

# CARLO GAVAZZI

Automation Components

CARLO GAVAZZI

## WM23-96

Power Quality Analyzer  
Analizzatore di Qualità  
della Rete

USER MANUAL  
MANUALE ISTRUZIONI



Control

Modular system

77) 268-3700 · www.carlogavazzi.com/modules@gr

## **WM23-96: Power Quality Analyzer**

*Plug and play module system;  
Harmonic analysis; Wmax and PFmin  
storage. These are only a few among  
many other functions performed by  
your WM23-96. What's more, Carlo  
Gavazzi means ISO9001 certification,  
a working experience of many  
decades and a widespread presence  
all over the world. All this because  
we want our customers to have the  
**top service and the top products.***

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**THANK YOU FOR CHOOSING CARLO GAVAZZI**  
Plug and Play  
Modules

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CARLO GAVAZZI  
WM23-96, Power Quality Analyzer  
FW rev. 01

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*Measuring pages description*

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We suggest you to keep the original packing in case it is necessary to return the instrument to our Technical Service Department. In order to achieve the best results with your instrument, we recommend you to read this instruction manual carefully.

## HOW TO USE THE SYMBOLS



Go to the page where the previous main subject is described.



Go to the page where the next main subject is described.



Go to the page where the subject written on the top of the current page starts.



Go to the page where the subject written on the top of the current page ends.



This symbol indicates a particularly important subject or information.

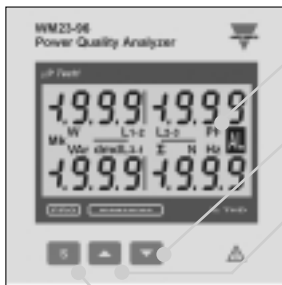


This symbol indicates that more details are given on the current subject.





## Frontal Panel Description



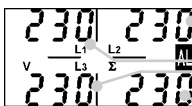
Back-lighted LCD Display.

Display previous page.

Display next page.

Access to programming or setting confirmation.

## List and Description of Displayed Measuring Pages

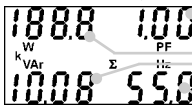


VL1-N

VL2-N

VL3-N

VΣ

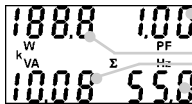


kWΣ

PFΣ

kvarΣ

Hz



kWΣ

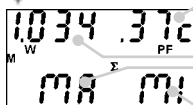
PFΣ

kVAΣ

Hz

Measuring pages

# To begin with **5**

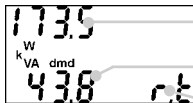


MW $\Sigma$  Max

PF $\Sigma$  Min

Max

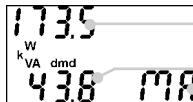
Min



kW dmd

Serial communication status: r=Rx; t=Tx (only with serial comm. module inserted)

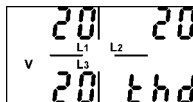
kVA dmd



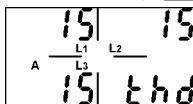
kW dmd, Max

kVA dmd, Max

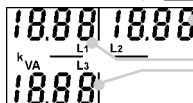
Max



Display total harmonic distortion for the single phase voltages expressed as %.



Display total harmonic distortion for the single phase currents expressed as %.



kVA L1

kVA L2

kVA L3



Index

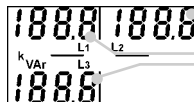
3

VT ratio

9

# 6

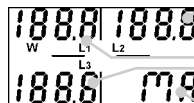
## To begin with



kvar L1

kvar L2

kvar L3

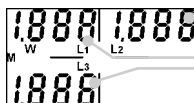


W L1 Max

W L2 Max

W L3 Max

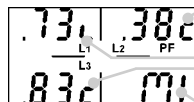
Max



W L1

W L2

W L3



PF L1 Min

PF L2 Min

PF L3 Min

Min

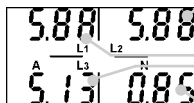


PF L1

PF L2

PF L3

PF Σ



A L1

A L2

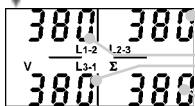
A L3

Neutral current



Change password

# Programming 7

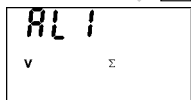


V L1-2

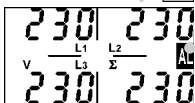
V L2-3

V L3-1

V Σ

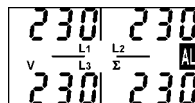


Display of alarm setting (AL1 and AL2 if both alarms have been set).  
Display of the variable connected to the alarm.



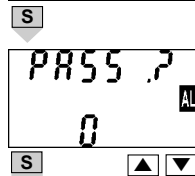
The scrolling of the measuring pages is cyclic, at the end it returns back to the first page on the left.

Active alarm indicator.



## Access to the main menu

To access to the programming menus from the measuring and display phase, press the **[S]** key: when the instrument asks for the password, enter the correct PASS value by means of the **▲** and **▼** keys; afterwards confirm by means of the **[S]** key. If the password is correct (when the instrument is new, the password is 0), the instrument goes to the main functions menu.



Access to the main menu



When the "AL" box (normally used for the alarm indication) is active during the programming phase, it means that the displayed value can be modified. This rule applies to all the programming menus.

Measuring pages

Synchronization

5

17

11



CnG PASS  
0

S

CnG PASS  
0

S

▲ ▼

## Change Password

This function allows the operator to choose the desired password value (from 0 to 1000).

Choose the “CnG.PASS” function by means of the ▲ and ▼ keys, then press **S** to modify PASS, enter the desired value by means of the ▲ and ▼ keys and confirm the new value with the **S** key.

SySTEn  
3P.n

S

SySTEn  
3P.n

S

SySTEn  
3P

S

▲ ▼

## System

This function allows the operator to select the electrical system choosing between three-phase with neutral (3P.n) and three-phase without neutral (3P).

Choose by means of ▲ and ▼ the “SySTEn” function, press **S** to enter the menu; then, select the desired system by means of the ▲ and ▼ keys and confirm with **S**.

CT ratio  
1

S

## CT ratio

This function allows the user to select the value of the CT ratio. Example: if the CT primary (current transformer) has a current of 300A

Index

3

Dmd calculation

10

Ct.rAtio 0  
1

S ▲ 12.2.1 ▼

rESEt  
no

rESEt  
YES

S ▲ ▼

Vt.rAtio 0  
10

S

Vt.rAtio 0  
10

S ▲ 12.2.1 ▼

rESEt  
no

rESEt  
YES

S ▲ ▼

and the secondary has a current of 5A, the CT ratio corresponds to 60 (obtained by carrying out the following calculation:  $300/5$ ). Choose the “Ct.rAtio” function by means of the ▲ and ▼ keys; to enter the menu press S; then select the desired value by means of the ▲ and ▼ keys and confirm the new value with S. *In order to store the new value, carry out the reset (rESEt YES ▶ S).*

## ■ VT ratio

This function allows the user to select the value of the VT ratio. Example: if the primary of the connected VT (voltage transformer) is of 20kV and the secondary is 100V, the VT ratio will correspond to 200 (obtained by carrying out the following calculation:  $20000/100$ ). Choose the “Vt.rAtio” function by means of the ▲ and ▼ keys; to enter the menu press S, then select the desired value by means of the ▲ and ▼ keys and confirm it with S. *In order to store the new value, carry out the reset (rESEt YES ▶ S).*



By changing the VT and CT ratio, the energy meters are reset.

Main menu

7

Alarm output

13

```
P.int t
  1 Min
```

[S]

```
P.int t
  1 Min
```

[S]

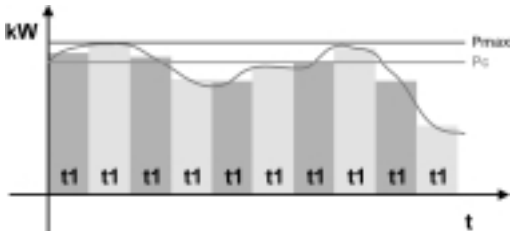
[▲] 1.2- [▼] .2.1

## ■ Dmd calculation

This function allows the user to select the integration time of the W, VA and var demand value (var only by means of RS485). To enter these functions select "P.int t" from the main menu by the [▲] and [▼] keys; to enter in the menu press [S]. Set the desired value by means of the [▲] and [▼] keys and confirm the new value with [S].



If for example, you select the value "15 minutes", the instrument calculates the demand value and updates the value every 15 minutes. See the diagram below.



Where:  $P_c$  is the contractual power  
 $t_1$  is the selected integration period

## ■ Synchronization

The synchronization allows the instrument, by means of the digital inputs, to start the integration of the power dmd at the same time as the official watt-hour meter. Without digital input module, the reset and the start of the energy integra-

tion are carried out as soon as the instrument is switched off. When the DIGITAL INPUT module is installed, the synchronization starts as soon as one of the digital inputs changes status (contacts 2 and 3 of the digital input mod-

SYnC  
YES

S

SYnC  
YES

AL

SYnC  
no

AL

S

▲ ▼

thd  
YES

S

thd  
YES

AL

thd  
no

AL

S

▲ ▼

ule). Every subsequent change of status, resets and synchronizes again the calculation of the power dmd. It is possible to enable or disable the synchronization function managed by the digital inputs.

Choose the “SYnC” function by means of the ▼ and ▲ keys, to enter the menu press S; Then set “YES” to enable the function or “No” to disable the synchronization by means of the ▲ and ▼ keys and confirm with S.

## ■ Total Harmonic Distortion

This function allows the user to enable the FFT analysis (Fast Fourier Transform) and the display of the total harmonic distortion (see also “displayed measuring pages” on page 5). Choose the “thd” function by means of the ▼ and ▲ keys, to enter the menu press S; then choose if the function is to be enabled (YES) or disabled (NO) by means of the ▲ and ▼ keys and confirm with S.

VT ratio

9

Serial port

15

diGout

S

diGout PF AL  
Σ  
rEn

S

▲ ▼

diGout AL  
ALr

S

Alarm digital output

Digital output 2 on page 14

diGout AL  
ALr

S

diGout PF AL  
Σ  
VAr

S

▲ ▼

## ■ Digital Outputs

### □ Digital Output 1

This function enables to set the parameters of the digital outputs. Choose the “diGout” function by means of the ▲ and ▼ keys, to enter the menu press **S**. Then, set one of the following parameters: **ALr**: access to the alarm function (see alarm digital output) confirm with **S** to enter the relevant menu; **rEn**: enable the activation of the output by means of the serial communication, confirm with **S** to enable the function.

### □ Alarm Digital Output

This function allows the user to set the parameters of the alarm digital output. Choose the “diGout1-ALr” function by means of the ▲ ▼ keys: to enter the menu press **S**. Then, set one of the following parameters: **VAr**: choose the variable to be associated to the alarm activation by means of the ▲ and ▼ keys and confirm with **S** ;

Main menu

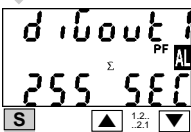
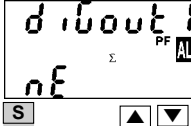
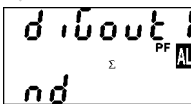
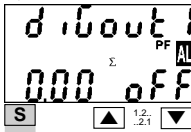
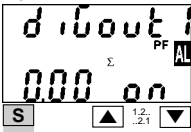
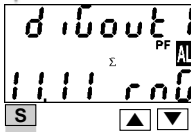
Analogue output

7

7

17

14



Digital Output 2  
on page 14

**rnG:** select the position of the digital point;

**Set-on:** activation set-point, value of the variable over which the alarm is activated. Select the value of the variable by means of the and keys and confirm with ;

**Set-off:** deactivation set-point, value of the variable over which the alarm is deactivated. Select the value of the variable by means of the and keys and confirm it with ;

**nd:** normally de-energized output when there is no alarm.

**nE:** normally energized output when there is no alarm.

Select the output status by means of the and keys and confirm it with ;

**SEC:** delay time at the activation of the alarm output. Choose the value of the delay time in seconds by means of the and keys (up to 255 seconds) and confirm with .

# 14 Programming

d i b o u t 2

S

d i b o u t 2  
AL  
ALr

d i b o u t 2  
PF AL  
Σ  
rEn

S ▲ ▼

## □ Digital Output 2

**ALr:** access to the alarm function (see alarm digital output on page 12) confirm with **S** to enter the relevant menu;

**rEn:** enable the activation of the output by means of the serial communication, confirm with **S** to enable the function.

AnA out

S

AnA out  
k<sub>VAR</sub> Σ AL  
VAR

S ▲ ▼

AnA out  
k<sub>VAR</sub> Σ AL  
1111 r n 0

S ▲ ▼

## ■ Analogue output

From the main menu select “AnA out” by means of the ▲ and ▼ keys;

to enter the menu press **S**:

**VAR:** variable to be associated to the output, choose among those available (see on page 20) by means of the ▲ and ▼ keys

and confirm the selection with **S**

**LoE:** minimum value of the variable input range. Select the desired value by means of the ▲ and ▼ keys and confirm it with **S**.

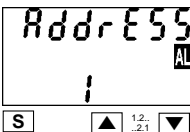
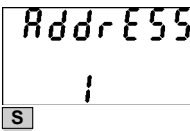
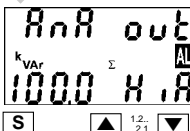
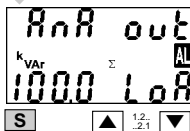
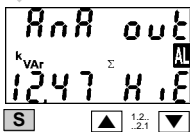
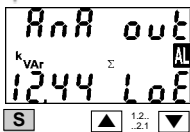
**HiE:** maximum value of the variable input range. Select the desired value by means of the ▲ and ▼

VT ratio

9

End of programming

16



keys and confirm it with **[S]**.

**LoA:** % value of the zero of the output range (0-20mA, 0-10V) that is generated by the minimum measured value (LoE). Select the

desired value by means of the **[▲]** and **[▼]** keys and confirm it with **[S]**.

**HiA:** % value of the full scale of the output range (0-20mA, 0-10V) that is generated by the maximum measured value (HiE). Select the

desired value by means of the **[▲]** and **[▼]** keys and confirm it with **[S]**.

See also “Example 1” in useful information on page 18.

## ■ RS422/485 Serial port address

Select “AddrESS” from the main menu by means of the **[▲]** and **[▼]** keys; to enter the menu press **[S]**, then set the desired address value (from 1 to 255) by means of the **[▲]** and **[▼]** keys and confirm it with **[S]**.



# 16 Programming

[S]

[S]

[▲] 1.2 [▼] 2.1

[S]

[▲] 1.2 [▼] 2.1

## ■ Digital Filter

Select “FiLteR” by means of the [▲] and [▼] keys: to enter the menu press [S]. Select the parameters to be set with the [▲] and [▼] keys, to enter the menu press [S].

There are two parameters:

- **mG**, to set the operating range of the digital filter. The value is expressed as % of the full scale value: set the desired value (from 0 to 100%) by means of the [▲] and [▼] keys and confirm it with [S];
- **Coe**, to set the filtering coefficient of

the instantaneous measurements, set the desired value (from 1 to 16) by means of the [▲] and [▼] keys and confirm it with [S]. By increasing the value both the stability and the settling time of the measurements are increased. **See also “Example 2” in Useful Information on page 19.**

[S]

To measuring mode

Instrument revision

## ■ End of programming

Use it to exit from programming and go back to the measuring mode. Select “End” from the main menu by means of the [▼] and [▲] keys, confirm it with [S].






Synchronization


11

Useful information

18

## Reset of min values

Select “rESEt MI” from the main menu by means of the   keys, then confirm with . When the instrument asks for the reset, choose, by means of the   keys: “no MI” to avoid the reset or “YES MI” to confirm it.

Then, press  to carry out the command.

rESEt MI





rESEt MI



rESEt MI



YES MI













RESET

## Reset of max values

Select “rESEt MA” from the main menu by means of the   keys, then confirm with . When the instrument asks for the reset, choose, by means of the   keys: “no MA” to avoid the reset or “yes MA” to confirm it.

Then, press  to carry out the command.

rESEt MA





rESEt MA



rESEt MA



YES MA



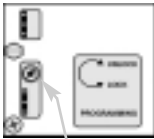




RESET



## ■ How to prevent the programming by key-pad



It is possible to prevent any access to programming by keypad by modifying the selector under the power supply slot (see the drawing on the left), or closing the contact number 1 of the digital input module, when present.

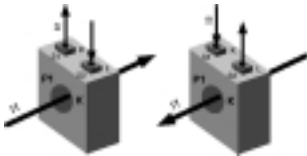
Selector: turn the selector with a little screwdriver.



- **Free** programming.
- **Lock** programming.



The variables measured by the instrument are correct if the polarities of the inputs have been observed (as shown in the figure below); if not, measuring and retransmission errors may occur due to the wrong direction of the current flowing in the primary / secondary of the connected current transformer.



## ■ Setting Examples

**Example 1 “Analogue output”:** take the measure of a power consumed up to 100kW, and retransmit it with a signal from 4 to 20 mA; the module to be used is AO1050 or AO1026 (single or dual output from 0 to 20mA), the instrument must be set as follows:

- VAr: (variable),  $W\Sigma$  (system active power)
- LoE: (minimum electrical scale) 0.0 K; the K and M mul-

titles are automatically selected by the instrument according to the selected VT and CT values;

- HiE: (maximum electrical scale) 100.0 K; the K and M multiples are automatically selected by the instrument according to the selected VT and CT values;
- LoA: (minimum electrical scale of the analogue output) 20.0% for 4mA, the calculation to be carried out is: (minimum output value / full scale output value)\*100 = (4mA/20mA)\*100 = 20%
- HiA: (maximum electrical scale of the analogue output) 100.0% for 20mA, the calculation to be carried out is: (maximum output value / full scale output value)\*100 = (20mA/20mA)\*100 = 100%

**Example 2 “Use of digital filter”:** it’s necessary to stabilize the displayed value of the VL1-N variable that varies between 222V and 228V. The parameters of the digital filter are to be set as follows:

- rnG: the variable varies within the average value, the amplitude of which is equal to  $\pm 1.3\%$  of the variable’s rated value, calculated as follows:

$(228-222)/2 = \pm 3V$ , then  $\pm 3 * 100 / 231V = \pm 1.3\%$  where 231V is the phase-neutral rated value of a 400V input range). The “range” parameter, that corresponds to the action range of the digital filter, is set at a value which is slightly higher than the percentage amplitude of the fluctuation: e.g. 2%.

- CoE: if the new value acquired by the instrument is within the filter’s action range, then the new displayed value is calculated by summing algebraically to the previous value the variation divided by the filtering coefficient. As a consequence, a value which is higher than this coefficient implies a longer settling time and therefore improves the stability. The latter can also be improved by increasing the filtering coefficient: the admitted values are within 1 and 16. Enter the value in consecutive attempts until you reach the desired stability.

## ■ What is ASY

The ASY variable allows the user to control the symmetry of the delta voltages (for systems without neutral) and star voltages (for systems with neutral). The variable is calculated according to the following formula:

$$ASY = \frac{V_{max} - V_{min}}{V_{avg}} * 100$$

Where:  $V_{max}$  is the max. value among VL1-N, VL2-N, VL3-N  
 $V_{min}$  is the min. value among VL1-N, VL2-N, VL3-N  
 $V_{avg}$  is the average:  $(VL1-N, VL2-N, VL3-N)/3$

The variable is not displayed by the instrument, but it can be retransmitted by the analogue or RS422 / 485 output and can be controlled by means of the alarm.

## ■ Retransmitted Variables

N°	Variable	Three-phase with neutral	Three-phase without neutral	Note
1	V L-NΣ	x		Σ = system
2	V L-LΣ	x	x	Σ = system
3	WΣ	x	x	Σ = system
4	varΣ	x	x	Σ = system
5	VAΣ	x	x	Σ = system
6	PFΣ	x	x	Σ = system
7	THD V	x	x	if FFT activated
8	THD A	x	x	if FFT activated
9	A n	x		
10	VA dmd	x	x	
11	W dmd	x	x	
12	ASY	x	x	asymmetry
13	All the instantaneous variables (powers, currents, voltages)			

## ■ Alarm digital output

The activation of the alarm can be UP or DOWN depending on how the ON and OFF parameters have been set, as per the following table:

ON-OFF VALUES STATUS	ALARM TYPE
ON $\geq$ OFF	UP
ON $<$ OFF	DOWN

## ■ Displaying of programming menu



It may be useful to know that the menus displayed by the instrument depend on its configuration; e.g.: the instrument will not display the menu relevant to the digital outputs if the optional module is not inserted.



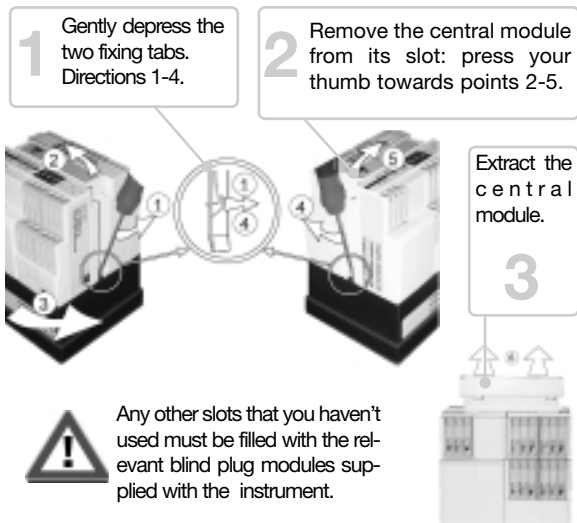
**IT IS IMPORTANT** that the instrument is switched off when you plug-in or disconnect the modules.

### ■ Preliminary operations

Before switching the instrument on, make sure that the power supply voltage corresponds to what is shown on the side label of the relevant module.

### ■ Before mounting the modules

To know in which slot every module is to be mounted, refer to the figure on page 24. For a correct mounting of the instrument, insert the modules in the relevant slots, then, at the end, enter the central module, which can be a blind type module or an RS232 communication module. The central module will help fixing also the other modules in the relevant slots. To remove the modules use a screwdriver as shown in the picture below.



Reset of min and max values

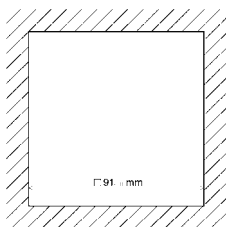
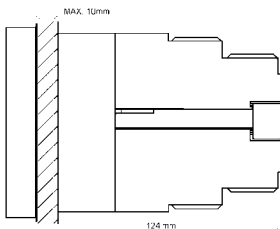
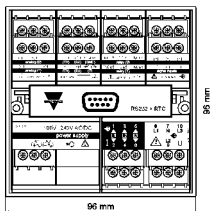
17

Available Modules

24

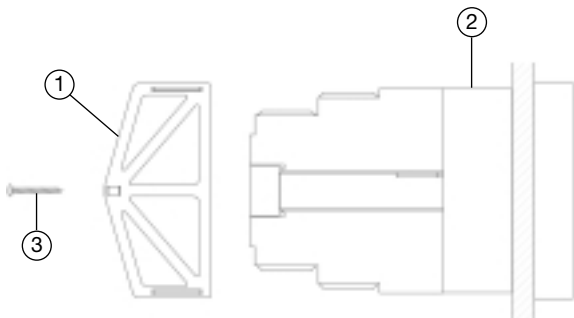
31

## Overall dimensions and panel cut-out



### Mounting

Insert the instrument (holding its front) 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.



Useful information

Optional module connections

21

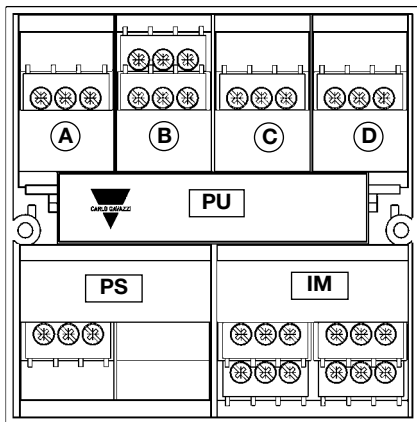
22

31

27

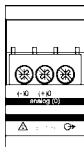


## Position of the slots and relevant modules



## Available modules

### Analogue output modules



Single analogue output

AO1050 (20mADC)

AO1051 (10VDC)

AO1052 ( $\pm 5$ mADC)

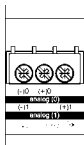
AO1053 ( $\pm 10$ mADC)

AO1054 ( $\pm 20$ mADC)

AO1055 ( $\pm 1$ VDC)

AO1056 ( $\pm 5$ VDC)

AO1057 ( $\pm 10$ VDC)



Dual analogue output

AO1026 (20mADC)

AO1027 (10VDC)

AO1028 ( $\pm 5$ mADC)

AO1029 ( $\pm 10$ mADC)

AO1030 ( $\pm 20$ mADC)

AO1031 ( $\pm 1$ VDC)

AO1032 ( $\pm 5$ VDC)

AO1033 ( $\pm 10$ VDC)

Useful information

Power supply modules

19

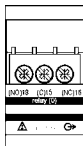
22

31

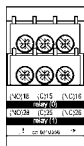
26

DESCRIPTION	A	B	C	D	PU	PS	IM
Single analogue output	✓						
Double analogue output	✓						
RS485 Serial port		✓					
RS232 Serial port					✓		
Single relay output			✓	✓			
Single open coll. output			✓	✓			
Dual relay output			✓	✓			
Dual open coll. output			✓	✓			
3 digital inputs			✓				
3 digital inputs+AUX			✓				
Power supply						✓	
Inputs							✓

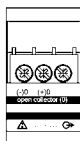
## □ Open collector digital output modules



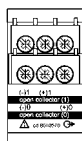
**AO1058**  
Single relay  
output



**AO1035**  
Dual relay  
output



**AO1059**  
Single open  
collector  
output



**AO1036**  
Dual open  
collector  
output

Mounting

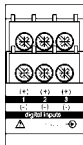
23

Serial port connections

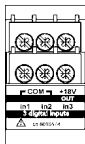
29

# 26 Installation

## □ Digital input modules

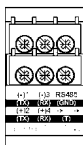


AQ1038  
3 digital  
inputs



AQ1042  
3 digital  
inputs + aux

## □ Serial port modules

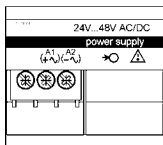


AR1034  
RS485 serial  
port



AR1039  
RS232 serial port

## □ Power supply modules



AP1020  
90-260 VAC/DC Power supply

- AP1021  
18-60VAC/DC Power supply
- AP1025  
24VAC Power supply
- AP1024  
48VAC Power supply
- AP1023  
115VAC Power supply
- AP1022  
230VAC Power supply

Useful information

21

Serial port connections

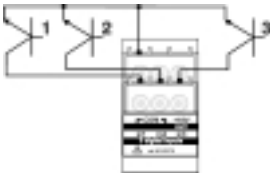
22

31

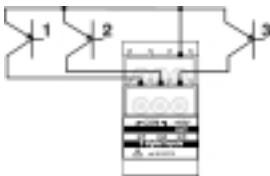
28

## ■ *Optional module connections*

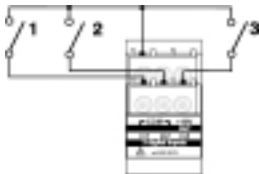
### □ *Digital inputs*



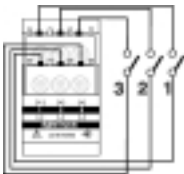
Connection by  
NPN transistor.  
AQ1042 Digital  
input module



Connection by  
PNP transistor.  
AQ1042 Digital  
input module



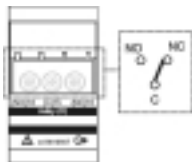
Connection by  
contacts.  
AQ1042 Digital  
input module



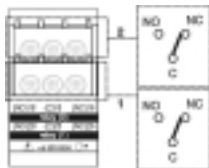
Connection by  
contacts.  
AQ1038 Digital  
input module



### □ Relay outputs

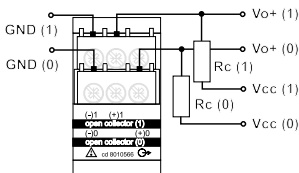


AO1058  
single relay output



AO1035  
dual relay output

### □ Open collector outputs

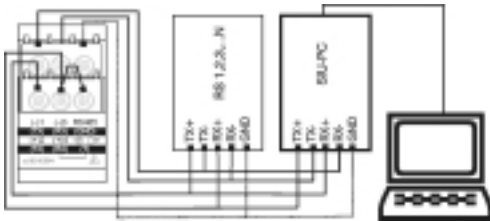


AO1059 single open collector  
output

AO1036 dual open collector  
output

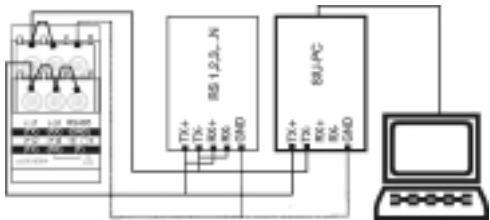
This diagram is valid also for the open collector modules with a lower number of outputs. The value of the load resistances ( $R_c$ ) must be chosen so that the short-circuit current is lower than 100mA; the VDC voltage must be lower than or equal to 30 VDC.

## RS485/422 serial port (AR1034)



4-wire connection.

Additional devices provided with RS422/RS485 (that is RS 1,2,3...N) are connected in parallel.



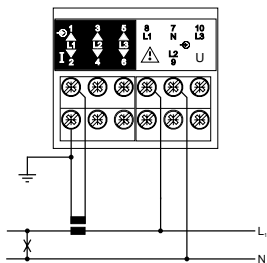
2-wire connection. Additional devices provided with RS422/RS485 (that is RS 1, 2, 3 ...N) are connected in parallel.



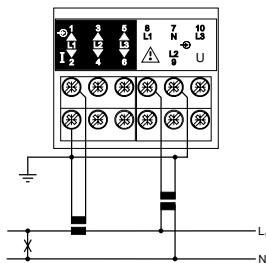
The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (Rx+) and (T). We recommend you to use the 4-wire connection: by means of the serial port the data are exchanged faster.

## Electrical diagrams

### Single-phase connection

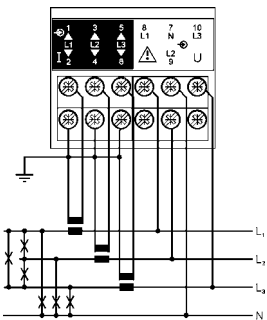


CT connections

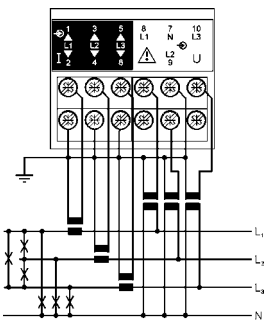


CT and VT connections

### Three-phase, 4-wire, unbalanced load



CT connections  
(4-wire system)



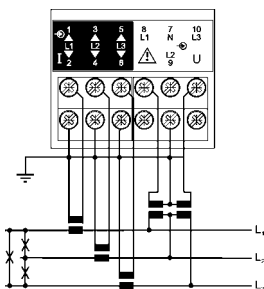
CT and VT connections  
(4-wire system)

Modules available

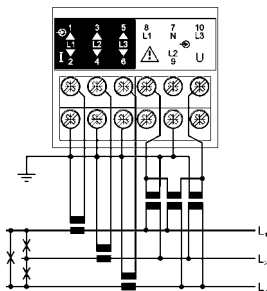
25

Technical features

32

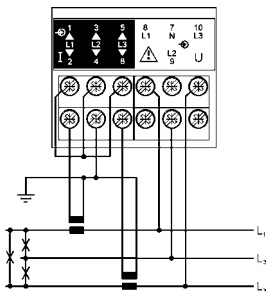


CT and VT connections  
(3-wire system)

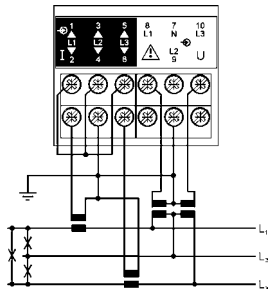


3 CT and 3 VT connections  
(3-wire system)

ARON connection, 3-phase, 3-wire, unbalanced load



CT connections  
(3-wire system) ARON



CT and VT connections  
(3-wire system) ARON



### ■ Number of inputs

Current: 3

Voltage: 4

### ■ Accuracy

(display, RS422/RS485)  $I_n=5A$ ;  $P_n= I_n^* U_n$

UN: FS ranges AV4-5-6-7

**Current:**  $\pm 0.5\% I_n + 2DGT$

**Phase-neutral voltage:**  $\pm 1\% U_n + 2DGT$

**Phase-phase voltage:**  $\pm 0.5\% U_n + 2DGT$

**Frequency:**  $\pm 0.1\% Hz$

**Active power** (@  $25^\circ C \pm 5^\circ C$ , R.H.  $\leq 60\%$ ):  $\pm 1\% P_n + 2DGT$

**Reactive Power** (@  $25^\circ C \pm 5^\circ C$ , R.H.  $\leq 60\%$ ):  $\pm 2\% P_n + 2DGT$

**Apparent power** (@  $25^\circ C \pm 5^\circ C$ , R.H.  $\leq 60\%$ ):  $\pm 1\% P_n + 2DGT$

**Harmonic distortion:**

(@  $25^\circ C \pm 5^\circ C$ , R.H.  $\leq 60\%$ ):  $\pm(3\%$  up to the 16th harmonic)

### ■ Additional errors

**Humidity:**  $\leq 0.3\%$  FS from 60% to 90% H.R.

### ■ Temperature drift

$\leq 200ppm/^\circ C$

### ■ Display

**Type:** LCD, 70x 38 mm, back lighted

**Display of instantaneous variables:** 4 x 3 1/2 digit

### ■ Measurements

Current, voltage, power, power factor, frequency, harmonic distortion. TRMS measurement of a distorted wave.

**Coupling type:** direct

## ■ **Input impedance**

AV4: 208VLL 5(6)AAC (AV4): >200 k $\Omega$

AV5: 400VLL 5(6)AAC (AV5): >900 k $\Omega$

AV6: 100VLL 5(6)AAC (AV6): >200 k $\Omega$

AV7: 660VLL 5(6)AAC (AV7): >900 k $\Omega$

## ■ **Frequency**

50 to 60 Hz

## ■ **Harmonic analysis**

**Analysis principle:** FFT

**Harmonic measurement:** Current, Up to 16th harmonic

**Voltage:** Up to 16th harmonic

**Type of harmonics:** THD VL1, THD VL2, THD VL3, THD AL1, THD AL2, THD AL3

**Display pages:** THD %

**System:** The harmonic distortion can be measured in both 3-wire or 4-wire systems.

## ■ **Interface modules technical features**

**Analogue Outputs** (on request)

**Number of outputs:** 1 (+1 redundant)

**Range:** 0 to 20 mADC, 0 to  $\pm 20$  mADC, 0 to  $\pm 10$  mADC, 0 to  $\pm 5$  mADC, 0 to 10 VDC, 0 to  $\pm 10$  VDC, 0 to  $\pm 5$  VDC  
0 to  $\pm 1$  VDC

**Accuracy:**  $\pm 0.2\%$ F.S.

**Temperature drift:**  $\leq 500$ ppm/ $^{\circ}$ C

**Scaling factor:** Programmable within the whole range of retransmission; it allows the retransmission of all values within the min and max relevant to the used module.

**Response time:** 900 ms (FFT filter excluded)

**Ripple:**  $\leq 1\%$

**Load:**  $20 \text{ mADC} \leq 600 \Omega$ ;  $\pm 20 \text{ mADC} \leq 550 \Omega$ ;  $\pm 10 \text{ mADC} \leq 1100 \Omega$ ;  $\pm 5 \text{ mADC} \leq 2200 \Omega$ ;  $10 \text{ VDC} \geq 10 \text{ k}\Omega$ ;  $\pm 10 \text{ VDC} \geq 10 \text{ k}\Omega$ ;  $\pm 5 \text{ VDC} \geq 10 \text{ k}\Omega$ ;  $\pm 1 \text{ VDC} \geq 10 \text{ k}\Omega$

**Insulation:** by means of optocouplers,  $4000 V_{\text{RMS}}$  output to measuring input  $4000 V_{\text{RMS}}$  output to power supply input.

**RS422/RS485** (on request). Module: AR 1034

**Type:** Multidrop, bidirectional (static and dynamic variables)

**Connections:** 2 or 4 wires, max. distance 1200m, termination directly on the instrument

**Addresses:** 1 to 255, selectable by key-pad

**Protocol:** MODBUS/JBUS (RTU)

**Data (bidirectional):**

**Dynamic (reading only):** system and phase variables

**Static (reading/writing):** all the configuration parameters, activation of the static output.

**Data format:** 1 start bit, 8 data bit, no parity, 1 stop bit

**Baud-rate:** 9600 bit/s.

**Insulation:** by means of optocouplers,  $4000 V_{\text{RMS}}$  output to measuring input,  $4000 V_{\text{RMS}}$  output to power supply input

**RS232** (on request) - **module** AR1039 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 (RTU)

**Digital outputs** (on request) AO1059/AO1036 module

To be used as alarm or remote control.

**Alarm outputs**

**Number of outputs:** up to 2, independent

**Alarm type:** Up alarm, down alarm

**Controlled variables:**  $V_{\Sigma}$ ,  $V_{n\Sigma}$ ,  $PF_{\Sigma}$ ,  $W_{\Sigma}$ ,  $VA_{\Sigma}$ ,  $var_{\Sigma}$ ,  $W_{dmd}$ ,  $VA_{dmd}$ ,  $A_n$ , ASY (asymmetry), THD V LN (the highest value among the three phases) THD A (the highest values among the three phases);

**On-time delay:** 0 to 255s

**Output type:** SPDT relay AC 1-8A @ 250VAC, DC 12-5A @ 24VDC, AC 15-2.5A @ 250VAC, DC 13-2.5A @ 24VDC

**Insulation:** by means of optocouplers, 4000  $V_{RMS}$  output to measuring input, 4000  $V_{RMS}$  output to supply input; insulation between the two outputs: functional.

## ■ Software 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 255, all data are protected.

**Transformer ratio:** CT from 1 to 5000

VT from 1.0 to 100.0 where,  $CT \times VT \leq 10000$  max

**Power dmd:** Integration time programmable from 1 to 30 min

**Filter:** filter operating range from 0 to 100% 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).

**Display** up to 4 variables per page (3-phase with neutral system):

Page 1: V L1, V L2, V L3, V LN $\Sigma$

Page 2: V L12, V L13, V L31,  $V_{\Sigma}$

Page 3: A L1, A L2, A L3,  $A_n$

Page 4: PF L1, PF L2, PF L3,  $PF_{\Sigma}$

Page 5: PF L1(min), PF L2(min), PF L3(min),

Page 6: W L1, W L2, W L3

Page 7: W L1(max), W L2(max), W L3(max),

Page 8: var L1, var L2, var L3

Page 9: VA L1, VA L2, VA L3

Page 10: AL1

Page 11: AL2

Page 12:  $W_{\Sigma}$ ,  $PF_{\Sigma}$ ,  $var_{\Sigma}$ , Hz

Page 13:  $W_{\Sigma}$ ,  $PF_{\Sigma}$ ,  $VA_{\Sigma}$ , Hz

Page 14:  $W_{\Sigma}$  (max),  $PF_{\Sigma}$  (min)

Page 15: W dmd, VA dmd, r.t.

Page 16: W dmd (max), VA dmd (max)

Page 17: THD VL1, THD VL2, THD VL3

Page 17: THD AL1, THD AL2, THD AL3

## ■ Power supply specifications

**AC voltage:** 90 to 260 VDC/VAC, 18 to 60VDC/VAC, 24 VAC - 15+10% 50-60Hz, 48 VAC -15+10% 50-60Hz, 115VAC - 15+10% 50-60Hz, 230 VAC -15+10% 50-60Hz

## ■ 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)

**Installation category** Cat. III (IEC 664)

**Key-pad lock:** by means of selector placed behind the display or by means of contact (in case of presence of the module 3 input contacts)

**Insulation:** 4000 VRMS between all inputs/outputs to ground

**Dielectric strength:** 4000 VRMS for 1 minute

### EMC

**Emissions:** EN50082-1 (class A) residential, commercial and light industry environment

**Immunity:** EN 61000-6-2 (class A) industrial environment

### Other standards

**Safety:** IEC 61010-1, EN 61010-1

**Product:** IEC 60688-1, EN 60688-1

**Approvals:** CE

**Connections 5(6)A:** Screw-type, max 2.5 mm<sup>2</sup> wires (2 x 1.5mm<sup>2</sup>)

**Housing**

**Dimensions:** 96x96x140 mm

**Material:** ABS, NORYL, PC (front) self-extinguishing: UL 94 V-0

**Protection degree:** Front: IP65; Connections: IP20

**Weight:** Approx. 400 g (packing incl.)

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Nota: Some pictures have been digitally modified and may not correspond to the instrument in all its details.

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## OUR SALES NETWORK

Carlo Gavazzi GmbH  
Wien - AUSTRIA

Carlo Gavazzi NV/SA  
Vilvoorde - BELGIUM

Carlo Gavazzi Inc.  
Mississauga, ON - CANADA  
Montreal, PQ - CANADA

Carlo Gavazzi Handel A/S  
Hadsten - DENMARK  
Carlo Gavazzi OY AB  
Helsinki - FINLAND

Carlo Gavazzi Sarl  
Roissy - FRANCE

Carlo Gavazzi GmbH  
Weiterstadt - GERMANY

Carlo Gavazzi UK Ltd  
Aldershot - GREAT BRITAIN

Carlo Gavazzi SpA  
Lainate (MI) - ITALY

Carlo Gavazzi Automation Sdn Bhd  
Petaling Jaya, Selangor - MALAYSIA

Carlo Gavazzi BV  
Beverwijk - NETHERLANDS

Carlo Gavazzi AS  
Porsgrunn - NORWAY

Carlo Gavazzi Lda  
Lisboa - PORTUGAL

Carlo Gavazzi SA  
Leioa (Bizkaia) - SPAIN

Carlo Gavazzi AB  
Karlstad - SWEDEN

Carlo Gavazzi AG  
Steinhausen - SWITZERLAND

Carlo Gavazzi Inc.  
Buffalo Grove IL - USA

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## OUR PRODUCTION SITES

Carlo Gavazzi Industri A/S  
Hadsten - DENMARK

Carlo Gavazzi Ltd  
Zejtun - MALTA

Carlo Gavazzi Controls SpA  
Belluno - ITALY

SAJET Elettronica SpA  
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