

# Energy Management Power Analyzer with plug-in Output Modules Type WM22-DIN

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- Front dimensions: 9 DIN modules
- Analogue output by means of optional module (20mA or 10VDC)
- RS 422/485 Serial port by means of optional module
- Alarm output by means of optional module
- Dual pulse output by means of optional module
- Control of phase asymmetry

- Class 0.5 (current/voltage)
- Three-phase power analyzer
- Back-lighted LCD
- 4 x 3 1/2 DGT instantaneous variables read out
- 7 1/2 DGT energy read-out
- Measurements of system and phase variables: W, Wdmd, var, VA, VAdmd, PF (cosφ), V, A, Hz, THD-A, THD-V
- Measurements of total energies: kWh, kvarh
- Measurements of partial energies: kWh, kvarh
- Energy measurements according to EN61036 and EN61268
- TRMS measurements of distorted wave forms (voltages/currents)
- Two basic models: direct connection 20(90)AAC, CT 5(10)AAC and VT connection
- Maximum value indication of W dmd and VA dmd (only 5A version); maximum value indication of A (only 90A version)
- Self power supply (available for some models only) or auxiliary power supply: 24V, 48V, 115V, 230V, 50-60Hz; 18 to 60VDC, 77 to 143VDC
- Degree of protection (front): IP 40

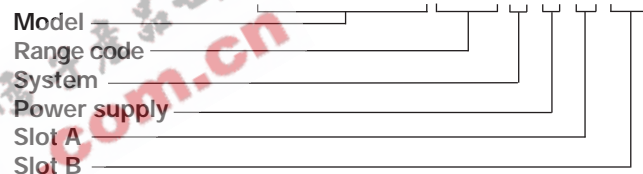
## Product description

Three-phase power analyzer with built-in configuration key-pad; Particularly indicated for the analysis of main, secondary and energy metering electrical variables. Housing for DIN-rail or wall-mounting, IP40 (front) protection degree. Completely sealable housing. In case of direct connection up to 90A, the measuring input terminals are suitable for cables with a cross-section

area from 6 to 35 mm<sup>2</sup>. The special design of the instrument's housing allows to add at any time the interface modules, even when the instrument is already installed. The following modules are available:

- for all versions: pulses output;
- only for the versions with auxiliary power supply: analogue output, RS485 port or alarm output.

## How to order WM22-DIN AV5 3 X X XX



### Important note:

- The models from AV0 to AV7 can be equipped with any type of available modules (slot A and B).
- The models AV8 and AV9 can be equipped only with the "O" and "R" type modules.
- The AV8 and AV9 models can measure all the parameters even if the three phase system being connected is missing one phase.
- The AV2 model is suitable only for three-phase unbalanced system without neutral.

## Type selection

| Range Code   | Power supply                           | Slot A (retransmission)  | Slot B (retransmission)                 |
|--|--|--|---|
| <b>Auxiliary Power Supply:</b>                                 | <b>For all versions</b>                | <b>X:</b> None   | <b>Only with A-B-C-D-4 power supply</b> |
| <b>AV0:</b> 208V <sub>L-L</sub> /20(90)AAC [3]                 | <b>A:</b> 24VAC                        | <b>O:</b> AO2900 module  | <b>XX:</b> None                         |
| <b>AV1:</b> 400V <sub>L-L</sub> /20(90)AAC [1]                 | -15+10%, 50-60Hz                       | Dual open collector output   | <b>A1:</b> AO2920 module                |
| <b>AV3:</b> 660V <sub>L-L</sub> /20(90)AAC [2]                 | <b>B:</b> 48VAC                        | Three operating modes:   | 0-20mADC                                |
| <b>AV4:</b> 208V <sub>L-L</sub> /5(10)AAC [3]                  | -15+10%, 50-60Hz                       | • two pulse outputs (kWh and kvarh);   | analogue output                         |
| <b>AV5:</b> 400V <sub>L-L</sub> /5(10)AAC [1]                  | <b>C:</b> 115VAC                       | • one alarm output and one pulse output (kWh or kvarh)   | <b>V1:</b> AO2921 module                |
| <b>AV6:</b> 100V <sub>L-L</sub> /5(10)AAC [3]                  | -15+10%, 50-60Hz                       | • one output which is remotely controlled by a serial port and one pulse output (kWh or kvarh) | 0-10VDC                                 |
| <b>AV7:</b> 660V <sub>L-L</sub> /5(10)AAC [2]                  | <b>D:</b> 230VAC                       |  | analogue output                         |
| <b>Self Power Supply:</b>                                      | -15+10%, 50-60Hz                       | <b>R:</b> AO2910 module.   | <b>S0:</b> AR2950 module                |
| <b>AV2:</b> 220V <sub>L-L</sub> /20(90)AAC [4]                 | <b>4:</b> 18 to 60VDC                  | One relay output + one open collector output.  | RS422/485                               |
| <b>AV8:</b> 208V <sub>L-L</sub> /20(90)AAC [1]                 | <b>5:</b> 77 to 143VDC                 | Operation modes like module AO2900.  | serial port                             |
| <b>AV9:</b> 400V <sub>L-L</sub> /20(90)AAC [1]                 | <b>AV2, AV8 and AV9 only</b>           |  |   |
| <b>System</b>  | <b>X:</b> Self Power Supply            |  |   |
| <b>3:</b> Three-phase, unbalanced load with or without neutral | 400V <sub>L-L</sub> (-20+15%, 50-60Hz) |  |   |
|  | 208V <sub>L-L</sub> (-20+15%, 50-60Hz) |  |   |
|  | 220V <sub>L-L</sub> (-10+15%, 50-60Hz) |  |   |

[1] Un: -20+15% [2] Un: -30+15% [3] Un: -20+20% [4] Un: -10 +15%

Specifications are subject to change without notice WM22-DINDS1003

## Input specifications

|   |  |                                       |  |
|---|--|---------------------------------------|--|
| <b>Number of inputs</b>                           |  | <b>Additional errors</b>              |  |
| Current   | 3  | Wave form                             | Acc. to EN61036, EN61268<br><1% (3 <sup>rd</sup> harmonic: 10%)  |
| Voltage   | 4  | Voltage asymmetry                     | < 0.5% (referred to Un)  |
| <b>Accuracy</b> (display, RS485)                  | Ib: 5A, I <sub>max</sub> : 10A<br>Ib: 20A, I <sub>max</sub> : 90A<br>Un: see previous page<br>"Range code"   | Magnetic induction                    | 0 (up to 0.5 mT)   |
| Current   | from 0.003Ib to 0.2Ib:<br>±(0.5%RDG +3DGT)<br>from 0.2Ib to I <sub>max</sub> :<br>±(0.5%RDG +1DGT)   | HF Electromagnetic fields             | < 1%   |
| Voltage   | in the range Un:<br>±(0,5% RDG + 1DGT)   | Operation of accessories              | 0  |
| Frequency   | ±0.1% RDG (50 to 60 Hz)  | <b>Temperature drift</b>              | ≤ 200ppm/°C  |
| Active power<br>(@ 25°C ± 5°C, R.H. ≤ 90%)        | ±(1% RDG +1DGT). PF 1,<br>0.1Ib to I <sub>max</sub> , in the Un range;<br>PF 0.5L, PF 0.8C, 0.2Ib to<br>I <sub>max</sub> , in the Un range   | <b>Sampling rate</b>                  | 1000 samplings/s @ 50Hz  |
| Reactive power<br>(@ 25°C ± 5°C, R.H. ≤ 90%)      | ±(2% RDG +1DGT). sinφ 1,<br>0.05Ib to I <sub>max</sub> , in the Un range;<br>sinφ 0.5L, sinφ 0.5C,<br>0.1Ib to I <sub>max</sub> , in the Un range  | <b>Display</b>                        | Type<br>Instantan. variables read-out<br>Energies  |
| Apparent power<br>(@ 25°C ± 5°C, R.H. ≤ 90%)      | ±(1% RDG +1DGT). PF 1,<br>0.1Ib to I <sub>max</sub> , in the Un range  |                                       | Back-lighted LCD<br>4x3 <sup>1</sup> / <sub>2</sub> DGT<br>Total: 1x7 <sup>1</sup> / <sub>2</sub> DGT<br>Partial: 1x7 <sup>1</sup> / <sub>2</sub> DGT          |
| Energies<br>(@ 25°C ± 5°C, R.H. ≤ 90%)            | Class 1 acc. to EN61036<br>Class 2 acc. to EN61268<br>Ib: 5A, I <sub>max</sub> : 10A<br>0.1Ib: 500mA,<br>Start up current: 20mA<br>Un: see table "range code"<br>Ib: 20A, I <sub>max</sub> : 90A<br>0.1Ib: 2A,<br>Start up current: 80mA<br>Un: see table "range code" | <b>Max. and Min. indication</b>       | Max. 1999 (19999999), Min. 0   |
| Harmonic distortion<br>(@ 25°C ± 5°C, R.H. ≤ 90%) | ±3% f.s. (f.s.: 100%)<br>up to the 7 <sup>th</sup> harmonic;<br>Un: see table "range code"   | <b>Measurements</b>                   | Current, voltage, power,<br>energy, power factor, frequen-<br>cy, harmonic distortion (see<br>display specs). TRMS<br>measurements of distorted<br>wave forms. |
| Ib 5A   | I <sub>min</sub> : 500mA;<br>I <sub>max</sub> : 15Ap;  | Coupling type                         | Direct   |
| Ib 20A  | I <sub>min</sub> : 2A;<br>I <sub>max</sub> : 127Ap;  | <b>Crest factor</b>                   |  |
|   |  | Ib 5A                                 | ≤3 (15A max. peak)   |
|   |  | Ib 20A                                | ≤6 (127A max. peak)  |
|   |  | <b>Current overload</b>               |  |
|   |  | 5(10) A, for 10ms                     | 300 A max, @ 50Hz  |
|   |  | 5(10) A, for 500ms                    | 200 A max, @ 50Hz  |
|   |  | 5(10) A, permanent                    | 10A, @ 50Hz  |
|   |  | 20(90) A, for 10ms                    | 2700A max, @ 50Hz  |
|   |  | 20(90) A, permanent                   | 90A, @ 50Hz  |
|   |  | <b>Voltage overload</b>               |  |
|   |  | Permanent                             | 1.2 Un   |
|   |  | For 1s                                | 2 Un   |
|   |  | <b>Input impedance</b>                |  |
|   |  | 400V <sub>L-L</sub> (AV1-AV5-AV9)     | > 720KΩ  |
|   |  | 208V <sub>L-L</sub> (AV0-AV4-AV8-AV2) | > 720KΩ  |
|   |  | 660V <sub>L-L</sub> (AV3-AV7)         | > 1.97MΩ   |
|   |  | 100V <sub>L-L</sub> (AV6)             | > 400KΩ  |
|   |  | 5(10) A (AV4-AV5-AV6-AV7)             | < 0.3VA  |
|   |  | 20(90) A (AV0-AV1-AV3-AV8-AV9)        | < 4VA  |
|   |  | 20(90) A (AV2)                        | < 4VA  |
|   |  | <b>Frequency</b>                      | 50 to 60 Hz  |

## Interface module specifications

|                                      |  |                     |  |
|--------------------------------------|--|---------------------|--|
| <b>Analogue outputs</b> (on request) |  |                     | the following ranges:<br>0 and 20mADC, 0 and 10VDC                                       |
| Number of outputs                    | 1  | Response time       |  |
| Range                                | 0 to 20 mADC<br>(AO2920 module slot B,<br>only for versions with<br>auxiliary power supply)<br>0 to 10VDC<br>(AO2921 module slot B,<br>only for versions with<br>auxiliary power supply) | System variables    | V, W, VA, var, PF (cosφ)   |
| Accuracy                             | ±0.5% F.S.   | FFT off, filter off | 900ms  |
| Temperature drift                    | ≤ 300 ppm/ °C  | FFT on, filter on   | 1.4s   |
| Scaling factor                       | Programmable within the<br>whole range of<br>retransmission;<br>it allows the retransmission<br>of all the values included in  | variables           | THD-V, THD-A   |
|                                      |  | Filter off          | 3s   |
|                                      |  | Ripple              | ≤ 1% according to IEC 60688-1,<br>EN 60688-1   |
|                                      |  | Load                |  |
|                                      |  | 20 mADC             | ≤ 500 Ω  |
|                                      |  | 10 VDC              | ≥ 10 kΩ  |
|                                      |  | Insulation          | By means of optocouplers,<br>2000 V <sub>RMS</sub> between output<br>and measuring input |

## Interface module specifications (cont.)

|                                     |  |                     |  |
|-------------------------------------|--|---------------------|--|
|                                     | 2000 V <sub>RMS</sub> between output and power supply input                                      |                     |  |
| <b>RS422/RS485</b> (on request)     | AR2950 module  | Insulation          | According to DIN43864  |
| Type                                | Multidrop bidirectional (static and dynamic variables)   |                     | By means of optocouplers, 2000 V <sub>RMS</sub> outputs to measuring inputs, 2000 V <sub>RMS</sub> output to supply input. |
| Connections                         | 2 or 4 wires, max. distance 1200m, termination directly on the module                            | Alarm output        | Insulation between the two outputs: functional   |
| Addresses                           | 255, selectable by key-pad   | Number of outputs   | 1  |
| Protocol                            | MODBUS/JBUS  | Alarm type          | Up alarm, down alarm   |
| Data (bidirectional)                |  | Setpoint adjustment | phase asymmetry, phase loss.   |
| Dynamic (reading only)              | Phase and system variables: see table "Display pages"  | Hysteresis          | 0 to 100% of the electrical scale  |
| Static (writing only)               | All the programming data, reset of energy, activation of static output.                          | On-time delay       | 0 to 100% of the electrical scale  |
| Data format                         | Stored energy (EEPROM) max. 19.999.999 kWh/kvarh   | Response time       | 0 to 255 seconds   |
| Baud-rate                           | 1 start bit, 8 data bit, no parity, 1 stop bit   | system variables    | V, W, VA, var, PF (cosφ)   |
| Insulation                          | 9600 bit/s   | FFT off, filter off | 700ms  |
|                                     | By means of optocouplers, 2000 V <sub>RMS</sub> output to measuring inputs                       | FFT on, filter on   | 1.2s   |
|                                     | 2000 V <sub>RMS</sub> output to supply input   | variables           | THD-V, THD-A   |
|                                     |  | Filter off          | 3s   |
|                                     |  | Output type         | Open collector (transistor NPN)  |
| <b>Digital outputs</b> (on request) |  | Insulation          | V <sub>ON</sub> 1.2 VDC / max. 100 mA  |
| AO2900 module                       | To be used as alarm, energy retransmission, or remote static outputs.                            |                     | V <sub>OFF</sub> 30 VDC max.   |
|                                     | Three working modes are selectable:  | AO2910 module       | By means of optocouplers, 2000 V <sub>RMS</sub> output to measuring input, 2000 V <sub>RMS</sub> output to supply input.   |
|                                     | • two pulse outputs (kWh and kvarh);   | Pulse output        | Insulation between the two outputs: functional   |
|                                     | • one alarm output and one pulse output (kWh or kvarh)   | Alarm output        | Relay + open collector output. Working mode like AO2900.   |
|                                     | • one output remotely controlled by means of the serial port and one pulse output (kWh or kvarh) | Output type         | One static output+one relay output, other characteristics like AO2900.   |
| Pulse outputs                       |  | Insulation          | Only relay output, other characteristics like AO2900.  |
| Number of outputs                   | 2  |                     | Static type like module AO2900;  |
| Number of pulses                    | From 0.01 to 100 pulses programmable according to the selected CT and VT ratios                  |                     | Relay type: SPDT, AC1, AC15: 1AAC @250VAC  |
| Output type                         | Open collector (transistor NPN)  |                     | By means of optocouplers, 2000 V <sub>RMS</sub> outputs to measuring inputs, 2000 V <sub>RMS</sub> output to supply input. |
| Pulse duration                      | V <sub>ON</sub> 1.2 VDC / max. 100 mA  |                     | Insulation between the two outputs: 2000 V <sub>RMS</sub>  |
|                                     | V <sub>OFF</sub> 30 VDC max.   |                     |  |
|                                     | 220 ms (ON), ≥ 220 ms (OFF)  |                     |  |

## Software functions

|  |  |                         |   |
|--|--|-------------------------|---|
| <b>Password</b>                                | Numeric code of max. 3 digits<br>2 protection levels of the programming data<br>Password "0", no protection<br>Password from 1 to 1000, all data are protected   | <b>Electrical range</b> | Programmable within the whole measuring range.  |
| 1 <sup>st</sup> level<br>2 <sup>nd</sup> level |  | <b>Filter</b>           |   |
| <b>System selection</b>                        | Three-phase with neutral<br>Three-phase without neutral  | Filter operating range  | 0 to 99.9% of the input electrical scale.   |
| <b>Transformer ratio</b>                       |  | Filter coefficient      | 1 to 16   |
| CT   | 1 to 5000  | Filter action           | Alarm, analogue and serial output (fundamental variables: V, A, W and their derived ones).  |
| VT   | 1.0 to 199.9 and 200 to 1999<br>Note:<br>The CT ratio* VT ratio must never exceed the value 5000. The current measuring inputs can manage CT's with a secondary of 1A and 5A (the accuracy always refer to 5A) | <b>Display</b>          |   |
| <b>Scaling factor</b>                          |  | System variables        | Up to 4 variables per page<br>Page 1: W-var-PF (cosφ)<br>Page 2: W dmd - VA dmd - Hz<br>Page 3: THD-V<br>Page 4: THD-A<br>Page 5: kWh total<br>Page 6: kvarh total<br>Page 7: kWh partial<br>Page 8: kvarh partial<br>Page 9: V <sub>L-N</sub><br>Page 10: A<br>Page 11a: A <sub>MAX</sub><br>Page 11b: W dmd <sub>MAX</sub> VA dmd <sub>MAX</sub><br>Page 12: W<br>Page 13: VA<br>Page 14: var<br>Page 15: PF (cosφ) |
| Operating mode                                 | Compression/expansion of the measuring range to be connected to the analogue output.   | Single phase variables  |   |
|  |  | System variables        |   |
|  |  | Single phase variables  |   |
|  |  | 20(90) A<br>5(10) A     |   |

## Supply specifications

|                               |   |   |
|-------------------------------|---|---|
| <b>Self supplied version</b>  | 400V <sub>L-L</sub><br>-20% +15%, 50-60Hz<br>208V <sub>L-L</sub><br>-20% +15%, 50-60Hz<br>220V <sub>L-L</sub><br>-10% +15%, 50-60Hz | 115VAC<br>-15 +10%, 50-60Hz<br>48VAC<br>-15 +10%, 50-60Hz<br>24VAC<br>-15 +10%, 50-60Hz |
| <b>Auxiliary power supply</b> | 230VAC<br>-15 +10%, 50-60Hz   | 18 to 60VDC<br>77 to 143VDC   |
|                               |   | <b>Energy consumption</b>   |
|                               |   | ≤ 7VA   |

## General Specifications

|   |   |                                    |   |
|---|---|------------------------------------|---|
| <b>Operating temperature</b>                  | 0 to +55°C<br>(R.H. < 90% non-condensing 40°C)              | <b>Pulse voltage (1.2/50μs)</b>    | 8kV (EN61000-4-5)                                     |
| <b>Storage temperature</b>                    | -20 to +60°C<br>(R.H. < 90% non-condensing 40°C)            | <b>Standards</b>                   |   |
| <b>Installation category</b>                  | Cat. III (IEC 664)  | Safety                             | IEC664-1  |
| <b>Insulation</b>                             | 2000 V <sub>RMS</sub> between all inputs / outputs to earth | Metrology                          | Energy measurements:<br>EN61036, EN61268.<br>DIN43864 |
| <b>Dielectric strength</b>                    | 4000 V <sub>RMS</sub> for 1 minute                          | Pulse output                       | DIN43864  |
| <b>Noise rejection</b>                        |   | <b>Approvals</b>                   | CE  |
| CMRR  | 100 dB, 48 to 62 Hz   | <b>Connections 5(10) A</b>         | Screw-type,<br>4 mm <sup>2</sup>                      |
| <b>EMC</b>                                    |   | Cable cross-section area           |   |
| Burst   | 4kV/level 4 (EN61000-4-4)                                   | <b>Connections 20(90) A</b>        | Screw-type,<br>6 mm <sup>2</sup> / 35 mm <sup>2</sup> |
| Immunity to irradiated electromagnetic fields | 10V/m 26-1000MHz (EN61000-4-3)                              | Min./Max. cable cross-section area |   |
| Electrostatic discharges                      | 15kV (EN61000-4-2)  | Min./Max. screws tightening torque | 2 Nm / 6 Nm   |
| Radio frequency emissions                     | according to CISPR 14 and CISPR 22                          | <b>Housing</b>                     |   |
|   |   | Dimensions                         | 162.5 x 90 x 63 mm                                    |
|   |   | Material                           | ABS, NORYL, PC<br>self-extinguishing: UL 94 V-0       |
|   |   | <b>Mounting</b>                    | DIN-rail and wall                                     |
|   |   | <b>Degree of protection</b>        | Front: IP40<br>Connections: IP20                      |
|   |   | <b>Weight</b>                      | 800 g approx.<br>(packing included)                   |

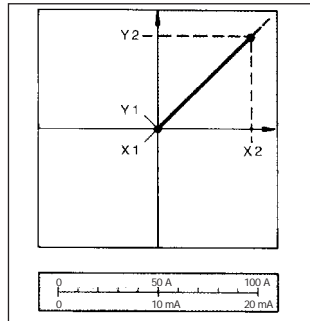
## Function description

### Input and output scaling capability

Working examples of the analogue output (Y) versus the input variable (x) - (input/output scaling possibilities).

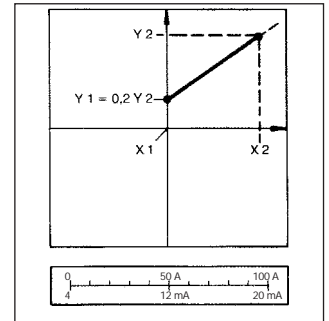
**Figure A**

The sign of measured quantity and output quantity remains the same. The output quantity is proportional to the measured quantity.



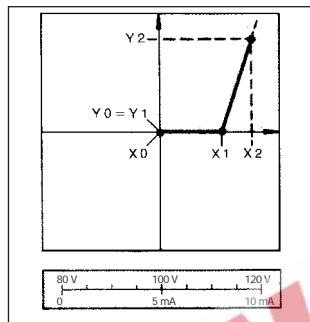
**Figure B**

The sign of measured quantity and output quantity remains the same. With the measured quantity being zero, the output quantity already has the value  $Y1 = 0.2 Y2$ . Live zero output.



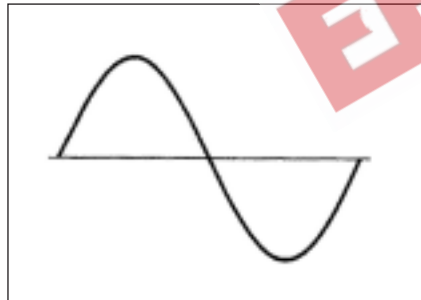
**Figure C**

The sign of measured quantity and output quantity remains the same. On the range  $X0...X1$ , the output quantity is zero. The range  $X1...X2$  is delineated on the entire output range  $Y0=Y1...Y2$  and thus presented in strongly expanded form.



## Mode of Operation

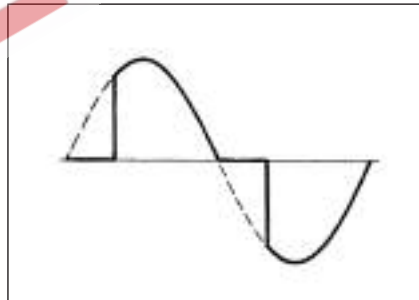
### Waveform of the signals that can be measured



**Figure D**

**Sine wave, undistorted**

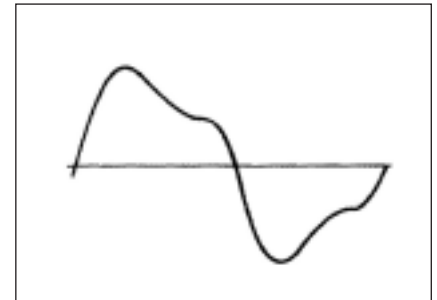
Fundamental content 100%  
 Harmonic content 0%  
 $A_{rms} = 1.1107 | \bar{A} |$



**Figure E**

**Sine wave, indented**

Fundamental content 10...100%  
 Harmonic contents 0...90%  
 Frequency spectrum: 3rd to the 16th harmonic  
 Additional error: <1% rdg



**Figure F**

**Sine wave, distorted**

Fundamental content 70...90%  
 Harmonic content 10...30%  
 Frequency spectrum: 3rd to the 16th harmonic  
 Additional error: <0.5% rdg

## Harmonic distortion analysis

|                             |  |                 |  |
|-----------------------------|--|-----------------|--|
| <b>Anaysis principle</b>    | FFT  | <b>Read-out</b> | THD (AL2), THD (AL3)   |
| <b>Harmonic measurement</b> |  | <b>System</b>   | THD %  |
| Current                     | Up to the 7 <sup>th</sup> harmonic         |                 | The harmonic distortion can be measured in 3-wire or 4-wire systems. |
| Voltage                     | Up to the 7 <sup>th</sup> harmonic         |                 |  |
| <b>Type of harmonics</b>    | THD (VL1), THD (VL2), THD (VL3), THD (AL1) |                 |  |



## Display pages

### Variables that can be displayed

| No  | 1 <sup>st</sup> variable | 2 <sup>nd</sup> variable | 3 <sup>rd</sup> variable | 4 <sup>th</sup> variable | Notes   |
|-----|--------------------------|--------------------------|--------------------------|--------------------------|---|
| 1   | W sys                    | PF sys                   | Var sys                  |                          | sys = system  |
| 2   | W dmd                    | Hz                       | VA dmd                   |                          | dmd = demand<br>(integration time from 1 to 30 minutes) |
| 3   | V <sub>L1</sub> THD      | V <sub>L2</sub> THD      | V <sub>L3</sub> THD      |                          | THD = tot. harmonic distortion                          |
| 4   | A <sub>L1</sub> THD      | A <sub>L2</sub> THD      | A <sub>L3</sub> THD      |                          | THD = tot. harmonic distortion                          |
| 5   | kWh                      |                          |                          |                          | total energy  |
| 6   | kvarh                    |                          |                          |                          | total energy  |
| 7   | kWh                      |                          |                          |                          | partial energy  |
| 8   | kvarh                    |                          |                          |                          | partial energy  |
| 9   | V <sub>L1</sub>          | V <sub>L2</sub>          | V <sub>L-3</sub>         | V <sub>L-L</sub> sys     | sys = system  |
| 10  | A <sub>L1</sub>          | A <sub>L2</sub>          | A <sub>L3</sub>          | Err                      | Err = in case of negative power                         |
| 11a | W dmd MAX                | VA dmd MAX               |                          |                          | Only version 1-5A, dmd = demand                         |
| 11b | A <sub>L1</sub> MAX      | A <sub>L2</sub> MAX      | A <sub>L3</sub> MAX      |                          | Only version 90A  |
| 12  | W <sub>L1</sub>          | W <sub>L2</sub>          | W <sub>L3</sub>          | W sys                    | sys = system  |
| 13  | VA <sub>L1</sub>         | VA <sub>L2</sub>         | VA <sub>L3</sub>         | VA sys                   | The system value remains always 0                       |
| 14  | Var <sub>L1</sub>        | Var <sub>L2</sub>        | Var <sub>L3</sub>        | Var sys                  | if the neutral is not connected                         |
| 15  | PF <sub>L1</sub>         | PF <sub>L2</sub>         | PF <sub>L3</sub>         | PF sys                   |   |

### Used calculation formulas

#### Phase variables

Instantaneous effective voltage

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

Instantaneous active power

$$W_1 = \frac{1}{n} \cdot \sum_1^n (V_{IN})_i \cdot (A_1)_i$$

Instantaneous power factor

$$\cos\phi_1 = \frac{W_1}{VA_1} \quad (\text{TPF})$$

Instantaneous effective current

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

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 system voltage

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

System reactive power

$$VAR_{\Sigma} = (VAR_1 + VAR_2 + VAR_3)$$

System active power

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

System apparent power

$$VA_{\Sigma} = \sqrt{W_{\Sigma}^2 + VAR_{\Sigma}^2}$$

System power factor

$$\cos\phi_{\Sigma} = \frac{W_{\Sigma}}{VA_{\Sigma}} \quad (\text{TPF})$$

Total harmonic distortion

$$THD_i = \frac{\sqrt{\sum_{n=2}^{\infty} T_n^2}}{T_1}$$

Note:

i = phase (L1, L2 or L3)

T = variable (V or I)

n = harmonic order

#### Consumption recording

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

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

Note:

i = phase (L1, L2 or L3)

P = active power

Q = reactive power

t<sub>1</sub>, t<sub>2</sub> = starting and ending time points of consumption recording

n = time unit

Δt = time interval of consumption recording

n<sub>1</sub>, n<sub>2</sub> = starting and ending discrete time points of consumption recording

## List of the of the variables that can be connected to the analogue and alarm output

| N° | Variable | Notes        | N° | Variable | Notes                                 |
|----|----------|--------------|----|----------|---------------------------------------|
| 1  | V sys    | sys = system | 6  | THD-V    | Max. THD value among the three phases |
| 2  | W sys    | sys = system | 7  | THD-A    | Max. THD value among the three phases |
| 3  | var sys  | sys = system | 8  | VA dmd   | Power demand in the selected          |
| 4  | VA sys   | sys = system | 9  | W dmd    | integration time                      |
| 5  | PF sys   | sys = system | 10 | ASY      | Phase asymmetry                       |

## Available models

| Type                   | Inputs                        | Power supply         | Ordering code   |
|------------------------|-------------------------------|----------------------|-----------------|
| WM22-DIN AV9.3.X.      | 400V <sub>L-L</sub> , 20(90)A | Self power supply    | AF2100          |
| WM22-DIN AV8.3.X.      | 208V <sub>L-L</sub> , 20(90)A | Self power-supply    | AF2101          |
| WM22-DIN AV2.3.D.      | 220V <sub>L-L</sub> , 20(90)A | Self power-supply    | AF2144          |
| WM22-DIN AV1.3.D.      | 400V <sub>L-L</sub> , 20(90)A | 230VAC, 50-60Hz      | AF2102          |
| WM22-DIN AV0.3.D.      | 208V <sub>L-L</sub> , 20(90)A | 230VAC, 50-60Hz      | AF2103          |
| WM22-DIN AV3.3.D.      | 660V <sub>L-L</sub> , 20(90)A | 230VAC, 50-60Hz      | AF2104          |
| WM22-DIN AV1.3.C.      | 400V <sub>L-L</sub> , 20(90)A | 115VAC, 50-60Hz      | AF2105          |
| WM22-DIN AV0.3.C.      | 208V <sub>L-L</sub> , 20(90)A | 115VAC, 50-60Hz      | AF2106          |
| WM22-DIN AV3.3.C.      | 660V <sub>L-L</sub> , 20(90)A | 115VAC, 50-60Hz      | AF2107          |
| WM22-DIN AV1.3.B.      | 400V <sub>L-L</sub> , 20(90)A | 48VAC, 50-60Hz       | AF2108          |
| WM22-DIN AV0.3.B.      | 208V <sub>L-L</sub> , 20(90)A | 48VAC, 50-60Hz       | AF2109          |
| WM22-DIN AV3.3.B.      | 660V <sub>L-L</sub> , 20(90)A | 48VAC, 50-60Hz       | AF2110          |
| WM22-DIN AV1.3.A.      | 400V <sub>L-L</sub> , 20(90)A | 24VAC, 50-60Hz       | AF2111          |
| WM22-DIN AV0.3.A.      | 208V <sub>L-L</sub> , 20(90)A | 24VAC, 50-60Hz       | AF2112          |
| WM22-DIN AV3.3.A.      | 660V <sub>L-L</sub> , 20(90)A | 24VAC, 50-60Hz       | AF2113          |
| WM22-DIN AV5.3.D.      | 400V <sub>L-L</sub> , 5(10)A  | 230VAC, 50-60Hz      | AF2114          |
| WM22-DIN AV4.3.D.      | 208V <sub>L-L</sub> , 5(10)A  | 230VAC, 50-60Hz      | AF2115          |
| WM22-DIN AV7.3.D.      | 660V <sub>L-L</sub> , 5(10)A  | 230VAC, 50-60Hz      | AF2116          |
| WM22-DIN AV5.3.C.      | 400V <sub>L-L</sub> , 5(10)A  | 115VAC, 50-60Hz      | AF2117          |
| WM22-DIN AV4.3.C.      | 208V <sub>L-L</sub> , 5(10)A  | 115VAC, 50-60Hz      | AF2118          |
| WM22-DIN AV7.3.C.      | 660V <sub>L-L</sub> , 5(10)A  | 115VAC, 50-60Hz      | AF2119          |
| WM22-DIN AV5.3.B.      | 400V <sub>L-L</sub> , 5(10)A  | 48VAC, 50-60Hz       | AF2120          |
| WM22-DIN AV4.3.B.      | 208V <sub>L-L</sub> , 5(10)A  | 48VAC, 50-60Hz       | AF2121          |
| WM22-DIN AV7.3.B.      | 660V <sub>L-L</sub> , 5(10)A  | 48VAC, 50-60Hz       | AF2122          |
| WM22-DIN AV5.3.A.      | 400V <sub>L-L</sub> , 5(10)A  | 24VAC, 50-60Hz       | AF2123          |
| WM22-DIN AV4.3.A.      | 208V <sub>L-L</sub> , 5(10)A  | 24VAC, 50-60Hz       | AF2124          |
| WM22-DIN AV7.3.A.      | 660V <sub>L-L</sub> , 5(10)A  | 24VAC, 50-60Hz       | AF2125          |
| WM22-DIN AV6.3.D.      | 100V <sub>L-L</sub> , 5(10)A  | 230VAC, 50-60Hz      | AF2126          |
| WM22-DIN AV6.3.C.      | 100V <sub>L-L</sub> , 5(10)A  | 115VAC, 50-60Hz      | AF2127          |
| WM22-DIN AV6.3.B.      | 100V <sub>L-L</sub> , 5(10)A  | 48VAC, 50-60Hz       | AF2128          |
| WM22-DIN AV6.3.A.      | 100V <sub>L-L</sub> , 5(10)A  | 24VAC, 50-60Hz       | AF2129          |
| WM22-DIN AV1.3.4 / [5] | 400V <sub>L-L</sub> , 20(90)A | 18-60VDC [77-143VDC] | AF2130 [AF2137] |
| WM22-DIN AV0.3.4 / [5] | 208V <sub>L-L</sub> , 20(90)A | 18-60VDC [77-143VDC] | AF2131 [AF2138] |
| WM22-DIN AV3.3.4 / [5] | 660V <sub>L-L</sub> , 20(90)A | 18-60VDC [77-143VDC] | AF2132 [AF2139] |
| WM22-DIN AV5.3.4 / [5] | 400V <sub>L-L</sub> , 5(10)A  | 18-60VDC [77-143VDC] | AF2133 [AF2140] |
| WM22-DIN AV4.3.4 / [5] | 208V <sub>L-L</sub> , 5(10)A  | 18-60VDC [77-143VDC] | AF2134 [AF2141] |
| WM22-DIN AV7.3.4 / [5] | 660V <sub>L-L</sub> , 5(10)A  | 18-60VDC [77-143VDC] | AF2135 [AF2142] |
| WM22-DIN AV6.3.4 / [5] | 100V <sub>L-L</sub> , 5(10)A  | 18-60VDC [77-143VDC] | AF2136 [AF2143] |

## Available modules

| Type                     | Channels | Code   | Type                    | Channels | Code   |
|--------------------------|----------|--------|-------------------------|----------|--------|
| Open collector output    | 2        | AO2900 | 0-10VDC Analogue Output | 1        | AO2921 |
| 0-20mADC analogue output | 1        | AO2920 | RS485 Serial Output     | 1        | AR2950 |
| Relay + open c. output   | 2        | AO2910 |                         |          |        |

## Possible module combinations

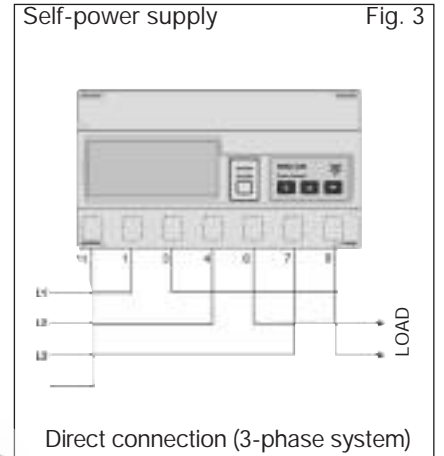
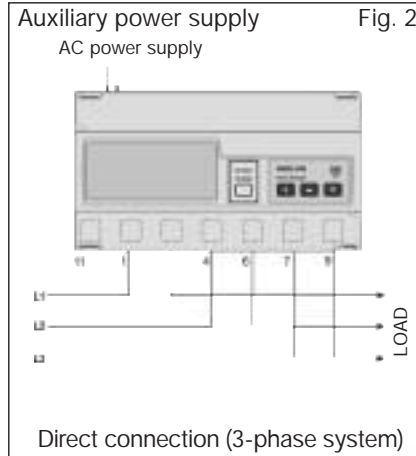
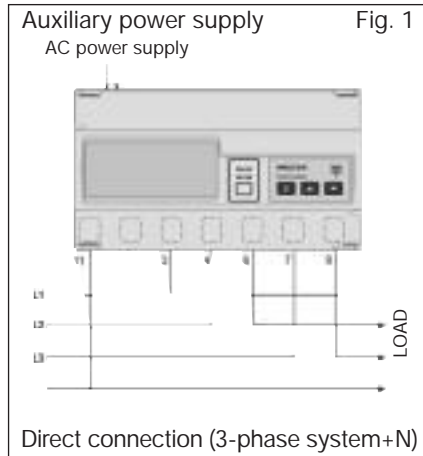
| Power supply           | Self p.s. |        | Auxiliary p.s. |        | Power supply        | Self p.s. |        | Auxiliary p.s. |        |
|------------------------|-----------|--------|----------------|--------|---------------------|-----------|--------|----------------|--------|
|                        | Slot A    | Slot B | Slot A         | Slot B |                     | Slot A    | Slot B | Slot A         | Slot B |
| Basic unit             |           |        |                |        | Basic unit          |           |        |                |        |
| Open collector output  | ●         |        | ●              |        | Analogue output     |           | ●(*)   |                | ●      |
| Relay + open c. output | ●         |        | ●              |        | RS485 Serial Output |           | ●(*)   |                | ●      |

(\*) AV2 only

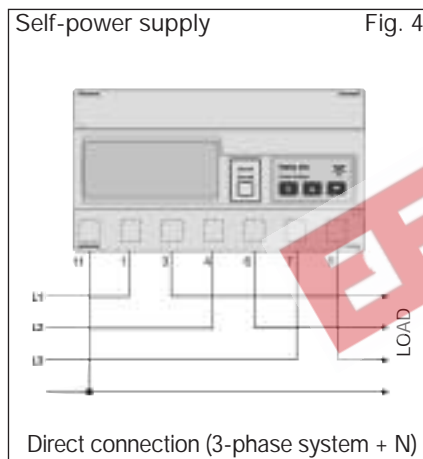


## Wiring diagrams

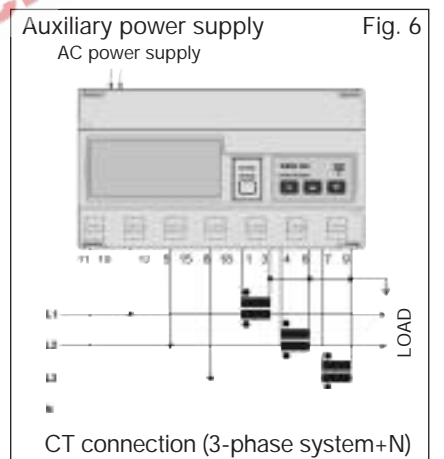
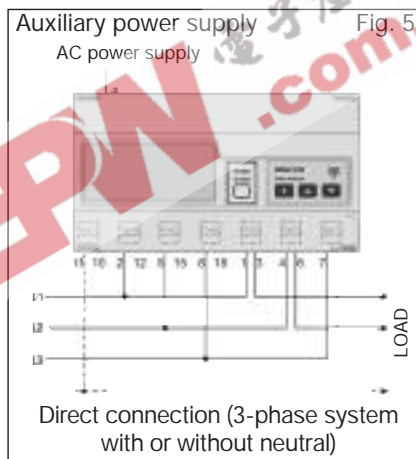
### 20(90)A model: three-phase unbalanced load



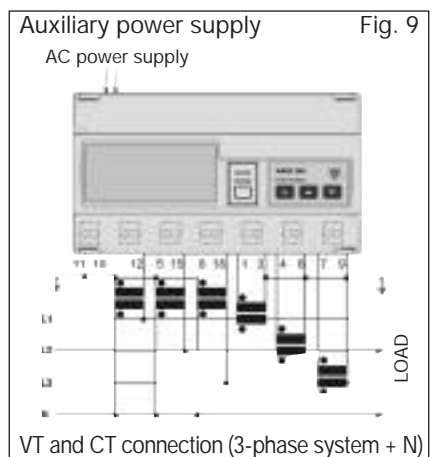
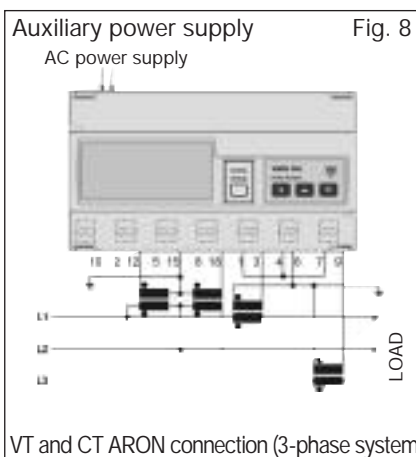
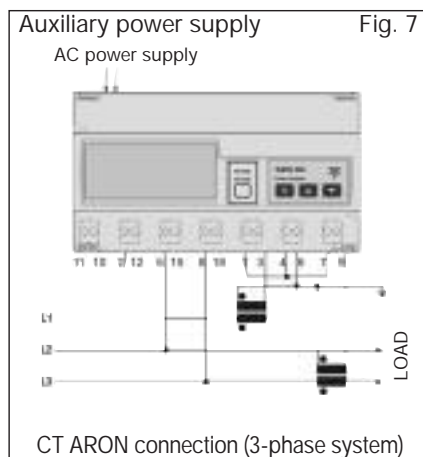
### 20(90)A model: three-phase unbalanced load



### 5(10)A model: three-phase unbalanced load

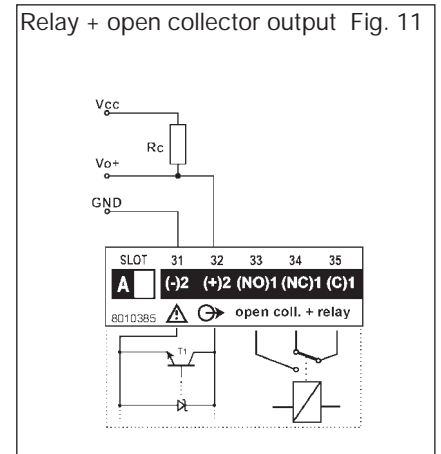
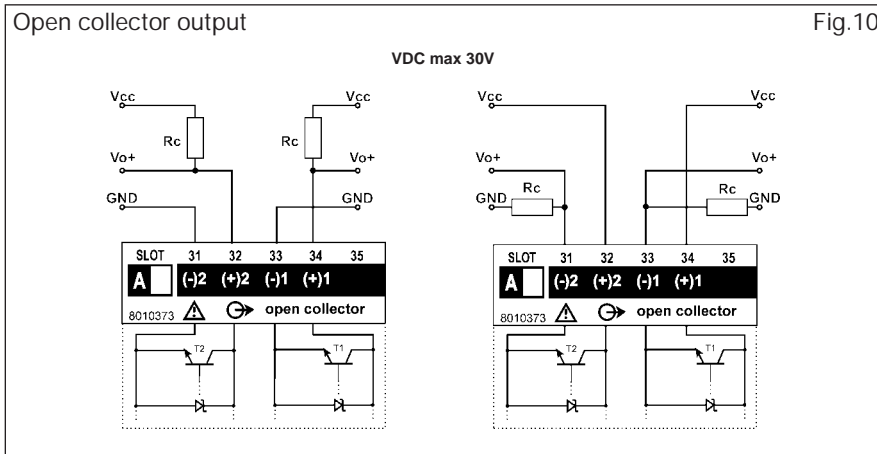


### 5(10)A model: three-phase unbalanced load

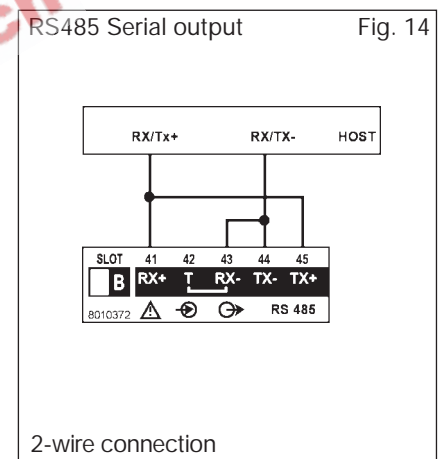
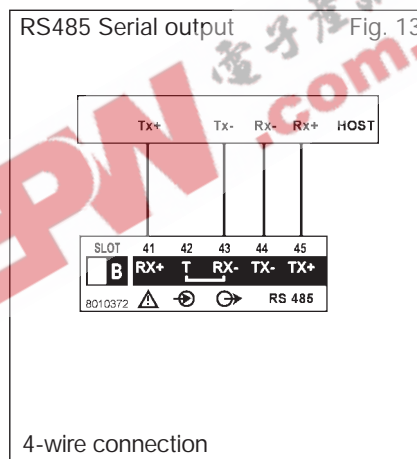
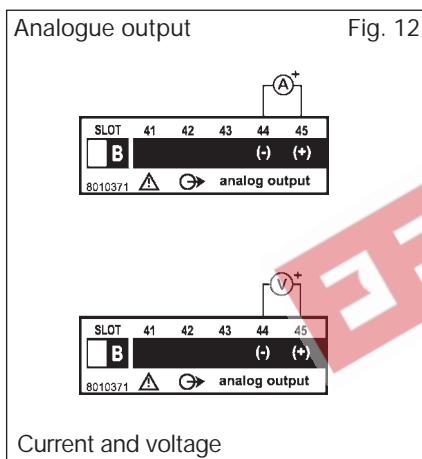




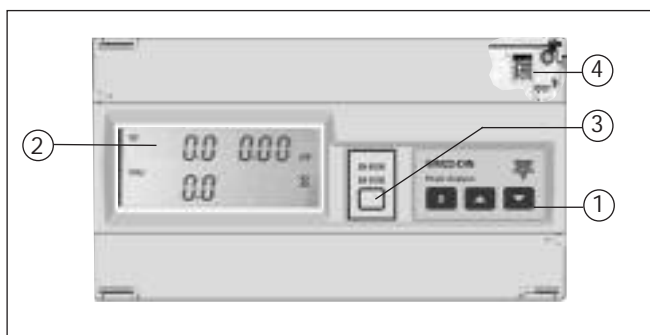
## Wiring diagrams (optional modules)



Only open collector outputs: the grounds of the outputs are separated, and therefore it's possible to carry out, for the same module, two different connections. The load resistance (Rc) must be designed so that the closed contact current is lower than 100mA; the VDC voltage must be lower than or equal to 30V. VDC: power supply voltage output. Vo+: positive output contact (open collector transistor). GND: ground output contact (open collector transistor).



## Front panel description



Keys for:

- value programming;
- function selection;
- displaying the measuring pages.

**2. Display**

- LCD with alphanumeric indications to:
- display configuration parameters;
  - display all the measured variables.

**3. Removable label**

Label to write the instrument ID number.

**4. Hidden dip-switch**

Enable/ disable the access to the programming procedure.

**1. Key-pad**

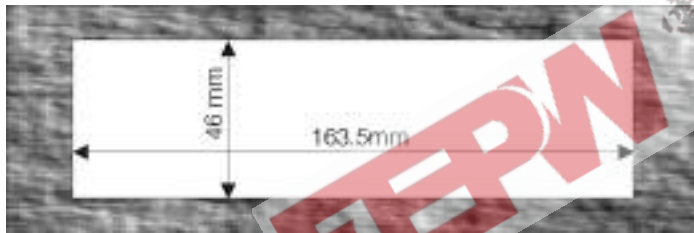
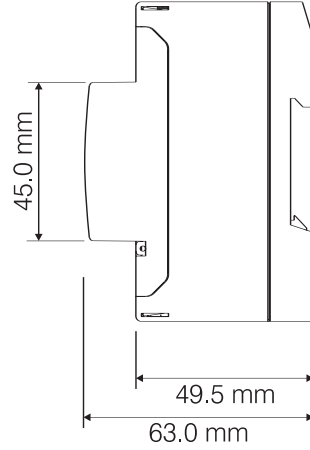
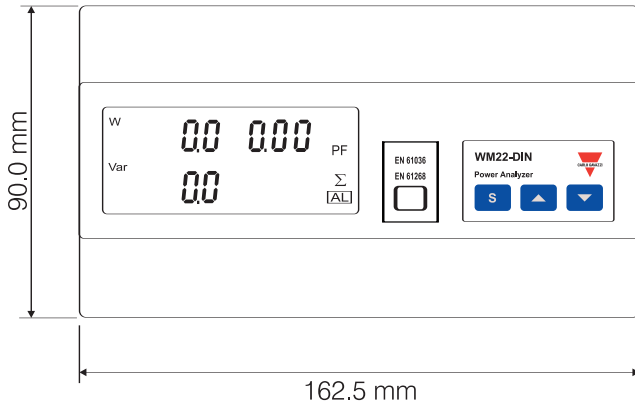
To program configuration parameters and to display variables.



S-key to enter programming and confirm selections;

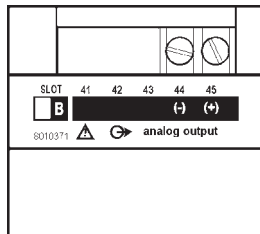


## Dimensions and panel cut-out



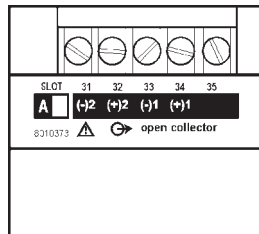
## Terminal boards

Analogue output module



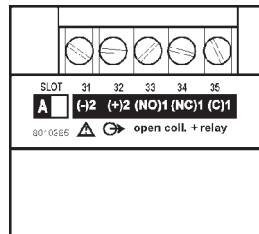
AO 2920: 0-20 mA  
AO 2921: 0-10 V

Dual output open collector module



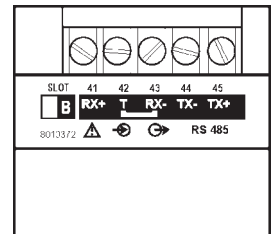
AO 2900

Relay output module + open collector output



AO 2910

RS485 serial output module



AR 2950