GOSSEN METRAWATT

Condensed Operating Instructions 3-349-868-03
8/8.22

# ENERGY**MID**

## Electronic Energy Meters
## Direct Connection EM2281/EM2289
## Via Transformer EM2381/EM2387/EM2389

**DANGER**

**Life endangering! Danger of injury!**
**Incorrect installation and use.**

Read and comply with all further product documentation, in particular the operating instructions. Available at www.gossenmetrawatt.com > Products > Industrial Measuring Technology > Energy Management > Energy Meters > EM2281 ... EM2389 or QR code shown above.

### Contact, Support and Service

Gossen Metrawatt GmbH can be reached directly and without hassle – we have a single number for all of your needs!

+49-911-8602-0 Monday to Thursday 8 a.m. to 4 p.m.
Friday: 8 a.m. to 2 p.m.

support.industrie@gossenmetrawatt.com

Please contact GMC-I Service GmbH for repairs and verification:

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## 1 Safety Precautions

**DANGER**

**Electric shock due to live components!**
**Life endangering due to electric arcs!**

Touching voltage conducting components is life endangering!
- Installation may only be performed by a qualified electrician.
- Observe and comply with all safety regulations which are applicable for your work environment.
- Wear suitable and appropriate personal protective equipment (PPE) whenever working with the instrument.
- During installation, the installation environment must be voltage-free.
  Observe the five safety rules in accordance with DIN VDE 0105-100.

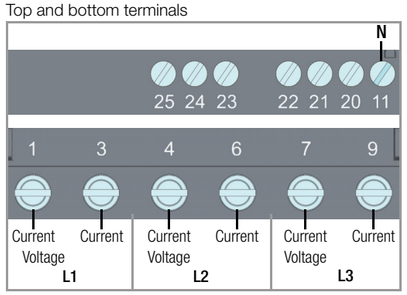
**CAUTION**

**Incorrect Installation**

Incorrect installation may result in property damage to the product and/or the respective system.
Risk of operational malfunctions.
- Observe the specified technical data, characteristic values and ambient conditions.
- The instrument may only be installed and operated if it and all connecting lines and cables are undamaged and in perfect working order.
  If the instrument doesn't function flawlessly, permanently remove it from operation and secure it against inadvertent use.

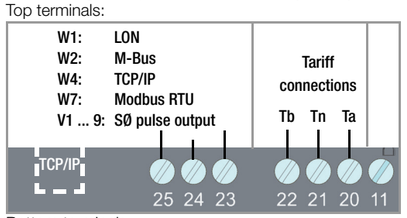
**Terminal Assignments, Direct Connection (EM228X))**

Top and bottom terminals

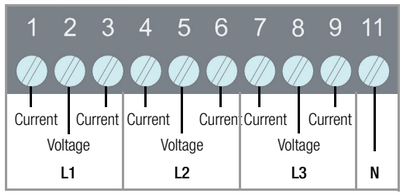



**Terminal Assignments, Transformer Connection (EM238X)**

Top terminals:




Bottom terminals:

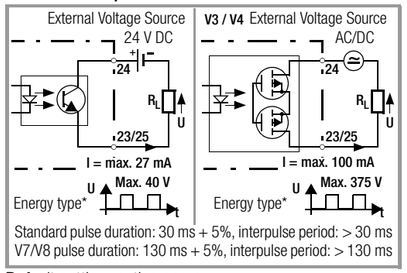



## 9 Bus Interfaces

LON-Bus (feature W1), M-Bus (feature W2), TCP/IP (feature W4), Modbus RTU (feature W7)

Complete information concerning the interfaces can be found in the interface descriptions, which can be accessed via the link on the title page.

## 10 Pulse Output




Standard pulse duration: 30 ms + 5%, interpulse period: > 30 ms
V7/V8 pulse duration: 130 ms + 5%, interpulse period: > 130 ms

Default setting: active energy
Terminal 23 (S01): import, terminal 25 (S02): export
* Type of energy can be selected with feature V2, V4.

| Pulse Rates | V1/V3, fixed [pulses per kWh] | V7 | V8 | V9, fixed | V2/V4, programmable |
|---|---|---|---|---|---|
| **Direct** | U228x | | | | |
| | 1000 | 100 | — | — | 1 … 1000 pls/kWh |
| **Transformer** | U2381 / U238x | | | | |
| | f (secondary) | | | | |
| | | | | 100 ... | |
| **CT x VT = 1 (Q0)** | 1000 | 100 | 1000 | 50000 | 1...1000...10,000 pls/kWh |
| **CTxVT=1(Q0)U6/7** | 1000 | 100 | 1000 | 20000 | 1...1000...10,000 pls/kWh |
| **CTxVT=1(Q0) U3** | 1000 | 100 | 1000 | 50000 | 1...1000...10,000 pls/kWh |
| **CT, VT, progr. (Q1)** | 1000 | 100 | 1000 | 50000 | 1...1000...50,000 pls/kWh |
| **CT, VT, progr. (Q1)U6/7** | 1000 | 100 | 1000 | 20000 | 1...1000...50,000 pls/kWh |
| **CT, VT, progr. (Q1)U3** | 1000 | 100 | 1000 | 50000 | 1...1000...50,000 pls/kWh |
| **CTxVT; CT, VT, fixed (Q9)** | f (primary) | | | | f (primary) |
| 2 … 10 | 1000 | 100 | — | — | 1 … 1000 pls/kWh |
| 11 … 100 | 100 | 10 | — | — | 0.1 … 100 pls/kWh |
| 101 … 1000 | 10 | 1 | — | — | 0.01 … 10 pls/kWh |
| 1001 … 10,000 | 1 | 100 | — | — | 1 … 1000 pls/MWh |
| 10,001 … 100,000 | 0.1 | 10 | — | — | 0.1 … 100 pls/MWh |
| 100,001..1,000,000 | 0.01 | 1 | — | — | 0.01 … 10 pls/MWh |

Underlined values are default values.

## 2 Application

**Intended Use / Use for Intended Purpose**

ENERGYMID EM2281, EM2289, EM2381, EM2387 and EM2389 instruments are multifunctional energy meters (certified in accordance with MID). They're used for the acquisition and billing of active energy.
Technical properties and other functions are defined by selecting the desired device type and via configurable features (when ordering). Refer to the data sheet and your order for your instrument variant.
All instruments include measures for protection against tampering (tamper-proof cover and configuration disabling).
Values are also forwarded to superordinate management systems via feature-dependent communication interfaces.
Safety of the operator, as well as that of the instrument, is only assured when it's used for its intended purpose.

**Use for Other than Intended Purpose**

The instrument may only be used for the measurements described in the documentation for the instrument.
Using the instrument for any purposes other than those described in these condensed operating instructions, or in the instrument's operating instructions, is contrary to use for intended purpose.

**Liability and Guarantee**

Gossen Metrawatt GmbH assumes no liability for property damage, personal injury or consequential damage resulting from improper or incorrect use of the product, in particular due to failure to observe the product documentation. Furthermore, all guarantee claims are rendered null and void in such cases.
Nor does Gossen Metrawatt GmbH assume any liability for data loss.

## 3 Scope of Delivery

1 Energy meter
1 Condensed operating instructions
1 Calibration certificate (only with feature P9)

## 4 Symbols on the Instrument

Marking with stamp of the federally approved test laboratory
(for verification only / with feature P9)

CE and metrology mark
with indication of year (M22) and registration number of the notified body for module D, country-specific calibration validity period

Metrological symbol for national approval in Germany (DE = Germany, M = Metrology) with indication of year (22) and registration number of the notified body.

**DE MTP 17 B 002 MI-003** (EM228x)
**DE MTP 16 B 004 MI-003** (EM238x)
**DE MTP 20 B 004** (EM228x Z2)
**DE MTP 20 B 005** (EM238x Z2)
Prototype test certificate


Meter type: bidirectional meter
Energy import
Energy export


Anti-reversing


Mains type: 2 or 3-wire energy meter

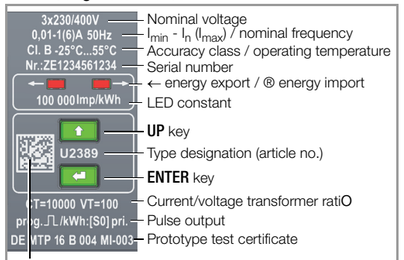

Double insulation (protection category II)


Warning concerning a point of danger (attention, observe documentation!)


European conformity marking


The device may not be disposed of with household trash. See section 15.

## 5 Rating Plate Entries




## 6 Ambient Conditions

| | |
|---|---|
| Operating temperature range | -25 ... +55 °C |
| Storage temperature range | -25 ... +70 °C |
| Relative humidity | Max. 95%, no condensation allowed<br>Max. 75% annual average and non-condensing |
| Elevation | Max. 2000 m |
| Place of use | Indoors |
| Mechanical classification | M1 |
| Electromagnetic classification | E2 |
| Protection | Front (panel-mount instrument): IP 51<br>Terminals: IP 20 |

**CAUTION**

**Incorrect Installation**

The instrument may only be installed inside an external housing, e.g. switch or meter cabinet. The housing must provide at least IP 51 protection and must be located indoors. Only in this case is protection against dust and water ingress guaranteed in accordance with the EN50470-1.

## 7 Tamper-Proof Sealing

1) The manufacturer's seal on the side of the instrument serves as a calibration and guarantee seal.
2) Four tamper-proof seals for the terminal cover: can be mounted to the left and right of each terminal cover.

## 8 Connector Pin Assignments and Wire Gauge

**Note:** Observe the wiring diagrams in the top and bottom terminal covers.

| Connections | Direct Meter (EM228X) | Trans. Meter (EM238X) |
|---|---|---|
| Current input | Fine wire:<br>6 to 16 mm²<br>Solid wire:<br>6 to 25 mm²<br>With wire end ferrule:<br>6 to 16 mm²<br>Torque: 3 Nm | Fine wire:<br>0.5 to 4 mm²<br>Solid wire:<br>0.5 to 6 mm²<br>With wire end ferrule:<br>0.5 to 2.5 mm²<br>Torque: 0.5 Nm |
| Voltage input | – | Fine wire:<br>0.5 to 4 mm²<br>Solid wire:<br>0.5 to 6 mm²<br>With wire end ferrule:<br>0.5 to 2.5 mm²<br>Torque: 0.5 Nm |
| S0 pulse output<br>Bus output<br>Tariff input<br>(power utility pulse) | Fine wire:<br>Solid wire:<br>With wire end ferrules:<br>Torque: | 0.2 to 2.5 mm²<br>0.2 to 2.5 mm²<br>0.25 to 1.5 mm²<br>0.4 Nm |
| LON (W1) [a] | Twisted pair copper cable, recommended:<br>JY (ST) Y 2 × 2 × 0.8 mm with twisted wire pairs (where 0.8 mm = wire diameter, wire cross-section = 0.5 mm²), maximum cable length of 900 m with bus topology (bus terminator at both ends), 500 m with free topology (bus terminator at one end) or 320 m from device to device | |
| M-Bus (W2) [a] | 2-wire twisted-pair | |
| TCP/IP (W4) [a] | RJ-45 (8P8C) | |
| Modbus (W7) [a] | 2-wire twisted-pair, shielded if possible, maximum length of 1000 m (depending on cable thickness and transmission speed), cross-section of at least 0.22 mm², wave impedance approx. 100 to 150 Ω, terminating resistors at both ends (the following applies: resistance value = line impedance) | |

a. For detailed information, refer to the interface description for your instrument which can be accessed via the link on the title page.

## 11 Display and Control Panel

### 11.1 Test LEDs

The **test LEDs** are located above the control keys. The left LED indicates energy export and the right LED indicates energy import. Blinking frequency accelerates as the measured power value increases. If all current values are smaller than starting current, both LEDs light up continuously.

**LED Constant**

Direct meter (EM228x): 10,000 pulses per kWh
Trans. meter (EM238x): 100,000 pulses per kWh

### 11.2 Resolution, Main Display (large characters), Energy Import

Internally, metering is executed with increased resolution. As a result, the last place in the overall register may be a few digits higher than the sum of the individual registers if multiple tariffs are used.

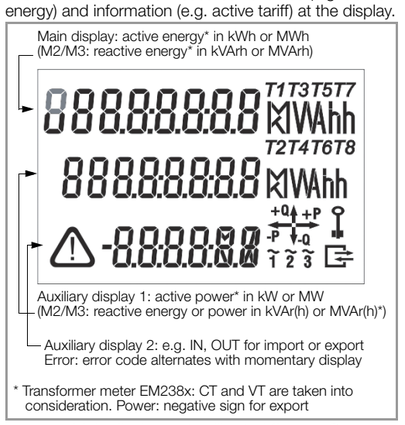
| Meter Feature | | CT × VT min. | CT × VT max. | Standard Display | Calibration Display * | Unit |
|---|---|---|---|---|---|---|
| U2281, U2289 | | — | — | 123456.78 | 23456.789 | kWh |
| U238x | Q0 | 1 | 1 | 12345.678 | 2345.6789 | kWh |
| | Q9 | 2 | 4 | 12345.678 | 2345.6789 | kWh |
| | | 5 | 40 | 123456.78 | 3456.7890 | kWh |
| | | 41 | 400 | 1234567.8 | 34567.890 | kWh |
| | | 401 | 4000 | 12345678 | 345678.90 | kWh |
| | | 4001 | 40000 | 123456.78 | 3456.7890 | MWh |
| | | 40001 | 400000 | 1234567.8 | 34567.890 | MWh |
| | | 400001 | 1000000 | 12345678 | 345678.90 | MWh |
| | Q1 ** | 1 | 4 | u12345.67 | ** | kWh |
| | | 5 | 40 | u123456.7 | ** | kWh |
| | | 41 | 400 | u1234567 | ** | kWh |
| | | 401 | 4000 | u12345.67 | ** | MWh |
| | | 4001 | 40000 | u123456.7 | ** | MWh |
| | | 40001 | 100000 | u1234567 | ** | MWh |

* An additional place to the right of the decimal point is included for the calibration display in the case of a main display which can be calibrated (Q0 or Q9). The leading digit is thus eliminated in the case of an 8-place display.

** In the case of Q1, the secondary display can be calibrated Q0, for which reason display overflow is based on the secondary display. The standard display is shifted one place to the left if necessary.

### 11.3 Display

The instrument shows measured variables (e.g. active energy) and information (e.g. active tariff) at the display.




* Transformer meter EM238x: CT and VT are taken into consideration. Power: negative sign for export

Main display, not calibrated (feature Q1, programmable CT/VT , see section 11.2). T1 ... T8: active tariff

Display of instantaneous power in 4 quadrants: positive or negative active power P, positive or negative reactive power Q.

Correct connection:
Continuous illumination of the phase symbols where P ≥ 0
Phase failure:
Symbol for affected phase is cleared from the display.
Incorrect phase sequence:
Phase symbols blink in following order: 3 - 2 - 1, background illumination blinks red.

Negative power:
Respective phase symbol blinks.

For bus connection: appears when the meter transmits a data packet.

Key symbols for parameters configuration with features Q1 and V2, V4:

CT, VT and S0 parameters can be changed depending on features.

CT, VT and S0 parameters disabled.

All other feature combinations:

CT, VT or S0 parameters (which are or can be calibrated) are preset at the factory and can be queried in the display mode, other values can be changed.

Parameters which are or can be calibrated are preset at the factory, other parameters are disabled with the enable key.

Values which are preset at the factory are printed additionally on the rating plate.

**Background Illumination**

Background illumination is switched on each time a key is activated. It goes back off after about 2 minutes.
Background illumination colors indicate various display menus:
- White: query menus
- Pink: Parameter display and setting menus
- Red: firmware version display
- Blinking red: in case of error

### 11.4 Operation

The standard display appears by default. The **UP** and **ENTER** keys can be used to switch to other displays or menus from the standard display. If no keys are pressed for a period of 1 minute, the meter is returned automatically to its standard display.
Settings can be changed if certain features are included:
- CT and VT parameters for U238x with feature Q1,
- S0 parameter for U228x/U238x with feature V2/V4

Other parameters in accordance with the interface description.

### 11.5 Viewing Values and Changing Parameters

Beginning from the standard display, it may be necessary to navigate through several displays/menus until you reach the value to be viewed or the parameter to be changed.

Parameter changes are only possible after activating the enable key, which makes it possible to enable or disable parameter changes. It's located underneath the top terminal cover between terminals 21 and 22 and is activated with a pointed object (e.g. an ESD safe screwdriver).


Pressing the enable key activates the "change parameters" operating mode (key off): → 

Pressing the enable key again disables the "change parameters" operating mode (key on): → 

If no keys are pressed for a period of about 2 minutes, the "change parameters" operating mode is exited automatically and disabled (key on).

➪ Briefly press the enable key.
The "change parameters" mode is active.

➪ Navigate through the various displays/menus until you reach the desired parameter. See "**Configuration and Operation**".

➪ You can now view the desired value or adjust a parameter. See "**Configuration and Operation**".
If no keys are pressed for a period of about one minute, the setting menu is exited.

➪ Press and hold the **ENTER** key or wait for one minute in order to change to the standard display.

➪ Press the enable key in order to disable the "change parameters" mode. Alternatively, disabling takes place automatically after 2 minutes.

### 11.6 Switching Amongst Tariffs

**Hardware Controlled**

Tariff inputs Ta and Tb are each connected with reference to Tn. The tariffs are controlled by applying a defined voltage level.

| Tariff Inputs | Tb | Ta |
|---|---|---|
| Tariff 1 | 0 | 0 |
| Tariff 2 | 0 | 1 |
| Tariff 3 | 1 | 0 |
| Tariff 4 | 1 | 1 |

Level 0 = < 12 $V_{AC}$
Level 1 = 45 … 265 $V_{AC}$

Depending on the combination of levels 0 and 1, the values measured at the instrument are recorded in the corresponding tariff. Recording is thus possible in a daytime and a nighttime tariff, for example.

**Software Controlled (not included in scope of MID approval)**

In the case of meters with bus (features W1 … W7), 4 further tariffs can be selected (software controlled).

## 12 Error Messages

If an error occurs, the respective error code and active energy or instantaneous power are displayed alternately.

| Error Code | Meaning | Cause/Remedy |
|---|---|---|
| ⚠ LOUoLt | All phase voltages < 75% | Check connection* |
| ⚠ UHi 1 | Maximum value for $U_1$ exceeded | Check connection |
| ⚠ UHi 2 | Maximum value for $U_2$ exceeded | Check connection |
| ⚠ UHi 3 | Maximum value for $U_3$ exceeded | Check connection |
| ⚠ IHi 1 | Maximum value for $I_1$ exceeded | Check connection |
| ⚠ IHi 2 | Maximum value for $I_2$ exceeded | Check connection |
| ⚠ IHi 3 | Maximum value for $I_3$ exceeded | Check connection |
| ⚠ Sync | Frequency measuring error | Meter connected to direct voltage |
| ⚠ COM | Interface error | Check connection |
| ⚠ EnErGy | Meter defective | Send meter in for repair |
| ⚠ cALi b | Balancing (calibration) required | |
| ⚠ AnALoG | DC offset too high | |
| ⚠ MEMErr | Memory error | |
| ⚠ CErt | Calibration logbook | Replace meter |

* In the case of meters with feature U3 (100…110V L-L) including TCP/IP or Modbus RTU bus connections (W4 und W7), background illumination and the bus connection are deactivated. The meter reading profile Z1 cannot be viewed as long as the error is pending. Meter functioning is otherwise unimpaired.

## 13 Repairs / Manufacturer's Guarantee

If your meter requires repair, please contact our service department (see reverse side of this folder).

**Note**

**Loss of Warranty and Guarantee Claims**

Unauthorized modification of the meter is prohibited. This also includes opening the meter.
If it can be ascertained that the instrument has been opened by unauthorized personnel, no guarantee claims can be honored by the manufacturer with regard to personal safety, measuring accuracy, compliance with applicable safety measures or any consequential damages.
If the manufacturer's seal is damaged or removed, all guarantee claims are rendered null and void.

The instruments are guaranteed for a period of 3 years after shipment. The manufacturer's guarantee covers materials and workmanship. Damages resulting from use for any other than the intended purpose or operating errors, as well as any and all consequential damages, are excluded.

## 14 Verification

The calibration period in Germany is 8 years.
Verification by our state-approved test laboratory (EB-8) is possible at any time (see reverse side of this folder).

## 15 Disposal and Environmental Protection

The following comments refer specifically to the legal situation in the Federal Republic of Germany. Owners or end users who are subject to other national requirements are required to comply with the respectively applicable national requirements and to implement them correctly on site.

The symbol on the left depicting a crossed-out garbage can on wheels refers to the legal obligation of the owner or end user (German electrical and electronic equipment act ElektroG and German battery act BattG) not to dispose of used electrical equipment and batteries with unsorted municipal waste ("household trash").
Old devices, electrical or electronic accessories and depleted batteries used in Germany can be returned free of charge to Gossen Metrawatt GmbH or the service provider responsible for their disposal in compliance with applicable regulations, in particular packaging and hazardous goods laws. Further information can be found on our website.

## 16 CE Declaration

The instrument fulfills all requirements of applicable EU directives and national regulations.
We confirm this with the CE mark. The CE declaration of conformity is available upon request (see link on title page).

### Operating Overview Key

**Keys**

| | |
|---|---|
| | **ENTER** key (press briefly) |
| Long | **ENTER** key (press and hold) |
| | **UP** key (press briefly) |

**Abbreviations**

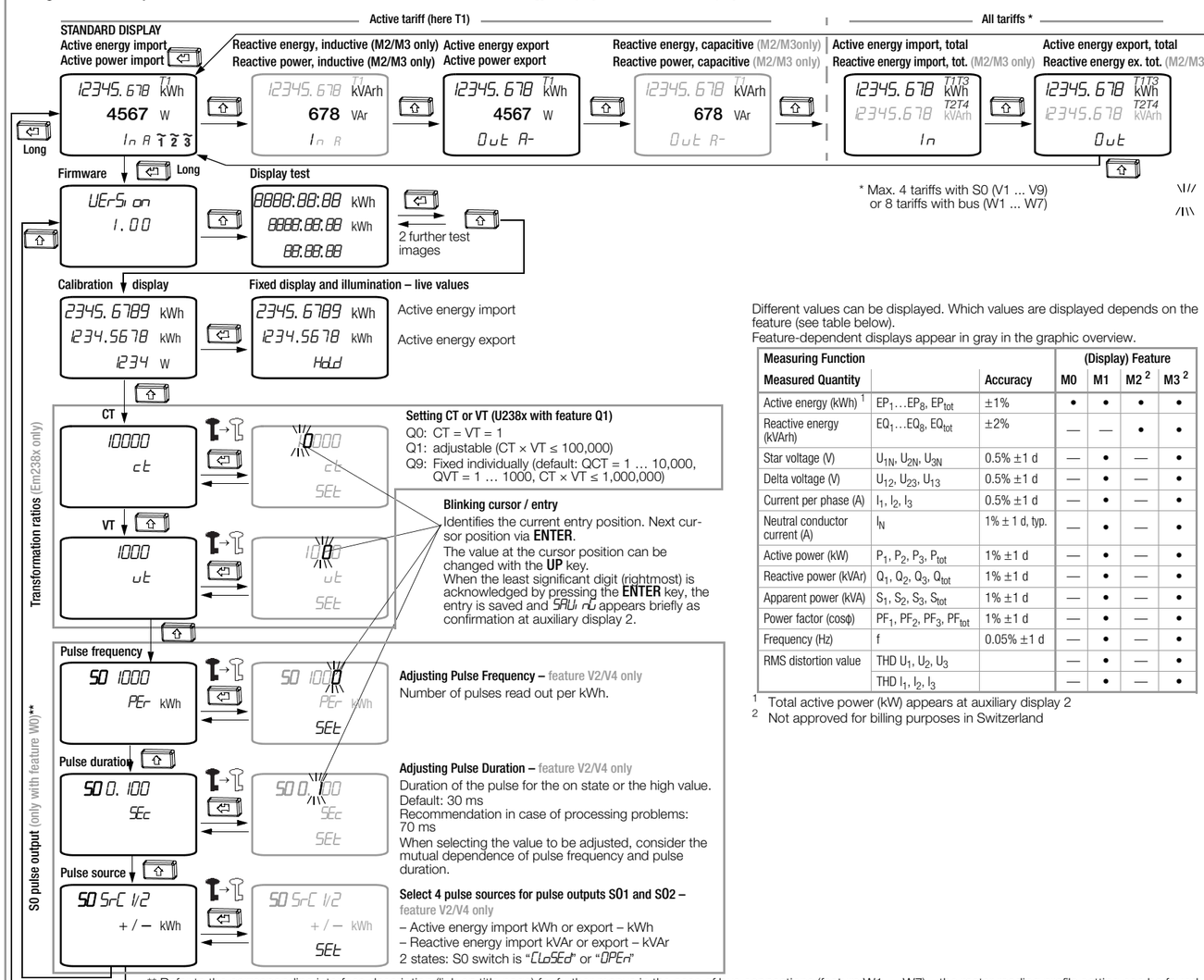
| | |
|---|---|
| CT | Transformation ratio, current |
| $I_N$ | N conductor current (calculated) |
| S0 | S0 pulse output |
| THD | Distortion component (for voltage and current) |
| VT | Transformation ratio, voltage |

**Features**

| | |
|---|---|
| M1 | Multifunctional variant: Measurement of U, I, P, Q, S, PF, f, THD, $I_N$ |
| M2 | Measurement of reactive energy |
| M3 | Multifunctional variant: Measurement of U, I, P, Q, S, PF, f, THD, $I_N$, reactive energy |
| Q1 | Programmable transformation ratios |
| Q9 | Fixed transformation ratios |
| V2/V4 | Programmable S0 |
| V9 | Customer-specific S0 rate |
| W1 … W7 | Bus connections |
| Z1 | Meter reading profile (only possible with bus) |
| Z2 | Certified meter reading profile |

## Configuration and Operation

### View Active and Reactive Energy / Display Test / Calibration Display / Set Transformation Ratio / Set S0 Interface Parameters

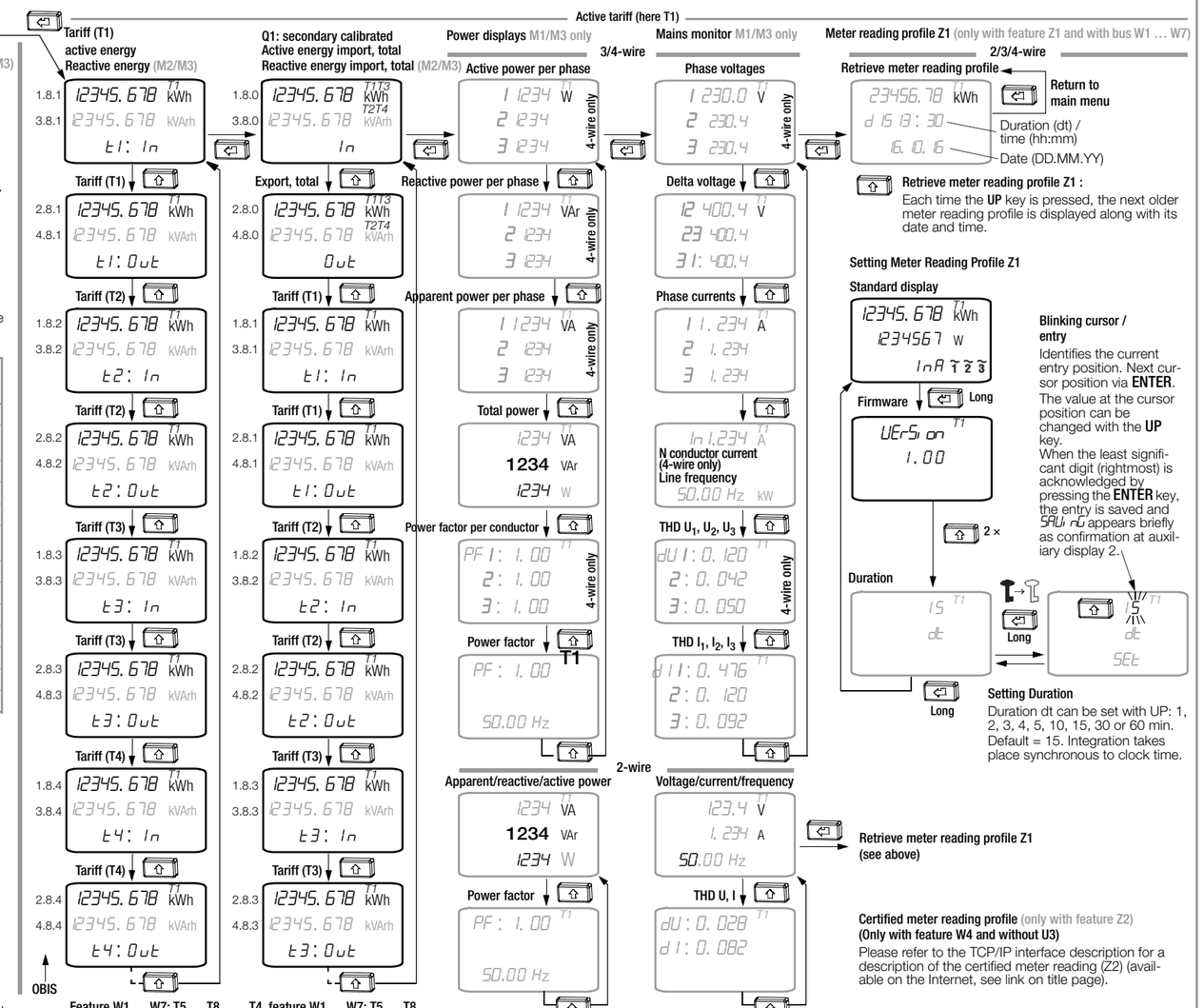



Different values can be displayed. Which values are displayed depends on the feature (see table below).
Feature-dependent displays appear in gray in the graphic overview.

| Measuring Function | | | (Display) Feature | | | |
|---|---|---|---|---|---|---|
| Measured Quantity | | Accuracy | M0 | M1 | M2 [2] | M3 [2] |
| Active energy (kWh) [1] | $EP_1$…$EP_8$, $EP_{tot}$ | ±1% | • | • | • | • |
| Reactive energy (kVArh) | $EQ_1$…$EQ_8$, $EQ_{tot}$ | ±2% | — | — | • | • |
| Star voltage (V) | $U_{1N}$, $U_{2N}$, $U_{3N}$ | 0.5% ±1 d | — | • | — | • |
| Delta voltage (V) | $U_{12}$, $U_{23}$, $U_{13}$ | 0.5% ±1 d | — | • | — | • |
| Current per phase (A) | $I_1$, $I_2$, $I_3$ | 0.5% ±1 d | — | • | — | • |
| Neutral conductor current (A) | $I_N$ | 1% ± 1 d, typ. | — | • | — | • |
| Active power (kW) | $P_1$, $P_2$, $P_3$, $P_{tot}$ | 1% ±1 d | — | • | — | • |
| Reactive power (kVAr) | $Q_1$, $Q_2$, $Q_3$, $Q_{tot}$ | 1% ±1 d | — | • | — | • |
| Apparent power (kVA) | $S_1$, $S_2$, $S_3$, $S_{tot}$ | 1% ±1 d | — | • | — | • |
| Power factor (cosϕ) | $PF_1$, $PF_2$, $PF_3$, $PF_{tot}$ | 1% ±1 d | — | • | — | • |
| Frequency (Hz) | f | 0.05% ±1 d | — | • | — | • |
| RMS distortion value | THD $U_1$, $U_2$, $U_3$ | | — | • | — | • |
| | THD $I_1$, $I_2$, $I_3$ | | — | • | — | • |

[1] Total active power (kW) appears at auxiliary display 2
[2] Not approved for billing purposes in Switzerland

### Switching Tariffs / View Active and Reactive Energy / Power Displays / Mains Monitor / Retrieving and Setting the Meter Reading Profile




** Refer to the corresponding interface description (link on title page) for further menus in the case of bus connections (feature W1 … W7) – the meter reading profile setting can be found