

Energy Management Energy Analyzer Type EM210

CARLO GAVAZZI



- Easy connections management
- Detachable display
- Multi-use housing: for both DIN-rail and panel mounting applications
- 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: 7 DGT
- System variables: W, var, PF, Hz, Phase-sequence.
- Single phase variables: VLL, VLN, A, PF
- Energy measurements: total kWh (imported and exported); 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)

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). Possibility to display also exported active energy (e.g. in case of regenerated energy in lifts or similar applications). Hous-

ing 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 trans-

formers. EM210 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

EM210 72D AV5 3 X O X X

Model	_____
Range code	_____
System	_____
Power supply	_____
Output 1	_____
Output 2	_____
Option	_____

Type Selection

Range code	System	Power supply	Options
AV5: 400VLL AC, 5(6)A or 1(6)A (*) (CT connection)	3: balanced and unbalanced load: 3-phase, 4-wire; 3-phase, 3-wire (without N connection); 2-phase, 3-wire; 1-phase, 2-wire	X: Self power supply from 40V to 480VAC LL, 45 to 65 Hz (connection VL2-VL3)	X: none
AV6: 120/230VLL AC 5(6)A or 1(6)A (*) (VT/PT and CT connections)			
Output 1	Output 2	(*) the range 1(6)A is available but not in compliance with the EN50470-3 standard.	
O: Single static output (opto-mosfet)	X: None S: RS485 port		

Input specification

Rated Input	System type: 3	Overload status	EEE indication when the value being measured is exceeding the "Continuous inputs overload" (maximum measurement capacity)
Current type	Not isolated (shunt inputs). Note: the external current transformers can be connected to earth individually.		
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: 9 999 999. Min. instantaneous variables: 0; energies 0.00.
Voltage (direct or by VT/PT)	AV5: 400VLL; AV6: 120/230VLL. 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.
Accuracy (Display + RS485) (@25°C ±5°C, R.H. ≤60%, 50Hz)		Max frequency	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).		
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.
Reactive energy	class 2 according to EN62053-23. In: 5A, I _{max} : 6A; 0.1 In: 0.5A. Start up current: 10mA.	Method	In 5A: ≤3 (15A max. peak).
Energy additional errors		Coupling type	
Influence quantities	According to EN62053-21, EN50470-1-3, EN62053-23	Crest factor	
Temperature drift	≤200ppm/°C.	Current Overloads	
Sampling rate	1600 samples/s @ 50Hz, 1900 samples/s @ 60Hz	Continuous	6A, @ 50Hz.
Display refresh time	1 second	For 500ms	120A, @ 50Hz.
Display	2 lines 1st line: 7-DGT, 2nd line: 3-DGT or 1st line: 3-DGT + 3-DGT, 2nd line: 3-DGT. LCD, h 7mm.	Voltage Overloads	
Type	LCD, h 7mm.	Continuous	1.2 Un
Instantaneous variables read-out	3-DGT.	For 500ms	2 Un
Energies	Total: 5+2, 6+1 or 7DGT	Current input impedance	
		5(6)A	< 0.3VA
		Voltage input impedance	
		Self-power supply	Power Consumption: < 2VA
		Frequency	50 ± 5Hz/60 ± 5Hz.
		Keypad	Two push buttons for variable selection and programming of the instrument working parameters.

Output specifications

Pulse output		Connections	
Number of outputs	1		2-wire max. distance 1000m, termination directly on the instrument.
Type	Programmable from 0.01 to 9.99 kWh per pulses. Output connectable to the energy meters (kWh)	Addresses	247, selectable by means of the front keypad
Pulse duration	TOFF ≥ 120 ms, according to EN62052-31. TON selectable (30 ms or 100 ms) according to EN62053-31	Protocol	MODBUS/JBUS (RTU)
Output Load	Static: opto-mosfet. VON 2.5 VAC/DC max. 70 mA, VOFF 260 VAC/DC max.	Data (bidirectional)	System and phase variables: see table "List of variables..."
Insulation	By means of optocouplers, 4000 VRMS output to measuring inputs.	Dynamic (reading only)	All the configuration parameters.
		Static (reading and writing)	1 start bit, 8 data bit, and even parity, 1 or 2 stop bit.
		Data format	9.6, 19.2, 38.4, 57.6, 115.2 kbps.
		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)		

Software functions

Password		Transformer ratio	
	Numeric code of max. 3 DGT; 2 protection levels of the programming data:	VT (PT) ratio	1.0 to 99.9 / 100 to 999
1st level	Password "0", no protection;	CT	1.0 to 99.9 / 100 to 999.
2nd level	Password from 1 to 999, all data are protected		The max CTxVT product for AV6 models is 2421 (X option).
Programming lock	By means of potentiometer (back-side of the display module) it is possible to lock the access to all the configuration parameters.	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 selection		Reset	By means of the front keypad: total energies (kWh, kvarh).
System 3-Ph.n unbalanced load	3-phase (4-wire) 3-phase (3-wire) without neutral connection.	Easy connection function	Wrong phase detection and displaying. For all the display selections (except "D" and "E") the current, power and energy measurement are independent on the current direction.
System 3-Ph.1 balanced load	<ul style="list-style-type: none"> • 3-phase (3-wire) one current and 3-phase to phase voltage measurements. • 3-phase (4-wire) one current and 3-phase to neutral voltage measurements. • 3-phase (2-wire) one current and 1-phase (L1, terminal 10) to neutral (N, terminal 9) voltage measurement. 		
System 2-Ph	2-phase (3-wire)		
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) 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) according to EN62053-21 and EN62053-23)	Radio frequency suppression	According to CISPR 22
Installation category	Cat. III (IEC 60664, EN60664)	Standard compliance	
Insulation (for 1 minute)	4000 VRMS between measuring inputs and digital output.	Safety	EC60664, IEC61010-1 EN60664, EN61010-1 EN62052-11
Dielectric strength	4000VAC RMS 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 5kV air discharge.	Housing	
Immunity to irradiated electromagnetic fields	Test with current: 10V/m from 80 to 2000MHz Test without any current: 30V/m from 80 to 2000MHz; On current and voltage measuring inputs circuit: 4kV	Dimensions (WxHxD)	72 x 72 x 65 mm
Burst		Material	Noryl, PA66 self-extinguishing: UL 94 V-0
Immunity to conducted disturbances	10V/m from 150kHz to 80Mhz	Mounting	Panel and DIN-rail
		Protection degree	
		Front	IP50
		Screw terminals	IP20
		Weight	Approx. 400g (packing included)

Power supply specifications

Self power supply	40 to 480VAC (45-65Hz). Across input "VL2" and "VL3"	Power consumption	≤2VA/1W
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Insulation between inputs and outputs

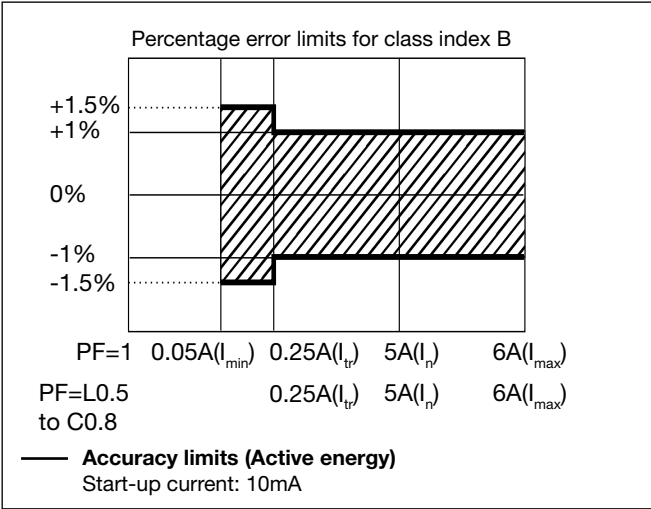
	Measuring input	Opto-Mosfet output	Communication port	Self power supply
Measuring inputs	-	4kV	4kV	0kV
Opto-Mosfet output	4kV	-	-	4kV
Communication port	4kV	-	-	4kV
Self power supply	0kV	4kV	4kV	-

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

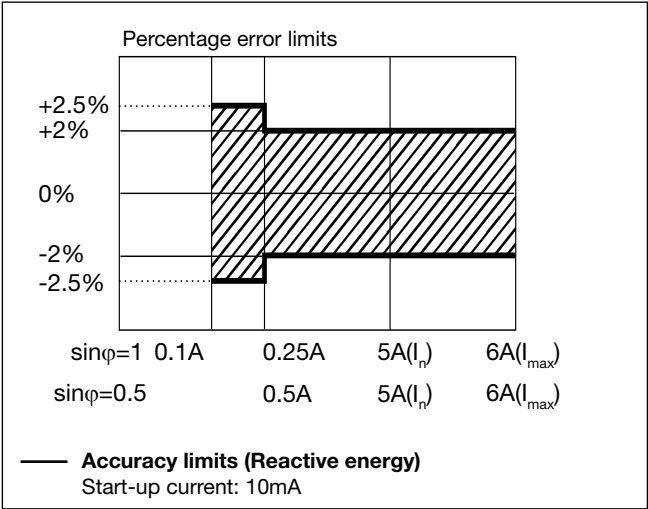


Accuracy (According to EN50470-3 and EN62053-23)

kWh, accuracy (RDG) depending on the current



kvarh, accuracy (RDG) depending on the current



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

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

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

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

Energy metering

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

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

Where:

i= considered phase (L1, L2 or L3)
P= active power; **Q**= reactive power;
t1, t2=starting and ending time points of consumption recording; **n**= time unit; **Δ t**= 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”)

N°	Variable	1-ph. sys.	2-ph. sys.	3-ph. 4-wire balanced system	3-ph. 3-wire balanced system	3-ph. 4-wire unbalanced system	3-ph. 3-wire unbalanced system	Notes
1	kWh	x	x	x	x	x	x	Total (2)
2	kvarh	x	x	x	x	x	x	Total (3)
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

(2) = also kWh- (exported) with application E (see next table)

(3) = sum (not algebraic) of kvarh imported and exported with application F (see next table)

Display pages

No	1st variable (1st half-line)	2nd variable (2nd half-line)	3rd variable (2nd line)	Note	Applications					
					A	B	C	D	E	F
	Phase sequence			The phase sequence triangle appears in any page only if there is a phase reverse	x	x	x	x	x	x
1	Total kWh		W sys		x	x	x	x	x	x
1b	Total kWh (-)		“NEG”	Exported active energy		+	+	+	+	T
2	Total kvarh		kvar sys			x	x	x	x	x
3		PF sys	Hz	Indication of C, -C, L, -L depending on the quadrant		x	x	x	x	x
4	PF L1	PF L2	PF L3	Indication of C, -C, L, -L depending on the quadrant			x	x	x	x
5	A L1	A L2	A L3				x	x	x	x
6	V L1-2	V L2-3	V L3-1				x	x	x	
7	V L1	V L2	V L3				x	x		

Notes: x = available

+ = only positive kvarh is measured (kvar sys is the algebraic sum of the phase kvar)

T = positive and negative kvarh are summed and measured in the same kvarh meter

(kvarsys is the sum of the absolute values of each phase kvar). The phase kvar are displayed with the correct sign.

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
Meter information 8	value	Sn	Secondary address (M-bus protocol)



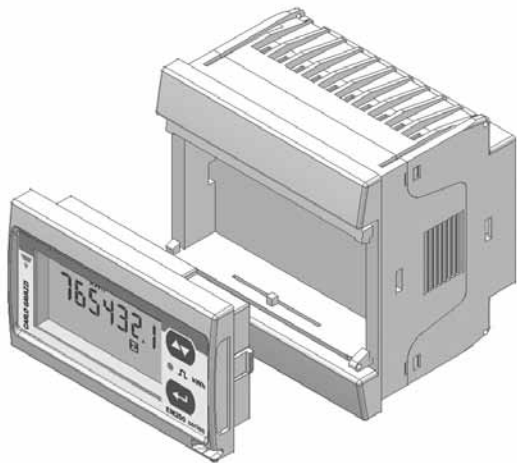
List of selectable applications

	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 (default selection)
D	Full set of variables +	Full set of available variables can be displayed +
E	Full set of variables +	Full set of variables with exported (negative) kWh meter
F	Full set of variables	Full set of variables with imported and exported kWh meters

Notes:

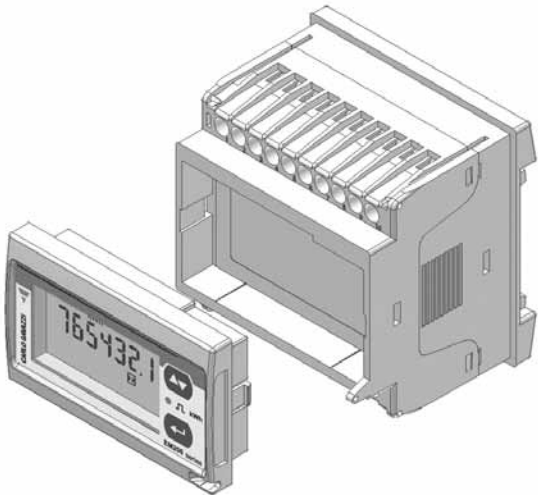
+ Only in “D” and “E” applications the actual direction of the current is considered.

One instrument with double mounting capability



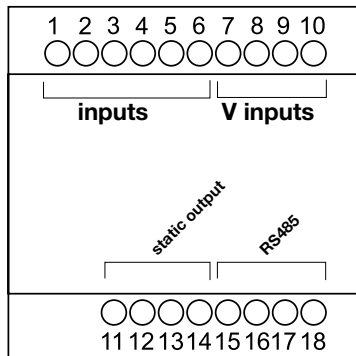
... as DIN-rail mounting meter.

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

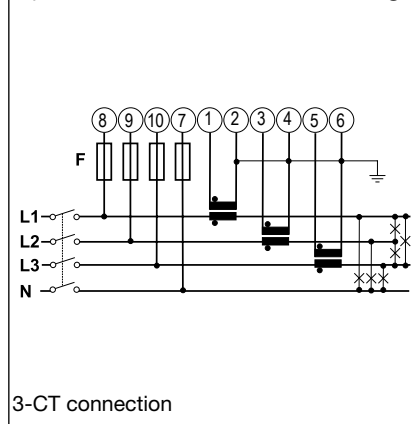


Wiring diagrams

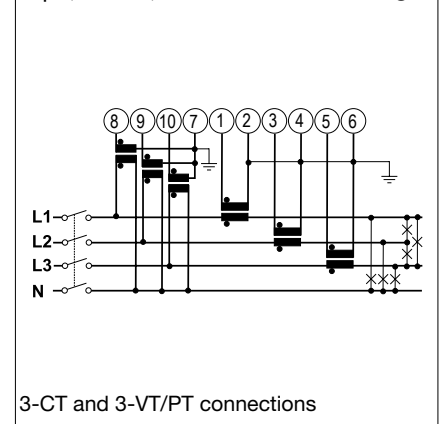
(6A) Self power supply, system type selection: 3P.n



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

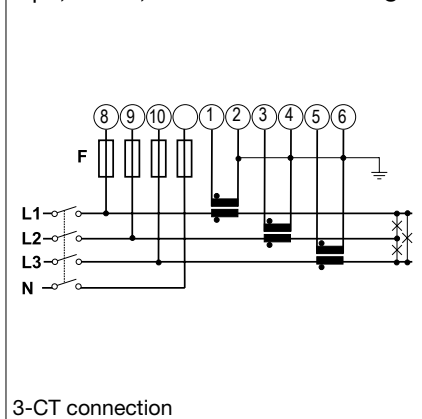


3-ph, 4-wire, unbalanced load **Fig.2**

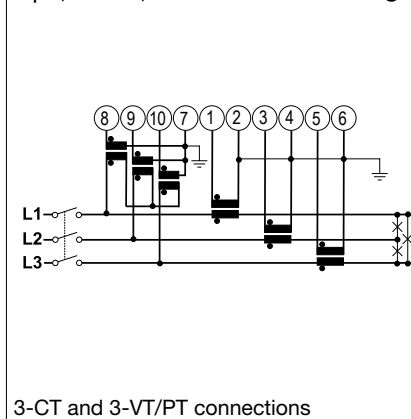


(6A) System type selection: 3P.n

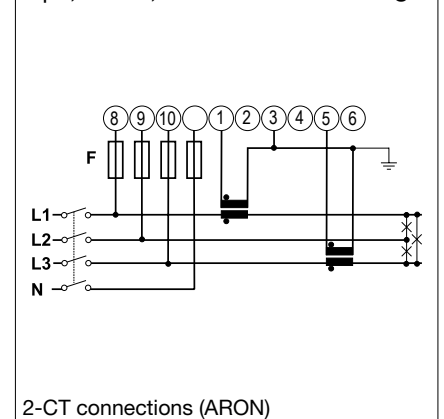
3-ph, 3-wire, unbalanced load **Fig.3**



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

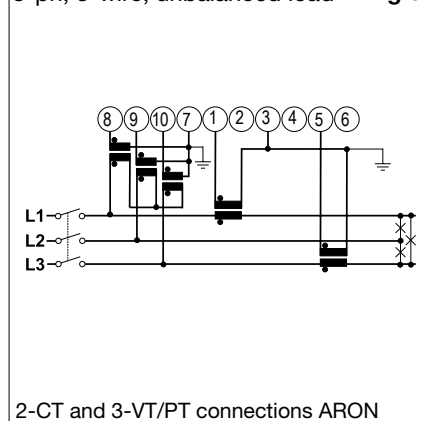


3-ph, 3-wire, unbalanced load **Fig.5**

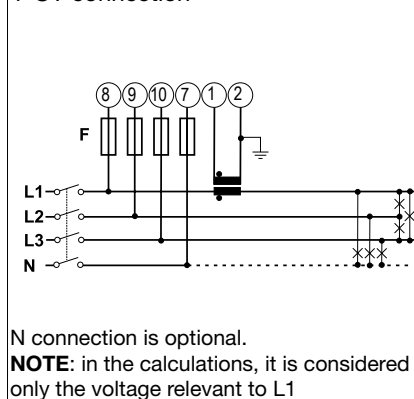


(6A) Self power supply, system type selection: 3P.1

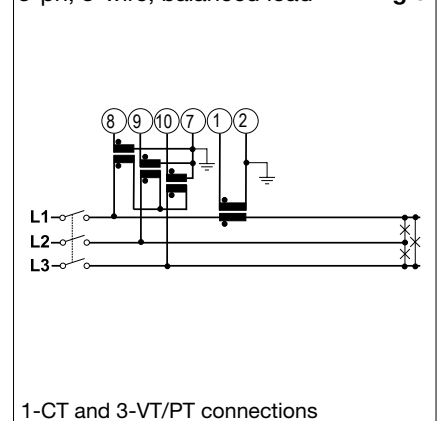
3-ph, 3-wire, unbalanced load **Fig.6**



3-ph, 3/4-wire, balanced load **Fig.7**
1-CT connection

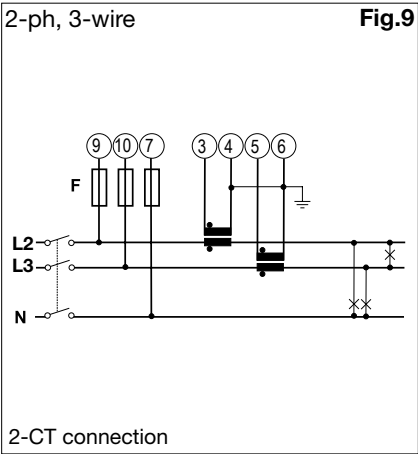


3-ph, 3-wire, balanced load **Fig.8**

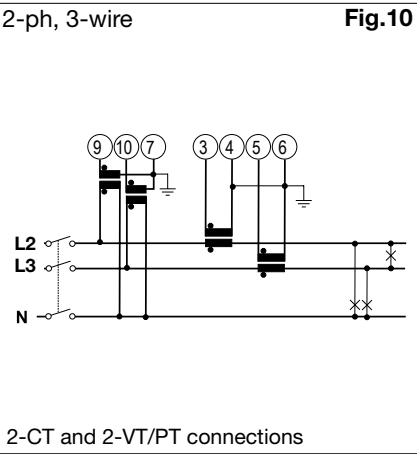


Wiring diagrams

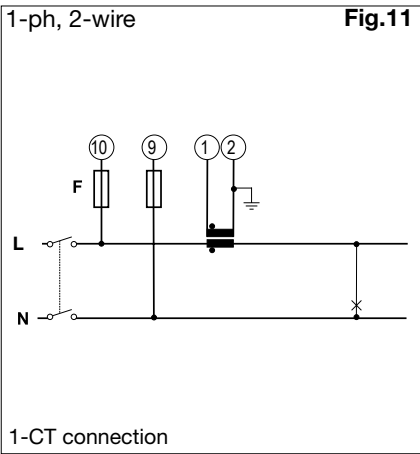
(6A) System type selection: 2P



(6A) System type selection: 1P

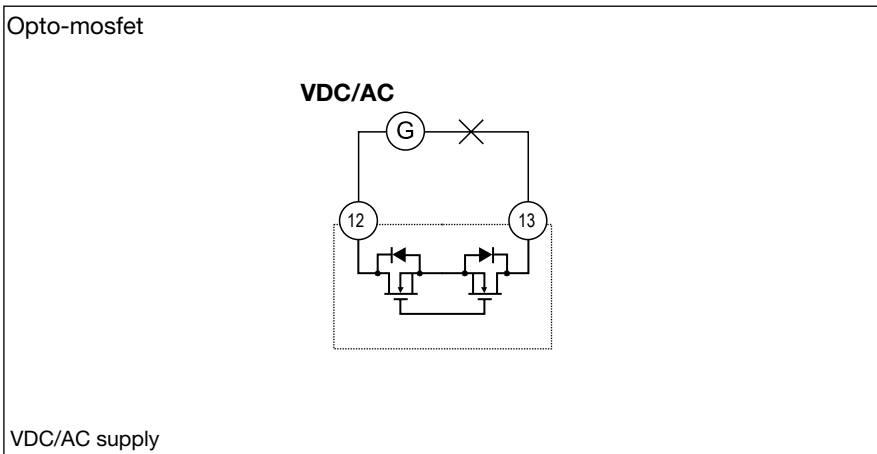
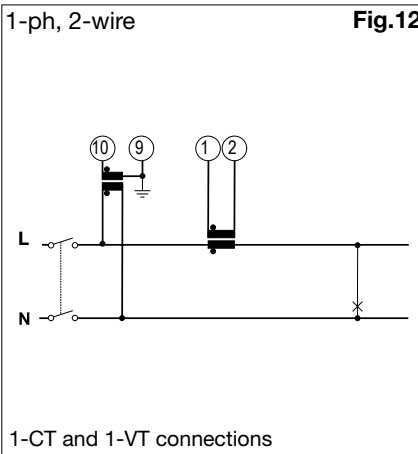


(6A) System type selection: 1P

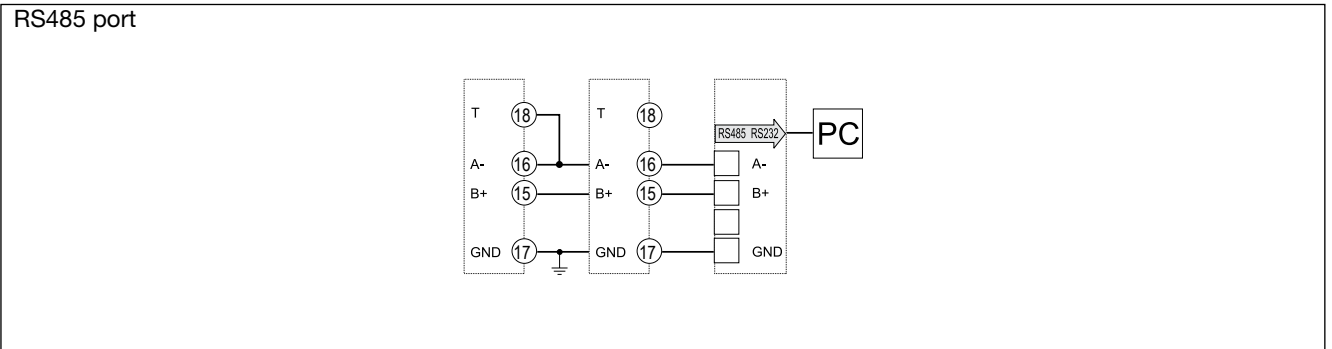


Static output wiring diagram

(6A) System type selection: 1P

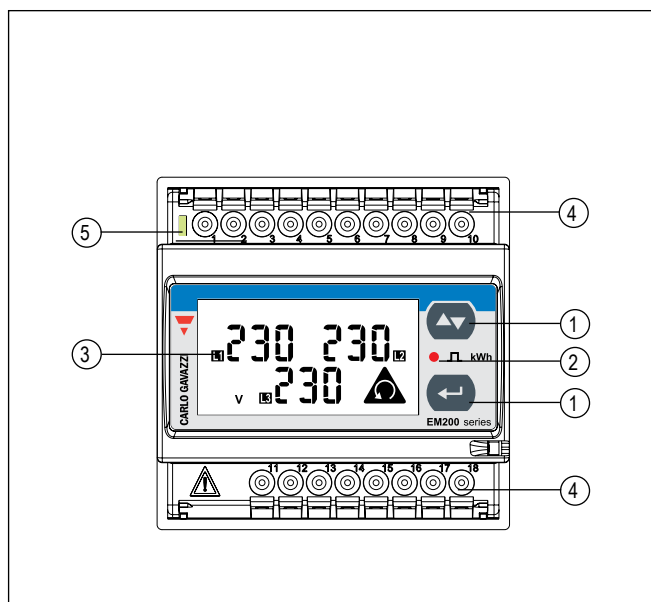


RS485 port wiring diagram



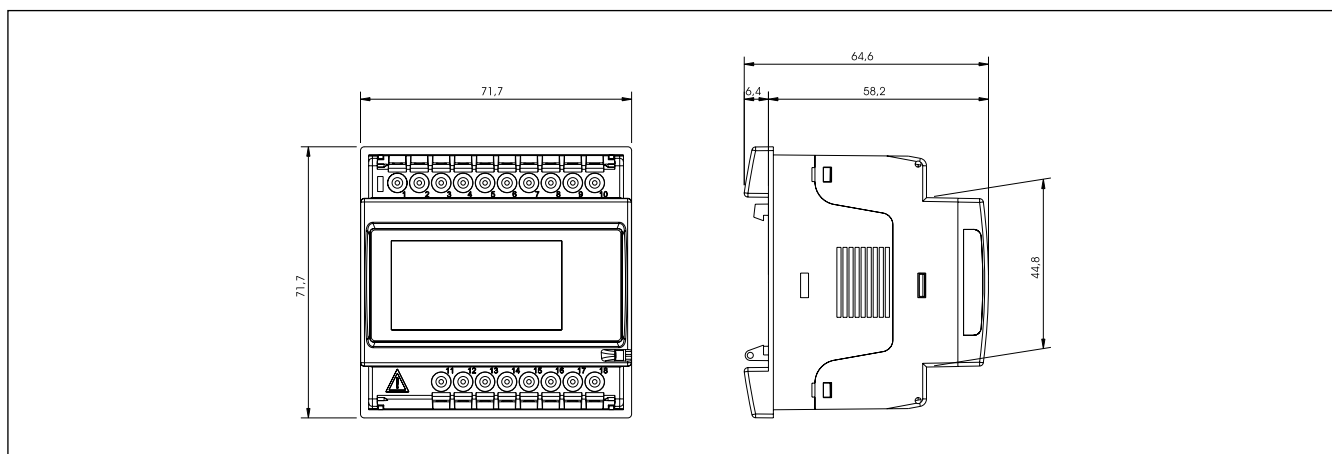
RS485 NOTE: additional devices provided with RS485 are connected as per the picture above. The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (B+) and (T).

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)

