MiCOM P241, P242 & P243

Rotating Machine Protection Relay

Software Version 51
Hardware Suffix J (P241)
Hardware Suffix K (P242/3)

Technical Data Sheet
P24x/EN TDS/I42

This Document Should be Read Alongside the Technical Manual
Improving competitiveness and performance while adapting to a rapidly changing business environment is key to any business.

New solutions must be developed to optimize return on investment from assets and benefit from the latest technologies.

MiCOM P24x relays offer a comprehensive package of protection for both synchronous and induction machines.

The advanced features of the MiCOM P24x provide complete protection and peace of mind, with the added value of a comprehensive range of measurements, control and monitoring to enhance power system diagnostics and fault analysis.

Thanks to this versatility, the MiCOM P24x represents the ideal choice for advanced protection and monitoring.

Customer Benefits
- Provide comprehensive protection for both induction and synchronous machines.
- Offer machines differential function (87).
- Optimize the machines’ thermal image monitoring.
- Facilitate and provide an aid to maintenance.
- Improve monitoring conditions.
- Save wiring cost.
- Reduce the addition of transducers and measurement devices.
- Programmable Scheme Logic allows easy customization of the protection and control functions.

MiCOM P241 in 40TE
MiCOM P243 in 80TE
APPLICATION

The MiCOM P24x are more than a conventional protection relay. They offer numerous additional functions suitable and crucial for a wide range of applications, which involve:

- Protection
- Monitoring
- Diagnosis
- Fault analysis tools
- Aid to maintenance

Compact, specially developed and designed for rotating machine, the MiCOM P24x relays perform an essential role in many industrial processes and generations where the following requirements must be achieved:

- Medium sized and large rotating machines
- High inertia machines
- Differential protection
- Wide range of starting and stalling currents and times
- Wide range of thermal withstand under balanced or unbalanced conditions

MAIN FUNCTIONS

By concept and design, the main functions are grouped in autonomous function groups which can be individually configured or disabled for particular applications.

This notion permits a wide scope of functions simplifying the setting procedure and providing adaptation to the protection, control and monitoring tasks under consideration.

FUNCTIONAL OVERVIEW

![Functional Overview Diagram]
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**CONTROL AND MONITORING**

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Emergency Restart | • | • | • |
Programmable Scheme Logic | • | • | • |
CB Control & Monitoring | IEC61850: XCBR | • | • | • |
Trip Circuit Supervision | • | • | • |
Relay commissioning mode | • | • | • |
4 Optional Current Loop Analog Outputs | • | • | • |
Setting Groups | 2 | 2 | 2 |
Programmable function keys | IEC61850: FnkGGIO | • | • | • |
Programmable LEDs, Red/Green/Yellow (R/G/Y) | IEC61850: StdLedGGIO/LedGGIO | 8R | 18 R/G/Y | 18 R/G/Y |

**MEASUREMENTS & RECORDS**

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Measurements (primary and secondary) | IEC61850: PriFouMMXU/PriStdMSQI and SecFouMMXU/SecStdMSQI | • | • | • |
Power and Energy Measurements | IEC61850: PriElIMTR/SecElIMTR | • | • | • |
Disturbance Records up to 20 x 10.5 s (backed-up) | IEC61850: RDRE | • | • | • |
Fault Records (backed-up) | 5 | 5 | 5 |
Event Logging (backed-up) | 250 | 250 | 250 |

**COMMUNICATION**

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Front port (RS232) | • | • | • |
Rear port (RS485) (COM1/1P1) | 1 | 1 | 1 |
Optional rear communications fibre optic port (COM1/1P1) | • | • | • |
Optional 2<sup>nd</sup> rear communication port (RS485/RS232) (COM2/2P2) | • | • | • |
Optional rear communications fibre optic/ethernet port (COM1/1P1) | • | • | • |

**REAR PORT PROTOCOL**

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Modbus RTU | • | • | • |
IEC 60870-5-103 | • | • | • |
Klbus-Courier | • | • | • |
IEC 61850 | • | • | • |

**HARDWARE**

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Logic inputs | IEC61850: OptGGIO | 8-12 | 16 | 16 |
Outputs relays | IEC61850: RlyGGIO | 7-11 | 16 | 16 |
1/5 dual rated AC Current inputs | 4 | 4 | 7 |
100 V AC Voltage inputs | 3 | 3 | 3 |
Optional IRIG-B Synchronization | • | • | • |
PROTECTION FUNCTIONS

> Short-circuit (50/51)
Four independent stages are available. All stages have definite time delay characteristics. Two of the stages may also be independently set to one of the nine inverse definite minimum time (IDMT) curves (IEC and IEEE). The IDMT stages have a programmable reset time for grading with electromechanical relays, to reduce autoreclose dead times and to reduce clearance times where intermittent faults occur.

> Stator protection (50N, 51N, 67N)
The earth fault current, which will appear following a stator earth fault, can be detected by two independent protection elements using either earth current measured from a sensitive current input, or earth current internally derived from the three phase currents. Both methods can be used simultaneously in the MiCOM P24x. Each function can be directional, in order to ensure the selectivity for isolated neutral systems.

> Wattmetric earth fault (32N/64N)
The sensitive earth fault protection is also suitable for Petersen Coil earthed systems by enabling a wattmetric element. This form of protection uses the same earth fault protection directional characteristic but with a current, a voltage and a residual power threshold providing additional qualifier on operation.

> Circuit breaker failure protection (50BF)
Two-stage circuit breaker failure protection may be used for tripping upstream circuit breakers and/or the local secondary trip coil. The circuit breaker failure logic may also be initiated externally from other protection devices if required.

> Voltage transformer supervision
Voltage transformer supervision (VTS) is provided to detect loss of one, two or three VT signals, providing indication and inhibition of voltage dependent protection elements. An optically isolated input may also be configured to initiate the voltage transformer supervision alarm and blocking when used with miniature circuit breakers (MCBs) or other external forms of voltage transformer supervision.

> Current transformer supervision
Current transformer supervision (CTS) is provided to detect loss of phase CT signals and inhibit the operation of current dependent protection elements. CTS is provided for both sets of 3 phase CTs in the P243 relay.

> Number of starts - Time between starts (66)
Hot/cold starts are supervised during a settable period. In addition, a minimum time between starts can be set to avoid too frequent starts and to protect against overheating of both the motor and starting system.

> Loss of Field (40)
To detect failure of the synchronous motor excitation, a two stage offset mho impedance element is provided. This allows a small instantaneous characteristic to be used to provide fast tripping for loss of excitation. The second stage can be set with a larger time delayed characteristic to provide stable, secure tripping under low power conditions. Integrating timers are provided to enable the impedance characteristic to provide time delayed pole slipping protection. A power factor alarm element is also available.

> Under power / Loss of load (37)
The active power, along with a pick-up time delay, is used to detect a loss of load due to a shaft failure or a pump running unprimed. The feature is disabled during starting.

> Negative sequence overcurrent (48)
Two elements are provided to detect a phase failure or unbalanced loads. Definite time or inverse definite time characteristics can be selected.

> Reverse power (32R)
Synchronous machines
One stage is available in the MiCOM P24x, based on the active power measurement to detect power flow from the machine to the system (motor) when the busbar supply is lost, or from the system to the machine (generator).

> Reverse phase sequence detection (47)
Both input voltage phase rotation and magnitude are monitored to ensure they are correct before allowing the machine to start.

> Phase reversal
A facility is provided to maintain correct operation of all the protection functions even when the motor is running in a reverse direction. This is achieved through user configurable settings available to two setting groups..

> Thermal overload (49)
The key characteristics are:
1. Alarm and trip stages can be selected.
2. RMS and negative sequence current elements are taken into account, so that any unbalance condition can be detected, and any abnormal heating of the rotor can be avoided.
3. Overload thermal curve with different time constants according to the machine cycles (heating, cooling or start-up), in order to provide the optimum protection.
4. Inhibition of the function in case of extreme starting conditions (very long start, very high start current).
5. Inhibition of a new start, until the machine has cooled down, immediately after a trip.
6. RTD to be optionally connected for ambient temperature compensation of the thermal element.
> Stator differential (87) (P243 only)
Three-phase machine differential protection is provided to detect stator phase faults. This can be set either as percentage bias scheme with a dual slope characteristic (Figure 1) or as a high impedance scheme. When high impedance is used, additional stabilising resistance and metrosil will be required.

> Reacceleration authorisation
Following a low voltage condition on the system for a definite time, the current can exceed the stalling current threshold upon recovery of the voltage. In order to allow motors to re-accelerate and provide improved continuity of the operating process, the stall protection is temporarily disabled when authorisation of re-acceleration is enabled.

> Under/Overvoltage (27/59)
Under/overvoltage protection will operate from the phase-phase voltage element. Two independent stages are available. The undervoltage thresholds can be disabled during the start of the machine.

> Residual overvoltage (59N)
Residual overvoltage protection is available for detecting earth faults in high impedance earthed or insulated systems. The neutral voltage can be derived from the three phase voltage inputs or measured from a residual voltage input. Two independent elements are available.

> Out-of-Step / Power Factor (55)
Synchronous machines
As current drawn during an out-of-step condition is at a very low power factor, power factor protection is provided for out-of-step protection on synchronous machines. Two stages are available. During starting, this feature is disabled.

> Anti backspin (27Abs)
If a motor with high inertia load, for example a fan, is stopped, the shaft continues to rotate for some time before the rotor stops completely. If the motor is switched back on while the rotor is still turning, something akin to a false coupling may occur, causing mechanical damage such as broken fan blades. The risk of such problems can be eliminated by setting a minimum time lapse between stopping the motor and re-starting it or by remanent voltage method.

> Underfrequency (81U)
Synchronous machines
To protect synchronous machines against loss of supply, an underfrequency feature provides two independent elements, each one being followed by a definite time delay. During starting, this feature is disabled.

> Start / stall protection (48/51LR)
To monitor the starting sequence of the motor, the MiCOM P24x relay provides excessive start time protection / locked rotor protection. Options for start detection include monitoring the circuit breaker state only, the starting current only, or the circuit breaker state along with the starting current. Where motor stall withstand time may be shorter than starting time, a digital input is provided to accommodate a speed switch to distinguish between start and stall.

> Emergency restart
By removing all start inhibits, this function permits a hot motor restart, via an opto-input, the user interface or the remote communication facility.

> Resistive Temperature Detectors (26)
Up to 10 RTDs can be optionally connected to the MiCOM P24x relay. For each selected RTD, both alarm and trip stages can be set. PT100, Ni100 or Ni120 RTDs are supported. Open and short circuit conditions monitoring are provided for each RTD channel.

> Analog Inputs
Up to 4 analog inputs can be optionally connected to the MiCOM P24x. For each selected analog input, both alarm and trip can be set and followed by a definite time delay. Analog inputs support: 4-20 mA, 0-20 mA, 0-10 mA and 0-1 mA.

For high inertia, large and medium machines, MiCOM P24x covers a wide range of starting and stalling currents and times.
CONTROL FUNCTIONS

> Independent protection setting groups
Two setting groups are provided for the protection settings to allow for different operating conditions and adaptive relaying, particularly for the protection of dual-speed motors.

> Programmable scheme logic
Programmable scheme logic allows the user to customise the protection and control functions. The opto-inputs, the relay outputs and the programmable LEDs are pre-configured as a default, but may be programmed by the user to be configured as latching or self reset for example. The programmable scheme logic comprises gate logic and general purpose timers. The gate logic includes OR, AND and most of gate functions, with the ability to invert inputs and outputs and provide feedback. The programmable scheme logic must be configured using the graphical MiCOM S1 PC based software, as illustrated in Figure 2.

> Circuit Breaker Control
Circuit breaker control is available from the front panel user interface, optically isolated inputs and remotely via the substation communications.

MEASUREMENT AND RECORDING FACILITIES

All events, fault and disturbance records are time tagged to a resolution of 1ms using an internal real time clock. An optional IRIG-B port is also provided for accurate time synchronisation. A lithium battery provides a back-up for the real time clock and all records in the event of supply failure. This battery is supervised and easily replaced from the front of the relay.

> Measurements
Phase currents and phase to neutral voltages are available in true RMS and fundamental quantities.
- Phase voltages Van, Vbn, Vcn
- Line voltages Vab, Vbc, Vca
- Neutral voltage Vn
- Phase current Ia, Ib, Ic
- Neutral current In, ISEF
- Sequence currents and voltages
- Frequency
- Three phase power factor
- Active, reactive and apparent powers (W, VAR, VA)
- Wh, VArh
- Current loop analog inputs

> Motor specific
- Thermal state, thermal load
- Temperature, RTD1...RTD10 in degrees C or F
- Start time, start current
- Time before thermal trip

> Specific P243:
- Phase current Ia2 Ib2 Ic2
- Bias current Ibias Ibbias Icbias
- Differential current Iadiff Ibdiff Icdiff

> Events records
Up to 250 time-tagged event records are stored in non-volatile memory and can be extracted using the front and rear communication ports or viewed on the front panel display.

Advanced features provide complete protection, with the added value of measurements, control and monitoring to enhance power system diagnostics and fault analysis.
Fault records
Records of the last 5 faults are stored in non-volatile memory. The information provided in the fault record includes:

- Indication of faulted phase
- Protection operation
- Active setting group

Disturbance records
The internal disturbance recorder has 8 analog channels, 32 digital and 1 time channel. Data are sampled 24 times a cycle and typically 20 disturbance records, each of up to 10.5 seconds duration are stored in non-volatile memory. All channels and the trigger source are user configurable. Disturbance records extracted using MiCOM S1 are automatically saved in the COMTRADE format and may be examined using disturbance viewer provided as illustrated in Figure 3.

Control Inputs
The ON/OFF status of 32 control inputs can be changed manually or remotely via the communications to provide user defined control functions.

Function Keys (P242 and P243 only)
Ten function keys are available for implementing scheme control functionality. The function keys operate in two modes, normal and toggled, and activate associated signals in PSL that can easily be used to customize the application. The following examples illustrate how scheme functionality can easily be implemented.

- Select Group 2 settings
- Reset thermal overload measurement
- Reset latched contacts and LED’s
- Trigger disturbance record

Each function key has an associated Tri-color LED (red, green, yellow) allowing for clear indication of the associated function’s state.

Indication
18 tri-color LED’s (P242/3) and 8 red LED’s are available for user programming. The P242/3 LED colors (red, green or yellow) are driven via digital signals in PSL and can be programmed to indicate up to four conditions/states. For example:

- Off - Not in service,
- Red - CB closed,
- Green - CB open,
- Yellow - CB not healthy.

INFORMATION INTERFACES
Information exchange is done via the local control panel, the front PC interface, the main rear communication interface (COMM1/RP1) or an optional second rear interface (COMM2/RP2).

Local communication
The front EIA(RS)232 Courier communication port has been designed for use with the MiCOM S1 software and is primarily for configuring the relay settings and programmable scheme logic. It is also used to locally extract event, fault and disturbance record information and can be used as a commissioning tool by viewing all relay measurements simultaneously.

Rear communication
The main rear communications interface supports the four protocols listed below (selected at the time of order) and is intended for integration with substation control systems.

- Courier/K-Bus
- Modbus
- IEC 60870-5-103
- IEC 61850

IEC 61850 is available when the optional Ethernet port is ordered. IEC 61850 offers high-speed data exchange, peer-to-peer communication, reporting, disturbance record extraction and time synchronization.

An optional fiber optic interface is available for any of the above protocols.

An optional 2nd rear communications port with the Courier protocol is available. This port is intended for central settings or remote access with MiCOM S1.

MiCOM P24x Management relays offer a comprehensive package of protection for both synchronous and induction motors.
Technical data

Mechanical specifications

Design
Modular MiCOM Px40 platform relay, P241 in 40TE case, P242 in 60TE case, P243 in 80TE case.
Mounting is front of panel flush mounting or 19" rack mounted (ordering options).

Enclosure protection
Per IEC 60529: 1992:
IP 52 Protection (front panel) against dust and dripping water,
IP 50 Protection for sides of the case,
IP 10 Protection for the rear.

Weight
P241 (40TE): 7.3kg
P242 (60TE): 9.2kg (with RTD, CLIO cards)
P243 (80TE): 11.5kg (with RTD, CLIO cards)

Terminals

AC current and voltage measuring inputs
Located on heavy duty (black) terminal block:
Threaded M4 terminals for ring lug connection
CT inputs have integral safety shorting, upon removal of the terminal block.

General input/output terminals
For power supply, opto inputs, output contacts and RP1 rear communications.
Located on general purpose (grey) blocks:
Threaded M4 terminals for ring lug connection

Case protective earth connection
Two rear stud connections, threaded M4.
Must be earthed (grounded) for safety, minimum earth wire size 2.5 mm².

Front port serial PC interface
EIA (RS) 232 DCE, 9 pin D-type female connector Socket SK1.
Courier protocol for interface to MiCOM S1 Studio software
Isolation to ELV (extra low voltage) level
Maximum cable length 15 m

Rear communications port (RP1)
EIA (RS) 485 signal levels, two wire connections located on general purpose block, M4 screw.
For screened twisted pair cable, multi-drop, 1000 m max.
For K-Bus, IEC-60870-5-103 or MODBUS
Isolation to SELV (safety extra low voltage) level

Optional rear fiber connection for SCADA/DCS
BFOC 2.5 -(ST®)-interface for glass fiber, as per IEC 874-10.
850 nm short-haul fibers, one Tx and one Rx.
For Courier, IEC-60870-5-103 or MODBUS

Optional second rear communications port (RP2)
EIA (RS)232, 9 pin D-type female connector, socket SK4.
Courier protocol: K-Bus, EIA(RS)232, or EIA(RS)485 connection.
Isolation to SELV level

Optional rear IRIG-B interface modulated or de-modulated
BNC plug
Isolation to SELV level
50 ohm coaxial cable

Optional rear Ethernet connection for IEC 61850 or DNP3.0

10BaseT/100BaseTX communications
Interface in accordance with IEEE802.3 and IEC 61850
Isolation: 1.5 kV
Connector type: RJ45
Cable type: Screened Twisted Pair (STP)

100 base FX interface
Interface in accordance with IEEE802.3 and IEC 61850
Wavelength: 1300 nm
Fiber: multi-mode 50/125 µm or 62.5/125 µm
Connector style: BFOC 2.5 -(ST®)
**Ratings**

**AC measuring inputs**
Nominal frequency: 50 and 60 Hz (settable)
Operating range: 45 to 65 Hz

**AC current**
Nominal current (In): 1 and 5 A dual rated.
(1 A and 5 A inputs use different transformer tap connections, check correct terminals are wired).

Nominal burden
< 0.04 VA at In, <40 mΩ (0-30, In) In = 1 A
< 0.01 VA at In, <8 mΩ (0-30, In) In = 5 A

Thermal withstand:
Continuous 4 In
for 10s: 30 In
for 1s: 100 In

Standard: linear to 64 In (non-offset AC current).
Sensitive: linear to 2 In (non-offset AC current).

**AC voltage**
Nominal voltage (Vn): 100 to 120 V phase-to-phase
Nominal burden per phase: < 0.02 VA rms at 110/√3 V

Thermal withstand:
Continuous 2 Vn
for 10 s: 2.6 Vn
Linear to 200 V.

**Power supply**

**Auxiliary voltage (Vx)**
Three ordering options:
(i) Vx: 24 to 48 Vdc
(ii) Vx: 48 to 110 Vdc, and 40 to 100 Vac (rms)
(iii) Vx: 110 to 250 Vdc, and 100 to 240 Vac (rms)

**Operating range**
(i) 19 to 65 V (dc only for this variant)
(ii) 37 to 150 V (dc), 32 to 110 V (ac)
(iii) 87 to 300 V (dc), 80 to 265 V (ac).
With a tolerable ac ripple of up to 12% for a dc supply, per IEC 60255-11: 1979.

**Nominal burden**
Quiescent burden: 11W or 24 VA. (Extra 1.25 W when fitted with second rear communications board).
Additions for energized binary inputs/outputs:
Per opto input:
0.09 W (24 to 54 V),
0.12 W (110/125 V),
0.19 W (220/250 V),
Per energized output relay: 0.13 W

**Power-up time**
Time to power up < 11 s

**Power supply interruption**
Per IEC 60255-11: 1979:
The relay will withstand a 20 ms interruption in the DC auxiliary supply, without de-energizing.
Per IEC 61000-4-11: 1994:
The relay will withstand a 20 ms interruption in an AC auxiliary supply, without de-energizing.

**Battery backup**
Front panel mounted
Type ½ AA, 3.6 V Lithium Thionyl Chloride Battery (SAFT advanced battery reference LS14250)
Battery life (assuming relay energized for 90% time) >10 years

**Field voltage output**
Regulated 48 Vdc
Current limited at 112 mA maximum output
Operating range 40 to 60 V with alarm at <35 V.

**Digital (“Opto”) inputs**
Universal opto input with programmable voltage thresholds (24/27, 30/34, 48/54, 110/125, 220/250 V). May be energized from the 48 V field voltage, or the external battery supply.
Rated nominal voltage: 24 to 250 Vdc
Operating range: 19 to 265 Vdc
Withstand: 300 Vdc, 300 Vrms.
Peak current of opto input when energized is 3.5 mA (0-300 V)
Nominal pick-up and reset thresholds:
Nominal battery 24/27: 60 - 80% DO/PU
(logic 0) <16.2 (logic 1) >19.2
Nominal battery 24/27: 50 - 70% DO/PU
(logic 0) <12.0 (logic 1) >16.8
Nominal battery 30/34: 60 - 80% DO/PU
(logic 0) <20.4 (logic 1) >24.0
Nominal battery 30/34: 50 - 70% DO/PU
(logic 0) <15.0 (logic 1) >21.0
Nominal battery 48/54: 60 - 80% DO/PU
(logic 0) <32.4 (logic 1) >38.4
Nominal battery 48/54: 50 - 70% DO/PU
(logic 0) <24.0 (logic 1) >33.6
Nominal battery 110/125: 60 - 80% DO/PU
(logic 0) <75.0 (logic 1) >88.0
Nominal battery 110/125: 50 - 70% DO/PU
(logic 0) <55.0 (logic 1) >77.0
Nominal battery 220/250: 60 - 80% DO/PU
(logic 0) <150.0 (logic 1) >176.0
Nominal battery 220/250: 50 - 70% DO/PU
(logic 0) <110 (logic 1) >154
Recognition time:
<2 ms with long filter removed,
<12 ms with half cycle ac immunity filter on
Output contacts

Standard contacts
General purpose relay outputs for signaling, tripping and alarming:
Continuous Carry Ratings (Not Switched):
Maximum continuous current: 10 A (UL: 8 A)
Short duration withstand carry: 30 A for 3 s
Continuous current: 50 A for 30 ms
Rated voltage: 300 V

Make & Break Capacity:
DC: 50 W resistive
DC: 62.5 W inductive (L/R = 50 ms)
AC: 2500 VA resistive (cos ϕ = unity)
AC: 2500 VA inductive (cos ϕ = 0.7)
Make, Carry:
30 A for 3 sec dc resistive, 10,000 operations (subject to the above limits of make / break capacity and rated voltage)
Make, Carry & Break:
30 A for 200 ms, ac resistive, 2,000 operations (subject to the above limits of make / break capacity & rated voltage)
4 A for 1.5 sec dc resistive, 10,000 operations (subject to the above limits of make / break capacity & rated voltage)
0.5 A for 1 sec, dc inductive, 10,000 operations (subject to the above limits of make / break capacity & rated voltage)
10 A for 1.5 sec ac resistive / inductive, 10,000 operations (subject to the above limits of make / break capacity & rated voltage)

Durability:
Loaded contact: 10,000 operations minimum,
Unloaded contact: 100,000 operations minimum.

Operate Time
Less than 5 ms
Reset Time
Less than 5 ms

Watchdog contacts
Non-programmable contacts for relay healthy/relay fail indication:
Breaking capacity:
DC: 30 W resistive
DC: 15 W inductive (L/R = 40 ms)
AC: 375 VA inductive (cos ϕ = 0.7)

IRIG-B 12X Interface (modulated)
External clock synchronization per IRIG standard 200-98, format B12x
Input impedance 6 kΩ at 1000 Hz
Modulation ratio: 3:1 to 6:1
Input signal, peak-peak: 200 mV to 20 V

Environmental conditions

Ambient temperature range
Per IEC 60255-6: 1988:
Operating temperature range:
-25°C to +55°C (or -13°F to +131°F)
Storage and transit:
-25°C to +70°C (or -13°F to +158°F)

Ambient humidity range
Per IEC 60068-2-3: 1969:
56 days at 93% relative humidity and +40 °C
Per IEC 60068-2-30: 1980
Damp heat cyclic, six (12 + 12) hour cycles, 93% RH, +25 to +55 °C

Corrosive environments
Per IEC 60068-2-60: 1995, Part 2, test, Ke Method (class) 3
Industrial corrosive environment, poor environmental control, mixed gas flow test.
21 days at 75% relative humidity and +30°C exposure to elevated concentrations of H₂S, NO₂, Cl₂ and SO₂.

Type tests

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

Creepage distances and clearances
IEC 60255-27: 2005
Pollution degree 3,
Overvoltage category III,
Impulse test voltage 5 kV

High voltage (dielectric) withstand
(i) Per IEC 60255-27: 2005, 2 kV rms AC, 1 minute:
Between all independent circuits and protective (earth) conductors terminal.
1 kV rms, AC for 1 minute, across open watchdog contacts
1 kV rms AC for 1 minute, across open contacts of changeover output relays.
1 kV rms AC for 1 minute for all D-type EIA (RS)232/EIA(RS) 485 ports between the communications port terminals and protective (earth) conductor terminal.
1.5 kV rms AC for 1 minute, across open contacts of normally open output relays
1 kV rms AC for 1 minute, across open watchdog contacts,
1 kV rms AC for 1 minute, across open contacts of changeover output relays.
Impulse voltage withstand test
Per IEC 60255-27: 2005:
Front time: 1.2 µs, Time to half-value: 50 µs,
Peak value: 5 kV, 0.5J
Between all independent circuits and protective (earth) conductor terminal
Between the terminals of all independent circuits
EIA (RS) 232 & EIA (RS) 485 ports and normally open contacts of output relays excepted.

Surge immunity test
(EIA (RS)232 ports excepted).
Per IEC 61000-4-5: 2005 Level 4,
Time to half-value: 1.2 / 50 µs,
Amplitude: 4 kV between all groups and protective (earth) conductor terminal,
Amplitude: 2 kV between terminals of each group.

Conducted/radiated immunity
For RTDs used for tripping applications the conducted and radiated immunity performance is guaranteed only when using totally shielded RTD cables (twisted leads).

Electromagnetic compatibility (EMC)

1MHz burst high frequency disturbance test
Per IEC 60255-22-1: 1988, Class III,
Common-mode test voltage: 2.5 kV,
Differential test voltage: 1.0 kV,
Test duration: 2 s, Source impedance: 200 Ω (EIA(RS)232 ports excepted).

Immunity to electrostatic discharge
Per IEC 60255-22-2: 1996, Class 4,
15 kV discharge in air to user interface, display, communication port and exposed metalwork.
8 kV point contact discharge to any part of the front of the product.

100kHz damped oscillatory test
Per EN61000-4-18: 2007: Level 3
Common mode test voltage: 2.5 kV
Differential mode test voltage: 1 kV

Immunity to electrostatic discharge
Per IEC 60255-22-2: 1996, Class 4
15 kV discharge in air to user interface, display, communication port and exposed metalwork.
8 kV point contact discharge to any part of the front of the product.

Electrical fast transient or burst requirements
Per IEC 60255-22-4: 2002 and EN61000-4-4:2004.Test severity Class III & IV:
Amplitude: 2 kV burst frequency 5 kHz (Class III),
Amplitude: 4 kV, burst frequency 2.5 kHz (Class IV).
Applied directly to auxiliary supply, and applied to all other inputs. (EIA (RS)232 ports excepted).
Amplitude: 4 kV, burst frequency 5 kHz (Class IV) applied directly to auxiliary.

Surge withstand capability
Per IEEE/ANSI C37.90.1: 2002:
4 kV fast transient and 2.5 kV oscillatory applied directly across each output contact, optically isolated input, and power supply circuit.
4 kV fast transient and 2.5 kV oscillatory applied common mode to communications, IRIG-B.

Conducted emissions
Per EN 55022: 1998 Class A:
0.15 - 0.5 MHz, 79dBµV (quasi peak)
66dBµV (average)
0.5 – 30MHz, 73dBµV (quasi peak) 60dBµV (average).
Radiated emissions
Per EN 55022: 1998 Class A:
30 – 230 MHz, 40dBμV/m at 10 m measurement distance
230 – GHz, 47dBμV/m at 10m measurement distance.

EU directives

EMC compliance
Per 2006/95/EC: Compliance to the European Commission Directive on EMC is claimed via the Technical Construction File route. Product Specific Standards were used to establish conformity: EN50263: 2000

Product safety
Compliance to the European Commission Low Voltage Directive (LVD) is demonstrated using a Technical File. A product specific standard was used to establish conformity. EN 60255-27: 2005

R&TTE compliance
Radio and Telecommunications Terminal Equipment (R&TTE) directive 99/5/EC Compliance demonstrated by compliance to both the EMC directive and Low voltage directive, down to zero volts. Applicable to rear communication ports

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

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

Compliance demonstrated by Notified Body certificates of compliance.

Mechanical robustness

Vibration test
Per IEC 60255-21-1: 1996: Response Class 2 Endurance Class 2

Shock and bump
Per IEC 60255-21-2: 1996:
Shock response Class 2
Shock withstand Class 1
Bump Class 1

Seismic test
Per IEC 60255-21-3: 1995:
Class 2

P24x third party compliances

Underwriters laboratory (UL)

File Number: E202519
Original Issue Date: 21-04-2005
(Complies with Canadian and US requirements).

Energy Networks Association (ENA)

Certificate Number: 104 Issue 2
Assessment Date: 16-04-2004

II (2) G
Protection functions

Thermal overload

Accuracy
Setting accuracy: ±5%
Reset: 97% of thermal setting ±5%
Thermal alarm Pick-up:
Calculated trip time ±5% or 40 ms whichever is the greater
Thermal overload Pick-up:
Calculated trip time ±5% or 40 ms whichever is the greater
Cooling time accuracy: ±5% of theoretical repeatability <2.5%

4-Stage non-directional short-circuit protection

Accuracy
Pick-up: Setting ±5%
Drop-off: 0.95 x Setting ±5%
Minimum trip level (IDMT): 1.05 x Setting ±5%
IDMT characteristic shape: ±5% or 40 ms whichever is greater
IEEE reset: ±5% or 50 ms whichever is greater
DT operation: ±2% or 50 ms whichever is greater
DT Reset: ±5%
Characteristic UK: IEC 6025-3…1998
Characteristic US: IEEE C37.112…1996
* Under reference conditions

Sensitive directional earth fault

SEF Accuracy
Pick-up: Setting ±5%
Drop-off: 0.95 x Setting ±5%
IDMT trip level elements: 1.05 x Setting ±5%
IDMT characteristic shape: ±5% or 40 ms whichever is greater
IEEE reset: ±5% or 40 ms whichever is greater
DT operation: ±2% or 40 ms whichever is greater
DT reset: ±5%
Repeatability: <2.5%

Polarizing quantities accuracy
Operating boundary Pick-up: ±2° of RCA ±90°
Hysteresis: <3°
ISEF>Vnpol Pick-up: Setting ±10%
ISEF>Vnpol Drop-off: 0.9 x Setting or 0.7V (whichever is greater) ±10%

2-Stage negative phase sequence over current

Accuracy
I2> Pick-up: Setting ±5%
I2> Drop-off: 0.95 x Setting ±5%
Vpol Pick-up: Setting ±5%
Vpol Drop-off: 0.95 x Setting ±5%
DT operation: ±2% or 40 ms whichever is greater
IDMT operation: ±5% or 40 ms whichever is the greater

3 phase voltage check

Accuracy
Pick-up: Setting ±5%
Drop-off: 0.95 x Setting ±5%
Repeatability (operating threshold): <1%
Repeatability (operating times): <10 ms

2 stage directional/non-directional derived earth fault

Accuracy
Pick-up: Setting ±5%
Drop-off: 0.95 x Setting ±5%
IDMT trip level elements: 1.05 x Setting ±5%
IDMT characteristic shape: ±5% or 40 ms whichever is greater
IEEE reset: ±5% or 40 ms whichever is greater
DT operation: ±2% or 40 ms whichever is greater
DT reset: ±5%
Repeatability: 2.5%

Zero polarizing
Operating Pick-Up: ±2%o Of Rca ±90°
Hysteresis: <3°
VN > pick-up: setting ±10%
VN > drop-off: 0.9 x setting ±10%

Negative polarizing
Operating pick-up: ±2%o of rca ±90°
Hysteresis: <3°
VN 2 > pick-up: setting ±10%
VN 2 > drop-off: 0.9 x setting ±10%
I2 > pick up: setting ±10%
I2 > drop-off: 0.9 x setting ±10%
**Stall protection**
Pick-up: Setting ±5%

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

**Motor differential protection**
**Accuracy**
Pick-up: Formula ±5%
Drop-off: 95% of setting ±5%
Operating time: <30 ms for current applied at 4x pickup level or greater
Repeatability: <7.5%
Disengagement time: <40 ms

**Neutral displacement/residual over voltage**
**Accuracy**
DT/IDMT Pick-up: Setting ±5%
Drop-off: 0.95 x Setting ±5%
IDMT characteristic shape: ±5% or 40 ms whichever is greater
DT operation: ±2% 40 ms whichever is greater
Instantaneous operation <55 ms
Reset: <35 ms
Repeatability: <1%

**Loss of load**
**Accuracy**
Pick-up: Setting ±5% or 2 W
Drop-off:
  0.95 of setting ±5%
Angle variation Pick-up:
  Expected pick-up angle ±2 degree
Angle variation Drop-off:
  Expected drop-off angle ±2.5 degree
Operating time: ±2% or 40 ms whichever is greater
Repeatability: <5%
Disengagement time: <50 ms
Reset: <75 ms
Instantaneous operating time: <50 ms

**Reverse power**
**Accuracy**
Pick-up: Setting ±5% or 2 W Drop-off:
  0.95 of setting ±5%
Angle variation Pick-up:
  Expected pick-up angle ±2 degree
Angle variation Drop-off:
  Expected drop-off angle ±2.5 degree
Operating time: ±2% or 40 ms whichever is greater
Repeatability: <5%
Disengagement time: <50 ms
Instantaneous operating time: <50 ms

**Field failure**
**Accuracy**
Mho characteristic Pick-up:
  Characteristic shape ±5%
Linear characteristic Pick-up:
  Characteristic shape ±10%
Mho characteristic Drop-off:
  105% of setting ±5%
Linear characteristic Drop-off:
  105% of setting ±10%
Operating time: ±2% or 60 ms whichever is greater
Repeatability: <1%
Disengagement time: <50 ms

**Voltage protection**

**Undervoltage**
**Accuracy**
DT Pick-up: Setting ±5%
IDMT Pick-up: (0.95 x Setting) ±5%
Drop-off: 1.05 x Setting ±5%
IDMT characteristic shape: ±5% or 40 ms whichever is greater
DT operation: ±2% or 20 ms whichever is greater
Reset: <75 ms
Repeatability: <1%

**Overvoltage**
**Accuracy**
DT Pick-up: Setting ±5%
IDMT Pick-up: Setting ±5% Drop-off: 0.95 x Setting ±5%
IDMT characteristic shape: ±5% or 40 ms whichever is greater
DT operation: ±2% or 20 ms whichever is greater
Reset: <75 ms
Repeatability: <1%
Underfrequency

**Accuracy**
Pick-up: Setting ±0.01 Hz
Drop-off: (Setting +0.025 Hz) ±0.01 Hz
DT operation: ±2% or 40 ms whichever is greater*

* The operating will also include a time for the relay to frequency track 20 Hz/ second.

Resistive temperature detectors

**Accuracy**
Pick-up: Setting ±1°C
Drop-off: (Setting -1°C)
Operating time: ±2% or <1.1 s

CB fail

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

Undercurrent accuracy
Pick-up: ±10% or 25 mA whichever is greater
Operating time: < 12 ms (Typical <10 ms)
Reset: < 15 ms (Typical < 10 ms)

CB state monitoring control and condition monitoring

**Accuracy**
Timers: ±2% or 20 ms whichever is greater
Broken current accuracy: ±5%

Programmable scheme logic

**Accuracy**
Output conditioner timer: Setting ±2% or 50 ms whichever is greater
Dwell conditioner timer: Setting ±2% or 50 ms whichever is greater
Pulse conditioner timer: Setting ±2% or 50 ms whichever is greater

Measurements and recording facilities

**Measurements**

**Accuracy**
Current: 0.05...3 In: ±1% of reading
Voltage: 0.05...2 Vn: ±5% of reading
Power (W): 0.2...2 Vn, 0.05...3 In: ±5% of reading at unity power factor
Reactive Power (VARs): 0.2...2 Vn, 0.05...3 In: ±5% of reading at zero power factor
Apparent Power (VA): 0.2...2 Vn, 0.05...3 In: ±5% of reading
Energy (Wh): 0.2...2 Vn, 0.2...3 In: ±5% of reading at zero power factor
Energy (Varh): 0.2...2 Vn, 0.2...3 In: ±5% of reading at zero power factor
Phase accuracy: 0°...360: ±5%
Frequency: 45...65 Hz: ±0.025 Hz

IRIG-B and real time clock

**Performance**
Year 2000: Compliant
Real time accuracy: < ±1 second / day

Features
Real time 24 hour clock settable in hours, minutes and seconds
Calendar settable from January 1994 to December 2092
Clock and calendar maintained via battery after loss of auxiliary supply
Internal clock synchronization using IRIG-B
Interface for IRIG-B signal is BNC

Current loop input and outputs

**Accuracy**
Current loop input accuracy: ±1% of full scale
CLI drop-off threshold: 0.95 x setting ±5% of full scale
CLI sampling interval: 50 ms
CLI instantaneous operating time: < 250 ms
CLI DT operating time: ±2% setting or 200 ms whichever is the greater
CLO conversion interval: 50 ms
CLO latency: < 0.27 s depending on CLO output parameter's internal refresh rate (0.2 s)
Current loop output accuracy: ±0.5% of full scale
Repeatability: <5%
CLI - Current Loop Input (Analog Input)
CLO - Current Loop Output (Analog Output)
Other specifications
CLI load resistance 0-1 mA: < 4kΩ
CLI load resistance 0-1 mA/0-20mA/4 20 mA: < 300 Ω
Isolation between common input channels: zero
Isolation between input channels and case-earth/other circuits: 2 kV rms for 1 minute
CLO compliance voltage 0-1 mA/0 10 mA: 10 V
CLO compliance voltage 0-20 mA/4 20 mA: 8.8 V
Isolation between common output channels: zero
Isolation between output channels and case-earth/other circuits: 2 kV rms for 1 minute

Disturbance records

Accuracy
Magnitude and relative phases: ±5% of applied quantities
Duration: ± 2%
Trigger Position: ± 2% (minimum 100ms)
Record length: 50 records each 1.5 s duration (75 s total memory) with 8 analog channels and 32 digital channels (Courier, MODBUS), 8 records each 3 s (50 Hz) or 2.5 s (60 Hz) duration (IEC 60870-5-103).

Event, fault & maintenance records
Maximum 250 events in a cyclic memory
Maximum 5 fault records
Maximum 5 maintenance records

Accuracy
Event time stamp resolution: 1 ms
## Settings, measurements and records list

### Settings list

#### Global settings (system data)
Language: English/French/German/Spanish
Frequency: 50/60 Hz

#### Circuit breaker control
**CB control**
- CB Control by:
  - Disabled
  - Local
  - Remote
  - Local + Remote
  - Opto
  - Opto + Local
  - Opto + Remote
  - Opto + Rem + Local
- Close Pulse Time: 0.1…5 sec
- Trip Pulse Time: 0.1…5 sec
- Man Close Delay: 0.0…60 sec

#### Date and time
- IRIG-B Sync: Disabled/Enabled
- Battery Alarm: Disabled/Enabled

### Configuration
- Setting Group:
  - Select via Menu
  - Select via Opto
- Active Settings: Group 1/2
- Setting Group 1: Disabled/Enabled
- Setting Group 2: Disabled/Enabled
- Thermal Overload: Disabled/Enabled
- Short Circuit: Disabled/Enabled
- Sensitive E/F: Disabled/Enabled
- Neg. Seq. O/C: Disabled/Enabled
- 3PH Volt Check: Disabled/Enabled
- Derived E/F: Disabled/Enabled
- Stall Detection: Disabled/Enabled
- Differential: Disabled/Enabled
- Residual O/V NVD: Disabled/Enabled
- Limit Nb Starts: Disabled/Enabled
- Loss of Load: Disabled/Enabled
- Out of Step: Disabled/Enabled
- Reverse Power: Disabled/Enabled
- Anti-Backspin: Disabled/Enabled
- Field Failure: Disabled/Enabled
- Volt Protection: Disabled/Enabled
- Under Frequency: Disabled/Enabled
- RTD Inputs: Disabled/Enabled
- CB Fail: Disabled/Enabled
- Supervision: Disabled/Enabled

### System Config
- Invisible/Visible

### Input Labels
- Invisible/Visible

### Output Labels
- Invisible/Visible

### RTD Labels
- Invisible/Visible

### CT & VT Ratios
- Invisible/Visible

### Record Control
- Invisible/Visible

### Disturb Recorder
- Invisible/Visible

### Measure’ t Setup
- Invisible/Visible

### Comms Settings
- Invisible/Visible

### Commission Tests
- Invisible/Visible

#### Setting Values
- Primary/Secondary

#### Control Inputs
- Invisible/Visible

#### CLIO Inputs
- Disabled/Enabled

#### CLIO Outputs
- Disabled/Enabled

#### CLIO Labels
- Disabled/Enabled

#### Function Keys
- Invisible/Visible

#### LCD Contrast
- 0…31

### CT and VT ratios
- **Main VT Primary:** 100…1000000 V
- **Main VT Sec’y:** 80…140 V
- **Phase CT Primary:** 1A…30 kA
- **Phase CT Sec’y:** 1A/5 A
- **SEF CT Primary:** 1A…30 kA
- **SEF CT Sec’y:** 1A/5 A

#### VT Connecting Mode
- 3 VT
- 2 VT + Residual
- 2 VT + Vremanent
  (Vremanent phase-phase)

#### NVD VT Primary
- 100…1000000V

#### NVD VT Secondary
- 80…140 V

### Sequence of event recorder
**record control**
- Alarm Event: No/Yes
- Relay O/P Event: No/Yes
- Opto Input Event: No/Yes
- General Event: No/Yes
- Fault Rec Event: No/Yes
- Maint Rec Event: No/Yes
- Protection Event: No/Yes
- DDB 31 - 0: (up to):
- DDB 1022 - 992:

*Binary function link strings, selecting which DDB signals will be stored as events, and which will be filtered out.*
Oscillography (Disturbance recorder)
Duration: 0.10…10.50 s
Trigger Position: 0.0…100.0%
Trigger Mode: Single/Extended
Analog Channel 1: (up to):
Analog Channel 8 (depending on model):
Disturbance channels selected from:
VA/VB/VC/IA/IB/IC/IA-2/IB-2/IC-2/IN/
VAB/VCB/VN/VRM (dependant on model)
Digital Input 1: (up to):
Digital Input 32:
Selected binary channel assignment from any
DDB status point within the relay (opto input,
output contact, alarms, starts, trips, controls,
logic…). Input 1 Trigger: No Trigger/Trigger Edge -/+ (Low to High)/Trigger Edge +/- (High to Low)
(up to): Input 32 Trigger: No Trigger/Trigger Edge -/+ / Trigger Edge +/-

Measured operating data
(measurement setup)
Default Display:
3Ph + N Current
3Ph Voltage
Power
Date and Time
Description
Plant Reference
Frequency
Thermal State
Local Values: Primary/Secondary
Remote Values: Primary/Secondary
Measurement Ref: VA/VB/VC/IA/IB/IC
Demand Interval: 1…99 mins
Alarm Fix Demand: Invisible/Visible
3 Phase Watt Thresh: 1In……120 In W
3 Phase Var Thresh: 1In……120 In VAr
Alarm Energies: Invisible/Visible
W Fwd Thresh: 1In……1000 In Wh
W Rev Thresh: 1In……1000 In Wh
Var Fwd Thresh: 1In……1000 In VArh
Var Rev Thresh: 1In……1000 In VArh
Motor Hour Run >1: Disable/Enable
Motor Hour Run >1: 1…9999 Hours
Motor Hour Run >2: Disable/Enable
Motor Hour Run >2: 1…9999 Hours
Remote 2 Values: Primary/Secondary

Communications
RP1 Protocol:
Courier
IEC60870-5-103
Modbus
RP1 Address: (Courier or IEC870-5-103):
0…255
RP1 Address: (MODBUS):
1…247
RP1 Inactive Timer: 1…30mins
RP1 Baud Rate: (IEC870-5-103):
9600/19200 bits/s
RP1 Baud Rate: (MODBUS, Courier):
9600/19200/38400 bits/s
RP1 Parity: Odd/Even/None
 Modbus
RP1 Meas Period: 1…60s
(IEC870-5-103)
RP1 Physical link: Copper (EIA (RS)485/K bus) or Fiber Optic
RP1 Time Sync: Disabled/Enabled
MODBUS IEC Timer: Standard/Reverse
RP1 CS103Blocking:
Disabled
Monitor Blocking
Command Blocking
RP1 Port Config: (Courier):
K Bus
EIA485 (RS485)
RP1 Comms Mode: (Courier):
IEC60870 FT1.2
IEC60870 10-Bit No parity
Note: If RP1 Port Config is K Bus the baud rate is fixed at 64 kbits

Optional Ethernet port
NIC Tnln Timeout: 1…30 mins
NIC Link Report Alarm, Event, None
NIC Link Timeout:0.1…60 s

Optional additional second rear communication (rear port2 (RP2))
RP2 Protocol:
Courier
RP2 Port Config:
EIA(RS)232
EIA(RS)485
K-Bus
RP2 Comms Mode:
IEC60870 FT1.2
IEC60870 10-Bit No parity
RP2 Address: 0…255
RP2 Inactive timer: 1…30 mins
RP2 Baud Rate:
9600/19200/38400 bits/s
Note: If RP2 Port Config is K Bus the baud rate is fixed at 64 kbits/s
Commission tests
Monitor Bit 1:
  (up to):
Monitor Bit 8:
  Binary function link strings, selecting which
  DDB signals have their status visible in the
  Commissioning menu, for test purposes
Test Mode:
  Disabled
  Test Mode
  Blocked Contacts
Test Pattern:
  Configuration of which output contacts are to
  be energized when the contact test is
  applied

Circuit breaker condition monitoring
(CB monitor setup)
Broken I^: 1.0…2.0
I^ Maintenance: Alarm Disabled/Enabled
I^ Maintenance: 1…25000
No. CB Ops Maint: Alarm Disabled/Enabled
No. CB Ops Maint: 1…10000
CB Time Maint: Alarm Disabled/Enabled
CB Time Maint: 0.005…0.500 s

Opto coupled binary inputs
(Opto config)
Global Nominal V:
  24 - 27 V
  30 - 34 V
  48 - 54 V
  110 - 125 V
  220 - 250 V
Custom
Opto Input 1:
  (up to):
Opto Input # (# = max. opto no. fitted):
  Custom options allow independent
  thresholds to be set per opto, from the same
  range as above.
Opto Filter Control:
  Binary function link string, selecting which
  opto will have an extra 1/2 cycle noise filter,
  and which will not.
Characteristics:
  Standard 60% - 80%
  50% - 70%

Control inputs into PSL
(ctrl I/P config)
Hotkey Enabled:
  Binary function link string, selecting which of
  the control inputs will be driven from
  Hotkeys.
Control Input 1:  Latched/Pulsed
  (up to):
Control Input 32: Latched/Pulsed
Ctrl Command 1:
  (up to):
Ctrl Command 32:
  ON/OFF
  SET/RESET
  IN/OUT
  ENABLED/DISABLED

Function keys
Fn. Key Status 1:
  (up to):
Fn. Key Status 10
  Disable
  Lock
  Unlock/Enable
Fn. Key 1 Mode: Toggled/Normal
  (up to):
Fn. Key 10 Mode: Toggled/Normal
Fn. Key 1 Label:
  (up to):
Fn. Key 10 Label:
  User defined text string to describe the
  function of the particular function key

IED configurator
Switch Conf .Bank: No Action/Switch Banks

IEC 61850 GOOSE
GoEna: Disabled/Enabled
Test Mode: Disabled/Pass Through/Forced
VOP Test Pattern: 0x00000000...
  0xFFFFFFFF
Ignore Test Flag: No/Yes

Control input user labels
(ctrl I/P labels)
Control Input 1:
  (upto):
Control Input 32:
  User defined text string to describe the
  function of the particular control input

Settings in multiple groups
Note: All settings here onwards apply for
setting groups # = 1 to 2.
Protection functions

**System config.**
Phase Sequence: Standard ABC/Reverse ACB

**Thermal**
- Ith Current Set: 0.2In...1.5In
- K Coefficient: 0...10
- Thermal Const T1: 1min...180min
- Thermal Const T2: 1mn...360mn
- Thermal Const Tr: 1mn...999mn
- Thermal Trip: Disabled/Enabled
- Thermal Alarm: Disabled/Enabled
- Alarm Threshold: 0.2%...100%
- Thermal Lockout: Disabled/Enabled
- Lockout Thresh: 0.2...100%
- Inh Trip Dur St: Disabled/Enabled

**4-stage non-directional short circuit protection**
Phase O/C: Sub Heading

I>1 Function:
- Disabled
- DT
- IEC S Inverse
- IEC V Inverse
- IEC E Inverse
- UK LT Inverse
- UK Rectifier
- RI
- IEEE M Inverse
- IEEE V Inverse
- IEEE E Inverse
- US Inverse
- US ST Inverse

- I>1 Current Set: 0.2...15 In
- I>1 Time Delay: 0.040...100.00s
- I>1 TMS: 0.025...1.200
- I>1 Time Dial: 0.01...100.00
- I>1 K (RI): 0.10...10.00
- I>1 tRESET: 0.00...100.00s
- I>2 as I>1
- I>3 Status: Disabled/Enabled
- I>3 Current Set: 0.20...15.00 In
- I>3 Time Delay: 0.040...100.00s
- I>4 as I>3

**IDMT curves**
Inverse time (IDMT) characteristic

IDMT characteristics are selectable from a choice of four IEC/UK and five IEEE/US curves as shown in the table below.

The IEC/UK IDMT curves conform to the following formula:

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

The IEEE/US IDMT curves conform to the following formula:

\[ t = TD x \left( \frac{K}{(I/I_s)^\alpha - 1} + L \right) \]

Where:
- \( t \) = Operation time
- \( K \) = Constant
- \( I \) = Measured current
- \( I_s \) = Current threshold setting
- \( \alpha \) = Constant
- \( L \) = ANSI/IEEE constant (zero for IEC/UK curves)
- \( T \) = Time multiplier setting for IEC/UK curves
- \( TD \) = Time dial setting for IEEE/US curves

<table>
<thead>
<tr>
<th>IDMT curve</th>
<th>Stand.</th>
<th>K</th>
<th>( \alpha )</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Inverse</td>
<td>IEC</td>
<td>0.14</td>
<td>0.02</td>
<td>0</td>
</tr>
<tr>
<td>Very Inverse</td>
<td>IEC</td>
<td>13.5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Extremely Inverse</td>
<td>IEC</td>
<td>80</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Long Time Inverse</td>
<td>UK</td>
<td>120</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Moderately Inverse</td>
<td>IEEE</td>
<td>0.0515</td>
<td>0.02</td>
<td>0.114</td>
</tr>
<tr>
<td>Very Inverse</td>
<td>IEEE</td>
<td>19.61</td>
<td>2</td>
<td>0.491</td>
</tr>
<tr>
<td>Extremely Inverse</td>
<td>IEEE</td>
<td>28.2</td>
<td>2</td>
<td>0.1217</td>
</tr>
<tr>
<td>Inverse</td>
<td>US-C08</td>
<td>5.95</td>
<td>2</td>
<td>0.18</td>
</tr>
<tr>
<td>Short Time Inverse</td>
<td>US-C02</td>
<td>0.1675</td>
<td>0.02</td>
<td>0.11858</td>
</tr>
</tbody>
</table>

The IEC extremely inverse curve becomes definite time at currents greater than 20x setting. The IEC standard, very and long time inverse curves become definite time at currents greater than 30x setting. The rectifier curve becomes definite time at currents greater than 8xstttings.

The definite time part of the IEC inverse time characteristics at currents greater than 20x and 30x setting are only relevant for currents in the operating range of the relay. The operating range of the P241/2/3 current inputs is 0 - 64In for the standard current inputs and is 0 - 2In for the sensitive current input.
The RI curve (electromechanical) has been included in the first and second stage characteristic setting options for Phase Over current and Earth Fault protections. The curve is represented by the following equation:

\[ t = K \times \left( \frac{1}{0.339 - \left( \frac{0.236}{M} \right)} \right) \text{ in seconds} \]

With \( K \) adjustable from 0.1 to 10 in steps of 0.05

\( M = I/I_s \)

For all IEC/UK curves, the reset characteristic is definite time only.

For all IEEE/US curves, the reset characteristic can be selected as either inverse curve or definite time.

The inverse reset characteristics are dependent upon the selected IEEE/US IDMT curve as shown in the table below.

All inverse reset curves conform to the following formula:

\[ t_{\text{RESET}} = \frac{TD \times S}{(1 - M^2)} \text{ in seconds} \]

Where:

TD = Time dial setting for IEEE curves

S = Constant

M = I/I_s

<table>
<thead>
<tr>
<th>Curve description</th>
<th>Standard</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderately Inverse</td>
<td>IEEE</td>
<td>4.85</td>
</tr>
<tr>
<td>Very Inverse</td>
<td>IEEE</td>
<td>21.6</td>
</tr>
<tr>
<td>Extremely Inverse</td>
<td>IEEE</td>
<td>29.1</td>
</tr>
<tr>
<td>Inverse</td>
<td>US</td>
<td>5.95</td>
</tr>
<tr>
<td>Short Time Inverse</td>
<td>US</td>
<td>2.261</td>
</tr>
</tbody>
</table>
### Earth fault

<table>
<thead>
<tr>
<th>ISEF&gt;1 Function:</th>
<th>Disabled</th>
<th>DT</th>
<th>IEC S Inverse</th>
<th>IEC V Inverse</th>
<th>IEC E Inverse</th>
<th>UK LT Inverse</th>
<th>UK Rectifier</th>
<th>IEEE M Inverse</th>
<th>IEEE V Inverse</th>
<th>IEEE E Inverse</th>
<th>US Inverse</th>
<th>US ST Inverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISEF&gt;1 Direction:</td>
<td>Non-Directional</td>
<td>Directional Fwd</td>
<td>ISEF&gt;1 Current:</td>
<td>0.005In...1ln</td>
<td>ISEF&gt;1 T Delay:</td>
<td>0.04...200.0 s</td>
<td>ISEF&gt;1 TMS:</td>
<td>0.025...1.2</td>
<td>ISEF&gt;1 Time Dial:</td>
<td>0.5...15</td>
<td>ISEF&gt;1 Reset Chr:</td>
<td>DT/Inverse</td>
</tr>
<tr>
<td>ISEF&gt;1 Current Set:</td>
<td>0.005In...1ln</td>
<td>ISEF&gt;1 T Delay:</td>
<td>0.04...200 s</td>
<td>ISEF&gt;1 Char Angle:</td>
<td>-180°...+180°</td>
<td>ISEF&gt;1 VN Pol Set:</td>
<td>0.5...25 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Earth Fault Wattmetric)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO&gt; Function:</td>
<td>Disabled/Enabled</td>
<td>PO&gt; Current Set:</td>
<td>0.005In...1ln</td>
<td>PO&gt; Voltage Set:</td>
<td>0.5...80 V</td>
<td>PO&gt; Coef K Set:</td>
<td>1...10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO&gt; Current Set:</td>
<td>0.005In...1ln</td>
<td>PO&gt; Voltage Set:</td>
<td>0.5...80 V</td>
<td>PO&gt; Coef K Set:</td>
<td>1...10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO&gt; Char Angle:</td>
<td>-180°...+180°</td>
<td>PO&gt; Time Delay:</td>
<td>0.04...100s</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Earth fault derived

<table>
<thead>
<tr>
<th>IN&gt;1 Function:</th>
<th>Disabled</th>
<th>DT</th>
<th>IEC S Inverse</th>
<th>IEC V Inverse</th>
<th>IEC E Inverse</th>
<th>UK LT Inverse</th>
<th>UK Rectifier</th>
<th>IEEE M Inverse</th>
<th>IEEE V Inverse</th>
<th>IEEE E Inverse</th>
<th>US Inverse</th>
<th>US ST Inverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN&gt;1 Direction:</td>
<td>Non-Directional</td>
<td>Directional Fwd</td>
<td>IN&gt;1 Current Set:</td>
<td>0.08In...32 ln</td>
<td>IN&gt;1 T Delay:</td>
<td>0.04...100 s</td>
<td>IN&gt;1 TMS:</td>
<td>0.025...1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN&gt;1 Time Dial:</td>
<td>0.5...15</td>
<td>IN&gt;1 Reset Chr:</td>
<td>DT/Inverse</td>
<td>IN&gt;1 Reset Chr:</td>
<td>DT/Inverse</td>
<td>IN&gt;1 tReset:</td>
<td>0...100 s</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN&gt;2 Function:</td>
<td>Disabled/Enabled</td>
<td>IN&gt;2 Direction:</td>
<td>Non-Directional</td>
<td>Directional Fwd</td>
<td>IN&gt;2 Current:</td>
<td>0.08 ln...32 ln</td>
<td>IN&gt;2 T Delay:</td>
<td>0.04...100 s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN&gt;2 Current Set:</td>
<td>0.08 In...32 ln</td>
<td>IN&gt;2 T Delay:</td>
<td>0.04...100 s</td>
<td>IN&gt;2 Char Angle:</td>
<td>-180°...+180°</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN&gt;2 VN Pol Set:</td>
<td>0.5...25 V</td>
<td>IN&gt;2 Type Pol Type:</td>
<td>Zero Sequence</td>
<td>Neg Sequence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN&gt;2 VN Pol Set:</td>
<td>0.5...25 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN2&gt; V2pol Set:</td>
<td>0.5...25 V</td>
<td>IN2&gt; I2pol Set:</td>
<td>0.002 ln...0.8 ln</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Stall detection

**Prolonged Start:**
- Disabled/Enabled
- Start Criteria:
  - 52 a
  - 52 a + I
- Starting Current:
  - 1*Ith...5*Ith
- Prol Start time:
  - 1...200 s

**Stall Rotor Strt:**
- Disabled/Enabled
- Stall Detection:
  - Disabled/Enabled
- Stall Setting:
  - 1*Ith...5*Ith
- Stall Time:
  - 0.1...60 s

**Reacceleration:**
- Disabled/Enabled
- Reacc Low Voltage Setting:
  - 50...120 V

### 3 phase voltage check

**Start Low V Set:**
- 0.1 Vn...1.0 Vn
Motor differential protection
Diff Function: Disabled
Percentage Bias
High Impedance
Diff Is1: 0.05…0.50 In
Diff k1: 0…20%
Diff Is2: 1…5.0 In
Diff k2 : 20…150.00%

Residual O/V NVD
VN>1 Function: Disabled
DT
IDMT
VN>1 Voltage Set: 0.5…80 V
VN>1 Time Delay: 0.04…100 s
VN>1 TMS: 0.05…100
VN>2 Status : Disabled/DT
VN>2 Voltage Set: 0.5…80 V
VN>2 Time Delay: 0.04…100 s

Limit Nb starts
Hot Start status: Disabled/Enabled
Hot start Nb: 1…5
Cold Start Status: Disabled/Enabled
Cold start Nb: 1…5
Supervising Time: 10…120 min
T Betw St Status: Disabled/Enabled
Time betw start: 1…120 min
Inhib Start Time: 1…120 min

Loss of load
P<1 Status: Disabled/DT
P<1 Power Set: 1*In …120*ln W
P<1 Time Delay: 0.04…100 s
P<2 Status : Disabled/DT
P<2 Power Set: 1*In …120*ln W
P<2 Time Delay: 0.04…100 s
P< Drop-off Time 0.05…300 s

Out of step (power factor)
PF< Status Lead: Disabled/DT
Power Fact lead: 0.1…0.9
PF< Lead TD: 0.05…100 s
PF< Status Llag: Disabled/DT
Power Fact Lag: 0.1…0.9
PF< Lag TD: 0.05…100 s
PF< Drop-of Ti: 0.05…300 s

Reverse power
Rev P< Power Set: 1*In...120*ln W
Rev P< Time Delay: 0.04…100 s
Rev P< Drop-of Ti: 0.05…300 s

Anti-backspin
VRem Anti-backs: 1…120 V
Anti-backs Delay: 1…7200 s

Field failure
FFail Alm Status: Disabled/Enabled
FFail Alm Angle: 15°…75°
FFail Alm Delay: 0.00…100.0 s
FFail 1 Status: Disabled/Enabled
FFail 1 -Xa1:
0…40.0/lnΩ
FFail 1 Xb1:
25…325.0/lnΩ
FFail 1 Time Delay: 0…100 s
FFail 1 DO Timer: 0…100 s
FFail 2 as FFail1

Volt protection

Undervoltage
V<1 Function: Disabled
DT
IDMT
V<1 Voltage Set: 15…120 V
V<1 Time Delay: 0.04…7200 s
V<1 TMS: 0.05…100
V<2 Status: Disabled/DT
V<2 Voltage Set: 15…120 V
V<2 Time Delay: 0.04…100 s
Inhib During St: Disabled/DT

Overvoltage
V>1 Status: Disabled/DT
V>1 Voltage Set: 50…200 V
V>1 Time Delay: 0.04…7200 s
V>1 TMS: 0.05…100
V>2 Status: Disabled/DT
V>2 Voltage Set: 50…200 V
V>2 Time Delay: 0.04…7200 s

Underfrequency
F<1 Status: Disabled/DT
F<1 Setting: 45…65 Hz
F<1 Time Delay: 0.1…100 s
F<2 Status: Disabled/DT
F<2 Setting: 45…65 Hz
F<2 Time Delay: 0.1…100 s
RTD protection

Select RTD:
- Bit 0 - Select RTD 1
- Bit 1 - Select RTD 2
- Bit 2 - Select RTD 3
- Bit 3 - Select RTD 4
- Bit 4 - Select RTD 5
- Bit 5 - Select RTD 6
- Bit 6 - Select RTD 7
- Bit 7 - Select RTD 8
- Bit 8 - Select RTD 9
- Bit 9 - Select RTD 10

Binary function link string, selecting which RTDs (1 - 10) are enabled.

RTD 1 Alarm Set: 0°C…200°C
RTD 1 Alarm Dly: 0s…100s
RTD 1 Trip Set: 0°C…200°C
RTD 1 Trip Dly: 0s…100s

RTD 2/3/4/5/6/7/8/9/10 as RTD1

Ext. Temp. Influence: Disabled/DT
Ext. Temp. RTD: 1…10
Ext. RTD Back-up: 1…10

Type RTD:
- PT100
- Ni100
- Ni120

RTD Unit:
- Degree Celsius
- Fahrenheit

CB fail

CB Fail 1 Status: Disabled/Enabled
CB Fail 1 Timer: 0.00…10.00 s
CB Fail 2 Status: Disabled/Enabled
CB Fail 2 Timer: 0.00…10.00 s
CBF Non I Reset: I< Only, CB Open & I<, Prot Reset & I<
CBF Ext Reset: I< Only, CB Open & I<, Prot Reset & I<
I< Current Set: 0.02…3.200 In

Supervisory functions

Voltage transformer supervision (fuse failure)

Accuracy

Fast block operation: <25 ms
Fast block reset: <30 ms
Time delay: Setting ±2% or 20 ms whichever is greater

Current transformer supervision

Accuracy

IN > Pick-up: Setting ±5%
VN < Pick-up: Setting ±5%
IN > Drop-off: 0.9 x Setting ±5%

VN < Drop-off: (1.05 x Setting) ±5% or 1 V whichever is greater
CTS block operation: < 1 cycle
CTS reset: < 35 ms

Input labels

Opto Input 1…16: Opto 1…Opto 16

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

Output labels

Relay 1…16: Relay 1…Relay 16

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

RTD labels

RTD 1-10: RTD1…RTD10

User defined text string to describe the function of the particular RTD.

CLIO labels

CLIO Input 1…16:
Analog Input 1…Analog Input 16

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

Analogue Input (current loop input)

CLIO Inputs

Range 1:
- Disabled
- 0 - 1 mA
- 0 - 10 mA
- 0 - 20 mA
- 4 - 20 mA

Unit 1: Unit Range
- None
- -32.5 k...50 k
- A: 0...100 k
- V: 0...20 k
- Hz: 0...100
- W: -1.41 G...1.41 G
- Var: -1.41 G...1.41 G
- VA: 0...1.41 G

°C: -40...400
°F: -40...752
%
- 0...150
- s: 0...300

Minimum 1: As above for unit range
Maximum 1: As above for unit range
Function 1: Disabled/Enabled
Alarm Set 1: As above for unit range
Alarm Delay 1: 0…300 s
Trip Set 1: As above for unit range
Trip Delay 1: 0…300 s
Drop-off Time: 0.1…300

CLI2/3/4 as CLI1

P241 Technical Data Sheet

J (P241) K (P242/3) Software Version 51k
Analogue output (current loop output)

CLIO Outputs
Range 1:
- 0 - 1 mA
- 0 - 10 mA
- 0 - 20 mA
- 4 - 20 mA
ANALOG OUTPUT 1: As shown below*
Minimum 1: Range, step size and unit corresponds to the selected parameter
Maximum 1: Same as Minimum 1
ANALOG OUTPUT2/3/4 as ANALOG OUTPUT1
ANALOG Output Parameters
Current Magnitude:
- IA Magnitude
- IB Magnitude
- IC Magnitude
- IN Measured Mag
  0.00…100 kA
Phase Currents:
- IA RMS
- IB RMS
- IC RMS
- In RMS
  0.00…100 kA
P-N Voltage Magnitude:
- VAN Magnitude
- VBN Magnitude
- VCN Magnitude
  0.0…20 kV
RMS Phase P-N Voltages:
- VAN RMS
- VBN RMS
- VCN RMS
  0.0…20 kV
P-P Voltage Magnitude:
- VAB Magnitude
- VBC Magnitude
- VCA Magnitude
  0.0…20 kV
RMS Phase P-P Voltages:
- VAB RMS
- VBC RMS
- VCA RMS
  0.0…20 kV
Frequency: 0.00…100.0 Hz
3 Phase Watts: -10 MW…10 MW
3 Phase Vars: -10 MVar…10 MVar
3 Phase VA: -100 MVA…100 MVA
3Ph Power Factor: -1…1
RTD 1-10: -40°C…400.0°C
Number of Hottest RTD: 1..10
Thermal State: 0-150
Time to Thermal Trip: 0…300 s
Time to Next Start: 0…300 s

Plant supervision

CB state monitoring control and condition monitoring

Accuracy
Timers: ±2% or 20 ms whichever is greater
Broken current accuracy: ±5%

Programmable scheme logic

Accuracy
Output conditioner timer: Setting ±2% or 50 ms whichever is greater
Dwell conditioner timer: Setting ±2% or 50 ms whichever is greater
Pulse conditioner timer: Setting ±2% or 50 ms whichever is greater

IEC 61850 Ethernet data

100 Base FX Interface

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output optical power BOL 62.5/125 μm, NA = 0.275 FIBER EOL</td>
<td>PO</td>
<td>-19</td>
<td>-16.8</td>
<td>-14</td>
<td>DBM AVG</td>
</tr>
<tr>
<td>Output optical power BOL 50/125 μm, NA = 0.20 FIBER EOL</td>
<td>PO</td>
<td>-22.5</td>
<td>-20.3</td>
<td>-14</td>
<td>DBM AVG</td>
</tr>
<tr>
<td>Optical extinction ratio</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>%</td>
</tr>
<tr>
<td>Output optical power at logic &quot;0&quot; state</td>
<td>PO (&quot;0&quot;)</td>
<td></td>
<td>-45</td>
<td>DBM AVG</td>
<td></td>
</tr>
</tbody>
</table>

BOL - Beginning of life
EOL - End of life

Receiver Optical Characteristics
(TA = 0°C TO 70°C, VCC = 4.75 V TO 5.25 V)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Optical Power Minimum At Window Edge</td>
<td>PIN Min. (W)</td>
<td>-33.5</td>
<td>-31</td>
<td>dBM avg</td>
<td></td>
</tr>
<tr>
<td>Input Optical Power Minimum At Eye Center</td>
<td>PIN Min. (C)</td>
<td>-34.5</td>
<td>-31.8</td>
<td>Bm avg</td>
<td></td>
</tr>
<tr>
<td>Input Optical Power Maximum</td>
<td>PIN Max.</td>
<td>-14</td>
<td>-11.8</td>
<td>dBM avg</td>
<td></td>
</tr>
</tbody>
</table>

Note: The 10 BASEFL connection will no longer be supported as IEC 61850 does not specify this interface
## Measurements list

### Measurements 1

<table>
<thead>
<tr>
<th>Measurement Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I_\varphi) Magnitude</td>
<td>Per phase ((\varphi = A, B, C)) current measurements</td>
</tr>
<tr>
<td>(I_\varphi) Phase Angle</td>
<td>Per phase ((\varphi = A, B, C)) RMS current measurements</td>
</tr>
<tr>
<td>IN Derived Mag</td>
<td></td>
</tr>
<tr>
<td>IN Derived Angle</td>
<td></td>
</tr>
<tr>
<td>ISEF Magnitude</td>
<td></td>
</tr>
<tr>
<td>ISEF Angle</td>
<td></td>
</tr>
<tr>
<td>I1 magnitude</td>
<td></td>
</tr>
<tr>
<td>I2 magnitude</td>
<td></td>
</tr>
<tr>
<td>I0 Magnitude</td>
<td></td>
</tr>
<tr>
<td>(I_\varphi) RMS</td>
<td></td>
</tr>
<tr>
<td>V(\varphi)-(\varphi) Magnitude</td>
<td>All phase-phase and phase-neutral voltages ((\varphi = A, B, C, N)).</td>
</tr>
<tr>
<td>V(\varphi)-(\varphi) Phase Angle</td>
<td>All phase-phase and phase-neutral voltages ((\varphi = A, B, C, AB, BC, CA)).</td>
</tr>
<tr>
<td>V(\varphi) Magnitude</td>
<td></td>
</tr>
<tr>
<td>V(\varphi) RMS</td>
<td></td>
</tr>
<tr>
<td>V(\varphi)-(\varphi) RMS</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>Ratio I2/I1</td>
</tr>
<tr>
<td>IA2 Magnitude</td>
<td></td>
</tr>
<tr>
<td>IA2 Angle</td>
<td></td>
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<tr>
<td>IB2 Magnitude</td>
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<td>IB2 Angle</td>
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<tr>
<td>IC2 Magnitude</td>
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<tr>
<td>IC2 Angle</td>
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<td>IA Differential</td>
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<td>IB Differential</td>
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<td>IC Differential</td>
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<td>IA Bias</td>
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<td>IB Bias</td>
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### Measurements 2

<table>
<thead>
<tr>
<th>Measurement Type</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>3 Phase Watts</td>
<td></td>
</tr>
<tr>
<td>3 Phase VArs</td>
<td></td>
</tr>
<tr>
<td>3 Phase VA</td>
<td></td>
</tr>
<tr>
<td>Zero Seq Power</td>
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</tr>
<tr>
<td>3Ph Power Factor</td>
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</tr>
<tr>
<td>3Ph WHours Fwd</td>
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</tr>
<tr>
<td>3Ph WHours Rev</td>
<td></td>
</tr>
<tr>
<td>3Ph VArHours Fwd</td>
<td></td>
</tr>
<tr>
<td>3Ph VArHours Rev</td>
<td></td>
</tr>
<tr>
<td>Reset Energies:</td>
<td>No/Yes</td>
</tr>
<tr>
<td>3Ph W Fix Demand</td>
<td></td>
</tr>
<tr>
<td>3Ph VArs Fix Dem</td>
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<tr>
<td>3Ph W Peak Dem</td>
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</tr>
<tr>
<td>3Ph VAr Peak Dem</td>
<td></td>
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<tr>
<td>Reset Demand:</td>
<td>No/Yes</td>
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<tr>
<td>3Ph I Maximum</td>
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</tr>
<tr>
<td>3Ph V Maximum</td>
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### Measurements 3 (model specific)

<table>
<thead>
<tr>
<th>Measurement Type</th>
<th>Description</th>
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</thead>
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<tr>
<td>Thermal Load</td>
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<tr>
<td>Thermal State</td>
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<tr>
<td>Time to Th Trip</td>
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</tr>
<tr>
<td>Reset Th State:</td>
<td>No/Yes</td>
</tr>
<tr>
<td>RTD#1 Temperature to RTD#10 Temperature</td>
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</tr>
<tr>
<td>Nb of Hot St Allow</td>
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</tr>
<tr>
<td>Nb of Cold St Allow</td>
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<tr>
<td>Time to Next St</td>
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</tr>
<tr>
<td>Emergency Rest:</td>
<td>No/Yes</td>
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<tr>
<td>Last Start Time</td>
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</tr>
<tr>
<td>Last St Current</td>
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</tr>
<tr>
<td>Nb of Starts</td>
<td></td>
</tr>
<tr>
<td>Reset Nb of St:</td>
<td>No/Yes</td>
</tr>
<tr>
<td>Nb Emergency Rst</td>
<td></td>
</tr>
<tr>
<td>Reset Nb Em Rst:</td>
<td>No/Yes</td>
</tr>
<tr>
<td>Nb of Reaccelerat</td>
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</tr>
<tr>
<td>Reset Nb of Reacc:</td>
<td>No/Yes</td>
</tr>
<tr>
<td>Motor Run Time</td>
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<tr>
<td>Reset Motor Run T:</td>
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<tr>
<td>RTD open Cct</td>
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<tr>
<td>RTD Short Cct</td>
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<td>RTD Data Error</td>
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<td>Reset RTD Flags:</td>
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<td>Nb Hottest RTD</td>
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<td>Hottest RTD Temp</td>
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<td>Reset Max RTD Temp:</td>
<td>No/Yes</td>
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<td>Analog Input 1</td>
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<tr>
<td>Analog Input 2</td>
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<td>Analog Input 3</td>
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<td>Analog Input 4</td>
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### Measurements 4 (model specific)

<table>
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<th>Measurement Type</th>
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<td>Nb Control trips</td>
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<td>Nb Thermal Trip</td>
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</tr>
<tr>
<td>Nb Trip I&gt; 1</td>
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</tr>
<tr>
<td>Nb Trip I&gt; 2</td>
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<tr>
<td>Nb Trip I&gt; 3</td>
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<td>Nb Trip I&gt; 4</td>
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<tr>
<td>Nb Trip ISEF&gt;1</td>
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</tr>
<tr>
<td>Nb Trip ISEF&gt;2</td>
<td></td>
</tr>
<tr>
<td>Nb Trip IN&gt;1</td>
<td></td>
</tr>
<tr>
<td>Nb Trip IN&gt;2</td>
<td></td>
</tr>
<tr>
<td>Nb Trip I2&gt;1</td>
<td></td>
</tr>
<tr>
<td>Nb Trip I2&gt; 2</td>
<td></td>
</tr>
<tr>
<td>Nb Trip PO&gt;</td>
<td></td>
</tr>
<tr>
<td>Nb Trip V&lt;1</td>
<td></td>
</tr>
<tr>
<td>Nb Trip V&lt;2</td>
<td></td>
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<tr>
<td>Nb Trip F&lt;1</td>
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</tr>
<tr>
<td>Nb Trip F&lt;2</td>
<td></td>
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<tr>
<td>Nb F.Fail1 Trip</td>
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<tr>
<td>Nb F.Fail2 Trip</td>
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</tr>
<tr>
<td>Nb Trip P&lt;1</td>
<td></td>
</tr>
<tr>
<td>Nb Trip P&lt;2</td>
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<tr>
<td>Nb Trip PF&lt; Lead</td>
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<tr>
<td>Nb Trip PF&lt; Lag</td>
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</tr>
<tr>
<td>Parameter</td>
<td>Value</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Nb Trip Rev P</td>
<td></td>
</tr>
<tr>
<td>Nb Trip V&gt; 1</td>
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<tr>
<td>Nb Trip V&gt; 2</td>
<td></td>
</tr>
<tr>
<td>Nb Trip VN&gt;1</td>
<td></td>
</tr>
<tr>
<td>Nb Trip VN&gt;2</td>
<td></td>
</tr>
<tr>
<td>Nb Prolong St</td>
<td></td>
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<tr>
<td>Nb Lock Rot-sta</td>
<td></td>
</tr>
<tr>
<td>Nb Lock-Rot-run</td>
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</tr>
<tr>
<td>Nb Trip RTD#1…Nb Trip RTD#10</td>
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<tr>
<td>Nb Trip Diff</td>
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<tr>
<td>Nb A Input 1Trip</td>
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</tr>
<tr>
<td>Nb A Input 2Trip</td>
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<tr>
<td>Nb A Input 3Trip</td>
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<tr>
<td>Nb A Input 4Trip</td>
<td></td>
</tr>
<tr>
<td>Nb FFail1 Trip</td>
<td></td>
</tr>
<tr>
<td>Nb FFail2 Trip</td>
<td></td>
</tr>
<tr>
<td>Nb Trip I&gt; 3</td>
<td></td>
</tr>
<tr>
<td>Nb Trip I&gt; 4</td>
<td></td>
</tr>
<tr>
<td>Reset Trip Stat:</td>
<td>No/Yes</td>
</tr>
</tbody>
</table>

**CB condition**

**CB Operations**

Cumulative breaker interruption duty on a per phase basis ($\phi = A, B, C$).

**CB Operate Time**

Reset CB Data: No/Yes
CASE DIMENSIONS

A = Clearance holes  
B = Mounting holes

Flush mounting panel  
Panel cut-out detail

Note: If mounting plate is required use flush mounting cut out dimensions

All dimensions in mm

P241 case dimensions (40TE case)
P242 case dimensions (60TE case)
P243 case dimensions (80TE case)
CONNECTION DIAGRAMS

P241 external connection diagram – 3VTs connection + RTD option
P241 External connection diagram – 2 VTs and residual connection + RTD option

NOTES:
1. C.T. SHORTING BLOCKS
2. RESIDUAL VOLTAGE MEASUREMENT
3. C.T. CONNECTIONS ARE ShOWN IN CONNECTION AND ARE TYPICAL ONLY.
4. FOR COMBINATION CONNECTIONS SEE DRAWING 10P4001.
5. DIRECTION OF FORWARD CURRENT FLOW FOR OPERATION OF THE DIODE.

P241 Technical Data Sheet
JPS241X-V42.0 Software Version 5.1K
P241 external connection diagram – 3VTs connection + CLIO option
P241 external connection diagram – CLIO option
P242 external connection diagram – 3VTs connection + RTD + CLIO options
P243 External connection diagram – 3VTs connection + RTD + CLIO options – biased differential [87M]
P243 External connection diagram – 3VTs connection + RTD + CLIO – high impedance differential [87M]
## ORDERING INFORMATION

### P241 Motor Protection Relay

<table>
<thead>
<tr>
<th>Vx Aux Rating</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>24-48 VDC</td>
<td>1</td>
</tr>
<tr>
<td>48-110 VDC, 40-100 VAC</td>
<td>2</td>
</tr>
<tr>
<td>110-250 VDC, 100-240 VAC</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>In/Vn Rating</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IN=1 A/5 A, VN=100/120 V</td>
<td>1</td>
</tr>
</tbody>
</table>

### Hardware Options

1. Nothing
2. Irig-B Only (Modulated)
3. Fiber Optic Rear Comms Port
4. IRIG-B (Modulated) & Fiber Optic Rear Comms Port
5. Ethernet (100 Mbps)
6. Second Rear Comms. Board*
7. IRIG-B (Modulated) Plus Second Rear Comms Board*
8. Ethernet (100mbps) + IRIG-B (Modulated) *
9. Ethernet (100mbps) + IRIG-B (De-Modulated) *
10. Redundant Ethernet Self-Healing Ring, 2 Multi-Mode Fiber Ports + Modulated IRIG-B (Not Yet Available)
12. Redundant Ethernet Rstp, 2 Multi-Mode Fiber Ports + Modulated IRIG-B (Not Yet Available)
13. Redundant Ethernet Rstp, 2 Multi-Mode Fiber Ports + Un-Modulated IRIG-B (Not Yet Available)
15. Redundant Ethernet Dual Homing Star, 2 Multi-Mode Fiber Ports + Un-Modulated IRIG-B (Not Yet Available)

### Product Specific

| Size 40TE Case, No Option (8 Optos + 7 Relays) | A |
| Size 40TE Case, 8 Optos + 7 Relays + RTD      | B |
| Size 40TE Case, 8 Optos + 7 Relays + Clio     | C |
| Size 40TE Case, 12 Optos + 11 Relays         | E |

### Protocol Options

1. K-Bus
2. Modbus
3. IEC 60870-5-103
4. IEC 61850 + Courier Via Rear Eia(Rs)485 Port*

### Mounting

- Panel Mounting

### Software Number

- Unless Specified The Latest Version Will Be Delivered: 51

### Settings File

- Default: 0
- Customer: 1

### Design Suffix

- Original
- Universal Opto, New Relays, New Power Supply
- Phase 2 CPU
### P242 Motor Protection Relay

#### Vx Aux Rating
- 24-48 VDC
- 48-110 VDC, 40-100 VAC
- 110-250 VDC, 100-240 VAC

#### In/Vn Rating
- IN=1 A/5 A, VN=100/120 V

#### Hardware Options
- Nothing
- IRIG-B Only (Modulated)
- Fiber Optic Rear Comms Port
- IRIG-B (Modulated) & Fiber Optic Rear Comms Port
- Ethernet (100 Mbps)*
- Second Rear Comms. Board*
- IRIG-B (Modulated) Plus 2nd Rear Comms Board*
- Ethernet (100 Mbps) + IRIG-B (Modulated)*
- Ethernet (100 Mbps) + IRIG-B (De-Modulated)*
- Redundant Ethernet Self-Healing Ring, 2 Multi-Mode Fiber Ports + Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet Self-Healing Ring, 2 Multi-Mode Fiber Ports + Un-Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet Rspt, 2 Multi-Mode Fiber Ports + Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet Rspt, 2 Multi-Mode Fiber Ports + Un-Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet Dual Homing Star, 2 Multi-Mode Fiber Ports + Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet Dual Homing Star, 2 Multi-Mode Fiber Ports + Un-Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet Dual Homing Star, 2 Multi-Mode Fiber Ports + Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet Dual Homing Star, 2 Multi-Mode Fiber Ports + Un-Modulated IRIG-B (Not Yet Available)

#### Product Specific
- Size 60TE Case, No Option (16 Optos + 16 Relays)
- Size 60TE Case, 16 Optos + 16 Relays + Rtd
- Size 60TE Case, 16 Optos + 16 Relays + Clio
- Size 60TE Case, 16 Optos + 16 Relays + Rtd + Clio

#### Protocol Options
- K-BUS
- Modbus
- IEC 60870-5-103
- IEC 61850 + Courier Via Rear Eia(Rs)485 Port*

#### Mounting
- Panel Mounting

#### Software Number
- Unless Specified The Latest Version Will Be Delivered

#### Settings File
- Default
- Customer

#### Design Suffix
- Universal Opto, New Relays, New Power Supply
- Extended Phase 2 CPU
### P243 Motor protection relay

<table>
<thead>
<tr>
<th>Vx Aux Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-48 Vdc</td>
</tr>
<tr>
<td>48-110 Vdc, 40-100 Vac</td>
</tr>
<tr>
<td>110-250 Vdc, 100-240 Vac</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>In/Vn Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>In=1A/5A, Vn=100/120V</td>
</tr>
</tbody>
</table>

#### Hardware Options

- Nothing
- IRIG-B Only (Modulated)
- Fiber Optic Rear Comms Port
- IRIG-B (Modulated) & Fiber Optic Rear Comms Port
- Ethernet (100 Mbps)*
- Second Rear Comms. Board*
- IRIG-B* (Modulated) Plus 2nd Rear Comms Board
- Ethernet (100 Mbps) + IRIG-B (Modulated)*
- Ethernet (100 Mbps) + IRIG-B (De-Modulated)*
- Redundant Ethernet Self-Healing Ring, 2 Multi-Mode Fiber Ports + Modulated Irig-B (Not Yet Available)
- Redundant Ethernet Self-Healing Ring, 2 Multi-Mode Fiber Ports + Un-Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet RSTP, 2 Multi-Mode Fiber Ports + Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet RSTP, 2 Multi-Mode Fiber Ports + Un-Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet Dual Homing Star, 2 Multi-Mode Fiber Ports + Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet Dual Homing Star, 2 Multi-Mode Fiber Ports + Un-Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet Dual Homing Star, 2 Multi-Mode Fiber Ports + Modulated IRIG-B (Not Yet Available)
- Redundant Ethernet Dual Homing Star, 2 Multi-Mode Fiber Ports + Un-Modulated IRIG-B (Not Yet Available)

#### Product Specific

- Size 80TE Case, 16 Optos + 16 Relays
- Size 80TE Case, 16 Optos + 16 Relays + RTD
- Size 80TE Case, 16 Optos + 16 Relays + Clio
- Size 80TE Case, 16 Optos + 16 Relays + RTD + Clio

#### Protocol Options

- K-Bus
- Modbus
- IEC 60870-5-103
- IEC 61850 + Courier Via Rear Eia(Rs)485 Port*

#### Mounting

- Panel Mounting
- Rack Mounting

#### Software Number

- Unless Specified The Latest Version Will Be Delivered

#### Settings File

- Default
- Customer

#### Design Suffix

- Universal Opto, New Relays, New Power Supply
- Extended Phase 2 CPU
SOFTWARE SUPPORT
Windows™ 98/ME/2000/NT compatible. MiCOM S1 software which comprises:
- Settings editor
- Programmable Scheme Logic editor
- Menu text editor
- Display of fault diagnostics and measurements
- Disturbance recorder viewer

HARDWARE DESCRIPTION
> Case
The MiCOM relays are housed in a specially designed case providing a high density of functionality within the product, a customisable user interface, and additional functions concealed by upper and lower covers.

Physical protection of the front panel user interface and prevention of casual access is provided by an optional transparent front cover, which can be fitted or omitted according to choice since the front panel has been designed to IP52 protection against dust and water. The case is suitable for either rack or panel mounting.

- P241 : MiCOM 40TE
- P242 : MiCOM 60TE
- P243 : MiCOM 80TE

> Weight
- P241 : 7.3 kg
- P242 : 9.2 kg (with RTD & CLIO)
- P243 : 11.5 kg (with RTD & CLIO)

EMC COMPLIANCE
CE 2006/95/EC
Compliance with the European Commission Directive on EMC

PRODUCT SAFETY
CE 2006/95/EC
Compliance with the European Commission Low Voltage Directive

ATEX COMPLIANCE
EX II(2)G
Compliance with the European Directive Article 1 (2) of 94/9/EC

P24X THIRD PARTY COMPLIANCES
File Number : E202519
Original Issue Date : 21-04-2005
(Complies with Canadian and US requirements)