



# **PM-1** Power measurement terminal

## Measuring energy flows flexibly and efficiently

Module PM-1 allows cost-effective measurement of relevant network values in low and medium voltage networks for monitoring the power supply and loads on the primary systems. It also allows for measurement of characteristic values for voltage quality in accordance with DIN EN 50160 and provides basic data as per ISO 50001.

As an extension module from the net-line FW-5 series5+/FW-5-GATE series, the PM-1 is inserted into the I/O area of the bay station controller which also supplies it. setIT specifies the parameters and the selection of measured values from V5.001. All values are integrated directly in the process data from where they can be monitored, sent and recorded based on custom criteria. The new variants using Rogoski coils or low voltage sensor even more simplify the integration of measurements in substations.

#### **Typical application areas**

- Distribution networks, local network stations, transformer stations
- Decentralised generation plants
- Systems with decentralised voltage distribution
- Industrial systems

#### **Brief profile PM-1**

Power measurement module for recording relevant mains values in low and medium voltage systems. Measuring currents  $I_{1}$ ,  $I_{2}$ ,  $I_{3}$ ,  $I_{N}$  using CT, Rogowski coil\* or sensor\*. Voltage measurement  $U_1, U_2, U_3$  in LV network, direct or via transformer/ sensor\*. Calculating I<sub>eff</sub>/U<sub>eff</sub> TRMS, U<sub>11</sub>, P, Q, S, W, f, THD, power factor, active and reactive power and temperature of the module in the field. Flexible selection of capacity from 46 measured values, 9 single-point information and 8 metered values. Integration as an extension module in telecontrol and station control systems of type FW-5 series5+ /FW-5-GATE.

Internal supply and communication via system bus. Configuration as an I/O card in setIT from V5.001. Dimensions: 22.5 x 105 x 115 mm (WxHxD)

#### **Convenient performance recording**

The connection of the power measurement terminal PM-1 to LV or MV networks is provided by means of measurement transducers, a Rogowski coil\* or sensors\*. Voltage measurement can be carried out directly in the LV network without the need for expensive components. All values are calculated directly in the module and do not load the core process. Additional variables can be determined using a calculated value function in the station.

### Values for the PM-1 power measurement terminal

- 4 currents  $I_1/I_2/I_3/I_N$
- 3 voltages U<sub>1</sub>/U<sub>2</sub>/U<sub>3</sub>
- External conductor voltages U<sub>12</sub>/U<sub>23</sub>/U<sub>31</sub>
- Active power P<sub>tot</sub>/P<sub>1</sub>/P<sub>2</sub>/P<sub>3</sub>
- Reactive power Q<sub>tot</sub>/Q<sub>1</sub>/Q<sub>2</sub>/Q<sub>3</sub>
- Apparent power  $S_{tot}/S_1/S_2/S_3$
- Power factors PF<sub>medium</sub>/PF<sub>1</sub>/PF<sub>2</sub>/PF<sub>3</sub>
- Frequencies  $f_{medium}/f_1/f_2/f_3$
- Harmonic distortion THDi,/THDi,/THDi,
- Harmonic distortion THDv<sub>1</sub>/THDv<sub>2</sub>/THDv<sub>2</sub>
- Energy W<sub>tot</sub>/W<sub>1</sub>/W<sub>2</sub>/W<sub>3</sub>
- Reactive energy Wb<sub>tot</sub>/Wb<sub>1</sub>/Wb<sub>2</sub>/Wb<sub>3</sub>
- Counter value energy W<sub>tot</sub>/W<sub>1</sub>/W<sub>2</sub>/W<sub>3</sub>
- Counter value reactive energy Wb<sub>tot</sub>/Wb<sub>1</sub>/Wb<sub>2</sub>/Wb<sub>3</sub>
- Temperature at the module
- Load flow direction L<sub>1</sub>/L<sub>2</sub>/L<sub>3</sub>
- Overcurrent/overvoltage message
- Connection error rotary field message

Wanderverhäbna								
						Skalerungen		
		primär		sekundär		Spannung	¥.	
Spannung	LI	1	1	1		Strom	A	
	L2	1	1	1		Wildeistung	kW	
	L3	1	1	1		Bindeistung	kvaR	
Strom	LT	250	12	1.4		Scheinleistung Energie	kva	
	12	250	1	1.4			kWh	2
	13	250	1	1.4			Wh kWh	
	N	1	1	1.4			Millh	_
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Network connection settings in setIT, here LV with direct voltage measurement

#### **Easy integration**

The PM-1 module is used as an extension to the FW-5 series5+ and FW-5-GATE systems. It is simply inserted directly onto the TBUS of the station. Parameterisation is integrated fully into setIT and can be successfully used with only a few configuration steps.

In the card properties you can adjust the transformer ratios phase by phase and select the network parameters. The measuring ranges are automatically stored with reference to the specifications; all you need to do is select the desired values from the process data list according to the application. The overvoltage and overcurrent are also set automatically. Further evaluation can take place individually with the limit monitoring of the measured values and the indication/logging functions of substation control.



Power detection and control function in the local network station

#### Energy management system according to EN ISO 50001

With the power measurement terminal, all options for recording the energy flows and therefore energy optimisation are available in one network section, one industrial plant or just one machine. The standard functions of the telemetry enable the aggregation of this data in interval archives or synchronous measurement recording, including failsafe storage, so that this data can be supplied inexpensively to an energy management system in accordance with ISO 50001.

#### Voltage stability according to EN 50160

The power measurement terminal provides a range of basic information for the evaluation based on EN 50160, in particular, voltages, frequencies, and distortion. The measurand module of the bay station controllers already enables the calculation of the required average values with the monitoring of four limit values. The separate measurement of fast and slow voltage changes can be achieved through virtual process data (calculated value). Through the selective imaging of limit value infringements as system messages it is possible to send separate information and record the number and duration of voltage range violations via operating hours and switching cycles in the station. These values can be collated using the archiving function and thereby provided for statistical evaluation based on EN 50160.

#### Current and voltage measurement with sensors

The use of current and voltage transformers represents a significant expense, not only with respect to installation, but also running costs. Sensors are an alternative here, also when retrofitted into existing installations. Voltage sensors can be used in the T-connectors in the cable harness of the switching station without on-site calibration. Current sensors are positioned around the cable or at the T-connector. Both of them supply a standardised small signal which can be connected directly to the PM-1-S\* without any further measuring transducers. Installation can be prepared by the system installer or subsequently carried out inexpensively by replacing the T-connectors.

#### **Elegant retrofitting with Rogowski coil**

Rogowski coils are an ideal way of measuring current. The Rogowski coil can be simply attached to the busbar or cable. As the output signal, the coil delivers a low voltage of 100 mV/1 kA; a measurement up to 4 kA is possible with only a small error and the best linearity.

Rogowski coils can be connected directly to the PM-1-R\* without a measurement signal transducer. As a result, the acquisition method is very elegant, particularly in the low voltage range.

Especially at stations at which there are many feeders connected to the low voltage system, the actual conditions in the LV network can be measured by this simple and inexpensive retrofitting before expensive equipment has to be replaced.

#### Properties of the Rogowski coil PACT RCP

- Linear measurement up to 4000 A ±0.1%
- Quick mounting without conversion
- Use on cable or busbar
- Acquisition almost independent of installation position, delta<1%</li>
- Coil available in three diameters 95 / 140 / 190 mm
- Busbar clip with arresting devices for confined installation
- Broad range of use -30° ... +80° C, 40 Hz to 20 kHz
- Rated insulation voltage 600 V AC (rms CAT IV) 1000 V AC (rms CAT III)



Installation of a Rogowski coil on busbar © Phoenix Contact GmbH

Technical data:	PM-1			
Design	Power measurement terminal for telecontrol and substation automation in micro-housing, polyamide V0, IP20, DIN top-hat rail installation	Product variants & accessories		
Networks	Measurement in medium voltage networks Measurement in low voltage networks Four-conductor networks, three-conductor networks, single-phase	<b>PM-1</b> Power measurement terminal direct voltage measurement (400 V)		
Current measurement	<b>PM-1</b> 4 current measurement inputs I <sub>1</sub> , I <sub>2</sub> , I <sub>3</sub> I <sub>N</sub> TRMS, sampling frequency 8 kHz, error ±0.2% 0 1 A /5 A, overload max. 60 A (1 s), resolution 1 mA, load impedance 10 mΩ	or via VT 100/110 V Current measurement via CT 1/5 A		
	<b>PM-1-R</b> 0 400 mV (4 kA primary, 50 Hz), resolution 24 μV (240 mA), imp. 490 kΩ <b>PM-1-S</b> 0 225 mV, resolution 24 μV, load impedance 490 kΩ	<b>PM-1-R</b> Variant with Rogowski coils* as		
Voltage measurement	<b>PM-1 / PM-1-R</b> 3 voltages U <sub>1</sub> , U <sub>2</sub> , U <sub>3</sub> TRMS, sampling frequency 8 kHz, error $\pm 0.2\%$ 0. 230 V AC U <sub>2</sub> calculated resolution 30 mV load impedance 1130 kQ	current transformer Voltage measurement as for PM-1		
	<b>PM-1-S</b> 0 3.25/ $\sqrt{3}$ V AC, U <sub>LL</sub> calculated, resolution 500 μV, load impedance 19.1 kΩ	<b>PM-1-S</b>		
Network variables	Frequency, 45 66 Hz, resolution 0.01 Hz, average and phase-selective P, Q, S capacity, error $\pm$ 0.5%, total and phase-selective Energy W, W <sub>b</sub> errors $\pm$ 0.5%, total and phase-selective THD, harmonics up to 63., errors $\pm$ 2%, phase-selective	for voltage and current		
Data range	<ul> <li>46 measured values (among others) I, U, U<sub>LL</sub>, P, S, Q, W, W<sub>b</sub>, f, PF, THD and temperature</li> <li>9 Single-point information: Faults, energy direction, rotary field errors</li> <li>8 Counter values for power measurement</li> <li>3 Single commands for acknowledgement</li> </ul>	<b>Measurement transducers</b> Typical measurement /split-core CT 1 A, 5 A or VT 100 V are used. Using measurement cores for		
Measurement accuracy	according to DIN EN 61557-12:2008	protection (P) is not permitted.		
Status indicators	LED in front plate for voltage, load, rotary fields and system status	Rogowski coil		
Supply	Internal via TBUS 150 mA @ TBUS	Current measurement up to 4000		
Dielectric strength	4 kV rated surge voltage, CAT III (300 V)	/140 /190 mm, including busbar		
Temperature	internal measurement sensor -20° +100° C, errors ±1%	holder, cable 3 m		
Standards	EMC: DIN EN 61000-6-2:2006, DIN EN 61000-6-4:2011 Insulation: DIN EN 60870-2-1:1997	* starting with setIT V5.003.02		
Housing	Micro housing, Polyamide V0, IP 20, dimensions 22.5×105×115 mm (W×H×D) DIN top-hat rail, DIN-EN 60715 TH35 Screw terminal MSTB, 0.2 to 2.5 mm <sup>2</sup>			
Ambient temperature	-20° C +70° C			
Relative humidity	< 95%, without condensation	IT-systems		

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