

Energy Management Modular Power Analyzers Type WM2-96

CARLO GAVAZZI



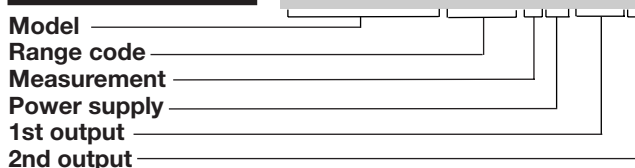
- Class 1
- Modular power analyzer
- Front size: 96 x 96 mm
- 3-dgt/6-dgt μ P-based indicator
- Manual or automatic scrolling of system and single phase: kW, kVAr, PF, kWh, kVArh, A, V_{L-L} avg, V_{L1-N} , V_{L2-N} , V_{L3-N}
- TRMS measurement of distorted waves (voltage/current)
- All configuration functions selectable by built-in key-pad
- Password protection of programming parameters
- Degree of protection (front): IP 65
- Optional pulse output (according to DIN43864)
- Optional serial RS 422/485 output
- MODBUS, JBUS protocol.

Product Description

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

phase measurements and indications. The housing is easy to mount on a panel and ensures a degree of protection (front) of IP 65.

Ordering Key **WM2-96 AV53DXXX**



Type Selection

Range code	Measurement	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) 2)}	XX: No output (standard)
AV7: 400/690 VAC - 5 AAC (max. 480 V (L-N)/ 830 V (L-L) - 6 A) ¹⁾		B: 48 VAC, -15%+10%, 50/60 Hz ^{1) 2)}	O1: Single open collector output (30 V/100 mA DC) ¹⁾
		C: 115 VAC, -15%+10%, 50/60 Hz ^{1) 2)}	O2: Dual open collector output (30 V/100 mA DC) ¹⁾
		D: 230 VAC, -15%+10%, 50/60 Hz (standard) ²⁾	R1: Single relay output (AC1-8 AAC, 250 VAC) ¹⁾
		L: 18 to 60 VDC/AC ³⁾	R2: Dual relay output (AC1-8 AAC, 250 VAC) ¹⁾
		H: 90 to 260 VDC/AC ³⁾	
			2nd output
			X: No output (standard)
			S: Serial output, RS 485 multidrop bidirectional ¹⁾

¹⁾ On request

²⁾ This power supply cannot be used if the RS485 module is needed

³⁾ Compatibel with any kind of output

Input Specifications

Accuracy (48 to 62 Hz)	Un: 250 V (AV5), 400 V (AV7) 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%)	$\pm 0.5\%$ f.s. (0 to 1.2 In, 0.5 to 1.2 Un)	Current	
Active power/energy (@ 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)	Voltage	
Reactive power/energy (@ 25°C \pm 5°C, R.H. \leq 60%)	$\pm 1\%$ f.s. (PF \geq 0.7 L/C, 0 to 1 In, 0 to 1 Un)	Insulation	
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)	Temperature drift	± 250 ppm/ $^{\circ}$ C
Additional errors		Display	Backlighted LCD, h 13mm, 3-dgt (instantaneous meas.) 6-dgt (energies)
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)	250 V/433 V ($\geq 400 \text{ k}\Omega$) 5 AAC ($\leq 0.3 \text{ VA} / \leq 0.1 \Omega$) 400 V/690 V ($\geq 650 \text{ k}\Omega$)
Max. and min. indication		Frequency range	48 to 62 Hz
Voltage	Max. 600 min. 0	Over-load protection	Un: 250 V (AV5), 400 V (AV7) In: 5 A 1.2 Un/In
Current (CT ratio = 1)	Max. 6.00 min. 0.00	Continuous: voltage/current For 1 s	
PF	Max. 1.00 min. 0.00	Voltage:	2 Un
Power (CT ratio = 1)	Max. 5.40 min. 0.00	Current:	20 In
Active energy	Max. 999999 min. -199999	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.
Reactive energy	Max. 999999 min. 0		
Sampling rate	3 times/second		
Measurements			
System variables	kW, kVAr, PF, V_{L-L} , A, kWh _{tot} , kVArh _{tot} , kWh _{partial} , KVarh _{partial}		
Single phase variables	kW, kVAr, PF, V_{star} , A		
Measurement method	TRMS measurement of a distorted voltage/current wave Coupling type: Direct Crest factor: ≥ 3		

Output Specifications

Pulse output (on request)		Data (bidirectional)	
Static type (according to DIN 43864)	From 0.1 to 999.9 programmable pulses for kWh, KVarh, open collector (NPN transistor) V_{ON} 1.2 VDC/ max. 100 mA V_{OFF} 30 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 All programming data, reset of energy: - partial kWh - partial kVArh - total kWh - total kVArh Stored energy (EEPROM) $\leq 999999 \text{ kWh}$ $\leq 999999 \text{ kVArh}$
Relay type	1 x SPDT AC 1 - 8 A, 250 VAC DC 12 - 5 A, 24 VDC AC 15 - 2.5 A, 250 VAC DC 13 - 2.5 A, 24 VDC	Static (writing only)	
Pulse duration	200 ms (ON), ≥ 200 ms (OFF)	Data format	1-start bit, 8-data bit, no parity/even parity, 1 stop bit
Insulation	By means of optocouplers, 4000 V _{rms} output to measuring input, 4000 V _{rms} output to supply input.	Baud-rate	1200, 2400, 4800 and 9600 selectable bauds
Serial output (on request)		Insulation	By means of optocouplers, 4000 V _{rms} output to measuring inputs 4000 V _{rms} output to supply input
Type	RS422/RS485; Multidrop bidirectional (static and dynamic variables)		
Connections	2 or 4 wires, max. distance 1200 m, termination directly on the module		
Addresses	1 to 255, selectable by key-pad		
Protocol	MODBUS/JBUS		

Software Functions

Password	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	Single phase:	Example: the CT is a 100A/5A so the ratio is 20, consequently the maximum counted energy is 299980 kWh or kVArh. Active power (kW), reactive power (kVAh), power factor (cos φ), current (A), phase-neutral voltage (V)
1st level 2nd level			
Measurement scrolling		Transformer ratio	For CT up to 5000 A
System:	Active power (kW), reactive power (kVAh), 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 (14999*CT).	Programmable ratio	0.1 to 999.9
		Digital Filter	
		Filter operating range	0 to 100% of the input electrical scale 1 to 64
		Filtering coefficient	On the display and on the variable being transmitted by the serial communication port.
		Filter action	

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 18 to 60 VDC/AC 90 to 260 VDC/AC	Power consumption	≤ 30 VA/12 W (90 to 260 V) ≤ 20 VA/12 W (18 to 60 V)
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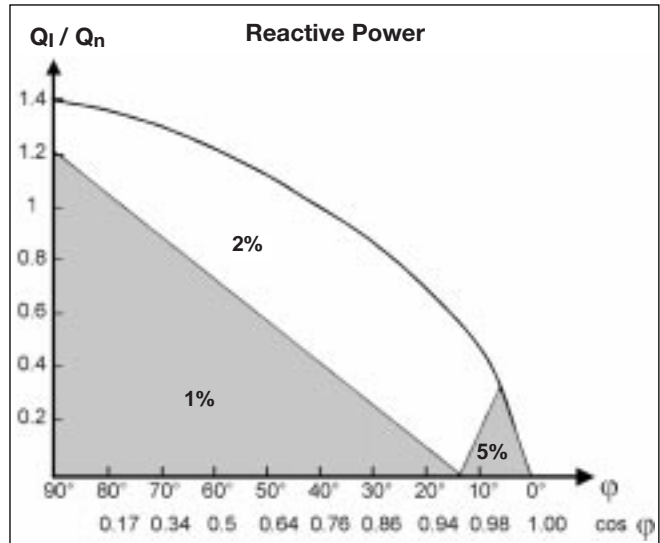
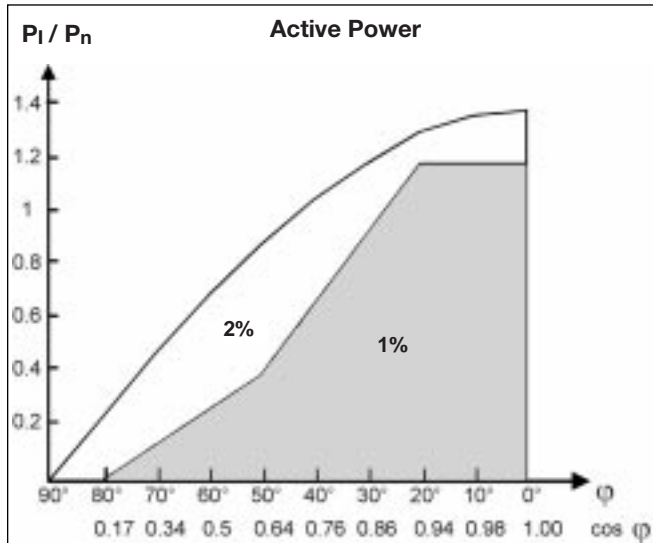
General Specifications

Operating temperature	0° to +50°C (32° to 122°F) (R.H. < 90% non-condensing)	Degree of protection	Front: IP65
Storage temperature	-10° to +60°C (14° to 140°F) (R.H. < 90% non-condensing)	Weight	Approx. 500 g (packing included)
Insulation reference voltage	300 Vrms to ground		
Insulation	4000 Vrms between all inputs/outputs to ground		
Dielectric strength	4000 Vrms for 1 minute		
Noise rejection CMRR	100 dB, 48 to 62 Hz		
EMC	EN 50 081-2, EN 50 082-2		
Safety standards	IEC 61010-1, EN 61010-1		
Other standards	Pulse output: DIN43864		
Connector	Screw-type, max. 2.5 mm ² wires x 2		
Housing			
Dimensions	96 x 96 x 140 mm		
Material	ABS, self-extinguishing: UL 94 V-0		



Mode of Operation

Accuracy class of the instrument as a relation of P_I/P_N and $\cos \varphi$ (power factor)



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	$U_n: 250$ V	$U_n: 430$ V	$I_n: 5$ A

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

$U_I = 400$ V (delta voltage)
 $I_I = 265$ A (single phase current)
 $\cos \varphi = 0.85$ (system power factor) (CT=300A)
 $U_n = 430$ V
 $I_n = 5$ A

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

$$P_I = \sqrt{3} \cdot U_I \cdot I_I \cdot \cos \varphi = \sqrt{3} \cdot 400 \cdot 265 \cdot 0.85 = 155.87 \text{ kW}$$

$$P_n = \sqrt{3} \cdot U_n \cdot I_n \cdot CT \text{ (ratio)} = \sqrt{3} \cdot 430 \cdot 5 \cdot 60 = 233.17 \text{ kW}$$

$$\frac{P_I}{P_n} = \frac{155.87}{233.17} = 0.698$$

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

$U_I = 230$ V
 $I_I = 110$ A (CT=300A)
 $\cos \varphi = 0.85$ ($\sin \varphi = 0.52$)
 $U_n = 250$ V
 $I_n = 5$ A

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

$$Q_I = 3 \cdot U_I \cdot I_I \cdot \sin \varphi = 3 \cdot 230 \cdot 110 \cdot 0.52 = 39.46 \text{ kVAr}$$

$$Q_n = 3 \cdot U_n \cdot I_n \cdot CT \text{ (ratio)} = 3 \cdot 250 \cdot 5 \cdot 60 = 225 \text{ kVAr}$$

$$\frac{P_I}{P_n} = \frac{39.46}{225} = 0.175$$

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

P_I/Q_I (installation power)
 One phase system:

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

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

Three phase, 3-wire system:

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

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

Three phase, 4-wire system:

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

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

where:

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

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

$\cos \varphi$ = the average $\cos \varphi$ 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 WM2-96.

I_n = the rated input current of WM2-96.

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

Mode of Operation (cont.)

Waveform of the signals that can be measured

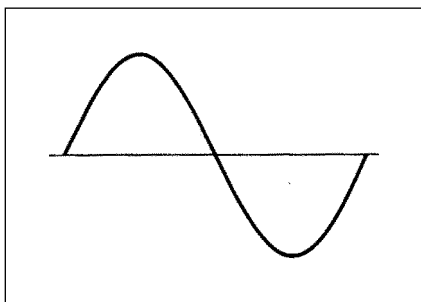


Figure G
Sine wave, undistorted
 Fundamental content 100%
 Harmonic content 0%
 $A_{rms} = 1.1107 | \bar{A} |$

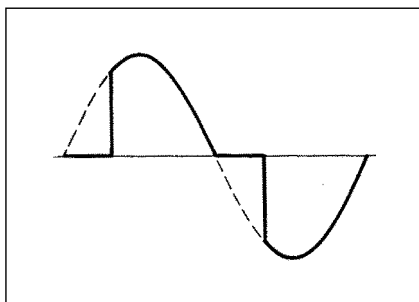


Figure H
Sine wave, indented
 Fundamental content 10...100%
 Harmonic content 0...90%
 Frequency spectrum 3rd to 16th harmonic
 Required result: additional error < 1%

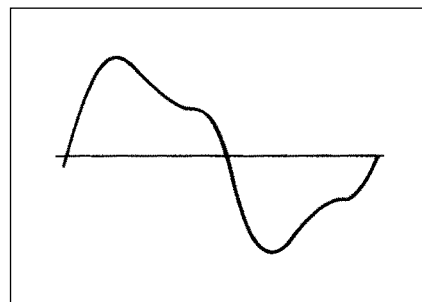
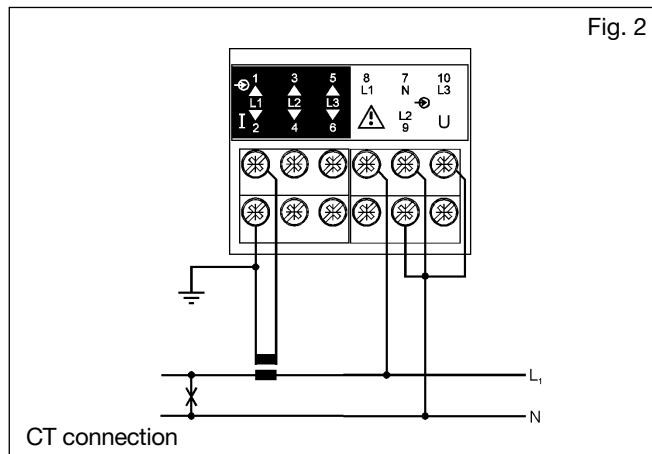
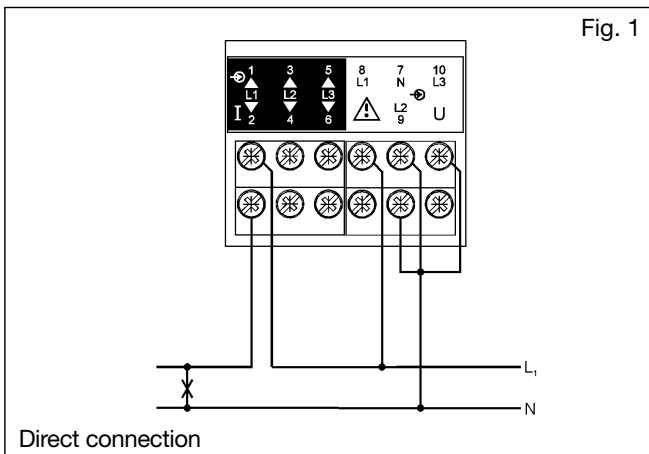


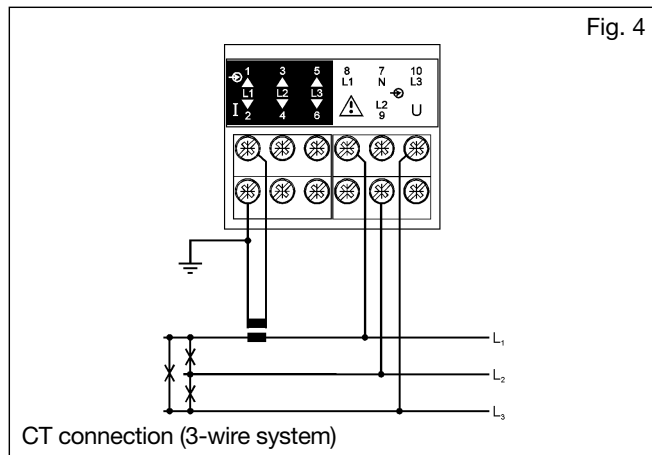
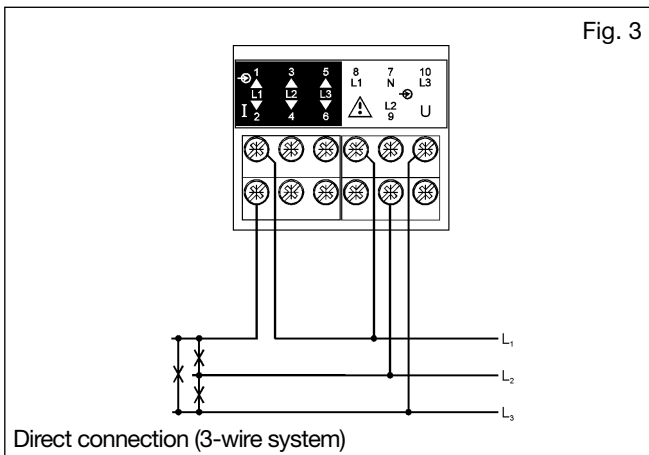
Figure I
Sine wave, distorted
 Fundamental content 70...90%
 Harmonic content 10...30%
 Frequency spectrum 3rd to 15th harmonic
 Required result: additional error < 0.5%

Wiring Diagrams

Single phase input connections

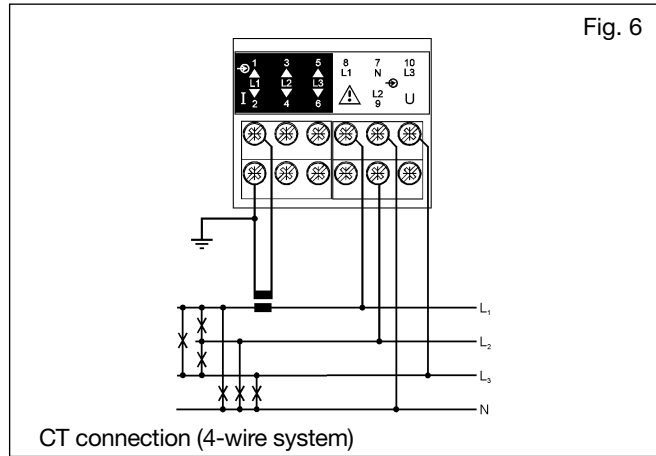
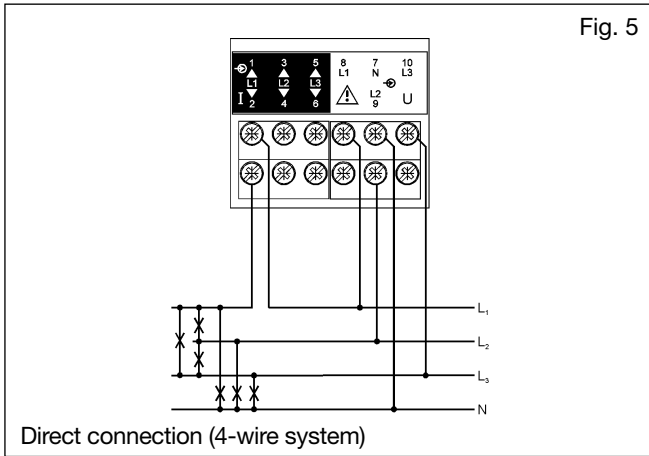


Three phase/3-wire input connections - Balanced loads

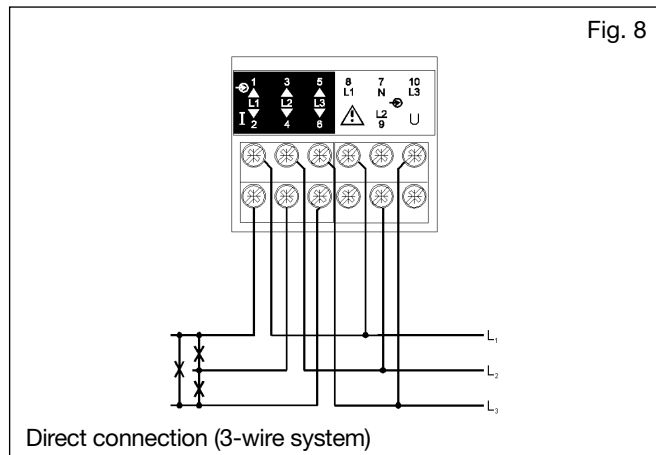
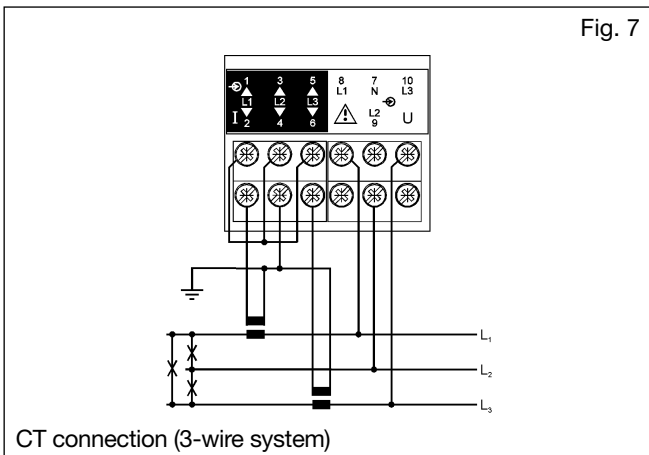


Wiring Diagrams (cont.)

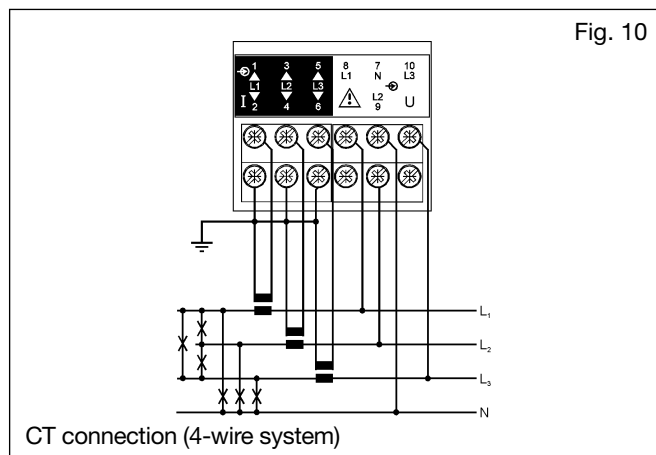
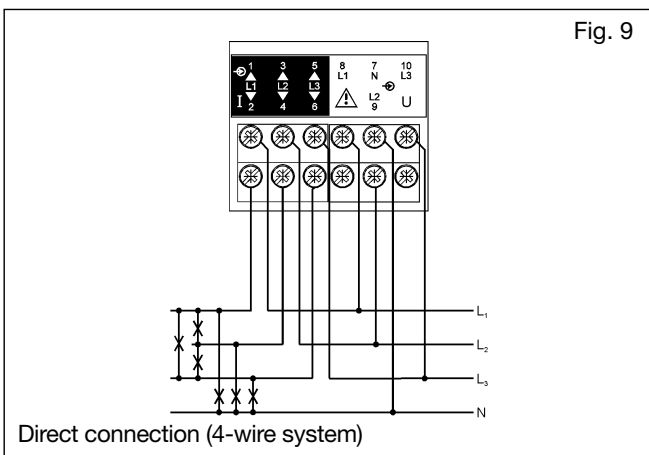
Three phase, 4-wire input connections - Balanced loads



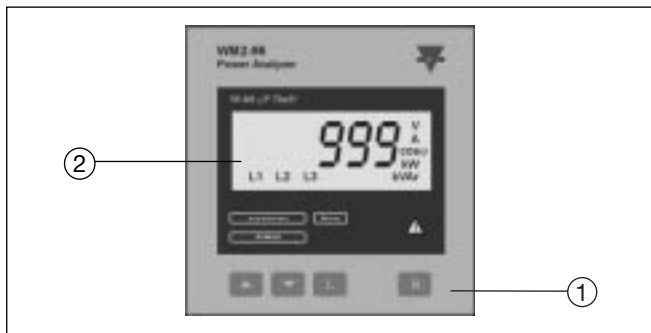
Three-phase, 3-wire input ARON connections - Unbalanced load



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

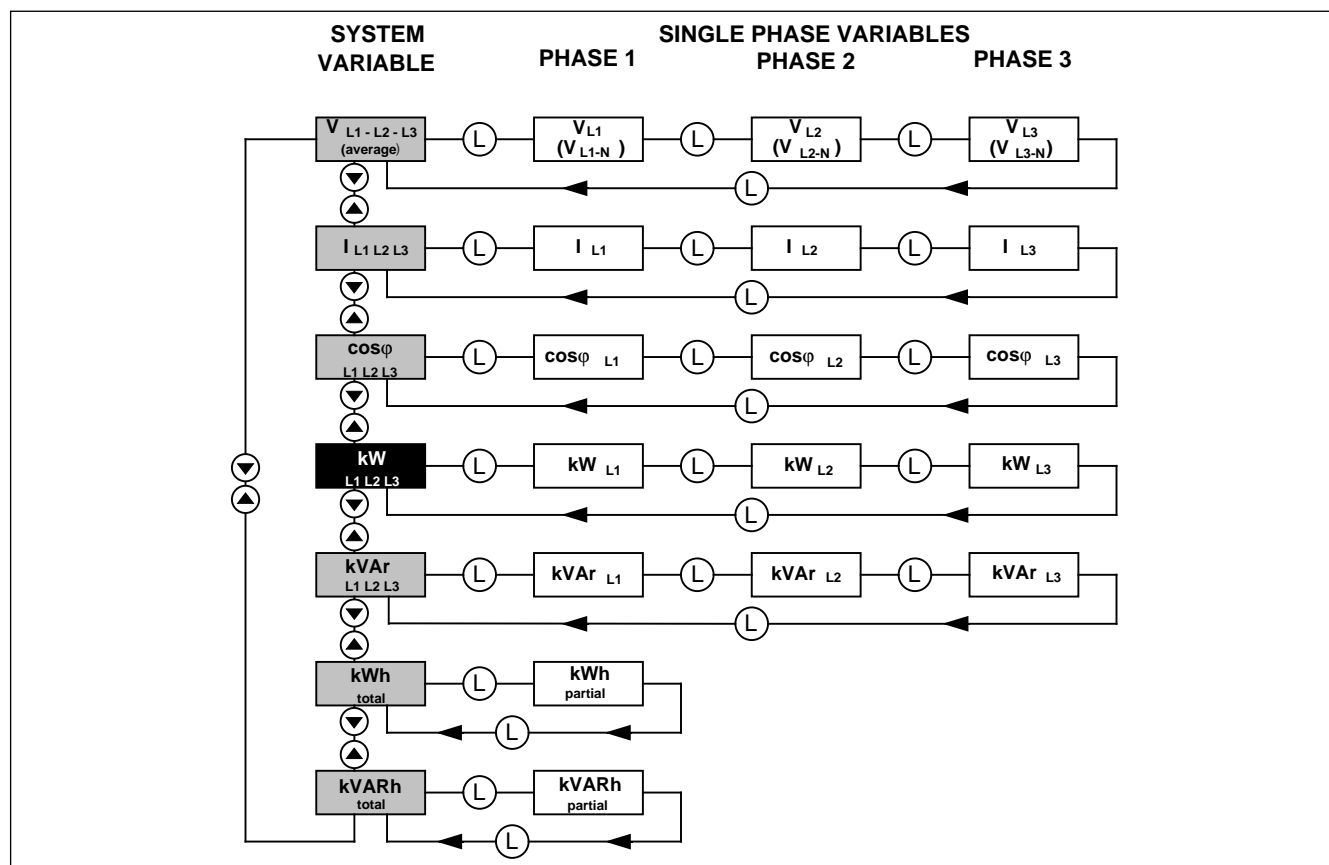
- To enter into the programming procedure and select programming functions together with the ”L” key.
- ”L”:
To scroll all the single phase variable of each basic measurement
- ”R”:
To reset the partial counted energies (kWh, kVARh).

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.

Sequence of the Variables on the Display



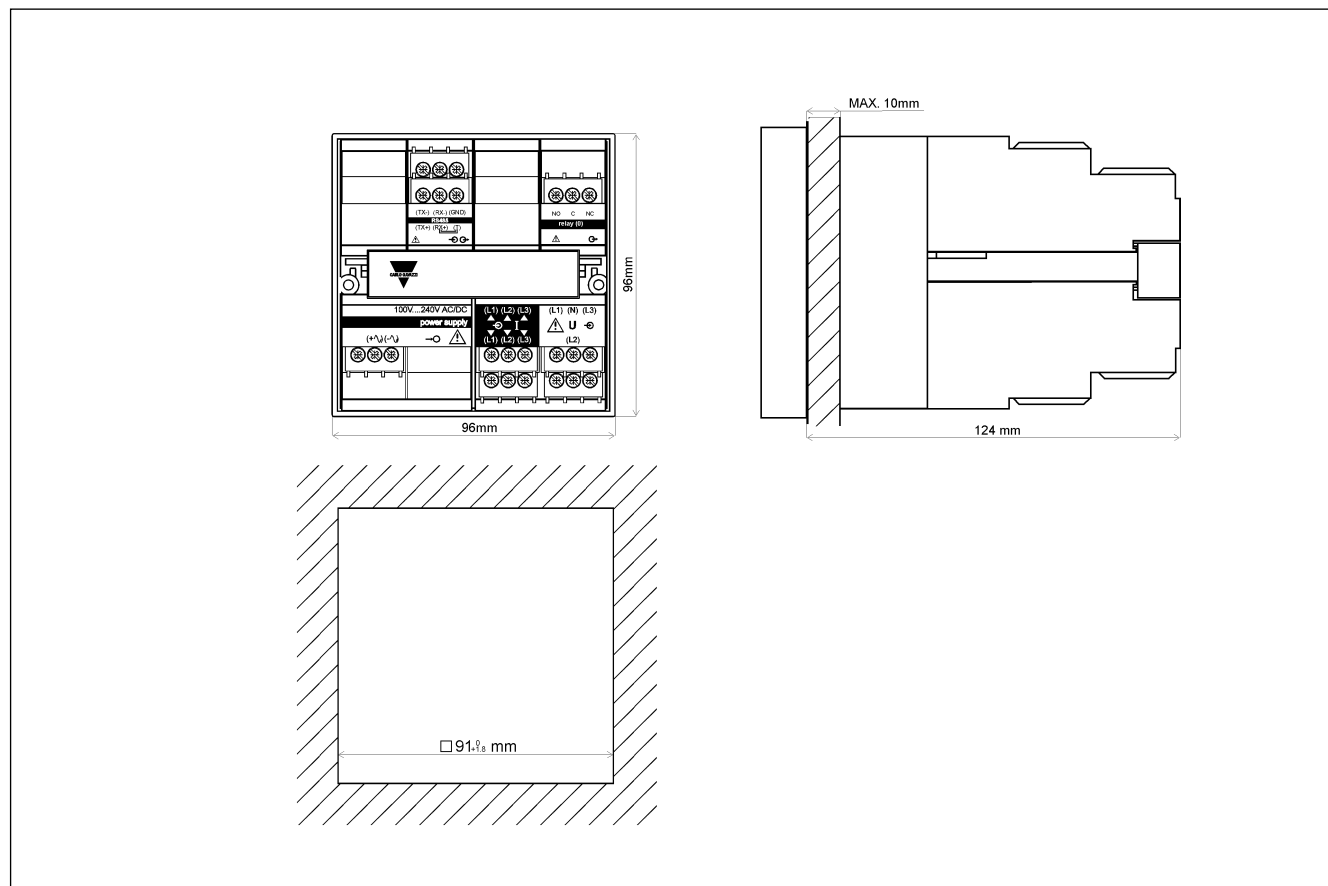
Available Modules

Type	N. of channels	Ordering code	Note
WM2-96 base + AV5.3 input		AB1012	
WM2-96 base + AV7.3 input		AB1013	
24 VAC power supply		AP1025	
48 VAC power supply		AP1024	
115 VAC power supply		AP1023	
230 VAC power supply		AP1022	
18-60 VAC/DC power supply		AP1021	
90-260 VAC/DC power supply		AP1020	
RS485 output	1	AR1034	
Relay output	1	AO1058	
Relay output	2	AO1035	The second output can be used as redundant output
Open collector output	1	AO1059	
Open collector output	2	AO1036	The second output can be used as redundant output

Possible Module Combinations

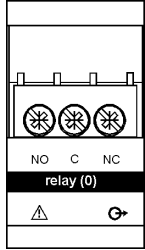
Basic unit	Out 1	Out 2	Basic unit	Out 1	Out 2
RS485 output	●		RS485 output	●	
Single relay output (pulse)		●	Dual relay output (pulse)		●
Single open collector output (pulse)		●	Dual open collector output (pulse)		●

Dimensions

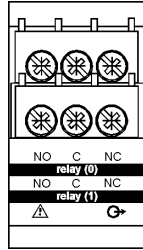


Terminal Boards

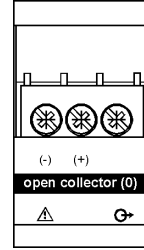
Digital output modules



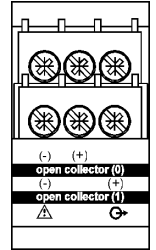
AO1058
Single relay output



AO1035
Dual relay output

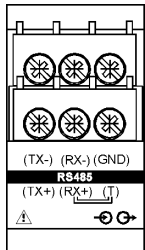


AO1059
Single open collector output



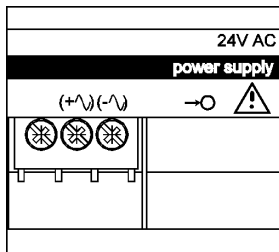
AO1036
Dual open collector output

Other input/output modules

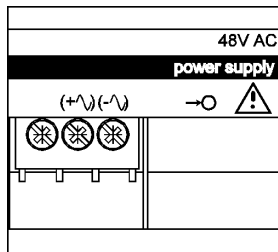


AR1034
RS485 output

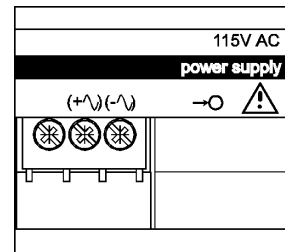
Power supply modules



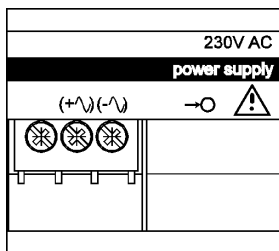
AP1025
24 VAC power supply



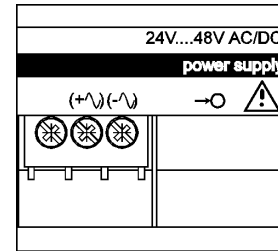
AP1024
48 VAC power supply



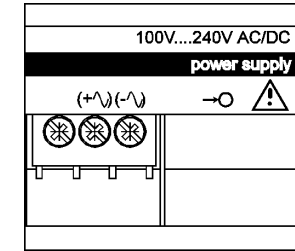
AP1023
115 AC power supply



AP1022
230 VAC power supply



AP1021
18-60 VAC/DC power supply



AP1020
90-260 VAC/DC power supply