

# 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

## 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

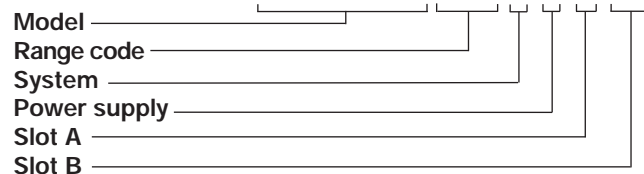
area from 6 to 35 mm<sup>2</sup>. The special design of the instrument's housing allows to add at any time the interface modules, even when the instrument is already installed.

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.

- Class 0.5 (current/voltage)
- Three-phase power analyzer
- Back-lighted LCD
- 4 x 3<sup>1</sup>/<sub>2</sub> DGT instantaneous variables read out
- 7<sup>1</sup>/<sub>2</sub> 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

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

[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>  | Acc. to EN61036, EN61268   |
| Current   | 3  | Wave form   | <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  | <b>Max. and Min. indication</b>   | 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 corrent: 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>Measurements</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"   | Coupling type   | Current, voltage, power,<br>energy, power factor, frequen-<br>cy, harmonic distortion (see<br>display specs). TRMS<br>measurements of distorted<br>wave forms.<br>Direct |
| Ib 5A   | I <sub>min</sub> : 500mA;<br>I <sub>max</sub> : 15Ap;  | <b>Crest factor</b>   |  |
| Ib 20A  | I <sub>min</sub> : 2A;<br>I <sub>max</sub> : 127Ap;  | Ib 5A<br>Ib 20A   | ≤3 (15A max. peak)<br>≤6 (127A max. peak)  |
|   |  | <b>Current overload</b>   |  |
|   |  | 5(10) A, for 10ms<br>5(10) A, for 500ms<br>5(10) A, permanent<br>20(90) A, for 10ms<br>20(90) A, permanent  | 300 A max, @ 50Hz<br>200 A max, @ 50Hz<br>10A, @ 50Hz<br>2700A max, @ 50Hz<br>90A, @ 50Hz  |
|   |  | <b>Voltage overload</b>   |  |
|   |  | Permanent<br>For 1s   | 1.2 Un<br>2 Un   |
|   |  | <b>Input impedance</b>  |  |
|   |  | 400V <sub>L-L</sub> (AV1-AV5-AV9)<br>208V <sub>L-L</sub> (AV0-AV4-AV8-AV2)<br>660V <sub>L-L</sub> (AV3-AV7)<br>100V <sub>L-L</sub> (AV6)<br>5(10) A (AV4-AV5-AV6-AV7)<br>20(90) A (AV0-AV1-AV3-AV8-AV9)<br>20(90) A (AV2) | > 720KΩ<br>> 720KΩ<br>> 1.97MΩ<br>> 400KΩ<br>< 0.3VA<br>< 4VA<br>< 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<br>FFT off, filter off<br>FFT on, filter on<br>variables<br>Filter off | V, W, VA, var, PF (cosφ)<br>900ms<br>1.4s<br>THD-V, THD-A<br>3s                          |
| Accuracy                             | ±0.5% F.S.   | Ripple  | ≤ 1% according to IEC 60688-1,<br>EN 60688-1   |
| Temperature drift                    | ≤ 300 ppm/ °C  | Load  | ≤ 500 Ω<br>≥ 10 kΩ   |
| Scaling factor                       | Programmable within the<br>whole range of<br>retransmission;<br>it allows the retransmission<br>of all the values included in  | 20 mADC<br>10 VDC<br>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. Static type like module AO2900;                                      |
| Number of outputs                   | 2  |                     | Relay type: SPDT, AC1, AC15: 1AAC @250VAC  |
| Number of pulses                    | From 0.01 to 100 pulses programmable according to the selected CT and VT ratios                  |                     | By means of optocouplers, 2000 V <sub>RMS</sub> outputs to measuring inputs, 2000 V <sub>RMS</sub> output to supply input. |
| Output type                         | Open collector (transistor NPN)  |                     | Insulation between the two outputs: 2000 V <sub>RMS</sub>  |
|                                     | V <sub>ON</sub> 1.2 VDC / max. 100 mA  |                     |  |
|                                     | V <sub>OFF</sub> 30 VDC max.   |                     |  |
| Pulse duration                      | 220 ms (ON), ≥ 220 ms (OFF)  |                     |  |



## Software functions

|   |   |  |   |
|---|---|--|---|
| <b>Password</b><br><br>1 <sup>st</sup> level<br>2 <sup>nd</sup> level | 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.  |
|   | <b>System selection</b>   | Three-phase with neutral<br>Three-phase without neutral  | <b>Filter</b><br>Filter operating range<br><br>Filter coefficient<br>Filter action  |
| <b>Transformer ratio</b><br>CT<br>VT                                  | 1 to 5000<br>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><br>System variables<br><br>Single phase variables<br><br>System variables<br><br>Single phase variables | 0 to 99.9% of the input electrical scale.<br>1 to 16<br>Alarm, analogue and serial output (fundamental variables: V, A, W and their derived ones).  |
| <b>Scaling factor</b><br>Operating mode                               | Compression/expansion of the measuring range to be connected to the analogue output.  | 20(90) A<br>5(10) A  | 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) |

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

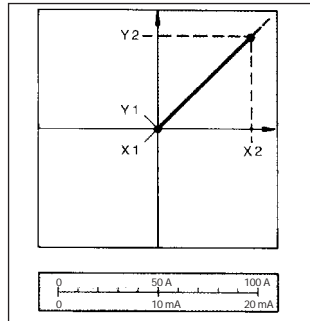
## Function description

### Input and output scaling capability

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

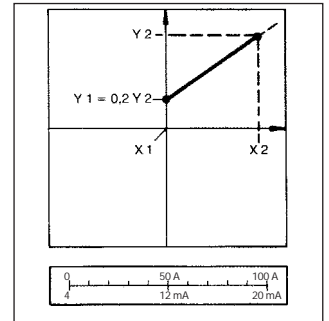
**Figure A**

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



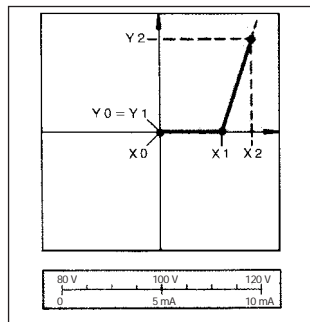
**Figure B**

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.



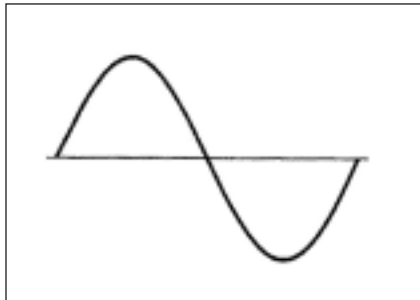
**Figure C**

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

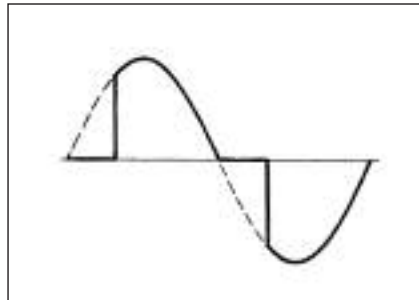
### Waveform of the signals that can be measured



**Figure D**

**Sine wave, undistorted**

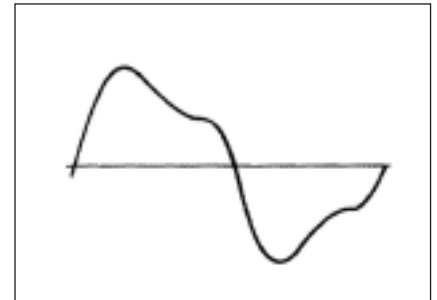
Fundamental content 100%  
Harmonic content 0%  
 $A_{rms} = 1.1107 | \bar{A} |$



**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<br>if the neutral is not connected |
| 14  | Var <sub>L1</sub>        | Var <sub>L2</sub>        | Var <sub>L3</sub>        | Var sys                  |  |
| 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

$$THD_i = \frac{\sqrt{\sum_{n=2}^n T_{n,i}^2}}{T_{1,i}}$$

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 |                         |          |        |

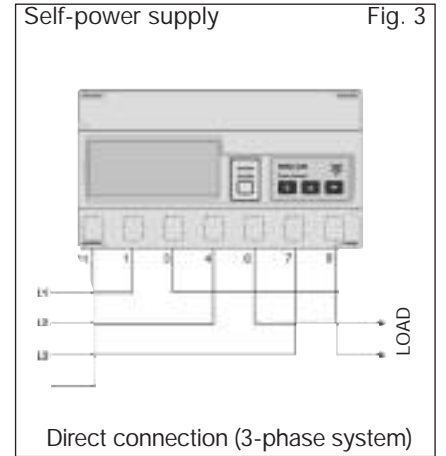
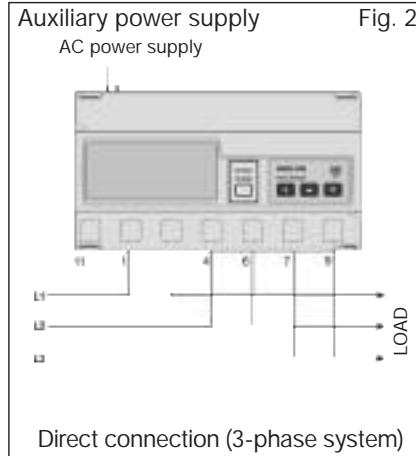
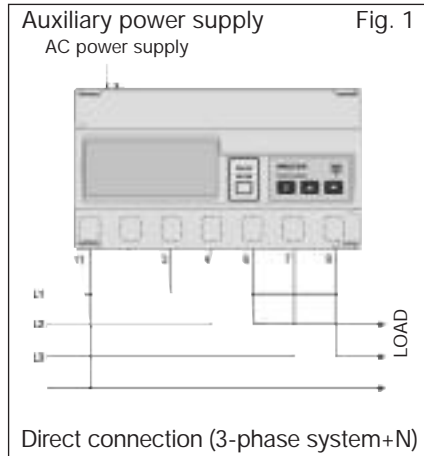
## Possible module combinations

| 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 |           | ●(*)   |                | ●      |

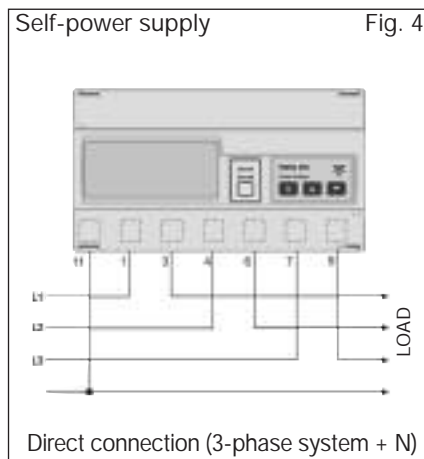
(\*) AV2 only

## Wiring diagrams

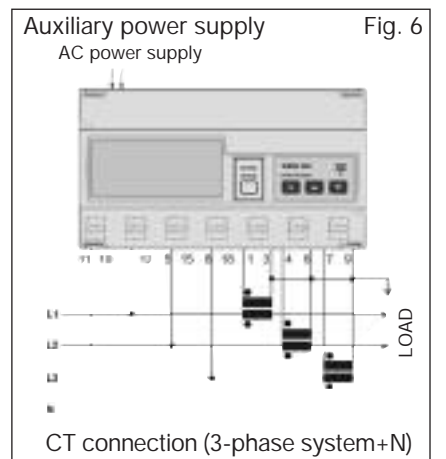
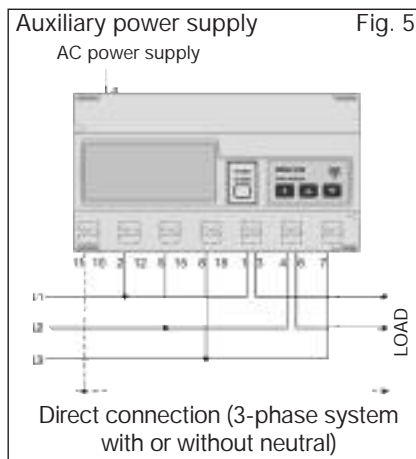
### 20(90)A model: three-phase unbalanced load



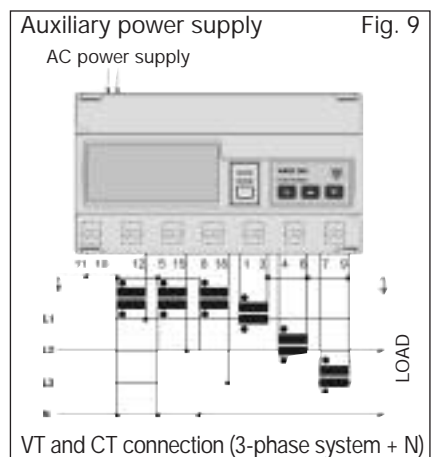
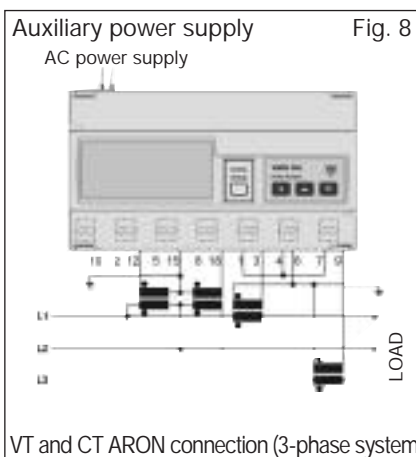
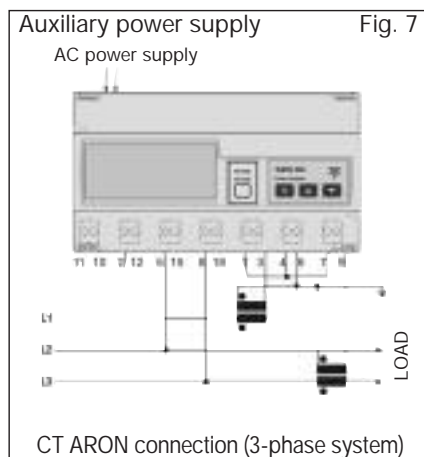
### 20(90)A model: three-phase unbalanced load



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

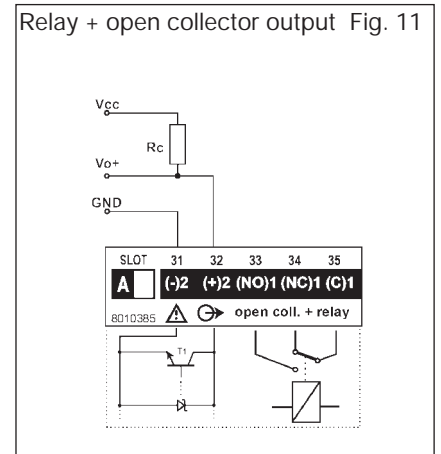
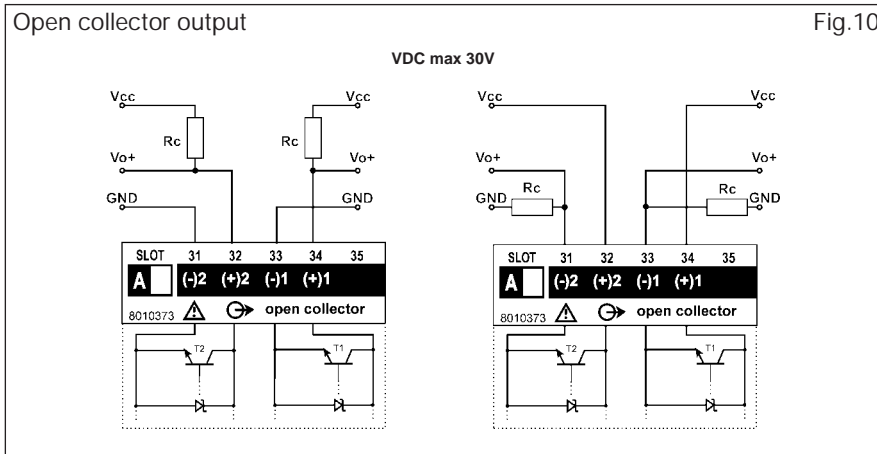


### 5(10)A model: three-phase unbalanced load

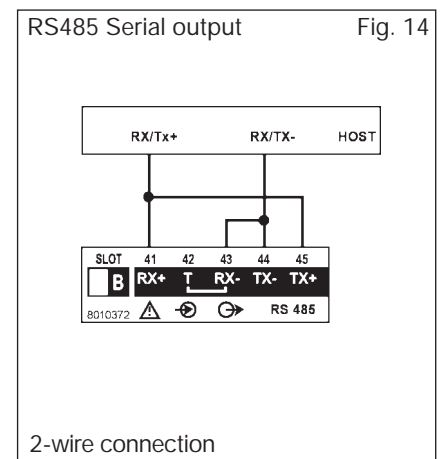
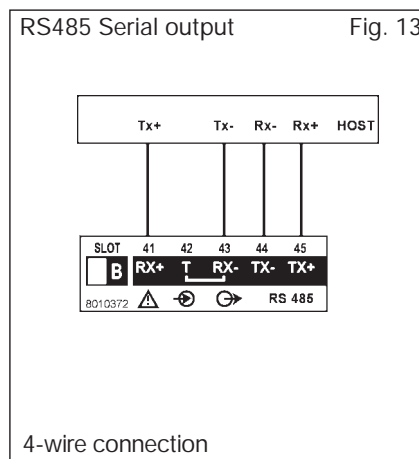
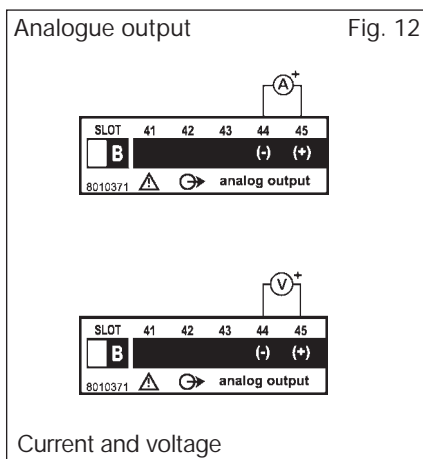




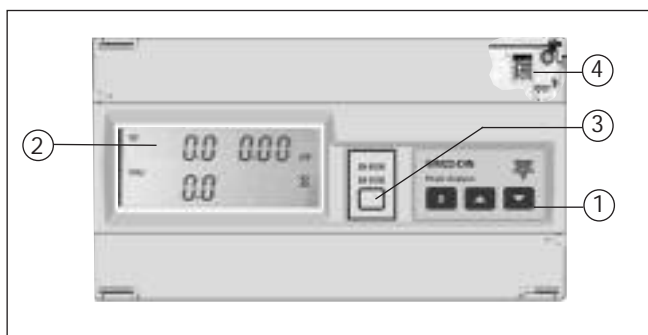
## Wiring diagrams (optional modules)



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 ( $R_c$ ) 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.

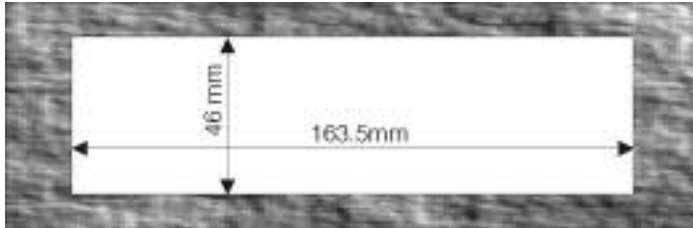
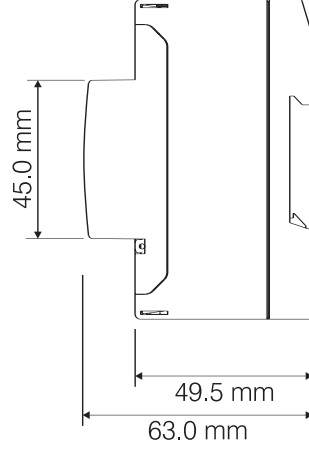
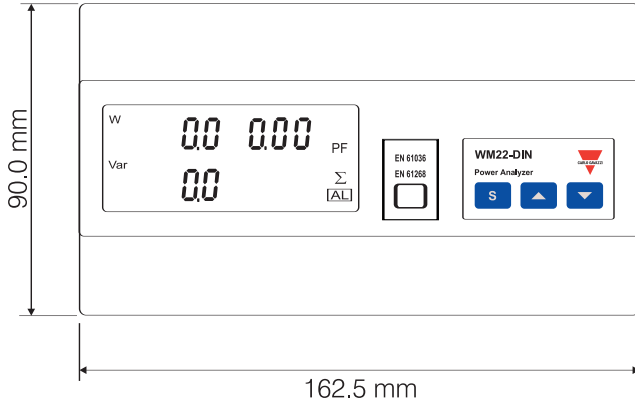
- 1. Key-pad**  
 To program configuration parameters and to display variables.  
 S-key to enter programming and confirm selections;

- 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.

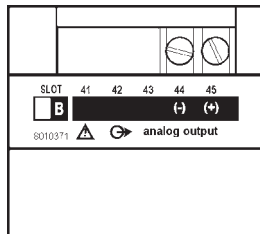
- 4. Hidden dip-switch**  
 Enable/ disable the access to the programming procedure.

## Dimensions and panel cut-out



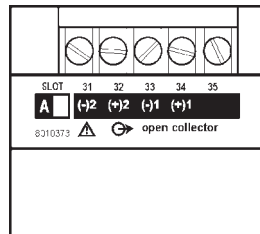
## Terminal boards

### Analogue output module



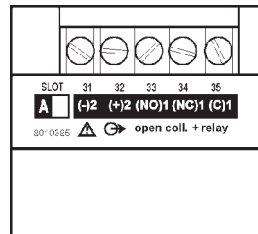
AO 2920: 0-20 mA  
AO 2921: 0-10 V

### Dual output open collector module



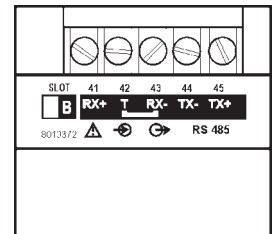
AO 2900

### Relay output module + open collector output



AO 2910

### RS485 serial output module



AR 2950