

ENGLISH

WM2 - 96 / EM2 - 96

OPERATING INSTRUCTIONS

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Important:

We suggest you keep the original packing in case it is necessary to return the instrument to our Technical Service Department.

In order to achieve the most from your instrument, we recommend you read this instruction manual carefully.

CARLO GAVAZZI Instruments
WM2-96 / EM2-96
16-bit- μ P-based modular universal power analyser /
modular energy meter

rev. 1

Operating instructions

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GENERAL FEATURES

The most important features are:

- TRMS measurements
- CT connection (up to 5000/5A)
- WM2-96 only: measurements of kWh (total), kvarh (total), kWh (partial), kvarh (partial), kW, kvar, power factor ($\cos\phi$), V (L-L) avg, V (L-N), A.
- EM2-96 only: measurements of kWh (total), kvarh (total), kWh (partial), kvarh (partial).
- Outputs: WM2-96 only: DC pulse (programmable pulse for kWh, Kvarh), serial RS 485 (MODBUS/JBUS); EM2-96 only: serial RS485 with digital output.

The main programming parameters are:

- Programming of the password
- Selection of the electrical system
- Programming of the CT ratio
- Programming of the serial output (when present)
- Selection of the energy measurement
- Programming of the digital filter
- Reset of energy counters.

WM2-96: TECHNICAL FEATURES

INPUT SPECIFICATIONS

ACCURACY (48 to 62 Hz):

- Voltage/current: $\pm 0.5\%$ f.s. includes also frequency and output load influences.
- Energy: $\pm 1\%$ rdg (hour time base). Includes also frequency and output load influences.
- Active power: (@ 25°C $\pm 5^\circ$ C, R.H. $\leq 60\%$): $\pm 1\%$ f.s. (PF ($\cos\phi$) ≥ 0.7 L/C, 0 to 1 In, 0.5 to 1.2 Un).
- Reactive power: (@ 25°C $\pm 5^\circ$ C, R.H. $\leq 60\%$): $\pm 1\%$ f.s. (PF ($\sin\phi$) ≥ 0.7 L/C, 0 to 1 In, 0 to 1 Un).
- Power factor ($\cos\phi$): (@ 25°C $\pm 5^\circ$ C, R.H. $\leq 60\%$): $\pm 1\%$ f.s. (PF ($\cos\phi$) ≥ 0.7 L/C, 0.6 to 1.2 In, 1 to 1.2 Un).

ADDITIONAL ERRORS:

- Humidity: $< 0.3\%$ f.s., 60% to 90% R.H.
- Power supply: ± 0.5 RDG, -15 +10% power supply
- Magnetic field: $< 0.1\%$ f.s. @ 400 A/m.

RATED INPUTS:

- Current: 2 inputs (one/three-phase balanced load); 6 inputs (one/three-phase unbalanced load).
- Voltage: 2 inputs (one/three-phase balanced load); 4 inputs (one/three-phase unbalanced load).
- Insulation: among the voltage and the current inputs: 2000Vrms; among the current inputs: 2000Vrms.

TEMPERATURE DRIFT: ± 250 ppm/ $^\circ$ C

DISPLAY: 3-dgt (instantaneous measurements) (only WM2-96); 6-dgt (energies); Back-lighted LCD, h 13mm.

DECIMAL POINT POSITION:

automatic selection according to the primary current of the current transformer being connected: CT ratio $\leq 5A$: 11.11; CT ratio $\leq 50.0A$: 111.1; CT ratio $\leq 500.0A$: 1111; CT ratio $\leq 999.9A$: 11110
 Energy measurements: max. resolution: 1 Wh/1 varh; min. resolution: 1 kWh/1 kvarh

MAX. AND MIN. INDICATION:

- Voltage: Max. 600; min. 0
- Current (CT ratio=1): Max. 6.00; min. 0.00

- Power Factor (Cos ϕ): Max. 1.00; min. 0.00
- Power (CT ratio=1): Max. 5.40; min. 0.00
- Active energy: Max. 999999; min.-199999
- Reactive energy: Max. 999999; min. 0

SAMPLING RATE: 3 times/second

MEASUREMENTS:

- System variables: kW, kvar, PF (cos ϕ), VL-L, A, kWh_{tot}, kvar_{tot}, kWh_{partial}, kvar_{partial}
- Single phase variables: kW, kvar, PF (cos ϕ), VL-N, A
- Measurement method: TRMS measurement of a distorted voltage/current wave.
Coupling type: direct
Crest factor: ≤ 3

RANGE (IMPEDANCE):

- 250 V/433 V (≥ 400 k Ω);
- 5 AAC (≤ 0.3 VA / ≤ 0.1 Ω)

FREQUENCY RANGE: 48 to 62 Hz

OVER-LOAD PROTECTION:

Un: 250V (AV5), 400V (AV7); In: 5A

Continuous: voltage/current: 1.2 x rated input

For 1s: voltage: 2 x rated input; current: 20 x rated input

- OUTPUT SPECIFICATIONS

PULSE OUTPUT: (ONLY WM2-96)

- Static output: From 0.1 to 999.9 programmable pulses for kWh, kvarh, open collector (NPN transistor).
According to DIN 43864
VON = 1.2VDC / max 100mA
VOFF = 30VDC max.
- Relay output: 1 x SPDT; AC 1 - 8A, 250 VAC; DC 12 - 5A, 24VDC; AC 15 - 2.5A, 250VAC; DC 13 - 2.5A, 24VDC
- Pulse duration: 200 ms(ON), ≥ 200 ms (OFF)
- Insulation: By means of optocouplers, 4000 Vrms output to measuring input, 4000 Vrms output to supply input.

SERIAL OUTPUT (on request):

- Type: RS422/RS485; Bidirectional multidrop (static and dynamic variables).
- Connections: 2 or 4 wires, max. distance 1200m; termination and/or

line bias by means of DIP-switches.

- Addresses: from 1 to 255, key-pad programmable
- Protocol: MODBUS/JBUS
- Data (bidirectional):
Dynamic (reading only)
System variables: P, Q, PF (cos ϕ), VL-L, energies.
Single phase variables: PL1, QL1, PF (cos ϕ PL1), VL1-N, AL1;
PL2, QL2, PF (cos ϕ PL2), VL2-N, AL2; PL3, QL3, PF (cos ϕ PL3), VL3-N, AL3,
Static (writing only)
All programmable data, reset of energies:
- Partial kWh; Partial kvarh; Total kWh; Total kvarh
stored energies (EEPROM); ≤ 999999 kWh; ≤ 999999 kvarh
- Data format: 1 start bit, 8 data bit, no parity/even parity, 1 stop bit,
- Baud-rate: 1200, 2400, 4800 and 9600 baud,
- Insulation: by means of optocouplers; 4000 Vrms output to measuring inputs; 4000 Vrms output to supply inputs.

- 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 255, all data are protected.

MEASUREMENT SCROLLING:

- System:
active power (kW), reactive power (kvar), power factor (cos ϕ), current (A), phase-phase average voltage (VL-L), total and partial active energy (kWh), total and partial reactive energy (kvarh)
Partial energy meters: the partial counters of active energy (kWh) and reactive energy (kvarh) are automatically reset when the energy reaches the value (14999 * CT ratio)
- Single phase:
active power (kW), reactive power (kvar), power factor (cos ϕ), current (A), phase-neutral voltage (VL-N)

CURRENT TRANSFORMER:

- up to 5000A. CT ratio programmable from 0.1 to 999.9

DIGITAL FILTER:

- Operating range: from 0 to 100% of input electrical scale
- Filtering coefficient: from 1 to 64
- Filter action: on the display and on the variables being transmitted by the serial communication port.

- SUPPLY SPECIFICATIONS -**AC VOLTAGE:**

- 230 VAC -15% + 10%; 50/60 Hz (standard); 24 VAC, 48 VAC, 115 VAC -15% ; +10% 50/60 Hz (on request); 18 - 60 VDC/AC; 90 - 260 VDC/AC

POWER CONSUMPTION:

- $\leq 30\text{VA} / 12\text{W}$ (90-260V); $\leq 20\text{VA} / 12\text{W}$ (18-60V)

- 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 VRMS to ground

INSULATION: 4000 VRMS between all inputs/outputs and ground

DIELECTRIC STRENGTH: 4000 VRMS for 1 minute

NOISE REJECTION (CMRR): 100dB, 48 to 62 Hz

EMC: EN 50 081-2, EN 50 082-2

SAFETY STANDARDS: IEC 61010-1, CEI EN 61010-1

OTHER STANDARDS: Pulse output: DIN43864

CONNECTOR: screw-type, max. 2.5 mm² wires x 2

HOUSING:

- Dimensions 96 x 96 x 140mm
- Material ABS, self-extinguishing: UL 94 V-0

DEGREE OF PROTECTION: Front: IP 65

WEIGHT: 500 g approx. (packing included)

EM2-96: TECHNICAL FEATURES**- SAME AS WM2-96 EXCEPT FOR:****ACCURACY (48 to 62 Hz):**

- Energy: $\pm 1\%$ RDG (hour time base) included frequency and output load influences

Data available only by means of RS485:

- Active power(@ 25°C $\pm 5^\circ\text{C}$, R.H. $\leq 60\%$): $\pm 1\%$ f.s.(PF (cos ϕ) ≥ 0.7 L/C, from 0 to 1.2 In, from 0.5 to 1.2 Un)
- Reactive power: (@ 25°C $\pm 5^\circ\text{C}$, R.H. $\leq 60\%$): $\pm 1\%$ f.s.(PF (sen ϕ) ≥ 0.7 L/C, from 0 to 1 In, from 0 to 1 Un)
- Power factor (cos ϕ) (@ 25°C $\pm 5^\circ\text{C}$, R.H. $\leq 60\%$): $\pm 1\%$ f.s.(PF (cos ϕ) ≥ 0.7 ; L/C, from 0.6 to 1.2 In, from 1 to 1.2 Un)

DISPLAY: 6-digit back-lighted LCD, h 13mm.

DECIMAL POINT POSITION: automatic selection according to the counted energy.

MAX. AND MINIMUM INDICATION:

- Active energy: Max. 999999 min. -199999
- Reactive energy: Max. 999999 min. 0

MEASUREMENTS:

- Total energy kWh, kvarh
- Partial energy: kWh, kvarh
- Measuring method: TRMS measurement of a distorted voltage/current wave; Coupling type: direct; Crest factor: ≤ 3

- SOFTWARE FUNCTIONS -**MEASUREMENT SCROLLING:**

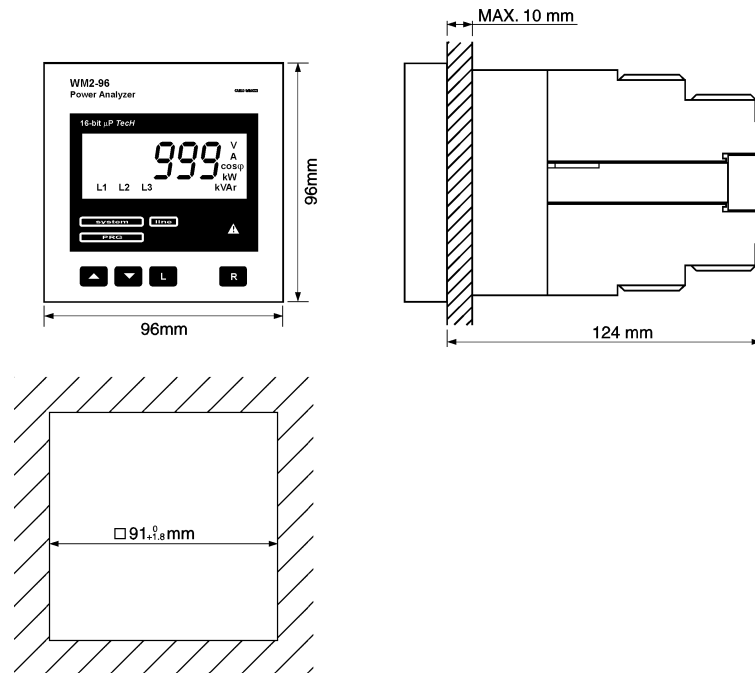
- total and partial active energy (kWh),
- total and partial reactive energy (kvarh).

DIGITAL FILTER:

- Filter operating range: 0 to 100% of the input electrical scale
- Filtering coefficient: 1 to 64
- Filter action: only on the variables being transmitted by the serial communication port

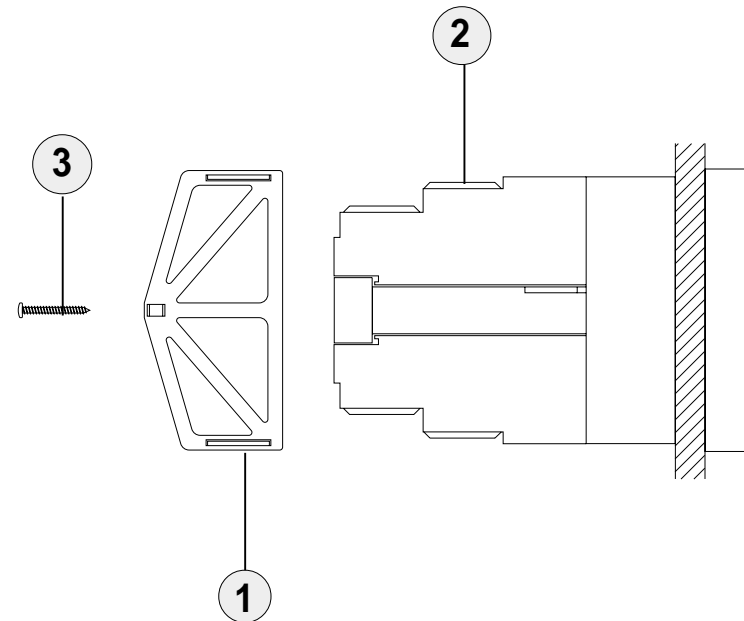
INSTALLATION

Overall dimensions and panel cut-out



Mounting

Insert the instrument (holding its front) into the panel and fasten it (from the back) by fixing the two lateral brackets (1) supplied with the instrument to the appropriate location (2), using the two screws (3) supplied with the instrument.

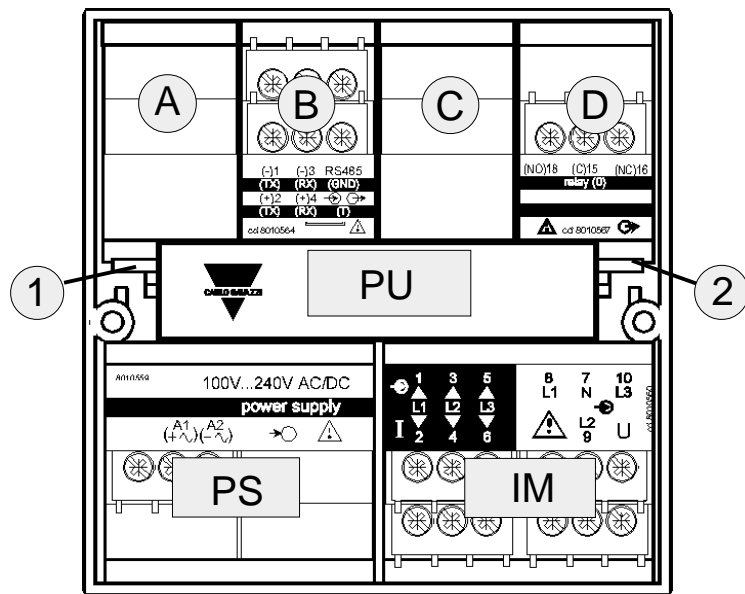


Connections

See the wiring diagrams illustrated in the appendix.

Position of the slots and relevant modules

NOTE: any slot which has not been used must be closed by means of the special blind modules.



	A	B	C	D	PU	PS	IM
RS485 serial port		•					
Single relay output				•			
Dual relay output				•			
Single open collector output				•			
Dual open collector output				•			
Power supply module						•	
Measuring input modules							•
Fixing module					•		

PRELIMINARY OPERATIONS

Before supplying the instrument, make sure that the power supply voltage corresponds to what is indicated on the lateral label of the relevant module. For example:

AP1020

Universal power supply

input range: **100V...240V DC/AC (50Hz to 60Hz)**

power consumption: **12W / 30VA 1 PHASE**

serial number: **S/N 001900/20115**

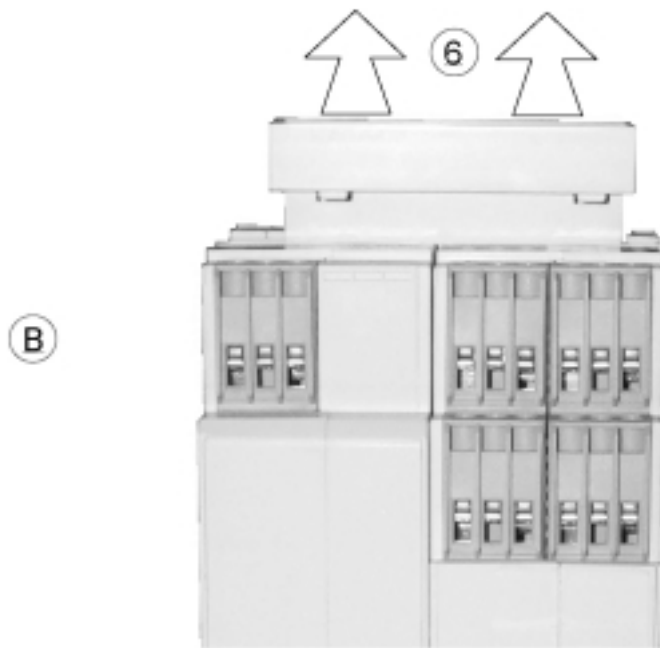
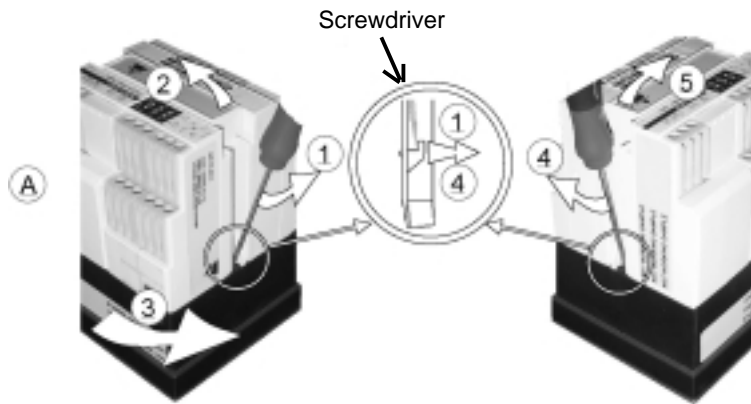
WARNING: the measuring input module is fixed and sealed to the main unit of the instrument. Its removal implies the breakage of the seal with subsequent expiry of the warranty.

The various modules (input, output and power supply) have been conceived to be mounted only in one of all the slots available.

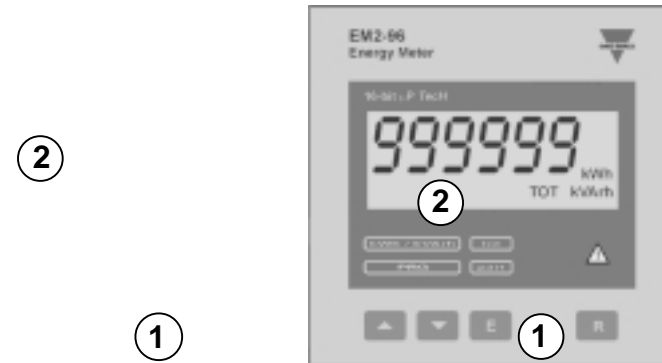
To know in which slot every module is to be mounted, refer to the drawing on the previous page.

For a correct mounting of the instrument, insert the modules in the relevant slots, then, at the end, enter the central module, which is a blind module and will fix the other modules in the relevant slots.

To remove the modules, use a screwdriver: A) gently lever the two fixing tabs (points "1" and "4" in the drawing on the following page) B) extract the central module, C) remove also the other modules.



FRONT PANEL DESCRIPTION



1. Key-pad

Functions available out of the programming phase.

Keys to be pressed:



scroll to the previous system variable



scroll to the next system variable



while they are pressed together: access to the programming phase

WM2-96:



if pressed while the instrument is displaying a partial energy: reset of the displayed value (kWh and kvarh).



scrolling of the single phase values and of the selected system variable

EM2-96:



scrolling of the active (kWh) or reactive (kvarh) energy

Functions available in the programming phase.**Keys to be pressed:**

Increase of the password value.
Increase of each parameter within its range.



Decrease of the password value.
Decrease of each parameter within its range.



Password confirmation
Goes to the next programming step.

2. Display

Alphanumeric indication by means of a 7-segment LCD (3 to 6 digits):

- of the programming parameters;
- of the measured variables.

OPERATING MODE

WM2-96 carries out the following instantaneous measurements: voltage, current, active and reactive power and PF ($\cos\phi$) on each phase or on the whole system. The measure of the active and reactive energy is also available.

Every measure can be displayed alternatively. The scrolling of the variables is carried out by means of the keyboard, as shown in the "WM2-96 DISPLAY FLOWCHART".

EM2-96 allows, by means of the keyboard, only the scrolling of the energy values, as illustrated in the "EM2-96 DISPLAY FLOWCHART".
WM2-96:

When the instrument is powered or when exiting from the programming phase, the system active power variable is displayed (default measurement).

During the programming phase, it's possible to enable either the automatic or the manual scrolling of the variables.

Automatic scrolling mode: (only WM2-96)

If this function is enabled (refer to the programming flowchart), horizontal scrolling is carried out automatically. When the last value of the row is

displayed, the instrument cycles on the first value of the same row. Press or to select the other basic measurements.

During the programming phase it is possible to choose the display time of the measure: from 3 seconds up to 10 seconds. By pressing (and keeping it pressed) you can stop the scrolling, when releasing it, the scrolling will start again after the display time of the measure. The automatic scrolling is available only for instantaneous values, not for energy measures, therefore it is not possible with the EM2-96;

Manual scrolling

If the parameter **S-t** (SCAN TIME) is set to 0, the instrument operates in manual scrolling. This latter working mode allows the cycling among the system and single phase measurements by pressing the key on the keyboard. Press or to select the further basic measurement. The key can be used to reset both partially counted active and reactive energies only while the energy to be reset is displayed.

PROGRAMMING PHASE

To enter the programming phase, press at the same time the and the keys.

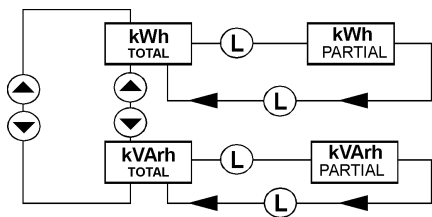
Please refer to the "Programming procedure flowchart" in the central pages of this manual for an overview of the programming steps;

At every step, keys and allow to set the desired value, while the key is used to confirm the values and go to the next programming step.

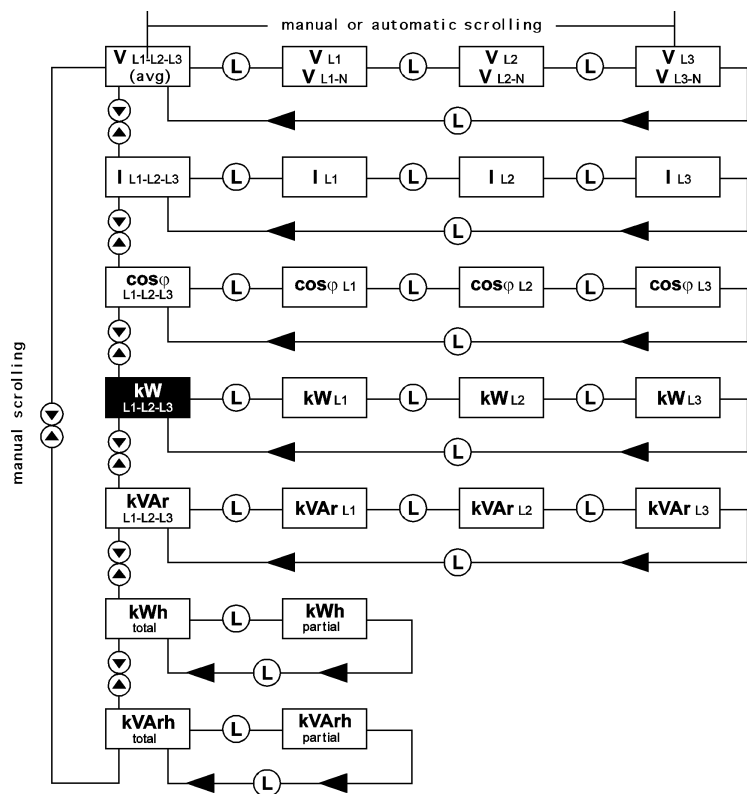
If no key is used within 5 minutes, the instrument will automatically exit the programming phase, storing only the changed values subsequently confirmed by the key.

To prevent corrupted calibration data, the instrument checks if the parameters are within the stated ranges. If not, default values are restored.

- EM2-96 DISPLAY FLOWCHART -



- WM2-96 DISPLAY FLOWCHART-



Programming steps

STEP 1:

“PAS”. A password between 0 and 255 is required. If the selected value matches the stored one, you go on to step 2, otherwise you will go back to the measurement phase and the system reactive power (default measurement) will be displayed.

STEP 2:

the password can be changed. The display will show “n_P” followed by the old password. The number can be changed by pressing the or keys.

Once the new value is selected, by pressing the or key you confirm the new password and go on to STEP 3. To keep the old value, press the or the key without changing the current value.

STEP 3:

“S_t”. This step allows you to choose the manual or the automatic scrolling of the system and single phase measurements. If you set the parameter to 0 (zero), the instrument will be in the manual scrolling mode. The values: 3, 4, 5, 6, 7, 8, 9 and 10 will enable the automatic scrolling mode and are expressed in seconds as duration time of every displayed electrical parameter. This working mode is available only for WM2-96.

STEP 4:



“SYS”. This step allows you to select the type of system to which the instrument is to be connected. Available selections:

- 1 = 1-PHASE system
 - 2 = 3-PHASE system - balanced load
 - 3 = 3-PHASE system - unbalanced load (default value)
- Set the value related to the connection of the instrument (see “Electrical connection diagrams” for details).



STEP 5:





“Ct”. It is possible to set the CT ratio between 0.1 and 999.9. The default value is 1.0; even if it is possible to work with a ratio < 1, it’s advisable to work with a ratio >1 to fulfil the accuracy specifications.

EM2-96 only: steps 6 and 7 are not available since EM2-96 is not equipped with the pulse output.

- STEP 6: "EnErGY". By pressing , the kWh value will be displayed and the consumed active energy will be retransmitted, while by pressing the  key, the reactive energy will be retransmitted and the kvarh will be displayed. The default value configures the instrument to retransmit the active energy (kWh).
- STEP 7: "PU". In this step, it is possible to program the number of pulses generated by the related output. The default value is 999.9 that means one pulse every Wh or varh (maximum resolution).

Steps 8, 9 and 10 are enabled only if the instrument is equipped with RS485.

- STEP 8: "Adr". The value of this parameter is the address of the instrument in a motoring network made by several instruments.
- STEP 9: "bdr". This parameter allows to set the communication speed of the information performed by the instrument.
- STEP 10: "PAR". This parameter allows to enable or disable the parity check on the serial communication. Pressing , "EVE" will be displayed and the "even" parity check is enabled, while pressing , parity check will be disabled and "no" will be displayed.
- STEP 11: "FIS". In this step you set the working range of the digital filter. The value is given as percentage of the full-scale value. By setting the parameter to 0 (zero) the filter is disabled. The default value is 2%.
- STEP 12: "FIC". This is the filtering coefficient of instantaneous measurements connected to the updating

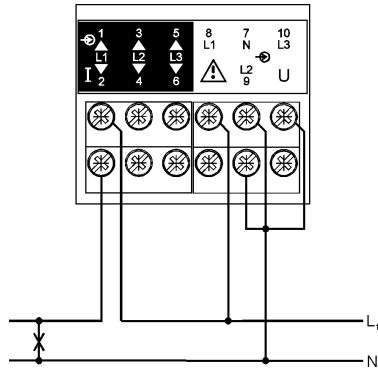
- STEP 13: "rES". In this step you can reset all the energy values (kWh and kvarh) measured until that moment. The default value is "no" to prevent accidental erasing. Pressing  the display will show you "YES". Subsequently pressing the " " or " " key, the reset will be confirmed. "No" has been set as a default condition, to prevent any accidental erasing. If, after selecting the reset command, you want to go back to the previous condition, press " ".

Programming parameters table

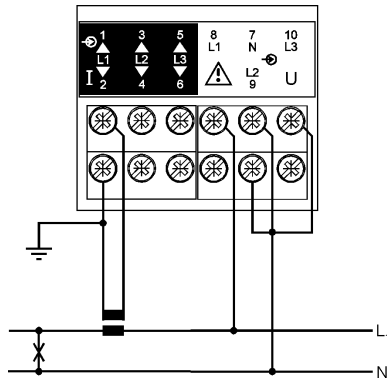
Parameter	Default value	Range	Description
n_P	0	0 to 255	password
St	0	0 or 3 to 10	manual/automatic scrolling time (seconds)
SYS	3	1 to 3	electrical system
Ct	1.0	0.1 to 999.9	current transformer ratio
EnErGY	kWh	kvarh - kWh	energy pulse - output
PU	999.9	0.1 to 999.9	No of pulses per 1kWh / 1kvarh
Adr	1	1 to 255	serial communication port address
bdr	9.6 (9600)	1.2-2.4-4.8-9.6	baud rate
PAR	NO	NO - EVE	parity
FI C	2	0% to 100%	filtering range
FI S	4	1 to 64	filtering coefficient

ELECTRICAL CONNECTION DIAGRAMS

SINGLE PHASE INPUT CONNECTIONS

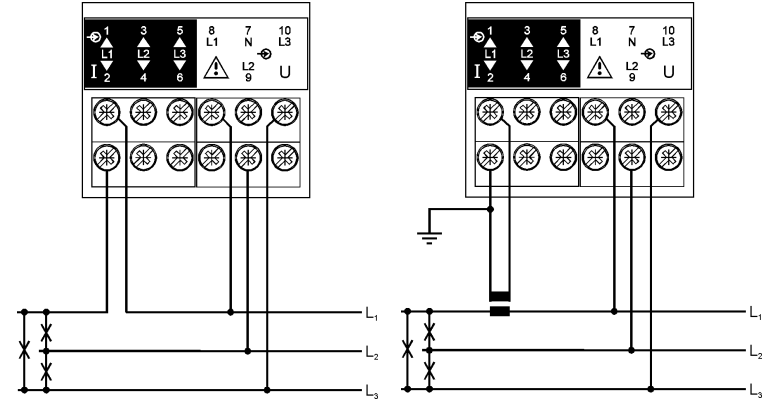


direct connection



CT connection

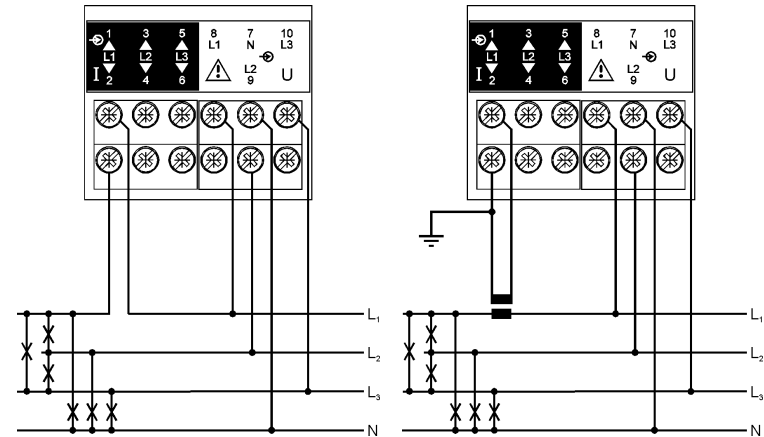
3-PHASE / 3-WIRE INPUT CONNECTIONS - BALANCED LOAD



direct connection
(3-wire system)

CT connection
(3-wire system)

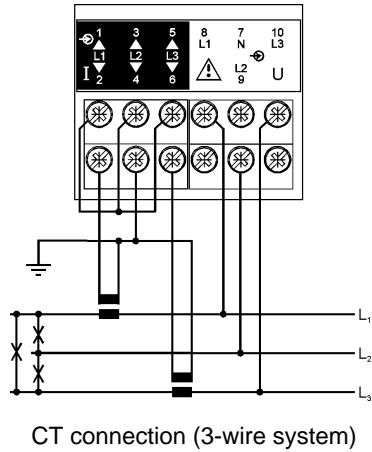
3-PHASE / 4-WIRE INPUT CONNECTIONS - BALANCED LOAD



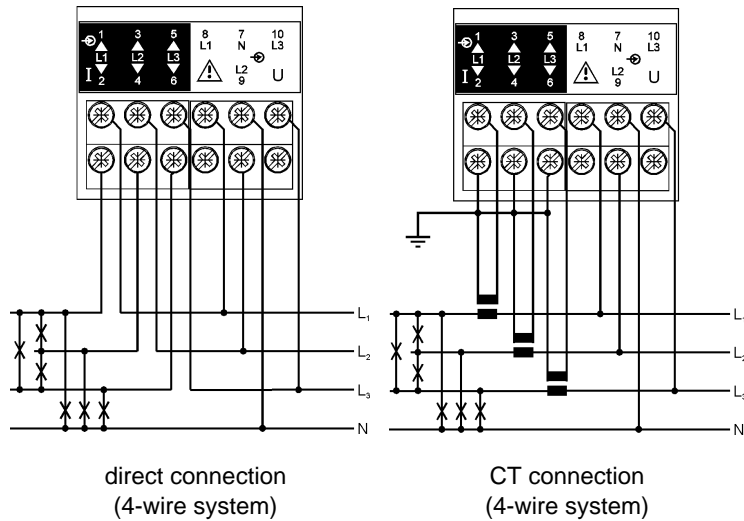
Direct connection
(4-wire system)

CT connection
(4-wire system)

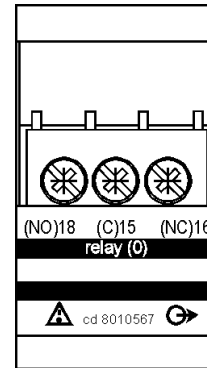
3-PHASE / 3-WIRE INPUT ARON CONNECTIONS - UNBALANCED LOAD



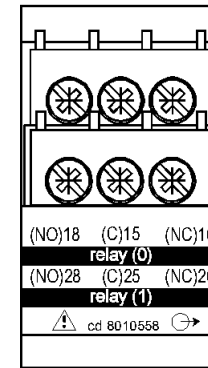
3-PHASE / 4-WIRE INPUT CONNECTIONS - UNBALANCED LOAD



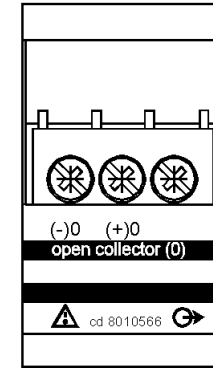
OUTPUT MODULES



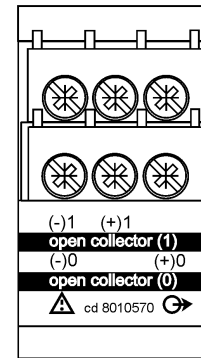
AO1058
Single relay output



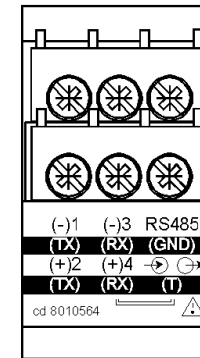
AO1035
Dual relay output



AO1059
Single open collector output



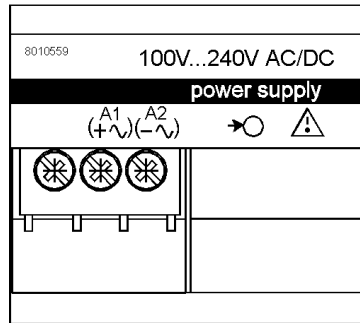
AO1036
Dual open collector output



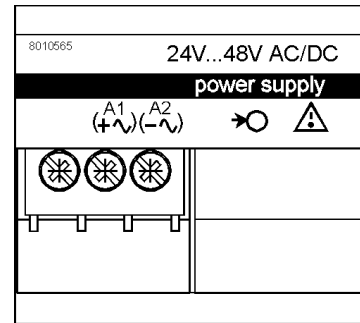
AR1034
RS485 output

POWER SUPPLY MODULES

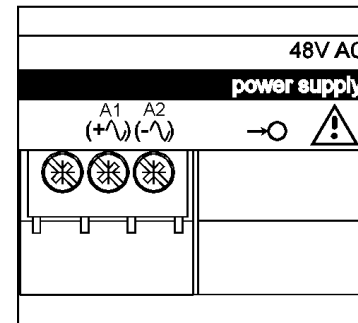
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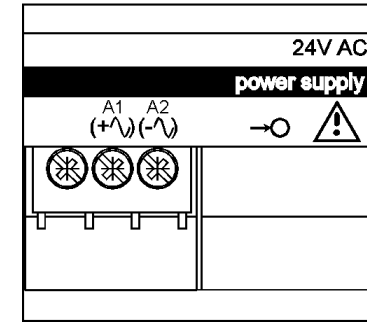
AP1020
90 - 260 VAC/DC power supply



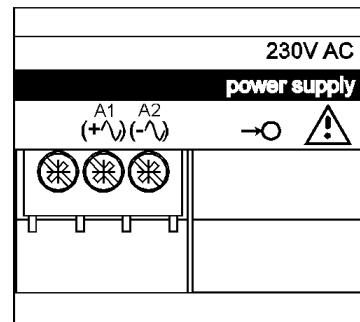
AP1021
18 - 60 VAC/DC power supply



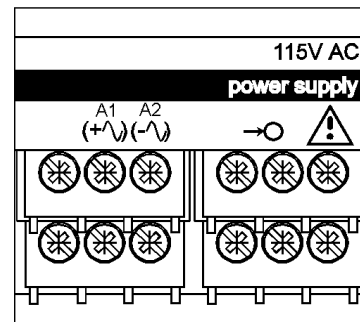
AP1024
48 VAC power supply



AP1025
24 VAC power supply



AP1022
230 VAC power supply

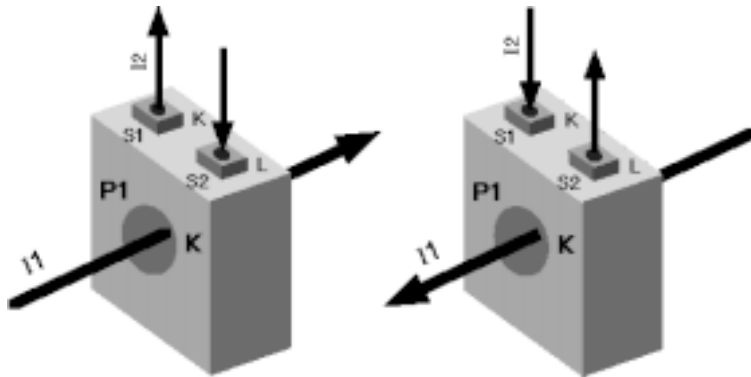


AP1023
115 VAC power supply

ENGLISH

USEFUL INFORMATION

The instrument is capable of displaying the measured current/power/energy variables according to the direction of the current flowing in the primary/secondary of the connected current transformer (if connected); see the figures below:



It is very important to respect the polarity of the measuring inputs, otherwise the instrument will not work properly. A wrong connection of the current inputs will not allow the correct displaying of the electrical variables.

Note:

In single phase or three-phase systems, when using one current transformer, please be sure to measure the L1 current (the same phase connected to terminal block 8 for voltage input). If you connect the C.T. to different phases, the readings will be unpredictable. All the connections shown in the "Electrical connection diagram" have to be carried out very carefully.