |
| Type and setting current stage in len, the Ue> in Volt and in degrees the torque angle and the trip zone | Value applied in In, in Volt and the angles in degrees | Delay Time Setting | Measured Trip Delay time | Drop value for len, Ue, Torque angle, and trip zone |
| le $>$ : | $2 \times \mathrm{le}>$ |  |  |  |
| Ue>:10V | 80 V |  |  |  |
| Torque angle : $0^{\circ}$ | $0^{\circ}$ |  |  |  |
| Trip Zone : +/- $90^{\circ}$ | +/-85 ${ }^{\circ}$ |  |  |  |

### 1.10 Earth Fault Wattmetric protection test

The earth fault wattmetric protection can be tested but as above needs of the residual voltage injection the wattmetric power is calculated as le $x \mathrm{Ue} \times \cos \left(\mathrm{le}{ }^{\wedge} \mathrm{Ue}+\varphi \mathrm{c}\right)$
The calculation is referred to the secondary values.
The same test can be repeated for the second stage.

| Type and setting Pe stage are in watt referred to the secondary. The setting value depends on the set nominal len current (1A). | Value applied in In, in Volt and the angles in degrees | Delay Time Setting | Measured Trip Delay time | Drop value for Ien, Ue, Torque angle, and trip zone |
| :---: | :---: | :---: | :---: | :---: |
| Pe>: 20W | $\begin{aligned} & 0.5 x \\ & \text { len }=0.5 \mathrm{~A} \end{aligned}$ | tPe>=1s |  |  |
|  | $\mathrm{Ue}=45 \mathrm{~V}$ |  |  |  |
|  | $\mathrm{Ue}^{\wedge} \mathrm{le}=0^{\circ}$ |  |  |  |
| $\varphi_{C}=0^{\circ}$ |  |  |  |  |

1.11 Over/Under Phase voltage protection test

| Type and setting threshold <br> in Volt | Value applied <br> in Volt | Delay <br> Time <br> Setting | Trip value in <br> Volt | Drop value in <br> Volt |
| :--- | :--- | :--- | :--- | :--- |
| $\mathrm{U}>:$ | $2 \times \mathrm{U}>$ | 1s |  |  |


| Type and setting threshold <br> in Volt | Value applied <br> in Volt | Delay <br> Time <br> Setting | Measured <br> Trip Delay <br> time | Drop value in <br> Volt |
| :--- | :--- | :--- | :--- | :--- |
| U>: | $2 \times U>$ | 1s |  |  |


| Type and setting threshold <br> in Volt | Value applied <br> in Volt | Delay <br> Time <br> Setting | Trip value in <br> Volt | Drop value in <br> Volt |
| :--- | :--- | :--- | :--- | :--- |
| $\mathrm{U}<:$ | $0.2 \times \mathrm{U}<$ | 1s |  |  |


| Type and setting threshold <br> in Volt | Value applied <br> in Volt | Delay <br> Time <br> Setting | Measured <br> Trip Delay <br> time | Drop value in <br> Volt |
| :--- | :--- | :--- | :--- | :--- |
| U<<: | $0.2 \times \mathrm{U} \ll$ | 1s |  |  |

1.12 Residual voltage protection test

| Type and setting threshold <br> in Volt | Value applied <br> in Volt | Delay Time <br> Setting | Trip value in <br> Volt | Drop value in <br> Volt |
| :--- | :--- | :--- | :--- | :--- |
| Ue>>>>: | $2 \times$ Ue>>>> | 1s |  |  |


| Type and setting threshold <br> in Volt | Value applied <br> in Volt | Delay Time <br> Setting | Measured <br> Trip Delay <br> time | Drop value in <br> Volt |
| :--- | :--- | :--- | :--- | :--- |
| Ue>>>>: | $2 \times$ Ue>>>> | 1s |  |  |

### 1.13 Autoreclose basic test

From the 6A firmware version the ARC function follows the other ones of the Px20 range.
The testing of this functionality requires a bit attention and some more setting.
Below the setting table and the test procedure is listed.

| MENU TEXT | SET FOR THE TEST |
| :---: | :---: |
| PROTECTION G1 |  |
| [67] Phase OC |  |
| $1>$ | Yes |
| I> | 1 ln |
| Delay type | DMT |
| tl> | 1 sec |
| l>> | Yes |
| l>> | 2 In |
| Delay | DMT |
| tl>> | 1 sec |
| l>>> | No |
| [67N] E/GND |  |
| le> | Yes |
| le> | 1 ln |
| Delay type | DMT |
| tle> | 1 sec |
| le>> and le>>> | No |
| AUTORECLOSE |  |
| Autoreclose? | YES |
| Ext CB Fail? | NO |
| Ext CB Fail Time | Do not shown |
| Ext Block? | NO |
| tD1 | 5 sec |
| tD2 | 5 sec |
| tD3 | 5 sec |
| tD4 | 5 sec |
| Reclaim Time tR | 10 sec |
| Inhibit Time tl | 0.2 sec |
| Phase Cycles | 4 |
| E/Gnd Cycles | 4 |
| Cycles tl> | $\begin{aligned} & 4321 \\ & 1111 \end{aligned}$ |
| Cycles tl>> | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ |
| Cycles tl>>> | $\begin{aligned} & 4321 \\ & 0000 \end{aligned}$ |


| MENU TEXT | SET FOR THE TEST |
| :--- | :--- |
| Cycles <br> tle> | 4321 |
| Cycles <br> tle>> | 4222 |
| Cycles <br> tle>>> | 0000 |
| Cycles <br> tPe/lecos>, | 4321 |
| Cycles <br> tPe/lecos>> | 0000 |
| Cycles <br> tAux1 | 4321 |
| Cycles <br> tAux2 | 4321 |

In the below table are listed the setting to have a corrected functionality of the 79 function.
The output relay, the digital input and the led assigne are free.
The indicating setting are those used for internal test.
In the output relay none other functionality can be assigned to the relay CB Close.

| AUTOMATIC CTRL MENU | SET FOR THE TEST |
| :--- | :--- |
| Output relay |  |
| CB Close | relay 2 |
| TRIP 79 | relay 8 |
| 79 Run | relay 7 |
| Inputs menu | input 1 |
| 52a | Yes |
| Trip Command | Yes |
| tl> | No |
| tle> |  |
| All the other ones | l> <br> le> |
| Configuration menu | tl> <br> tle> |
| LED | Recl. Blocked |
| Led 5 | Recl Run |
| Led 6 | Led 7 |
| Led 8 |  |

NOTE : To execute the ARC test you have to connect an external relay for the monitoring the CB status (52a OFF when the CB is open, ON when $C B$ is closed). Further the flowing of the current to the relay must be interrupted when the 52 a is OFF; CB is open.
1.13.1 ARC test procedure with tl>

- Close the CB and inject current the led 7 lights for 0.2 s .
- After 1 sec the CB open tD1 start the led 8 lights
- After 5 seconf the CB closes and start tR
- $\quad$ After 1 sec. The CB open and td 2 start
- ...........................................
- When we are to the td 4 when the CB close and after 1 sec the tl> trip the 79 trip and Recl Blocked will be actived. 4 shots was done.
1.13.2 ARC test procedure with tle>
- $\quad$ Close the CB and inject the le current, the led 7 lights for 0.2 s .
- $\quad$ After 1 sec the CB does not open and $t D x$ does not start none led will be light

This result is corrected because to the le was imposed the setting " 2 ".

| Commissioning Engineer: |  |
| :--- | :--- |
| Date : |  |

## Remarks

|  |
| :--- |
|  |
|  |
|  |
|  |

## 2. COMMISSIONING RECORD SHEET

|  | RELAY TYPE |  |  | Setting Range |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Min | Max |  | Step |
| OP.PARAMETERS |  |  |  |  |  |  |  |
| Password |  |  |  | Alphabetic uppercase 4 characters |  |  |  |
| Description |  |  |  |  |  |  |  |
| Reference |  |  |  | Alphanumeric uppercase characters |  |  |  |
| Software Version |  |  |  | ( X.X ) |  |  |  |
| Frequency |  |  |  | 50 Hz | 60 Hz |  | 10 Hz |
| Active Group |  |  |  | 1 |  | 2 |  |
| Date |  |  |  | 01 $\div 31 / 01 \div 12 / 00 \div 99$ |  |  |  |
| Time |  |  |  | $00 \div 23$ | 00 $\div 59$ |  |  |
| CONFIGURATION |  |  |  |  |  |  |  |

General Options

| VT Connection | N.A. |  | $\square 3 \mathrm{Vpn}$ or $\square 2 \mathrm{Vpp}+\mathrm{Vr}$ or $\square 2 \mathrm{Vpn}+\mathrm{Vr}$ |  |
| :--- | :--- | :--- | :--- | :--- |
| Default Display | N.A. |  |  | $\square$ IA or $\square$ IB or $\square$ IC or $\square$ IN |

Transfo. Ratio

| Line CT primary | N.A. |  | 1A | 9999A | 1A |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Line CT sec | N.A. |  | 1A | 5A | 1A |
| E/Gnd CT primary |  |  | 1A | 9999A | 1A |
| E/Gnd CT sec |  |  | 1A | 5A | 1/5 |
| 57-130V Input voltage | Cortec code: P12--AX---X |  |  |  |  |
| Line VT primary | N.A. | N.A. | 0.10kV | 1000.00kV | 0.01kV |
| Line VT sec | N.A. | N.A. | 57V | 130V | 0.1V |
| E/Gnd VT primary |  |  | 0.10kV | 1000.00kV | 0.01 kV |
| E/Gnd VT sec |  |  | 57V | 130V | 0.1V |
| 220-480V Input voltage | Cortec code: P12--BX---X |  |  |  |  |
| Line VT primary | N.A. | N.A. | 220 V | 480 V | 1V |
| E/Gnd VT primary |  |  | 220 V | 480 V | 1V |

Led
Led 5

| l> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| tl> | N.A. |  |  |  |  |  |
| l>> | N.A. |  |  |  |  |  |
| tl>> | N.A. |  | $\square$ Yes | $\square$ No |  |  |
| l>>> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| tl>>> | N.A. |  | $\square$ Yes | $\square$ No |  |  |
| tlA> | N.A. |  | $\square$ Yes | $\square$ No |  |  |
| tlB> | N.A. |  | $\square$ Yes | $\square$ No |  |  |
| tlC $>$ | N.A. |  | $\square$ Yes | $\square$ No |  |  |
| le> |  |  | $\square$ Yes | $\square$ No |  |  |



Page 14/48
MiCOM P125/P126 \& P127

|  | RELAY TYPE |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Min | Max | Step |
| tAux1 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tAux2 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tSOTF | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Led 6 |  |  |  |  |  |  |
| I> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| l>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| 1>>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl>>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tIA> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tIB> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tIC> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| le> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tle> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| le>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tle>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| le>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tle>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Pe/leCos> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tPe/leCos> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Pe/leCos>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tPe/leCos>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| 12> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| t12> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| 12>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| t12>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| 12>>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square \mathrm{Yes}$ |  |
| t12>>> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Ther. Trip | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| K | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl< | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tU> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U>> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tU>> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U< | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| $t \mathrm{U}<$ | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U<< | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |


|  | RELA |  |  | Setting |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Min | Max | Step |
| tU<< | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Ue>>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tUe>>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Brkn. Cond | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| CB Fail | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 1 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 2 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 3 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 4 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 5 | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 6 | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 7 | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Recloser Run | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Recl. Blocked | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tAux1 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tAux2 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tSOTF | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Led 7 |  |  |  |  |  |  |
| I> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| l>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| l>>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl>>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tIA> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tIB> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tIC> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| le> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tle> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| le>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tle>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| le>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tle>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Pe/leCos> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tPe/leCos> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Pe/leCos>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tPe/leCos>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| 12> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| t12> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |

Page 16/48
MiCOM P125/P126 \& P127

|  | RELAY TYPE |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Min | Max | Step |
| 12>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| t12>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| 12>>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square \mathrm{Yes}$ |  |
| tl2>>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Ther. Trip | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| k | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl< | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tU> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U>> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tU>> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U< | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tU< | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U<< | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tU<< | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Ue>>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tUe>>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Brkn. Cond | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| CB Fail | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 1 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 2 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 3 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 4 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 5 | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 6 | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 7 | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Recloser Run | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Recl. Blocked | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tAux1 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tAux2 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tSOTF | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Led 8 |  |  |  |  |  |  |
| 1> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| $1 \gg$ | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| $1 \ggg$ | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl>>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| t\|A> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |


|  | RELA |  |  | Setting |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Min | Max | Step |
| tIB> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tIC> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| le> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tle> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| le>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tle>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| le>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tle>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Pe/leCos> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tPe/leCos> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Pe/leCos>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tPe/leCos>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| 12> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| t12> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| 12>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| t12>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| 12>>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square \mathrm{Yes}$ |  |
| tl2>>> | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Ther. Trip | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| K | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tl< | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tU> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U>> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tU>> | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U< | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tU< | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| U<< | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tU<< | N.A. | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Ue>>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| tUe>>>> |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Brkn. Cond | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| CB Fail | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 1 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 2 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 3 |  |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 4 |  |  |  | $\square$ Yes | $\square$ No |  |
| Input 5 | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Input 6 | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Input 7 | N.A. |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |

Page 18/48
MiCOM P125/P126 \& P127



Page 20/48
MiCOM P125/P126 \& P127

|  | RELAY TYPE |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Min | Max | Step |
| [67N] Earth Fault Overcurrent |  |  |  |  |  |  |
| High sensitivity: Current input from 0.002 to 1 Ien Cortec code P12-C-X---X |  |  |  |  |  |  |
| le> |  |  |  | $\square$ No or $\square$ | $\square$ |  |
| le> |  |  |  | 0.002 len | 1 len | 0.001 len |
| Delay type |  |  |  | $\square$ DT or IEC EI, IE IEEE_EI, | T (IEC <br> I, C02, <br> CT cu | SI, IEC_VI, E_MI, IIEEE_VI, |
| le> Trip delay time |  |  |  | 0 s | 150s | 0.01s |
| le> TMS |  |  |  | 0.025 | 1.5 | 0.025 |
| k |  |  |  | 0 | 10 | 0.001 |
| le> Reset char |  |  |  | $\square$ DT or |  |  |
| le> RTMS |  |  |  | 0.025 | 3.2 | 0.025 |
| le> tReset |  |  |  | 0.00 s | 100 s | 0.01 s |
| Interlock le>. le>> le>>> |  |  |  | $\square$ No or |  |  |
| le> R.C.A.(Torque Angle) |  |  |  | $0^{\circ}$ | $359{ }^{\circ}$ | $1^{\circ}$ |
| le> Trip zone |  |  |  | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| 57-130V Input voltage. | Cortec code: P127CAX---X |  |  |  |  |  |
| Ue> |  |  |  | 1 V | 260 V | 0.1 V |
| 220-480V Input voltage. | Cortec code: P127CBX---X |  |  |  |  |  |
| Ue> |  |  |  | 4 V | 960 V | 0.5 V |
| le>> |  |  |  | $\square$ No or $\square$ | or $\square \mathrm{D}$ |  |
| le>> |  |  |  | 0.002 len | 1 len | 0.001 len |
| Delay type |  |  |  | DT or IEC_EI, IE IEEE_EI, | T (IEC <br> I, C02, <br> CT cur | $\begin{aligned} & \text { SI, IEC_VI, } \\ & \text { E_MI, IIEEE_VI, } \end{aligned}$ |
| le>> Trip delay time |  |  |  | 0 s | 150s | 0.01s |
| le>> TMS |  |  |  | 0.025 | 1.5 | 0.025 |
| K |  |  |  | 0 | 10 | 0.001 |
| le>> Reset char |  |  |  | $\square$ DT or $\square$ |  |  |
| le>> RTMS |  |  |  | 0.025 | 3.2 | 0.025 |
| le> tReset |  |  |  | 0.00 s | 100 s | 0.01 s |
| le>> |  |  |  | $\square$ No or $\square$ | or $\square \mathrm{D}$ |  |
| le>> |  |  |  | 0.002 len | 1 len | 0.001 len |
| le>> Trip delay time |  |  |  | 0 s | 150s | 0.01s |
| le>> tReset |  |  |  | 0.00 s | 100 s | 0.01 s |
| le>> R.C.A.(Torque Angle) |  |  |  | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| le>> Trip zone |  |  |  | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| 57-130V Input voltage. | Cortec code: P127CAX---X |  |  |  |  |  |
| Ue>> |  |  |  | 1 V | 260 V | 0.1 V |


|  | RELAY TYPE |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Min | Max | Step |
| 220-480V Input voltage. | Cortec code: P127CBX---X |  |  |  |  |  |
| Ue>> |  |  |  | 4 V | 960 V | 0.5 V |
| le>>> |  |  |  | $\square$ No or | $\square \mathrm{D}$ |  |
| le>>> |  |  |  | 0.002 len | 1 len | 0.001 len |
| $l e \ggg$ Trip delay time |  |  |  | 0 s | 150s | 0.01s |
| le>>> tReset |  |  |  | 0.00 s | 100 s | 0.01 s |
| le>>> R.C.A.(Torque Angle) |  |  |  | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| le>>> Trip zone |  |  |  | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| 57-130V Input voltage. | Cortec code: P127CAX---X |  |  |  |  |  |
| Ue>>> |  |  |  | 1 V | 260 V | 0.1 V |
| 220-480V Input voltage. | Cortec code: P127CBX---X |  |  |  |  |  |
| Ue>>> |  |  |  | 4 V | 960 V | 0.5 V |
| Med. sensitivity Current input from 0.01 to 8 len Cortec code P12-B-X---X |  |  |  |  |  |  |
| le> |  |  |  | $\square$ No or $\square$ Yes or $\square$ DIR |  |  |
| le> |  |  |  | 0.01 len | 1 len | 0.005 Ien |
| Delay type |  |  |  | $\square$ DT or $\square$ IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| le> Trip delay time |  |  |  | 0 s | 150s | 0.01s |
| le> TMS |  |  |  | 0.025 | 1.5 | 0.025 |
| k |  |  |  | 0 | 10 | 0.001 |
| le> Reset char |  |  |  | $\square$ DT or $\square$ IDMT |  |  |
| le> RTMS |  |  |  | 0.025 | 3.2 | 0.025 |
| le> tReset |  |  |  | 0.00 s | 100 s | 0.01 s |
| Interlock le> le>>le>>> |  |  |  | $\square$ No or $\square$ Yes |  |  |
| le> R.C.A.(Torque Angle) |  |  |  | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| le> Trip zone |  |  |  | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| 57-130V Input voltage. | Cortec code: P127BAX---X |  |  |  |  |  |
| Ue> |  |  |  | 1 V | 260 V | 0.1 V |
| 220-480V Input voltage. | Cortec code: P127BBX---X |  |  |  |  |  |
| Ue> |  |  |  | 4 V | 960 V | 0.5 V |
| le>> |  |  |  | $\square$ No or $\square$ Yes or $\square$ DIR |  |  |
| le>> |  |  |  | 0.01 Ien | 1 len | 0.005 len |
| Delay type |  |  |  | $\square$ $\square$ DT or $\square$ IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| le>> Trip delay time |  |  |  | 0 s | 150s | 0.01s |
| le>> TMS |  |  |  | 0.025 | 1.5 | 0.025 |
| K |  |  |  | 0 | 10 | 0.001 |
| le>> Reset char |  |  |  | $\square$ DT or $\square$ |  |  |
| le>> RTMS |  |  |  | 0.025 | 3.2 | 0.025 |

Page 22/48
MiCOM P125/P126 \& P127

|  | RELAY TYPE |  |  |  |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 |  | P126 |  | P127 |  | Min | Max | Step |
| le>> tReset |  |  |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| le>> |  |  |  |  |  |  | $\square$ No or $\square$ Yes or | $\square$ DIR |  |
| le>> R.C.A.(Torque Angle) |  |  |  |  |  |  | $0^{\circ}$ | $359{ }^{\circ}$ | $1^{\circ}$ |
| le>> Trip zone |  |  |  |  |  |  | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| 57-130V Input voltage. | Cortec code: P127BAX---X |  |  |  |  |  |  |  |  |
| Ue>> |  |  |  |  |  |  | 1 V | 260 V | 0.1 V |
| 220-480V Input voltage. | Cortec code: P127BBX---X |  |  |  |  |  |  |  |  |
| Ue>> |  |  |  |  |  |  | 4 V | 960 V | 0.5 V |
| le>>> |  |  |  |  |  |  | $\square$ No or $\square$ Yes or | $\square$ DIR or $\square$ |  |
| le>>> |  |  |  |  |  |  | 0.01 Ien | 8 Ien | 0.005 Ien |
| le>>> Trip delay time |  |  |  |  |  |  | 0 s | 150s | 0.01s |
| le>>> tReset |  |  |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| le>>> R.C.A. (Torque Angle) |  |  |  |  |  |  | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| le>>> Trip zone |  |  |  |  |  |  | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| 57-130V Input voltage. | Cortec code: P127BAX---X |  |  |  |  |  |  |  |  |
| Ue>>> |  |  |  |  |  |  | 1 V | 260 V | 0.1 V |
| 220-480V Input voltage. | Cortec code: P127BBX---X |  |  |  |  |  |  |  |  |
| Ue>>> |  |  |  |  |  |  | 4 V | 960 V | 0.5 V |
| Low sensitivity Current input from 0.1to 40 len Cortec code P12-A-X---X |  |  |  |  |  |  |  |  |  |
| le> |  |  |  |  |  |  | $\square$ No or $\square$ Yes or $\square$ DIR |  |  |
| le> |  |  |  |  |  |  | 0.1 len | 25 len | 0.01 Ien |
| Delay type |  |  |  |  |  |  | $\square$ DT or $\square$ IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| le> Trip delay time |  |  |  |  |  |  | 0 s | 150s | 0.01s |
| le> TMS |  |  |  |  |  |  | 0.025 | 1.5 | 0.025 |
| k |  |  |  |  |  |  | 0 | 10 | 0.001 |
| le> Reset char |  |  |  |  |  |  | $\square$ DT or $\square$ IDMT |  |  |
| le> RTMS |  |  |  |  |  |  | 0.025 | 3.2 | 0.025 |
| le> tReset |  |  |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| Interlock le> by le>>...le>>> |  |  |  |  |  |  | $\square$ No or $\square$ Yes |  |  |
| le> R.C.A.(Torque Angle) |  |  |  |  |  |  | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| le> Trip zone |  |  |  |  |  |  | $\pm 10^{\circ}$ | $\pm 170^{\circ}$ | $1^{\circ}$ |
| 57-130V Input voltage. | Cortec code: P127AAX---X |  |  |  |  |  |  |  |  |
| Ue> |  |  |  |  |  |  | 1 V | 260 V | 0.1 V |
| 220-480V Input voltage. | Cortec code: P127ABX---X |  |  |  |  |  |  |  |  |
| Ue> |  |  |  |  |  |  | 4 V | 960 V | 0.5 V |
| le>> |  |  |  |  |  |  | $\square$ No or $\square$ Yes or | or $\square$ DIR |  |
| le>> |  |  |  |  |  |  | 0.1 Ien | 25 Ien | 0.01 Ien |


[32N] Earth Fault Wattmetric

| Mode |  |  |  |  |  |  | $\square \mathrm{Pe}$ or $\square \mathrm{leCos}$ |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| High sensitivity | Current input from 0.002 to 1 len |  |  |  |  |  |  |  |  |
| 57-130V Input voltage | Cortec code: P12-CAX---X |  |  |  |  |  |  |  |  |
| Pe> |  |  |  |  |  |  | $\square$ No or $\square \mathrm{Yes}$ |  |  |
| Pe> |  |  |  |  |  |  | $0.2 \times \mathrm{KW}$ (*) | $20 \times \mathrm{K}$ W ${ }^{*}$ ) | $0.02 \times \mathrm{KW}$ (*) |
| Delay type |  |  |  |  |  |  | $\square$ DT or $\square$ IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tPe> Trip delay time |  |  |  |  |  |  | 0 s | 150s | 0.01s |
| Pe> TMS |  |  |  |  |  |  | 0.025 | 1.5 | 0.025 |
| k |  |  |  |  |  |  | 0 | 10 | 0.001 |
| Pe> Reset char |  |  |  |  |  |  | $\square$ DT or $\square$ IDMT |  |  |
| Pe> RTMS |  |  |  |  |  |  | 0.025 | 1.5 | 0.025 |
| Pe> tReset |  |  |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| Pe>> |  |  |  |  |  |  | $\square$ No or $\square \mathrm{Yes}$ |  |  |

Page 24/48
MiCOM P125/P126 \& P127

|  | RELAY TYPE |  |  |  |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 |  | P126 |  | P127 |  | Min | Max | Step |
| Pe>> |  |  |  |  |  |  | $0.2 \times \mathrm{K} \mathrm{W}{ }^{*}$ ) | $20 \times \mathrm{K} \mathrm{W}$ (*) | $0.02 \times \mathrm{K}$ W ${ }^{*}$ ) |
| tPe>> Trip delay time |  |  |  |  |  |  | 0 s | 150s | 0.01s |
| Pe>> tReset |  |  |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| Pe/leCos Angle |  |  |  |  |  |  | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| 220-480V Input voltage | Cortec code: P12-CBX---X |  |  |  |  |  |  |  |  |
| Pe> |  |  |  |  |  |  | $\square$ No or $\square$ Yes |  |  |
| Pe> |  |  |  |  |  |  | $1 \times \mathrm{K} \mathrm{W}$ (*) $^{\text {( }}$ | $80 \times \mathrm{K} \mathrm{W}\left({ }^{*}\right)$ | $0.1 \times \mathrm{K} \mathrm{W}{ }^{*}$ ) |
| Delay type |  |  |  |  |  |  | $\square$ DT or $\square$ ID IEC EI, IEC L IEEE_EI, RI, | (IEC_STI, IEC C02, C08, IE CT curve) | SI, IEC_VI, E_MI, IIEEE_VI, |
| tPe> Trip delay time |  |  |  |  |  |  | 0 s | 150s | 0.01s |
| $\mathrm{Pe}>$ TMS |  |  |  |  |  |  | 0.025 | 1.5 | 0.025 |
| k |  |  |  |  |  |  | 0 | 10 | 0.001 |
| Pe> Reset char |  |  |  |  |  |  | $\square$ DT or $\square$ IDM |  |  |
| Pe> RTMS |  |  |  |  |  |  | 0.025 | 1.5 | 0.025 |
| Pe> tReset |  |  |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| Pe>> |  |  |  |  |  |  | $\square$ No or $\square$ Yes |  |  |
| Pe>> |  |  |  |  |  |  | $1 \times \mathrm{K} \mathrm{W}$ (*) | $80 \times \mathrm{K} \mathrm{W}\left({ }^{*}\right)$ | $0.1 \times \mathrm{K}$ W ${ }^{*}$ ) |
| tPe>> Trip delay time |  |  |  |  |  |  | 0 s | 150s | 0.01s |
| Pe>> tReset |  |  |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| $\mathrm{Pe} / \mathrm{leCos}$ Angle |  |  |  |  |  |  | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| Med. sensitivity | Current input from 0.01 to 8 len |  |  |  |  |  |  |  |  |
| 57-130V Input voltage | Cortec code: P12-BAX---X |  |  |  |  |  |  |  |  |
| Pe> |  |  |  |  |  |  | $\square$ No or $\square$ Yes |  |  |
| Pe> |  |  |  |  |  |  | $1 \times \mathrm{K}$ W(*) | $160 \times \mathrm{K} \mathrm{W}\left(^{*}\right)$ | $0.1 \times \mathrm{K} \mathrm{W}{ }^{*}$ ) |
| Delay type |  |  |  |  |  |  | $\square$ $\square$ IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| tPe> Trip delay time |  |  |  |  |  |  | 0 s | 150s | 0.01s |
| Pe>tReset |  |  |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| Pe> TMS |  |  |  |  |  |  | 0.025 | 1.5 | 0.025 |
| k |  |  |  |  |  |  | 0 | 10 | 0.001 |
| $\mathrm{Pe}>$ Reset char |  |  |  |  |  |  | $\square$ DT or $\square$ IDMT |  |  |
| Pe> RTMS |  |  |  |  |  |  | 0.025 | 1.5 | 0.025 |
| Pe> tReset |  |  |  |  |  |  | 0.04 s | 100 s | 0.01 s |
| Pe>> |  |  |  |  |  |  | $\square$ No or $\square$ Yes |  |  |
| Pe>> |  |  |  |  |  |  | $1 \times \mathrm{K} \mathrm{W}\left({ }^{*}\right)$ | $160 \times \mathrm{K}$ W ${ }^{*}$ ) | $0.1 \times \mathrm{K} \mathrm{W}\left({ }^{*}\right)$ |
| tPe>> Trip delay time |  |  |  |  |  |  | 0 s | 150s | 0.01s |
| Pe>> tReset |  |  |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| Pe/leCos Angle |  |  |  |  |  |  | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |



Page 26/48
MiCOM P125/P126 \& P127


|  | RELAY TYPE |  |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 |  | P126 | P127 | Min | Max | Step |
| leCos>> Trip delay time |  |  |  |  | 0 s | 150s | 0.01s |
| leCos> tReset |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| $\mathrm{Pe} / \mathrm{leCos}$ Angle |  |  |  |  | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| Low sensitivity lecos set | Cortec code P12-A-X---X |  |  |  |  |  |  |
| leCos> |  |  |  |  | $\square$ Yes or $\square$ No |  |  |
| leCos> |  |  |  |  | 0.1 Ien | 25 len | 0.01 Ien |
| Delay type |  |  |  |  | $\square$ DT or $\square$ IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| leCos> Trip delay time |  |  |  |  | 0 s | 150s | 0.01s |
| k |  |  |  |  | 0 | 10 | 0.001 |
| leCos> TMS |  |  |  |  | 0.025 | 1.5 | 0.025 |
| leCos> Reset char |  |  |  |  | $\square$ DT or $\square$ IDMT |  |  |
| leCos> RTMS |  |  |  |  | 0.025 | 1.5 | 0.025 |
| leCos> tReset |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| leCos>> |  |  |  |  | $\square$ Yes or $\square$ No |  |  |
| leCos>> |  |  |  |  | 0.5 Ien | 40 len | 0.01 Ien |
| leCos>> Trip delay time |  |  |  |  | 0 s | 150s | 0.01s |
| leCos>> tReset |  |  |  |  | 0.00 s | 100 s | 0.01 s |
| $\mathrm{Pe} / \mathrm{leCos}$ Angle |  |  |  |  | $0^{\circ}$ | $359^{\circ}$ | $1^{\circ}$ |
| [46] Neg.Seq. OC |  |  |  |  |  |  |  |
| 12> | N.A. | N.A. |  |  | $\square$ No or $\square$ Yes |  |  |
| 12> | N.A. | N.A. |  |  | 0.1 ln | 25 ln | 0.01 ln |
| Delay type | N.A. | N.A. |  |  | $\square$ DT or $\square$ IDMT (IEC_STI, IEC_SI, IEC_VI, IEC_EI, IEC_LTI, C02, C08, IEEE_MI, IIEEE_VI, IEEE_EI, RI, RECT curve) |  |  |
| 12> Trip delay time | N.A. | N.A. |  |  | 0 s | 150s | 0.01s |
| I2> TMS | N.A. | N.A. |  |  | 0.025 | 1.5 | 0.025 |
| k |  |  |  |  | 0 | 10 | 0.001 |
| 12> Reset char | N.A. | N.A. |  |  | $\square$ DT or $\square$ IDMT |  |  |
| I2> RTMS | N.A. | N.A. |  |  | 0.025 | 1.5 | 0.025 |
| I2> tReset | N.A. | N.A. |  |  | 0.04 s | 100 s | 0.01 s |
| I2>> | N.A. | N.A. |  |  | $\square$ No or $\square$ Yes |  |  |
| I2>> Current set | N.A. | N.A. |  |  | 0.5 ln | 40 ln | 0.01 ln |
| I2>> Trip delay time | N.A. | N.A. |  |  | 0 s | 150s | 0.01s |
| 12>>> | N.A. | N.A. |  |  | $\square$ No or $\square$ Yes |  |  |
| I2>>> Current set | N.A. | N.A. |  |  | 0.5 ln | 40 ln | 0.01 ln |
| I2>>> Trip delay time | N.A. | N.A. |  |  | 0 s | 150s | 0.01s |

Page 28/48
MiCOM P125/P126 \& P127

|  | RELAY TYPE |  |  |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 |  | P126 |  | P127 | Min Max |  | Step |
| [49] Thermal Overload |  |  |  |  |  |  |  |  |
| Therm. OL | N.A. | N.A. |  |  |  | $\square$ No or $\square$ Yes |  |  |
| $1 \theta$ | N.A. | N.A. |  |  |  | 0.1 ln | 3.2 ln | 0.01 |
| Te | N.A. | N.A. |  |  |  | 1 mn | 200 mn | 1 mn |
| k | N.A. | N.A. |  |  |  | 1 | 1,5 | 0.01 |
| $\theta$ Trip | N.A. | N.A. |  |  |  | 50\% | 200\% | 1\% |
| $\theta$ Alarm | N.A. | N.A. |  |  |  | $\square$ No |  |  |
| $\theta$ Alarm | N.A. | N.A. |  |  |  | 50\% | 200\% | 1\% |
| [37] Under Current |  |  |  |  |  |  |  |  |
| 1< | N.A. | N.A. |  |  |  | $\square$ No or $\square$ Yes |  |  |
| I< Current set | N.A. | N.A. |  |  |  | 0.1 ln | 1 ln | 0.01 ln |
| $\mathrm{tl}<$ | N.A. | N.A. |  |  |  | 0 s | 150 s | 0.01 s |
| [59] Phase Over Voltage |  |  |  |  |  |  |  |  |
| U> | N.A. | N.A. | N.A. | N.A. |  | $\square$ No | or $\square$ OR |  |
| 57-130V Input voltage. | Cortec code: P127-AX---X |  |  |  |  |  |  |  |
| U> | N.A. | N.A. | N.A. | N.A. |  | 2 V | 260 V | 0.1 V |
| 220-480V Input voltage. | Cortec code: P127-BX---X |  |  |  |  |  |  |  |
| U> | N.A. | N.A. | N.A. | N.A. |  | 10 V | 960 V | 0.5 V |
| $t \cup>$ | N.A. | N.A. | N.A. | N.A. |  | 0 s | 600 s | 0.01 s |
| U>> | N.A. | N.A. | N.A. | N.A. |  | $\square$ No | or $\square$ OR |  |
| 57-130V Input voltage. | Cortec code: P127-AX---X |  |  |  |  |  |  |  |
| U>> | N.A. | N.A. | N.A. | N.A. |  | 2 V | 260 V | 0.1 V |
| 220-480V Input voltage. | Cortec code: P127-BX---X |  |  |  |  |  |  |  |
| U>> | N.A. | N.A. | N.A. | N.A. |  | 10V | 960 V | 0.5 V |
| tU>> | N.A. | N.A. | N.A. | N.A. |  | 0 s | 600 s | 0.01 s |

## [27] Phase Under Voltage



|  | RELAY TYPE |  |  |  |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 |  | P126 |  | P127 |  | Min | Max | Step |
| [59N] Residual Over voltage |  |  |  |  |  |  |  |  |  |
| 57-130V Input voltage. | Cortec code: P12-AX---X |  |  |  |  |  |  |  |  |
| Ue>>>> |  |  |  |  |  |  | $\square$ No or |  |  |
| Ue>>>> |  |  |  |  |  |  | 1 V | 260 V | 0.1 V |
| tUe>>>> |  |  |  |  |  |  | 0 s | 600 s | 0.01 s |
| 220-480V Input voltage. | Cortec code: P12-BX---X |  |  |  |  |  |  |  |  |
| Ue>>>> |  |  |  |  |  |  | $\square$ No or |  |  |
| Ue>>>> |  |  |  |  |  |  | 5 V | 960 V | 0.5 V |
| tUe>>>> |  |  |  |  |  |  | 0 s | 600 s | 0.01 s |
| [79] Autoreclose |  |  |  |  |  |  |  |  |  |
| Autoreclose | N.A. | N.A. |  |  |  |  | $\square$ Yes or $\square$ No |  |  |
| Ext. CB Fail | N.A. | N.A. |  |  |  |  | $\square$ Yes or $\square$ No |  |  |
| Ext. CB Fail time | N.A. | N.A. |  |  |  |  | 0.01s | 600s | 0.01 s |
| Ext. Block | N.A. | N.A. |  |  |  |  | $\square$ Yes or $\square$ No |  |  |
| td1 Dead time 1 | N.A. | N.A. |  |  |  |  | 0.01 s | 300 s | 0.01 s |
| td2 Dead time 2 | N.A. | N.A. |  |  |  |  | 0.01 s | 300 s | 0.01 s |
| td3 Dead time 3 | N.A. | N.A. |  |  |  |  | 0.01 s | 600 s | 0.01 s |
| td4 Dead time 4 | N.A. | N.A. |  |  |  |  | 0.01 s | 600 s | 0.01 s |
| tR Reclain time | N.A. | N.A. |  |  |  |  | 0.02 s | 600 s | 0.01 s |
| Inhib Time tl | N.A. | N.A. |  |  |  |  | 0.02 s | 600 s | 0.01 s |
| Phase Cycle | N.A. | N.A. |  |  |  |  | 0 | 4 | 1 |
| E/Gnd Cycle | N.A. | N.A. |  |  |  |  | 0 | 4 | 1 |
| Cycles tl> | N.A. | N.A. | 4321 | 4321 | 4321 | 4321 | 0 | 2 | 1 |
| Cycles tl>> | N.A. | N.A. | 4321 | 4321 | 4321 | 4321 | 0 | 2 | 1 |
| Cycles tl>>> | N.A. | N.A. | 4321 | 4321 | 4321 | 4321 | 0 | 2 | 1 |
| Cycles tle> | N.A. | N.A. | 4321 | 4321 | 4321 | 4321 | 0 | 2 | 1 |
| Cycles tle>> | N.A. | N.A. | 4321 | 4321 | 4321 | 4321 | 0 | 2 | 1 |
| Cycles tle>>> | N.A. | N.A. | 4321 | 4321 | 4321 | 4321 | 0 | 2 | 1 |
| Cycles tPe/lecos>, | N.A. | N.A. | 4321 | 4321 | 4321 | 4321 | 0 | 2 | 1 |
| Cycles tPe/lecos>> | N.A. | N.A. | 4321 | 4321 | 4321 | 4321 | 0 | 2 | 1 |
| Cycles tAux1 | N.A. | N.A. | 4321 | 4321 | 4321 | 4321 | 0 | 2 | 1 |
| Cycles tAux2 | N.A. | N.A. | 4321 | 4321 | 4321 | 4321 | 0 | 2 | 1 |

Page 30/48

| RELAY TYPE |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| P125 | P126 | P127 | Min | Max | Step |

## AUTOMAT. CTRL

Trip Commands

| Trip tl> | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Trip tl>> | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tl>>> | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tle> |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tle>> |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tle>>> |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tPe/leCos> |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tPe/leCos>> |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip t12> | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip t12>> | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tl2>>> | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Thermal Trip | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tl< | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tU> | N.A. | N.A. | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tU>> | N.A. | N.A. | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tU< | N.A. | N.A. | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tU<< | N.A. | N.A. | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tUe>>>> | N.A. | N.A. | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip Brkn. Cond | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tAux1 |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tAux2 |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tAux3 |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip tAux4 |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Trip SOTF | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Ctrl Trip |  |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Equation A | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Equation B | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Equation C | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |
| Equation D | N.A. |  | $\square \mathrm{Yes}$ | $\square$ No |  |


| Latch relays |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Relay 1 |  |  | $\square 0$ | $\square 1$ | $\square 1$ |  |
| Relay 2 |  |  | $\square$ | $\square 0$ | $\square 1$ | $\square 1$ |
| Relay 3 |  |  |  | $\square 0$ | $\square 1$ | $\square 1$ |
| Relay 4 |  |  |  | $\square 0$ | $\square 1$ | $\square 1$ |
| Relay 5 | N.A |  |  | $\square 0$ | $\square 1$ | $\square 1$ |
| Relay 6 | N.A |  |  | $\square 0$ | $\square 1$ | $\square 1$ |
| Relay 7 | N.A |  | $\square 0$ | $\square 1$ | $\square 1$ |  |



Page 32/48
MiCOM P125/P126 \& P127

|  | RELAY TYPE |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Min | Max | Step |
| l>>_R | N.A. |  |  | 0 | 1 | 1 |
| l>>> | N.A. |  |  | 0 | 1 | 1 |
| tl>>> | N.A. |  |  | 0 | 1 | 1 |
| l>>>_R | N.A. |  |  | 0 | 1 | 1 |
| tIA> | N.A. |  |  | 0 | 1 | 1 |
| tIB> | N.A. |  |  | 0 | 1 | 1 |
| tIC> | N.A. |  |  | 0 | 1 | 1 |
| le> |  |  |  | 0 | 1 | 1 |
| tle> |  |  |  | 0 | 1 | 1 |
| $l e>$ _R |  |  |  | 0 | 1 | 1 |
| le>> |  |  |  | 0 | 1 | 1 |
| tle>> |  |  |  | 0 | 1 | 1 |
| le>>_R |  |  |  | 0 | 1 | 1 |
| le>>> |  |  |  | 0 | 1 | 1 |
| tle>>> |  |  |  | 0 | 1 | 1 |
| le>>>_R |  |  |  | 0 | 1 | 1 |
| Pe/leCos> |  |  |  | 0 | 1 | 1 |
| tPe/leCos> |  |  |  | 0 | 1 | 1 |
| Pe/leCos>> |  |  |  | 0 | 1 | 1 |
| tPe/leCos>> |  |  |  | 0 | 1 | 1 |
| 12> | N.A. |  |  | 0 | 1 | 1 |
| tl2> | N.A. |  |  | 0 | 1 | 1 |
| I2>> | N.A. |  |  | 0 | 1 | 1 |
| tl2>> | N.A. |  |  | 0 | 1 | 1 |
| I2>>> | N.A. |  |  | 0 | 1 | 1 |
| tl2>>> | N.A. |  |  | 0 | 1 | 1 |
| Therm Alarm | N.A. |  |  | 0 | 1 | 1 |
| Ther. Trip | N.A. |  |  | 0 | 1 | 1 |
| I< | N.A. |  |  | 0 | 1 | 1 |
| $\mathrm{tl}<$ | N.A. |  |  | 0 | 1 | 1 |
| U> | N.A. | N.A. |  | 0 | 1 | 1 |
| $t \cup>$ | N.A. | N.A. |  | 0 | 1 | 1 |
| U>> | N.A. | N.A. |  | 0 | 1 | 1 |
| tU>> | N.A. | N.A. |  | 0 | 1 | 1 |
| $U<$ | N.A. | N.A. |  | 0 | 1 | 1 |
| $\mathrm{tU}<$ | N.A. | N.A. |  | 0 | 1 | 1 |
| U<< | N.A. | N.A. |  | 0 | 1 | 1 |
| tU<< | N.A. | N.A. |  | 0 | 1 | 1 |
| Ue>>>> |  |  |  | 0 | 1 | 1 |


|  | RELAY TYPE |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Min | Max | Step |
| tUe>>>> |  |  |  | 0 | 1 | 1 |
| Brkn. Cond | N.A. |  |  | 0 | 1 | 1 |
| CB Alarm | N.A. |  |  | 0 | 1 | 1 |
| 52 Fail | N.A. |  |  | 0 | 1 | 1 |
| CB Fail | N.A. |  |  | 0 | 1 | 1 |
| CB close | N.A. |  |  | 0 | 1 | 1 |
| tAux1 |  |  |  | 0 | 1 | 1 |
| tAux2 |  |  |  | 0 | 1 | 1 |
| tAux3 |  |  |  | 0 | 1 | 1 |
| tAux4 |  |  |  | 0 | 1 | 1 |
| 79 Run | N.A. |  |  | 0 | 1 | 1 |
| 79 Trip | N.A. |  |  | 0 | 1 | 1 |
| SOTF | N.A. |  |  | 0 | 1 | 1 |
| Control Close |  |  |  | 0 | 1 | 1 |
| CTRL Trip |  |  |  | 0 | 1 | 1 |
| Active Group |  |  |  | 0 | 1 | 1 |
| t EQU A | N.A. |  |  | 0 | 1 | 1 |
| t EQU B | N.A. |  |  | 0 | 1 | 1 |
| t EQU C | N.A. |  |  | 0 | 1 | 1 |
| t EQU D | N.A. |  |  | 0 | 1 | 1 |
| Inputs |  |  |  |  |  |  |
| Input 1 |  |  |  | None, Unlatch, 52 a, 52 b, Blk Log 1, Blk Log 2, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block 79, Trip Circ , Start tBF, Maint.M.Man.Close,Local |  |  |
| Input 2 |  |  |  | None, Unlatch, 52 a, 52 b, Blk Log 1, Blk Log 2, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block 79, Trip Circ , Start tBF, Maint.M.Man.Close,Local |  |  |
| Input 3 |  |  |  | None, Unlatch, 52 a, 52 b, Blk Log 1, Blk Log 2, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block 79, Trip Circ , Start tBF, Maint.M.Man.Close,Local |  |  |
| Input 4 |  |  |  | None, Unlatch, 52 a, 52 b, Blk Log 1, Blk Log 2, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block 79, Trip Circ , Start tBF, Maint.M.Man.Close,Local |  |  |
| Input 5 | N.A. |  |  | None, Unlatch, 52 a, 52 b, Blk Log 1, Blk Log 2, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block 79, Trip Circ , Start tBF, Maint.M.Man.Close,Local |  |  |
| Input 6 | N.A. |  |  | None, Unlatch, 52 a, 52 b, Blk Log 1, Blk Log 2, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block 79, Trip Circ , Start tBF, Maint.M.Man.Close,Local |  |  |

Page 34/48
MiCOM P125/P126 \& P127

|  | RELAY TYPE |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Min | Max | Step |
| Input 7 | N.A. |  |  | None, Unlatch, 52 a, 52 b, Blk Log 1, Blk Log 2, Aux 1, Aux 2, Aux 3, Aux 4, CB FLT, $\theta$ Reset, Change set, Log Sel 2, Log Sel 1, Cold L PU, Strt Dist, Block 79, Trip Circ , Start tBF, Maint.M.Man.Close,Local |  |  |
| Aux1 time |  |  |  | 0 | 200s | 0.01 s |
| Aux2 time |  |  |  | 0 | 200s | 0.01 s |
| Aux3 time |  |  |  | 0 | 200s | 0.01 s |
| Aux4 time |  |  |  | 0 | 200s | 0.01s |
| Broken Conductor |  |  |  |  |  |  |
| Brkn.Cond | N.A. |  |  | $\square$ Yes or $\square$ No |  |  |
| Brkn.Cond | N.A. |  |  | 20\% | 100\% | 1\% |
| Brkn.Cond Time | N.A. |  |  | 0 s | 14400 s | 1 s |
| Cold Load Pick Up |  |  |  |  |  |  |
| Cold Load PU | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Cold Load PU tl> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Cold Load PU tl>> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Cold Load PU tl>>> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Cold Load PU tle> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Cold Load PU tle>> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Cold Load PU tle>>> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Cold Load PU tl2> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Cold Load PU tl2>> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Cold Load PU tl2>>> | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Cold Load PU Thermal | N.A. |  |  | $\square$ Yes | $\square$ No |  |
| Level | N.A. |  |  | 100\% | 500\% | 1\% |
| tCL | N.A. |  |  | 0.1 s | 3600 s | 0.1 s |
| 51 V (57-130V) | N.A. | N.A. |  |  |  |  |
| $(\mathrm{U}<\mathrm{ORV} 2>$ )\&1>>? | N.A. | N.A. |  | $\square$ Yes | $\square$ No |  |
| V2> | N.A. | N.A. |  | 3V | 200V | 0.1V |
| ( $\mathrm{U} \ll$ ORV2>>>)\&1>>>? | N.A. | N.A. |  | $\square$ Yes | $\square$ No |  |
| V2>> | N.A. | N.A. |  | 3V | 200V | 0.1V |
| 51 V (220-480V) | N.A. | N.A. |  | $\square$ Yes | $\square$ No |  |
| V2> | N.A. | N.A. |  | 20V | 720 V | 0.5 V |
| ( $\mathrm{U} \ll$ ORV2>>)\&1>>>? | N.A. | N.A. |  | $\square$ Yes | $\square$ No |  |
| V2>> | N.A. | N.A. |  | 20V | 720 V | 0.5V |
| VTS Blocks 51V? | N.A. | N.A. |  | $\square$ Yes | $\square$ No |  |
| VTS Alarm? | N.A. | N.A. |  | $\square$ Yes | $\square$ No |  |


|  | RELAY TYPE |  |  |  |  |  |  |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 |  |  |  | P127 |  |  |  | Min | Max | Step |
| CB Fail |  |  |  |  |  |  |  |  |  |  |  |  |
| $1>B F$ | N.A. |  |  |  |  |  |  |  |  | 0.02 ln | 1 ln | 0.01 ln |
| CB Fail | N.A. |  |  |  |  |  |  |  |  | $\square$ Yes | $\square$ No |  |
| CB Fail Time tBF | N.A. |  |  |  |  |  |  |  |  | 0 s | 10 s | 0.01 s |
| Block I> | N.A. |  |  |  |  |  |  |  |  | $\square$ Yes | $\square$ No |  |
| Block le> | N.A. |  |  |  |  |  |  |  |  | $\square$ Yes | $\square$ No |  |
| CB Supervision |  |  |  |  |  |  |  |  |  |  |  |  |
| TC Supervision | N.A. |  |  |  |  |  |  |  |  | $\square$ Yes | $\square$ No |  |
| t Trip Circuit | N.A. |  |  |  |  |  |  |  |  | 0.1 s | 10 s | 0.1 s |
| CB Open S'vision | N.A. |  |  |  |  |  |  |  |  | $\square$ Yes | $\square$ No |  |
| CB Open time | N.A. |  |  |  |  |  |  |  |  | 0.05 s | 1 s | 0.01 s |
| CB Close S'vision | N.A. |  |  |  |  |  |  |  |  | $\square$ Yes | $\square$ No |  |
| CB Close time | N.A. |  |  |  |  |  |  |  |  | 0.05 s | 1 s | 0.01 s |
| CB Open Alarm | N.A. |  |  |  |  |  |  |  |  | $\square$ Yes | $\square$ No |  |
| CB Open NB | N.A. |  |  |  |  |  |  |  |  | 0 | 50000 | 1 |
| $\Sigma \operatorname{Amps}(\mathrm{n})$ | N.A. |  |  |  |  |  |  |  |  | 0 Exp6 A | 4000 Exp6 A | 1 Ecp6 A |
| n | N.A. |  |  |  |  |  |  |  |  | 1 | 2 | 1 |
| CB Open pulse | N.A. |  |  |  |  |  |  |  |  | $\square$ Yes | $\square$ No |  |
| tOpen Pulse | N.A. |  |  |  |  |  |  |  |  | 0.1 s | 5 s | 0.1 s |
| tClose Pulse | N.A. |  |  |  |  |  |  |  |  | 0.1 s | 5 s | 0.1 s |
| SOTF |  |  |  |  |  |  |  |  |  |  |  |  |
| Sotf | N.A. |  |  |  |  |  |  |  |  | $\square$ Yes | $\square$ No |  |
| tSotf | N.A. |  |  |  |  |  |  |  |  | 100 ms | 500 ms | 100 ms |
| l>> | N.A. |  |  |  |  |  |  |  |  | $\square$ Yes | $\square$ No |  |
| l>>> | N.A. |  |  |  |  |  |  |  |  | $\square$ Yes | $\square$ No |  |
| AND LOGIC EQUAT |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | A | B | C | D | A | B | C | D |  |  |  |
| 1> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| tl> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| l>> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| tl>> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| l>>> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| tl>>> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| le> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| tle> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| le>> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| tle>> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| le>>> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| tle>>> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| Pe/leCos> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| tPe/leCos> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |
| Pe/leCos>> | N.A. |  |  |  |  |  |  |  |  | 0 | 1 | 1 |

Page 36/48
MiCOM P125/P126 \& P127


|  | RELAY TYPE |  |  | Setting Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | P125 | P126 | P127 | Min | Max | Step |
| RECORDS |  |  |  |  |  |  |
| Fault Record |  |  |  |  |  |  |
| Record Number | N.A. |  |  | 1 | 5 | 1 |
| Disturb Record |  |  |  |  |  |  |
| Pre-Time | N.A. |  |  | 0.1 | 3 | 0.1 |
| Post-Time | N.A. |  |  | 0.1 | 3 | 0.1 |
| Disturb rec Trig | N.A. |  |  | $\square$ ON TRIP or $\square$ ON INST. |  |  |
| Time Peak Value |  |  |  |  |  |  |
| Time Window | N.A. |  |  | $\square 5 \mathrm{mn}, \square 10 \mathrm{mn}, \square 15 \mathrm{mn}, \square 30 \mathrm{mn}, \square 60 \mathrm{mn}$ |  |  |
| Rolling Demand | N.A. |  |  | $\square 5 \mathrm{mn}, \square 10 \mathrm{mn}, \square 15 \mathrm{mn}, \square 30 \mathrm{mn}, \square 60 \mathrm{mn}$ |  |  |
| Time Window | N.A. |  |  | $\square 1 \mathrm{mn}$ | $\square 60 \mathrm{mn}$ | $\square 1 \mathrm{mn}$ |

## 3. P126 \& P127 FURTHER TESTS

### 3.1 Introduction

The following procedures are written for demonstrating the main protection functions of the MiCOM P126 (where possible) \& P127 relays using an Omicron test or similar. The tests do not test the limits / boundaries of all available function characteristics. They do tests that the function is operating at one or two chosen points an a characteristic. This document is not a complete commissioning procedure but could be referred to when performing commissioning tests in association with the commissioning section of the service manual.

The procedures will state if a deviation from the standard connections or default settings is required for testing a particular function. For specific on site applications only enabled functions would be tested using application specific settings.

### 3.2 Test equipment

The test procedure has been written on the assumption that an Omicron, or equivalent, test set will be used. Auxiliary supplies of adequate rating will also be required.

### 3.3 Type used relay

The following tests have been done using a P127 with the following characteristic.

- Earth Current :
- Voltage input :
- Auxiliary supply voltage :
- Communication protocol :
- HMI Language :
- Relay software :
0.01 to 8len
$57-130 \mathrm{~V}$
$130-250 \mathrm{Vdc} / 110-250 \mathrm{Vac}$
Mod Bus
English
Current Version


### 3.4 Test configuration

Input the factory default settings. These settings shall then be downloaded and recorded in the test results. Any changes to the settings required by this test procedure shall be recorded in the test results. Any deviation from the default settings will be indicated for each test.

### 3.5 Connections to test equipment

The test equipment will be wired as described in the table below unless otherwise stated.

### 3.6 Test Overcurrent Protection

The following general settings for the relay are suggested

- VT Connection : 3Vpn
- Line CT primary : 1A
- Line CT secondary : 1A
- E/Gnd CT primary : 1A
- E/Gnd CT secondary : 1A
- Line VT primary : 0.10 kV
- Line VT secondary : 100 V


### 3.7 Non-directional overcurrent protection

3.7.1 Overcurrent sensitivity tests

Object:
The following tests verify that the relay overcurrent elements operate at the set thresholds.
Test with the following relay settings (all thresholds set as non-directional):

- ON
- 1 In
- Characteristic IDMT
- Curve

IEC_SI (Standard Inverse)

- TMS
0.025
- Reset time delay
0.04 s

Inject current of 0.95 In into the A phase input. Increase the current in 0.01In steps, pausing for 2.5 s between each step, until the relay operates. The current must then be reduced in the same manner until the protection resets.

Repeat the above tests for all phases.
Repeat the above test for other overcurrent stages taking in account that the delay time for nthe second and third threshold is DMT ( $\mathrm{t}=0 \mathrm{~s}$ ). Make the test before on l>> after on l>>>.

### 3.7.1.1 Pass Criteria

For the relay to pass it shall operate as detailed below.
Delay trip IDMT (inverse time only for $1>$ ):

- Pick-up should occur at 1.1 ls $\pm 2 \%$.
- Reset should occur at
$1.04 \mathrm{Is} \pm 2 \%$.
Delay Trip DT (definite time for $1>, 1 \gg, \mid \ggg$ )
- Pick-up should occur at : Is $\pm 2 \%$.
- Reset should occur at 0.95

Is $\pm 2 \%$.
3.7.2 Overcurrent characteristic tests

Object:
The following tests verify that the relay overcurrent elements trip in the correct time.
Test with the following relay settings:

- Is
- Characteristic
- Curve
- TMS
- Time Delay
- Directionality
- Reset time delay

1 In
DT / IDMT
IEC_SI (Standard Inverse)
1.0

1s
Non-directional
0s

Enable stage 1 overcurrent and prepare the tests set so that A phase current can be instantaneously applied at 2 In and 10 In respectively. Measure the operating times of the relay start and trip contacts. Repeat the test with the element set to IDMT. Repeat the test with the element disabled and verify that no start or trip elements operate.
Repeat the above testing for all phases and stages (with the exception of IDMT which is only for the first stage).

Page 40/48
MiCOM P125/P126 \& P127

### 3.7.2.1 Pass Criteria

For the relay to pass it shall operate as detailed below

- DT operating time $1.0 \mathrm{~s} \pm 2 \%$
- IDMT operating time: $10.070 \mathrm{~s} \pm 2 \%$ at 2 ln .
- $2.991 \mathrm{~s} \pm 2 \%$ at 10 ln .
3.7.3 Non-directional earth fault overcurrent protection
3.7.3.1 Neutral sensitivity test

Object:
The following tests verify that the relay earth fault elements operate at the set thresholds.
Test with the following relay settings:

- 0.1len
- Characteristic IDMT
- Curve IEC_SI (Standard Inverse)
- TMS
0.025
- Delay time Os
- Directionality Non-directional
- Reset time delay 0.04s

Enable stage 1of Earth Fault protection and inject current of 0.095les into the le current input. Increase the current in 0.001In steps, pausing for 2.5 s between each step, until the relay operates.
The current must then be reduced in the same manner until the protection resets.
Repeat the above test for all stages of Earth fault protection (delay type is DT).
3.7.3.2 Pass Criteria

For the relay to pass it shall operate as detailed below.

- Pick-up should occur at 1.1 les $\pm 2 \%$.
- Reset should occur at 1.05 les $\pm 2 \%$.
3.7.4 Neutral characteristic tests

Object:
The following tests verify that the relay earth fault elements trip in the correct time.
Test with the following relay settings:

- Characteristic
- Curve
- TMS
- Time Delay
- Directionality
- Reset time delay
- Is

Enable stage 1 of Earth Fault protection and prepare the tests set so that le current can be instantaneously applied at 2 les and 10 les respectively. Measure the operating times of the relay start and trip contacts. Repeat the test with the element set to IDMT. Repeat the test with the element disabled and verify that no start or trip elements operate.
Repeat the above testing for all stages (IDMT is only for the first stage).

### 3.7.4.1 Pass Criteria

For the relay to pass it shall operate as detailed below.

- DT operating time
- $1.0 \mathrm{~s} \pm 2 \%$
- IDMT operating time :
- $\quad 10.07 \mathrm{~s} \pm 2 \%$ at 2 les
- $2.999 \mathrm{~s} \pm 2 \%$ at 10 les
3.7.5 Directional earth fault overcurrent protection
3.7.5.1 Neutral sensitivity test

Object:
The following tests verify that the relay directional earth fault elements operate at the set thresholds and boundary trip zone

Wirng scheme: 3Vpn for the voltage, Holmgreen insertion for the currents. The le current is the output common of the phase current inputs.

Test with the following relay settings:

- E/GND Primary 5A
- E/GND Secondary 5A
- le> 0.2 len
- Characteristic IDMT
- Curve IEC_SI (Standard Inverse)
- TMS 1
- Ue 1 V
- Trip Zone $-45 \%+45^{\circ}$
- Torque Angle $180^{\circ}$
- Directionality Directional
- Reset time delay 0.04s

Set the phase voltage adn phase current as following

- $\mathrm{Ua}=50 \mathrm{~V}, \mathrm{Ub}=57.70 \mathrm{~V}, \mathrm{Uc}=57.70 \mathrm{~V}$.

Set the la current to have the ratio $\mathrm{la} / \mathrm{le}>$ as:

- la/le> =2 Trip time in 10.08 s
- Inject the current and verify the delay trip time.
- Repeat the test for the following ratio
- $\quad \mathrm{la} / \mathrm{le}>=3$ Trip time in 6.36 s
- $\quad \mathrm{la} / \mathrm{le}>=4$ Trip in 5.022 s


### 3.7.5.2 Pass Criteria

For the relay to pass it shall operate as detailed below.
Pick-up should occur at 1.1 les $\pm 2 \%$.

- Time accuracy $+/-2 \%$ or $20 \ldots .40 \mathrm{~ms}$

Page 42/48
MiCOM P125/P126 \& P127

### 3.7.6 Reset time test

Repeat the test at the paragraph 6.8.1 using definite time setting the tle> to 10 s and Treset to 10 s .

Make the sequence:
On Input current 2A, after 5 s inject 0 A after 5 seconds again 2A
3.7.6.1 Pass Criteria

For the relay to pass; it shall operate as detailed below.
The trip occurs after 5 s .
Time accuracy: +/-2\% or $20 . \ldots .40 \mathrm{~ms}$
3.7.7 Directional earth fault operating boundary

Object:
The following tests verify the operating boundary of the characteristic and to verify its pick-up and drop-off.
Test with the following relay settings:

- VT connection $3 V p n$.
- Characteristic
- t
- Is
- Torque Angle(RCA)
- Boundary trip zone

DT
10s (Operation to be determined by start contacts)
0.2 len
$180^{\circ}$
$+/-45^{\circ}$

Enable stage and configure the test set applying Ua=50V, Ub=57.70V, Uc=57.70V .
Apply A phase current of twice setting at $50^{\circ}$ leading the A phase voltage.
Increase/decrease the angle between the phase A voltage and current in step of $1^{\circ}$ every 2.5 s and determine the angle at which the start contacts non-operate and operate, once the element has started decrease/increase the angle and determine the drop-off.

Repeat the same test for IDMT delay trip time using the previous settings.

### 3.7.7.1 Pass Criteria

For the relay to pass the following must be satisfied:
The directional decision shall be from the following equations:
Directional forward $\quad-45^{\circ}<$ RCA (Torque angle) $<45^{\circ}$
The operating boundary shall be within $\pm 3^{\circ}$ of the relay characteristic angle $\pm 45^{\circ}$.
The element shall drop off within $3^{\circ}$ of pick-up.

### 3.7.8 Neutral characteristic tests

Object:
The following tests verify that the relay earth fault elements trip in the correct time.
Test with the following relay settings:

- Characteristic
- Curve
- TMS
- Time Delay
- Directionality
- Reset time delay
- Is

DT / IDMT
Standard Inverse
1.0

1s
Non-directional
0s
1 len

Enable stage 1 of Earth Fault protection and prepare the tests set so that le current can be instantaneously applied at 2 les and 10 les respectively. Measure the operating times of the relay start and trip contacts. Repeat the test with the element set to IDMT. Repeat the test with the element disabled and verify that no start or trip elements operate.

Repeat the above testing for all stages (IDMT is only for the first stage).

### 3.7.8.1 Pass Criteria

For the relay to pass it shall operate as detailed below.
DT operating time

- $1.0 \mathrm{~s} \pm 2 \%$,

IDMT operating time :

- $10.07 \mathrm{~s} \pm 2 \%$ at 2 les
- $2.999 \mathrm{~s} \pm 2 \%$ at 10 les
3.7.9 Directionaloperating boundary - PHASE overcurrent (only P127)

Object:
The following tests verify the operating boundary of the characteristic and to verify its pick-up and drop-off.

Test with the following relay settings:

- VT connection
- Characteristic
- t
- Is
- $\quad$ Characteristic Angle (RCA)
- Boundary trip zone
$3 V p n$.
DT
10s (Operation to be determined by start contacts)
1 In
$0^{\circ}$
$+/ 80^{\circ}$

Enable stage 1of Overcurrent and configure the test set to apply balanced three phase nominal voltages ( 57.7 V ) to the voltage inputs.

Apply A phase current of twice setting at $30^{\circ}$ leading the A phase voltage.
Increase/decrease the angle between the A phase voltage and current in step of $1^{\circ}$ evry 2.5 s and determine the angle at which the start contacts non-operate and operate, once the element has started decrease/increase the angle and determine the drop-off.

### 3.7.9.1 Pass Criteria

For the relay to pass the following must be satisfied:
The directional decision shall be from the following equations:
Directional forward $-80^{\circ}<\operatorname{RCA}$ (Torque angle) $<80^{\circ}$
The operating boundary shall be within $\pm 3^{\circ}$ of the relay characteristic angle $\pm 80^{\circ}$.
The element shall drop off within $3^{\circ}$ of pick-up.
3.7.10 Earth directional wattmetric test

Wiring scheme is:

- $\quad 3 \mathrm{Vpn}$ for the voltage
- Holmgreen insertion for the phase and earth current
- CT phase and E/GND ratio primary and secondary to 5A
- VTs primary and secondary set to 0.1 kV and 100 V


## Relay settings:

- $\quad \mathrm{Pe}>5 \times \mathrm{KW}->25 \mathrm{~W}$
- Delay type IDMT: IEC SI CURVE
- Reset time 0.04s
- Torque angle $180^{\circ}$
- Inject: $\mathrm{Ua}=57.7 \mathrm{~V}, \mathrm{Ub}=57.7 \mathrm{~V}, \mathrm{Uc}=57.7 \mathrm{~V}$ with these values the Ue is equal to 0 .

Inject the la phase current with displacement $0^{\circ}$ with Ua to have the following ratios $\mathrm{Pe} / \mathrm{Pe}>$ : 2, 3, 4

- Inject $\mathrm{Ua}=27.7 \mathrm{~V}, \mathrm{Ub}=57.7 \mathrm{~V}, \mathrm{Uc}=57.7 \mathrm{~V}$
- $\quad \mathrm{Ue}=1 / 3(\mathrm{Ua}+\mathrm{Ub}+\mathrm{Uc})$ (vectorial summation)


## The relay calculates the Pe as:

$\mathrm{Pe}=\mathrm{Ue} \times \mathrm{le} \times \mathrm{Cos}\left(\mathrm{Ie} \mathrm{U}^{\mathrm{Ue}}+\right.$ Torque angle)
$\mathrm{Pe}=(27.7-57.7) / 3 \times \mathrm{la} \times \cos \left(180^{\circ}\right)$ with la $=5 \mathrm{~A}$ you have 50 W the ratio is equal 2 follow the other ones.

Inject 5A for a ratio equal to 2; theoretical delay time 10.03s, measured delay time 10,273s Inject 7.5A for a ratio equal to 3 theoretical delay time 6.3 s , measured delay time 6.43 s Inject 10A for a ratio equal to 4 theoretical delay time 10.03s, measured delay time 5.077 s

### 3.7.10.1 Pass Criteria

For the relay to pass it shall operate as detailed below.
IDMT operating time :

- Accuracy: $\pm 2 \%$ or $30 \ldots . .40 \mathrm{~ms}$
3.7.11 Negative sequence overcurrent

Object:
To verify that the negative sequence overcurrent operation is recorded as a fault record.
Test with the following relay settings:

- DT time Delay

10s

- $12>$ 0.1 ln

Apply three phase currents to the relay at a magnitude of In . Step change the A phase current to a magnitude of 0.5 In . Verify that the fault record indicates that the negative sequence overcurrent has started.

Repeat the above testing with the time delay set to 0 s . The fault record should now indicate trips.

### 3.7.11.1 Pass Criteria

For the relay to pass it shall operate as detailed above.
3.7.12 Thermal overload

Object:
The following tests verify that thermal overload starts and trips applied to the relay operate correctly.

Test with the following relay settings:

- Thermal trip current l $\theta>0.5 \mathrm{ln}$
- Thermal alarm $\theta>$ No
- Time Constant Te 1 min
- K 1
- $\theta$ Trip 100\%

Configure the test set to apply 3 phase balanced current to the relay
Reset the thermal time state of the relay. Inject three phase 0.55 In to the relay and measure the operating time of the contact. Verify that the fault record indicates that the thermal overload alarm has operated followed by a thermal overload trip after $107 \mathrm{~s} \pm 2 \%$.

### 3.7.12.1 Pass Criteria

For the relay to pass it shall operate as detailed above.

## $3.8 \quad$ Voltage Protection (only P127)

The voltage protection 27 and 59 compare the line voltage to the setting elements of each protection.

### 3.8.1 Under voltage

Object:
The following tests verify that under voltage starts and trips applied to the relay operate correctly.
Test with the following relay settings:

- Mode OR
- Characteristic DT
- DT 30s


### 3.8.2 Phase to neutral under voltage element

Test with the following relay settings:

- $\quad \mathrm{U}<$

50V
Enable stage 1 over voltage and apply rated three phase voltages ( 57.7 V per phase) to the relay. After 2 s reduce the phase $A$ voltage and phase $B$ voltage to 20 V . Measure the operating times of the relay start and trip contacts. Repeat the test with the element disabled and verify that no start or trip elements operate.
Repeat the above tests for stage 2 under voltage.

### 3.8.3 Over voltage

Object:
To verify that over voltage starts and trips applied to the relay operate correctly.
Test with the following relay settings:

- Mode OR
- Characteristic DT
- DT 10s
3.8.4 Phase to neutral over voltage element

Test with the following relay settings:

- $U>100 \mathrm{~V}$

Enable stage 1 and apply three phase voltages ( 50 V per phase) to the relay. After 1 s increase the phase A voltage and phase B voltage to 60 V . Measure the operating times of the relay start and trip contacts. Repeat the test with the element disabled and verify that no start or trip elements operate.

Repeat the above testing for stage 2 overvoltage.
3.8.5 Residual over voltage

Object:
The following tests verify that residual over voltage starts and trips applied to the relay are recorded as fault records.
Test with the following relay settings:

- Ue Derived (VT Connection setting 3Vpn)
- Ue>>>> 10V
- Trip Delay 10s

Enable stage of the residual overvoltage protection and apply balanced three phase voltages to the relay ( 57.7 V per phase) after 2 s reduce UA phase voltage to 25 V . Measure the operating times of the relay start and trip contacts. Repeat the test with the element disabled and verify that no start or trip elements operate.

### 3.8.5.1 Pass Criteria

For the relay to pass it shall operate as detailed below.

### 3.9 Automatic control functions

3.9.1 Trip circuit supervision

Connect the coil of the external auxiliary relay as the example in the Technical Guide P12y/EN AP page 55.


Set the following parameters.
Set in the CB Monitoring TCS ON and
Input menu:
Assign Trip. Circ. to input 1
Assign an output relay to the 52 Fail
Procedure
Supply the input and verify that the led and the relay are OFF
Remove the supply from the input and verify that the output relay are ON after the set of the TCS timer.

### 3.9.2 Circuit breaker failure

Object:
The following test verifies the Breaker Failure operation.
Test with the following relay settings:
Overcurrent:

- Characteristic

DT

- Time Delay
- Directionality
- Reset time delay
- $\quad$ Is (l>)

CBF:

- Time Delay
- $\quad 1<B F$
- tBF

The relay shall be configured with trip commands relay assigned to t_l>, with relay 2 assigned to CB fail function and with relay 2 assigned as latched.

Enable stage 1 overcurrent and apply three phase currents to the relay at 0.8 In for 1 s ; instantaneously increase the currents applied to the ABC phase inputs to 2 In for 7 s . Verify after the increase that tat the relays number 2 change in the status display windows to level 1 after 5 s .

### 3.9.2.1 Pass Criteria

For the relay to pass it shall operate as detailed above.

### 3.9.3 Cold load pick-up

Test with the following relay settings:
Cold load pick-up:

- t_l> Yes
- Level 200\%
- tCL 5.0 s

Overcurrent:

- Characteristic DT
- Time Delay 2s
- Directionality Non-directional
- Reset time delay Os
- Is (l>) 1 In

Inputs:

- Input 1

Cold L PU
Apply three phase currents to the relay at a magnitude of 1.5 In and supply the input 1. Verify after 8 sec the trip of the overcurrent is recrided as a fault record
3.9.3.1 Pass Criteria

For the relay to pass it shall operate as detailed above.
3.9.4 Broken Conductor

Object:
The following tests verify that a broken conductor condition causes the relay to operate correctly.

Test with the following relay settings:

- I2/I1 setting 20\%
- Characteristic DT
- Time Delay 10s

Apply rated three phase currents ( 1 In ). After 10 seconds have elapsed, reduce the current in A phase to zero and measure the time taken for the relay to indicate a broken conductor trip.

Repeat the test with the element disabled and verify that no start or trip elements operate.
3.9.4.1 Pass Criteria

For the relay to pass it shall operate as detailed below.

- DT operating time $10.0 \mathrm{~s} \pm 2 \%$


[^0]:    ${ }^{3}$ Informations of instantaneous and temporised memorised $\mathrm{l}>, \mathrm{l} \gg, 1 \ggg$ and I < have different address Modbus from release V3/V4/V5 to V6. This old address Modbus V5 aren't used (001Bh to

[^1]:    ${ }^{3}$ Informations of instantaneous and temporised memorised l>, l>>, l>>> and I< have different address Modbus from release V3/V4/V5 to V6. This old address Modbus V5 aren't used (001Bh to 001Fh and 0024h) and all are integrated in the new one address 002Bh (see format description F36C).

