

Energy Management Energy Meter Type EM21 72D

CARLO GAVAZZI



- Certified according to MID Directive, Annex "B" "Type examination" relevant to active electrical energy meters (see Annex MI-003), see option "P" below
- Certified according to MID Directive, Annex "B" + Annex "F" for legal metrology relevant to active electrical energy meters (see Annex MI-003), see option "PF" below.

- Class B (kWh) according to EN50470-3
- Class 1 (kWh) according to EN62053-21
- Class 2 (kvarh) according to EN62053-23
- Accuracy ± 0.5 RDG (current/voltage)
- Energy meter
- Instantaneous variables readout: 3 DGT
- Energies readout: 6+1 DGT
- System variables: W, var, PF, Hz, Phase-sequence.
- Single phase variables: V_{LL} , V_{LN} , A, PF
- Energy measurements: total kWh and kvarh
- TRMS measurements of distorted sine waves (voltages/currents)
- Self power supply
- Dimensions: 4-DIN modules and 72x72mm
- Protection degree (front): IP50
- Application adaptable display and programming procedure (Easyprog function)
- Easy connections management
- Detachable display
- Multi-use housing: for both DIN-rail and panel mounting applications

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 a 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 current transformers and voltage measurements carried out either by means of direct connection or by means of potential transformers. EM21-72D is provided, as standard, with a pulsating output for active energy retransmission. In addition a 2-wire RS485 communication port is available as an option.

How to order EM21 72D AV5 3 X O X X

Model	EM21 72D
Range code	AV5
System	3
Power supply	X
Output 1	O
Output 2	X
Option	X

Type Selection

Range codes	System	Power supply	Options
AV5 (*) : 400V _{LL} AC, 5(6)A or 1(6)A (***) (CT connection) AV6 (**) : 120V _{LN} /230V _{LL} AC 5(6)A or 1(6)A (***) (VT/PT and CT connections)	3 (*) : balanced and unbalanced load: 3-phase, 4-wire; 3-phase, 3-wire; 2-phase, 3-wire; 1-phase, 2-wire	X (*) : Self power supply from 18V to 260VAC VLN, 45 to 65 Hz (connection VL1-N)	X (*) : None P : Certified according to MID Directive, Annex "B" "Type examination" relevant to active electrical energy meters (see Annex MI-003) (*) PF : Certified according to MID Directive, Annex "B" + Annex "F" for legal metrology relevant to active electrical energy meters (see Annex MI-003) (***)
Output 2 X (*) : None S (**) : RS485 port	Output 1 O (*) : Single static output (opto-mosfet)	(*) as standard. (**) on request. (***) the range 1(6)A is available but not in compliance with the EN50470-3 standard.	

Input specifications

Rated inputs	System type: 3 Not isolated (shunt inputs). Note: the external current transformers can be connected to earth individually.	Energies	Imported Total: 6+1DGT or 7DGT
Current type		Overload status	EEE indication when the value being measured is exceeding the "Continuous inputs overload" (maximum measurement capacity)
Current range (by CT)	AV5 and AV6: 5(6)A. The "1(6)A" range is available but not in compliance with the EN50470-3 standard.	Max. and Min. indication	Max. instantaneous variables: 999; energies: 999 999.9 or 9 999 999. Min. instantaneous variables: 0; energies 0.0.
Voltage (direct or by VT/PT)	AV5: 400VLL; AV6: 120/230VLL		
Accuracy (Display + RS485) (@25°C ±5°C, R.H. ≤60%, 48 to 62 Hz)	In: see below, Un: see below	LEDs	Red LED (Energy consumption) 0.001 kWh by pulse if CT ratio x VT ratio is <7; 0.01 kWh by pulse if CT ratio x VT ratio is ≥ 7.0 < 70.0; 0.1 kWh by pulse if CT ratio x VT ratio is ≥ 70.0 < 700.0; 1 kWh by pulse if CT ratio x VT ratio is ≥ 700.0; 16Hz, according to EN50470-3 Green LED (on the terminal blocks side) for power on (steady) and communication status: RX-TX (in case of RS485 option only) blinking.
AV5 model	In: 5A, I _{max} : 6A; Un: 160 to 260VLN (277 to 450VLL).		
AV6 model	In: 5A, I _{max} : 6A; Un: 40 to 144VLN (70 to 250VLL).		
Current AV5, AV6 models	From 0.002In to 0.2In: ±(0.5% RDG +3DGT). From 0.2In to I _{max} : ±(0.5% RDG +1DGT).	Max frequency	
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	±(1%RDG +2DGT).		
Power Factor	±[0.001+1%(1.000 - "PF RDG")].		
Reactive power	±(2%RDG +2DGT).		
Active energy	class B according to EN50470-1-3; class 1 according to EN62053-21.	Measurements	See "List of the variables that can be connected to:" TRMS measurements of distorted wave forms. By means of external CT's.
	class 2 according to EN62053-23.	Method	
Reactive energy	In: 5A, I _{max} : 6A; 0.1 In: 0.5A. Start up current: 10mA.	Coupling type	
		Crest factor	In 5A: ≤3 (15A max. peak).
Energy additional errors		Current Overloads	
Influence quantities	According to EN62053-21, EN50470-1-3, EN62053-23	Continuous	6A, @ 50Hz.
		For 500ms	120A, @ 50Hz.
Temperature drift	≤200ppm/°C.	Voltage Overloads	
Sampling rate	1600 samples/s @ 50Hz, 1900 samples/s @ 60Hz	Continuous	1.2 Un
Display refresh time	1 second	For 500ms	2 Un
Display	2 lines 1 st line: 7-DGT, 2 nd line: 3-DGT or 1 st line: 3-DGT + 3-DGT, 2 nd line: 3-DGT.	Current input impedance	
	LCD, h 7mm.	5(6)A	< 0.3VA
Type	3-DGT.	Voltage input impedance	
Instantaneous variables read-out		Self-power supply	Power consumption: <2VA.
		Frequency	45 to 65 Hz.
		Key-pad	Two push buttons for variable selection and programming of the instrument working parameters.

Output specifications

Pulse output			
Number of outputs	1	Addresses	on the instrument. 247, selectable by means of the front keypad
Type	Programmable from 0.01 to 9.99 kWh per pulses. Output connectable to the energy meters (kWh)	Protocol	MODBUS/JBUS (RTU)
Pulse duration	$\geq 100\text{ms} < 120\text{ms}$ (ON), $\geq 120\text{ms}$ (OFF), according to EN62052-31.	Data (bidirectional)	System and phase variables: see table "List of variables..."
Output Load	Static: opto-mosfet. V_{ON} 2.5 VAC/DC max. 70 mA, V_{OFF} 260 VAC/DC max.	Dynamic (reading only)	All the configuration parameters.
Insulation	By means of optocouplers, 4000 VRMS output to measuring inputs.	Static (reading and writing)	1 start bit, 8 data bit, no parity, 1 stop bit.
		Data format	9600 bits/s.
		Baud-rate	1/5 unit load. Maximum 160 transceiver on the same bus.
		Driver input capability	By means of optocouplers, 4000 VRMS output to measuring input.
RS485		Insulation	
Type	Multidrop, bidirectional (static and dynamic variables)		
Connections	2-wire. Max. distance 1000m, termination directly		

Software functions

Password			
	Numeric code of max. 3 digits; 2 protection levels of the programming data:	Transformer ratio	1.0 to 99.9 / 100 to 999 / 1.00k to 6.00k
1st level	Password "0", no protection;	VT (PT)	1.0 to 99.9 / 100 to 999 / 1.00k to 9.99k / 10.0k to 60.0k.
2nd level	Password from 1 to 999, all data are protected	CT	The maximum power being measured cannot exceed 210 MW calculated as maximum input voltage and current, (see the "Accuracy" paragraph).
Programming lock	By means of potentiometer (back-side of the display module) it is possible to lock the access to all the configuration parameters.		The maximum VT by CT ratio is 48.600. For MID complaint applications the maximum power being measured is 25 MW.
System selection			
System 3-Ph.n unbalanced load	3-phase (4-wire) 3-phase (3-wire)	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.
System 3-Ph.1 balanced load	3-phase (3-wire) one current and 3-phase to phase voltage measurements. Note: the phase to phase voltage is calculated multiplying by 1.73 the virtual phase to neutral voltage. 3-phase (4-wire) one current and 3-phase to neutral voltage measurements. Note: the phase to phase voltage is calculated multiplying by 1.73 the virtual phase to neutral voltage. 3-phase (2-wire) one current and 1-phase (L1) to neutral voltage measurement.	Reset	By means of the front keypad: total energies (kWh, kvarh).
System 2-Ph	2-phase (3-wire)	Easy connection function	Wrong phase detection and displaying. For all the display selections, both energy measurements are dependent from the current direction, both power measurements are independent from the current direction. The power measurements are always positive.
System 1-Ph	1-phase (2-wire)		

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 and EN62053-23.	Surge	On current and voltage measuring inputs circuit: 6kV; According to CISPR 22
Storage temperature	-30°C to +70°C (-22°F to 158°F) (R.H. < 90% non-condensing @ 40°C) according to EN62053-21 and EN62053-23.	Radio frequency suppression	According to CISPR 22
Installation category	Cat. III (IEC60664, EN60664).	Standard compliance	
Insulation (for 1 minute)	4000 VRMS between measuring inputs and digital output.	Safety	IEC60664, IEC61010-1 EN60664, EN61010-1 EN62052-11
Dielectric strength	4000 VRMS for 1 minute.	Metrology	EN62053-21, EN62053-23, EN50470-3
Noise rejection CMRR	100 dB, 48 to 62 Hz.	Pulse output Approvals	DIN43864, IEC62053-31 CE, cULus listed
EMC		Connections	Screw-type 2.4 x 3.5 mm Min./Max. screws tightening torque: 0.4 Nm / 0.8 Nm
Electrostatic discharges	According to EN62052-11 15kV air discharge; Test with current: 10V/m from 80 to 2000MHz;	Housing	
Immunity to irradiated	Test without any current: 30V/m from 80 to 2000MHz;	Dimensions (WxHxD)	72 x 72 x 65 mm
Electromagnetic fields	On current and voltage measuring inputs circuit: 4kV	Material	Noryl PA66, self-extinguishing: UL 94 V-0 Panel and DIN-rail
Burst	10V/m from 150KHz to 80MHz	Mounting	
Immunity to conducted disturbances		Protection degree	
		Front	IP50
		Screw terminals	IP20
		Weight	Approx. 400 g (packing included)

Power supply specifications

Self power supply	18 to 260VAC (48-62Hz). Across input "VL1" and "N"	Power consumption	≤2VA/1W
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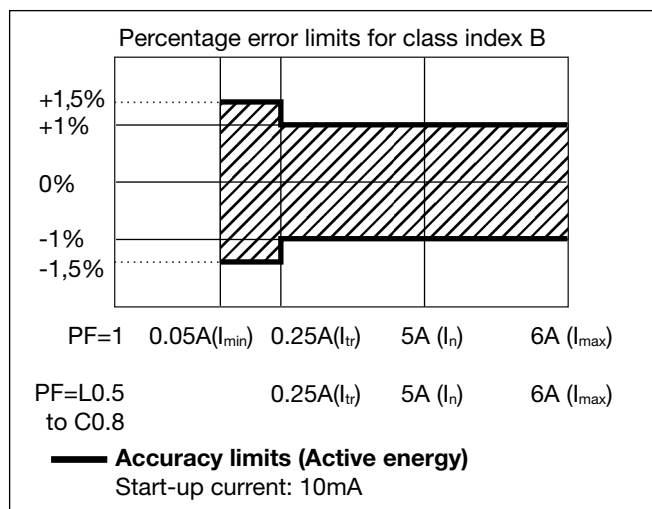
Insulation between inputs and outputs

	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	-

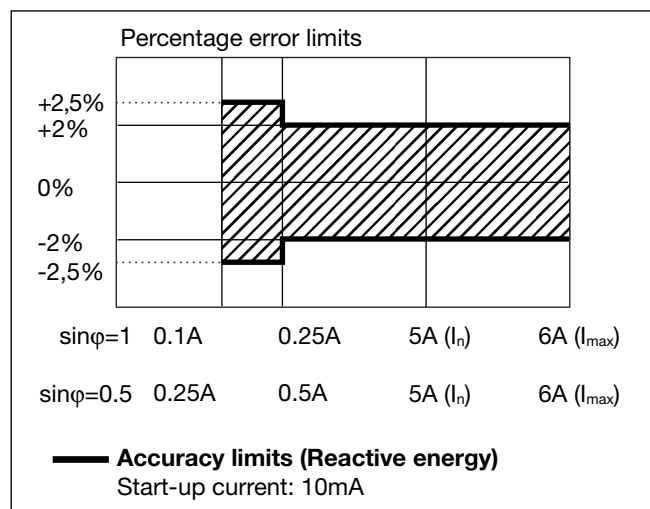
NOTE: all the models have, mandatorily, to be connected to external current transformers.

Accuracy (According to EN50470-3 and EN62053-23)

kWh, accuracy (RDG) depending on the current



kvarh, accuracy (RDG) depending on the current



MID "Annex MI-003" compliance

Accuracy

0.9 U_n ≤ U ≤ 1.1 U_n;
0.98 f_n ≤ f ≤ 1.02 f_n;
f_n: 50Hz;
cosφ: 0.5 inductive to 0.8
capacitive.
Class B
I_{st}: 0.01A;
I_{min}: 0.05A;
I_{tr}: 0.25A;

Operating temperature

EMC compliance

I_n: 5A
I_{max}: 6A.

-25°C to +55°C (-13°F to
131°F) (R.H. from 0 to 90%
non-condensing @ 40°C)

E2

Used calculation formulas

Phase variables

Instantaneous effective voltage

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

Instantaneous active power

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

Instantaneous power factor

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

Instantaneous effective current

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

Instantaneous apparent power

$$VA_1 = V_{IN} \cdot A_1$$

Instantaneous reactive power

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

System variables

Equivalent three-phase voltage

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

Voltage asymmetry

Three-phase active power

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

Three-phase apparent power

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

Three-phase power factor

$$\cos\varphi_{\Sigma} = \frac{W_{\Sigma}}{VA_{\Sigma}} \quad (\text{TPF})$$

Energy metering

$$k \text{ var hi} = \int_{t_1}^{t_2} Q_i(t) dt \cong \Delta t \sum_{n_1}^{n_2} Q_{nj}$$

$$kWh_i = \int_{t_1}^{t_2} P_i(t) dt \cong \Delta t \sum_{n_1}^{n_2} P_{nj}$$

Where:

i= considered phase (L1, L2 or L3)
P= active power; Q= reactive power;
t₁, t₂=starting and ending time points
of consumption recording; n= time
unit; Δt= time interval between two
successive power consumptions;
n₁, n₂= starting and ending discrete
time points of consumption recording

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. 4-wire balanced system	3-ph. 3-wir balanced system	3-ph. 4-wire unbalanced system	3-ph. 3-wir unbalanced system	Notes
1	kWh	x	x	x	x	x	x	Total
2	kvarh	x	x	x	x	x	x	Total
3	V L-N sys (1)	o	x	x	x	x	x	sys=system (Σ)
4	V L1	x	x	x	x	x	x	
5	V L2	o	x	x	x	x	x	
6	V L3	o	o	x	x	x	x	
7	V L-L sys (1)	o	x	x	x	x	x	sys=system (Σ)
8	V L1-2	o	x	x	x	x	x	
9	V L2-3	o	o	x	x	x	x	
10	V L3-1	o	o	x	x	x	x	
11	A L1	x	x	x	x	x	x	
12	A L2	o	x	x	x	x	x	
13	A L3	o	o	x	x	x	x	
14	VA sys (1)	x	x	x	x	x	x	sys=system (Σ)
15	VA L1 (1)	x	x	x	x	x	x	
16	VA L2 (1)	o	x	x	x	x	x	
17	VA L3 (1)	o	o	x	x	x	x	
18	var sys	x	x	x	x	x	x	sys=system (Σ)
19	var L1 (1)	x	x	x	x	x	x	
20	var L2 (1)	o	x	x	x	x	x	
21	var L3 (1)	o	o	x	x	x	x	
22	W sys	x	x	x	x	x	x	sys=system (Σ)
23	W L1 (1)	x	x	x	x	x	x	
24	W L2 (1)	o	x	x	x	x	x	
25	W L3 (1)	o	o	x	x	x	x	
26	PF sys	x	x	x	x	x	x	sys=system (Σ)
27	PF L1	x	x	x	x	x	x	
28	PF L2	o	x	x	x	x	x	
29	PF L3	o	o	x	x	x	x	
30	Hz	x	x	x	x	x	x	
31	Phase sequence	o	o	x	x	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 (1 st half-line)	2nd variable (2 nd half-line)	3rd variable (2nd line)	Note	Applications		
					A	B	C
	Phase sequence			The phase sequence triangle appears in any page only if there is a phase reverse	x	x	x
1	Total kWh		W sys		x	x	x
2	Total kvarh		kvar sys			x	x
3		PF sys	Hz	Indication of C, -C, L, -L depending on the quadrant	x	x	x
4	PF L1	PF L2	PF L3	Indication of C, -C, L, -L depending on the quadrant			x
5	A L1	A L2	A L3				x
6	V L1-2	V L2-3	V L3-1				x
7	V L1	V L2	V L3				x

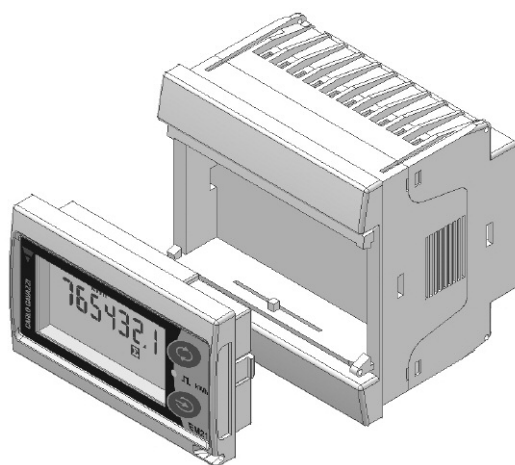
Additional available information on the display

Type	1st line	2nd line	note
Meter information 1	Y. 2007	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]	value	System type and connection type
Meter information 4	Ct rAt.	value	Current transformer ratio
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

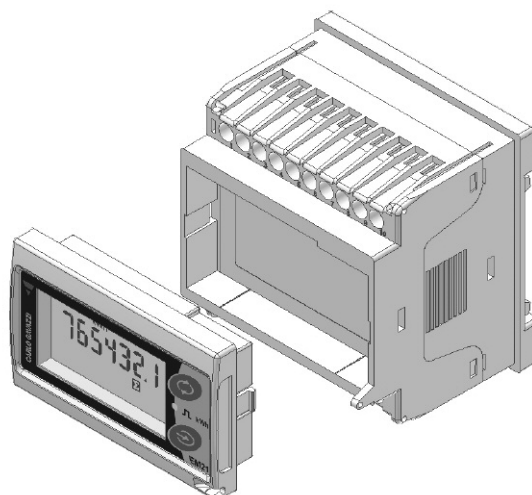
List of selectable applications

	Description	Notes
A	Active energy meter	Active energy measurement with some minor parameters
B	Active and reactive energy meter	Active and reactive energy measurement with some minor parameters
C	Full set of variables	Full set of available variables can be displayed

One instrument with double mounting capability



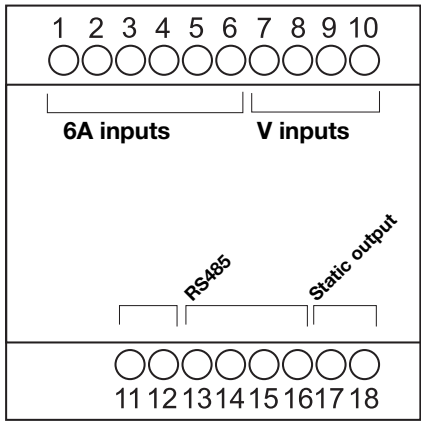
By means of the patented detachable display it is possible to configure the same instrument either as a panel mounting meter or...



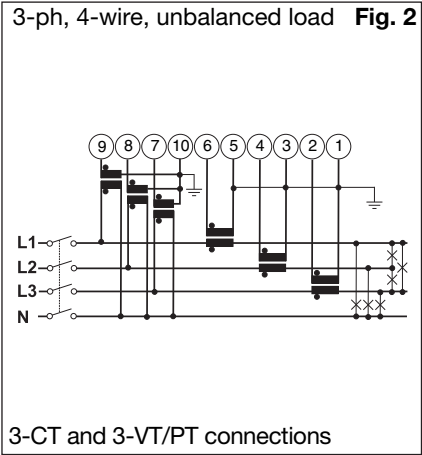
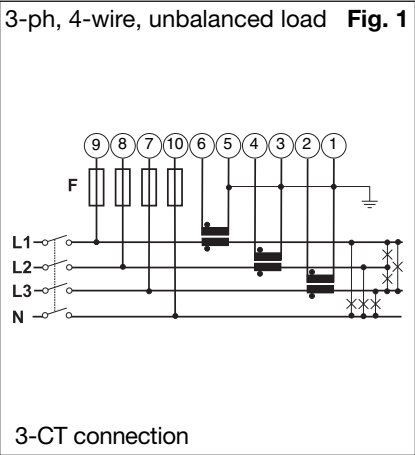
... as DIN-rail mounting meter.



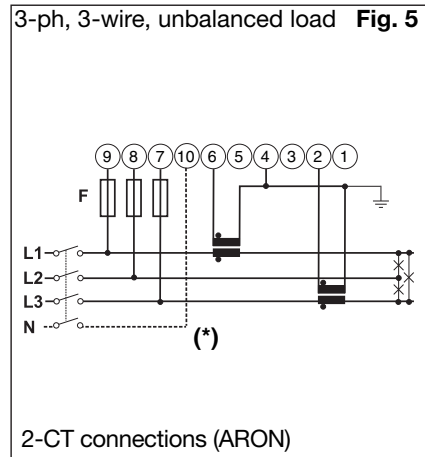
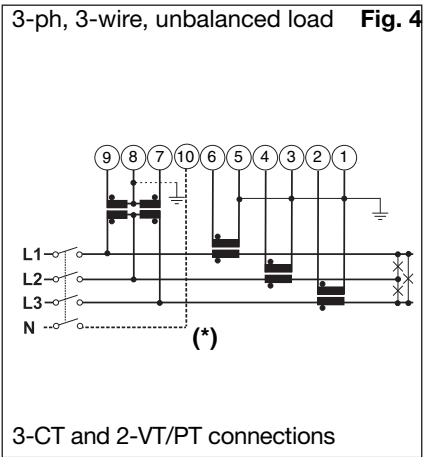
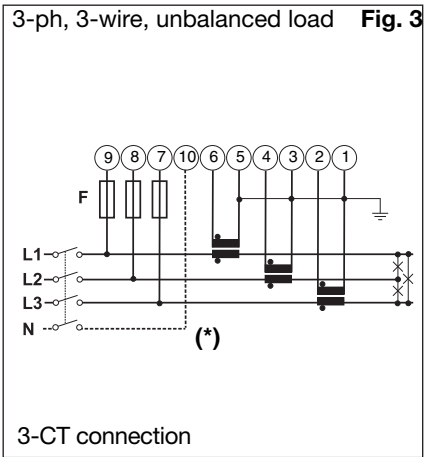
Wiring diagrams



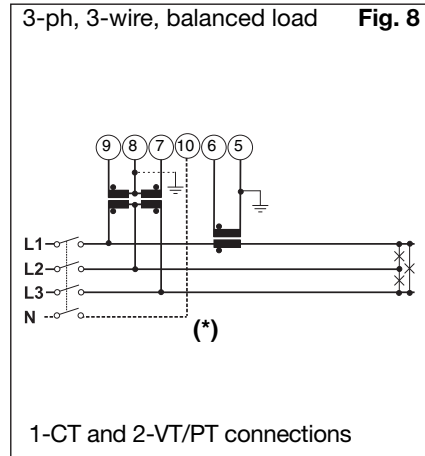
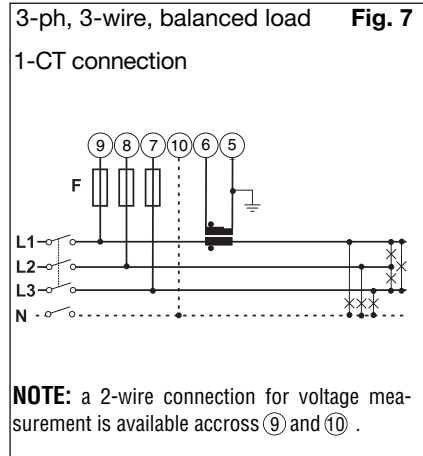
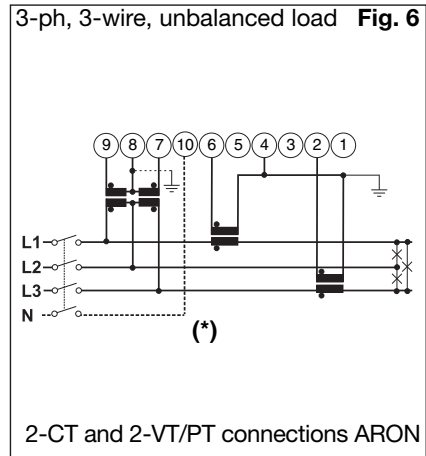
(6A) Self power supply, system type selection: 3P.n



(6A) System type selection: 3P.n



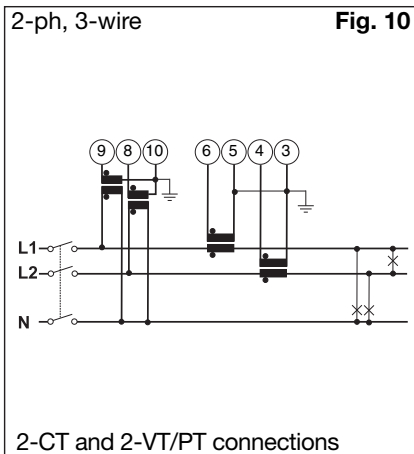
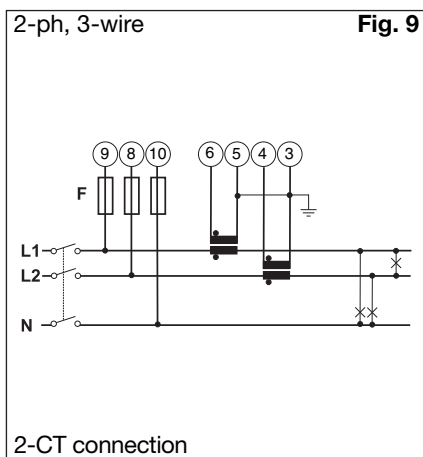
(6A) Self power supply, system type selection: 3P.1



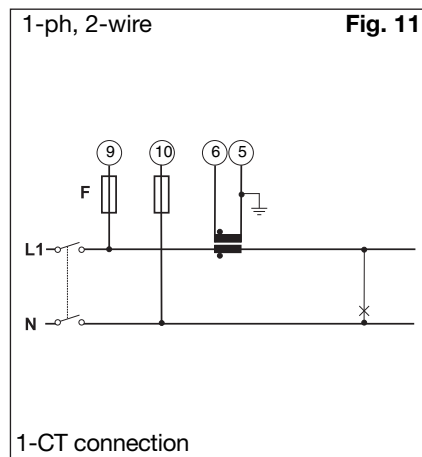
(*) **NOTE:** For a correct power supply of the instrument, the neutral must always be connected.

Wiring diagrams

(6A) System type selection: 2P

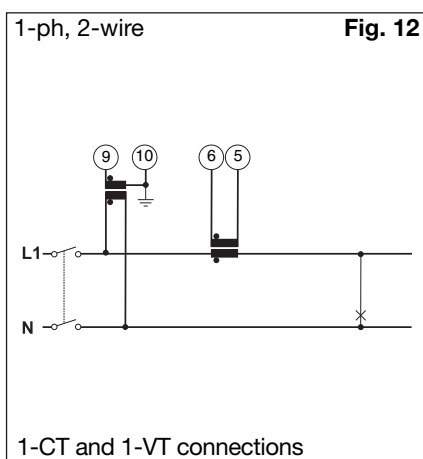


(6A) System type selection: 1P

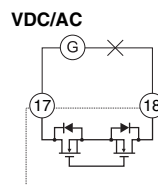


Static output wiring diagram

(6A) System type selection: 1P

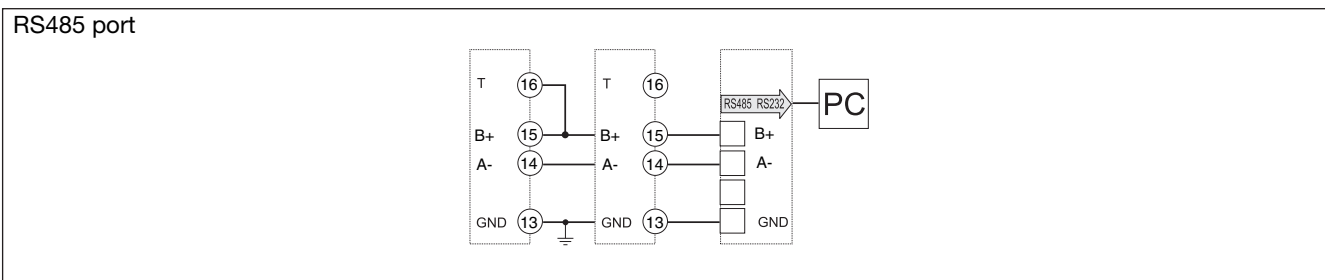


Opto-mosfet



VDC/AC supply

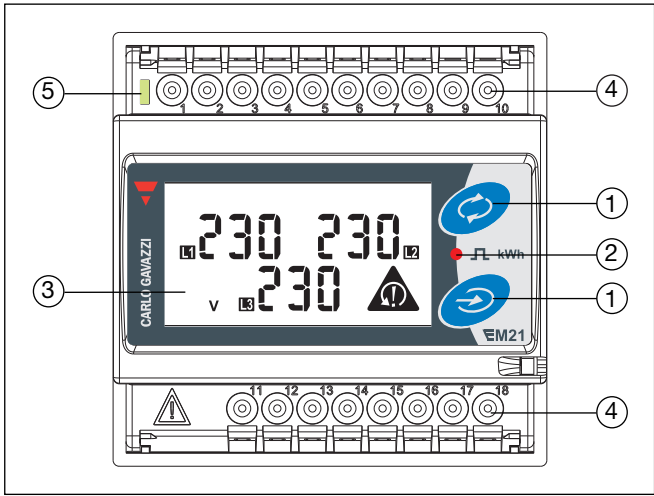
RS485 port wiring diagram



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).

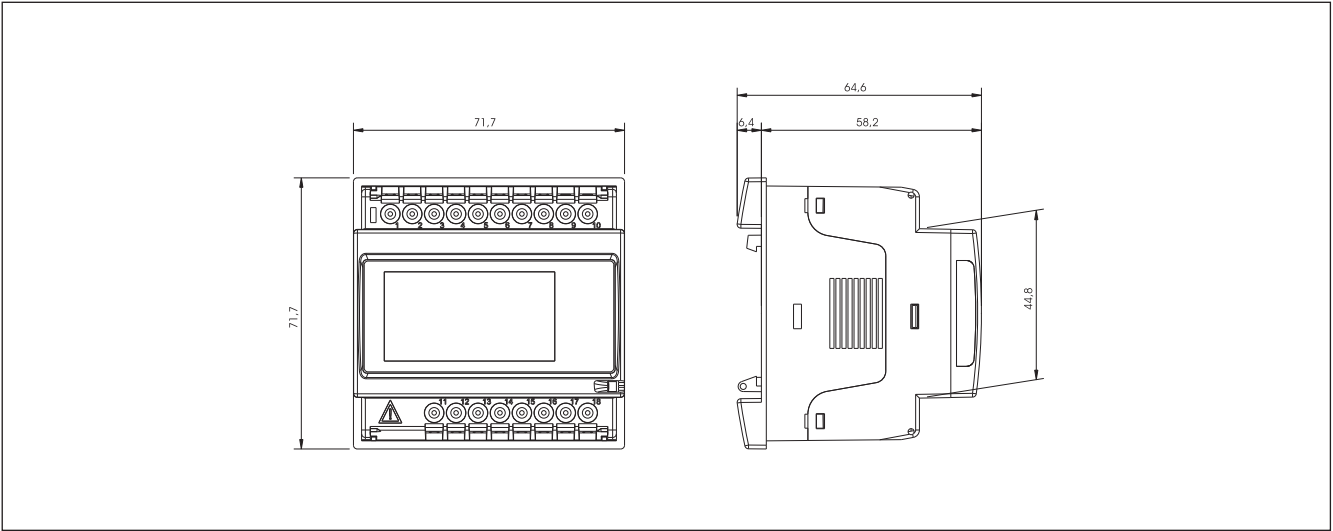


Front panel description



- 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)

