

# Energy Management Energy Analyzer Type EM24 DIN

CARLO GAVAZZI



- Application adaptable display and programming procedure (Easyprog function)
- Easy connections management
- Certified according to MID Directive (option PF): see "how to order" below
- Other versions available (not certified, option X): see "how to order" on the next page

- Class 1 (kWh) according to EN62053-21
- Class B (kWh) according to EN50470-3
- Class 2 (kvarh) according to EN62053-23
- Accuracy  $\pm 0.5$  RDG (current/voltage)
- Energy analyzer
- Instantaneous variables readout: 4 DGT
- Energies/gas/water readout: 8 DGT
- System variables: VLL, VLN, Admd max, VA, VAdmd, VAdmd max, W, Wdmd, Wdmd max, var, PF, Hz, Phase-sequence.
- Single phase variables: VLL, VLN, A, VA, W, var, PF
- Energy measurements: total and partial kWh and kvarh or based on 4 different tariffs; single phase measurements
- Gas, cold water, hot water, kWh remote heating measurements
- Hour counter (6+2 DGT)
- TRMS measurements of distorted sine waves (voltages/currents)
- Self power supply (AV2-AV9 inputs)
- Auxiliary power supply (AV5-AV6 inputs)
- 3 digital inputs for tariff selection, DMD synch or gas/water (hot-cold) and remote heating metering (on request)
- 2 digital outputs for pulses or for alarms or as a mix of them
- Dimensions: 4-DIN modules
- Protection degree (front): IP50
- RS485 serial output (MODBUS-RTU), iFIX SCADA compatibility
- Dupline communication capability (DP option)

## Product Description

Three-phase energy analyzer with built-in configuration joystick and LCD data displaying; particularly indicated for active and reactive energy metering and for cost allocation. Housing

for DIN-rail mounting with IP50 (front) protection degree. Direct connection up to 65A and by means of external current and potential transformers. Moreover the meter can be

provided with digital outputs that can be either for pulse proportional to the active (imported and exported) and reactive energy being measured or for alarm outputs. In alternative the

RS485 communication port and 3 digital inputs or Dupline port and 3 digital inputs are available as an option.

**MID**

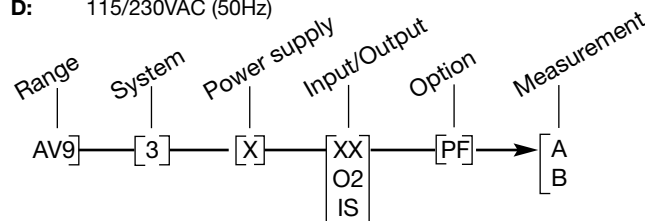
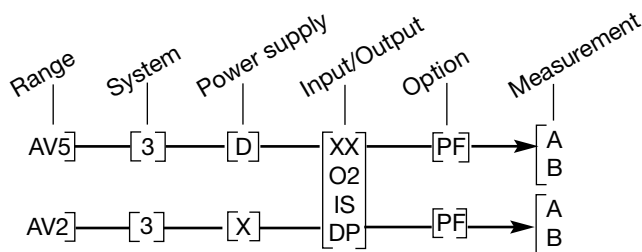
Certified according to MID Directive, Annex "B" + Annex "D" for legal metrology relevant to active electrical energy meters (see Annex MI-003 of MID). Can be used for fiscal (legal) metrology. Only the total positive energy meter is certified according to MID.

## How to order **EM24 DIN AV5 3 D O2 PF A**



## Type Selection for MID version

Range codes	System	Inputs/Outputs	Measurement
<b>AV5:</b> 400V <sub>LL</sub> AC - 5(10)A (CT connection) <b>AV2:</b> 400V <sub>LL</sub> AC 10(65)A (direct connection) V <sub>LN</sub> : 113V to 265V <sub>LN</sub> V <sub>LL</sub> : 196V to 460V <sub>LL</sub> <b>AV9:</b> 400V <sub>LL</sub> AC - 10(65)A (direct connection) V <sub>LN</sub> : 113V to 265V <sub>LN</sub> V <sub>LL</sub> : 196V to 460V <sub>LL</sub>	<b>3:</b> 3-phase, 4-wire  <b>NOTE: please check the availability of the needed code on the verification path diagram below before order.</b>	<b>XX:</b> none <b>O2:</b> dual open collector type (dual pulse or one pulse + one alarm or dual alarm) <b>IS:</b> 3 digital inputs for tariff selection or Gas/Water/remote heating metering plus RS485 port <b>DP:</b> Dupline port plus 3 digital inputs for Gas/water/remote heating metering	<b>A:</b> The power is always integrated (both in case of positive -imported- and negative -exported- power) and the total energy meter is certified according to MID.  <b>B:</b> Only the total positive -imported- energy meter is certified according to MID. The negative -exported- energy meter is not certified according to MID.
<b>Options</b>  <b>PF:</b> Certified according to MID Directive, Annex "B" + Annex "D" for legal metrology relevant to active electrical energy meters (see Annex MI-003 of MID). Can be used for fiscal (legal) metrology.		<b>Power supply</b>  <b>X:</b> Self power supply (See "Power supply specifications") <b>D:</b> 115/230VAC (50Hz)	

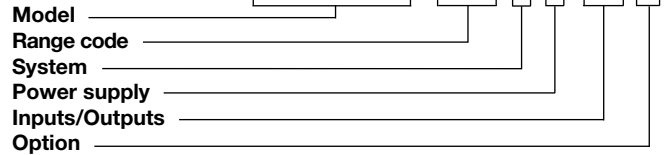




**STANDARD**

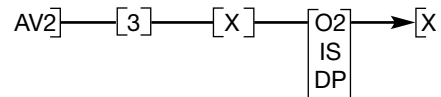
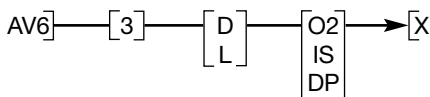
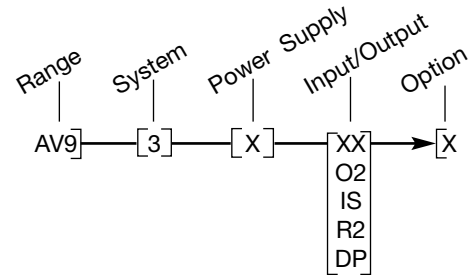
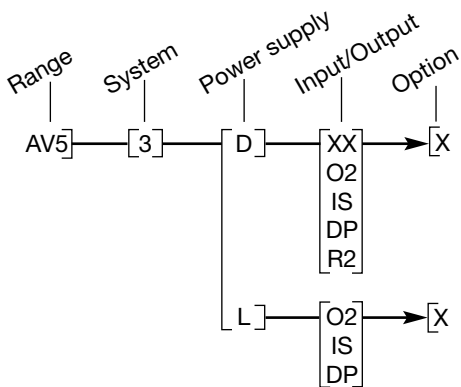
Not certified according to MID directive. Cannot be used for fiscal (legal) metrology.

**How to order EM24 DIN AV5 3 D O2 X**



**Type Selection for standard version**

Range codes	System	Power supply	Inputs/Outputs	
<b>AV5:</b> 400V <sub>LL</sub> AC - 1/5 (10)A (CT connection) V <sub>LN</sub> : 160 V to 480V <sub>LN</sub> V <sub>LL</sub> : 277 V to 830V <sub>LL</sub>	<b>3:</b> balanced and unbalanced load: 3-phase, 4-wire; 3-phase, 3-wire; 2-phase, 3-wire; 1-phase, 2-wire	<b>X:</b> Self power supply (See "Power supply specifications")	<b>XX:</b> none <b>O2:</b> dual open collector type (dual pulse or one pulse + one alarm or dual alarm)	
<b>AV6:</b> 208V <sub>LL</sub> AC - 1/5(10)A (VT/PT and CT connections) V <sub>LN</sub> : 40V to 144V <sub>LN</sub> V <sub>LL</sub> : 70V to 250V <sub>LL</sub>		<b>L:</b> 18 to 60VAC/DC (48 to 62Hz)	<b>D:</b> 115/230 VAC (48 to 62Hz)	<b>R2:</b> dual relay type (functions as per "O2") <b>IS:</b> 3 digital inputs for tariff selection or Gas/ water/ remote heating metering plus RS485 port
<b>AV2:</b> 400V <sub>LL</sub> AC 10(65)A (direct connection) V <sub>LN</sub> : 113V to 265V <sub>LN</sub> V <sub>LL</sub> : 196V to 460V <sub>LL</sub>		<b>NOTE: please check the availability of the needed code on the verification path tables below before order.</b>	<b>Options</b>	<b>DP:</b> Dupline port plus 3 digital inputs for Gas / water / remote heating metering
<b>AV9:</b> 400V <sub>LL</sub> AC - 10(65)A (direct connection) V <sub>LN</sub> : 184V to 276V <sub>LN</sub> V <sub>LL</sub> : 318V to 480V <sub>LL</sub>			<b>X:</b> none	



## Input specifications

<b>Rated inputs</b>	System type: 3-phase Galvanic insulation by means of built-in CT's (AV5 and AV6 models). By direct connection (AV2 and AV9) AV5 and AV6: 1/5(10)A AV2: 10(65)A; AV9: 10(65)A AV5: 400 VLL AV2: 230/400 VLL AV9: 400 VLL AV6: 120VLN/208 VLL	
Current type		Exported Total/Partial/Tariff: 6+1 or 7DGT (with “-“ sign)
Current range (by CT)		EEEE indication when the value being measured is exceeding the “Continuous inputs overload” (maximum measurement capacity)
Current range (direct)		Max. instantaneous variables: 9999; energies: 99 999 999. Min. instantaneous variables: 0.000; energies 0.00.
Voltage		
Voltage by VT/PT		
<b>Accuracy</b> (Display + RS485) (@25°C ±5°C, R.H. ≤60%, 50±5Hz/60±5Hz)	lb: see below, Un: see below	
AV5 model	In: 5A, Imax: 10A; Un: 160 to 480VLN (277 to 830VLL)	<b>LEDs</b>
AV6 model	In: 5A, Imax: 10A; Un: 40 to 144VLN (70 to 250VLL)	AV5, AV6 models
AV2 model	lb: 10A, Imax: 65A, Un: 113 to 265VLN (196 to 460VLL)	
AV9 model	lb: 10A, Imax: 65A; Un: 184 to 276VLN (318 to 480VLL)	
Current		
AV5, AV6 models	From 0.002In to 0.2In: ±(0.5% RDG +3DGT) From 0.2In to Imax: ±(0.5% RDG +1DGT).	AV2, AV9 models Max frequency
AV2, AV9 models	From 0.004lb to 0.2lb: ±(0.5% RDG +3DGT) From 0.2lb to Imax: ±(0.5% RDG +1DGT).	<b>Measurements</b>
Phase-neutral voltage	In the range Un: ±(0,5% RDG +1DGT)	Method
Phase-phase voltage	In the range Un: ±(1% RDG +1DGT)	Coupling type
Frequency	±0.1Hz (50±5Hz/60±5Hz)	
Active and Apparent power	±(1%RDG +2DGT)	<b>Crest factor</b>
Power Factor	±[0.001+1%(1.000 - “PF RDG”)]	lb 10A ≤4 (91A max. peak) In 5A ≤3 (15A max. peak)
Reactive power	±(2%RDG +2DGT)	
Active energy	Class 1 according to EN62053-21 and MID Annex MI-003 Class B according to EN50470-3	<b>Current Overloads</b>
Reactive energy	Class 2 according to EN62053-23	Continuous
AV5, AV6 models	In: 5A, Imax: 10A; 0.1 In: 0.5A, Start up current: 10mA	For 500ms For 10ms
AV2, AV9 models	lb: 10A, Imax: 65A; 0.1 lb: 1.0A Start up current: 40mA	<b>Voltage Overloads</b>
<b>Energy additional errors</b>		Continuous
Influence quantities	According to EN62053-21, EN50470-3, EN62053-23	For 500ms
<b>Temperature drift</b>	≤200ppm/°C	<b>Input impedance</b>
<b>Sampling rate</b>	1600 samples/s @ 50Hz 1900 samples/s @ 60Hz	208VL-L (AV6) 230/400VL-L (AV2)
<b>Display refresh time</b>	750 ms	400VL-L (AV5) 400VL-L (AV9)
<b>Display</b>	3 lines (1 x 8 DGT; 2 x 4 DGT)	1/5(10)A (AV5-AV6) 10(65)A (AV2-AV9)
Type	LCD, h 7mm	<b>Frequency</b>
Instantaneous variables read-out	4 DGT	50±5Hz/60±5Hz
Energies	Imported Total 6+2, 7+1 or 8DGT	<b>Joystick</b>
		For variable selection and programming of the instrument working parameters

## Output specifications

<b>Digital outputs</b> Pulse type Number of outputs  Type Pulse duration  Alarm type Number of outputs Alarm modes  Set-point adjustment  Hysteresis On-time delay Output status  Min. response time  <b>Note</b>	Up to 2, independent. Programmable from 0.001 to 10.00kWh/kvarh by pulse.  Outputs connectable to the energy meters (kWh/kvarh) $T_{OFF} \geq 120\text{ms}$ , according to EN62053-31 $T_{ON}$ selectable (30 ms or 100 ms), according to EN62053-31  Up to 2, independent Up alarm, down alarm (see the table "List of the variables that can be connected to")  From 0 to 100% of the display scale From 0 to full scale 0 to 255s Selectable; normally de-energized or normally energized $\leq 700\text{ms}$ , filter excluded, set-point on-time delay: "0 s" The 2 digital outputs can also work as a dual pulse output, dual alarm output, one pulse output and one alarm output.	Insulation  <b>Note</b>  <b>RS485</b> Type  Connections  Addresses  Protocol Data (bidirectional) Dynamic (reading only)  Static (reading and writing)  Data format  Baud-rate Driver input impedance  Insulation  <b>Note:</b>	4000 VRMS output to measuring input 4000 VRMS output to power supply input. The meters equipped with the relay outputs ("AV9" models with "R2" option) work even if VL3 is missing (VL1, VL2 and neutral have to be available)(see table "working mode notes")  Multidrop, bidirectional (static and dynamic variables) 2-wire Max. distance 1000m 247, selectable by means of the front joystick MODBUS/JBUS (RTU)  System and phase variables: see table "List of variables..." All the configuration parameters. 1 start bit, 8 data bit, no parity, 1 stop bit 4800, 9600 bit/s 1/5 unit load Maximum 160 transceivers on the same bus. By means of optocouplers, 4000 VRMS output to measuring input, 4000 VRMS output to power supply input. The meters equipped with the communication port ("AV9" models with "XS" and "IS" options) work even if VL3 is missing (VL1, VL2 and neutral have to be available)(see table "working mode notes")
<b>Static output</b> Purpose  Signal  Insulation	For pulse output or alarm output $V_{ON}$ 1.2 VDC/ max. 100 mA $V_{OFF}$ 30 VDC max. By means of optocouplers, 4000 VRMS output to measuring inputs, 4000 VRMS output to power supply input.		
<b>Relay output</b> Purpose  Type	For alarm output or pulse output Relay, SPST type AC 1-5A @ 250VAC DC 12-5A @ 24VDC AC 15-1.5A @ 250VAC DC 13-1.5A @ 24VDC		

## Dupline specifications

<b>Counters</b> Used Dupline function  Number of counters  Counter range Used channels Multiplexer Reset Value Counter reset	Multiplexer for counter values 6 per instrument, 128 per network 0... 99 999 999 B to F B2 to B8 B1 C1 to F8 Enable/disable function for all the counters	Available counters  <b>Analogue variables</b> Used Dupline function	kWh tot, -kWh tot, kvarh tot, -kvarh tot, kWh t1, kWh t2, kWh L1, kWh L2, kWh L3, counter dig. in. 1, counter dig. in. 2, counter dig. in. 3, hour counter.  Multiplexer for analogue values
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## Dupline specifications

Number of variables	8 per instrument 80 per network		
<b>Dupline data format</b>	3 1/2 DGT BCD		
Full scale value	Selectable from 1.999 to 1999M		
Used channels	depending on the number of variables		
Multiplexer Value	A1 to A4 G1 to H8 (1 <sup>st</sup> group of 16 variables) I1 to J8 (2 <sup>nd</sup> group of 16 variables) K1 to L8 (3 <sup>th</sup> group of 16 variables) M1 to N8 (4 <sup>th</sup> group of 16 variables) O1 to P8 (5 <sup>th</sup> group of 16 variables)		
Available variables	All, except for the "max" variables		
<b>Synchro/Tariff input</b>			
Used Dupline functions	Monostable (push-button) Realtime		
Used channels	A5		
Working mode	Selectable: • none • Wdmd synchronization		
		<b>Alarms</b>	
		Used Dupline function	• total and partial energy meter (kWh, kvarh) managed by time periods (t1-t2).
		Used channels	Monostable (push-button) Selectable (A1 to P8). No control that the selected channels are not used for counters or analog variables.
		Number of alarms	2 per instrument
		Alarm modes	Up alarm, down alarm (see the table "List of the variables that can be connected to")
		Set-point adjustment	From 0 to 100% of the display scale
		Hysteresis	From 0 to full scale
		On-time delay	0 to 255s
		Output status	Normally energised
		Available variables	All, except for the "max" variables

## Digital input specifications

Number of inputs	3		
Input frequency	20Hz max, duty cycle 50%		
Prescaler adjustment	From 0.001 to 999.9 m <sup>3</sup> or kWh per pulse		
Contact measuring voltage	5VDC +/- 5%		
Contact measuring current	10mA max		
Input impedance	680Ω		
Contact resistance	≤100Ω, closed contact ≥500kΩ, open contact		
Working modes (DP version excluded)	Selectable: • total and partial energy meters (kWh and kvarh) without digital inputs; • total and partial energy meters (kWh and kvarh) managed by time periods (t1-t2-t3-t4), W dmd synchronisation (the synchronisation is made every time the tariff changes) and GAS (m <sup>3</sup> ) or WATER (hot-cold m <sup>3</sup> ) or remote heating (kWh) meters or external kWh meter; • total and partial energy meters (kWh and kvarh) managed by time periods (t1-t2), W dmd synchronisation (the synchronisation		
		Working modes (DP version only)	is made independently from the tariff selection) and GAS (m <sup>3</sup> ) or WATER (hot-cold m <sup>3</sup> ) or remote heating (kWh) meters or external kWh meter; • total energy (kWh, kvarh) and GAS, WATER (hot-cold m <sup>3</sup> ), remote heating, external kWh meters (3 choices only).
		Note	Selectable: • GAS (m <sup>3</sup> ) or WATER (hot-cold m <sup>3</sup> ) or remote heating (kWh) meters The energy metering is only made by means of the analogue inputs.
		Insulation	By means of optocouplers, 4000 VRMS digital inputs to measuring inputs, 4000 VRMS digital inputs to power supply input.

## Software functions

<b>Password</b>	Numeric code of max. 4 digits; 2 protection levels of the programming data: 1st level Password "0", no protection 2nd level Password from 1 to 9999, all data are protected	<b>Filter</b>	Operating range Filtering coefficient Filter action	0 to 100% of the input display scale 1 to 32 Measurements, serial output (fundamental variables: V, A, W and their derived ones).
<b>System selection</b> System 3-P:n unbalanced load System 3-P unbalanced load System 3-P:1 (only AV5 and AV6) balanced load	3-phase (4-wire) 3-phase (3-wire)  3-phase (3-wire) one current and 3-phase to phase voltage measurements 3-phase (4-wire) one current and 1-phase (L1) to neutral voltage measurement	<b>Displaying</b>		Up to 3 variables per page (see « Display pages ») 8 different set of variables available (see « Display pages ») according to the application being selected
System 2-P System 1-P	2-phase (3-wire) 1-phase (2-wire)	<b>Reset</b>		By means of the front joystick: - dmd and dmd max; - total energies (kWh and kvarh) and gas/water; - partial energies and tariffs: kWh, kvarh
<b>Transformer ratio</b> VT (PT)  CT	1.0 to 999.9 / 1000 to 6000 (only AV5 and AV6) 1.0 to 999.9 / 1000 to 9999 / 10.00k to 60.00k (only AV5 and AV6). The maximum power being measured cannot exceed 210 MW (calculated as maximum input voltage and current, see the "Accuracy" paragraph before). The maximum VT by CT ratio is 48600. For MID complaint applications the maximum power being measured is 25MW.	<b>Easy connection function</b> AV2 and AV9 models  AV5-AV6-AV2-AV9 models		Automatic phase sequence detection with current and voltage synchronisation. For all the display selections, both energy and power measurements are independent from the current direction. The displayed energy is always "imported" with the only exception of "F" and "H" types (see "display pages" table). For those latter selections the energies can be either "imported" or "exported" depending on the current direction.

## General specifications

<b>Operating temperature</b>	-25°C to +55°C (-13°F to 131°F) (R.H. from 0 to 90% non-condensing @ 40°C) according to EN62053-21, EN50470-1 and EN62053-23	<b>Dielectric strength</b>	4000 VRMS for 1 minute
<b>Storage temperature</b>	-30°C to +70°C (-22°F to 158°F) (R.H. < 90% non-condensing @ 40°C) according to EN62053-21, EN50470-1 and EN62053-23	<b>Noise rejection CMRR</b>	100 dB, 48 to 62 Hz
<b>Installation category</b>	Cat. III (IEC60664, EN60664)	<b>EMC</b>	According to EN62052-11
<b>Insulation (for 1 minute)</b>	4000 VRMS between measuring inputs and power supply 4000 VRMS between power supply and RS485/digital output	Electrostatic discharges Immunity to irradiated  Electromagnetic fields  Burst  Immunity to conducted disturbances  Surge  Radio frequency suppression	15kV air discharge 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  10V/m from 150KHz to 80MHz On current and voltage measuring inputs circuit: 4kV; on "L" auxiliary power supply input: 1kV According to CISPR 22

## General specifications (cont.)

<b>Standard compliance</b> Safety	IEC60664, IEC61010-1 EN60664, EN61010-1 EN62052-11.	Cable cross-section area AV5-AV6 models	Max. 1.5 mm <sup>2</sup> Screws tightening torque: 0.5 Nm
	Metrology		EN62053-23, EN50470-3. MID "annex MI-003"
Pulse output Approvals	DIN43864, IEC62053-31 CE, cULus listed (AV5, AV6 options only), MID (PF option only)	<b>Housing DIN</b> Dimensions (WxHxD) Material	71 x 90 x 64.5 mm Nylon PA66, self-extinguishing: UL 94 V-0 DIN-rail
<b>Connections</b> Cable cross-section area AV2-AV9 models	Screw-type	Mounting	
	measuring inputs max. 16 mm <sup>2</sup> ; min. 2.5 mm <sup>2</sup> (by cable lug). Min./Max. screws tightening torque: 1.7 Nm / 3 Nm Other inputs: 1.5 mm <sup>2</sup> Screws tightening torque: 0.5 Nm	<b>Protection degree</b> Front Screw terminals	IP50 IP20
		<b>Weight</b>	Approx. 400 g (packing included)

## Power supply specifications

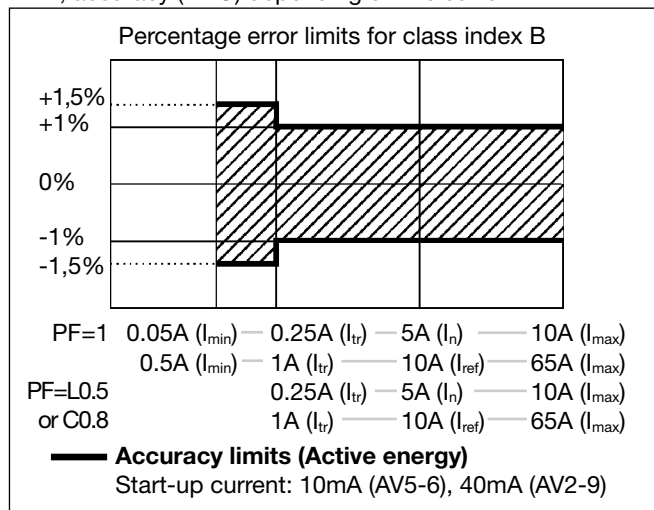
<b>Self supplied version</b>	AV9 models "XX" and "O2" options only: -20% +15%, 48- 62Hz. "R2", "XS" and "IS" options only: -15% +10%, 48-62Hz. AV2 model: "XX", "O2", "IS" and "DP" options: -15% +15%, 48- 62Hz. In case of 3-phase system, 4-wire connection: 113 to 265V. In case of 3- phase system, 3-wire con- nection: 196 to 460V.	phase connection has to be performed the L1 and L2 voltage inputs have to be short circuited. The instrument provided with "O2" option, working in a 3-phase system with neu- tral may work also if one or two phases are missing.
	<b>Note</b>	The instruments provided with "IS" and "R2" options work only if all the voltage inputs are connected (3- phase and neutral) if a 1-
		<b>Auxiliary power supply</b>
		AV5-AV6 modules: L: 18 to 60VAC/DC; D: 115VAC/230VAC (48 to 62Hz)
		<b>Power consumption</b>
		AV9-AV2 models AV9-AV2 models (IS and DP option only) AV5-AV6 models
		≤ 20VA/1W ≤ 12VA/2W ≤ 2VA/2W

## Working mode notes (only "Self power supply" version)

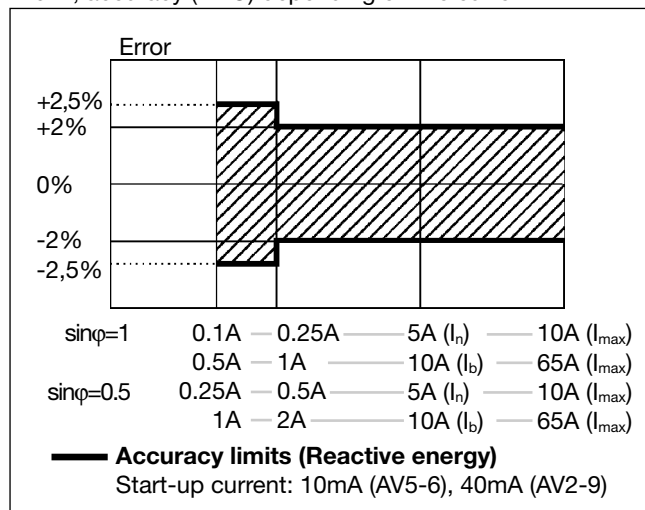
Output	Model	Note
Open collector output	"AV9" models with "O2" option	The meter works even if up to two voltages "phase to neutral" are missing or if one voltage "phase to phase" is missing.
Relay output	"AV9" models with "R2" option	The neutral wire has always to be available. The meter works even if "Phase 3" is missing but, mandatorily, both "phase 1" and "Phase 2" have to be available.
RS485 port	"AV9" models with "IS" option	
Dupline port	"AV2" model with "DP" option	The meter works even if up to two voltages "phase to neutral" are missing or if one voltage "phase to phase" is missing.
Relay output	"AV2" model with "R2" option	
RS485 port	"AV2" model with "IS" option	

## 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 (PF option only)

<b>Accuracy</b>	0.9 $U_n \leq U \leq 1.1 U_n$ ; 0.98 $f_n \leq f \leq 1.02 f_n$ ; $f_n$ : 50Hz; $\cos\varphi$ : 0.5 inductive to 0.8 capacitive. Class B. I st: 0.04A; I min: 0.5A; I tr: 1A; I ref: 10A; I max: 65A. Class B. I st: 0.01A; I min: 0.05A; I tr: 0.25A; I ref: 5A; I max: 10A.	<b>EMC compliance</b>	E2
AV2-AV9 models		<b>Mechanical compliance</b>	M2
AV5 models		<b>Protection degree</b>	in order to achieve the protection against dust and water required by the norms harmonized to MID, the meter must be used only installed in IP51 (or better) cabinets.
<b>Operating temperature</b>	-25°C to +55°C (-13°F to 131°F) (R.H. from 0 to 90% non-condensing @ 40°C)		

## 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

$$ASY_{LL} = \frac{(V_{LL,max} - V_{LL,min})}{V_{LL,\Sigma}}$$

$$ASY_{LN} = \frac{(V_{LN,max} - V_{LN,min})}{V_{LN,\Sigma}}$$

Three-phase reactive power

$$\text{var}_{\Sigma} = (\text{var}_1 + \text{var}_2 + \text{var}_3)$$

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

$$k \text{ var hi} = \int_{t_1}^{t_2} Q_i(t) dt \cong \Delta t \sum_{n1}^{n2} Q_{nj}$$

$$kWh_i = \int_{t_1}^{t_2} P_i(t) dt \cong \Delta t \sum_{n1}^{n2} P_{nj}$$

Where:

**i**= considered phase (L1, L2 or L3)  
**P**= active power; **Q**= reactive power;  
**t<sub>1</sub>**, **t<sub>2</sub>**= starting and ending time points of consumption recording; **n**= time unit; **Δt**= time interval between two successive power consumptions;  
**n<sub>1</sub>**, **n<sub>2</sub>**= starting and ending discrete time points of consumption recording



## List of the variables that can be connected to:

- RS485 communication port
- Alarm outputs (“max” variable”, “energies” and “hour counter” excluded)
- Pulse outputs (imported and exported kWh, imported kvarh)
- Dupline bus

No	Variable	1-phase system	2-phase system	3-ph. 4-wire balanced sys.	3-ph. 4-wire unbal. sys.	3 ph. 3-wire bal. sys.	3 ph. 3-wire unbal. sys.	Notes
1	V L-N sys	o	x	x	x	x	#	sys=system
2	V L1	x	x	x	x	x	#	
3	V L2	o	x	x	x	x	#	
4	V L3	o	o	x	x	x	#	
5	V L-L sys	o	x	x	x	x	x	sys=system
6	V L1-2	#	x	x	x	x	x	
7	V L2-3	#	o	x	x	x	x	
8	V L3-1	#	o	x	x	x	x	
9	A dmd max	o	x	x	x	x	x	Highest “dmd” current among the phases (1)(2)
10	A L1	x	x	x	x	x	x	
11	A L2	o	x	x	x	x	x	
12	A L3	o	o	x	x	x	x	
13	VA sys	x	x	x	x	x	x	sys=system
14	VA sys dmd	x	x	x	x	x	x	sys=system (1)
15	VA L1	x	x	x	x	x	#	
16	VA L2	o	x	x	x	x	#	
17	VA L3	o	o	x	x	x	#	
18	var sys	x	x	x	x	x	#	sys=system
19	var L1	x	x	x	x	x	#	
20	var L2	o	x	x	x	x	#	
21	var L3	o	o	x	x	x	#	
22	W sys	x	x	x	x	x	x	sys=system
23	W sys dmd	x	x	x	x	x	x	sys=system (1)
24	W L1	x	x	x	x	x	#	
25	W L2	o	x	x	x	x	#	
26	W L3	o	o	x	x	x	#	
27	PF sys	x	x	x	x	x	x	
28	PF L1	x	x	x	x	x	#	
29	PF L2	o	x	x	x	x	#	
30	PF L3	o	o	x	x	x	#	
31	Hz	x	x	x	x	x	x	
32	Phase seq.	o	x	x	x	x	x	
33	Hours	x	x	x	x	x	x	
34	kWh (+)	x	x	x	x	x	x	Total or by user
35	kvarh (+)	x	x	x	x	x	#	Total or by user
36	kWh (+)	x	x	x	x	x	x	Partial or by tariff
37	kvarh (+)	x	x	x	x	x	#	Partial or by tariff
38	kWh (-)	x	x	x	x	x	x	Total
39	kvarh (-)	x	x	x	x	x	#	Total
40	m <sup>3</sup> Gas	x	x	x	x	x	x	Total
41	m <sup>3</sup> Cold H <sub>2</sub> O	x	x	x	x	x	x	Total
42	m <sup>3</sup> Hot H <sub>2</sub> O	x	x	x	x	x	x	Total
43	kWh H <sub>2</sub> O	x	x	x	x	x	x	Total
44	kWh out	x	x	x	x	x	x	Total

(x) = available

(o) = not available (zero indication on the display)

(#) = not available (the relevant page is not displayed)

(1) = max. value with data storage

(2) = not available with the “DP” option

## Display pages

Sel. pos.	No	1st variable (1st line)	2nd variable (2nd line)	3rd variable (3rd line)	Note	Applications							
						A	B	C	D	E	F	G	H
	1	Phase seq.	VLN sys	Hz		7	7	7		7	7	7	7
	2	Phase seq.	VLL sys	Hz							x	x	x
	3	Total kWh (+)	W sys dmd	W sys dmd max		x	x	x		x	x	x	x
	4	kWh (+)	A dmd max	(text) "PArT"	"PArT" = Partial kWh (+)						x	x	x
	5	Total kvarh (+)	VA sys dmd	VA sys dmd max			7				7	7	7
	6	kvarh (+)	VA sys	(text) "PArT"	"PArT" = Partial kvarh (+)						7	7	7
	7	Totalizer 1 (2)	W sys (8)	(text) (3)	(1)			x			x	x	x
	8	Totalizer 2 (2)	W sys (8)	(text) (3)	(1)			x			x	x	x
	9	Totalizer 3 (2)	W sys (8)	(text) (3)	(1)			x			x	x	x
	10	kWh (+)	t1 tariff (4)	W sys dmd	(1) digital input enabled			x			x	x	x
	11	kWh (+)	t2 tariff (4)	W sys dmd	(1) digital input enabled			x			x	x	x
	12	kWh (+)	t3 tariff (4)	W sys dmd	(1) digital input enabled			5			5	5	5
	13	kWh (+)	t4 tariff (4)	W sys dmd	(1) digital input enabled			5			5	5	5
	14	kvarh (+)	t1 tariff (4)	W sys dmd	(1) digital input enabled			7			7	7	7
	15	kvarh (+)	t2 tariff (4)	W sys dmd	(1) digital input enabled			7			7	7	7
	16	kvarh (+)	t3 tariff (4)	W sys dmd	(1) digital input enabled			5,7			5,7	5,7	5,7
	17	kvarh (+)	t4 tariff (4)	W sys dmd	(1) digital input enabled			5,7			5,7	5,7	5,7
	18	kWh (+) X	W X	User X	(1) specific function enabled				x				
	19	kWh (+) Y	W Y	User Y	(1) specific function enabled				x				
	20	kWh (+) Z	W Z	User Z	(1) specific function enabled				x				
	21	Total kvarh (-)	VA sys dmd	VA sys dmd max							7		7
	22	Total kWh (-)	W sys dmd	W sys dmd max						x	x		x
	23	Hours	W sys	PF sys						x	x	x	x
	24	Hours	var sys	PF sys						7	7	7	7
	25	var L1	var L2	var L3								7	7
	26	VA L1	VA L2	VA L3								7	7
	27	PF L1	PF L2	PF L3								7	7
	28	W L1	W L2	W L3						7		7	7
	29	A L1	A L2	A L3				x		x		x	x
	30	V L1-2	V L2-3	V L3-1				6				6	6
	31	V L1	V L2	V L3				7		7	7		7
<b>0</b>	Selector position which can be linked to any of the variable combinations listed above (No. from 1 to 31)												
<b>1</b>	Selector position which can be linked to any of the variable combinations listed above (No. from 1 to 31)												
<b>2</b>	Selector position which can be linked to any of the variable combinations listed above (No. from 1 to 31)												
<b>3</b>	Selector position which can be linked to any of the variable combinations listed above (No. from 1 to 31) In this position the front LED blinks proportionally to the reactive energy (kvarh) being measured												

- (1) The page is available according to the enabled measurement.  
(2) m<sup>3</sup> Gas, m<sup>3</sup> Water, kWh remote heating, external kWh meter.  
(3) Hot and Cold (water), GAS. ENE (external energy meter).  
(4) The active tariff is displayed with an "A" before the "t1-t2-t3-t4" symbols.  
(5) These pages are not available in case of Dupline system.  
(6) Pages not available in case of 1-phase system (1P selection).  
(7) Pages not available in case of 3-phase unbalanced system (3P selection).  
(8) In case of external kWh meter the text "W sys" is replaced by "out".

**Note:** in case of alarm the whole display blinks. The blinking stops when either the selector or the joystick are used. The display starts to blink again after 60 seconds of the last command being used. There is a time-out of 60s that brings the scrolled page to the default one (selectable according to the table given above).

## Additional available information on the display

Type	1st line	2nd line	3rd line
Meter information	Firmware revision	YEAr (text)	Year of production
Meter information	PuLSE (text)	LEd (text)	Numb. of kWh per pulse
Meter information	System (1-2-3-phase)	Connection (2-3-4-wire)	dmd (time)
Meter information (AV5-6)	Ct rAtio (text)	1.0 ... 60.0k	
Meter information (AV5-6)	UT rAtio (text)	1.0 ...6.0k	
In case of alarm output	Alarm output 1 or 2 status	Set-point value	Alarm type
In case of pulse output	Pulse output 1 or 2 variable link (kWh/kvarh)	Output pulse weight (kWh-kvarh / pulse)	Empty (positive energy pulse) nEG (negative energy pulse)
In case of communication port	SErIAL (text)	Address number	RS485 status (RX-TX)
In case of communication port	Secondary address (for M-bus protocol)		Sn
In case of Dupline port	Dupline (text) or EM24 (text)	OK ... err	

## List of selectable applications

	Description	Notes
<b>A</b>	Basic domestic	** Mainly energy metering
<b>B</b>	Shopping centres	** Mainly energy metering
<b>C</b>	Advanced domestic	** Mainly energy metering (total and based on tariff), gas and water metering
<b>D</b>	Multi domestic (also camping and marinas)	* / ** Mainly energy metering (3 by single phase)
<b>E</b>	Solar	* Energy meter with some basic power analyzer functions
<b>F</b>	Industrial	* Mainly energy metering
<b>G</b>	Advanced industrial	** Energy metering and power analysis
<b>H</b>	Advanced industrial for power generation	* Complete energy metering and power analysis

Notes: \* Not available with option PF A. \*\* Not available with option PF B

## Insulation between inputs and outputs

	Measuring Inputs	Relay outputs	Open collector outputs	Comm. port and digital inputs	Dupline	Self power supply	Auxiliary power supply
Measuring Inputs	-	4kV	4kV	4kV	4kV	0kV	4kV
Relay outputs	4kV	-	-	-	-	4kV	4kV
Open collector outputs	4kV	-	-	-	-	4kV	4kV
Comm. port and digital inputs	4kV	-	-	-	-	4kV	4kV
Dupline	4kV	-	-	-	-	4kV	4kV
Self power supply	0kV	4kV	4kV	4kV	4kV	-	-
Aux. power supply	4kV	4kV	4kV	4kV	4kV	-	-

**NOTE:** all the models with auxiliary power supply have, mandatorily, to be connected to external current transformers because the isolation among the current inputs is just functional (100VAC).

## Tamper proof accessory kit



The "tamper proof" kit (two screw protection covers) is available with the "PF" option.

The instrument (PF option) is sealed in one point:

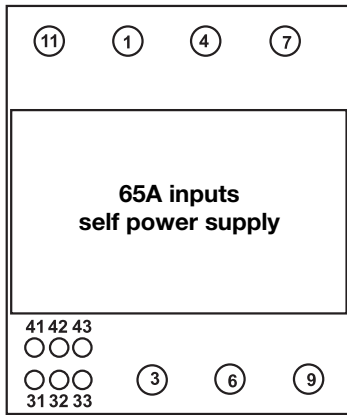
- Front selector (to lock the instrument programming).

After installation it must be sealed in other two points:

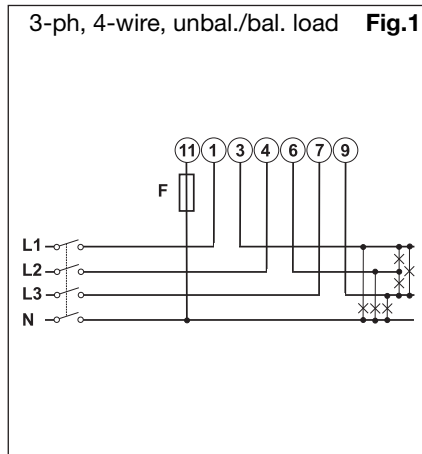
- Upper cover;  
- Lower cover.



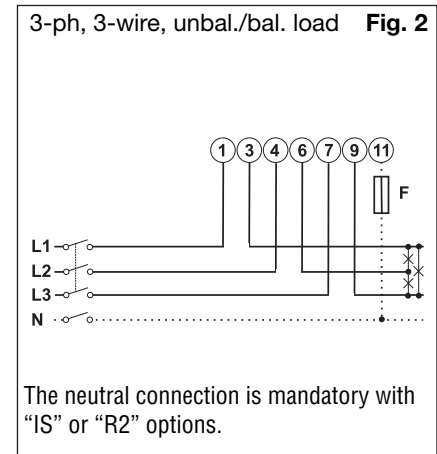
# Wiring diagrams



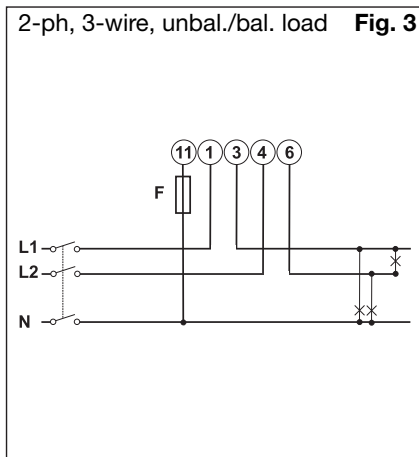
**(65A) System type selection: 3P.n**



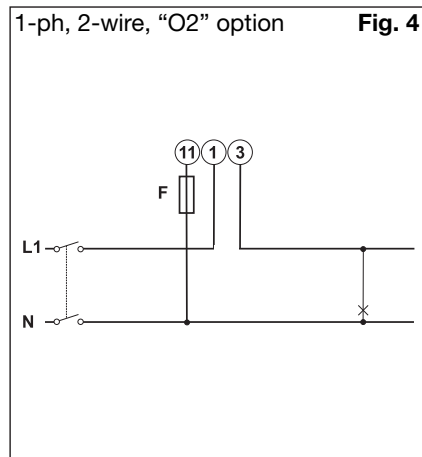
**(65A) System type selection: 3P**



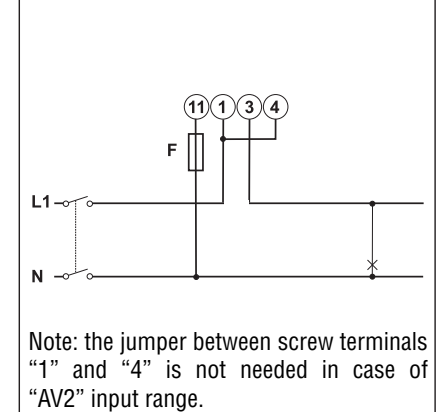
**(65A) System type selection: 2P**



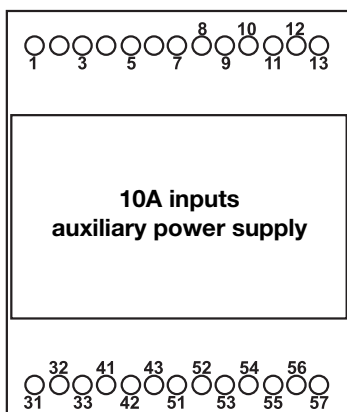
**(65A) System type selection: 1P**



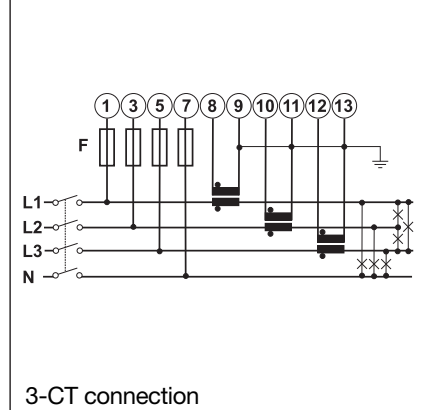
**1-ph, 2-wire, "IS" and "R2" option Fig. 5**



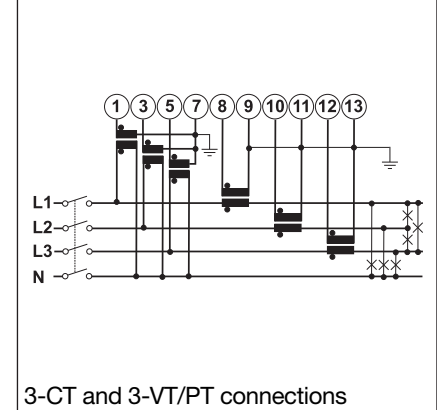
**(10A) System type selection: 3P.n**



**3-ph, 4-wire, unbalanced load Fig. 6**

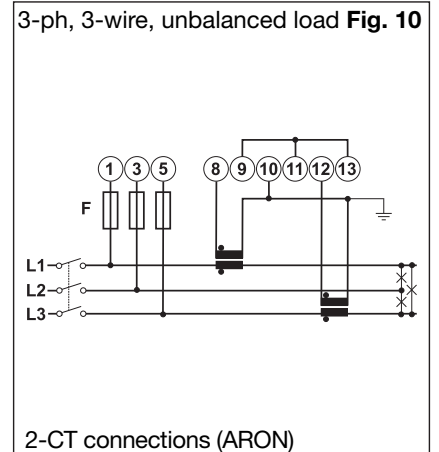
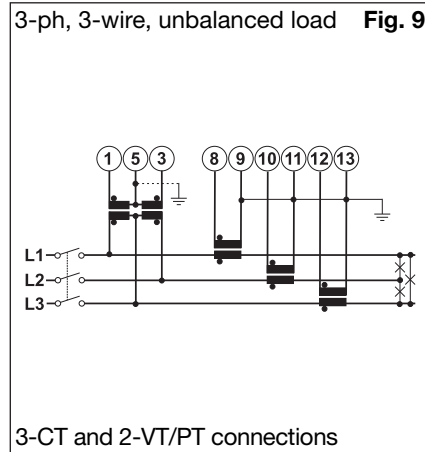
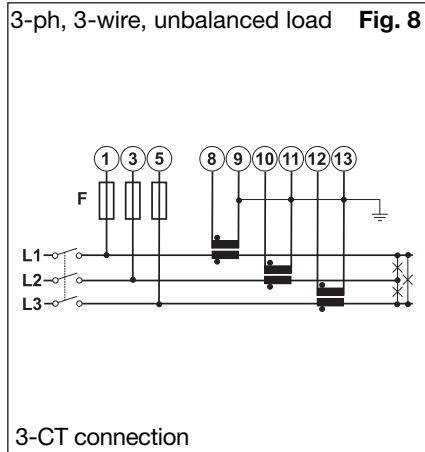


**3-ph, 4-wire, unbalanced load Fig. 7**

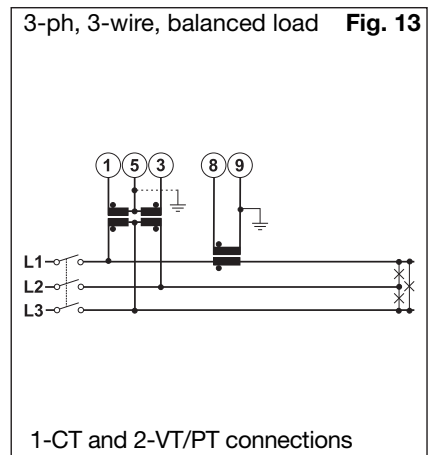
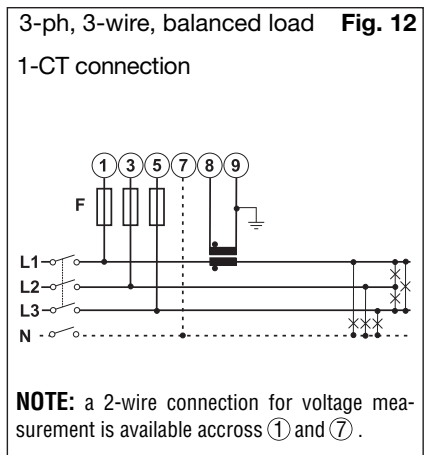
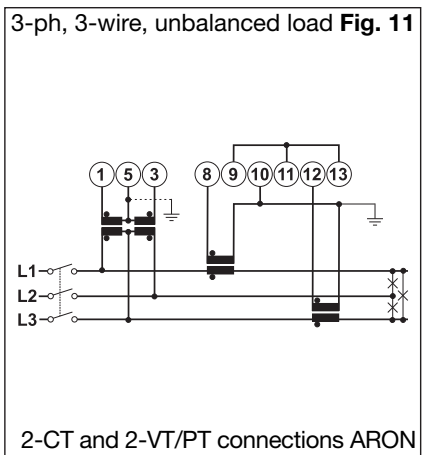


## Wiring diagrams

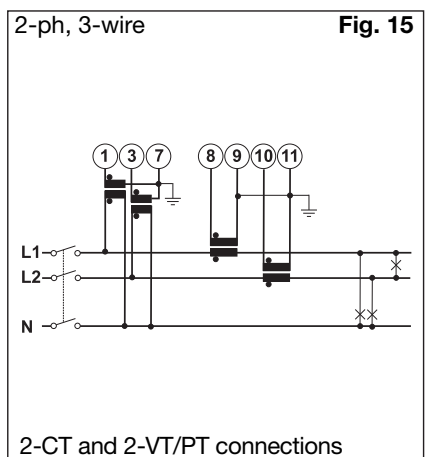
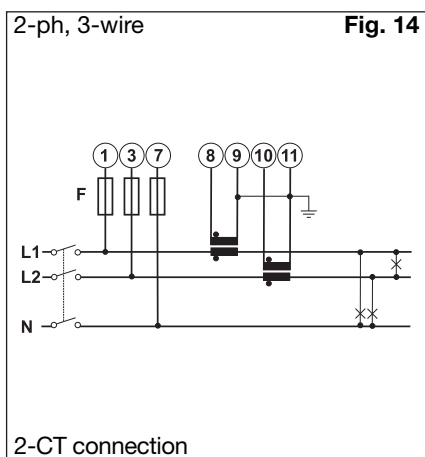
### (10A) System type selection: 3P.n



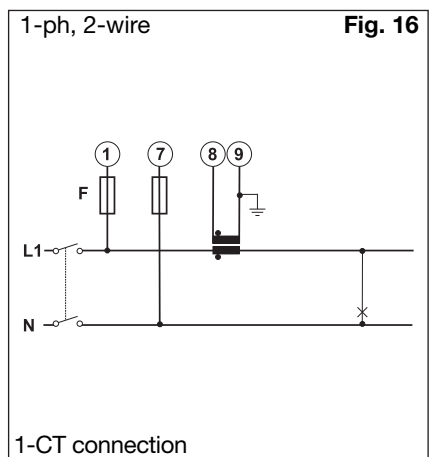
### (10A) System type selection: 3P.1



### (10A) System type selection: 2P

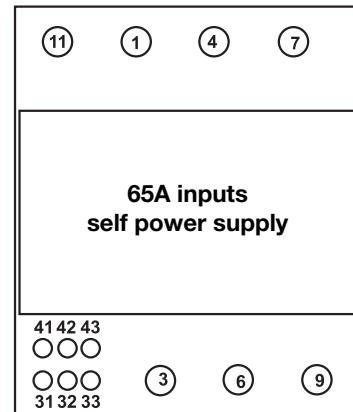
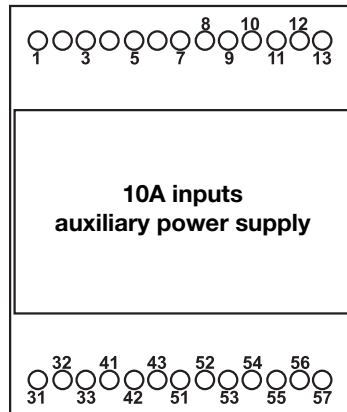
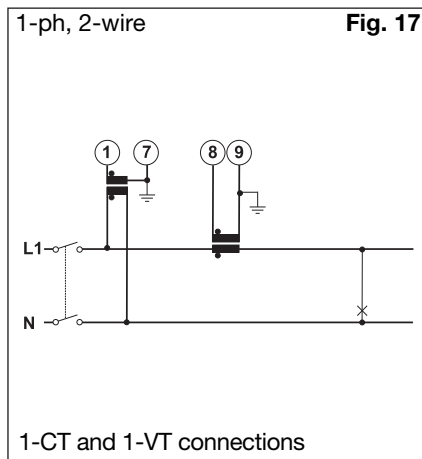


### (10A) System type selection: 1P

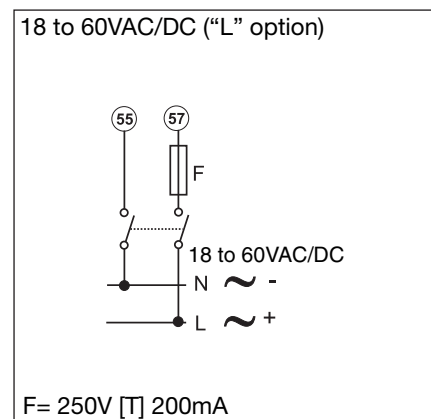
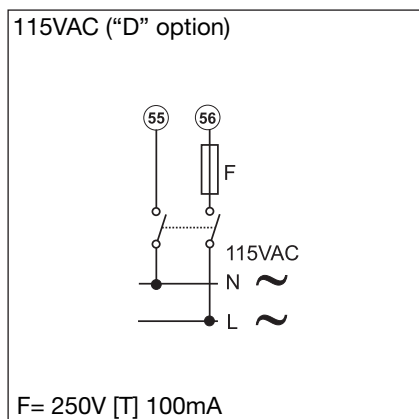
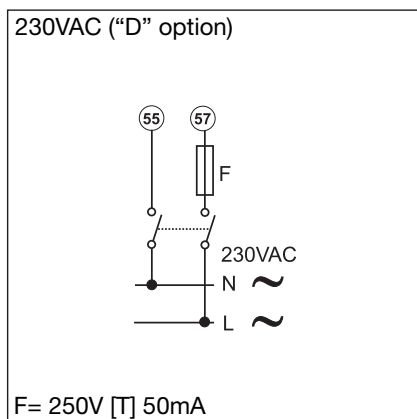


## Wiring diagrams

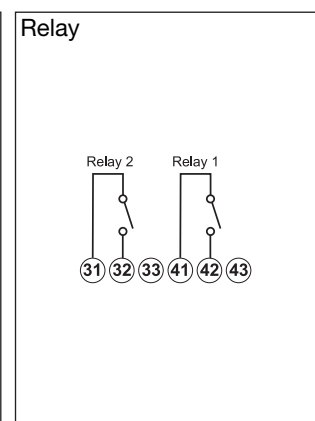
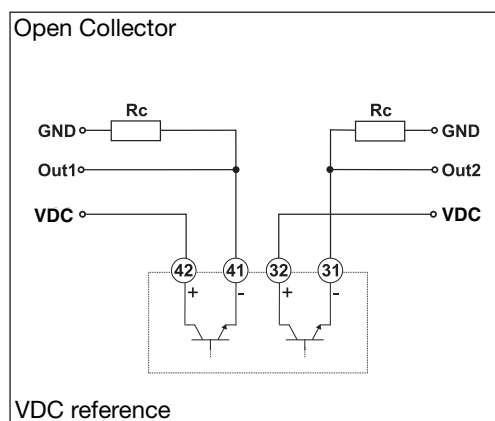
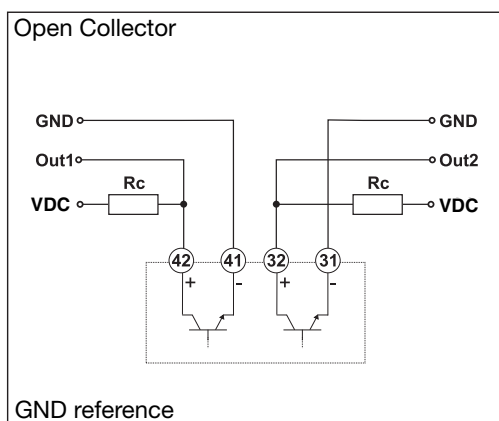
### (10A) System type selection: 1P



## Power supply wiring diagrams (auxiliary power supply)

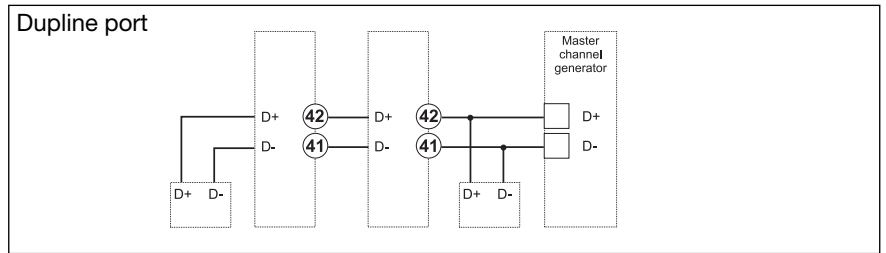
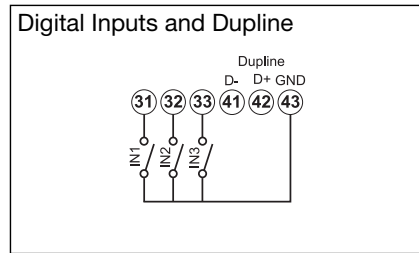
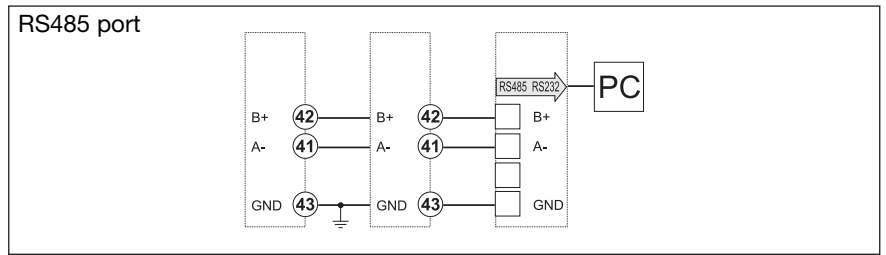
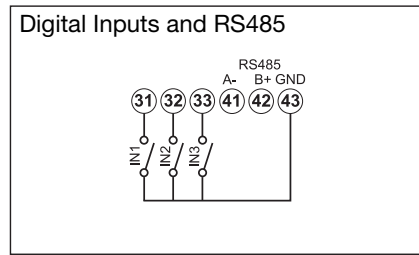


## Open collector and relay outputs wiring diagrams

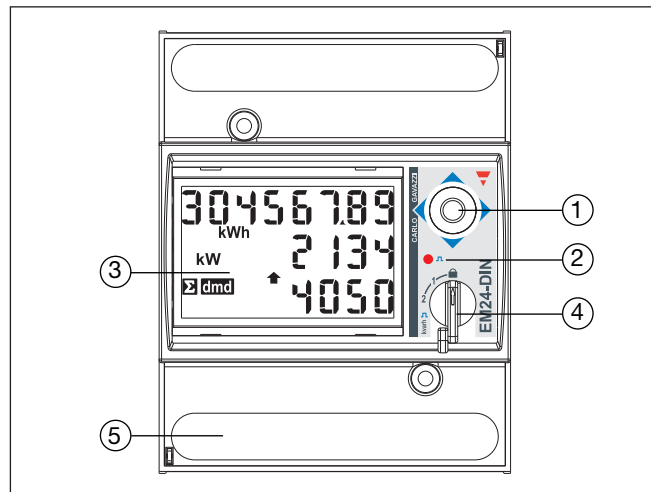


The load resistances (RC) must be designed so that the close contact current is lower than 100mA; the VDC voltage must be lower than or equal to 30VDC.

## Digital inputs, RS485 and Dupline ports wiring diagrams



## Front panel description



1. **Joystick**  
To program the configuration parameters and scroll the variables on the display.
2. **LED**  
Red LED blinking proportional to the energy being measured.
3. **Display**  
LCD-type with alphanumeric indications to:  
- display configuration parameters;  
- display all the measured variables.
4. **Selector**  
To select the desired display pages and to lock the programming.
5. **Connections**  
Screw terminal blocks for instrument wiring.

## Dimensions

