MiCOM P116

Numerical CT and Vx Auxiliary Voltage-Powered Overcurrent Relays

MiCOM P116 are numerical relays designed to offer overcurrent and earth fault protection without requiring a guaranteed external auxiliary supply.

They can be applied to medium and high voltage electrical systems as either main or backup protection.

When supervision functions are required, the dual-powered relay offers additional measurement, monitoring and recording functions.

The P116 can be fully configured manually, without using setting software.

Alternatively, MiCOM S1 Studio setting software allows configuration parameters to be modified for a specific application via the USB port.

IEC 60870-5-103 and Modbus RTU integrated communication protocols are available for flexible integration into most substation control or DCS systems.

A capacitance discharge output is able to provide sufficient power to energise a circuit breaker's low energy trip coil.

An external flag indicator is used for remote or local indication that a trip has occurred.

Accessories such as low energy striker or capacitor trip unit are also available to fit your particular application.

For Flush or Wall Mounted applications, an optional secondary case is available for ease of installation.

CUSTOMER BENEFITS

- No need for a guaranteed auxiliary power supply
- Settings made easy
- Simplicity of switchgear panels
- Communication features for DCS/SCADA system
- Full knowledge of what has happened (monitoring and recording)
- User-friendly maintenance thanks to an optional withdrawable case
- USB port for local communications with self-powering facilities
- Effortless installation (typical 1A or 5A CTs)
- FRAM memory: Battery back-up not required

APPLICATION

The MiCOM P116 numerical overcurrent protection relays provide an optimized and cost efficient solution where no external auxiliary power supply is available or guaranteed.

Typical applications are:

- Utility and industrial substation fitted with cost-optimized MV switchboards
- HV back-up protection (HV/MV transformers)
- Retrofit relays of old technology, particularly during installation of DCS systems.

P116 offers two models:

- Dual powered Model A - suitable for application when communication and full recording facility is required
- CT powered Model L – the best for basic application (cost optimised switchgear panels without communication, retrofit, replacement, etc)

In addition to its protection functions and when powered by an external auxiliary supply, the dual-powered P116 (Model A) is able to transmit recorded and measured data to a supervisor through communication networks. Should the auxiliary power supply (Vx) fail, protection and tripping functions remain fully operational.

MiCOM P116 relays draw the power necessary to their operation from the line's current transformers and the auxiliary voltage supply (Model A).

Schneider Electric

MAIN FUNCTIONS

The circuit-breaker can be tripped using internal tripping energy (capacitor charge within the P116), drawn from the fault's energy (CTs) and/or from the auxiliary voltage (Model A).

The capacitor discharge energy from P116 is sufficient for energising a sensitive CB trip coil/striker (12-24Vdc/0.1J) or MiTOP (SE CBs), thus releasing the actuating mechanism of the circuit-breaker.

For legacy CB applications (not fitted with a sensitive CB coil) the trip command can be based on the energy stored in the microprocessor capacitor trip unit - MiCOM E124 (P116 accessories). A relay output can send a command directly to the standard circuit-breaker coil.

This solution is easier to install than the striker solution, as no mechanical connection with the CB is required. However is is necessary to guarantee the auxiliary supply for charging of the E124. Approximately 1 minute of charge can ensure E124 is ready to operate for over 8 days.

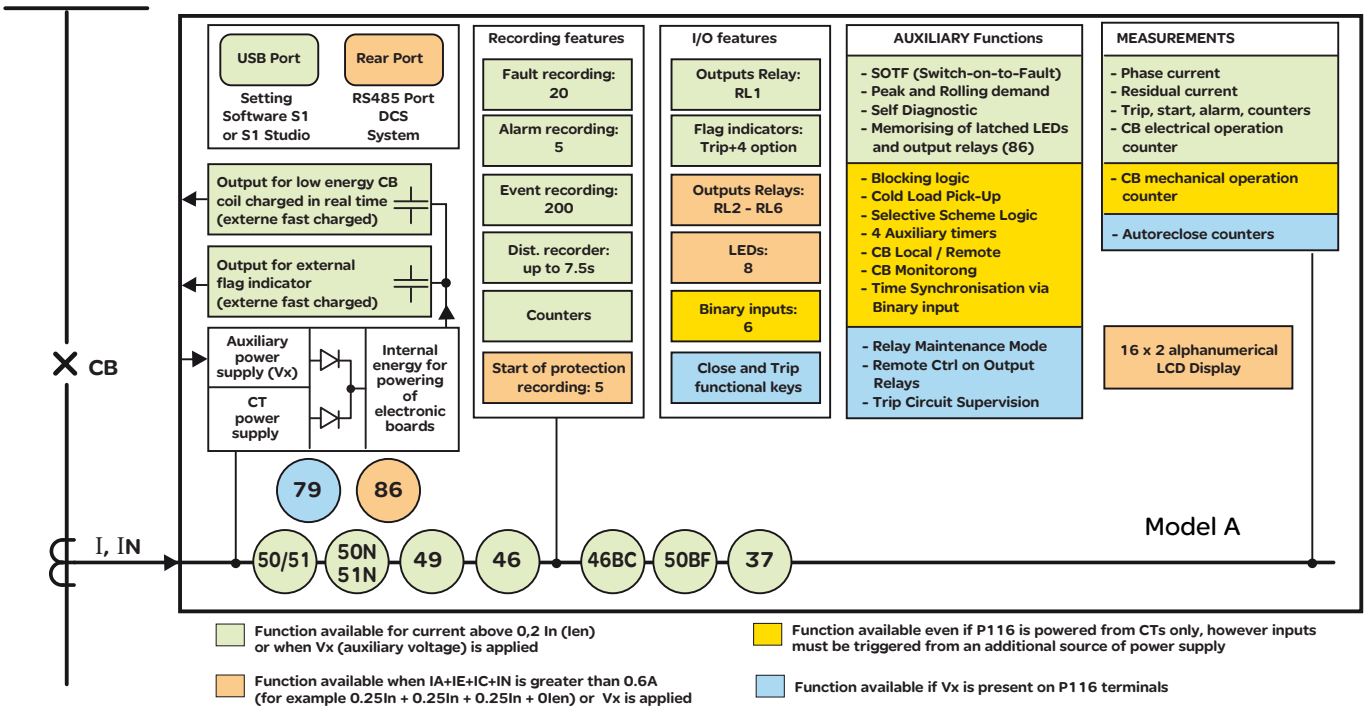
E124 provides two independent capacitor banks.

For dual powered application, if an auxiliary voltage (Vx): AC or DC, is available, redundant tripping commands can be executed using P116's relay contacts and substation auxiliary voltage.

FUNCTIONS OVERVIEW

ANSI Code	Functions	Model L	Model A
50/51	Three-phase non directional overcurrent: 3 independent thresholds (12 groups of IDMT curves)	•	•
50N/51N	Phase-earth non directional overcurrent: 3 independent thresholds (12 groups of IDMT curves)	•	•
49	Thermal overload (true RMS): 2 independent thresholds (Alarm, Trip)	•	•
37	Undercurrent		•
46	Negative phase sequence overcurrent		•
46BC	Broken conductor detection (I2/I1)		•
50HS	Switch on to fault (SOTF)		•
	Inrush blocking	•	•
	Blocking logic **(Note 1)**		•
	Selective relay scheme logic **(Note 1)**		•
	Cold load pick-up **(Note 1)**		•
79	Autorecloser option (4 shots) **(Note 3)**		•
50BF	Circuit breaker failure	•	•
	2 setting groups **(Note 1)**		•
	Output for low energy sensitive CB trip coil/striker (12-24Vdc/0.1J) or MiTOP (SE CBs)	•	•
	Output for standalone flag indicator (24VDC/0.01J)		•
	1 "Trip" (standard option) / 4 (ordering option, configurable) electro-magnetic indicator flags	• / -	• / •
	Freely configurable output relays / 1 watchdog contact / Binary inputs	1BO/WD/0BI	6BO/WD/6BI
86	Output relay latching **(Note 2)**		•
	8 signalling LEDs ("Healthy" + "Trip" + "Alarm" + 5 freely configurable LEDs) **(Note 2)**	•	•
	Circuit breaker supervision and counters **(Note 1)**		•
	Fault records for the 20 most recent trips / Alarm records for the 5 most recent alarms	• / -	• / •
	Event records (up to 200 events)		•
	Disturbance records (up to 7.5s)	•	•
	Front USB port for local downloading of settings, events and/or fault records with self-supplying facilities	•	•
	Rear port RS485 communications (Modbus RTU and IEC60870-5-103) **(Note 2)**		•
	Time synchronization: via rear communications port (DCS) and/or via digital input (external clock) **(Note 1)**		•
	Measurements (true RMS) / CB control available via communications ports **(Note 2)**	• / -	• / •
	Maximum and mean current values	•	•
	Setting software: MiCOM S1 and/or S1 Studio	•	•
	Optional cassette (adaptor) for: wall-mounted or flush-mounted solution with withdrawable feature	•	•
	(Note 1): Function available even if the P116 is supplied from CTs only (without Vx /loss of Vx), but in this case inputs must be triggered from an additional power supply source **(Note 2): Function available even if the P116 is not supplied from the Vx auxiliary power but currents must be higher than the CT powering threshold: (I1+I2+I3+IN) > 0.6 In** **(Note 3): Function available if P116 is supplied from the Vx auxiliary power supply**		

Functional Overview for P116 Model A (Description of ANSI code nos. see Functions Overview)



MAIN FEATURES

The power supply to the electronic circuits of the MiCOM P116 has been optimised so that it can trigger the circuit-breaker with a load current of 0.2 In on at least one phase. The scope of functionality depends on the following CT powering threshold:

- (I1+I2+I3+IN) < 0.6 In: all protection and recording functions, RL1, trip energy and flag indicators are active. But in order to save power – reduce the consumption of energy from the CTs (i.e. lower CT requirements), outputs contacts RL2-RL6, the LCD display, the LEDs and the RS485 port are switched off.
- (I1+I2+I3+IN) > 0.6 In: full functionality.

The front panel includes an electromagnetic bistable flag to indicate that a trip has occurred. As an option in the dual-powered P116, four additional magnetic indicator flags are configurable.

8 LEDs indicate the correct operation of the relay as well as other information regarding the protection of the electrical system.

The hardware architecture and software algorithms have been designed to operate on very short failure detection times. Tripping occurs typically within no more than 40 ms (for a switch-on-to-fault condition without Vx auxiliary voltage: typically 60 ms. This time includes 20ms for P116 booting).

The standard flush mounting case is fitted with a CT circuit-shorting solution: a plug is built into some of the P116's terminals so that it is possible to withdraw only removable terminals even if the CB is closed and there are currents present.

For easier withdrawal of the P116 from the front of the switchgear panel, the standard P116 case can be fitted in an optional flush mounting secondary case (P116 accessories).

For wall- or plate-mounting of the P116, the wall-mounting cassette is used (P116 accessories).

PROTECTION FUNCTIONS

(see Functions Overview)

Three-Phase Overcurrent (50/51) & Earth Fault Overcurrent (50N/51N)

Three independent stages are available both for phase and earth fault protection. For the first and second (50/51 only) stages the user may independently select a definite time delay (DMT) or an inverse time delay (IDMT) with different types of curves (IEC, IEEE/ANSI, RI, RECT, RXIDG, BNP).

Each stage and related time-delay can be programmed to provide maximum selectivity.

The IDMT stages have a selectable reset feature: DMT (0 to 600 s) or an IDMT timer so as to reduce clearance times when intermittent faults occur.

The MiCOM P116 relays have separate instantaneous and delayed indications for each stage and output relays and LEDs can be configured to indicate the faulted phase(s).

Each protection stage can be disabled, configured to trip a circuit-breaker or to issue an ALARM signal only.

MiCOM P116: Innovative CT-Powered Numerical Relays

Switch-on-to-Fault (based on 50/51)

The closing of a circuit breaker might inadvertently lead to a short-circuit fault due to a maintenance ground clamp not yet removed. The P116 relays incorporate a settable switch-on–to-fault protection function. It provides an instantaneous trip over a settable time period after local or remote manual closure.

Inrush current in transformer applications can have an influence on the selectivity of instantaneous trips; the short time-delay (DMT) can therefore be set for this protection element in order to maintain selectivity and make it possible to have a current threshold below any inrush current peak.

One independent DMT current stage is available for phase fault protection.

Thermal Overload (49)

The protection of transformers and cables must take into account their particular thermal characteristics.

MiCOM P116 relays include a thermal replica element based on the true RMS value of the current, up to the 10th harmonic. Alarm and Trip overload thresholds and time constant are fully programmable to match each application requirement.

Negative Sequence Overcurrent (46)

The MiCOM P116 relays include a programmable function specially designed to detect unbalanced load or fault conditions.

The negative sequence overcurrent (I2>) stage has the same setting ranges as the phase overcurrent function.

Thus, a negative sequence overcurrent element can operate for both phase-to-phase and phase-to-earth faults.

The I2> stage can be independently selected as a definite time DMT) or inverse time-delay (IDMT) with different types of curves (IEC, IEEE/ANSI, RI, RECT).

Broken Conductor (46BC)

A typical unbalanced fault that can occur on the system is an open circuit fault. This fault can arise from a broken conductor, a discrepancy in the position of the poles of one switchgear or a blown fuse.

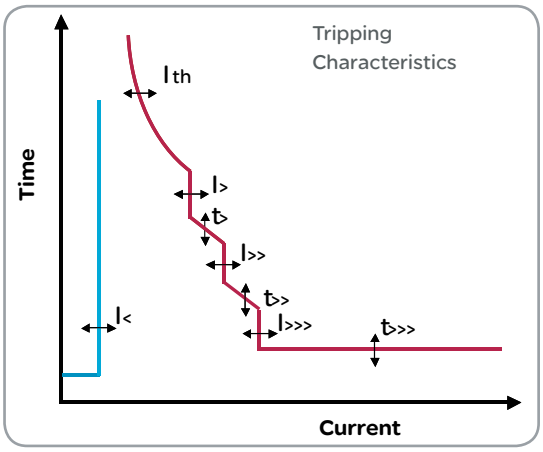
MiCOM P116 relays can measure the ratio of negative to positive sequence current (I2/I1).

This fully programmable function offers more sensitivity and stability than pure negative sequence measurement.

Undercurent Protection (37)

MiCOM P116 relays provide definite time undercurrent protection. This function allows typical applications such as loss of load or simple broken conductor detection.

The undercurrent stage can be blocked when the circuit breaker is opened.



Circuit Breaker Failure (50BF)

The circuit breaker failure protection function verifies the effective opening of the CB using a dedicated undercurrent threshold.

The circuit breaker failure function can be activated by the trip of an internal protection function and/or an external command through the relevant digital input. The circuit breaker failure protection function can also be used to trip upstream circuit breakers.

Autorecloser (79)

MiCOM P116 dual-powered relays incorporate a 4-shot autorecloser. All programmed protection functions may independently start any of the shots and the user can program which functions are allowed to trip after any of the shots.

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

Dead and reclaim times are freely adjustable.

Front panel LEDs can be configured to display the status of the autorecloser.

A counter stores the number of reclose commands. This information can be displayed either locally or remotely.

The autorecloser can be enabled when the auxiliary power supply is present.

Inrush Blocking

The 2nd Harmonic Blocking detects high inrush current inflows that occur upon connection of transformers or rotating machines. The function will block the phase overcurrent, earth fault and negative sequence overcurrent elements (freely selectable).

Timers AUX1, AUX2, AUX3, AUX4

Timers operate if the state of an input mapped to this function changes in such a way that the function will be triggered. Timers can be used for CB tripping or alarm signalling.

This function is available when inputs are energised via an auxiliary power supply.

Blocking Logic

When MiCOM P116 relays are used in critical networks, the management of protection relays must take surrounding devices into consideration. Any blocking digital inputs can be independently configured to lock any combination of selected elements (i.e. current stages, thermal replica, etc).

A typical application is to use a dedicated digital input to block the time-delayed 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 quickly and correctly when used in a cascading scheme.

Selective Relay Scheme Logic

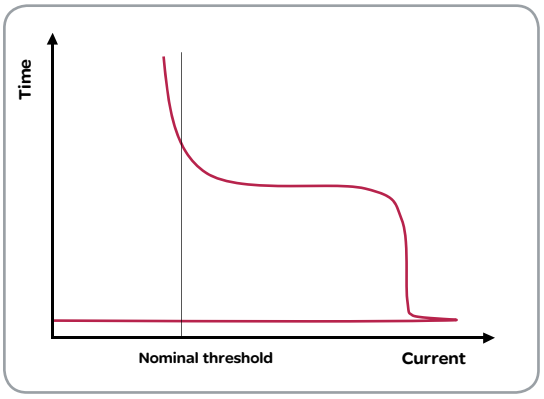
The P116 relays include selective relaying scheme logic.

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 quickly clear the fault when used in a cascading scheme.

Cold Load Pick-Up

Cold load pick-up temporarily raises the setting of selectable stages closer to the load profile in order to avoid unwanted trips.



The setting value can be increased by 800% for example for a settable duration. To trigger this function, the CB closed position or current criteria are used.

Output Relay Latching (86)

The RL2-RL6 output contacts may be latched freely.

Latching status information is stored so that even if the P116 does not have enough power to trigger the output contacts (CT powering threshold: I1+I2+I3+IN < 0.6In), after the return of sufficient power the latched statuses of the LEDs and outputs are recovered.

Latched outputs can be reset via the activation of a logic input through the front panel interface or by remote communication.

Instantaneous Information

Outputs and LEDs can be programmed with instantaneous information from freely selectable protection elements: with or without latching.

Additionally, every start of a protection element is recorded in the event recorder and the instantaneous recorder.

The instantaneous information is typically generated within 30 ms after the threshold has been exceeded with a load current and/or auxiliary voltage applied.

In a switch-on-to-fault case without auxiliary voltage powering, this instantaneous information is typically generated within 60 ms.

Trip Via Binary Input

Opto-isolated binary inputs are freely configured to timers AUX1 and/or AUX2.

This function works if inputs are triggered via the auxiliary voltage and when sufficient power is applied to the relay.

Communication & Synchronization

The MiCOM P116 offers a wide range of communication protocols allowing its utilization in most network control and data acquisition systems (via Modbus, IEC 60870-5-103). The protocol can be selected in the P116 menu.

It has been designed for permanent multi-drop connection through the rear RS485 communication port.

The MiCOM P116 incorporates an internal clock to allow 1 ms accuracy time tagging of alarms, events, fault and disturbance records. To avoid any drifting of the time-tagging clock, it's necessary to periodically synchronize the relays. To do this the P116 offers two solutions:

- Synchronization from the substation control system via the rear communication port.
- Synchronization from an external clock via a dedicated digital input.

The back-up capacitor of the internal clock is charged from an auxiliary voltage supply only and supports the internal clock typically up to three days.

MiCOM P116 : The advanced protection solution for use anywhere, when auxiliary voltage is not available / guaranteed

OPERATION & MAINTENANCE

Two Setting Groups

External conditions may require the need for different settings or I/O configuration. The MiCOM P116 Model A provides two independent setting groups. The active setting group can be switched from the local HMI or due to external conditions (digital input change of state or DCS control).

The two setting groups include protection settings, binary input, output and LED configuration.

Switching between setting groups is possible even while a protection function is active (no time delay is lost). This allows this function to be used in advanced applications where the specific parameters (including I/O) have to be changed during certain processes.

Local/Remote Mode of CB Commands (Model A)

The goal of this feature is to make it possible to block commands sent remotely through communication networks (such as setting parameters, control commands, etc.) in order to prevent any accidents or maloperation during maintenance work performed on site.

The local mode can be set via the HMI, a digital input assigned to this feature or an RS485.The Local/Remote mode state can be indicated via the HMI.

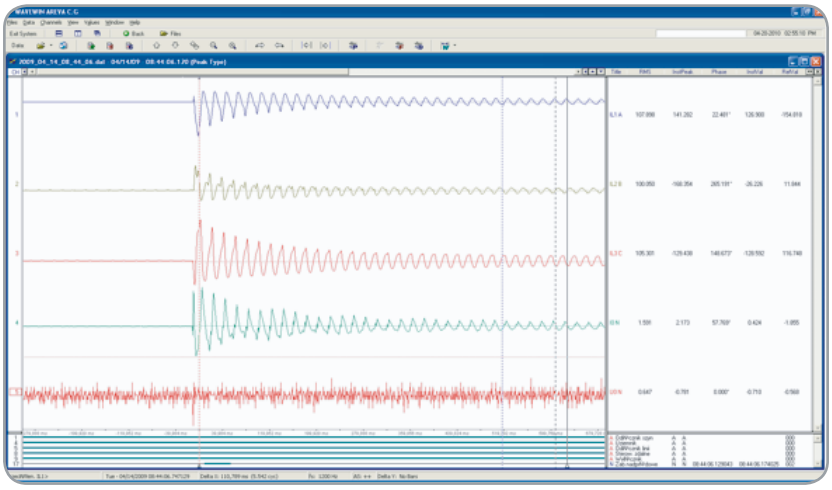
Circuit Breaker Command (Model A)

Circuit breaker control is available from the front panel user interface, optically-isolated inputs and remotely via substation communications. Circuit breaker control is also possible via the function keys (Close/Open).

It is possible to send a local open/close command through the HMI upon operator confirmation.

Trip Supervision

Trip circuit supervision in both circuit breaker open and closed states is possible using the optically isolated-inputs included in the P116 (Model A) scheme logic.



WaveWin – Data Analyzer Software

Circuit Breaker Condition Monitoring (Model A)

The circuit breaker condition monitoring features include:

- Monitoring the number of breaker trip operations
- Recording the sum of the broken current quantity ΣI^X, (where x: 1 or 2)
- Monitoring the breaker operating time

An alarm signal is emitted if the above parameters exceed the settable threshold.

Event Recording

200 events are stored in the MiCOM P116 (Model A) relays (even after a power supply loss). Events include input/output state changes, alarms and contact operations.

To upload them, it is possible to use the front USB port (MiCOM S1) or the rear serial port (DCS). Event records are stored in a non volatile FRAM memory. All events are time-stamped to 1 ms.

Fault, Alarm & Instantanenous Recording

The last 20 faults, 5 alarms (Model A) and 5 instantaneous records (Model A) are stored inside the MiCOM P116 relays.

Each fault includes: Record number/ Fault time (Model A) / Active setting group (Model A) / Faulted phase / Protection operation / Magnitude of input quantities.

Fault indication helps the user to clearly identify the fault and monitor the relay's settings and operations as all information is available on the relay HMI.

Fault records are stored in a non-volatile FRAM memory.

Disturbance Recording

Up to 5 disturbance files are stored in the relay. Even if the total duration is set to 7.5 s, it is fully adjustable for easy adaptation to customer requirements. They are stored in COMTRADE format.

The disturbance recording function is triggered either by any of the programmed thresholds, by an external input, or through the communications. All digital and analog information is stored in non-volatile FRAM memory and can be transferred using the front communication port or the rear port to be used by an external data analyser. Disturbance records are stored in a non-volatile FRAM memory.

I/O Configuration

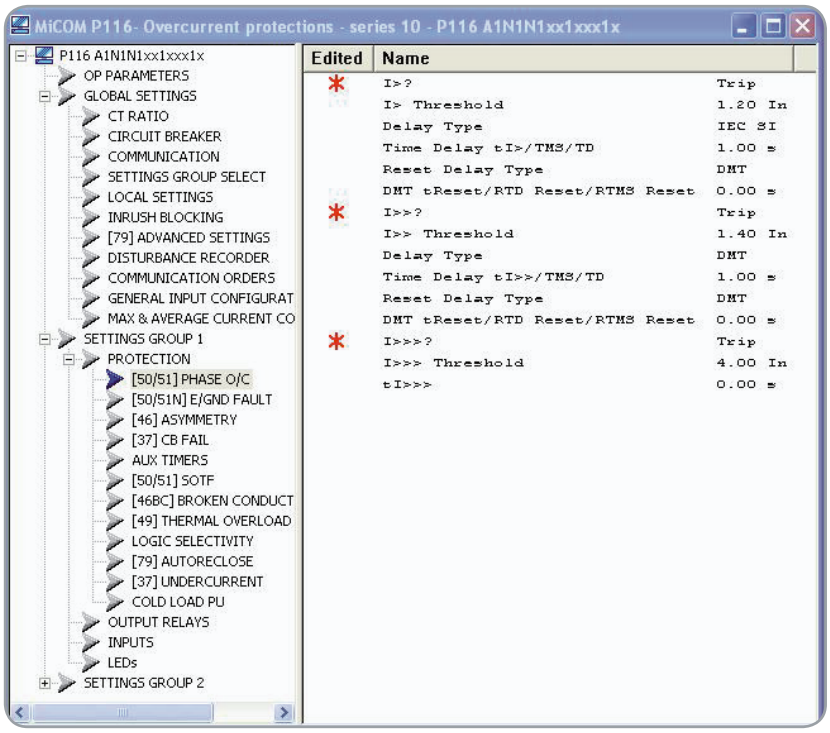
Every input and output can be freely configured to available functions (blocking of protection element, reset LED or outputs, start, trip of every protection element, etc). Any input and output can be assigned to any predefined function.

The P116 (Model A) can be fitted with (ordering option):

- Universal binary inputs which have selectable options: AC only, DC only or AC/DC energizing criteria with enhanced immunity to transients and disturbances, which can appear in secondary wiring.
- DC inputs with a selectable operation threshold (110V DC / 127V DC / 220V DC).

Relay Maintenance Mode (Model A)

The P116 incorporates direct control of the output relays (without the need to inject any current). This functionality allows the user to quickly check the external wiring of the relay's output contacts.



MiCOM S1 Studio- Communication software

Support Software

MiCOM S1 Studio and MiCOM S1 (Windows™ compatible) support software is available for the entire MiCOM family, including the P116 relays.

This Support Software is used to set all parameters in the P116 or download setting parameters, fault and event records. Communication with a PC is managed by the front USB port of the P116.

Self-Monitoring

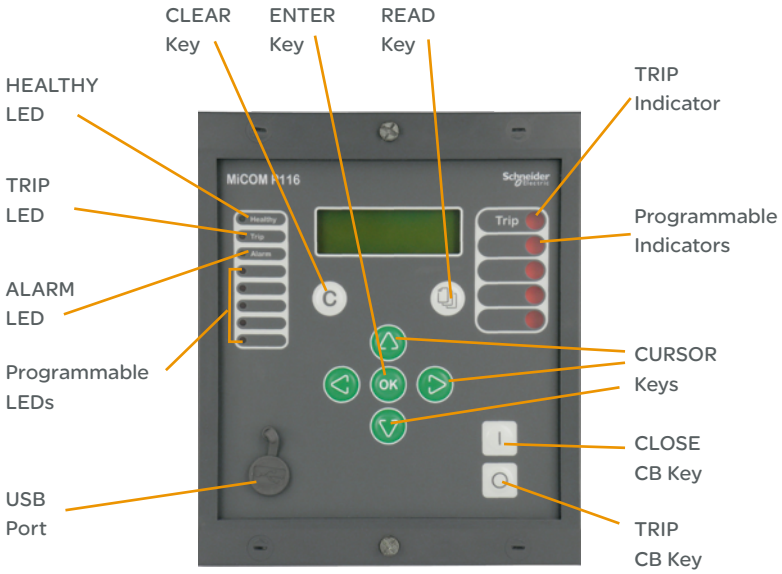
Comprehensive self-monitoring procedures within the P116 ensure that internal hardware or software errors are detected and do not cause malfunctions of the device. When the auxiliary voltage is turned on, a functional test is carried out. Cyclic self-monitoring tests are run during operation. Any deviations are stored in non-volatile memory and determines whether protection is blocked or an alarm is raised. The result of the fault diagnostics determines whether the protection unit will be blocked or only an alarm will emitted.

Multi-Language User Interface (HMI)

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

The backlit LCD informs the user about settings, measurements & faults with a pull-down menu structure allowing easy and quick access to any data. The relay display language can be changed in the menu system: English/ German / French / Spanish / Portuguese / Russian / Turkish / Regional.

P116 Front Panel



MiCOM P116 : An integral part of a DCS system

MiCOM SERIES RELAYS TRACK RECORD

- **P11x MiCOM series** introduced in 2001. Worldwide application with approx. 40 000 units delivered
- **P12x MiCOM series** introduced in 1999. Worldwide application with approx. 243 000 units delivered (including approx. 21 000 Self/Dual powered devices)
- **P13x MiCOM series** introduced in 2001. Worldwide application with approx.18 000 units delivered

THE WAY OF ORDERING
FOR ORDER PLACED IN SE IDC CHANNEL:
CATALOGUE NO. (for example: MICOM P116, REL10200)

Note: If your preferred variant is not available in the table below, for more information please contact Schneider Electric Sales Team in your country.

P116 Model A ordering variants available via SE International Distribution Centre (IDC)

Catalog No.	Cortec type	Description:
REL102xx	**P116A1NxNxx115111x**	**Model A - dual powered (Vx&CT: current transformers or/and auxiliary voltage); USB and RS485 (Modbus/IEC103); Energy trip output for: low energy coil/striker (12-24Vdc/0.1J) or MiTOP; Language: English/German/French/Spanish/ Portuguese/Russian/Turkish; Universal Binary Inputs 24-240Vac or 24-250Vdc; 5 electro-magnetic flags on the front panel**
REL10200	P116A1N1N15115111N	In=1A , o/c: 0.1-40In; Ien=1A, e/f: 0.002-1Ien; Vx=60-240Vac/250Vdc; Standard flush mounting case (**not** withdraw-able)
REL10201	P116A1N1N14115111N	In=1A , o/c: 0.1-40In; Ien=1A, e/f: 0.002-1Ien; Vx=24-60Vac/60Vdc; Standard flush mounting case (**not** withdraw-able)
REL10202	P116A1N2N15115111N	In=1A , o/c: 1.2-40In; Ien=1A, e/f: 0.01-8Ien; Vx=60-240Vac/250Vdc; Standard flush mounting case (**not** withdraw-able)
REL10203	P116A1N2N14115111N	In=1A , o/c: 0.1-40In; Ien=1A, e/f: 0.01-8Ien; Vx=24-60Vac/60Vdc; Standard flush mounting case (**not** withdraw-able)
REL10204	P116A1N5N25115111N	In=5A , o/c: 0.1-40In; Ien=5A, e/f: 0.01-8Ien; Vx=60-240Vac/250Vdc; Standard flush mounting case (**not** withdraw-able)
REL10205	P116A1N5N24115111N	In=5A , o/c: 0.1-40In; Ien=5A, e/f: 0.01-8Ien; Vx=24-60Vac/60Vdc; Standard flush mounting case (**not** withdraw-able)
REL10210	P116A1N1N15115111W	In=1A , o/c: 0.1-40In; Ien=1A, e/f: 0.002-1Ien; Vx=60-240Vac/250Vdc; Flush mounting **withdraw-able** case
REL10211	P116A1N1N14115111W	In=1A , o/c: 0.1-40In; Ien=1A, e/f: 0.002-1Ien; Vx=24-60Vac/60Vdc; Flush mounting **withdraw-able** case
REL10212	P116A1N2N15115111W	In=1A , o/c: 1.2-40In; Ien=1A, e/f: 0.01-8Ien; Vx=60-240Vac/250Vdc; Flush mounting **withdraw-able** case
REL10213	P116A1N2N14115111W	In=1A , o/c: 0.1-40In; Ien=1A, e/f: 0.01-8Ien; Vx=24-60Vac/60Vdc; Flush mounting **withdraw-able** case
REL10214	P116A1N5N25115111W	In=5A , o/c: 0.1-40In; Ien=5A, e/f: 0.01-8Ien; Vx=60-240Vac/250Vdc; Flush mounting **withdraw-able** case
REL10215	P116A1N5N24115111W	In=5A , o/c: 0.1-40In; Ien=5A, e/f: 0.01-8Ien; Vx=24-60Vac/60Vdc; Flush mounting **withdraw-able** case

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