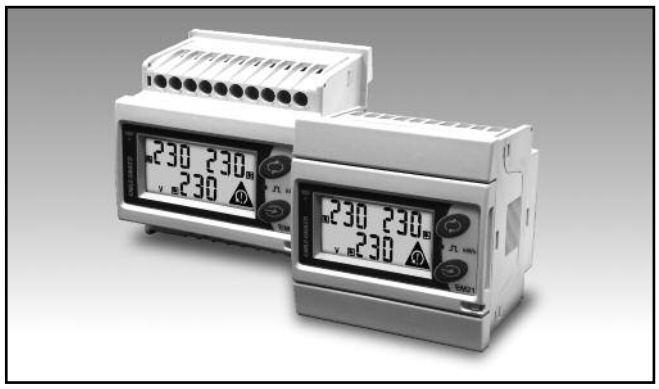
Energy Management
Energy Meter
Type EM21 72V



- **Easy connections management**
- **Detachable display**
- **Multi-use housing: for both DIN-rail and panel mounting applications**

- **Equivalent to Class 1 (kWh) of EN62053-21**
- **Equivalent to Class 2 (kvarh) of EN62053-23**
- **Accuracy ±0.5% RDG (current/voltage)**
- **Energy meter**
- **Instantaneous variables readout: 3 DGT**
- **Energies readout: 7 DGT**
- **System variables: W, var, PF, Hz, Phase-sequence.**
- **Single phase variables: VLL, VLN, A, PF**
- **Energy measurements: total kWh and kvarh**
- **TRMS measurements of distorted sine waves (voltages/currents)**
- **One pulsating output (opto-mosfet)**
- **RS485 serial output (on request) (MODBUS-RTU), iFIX SCADA compatibility**
- **Self-power supply**
- **Dimensions: 4-DIN modules and 72x72mm**
- **Protection degree (front): IP50**
- **Application adaptable display and programming procedure (Easyprog function)**

Product Description

Three-phase energy meter with removable front LCD display unit. The same unit can be used either as a DIN-rail mounting or panel mounting energy meter. This general purpose three-phase energy meter is suitable for both active and reactive energy metering for cost allocation but also for main electrical parameter measurement and retransmission (transducer function). Housing for DIN-rail mounting with IP50 (front) protection degree. Current measurements carried out by means of external split-core current sensors with 0.333 V output while voltage measurements carried out either by means of direct connection or by means of potential transformers. EM21-72V is provided, as standard, with a pulsating output for active energy retransmission. In addition the 2-wire RS485 communication port is available as an option.

How to order

EM21 72V MV5 3 X O X X

Model
Range code
System
Power supply
Output 1
Output 2
Option

Type Selection

Range codes

MV5: 230/400V_{LL} AC - 0.333V (current sensor connection)
MV6: 120/230V_{LL} AC - 0.333V (VT/PT and current sensor connection)

System

3: balanced and unbalanced load: 3-phase, 4-wire; 3-phase, 3-wire; 2-phase, 3-wire; 1-phase, 2-wire

Power supply

X: Self power supply from 18V to 260VAC VLN, 45 to 65 Hz

Options

X: None

Output 1

O: Single static output (opto-mosfet)

Output 2

X: None
S: RS485 port

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Input specifications

Rated inputs	System type: 3pn, 2, 1
Current type	By external split-core current sensors (output 0.333V)
Current range (by voltage CT)	MV5 and MV6: In corresponding to 0.333V. Primary current from 10 to 10000 A
Voltage (direct or by VT/PT)	MV5: 230/400VLL; MV6: 120/230VLL
Accuracy (Display + RS485) (@25°C ±5°C, R.H. ≤60%, 45 to 65 Hz)	
MV5 model	In: full-scale current corresponding to 0.333V; Un: 160 to 260VLN (277 to 450VLL)
MV6 model	In: full-scale current corresponding to 0.333V; Un: 40 to 144VLN (70 to 250VLL)
Current MV5, MV6 models	From 0.02 In to 0.05 In: ±(1% RDG +3DGT) From 0.05 In to Imax: ±(0.5% RDG +1DGT)
Phase-neutral voltage	In the range Un: ±(0,5% RDG +1DGT)
Phase-phase voltage	In the range Un: ±(1% RDG +1DGT)
Frequency	Range: 45 to 65Hz. Resolution: 1Hz
Active power	From 0.05 In to Imax, within Un range, PF=1: ±(1% RDG +1DGT) From 0.1 In to Imax, within Un range, PF=0.5L or 0.8C: ±(1% RDG +1DGT)
Power Factor	±[0.001+1%(1.000 - "PF RDG")]
Reactive power	From 0.05 In to Imax, within Un range, sinphi`=1: ±(2% RDG +1DGT) From 0.1 In to Imax, within Un range, sinphi`=0.5L or 0.8C: ±(2% RDG +1DGT)
Energies	kWh: equivalent to class 1 of EN62053-21 kvarh: equivalent to class 2 of EN62053-23 when considering: In corresponding to 0.333 V; Imax corresponding to 0.400 V; 0.1 In corresponding to 0.033V. Start up current: corresponding to 0.2 % In (0.0007V)
Energy additional errors	
Influence quantities	According to EN62053-21, EN62053-23
Temperature drift	≤200ppm/°C.
Sampling rate	1600 samples/s @ 50Hz, 1900 samples/s @ 60Hz
Display refresh time	1 second

Display	2 lines 1st line: 7-DGT, 2nd line: 3-DGT or 1st line: 3-DGT + 3-DGT, 2nd line: 3-DGT.
Type	LCD, h 7mm.
Instantaneous variables read-out	3-DGT.
Energies	5+2, 6+1, or 7+1 digit
Overload status	EEE indication when the value being measured is exceeding the "Continuous inputs overload" (maximum measurement capacity)
Max. and Min. indication	Max. instantaneous variables: 999; energies: 9 999 999. Min. instantaneous variables: 0; energies 0.00.
LEDs	Red LED for Energy consumption according to EN62052-11. 0.001kWh/pulse if VT ratio by In < 35.0 0.01kWh/pulse if VT ratio by In ≥35.0 and <350.0 0.1kWh/pulse if VT ratio by In 350.0 and <3500.0 1kWh/pulse if VT ratio by In 3500.0 Green LED (on the terminal blocks side) for power on (steady) and communication status: RX-TX (in case of RS485 option only) blinking.
Measurements	See "List of the variables that can be connected to:"
Method	TRMS measurements of distorted wave forms.
Coupling type	By means of external CT's.
Crest factor (current input)	1.414 @ Imax (Imax=1.2 In = 0.4V). In any case: Vpeak max = 0.565V.
Current Overloads	
Continuous	Imax = 1.2 In corresponding to 0.400 V
For 500ms	4V
Voltage Overloads	
Continuous	1.2 Un
For 500ms	2 Un
Current input impedance	
0.333 V input	>100 kΩ
Voltage input impedance	
Self-power supply	Power consumption: <2VA.
Frequency	45 to 65Hz.
Key-pad	Two push buttons for variable selection and programming of the instrument working parameters.

Output specifications

Pulse output	
Number of outputs	1
Type	Programmable from 0.001 to 9.999 kWh per pulses. Output connectable to the energy meters (kWh)
Pulse duration	≥100ms < 120ms (ON), ≥120ms (OFF), or 30ms (ON), 30ms (OFF), according to EN62052-31.
Output	Static: opto-mosfet.
Load	V_{ON} 2.5 VAC/DC max. 70 mA, V_{OFF} 260 VAC/DC max.
Insulation	By means of optocouplers, 4000 VRMS output to measuring inputs.
RS485	
Type	Multidrop, bidirectional (static and dynamic variables)
Connections	2-wire. Max. distance 1000m, termination directly on the instrument.
Addresses	247, selectable by means of the front keypad
Protocol	MODBUS/JBUS (RTU)
Data (bidirectional)	
Dynamic (reading only)	System and phase variables: see table “List of variables...”
Static (reading and writing)	All the configuration parameters.
Data format	1 start bit, 8 data bit, no parity,1 stop bit.
Baud-rate	9600 bits/s.
Driver input capability	1/5 unit load. Maximum 160 transceiver on the same bus.
M-bus communication	By means of VMUB_01 adapter. Fixed secondary address available
Insulation	By means of optocouplers, 4000 VRMS output to measuring input.

Software functions

Password	Numeric code of max. 3 DGT; 2 protection levels of the programming data:
1st level	Password “0”, no protection;
2nd level	Password from 1 to 999, all data are protected
Lock knob	The programming can be inhibit by means of the lock knob on the rear of the display unit.
System selection	
System 3-Ph.n unbalanced load	3-phase (4-wire)
System 3-Ph.1 balanced load	3-phase (4-wire) one current and 3-phase to neutral voltage measurements. 3-phase (2-wire) one current and 1-phase (L1) to neutral voltage measurement.
System 2-Ph	2-phase (3-wire)
System 1-Ph	1-phase (2-wire)
Transformer ratio	
VT (PT)	1.0 to 99.9 / 100 to 999
CT	10 to 9999 A (primary current). The maximum value of the VT by primary current product is 220000 (MV5) or 397000 (MV6).
Displaying	Up to 3 variables per page. See « Display pages », 3 different set of variables available (see « Display pages ») according to the metering function being selected.
Reset	By means of the front keypad: total energies (kWh, kvarh).
Easy connection function	Wrong phase detection and displaying. In the metering functions “a”, “b”, and “c” both energy and power measurements are independent on the current direction. The displayed energy is always “imported”. In the metering function “d” both energy and power measurements are dependent on the current direction. The displayed energy is only the “imported” one (positive). The “exported” one (negative) is not calculated nor displayed.

General specifications

Operating temperature	-25°C to +55°C (-13°F to 131°F) (R.H. from 0 to 90% non-condensing @ 40°C) according to EN62053-21, EN50470-3 and EN62053-23.
Storage temperature	-30°C to +70°C (-22°F to 158°F) (R.H. < 90% non-condensing @ 40°C) according to EN62053-21, EN50470-3 and EN62053-23.
Installation category	Cat. III (IEC60664, EN60664).
Insulation (for 1 minute)	4000 VRMS between measuring inputs and digital autput. 4000 VRMS between power supply and RS485 port.
Dielectric strength	4000 VRMS for 1 minute.
Noise rejection CMRR	100 dB, 48 to 62 Hz.
EMC	According to EN62052-11 and EN50470-1
Electrostatic discharges Immunity to irradiated	15kV air discharge; Test with current: 10V/m from 80 to 2000MHz;
Electromagnetic fields	Test without any current: 30V/m from 80 to 2000MHz;
Burst	On current and voltage measuring inputs circuit: 4kV
Immunity to conducted disturbances	10V/m from 150KHz to 80MHz
Surge	On current and voltage measuring inputs circuit: 6kV;
Radio frequency suppression	According to CISPR 22
Standard compliance	
Safety	IEC60664, IEC61010-1 EN60664, EN61010-1 EN62052-11
Metrology	EN62053-21, EN62053-23, EN50470-3
Pulse output	DIN43864, IEC62053-31
Approvals	CE, cULus
Connections	Screw-type
Cable cross section area	2.4 x 3.5 mm Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
Housing	
Dimensions (WxHxD)	72 x 72 x 65 mm
Material	Noryl, self-extinguishing: UL 94 V-0
Mounting	Panel and DIN-rail
Protection degree	
Front	IP50
Screw terminals	IP20
Weight	Approx. 400 g (packing included)

Power supply specifications

Self power supply	18 to 260VAC (45-65Hz). Across input “L1” and “N”	**Power consumption**	≤2VA/2W

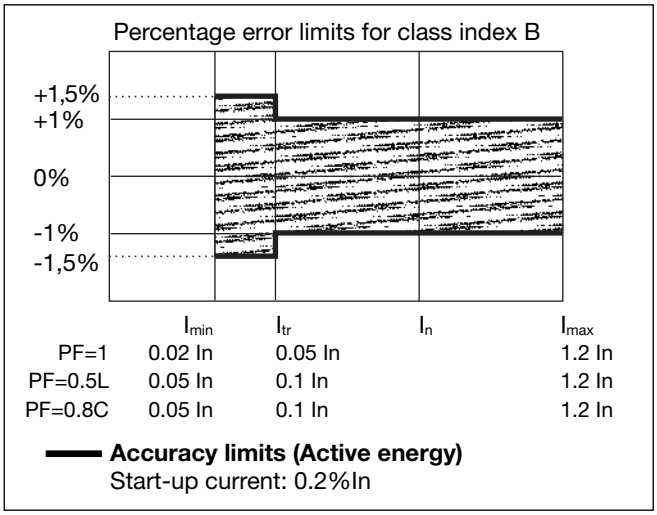
Insulation between inputs and outputs

	Measuring Inputs	Opto-Mosfet output	Communication port	Self power supply
Measuring Inputs	-	4kV	4kV	0kV
Opto-Mosfet output	4kV	-	-	4kV
Communication port	4kV	-	-	4kV
Self power supply	0kV	4kV	4kV	-

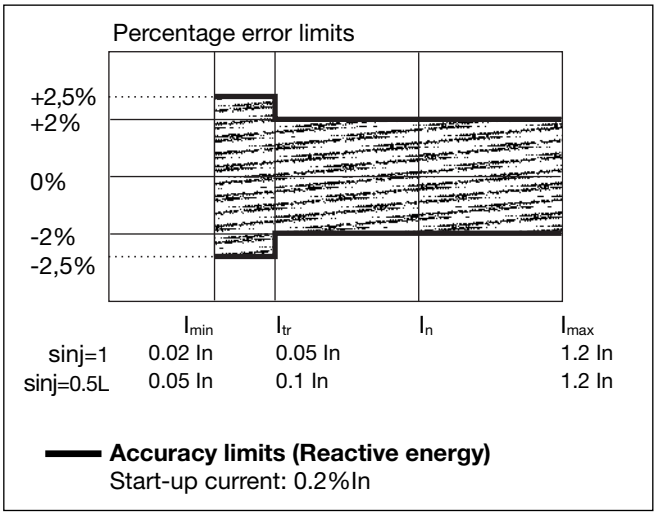
NOTE: all the models have, mandatorily, to be connected to external current transformers.

Accuracy

kWh, accuracy (RDG) depending on the current



kvarh, accuracy (RDG) depending on the current



Used calculation formulas

Phase variables

Instantaneous effective voltage

$$V_{1N} = \sqrt{\frac{1}{n} \cdot \sum_{1}^{n} (V_{1N})_i^2}$$

Instantaneous active power

$$W_1 = \frac{1}{n} \cdot \sum_{1}^{n} (V_{1N})_i \cdot (A_1)_i$$

Instantaneous power factor

$$\cos\varphi_1 = \frac{W_1}{VA_1}$$

Instantaneous effective current

$$A_1 = \sqrt{\frac{1}{n} \cdot \sum_{1}^{n} (A_1)_i^2}$$

Instantaneous apparent power

$$VA_1 = V_{1N} \cdot A_1$$

Instantaneous reactive power

$$\mathrm{var}_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

System variables

Equivalent three-phase voltage

$$V_\Sigma = \frac{V_1 + V_2 + V_3}{3} \cdot \sqrt{3}$$

Three-phase active power

$$W_\Sigma = W_1 + W_2 + W_3$$

Three-phase apparent power

$$VA_\Sigma = \sqrt{W_\Sigma^2 + \mathrm{var}_\Sigma^2}$$

Three-phase power factor (TPF)

$$\cos\varphi_\Sigma = \frac{W_\Sigma}{VA_\Sigma}$$

Energy metering

$$k\,\mathrm{var}\,hi = \int_{t1}^{t2} Qi(t)dt \cong \Delta t \sum_{n1}^{n2} Qnj$$

$$kWhi = \int_{t1}^{t2} Pi(t)dt \cong \Delta t \sum_{n1}^{n2} Pnj$$

Where:

i= considered phase (L1, L2 or L3)
P= active power; **Q**= reactive power;
$\mathbf{t_1}$, $\mathbf{t_2}$ =starting and ending time points of consumption recording; **n**= time unit; **t**= time interval between two successive power consumptions;
$\mathbf{n_1}$, $\mathbf{n_2}$ = starting and ending discrete time points of consumption recording

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List of the variables that can be connected to:

- RS485 communication port
- Pulse outputs (only “energies”)

No	Variable	1-ph. sys.	2-ph. sys.	3-ph. balanced system	3-ph. unbalanced system	Notes
1	kWh	x	x	x	x	Total
2	kvarh	x	x	x	x	Total
3	V L-N sys (1)	o	x	x	x	sys=system (∑)
4	V L1	x	x	x	x	
5	V L2	o	x	x	x	
6	V L3	o	o	x	x	
7	V L-L sys (1)	o	x	x	x	sys=system (∑)
8	V L1-2	o	x	x	x	
9	V L2-3	o	o	x	x	
10	V L3-1	o	o	x	x	
11	A L1	x	x	x	x	
12	A L2	o	x	x	x	
13	A L3	o	o	x	x	
14	VA sys (1)	x	x	x	x	sys=system (∑)
15	VA L1 (1)	x	x	x	x	
16	VA L2 (1)	o	x	x	x	
17	VA L3 (1)	o	o	x	x	
18	var sys	x	x	x	x	sys=system (∑)
19	var L1 (1)	x	x	x	x	
20	var L2 (1)	o	x	x	x	
21	var L3 (1)	o	o	x	x	
22	W sys	x	x	x	x	sys=system (∑)
23	W L1 (1)	x	x	x	x	
24	W L2 (1)	o	x	x	x	
25	W L3 (1)	o	o	x	x	
26	PF sys	x	x	x	x	sys=system (∑)
27	PF L1	x	x	x	x	
28	PF L2	o	x	x	x	
29	PF L3	o	o	x	x	
30	Hz	x	x	x	x	
31	Phase sequence	o	o	x	x	

(x) = available
(o) = not available (zero indication on the display)
(1) = Variable available only through the serial communication port RS485

Display pages

No	1st variable (1st half-line)	2nd variable (2nd half-line)	3rd variable (2nd line)	Note	Metering function			
					A	B	C	D
		Phase sequence		The phase sequence triangle appears in any page only if there is a phase reverse	x	x	x	x
1	Total kWh		W sys	W with “-“ sign when <0 (only function D)	x	x	x	x
2	Total kvarh		kvar sys	var with “-“ sign when <0 (only function B, C, D)		x	x	x
3		PF sys	Hz	PF with L/C indication (±L/C only in function D)		x	x	x
4	PF L1	PF L2	PF L3	PF with L/C indication (±L/C only in function D)			x	x
5	A L1	A L2	A L3	A with “-“ indication in case of reverse connection or exported power (only function D)			x	x
6	V L1-2	V L2-3	V L3-1				x	x
7	V L1	V L2	V L3				x	x

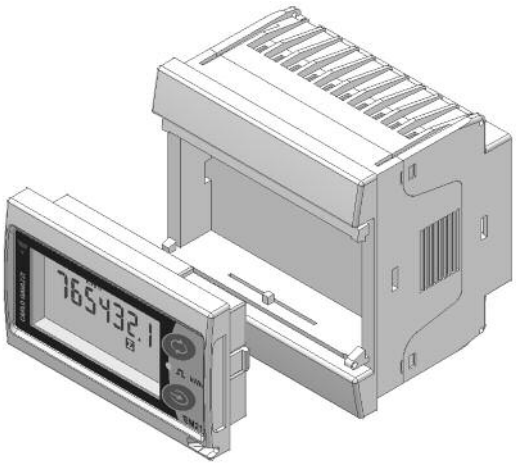
Additional available information on the display

Type	1st line	2nd line	note
Meter information 1	Y. 2012	r.A0	Year of production and firmware release
Meter information 2	[value]	LEd (kWh)	KWh per pulse of the LED
Meter information 3	SYS [3P.n]	[4W]	3P.n, 3P.1, 2P, 1P
Meter information 4	Ct Prin	[value]	Primary current transformer value
Meter information 5	Ut rAt.	[value]	Voltage transformer ratio
Meter information 6	PuLSE (kWh)	[value]	Pulse output: kWh per pulse
Meter information 7	Add	[value]	Serial communication address
Meter information 8	[value]	Sn	Secondary address M-bus communication

List of selectable applications

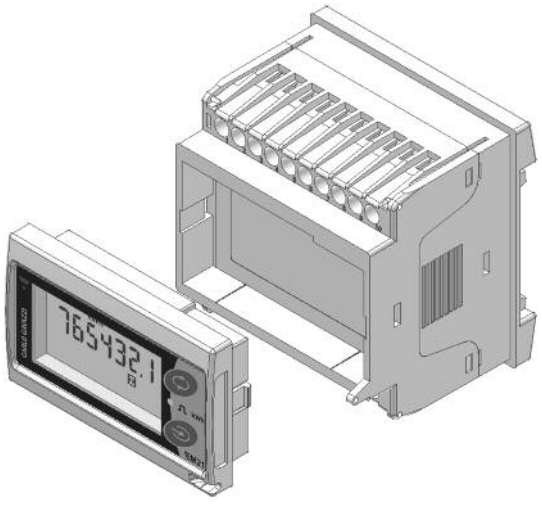
	Description	Notes
A	Basic 1 energy meter	Active energy measurement with some minor parameters: easy connection (only imported energy, measurement independent on the current direction).
B	Basic 2 energy meter	Active and reactive energy measurements with some minor parameters: easy connection (only imported energy, measurement independent on the current direction).
C	Installation parameters – easy connection	Full set of parameters so to carry out the instrument installation in a quick and correct way: easy connection (only imported energy, measurement independent on the current direction).
D	Installation parameters	Full set of parameters so to carry out the instrument installation in a quick and correct way: imported and exported power; only imported energy; the exported energy is not calculated nor displayed; measurement dependent on the current direction.

One instrument with double mounting capability



... as DIN-rail mounting meter.

By means of the patented detachable display it is possible to configure the same instrument either as a panel mounting meter or...



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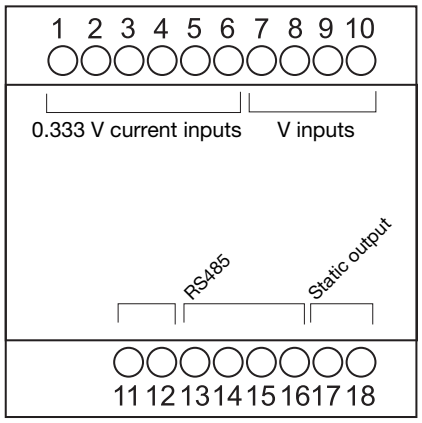
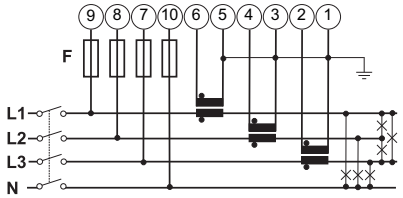
Wiring diagrams



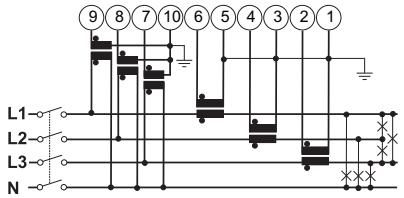
Self power supply, system type selection: 3P.n

3-ph, 4-wire, unbalanced load **Fig. 1**



3-CT connection

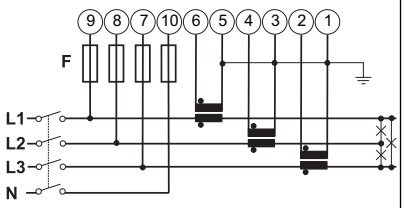
3-ph, 4-wire, unbalanced load **Fig. 2**



3-CT and 3-VT/PT connections

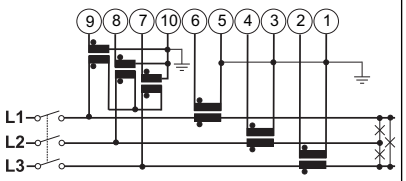
Self power supply, system type selection: 3P.1

3-ph, 3-wire, unbalanced load **Fig. 3**



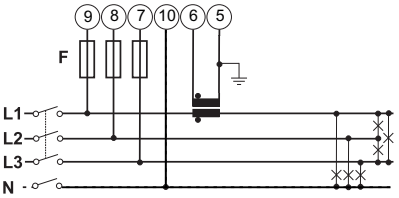
3-CT connection

3-ph, 3-wire, unbalanced load **Fig. 4**



3-CT and 3-VT/PT connections

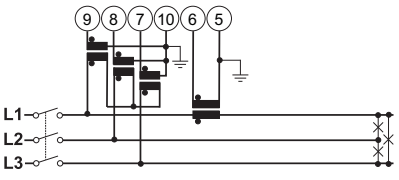
3-ph, 4-wire, balanced load **Fig. 5**



1-CT connections

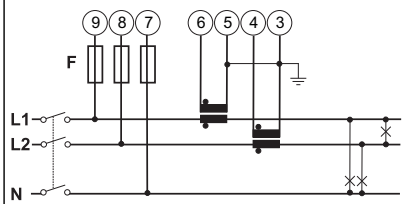
Self power supply, system type selection: 2P

3-ph, 3-wire, balanced load **Fig. 6**



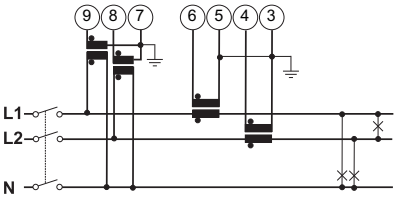
1-CT and 3-VT/PT connections

2-ph, 3-wire **Fig. 7**



2-CT connection

2-ph, 3-wire, **Fig. 8**



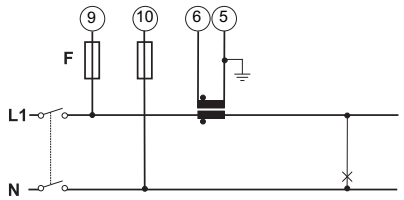
2-CT and 2-VT/PT connections

NOTE: For a correct power supply of the instrument, the neutral must always be connected.

Wiring diagrams

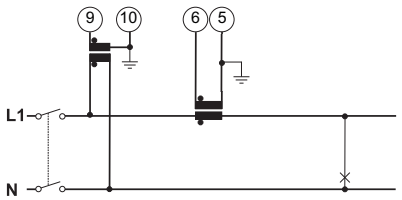
System type selection: 1P

1-ph, 2-wire **Fig. 9**



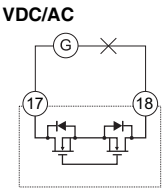
1-CT connection

1-ph, 2-wire **Fig. 10**



1-CT and 1-VT connections

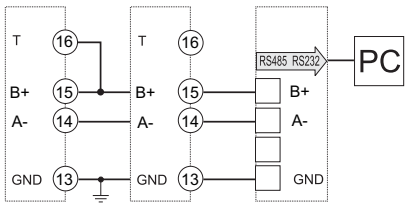
Static output. Opto-mosfet **Fig. 11**



VDC/AC supply

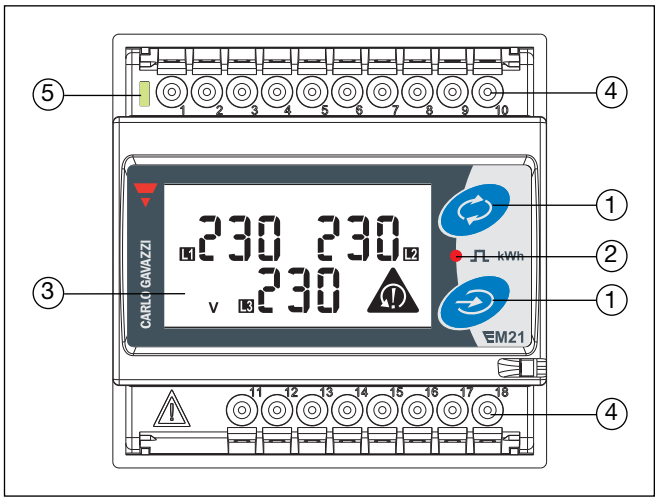
RS485 port wiring diagram

RS485 port



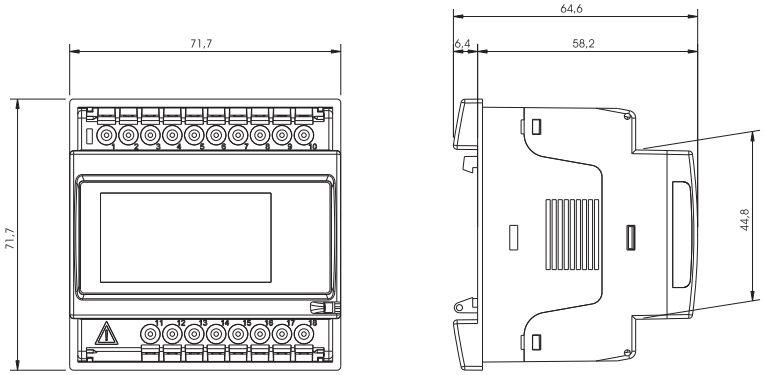
RS485 NOTE: additional devices provided with RS485 are connected as per the picture above. The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (B+) and (T).

Front panel description



1. Keypad
   To program the configuration parameters and scroll the variables on the display.
2. Pulse output LED
   Red LED blinking proportional to the energy being measured.
3. Display
   LCD-type with alphanumeric indications to display all the measured variables.
4. Connections
   Screw terminal blocks for instrument wiring.
5. Green LED
   Lit when power supply is available

Dimensions (DIN configuration)



Dimensions and panel cut out (72x72 panel mounting configuration)