



MT174

Three-Phase Static Electricity
Multi Tariff Meter
with Maximum Demand Indicator
and Load-profile



MT174 - Electronic three-phase time-of-use electricity meters

The MT174 electronic three-phase meters are designed for measurement and registration of active, reactive and apparent energy and demand in three-phase four-wire networks. They can be connected directly to the network. The metering and technical properties of the meters comply with the EN 50470-1 and -3 European standards for active energy meters, classes A and B, as well as with the IEC 62053-21 and IEC 62052-11 international standards for electronic meters of active energy for classes 1 and 2, and optionally with the IEC 62053-23 international standard for electronic meters of reactive energy for classes 2 and 3.

A built-in time-switch complies with the IEC 62054-21 and IEC 62052-21 standards. It enables energy registration in up to four tariffs.

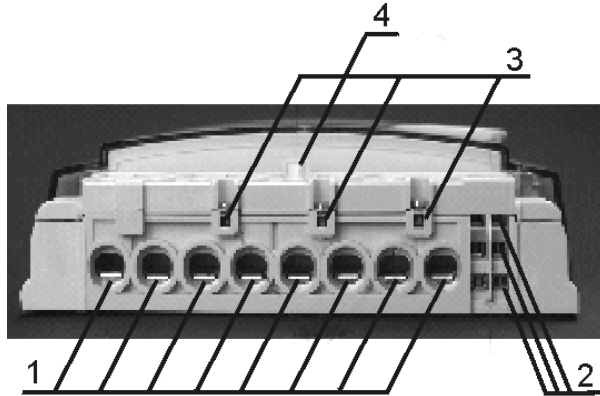
The meter software complies with WELMEC 7.2 Issue 1 Software Guide (Measuring Instruments Directive 2004/22/EC).

The MT174 meters are designed for mechanical environment M1, electromagnetic environment E2 and climatic environment -40°C ... +60°C, relative humidity 95% non-condensing, closed location. The meters can be installed in any position.

The meters are designed and manufactured in compliance with the ISO 9001 (2000) standard.

Terminal block for direct connected meters

The terminal block for direct connected meters contains current terminals, auxiliary terminals and potential links for power supply of the voltage metering circuitry.

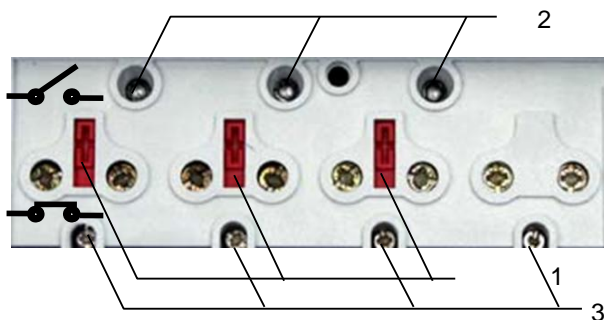


Terminal block of direct connected meters

- 1. Current terminals
- 2. Auxiliary terminals
- 3. Auxiliary voltage terminals for an add-on unit
- 4. Terminal cover opening detector

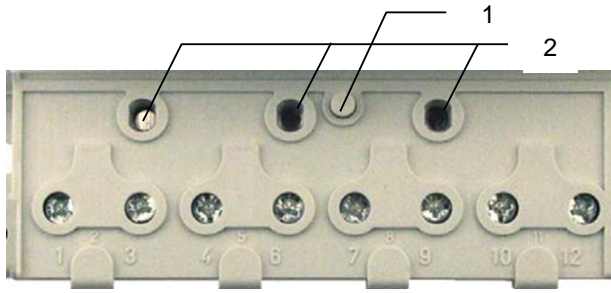
The 85 A terminal blocks has only one screw per current terminal, while 120 A terminal blocks has two screws per current terminal. Due to indirect pressure to the conductors the terminal screws do not damage it. The current terminals make a reliable and durable contact regardless if the conductor is made of copper or aluminium.

Voltage metering elements are power supplied via potential links. Sliding potential links are self-braking and enable easy disconnection of current and voltage metering circuitry. In the metering mode they should be in their lowest position (closed contact), and in the meter testing mode they should be in their highest position (opened contact). On request, the potential links can be located under the meter cover.



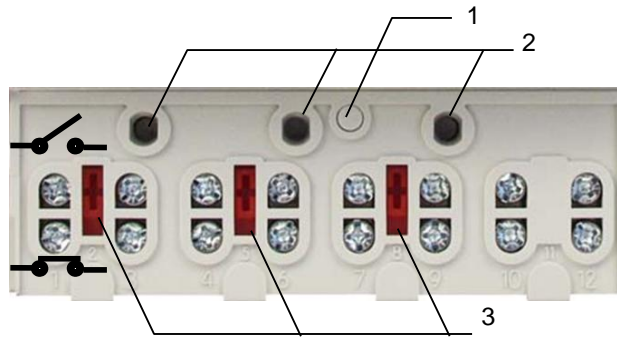
- 1. Sliding potential links (opened contacts)
- 2. Phase voltage test contacts
- 3. Terminals of auxiliary voltages

Potential links in the terminal block



- 1. Detector of terminal cover opening
- 2. Phase voltage test contacts
- b. Potential links under meter cover

Terminal blocks of direct connected meters for $I_{max} = 85 \text{ A}$



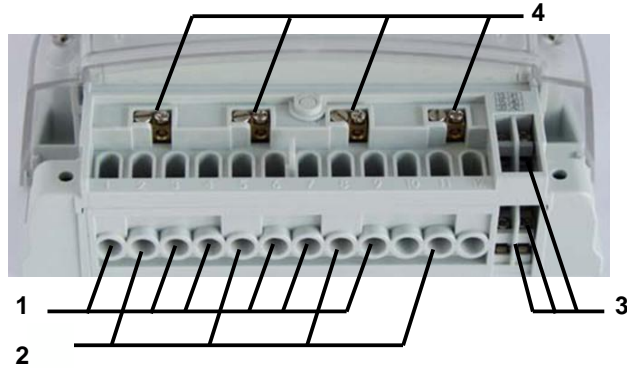
- 1. Detector of terminal cover opening
- 2. Phase voltage test contacts
- 3. Sliding potential links (opened contacts)

Potential links in the terminal block of direct connect meters for $I_{max} = 120 \text{ A}$

Terminal block for CT operated meters

The CT operated meters have separate voltage terminals (Fig. 5, item 2) in the terminal block. They are used for supplying the voltage metering circuitry. The voltage terminals are equal to the current terminals (Fig. 5, item 1). The current and voltage terminals are made of solid brass with a 5 mm bore diameter; the conductors are fixed in the terminals with two screws.

Terminal block of a CT operated meter



- 1. Current terminals
- 2. Voltage terminals
- 3. Auxiliary terminals
- 4. Auxiliary voltage terminals for add-on unit

Auxiliary Terminals

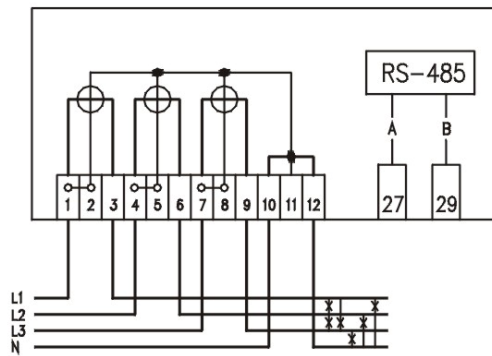
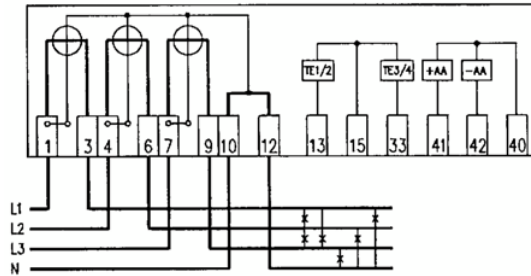
Up to six auxiliary terminals can be built in a terminal block. They are used for tariff inputs, impulse outputs or tariff outputs or RS485 interface. Due to a limited number of auxiliary terminals, all stated inputs and outputs as well as the interface can not be built in the meter at the same time. The bore diameter of the auxiliary terminals is 3.5 mm. Wires are fixed with a screw. Three auxiliary voltage terminals for power supply of an external device can be also built-in. The auxiliary terminals are nickel-plated at a tropical meter version.

The auxiliary terminals enable combinations of the following meter functionalities:

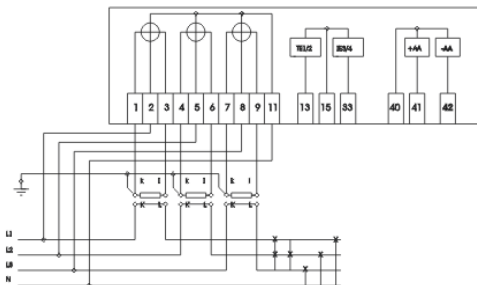
Version	Left side auxiliary terminals	Right side auxiliary terminals
1	Two tariff inputs	Two pulse outputs
2	Two tariff inputs	RS485 interface
3	Two pulse or tariff outputs	RS485 interface

METER CONNECTION DIAGRAM

The meter connection diagram is stuck on the inner side of the terminal block cover or is printed on the meter nameplate. The meters can be connected in three-phase four- or three-wire networks, as well as in a single-phase two-wire network.



a. Connection diagrams of direct connected meters MT174



b. Connection diagram of CT operated meter MT174

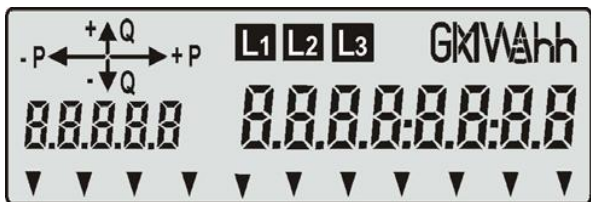
METER INSTALLATION

1. Check if voltage and maximum current printed on the meter name plate correspond to the voltage on the network and to the current which will flow through the meter.
2. Fix the meter with three screws to the measuring place.
3. Connect the meter in compliance with the connection diagram which is stuck in the inner side of the terminal cover (or printed on the meter name plate).
4. Tighten the terminal screws with appropriate torque. The recommended torque for tightening current terminal screws is 2.5 Nm.
5. Check the meter operation indicators:
 - kWh/imp (kvarh/imp) LED is lit (load current is smaller than the meter starting current)
 - kWh/imp (kvarh/imp) LED is blinking with frequency that is proportional to the measured demand (the meter measures and registers energy)
 - kWh/imp (kvarh/imp) LED is not lit (the meter is in no-power state). In this case the following should be checked:
 - a) At directly connected meters: voltage links in lower position (if not, the voltage links slides should be moved to their lower position)
 - b) Connected current conductors to the meter (if not, they should be connected)
 - c) If both above conditions are fulfilled, it means that there is no voltage in the network. If there is a voltage in the network, something is wrong with the meter. In such a case the meter should be replaced.
6. Check the **L1**, **L2** and **L3** indicators on the LCD if current conductors are connected correctly:
 - **L1 L2 L3** indicators are displayed - all three phase voltages are present
 - Some of the **L1 L2 L3** indicators are not displayed (voltage in these phases is not present). Check if current conductors of these phases are connected and/or their voltage links are in the bottom position (at direct connected meters) or find the reason for the phase voltage absence and eliminate it.
 - Some of the **L1 L2 L3** indicators are blinking and at the same time import energy indicator is displayed indicating that current through that metering element is reversed. In such a case change the input and the output of the corresponding current terminals.
 - **L1 L2 L3** indicators are blinking – reversed phase sequence that causes rotation of magnetic field in reversed direction. In this case check current conductors sequence in the meter or find the place of reversed voltage phase sequence and connect them correctly.

Note: Reversed phase sequence does not influence in energy measurement accuracy
7. Check if alarm flags are displayed on the LCD and delete them. If necessary, remove a cause that they are displayed.
8. Check RTC date and time and correct them, if necessary.
9. Perform a meter billing reset (press the orange pushbutton)
10. Seal the meter (the terminal cover and the orange pushbutton cover).

LCD

The 7-segment LCD, with additional characters and symbols, complies with the VDEW specifications. Large characters and a wide angle view enable easy data reading. The LCD back-light illumination is available on request. The LCD is illuminated by short ($T_p < 2$ s) pressing the blue pushbutton. On request the back-light is turned-on all the time.



LCD

Data are displayed in the right-side by means of eight alphanumeric characters. The size of data characters is 8 mm high and 4 mm width. The OBIS code (by IEC 62056-61), without the first two characters from the left side, is employed for data identification. It is displayed in the left side corner by means of five 6 mm high alphanumeric characters.

An indicator of energy flow direction is displayed in the left top corner.

Note: If there is no load or the load current is lower than the meter starting current, the indicator of energy flow direction is not displayed.

A physical unit of displayed physical quantity is shown in the right top corner. The indicator of L1, L2, L3 phase voltages presence is displayed in the middle of the top row. If certain phase voltage is not present, the indicator of that phase is not displayed.

When the indicators L1L2L3 blink, this indicates wrong phase sequence.

When the indicator L1, L2 or L3 blinks and at the same time the arrow \leftarrow indicating export energy flow direction is displayed, it indicates reverse energy flow through the metering element in that phase. In the LCD bottom row there are eleven signal flags that indicate current valid tariff, meter status and alarms. The meaning of signal flags (see item 2.5.3) is engraved on the meter name plate below them.

DATA DISPLAY

Data defined in Auto scroll sequence and in Manual scroll sequence are displayed on the LCD.

Data from Auto scroll sequence are displayed in a circle, and each data is displayed for 8 seconds as a standard (default) display time.

At Manual scroll sequence the blue push-button should be pressed for displaying the next piece of data. Data in Manual scroll sequence remains displayed until the push-button is pressed again or until time for automatic return into the Auto scroll sequence is elapsed.

SIGNAL AND ALARM FLAGS

The signal flags in the LCD bottom row indicate certain meter status and alarms. They are grouped into three groups:

- actual tariff (first four flags on the left side)
- alarms (four flags in the middle)
- meter status (last three flags on the right side)

The MT174 meters enable indication of many different alarms but only four of them can be displayed on the LCD. If more than four alarms are to be indicated on the LCD, one signal flag can be used for two different alarms (e.g. one signal flag for both the meter cover and the terminal cover opening)

The signal flags from left to right have the following functions:

No.	FLAG	STATUS	MEANING
1	T1	Lit	Active first tariff
2	T2	Lit	Active second tariff
3	T3	Lit	Active third tariff
4	T4	Lit	Active fourth tariff
5 to 8	TC	Lit	Terminal cover has been opened ¹⁾ (option)
	MC	Lit	Meter cover has been opened ¹⁾ (option)
	FD	Lit	Field detector ²⁾ (meter has been tampered with a permanent magnet - option)
	REV	Lit	Energy flowing in reversed direction ³⁾ (option)
	BAT	Lit	Li-battery low ⁴⁾
	PD	Lit	Data display on LCD in no-power meter state ⁵⁾
9	DRO	Lit	Meter data downloading is in progress
10	FF	Lit	Meter fatal error ⁶⁾
11	SET	Lit	Meter in programming mode

¹⁾ The flag is active only if a corresponding cover opening detector is built into the meter.

²⁾ The flag is active only if an external magnetic field detector is built into the meter (option)

³⁾ The flag could be implemented only at one direction energy flow and at absolute energy meters

⁴⁾ The flag indicates that Li-battery is low and should be replaced.

⁵⁾ The flag is active only if no-power data displaying in the LCD was requested (option)

⁶⁾ If the FF signal flag is displayed, the meter should be dismantled from a place of measurement and sent to an authorized repair shop or to the manufacturer for examination and repair. At the same time the F.F.0 register is displayed. For its meaning see item 2.8.4 Fatal -error register.

LEDs

The meters for active energy only are provided with a LED (imp/kWh). The meters for active and reactive energy are provided with two LEDs (imp/kWh and imp/kvarh). The meters for active, reactive and apparent energy are provided with three LEDs (imp/kWh, imp/kVAh and imp/kvarh). The LED(s) are used for testing the meter accuracy and indicating meter operation. If current through the meter is smaller than the meter starting current, the LEDs (or a LED) are (is) permanently lit.

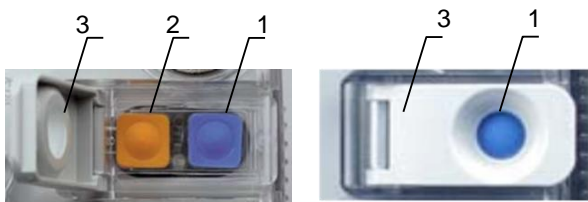
LED	STATUS	INDICATION
Imp/kWh Imp/kVAh Imp/kvarh	Blinks	Energy is registered. The pulse rate is proportional to the consumed power.
	Lit	Voltages applied to the meter, but load current is lower than the meter starting current.
	Not lit	Voltage not applied to the meter.

The emitted pulse rate depends on the meter version and load current.

Meter version	I _{max}	Meter constant
Direct connected (D2)	120 A	500 imp/kWh (500 imp/kVAh 500 imp/kvarh)
Direct connected (D1)	85 A	1.000 imp/kWh (1.000 imp/kVAh 1.000 imp/kvarh)
CT operated (T1)	6 A	10.000 imp/kWh (10.000 imp/kvarh, 10.000 imp/kVAh)

In the meter test mode pulse rate is increased to 40.000 imp/kWh (kVAh/imp and kvarh/imp) in order to shorten time needed for testing the meters at low loads.

Two pushbuttons are built in the meter cover



- 1 – Data scroll pushbutton
- 2 – Reset pushbutton
- 3 – Cover of the Reset pushbutton

Pushbuttons on the meter cover

RESET - an orange pushbutton under the hinged door that is fixed to the meter cover
Its primary function is to perform manual billing reset of the meter.

DATA SCROLL - a blue pushbutton that is always accessible. Its primary function is to display data from the Manual sequence on request

At the orange pushbutton the time duration of pressing does not influence to its function, while at the blue pushbutton there are three different time durations of pressing - each of them causing different effect:

- a. **Short** - pressing **shorter than 2 sec.** - the next data in the menu is displayed.
- b. **Long** - pressing **longer than 2 sec. and shorter than 5 sec.** - a submenu or a function whose name is displayed on the LCD is selected.
- c. **Prolonged** - pressing **longer than 5 sec.**
- the meter is returned up for one level of operation (e.g. on the third level it is necessary to press the blue pushbutton three times and always keep it pressed for more than 5 sec. in order to return to the automatic data display mode).

DISPLAY TESTING

A display is tested to check if all its segments function properly. In the automatic data display the blue pushbutton should be pressed for a short time ($T_p < 2$ s). The display is tested for 10 seconds and all its segments are displayed. After 10 seconds the meter returns to automatic data display mode automatically.

MANUAL DATA DISPLAY

Data are displayed on request as follows. The meter is set to the display testing mode. During the LCD test, the blue pushbutton is pressed for a short time ($T_p < 2$ s). The **Std dAtA** title is displayed. In this way a menu for selecting data display on request is entered.



In order to enter into the data display on request menu, the blue pushbutton should be pressed for a long time ($2 \text{ s} < T_p < 5 \text{ s}$). The first data from the Manual scroll list is displayed on the LCD. For displaying the following data from the Manual scroll list (see below), the blue pushbutton should be pressed for a short time again.

If the blue pushbutton has not been pressed for some time, the meter automatically returns back into the Auto scroll mode.

The exit from the Manual data display mode is performed by prolonged pressing the blue push-button ($T_p > 5 \text{ s}$).

Manual Scroll List

Active energy registers	
1.8.0	Positive active energy (A+) total [kWh]
1.8.1	Positive active energy (A+) in tariff T1 [kWh]
1.8.2	Positive active energy (A+) in tariff T2 [kWh]
2.8.0	Negative active energy (A-) total [kWh]
2.8.1	Negative active energy (A-) in tariff T1 [kWh]
2.8.2	Negative active energy (A-) in tariff T2 [kWh]
Instantaneous power registers	
21.7.0	Positive active instantaneous power (A+) in phase L1 [kW]
41.7.0	Positive active instantaneous power (A+) in phase L2 [kW]
61.7.0	Positive active instantaneous power (A+) in phase L3 [kW]
22.7.0	Negative active instantaneous power (A-) in phase L1 [kW]
42.7.0	Negative active instantaneous power (A-) in phase L2 [kW]
62.7.0	Negative active instantaneous power (A-) in phase L3 [kW]
Electricity network quality registers	
31.7.0	Instantaneous current (I) in phase L1 [A]
51.7.0	Instantaneous current (I) in phase L2 [A]
71.7.0	Instantaneous current (I) in phase L3 [A]
32.7.0	Instantaneous voltage (U) in phase L1 [V]
52.7.0	Instantaneous voltage (U) in phase L2 [V]
72.7.0	Instantaneous voltage (U) in phase L3 [V]
Miscellaneous registers used in sequences	
0.4.2	Current transformer ratio
0.9.1	Current time (hh:mm:ss)
0.9.2	Date (YY.MM.DD or DD.MM.YY)

PULSE OUTPUT

One pulse output (active energy meters for one energy flow direction or absolute meters) or two pulse outputs (active and reactive energy meter for one energy flow direction or active energy meters for two energy flow directions) can be built into the MT174 meters.

Note: Pulse output(s) are not available, if the meter is equipped with tariff output(s).

Pulse output	Default output pulse constant (pls/kWh)	
	I _{max} up to 85 A	I _{max} = 100 A or 120 A
Class A (S0)	500	250
Optomos relay	100	50

Note: Besides the 41 terminal either the 42 or the 43 auxiliary terminal can be used.

The pulse output is passive and complies with the IEC 62053-32 standard, class A (S0 in compliance with DIN 43864). The pulse constant is equal to the half value of the meter constant and the standard pulse width is 40 ms. However, a smaller pulse constant or a larger pulse length can be set on request. The class A pulses can be transferred to 0.5 m distance.

The pulse output(s) can be performed as an opto- mos relay with a make contact that can changeover 25 W (100 mA, 250 V) on request. In this case pulse transmission at a distance of 1 km is made possible. The pulse constant is equal to one tenth of the meter constant and the standard pulse width is 100 ms. However, a smaller pulse constant or other pulse lengths can be set on request.

Optional pulse widths are: 10 ms, 20 ms, 30 ms, 40 ms, 50 ms, 60 ms, 80 ms and 100 ms. The default pulse width is 40 ms at class A pulse output and 100 ms at optomos relay pulse outputs.

Optional pulse constants at direct connected meters are: 1.000 pls/kWh, 500 pls/kWh, 250 pls/kWh, 200 pls/kWh, 100 pls/kWh, 50 pls/kWh, 25 pls/kWh, 20 pls/kWh and 10 pls/kWh

The default pulse constants depending on the pulse output type and the meter I_{max} current is given in the table below

Pulse output	Default output pulse constant	
	I _{max} up to	I _{max} = 100 A
Class A	50	25
Optomo	10	50

Warning:

When other than default pulse width and pulse constant are required, attention should be paid that the selected values do not cause overlapping of the pulses at maximum load.

The pulse outputs can be dedicated to any energy which is measured.

MT174 METER IN PHOTOVOLTAIC (PV) INSTALLATIONS

The renewable energy sources including photovoltaic panels, fuel cells and wind power plants deliver environmentally friendly, sustainable electrical power. In recent years, the power generating photovoltaic systems have become increasingly popular with the residential consumers.

To make the DC voltage produced by these systems available to consumers or to feed it into the power grid it needs to be transformed into AC voltage of 230 V and 50 Hz. This transformation is commonly made by the use of photovoltaic converters. Unfortunately, these devices may produce broad frequency disturbance signals ranging from the low frequency harmonics to conductive and radiated electromagnetic interference in the MHz range.

In a typical residential photovoltaic system a three-phase electricity meter will be installed as shown on Fig. 18 below. This way it can measure the consumed electric energy and the energy delivered to the grid (note: a second single-phase PV meter may be used to measure only the energy delivered by the solar panels).

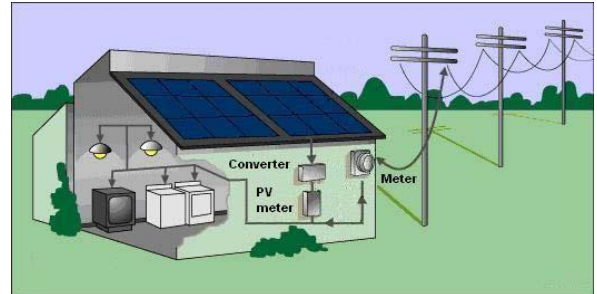


Fig. 18: A typical residential solar installation

The three-phase electricity meter of type MT174 complies with the requirements of the »Leitfaden zur Bewertung der Zuverlässigkeit und Messbeständigkeit von Elektrizitätszählern und Zusatzeinrichtungen« published by the German VDE (Verband der Elektrotechnik Elektronik Informationstechnik) in March 2011. This means that the meter is resistant to the symmetrical perturbation currents emitted by PV converters in the range 2 - 150 kHz and may therefore safely be used in a photovoltaic installation.