

# Energy Management Energy Analyzer Type EM24 DIN

CARLO GAVAZZI



- RS485 serial output (MODBUS-RTU), iFIX SCADA compatibility
- M-bus communication port (option M1)
- Dupline communication capability (option DP)
- 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

## 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

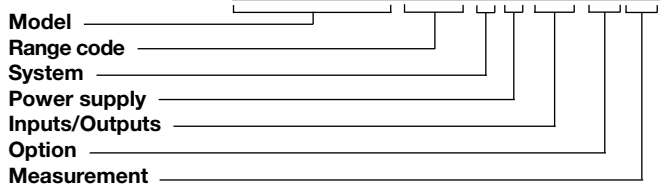
provided with digital outputs that can be either for pulse proportional to the active (imported and exported) and reactive energy being measured or for alarm outputs. In alternative the RS485

communication port and 3 digital inputs or Dupline port and 3 digital inputs or the M-bus communication port 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**

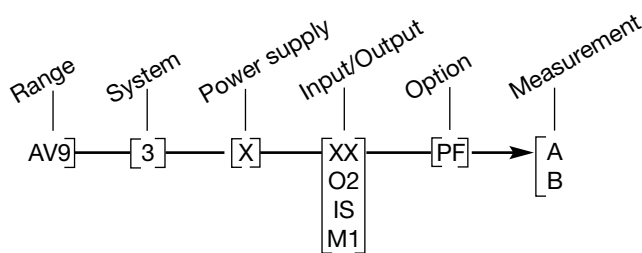
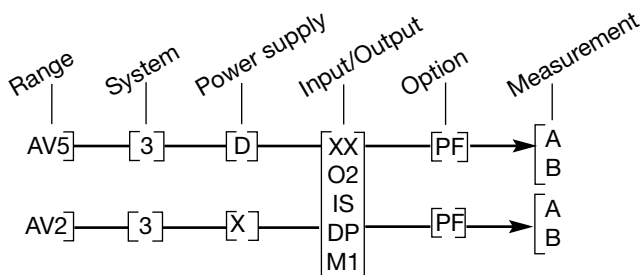


**Type Selection for MID version**

Range codes	System	Power supply	Inputs/Outputs
<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>X:</b> Self power supply (See "Power supply specifications") <b>D:</b> 115/230VAC (50Hz)  <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>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>M1:</b> M-bus port

**Measurement**

- A:** 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:** Only the total positive imported- energy meter is certified according to MID. The negative exported-energy meter is not certified according to MID.

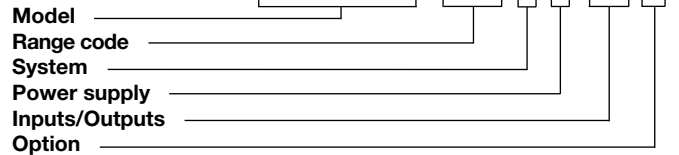




**STANDARD**

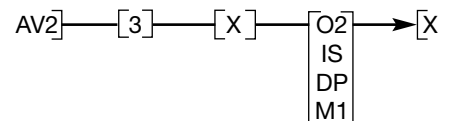
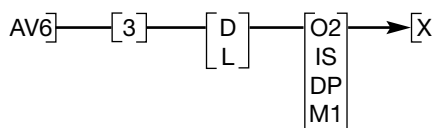
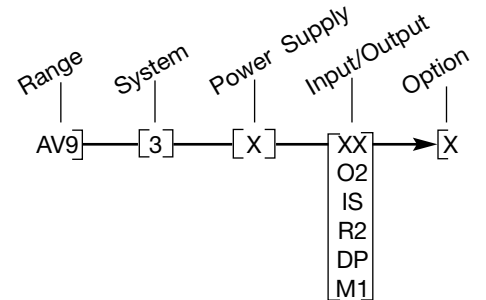
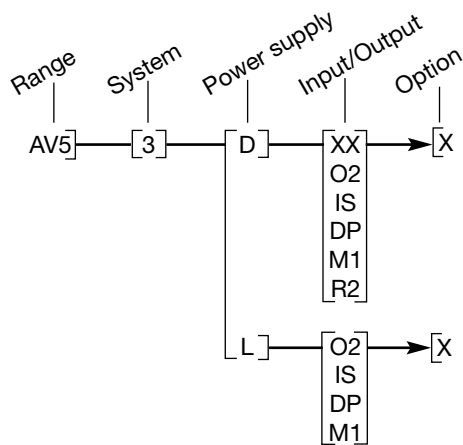
Not certified according to MID directive. Cannot be used for fiscal (legal) metrology.

**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>M1:</b> M-bus port
<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)		
Current type	AV5 and AV6: 1/5(10)A AV2: 10(65)A; AV9: 10(65)A	Overload status	Exported Total/Partial/Tariff: 6+1 or 7DGT (with “-“ sign) EEEE indication when the value being measured is exceeding the “Continuous inputs overload” (maximum measurement capacity)
Current range (by CT)	AV5: 400 VLL AV2: 230/400 VLL AV9: 400 VLL	Max. and Min. indication	Max. instantaneous variables: 9999; energies: 99 999 999. Min. instantaneous variables: 0.000; energies 0.00.
Current range (direct)	AV6: 120VLL/208 VLL		
Voltage			
Voltage by VT/PT			
<b>Accuracy</b> (Display + RS485) (@25°C ±5°C, R.H. 60%, 50±5Hz/60±5Hz)	Ib: see below, Un: see below	<b>LEDs</b>	
AV5 model	In: 5A, I <sub>max</sub> : 10A; Un: 160 to 480VLL (277 to 830VLL)	AV5, AV6 models	Red LED (Energy consumption), according to EN50470-3, EN62052-11 0.001 kWh/kvarh by pulse if CT ratio by VT ratio is ≤7; 0.01 kWh/kvarh by pulse if CT ratio by VT ratio is > 7.1 ≤ 70.0; 0.1 kWh/kvarh pulse if CT ratio by VT ratio is > 70.1 ≤ 700.0; 1 kWh/kvarh by pulse if CT ratio x VT ratio is > 700.1;
AV6 model	In: 5A, I <sub>max</sub> : 10A; Un: 40 to 144VLL (70 to 250VLL)	AV2, AV9 models	0.001 kWh/kvarh by pulse 16Hz
AV2 model	Ib: 10A, I <sub>max</sub> : 65A; Un: 113 to 265VLL (196 to 460VLL)	Max frequency	
AV9 model	Ib: 10A, I <sub>max</sub> : 65A; Un: 184 to 276VLL (318 to 480VLL)	<b>Measurements</b>	See “List of the variables that can be connected to:” TRMS measurements of distorted wave forms. Direct for AV2 and AV9 models. By means of external CT's for AV5 and AV6
Current		Method	
AV5, AV6 models	From 0.002I <sub>n</sub> to 0.2I <sub>n</sub> : ±(0.5% RDG +3DGT) From 0.2I <sub>n</sub> to I <sub>max</sub> : ±(0.5% RDG +1DGT).	Coupling type	
AV2, AV9 models	From 0.004I <sub>b</sub> to 0.2I <sub>b</sub> : ±(0.5% RDG +3DGT) From 0.2I <sub>b</sub> to I <sub>max</sub> : ±(0.5% RDG +1DGT).	<b>Crest factor</b>	I <sub>b</sub> 10A 4 (91A max. peak) I <sub>n</sub> 5A 3 (15A max. peak)
Phase-neutral voltage	In the range Un: ±(0,5% RDG +1DGT)	<b>Current Overloads</b>	
Phase-phase voltage	In the range Un: ±(1% RDG +1DGT)	Continuous	1/5(10) A: 10A, @ 50Hz 10(65) A: 65A, @ 50Hz
Frequency	±0.1Hz (50±5Hz/60±5Hz)	For 500ms	1/5(10) A: 200A, @ 50Hz
Active and Apparent power	±(1%RDG +2DGT)	For 10ms	10(65) A: 1920A max., @ 50Hz
Power Factor	±[0.001+1%(1.000 - “PF RDG”)]	<b>Voltage Overloads</b>	
Reactive power	±(2%RDG +2DGT)	Continuous	1.2 Un
Active energy	Class 1 according to EN62053-21 and MID Annex MI-003 Class B according to EN50470-3	For 500ms	2 Un
Reactive energy	Class 2 according to EN62053-23	<b>Input impedance</b>	
AV5, AV6 models	In: 5A, I <sub>max</sub> : 10A; 0.1 In: 0.5A, Start up current: 10mA	208VL-L (AV6)	>1600KΩ
AV2, AV9 models	I <sub>b</sub> : 10A, I <sub>max</sub> : 65A; 0.1 I <sub>b</sub> : 1.0A Start up current: 40mA	230/400VL-L (AV2)	Refer to “Power Consumption”
<b>Energy additional errors</b>		400VL-L (AV5)	>1600KΩ
Influence quantities	According to EN62053-21, EN50470-3, EN62053-23	400VL-L (AV9)	Refer to “Power Consumption”
<b>Temperature drift</b>	≤200ppm/°C	1/5(10)A (AV5-AV6)	< 0.3VA
<b>Sampling rate</b>	1600 samples/s @ 50Hz 1900 samples/s @ 60Hz	10(65)A (AV2-AV9)	< 4VA
<b>Display refresh time</b>	750 ms	<b>Frequency</b>	50±5Hz/60±5Hz
<b>Display</b>	3 lines (1 x 8 DGT; 2 x 4 DGT)	<b>Joystick</b>	For variable selection and programming of the instrument working parameters
Type	LCD, h 7mm		
Instantaneous variables read-out	4 DGT		
Energies	Imported Total 6+2, 7+1 or 8DGT		

## Output specifications

<p><b>Digital outputs</b></p> <p>Pulse type</p> <p>Number of outputs</p> <p>Type</p> <p>Pulse duration</p> <p>Alarm type</p> <p>Number of outputs</p> <p>Alarm modes</p> <p>Set-point adjustment</p> <p>Hysteresis</p> <p>On-time delay</p> <p>Output status</p> <p>Min. response time</p> <p><b>Note</b></p>	<p>Up to 2, independent. Programmable from 0.001 to 10.00kWh/kvarh by pulse.</p> <p>Outputs connectable to the energy meters (kWh/kvarh)</p> <p><math>T_{OFF} \geq 120\text{ms}</math>, according to EN62053-31</p> <p><math>T_{ON}</math> selectable (30 ms or 100 ms), according to EN62053-31</p> <p>Up to 2, independent</p> <p>Up alarm, down alarm (see the table "List of the variables that can be connected to")</p> <p>From 0 to 100% of the display scale</p> <p>From 0 to full scale</p> <p>0 to 255s</p> <p>Selectable; normally de-energized or normally energized</p> <p><math>\leq 700\text{ms}</math>, filter excluded, set-point on-time delay: "0 s"</p> <p>The 2 digital outputs can also work as a dual pulse output, dual alarm output, one pulse output and one alarm output.</p>	<p>Connections</p> <p>Addresses</p> <p>Protocol</p> <p>Data (bidirectional)</p> <p>Dynamic (reading only)</p> <p>Static (reading and writing)</p> <p>Data format</p> <p>Baud-rate</p> <p>Driver input impedance</p> <p>Insulation</p>	<p>2-wire</p> <p>Max. distance 1000m</p> <p>247, selectable by means of the front joystick</p> <p>MODBUS/JBUS (RTU)</p> <p>System and phase variables: see table "List of variables..."</p> <p>All the configuration parameters.</p> <p>1 start bit, 8 data bit, no parity, 1 stop bit</p> <p>4800, 9600 bit/s</p> <p>1/5 unit load</p> <p>Maximum 160 transceivers on the same bus.</p> <p>By means of optocouplers, 4000 VRMS output to measuring input, 4000 VRMS output to power supply input.</p>
<p><b>Static output</b></p> <p>Purpose</p> <p>Signal</p> <p>Insulation</p>	<p>For pulse output or alarm output</p> <p><math>V_{ON}</math> 1.2 VDC/ max. 100 mA</p> <p><math>V_{OFF}</math> 30 VDC max.</p> <p>By means of optocouplers, 4000 VRMS output to measuring inputs, 4000 VRMS output to power supply input.</p>	<p><b>M-bus</b></p> <p>Type</p> <p>Connections</p> <p>Addresses</p> <p>Primary address</p> <p>Secondary address</p> <p>Protocol</p> <p>Available data and frame format</p> <p>Baud-rate</p> <p>Baud-rate selection</p> <p>Driver input capability</p> <p>Special functions</p> <p>Insulation</p>	<p>One-drop, directional</p> <p>2-wire, max. distance according to EN13757-1</p> <p>247, selectable by means of the front joystick and via M-bus (default 0). The primary address can be set to 0 again after begin set to another value only via M-bus.</p> <p>Predefined, univocally present during manufacturing</p> <p>M-bus according to EN13757-1</p> <p>See table "M-bus available variables and frame format"</p> <p>300, 2400 (default), 9600 bits/s</p> <p>Set during programming or set directly by the M-bus master</p> <p>1 unit load</p> <p>None</p> <p>By means of optocouplers, 4000 VRMS output to measuring input</p>
<p><b>Relay output</b></p> <p>Purpose</p> <p>Type</p> <p>Insulation</p> <p><b>Note</b></p>	<p>For alarm output or pulse output</p> <p>Relay, SPST type</p> <p>AC 1-5A @ 250VAC</p> <p>DC 12-5A @ 24VDC</p> <p>AC 15-1.5A @ 250VAC</p> <p>DC 13-1.5A @ 24VDC</p> <p>4000 VRMS output to measuring input</p> <p>4000 VRMS output to power supply input.</p> <p>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")</p>	<p><b>Note (for RS485 and M-bus ports)</b></p>	<p>The meters equipped with the communication port ("AV9" models with "M1" and "IS" options) work even if VL3 is missing (VL1, VL2 and neutral have to be available)(see table "working mode notes")</p>
<p><b>RS485</b></p> <p>Type</p>	<p>Multidrop, bidirectional (static and dynamic variables)</p>		

## Dupline specifications

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

## Digital input specifications

Number of inputs Input frequency Prescaler adjustment Contact measuring voltage Contact measuring current Input impedance Contact resistance Working modes (DP version excluded)	3 20Hz max, duty cycle 50% From 0.001 to 999.9 m <sup>3</sup> or kWh per pulse 5VDC +/- 5% 10mA max 680Ω ≤100Ω, closed contact ≥500kΩ, open contact 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 synchro-	nisation 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 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
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## Digital input specifications (cont.)

Working modes (DP version only)	m <sup>3</sup> , remote heating, external kWh meters (3 choices only).	Insulation	only made by means of the analogue inputs. By means of optocouplers, 4000 VRMS digital inputs to measuring inputs, 4000 VRMS digital inputs to power supply input.
Note	Selectable: • GAS (m <sup>3</sup> ) or WATER (hot-cold m <sup>3</sup> ) or remote heating (kWh) meters The energy metering is		

## Software functions

<b>Password</b>	Numeric code of max. 4 digits; 2 protection levels of the programming data: Password "0", no protection Password from 1 to 9999, all data are protected	<b>Filter</b>	0 to 100% of the input display scale 1 to 32 Measurements, serial output (fundamental variables: V, A, W and their derived ones).
1st level		Operating range	
2nd level		Filtering coefficient Filter action	
<b>System selection</b>	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 2-phase (3-wire) 1-phase (2-wire)	<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 3-Pn unbalanced load System 3-P unbalanced load System 3-P1 (only AV5 and AV6) balanced load		<b>Reset</b>	
System 2-P System 1-P		<b>Easy connection function</b>	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.
<b>Transformer ratio</b>	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.	AV2 and AV9 models	
VT (PT)			AV5-AV6-AV2-AV9 models
CT			



## 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	Radio frequency suppression	supply input: 1kV According to CISPR 22
<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>Standard compliance</b>	
<b>Installation category</b>	Cat. III (IEC60664, EN60664)	Safety	IEC60664, IEC61010-1 EN60664, EN61010-1 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	Metrology	EN62053-23, EN50470-3. MID "annex MI-003"
<b>Dielectric strength</b>	4000 VRMS for 1 minute	Pulse output	DIN43864, IEC62053-31
<b>Noise rejection CMRR</b>	100 dB, 48 to 62 Hz	Approvals	CE, cULus listed (AV5, AV6 options only), MID (PF option only)
<b>EMC</b>		<b>Connections</b>	Screw-type
Electrostatic discharges	According to EN62052-11 15kV air discharge Test with current: 10V/m from 80 to 2000MHz	Cable cross-section area AV2-AV9 models	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
Immunity to irradiated		Cable cross-section area AV5-AV6 models	Max. 1.5 mm <sup>2</sup> Screws tightening torque: 0.5 Nm
Electromagnetic fields	Test without any current: 30V/m from 80 to 2000MHz	<b>Housing DIN</b>	
Burst	On current and voltage measuring inputs circuit: 4kV	Dimensions (WxHxD)	71 x 90 x 64.5 mm
Immunity to conducted disturbances	10V/m from 150KHz to 80MHz	Material	Nylon PA66, self-extinguishing: UL 94 V-0 DIN-rail
Surge	On current and voltage measuring inputs circuit: 4kV; on "L" auxiliary power	Mounting	
		<b>Protection degree</b>	
		Front	IP50
		Screw terminals	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", "M1" 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 connection: 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 neutral 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

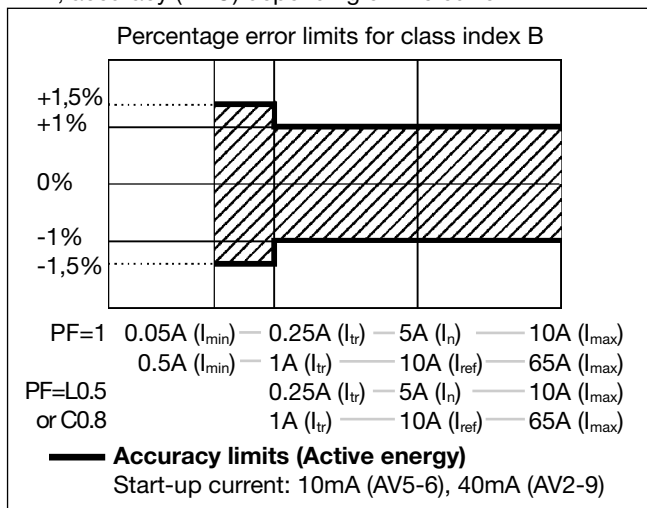


## Working mode notes (only "Self power supply" version)

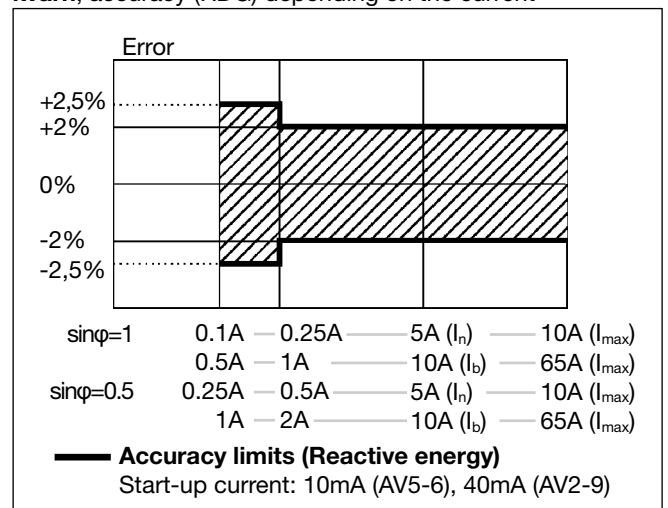
Output	Model	Note
Open collector output	"AV9" models with "O2" option	The meter works even if up to two voltages "phase to neutral" are missing or if one voltage "phase to phase" is missing.
Relay output	"AV9" models with "R2" option	The neutral wire has always to be available. The meter works even if "Phase 3" is missing but, mandatorily, both "phase 1" and "Phase 2" have to be available.
RS485 and M-bus ports	"AV9" models with "IS" and "M1" options	
Dupline port	"AV2" model with "DP" option	
Relay output	"AV2" model with "R2" option	The meter works even if up to two voltages "phase to neutral" are missing or if one voltage "phase to phase" is missing.
RS485 and M-bus ports	"AV2" model with "IS" and "M1" options	

## 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 Un ≤ U ≤ 1.1 Un; 0.98 fn ≤ f ≤ 1.02 fn; fn: 50Hz; cosφ: 0.5 inductive to 0.8 capacitive.	<b>EMC compliance</b>	E2
AV2-AV9 models	Class B. I st: 0.04A; I min: 0.5A; I tr: 1A; I ref: 10A; I max: 65A.	<b>Mechanical compliance</b>	M2
AV5 models	Class B. I st: 0.01A; I min: 0.05A; I tr: 0.25A; I ref: 5A; I max: 10A.	<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

$$V_{1N} = \sqrt{\frac{1}{n} \cdot \sum_1^n (V_{1N})_i^2}$$

Instantaneous active power

$$W_1 = \frac{1}{n} \cdot \sum_1^n (V_{1N})_i \cdot (A_1)_i$$

Instantaneous power factor

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

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

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

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

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

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

### Energy metering

$$k \text{ var hi} = \int_{n_1}^{n_2} Qi(t) dt \cong \Delta t \sum_{n_1}^{n_2} Qnj$$

$$kWhi = \int_{n_1}^{n_2} Pi(t) dt \cong \Delta t \sum_{n_1}^{n_2} Pnj$$

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; **t**= 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 and M-bus 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 (3)
41	m <sup>3</sup> Cold H <sub>2</sub> O	x	x	x	x	x	x	Total (3)
42	m <sup>3</sup> Hot H <sub>2</sub> O	x	x	x	x	x	x	Total (3)
43	kWh H <sub>2</sub> O	x	x	x	x	x	x	Total (3)
44	kWh out	x	x	x	x	x	x	Total (3)

(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

(3) = not available via M-bus communication

## 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	I
	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	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	7
	32	Total kWh (+)	W sys											x
<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. Not available in M-bus version.

(3) Hot and Cold (water), GAS. ENE (external energy meter). Not available in M-bus version.

(4) The active tariff is displayed with an "A" before the "t1-t2-t3-t4" symbols. Not available in M-bus version.

(5) These pages are not available in case of Dupline model.

(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 communication port (Modbus or M-bus)	SEriAL (text)	Address number	RS485 status (RX-TX)
In case of communication port (Modbus or M-bus)	Secondary address (for M-bus protocol)		Sn
In case of Dupline port	Dupline (text) or EM24 (text)	OK ... err	
In case of alarm output 1	AL1 oFF/on (text) Alarm ststus	Set-point value	Alarm type
In case of alarm output 2	AL2 oFF/on (text) Alarm ststus	Set-point value	Alarm type
In case of pulse output 1	PuLSE 1 (text) (variable link kWh/kvarh)	Output pulse weight (kWh-kvarh / pulse)	
In case of pulse output 2	PuLSE 2 (text) (variable link kWh/kvarh)	Output pulse weight (kWh-kvarh / pulse)	

## 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
<b>I</b>	Basic for metering systems	** Mainly energy metering

**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 included.

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.

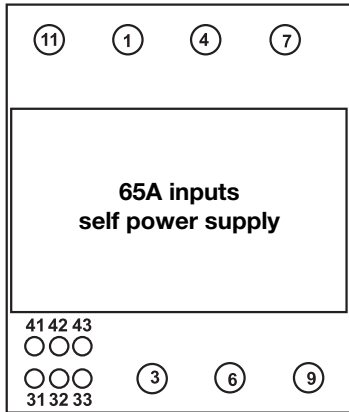


## M-bus available variables and frame format

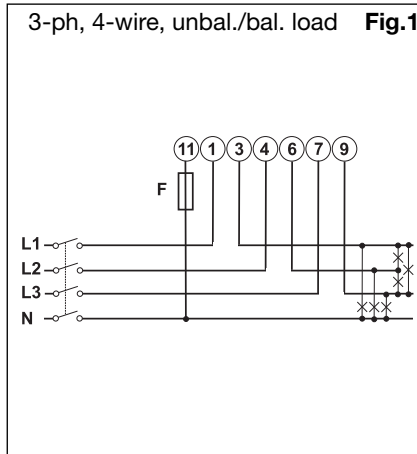
• According to the selected system, the available variables (see above table) are transmitted via M-bus according to the following frames.

Frame	Number	Variable	Data Format	Frame	Number	Variable	Data Format
1	1	kWh (+) TOT	INT32	1	8	VAsys	INT32
1	2	kvarh (+) TOT	INT32	1	9	PFsys	INT16
1	3	kWh (+) L1	INT32	1	10	VLLsys	INT32
1	4	kWh (+) L2	INT32	1	11	VLNsys	INT32
1	5	kWh (+) L3	INT32	1	12	AL1	INT32
1	6	W sys	INT32	1	13	AL2	INT32
1	7	var sys	INT32	1	14	AL3	INT32
Frame	Number	Variable	Data Format	Frame	Number	Variable	Data Format
2	1	WL1	INT32	2	8	VAL2	INT32
2	2	WL2	INT32	2	9	VAL3	INT32
2	3	WL3	INT32	2	10	PFL1	INT16
2	4	varL1	INT32	2	11	PFL2	INT16
2	5	varL2	INT32	2	12	PFL3	INT16
2	6	varL3	INT32	2	13		
2	7	VAL1	INT32	2	14		
Frame	Number	Variable	Data Format	Frame	Number	Variable	Data Format
3	1	V12	INT32	3	8	kvarh (+) PAR	INT32
3	2	V23	INT32	3	9	kWh (-) TOT	INT32
3	3	V31	INT32	3	10	kvarh (-) TOT	INT32
3	4	VL1-N	INT32	3	11	Hourmeter	INT32
3	5	VL2-N	INT32	3	12	Hz	INT16
3	6	VL3-N	INT32	3	13		
3	7	kWh (+) PAR	INT32	3	14		
Frame	Number	Variable	Data Format	Frame	Number	Variable	Data Format
4	1	DMD W sys	INT32	4	8		
4	2	DMD W sys max	INT32	4	9		
4	3	DMD VA sys	INT32	4	10		
4	4	DMD VA sys max	INT32	4	11		
4	5	DMD A max	INT32	4	12		
4	6			4	13		
4	7			4	14		

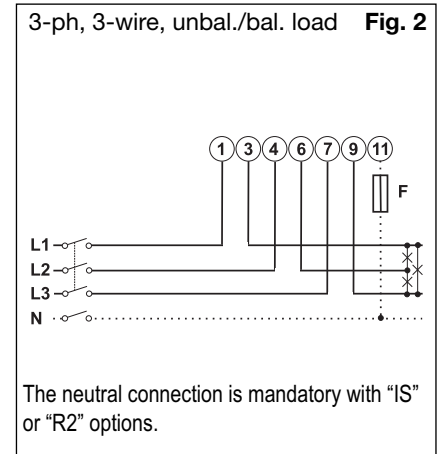
# Wiring diagrams



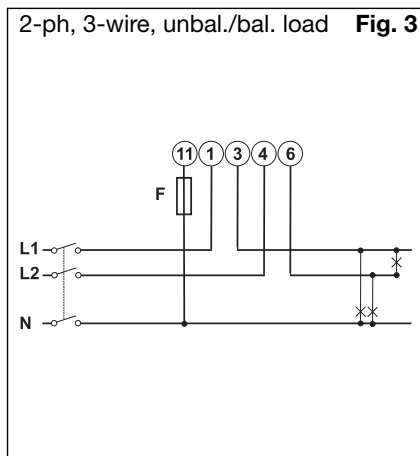
(65A) System type selection: 3P.n



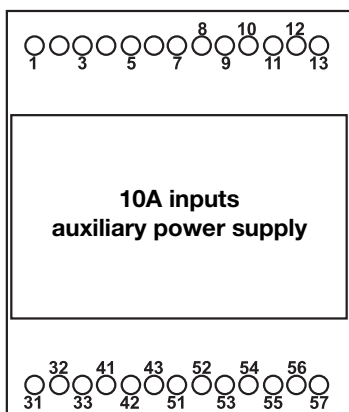
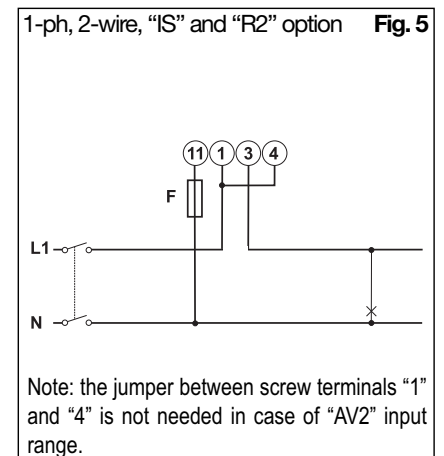
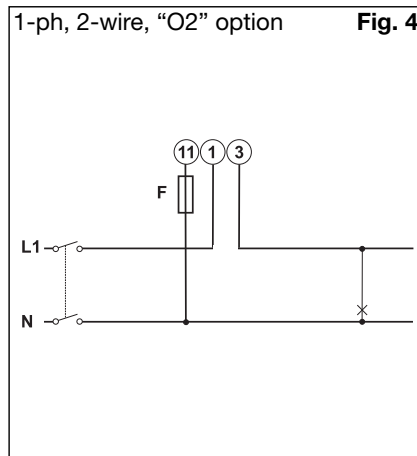
(65A) System type selection: 3P



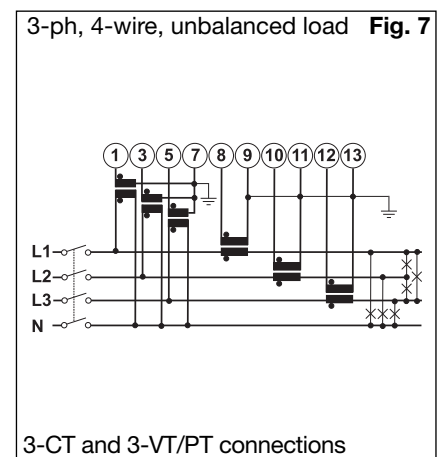
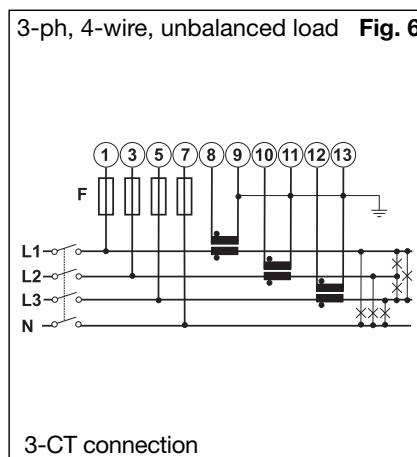
(65A) System type selection: 2P



(65A) System type selection: 1P

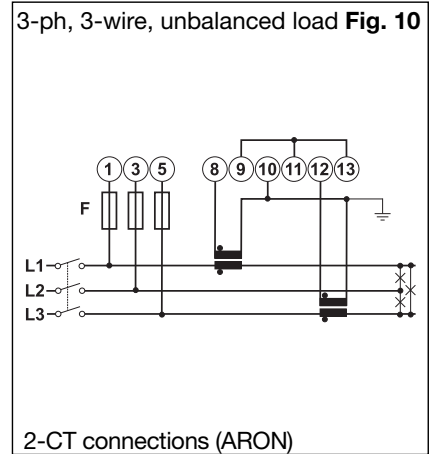
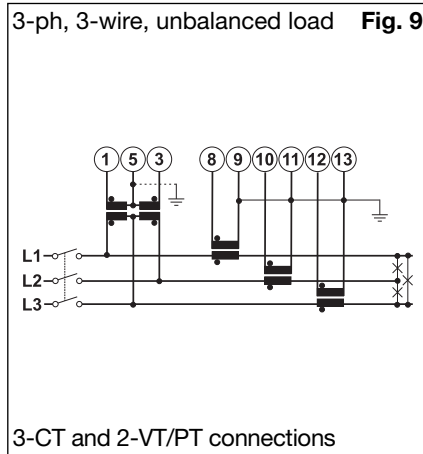
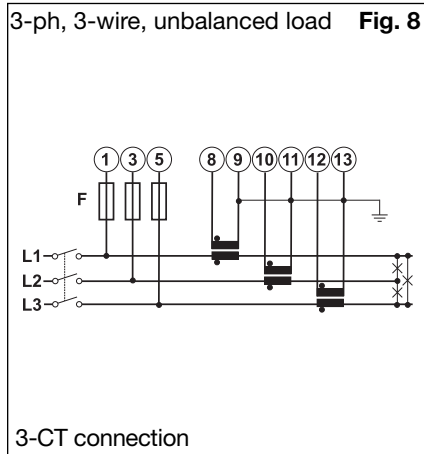


(10A) System type selection: 3P.n

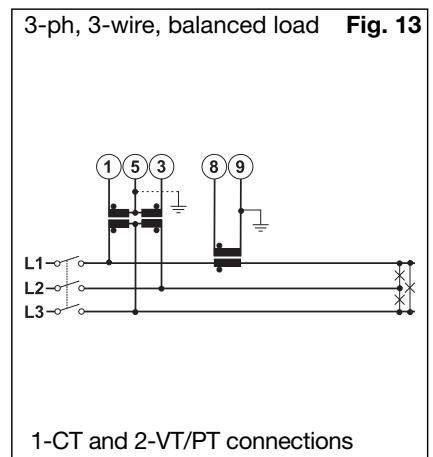
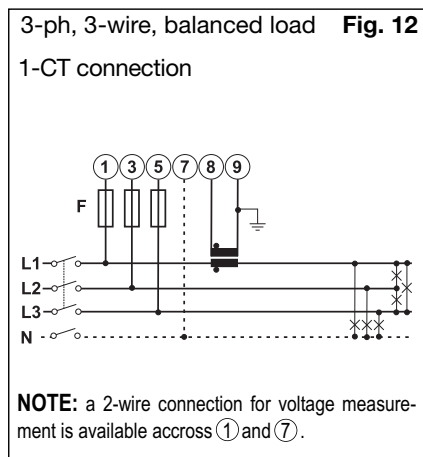
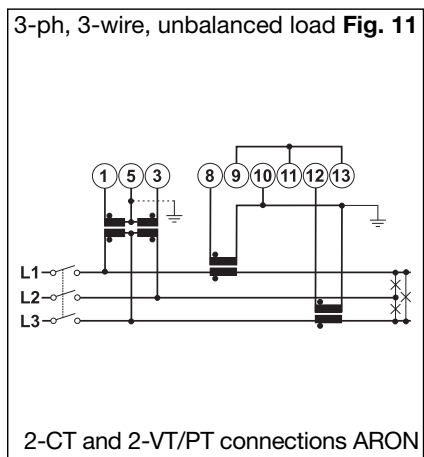


# Wiring diagrams

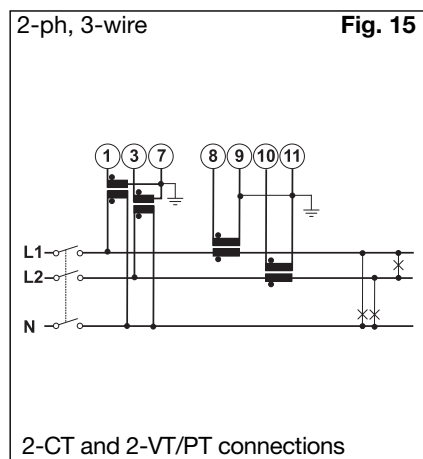
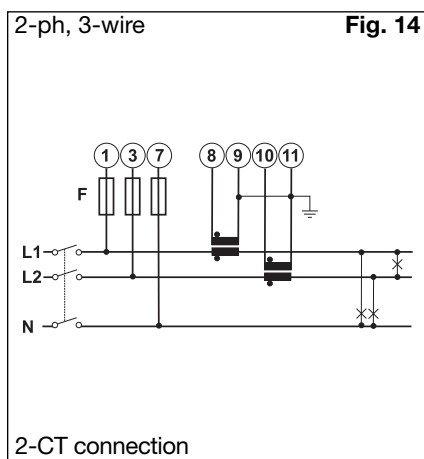
## (10A) System type selection: 3P.n



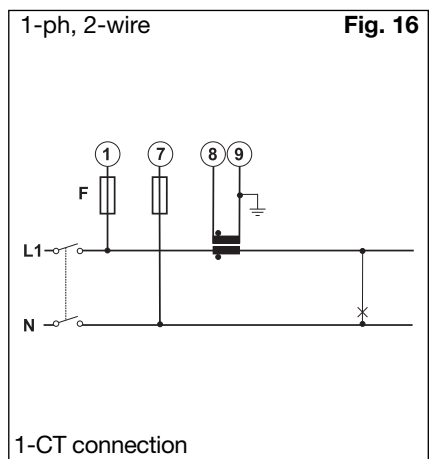
## (10A) System type selection: 3P.1



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



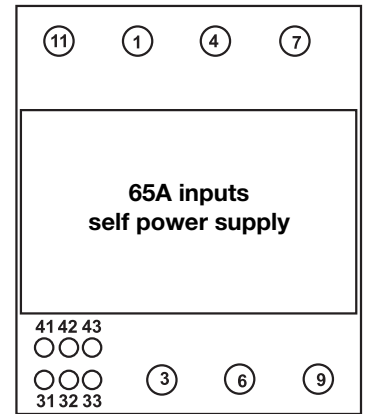
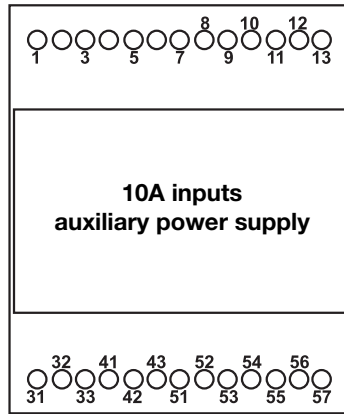
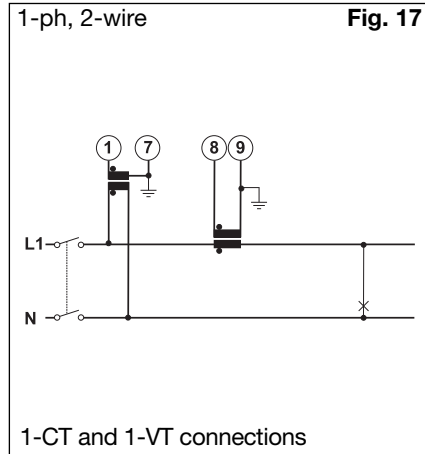
## (10A) System type selection: 1P



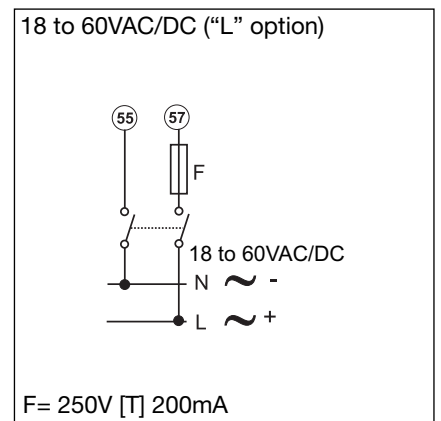
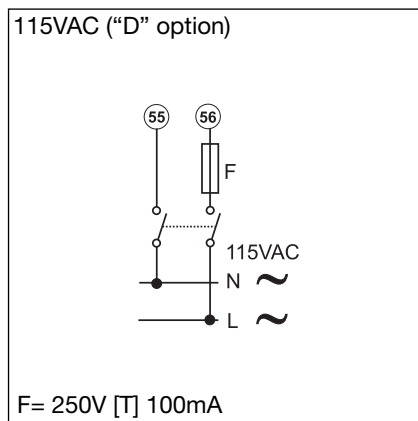
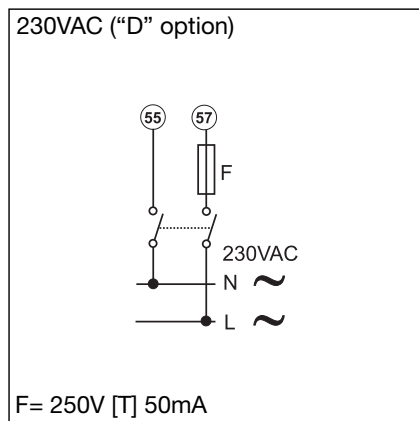


## Wiring diagrams

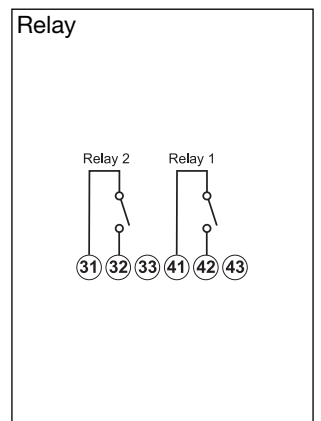
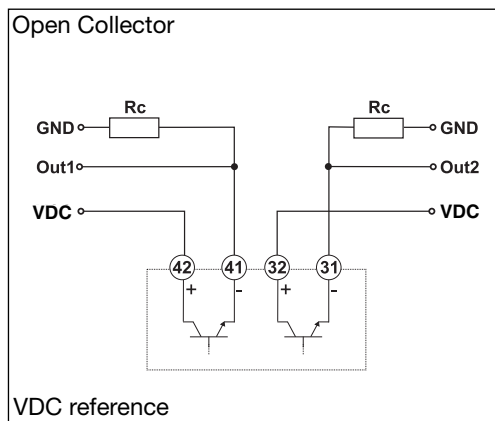
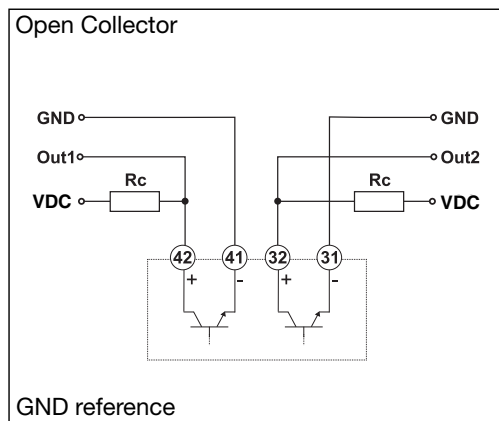
### (10A) System type selection: 1P



## Power supply wiring diagrams (auxiliary power supply)

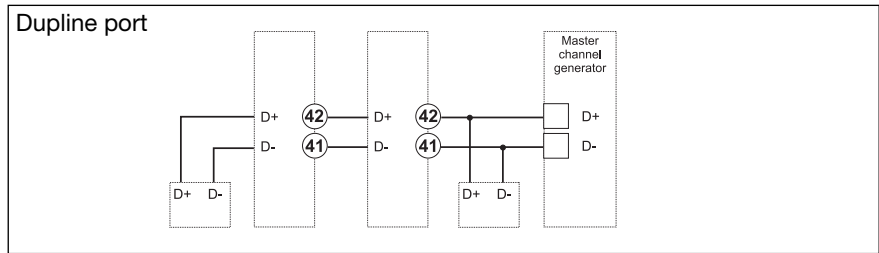
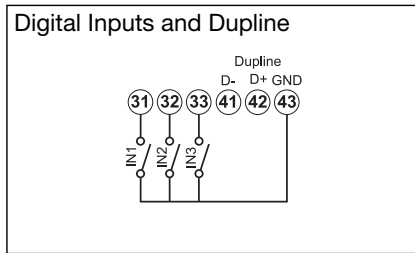
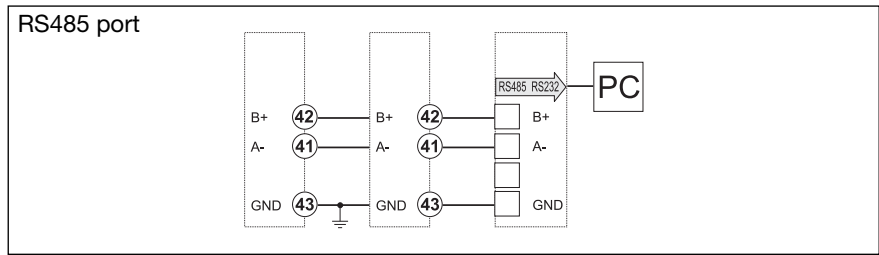
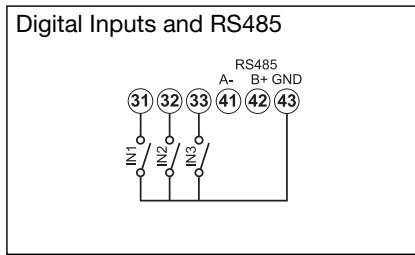


## Open collector and relay outputs wiring diagrams

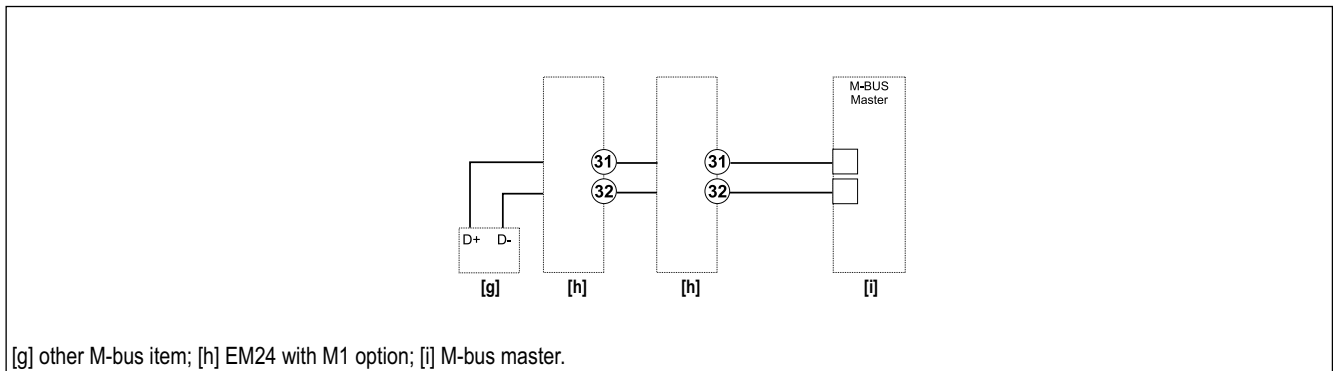


The load resistances (RC) must be designed so that the close contact current is lower than 100mA; the VDC voltage must be lower than or equal to 30VDC.

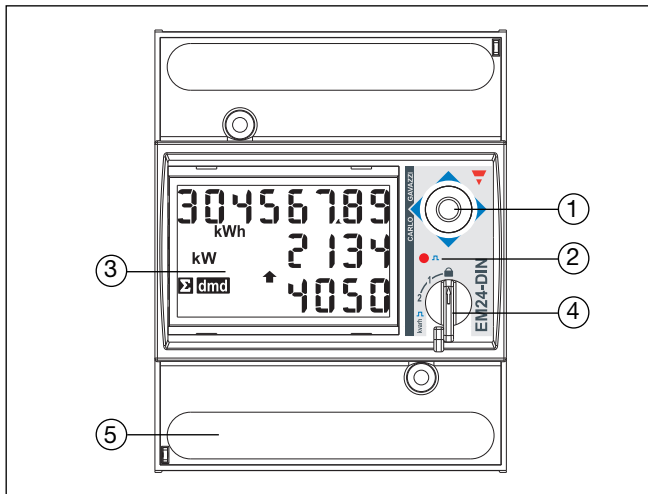
## Digital inputs, RS485 and Dupline ports wiring diagrams



## M-bus wiring connection



## 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

