

Energy Management Modular Universal Utility Meter and Power Analyzer Type WM24-96



- Class 1 (active energy)
- Class 2 (reactive energy)
- Accuracy 0.5% RDG (current/voltage)
- Universal utility meter and power analyzer
- Backlighted LCD display
- Front size: 96x96 mm
- Measurements of phase and system variables: W, W_{dmd}, var, VA, VA_{dmd}, PF, V_{L-N}, A, Hz
- Measurements of total energies: kWh, kvarh C+/C-, kvarh L+/L-
- Measurements of partial energies: kWh, kvarh C+/C-, kvarh L+/L-
- Measurements according to EN61036 and EN61268
- Time periods (t1, t2, t3, t4) management by means of input contacts
- Measurements of m³ H₂O and m³ GAS by means of input contacts

- Up to 2 pulse outputs and up to 2 alarm outputs
- Up to 3 digital inputs for the time period and H₂O and GAS meters management
- MODBUS/JBUS (RTU) Protocol
- Optional RS232, RS422/485 serial ports

- TRMS measurement of distorted waves (currents/voltages)
- Universal power supply: 18-60VAC/VDC, 90-260 VAC/VDC
- Instantaneous variables read-out: 4x3 1/2 digit
- Energies, water, gas, variables read-out: 1x7 1/2 digit
- Protection degree (front): IP 65

Product Description

µP-based modular universal utility meter and power analyzer with built-in programming key-pad. Particularly recommended for the analysis of the electrical

variables, for the multi time periods (t1, t2, t3, t4) energy metering and water/gas metering. Housing for panel mounting and IP65 (front) protection degree.

Ordering Key

WM24-96AV53H XX XX XX XX X



Type selection

Range code	Power supply	Slot B (communication)	Slot D (alarm output)
AV4: 208VLL/1/5(6)AAC -20% ≤ Un ≤ +20%	A: 24 VAC -15 +10% 50-60Hz	XX: None	XX: None
AV5: 400VLL/1/5(6)AAC -20% ≤ Un ≤ +15%	B: 48 VAC -15 +10% 50-60Hz	S1: Serial port, RS485 multidrop, bidirectional	R1: Single relay output, (AC1-8AAC, 250VAC)
AV6: 100VLL/1/5(6)AAC -20% ≤ Un ≤ +15%	C: 115VAC -15 +10% 50-60Hz	Slot C (redundant output or digital inputs)	R2: Dual relay output, (AC1-8AAC, 250VAC)
AV7: 660VLL/1/5(6)AAC -30% ≤ Un ≤ +15%	D: 230 VAC -15 +10% 50-60Hz		O1: Single open collector output (30V/100mADC)
50-60 Hz for all input modules. Module not removable.	L: 18 to 60VAC/VDC	XX: None	O2: Dual open collector output (30V/100mADC)
	H: 90 to 260VAC/VDC	R1: Single relay output (AC1-8AAC, 250VAC)	Options
System	Slot A	R2: Dual relay output (AC1-8AAC, 250VAC)	
3: Three-phase, unbalanced load, with or without neutral	XX: None	O1: Single open collector output (30V/100mADC)	
		O2: Dual open collector output (30V/100mADC)	
		D1: 3 digital inputs	X: None
		D2: 3 digital inputs + aux output	S: RS232 serial port

NOTE: max digital output (alarms and/or pulses): 2, any exceeding output is redundant.

NOTE: with the A, B, C, D types power supply, only an open collector module or a single relay output module can be used. The instrument can be fully equipped only with L and H type power supply.



Input Specifications

Number of measure inputs		Apparent power (@ 25°C ± 5°C, R.H. ≤ 60%)	±(1% Pn +2DGT) Ib:1A; Pn= Ib* Un
Current	3	Current (@ 25°C ± 5°C, R.H. ≤ 60%)	0.02Ib to Ib:
Voltage	4	Phase-neutral voltage (@ 25°C ± 5°C, R.H. ≤ 60%)	±(0.5%RDG + 3DGT);
Digital inputs	(on request)	Frequency	Range Un:
AQ1038	Number of inputs: 3 (voltage free)	Active power (@ 25°C ± 5°C, R.H. ≤ 60%)	±(0.5% RDG +1DGT)
Reading voltage	24VDC/1mA	Reactive power (@ 25°C ± 5°C, R.H. ≤ 60%)	±0.1 Hz
Input frequency	Max. 20Hz, dutycycle 50%	Temperature drift	0.5Ib to Ib: ±(1%RDG +1DGT)
Contact 1 purpose	key-pad programming lock (when the contact is closed).	Display	0.02Ib to 0.5Ib:
Contact 2-3 purpose	To be used in 3 different ways: • time period selection (t1-t2-t3-t4) and W _{dmd} , VA _{dmd} synchronization; • Gas total meter, and night and day tariffs selections • GAS and WATER, total meters;	Display refresh time	±(1.5%RDG +3DGT)
AQ1042	Number of inputs: 3+excitation output (AUX) (16V<Aux<24VDC, max 15mA) other characteristics like AQ1038	Measurements	0.5Ib to Ib: ±(2%RDG +1DGT)
Accuracy (display, RS232, RS485)	Ib:5A; Pn= Ib* Un	Coupling type	±(3%RDG +3DGT)
Current (@ 25°C ± 5°C, R.H. ≤ 60%)	0.003Ib to 0.2Ib: ±(0.5% RDG + 3DGT); 0,2Ib to I _{max} : ±(0.5 RDG + 1DGT)	Input impedance	≤200ppm/°C
Phase-neutral voltage (@ 25°C ± 5°C, R.H. ≤ 60%)	Range Un: ±(0.5% RDG + 1DGT)	208VLL 5(6)AAC (AV4):	Back-lighted LCD 4x3 1/2 digits (instantaneous variables) or 1x7 1/2 digits (energy, gas, water) 70 x 38mm
Frequency	±0.1 Hz	400VLL 5(6)AAC (AV5):	
Active power/energy (@ 25°C ± 5°C, R.H. ≤ 60%)	Class 1 according to EN61036 (I start-up: 20mA)	100VLL 5(6)AAC (AV6):	
Reactive power/energy (@ 25°C ± 5°C, R.H. ≤ 60%)	Class 2 according to EN61268 (I start-up: 20mA)	660VLL 5(6)AAC (AV7):	

Output Specifications

RS422/RS485	(on request) Multidrop bidirectional (static and dynamic variables)	Baud-rate	no parity, 1 stop bit
Connections	2 or 4 wires, max. distance 1200m, termination directly on the instrument	Protocol	9600 bauds
Addresses	255, selectable by key-pad	other characteristics	MODBUS/JBUS (RTU) as per RS422/485
Protocol	MODBUS/JBUS (RTU)	Pulse outputs (on request)	
Data (bidirectional)	System and phase variables: see table "display pages"	Number of outputs	up to 2
Dynamic (reading only)	All the configuration parameters, activation of the static output.	Type	programmable from 1 to 1000 pulses
Static (writing only)		Pulse duration	V _{ON} 1.2 VDC/ max. 100 mA V _{OFF} 30 VDC max.
Data format	1 start bit, 8 data bit, no parity, 1 stop bit	Insulation	Outputs conectable to the total and/or partial energy meters
Baud-rate	9600 bauds	Notes	220 ms (ON), ≥ 220 ms (OFF) according to DIN43864
Insulation	By means of optocouplers, 4000 V _{RMS} output to measuring input 4000 V _{RMS} output to supply input		By means of optocouplers, 4000 V _{RMS} output to measuring inputs, 4000 V _{RMS} output to power supply input.
RS232	(on request) bidirectional (static and dynamic variables)		The outputs can be either open collector type or relay type (for the relay outputs refer to the specifications described in the "alarm outputs").
Connections	3 wires, max. distance 15m,		
Data format	1 start bit, 8 data bit		



Output Specifications (cont.)

Alarm outputs	(on request)		
Number of outputs	up to 2, independent		
Alarm type	Up alarm, down alarm		
Variables to be controlled	see the "List of the variables that can be connected..."	Min. response time	DC 12-5A @ 24VDC AC 15-2.5A @ 250VAC DC 13-2.5A @ 24VDC ≤150ms, filters excluded, Set-point on-time delay: "0 s"
Set-point adjustment	from 0 to 100% of the electrical scale	Insulation	By means of optocouplers, 4000 V _{RMS} output to measuring input, 4000 V _{RMS} output to supply input.
Hysteresis	from 0 to 100% of the electrical scale	Note	The outputs can be either relay type or open collector type (for the open collector output refer to the specifications described in the "pulse outputs")
On-time delay	0 to 255s		
Relay status	Selectable; normally de-energized and normally energized		
Output type	Relay, SPDT type AC 1-8A @ 250VAC		

Software Functions

Password	Numeric code of max 4 digits; 2 protection levels of the programming data	Page Variables	Up to 4 by page
1st level	Password "0", no protection	Three-phase system with neutral	Page 1: V L1, V L2, V L3, V LNΣ
2nd level	Password from 1 to 1000, all data are protected.		Page 2: AL1, AL2, AL3
Transformer ratio	CT from 1 to 5000 VT from 1.0 to 1999, where CT x VT ≤ 10000		Page 3: W L1, W L2, W L3
Power demand (dmd)			Page 4: VA L1, VA L2, VA L3
Integration time	Programmable from 1 to 30 min		Page 5: var L1, var L2, var L3
Filter			Page 6: PF L1, PF 2, PF L3, PF Σ
Filter operating range	From 0 to 100% of the input electrical scale		Page 7: W Σ, var Σ, PF Σ, Hz
Filtering coefficient	1 to 16		Page 8: W Σ, VA Σ, PF Σ, Hz
Filter action	Measurements, alarms, serial port (fundamental variables: V, A, W and their derived ones).	Energy, gas, water, meter pages	Page 9: W dmd, VA dmd See "Energy, gas, water meter settings" table

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
		Power consumption	≤ 30VA/12W (90 to 260V) ≤ 20VA/12W (18 to 60V)



General Specifications

Operating temperature	0 to +50°C (32 to 122°F) (R.H. < 90% non-condensing)	Immunity	residential, commercial and light industry environment EN 61000-6-2 (class A) industrial environment
Storage temperature	-10 to +60°C (14 to 140°F) (R.H. < 90% non-condensing)		Other standards
Installation category	Cat. III (IEC 60664)	Approvals	CE
Pollution degree	2	Connections 5(6)A	Screw-type, max 2.5 mm ² wires (2 x 1.5mm ²)
Key-pad lock	by means of a rotary switch placed behind the display or by means of a contact (in case of presence of the digital inputs modules)	Housing	96x96x140 mm ABS, NORYL, PC (front) self-extinguishing: UL 94 V-0
Insulation	4000 V _{RMS} between all inputs/outputs to ground	Dimensions	
Dielectric strength	4000 V _{RMS} for 1 minute	Material	
EMC		Protection degree	Front: IP65 Connections: IP20
Emissions	EN50082-1 (class A)	Weight	Approx. 400 g (packing incl.)

Mode of operation

Waveform of the signals that can be measured

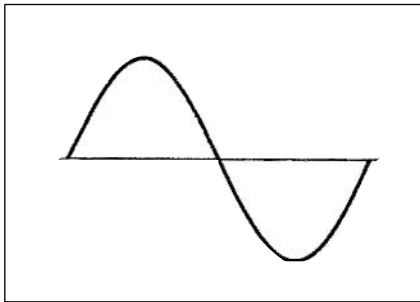


Figure G
Sinewave, undistorted

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

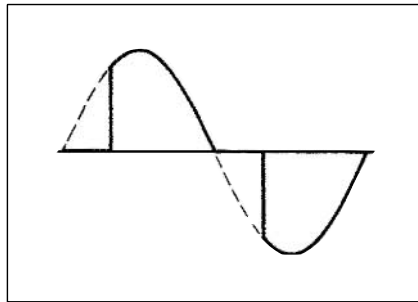


Figure H
Sinewave, indented

Fundamental content 10...100%
Harmonic content 0...90%
Frequency spectrum: 3rd to 16th harmonic

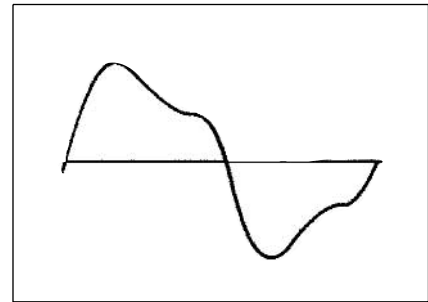
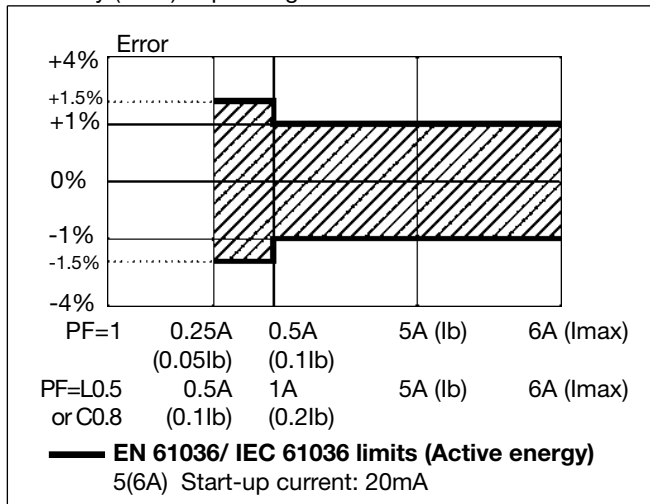


Figure I
Sinewave, distorted

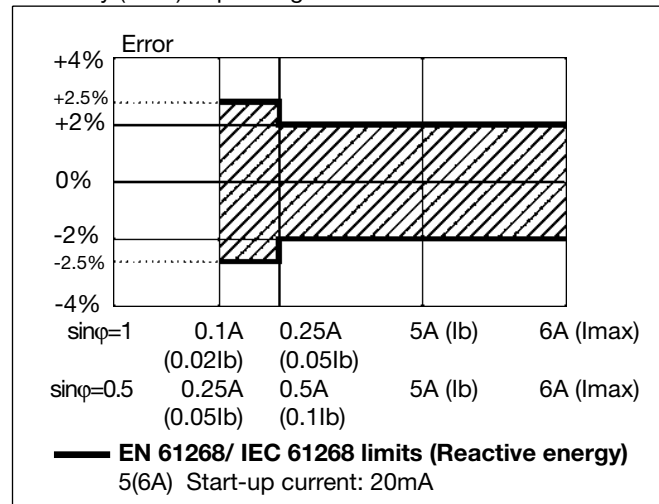
Fundamental content 70...90%
Harmonic content 10...30%
Frequency spectrum: 3rd to 16th harmonic

Accuracy

Accuracy (RDG) depending on the current



Accuracy (RDG) depending on the current



Display pages

Variables that can be displayed in case of a three-phase system, 4-wire connection.

No	1st variable	2st variable	3st variable	4th variable	Notes
1	V L1-N	V L2-N	V L3-N	V Σ	Σ = system
2	A L1	A L2	A L3		
3	W L1	W L2	W L3		
4	VA L1	VA L2	VA L3		
5	var L1	var L2	var L3		
6	PF L1	PF L2	PF L3	PF Σ	Σ = system
7	W Σ	PF Σ	PF Σ	Hz	Σ = system
8	W Σ	PF Σ	VA Σ	Hz	Σ = system
9	W dmd	VA dmd	r.t.		r.t.= symbol of communication Rx/Tx on the serial port
10	Wh+ (total)				It depends on the instrument configuration (see also "Energy, gas, water settings")
11	Wh- (total)				
12	Wh (total)				
13	varh (total)				
14	varh L+ (total)				
15	varh L- (total)				
16	varh C+ (total)				
17	varh C- (total)				
18	m3 GAS (day)				
19	m3 GAS (night)				
20	m3 GAS (total)				
21	m3 ACQUA (total)				
22	Wh (tariff 1)				
23	Wh (tariff 2)				
24	Wh (tariff 3)				
25	Wh (tariff 4)				
26	varh (tariff 1)				
27	varh (tariff 2)				
28	varh (tariff 3)				
29	varh (tariff 4)				

Energy, gas, water meter settings

The instrument can be configured with four different ways of management of the meters as explained in the table below.

Set 1 (total)	Set 2 (total and tariffs)	Set 3 (total and gas)	Set 4 (total, gas and water)
Wh+ (total)	Wh (total)	Wh+ (total)	Wh+ (total)
Wh- (total)	varh (total)	Wh- (total)	Wh- (total)
varh C+ (total)	Wh t1 (partial)	varh C+ (total)	varh C+ (total)
varh C- (total)	varh t1 (partial)	varh C- (total)	varh C- (total)
varh L+ (total)	Wh t2 (partial)	varh L+ (total)	varh L+ (total)
varh L- (total)	varh t2 (partial)	varh L- (total)	varh L- (total)
	Wh t3 (partial)	m ³ GAS (day tariff)	m ³ GAS (total)
	varh t3 (partial)	m ³ GAS (night tariff)	m ³ WATER (total)
	Wh t4 (partial)		
	varh t4 (partial)		



Used Calculation Formulas

Phase Variables

Instantaneous effective voltage

$$V_{IN} = \sqrt{\frac{1}{n} \cdot \sum_1^n (V_{IN})_i^2}$$

Instantaneous active power

$$W_1 = \frac{1}{n} \cdot \sum_1^n (V_{IN})_i \cdot (A_1)_i$$

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

$$VA_1 = V_{IN} \cdot A_1$$

Instantaneous reactive power

$$VAR_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

System variables

Equivalent system voltage

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

System reactive power

$$VAR_2 = (VAR_1 + VAR_2 + VAR_3)$$

System active power

$$W_2 = W_1 + W_2 + W_3$$

System apparent power

$$VA_2 = \sqrt{W_2^2 + VAR_2^2}$$

System power factor

$$\cos\phi_2 = \frac{W_2}{VA_2} \quad (\text{TPF})$$

Energy metering

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

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

Where:

i = considered phase (L1, L2 or L3)

P = active power

Q = reactive power

t₁, t₂ = starting and ending time points of consumption recording

n = time unit

Δt = time interval between two successive power consumption

n₁, n₂ = starting and ending discrete time points of consumption recording

The possible module combinations

Base unit	Slot A	Slot B	Slot C	Slot D
RS485 port		●		
Single relay output			●	●
Single open coll. output			●	●
Dual relay output			●	●
Dual open coll. output			●	●
3 digital inputs			●	
3 digital inputs + AUX			●	
Base unit	Slot E			
RS232 port		●		

The available modules

Type	N. of channels	Ordering code
WM24-96 400V L-L 5A (base)		AJ2400
WM24-96 208V L-L 5A (base)		AJ2401
WM24-96 100V L-L 5A (base)		AJ2402
WM24-96 660V L-L 5A (base)		AJ2403
24VAC power supply		AP1025
48VAC power supply		AP1024
115VAC power supply		AP1023
230VAC power supply		AP1022
18-60VAC/DC power supply		AP1021
90-260VAC/DC power supply		AP1020
Relay output	1	AO1058
Relay output	2	AO1035
Open collector output	1	AO1059
Open collector output	2	AO1036
Digital inputs	3	AQ1038
Digital inputs + AUX	3	AQ1042
RS485 serial port (1)	1	AR1034
RS232 serial port (1)	1	AR1039

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

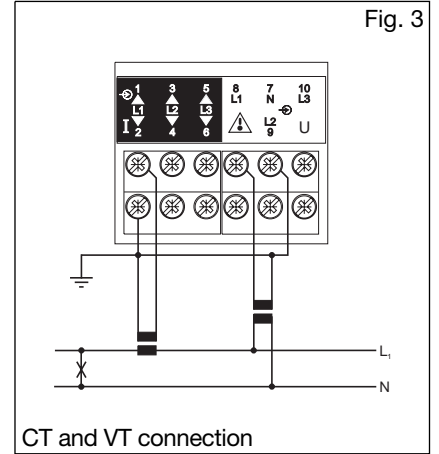
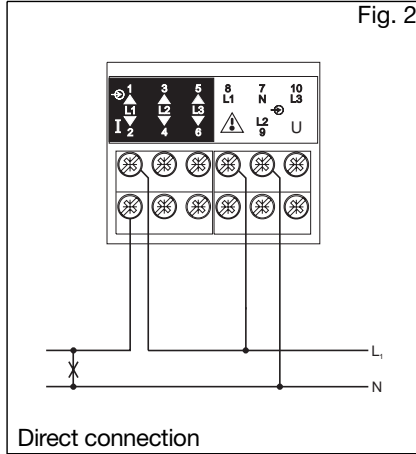
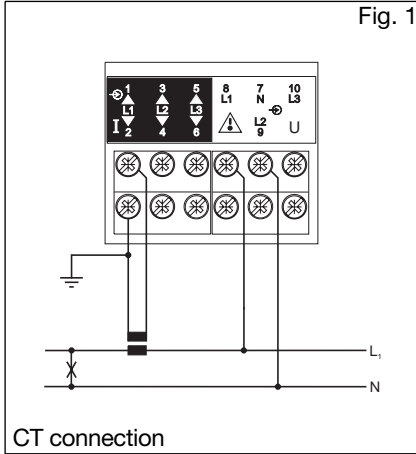
List of the variables that can be connected to:

• Alarm outputs

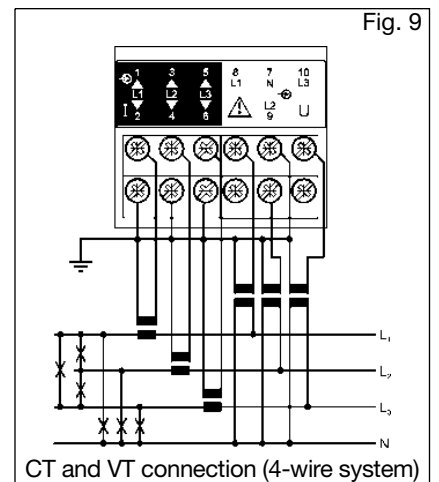
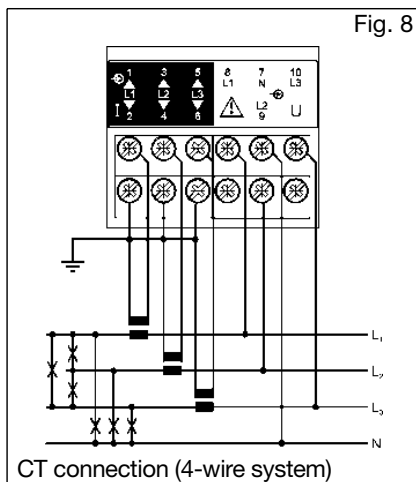
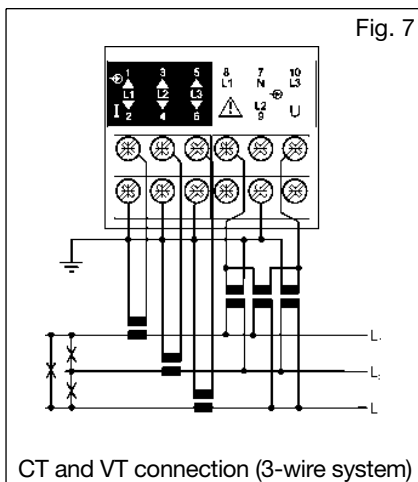
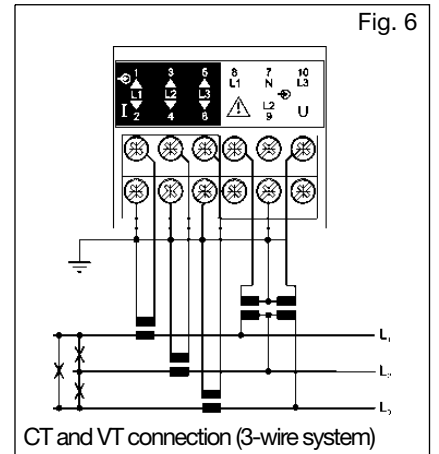
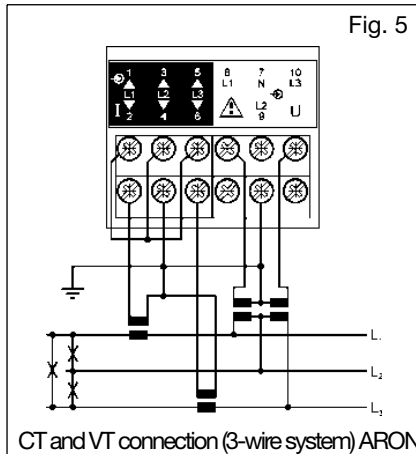
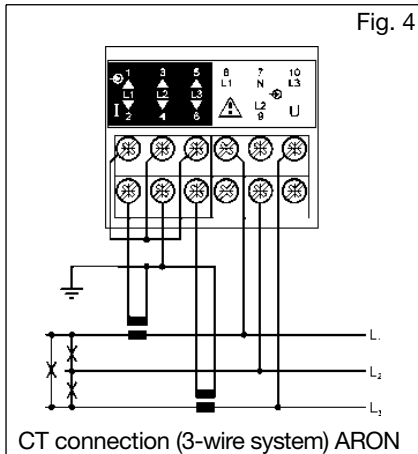
N°	Variable	3-phase + neutral	3-phase no neutral	Note
1	V _{L-N} Σ	x		Σ = system
2	W Σ	x	x	Σ = system
3	var Σ	x	x	Σ = system
4	VA Σ	x	x	Σ = system
5	PF Σ	x	x	Σ = system
6	VA _{dmd}	x	x	
7	W _{dmd}	x	x	
8	ASY	x	x	asymmetry

Wiring Diagrams

Single phase

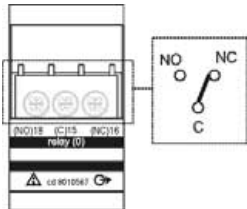


Three-phase - Unbalanced load

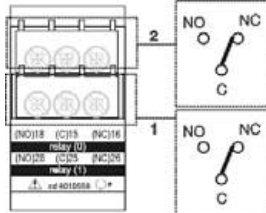




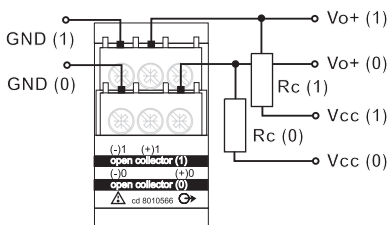
Wiring diagrams (optional modules)



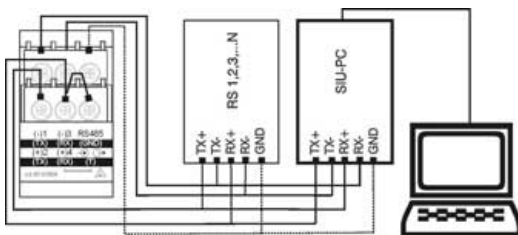
1 relay output



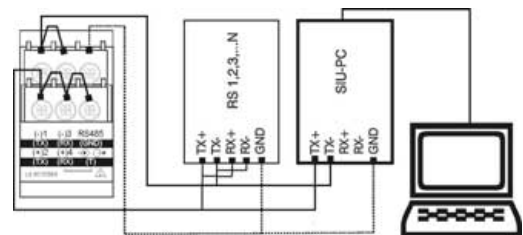
2 relay outputs



Open collector output connection. This wiring diagram is valid also for the open collector module with one output. 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.

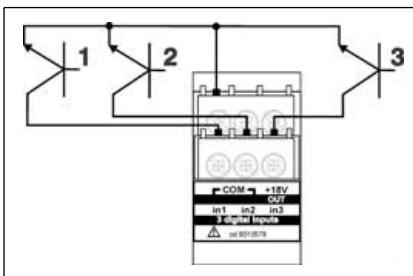


4-wire connection of RS485 serial port



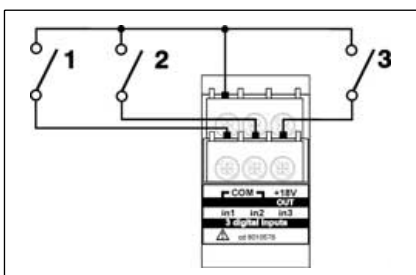
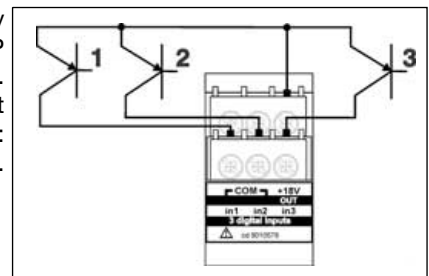
2-wire connection of RS485 serial port

Wiring diagrams: digital input modules



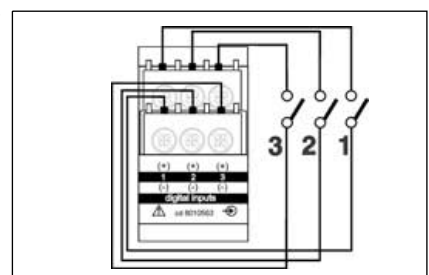
Connection by means of NPN transistors. Digital input module: AQ1042.

Connection by means of PNP transistors. Digital input module: AQ1042.

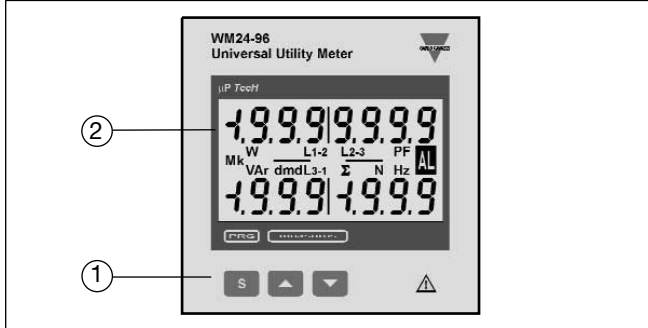


Connection by means of contacts. Digital input module: AQ1042.

Connection by means of contacts. Digital input module: AQ1038.



Front Panel Description



1. Key-pad

The programming of configuration parameters and the display are easily controlled by means of the 3 push buttons:

- "S" to enter into the programming phase and to confirm the password

- ▲ and ▼
- for value programming
- for function selections
- for page scrolling

2. Display

Instantaneous measurements:

- 4x 3 1/2 digit (maximum read-out 1999)

Energies, gas and water:

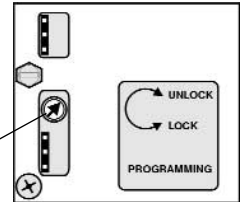
- 1x 7 1/2 digit (maximum read-out 19.999.999).

Alphanumeric indications by means of LCD display for:

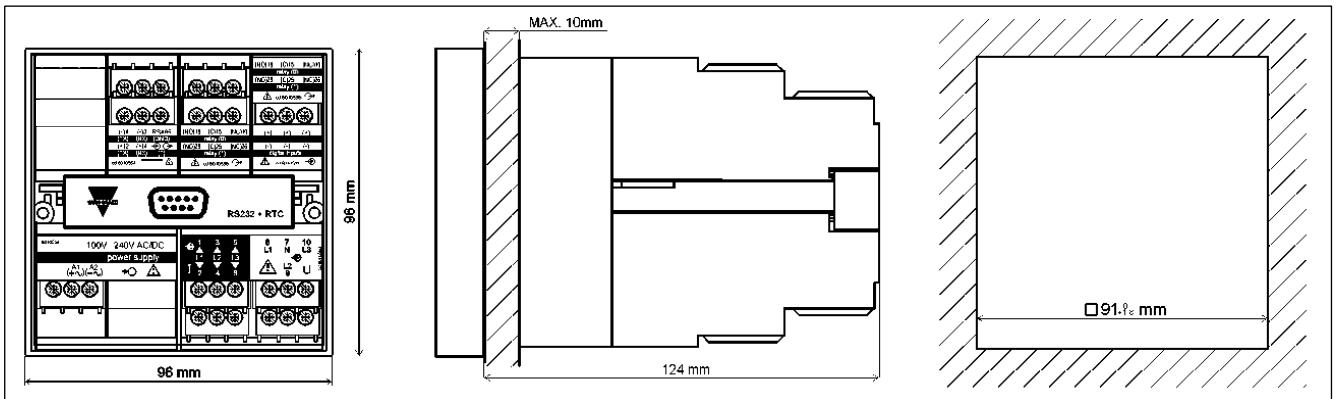
- Displaying configuration parameters
- Displaying all the measured variables.

3. Programming lock

It's possible to lock the programming key-pad by means of a rotary switch located behind the instrument into the power supply slot. Turn counterclockwise the switch to lock the programming key-pad.



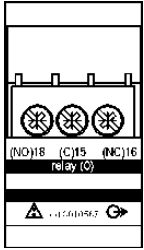
Dimensions



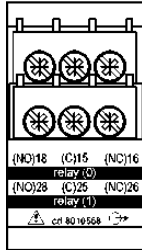


Terminal boards

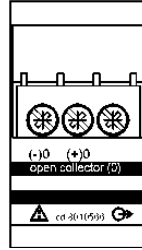
Digital output modules



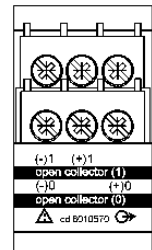
AO1058
Single relay output



AO1035
Dual relay output

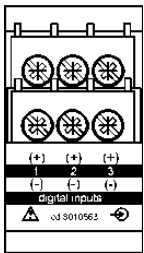


AO1059
Single open collector output

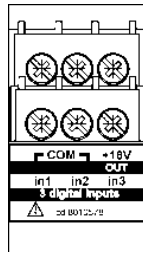


AO1036
Dual open collector output

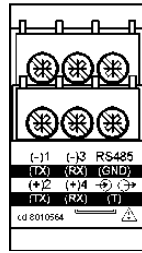
Other input/output modules



AQ1038
3 digital inputs



AQ1042
3 digital inputs + aux

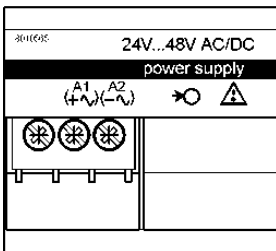


AR1034
RS422/485 communication port



AR1039
RS232 communication port

Power supply modules



- AP1021**
18-60 VAC/DC power supply
- AP1020**
90-260 VAC/DC power supply
- AP1025**
24VAC power supply
- AP1024**
48VAC power supply
- AP1023**
115VCA power supply
- AP1022**
230VCA power supply