

Energy Management Energy Analyzer Type EM24 DIN

CARLO GAVAZZI



- RS485 serial output (MODBUS-RTU), iFIX SCADA compatibility
- M-bus communication port (option M1 and option M2)
- 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 ± 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

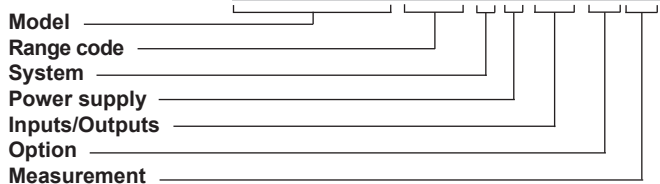
provided with digital outputs that can be either for pulse proportional to the active (imported and exported) and reactive energy being measured or for alarm outputs. In alternative the RS485 com-

munication 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, Module B and Module D of Annex II, for legal metrology relevant to active electrical energy meters (see Annex V, MIO03, 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 X O2 PF A**

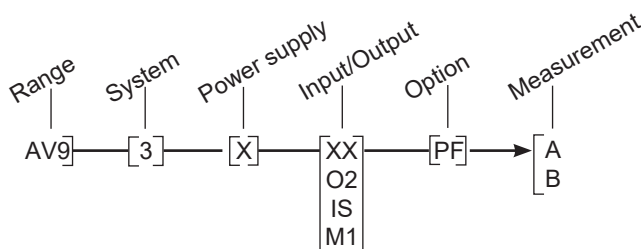
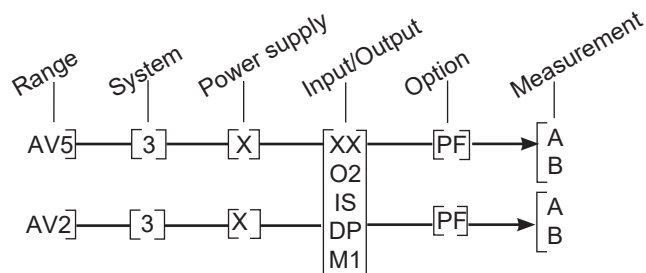


Type Selection for MID version

Range codes	System	Power supply	Inputs/Outputs
AV5: 400V _{LL} AC - 5(10)A (CT connection) AV2: 230 to 400V _{LL} AC 10(65)A (direct connection) AV9: 400V _{LL} AC - 10(65)A (direct connection)	3: 3-phase, 4-wire NOTE: please check the availability of the needed code on the verification path diagram below before order.	X: Self power supply (See "Power supply specifications") Options PF: Certified according to MID Directive. Can be used for fiscal (legal) metrology.	XX: none O2: dual open collector type (dual pulse or one pulse + one alarm or dual alarm) IS: 3 digital inputs for tariff selection or Gas/Water/ remote heating metering plus RS485 port DP: Dupline port plus 3 digital inputs for Gas/water/ remote heating metering M1: M-bus port according EN13757-3:2005

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.

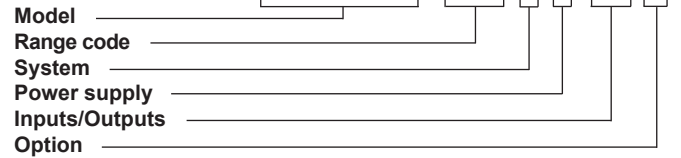




STANDARD

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

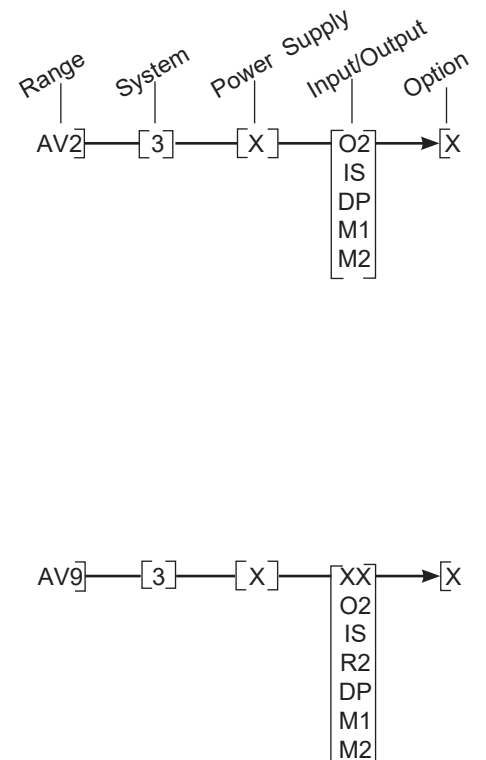
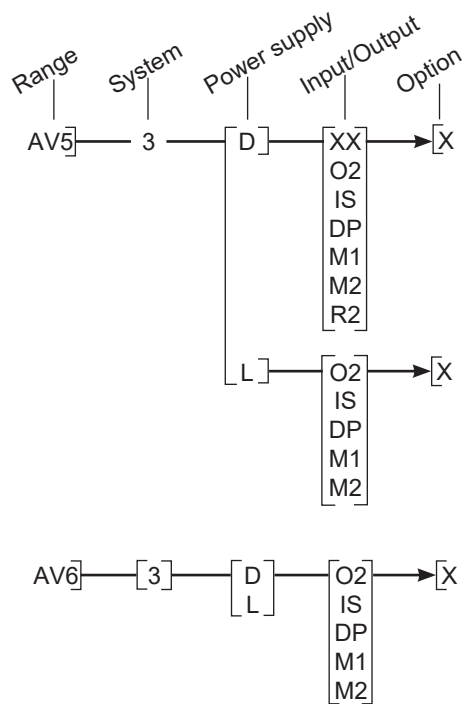
How to order EM24 DIN AV5 3 D O2 X



Type Selection for standard version

Range codes	System	Power supply	Inputs/Outputs
AV5: 400V _{LL} AC - 1/5 (10)A (CT connection) V _{LN} : 160 V to 480V _{LN} V _{LL} : 277 V to 830V _{LL}	3: balanced and unbalanced load: 3-phase, 4-wire; 3-phase, 3-wire; 2-phase, 3-wire; 1-phase, 2-wire	X: Self power supply (See "Power supply specifications")	XX: none O2: dual open collector type (dual pulse or one pulse + one alarm or dual alarm)
AV6: 208V _{LL} AC - 1/5(10)A (VT/PT and CT connections) V _{LN} : 40V to 144V _{LN} V _{LL} : 70V to 250V _{LL}		L: 18 to 60VAC/DC (48 to 62Hz) D: 115/230 VAC (48 to 62Hz)	R2: dual relay type (functions as per "O2") IS: 3 digital inputs for tariff selection or Gas/ water/ remote heating metering plus RS485 port
AV2: 400V _{LL} AC 10(65)A (direct connection) V _{LN} : 113V to 265V _{LN} V _{LL} : 196V to 460V _{LL}		Options X: none	DP: Dupline port plus 3 digital inputs for Gas / water / remote heating metering M1: M-bus port according EN13757-3:2005 M2: M-bus port according EN13757-3:2013
AV9: 400V _{LL} AC - 10(65)A (direct connection) V _{LN} : 184V to 276V _{LN} V _{LL} : 318V to 480V _{LL}			

NOTE: please check the availability of the needed code on the verification path tables below before order.



Input specifications

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

Output specifications

<p>Digital outputs</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>Note</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>$T_{OFF} \geq 120\text{ms}$, according to EN62053-31</p> <p>T_{ON} 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>$\leq 700\text{ms}$, 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>Static output</p> <p>Purpose</p> <p>Signal</p> <p>Insulation</p>	<p>For pulse output or alarm output</p> <p>V_{ON} 1.2 VDC/ max. 100 mA</p> <p>V_{OFF} 30 VDC max.</p> <p>By means of optocouplers, 4000 VRMS output to measuring inputs, 4000 VRMS output to power supply input.</p>	<p>M-bus</p> <p>Type</p> <p>Connections</p> <p>Addresses</p> <p>Indirizzo primario</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</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 EN13757-3:2005 (option M1), EN13757-3:2013 (option M2)</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>Relay output</p> <p>Purpose</p> <p>Type</p> <p>Insulation</p> <p>Note</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>Note (for RS485 and M-bus ports)</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>RS485</p> <p>Type</p>	<p>Multidrop, bidirectional (static and dynamic variables)</p>		

Dupline specifications

Counters 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 Synchro/Tariff input Used Dupline functions Used channels Working mode	M1 to N8 (4 th group of 16 variables) O1 to P8 (5 th 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).
Analogue variables Used Dupline function Number of variables	Multiplexer for analogue values 8 per instrument 80 per network	Alarms Used Dupline function Used channels Number of alarms Alarm modes Set-point adjustment Hysteresis On-time delay Output status Available variables	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
Dupline data format 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 st group of 16 variables) I1 to J8 (2 nd group of 16 variables) K1 to L8 (3 th group of 16 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 ³ 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 synchronisation is made every time the tariff changes) and	GAS (m ³) or WATER (hot-cold m ³) 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 ³) or WATER (hot-cold m ³) or remote heating (kWh) meters or external kWh meter; • total energy (kWh, kvarh) and GAS, WATER (hot-cold m ³), remote heating, external kWh meters (3 choices only).
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Digital input specifications (cont.)

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

Software functions

Password	Numeric code of max. 4 digits; 2 protection levels of the programming data:	Filter	
1st level	Password "0", no protection	Operating range	0 to 100% of the input display scale
2nd level	Password from 1 to 9999, all data are protected	Filtering coefficient	1 to 32
		Filter action	Measurements, serial output (fundamental variables: V, A, W and their derived ones).
System selection		Displaying	Up to 3 variables per page (see « Display pages »)
System 3-P.n unbalanced load	3-phase (4-wire)		8 different set of variables available (see « Display pages ») according to the application being selected
System 3-P unbalanced load	3-phase (3-wire)		
System 3-P.1 (only AV5 and AV6) balanced load	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	Reset	By means of the front joystick:
System 2-P	2-phase (3-wire)		- dmd and dmd max;
System 1-P	1-phase (2-wire)		- total energies (kWh and kvarh) and gas/water;
			- partial energies and tariffs: kWh, kvarh
Transformer ratio		Easy connection function	
VT (PT)	1.0 to 999.9 / 1000 to 6000 (only AV5 and AV6)	AV2 and AV9 models	Automatic phase sequence detection with current and voltage synchronisation.
CT	1.0 to 999.9 / 1000 to 9999 / 10.00k to 60.00k (only AV5 and AV6). The maximum VT by CT ratio is 3150 for AV5_PF models, 4629 for AV5_X models, 14529 for AV6_X models.	AV5-AV6-AV2-AV9 models	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.
	Note 1: for MID complaint applications the maximum power being measured is 25 MW for AV5_PF models, 51 kW for AV9_PF and AV2_PF models. Note 2: for non-MID complaint applications the maximum power (calculated as maximum input voltage and current) being measured cannot exceed 66 MW for AV5_X models, 62 MW for AV6_X models, 51 kW for AV2_X models and 54 kW for AV9_X models.		

General specifications

Operating temperature	-25°C to +55°C (-13°F to 131°F) (R.H. from 0 to 90% non-condensing @ 40°C) according to EN62053-21, EN50470-1 and EN62053-23	Standard compliance	IEC60664, IEC61010-1 EN60664, EN61010-1 EN62052-11. EN62053-23, EN50470-3. DIN43864, IEC62053-31 CE, cULus listed (AV5, AV6 options only, except option M2), MID (PF option only)
Storage temperature	-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	Safety Metrology Pulse output Approvals	
Installation category	Cat. III (IEC60664, EN60664)	Connections	Screw-type
Insulation (for 1 minute)	4000 VRMS between measuring inputs and power supply 4000 VRMS between power supply and RS485/digital output	Cable cross-section area AV2-AV9 models	measuring inputs max. 16 mm ² ; min. 2.5 mm ² (by cable lug). Min./Max. screws tightening torque: 1.7 Nm / 3 Nm Other inputs: 1.5 mm ² Screws tightening torque: 0.5 Nm
Dielectric strength	4000 VRMS for 1 minute	Cable cross-section area AV5-AV6 models	Max. 1.5 mm ² Screws tightening torque: 0.5 Nm
Noise rejection CMRR	100 dB, 48 to 62 Hz	Housing DIN	71 x 90 x 64.5 mm Nylon PA66, self-extinguishing: UL 94 V-0
EMC	According to EN62052-11	Dimensions (WxHxD) Material	
Electrostatic discharges Immunity to irradiated	15kV air discharge Test with current: 10V/m from 80 to 2000MHz	Mounting	DIN-rail
Electromagnetic fields	Test without any current: 30V/m from 80 to 2000MHz	Protection degree	IP50 IP20
Burst	On current and voltage measuring inputs circuit: 4kV	Front Screw terminals	
Immunity to conducted disturbances	10V/m from 150KHz to 80MHz	Weight	Approx. 400 g (packing included)
Surge	On current and voltage measuring inputs circuit: 4kV; on "L" auxiliary power supply input: 1kV		
Radio frequency suppression	According to CISPR 22		

Power supply specifications

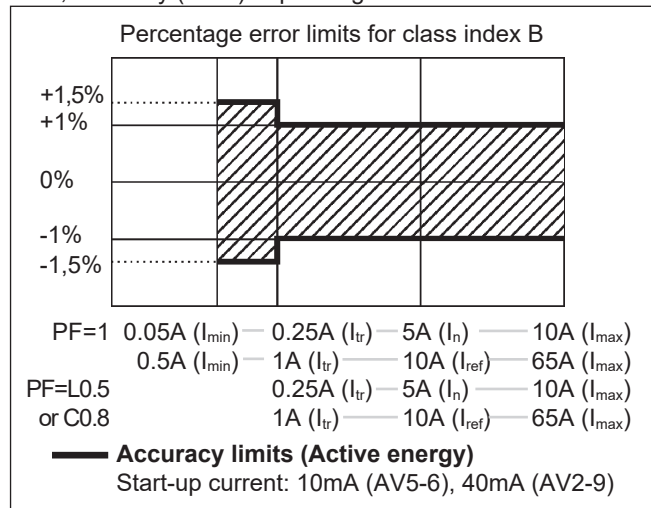
Self supplied version	AV9 models "XX" and "O2" options only: -20% +15%, 48-62Hz. "R2", "M1" and "IS" options only: -15% +10%, 48-62Hz. AV2 model: "XX", "O2", "IS" and "DP" options: -15% +15%, 48-62Hz. AV5 models, PF option (MID) -15, +10%, 50 Hz. In case of 3-phase system, 4-wire connection: 113 to 265V. In case of 3-phase system, 3-wire connection: 196 to 460V.	(3-phase and neutral) if a 1-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.
Note	The AV9 models provided with "IS" and "R2" options work only if all the voltage inputs are connected	
	Auxiliary power supply	AV5-AV6 modules, X option (non MID): L: 24 to 48VAC/DC; D: 115VAC/230VAC (-/+15%) from 48 to 62Hz
	Power consumption	AV9-AV2 models ≤ 20VA/1W AV9-AV2 models (IS and DP option only) ≤ 12VA/2W AV5-AV6 models ≤ 2VA/2W

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

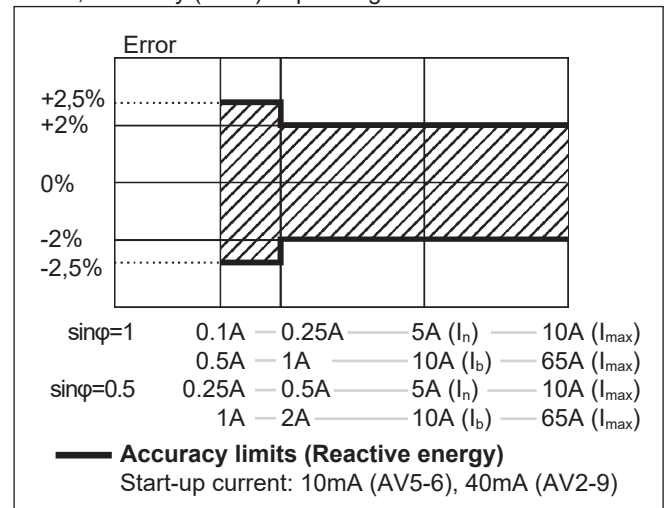
Output	Model	Note
Open collector output	"AV9" models with "O2" option	The meter works even if up to two voltages "phase to neutral" are missing or if one voltage "phase to phase" is missing.
Relay output	"AV9" models with "R2" option	The neutral wire has always to be available. The meter works even if "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	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 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 compliance (PF option only)

Accuracy	0.9 Un ≤ U ≤ 1.1 Un; 0.98 fn ≤ f ≤ 1.02 fn; fn: 50Hz; cosφ: 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.	EMC compliance	E2
		Mechanical compliance	M2
AV2-AV9 models	Class B. I st: 0.01A; I min: 0.05A; I tr: 0.25A; I ref: 5A; I max: 10A.	Protection degree	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.
AV5 models			
Operating temperature	-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	System variables	Three-phase power factor (TPF)
Instantaneous effective voltage $V_{IN} = \sqrt{\frac{1}{n} \cdot \sum_1^n (V_{IN})_i^2}$	Equivalent three-phase voltage $V_{\Sigma} = \frac{V_1 + V_2 + V_3}{3} \cdot \sqrt{3}$	$\cos\varphi_{\Sigma} = \frac{W_{\Sigma}}{VA_{\Sigma}}$
Instantaneous active power $W_1 = \frac{1}{n} \cdot \sum_1^n (V_{IN})_i \cdot (A_1)_i$	Voltage asymmetry $ASY_{LL} = \frac{(V_{LL\max} - V_{LL\min})}{V_{LL\Sigma}}$	Energy metering $k \text{ var hi} = \int_{n_1}^{n_2} Qi(t) dt \cong \Delta t \sum_{n_1}^{n_2} Qnj$
Instantaneous power factor $\cos\varphi_1 = \frac{W_1}{VA_1}$	$ASY_{LN} = \frac{(V_{LN\max} - V_{LN\min})}{V_{LN\Sigma}}$	$kWhi = \int_{n_1}^{n_2} Pi(t) dt \cong \Delta t \sum_{n_1}^{n_2} Pnj$
Instantaneous effective current $A_1 = \sqrt{\frac{1}{n} \cdot \sum_1^n (A_1)_i^2}$	Three-phase reactive power $\text{var}_{\Sigma} = (\text{var}_1 + \text{var}_2 + \text{var}_3)$	Where: i= considered phase (L1, L2 or L3) P= active power; Q= reactive power; t ₁ , t ₂ = starting and ending time points of consumption recording; n= time unit; Δt= time interval between two successive power consumptions; n ₁ , n ₂ = starting and ending discrete time points of consumption recording
Instantaneous apparent power $VA_1 = V_{IN} \cdot A_1$	Three-phase active power $W_{\Sigma} = W_1 + W_2 + W_3$	
Instantaneous reactive power $\text{var}_1 = \sqrt{(VA_1)^2 - (W_1)^2}$	Three-phase apparent power $VA_{\Sigma} = \sqrt{W_{\Sigma}^2 + \text{var}_{\Sigma}^2}$	

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 ³ Gas	x	x	x	x	x	x	Total (3)
41	m ³ Cold H ₂ O	x	x	x	x	x	x	Total (3)
42	m ³ Hot H ₂ O	x	x	x	x	x	x	Total (3)
43	kWh H ₂ 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) "PAr"	"PAr" = Partial kWh (+)						x	x	x		
	5	Total kvarh (+)	VA sys dmd	VA sys dmd max			7				7	7	7		
	6	kvarh (+)	VA sys	(text) "PAr"	"PAr" = 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	
0	Selector position which can be linked to any of the variable combinations listed above (No. from 1 to 31)														
1	Selector position which can be linked to any of the variable combinations listed above (No. from 1 to 31)														
2	Selector position which can be linked to any of the variable combinations listed above (No. from 1 to 31)														
3	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) m³ Gas, m³ 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 sttus	Set-point value	Alarm type
In case of alarm output 2	AL2 oFF/on (text) Alarm sttus	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
A	Basic domestic	**	Mainly energy metering
B	Shopping centres	**	Mainly energy metering
C	Advanced domestic	**	Mainly energy metering (total and based on tariff), gas and water metering
D	Multi domestic (also camping and marinas)	* / **	Mainly energy metering (3 by single phase)
E	Solar	*	Energy meter with some basic power analyzer functions
F	Industrial	*	Mainly energy metering
G	Advanced industrial	**	Energy metering and power analysis
H	Advanced industrial for power generation	*	Complete energy metering and power analysis
I	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 (option M1)

• 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		

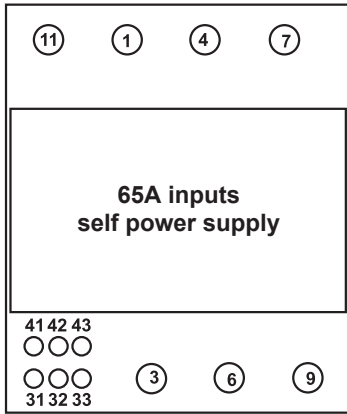
M-bus available variables and frame format (option M2)

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

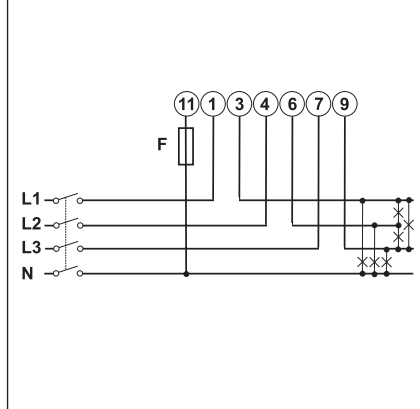
Frame	Number	Variable	Data Format	Frame	Number	Variable	Data Format
1	1	KWh (+) TOT	INT32	1	7	V L-L sys	INT32
1	2	Kvarh (+) TOT	INT32	1	8	V L-N sys	INT32
1	3	W sys	INT32	1	9	A L1	INT32
1	4	VAR sys	INT32	1	10	A L2	INT32
1	5	VA sys	INT32	1	11	A L3	INT32
1	6	PF sys	INT16				
Frame	Number	Variable	Data Format	Frame	Number	Variable	Data Format
2	1	W L1	INT32	2	7	VA L1	INT32
2	2	W L2	INT32	2	8	VA L2	INT32
2	3	W L3	INT32	2	9	VA L3	INT32
2	4	VAR L1	INT32	2	10	PF L1	INT16
2	5	VAR L2	INT32	2	11	PF L2	INT16
2	6	VAR L3	INT32	2	12	PF L3	INT16
Frame	Number	Variable	Data Format	Frame	Number	Variable	Data Format
3	1	V L1-L2	INT32	3	7	KWh (+) PAR	INT32
3	2	V L2-L3	INT32	3	8	Kvarh (+) PAR	INT32
3	3	V L3-L1	INT32	3	9	KWh (-) TOT	INT32
3	4	V L1-N	INT32	3	10	Kvarh (-) TOT	INT32
3	5	V L2-N	INT32	3	11	Hz	INT16
3	6	V L3-N	INT32				
Frame	Number	Variable	Data Format	Frame	Number	Variable	Data Format
4	1	KWh (+) L1	INT32	4	6	DMD VA sys	INT32
4	2	KWh (+) L2	INT32	4	7	DMD VA sys max	INT32
4	3	KWh (+) L3	INT32	4	8	DMD A max	INT32
4	4	DMD W sys	INT32	4	9	Hour	INT32
4	5	DMD W sys max	INT32				

Wiring diagrams

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

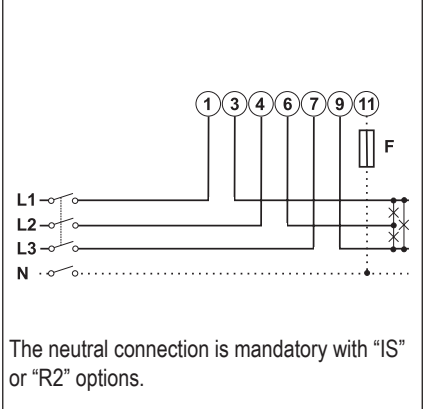


3-ph, 4-wire, unbal./bal. load Fig.1



(65A) System type selection: 3P

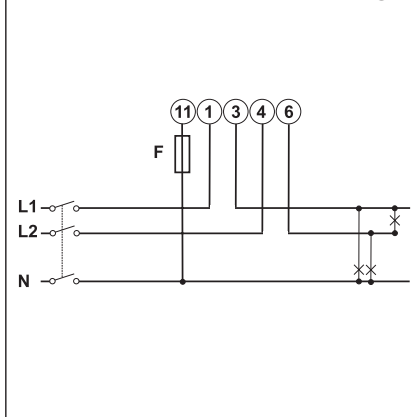
3-ph, 3-wire, unbal./bal. load Fig. 2



The neutral connection is mandatory with "IS" or "R2" options.

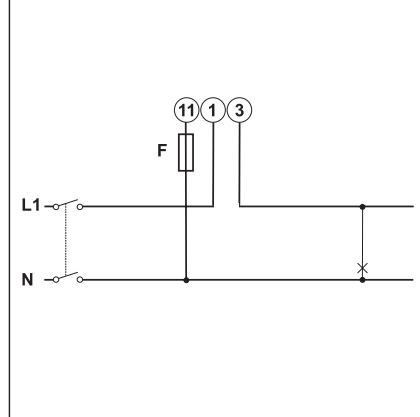
(65A) System type selection: 2P

2-ph, 3-wire, unbal./bal. load Fig. 3

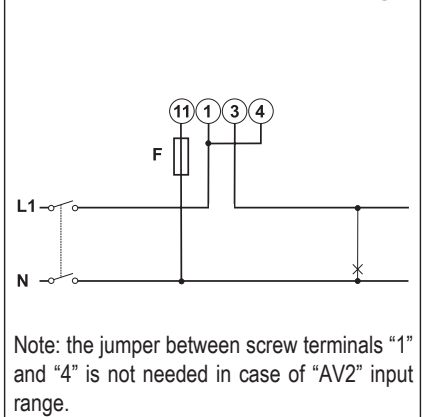


(65A) System type selection: 1P

1-ph, 2-wire, "O2" option Fig. 4

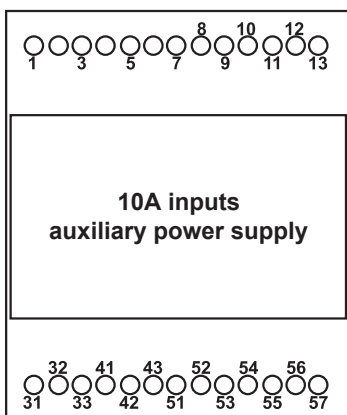


1-ph, 2-wire, "IS" and "R2" option Fig. 5

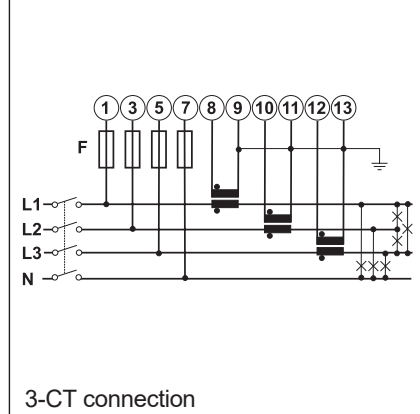


Note: the jumper between screw terminals "1" and "4" is not needed in case of "AV2" input range.

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

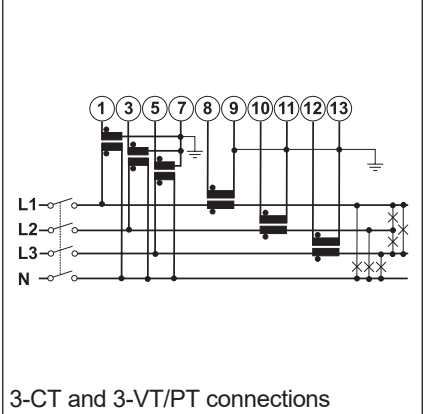


3-ph, 4-wire, unbalanced load Fig. 6



3-CT connection

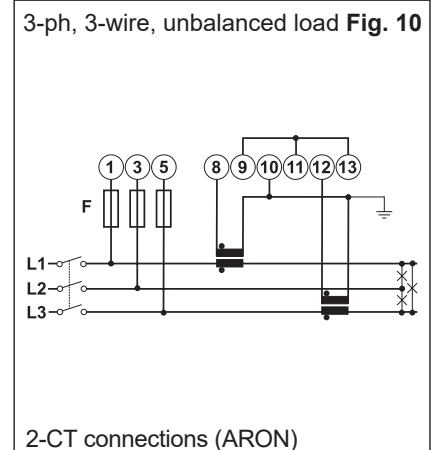
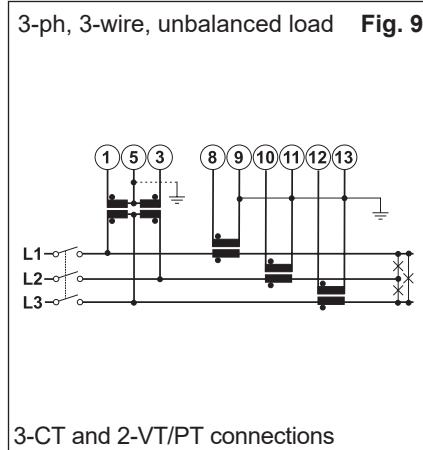
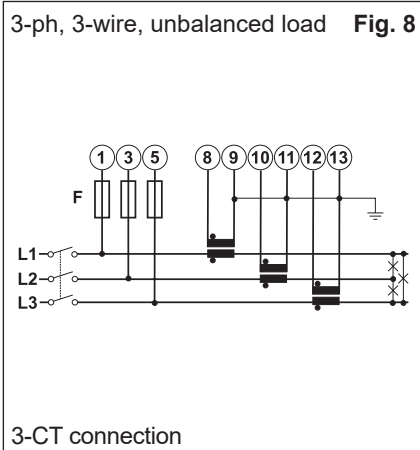
3-ph, 4-wire, unbalanced load Fig. 7



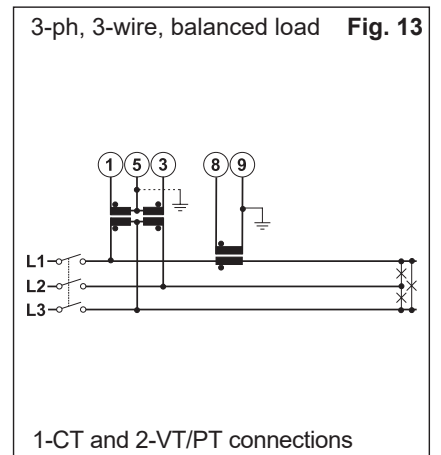
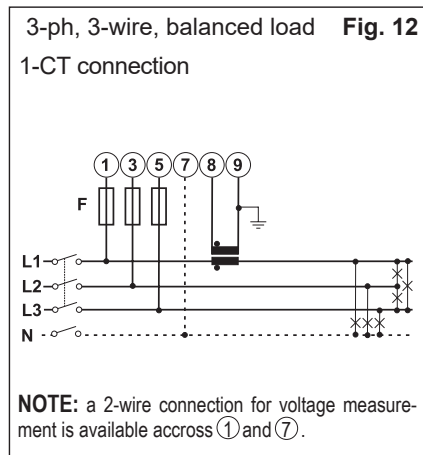
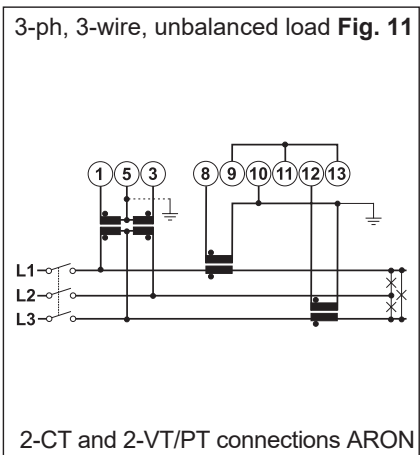
3-CT and 3-VT/PT connections

Wiring diagrams

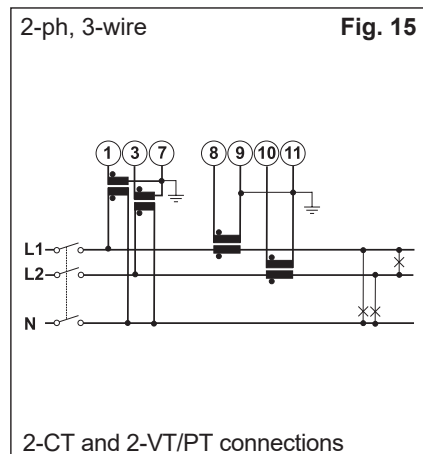
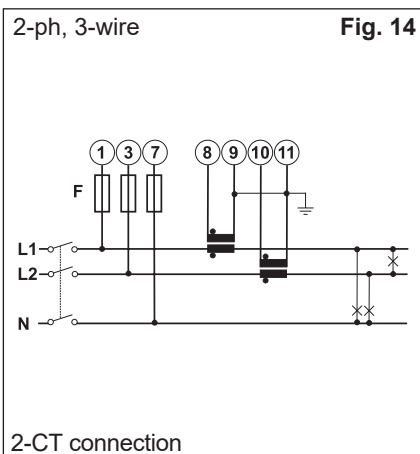
(10A) System type selection: 3P



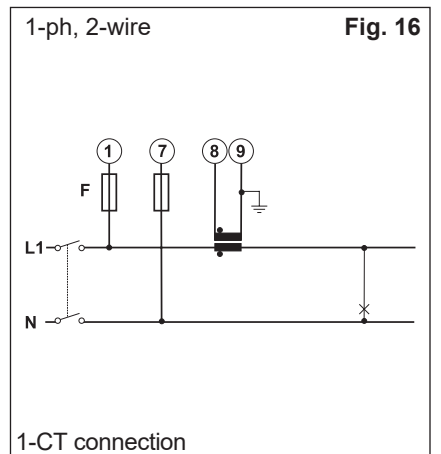
(10A) System type selection: 3P.1



(10A) System type selection: 2P

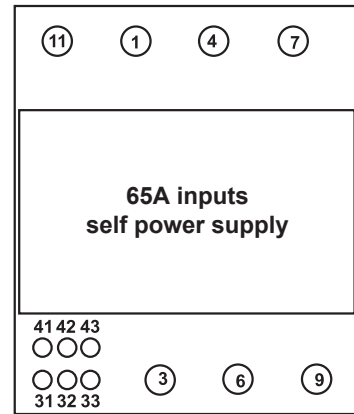
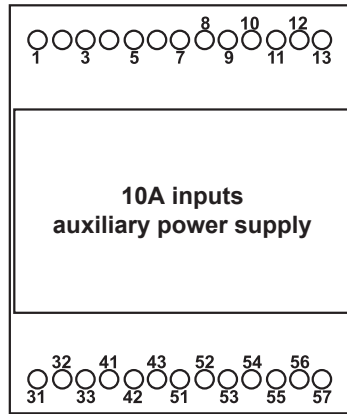
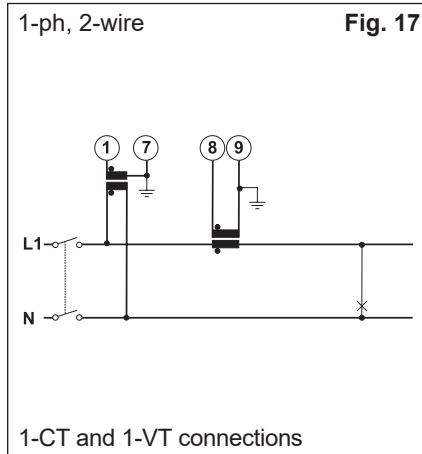


(10A) System type selection: 1P

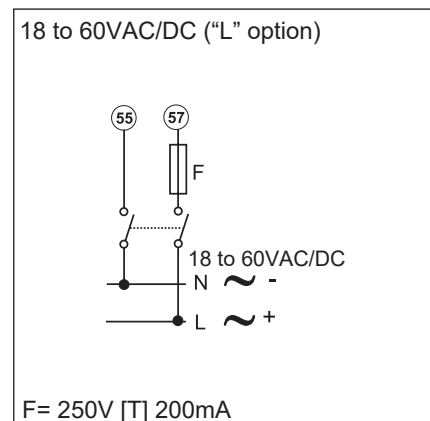
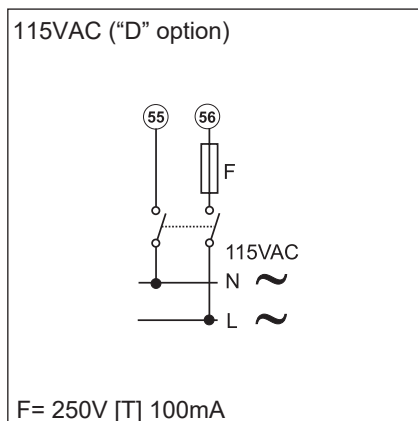
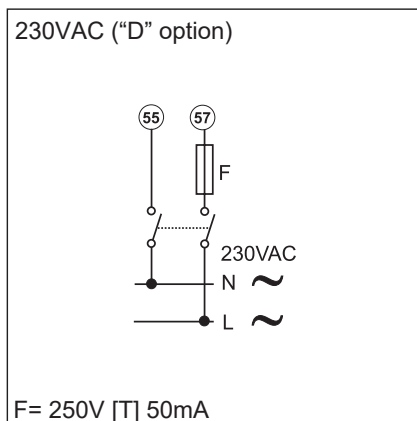


Wiring diagrams

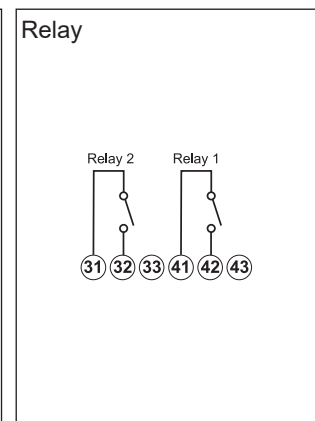
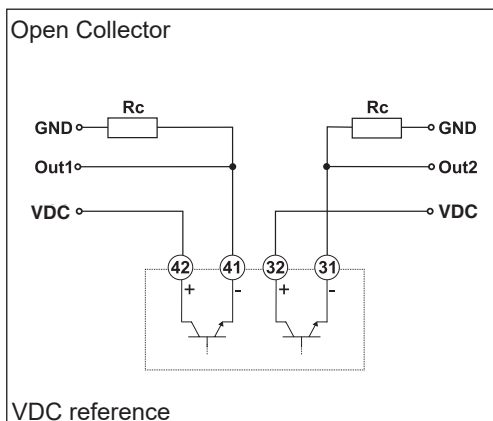
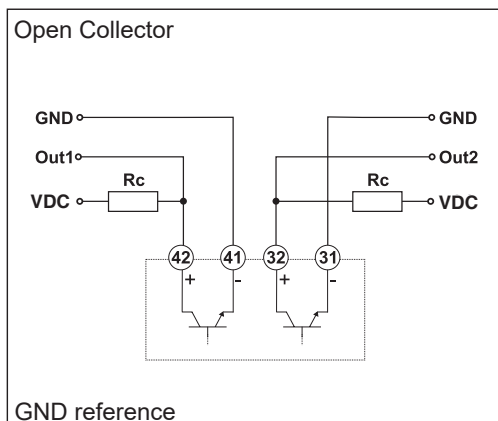
(10A) System type selection: 1P



Power supply wiring diagrams (auxiliary power supply)

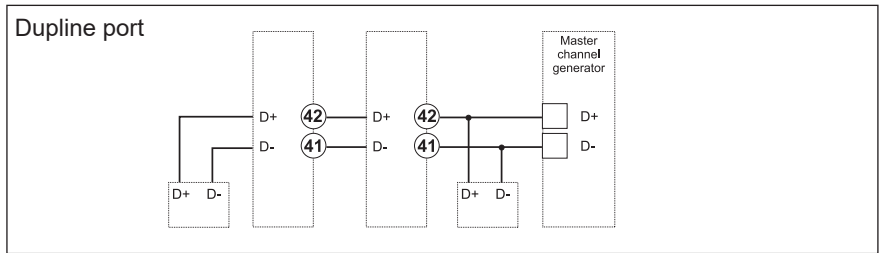
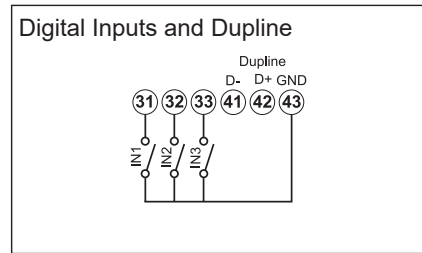
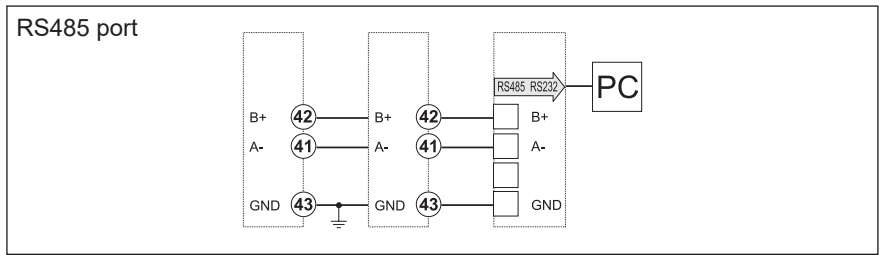
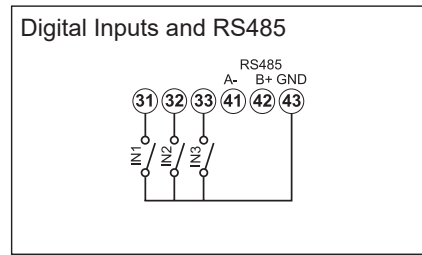


Open collector and relay outputs wiring diagrams

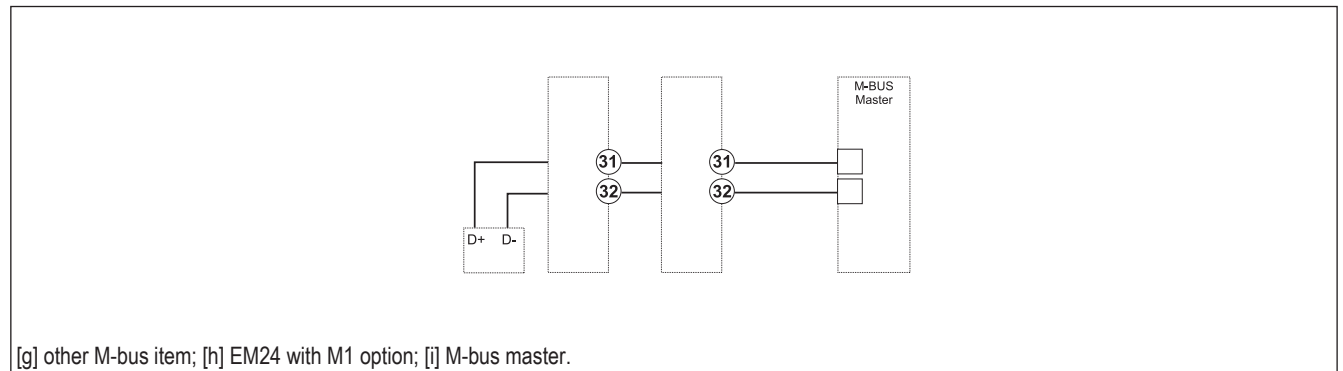


The load resistances (RC) must be designed so that the close contact current is lower than 100mA; the VDC voltage must be lower than or equal to 30VDC.

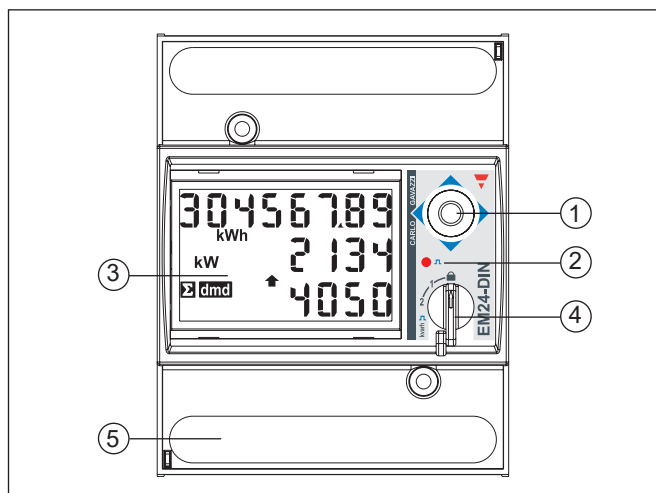
Digital inputs, RS485 and Dupline ports wiring diagrams



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

