Energy Management Power Analyzer Type WM14-96 "Basic Version"

CARLO GAVAZZI

- Optional dual pulse output
- Alarms (visual only) V_{LN}, An
- Optional galvanically insulated measuring inputs

- Class 1 (active energy)
- Class 2 (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
- Optional RS422/485 serial port

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 or dual pulse output. Parameters programmable by means of CptBSoft.

How to order

WM14-96 AV5 3 D PG

- Model
- Range code
- System
- Power supply
- Option

How to order CptBSoft

CptBSoft (compatible only with S or SG options): software to program the working parameters of the power analyzer and to read the energy and the instantaneous variables.

Type Selection

Range codes	System	Power supply	Options
AV5: 380/660V_{L-L}/5(6)AAC VL-N: 185 V to 460 V VL-L: 320 V to 800 V	**3 :** 1-2-3-phase, balanced/unbalanced load, with or without neutral	**A:** 24VAC -15+10%, 50-60Hz	**X:** None
AV6: 120/208V_{L-L}/5(6)AAC VL-N: 45 V to 145 V VL-L: 78 V to 250 V		**B:** 48VAC -15+10%, 50-60Hz	**S:** RS485 port
Phase current: 0.03A to 6A Neutral current: 0.09 to 6A		**C:** 115VAC -15+10%, 50-60Hz	**SG:** RS485+galvanic insulated measurig inputs
		D: 230VAC -15+10%, 50-60Hz	**PG:** Dual pulse output + galvanically insulated measuring inputs.
		3: 18 to 60VDC (not available in case of SG or PG options)	

Input specifications

Rated inputs			
Current "X-S options"	3 (non insulated each other)	Active energy "X-S option"	0.03A to 0.25A:±(2% FS +5DGT) Class 2 (start up "I": 30mA)
Current "SG-PG options"	3 (insulated each other)	Reactive energy "X-S option"	Class 3 (start up "I": 30mA)
Voltage	4	Active energy "SG-PG opt."	Class 1 (start up "I": 30mA)
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	Reactive energy "SG-PG opt."	Class 2 (start up "I": 30mA)
		Frequency	±0.1Hz (48 to 62Hz)
		Additional errors	
		Humidity	≤0.3% FS, 60% to 90% RH
Current	0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A:±(0.5% FS+7DGT)	**Temperature drift**	≤ 200ppm/°C
Neutral current	0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A:±(0.5% FS+7DGT)	**Sampling rate**	1400 samples/s @ 50Hz 1700 samples/s @ 60Hz
Phase-phase voltage	±(1.5% FS +1 DGT)	**Display refresh time**	700ms
Phase-neutral voltage	±(0.5% FS + 1 DGT)	**Display**	
Active and Apparent power,	0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS +5DGT)	Type Read-out for instant. var. Read-out for energies	LED, 14mm 3x3 DGT 3+3+3 DGT (Max indication: 999 999 99.9)
Reactive power	0.25 to 6A: ±(2% FS +1DGT);		

Input specifications (cont.)

Display (cont.)		Input impedance	(X-S options)
Read-out for hour counter	1+3+3 DGT (Max. indication: 9 999 9.99)	380/660V$_{L-L}$ (AV5)	1 MΩ ±5%
		120/208V$_{L-L}$ (AV6)	453 KΩ ±5%
Measurements	Current, voltage, power, power factor, frequency, energy, TRMS measurement of distorted waves.	Current	≤ 0.02Ω
		Input impedance	**(PG-SG options)**
		380/660V$_{L-L}$ (AV5)	1 MΩ ±1%
		120/208V$_{L-L}$ (AV6)	1 MΩ ±1%
Coupling type	Direct	Current	≤ 0.02Ω
Crest factor	< 3, max 10A peak		
		Frequency	48 to 62 Hz
		Overload protection	
		Continuos voltage/current	1.2 F.S.
		For 500ms: voltge/current	2 Un/36A

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
		Data format	1 bit di start , 8 data bit, no parity, 1 stop bit
Addresses	1 to 255, key-pad selectable	Baud-rate	9600 bit/s
Protocol	MODBUS/JBUS		

CptBSoft software: parameter programming and reading data

CptBSoft	Multi language software to program the working parameters of the power analyzer and to read the energies and the instantaneous variables. The program runs under Windows 95/98/98SE/2000/	Working mode	NT/XP. Two different working modes can be selected: - management of a local RS485 network; - management of communication from a single instrument to PC (RS232);
		Data access	By means of RS485 serial port.

Dual pulse output

Digital outputs (on request)			Electrical life: min 2*10⁵ cycles
Pulse outputs			Mechanial life: 5*10⁶ cycles
Number of outputs	2 (one for kWh one for kvarh)	Pulse duration	≥100ms <120ms (ON)
Number of pulses	From 0.01 to 999 in compliance with the following formula:		≥100ms (OFF) According to EN622053-31
	[**Psys max** (kW or kvar)**pulses** (pulses/kWh or kvarh)] **<14400**	Insulation	By means of relays, 4000 V$_{RMS}$ outputs to measuring inputs, 4000 V$_{RMS}$ output to supply input.
Output type	Relay min current 0.05A@250VAC/30VDC max current 5A@250VAC/30VDC		Insulation between the two outputs: 1000V$_{RMS}$

Software functions

Password	Numeric code of max. 3 digits; 2 protection levels of the programming data		Page 5: An, An Alarm
Page 6: W L1, W L2, W L3
Page 7: PF L1, PF L2, PF L3
1st level	Password "0", no protection		Page 8: var L1, var L2, var L3
Page 9: VA L1, VA L2, VA L3
2nd level	Password from 1 to 999, all data are protected		Page 10: VA $\sum$, W $\sum$, var $\sum$
Page 11: VA dmd, W dmd, Hz
System selection	3-phase with/without n, unbal.
3-phase balanced
3-phase ARON, unbalanced
2-phase
Single phase		Page 12: W dmd max (*)
Page 13: Wh (*)
Page 14: varh (*)
Page 15: VL-L $\sum$, PF $\sum$, VLN Alarm
Page 16: A max (*)
Page 17: A dmd max (*)
Page 18: hour counter (*)
(*) = These variables are stored in EEPROM when the instrument is switched off
Transformer ratio
CT
VT	1 to 999
1.0 to 99.9		
Filter
Operating range	0 to 100% of the input display scale	**Alarms**	Programmable, for the VL$\sum$ and An (neutral current).
Note: the alarm is only visual, by means of LED on the front of the instrument.
Filtering coefficient
Filter action	1 to 16
Measurements, alarms, serial out. (fundamental var: V, A, W and their derived ones).		
Displaying
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
Page 3: A L1, A L2, A L3
Page 4: A L1 dmd, A L2 dmd, A L3 dmd	**Reset**	Independent
alarm (VL$\sum$, An)
max: A dmd, W dmd
all energies (Wh, varh) and hour counter

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)		mesuring inputs and RS485. 4000VAC, 500VDC between power supply and RS485
Storage temperature	-30 to +60°C (-22 to 140°F)
(RH < 90% non condensing)	**Dielectric strength**	4000 VAC (for 1 min)
Installation category	Cat. III (IEC 60664, EN60664)	**EMC**	
Insulation (for 1 minute)	4000VAC, 500VDC between mesuring inputs and power supply. 500VAC/DC between	Emissions	EN50084-1 (class A) residential environment, commerce and light industry

General Specifications (cont.)

EMC (cont.)	
Immunity	EN61000-6-2 (class A) industrial environment.
Pulse voltage (1.2/50µs)	EN61000-4-5
Safety standards	IEC60664, EN60664
Approvals	CE, cULus
Connections 5(6) A	Screw-type
Max cable cross sect. area	2.5 mm²

Housing	
Dimensions (WxHxD)	96 x 96 x 63 mm
Material	ABS self-extinguishing: UL 94 V-0
Mounting	Panel
Protection degree	Front: IP65 (standard), NEMA4x, NEMA12 Connections: IP20
Weight	Approx. 400 g (pack. incl.)

Display pages

Display variables in 3-phase systems (in a 3-phase system with neutral)

No	1st variable	2nd variable	3rd variable	Note
1	V L1	V L2	V L3	
2	V L12	V L23	V L31 of the display	Decimal point blinking on the right
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

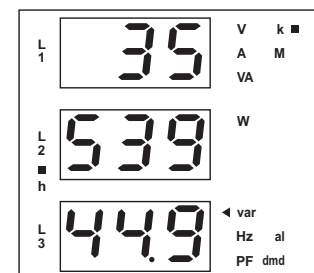MSD: most significant digit
LSD: least significant digit
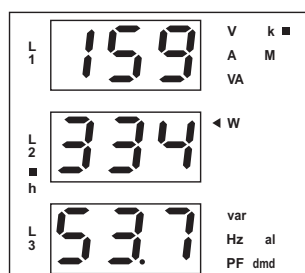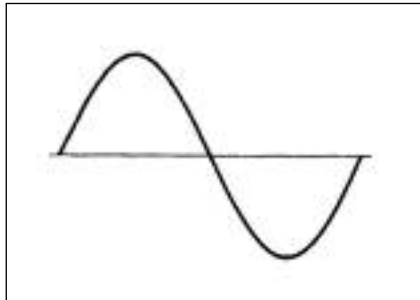
1) Example of kWh visualization:

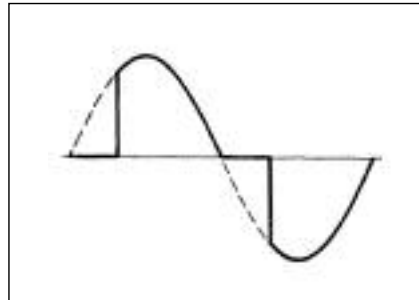This example is showing 15 933 453.7 kWh

2) Example of kvarh visualization:
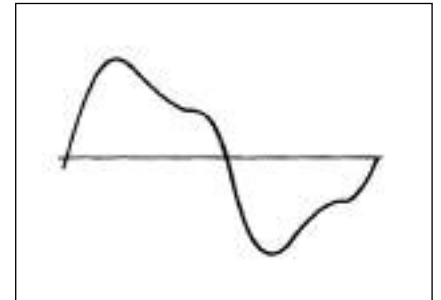
This example is showing 3 553 944.9 kvarh

Waveform of the signals that can be measured

Figure A
Sine wave, undistorted

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

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

kWh, accuracy (RDG) depending on the current
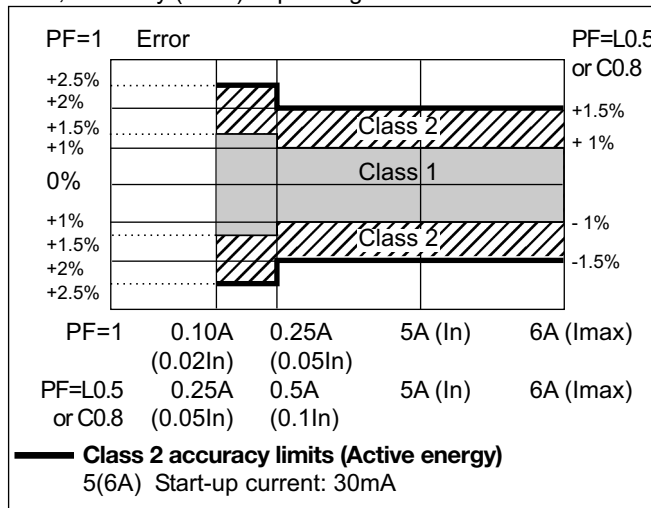
Class 2 accuracy limits (Active energy)
5(6A) Start-up current: 30mA

kvarh, accuracy (RDG) depending on the current

Class 3 accuracy limits (Reactive energy)
5(6A) Start-up current: 30mA
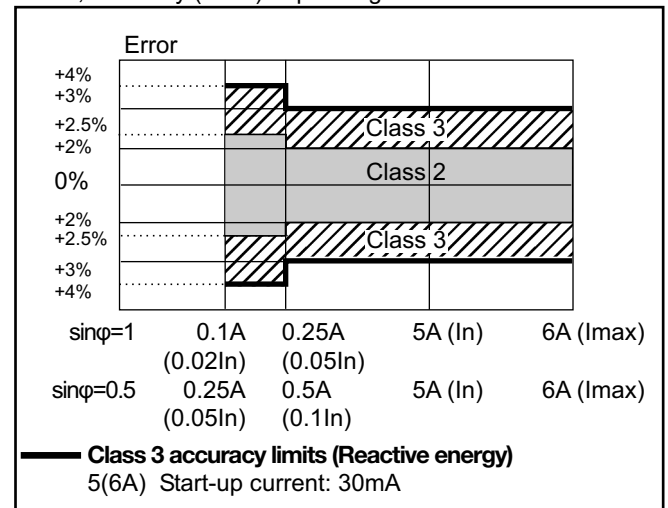
: this graph is only referred to instrument models with the "SG or PG" option.

: this graph is only referred to instrument models with the "X or S" option.

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.)

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

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

Energy metering

Where:

i = considered phase (L1, L2 or L3)

P = active power

Q = reactive power

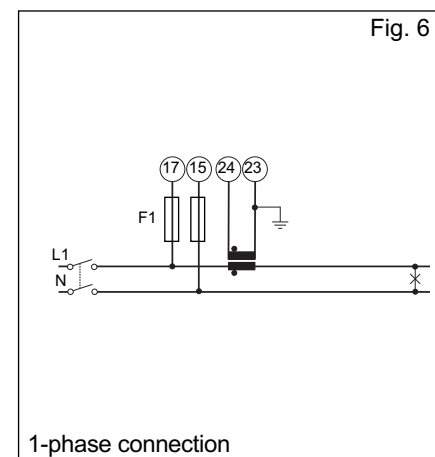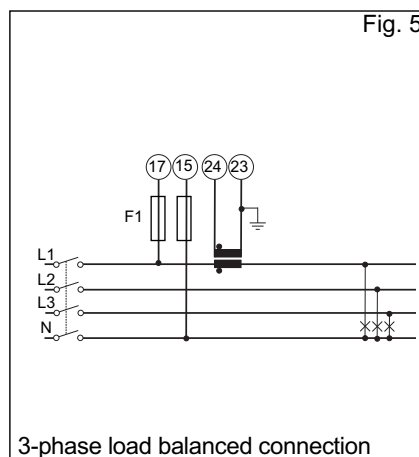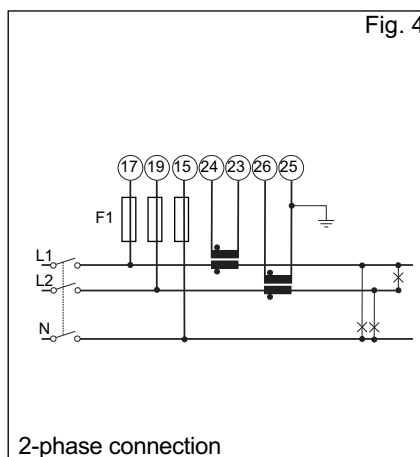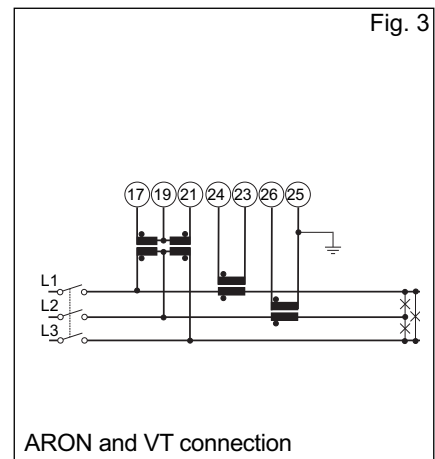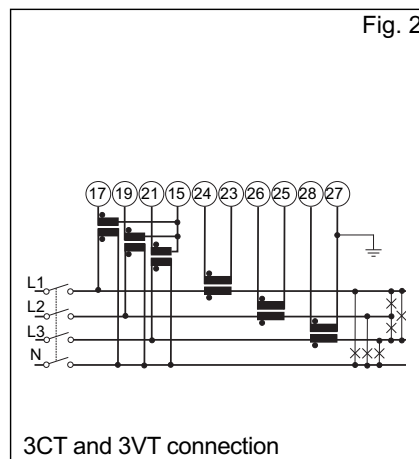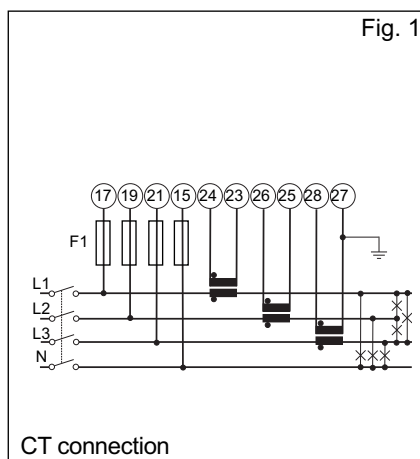t_1, t_2 = starting and ending time points of consumption recording

n = time unit

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

F1= 315mA

NOTE: Only for **"PG"** and **"SG"** options: the current measuring inputs are galvanically insulated and therefore they can be connected to ground singly.

NOTE: For all models except for **"PG"** or **"SG"** the current inputs can be connected to the lines ONLY by means of current transformers. The direct connection is not allowed.

ATTENTION: only one ammeter input can be connected to earth, as shown in the electrical diagrams.
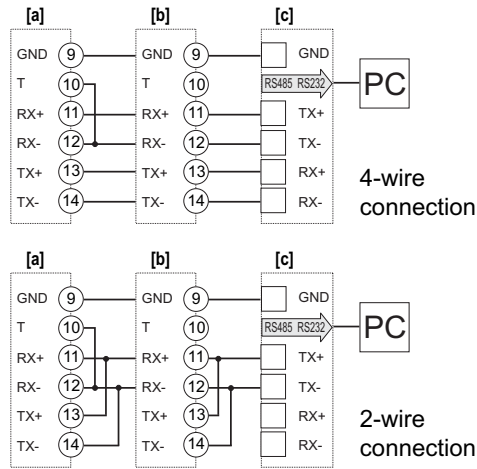
RS485 port connections

Fig. 7: **a**-Last instrument; **b**-1...n Instrument **c**-RS485/232 serial converter
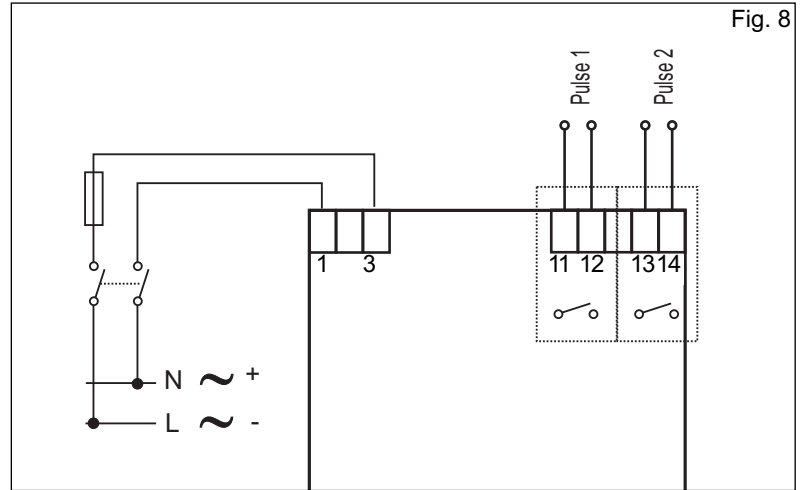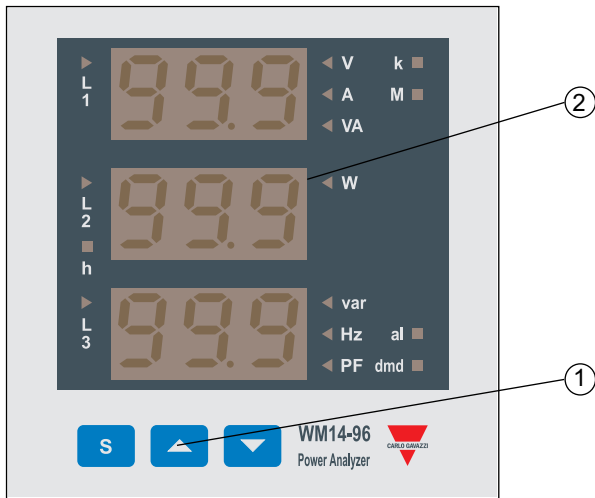
Dual pulse output connections

Fig. 8

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