MiCOM P24x

Rotating Machine Management Relay

MiCOM P241 in 40TE

MiCOM P243 in 80TE

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.

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

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 and Programmable Curves allow easy customization of the protection and control functions

Compact, specially developped 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

Schneider Electric

ANSI	IEC 61850	PROTECTION and FEATURES	P241	P242	P243
50/51	OcpPTOC	Short circuit	•	•	•
50N/51N	EfdPTOC	Earth fault	•	•	•
50N/51N/67N	SenEftPTOC	Directional/Non Directionnal sensitive earth fault	•	•	•
32N/64N	SenEftPDOP	Wattmetric characteristic	•	•	•
50BF	CbfRBRF	Breaker Failure	•	•	•
	SvnRVCS1	Current Transformer Supervision	•	•	•
	SvnRVCS1	Voltage Transformer Supervision	•	•	•
66	MotPMRI	Number of starts limitation	•	•	•
37	LosLodPDUP	Loss of load / Underpower	•	•	•
46	NgcPTOC	Negative Sequence Overcurrent	•	•	•
32R	PwrRevPDOP	Reverse Power	•	•	•
47		Reverse phase sequence detection	•	•	•
49	ThmPTTR	Thermal Overload	•	•	•
		Auto adaptation of thermal replica to ambient temp. by RTD	•	•	•
40	UxpPDUP	Loss of Field	•	•	•
87	DifLzdPDIF	Machine Differential			•
27/59	VtpPhsPTUV/Vt pPhsPTOV	Undervoltage / Overvoltage	•	•	•
27Abs	AbsPTUV	Anti backspin	•	•	•
59N	VtpResPTOV	Residual Overvoltage	•	•	•
81U	UfpPTUF	Underfrequency	•	•	•
48/ 51LR	MotPMSS	Start / Stalled protection / Motor Reacceleration	•	•	•
51S	MotPMSS	Locked rotor during starting	•	•	•
51LR	MotPMSS	Locked rotor after successful start	•	•	•
55	PfrPPAM	Out of step / Power Factor	•	•	•
14		Speed switch input	•	•	•
26	RtdPTTR	10 Optional RTD inputs	•	•	•
	OcpCliPTOC/M siCliGGIO	4 Optional Current Loop Analog Inputs	•	•	•

Control and monitoring			P241	P242	P243
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				10	10
Programmable LEDs, Red/Green/Yellow (R/G/Y) IEC61850: StdLedGGIO/LedGGIO			8R	18 R/G/Y	18 R/G/Y

Measurements & records			P241	P242	P243
Measurements (primary and secondary) IEC61850: PriFouMMXU/PriStdMSQI and SecFouMMXU/SecStdMSQI			•	•	•
Power and Energy Measurements IEC61850: PriEflMMTR/SecEflMMTR			•	•	•
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			P241	P242	P243
Front face	RS232 port		1	1	1
	RS485 (COMM1/RP1)		1	1	1
Rear face	Optional 2nd communication port RS485/RS232 (COMM2/RP2)		•	•	•
	Optional communications fibre optic/ethernet port (COMM1/RP1)		•	•	•
	Optional communications redundant Ethernet port (COMM1/RP1)		•	•	•
	Optional communications fibre optic port (COMM1/RP1)		•	•	•

Rear Port Protocol	P241	P242	P243
IEC 61850	•	•	•
Modbus RTU	•	•	•
IEC 60870-5-103	•	•	•
Kbus-Courier	•	•	•
Hardware	**P241**	**P242**	**P243**
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	•	•	•

Functional Overview

(Description of ANSI code nos., see Protection Function Overview)
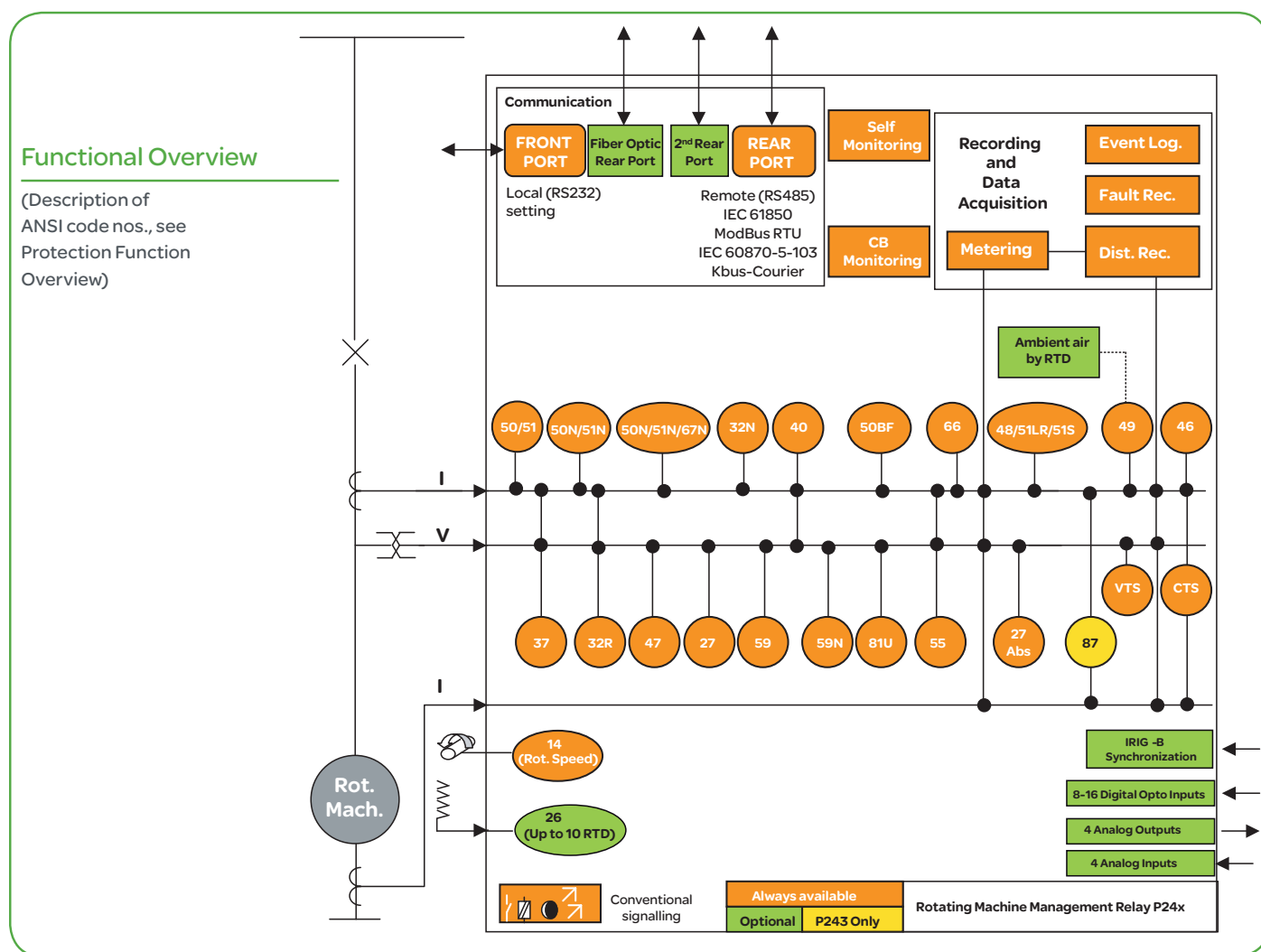
MAIN FUNCTIONS

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.

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 and User Curve). 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. The stator earth fault protection includes standard IEC and IEEE IDMT curves and also a user programmable curve for additional flexibility.

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 for 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 (46)

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.
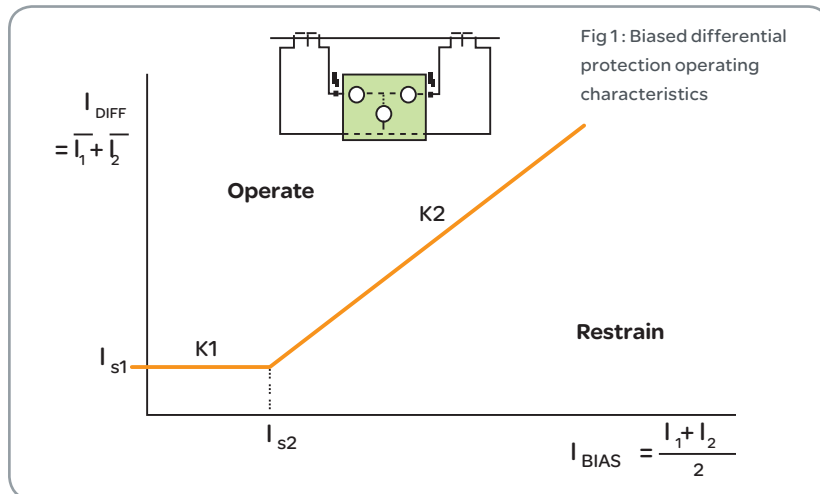
Standard or User Programmable Thermal Overload (49)

The key characteristics are:

- Alarm and trip stages can be selected.
- 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.
- Standard overload thermal curve with different time constants according to the machine cycles (heating, cooling or start-up), in order to provide the optimum protection.
- A user programmable curve feature gives the user additional flexibility. If a standard thermal overload curve is not suitable for the application, the user can program and upload a customised thermal overload curve (both operate and reset) to the relay. Applications such as induction fan drives and high inertia rotors/loads in which the motor stator and rotor thermal limits differ significantly can take advantage of this feature for optimum grading with the motor characteristics.
- Inhibition of the function in case of extreme starting conditions (very long start, very high start current).
- Inhibition of a new start, until the machine has cooled down, immediately after a trip.
- 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.

Fig 1: Biased differential protection operating characteristics

$I_{DIFF} = \bar{I_1} + \bar{I_2}$

Operate

K2

K1

I_{s1}

Restrain

I_{s2}

$I_{BIAS} = \dfrac{I_1 + I_2}{2}$

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.

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.

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

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 reacceleration is enabled.

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.

Resistive Temperature Detectors (26)

Up to 10 RTDs can be optionally connected to theMiCOM 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.
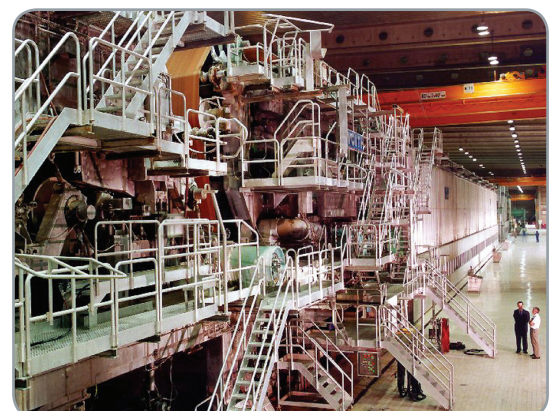
CONTROL FUNCTIONS

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 dualspeed 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.
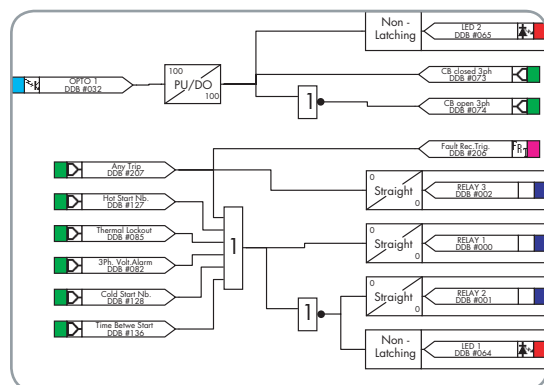

Fig 2: Scheme logic example

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   Iabias Ibbias Icbias
- Differential current   Iadiff Ibdiff Icdiff

Events Records

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

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

Advanced features provide complete protection, with the added value of measurements, control and monitoring to enhance power system diagnostics and fault analysis.

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.
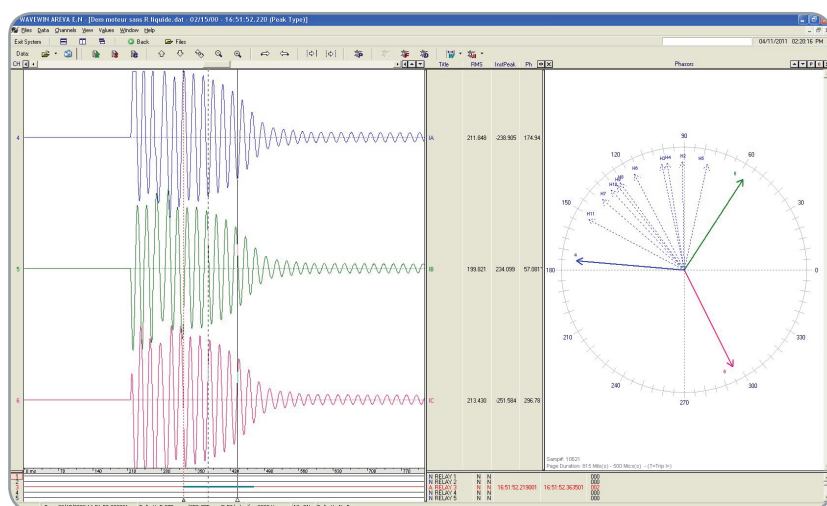

Fig 3: Motor starting

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.

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

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

IEC61850 is available when the optional Ethernet or redundant 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 theCourier protocol is available. This port is intended for central settings or remote access with MiCOM S1.

Redundant Ethernet Ports (IEC61850)

An optional interface is available allowing an alternative path to be always available in case of Ethernet network faults. This facility can provide a bumpless redundancy. It is also possible to extend the number of devices, or the size of a sub-station network, without stopping the network.

There are three redundancy protocols available which quickly reconnect a network fault by finding an alternative path, allowing loop-free network topology: RSTP (Rapid Spanning Tree Protocol), SHP (Self Healing Protocol), DHP (Dual Homing Protocol).

The RSTP recovery time is typically 300 ms and is based on open standards and so is compatible with other manufacturers' IEDs that use RSTP. SHP and DHP solutions deliver a very fast recovery time for the entire network of <1 ms, responding to the constraints of critical time applications such as GOOSE.

SOFTWARE SUPPORT

Windows™ 98/ME/2000/NT/XP/7 compatible MiCOM S1 Studio 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: 9,2kg (with temperature and CLIO cards)
- P243: 11, 5 kg (with temperature and CLIO cards)

TRACK RECORD - MOTOR & MACHINE PROTECTION RELAYS

- Over **30 years experience** in Motor and Machine Protection Design.
- First numerical motor protection relay, **OPN/ MOPN** launched in 1988. More than 6700 devices installed.
- **MiCOM motor protection series** introduced in 1999 derived from previous successful range and user feedback. Employ all latest numerical technique to enhance relay efficiency, reliability and user-friendliness. Worlwide application with over 7000 units delivered.

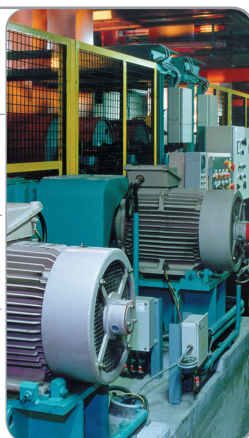|		
EMC Compliance CE 2006/95/EC	Compliance with the European Commission Directive on EMC	
Product safety CE 2006/95/EC	Compliance with the European Commission Low voltage directive	
Atex Compliance EX II(2)G	Compliance with the European Directive Article 1 (2) of 94/9/EC	
P24X third party compliances c(UL)us	File Number : E202519 Original Issue Date : 21-04-2005 (Complies with Canadian and US requirements)	