3-phase energy meter with universal current input

S1MMmA500VM
S1MMmA500VLM
S1MMmA500VHM

Equivalent to class 0,5S (KWh) of EN62053-22

Equivalent to class 0,5S (KVARh) of EN62053-24

Accuracy ±0,5% RDG

Universal input for current measurement

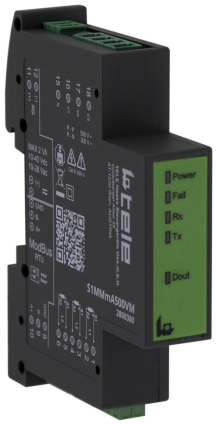
Energy meter

TRMS measurement of distorted sine waves (voltage/current)

Neutral current measurement

One digital output (mosfet) for alarms

Serial RS485 output



Technical data

Function
3-phase energy meter with universal current input

1. Mechanical Design
PBT plastic housing, IP rating IP20
DIN-rail mountable, ready to be mounted on T-BUS system

Mounting position:	any
Dimensions:	17,5 x 70,8 x 55,26mm (without connectors) 17,5 x 93 x 68,3mm (with connectors)
Removeable terminals:	- 1,5mm² 2-pole connector (3,5mm pitch) - 1,5mm² 3-pole connector (3,5mm pitch) - 1,5mm² 6-pole connector (3,5mm pitch) - 1,5mm² 4-pole connector (5,08mm pitch)
DIP-switch:	2 poles (Baudrate and Address) for connection with the configuration software
Weight:	60g

2. Indicators

Green LED Power:	indication of supply voltage
Yellow LED Comm (Fail):	indication of fault / error
Red LED's TX, RX:	indication of communication via RS485
Green LED Dout:	indication of state of digital output

2. Power supply

Supply voltage:	10 ... 40V DC; 19 ... 28V AC terminals 11(-), 12(+)
Power consumption:	< 0,7W

3. Digital output

Kind of output:	Solid state (Mosfet); terminals 8, 10 Max 100mA / 40V DC

The contact can be used as alarm contact (activated via software as an alternative to RS485).

4. RS485 Modbus RTU

Baudrate:	1200 ... 115200 Baud (Standard: 9600) terminals 8 (GND), 9 (B-), 10(A+), or via T-BUS

5. Measuring circuit

Working frequency:	1 - 70Hz
Voltage:	
Impedance:	400 kΩ
Nominal voltage U_N:	300 V_{LN} / 500 V_{LL}
Continuous overload U_{MAX}:	400 V_{LN} / 700 V_{LL}
Overload for 500 ms:	600 V_{LN} / 1000 V_{LL}
Current:	
Type:	Not isolated (external CTs necessary)
Current output CTs:	
Nominal current I_N:	5 A AC
Crest factor:	< 4 (20 A_{PK} MAX)
Impedance:	< 0,5 VA per phase
Continuous overload I_{MAX}:	6 A AC
Overload for 500 ms:	40 A AC
Voltage output CTs:	
Nominal voltage V_N:	333 mV AC
Crest factor:	< 3 (1 V_{PK} MAX)
Impedance:	220 KΩ
Continuous overload V_{MAX}:	2,1 V_{PK}
Overload for 500 ms:	13 V_{PK}

6. Accuracy (@25°±5°C / 50Hz)

Frequency:	± 0,1 Hz (40..70 Hz)
Active energy:	Class C according to EN50470-1/3 Class 0,5 S according to EN62053-22
Reactive energy:	Class 0,5 S according to EN62053-24
Power factor:	± (0,001 +1%(1.00-PF))
Bandwidth (-3dB):	> 2kHz
Thermal drift:	<100 ppm/°C
Energy backup:	Via Flash, minimum lifetime: 3 years

7. Software functions

Measurement type:	TRMS
Sampling rate:	6400 samples/s @ 50Hz 7280 samples/s @ 60Hz
Measurement refresh rate:	Software configurable Default: 50 AC cycles MAX: 65535 cycles
Transformer ratio:	CT and VT default 1,0 Software configurable
Transformer delay:	0,0° @50 Hz default Software configurable
Minimum display cutoff:	Configurable on voltage, current and power

8. General specifications

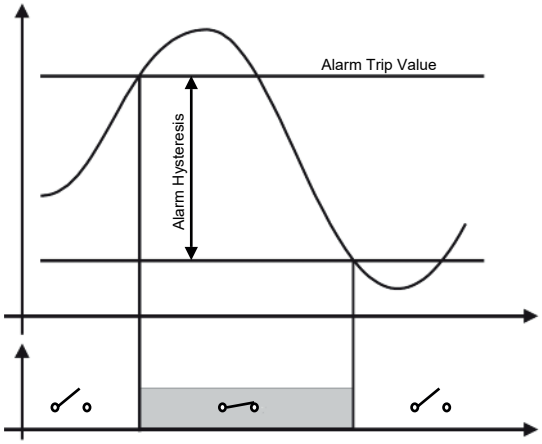
Operation temperature:	-10 to +60°C
Storage temperature:	-40 to +85°C
Humidity:	10 to 90% (not condensing)
Altitude:	Up to 2000m above sea level
Installation category:	Cat. III (IEC 60664, EN60664)
Isolation:	4 kV between power supply and measuring inputs 4 kV between RS485 and measuring inputs 1,5 kV between power supply and RS485
Standards:	
EMC / EMI:	EN61000-6-4; EN61000-6-2; EN61000-4-2; EN61000-4-3; EN61000-4-4; EN61000-4-5 ; EN61000-4-6;
Safety:	EN61010-1; EN61010-2-030;
Configuration:	With software or via RS485 Modbus. Comunication to free interface program for: - configuration of all the available parameters; - possibility of firmware upgrade (if available).

Variants

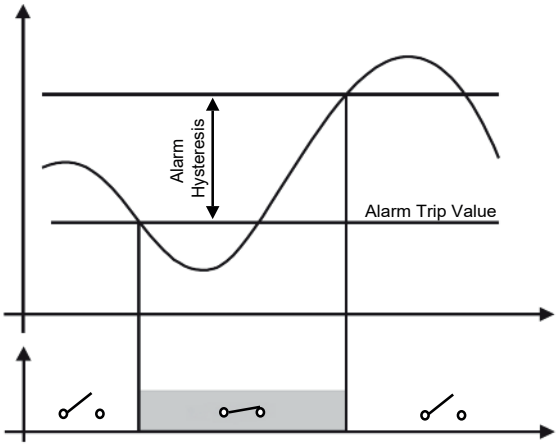
S1MMmA500VM Part No. 2800300	S1MMmA500VLM Part No. 2800310	S1MMmA500VHM Part No. 2800320
$V_{RMS\ LL}$ and $V_{RMS\ LN}$[V]	Distorted power factor	Harmonics up to 63rd order
I_{RMS} [A]	Tan φ	Interharmonics
Power: • Active [W] • Reactive [VAR] • Apparent [VA]	Average, MAX and MIN: V_{LL}, V_{LN}, I, W, VAR, VA, Cos φ	Power quality: • Sag • Swell • Interruption
Cos φ	Phase sequence monitoring	Waveforms display through configuration software
Crest Factor	Internal temperature [°C]	
Frequency [Hz]	MAX demand	Single phase device efficiency measurement
Peaks on: • Voltage V_{LL} [V] • Voltage V_{LN} [V] • Currents I [A]	Time above given threshold for P_1, P_2, P_3, P_{3PH}	
Energies (pos, neg, total): • Active [Wh] • Reactive [VARh] • Apparent [Vah]	Inverter input (PWM modulated input)	
	THD, TDD	

Digital output alarms

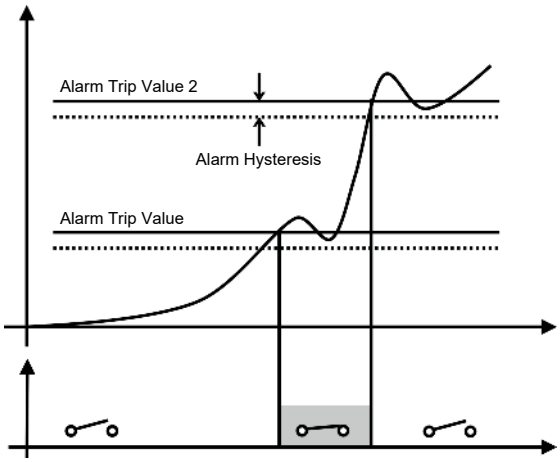
Rising: Normally open contact



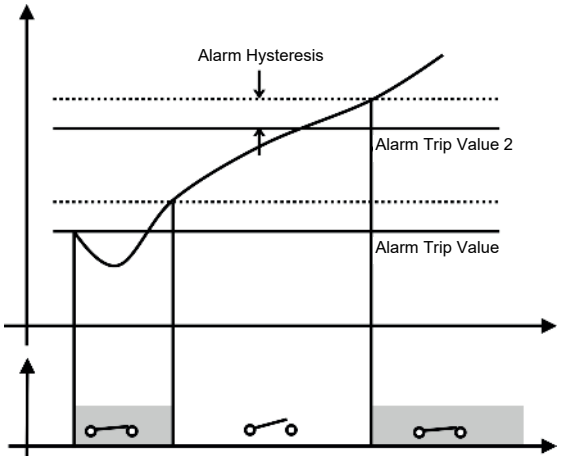
Falling: Normally closed contact



Windowed: closed contact between thresholds



Windowed: closed contact outside thresholds



Note: To enable digital output alarms, RS485 terminals must be configured for digital output. Communication will be available only on T-BUS.

Calculation formulars

Phase variables

RMS voltage

$$V_i = \sqrt{\frac{1}{N} * \sum_{1}^{N} (v_L)_i^2}$$

RMS current

$$I_i = \sqrt{\frac{1}{N} * \sum_{1}^{N} (i_L)_i^2}$$

Active Power

$$P_i = \frac{1}{N} * \sum_{1}^{N} v_{Li} * i_{Li}$$

Apparent power

$$S_i = V_i * I_i$$

Reactive power

$$Q_i = \frac{1}{N} * \sum_{1}^{N} v_{Li} \hat{i}_{Li} \quad \textit{Budeanu}$$

$$Q_i = \sqrt{S_i^2 - P_i^2} \quad \textit{triangular}$$

Power factor

$$\cos\varphi_i = \frac{P_i}{S_i}$$

System variables

Voltage average

$$V_{AVG} = \frac{V_1 + V_2 + V_3}{3}$$

Current average

$$I_{AVG} = \frac{I_1 + I_2 + I_3}{3}$$

Three phase active power

$$P_{3PH} = P_1 + P_2 + P_3$$

Three phase apparent power

$$S_{3PH} = S_1 + S_2 + S_3$$

Three phase reactive power

$$Q_{3PH} = Q_1 + Q_2 + Q_3$$

Three phase power factor

$$\cos\varphi_{3PH} = \frac{P_{3PH}}{S_{3PH}}$$

Energy metering

Active energy

$$Wh_i = \int_{t_1}^{t_2} P_i(t)\,dt \approx \Delta t \sum_{n_1}^{n_2} P(n)_i$$

Reactive energy

$$VARh_i = \int_{t_1}^{t_2} Q_i(t)\,dt \approx \Delta t \sum_{n_1}^{n_2} Q(n)_i$$

Apparent energy

$$VAh_i = \int_{t_1}^{t_2} S_i(t)\,dt \approx \Delta t \sum_{n_1}^{n_2} S(n)_i$$

i= phase observed (L1, L2 or L3);
P= Active power;
Q= Reactive power;
t1, t2 = starting and ending time points of consumption recording;
n= time unit;
t= time unit length;
n1, n2 = starting and ending discrete time points of consumption recording.

LED description

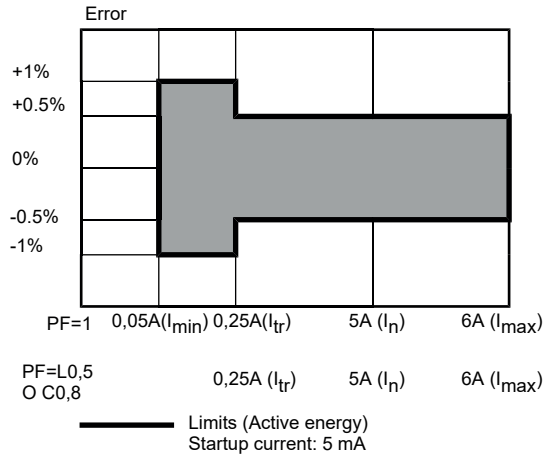
Function	State	Note	
Power (green)	Steady on	Powered device	
Fail (yellow)	Blinking	Bootloader active: Can be executed through Modbus command, or because of program flash corruption.	
	Steady on	At least one of the following state is present:	
		Eeprom fail	Error on storing flash for settings, calibration or energies
		Phase reversal	Phase sequence L1, L2, L3 is not correct
		I_i or V_i over-range	Current or voltage phase i has a too high positive value
		I_i or V_i under-range	Current or voltage phase i has a too high negative value
Rx (red)	Blinking	The device is receiving data from RS485	
Tx (red)	Blinking	The device is sending data via RS485	
D_{out} (green)	Steady on	Digital output is closed	

Dip switch settings

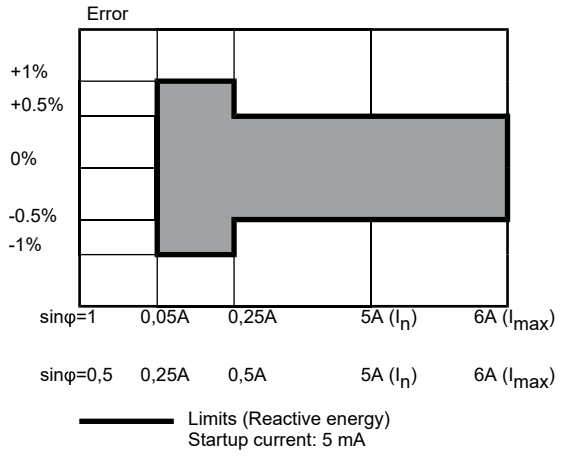
DIP 1	DIP 2	
0	X	RS485 settings from Eeprom
1	0	Address 1, Baudrate 9600, no parity
1	1	Address 1, Baudrate 38400, no parity

Accuracy diagrams (According to EN50470-3 and EN62053-24)

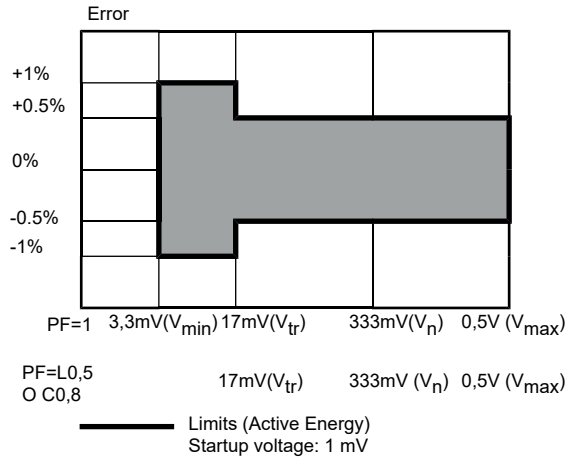
Wh, accuracy depending on the load (current output CT)



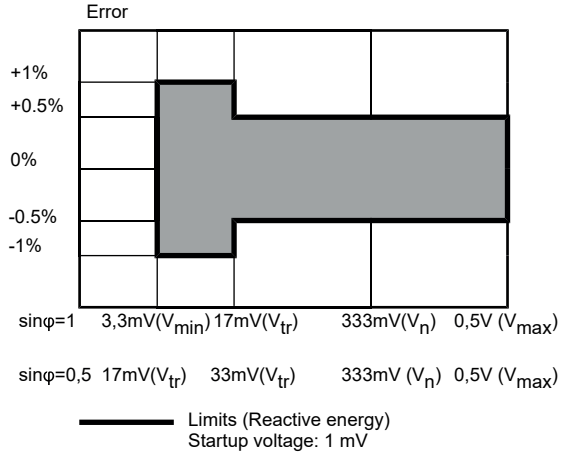
VARh, accuracy depending on the load (current output CT)



Wh, accuracy depending on the load (voltage output CT)



VARh, accuracy depending on the load (voltage output CT)



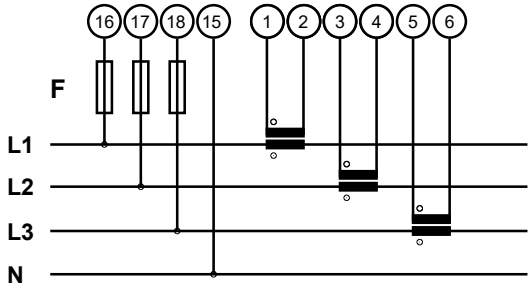
Note: Reactive power accuracy is granted if the instrument Q calculation is according Budeanu formula.

Configuration software

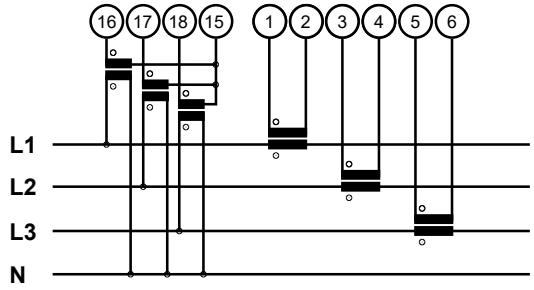
The free interface software is downloadable from our website www.tele-online.com/products/sensact
To communicate with the module you have to connect via USB port directly on your PC using the serial converter S-USB485; part No. 498513.
You can configure the module via RS485 using the register map downloadable at www.tele-online.com/products/sensact

Wiring diagrams

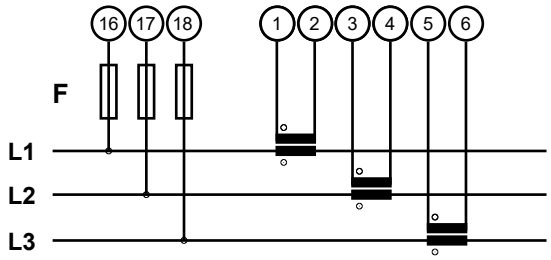
3-ph, 4 wires, 3 CTs connection



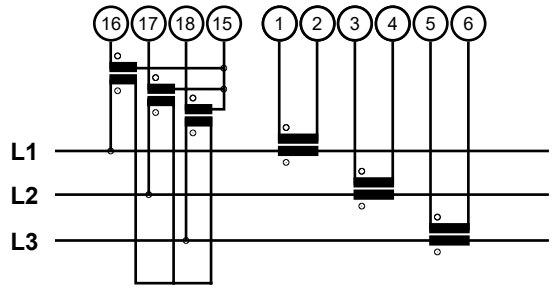
3-ph, 4 wires, 3 CTs and 3 VTs connection



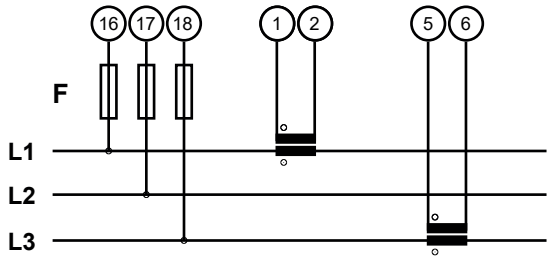
3-ph, 3 wires, 3 CTs connection



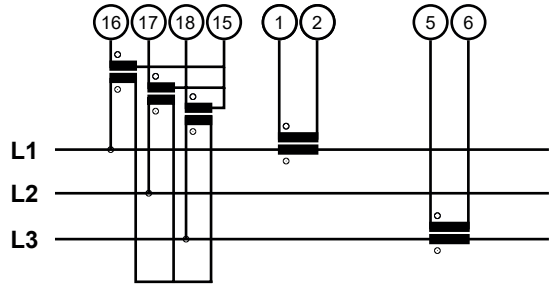
3-ph, 3 wires, 3 CTs and 3 VTs connection



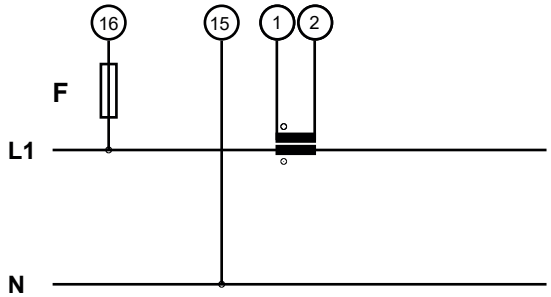
3-ph, 3 wires, 2 CTs connection (Aron)



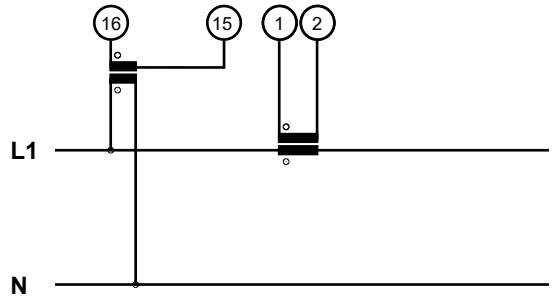
3-ph, 3 wires, 2 CTs 3 VTs connection (Aron)



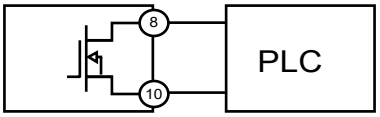
1-ph, 2 wires, 1 CT connection



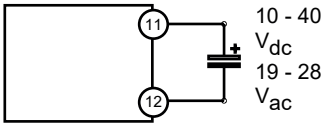
1-ph, 2 wires, 1 CT and 1 VT connection



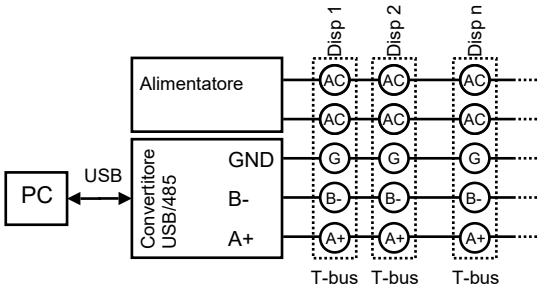
Digital output on terminal 8-9-10 in digital output configuration



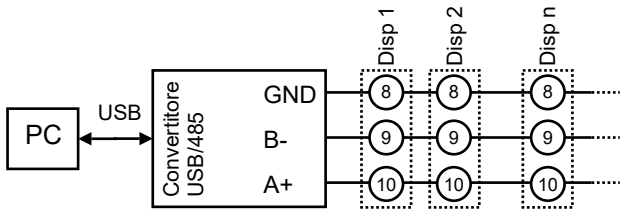
Power supply



Communication via T-BUS (with the proper optional connector)



Communication via terminal 8-9-10 in RS485 configuration



CONFIGURATION REGISTER 40007

This 16 bit register sets the configuration of the device. Hereafter the details

Setting	Value	Detail
CT input type	xxxx xxxx xxxx xxx0	Current input (e.g. CT 5A)
	xxxx xxxx xxxx xxx1	Voltage input (e.g. CT 333 mV, Rogowski)
Insertion handling	xxxx xxxx xxxx x00x	Single phase insertion
	xxxx xxxx xxxx x01x	Three phase insertion: three wires, 2 CTs (Aron)
	xxxx xxxx xxxx x10x	Three phase insertion: three wires, 3 CTs
	xxxx xxxx xxxx x11x	Three phase insertion: four wires, 3 CTs
FFT representation	xxxx xxxx xxxx 0xxx	Absolute: each harmonic RMS is displayed
	xxxx xxxx xxxx 1xxx	Relative to First harmonic: Xn/X1 is displayed
Reactive power formula	xxxx xxxx xx0x xxxx	Triangular method: this method gives you an indirect reactive power measurement. It's the most used in energy meters
	xxxx xxxx xx1x xxxx	Phase shifting method (Budeanu). This method measures reactive power directly. Accuracy is given with this method
8-9-10 terminal usage	xxxx xxxx x0xx xxxx	Used as RS485: 8 = GND, 9 = B-, 10 = A-
	xxxx xxxx x1xx xxxx	Used as digital output between terminal 8 and 10. Communication RS485 is still present on T-Bus connector
Frequency channel	xxxx xxxx 0xxx xxxx	Voltage channel, L1 phase
	xxxx xxxx 1xxx xxxx	Current channel, L1 phase
Voltage input type	xxxx xxx0 xxxx xxxx	Standard load
	xxxx xxx1 xxxx xxxx	PWM input voltage
Energy saving	xxxx xx0x xxxx xxxx	Saving disabled
	xxxx xx1x xxxx xxxx	Saving enabled
Dynamic data representation	xxx0 0xxx xxxx xxxx	Float
	xxx0 1xxx xxxx xxxx	Float swapped
	xxx1 0xxx xxxx xxxx	Integer = Float/100
	xxx1 1xxx xxxx xxxx	Integer swapped = Float/100
Integrator	xx0x xxxx xxxx xxxx	Disabled
	xx1x xxxx xxxx xxxx	Enabled, for Rogowski input
Digital output behaviour	x0xx x0xx xxxx xxxx	Rising: Normally open contact
	x1xx x0xx xxxx xxxx	Falling: Normally closed contact
	x0xx x1xx xxxx xxxx	Windowed: closed contact between thresholds
	x1xx x1xx xxxx xxxx	Windowed: closed contact outside thresholds
Filtering	0xxx xxxx xxxx xxxx	Filtering disabled: less stable but faster measurement
	1xxx xxxx xxxx xxxx	Filtering enabled: more stable but slower measurement

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