Energy Management
Modular Smart Power Quality Analyzer
Type WM3-96

CARLO GAVAZZI

- 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 par-

ticularly 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	
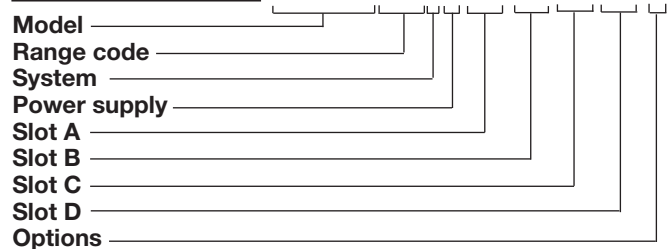
Type Selection

Range code		Slot A (signal retransmission)		Slot B (signal retransmission)		Slot C (alarm or pulse out)	
AV5:	240/415 VAC - 1/5 AAC (max. 300 V (L-N)/ 520 V (L-L) - 6 A) (standard)	**XX:**	None	**XX:**	None	**XX:**	None
		A1:	Single analogue output, 20mADC (standard)	**B1:**	Dual analogue output, 20mADC (standard)	**R1:**	Single relay output, (AC1-8AAC, 250VAC) [1]
AV7:	400/690VAC - 1/5 AAC (max. 480V (L-N) / 830 V (L-L) / 6 A [1]	**A2:**	Single analogue output, ±5mADC [1]	**B2:**	Dual analogue output, ±5mADC [1]	**R2:**	Dual relay output, (AC1-8AAC, 250VAC) [1]
		A3:	Single analogue output, ±10mADC [1]	**B3:**	Dual analogue output, ±10mADC [1]	**O1:**	Single open collector output (30V/100mADC) [1]
		A4:	Single analogue output, ±20mADC [1]	**B4:**	Dual analogue output, ±20mADC [1]	**O2:**	Dual open collector output (30V/100mADC) [1]
System		**B1:**	Dual analogue output, 20mADC (standard)	**W1:**	Dual analogue output, 10VDC (standard)	**D1:**	3 digital inputs [1]
3:	One phase, three-phase system (3 or 4 wires, balanced load) Three phase system (3 or 4 wires, unbalanced load)	**B2:**	Dual analogue output, ±5mADC [1]	**W2:**	Dual analogue output, ±1VDC [1]		
		B3:	Dual analogue output, ±10mADC [1]	**W3:**	Dual analogue output, ±5VDC [1]	**Slot D (alarm or pulse out)**	
		B4:	Dual analogue output, ±20mADC [1]	**W4:**	Dual analogue output, ±10VDC [1]	**XX:**	None
		V1:	Single analogue output, 10VDC (standard)	**S1:**	Serial port, RS485 multidrop, bidirectional [1]	**R2:**	Dual relay output, (AC1-8AAC, 250VAC) [1]
Power supply		**V2:**	Single analogue output, ±1VDC [1]			**O2:**	Dual open collector output (30V/100mADC) [1]
		V3:	Single analogue output, ±5VDC [1]	**Note:**		**O4:**	4 open collector outputs (30V/100mADC) [1]
L:	18 to 60VAC/DC [1]	**V4:**	Single analogue output, ±10VDC [1]	Slot A + Slot B Max 4 analogue outputs			
H:	90 to 260VAC/DC	**W1:**	Dual analogue output, 10VDC (standard)			**Options**	
		W2:	Dual analogue output, ±1VDC [1]	Slot C + Slot D max 4 digital outputs			
[1] On request		**W3:**	Dual analogue output, ±5VDC [1]			**X:**	None
		W4:	Dual analogue output, ±10VDC [1]			**S:**	Serial RS232 + RTC
						N:	With N2 Metasys protocol
						C :	options: S+N

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Input Specifications

Number of inputs		Magnetic field	≤ 0.5%RDG, @ 400 A/m
Current	2 (system: single phase)	**Temperature drift**	≤200ppm/°C
	6 (system: 3-phase)	**Sampling rate**	6400 samples/s @ 50Hz
Voltage	2 (system: single phase	**Display**	Graph LCD, 128x64pixel,
	4 (system: 3-phase)		back-lighted. Selectable
Digital	3 free of voltage contacts		read-out for the instanta-
	for Wdmd, VAdmd,		neous variables: 4x4-dgt or
	An dmd, PFavg synchronization		$4x3^1/_2$-dgt
	Reading voltage/current:		Total Energies: 4x9-dgt;
	17.5 to 25VDC/<8mA		Partial: 4x6-dgt
Accuracy (display, RS232, RS485)	In: 5A, If.s.: 6A, start-up I: 15mA	**Max. and min. indication**	Max. 9999 (999,999,999),
Current (A_{L1}, A_{L2}, A_{L3})	±0.5% RDG (0.2 to1.2 In)		Min. -9999 (−999,999,999)
	±5mA (0.02 to 0.2 In)	**Measurements**	Current, voltage, power,
Current (A_n)	±1% RDG (0.2 to 1.2 In)		energy, harmonic distortion
	@ 40 to 100 Hz		(see "Display pages" table).
Voltage AV5 range:	±0.5% RDG (48 to 300 V_{L-N})		TRMS measurement of a dis-
	±1% RDG (84 to 519 V_{L-L})		torted wave (voltage/current).
AV7 range:	±0.5% RDG (80 to 480 V_{L-N})		Coupling type: Direct
	±1% RDG (139 to 830 V_{L-L})		Crest factor: ≤3
	includes also:		(max. 15Ap/500Vp (V L-N)
	frequency, power supply		or 15Ap/800Vp (V L-N)
	and output load influences		
Frequency	±0.1% RDG (40 to 440 Hz)	**Ranges (impedances)**	
Active power		AV5	58/100 V (>500 kΩ) -
(@ 25°C ± 5°C, R.H. ≤ 60%)	±0.5% (RDG + FS) (PF 0.5 L/C,		1 AAC (≤ 0.3 VA)
	0.1 to 1.2 In, AV5 range) or		58/100 V (>500 kΩ) -
	±1% RDG (PF 0.5 L/C,		5 AAC (≤ 0.3 VA)
	0.1 to 1.2 In, AV5 range)		240/415 V (>500 kΩ) -
			1 AAC (≤ 0.3 VA)
Reactive power			240/415 V (>500 kΩ) -
(@ 25°C ± 5°C, R.H. ≤ 60%)	±0.5% (RDG + FS) (PF 0.5 L/C,		5 AAC (≤ 0.3 VA)
	0.1 to 1.2 In, AV5 range) or	AV7	100/170 V ((>500 kΩ)
	±1% RDG (PF 0.5 L/C,		1 AAC (≤ 0.3 VA)
	0.1 to 1.2 In, AV5 range)		100/170 V (>500 kΩ) -
Apparent power			5 AAC (≤ 0.3 VA)
(@ 25°C ± 5°C, R.H. ≤ 60%)	±0.5% (RDG + FS)		400/690 V (>500 kΩ) -
	(0.1 to 1.2 In, AV5 range) or		1 AAC (≤ 0.3 VA)
	±1% RDG		400/690 V (>500 kΩ) -
	(0.1 to 1.2 In, AV5 range)		5 AAC (≤ 0.3 VA)
Energies		**Frequency range**	40 to 440 Hz
(@ 25°C ± 5°C, R.H. ≤ 60%)	Active: class 1 according to	**Over-load protection**	
	EN61036	Continuous: voltage/current	AV5: 300 V_{LN}/520 V_{LL}/6A
	Reactive: class 2 according		AV7: 480 V_{LN}/830 V_{LL}/6A
	to EN61268	For 1 s	
	Ib: 5A, Imax: 6A	AV5	600 V_{LN}/1040 V_{LL}/120A
	0.1Ib: 500mA	AV7	960 V_{LN}/1660 V_{LL}/120A
	Start up current: 20mA	**Keypad**	4 keys:
	Un: 240V (AV5), 400V (AV7)		"S" for enter programming
Harmonic distorsion	1% FS (FS: 100%)		phase and password confir-
(@ 25°C ± 5°C, R.H. ≤ 60%)	phase: ±2°; Imin: 0.1Arms;		mation,
	Imax: 15Ap; Umin: 50Vrms;		"UP" and "DOWN" for
	Umax: 500Vp		value programming/function
	Sampling frequency		selection, page scrolling
	6400 samples/s @ 50Hz		"F" for special functions
Additional errors			
Humidity	≤ 0.3%RDG, 60% to 90% R.H.		
Input frequency	≤ 0.4%RDG, 62 to 400 Hz		

Output Specifications

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

Specifications are subject to change without notice   WM3-96DS 200706

Output Specifications (cont.)

Scaling factor	Programmable within the whole range of retransmission; it allows the retransmission management of all values from: 0 to 20 mADC, 0 to ±20 mADC 0 to ±10 mADC, 0 to ±5 mADC 0 to 10 VDC, 0 to ±10 VDC 0 to ±5 VDC 0 to ±1 VDC	Connections Data format	3 wires, max. distance 15m, 1-start bit, 8-data bit, no parity, 1-stop bit
		Baud-rate	9600 bauds
		Protocol	MODBUS (JBUS)
		Other data	as for RS422/485
Variables to be retransmitted	All (see table"List of the variables that can be connected to:"...)	**Digital outputs (on request)**	Up to 4 outputs (combination of alarms and pulse outputs) 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
Response time	≤ 200 ms typical (filter excluded, FFT excluded 3 1/2 dgt indication)		
Ripple	≤ 1% according to IEC 60688-1 and EN 60688-1	**Pulse outputs (on request)**	
Temperature drift	200 ppm/°C	Number of outputs	Up to 4, independent
Load: 20 mA output	≤ 600 Ω	Type	From 1 to 1000 programmable pulses 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 partial energy meters
±20 mA output	≤ 550 Ω		
±10 mA output	≤ 1100 Ω		
± 5 mA output	≤ 2200 Ω		
10 V output	≥ 10 kΩ	Pulse duration	220 ms (ON), ≥ 220 ms (OFF) According to DIN43864
±10 V output	≥ 10 kΩ	Insulation	By means of optocouplers, 4000 V_{rms} output to measuring input, 4000V_{rms} output to supply input.
± 5 V output	≥ 10 kΩ		
± 1 V output	≥ 10 kΩ		
Insulation	By means of optocouplers, 4000V_{RMS} output to measuring input 4000V_{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).
RS422/RS485 output (on request)	Multidrop bidirectional (static and dynamic variables)	**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
Connections	4 wires, max. distance 1200m, termination directly on the module		
Addresses	1 to 255, selectable by key-pad	Variables to be controlled	All (see table"List of the variables that can be connected to:"...)
Protocol	MODBUS RTU /JBUS, (N2 METASYS on request)		
Data (bidirectional)		Setpoint adjustment	0 to 100% of the electrical scale
Dynamic (reading only)	All display variables (see also the table, "List of the variables that can be connected to"...)	Hysteresis	0 to 100% of the electrical scale
		On-time delay	0 to 255 s
		Relay status	Selectable, Normally de-energized, normally energized
Static (writing only)	All configuration parameters, reset of energy, activation of digital output Stored energy (EEPROM) max. 999.999.999 kWh/kvarh	Output type	Relay, SPDT AC 1-8A, 250VAC DC 12-5A, 24VDC AC 15-2.5A, 250VAC DC 13-2.5A, 24VDC
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	Min. response time	≤ 150 ms, filter excluded, FFT excluded, setpoint on-time delay: "0s"
Insulation	By means of optocouplers, 4000 V_{RMS} output to measuring inputs 4000 V_{RMS} output to supply input	Insulation	4000 V_{RMS} output to measuring input, 4000V_{RMS} output to supply input
RS232 output (on request)	Bidirectional (static and dynamic variables)	Note	The outputs can be either relay type or open collector type (for this latter one, see the characteristics 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	**Filter action**	Display, alarm, analogue and serial outputs (fundamental variables: V, A, W and their derived ones)
1st level	Password "0", no protection	**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
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		**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.
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	**Display language**	English, Italian, French, German, Spanish
Filter			
Filter operating range	0 to 99.9% of the input electrical scale		
Filtering coefficient	1 to 255		

Supply Specifications

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

General Specifications

Operating temperature	0 to +50°C (32 to 122°F) (R.H. < 90% non-condensing)	Product requirements	Energy measurements: EN61036, EN61268. DIN43864
Storage temperature	-10 to +60°C (14 to 140°F) (R.H. < 90% non-condensing)	Pulse output:	
		Approvals	CE, UL, CSA
Insulation reference voltage	300 V_{RMS} to ground (AV5 input)		
Insulation	4000 V_{RMS} between all inputs/ outputs to ground	**Connector**	Screw-type, max. 2.5 mm^2 wires x 2
Dielectric strength	4000 V_{RMS} for 1 minute	**Housing**	
Noise rejection		Dimensions	96x96x140 mm
CMRR	100 dB, 48 to 62 Hz	Material	ABS, self-extinguishing: UL 94 V-0
EMC	EN 50081-2, EN 50082-2	**Degree of protection**	Front: IP65, NEMA4x, NEMA12
Other standards		**Weight**	Approx. 600 g (packing included)
Safety requirements:	IEC 61010-1, EN 61010-1		
Product requirements:	IEC 60688-1, EN 60688-1		

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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.
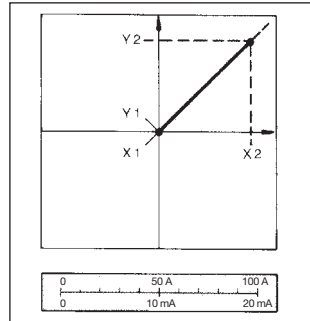
Figure D
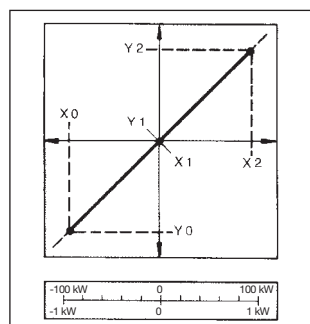The sign of measured quantity and output quantity remains the same. With the measured quantity being zero, the output quantity already has the value Y1 = 0.2 Y2.
Live zero output.
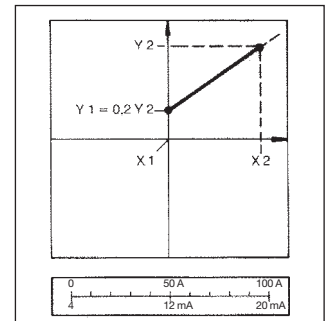
Figure B
The sign of measured quantity and output quantity changes simultaneously. The output quantity is proportional to the measured quantity.

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.
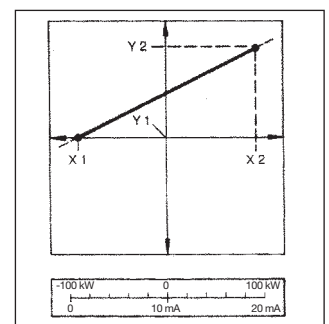
Figure C
The sign of measured quantity and output quantity remains the same. On the range X0...X1, the output quantity is zero. The range X1...X2 is delineated on the entire output range Y0 = Y1...Y2 and thus presented in strongly expanded form.
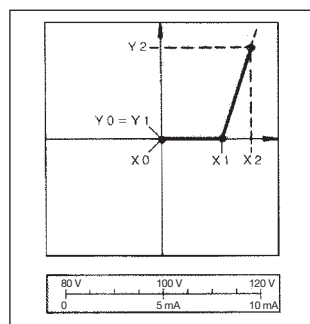
Figure F
The sign of the measured quantity remains the same, that of the output quantity changes as the measured quantity leaves range X0...X1 and passes to range X1...X2 and vice versa.
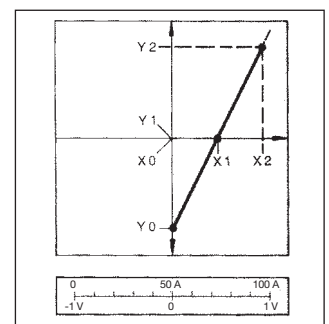
Mode of Operation

Waveform of the signals that can be measured
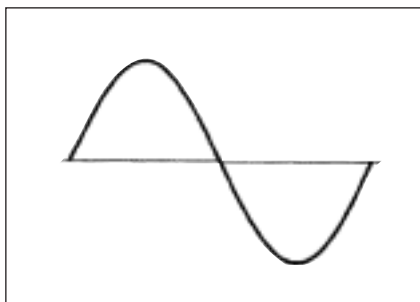
Figure G
Sine wave, undistorted

Fundamental content	100%
Harmonic content	0%
$A_{rms} =$	$1.1107 \mid \overline{A} \mid$
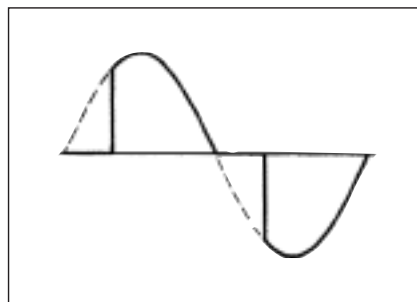
Figure H
Sine wave, indented

Fundamental content	10...100%
Harmonic content	0...90%
Frequency spectrum 3rd to 50th harmonic	
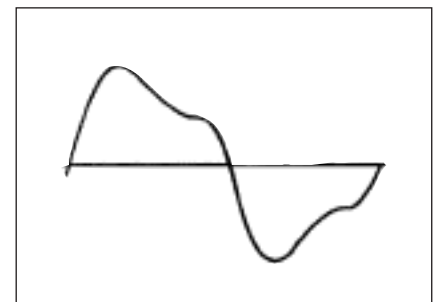
Figure I
Sine wave, distorted

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

Harmonic distortion analysis

Analysis principle	FFT
Harmonic measurement Current Voltage	Up to 50th harmonic Up to 50th harmonic
Type of harmonics	THD (V$_L$1) THD odd (V$_L$1) THD even (V$_L$1) and also for the other phases: L2, L3. THD (I$_L$1) THD odd (I$_L$1) THD even (I$_L$1) 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: THD in % / RMS value THD odd in % / RMS value THD even in % / RMS value single harmonic in % / RMS value
Others	The harmonic distortion can be measured in 2-wire, 3-wire or 4-wire systems. 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) (no partial meters)
Dual time Number of energy meters Time periods	Total: 4 (9-digit) Partial: 8 (6-digit) 2, programmable within 24 hours
Multi time Number of energy meters Time periods Time seasons	Total: 4 (9-digit) Partial: 48 (6-digit) 4, programmable within 24 hours 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)

(a) +Wh, +VArh, –Wh, -VArh

max. 4

(b) Time period (24 hours)

max. 3

(c) Season (12 months)

Partial: up to 48 energy meters (axbxc)

Total: up to 4 energy meters ("a" type)
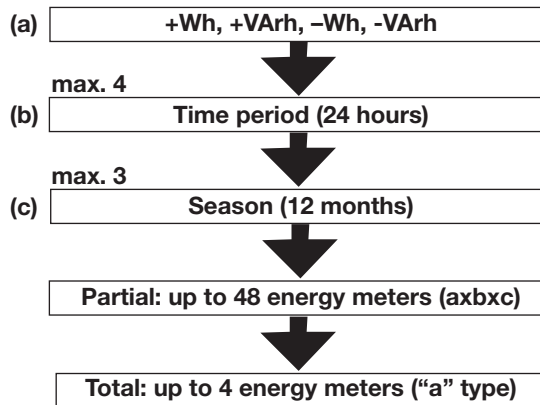
Example of Multi-time energy metering

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	
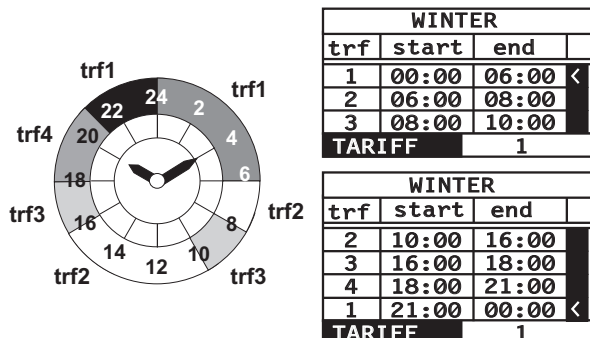
Display pages

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
15	(MAX5)	(MAX6)	(MAX7)	(MAX8)	above mentioned (No. 1 to No. 13)
16	(MAX9)	(MAX10)	(MAX11)	(MAX12)	
17	(MIN1)	(MIN2)	(MIN3)	(MIN4)	The MIN value can be one of the
18	(MIN5)	(MIN6)	(MIN7)	(MIN8)	above mentioned (No. 1 to No. 13)
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

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

Total harmonic distortion

$$THD_i = \frac{\sqrt{\sum_{n,n\neq1} T_{n,i}^2}}{T_{1i}}$$

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

Δt = time interval between two successive power consumptions

n1, n2 = 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;
• 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.

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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
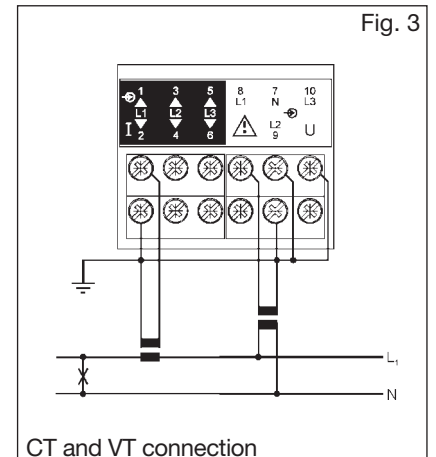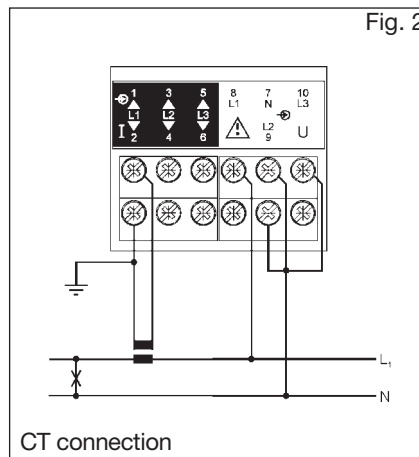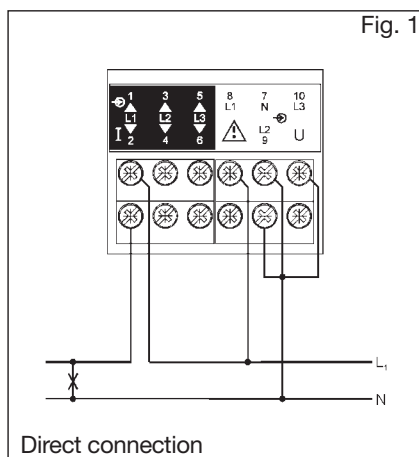
Wiring Diagrams (cont.)

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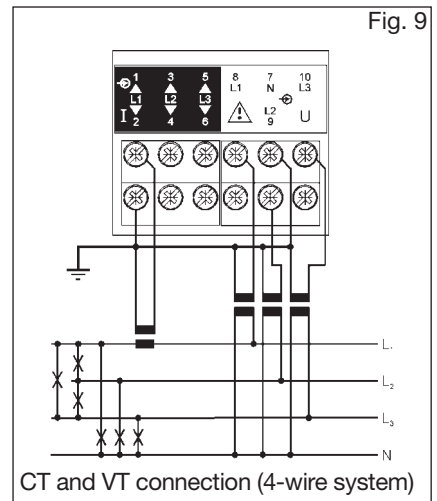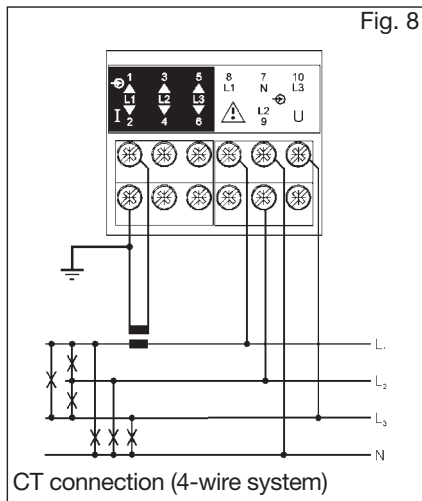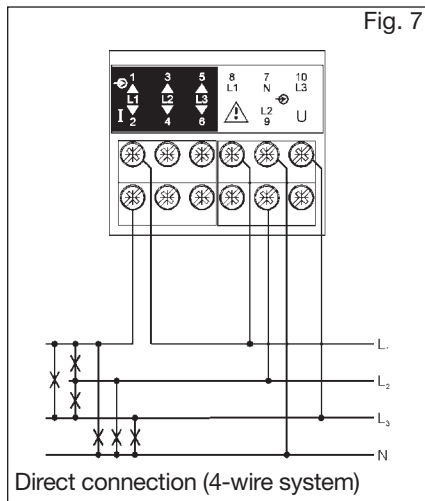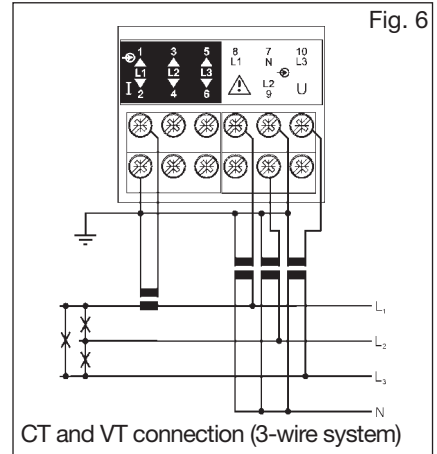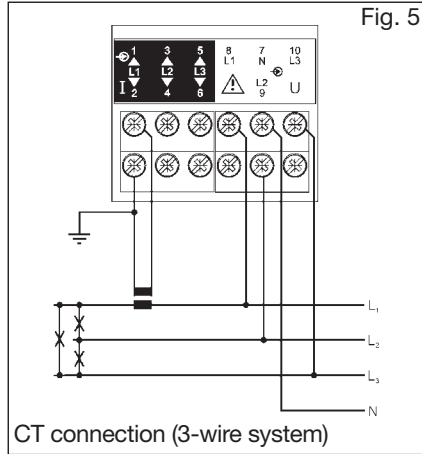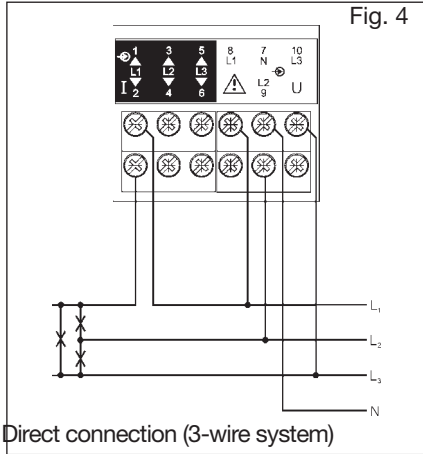
Three-phase, 3-wire ARON input connections - Unbalanced loads
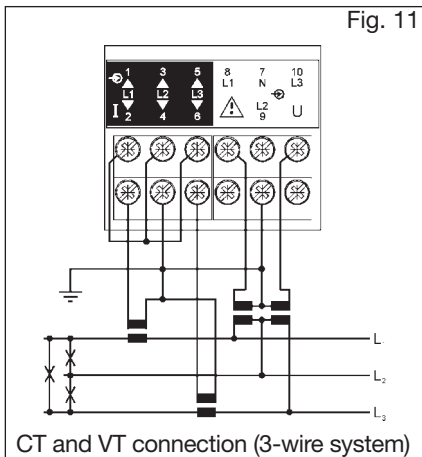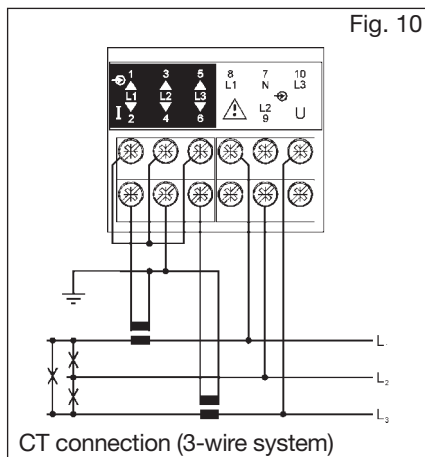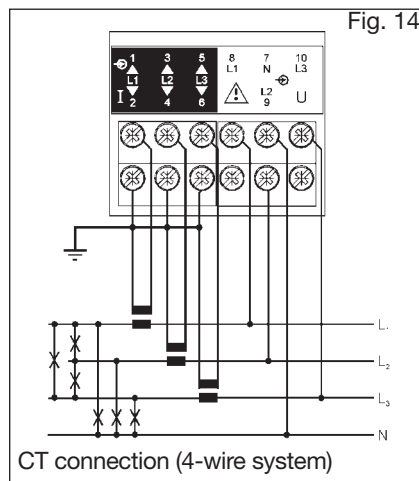
Three-phase, 3-wire input connections - Unbalanced loads

Fig. 10

CT connection (3-wire system)

Fig. 11

CT and VT connection (3-wire system)

Fig. 12

CT and VT connection (3-wire system)
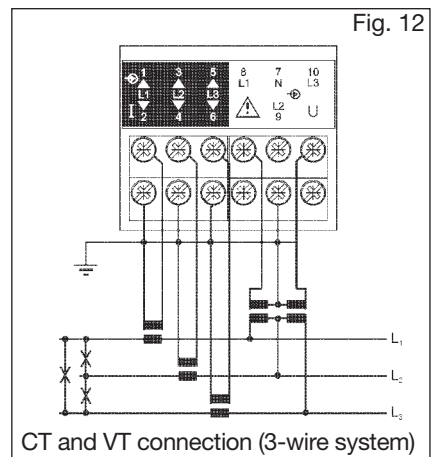
Wiring Diagrams (cont.)

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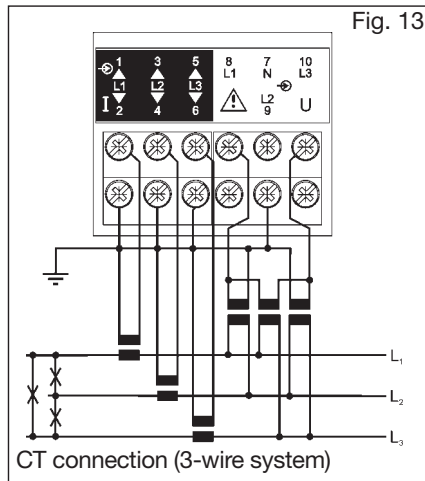
Three-phase four-wire input connections - Unbalanced load

Fig. 13

CT connection (3-wire system)

Fig. 14

CT connection (4-wire system)

Fig. 15

CT and VT connection (4-wire system)
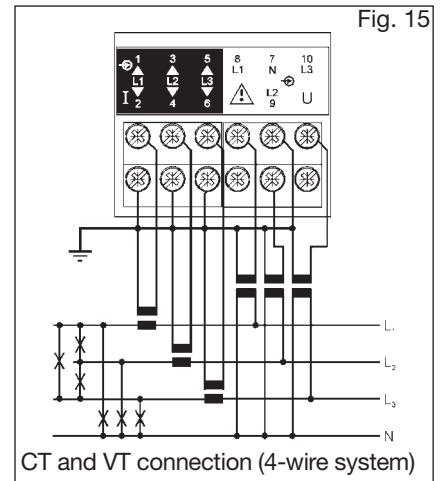
Wiring diagrams (optional modules)
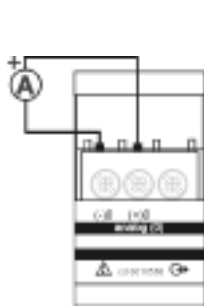
AO1050
1 analogue
output (mA)
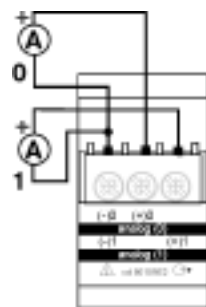
AO1026
2 analogue
outputs (mA)
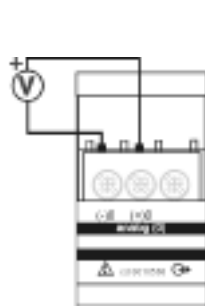
AO1051
1 analogue
output (V)
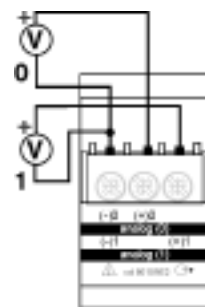
AO1027
2 analogue
outputs (V)

AO1038
3 digital inputs

VDC (4)
VDC (2)
Rc (4)   Rc (2)
Vo+ (4)
GND (4-2)
Vo+ (2)
Vo+ (1)
GND (1-3)
Vo+ (3)
Rc (1)
(COM) (+)4 (+)2
open collector (4) (2)
(COM) (+)1 (+)3
open collector (1) (3)
Rc (3)
VDC (1)
VDC (3)

AO1037

AO1058
1 relay output
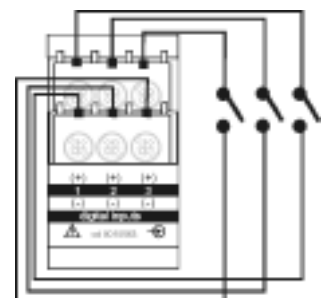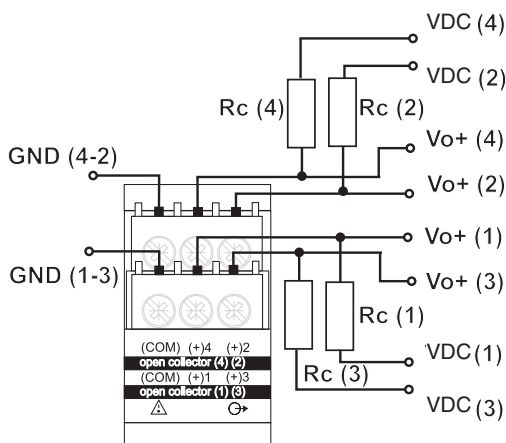
AO1035
2 relay outputs

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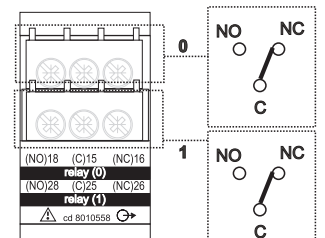
Wiring diagrams (optional modules, cont.)
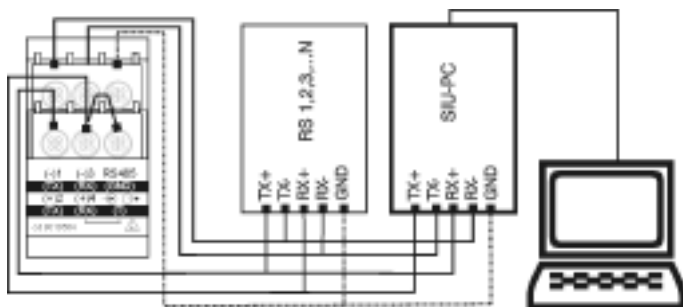
RS422/485 4-wires connection: additional devices provided with RS422/485 (that is RS 1, 2, 3...N) are connected in parallel.
The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (Rx+) and (T).
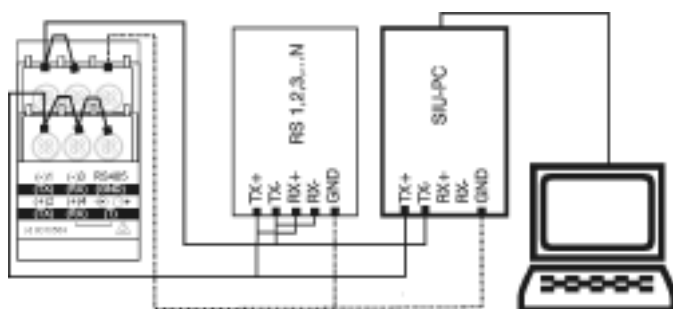
RS422/485 2-wires connection: additional devices provided with RS422/485 (that is RS 1, 2, 3...N) are connected in parallel.
The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (Rx+) and (T).

Front Panel Description
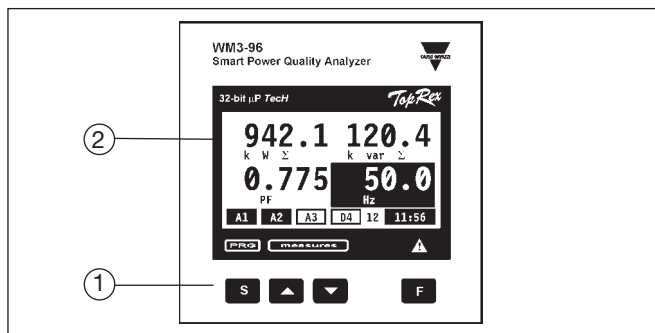
▲   ▼
- for value programming/function selection, page scrolling
- "F" for special functions

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.

1. **Key-pad**
Set-up and programming procedures are easily controlled by the 4 pushbuttons.
- "S" for enter programming phase and password confirmation,

Dimensions

Specifications are subject to change without notice   WM3-96DS 200706

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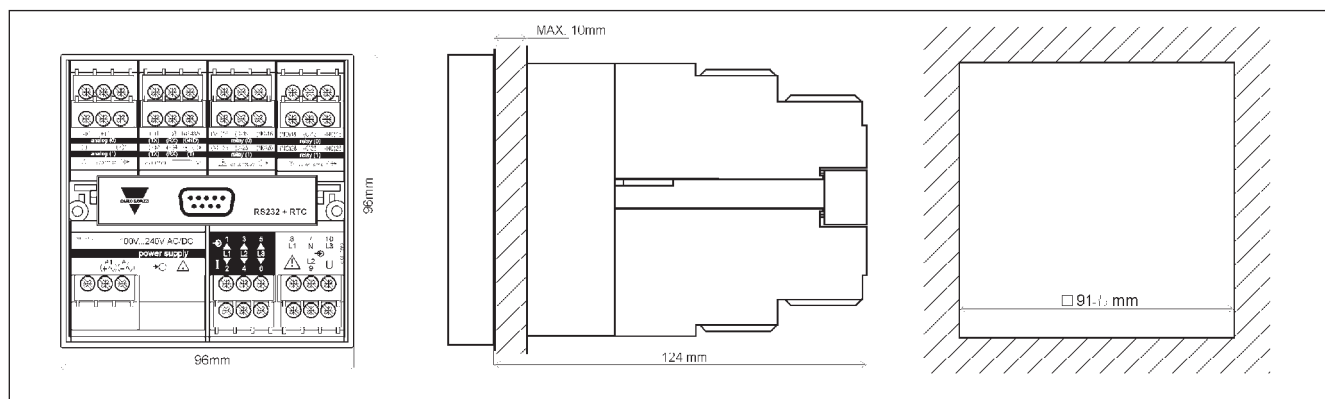
Terminal boards

Single analogue output modules
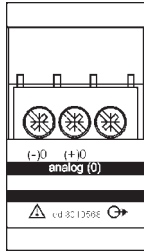
AO1050	(20mADC)
AO1051	(10VDC)
AO1052	(±5mADC)
AO1053	(±10mADC)
AO1054	(±20mADC)
AO1055	(±1VDC)
AO1056	(±5VDC)
AO1057	(±10VDC)

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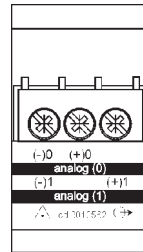
AO1026	(20mADC)
AO1027	(10VDC)
AO1028	(±5mADC)
AO1029	(±10mADC)
AO1030	(±20mADC)
AO1031	(±1VDC)
AO1032	(±5VDC)
AO1033	(±10VDC)

Digital output modules
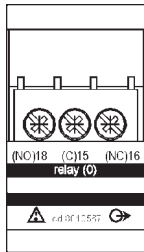
AO1058
Single relay output
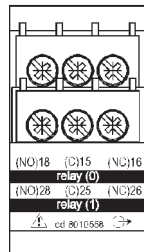
AO1035
Dual relay output
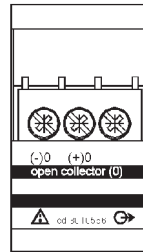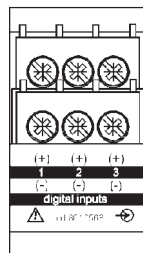
AO1059
Single open collector output
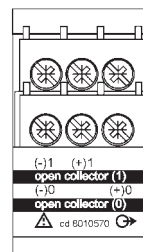
AO1036
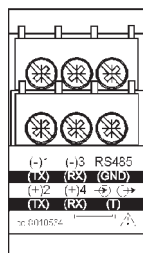Dual open collector output

Other input/output modules
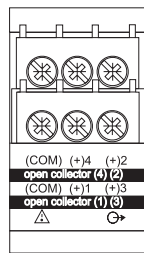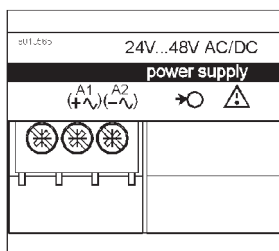
AO1037
4 open collector outputs

AQ1038
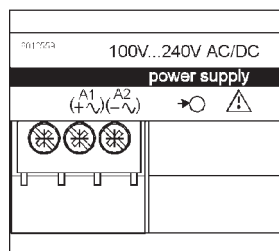3 Digital inputs

AR1034
RS485 port

AR1039
RS232 port + RTC

Power supply modules

AP1021
18-60VAC/DC power supply

AP1020
90-260 VAC/DC power supply