# Energy Management
# Modular Smart Power Quality Analyzer
# Type WM3-96

- **Class 0.5 (current/voltage)**
- **32-bit µP-based modular smart power quality analyzer**
- **Graph display (128x64 dots)**
- **Front size: 96x96 mm**
- **Measurements of single phase and system variables: W, Wdmd, var, VA, VAdmd, PF, PFavg, V, A, An dmd (for all of them max. and min. values). Energies: kWh and kvarh on 4 quadrants.**
- **Neutral current measurement**
- **TRMS measurement of distorted waves (voltage/current)**
- **Current and voltage inputs with autoranging capability**
- **4x4-dgt instantaneous variable read-out**
- **4x9-dgt total energies read-out**
- **4x6-dgt partial energies read-out**
- **48 independent energy meters to be used as single, dual, multi-time energy management**
- **Display refresh time: 100 msec @ 50 Hz**
- **Harmonic distorsion analysis (FFT) up to 50th harmonic with both graph and numerical indication (of current and voltage)**
- **Harmonics source detection**
- **Optional RS232 + real time clock function with data logging of alarm and MIN/MAX events, monthly energy metering recording**
- **Degree of protection (front): IP 65**
- **Up to 4 optional alarm setpoints**
- **Up to 4 optional pulse outputs**
- **Up to 4 optional analogue outputs**
- **Optional serial RS 422/485 output**
- **Universal power supply: 18 to 60VAC/DC - 90 to 260 VAC/DC**
- **MODBUS RTU, JBUS, (N2 METASYS protocols on request)**

## Product Description

32-bit µP-based smart power quality analizer with a built-in configuration key-pad.
The housing is for panel mounting and ensures a degree of protection (front) of IP 65. The instrument is particularly indicated for those application where there is the need to control the power supply quality. The variables being displayed are more than 400.

## Ordering Key

**WM3-96AV53H XX XX XX XX X**

- **Model**
- **Range code**
- **System**
- **Power supply**
- **Slot A**
- **Slot B**
- **Slot C**
- **Slot D**
- **Options**

## Type Selection

**Range code**

| | |
|---|---|
| **AV5:** | 240/415 VAC - 1/5 AAC (max. 300 V (L-N)/ 520 V (L-L) - 6 A) (standard) |
| **AV7:** | 400/690VAC - 1/5 AAC (max. 480V (L-N) / 830 V (L-L) / 6 A [1)] |

**System**

| | |
|---|---|
| **3:** | One phase, three-phase system (3 or 4 wires, balanced load) Three phase system (3 or 4 wires, unbalanced load) |

**Power supply**

| | |
|---|---|
| **L:** | 18 to 60VAC/DC [1)] |
| **H:** | 90 to 260VAC/DC |

[1)] On request

**Slot A (signal retransmission)**

| | |
|---|---|
| **XX:** | None |
| **A1:** | Single analogue output, 20mADC (standard) |
| **A2:** | Single analogue output, ±5mADC [1)] |
| **A3:** | Single analogue output, ±10mADC [1)] |
| **A4:** | Single analogue output, ±20mADC [1)] |
| **B1:** | Dual analogue output, 20mADC (standard) |
| **B2:** | Dual analogue output, ±5mADC [1)] |
| **B3:** | Dual analogue output, ±10mADC [1)] |
| **B4:** | Dual analogue output, ±20mADC [1)] |
| **V1:** | Single analogue output, 10VDC (standard) |
| **V2:** | Single analogue output, ±1VDC [1)] |
| **V3:** | Single analogue output, ±5VDC [1)] |
| **V4:** | Single analogue output, ±10VDC [1)] |
| **W1:** | Dual analogue output, 10VDC (standard) |
| **W2:** | Dual analogue output, ±1VDC [1)] |
| **W3:** | Dual analogue output, ±5VDC [1)] |
| **W4:** | Dual analogue output, ±10VDC [1)] |

**Slot B (signal retransmission)**

| | |
|---|---|
| **XX:** | None |
| **B1:** | Dual analogue output, 20mADC (standard) |
| **B2:** | Dual analogue output, ±5mADC [1)] |
| **B3:** | Dual analogue output, ±10mADC [1)] |
| **B4:** | Dual analogue output, ±20mADC [1)] |
| **W1:** | Dual analogue output, 10VDC (standard) |
| **W2:** | Dual analogue output, ±1VDC [1)] |
| **W3:** | Dual analogue output, ±5VDC [1)] |
| **W4:** | Dual analogue output, ±10VDC [1)] |
| **S1:** | Serial port, RS485 multidrop, bidirectional [1)] |

**Note:**

Slot A + Slot B
Max 4 analogue outputs

Slot C + Slot D
max 4 digital outputs

**Slot C (alarm or pulse out)**

| | |
|---|---|
| **XX:** | None |
| **R1:** | Single relay output, (AC1-8AAC, 250VAC) [1)] |
| **R2:** | Dual relay output, (AC1-8AAC, 250VAC) [1)] |
| **O1:** | Single open collector output (30V/100mADC) [1)] |
| **O2:** | Dual open collector output (30V/100mADC) [1)] |
| **D1:** | 3 digital inputs [1)] |

**Slot D (alarm or pulse out)**

| | |
|---|---|
| **XX:** | None |
| **R2:** | Dual relay output, (AC1-8AAC, 250VAC) [1)] |
| **O2:** | Dual open collector output (30V/100mADC) [1)] |
| **O4:** | 4 open collector outputs (30V/100mADC) [1)] |

**Options**

| | |
|---|---|
| **X:** | None |
| **S:** | Serial RS232 + RTC |
| **N:** | With N2 Metasys protocol |
| **C:** | options: S+N |

CARLO GAVAZZI

## Input Specifications

| | |
|---|---|
| **Number of inputs** | |
| Current | 2 (system: single phase)<br>6 (system: 3-phase) |
| Voltage | 2 (system: single phase<br>4 (system: 3-phase) |
| Digital | 3 free of voltage contacts for Wdmd, VAdmd, An dmd, PFavg synchronization<br>Reading voltage/current: 17.5 to 25VDC/<8mA |
| **Accuracy** (display, RS232, RS485) | In: 5A, If.s.: 6A, start-up I: 15mA |
| Current ($A_{L1}$, $A_{L2}$, $A_{L3}$) | ±0.5% RDG (0.2 to1.2 In)<br>±5mA (0.02 to 0.2 In) |
| Current ($A_n$) | ±1% RDG (0.2 to 1.2 In)<br>@ 40 to 100 Hz |
| Voltage AV5 range: | ±0.5% RDG (48 to 300 $V_{L-N}$)<br>±1% RDG (84 to 519 $V_{L-L}$) |
| AV7 range: | ±0.5% RDG (80 to 480 $V_{L-N}$)<br>±1% RDG (139 to 830 $V_{L-L}$)<br>includes also:<br>frequency, power supply and output load influences |
| Frequency | ±0.1% RDG (40 to 440 Hz) |
| Active power (@ 25°C ± 5°C, R.H. ≤ 60%) | ±0.5% (RDG + FS) (PF 0.5 L/C, 0.1 to 1.2 In, AV5 range) or<br>±1% RDG (PF 0.5 L/C, 0.1 to 1.2 In, AV5 range) |
| Reactive power (@ 25°C ± 5°C, R.H. ≤ 60%) | ±0.5% (RDG + FS) (PF 0.5 L/C, 0.1 to 1.2 In, AV5 range) or<br>±1% RDG (PF 0.5 L/C, 0.1 to 1.2 In, AV5 range) |
| Apparent power (@ 25°C ± 5°C, R.H. ≤ 60%) | ±0.5% (RDG + FS) (0.1 to 1.2 In, AV5 range) or<br>±1% RDG (0.1 to 1.2 In, AV5 range) |
| Energies (@ 25°C ± 5°C, R.H. ≤ 60%) | Active: class 1 according to EN61036<br>Reactive: class 2 according to EN61268<br>Ib: 5A, Imax: 6A<br>0.1Ib: 500mA<br>Start up current: 20mA<br>Un: 240V (AV5), 400V (AV7) |
| Harmonic distorsion (@ 25°C ± 5°C, R.H. ≤ 60%) | 1% FS (FS: 100%)<br>phase: ±2°; Imin: 0.1Arms; Imax: 15Ap; Umin: 50Vrms; Umax: 500Vp<br>Sampling frequency<br>6400 samples/s @ 50Hz |
| **Additional errors** | |
| Humidity | ≤ 0.3%RDG, 60% to 90% R.H. |
| Input frequency | ≤ 0.4%RDG, 62 to 400 Hz |
| Magnetic field | ≤ 0.5%RDG, @ 400 A/m |
| **Temperature drift** | ≤ 200ppm/°C |
| **Sampling rate** | 6400 samples/s @ 50Hz |
| **Display** | Graph LCD, 128x64pixel, back-lighted. Selectable read-out for the instantaneous variables: 4x4-dgt or 4x3½-dgt<br>Total Energies: 4x9-dgt; Partial: 4x6-dgt |
| **Max. and min. indication** | Max. 9999 (999,999,999), Min. -9999 (–999,999,999) |
| **Measurements** | Current, voltage, power, energy, harmonic distortion (see “Display pages” table).<br>TRMS measurement of a distorted wave (voltage/current).<br>Coupling type: Direct<br>Crest factor: ≤3<br>(max. 15Ap/500Vp (V L-N) or 15Ap/800Vp (V L-N) |
| **Ranges (impedances)** | |
| AV5 | 58/100 V (>500 kΩ) - 1 AAC (≤ 0.3 VA)<br>58/100 V (>500 kΩ) - 5 AAC (≤ 0.3 VA)<br>240/415 V (>500 kΩ) - 1 AAC (≤ 0.3 VA)<br>240/415 V (>500 kΩ) - 5 AAC (≤ 0.3 VA) |
| AV7 | 100/170 V ((>500 kΩ) 1 AAC (≤ 0.3 VA)<br>100/170 V (>500 kΩ) - 5 AAC (≤ 0.3 VA)<br>400/690 V (>500 kΩ) - 1 AAC (≤ 0.3 VA)<br>400/690 V (>500 kΩ) - 5 AAC (≤ 0.3 VA) |
| **Frequency range** | 40 to 440 Hz |
| **Over-load protection** | |
| Continuous: voltage/current | AV5: 300 $V_{LN}$/520 $V_{LL}$/6A<br>AV7: 480 $V_{LN}$/830 $V_{LL}$/6A |
| For 1 s | |
| AV5 | 600 $V_{LN}$/1040 $V_{LL}$/120A |
| AV7 | 960 $V_{LN}$/1660 $V_{LL}$/120A |
| **Keypad** | 4 keys:<br>”S” for enter programming phase and password confirmation,<br>”UP” and “DOWN” for value programming/function selection, page scrolling<br>“F” for special functions |

## Output Specifications

| | |
|---|---|
| **Analogue outputs (on request)** | |
| Number of outputs | Up to 4 (on request) |
| Accuracy | ±0.2% FS (@ 25°C ±5°C, R.H. ≤60%) |
| Range | 0 to 20 mADC,<br>0 to ±20 mADC<br>0 to ±10 mADC,<br>0 to ±5 mADC<br>0 to 10 VDC,<br>0 to ±10 VDC<br>0 to ±5 VDC<br>0 to ±1 VDC |

CARLO GAVAZZI

## Output Specifications (cont.)

| | |
|---|---|
| Scaling factor | Programmable within the whole range of retransmission; it allows the retransmission management of all values from:<br>0 to 20 mADC,<br>0 to ±20 mADC<br>0 to ±10 mADC,<br>0 to ±5 mADC<br>0 to 10 VDC,<br>0 to ±10 VDC<br>0 to ±5 VDC<br>0 to ±1 VDC |
| Variables to be retransmitted | All (see table"List of the variables that can be connected to:"...) |
| Response time | ≤ 200 ms typical<br>(filter excluded, FFT excluded 3 1/2 dgt indication) |
| Ripple | ≤ 1% according to IEC 60688-1 and EN 60688-1 |
| Temperature drift | 200 ppm/°C |
| Load: 20 mA output | ≤ 600 Ω |
| ±20 mA output | ≤ 550 Ω |
| ±10 mA output | ≤ 1100 Ω |
| ± 5 mA output | ≤ 2200 Ω |
| 10 V output | ≥ 10 kΩ |
| ±10 V output | ≥ 10 kΩ |
| ± 5 V output | ≥ 10 kΩ |
| ± 1 V output | ≥ 10 kΩ |
| Insulation | By means of optocouplers, 4000$V_{RMS}$ output to measuring input<br>4000$V_{RMS}$ output to supply input |
| **RS422/RS485 output (on request)** | Multidrop bidirectional (static and dynamic variables) |
| Connections | 4 wires, max. distance 1200m, termination directly on the module |
| Addresses | 1 to 255, selectable by key-pad |
| Protocol | MODBUS RTU /JBUS, (N2 METASYS on request) |
| Data (bidirectional) | |
| Dynamic (reading only) | All display variables (see also the table, "List of the variables that can be connected to"...) |
| Static (writing only) | All configuration parameters, reset of energy, activation of digital output<br>Stored energy (EEPROM) max. 999.999.999 kWh/kvarh |
| Data format | 1-start bit, 8-data bit, no parity/even parity, odd parity, 1 stop bit |
| Baud-rate | 1200, 2400, 4800 and 9600 selectable bauds |
| Insulation | By means of optocouplers, 4000 $V_{RMS}$ output to measuring inputs<br>4000 $V_{RMS}$ output to supply input |
| **RS232 output (on request)** | Bidirectional (static and dynamic variables) |
| Connections | 3 wires, max. distance 15m, |
| Data format | 1-start bit, 8-data bit, no parity, 1-stop bit |
| Baud-rate | 9600 bauds |
| Protocol | MODBUS (JBUS) |
| Other data | as for RS422/485 |
| **Digital outputs (on request)** | Up to 4 outputs (combination of alarms and pulse outputs)<br>The working of the outputs: pulse or alarm or both of them is fully programmable and is independent from the chosen output module. Outputs remotely controlled by the serial communication port |
| **Pulse outputs (on request)** | |
| Number of outputs | Up to 4, independent |
| Type | From 1 to 1000 programmable pulses for K-M-G Wh, K-M-G varh, open collector (NPN transistor)<br>$V_{ON}$ 1.2 VDC/ max. 100 mA<br>$V_{OFF}$ 30 VDC max.<br>Outputs connectable to total and partial energy meters |
| Pulse duration | 220 ms (ON), ≥ 220 ms (OFF)<br>According to DIN43864 |
| Insulation | By means of optocouplers, 4000 $V_{rms}$ output to measuring input,<br>4000$V_{rms}$ output to supply input. |
| Note | The outputs can be either open collector type or relay type (for this latter one see the characteristics mentioned in the ALARMS). |
| **Alarms outputs (on request)** | |
| Number of setpoints | Up to 4, independent |
| Alarm type | Up alarm, down alarm, up alarm with latch, down alarm with latch, phase assymetry, phase loss, neutral loss |
| Variables to be controlled | All (see table"List of the variables that can be connected to:"...) |
| Setpoint adjustment | 0 to 100% of the electrical scale |
| Hysteresis | 0 to 100% of the electrical scale |
| On-time delay | 0 to 255 s |
| Relay status | Selectable, Normally de-energized, normally energized |
| Output type | Relay, SPDT<br>AC 1-8A, 250VAC<br>DC 12-5A, 24VDC<br>AC 15-2.5A, 250VAC<br>DC 13-2.5A, 24VDC |
| Min. response time | ≤ 150 ms, filter excluded, FFT excluded,<br>setpoint on-time delay: "0s" |
| Insulation | 4000 $V_{RMS}$ output to measuring input,<br>4000$V_{RMS}$ output to supply input |
| Note | The outputs can be either relay type or open collector type (for this latter one, see the characteristics mentioned in the PULSE OUTPUTS). |

CARLO GAVAZZI

## 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 499, all data are protected |
| **Transformer ratio** | For CT up to 30000 A, For VT up to 600 kV |
| **Scaling factor** | |
| Operating mode | Electrical scale: compression/ expansion of the input scale to be connected to up to 4 analogue outputs. |
| Electrical range | Programmable within the whole measuring range |
| **Filter** | |
| Filter operating range | 0 to 99.9% of the input electrical scale |
| Filtering coefficient | 1 to 255 |
| Filter action | Display, alarm, analogue and serial outputs (fundamental variables: V, A, W and their derived ones) |
| **Event logging** | Only with RS232 + RTC module. The alarms max/min values will be stored with time (hh:mm:ss) and date (dd:mm:yy) references Max. capacity: 480 events |
| **Page Variables** | Max. 4/page, one freely prog. page + 26 variable pages + according to the kind of period selection: up to 12 energy meter pages. |
| **Display language** | English, Italian, French, German, Spanish |

## Supply Specifications

| | |
|---|---|
| **AC/DC voltage** | 90 to 260VAC/DC (standard), 18 to 60VAC/DC (on request), |
| **Power consumption** | ≤ 30VA/12W (90to 260V) ≤ 20VA/12W (18 to 60V) |

## General Specifications

| | |
|---|---|
| **Operating temperature** | 0 to +50°C (32 to 122°F) (R.H. < 90% non-condensing) |
| **Storage temperature** | -10 to +60°C (14 to 140°F) (R.H. < 90% non-condensing) |
| **Insulation reference voltage** | 300 $V_{RMS}$ to ground (AV5 input) |
| **Insulation** | 4000 $V_{RMS}$ between all inputs/ outputs to ground |
| **Dielectric strength** | 4000 $V_{RMS}$ for 1 minute |
| **Noise rejection** | |
| CMRR | 100 dB, 48 to 62 Hz |
| **EMC** | EN 50081-2, EN 50082-2 |
| **Other standards** | |
| Safety requirements: | IEC 61010-1, EN 61010-1 |
| Product requirements: | IEC 60688-1, EN 60688-1 |
| Product requirements | Energy measurements: EN61036, EN61268. |
| Pulse output: | DIN43864 |
| **Approvals** | CE, UL, CSA |
| **Connector** | Screw-type, max. 2.5 $mm^2$ wires x 2 |
| **Housing** | |
| Dimensions | 96x96x140 mm |
| Material | ABS, self-extinguishing: UL 94 V-0 |
| **Degree of protection** | Front: IP65 |
| **Weight** | Approx. 600 g (packing included) |

CARLO GAVAZZI

# Function Description

**Input and output scaling capability**
Working of the analogue outputs (y) versus input variables (x)

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

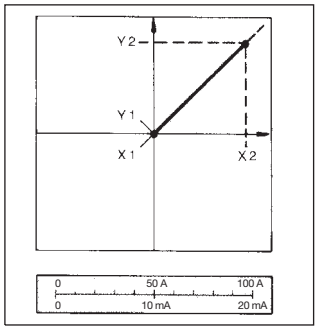



**Figure B**
The sign of measured quantity and output quantity changes simultaneously. The output quantity is proportional to the measured quantity.

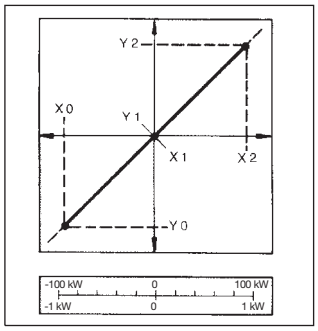



**Figure C**
The sign of measured quantity and output quantity remains the same. On the range X0...X1, the output quantity is zero. The range X1...X2 is delineated on the entire output range Y0 = Y1...Y2 and thus presented in strongly expanded form.

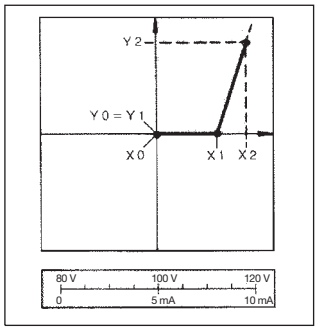



**Figure D**
The sign of measured quantity and output quantity remains the same. With the measured quantity being zero, the output quantity already has the value
Y1 = 0.2 Y2.
Live zero output.

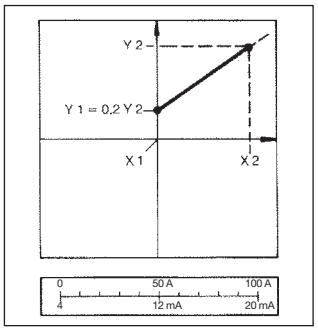



**Figure E**
The sign of the measured quantity changes but that of the output quantity remains the same. The output quantity steadily increases from value X1 to value X2 of the measured quantity.

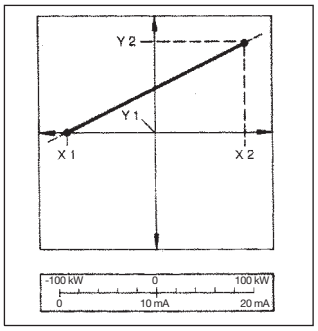
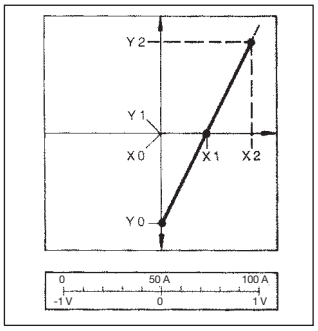



**Figure F**
The sign of the measured quantity remains the same, that of the output quantity changes as the measured quantity leaves range X0...X1 and passes to range X1...X2 and vice versa.




# Mode of Operation

**Waveform of the signals that can be measured**

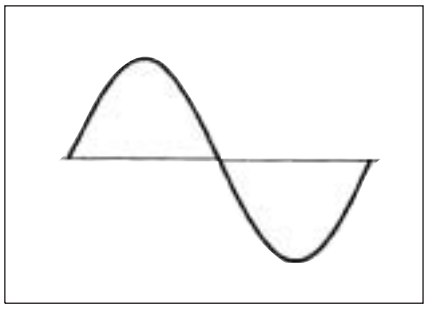


**Figure G**
**Sine wave, undistorted**

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

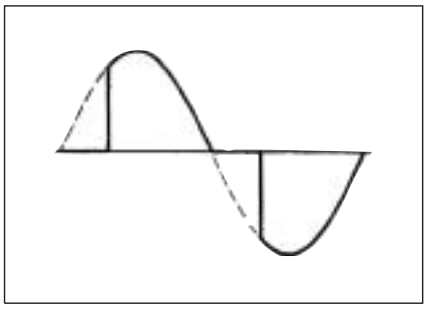


**Figure H**
**Sine wave, indented**

| | |
|---|---|
| Fundamental content | 10...100% |
| Harmonic content | 0...90% |
| Frequency spectrum 3rd to 50th harmonic | |

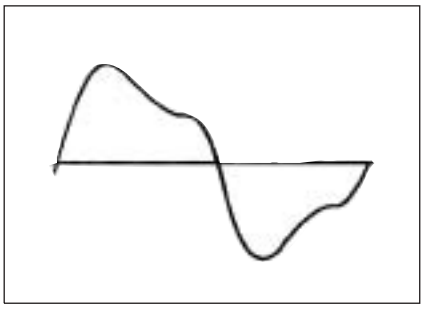


**Figure I**
**Sine wave, distorted**

| | |
|---|---|
| Fundamental content | 70...90% |
| Harmonic content | 10...30% |
| Frequency spectrum 3rd to 50th harmonic | |

CARLO GAVAZZI

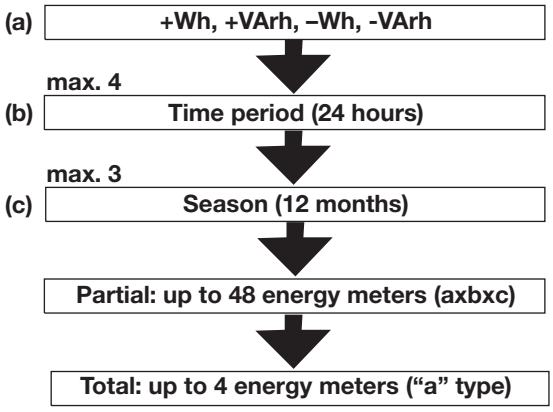
## Harmonic distortion analysis

| | |
|---|---|
| **Analysis principle** | FFT |
| **Harmonic measurement** | |
| Current | Up to 50th harmonic |
| Voltage | Up to 50th harmonic |
| **Type of harmonics** | THD ($V_{L1}$)<br>THD odd ($V_{L1}$)<br>THD even ($V_{L1}$)<br>and also for the other phases: L2, L3.<br>THD ($I_{L1}$)<br>THD odd ($I_{L1}$)<br>THD even ($I_{L1}$)<br>and also for the other phases: L2, L3. |
| **Harmonic phase angle** | The instrument measures the angle between the single harmonic of "V" and the single harmonic of "I" of the same order. According to the value of the electrical angle, it is possible to know if the distortion is absorbed or generated. Note: if the system has 3 wires the angle cannot be measured. |
| **Harmonic details** | For every THD page it is possible to see the harmonic order. |
| **Display pages** | The harmonics content is displayed as a graph showing the whole harmonic spectrum. The information is given also as numerical information:<br>THD in % / RMS value<br>THD odd in % / RMS value<br>THD even in % / RMS value<br>single harmonic in % / RMS value |
| **Others** | The harmonic distortion can be measured in 2-wire, 3-wire or 4-wire systems.<br>Tw: 0.02 |

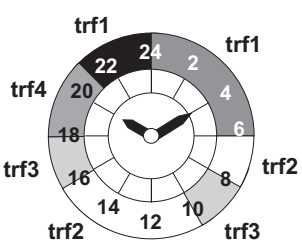
## Energy time period management

| | |
|---|---|
| **Time periods** | Selectable: single time, dual time and multi-time |
| **Single time** | |
| Number of energy meters | Total: 4 (9-digit)<br>(no partial meters) |
| **Dual time** | |
| Number of energy meters | Total: 4 (9-digit)<br>Partial: 8 (6-digit) |
| Time periods | 2, programmable within 24 hours |
| **Multi time** | |
| Number of energy meters | Total: 4 (9-digit)<br>Partial: 48 (6-digit) |
| Time periods | 4, programmable within 24 hours |
| Time seasons | 3, programmable within 12 months |
| **Pulse outputs** | Connectable to total and partial energy meters (Single time, dual time, multi time periods) |
| **Energy metering recording** | Energy consumption story, recording of energy metering by months, oldest data: 2 months before current month. Recording of total and partial energy metering |

**Management concept (multi-time)**




**Example of Multi-time energy metering**




| WINTER | | | |
|---|---|---|---|
| trf | start | end | |
| 1 | 00:00 | 06:00 | < |
| 2 | 06:00 | 08:00 | |
| 3 | 08:00 | 10:00 | |
| TARIFF | | 1 | |

| WINTER | | | |
|---|---|---|---|
| trf | start | end | |
| 2 | 10:00 | 16:00 | |
| 3 | 16:00 | 18:00 | |
| 4 | 18:00 | 21:00 | |
| 1 | 21:00 | 00:00 | < |
| TARIFF | | 1 | |

CARLO GAVAZZI

# Display pages

**Variables that can be displayed in case of a three-phase system, 4-wire connection.**

| No | 1st variable | 2nd variable | 3rd variable | 4th variable | Note |
|---|---|---|---|---|---|
| | Selectable | Selectable | Selectable | Selectable | |
| 1 | V L1 | V L2 | V L3 | V L-N sys | Sys = Σ |
| 2 | V L1-2 | V L2-3 | V L3-1 | V L-L sys | Sys = Σ |
| 3 | A L1 | A L2 | A L3 | A n | |
| 4 | W L1 | W L2 | W L3 | W sys | Sys = Σ |
| 5 | var L1 | var L2 | var L3 | var sys | Sys = Σ |
| 6 | VA L1 | VA L2 | VA L3 | VA sys | Sys = Σ |
| 7 | PF L1 | PF L2 | PF L3 | PF sys | |
| 8 | V L1 | A L1 | PF L1 | W L1 | |
| 9 | V L2 | A L2 | PF L2 | W L2 | |
| 10 | V L3 | A L3 | PF L3 | W L3 | |
| 11 | V L-L sys | PF sys | var sys | W sys | Sys = Σ |
| 12 | A n | PF sys | Hz | W sys | Sys = Σ |
| 13 | A n dmd | VA dmd | PF avg | W dmd | dmd=demand, avg=average |
| 14 | (MAX1) | (MAX2) | (MAX3) | (MAX4) | The MAX value can be one of the above mentioned (No. 1 to No. 13) |
| 15 | (MAX5) | (MAX6) | (MAX7) | (MAX8) | |
| 16 | (MAX9) | (MAX10) | (MAX11) | (MAX12) | |
| 17 | (MIN1) | (MIN2) | (MIN3) | (MIN4) | The MIN value can be one of the above mentioned (No. 1 to No. 13) |
| 18 | (MIN5) | (MIN6) | (MIN7) | (MIN8) | |
| 19 | Histogram FFT V1 (THD, TADo, THDe, Single harmonic) | | | | Only if analysis V1-A1 is activated |
| 20 | Histogram FFT A1 (THD, TADo, THDe, Single harmonic) | | | | Only if analysis V1-A1 is activated |
| 21 | Histogram FFT V2 (THD, TADo, THDe, Single harmonic) | | | | Only if analysis V2-A2 is activated |
| 22 | Histogram FFT A2 (THD, TADo, THDe, Single harmonic) | | | | Only if analysis V2-A2 is activated |
| 23 | Histogram FFT V3 (THD, TADo, THDe, Single harmonic) | | | | Only if analysis V3-A3 is activated |
| 24 | Histogram FFT A3 (THD, TADo, THDe, Single harmonic) | | | | Only if analysis V3-A3 is activated |
| 25 | KWh + TOT | KWh – TOT | Kvar+ TOT | Kvar– TOT | |
| 26 | KWh+ | KWh– | Kvar+ | Kvar– | Partial energy meters |

**Used Calculation Formulas**

**Formulas being used for single-phase measurements**

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

$$VAr_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

**Formulas being used for 3-phase measurements**

Equivalent three-phase voltage

$$V_\Sigma = \frac{V_{12} + V_{23} + V_{31}}{3}$$

Three-phase reactive power

$$VAr_\Sigma = (VAr_1 + VAr_2 + VAr_3)$$

Neutral current

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

Three-phase active power

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

Three-phase apparent power

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

Equivalent three-phase power factor

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

Total harmonic distortion

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

Harmonic values:
THDi-THD of parameter T at phase i

Tn,i - value of parameter T at the n'th harmonic of phase i

**Energy metering**

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

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

$kWh_i$ = total consumed active energy at phase i

$kVARh_i$ = total consumed reactive energy at phase i

$P_i(t)$ = total RMS active power at phase i of time t

$Q_i(t)$ = total RMS reactive power at phase i of time t

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

$P_{n,i}$ = total RMS active power at phase i of discrete time n

$Q_{n,i}$ = total RMS reactive power at phase i of discrete time n

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

n1, n2 = starting and ending discrete time points of consumption recording

CARLO GAVAZZI

## List of the variables that can be connected to:

- max/min variable detection;
- analogue outputs;
- alarm outputs.

| No | Variable | 1-phase Sys. | 3-ph. + N Bal. Sys. | 3-ph. + N Unbal. Sys. | 3-ph. Bal. Sys. | 3-ph. Unbal. Sys. | Note |
|---|---|---|---|---|---|---|---|
| 1 | V L1 | o | x | x | o | o | |
| 2 | V L2 | o | x | x | o | o | |
| 3 | V L3 | o | x | x | o | o | |
| 4 | V L-N sys | o | x | x | o | o | Sys = Σ |
| 5 | V L1-2 | x | x | x | x | x | |
| 6 | V L2-3 | o | x | x | x | x | |
| 7 | V L3-1 | o | x | x | x | x | |
| 8 | V L-L sys | o | x | x | x | x | Sys = Σ |
| 9 | A L1 | x | x | x | x | x | |
| 10 | A L2 | o | x | x | x | x | |
| 11 | A L3 | o | x | x | x | x | |
| 12 | A n | o | x | x | o | o | Neutral current |
| 13 | W L1 | x | x | x | o | o | |
| 14 | W L2 | o | x | x | o | o | |
| 15 | W L3 | o | x | x | o | o | |
| 16 | W sys | o | x | x | x | x | Sys = Σ |
| 17 | var L1 | x | x | x | o | o | |
| 18 | var L2 | o | x | x | o | o | |
| 19 | var L3 | o | x | x | o | o | |
| 20 | var sys | o | x | x | x | x | Sys = Σ |
| 21 | VA L1 | x | x | x | o | o | |
| 22 | VA L2 | o | x | x | o | o | |
| 23 | VA L3 | o | x | x | o | o | |
| 24 | VA sys | o | x | x | x | x | Sys = Σ |
| 25 | PF L1 | x | x | x | o | o | |
| 26 | PF L2 | o | x | x | o | o | |
| 27 | PF L3 | o | x | x | o | o | |
| 28 | PF sys | o | x | x | x | x | Sys = Σ |
| 29 | Hz | x | x | x | x | x | |
| 30 | THD V1 | x | x | x | x | x | if FFT V1-A1 is activated |
| 31 | THDo V1 | x | x | x | x | x | if FFT V1-A1 is activated |
| 32 | THDe V1 | x | x | x | x | x | if FFT V1-A1 is activated |
| 33 | THD V2 | o | x | x | x | x | if FFT V2-A2 is activated |
| 34 | THDo V2 | o | x | x | x | x | if FFT V2-A2 is activated |
| 35 | THDe V2 | o | x | x | x | x | if FFT V2-A2 is activated |
| 36 | THD V3 | o | x | x | x | x | if FFT V3-A3 is activated |
| 37 | THDo V3 | o | x | x | x | x | if FFT V3-A3 is activated |
| 38 | THDe V3 | o | x | x | x | x | if FFT V3-A3 is activated |
| 39 | THD A1 | x | x | x | x | x | if FFT V1-A1 is activated |
| 40 | THDo A1 | x | x | x | x | x | if FFT V1-A1 is activated |
| 41 | THDe A1 | x | x | x | x | x | if FFT V1-A1 is activated |
| 42 | THD A2 | o | x | x | x | x | if FFT V2-A2 is activated |
| 43 | THDo A2 | o | x | x | x | x | if FFT V2-A2 is activated |
| 44 | THDe A2 | o | x | x | x | x | if FFT V2-A2 is activated |
| 45 | THD A3 | o | x | x | x | x | if FFT V3-A3 is activated |
| 46 | THDo A3 | o | x | x | x | x | if FFT V3-A3 is activated |
| 47 | THDe A3 | o | x | x | x | x | if FFT V3-A3 is activated |
| 48 | A n dmd | x | x | x | x | x | Integration time programmable from 1 to 30 minutes |
| 49 | VA dmd | x | x | x | x | x | Integration time prog. from 1 to 30 min. |
| 50 | PF avg | x | x | x | x | x | Integration time prog. from 1 to 30 min. |
| 51 | W dmd | x | x | x | x | x | Integration time prog. from 1 to 30 min. |
| 52 | ASY | o | x | x | x | x | Integration time prog. from 1 to 30 min. |

Note: (x) stands for an “available” variable, (o) stands for a “not-available” variable.

CARLO GAVAZZI

## The available modules

| Type | N. of channels | Ordering code |
|---|---|---|
| WM3-96 base | | AD 1016H |
| WM3-96 N2 METASYS base | | AD 1016HN2 |
| AV5.3 measuring inputs | | AQ 1018 |
| AV7.3 measuring inputs | | AQ 1019 |
| 18-60VAC/DC power supply | | AP1021 |
| 90-260VAC/DC power supply | | AP1020 |
| 20mADC analogue output | 1 | AO1050 |
| 10VDC analogue output | 1 | AO1051 |
| ±5mADC analogue output | 1 | AO1052 |
| ±10mADC analogue output | 1 | AO1053 |
| ±20mADC analogue output | 1 | AO1054 |
| ±1VDC analogue output | 1 | AO1055 |
| ±5VDC analogue output | 1 | AO1056 |
| ±10VDC analogue output | 1 | AO1057 |
| 20mADC analogue output | 2 | AO1026 |
| 10VDC analogue output | 2 | AO1027 |
| ±5mADC analogue output | 2 | AO1028 |
| ±10mADC analogue output | 2 | AO1029 |
| ±20mADC analogue output | 2 | AO1030 |
| ±1VDC analogue output | 2 | AO1031 |
| ±5VDC analogue output | 2 | AO1032 |
| ±10VDC analogue output | 2 | AO1033 |
| RS485 output | 1 | AR1034 |
| Relay output | 1 | AO1058 |
| Relay output | 2 | AO1035 |
| Open collector output | 1 | AO1059 |
| Open collector output | 2 | AO1036 |
| Open collector output | 4 | AO1037 |
| Digital inputs | 3 | AQ1038 |
| RS232 output + RTC (1) | 1 | AR1039 |

## The possible module combinations

| Basic unit | Slot A | Slot B | Slot C | Slot D |
|---|---|---|---|---|
| Single analogue output | ● | | | |
| Dual analogue output | ● | ● | | |
| RS485 input/output | | ● | | |
| Single relay output (*) | | | ● | |
| Single open collector out (*) | | | ● | |
| Dual relay output (*) | | | ● | ● |
| Dual open coll. out (*) | | | ● | ● |
| 4 open coll. output (*) | | | | ● |
| 3 digital inputs | | | ● | |
| **Basic unit** | **Slot E** | | | |
| RS232 input/output + RTC | ● | | | |

(*) alarm or pulse

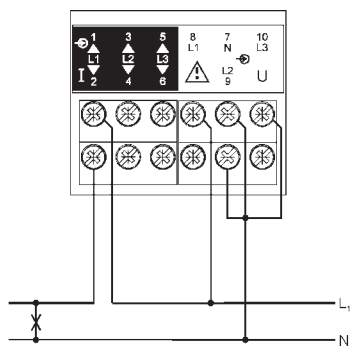
N2-Open Metasys protocol full compatibility (available on request).

(1) The RS232 communication port works as alternative of the RS485 module.

## Wiring Diagrams

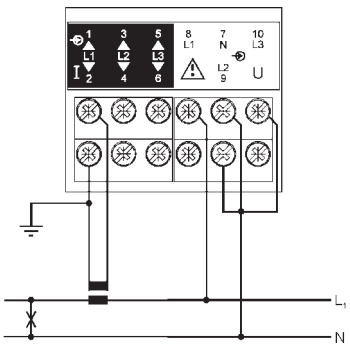
**Single phase input connections**

Fig. 1



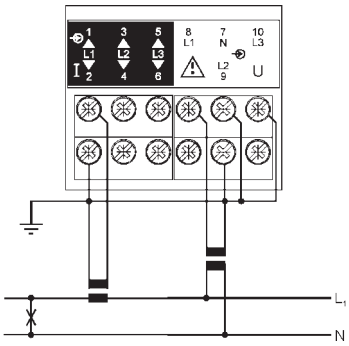
Direct connection

Fig. 2



CT connection

Fig. 3

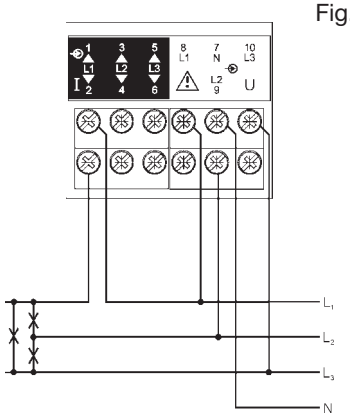


CT and VT connection

## Wiring Diagrams (cont.)

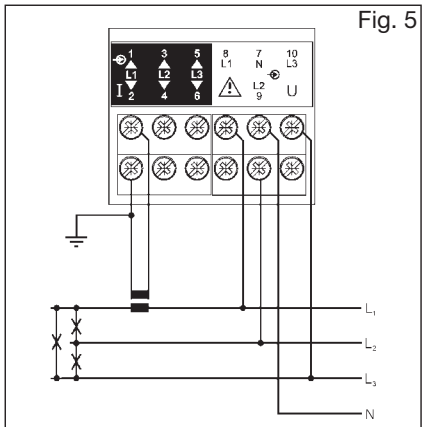
**Three-phase wire input connections - Balanced loads**

Fig. 4



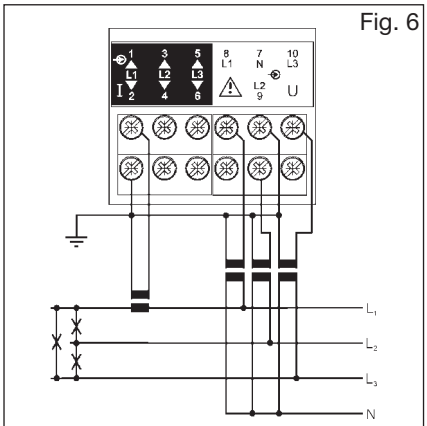

Direct connection (3-wire system)

Fig. 5



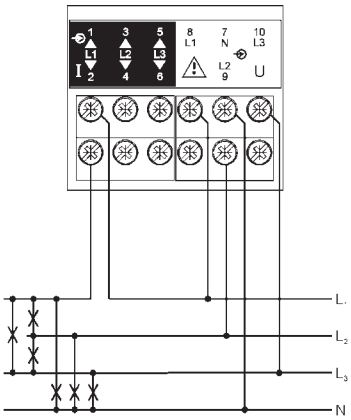

CT connection (3-wire system)

Fig. 6



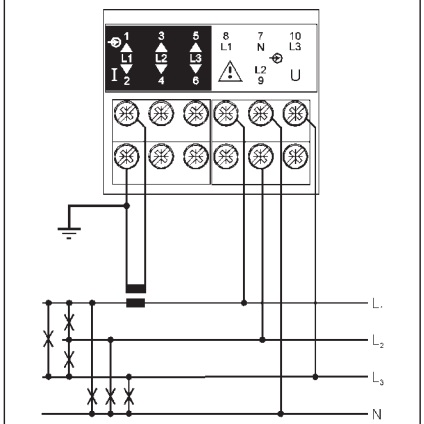

CT and VT connection (3-wire system)

Fig. 7



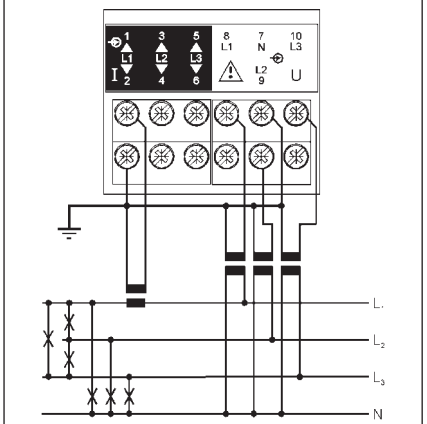

Direct connection (4-wire system)

Fig. 8




CT connection (4-wire system)

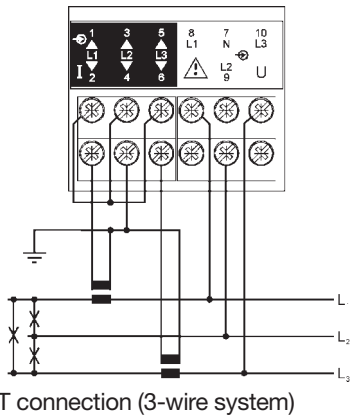
Fig. 9




CT and VT connection (4-wire system)

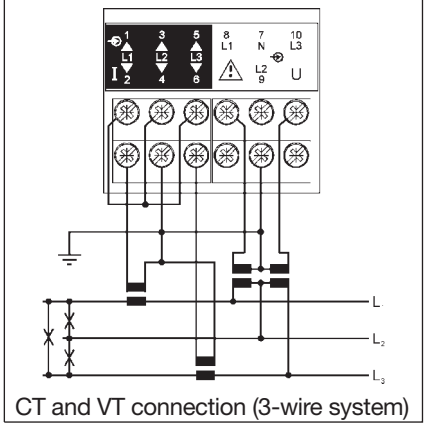
**Three-phase, 3-wire ARON input connections - Unbalanced loads**

Fig. 10




CT connection (3-wire system)

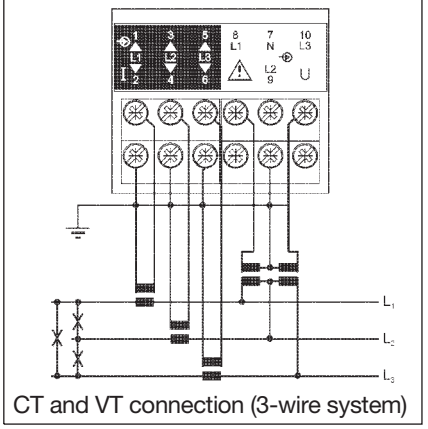
Fig. 11




CT and VT connection (3-wire system)

**Three-phase, 3-wire input connections - Unbalanced loads**

Fig. 12



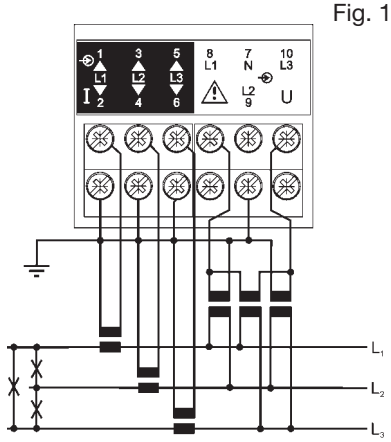

CT and VT connection (3-wire system)

CARLO GAVAZZI

## Wiring Diagrams (cont.)

**Three-phase three-wire input connections**
**Unbalanced load**

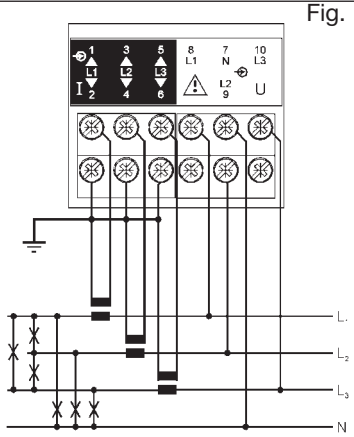
Fig. 13




CT connection (3-wire system)

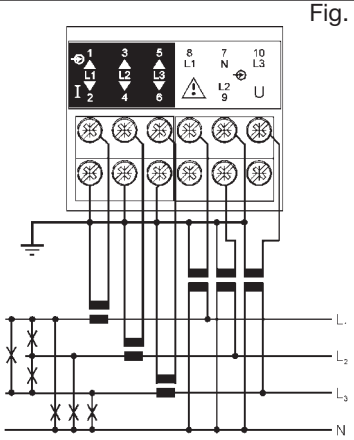
**Three-phase four-wire input connections - Unbalanced load**

Fig. 14



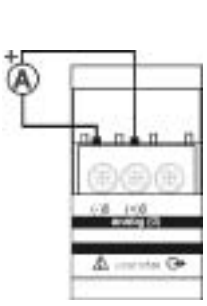

CT connection (4-wire system)

Fig. 15

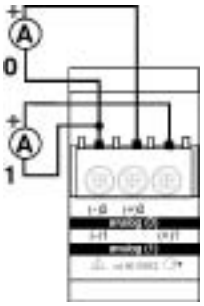



CT and VT connection (4-wire system)

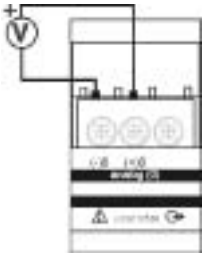
## Wiring diagrams (optional modules)



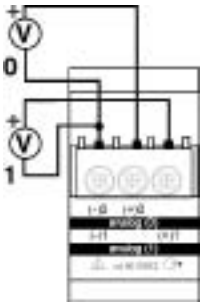
**AO1050**
**1 analogue output (mA)**



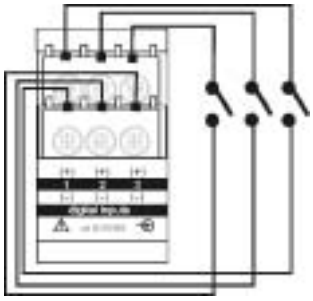
**AO1026**
**2 analogue outputs (mA)**



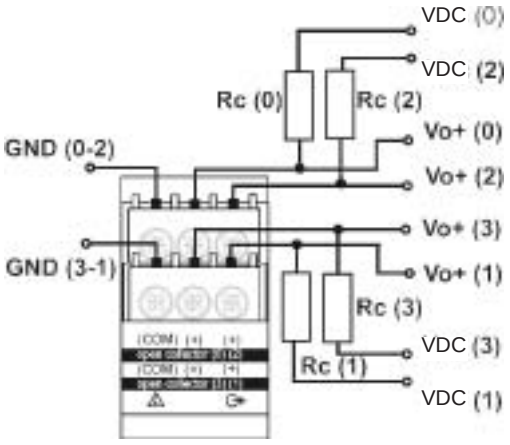
**AO1051**
**1 analogue output (V)**



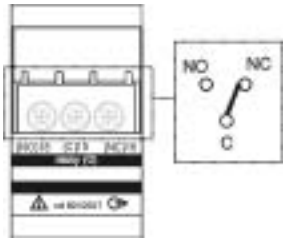
**AO1027**
**2 analogue outputs (V)**



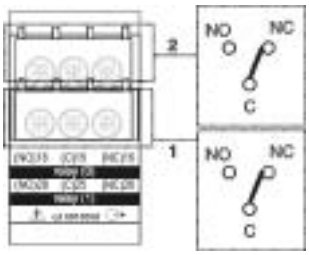
**AO1038**
**3 digital inputs**




**AO1037**



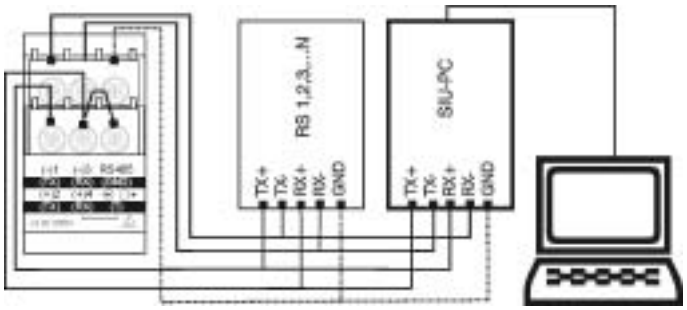

**AO1058**
**1 relay output**



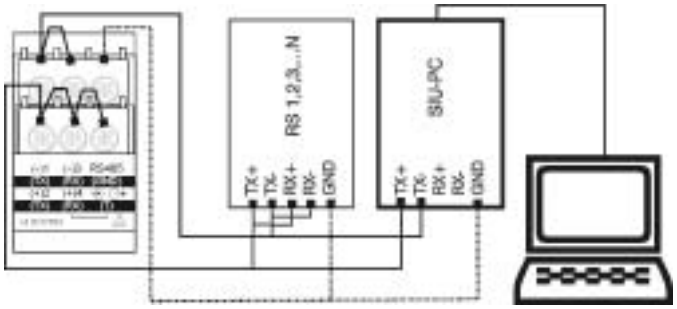

**AO1035**
**2 relay outputs**

**4 open collector outputs:** 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).

## Wiring diagrams (optional modules, cont.)

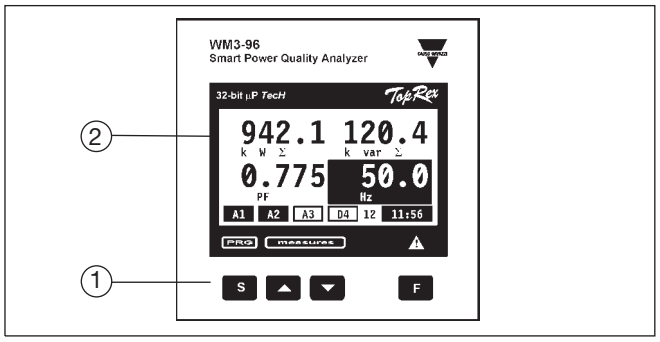



**RS422/485 4-wires connection:** additional devices provided with RS422/485 (that is RS 1, 2, 3...N) are connected in parallel.
The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (Rx+) and (T).




**RS422/485 2-wires connection:** additional devices provided with RS422/485 (that is RS 1, 2, 3...N) are connected in parallel.
The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (Rx+) and (T).

## Front Panel Description

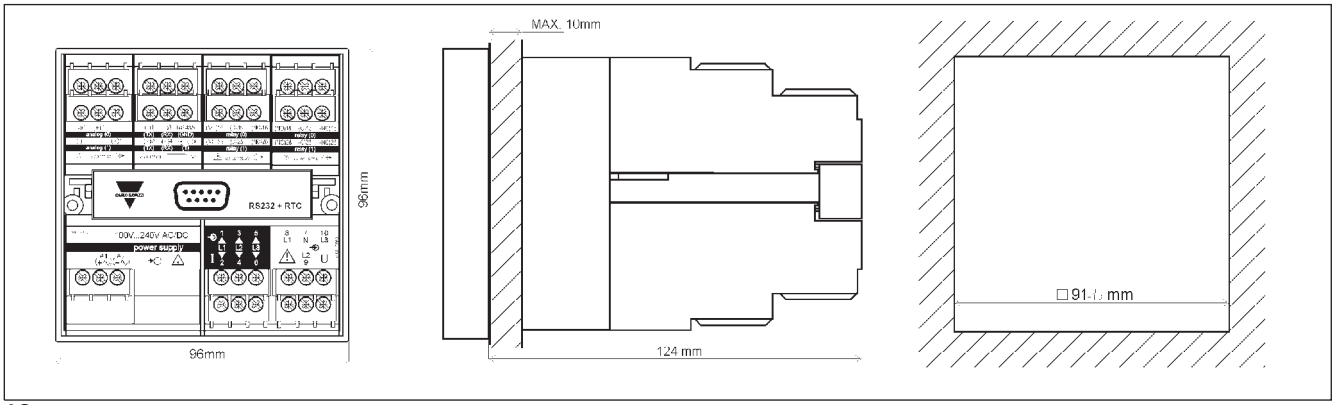



1. **Key-pad**
   Set-up and programming procedures are easily controlled by the 4 pushbuttons.
   - "S" for enter programming phase and password confirmation,
   - ▲ ▼ for value programming/function selection, page scrolling
   - "F" for special functions

2. **Display**
   Istantaneous measurements:
   - 4-digit (maximum read-out 9999)
   Energies:
   - 9-digit (maximum read-out 999999999).

   Alphanumeric indication by means of LCD display for:
   - Displaying the configuration parameters
   - All the measured variables.

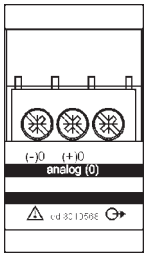
## Dimensions



CARLO GAVAZZI

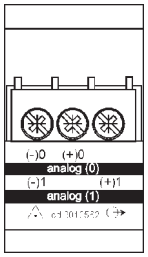
# Terminal boards

### Single analogue output modules



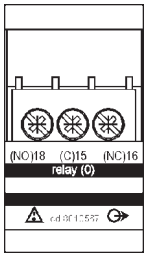

**AO1050** (20mADC)
**AO1051** (10VDC)
**AO1052** (±5mADC)
**AO1053** (±10mADC)
**AO1054** (±20mADC)
**AO1055** (±1VDC)
**AO1056** (±5VDC)
**AO1057** (±10VDC)

### Dual analogue outputs

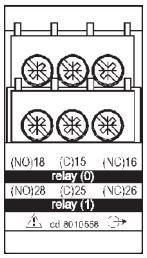



**AO1026** (20mADC)
**AO1027** (10VDC)
**AO1028** (±5mADC)
**AO1029** (±10mADC)
**AO1030** (±20mADC)
**AO1031** (±1VDC)
**AO1032** (±5VDC)
**AO1033** (±10VDC)

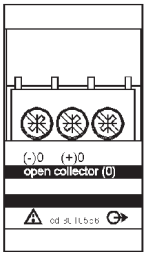
### Digital output modules



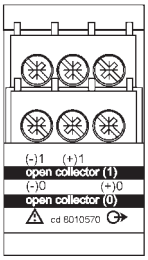

**AO1058**
Single relay output




**AO1035**
Dual relay output

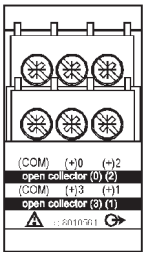



**AO1059**
Single open collector output

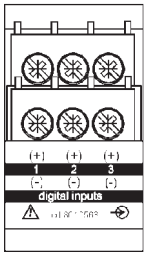



**AO1036**
Dual open collector output

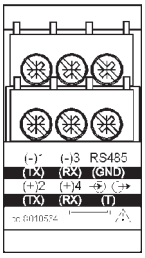
### Other input/output modules




**AO1037**
4 open collector outputs



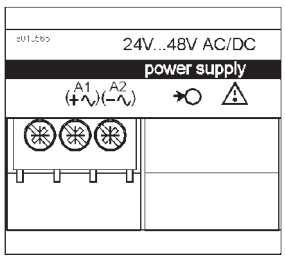

**AQ1038**
3 Digital inputs



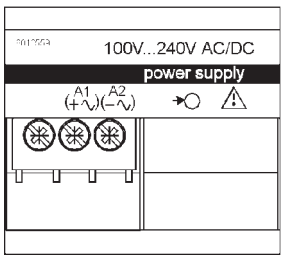

**AR1034**
RS485 port


**AR1039**
RS232 port + RTC

### Power supply modules




**AP1021**
18-60VAC/DC power supply




**AP1020**
90-260 VAC/DC power supply