

# Energy Management Compact Power Transducer Type CPT-DIN "Advanced version"

CARLO GAVAZZI



- One digital output and RS485 communication port (2 wires only)
- 16 freely configurable alarms with OR/AND logic linkable to up to 2 digital outputs
- RS422/485/RS232 communication port (MODBUS-RTU), iFIX SCADA compatibility

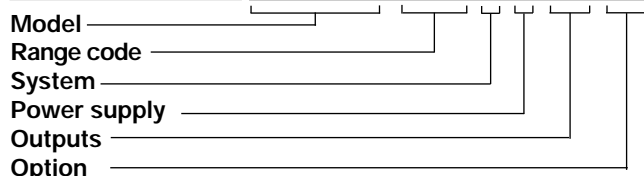
## Product Description

3-phase compact power transducer. Particularly recommended for the measurement of the main electrical variables also on board of machines. Housing for DIN-rail mount-

ing, with up to 3 analogue outputs, or RS485 communication port or alarm outputs or "Dupline" bus. Parameters programmable by means of CptASoft.

- Class 1 (kWh), Class 2 (kvarh)
- Accuracy  $\pm 0.5$  F.S. (current/voltage)
- Compact power transducer
- Instantaneous variables data format: 4 DGT
- Energies data format: 8+1 DGT
- System variables and phase measurements:  $V_{LL}$ ,  $V_{LN}$ ,  $A$ ,  $A_{max}$ ,  $A_n$ ,  $A_{dmd}$ ,  $A_{dmd\ max}$ ,  $VA$ ,  $VA_{dmd}$ ,  $VA_{dmd\ max}$ ,  $W$ ,  $W_{dmd}$ ,  $W_{dmd\ max}$ ,  $W_{L1}$ ,  $W_{L2}$ ,  $W_{L3}$  max, var, PF,  $PF_{L1}$ ,  $PF_{L2}$ ,  $PF_{L3}$  min, Hz, ASY
- Four quadrant power measurement
- Energy measurements: total and partial kWh and kvarh (according to EN62053-21 and EN62053-23)
- Hour counter (5+2 DGT)
- TRMS meas. of distorted sine waves (voltages/currents)
- Universal power supply: 90 to 260 VAC/DC, 18 to 60 VAC/DC
- Dimensions: 45x83.5x98.5mm
- Voltage asymmetry, phase sequence, phase loss control
- Up to 3 analogue outputs (20mA or 10VDC)
- 2 digital outputs

## How to order CPT-DIN AV5 3 H A3 AX



## How to order CptASoft-kit

CptASoft: software to program the working parameters of the transducer and to read the energies and the instantaneous variables. The kit includes the communication cable.

## Type Selection

Range codes	System	Outputs	Options
<b>AV5:</b> 400/690V <sub>LL</sub> /1/5(6)AAC $V_{L-N}$ : 185 V to 460 V $V_{L-L}$ : 320 V to 800 V <b>AV6:</b> 120/208V <sub>LL</sub> /1/5(6)AAC $V_{L-N}$ : 45 V to 145 V $V_{L-L}$ : 78 V to 250 V Phase current: 0.01A to 6A Neutral current: 0.05A to 6A	<b>3 :</b> 1-2-3-phase, balanced/unbalanced load, with or without neutral <b>1 :</b> 1-3-phase, balanced load (*)	<b>R2:</b> 2-relay outputs <b>O2:</b> 2-open collector outputs <b>A1:</b> 1-analogue output: 0/4 to 20mA DC <b>A3:</b> 3-analogue outputs: 0/4 to 20mA DC <b>V1:</b> 1-analogue output: 0 to 10V DC <b>V3:</b> 3-analogue outputs: 0 to 10V DC <b>S1:</b> RS485/RS422 port <b>S2:</b> RS232 port <b>DB:</b> Dupline bus	<b>AX:</b> advanced functions <b>Power supply</b> <b>L:</b> 18 to 60 VAC/VDC <b>H:</b> 90 to 260 VAC/VDC

(\*) Note: the 3-phase balanced load measurement requires the connection of the neutral according to fig. 15 and 16 in the final part of this document.

## Input specifications

<b>Rated inputs</b> Current Voltage Current Voltage	System type: 3 3 (internal current transformers) 4 System type: 1 1 (internal CT) 2	Neutral current Phase-phase voltage Phase-neutral voltage Active and Apparent power, Reactive power Range accuracy: 0.05I <sub>n</sub> to I <sub>max</sub> Current Neutral current Phase-phase voltage Phase-neutral voltage Active and Apparent power,	$\pm(2\%RDG+3DGT)$ $\pm(0.5\%RDG+2DGT)$ $\pm(0.5\%RDG+2DGT)$ $\pm(1.5\%RDG+3DGT)$ $\pm(3\%RDG+3DGT)$ $\pm(0.5\%RDG+2DGT)$ $\pm(1\%RDG+3DGT)$ $\pm(0.5\%RDG+2DGT)$ $\pm(0.5\%RDG+2DGT)$ $\pm(0.5\%RDG+2DGT)$ $\pm(1\%RDG+3DGT)$
<b>Accuracy (RS485)</b> (@25°C $\pm 5^\circ C$ , R.H. $\leq 60\%$ ) Range accuracy: 0.02I <sub>n</sub> to 0.05I <sub>n</sub> Current	I <sub>max</sub> : 6A, V <sub>max</sub> : 400V <sub>LN</sub> (690V <sub>LL</sub> ), I <sub>n</sub> : 5A, V <sub>n</sub> : 230V <sub>LN</sub> (400V <sub>LL</sub> ) CT: 1, VT (PT): 1 $\pm(0.5\%FS)$ or $\pm(1\%RDG+2DGT)$		



## Input specifications (cont.)

Reactive power	$\pm(2\%RDG+3DGT)$	Hourcounter	5+2 DGT, max indication 9 999 9.99
Active energy	Class 2 according to EN62053-21 (I start up: 10mA)	<b>Measurements</b>	Current, voltage, power, power factor, frequency TRMS measurement of distorted waves.
Reactive energy	Class 3 according to EN62053-23 (I start up: 10mA)		
Frequency	$\pm 0.1\text{Hz}$ (48 to 62Hz)	Type	Direct
<b>Additional errors</b>		Coupling type	< 3, max 10A peak
Humidity	$\leq 0.3\%$ FS, 60% to 90% RH	Crest factor	
Frequency	$\leq 0.3\%$ FS (45 to 48Hz and 62 to 65Hz)	<b>Input impedance</b>	
<b>Temperature drift</b>	$\leq 200\text{ppm}/^\circ\text{C}$	400/690V <sub>L-L</sub> (AV5)	1.6 M $\Omega$ $\pm 5\%$
<b>Sampling rate</b>	1600 samples/s @ 50Hz 1900 samples/s @ 60Hz	120/208V <sub>L-L</sub> (AV6)	1.6 M $\Omega$ $\pm 5\%$
<b>Measurement refresh time</b>	200ms	Current	$\leq 0.01\Omega$
<b>Measurement format</b>	(serial communication)	<b>Frequency</b>	45 to 65 Hz
Instantaneous variables	4 DGT, max indication 9999	<b>Overload protection</b>	(max values)
Energies	8+1 DGT, max indication 999 999 99.9	Continuous voltage/current	AV5: 460V <sub>LN</sub> /800V <sub>LL</sub> /6A AV6: 145V <sub>LN</sub> /250V <sub>LL</sub> /6A
		For 500ms: voltage/current	AV5: 800V <sub>LN</sub> /1380V <sub>LL</sub> /36A AV6: 240V <sub>LN</sub> /416V <sub>LL</sub> /36A

## Output Specifications

<b>Analogue Outputs</b>		Set-point adjustment	From 0 to 100% of the retransmitted scale from 0 to full scale
Number of outputs	Up to 3	Hysteresis	From 0 to full scale
Accuracy (@ 25°C $\pm 5^\circ\text{C}$ , R.H. $\leq 60\%$ )	$\pm 0.3\%$ FS	On-time delay	0 to 255s
Range	0 to 20mA or 0 to 10 VDC	Output status	Selectable; normally de-energized and normally energized
Scaling factor:	Programmable within the whole range of retransmission; it allows the retransmission management of all values from: 0 and 20 mA, 0 and 10VDC	Min. response time	$\leq 400\text{ms}$ , filters excluded and with alarm delay: "0 s"
Response time	$\leq 400\text{ms}$ typical (filter excluded)	<b>Note</b>	The 2 digital outputs can also work as one pulse output and one alarm output.
Ripple	$\leq 1\%$ , according to IEC 60688-1, EN 60688-1	<b>Static outputs</b>	
Total temperature drift	$\leq 500\text{ppm}/^\circ\text{C}$	Purpose	For alarm outputs or for pulse outputs
Load: 20 mADC	$\leq 350\Omega$	Signal	V <sub>ON</sub> 1.2 VDC/ max. 100 mA V <sub>OFF</sub> 30 VDC max.
10 VDC	$\geq 10\text{K}\Omega$	Insulation	By means of optocouplers, See table "Insulation between inputs and outputs"
Insulation	By means of optocouplers, See table "Insulation between inputs and outputs"	<b>Relay outputs</b>	
<b>Digital outputs</b>		Purpose	For alarm outputs or for pulse outputs
Pulse		Type	Relay, SPST type AC 1-5A @ 250VAC DC 12-5A @ 24VDC AC 15-1.5A @ 250VAC DC 13-1.5A @ 24VDC
Number of outputs	Up to 2	Insulation	See table "Insulation between inputs and outputs"
Type	Programmable from 0.01 to 500 pulses per kWh/kvarh (total counters) Outputs connectable to the total energy meters (Wh/varh)	<b>RS422/RS485</b>	(on request) Multidrop bidirectional (static and dynamic variables)
Pulse duration	$\geq 100\text{ms}$ < 120msec (ON), $\geq 120\text{ms}$ (OFF) according to EN62053-31	Connections	2 or 4 wires, max. distance 1200m, termination directly on the instrument
Alarm		Addresses	From 1 to 255, selectable via software
Number of outputs	up to 2, independent	Protocol	MODBUS/JBUS (RTU)
Alarm modes	Up alarm, down alarm, in window alarm, out window alarm. Start-up deactivation function at power-on for all kinds of alarm. All of them connectable to all variables (see the table "List of the variables that can be connected to")		



## Output Specifications (cont.)

Data (bidirectional) Dynamic (reading only)	System and phase variables: see table "List of variables..." All the configuration parameters. 1 start bit, 8 data bit, no parity, 1 stop bit 4800, 9600, 19200, 38400 bits/s By means of optocouplers, See table "Insulation between inputs and outputs"	Baud-rate	4800, 9600, 19200, 38400 bits/s other characteristics like R422/RS485 port
Static (writing only) Data format		<b>Dupline</b> Bus Address Variables	Full Dupline compatibility Programmable using CptASoft kWh, kvarh + 8 variables chosen among the available ones. By means of optocouplers. See table "Insulation between inputs and outputs"
Baud-rate		Insulation	
Insulation			
<b>RS232</b> Type Connections Address Protocol	Halfduplex communication Point to point connection 3-wire, max. distance 15m 1 to 255 selectable via software MODBUS/JBUS (RTU)		

## RS232 Configuration Bus

Connections Baud-rate Data format	RJ12 (3-wire) for special cable 4800 bits/s 1 start bit, 8 data bit, no parity, 1 stop bit	Insulation	By means of optocouplers, See table "Insulation between inputs and outputs"
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## CptASoft software: parameter programming and data reading

<b>CptASoft</b>	Multi language software to program the working parameters of the transducer and to read the energies and the instantaneous variables. Compatibility with Windows 95/98/98SE/2000/XP. Two different working modes can be selected: - management of a local RS485 network; - management of the communication from single instrument to PC (RS232); System selection: 1-2-3 phases CT/VT ratios		Filtering parameters Alarm variables Alarm set-points and relevant parameters Variables to be connected to the analogue outputs Scaling of analogue outputs Energies to be connected to the pulse outputs Parameters related to the pulse outputs Reset function: max/min values, energies, dmd
Working mode			
Programming parameters		<b>Data access</b>	By means of RS232 serial port, RS485 serial port or RS232 configuration port (RJ12)

## Software functions

<b>System selection</b> System 3, unbalanced	3-phase (3-wire, 4-wire) 3-phase ARON 2-phase (3-wire) 1-phase (2-wire) 3-phase (3-wire, 4-wire) 3-phase (3-wire) "1CT+1VT" 3-phase (3-wire) "1CT+3VT" 3-phase (4-wire) "1CT+1VT" 3-phase (4-wire), phase to neutral voltage measurement 1-phase (2-wire)	<b>Transformer ratio</b> CT VT (PT)	1 to 60 000 1.0 to 6 000.0
System 3, balanced		<b>Filter</b> Operating range	0 to 100% of the retransmitted scale 1 to 32
System 1, balanced		Filtering coefficient Filter action	Measurements, alarms, serial output (fundamental variables: V, A, W and their derived ones).



## Software functions (cont.)

<b>Alarms</b>	<p>Working mode</p> <p>“OR” or “AND” or “OR+AND” functions (see “Alarm parameter and logic” page). The user can freely program up to 16 total alarms. (out1+out2). The alarms can be connected to any variables available in the table “List of the variables that can be connected to”</p>	<p>- W dmd max, VA dmd max, A<sub>1</sub> max, A<sub>2</sub> max, A<sub>3</sub> max, W<sub>L1</sub> max, W<sub>L2</sub> max, W<sub>L3</sub> max, W sys max, A<sub>1</sub> dmd max, A<sub>2</sub> dmd max, A<sub>3</sub> dmd max, VA sys dmd max, W sys dmd max, PF<sub>1</sub> min, PF<sub>2</sub> min, PF<sub>3</sub> min          - all the counters: total kWh, partial kWh, total kvarh, partial kvarh, hour counters          - reset of all the above mentioned variables in a single command</p>
<b>Reset</b>	<p>The following resets are available by means of the configuration software:</p> <ul style="list-style-type: none"> <li>- all the maximum/min values:</li> </ul>	

## Power Supply Specifications

<b>AC/DC voltage</b>	<p>90 to 260VAC/DC 18 to 60VAC/DC</p>	<b>Power consumption</b>	<p>AC: 2.5 VA DC: 2W</p>
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## General Specifications

<p><b>Front LED's</b></p> <p>Power on Diagnostics</p> <p>RS485/RS422/RS232</p> <p>Dupline bus</p> <p>Alarm outputs</p> <p>Pulse outputs</p> <p>Analogue outputs</p>	<p>Green</p> <p>TX data (Green) RX data (Red)</p> <p>TX data (Green) RX data (Red)</p> <p>1st output activation (Green) 2nd output activation (Red)</p> <p>1st output activation (Green) 2nd output activation (Red)</p> <p>Output signal within the programmed scale (Green) Output signal exceeding 110% of full scale (Red)</p>	<b>Dielectric strength</b>	4kVAC <sub>RMS</sub> (for 1 min)
<b>Operating temperature</b>	0° to +50°C (32° to 122°F) (RH < 90% non condensing)	<b>EMC</b>	<p>Emissions</p> <p>EN61000-6-3, EN60688 residential environment, commerce and light industry</p> <p>Immunity</p> <p>EN61000-6-2 industrial environment.</p>
<b>Storage temperature</b>	-10° to +60°C (14° to 140°F) (RH < 90% non condensing)	<b>Pulse voltage (1.2/50µs)</b>	EN61000-4-5
<b>Overvoltage category</b>	Cat. III (IEC 60664, EN60664)	<b>Safety standards</b>	IEC60664, IEC61010-1 EN60664, EN61010-1
<b>Insulation (for 1 minute)</b>	<p>4kVAC<sub>RMS</sub> between measuring inputs and power supply.</p> <p>4kVAC/DC @ I<sub>≥</sub> 3mA between measuring inputs and RS485/RS232/programming port (RJ12)</p> <p>4kVAC<sub>RMS</sub> between power supply and RS485/RS232/programming port (RJ12)</p>	<b>Mesurement standards</b>	IEC60688, EN60688, EN62053-31, EN62053-23
		<b>Approvals</b>	CE, cURus, CSA
		<b>Connections 5(6) A</b>	Screw-type Max cable cross sect. area 2.5 mm <sup>2</sup>
		<b>Housing</b>	<p>Dimensions (WxHxD)</p> <p>45 x 83.5 x 98.5 mm</p> <p>Material</p> <p>ABS self-extinguishing: UL 94 V-0</p>
		<b>Mounting</b>	DIN-rail
		<b>Protection degree</b>	IP20
		<b>Weight</b>	Approx. 200 g (pack. incl.)

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

- RS485/RS422/RS232 communication port
- Analogue outputs ("max" variables, "energies" and "hour counter" excluded)
- Alarm outputs ("max" variables, energies and "hour counter" excluded)
- Pulse outputs (only "energies")
- Dupline bus (only "total energies" + up to 8 selectable variables)

No	Variable	1-phase system	2-phase system	3-ph. 4-wire balanced sys.	3-ph. 4-wire unbal. sys.	3-ph. 3-wire bal. sys.	3-ph. 3-wire unbal. sys.	Notes
1	V L1	x	x	x	x	o	o	
2	V L2	o	x	x	x	o	o	
3	V L3	o	o	x	x	o	o	
4	V L-N sys	o	x	x	x	o	o	Sys = system
5	V L1-2	o	x	x	x	x	x	
6	V L2-3	o	x	x	x	x	x	
7	V L3-1	o	o	x	x	x	x	
8	V L-L sys	o	x	x	x	x	x	Sys = system
9	A L1	x	x	x	x	x	x	#
10	A L2	o	x	x	x	x	x	#
11	A L3	o	o	x	x	x	x	#
12	Amax/ Admd max	x	x	x	x	x	x	◆ Highest value among the 3-ph
13	An	o	x	x	x	x	x	
14	W L1	x	x	x	x	o	o	◆
15	W L2	o	x	x	x	o	o	◆
16	W L3	o	o	x	x	o	o	◆
17	W sys	o	x	x	x	x	x	Sys = system
18	var L1	x	x	x	x	o	o	
19	var L2	o	x	x	x	o	o	
20	var L3	o	o	x	x	o	o	
21	var sys	o	x	x	x	x	x	Sys = system
22	VA L1	x	x	x	x	o	o	
23	VA L2	o	x	x	x	o	o	
24	VA L3	o	o	x	x	o	o	
25	VA sys	o	x	x	x	x	x	Sys = system
26	PF L1	x	x	x	x	o	o	★
27	PF L2	o	x	x	x	o	o	★
28	PF L3	o	o	x	x	o	o	★
29	PF sys	o	x	x	x	x	x	Sys = system
30	Hz	x	x	x	x	x	x	
31	Phase seq.	o	o	x	x	x	x	
32	ASY L-N	o	x	x	x	x	x	
33	ASY L-L	o	x	x	x	x	x	
34	VA sys dmd	x	x	x	x	x	x	Sys = system ◆
35	W sys dmd	x	x	x	x	x	x	Sys = system ◆
36	A L1 dmd	x	x	x	x	x	x	dmd = (*)
37	A L2 dmd	o	x	x	x	x	x	dmd = (*)
38	A L3 dmd	o	o	x	x	x	x	dmd = (*)
39	VA L1 dmd	x	x	x	x	x	x	dmd = (*)
40	VA L2 dmd	o	x	x	x	x	x	dmd = (*)
41	VA L3 dmd	o	o	x	x	x	x	dmd = (*)
42	W L1 dmd	x	x	x	x	x	x	# dmd = (*)
43	W L2 dmd	o	x	x	x	x	x	# dmd = (*)
44	W L3 dmd	o	o	x	x	x	x	# dmd = (*)
45	kWh	x	x	x	x	x	x	Total and partial
46	kvarh	x	x	x	x	x	x	Total and partial
47	hours	x	x	x	x	x	x	

(x) = available (o) = not available

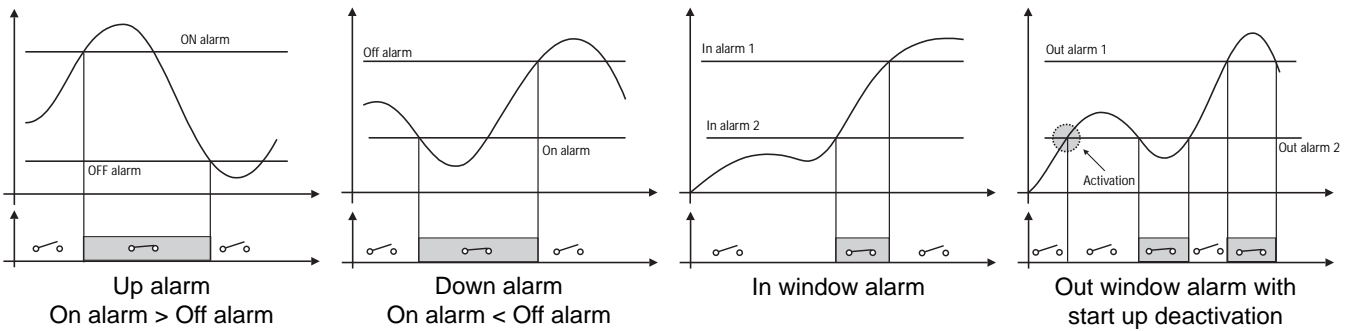
- ◆ These variables are available also for the MAX values stored in the EEPROM when the instrument switches off.  
 ★ These variables are available also for the MIN values stored in the EEPROM when the instrument switches off.  
 (\*) dmd value integrated in a programmed time interval.  
 (#) The variables are available also for the max values. When the instrument switches off, the values are not stored.

## Alarm parameters and logic



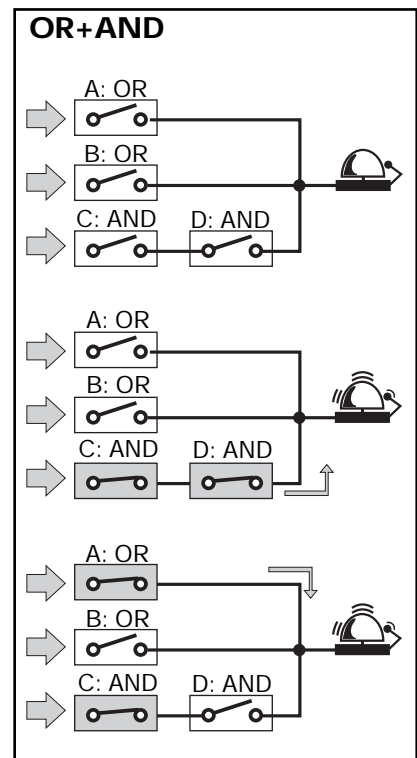
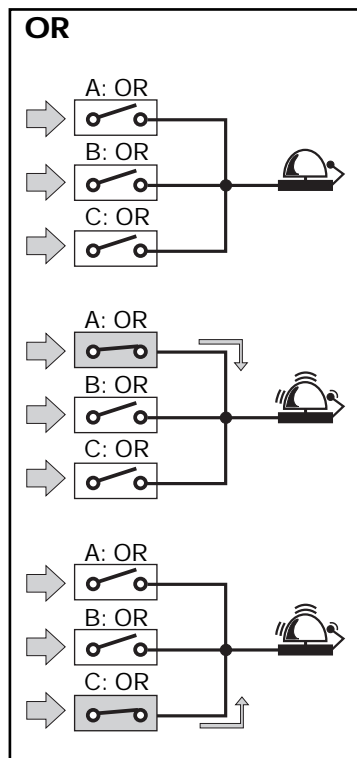
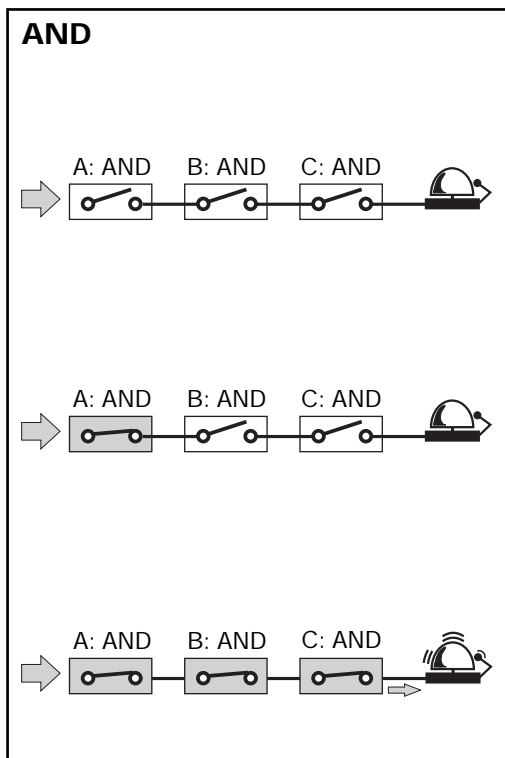
- Block enable.
- Controlled variable (VLN, ...).
- Alarm type (up, down, in window alarm, out window alarm).
- Activation function.
- ON set-point.
- OFF set-point.
- ON delay.
- Logical function (AND, OR).
- Digital output (1, 2).

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



**Note:** any alarm working mode can be linked to the "start up deactivation" function which disables only the first alarm after power on of the transducer.

### AND/OR logical alarm examples:

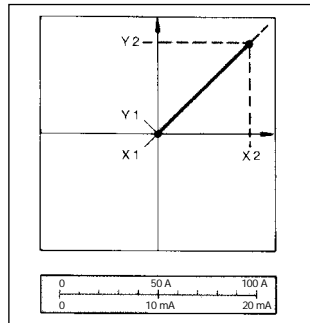


## Function Description

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

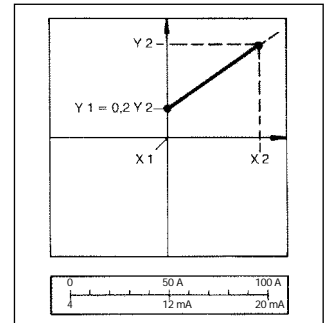
**Figure A**

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



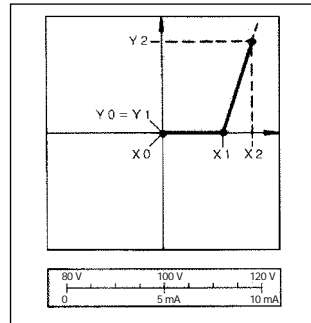
**Figure C**

The sign of measured quantity and output quantity remains the same. With the measured quantity being zero, the output quantity already has the value  $Y_1 = 0.2 Y_2$ . Live zero output.



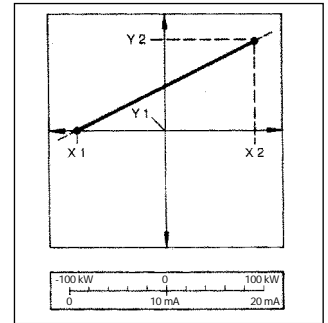
**Figure B**

The sign of measured quantity and output quantity remains the same. On the range  $X_0...X_1$ , the output quantity is zero. The range  $X_1...X_2$  is delineated on the entire output range  $Y_0 = Y_1...Y_2$  and thus presented in strongly expanded form.



**Figure D**

The sign of the measured quantity changes but that of the output quantity remains the same. The output quantity steadily increases from value  $X_1$  to value  $X_2$  of the measured quantity.

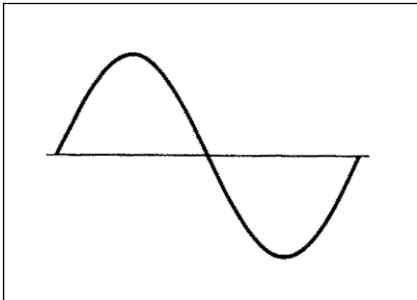


## Insulation between inputs and outputs

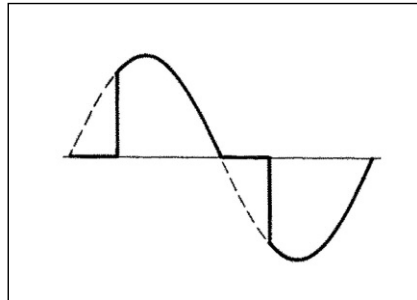
	Measuring Input	Relay Output	Open collector output	Dupline output	Analogue Output	RS232/RS485	RS232 (RJ12)	90-260VAC/DC Power supply	18-60VCA/CC Power supply
Measuring input	-	4kV	2,5kV @ $I \geq 3mA$	2,5kV	2,5kV @ $I \geq 3mA$	2,5kV @ $I \geq 3mA$	2,5kV @ $I \geq 3mA$	4kV	4kV
Relay output	4kV	-	-	-	-	-	4kV	4kV	4kV
Open collector output	2,5kV @ $I \geq 3mA$	-	-	-	-	-	4kV	4kV	4kV
Dupline output	2,5kV	-	-	-	-	-	2,5kV	2,5kV	2,5kV
Analogue output	2,5kV @ $I \geq 3mA$	-	-	-	-	-	4kV	4kV	4kV
RS232/RS485	2,5kV @ $I \geq 3mA$	-	-	-	-	-	4kV	4kV	4kV
RS232 (RJ12)	2,5kV @ $I \geq 3mA$	4kV	4kV	2,5kV	4kV	4kV	-	4kV	4kV
90-260 VAC/DC	4kV	4kV	4kV	2,5kV	4kV	4kV	4kV	-	-
18-60 VAC/DC	4kV	4kV	4kV	2,5kV	4kV	4kV	4kV	-	-

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

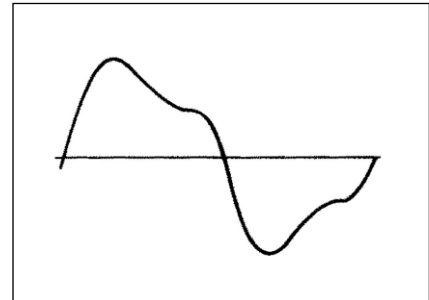
Waveform of the signals that can be measured



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



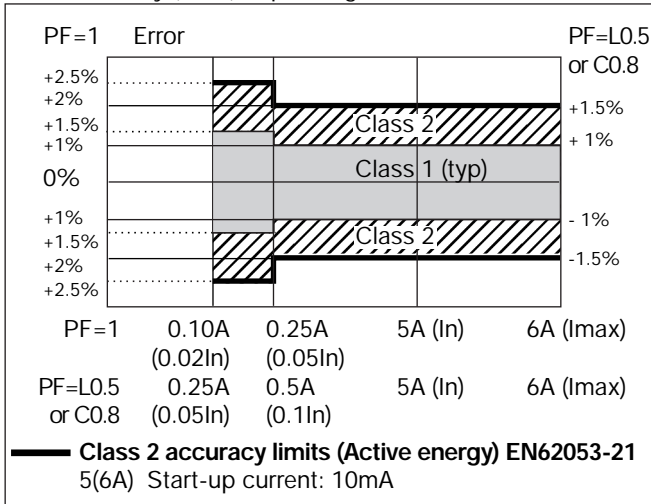
**Figure B**  
**Sine wave, indented**  
 Fundamental content 10...100%  
 Harmonic content 0...90%  
 Frequency spectrum: 3rd to 16th harmonic  
 Additional error: <1% FS



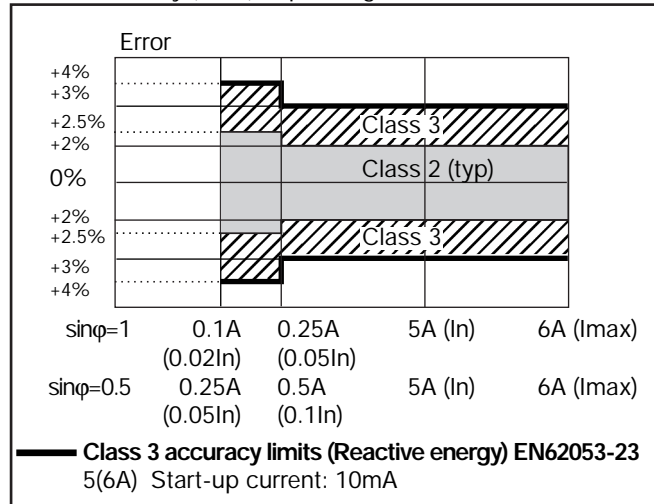
**Figure C**  
**Sine wave, distorted**  
 Fundamental content 70...90%  
 Harmonic content 10...30%  
 Frequency spectrum: 3rd to 16th harmonic  
 Additional error: <0.5% FS

**Accuracy**

**kWh, accuracy (RDG) depending on the current**



**kvarh, accuracy (RDG) depending on the current**



**Used calculation formulas**

**Phase variables**

Instantaneous effective voltage

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

Instantaneous active power

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

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 three-phase voltage

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

Voltage asymmetry

$$ASY_{LL} = \frac{(V_{LLmax} - V_{LLmin})}{V_{LL\Sigma}}$$

$$ASY_{LN} = \frac{(V_{LNmax} - V_{LNmin})}{V_{LN\Sigma}}$$

Three-phase reactive power

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

Neutral current

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

Three-phase active power

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

Three-phase apparent power

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

Three-phase power factor (TPF)

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

**Energy metering**

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

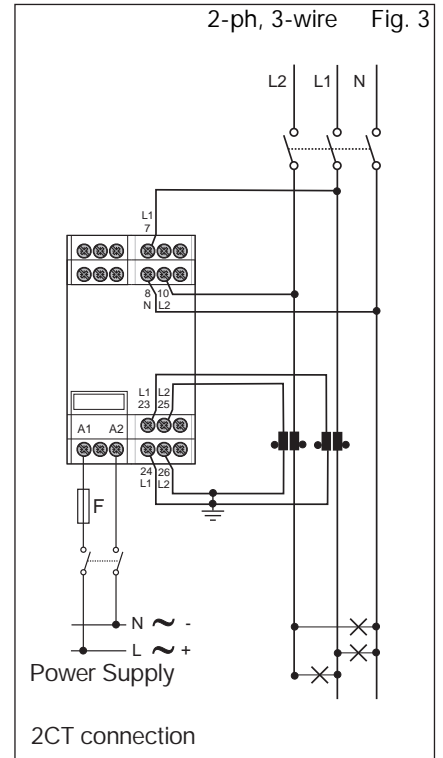
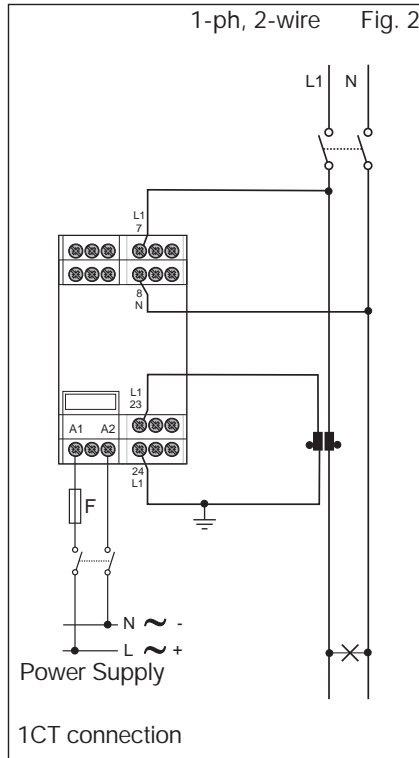
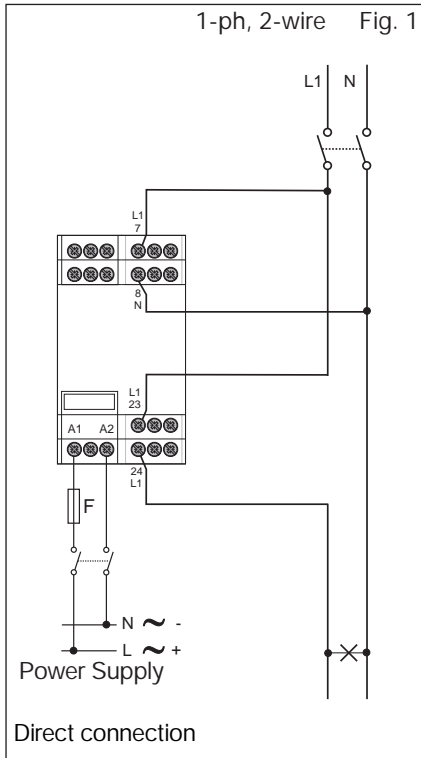
$$kVarh_i = \int_{t_1}^{t_2} Q_i(t) dt \approx \Delta t \sum_{n_1}^{n_2} Q_{i,j}$$

Where:

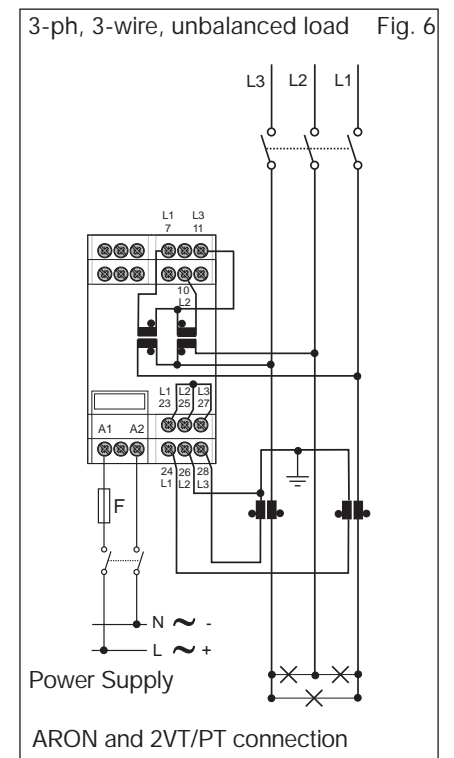
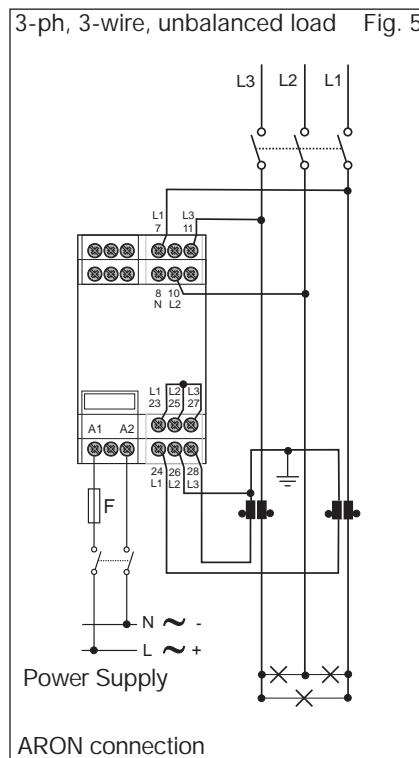
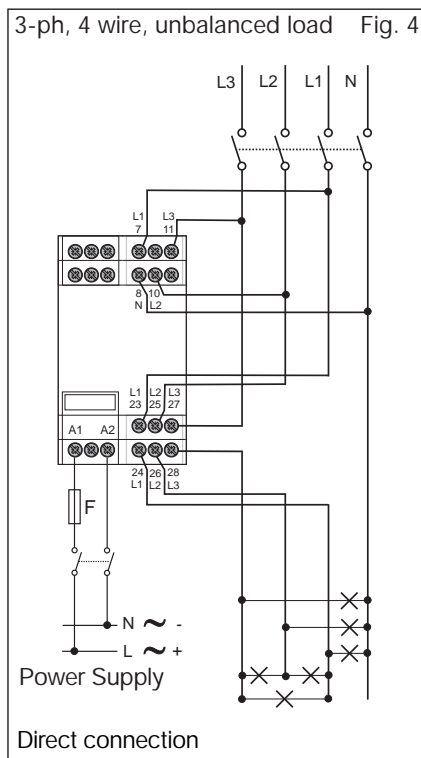
i= considered phase (L1, L2 or L3)  
 P= active power; Q= reactive power;  
 $t_1, t_2$  = starting and ending time points of consumption recording; n= time unit;  $\Delta t$  = time interval between two successive power consumptions;  
 $n_1, n_2$  = starting and ending discrete time points of consumption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



### Wiring diagrams "system type selection: 3"

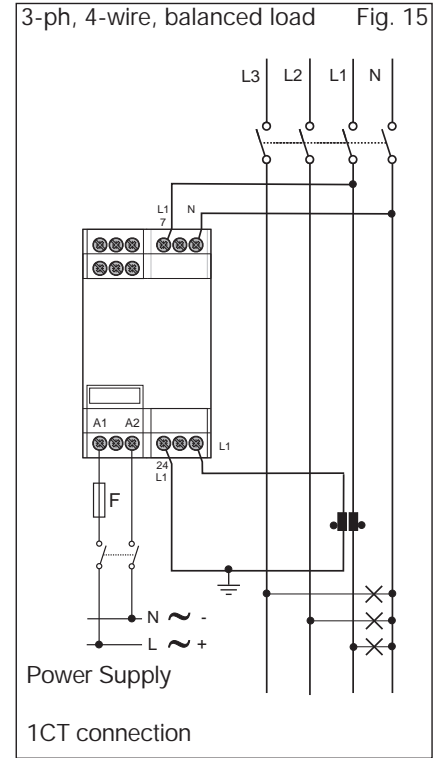
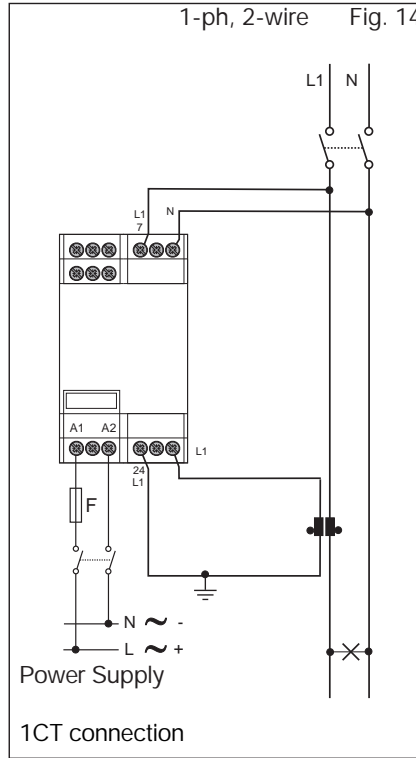
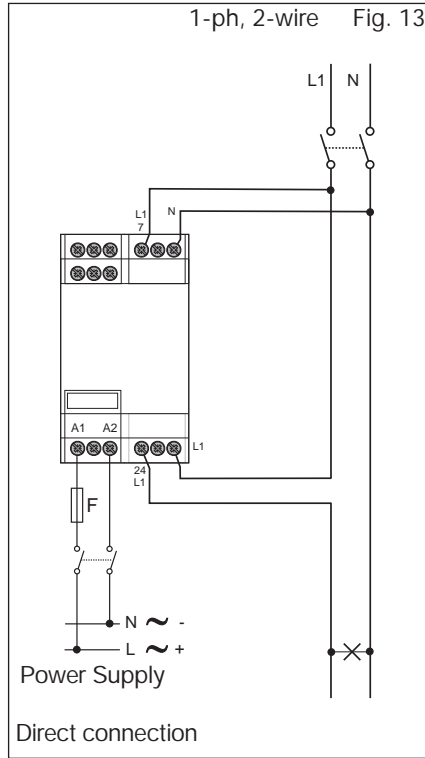


F= 630 mA T (18 to 60VAC/DC)  
125 mA T (90 to 260VAC/DC)



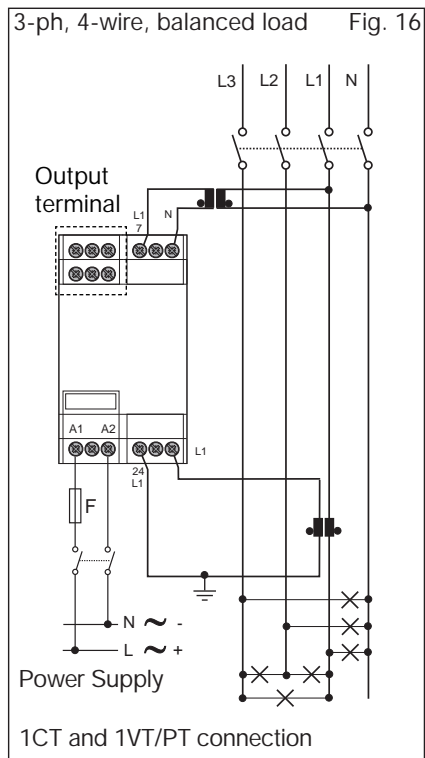


## Wiring diagrams "system type selection: 1"



F= 630 mA T (18 to 60VAC/DC)  
125 mA T (90 to 260VAC/DC)

## Outputs



Analogue output 0-20mA

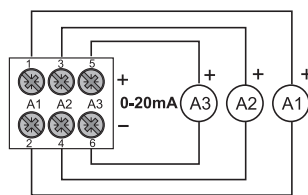


Fig. 17

Analogue output 0-10V

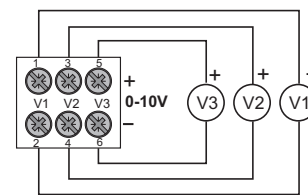


Fig. 18

Relay out.

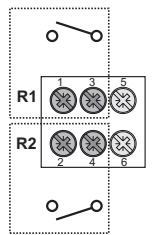


Fig. 19

**NOTE:** the analogue outputs are not insulated among each other.

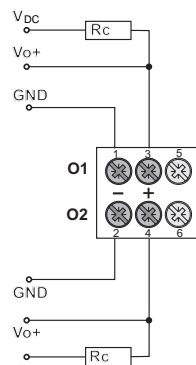


Fig. 20

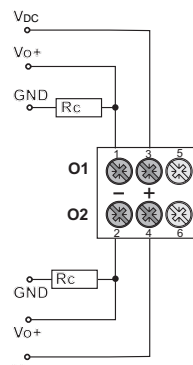
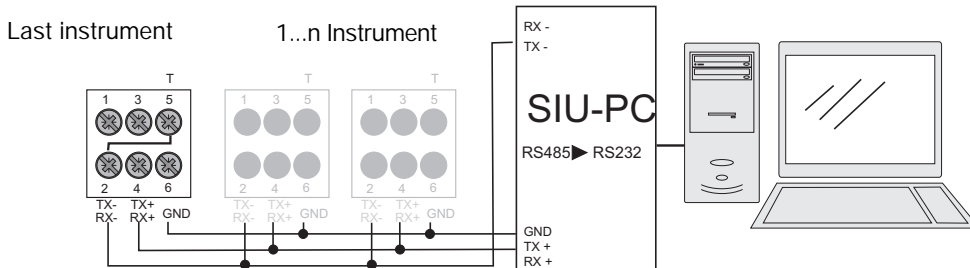


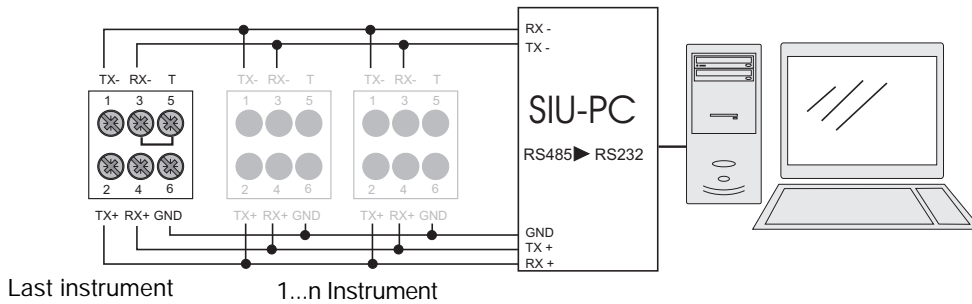
Fig. 21

**Open collector outputs:** The load resistance ( $R_c$ ) must be calculated 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 (external). Vo+: positive output contact (open collector transistor). GND: ground output contact (open collector transistor).

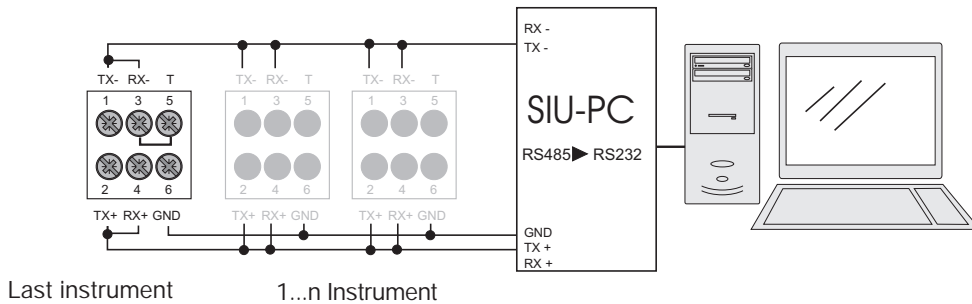
## RS485 serial port and one relay connections



2-wire connection of RS485 serial port. The terminalization must be carried out only on the last instrument of the network



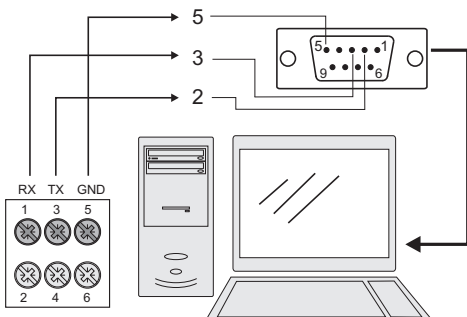
4-wire connection of RS485 serial port, the terminalization must be carried out only on the last instrument of the network



2-wire connection of RS485 serial port, the terminalization must be carried out only on the last instrument of the network

## RS232 Serial port connection

## Easy programming



RJ12 communication port for parameters programming. The configuration of the transducer can be easily performed by means of CptASoft. CptASoft-kit includes also 1m long connection cable (RJ12 6-pole / RS232 9-pole female).