Energy Management Power Analyzer Type WM14-96 "Profibus DP"

CARLO GAVAZZI

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

- 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)
- Galvanically insulated measuring inputs
- Profibus DP-V0 serial port
- Alarms (visual only) V_{LN}, An
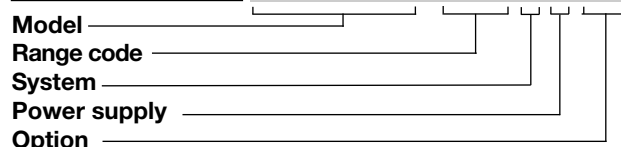- Power supply: 90 to 260VAC/DC

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 Profibus DP communication port.

How to order   WM14-96   AV5 3 H DG

Model
Range code
System
Power supply
Option

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 **AV6:** 120/208V_{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	**H:** 90 to 260VAC/DC	**DG:** Profibus DP + galvanic insulated measuring inputs

Input specifications

Rated inputs	
Current	3
Voltage	4
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
Current	0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A: ±(0.5% FS+7DGT)
Neutral current	0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A: ±(0.5% FS+7DGT)
Phase-phase voltage	±(1.5% FS +1 DGT)
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)
Reactive power	0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS +5DGT)
Active energy	Class 1 (start up "I": 30mA)
Reactive energy	Class 2 (start up "I": 30mA)

Frequency	±0.1Hz (48 to 62Hz)
Additional errors	
Humidity	≤0.3% FS, 60% to 90% RH
Temperature drift	≤ 200ppm/°C
Sampling rate	1400 samples/s @ 50Hz 1700 samples/s @ 60Hz
Display refresh time	700ms
Display	
Type	LED, 14mm
Read-out for instant. var.	3x3 DGT
Read-out for energies	3+3+3 DGT (Max indication: 999 999 99.9)
Read-out for hour counter	1+3+3 DGT (Max. indication: 9 999 9.99)
Measurements	Current, voltage, power, power factor, frequency, energy, TRMS measurement of distorted waves.
Coupling type	Direct

Input specifications (cont.)

Crest factor	< 3, max 10A peak	**Frequency**	48 to 62 Hz
Input impedance		**Overload protection**	
380/660V$_{L-L}$ (AV5)	1 MΩ ±1%	Continuous voltage/current	1.2 F.S.
120/208V$_{L-L}$ (AV6)	1 MΩ ±1%	For 500ms: voltage/current	2 Un/36A
Current	≤ 0.02Ω		

Profibus DP Serial Port Specifications

Profibus		Data	
Type	DP-V0 enable only for data reading	Dynamic (reading only)	System, phase variables and energies
Connections	max distance (1200m @ 9.6kbit/s, 100m @ 6Mbit/s) according to IEC61158, 9-pole connector and 10 screw terminals block.	Baud-rate	Up to 6Mbit/s (mainly depending on the length of the wiring and on the number of instruments belonging to the network)
Addresses	1 to 125, key-pad selectable		
Protocol	Profibus DP-V0		

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
2nd level	Password from 1 to 999, all data are protected		Page 9: VA L1, VA L2, VA L3
			Page 10: VA Σ, W Σ, var Σ
System selection	3-phase with/without n, unbal.		Page 11: VA dmd, W dmd, Hz
	3-phase balanced		Page 12: W dmd max (*)
	3-phase ARON, unbalanced		Page 13: Wh (*)
	2-phase		Page 14: varh (*)
	Single phase		Page 15: VL-L Σ, PF Σ, VLN Alarm
Transformer ratio			Page 16: A max (*)
CT	1 to 999		Page 17: A dmd max (*)
VT	1.0 to 99.9		Page 18: hour counter (*)
Filter			(*) = These variables are stored in EEPROM when the instrument is switched off
Operating range	0 to 100% of the input display scale		
Filtering coefficient	1 to 16	**Alarms**	Programmable, for the VLNΣ and An (neutral current). Note: the alarm is only visual, by means of LED on the front of the instrument.
Filter action	Measurements, alarms, serial out. (fundamental var: V, A, W and their derived ones).		
Displaying	Up to 3 variables per page	**Reset**	Independent for: alarm (VLNΣ, An) max: A dmd, W dmd all energies (Wh, varh) and hour counter
3-phase system with neutral	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		

Power Supply Specifications

Auxiliary power supply	90 to 260 VAC/DC	**Power consumption**	AC: 4.5 VA DC: 4W

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General Specifications

Operating temperature	0 to +50°C (32 to 122°F) (RH < 90% non condensing)	**EMC (cont.)** Immunity	EN61000-6-2 (class A) industrial environment.
Storage temperature	-10 to +60°C (14 to 140°F) (RH < 90% non condensing)	**Pulse voltage (1.2/50µs)**	EN61000-4-5
Installation category	Cat. III (IEC 60664, EN60664)	**Safety standards**	IEC60664, EN60664
Insulation (for 1 minute)	4000VAC between measuring inputs and power supply. 2000VAC between measuring inputs and the communication port. 2000VAC between power supply and the communication port.	**Approvals**	CE
		Connections 5(6) A Max cable cross sect. area	Screw-type 2.5 mm^2
		Housing Dimensions (WxHxD) Material	96 x 96 x 63 mm ABS self-extinguishing: UL 94 V-0
Dielectric strength	4000 VAC (for 1 min)	**Mounting**	Panel
EMC Emissions	EN50084-1 (class A) residential environment, commerce and light industry	**Protection degree**	Front: IP65 (standard) 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	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
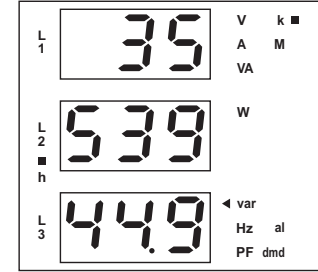LSD: least significant digit

Display pages (cont.)
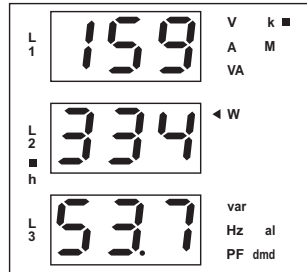
1) Example of kWh visualization:

This example is showing 15 933 453.7 kWh

2) Example of kvarh visualization:

This example is showing 3 553 944.9 kvarh

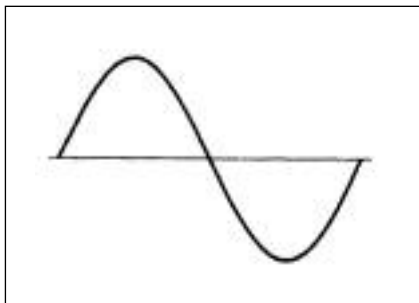# Waveform of the signals that can be measured

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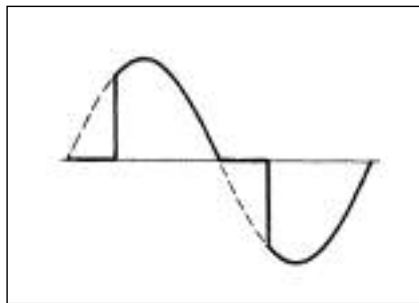Harmonic content   0%
$A_{rms} =$ 1.1107 | $\overline{A}$ |

Figure B
Sine wave, indented
Fundamental content   10...100%
Harmonic content   0...90%
Frequency spectrum: 3rd to 16th harmonic
Additional error: <1% FS
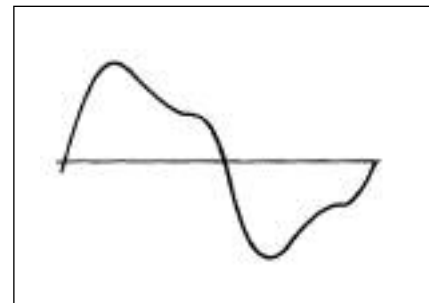
Figure C
Sine wave, distorted
Fundamental content   70...90%
Harmonic content   10...30%
Frequency spectrum: 3rd to 16th harmonic
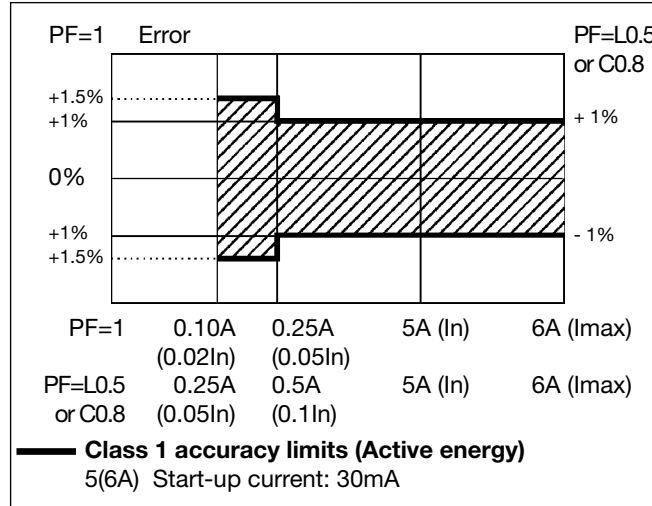Additional error: <0.5% FS

Insulation between inputs and outputs

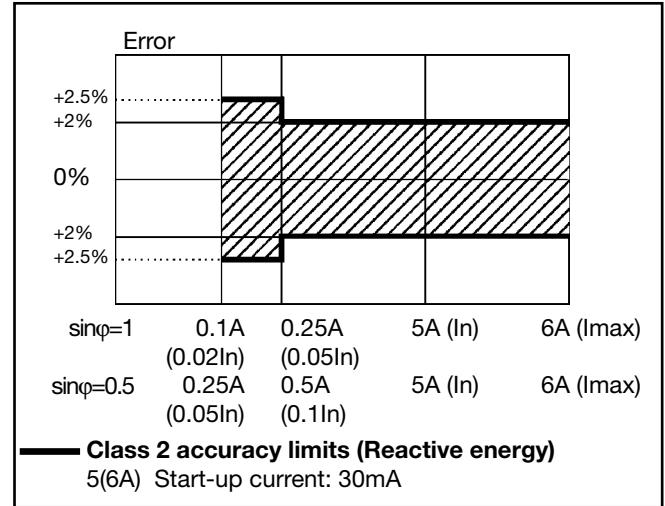|	Measuring Inputs V	Measuring Inputs A	Profibus Port	Power Supply
Measuring Inputs V	-	-	2kV	4kV
Measuring Inputs A	-	-	2kV	4kV
Profibus Port	2kV	2kV	-	2kV
Power supply	4kV	4kV	2kV	-

NOTE: In case of fault of first insulation the current from the measuring inputs to the ground is lower than 2 mA.

Accuracy

kWh, accuracy (RDG) depending on the current

| PF=1 | 0.10A (0.02In) | 0.25A (0.05In) | 5A (In) | 6A (Imax) |
| PF=L0.5 or C0.8 | 0.25A (0.05In) | 0.5A (0.1In) | 5A (In) | 6A (Imax) |

Class 1 accuracy limits (Active energy)
5(6A) Start-up current: 30mA

kvarh, accuracy (RDG) depending on the current

| sinφ=1 | 0.1A (0.02In) | 0.25A (0.05In) | 5A (In) | 6A (Imax) |
| sinφ=0.5 | 0.25A (0.05In) | 0.5A (0.1In) | 5A (In) | 6A (Imax) |

Class 2 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

$$\cos\varphi_1 = \frac{W_1}{VA_1}$$

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

$$\text{var}_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

System variables
Equivalent 3-phase voltage

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

3-phase reactive power

$$\text{var}_\Sigma = (\text{var}_1 + \text{var}_2 + \text{var}_3)$$

3-phase active power

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

3-phase apparent power

$$VA_\Sigma = \sqrt{W_\Sigma^2 + \text{var}_\Sigma^2}$$

3-phase power factor

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

Neutral current

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

$$kWhi = \int_{t1}^{t2} Pi(t)dt \cong \Delta t \sum_{n1}^{n2} Pnj$$

$$k\,\text{var}\,hi = \int_{t1}^{t2} Qi(t)dt \cong \Delta t \sum_{n1}^{n2} Qnj$$

Energy metering
Where:
i = considered phase (L1, L2 or L3)
P = active power
Q = reactive power
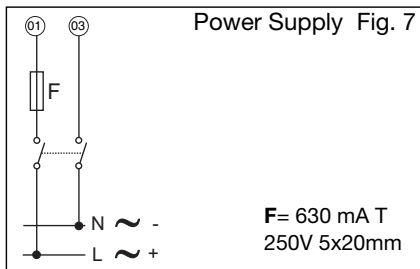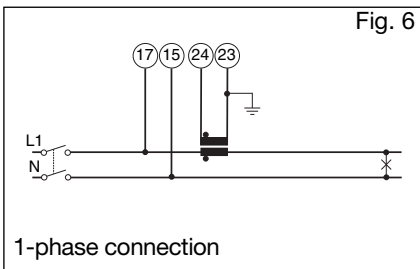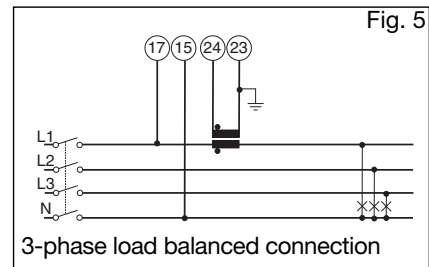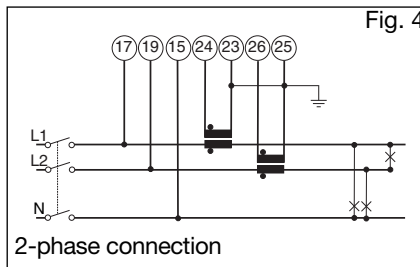t_1, t_2 = starting and ending time points of consumption recording
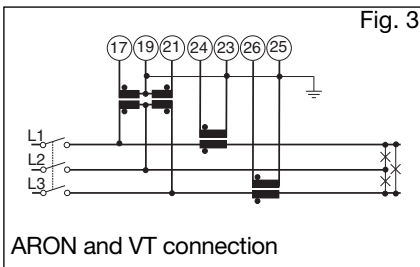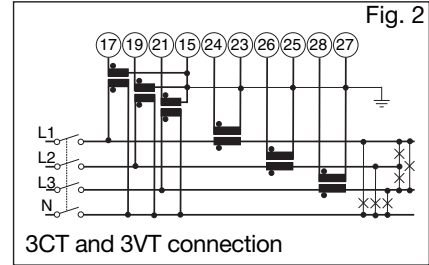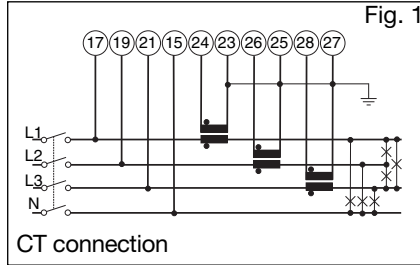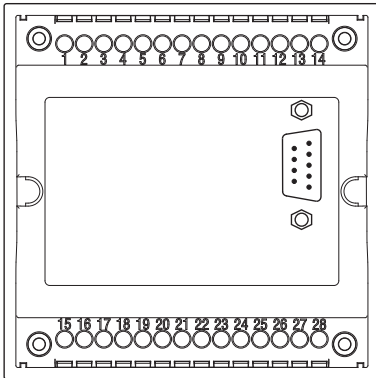n = time unit
Δt = time interval between two successive power consumptions
n_1, n_2 = starting and ending discrete time points of consumption recording

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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

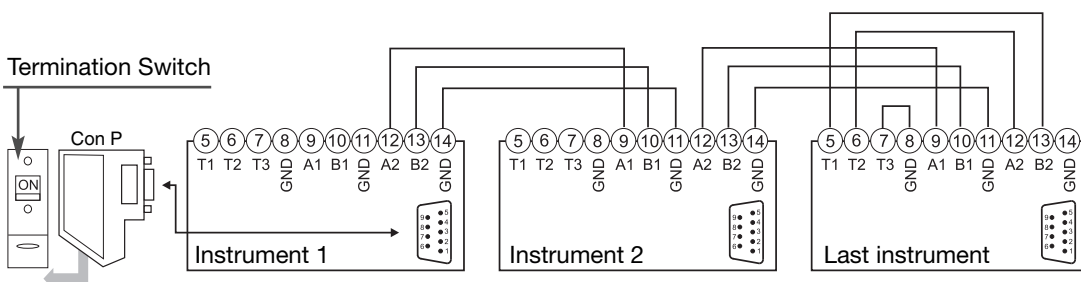Power Supply Fig. 7
F= 630 mA T
250V 5x20mm

NOTE: the direct connection is not allowed.

# Profibus port Wiring diagrams
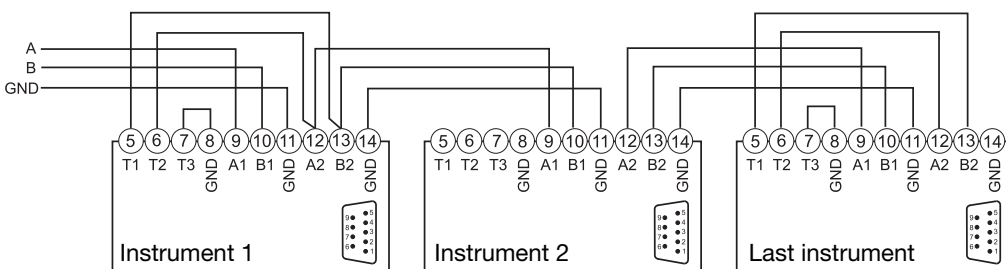
Terminate the first WM14 and the last WM14 by means of the screw terminals T1, T2, T3. Use a two pole shielded cable, about the connection length (from the first to the last instrument) refer to "TAB1".

Terminate the first WM14 positioning the dip-switch in ON on the "Con P" connector and the last WM14 by connecting T1, T2, T3. Use a two pole shielded cable, about the connection length (from the first to the last instrument) refer to "TAB1".

Profibus port Wiring diagrams (cont.)

TAB 1	
Kbit/s	**m**
9.6 / 19.2 / 45.45 / 93.75	≤1 200
187.5	≤1 000
500	≤400
1 500	≤200
3 000 / 6 000	≤100
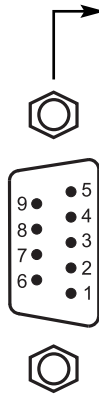
Pin no.	Signal	Meaning	Note
1	Shield	Shield/ protective ground	Not connected
2	M24	Ground of 24V output voltage	Not connected
3	**1B (*)**	**Receive data / transmission data (+)**	**RxD/TxD-P**
4	**CNTR-P (RTS)**	**Control signal for repeater (direction control)**	
5	**GND (*)**	**Data transmission potential (ground to 5 V)**	**DGND**
6	**VP (*)**	**Supply voltage of the terminatig resistor-P, (P5V)**	
7	P24	Output voltage 24V (+)	Not connected
8	**1A (*)**	**Receive data / transmission data (-)**	**RxD/TxD-N**
9	CNTR-N	Control signal for repeater (direction control)	Not connected

(*) The mandatory signals have to be made available by the user.

Front Panel Description
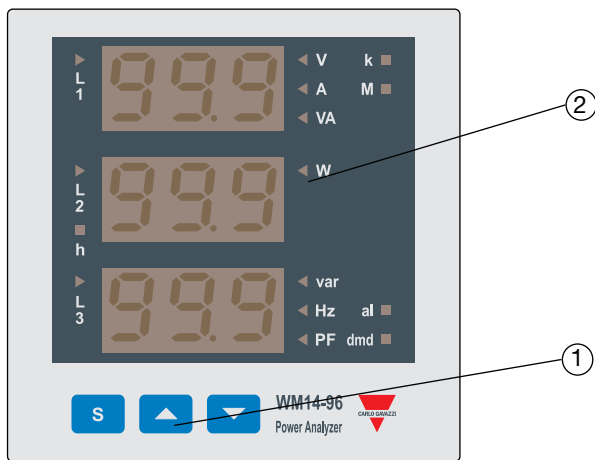
1. **Key-pad**
   To program the configuration parameters and the display of the variables.

   $\boxed{\text{S}}$

   Key to enter programming and confirm selections;

   $\boxed{\blacktriangle}$ $\boxed{\blacktriangledown}$
   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

96mm

61.4mm   15.4mm

64.4mm

□91mm