MTR-4P

Multi-functional protection relay

Data sheet

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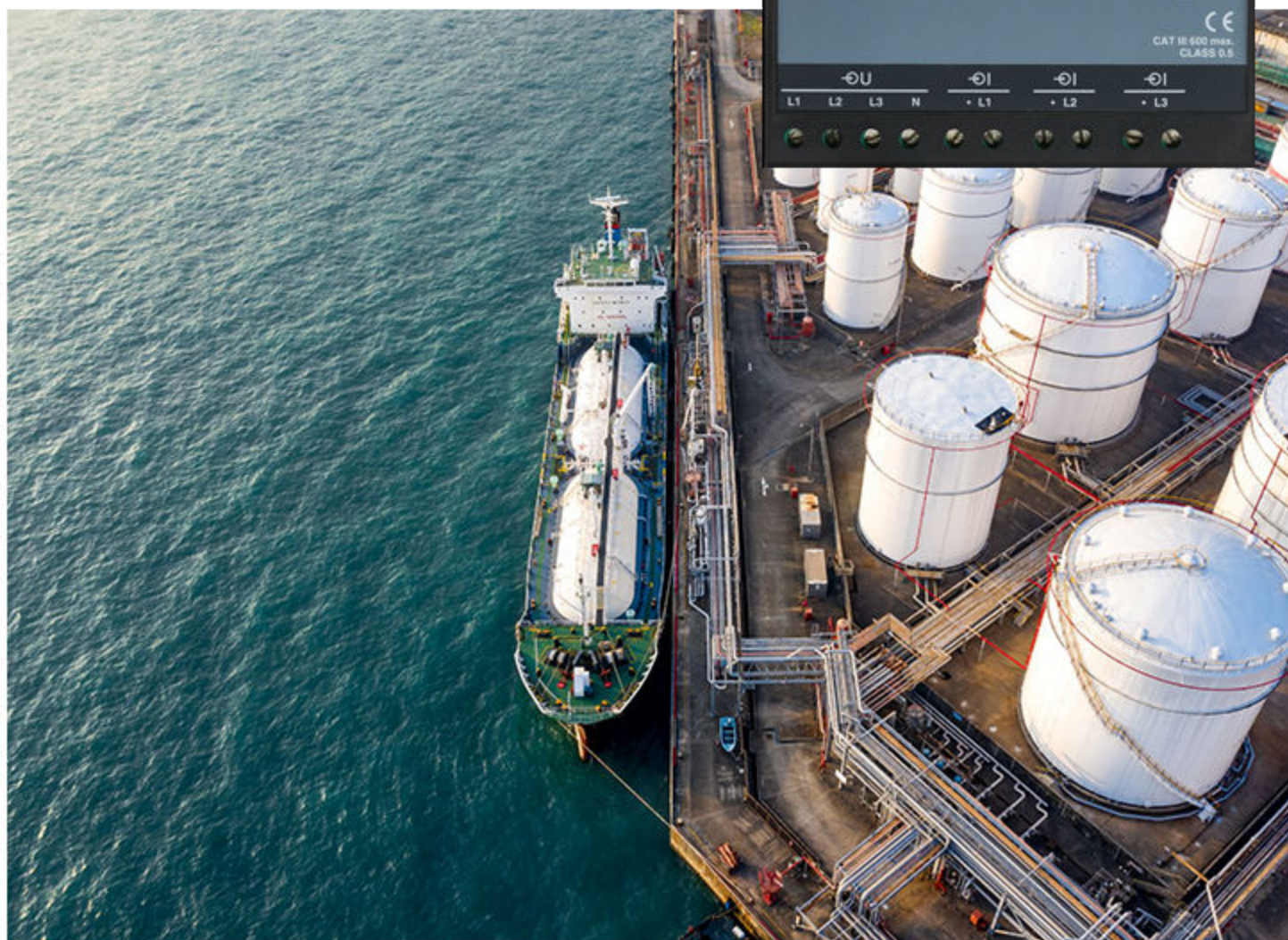
1. MTR-4P

1.1 About the MTR-4P

The MTR-4P is a traditional protection relay suitable for both single-phase and three-phase electrical power networks, including those that require marine approval.

The MTR-4P measures RMS values by means of fast sampling of voltage and current signals, which makes the instrument suitable for acquisition of transient events.

A built-in microcontroller calculates measurements from the measured signals. For example, voltage, current, frequency, energy, power, power factor, THD and phase angle.

Features
• 13 multi-function protections
• Measurements of instantaneous values, for example, V, A, kW, kVA, kvar, kWh, kvarh, PF, Hz, MD thermal and THD. With configurable outputs for more than 50 parameters.
• Power accuracy class 0.5 (0.4)
• Serial communication, RS-485 up to 115,200 bit/s optional
• Modbus communication protocol
• Up to four relays
• Single wide auxiliary power supply range 20 to 300 V DC, 48 to 276 V AC (tolerances included)
• Automatic range of nominal current and voltage (max. 20 A (12.5 to 20 A for 60 s) and 600 V_{L-N})
• Housing for DIN rail mounting
• Start-up delay
• Password protection (two levels)
• User-friendly configuration software

1.2 Standard compliance

Standard	Description
EN 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use.
EN 60688	Electrical measuring transducers for converting AC electrical variables into analogue and digital signals.
EN 61000-6-2	Electromagnetic compatibility (EMC) – Immunity for industrial environments.
EN 61000-6-4	Electromagnetic compatibility (EMC) – Emission standard for industrial environments.
EN 60529	Degrees of protection provided by enclosures (IP code).
EN 60068-2-1/ -2/ -6/ -27/-30	Environmental testing (-1 cold, -2 dry heat, -6 vibration, -27 shock, -30 damp heat).
IEC 60255-1/-127	Type tests (partly) in accordance with IEC 60255-1 (2009) and -127 (2010). Environmental tests in accordance with DNV/GL -CG-0339 ed. November 2015: Temperature, Humidity, Cold, Vibration and EMC
UL 94	Tests for flammability of plastic materials for parts in devices and appliances.

1.3 Application

The range of I/O modules makes MTR-4P the perfect choice for many applications.

MTR-4P supports standard serial communication RS-485 with speeds up to 115,200 baud, which is perfect for simple applications and serial bus interfacing.

The USB 2.0 interface can be used for fast setup, without any need for an auxiliary power supply.

However, the USB 2.0 interface is NOT galvanically separated from the power input and must be used ONLY unconnected to power inputs.

1.4 Programming

The MTR-4P protection relay is fully programmable using M-Set utility software.

Values such as primary-secondary ratio (U, I), energy counter, input and output are all programmed by setting software on the USB or the RS-485 communication.

1.5 Protections

MTR-4P supports 13 different protection functions in six different logical categories.

Category	Protection function
Voltage	Over/under voltage
Current	Over-current
Frequency	Over/under frequency
Asymmetry	Voltage unbalances and phase imbalances
Load	Directional power, power underrun
LoM	phase shift, ROCOF df/dt

ANSI designation	Protection function	Symbol	Notes
50	Over-current	$(>I, >>I)$	You can define up to two over-current limits with up to 2000 % of nominal current.
50N/G	Over-current – earth	$(>I_E, >>I_E)$	You can define up to two over-current limits within the range of 0.4 to 550 % of nominal current
87N	Over-current – differential	$(>I_{diff}, >>I_{diff})$	You can define up to two over-current limits within the range of 0.8 to 200 % of nominal current.
59	Over-voltage	$>U, >>U$	You can define up to two over-voltage limits with up to 150 % of nominal voltage.
27	Under-voltage	$<U, <<U$	You can define up to two under-voltage limits with down to 50 % of nominal voltage.
81O	Over-frequency	$(>f, >>f)$	You can define up to two over-frequency limits with up to 150 % of nominal frequency.
81U	Under-frequency	$(<f, <<f)$	You can define up to two under-frequency limits with down to 50 % of nominal frequency
32	Directional power	$(>P, >>P)$	Protection based on calculated active power. Active over-power monitoring is used to detect overloads and allow load shedding. You can define up to two alarm limits within the range of -300 % to 300 % of the rated active power.
32R/U	Power underrun	$(<P, <<P)$	Protection based on calculated active power. This user-defined limit defines the permissible deviation of the load from defined thresholds.

ANSI designation	Protection function	Symbol	Notes
			The alarm is triggered if the measured value drops below the rated active power limit and can be set between -300 % and 300 %.
46	Phase imbalance	$(>I_{im}, >>I_{im})$	Protection over phase imbalance resulting from phase inversion, unbalanced supply or distant fault, detected by the measurement of negative sequence voltage. This threshold is defined relative to the rated current and has a range of 0 to 100 %.
47	Voltage unbalance	$(>U_{Un})$	Protection over phase unbalance resulting from phase inversion, unbalanced supply or distant fault, detected by the measurement of negative sequence voltage component of a three-phase system. This parameter has a range of 0 to 100% of the rated nominal voltage
78	Phase shift	$(> dPhi/dt)$	Protection based on exceeding the phase angle deviation rate for any of the three phases. This limit for single-phase and three-phase shifts respectively can be set in the range of 0 to 90°.
81R	ROCOF	(df/dt)	Protection based on exceeding the Rate Of Change Of Frequency within the system. This parameter has a permissible limit range of 0 to 10 Hz/s.

Under each particular protection category, an alarm triggering limit can be set for each function, based on a particular parameter limit in %.

Compare time delay
From 0 to 300 seconds.

Compare time delay is set to define the time limit before the protection takes effect. When the protection function is switched off a hysteresis value (0 to 10%) is set to prevent premature triggering.

An *assigned output* can be selected for each protection function.

Available protections in detail
Each individual relay output can be set up with different output signals. For example, normal, normal inverse, latched, latched inverse, pulsed, pulsed inverse, always ON or always OFF.

MTR-4P has a *start-up delay* (0 to 300 s), inhibiting the output relays when the auxiliary supply is powered on.

The protection functions start simultaneously with the start-up delay, but the relay outputs stay in OFF state until expiration of the start-up delay time.

After expiration of the start-up delay time, modules are set according to present network conditions. If a fault is detected and the compare time delay has expired during the start-up delay, it will change into fault condition when the start-up timer has expired.

The start-up delay and the latched output function are often used as a manually reset function of fault condition, by which a normally closed switch (external) resets the auxiliary supplies.

2. Technical specifications

2.1 Dimensions
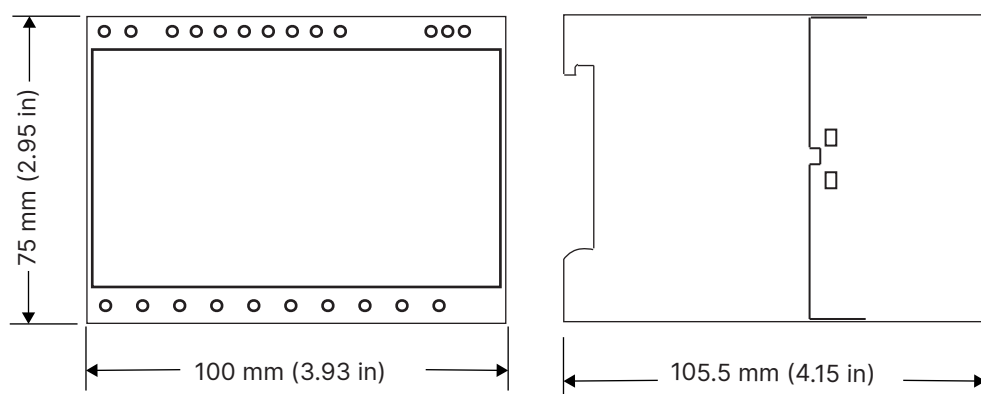
Category	Specifications
Dimensions	W X H X D: 100 x 75 x 105.5 mm (3.93 x 2.95 x 4.15 in)
Weight	370 g (0.81 lb)

2.2 Accuracy

Measured values	Range		Accuracy class*
RMS current (I1, I2, I3, Iavg, In)	-1/-5 A		0.4 (0.2)**
Maximum current	20 A (12.5 A to 20 A for 60 s)		0.4 (0.2)**
RMS phase voltage (U1, U2, U3, Uavg)	62.5, 125, 250, 500 V $_{L-N}$		0.4 (0.2)**
Maximum voltage	600 V $_{L-N}$ (1000 V $_{L-L}$)		0.4 (0.2)**
RMS phase-to-phase voltage (U12, U23, U31, Uavg)	866 V $_{L-L}$		0.4 (0.2)**
Frequency (f)	16 to 400 Hz		0.02 or 10 mHz
Power angle (φ)	−180 to 0 to 180°		0.2°
Power factor (PF)	−1 to 0 to +1 U = 50 to 120 % U_n [1]I = 20 % to 200 % I_n [2]I = 2 % to 20 % I_n		[1]0.2 [2]0.5
THD (U), THD (I)	5 to 500 V 0 to 400 %		0.5
Active Power	75	375	
Reactive power	120 250	600 1250	0.5 (0.3)**
Apparent power	500 [W/var/VA] I_n = 1 A	2500 [W/var/VA] I_n = 5 A	
Active energy			Class 1
Reactive energy			Class 2

NOTE * All measurements are calculated with high harmonic signals.

  ** Accuracy on RS-485 Modbus values.

2.3 Analogue inputs

Voltage inputs	
Number of channels	4 *
Nominal range values	62.5, 125, 250, 500 V_{LN} - Auto range
Nominal voltage (U_N)	500 V_{LN}, 866 V_{LL}
Measuring range (cont.)	2 to 600 V_{LN} (1000 V_{LL}) sinusoidal
Max. allowed value acc. to IEC/EN 60688	1.2 x U_n permanently 2 × U_n, 1 s, 10 times and 10 s interval
Consumption	< U^2/3.3 MΩ per phase
Input impedance	3.3 MΩ per phase

Current inputs	
Nominal range values	0.01 to 10 A – Auto range
Nominal current (I_N)	1 A or 5 A (defined by software settings)
Measuring range	1 mA to 20.0 A sinusoidal (12.5 to 20 A for 60 s)
Min. measurement (noise reduction)	Settings from *starting current for all powers*****
Max. measurement	20 × I_n (I_n = 1 A), 4 × In (I_n = 5 A)
Max. allowed value (thermal)	15 A cont.
Acc. to IEC/EN 60688	20 × I_N, 5 × 1 s, 300 s
Acc. to IEC/EN 60255	20 A for 60 s
Consumption	< I^2 × 0.01 Ω per phase

Frequency	
Nominal frequency (f_n)	50 or 60 Hz
Measuring range	16 to 400 Hz***

Universal power supply	
Nominal voltage AC	48 to 276 V (tolerances included)
Nominal frequency	45 to 65 Hz
Nominal voltage DC	20 to 300 V (tolerances included)
Consumption	< 8 VA
Power-on transient	< 20 A, 1 ms

NOTE * 4th channel is used to measure $U_{EARTH-NEUTRAL}$.

** Starting current is set by setting software M-Set/settings/general.

*** For frequency measurement only.

2.4 Relay outputs

Electromechanical relay output	
Purpose	Alarm, pulse, general purpose digital output.
Type	Electromechanical relay switch

Electromechanical relay output	
Rated voltage	48 V AC/DC (+40 % max)
Max. switching current	1000 mA
Contact resistance	≤ 100 mΩ (100 mA, 24 V)
Pulse	Max. 4000 pulses/hour
Pulse length (if used as pulse output)	Min. 100 ms
Insulation voltage between coil and contact	4000 V DC
Insulation voltage between contacts	1000 V DC
Response time	<= 50 ms

Connection

The terminal connections are designed for a maximum conductor cross-section of 2.5 mm^2 with a pin terminal or 4 mm^2 with a solid wire.

2.5   Communication

Communication		
Interface	RS-485	USB
Type of connection	Network	Direct
Max. connection length	1000 m	3 m
Number of bus stations	≤ 32	-
Terminals	Screw terminals	USB-mini
Insulation	Protection class I, 3.3 kV AC RMS 1 min	No galvanic separation!
Transmission mode	Asynchronous	
Protocol	Modbus RTU	
Transmission speed	2400 to 115,200 bit/s	USB 2.0

2.6   Response time and power status

Feature	Description
Response time input→communication	All calculations are averaged over a time interval, consisting of between 8 to 256 periods. The preset interval is 64 periods, which is 1.28 s at 50 Hz. Modbus table refresh time is 50 ms.
Power status LED	Red = instrument power ON

2.7   Environmental specifications

Operating conditions and mechanical specifications	
Protection degree	Acc. to IEC/EN 60529 IP20 Protection class II
Pollution degree	2
Installation category	Acc. to EN 61010-1 CAT III, 600 V meas. inputs CAT III, 300 V aux. supply

Operating conditions and mechanical specifications	
Galvanic isolation	Acc. to EN 61010-1 UAUX↔AO, COM: 3310 V AC, 50 Hz, 60 s UAUX↔U, I inputs: 3310 V AC, 50 Hz, 60 s U in↔AO, COM: 3310 V AC, 50 Hz, 60 s I in↔AO, COM: 2210V AC, 50 Hz, 60 s U in↔I in: 3310 V AC, 50 Hz, 60 s
Vibration	IEC 60068-2-6, 3 to 13.2 Hz: 2 mmpp. 13.2 to 100 Hz: 0.7 g. Acc. to IEC 60068-2-6 & IACS UR E10
Shock	50 g, 11 ms, half sine. Acc. to IEC 60068-2-27
EMC	Acc. to EN 61000-6-2 and EN 61000-6-4
Mounting	Rail mounting 35 × 15 mm Acc. to DIN EN 50022
Enclosure material	PC/ABS
Flammability	Acc. to UL 94 V-0
Ambient temperature	Usage group I
	-5 to 0 to 45 to 55 °C (accuracy outside reference temperature range is not more than 2x class)
	Acc. to IEC/EN 60688
Operating temperature	-30 to +70 °C
Storage temperature	-40 to +70 °C
Average annual humidity	≤ 93 % RH

2.8   Order specification

Name	Output				RS-485	DEIF no.	EAN no.
	1	2	3	4			
MTR-4P105	RO					1200510030	5703727116287
MTR-4P205	RO	RO				1200510031	5703727116294
MTR-4P415	RO	RO	RO	RO	●	1200510032	5703727116300

3. Legal information

3.1 Disclaimer and copyright

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