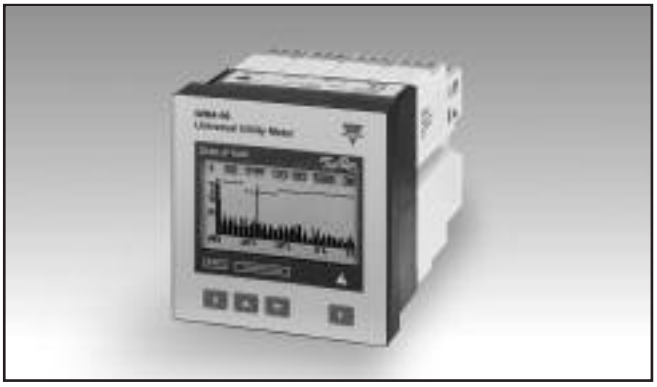
Energy Management
Modular Universal Utility Meter and Power Analyzer
Type WM4-96

CARLO GAVAZZI



- **Class 0.5 (current/voltage)**
- **Universal meter: energy, water and gas**
- **32-bit µP-based multifunction power analyzer**
- **Back-lighted graph display (128x64 dots)**
- **Front size: 96x96 mm**
- **Measurement of single phase and system instantaneous variables: W, W_{dmd}, var, var_{dmd}, VA, VA_{dmd}, PF, PF_{avg}, V, A_L, A_n, Hz, THD (for all measurements max and min values)**
- **Measured energies: kWh and kvarh on 4 quadrants**
- **Graphic display of the load profile (daily, weekly, monthly display)**
- **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**

- **Optional RS 422/485 serial output**
- **Optional RS232 + real time clock function and 2Mb data logging of alarms, MIN/MAX events and up to 8 variables with programmable time interval.**
- **MODBUS RTU, JBUS protocol**
- **Transmission and reception of SMS messages (variables and alarm status)**
- **Data transmission and reception by means of analogue modem**
- **Up to 4 optional pulse outputs**
- **Up to 4 optional alarm outputs**
- **Universal power supply: 18-60VAC/VDC, 90-260 VAC/VDC**
- **Front degree protection: IP 65**

- **48 independent energy meters to be used as single, dual, multi-time energy management**
- **Interface with watt-hour meters by means of digital inputs (+kWh, +kvarh, -kWh, -kvarh)**
- **Interface with gas and water meters by means of digital inputs (one water meter, two gas meters to be used as single or dual time management)**
- **Display refresh rate: 10 samples/s**
- **Harmonic distortion analys (FFT) up to the 50th harmonic with graphic and numeric indication (current and voltage)**
- **Harmonics source detection**

Product Description

Universal utility meter and power analyzer which can be used in 3 different operating modes:
- direct measurements for the power quality analysis (LV or MV/HV connection);
- indirect energy and power measurements by means of watt-hour meters (LV or MV/HV connection);
- direct measurements for the instantaneous variables (LV connection) and indirect measurements for the energy variables (LV or MV/HV).

It's possible to add the management of gas and water metering to all of these working modes.
Automatic transmission of SMS alarm messages.
Remote read-out from GSM mobile phones of all the instantaneous variables, the last variables available in the data logging and the energy meters.

How to order

WM4-96 AV53H XX XX XX XX X

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

How to order

Wm4Soft Network
Wm4Soft Remote

Wm4Soft Network: programm to download memory data and to manage a modem. Wm4Soft Remote: programm to set all the programming parameters.

Type selection

Range code (on request)

XXX:	**None**
AV5:	240/415 VAC- 1/5 AAC (max. 300 V (L-N)/ 520 V (L-L) - 6 A)
AV7:	400/690VAC - 1/5 AAC (max. 480V (L-N) / 830 V (L-L) / 6 A

Power supply

L:	18 to 60VAC/VDC
H:	90 to 260VAC/VDC

Slot A (interfacing)

XX:	None
D2:	3 universal digital inputs + excitation output (16-24VDC)

Slot D (alarm or pulse)

XX:	None
R2:	Dual relay output, (AC1-8AAC, 250VAC)
O2:	Dual open collector output (30V/100mADC)
O4:	Four open collector output (30V/100mADC)

Slot B (communication)

XX:	None
S1:	Serial output, RS485 multidrop, bidirectional

Options

X:	None
M:	Serial port RS232+RTC+ 2Mb or Data memory to store all events and continuous record up to 8 variables
E1:	WEB-server option

Slot C (alarm or pulse)

XX:	None
R1:	Single relay output (AC1-8AAC, 250VAC)
R2:	Dual relay output, (AC1-8AAC, 250VAC)
O1:	Single open collector output (30V/100mADC)
O2:	Dual open collector output (30V/100mADC)
D1:	3 digital inputs for voltage-free contacts
D2:	3 universal digital inputs + excitation output (16-24VDC)

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Input specifications

Number of analogue inputs	
Current	1 (1-phase; system code: 3) 3 (3-phase; system code: 3)
Voltage	1 (1-phase; system code: 3) 4 (3-phase; system code: 3)
Digital inputs	
AQ1038	No. of inputs: 3 (voltage-free)
Purpose	W_{dmd} measurement synchronization + var_{dmd} and PF_{dmd}. Interfacing with watt-hour meters (+kWh, +kvarh). Tariff selection: energy.
Contact measuring current	<8mA/ 17.5 to 25VDC
AQ1042	Number of inputs: 3 + excitation output
Purpose	W_{dmd} measurement synchronization + var_{dmd} and PF_{dmd}. Interfacing with watt-hour meters (-kWh, -kvarh) or/and measurements of gas /water m^3. Tariff selection: energy or GAS.
Excitation output	16V<+Aux<24VDC Max 15mA
Contact measuring current	15mA
Common characteristics	
Input frequency	Max 20 Hz, dutycycle 50%
Close contact resistance	Max 1kΩ
Open contact resistance	Min 100kΩ
Insulation	4000VRMS
Max. input number	6 in the configuration: AQ1038+AQ1042 or 2*AQ1042
Accuracy (display, RS232, RS485)	In: 5A, If.s.: 6A Vn: 240VL-N, Vf.s.: 300VL-N
Current (A_{L1}, A_{L2}, A_{L3}) (@25°C ±5°C, R.H. ≤60%)	±0.5% RDG (0.2 to 1.2 In) ±5mA (0.02 to 0.2 In)
Current (A_n)	±1% RDG (0.2 to 1.2 In) @ 40 to 100 Hz
Voltage AV5 range: (@25°C ±5°C, R.H. ≤60%)	±0.5% RDG (48 to 300 V_{L-N}) ±1% RDG (84 to 519 V_{L-L})
AV7 range:	±0.5% RDG (80 to 480 V_{L-N}) ±1% RDG (139 to 830 V_{L-L})
	Includes also: 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, range AV5) or ±1% RDG (PF 0.5 L/C, 0.1 to 1.2 In, range AV5)
Reactive power (@ 25°C ± 5°C, R.H. ≤ 60%)	±0.5% (RDG + FS) (PF 0.5 L/C, 0.1 to 1.2 In, range AV5) or ±1% RDG (PF 0.5 L/C, 0.1 to 1.2 In, range AV5)
Apparent power (@ 25°C ± 5°C, R.H. ≤ 60%)	±0.5% (RDG + FS) (0.1 to 1.2 In, range AV5) or ±1% RDG (0.1 to 1.2 In, range AV5)
Energies (@ 25°C ± 5°C, R.H. ≤ 60%)	Active: class 1 according to EN61036 Reactive: class 2 according to EN61268
	Ib: 5A, Imax: 6A 0.1Ib: 500mA, Start-up current: 20mA Un: 240V (AV5), 400V (AV7)
Harmonic distortion (@ 25°C ± 5°C, R.H. ≤ 60%)	1% FS (FS: 100%) phase: ±2°; Imin: 0.1Arms; Imax: 15Ap; Umin: 50V_{RMS}; Umax: 500Vp Sampling frequency: 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
	NOTE: all accuracies are referred to measurements carried out with the analogue input module
Temperature drift	≤ 200ppm/°C
Sampling rate	6400 samples/s @ 50Hz
Display	Graph LCD backlighted (128x64 dots). Read-out for the instantaneous variables: 4x4 digit or 4x3½ digit Total energies: 4x9 digit; Partial energies: 4x6 digit
Max. and min. indication	Max. 9999 (999,999,999), Min. -9999 (–999,999,999)
Measurements	Current, voltage, power, energy, power factor, frequency, harmonic distortion (see "Display Pages"). TRMS measurement of a distorted wave (voltage/current) .
Coupling type	Direct.
Crest factor	≤3, max. 15Ap/500Vp "AV5" (L-N), 15Ap/800Vp "AV7" (L-N)
Ranges (impedances)	
AV5	58/100 V (> 500 kΩ) - 1 AAC (≤ 0.3 VA) 58/100 V (> 500 kΩ) - 5 AAC (≤ 0.3 VA) 240 V/415 V (> 500 kΩ) - 1 AAC (≤ 0.3 VA) 240 V/415 V (> 500 kΩ) - 5 AAC (≤ 0.3 VA)
AV7	100/170 V (> 500 kΩ) - 1 AAC (≤ 0.3 VA) 100/170 V (> 500 kΩ) - 5 AAC (≤ 0.3 VA) 400/690 V (> 500 kΩ) - 1 AAC (≤ 0.3 VA) 400/690 V (> 500 kΩ) - 5 AAC (≤ 0.3 VA)
Frequency	40 to 440 Hz
Overload protection	
Continuous: voltage/current:	AV5: 300V_{L-N} / 500V_{L-L} / 6A AV7: 480V_{L-N} / 830V_{L-L} / 6A
For 1s: voltage/current:	AV5: 600V_{L-N}/1040V_{L-L}/120A AV7: 960V_{L-N}/1660V_{L-L}/120A

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Output specifications

RS422/RS485 (on request)	Multidrop bidirectional (static and dynamic variables)
Connections	2 or 4 wires, max. distance 1200m, termination directly on the module
Addresses	from 1 to 255, key-pad selectable
Protocol	MODBUS RTU/JBUS
Data (bidirectional)	
Dynamic (reading only)	All display variables, see also the table, “List of the connected variables”.
Static (writing only)	All configuration parameters energy reset, activation of digital outputs.
Data format	1 start bit, 8 data bit, no parity/even parity/ odd parity, 1 stop bit
Baud rate	1200, 2400, 4800 and 9600 bit/s selectable
Insulation	By means of optocouplers, 4000 V_{RMS} output to measuring inputs 4000 V_{RMS} output to power supply input
RS232 (on request)	Bidirectional (static and dynamic variables)
Connections	3 wires, max. distance15m
Data format	1 start bit, 8 data bit, no parity, 1 stop bit
Baud rate	2400, 4800, 9600, 38400 bit/s
Protocol	MODBUS RTU (JBUS)
Other features	As per RS422/485
Communication by modem	
Analogue modem	For the remote communication of all the data measured and managed by WM4. External communication Modem. Recommended type: US Robotics
GSM Modem	For the transmission of SMS messages: alarms, instantaneous variables, last available variables of data logging and energy meters. The alarms can also be transmitted automatically, while the variables can be recalled by means of special SMS question codes
GSM kit type-tested for WM4	Siemens kit (external) model “TC35 TERMINAL” included GSM module, antenna and 230V power supply.
Digital outputs (on request)	To be used as alarms and/or retransmission of the energy, gas, water metering and/or outputs remotely controlled by the serial communication port. The outputs are completely programmable independently of the type of module being used.
Pulse outputs (on request)	
Number of outputs	Up to 4
Type	From 1 to 1000 pulses programmable for k-M-G Wh, k-M-G varh, open collector (NPN transistor) V_{ON} 1.2 VDC/ max. 100 mA V_{OFF} 30 VDC max. Outputs connectable to total and/or partial energy meters
Pulse duration	220 ms (ON), ≥ 220 ms (OFF) According to DIN43864
Insulation	By means of optocouplers, 4000 V_{RMS} output to measuring inputs, 4000 V_{RMS} output to power supply input.
Notes	The outputs can be either open collector type or relay type (for the relay output refer to the specifications described in the “alarm outputs” section).
Alarm outputs (on request)	
Number of set-points	Up to 4, independent
Alarm type	Up alarm, down alarm with or without latch , phase asymmetry, phase loss, neutral loss.
Monitoring of the variable	All the variables listed at the paragraph “List of the connectable variables”.
Set-point 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 or normally energized
Output type	Relay, SPDT AC 1-8A, 250VAC DC 12-5A, 24VDC AC 15-2.5A, 250VAC DC 13-2.5A, 24VDC
Min. response time	≤ 150 ms, filters excluded, FFT excluded, setpoint on-time delay: ”0s”
Insulation	4000 V_{RMS} output to measuring input, 4000 V_{RMS} output to power supply input.
Notes	The outputs can be either relay type or open collector type (for this latter one, see the specifications mentioned in the pulse outputs)

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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 Note: by entering in the programming mode by means of password, the measurement is inhibited.
Operating mode selection	- Direct measurements for the power quality analysis (LV or MV/HV connection); - Indirect energy and power measurements by means of watt-hour meters (LV or MV/HV connection); - Direct measurements for the instantaneous variables (LV connection) and indirect measurements for the energy variables (LV or MV/HV). It’s possible to add the management of gas and water metering to all of these working modes.
Pulse weight	Water/gas meter inputs: selectable from 1 to 10000 pulses/m^3, energy from 1 to 10000.00 imp/kWh/kvarh
Transformer ratio	CT up to 30000A (6000) VT up to 600 kV (6000)
Filters	
Filter operating range	0 to 99.9% of the input electrical scale.
Filtering coefficient	1 to 255
Filter action	Display, alarms, serial outputs (fundamental variables: V, A, W and their derived ones).
Event logging	Only with RS232+RTC module+ Data memory
Type of data	Alarms and max./min. (max. 480 events) stored with date (dd:mm:yy) and hour (hh:mm:ss) reference, data logger and load profile
Sampling management	Only for data logger and load profile. The sample stored within the selected time interval results from the continuous average of the measured values. The average is calculated (min. sample) with an interval within two following measurements of approx. 200 ms.
Data management type:	FIFO
Memory size	2 Mbyte
Battery life	10 years
Data logger function	The data are stored at time intervals from 1 to 60 min.; up to 8 instantaneous variables can be selected.
Historical data storing time	See the “Historical data storing time table”.
Data format	Date: day, month time: hours, minutes, seconds, type of stored variable: variable value.
Load profile	Storage at time intervals of 5-10-15-20-30 min of Wdmd.
Historical data storing time	30 weeks: with recording interval of 5min. 90 weeks: with storing interval of 15min.
Data format	Wdmd variable value, minutes, seconds, day, month.
Displaying	4 variables per page 1 page that can be layed out by the user 30 fixed pages
Energy meters	Up to 12 pages depending on the selected tariff mode. Displaying of the consumed energy up to two months preceding the current one by means of password (depending on the selected tariff mode).
Water and gas meters	1 page with two displaying modes depending on the selected one: water and gas m^3 or day-time and night gas m^3.
Stored events	240 pages. Display of the data by means of password.
Data logger	Display of the data by means of password with reset function of the relevant memory section.
Load profile	3 pages, daily, weekly and monthly graphic display. Reset function of the relevant memory section by means of password.
Display language	Selectable: Italian, English, French, German, Spanish

Wm4Soft software: parameter programming and memory data transfer

Wm4Soft Network	English language software to transfer memory data and write messages to be coupled to the SMS alarms, plus modem communication
Working mode	management. The program runs under Windows /95/98/98SE/2000/NT/XP. Three different working modes can be selected: - management of a local

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Wm4Soft software: memory data transfer (cont.)

Data Storing	RS485 network; - management of modem communication from a single instrument to PC (data download); - management of modem communication from local networks (RS485 communication) to a common PC (data download). In pre-formatted XLS files (Excel data base). The instantaneous and the energy, gas, water variables are stored into two separated files.
Data Transfer	Manual or automatic at programmable timings.

Modem communication	Phone book management (save up to 100 numbers). Each number is associated to a modem that corresponds either to the single instrument or to a network of instruments. Each network can manage up to 10 local instruments.
Wm4Soft Remote	English language software to program the working parameters of the instrument The program runs under Windows 95/98/98SE/2000/ NT/XP.
Data access	By means of RS232 serial port to be coupled to a GSM or analogue modem or RS485 port (also multi-drop availability.).

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 VRMS to ground (AV5 input)
Insulation	4000 VRMS between all inputs/ outputs to ground
Dielectric strength	4000 VRMS for 1 minute
Noise Rejection CMRR	100 dB, 48 to 62 Hz
EMC	IEC EN 61000-6-2, IEC EN 61000-6-3

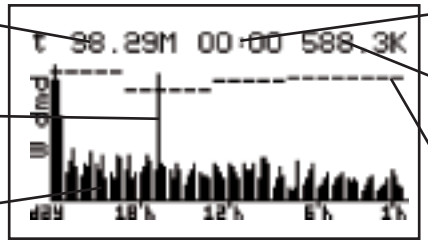
Other standards Safety Product Pulse output	 IEC 61010-1, EN 61010-1 Energy measurements: EN61036, EN61268. DIN43864
Approvals	CE, UL and CSA
Connector	Screw-type max. 2.5 mm² wires (2x 1.5mm²)
Housing Dimensions Material **Protection degree**	 96x96x140 mm ABS, self-extinguishing: UL 94 V-0 Front: IP65, NEMA4x, NEMA12
Weight	Approx. 600 g (packing included)

Load profile display

Installed power

Example: the consumed power integrated in 15 minutes exceeds the installed power

Graph of consumptions

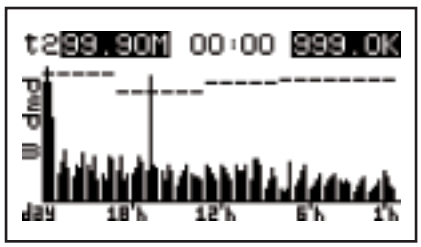


Time of the last integration

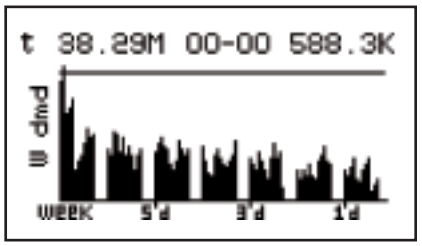
Wdmd of the last integration period

Profile of the installed power divided into time periods

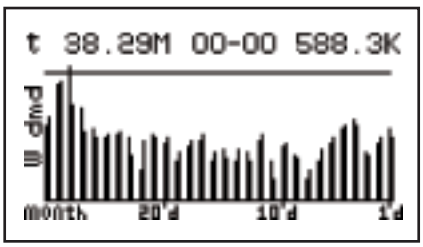
By means of the “F” key you can display the single integration time periods and the details relating to the value of the installed power programmed for that time period, the storing time of the Wdmd sample and the relevant value.



Daily graph: resolution of 15 minutes, total time of 24 hours.



Weekly graph: resolution of 2 hours, total time of 7 days.



Monthly graph: resolution of 12 hours, maximum total time of 31 days.

Supply specifications

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

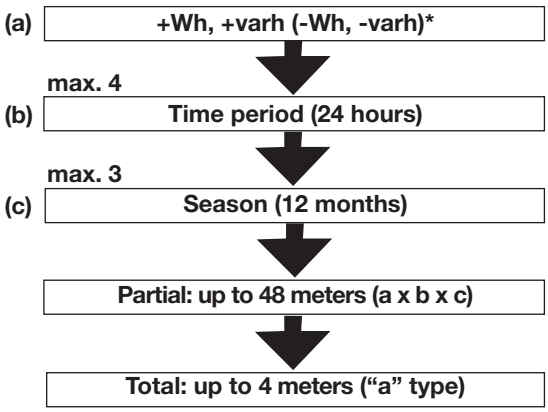
Harmonic distortion analysis

Analysis principle	FFT
Harmonic measurement	
Current	Up to the 50th harmonic
Voltage	Up to the 50th harmonic
Type of harmonics	THD (VL1) THD odd (VL1) THD even (VL1) The same for the other phases: L2, L3. THD (AL1) THD odd (AL1) THD even (AL1) The same 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	The harmonic contents is displayed as a graph showing the whole harmonic spectrum. This value is also given as a numerical information: THD % / RMS value THD even % / RMS value THD odd% / RMS value single harmonics in % / RMS value
System	The harmonic distortion can be measured in single-phase, 3-wire or 4-wire systems. Tw: 0.02

Time period management (energy, water and gas metering)

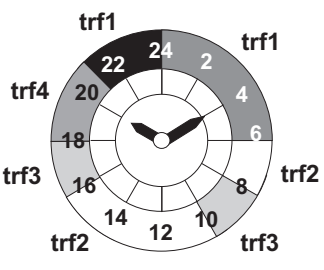
Time periods	Energy Selectable: single time, dual time and multi-time
Single time	Energy, water, gas
Number of meters	Total: 4 (9-digit) (no partial meters)
Dual time	Energy, gas
Number of meters	Total: 4 (9-digit) Partial: 8 (6-digit);
Time periods	2, programmable within 24 hours
Multi-time	Energy
Number of meters	Total: 4 (9-digit) Partial: 48 (6-digit);
Time periods	4, programmable within 24 hours
Time seasons	3, programmable within 12 months;
Pulse output	Connectable to total and/or partial meters (dual time, multi-time periods)
Energy metering recording	Energy consumption history, recording of energy metering by months, oldest data: 2 months before current date. Recording of total and partial energy metering. Energy metering recording (EEPROM) Max.999,999,999.99kWh/kvarh.

Management concept (multi-time)



* Only if measuring analogue inputs are present.

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

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Display pages

Display variables in three-phase systems, 4-wire connections

No	1st variable	2nd variable	3rd variable	4th variable	Note
0	Selectable	Selectable	Selectable	Selectable	
1	V L1	V L2	V L3	V L-N sys	Sys = system = Σ
2	V L1-2	V L2-3	V L3-1	V L-L sys	Sys = system = Σ
3	A L1	A L2	A L3	An	A n = neutral current
4	W L1	W L2	W L3	W sys	Sys = system = Σ
5	var L1	var L2	var L3	var sys	Sys = system = Σ
6	VA L1	VA L2	VA L3	VA sys	Sys = system = 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 sys	PF sys	var sys	W sys	Sys = system = Σ
12	An	PF sys	Hz	W sys	Sys = system = Σ
13	W dmd	var dmd	PF avg	VA dmd	
14	(MAX1)	(MAX2)	(MAX3)	(MAX4)	The MAX value can be one of the above mentioned (From No 0 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 (From No 0 to No 13)
18	(MIN5)	(MIN6)	(MIN7)	(MIN8)	
19	Hystogram FFT V1 (THD, THDo, THDe, Single harmonic)				Only if analysis V1-A1 are activated
20	Hystogram FFT A1 (THD, THDo, THDe, Single harmonic)				Only if analysis V1-A1 are activated
21	Hystogram FFT V2 (THD, THDo, THDe, Single harmonic)				Only if analysis V2-A2 are activated
22	Hystogram FFT A2 (THD, THDo, THDe, Single harmonic)				Only if analysis V2-A2 are activated
23	Hystogram FFT V3 (THD, THDo, THDe, Single harmonic)				Only if analysis V3-A3 are activated
24	Hystogram FFT A3 (THD, THDo, THDe, Single harmonic)				Only if analysis V3-A3 are activated
25	kWh + TOT	kWh – TOT	kvarh + TOT	kvarh – TOT	
26	kWh+	kWh–	kvarh+	kvarh–	Partial energy being measured
27	GAS m^3	WATER m^3 or GAS m^3 night tariff			According to the setting

Used calculation formulas

Phase variables

Instantaneous effective voltage

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

Instantaneous active power

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

Instantaneous power factor

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

Instantaneous effective current

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

Instantaneous apparent power

$$VA_1 = V_{1N} \cdot A_1$$

Instantaneous reactive power

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

System variables

Equivalent 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

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

Three-phase power factor

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

Total harmonic distortion

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

Where:
i = considered phase (L1, L2 or L3)
T = considered variable (V or A)
n = harmonic order

Energy metering

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

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

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

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List of the variables that can be connected to:

- **Max./Min. variable detection**
- **Alarm outputs**
- **Pulse outputs**

No	Variable	1-phase system	3-ph. 4-wire balanced sys.	3-ph. 4-wire unbal. sys.	3 ph. 3-wire bal. sys.	3 ph. 3-wire unbal. sys.	meas. module not available	Notes
1	V L1	o	x	x	o	o	o	
2	V L2	o	x	x	o	o	o	
3	V L3	o	x	x	o	o	o	
4	V L-N sys	o	x	x	o	o	o	Sys = system = Σ
5	V L1-2	o	x	x	x	x	o	
6	V L2-3	o	x	x	x	x	o	
7	V L3-1	o	x	x	x	x	o	
8	V L-L sys	o	x	x	x	x	o	Sys = system = Σ
9	A L1	x	x	x	x	x	o	
10	A L2	o	x	x	x	x	o	
11	A L3	o	x	x	x	x	o	
12	An	o	x	x	x	x	o	
13	W L1	x	x	x	o	o	o	
14	W L2	o	x	x	o	o	o	
15	W L3	o	x	x	o	o	o	
16	W sys	o	x	x	x	x	o	Sys = system = Σ
17	var L1	x	x	x	o	o	o	
18	var L2	o	x	x	o	o	o	
19	var L3	o	x	x	o	o	o	
20	var sys	o	x	x	x	x	o	Sys = system = Σ
21	VA L1	x	x	x	o	o	o	
22	VA L2	o	x	x	o	o	o	
23	VA L3	o	x	x	o	o	o	
24	VA sys	o	x	x	x	x	o	Sys = system = Σ
25	PF L1	x	x	x	o	o	o	
26	PF L2	o	x	x	o	o	o	
27	PF L3	o	x	x	o	o	o	
28	PF sys	o	x	x	x	x	o	Sys = system = Σ
29	Hz	x	x	x	x	x	o	
30	THD V1	x	x	x	x	x	o	FFT V1-A1 ON
31	THDo V1	x	x	x	x	x	o	FFT V1-A1 ON
32	THDe V1	x	x	x	x	x	o	FFT V1-A1 ON
33	THD V2	o	x	x	x	x	o	FFT V2-A2 ON
34	THDo V2	o	x	x	x	x	o	FFT V2-A2 ON
35	THDe V2	o	x	x	x	x	o	FFT V2-A2 ON
36	THD V3	o	x	x	x	x	o	FFT V3-A3 ON
37	THDo V3	o	x	x	x	x	o	FFT V3-A3 ON
38	THDe V3	o	x	x	x	x	o	FFT V3-A3 ON
39	THD A1	x	x	x	x	x	o	FFT V1-A1 ON
40	THDo A1	x	x	x	x	x	o	FFT V1-A1 ON
41	THDe A1	x	x	x	x	x	o	FFT V1-A1 ON
42	THD A2	o	x	x	x	x	o	FFT V2-A2 ON
43	THDo A2	o	x	x	x	x	o	FFT V2-A2 ON
44	THDe A2	o	x	x	x	x	o	FFT V2-A2 ON
45	THD A3	o	x	x	x	x	o	FFT V3-A3 ON
46	THDo A3	o	x	x	x	x	o	FFT V3-A3 ON
47	THDe A3	o	x	x	x	x	o	FFT V3-A3 ON
48	A dmd	x	x	x	x	x	o	
49	VA dmd	x	x	x	x	x	x	
50	PF avg	x	x	x	x	x	x	
51	W dmd	x	x	x	x	x	x	◆
52	ASY	o	x	x	x	x	o	

(x) = available (o) = not available

(◆) **Notes: the alarm outputs can be connected to Wdmd total and/or Wdmd tariff1, Wdmd tariff2, Wdmd tariff3, Wdmd tariff4.**

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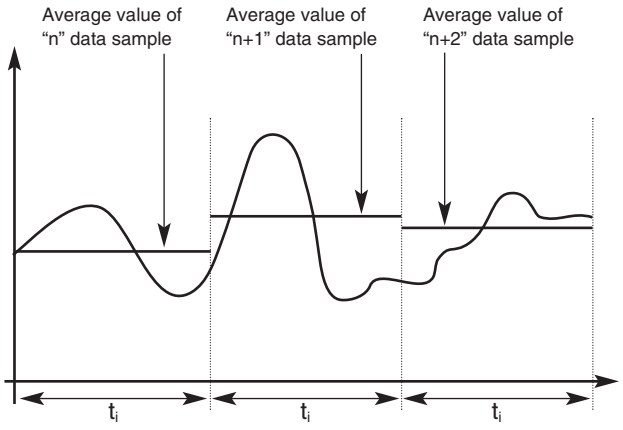
Historical data storing time table

Average values only	2 Selected variables			4 Selected variables			6 Selected variables			8 Selected variables		
Time interval	Data storing time			Data storing time			Data storing time			Data storing time		
(minutes)	DAYS	WEEK	YEARS	DAYS	WEEK	YEARS	DAYS	WEEK	YEARS	DAYS	WEEK	YEARS
1	122	17	-	81	12	-	61	9	-	49	7	-
5	610	87	1.7	407	58	1.1	305	44	-	244	35	-
10	-	174	3.4	814	116	2.2	610	87	1.7	488	70	1.3
15	-	262	5.0	-	174	3.4	915	131	2.5	732	105	2
20	-	349	6.7	-	232	4.5	-	174	3.4	976	139	2.7
25	-	436	8.4	-	291	5.6	-	218	4.2	-	174	3.4
30	-	523	10.1	-	349	6.7	-	262	5	-	209	4
35	-	610	11.7	-	407	7.8	-	305	5.9	-	244	4.7
40	-	697	13.4	-	465	8.9	-	349	6.7	-	279	5.4
45	-	785	15.1	-	523	10.1	-	392	7.5	-	314	6
50	-	872	16.8	-	581	11.2	-	436	8.4	-	349	6.7
55	-	959	18.4	-	639	12.3	-	479	9.2	-	384	7.4
60	-	-	20.1	-	697	13.4	-	523	10.1	-	418	8

The working mode of data logging



t_i= time interval (programmable from 1 to 60 minutes)

The Wm4Soft network potential

Download data files from WM4-96 to PC

Type of Network	No. of Network	No. of WM4	Port	Local Accessory	PC Accessory	User	◆
Local	1	1	AR1041 (RS232)	None	None	PC	A
Local	1	10	AR1041 AR1034	None	SIU-PC	PC	B
Remote	100	1	AR1041 (RS232)	Analogue modem	Analogue modem	PC	A
Remote	100	1	AR1041 (RS232)	GSM modem	Analogue modem	PC	C
Remote	100	10	AR1041 AR1034 (RS485)	SIU-PC+ analogue modem	Analogue modem	PC	B
Remote	100	10	AR1041 AR1034 (RS485)	SIU-PC+ GSM modem	Analogue modem	PC	B

◆ **Notes:**
A- Only data download
B- Data download. Each AR1041 can be connected to a GSM modem in order to manage the SMS messages.
C- The WM4-96 can be set to manage the data download or to manage SMS messages.

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The available modules

Type	N. of channels	Order code
WM4-96 base		AD1040
AV5.3 measuring inputs		AQ1018
AV7.3 measuring inputs		AQ1019
18-60VAC/DC power supply		AP1021
90-260VAC/DC power supply		AP1020
RS485 port (1)	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
Digital inputs + Aux	3	AQ1042
RS232 port + RTC + 2Mb Data memory (1)	1	AR1041

The possible module combinations

Basic unit	Slot A	Slot B	Slot C	Slot D
RS485 port		●		
Single relay output (*)			●	●
Single open collect. output (*)			●	●
Dual relay output (*)			●	●
Dual open coll. output (*)			●	●
4 open coll. output (*)				●
3 digital inputs			●	
3 digital inputs + Aux	●		●	

Basic unit	Slot E
RS232 port + RTC + 2Mb Data memory	●

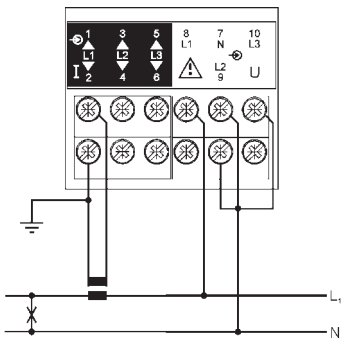
(*) Alarm or pulse

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

Wiring diagrams

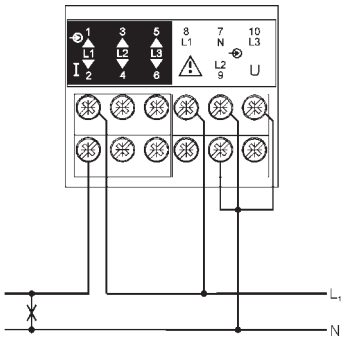
Single phase input connections

Fig. 1



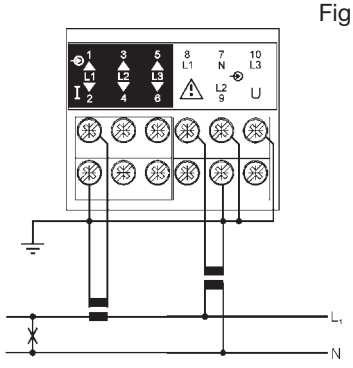
CT connection

Fig. 2



Direct connection

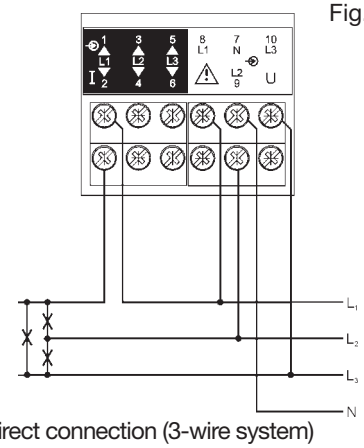
Fig. 3



CT and VT connection

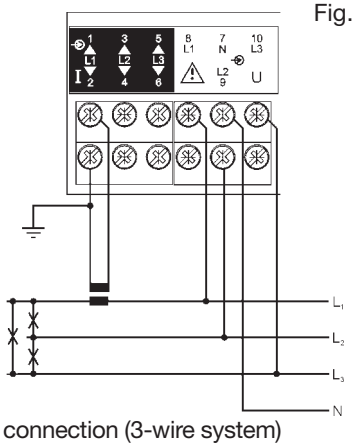
Three-phase three-wire input connections - Balanced load

Fig. 4



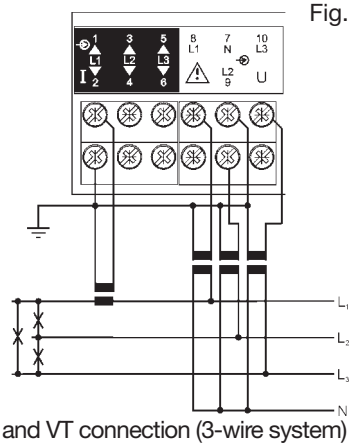
Direct connection (3-wire system)

Fig. 5



CT connection (3-wire system)

Fig. 6



CT and VT connection (3-wire system)

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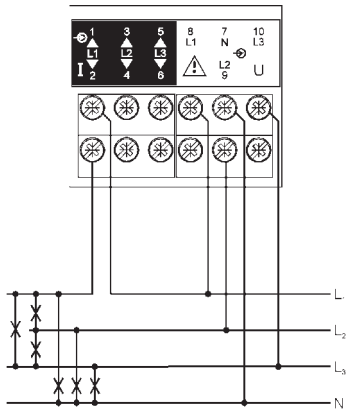
Wiring diagrams (cont.)

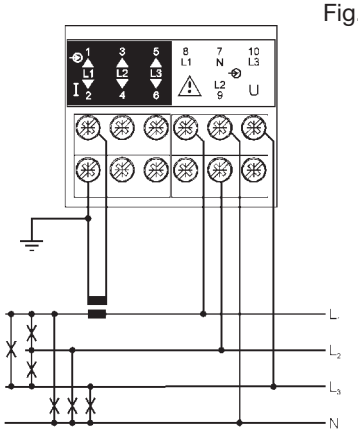
Three-phase, four-wire input connections - Balanced load

Fig. 7



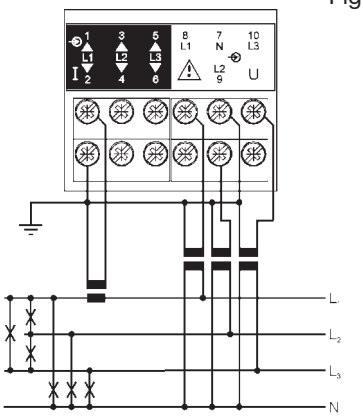
Direct connection (4-wire system)

Fig. 8



CT connection (4-wire system)

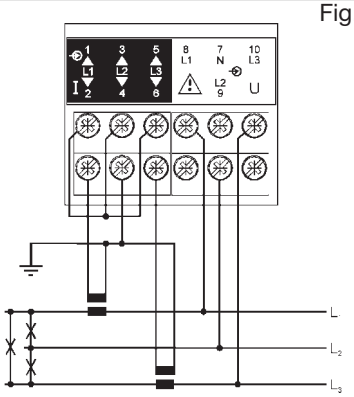
Fig. 9



CT and VT connection (4-wire system)

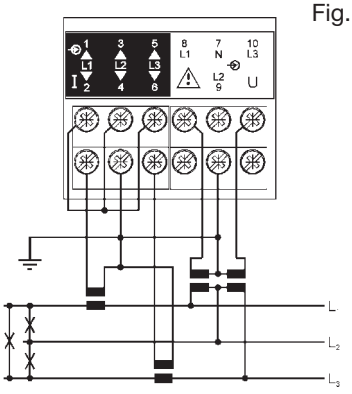
Three-phase, three-wire input connections - Unbalanced load

Fig. 10



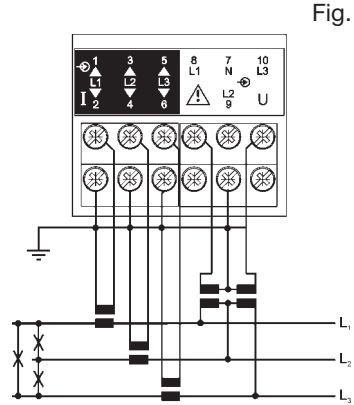
CT connection (3-wire system) ARON

Fig. 11



CT and VT connection (3-wire system) ARON

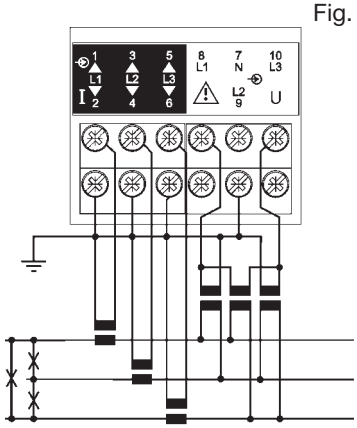
Fig. 12



CT and VT connection (3-wire system)

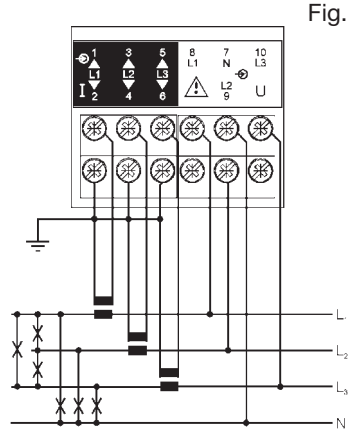
Three-phase, three and four wires input connections - Unbalanced load

Fig. 13



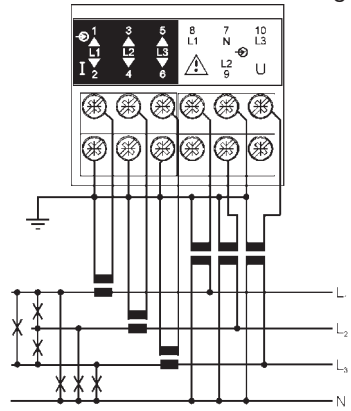
CT and VT connection (3-wire system)

Fig. 14



CT connection (4-wire system)

Fig. 15



CT and VT connection (4-wire system)

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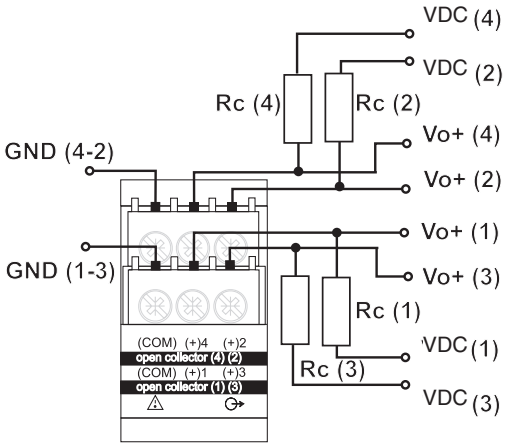
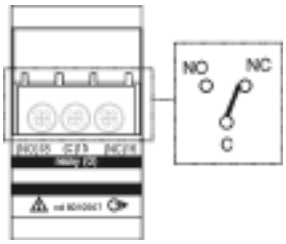
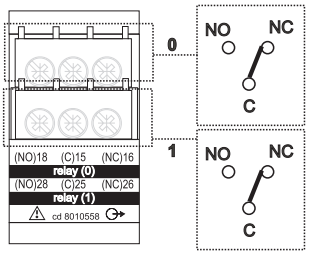
Wiring diagrams of optional modules



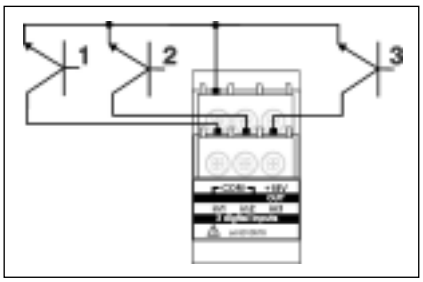


AO1058 1 relay output



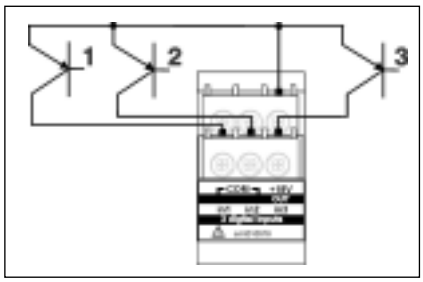
AO1035 2 relay outputs

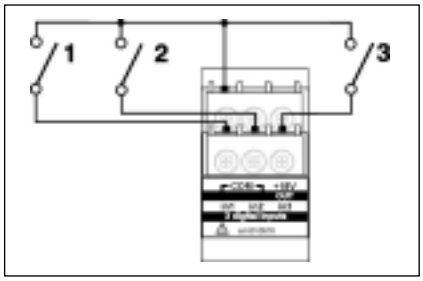
AO1037 4 open collector outputs: The load resistance (Rc) must be designed so that the closed contact current is lower than 100mA; the VDC voltage must be lower than or equal to 30V.
VDC: power supply voltage output. Vo+: positive output contact (open collector transistor). GND: ground output contact (open collector transistor).



AQ1042 digital input module. Connection by means of NPN transistor.

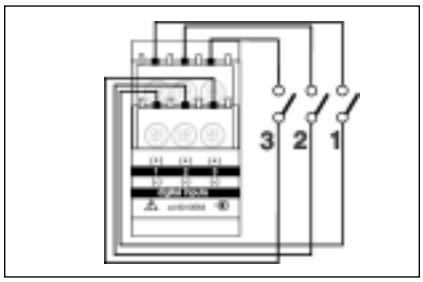
AQ1042 digital input module. Connection by means of PNP transistor.

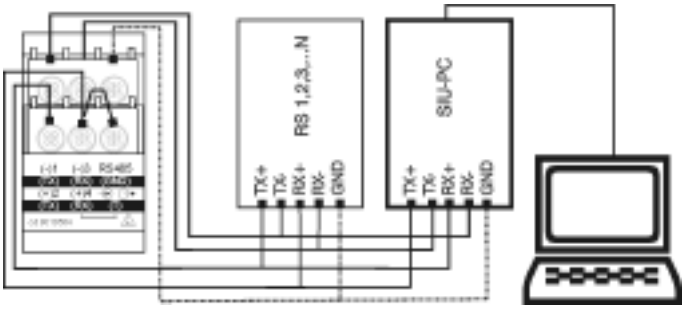




AQ1042 digital input module. Connection by means of contacts.

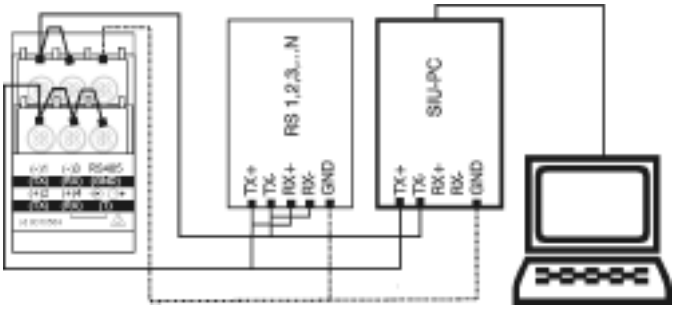
AQ1038 digital input module. Connection by means of contacts.





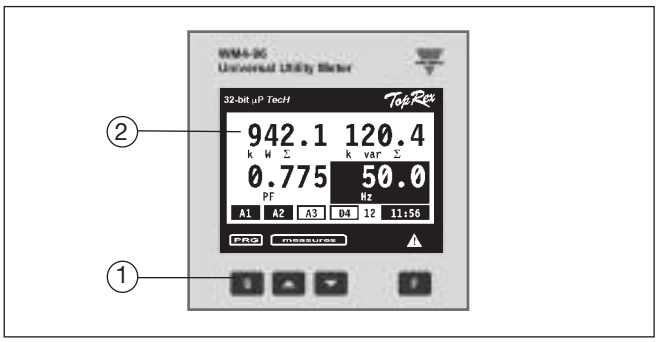
AR1034 RS422/485 4-wires connection: additional devices provided with RS422/485 (that is RS 1, 2, 3...N) are connected in parallel.
The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (Rx+) and (T).

Wiring diagrams optional modules, cont.



AR1034 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

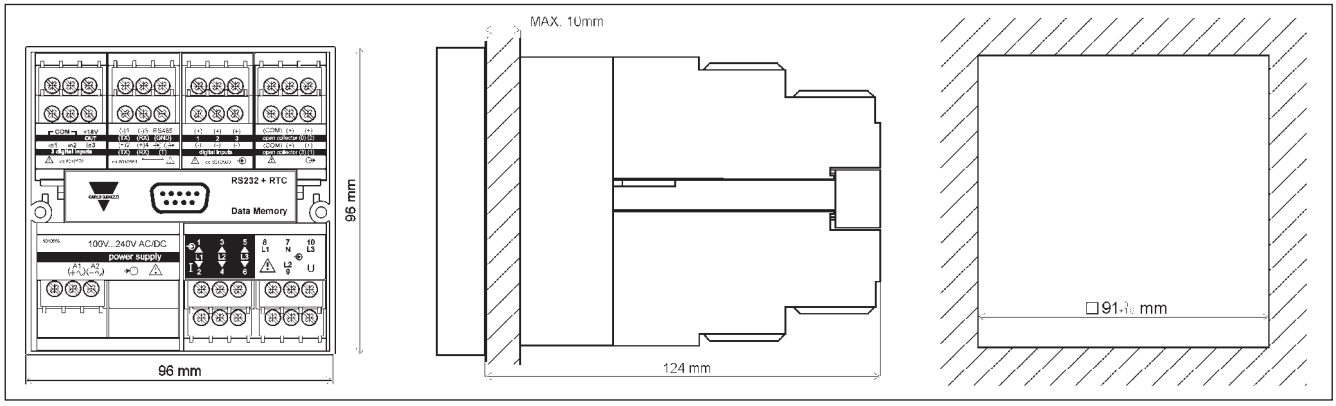


1. **Key-pad**
   Set-up, programming and display parameters are easily controlled by the 4 push-buttons.
   - [S] to enter programming and to confirm password.
   - [▲] and [▼]
     - to program values
     - to select functions
     - to scroll display pages
   - [F] for special functions

2. **Display**
   Istantaneous measurements:
   - 4 digits (max display 9999)
   Energies, gas, water:
   - 9 digits (max display 999999999).

   Alphanumeric indications by means of LCD display for:
   - Display of configuration parameters
   - All measuring variables.

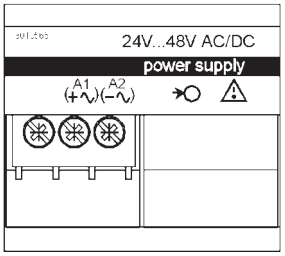
Dimensions



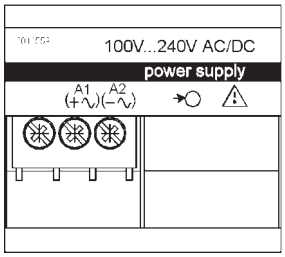
Modules

AR1041
RS232 Interface + RTC+ 2Mb
Data memory

Power supply modules

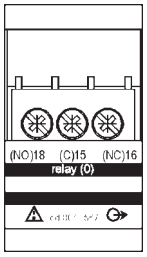


AP1021
Power supply 18-60VAC/DC

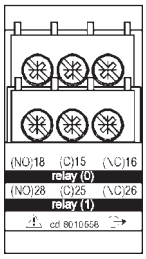


AP1020
Power supply 90-260 VAC/DC

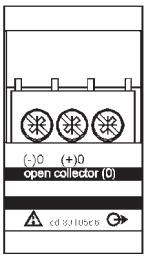
Digital output modules



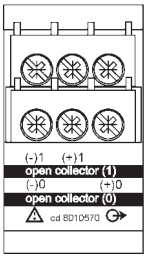
AO1058
Single relay output



AO1035
Dual relay output

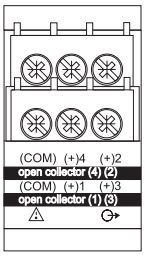


AO1059
Single open
collector output



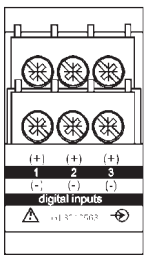
AO1036
Dual open
collector output

Digital output modules

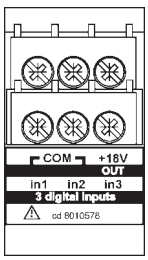


AO1037
4 open collector
outputs

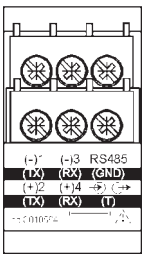
Other input/output modules



AQ1038
3 digital inputs



AQ1042
3 digital inputs + aux



AR1034
RS485 port