Power analyzers and Energy Meters
Power Analyzer
Type WM14-96

CARLO GAVAZZI

- Optional RS422/485 serial port
- Alarms (visual only) V$_{LN}$, An

- 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, An, 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
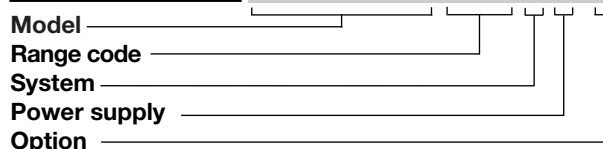- Protection degree (front): IP65
- Front dimensions: 96x96mm

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		Sampling rate	1400 samples/s @ 50Hz 1700 samples/s @ 60Hz
Current	3 (shunt)	**Display refresh time**	700ms
Voltage	4	**Display**	
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	Type Read-out for instant. var.	LED, 14mm 3x3 DGT
Current	0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A: ±7DGT	Read-out for energies	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)		
Active and Apparent power,	0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS +5DGT)	Measuring method	TRMS measurement of distorted waves.
		Coupling type	Direct
Reactive power	0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS +5DGT)	Crest factor	< 3; max 10A peak
Active energy	Class 2 (I start up: 30mA)	**Input impedance**	
Reactive energy	Class 3 (I start up: 30mA)	400/660V$_{L-L}$ (AV5)	1 MΩ ±5%
Frequency	±0.1%Hz (48 to 62Hz)	100/208V$_{L-L}$ (AV6)	453 KΩ ±5%
Additional errors		Current	≤ 0.02Ω
Humidity	≤0.3% FS, 60% to 90% RH	**Frequency**	48 to 62 Hz
Temperature drift	≤ 200ppm/°C	**Overload protection**	
		Continuos voltage/current	1.2 F.S.
		For 500ms: voltage/current	2 Un/36A

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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
		Static (writing only)	All configuration parameters
Connections	2 or 4 wires, max. distance 1200m, termination directly on the instrument	Data format	1 start bit, 8 data bit, no parity, 1 stop bit.
Addresses	1 to 255, key-pad selectable	Baud-rate	9600 bit/s
Protocol	MODBUS/JBUS		

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
System selection	3-phase with/without n, unbal. 3-phase balanced 3-phase ARON 2-phase Single phase		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
Transformer ratio			Page 15: VL-L Σ, PF Σ, VLN Alarm
CT	1 to 999		Page 16: A max
VT	1.0 to 99.9		Page 17: A dmd max
Filter			Page 18: working hours
Operating range	0 to 99.9% of the input electrical scale	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.
Filtering coefficient	1 to 16		
Filter action	Measurements, alarms, serial output (fundamental variables: V, A, W and their derived ones).		
		Reset	Independent alarm (VLΣ, An) max: A dmd, W dmd all counters (Wh, varh, h)
Displaying	Up to 3 variables per page		
3-phase system with neutral	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

Specifications are subject to change without notice   WM14-96DS0904

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		
Connections 5(6) A Max cable cross sect. area	Screw-type 2.5 mm²	**Weight**	Approx. 400 g (pack. incl.)
Housing Dimensions (WxHxD)	96 x 96 x 63 mm		

Display pages

Display variables in a 3-phase system with neutral

No	1st variable	2nd variable	3rd 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:

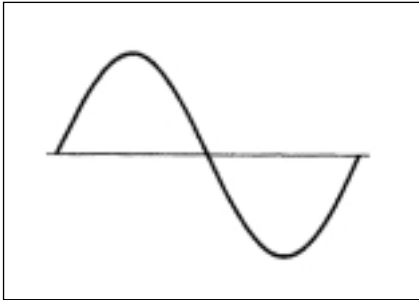This example is showing 15 933 453.7 kWh

2) Example of kvarh visualization:

This example is showing 3 553 944.9 kvarh
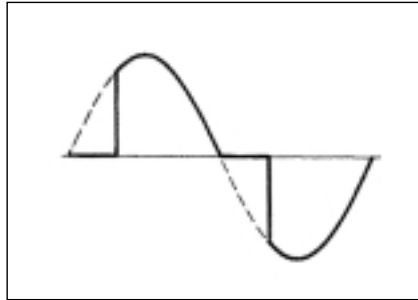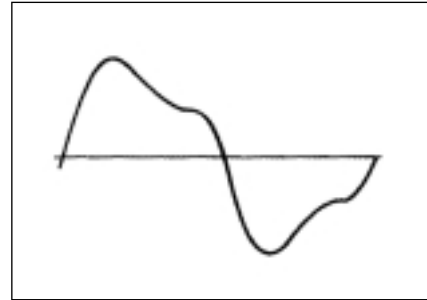
Waveform of the signals that can be measured

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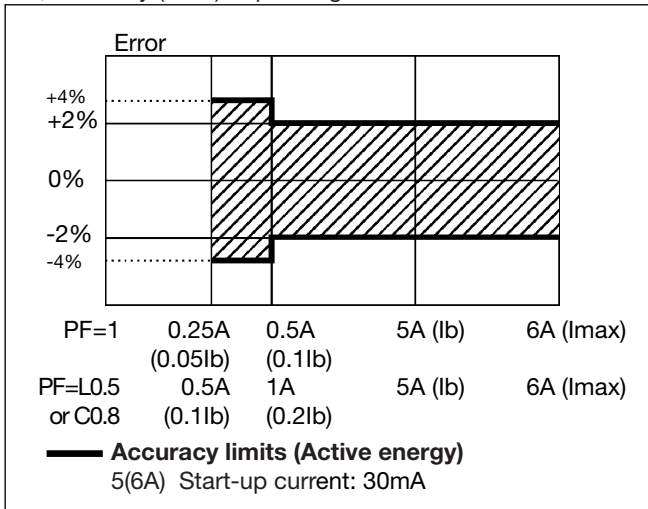A_{rms} =   1.1107 | $\overline{A}$ |

Figure B
Sine wave, indented
Fundamental content   10...100%
Harmonic content   0...90%
Frequency spectrum: 3rd to 16th harmonic
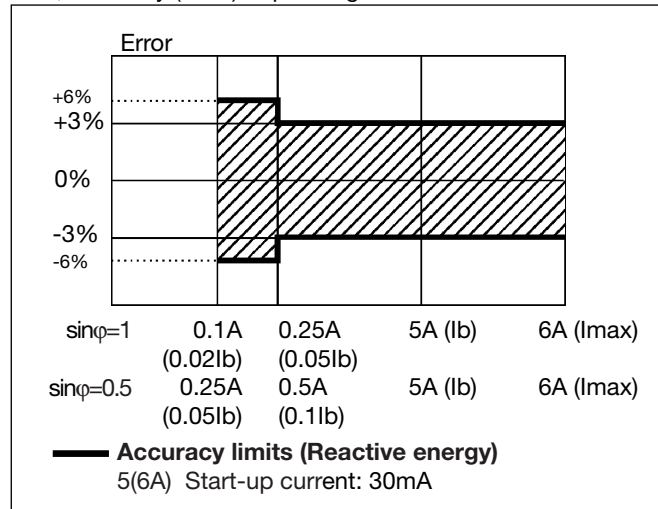Additional error: <1% FS

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

PF=1	0.25A (0.05Ib)	0.5A (0.1Ib)	5A (Ib)	6A (Imax)
PF=L0.5 or C0.8	0.5A (0.1Ib)	1A (0.2Ib)	5A (Ib)	6A (Imax)

— Accuracy limits (Active energy)
5(6A) Start-up current: 30mA

$\sin\varphi$=1	0.1A (0.02Ib)	0.25A (0.05Ib)	5A (Ib)	6A (Imax)
$\sin\varphi$=0.5	0.25A (0.05Ib)	0.5A (0.1Ib)	5A (Ib)	6A (Imax)

— Accuracy limits (Reactive energy)
5(6A) Start-up current: 30mA

Used calculation formulas

Phase variables
Instantaneous effective voltage

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

Instantaneous active power

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

Instantaneous power factor

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

Instantaneous effective current

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

Instantaneous apparent power

$$VA_1 = V_{1N} \cdot A_1$$

Instantaneous reactive power

$$VAr_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

System variables
Equivalent 3-phase voltage

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

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

$$An = \overline{A}_{L1} + \overline{A}_{L2} + \overline{A}_{L3}$$

Used calculation formulas (cont.)

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

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

Energy metering

Where:

i = considered phase (L1, L2 or L3)
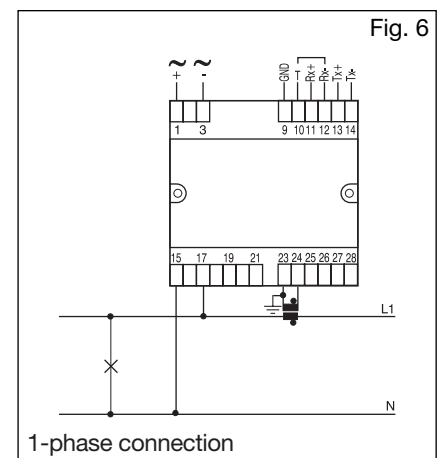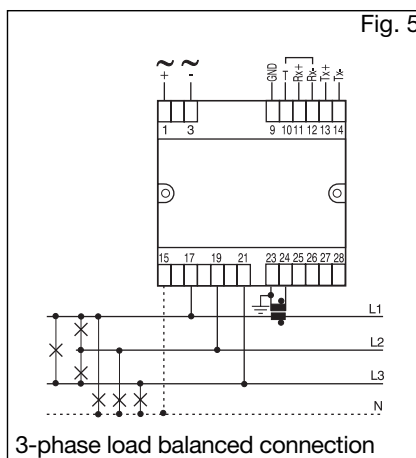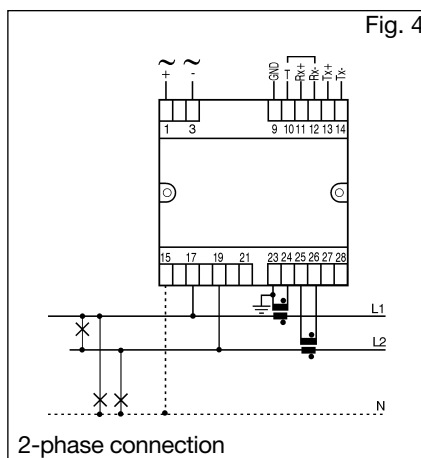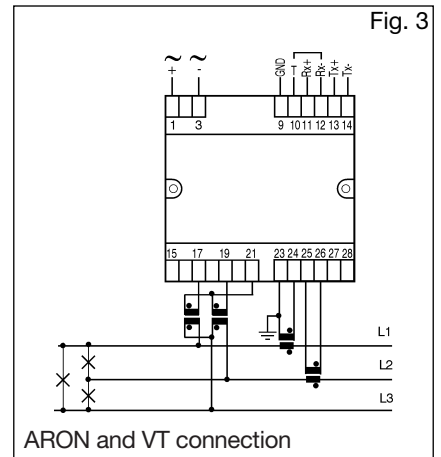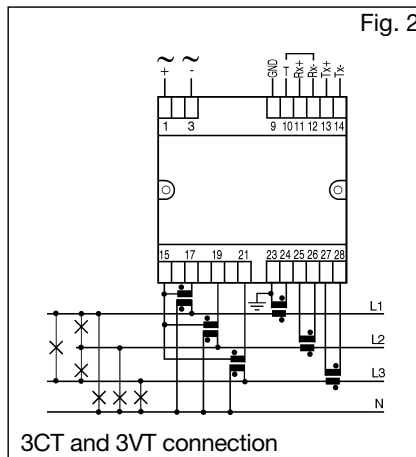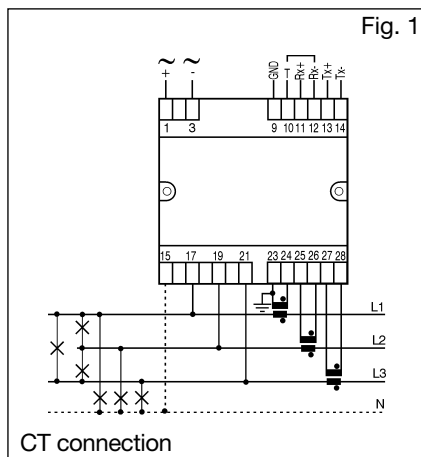
P = active power

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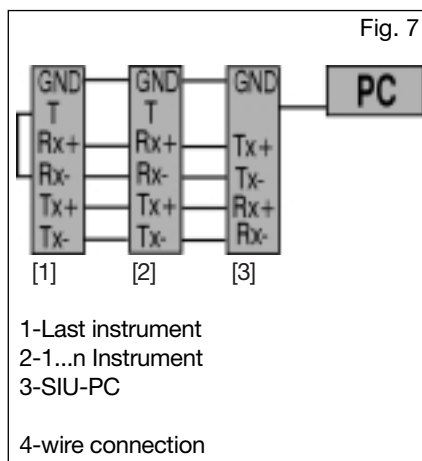
n_1, n_2 = starting and ending discrete time points of consumption recording
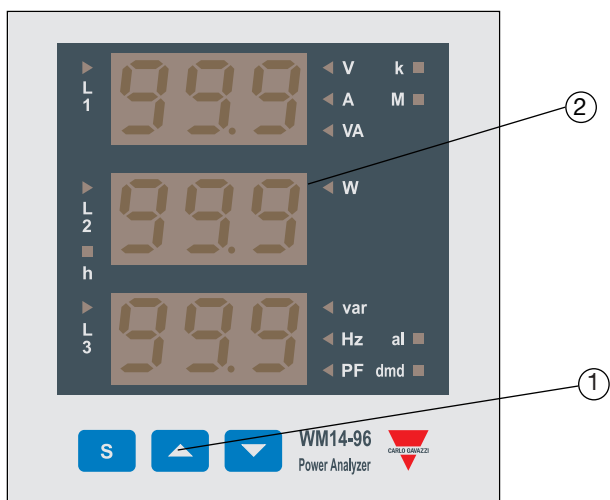
Wiring diagrams

Fig. 1

CT connection

Fig. 2

3CT and 3VT connection

Fig. 3

ARON and VT connection

Fig. 4

2-phase connection

Fig. 5

3-phase load balanced connection

Fig. 6

1-phase connection

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

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RS485 Serial connection

Fig. 7

[1]   [2]   [3]

1-Last instrument
2-1...n Instrument
3-SIU-PC

4-wire 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

96mm

96mm

96mm

61.4mm   15.4mm

91mm