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3-phase energy consumption meter

LE-03ETH-CT

User manual

v. 1.0.0

Safety information regarding the use of the controller is marked with the following symbols. All information and recommendations marked with these symbols must be strictly observed.

	Risk of electric shock.
	Potentially dangerous situation that may result in danger to operating personnel or damage to the device.
Information regarding the design, operation and use of the controller is indicated by the following symbols:	
	Important information, valuable tip.
	Practical advice, problem solution.
	Example of use or operation.

Table of contents

Part 1. Purpose

LE-03ETH-CT is an electronic, legalised (MID declaration) AC electricity meter designed for measurements in a semi-direct system (using current transformers) or a direct system (using voltage and current transformers). The meter is designed for measurements in 1-phase and 3-phase (3- and 4-wire) systems. The device works with 1 A and 5 A current transformers with a ratio of 1 to 9999, and with voltage transformers in the range of 100÷500 V and a ratio of 1 to 9999.

The meter enables bidirectional (import and export) energy and power measurement and monitoring of many additional network parameters, such as: voltage, current, active power, reactive power, apparent power, frequency, power factor, THD harmonics, and power and current demand. In addition, the device has the option of password-protecting the set configuration.

The LE-03ETH-CT meter is also equipped with an Ethernet communication port supporting the Modbus TCP protocol, which enables remote reading and configuration of the meter. Touch buttons on the front of the meter allow you to select the parameter to be displayed and change the meter settings. The backlit LCD display facilitates the reading of measured values.

Part 2. Device characteristics

MID certificate

The LE-03ETH-CT has been awarded MID (Measuring Instruments Directive) certification confirming compliance with the requirements of Directive **2014/32/EU** regulating the rules for measuring instruments in the European Union. This means that measurements are accurate and reliable, and the meter can be used for official settlements with customers (e.g. in multi-family buildings, companies, rentals).

Recorded values

- active energy (imported and exported),
- reactive energy (imported and exported).

Measured values

- active, reactive and apparent power, power factor,
- phase and interphase voltages,
- phase currents,
- power demand,
- percentage content of voltage and current harmonics.

	Access to an extended list of measured parameters is possible via the Modbus TCP communication protocol.	

Front panel

The meter is equipped with a multifunctional, backlit LCD display for displaying measured and recorded values. Four touch buttons allow you to select the parameters to be displayed and configure the meter parameters.

	Access to the meter configuration can be secured by assigning a security code (PIN).	

Communication port

The meter is equipped with an Ethernet port supporting the Modbus TCP protocol. The Ethernet communication port allows the meter to be connected to networks enabling remote reading and configuration of meter operation.

Part 3. Installation

Safety precautions

	Before installing the meter, carefully read the operating instructions	
	The device may be installed by qualified installers with knowledge and experience in electrical installations. Read the operating instructions before installation.	
	All installation work must be carried out with the power supply switched off. Care should be taken to tighten the cables securely – loose cables can lead to sparking or, in extreme cases, to the device catching fire.	
	Do not disconnect the outputs of the current transformers when current is flowing in the measured circuit. After disconnecting from the meter, the outputs of the secondary side of the current transformers must be short-circuited.	
	Do not install a meter that is damaged or incomplete.	
	Before connecting the power supply, ensure that all cables are properly tightened.	
	The user is responsible for selecting the installation connected to the meter, including: the type and diameter of cables, overcurrent, residual current and surge protection devices.	
	Strictly observe the operating conditions of the meter.	
	Do not make any changes to the device. This may result in improper operation or damage to the meter, and may also pose a risk to the operator.	
	The manufacturer is not liable for faults and damage caused by incorrect configuration or operation of the meter.	

Assembly

Connect the meter to the electrical system in accordance with the diagram below.

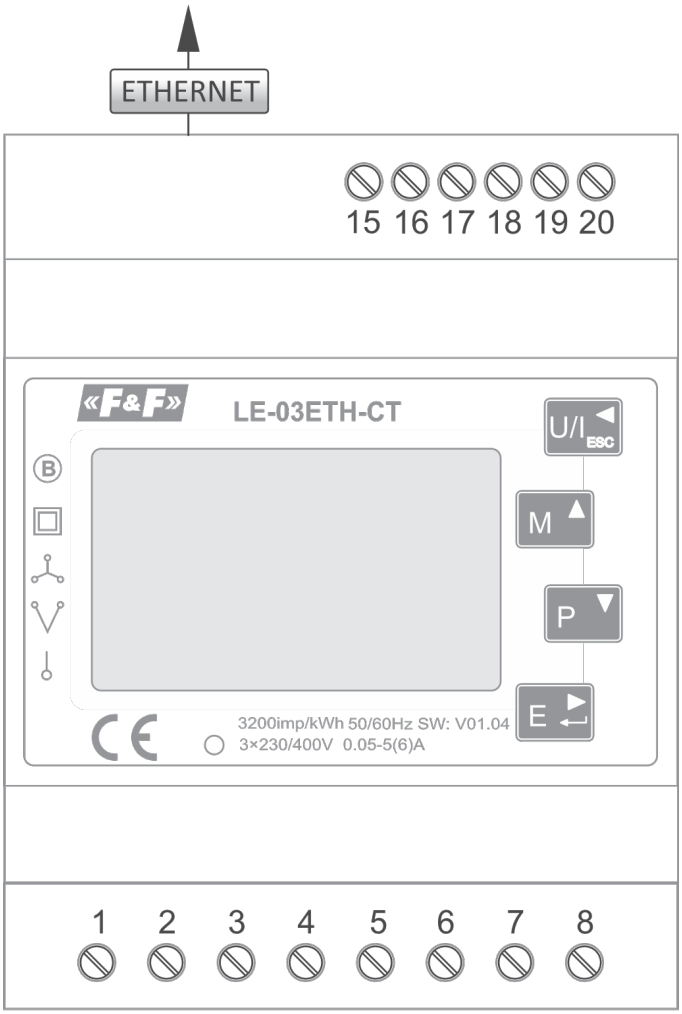
In order for the meter to operate, it is necessary to connect an auxiliary 230V AC power supply to terminals L_A- N_A. Terminals 5 - 7 (L_A) and 6 - 8 (N_A) are connected inside the meter.

The meter is designed to measure current using current transformers with a secondary current of 1 or 5A. A permanent exceedance of 6A may damage the meter.

When selecting current transformers for the meter, pay attention to the transformer power, which must be sufficient to cover power losses in the measuring circuits (< 1VA) and energy losses in the cables. Examples of maximum cable lengths between the meter and the transformer, depending on the cable core diameter and transformer power, are shown in the table below:

Transformer power	0.5 mm^2	0.75 mm^2	1 mm^2	1.5 mm^2	2.5 mm^2
1 VA	-	-	-	-	-
1.5 VA	**0.25 m**	**0.37 m**	**0.5 m**	**0.7 m**	**1.1 m**
2.5VA	**0.75 m**	**1.1 m**	**1.5 m**	**2.1 m**	**3.3 m**
5 VA	**2 m**	**3 m**	**4 m**	**5.7 m**	**8.9 m**

A detailed table for calculating cable lengths can be found at www.fif.com.pl on the meter subpage in the Downloads tab.



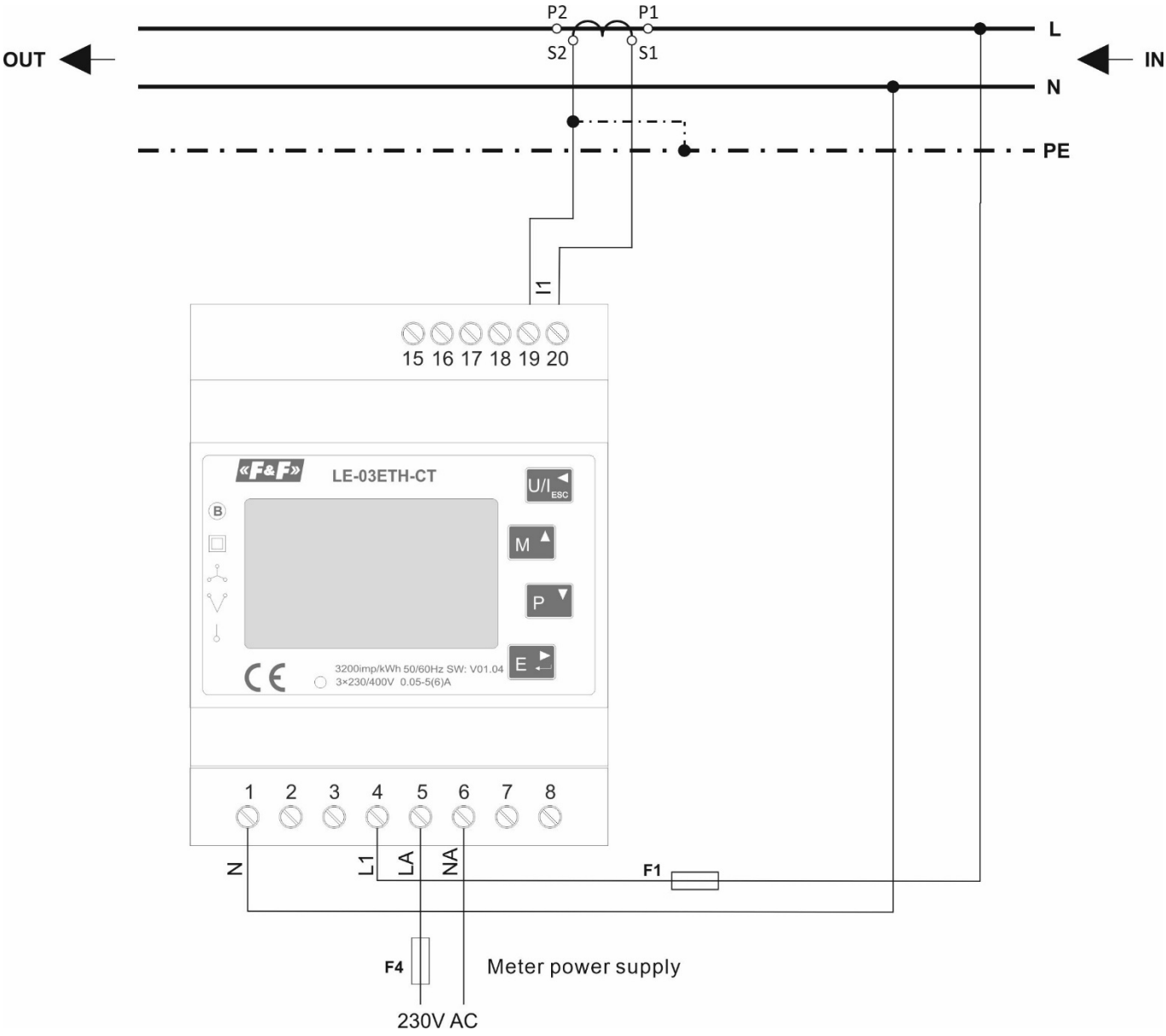
Meter terminal functions

1	N	Voltage measurement inputs
2	L3	
3	L2	
4	L1	
5-7	L_A	Meter power supply
6-8	N_A	
		Ethernet communication output (Modbus TCP)
15-16	L3	Current measurement circuits
17-18	L2	
19-20	L1	

Connection diagrams

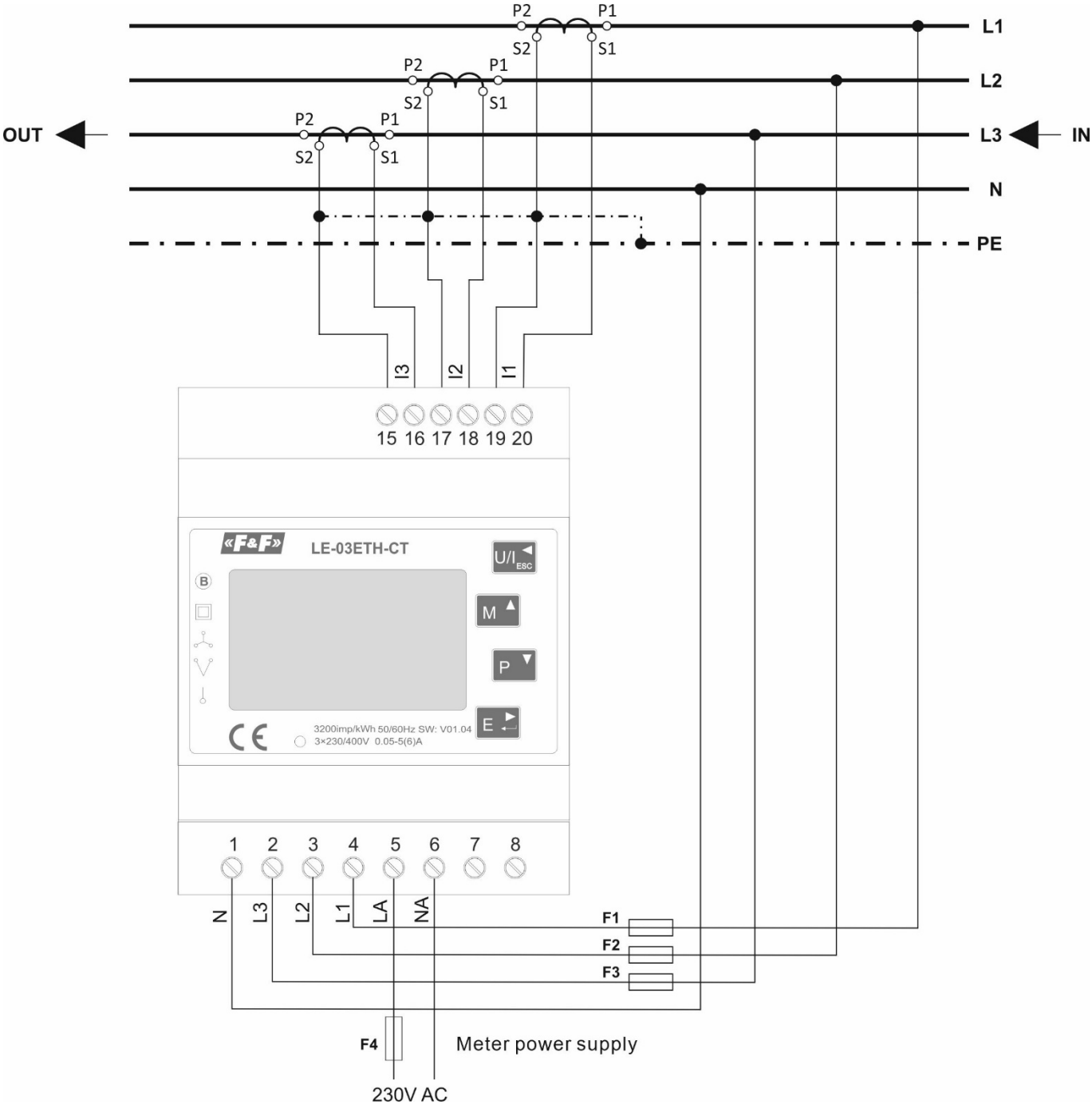
	The meter is configured by default to operate in a 3-phase, 4-wire (3P4W) system. For other measurement systems, adjust the **SYS** parameter setting of the meter accordingly.	

1P2W: 1-phase, 2-wire, semi-direct measurement



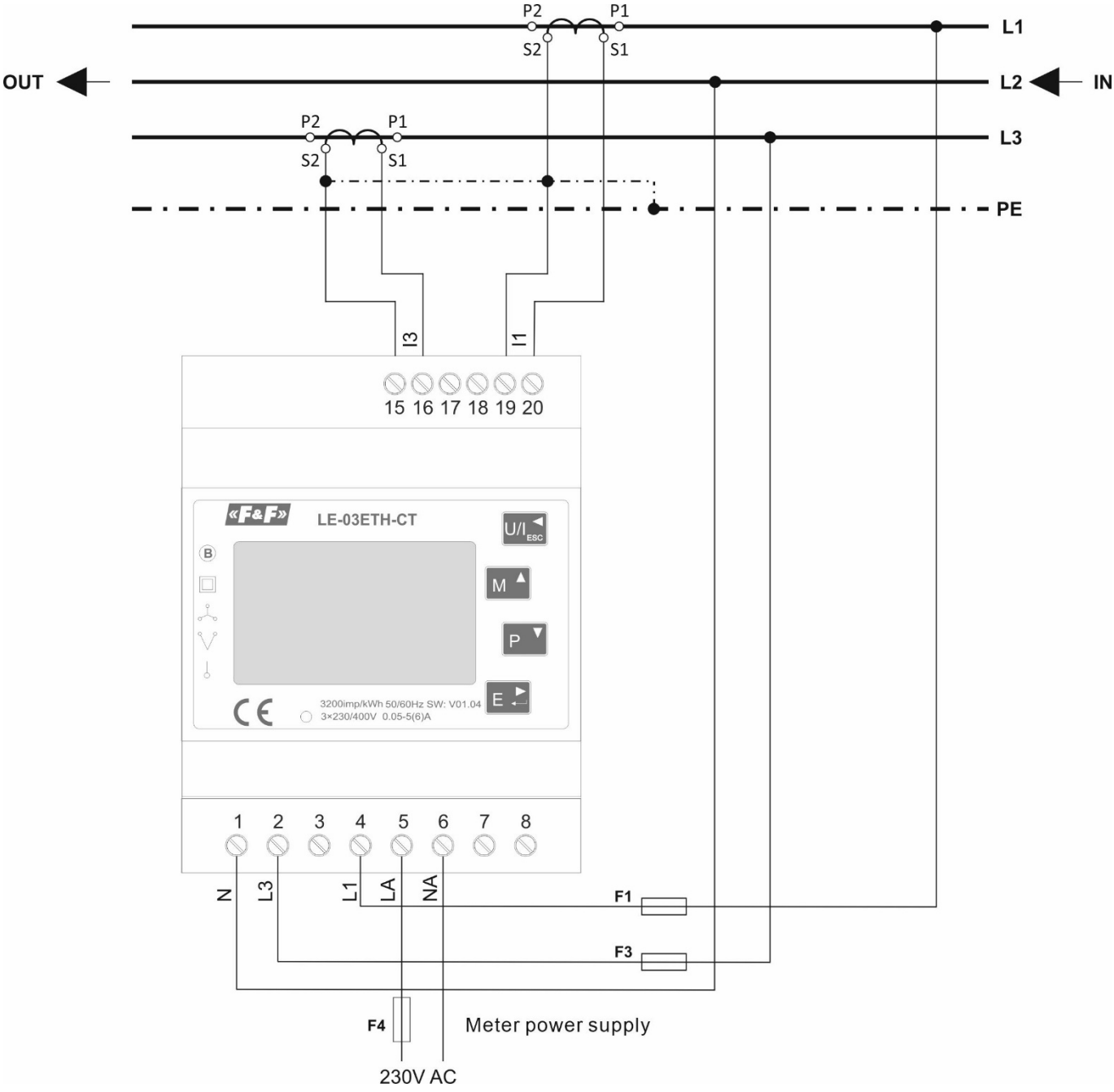
	It is recommended to protect the meter power supply (LA) and the L1 voltage measurement input with slow-blow fuses with a low tripping current (e.g. 0.25A).	

3P4W: 3-phase, 4-wire, semi-direct measurement



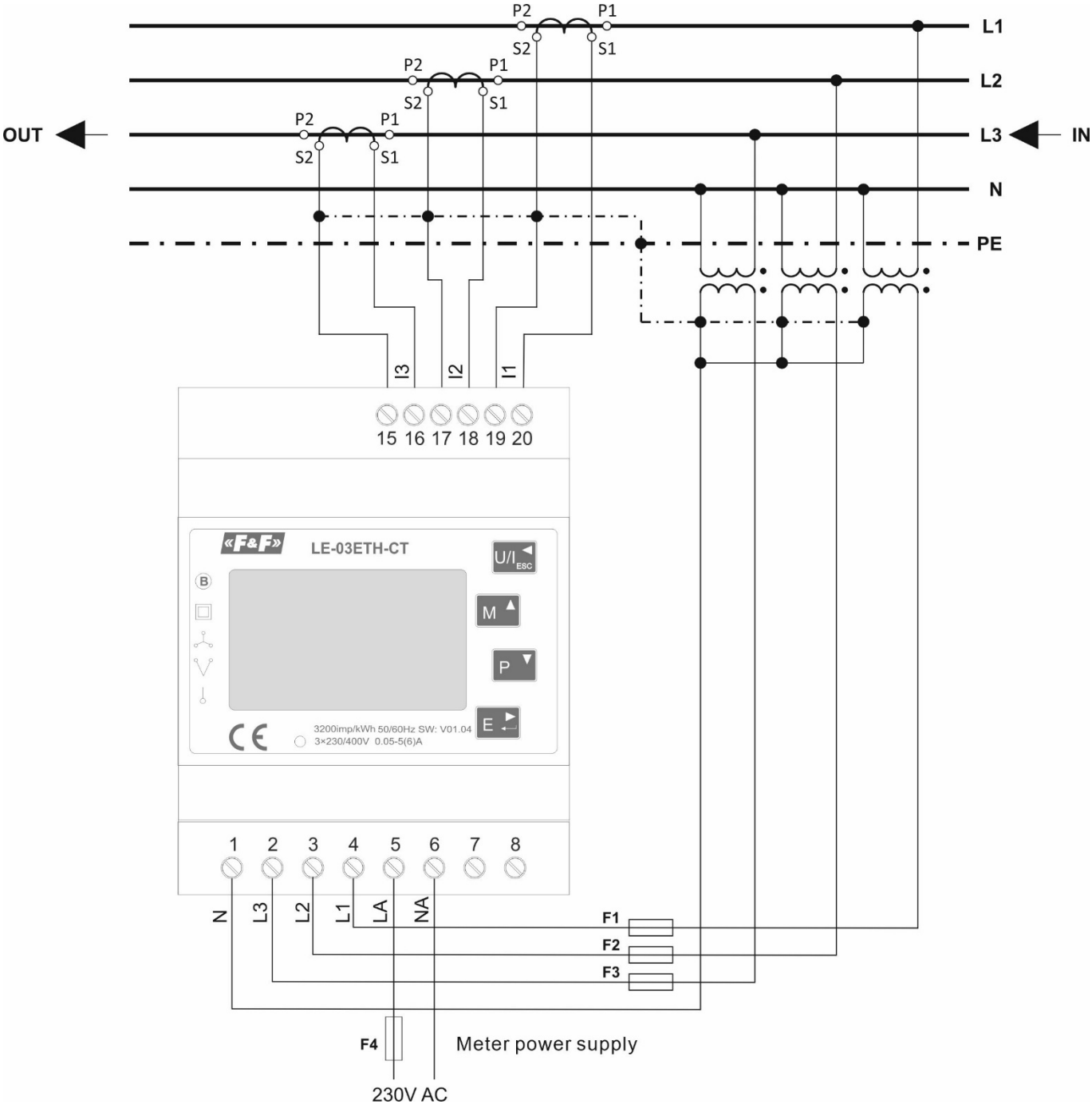
	It is recommended to protect the meter power supply (LA) and voltage measurement inputs (L1-L2-L3) with slow-blow fuses with a low tripping current (e.g. 0.25 A).	

3P3W: 3-phase, 3-wire, semi-direct measurement



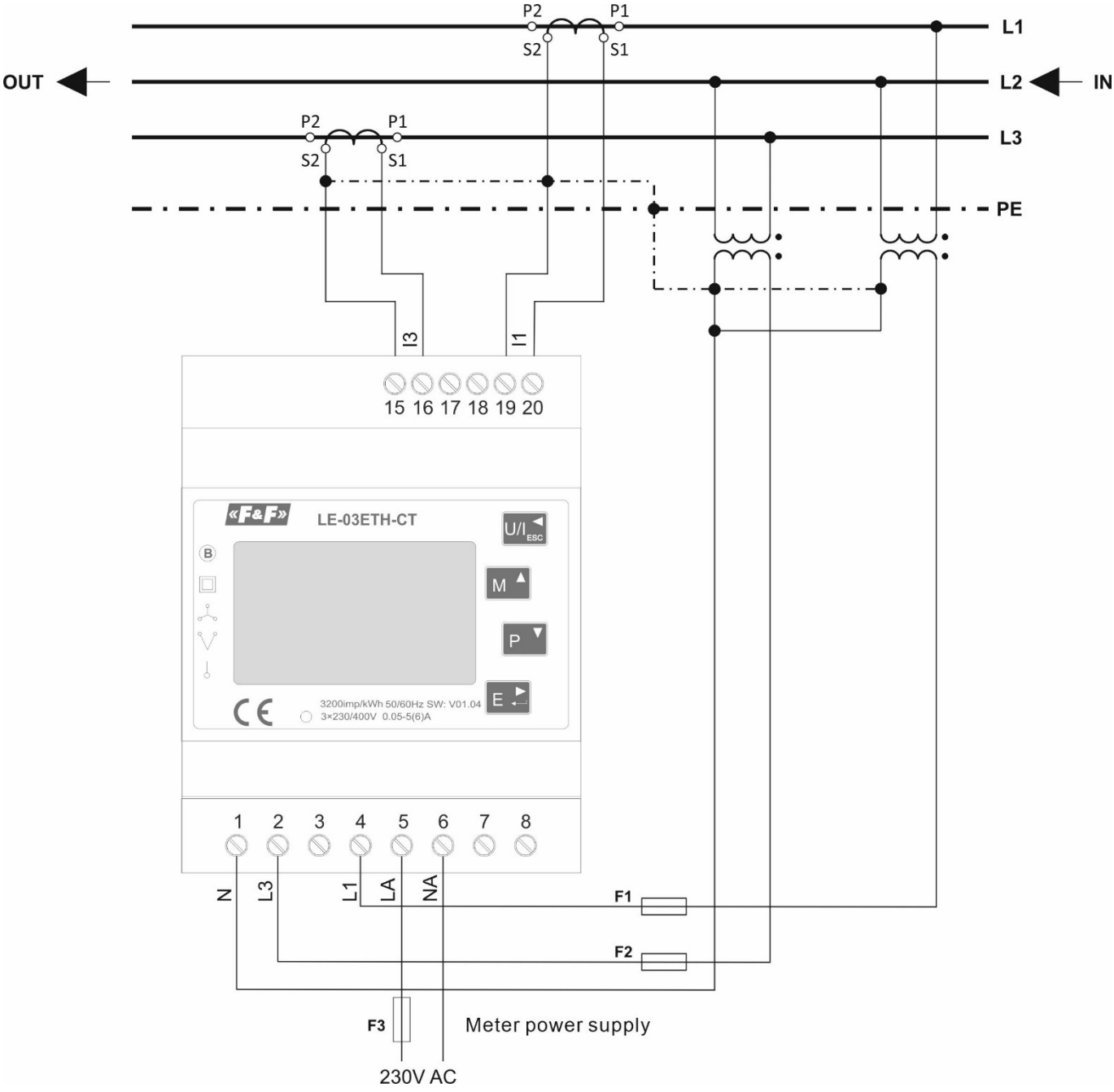
	It is recommended to protect the meter power supply (LA) and voltage measurement inputs (L1-L3) with slow-blow fuses with a low tripping current (e.g. 0.25 A).	

3P4W: 3-phase, 4-wire, indirect measurement



	It is recommended to protect the meter power supply (LA) and voltage measurement inputs (L1-L2-L3) with slow-blow fuses with a low tripping current (e.g. 0.25 A).	

3P3W: 3-phase, 3-wire, indirect measurement



	It is recommended to protect the meter power supply (LA) and voltage measurement inputs (L1-L3) with slow-blow fuses with a low tripping current (e.g. 0.25 A).	

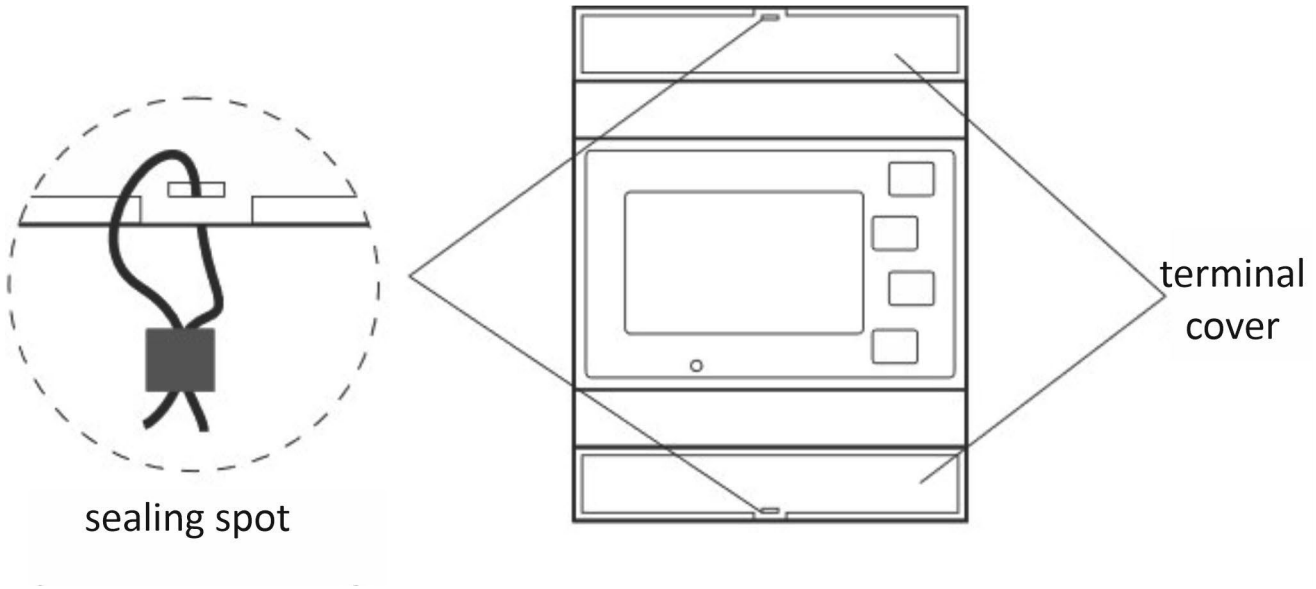
Ethernet communication output

The Ethernet interface enables the meter to communicate within a local area network (LAN) or to transmit data remotely via a TCP/IP network. This is a modern and fast way of transferring information, used both in automation systems and in remote monitoring solutions. To ensure proper Ethernet communication, the following requirements must be met:

- Twisted pair cable, minimum category 5e (UTP/STP) – the use of shielded STP cables is recommended in environments with high levels of electromagnetic interference.
- Wave impedance 100 Ω – compliant with the Ethernet transmission standard.
- Cable length up to 100 m between devices (for point-to-point connection).
- RJ45 connector – standard socket for connecting a network cable.
- Avoid running Ethernet cables parallel to power cables and keep them away from sources of interference.
- In the case of a shielded network, the cable shield should be grounded on one side only.
- In order to ensure communication with the master system, the device must have correctly configured network parameters (IP address, subnet mask, default gateway).

Sealing

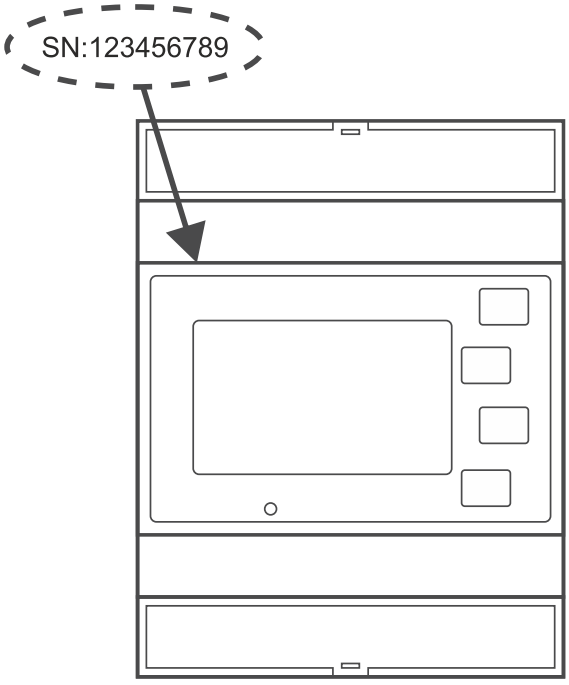
After connecting the meter, access to its terminals can be secured with seals connecting the meter body to the terminal covers.



	Security seals are not included with the meter.	

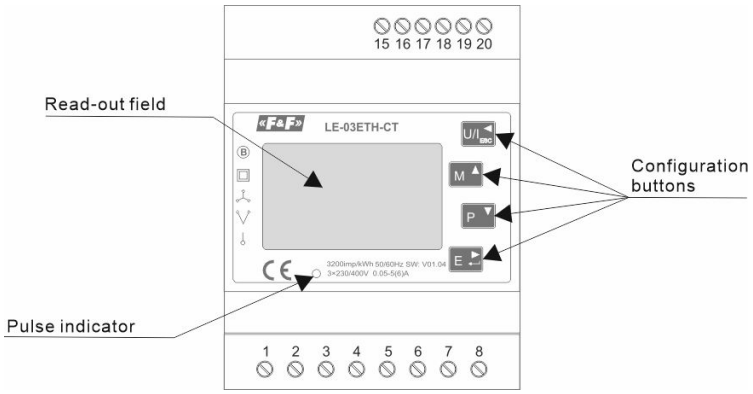
Meter serial number

The meter is marked with an individual serial number for unambiguous identification. The marking is permanent (laser engraved).



Part 3. Operation

Direct reading of measured values and meter configuration are available via the controls on the front panel of the display.



Reading field – LCD digital display showing the value of the measured parameter.

Button – touch button. A short press of the button switches the view to the next of the displayed parameters. A long press activates the meter configuration mode.

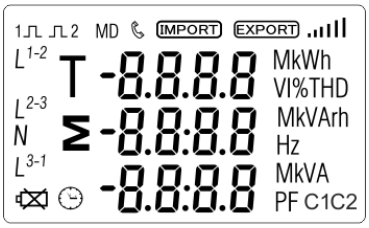
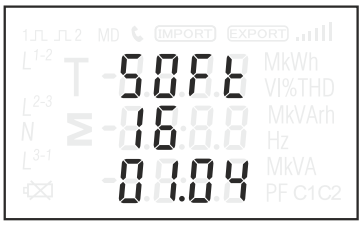
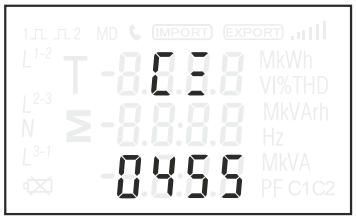
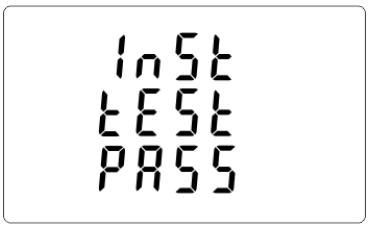
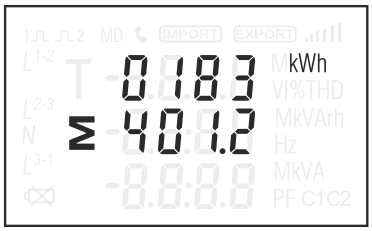
Pulse indicator – this is an LED indicator whose flashes correspond to the recorded increase in active energy consumption. A single flash is equivalent to 0.3125 Wh of energy consumption (3200 pulses = 1 kWh).

Button functions

E	Display screens with recorded energy consumption values. Pressing again switches the view to the next screen. In configuration mode, the **RIGHT** button moves to the next parameter digit for editing. When editing the last parameter digit, the button acts as **ENTER** to confirm the new value.
U/I ESC	Display screens with current voltage and current values. Pressing it again switches the view to the next screen. In configuration mode, the **LEFT** button moves to the previous parameter digit for editing. When editing the first parameter digit, the button acts as **ESC,** abandoning parameter editing without saving changes.
P	Display screens with current power values. Pressing it again switches the view to the next screen. In edit mode, the **DOWN** button decreases the value of the edited digit.
M	Display screens with current values of power factor, frequency and power demand. Pressing again switches the view to the next screen. In edit mode, the **UP** button increases the value of the digit being edited.

Starting the meter

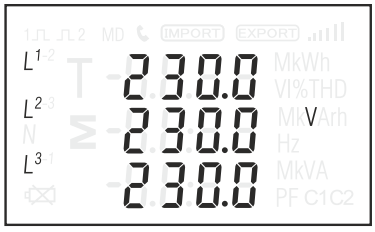
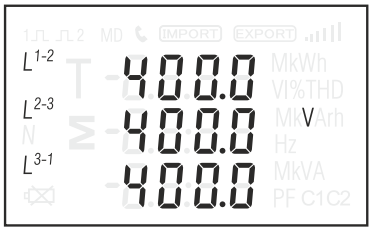
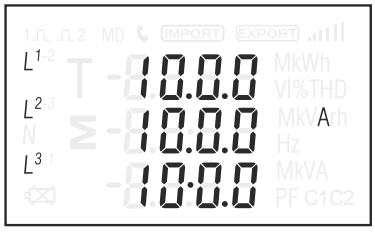
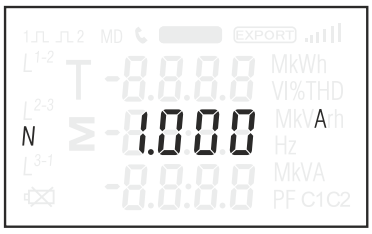
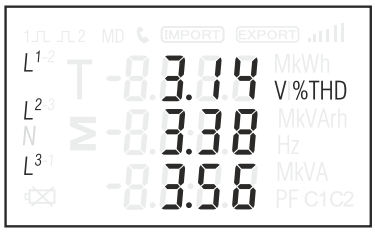
After switching on the meter, an automatic test procedure is performed during which the following information is displayed

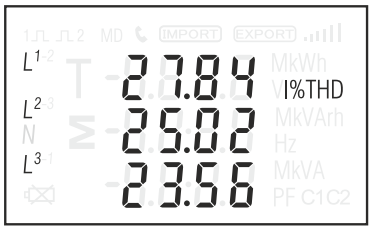
	All display segments are switched on
	Software version
	Programme checksum
	Testing of meter components.
	After the start-up procedure is complete, the total active energy consumption value is displayed on the screen.

Measurements displayed on the LCD screen

Voltage, current, voltage and current harmonics

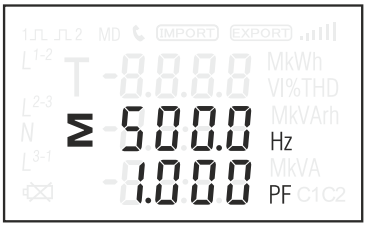
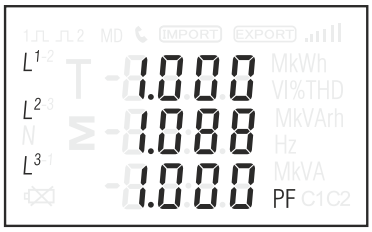
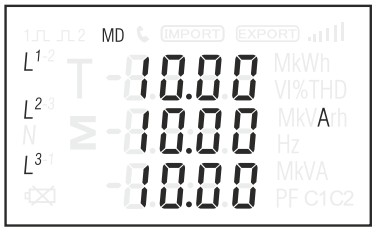
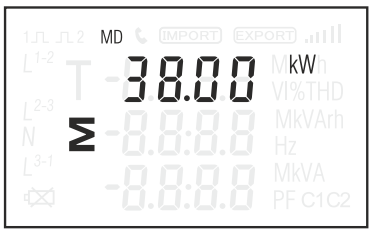
	Switching between voltage and current measurements is done by pressing the button U/I ESC	

	Phase voltage [V]
	Phase-to-phase voltage [V]
	Phase currents [A]
	Neutral conductor current [A]
	Content [%] of harmonic components in phase voltages

	Content [%] of harmonic components in phase currents

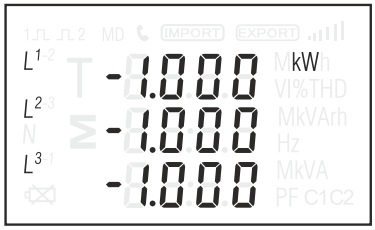
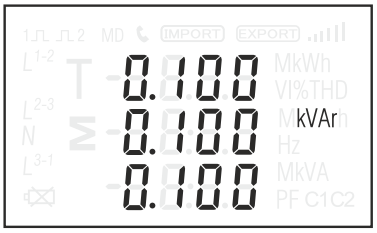
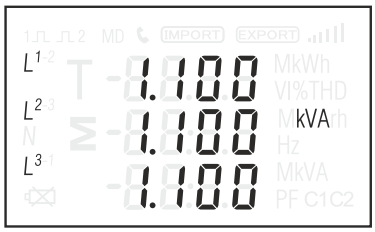
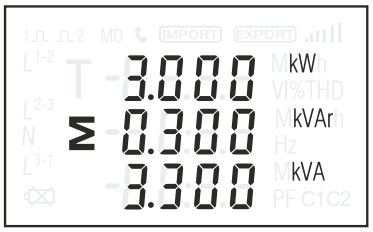
Frequency, total power factor, current and power demand

	Switching between measurements related to frequency, power factor and power demand is done by pressing the button M	

	Frequency [Hz] and total power factor [-]
	Power factor for individual phases [-]
	Current demand for individual phases [A]
	Total power demand [kW]

Power

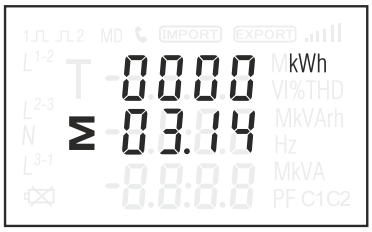
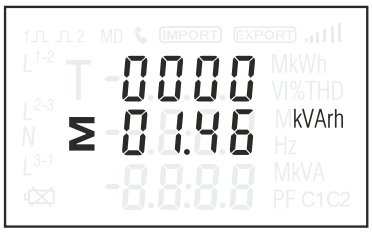
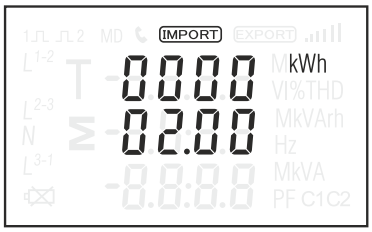
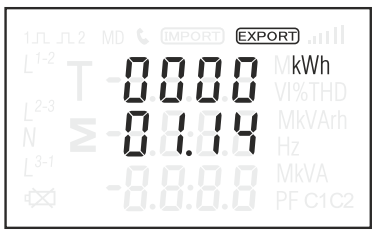
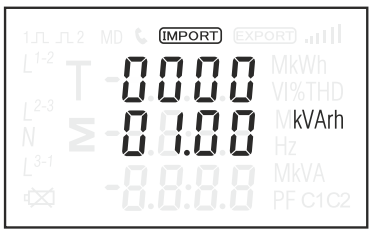
	Switching between measurements related to current power measurement is done by pressing the button P	

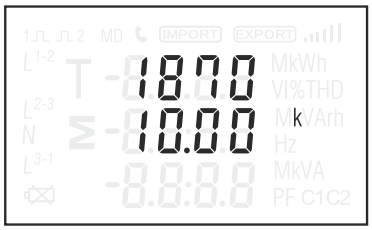
	Active power [kW] broken down by phase
	Reactive power [kVAr] broken down by phase
	Apparent power [kVA] broken down by phase
	Total (sum of three phases) active power [kW], reactive power [kVAr] and apparent power [kVA]

Energy

	Switching between energy measurement modes is performed by pressing the button 	

	Total energy consumption is displayed in a format of six whole digits and two decimal places after the decimal point, e.g. 000003.14. The four upper digits of the result (0000) are displayed in the upper line, and the last two digits of the integer part and the fractional part (03.14) are displayed in the lower line.	

	Total active energy [kWh/MWh]
	Total reactive energy [kVArh/MVArh]
	Imported active energy [kWh/MWh]
	Exported energy [kWh/MWh] active
	Imported reactive energy [kVArh/MVArh]

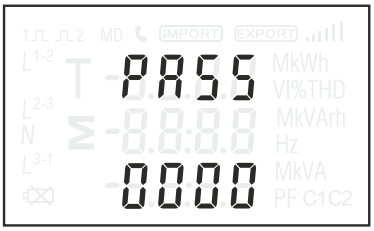
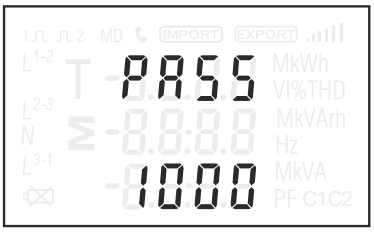
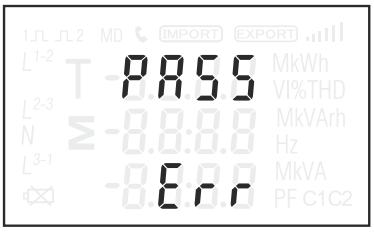
	Exported reactive energy [kVArh/MVArh]
	Carbon dioxide emissions per kWh of electricity

Meter configuration

The meter's operating parameters can be configured directly from the meter or remotely using the Ethernet interface and Modbus TCP protocol. Access to the configuration is protected by a 4-digit PIN code.

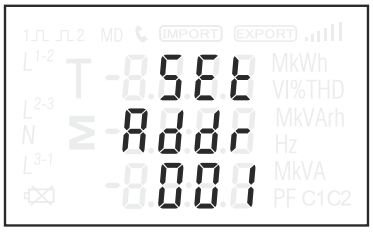
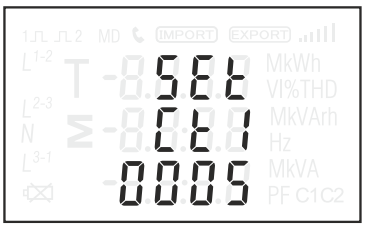
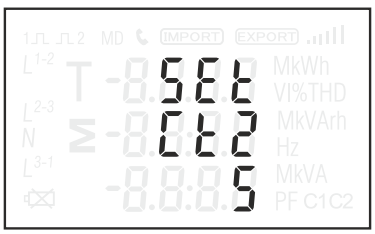
	The default PIN code for the LE-03ETH-CT meter is **1000**	

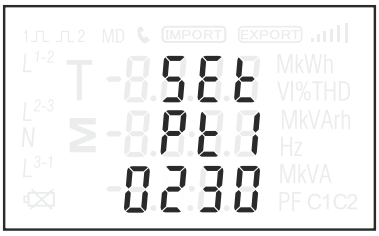
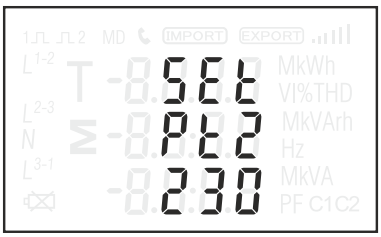
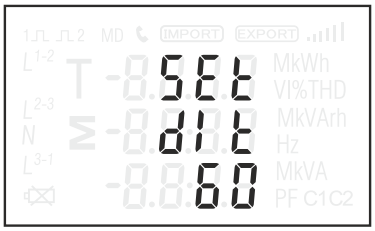
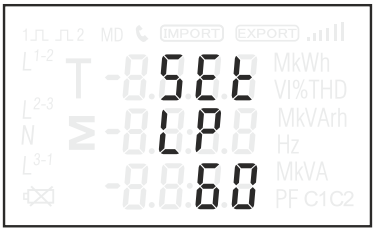
To enter configuration mode, press and hold the button for three seconds.

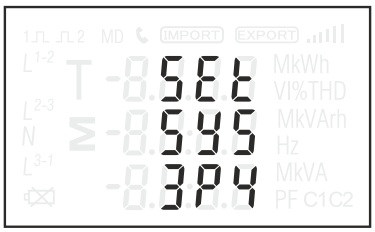
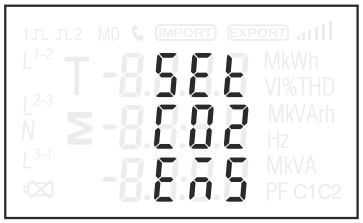
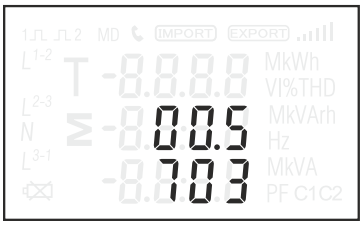
Entering the password	
	When the PASS message appears, enter the device PIN number.
	Password entered into the device
	If an incorrect PIN number is entered, an error message (Err) will be displayed

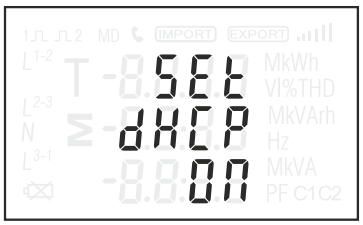
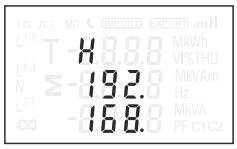
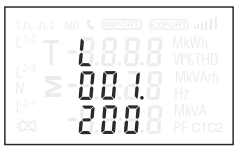
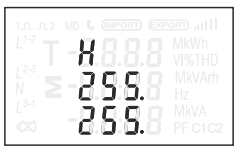
	Navigating the device menu and editing parameters is done according to the following scheme. Use **the Up** ( ) and **Down** ( ) buttons to select the parameter to be edited. To enter the selected parameter for editing, press the **ENTER/RIGHT** button ( ). In edit mode, the parameter value is changed using **the Up** and **Down** buttons. If the parameter is stored in several digits, each of them is set separately. To move to the next digit for editing, press the **RIGHT/ENTER** button ( ); to return to editing the previous digit, press the **LEFT/ESC** button ( ). To confirm the value, press the **RIGHT/ENTER** button ( ) after setting the last digit of the parameter.	

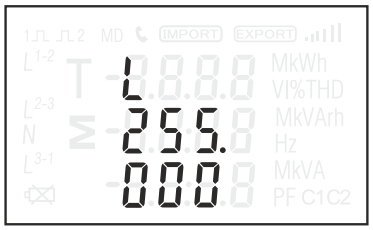
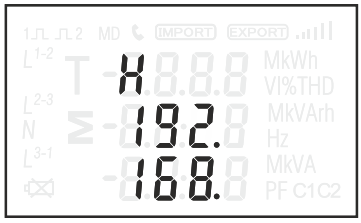
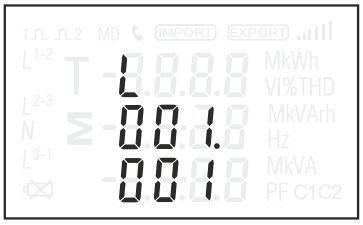
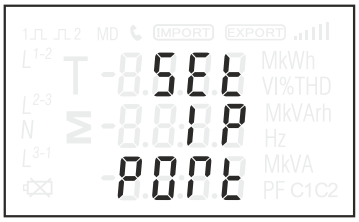
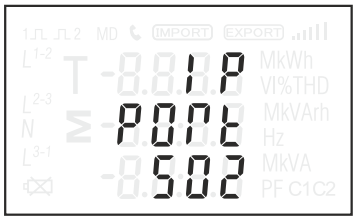
	To exit edit mode, press the **LEFT/ESC** button ( ) until the measurement screen is displayed.	

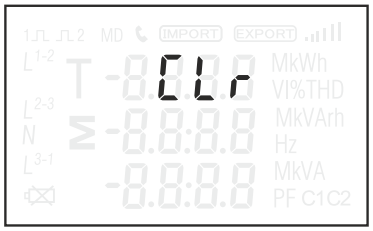
Settings	
	**Device address in the Modbus TCP network** Setting range: 1 – 247. Default value: **1**
	**Current transformer – primary current** Setting range: 1 – 9999. Default value: **5** **Note: Due to restrictions imposed during MID certification of the meter, each of the current and voltage transformer parameters can only be changed once!**
	**Current transformer – secondary current** Setting range: 1 or 5 A Default value: **5A** **Note: Due to restrictions imposed during MID certification of the meter, the setting of each of the current and voltage transformer parameters can only be**

	changed once!
	**Voltage transformer – primary side voltage** Setting range: 1 – 9999. Default value: **230** **Note: Due to restrictions imposed during MID certification of the meter, the setting of each of the current and voltage transformer parameters can only be changed once!**
	**Voltage transformer – secondary side voltage** Setting range: 100 or 500 V Default value: **230** **Note: Due to restrictions imposed during MID certification of the meter, each of the current and voltage transformer parameters can only be changed once!**
	**Current and power demand** The length of time during which the maximum power and current demand values are recorded. Setting range: 0 – 5 – 8 – 10 – 15 – 20 – 30 – 60 min. Default value: **60 min**. Note: the value 0 means that the maximum current and power values are recorded. The recorded value can be deleted using the CLR function, which is described below.
	**Screen backlight** The time during which the display backlight is on. Setting range: 0 (always on) – 5 – 10 – 30 – 60 – 120 – 121 min (always off).

	Default value: 60 min Note: Pressing any button on the meter reactivates the backlight for the set time.
	**Measurement system configuration** Parameter defining the type of installation (number of phases and wires) for which the energy meter is used for measurement. Setting range: 1P2 – 1-phase, 2-wire network 3P3 – 3-phase, 3-wire network 3P4 – 3-phase, 4-wire network Default value: 3P4 – 3-phase, 4-wire network.
Carbon dioxide emissions	
	**CO2 settings**
	**CO2 – conversion factor** Conversion factor between energy consumption in kWh and carbon dioxide emissions. Default value: (0.5703)

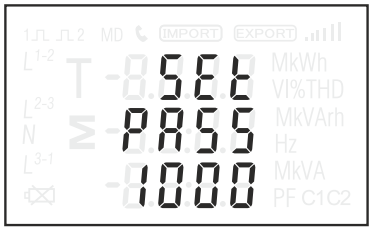
Ethernet communication – settings	
Ethernet communication – settings – DHCP	
	**TCP IP settings**
	**DHCP** Default value: OFF
Ethernet communication – settings – TCP IP	
	**Meter IP address**
	**Upper half of the meter IP address** Default value: 192.168 Note: The meter's TCP IP address can only be changed when DHCP is set to OFF.
	**Lower half of the meter IP address** Default value: 001.200
Ethernet communication settings – Subnet mask settings	
	**Subnet mask setting**
	**Subnet mask – upper half of the subnet mask** Default value: 255.255

	**Subnet mask – lower half of the subnet mask** Default value: 255.0
Ethernet communication – settings – TCP network gateway – settings	
	**TCP network gateway IP address**
	**Network gateway – upper half of the address** Default value: 192.168
	**Network gateway – lower half of the address** Default value: 001.001
Ethernet communication – settings – IP port number – settings	
	**IP port number**
	**IP port number** Default value: 502



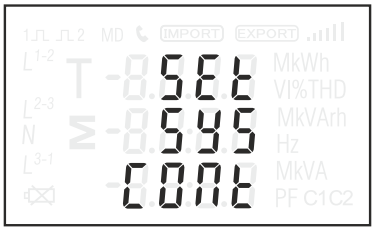
Resetting the power demand value

Note: after selecting the Clr option from the menu, press the ENTER ( ) button, and then when the MD symbol starts flashing on the display, confirm the command by pressing the ENTER button again.



Setting the meter access password

Note: if you set a password other than the default one, it is recommended that you write down the new password in a safe place. If you do not know the password, you will not be able to access the device settings.



Current transformer – direction

The direction of the current transformer connection can be reversed via software.

Parameters:

Phase L1	Phase L2	Phase L3
1A	1b	1C

Setting

No change in direction	Change of direction
Frd	rEU

Part 4 Ethernet communication

The meter is equipped with an Ethernet communication interface supporting the Modbus TCP protocol.

Default communication settings

No.	Parameter	Default
3	IP address	**192.168.1.200**
4	Port	**502**
5	Subnet mask	**255.255.255.0**
6	Gateway	**192.168.1.1**
7	DHCP	**Disabled**

For remote configuration of the meter, we recommend using the free **LE Config** software (for computers running Windows), available at www.fif.com.pl on the product subpage.

List of measurement registers

All measurement results are read-only data. Data reading, in accordance with the Modbus TCP protocol, is performed using the **Read Input Register** command (**command code 0x04**).

Some of the measurement results are stored as 32-bit floating point numbers (FLOAT), in accordance with the IEEE 754 standard. In this case, each number is stored in two consecutive Modbus registers.
In some cases, data may also be stored as 32-bit (INT32) or 64-bit (INT64) integers, depending on the type of parameter. These values occupy two or four consecutive Modbus registers, respectively.

Not all measurement results are available for all measurement systems. Please refer to the **Measurement System** columns in the table below:

● - measurement available

○ - measurement unavailable

No.	Parameter	Address		Format	R/W	Measuring system			Unit
		HEX	DEC			3P4W	3P3W	1P1W	
1	Phase L1 – phase voltage (L1-N)	0x0000	0	F	R	●	○	●	V
2	Phase L2 – phase voltage (L2-N)	0x0002	2	F	R	●	○	○	V
3	Phase L3 – phase voltage (L3-N)	0x0004	4	F	R	●	○	○	V
4	Phase L1 – phase current	0x0006	6	F	R	●	●	●	A
5	Phase L2 – phase current	0x0008	8	F	R	●	●	○	A
6	Phase L3 – phase current	0x000A	10	F	R	●	●	○	A
7	Phase L1 – active power	0x000C	12	F	R	●	○	●	W
8	Phase L2 – active power	0x000E	14	F	R	●	○	○	W
9	Phase L3 – active power	0x0010	16	F	R	●	○	○	W
10	Phase L1 – apparent power	0x0012	18	F	R	●	○	●	VA
11	Phase L2 – apparent power	0x0014	20	F	R	●	○	○	VA
12	Phase L3 – apparent power	0x0016	22	F	R	●	○	○	VA
13	Phase L1 – reactive power	0x0018	24	F	R	●	○	●	VAr
14	Phase L2 – reactive power	0x001A	26	F	R	●	○	○	VAr
15	Phase L3 – reactive power	0x001C	28	F	R	●	○	○	VAr
16	Phase L1 – power factor (1)	0x001E	30	F	R	●	○	●	-
17	Phase L2 – power factor (1)	0x0020	32	F	R	●	○	○	-
18	Phase L3 – power factor ()	0x0022	34	F	R	●	○	○	-
19	Phase L1 – phase shift	0x0024	36	F	R	●	○	●	o
20	Phase L2 – phase shift	0x0026	38	F	R	●	○	○	o
21	Phase L3 – phase shift	0x0028	40	F	R	●	○	○	o

No.	Parameter	Address		Format	R/W	Measuring system			Unit
		HEX	DEC			3P4W	3P3W	1P1W	
22	Average phase voltage	0x002A	42	F	R	●	○	○	V
23	Average phase current	0x002E	46	F	R	●	●	●	A
24	Sum of phase currents	0x0030	48	F	R	●	●	●	A
25	Total active power	0x0034	52	F	R	●	●	●	W
26	Total apparent power	0x0038	56	F	R	●	●	●	VA
27	Total reactive power	0x003C	60	F	R	●	●	●	VAr
28	Total power factor (1)	0x003E	62	F	R	●	●	●	-
29	Average phase shift	0x0042	66	F	R	●	●	●	o
30	Frequency	0x0046	70	F	R	●	●	●	Hz
31	Total imported active energy	0x0048	72	F	R	●	●	●	kWh
32	Total exported active energy	0x004A	74	F	R	●	●	●	kWh
33	Total imported reactive energy	0x004C	76	F	R	●	●	●	kVArh
34	Total exported reactive energy	0x004E	78	F	R	●	●	●	kVArh
35	Total number of volt-ampere hours	0x0050	80	F	R	●	●	●	kVAh
36	Total number of ampere-hours	0x0052	82	F	R	●	●	●	Ah
37	Active power demand (2)	0x0054	84	F	R	●	●	●	W
38	Maximum active power demand (2)	0x0056	86	F	R	●	●	●	W
39	Demand for imported active power	0x0058	88	F	R	●	●	●	W
40	Maximum demand for imported active power	0x005A	90	F	R	●	●	●	W
41	Demand for exported active power	0x005C	92	F	R	●	●	●	W

No.	Parameter	Address		Format	R/W	Measuring system			Unit
		HEX	DEC			3P4W	3P3W	1P1W	
42	Maximum demand for exported active power	0x005E	94	F	R	●	●	●	W
43	Apparent power demand	0x0064	10	F	R	●	●	●	VA
44	Maximum apparent power demand	0x0066	102	F	R	●	●	●	VA
45	Neutral wire current demand	0x0068	104	F	R	●	○	○	A
46	Maximum current demand of the neutral conductor	0x006A	106	F	R	●	○	○	A
47	Reactive power demand (2)	0x006C	108	F	R	●	○	●	Var
48	Maximum reactive power demand (2)	0x006E	110	F	R	●	○	●	Var
49	Line voltage L1 – L2	0x00C8	200	F	R	●	●	○	V
50	Line voltage L2 – L3	0x00CA	202	F	R	●	●	○	V
51	Line voltage L3– L1	0x00CC	204	F	R	●	●	○	V
52	Average line voltage	0x00CE	206	F	R	●	●	○	V
53	Neutral wire current	0x00E0	224	F	R	●	○	○	A
54	Phase L1 – voltage harmonic content	0x00EA	234	F	R	●	○	●	%
55	Phase L2 – voltage harmonic content	0x00EC	236	F	R	●	○	○	%
56	Phase L3 – voltage harmonic content	0x00EE	238	F	R	●	○	○	%
57	Phase L1 – current harmonic content	0x00F0	240	F	R	●	○	●	%
58	Phase L2 – current harmonic content	0x00F2	242	F	R	●	○	○	%
59	Phase L3 – current harmonic content	0x00F4	244	F	R	●	○	○	%
60	Average voltage harmonic content	0x00F8	248	F	R	●	○	●	%
61	Average harmonic content of current	0x00FA	250	F	R	●	●	●	%

No.	Parameter	Address		Format	R/W	Measuring system			Unit
		HEX	DEC			3P4W	3P3W	1P1W	
62	Total power factor (1)	0x00FE	254	F	R	●	●	●	-
63	Phase L1 – current demand	0x0102	258	F	R	●	●	●	A
64	Phase L2 – current demand	0x0104	260	F	R	●	●	○	A
65	Phase L3 – current demand	0x0106	262	F	R	●	●	○	A
66	Phase L1 – maximum current demand	0x0108	264	F	R	●	●	●	A
67	Phase L2 – maximum current demand	0x010A	266	F	R	●	●	○	A
68	Phase L3 – maximum current demand	0x010C	268	F	R	●	●	○	A
69	Phase-to-phase voltage L1-L2 – voltage harmonic content	0x014E	334	F	R	●	●	○	%
70	Phase-to-phase voltage L2-L3 – voltage harmonic content	0x0150	336	F	R	●	●	○	%
71	Phase-to-phase voltage L3-L1 – voltage harmonic content	0x0152	338	F	R	●	●	○	%
72	Interphase voltages – average harmonic content	0x0154	340	F	R	●	●	○	%
73	Total active energy (3)	0x0156	342	F	R	●	●	●	kWh
74	Total reactive energy (3)	0x0158	344	F	R	●	●	●	kVArh
75	Phase L1 – imported active energy	0x015A	346	F	R	●	●	●	kWh
76	Phase L2 – imported active energy	0x015C	34	F	R	●	●	○	kWh
77	Phase L3 – imported active energy	0x015E	350	F	R	●	●	○	kWh
78	Phase L1 – exported active energy	0x0160	352	F	R	●	●	●	kWh
79	Phase L2 – exported active energy	0x0162	354	F	R	●	●	○	kWh
80	Phase L3 – exported active energy	0x0164	356	F	R	●	●	○	kWh

No.	Parameter	Address		Format	R/W	Measuring system			Unit
		HEX	DEC			3P4W	3P3W	1P1W	
81	Phase L1 – total active energy	0x0166	358	F	R	●	●	●	kWh
82	Phase L2 – total active energy	0x0168	360	F	R	●	●	●	kWh
83	Phase L3 – total active energy	0x016A	362	F	R	●	●	●	kWh
84	Phase L1 – imported reactive energy	0x016C	364	F	R	●	●	●	kVArh
85	Phase L2 – imported reactive energy	0x016E	366	F	R	●	●	○	kVArh
86	Phase L3 – imported reactive energy	0x0170	368	F	R	●	●	○	kVArh
87	Phase L1 – exported reactive energy	0x0172	370	F	R	●	●	●	kVArh
88	Phase L2 – exported reactive energy	0x0174	372	F	R	●	●	○	kVArh
89	Phase L3 – exported reactive energy	0x0176	374	F	R	●	●	○	kVArh
90	Phase L1 – total reactive energy	0x0178	376	F	R	●	●	●	kVArh
91	Phase L2 – total reactive energy	0x017A	378	F	R	●	●	●	kVArh
92	Phase L3 – total reactive energy	0x017C	380	F	R	●	●	●	kVArh
93	Net active energy (Import - Export)	0x018C	396	F	R	●	●	●	kWh
94	Net reactive energy (Import - Export)	0x018E	398	F	R	●	●	●	kVArh
95	Total active energy imported	0x2710	10000	I64	R	●	●	●	Wh
96	Total active energy exported	0x2714	10004	I64	R	●	●	●	Wh
97	Total reactive energy imported	0x2718	10008	I64	R	●	●	●	VArh
98	Total reactive energy exported	0x271C	10012	I64	R	●	●	●	VArh
99	Total apparent energy	0x2720	10016	I64	R	●	●	●	VAh
100	Total active energy	0x2724	10020	I64	R	●	●	●	Wh
101	Total reactive energy	0x2728	10024	I64	R	●	●	●	VArh

No.	Parameter	Address		Format	R/W	Measuring system			Unit
		HEX	DEC			3P4W	3P3W	1P1W	
102	Phase L1 - active energy imported	0x272C	10028	I64	R	●	●	●	Wh
103	Phase L2 - active energy imported	0x2730	10032	I64	R	●	●	●	Wh
104	Phase L3 - active energy imported	0x2734	10036	I64	R	●	●	●	Wh
105	Phase L1 - active energy exported	0x2738	10040	I64	R	●	●	●	Wh
106	Phase L2 - active energy exported	0x273C	10044	I64	R	●	●	●	Wh
107	Phase L3 - active energy exported	0x2740	10048	I64	R	●	●	●	Wh
108	Phase L1 - total active energy	0x2744	10052	I64	R	●	●	●	Wh
109	Phase L2 - total active energy	0x2748	10056	I64	R	●	●	●	Wh
110	Phase L3 - total active energy	0x274C	10060	I64	R	●	●	●	Wh
111	Phase L1 - imported reactive energy	0x2750	10064	I64	R	●	●	●	VArh
112	Phase L2 - imported reactive energy	0x2754	10068	I64	R	●	●	●	VArh
113	Phase L3 - imported reactive energy	0x2758	10072	I64	R	●	●	●	VArh
114	Phase L1 - reactive energy exported	0x275C	10076	I64	R	●	●	●	VArh
115	Phase L2 - exported reactive energy	0x2760	10080	I64	R	●	●	●	VArh
116	Phase L3 - reactive energy exported	0x2764	10084	I64	R	●	●	●	VArh
117	Phase L1 - total reactive energy	0x2768	10088	I64	R	●	●	●	VArh
118	Phase L2 - total reactive energy	0x276C	10092	I64	R	●	●	●	VArh
119	Phase L3 - total reactive energy	0x2770	10096	I64	R	●	●	●	VArh
120	Phase 1 voltage relative to neutral wire	0x280A	10250	I32	R	●	○	●	0.1V
121	Phase 2 voltage relative to neutral wire	0x280C	10252	I32	R	●	○	○	0.1V
122	Phase 3 voltage relative to neutral wire	0x280E	10254	I32	R	●	○	○	0.1V

No.	Parameter	Address		Format	R/W	Measuring system			Unit
		HEX	DEC			3P4W	3P3W	1P1W	
123	Phase 1 - phase current	0x2810	10256	I32	R	●	●	●	0.001A
124	Phase 2 - phase current	0x2812	10258	I32	R	●	●	○	0.001A
125	Phase 3 - phase current	0x2814	10260	I32	R	●	●	○	0.001A
126	Phase 1 - active power	0x2816	10262	I32	R	●	○	●	0.1W
127	Phase 2 - active power	0x2818	10264	I32	R	●	○	○	0.1W
128	Phase 3 - active power	0x281A	10266	I32	R	●	○	○	0.1W
129	Phase 1 - apparent power	0x281C	10268	I32	R	●	○	●	0.1VA
130	Phase 2 - apparent power	0x281E	10270	I32	R	●	○	○	0.1VA
131	Phase 3 - apparent power	0x2820	10272	I32	R	●	○	○	0.1VA
132	Phase 1 - reactive power	0x2822	10274	I32	R	●	○	●	0.1VAr
133	Phase 2 - reactive power	0x2824	10276	I32	R	●	○	○	0.1VAr
134	Phase 3 - reactive power	0x2826	10278	I32	R	●	○	○	0.1VAr
135	Phase 1 - power factor	0x2828	10280	I32	R	●	○	●	0.01
136	Phase 2 - power factor	0x282A	10282	I32	R	●	○	○	0.01
137	Phase 3 - power factor	0x282C	10284	I32	R	●	○	○	0.01
138	Phase 1 - phase shift	0x282E	10286	I32	R	●	○	●	0.01°
139	Phase 2 - phase shift	0x2830	10288	I32	R	●	○	○	0.01°
140	Phase 3 - phase shift	0x2832	10290	I32	R	●	○	○	0.01°
141	Average phase voltage relative to neutral wire	0x2834	10292	I32	R	●	○	○	0.1V
142	Average phase current	0x2836	10294	I32	R	●	●	●	0.1A
143	Sum of phase currents	0x2838	10296	I32	R	●	●	●	0.1A

No.	Parameter	Address		Format	R/W	Measuring system			Unit
		HEX	DEC			3P4W	3P3W	1P1W	
144	Total system power	0x283A	10298	I32	R	●	●	●	0.1W
145	Total apparent power of the system	0x283C	10300	I32	R	●	●	●	0.1VA
146	Total reactive power of the system	0x283E	10302	I32	R	●	●	●	0.1Ar
147	Total power factor of the system	0x2840	10304	I32	R	●	●	●	0.01
148	Total phase shift of the system	0x2842	10306	I32	R	●	●	●	0.01°
149	Power supply frequency	0x2844	10308	I32	R	●	●	●	0.01Hz
150	CO_2 emissions	0x2846	10310	I64	R	●	●	●	0.001 kg
151	CO_2 emissions	0x4EA2	323234	F	R	●	●	●	Kg

(1) The power factor sign indicates the direction of active energy flow. A positive value indicates active energy import, a negative value indicates active energy export.

(2) Total power (sum of three phases) is calculated as an algebraic sum (imported power – exported power).

(3) Total energy consumption is calculated as the sum of imported and exported energy.

(4) Total power demand is calculated as the difference between imported and exported power.

List of configuration registers

All measurement results are read-only data. Data is read in accordance with the Modbus TCP protocol using the **Read Holding Registers** command (**command code 0x03**). Data is written using the **Write Multiple Registers** command **(command code 0x10)**.

	One write command can change the value of only one parameter.	

	Most measurement results are stored as 32-bit floating point numbers (FLOAT), in accordance with the IEEE 754 standard. Each number is stored in two consecutive Modbus registers. Some results are given in hexadecimal (HEX) format or as 32-bit integers (INT32).	

No.	Parameter	Address		Format	R/W	Description
		HEX	DEC			
1	Demand – time to end of period	0x0000	0	Float	R	Value in minutes indicating the time for which the power and current demand is calculated. When the value reaches the set period length, this will indicate the correct values of the read power and current demand.
2	Power and current demand – period length	0x0002	2	Float	R/W	The period of time on the basis of which the maximum active power and phase current demand is calculated. Setting range: 0, 5, 8, 10, 15, 20, 30, 60 min. Default value: **10 min** **Note**: A setting of 0 means that the demand values will indicate the maximum power and current values from the moment the power is switched on, while values greater than zero mean that the power demand will be reset and refreshed every specified time.
3	Measuring system	0x000A	10	Float	R/W	Parameter defining the measurement system in which the meter operates. Setting range: 1 – 1-phase, 2-wire system (1P2W) 2 – 3-phase, 3-wire system (3P3W) 3 – 3-phase, 4-wire system (3P4W)

						Default value: **3** **Note: changing the measurement system requires entering a security code into register 0x18** **Note:** setting the SYS parameter in accordance with the measurement system in which the meter operates is crucial for correct measurements.
4	Security status	0x000E	14	Float	R	This parameter indicates whether remote access to key parameters is secured. 0 – Secure access 1 – Access unlocked Note: access to key parameters is unlocked by entering a PIN code into parameter 6.
5	Ethernet – device address	0x0014	20	Float	R/W	Device address in the Ethernet communication network Setting range: 1 – 247. Default value: **1**
6	PIN code	0x0018	24	Float	R	Entering the correct password for this register will enable the editing of key meter parameters. **Note**: the lock status can be read in parameter 4
7	Voltage transformer – primary side voltage	0x002E	46	Float	R/W	Setting range: 1 – 9999. Default value: **230**
8	Voltage transformer –	0x0030	4	Float	R/W	Setting range: 100 – 500 V

	secondary side voltage					Default value: **230 V**  **Note: Due to restrictions imposed during MID certification of the meter, each of the current and voltage transformer parameters can only be changed once!**
9	Current transformer – primary current	0x0032	50	Float	R/W	Setting range: 1 – 9999. Default value: **5**
10	Current transformer – secondary current	0x0034	52	Float	R/W	Setting range: 1 or 5 A Default value: **5A**  **Note: Due to restrictions imposed during MID certification of the meter, each of the current and voltage transformer parameters can only be changed once!**
11	Current transformer – direction	0x0038	56	Float	R/W	Possibility of programmatically reversing the connection direction of the current transformer. Setting range: 0 = L1 Frd, L2 Frd, L3 Frd 1 = L1 Rev, L2 Frd, L3 Frd 2 = L1 Frd, L2 Rev, L3 Frd 3 = L1 Rev, L2 Rev, L3 Frd 4 = L1 Frd, L2 Frd, L3 Rev 5 = L1 Rev, L2 Frd, L3 Rev 6 = L1 Forward, L2 Reverse, L3 Reverse 7 = L1 Rev, L2 Rev, L3 Rev
12	Screen backlight	0x003C	60	Float	R/W	The time during which the display backlight is on. Setting range: 0-121 minutes

						0 - (always on) 121 -(always off) Default value: 60 min
13	CO2 emissions - conversion factor	0x0046	70	Hex	R/W	Conversion factor between energy consumption in kWh and carbon dioxide emissions. Result stored as a HEX number on a scale of 0.0001 kg Default value: 0.5703 kg (0x1647 in HEX)
14	Ethernet communication - parameters	0xF006	61446	Hex	R/W	Ethernet communication settings. 0xF006) IP address – upper half of the address 0xF007) IP address – lower half of the address 0xF008) Subnet mask – upper half of the mask 0xF009) Subnet mask – lower half of the mask 0xF00A) Network gateway – upper half of the mask 0xF00B) Network gateway – lower half of the mask 0xF00C) IP port number Default values: IP address: 192.168.1.200 Network mask: 255.255.255.0 Network gateway: 192.168.1.1 IP port number: 502

						Example of value encoding: IP address – upper half of the address: 192.168 (0xC0A8) **Note:** If DHCP is enabled, the register is read-only, not writable, and the values displayed here indicate the network settings assigned by the router and the DHCP mechanism.
15	DHCP	0xF00E	61454	Hex	R/W	Obtain an IP address automatically (DHCP) 0 = disabled 1 = enabled
16	Reset counters	0xF010	61456	Hex	W	0 – Reset current demand meters
17	Meter operating time	0xF930	63792	Float	R/W	Counter operating time – value given in hours
18	Serial number	0xFC00	64512	Int32	R	Counter serial number
19	Meter code	0xFC02	64514	Hex	R	0x1118
20	Counter version	0xFC84	64644	Hex	R	Counter version: XX.YY
21	CRC code	0xFC88	64648	Hex	R	Programme checksum

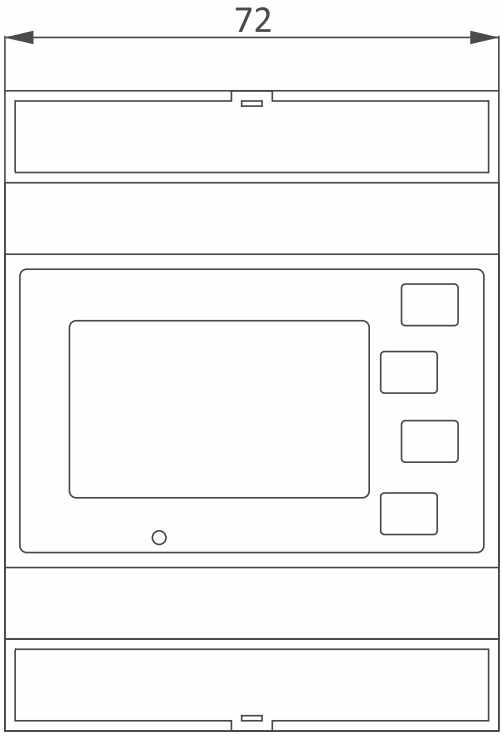
Part 5. Technical data

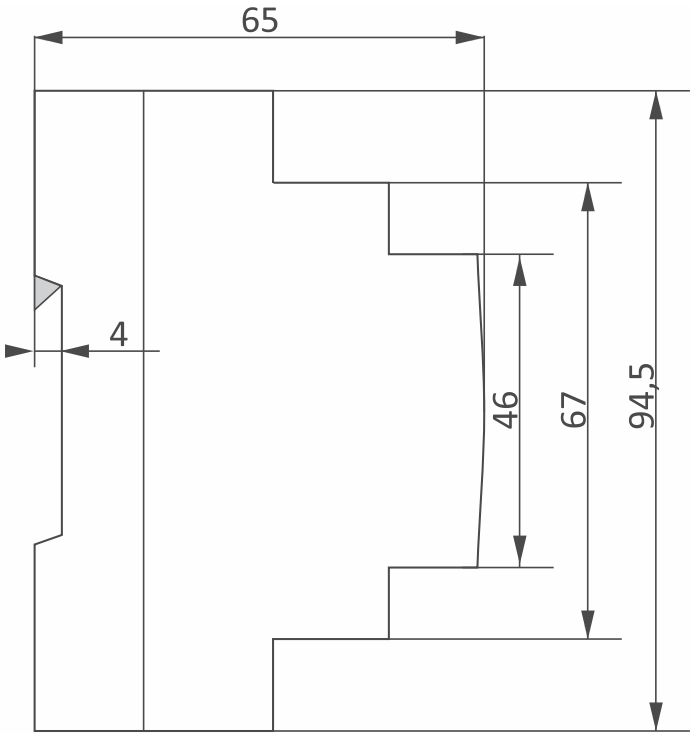
Rated voltage		3x230/400 V AC
Current	Minimum detection current	0.02 A
	Minimum	0.25 A
	base	5 A
	maximum	6 A
Overload capacity		20 × Imax/0.5 s
Insulation		4 kV /1 min, 6kV / 1.2 us
Insulation protection class		Class II
Environmental conditions class		
Mechanical		M1
electromagnetic		E2
Voltage measurement range (L -N)		100–276 V AC
Voltage measurement range (L-L)		172–480 V AC
Measurement accuracy		
Voltage		0.5
Current		0.5
Frequency		0.2
Active power		1
Reactive power		1
Apparent power		1
Active energy		Class B (EN50470-1/3)
Reactive energy		Class 2 (IEC62053-23)
Rated frequency		50/60 Hz
Housing		PC + ABS plastic (self-extinguishing)

Meter power consumption	<10VA, 2W
Meter display range	0 – 9999999.9 kWh/kVArh
Display	Backlit LCD (blue)
Meter constant	3200 imp./kWh
Communication	
Communication interface	Ethernet
Communication protocol:	Modbus TCP
IP	192.168.1.200
port	502
subnet mask	255.255.255.0
gateway	192.168.1.1
DHCP	disabled
Energy reading indication	LED, red
Operating temperature	-40 το 705 °C
Storage temperature	-40 ÷ +70 ° C
Humidity (without condensation)	≤ 95
Vibration resistance	2g (10-50 Hz, according to IEC60068-2-6)
Installation altitude	Up to 2000 m above sea level
Connection	Screw terminals 0.5 – 2.5 mm². Max. tightening torque 0.4 N·m.
Dimensions	4 modules (72 mm)
Installation	On TH-35 rail
Indoor (recommended enclosure)	IP51
external (enclosure required)	IP54
Degree of protection	IP51

(*) Factory setting

Dimensions





Part 6. Revision history

Date	Version	Description

Part 7. Warranty

1. The meter is covered by a 24-month warranty. The warranty period starts from the date of purchase.
2. The warranty is valid only with proof of purchase.
3. Complaints should be made at the point of purchase or directly to the manufacturer:

F&F Filipowski sp. k.
ul. Konstantynowska 79/81
95-200 Pabianice
Tel. (42) 227-09 71
e-mail: techniczny@fif.com.pl

4. The complaint should be accompanied by written information about the nature of the defect and the circumstances in which it occurred.
5. F&F Filipowski sp. j. undertakes to consider complaints in accordance with Polish law.
6. The choice of how to handle the complaint: replacement of the goods with goods free from defects, repair or refund is at the discretion of the manufacturer.
7. The warranty does not cover:
    a. Mechanical and chemical damage
    b. Damage resulting from improper use or use not in accordance with the operating instructions
    c. Damage occurring after sale as a result of accidents or other events for which neither the manufacturer nor the point of sale is responsible, e.g. damage during transport.
8. The warranty does not cover activities that, according to the instructions, should be performed by the user, e.g.: installation of a multimeter, electrical installation, installation of other required electrical safety devices.
9. The warranty does not limit the buyer's rights resulting from the non-compliance of the goods with the contract.

Part 8. CE Declaration

F&F Filipowski sp. k. declares that the device complies with the requirements of the Low Voltage Directive LVD 2014/35/EU and the Electromagnetic Compatibility Directive EMC 2014/30/EU. MID and CE declarations of conformity, together with references to the standards with which conformity is declared, can be found at: www.fif.com.pl on the product subpage.