

# Energy Management Modular Power Quality Transducer Type PQT-90

CARLO GAVAZZI



- MODBUS RTU, JBUS protocol
- Transmission and reception of SMS messages (variables and alarm status)
- Data transmission and reception by means of analogue modem
- Up to 4 optional pulse outputs
- Up to 4 optional alarm outputs
- Up to 4 optional analogue outputs
- Universal power supply: 18-60VAC/VDC, 90-260 VAC/VDC

## Product Description

Power quality transducer which can be used in 3 different operating modes:

- direct measurements for the power quality analysis (LV or MV/HV connection);
- indirect energy and power measurements by means of watt-hour meters (LV or MV/HV connection);
- direct measurements for the instantaneous variables (LV connection) and indirect measure-

ments for the energy variables (LV or MV/HV).

It's possible to add the management of gas and water metering to all of these working modes.

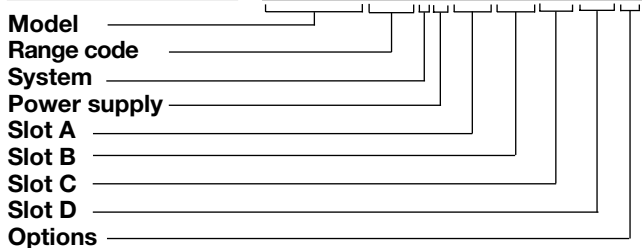
Automatic transmission of SMS alarm messages.

Remote read-out from GSM mobile phones of all the instantaneous variables, the last variables available in the data logging and the energy meters.

- Class 0.5 (current/voltage)
- Universal transducer: energy, water and gas
- 32-bit  $\mu$ P-based multifunction power transducer
- Front size: 90x90 mm
- Measurement of single phase and system instantaneous variables: W, Wdmd, var, var dmd, VA, VA dmd, PF, PF avg,  $V_{LN}$ ,  $V_{LL}$ ,  $A_L$ ,  $A_n$ , Hz, THD (for all measurements max and min values)
- Measured energies: kWh and kvarh on 4 quadrants
- Current and voltage inputs with autoranging capability
- 48 independent energy meters to be used as single, dual, multi-time energy management
- Interface with watt-hour meters by means of digital inputs (+kWh, +kvarh, -kWh, -kvarh)
- Interface with gas and water meters by means of digital inputs (one water meter, two gas meters to be used as single or dual time management)
- Harmonic distortion analysis (FFT) up to the 50th harmonic (current and voltage)
- Harmonics source detection
- Optional RS422/485 serial port
- Optional RS232 + real time clock function and 2Mb data logging of alarms, MIN/MAX events and up to 8 variables with programmable time interval.

## How to order

PQT-90 AV53H XX XX XX XX X



## How to order

PqtSoft Network  
PqtSoft Remote

PqtSoft Network: programm to download memory data and to manage a modem. PqtSoft Remote: programm to set all the programming parameters.

## Type selection

Range code (on request)	Slot A (interfacing cont.)	Slot B (communication)	Slot C (alarm or pulse)
<b>XXX:</b> None	<b>B1:</b> Dual analogue output, 20mADC (standard)	<b>XX:</b> None	<b>XX:</b> None
<b>AV5:</b> 240/415 VAC-1/5 AAC (max. 300 V (L-N)/520 V (L-L) - 6 A)	<b>B2:</b> Dual analogue output, $\pm 5$ mADC <sup>1)</sup>	<b>S1:</b> Serial output, RS485 multidrop, bidirectional	<b>R1:</b> Single relay output (AC1-8AAC, 250VAC)
<b>AV7:</b> 400/690VAC - 1/5 AAC (max. 480V (L-N) / 830 V (L-L) / 6 A)	<b>B3:</b> Dual analogue output, $\pm 10$ mADC <sup>1)</sup>	<b>B1:</b> Dual analogue output, 20mADC (standard)	<b>R2:</b> Dual relay output, (AC1-8AAC, 250VAC)
<b>Power supply</b>	<b>B4:</b> Dual analogue output, $\pm 20$ mADC <sup>1)</sup>	<b>B2:</b> Dual analogue output, $\pm 5$ mADC <sup>1)</sup>	<b>O1:</b> Single open collector output (30V/100mADC)
<b>L:</b> 18 to 60VAC/VDC	<b>V1:</b> Single analogue output, 10VDC (standard)	<b>B3:</b> Dual analogue output, $\pm 10$ mADC <sup>1)</sup>	<b>O2:</b> Dual open collector output (30V/100mADC)
<b>H:</b> 90 to 260VAC/VDC	<b>V2:</b> Single analogue output, $\pm 1$ VDC <sup>1)</sup>	<b>B4:</b> Dual analogue output, $\pm 20$ mADC <sup>1)</sup>	<b>D1:</b> 3 digital inputs for voltage-free contacts
<b>Slot A (interfacing)</b>	<b>V3:</b> Single analogue output, $\pm 5$ VDC <sup>1)</sup>	<b>W1:</b> Dual analogue output, 10VDC (standard)	<b>D2:</b> 3 universal digital inputs + excitation output (16-24VDC)
<b>XX:</b> None	<b>V4:</b> Single analogue output, $\pm 10$ VDC <sup>1)</sup>	<b>W2:</b> Dual analogue output, $\pm 1$ VDC <sup>1)</sup>	<b>Slot D (alarm or pulse)</b>
<b>D2:</b> 3 universal digital inputs + excitation output (16-24VDC)	<b>W1:</b> Dual analogue output, 10VDC (standard)	<b>W3:</b> Dual analogue output, $\pm 5$ VDC <sup>1)</sup>	<b>XX:</b> None
<b>A1:</b> Single analogue output, 20mADC (standard)	<b>W2:</b> Dual analogue output, $\pm 1$ VDC <sup>1)</sup>	<b>W4:</b> Dual analogue output, $\pm 10$ VDC <sup>1)</sup>	<b>R2:</b> Dual relay output, (AC1-8AAC, 250VAC)
<b>A2:</b> Single analogue output, $\pm 5$ mADC <sup>1)</sup>	<b>W3:</b> Dual analogue output, $\pm 5$ VDC <sup>1)</sup>	<b>Options</b>	<b>O2:</b> Dual open collector output (30V/100mADC)
<b>A3:</b> Single analogue output, $\pm 10$ mADC <sup>1)</sup>	<b>W4:</b> Dual analogue output, $\pm 10$ VDC <sup>1)</sup>	<b>X:</b> None	<b>O4:</b> Four open collector output (30V/100mADC)
<b>A4:</b> Single analogue output, $\pm 20$ mADC <sup>1)</sup>	<b>Note:</b> Slot A + Slot B Max 4 analogue outputs.	<b>M:</b> Serial port RS232+RTC+ 2Mb or Data memory to store all events, continuous record up to 8 variables and load profile $W_{dmd}$	
	Slot C + Slot D max 4 digital outputs.		
	<sup>1)</sup> On request		

## Input specifications

<b>Number of analogue inputs</b>			EN61036
Current	1 (1-phase; system code: 3) 3 (3-phase; system code: 3)		Reactive: class 2 according to EN61268
Voltage	1 (1-phase; system code: 3) 4 (3-phase; system code: 3)		Ib: 5A, I <sub>max</sub> : 6A 0.1Ib: 500mA, Start-up current: 20mA U <sub>n</sub> : 240V (AV5), 400V (AV7)
<b>Digital inputs</b>			1% FS (FS: 100%) phase: ±2°; I <sub>min</sub> : 0.1Arms; I <sub>max</sub> : 15Ap; U <sub>min</sub> : 50V <sub>RMS</sub> ; U <sub>max</sub> : 500Vp Sampling frequency: 6400 samples/s @ 50Hz
AQ1038	No. of inputs: 3 (voltage-free)	Harmonic distortion (@ 25°C ± 5°C, R.H. ≤ 60%)	
Purpose	W <sub>dmd</sub> measurement synchronization + var <sub>dmd</sub> and PF <sub>dmd</sub> . Interfacing with watt-hour meters (+kWh, +kvarh). Tariff selection: energy. <8mA/ 17.5 to 25VDC		
Contact measuring current	<8mA/ 17.5 to 25VDC		
AQ1042	Number of inputs: 3 + excitation output	<b>Additional errors</b>	
Purpose	W <sub>dmd</sub> measurement synchronization + var <sub>dmd</sub> and PF <sub>dmd</sub> . Interfacing with watt-hour meters (-kWh, -kvarh) or/and measurements of gas /water m <sup>3</sup> . Tariff selection: energy or GAS. 16V<+Aux<24VDC Max 15mA 15mA	Humidity	≤ 0.3% RDG, 60% to 90% R.H.
Excitation output		Input frequency	≤ 0.4% RDG, 62 to 400 Hz
Contact measuring current		Magnetic field	≤ 0.5% RDG @ 400 A/m
Common characteristics			NOTE: all accuracies are referred to measurements carried out with the analogue input module
Input frequency	Max 20 Hz, dutycycle 50%	<b>Temperature drift</b>	≤ 200ppm/°C
Close contact resistance	Max 1kΩ	<b>Sampling rate</b>	6400 samples/s @ 50Hz
Open contact resistance	Min 100kΩ	<b>Measurements</b>	Current, voltage, power, energy, power factor, frequency, harmonic distortion (see "Display Pages"). TRMS measurement of a distorted wave (voltage/current) .
Insulation	4000VRMS		Direct.
Max. input number	6 in the configuration: AQ1038+AQ1042 or 2* AQ1042	Coupling type	≤ 3, max. 15Ap/500Vp "AV5" (L-N), 15Ap/800Vp "AV7" (L-N)
<b>Accuracy</b> (display, RS232, RS485)	In: 5A, I <sub>f.s.</sub> : 6A V <sub>n</sub> : 240VL-N, V <sub>f.s.</sub> : 300VL-N	Crest factor	
Current (A <sub>L1</sub> , A <sub>L2</sub> , A <sub>L3</sub> ) (@ 25°C ± 5°C, R.H. ≤ 60%)	±0.5% RDG (0.2 to 1.2 In) ±5mA (0.02 to 0.2 In)	<b>Ranges (impedances)</b>	
Current (A <sub>n</sub> ) @ 40 to 100 Hz	±1% RDG (0.2 to 1.2 In)	AV5	58/100 V (> 500 kΩ) - 1 AAC (≤ 0.3 VA) 58/100 V (> 500 kΩ) - 5 AAC (≤ 0.3 VA) 240 V/415 V (> 500 kΩ) - 1 AAC (≤ 0.3 VA) 240 V/415 V (> 500 kΩ) - 5 AAC (≤ 0.3 VA)
Voltage range AV5: range AV7: (@ 25°C ± 5°C, R.H. ≤ 60%)	±0.5% RDG (from 48 to 300V <sub>L-N</sub> ) ±0.5% RDG (from 80 to 480V <sub>L-N</sub> ) Includes also: frequency, power supply and output load influences	AV7	100/170 V (> 500 kΩ) - 1 AAC (≤ 0.3 VA) 100/170 V (> 500 kΩ) - 5 AAC (≤ 0.3 VA) 400/690 V (> 500 kΩ) - 1 AAC (≤ 0.3 VA) 400/690 V (> 500 kΩ) - 5 AAC (≤ 0.3 VA)
Frequency	±0.1% RDG (40 to 440 Hz)	<b>Frequency</b>	40 to 440 Hz
Active power (@ 25°C ± 5°C, R.H. ≤ 60%)	±0.5% (RDG + FS) (PF 0.5 L/C, 0.1 to 1.2 In, range AV5) or ±1% RDG (PF 0.5 L/C, 0.1 to 1.2 In, range AV5)	<b>Overload protection</b>	
Reactive power (@ 25°C ± 5°C, R.H. ≤ 60%)	±0.5% (RDG + FS) (PF 0.5 L/C, 0.1 to 1.2 In, range AV5) or ±1% RDG (PF 0.5 L/C, 0.1 to 1.2 In, range AV5)	Continuous: voltage/current:	AV5: 300V <sub>L-N</sub> / 500V <sub>L-L</sub> / 6A AV7: 480V <sub>L-N</sub> / 830V <sub>L-L</sub> / 6A
Apparent power (@ 25°C ± 5°C, R.H. ≤ 60%)	±0.5% (RDG + FS) (0.1 to 1.2 In, range AV5) or ±1% RDG (0.1 to 1.2 In, range AV5)	For 1s: voltage/current:	AV5: 600V <sub>L-N</sub> /1040V <sub>L-L</sub> /120A AV7: 960V <sub>L-N</sub> /1660V <sub>L-L</sub> /120A
Energies (@ 25°C ± 5°C, R.H. ≤ 60%)	Active: class 1 according to		

## Output Specifications

### Analogue outputs (on request)

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

## Output specifications (cont.)

Scaling factor	Programmable within the whole range of retransmission; it allows the retransmission management of all values from: 0 to 20 mADC, 0 to $\pm 20$ 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	Protocol Other features	MODBUS RTU (JBUS) As per RS422/485
Variables to be retransmitted	All (see table "List of the variables that can be connected to:"...)	<b>Communication by modem</b> Analogue modem	For the remote communication of all the data measured and managed by PQT. External communication Modem. Recommended type: US Robotics
Response time	$\leq 200$ ms typical (filter excluded, FFT excluded 3 1/2 dgt indication)	GSM Modem	For the transmission of SMS messages: alarms, instantaneous variables, last available variables of data logging (only average values) and energy meters. The alarm messages are given with the date and the time of the event. The type and value of the set-point can be put into the alarm message (max 99 characters). The alarms can also be transmitted automatically, while the variables can be recalled by means of special SMS question codes.
Ripple	$\leq 1\%$ according to IEC 60688-1 and EN 60688-1	GSM kit type-tested for PQT	Siemens kit (external) model "TC35 TERMINAL" included GSM module, antenna and 230V power supply.
Temperature drift	200 ppm/ $^{\circ}$ C		
Load:			
20 mA output	$\leq 600 \Omega$		
$\pm 20$ mA output	$\leq 550 \Omega$		
$\pm 10$ mA output	$\leq 1100 \Omega$		
$\pm 5$ mA output	$\leq 2200 \Omega$		
10 V output	$\geq 10 \text{ k}\Omega$		
$\pm 10$ V output	$\geq 10 \text{ k}\Omega$		
$\pm 5$ V output	$\geq 10 \text{ k}\Omega$		
$\pm 1$ V output	$\geq 10 \text{ k}\Omega$		
Insulation	By means of optocouplers, 4000V <sub>rms</sub> output to measuring input 4000V <sub>rms</sub> output to supply input		
<b>RS422/RS485 (on request)</b>		<b>Digital outputs (on request)</b>	To be used as alarms and/or retransmission of the energy metering and/or outputs remotely controlled by the serial communication port. The outputs are completely programmable independently of the type of module being used.
Connections	Multidrop bidirectional (static and dynamic variables) 2 or 4 wires, max. distance 1200m, termination directly on the module		
Addresses	from 1 to 255, key-pad selectable		
Protocol	MODBUS RTU/JBUS		
Data (bidirectional)		<b>Pulse outputs (on request)</b>	
Dynamic (reading only)	All variables, see also the table, "List of the connected variables".	Number of outputs	Up to 4
Static (writing only)	All configuration parameters energy reset, activation of digital outputs.	Type	From 1 to 1000 pulses programmable for k-M-G Wh, k-M-G varh, open collector (NPN transistor) V <sub>ON</sub> 1.2 VDC/ max. 100 mA V <sub>OFF</sub> 30 VDC max.
Data format	1 start bit, 8 data bit, no parity/even parity/odd parity, 1 stop bit	Pulse duration	Outputs connectable to total and/or partial energy meters 220 ms (ON), $\geq 220$ ms (OFF) According to DIN43864
Baud rate	9600 bit/s	Insulation	By means of optocouplers, 4000 V <sub>RMS</sub> output to measuring inputs, 4000 V <sub>RMS</sub> output to power supply input.
Insulation	By means of optocouplers, 4000 V <sub>RMS</sub> output to measuring inputs 4000 V <sub>RMS</sub> output to power supply input	Notes	The outputs can be either open collector type or relay type (for the relay output refer to the specifications described in the "alarm outputs" section).
<b>RS232 (on request)</b>			
Connections	Bidirectional (static and dynamic variables) 3 wires, max. distance 15m		
Data format	1 start bit, 8 data bit, no parity, 1 stop bit		
Baud rate	9600, 38400 bit/s		



## Output specifications (cont.)

<b>Alarm outputs (on request)</b>			
Number of set-points	Up to 4, independent	Min. response time	DC 12-5A, 24VDC AC 15-2.5A, 250VAC DC 13-2.5A, 24VDC ≤ 150 ms, filters excluded, FFT excluded, setpoint on-time delay: "0s"
Alarm type	Up alarm, down alarm with or without latch, phase asymmetry, phase loss, neutral loss.		
Monitoring of the variable	All the variables listed at the paragraph "List of the connectable variables".	Insulation	4000 V <sub>RMS</sub> output to measuring input, 4000 V <sub>RMS</sub> output to power supply input.
Set-point adjustment	0 to 100% of the electrical scale	Notes	The outputs can be either relay type or open collector type (for this latter one, see the specifications mentioned in the pulse outputs)
Hysteresis	0 to 100% of the electrical scale		
On-time delay	0 to 255 s		
Relay status	Selectable: normally de-energized or normally energized		
Output type	Relay, SPDT AC 1-8A, 250VAC		

## Software functions

<b>Operating mode selection</b>	<ul style="list-style-type: none"> <li>- Direct measurements for the power quality analysis (LV or MV/HV connection);</li> <li>- Indirect energy and power measurements by means of watt-hour meters (LV or MV/HV connection);</li> <li>- Direct measurements for the instantaneous variables (LV connection) and indirect measurements for the energy variables (LV or MV/HV). It's possible to add the management of gas and water metering to all of these working modes.</li> </ul>	Sampling management	Only for data logger. The sample stored within the selected time interval results from the continuous average of the measured values. The average is calculated (min. sample) with an interval within two following measurements of approx. 200 ms. The variables, up to 8 can be stored as average value, minimum and maximum instantaneous values. Minimum is intended as lowest value among those sampled in the programmed time interval. Maximum is intended as highest value among those sampled in the programmed time interval. See "The working mode of data logging".
<b>Pulse weight</b>	Water/gas meter inputs: selectable from 1 to 1000 pulses/m <sup>3</sup> , energy from 1 to 1000.00 imp/kWh/kvarh		
<b>Transformer ratio</b>	Up to 6000 (CT up to 30kA) Up to 6000 (VT up to 600kV)	Data management type: Memory size Battery life	FIFO 2Mb 10 years
<b>Filters</b>		<b>Data logger function</b>	The data are stored at time intervals from 1 to 60 min.; up to 8 instantaneous variables can be selected.
Filter operating range	0 to 99.9% of the input electrical scale.	Historical data storing time	Two different data logger function can be selected: - average calculation within the programmed time interval. - Minimum, maximum values and average calculation
Filtering coefficient	1 to 255		
Filter action	Display, alarms, serial outputs (fundamental variables: V, A, W and their derived ones).		
<b>Event logging</b>			
Type of data	Only with RS232+RTC module+ Data memory Alarms and max./min. (max. 480 events) stored with date (dd:mm:yy) and hour (hh:mm:ss) reference, data logger.		



## Software functions (cont.)

Data format	tion within the programmed time interval. See the "Historical data storing time" table. date: day, month time: hours, minutes, seconds, type of stored variable variable value.	<b>Load profile</b>  Historical data storing time  Data format	Storage at time intervals of 5-10-15-20-30 min of Wdmd. 30 weeks: with recording interval of 5min. 90 weeks: with storing interval of 15min. Wdmd variable value, minutes, seconds, day, month.
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## PqtSoft software: parameter programming and memory data transfer

<b>PqtSoft Network</b>	English language software to transfer memory data and write messages to be coupled to the SMS alarms, plus modem communication management. The program runs under Windows /95/98/98SE/2000/NT/XP.	Data Transfer  Modem communication	energy, gas, water variables are stored into two separated files. Manual or automatic at programmable timings. Phone book management (save up to 100 numbers). Each number is associated to a modem that corresponds either to the single instrument or to a network of instruments. Each network can manage up to 10 local instruments.
Working mode	Three different working modes can be selected: - management of a local RS485 network; - management of modem communication from a single instrument to PC (data download); - management of modem communication from local networks (RS485 communication) to a common PC (data download). In pre-formatted XLS files (Excel data base). The instantaneous and the	<b>PqtSoft Remote</b>	English language software to program the working parameters of the transducer The program runs under Windows 95/98/98SE/2000/NT/XP.
Data Storing		<b>Data access</b>	By means of RS232 serial port to be coupled to a GSM or analogue modem or RS485 port (also multi-drop availability).

## General Specifications

<b>Operating Temperature</b>	0 to +50°C (32 to 122°F) (R.H. < 90% non-condensing)	<b>Product</b>	Energy measurements: EN61036, EN61268. DIN43864
<b>Storage temperature</b>	-10 to +60°C (14 to 140°F) (R.H. < 90% non-condensing)	Pulse output	
<b>Insulation reference voltage</b>	300 V <sub>RMS</sub> to ground (AV5 input)	<b>Approvals</b>	CE UL and CSA
<b>Insulation</b>	4000 V <sub>RMS</sub> between all inputs/outputs to ground	<b>Connector</b>	Screw-type max. 2.5 mm <sup>2</sup> wires (2x 1.5mm <sup>2</sup> )
<b>Dielectric strength</b>	4000 V <sub>RMS</sub> for 1 minute	<b>Housing</b>	
<b>Noise Rejection</b>		Dimensions	90x90x140 mm
CMRR	100 dB, 48 to 62 Hz	Material	ABS, self-extinguishing: UL 94 V-0
<b>EMC</b>	EN 50081-2, EN 50082-2	<b>Protection degree</b>	Front: IP20
<b>Other standards</b>		<b>Weight</b>	Approx. 600 g (packing included)
Safety	IEC 61010-1, EN 61010-1		



## Supply specifications

<b>AC/DC voltage</b>	90 to 260V (standard) 18 to 60V (on request)	<b>Power consumption</b>	≤ 30VA/12W (90 to 260V) ≤ 20VA/12W (18 to 60V)
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## Harmonic distortion analysis

<b>Analysis principle</b>	FFT		harmonic of “I” of the same order. According to the value of the electrical angle, it is possible to know if the distortion is absorbed or generated. Note: if the system has 3 wires the angle cannot be measured.
<b>Harmonic measurement</b> Current Voltage	Up to the 50 <sup>th</sup> harmonic Up to the 50 <sup>th</sup> harmonic		
<b>Type of harmonics</b>	THD (VL1) THD odd (VL1) THD even (VL1) The same for the other phases: L2, L3. THD (AL1) THD odd (AL1) THD even (AL1) The same for the other phases: L2, L3.	<b>Harmonic details</b>	THD % / RMS value THD even % / RMS value THD odd % / RMS value single harmonics in % / RMS value
<b>Harmonic phase angle</b>	The instrument measures the angle between the single harmonic of “V” and the single	<b>System</b>	The harmonic distortion can be measured in single-phase, 3-wire or 4-wire systems. Tw: 0.02

## Time period management (energy, water and gas metering)

<b>Time periods</b>	Energy Selectable: single time, dual time and multi-time	<b>Energy metering recording</b>	Energy consumption history, recording of energy metering by months, oldest data: 2 months before current date. Recording of total and partial energy metering. Energy metering recording (EEPROM) Max.999,999,999.99 kWh/kvarh.
<b>Single time</b> Number of meters	Energy, water, gas Total: 4 (kWh+/kvar+) from 0.00 to 999,999,999.99 (no partial meters) (kWh-/kvar-) from 0.00 to -999,999,999.99	<b>Management concept (multi-time)</b> (a) $+Wh, +varh (-Wh, -varh)^*$ ↓ max. 4 (b) <b>Time period (24 hours)</b> ↓ max. 3 (c) <b>Season (12 months)</b> ↓ <b>Partial: up to 48 meters (a x b x c)</b> ↓ <b>Total: up to 4 meters (“a” type)</b>	
<b>Dual time</b> Number of meters	Energy, gas Total/partial: 4 (kWh+/kvar+) from 0.00 to 999,999,999.99 (kWh-/kvar-) from 0.00 to -999,999,999.99		
Time periods	2, programmable within 24 hours		
<b>Multi-time</b> Number of meters	Energy Total: 4; partial: 48 (kWh+/kvar+) from 0.00 to 999,999,999.99 (kWh-/kvar-) from 0.00 to -999,999,999.99		
Time periods	4, programmable within 24 hours		
Time seasons	3, programmable within 12 months;		
<b>Pulse output</b>	Connectable to total and/or partial meters (dual time, multi-time periods)		

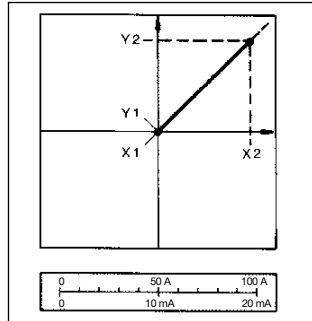
\* Only if measuring analogue inputs are present.

## Function Description

**Input and output scaling capability.** Working of the analogue outputs (y) versus input variables (x)

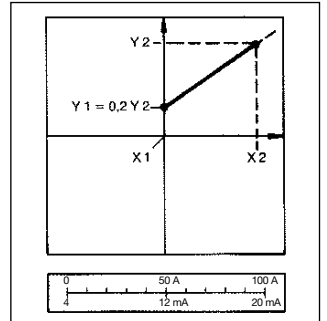
**Figure A**

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



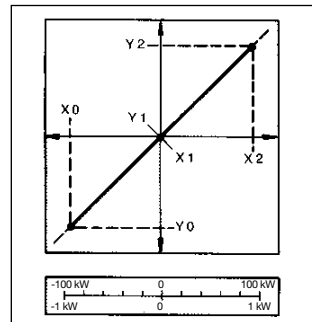
**Figure D**

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



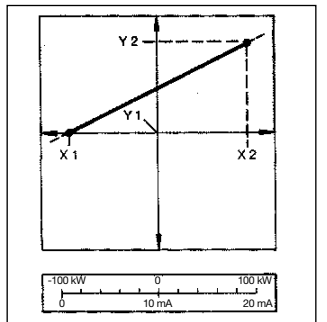
**Figure B**

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



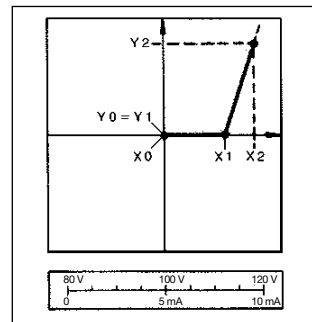
**Figure E**

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



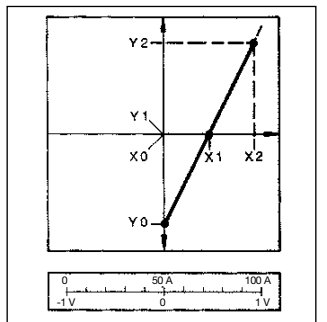
**Figure C**

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



**Figure F**

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



### Used calculation formulas

#### Phase variables

Instantaneous effective voltage

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

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

$$A_1 = \sqrt{\frac{1}{n} \cdot \sum_1^n (A_1)^2}$$

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 three-phase voltage

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

Three-phase reactive power

$$VAR_{\Sigma} = (VAR_1 + VAR_2 + VAR_3)$$

Neutral current

$$A_n = \overline{A_{L1}} + \overline{A_{L2}} + \overline{A_{L3}}$$

Three-phase active power

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

Three-phase apparent power

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

Three-phase power factor

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

Total harmonic distortion

$$THD_1 = \frac{\sqrt{\sum_{n=2}^{\infty} T_{1,n}^2}}{T_{1,1}}$$

Where:

i = considered phase (L1, L2 or L3)

T = considered variable (V or A)

n = harmonic order

#### Energy metering

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

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

Where:

i = considered phase (L1, L2 or L3)

P = active power

Q = reactive power

$t_1, t_2$  = starting and ending time points of consumption recording

n = time unit

$\Delta t$  = time interval between two successive power consumptions

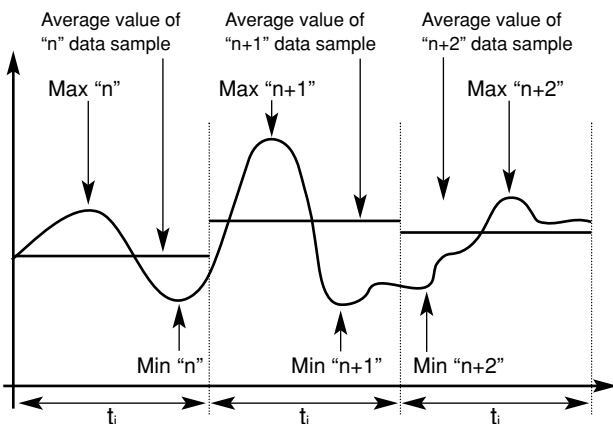
$n_1, n_2$  = starting and ending discrete time points of consumption recording



## Historical data storing time table

Average values only	2 Selected variables			4 Selected variables			6 Selected variables			8 Selected variables		
	Data storing time			Data storing time			Data storing time			Data storing time		
Time interval (minutes)	DAYS	WEEK	YEARS	DAYS	WEEK	YEARS	DAYS	WEEK	YEARS	DAYS	WEEK	YEARS
1	122	17	-	81	12	-	61	9	-	49	7	-
5	610	87	1.7	407	58	1.1	305	44	-	244	35	-
10	-	174	3.4	814	116	2.2	610	87	1.7	488	70	1.3
15	-	262	5.0	-	174	3.4	915	131	2.5	732	105	2
20	-	349	6.7	-	232	4.5	-	174	3.4	976	139	2.7
25	-	436	8.4	-	291	5.6	-	218	4.2	-	174	3.4
30	-	523	10.1	-	349	6.7	-	262	5	-	209	4
35	-	610	11.7	-	407	7.8	-	305	5.9	-	244	4.7
40	-	697	13.4	-	465	8.9	-	349	6.7	-	279	5.4
45	-	785	15.1	-	523	10.1	-	392	7.5	-	314	6
50	-	872	16.8	-	581	11.2	-	436	8.4	-	349	6.7
55	-	959	18.4	-	639	12.3	-	479	9.2	-	384	7.4
60	-	-	20.1	-	697	13.4	-	523	10.1	-	418	8
Average + Min + Max values												
1	73	10	-	43	6	-	31	4	-	24	3	-
5	365	52	1	215	31	-	153	22	-	118	17	-
10	732	104	2	431	62	1.2	305	44	-	236	34	-
15	-	156	3	646	92	1.8	458	65	1.3	354	51	1
20	-	208	4	861	123	2.4	610	87	1.7	472	67	1.3
25	-	262	5	-	154	3	763	109	2.1	591	84	1.6
30	-	314	6	-	185	3.5	915	131	2.5	709	101	1.9
35	-	366	7	-	215	4.1	-	153	2.9	827	118	2.3
40	-	418	8	-	246	4.7	-	174	3.4	945	135	2.6
45	-	471	9.1	-	277	5.3	-	196	3.8	-	152	2.9
50	-	523	10.1	-	308	5.9	-	218	4.2	-	169	3.2
55	-	575	11.1	-	338	6.5	-	240	4.6	-	186	3.6
60	-	628	12.1	-	369	7.1	-	262	5	-	202	3.9

### The working mode of data logging



$t_i$  = time interval (programmable from 1 to 60 minutes)

### The PqtSoft network potential

Download data files from PQT to PC

Type of Network	No. of Network	No. of PQT	Port	Local Accessory	PC Accessory	User	◆
Local	1	1	AR1041 (RS232)	None	None	PC	A
Local	1	255	AR1041 AR1034	None	SIU-PC	PC	B
Remote	100	1	AR1041 (RS232)	Analogue modem	Analogue modem	PC	A
Remote	100	1	AR1041 (RS232)	GSM modem	Analogue modem	PC	C
Remote	100	255	AR1041 AR1034 (RS485)	SIU-PC+ analogue modem	Analogue modem	PC	B
Remote	100	255	AR1041 AR1034 (RS485)	SIU-PC+ GSM modem	Analogue modem	PC	B

◆ **Notes:**

- A- Only data download
- B- Data download. Each AR1041 can be connected to a GSM modem in order to manage the SMS messages.
- C- The PQT can be set to manage the data download or to manage SMS messages.

## List of the variables that can be connected to:

- Max./Min. variable detection
- Alarm outputs
- Analogue outputs

No	Variable	1-phase system	3-ph. 4-wire balanced sys.	3-ph. 4-wire unbal. sys.	3 ph. 3-wire bal. sys.	3 ph. 3-wire unbal. sys.	meas. module not available	Notes
1	V L1	x	x	x	o	o	o	
2	V L2	o	x	x	o	o	o	
3	V L3	o	x	x	o	o	o	
4	V L-N sys	o	x	x	o	o	o	Σ Sys = system = Σ
5	V L1-2	o	x	x	x	x	o	
6	V L2-3	o	x	x	x	x	o	
7	V L3-1	o	x	x	x	x	o	
8	V L-L sys	o	x	x	x	x	o	Σ Sys = system = Σ
9	A L1	x	x	x	x	x	o	
10	A L2	o	x	x	x	x	o	
11	A L3	o	x	x	x	x	o	
12	An	o	x	x	x	x	o	
13	W L1	x	x	x	o	o	o	
14	W L2	o	x	x	o	o	o	
15	W L3	o	x	x	o	o	o	
16	W sys	o	x	x	x	x	o	Σ Sys = system = Σ
17	var L1	x	x	x	o	o	o	
18	var L2	o	x	x	o	o	o	
19	var L3	o	x	x	o	o	o	
20	var sys	o	x	x	x	x	o	Σ Sys = system = Σ
21	VA L1	x	x	x	o	o	o	
22	VA L2	o	x	x	o	o	o	
23	VA L3	o	x	x	o	o	o	
24	VA sys	o	x	x	x	x	o	Σ Sys = system = Σ
25	PF L1	x	x	x	o	o	o	
26	PF L2	o	x	x	o	o	o	
27	PF L3	o	x	x	o	o	o	
28	PF sys	o	x	x	x	x	o	Σ Sys = system = Σ
29	Hz	x	x	x	x	x	o	
30	THD V1	x	x	x	x	x	o	FFT V1-A1 ON
31	THDo V1	x	x	x	x	x	o	FFT V1-A1 ON
32	THDe V1	x	x	x	x	x	o	FFT V1-A1 ON
33	THD V2	o	x	x	x	x	o	FFT V2-A2 ON
34	THDo V2	o	x	x	x	x	o	FFT V2-A2 ON
35	THDe V2	o	x	x	x	x	o	FFT V2-A2 ON
36	THD V3	o	x	x	x	x	o	FFT V3-A3 ON
37	THDo V3	o	x	x	x	x	o	FFT V3-A3 ON
38	THDe V3	o	x	x	x	x	o	FFT V3-A3 ON
39	THD A1	x	x	x	x	x	o	FFT V1-A1 ON
40	THDo A1	x	x	x	x	x	o	FFT V1-A1 ON
41	THDe A1	x	x	x	x	x	o	FFT V1-A1 ON
42	THD A2	o	x	x	x	x	o	FFT V2-A2 ON
43	THDo A2	o	x	x	x	x	o	FFT V2-A2 ON
44	THDe A2	o	x	x	x	x	o	FFT V2-A2 ON
45	THD A3	o	x	x	x	x	o	FFT V3-A3 ON
46	THDo A3	o	x	x	x	x	o	FFT V3-A3 ON
47	THDe A3	o	x	x	x	x	o	FFT V3-A3 ON
48	VA dmd	x	x	x	x	x	x	
49	PF avg	x	x	x	x	x	x	
50	W dmd	x	x	x	x	x	x	◆
51	var dmd	x	x	x	x	x	x	
52	ASY	o	x	x	x	x	o	

(x) = available (o) = not available

◆ Notes: the alarm outputs can be connected to Wdmd total and/or Wdmd tariff1, Wdmd tariff2, Wdmd tariff3, Wdmd tariff4.

## The available modules

Type	N. of channels	Ordering code
PQT-90 base		AD1047
AV5.3 measuring inputs		AQ1018
AV7.3 measuring inputs		AQ1019
18-60VAC/DC power supply		AP1021
90-260VAC/DC power supply		AP1020
20mADC analogue output	1	AO1050
10VDC analogue output	1	AO1051
±5mADC analogue output	1	AO1052
±10mADC analogue output	1	AO1053
±20mADC analogue output	1	AO1054
±1VDC analogue output	1	AO1055
±5VDC analogue output	1	AO1056
±10VDC analogue output	1	AO1057
20mADC analogue output	2	AO1026
10VDC analogue output	2	AO1027
±5mADC analogue output	2	AO1028
±10mADC analogue output	2	AO1029
±20mADC analogue output	2	AO1030
±1VDC analogue output	2	AO1031
±5VDC analogue output	2	AO1032
±10VDC analogue output	2	AO1033
RS485 port	1	AR1034
Relay output	1	AO1058
Relay output	2	AO1035
Open collector output	1	AO1059
Open collector output	2	AO1036
Open collector output	4	AO1037
Digital inputs	3	AQ1038
Digital inputs + AUX	3	AQ1042
RS232 port + RTC +2MB data memory (1)	1	AR1041

## The possible module combinations

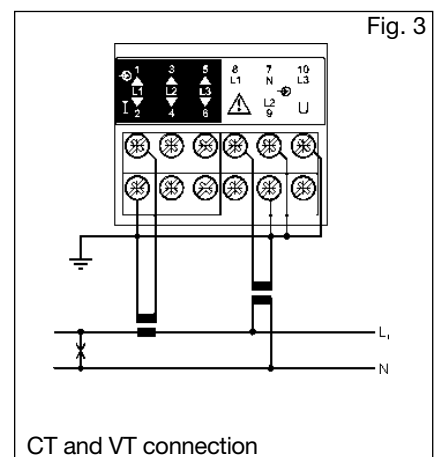
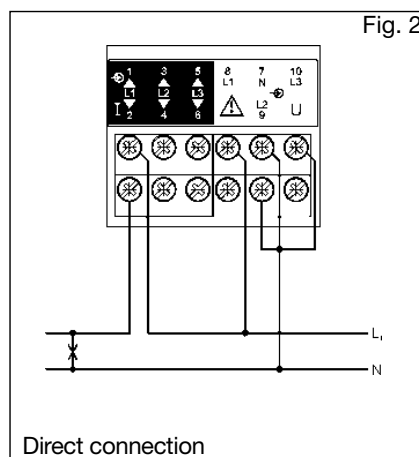
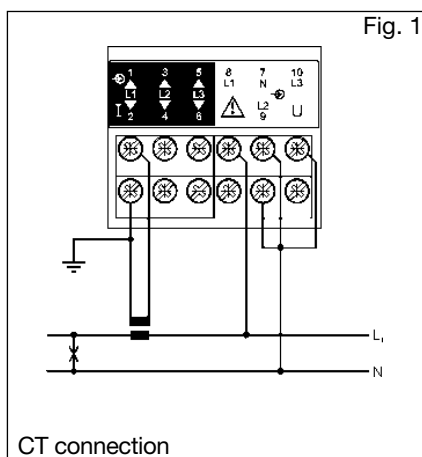
Basic unit	Slot A	Slot B	Slot C	Slot D
Single analogue output	●			
Dual analogue output	●	●		
RS485 port		●		
Single relay output (*)			●	
Single open collector out (*)			●	
Dual relay output (*)			●	●
Dual open coll. out (*)			●	●
4 open coll. output (*)				●
3 digital inputs			●	
3 digital inputs +aux	●		●	
Basic unit	Slot E			
RS232 port + RTC + 2MB data memory		●		

(\*) Alarm or pulse.

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

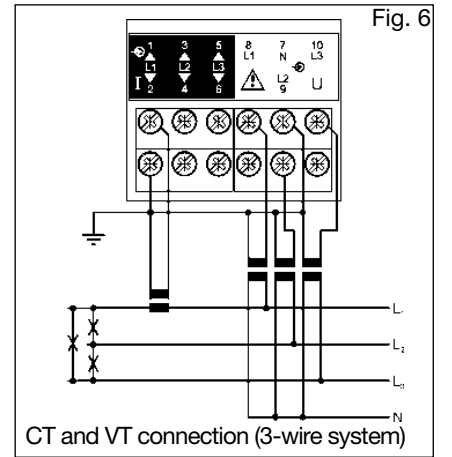
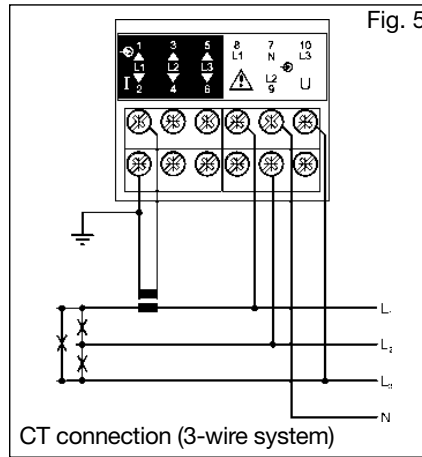
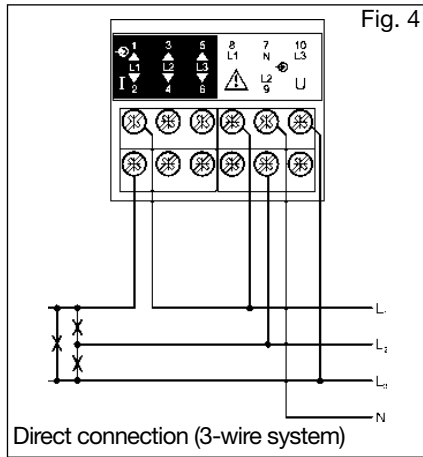
## Wiring diagrams

### Single phase input connections

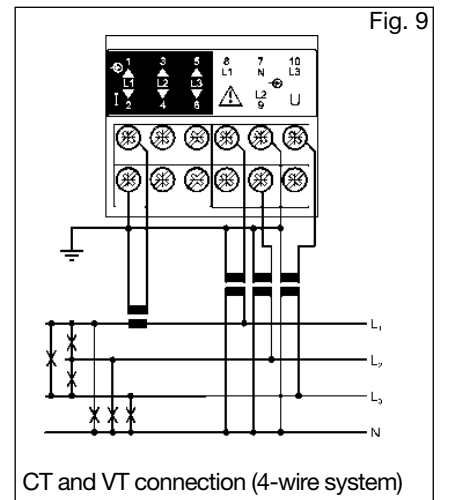
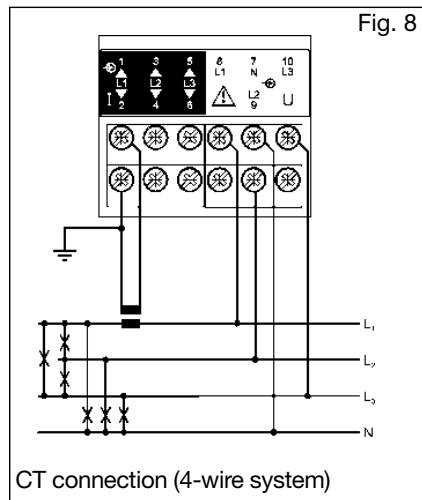
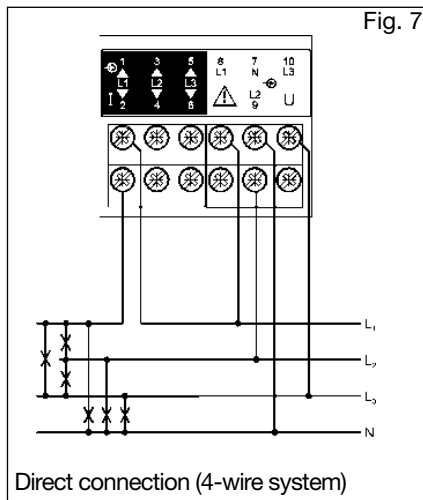


## Wiring diagrams (cont.)

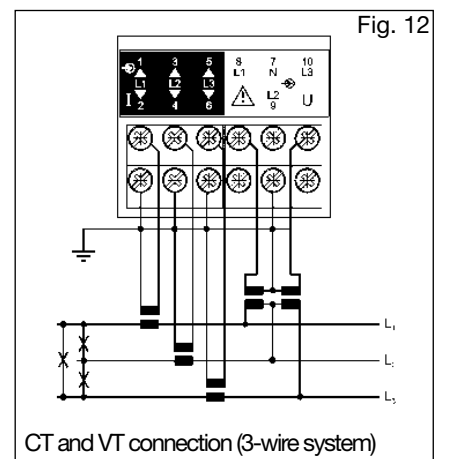
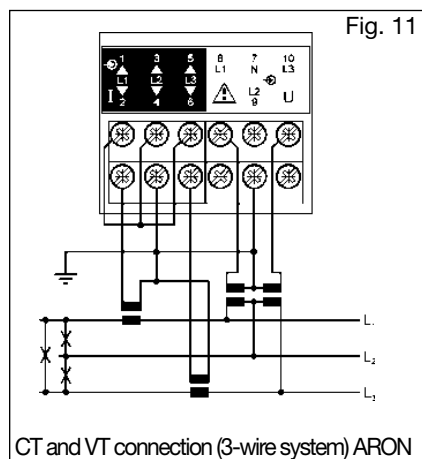
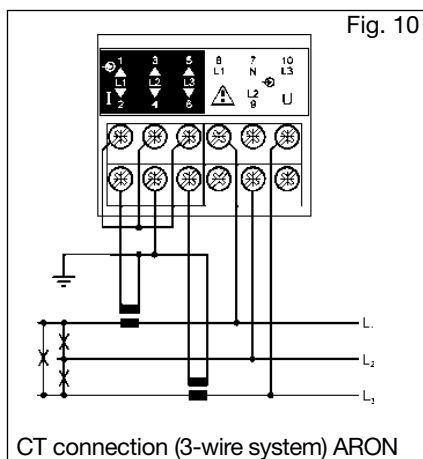
### Three-phase, three-wire input connections - Balanced load



### Three-phase, four-wire input connections - Balanced load

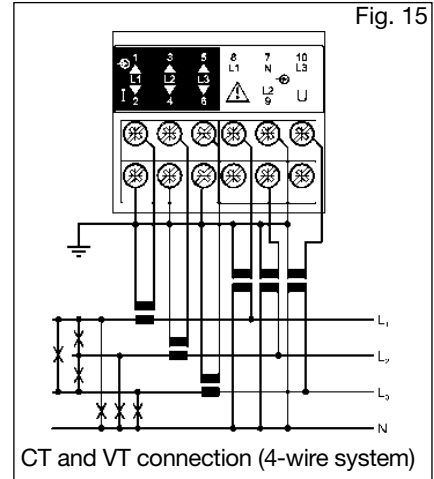
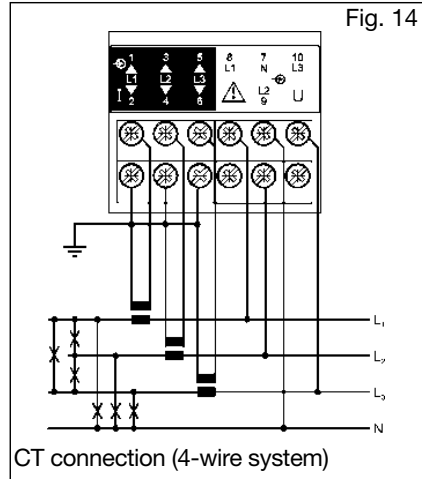
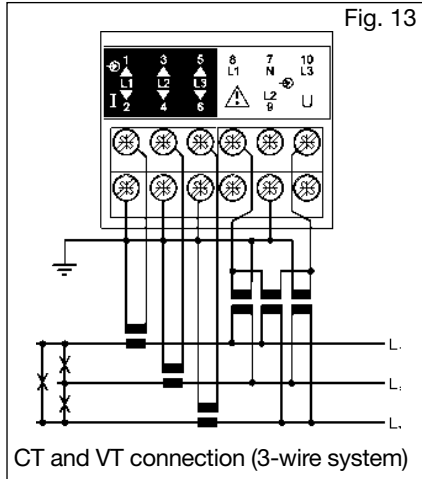


### Three-phase, three-wire input connections - Unbalanced load

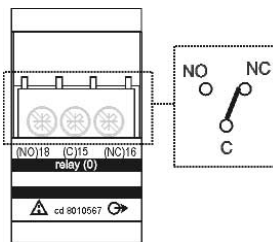
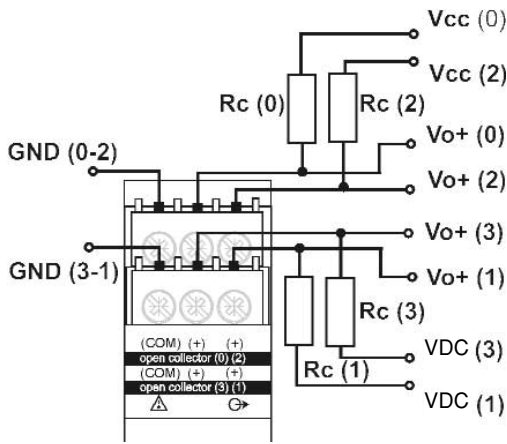


## Wiring diagrams (cont.)

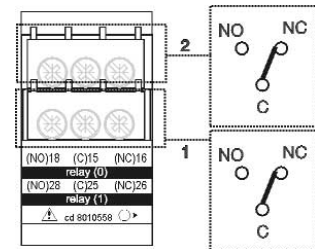
Three-phase, three and four-wires input connections - Unbalanced load



## Wiring diagrams of optional modules



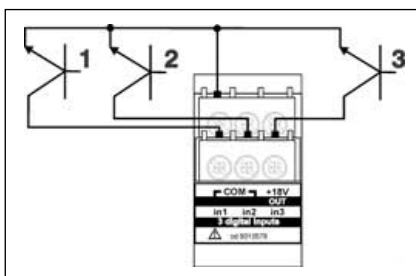
AO1058 1 relay output



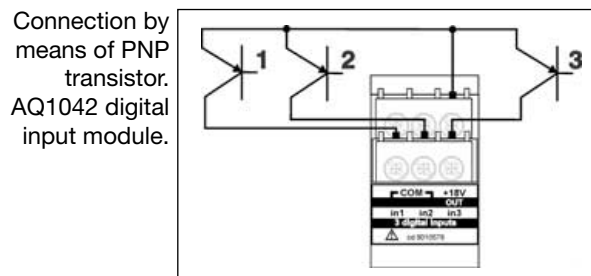
AO1035 2 relay outputs

**AO1037 4 open collector outputs:** The load resistance ( $R_c$ ) must be designed so that the closed contact current is lower than 100mA; the VDC voltage must be lower than or equal to 30V.

VDC: power supply voltage output. Vo+: positive output contact (open collector transistor). GND: ground output contact (open collector transistor).

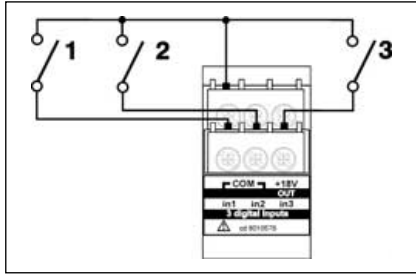


Connection by means of NPN transistor.  
AQ1042 digital input module.

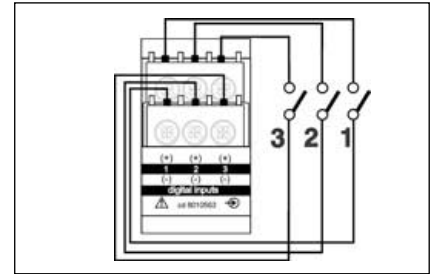


Connection by means of PNP transistor.  
AQ1042 digital input module.

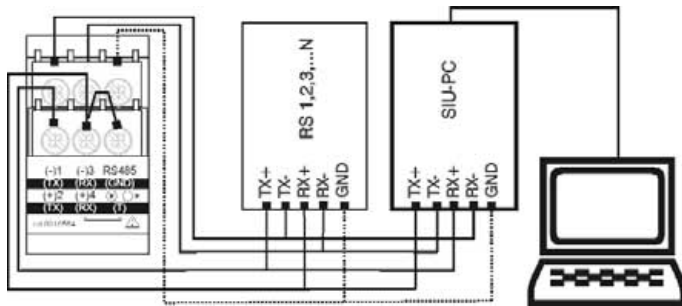
## Wiring diagrams of optional modules (cont.)



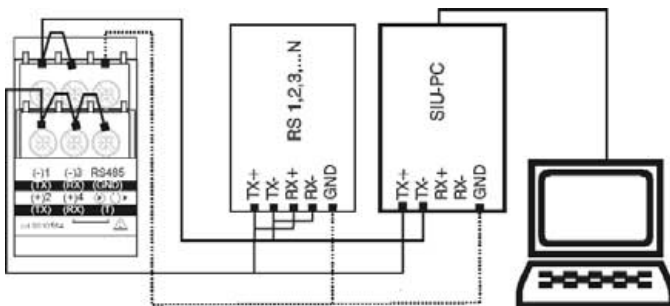
Connection by means of contacts. AQ1042 digital input module.



Connection by means of contacts. AQ1038 digital input module.

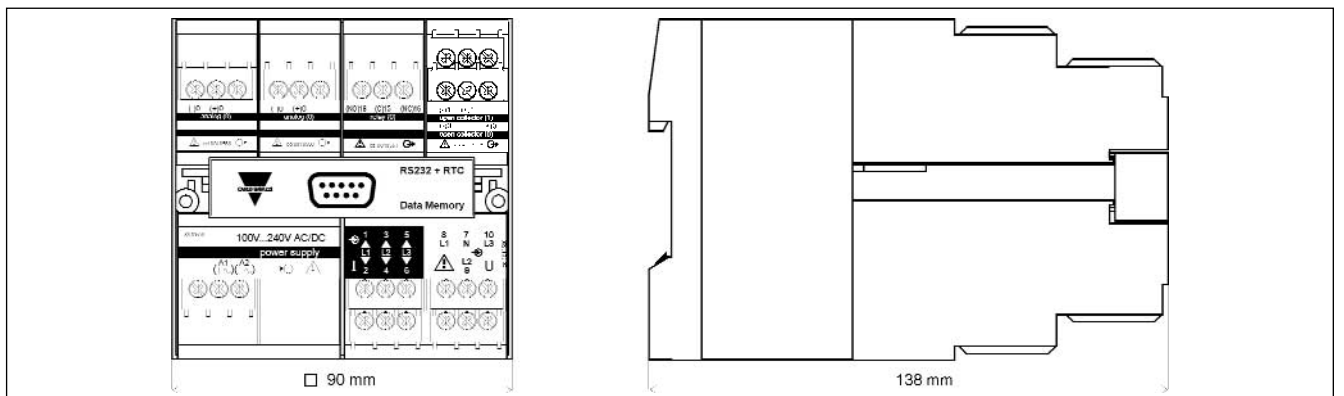


**AR1034 RS422/485 4-wires connection:** additional devices provided with RS422/485 (that is RS 1, 2, 3...N) are connected in parallel. The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (Rx+) and (T).



**AR1034 RS422/485 2-wires connection:** additional devices provided with RS422/485 (that is RS 1, 2, 3...N) are connected in parallel. The termination of the serial output is carried out only on the last instrument of the network, by means of a jumper between (Rx+) and (T).

## Dimensions



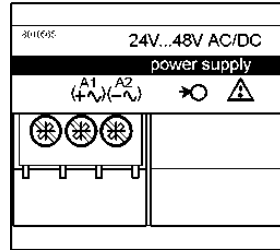


# Modules

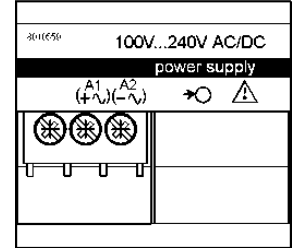
## Power supply modules



**AR1041**  
RS232 Port + RTC+2MB Data memory

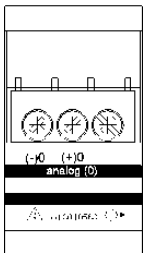


**AP1021**  
Power supply 18-60VAC/DC



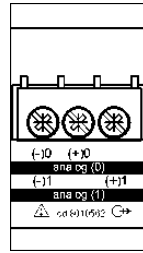
**AP1020**  
Power supply 90-260 VAC/DC

## Single analogue output modules



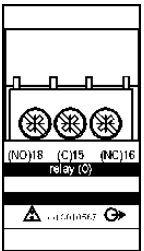
- AO1050** (20mADC)
- AO1051** (10VDC)
- AO1052** ( $\pm 5$ mADC)
- AO1053** ( $\pm 10$ mADC)
- AO1054** ( $\pm 20$ mADC)
- AO1055** ( $\pm 1$ VDC)
- AO1056** ( $\pm 5$ VDC)
- AO1057** ( $\pm 10$ VDC)

## Dual analogue outputs

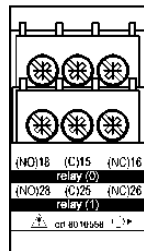


- AO1026** (20mADC)
- AO1027** (10VDC)
- AO1028** ( $\pm 5$ mADC)
- AO1029** ( $\pm 10$ mADC)
- AO1030** ( $\pm 20$ mADC)
- AO1031** ( $\pm 1$ VDC)
- AO1032** ( $\pm 5$ VDC)
- AO1033** ( $\pm 10$ VDC)

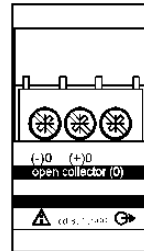
## Digital output modules



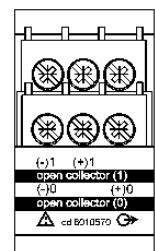
**AO1058**  
Single relay output



**AO1035**  
Dual relay output

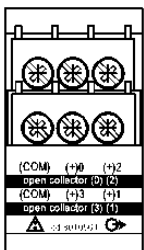


**AO1059**  
Single open collector output



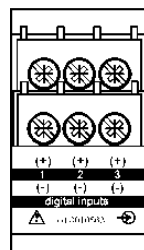
**AO1036**  
Dual open collector output

## Digital output modules

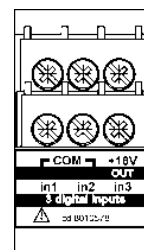


**AO1037**  
4 open collector outputs

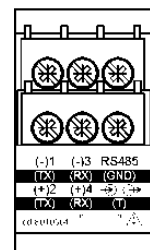
## Other input/output modules



**AQ1038**  
3 digital inputs



**AQ1042**  
3 digital inputs + aux



**AR1034**  
RS485 Port