

Energy Management Power Analyzers Type WM2-DIN

CARLO GAVAZZI



- 3-dgt/6-dgt μ P-based indicator
- Manual or automatic scrolling of system and single phase: kW, kVAr, PF, kWh, kVArh, I, V_{Δ} avg, VL1-N, VL2-N, VL3-N.
- TRMS measurement of distorted waves (voltage/current)
- All configuration functions selectable by built-in key-pad
- Password protection of programming parameters
- Degree of protection (front): IP 40
- Standard pulse output
- Optional serial RS 422/485 output
- MODBUS, JBUS protocol.

Product Description

μ P-based power analyzer with a built-in configuration key-pad. The power, PF, current and voltage are system and single phase measure-

ments and indications. The housing is easy to mount on DIN-rail and ensures a degree of protection (front) of IP 40.

Ordering Key

WM2-DINAV53DPX



Type Selection

Range code	System	Power supply	1st output
AV5: 250/433 VAC - 5 AAC (max. 300 V (L-N)/ 520 V (L-L) - 6 A)	3: One phase, three-phase system, 3 or 4 wires, balanced load; three phase system, 3 or 4 wires, unbalanced load	A: 24 VAC, -15% +10%, 50/60 Hz ¹⁾ B: 48 VAC, -15%+10%, 50/60 Hz ¹⁾ C: 115 VAC, -15% +10%, 50/60 Hz ¹⁾ D: 230 VAC, -15% +10%, 50/60 Hz (standard)	P: Pulse, static, DC type (standard) 2nd output X: No output (standard) S: Serial output, RS 485 multidrop bidirectional ¹⁾

¹⁾ On request

Input Specifications

Accuracy (48 to 62 Hz)	Un: 250V (AV5), In: 5A	Rated input	2 inputs (one/three-phase balanced load) 6 inputs (one/three-phase unbalanced load) 2 inputs (one/three-phase balanced load) 4 inputs (one/three-phase unbalanced load) among the voltage and the current inputs: 2000Vrms; among the current inputs: 2000 Vrms	
Voltage/current (@ 25°C \pm 5°C, R.H. \leq 60%)	\pm 1% f.s. (0 to 1.2 In, 0.5 to 1.2 Un)	Current		
Energy (@ 25°C \pm 5°C, R.H. \leq 60%)	1% rdg (hour time base)	Voltage		
Active power (@ 25°C \pm 5°C, R.H. \leq 60%)	\pm 1% f.s. (PF \geq 0.7 L/C, 0 to 1.2 In, 0.5 to 1.2 Un)	Insulation		
Reactive power (@ 25°C \pm 5°C, R.H. \leq 60%)	\pm 1% f.s. (PF \geq 0.8 L/C, 0 to 1 In, 0 to 1 Un)	Temperature drift		\pm 250 ppm/°C
Power factor (PF) (@ 25°C \pm 5°C, R.H. \leq 60%)	\pm 1% f.s., PF \geq 0.7 L/C, (0.6 to 1.2 In, 1 to 1.2 Un)	Display		Backlighted LCD, h 13mm, 3-dgt (instantaneous meas.) 6-dgt (energies)
Additional errors				
Humidity	< 0.3% f.s., 60% to 90% R.H.			
Power supply	\pm 0.5% rdg, -15 +10% p.s.			
Magnetic field	< 0.1% f.s. @ 400 A/m			

Input Specifications (cont.)

Decimal point position	Instantaneous measurements: Automatic selection according to the current transformer ratio of the CT being connected (max. indication - single phase): CT ratio ≤ 5 : 11.11 (25.00A) CT ratio ≤ 50.0 : 111.1 (250.0A) CT ratio ≤ 500.0 : 1111 (2500A) CT ratio ≤ 999.9 : 11110 (6000A) Energy measurements: max. resolution: 1 Wh/1 VARh min. resolution: 1 kWh/1 kVARh	Ranges (impedances)	Crest factor: ≥ 3 250 V/433 V ($\geq 1 \text{ M}\Omega$) 5 AAC ($\leq 0.3 \text{ VA} / \leq 0.1 \Omega$)
Max. and min. indication		Frequency range	48 to 62 Hz
Voltage	Max. 600 min. 0	Over-load protection	Un: 250 (AV5), In: 5A 1.2 Un/In
Current (CT ratio = 1)	Max. 6.00 min. 0.00	Continuous: voltage/current	
PF	Max. 1.00 min. 0.00	For 1 s	
Power (CT ratio = 1)	Max. 5.40 min. 0.00	Voltage:	2 Un
Active energy	Max. 999999 min. -199999	Current:	20 In
Reactive energy	Max. 999999 min. 0	Keyboard	4 keys: "Δ∇": - to enter programming phase and password confirmation; - for value programming and basic measurement scrolling. "L": - for confirmation of new programmed values and going ahead to the next programming step, - single phase measurement scrolling. "R": - for the reset of the partial counted active and/or reactive energy.
Sampling rate	3 times / second		
Measurements			
System variables	kW, kVA _r , PF, V _{L-L} , A, kWh tot, kVA _r h tot, kWh partial, kVA _r h partial		
Single phase variables	kW, kVA _r , PF, V _{L-N} , A		
Measurement method	TRMS measurement of a distorted voltage/current wave Coupling type: Direct		

Output Specifications

Pulse output		Data (bidirectional)	
Type	From 0.1 to 999.9 programmable pulses for kWh, kVA _r h, open collector (NPN transistor) V _{ON} 0.6 VDC/ max. 4 mA V _{OFF} 26 VDC max.	Dynamic (reading only)	System variables: P, Q, PF, V _{L-L} , energies, Single phase variables: PL1, QL1, PFL1, VL1-N, AL1, PL2, QL2, PFL2, VL2-N, AL2, PL3, QL3, PFL3, VL3-N, AL3
Pulse duration	200 ms (ON), ≥ 200 ms (OFF)	Static (writing only)	All programming data, reset of energy: - partial kWh - partial kVA _r h - total kWh - total kVA _r h
Insulation	By means of optocouplers, 4000 V _{rms} output to measuring input, 4000 V _{rms} output to supply input.		Stored energy (EEPROM) ≤ 999999 kWh ≤ 999999 kVA _r h
Serial output (on request)		Data format	1-start bit, 8-data bit, no parity/even parity, 1 stop bit
Type	RS422/RS485; Multidrop bidirectional (static and dynamic variables)	Baud-rate	1200, 2400, 4800 and 9600 selectable bauds
Connections	4 wires, max. distance 1200m, termination and/or line bias by means of DIP-switches directly on the instrument	Insulation	By means of optocouplers, 4000 V _{rms} output to measuring inputs 4000 V _{rms} output to supply input
Addresses	255, selectable by key-pad		
Protocol	MODBUS/JBUS		

Software Functions

Password 1st level 2nd level	Numeric code of max. 3 digits; 2 protection levels of the programming data Password "0", no protection Password from 1 to 255, all data are protected		(14999*CT). Example: the CT is a 100A/5A so the ratio is 20, consequently the maximum counted energy is 299980 kWh or kVAh.
Measurement scrolling System:	Active power (kW), reactive power (kVA), power factor (cos φ), current (A), average phase-phase voltage (V) total and partial active energy (kWh), total and partial reactive energy (kVAh) Partial energy meters: the counters of kWh and kVAh are automatically reset when the energy reaches the value	Single phase:	Active power (kW), reactive power (kVA), power factor (cos φ), current (A), phase-neutral voltage (V)
		Transformer ratio	For CT up to 5000 A
		Programmable ratio	0.1 to 999.9
		Digital Filter	
		Filter operating range	0 to 100% of the input electrical scale
		Filtering coefficient	1 to 64
		Filter action	On the display and on the variable being transmitted by the serial communication port.

Supply Specifications

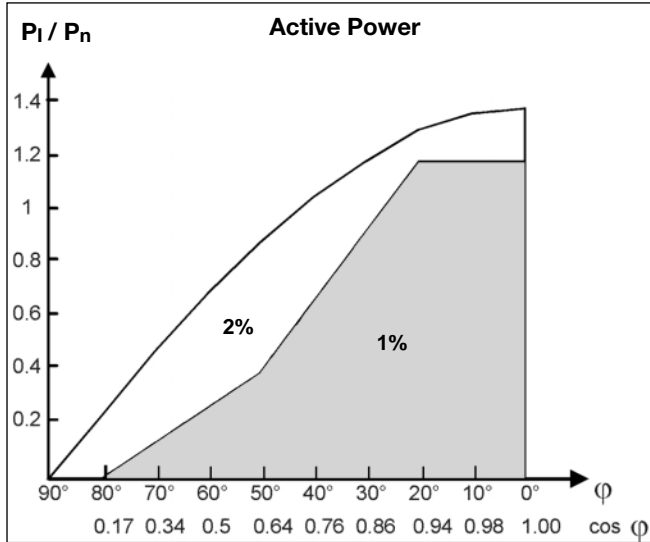
AC voltage	230 VAC (standard), -15%+10% 50/60 Hz 24 VAC, 48 VAC, 115 VAC (on request), -15%+10% 50/60 Hz	Power consumption	≤ 7 VA
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General Specifications

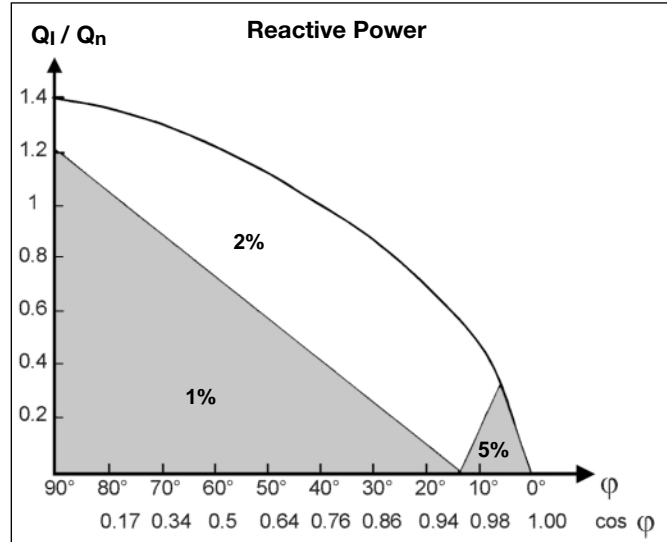
Operating temperature	0° to +50°C (32° to 122°F) (R.H. < 90% non-condensing)	Safety standards	IEC 61010-1, EN 61010-1
Storage temperature	-10° to +60°C (14° to 140°F) (R.H. < 90% non-condensing)	Connector	Screw-type, max. 2.5 mm ² wires
Insulation reference voltage	300 Vrms to ground	Housing	
Insulation	4000 Vrms between all inputs/outputs to ground	Dimensions	6 DIN modules, 58.5 x 89 x 107 mm
Dielectric strength	4000 Vrms for 1 minute	Material	ABS, self-extinguishing: UL 94 V-0
Noise rejection CMRR	100 dB, 48 to 62 Hz	Degree of protection	Front: IP40
EMC	EN 50081-2, EN 50082-2	Weight	Approx. 500 g (packing included)
		Approval	CE

Mode of Operation

Accuracy class of the instrument as a relation of P_I/P_n and PF



Test conditions:
 $V = 0.8$ to $1.2 U_n$,
 $I = 0.1$ to $1.2 I_n$,
 $f = 48$ to 62 Hz



Test conditions:
 $V = 0.8$ to $1.2 U_n$,
 $I = 0.1$ to $1.2 I_n$,
 $f = 48$ to 62 Hz

Input	Star voltage	Delta voltage	Current
AV5	$U_n: 230$ V	$U_n: 398$ V	$I_n: 5$ A

Example 1:
 Model AV5.3 (3-wire system).

$U_I = 380$ V (delta voltage)
 $I_I = 265$ A (single phase current)
 $\cos \phi = 0.85$ (system power factor) (CT=300A)

$U_n = 398$ V
 $I_n = 5$ A

$$CT \text{ (ratio)} = \frac{300}{5} = 60$$

$$P_I = \sqrt{3} \cdot U_I \cdot I_I \cdot \cos \phi = \sqrt{3} \cdot 380 \cdot 265 \cdot 0.85 = 148.07 \text{ kW}$$

$$P_n = \sqrt{3} \cdot U_n \cdot I_n \cdot CT \text{ (ratio)} = \sqrt{3} \cdot 398 \cdot 5 \cdot 60 = 206.56 \text{ kW}$$

$$\frac{P_I}{P_n} = \frac{148.07}{206.56} = 0.716$$

Example 2:
 Model AV5.3 (4-wire system).

$U_I = 220$ V
 $I_I = 110$ A (CT=300A)

$\cos \phi = 0.85$ ($\sin \phi = 0.52$)
 $U_n = 230$ V
 $I_n = 5$ A

$$CT \text{ (ratio)} = \frac{300}{5} = 60$$

$$Q_I = 3 \cdot U_I \cdot I_I \cdot \sin \phi = 3 \cdot 220 \cdot 110 \cdot 0.52 = 37.75 \text{ Kvar}$$

$$Q_n = 3 \cdot U_n \cdot I_n \cdot CT \text{ (ratio)} = 3 \cdot 230 \cdot 5 \cdot 60 = 207 \text{ Kvar}$$

$$\frac{P_I}{P_n} = \frac{37.75}{207} = 0.183$$

In both examples the accuracy of the measurement is 1% f.s. when considering the changing of the measured voltage from $0.9 U_n$ to $1 U_n$ and the measured current from $0.1 I_n$ to $0.9 I_n$ with a $\cos \phi$ of 0.85 ($\sin \phi$ 0.52).

P_I/Q_I (installation power)

One phase system:

$$P_I = U_I \cdot I_I \cdot \cos \phi$$

$$Q_I = U_I \cdot I_I \cdot \sin \phi$$

Three phase, 3-wire system:

$$P_I = \sqrt{3} \cdot U_I \cdot I_I \cdot \cos \phi$$

$$Q_I = \sqrt{3} \cdot U_I \cdot I_I \cdot \sin \phi$$

Three phase, 4-wire system:

$$P_I = 3 \cdot U_I \cdot I_I \cdot \cos \phi$$

$$Q_I = 3 \cdot U_I \cdot I_I \cdot \sin \phi$$

where:

U_I = the real star voltage of the electrical system being measured.

I = the maximum phase current of the electrical system being measured.

$\cos \phi$ = the average $\cos \phi$ of the electrical system being measured.

P_n / Q_n (rated power of the instrument):

One phase system:

$$P_n = Q_n = U_n \cdot I_n \cdot CT \text{ (ratio)}$$

Three phase, 3-wire system:

$$P_n = Q_n = \sqrt{3} \cdot U_n \cdot I_n \cdot CT \text{ (ratio)}$$

Three phase, 4-wire system:

$$P_n = Q_n = 3 \cdot U_n \cdot I_n \cdot CT \text{ (ratio)}$$

where:

U_n = the rated input voltage of WM2-DIN.

I_n = the rated input current of WM2-DIN.

CT (ratio) = the value of the current transformer ratio.

Mode of Operation (cont.)

Waveform of the signals that can be measured

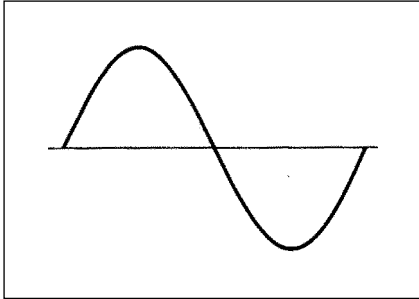


Figure G
Sine wave, undistorted
 Fundamental content 100%
 Harmonic content 0%
 $A_{rms} = 1.1107 | \bar{A} |$

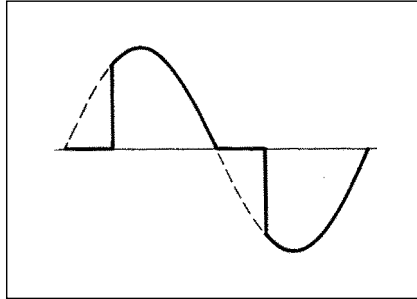


Figure H
Sine wave, indented
 Fundamental content 10...100%
 Harmonic content 0...90%
 Frequency spectrum 3rd to 16th harmonic
 Required result: additional error < 1%

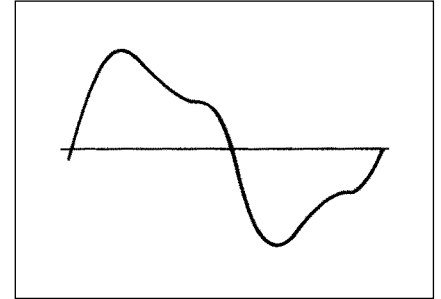
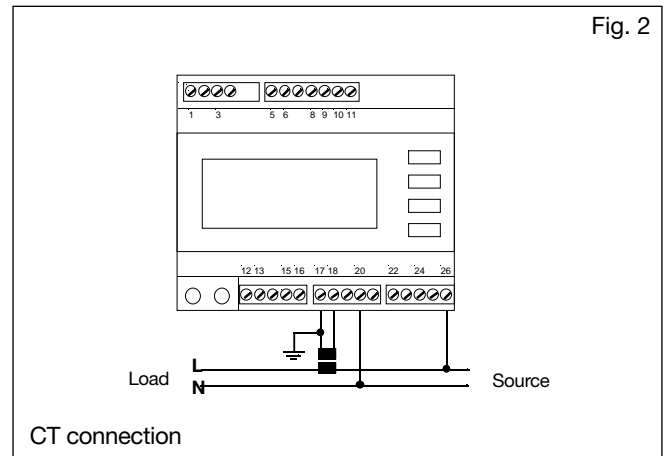
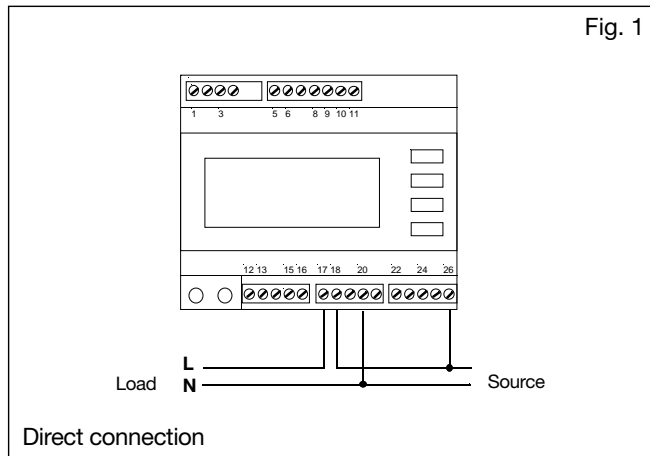


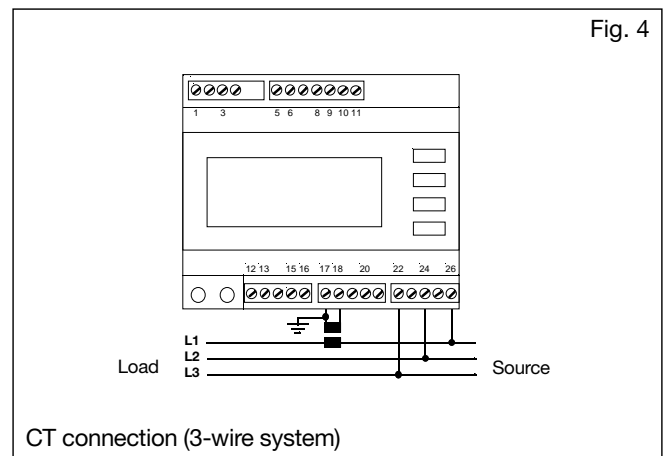
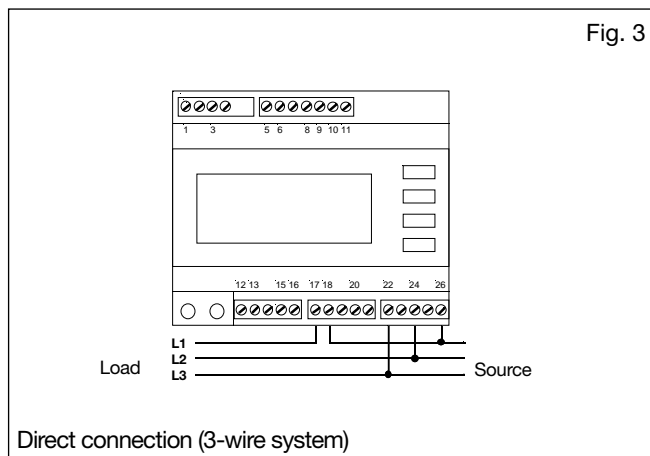
Figure I
Sine wave, distorted
 Fundamental content 70...90%
 Harmonic content 10...30%
 Frequency spectrum 3rd to 15th harmonic
 Required result: additional error < 0.5%

Wiring Diagrams

Single phase input connections

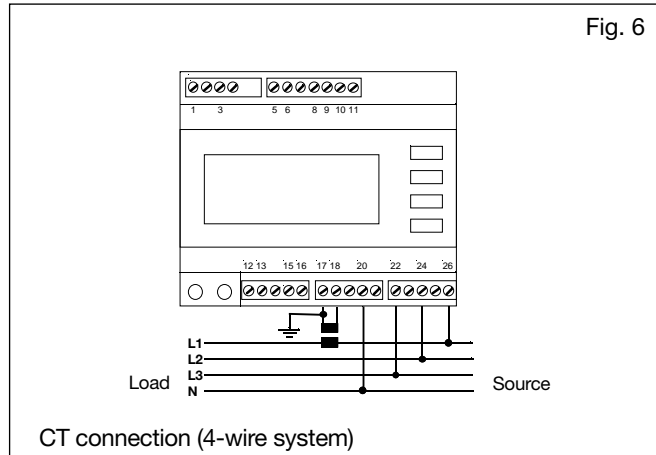
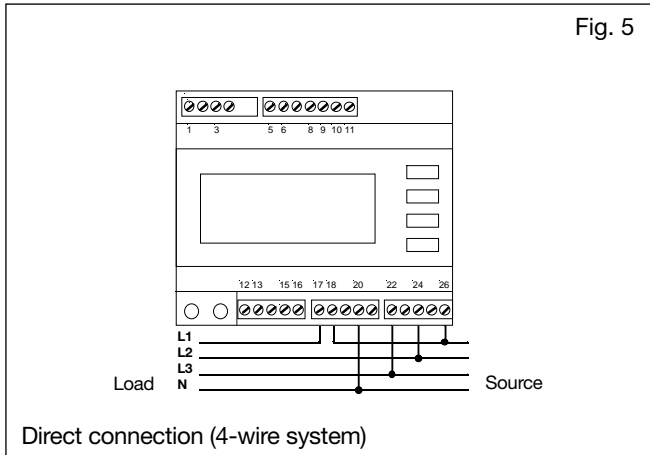


Three phase/3-wire input connections - Balanced loads

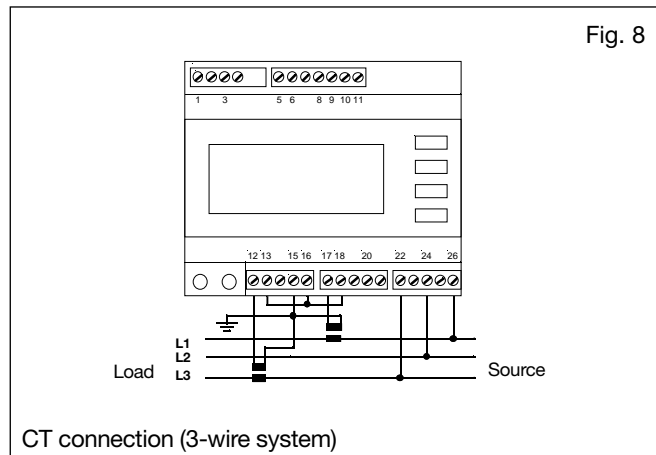
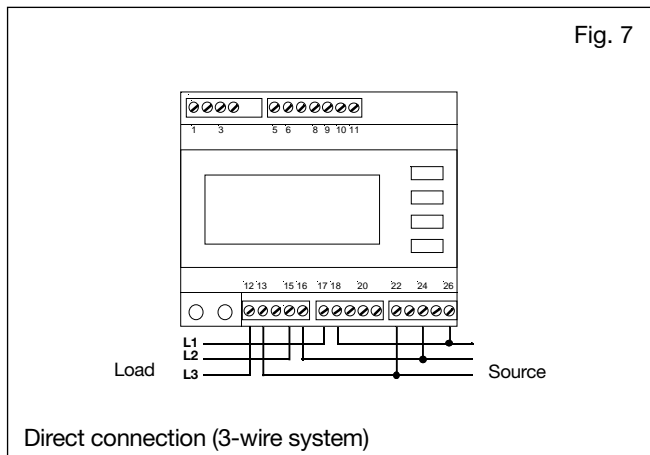


Wiring Diagrams (cont.)

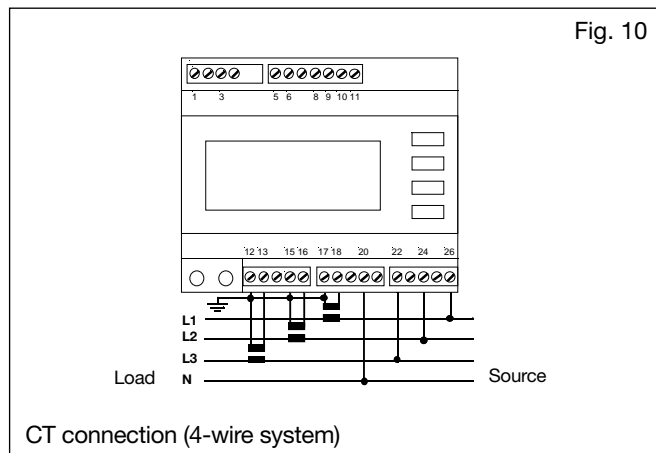
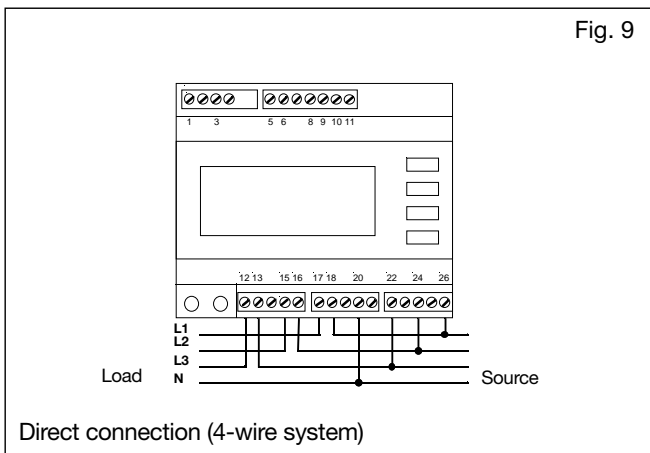
Three phase, 4-wire input connections - Balanced loads



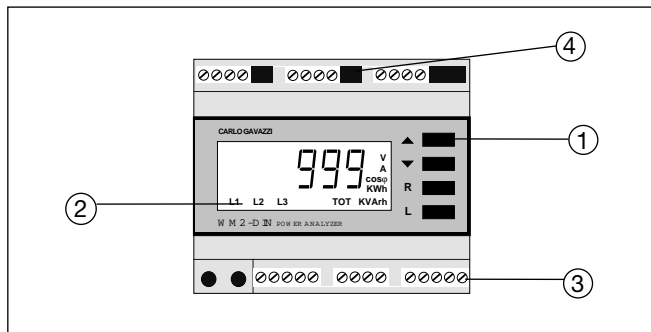
Three-phase, 3-wire input ARON connections - Unbalanced load



Three phase, 4-wire input connections - Unbalanced load



Front Panel Description



1. Key-pad

Set-up and programming procedures are easily controlled by the 4 pushbuttons.

”▲” and ”▼”

- To scroll all the basic measurements (system variables)
- To increase or decrease programming values

- To enter into the programming procedure and select programming functions together with the ”L” key.

”L”:

To scroll all the single phase variable of each basic measurement

”R”:

To reset the partial counted energies (kWh, kVAh).

2. Display

Instantaneous measurements:

- 3-digit (maximum read-out 999)

Energies:

- 6-digit (maximum read-out 999999).

Alphanumeric indication by means of LCD display for:

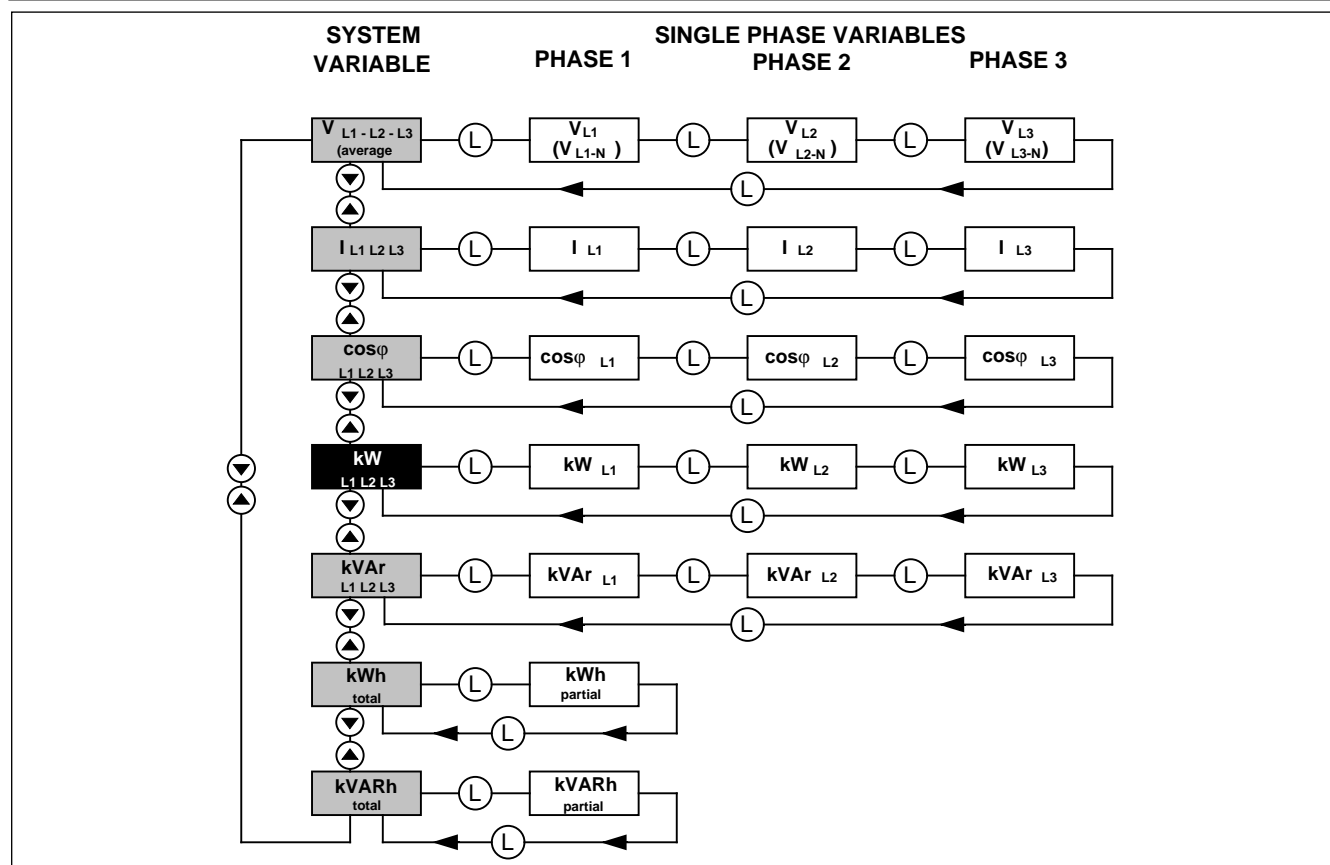
- Displaying the configuration parameters
- All the measured variables.

3. Connection terminal blocks

4. Dip-switch

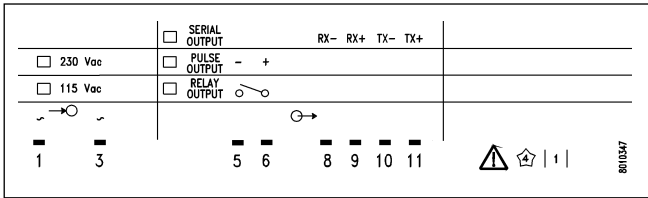
- For the selection of 2/4 wire connection, line biasing and/or line termination (only in case of RS 485 option)

Sequence of the variables on the display

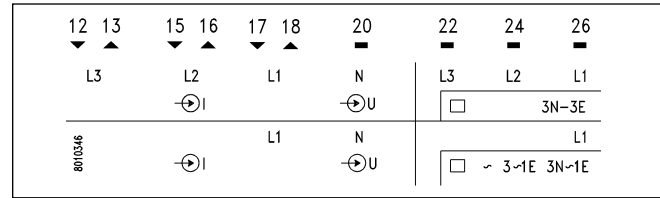


Terminal boards

Upper terminal board



Lower terminal board



Dimensions

