

MiCOM P12x

Directional / non Directional Overcurrent
Protection

P12xy/EN TDS/I86

Version	P120	Phase II V11
	P121, P122 & P123	Phase II V12
	P125, P126 & P127	Phase II V14

Technical Data Sheet

Application and Scope

The MiCOM P12x relays are suitable for all the applications where overcurrent and earth-fault protection are required.

The P12x relays can be used for a range of overcurrent applications from single phase/earth fault applications, P120 (non directional), P125 (directional) to three phase and earth fault applications, P123 (non directional), P127 (directional). The P127 also includes voltage & frequency protections and power measurement.

The P12x relays provide a comprehensive suite of overcurrent protection and automation features for easy and flexible adaptation under different operating conditions.

The typical applications are overhead lines, underground cables and backup for HV systems in insulated, solid, resistance and Petersen coil earthed neutral systems, used in MV utility, Industry, Transport, generator and transformer schemes.

To answer the tremendous challenge of managing energy flows, the MiCOM P127 now offers both Class 0.5 metering and protection functions in a single compact box.

Dedicated measurement CTs permit data acquisitions to reach Class 0.5 for power and energy. Power quality measurements such as harmonics, THD and TDD are provided to evaluate network reliability.

For easy adaptation to varying system operating conditions, up to eight independent setting groups are provided.

1A and 5A dual rated CT inputs are available with all MiCOM P12x relays using separate terminals. Two line/phase voltage input ranges, 57-130V and 220-480V, are available by ordering code. The auxiliary voltage for the power supply and the digital inputs is a wide-range design from 24 to 250 Vac/dc.

The P12x relays are housed in a robust 4U metal case for panel or rack mounting with 20TE width (P120, P121, P122, P123 and P125) or 30TE width (P126 and P127). To ease maintenance, the relay can be withdrawn from its case (draw out case).



Functions overview

ANSI CODES	FEATURES	P120	P121	P122	P123	P125	P126	P127
50/51P/N	1 phase or earth overcurrent	•				•		
50/51	3 phase overcurrent		•	•	•		•	•
50/51N	Earth overcurrent		•	•	•		•	•
67P	3 phase directional overcurrent							•
67N	Earth fault directional overcurrent					•	•	•
51V	Voltage controlled overcurrent							•
37	3 phase undercurrent			•	•		•	•
46	Negative phase sequence overcurrent			•	•		•	•
27/59	Phase under/over voltage (AND & OR mode)							•
59N	Residual over voltage					•	•	•
32	3 phases Active / reactive over / under power							•
32N	Wattmetric Earth Fault					•	•	•
81U/O	Under/over frequency							•
81R	Rate of frequency							•
49	Thermal overload			•	•		•	•
86	Output relay latching	•	•	•	•	•	•	•
79	Autoreclose				•		•	•
50BF	Circuit breaker failure detection			•	•		•	•
46BC	Broken conductor detection I2/I1			•	•		•	•
	Blocking Logic	•	•	•	•	•	•	•
	Test of output relays (Maintenance)			•	•	•	•	•
	CB control Local/ remote				•	•	•	•
	Circuit Breaker Maintenance and Trip Circuit Supervision			•	•		•	•
	Cold load pick up			•	•		•	•
	Selective relay scheme logic			•	•		•	•
	Inrush blocking			•	•			•
	Switch on to fault (SOTF)				•		•	•
	Phase rotation			•	•			•
	CT/VT supervision (CTS/VTs)							•

GENERAL FEATURES		P120	P121	P122	P123	P125	P126	P127
Number of digital inputs		2	2	3	5	4	7	7/12 *
Total number of outputs relays		4	4	6	8	6	8	8
Events recording		250	0	250	250	250	250	250
Fault recording		25	0	25	25	25	25	25
Disturbance recording		5	0	5	5	5	5	5
Setting group		1	1	2	2	2	2	8
Auxiliary timers		2	2	3	5	4	7	7/12
Rear RS485 port		1	1	1	1	1	1	1/2 *
Communication	IEC60870-5-103, DNP 3.0 & Modbus RTU (port #1)	•	•	•	•	•	•	•
	Courier (port #1)	•	•	•	•			
	Modbus (port #2)							•*
Time synchronisation	Via rear communication port (DCS)	•		•	•	•	•	•
	Via digital input (external clock)	•		•	•	•	•	•
	Modulated and demodulated IRIG-B							•*
Settings software	MiCOM S1 using RS232 front port	•	•	•	•	•	•	•
Logic equation	AND, OR and NOT gates (8 equations)		•	•	•		•	•
Measurements	RMS currents values & frequency	•	•	•	•	•	•	•
	Peak and rolling currents values			•	•		•	•
	Max and average currents values			•	•		•	•
	Phase and/or neutral angle					•	•	•
	Max and average voltage values							•
	Power and Energy							•
	Apparent power and apparent energy							•
Metering	Harmonics value, THD & TDD							•*
	Class 0.5 measurements value (P, Q, S, E)							•*

* Optional features

Control and display

All functions including protection automation, communication, LEDs, inputs and outputs can be programmed and modified using the front panel user interface.

The 2 line, 16 alphanumeric backlit LCD display (available in a range of languages) provides the user with key information (faults, measurements, metering, settings, etc.).

The default display can be selected by the user. It is possible to show the phase or earth current value by selecting Phase A, Phase B, Phase C, Earth N or the four values simultaneously (P121/2/3/6/7). The P120/5 will be able to show the earth fault current only.

The menus have a pull-down structure for easy use and quick access to any data.

Dedicated LEDs

4 LEDs indicate the state of the relay (Trip, Alarm, Warning, Healthy).

Acknowledgement of alarm and trip LEDs can be easily performed locally or remotely.

Programmable LEDs

4 freely programmable LEDs are provided on all models.

The user can assign independently each LED to any signal, programmable function or combination of thresholds.

Keypad

A seven-button tactile keypad on the front panel allows the user easy access to any data.

Remote control from HMI

It is possible to open or close manually, and to start a disturbance record using a specific menu.

Communication RS485

All P12x series relays have one rear RS485 communications port by default to communicate with MODBUS, IEC 60870-5-103, Courier and DNP3 protocols. (Courier is not available on P125, P126 and P127 relays). An additional RS485 communications port is optionally available on P127 (Modbus or IEC 60870-5-103 by order)

The relays can communicate to the local monitoring system, or remotely to the SCADA, settings, measurements, meterings and alarms, as well as fault, event and disturbance records (not available in P121).

All communication parameters (relay address, data rate, parity, etc.) can be set using the front panel user interface.

Communication RS232

An RS232 front port is available in the MiCOM P12x series.

It allows the user to download new firmware (update, language changing,...) and also allows to set the relay using a PC with the setting software MiCOM S1.

The simple and powerful software interface provides the user easy configuration and access to all measurements and stored information for maintenance and post-fault analysis purposes.

Password Protection

A four-character password is requested in order to prevent inadvertent or unauthorized change of settings or trigger of control functions.

Self-Monitoring

Comprehensive self-monitoring procedures within the devices ensure that internal hardware or software errors are detected and do not cause malfunctions of the device. As the auxiliary voltage is turned on, a functional test is carried out. Cyclic self-monitoring tests are running during operation. If test results deviate from the default value then the corresponding signal is entered into the non-volatile monitoring signal memory. The result of the fault diagnosis determines whether a blocking of the protection and control unit will occur or whether a warning only is issued.

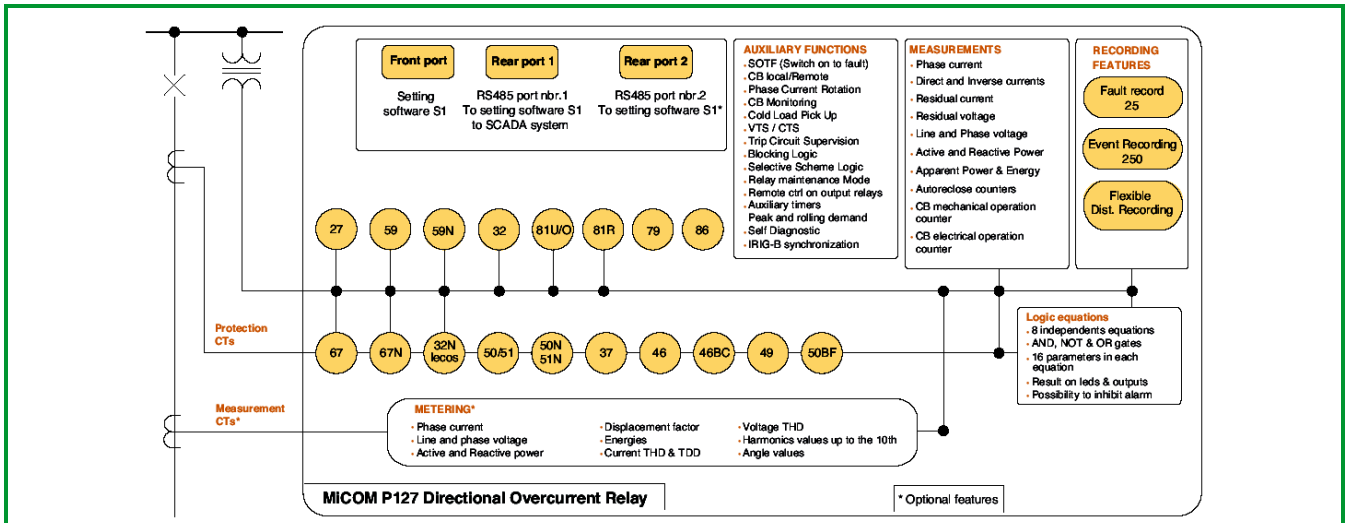


Main Functions

The relays comprise a full suite of protection functions as well as an automatic recloser and auxiliary functions.

Each function can be individually configured or disabled suiting any particular application.

MiCOM P127 FUNCTIONAL OVERVIEW



(Description of ANSI code: see Functions Overview)

Three-phase Overcurrent Protection (50/51) Earth Fault Overcurrent Protection (50N/51N)

Three independent stages are available for phase and earth fault protection. A fourth earth fault threshold is used for derived current calculation (when no earth CT available)

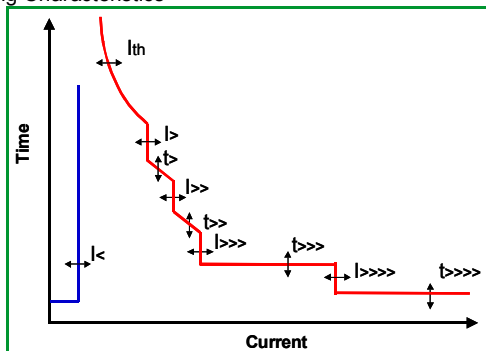
The first and second stage can be independently selected as definite time delay or inverse time delay with different types of curve (IEC, IEEE/ANSI, RI, RECT), except for P120 and P121 where the second stage can only be set as definite time.

The third stage for the P122, P123, P126 & P127 can also be configured as peak detection with a definite time delay only.

Each stage and related time delay can be programmed to provide maximum selectivity. The IDMT stages have definite or inverse time reset capability reducing clearance times when intermittent faults happen.

In P121, P122, P123, P125, P126, P127 the 2nd and 3rd threshold pick-up can suspend the 1st threshold output to control selectivity.

Tripping Characteristics

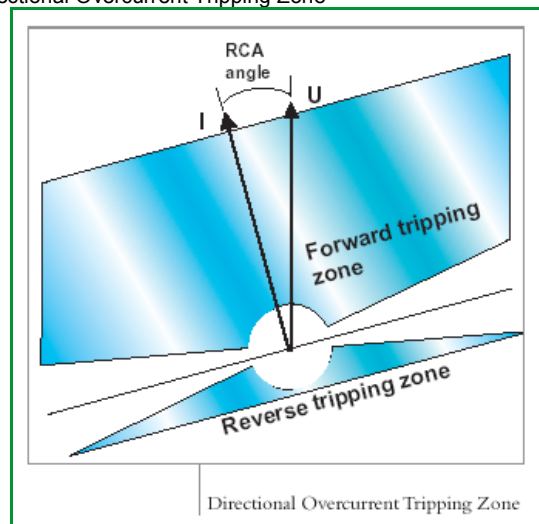


The MiCOM P12x relays have separate instantaneous (start) and delayed (trip) outputs for each stage. P123, P126 & P127 can indicate the faulted phase(s) by configuring output relays (first stage only). The range of earth fault current sensitivity can be selected by ordering code.

Three-phase Directional Overcurrent (67)

Each one of the three-phase overcurrent stages of the P127 can be independently configured as directional protection with specific relay characteristic angle (RCA) settings and boundaries. Each directional stage has instantaneous (start) forward/reverse outputs available.

Directional Overcurrent Tripping Zone

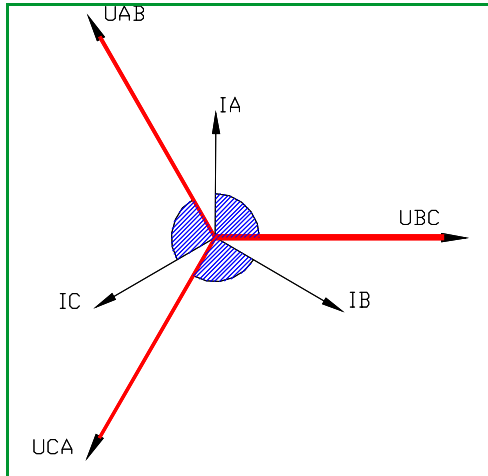


The first and second stage can be independently select as definite time delay or inverse time delay with different types of curve (IEC, IEEE/ANSI, RI, RECT, EDF BPN). The third stage can be configured with definite time delay only. The 2nd

and 3rd threshold pick-up can suspend the 1st threshold output to control selectivity

The phase fault directional elements are internally polarised by quadrature phase-phase voltages.

A synchronous polarising function is provided to ensure correct operation of the overcurrent elements for close-up three phase faults where the collapse of the polarising line voltages can occur.



The absolute phase angle of line voltages is measured every cycle and the last value is stored in the relay memory.

The polarisation discrimination voltage value is 0.6V (fixed value) for relays with a system voltage of 57 to 130V and 3V (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 persists longer than 5s the directional overcurrent protection is blocked.

Earth-fault Directional Overcurrent (67N)

Each of the three earth-fault stages of P125, P126 and P127 can be configured as directional protection with specific characteristic angle (RCA). Each directional stage has instantaneous (start) forward/reverse outputs available.

The first and second stage can be independently select as definite time or inverse time delay with different type of curves (IEC, IEEE/ANSI, RI, RECT). The third stage can be configured with a definite time delay only. The 2nd and 3rd threshold pick-up can suspend the 1st threshold output to control selectivity

In addition to the residual current, the residual voltage must be connected to a dedicated input or internally calculated as a vector sum (P127 only) in order to make directional operation possible.

Each earth-fault directional stage measures the residual current, the residual voltage, and the angle between residual voltage and current.

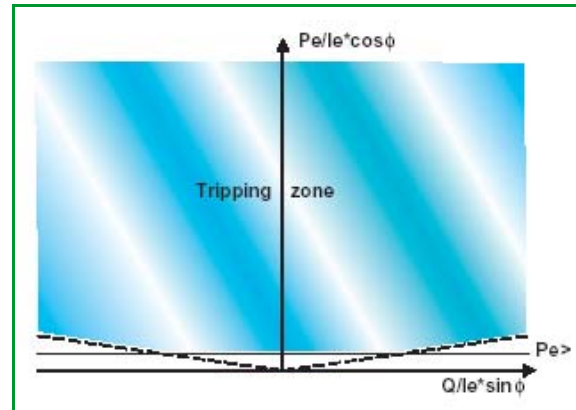
Wattmetric/ $I_e \cdot \cos \phi$ protection (32N)

Two additional stages are configurable with Wattmetric or $I_e \cdot \cos \phi$ characteristics. The first stage can be set with a definite time or with various IDMT curves as the 51N and 67N. The second stage is definite time only.

The P_e threshold setting value is automatically corrected selecting the rated I_e current.

The two-stages can be independently configured with specific characteristic boundaries. The RCA angle is common for the two stages.

Wattmetric characteristic



UnderCurrent protection (37)

MiCOM P122, P123, P126 & P127 relays provide a definite time undercurrent protection.

This function allows typical applications such as loss of load or simple broken conductor detection.

For the P122 and P123 the undercurrent protection stage is conditioned to the status of the CB auxiliary contact. The stage operates when the CB is closed as indicated by a logic digital input energised via the 52a auxiliary contact of the CB.

Thermal overload (49)

The thermal overload protection can be applied to prevent damage 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.

The P122, P123, P126 and P127 relays incorporate a current based thermal replica, using load current to reproduce the heating and cooling of the equipment to be protected. The thermal overload element can be set with both alarm and trip stages.

The heating within any plant equipment, such as cables or transformers, is of resistive type ($I^2R \times t$). Thus, the quantity of heat generated is directly proportional to current squared (I^2).

The thermal time characteristic used in the relay is based on current squared, integrated over time.

The P122, P123, P126 and P127 automatically use the highest phase current as input information for the thermal model.

The mathematical formula applicable is:

$$t_{Trip} = T_e * \ln \left(\frac{|K^2 - \theta|}{|K^2 - \theta_{Trip}|} \right)$$

Where:

t_{Trip} is the time to trip in seconds

T_e is the thermal time constant of the equipment to be protected in seconds

K is the thermal overload calculated by I_{eq}/k , where I_{eq} is the equivalent current corresponding to the RMS value of the largest measured phase current and k is a factor associated to the thermal state formula.

θ is the actual thermal status,

θ_{Trip} is the trip thermal state.

An alarm stage, θ_{alarm} , is provided for the initial thermal status.

Negative phase sequence overcurrent protection (46)

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.

The MiCOM P122, P123, P126 & P127 relays include a programmable function specially designed to detect unbalanced load or fault conditions. The three stages of negative sequence overcurrent have the same setting ranges as the phase overcurrent. The first stage can be independently select as a definite time or inverse time delay with different types of curve (IEC, IEEE/ANSI, RI, RECT).

The second and third stage can be configured with a definite time delay only.

IDMT trip and reset curves

IEC, ANSI/IEEE trip curve

The minimum guaranteed value of the operating current for all the curves with the inverse time characteristic is 1.1Is (with a tolerance of $\pm 0.05I_s$).

When the first or the second stages of the phase overcurrent protection are set to an IDMT curve, the maximum setting recommended should be 2 times the nominal. When the earth fault elements are set to an IDMT curve, the maximum setting recommended should 1/20th of the neutral CT input rating.

$$t = T * \left(\frac{K}{(I / I_s)^\alpha - 1} + L \right)$$

Where:

t Operation time

K Factor (see table)

I Value of measured current

I_s Value of the programmed threshold (pick-up value)

α 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	α factor	L factor
Short time inverse	Schneider Electric	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	Schneider Electric	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
EDF BPN (P123)	Schneider Electric	1000	2	0,655

The RI curve has the following definition:

$$t = K * \frac{1}{0.339 - \frac{0.236}{(I/I_s)}}$$

K setting is from 0.10 to 10 in steps of 0.05.

RXIDG CURVES (P122, P123)

The first and second earth threshold can be selected with dedicated RXIDG curves.

The curves available follow the following formula:

$$t = 5.8 - 1.35 * \ln (1 / (k * I_s/I))$$

Where:

t = tripping time

k = coefficient (from 0.3 to 1, by steps of 0.1)

I_s = value of the programmed threshold (Pick-up value)

I = value of measured current

In order to be compliant with Netmanagement specifications the relay has to have:

- An earth current range 0.01 Ion to 8 Ion (corresponding to Cortec model number P12-B-X--X)

- A rated current of 1A
- A core balanced CT with a ratio 25/1.

Reset ANSI/IEEE curve

The equation is valid for $1.1 \leq I/I_s \leq 20$.

$$t = T * \left(\frac{K}{1 - (I / I_s)^\alpha} \right)$$

Where:

- t: Reset time
- K: Factor (see table)
- I: Value of the measured current
- I_s: Value of the programmed threshold (pick-up value)
- α: Factor (see table)
- T: Reset time multiplier (RTMS) setting between 0.025 and 3.2.

Type of curve	Standard	K factor	α 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

Broken conductor detection (46BC)

A typical unbalanced fault that can occur on the system is an open circuit fault. This fault can arise from a broken conductor, mal-operation of one of the switchgear poles, or blowing of a fuse.



MiCOM P122/3 and P126/7 relays incorporate an element, which measures the ratio of negative to positive sequence current (I₂/I₁). This fully programmable function allows more sensitivity and stability than pure negative sequence measurement.

Under / Over voltage protection (27/59)

Under-voltage conditions may occur on a power system for increased system loading, complete loss

of busbar voltage or for faults occurring on the phases the power system.

Over-voltage conditions generally happen in a loss of load condition or during an earth fault condition where there may be an increase of the voltage magnitude in the healthy phases.

The P127 relay provides two independent under-voltage stages and two over-voltage stages. They are definite time elements.

Each stage can be configured to operate in single-phase mode (OR mode) or three-phase mode (AND mode). To ease settings whatever is the VT connexion, it's now possible to choose if setting should be based on phase to phase voltage or phase to neutral voltage.

Residual over voltage (59N)

P125, P126 and P127 provide an additional residual over-voltage stage that can be used for generic earth fault detection, particularly in insulated neutral systems or as backup at the busbar level. The protection element has one programmable stage with definite delay time.

Autorecloser (79)

Most faults on overhead line networks are transient in nature. A transient fault, such as an insulator flashover, is a self-clearing non-damage fault. It can be cleared by the immediate tripping of one or more circuit breakers, 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 auto-recloser function is applied for automatically reclosing of a switching device after it has been opened due to operation of protection where transient and non-permanent faults are prevalent.

MiCOM P123, P126 and P127 relays include a 4-shot auto-recloser. All the programmed protection functions can independently start any of the shots and the user can programme which functions are allowed to trip after any of the shots. This makes possible special reclosing cycles e.g. for co-ordination with fuses in distribution systems with teed transformers.

To prevent excessive number of reclosing cycle in a short period of time, a setting can be used to define the maximum number of reclosing cycle allowed in a period of time after first one was detected.

Dead and reclaim times are freely adjustable.

A counter stores the number of recloser commands. This information is available locally or remotely.

To inform operator that autorecloser has been blocked internally or externally, output relays can be assigned to these signals.

Switch On To Fault protection

Some faults may be due to fault conditions not removed from the feeder after a reclosing cycle or manual tripping, or due to earthing clamps left on following maintenance works. In these cases, it may be desirable to clear the fault condition in a faster time, rather than waiting for the trip delay time DT or IDMT associated with the involved protection to elapse.

Another condition where this function is particularly adapted is in case of manual close of the CB on an existing fault. This is considered as a particularly critical situation since the overcurrent protection would not clear the fault until the set operate delay had elapsed.

Hence for all these situations, it is desirable to clear the fault in the fastest time possible.

The P123, P126 and P127 relays incorporate configurable switch on to fault protection. It provides an instantaneous trip during a settable time after local or remote manual close, after automatic reclose or when triggered by a digital Input (downstream protection or 52A).

The SOTF function incorporates a fixed time window of 500 ms during which the detection of the fault is enabled.

Circuit breaker failure protection (50BF)

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.

The circuit breaker failure protection verifies the effective opening of the CB by a dedicated undercurrent threshold isolating the fault and preventing damage or further damage to the power system.

The 50BF protection in the P122, P123, P126 and P127 can be activated by trip of a generic protection or/and external command by the relevant digital input associated to the label Strt. tBF.

The Circuit breaker failure protection can also be used to trip upstream circuit breakers.

The circuit breaker failure provides the possibility to block the instantaneous $I>$ and $Ie>$ thresholds when a 50BF signal is emitted. This allows more flexibility in the fault localisation and isolation with blocking schemes.

High impedance restricted Earth-Fault (64N)

MiCOM P12x range offer the REF feature applied to enhanced ground fault detection on each transformer winding.

The relays ensure a high degree of stability against external fault conditions and a reliable performance against internal faults.

All the 50N/51N stages can be used for this application.

High impedance Three-Phase Differential protection (87)

The phase inputs of MiCOM P12x relays can be applied in the typical high-impedance scheme for busbar or machine protection.

The relays ensure a high degree of stability against external fault conditions and a reliable performance against internal faults.

All the 50/51 stages can be used for this application, the third stage configured in peak mode is recommended for the best performance.

Under/Over Frequency (81U/O)

Time delayed under and over frequency protection available on P127 provides the fundamental form of frequency protection.

Six thresholds are available: Each one can be configured to detect an under or over frequency within the range $[f_n - 4,9\text{Hz}, f_n + 4,9\text{Hz}]$, where f_n is the nominal frequency selected (50Hz or 60Hz). A definite timer is assigned to each threshold.

When the frequency measured is crossing one of the 6 pre-defined thresholds, the relays generates a start signal and after a user settable time delay, a trip signal.

Rate of change of frequency (81R)

Time delayed rate of frequency protection in MiCOM P127 is used for severe disturbances when shedding load in small steps may not be sufficient.

It can also compliment the generator control system to reduce or shed generation when the frequency rises above the nominal frequency at a high rate.

Directional power protection (32)

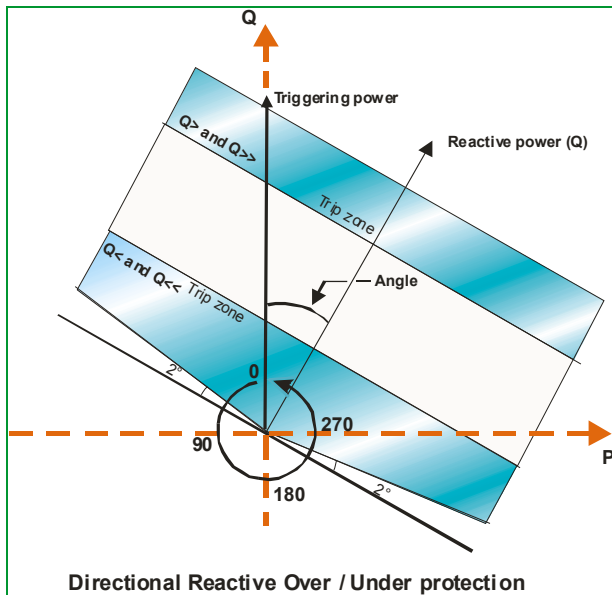
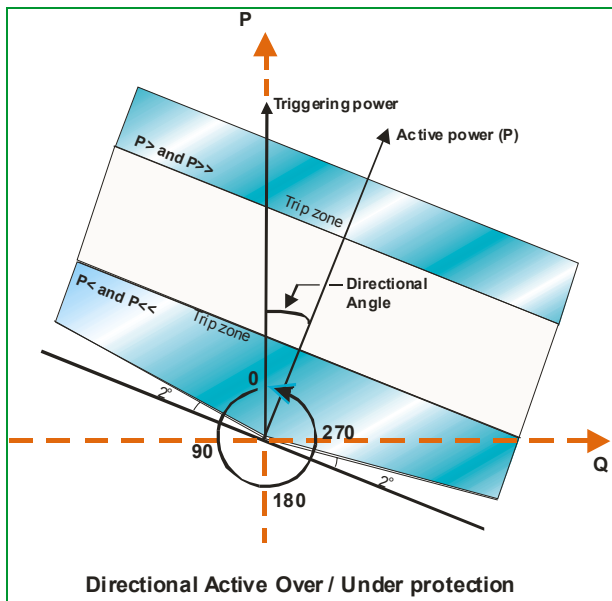
MiCOM P127 provides the three-phase under / over power protection which monitors the active and reactive power limits and detects excessive active power values.

$$P = U_a \cdot I_a \cdot \cos(\angle U_a \wedge I_a) + U_b \cdot I_b \cdot \cos(\angle U_b \wedge I_b) + U_c \cdot I_c \cdot \cos(\angle U_c \wedge I_c)$$

$$S_n = 3 \cdot I_n \cdot U_n$$

It can be used, for instance, to protect alternators from reverse power.

Four independent over and under power thresholds can be used to define the tripping zone whatever is active or reactive power.



Each threshold can be set as directional by configuring a dedicated angle.

A definite timer is assigned to each threshold. When the active and reactive power measurements are inside the trip zone, the relays generates a start signal and after a user settable time delay, a trip signal.

Phase current rotation

In some applications there is a need to match the plant phase sequence with the connected relay without changing the cabling. The P122, P123 & P127 relays include the phase rotation feature that allows the setting of the phases in clockwise or in anti-clockwise rotation (ABC or ACB sequence).

Blocking logic

When the MiCOM P12x and P12y relays are used in critical networks, management of protection relays must take surrounding devices into consideration.

Two blocking logic inputs can be configured independently of each other to block any combination of the selected elements (i.e. current or voltage stages, thermal replica, etc).

A typical application is to use a dedicated digital input to block the time delay settings of phase/earth fault protection in a relay in response to the phase/earth fault start condition of a downstream relay.

This function allows the MiCOM relays to clear the fault fastly and correctly when used in a cascade scheme.

Selective relay scheme logic

The P122/3 and P126/7 relays include selective relay scheme logic.

A dedicated digital input can temporarily alter the time delay settings in response to the phase/earth fault start condition of a downstream relay. This function allows the MiCOM relays to clear the fault fast and correctly when used in a cascade scheme.

Local/remote Control

In the P123, P125, P126 and P127 one logic input associated to the label LOCAL MODE is dedicated to this feature. If this logic input is powered, all the remote communications (setting parameters, control command....) will be forbidden to avoid a mal-operation during a local operation.

The time synchronization via the network stays active because there is no effect on the output relays.

Circuit Breaker Monitoring and Supervision

Circuit-breaker preventative maintenance is the advanced function provided by the MiCOM P122, P123, P126 and P127 relays with adjustable closing and opening time measurements. All phase currents (I or I^2) are accumulated to inform about the total interrupted fault current.

MiCOM P122 P123 P126 and P127 relays allow trip circuit supervision via a specific input associated to the label Trip Circ. The result of this monitoring can be viewed locally or remotely.

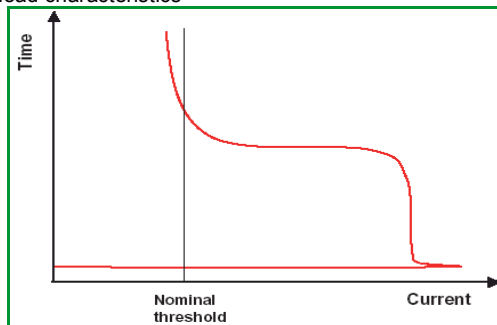
Cold Load Pick up

When a feeder is energised, the current levels that flow for a period of time following energisation 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 P122, P123, P126 & P127 relays raises the settings of selected protection stages for a setting time of the tCL timer initiated via a dedicated logic input (associated to the label Cold L PU) or automatically when at least one phase current is increasing by 95% in less than 200ms. Setting value can be increased by 800% during a settable duration. To trigger this function, either CB close position can be used or an automatic detection based on a sudden raise of current value.

This allows the protection settings to be set closer to the load profile by automatically increasing settings after energisation.

Cold-load characteristics



Inrush blocking

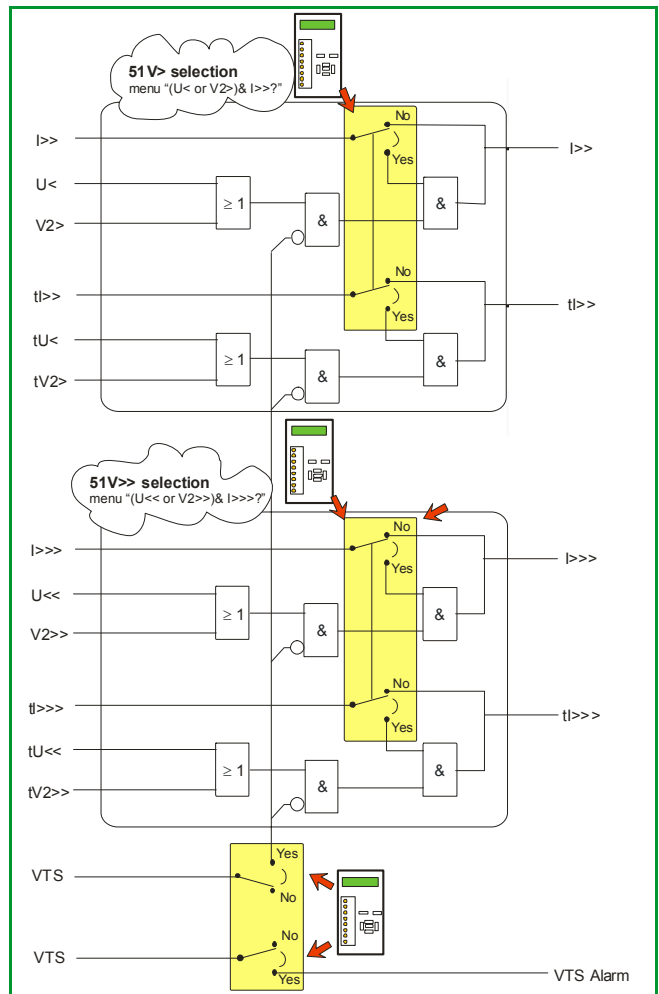
In the P122, P123 and P127, starting of the phase current stage, earth current and the negative-sequence current stage can be blocked under inrush conditions to avoid unsuitable trip during transformer magnetization.

As soon as the ratio of second harmonic component is above the settings (in percentage), selected phase, earth and negative current threshold will be blocked for a settable duration (maximum 2seconds)

Voltage controlled overcurrent (51V)

51V in P127 is a combination of $I >>$ and $U <$ functions to inhibit trip normal generator current is already bigger than $I >>$ threshold:

Overcurrent function trip will be inhibited if current is bigger than $I >>$ AND voltage greater than $U <$ (Generator ON => Live busbar). Overcurrent function will trip if current is bigger than $I >>$ AND voltage smaller than $U <$ (Generator OFF => dead MV busbar)



The 51V function is also supervised by voltage transformer supervision (VTS). In case 51V is used, undervoltage alarm will be inhibited to avoid confusion of the user.

Voltage Transformer Supervision (VTS)

VTS is used to detect VT failure.

$$VTS = [(V2 > 0.3V_n) \text{ AND } (I_2 < 0.5I_n)] \text{ OR } [(V1 < 0.1V_n) \text{ AND } (I > 0.1I_n)].$$

When VTS is detected, overcurrent function can be blocked or changed to a non directional overcurrent. Moreover, as soon as VTS is detected, all protection functions which needs voltage measure will be blocked (27 & 32N, for instance).

Current Transformer Supervision (CTS)

Current transformer supervision is provided in MiCOM P127 to detect loss of phase CT based on zero sequence current occurrence combined with zero sequence voltage disappearance.

Inputs and Outputs

The P12x relays include freely configurable digital inputs and output relays for CB control and signalling.

Each input can be configured as active high or active low and the supply type can be chosen as DC or AC at the order.

Any input can be configured for blocking, selective logic, control, etc. by the label associated to the specific function.

Each instantaneous and delayed trip is assignable to any output relays and to the led on the front panel. To the trip relay (relay 1) only the delayed trip of the protections and some accessory function are assignable. A single digital input can be used for several internal functions or assigned directly to any output contact

The two first output contacts (RL1 & RL2) can be used as failsafe relays to provide a “fail safe alarm” in case of power supply loss or major hardware failure. Other available relays can be inverted to reverse NO relays operating condition (output relays closing when logicalstate of the signal changes from 1 to 0).

Output relay latching (86)

Any outputs, including trip, can be latched. Reset of the latched outputs is possible by logic input, front panel operator interface or by remote communication.

Relay Maintenance mode

The P122, P123, P125, P126 and P127 incorporate the direct control of the output relays (without the need to inject any current). This functionality allows the user to quickly verify the external wiring of the relay output contacts.

Remote control on output relays

The P122 and P123 allow the direct control of 4 CB by selected output relays. The control can be performed by the software interface locally (S1) or by remote control (DCS system).

Circuit breaker command

P122 and P123 are now able to locally send open/close command through the HMI. Any CB command needs to be confirmed by the operator to avoid maloperation.

Setting Groups

The P122, P123, P125 and P126 relays have two protection related setting groups. The P127 relay has eight protection related setting groups;

Changes between the groups are executed via the front interface, a dedicated logic input or through the communication port.

To avoid any undesirable tripping, the setting group change is only executed when none of the protection functions are running (deactivated or inhibited) except for the thermal overload. If a setting group change is received during any protection or automation function, it is stored and executed after the last timer has elapsed.

Time tagging

The MiCOM P12x/y incorporates an internal clock to allow a 1ms accuracy time tagging of alarms, events, fault and disturbance record. To avoid any drifting of the time tagging clock, it's necessary to periodically synchronize the relays. To do this P12x/y offers three solutions:

- Synchronization from the substation control system via the rear communication port
- Synchronization from an external GPS clock via a dedicated digital input (not P121).
- Synchronization from an external GPS clock via a modulated or demodulated IRIG-B signal (P127 only)



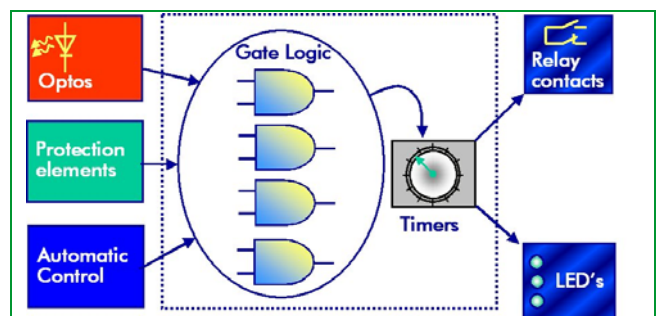
Logic Equations

The MiCOM P121/2/3 & P126/7 relays integrate complete logic equations to allow customization of the product based on customer application.

Up to 8 independent Boolean equations can be used. Each equation offers the possibility to use AND, OR & NOT logical gates. Up to 16 parameters can be used for each equation including any threshold and opto-input status.

Every result of equation can be time delayed and assigned to any output relays, trip, trip latching and/or HMI LEDs.

To avoid any operator disturbance, any alarms related to boolean equation results could be inhibited.



Auxiliary timers

Auxiliary timers are available on P12x range to temporized any opto-inputs status change (D-well or drop-off)

- P120 & P121: tAux1, tAux2
- P122: tAux1, tAux2 & tAux3
- P123: 5 tAux
- P125: tAux1, tAux2, tAux3 & tAux4
- P126: 7 tAux
- P127: 7 to 12 tAux

When the logic inputs are energised, the relevant timer starts and when the set time is elapsed the associated output relay trip.

Each auxiliary timer can be associated to any output relay including the trip relay (RL1) and any leds.

Measurements

MiCOM P120, P121, P122, P123, P125, P126 and P127 relays continually monitor all of the available analogue inputs. The relays display the values on the LCD and store the measurements in memory.

The measured values are the true RMS up to the 10th harmonic with 2% accuracy for current and voltage (nominal conditions at 50 Hz). Power and energy calculation accuracy are about 5% due the angle contribution.

The calculation of the average value for each phase during a selectable rolling sub-period is also available. Peak demands with a 15-minute window are also memorised.

All the measured and derived values can be displayed on the front panel LCD or transferred locally or remotely on user request.

For the complete list of the available measurements refer to the technical data in other part of this document.

Protection start records

Five protection start records are stored in the MiCOM P120, P122, P123, P125, P126 & P127 relays.

Each instantaneous (start) record includes:

- instantaneous (start) time (date & duration)
- origin (phase & earth thresholds)

Start records give the user useful information for preventative maintenance of the electrical system.

Event recording

250 events are stored in the MiCOM P120, P122, P123, P125, P126 and P127 flash memory. Events include inputs/outputs, state changes, alarms and contact operations.

All events are time-tagged to 1ms.

Fault records

25 faults are stored inside the flash memory of P12x relays (except P121). Each record includes:

- Fault indicators
- Value of the available measurements for each relay
- Tripping time

Fault indications help the user to clearly identify the cause of the fault and monitor the P120, P122, P123, P125, P126 and P127 settings.

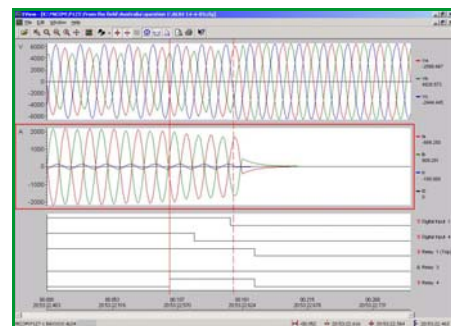
Disturbance recording

5 Current waveforms are captured by the P120, P122, P123, P125 P126 and P127 relays and stored in there flash memory. Four disturbance record duration could be used among the following:

- 5 records of 3 seconds (150 periods at 50hz)
- 3 records of 5 seconds (250 periods at 50hz)
- 2 records of 7 seconds (350 periods at 50hz)
- 1 records of 9 seconds (450 periods at 50hz)

The disturbance recording function is triggered either by any of the programmed thresholds or by an external input, or through the communications.

All the logic and analogue information are stored in memory and can be transferred to an external data analyser by the front communication port or one RS485 rear port by an appropriate protocol.



Device Identification, Ports

The front of the relay has two flaps. The upper flap identifies the product name. It can be lifted to access the product model number, serial number and ratings.

Under the lower flap there is a 9 pin RS232 port can be used for relay setting and for software upgrade.



To prevent unauthorized users to open the lower flap, the case can fit a security seal.

Case

For all MiCOM P12x the units have a draw out metal 4U case high.

The width is 20TE for the P120 P121 P122 P123 P125, 30TE for the P126 and P127.

All CTs inputs are short-circuited if the active unit is withdrawn from the case. This feature allows a quick and easy replacement of the unit in case of failure, without the need to rewire the relay.

All P12x relays can be panel or rack mounted.

Wiring

External connections are made via MIDOS type terminal blocks.

Each connection includes two 6.35mm Fast on and one M4 screw fixing.

The wiring for all the MiCOM P120, P121, P122, P123, P125, P126 and P127 relays is standard to provide maximum compatibility.

TECHNICAL DATA

MiCOM P12x Overcurrent protections

- * earth or Single Phase Overcurrent (P120)
- * 3-phase and earth overcurrent (P121, advanced P122 & expert P123)
- * directional and non-directional (E/F) overcurrent (P125)
- * directional and non-directional 3-phase overcurrent and directional and non-directional earth fault (P126, P127)

Input / Output (I/O)

- * P120, P121: 2I/4O
- * P122: 3I/4O
- * P123: 5I/8O
- * P125: 4I/6O
- * P126: 7I/8O
- * P127: 7I (or optional 12I)/8O

Earth current input

- * 0.1 – 0 Ion,
- * 0.01 – 8 Ion,
- * 0.002 – 1 Ion.

Protocol options

- * Modbus,
- * K-Bus/Courier,
- * IEC60870-5-103
- * DNP3.0

Languages options:

- * French, English, Spanish, German, Italian, Russian, Polish, Portuguese, Dutch, Czech, Hungarian, Greek, Chinese, Turkish.

Mechanical specifications

Design

Modular MiCOM Px2x platform relay:

- * MiCOM P120/1/2/3/5 20 TE
- * MiCOM P126/7 30 TE

Mounting

Rack or flush mounting

Connections

- * Rear (double fast on + M4 screw per connection)
- * Full draw-out with automatic CT shorting in the case of the relay

Dimensions

Case size of the different models:

4U (177mm)	226mm	MiCOM P120/1/2/3/5: 20 TE MiCOM P126/7: 30 TE
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Weight approx.:

- * MiCOM P120/1/2/3/5 approx. 3.0 kg
- * MiCOM P126/7 approx. 4.0 kg

PC Interface

- * DIN 41652 connector (X6),
- * type D-Sub, 9-pin.

Environmental Conditions

Ambient Temperature Range

Temperature	IEC 60255-6: 1988	Operating temperature range Continuous Withstand: -25 to +55°C (or -13°F to +131°F) Limit: -25 to +70°C (or -28°F to +158°F) <i>(The upper limit is permissible for a single 6-hour duration within any 24 hour period)</i> Storage Temperature Range: -25 to +70°C (or -28°F to +158°F) Tested as per IEC 60068-2-1:2007: -25°C storage (96 hours) -40°C operation (96 hours) IEC 60068-2-2:2007: +85°C storage (96 hours) +85°C operation (96 hours)
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Ambient Humidity Range

Humidity	IEC 60068-2-78: 2001	56 days at: * 93% relative humidity (RH) * +40 °C
Cyclic temperature with humidity	IEC 60068-2-30: 2005	Damp heat cyclic, six (12 + 12) hour cycles, 93% RH, +25 to +55 °C

Solar radiation

Avoid exposure of the front panel to direct solar radiation.

Mechanical environment

Enclosure protection

Enclosure protection	IEC 60529: 2001	IP 52 Protection (front panel) against dust and dripping water, IP 50 Protection for the rear and sides of the case against dust,, IP 10 Product safety protection for the rear due to live connections on the terminal block
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Vibration Test

Sinusoidal vibrations	IEC 60255-21-1:1988	Vibration response Class 2 – 1g Vibration endurance Class 2 – 2g
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Shock and Bump Test

Shock	IEC 60255-21-2:1988	Shock response Class 2 – 10g Shock withstand Class 1 – 15g
Bump	IEC 60255-21-2:1988	Class 1 – 10g

Seismic Test

Shock	IEC 60255-21-3:1988	Class 2
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Creepage distances and clearances

Creepage distances and clearances	IEC 60255-27:2005	Pollution degree 2, Overvoltage category III, Impulse test voltage 5 kV
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Corrosive Environments

Corrosive Environments	Per IEC 60068-2-60: 1995, Part 2, Test Ke, Method (class) 3	Industrial corrosive environment/poor environmental control, mixed gas flow test. 21 days at 75% relative humidity and +30°C Exposure to elevated concentrations of H ₂ S (100ppb), NO ₂ (200ppb) and Cl ₂ (20ppb)
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Product safety



2006/95/EC
(replacing 73/23/EEC from 01/2007)

Compliance with European Commission Low Voltage (safety and insulation) Directive.

Compliance is demonstrated by reference to generic safety standards:

- * IEC 60255-27:2005
- * EN 60255-5:2001

Power Supply

Nominal auxiliary voltage V _x	24-60Vdc, 48-250Vdc / 48-250 Vac or Universal power supply 24-250Vdc / 24-250 Vac
Operating range	DC ± 20% of V _x AC – 20%, +10% of V _x
Aux Supply ripple	Up to 12%
Stored energy time	≥50 ms for interruption of V _x
Burden P _{120/1/2/3/4/5}	Stand by: <3W DC or <8 VA Max: <5W DC or <12 VA
Burden P _{126/7}	Stand by: <3W DC or <8VA Max: <6W DC or <14VA

Type Tests

Insulation

Insulation resistance	IEC 60255-5: 2000	> 1000MΩ at 500Vdc
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High Voltage (Dielectric) Withstand

Dielectric withstand	IEC 60255-5: 2000	* 2.0kVrms for one minute between all terminals and case earth * 2.0kVrms for one minute between all terminals of independent circuits, including contact circuits * 1.5kVrms for one minute across dedicated normally open contacts of output relays.
	ANSI/IEC C37.90: 1989	1.5kVrms AC for 1 minute (reaffirmed 1994) across open contacts and across open contacts of changeover output relays

Impulse Voltage Withstand Test

Impulse voltage	IEC 60255-5: 2000	1.2 / 50 μs, peak value: 5 kV, 0.5J (between all terminals, and all terminals and case earth)
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Electromagnetic environment

Electromagnetic Compatibility (EMC)

High frequency disturbance	IEC 60255-22-1:1998	2.5 kV common mode, class 3 1 kV differential mode, class 3
Fast transient	IEC 60255-22-4:2002	Class A 2 kV 5kHz terminal block comms 4 kV 2.5kHz all circuits excluding comms.
	EN 61000-4-4:1995 Level 4	2 kV 5kHz all circuits excluding power supply 4 kV 5kHz power supply
Electrostatic discharge	EN 61000-4-2:1995 & IEC60255-22-2:1996	8 kV contact discharge, class 4 15kV air discharge, class 4
Surge Immunity	EN 61000-4-5:1995 & IEC 60255-22-5:2002	4kV common mode, level 4 2kV differential mode, level 4
Conducted emissions	EN55022:1998 & IEC 60255-25:2000	0.15-0.5MHz, 79dB μ V (quasi peak) 66 dB μ V (average) 0.5-30MHz, 73dB μ V (quasi peak) 60 dB μ V (average)
Radiated emissions	EN55022:1998 & IEC 60255-25:2000	30-230MHz, 40dB μ V/m at 10m measurement distance 230-1GHz, 47dB μ V/m at 10m measurement distance
Conducted immunity	EN 61000-4-6:1996 & IEC 60255-22-6:2001	Level 3, 10V rms @ 1kHz 80% am, 150kHz to 80MHz
Radiated Immunity	EN 61000-4-3:2002 & IEC 60255-22-3:2000	Level 3, 10V/m 80MHz to 1GHz @ 1kHz 80% am
Radiated Immunity from digital telephones	EN 61000-4-3:2002	Level 4, 30V/m 800MHz to 960MHz and 1.4GHz to 2GHz @ 1kHz 80% am
	ANSI/IEEE C37.90.2:2004	35V/m 80MHz to 1GHz @ 1kHz 80% am 35V/m 80MHz to 1GHz @ 100% pulse modulated front face only
Magnetic field immunity	EN 61000-4-8:1994	Level 5, 100A/m applied continuously, 1000A/m for 3s
	EN 61000-4-9:1993	Level 5, 1000A/m
	EN 61000-4-10:1993	Level 5, 100A/m at 100kHz and 1MHz
ANSI Surge withstand capability	IEEE/ANSI C37.90.1:2002	4kV fast transient and 2.5kV damped oscillatory applied common and transverse mode

EMC compliance



89/336/EEC

93/31/EEC

Compliance with European Commission EMC Directive.
Generic standards were used to establish conformity:
EN50081-2: 1994
EN60952-2: 1995

RATINGS

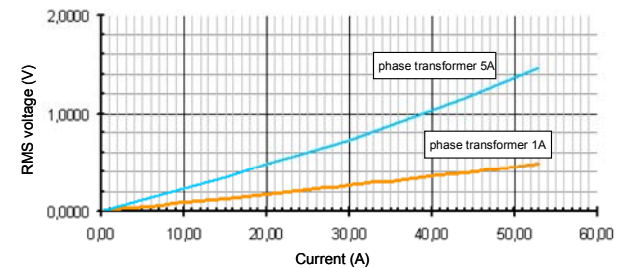
Frequency

Operating range	from 45 Hz to 65 Hz
Nominal Frequency	50 or 60 Hz

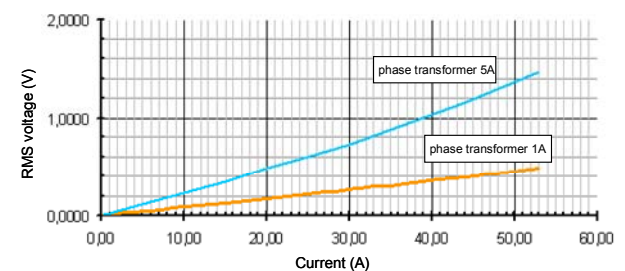
Current inputs (P120/1/2/3)

Nominal current (In)	1A and 5A dual rated
Earth nominal current	1A and 5A dual rated
Operating range	selection by ordering code (Cortec)
Nominal burden per phase	< 0.025 VA (1A) < 0.3 VA (5A)
Nominal burden per earth	< 0.08 VA (1A) < 0.42 VA (5A)
Rrp (Impedance of relay phase current input at 30In)	25 m Ω (1A input) 8 m Ω (5A input)
Rrn (Impedance of relay neutral current input at 30In)	87 m Ω (1A input) 15 m Ω (5A input)
Thermal withstand	continuous @ $2 \times I_n$ 1s @ $40 \times I_n$ 2s @ $100 \times I_n$

Earth CT consumption



Phase CT consumption



Voltage inputs (P125/6/7)

Voltage input range Un	57 to 130V	220 to 480V
Operating (measuring) range	0 to 260V	0 to 960V
Burden	Resistive 44kΩ: 0.074W/57V 0.38W/130V 1.54W/260V	438 kΩ: 0.1102W/220V 0.525W/480V 2.1W/960V
Thermal withstand Continuous 10 seconds	260V ph-ph 300V ph-ph	960V ph-ph 1300V ph-ph

Metering range

(P127 with measurement CTs)

Phase current inputs	1A and 5A (by connection)
Measurement accuracy	
Current	<0.2% (at IN),
Voltage	<0.2% (at VN),
Power	<0.5% (P, Q and S),
Operating range	selection by ordering code (Cortec)
Burden Phase input	< 0.5VA
Bandwith	500Hz
Thermal withstand	continuous @ 2 × In 1s @ 20 × In 4s @ 10 × In

LOGIC INPUTS

Logic input

Type	Independent, optically insulated
Burden	< 10mA per input
Recognition time	< 5ms

Supply

Ordering Code	Relay auxiliary power supply		Logic Inputs				
	Nominal voltage range Vx	Operating voltage range	Nominal Voltage range	Minimal polarisation voltage	Maximum polarisation current	Holding current after 2ms	Maximum continuous withstand
A	24–60Vdc	19,2–76Vdc	24–250Vdc 24–240Vac	19.2Vdc 19.2Vac	35mA	2.3mA	300Vdc 264Vac
F	48–250Vdc 48–240Vac	38.4–300Vdc 38.4–264Vac					
T	48–250Vdc 48–240Vac Special EA*	38.4–300Vdc 38.4–264Vac	24–250Vdc 24–240Vac	19.2Vdc 19.2Vac	35mA	2.3mA	300Vdc 264Vac
H	48–250Vdc 48–240Vac	38.4–300Vdc 38.4–264Vac	129Vdc	105Vdc	3.0 mA @ 129Vdc		145Vdc
V	48–250Vdc 48–240Vac	38.4–300Vdc 38.4–264Vac	110Vdc	77Vdc	7.3 mA @ 110Vdc		132Vdc
W	48–250Vdc 48–240Vac	38.4–300Vdc 38.4–264Vac	220Vdc	154Vdc	3.4 mA @ 220Vdc		262Vdc
Z	24–250Vdc 48–240Vac	19.2–300Vdc 38.4–264Vac	24–250Vdc 24–240Vac	19.2Vdc 19.2Vac	35mA	2.3mA	300Vdc 264Vac

(*) Logic input recognition time for ENA assessment. Dedicated filtering on 24 samples (15ms at 50Hz).

Output relays

Contact rating

Contact relay	Dry contact Ag Ni
Make current	Max. 30A and carry for 3s
Carry capacity	5A continuous
Rated Voltage	250Vac

Breaking characteristic

Breaking capacity AC	1500 VA resistive 1500 VA inductive (P.F. = 0.5) 220 Vac, 5A (cos φ = 0.6)
Breaking capacity DC	135 Vdc, 0.3A (L/R = 30 ms) 250 Vdc, 50W resistive or 25W inductive (L/R=40ms)
Operating time	<7ms

Durability

Loaded contact	10000 operations minimum
Unloaded contact	100000 operations minimum

Communication interface

Type Port	Physical Link	Connectors
RS485	Screened twister pair	Screws or snap-on
RS485 isolated	Screened twister pair	Screws or snap-on
RS232	Screened twister pair	Sub-D 9 pin female connector

PC Interface (front RS232)

Transmission rate:	19200 baud (fixed)
Parity:	None
Frame:	8 bit
Stop bit:	1 bit
Protocol:	Modbus RTU

Remote access (rear RS485 port)

Default RS485 port:	
2kV-isolation hardware support common mode	
Transmission rate:	300 to 38400 baud (programmable)

Protocols available	
P120, P121, P122 & P123	Modbus RTU, DNP3, IEC60870-5-103 & Courier
P125, P126 & P127	Modbus RTU, DNP3 & IEC60870-5-103

Optional second port (RS485)

Isolated RS485 port.	
Transmission rate:	300 to 38400 baud (programmable)

Protocols available	
P127	Modbus or IEC60870-5-103 (selection by ordering code (Cortec))

PROTECTIONS FUNCTIONS

Settings

Phase overcurrent [67/50/51]

(P120, P121, P122, P123, P125, P126, P127)

Range 0.1 to 40 In

- I>:	0.1 to 25 In
- I>>:	
P120, P121, P122, P123	0.5 to 40 In
P125, P126, P127	0.1 to 40 In
- I>>>:	
P120, P121, P122, P123	0.5 to 40 In
P125, P126, P127	0.1 to 40 In
- Setting Step:	0.01In

If I> or I>> are set to IDMT operation, the maximum recommended setting should be 2x In to give a full operating curve.

P127 in directional mode

Relay characteristic angle

RCA-Torque angle for each stage: 0° to 359°

Trip zone for each stage: ±10° to ±170°

Trip delay time:

- DT for: tI>, tI>>, tI>>>	0 to 150s in steps of 0.01s
- IDMT for I> and I>> (except P120, P121):	IEC, ANSI/IEEE, RI and RECT curve
- TMS:	0.025 to 1.5 in steps of 0.001
- Reset time for DT on I>, I>> (P120/1/2/3):	0 to 600sec in steps of 0.01In

Reset time for IDMT for P120/1 only:

- tI>, tI>> fixed 50 ms

Reset time for P122 & P123

- tI>, tI>> with IEC curve:	0.04 to 100s in steps of 0.01s
- tI>, tI>> with ANSI/IEEE curve:	0.04 to 100s in steps of 0.01s

RTMS:	0.025 to 3.2 in steps of 0.025
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Reset time for P126 & P127:

- tI>, tI>> with IEC curve:	0 to 100s in steps of 0.01s
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tI>, tI>> with ANSI/IEEE curve:

- RTMS:	0.025 to 3.2 in steps of 0.025
- DT:	0.00 to 100s in steps of 0.01s

Earth fault overcurrent [67N/50N/51N]

(P120, P121, P122, P123, P125, P126, P127)

Range: 0.1 to 40 Ien

- Ie>	0.1 to 25 Ien
- Ie>>, Ie>>>	from 0.1 to 40 Ien
- Ie>>>>	from 0.5 to 40 Ien
- Setting Step:	from 0.1 to 40 Ien
	0.01Ien

If Ie> or Ie>> are set to IDMT operation, the maximum recommended setting should be 2x In to give a full operating curve.

Range: 0.01 to 8 Ien

- Ie>	from 0.01 to 1 Ien
- Ie>>, Ie>>>	from 0.01 to 8 Ien
- Ie>>>>	from 0.1 to 40 Ien
- Setting Step:	0.001 Ien

If Ie> or Ie>> are set to IDMT operation, the maximum recommended setting should be 0.4x In to give a full operating curve.

Range: 0.002 to 1 Ien

- Ie>, Ie>>, Ie>>>	from 0.002 to 1 Ien
- Ie>>>>	from 0.1 to 40 Ien
- Setting steps	0.001 Ien

If Ie> or Ie>> are set to IDMT operation, the maximum recommended setting should be 0.05x In to give a full operating curve.

P125/6/7 directional mode

Relay characteristic angle RCA-Torque angle for each stage 0° to 359°

Trip zone for each stage ±10° to ±170°

- Ue>, Ue>>, Ue>>> for 57 to 130V version:
1V to 260V in steps of 0.1V

- Ue>, Ue>>, Ue>>> for 220 to 480V version:
4V to 960V in steps of 0.5V

Earth fault current trip delay time:

- DT for tIe>, tIe>>, tIe>>>	0 to 150s in steps of 0.01s
- IDMT for Ie> and Ie>> (except for P120, P121)	IEC, ANSI/IEEE, RI and RECT curve
- TMS	0.025 to 1.5 in steps of 0.001

Reset time for DT on Ie>, Ie>>: (P120/1/2/3)

0 to 600s in steps of 0.01In

Reset time for IDMT for P120/1 only:

- tIe>, tIe>> fixed 50 ms

Reset time for P122 & P123:

- tIe>, tIe>> with IEC curve:	0.04 to 100s in steps of 0.01s
- tIe>, tIe>> with ANSI/IEEE curve:	0.04 to 100s in steps of 0.01s
- RTMS:	0.025 to 3.2 in steps of 0.025
- DT:	0.04 to 100s in steps of 0.01s

Reset time for P125, P126 & P127:

- tIe>, tIe>> with IEC curve:	0 to 100s in steps of 0.01s
- tIe>, tIe>> with ANSI/IEEE curve:	0 to 100s in steps of 0.01s
- RTMS:	0.025 to 3.2 in steps of 0.025
- DT:	0 to 100s in steps of 0.01s

For the range 0.002 to 1Ien, RXIDG curves are available on the P122 & P123 only.

Wattmetric /Iecos earth fault [32N] (P125, P126, P127)

The setting value has to be multiplied by Ien for 32N only (I.e. Ien=5A Pe>: 2.00 x 5 W. your setting is 10W)

- Range:	0.1 to 40 Ien
- voltage range 57 to 130V	
* Pe>, Pe>>	10 to 800 W
* Setting Step:	1 W
- voltage range 220 to 480V	
* Pe>, Pe>>	40 to 3200 W
* Setting Step:	5 W
- Ie cos>	0.1 to 25 Ien
- Iecos>>	0.5 to 40 Ien
- Setting Step:	0.01 Ien
- Range:	0.01 to 8 Ien
- voltage range 57 to 130V	
* Pe>, Pe>>	1 to 160 W
* Setting Step:	0.1 W
- voltage range 220 to 480V	
* Pe>, Pe>>	4 to 640 W
* Setting Step:	0.5 W
- Ie cos>	0.01 to 1 Ien
- Iecos>>	0.01 to 8 Ien

- Setting Step: 0.005 I_{en}
- Range: 0.002 to 1 I_{en}
- voltage range 57 to 130V
 - * Pe>, Pe>> from 0.2 to 20 W
- * Setting Step: 0.02 W
- voltage range 220 to 480V
 - * Pe>, Pe>> from 1.0 to 80 W
 - * Setting Step: 0.01 W
- I_e cos> from 0.002 to 1 I_{en}
- I_ecos>> from 0.002 to 1 I_{en}
- Setting Step: 0.001 I_{en}
- Relay characteristic angle RCA-Torque angle for each of the Pe/I_ecos elements 0° to 359°
- Setting step 1°
- Trip Zone: +/- 80°
- DT for: tPe>, tPe>>, I_ecos>, I_ecos>> 0 to 150s
- IDMT for Pe> and I_ecos> IEC, ANSI/IEEE, RI and RECT curve
- TMS 0.025 to 1.5 in steps of 0.001
- Reset time:
 - tI_{Pe}>, tI_ecos> with IEC curve: 0 to 100s in steps of 0.01s
 - tI_{Pe}>, tI_ecos> with ANSI/IEEE curve:
 - RTMS: 0.025 to 3.2 in steps of 0.025
 - DT: 0 to 100s in steps of 0.01s

Negative Sequence [46] (P122, P123, P126, P127)

- P126 & P127:
- I₂> 0.1 to 25 I_n
 - I₂>> 0.5 to 40 I_n
 - I₂>>> 0.5 to 40 I_n
 - Setting Step 0.01I_n

- P122 & P123:
- I₂> 0.1 to 40 I_n
 - I₂>> 0.1 to 40 I_n
 - Setting Step 0.01I_n

If I₂> is set to IDMT operation, the maximum recommended setting should be 2x I_n to give a full operating curve.

- DT for: tI₂>, tI₂>>, tI₂>>> 0 to 150s in steps of 0.01s
- IDMT for I₂> IEC, ANSI/IEEE, RI and RECT curve
- TMS 0.025 to 1.5 in steps of 0.001
- Reset time P122, P123, P126, P127
- tI₂> with IEC curve: 0.04 to 100s in steps of 0.01s
- tI₂> with ANSI/IEEE curve:
 - RTMS: 0.025 to 3.2 in steps of 0.025
 - DT: 0.04 to 100s in steps of 0.01s

Thermal Overload element [49] (P122, P123, P126, P127)

- I_θ> 0.1 to 3.2I_n in steps of 0.01I_n
- T_e 1 to 200mn in steps of 1mn
- K 1 to 1.5 in steps of 0.01
- θ Trip 50% to 200% in steps of 1%
- θ Alarm 50% to 200% in steps of 1%

Three phase undercurrent [37] (P122, P123, P126, P127)

- I< (P122 P123) 0.02 to 1 I_n in steps of 0.01
- I< (P126 P127) 0.1 to 1 I_n in steps of 0.01
- DT for: tI< 0 to 150s in steps of 0.01s

Phase/line under voltage [27] (P127)

- Protection phase to phase or phase to neutral
- Nominal Voltage range 57 – 130V
- U< AND/OR/OFF
 - U< 2 to 130V in steps of 0.1V
 - U<< AND/OR/OFF
 - U<< 2 to 130V in steps of 0.1V
- Nominal Voltage range 220 – 480V
- U< AND/OR/OFF
 - U< 10 to 480V in steps of 0.5V
 - U<< AND/OR/OFF
 - U<< 10 to 480V in steps of 0.5V
- DT for tU<, tU<< 0 to 600s in steps of 0.01
- 52a Inhib. U<, U<< Yes or No

Setting OR / AND in the stage means:
 OR: trip by start of one or two or three phase
 AND: trip by start of three phases.

Phase/line over voltage [59] (P127)

- Protection phase to phase or phase to neutral
- Nominal Voltage range 57 – 130V
- U> AND/OR/OFF
 - U> 2 to 260V in steps of 0.1V
 - U>> AND/OR/OFF
 - U>> 2 to 260V in steps of 0.1V
- Nominal Voltage range 220 – 480V
- U> AND/OR/OFF
 - U> 10 to 960V in steps of 0.5V
 - U>> AND/OR/OFF
 - U>> 10 to 960V in steps of 0.5V

DT for tU>, tU>> 0 to 600s in steps of 0.01

The setting OR / AND in the stages means:
 OR: trip by start of one or two or three phase
 AND: trip by start of three phases.

Residual over voltage [59N] (P125, P126, P127)

- Nominal Voltage range 57 – 130V
- U_e>>>> 1 to 260V in steps of 0.1V
- Nominal Voltage range 220 – 480V
- U_e>>>> 5 to 960V in steps of 0.5V
- DT for t U_e>>>> 0 to 600s in steps of 0.01

Autoreclose [79] (P123, P126, P127)

Up to 4 cycles can be configured

Autoreclose settings			
Ext CB Fail?	no	yes	
Ext CB Fail Time	000.01 ms	600, 00sec	0.01sec
Ext Block?	no	yes	
Rolling demand	no	yes	
- Max cycle nbr	2	10	1
- Time period	10mn	24h	10mn
Dead time tD1	0.01s	300, 00s	0.01s
Dead time tD2	0.01s	300, 00s	0.01s
Dead time tD3	0.01s	600, 00s	0.01s
Dead time tD4	0.01s	600, 00s	0.01s
Dead time tI>	0.05s	600s	0.01s
Dead time tI>>	0.05s	600s	0.01s
Dead time tI>>>	0.05s	600s	0.01s
Dead time tIe>	0.05s	600s	0.01s
Dead time tIe>>	0.05s	600s	0.01s
Dead time tIe>>>	0.05s	600s	0.01s
Reclaim Time tR	000.02s	600, 00s	0.01s
Inhibit Time tI	000.02s	600, 00s	0.01s
Phase Cycles	0	4	1
E/Gnd Cycles	0	4	1
Cycles	4321	4321	0/1/2
tI>	0000	2222	

Autoreclose settings			
Cycles tl>>	4321 0000	4321 2222	0/1/2
Cycles tl>>>	4321 0000	4321 2222	0/1/2
Cycles tle>	4321 0000	4321 2222	0/1/2
Cycles tle>>	4321 0000	4321 2222	0/1/2
Cycles tle>>>	4321 0000	4321 2222	0/1/2
Cycles (P126/7) tPe/lecos>	4321 0000	4321 2222	0/1/2
Cycles (P126/7) tPe/lecos>>	4321 0000	4321 2222	0/1/2
Cycles tAux1	4321 0000	4321 2222	0/1/2/3
Cycles tAux2	4321 0000	4321 2222	0/1/2/3

The settings 0, 1, 2 & 3 means:

0 = The autoreclose is not initiated.

1 = trip on threshold pick up, followed by the programmed reclosing activity

2 = no trip on threshold pick up, whatever has been set in the any trip control menu. With this setting after the Reclaim time is expired, the autoreclose is ready for a new sequence.

3 = Trip is coming from an external device but reclosing is done by the relays (triggered by opto-input)

Under / over frequency [81U/O] (P127)

6 independants threshold (x = [1 ; 6])

Fx? 81> OR 81<
tFx 0 to 600s in step of 0.01s

Nominal frequency = 50Hz / 60Hz

Fx (Fn +/- 4,9Hz) 45.1 to 64.9Hz in step of 0.01Hz

Rate of change of frequency [81R] (P127)

6 independants threshold (x = [1 ; 6])

Fx? Yes OR No
dF/dtx -10Hz/s to +10Hz/s in step of 0.1Hz/s

Directional power [32] (P127)

"P>?" or "Q>?" or "P<?" or "Q<?" Yes or No

P> or Q> or P< or Q<:

- Nominal Voltage range 57 – 130V:
1 to 10000W*k in steps of 1W (k=1 or 5)*

- Nominal Voltage range 220 – 480V:
4 to 40000W*k in steps of 1W (k=1 or 5)*

Directional angle: 0 to 359° in step of 1°

tP> or tQ> or tP< or tQ< 0 to 150s in steps of 0,01s

"P>>?" or "Q>>?" or "P<<?" or "Q<<?" Yes or No

P>> or Q>> or P<< or Q<<:

- Nominal Voltage range 57 – 130V:
1 to 10000W*k in steps of 1W (k=1 or 5)*

- Nominal Voltage range 220 – 480V:
4 to 40000W*k in steps of 1W (k=1 or 5)*

Directional angle: 0 to 359° in step of 1°

tP>> or tQ>> or tP<< or tQ<<:

0 to 150s in steps of 0,01s

*: k = TC secondary ratio

AUTOMATION & ACCESSORY FUNCTIONS

Trip command

Each one of the protection function outputs (after a time delay, e.g. tl>), auxiliary timers, and logic equations can be assigned to the trip command (relay 1).

Latch functions

Each of the protection function outputs (after a time delay, e.g. tl>), auxiliary timers and CB fail can be latched in P120, P121, P122, and P123.

Latch output relays

The output relays that can be latched are as follows:

P120: latching relays not available
P121: relay 2 to 4
P122: relay 2 to 6
P123: relay 2 to 8
P125: relay 1 to 6
P126, P127: relay 1 to 8

Circuit breaker failure detection [50BF]

(P122, P123, P126, P127)

I< CB 0.02 to 1In in steps of 0.01In
t BF (P126, P127) 0.01 to 10s in steps of 0.01s
t BF (P122, P123) 0.01 to 10s in steps of 0.01s
Block on I> Yes/No
Block on Ie> Yes/No

Blocking logic (P120 P121 P122. P123, P125, P126, P127)

The follow stages locked by a digital input associated to the label Blk. Log1/2 are for the P12x:

I>, I>>, I>>>, Ie>, Ie>>, Ie>>>, I2>, I2>>, Thermal θ, Brkn. Cond., t Aux1, t Aux2, tAux3, tAux4. tIe>>>>

In addition for the P125/6/7 are:

tPe/lecos>, tPe/lecos>>, tI<, I2>>>, tUe>>>>.

For the P127 only: tU>, tU>>, tU<, tU<<, F1 to F6, tF1 to dF6, dF/dt1 to dF/dt6, tP>, tP>>, tP<, tP<<, tQ>, tQ>>, tQ<, tQ<<

Selective scheme logic (P122. P123, P126, P127)

The involved stages are:

tl>, tl>>, tl>>>, tIe>, tIe>>, tIe>>>.

t sel: 0 to 150s in steps of 0.01s

Broken conductor (46BC) (P122, P123, P126, P127)

Ratio I2/I1 20% to 100% in steps of 1%
t BC 0 to 14400s in steps of 1s

Cold load pick up (P122, P123, P126, P127)

Started by digital input 52a or when I grows from 0.05<IN to I > IN in less than 200ms (automatic detection)

Level 20% to 800% in steps of 1%
t CL 0.1 to 3600s in steps of 0.1s

The involved stages are:

tl>, tl>>, tl>>>
tIe>, tIe>>, tIe>>>
tI2>, tI2>>, tI2>>>
tI2>>> (P126, P127)
tTherm.

Inrush blocking (P122, P123, P127)

Inrush Block? Yes or No
Inrush H2 ratio 10 to 35% in steps of 0.1%
Inrush tReset 0 to 2s in steps of 0,1s
Inrush Blocking:

I>, I>>, I>>>, Ie>, Ie>>, Ie>>>, Ie>>>>, I2>, I2>>, I2>>>

Voltage controlled overcurrent [51V] (P127)

Voltage range: 57 to 130V
Block of $I_{>>} = (U < OR V_{2>}) \& I_{>>}$
 $V_{2 >}$ 3V to 200V in steps of 0.1V
Block of $I_{>>>} (U << OR V_{2>>}) \& I_{>>>}$
 $V_{2 >>}$ 3V to 200V in steps of 0.1V
Voltage range: 220 to 480V
 $V_{2 >}, V_{2>>}$ 20V to 720V in steps of 0.5V

Voltage transformer supervision [VTS] (P127)

VTS blocks 51V Yes/No
VTS Alarm Yes/No
VTS blocks protection? Yes/No
VTS non directional $I_{>}, I_{>>}, I_{>>>}, I_{e>}, I_{e>>}, I_{e>>>}$ Yes/No

Current transformer supervision [CTS] (P127)

CT Supervision Yes/No
 $I_{e>}$ $0.08 \times I_n$ to $1.0 \times I_n$ in steps of $0.01 \times I_n$
 $U_{e<}$: 0.5V to 22V in steps of 0.1V (P127xA)
2V to 88V in steps of 0.5V (P127xB)
tCTS 0 to 100s, in steps of 0.01s

CB supervision and control (P122, P123, P126, P127)

CB Fail ? Yes/No
 $I < BF$ $0.02 I_n$ to $1 I_n$ in steps of $0.01 I_n$
CB fail time tBF 0 to 10s in steps of 0.01s
Block $I_{>}$ Yes/No
Block $I_{e>}$ Yes/No

Trip circuit supervision

TC supervision time:
t SUP 0.1 to 10s in steps of 0.01s

CB open/close supervision time

CB open sup. time 0.05 to 1s in step of 0.01s
CB close sup. time 0.05 to 1s in step of 0.01s
CB open number 0 to 5000 in steps of 1

CB trip operations stages

CB trip mechanical operations: 0 to 50000 in steps of 1
CB trip electrical operations Σa^n
0 to 4000 Exp6 in steps 1 E6
CB trip electrical operations exp n: 1 or 2

CB open time and close time control

CB open control time 0 to 5 s in step of 0.01s
CB close control time 0 to 5 s in step of 0.01s

Auxiliary timers (P120, P121, P122, P123, P125)

$t_{Aux 1}, t_{Aux 2}, t_{Aux 3}^*, t_{Aux 4}^*, t_{Aux 5}^*$:
0 to 200s in steps of 0.01s

*: depending on model

Auxiliary timers (P126, P127)

$t_{Aux 1}, t_{Aux 2}, t_{Aux 3}, t_{Aux 4}$: 0 to 200s in steps of 0.01s
 $t_{Aux 5}, t_{Aux 6}, t_{Aux 7}$: 0 to 20000s in steps of 0.01s
 $t_{Aux 8}, t_{Aux 9}, t_{Aux 10}, t_{Aux 11} \& t_{Aux 12}$ (optional):
0 to 200s in steps of 0.01s

Switch On To Fault / Trip on reclude (P123/6/7)

tSOTF 0 to 500ms in steps of 10ms
Possibility to start the SOTF by $I_{>}, I_{>>}$, ctrl close input, HMI closing order, [79] closing, front comm., rear or optional rear2 comm.

Logic equation (P121, P122, P123, P126, P127)

8 independants equations are available.
Each one can used a maximum of 16 operands among all start and trip signal
Each one can used NOT, OR, AND, OR NOT, AND NOT logical gates.
t operate 0 to 600s in steps of 0.01s
t Reset 0 to 600s in steps of 0.01s

Disturbance Recording (P120, P122, P123, P125, P126, P127)

Up to 15s disturbance records*:

– 5 × 3s,
– 4 × 3s,
– 3 × 5s,
– 2 × 7s,
– 1 × 9s.

Pre-time 0 to 3 s in steps of 0.1s
Post-time (P120) 0 to 3 s in steps of 0.1s
Trigger for disturbance ON Inst. or ON Trip

Time peak value (P122, P123, P126, P127)

Windows time 5mn, 10mn, 15mn, 30mn, or 60mn

Rolling demand (P122, P123, P126, P127)

Sub period 1 to 60mn in steps of 1mn
Num sub period 1 to 24 in steps of 1

Communication order delay (P127)

tCommand1 to tCommand4 0 to 600s in steps of 50ms

Configuration parameters

VT connections (P127)

3 phase to neutral (UA, UB, UC) 3Vpn
 U_e is calculated: $U_e = (U_A + U_B + U_C) / 3$
2 phase to neutral and residual voltage (UA,UB,Ur): $2V_{pn} + V_r$
2 phase to phase and residual voltage (UAB,UBC,Ur): $2V_{pp} + V_r$

VT connections (P125, P126)

Residual voltage: V_r

Display (P125, P126, P127)

Default display: IA or IB or IC or IN

Display (P120, P121)

Default display: A or B or C or N
L1 or L2 or L3 or E
R or S or T or G

Display (P122, P123)

Default display: A or B or C or N or IA, IB, IC, IN
L1 or L2 or L3 or E or L1, L2, L3, E
R or S or T or G or R, S, T, G

Transformer Ratio

Phase CTs

Primary: 0 to 9999A
Secondary: 1A or 5A

Earth CTs

Primary: 0 to 9999A
Secondary: 1A or 5A

Phase Voltage VTs

P127 Ordering code A (57 to 130V)

Primary nominal (phase to phase) 0.10 to 1000.00kV
Secondary (phase to phase) 57 to 130V

P127 Ordering code B (220 to 480V)

Direct input (phase to phase) 220 to 480V

Residual Voltage VTs

P125, P126, P127 Ordering code A (57 to 130V)

Primary 0.10 to 1000.00kV
Secondary 57 to 130V

P125, P126, P127 Ordering code B (220 to 480V)

Direct input 220 to 480V

Other configurations

Phase rotation (P122 P123, P127)

Phase rotation P122 P123 P127: A-B-C or A-C-B

Group select

Change Group on Input labeled: change set
MENU or INPUT

P127:
Setting Group 1, 2, 3, 4, 5, 6, 7 or 8,
Group copy menu

P122, P123, P125, P126:

Setting Group 1 or 2

Alarms (P121, P122, P123, P125, P126, P127)

Inst. Self-reset ? Yes or No
Led ack on fault ? Yes or No
Inh Alarm tAux ? tAux1, tAux2, tAux3, tAux4, tAux5,
Equation A/B/C/D/E/F/G,H, I<, U<, P<, P<<, Q<, Q<<,
79 ext lock, Ctrl Trip, Fx<

Digital Inputs configuration

Each of the digital inputs can be set as:

- Active high (rising edge/high level)
or Active low (falling edge/low level)
- P120 and P121 have two inputs.
- P122 has three inputs.
- P123 has five inputs.
- P125 has four inputs.
- P126 has seven inputs.
- P127 have seven input by default (up to twelve if
optional board used)

*The voltage for digital inputs is DC or AC selectable,
depending from the model; see ordering code tables.*

Relay Maintenance mode

Relays maintenance mode P122 P123 P125 P126 P127

P122 P125 relays 65W(*)4321
P123 P126 P127 Relays 8765W(*)4321
(*) watchdog relay

Measurement range

IA, IB, IC

with Sec. max 40 In x CT prim. max 9999:
0 to 400kA by step of 0.01A

UA,UB,UC (Un = 57..130 V)

with Sec max 260 x VT prim. Max 1 MV / VT sec. min
57: 0 to 4.56MV by step of 0.01V

UA,UB,UC (Un = 220...480 V)

with Sec max 960: 0 to 960V by step of 0.01V

UAB,UBC,UCA (Un = 57...130V) with
2 x VA, VB or VC max if angle = 180°
between 2 phases:

0 to 9.12MV by step of 0.01V

UAB,UBC,UCA (Un = 220..480 V)

with 2 x VA, VB or VC max if angle = 180°between
2 phases:

0 to 1.92kV by step of 0.01V

le (0.1 to 40 len)

with Sec. max 40 len x CT prim. max 9999:0 to 400kA
by step of 0.01A:

le (0.01 to 8 len)

with Sec. max 8 len x CT prim. max 9999:
0 to 80 kA by step of 0.01A

le (0.002 to 1 len)

with Sec. max 1 len x CT prim. max 9999:
0 to 10 kA by step of 0.01A

Ue (Uen = 57..130 V)

with Sec max 260 x VT prim. Max 1 MV / VT sec. min
57:

0 to 4.56 MV by step of 0.01V

Ue (Uen = 220...480 V)

with Sec max 960: 0 to 960V by step of 0.01V

Pe Power (0.1 to 40 len, Uen = 57..130 V)

with (le max 400kA x Ue max 4.56MV):
0 to 1824GW by step of 1W

Pe Power (0.01 to 8 len, Uen = 57..130 V)

with le max 80 kA x Ue max 4.56 MV:
0 to 365GW by step of 1W

Pe Power (0.002 to 1 len, Uen = 57..130 V)

with le max 10 kA x Ue max 4.56 MV:
0 to 45.6GW by step of W

Pe Power (0.1 to 40 len, Uen = 220..480 V)

with le max 400 kA x Ue max 960 V:
0 to 384MW by step of 1W

Pe Power (0.01 to 8 len, Uen = 220..480 V)

with le max 80 kA x Ue max 960 V:
0 to 76.8MW by step of 1W

(le max 80 kA x Ue max 960 V)

Pe Power (0.002 to 1 len, Uen = 220..480 V) with le max

10 kA x Ue max 960 V 0 to 7.7 MW by step of 1 W

Angle le^Ue

0° to 359°

Active Power

0 to 9999 GW

Reactive Power

0 to 9999 GVar

Power factor

0 to 1

Active Energy Power

0 to 4200 GWh

Reactive Energy Power

0 to 4200 Gvarh

Further:

I1, I2, Ratio I2/I1, Thermal status (resettable)

Max & Average (resettable)

Max IA Rms, Max IB Rms, Max IC Rms
Average IA Rms, Average IB Rms, Average IC Rms

Recloser operations counters (resettable)

Total Recloses, Cycle 1, Cycle 2, Cycle 3, Cycle 4
Total Trip & Lockout

COMMUNICATION

ModBus protocol

P120 P121 P122. P123, P125, P126, P127

Baud Rate:

300, 600, 1200, 2400, 4800, 9600, 19200, 38400 bd

Parity Even/Odd/None

Stop Bits 1 or 2

Relay Address 1 to 255

IEC 60870-5-103

P120 P121 P122. P123, P125, P126, P127

Baud Rate

300, 600, 1200, 2400, 4800, 9600, 19200, 38400 bd

Relay Address 1 to 255

DNP3.0

P120 P121 P122. P123, P125, P126, P127

Baud Rate:

300, 600, 1200, 2400, 4800, 9600, 19200, 38400 bd

Parity Even/Odd/None

Stop Bits 1 or 2

Relay Address 1 to 255

Courier

P120 P121 P122. P123

Relay Address

1 to 255

CT/VT requirement

Phase inputs Typical 5VA 10P20

Earth inputs Core balanced CT or residual

Phase input Typical Protection VT

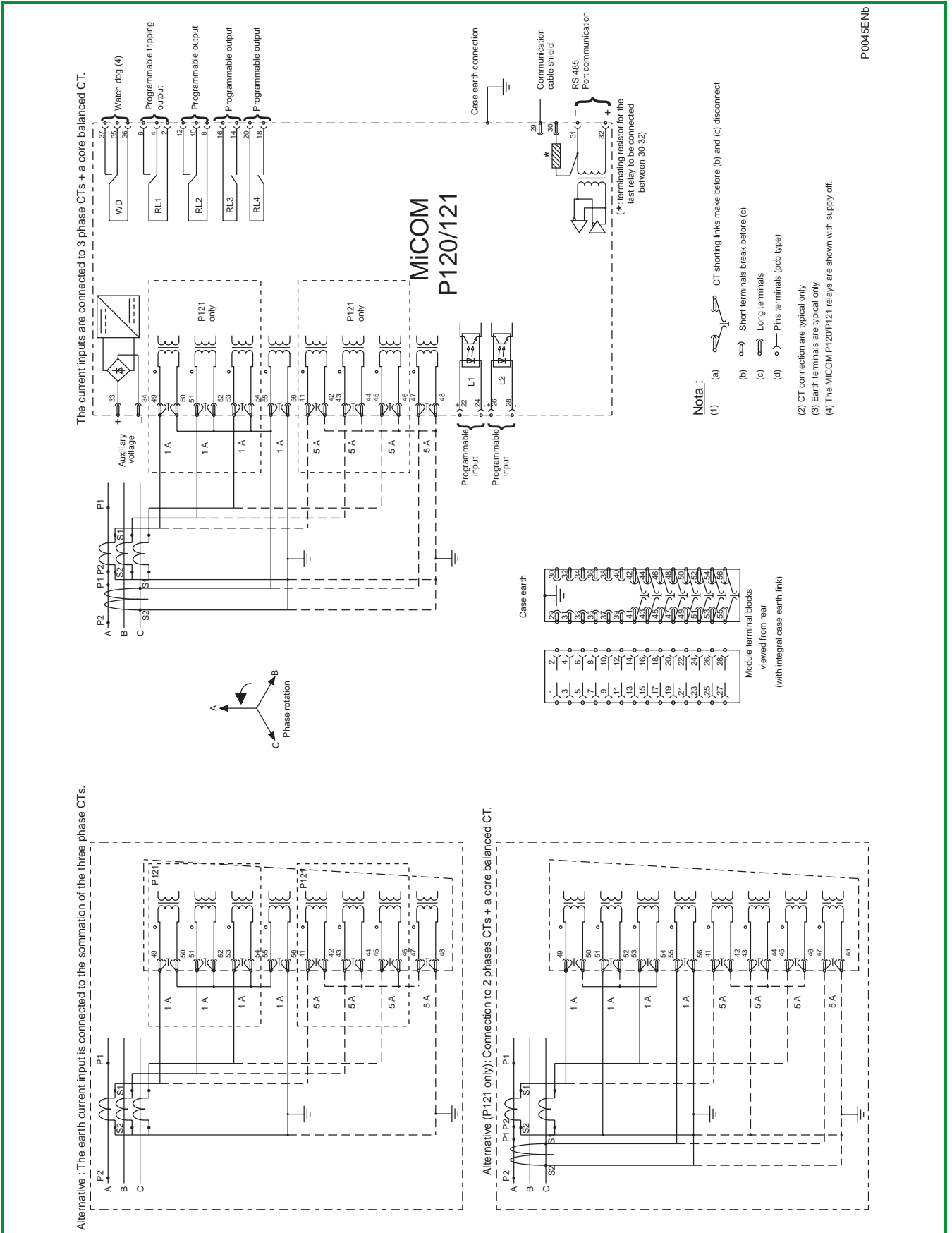
Residual voltage input
Typical protection VT or Open Delta VT

ACCURACY

Element	Deviation	Trigger	Reset	Time deviation
Phase overcurrent elements P120/1/2/3/6/7	$\pm 2\%$	DT: $I_s \pm 2\%$ IDMT: $1.1I_s \pm 2\%$	0.95 $I_s \pm 2\%$ 1.05 $I_s \pm 2\%$	$\pm 2\% + 20 \dots 50\text{ms}$ $\pm 5\% + 20 \dots 50\text{ms}$
Relay characteristic angle RCA (RCA-Torque angle) P125/6/7	$\leq 3^\circ$			
Trip zone P125/6/7	$\leq 3^\circ$			
Earth fault overcurrent elements P121/2/3/6/7	$\pm 2\%$	DT: $I_{es} \pm 2\%$ IDMT: $1.1I_{es} \pm 2\%$	0.95 $I_{es} \pm 2\%$ 1.05 $I_{es} \pm 2\%$	$\pm 2\% + 20 \dots 50\text{ms}$ $\pm 5\% + 20 \dots 50\text{ms}$
Wattmetric earth fault elements P125/6/7	$\pm 4\% \pm \text{error on } \cos\phi$	DT: P_{es} $\pm \text{accuracy}$ IDMT: $1.1P_{es}$ $\pm \text{accuracy}$	0.95 P_{es} $\pm \text{accuracy}$ 1.05 P_{es} $\pm \text{accuracy}$	$\pm 2\% + 30 \dots 50\text{ms}$ $\pm 5\% + 30 \dots 50\text{ms}$
$I_e \cos\phi$ earth fault overcurrent elements P125/6/7	$\pm 2\% \pm \text{error on } \cos\phi$	DT: $I_e \cos\phi \pm \text{accuracy}$ IDMT: $1.1 I_e \cos\phi \pm \text{accuracy}$	0.95 $I_e \cos\phi \pm \text{accuracy}$ 1.05 $I_e \cos\phi \pm \text{accuracy}$	$\pm 2\% + 30 \dots 50\text{ms}$ $\pm 5\% + 30 \dots 50\text{ms}$
Negative sequence phase overcurrent elements P122/3/6/7	$\pm 2\%$	DT: $I_2s \pm 2\%$ IDMT: $1.1I_2s \pm 2\%$	0.95 $I_2s \pm 2\%$ 1.05 $I_2s \pm 2\%$	$\pm 2\% + 20 \dots 50\text{ms}$ $\pm 5\% + 20 \dots 50\text{ms}$
Phase undercurrent element P122/3/6/7	$\pm 2\%$	DT: $I < \pm 2\%$	1.05 $I < \pm 2\%$	$\pm 2\% + 20 \dots 50\text{ms}$
Broken conductor P122/3/6/7	$\pm 3\%$	DT: $I_2/I_1 \pm 3\%$	0.95 $I_2/I_1 \pm 3\%$	$\pm 2\% + 20 \dots 50\text{ms}$
Thermal overload P122/3/6/7	$\pm 3\%$	IDMT: $I_0 > \pm 3\%$	0.97 $I_0 > \pm 3\%$	$\pm 5\% + 20 \dots 50\text{ms}$ (ref. IEC 60255-8)
Overvoltage P127	$\pm 2\%$	DT: $U_s \pm 2\%$	0.95 $U_s \pm 2\%$	$\pm 2\% + 20 \dots 40\text{ms}$
Undervoltage P127	$\pm 2\%$	DT: $U_s \pm 2\%$	1.05 $U_s \pm 2\%$	$\pm 2\% + 20 \dots 40\text{ms}$
Overfrequency P127	$\pm 2\%$	DT: $F_s \pm 2\%$	0.95 $F_s \pm 2\%$	$\pm 2\% + 80 \dots 100\text{ms}$
Underfrequency P127	$\pm 2\%$	DT: $F_s \pm 2\%$	1.05 $F_s \pm 2\%$	$\pm 2\% + 80 \dots 100\text{ms}$
Overpower P127	$\pm 5\%$	DT: $P_s \pm 2\%$	0.95 $P_s \pm 2\%$	$\pm 2\% + 20 \dots 50\text{ms}$
Derived residual overvoltage P125/6/7	$\pm 2\%$ or 1V	DT: $U_{rs} \pm 2\%$	0.95 $U_{rs} \pm 2\%$	$\pm 2\% + 20 \dots 40\text{ms}$
Auxiliary Timers				$\pm 2\% + 10 \dots 20 \text{ms}$
Timers of logic functions				$\pm 2\% + 10 \dots 20 \text{ms}$
Autoreclosing Timers				$\pm 2\% + 10 \dots 20 \text{ms}$

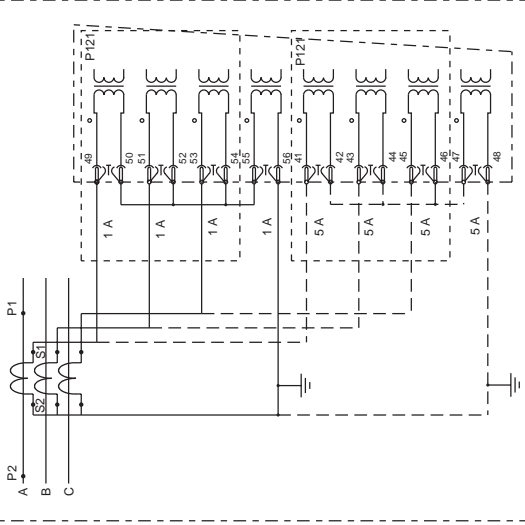
WIRING CONNECTIONS

Typical application diagram P120 P121

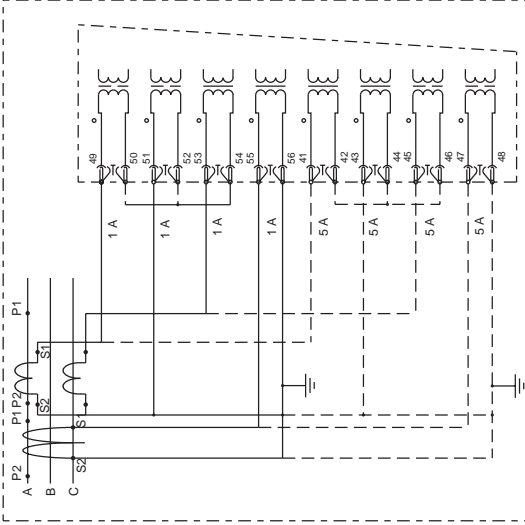


P0045ENb

Alternative 1: The earth current input is connected to the summation of the three phase CTs.

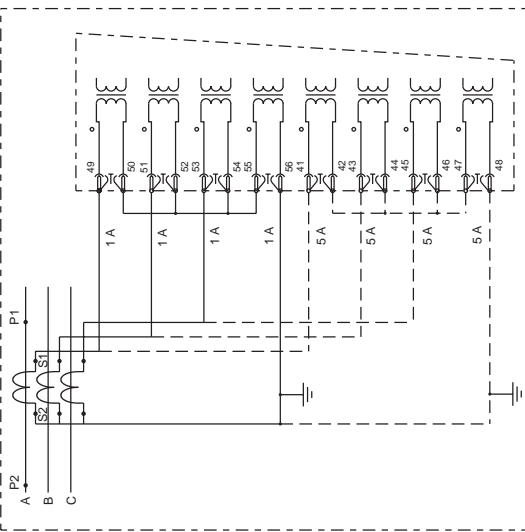


Alternative (P121 only): Connection to 2 phases CTs + a core balanced CT.

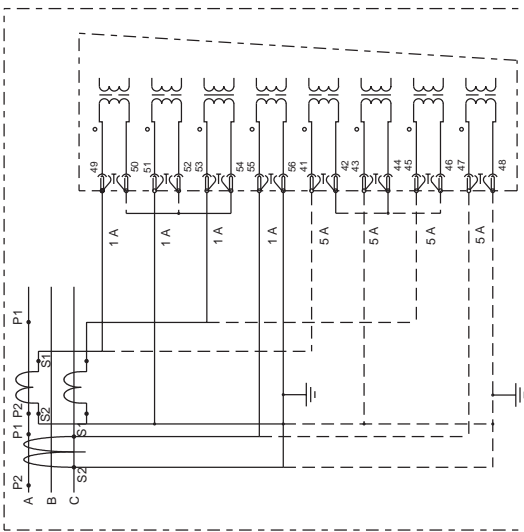


Typical application diagram P122 P123

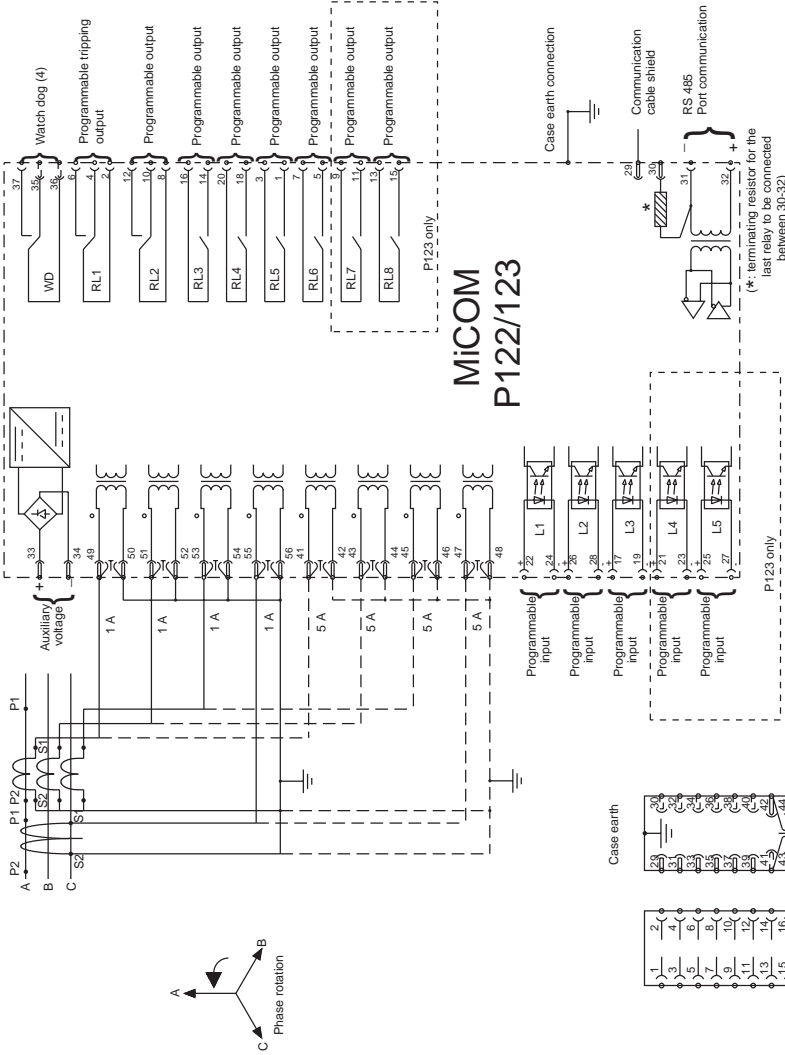
Alternative : The earth current input is connected to the summation of the three phase CTs.



Alternative : Connection to 2 phases CTs + a core balanced CT.



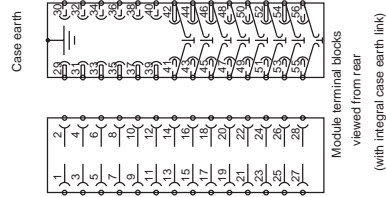
The current inputs are connected to 3 phase CTs + a core balanced CT.



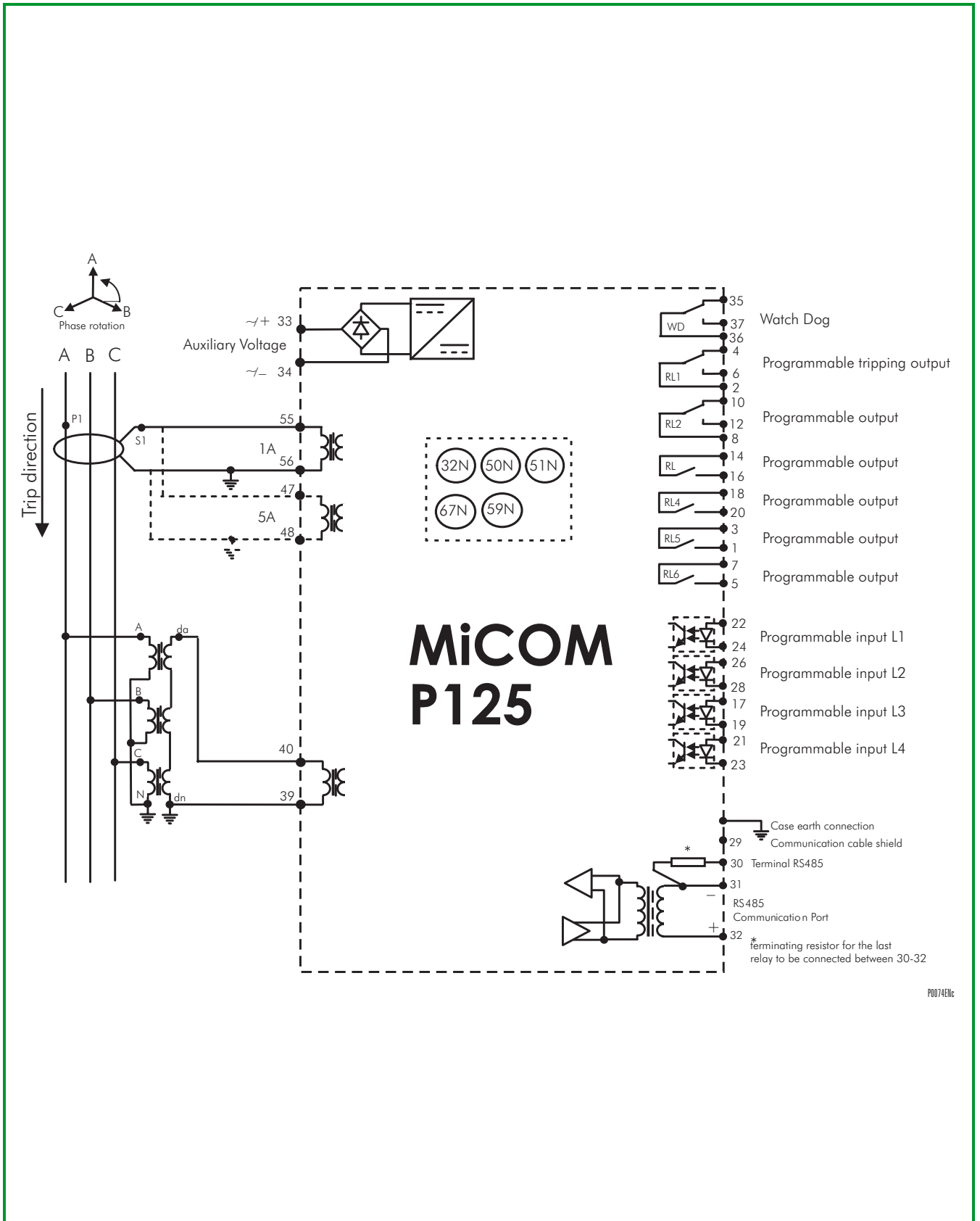
MiCOM P122/123

Nota :

- (1) CT shorting links make before (b) and (c) disconnect
- (2) CT connection are typical only
- (3) Earth terminals are typical only
- (4) The MiCOM P122/P123 relays are shown with supply off.

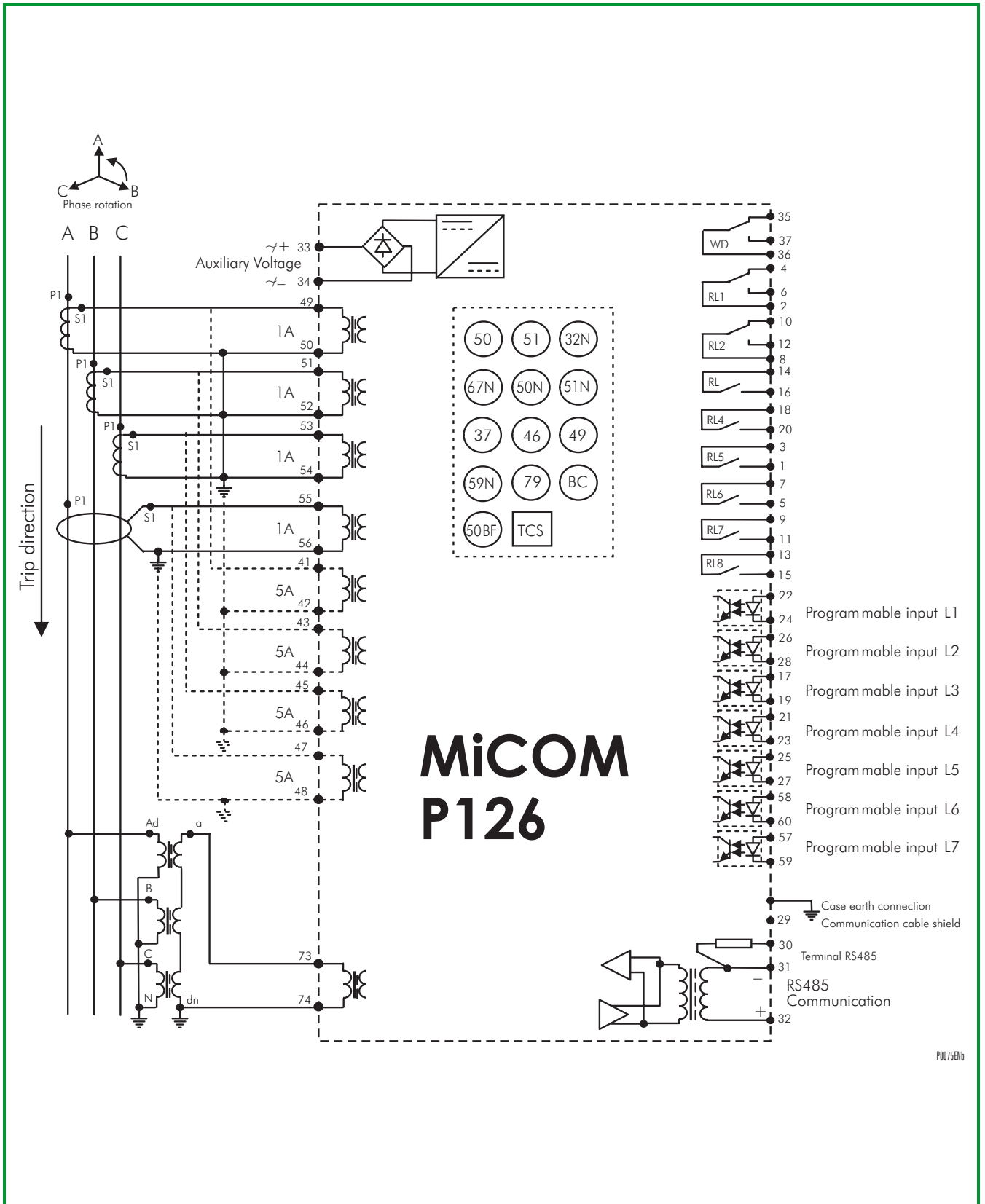


Typical application diagram P125



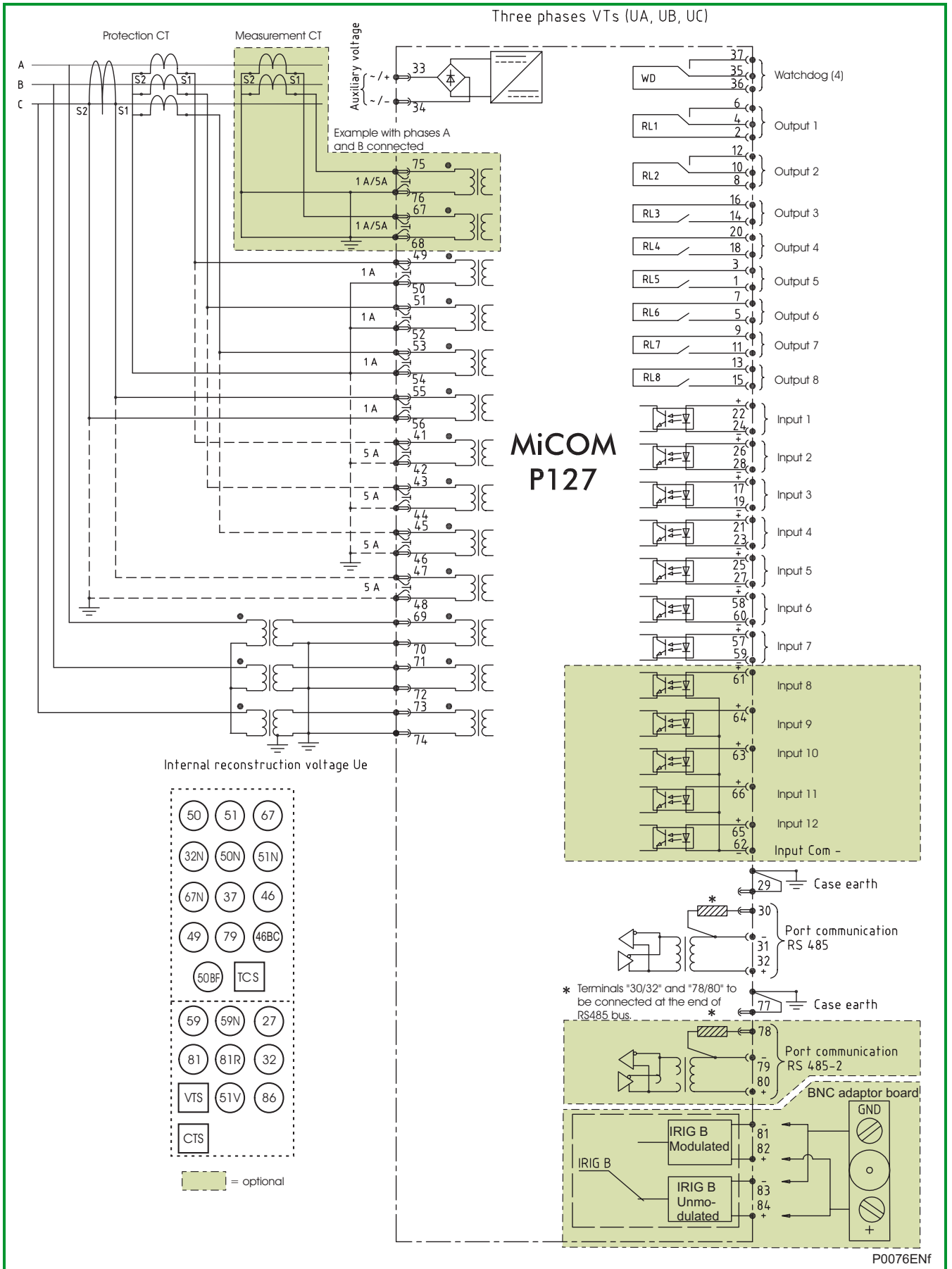
P0074ENC

Typical application diagram P126



P0075ENb

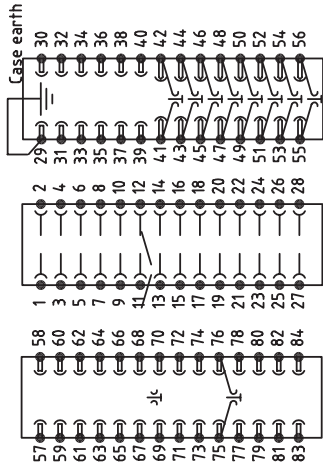
Typical application diagram P127



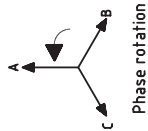
Nota:

- (1) (a) CT shorting links make before (b) and (c) disconnect.
 - (b) Short terminals break before (c).
 - (c) Long terminals
 - (d) Pins terminals (pcb type).
- (2) CT connection are typical only.
 (3) Earth terminals are typical only.
 (4) The MICOM relay P127 is shown with supply otr.

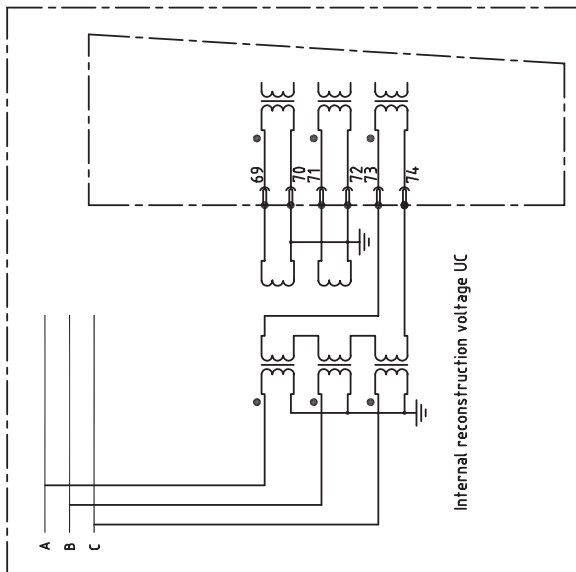
ADVICE FOR CONNECTION:
 A tightening torque of 13 Newton metres is recommended for all screws fitted to the MIDOS terminal blocks.
 Functioning temperature limited to 55°C
 For any connection use the provided kit or use cable terminals UL LISTED.
 Wiring : use copper conductors only size AWG22 to AWG10



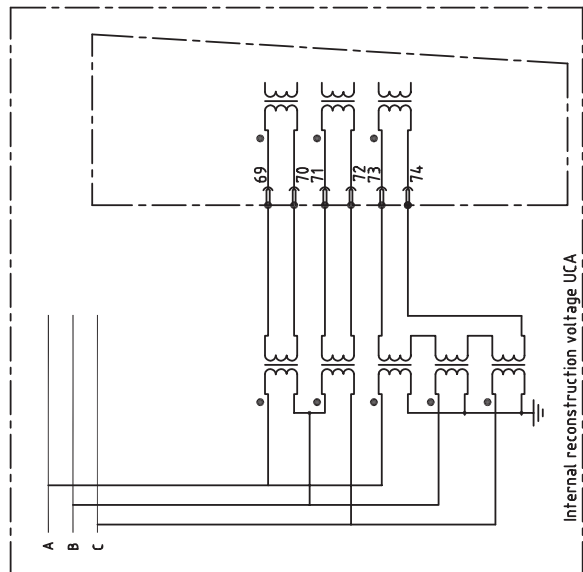
Module terminal blocks viewed from rear (with integral case earth link)



Two phases-neutral plus delta earth connection

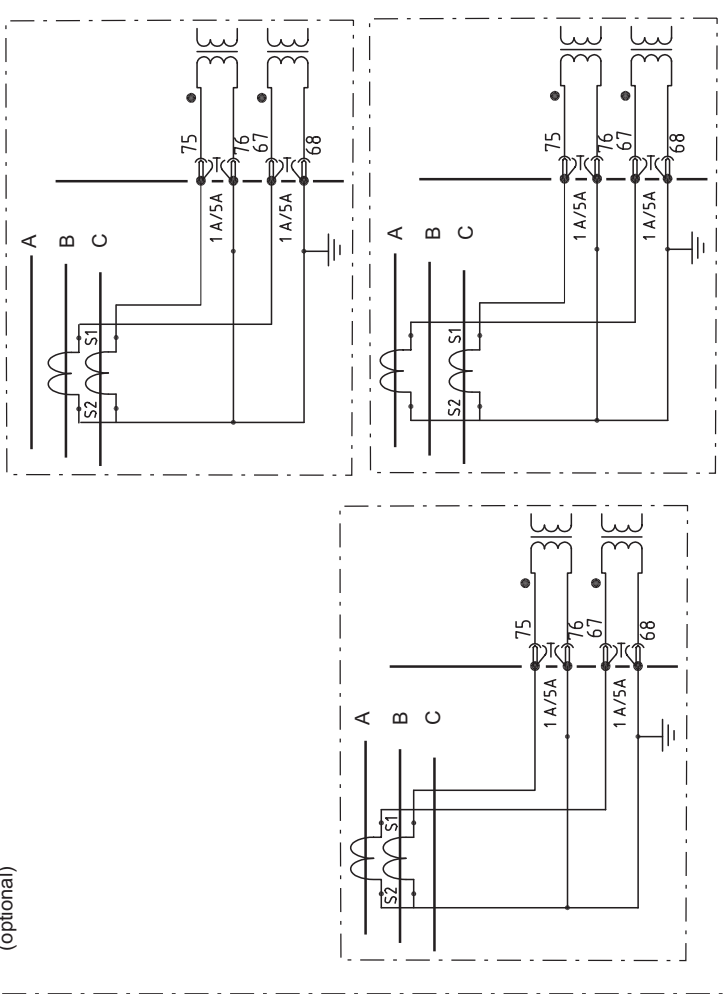


Two phase to phase plus delta earth connection



P3947ENb

Measurement CT connection (optional)



Information required with order

P120

Information required with order		Order - No.													
Versions		1	2	3	4	5	6	7	8	9	10	11	12	13	14
MiCOM P12x – Overcurrent protection		P	1	2	0	*	0	0	*	*	*	2	*	*	*
Variant															
Earth or single Phase overcurrent	0														
Earth current input															
0.1 to 40 Ion	A														
0.01 to 8 Ion	B														
0.002 to 1 Ion	C														
Auxiliary voltage	Digital input voltage														
48 - 250 Vdc / 48 - 240 Vac	105 - 145 Vdc								H						
48 - 250 Vdc / 48 - 240 Vac	24 - 250 Vdc (Special option for ENA UK)								T						
48 - 250 Vdc / 48 - 240 Vac	110 Vdc -30% / +20%								V						
48 - 250 Vdc / 48 - 240 Vac	220 Vdc -30% / +20%								W						
24 - 250 Vdc / 48 - 240 Vac	24-250Vdc / 24-240Vdc								Z						
Communication interface															
Modbus										1					
KBus / Courier										2					
IEC 60870-5-103										3					
DNP3										4					
Language															
French											0				
English / American											1				
Spanish											2				
German											3				
Italian											4				
Russian											5				
Polish											6				
Turkish											E				
Latest Major Software release															
V XX.X ⁽²⁾														?	
Latest Minor Software release															
V XX.X ⁽²⁾															?
Mounting option															
None (default) ⁽³⁾															0
Pre-fixed HMI (no withdrawability)															1
Sealed cover ⁽³⁾															2
Pre-fixed with sealed cover															3

⁽¹⁾ Available only with larger LCD

⁽²⁾ Unless specified, the latest version will be delivered

⁽³⁾ Not available with "Auxiliary voltage – Digital input voltage code T

(*) please contact us in order to know the availabilities

P121, P122 or P123

Information required with order														
Versions	Order - No.													
MiCOM P12x – Overcurrent protection	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	P12	*	*	0	0	*	*	*	*	*	*	*	*	*
Variant	3 Phase and Earth overcurrent	1	Advanced – 3 Phase and Earth overcurrent	2	Expert – 3 Phase and Earth overcurrent	3								
Earth current input	0.1 to 40 I _{on}		0.01 to 8 I _{on}	A										
	0.002 to 1 I _{on}			B										
				C										
Voltage Input	57 – 130 V		220 – 480 V	A										
				B										
Auxiliary voltage	48 - 250 Vdc / 48 - 240 Vac		Digital input voltage	105 - 145 Vdc										
	48 - 250 Vdc / 48 - 240 Vac			24 - 250 Vdc (Special option for ENA UK)										
	48 - 250 Vdc / 48 - 240 Vac			110 Vdc -30% / +20%										
	48 - 250 Vdc / 48 - 240 Vac			220 Vdc -30% / +20%										
	24 - 250 Vdc / 48 - 240 Vac			24-250Vdc / 24-240Vdc										
Communication interface	Modbus													
	KBus / Courier													
	IEC 60870-5-103													
	DNP3													
Language	French													
	English / American													
	Spanish													
	German													
	Italian													
	Russian													
	Polish													
	Portuguese													
	Dutch													
	Czech													
	Hungarian													
	Greek													
	Chinese (only available in phase II hardware with larger LCD display)													
	Turkish													
Hardware version	Text display													
	Larger LCD display													
Latest Major Software release	V XX.X ⁽²⁾													
Latest Minor Software release	V XX.X ⁽²⁾													
Mounting option	None (default) ⁽³⁾													
	Pre-fixed HMI (no withdrawability)													
	Sealed cover ⁽³⁾													
	Pre-fixed with sealed cover													

- (1) Available only with larger LCD
 - (2) Unless specified, the latest version will be delivered
 - (3) Not available with "Auxiliary voltage – Digital input voltage code T"
- (*) please contact us in order to know the availabilities

P125 or P126

Information required with order		Order - No.													
Versions		1	2	3	4	5	6	7	8	9	10	11	12	13	14
MiCOM P12x – Overcurrent protection		P12 * * * 0 * * * * * * *													
Variant															
Directional//non-directional E/F relay	5														
Directional//non-directional three phase overcurrent and directional/non directional earth fault relay	6														
Earth current input															
0.1 to 40 I _{on}	A														
0.01 to 8 I _{on}	B														
0.002 to 1 I _{on}	C														
Voltage Input															
57 – 130 V	A														
220 – 480 V	B														
Auxiliary voltage															
48 - 250 Vdc / 48 - 240 Vac									H						
Note: option H not available with graphical display: Chinese															
48 - 250 Vdc / 48 - 240 Vac									T						
48 - 250 Vdc / 48 - 240 Vac									V						
48 - 250 Vdc / 48 - 240 Vac									W						
24 - 250 Vdc / 48 - 240 Vac									Z						
Digital input voltage															
105 - 145 Vdc (special application)															
24 - 250 Vdc (Special option for ENA UK)															
110 Vdc -30% / +20% (special application)															
220 Vdc -30% / +20% (special application)															
24-250Vdc / 24-240Vdc															
Communication interface															
Modbus										1					
IEC 60870-5-103										3					
DNP3										4					
Language															
French													0		
English / American													1		
Spanish													2		
German													3		
Italian													4		
Russian													5		
Polish													6		
Portuguese													7		
Dutch													8		
Czech													A		
Hungarian													B		
Chinese (only available in phase II hardware with larger LCD display)													D		
Turkish													E		
Hardware version															
Text display														2	
Larger LCD display														3	
Latest Major Software release															
V XX.X ⁽²⁾														?	
Latest Minor Software release															
V XX.X ⁽²⁾														?	
Mounting option															
None (default) ⁽³⁾															0
Pre-fixed HMI (no withdrawability)															1
Sealed cover ⁽³⁾															2
Pre-fixed with sealed cover															3

(1) Available only with larger LCD

(2) Unless specified, the latest version will be delivered

(3) Not available with "Auxiliary voltage – Digital input voltage code T

(*) please contact us in order to know the availabilities

Information required with order		Order - No.													
Versions		1	2	3	4	5	6	7	8	9	10	11	12	13	14
MiCOM P12x – Overcurrent protection		P12	7	*	*	*	*	*	*	*	*	*	*	*	*
Variant															
Directional//non-directional three phase overcurrent and directional/non directional earth fault relay	7														
Earth current input															
0.1 to 40 Ion	A														
0.01 to 8 Ion	B														
0.002 to 1 Ion	C														
Voltage Input															
57 – 130 V	A														
220 – 480 V	B														
Optional features															
None	0														
Additional 5 digital inputs	1														
IRIG-B inputs + additional 2nd rear port	2														
IRIG-B inputs + additional 2nd rear port + additional 5 digital inputs	3														
Measurement CTs ⁽¹⁾	4														
Measurement CTs + additional 5 digital inputs ⁽¹⁾	5														
Measurement CTs + IRIG-B input + additional 2nd rear port ⁽¹⁾	6														
Measurement CTs + IRIG-B input + additional 2nd rear port + additional 5 digital inputs ⁽¹⁾	7														
Auxiliary voltage															
48 - 250 Vdc / 48 - 240 Vac	105 - 145 Vdc (special application)									H					
Note: option H not available with graphical display: Chinese															
48 - 250 Vdc / 48 - 240 Vac	24 - 250 Vdc (Special option for ENA UK)									T					
48 - 250 Vdc / 48 - 240 Vac	110 Vdc -30% / +20% (special application)									V					
48 - 250 Vdc / 48 - 240 Vac	220 Vdc -30% / +20% (special application)									W					
24 - 250 Vdc / 48 - 240 Vac	24-250Vdc / 24-240Vdc									Z					
Communication interface															
Modbus / Modbus (if 2 nd RS485 port available)										1					
IEC 60870-5-103 / Modbus (if 2 nd RS485 port available)										3					
DNP3 / Modbus (if 2 nd RS485 port available)										4					
IEC 60870-5-103 / IEC 60870-5-103 (only available with additional 2 nd rear port)										5					
Language															
French										0					
English / American										1					
Spanish										2					
German										3					
Italian										4					
Russian										5					
Polish										6					
Portuguese										7					
Dutch										8					
Czech										A					
Hungarian										B					
Chinese (only available in phase II hardware with larger LCD display)										D					
Turkish										E					
Hardware version															
Text display														2	
Larger LCD display														3	
Latest Major Software release															
V XX.X ⁽²⁾														?	
Latest Minor Software release															
V XX.X ⁽²⁾															?
Mounting option															
None (default) ⁽³⁾															0
Pre-fixed HMI (no withdrawability)															1
Sealed cover ⁽³⁾															2
Pre-fixed with sealed cover															3

(1) Available only with larger LCD
 (2) Unless specified, the latest version will be delivered
 (3) Not available with "Auxiliary voltage – Digital input voltage code T
 (*) please contact us in order to know the availabilities

Guide Form Specification MiCOM P120 P121 P122 P123

Phase and earth numerical overcurrent relay in drawout 4U metal case.

The following functions are available:

- 3 independent phase stages (instantaneous and time-delayed) 50/51
- 3 independent earth stages (instantaneous and time-delayed) 50N/51N
- 1 derived earth stages (instantaneous and time-delayed)
- Tripping curves type IEC (short time inverse, standard inverse, very inverse, extremely inverse, long time inverse) and IEEE/ANSI (short time inverse, moderately inverse, inverse, very inverse, extremely inverse)
- RXIDG curves
- Rectifier curve
- Negative sequence overcurrent - 46
- Undercurrent - 37
- Thermal overload - 49
- Output relay latching - 86
- Broken conductor detection
- 4 shot autorecloser - 79
- Circuit breaker failure detection - 50 BF
- Circuit breaker monitoring
- Trip circuit supervision
- Inrush blocking

The relay provides complete measurements and recording functions including:

- True RMS values
- Event recorder with the last 250 events, 1ms time-tagged.
- Fault recorder with the last 25 faults
- Instantaneous recorder with the last 5 instantaneous starts
- Flexible disturbance recorder (total duration = 15s)

User interface includes:

- A 32-character backlit display
- Programmable LEDs
- A front panel EIA RS232 for local settings
- A EIA RS485 rear port compatible with MODBUS, Courier, IEC 60870-5-103, or DNP3.0
- An easy to use PC setting software

MiCOM P125 P126

- Non Directional Phase Overcurrent & Directional / non Directional earth fault overcurrent relay in drawout 4U metal case.

The following functions are available:

- 3 independent phase thresholds (instantaneous and delayed) 50/51
- 3 independent earth fault thresholds (instantaneous and delayed) 67N/50N/51N
- 2 Wattmetric Pe/Iecos earth fault thresholds 32N
- Tripping curves type IEC (short time inverse, standard inverse, very inverse, extremely inverse, long time inverse) IEEE/ANSI (short time inverse, moderately inverse, inverse, very inverse, extremely inverse), RI and RECT
- 3 Negative phase sequence overcurrent thresholds 46
- Undercurrent - 37
- 2 Thermal overload thresholds 49
- 1 Residual Overvoltage thresholds 59N
- Output relay latching 86
- Broken conductor detection
- 4 shot auto-recloser 79
- Circuit breaker failure detection 50BF
- Circuit breaker monitoring
- Trip circuit supervision

The relay provides complete measurements and recording functions including:

- True RMS values
- Event recorder with the last 250 events, 1ms time stamped.
- Fault recorder with the last 25 faults
- Instantaneous recorder with the last 5 instantaneous starts
- Disturbance recorder with storage of 5 records for 3 seconds each

User interface includes:

- A 32 characters backlit display
- Programmable LEDs
- A front panel RS232 for local settings
- A RS485 rear port compatible with MODBUS , DNP3 or IEC60870-5-103

An easy to use PC setting software.

MiCOM P127

- Directional / non Directional Phase Overcurrent
Directional / non Directional earth fault
overcurrent relay in drawout 4U metal case.

The following functions are available:

- The following functions are available:
- 3 independent phase thresholds (instantaneous and delayed) 67/50/51
- 3 independent earth fault thresholds (instantaneous and delayed) 67N/50N/51N
- 1 derived earth stages (instantaneous and time-delayed)
- 2 Wattmetric Pe/Iecos earth fault thresholds 32N
- Tripping curves type IEC (short time inverse, standard inverse, very inverse, extremely inverse, long time inverse) IEEE/ANSI (short time inverse, moderately inverse, inverse, very inverse, extremely inverse), RI and RECT
- 3 Negative phase sequence overcurrent thresholds 46
- Undercurrent - 37
- 2 Thermal overload thresholds 49
- 2 Phase Overvoltage thresholds 59
- 2 Phase Undervoltage thresholds 27
- 1 Residual Overvoltage thresholds 59N
- 8 independents threshold for 3 phase active and reactive under / over power protection (32)
- 6 independents threshold for under/overfrequency protection (81U/O)
- 6 independents threshold for rate of frequency protection (81R)
- Output relay latching 86
- Broken conductor detection
- 4 shot auto-recloser 79
- Circuit breaker failure detection 50BF
- Circuit breaker monitoring
- Trip circuit supervision
- Inrush blocking
- Phase rotation
- VT Supervision
- CT Supervision

The relay provides complete measurements, metering and recording functions including:

- Frequency,
- True RMS values
- Max and average voltage values
- Class 0.5 Energy values*
- Active, reactive, apparent power
- Currents Total harmonics distortion (THD) and Total demand distortion (TDD)*,
- Voltage Total harmonics distortion (THD)*
- K Factor*,
- Phase current harmonics (ratio)*,
- Event recorder with the last 250 events, 1ms time stamped.
- Fault recorder with the last 25 faults
- Instantaneous recorder with the last 5 instantaneous starts
- Disturbance recorder with storage of 5 records for 3 seconds each

* with measurement CTs option

User interface includes:

- A backlit LCD display
- Programmable LEDs
- A front RS232 port for local settings

A multi protocol RS485 rear port is available for communications with digital control system (MODBUS , DNP3 or IEC60870-5-103)

Optional hardware features:

- Up to 12 opto-inputs
- IRIG-B synchronization (modulated and demodulated)
- Additional RS485 port in Modbus or IEC60870-5-103
- Two measurements CTs



Customer Care Centre

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