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

- **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**

**AV5:** 380/660$V_{L-L}$/5(6)AAC
VL-N: 185 V to 460 V
VL-L: 320 V to 800 V
**AV6:** 120/208$V_{L-L}$/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

**System**

**3 :** 1-2-3-phase, balanced/unbalanced load,with or without neutral

**Power supply**

**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 (not available in case of SG or PG options)

**Options**

**X:** None
**S:** RS485 port
**SG:** RS485+galvanic insulated measurig inputs
**PG:** Dual pulse output + galvanically insulated measuring inputs.

## Input specifications

| | |
|---|---|
| **Rated inputs** | |
| Current "X-S options" | 3 (non insulated each other) |
| Current "SG-PG options" | 3 (insulated each other) |
| 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)<br>0.03A to 0.25A: ±(0.5% FS+7DGT) |
| Neutral current | 0.25 to 6A: ±(1.5% FS +1DGT)<br>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);<br>0.03A to 0.25A: ±(1% FS +5DGT) |
| Reactive power | 0.25 to 6A: ±(2% FS +1DGT);<br>0.03A to 0.25A: ±(2% FS +5DGT) |
| Active energy "X-S option" | Class 2 (start up "I": 30mA) |
| Reactive energy "X-S option" | Class 3 (start up "I": 30mA) |
| Active energy "SG-PG opt." | Class 1 (start up "I": 30mA) |
| 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 |
| **Temperature drift** | ≤200ppm/°C |
| **Sampling rate** | 1400 samples/s @ 50Hz<br>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) |

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## Input specifications (cont.)

| | |
|---|---|
| **Display (cont.)** | |
| 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 |
| Crest factor | < 3, max 10A peak |
| **Input impedance** | **(X-S options)** |
| 380/660$V_{L-L}$ (AV5) | 1 MΩ ±5% |
| 120/208$V_{L-L}$ (AV6) | 453 KΩ ±5% |
| Current | ≤ 0.02Ω |
| **Input impedance** | **(PG-SG options)** |
| 380/660$V_{L-L}$ (AV5) | 1 MΩ ±1% |
| 120/208$V_{L-L}$ (AV6) | 1 MΩ ±1% |
| Current | ≤ 0.02Ω |
| **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) | |
| Type | Multidrop bidirectional (static and dynamic variables) |
| Connections | 2 or 4 wires, max. distance 1200m, termination directly on the instrument |
| Addresses | 1 to 255, key-pad selectable |
| Protocol | MODBUS/JBUS |
| Data (bidirectional) | |
| Dynamic (reading only) | System, phase variables and energies |
| Static (writing only) | All configuration parameters |
| Data format | 1 bit di start , 8 data bit, no parity, 1 stop bit |
| Baud-rate | 9600 bit/s |

## 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) | |
| Pulse outputs | |
| Number of outputs | 2 (one for kWh one for kvarh) |
| Number of pulses | From 0.01 to 999 in compliance with the following formula: [**Psys max** (kW or kvar)***pulses** (pulses/kWh or kvarh)] **<14400** |
| Output type | Relay<br>min current: 0.05A@250VAC/30VDC<br>max current: 5A@250VAC/30VDC |
| Pulse duration | Electrical life: min $2*10^5$ cycles<br>Mechanial life: $5*10^6$ cycles<br>≥100ms <120ms (ON)<br>≥100ms (OFF) |
| Insulation | According to EN622053-31<br>By means of relays,<br>4000 $V_{RMS}$ outputs to measuring inputs,<br>4000 $V_{RMS}$ output to supply input.<br>Insulation between the two outputs: 1000$V_{RMS}$ |

## Software functions

| | |
|---|---|
| **Password** | Numeric code of max. 3 digits; 2 protection levels of the programming data |
| 1st level | Password “0”, no protection |
| 2nd level | Password from 1 to 999, all data are protected |
| **System selection** | 3-phase with/without n, unbal.<br>3-phase balanced<br>3-phase ARON, unbalanced<br>2-phase<br>Single phase |
| **Transformer ratio** | |
| CT | 1 to 999 |
| VT | 1.0 to 99.9 |
| **Filter** | |
| Operating range | 0 to 100% of the input display scale |
| Filtering coefficient | 1 to 16 |
| Filter action | Measurements, alarms, serial out. (fundamental var: V, A, W and their derived ones). |
| **Displaying** | Up to 3 variables per page |
| 3-phase system with neutral | Page 1: V L1, V L2, V L3<br>Page 2: V L12, V L23, V L31<br>Page 3: A L1, A L2, A L3<br>Page 4: A L1 dmd, A L2 dmd, A L3 dmd<br>Page 5: An, An Alarm<br>Page 6: W L1, W L2, W L3<br>Page 7: PF L1, PF L2, PF L3<br>Page 8: var L1, var L2, var L3<br>Page 9: VA L1, VA L2, VA L3<br>Page 10: VA Σ, W Σ, var Σ<br>Page 11: VA dmd, W dmd, Hz<br>Page 12: W dmd max (*)<br>Page 13: Wh (*)<br>Page 14: varh (*)<br>Page 15: VL-L Σ, PF Σ, VLN Alarm<br>Page 16: A max (*)<br>Page 17: A dmd max (*)<br>Page 18: hour counter (*)<br>(*) = These variables are stored in EEPROM when the instrument is switched off |
| **Alarms** | Programmable, for the VLΣ and An (neutral current).<br>Note: the alarm is only visual, by means of LED on the front of the instrument. |
| **Reset** | Independent<br>alarm (VLΣ, An)<br>max: A dmd, W dmd<br>all energies (Wh, varh) and hour counter |

## Power Supply Specifications

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

## General Specifications

| | |
|---|---|
| **Operating temperature** | 0 to +50°C (32 to 122°F)<br>(RH < 90% non condensing) |
| **Storage temperature** | -30 to +60°C (-22 to 140°F)<br>(RH < 90% non condensing) |
| **Installation category** | Cat. III (IEC 60664, EN60664) |
| **Insulation** (for 1 minute) | 4000VAC, 500VDC between mesuring inputs and power supply.<br>500VAC/DC between mesuring inputs and RS485.<br>4000VAC, 500VDC between power supply and RS485 |
| **Dielectric strength** | 4000 VAC (for 1 min) |
| **EMC** | |
| 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, (cURus, CSA only "X" and "S" options) |
| **Connections 5(6) A** Max cable cross sect. area | Screw-type 2.5 $mm^2$ |

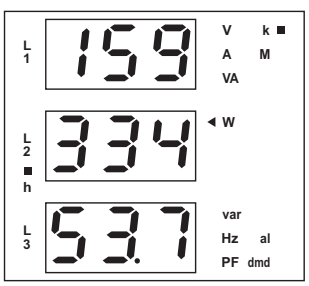
| | |
|---|---|
| **Housing** | |
| Dimensions (WxHxD) | 96 x 96 x 63 mm |
| Material | ABS self-extinguishing: UL 94 V-0 |
| **Mounting** | Panel |
| **Protection degree** | Front: IP65 (standard), NEMA4x, NEMA12 Connections: IP20 |
| **Weight** | Approx. 400 g (pack. incl.) |

## 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 | 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

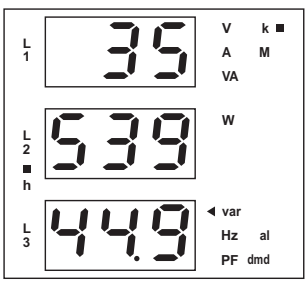



**1) Example of kWh visualization:**

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**

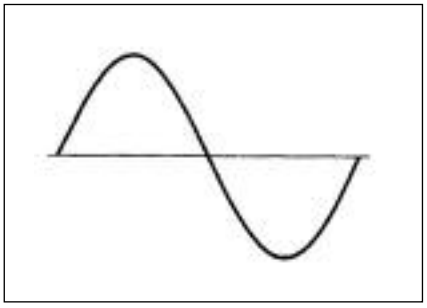


**Figure A**
**Sine wave, undistorted**

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

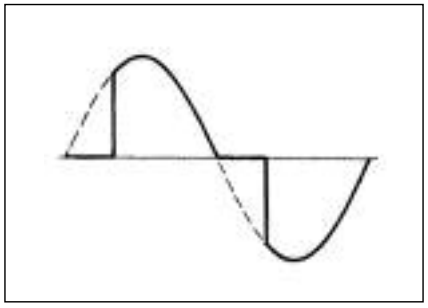


**Figure B**
**Sine wave, indented**

| | |
|---|---|
| Fundamental content | 10...100% |
| Harmonic content | 0...90% |

Frequency spectrum: 3rd to 16th harmonic
Additional error: <1% FS

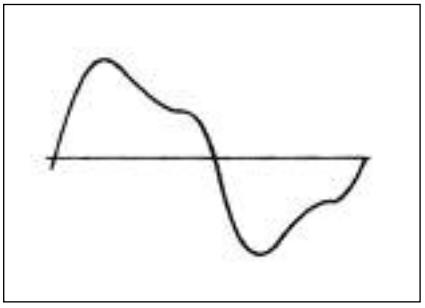


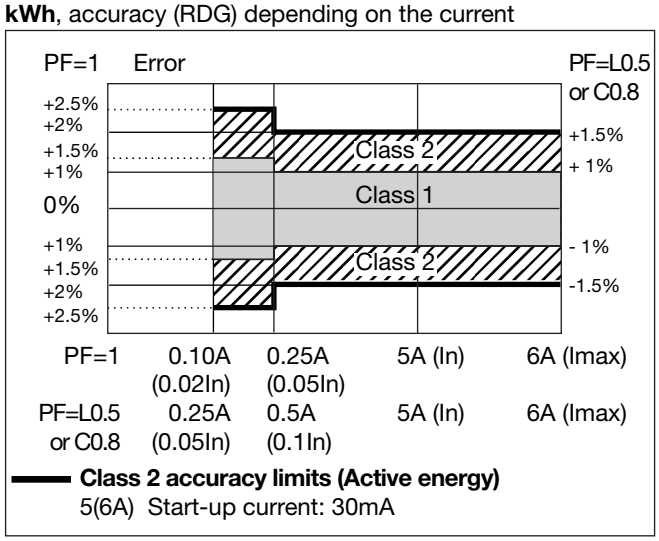
**Figure C**
**Sine wave, distorted**

| | |
|---|---|
| Fundamental content | 70...90% |
| Harmonic content | 10...30% |

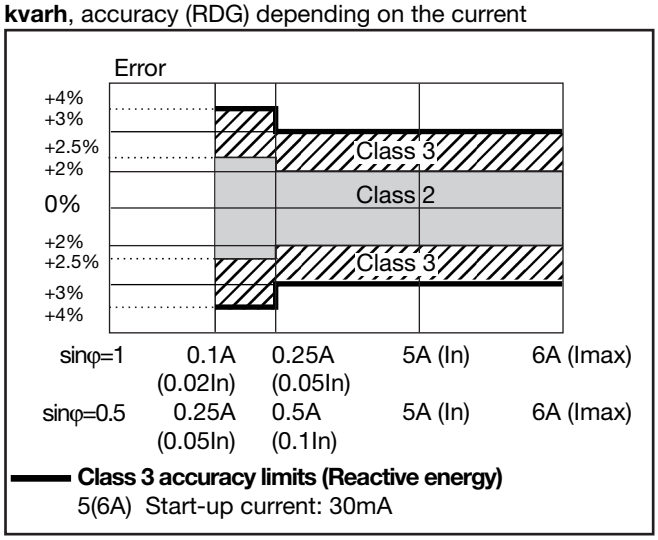
Frequency spectrum: 3rd to 16th harmonic
Additional error: <0.5% FS

## Accuracy

**kWh**, accuracy (RDG) depending on the current




**kvarh**, accuracy (RDG) depending on the current




: 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

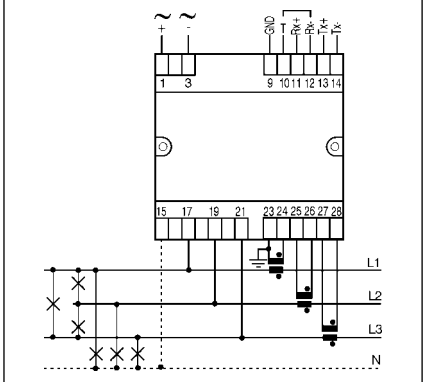
n = time unit

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

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

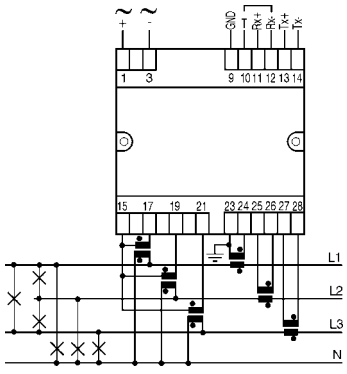
## Wiring diagrams

Fig. 1



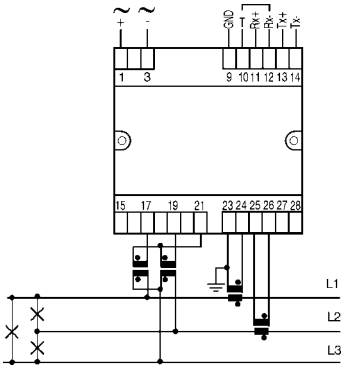

CT connection

Fig. 2



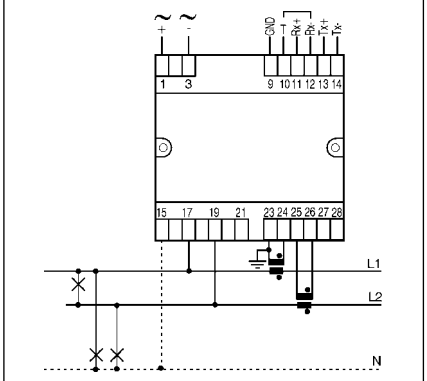

3CT and 3VT connection

Fig. 3



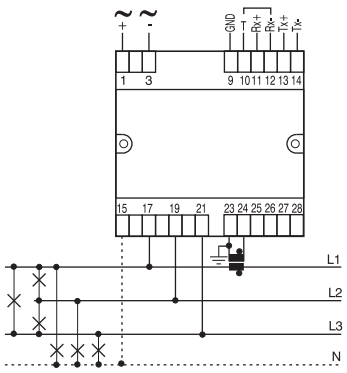

ARON and VT connection

Fig. 4



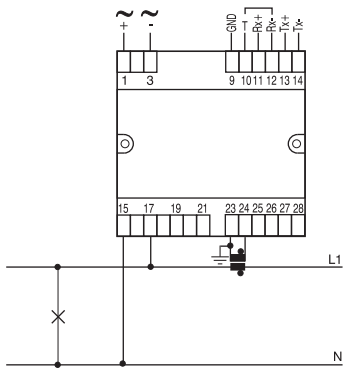

2-phase connection

Fig. 5




3-phase load balanced connection

Fig. 6




1-phase connection

**NOTE:** 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

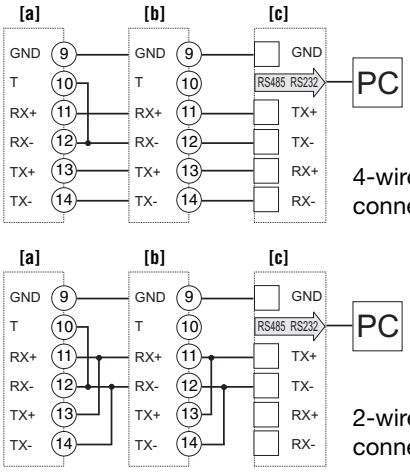
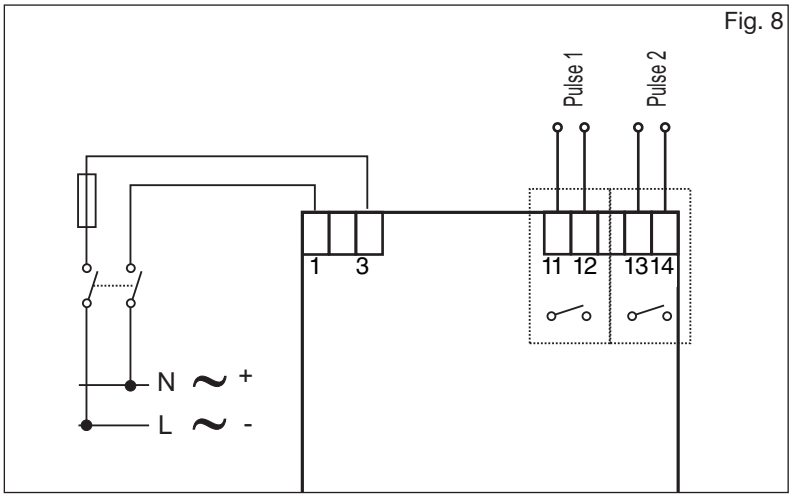


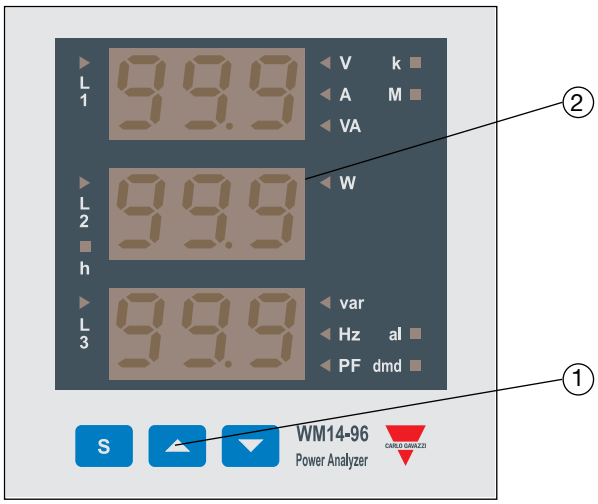

Fig. 7: **a**-Last instrument; **b**-1...n Instrument **c**-RS485/232 serial converter

## 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