WM
Технические характеристики

По вопросам продаж и поддержки обращайтесь:

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Челябинск (351)202-03-61
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Energy Management
Modular Smart Power Quality Analyzer
Type WM5-96

- **MODBUS RTU and TCP, JBUS protocol, iFIX SCADA compatibility**
- **Real time clock function (without back-up)**
- **Up to 12 optional digital inputs (sync function, remote digital input control)**
- **Up to 16 optional digital outputs (pulse, alarm, remote control)**
- **16 freely configurable alarms with OR/AND logic linkable with up to 4 relay outputs and up to 16 open collector outputs**
- **Up to 8 optional analogue outputs (+20mA, +10VDC, +/- 5mA)**
- **Universal power supply: 18-60VAC/VDC, 90-260 VAC/VDC**
- **Front protection degree: IP 65, NEMA4x, NEMA12**
- **Class 0.2 (current/voltage)**
- **ARM® powered**
- **Back-lighted graph display (128x64 dots)**
- **Bargraph indication of instantaneous power (kW sys)**
- **Front size: 96x96 mm**
- **Measurement of single phase and system instantaneous variables: W, var, VA, PF, VLL, VLN, A_L, A_n, Hz, THD, ASY VLL, ASY VLN (for all measurements max, min, dmd/AVG and max dmd/AVG values)**
- **Measured energies (imported/exported): kWh and kvarh**
- **Current and voltage inputs with autoranging capability**
- **4x4 DGT instantaneous variable read-out**
- **4x9 DGT total energies read-out**
- **4x9 DGT partial energies read-out**
- **Energy measurements according to ANSI C12.20, CA 0.5, EN62053-22 CL 0.5S and ANSI C12.1, EN62053-23 CL 2**
- **4 total 3-phase, 48 partial 3-phase and 12 total single phase independent energy meters to be used as single, dual, multi-time tariff management**
- **Display refresh rate: 10 time / sec**
- **Harmonic distortion analysis (FFT) up to the 63rd harmonic with graphic and numeric indication (current and voltage)**
- **Harmonics source detection**
- **Data stamping of up to 10,000 events: alarm, min, max, digital input status, digital output status as remote control, resets**
- **4 independent communication ports: optical front communication port (ANSI C12.18) optional RS 422/485 serial port, optional RS232 + real time clock function, optional Ethernet port**

Product Description

3-phase utility grade power quality analyzer. Particularly recommended for the measurement of the main electrical variables.
Housing for panel mounting, with optical communication port (according to the ANSI standards), RS485/RS232 or Ethernet communication ports, pulse and alarm outputs. Parameters programming and data reading by means of Wm5Soft.

How to order

WM5-96 see next page

How to order

Wm5Soft

Parameters programming and data reading by means of Wm5Soft.

Modules Combination

Description	Part N.	Slot A	Slot B	Slot C	Slot D	Slot E
WM5-96 base with ANSI local port	AD2001					
WM5-96 base without local port	AD2000					
Power supply (18-60VAC/DC)	AP1021					
Power supply (90-260VAC/DC)	AP1020					
Measuring input (AV5: 400/690VL-L)	AQ2030					
Measuring input (AV6: 120/208VL-L)	AQ2031					
RS485 port (9 600 bps)	AR1034		1-port			
RS485 port (115,200 bps)	AR2040		1-port			
Ethernet/Internet port	AR1061	1-port				
Analogue output (20mA DC)	AO2050	2-out	2-out			
Analogue output (10V DC)	AO2051	2-out	2-out	2-out	2-out	
Analogue output (+/-5mA DC)	AO2052	2-out	2-out	2-out	2-out	
Relay output	AO1058	1-out	1-out	1-out	1-out	
Relay output	AO1035			2-out	2-out	
Open collector output	AO1059	1-out	1-out	1-out	1-out	
Open collector output	AO1036	2-out	2-out	2-out	2-out	
Open collector output	AO1037	4-out	4-out	4-out	4-out	
Digital inputs	AQ1038	3-in	3-in	3-in	3-in	
Digital inputs + Aux	AQ1042	3-in	3-in	3-in	3-in	
RS232 port + RTC (9 600 bps)	AR1039					1-port

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How to order WM5 96

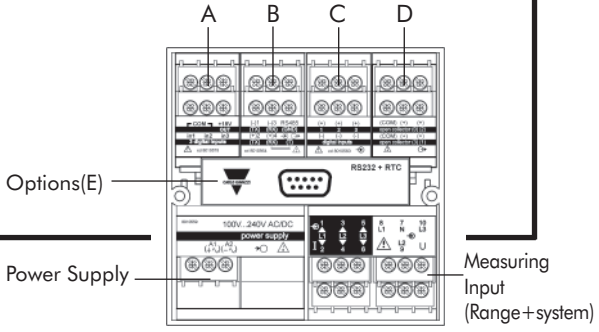
Minimum modules for a basic unit on grey background
Ordering key (fully assembled instrument):

WM5 96 AV53 H XX XX XX XX XX

Description	Ch	Part No.	Legend
Model			
WM5-96 with optical port ANSI C12.18 type		AD2001	WM5 96
WM5-96 without optical port		AD2000	WM5 96
Range code+sys (meas. inputs)			
400/690VL-L 1/5A (10A)		AQ2030	AV5.3
120/208VL-L 1/5A (10A)		AQ2031	AV6.3
Power supply			
18-60VAC/DC power supply		AP1021	L
90-260VAC/DC power supply		AP1020	H
None			XX
Ethernet/Internet port	1	AR1061	E2
Digital inputs	3	AQ1038	D1
Digital inputs + aux	3	AQ1042	D2
Open collector output	4	AO1037	O4
Open collector output	2	AO1036	O2
Open collector output	1	AO1059	O1
Relay output	1	AO1058	R1
Analogue output 20mADC	2	AO2050	B1
Analogue output 10VDC	2	AO2051	W1
Analogue output +/-5mA	2	AO2052	B2
SLOT A			
None			XX
Digital inputs	3	AQ1038	D1
Digital inputs + aux	3	AQ1042	D2
Open collector output	4	AO1037	O4
Open collector output	2	AO1036	O2
Open collector output	1	AO1059	O1
Relay output	1	AO1058	R1
Analogue output 20mADC	2	AO2050	B1
Analogue output 10VDC	2	AO2051	W1
Analogue output +/-5mA	2	AO2052	B2
RS485 9600bps	1	AR1034	S1
RS485 115200bps	1	AR2040	S2
SLOT B			
None			XX
Digital inputs	3	AQ1038	D1
Digital inputs + aux	3	AQ1042	D2
Open collector output	4	AO1037	O4
Open collector output	2	AO1036	O2
Open collector output	1	AO1059	O1
Relay output	1	AO1058	R1
Relay output	2	AO1035	R2
Analogue output 10VDC	2	AO2051	W1
Analogue output +/-5mA	2	AO2052	B2
SLOT C			
None			XX
Digital inputs	3	AQ1038	D1
Digital inputs + aux	3	AQ1042	D2
Open collector output	4	AO1037	O4
Open collector output	2	AO1036	O2
Open collector output	1	AO1059	O1
Relay output	1	AO1058	R1
Relay output	2	AO1035	R2
Analogue output 10VDC	2	AO2051	W1
Analogue output +/-5mA	2	AO2052	B2
SLOT D			
Utility grade with optical port			XX
RS232 + RTC (utility grade)	1	AR1039	SX
"Type approval" Canada for further "Revenue approval" process **(*)**			XU
RS232+RTC + "XU" option	1	AR1039	SU
Utility grade without optical port			YY
RS232 + RTC (utility grade) without optical port	1	AR1039	SY
OPTIONS SLOT E			

Example of which modules to order for:
WM5-96 AV53 H B1 S1 R2 O2 SX

Bill of material	Ordering No.
WM5 96	AD2001
AV53 measuring inputs (400/690VL-L)	AQ2030
90-260VAC/DC power supply	AP1020
Analogue output 20mA (2 channels)	AO2050
RS485 serial port 9600 bps	AR1034
Relay output (2 channels)	AO1035
Open collector (2 channels)	AO1036
RS232 port+RTC	AR1039



(*) Available only for the assembled meters having the 2 possible minimum base configuration, respectively made up of:
1. display module + power supply module H + AV5 3 special mode
2. display module + power supply module H + AV6 3 special mode.

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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 (on request)	Up to 12
AQ1038	No. of inputs: 3 (voltage-free)
Purpose	"dmd" measurements synchronisation. Tariff selection: energy. Contact status reading. Clock synchronisation.
Contact measuring current	<8mA/ 17.5 to 25VDC
AQ1042	Number of inputs: 3 + excitation output
Purpose	"dmd" measurements synchronisation. Tariff selection: energy. Contact status reading. Clock synchronisation.
Excitation output	16V<+Aux<24VDC Max 15mA
Contact measuring current	15mA
Common characteristics	
Close contact resistance	Max 1k Ω
Open contact resistance	Min 100kΩ
Insulation	see "Insulation between inputs and outputs" table
Accuracy (display, RS232, RS485)	In: 5A, If.s.: 10A Un: see voltage ranges below
Current (A_{L1}, A_{L2}, A_{L3}) (@20°C ±5°C, R.H. 75%)	from 0.05In to Imax: ±(0.2%RDG+2DGT) from 0.01In to 0.05In: ±(0.5%RDG+2DGT)
Current (A_n)	±0.5% RDG (0.2 to 2 In) @ 40 to 100 Hz
Voltage (@20°C±5°C,R.H. 75%)	
range AV5:	400/690V_{L-L} AC V_{L-N}: 185 V to 460 V V_{L-L}: 320 V to 800 V ±(0.2%RDG+1DGT)
range AV6:	120/208V_{L-L} AC V_{L-N}: 45 V to 145 V V_{L-L}: 78 V to 250 V ±(0.2%RDG+1DGT)
	Includes also: frequency, power supply and output load influences
Frequency	±0.1% RDG (40 to 440 Hz)
Active power and apparent power (@ 20°C ± 5°C, R.H. 75%)	0.05In to Imax, PF 1: ±(0.5%RDG+1DGT) 0.01In to 0.05In, PF 1: ±(1%RDG+1DGT) 0.1In to Imax, PF0.5L, PF 0.8C: ±(0.6%RDG+1DGT) 0.02In to 0.1In,PF0.5L, PF 0.8C: ±(1%RDG+1DGT)
Reactive power (@ 20°C ± 5°C, R.H. 75%)	0.1In to Imax, senφ 0.5L/C: ±(2%RDG+1DGT) 0.05In to 0.1In, senφ 0.5L/C: ±(2.5%RDG+1DGT) 0.05In to Imax, senφ 1: ±(2%RDG+1DGT) 0.02In to 0.05In, senφ 1: ±(2.5%RDG+1DGT)
Energies (@ 20°C ± 5°C, R.H. ≤75%)	Active: class 0.5 according to EN62053-22, ANSI C12.20 Reactive: class 2 according to EN62053-23, ANSI C12.1 In: 5A, Imax: 10A 0.1In: 500mA, Start-up current: 5mA Un: 400/690V_{L-L} (AV5) Un: 120/208V_{L-L} (AV6)
Harmonic distortion (@ 20°C ± 5°C, R.H. ≤ 75%)	1% FS (FS: 100%) phase: ±2°; Imin: 5mA_{RMS}; Imax: 15Ap; Umin: 30V_{RMS}; Umax: 500Vp
Temperature drift	≤ 200ppm/°C (A/V), ≤300ppm/°C (all the other measurements)
Sampling rate	6400 samples/s @ 50Hz 7680 samples/s @ 60Hz
Display	Graph LCD backlighted (128x64 dots). Read-out for the instantaneous variables: 4x4 digit Total energies: 4x9 digit; Partial energies: 4x9 digit
Display refresh time	100ms
Max. and min. indication	Max. 9999 (999,999,999), Min. -9999 (–999,999,999)
Front LED	Red Blinking light in case of virtual alarm Fixed light in case of digital output activation (alarm)
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 10A peak
Input impedance	
400/690V_{L-L} (AV5)	1.77 MΩ ±5%
120/208V_{L-L} (AV6)	885 kΩ ±5%
Current	≤ 0.01Ω
Frequency	40 to 440 Hz
Overload protection	(max values)
Continuous voltage/current	AV5: 460V_{LN}, 800V_{LL}/10A AV6: 145V_{LN}, 250V_{LL}/10A
For 500ms: voltage/current	AV5: 800V_{LN}, 1380V_{LL}/36A AV6: 240V_{LN}, 416V_{LL}/36A

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Output specifications

Analogue Outputs (on request)	
Number of outputs	Up to 8 (max 4 x 20mA + 4 x 10VDC or 4 x 20mA + 4 x ±5mA or 8 x 10VDC or 8 x ±5mA)
Accuracy (@ 25°C ±5°C, R.H. ≤60%)	±0.1%FS (20mA or 10VDC) ±0.5%FS (±5mA), FS=10mA
Range	0 to 20mA or 0 to 10 VDC or ±5mA
Scaling factor:	Programmable within the whole range of retransmission; it allows the retransmission management of all values from: 0 and 20 mA, 0 and 10VDC, or -5mA and +5mA
Response time	400 ms typical (filter excluded)
Ripple	1% (according to IEC 60688-1, EN 60688-1)
Total temperature drift	≤ 500 ppm/°C
Load: 20 mADC	≤ 350 Ω
10 VDC	≥ 10kΩ
±5 mA	≤ 1400Ω
Insulation	see "Insulation between inputs and outputs" table
Optical communication port	According to ANSI C12.18
RS422/RS485 port (on request)	Multidrop bidirectional (static and dynamic variables)
Connections	2 or 4 wires, max. distance 1000m, termination directly on the module
Addresses	1 to 247, selectable by key-pad
Protocol	MODBUS RTU /JBUS,
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
	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	9.6k, 19.2k, 38.4k, 115.2k bit/s selectable bauds
Insulation	see "Insulation between inputs and outputs" table
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, even parity, odd parity, 1 stop bit
Baud-rate	9.6k bit/s
Protocol	MODBUS RTU /JBUS
Other data	as for RS422/485

Ethernet/Internet port	
Protocols	Modbus TCP
IP configuration	Static IP
TCP port	Selectable (default 502)
Client connections	Max 5 simultaneously
Connections	RJ45 10/100 Base T
Digital outputs (on request)	
Pulse type	
Number of outputs	Up to 16
Type	Programmable from 1.000 to 1000 pulses per Wh/varh (total and partial) Outputs connectable to the total and/or partial energy meters (Wh/varh)
Pulse duration	≥ 100ms, < 120msec (ON), ≥ 100ms (OFF) according to EN62053-31
Alarm type	
Number of outputs	up to 16, independent
Alarm modes	Up alarm, down alarm, in window alarm, out window alarm. All of them can be used with start up deactivation function and/or latch. All the alarms can be connected to all variables (see the table "List of the variables that can be connected to").
Set-point adjustment	from 0 to 100% of the electrical scale
Hysteresis	from 0 to full scale
On-time delay	0 to 255s
Output status	Selectable; normally de-energised and normally energised
Min. response time	≤ 200ms, filters excluded, Set-point on-time delay: "0 s"
Note	The 16 digital outputs can also work as combination of pulse outputs and alarm outputs.
Static (digital) outputs	**(on request)**
Purpose	For pulse outputs or for alarm outputs
Signal	V_{ON} 1.2 VDC/ max. 100 mA V_{OFF} 30 VDC max.
Insulation	see "Insulation between inputs and outputs" table
Relay (digital) outputs	**(on request)**
Purpose	For alarm outputs or for pulse outputs
Output type	Relay SPDT AC 1-8A, 250VAC DC 12-5A, 24VDC AC 15-2.5A, 250VAC DC 13-2.5A, 24VDC
Insulation	see "Insulation between inputs and outputs" table
Electrical life:	≥ 10^5 operations (@ 8A, 250 V, PF 1)
Mechanical life:	≥ 30 - 10^6 operations

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Software functions

Password	Numeric code of max 4 digits from 0 to 1000; 2 protection levels of the programming data
1st level	Password “0”: no protection
2nd level	Password from 1 to 1000: all data are protected.
System selection	
System 1	1-phase (2 wires)
System 2, unbalanced	2-phase (3 wires)
System 3, balanced	3-phase (3 wires+1CT)
System 3, unbalanced	3-phase (3 wires) 3-phase (4 wires)
Transformer ratio	CT up to 30 kA (6000 max) VT (PT) up to 600 kV (6000 max)
Filters	
Filter operating range	0.1 to 100% 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).
Alarms	
Working mode	“OR” or “AND” or “OR+AND” functions (see “Alarm parameter and logic” page). Freely programmable on up to 16 alarms. The alarms can be connected to any variables available in the table “List of the variables that can be connected to”
Reset	By means of the key-pad or of the configuration software, it is possible to reset the following data: - all the min, max, dmd, dmd-max values. - total and partial counters. - latch alarms. - all the events.

Data stamping	
Type of data	Alarm, min, max, digital input status, digital output status as remote control, resets. All events are stored with date (dd:MM:yy) and hour (hh:mm:ss) reference
Number of events	Up to 10,000
Data management type:	FIFO
Data storage type	Data flash
Displaying	4 variables per page 1 page that can be laid out by the user Up to 36 pages
Energy meters	Up to 28 pages depending on the selected tariff mode. Displaying of the consumed energy of the previous 12 months.
Stored events	10,000 events.
Display language	Selectable: English, Italian, French, German, Spanish

Wm5Soft parameter programming and variable reading software

Wm5Soft	Multi-language software (Italian, English, French, German, Spanish) for variable reading, instrument calibration and parameters programming. The program runs under Windows /98/98SE/2000/NT/XP.
Working mode	Three different working modes can be selected:

	- management of local RS232 (MODBUS); - management of local optical port (MODBUS); - management of a local RS485 network (MODBUS);
Data Storing	In pre-formatted XLS files (Excel data base).
Data Transfer	Manual or automatic at programmable timings.

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Time period management

Meters	
Total	4 (9-digit)
Partial and multitariff	48 (9-digit)
Tariffs	Up to 12
Time periods	
Number of periods	Up to 24 per day Up to 100 different days per year
Pulse output	Connectable to total and/or partial meters (multitariff)
Energy meter recording	Consumption history by recording of the monthly energy meters (12 previous months). Recording of total and partial energy meters. Energy meter recording (EEPROM) Max.999,999,999kWh/kvarh.

Energy Meters	
Total energy meters	4 (+kWh, +kvarh, -kWh, -kvarh) It is possible to divide each energy meter here above listed in 3 additional energy meters (1 for each phase "L1-L2-L3")
Monthly energy meters	48 (energy meters for each month: "+kWh, +kvarh, -kWh, -kvarh")
Partial energy meters	16 (using digital inputs: max 4 tariffs). 48 (using the internal clock: max 12 tariffs)
GAS/WATER meters	GAS (m^3) or WATER (hot-cold m^3) or remote heating (kWh) meters

Harmonic distortion analysis

Analysis principle	FFT
Harmonic measurement	
Current	Up to the 63rd harmonic
Voltage	Up to the 63rd harmonic
Type of harmonics	THD (V_{L1} and V_{L1-N}) THD odd (V_{L1} and V_{L1-N}) THD even (V_{L1} and V_{L1-N}) The same for the other phases: L2, L3. THD (A_{L1}) THD odd (A_{L1}) THD even (A_{L1}) 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 sec@50Hz without filter

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General Specifications

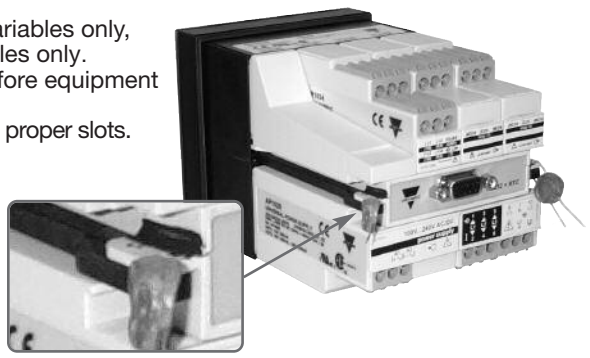
Operating temperature	-10° to +45°C (14° to 113°F) (R.H. < 90% non-condensing)
Limit range of operating temp.	-20° to +55°C (-4° to 131°F) (R.H. <90% non-condensing)
Storage temperature	-30° to +60°C (-22° to 140°F) (R.H. < 90% non-condensing)
Installation category	III
Pollution degree	2
Altitude	up to 2000m (6560 feet) above sea-level
Insulation reference voltage	300 V_{RMS} to ground (AV5 input)
Dielectric strength	4kVAC$_{RMS}$ (for 1 min)
Noise Rejection CMRR	100 dB, 48 to 62 Hz
EMC Emissions	EN61000-6-3, EN60688 residential environment, commerce and light industry
Immunity	EN61000-6-2 industrial environment. ANSI/IEEE C37.90-1989 (surge, withstand and fast transient test)
Pulse voltage (1.2/50µs)	EN61000-4-5
Safety standards	IEC60664, IEC61010-1 EN60664, EN61010-1
Measurement standards	IEC60688, EN60688, EN62053-22, EN62053-23, ANSI C12.20, ANSI C12.1
Approvals	CE, cURus and CSA
Connections 5(6) A	Screw-type max. 2.5 mm^2 wires (2x 1.5mm^2) Max. screws tighteinig torque: 0.5 Nm
Housing Dimensions	96x96x140 mm
Material	ABS, self-extinguishing: UL 94 V-0
Protection degree	Front: IP65, NEMA4x, NEMA12
Weight	Approx. 600 g (packing included)

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)

Revenue approval settings

- The access to the programming parameters via front key pad and/or serial communication ports is locked.
- The front key pad (up and down keys) allows the displaying of the variables only, while the communication ports allows the transmission of the variables only.
- A proper “instrument settings” form must be filled up by the user before equipment supplying.
- WM5-96 is supplied with the desired modules plugged and sealed in the proper slots.
- WM5-96 fulfils: the ANSI/IEEE C12.20-1998 requirements;
  the CAN3-C17-M84 requirements;
  and can be certified according to:
  C12.20-1998, class 0.5 (independent labs);
  AE-1507 Industry Canada Approval.
  In this case there are 2 base configurations:
  1. display module + measuring input module AV5 3 + power supply module H.
  2. display module + measuring input module AV6 3 + power supply module H.



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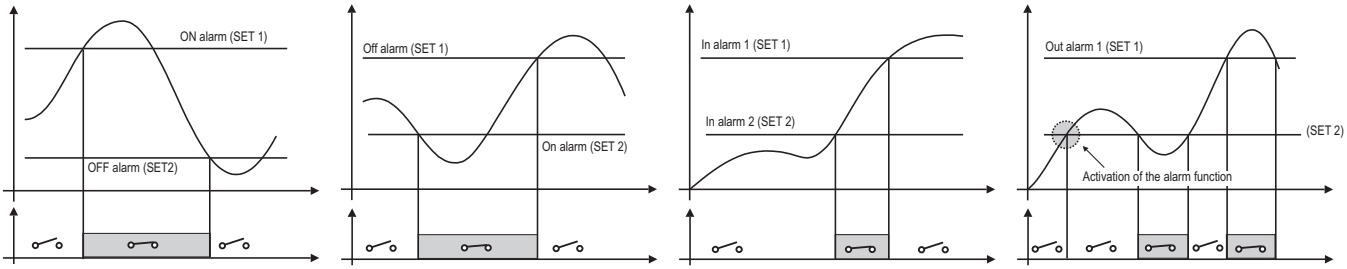
Alarm parameters and logic

- Block enable.
- Controlled variable (VLN, ...).
- Alarm type (up, down, window int, window ext).
- Activation function.
- Latch
- SET 1.
- SET 2.
- ON delay.
- OFF delay
- Logical function (AND, OR).
- Digital output (1 to 16).

A, B, C... up to 16 parameter control blocks.



Up alarm
SET 1 > SET 2

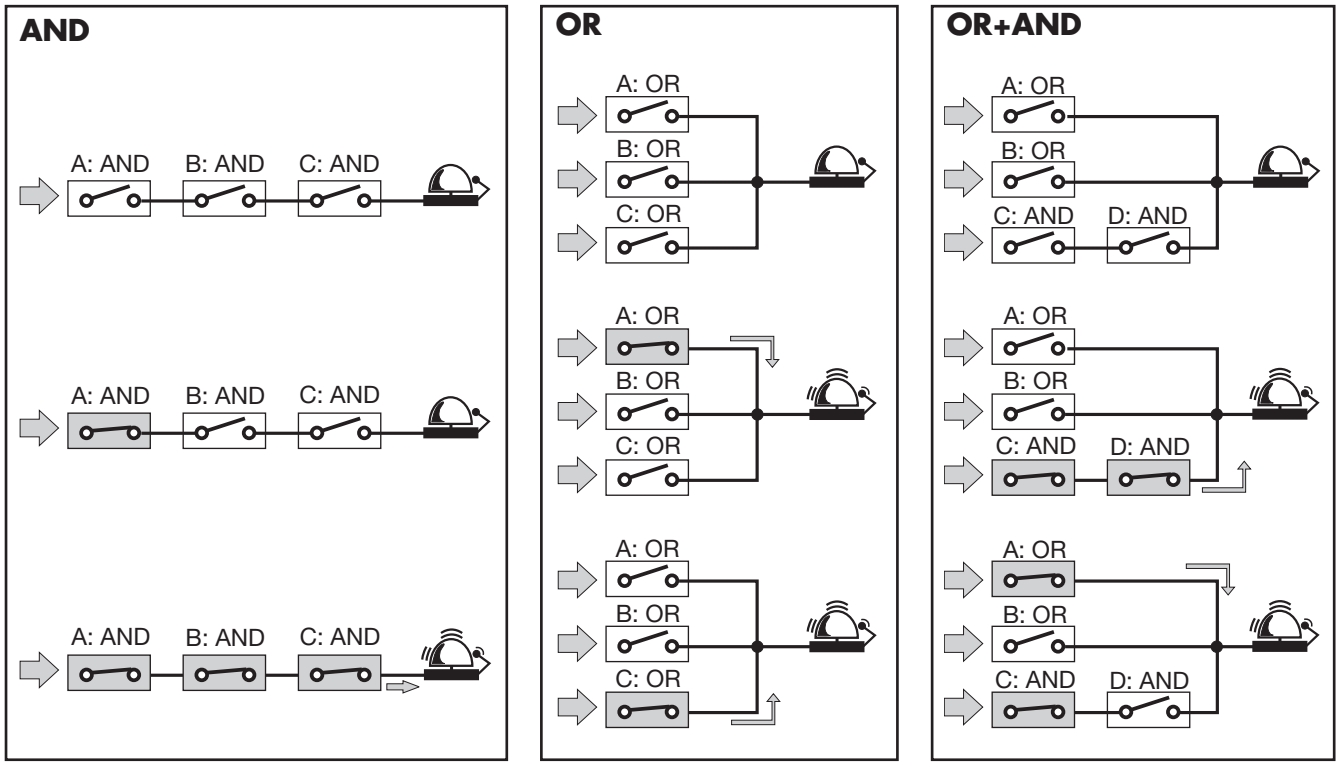
Down alarm
SET 2 < SET 1

In windows alarm
In alarm between
SET 1 and SET 2

Out windows alarm with
start up deactivation
In alarm over SET 1 and
below SET 2

Note: any alarm working mode can be linked to the “Activation” function which disables only the first alarm at the power on of the instrument. All the alarms can be used with the latch function.

AND/OR logical alarm examples:



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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.

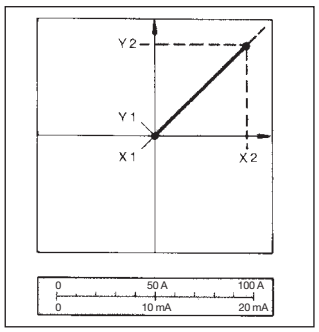


Figure B
The sign of measured quantity and output quantity changes simultaneously. The output quantity is proportional to the measured quantity.

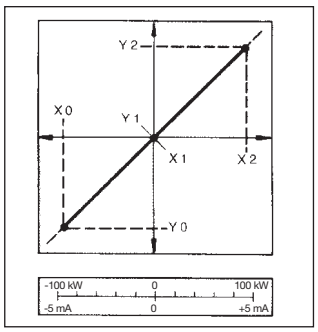


Figure C
The sign of measured quantity and output quantity remains the same. On the range X0...X1, the output quantity is zero. The range X1...X2 is delineated on the entire output range Y0 = Y1...Y2 and thus presented in strongly expanded form.

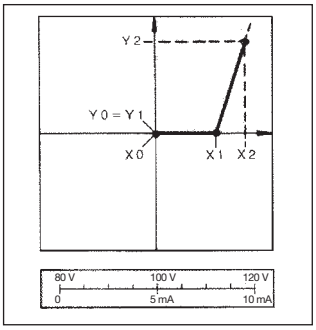


Figure D
The sign of measured quantity and output quantity remains the same. With the measured quantity being zero, the output quantity already has the value Y1 = 0.2 Y2.
Live zero output.

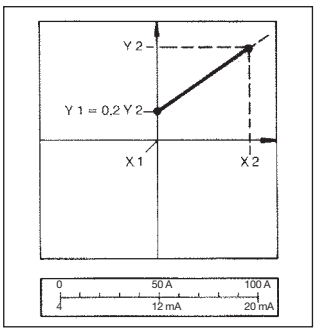


Figure E
The sign of the measured quantity changes but the one of the output quantity remains the same. The output quantity steadily increases from value X1 to value X2 of the measured quantity.

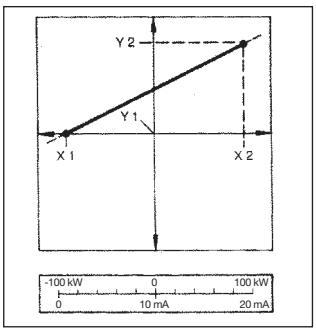
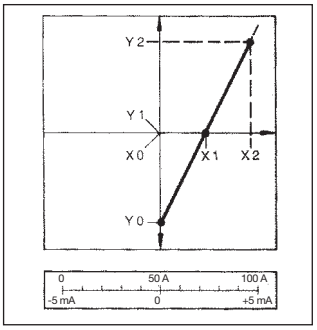


Figure F
The sign of the measured quantity remains the same, the one of the output quantity changes as the measured quantity leaves range X0...X1 and passes to range X1...X2 and vice versa.



Insulation between inputs and outputs

	Meas. /digital inputs	Relay output	Open collector output	Analogue out. 10V, 20mA	Analogue out. ±5mA	AR1034	AR2040	AR1039	Power Supply 90-260VAC/DC	Power Supply 18-60VAC/DC
Meas. /digital inputs	-	4kV	4kV	2kV	2kV	4kV	2kV	4kV	4kV	4kV
Relay output	4kV	4kV (*)	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV
Open coll.out.	4kV	4kV	4kV (*)	4kV	4kV	4kV	4kV	4kV	4kV	4kV
Analogue out. 10V, 20mA	2kV	4kV	4kV	4kV (*)	4kV	4kV	4kV	4kV	4kV	4kV
Analogue out. ±5mA	2kV	4kV	4kV	4kV	200V (**)	4kV	4kV	4kV	4kV	4kV
AR1034	4kV	4kV	4kV	4kV	4kV	-	-	4kV	4kV	4kV
AR2040	2kV	4kV	4kV	4kV	4kV	-	-	4kV	4kV	4kV
AR1039	4kV	4kV	4kV	4kV	4kV	4kV	4kV	-	4kV	4kV
90-260VAC/DC	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	-	-
18-60VAC/DC	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	-	-

NOTE: In case of fault of first insulation the current from the measuring inputs to the ground is lower than 2 mA.
(*) The given insulation is granted among outputs plugged in different slots. The modules equipped with two or four outputs have therefore non insulation among the outputs. **(**)** Insulation between the 2 outputs of the same module is 200V for 1 min.

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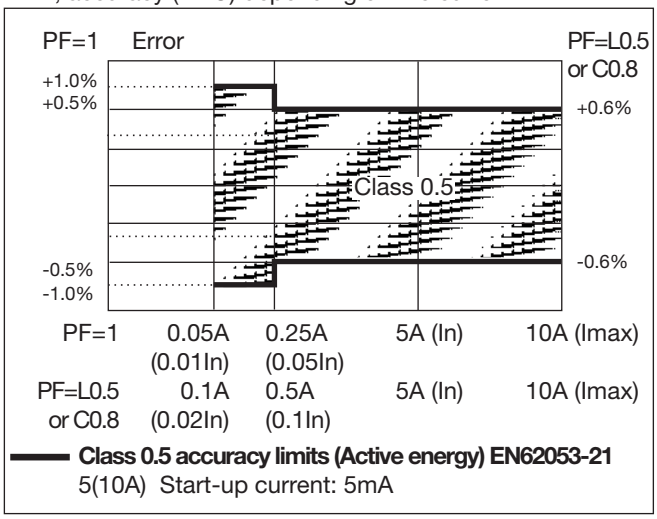
Digital outputs important note

Code	Description	Slot A				Slot B				Slot C				Slot D			
AO1058	1 relay output	A0				B0				C0				D0			
AO1059	1 open coll. output	A0				B0				C0				D0			
AO1035	2 relay outputs	A0	A1			B0	B1			C0	C1			D0	D1		
AO1036	2 open coll. outputs	A0	A1			B0	B1			C0	C1			D0	D1		
AO1037	4 open coll. outputs	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4

The grey-marked digital outputs are activated for a while during the instrument start-up, therefore they are not suggested for pulse output purpose.

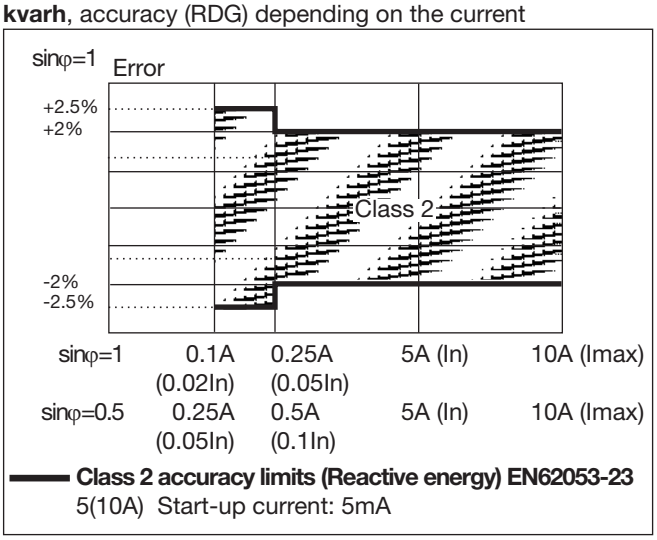
Accuracy

kWh, accuracy (RDG) depending on the current



Class 0.5 accuracy limits (Active energy) EN62053-21
5(10A) Start-up current: 5mA

kvarh, accuracy (RDG) depending on the current



Class 2 accuracy limits (Reactive energy) EN62053-23
5(10A) Start-up current: 5mA

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

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

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

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

Voltage asymmetry

$$ASY_{LL} = \frac{(V_{LL\max} - V_{LL\min})}{V_{LL\,\Sigma}}$$

$$ASY_{LN} = \frac{(V_{LN\max} - V_{LN\min})}{V_{LN\,\Sigma}}$$

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 (TPF)

$$\cos\phi_\Sigma = \frac{W_\Sigma}{VA_\Sigma}$$

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;
$\mathbf{t_1}$, $\mathbf{t_2}$ =starting and ending time points of consumption recording; **n**= time unit; **t**= time interval between two successive power measurements;
$\mathbf{n_1}$, $\mathbf{n_2}$ = starting and ending discrete time points of power recording

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List of the variables that can be connected to:

Analogue outputs (all variables with the only exception of energies), alarm outputs (all variables with the only exception of energies), pulse outputs (only energies), communication (all variables).

No	Variable	1-phase system	2-ph. 3-wire system	3-ph. 4-wire bal. (1 CT)	3-ph. 3-wire unbal. sys.	3-ph. 4-wire unbal. sys.	Notes
1	V L1	x	x	x	o	x	
2	V L2	o	x	x	o	x	
3	V L3	o	o	x	o	x	
4	V L-N sys	o	x	x	o	x	Sys = system = Σ
5	V L1-2	o	x	x	x	x	
6	V L2-3	o	o	x	x	x	
7	V L3-1	o	o	x	x	x	
8	V L-L sys	o	o	x	x	x	Sys = system = Σ
9	A L1	x	x	x	x	x	
10	A L2	o	x	x	x	x	
11	A L3	o	o	x	x	x	
12	An	o	x	x	o	x	An=neutral current
13	W L1	x	x	x	x	x	
14	W L2	o	x	x	x	x	
15	W L3	o	o	x	x	x	
16	W sys	o	x	x	x	x	
17	var L1	x	x	x	x	x	
18	var L2	o	x	x	x	x	
19	var L3	o	o	x	x	x	
20	var sys	o	x	x	x	x	Sys = system = Σ
21	VA L1	x	x	x	x	x	
22	VA L2	o	x	x	x	x	
23	VA L3	o	o	x	x	x	
24	VA sys	o	x	x	x	x	Sys = system = Σ
25	PF L1	x	x	x	x	x	
26	PF L2	o	x	x	x	x	
27	PF L3	o	o	x	x	x	
28	PF sys	o	x	x	x	x	Sys = system = Σ
29	Hz	x	x	x	x	x	
30	ASY VL-N	o	x	x	o	x	Asymmetry of phase-neutral
31	ASY VL-L	o	o	x	x	x	Asymmetry of phase-phase
32	THD V1	x	x	x	o	x	
33	THD V2	o	x	x	o	x	
34	THD V3	o	o	x	o	x	
35	THD V1-2	o	x	x	x	x	
36	THD V2-3	o	o	x	x	x	
37	THD V3-1	o	o	x	x	x	
38	THD A1	x	x	x	x	x	
39	THD A2	o	x	x	x	x	
40	THD A3	o	o	x	x	x	
41	THDo V1	x	x	x	o	x	
42	THDo V2	o	x	x	o	x	
43	THDo V3	o	o	x	o	x	
44	THDo V1-2	o	x	x	x	x	
45	THDo V2-3	o	o	x	x	x	
46	THDo V3-1	o	o	x	x	x	
47	THDo A1	x	x	x	x	x	
48	THDo A2	o	x	x	x	x	
49	THDo A3	o	o	x	x	x	
50	THDe V1	x	x	x	o	x	
51	THDe V2	o	x	x	o	x	
52	THDe V3	o	o	x	o	x	
53	THDe V1-2	o	x	x	x	x	
54	THDe V2-3	o	o	x	x	x	
55	THDe V3-1	o	o	x	x	x	
56	THDe A1	x	x	x	x	x	
57	THDe A2	o	x	x	x	x	
58	THDe A3	o	o	x	x	x	
59	Phase seq.	o	o	x	x	x	Phase sequence

(x) = available (o) = not available

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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	See note	kWh + kvarh meters + W% bargraph
1	V L1	V L2	V L3	V L-N sys	instant.-min-max-dmd-max dmd
2	V L1-2	V L2-3	V L3-1	V L-L sys	instant.-min-max-dmd-max dmd
3	A L1	A L2	A L3	An	instant.-min-max-dmd-max dmd
4	W L1	W L2	W L3	W sys	instant.-min-max-dmd-max dmd
5	var L1	var L2	var L3	var sys	instant.-min-max-dmd-max dmd
6	VA L1	VA L2	VA L3	VA sys	instant.-min-max-dmd-max dmd
7	PF L1	PF L2	PF L3	PF sys	instant.-min-max-dmd-max dmd
8	V L1	A L1	PF L1	W L1	instant.-min-max-dmd-max dmd
9	V L2	A L2	PF L2	W L2	instant.-min-max-dmd-max dmd
10	V L3	A L3	PF L3	W L3	instant.-min-max-dmd-max dmd
11	V L-L sys	ASY V L-L	Hz	An	instant.-min-max-dmd-max dmd
12	V L-N sys	ASY V L-N	Hz	An	instant.-min-max-dmd-max dmd
13	W sys	var sys	PF sys	VA sys	instant.-min-max-dmd-max dmd
14	THD VL1 tot	THD VL2 tot	THD VL3 tot		instant.-min-max-dmd-max dmd
15	THD VL1 odd	THD VL2 odd	THD VL3 odd		instant.-min-max-dmd-max dmd
16	THD VL1 even	THD VL2 even	THD VL3 even		instant.-min-max-dmd-max dmd
17	THD VL1-2 tot	THD VL2-3 tot	THD VL3-1 tot		instant.-min-max-dmd-max dmd
18	THD VL1-2 odd	THD VL2-3 odd	THD VL3-1 odd		instant.-min-max-dmd-max dmd
19	THD VL1-2 even	THD VL2-3 even	THD VL3-1 even		instant.-min-max-dmd-max dmd
20	THD AL1 tot	THD AL2 tot	THD AL3 tot		instant.-min-max-dmd-max dmd
21	THD AL1 odd	THD AL2 odd	THD AL3 odd		instant.-min-max-dmd-max dmd
22	THD AL1 even	THD AL2 even	THD AL3 even		instant.-min-max-dmd-max dmd
23	Histogram FFT V1 (THD, THDo, THDe, Single harmonic)				
24	Histogram FFT V2 (THD, THDo, THDe, Single harmonic)				
25	Histogram FFT V3 (THD, THDo, THDe, Single harmonic)				
26	Histogram FFT V1-2 (THD, THDo, THDe, Single harmonic)				
27	Histogram FFT V2-3 (THD, THDo, THDe, Single harmonic)				
28	Histogram FFT V3-1 (THD, THDo, THDe, Single harmonic)				
29	Histogram FFT A1 (THD, THDo, THDe, Single harmonic)				
30	Histogram FFT A2 (THD, THDo, THDe, Single harmonic)				
31	Histogram FFT A3 (THD, THDo, THDe, Single harmonic)				
32	Digital input status				
33	Digital output status				
34	Energy meters				
35	Events				
36	Alarms status				
37	Info				
38	Info				
39	Info				

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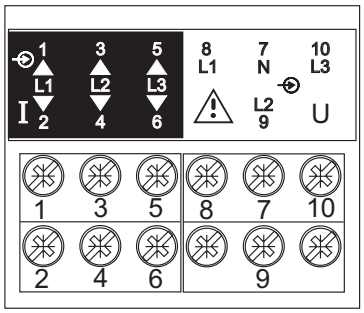
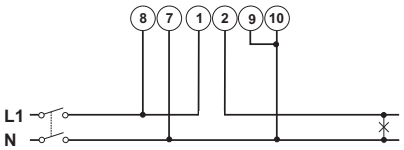
Wiring diagrams



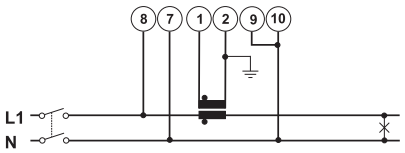
1-phase, 2-wire input connections (1P)

Fig. 1



Direct connection

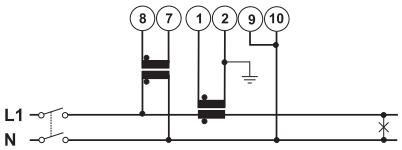
Fig. 2



CT connection

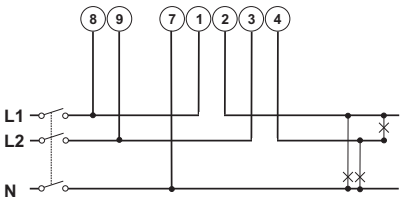
2-phase, 3-wire input connections (2P)

Fig. 3



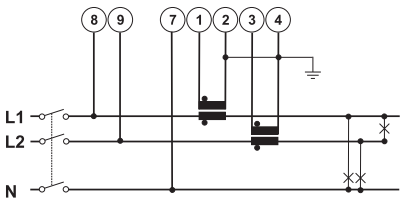
CT and VT connections

Fig. 4



Direct connection

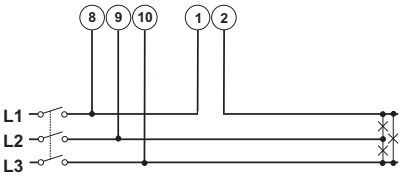
Fig. 5



CT connection

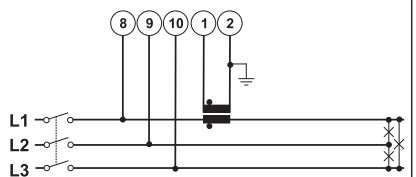
3-phase, 3 and 4-wire input connections - Balanced load (3P)

Fig. 6



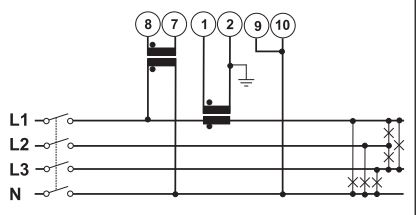
Direct connection (3-wire system)

Fig. 7



CT connection (3-wire system)

Fig. 8



CT and VT connections (4-wire system)

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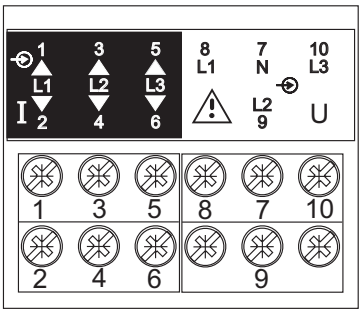
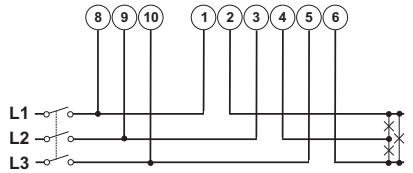
Wiring diagrams (cont.)



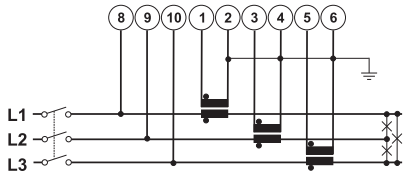
3-phase, 3-wire input connections - Unbalanced load (3P)

Fig. 9



Direct connection (3-wire system)

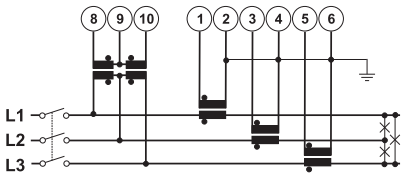
Fig. 10



CT connection (3-wire system)

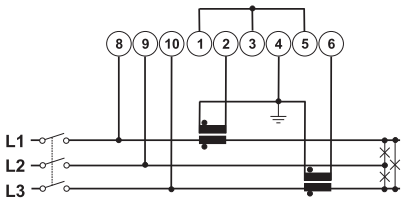
3-phase, 3-wire input connections ARON (3P)

Fig. 11



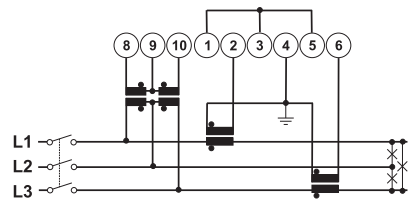
CT and VT connections (3-wire system)

Fig. 12



ARON connection (3-wire system)

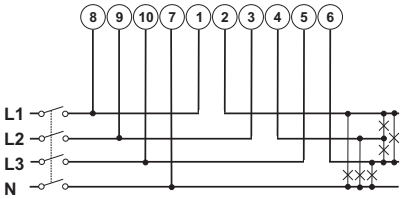
Fig. 13



ARON and VT connections (3-wire system)

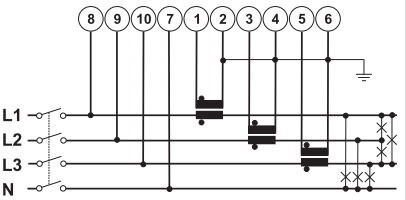
3-phase, 4 wires input connections - Unbalanced load (3p+N)

Fig. 14



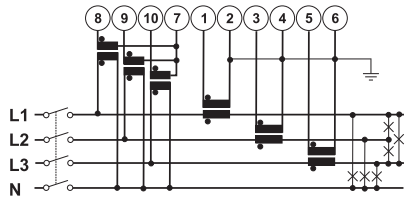
Direct connection (4-wire system)

Fig. 15



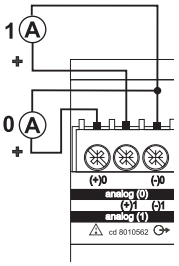
CT connection (4-wire system)

Fig. 16

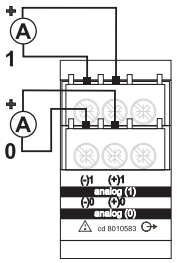


CT and VT connections (4-wire system)

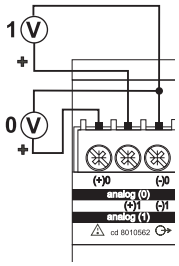
Wiring diagrams (optional modules)



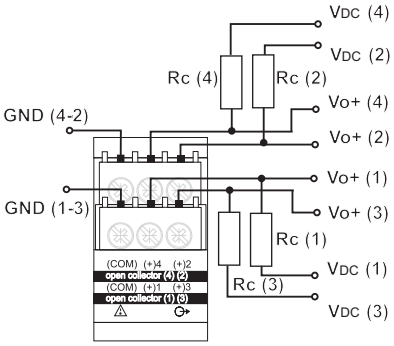
AO2050
2 analogue outputs (0-20mA)



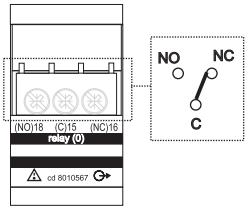
AO2052
2 analogue outputs (+/-5mA)



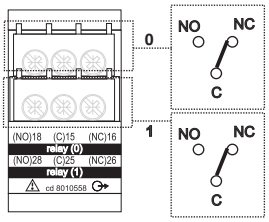
AO1051
2 analogue outputs (10V)



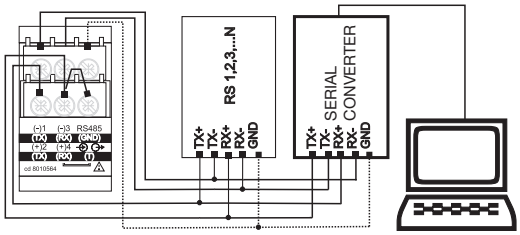
AO1037 4-open collector output connection:
This wiring diagram is valid also for the open collector module with one or two outputs.
The load resistances (RC) must be designed so that the close contact current is lower than 100mA; the VDC voltage must be lower than or equal to 30VDC.



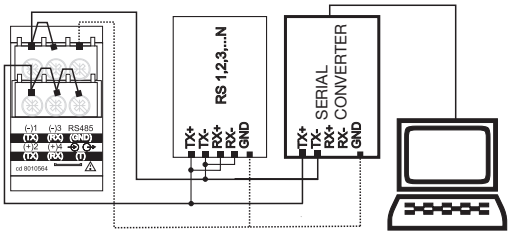
AO1058
1 relay output



AO1035
2 relay outputs



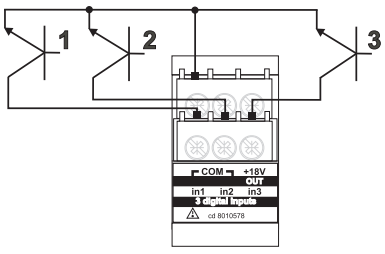
AR1034/AR2040
4-wire connection of RS485 serial port



AR1034/AR2040
2-wire connection of RS485 serial port

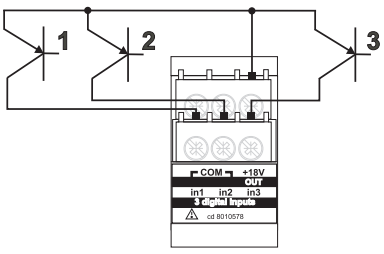
RS422/485 NOTE: additional devices provided with RS422/485 (that is RS 1, 2, 3...N) are connected in parallel. The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (RX+) and (T).

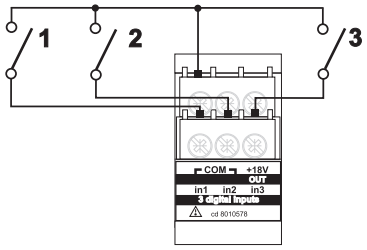
Wiring diagrams: digital input modules



AQ1042
Connection by means of NPN transistors.

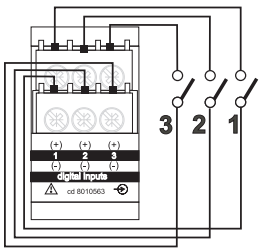
AQ1042
Connection by means of PNP transistors.



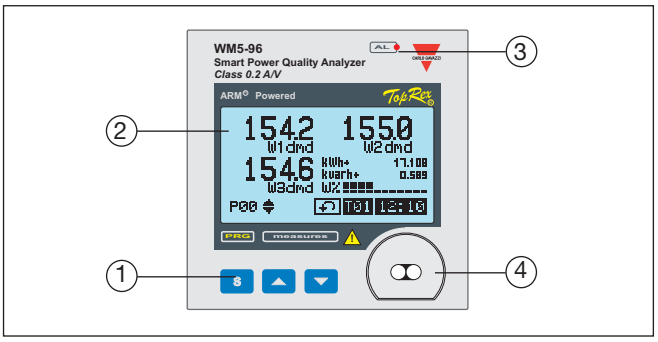


AQ1042
Connection by means of contacts.

AQ1038
Connection by means of contacts.

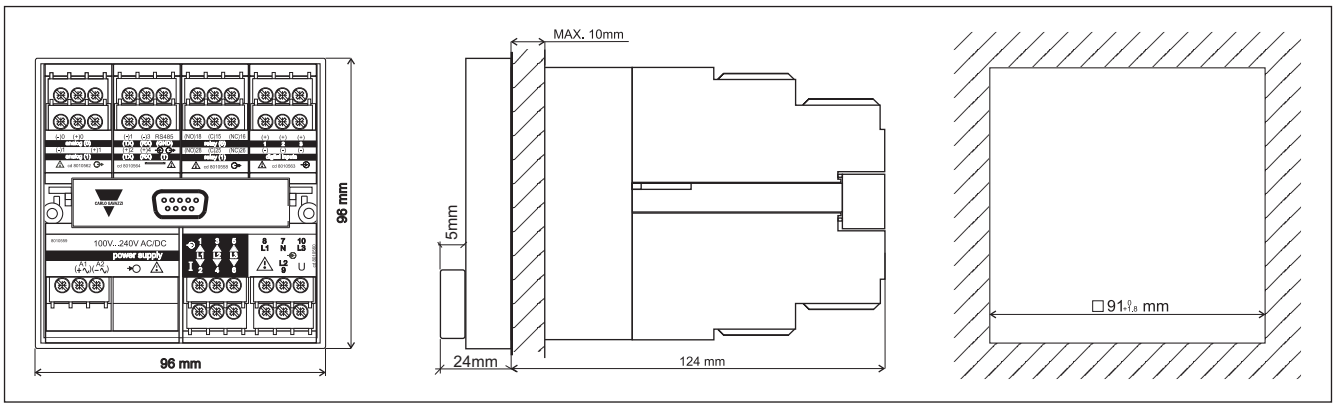


Front panel description



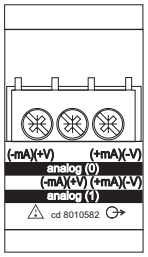
1. **Key-pad**
   Set-up, programming and display parameters are easily controlled by the 3 push-buttons.
   - S to enter programming and to confirm password.
   - ▲ and ▲
   - to program values
   - to select functions
   - to scroll display pages
2. **Display**
   Instantaneous measurements:
   - 4 digits (max display 9999)
   Energies:
   - 9 digits (max display 999 999 999).
   Alphanumeric indications by means of LCD display for:
   - Display of configuration parameters
   - All measuring variables.
3. **LED**
   Alarm LED.
4. **Optical Port**
   For data reading and programming (or pulse output).

Dimensions

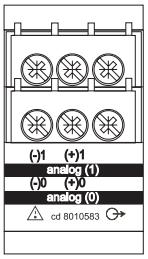


Modules

Dual analogue output modules

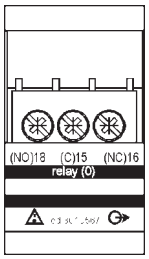


AO2050 (20mADC)
AO2051 (10VDC)

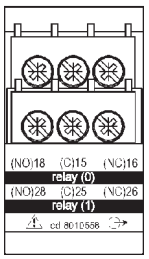


AO2052 (+/-5mADC)

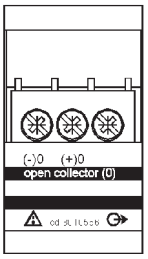
Digital output modules



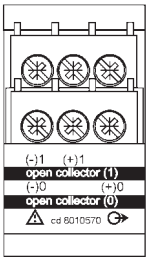
AO1058
Single relay output



AO1035
Dual relay output

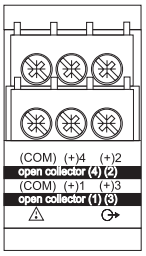


AO1059
Single open collector output

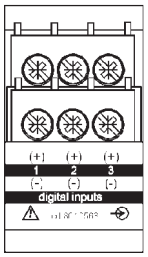


AO1036
Dual open collector output

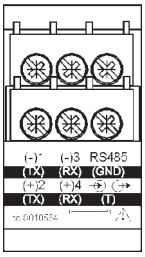
Other input/output modules



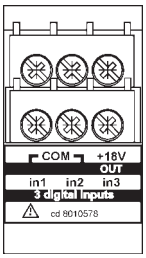
AO1037
4 open collector outputs



AQ1038
3 digital inputs

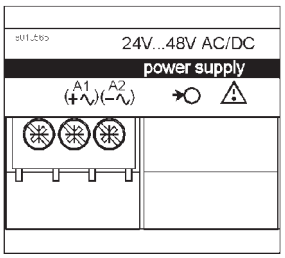


AR1034
AR2040
RS485 port

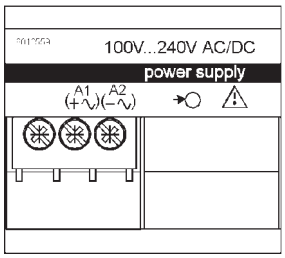


AQ1042
3 digital inputs + aux

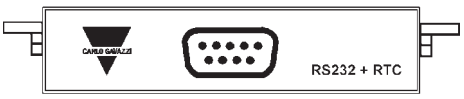
Power supply modules



AP1021
18-60VAC/DC power supply

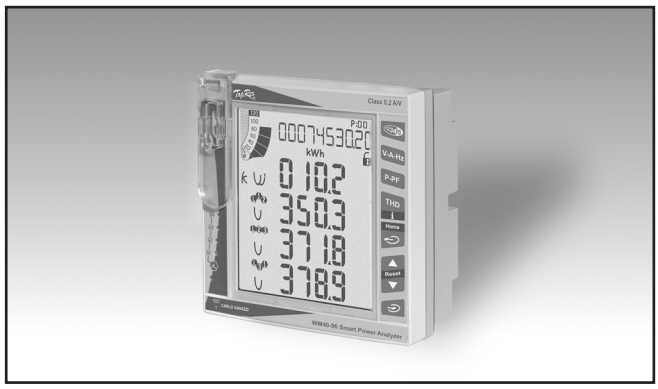


AP1020
90-260 VAC/DC power supply



AR1039
RS232 port + RTC

Energy Management
Smart Modular Power Analyzer
Type WM40 96



- Optical front communication port (ANSI type 2)
- Up to one RS232 and RS485 port (on request)
- Communication protocol: MODBUS-RTU
- MODBUS TCP/IP Ethernet port (on request)
- BACnet-IP over Ethernet port (on request)
- BACnet MS/TP over RS485, BTL approved (on request)
- Profibus DP V0 port, PROFIBUS Nutzerorganisation e.V. approved (on request)
- Up to 6 digital inputs for tariff selection, “dmd” synch, gas/water (hot-cold) and remote heating metering (on request)
- Up to 8 static outputs (pulse, alarm, remote control) (on request)
- Up to 6 relay outputs (pulse, alarm, remote control) (on request)
- Up to 16 freely configurable alarms with OR/AND logic linkable with up to either 4 relay outputs or up to 6 static outputs (on request)
- Up to 4 analogue outputs (+20mA, +10VDC) (on request)
- Class 0.5S (kWh) according to EN62053-22
- Class 2 (kvarh) according to EN62053-23
- Accuracy ±0.2% RDG (current/voltage)
- Instantaneous variables readout: 4x4 DGT
- Energies readout: 9+1 DGT
- System variables: VLL, VLN, A, VA, W, var, PF, Hz, phase-sequence, phase-asymmetry and phaseloss.
- Single phase variables: VLL, VLN, AL, An (calculated or real depending on the option), VA, W, var, PF
- Both system and singles phase variables with average, max and min calculation
- Direct neutral current measurement (on request)
- Harmonic analysis (FFT) up to the 32nd harmonic (current and voltage) with harmonics source detection (imported/exported, only via serial port)
- Energy measurements (imported/exported): total and partial kWh and kvarh (inductive and capacitive) or based on 6 different tariffs (on request)
- Energy measurements according to ANSI C12.20, CA 0.5, ANSI C12.1
- Gas, cold water, hot water, remote heating measurements (on request)
- Run hours counter (8+2 DGT)
- Real time clock function
- Data stamping of up to 10,000 events: alarm, min, max, digital input status, digital output status, resets, programming changing (on request)
- Application adaptable display and programming procedure (Easyprog function)
- Universal power supply: 24-48 VDC/AC, 100-240 VDC/AC
- Front dimensions: 96x96 mm
- Front protection degree: IP65, NEMA4x, NEMA12

Product Description

Three-phase smart power analyzer with built-in application configuration system and LCD data displaying. Particularly recommended for the measurement of the main electrical variables.
WM40 is based on a modular housing for panel mounting with IP65 (front) protection degree. Moreover the analyzer can be provided with digital outputs that can be either for pulse proportional to the active and reactive total, partial and tariff energy being measured or/and for alarm outputs.
The instrument is equipped with optical communication port, further I/O’s such as: RS485/RS232, Ethernet, BACnet-IP, BACnet MS/TP or Profibus DP V0 communication ports, pulse and alarm outputs and 6 digital inputs or analogue outputs are available on request. Parameters programming and data reading can be easily performed by means of UCS (Universal Configuration Software).

CARLO GAVAZZI

How to order

WM40-96 AV5 3 H R4 CT S1 XX

- **Model**
- **Range code**
- **System**
- **Power Supply**
- **A Inputs/Outputs**
- **B Inputs/Outputs**
- **Communication and data stamping**
- **Option**

Type Selection

Range codes

AV4: 3x220 (380)... 3x400(690)V 1(2)A
V_{LN}: 220 to 400
V_{LL}: 380 to 690

AV5: 3x220(380)... 3x400(690)V 5(6)A
V_{LN}: 220 to 400
V_{LL}: 380 to 690

AV6: 3x57.7(100)... 3x133(230)V 5(6)A
V_{LN}: 57.7 to 133
V_{LL}: 100 to 230

AV7: 3x57.7(100)... 3x133(230)V 1(2)A
V_{LN}: 57.7 to 133
V_{LL}: 100 to 230

B Inputs/Outputs

XX: none
A2: Dual channel 20mADC output
V2: Dual channel 10VDC output
TP: One temperature and one process signal input
CT: Direct neutral current measurement + One temperature and one process signal input

System

3: balanced and unbalanced load: 3-phase, 4-wire; 3-phase, 3-wire; 2-phase, 3-wire; 1-phase, 2-wire

Communication and data S.

XX: none
S1: RS485/RS232 port
S3: RS485/RS232 port with data stamping
E2: Ethernet / Internet port
E3: Ethernet / Internet port with data stamping
B1: BACnet (IP) over Ethernet
B2: BACnet (IP) over Ethernet with data stamping
B3: BACnet (MS/TP) over RS485
B4: BACnet (MS/TP) over RS485 with data stamping
P1: Profibus DP/V0 port
P2: Profibus DP/V0 port with data stamping

Power supply

H: 100-240 +/-10% (90 to 255) VDC/AC (50/60 Hz)
L: 24-48 +/-15% (20 to 55) VDC/AC (50/60 Hz)

Options

XX: none

A Inputs/Outputs

XX: none
R2: Dual channel relay output
O2: Dual channel static output
A2: Dual channel 20mADC output
V2: Dual channel 10VDC output
R4: Advanced six channel digital inputs + four channel relay outputs + OR/AND alarm logic management
O6: Advanced six channel digital inputs + six channel static outputs + OR/AND alarm logic management

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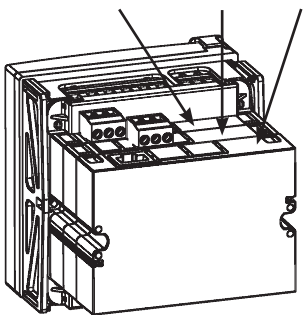
Position of modules and combination

Ref	Description	Main features	Part number	Pos. A	Pos. B	Pos. C
1	WM40 base provided with display, power supply, measuring inputs, optical front communication port.	• Inputs/system: AV5.3 • Power supply: H	WM40 AV5 3 H			
2		• Inputs/system: AV6.3 • Power supply: H	WM40 AV6 3 H			
3		• Inputs/system: AV4.3 • Power supply: H	WM40 AV4 3 H			
4		• Inputs/system: AV7.3 • Power supply: H	WM40 AV7 3 H			
5		• Inputs/system: AV5.3 • Power supply: L	WM40 AV5 3 L			
6		• Inputs/system: AV6.3 • Power supply: L	WM40 AV6 3 L			
7		• Inputs/system: AV4.3 • Power supply: L	WM40 AV4 3 L			
8		• Inputs/system: AV7.3 • Power supply: L	WM40 AV7 3 L			
9	Dual relay output (SPST)	• 2-channel • Alarm or/and pulse output	M O R2	X		
10	Dual static output (AC/DC Opto-Mos)	• 2-channel • Alarm or/and pulse output	M O O2	X		
11	Dual analogue output (+20mADC)	• 2-channel	M O A2	X	X	
12	Dual analogue output (+10VDC)	• 2-channel	M O V2	X	X	
13	RS485 / RS232 port module	• Max. 115.2 Kbps	M C 485 232			X
14	Ethernet/TCP IP port module	• RJ45 10/100 BaseT	M C ETH			X
15	BACnet-IP port module	• Based on Ethernet bus	M C BAC IP			X
16	BACnet MS/TP port module	• Over RS485	M C BAC MS			X
17	BACnet MS/TP port module	• Over RS485 • Data Stamping	M C BAC MS M			X
18	Combined digital inputs and Relay outputs (SPST)	• 6-input channels • 4-output channels • Complex tariff management • OR/AND logic management	M F I6 R4		X	
19	Combined digital inputs and Static outputs (AC/DC Opto-Mos)	• 6-input channels • 6-output channels • Complex tariff management. • OR/AND logic management	M F I6 O6		X	
20	RS485 / RS232 port module with integrated Memory	• Max. 115.2 Kbps • Data stamping	M C 485 232 M			X
21	Ethernet port module with integrated Memory	• RJ45 10/100 BaseT • Data Stamping	M C ETH M			X
22	BACnet over IP port module with integrated Memory	• Based on Ethernet bus • Data Stamping	M C BAC IP M			X
23	Temperature + Process signal measurements (°C/°F)	• “Pt” type input • 20mA input	M A T P		X	
24	Direct neutral current measurement + Temperature + Process signal measurements (°C/°F)	• As above + signal input like a common current input (CT ratio etc.)	M A T P N		X	
25	Profibus module	• Profibus DP V0 • Over RS485	M C P B			X
26	Profibus module with integrated memory	• Profibus DP V0 • Over RS485 • Data stamping	M C P B M			X

NOTE: The position of the modules shall respect the sequence A-B-C. Possible arrangements are M, M-A, M-B, M-C, M-A-B, M-A-C, M-B-C and M-A-B-C where “M” is the basic module (WM40-96).

It is possible to use the WM40-96 without any additional module as a simple indicator.



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Input specifications

Rated inputs	System type: 1, 2 or 3-phase
Current type	Galvanic insulation by means of built-in CT's
Current range (by CT)	AV5 and AV6: 5(6)A AV4 and AV7: 1(2)A
Voltage (by direct connection or VT/PT)	AV4, AV5: 3x220 (380)... 3x400 (690) V; AV6, AV7: 3x57.7 (100) ... 3x133(230) V
Accuracy (Display + RS485) (@23°C ±2°C, R.H. ≤60%)	0.01In=0.05A (AV5, AV6 - kWh, PF=1) 0.01In=0.01A (AV4, AV7 - kWh, PF=1) 0.05In=0.25A (AV5, AV6 - kWh, PF=1) 0.05In=0.05A (AV4, AV7 - kWh, PF=1) In: see below, Un: see below
AV4 model	In: 1A, Imax: 2A; Un: 220 to 400VLN (380 to 690VLL)
AV5 model	In: 5A, Imax: 6A; Un: 220 to 400VLN (380 to 690VLL)
AV6 model	In: 5A, Imax: 6A; Un: 57.7 to 133VLN (100 to 230VLL)
AV7 model	In: 1A, Imax: 2A; Un: 57.7 to 133VLN (100 to 230VLL)
Current AV4, AV5, AV6, AV7 models	From 0.01In to 0.05In: ±(0.5% RDG +2DGT) From 0.05In to Imax: ±(0.2% RDG +2DGT)
Phase-neutral voltage	In the range Un: ±(0,2% RDG +1DGT)
Phase-phase voltage	In the range Un: ±(0.5% RDG +1DGT)
Voltage tolerance	Un -20%, Un +15%
Frequency	From 40 to 65 Hz ±(0.02% RDG + 1 DGT), From 65 to 340 Hz ±(0.05% RDG + 1 DGT). From 340 to 440 Hz ±(0.1% RDG + 1 DGT)
Active and Apparent power	From 0.01In to 0.05In, PF 1: ±(1%RDG+1DGT) From 0.05In to Imax PF 0.5L, PF1, PF0.8C: ±(0.5%RDG+1DGT)
Power Factor	±[0.001+0.5% (1.000 - "PF RDG")]
Reactive power	From 0.02In to 0.05In, senφ 1: ±(1.5%RDG+1DGT) From 0.05In to Imax, senφ 1: ±(1%RDG+1DGT) From 0.05In to 0.1In, senφ 0.5L/C: ±(1.5%RDG+1DGT) From 0.1In to Imax, senφ 0.5L/C: ±(1%RDG+1DGT)
Active energy	Class 0.5S according to EN62053-22, ANSI C12.20.
Reactive energy	Class 2 according to EN62053-23, ANSI C12.1.
Start up current AV5, AV6	5mA
Start up current AV4, AV7	1mA
Energy additional errors	According to EN62053-22, ANSI C12.20,
Influence quantities	according to EN62053-23, ANSI C12.1
Total Harmonic Distortion (THD)	±1% FS (FS: 100%) AV4: Imin: 5mARMS; Imax: 3A; Umin: 30VRMS; Umax: 679Vp AV5: Imin: 5mARMS; Imax: 15Ap; Umin: 30VRMS; Umax: 679Vp AV6: Imin: 5mARMS; Imax: 15Ap; Umin: 30VRMS; Umax: 204Vp AV7: Imin: 5mARMS; Imax: 3A; Umin: 30VRMS; Umax: 204Vp
Total Demand Distortion (TDD)	±1% FS (FS: 100%) Imin: 5mA RMS; Imax: 15Ap
K-Factor and factor K	±(0.5%RDG+1DGT)
Temperature drift	≤200ppm/°C
Sampling rate	3200 samples/s @ 50Hz, 3840 samples/s @ 60Hz
Measurements	See "List of the variables that can be connected to:"
Method	TRMS measurements of distorted wave forms.
Coupling type	By means of CT's
Crest factor	AV5, AV6: ≤3 (15A max. peak) AV4, AV7: ≤3 (3A max. peak)

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Input specifications (cont.)

Current Overloads	
Continuous (AV5 and AV6)	6A, @ 50Hz/60Hz
Continuous (AV4 and AV7)	2A, @ 50Hz/60Hz
For 500ms (AV5 and AV6)	120A, @ 50Hz/60Hz
For 500ms (AV4 and AV7)	40A, @ 50Hz/60Hz
Voltage Overloads	
Continuous	1.2 Un
For 500ms	2 Un

Input impedance	
400VL-L (AV4 and AV5)	> 1.6MΩ
208VL-L (AV6 and AV7)	> 1.6MΩ
5(6)A (AV5 and AV6)	< 0.2VA
1(2)A (AV4 and AV7)	< 0.2VA
Frequency	40 to 440 Hz

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Output specifications

Relay outputs (M O R2)	
Physical outputs	2 (max. 1 module per instrument)
Purpose	For either alarm output or pulse output
Type	Relay, SPST type AC 1-5A @ 250VAC; AC 15-1A @ 250VAC
Configuration	By means of the front key-pad or UCS software
Function	The outputs can work as alarm outputs but also as pulse outputs, remote controlled outputs, or in any other combination.
Alarms	Up alarm and down alarm and windows alarm (in and out) linked to the virtual alarms, other details see Virtual alarms
Min. response time	≤200ms, filters excluded. Set-point on-time delay: “0 s”.
Pulse	
Signal retransmission	Total: +kWh, -kWh, +kvarh, -kvarh. Partial: +kWh, -kWh, +kvarh, -kvarh.
Pulse type	Programmable from 0.001 to 10.00 kWh/kvarh per pulse. The above listed variables can be connected to any output.
Pulse duration	30 ms (ON), ≥ 30ms (OFF), according to EN62053-31
Remote controlled outputs	The activation of the outputs is managed through the serial communication port
Insulation	See “Insulation between inputs and outputs” table
Static outputs (M O O2)	Opto-Mos type
Physical outputs	2 (max. 1 module per instrument)
Purpose	For either pulse output or alarm output
Signal	V_{ON}:2.5VAC/DC/max.100mA V_{OFF}: 42VDC max.
Configuration	By means of the front key-pad or UCS software
Function	The outputs can work as alarm outputs but also as pulse outputs, remote controlled outputs, or in any other combination.
Alarms	Up alarm and down alarm linked to the virtual alarms, other details see Virtual alarms
Min. response time	≤200ms, filters excluded. Set-point on-time delay: “0 s”.
Pulse	
Signal retransmission	Total: +kWh, -kWh, +kvarh, -kvarh. Partial: +kWh, -kWh, +kvarh, -kvarh.
Pulse type	Programmable from 0.001 to 10.00 kWh/kvarh per pulse. The above listed variables can be connected to any output.
Pulse duration	30 ms (ON), ≥ 30 ms (OFF), according to EN62053-31
Remote controlled outputs	The activation of the outputs is managed through the serial communication port
Insulation	See “Insulation between inputs and outputs” table
20mA analogue outputs (M O A2)	
Number of outputs	2 per module (max. 2 modules per instrument)
Accuracy (@ 23°C ±2°C)	±0.2%FS
Range	0 to 20mA
Configuration	By means of the front key-pad or UCS software
Signal retransmission	The signal output can be connected to any instantaneous variable available in the table “List of the variables that can be connected to”.
Scaling factor	Programmable within the whole range of retransmission.
Response time	≤400 ms typical (filter excluded)
Ripple	≤1% (according to IEC 60688, EN 60688)
Total temperature drift	≤500 ppm/°C
Load	≤600Ω
Insulation	See “Insulation between inputs and outputs” table
10VDC analogue outputs (M O V2)	
Number of outputs	2 per module (max. 2 modules per instrument)
Accuracy (@ 23°C ±2°C)	±0.2%FS
Range	0 to 10 VDC
Configuration	By means of the front key-pad or UCS software
Signal retransmission	The signal output can be connected to any instantaneous variable available in the table “List of the variables that can be connected to”.
Scaling factor	Programmable within

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Output specifications (cont.)

	the whole range of retransmission.
Response time	≤400 ms typical (filter excluded)
Ripple	≤1% (according to IEC 60688, EN 60688)
Total temperature drift	≤350 ppm/°C
Load	≥10kΩ
Insulation	See “Insulation between inputs and outputs” table
RS485 serial port (M C 485 232 on request)	
RS485	
Type	Multidrop, bidirectional (static and dynamic variables)
Connections	2-wire Max. distance 1000m, termination directly on the module
Addresses	247, selectable by means of the front key-pad
Protocol	MODBUS/JBUS (RTU)
Data (bidirectional)	
Dynamic (reading only)	System and phase variables: see table “List of variables...”
Static (reading and writing only)	All the configuration parameters.
Data format	1 start bit, 8 data bit, no/ even/odd parity,1 stop bit
Baud-rate	Selectable: 9.6k, 19.2k, 38.4k, 115.2k bit/s
Driver input capability	1/5 unit load. Maximum 160 transceivers on the same bus.
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed. In this case just the data reading is allowed.
Insulation	See “Insulation between inputs and outputs” table
RS232 port (on request)	
Type	Bidirectional (static and dynamic variables)
Connections	3 wires. Max. distance 15m
Protocol	MODBUS RTU /JBUS
Data (bidirectional)	
Dynamic (reading only)	System and phase variables: see table “List of variables...”
Static (reading and writing only)	All the configuration parameters
Data format	1 start bit, 8 data bit, no/ even/odd parity,1 stop bit
Baud-rate	Selectable: 9.6k, 19.2k, 38.4k, 115.2k bit/s
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed. In this case just the data reading is allowed.
Insulation	See “Insulation between inputs and outputs” table
Module with data stamping and event recording memory	
(M C 485 232 M)	
Event stamping	
Type of data	Alarm, min, max, digital input status, digital output status as remote control, resets.
Stamping format	Date (dd:MM:yy) and hour (hh:mm:ss) reference.
Number of events	Up to 10,000
Data management type	FIFO
Data stamping	
Type of data	Any measured variable can be stored in the memory.
Stamping format	Date (dd:MM:yy) and hour (hh:mm:ss) reference.
Number of variables	Up to 19 different type of variables can be stored.
Time interval	From 1 minute up to 60 minutes.
Data management type	FIFO
Memory type	Data flash
Ethernet/Internet port (M C ETH on request)	
Protocols	Modbus TCP/IP
IP configuration	Static IP / Netmask / Default gateway
Port	Selectable (default 502)
Client connections	Max 5 simultaneously
Connections	RJ45 10/100 BaseTX Max. distance 100m
Data (bidirectional)	
Dynamic (reading only)	System and phase variables: see table “List of variables...”
Static (reading and writing only)	All the configuration parameters.
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed. In this case just

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Output specifications (cont.)

Insulation	the data reading is allowed. See “Insulation between inputs and outputs” table
Module with data stamping and event recording memory	
(M C ETH M)	
Event stamping	
Type of data	Alarm, min, max, digital input status, digital output status as remote control, resets.
Stamping format	Date (dd:MM:yy) and hour (hh:mm:ss) reference.
Number of events	Up to 10,000
Data management type	FIFO
Data stamping	
Type of data	Any measured variable can be stored in the memory.
Stamping format	Date (dd:MM:yy) and hour (hh:mm:ss) reference.
Number of variables	Up to 19 different type of variables can be stored.
Time interval	From 1 minute up to 60 minutes.
Data management type	FIFO
Memory type	Data flash
BACnet-IP (on request)	
Protocols	BACnet-IP (for measurement reading purpose and to write object description) and Modbus TCP/IP (for measurement reading purpose and for programming parameter purpose)
BACnet-IP	
IP configuration	Static IP / Netmask / Default gateway
Port	Fixed: BAC0h
Device object instance	0 to 9999 selectable by key-pad 0 to 2^22-2 = 4.194.302, selectable by programming software or by BACnet.
Supported services	“I have”, “I am”, “Who has”, “Who is”, “Read (multiple) Property”
Supported objects	Type 2 (analogue value, including COV property), Type 5 (binary-value for up to 16 virtual alarm re-transmission) Type 8 (device)
IP configuration	Static IP / Netmask / Default gateway
Modbus TCP/IP	See “Ethernet/Internet port” above
Client connections	Modbus only: max 5 simultaneously
Connections	RJ45 10/100 BaseTX Max. distance 100m
Data	
Dynamic (reading only)	System and phase variables (BACnet-IP and Modbus): see table “List of variables”
Static (reading and writing only)	All the configuration parameters (Modbus only)
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed anymore. In this case just the data reading is allowed.
Insulation	See “Insulation between inputs and outputs” table
Module with data stamping and event recording memory	
(M C BAC IP M)	
Event stamping	
Type of data	Alarm, min, max, digital input status, digital output status as remote control, resets.
Stamping format	Date (dd:MM:yy) and hour (hh:mm:ss) reference.
Number of events	Up to 10,000
Data management type	FIFO
Data stamping	
Type of data	Any measured variable can be stored in the memory.
Stamping format	Date (dd:MM:yy) and hour (hh:mm:ss) reference.
Number of variables	Up to 19 different type of variables can be stored.
Time interval	From 1 minute up to 60 minutes.
Data management type	FIFO
Memory type	Data flash
BACnet MS/TP (on request)	
Available ports	2: RS485 and Ethernet
RS485 port	
Type	Multidrop, mono-directional (dynamic variables)
Connections	2-wire Max. distance 1000m, termination directly on the module
Device object instance	0 to 9999 selectable by key-pad 0 to 2^22-2 = 4.194.302, selectable by means of programming software or by BACnet.
Protocol	BACnet MS/TP (for measurement reading purpose and to write object description)
Supported services	“I have”, “I am”, “Who has”,

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Output specifications (cont.)

Supported objects	"Who is", "Read (multiple) Property" Type 2 (analogue value, including COV property), Type 5 (binary-value for up to 16 virtual alarm re-transmission) Type 8 (device)
Data (mono-directional)	
Dynamic	System and phase variables: see table "List of variables..."
Static	Not available
Data format	1 start bit, 8 data bit, no parity,1 stop bit
Baud-rate	Selectable: 9.6k, 19.2k, 38.4k kbit/s
Driver input capability	1/5 unit load. Maximum 160 transceivers on the same bus.
MAC addresses	Selectable: 0 to 127
Ethernet port	
Protocol	Modbus TCP/IP (for programming parameter purpose)
IP configuration	Static IP / Netmask / Default gateway
Modbus Port	Selectable (default 502)
Client connections	Modbus only: max 5 simultaneously
Connections	RJ45 10/100 BaseTX Max. distance 100m
Data	
Dynamic (reading only)	System and phase variables: see table "List of variables..."
Static (reading and writing only)	All the configuration parameters (Modbus only).
Bacnet MS/TP + event recording memory	
Event stamping	
Type of data	Alarm, min, max, digital input status, digital output status as remote control, resets.
Stamping format	Date (dd:MM:yy) and hour (hh:mm:ss) reference.
Number of events	Up to 10,000
Data management type	FIFO
Data stamping	
Type of data	Any measured variable can be stored in the memory.
Stamping format	Date (dd:MM:yy) and hour (hh:mm:ss) reference.
Number of variables	Up to 19 different type of variables can be stored.
Time interval	From 1 minute up to 60 minutes.
Data management type	FIFO
Memory type	Data flash
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed. In this case just the data reading is allowed.
Insulation	See "Insulation between inputs and outputs" table
Approval	BTL
Profibus (MCPB)	
Available ports	2: USB and Profibus DP V0
USB	
Purpose	Programmable parameters setting
Connector	USB micro B
Protocol	Modbus RTU
Data format	1 start bit, 8 data bit, no parity,1 stop bit
Baudrate	autorange depending on the master (max 115200 bps)
Address	1
Profibus	
Purpose	Data reading (12 programmable profiles realtime selectable) ; remote output control ; remote tariff control ;
Modules Selectable:	output up to 4 bytes, input up to 62 words
Data format	totalizers : FLOAT or INT32; electrical variables : FLOAT or INT16 ; status variables : UINT16
Connector	RS485 DB9
Protocol	Profibus DP V0 slave
Baudrate	9.6 k to 12 Mbps (9.6, 19.2, 45.45, 93.75, 187.5, or 500 kbps; 1.5, 3, 6, or 12 Mbps)
Address	2-125 (default 126)
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed. In this case just the data reading is allowed.
Insulation	See "Insulation between inputs and outputs" table
Module with data stamping	

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Output specifications (cont.)

and event recording memory (MCPBM)	
Event stamping	
Type of data	Alarm, min, max, digital input status, digital output status as remote control, resets.
Stamping format	Date (dd:MM:yy) and hour (hh:mm:ss) reference.
Number of events	Up to 10,000
Data management type	FIFO
Data stamping	
Type of data	Any measured variable can be stored in the memory.
Stamping format	Date (dd:MM:yy) and hour (hh:mm:ss) reference.
Number of variables	Up to 19 different type of variables can be stored.
Time interval	From 1 minute up to 60 minutes.
Data management type	FIFO
Memory type	Data flash
Approval	PROFIBUS Nutzerorganisation e.V.
Relay Output and Digital Input (M F I6 R4 on request)	
Relay Outputs	
Physical outputs	4 (max. 1 module per instrument)
Purpose	For either pulse output or alarm output
Type	Relay, SPST type
	AC 1-5A @ 250VAC; AC 15-1A @ 250VAC
Configuration	Only by means of the programming software UCS. In this latter case using either the serial communication port or the front optical port.
Function	The outputs can work as advanced alarm outputs and as remote controlled outputs, or in any other combination.
Standard alarm modes	Up alarm, down and window alarm. There is also the possibility to remote the control of the outputs: the activation of the outputs is managed through the serial communication port (in this case the local alarms are disabled).
Advanced alarm modes	“OR” or “AND” or “OR+AND” functions (see “Alarm parameter and logic” page). Freely programmable on up to 16 alarms.
Controlled variables	The alarms can be connected to any variable available in the table “List of the variables that can be connected to”
Set-point adjustment	From 0 to 100% of the display scale
Hysteresis	From 0 to full scale
On-time delay	0 to 255s
Output status	Selectable: normally de-energized or normally energized
Min. response time	≤200ms, filters excluded. Set-point on-time delay: “0 s”.
Digital inputs	
Number of inputs	6 (voltage-free contacts)
Purpose	Contact status reading. “dmd” measurements synchronisation and clock synchronisation. Energy tariff selection. Utility meter counters. Trip counter. Interfacing with external energy meters (+kWh, +kvarh, -kWh, -kvarh).
Input frequency	20Hz max, duty cycle 50%
Prescaler adjustment	From 0.1 to 999.9 m^3 or kWh/pulse
Open Contact voltage	≤3.3VDC
Closed Contact current	<1mADC
Contact resistance	≤300Ω closed contact ≥50kΩ open contact
Input voltage	0 to 0.5VDC: LOW 2.4 to 25VDC: HIG
Working mode	• Total and partial energy meters (kWh and kvarh) without digital inputs; • Total and partial energy meters (kWh and kvarh) managed by time periods (t1-t2-t3-t4-t5-t6), W dmd synchronisation (the synchronisation is made every time the tariff changes) and GAS (m^3) or WATER (hot/cold/m^3) or remote heating (kWh) meters; • Total and partial energy meters (kWh and kvarh) managed by time periods (t1-t2), W dmd synchronisation (the synchronisation is made independently of the tariff selection) and GAS (m^3) or WATER (hot/cold/m^3) or remote heating (kWh)

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Output specifications (cont.)

	meters; • Total energy (kWh, kvarh) and GAS, WATER (hot-cold m^3) and remote heating meters (3 choices only). • Remote alarm reset. • Trip counter of installation protection. • Direct measurements for the power quality analysis (LV or MV/HV connection); • Indirect energy and power measurements by means of external energy 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).
Insulation	By means of opto-mos See “Insulation between inputs and outputs” table.
Opto-mos Output and Digital Input (M F I6 O6 on request)	
Static Outputs	
Physical outputs	6 (max. 1 module per instrument)
Purpose	For either pulse output or alarm output
Type of outputs	Opto-Mos
Signal	VON: 2.5VDC/max.100mA VOFF: 42VDC
Function	The outputs can work as pulse outputs, but also as alarm outputs, remote controlled outputs, or in any other combination.
Signal retransmission	Total: +kWh, -kWh, +kvarh, -kvarh. Partial: +kWh, -kWh, +kvarh, -kvarh Tariff: +kWh, -kWh, +kvarh, -kvarh.
Pulse type	Programmable from 0.001 to 10.00 kWh/kvarh per pulse. Outputs connectable to the energy meters (kWh/kvarh)
Pulse duration	30 ms (ON), ≥ 30 ms (OFF), according to EN62053-31
Advanced tariff management	
No. of tariffs	Up to 6
No. of total energies	Up to 4 (+kWh, -kWh, +kvarh, -kvarh)
Data format	9-DGT for Total and partial/tariff, gas and water metering.
Digital inputs	
Number of inputs	6 (voltage-free contacts)
Purpose	Contact status reading. “dmd” measurements synchronisation and clock synchronisation. Energy tariff selection. Utility meter counters. Trip counter. Remote input. Interfacing with external energy meters (+kWh, +kvarh, -kWh, -kvarh).
Input frequency	20Hz max, duty cycle 50%
Prescaler adjustment	From 0.1 to 999.9 m^3 or kWh/pulse
Open Contact voltage	≤3.3VDC
Closed Contact current	<1mADC
Contact resistance	≤300Ω closed contact ≥50kΩ open contact
Input voltage	0 to 0.5VDC LOW 2.4 to 25VDC HIG
Working mode	• Total and partial energy meters (kWh and kvarh) without digital inputs; • Total and partial energy meters (kWh and kvarh) managed by time periods (t1-t2-t3-t4-t5-t6), W dmd synchronisation (the synchronisation is made every time the tariff changes) and GAS (m^3) or WATER (hot/cold/m^3) or remote heating (kWh) meters; • Total and partial energy meters (kWh and kvarh) managed by time periods (t1-t2), W dmd synchronisation (the synchronisation is made independently of the tariff selection) and GAS (m^3) or WATER (hot/cold/m^3) or remote heating (kWh) meters; • Total energy (kWh, kvarh) and GAS, WATER (hot-cold m^3) and remote heating meters (3 choices only). • Remote alarm reset. • Remote input channel status. • Trip counter of installation

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Output specifications (cont.)

	protection. • 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 by external energy meters (LV or MV/HV).
Insulation	By means of opto-mos See “Insulation between inputs and outputs” table.
Temperature and Process signal inputs (M A T P on request)	
Temperature signal	
Number of inputs	1
Accuracy (Display + RS485)	See table “Temperature input characteristics”
Temperature drift	≤150ppm/°C
Temperature probe	Pt100, Pt1000
Number of wires	2 or 3-wire connection
Wire compensation	Up to 10Ω
Engineering unit	Selectable °C o °F
Process signal	
Number of inputs	1
Accuracy (Display + RS485)	±(0,2%RDG+2DGT) da 0% a 25% FS; ±(0,1%RDG+2DGT) da 25% a 110% FS.
Temperature drift	≤150ppm/°C
Process signal input	-20mA to +20mADC
Signal overload	Continuous: 50mADC For 1 s.: 150mADC
Input impedance	<12Ω
Min. and Max. indication	-9999 to +9999 fully programmable scaling with decimal point positioning.
Module with true neutral current input (M A T P N)	In: 1A
Accuracy (Display + RS485)	From 0.01In to 0.05In: ±(0,5% RDG +2DGT) From 0.05In to 1.2In: ±(0.2% RDG +2DGT)
Temperature drift	≤150ppm/°C
Measuring input type	To be connected to external current transformer
Transformer ratio	Up to 10kA (CT ratio 9999 max)
Crest factor	≤3 (3A max. peak)
Current Overloads	
Continuous	1.2A, @ 50Hz
For 500ms	10A, @ 50Hz
Input impedance	0.5Ω
Frequency	45 to 65 Hz

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Temperature input characteristics

Probe	Range	Accuracy	Min Indication	Max Indication
Pt100	-60.0°C to +300.0°C	±(0.5%RDG +5DGT)	- 60.0	+ 300.0
Pt100	-76°F to+572°F	±(0.5%RDG +5DGT)	- 76.0	+ 572.0
Pt1000	-60.0°C to +300.0°C	±(0.5%RDG +5DGT)	- 60.0	+ 300.0
Pt1000	-76°F to+572°F	±(0.5%RDG +5DGT)	- 76.0	+ 572.0

Tariff energy meters and time period management

NOTE: only in case of M F I6 R4 and M F I6 O6 modules.

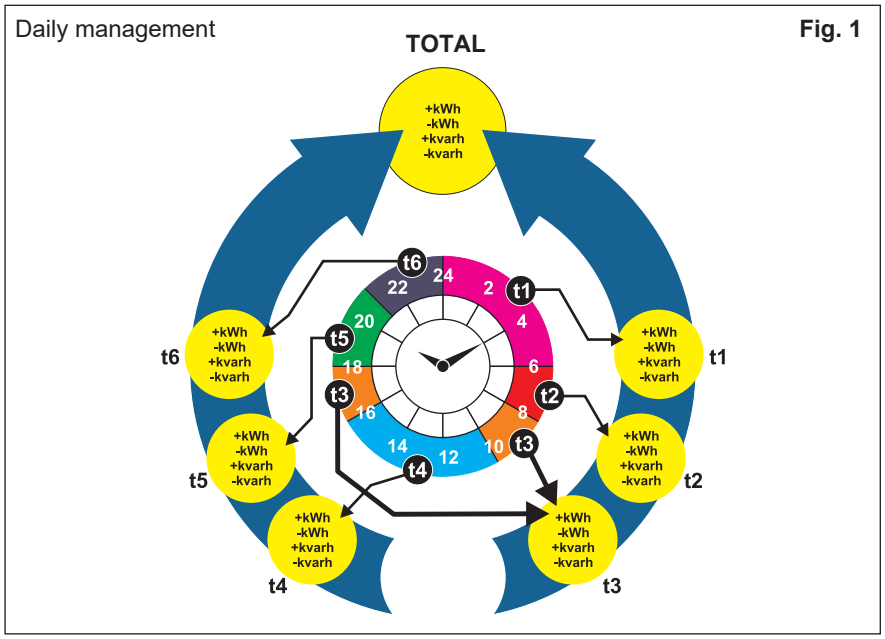
Meters Total Partial	 4 (up to 10 digit) 72 (up to 10 digit)
Tariffs	Up to 6
Time periods	Up to 3 year
Pulse output	Connectable to total and/or partial meters
Storage	Consumption history by storing the monthly energy meters (12 previous months) into the EEPROM. Storage of total and partial energy meters. Energy meter storage format (EEPROM) Min. -9,999,999,999 kWh/kvarh Max. 9,999,999,999 kWh/kvarh
Energy Meters	Base on digital inputs and clock management
“Total” energy meters	+kWh, +kvarh, -kWh, -kvarh.
“Standard Period” energy meters	Up to 2 (“P1” and “P2”) which can be set by month and year each.
“Holiday Period” energy meters	Up to 10 (“H1 … H10”). As per standard period management every single one can be set by day/ month/year.
“Tariff” energy meters	Up to 6 per period (P1/ P2 and H1 … H10). Every tariff is daily based and is called “t1” … “t6”. The single tariff can be set as “Hours and minutes”. Every single tariff “t” may has an independent start and stop which may be different also from period to period “P1 and P2”. Every single tariff manages an independent energy meter which is split according the measured energy in: +kWh, -kWh, +kvarh.
Partial energy meters	+kWh, +kvarh, -kWh, -kvarh (basic unit without any module)

Tariff energy meters overall working scheme

NOTE: only in case of M F I6 R4 and M F I6 O6 modules.

Daily management

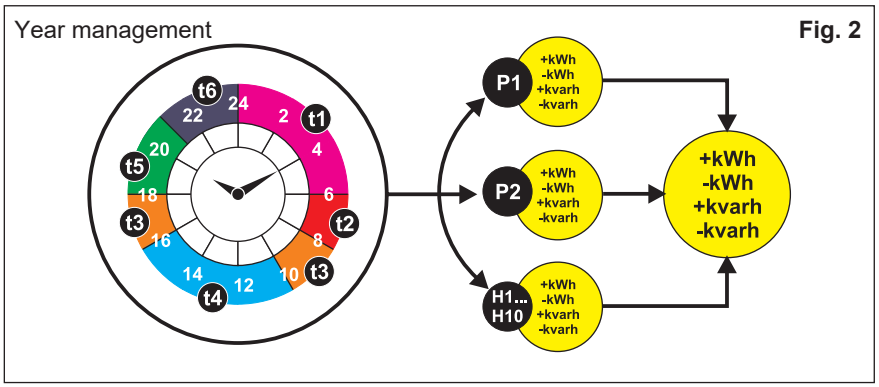
Fig. 1



Where t1 to t6 are the “Tariffs”.

Year management

Fig. 2



Where P1 and P2 are the “Standard Periods” and H1 … H10 Holiday periods which are identified by a defined day (non working day), by a vacation period or by a season period.

Note: the displaying of every single energy tariff is relevant only to the period being used. Other periods are available through the communication port.

Energy meters

Meters	
Total	4 (8+2, 9+1, 10 digit)
Partial	4 (8+2, 9+1, 10 digit)
Pulse output	Connectable to total and/or partial meters
Energy meter recording	Storage of total and partial energy meters. Energy meter storage format (EEPROM) Min. -9,999,999,999 kWh/kvarh Max. 9,999,999,999 kWh/kvarh.

Energy Meters	
Total energy meters	+kWh, +kvarh, -kWh, -kvarh
Partial energy meters	+kWh, +kvarh, -kWh, -kvarh

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Management of the digital inputs

NOTE: only in case of M F I6 R4 and M F I6 O6 modules.

Function	Note	Digital inputs					
		1	2	3	4	5	6
Synch (dmd)	(1)	YES					
Tariff change	(2)	YES	YES	YES			
Hot Water	(3)				YES	YES	YES
Cold Water	(3)				YES	YES	YES
Gas	(3)				YES	YES	YES
Remote heating	(3)				YES	YES	YES
Remote alarm reset	(4)				YES		
Trip counter of protection	(5)				YES		
Remote input channel status	(6)	YES	YES	YES	YES	YES	YES
kWh counting (-)	(7)			YES			
kWh counting (+)	(7)				YES		
kvarh counting (+)	(7)					YES	

Note: every single digital input can be configured according to the table above.
(1) At each status change of digital signal (from OFF to ON) the instrument synchronises the DMD calculation. It also synchronises the clock to the multiple of the integration time nearest to the current time.
(2) It is used to select by means of the logic of three inputs up to 6 different tariffs: t1-t2-t3-t4-t5-t6. Every time the tariff changes, it starts also the synchronisation of the “dmd” calculation.
(3) It is used to count the pulses coming from different Utility meters like: cold water, hot water, gas and remote heating.
(4) It is used to remotely reset the alarms (In case of latch alarm).
(5) It is used to count how many times an external protection device trips.
(6) This function is available only in case of serial communication. It allows to detect the status of the digital input. The status is displayed on the display as well.
(7) The energy is metered by means of pulses coming from a external energy meter. This meter can be provided with up to 3 outputs (for imported active and reactive energy and for exported active energy). Note: the pulses counted from the watt-hour meter replaces the standard measurement of energy and the relevant displaying (total, partial and tariff), all other measurements (eg: V-A-W-VA-var, THD and so on) are still performed and displayed.

Harmonic distortion analysis

Analysis principle	FFT
Harmonic measurement	
Current	Up to the 32nd harmonic
Voltage	Up to the 32nd harmonic
Type of harmonics	THD (VL1 and VL1-N) THD odd (VL1 and VL1-N) THD even (VL1 and VL1-N) TDD 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 without neutral the angle cannot be measured.
Harmonic details	The harmonic spectrum so to built-up a graph is available only by means of the serial communication.

CARLO GAVAZZI

Event logging, data logging and load profiling

NOTE: only in case of M C 485 232 M, M C ETH M, M C BAC IP M, M C BAC MS M, M C PB M and M C EI M modules

Event logging	Only with communication module provided with data memory.
Data displaying	The data are available on the display limited to the last 99 events. All events can be both checked and downloaded using any available communication port in combination with UCS software.
Function enabling	Activation: NO/YES
Stored data type	Alarms, max./min.
Number of events	Max. 10,000
Data reset	All events can be reset manually
Data format	Event, date (dd:mm:yy) and time (hh:mm:ss)
Storage method	FIFO
Memory type	Flash
Memory retention time	10 years
Data logging	Only with communication module provided with data memory.
Data displaying	The data are not available on the display but they can be both checked and downloaded using any available communication port in combination with UCS software.
Function enabling	Activation: NO/YES
Stored data type	All variables.
Storage interval	Programmable from 1 min. to 60 min.; all instantaneous variables can be selected (max 19 variables)
Sampling management	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. 100 ms.
Storage duration	Before overwriting, see “Historical data storing time table.
Number of variables	See “Historical data storing time table”.
Data format	Variable, date (dd:mm:yy) and time (hh:mm:ss)
Storage method	FIFO
Memory type	Flash
Memory size	4Mb
Memory retention time	10 years
Load profiling	Only with communication module provided with data memory.
Data displaying	The data are not available on the display but they can be both checked and downloaded using any available communication port in combination with UCS software.
Function enabling	Activation: NO/YES
Storage interval	Selectable: 5-10-15-20-30-60 minutes of Wdmd and VAdmd.
Storage duration	Before overwriting, 100 weeks: with recording interval of 5min; 300 weeks: with storing interval of 15min.
Data format	Wdmd variable value, minutes, day, month.
Data synchronisation	Based on internal clock
Other characteristics	As per Event and Data logging.

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Display, LED's and commands

Display refresh time	≤ 250 ms
Display	4 lines, 4-DGT, 1 lines, 10-DGT
Type	LCD, dual colour backlight (selectable)
Digit dimensions	4-DGT: h 11 mm; 10-DGT: h 7 mm
Instantaneous variables read-out	4-DGT
Energies variables read-out	Imported Total/Partial/ Tariff: 8+2DGT, 9+1DGT or 10DGT; Exported Total/ Partial/ Tariff: 8+2DGT, 9+1DGT or 10DGT (with "-" sign).
Gas-water-remote heating read-out	8+2DGT, 9+1DGT or 10DGT
Run Hours counter	8+2 DGT (99.999.999 hours and 59 minutes max)
Overload status	EEEE indication when the value being measured is exceeding the "Continuous inputs overload" (maximum measurement capacity)
Max. and Min. indication	Max. instantaneous variables: 9999; energies: 9 999 999 999. Min. instantaneous variables: 0.000; energies 0.00
Front position LEDs	
Bar-graph	Three groups of 3-LED (green-red) split by phase L1-L2-L3 and level of measurement. The full scale (100%) is referred to a programmable value which is corresponding to the variable being measured and displayed by the instrument at the time.
Virtual alarms	4 red LED available in case of virtual alarm (ALG1-AL G2-AL G3-AL G4), every LED groups 4 alarms. Note: the real alarm is just the activation of the proper static or relay output if the proper module is available.
Energy consumption kWh pulsating	Red LED (only kWh) 0.001 kWh/kvarh by pulse if the Ct ratio by VT ratio is ≤7 0.01 kWh/kvarh by pulse if the Ct ratio by VT ratio is ≥7.1 ≤70.0 0.1 kWh/kvarh by pulse if the Ct ratio by VT ratio is ≥70.1 ≤700.0 1 kWh/kvarh by pulse if the Ct ratio by VT ratio is ≥700.1 ≤7000 10 kWh/kvarh by pulse if the Ct ratio by VT ratio is ≥7001 ≤70.00k 100 kWh/kvarh by pulse if the Ct ratio by VT ratio is >70.01k Max frequency: 16Hz, according to EN 62052-11
Back position LEDs	
On the base	Green as power-on
On the communication modules	Two LEDs: one for TX (green) and one for RX (amber).
Key-pad	For variable selection, programming of the instrument working parameters reset, "dmd", "max", total energy and partial energy and event.

Main functions

Password	Numeric code of max. 4 digits; 2 protection levels of the programming data:
1st level	Password "0", no protection;
2nd level	Password from 1 to 9999, all data are protected
System selection	
System 3-Ph.n unbalanced load	3-phase (4-wire)
System 3-Ph. unbalanced load	3-phase (3-wire), three currents and 3-phase to phase voltage measurements, or in case of Aaron connection two currents (with special wiring on screw terminals)
System 3-Ph.1 balanced load	3-phase (3-wire), one current and 3-phase to phase voltage measurements and 3-phase to phase voltage measurements.
System 3-Ph.2 balanced load	3-phase (4-wire), one current and 3-phase to neutral voltage measurements. 3-phase (2-wire), one current and 1-phase (L1) to neutral voltage measurement.
System 2-Ph	2-phase (3-wire)
System 1-Ph	1-phase (2-wire)

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Main functions (cont.)

Transformer ratio	
VT (PT)	1.0 to 999.9 / 1000 to 9999.
CT	1.0 to 999.9 / 1000 to 9999 (up to 10kA in case of CT with 1A secondary current and up to 50kA in case of CT with 5A secondary current).
Maximum CT ratio x VT ratio	9999 x 9999
Filter	
Operating range	Selectable from 0 to 100% of the input display scale
Filtering coefficient	Selectable from 1 to 32
Filter action	Measurements, analogue signal retransmission, serial communication (fundamental variables: V, A, W and their derived ones).
Displaying	
Number of variables	Up to 5 variables per page. See “Front view”. Many different set of variables available (see “Display pages”) according to the application being selected. One page is freely programmable as combination of variables.
Backlight	The backlight time is programmable from 0 (always on) to 255 minutes
Virtual alarms	
Working condition	In case of basic unit or with the addition of M O R2, M O O2 , M F I6 R4 or MF I6 O6.
No. of alarms	Up to 16
Working mode	Up alarm and down alarm and windows alarm (IN/OUT).
Controlled variables	The alarms can be connected to any instantaneous variable available in the table “List of the variables that can be connected to”.
Set-point adjustment	From 0 to 100% of the display scale
Hysteresis	From 0 to 100%
On-time delay	0 to 255s
Min. response time	≤ 200ms, filters excluded. Set-point on-time delay: “0 s”.
Alarm highlight	In case of alarm and if the relevant function is enabled, the display changes the colour from white backlight to blue backlight or to another available colour combination (fore more details see “Working mode of the display in a normal/abnormal condition”)
Reset	By means of the front key-pad or the configuration software. It is possible to reset the following data: - all the min, max, dmd, and dmd-max values. - total energies: kWh, kvarh; - partial energies and tariffs: kWh, kvarh; - gas, water and remote heating; - latch alarms; - all the events; - all the load profiling; - all data logging
Harmonic analysis	Up to the 32nd harmonics on current and voltage including also “odd” and “even” THD. In case of communication module availability (any type) every single information is available in the communication protocol.
Clock	
Functions	Universal clock and calendar.
Time format	Hour: minutes: seconds with selectable 24H or 12H AM/PM format.
Date format	Day-month-year with selectable DD-MM-YY or MM-DD-YY format.
Battery life	10 years
Easy programming function	The displayed energy is always “imported” with the only exception of “C”, “D”, “E” and “G” types (see “display pages” table). For those latter selections the energies can be either “imported” or “exported” depending on the current direction.

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General specifications

Operating temperature	-25°C to +55°C (-13°F to 131°F) (R.H. from 0 to 90% non-condensing @ 40°C) according to EN62053-21, EN62053-23
Storage temperature	-30°C to +70°C (-22°F to 158°F) (R.H. < 90% non-condensing @ 40°C) according to EN62053-21, EN62053-23
Installation category	Cat. III (IEC60664, EN60664)
Insulation (for 1 minute)	See “Insulation between inputs and outputs” table
Dielectric strength	4kVAC RMS for 1 minute
Noise rejection CMRR	100 dB, 48 to 62 Hz
EMC	
Immunity and emissions	According to EN62052-11
Standard compliance	
Safety	IEC60664, IEC61010-1 EN60664, EN61010-1 EN62052-11.
Metrology	EN62053-22, EN62053-23.
Pulse output	IEC62053-31
Approvals	CE, cULus “Listed” (cULus: max. 40°C, all modules i n all combinations)
Connections	Screw-type
Cable cross-section area	max. 2.5 mm^2. min./max. screws tightening torque: 0.4 Nm / 0.8 Nm. Suggested screws tightening torque: 0.5 Nm
Housing	
Dimensions (WxHxD)	Module holder: 96x96x50mm. “A” and “B” type modules: 89.5x63x16mm. “C” type module: 89.5x63x20mm.
Max. depth behind the panel	With 3 modules (A+B+C): 81.7 mm
Material	Polycarbonate/ABS/Nylon PA66, self-extinguishing: UL 94 V-0
Mounting	Panel mounting
Protection degree	
Front	IP65, NEMA4x, NEM12
Screw terminals	IP20
Weight	Approx. 420 g (packing included)

Power supply specifications

Auxiliary power supply	H:100-240 +/-10% (90 to 255) VDC/AC (50/60 Hz) L: 24-48 +/-15% (20 to 55) VDC/AC (50/60 Hz)
Power consumption	AC: 20 VA; DC: 10 W

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Insulation between inputs and outputs

	Power Supply	Measuring Input	Relay outputs (MOR2)	Relay outputs (MFR4I6)	Static outputs (MOO2)	Static outputs (MFO6I6)	Serial communication	Ethernet port	Analogue output	Digital inputs	Neutral current input	20mA input	Temperature input
Power Supply	-	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV
Measuring Input	4kV	-	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV
Relay outputs (MOR2)	4kV	4kV	2kV	4kV	-	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV
Relay outputs (MFR4I6)	4kV	4kV	4kV	2kV	4kV	-	4kV	4kV	4kV	4kV	4kV	4kV	4kV
Static outputs (MOO2)	4kV	4kV	-	4kV	2kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV
Static outputs (MFO6I6)	4kV	4kV	4kV	-	4kV	0kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV
Serial communication	4kV	4kV	4kV	4kV	4kV	4kV	-	-	4kV	4kV	4kV	4kV	4kV
Ethernet port	4kV	4kV	4kV	4kV	4kV	4kV	-	-	4kV	4kV	4kV	4kV	4kV
Analogue output	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV*	4kV	4kV	4kV	4kV
Digital inputs	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	0kV	4kV	4kV	4kV
Neutral current input	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	-	0kV	0kV
20mA input	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	0kV	-	0kV
Temperature input	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	4kV	0kV	0kV	-

*: 4kV respect another module 4kV, in the same module 0kV.
0kV: not isolated.
-: combination not allowed.
NOTE: all the models have, mandatory, to be connected to external current transformers because the isolation among the current inputs is just functional (100VAC).

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List of the variables that can be connected to:

- Communication port (all listed variables)
- Analogue outputs (all variables with the only exclusion of “totalizers” and “run hour counter”
- Pulse outputs (only “energies”)
- Alarm outputs (“totalizers”, “hour counter” and “max” excluded)

No.	Variable	1-ph. sys (1P)	2-ph. sys (2P)	3-ph. 3-wire balanced sys (3P.1)	3-ph. 2-wire balanced sys (3P.2)	3-ph. 3-wire unbal. sys (3P)	3-ph. 4-wire unbal. sys (3P.n)	Notes
1	VL-N sys	O	X	X	X	#	X	sys= system= ∑ (1)(2)(3)
2	VL1	X	X	X	X	#	X	(1)(2)(3)
3	VL2	O	X	H	H	#	X	(1)(2)(3), (H)=VL1
4	VL3	O	O	H	H	#	X	(1)(2)(3), (H)=VL1
5	VL-L sys	#	#	X	X	X	X	sys= system= ∑ (1)
6	VL1-2	#	X	X	P	X	X	(1)(2)(3), (P)=VL1*1.73
7	VL2-3	#	O	X	P	X	X	(1)(2)(3), (P)=VL1*1.73
8	VL3-1	#	O	X	P	X	X	(1)(2)(3), (P)=VL1*1.73
9	Asys	O	X	O	O	X	X	
10	An	#	X	O	O	O	X	
11	AL1	X	X	X	X	X	X	(1)(2)(3)
12	AL2	O	X	R	R	X	X	(1)(2)(3), (R)=AL1
13	AL3	O	O	R	R	X	X	(1)(2)(3), (R)=AL1
14	VA sys	O	X	X	X	X	X	sys= system= ∑ (1)(2)(3)
15	VA L1	X	X	X	X	O	X	(1)(2)(3)
16	VA L2	O	X	U	U	O	X	(1)(2)(3) U=VAL1
17	VA L3	O	O	U	U	O	X	(1)(2)(3) U=VAL1
18	var sys	X	X	X	X	X	X	sys= system= ∑ (1)(2)(3)
19	var L1	X	X	X	X	O	X	(1)(2)(3)
20	var L2	O	X	V	V	O	X	(1)(2)(3) V=VARL1
21	var L3	O	O	V	V	O	X	(1)(2)(3) V=VARL1
22	W sys	O	X	X	X	X	X	sys= system= ∑ (1)(2)(3)
23	WL1	X	X	X	X	O	X	(1)(2)(3)
24	WL2	O	X	S	S	O	X	(1)(2)(3), (S)=WL1
25	WL3	O	O	S	S	O	X	(1)(2)(3), (S)=WL1
26	PF sys	O	X	X	X	X	X	sys= system= ∑ (1)
27	PF L1	X	X	X	X	O	X	(1)(2)(3)
28	PF L2	O	X	T	T	O	X	(1)(2)(3), (T)=PFL1
29	PF L3	O	O	T	T	O	X	(1)(2)(3), (T)=PFL1
30	Hz	X	X	X	X	X	X	(1)(2)(3)
31	Phase seq.	O	O	X	O	X	X	

(X) = available; (O) = not available; (#) Not available (the relevant page is not displayed)
(1) Min. and Max. value with data storage; (2) “dmd” calculation and data storage; (3) “dmd-max” calculation and data storage; (5) On 4 quadrants (ind/cap); (6) C1, C2 and C3 may be set as either cold water, hot water, remote heating or gas depending on the input configuration.

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List of the variables that can be connected to (cont.):

- Communication port (all listed variables)
- Analogue outputs (all variables with the only exclusion of “energies” and “run hour counter”
- Pulse outputs (only “energies”)
- Alarm outputs (“energies”, “hour counter” and “max” excluded)

No.	Variable	1-ph. sys (1P)	2-ph. sys (2P)	3-ph. 3-wire balanced sys (3P.1)	3-ph. 2-wire balanced sys (3P.2)	3-ph. 3-wire unbal. sys (3P)	3-ph. 4-wire unbal. sys (3P.n)	Notes
32	Asy VLL	O	O	X	O	X	X	Asymmetry
33	Asy VLN	O	X	O	O	O	X	Asymmetry
34	Run Hours	X	X	X	X	X	X	
35	kWh (+)	X	X	X	X	X	X	Total
36	kvarh (+)	X	X	X	X	X	X	Total (5)
37	kWh (+)	X	X	X	X	X	X	Partial or by tariff
38	kvarh (+)	X	X	X	X	X	X	Partial or by tariff (5)
39	kWh (-)	X	X	X	X	X	X	Total
40	kvarh (-)	X	X	X	X	X	X	Total (5)
41	kWh (-)	X	X	X	X	X	X	Partial
42	kvarh (-)	X	X	X	X	X	X	Partial (5)
43	C1 (input 4)	X	X	X	X	X	X	Total (6)
44	C2 (input 5)	X	X	X	X	X	X	Total (6)
45	C3 (input 6)	X	X	X	X	X	X	Total (6)
46	Trip counter	X	X	X	X	X	X	Total
47	kWh Water	X	X	X	X	X	X	Total
48	A L1 THD	X	X	X	X	X	X	(2) (3) (4)
49	A L2 THD	O	X	F	F	X	X	(2)(3)(4), (F)=AL1THD
50	A L3 THD	O	O	F	F	X	X	(2)(3)(4), (F)=AL1THD
51	V L1 THD	X	X	X	X	O	X	(2)(3)(4)
52	V L2 THD	O	X	X	G	O	X	(2)(3)(4), (G)=VL1THD
53	V L3 THD	O	O	X	G	O	X	(2)(3)(4), (G)=VL1THD
54	V L1-2 THD	#	X	X	#	X	X	(2) (3) (4)
55	V L2-3 THD	#	O	X	#	X	X	(2) (3) (4)
56	V L3-1 THD	#	O	X	#	X	X	(2) (3) (4)
57	A L1 TDD	X	X	X	X	X	X	(2) (3) (4)
58	A L2 TDD	O	X	X	X	X	X	(2) (3) (4)
59	A L3 TDD	X	X	X	X	X	X	(2) (3) (4)
60	K-Factor	O	O	X	X	X	X	(2) (3) (4)

(X) = available; (O) = not available; (#) Not available (the relevant page is not displayed); (2) “dmd” calculation and data storage; (3) “dmd-max”calculation and data storage; (4) Odd and Even THD’s;

List of selectable applications

	Description	Notes
A	Cost allocation	Imported energy metering (Easy connection)
B	Cost control	Imported and partial energy metering and utilities (Easy connection)
C	Complex cost allocation	Imported/exported energy (total, partial and tariff) and utilities
D	Solar	Imported and exported energy metering with some basic power analyzer function
E	Complex cost and power analysis	Imported/exported energy (total and partial) and power analysis (Easy connection)
F	Cost and power quality analysis	Imported energy and power quality analysis
G	Advanced energy and power analysis for power generation	Complete energy metering and power quality analysis

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Display pages

No.	Line 1 Variable Type	Line 2 Variable Type	Line 3 Variable Type	Line 4 Variable Type	Line 5 Variable Type	Note	Applications						
							A	B	C	D	E	F	G
0	Total kWh (+)						x	x	x	x	x	x	x
1	Total kvarh (+)						x	x	x		x	x	x
2	Total kWh (-)								x	x	x		x
3	Total kvarh (-)								x		x		x
4	kWh (+) partial							x	x		x	x	x
5	kvarh (+) part.							x	x		x	x	x
6	kWh (-) partial								x		x		x
7	kvarh (-) part.								x		x		x
8	Run Hours (99999999.99)								x	x	x	x	x
9	kWh (+) t1								x		x		x
10	kvarh (+) t1								x		x		x
11	kWh (-) t1								x		x		x
12	kvarh (-) t1								x		x		x
13	kWh (+) t2								x		x		x
14	kvarh (+) t2								x		x		x
15	kWh (-) t2								x		x		x
16	kvarh (-) t2								x		x		x
17	kWh (+) t3								x		x		x
18	kvarh (+) t3								x		x		x
19	kWh (-) t3								x		x		x
20	kvarh (-) t3								x		x		x
21	kWh (+) t4								x		x		x
22	kvarh (+) t4								x		x		x
23	kWh (-) t4								x		x		x
24	kvarh (-) t4								x		x		x
25	kWh (+) t5								x		x		x
26	kvarh (+) t5								x		x		x
27	kWh (-) t5								x		x		x
28	kvarh (-) t5								x		x		x
29	kWh (+) t6								x		x		x
30	kvarh (+) t6								x		x		x
31	kWh (-) t6								x		x		x
32	kvarh (-) t6								x		x		x
33	C1					(5)		x	x		x		x
34	C2					(5)		x	x		x		x
35	C3					(5)		x	x		x		x
36		VLN ∑	VL1	VL2	VL3	(1) (2) (3)				x	x	x	x
37		VLL ∑	VL1-2	VL2-3	VL3-1	(1) (2) (3)				x	x	x	x
38		An	AL1	AL2	AL3	(1) (2) (3)				x	x	x	x
39		Hz	“ASY”	VLL sys (% asy)	VLN sys (% asy)	(1) (2) (3)				x	x	x	x
40		A ∑	AL1	AL2	AL3	(1) (2) (3)				x	x	x	x
41		W ∑	WL1	WL2	WL3	(1) (2) (3)				x	x	x	x
42		var ∑	var L1	var L2	var L3	(1) (2) (3)					x	x	x
43		PF ∑	PF L1	PF L2	PF L3	(1) (2) (3)					x	x	x
44		VA ∑	VA L1	VA L2	VA L3	(1) (2) (3)					x	x	x
45				Process sig.	Temperature	(1) (2) (3)						x	x
46			THD V1	THD V2	THD V3	(1) (2) (3)						x	x
47			THD V12	THD V23	THD V31	(1) (2) (3)						x	x
48			THD A1	THD A2	THD A3	(1) (2) (3)						x	x
49			THD V1 odd	THD V2 odd	THD V3 odd	(1) (2) (3)						x	x
50			THD V12 odd	THD V23 odd	THD V31 odd	(1) (2) (3)						x	x
51			THD A1 odd	THD A2 odd	THD A3 odd	(1) (2) (3)						x	x
52			THD V1 even	THD V2 even	THD V3 even	(1) (2) (3)						x	x
53			THD V12 even	THD V23 even	THD V31 even	(1) (2) (3)						x	x
54			THD A1 even	THD A2 even	THD A3 even	(1) (2) (3)						x	x
55			TDD A1	TDD A2	TDD A3	(1) (2) (3)						x	x
56			k-FACT L1	k-FACT L2	k-FACT L3	(1) (2) (3)						x	x

Note: the table refers to system 3P.n.
(1) Also Minimum value (no EEPROM storage). (2) Also Maximum value (no EEPROM storage). (3) Also Average (dmd) value (no EEPROM storage). (5) C1, C2 and C3 may be set as either cold water, hot water, remote heating or gas depending on the digital inputs configuration.

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Additional available information on the display

No.	8 Line 1	Line 2	Line 3	Line 4	Line 5	Applications						
						A	B	C	D	E	F	G
1	Lot n. (text) xxxx	Yr. (text) xx	rEL	X.xx	1...60 (min) “dmd”	x	x	x	x	x	x	x
2	Conn. xxx.x (3ph.n/3ph/3ph.1/ 3ph.2/1ph/2ph)	CT.rA (text)	1.0 … 99.99k	PT.rA (text)	1.0...9999	x	x	x	x	x	x	x
3	LED PULSE (text) kWh	xxxx kWh per pulse				x	x	x	x	x	x	x
4	PULSE out1 (text) kWh/kvarh	xxxx kWh/kvarh per pulse	+/- tot/PAr/ tAr 1-2-3-4			x	x	x	x	x	x	x
5	PULSE out2 (text) kWh/kvarh	xxxx kWh/kvarh per pulse	+/- tot/PAr/ tAr 1-2-3-4			x	x	x	x	x	x	x
6	PULSE out3 (text) kWh/kvarh	xxxx kWh/kvarh per pulse	+/- tot/PAr/ tAr 1-2-3-4			x	x	x	x	x	x	x
7	PULSE out4 (text) kWh/kvarh	xxxx kWh/kvarh per pulse	+/- tot/PAr/ tAr 1-2-3-4			x	x	x	x	x	x	x
8	PULSE out5 (text) kWh/kvarh	xxxx kWh/kvarh per pulse	+/- tot/PAr/ tAr 1-2-3-4			x	x	x	x	x	x	x
9	PULSE out6 (text) kWh/kvarh	xxxx kWh/kvarh per pulse	+/- tot/PAr/ tAr 1-2-3-4			x	x	x	x	x	x	x
10	PULSE out7 (text) kWh/kvarh	xxxx kWh/kvarh per pulse	+/- tot/PAr/ tAr 1-2-3-4			x	x	x	x	x	x	x
11	PULSE out8 (text) kWh/kvarh	xxxx kWh/kvarh per pulse	+/- tot/PAr/ tAr 1-2-3-4			x	x	x	x	x	x	x
12	Remote out.	Out 1 (text)	on/oFF	Out 2 (text)	on/oFF	x	x	x	x	x	x	x
13	Remote out.	Out 3 (text)	on/oFF	Out 4 (text)	on/oFF	x	x	x	x	x	x	x
14	Remote out.	Out 5 (text)	on/oFF	Out 6 (text)	on/oFF	x	x	x	x	x	x	x
15	Remote out.	Out 7 (text)	on/oFF	Out 8 (text)	on/oFF	x	x	x	x	x	x	x
16	AL1 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
17	AL2 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
18	AL3 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
19	AL4 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
20	AL5 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
21	AL6 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
22	AL7 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
23	AL8 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
24	AL9 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
25	AL10 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
26	AL11 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
27	AL12 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
28	AL13 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
29	AL14 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
30	AL15 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
31	AL16 OUTx NE/ND	Variable link L 1/2/3	Set1	Set2	(Measurement)				x	x	x	x
32	Analogue 1	Hi:E	0.0 ... 9999	Hi.A	0.0 ... 100.0%				x	x	x	x
33	Analogue 2	Hi:E	0.0 ... 9999	Hi.A	0.0 ... 100.0%				x	x	x	x
34	Analogue 3	Hi:E	0.0 ... 9999	Hi.A	0.0 ... 100.0%				x	x	x	x
35	Analogue 4	Hi:E	0.0 ... 9999	Hi.A	0.0 ... 100.0%				x	x	x	x
36	Optical	bdr (text)	9.6/19.2/ 38.4/115.2			x	x	x	x	x	x	x
37	COM port	Add (text)	xxx (address)	bdr (text)	9.6/19.2/ 38.4/115.2	x	x	x	x	x	x	x
38	IP address	XXX	XXX	XXX	XXX	x	x	x	x	x	x	x
39	xx.xx.xx xx:xx	Date	Time			x	x	x	x	x	x	x
40	Event page Date Time								x	x	x	x

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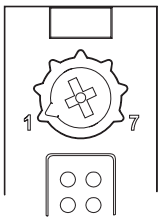
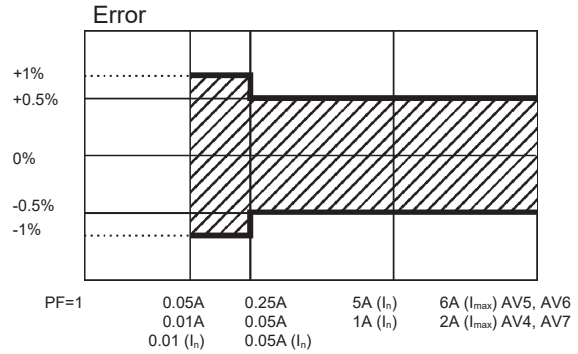
Back protection rotary switch

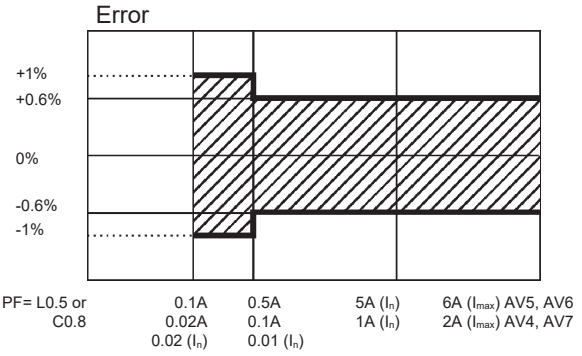


Function	Rotary switch position	Description
Unlock	1	All programming parameters are freely modifiable by means of the front key-pad and by means of the communication port.
Lock	7	The key-pad, as far as programming is concerned and the data through the serial communication cannot be changed (no writing into meter allowed). Data reading is allowed.

Accuracy (According to EN62053-22 and EN62053-23)

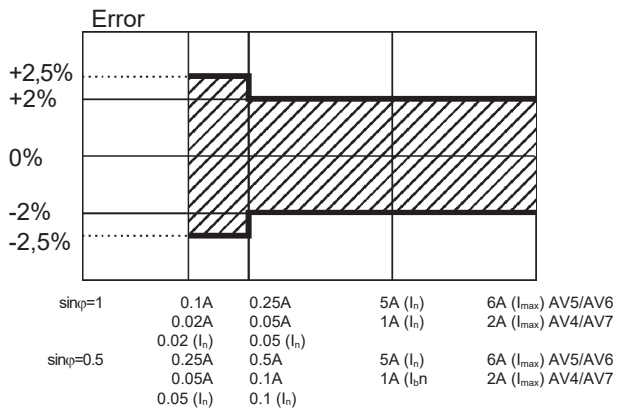
kWh, accuracy (RDG) depending on the current





Class 0.5S accuracy limits (Active energy)
Start-up current: 5mA (AV5-AV6), 1mA (AV4-AV7)

kvarh, accuracy (RDG) depending on the current



Class 2 accuracy limits (Reactive energy)
Start-up current: 5mA (AV5-AV6), 1mA (AV4-AV7)

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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

$$\cos\varphi_1 = \frac{W_1}{VA_1}$$

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

$$\mathrm{var}_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

System variables

Equivalent three-phase voltage

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

Voltage asymmetry

$$ASY_{LL} = \frac{(V_{LL\max} - V_{LL\min})}{V_{LL\,\Sigma}}$$

$$ASY_{LN} = \frac{(V_{LN\max} - V_{LN\min})}{V_{LN\,\Sigma}}$$

Three-phase reactive power

$$\mathrm{var}_\Sigma = (\mathrm{var}_1 + \mathrm{var}_2 + \mathrm{var}_3)$$

Three-phase active power

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

Three-phase apparent power

$$VA_\Sigma = \sqrt{W_\Sigma^2 + \mathrm{var}_\Sigma^2}$$

Total harmonic distortion

$$THD_N = 100 \frac{\sqrt{\sum_{n=2}^{N} |X_n|^2}}{|X_1|}$$

Three-phase power factor (TPF)

$$\cos\varphi_\Sigma = \frac{W_\Sigma}{VA_\Sigma}$$

Energy metering

$$k\,\mathrm{var}hi = \int_{t1}^{t2} Qi(t)dt \cong \Delta t \sum_{n1}^{n2} Qnj$$

$$kWhi = \int_{t1}^{t2} Pi(t)dt \cong \Delta t \sum_{n1}^{n2} Pnj$$

Where:

i= considered phase (L1, L2 or L3)
P= active power; **Q**= reactive power;
$\mathbf{t_1}$, $\mathbf{t_2}$ =starting and ending time points of consumption recording; **n**= time unit;
Δ**t**= time interval between two successive power consumption;
$\mathbf{n_1}$, $\mathbf{n_2}$ = starting and ending discrete time points of consumption recording

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UCS parameter progr. and var. reading software

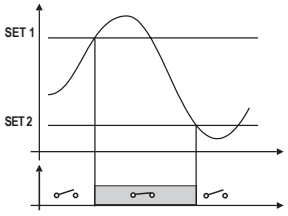
UCS software	Multi-language software (Italian, English, French, German, Spanish, Danish, Czech, Chinese) for variable reading and parameters programming (both online and offline).The program runs under Windows 7 and following versions.	Data Storing	- management of local RS232 (MODBUS); - management of local optical port (MODBUS); - management of a local RS485 network (MODBUS); - managed via TCP port. In pre-formatted CSV or Excel files).
Working mode	Four different working modes can be selected:	Data download	Manual.

Alarm parameters and logic

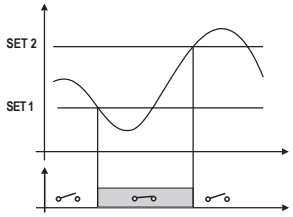
Each symbol includes all the settings described in the “alarm” paragraph and listed on the right:

- Enable.
- Variable
- Type
- Latch
- Disable
- Set 1
- Set 2
- OUT
- Delay on. Delay off.
- Function (and/or)

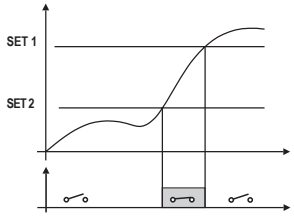
A, B, C... up to 16 locks to control parameters.



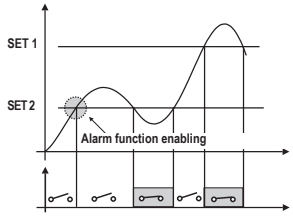
UP alarm
SET1 > SET2



DOWN alarm
SET2 > SET1

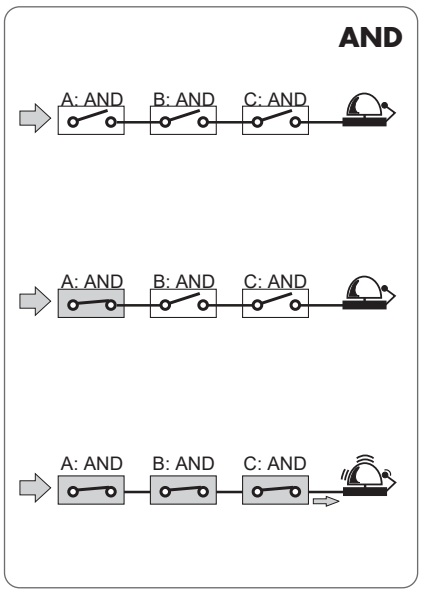


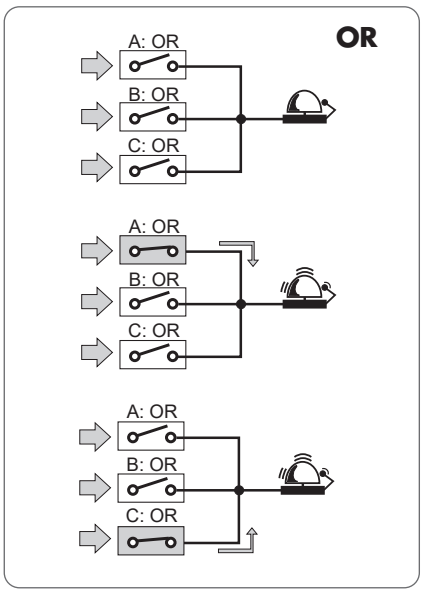
In-window alarm
Alarm is on when the value is between SET 1 and SET 2

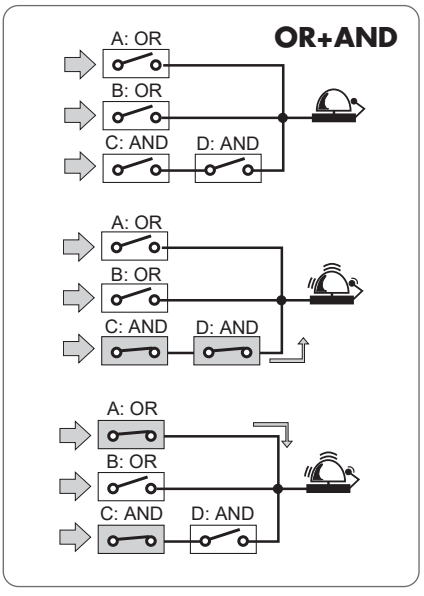


Ext. window alarm with disabling at power on
Alarm is on when value exceeds SET 1 or goes below SET 2

Example of AND/OR logic alarm:







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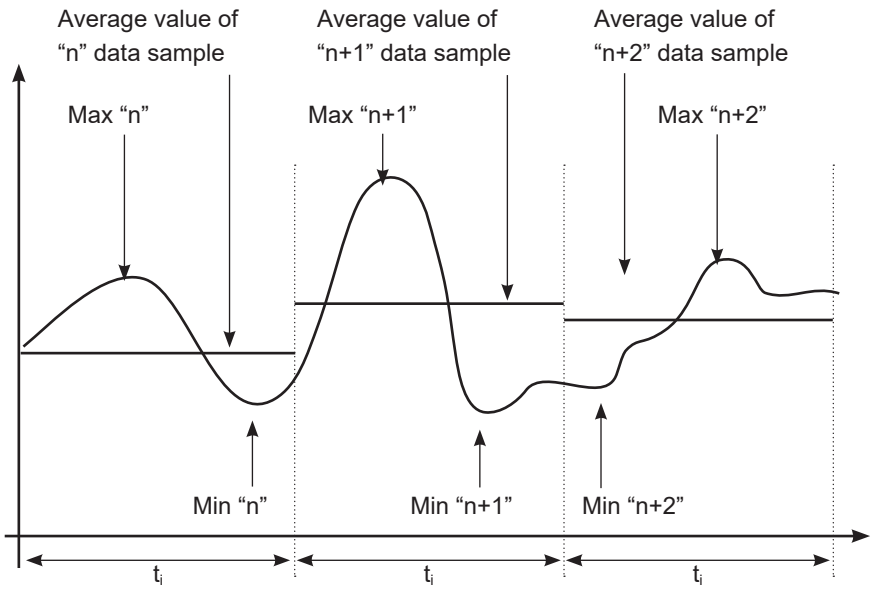
Historical data storing time table

Time interval (minutes)	4 selected variables			8 selected variables			12 selected variables			19 selected variables		
	Data storing time			Data storing time			Data storing time			Data storing time		
	Days	Week	Year	Days	Week	Year	Days	Week	Year	Days	Week	Year
1	32	5	-	19	3	-	15	2	-	8	1	-
5	161	23	-	97	14	-	73	10	-	40	6	-
10	323	46	-	194	28	-	145	21	-	81	12	-
15	484	69	1.3	291	42	-	218	31	-	121	17	-
20	646	92	1.8	388	55	1.1	291	42	-	161	23	-
30	969	138	2.7	581	83	1.6	436	62	1.2	242	35	-
45	1453	208	4	872	125	2.4	654	93	1.8	363	52	1
60	1938	277	5.3	1163	166	3.2	872	125	2.4	484	69	1.3

The working of data logging



t_i= time interval

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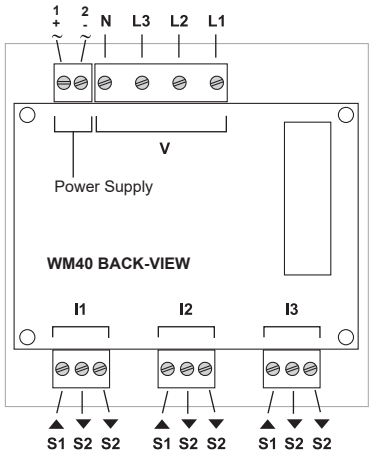
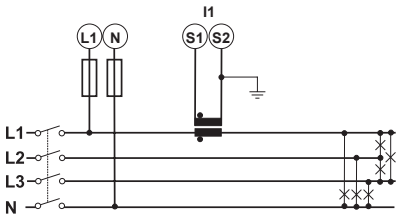
Wiring diagrams



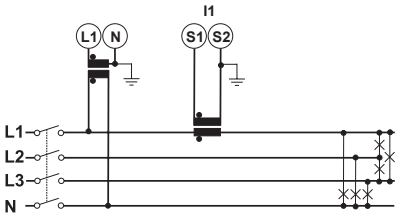
System type selection: 3-Ph.2

3-ph, 2-wire, balanced load **Fig. 1**



1-CT connection F=315 mA [T]

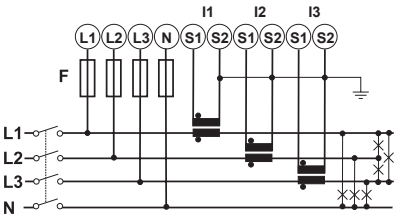
3-ph, 2-wire, balanced load **Fig. 2**



1-CT and 1-VT/PT connections

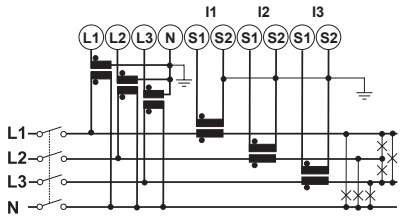
System type selection: 3-Ph.n

3-ph, 4-wire, unbalanced load **Fig. 3**



3-CT connection F=315 mA [T]

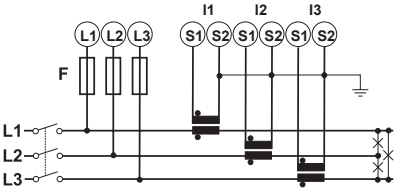
3-ph, 4-wire, unbalanced load **Fig. 4**



3-CT and 3-VT/PT connections

System type selection: 3-Ph

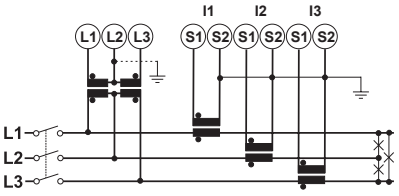
3-ph, 3-wire, unbalanced load **Fig. 5**



3-CT connection F=315 mA [T]

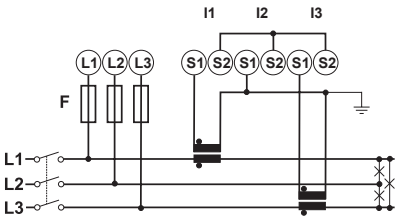
System type selection: 3-Ph (cont.)

3-ph, 3-wire, unbalanced load **Fig. 6**



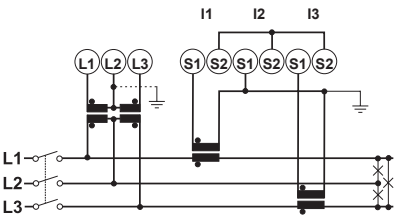
3-CT and 2-VT/PT connections

3-ph, 3-wire, unbalanced load **Fig. 7**



2-CT connections (ARON)
F=315 mA [T]

3-ph, 3-wire, unbalanced load **Fig. 8**

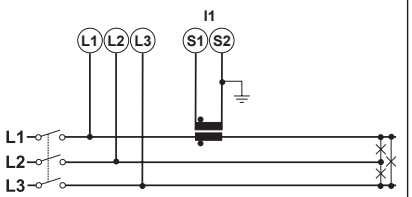


2-CT and 2-VT/PT connections ARON

Wiring diagrams

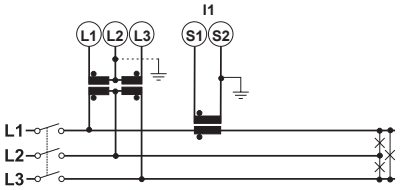
System type selection: 3-Ph.1

3-ph, 3-wire, balanced load **Fig. 9**



1-CT connections F=315 mA [T]

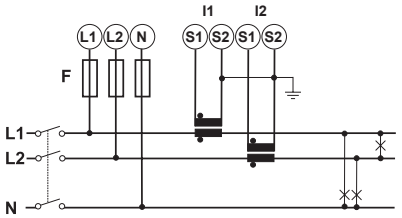
3-ph, 3-wire, balanced load **Fig. 10**



1-CT and 2-VT/PT connections

System type selection: 2-Ph

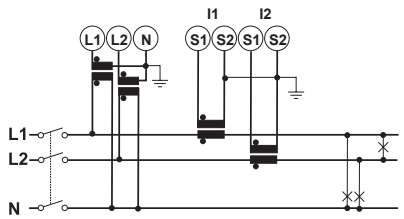
2-ph, 3-wire **Fig. 11**



2-CT connection

System type selection: 2-Ph (cont.)

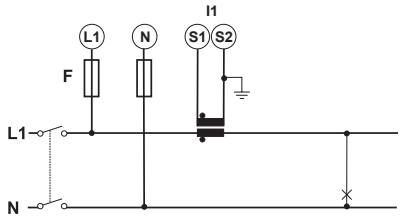
2-ph, 3-wire **Fig. 12**



2-CT and 2-VT/PT connections

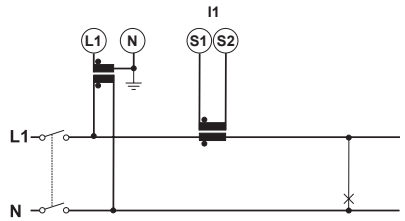
System type selection: 1-Ph

1-ph, 2-wire **Fig. 13**



1-CT connection F=315 mA [T]

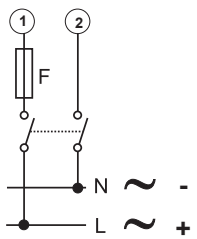
1-ph, 2-wire **Fig. 14**



1-CT and 1-VT/PT connections

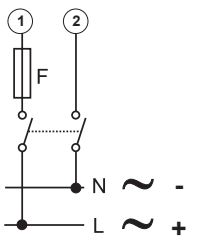
Power Supply

90 to 260VAC/DC (H option) **Fig. 15**



F= 250V [T] 630mA

18 to 60VAC/DC (L option) **Fig. 16**



F= 250V [T] 3,15A

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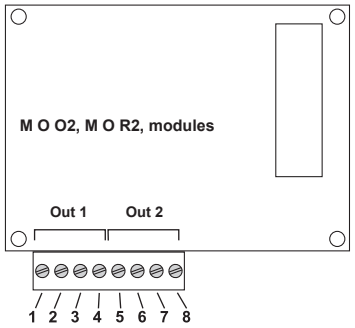
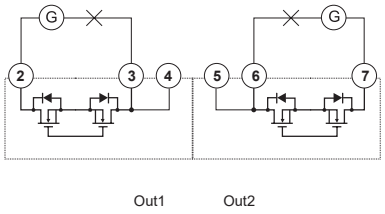
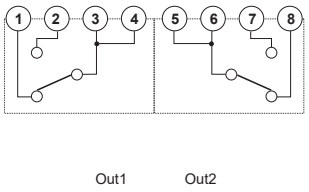
Static, relay, analogue out. and digital in. wiring diagrams

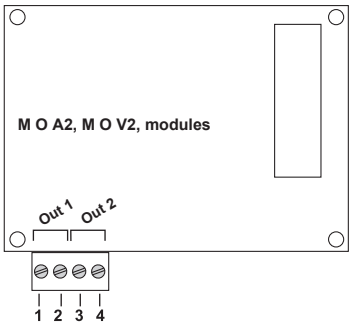


Opto-mosfet MOO2

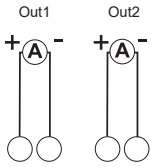


Relays MOR2

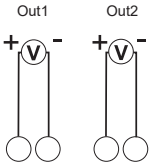


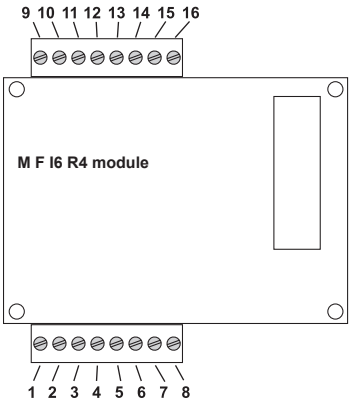


Analogue 20mA DC MOA2

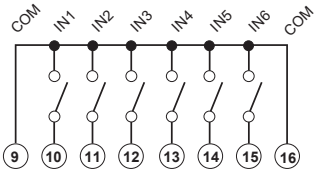


Analogue 10V DC MOV2

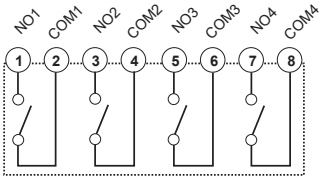


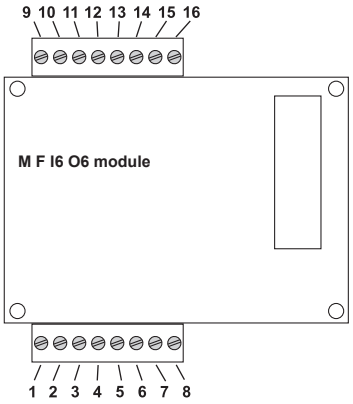


6 Digital inputs

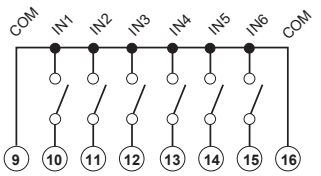


4 Relay outputs

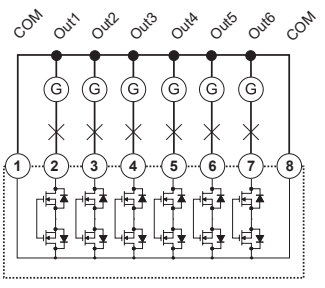




6 Digital inputs



6 Opto-mosfet outputs



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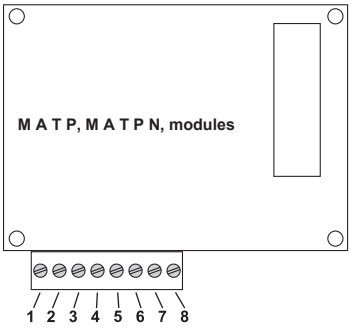
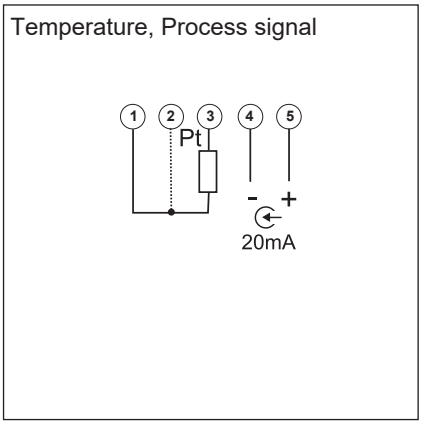
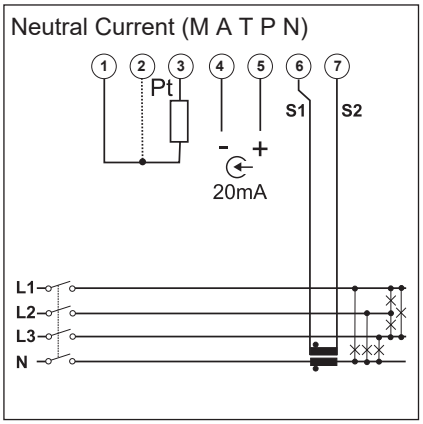
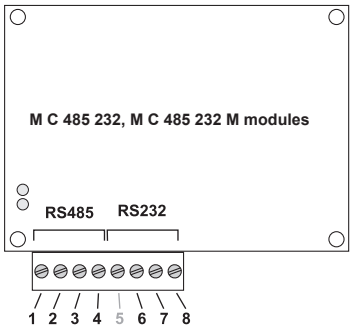
Temperature, process signal and true In wiring diagrams

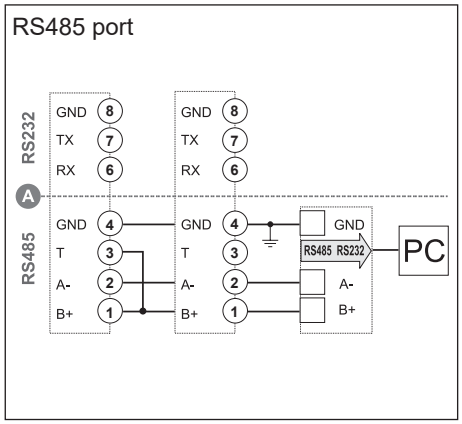


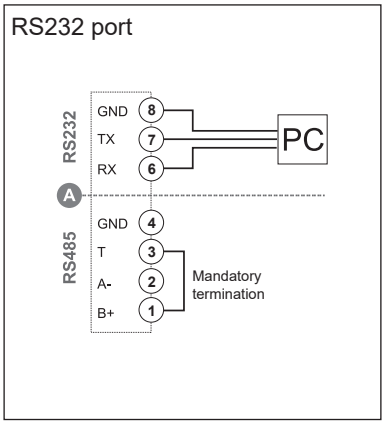




RS485 and RS232 wiring diagrams

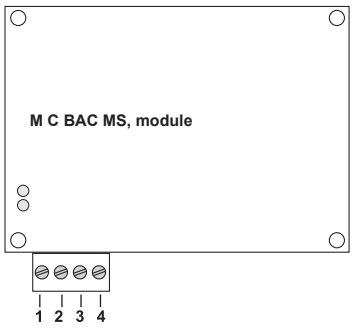


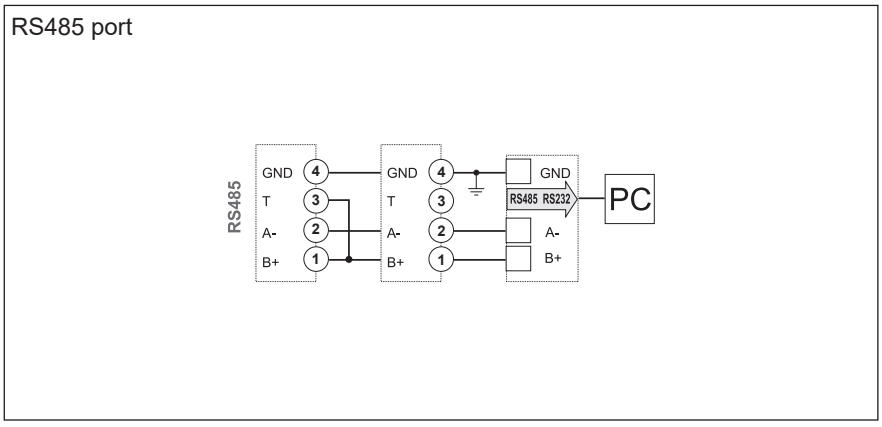




NOTE. RS485: additional devices provided with RS485 are connected in parallel. The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (B+) and (T). The (A) communication RS232 and RS485 ports **can't be** connected and used simultaneously.

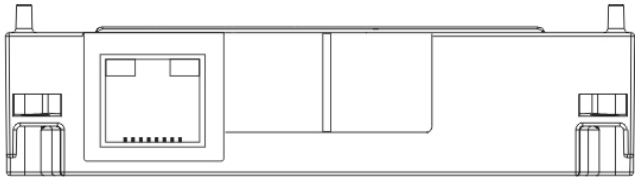
RS485 wiring diagram of Bacnet module





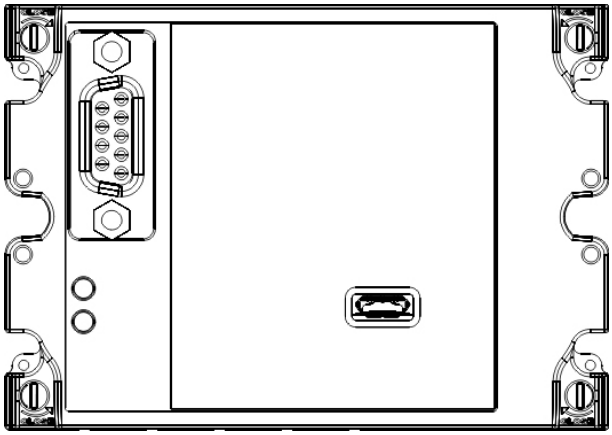
NOTE. RS485: additional devices provided with RS485 are connected in parallel. The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (B+) and (T).

Ethernet and BACnet-IP connections



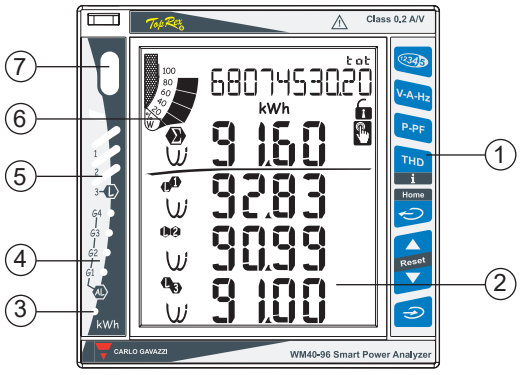
Connection to Ethernet or BACnet modules using the RJ45 connector.

Profibus module connections



Connection to the Profibus module using USB micro type B (Modbus RTU) and RS485 DB9 (Profibus DP-V0).

Front panel description



1. **Key-pad**
   To program the configuration parameters and scroll the variables on the display.
2. **Display**
   LCD-type with alphanumeric indications to:
   - display configuration parameters;
   - display all the measured variables.
3. **kWh LED**
   Red LED blinking proportional to the energy being measured.
4. **Alarm LED's**
   Red LED's light-on when virtual alarms are activated.
5. **Multiple bar-graph**
   To show at a glance the status of the single phases L1-L2-L3.
6. **Main bar-graph**
   To display the power consumption versus the installed power.
7. **Optical communication port**
   To program the working parameters, to read the measurements and to download the stored data.

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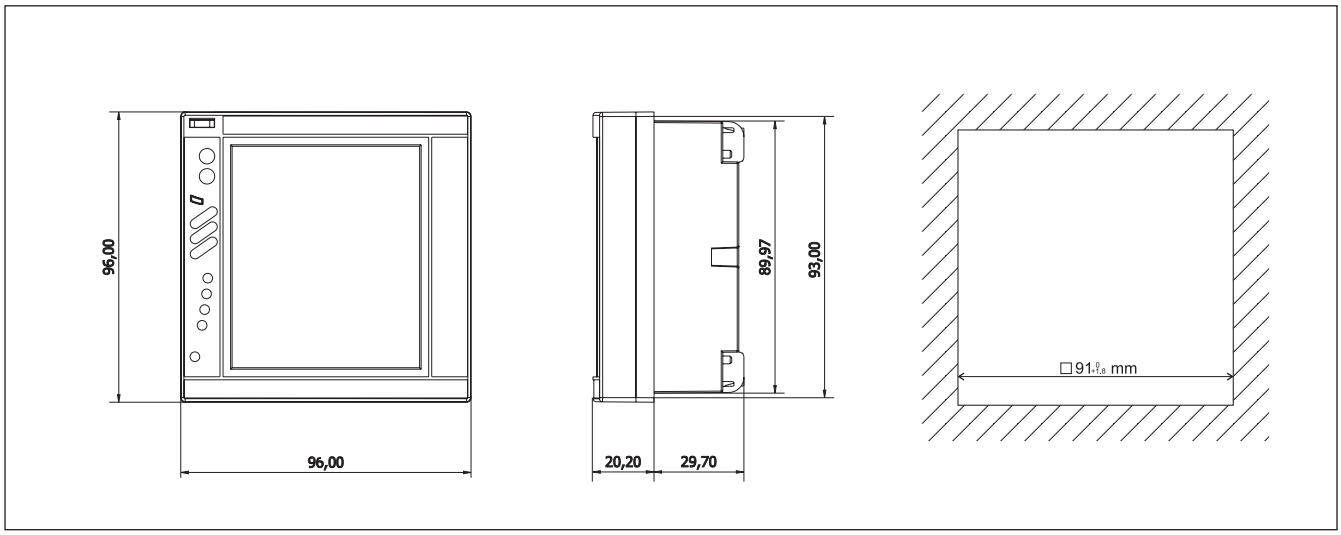
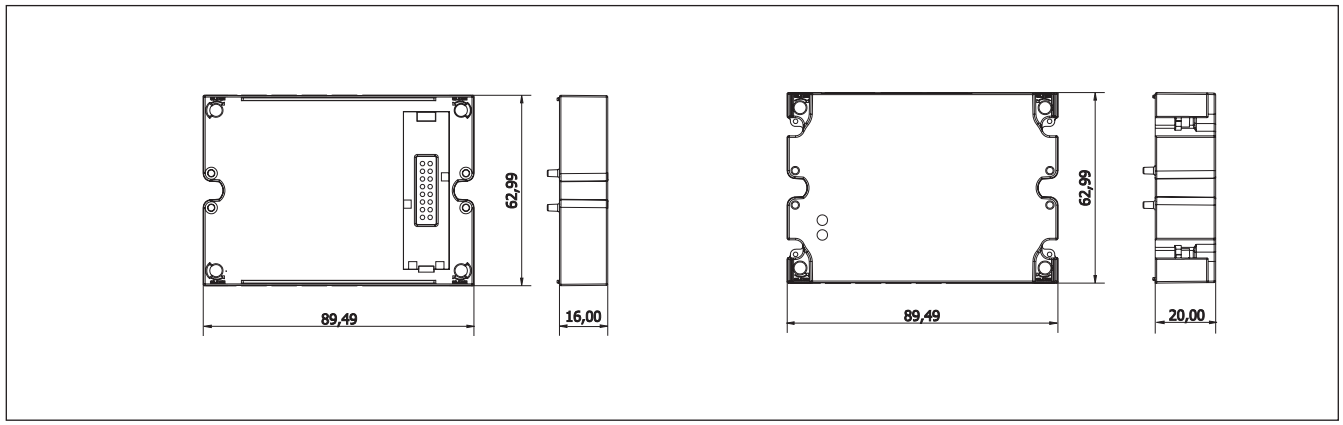
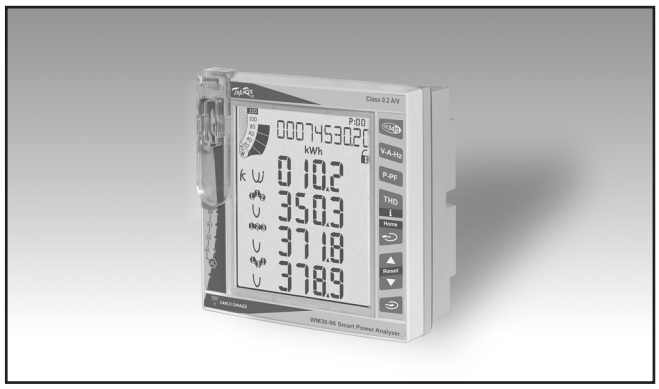
Dimensions and Panel cut-out





Energy Management
Smart Modular Power Analyzer
Type WM30 96



- **Communication protocol: MODBUS-RTU**
- **MODBUS TCP/IP Ethernet port (on request)**
- **BACnet-IP over Ethernet port (on request)**
- **BACnet MS/TP over RS485, BTL approved (on request)**
- **Profibus DP V0 port, PROFIBUS Nutzerorganisation e.V. approved (on request)**
- **Up to 2 digital outputs (pulse, alarm, remote control) (on request)**
- **Up to 4 freely configurable virtual alarms**
- **Up to 2 analogue outputs (+20mA, +10VDC) (on request)**
- **Class 0.5S (kWh) according to EN62053-22**
- **Class 2 (kvarh) according to EN62053-23**
- **Accuracy ±0.2% RDG (current/voltage)**
- **Instantaneous variables readout: 4x4 DGT**
- **Energies readout: 9+1 DGT**
- **System variables: VLL, VLN, A, VA, W, var, PF, Hz, Phase-sequence-asymmetry-loss.**
- **Single phase variables: VLL, VLN, AL, An (calculated), VA, W, var, PF**
- **Both system and single phase variables with average and max calculation**
- **Harmonic analysis (FFT) up to the 32nd harmonic (current and voltage)**
- **Energy measurements (imported/exported): total and partial kWh and kvarh**
- **Energy measurements according to ANSI C12.20 CA 0.5, ANSI C12.1**
- **Run hours counter (8+2 DGT)**
- **Real time clock function**
- **Application adaptable display and programming procedure (Easyprog function)**
- **Universal power supply: 24-48 VDC/AC, 100-240 VDC/AC**
- **Front dimensions: 96x96 mm**
- **Front protection degree: IP65, NEMA4X, NEMA12**
- **One RS232 and RS485 port (on request)**

Product Description

Three-phase smart power analyzer with built-in advanced configuration system and LCD data displaying. Particularly recommended for the measurement of the main electrical variables. WM30 is based on a modular housing for panel mounting with IP65 (front) protection degree. Moreover, the analyzer can be provided with digital outputs that can be either for pulse proportional to the active and reactive energy being measured or/and for alarm outputs. The instrument can be equipped with the following modules: RS485/ RS232, Ethernet, BACnet-IP, BACnet MS/TP or Profibus DP V0 communication ports, pulse and alarm outputs. Parameters programming and data reading can be easily performed by means of UCS (Universal Configuration Software).

How to order

WM30-96 AV5 3 H R2 A2 S1 XX

- **Model**
- **Range code**
- **System**
- **Power Supply**
- **A Outputs**
- **B Outputs**
- **Communication**
- **Option**

Type Selection

Range codes

AV4: 3x220(380)...3x400(690)V 1(2)A
V_{LN}: 220 to 400 V_{LN}
V_{LL}: 380 to 690 V_{LL}

AV5: 3x220(380)...3x400(690)V 5(6)A
V_{LN}: 220 to 400 V_{LN}
V_{LL}: 380 to 690 V_{LL}

AV6: 3x57.7(100)...3x133(230)V 5(6)A
V_{LN}: 57.7 to 133 V_{LN}
V_{LL}: 100 to 230 V_{LL}

AV7: 3x57.7(100)...3x133(230)V 1(2)A
V_{LN}: 57.7 to 133 V_{LN}
V_{LL}: 100 to 230 V_{LL}

System

3: balanced and unbalanced load: 3-phase, 4-wire; 3-phase, 3-wire; 2-phase, 3-wire; 1-phase, 2-wire

Options

XX: none

Power supply

H: 100-240 +/-10% (90 to 255) VDC/AC (50/60 Hz)
L: 24-48 +/-15% (20 to 55) VDC/AC (50/60 Hz)

Communication

XX: none
S1: RS485/RS232 port
E2: Ethernet / Internet port
B1: BACnet (IP) over Ethernet
B3: BACnet (MS/TP) over RS485
P1: Profibus DP/V0 port

A Outputs

XX: none
O2: Dual channel static output
R2: Dual channel relay output

B Outputs

XX: none
A2: Dual channel 20mA DC output
V2: Dual channel 10V DC output

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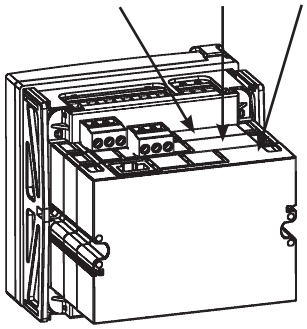
Position of modules and combination

Ref	Description	Main features	Part number	Pos. A	Pos. B	Pos. C
1	WM30 base provided with display, power supply, measuring inputs	• Inputs/system: AV5.3 • Power supply: H	WM30 AV5 3 H			
2		• Inputs/system: AV6.3 • Power supply: H	WM30 AV6 3 H			
3		• Inputs/system: AV4.3 • Power supply: H	WM30 AV4 3 H			
4		• Inputs/system: AV7.3 • Power supply: H	WM30 AV7 3 H			
		• Inputs/system: AV5.3 • Power supply: L	WM30 AV5 3 L			
		• Inputs/system: AV6.3 • Power supply: L	WM30 AV6 3 L			
		• Inputs/system: AV4.3 • Power supply: L	WM30 AV4 3 L			
		• Inputs/system: AV7.3 • Power supply: L	WM30 AV7 3 L			
5	Dual relay output (SPDT)	• 2-channel • Alarm or/and pulse output	M O R2	X		
6	Dual static output (AC/DC Opto-Mos)	• 2-channel • Alarm or/and pulse output	M O O2	X		
7	Dual analogue output (+20mADC)	• 2-channel	M O A2		X	
8	Dual analogue output (+10VDC)	• 2-channel	M O V2		X	
9	RS485 / RS232 port module	• Max. 115.2 Kbps	M C 485 232			X
10	Ethernet port module	• RJ45 10/100 BaseT	M C ETH			X
11	BACnet-IP port module	• Based on Ethernet bus	M C BAC IP			X
12	BACnet-MS/TP port module	• Over RS485	M C BAC MS			X
13	Profibus module	• Profibus DP V0 • Over RS485	M C P B			X



NOTE:

The position of the modules shall respect the sequence A-B-C. Possible arrangements are M, M-A, M-B, M-C, M-A-B, M-A-C, M-B-C and M-A-B-C where “M” is the basic module (WM30-96).

It is possible to use the WM30-96 without any additional module as a simple indicator.

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Input specifications

Rated inputs	System type: 1, 2 or 3-phase
Input type	Galvanic insulation by means of built-in CT's
Current range (by CT)	AV5 and AV6: 5(6)A AV4 and AV7: 1(2)A
Voltage (by direct connection or VT/PT)	AV4, AV5: 3x220(380)...3x400(690)V AV6, AV7: 3x57.7(100)...3x133(230)V
Accuracy (Display + RS485) (@23°C ±2°C,	0.01In=0.05A (AV5, AV6 - kWh, PF=1) 0.01In=0.01A (AV4, AV7 - kWh, PF=1) 0.05In=0.25A (AV5, AV6 - kWh, PF=1) 0.05In=0.05A (AV4, AV7 - kWh, PF=1)
	In: see below, Un: see below
AV4 model	In: 1A, Imax: 2A; Un: 220 to 400VLN (380 to 690VLL)
AV5 model	In: 5A, Imax: 6A; Un: 220 to 400VLN (380 to 690VLL)
AV6 model	In: 5A, Imax: 6A; Un: 57.7 to 133VLN (100 to 230VLL)
AV7 model	In: 1A, Imax: 2A; Un: 57.7 to 133VLN (100 to 230VLL)
Current AV4, AV5, AV6, AV7 models	From 0.01In to 0.05In: ±(0.5% RDG +2DGT) From 0.05In to Imax: ±(0.2% RDG +2DGT)
Phase-neutral voltage	In the range Un: ±(0,2% RDG +1DGT)
Phase-phase voltage	In the range Un: ±(0.5% RDG +1DGT)
Voltage tolerance	Un -20%, Un +15%
Frequency	From 40 to 65 Hz ±(0.02% RDG + 1 DGT), From 65 to 340 Hz ±(0.05% RDG + 1 DGT). From 340 to 440 Hz ±(0.1% RDG + 1 DGT)
Active and Apparent power	From 0.01In to 0.05In, PF 1: ±(1%RDG+1DGT) From 0.05In to Imax PF 0.5L, PF1, PF0.8C: ±(0.5%RDG+1DGT)
Power Factor	±[0.001+0.5% (1.000 - "PF RDG")]
Reactive power	From 0.02In to 0.05In, senφ 1: ±(1.5%RDG+1DGT) From 0.05In to Imax, senφ 1: ±(1%RDG+1DGT) From 0.05In to 0.1In, senφ 0.5L/C: ±(1.5%RDG+1DGT) From 0.1In to Imax, senφ 0.5L/C: ±(1%RDG+1DGT)
Active energy	Class 0.5S according to EN62053-22, ANSI C12.20
Reactive energy	Class 2 according to EN62053-23, ANSI C12.1.
Start up current AV5, AV6	5mA
Start up current AV4, AV7	1mA
Energy additional errors	According to EN62053-22, ANSI C12.20,
Influence quantities	According to EN62053-23, ANSI C12.1
Total Harmonic Distortion (THD)	±1% FS (FS: 100%) AV4: Imin: 5mARMS; Imax: 3A; Umin: 30VRMS; Umax: 679Vp AV5: Imin: 5mARMS; Imax: 15Ap; Umin: 30VRMS; Umax: 679Vp AV6: Imin: 5mARMS; Imax: 15Ap; Umin: 30VRMS; Umax: 204Vp AV7: Imin: 5mARMS; Imax: 3A; Umin: 30VRMS; Umax: 204Vp
Temperature drift	≤200ppm/°C
Sampling rate	3200 samples/s @ 50Hz, 3840 samples/s @ 60Hz
Measurements	See "List of the variables that can be connected to:"
Method	TRMS measurements of distorted wave forms.
Coupling type	By means of CT's
Crest factor	AV5, AV6: ≤3 (15A max. peak) AV4, AV7: ≤3 (3A max. peak)
Current Overloads	
Continuous (AV5 and AV6)	6A, @ 50Hz
Continuous (AV4 and AV7)	2A, @ 50Hz
For 500ms (AV5 and AV6)	120A, @ 50Hz
For 500ms (AV4 and AV7)	40A, @ 50Hz
Voltage Overloads	
Continuous	1.2 Un
For 500ms	2 Un
Input impedance	
400VL-L (AV4 and AV5)	> 1.6MΩ
208VL-L (AV6 and AV7)	> 1.6MΩ
5(6)A (AV5 and AV6)	< 0.2VA
1(2)A (AV4 and AV7)	< 0.2VA
Frequency	40 to 440 Hz

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Output specifications

Relay outputs (M O R2)	
Physical outputs	2 (max. 1 module per instrument)
Purpose	For either alarm output or pulse output
Type	Relay, SPDT type AC 1-5A @ 250VAC; AC 15-1.5A @ 250VAC
Configuration	By means of the front key-pad or UCS software
Function	The outputs can work as alarm outputs but also as pulse outputs, remote controlled outputs, or in any other combination.
Alarms	Up alarm and down alarm linked to the virtual alarms, other details see Virtual alarms
Min. response time	≤200ms, filters excluded. Set-point on-time delay: “0 s”.
Pulse	
Signal retransmission	Total: +kWh, -kWh, +kvarh, -kvarh. Partial: +kWh, -kWh, +kvarh, -kvarh.
Pulse type	Programmable from 0.001 to 10.00 kWh/kvarh per pulse.The above listed variables can be connected to any output.
Pulse duration	30 ms (ON), ≥30 ms (OFF), according to EN62053-31
Remote controlled outputs	The activation of the outputs is managed through the serial communication port
Insulation	See “Insulation between inputs and outputs” table
Static outputs (M O O2)	Opto-Mos type
Physical outputs	2 (max. 1 module per instrument)
Purpose	For either pulse output or alarm output
Signal	V_{ON}: 2.5VAC/DC/max.100mA V_{OFF}: 42VDC max.
Configuration	By means of the front key-pad or UCS software
Function	The outputs can work as alarm outputs but also as pulse outputs, remote controlled outputs, or in any other combination.
Alarms	Up alarm and down alarm linked to the virtual alarms, other details see Virtual alarms
Min. response time	≤200ms, filters excluded. Set-point on-time delay: “0 s”.
Pulse	
Signal retransmission	Total: +kWh, -kWh, +kvarh, -kvarh. Partial: +kWh, -kWh, +kvarh, -kvarh.
Pulse type	Programmable from 0.001 to 10.00 kWh/kvarh per pulse.The above listed variables can be connected to any output.
Pulse duration	30 ms (ON), ≥30 ms (OFF), according to EN62053-31
Remote controlled outputs	The activation of the outputs is managed through the serial communication port
Insulation	See “Insulation between inputs and outputs” table
20mA analogue outputs (M O A2)	
Number of outputs	2 per module (max. 1 module per instrument)
Accuracy (@ 25°C ±5°C, R.H. ≤60%)	±0.2%FS
Range	0 to 20mA
Configuration	By means of the front key-pad or UCS software
Signal retransmission	The signal output can be connected to any instantaneous variable available in the table “List of the variables that can be connected to”.
Scaling factor	Programmable within the whole range of retransmission.
Response time	≤400 ms typical (filter excluded)
Ripple	≤1% (according to IEC 60688-1, EN 60688-1)
Total temperature drift	≤500 ppm/°C
Load	≤600Ω
Insulation	See “Insulation between inputs and outputs” table
10VDC analogue outputs (M O V2)	
Number of outputs	2 (max. 1 module per instrument)
Accuracy (@ 25°C ±5°C, R.H. ≤60%)	±0.2%FS
Range	0 to 10 VDC
Configuration	By means of the front key-pad or UCS software
Signal retransmission	The signal output can be connected to any instantaneous variable available in the table “List of the variables that can be connected to”.
Scaling factor	Programmable within the whole range of retransmission;
Response time	≤400 ms typical (filter excluded)
Ripple	≤1% (according to IEC 60688, EN 60688)
Total temperature drift	≤350 ppm/°C
Load	≥10kΩ
Insulation	See “Insulation between inputs and outputs” table

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Output specifications (cont.)

RS485 (on request)	
Type	Multidrop, bidirectional (static and dynamic variables)
Connections	2-wire Max. distance 1000m, termination directly on the module
Addresses	247, selectable by means of the front key-pad
Protocol	MODBUS/JBUS (RTU)
Data (bidirectional)	
Dynamic (reading only)	System and phase variables: see table “List of variables...”
Static (reading and writing only)	All the configuration parameters.
Data format	1 start bit, 8 data bit, no/ even/odd parity,1 stop bit
Baud-rate	Selectable: 9.6k, 19.2k, 38.4k, 115.2k bit/s
Driver input capability	1/5 unit load. Maximum 160 transceivers on the same bus.
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed anymore. In this case just the data reading is allowed.
Insulation	See “Insulation between inputs and outputs” table
RS232 port (on request)	
Type	Bidirectional (static and dynamic variables)
Connections	3 wires. Max. distance 15m
Protocol	MODBUS RTU /JBUS
Data (bidirectional)	
Dynamic (reading only)	System and phase variables: see table “List of variables...”
Static (reading and writing only)	All the configuration parameters
Data format	1 start bit, 8 data bit, no/ even/odd parity,1 stop bit
Baud-rate	Selectable: 9.6k, 19.2k, 38.4k, 115.2k bit/s
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed anymore. In this case just the data reading is allowed.
Insulation	See “Insulation between inputs and outputs” table

Ethernet/Internet port (on request)	
Protocols	Modbus TCP/IP
IP configuration	Static IP / Netmask / Default gateway
Port	Selectable (default 502)
Client connections	Max 5 simultaneously
Connections	RJ45 10/100 BaseTX Max. distance 100m
Data (bidirectional)	
Dynamic (reading only)	System and phase variables: see table “List of variables...”
Static (reading and writing only)	All the configuration parameters.
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed anymore. In this case just the data reading is allowed.
Insulation	See “Insulation between inputs and outputs” table
BACnet-IP (on request)	
Protocols	BACnet-IP (for measurement reading purpose and to write object description) and Modbus TCP/IP (for measurement reading purpose and for programming parameter purpose)
BACnet-IP	
IP configuration	Static IP / Netmask / Default gateway
Port	Fixed: BAC0h
Device object instance	0 to 9999 selectable by key-pad 0 to 2^22-2 = 4.194.302, selectable by programming software or by BACnet.
Supported services	“I have”, “I am”, “Who has”, “Who is”, “Read (multiple) Property”
Supported objects	Type 2 (analogue value, including COV property), Type 5 (binary-value for up to 4 virtual alarm re-transmission) Type 8 (device)
IP configuration	Static IP / Netmask / Default gateway
Modbus TCP/IP	See “Ethernet/Internet port” above
Client connections	Modbus only: max 5 simultaneously
Connections	RJ45 10/100 BaseTX Max. distance 100m

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Output specifications (cont.)

Data	
Dynamic (reading only)	System and phase variables (BACnet-IP and Modbus): see table “List of variables”
Static (reading and writing only)	All the configuration parameters (Modbus only)
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed anymore. In this case just the data reading is allowed.
Insulation	See “Insulation between inputs and outputs” table
BACnet MS/TP (on request)	
Available ports	2: RS485 and Ethernet
RS485 port	
Type	Multidrop, mono-directional (dynamic variables)
Connections	2-wire Max. distance 1000m, termination directly on the module
Device object instance	0 to 9999 selectable by key-pad 0 to 2^22-2 = 4.194.302, selectable by programming software or by BACnet.
Protocol	BACnet MS/TP (for measurement reading purpose and to write object description)
Supported services	“I have”, “I am”, “Who has”, “Who is”, “Read (multiple) Property”
Supported objects	Type 2 (analogue value, including COV property), Type 5 (binary-value for up to 4 virtual alarm re-transmission) Type 8 (device)
Data (mono-directional)	
Dynamic	System and phase variables: see table “List of variables...”
Static	Not available
Data format	1 start bit, 8 data bit, no parity,1 stop bit
Baud-rate	Selectable: 9.6k, 19.2k, 38.4k or 76.8k kbit/s
Driver input capability	1/5 unit load. Maximum 160 transceivers on the same bus.
MAC addresses	Selectable: 0 to 127

Ethernet port	
Protocol	Modbus TCP/IP (for programming parameter purpose)
IP configuration	Static IP / Netmask / Default gateway
Modbus Port	Selectable (default 502)
Client connections	Modbus only: max 5 simultaneously
Connections	RJ45 10/100 BaseTX Max. distance 100m
Data	
Dynamic (reading only)	System and phase variables: see table “List of variables...”
Static (reading and writing only)	All the configuration parameters (Modbus only).
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed anymore. In this case just the data reading is allowed.
Insulation	See “Insulation between inputs and outputs” table
Approval	BTL
Profibus (MCPB)	
Available ports	2: USB and Profibus DP V0
USB	
Purpose	Programmable parameters setting
Connector	USB micro B
Protocol	Modbus RTU
Data format	1 start bit, 8 data bit, no parity,1 stop bit
Baudrate	autorange depending on the master (max 115200 bps)
Address	1
Profibus	
Purpose	Data reading (12 programmable profiles realtime selectable); remote output control; remote tariff control;
Modules Selectable:	output up to 4 bytes, input up to 62 words
Data format (profiles)	totalizers : FLOAT or INT32; electrical variables: FLOAT or INT16; status variables : UINT16
Connector	RS485 DB9

Output specifications (cont.)

Protocol	Profibus DP V0 slave
Baudrate	9.6 k to 12 Mbps (9.6, 19.2, 45.45, 93.75, 187.5, or 500 kbps; 1.5, 3, 6, or 12 Mbps)
Address	2-125 (default 126)
Note	With the rotary switch (on the back of the basic unit) in lock position the modification of the programming parameters and the reset command by means of the serial communication is not allowed. In this case just the data reading is allowed.
Insulation	See “Insulation between inputs and outputs” table
Approval	PROFIBUS Nutzerorganisation e.V.

Energy meters

Meters	
Total	4 (8+2, 9+1, 10 digit)
Partial	4 (8+2, 9+1, 10 digit)
Pulse output	Connectable to total and/or partial meters
Energy meter recording	Storage of total and partial energy meters. Energy meter storage format (EEPROM)
	Min. -9,999,999,999 kWh/kvarh Max. 9,999,999,999 kWh/kvarh.
Type	
Total energy meters	+kWh, +kvarh, -kWh, -kvarh
Partial energy meters	+kWh, +kvarh, -kWh, -kvarh

Harmonic distortion analysis

Analysis principle	FFT
Harmonic measurement	
Current	Up to the 32nd harmonic
Voltage	Up to the 32nd harmonic
Type of harmonics	THD (VL1 and VL1-N) The same for the other phases: L2, L3. THD (AL1)
	The same for the other phases: L2, L3.
System	The harmonic distortion can be measured in 3-wire or 4-wire systems. Tw: 0.02 sec@50Hz without filter

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Display, LED's and commands

Display refresh time	≤ 250 ms
Display	4 lines, 4-DGT, 1 lines, 10-DGT
Type	LCD, single colour backlight
Digit dimensions	4-DGT: h 9.5mm; 10-DGT: h 6.0mm
Instantaneous variables read-out	4-DGT
Energies variables read-out	Imported Total/Partial: 8+2DGT, 9+1DGT or 10DGT; Exported Total/Partial: 8+2DGT, 9+1DGT or 10DGT (with "-" sign).
Run Hours counter	8+2 DGT (99.999.999 hours and 59 minutes max)
Overload status	EEEE indication when the value being measured is exceeding the "Continuous inputs overload" (maximum measurement capacity)
Max. and Min. indication	Max. instantaneous variables: 9999; energies: 9 999 999 999. Min. instantaneous variables: 0.000; energies 0.00
Front position LEDs	
Virtual alarms	4 red LED available in case of virtual alarm (AL1-AL2-AL3-AL4). Note: the real alarm is just the activation of the proper static or relay output if the proper module is available.
Energy consumption kWh pulsating	Red LED (only kWh) 0.001 kWh/kvarh by pulse if the Ct ratio by VT ratio is ≤7 0.01 kWh/kvarh by pulse if the Ct ratio by VT ratio is ≥7.1 ≤70.0 0.1 kWh/kvarh by pulse if the Ct ratio by VT ratio is ≥70.1 ≤700.0 1 kWh/kvarh by pulse if the Ct ratio by VT ratio is ≥700.1 ≤7000 10 kWh/kvarh by pulse if the Ct ratio by VT ratio is ≥7001 ≤70.00k 100 kWh/kvarh by pulse if the Ct ratio by VT ratio is >70.01k Max frequency: 16Hz, according to EN 62052-11
Back position LEDs	
On the base	Green as power-on
On the communication modules	Two LEDs: one for TX (green) and one for RX (amber).
Key-pad	For variable selection, programming of the instrument working parameters, "dmd", "max", total energy and partial energy Reset

Main functions

Password	Numeric code of max. 4 digits; 2 protection levels of the programming data:
1st level	Password "0", no protection;
2nd level	Password from 1 to 9999, all data are protected
System selection	
System 3-Ph.n unbalanced load	3-phase (4-wire)
System 3-Ph. unbalanced load	3-phase (3-wire), three currents and 3-phase to phase voltage measurements, or in case of Aaron connection two currents (with special wiring on screw terminals) and 3-phase to phase voltage measurements.
System 3-Ph.1 balanced load	3-phase (3-wire), one current and 3-phase to phase voltage measurements 3-phase (4-wire), one current and 3-phase to neutral voltage measurements.
System 3-Ph.2 balanced load	3-phase (2-wire), one current and 1-phase (L1) to neutral voltage measurement.
System 2-Ph	2-phase (3-wire)
System 1-Ph	1-phase (2-wire)
Transformer ratio	
VT (PT)	1.0 to 999.9 / 1000 to 9999.
CT	1.0 to 999.9 / 1000 to 9999 (up to 10kA in case of CT with 1A secondary current and up to 50kA in case of CT with 5A secondary current).
Maximum CT ratio x VT ratio	9999 x 9999
Filter	
Operating range	Selectable from 0 to 100% of the input display scale
Filtering coefficient	Selectable from 1 to 32
Filter action	Measurements, analogue signal retransmission, serial communication (fundamental variables: V, A, W and their derived

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Main functions (cont.)

	ones).
Displaying	
Number of variables	Up to 5 variables per page. See “Front view”. 7 different set of variables available (see “Display pages”) according to the application being selected. One page is freely programmable as combination of variables.
Backlight	The backlight time is programmable from 0 (always on) to 255 minutes
Virtual alarms	
Working condition	In case of basic unit or with the addition of M O R2 or M O O2 digital output modules.
No. of alarms	Up to 4
Working mode	Up alarm and down alarm.
Controlled variables	The alarms can be connected to any instantaneous variable available in the table “List of the variables that can be connected to”.
Set-point adjustment	From 0 to 100% of the display scale
Hysteresis	From 0 to 100% of the display scale
On-time delay	0 to 255s
Min. response time	≤ 200ms, filters excluded. Set-point on-time delay: “0 s”.
Reset	By means of the front key-pad. It is possible to reset the following data: - all the max and dmd values. - total energies: kWh, kvarh; - partial energies: kWh, kvarh
Harmonic analysis	Up to the 32nd harmonics on current and voltage
Clock	
Functions	Universal clock and calendar.
Time format	Hour: minutes: seconds with selectable 24 hours or 12H AM/PM format.
Date format	Day-month-year with selectable DD-MM-YY or MM-DD-YY format.
Battery life	10 years
Easy programming function	The displayed energy is always “imported” with the only exception of “C”, “D”, “E” and “G” types (see “display pages” table). For those latter selections the energies can be either “imported” or “exported” depending on the current direction.

General specifications

Operating temperature	-25°C to +55°C (-13°F to 131°F) (R.H. from 0 to 90% non-condensing @ 40°C) according to EN62053-21, EN62053-23
Storage temperature	-30°C to +70°C (-22°F to 158°F) (R.H. < 90% non-condensing @ 40°C) according to EN62053-21, EN62053-23
Installation category	Cat. III (IEC60664, EN60664)
Insulation (for 1 minute)	See “Insulation between inputs and outputs” table
Dielectric strength	4kVAC RMS for 1 minute
Noise rejection CMRR	100 dB, 48 to 62 Hz
EMC Immunity and emissions	According to EN62052-11

General specifications (cont.)

Standard compliance	
Safety	IEC60664, IEC61010-1 EN60664, EN61010-1 EN62052-11.
Metrology	EN62053-22, EN62053-23.
Pulse output	IEC62053-31
Approvals	Eligible System performance Meter for Go Solar California, CE, cULus "Listed"
Connections	Screw-type
Cable cross-section area	max. 2.5 mm^2. min./max. screws tightening torque: 0.4 Nm / 0.8 Nm. Suggested screws tightening torque: 0.5 Nm
Housing DIN	
Dimensions (WxHxD)	Module holder: 96x96x50mm. "A" and "B" type modules: 89.5x63x16mm. "C" type module: 89.5x63x20mm.
Max. depth behind the panel	With 3 modules (A+B+C): 81.7 mm
Material	Polycarbonate/ABS/Nylon PA66, self-extinguishing: UL 94 V-0
Mounting	Panel mounting
Protection degree	
Front	IP65, NEMA4x, NEMA12
Screw terminals	IP20
Weight	Approx. 420 g (packing included)

Insulation between inputs and outputs

	Power Supply (H o L)	Mesuring inputs	Relay output (MOR2)	Static ouput (MOO2)	Serial port	Ethernet port	Analogue outputs
Power Supply (H o L)	-	4kV	4kV	4kV	4kV	4kV	4kV
Mesuring inputs	4kV	-	4kV	4kV	4kV	4kV	4kV
Relay output (MOR2)	4kV	4kV	2kV	-	4kV	4kV	4kV
Static ouput (MOO2)	4kV	4kV	-	2kV	4kV	4kV	4kV
Serial port	4kV	4kV	4kV	4kV	-	-	4kV
Ethernet port	4kV	4kV	4kV	4kV	-	-	4kV
Analogue outputs	4kV	4kV	4kV	4kV	4kV	4kV	4kV(1)

(1): respect another module 4kV, in the same module 0kV.
-: combination not allowed.
NOTE: all the models have, mandatory, to be connected to external current transformers because the isolation among the current inputs is just functional (100VAC).

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List of the variables that can be connected to:

- Communication port (all listed variables)
- Analogue outputs (all variables with the only exclusion of “energies” and “run hour counter”
- Pulse outputs (only “energies”)
- Alarm outputs (“energies”, “hour counter” and “max” excluded)

No	Variable	1-ph. sys (1P)	2-ph. sys (2P)	3-ph. 3-wire balanced sys (3P.1)	3-ph. 2-wire balanced sys (3P.2)	3-ph. 3-wire unbal. sys (3P)	3-ph. 4-wire unbal. sys (3P.n)	Notes
1	VL-N sys	O	X	X	X	#	X	sys= system= ∑
2	VL1	X	X	X	X	#	X	
3	VL2	O	X	H	H	#	X	(H)=VL1
4	VL3	O	O	H	H	#	X	(H)=VL1
5	VL-L sys	O	#	X	X	X	X	sys= system= ∑
6	VL1-2	#	X	X	P	X	X	(P)=VL1*1.73
7	VL2-3	#	O	X	P	X	X	(P)=VL1*1.73
8	VL3-1	#	O	X	P	X	X	(P)=VL1*1.73
9	Asys	O	X	O	O	X	X	
10	An	#	X	O	O	O	X	
11	AL1	X	X	X	X	X	X	
12	AL2	O	X	K	R	X	X	(R)=AL1
13	AL3	O	O	K	R	X	X	(R)=AL1
14	VA sys	X	X	X	X	X	X	sys= system= ∑
15	VA L1	X	X	X	X	O	X	
16	VA L2	O	X	U	U	O	X	(U)=VAL1
17	VA L3	O	O	U	U	O	X	(U)=VAL1
18	var sys	X	X	X	X	X	X	sys= system= ∑
19	var L1	X	X	X	X	O	X	
20	var L2	O	X	V	V	O	X	(V)=VARL1
21	var L3	O	O	V	V	O	X	(V)=VARL1
22	W sys	X	X	X	X	X	X	sys= system= ∑
23	WL1	X	X	X	X	O	X	
24	WL2	O	X	S	S	O	X	(S)=WL1
25	WL3	O	O	S	S	O	X	(S)=WL1
26	PF sys	X	X	X	X	X	X	sys= system= ∑
27	PF L1	X	X	X	X	O	X	
28	PF L2	O	X	T	T	O	X	(T)=PFL1
29	PF L3	O	O	T	T	O	X	(T)=PFL1
30	Hz	X	X	X	X	X	X	
31	Phase seq.	O	X	X	X	X	X	
32	Asy VLL	O	O	X	O	X	X	Asymmetry
33	Asy VLN	O	X	O	O	O	X	Asymmetry
34	Run Hours	X	X	X	X	X	X	
35	kWh (+)	X	X	X	X	X	X	Total
36	kvarh (+)	X	X	X	X	X	X	Total (1)
37	kWh (+)	X	X	X	X	X	X	Partial
38	kvarh (+)	X	X	X	X	X	X	Partial (1)
39	kWh (-)	X	X	X	X	X	X	Total
40	kvarh (-)	X	X	X	X	X	X	Total (1)
41	kWh (-)	X	X	X	X	X	X	Partial
42	kvarh (-)	X	X	X	X	X	X	Partial (1)
43	A L1 THD	X	X	X	X	X	X	
44	A L2 THD	O	X	F	F	X	X	(F)=AL1THD (F)=AL1THD
45	A L3 THD	O	O	F	F	X	X	
46	V L1 THD	X	X	X	X	O	X	(G)=VL1THD
47	V L2 THD	O	X	X	G	O	X	(G)=VL1THD
48	V L3 THD	O	O	X	G	O	X	
49	V L1-2 THD	X	X	X	#	X	X	
50	V L2-3 THD	O	X	X	#	X	X	
51	V L3-1 THD	O	O	X	#	X	X	

(X) = available; (O) = not available (variable not available); (#) Not available (the relevant page is not displayed)
(1): On 4 quadrants (ind/cap)

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Power supply specifications

Auxiliary power supply	H: 100-240 +/-10% (90 to 255) VDC/AC (50/60 Hz); L: 24-48 +/-15% (20 to 55) VDC/AC (50/60 Hz)	Power consumption	AC: 20 VA; DC: 10 W

List of selectable applications

	Description	Notes
A	Cost allocation	Imported energy metering (Easy connection)
B	Cost control	Imported and partial energy metering (Easy connection)
C	Complex cost allocation	Imported/exported energy (total and partial)
D	Solar	Imported and exported energy metering with some basic power analyzer function
E	Complex cost and power analysis	Imported/exported energy (total and partial) and power analysis
F	Cost and power quality analysis	Imported energy and power quality analysis (Easy connection)
G	Advanced energy and power analysis for power generation	Complete energy metering and power quality analysis

Display pages

Var Type	No	Line 1 Variable Type	Line 2 Variable Type	Line 3 Variable Type	Line 4 Variable Type	Line 5 Variable Type	Note	Applications						
								A	B	C	D	E	F	G
	0	Home page	Programmable					x	x	x	x	x	x	x
a	1	Total kWh (+)	b, c, d	b, c, d	b, c, d	b, c, d		x	x	x	x	x	x	x
a	2	Total kvarh (+)	b, c, d	b, c, d	b, c, d	b, c, d		x	x	x	x	x	x	x
a	3	Total kWh (-)	b, c, d	b, c, d	b, c, d	b, c, d				x	x	x		x
a	4	Total kvarh (-)	b, c, d	b, c, d	b, c, d	b, c, d				x	x	x		x
a	5	kWh (+) partial	b, c, d	b, c, d	b, c, d	b, c, d			x	x		x	x	x
a	6	kvarh (+) part.	b, c, d	b, c, d	b, c, d	b, c, d			x	x		x	x	x
a	7	kWh (-) partial	b, c, d	b, c, d	b, c, d	b, c, d				x		x		x
a	8	kvarh (-) part.	b, c, d	b, c, d	b, c, d	b, c, d				x		x		x
a	9	Run Hours (99999999.99)	b, c, d	b, c, d	b, c, d	b, c, d				x	x	x	x	x
b	10	a/Phase seq.	VLN ∑	VL1	VL2	VL3	(1) (2)				x	x	x	x
b	11	a/Phase seq.	VLN ∑	VL1-2	VL2-3	VL3-1	(1) (2)				x	x	x	x
b	12	a/Phase seq.	An	AL1	AL2	AL3	(1) (2)				x	x	x	x
b	13	a/Phase seq.	Hz	“ASY”	VLL sys (% asy)	VLL sys (% asy)	(1) (2)				x	x	x	x
b	14	a/Phase seq.	A ∑	AL1	AL2	AL3	(1) (2)				x	x	x	x
c	15	a/Phase seq.	W ∑	WL1	WL2	WL3	(1) (2)				x	x	x	x
c	16	a/Phase seq.	var ∑	var L1	var L2	var L3	(1) (2)					x	x	x
c	17	a/Phase seq.	PF ∑	PF L1	PF L2	PF L3	(1) (2)					x	x	x
c	18	a/Phase seq.	VA ∑	VA L1	VA L2	VA L3	(1) (2)					x	x	x
d	19	a/Phase seq.		THD V1	THD V2	THD V3	(1) (2)						x	x
d	20	a/Phase seq.		THD V12	THD V23	THD V31	(1) (2)						x	x
d	21	a/Phase seq.		THD A1	THD A2	THD A3	(1) (2)						x	x

Note: the table refers to system 3P.n.
(1) Also maximum value storage (no EEPROM storage).
(2) Also average (dmd) value (no EEPROM storage).

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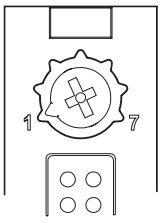
Additional available information on the display

No	Line 1	Line 2	Line 3	Line 4	Line 5	Note	Applications						
							A	B	C	D	E	F	G
1	Lot n. (text) xxxx	Yr. (text) xx	SYS (text)	x (1/2/3)	1...60 (min) “dmd”		x	x	x	x	x	x	x
2	Conn. xxx.x (3ph.n/3ph/3ph./ 3ph.2/1ph/2ph)	CT.rA (text)	1.0 … 99.99k	PT.rA (text)	1.0...9999		x	x	x	x	x	x	x
3	LED PULSE (text) kWh	xxxx kWh per pulse					x	x	x	x	x	x	x
4	PULSE out1 (text) kWh/kvarh	xxxx kWh/kvarh per pulse	+/- tot/PAr				x	x	x	x	x	x	x
5	PULSE out2 (text) kWh/kvarh	xxxx kWh/kvarh per pulse	+/- tot/PAr				x	x	x	x	x	x	x
6	Remote out	out1 (text)	on/oFF	Out2 (text)	on/oFF		x	x	x	x	x	x	x
7	Alarm 1 nE/nd	None / out 1 / out 2	Set 1	Set 2	(measurement)					x	x	x	x
8	Alarm 2 nE/nd	None / out 1 / out 2	Set 1	Set 2	(measurement)					x	x	x	x
9	Alarm 3 nE/nd	None / out 1 / out 2	Set 1	Set 2	(measurement)					x	x	x	x
10	Alarm 4 nE/nd	None / out 1 / out 2	Set 1	Set 2	(measurement)					x	x	x	x
11	Analogue 1	Hi:E	0.0 ... 9999	Hi.A	0.0 ... 100.0%					x	x	x	x
12	Analogue 2	Hi:E	0.0 ... 9999	Hi.A	0.0 ... 100.0%					x	x	x	x
13	COM port	None / out 1 / out 2	xxx (address)	bdr (text)	9.6/19.2/ 38.4/115.2		x	x	x	x	x	x	x
14	IP address	XXX	XXX	XXX	XXX		x	x	x	x	x	x	x

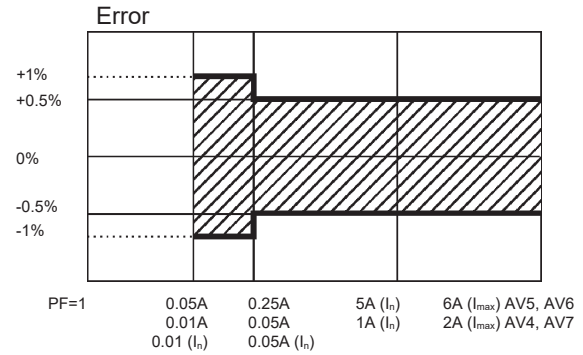
Back protection rotary switch

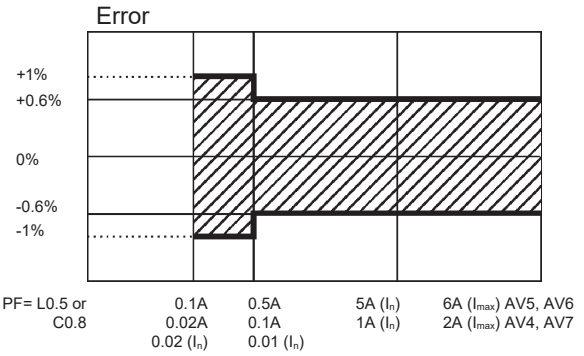


Function	Rotary switch position	Description
Unlok	1	All programming parameters are freely modifiable by means of the front key-pad and by means of the communication port.
Lock	7	The key-pad, as far as programming is concerned and the data through the serial communication cannot be changed (no writing into meter allowed). Data reading is allowed.

Accuracy (According to EN62053-22 and EN62053-23)

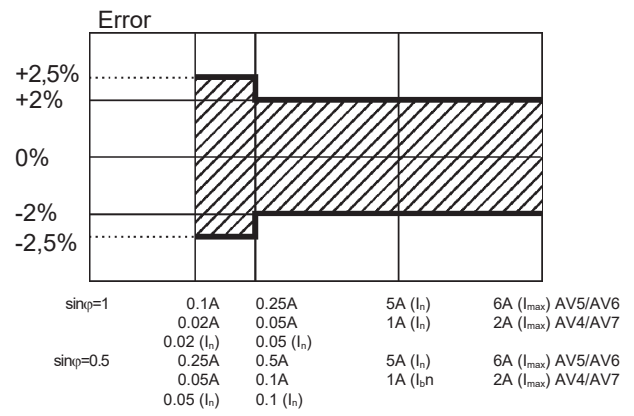
kWh, accuracy (RDG) depending on the current





Class 0.5S accuracy limits (Active energy)
Start-up current: 5mA (AV5-AV6), 1mA (AV4-AV7)

kvarh, accuracy (RDG) depending on the current



Class 2 accuracy limits (Reactive energy)
Start-up current: 5mA (AV5-AV6), 1mA (AV4-AV7)

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UCS parameter progr. and var. reading software

UCS Software

Multi-language software (Italian, English, French, German, Danish, Czech, Chinese, Spanish) for variable reading, and parameters programming (both online and offline). The program runs under Windows and following

Working mode

Four different working modes can be selected:
- management of local RS232 (MODBUS);
- management of local optical port (MODBUS)
- management of a local RS485 network (MODBUS);
- managed via TCP port

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

$$\cos\varphi_1 = \frac{W_1}{VA_1}$$

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

$$\mathrm{var}_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

System variables

Equivalent three-phase voltage

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

Voltage asymmetry

$$ASY_{LL} = \frac{(V_{LL\max} - V_{LL\min})}{V_{LL\,\Sigma}}$$

$$ASY_{LN} = \frac{(V_{LN\max} - V_{LN\min})}{V_{LN\,\Sigma}}$$

Three-phase reactive power

$$\mathrm{var}_\Sigma = (\mathrm{var}_1 + \mathrm{var}_2 + \mathrm{var}_3)$$

Three-phase active power

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

Three-phase apparent power

$$VA_\Sigma = \sqrt{W_\Sigma^2 + \mathrm{var}_\Sigma^2}$$

Total harmonic distortion

$$THD_N = 100 \frac{\sqrt{\sum_{n=2}^{N} |X_n|^2}}{|X_1|}$$

Three-phase power factor (TPF)

$$\cos\varphi_\Sigma = \frac{W_\Sigma}{VA_\Sigma}$$

Energy metering

$$k\,\mathrm{var}hi = \int_{t1}^{t2} Qi(t)dt \cong \Delta t \sum_{n1}^{n2} Qnj$$

$$kWhi = \int_{t1}^{t2} Pi(t)dt \cong \Delta t \sum_{n1}^{n2} Pnj$$

Where:

i= considered phase (L1, L2 or L3)
P= active power; **Q**= reactive power;
$\mathbf{t_1}$, $\mathbf{t_2}$ =starting and ending time points of consumption recording; **n**= time unit Δ;Δ**t**= time interval between two successive power consumptions;
$\mathbf{n_1}$, $\mathbf{n_2}$ = starting and ending discrete time points of consumption recording

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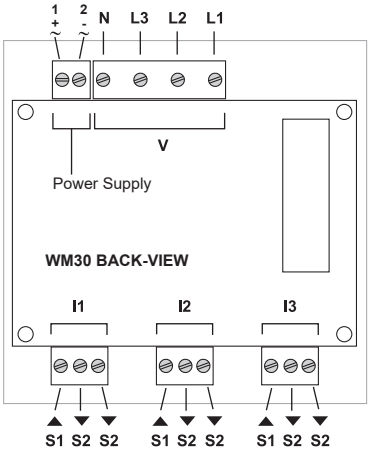
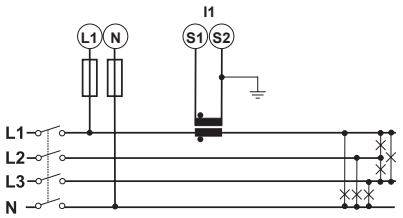
Wiring diagrams



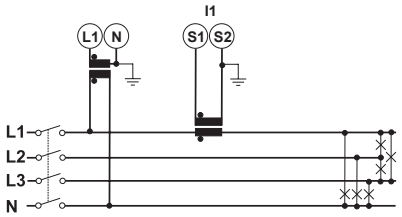
System type selection: 3-Ph.2

3-ph, 2-wire, balanced load **Fig. 1**



1-CT connection F=315 mA [T]

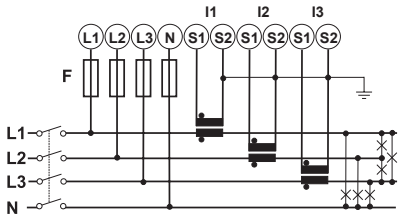
3-ph, 2-wire, balanced load **Fig. 2**



1-CT and 1-VT/PT connections

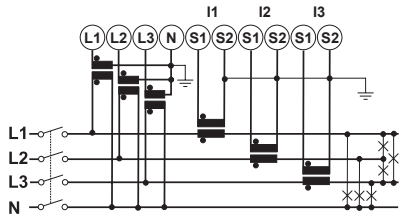
System type selection: 3-Ph.n

3-ph, 4-wire, unbalanced load **Fig. 3**



3-CT connection F=315 mA [T]

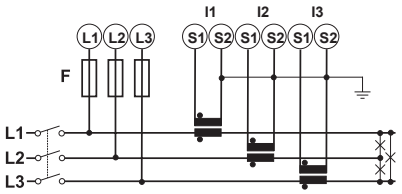
3-ph, 4-wire, unbalanced load **Fig. 4**



3-CT and 3-VT/PT connections

System type selection: 3-Ph

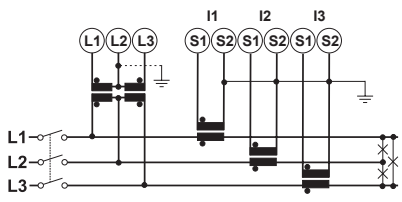
3-ph, 3-wire, unbalanced load **Fig. 5**



3-CT connection F=315 mA [T]

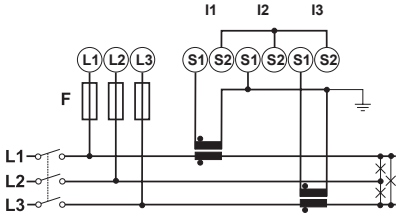
System type selection: 3-Ph (cont.)

3-ph, 3-wire, unbalanced load **Fig. 6**



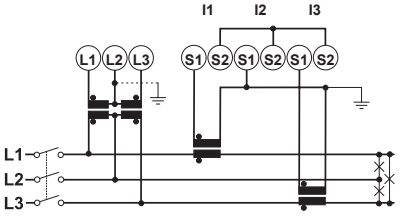
3-CT and 2-VT/PT connections

3-ph, 3-wire, unbalanced load **Fig. 7**



2-CT connections (ARON) F=315 mA [T]

3-ph, 3-wire, unbalanced load **Fig. 8**



2-CT and 2-VT/PT connections ARON

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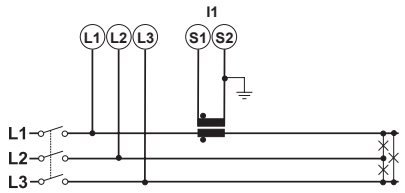
Wiring diagrams

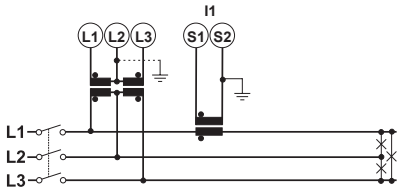
System type selection: 3-Ph.1

3-ph, 3-wire, balanced load **Fig. 9**



1-CT connections F=315 mA [T]

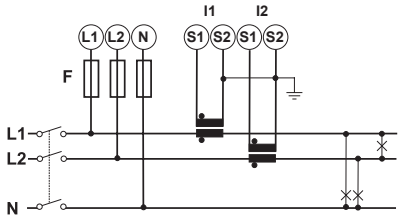
3-ph, 3-wire, balanced load **Fig. 10**



1-CT and 2-VT/PT connections

System type selection: 2-Ph

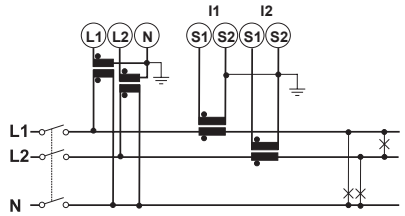
2-ph, 3-wire **Fig. 11**



2-CT connection F=315 mA [T]

System type selection: 2-Ph (cont.)

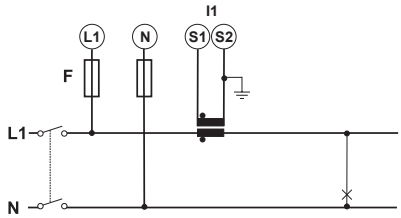
2-ph, 3-wire **Fig. 12**



2-CT and 2-VT/PT connections

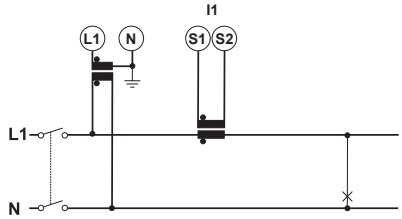
System type selection: 1-Ph

1-ph, 2-wire **Fig. 13**



1-CT connection F=315 mA [T]

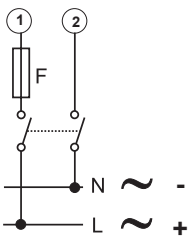
1-ph, 2-wire **Fig. 14**



1-CT and 1-VT/PT connections

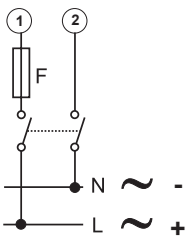
Power Supply

90 to 260VAC/DC (H option) **Fig. 15**



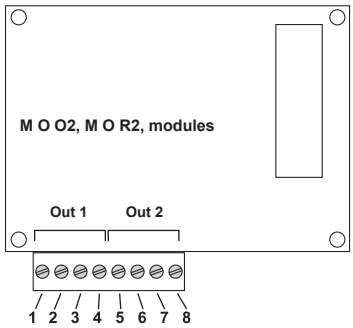
F= 250V [T] 630mA

18 to 60VAC/DC (L option) **Fig. 16**

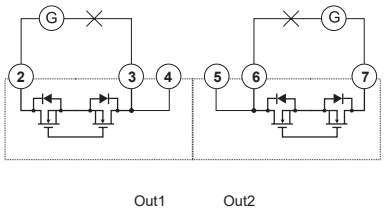


F= 250V [T] 3,15A

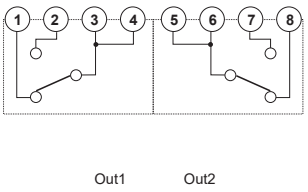
Static, relay and analogue outputs wiring diagrams

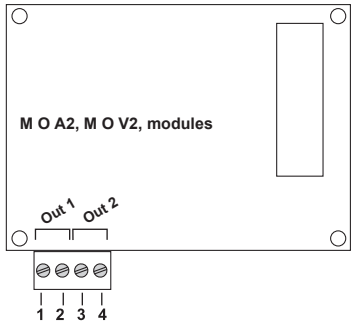


Opto-mosfet

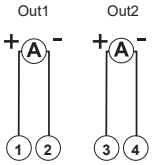


Relays

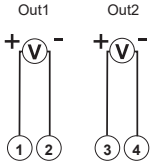




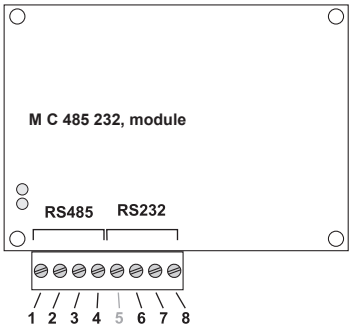
Analogue 20mA DC



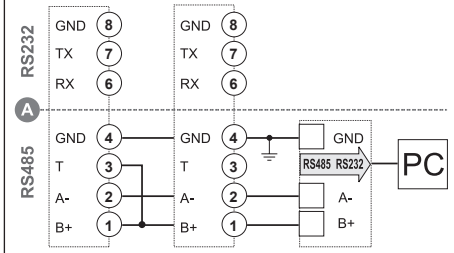
Analogue 10V DC



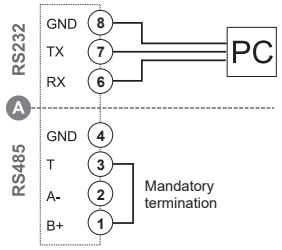
RS485 and RS232 wiring diagrams



RS485 port

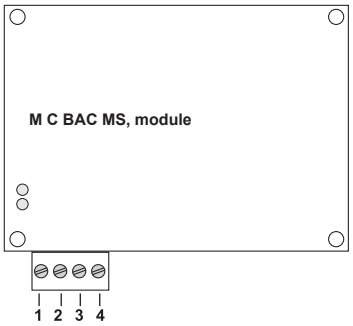


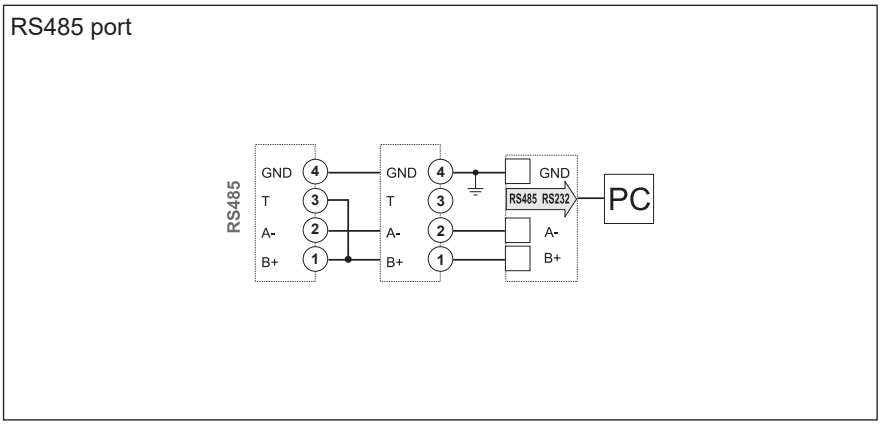
RS232 port



NOTE. RS485: additional devices provided with RS485 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 (B+) and (T). The communication RS232 and RS485 ports **can't be** connected and used simultaneously.

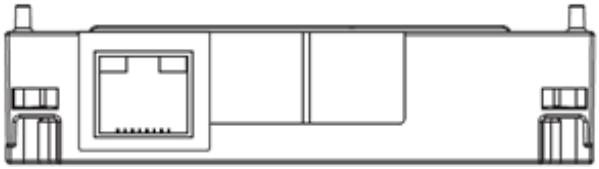
RS485 wiring diagram of Bacnet module





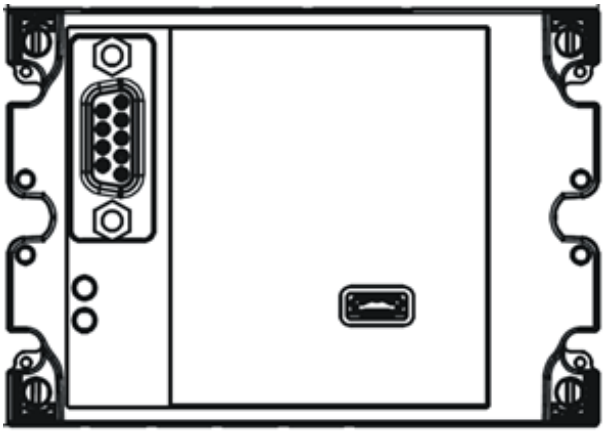
NOTE. RS485: additional devices provided with RS485 are connected in parallel. The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (B+) and (T).

Ethernet and BACnet-IP connections



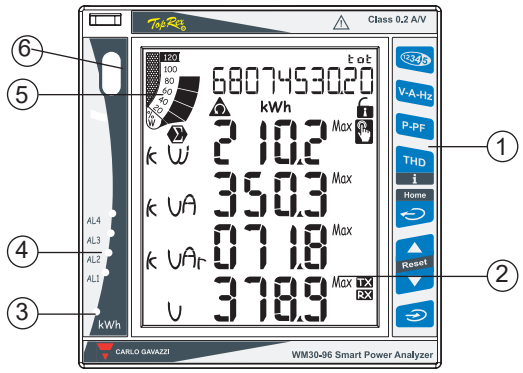
Connection to Ethernet or BACnet modules using the RJ45 connector.

Profibus module connections



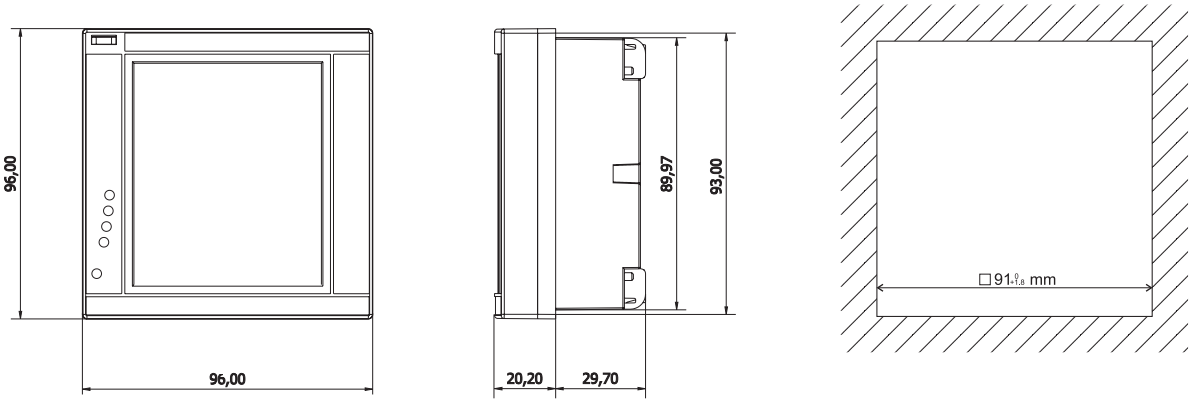
Connection to the Profibus module using USB micro type B (Modbus RTU) and RS485 DB9 (Profibus DP-V0).

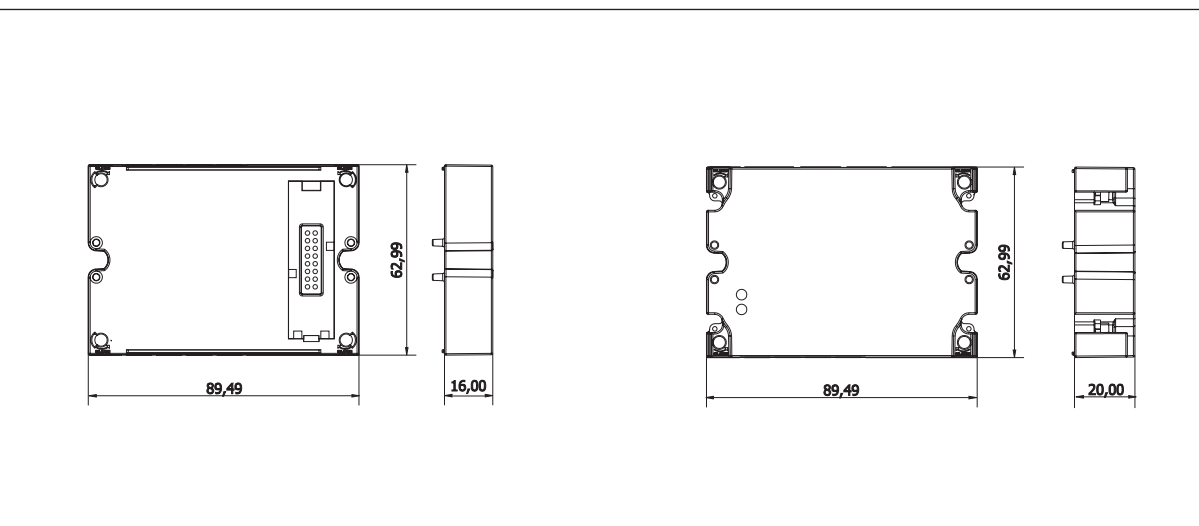
Front panel description



1. **Key-pad**
   To program the configuration parameters and scroll the variables on the display.
2. **Display**
   LCD-type with alphanumeric indications to:
   - display configuration parameters;
   - display all the measured variables.
3. **kWh LED**
   Red LED blinking proportional to the energy being measured
4. **Alarm LED's**
   Red LED's light-on when virtual alarms are activated.
5. **Main bar-graph**
   To display the power consumption versus the installed power.
6. **Optical communication port**
   To program the working parameters and to read the measurements.

Dimensions and Panel cut-out





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 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

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Input Specifications

Number of inputs	
Current	2 (system: single phase) 6 (system: 3-phase)
Voltage	2 (system: single phase 4 (system: 3-phase)
Digital	3 free of voltage contacts for Wdmd, VAdmd, An dmd, PFavg synchronization 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) ±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:	±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, AV5 range) or ±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 ±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 ±1% RDG (0.1 to 1.2 In, AV5 range)
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 distorsion (@ 25°C ± 5°C, R.H. ≤ 60%)	1% FS (FS: 100%) phase: ±2°; Imin: 0.1Arms; Imax: 15Ap; Umin: 50Vrms; 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
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 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). TRMS measurement of a distorted wave (voltage/current). Coupling type: Direct Crest factor: ≤3 (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) 58/100 V (>500 kΩ) - 5 AAC (≤ 0.3 VA) 240/415 V (>500 kΩ) - 1 AAC (≤ 0.3 VA) 240/415 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 range	40 to 440 Hz
Over-load protection	
Continuous: voltage/current	AV5: 300 V_{LN}/520 V_{LL}/6A 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: ”S” for enter programming phase and password confirmation, ”UP” and “DOWN” for value programming/function selection, page scrolling “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, 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

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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
Variables to be retransmitted	All (see table"List of the variables that can be connected to:"...)
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
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, 4000V_{RMS} output to measuring input 4000V_{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 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 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) 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) V_{ON} 1.2 VDC/ max. 100 mA V_{OFF} 30 VDC max. Outputs connectable to total and 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 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).
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 AC 1-8A, 250VAC DC 12-5A, 24VDC AC 15-2.5A, 250VAC DC 13-2.5A, 24VDC
Min. response time	≤ 150 ms, filter excluded, FFT excluded, setpoint on-time delay: "0s"
Insulation	4000 V_{RMS} output to measuring input, 4000V_{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).

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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
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, NEMA4x, NEMA12
Weight	Approx. 600 g (packing included)

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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.

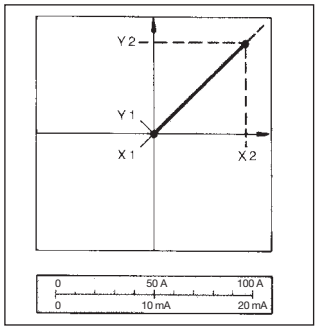


Figure B
The sign of measured quantity and output quantity changes simultaneously. The output quantity is proportional to the measured quantity.

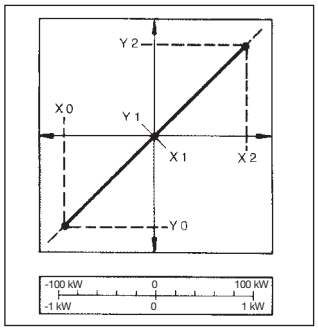


Figure C
The sign of measured quantity and output quantity remains the same. On the range X0...X1, the output quantity is zero. The range X1...X2 is delineated on the entire output range Y0 = Y1...Y2 and thus presented in strongly expanded form.

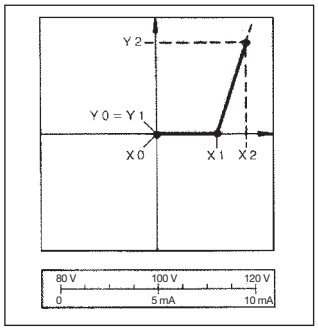


Figure D
The sign of measured quantity and output quantity remains the same. With the measured quantity being zero, the output quantity already has the value
Y1 = 0.2 Y2.
Live zero output.

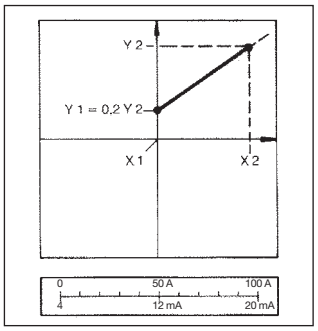


Figure E
The sign of the measured quantity changes but that of the output quantity remains the same. The output quantity steadily increases from value X1 to value X2 of the measured quantity.

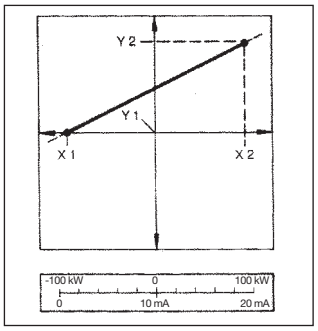
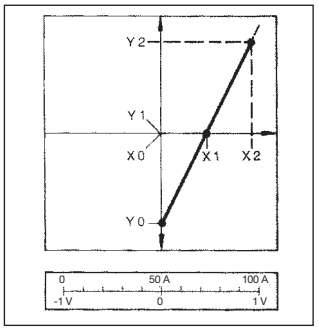


Figure F
The sign of the measured quantity remains the same, that of the output quantity changes as the measured quantity leaves range X0...X1 and passes to range X1...X2 and vice versa.



Mode of Operation

Waveform of the signals that can be measured

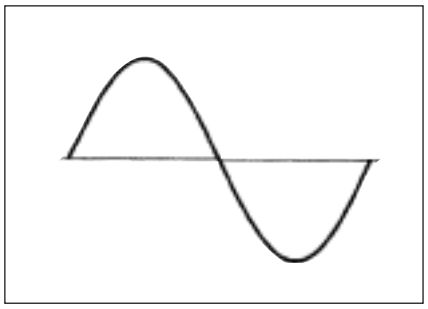


Figure G
Sine wave, undistorted

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

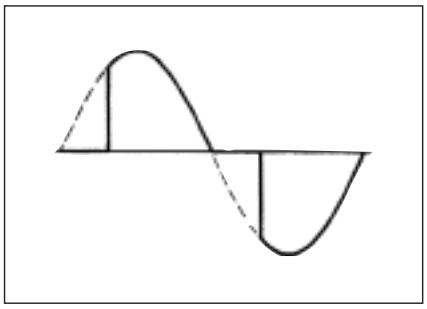


Figure H
Sine wave, indented

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

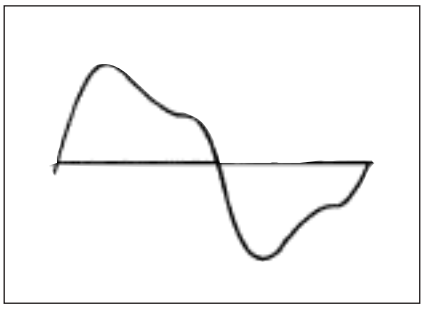


Figure I
Sine wave, distorted

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

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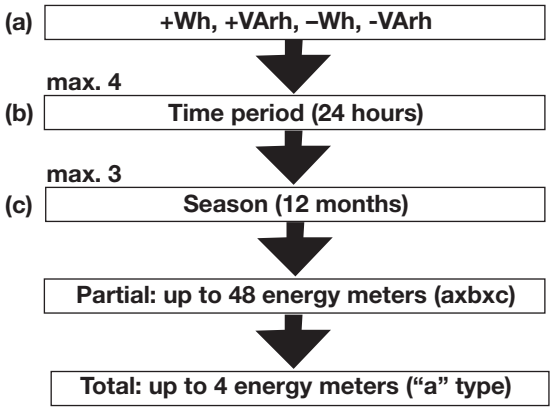
Harmonic distortion analysis

Analysis principle	FFT
Harmonic measurement	
Current	Up to 50th harmonic
Voltage	Up to 50th harmonic
Type of harmonics	THD (V_{L1}) THD odd (V_{L1}) THD even (V_{L1}) and also for the other phases: L2, L3. THD (I_{L1}) THD odd (I_{L1}) THD even (I_{L1}) 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

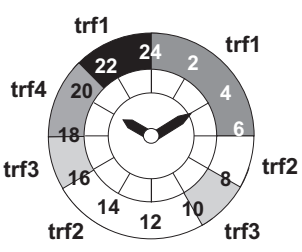
Energy time period management

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	Total: 4 (9-digit) Partial: 8 (6-digit)
Time periods	2, programmable within 24 hours
Multi time	
Number of energy meters	Total: 4 (9-digit) 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	

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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

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

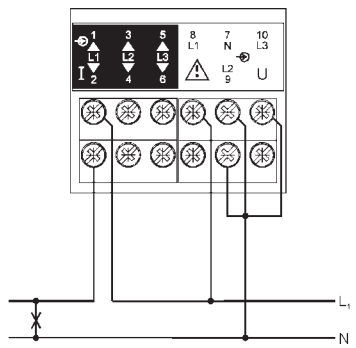
N2-Open Metasys protocol full compatibility (available on request).

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

Wiring Diagrams

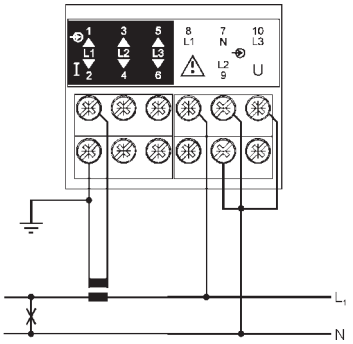
Single phase input connections

Fig. 1



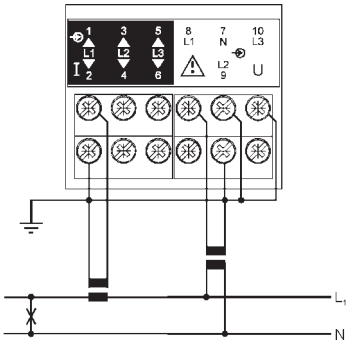
Direct connection

Fig. 2



CT connection

Fig. 3



CT and VT connection

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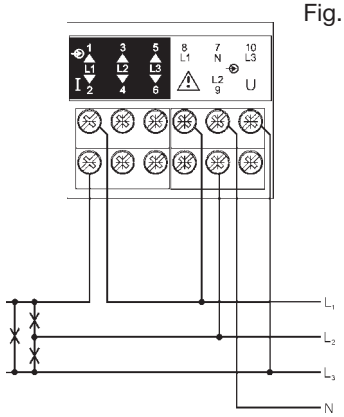
Wiring Diagrams (cont.)

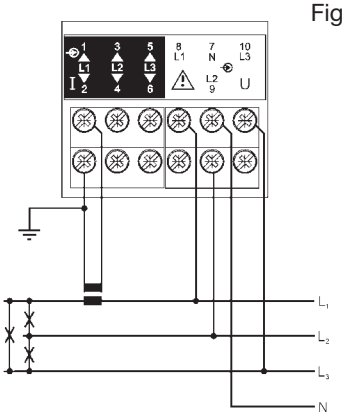
Three-phase wire input connections - Balanced loads

Fig. 4



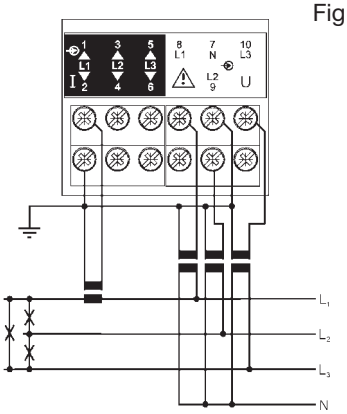
Direct connection (3-wire system)

Fig. 5



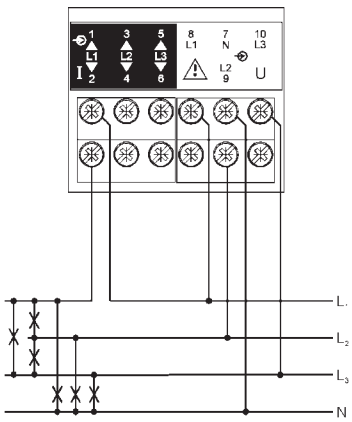
CT connection (3-wire system)

Fig. 6



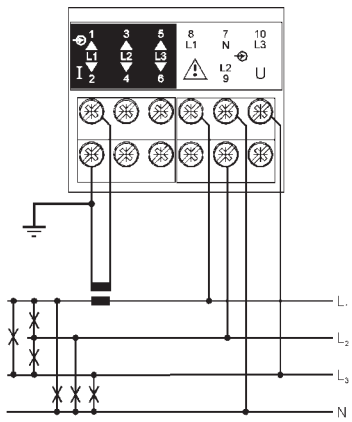
CT and VT connection (3-wire system)

Fig. 7



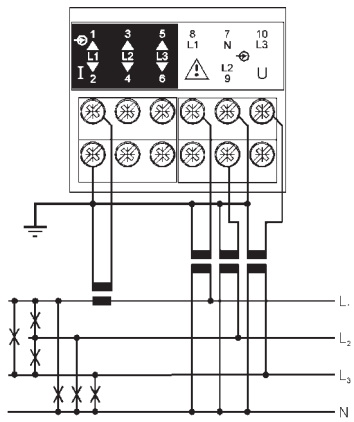
Direct connection (4-wire system)

Fig. 8



CT connection (4-wire system)

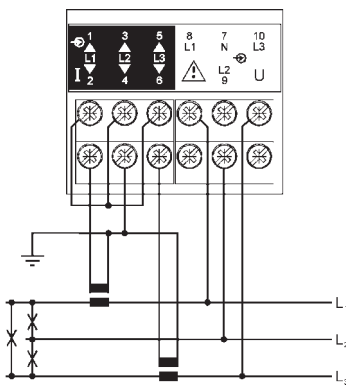
Fig. 9



CT and VT connection (4-wire system)

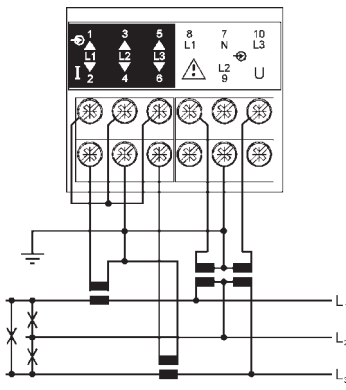
Three-phase, 3-wire ARON input connections - Unbalanced loads

Fig. 10



CT connection (3-wire system)

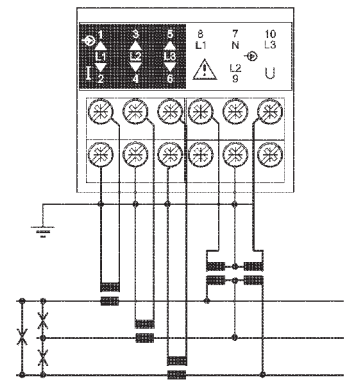
Fig. 11



CT and VT connection (3-wire system)

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

Fig. 12



CT and VT connection (3-wire system)

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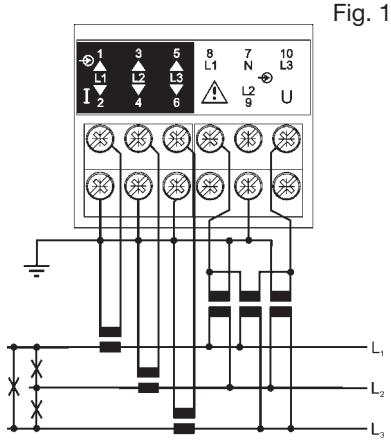
Wiring Diagrams (cont.)

Three-phase three-wire input connections
Unbalanced load

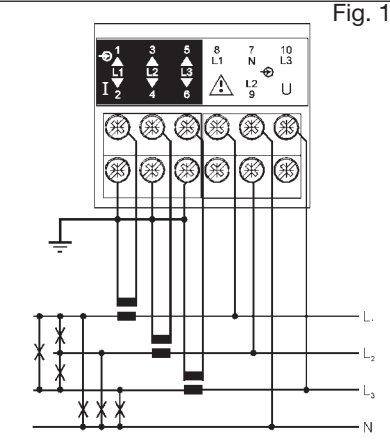
Fig. 13



CT connection (3-wire system)

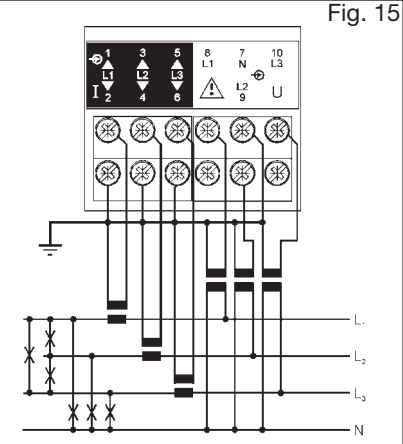
Three-phase four-wire input connections - Unbalanced load

Fig. 14



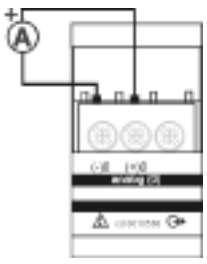
CT connection (4-wire system)

Fig. 15

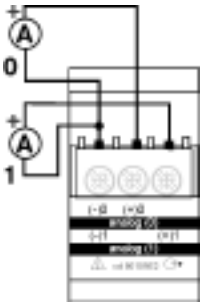


CT and VT connection (4-wire system)

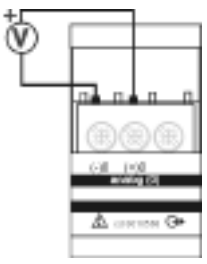
Wiring diagrams (optional modules)



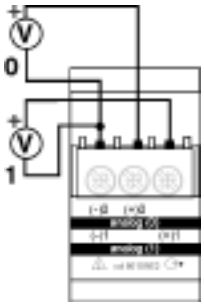
AO1050
1 analogue output (mA)



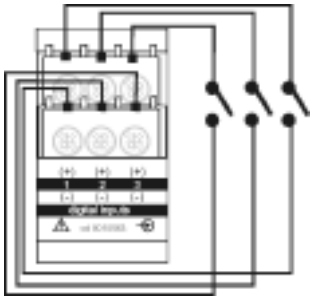
AO1026
2 analogue outputs (mA)



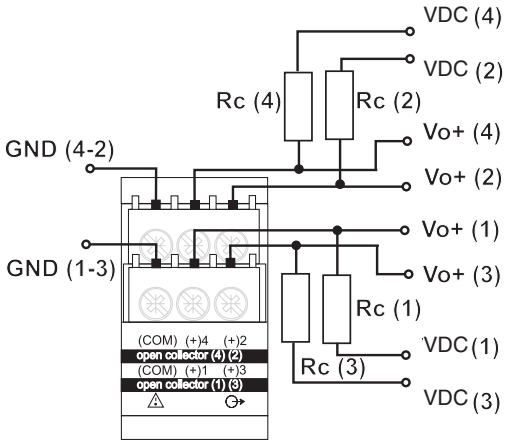
AO1051
1 analogue output (V)



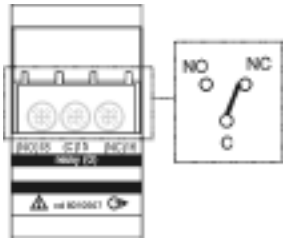
AO1027
2 analogue outputs (V)



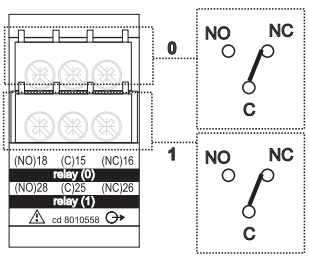
AO1038
3 digital inputs



AO1037



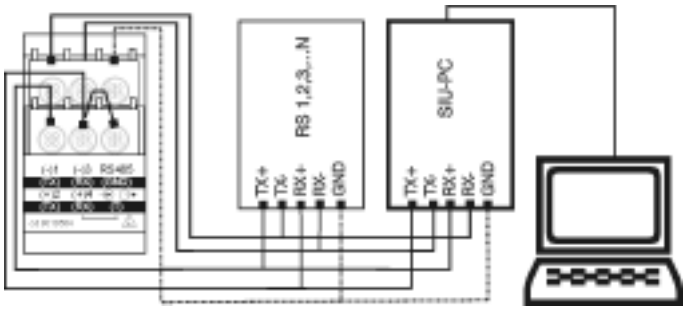
AO1058
1 relay output



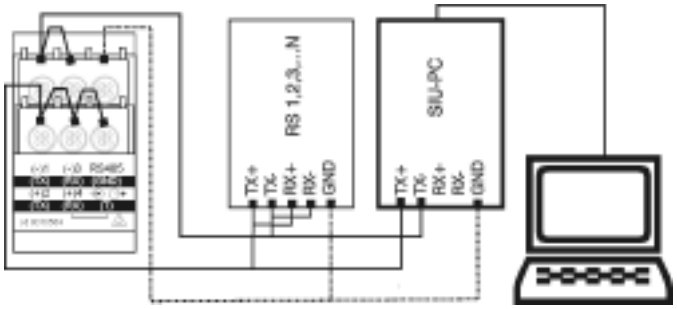
AO1035
2 relay outputs

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.)

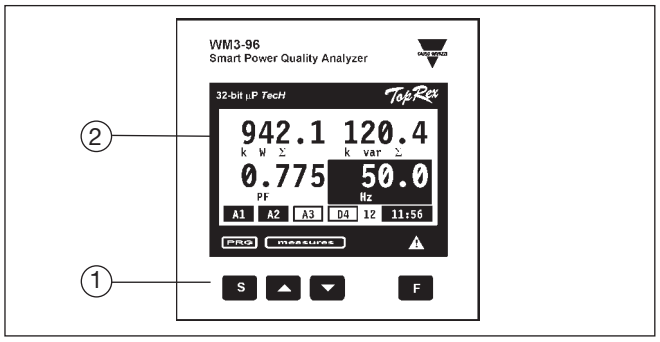


RS422/485 4-wires connection: additional devices provided with RS422/485 (that is RS 1, 2, 3...N) are connected in parallel.
The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (Rx+) and (T).



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

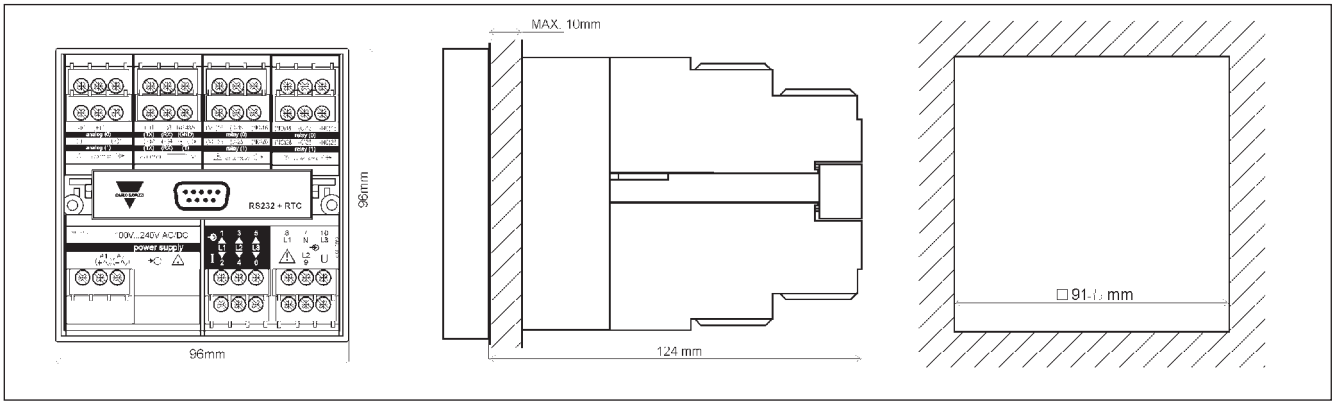


1. Key-pad
Set-up and programming procedures are easily controlled by the 4 pushbuttons.
- ”S” for enter programming phase and password confirmation,
- ▲ ▼ for value programming/function selection, page scrolling
- “F” for special functions

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

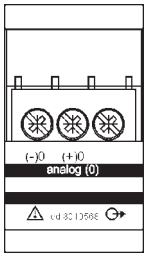
Alphanumeric indication by means of LCD display for:
- Displaying the configuration parameters
- All the measured variables.

Dimensions



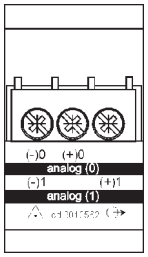
Terminal boards

Single analogue output modules



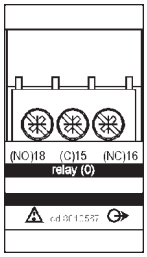
AO1050 (20mADC)
AO1051 (10VDC)
AO1052 (±5mADC)
AO1053 (±10mADC)
AO1054 (±20mADC)
AO1055 (±1VDC)
AO1056 (±5VDC)
AO1057 (±10VDC)

Dual analogue outputs

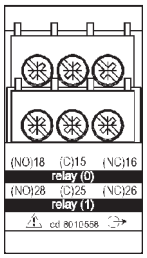


AO1026 (20mADC)
AO1027 (10VDC)
AO1028 (±5mADC)
AO1029 (±10mADC)
AO1030 (±20mADC)
AO1031 (±1VDC)
AO1032 (±5VDC)
AO1033 (±10VDC)

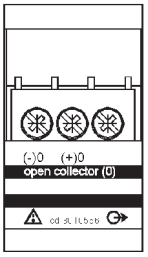
Digital output modules



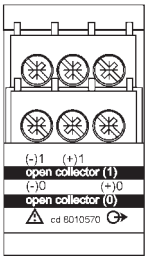
AO1058
Single relay output



AO1035
Dual relay output

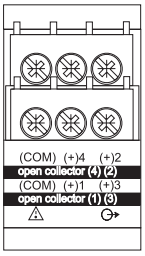


AO1059
Single open collector output

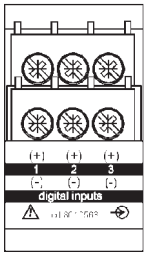


AO1036
Dual open collector output

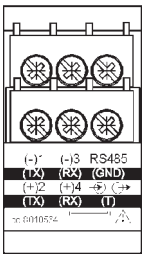
Other input/output modules



AO1037
4 open collector outputs



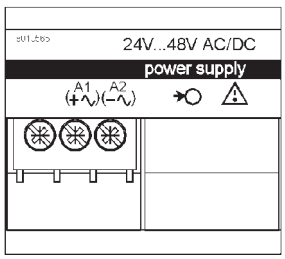
AQ1038
3 Digital inputs



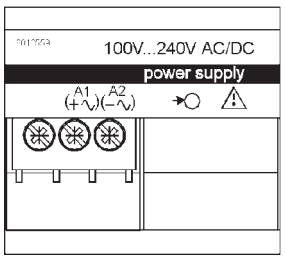
AR1034
RS485 port

AR1039
RS232 port + RTC

Power supply modules



AP1021
18-60VAC/DC power supply



AP1020
90-260 VAC/DC power supply

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

- **Front dimensions: 9 DIN modules**
- **Analogue output by means of optional module (20mA or 10VDC)**
- **RS 422/485 Serial port by means of optional module**
- **Alarm output by means of optional module**
- **Dual pulse output by means of optional module**
- **Control of phase asymmetry**
- **Class 0.5 (current/voltage)**
- **Three-phase power analyzer**
- **Back-lighted LCD**
- **4 x $3^1/_2$ DGT instantaneous variables read out**
- **$7^1/_2$ DGT energy read-out**
- **Measurements of system and phase variables: W, Wdmd, var, VA, VAdmd, PF (cosφ), V, A, Hz, THD-A, THD-V**
- **Measurements of total energies: kWh, kvarh**
- **Measurements of partial energies: kWh, kvarh**
- **Energy measurements according to EN61036 and EN61268**
- **TRMS measurements of distorted wave forms (voltages/currents)**
- **Two basic models: direct connection 20(100)AAC, CT 5(10)AAC and VT connection**
- **Maximum value indication of W dmd and VA dmd (only 5A version); maximum value indication of A (only 100A version)**
- **Self power supply (available for some models only) or auxiliary power supply: 24V, 48V, 115V, 230V, 50-60Hz; 18 to 60VDC, 77 to 143VDC**
- **Degree of protection (front): IP 40**

Product description

Three-phase power analyzer with built-in configuration keypad;
Particularly indicated for the analysis of main, secondary and energy metering electrical variables.
Housing for DIN-rail or wall-mounting, IP40 (front) protection degree.
Completely sealable housing.
In case of direct connection up to 100A, the measuring input terminals are suitable for cables with a cross-section area from 6 to 35 mm^2. The special design of the instrument's housing allows to add at any time the interface modules, even when the instrument is already installed.
The following modules are available:
- for all versions: pulses output;
- only for the versions with auxiliary power supply: analogue output, RS485 port, alarm output or BUS Dupline.

How to order

WM22-DIN AV5 3 X X XX

Model
Range code
System
Power supply
Slot A
Slot B

Important note:
- The models from AV0 to AV7 can be equipped with any type of available modules (slot A and B).
- The models AV8 and AV9 can be equipped only with the "O" and "R" type modules.
- The AV8 and AV9 models can measure all the parameters even if the three phase system being connected is missing one phase.
- The Av2 model is suitable only for three-phase unbalanced system without neutral.

Type selection

Range Code

Auxiliary Power Supply:
AV0: 208V_{L-L}/20(100)AAC [3]
AV1: 400V_{L-L}/20(100)AAC [1]
AV3: 660V_{L-L}/20(100)AAC [2]
AV4: 208V_{L-L}/5(10)AAC [3]
AV5: 400V_{L-L}/5(10)AAC [1]
AV6: 100V_{L-L}/5(10)AAC [3]
AV7: 660V_{L-L}/5(10)AAC [2]
Self Power Supply:
AV2: 220V_{L-L}/20(100)AAC [4]
AV8: 208V_{L-L}/20(100)AAC [1]
AV9: 400V_{L-L}/20(100)AAC [1]

System

3 : Three-phase, unbalanced load with or without neutral

Power supply

For all versions
A: 24VAC -15+10%, 50-60Hz
B: 48VAC -15+10%, 50-60Hz
C: 115VAC -15+10%, 50-60Hz
D: 230VAC -15+10%, 50-60Hz
4: 18 to 60VDC
5: 77 to 143VDC
AV2, AV8 and AV9 only
X: Self Power Supply
400V_{L-L} (-20+15%, 50-60Hz)
208V_{L-L} (-20+15%, 50-60Hz)
220V_{L-L} (-10+15%, 50-60Hz)

Slot A (retransmission)

X: None
O: AO2900 module
Dual open collector output
Three operating modes:
- two pulse outputs (kWh and kvarh);
- one alarm output and one pulse output (kWh or kvarh)
- one output which is remotely controlled by a serial port and one pulse output (kWh or kvarh)

R: AO2910 module.
One relay output + one open collector output.
Operation modes like module AO2900.

Slot B (retransmission)

Only with A-B-C-D-4 power supply
XX: None
A1: AO2920 module 0-20mADC analogue output
V1: AO2921 module 0-10VDC analogue output
S0: AR2950 module RS422/485 serial port

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

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Input specifications

Number of inputs	
Current	3
Voltage	4
Accuracy (display, RS485)	Ib: 5A, Imax: 10A Ib: 20A, Imax:100A Un: see previous page "Range code"
Current	from 0.003Ib to 0.2Ib: ±(0.5%RDG +3DGT) from 0.2Ib to Imax: ±(0.5%RDG +1DGT)
Voltage	in the range Un: ±(0,5% RDG + 1DGT)
Frequency	±0.1% RDG (50 to 60 Hz)
Active power (@ 25°C ± 5°C, R.H. ≤ 90%)	±(1% RDG +1DGT). PF 1, 0.1Ib to Imax, in the Un range; PF 0.5L, PF 0.8C, 0.2Ib to Imax, in the Un range
Reactive power (@ 25°C ± 5°C, R.H. ≤ 90%)	±(2% RDG +1DGT). sinφ 1, 0.05Ib to Imax, in the Un range; sinφ 0.5L, sinφ 0.5C, 0.1Ib to Imax, in the Un range
Apparent power (@ 25°C ± 5°C, R.H. ≤ 90%)	±(1% RDG +1DGT). PF 1, 0.1Ib to Imax, in the Un range
Energies (@ 25°C ± 5°C, R.H. ≤ 90%)	Class 1 acc. to EN61036 Class 2 acc. to EN61268 Ib: 5A, Imax: 10A 0.1Ib: 500mA, Start up corrent: 20mA Un: see table "range code" Ib: 20A, Imax: 100A 0.1Ib: 2A, Start up current: 80mA Un: see table "range code"
Harmonic distortion (@ 25°C ± 5°C, R.H. ≤ 90%)	±3% f.s. (f.s.: 100%) up to the 7th harmonic; Un: see table "range code"
Ib 5A	Imin: 500mA; Imax: 15Ap;
Ib 20A	Imin: 2A; Imax: 127Ap;

Additional errors	Acc. to EN61036, EN61268
Wave form	<1% (3rd harmonic: 10%)
Voltage asymmetry	< 0.5% (referred to Un)
Magnetic induction	0 (up to 0.5 mT)
HF Electromagnetic fields	< 1%
Operation of accessories	0
Temperature drift	≤ 200ppm/°C
Sampling rate	1000 samplings/s @ 50Hz
Display	
Type	Back-lighted LCD
Instantan. variables read-out	4x3½ DGT
Energies	Total:1x7½ DGT Partial: 1x7½ DGT
Max. and Min. indication	Max. 1999 (19999999), Min. 0
Measurements	Current, voltage, power, energy, power factor, frequency, harmonic distortion (see display specs). TRMS measurements of distorted wave forms.
Coupling type	Direct
Crest factor	
Ib 5A	≤3 (15A max. peak)
Ib 20A	≤6 (127A max. peak)
Current overload	
5(10) A, for 10ms	300 A max, @ 50Hz
5(10) A, for 500ms	200 A max, @ 50Hz
5(10) A, permanent	10A, @ 50Hz
20(100) A, for 10ms	2700A max, @ 50Hz
20(100) A, permanent	100A, @ 50Hz
Voltage overload	
Permanent	1.2 Un
For 1s	2 Un
Input impedance	
400V_{L-L} (AV1-AV5-AV9)	> 720KΩ
208V_{L-L} (AV0-AV4-AV8-AV2)	> 720KΩ
660V_{L-L} (AV3-AV7)	> 1.97MΩ
100V_{L-L} (AV6)	> 400KΩ
5(10) A (AV4-AV5-AV6-AV7)	< 0.3VA
20(100) A (AV0-AV1-AV3-AV8-AV9)	< 4VA
20(100) A (AV2)	< 4VA
Frequency	50 to 60 Hz

Interface module specifications

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

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Interface module specifications (cont.)

	2000 V_{RMS} between output and power supply input
RS422/RS485 (on request)	AR2950 module
Type	Multidrop bidirectional (static and and dynamic variables)
Connections	2 or 4 wires, max. distance 1000m, termination directly on the module
Addresses	255, selectable by key-pad
Protocol	MODBUS/JBUS
Data (bidirectional)	
Dynamic (reading only)	Phase and system variables: see table “Display pages”
Static (writing only)	All the programming data, reset of energy, activation of static output.
	Stored energy (EEPROM) max. 19.999.999 kWh/kvarh
Data format	1 start bit, 8 data bit, no parity, 1 stop bit
Baud-rate	9600 bit/s
Insulation	By means of optocouplers, 2000 V_{RMS} output to measuring inputs 2000 V_{RMS} output to supply input
Digital outputs (on request)	
AO2900 module	To be used as alarm, energy retransmission, or remote static outputs.
	Three working modes are selectable: • two pulse outputs (kWh and kvarh); • one alarm output and one pulse output (kWh or kvarh) • one output remotely controlled by means of the serial port and one pulse output (kWh or kvarh)
Pulse outputs	
Number of outputs	2
Number of pulses	From 0.01 to 100 pulses programmable according to the selected CT and VT ratios
Output type	Open collector (transistor NPN) V_{ON} 1.2 VDC / max. 100 mA V_{OFF} 30 VDC max.
Pulse duration	220 ms (ON), ≥ 220 ms (OFF)
Insulation	According to DIN43864 By means of optocouplers, 2000 V_{RMS} outputs to measuring inputs, 2000 V_{RMS} output to supply input. Insulation between the two outputs: functional
Alarm output	
Number of outputs	1
Alarm type	Up alarm, down alarm phase asymmetry, phase loss.
Setpoint adjustment	0 to 100% of the electrical scale
Hysteresis	0 to 100% of the electrical scale
On-time delay	0 to 255 seconds
Response time	
system variables	V, W, VA, var, PF (cosφ) 700ms
FFT off, filter off	1.2s
FFT on, filter on variables	THD-V, THD-A 3s
Filter off	
Output type	Open collector (transistor NPN) V_{ON} 1.2 VDC / max. 100 mA V_{OFF} 30 VDC max.
Insulation	By means of optocouplers, 2000 V_{RMS} output to measuring input, 2000 V_{RMS} output to supply input. Insulation between the two outputs: functional
AO2910 module	Relay + open collector output. Working mode like AO2900.
Pulse output	One static output+one relay output, other characteristics like AO2900.
Alarm output	Only relay output, other characteristics like AO2900.
Output type	Static type like module AO2900; Relay type: SPDT, AC1, AC15: 1AAC @250VAC
Insulation	By means of optocouplers, 2000 V_{RMS} outputs to measuring inputs, 2000 V_{RMS} output to supply input. Insulation between the two outputs: 2000 V_{RMS}

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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 1000, all data are protected
System selection	Three-phase with neutral Three-phase without neutral
Transformer ratio	
CT	1 to 5000
VT	1.0 to 199.9 and 200 to 1999 Note: The CT ratio* VT ratio must never exceed the value 5000. The current measuring inputs can manage CT's with a secondary of 1A and 5A (the accuracy always refer to 5A)
Scaling factor	
Operating mode	Compression/expansion of the measuring range to be connected to the analogue output.
Electrical range	Programmable within the whole measuring range.
Filter	
Filter operating range	0 to 99.9% of the input electrical scale.
Filter coefficient	1 to 16
Filter action	Alarm, analogue and serial output (fundamental variables: V, A, W and their derived ones).
Display	Up to 4 variables per page
System variables	Page 1: W-var-PF (cosφ) Page 2: W dmd - VA dmd - Hz
Single phase variables	Page 3: THD-V Page 4: THD-A
System variables	Page 5: kWh total Page 6: kvarh total Page 7: kWh partial Page 8: kvarh partial
Single phase variables	Page 9: V_{L-N} Page 10: A
20(90) A 5(10) A	Page 11a: A_{MAX} Page 11b: W dmd $_{MAX}$ VA dmd $_{MAX}$
	Page 12: W Page 13: VA Page 14: var Page 15: PF (cosφ)

Supply specifications

Self supplied version	400V_{L-L} -20% +15%, 50-60Hz 208V_{L-L} -20% +15% , 50-60Hz 220V_{L-L} -10% +15% , 50-60Hz
Auxiliary power supply	230VAC -15 +10%, 50-60Hz 115VAC -15 +10%, 50-60Hz 48VAC -15 +10%, 50-60Hz 24VAC -15 +10%, 50-60Hz 18 to 60VDC 77 to 143VDC
Energy consumption	≤ 7VA

General Specifications

Operating temperature	0 to +55° C (32° F to 131°F) (R.H. < 90% non-condensing 40°C)
Storage temperature	-20 to +60°C (-4° F to +140°F) (R.H. < 90% non-condensing 40°C)
Installation category	Cat. III (IEC 664)
Insulation	2000 V_{RMS} between all inputs / outputs to earth
Dielectric strength	4000 V_{RMS} for 1 minute
Noise rejection	
CMRR	100 dB, 48 to 62 Hz
EMC	
Burst	4kV/level 4 (EN61000-4-4)
Immunity to irradiated electromagnetic fields	10V/m 26-1000MHz (EN61000-4-3)
Electrostatic discharges	15kV (EN61000-4-2)
Radio frequency emissions	according to CISPR 14 and CISPR 22
Pulse voltage (1.2/50µs)	8kV (EN61000-4-5)
Standards	
Safety	IEC664-1
Metrology	Energy measurements: EN61036, EN61268.
Pulse output	DIN43864
Approvals	CE
Connections 5(10) A	Screw-type,
Cable cross-section area	4 mm^2
Connections 20(90) A	Screw-type,
Min./Max. cable cross-section area	6 mm^2 / 35 mm^2
Min./Max. screws tightening torque	2 Nm / 6 Nm
Min./Max. screws tightening torque	0,4 Nm / 0,8 Nm (other outputs / inputs)
Housing	
Dimensions	162.5 x 90 x 63 mm
Material	ABS, NORYL, PC self-extinguishing: UL 94 V-0
Mounting	DIN-rail and wall
Degree of protection	Front: IP40 Connections: IP20
Weight	800 g approx. (packing included)

Function description

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

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

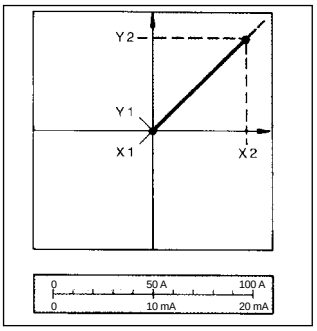


Figure B
The sign of measured quantity and output quantity remains the same. With the measured quantity being zero, the output quantity already has the value Y1 = 0.2 Y2.
Live zero output.

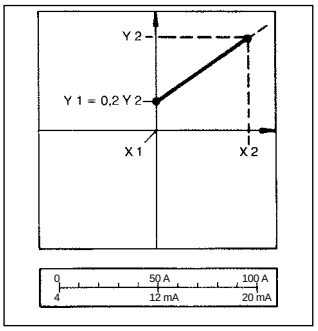
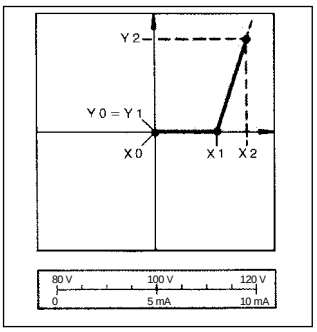


Figure C
The sign of measured quantity and output quantity remains the same. On the range X0...X1, the output quantity is zero. The range X1...X2 is delineated on the entire output range Y0=Y1...Y2 and thus presented in strongly expanded form.



Mode of Operation

Waveform of the signals that can be measured

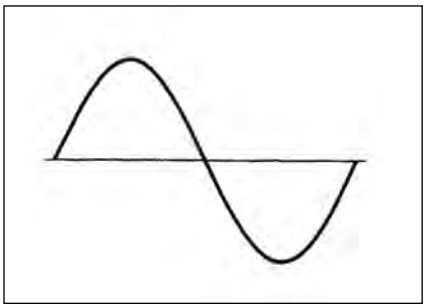


Figure D
Sine wave, undistorted

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

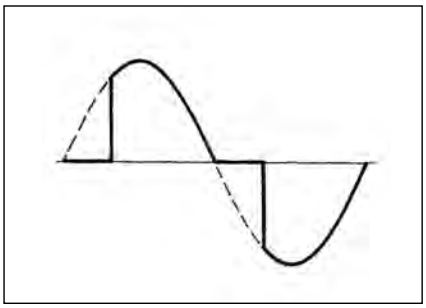


Figure E
Sine wave, indented

Fundamental content	10...100%
Harmonic contents	0...90%

Frequency spectrum: 3rd to the 16th harmonic
Additional error: <1% rdg

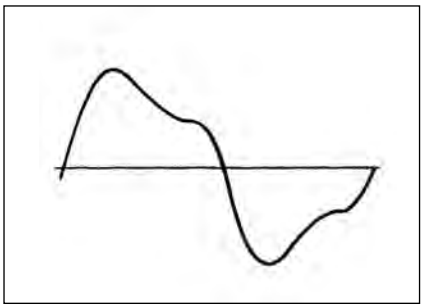


Figure F
Sine wave, distorted

Fundamental content	70...90%
Harmonic content	10...30%

Frequency spectrum: 3rd to the 16th harmonic
Additional error: <0.5% rdg

Harmonic distortion analysis

Anaysis principle	FFT
Harmonic measurement	
Current	Up to the 7th harmonic
Voltage	Up to the 7th harmonic
Type of harmonics	THD (V_{L1}), THD (V_{L2}), THD (V_{L3}), THD (A_{L1})
	THD (A_{L2}), THD (A_{L3})
Read-out	THD %
System	The harmonic distortion can be measured in 3-wire or 4-wire systems.

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Display pages

Variables that can be displayed

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

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 (TPF)

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

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

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

System variables

Equivalent system voltage

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

System reactive power

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

System active power

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

System apparent power

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

System power factor (TPF)

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

Total harmonic distortion

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

Note:
i = phase (L1, L2 or L3)
T = variable (V or I)
n = harmonic order

Consumption recording

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

Note:
i = 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 of consumption recording
n_1, n_2 = starting and ending discrete time points of consumption recording

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

N°	Variable	Notes
1	V sys	sys = system
2	W sys	sys = system
3	var sys	sys = system
4	VA sys	sys = system
5	PF sys	sys = system

N°	Variable	Notes
6	THD-V	Max. THD value among the three phases
7	THD-A	Max. THD value among the three phases
8	VA dmd	Power demand in the selected integration time
9	W dmd	
10	ASY	Phase asymmetry

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Available models

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

Available modules

Type	Channels	Code
Open collector output	2	AO2900
0-20mADC analogue output	1	AO2920
Relay + open c. output	2	AO2910

Type	Channels	Code
0-10VDC Analogue Output	1	AO2921
RS485 Serial Output	1	AR2950

Possible module combinations

Power supply	Self p.s.		Auxiliary p.s.	
Basic unit	Slot A	Slot B	Slot A	Slot B
Open collector output	●		●	
Relay + open c. output	●		●	

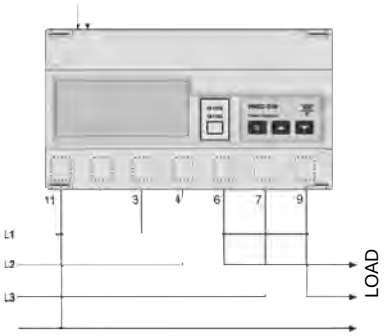
Power supply	Self p.s.		Auxiliary p.s.	
Basic unit	Slot A	Slot B	Slot A	Slot B
Analogue output		●(*)		●
RS485 Serial Output		●(*)		●

(*) AV2 only

Wiring diagrams

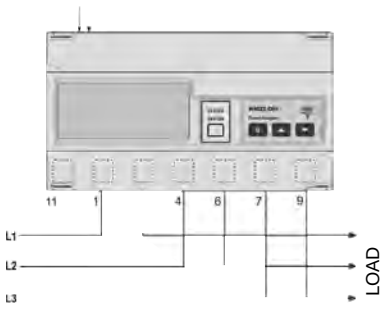
20(100)A model: three-phase unbalanced load

Auxiliary power supply Fig. 1
AC power supply



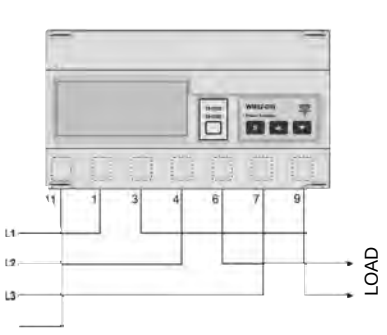
Direct connection (3-phase system+N)

Auxiliary power supply Fig. 2
AC power supply



Direct connection (3-phase system)

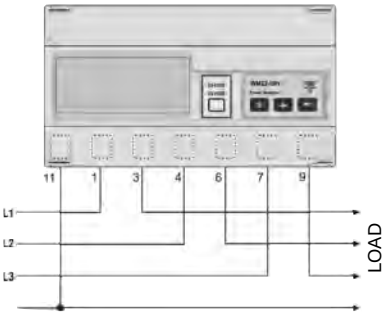
Self-power supply Fig. 3



Direct connection (3-phase system)

20(100)A model: three-phase unbalanced load

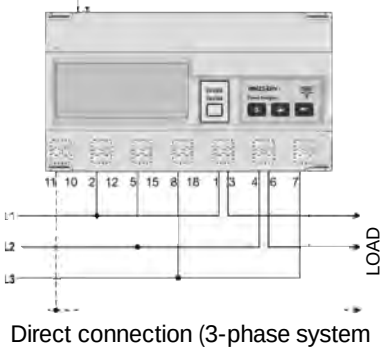
Self-power supply Fig. 4



Direct connection (3-phase system + N)

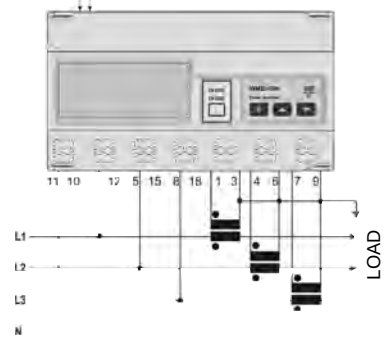
5(10)A model: three-phase unbalanced load

Auxiliary power supply Fig. 5
AC power supply



Direct connection (3-phase system with or without neutral)

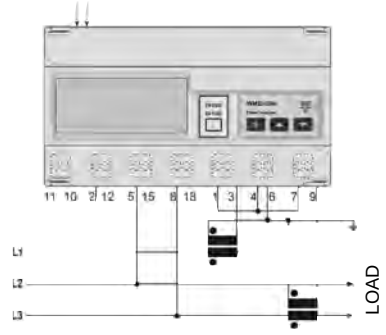
Auxiliary power supply Fig. 6
AC power supply



CT connection (3-phase system+N)

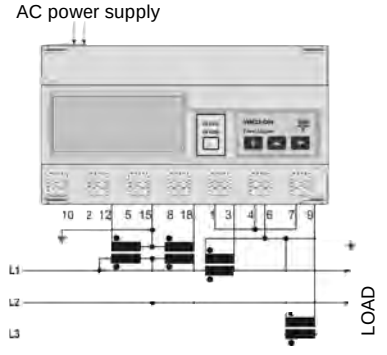
5(10)A model: three-phase unbalanced load

Auxiliary power supply Fig. 7
AC power supply



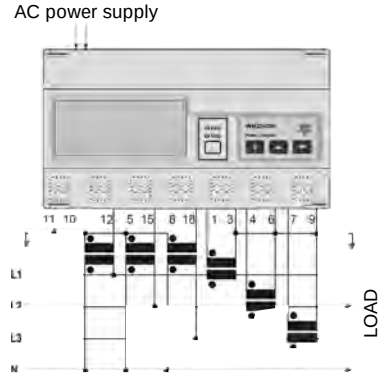
CT ARON connection (3-phase system)

Auxiliary power supply Fig. 8
AC power supply



VT and CT ARON connection (3-phase system)

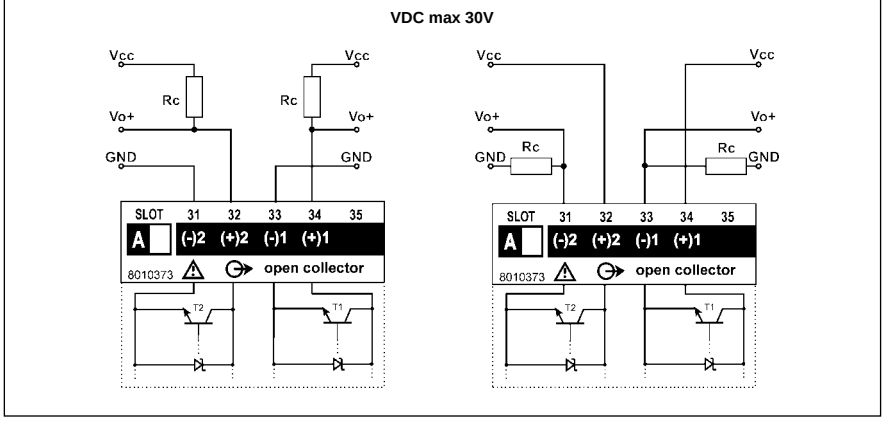
Auxiliary power supply Fig. 9
AC power supply



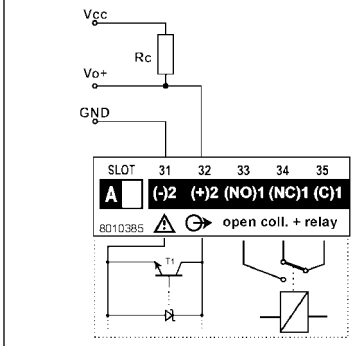
VT and CT connection (3-phase system + N)

Wiring diagrams (optional modules)

Open collector output Fig.10

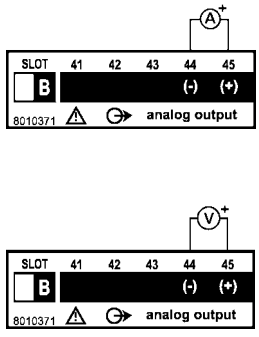


Relay + open collector output Fig. 11



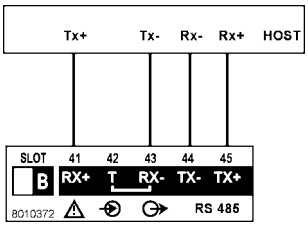
Only open collector outputs: the grounds of the outputs are separated, and therefore it's possible to carry out, for the same module, two different connections. The load resistance (Rc) must be designed so that the closed contact current is lower than 100mA; the VDC voltage must be lower than or equal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

Analogue output Fig. 12



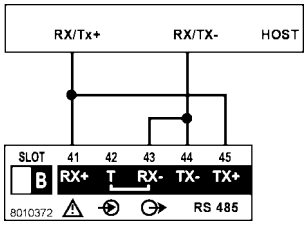
Current and voltage

RS485 Serial output Fig. 13



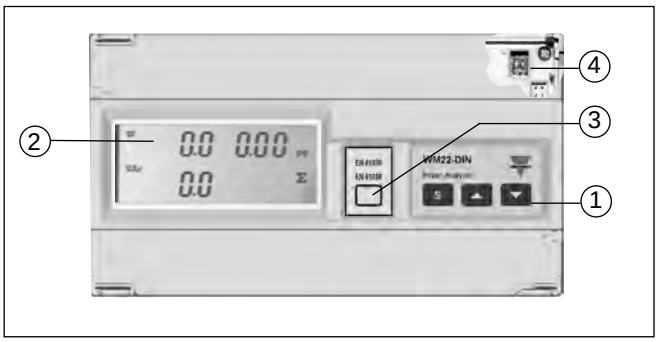
4-wire connection

RS485 Serial output Fig. 14



2-wire connection

Front panel description



1. Key-pad
To program configuration parameters and to display variables.

S

S-key to enter programming and confirm selections;

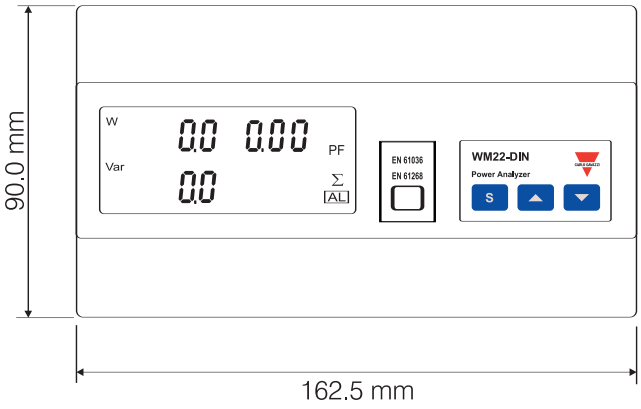
Keys for:
- value programming;
- function selection;
- displaying the measuring pages.

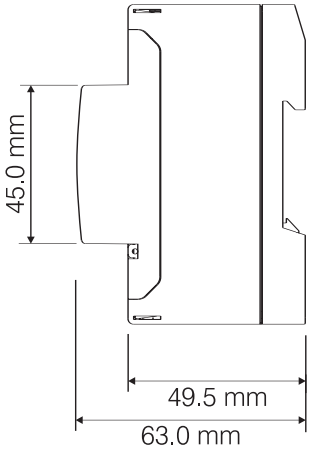
2. Display
LCD with alphanumeric indications to:
- display configuration parameters;
- display all the measured variables.

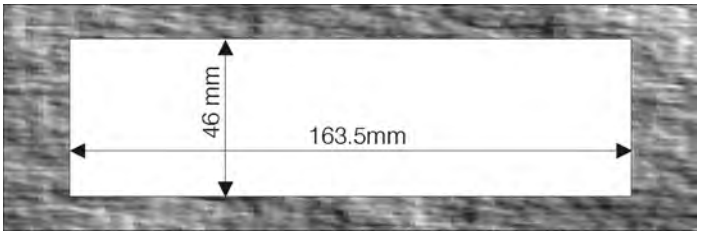
3. Removable label
Label to write the instrument ID number.

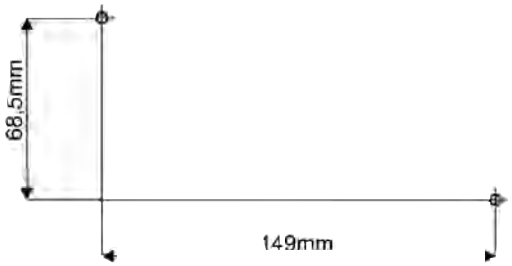
4. Hidden dip-switch
Enable/ disable the access to the programming procedure.

Dimensions and panel cut-out



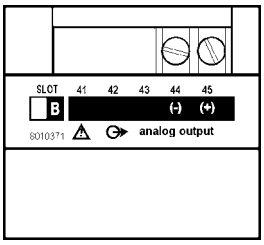






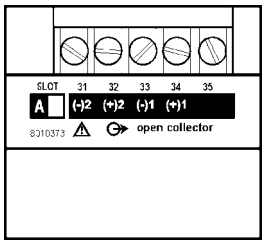
Terminal boards

Analogue output module



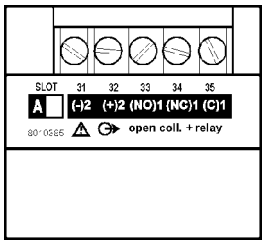
AO 2920: 0-20 mA
AO 2921: 0-10 V

Dual output
open collector module



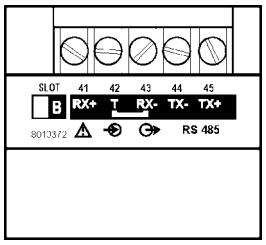
AO 2900

Relay output module +
open collector output



AO 2910

RS485
serial output module



AR 2950

WM20

Power analyzer for three-phase systems

Description

WM20 is a modular power analyzer for single-, two- and three-phase systems.
It is made up of a maximum of three components: the main unit that displays measurements on the LCD display and manages two alarms, and two accessory modules, one with digital outputs and the other for communication.
The digital output module associates alarms with static or relay outputs and/or transmits pulses proportional to energy consumption.
The communication module allows you configure the analyzer and transmit data using a different communication protocol according to the version.

Benefits

- **Clarity.** The wide backlit LCD display clearly shows the measurements and the configuration parameter values.
- **Simplicity.** The rotating pages function automatically shows all measurements in sequence without having to use the keypad. An optical port is available for quick analyzer configuration using OptoProg (CARLO GAVAZZI).
- **Specific software.** WM20 can be configured and measurements viewed from UCS configuration software (CARLO GAVAZZI). The software and subsequent updates are free.
- **Scalability.** Two accessory modules can be added to WM20 according to need. This way, the analyzer extends its control capacities and communicates data remotely.
- **Communication flexibility.** The communication module is available in Modbus RTU, Modbus TCP/IP, BACnet IP, BACnet MS/TP and Profibus DP V0 versions.
- **Fast installation.** WM20 and accessory modules are all equipped with detachable terminals. Modules can be quickly installed via the specifically designed fast coupling pins.
- **Tamper-proof.** WM20 configuration access can be locked. Terminals and accessory modules can be sealed.
- **Installation flexibility.** WM20 is suitable for single-phase, two-phase, three-phase and wild-leg systems.

Applications

WM20 can be installed in any switchboard to control energy consumption, main electrical variables and harmonic distortion.
In automation, WM20 can use the communication module with Profibus protocol to both communicate data on consumption to supervision systems and manage them independently if installed on a machine.
In building, WM20 can be installed in existent architectures using the communication module with BACnet protocol (on RS485 or Ethernet).

Main functions

- Measure main electrical variables and voltage and current harmonic distortions
- Measure active and reactive energy
- Measure load operating hours
- Manage up to two alarms
- Manage two digital outputs (via optional accessory module)
- Transmit data to other systems (via optional accessory module)

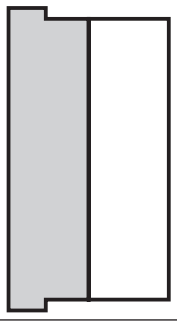
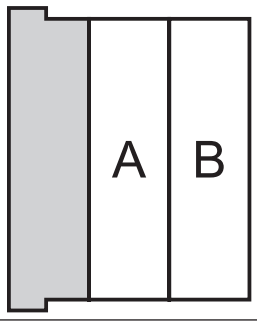
Components

Module	Description
WM20	Main unit, measures and displays main electrical variables. With LCD display and touch keypad, it lets you set measurement parameters, configure accessory modules and manage up to two alarms.
Digital outputs (optional)	Accessory module with two digital outputs. Expands main unit capacity, specifically allowing you to: Transmit pulses proportional to energy consumption Control digital outputs (static or relay according to the module)
Communication (optional)	Accessory module that lets you transmit data to other systems or configure the analyzer from remote

Compatible accessory modules

Type	Module description	Code
Digital outputs	Double static output	M O O2
	Double relay output	M O R2
Communication	Modbus RTU communication on RS485/RS232	M C 485232
	Modbus TCP/IP communication on Ethernet	M C ETH
	BACnet IP communication on Ethernet	M C BAC IP
	BACnet MS/TP communication on RS485	M C BAC MS
	Profibus DP V0 communication on RS485	M C PB

Possible configurations

WM20 only	WM20 + 1 module	WM20 + 2 modules
		

WARNING: maximum 1 module per type. In the configuration with 2 modules, the communication module is installed last.

Features

General

Material	Front: ABS, self-extinguishing V-0 (UL 94) Back and accessory modules: PA66, self-extinguishing V-0 (UL 94)
Protection grade	Front: IP65 NEMA 4x NEMA 12 Terminals: IP20
Terminals	Type: detachable Section: 2.5 mm2 maximum Torque: 0.5 Nm
Overvoltage category	Cat. III
Pollution degree	2
Rejection (CMRR)	100 dB, from 42 to 62 Hz
Insulation	Double electrical insulation on areas accessible to the user. For insulation between inputs and outputs, see "Input and output insulation".

Input and output insulation

NOTE: test conditions: 4 kV rms ac for one minute.

Type	Power supply (H or L) [kV]	Measurement inputs [kV]	Digital outputs [kV]	Serial port [kV]	Ethernet port [kV]
Power supply (H or L)	-	4	4	4	4
Measurement inputs	4	-	4	4	4
Digital outputs	4	4	-	4	4
Serial port	4	4	4	-	NP
Ethernet port	4	4	4	NP	-

Key
- NP: combination not possible
- 4: 4 kV rms insulation (EN 61010-1, IEC 60664-1, overvoltage category III, pollution degree 2, double insulation on system with maximum 300 V rms to ground)

Environmental

Operating temperature	From -25 to +55 °C/from -13 to +131 °F
Storage temperature	From -30 to +70 °C/from -22 to +158 °F

NOTE: R.H. < 90 % non-condensing @ 40 °C / 104 °F.

Compatibility and conformity

Directives	2014/35/EU (Low Voltage) 2014/30/EU (Electromagnetic Compatibility) 2011/65/EU (Electric-electronic equipment hazardous substances)
Standards	Electromagnetic compatibility (EMC) - emissions and immunity: EN62052-11 Electrical safety: EN61010-1 Metrology: EN62053-22, EN62053-22 Pulse outputs: IEC62053-31, DIN43864
Approvals	CE c UL us LISTED

Main unit

Description

Main unit with LCD display and touch keypad to view measurements, configure the system and manage two alarms.
It can be integrated by a digital output and communication module.
Four versions are available (AV4, AV5, AV6 and AV7) to manage different current and voltage inputs.
It can be quickly configured with OptoProg via optical port.

Main features

- System and phase variables (4 x 3 digits): V L-L, V L-N, A, W/var/VA, PF, Hz
- Active and reactive imported and exported energy meters (10 digits)
- Calculate the average and maximum system and phase power values
- Calculate current and voltage THD (total harmonic distortions) up to the 32nd harmonic
- Calculate load operating hours
- Rotating pages function
- Auxiliary power supply
- Two virtual alarms
- Backlit LCD display and touch keypad
- Optical port
- Detachable terminals
- Sealable terminal caps
- Configuration via keypad or UCS configuration software
- Filter to stabilize displayed measurements

Main functions

- Measure main electrical variables and harmonic voltage and current distortions
- Measure active and reactive energy
- Measure load operating hours
- Manage up to two alarms

Structure

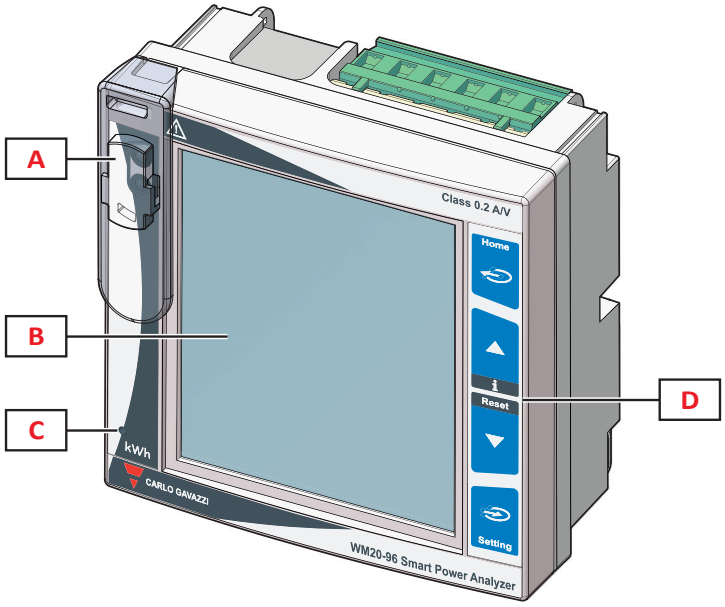


Fig. 1 *Front*

Element	Description
A	Optical port and plastic support for OptoProg (CARLO GAVAZZI) connection
B	Backlit LCD display
C	LED that blinks with frequency proportional to active energy consumption, see "LED" on page 11
D	Touch keypad

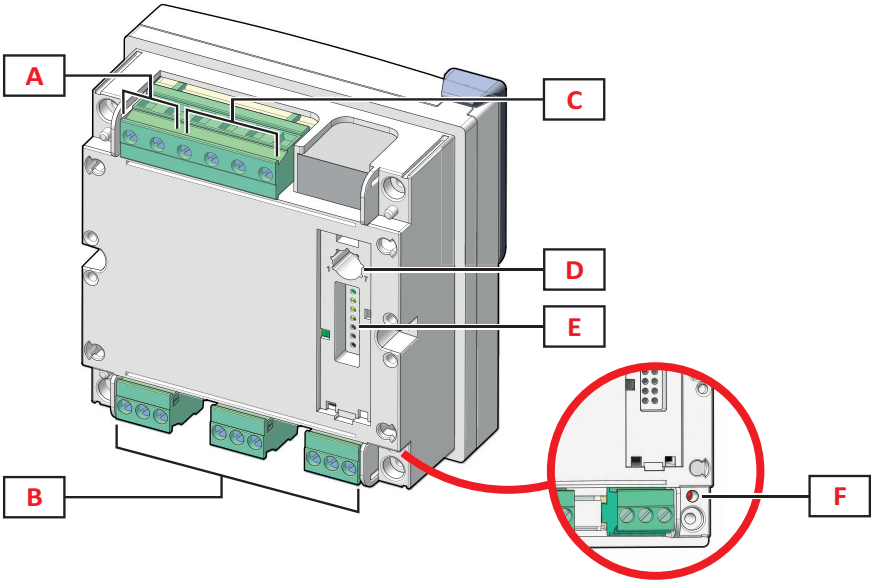


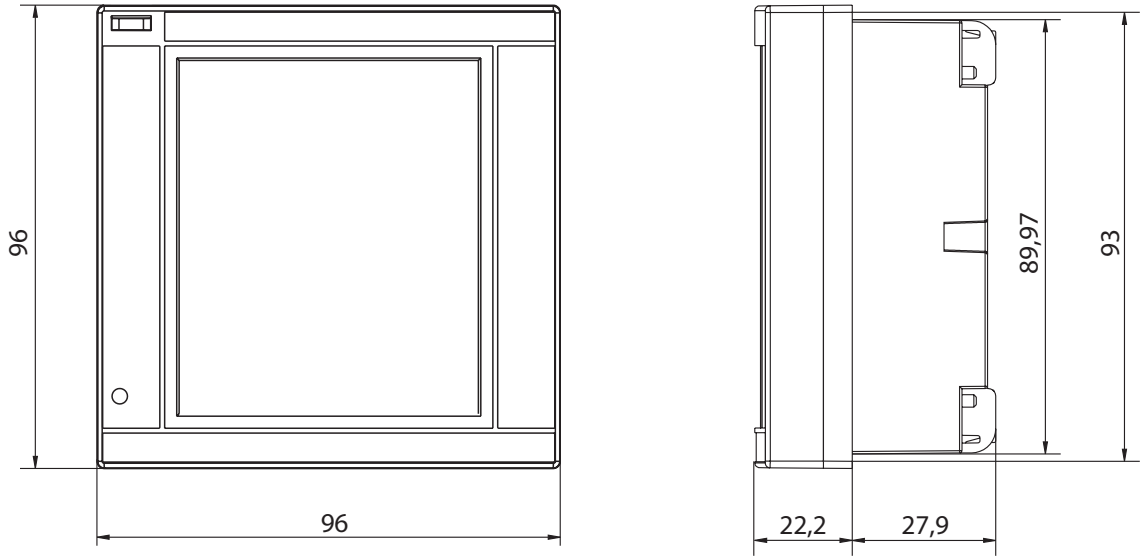
Fig. 2 *Back*

Element	Description
A	Detachable power supply terminals
B	Detachable current input terminals
C	Detachable voltage input terminals
D	Rotary selector to lock configuration
E	Local bus port for accessory modules
F	Power supply status LED, see "LED" on page 11

Features

General

Assembly	Panel mounting
Weight	420g



Electrical specifications

Electrical system	
Managed electrical system	Single-phase (2-wire) Two-phase (3-wire) Three-phase with neutral (4-wire) Three-phase without neutral (3-wire)

Voltage				
Inputs	AV4	AV5	AV6	AV7
Voltage connection	Direct or via VT/PT			
VT/PT transformation ratio	From 1 to 9999			
Rated voltage L-N (from Un min to Un max)	From 220 to 400 V		From 57.7 to 133 V	
Rated voltage L-L (from Un min to Un max)	From 380 to 690 V		From 100 to 230 V*	
Voltage tolerance	-20%, + 15%			
Overload	Continuous: 1.2 Un max For 500 ms: 2 Un max			
Input impedance	>1.6 MΩ			
Frequency	From 40 to 440 Hz			

NOTE*: in case of two-phase or wild leg system:
rated voltage L-L up to 240 V.

NOTE: in case of wild leg system (three-phase, four-wire delta) one of the line-to-neutral voltage can exceed the rated range in the table up to:
• 415 V (AV4, AV5)
• 208 V (AV6, AV7).

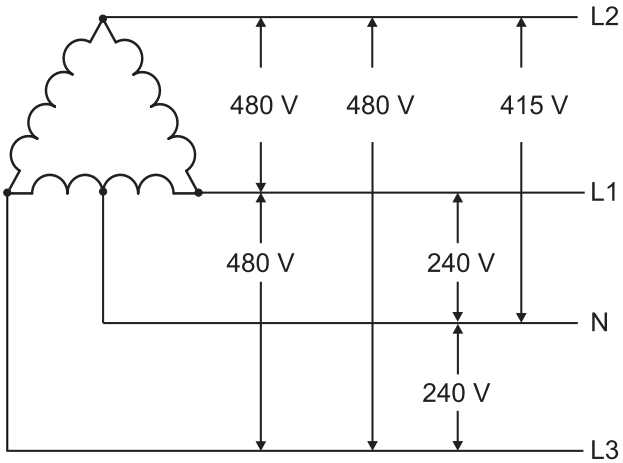


Fig. 3 *AV4, AV5*

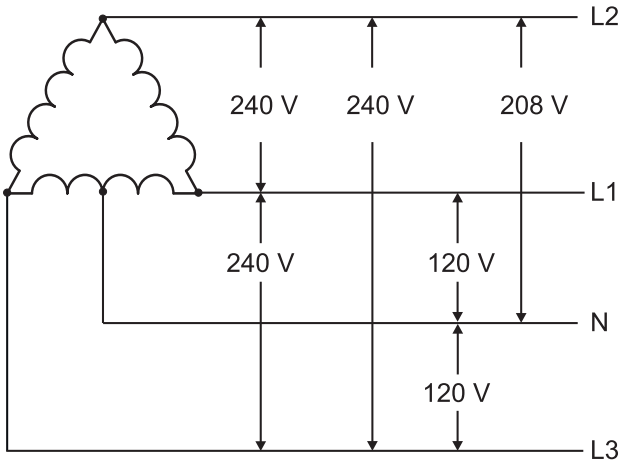


Fig. 4 *AV6, AV7*

Current				
Inputs	AV4	AV5	AV6	AV7
Current connection	Via CT			
CT transformation ratio	From 1 to 9999			
Rated current (In)	1 A	5 A		1 A
Minimum current (Imin)	0.01 A	0.05 A		0.01 A
Maximum current (Imax)	2 A	6 A		2 A
Start-up current (Ist)	1 mA	5 mA		1 mA
Overload	Continuous: Imax For 500 ms: 20 Imax			
Input impedance	< 0.2 VA			
Maximum CTxVT ratio	9999 x 9999			

Power Supply

	H	**L**
Power Supply	From 100 to 240 V ac/dc ± 10%	From 24 to 48 V ac/dc ± 15%
Consumption	3.5 W, 6 VA	

Measurements

Method	TRMS measurements of distorted waveforms
Sampling	3200 samples/s @50 Hz 3840 samples/s @60 Hz

Available measurements

Active energy	Unit	System	Phase
Imported (+) Total	kWh+	●	-
Imported (+) partial	kWh+	●	-
Exported (+) Total	kWh-	●	-
Exported (+) partial	kWh-	●	-

Reactive energy	Unit	System	Phase
Imported (+) Total	kvarh+	●	-
Imported (+) partial	kvarh+	●	-
Exported (+) Total	kvarh-	●	-
Exported (+) partial	kvarh-	●	-

Electrical variable	Unit	System	Phase
Voltage L-N	V	●	●
Voltage L-L	V	●	●
Current	A	●	●
Active power	kW	●	●
DMD	kW	●	●
MAX	kW	●	●
DMD MAX	kW	●	●
Apparent power	kVA	●	●
DMD	kVA	●	●
MAX	kVA	●	●
DMD MAX	kVA	●	●
Reactive power	kvar	●	●
DMD	kvar	●	●
MAX	kvar	●	●
DMD MAX	kvar	●	●
Power factor	PF	●	●
Frequency	Hz	●	-
THD Current*	THD A %	-	●
THD Voltage L-N*	THD L-N %	-	●
THD Voltage L-L*	THD L-L %	-	●
Run hour meter	h	●	-

NOTE: the available variables depend on the type of system set.
* Up to 32nd harmonic

Measurement accuracy

Current	
From 0.05 In to Imax	±(0.2% rdg + 2dgt)
From 0.01 In to 0.05 In	±(0.5% rdg + 2dgt)

Phase-phase voltage	
From Un min -20% to Un max + 15%	±(0.5% rdg +1dgt)

Phase-neutral voltage	
From Un min -20% to Un max + 15%	±(0.2% rdg +1dgt)

Active and apparent power	
From 0.05 In to Imax (PF=0.5L, 1, 0.8C)	±(0.5% rdg +1dgt)
From 0.01 In to 0.05 In (PF=1)	±(1% rdg +1dgt)

Reactive power	
From 0.1 In to Imax (sinϕ=0.5L, 0.5C) From 0.05 In to Imax (sinϕ=1)	±(1% rdg + 1 dgt)
From 0.05 In to 0.1 In (sinϕ=0.5L, 0.5C) From 0.02 In to 0.05 In (PF=1)	±(1.5% rdg + 1 dgt)
Power factor	±[0.001+0.5%(1 – PF rdg)]
Active energy	Class 0.5S (EN62053-22), class 0.5 (ANSI C12.20)
Reactive energy	Class 2 (EN62053-23, ANSI C12.1)
THD	±1%

Frequency	
From 40 to 65 Hz	±(0.02% rdg + 1 dgt)
From 65 to 340 Hz	±(0.05% rdg + 1 dgt)
From 340 to 440 Hz	±(0.1% rdg + 1 dgt)

Display

Type	Backlit LCD
Refresh time	500 ms
Description	4 rows: 1st: 10 digits (7.5 mm) 2nd, 3rd, 4th: 4 digits (14 mm)
Variable readout	Instantaneous: 4 digits, min: 0.001 currents, 0.01 powers/PFs/frequency/THDs, 0.1 voltages, max: 9 999 Energy: 10 digits, min: 0.01, max: 9 999 999 999

LED

Front	Red. Weight: proportional to energy consumption and depending on the CT and VT/PT ratio product (16 Hz maximum frequency):	
	Weight (kWh per pulse)	**CT*VT/PT**
	0.001	< 7
	0.01	From 7.1 to 70
	0.1	From 70.1 to 700
	1	From 700.1 to 7000
	10	From 7001 to 70 k
	100	> 70.01 k
Back	Green. Power supply status.	

Special functions

- Two virtual alarms (up or down alarm)
- Filter to stabilize variable measurements with high fluctuations
- Automatic measurement display sequence (rotating pages function)
- Load operating hour meter
- Total active and reactive energy meters and average and maximum values reset
- Optical port for configuration via OptoProg
- Password protected settings menu

Connection Diagrams

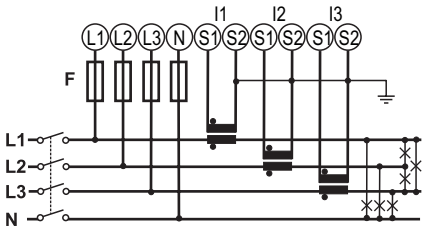


Fig. 5 *Three-phase system with neutral (4-wire), unbalanced load and 3 CT. 315 mA fuse (F).*

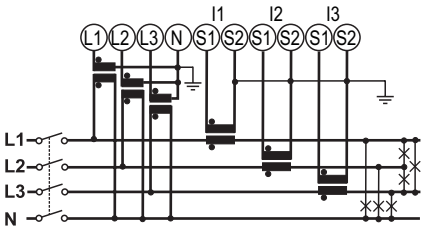


Fig. 6 *Three-phase system with neutral (4-wire), unbalanced load, 3 CT and 3 VT/PT*

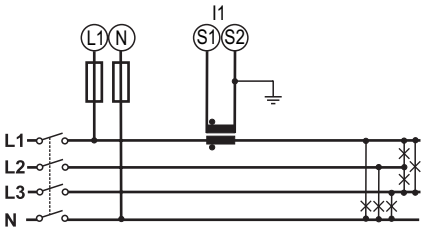


Fig. 7 *Three-phase system with neutral (4-wire), balanced load, 1 CT. 315 mA fuse (F).*

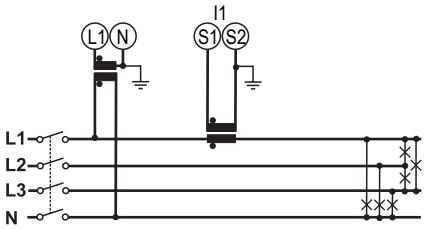


Fig. 8 *Three-phase system with neutral (4-wire), balanced load, 1 CT and 1 VT/PT*

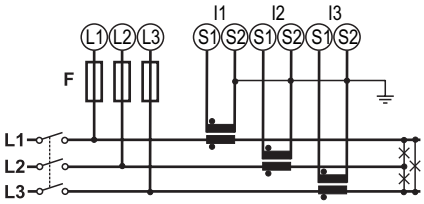


Fig. 9 *Three-phase system without neutral (3-wire), unbalanced load and 3 CT. 315 mA fuse (F).*

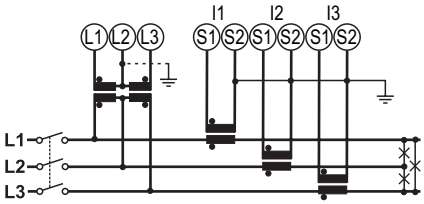


Fig. 10 *Three-phase system without neutral (3-wire), unbalanced load, 3 CT and 2 VT/PT.*

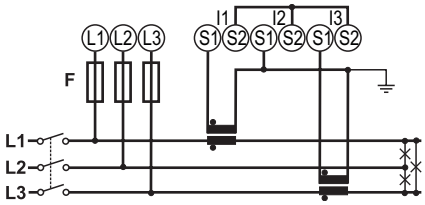


Fig. 11 *Three-phase system without neutral (3-wire) unbalanced load and 2 CT (Aron). 315 mA fuse (F).*

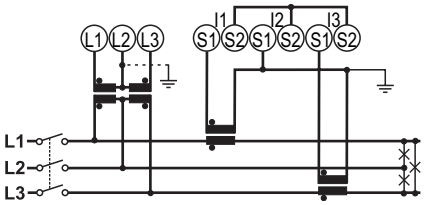


Fig. 12 *Three-phase system without neutral (3-wire), unbalanced load, 2 CT (Aron) and 2 VT/PT.*

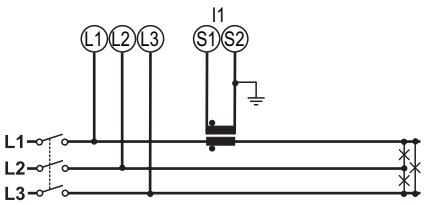


Fig. 13 *Three-phase system without neutral (3-wire), balanced load, 1 CT.*

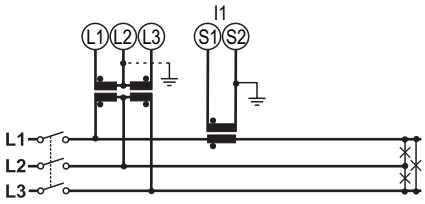


Fig. 14 *Three-phase system without neutral (3-wire), balanced load, 1 CT and 2 VT/PT.*

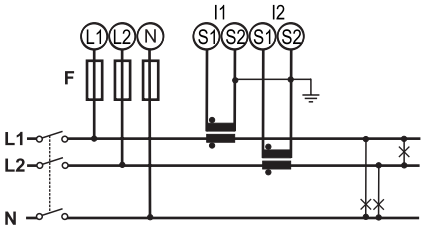


Fig. 15 *Two-phase system (3-wire), 2 CT. 315 mA fuse (F).*

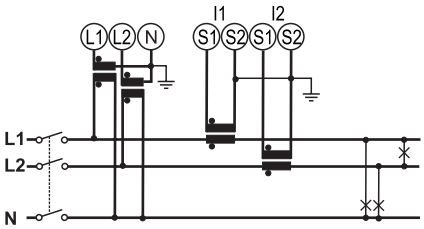


Fig. 16 *Two-phase system (3-wire), 2 CT and 2 VT/PT.*

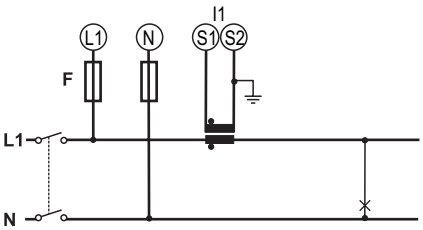


Fig. 17 *Single-phase system (2-wire), 1 CT. 315 mA fuse (F).*

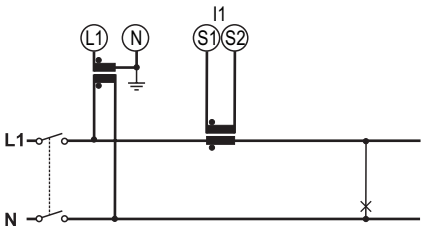


Fig. 18 *Single-phase system (2-wire), 1 CT and 1 VT/PT.*

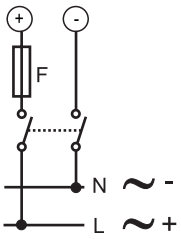


Fig. 19 *Auxiliary power supply. 250 V [T] 630 mA fuse (F).*

References

Order code

WM20 AV ☐ 3 ☐ (9 characters total)

Enter the code option instead of ☐

Code	Option	Description
W	-	-
M	-	-
2	-	-
0	-	-
A	-	-
V	-	-
☐	4	From 380 to 690 V L-L ac, 1(2) A, connection via CT
	5	From 380 to 690 V L-L ac, 5(6) A, connection via CT
	6	From 100 to 230 V L-L ac, 5(6) A, connection via CT
	7	From 100 to 230 V L-L ac, 1(2) A, connection via CT
3	-	-
☐	H	auxiliary power supply from 100 to 240 V ac/dc
	L	auxiliary power supply from 24 to 48 V ac/dc

CARLO GAVAZZI compatible components

Purpose	Component name/code	Notes
Current measurement accessories	CTD1X, CTD2X, CTD3X, CTD4X	Solid core current transformers (1 or 5 A secondary current, 40 to 1600 A primary current) for cable or bus bar. See relevant data-sheets.
	CTD1Z, CTD2Z, CTD3Z	Solid core current transformers (5 A secondary current, 40 to 600 A primary current) for cable or bus bar. See relevant datasheets.
	CTD5S, CTD6S, CTD8S, CTD9S, CTD10S	Split core current transformers (5 A secondary current, 100 to 3200 A primary current) for bus bar. See relevant datasheets.
	CTD8V, CTD8V, CTD9V, CTD9H, CTD10V, CTD10H	Solid core current transformers (1 or 5 A secondary current, 150 to 3200 A primary current) for bus bar. See relevant datasheets.
	CTD8Q	Solid core current transformers (1 or 5 A secondary current, 1000 to 4000 A primary current) for bus bar. See relevant datasheets.
Manage two digital outputs/associate alarms to digital outputs	M O O2 M O R2	See "Digital output modules"
Transmit data remotely	M C 485232 M C ETH M C BAC IP M C BAC MS M C PB	See "Communication modules"
Configure analyzer via desktop application	UCS configuration software	
Monitor data from several analyzers	VMU-C	See relevant datasheet
Quickly configure several analyzers via optical interface	OptoProg	See relevant datasheet
RS485/USB conversion	SIU-PC3	See relevant datasheet

Digital output modules

Main features

- Two digital outputs (static or relay)
- Three possible functions for each output
- Configuration via main unit keypad or UCS configuration software
- Easy mounting on main unit
- Detachable terminals
- Local bus connection to main unit

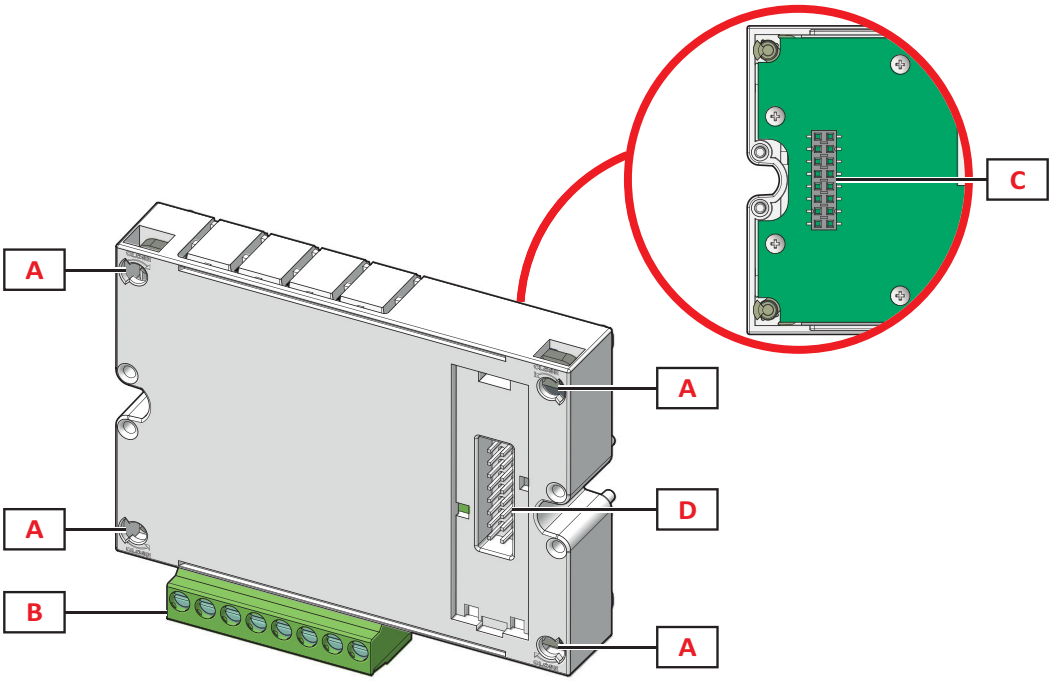
Main functions

- Manage two static or relay outputs
- Associate static or relay outputs with alarms
- Transmit pulses proportional to energy consumption

Description

Accessory module for WM analyzer family that associates static or relay outputs to alarms and/or transmits pulses proportional to energy consumption.
Each output can run three different functions: alarm, remote control or pulse.

Structure



Element	Description
A	Main unit fastening pins
B	Detachable digital output terminals
C	Local bus port for main unit
D	Local bus port for communication module

Digital output functions

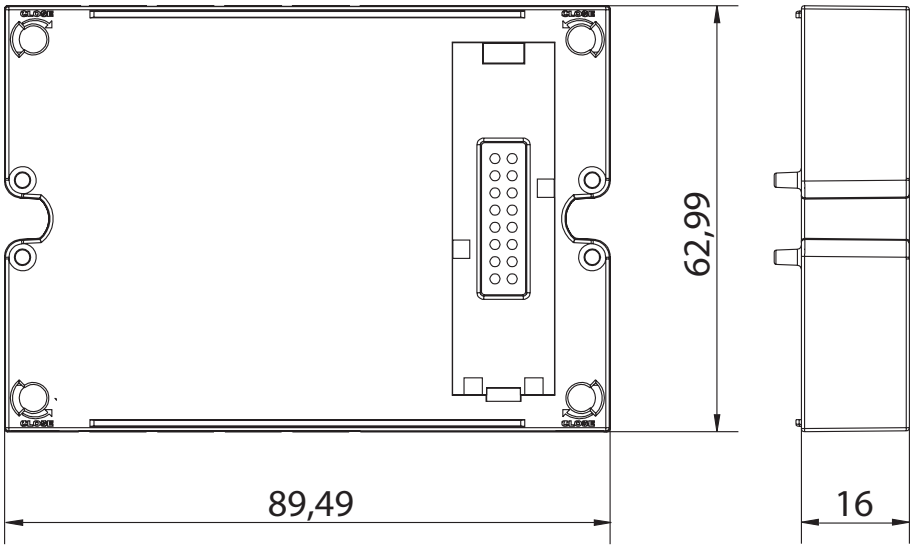
Digital outputs can run three different functions:

- Alarm: output associated with an alarm and directly managed by WM20
- Remote control: output status managed via communication
- Pulse: pulse transmission output on active or reactive, imported or exported energy consumption.

Features

General

Mounting	On main unit
Weight	80g
Power supply	Self power supply via local bus



Static output module (M O O2)

Maximum number of outputs	2
Type	Opto-mosfet
Features	V_{ON}: 2.5 V dc, 100 mA max V_{OFF}: 42 V dc max
Configuration parameters	Output function: alarm/remote control/pulse Associated output alarm and normal status ("alarm" function only) Pulse weight, transmitted energy type, test transmission settings ("pulse" function only)
Configuration mode	Via keypad or UCS software

Relay output module (M O R2)

Maximum number of outputs	2
Type	SPDT relay
Features	AC1: 5 A @ 250 V ac AC15: 1 A @250 V ac
Configuration parameters	Output function: alarm/remote control/pulse Associated output alarm and normal status ("alarm" function only) Pulse weight, transmitted energy type, test transmission settings ("pulse" function only)
Configuration mode	Via keypad or UCS software

Connection Diagrams

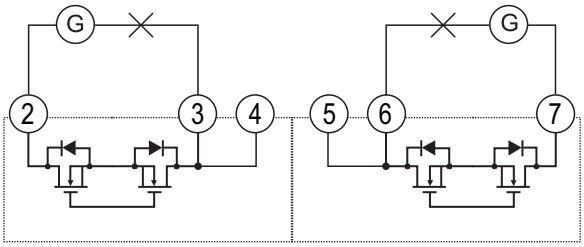


Fig. 20 *M O O2. Double static opto-mosfet output.*

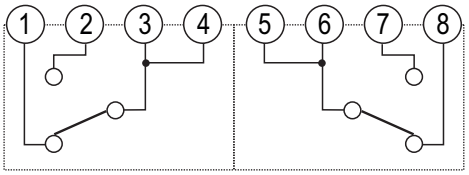


Fig. 21 *M O R2. Double relay output.*

References

Order code

Code	Description
M O O2	Double static output
M O R2	Double relay output

Further reading

Information	Where to find it
Instruction manual - WM20	
Digital output module instruction manual	

CARLO GAVAZZI compatible components

Purpose	Component name/code	Notes
Power the module via analyzer	WM20 WM30 WM40	The digital output module only works connected to an analyzer. See relevant datasheets.

Communication modules

Main features

- Supported communication protocols: Modbus, BACnet, Profibus. See "Communication module overview " on page 21
- Configuration via main unit keypad or UCS configuration software
- Easy mounting on main unit
- Local bus connection to main unit

Main functions

- Transmit data remotely
- Configure the system

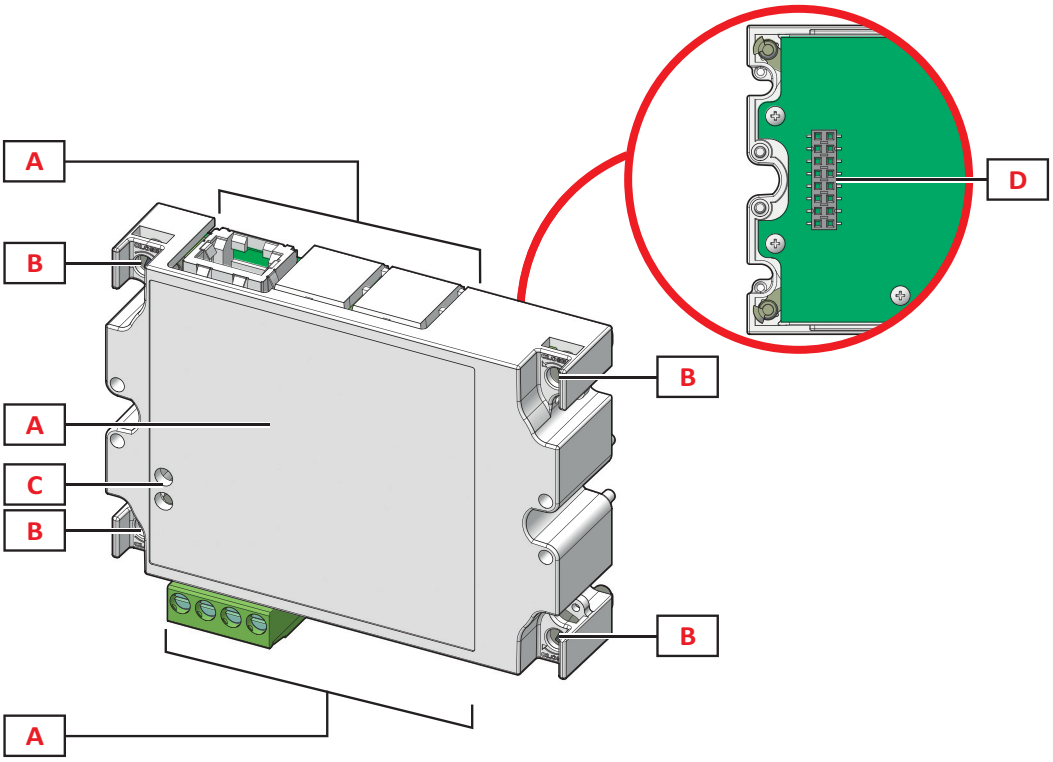
Description

Accessory module for WM analyzer family connected to the main unit that transmits system data remotely using a different communication protocol according to the version.

Communication module overview

Module code	Communication protocols	Port
M C 485232	Modbus RTU	RS485, RS232
M C ETH	Modbus TCP/IP	Ethernet
M C BAC IP	BACnet IP, Modbus TCP/IP	Ethernet
M C BAC MS	BACnet MS/TP	RS485
	Modbus TCP/IP	Ethernet
M C PB	Profibus DP V0 slave	RS485
	Modbus RTU	Micro-USB

Structure



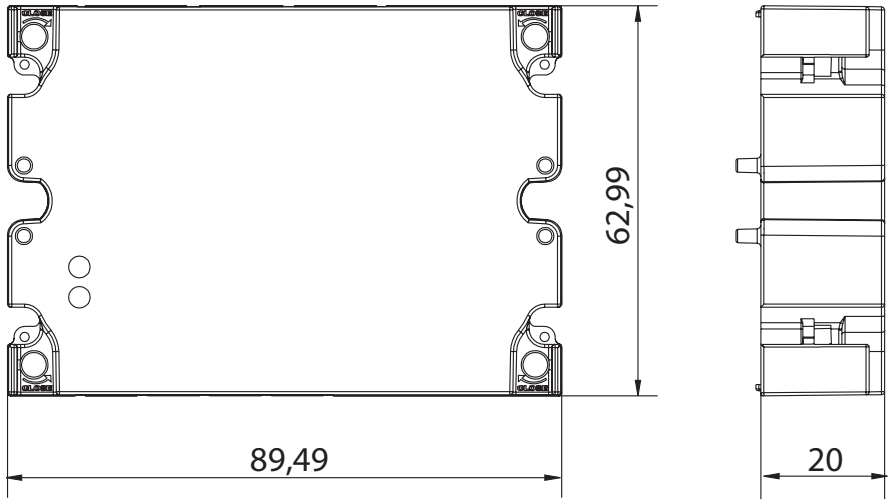
NOTE: the image refers to the M C BAC MS module.

Element	Description
A	Communication port area NOTE: the communication ports depend on the communication module, see "Communication module overview" on page 21.
B	Main unit fastening pins
C	Communication status LED (M C 485232, M C BAC MS, M C PB)
D	Local bus port for main unit or digital output module

Features

General

Assembly	On main unit (with or without digital output module)
Weight	80g
Power supply	Self power supply via local bus



M C 485232 module

RS485 port	
Protocols	Modbus RTU
Devices on the same bus	Max 160 (1/5 unit load)
Communication type	Multidrop, bidirectional
Connection type	2 wires, maximum distance 1000 m
Configuration parameters	Modbus address (from 1 to 247) Baud rate (9,6/ 19,2/ 38,4/ 115,2 kbps) Parity (None/ Odd/ Even)
Configuration mode	Via keypad or UCS software

RS232 port	
Protocols	Modbus RTU
Communication type	Bidirectional
Connection type	3 wires, maximum distance 15 m
Configuration parameters	Modbus address (from 1 to 247) Baud rate (9,6/ 19,2/ 38,4/ 115,2 kbps) Parity (None/ Odd/ Even)
Configuration mode	Via keypad or UCS software

NOTE: the RS485 and RS232 ports are alternative.

LED	
Meaning	Communication status: Yellow: receiving Green: transmitting

M C ETH module

Ethernet port	
Protocols	Modbus TCP/IP
Client connections	Maximum 5 simultaneously
Connection type	RJ45 connector (10 Base-T, 100 Base-TX), maximum distance 100 m
Configuration parameters	IP address Subnet mask Gateway TCP/IP port
Configuration mode	Via keypad or UCS software

M C BAC IP module

Ethernet port	
Protocols	BACnet IP (reading) Modbus TCP/IP (reading and configuration)
Client connections	(Modbus only) Maximum 5 simultaneously
Connection type	RJ45 connector (10 Base-T, 100 Base-TX), maximum distance 100 m
Configuration parameters	BACnet IP protocol: Instance number (from 0 to 9999 via keypad, from 0 to 4194302 via communication) Foreign Device enabling BBMD address UDP port WM20 time-to-live recording as Foreign Device on specified BBMD server Modbus TCP/IP protocol: IP address Subnet mask Gateway TCP/IP port
Configuration mode	Via keypad or UCS software

M C BAC MS module

RS485 port	
Protocols	BACnet MS/TP (measurement reading and object description writing)
Communication type	Multidrop, monodirectional
Connection type	2 wires, maximum distance 1000 m
Supported services	"I-have", "I-am", "Who-has", "Who-is", "Read-property (multiple)"
Supported objects	Type 2 (analogue value including COV property), type 5 (binary value, for alarm transmission), type 8 (device)
Configuration parameters	BACnet IP protocol: Instance number (from 0 to 9999 via keypad, from 0 to 4194302 via communication) Baud rate (9,6/ 19,2/ 38,4/ 57,6/ 76,8 kbps) MAC address (from 0 to 127)
Configuration mode	Via keypad or UCS software

Ethernet port	
Protocols	Modbus TCP/IP (configuration)
Client connections	(Modbus only) Maximum 5 simultaneously
Connection type	RJ45 connector (10 Base-T, 100 Base-TX), maximum distance 100 m
Configuration parameters	IP address Subnet mask Gateway TCP/IP por
Configuration mode	Via keypad or UCS software

LED	
Meaning	Communication status: Yellow: receiving Green: transmitting

M C PB module

Profibus port	
Protocols	Profibus DP V0 slave
Connection type	9-pin D-sub receptacle RS485
Configuration parameters	Address, via keypad Other settings with UCS software via serial communication
Configuration mode	Via keypad or UCS software

Micro-USB port	
Protocols	Modbus RTU
Type	USB 2.0 (USB 3.0 compatible)
Connection type	Micro-USB B
Baud rate	Any (maximum 115.2 kbps)
Address	1

LED	
Meaning	Communication status: Red: between module and main unit Green: between module and Profibus master

Connection Diagrams

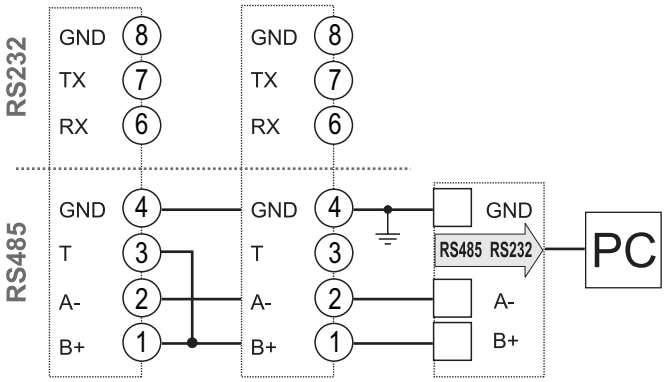


Fig. 22 *M C 485232. RS485 serial port.*

NOTE: additional meters with RS485 are connected in daisy chain. The serial output must only be terminated on the last network meter connecting terminals B+ and T.

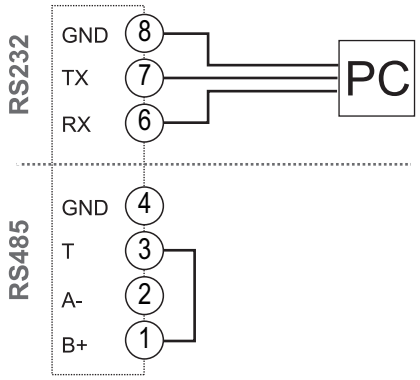


Fig. 23 *M C 485232. RS232 serial port.*

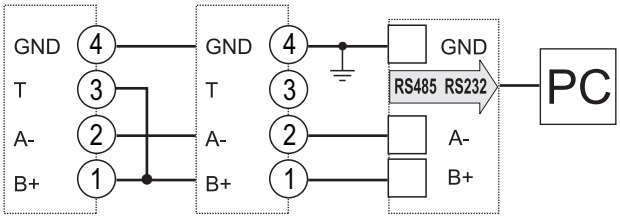


Fig. 24 *M C BAC MS. RS485 serial port.*

NOTE: additional meters with RS485 are connected in daisy chain. The serial output must only be terminated on the last network meter connecting terminals B+ and T.

References

Order code

Code	Description
MC 485232	Modbus RTU communication on RS485/RS232
MC ETH	Modbus TCP/IP communication on Ethernet
MC BAC IP	BACnet IP communication on Ethernet
MC BAC MS	BACnet MS/TP communication on RS485
MC PB	Profibus DP V0 communication on RS485

Further reading

Information	Where to find it
WM20 instruction manual	
Communication module instruction manual (M C 485232, M C ETH, M C BAC IP, M C BAC MS)	
Communication module instruction manual (M C PB)	

CARLO GAVAZZI compatible components

Purpose	Component name/code	Notes
Power the module via analyzer	WM20 WM30 WM40	The communication module only works connected to an analyzer. See relevant datasheets.

Energy Management
Power Analyzer
Type WM14-DIN "Basic Version"

- **Optional dual pulse output**
- **Alarms (visual only) V_{LN}, An**
- **Optional galvanically insulated measuring inputs**

- **Class 1 (active energy)**
- **Class 2 (reactive energy)**
- **Accuracy ±0.5 F.S. (current/voltage)**
- **Power analyzer**
- **Display of instantaneous variables: 3x3 digit**
- **Display of energies: 8+1 digit**
- **System variables and phase measurements: W, W_{dmd}, var, VA, VA_{dmd}, PF, V, A, An, A_{dmd}, Hz**
- **A_{max}, $A_{dmd\ max}$, $W_{dmd\ max}$ indication**
- **Energy measurements: kWh and kvarh**
- **Hour counter (5+2 DGT)**
- **TRMS meas. of distorted sine waves (voltages/currents)**
- **Power supply: 24V, 48V, 115V, 230V, 50-60Hz; 18 to 60VDC**
- **Protection degree (front): IP40**
- **Front dimensions: 107.8x90mm**
- **Optional RS422/485 serial port**

Product Description

3-phase power analyzer with built-in programming key-pad. Particularly recommended for displaying the main electrical variables. Housing for DIN-rail mounting, (front) protection degree IP40, and optional RS485 serial port or dual pulse output. Parameters programmable by means of CptBSoft.

How to order WM14-DIN AV5 3 D PG

Model
Range code
System
Power supply
Option

How to order CptBSoft

CptBSoft (compatible only with S or SG options): software to program the working parameters of the power analyzer and to read the energy and the instantaneous variables.

Type Selection

Range codes

AV5: 380/660V_{L-L}/5(6)AAC
VL-N: 185 V to 460 V
VL-L: 320 V to 800 V
AV6: 120/208V_{L-L}/5(6)AAC
VL-N: 45 V to 145 V
VL-L: 78 V to 250 V
Phase current: 0.03A to 6A
Neutral current: 0.09 to 6A

System

3 : 1-2-3-phase, balanced/unbalanced load,with or without neutral

Power supply

A: 24VAC -15+10%, 50-60Hz
B: 48VAC -15+10%, 50-60Hz
C: 115VAC -15+10%, 50-60Hz
D: 230VAC -15+10%, 50-60Hz
3: 18 to 60VDC (not available in case of SG or PG options)

Options

X: None
S: RS485 port
SG: RS485+galvanic insulated measurig inputs
PG: Dual pulse output + galvanically insulated measuring inputs.

Input specifications

Rated inputs	
Current "X-S options"	3 (non insulated each other)
Current "SG-PG options"	3 (insulated each other)
Voltage	4
Accuracy (display, RS485) (@25°C ±5°C, R.H. ≤60%)	with CT=1 and VT=1 AV5: 1150W-VA-var, FS:230VLN, 400VLL; AV6: 285W-VA-var, FS:57VLN, 100VLL
Current	0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A: ±(0.5% FS+7DGT)
Neutral current	0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A: ±(0.5% FS+7DGT)
Phase-phase voltage	±(1.5% FS +1 DGT)
Phase-neutral voltage	±(0.5% FS + 1 DGT)
Active and Apparent power,	0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS+5DGT)
Reactive power	0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS+5DGT)
Active energy "X-S option"	Class 2 (start up "I": 30mA)
Reactive energy "X-S option"	Class 3 (start up "I": 30mA)
Active energy "SG-PG opt."	Class 1 (start up "I": 30mA)
Reactive energy "SG-PG opt."	Class 2 (start up "I": 30mA)
Frequency	±0.1Hz (48 to 62Hz)
Additional errors	
Humidity	≤0.3% FS, 60% to 90% RH
Temperature drift	≤ 200ppm/°C
Sampling rate	1400 samples/s @ 50Hz 1700 samples/s @ 60Hz
Display refresh time	700ms
Display	
Type	LED, 9mm
Read-out for instant. var.	3x3 DGT
Read-out for energies	3+3+3 DGT (Max indication: 999 999 99.9)
Read-out for hour counter	1+3+3 DGT (Max. indication: 9 999 9.99)

CARLO GAVAZZI

Input specifications (cont.)

Measurements	Current, voltage, power, power factor, frequency, energy, TRMS measurement of distorted waves.
Coupling type	Direct
Crest factor	< 3, max 10A peak
Input impedance	**(X-S options)**
380/660V_{L-L} (AV5)	1 MΩ ±5%
120/208V_{L-L} (AV6)	453 KΩ ±5%
Current	≤ 0.02Ω

Input impedance	**(PG-SG options)**
380/660V_{L-L} (AV5)	1 MΩ ±1%
120/208V_{L-L} (AV6)	1 MΩ ±1%
Current	≤ 0.02Ω
Frequency	48 to 62 Hz
Overload protection	
Continuos voltage/current	1.2 F.S.
For 500ms: voltge/current	2 Un/36A

RS485 Serial Port Specifications

RS422/RS485 (on request)	
Type	Multidrop bidirectional (static and dynamic variables)
Connections	2 or 4 wires, max. distance 1200m, termination directly on the instrument
Addresses	1 to 255, key-pad selectable
Protocol	MODBUS/JBUS

Data (bidirectional)	
Dynamic (reading only)	System, phase variables and energies
Static (writing only)	All configuration parameters
Data format	1 bit di start , 8 data bit, no parity, 1 stop bit
Baud-rate	9600 bit/s

CptBSoft software: parameter programming and reading data

CptBSoft	Multi language software to program the working parameters of the power analyzer and to read the energies and the instantaneous variables. The program runs under Windows 95/98/98SE/2000/ NT/XP.

Working mode	Two different working modes can be selected: - management of a local RS485 network; - management of communication from a single instrument to PC (RS232);
Data access	By means of RS485 serial port.

Dual pulse output

Digital outputs (on request)	
Pulse outputs	
Number of outputs	2 (one for kWh one for kvarh)
Number of pulses	From 0.01 to 999 in compliance with the following formula: [Psys max (kW or kvar)*pulses (pulses/kWh or kvarh)] <14400
Output type	Relay min current: .05A@250VAC/30VDC max current: A@250VAC/30VDC Electrical life: min $2*10^5$ cycles Mechanical life: $5*10^6$ cycles

Pulse duration	≥100ms <120ms (ON) ≥100ms (OFF)
Insulation	According to EN622053-31 By means of relays, 4000 V_{RMS} outputs to measuring inputs, 4000 V_{RMS} output to supply input. Insulation between the two outputs: 1000V_{RMS}

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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 999, all data are protected
System selection	3-phase with/without n, unbal. 3-phase balanced 3-phase ARON, unbalanced 2-phase Single phase
Transformer ratio	
CT	1 to 999
VT	1.0 to 99.9
Filter	
Operating range	0 to 100% of the input display scale
Filtering coefficient	1 to 16
Filter action	Measurements, alarms, serial out. (fundamental var: V, A, W and their derived ones).
Displaying	Up to 3 variables per page
3-phase system with neutral	Page 1: V L1, V L2, V L3 Page 2: V L12, V L23, V L31 Page 3: A L1, A L2, A L3 Page 4: A L1 dmd, A L2 dmd, A L3 dmd Page 5: An, An Alarm Page 6: W L1, W L2, W L3 Page 7: PF L1, PF L2, PF L3 Page 8: var L1, var L2, var L3 Page 9: VA L1, VA L2, VA L3 Page 10: VA ∑, W ∑, var ∑ Page 11: VA dmd, W dmd, Hz Page 12: W dmd max (*) Page 13: Wh (*) Page 14: varh (*) Page 15: VL-L ∑, PF ∑, VLN Alarm Page 16: A max (*) Page 17: A dmd max (*) Page 18: hour counter (*) (*) = These variables are stored in EEPROM when the instrument is switched off
Alarms	Programmable, for the VL∑ and An (neutral current). Note: the alarm is only visual, by means of LED on the front of the instrument.
Reset	Independent alarm (VL∑, An) max: A dmd, W dmd all energies (Wh, varh) and hour counter

Power Supply Specifications

Auxiliary power supply	230VAC -15 +10%, 50-60Hz 115VAC -15 +10%, 50-60Hz 48VAC -15 +10%, 50-60Hz 24VAC -15 +10%, 50-60Hz 18 to 60VDC
Power consumption	AC: 4.5 VA DC: 4W

General Specifications

Operating temperature	0° to +50°C (32 to 122°F) (RH < 90% non condensing)
Storage temperature	-30 to +60°C (-22 to 140°F) (RH < 90% non condensing)
Installation category	Cat. III (IEC 60664, EN60664)
Insulation (for 1 minute)	4000VAC, 500VDC between mesuring inputs and power supply. 500VAC/DC between mesuring inputs and RS485. 4000VAC, 500VDC between power supply and RS485
Dielectric strength	4000 VAC (for 1 min)
EMC	
Emissions	EN50084-1 (class A) residential environment, commerce and light industry

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General Specifications (cont.)

EMC (cont.) Immunity	EN61000-6-2 (class A) industrial environment.
Pulse voltage (1.2/50µs)	EN61000-4-5
Safety standards	IEC60664, EN60664
Approvals	CE, cULus
Connections 5(6) A Max cable cross sect. area	Screw-type 2.5 mm^2

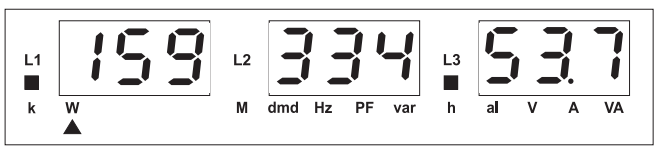
Housing Dimensions (WxHxD) Material	107.8 x 90 x 64.5 mm ABS self-extinguishing: UL 94 V-0
Mounting	DIN-rail
Protection degree	Front: IP40 (standard) Connections: IP20
Weight	Approx. 400 g (pack. incl.)

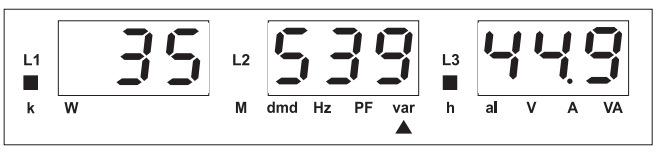
Display pages

Display variables in 3-phase systems (in a 3-phase system with neutral)

No	1st variable	2nd variable	3rd variable	Note
1	V L1	V L2	V L3	
2	V L12	V L23	V L31 of the display	Decimal point blinking on the right
3	A L1	A L2	A L3	
4	A L1 dmd	A L2 dmd	A L3 dmd	dmd = demand (integration time selectable from 1 to 30 minutes)
5	An	AL.n		AL.n if neutral current alarm is active
6	W L1	W L2	W L3	Decimal point blinking on the right of the display if generated power
7	PF L1	PF L2	PF L3	
8	var L1	var L2	var L3	Decimal point blinking on the right of the display if generated power
9	VA L1	VA L2	VA L3	
10	VA system	W system	var system	
11	VA dmd (system)	W dmd (system)	Hz (system)	dmd = demand (integration time selectable from 1 to 30 minutes)
12		W dmd MAX		Maximum sys power demand
13	Wh (MSD)	Wh	Wh (LSD) max 3 groups of 3 digits.	The total indication is given in
14	varh (MSD)	varh	varh (LSD) max 3 groups of 3 digits.	The total indication is given in
15	V LL system	AL.U	PF system	AL.U= is activated only if one of VLN is not within the set limits.
16	A MAX			max. current among the three phases
17	A dmd max			max. dmd current among the three phases
18	h			hour counter

MSD: most significant digit
LSD: least significant digit





1) Example of kWh visualization:
This example is showing 15 933 453.7 kWh

2) Example of kvarh visualization:
This example is showing 3 553 944.9 kvarh

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Waveform of the signals that can be measured

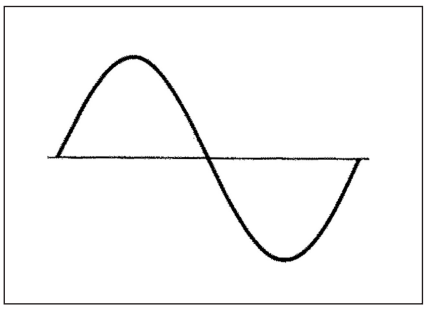


Figure A
Sine wave, undistorted

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

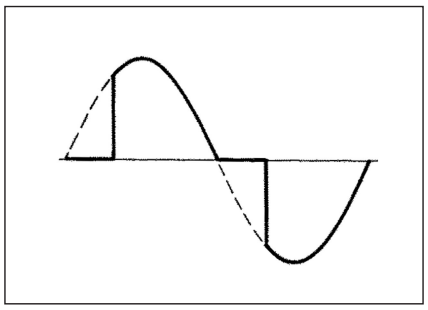


Figure B
Sine wave, indented

Fundamental content	10...100%
Harmonic content	0...90%

Frequency spectrum: 3rd to 16th harmonic
Additional error: <1% FS

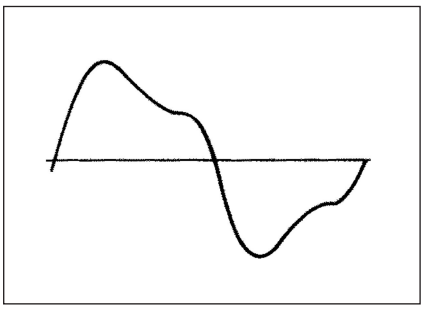


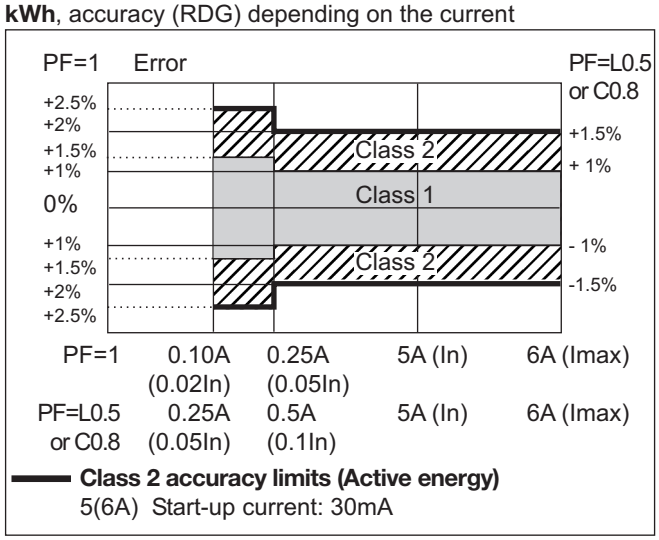
Figure C
Sine wave, distorted

Fundamental content	70...90%
Harmonic content	10...30%

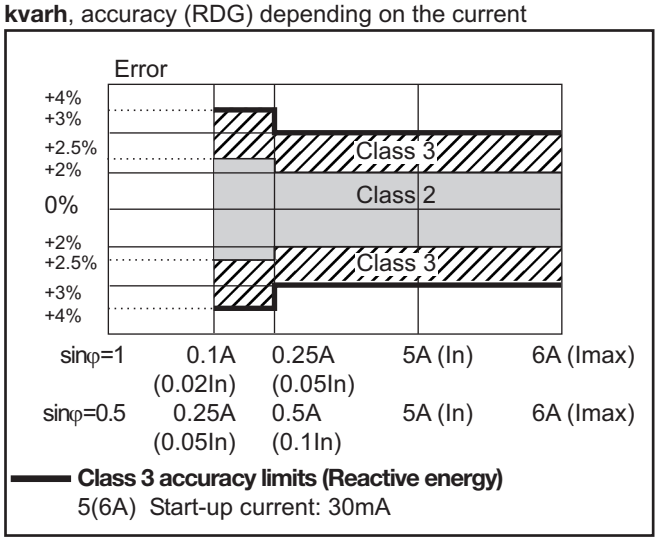
Frequency spectrum: 3rd to 16th harmonic
Additional error: <0.5% FS

Accuracy

kWh, accuracy (RDG) depending on the current



kvarh, accuracy (RDG) depending on the current



: this graph is only referred to instrument models with the “SG or PG” option.

: this graph is only referred to instrument models with the “X or S” option.

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

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

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 3-phase voltage

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

3-phase reactive power

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

3-phase active power

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

3-phase apparent power

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

3-phase power factor

$$\cos\phi_\Sigma = \frac{W_\Sigma}{VA_\Sigma}$$

Neutral current

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

Used calculation formulas (cont.)

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

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

Energy metering

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

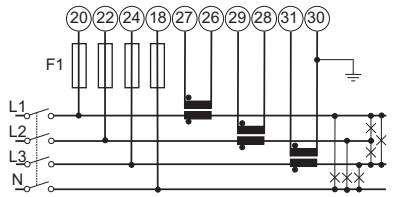
n = time unit

Δt = time interval between two successive power consumptions

n_1, n_2 = starting and ending discrete time points of consumption recording

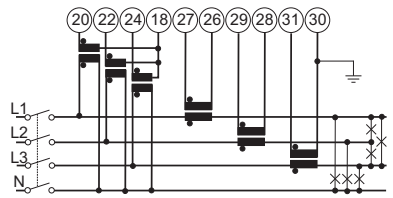
Wiring diagrams

Fig. 1



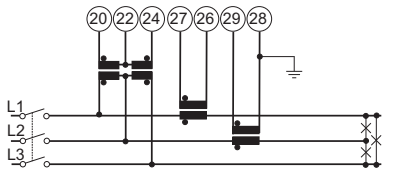
CT connection

Fig. 2



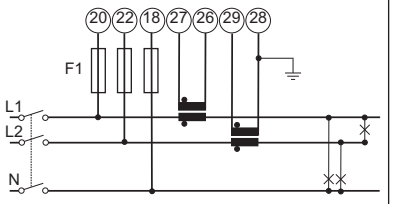
3CT and 3VT connection

Fig. 3



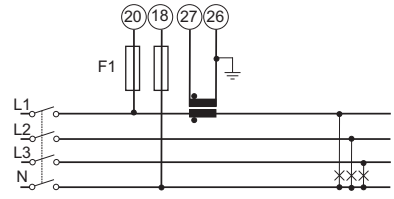
ARON and VT connection

Fig. 4



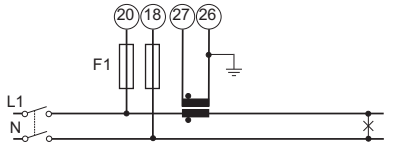
2-phase connection

Fig. 5



3-phase load balanced connection

Fig. 6



1-phase connection

F1= 315mA

NOTE: Only for **"PG"** and **"SG"** options: the current measuring inputs are galvanically insulated and therefore they can be connected to ground singly.

NOTE: For all models except for **"PG"** or **"SG"** the current inputs can be connected to the lines ONLY by means of current transformers. The direct connection is not allowed.

ATTENTION: only one ammeter input can be connected to earth, as shown in the electrical diagrams.

RS485 port connections

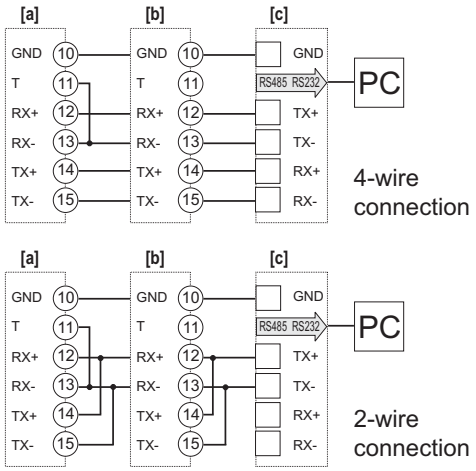
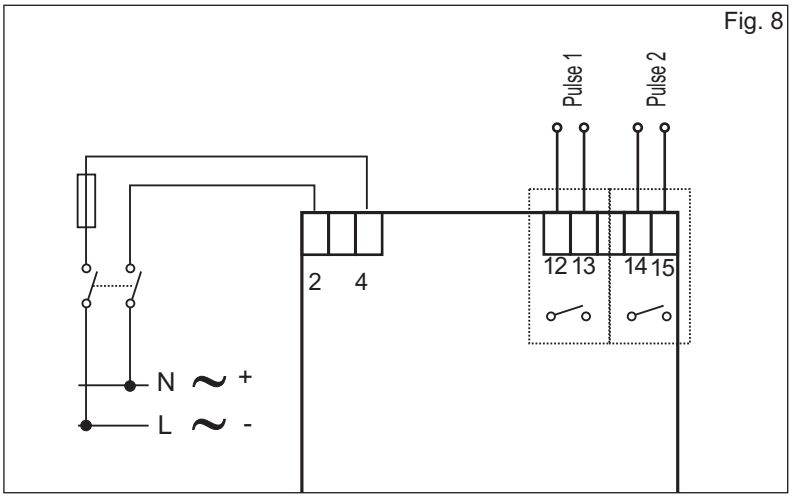
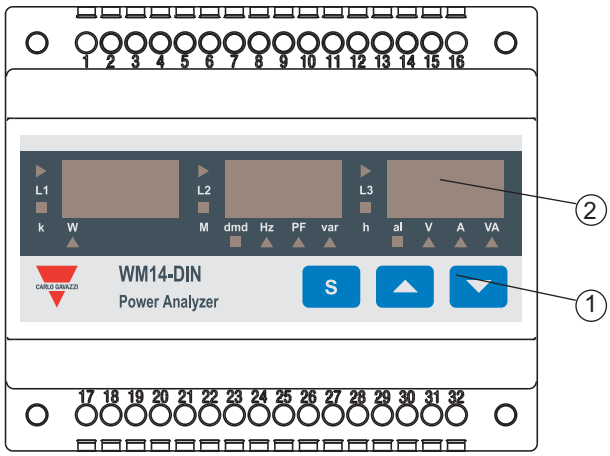


Fig. 7: **a**-Last instrument; **b**-1...n Instrument **c**-RS485/232 serial converter

Dual pulse output connections



Front Panel Description



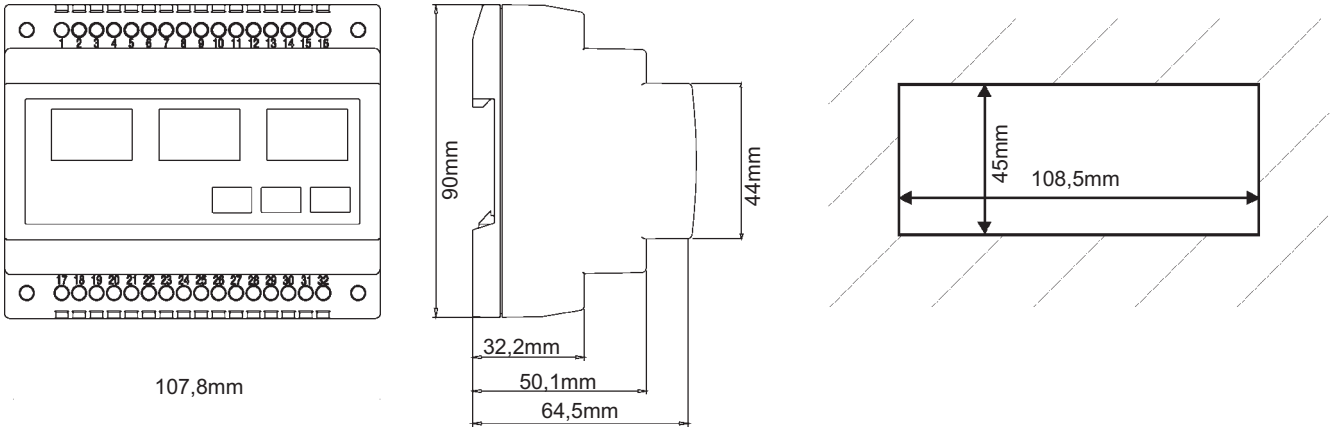
1. **Key-pad**
   To program the configuration parameters and the display of the variables.

   S
   Key to enter programming and confirm selections;

   ▲ ▼
   Keys to:
   - programme values;
   - select functions;
   - display measuring pages.

2. **Display**
   LED-type with alphanumeric indications to:
   - display configuration parameters;
   - display all the measured variables.

Dimensions and Panel Cut-out



Energy Management
Power Analyzer
Type WM14 DIN "Advanced version"

- **Protection degree (front): IP40**
- **2 digital outputs**
- **16 freely configurable alarms with OR/AND logic linkable with up to 2 digital outputs**
- **RS422/485 serial output (MODBUS-RTU), iFIX SCADA compatibility**
- **Class 1 (kWh), Class 2 (kvarh)**
- **Accuracy ±0.5 F.S. (current/voltage)**
- **Power Analyzer**
- **Instantaneous variables read-out: 3 DGT**
- **Energies readout: 8+1 DGT**
- **System variables: V_{LL}, V_{LN}, An, $A_{dmd\ max}$, VA, VA_{dmd}, $VA_{dmd\ max}$, W, W_{dmd}, $W_{dmd\ max}$, var, PF, Hz, ASY**
- **Single phase variables: V_{LL}, V_{LN}, $V_{LN\ min}$, $V_{LN\ max}$, A, A_{min}, A_{max}, A_{dmd}, VA, W, W_{dmd}, W_{max}, var, PF, PF_{min}**
- **Harmonic analysis (FFT) up to the 15th harmonic (current and voltage)**
- **Four quadrant power measurement**
- **Energy measurements: total and partial kWh and kvarh**
- **Hour counter (5+2 DGT)**
- **TRMS meas. of distorted sine waves (voltages/currents)**
- **Universal power supply: 90 to 260 VAC/DC, 18 to 60 VAC/DC**
- **Front dimensions: 107,8x90mm (6 DIN modules)**
- **Voltage asymmetry, phase sequence, phase loss control**

Product Description

3-phase advanced power analyzer with integrated programming key-pad. Particularly recommended for the measurement of the main electrical variables.

Housing for DIN-RAIL mounting, with RS485 communication port or pulse and/or alarm outputs.

How to order

WM14-DIN AV5 3 H R2 S1 AX

- **Model**
- **Range code**
- **System**
- **Power supply**
- **Output 1**
- **Output 2**
- **Option**

Type Selection

Range codes

AV5: 380/660V_{L-L}/1/5(6)AAC
V_{L-N}: 185 V to 460 V
V_{L-L}: 320 V to 800 V
AV6: 120/208V_{L-L}/1/5(6)AAC
V_{L-N}: 45 V to 145 V
V_{L-L}: 78 V to 250 V
Phase current: 0.03A to 6A
Neutral current: 0.09A to 6A

System

3 : 1, 2 or 3 phase, balanced/unbalanced load, with or without neutral

Power supply

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

Output 1

R2: 2-relay outputs
O2: 2-open collector outputs

Output 2

XX: None
S1: RS485/RS422 port

Options

AX: advanced functions

Input specifications

Rated inputs	System type: 3 - phase
Current	3 (by Shunts)
Voltage	4
Accuracy (display, RS485) (@25°C ±5°C, R.H. ≤60%)	with CT=1 and VT=1 AV5: 1150W-VA-var, FS:230VLN, 400VLL; AV6: 285W-VA-var, FS:57VLN, 100VLL
Current	0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A: ±(0.5% FS +7DGT)
Neutral current	0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A: ±(1.5% FS +7DGT)
Phase-phase voltage	±(1.5% FS +1 DGT)
Phase-neutral voltage	±(0.5% FS + 1 DGT)
Active and Apparent power,	0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS +5DGT)
Reactive power	0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS +5DGT)
Active energy	Class 1 (start up current: 30mA)
Reactive energy	Class 2 (start up current: 30mA)
Frequency	±0.1Hz (48 to 62Hz)
Harmonic distortion	±3% F.S. (up to 15th harmonic) (F.S.: 100%)

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Input specifications (cont.)

Additional errors	
Humidity	≤0.3% FS, 60% to 90% RH
Temperature drift	≤ 200ppm/°C
Sampling rate	1600 samples/s @ 50Hz 1900 samples/s @ 60Hz
Display refresh time	200ms (FFT off) 500ms (FFT on)
Display	
Type	LED, 9mm
Read-out for instant. var.	3x3 DGT
Read-out for energies	3+3+3 DGT (Max indication: 999 999 99.9)
Read-out for hour counter	1+3+3 DGT (Max. indication: 9 999 9.99)

Measurements	Current, voltage, power, power factor, frequency
Type	TRMS measurement of distorted waves.
Coupling type	Direct
Crest factor	< 3, max 10A peak
Input impedance	
380/660V_{L-L} (AV5)	1.6 MΩ ±5%
120/208V_{L-L} (AV6)	1.6 MΩ ±5%
Current	≤ 0.02Ω
Frequency	48 to 62 Hz
Overload protection	(max values)
Continuous: voltage/current	AV5: 460V_{LN}, 800V_{LL}/6A AV6: 145V_{LN}, 250V_{LL}/6A
For 500ms: voltage/current	AV5: 800V_{LN}, 1380V_{LL}/36A AV6: 240V_{LN}, 416V_{LL}/36A

Output Specifications

Digital outputs	
Pulse type	
Number of outputs	Up to 2
Type	Programmable from 0.01 to 500 pulses per kWh/kvarh Pulse duration ≥ 100ms < 120msec (ON), ≥ 100ms (OFF) according to EN62053-31
Alarm type	
Number of outputs	Up to 2, independent
Alarm modes	Up alarm, down alarm, in window alarm, out window alarm. Start-up deactivation function available for all kinds of alarm. All of them connectable on all variables (see the table "List of the variables that can be connected to")
Set-point adjustment	From 0 to 100% of the display scale
Hysteresis	From 0 to full scale
On-time delay	0 to 255s
Output status	Selectable; normally de-energized and normally energized
Min. response time	≤400ms, filters excluded, With FFT off; ≤1s, with FFT on. (with set-point on-time delay: "0 s")
Remote control	The digital ouputs status can be managed by means of serial communication RS485, if programmed as "rEM".
Note	The 2 digital outputs can also work as pulse output and alarm output.
Static outputs	
Purpose	For pulse outputs or for alarm outputs
Signal	V_{ON} 1.2 VDC/ max. 100 mA V_{OFF} 30 VDC max.
Insulation	By means of optocuplers, 4000 V_{RMS} output to measuring inputs, 4000 V_{RMS} output to power supply input.
Relay outputs	
Purpose	For alarm outputs or for pulse outputs
Type	Relay, SPST type AC 1-5A @ 250VAC DC 12-5A @ 24VDC AC 15-1.5A @ 250VAC DC 13-1.5A @ 24VDC
Mechanical life:	≥ 30 x 10^6 operations
Electrical life:	≥ 10^5 operations (@ 5A, 250 V, PF 1)
Insulation	4000 V_{RMS} output to measuring input, 4000 V_{RMS} output to supply input.
RS422/RS485	(on request) Multidrop bidirectional (static and dynamic variables)
Connections	2 or 4 wires, max. distance 1000m, termination directly on the instrument
Addresses	From 1 to 255, selectable
Protocol	MODBUS/JBUS (RTU)
Data (bidirectional)	
Dynamic (reading only)	System and phase variables: see table "List of variables..."
Static (reading and writing)	All the configuration parameters.
Data format	1 start bit, 8 data bit, no parity,1 stop bit
Baud-rate	4800, 9600,19200, 38400bits/s
Insulation	By means of optocouplers, 2.5 K V_{RMS} output to measuring input 2.5 K V_{RMS} output to supply input

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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 999, all data are protected
System selection	
System 3, unbalanced	3-phase (3-wire, 4-wire) 3-phase ARON 2-phase (3-wire)
System 3, balanced	3-phase (3-wire, 4-wire) 3-phase (4-wire) “1CT+1VT” 3-phase (3-wire) “1CT+2VT” 1-phase (2-wire)
Transformer ratio	
CT VT/PT 1.0 to 6000.0	1 to 60000
Filter	
Operating range	0 to 100% of the input display scale
Filtering coefficient	1 to 32
Filter action	Measurements, alarms, serial output (fundamental variables: V, A, W and their derived ones).
Displaying	Up to 3 variables per page See table “Display pages”

Alarms	
Working mode	“OR” or “AND” or “OR+AND” functions (see “Alarm parameter and logic” page). Freely programmable on up to 16 total alarms (out1+out2). The alarms can be connected to any variables available in the table “List of the variables that can be connected to”
Reset	By means of keypad: The following kinds of reset are available: - all values stored as “dmd max”: Admd max, Wdmd max, VAdmd max - all values stored as “max”: A_1, A_2, A_3, WL_1, WL_2, WL_3, VL_1, VL_2, VL_3, and as “Min”: PF_1, PF_2, PF_3, A_1, A_2, A_3, VL_1, VL_2, VL_3 . - Only the kWh and kvarh partial counters - Both the kWh and kvarh total and partial counters - the hour counter.

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Power Supply Specifications

AC/DC voltage	90 to 260VAC/DC 16 to 60VAC/DC	**Power consumption**	AC: 6 VA DC: 3.5 W

General Specifications

Operating temperature	0 to +50°C (32 to 122°F) (RH < 90% non condensing)
Storage temperature	-30 to +60°C (-22 to 140°F) (RH < 90% non condensing)
Overvoltage category	Cat. III (IEC 60664, EN60664)
Insulation (for 1 minute)	4kVAC$_{RMS}$ between measuring inputs and power supply. 4kVAC/DC @ I ≤3mA between measuring inputs and RS485. 4kVAC $_{RMS}$ between power supply and RS485.
Dielectric strength	4kVAC$_{RMS}$ (for 1 min)
EMC	
Emissions	EN61000-6-3 residential environment, commerce and light industry
Immunity	EN61000-6-2 industrial environment.
Pulse voltage (1.2/50µs)	EN61000-4-5
Safety standards	IEC60664, IEC61010-1 EN60664, EN61010-1
Approvals	CE, cULus
Connections 5(6) A Max cable cross sect. area	Screw-type 2.5 mm^2
Housing	
Dimensions (WxHxD)	107.80x90x64,5 mm
Material	ABS self-extinguishing: UL 94 V-0
Mounting	DIN-RAIL
Protection degree	Front: IP40 (standard) Connections: IP20
Weight	Approx. 400 g (pack. incl.)

Insulation between inputs and outputs

	Measuring Inputs V	Measuring Inputs A	Relay outputs	Open collector outputs	Communication Port	Power Supply 90-260VAC/DC	Power Supply 18-60VAC/DC
Measuring Inputs V	-	-	4kV	4kV	2.5kV	4kV	4kV
Measuring Inputs A	-	-	4kV	4kV	2.5kV	4kV	4kV
Relay outputs	4kV	4kV	-	-	4kV	4kV	4kV
Open col. outputs	4kV	4kV	-	-	2.5kV	4kV	4kV
Communication Port	2.5kV	2.5kV	-	-	-	4kV	4kV
90-260VAC/DC	4kV	4kV	4kV	4kV	4kV	-	-
18-60VAC/DC	4kV	4kV	4kV	4kV	4kV	-	-

NOTE: In case of fault of first insulation the current from the measuring inputs to the ground is lower than 2 mA.

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List of the variables that can be connected to:

- **RS485/RS422 communication port**
- **Alarm outputs (“max / min” variable, “energies” and “hour counter” excluded)**
- **Pulse outputs (only “energies”)**

No	Variable	1-phase system	2-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.	Notes
1	V L1	x	x	x	x	o	o	# Δ
2	V L2	o	x	x	x	o	o	# Δ
3	V L3	o	o	x	x	o	o	# Δ
4	V L-N sys	o	x	x	x	o	o	Sys = system
5	V L1-2	o	x	x	x	x	x	
6	V L2-3	o	x	x	x	x	x	
7	V L3-1	o	o	x	x	x	x	
8	V L-L sys	o	x	x	x	x	x	Sys = system
9	A L1	x	x	x	x	x	x	# Δ
10	A L2	o	x	x	x	x	x	# Δ
11	A L3	o	o	x	x	x	x	# Δ
12	An	o	x	x	x	x	x	
13	W L1	x	x	x	x	o	o	◆
14	W L2	o	x	x	x	o	o	◆
16	W L3	o	o	x	x	o	o	◆
17	W sys	o	x	x	x	x	x	Sys = system
18	var L1	x	x	x	x	o	o	
19	var L2	o	x	x	x	o	o	
20	var L3	o	o	x	x	o	o	
21	var sys	o	x	x	x	x	x	Sys = system
22	VA L1	x	x	x	x	o	o	
23	VA L2	o	x	x	x	o	o	
24	VA L3	o	o	x	x	o	o	
25	VA sys	o	x	x	x	x	x	Sys = system
26	PF L1	x	x	x	x	o	o	ℙ
27	PF L2	o	x	x	x	o	o	ℙ
28	PF L3	o	o	x	x	o	o	ℙ
29	PF sys	o	x	x	x	x	x	Sys = system
30	Hz	x	x	x	x	x	x	
31	Phase seq.	o	o	x	x	x	x	
32	ASY L-N	o	x	x	x	x	x	
33	ASY L-L	o	x	x	x	x	x	
34	Phase loss	o	x	x	x	x	x	
35	VA sys dmd	x	x	x	x	x	x	Sys = system ◆ ❍
36	W sys dmd	x	x	x	x	x	x	Sys = system ◆ ❍
37	A L1 dmd	x	x	x	x	x	x	
38	A L2 dmd	o	x	x	x	x	x	
39	A L3 dmd	o	o	x	x	x	x	
40	A L dmd	x	x	x	x	x	x	□ ◆
41	A L1 THD	x	x	x	x	x	x	
42	A L2 THD	o	x	x	x	x	x	
43	A L3 THD	o	o	x	x	x	x	
44	V L1 THD	x	x	x	x	x	x	
45	V L2 THD	o	x	x	x	x	x	
46	V L3 THD	o	o	x	x	x	x	
47	kWh	x	x	x	x	x	x	Total and partial
48	kvarh	x	x	x	x	x	x	Total and partial
49	hours	x	x	x	x	x	x	

(x) = available (o) = not available

(◆) These variables are available also as MAX detection and data storage (on EEPROM at power down).
(ℙ) These variables are available also as MIN detection and data storage (on EEPROM at power down).
(□) Highest value among the 3-phase.
(❍) Alarm available only on the consumed power (+).
(#) These variables are available also for the MAX values, which have not been stored in the EEPROM at power down.
(Δ) These variables are available also for the MIN values, which have not been stored in the EEPROM at power down.

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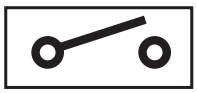
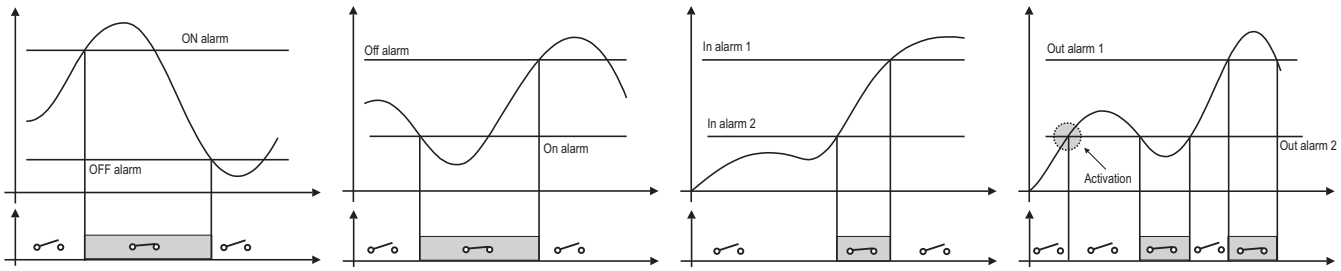
Alarm parameters and logic



- Block enable.
- Controlled variable (VLN, ...).
- Alarm type (up, down, in window, out window).
- Activation function.
- ON set-point.
- OFF set-point.
- ON delay.
- Logical function (AND, OR).
- Digital output (1, 2).

A, B, C... up to 16 parameter control blocks.



Up alarm
On alarm > Off alarm

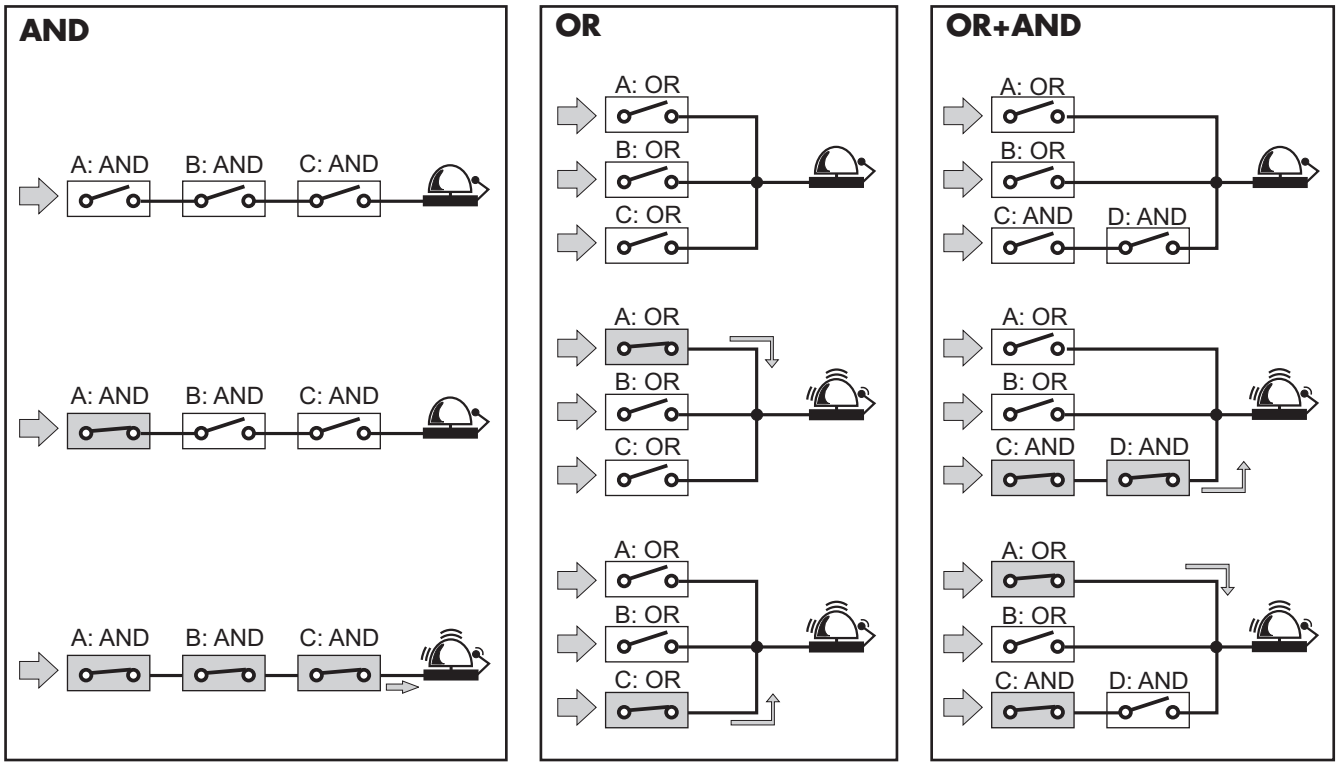
Down alarm
On alarm < Off alarm

In window alarm

Out window alarm with start up deactivation

Note: any alarm working mode can be linked to the “Start-up deactivation” function which disables only the first alarm after power on of the instrument.

AND/OR logical alarm examples:

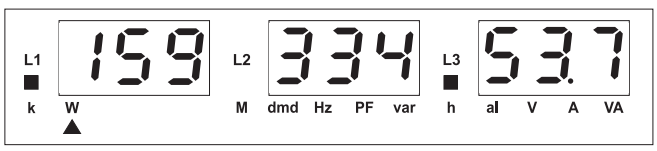


Display pages

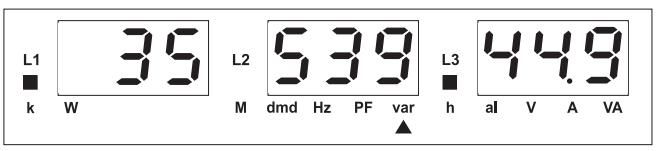
Display variables in 3-phase systems (in a 3-phase system with neutral)

No	1st variable	2nd variable	3rd variable	Note
1	%	“ASY”	“L N”	Phase to neutral asymmetry
2	V L1	V L2	V L3	
3	V LN sys		PF sys	Sys = system
4	V LL sys		PF sys	Decimal point blinking on the right of the display
5	V L1 2	V L2 3	V L3 1	Decimal point blinking on the right of the display
6	%	“ASY”	“L L”	Phase to phase asymmetry
7	“PH”	“SEq”	1 2 3 / 1 3 2	Phase sequence
8	A L1	A L2	A L3	
9	A dmd L1	A dmd L2	A dmd L3	dmd = demand (integration time selectable from 1 to 30 minutes)
10	An	“n”	Hz	An= neutral current
11	W L1	W L2	W L3	
12	W dmd L1	W dmd L2	W dmd L3	dmd = demand (integration time selectable from 1 to 30 minutes)
13	PF L1	PF L2	PF L3	
14	var L1	var L2	var L3	
15	VA L1	VA L2	VA L3	
16	VA sys	W sys	var sys	
17	VA dmd sys	W dmd sys	Hz	dmd = demand (integration time selectable from 1 to 30 minutes)
18	V max L1	V max L2	V max L3	Max value of phase to neutral voltage
19	V min L1	V min L2	V min L3	Min value of phase to neutral voltage
20	A max L1	A max L2	A max L3	Max value of current
21	A min L1	A min L2	A min L3	Min value of current
22	W max L1	W max L2	W max L3	Max value of W
23	PF min L1	PF min L2	PF min L3	Min value of PF
24	VA dmd sys max	W dmd sys max	“H”	Max system dmd
25	A dmd max		“H”	Highest value among the 3-phase
26	V L1 THD	V L2 THD	V L3 THD	
27	A L1 THD	A L2 THD	A L3 THD	
28	h (MSD)	h	h (LSD)	Hour counter
29	kvarh (MSD)	kvarh	kvarh (LSD)	Partial counter
30	kWh (MSD)	kWh	kWh (LSD)	Partial counter
31	kvarh (MSD)	kvarh	kvarh (LSD)	Total counter
32	kWh (MSD)	kWh	kWh (LSD)	Total counter

MSD: most significant digit
LSD: least significant digit



1) Example of kWh visualization:
This example is showing 15 933 453.7 kWh



2) Example of kvarh visualization:
This example is showing 3 553 944.9 kvarh

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Waveform of the signals that can be measured

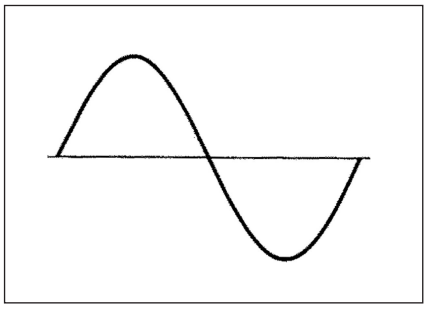


Figure A
Sine wave, undistorted

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

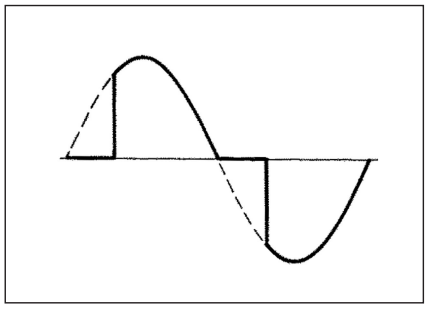


Figure B
Sine wave, indented

Fundamental content	10...100%
Harmonic content	0...90%

Frequency spectrum: 3rd to 16th harmonic
Additional error: <1% FS

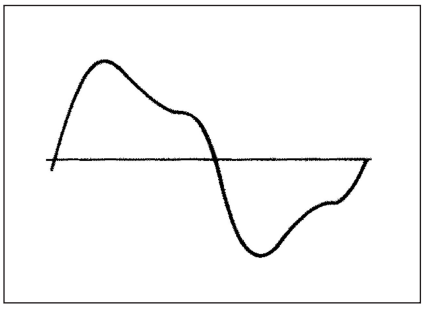


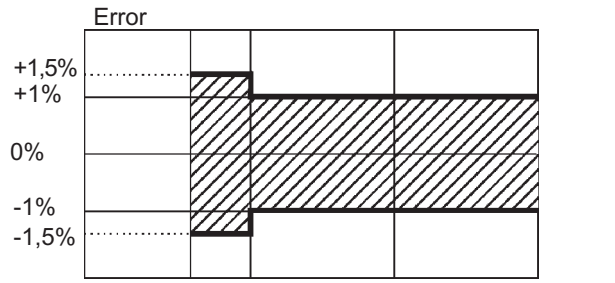
Figure C
Sine wave, distorted

Fundamental content	70...90%
Harmonic content	10...30%

Frequency spectrum: 3rd to 16th harmonic
Additional error: <0.5% FS

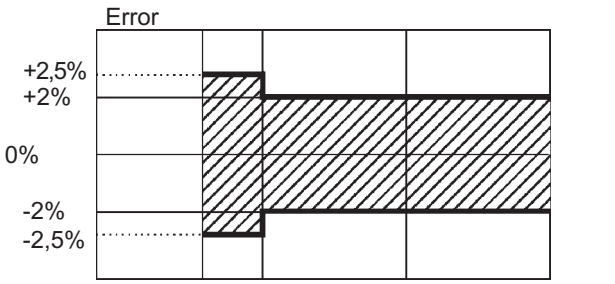
Accuracy

Wh, accuracy (RDG) depending on the current



Accuracy limits (Active energy)
5(6A) Start-up current: 30mA

varh, accuracy (RDG) depending on the current



Accuracy limits (Reactive energy)
5(6A) Start-up current: 30mA

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

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

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 (TPF)

$$\cos\phi_\Sigma = \frac{W_\Sigma}{VA_\Sigma}$$

Energy metering

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

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

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;Δ**t**= time interval between two successive power consumptions;
n_1, n_2 = starting and ending discrete time points of consumption recording

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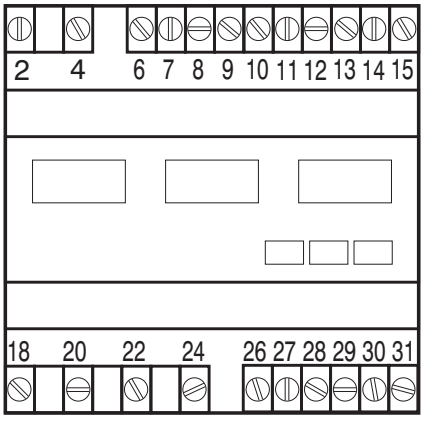
Harmonic Analysis

Analysis principle	FFT	**Display of harmonic values**	THD %
Harmonic measurement		**Others**	The harmonic distortion can be measured in both 3-wire or 4-wire systems.
Current	Up to 15th harmonic		
Voltage	Up to 15th harmonic		
Type of harmonics	THD (V_{L1}) THD (V_{L2}) THD (V_{L3}) THD (A_{L1}) THD (A_{L2}) THD (A_{L3})		

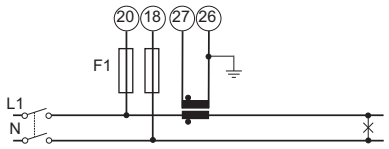
Wiring diagrams

When the CT is connected to earth, a leakage current from 0 to 1.8mA max is generated, whose value depends on the input impedance values of the instrument, on the type of connection and on the line voltage measured by the instrument.



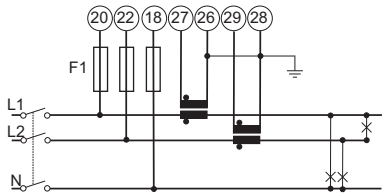
F1= 315mA

1-ph, 2-wire Fig. 1



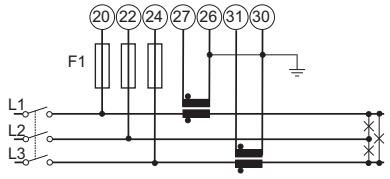
1-CT connection

2-ph, 3-wire Fig. 2



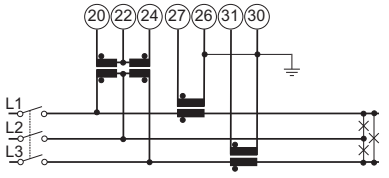
2-CT connection

3-ph, 3-wire, unbalanced load Fig. 3



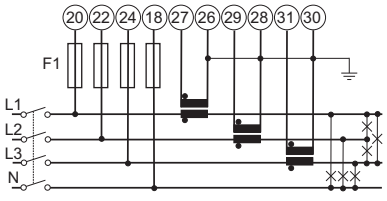
ARON connection

3-ph, 3-wire, unbalanced load Fig. 4



ARON and 2-VT/PT connections

3-ph, 4-wire, unbalanced load Fig. 5



3-CT connection

NOTE: the current inputs can be connected to the mains ONLY by means of current transformers. The direct connection is not allowed.

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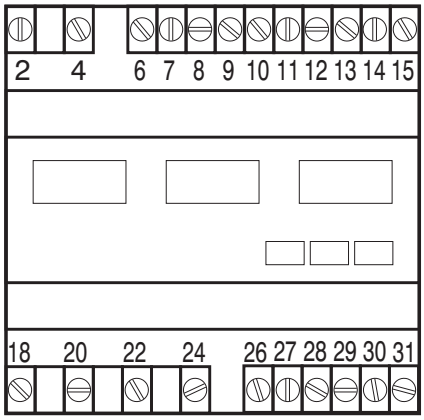
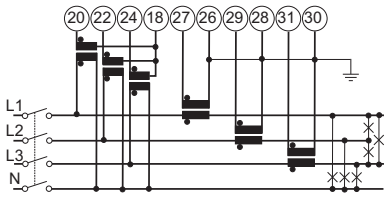
Wiring diagrams

When the CT is connected to earth, a leakage current from 0 to 1.8mA max is generated, whose value depends on the input impedance values of the instrument, on the type of connection and on the line voltage measured by the instrument.

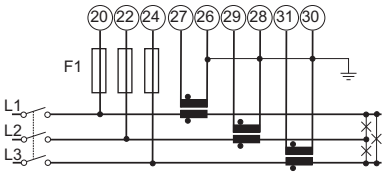


3-ph, 4-wire, unbalanced load Fig. 6



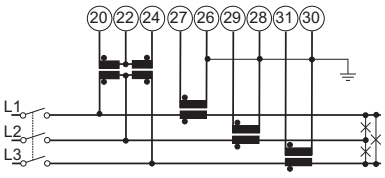
3-CT and 3-VT/PT connections

3-ph, 3-wire, unbalanced load Fig. 7



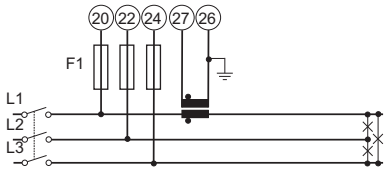
3-CT connection

3-ph, 3-wire, unbalanced load Fig. 8



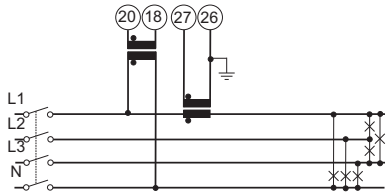
3-CT and 2-VT/PT connections

3-ph, 3-wire, balanced load Fig. 9



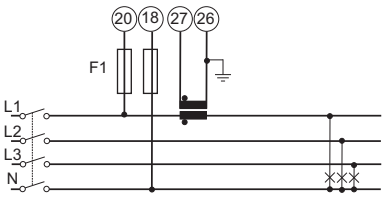
1-CT connection

3-ph, 4-wire balanced load Fig. 10



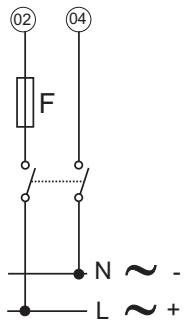
1-CT and 1-VT/PT connections

3-ph, 4-wire, balanced load Fig. 11



1-CT connection

Fig. 12



Power supply connection

NOTE: the current inputs can be connected to the mains ONLY by means of current transformers. The direct connection is not allowed.

Output connections

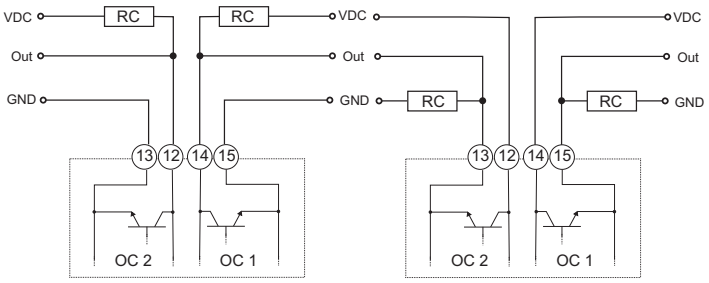


Fig. 13 Fig. 14

Relay out.

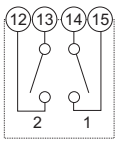


Fig. 15

RS485 port

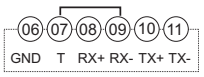
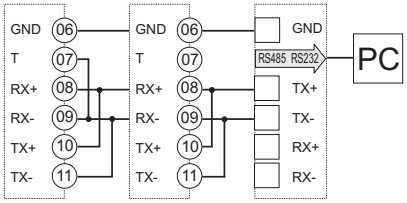


Fig.16



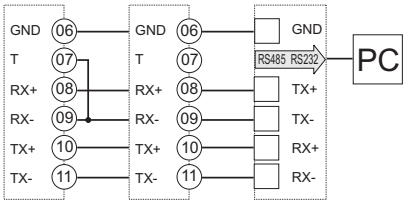
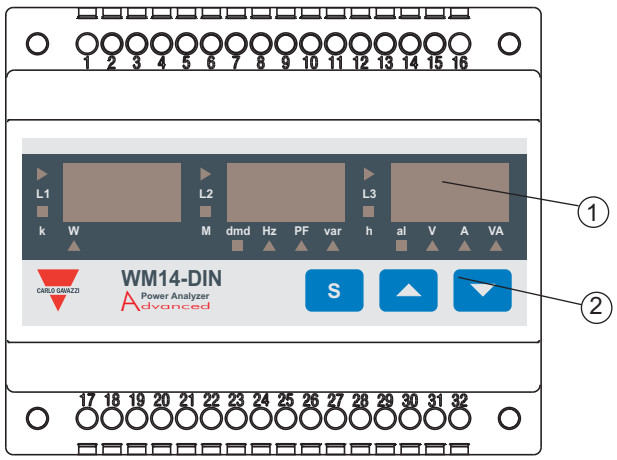


Fig. 17

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: external power supply voltage. Out: positive output contact (open collector transistor). GND: ground output contact (open collector transistor).

Front Panel Description



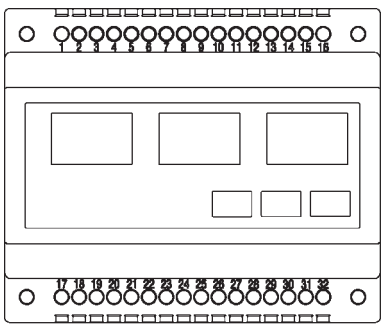
1. **Display**
   LED-type with alphanumeric indications to:
   - display configuration parameters;
   - display all the measured variables.

2. **Key-pad**
   To program the configuration parameters and the display of the variables.

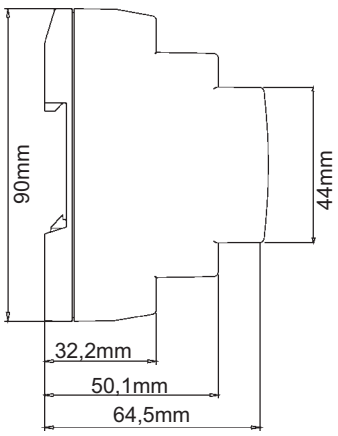
   S
   Key to enter programming and confirm selections;

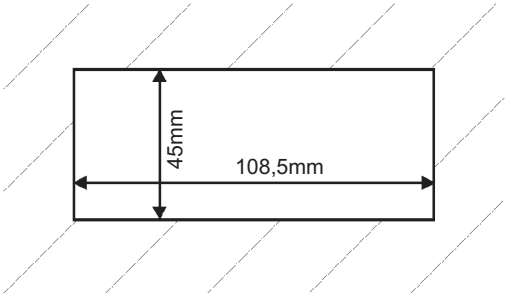
   ▲ ▼
   Keys to:
   - programme values;
   - select functions;
   - display measuring pages.

Dimensions and Panel Cut-out



107,8mm





Energy Management
Power Analyzer
Type WM14-96 "Basic Version"

- **Optional dual pulse output**
- **Alarms (visual only) V_{LN}, An**
- **Optional galvanically insulated measuring inputs**

- **Class 1 (active energy)**
- **Class 2 (reactive energy)**
- **Accuracy ±0.5 F.S. (current/voltage)**
- **Power analyzer**
- **Display of instantaneous variables: 3x3 digit**
- **Display of energies: 8+1 digit**
- **System variables and phase measurements: W, W_{dmd}, var, VA, VA_{dmd}, PF, V, A, An, A_{dmd}, Hz**
- **A_{max}, $A_{dmd\ max}$, $W_{dmd\ max}$ indication**
- **Energy measurements: kWh and kvarh**
- **Hour counter (5+2 DGT)**
- **TRMS meas. of distorted sine waves (voltages/currents)**
- **Power supply: 24V, 48V, 115V, 230V, 50-60Hz; 18 to 60VDC**
- **Protection degree (front): IP65**
- **Front dimensions: 96x96mm**
- **Optional RS422/485 serial port**

Product Description

3-phase power analyzer with built-in programming key-pad. Particularly recommended for displaying the main electrical variables. Housing for panel mounting, (front) protection degree IP65, and optional RS485 serial port or dual pulse output. Parameters programmable by means of CptBSoft.

How to order WM14-96 AV5 3 D PG

Model
Range code
System
Power supply
Option

How to order CptBSoft

CptBSoft (compatible only with S or SG options): software to program the working parameters of the power analyzer and to read the energy and the instantaneous variables.

Type Selection

Range codes

AV5: 380/660V_{L-L}/5(6)AAC
VL-N: 185 V to 460 V
VL-L: 320 V to 800 V
AV6: 120/208V_{L-L}/5(6)AAC
VL-N: 45 V to 145 V
VL-L: 78 V to 250 V
Phase current: 0.03A to 6A
Neutral current: 0.09 to 6A

System

3 : 1-2-3-phase, balanced/unbalanced load,with or without neutral

Power supply

A: 24VAC -15+10%, 50-60Hz
B: 48VAC -15+10%, 50-60Hz
C: 115VAC -15+10%, 50-60Hz
D: 230VAC -15+10%, 50-60Hz
3: 18 to 60VDC (not available in case of SG or PG options)

Options

X: None
S: RS485 port
SG: RS485+galvanic insulated measurig inputs
PG: Dual pulse output + galvanically insulated measuring inputs.

Input specifications

Rated inputs	
Current "X-S options"	3 (non insulated each other)
Current "SG-PG options"	3 (insulated each other)
Voltage	4
Accuracy (display, RS485) (@25°C ±5°C, R.H. ≤60%)	with CT=1 and VT=1 AV5: 1150W-VA-var, FS:230VLN, 400VLL; AV6: 285W-VA-var, FS:57VLN, 100VLL
Current	0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A: ±(0.5% FS+7DGT)
Neutral current	0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A: ±(0.5% FS+7DGT)
Phase-phase voltage	±(1.5% FS +1 DGT)
Phase-neutral voltage	±(0.5% FS + 1 DGT)
Active and Apparent power,	0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS +5DGT)
Reactive power	0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS +5DGT)
Active energy "X-S option"	Class 2 (start up "I": 30mA)
Reactive energy "X-S option"	Class 3 (start up "I": 30mA)
Active energy "SG-PG opt."	Class 1 (start up "I": 30mA)
Reactive energy "SG-PG opt."	Class 2 (start up "I": 30mA)
Frequency	±0.1Hz (48 to 62Hz)
Additional errors	
Humidity	≤0.3% FS, 60% to 90% RH
Temperature drift	≤ 200ppm/°C
Sampling rate	1400 samples/s @ 50Hz 1700 samples/s @ 60Hz
Display refresh time	700ms
Display	
Type	LED, 14mm
Read-out for instant. var.	3x3 DGT
Read-out for energies	3+3+3 DGT (Max indication: 999 999 99.9)

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Input specifications (cont.)

Display (cont.)	
Read-out for hour counter	1+3+3 DGT (Max. indication: 9 999 9.99)
Measurements	Current, voltage, power, power factor, frequency, energy, TRMS measurement of distorted waves.
Coupling type	Direct
Crest factor	< 3, max 10A peak

Input impedance	**(X-S options)**
380/660V_{L-L} (AV5)	1 MΩ ±5%
120/208V_{L-L} (AV6)	453 KΩ ±5%
Current	≤ 0.02Ω
Input impedance	**(PG-SG options)**
380/660V_{L-L} (AV5)	1 MΩ ±1%
120/208V_{L-L} (AV6)	1 MΩ ±1%
Current	≤ 0.02Ω
Frequency	48 to 62 Hz
Overload protection	
Continuos voltage/current	1.2 F.S.
For 500ms: voltge/current	2 Un/36A

RS485 Serial Port Specifications

RS422/RS485 (on request)	
Type	Multidrop bidirectional (static and dynamic variables)
Connections	2 or 4 wires, max. distance 1200m, termination directly on the instrument
Addresses	1 to 255, key-pad selectable
Protocol	MODBUS/JBUS

Data (bidirectional)	
Dynamic (reading only)	System, phase variables and energies
Static (writing only)	All configuration parameters
Data format	1 bit di start , 8 data bit, no parity, 1 stop bit
Baud-rate	9600 bit/s

CptBSoft software: parameter programming and reading data

CptBSoft	Multi language software to program the working parameters of the power analyzer and to read the energies and the instantaneous variables. The program runs under Windows 95/98/98SE/2000/

Working mode	NT/XP. Two different working modes can be selected: - management of a local RS485 network; - management of communication from a single instrument to PC (RS232);
Data access	By means of RS485 serial port.

Dual pulse output

Digital outputs (on request)	
Pulse outputs	
Number of outputs	2 (one for kWh one for kvarh)
Number of pulses	From 0.01 to 999 in compliance with the following formula: [**Psys max** (kW or kvar)***pulses** (pulses/kWh or kvarh)] **<14400**
Output type	Relay min current: 0.05A@250VAC/30VDC max current: 5A@250VAC/30VDC

	Electrical life: min $2*10^5$ cycles Mechanial life: $5*10^6$ cycles
Pulse duration	≥100ms <120ms (ON) ≥100ms (OFF)
	According to EN622053-31
Insulation	By means of relays, 4000 V_{RMS} outputs to measuring inputs, 4000 V_{RMS} output to supply input. Insulation between the two outputs: 1000V_{RMS}

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 999, all data are protected
System selection	3-phase with/without n, unbal. 3-phase balanced 3-phase ARON, unbalanced 2-phase Single phase
Transformer ratio	
CT	1 to 999
VT	1.0 to 99.9
Filter	
Operating range	0 to 100% of the input display scale
Filtering coefficient	1 to 16
Filter action	Measurements, alarms, serial out. (fundamental var: V, A, W and their derived ones).
Displaying	Up to 3 variables per page
3-phase system with neutral	Page 1: V L1, V L2, V L3 Page 2: V L12, V L23, V L31 Page 3: A L1, A L2, A L3 Page 4: A L1 dmd, A L2 dmd, A L3 dmd Page 5: An, An Alarm Page 6: W L1, W L2, W L3 Page 7: PF L1, PF L2, PF L3 Page 8: var L1, var L2, var L3 Page 9: VA L1, VA L2, VA L3 Page 10: VA ∑, W ∑, var ∑ Page 11: VA dmd, W dmd, Hz Page 12: W dmd max (*) Page 13: Wh (*) Page 14: varh (*) Page 15: VL-L ∑, PF ∑, VLN Alarm Page 16: A max (*) Page 17: A dmd max (*) Page 18: hour counter (*) (*) = These variables are stored in EEPROM when the instrument is switched off
Alarms	Programmable, for the VL∑ and An (neutral current). Note: the alarm is only visual, by means of LED on the front of the instrument.
Reset	Independent alarm (VL∑, An) max: A dmd, W dmd all energies (Wh, varh) and hour counter

Power Supply Specifications

Auxiliary power supply	230VAC -15 +10%, 50-60Hz 115VAC -15 +10%, 50-60Hz 48VAC -15 +10%, 50-60Hz 24VAC -15 +10%, 50-60Hz 18 to 60VDC
Power consumption	AC: 4.5 VA DC: 4W

General Specifications

Operating temperature	0 to +50°C (32 to 122°F) (RH < 90% non condensing)
Storage temperature	-30 to +60°C (-22 to 140°F) (RH < 90% non condensing)
Installation category	Cat. III (IEC 60664, EN60664)
Insulation (for 1 minute)	4000VAC, 500VDC between mesuring inputs and power supply. 500VAC/DC between mesuring inputs and RS485. 4000VAC, 500VDC between power supply and RS485
Dielectric strength	4000 VAC (for 1 min)
EMC	
Emissions	EN50084-1 (class A) residential environment, commerce and light industry

General Specifications (cont.)

EMC (cont.) Immunity	EN61000-6-2 (class A) industrial environment.
Pulse voltage (1.2/50µs)	EN61000-4-5
Safety standards	IEC60664, EN60664
Approvals	CE, cULus
Connections 5(6) A Max cable cross sect. area	Screw-type 2.5 mm^2

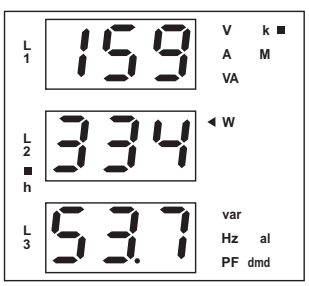
Housing Dimensions (WxHxD) Material	96 x 96 x 63 mm ABS self-extinguishing: UL 94 V-0
Mounting	Panel
Protection degree	Front: IP65 (standard), NEMA4x, NEMA12 Connections: IP20
Weight	Approx. 400 g (pack. incl.)

Display pages

Display variables in 3-phase systems (in a 3-phase system with neutral)

No	1st variable	2nd variable	3rd variable	Note
1	V L1	V L2	V L3	
2	V L12	V L23	V L31 of the display	Decimal point blinking on the right
3	A L1	A L2	A L3	
4	A L1 dmd	A L2 dmd	A L3 dmd	dmd = demand (integration time selectable from 1 to 30 minutes)
5	An	AL.n		AL.n if neutral current alarm is active
6	W L1	W L2	W L3	Decimal point blinking on the right of the display if generated power
7	PF L1	PF L2	PF L3	
8	var L1	var L2	var L3	Decimal point blinking on the right of the display if generated power
9	VA L1	VA L2	VA L3	
10	VA system	W system	var system	
11	VA dmd (system)	W dmd (system)	Hz (system)	dmd = demand (integration time selectable from 1 to 30 minutes)
12		W dmd MAX		Maximum sys power demand
13	Wh (MSD)	Wh	Wh (LSD)	The total indication is given in max 3 groups of 3 digits.
14	varh (MSD)	varh	varh (LSD)	The total indication is given in max 3 groups of 3 digits.
15	V LL system	AL.U	PF system	AL.U= is activated only if one of VLN is not within the set limits.
16	A MAX			max. current among the three phases
17	A dmd max			max. dmd current among the three phases
18	h			hour counter

MSD: most significant digit
LSD: least significant digit

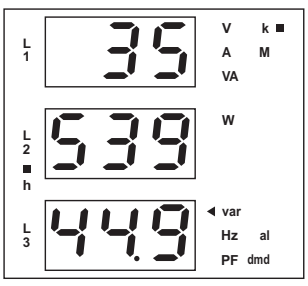


1) Example of kWh visualization:

This example is showing 15 933 453.7 kWh

2) Example of kvarh visualization:

This example is showing 3 553 944.9 kvarh



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Waveform of the signals that can be measured

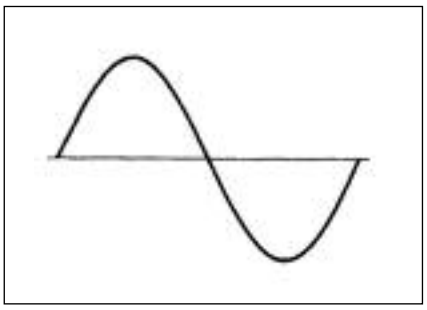


Figure A
Sine wave, undistorted

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

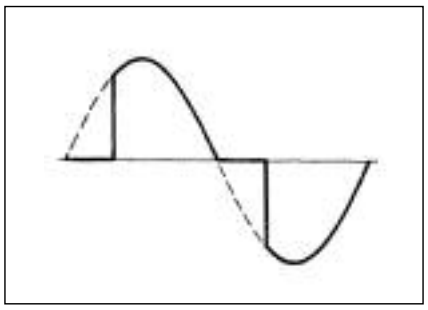


Figure B
Sine wave, indented

Fundamental content	10...100%
Harmonic content	0...90%

Frequency spectrum: 3rd to 16th harmonic
Additional error: <1% FS

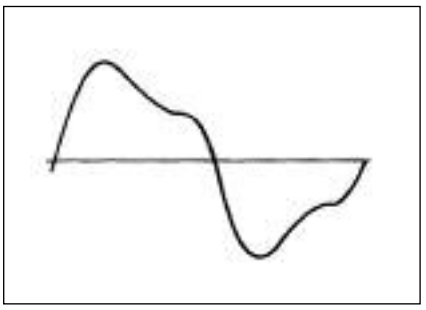


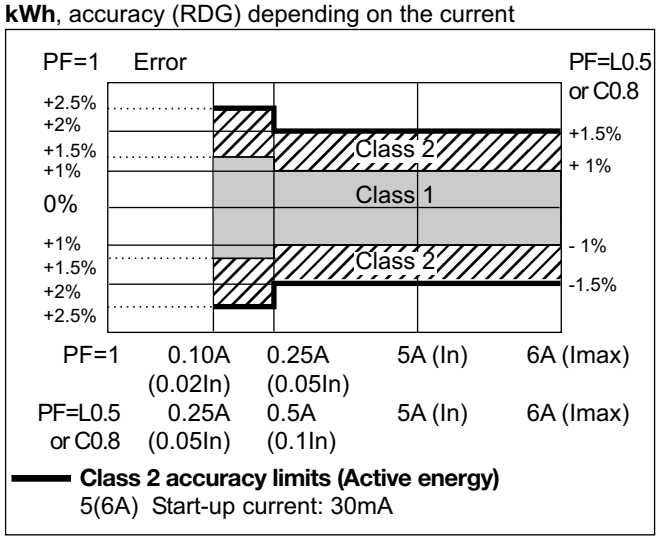
Figure C
Sine wave, distorted

Fundamental content	70...90%
Harmonic content	10...30%

Frequency spectrum: 3rd to 16th harmonic
Additional error: <0.5% FS

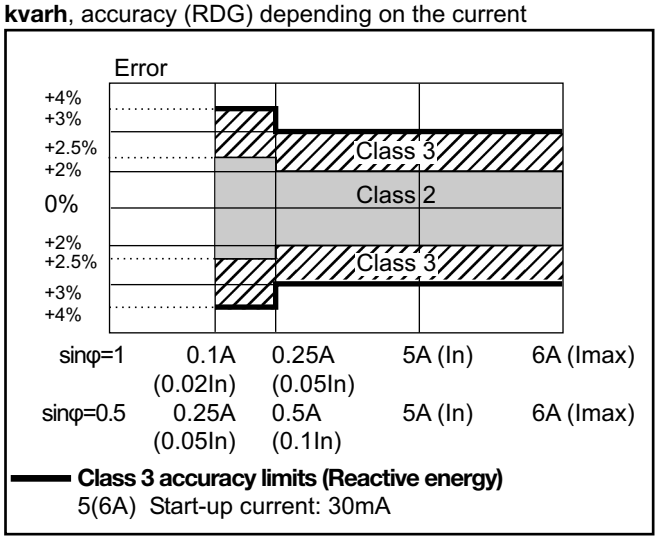
Accuracy

kWh, accuracy (RDG) depending on the current



Class 2 accuracy limits (Active energy)
5(6A) Start-up current: 30mA

kvarh, accuracy (RDG) depending on the current



Class 3 accuracy limits (Reactive energy)
5(6A) Start-up current: 30mA

: this graph is only referred to instrument models with the “SG or PG” option.

: this graph is only referred to instrument models with the “X or S” option.

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

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

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 3-phase voltage

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

3-phase reactive power

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

3-phase active power

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

3-phase apparent power

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

3-phase power factor

$$\cos\phi_{\Sigma} = \frac{W_{\Sigma}}{VA_{\Sigma}}$$

Neutral current

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

Used calculation formulas (cont.)

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

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

Energy metering

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

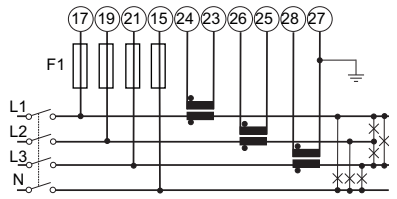
n = time unit

Δt = time interval between two successive power consumptions

n_1, n_2 = starting and ending discrete time points of consumption recording

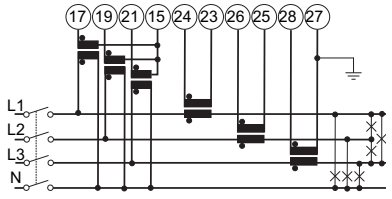
Wiring diagrams

Fig. 1



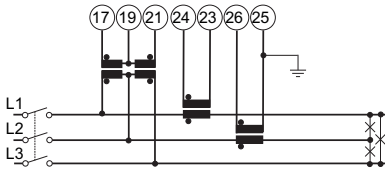
CT connection

Fig. 2



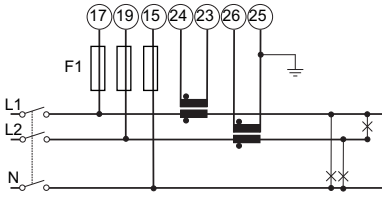
3CT and 3VT connection

Fig. 3



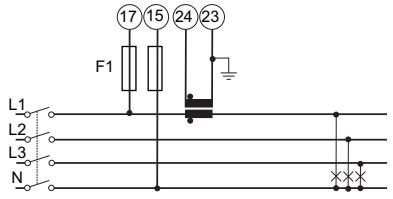
ARON and VT connection

Fig. 4



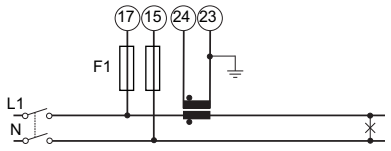
2-phase connection

Fig. 5



3-phase load balanced connection

Fig. 6



1-phase connection

F1= 315mA

NOTE: Only for **"PG"** and **"SG"** options: the current measuring inputs are galvanically insulated and therefore they can be connected to ground singly.

NOTE: For all models except for **"PG"** or **"SG"** the current inputs can be connected to the lines ONLY by means of current transformers. The direct connection is not allowed.

ATTENTION: only one ammeter input can be connected to earth, as shown in the electrical diagrams.

RS485 port connections

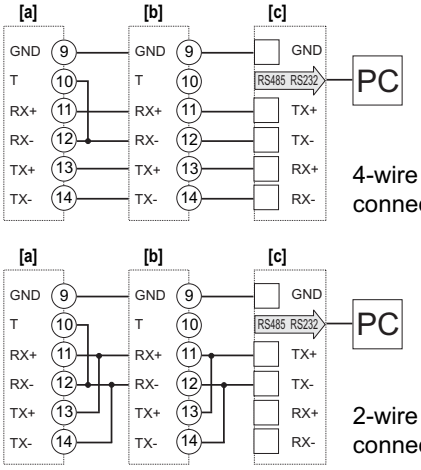
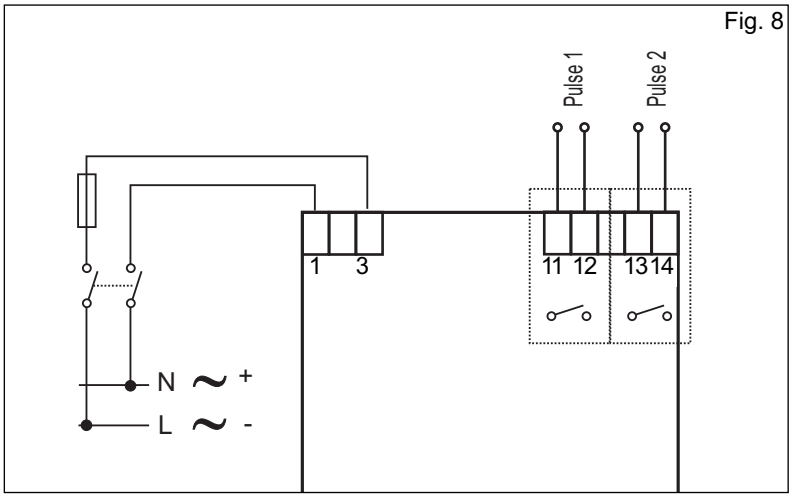


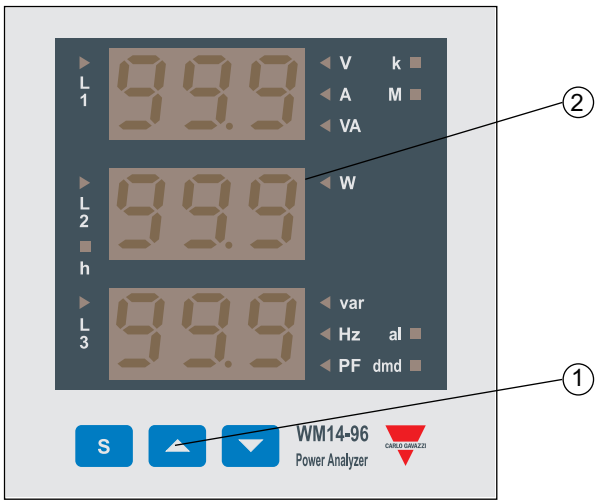
Fig. 7: **a**-Last instrument; **b**-1...n Instrument **c**-RS485/232 serial converter

Dual pulse output connections

Fig. 8



Front Panel Description



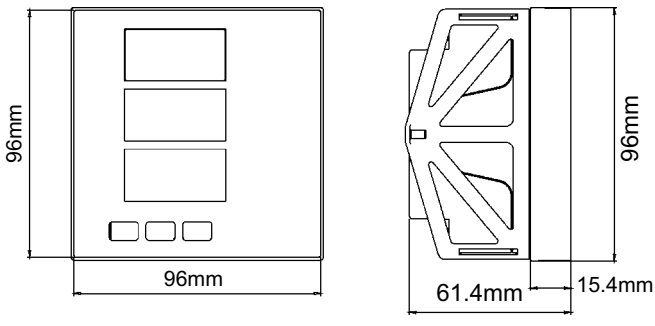
1. **Key-pad**
   To program the configuration parameters and the display of the variables.

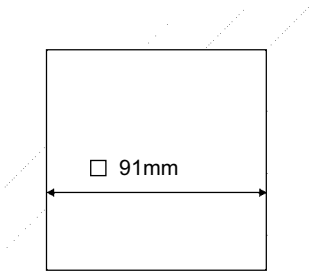
   S
   Key to enter programming and confirm selections;

   ▲ ▼
   Keys to:
   - programme values;
   - select functions;
   - display measuring pages.

2. **Display**
   LED-type with alphanumeric indications to:
   - display configuration parameters;
   - display all the measured variables.

Dimensions and Panel Cut-out





Energy Management
Power Analyzer
Type WM14-96 "Profibus DP"

- **Protection degree (front): IP65**
- **Front dimensions: 96x96mm**

- **Class 1 (active energy)**
- **Class 2 (reactive energy)**
- **Accuracy ±0.5 F.S. (current/voltage)**
- **Power analyzer**
- **Display of instantaneous variables: 3x3 digit**
- **Display of energies: 8+1 digit**
- **System variables and phase measurements: W, W_{dmd}, var, VA, VA_{dmd}, PF, V, A, An, A_{dmd}, Hz**
- **A_{max}, $A_{dmd\ max}$, $W_{dmd\ max}$ indication**
- **Energy measurements: kWh and kvarh**
- **Hour counter (5+2 DGT)**
- **TRMS meas. of distorted sine waves (voltages/currents)**
- **Galvanically insulated measuring inputs**
- **Profibus DP-V0 serial port**
- **Alarms (visual only) V_{LN}, An**
- **Power supply: 90 to 260VAC/DC**

Product Description

3-phase power analyzer with built-in programming key-pad. Particularly recommended for displaying the main electrical variables.

Housing for panel mounting, (front) protection degree IP65 and Profibus DP communication port.

How to order

WM14-96 AV5 3 H DG

- **Model**
- **Range code**
- **System**
- **Power supply**
- **Option**

Type Selection

Range codes		System		Power supply		Options	
AV5:	380/660V_{L-L}/5(6)AAC VL-N: 185 V to 460 V VL-L: 320 V to 800 V	**3 :**	1-2-3-phase, balanced/unbalanced load,with or without neutral	**H:**	90 to 260VAC/DC	**DG:**	Profibus DP + galvanic insulated measuring inputs
AV6:	120/208V_{L-L}/5(6)AAC VL-N: 45 V to 145 V VL-L: 78 V to 250 V						
Phase current: 0.03A to 6A Neutral current: 0.09 to 6A							

Input specifications

Rated inputs	
Current	3
Voltage	4
Accuracy (display, RS485) (@25°C ±5°C, R.H. ≤60%)	with CT=1 and VT=1 AV5: 1150W-VA-var, FS:230VLN, 400VLL; AV6: 285W-VA-var, FS:57VLN, 100VLL
Current	0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A: ±(0.5% FS+7DGT)
Neutral current	0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A: ±(0.5% FS+7DGT)
Phase-phase voltage	±(1.5% FS +1 DGT)
Phase-neutral voltage	±(0.5% FS + 1 DGT)
Active and Apparent power	0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS +5DGT)
Reactive power	0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS +5DGT)
Active energy	Class 1 (start up "I": 30mA)
Reactive energy	Class 2 (start up "I": 30mA)
Frequency	±0.1Hz (48 to 62Hz)
Additional errors	
Humidity	≤0.3% FS, 60% to 90% RH
Temperature drift	≤ 200ppm/°C
Sampling rate	1400 samples/s @ 50Hz 1700 samples/s @ 60Hz
Display refresh time	700ms
Display	
Type	LED, 14mm
Read-out for instant. var.	3x3 DGT
Read-out for energies	3+3+3 DGT (Max indication: 999 999 99.9)
Read-out for hour counter	1+3+3 DGT (Max. indication: 9 999 9.99)
Measurements	Current, voltage, power, power factor, frequency, energy, TRMS measurement of distorted waves.
Coupling type	Direct

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Input specifications (cont.)

Crest factor	< 3, max 10A peak
Input impedance	
380/660V_{L-L} (AV5)	1 MΩ ±1%
120/208V_{L-L} (AV6)	1 MΩ ±1%
Current	≤ 0.02Ω

Frequency	48 to 62 Hz
Overload protection	
Continuous voltage/current	1.2 F.S.
For 500ms: voltage/current	2 Un/36A

Profibus DP Serial Port Specifications

Profibus	
Type	DP-V0
Connections	enable only for data reading max distance (1200m @ 9.6kbit/s, 100m @ 6Mbit/s) according to IEC61158, 9-pole connector and 10 screw terminals block.
Addresses	1 to 125, key-pad selectable
Protocol	Profibus DP-V0

Data	
Dynamic (reading only)	System, phase variables and energies
Baud-rate	Up to 6Mbit/s (mainly depending on the length of the wiring and on the number of instruments belonging to the network)

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 999, all data are protected
System selection	3-phase with/without n, unbal. 3-phase balanced 3-phase ARON, unbalanced 2-phase Single phase
Transformer ratio	
CT	1 to 999
VT	1.0 to 99.9
Filter	
Operating range	0 to 100% of the input display scale
Filtering coefficient	1 to 16
Filter action	Measurements, alarms, serial out. (fundamental var: V, A, W and their derived ones).
Displaying	Up to 3 variables per page
3-phase system with neutral	Page 1: V L1, V L2, V L3 Page 2: V L12, V L23, V L31 Page 3: A L1, A L2, A L3 Page 4: A L1 dmd, A L2 dmd, A L3 dmd Page 5: An, An Alarm Page 6: W L1, W L2, W L3 Page 7: PF L1, PF L2, PF L3 Page 8: var L1, var L2, var L3 Page 9: VA L1, VA L2, VA L3 Page 10: VA ∑, W ∑, var ∑ Page 11: VA dmd, W dmd, Hz Page 12: W dmd max (*) Page 13: Wh (*) Page 14: varh (*) Page 15: VL-L ∑, PF ∑, VLN Alarm Page 16: A max (*) Page 17: A dmd max (*) Page 18: hour counter (*) (*) = These variables are stored in EEPROM when the instrument is switched off
Alarms	Programmable, for the VLN∑ and An (neutral current). Note: the alarm is only visual, by means of LED on the front of the instrument.
Reset	Independent for: alarm (VLN∑, An) max: A dmd, W dmd all energies (Wh, varh) and hour counter

Power Supply Specifications

Auxiliary power supply	90 to 260 VAC/DC
Power consumption	AC: 4.5 VA DC: 4W

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General Specifications

Operating temperature	0 to +50°C (32 to 122°F) (RH < 90% non condensing)
Storage temperature	-10 to +60°C (14 to 140°F) (RH < 90% non condensing)
Installation category	Cat. III (IEC 60664, EN60664)
Insulation (for 1 minute)	4000VAC between measuring inputs and power supply. 2000VAC between measuring inputs and the communication port. 2000VAC between power supply and the communication port.
Dielectric strength	4000 VAC (for 1 min)
EMC	
Emissions	EN50084-1 (class A) residential environment, commerce and light industry
EMC (cont.)	
Immunity	EN61000-6-2 (class A) industrial environment.
Pulse voltage (1.2/50µs)	EN61000-4-5
Safety standards	IEC60664, EN60664
Approvals	CE
Connections 5(6) A	Screw-type
Max cable cross sect. area	2.5 mm^2
Housing	
Dimensions (WxHxD)	96 x 96 x 63 mm
Material	ABS self-extinguishing: UL 94 V-0
Mounting	Panel
Protection degree	Front: IP65 (standard) Connections: IP20
Weight	Approx. 400 g (pack. incl.)

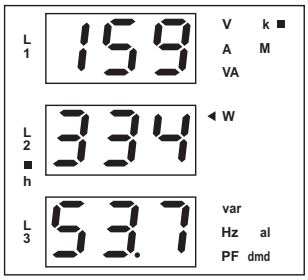
Display pages

Display variables in 3-phase systems (in a 3-phase system with neutral)

No	1st variable	2nd variable	3rd variable	Note
1	V L1	V L2	V L3	
2	V L12	V L23	V L31	Decimal point blinking on the right of the display
3	A L1	A L2	A L3	
4	A L1 dmd	A L2 dmd	A L3 dmd	dmd = demand (integration time selectable from 1 to 30 minutes)
5	An	AL.n		AL.n if neutral current alarm is active
6	W L1	W L2	W L3	Decimal point blinking on the right of the display if generated power
7	PF L1	PF L2	PF L3	
8	var L1	var L2	var L3	Decimal point blinking on the right of the display if generated power
9	VA L1	VA L2	VA L3	
10	VA system	W system	var system	
11	VA dmd (system)	W dmd (system)	Hz (system)	dmd = demand (integration time selectable from 1 to 30 minutes)
12		W dmd MAX		Maximum sys power demand
13	Wh (MSD)	Wh	Wh (LSD)	The total indication is given in max 3 groups of 3 digits.
14	varh (MSD)	varh	varh (LSD)	The total indication is given in max 3 groups of 3 digits.
15	V LL system	AL.U	PF system	AL.U= is activated only if one of VLN is not within the set limits.
16	A MAX			max. current among the three phases
17	A dmd max			max. dmd current among the three phases
18	h			hour counter

MSD: most significant digit
LSD: least significant digit

Display pages (cont.)

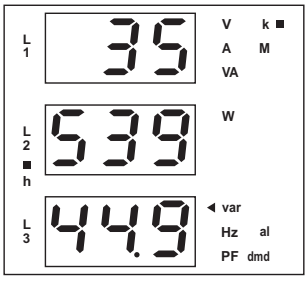


1) Example of kWh visualization:

This example is showing 15 933 453.7 kWh

2) Example of kvarh visualization:

This example is showing 3 553 944.9 kvarh



Waveform of the signals that can be measured

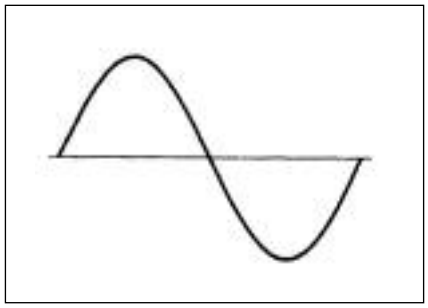


Figure A
Sine wave, undistorted

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

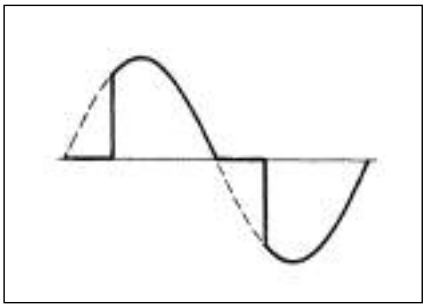


Figure B
Sine wave, indented

Fundamental content	10...100%
Harmonic content	0...90%

Frequency spectrum: 3rd to 16th harmonic
Additional error: <1% FS

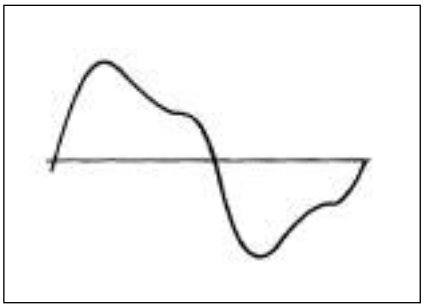


Figure C
Sine wave, distorted

Fundamental content	70...90%
Harmonic content	10...30%

Frequency spectrum: 3rd to 16th harmonic
Additional error: <0.5% FS

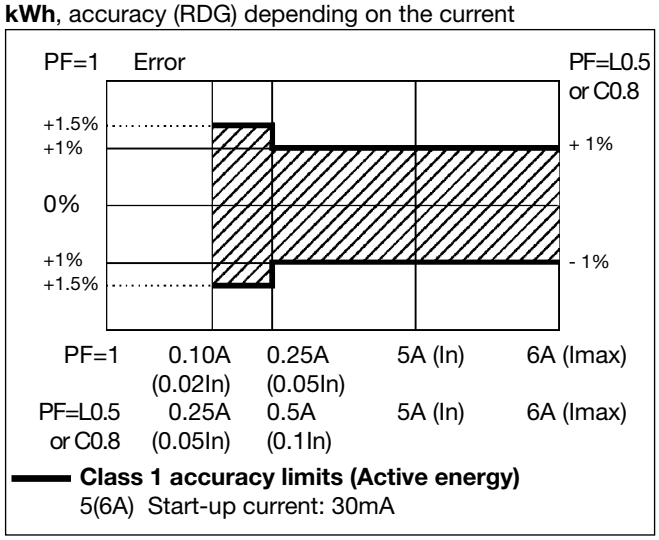
Insulation between inputs and outputs

	Measuring Inputs V	Measuring Inputs A	Profibus Port	Power Supply
Measuring Inputs V	-	-	2kV	4kV
Measuring Inputs A	-	-	2kV	4kV
Profibus Port	2kV	2kV	-	2kV
Power supply	4kV	4kV	2kV	-

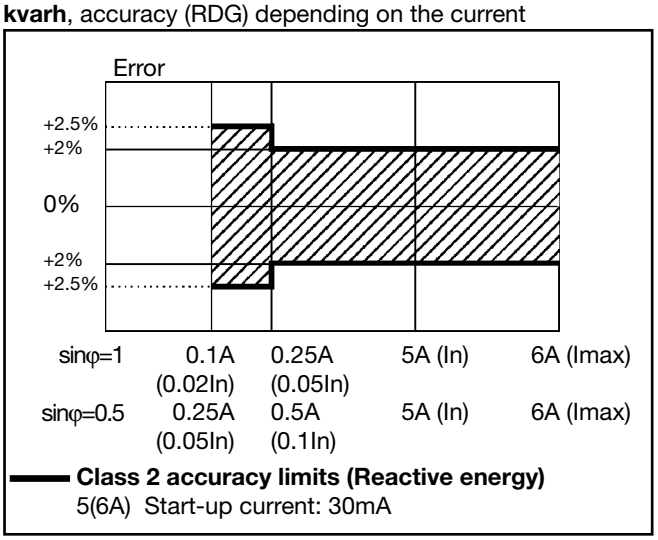
NOTE: In case of fault of first insulation the current from the measuring inputs to the ground is lower than 2 mA.

Accuracy

kWh, accuracy (RDG) depending on the current



kvarh, accuracy (RDG) depending on the current



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

$$\cos\varphi_1 = \frac{W_1}{VA_1}$$

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

$$\mathrm{var}_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

System variables

Equivalent 3-phase voltage

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

3-phase reactive power

$$\mathrm{var}_\Sigma = (\mathrm{var}_1 + \mathrm{var}_2 + \mathrm{var}_3)$$

3-phase active power

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

3-phase apparent power

$$VA_\Sigma = \sqrt{W_\Sigma^2 + \mathrm{var}_\Sigma^2}$$

3-phase power factor

$$\cos\varphi_\Sigma = \frac{W_\Sigma}{VA_\Sigma}$$

Neutral current

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

$$kWhi = \int_{t1}^{t2} Pi(t)dt \cong \Delta t \sum_{n1}^{n2} Pnj$$

$$k\,\mathrm{var}\,hi = \int_{t1}^{t2} Qi(t)dt \cong \Delta t \sum_{n1}^{n2} Qnj$$

Energy metering

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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Wiring diagrams

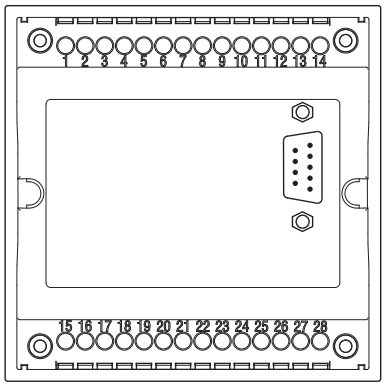
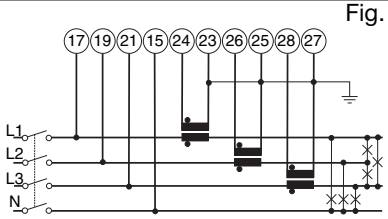
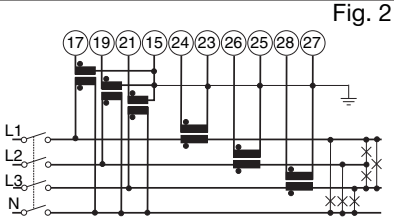


Fig. 1



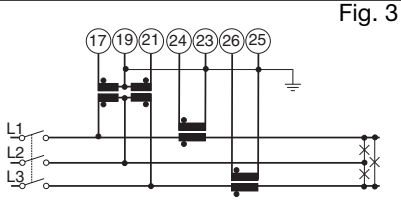
CT connection

Fig. 2



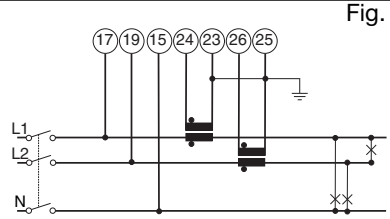
3CT and 3VT connection

Fig. 3



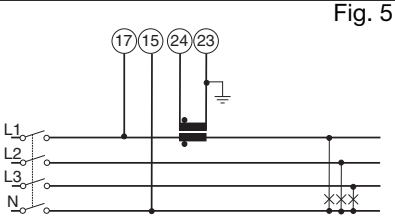
ARON and VT connection

Fig. 4



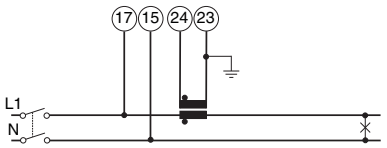
2-phase connection

Fig. 5



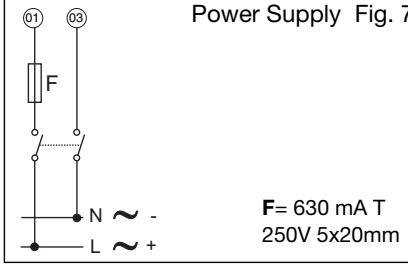
3-phase load balanced connection

Fig. 6



1-phase connection

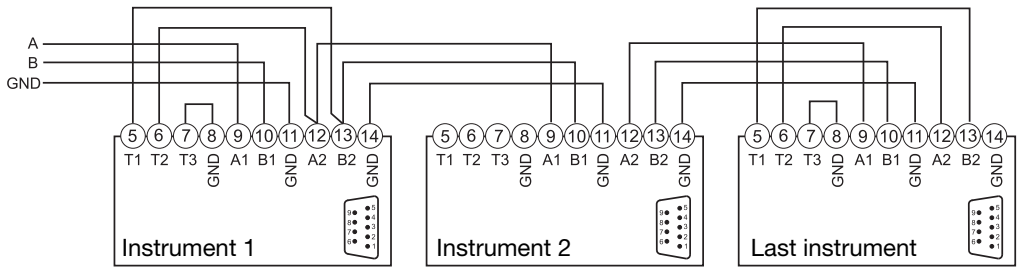
Power Supply Fig. 7



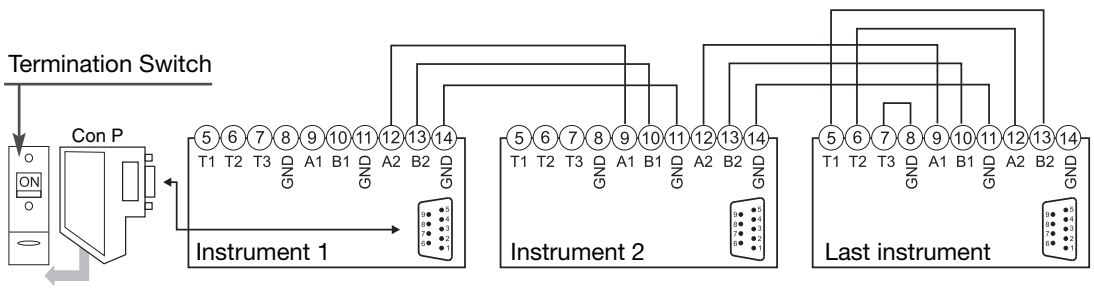
F= 630 mA T
250V 5x20mm

NOTE: the direct connection is not allowed.

Profibus port Wiring diagrams



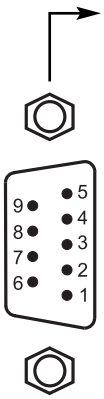
Terminate the first WM14 and the last WM14 by means of the screw terminals T1, T2, T3. Use a two pole shielded cable, about the connection length (from the first to the last instrument) refer to “TAB1”.



Terminate the first WM14 positioning the dip-switch in ON on the “Con P” connector and the last WM14 by connecting T1, T2, T3. Use a two pole shielded cable, about the connection length (from the first to the last instrument) refer to “TAB1”.

Profibus port Wiring diagrams (cont.)

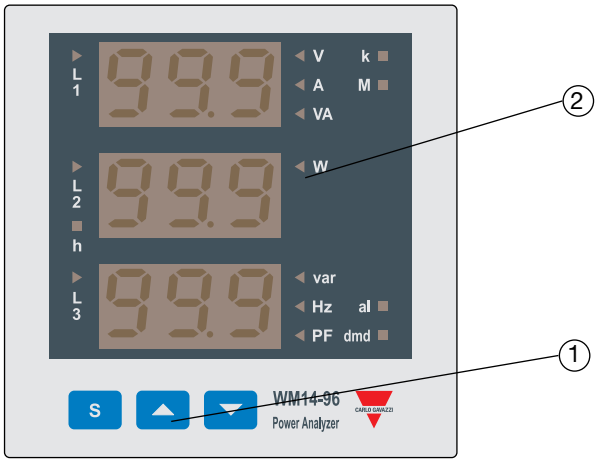
TAB 1	
Kbit/s	**m**
9.6 / 19.2 / 45.45 / 93.75	≤1 200
187.5	≤1 000
500	≤400
1 500	≤200
3 000 / 6 000	≤100



Pin no.	Signal	Meaning	Note
1	Shield	Shield/ protective ground	Not connected
2	M24	Ground of 24V output voltage	Not connected
3	**1B (*)**	**Receive data / transmission data (+)**	**RxD/TxD-P**
4	**CNTR-P (RTS)**	**Control signal for repeater (direction control)**	
5	**GND (*)**	**Data transmission potential (ground to 5 V)**	**DGND**
6	**VP (*)**	**Supply voltage of the terminatig resistor-P, (P5V)**	
7	P24	Output voltage 24V (+)	Not connected
8	**1A (*)**	**Receive data / transmission data (-)**	**RxD/TxD-N**
9	CNTR-N	Control signal for repeater (direction control)	Not connected

(*) The mandatory signals have to be made available by the user.

Front Panel Description



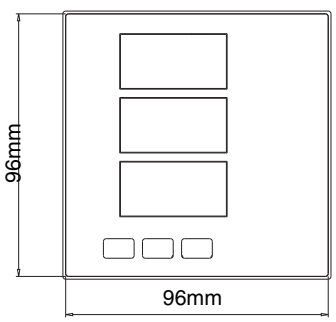
1. **Key-pad**
   To program the configuration parameters and the display of the variables.

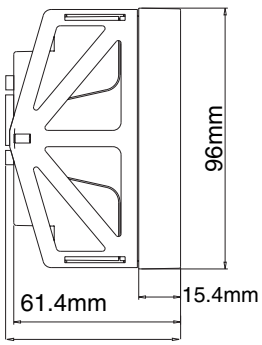
   S
   Key to enter programming and confirm selections;

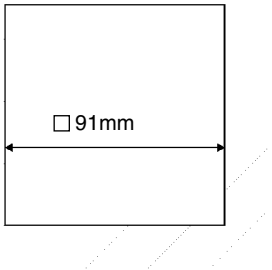
   ▲ ▼
   Keys to:
   - programme values;
   - select functions;
   - display measuring pages.

2. **Display**
   LED-type with alphanumeric indications to:
   - display configuration parameters;
   - display all the measured variables.

Dimensions and Panel Cut-out







Energy Management
Power Analyzer
Type WM14 96 "Advanced version"

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- **Protection degree (front): IP65**
- **2 digital outputs**
- **16 freely configurable alarms with OR/AND logic linkable with up to 2 digital outputs**
- **RS422/485 serial output (MODBUS-RTU), iFIX SCADA compatibility**
- **Class 1 (kWh), Class 2 (kvarh)**
- **Accuracy ±0.5 F.S. (current/voltage)**
- **Power Analyzer**
- **Instantaneous variables read-out: 3 DGT**
- **Energies readout: 8+1 DGT**
- **System variables: V_{LL}, V_{LN}, An, $A_{dmd\ max}$, VA, VA_{dmd}, $VA_{dmd\ max}$, W, W_{dmd}, $W_{dmd\ max}$, var, PF, Hz, ASY**
- **Single phase variables: V_{LL}, V_{LN}, $V_{LN\ min}$, $V_{LN\ max}$, A, A_{min}, A_{max}, A_{dmd}, VA, W, W_{dmd}, W_{max}, var, PF, PF_{min}**
- **Harmonic analysis (FFT) up to the 15th harmonic (current and voltage)**
- **Four quadrant power measurement**
- **Energy measurements: total and partial kWh and kvarh**
- **Hour counter (5+2 DGT)**
- **TRMS meas. of distorted sine waves (voltages/currents)**
- **Universal power supply: 90 to 260 VAC/DC, 18 to 60 VAC/DC**
- **Front dimensions: 96x96mm**
- **Voltage asymmetry, phase sequence, phase loss control**

Product Description

3-phase advanced power analyzer with integrated programming key-pad. Particularly recommended for the measurement of the main electrical variables.

Housing for panel mounting, with RS485 communication port or pulse and/or alarm outputs.

How to order

WM14-96 AV5 3 H R2 S1 AX

- **Model**
- **Range code**
- **System**
- **Power supply**
- **Output 1**
- **Output 2**
- **Option**

Type Selection

Range codes

AV5: 380/660V_{L-L}/1/5(6)AAC
V_{L-N}: 185 V to 460 V
V_{L-L}: 320 V to 800 V
AV6: 120/208V_{L-L}/1/5(6)AAC
V_{L-N}: 45 V to 145 V
V_{L-L}: 78 V to 250 V
Phase current: 0.03A to 6A
Neutral current: 0.09A to 6A

System

3 : 1, 2 or 3 phase, balanced/unbalanced load, with or without neutral

Power supply

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

Output 1

R2: 2-relay outputs
O2: 2-open collector outputs

Output 2

XX: None
S1: RS485/RS422 port

Options

AX: advanced functions

Input specifications

Rated inputs	System type: 3 - phase
Current	3 (By shunts)
Voltage	4
Accuracy (display, RS485) (@25°C ±5°C, R.H. ≤60%)	with CT=1 and VT=1 AV5: 1150W-VA-var, FS:230VLN, 400VLL; AV6: 285W-VA-var, FS:57VLN, 100VLL
Current	0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A: ±(0.5% FS +7DGT)
Neutral current	0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A: ±(1.5% FS +7DGT)
Phase-phase voltage	±(1.5% FS +1 DGT)
Phase-neutral voltage	±(0.5% FS + 1 DGT)
Active and Apparent power,	0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS +5DGT)
Reactive power	0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS +5DGT)
Active energy	Class 1 (start up current: 30mA)
Reactive energy	Class 2 (start up current: 30mA)
Frequency	±0.1Hz (48 to 62Hz)
Harmonic distortion	±3% F.S. (up to 15th harmonic) (F.S.: 100%)

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Input specifications (cont.)

Additional errors	
Humidity	≤0.3% FS, 60% to 90% RH
Temperature drift	≤ 200ppm/°C
Sampling rate	1600 samples/s @ 50Hz 1900 samples/s @ 60Hz
Display refresh time	200ms (FFT off) 500ms (FFT on)
Display	
Type	LED, 14mm
Read-out for instant. var.	3x3 DGT
Read-out for energies	3+3+3 DGT (Max indication: 999 999 99.9)
Read-out for hour counter	1+3+3 DGT (Max. indication: 9 999 9.99)

Measurements	Current, voltage, power, power factor, frequency
Type	TRMS measurement of distorted waves.
Coupling type	Direct
Crest factor	< 3, max 10A peak
Input impedance	
380/660V_{L-L} (AV5)	1.6 MW ±5%
120/208V_{L-L} (AV6)	1.6 MW ±5%
Current	≤ 0.02Ω
Frequency	48 to 62 Hz
Overload protection	(max values)
Continuous: voltage/current	AV5: 460V_{LN}, 800V_{LL}/6A AV6: 145V_{LN}, 250V_{LL}/6A
For 500ms: voltage/current	AV5: 800V_{LN}, 1380V_{LL}/36A AV6: 240V_{LN}, 416V_{LL}/36A

Output Specifications

Digital outputs	
Pulse type	
Number of outputs	Up to 2
Type	Programmable from 0.01 to 500 pulses per kWh/kvarh Pulse duration ≥ 100ms < 120msec (ON), ≥ 100ms (OFF) according to EN62053-31
Alarm type	
Number of outputs	Up to 2, independent
Alarm modes	Up alarm, down alarm, in window alarm, out window alarm. Start-up deactivation function available for all kinds of alarm. All of them connectable on all variables (see the table "List of the variables that can be connected to")
Set-point adjustment	From 0 to 100% of the display scale
Hysteresis	From 0 to full scale
On-time delay	0 to 255s
Output status	Selectable; normally de-energized and normally energized
Min. response time	≤400ms, filters excluded, With FFT off; ≤1s, with FFT on. (With Set-point on-time delay: "0 s")
Remote control	The digital outputs status can be managed by means of serial communication RS485 if programmed as "rEm"
Note	The 2 digital outputs can also work as pulse output and alarm output.
Static outputs	
Purpose	For pulse outputs or for alarm outputs
Signal	V_{ON} 1.2 VDC/ max. 100 mA V_{OFF} 30 VDC max.
Insulation	By means of optocuplers, 4000 V_{RMS} output to measuring inputs, 4000 V_{RMS} output to power supply input.
Relay outputs	
Purpose	For alarm outputs or for pulse outputs
Type	Relay, SPST type AC 1-5A @ 250VAC DC 12-5A @ 24VDC AC 15-1.5A @ 250VAC DC 13-1.5A @ 24VDC
Mecanical life	≥30x10^6 operations
Electrical life	≥10^5 operations (@ 5A, 250V, PF1)
Insulation	4000 V_{RMS} output to measuring input, 4000 V_{RMS} output to supply input.
RS422/RS485	(on request) Multidrop bidirectional (static and dynamic variables)
Connections	2 or 4 wires, max. distance 1000m, termination directly on the instrument
Addresses	From 1 to 255, selectable
Protocol	MODBUS/JBUS (RTU)
Data (bidirectional)	
Dynamic (reading only)	System and phase variables: see table "List of variables..."
Static (reading and writing)	All the configuration parameters.
Data format	1 start bit, 8 data bit, no parity,1 stop bit
Baud-rate	4800, 9600,19200, 38400bits/s
Insulation	By means of optocouplers, 2.5 K V_{RMS} output to measuring input 2.5 K V_{RMS} output to supply input

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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 999, all data are protected
System selection	
System 3, unbalanced	3-phase (3-wire, 4-wire) 3-phase ARON 2-phase (3-wire)
System 3, balanced	3-phase (3-wire, 4-wire) 3-phase (4-wire) “1CT+1VT” 3-phase (3-wire) “1CT+2VT” 1-phase (2-wire)
Transformer ratio	
CT	1 to 60000
VT/PT	1.0 to 6000.0
Filter	
Operating range	0 to 100% of the input display scale
Filtering coefficient	1 to 32
Filter action	Measurements, alarms, serial output (fundamental variables: V, A, W and their derived ones).
Displaying	Up to 3 variables per page See table “Display pages”

Alarms	
Working mode	“OR” or “AND” or “OR+AND” functions (see “Alarm parameter and logic” page). Freely programmable on up to 16 total alarms (out1+out2). The alarms can be connected to any variables available in the table “List of the variables that can be connected to”
Reset	By means of keypad: The following kinds of reset are available: - all values stored as “dmd max”: Admd max, Wdmd max, VAdmd max - all values stored as “max”: A_1, A_2, A_3, WL_1, WL_2, WL_3, VL_1, VL_2, VL_3, and as “Min”: PF_1, PF_2, PF_3, A_1, A_2, A_3, VL_1, VL_2, VL_3 . - Only the kWh and kvarh partial counters - Both the kWh and kvarh total and partial counters - the hour counter.

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Power Supply Specifications

AC/DC voltage	90 to 260VAC/DC 16 to 60VAC/DC	**Power consumption**	AC: 6 VA DC: 3.5 W

General Specifications

Operating temperature	0 to +50°C (32 to 122°F) (RH < 90% non condensing)
Storage temperature	-30 to +60°C (-22 to 140°F) (RH < 90% non condensing)
Overvoltage category	Cat. III (IEC 60664, EN60664)
Insulation (for 1 minute)	4kVAC$_{RMS}$ between measuring inputs and power supply. 4kVAC/DC @ I ≤3mA between measuring inputs and RS485. 4kVAC $_{RMS}$ between power supply and RS485.
Dielectric strength	4kVAC$_{RMS}$ (for 1 min)
EMC	
Emissions	EN61000-6-3 residential environment, commerce and light industry
Immunity	EN61000-6-2 industrial environment.
Pulse voltage (1.2/50µs)	EN61000-4-5
Safety standards	IEC60664, IEC61010-1 EN60664, EN61010-1
Approvals	CE, cULus
Connections 5(6) A Max cable cross sect. area	Screw-type 2.5 mm^2
Housing	
Dimensions (WxHxD)	96 x 96 x 63 mm
Material	ABS self-extinguishing: UL 94 V-0
Mounting	Panel
Protection degree	Front: IP65 (standard), NEMA4x, NEMA12 Connections: IP20
Weight	Approx. 400 g (pack. incl.)

Insulation between inputs and outputs

	Measuring Inputs V	Measuring Inputs A	Relay outputs	Open collector outputs	Communication Port	Power Supply 90-260VAC/DC	Power Supply 18-60VAC/DC
Measuring Inputs V	-	-	4kV	4kV	2.5kV	4kV	4kV
Measuring Inputs A	-	-	4kV	4kV	2.5kV	4kV	4kV
Relay outputs	4kV	4kV	-	-	2.5kV	4kV	4kV
Open col. outputs	4kV	4kV	-	-	2.5kV	4kV	4kV
Communication Port	2.5kV	2.5kV	-	-	-	4kV	4kV
90-260VAC/DC	4kV	4kV	4kV	4kV	4kV	-	-
18-60VAC/DC	4kV	4kV	4kV	4kV	4kV	-	-

NOTE: In case of fault of first insulation the current from the measuring inputs to the ground is lower than 2 mA.

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List of the variables that can be connected to:

- **RS485/RS422 communication port**
- **Alarm outputs (“max / min” variable, “energies” and “hour counter” excluded)**
- **Pulse outputs (only “energies”)**

No	Variable	1-phase system	2-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.	Notes
1	V L1	x	x	x	x	o	o	# Δ
2	V L2	o	x	x	x	o	o	# Δ
3	V L3	o	o	x	x	o	o	# Δ
4	V L-N sys	o	x	x	x	o	o	Sys = system
5	V L1-2	o	x	x	x	x	x	
6	V L2-3	o	x	x	x	x	x	
7	V L3-1	o	o	x	x	x	x	
8	V L-L sys	o	x	x	x	x	x	Sys = system
9	A L1	x	x	x	x	x	x	# Δ
10	A L2	o	x	x	x	x	x	# Δ
11	A L3	o	o	x	x	x	x	# Δ
12	An	o	x	x	x	x	x	
13	W L1	x	x	x	x	o	o	◆
14	W L2	o	x	x	x	o	o	◆
16	W L3	o	o	x	x	o	o	◆
17	W sys	o	x	x	x	x	x	Sys = system
18	var L1	x	x	x	x	o	o	
19	var L2	o	x	x	x	o	o	
20	var L3	o	o	x	x	o	o	
21	var sys	o	x	x	x	x	x	Sys = system
22	VA L1	x	x	x	x	o	o	
23	VA L2	o	x	x	x	o	o	
24	VA L3	o	o	x	x	o	o	
25	VA sys	o	x	x	x	x	x	Sys = system
26	PF L1	x	x	x	x	o	o	H
27	PF L2	o	x	x	x	o	o	H
28	PF L3	o	o	x	x	o	o	H
29	PF sys	o	x	x	x	x	x	Sys = system
30	Hz	x	x	x	x	x	x	
31	Phase seq.	o	o	x	x	x	x	
32	ASY L-N	o	x	x	x	x	x	
33	ASY L-L	o	x	x	x	x	x	
34	Phase loss	o	x	x	x	x	x	
35	VA sys dmd	x	x	x	x	x	x	Sys = system ◆❍
36	W sys dmd	x	x	x	x	x	x	Sys = system ◆❍
37	A L1 dmd	x	x	x	x	x	x	
38	A L2 dmd	o	x	x	x	x	x	
39	A L3 dmd	o	o	x	x	x	x	
40	A L dmd	x	x	x	x	x	x	□ ◆
41	A L1 THD	x	x	x	x	x	x	
42	A L2 THD	o	x	x	x	x	x	
43	A L3 THD	o	o	x	x	x	x	
44	V L1 THD	x	x	x	x	x	x	
45	V L2 THD	o	x	x	x	x	x	
46	V L3 THD	o	o	x	x	x	x	
47	kWh	x	x	x	x	x	x	Total and partial
48	kvarh	x	x	x	x	x	x	Total and partial
49	hours	x	x	x	x	x	x	

(x) = available (o) = not available

(◆) These variables are available also as MAX detection and data storage (on EEPROM at power down).

(H) These variables are available also as MIN detection and data storage (on EEPROM at power down).

(□) Highest value among the 3-phase.

(❍) Alarm available only on the consumed power (+).

(#) These variables are available also for the MAX values, which have not been stored in the EEPROM at power down.

(Δ) These variables are available also for the MIN values, which have not been stored in the EEPROM at power down.

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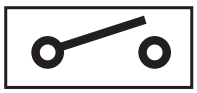
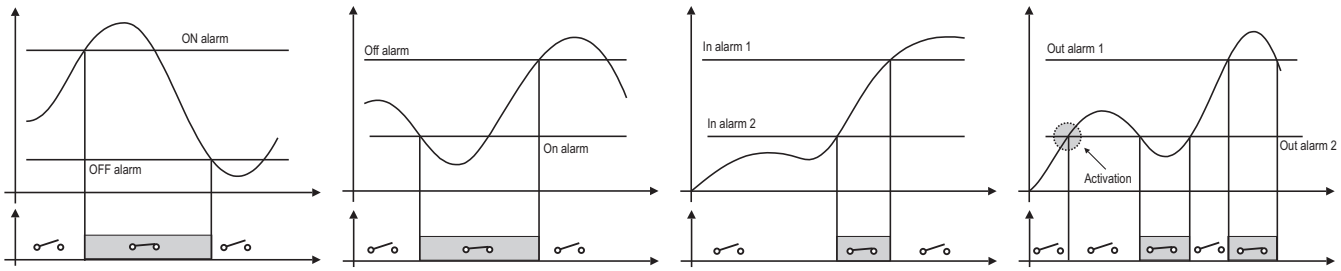
Alarm parameters and logic



- Block enable.
- Controlled variable (VLN, ...).
- Alarm type (up, down, in window, out window).
- Activation function.
- ON set-point.
- OFF set-point.
- ON delay.
- Logical function (AND, OR).
- Digital output (1, 2).

A, B, C... up to 16 parameter control blocks.



Up alarm
On alarm > Off alarm

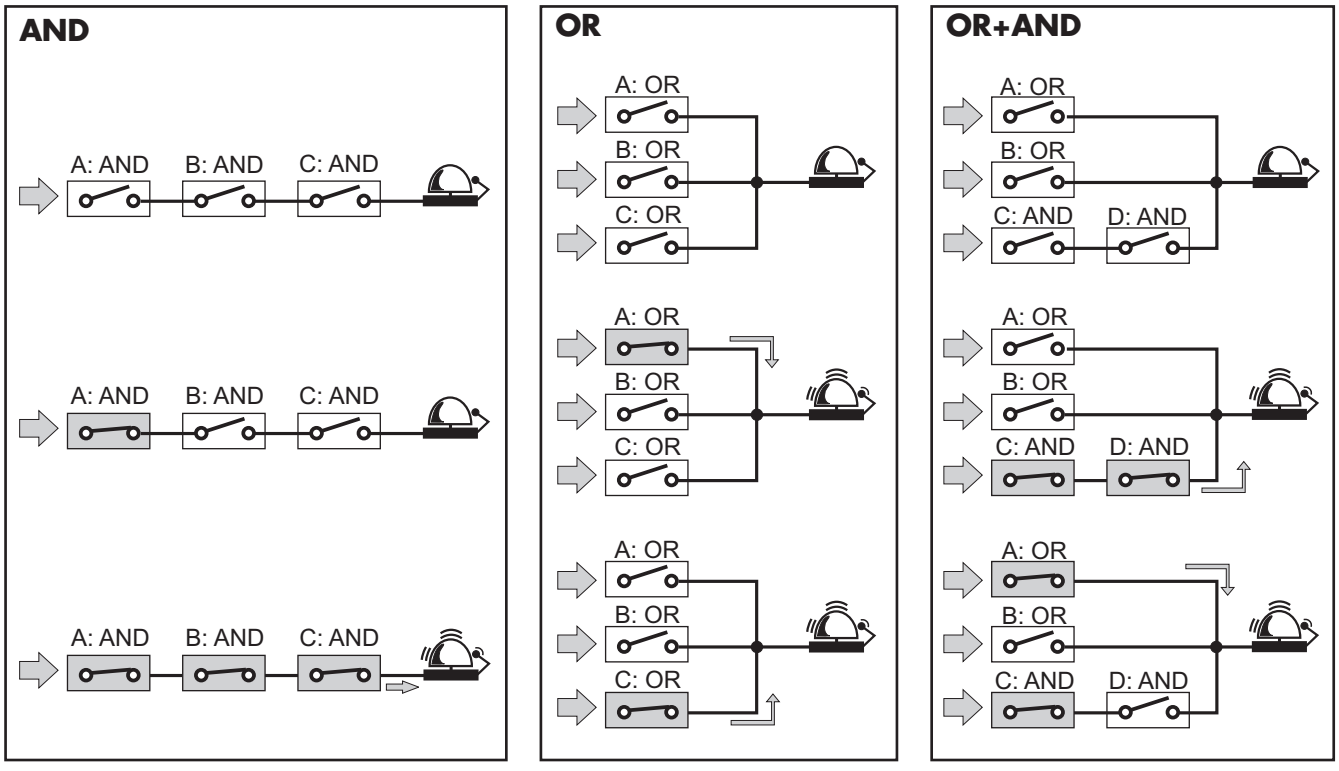
Down alarm
On alarm < Off alarm

In window alarm

Out window alarm with start up deactivation

Note: any alarm working mode can be linked to the “Start-up deactivation” function which disables only the first alarm after power on of the instrument.

AND/OR logical alarm examples:



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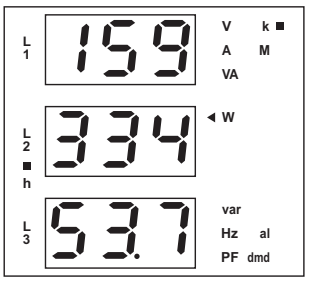
Display pages

Display variables in 3-phase systems (in a 3-phase system with neutral)

No	1st variable	2nd variable	3rd variable	Note
1	%	“ASY”	“L N”	Phase to neutral asymmetry
2	V L1	V L2	V L3	
3	V LN sys		PF sys	Sys = system
4	V LL sys		PF sys	Decimal point blinking on the right of the display
5	V L1 2	V L2 3	V L3 1	Decimal point blinking on the right of the display
6	%	“ASY”	“L L”	Phase to phase asymmetry
7	“PH”	“SEq”	1 2 3 / 1 3 2	Phase sequence
8	A L1	A L2	A L3	
9	A dmd L1	A dmd L2	A dmd L3	dmd = demand (integration time selectable from 1 to 30 minutes)
10	An	“n”	Hz	An= neutral current
11	W L1	W L2	W L3	
12	W dmd L1	W dmd L2	W dmd L3	dmd = demand (integration time selectable from 1 to 30 minutes)
13	PF L1	PF L2	PF L3	
14	var L1	var L2	var L3	
15	VA L1	VA L2	VA L3	
16	VA sys	W sys	var sys	
17	VA dmd sys	W dmd sys	Hz	dmd = demand (integration time selectable from 1 to 30 minutes)
18	V max L1	V max L2	V max L3	Max value of phase to neutral voltage
19	V min L1	V min L2	V min L3	Min value of phase to neutral voltage
20	A max L1	A max L2	A max L3	Max value of current
21	A min L1	A min L2	A min L3	Min value of current
22	W max L1	W max L2	W max L3	Max value of W
23	PF min L1	PF min L2	PF min L3	Min value of PF
24	VA dmd sys max	W dmd sys max	“H”	Max system dmd
25	A dmd max		“H”	Highest value among the 3-phase
26	V L1 THD	V L2 THD	V L3 THD	
27	A L1 THD	A L2 THD	A L3 THD	
28	h (MSD)	h	h (LSD)	Hour counter
29	kvarh (MSD)	kvarh	kvarh (LSD)	Partial counter
30	kWh (MSD)	kWh	kWh (LSD)	Partial counter
31	kvarh (MSD)	kvarh	kvarh (LSD)	Total counter
32	kWh (MSD)	kWh	kWh (LSD)	Total counter

MSD: most significant digit
LSD: least significant digit

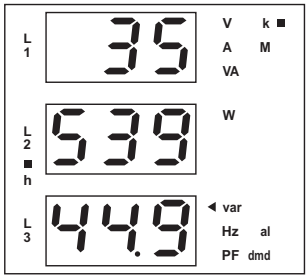


1) Example of kWh visualization:

This example is showing 15 933 453.7 kWh

2) Example of kvarh visualization:

This example is showing 3 553 944.9 kvarh



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Waveform of the signals that can be measured

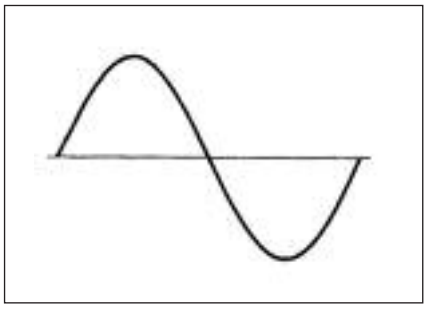


Figure A
Sine wave, undistorted

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

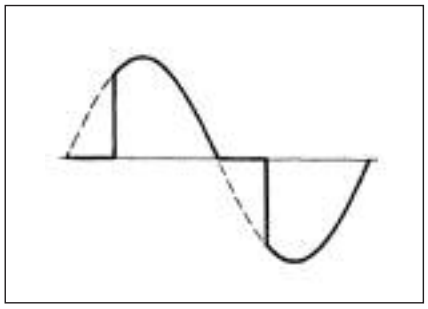


Figure B
Sine wave, indented

Fundamental content	10...100%
Harmonic content	0...90%

Frequency spectrum: 3rd to 16th harmonic
Additional error: <1% FS

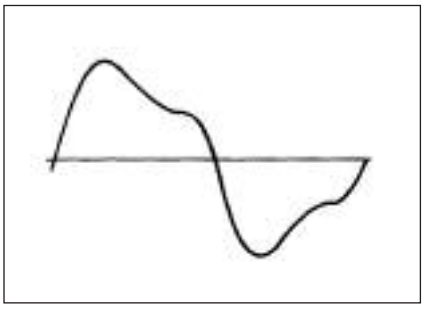


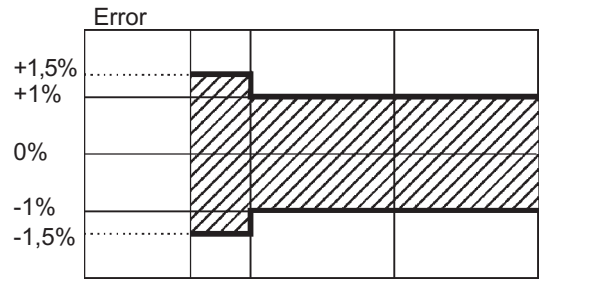
Figure C
Sine wave, distorted

Fundamental content	70...90%
Harmonic content	10...30%

Frequency spectrum: 3rd to 16th harmonic
Additional error: <0.5% FS

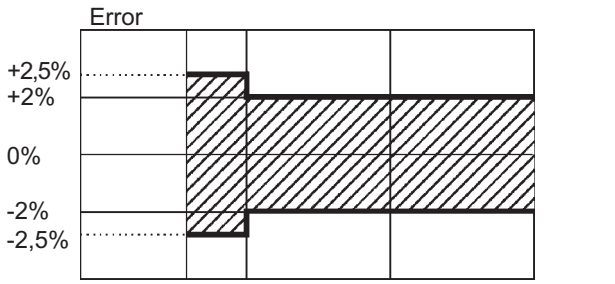
Accuracy

Wh, accuracy (RDG) depending on the current



Accuracy limits (Active energy)
5(6A) Start-up current: 30mA

varh, accuracy (RDG) depending on the current



Accuracy limits (Reactive energy)
5(6A) Start-up current: 30mA

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

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

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

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

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 (TPF)

$$\cos\phi_\Sigma = \frac{W_\Sigma}{VA_\Sigma}$$

Energy metering

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

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

Where:

i= considered phase (L1, L2 or L3)
P= active power; **Q**= reactive power;
$\mathbf{t_1}$, $\mathbf{t_2}$ =starting and ending time points of consumption recording; **n**= time unit;Δ**t**= time interval between two successive power consumptions;
$\mathbf{n_1}$, $\mathbf{n_2}$ = starting and ending discrete time points of consumption recording

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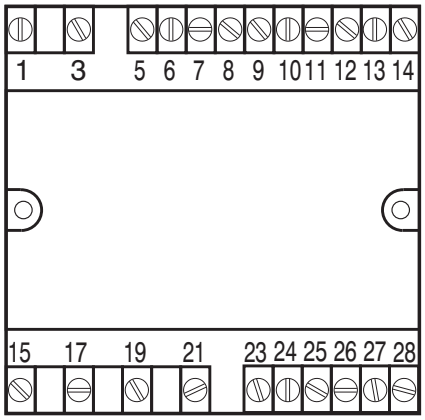
Harmonic Analysis

Analysis principle	FFT	**Display of harmonic values**	THD %
Harmonic measurement		**Others**	The harmonic distortion can be measured in both 3-wire or 4-wire systems.
Current	Up to 15th harmonic		
Voltage	Up to 15th harmonic		
Type of harmonics	THD (V_{L1}) THD (V_{L2}) THD (V_{L3}) THD (A_{L1}) THD (A_{L2}) THD (A_{L3})		

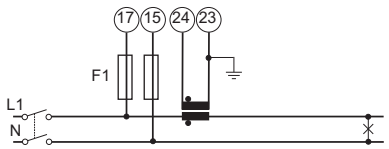
Wiring diagrams

When the CT is connected to earth, a leakage current from 0 to 1.8mA max is generated, whose value depends on the input impedance values of the instrument, on the type of connection and on the line voltage measured by the instrument.



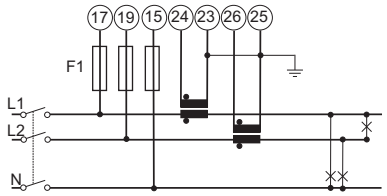
F1= 315mA

1-ph, 2-wire Fig. 1



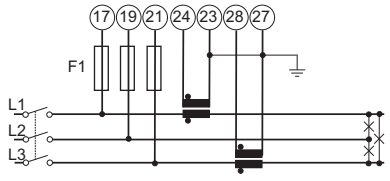
1-CT connection

2-ph, 3-wire Fig. 2



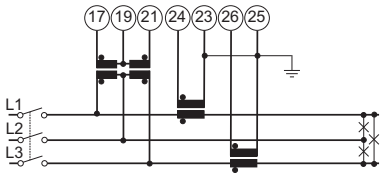
2-CT connection

3-ph, 3-wire, unbalanced load Fig. 3



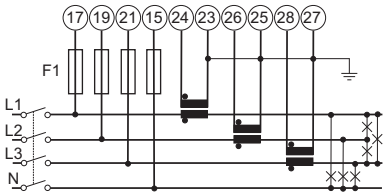
ARON connection

3-ph, 3-wire, unbalanced load Fig. 4



ARON and 2-VT/PT connections

3-ph, 4-wire, unbalanced load Fig. 5



3-CT connection

NOTE: the current inputs can be connected to the mains ONLY by means of current transformers. The direct connection is not allowed.

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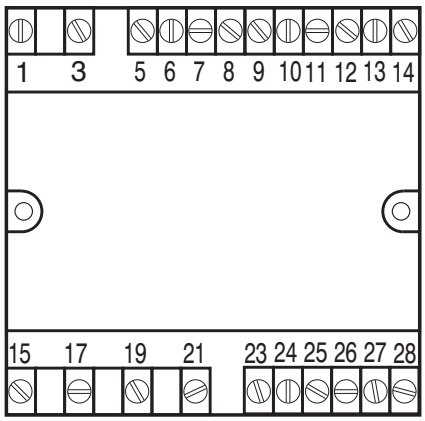
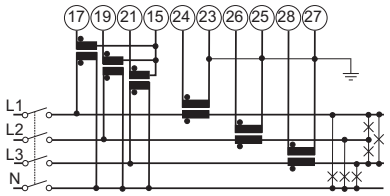
Wiring diagrams

When the CT is connected to earth, a leakage current from 0 to 1.8mA max is generated, whose value depends on the input impedance values of the instrument, on the type of connection and on the line voltage measured by the instrument.

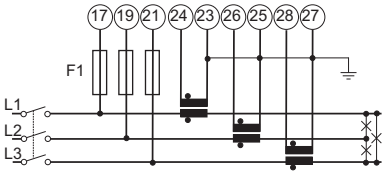


3-ph, 4-wire, unbalanced load Fig. 6



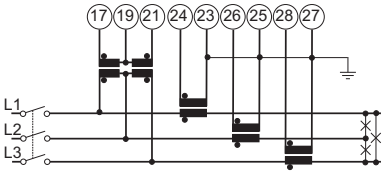
3-CT and 3-VT/PT connections

3-ph, 3-wire, unbalanced load Fig. 7



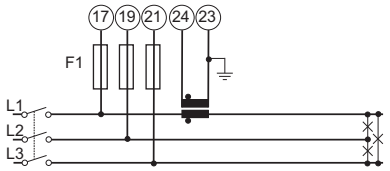
3-CT connection

3-ph, 3-wire, unbalanced load Fig. 8



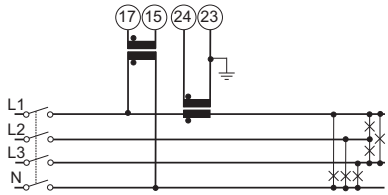
3-CT and 2-VT/PT connections

3-ph, 3-wire, balanced load Fig. 9



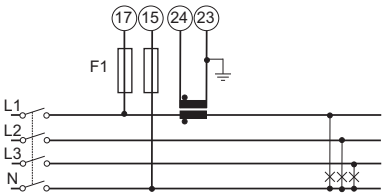
1-CT connection

3-ph, 4-wire balanced load Fig. 10



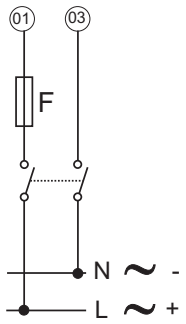
1-CT and 1-VT/PT connections

3-ph, 4-wire, balanced load Fig. 11



1-CT connection

Fig. 12



Power supply connection

NOTE: the current inputs can be connected to the mains ONLY by means of current transformers. The direct connection is not allowed.

Output connections

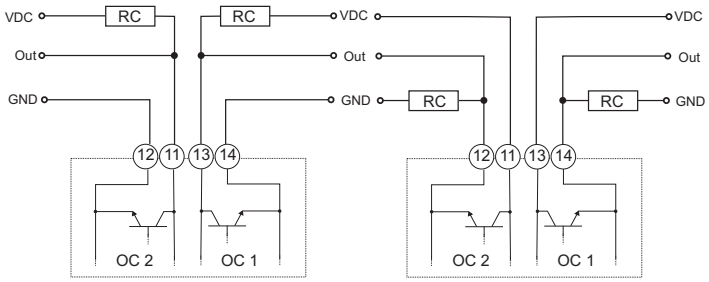


Fig. 13 Fig. 14

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: external power supply voltage. Out: positive output contact (open collector transistor). GND: ground output contact (open collector transistor).

Relay out.

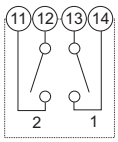


Fig. 15

RS485 port

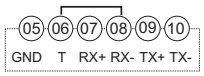
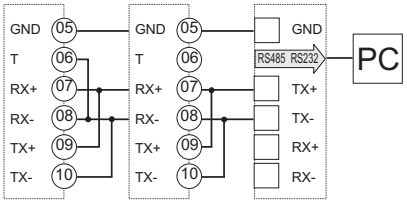


Fig.16



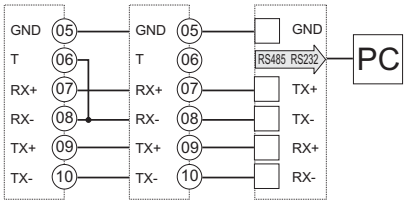
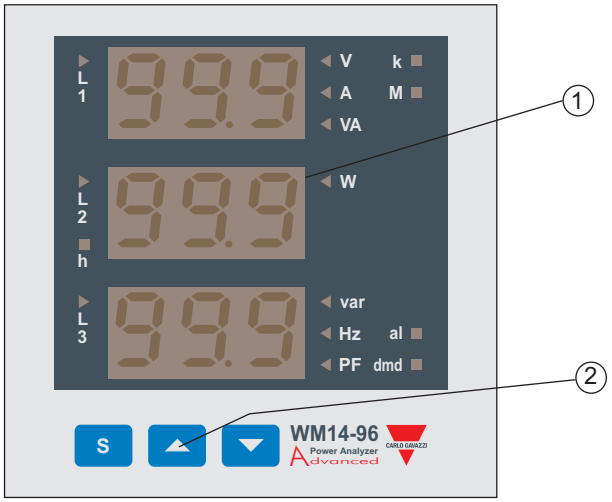


Fig. 17

Front Panel Description



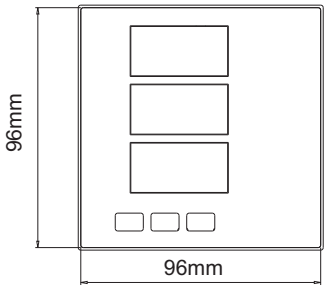
1. **Display**
   LED-type with alphanumeric indications to:
   - display configuration parameters;
   - display all the measured variables.

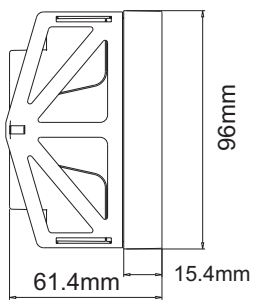
2. **Key-pad**
   To program the configuration parameters and the display of the variables.

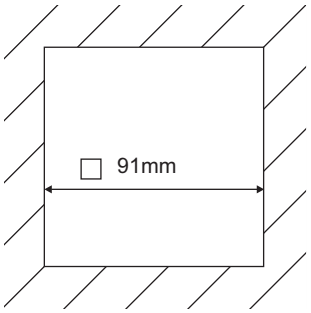
   S
   Key to enter programming and confirm selections;

   ▲ ▼
   Keys to:
   - programme values;
   - select functions;
   - display measuring pages.

Dimensions and Panel Cut-out







Energy Management Multifunction meter Type WM10 DIN

- **Accuracy ±0.5% RDG (current/voltage)**
- **Multifunction meter**
- **Instantaneous variables readout: 3 DGT**
- **System variables: W, var, PF, Hz and phase-sequence.**
- **Single phase variables: A, VL-N, VL-L, W, var**
- **TRMS measurements of distorted sine waves (voltages/currents)**
- **Direct connection up to 65A**
- **Self power supply**
- **Dimensions: 4-DIN modules**
- **Protection degree (front): IP50**
- **Easy installation: no parameters programming needed.**

Product Description

Three-phase multifunction meter with built-in joystick and LCD data displaying. Housing for DIN-rail mounting with IP50 (front) protection degree. Direct connection up to 65A. No set-up needed.

How to order

WM10 DIN AV9 3 X XX X

- **Model**
- **Range code**
- **System**
- **Power supply**
- **Output**
- **Option**

Type Selection

Range codes

AV9: 400V_{LL} AC - 10(65)A (Direct connection)

System

3: balanced and unbalanced load: 3-phase, 4-wire; 3-phase, 4-wire

Output

XX: none

Power supply

X: Self power supply -15% +20% of the rated measuring input voltage, 45 to 65 Hz

Options

X: none

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Input specifications

Rated inputs	
System type	3-phase
Current type	Galvanic insulation by means of built-in CT's
Current range (direct)	10(65)ACA
Voltage (AV9)	400VLL CA
Accuracy (Display + RS485)	Ib: 10A, Imax: 65A; 0.1Ib: 1.0A (@25°C ±5°C, R.H. ≤60%, 48 to 62 Hz)
AV9 model	Ib: 10A, Imax: 65A; Un: 184 to 276VLN (318 to 480VLL)
Current	From 0.004Ib to 0.2Ib: ±(0.5% RDG +3DGT) From 0.2Ib to Imax: ±(0.5% RDG +1DGT)
Phase-neutral voltage	In the range Un: ±(0,5% RDG +1DGT)
Phase-phase voltage	In the range Un: ±(1% RDG +1DGT)
Active power	±(1%RDG +2DGT)
Reactive power	±(2%RDG +2DGT)
Power Factor	±[0.001+1%(1.000 - "PF RDG")]
Start up current	40mA
Energy additional errors	
Influence quantities	According to EN62053-21, EN62053-23 and EN50470-1-2
Temperature drift	≤200ppm/°C
Sampling rate	1600 samples/s @ 50Hz 1900 samples/s @ 60Hz
Display refresh time	750 ms
Display	2 lines (1 x 7 DGT; 1 x 3DGT)
Type	LCD, h 9mm
Instantaneous variables read-out	3 DGT
Overload status	EEE indication when the value being measured is exceeding the "Continuous inputs overload" (maximum measurement capacity)
Max and Min indication	Max instantaneous variables: 999. Min instantaneous variables: 0
Measurements	See "List of the variables that can be displayed"
Method	TRMS measurements of distorted wave forms.
Coupling type	Direct
Crest factor	Ib 10A ≤4 (91A max. peak)
Current Overloads	
Continuous	65A, @ 50Hz
For 10ms	1920A max, @ 50Hz
Voltage Overloads	
Continuous	1.2 Un
For 500ms	2 Un
Input impedance	
400VL-L	Refer to "Power Consumption"
10(65) A	< 4VA
Frequency	45 to 65 Hz
Joystick	For variable selection.

Software functions

Displaying	Up to 3 variables per page
Easy connection function	Automatic phase sequence detection with current and voltage synchronisation. Power measurements are independent from the current direction. The displayed energy is always "imported".

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General specifications

Operating temperature	-25°C to +55°C (-13°F to 131°F) (R.H. from 0 to 90% non-condensing @ 40°C)
Storage temperature	-30°C to +70°C (-22°F to 158°F) (R.H. < 90% non-condensing @ 40°C) a
Installation category	Cat. III (IEC60664, EN60664)
Dielectric strength	4000 VRMS for 1 minute
Noise rejection CMRR	100 dB, 48 to 62 Hz
EMC	According to EN62052-11
Electrostatic discharges	15kV air discharge;
Immunity to irradiated Electromagnetic fields	Test with current: 10V/m from 80 to 2000MHz; Test without any current: 30V/m from 80 to 2000MHz;
Burst	On current and voltage measuring inputs circuit: 4kV
Immunity to conducted disturbances	10V/m from 150KHz to 80MHz
Surge	On current and voltage measuring inputs circuit: 4kV.
Radio frequency suppression	According to CISPR 22
Standard compliance	
Safety	IEC60664, IEC61010-1 EN60664, EN61010-1

Approvals	CE
Connections	Screw-type
Cable cross-section area	Max. 16 mm^2 Min. 2.5 mm^2 (measuring inputs); Min./Max. screws tightening torque: 1.7 Nm / 3 Nm
Housing DIN	
Dimensions (WxHxD)	71 x 90 x 64.5 mm
Material	Nylon PA66, self-extinguishing: UL 94 V-0
Mounting	DIN-rail
Protection degree	
Front	IP50
Screw terminals	IP20
Weight	Approx. 400 g (packing included)

Power supply specifications

Self supplied version	-15% +20% of Un, 48-62Hz.
Note	The instrument working in a 3-phase system with neutral may work also if one or two phases are missing. The instrument working in a 3-phase system without neutral may work also if one phase is missing.
Power consumption	≤20VA/1W

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List of the variables that can be displayed:

No	Variable	3-ph. 4-wire balanced system	3-ph. 4-wire unbalanced system	3-ph. 3-wire balanced system	3-ph. 3-wire unbalanced system	Notes
1	V L1-N	x	x	y	y	
2	V L2-N	x	x	y	y	
3	V L3-N	x	x	y	y	
4	V L-N sys	x	x	y	y	sys=system
5	V L1-2	x	x	x	x	
6	V L2-3	x	x	x	x	
7	V L3-1	x	x	x	x	
8	V L-L sys	x	x	x	x	sys=system
9	A L1	x	x	x	x	
10	A L2	x	x	x	x	
11	A L3	x	x	y	y	
12	W L1	x	x	y	y	
13	W L2	x	x	y	y	
14	W L3	x	x	y	y	
15	W sys	x	x	y	y	sys=system
16	var L1	x	x	y	y	
17	var L2	x	x	y	y	
18	var L3	x	x	y	y	
19	var sys	x	x	y	y	sys=system
20	PF sys	x	x	y	y	sys=system
21	Hz	x	x	x	x	
22	Phase sequence	x	x	x	x	

(x) = available
(y) = virtual

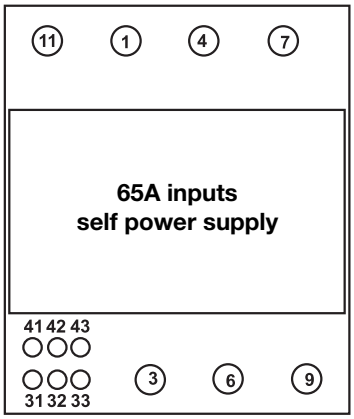
Display pages

Display variables in 3-phase systems with or without neutral

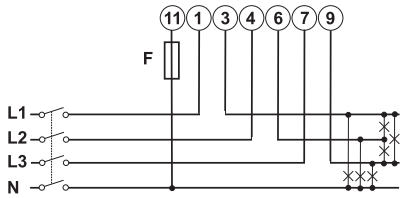
No	Joystick	1st line	2nd line	Phase Sequence
1	UP	W L1, WL2	W L3	Warning triangle if reverse sequence
2	UP	“SYS” (text)	W sys	Warning triangle if reverse sequence
3	UP	var L1, var L2	var L3	Warning triangle if reverse sequence
4	UP	“SYS” (text)	var sys	Warning triangle if reverse sequence
5	UP	“SYS PF” (text)	PF sys	Warning triangle if reverse sequence
6	LEFT	V L1-N, V L2-N	V L3-N	Warning triangle if reverse sequence
7	LEFT	“SYS V LN” (text)	V L-N sys	Warning triangle if reverse sequence
8	LEFT	V L1-L2, “_” V L2-L3	V L3-L1	Warning triangle if reverse sequence
9	LEFT	“SYS V LL” (text)	V L-L sys	Warning triangle if reverse sequence
10	LEFT	“SYS Hz” (text)	Hz	Warning triangle if reverse sequence
11	DOWN	A L1 - A L2	A L3	Warning triangle if reverse sequence

Note: whatever page the user has selected, after 60s it goes back to page 1.
On “Page 8” the symbol “_” means that all the values on this page are “phase to phase”.

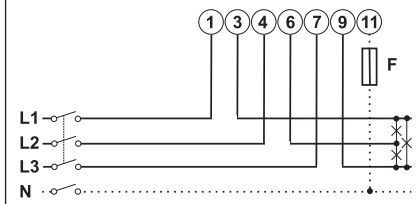
Wiring diagrams



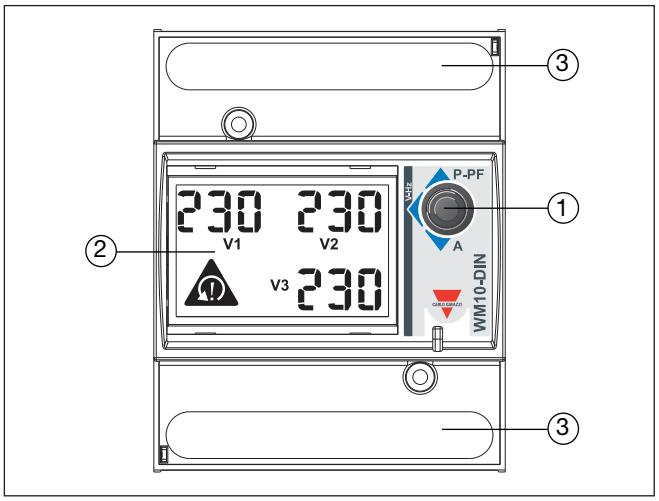
3-ph, 4-wire, unbal./bal. load **Fig.1**



3-ph, 3-wire, unbal./bal. load **Fig. 2**

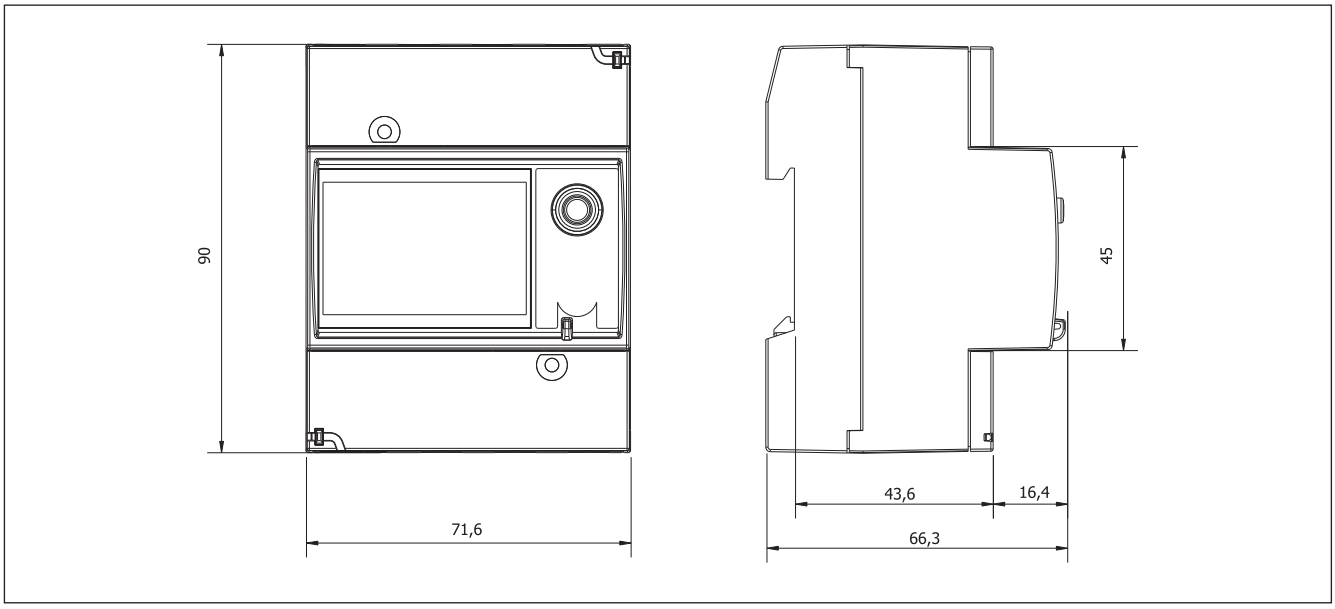


Front panel description



1. **Joystick**
   To scroll the variables on the display.
2. **Display**
   LCD-type with alphanumeric indications to display all the measured variables.
3. **Connections**
   Screw terminal blocks for instrument wiring.

Dimensions



Energy Management Multifunction indicator Type WM12-DIN

- **Accuracy ±0.5 F.S. (current/voltage)**
- **Multifunction indicator**
- **Display of instantaneous variables: 3x3 digit**
- **Variable system and phase measurements: W, W_{dmd}, var, VA, VA_{dmd}, PF, V, A, An, Hz**
- **A_{max}, $W_{dmd\ max}$ indication**
- **TRMS meas. of distorted sine waves (voltages/currents)**
- **Power supply: 24V, 48V, 115V, 230V, 50-60Hz; 18 to 60VDC**
- **Protection degree (front): IP 40**
- **Front dimensions: 6 DIN modules**
- **Optional RS422/485 serial output**
- **Alarms (visual only) V LN, An**

Product Description

3-phase multifunction power indicator with built-in programming key-pad. Particularly recommended for displaying the main electrical variables.
Housing for DIN-rail mounting, (front) protection degree IP40 and optional RS485 serial output.

How to order

WM12-DIN AV5 3 D X

Model
Range code
System
Power supply
Option

Type Selection

Range codes

AV5: 380/660V_{L-L}/5(6)AAC
VL-N: 185 V to 460 V
VL-L: 320 V to 800 V
AV6: 120/208V_{L-L}/5(6)AAC
VL-N: 45 V to 145 V
VL-L: 78 V to 250 V
Phase current: 0.03A to 6A
Neutral current: 0.09 to 6A

System

3 : 1-2-3-phase, unbalanced load, with or without neutral

Power supply

A: 24VAC -15+10%, 50-60Hz
B: 48VAC -15+10%, 50-60Hz
C: 115VAC -15+10%, 50-60Hz
D: 230VAC -15+10%, 50-60Hz
3: 18 to 60VDC

Options

X: None
S: RS485 output

Input specifications

Rated inputs	
Current	3 (shunt)
Voltage	4
Accuracy (display, RS485) (@25°C ±5°C, R.H. ≤60%)	with CT=1 and VT=1 AV5: 1150W-VA-var, FS:230VLN, 400VLL; AV6: 285W-VA-var, FS:57VLN, 100VLL
Current	0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A: ±7DGT
Neutral current	0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A: ±7DGT
Phase-phase voltage	±(1.5% FS +1 DGT)
Phase-neutral voltage	±(0.5% FS + 1 DGT)
Active and Apparent power, Power factor	0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS +5DGT)
Reactive power	0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS +5DGT)
Frequency	±0.1%Hz (48 to 62Hz)
Additional errors	
Humidity	≤0.3% FS, 60% to 90% RH
Temperature drift	≤ 200ppm/°C

Sampling rate	1400 samples/s @ 50Hz 1700 samples/s @ 60Hz
Display refresh time	700ms
Display	
Type	LED, 9mm
Read-out for the instant. var.	3x3 DGT
Measurements	Current, voltage, power, power factor, frequency TRMS measurement of distorted waves.
Coupling type	Direct
Crest factor	< 3, max 10A peak
Input impedance	
380/660V_{L-L} (AV5)	1 MΩ ±5%
120/208V_{L-L} (AV6)	453 KΩ ±5%
Current	≤ 0.02Ω
Frequency	48 to 62 Hz
Overload protection	
Continuous voltage/current	1.2 F.S.
For 500ms: voltage/current	2 Un/36A

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RS485 Serial Output Specifications

RS422/RS485 (on request)	
Type	Multidrop bidirectional (static and dynamic variables)
Connections	2 or 4 wires, max. distance 1200m, termination directly on the instrument
Addresses	1 to 255, key-pad selectable
Protocol	MODBUS/JBUS
Data (bidirectional)	
Dynamic (reading only)	System and phase variables
Static (writing only)	All configuration parameters
Data format	1 bit di start , 8 data bit, no parity, 1 stop bit
Baud-rate	9600 bit/s

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 999, all data are protected
System selection	3-phase with neutral 3-phase without neutral 3-phase ARON 2-phase Single phase
Transformer ratio	
CT	1 to 999
VT	1.0 to 99.9
Filter	
Operating range	0 to 99.9% of the input electrical scale
Filtering coefficient	1 to 16
Filter action	Measurements, alarms, serial output (fundamental variables: V, A, W and their derived ones).

Displaying	Up to 3 variables per page
3-phase system with neutral	Page 1: V L1, V L2, V L3 Page 2: V L12, V L23, V L31 Page 3: A L1, A L2, A L3 Page 4: An Page 5: WL1, WL2, WL3 Page 6: PF L1, PF L2, PF L3 Page 7: var L1, var L2, var L3 Page 8: VA L1, VA L2, VA L3 Page 9: VA ∑, W ∑, var ∑ Page 10: VA dmd, W dmd, Hz Page 11: W dmd MAX Page 12: VL-L ∑, PF ∑ Page 13: A MAX
Alarms	Programmable, for the VL∑ and An (neutral current). Note: the alarm is only visual, by means of LED on the front of the instrument.
Reset	Independent alarm (VL∑, An) max: A, Wdmd

Power Supply Specifications

Auxiliary power supply	230VAC -15 +10%, 50-60Hz 115VAC -15 +10%, 50-60Hz 48VAC -15 +10%, 50-60Hz
	24VAC -15 +10%, 50-60Hz 18 to 60VDC
Power consumption	AC: 4.5 VA DC: 4W

General Specifications

Operating temperature	0 to +50°C (32 to 122°F) (RH < 90% non condensing at 40°C)
Storage temperature	-30 to +60°C (-22 to 140°F) (RH < 90% non condensing at 40°C)
Installation category	Cat. III (IEC 60664, EN60664)
Insulation (for 1 minute)	4000VAC, 500VDC between measuring inputs and power supply.
	500VAC/DC between measuring inputs and RS485. 4000VAC, 500VDC between power supply and RS485.
Dielectric strength	4000 VAC (for 1 minute)
EMC	
Emissions	EN50084-1 (class A) residential environment, commerce and light industry

General Specifications (cont.)

Immunity	EN 61000-6-2 (class A) industrial environment.	Material	ABS self-extinguishing: UL 94 V-0
Pulse voltage (1.2/50µs)	EN61000-4-5	**Mounting**	DIN-rail
Safety standards	IEC 60664, EN60664	**Protection degree**	Front: IP40 Connections: IP20
Approvals	CE, cULus	**Weight**	
Connections 5(6) A Max cable cross sect. area	Screw-type 2.5 mm^2	Approx. 400 g (pack. incl.)	
Housing Dimensions (WxHxD)	107.8 x 80 x 64.5 mm		

Waveform of the signals that can be measured

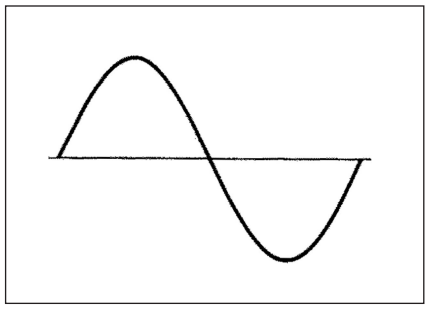


Figure A
Sine wave, undistorted
Fundamental content 100%
Harmonic content 0%
A_{rms} = 1.1107 | $\overline{A}$ |

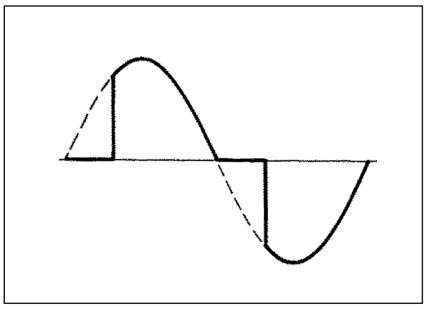


Figure B
Sine wave, indented
Fundamental content 10...100%
Harmonic content 0...90%
Frequency spectrum: 3rd to 16th harmonic
Additional error: <1% FS

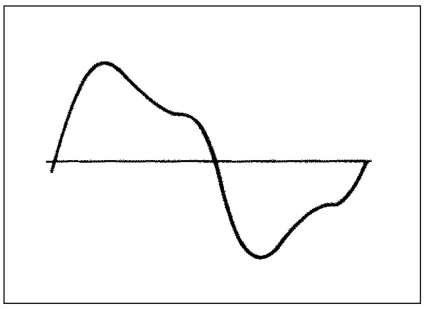


Figure C
Sine wave, distorted
Fundamental content 70...90%
Harmonic content 10...30%
Frequency spectrum: 3rd to 16th harmonic
Additional error: <0.5% FS

Display pages

Display variables in 3-phase systems (in a 3-phase system with neutral)

No	1st variable	2nd variable	3rd variable	Note
1	V L1	V L2	V L3	
2	V L12	V L23	V L31	Decimal point blinking on the right of the display
3	A L1	A L2	A L3	
4	An	AL.n		AL.n if neutral current alarm is active
5	W L1	W L2	W L3	Decimal point blinking on the right of the display if generated power
6	PF L1	PF L2	PF L3	
7	VAR L1	VAR L2	VAR L3	Decimal point blinking on the right of the display if generated power
8	VA L1	VA L2	VA L3	
9	VA system	W system	VAR system	
10	VA dmd (system)	W dmd (system)	Hz (system)	dmd = demand (integration time selectable from 1 to 30 minutes)
11		W dmd MAX		Maximum sys power demand
12	V LL system	AL.U	PF system	AL.U= is activated only if one of VLN is not within the set limits
13	A MAX			max. current among the three phases

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

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

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 3-phase voltage

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

3-phase reactive power

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

3-phase active power

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

3-phase apparent power

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

3-phase power factor

$$\cos\phi_\Sigma = \frac{W_\Sigma}{VA_\Sigma}$$

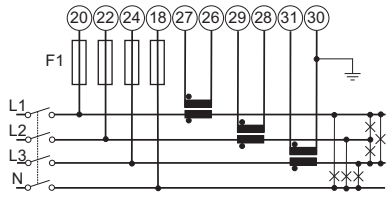
Neutral current

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

F1= 315mA

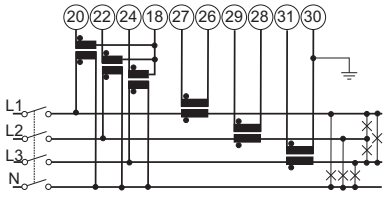
Wiring diagrams

Fig. 1



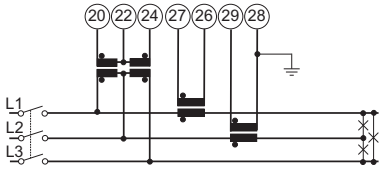
CT connection

Fig. 2



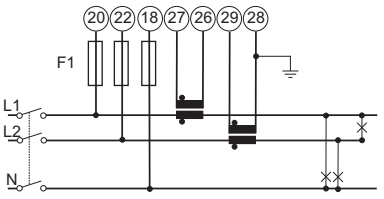
3CT and 3VT connection

Fig. 3



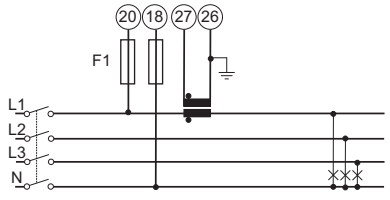
ARON connection

Fig. 4



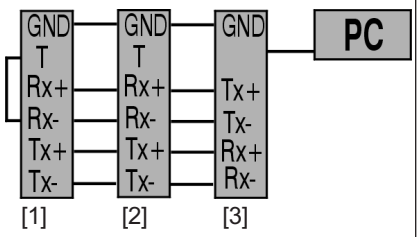
ARON and VT connection

Fig. 5



2-phase connection

RS485 serial connection Fig. 6

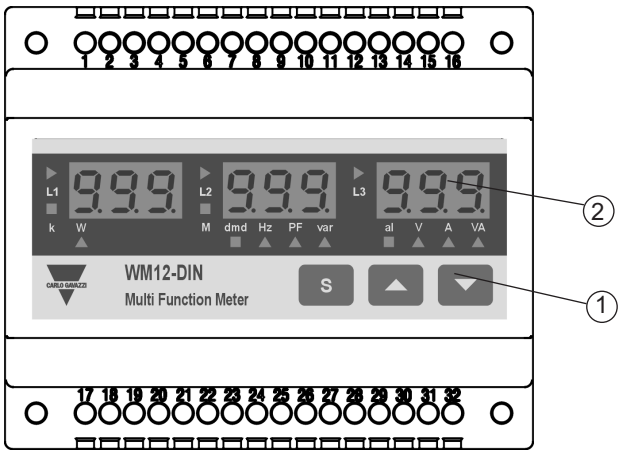


1-Last instrument
2-1...n Instrument
3-SIU-PC

4-wire connection

NOTE: the current inputs can be connected to the lines ONLY by means of current transformers. The direct connection is not allowed.
ATTENTION: Only one ammeter input can be connected to earth, as shown in the electrical diagrams.

Front Panel Description



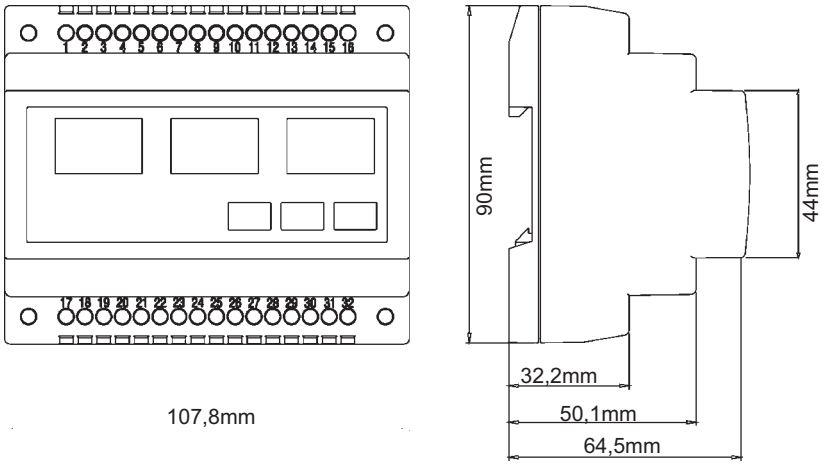
1. **Key-pad**
   To program the configuration parameters and the display of the variables.

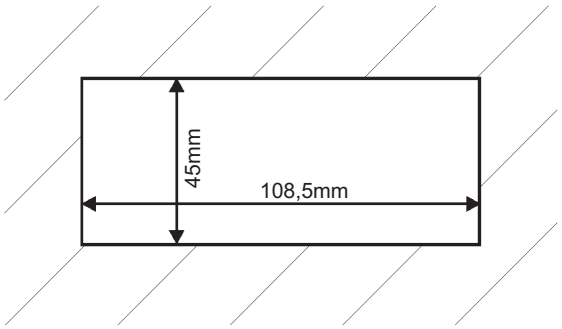
   S
   Key to enter programming and confirm selections;

   ▲ ▼
   Keys to:
   - programme values;
   - select functions;
   - display measuring pages.

2. **Display**
   LED-type with alphanumeric indications to:
   - display configuration parameters;
   - display all the measured variables.

Dimensions and Panel Cut-out





Energy Management Multifunction indicator Type WM12-96

- **Accuracy ±0.5 F.S. (current/voltage)**
- **Multifunction indicator**
- **Display of instantaneous variables: 3x3 digit**
- **Variable system and phase measurements: W, W_{dmd}, var, VA, VA_{dmd}, PF, V, A, An, Hz**
- **A_{max}, $W_{dmd\ max}$ indication**
- **TRMS meas. of distorted sine waves (voltages/currents)**
- **Power supply: 24V, 48V, 115V, 230V, 50-60Hz; 18 to 60VDC**
- **Protection degree (front): IP65**
- **Front dimensions: 96x96mm**
- **Optional RS422/485 serial output**
- **Alarms (visual only) V_{LN}, An**

Product Description

3-phase multifunction power indicator with built-in programming key-pad. Particularly recommended for displaying the main electrical variables.

Housing for panel mounting, (front) protection degree IP65 as standard, and optional RS485 serial output.

How to order

WM12-96 AV5 3 D X

Model
Range code
System
Power supply
Option

Type Selection

Range codes

AV5: 380/660V_{L-L}/5(6)AAC
VL-N: 185 V to 460 V
VL-L: 320 V to 800 V
AV6: 120/208V_{L-L}/5(6)AAC
VL-N: 45 V to 145 V
VL-L: 78 V to 250 V
Phase current: 0.03A to 6A
Neutral current: 0.09 to 6A

System

3 : 1-2-3-phase, unbalanced load, with or without neutral

Power supply

A: 24VAC -15+10%, 50-60Hz
B: 48VAC -15+10%, 50-60Hz
C: 115VAC -15+10%, 50-60Hz
D: 230VAC -15+10%, 50-60Hz
3: 18 to 60VDC

Options

X: None
S: RS485 output

Input specifications

Rated inputs	
Current	3 (shunt)
Voltage	4
Accuracy (display, RS485) (@25°C ±5°C, R.H. ≤60%)	with CT=1 and VT=1 AV5: 1150W-VA-var, FS:230VLN, 400VLL; AV6: 285W-VA-var, FS:57VLN, 100VLL
Current	0.25 to 6A: ±(0.5% FS +1DGT) 0.03A to 0.25A: ±7DGT
Neutral current	0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A: ±7DGT
Phase-phase voltage	±(1.5% FS +1 DGT)
Phase-neutral voltage	±(0.5% FS + 1 DGT)
Active and Apparent power, Power factor	0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS +5DGT)
Reactive power	0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS +5DGT)
Frequency	±0.1%Hz (48 to 62Hz)
Additional errors	
Humidity	≤0.3% FS, 60% to 90% RH
Temperature drift	≤ 200ppm/°C

Sampling rate	1400 samples/s @ 50Hz 1700 samples/s @ 60Hz
Display refresh time	700ms
Display	
Type	LED, 14mm
Read-out for the instant. var.	3x3 DGT
Measurements	Current, voltage, power, power factor, frequency TRMS measurement of distorted waves.
Coupling type	Direct
Crest factor	< 3, max 10A peak
Input impedance	
380/660V_{L-L} (AV5)	1 MΩ ±5%
120/208V_{L-L} (AV6)	453 KΩ ±5%
Current	≤ 0.02Ω
Frequency	48 to 62 Hz
Overload protection	
Continuous voltage/current	1.2 F.S.
For 500ms: voltage/current	2 Un/36A

CARLO GAVAZZI

RS485 Serial Output Specifications

RS422/RS485 (on request)	
Type	Multidrop bidirectional (static and dynamic variables)
Connections	2 or 4 wires, max. distance 1200m, termination directly on the instrument
Addresses	1 to 255, key-pad selectable
Protocol	MODBUS/JBUS
Data (bidirectional)	
Dynamic (reading only)	System and phase variables
Static (writing only)	All configuration parameters
Data format	1 bit di start , 8 data bit, no parity, 1 stop bit
Baud-rate	9600 bit/s

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 999, all data are protected
System selection	3-phase with neutral 3-phase without neutral 3-phase ARON 2-phase Single phase
Transformer ratio	
CT	1 to 999
VT	1.0 to 99.9
Filter	
Operating range	0 to 99.9% of the input electrical scale
Filtering coefficient	1 to 16
Filter action	Measurements, alarms, serial output (fundamental variables: V, A, W and their derived ones).

Displaying	Up to 3 variables per page
3-phase system with neutral	Page 1: V L1, V L2, V L3 Page 2: V L12, V L23, V L31 Page 3: A L1, A L2, A L3 Page 4: An Page 5: W L1, W L2, W L3 Page 6: PF L1, PF L2, PF L3 Page 7: var L1, var L2, var L3 Page 8: VA L1, VA L2, VA L3 Page 9: VA ∑, W ∑, var ∑ Page 10: VA dmd, W dmd, Hz Page 11: Wdmd MAX Page 12: VL-L ∑, PF ∑ Page 13: A MAX
Alarms	Programmable, for the VL∑ and An (neutral current). Note: the alarm is only visual, by means of LED on the front of the instrument.
Reset	Independent alarm (VL∑, An) max: A, Wdmd

Power Supply Specifications

Auxiliary power supply	230VAC -15 +10%, 50-60Hz 115VAC -15 +10%, 50-60Hz 48VAC -15 +10%, 50-60Hz
Power consumption	24VAC -15 +10%, 50-60Hz 18 to 60VDC AC: 4.5 VA DC: 4W

General Specifications

Operating temperature	-5 to +50°C (23 to 122°F) (RH < 90% non condensing at 40°C)
Storage temperature	-30 to +60°C (-22 to 140°F) (RH < 90% non condensing at 40°C)
Installation category	Cat. III (IEC 60664, EN60664)
Insulation (for 1 minute)	4000VAC, 500VDC between measuring inputs and power supply.

RS485.	500VAC/DC between measuring inputs and 4000VAC, 500VDC between power supply and RS485
Dielectric strength	4000 VAC (for 1 min)
EMC	
Emissions	EN50084-1 (class A) residential environment,

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General Specifications (cont.)

Immunity	commerce and light industry EN61000-6-2 (class A) industrial environment.
Pulse voltage (1.2/50µs)	EN61000-4-5
Safety standards	IEC60664, EN60664
Approvals	CE, cULus
Connections 5(6) A Max cable cross sect. area	Screw-type 2.5 mm^2
Housing	

Dimensions (WxHxD) Material	96 x 96 x 63 mm ABS self-extinguishing: UL 94 V-0
Mounting	Panel
Protection degree	Front: IP65 (standard), NEMA4x, NEMA12 Connections: IP20
Weight	Approx. 400 g (pack. incl.)

Waveform of the signals that can be measured

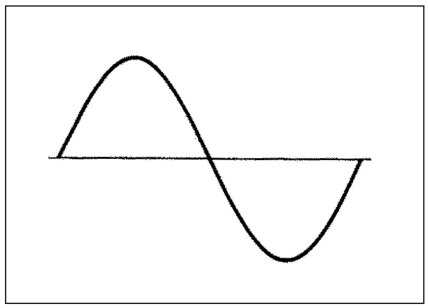

Figure A
Sine wave, undistorted
Fundamental content 100%
Harmonic content 0%
A_{rms} = 1.1107 | $\overline{A}$ |

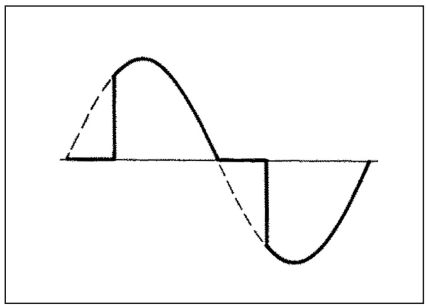

Figure B
Sine wave, indented
Fundamental content 10...100%
Harmonic content 0...90%
Frequency spectrum: 3rd to 16th harmonic
Additional error: <1% FS

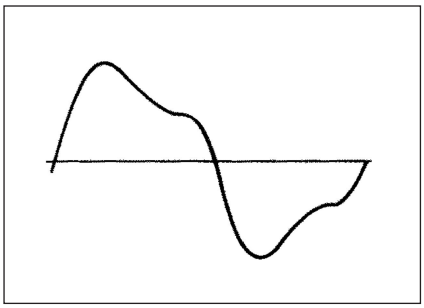

Figure C
Sine wave, distorted
Fundamental content 70...90%
Harmonic content 10...30%
Frequency spectrum: 3rd to 16th harmonic
Additional error: <0.5% FS

Display pages

Display variables in 3-phase systems (in a 3-phase system with neutral)

No	1st variable	2nd variable	3rd variable	Note
1	V L1	V L2	V L3	
2	V L12	V L23	V L31	Decimal point blinking on the right of the display
3	A L1	A L2	A L3	
4	An	AL.n		AL.n if neutral current alarm is active
5	W L1	W L2	W L3	Decimal point blinking on the right of the display if generated power
6	PF L1	PF L2	PF L3	
7	VAR L1	VAR L2	VAR L3	Decimal point blinking on the right of the display if generated power
8	VA L1	VA L2	VA L3	
9	VA system	W system	VAR system	
10	VA dmd (system)	W dmd (system)	Hz (system)	dmd = demand (integration time selectable from 1 to 30 minutes)
11		W dmd MAX		Maximum sys power demand
12	V LL system	AL.U	PF system	AL.U= is activated only if one of VLN is not within the set limits
13	A MAX			max. current among the three phases

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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

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

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 3-phase voltage

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

3-phase reactive power

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

3-phase active power

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

3-phase apparent power

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

3-phase power factor

$$\cos\phi_\Sigma = \frac{W_\Sigma}{VA_\Sigma}$$

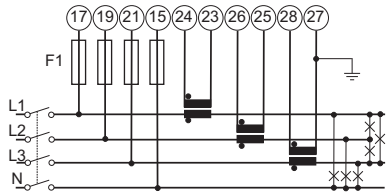
Neutral current

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

F1= 315mA

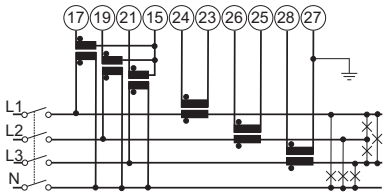
Wiring diagrams

Fig. 1



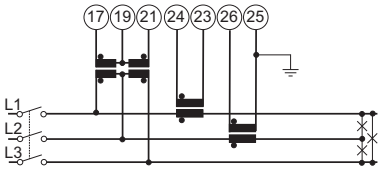
CT connection

Fig. 2



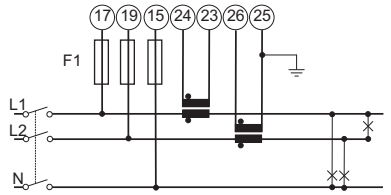
3CT and 3VT connection

Fig. 3



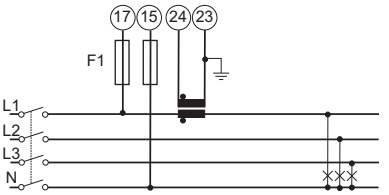
ARON connection

Fig. 4



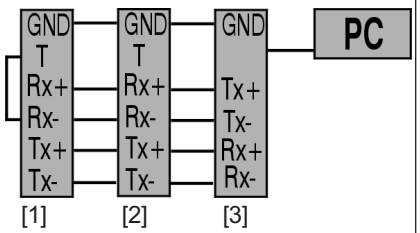
ARON and VT connection

Fig. 5



2-phase connection

RS485 serial connection Fig. 6



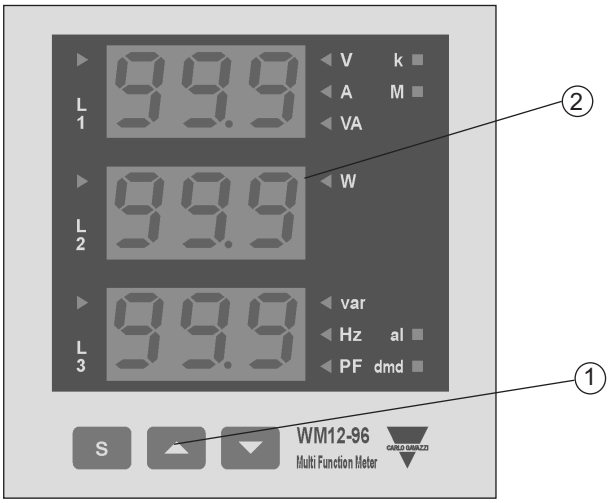
1-Last instrument
2-1...n Instrument
3-SIU-PC

4-wire connection

NOTE: the current inputs can be connected to the lines ONLY by means of current transformers. The direct connection is not allowed.

ATTENTION: Only one ammeter input can be connected to earth, as shown in the electrical diagrams.

Front Panel Description



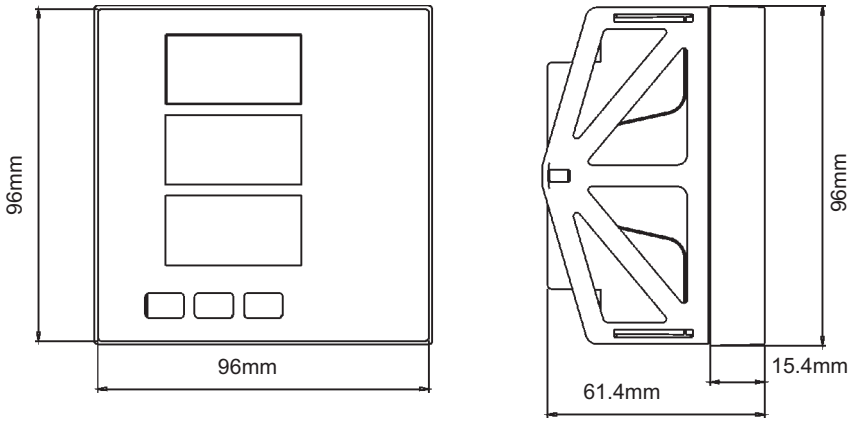
1. **Key-pad**
   To program the configuration parameters and the display of the variables.

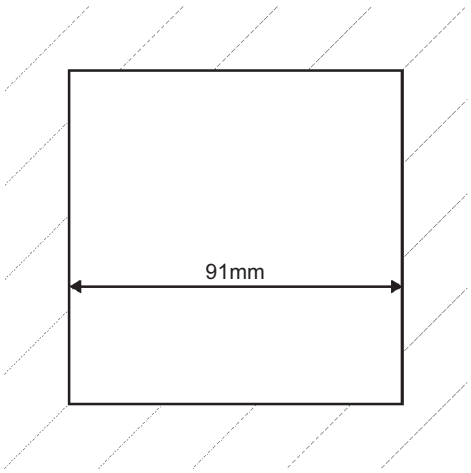
   S
   Key to enter programming and confirm selections;

   ▲ ▼
   Keys to:
   - programme values;
   - select functions;
   - display measuring pages.

2. **Display**
   LED-type with alphanumeric indications to:
   - display configuration parameters;
   - display all the measured variables.

Dimensions and Panel Cut-out





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Барнаул (3852)73-04-60
Белгород (4722)40-23-64
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Красноярск (391)204-63-61
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Липецк (4742)52-20-81
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Пермь (342)205-81-47
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Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
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Ставрополь (8652)20-65-13
Сургут (3462)77-98-35
Тверь (4822)63-31-35
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