

Power analyzers and Energy Meters

Power Analyzer

Type WM14-96

CARLO GAVAZZI



- Optional RS422/485 serial port
- Alarms (visual only) V_{LN} , A_n

- Class 2 (active energy)
- Class 3 (reactive energy)
- Accuracy ± 0.5 F.S. (current/voltage)
- Power analyzer
- Display of instantaneous variables: 3x3 digit
- Display of energies: 8+1 digit
- System variables and phase measurements: W , W_{dmd} , var , VA , VA_{dmd} , PF , V , A , A_n , A_{dmd} , Hz
- A_{max} , $A_{dmd\ max}$, $W_{dmd\ max}$ indication
- Energy measurements: kWh and kvarh
- Hour counter (5+2 DGT)
- TRMS meas. of distorted sine waves (voltages/currents)
- Power supply: 24V, 48V, 115V, 230V 50-60Hz; 18 to 60VDC
- Protection degree (front): IP65
- Front dimensions: 96x96mm

Product Description

3-phase power analyzer with built-in programming key-pad. Particularly recommended for displaying the main electrical variables.

Housing for panel mounting, (front) protection degree IP65 and optional RS485 serial port.

How to order

WM14-96 AV5 3 D X

Model _____
 Range code _____
 System _____
 Power supply _____
 Option _____

Type Selection

Range codes	System	Power supply	Options
AV5: 400/660V _{L-L} /5(6)AAC VL-N: 185 V to 460 V VL-L: 320 V to 800 V AV6: 100/208V _{L-L} /5(6)AAC VL-N: 45 V to 145 V VL-L: 78 V to 250 V Phase current: 0.03A to 6A Neutral current: 0.09 to 6A	3 : 1-2-3-phase, balanced/unbalanced load, with or without neutral	A: 24VAC -15+10%, 50-60Hz B: 48VAC -15+10%, 50-60Hz C: 115VAC -15+10%, 50-60Hz D: 230VAC -15+10%, 50-60Hz 3: 18 to 60VDC	X: None S: RS485 port

Input specifications

Rated inputs Current Voltage	3 (shunt) 4	Sampling rate	1400 samples/s @ 50Hz 1700 samples/s @ 60Hz
Accuracy (display, RS485) (@25°C ±5°C, R.H. ≤60%)	with CT=1 and VT=1 AV5: 1150W-VA-var, FS:230VLN, 400VLL; AV6: 285W-VA-var, FS:57VLN, 100VLL	Display refresh time	700ms
Current	0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A: ±7DGT	Display Type Read-out for instant. var. Read-out for energies	LED, 14mm 3x3 DGT 3+3+3 DGT (Max indication: 999 999 99.9)
Neutral current	0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A: ±7DGT	Read-out for hour counter	1+3+3 DGT (Max. indication: 9 999 9.99)
Phase-phase voltage	±(1.5% FS +1 DGT)	Measurements	Current, voltage, power, power factor, frequency, energy.
Phase-neutral voltage	±(0.5% FS + 1 DGT)	Measuring method	TRMS measurement of distorted waves.
Active and Apparent power,	0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS +5DGT)	Coupling type Crest factor	Direct < 3; max 10A peak
Reactive power	0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS +5DGT)	Input impedance 400/660V _{L-L} (AV5) 100/208V _{L-L} (AV6) Current	1 MΩ ±5% 453 KΩ ±5% ≤ 0.02Ω
Active energy	Class 2 (I start up: 30mA)	Frequency	48 to 62 Hz
Reactive energy	Class 3 (I start up: 30mA)	Overload protection Continuos voltage/current For 500ms: voltage/current	1.2 F.S. 2 Un/36A
Frequency	±0.1%Hz (48 to 62Hz)		
Additional errors Humidity	≤0.3% FS, 60% to 90% RH		
Temperature drift	≤ 200ppm/°C		

RS485 Serial Port Specifications

RS422/RS485 (on request)		Data (bidirectional)	
Type	Multidrop bidirectional (static and dynamic variables)	Dynamic (reading only)	System, phase variables and energies
Connections	2 or 4 wires, max. distance 1200m, termination directly on the instrument	Static (writing only)	All configuration parameters
Addresses	1 to 255, key-pad selectable	Data format	1 start bit, 8 data bit, no parity, 1 stop bit.
Protocol	MODBUS/JBUS	Baud-rate	9600 bit/s

Software functions

Password	Numeric code of max. 3 digits; 2 protection levels of the programming data		Page 3: A L1, A L2, A L3 Page 4: A L1 dmd, A L2 dmd, A L3 dmd
1st level	Password "0", no protection		Page 5: An, An Alarm
2nd level	Password from 1 to 999, all data are protected		Page 6: W L1, W L2, W L3 Page 7: PF L1, PF L2, PF L3 Page 8: var L1, var L2, var L3 Page 9: VA L1, VA L2, VA L3 Page 10: VA Σ, W Σ, var Σ Page 11: VA dmd, W dmd, Hz Page 12: W dmd max Page 13: Wh Page 14: varh Page 15: VL-L Σ, PF Σ, VLN Alarm
System selection	3-phase with/without n, unbal. 3-phase balanced 3-phase ARON 2-phase Single phase		Page 16: A max Page 17: A dmd max Page 18: working hours
Transformer ratio			
CT	1 to 999		
VT	1.0 to 99.9		
Filter			
Operating range	0 to 99.9% of the input electrical scale		
Filtering coefficient	1 to 16		
Filter action	Measurements, alarms, serial output (fundamental variables: V, A, W and their derived ones).	Alarms	Programmable, for the $V_{LN\Sigma}$ and An (neutral current). Note: the alarm is only visual, by means of LED on the front of the instrument.
Displaying		Reset	Independent alarm ($V_{L\Sigma}$, An) max: A dmd, W dmd all counters (Wh, varh, h)
3-phase system with neutral	Up to 3 variables per page Page 1: V L1, V L2, V L3 Page 2: V L12, V L23, V L31		

Power Supply Specifications

Auxiliary power supply	230VAC -15 +10%, 50-60Hz 115VAC -15 +10%, 50-60Hz 48VAC -15 +10%, 50-60Hz		24VAC -15 +10%, 50-60Hz 18 to 60VDC
		Power consumption	AC: 4.5 VA DC: 4W

General Specifications

Operating temperature	0° to +50°C (32° to 122°F) (RH < 90% non condensing)		measuring inputs and RS485. 4kVAC, 500VDC between power supply and RS485
Storage temperature	-10° to +60°C (14° to 140°F) (RH < 90% non condensing)	Dielectric strength	4kVAC (for 1 min)
Installation category	Cat. III (IEC 60664, EN60664)	EMC	
Insulation (for 1 minute)	4kVAC, 500VDC between measuring inputs and power supply. 500VAC/DC between	Emissions	EN50084-1 (class A) residential environment, commerce and light industry

General Specifications (cont.)

Immunity	EN61000-6-2 (class A) industrial environment.	Material	ABS self-extinguishing: UL 94 V-0
Pulse voltage (1.2/50µs)	EN61000-4-5	Mounting	Panel
Safety standards	IEC60664, EN60664	Protection degree	Front: IP65 (standard) Connections: IP20
Approvals	CE, UL and CSA	Weight	Approx. 400 g (pack. incl.)
Connections 5(6) A Max cable cross sect. area	Screw-type 2.5 mm ²		
Housing Dimensions (WxHxD)	96 x 96 x 63 mm		

Display pages

Display variables in a 3-phase system with neutral

No	1 st variable	2 nd variable	3 rd variable	Notes
1	V L1	V L2	V L3	
2	V L12	V L23	V L31	Decimal point blinking on the right of the display
3	A L1	A L2	A L3	
4	A L1 dmd	A L2 dmd	A L3 dmd	dmd = demand (integration time selectable from 1 to 30 minutes)
5	An	AL.n		AL.n if neutral current alarm is active
6	W L1	W L2	W L3	Decimal point blinking on the right of the display if generated power
7	PF L1	PF L2	PF L3	
8	var L1	var L2	var L3	Decimal point blinking on the right of the display if generated power
9	VA L1	VA L2	VA L3	
10	VA system	W system	var system	
11	VA dmd (system)	W dmd (system)	Hz (system)	dmd = demand (integration time selectable from 1 to 30 minutes)
12		W dmd MAX		Maximum sys power demand
13	Wh (MSD)	Wh	Wh (LSD)	The total indication is given in max 3 groups of 3 digits.
14	varh (MSD)	varh	varh (LSD)	The total indication is given in max 3 groups of 3 digits.
15	V LL system	AL.U	PF system	AL.U= is activated only if one of VLN is not within the set limits.
16	A MAX			max. current among the three phases
17	A dmd max			max. dmd current among the three phases
18	h			hour counter

MSD: most significant digit

LSD: least significant digit



1) Example of kWh visualization:

This example is showing 15 933 453.7 kWh

2) Example of kvarh visualization:

This example is showing 3 553 944.9 kvarh



Waveform of the signals that can be measured

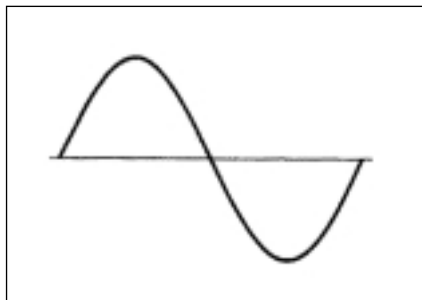


Figure A
Sine wave, undistorted

Fundamental content 100%
Harmonic content 0%
 $A_{rms} = 1.1107 |A|$

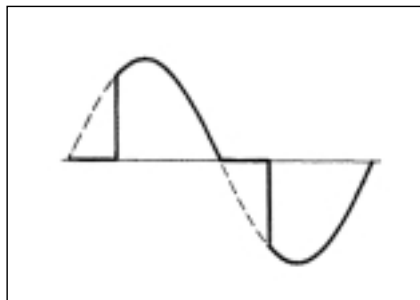


Figure B
Sine wave, indented

Fundamental content 10...100%
Harmonic content 0...90%
Frequency spectrum: 3rd to 16th harmonic
Additional error: <1% FS

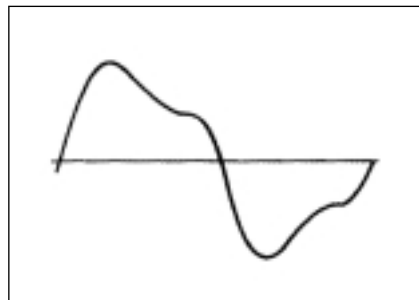
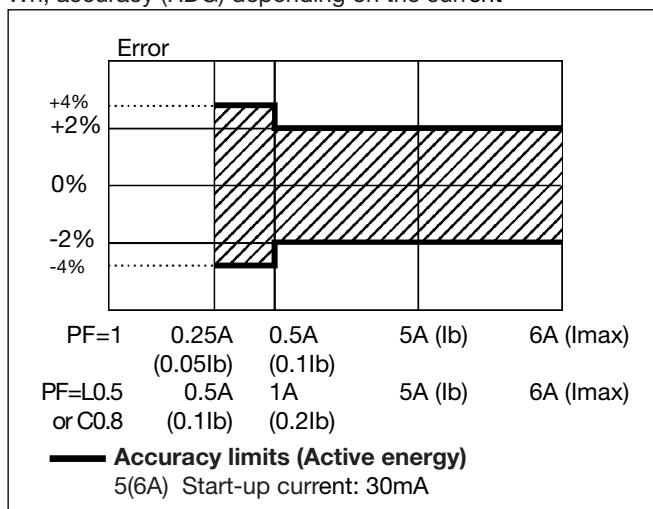


Figure C
Sine wave, distorted

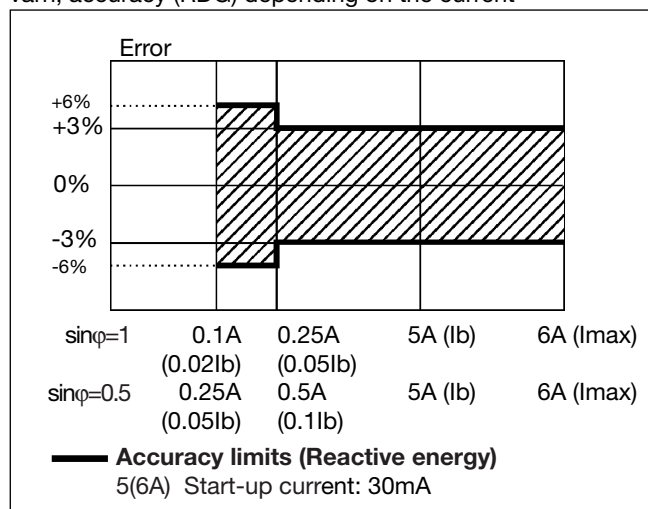
Fundamental content 70...90%
Harmonic content 10...30%
Frequency spectrum: 3rd to 16th harmonic
Additional error: <0.5% FS

Accuracy

Wh, accuracy (RDG) depending on the current



varh, accuracy (RDG) depending on the current



Used calculation formulas

Phase variables

Instantaneous effective voltage

$$V_{IN} = \sqrt{\frac{1}{n} \cdot \sum_{i=1}^n (V_{INi})^2}$$

Instantaneous active power

$$W_1 = \frac{1}{n} \cdot \sum_{i=1}^n (V_{INi}) \cdot (A_1)_i$$

Instantaneous power factor

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

Instantaneous effective current

$$A_1 = \sqrt{\frac{1}{n} \cdot \sum_{i=1}^n (A_1)_i^2}$$

Instantaneous apparent power

$$VA_1 = V_{IN} \cdot A_1$$

Instantaneous reactive power

$$VAR_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

System variables

Equivalent 3-phase voltage

$$V_{\Sigma} = \frac{V_1 + V_2 + V_3}{3} \cdot \sqrt{3}$$

3-phase reactive power

$$VAR_{\Sigma} = (VAR_1 + VAR_2 + VAR_3)$$

3-phase active power

$$W_{\Sigma} = W_1 + W_2 + W_3$$

3-phase apparent power

$$VA_{\Sigma} = \sqrt{(W_{\Sigma})^2 + (VAR_{\Sigma})^2}$$

3-phase power factor

$$\cos\phi_{\Sigma} = \frac{W_{\Sigma}}{VA_{\Sigma}}$$

Neutral current

$$A_n = \bar{A}_{L1} + \bar{A}_{L2} + \bar{A}_{L3}$$

Used calculation formulas (cont.)

Energy metering

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

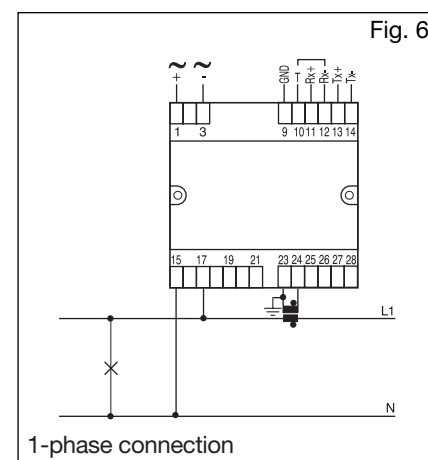
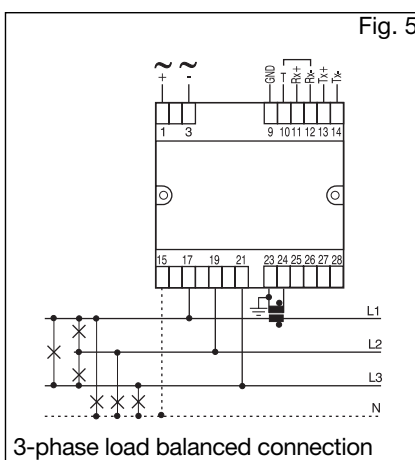
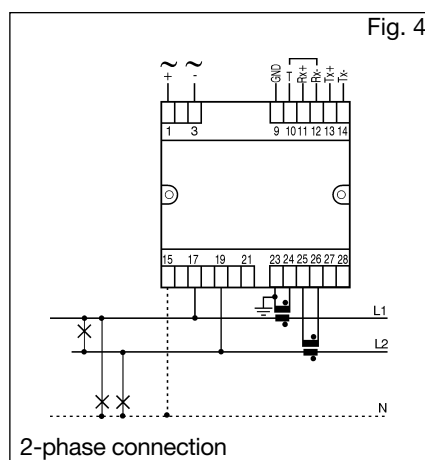
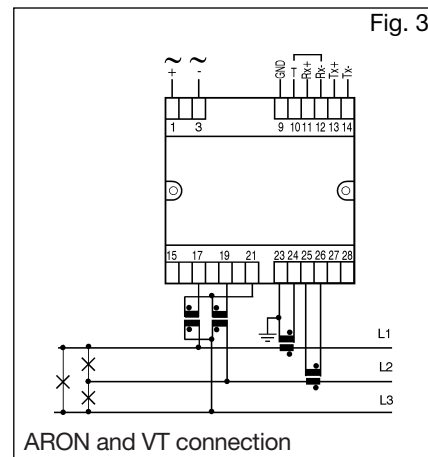
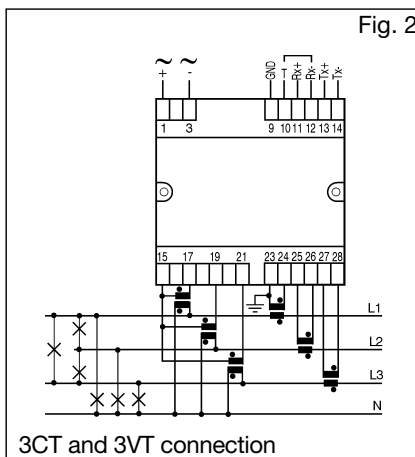
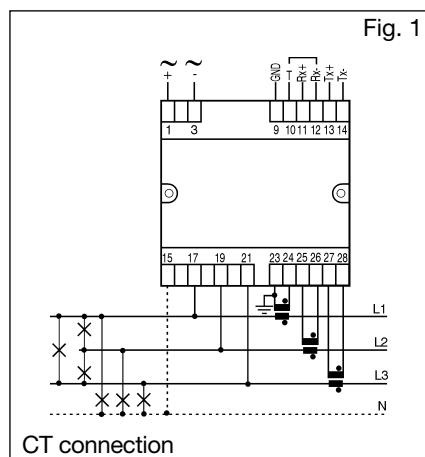
Δt = time interval between two successive power consumptions

n_1, n_2 = starting and ending discrete time points of consumption recording

$$kWh_i = \int_{t_1}^{t_2} P_i(t) dt \approx \Delta t \sum_{n_1}^{n_2} P_{a,i}$$

$$kVarh_i = \int_{t_1}^{t_2} Q_i(t) dt \approx \Delta t \sum_{n_1}^{n_2} Q_{a,i}$$

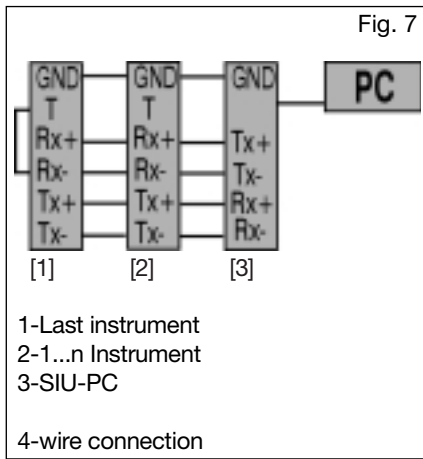
Wiring diagrams



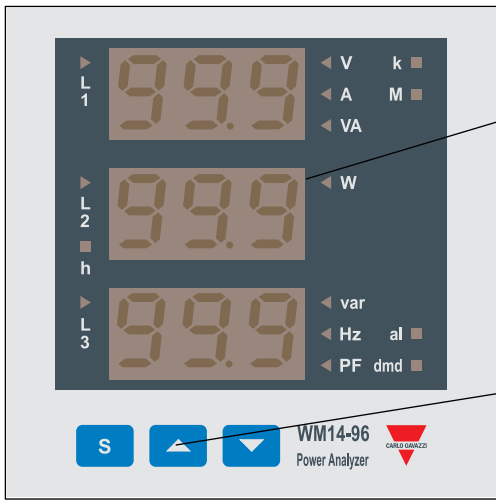
NOTE: the current inputs can be connected to the lines ONLY by means of current transformers. The direct connection is not allowed.



RS485 Serial connection



Front Panel Description



1. **Key-pad**
To program the configuration parameters and the display of the variables.
- S**
Key to enter programming and confirm selections;
- Keys to:
- programme values;
- select functions;
- display measuring pages.
2. **Display**
LED-type with alphanumeric indications to:
- display configuration parameters;
- display all the measured variables.

Dimensions and Panel Cut-out

