

# Power analyzers and Energy Meters

## Power Analyzer

### Type WM14-96



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

- Class 2 (active energy)
- Class 3 (reactive energy)
- Accuracy  $\pm 0.5$  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 keypad. 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**



### Type Selection

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

### Input specifications

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

Specifications are subject to change without notice WM14-96DS0904



## RS485 Serial Port Specifications

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

## Software functions

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

## Power Supply Specifications

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

## General Specifications

<b>Operating temperature</b>	0° to +50°C (32° to 122°F) (RH < 90% non condensing)	measuring inputs and RS485. 4kVAC, 500VDC between power supply and RS485
<b>Storage temperature</b>	-10° to +60°C (14° to 140°F) (RH < 90% non condensing)	<b>Dielectric strength</b> 4kVAC (for 1 min)
<b>Installation category</b>	Cat. III (IEC 60664, EN60664)	<b>EMC</b>
<b>Insulation</b> (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 <sup>2</sup>		
Housing Dimensions (WxHxD)	96 x 96 x 63 mm		

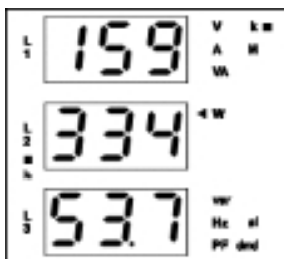
## Display pages

### Display variables in a 3-phase system with neutral

No	1 <sup>st</sup> variable	2 <sup>nd</sup> variable	3 <sup>rd</sup> 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

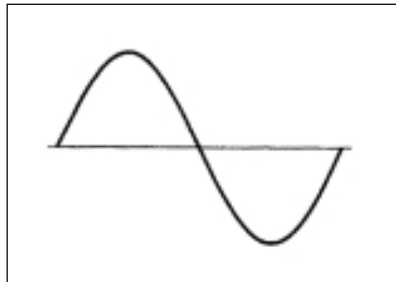
#### 2) Example of kvarh visualization:

This example is showing 3 553 944.9 kvarh

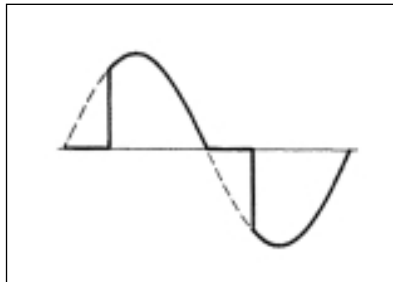




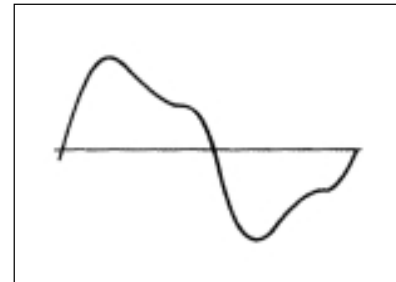
Waveform of the signals that can be measured



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



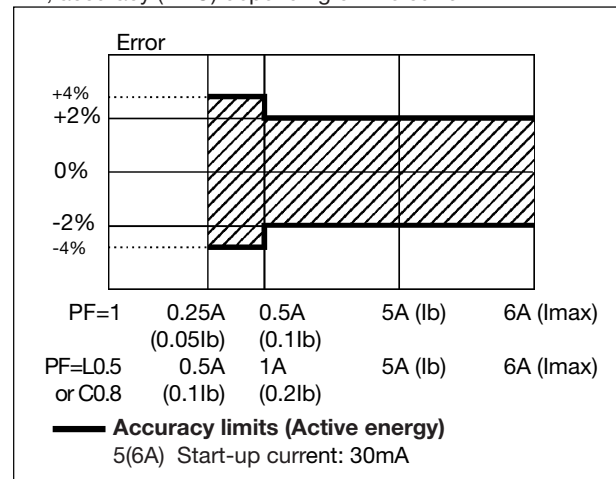
**Figure B**  
**Sine wave, indented**  
 Fundamental content 10...100%  
 Harmonic content 0...90%  
 Frequency spectrum: 3rd to 16th harmonic  
 Additional error: <1% FS



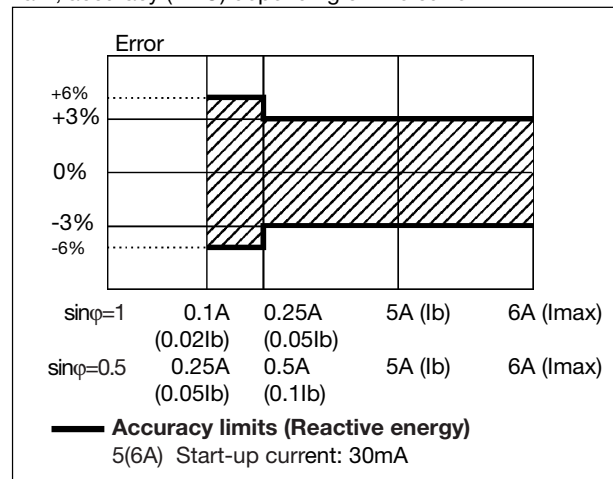
**Figure C**  
**Sine wave, distorted**  
 Fundamental content 70...90%  
 Harmonic content 10...30%  
 Frequency spectrum: 3rd to 16th harmonic  
 Additional error: <0.5% FS

Accuracy

Wh, accuracy (RDG) depending on the current



varh, accuracy (RDG) depending on the current



Used calculation formulas

Phase variables

Instantaneous effective voltage

$$V_{IN} = \sqrt{\frac{1}{n} \cdot \sum_1^n (V_{INi})^2}$$

Instantaneous active power

$$W_1 = \frac{1}{n} \cdot \sum_1^n (V_{INi}) \cdot (A_i)$$

Instantaneous power factor

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

Instantaneous effective current

$$A_1 = \sqrt{\frac{1}{n} \cdot \sum_1^n (A_i)^2}$$

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.)

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

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

### Energy metering

Where:

$i$  = considered phase (L1, L2 or L3)

$P$  = active power

$Q$  = reactive power

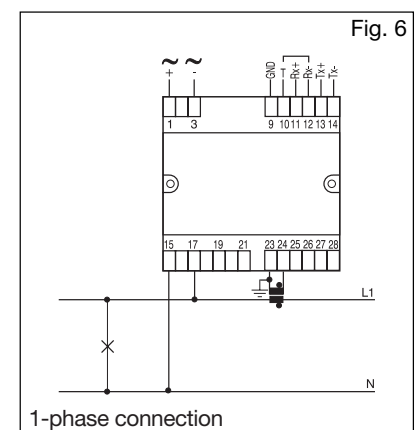
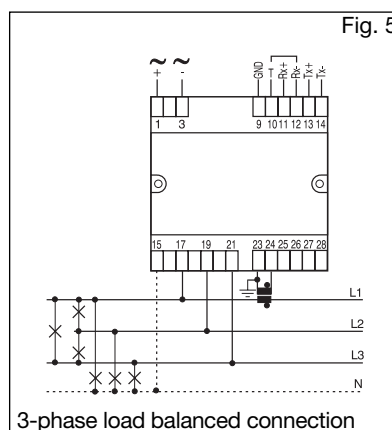
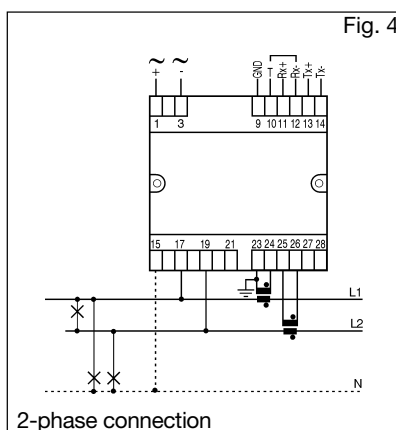
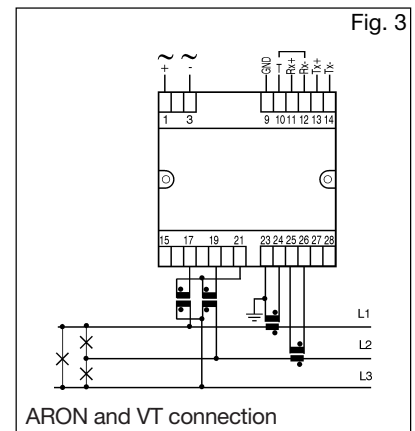
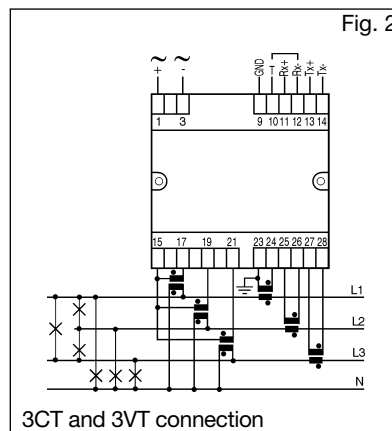
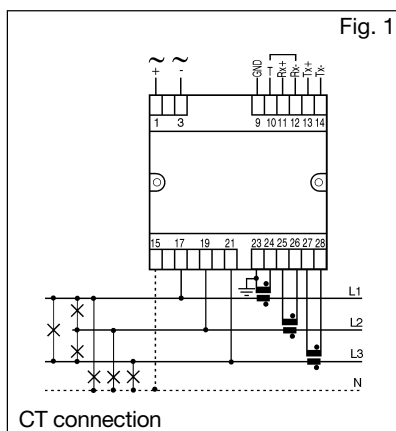
$t_1, t_2$  = starting and ending time points of consumption recording

$n$  = time unit

$\Delta t$  = time interval between two successive power consumptions

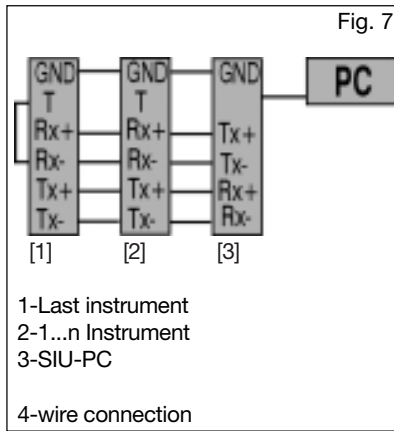
$n_1, n_2$  = starting and ending discrete time points of consumption recording

## Wiring diagrams

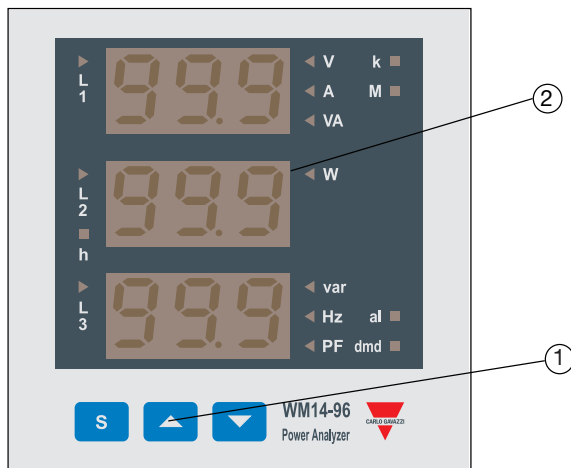


**NOTE:** the current inputs can be connected to the lines ONLY by means of current transformers. The direct connection is not allowed.

## RS485 Serial connection



## Front Panel Description



### 1. Key-pad

To program the configuration parameters and the display of the variables.



Key to enter programming and confirm selections;



Keys to:

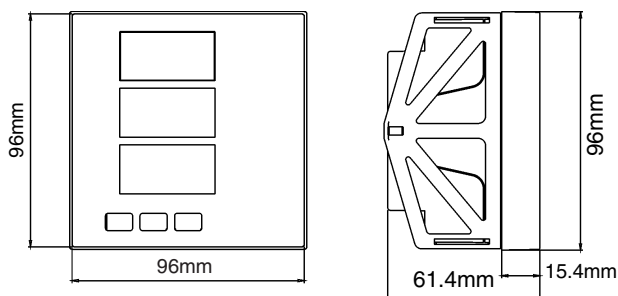
- programme values;
- select functions;
- display measuring pages.

### 2. Display

LED-type with alphanumeric indications to:

- display configuration parameters;
- display all the measured variables.

## Dimensions and Panel Cut-out



<b><u>Abbreviation</u></b>		<b><u>Description</u></b>
LCD	=	Liquid Crystal Display
W	=	Active power
VA	=	Apparent power
var	=	Reactive power
VLL	=	Voltage phase to phase
VLN	=	Voltage phase to neutral
ppm	=	Part per milion
Ib	=	Basic current
I <sub>max</sub>	=	Maximum current
dmd	=	Demanded
CT	=	Current Transformer
VT	=	Voltage Transformer
An	=	Neutral current
TRMS	=	True Root means square
PF	=	Power Factor
Hz	=	Frequency
THD	=	Total Harmonic Distortion
Wh	=	Active Energy
Wh total	=	Total Active Energy
Wh partial	=	Partial Energy
varh	=	Reactive Energy
varh total	=	Total Reactive Energy
varh partial	=	Partial Reactive Energy
R.H.	=	Relative Humidity
SW	=	Software
HW	=	Hardware
Wdmd	=	Demanded Power
VAdmd	=	Demanded Apparent Power
A <sub>max</sub>	=	Maximum current
Wdmd max	=	Maximum Demanded Power
PF avg	=	Average Power Factor