MEASUREMENT OF ALTERNATING SIGNALS

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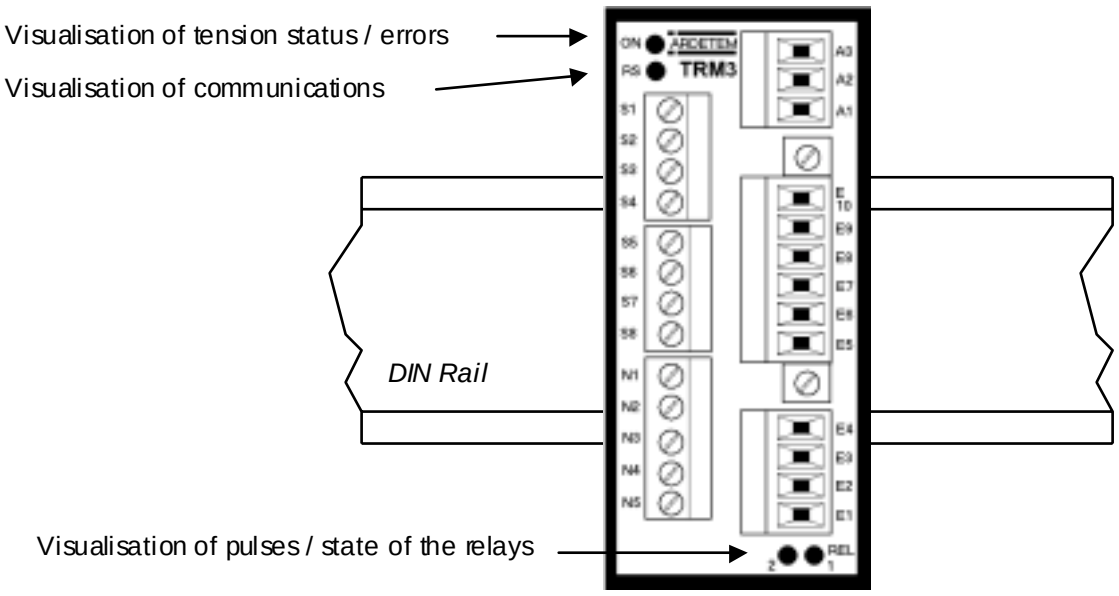
TRM 3

USE

1. RECEIPT AND STARTING OF THE INSTRUMENT

☐ Check that the instrument configuration (printed on case side label) corresponds to your request. In case of repair or on-line assistance, its programme version and identification number will need to be known.
☐ Latch the instrument on a symmetrical DIN rail
☐ Connect the power supply (see the wiring diagrams). The tension LED lights up.
☐ The instrument now starts to measure. It has a standard configuration (except specific indications on your order).
☐ The instrument can now be programmed, preferably before wiring the measure signals.
☐ Then connect all signals : see the wiring diagrams.
☐ In standard, the communication parameters for the PC software are :
slave number = 250, baud rate = 9600 bauds no parity 1 stop bit

2. FRONT FACE ORGANISATION



IN CASE OF PROBLEM ...

• If the instrument does not light up :	Check the presence of the power supply (even in the case of a self-powered instrument).
• If the instrument won't measure :	Check the presence of measure signals. Check the programming.
• If LED "ON" is blinking :	A wiring or configuration error has been made. See chapter 4 - operating : "list of errors"

3. LIST OF THE MEASURED PARAMETERS.

Nr	Measured parameter	MONO	4FIL E	4FIL NE	3FILNE.2	3FILNE.3	3FIL E
1	$U_{L_1-L_3}$ (Mesh voltage U13)	X	X	X	X	X	X
2	$U_{L_1-L_2}$ (Mesh voltage U12)			X	X	X	
3	$U_{L_2-L_3}$ (Mesh voltage U23)			X	X	X	
21	U_{L_1}-N (Single voltage UL1)		X	X			
22	U_{L_2}-N (Single voltage UL2)			X			
23	U_{L_3}-N (Single voltage UL3)			X			
4	I_{L_1} (Line current IL1)	X	X	X	X	X	X
5	I_{L_2} (Line current IL2)			X	X	X	
6	I_{L_3} (Line current IL3)			X	X	X	
71	**THD** (Distortion rate THD)	X	X	X	X	X	X
72	**H2** (Harmonics rank 2 H2)	X	X	X	X	X	X
120	**H50** (Harmonics rank 50 H50)	X	X	X	X	X	X
24	P_{L_1} (Active power phase 1 PL1)		X	X			
25	P_{L_2} (Active power phase 2 PL2)			X			
26	P_{L_3} (Active power phase 3 PL3)			X			
7	**P** (Total active power P)	X	X	X	X	X	X
8	**Q** (Total reactive power Q)	X	X	X	X	X	X
9	**S** (Total apparent power S)	X	X	X	X	X	X
27	Q_{L_1} (Reactive power phase 1 QL1)		X	X			
28	Q_{L_2} (Reactive power phase 2 QL2)			X			
29	Q_{L_3} (Reactive power phase 3 QL3)			X			
10	**F** (Frequency F)	X	X	X	X	X	X
11	**cos φ** (Total cosine COS)	X	X	X	X	X	X
12	I_N (Leak current In)			X		X	
30	**cos φ** $_{L_1}$ (Cosine phase L1 PF1)			X			
31	**cos φ** $_{L_2}$ (Cosine phase L2 PF2)			X			
32	**cos φ** $_{L_3}$ (Cosine phase L3 PF3)			X			
13	**Ea** (Active energy Eo)	X	X	X	X	X	X
17	**Er ind** (Reactive inductive energy El)	X	X	X	X	X	X
19	**Er cap** (Reactive capacitive energy Ec)	X	X	X	X	X	X
13+14	**Ea out** (Active out energy, 6 digits)	X	X	X	X	X	X
15+16	**Ea in** (Active In energy, 6 digits)	X	X	X	X	X	X
17+18	**Er ind** (Reactive inductive energy, 6 digits)	X	X	X	X	X	X
19+20	**Er cap** (Reactive capacitive energy, 6 digits)	X	X	X	X	X	X

MONO : single-phase.
4FIL E : 3-phase balanced with neutral.
4FIL NE : 3-phase unbalanced with neutral.
3FIL NE.2C : 3-phase unbalanced without neutral, without leak current.
3FIL NE.3C : 3-phase unbalanced without neutral, measuring of the 3 currents.
3FIL E : 3-phase balanced without neutral.

4. LIST OF THE ERRORS

In case of cumulation of various errors, numbers will be added. Eg : 1+8=9

AL	Error types	Notes
1	Wiring error	Wrong wiring of U/I measure signals
4	Current caliber overstepping	CTs not adpated
8	Voltage caliber overstepping	VTs not adapted , or wiring error, or error in network type programming
16	Frequency out of span (45Hz - 65Hz)	Signals disturbed or deformed , or frequency too high
32	Configuration loss	Reprogramme the instrument
64	Calibration loss	Return to the factory for recalibrating

5. ODNESS OF THE SIGNED PARAMETERS :

Powers are always transmitted with their sign by the digital output.
Moreover, the cosine display allows knowing of this sign :

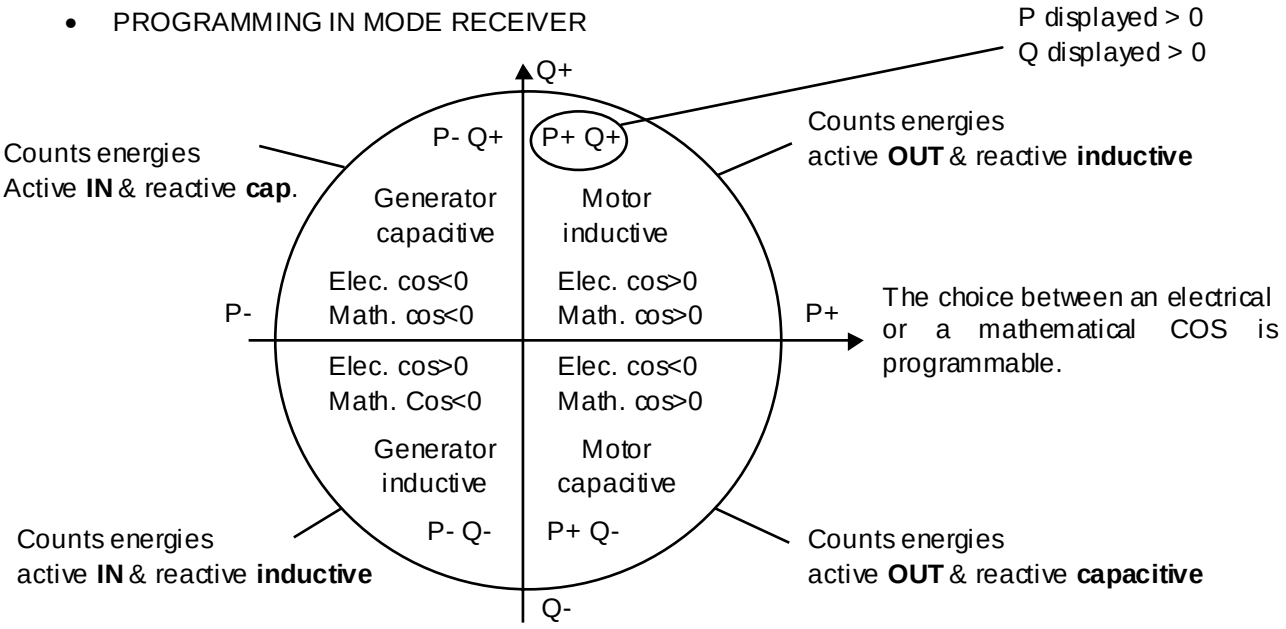
- If the programmed COS type is electrical, it allows knowing the sign of the reactive power. The COS indicates the load nature (L or C on the micro-console, + or - on the PC software).
- If the programmed COS type is mathematical, it allows knowing the sign of the active power. The COS indicates the current direction : + = generator and - = receiver

6. USE OF THE "CUT OFF"

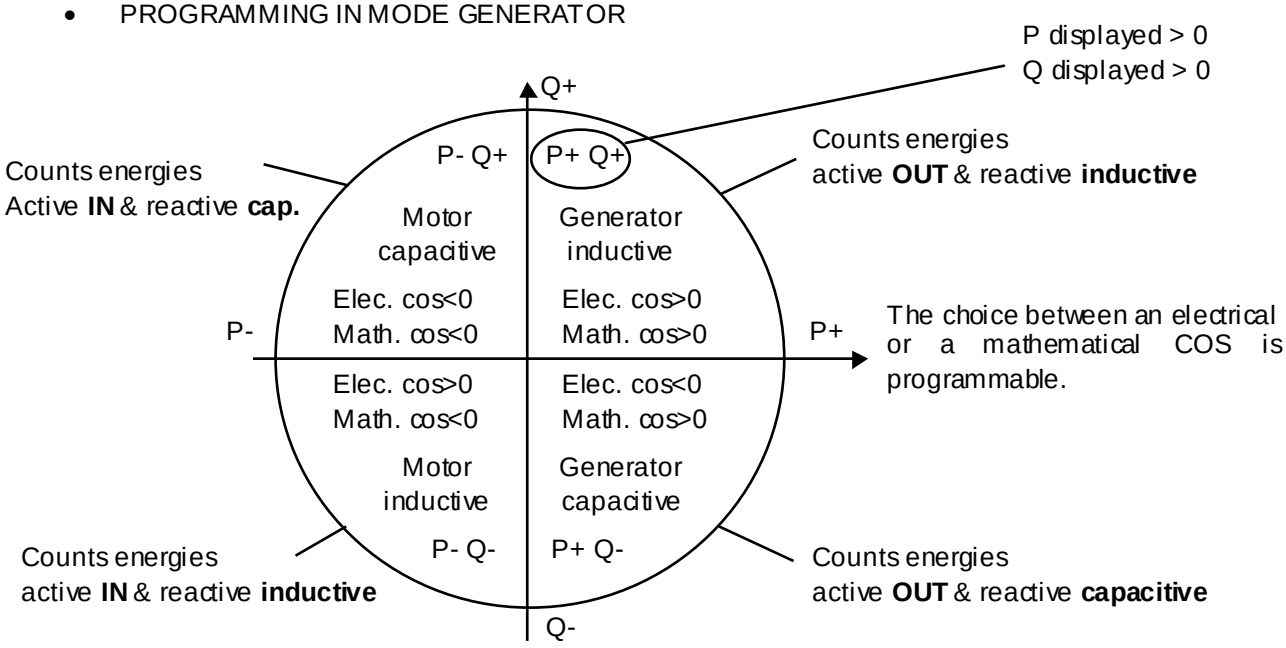
The "cut off" is an instrument programming option, that allows separate setting of display at zero for U and I small values (see chapter "programming of the CUT OFF").
Once the menu is validated, the instrument will measure the values on its inputs, and enforces to zero any values smaller than the "cut off" programmed in percentage of the full scale.

7. MEANING OF THE VARIOUS ENERGY METERS :

- PROGRAMMING IN MODE RECEIVER



- PROGRAMMING IN MODE GENERATOR



PROGRAMMING BY PC SOFTWARE

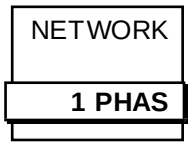
A detailed step by step information is provided in the software help

1. ACCESS TO THE CONFIGURATION

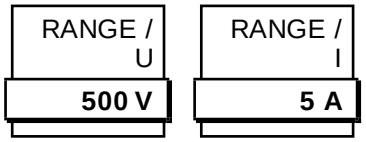
In software supervision, choose headline "configuration".
Once the insturment is selected, access to detailed configuration is possible.
The configuration is divided into 3 groups : INPUT, MODBUS and OUTPUT.

2. NETWORKS CONFIGURATION

2-1. Choice of the measure network

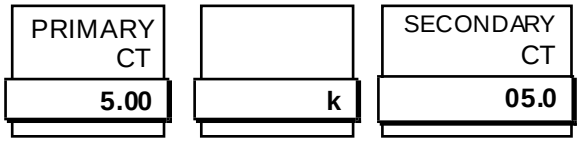


1 PHAS : single phase
4FIL E : 3-phase balanced with neutral
4FIL NE : 3-phase unbalanced with neutral
3FIL NE.2C : 3-phase unbalanced without neutral, without leak current
3FIL NE.3C : 3-phase unbalanced without neutral, measurement of the 3 currents
3FIL E : 3-phase balanced without neutral

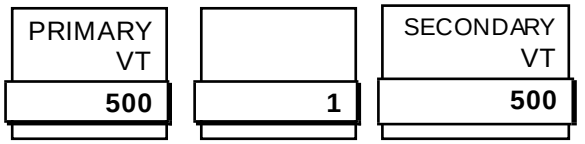


Choice of the voltage caliber : 150V or 500V
(caliber for single voltages in 4 wire or for mesh voltages in 3 wire)
And choice of the current caliber : 1A or 5A

2-2. Entering of CT and VT ratios

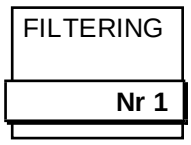


Programming of the CT primary and its unit (1 = unit, k = kilo)
Programming of the CT secondary, without unit



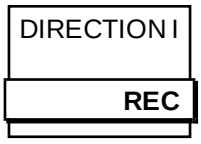
Programming of the VT primary and its unit (1 = unit, k = kilo)
Programming of the VT secondary, without unit

2-3. Choice of the digital filtering



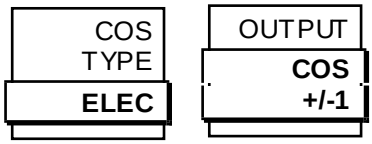
Choice of the digital filtering weight :
OFF, Nr1, Nr2 ...
Increase the value in case measures are unsteady.

2-4. Mode choice



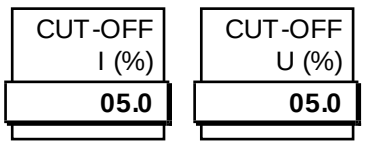
Choice of mode receiver or generator : defines current direction (180° rotation in the 4-quadrant diagram).

2-5. Cosine Programming



Choice of the cosine type : electrical or mathematical
Choice of the cosine centering : +/-1 or centered on 0
See chapter 3.

2-6. Programming of the « cut off »



Programming of the current and voltage cut off.
This is the value below which the instrument will enforce the measure at 0.
It is entered in percentage of the caliber full scale.

3. OUTPUTS CONFIGURATION

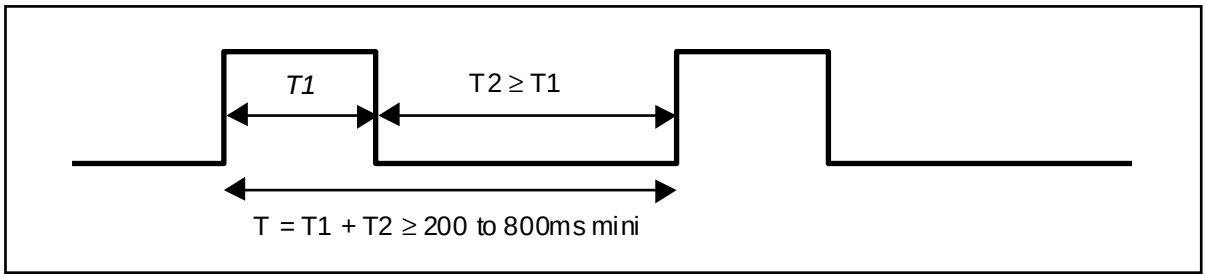
This instrument can run 2 types of outputs : relays (pulses / alarm) or analog.
The software SUPERVISION will recognise for each of the outputs its devoted type, and propose the appropriate configuration.

3-1. Configuration of a relay output (alarm or pulses)

Each output can be configured either as alarm, or pulses.

3-11. configurating in mode pulses :

This configuration is accessible only for energy counting.

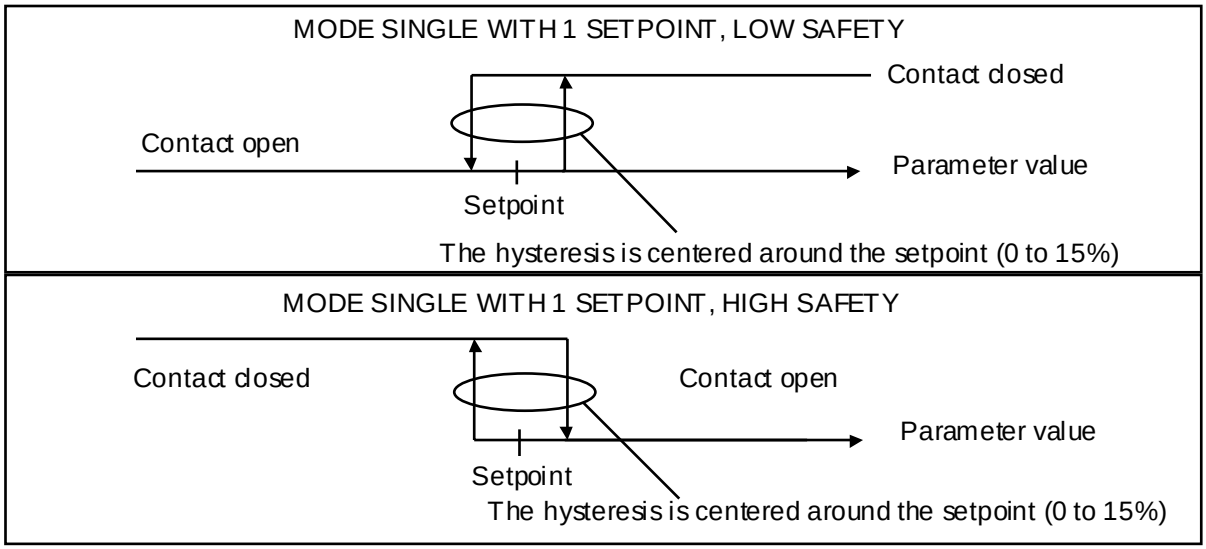


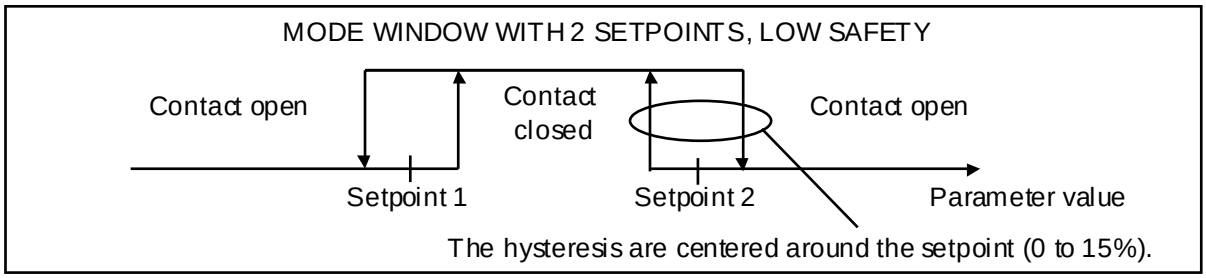
- Procedure to be followed :

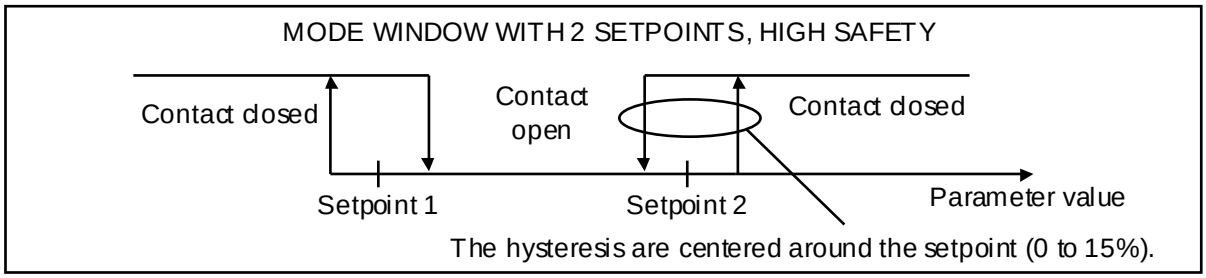
OUTPUT 2 **PULSE**	Choice of the output type : eg. If output 2 is a relay output **ALARM or PULSE**
PARAMETER **13 Ea.I**	Choice of the parameter dedicated to the output (the number and name of the parameter are displayed).
PUL **400 ms**	Width of the pulses : 100ms, 200ms, 400ms (see above diagram)
PULSE VAL **1.00**	
k	Programming of the weight and unit of the pulses : 1, k=kilo, M=MEGA, G=GIGA

3-12. Configuration in mode setpoint (alarms) :

2 modes can be combined with 2 types of safeties







- Procedure to be followed :

OUTPUT 2 **ALARM**	Choice of the output type : eg. If output 2 is a relay output **ALARM or PULSE** (pulse is proposed only if the instrument measures the energies)
PARAMETER **4** **IL1**	Choice of the parameter dedicated to the output (the number and the name of the parameter appear)
WINDOW **YES**	YES = window mode (2 setpoints) NO = single mode (1 setpoint)
SECURITY **LO**	Choice of safety type : **LO**=low or **HI**=high
THRESHOLD #1 **2.00** / **1**	Setpoint sign (powers only, +/-) Value of 1st setpoint and its unit : 1, K, M, G
THRESHOLD #2 **4.00** / **1**	Setpoint sign (powers only, +/-) Value of 2nd setpoint and its unit : 1, K, M, G **Do not program this value in single mode.**
TEMPO. (S) **0** / HYST. (%) **2**	Programming of the response time (0-15s) and hysteresis (0-15%).

NOTE : One setpoint can be dedicated to the error parameter (56). With a value of 0.5, all errors will be watched. With a value of 17, only the programming or calibration loss will be watched (see list of errors ch.4).

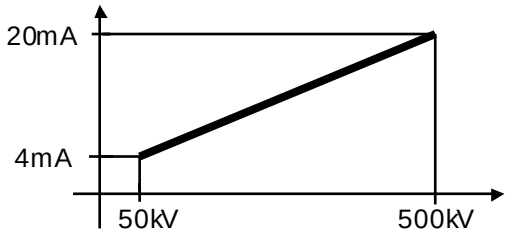
3-2. CONFIGURATION OF AN ANALOG OUTPUT

3-21. Function mode of an analog output – General case :

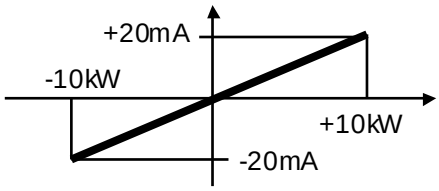
To configurate a current output, you have to define :
- The type of output : 4-20mA, 0-20mA, -20+20mA, -5+5mA, -10+10mA, 0-5mA, 0-10mA
- The number of the parameter dedicated to the output (see list of parameters)
- The down scale and full scale for the measured parameter
- The return value for saturation in case of alarm

N.B. : On setting on tension, the outputs will deliver –22mA during a few seconds.

Eg. : output 4-20mA for Vr between 50kV & 500Kv.



Eg. : output –20+20mA for Q between –10kW & +10kW.



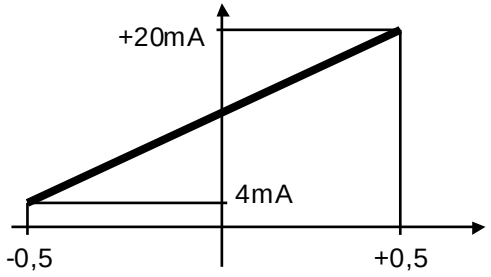
3-22. Special case of the power factor (COS) :

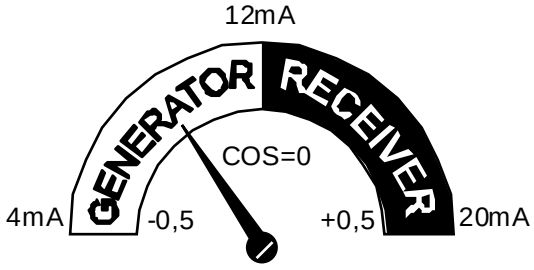
The power factor can be retransmitted on a current output in 3 different ways:

COS TYPE
MAth

- **MATHEMATICAL COSINE** : The cosine sign indicates the direction of current (receiver or generator)

***Example** : The load can be either current receiving, or generating. A cosine between –0.5 and +0.5 is retransmitted on a 4-20mA output.*



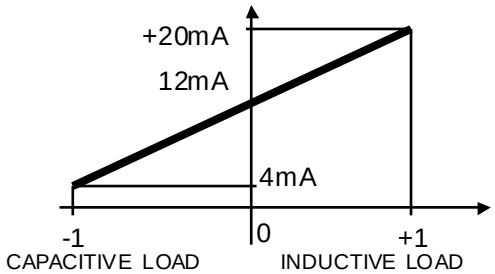


COS TYPE	OUTPUT COS
ELEC	**0**

- **ELECTRICAL COS CENTERED ON 0 :**

The cosine sign indicates the load nature (capacitive or inductive)

***Example :** Measurement of a network with a cosine compensation by capacitors. The nature of the load is inductive, but if we compensate too much we may obtain a capacitive load.*
The cosine will oscillate around +/-1. We programme a 4-20mA output for a cosine between –1 and +1.



The cosine oscillates between +/-1. The current output jumps from 4 to 20mA.
We can not use a viewmeter, but the linear transfer function allows for use of a digital panel meter on the current output.

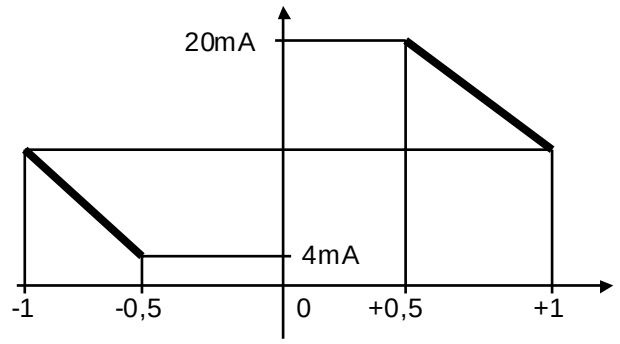
To avoid the jumps between 4 and 20mA, use following configuration :

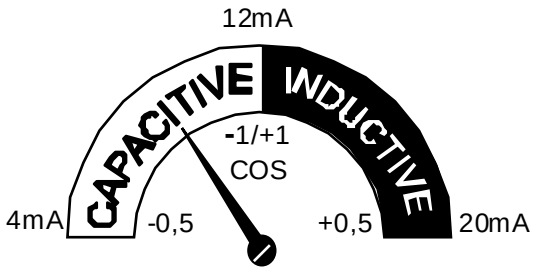
COS TYPE	OUTPUT COS
ELEC	**+/-1**

- **<u>ELECTRICAL COSINE CENTERED ON +/-1 :</u>**

The cosine sign always indicates the nature of the load
(capacitive or inductive, but the current output will be centered on a +/-1 cosine).

Eg. : If we take the previous example again, we programme the 4-20mA output for a cosine from –0.5 to +0.5





When the cosine oscillates between +/-1, the current output remains around 12mA.
The unlinear transfer function forbids the use of a digital panel meter on the current output.

3-23. Configuration of an output : procedure to be followed

PARAMETER
4 IL1

Choice of the parameter dedicated to the output
(the number and name of the parameter are displayed).

RANGE
0 20

Choice of the output type : -20/+20, -10/+10, -5/+5, 0/20 ...

LO RANGE	
2.00	**1**

Programming of the sign only for powers
Programming of the down scale and its unit
1, K, M, G

HI RANGE	
3.00	**1**

Programming of the sign only for powers
Programming of the full scale and its unit
1, K, M, G

FOLD DOWN
22 mA

Choice of the return value in mA between +22mA and –22mA.
It is the output return value in case of measure error.

4. CONFIGURATION OF A DIGITAL OUTPUT (RS)

4-1. General data :

- Transmission format :
  - 1 start bit
  - 8 data bits
  - parity : without / even / odd
  - 1 on 2 stop bits
- Baud rates :

Programmable :
  - 4800 bauds
  - 9600 bauds
  - 19200 bauds
- Slave number :

Programmable from 1 to 250

Measures are coded in integer format (2 bytes), and double integer for the energies.
The format is programmable.

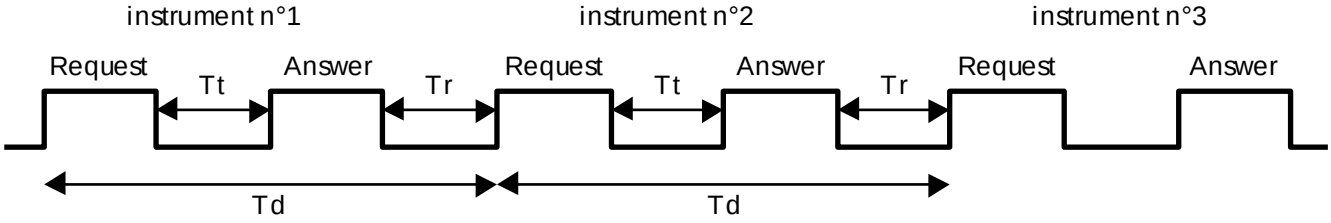
Maximum length of the RS pattern : 209 bytes (or 100 measures)

- Interface :

The instrument integrates an internal RS485 / RS422 board (2 or 4 wire)
Rx and Tx are indicated on page 6 respectivelly by Leds kilo and giga. A pattern analysis function is available (see p. 7).
For an RS485 two-wire wiring, check that your board and communication software (PC/PLC) accept 2-wire dialogues.

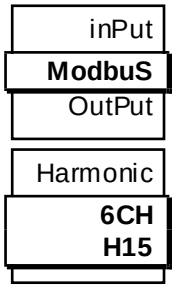
- Modbus functions used :
  - Function 1 : Reading of N bits
  - (only for sequences of 8 bits)
  - Function 3 : Reading of N words
  - Function 6 : writing of 1 word
  - Function 7 : Fast reading of the instrument type
  - Function 15 : Writing of N bits
    (only for sequences of 8 bits)
  - Function 16 : Writing of N words.
- Exception codes :
  - N°1 : function unknown
  - N°2 : address incorrect
  - N°3 : data incorrect
  - N°8 : writing error
  - N°9 : area overlapping.

- Durations to be respected :
  Request processing time : 75ms<Tt<130ms - Tr = 10ms min.
  Time of request repeat (in ms) : (N = number of measures requested)
  4800Bds : Td > 4N+168 9600Bds : Td > 2N+154 19200Bds : Td > N+147
  Example : at 9600bds for 10 measures : Td > 174ms



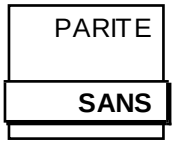
4-2. Output configuration : procedure to be followed.

For a fast reading of 12 measures of your choice, you can use the address area 39 to 50 to programme the 12 requested consecutive measures. Following programming is given as example :

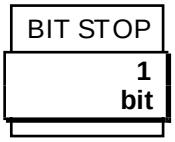


Enter the instrument configuration menu and choose MODBUS.

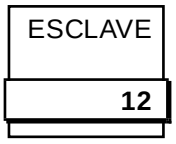
Option H only
Type of retransmission of the harmonics :
6CH/H15 = the 15 odd harm. of the 6 channels are transmitted (U and I)
1CH/H50 = the 50 harmonics of the selected channel are transmitted
(See annexe 1)



Choice of the parity bit:
SANS, PAIR, IMPAIR
(without / even / odd)



Choose the number of stop bits :
1 or 2 bits



Choose the slave number assigned to the instrument (1-250).

VITESSE
9600 bd

Choose the communication speed.
4800, 9600, 19200 bauds.

FORMAT
Nr1 2143

Programming of the format of the measures
1-2143 or 2-4321 or 3-1234 or 4-3412
(see format details next pages)

PARAMETRE
4 IL1

Programmng of the 12 parameters to be read consecutively :
Programme 1st chosen measure.

PARAMETRE
...

Programme the other chosen measures. Caution : an energy will take 2 locations.

4-3. Addresses of the measures

The value read in the first table gives the measure module (on 4 significant ciphers, resolution x10). To know the unit and decimal point of this measure, read them in the second table.

The unit and decimal point do not vary. They depend on the programmed CT/VT ratios. Hence, the second table does not need to be read permanently. This allows a quick reading of measures coded on a single integer.

	instrument measure	type	Address	Measure units
	1-U13 (Mesh voltage)	E	0	V, kV
	2-U12 (Mesh voltage)	E	1	V, kV
	3-U23 (Mesh voltage)	E	2	V, kV
	4-IL1 (Line current phase 1)	E	3	A, kA
	5-IL2 (Line current phase 2)	E	4	A, kA
	6-IL3 (Line current phase 3)	E	5	A, kA
	7- Total active power	E	6	W,kW,MW
	8- Total reactive power	E	7	Var,kVar,Mvar
	9- Total apparent power	E	8	VA,kVA,MVA
	10- Frequency	E	9	Hz
	11- Total COS (power factor)	E	10	-
	12- Leak current In	E	11	A
	13- Active energy drawn – LSB	E	12	Wh,kWh,MWh,GWh
	14- Active energy drawn – MSB	E	13	Wh,kWh,MWh,GWh
	15- Active energy supplied – LSB	E	14	Wh,kWh,MWh,GWh
	16- Active energy supplied – MSB	E	15	Wh,kWh,MWh,GWh
	17- Reactive inductive energy – LSB	E	16	Varh,kVarh,MVarh,GVarh
	18- Reactive inductive energy – MSB	E	17	Varh,kVarh,MVarh,GVarh
1	19- Capacitive energy – LSB	E	18	Varh,kVarh,MVarh,GVarh
	20- Capacitive energy – MSB	E	19	Varh,kVarh,MVarh,GVarh
	21-UL1 (Single voltage phase 1)	E	20	V, kV
	22-UL2 (Single voltage phase 2)	E	21	V, kV
	23-UL3 (Single voltage phase 3)	E	22	V, kV
	24-PL1 (Active power phase 1)	E	23	W,kW,MW
	25-PL2 (Active power phase 2)	E	24	W,kW,MW
	26-PL3 (Active power phase 3)	E	25	W,kW,MW
	27-QL1 (Reactive power phase 1)	E	26	Var,kVar,Mvar
	28-QL2 (Reactive power phase 2)	E	27	Var,kVar,Mvar
	29-QL3 (Reactive power phase 3)	E	28	Var,kVar,Mvar
	30-COSL1 (Power factor phase 1)	E	29	-
	31-COSL2 (Power factor phase 2)	E	30	-
	32-COSL3 (Power factor phase 3)	E	31	-
	33-Tangent φ	not av.	32	-
	34-φ	not av.	33	-
	35- Totalizer of operation hours	not av.	34	Hr
	36- Impedance	not av.	35	Ω
	37- Mesh voltages average	not av.	36	V, kV
	38- Single voltages average	not av.	37	V, kV
	39- Line currents average	not av.	38	A, kA

	40- Mesh voltages watching	not av.	39	V, kV	
	41- Single voltages watching	not av.	40	V, kV	
	42- Line currents watching	not av.	41	A, kA	
	43- Il1 (start current) maximum	not av.	42	A, kA	
	44- Il2 (start current) maximum	not av.	43	A, kA	
	45- Il3 (start current) maximum	not av.	44	A, kA	
	46- Average active power (N minutes)	not av.	45	W,kW,MW	
	47- Average reactive power (N minutes)	not av.	46	Var,kVar,Mvar	
	48- Average max.active power max. (N minutes)	not av.	47	W,kW,MW	
	49- Average max. reactive power (N minutes)	not av.	48	Var,kVar,Mvar	
	50- External counting / external parameter n°1	not av.	49	-	
	51- External counting / external parameter n°2	not av.	50	-	
	52- External counting / external parameter n°3	not av.	51	-	
	53- DC input n°1	not av.	52	-	
	54- DC input n°2	not av.	53	-	
	55- DC input n°3	not av.	54	-	
	56- diagnosis / measure errors	**E**	**55**	-	
	57- Free	not av.	56	-	
	58- Choice of measure n°1	**E**	**57**		**12 chosen measures**
2	**59- Choice of measure n°2**	**E**	**58**	**-**	
	…				
	69- Choice of measure n°12	**E**	**68**	**-**	
3	**70- Harmonics measurement channel (see annexe 1)**	**EH**	**69**	**-**	
	71- Area of harmonics measurement (see annexe 1)	**EH**	**70**	**%**	
	…				
	120-	**EH**	**119**	**%**	
	121-Year	not av.	120	-	
1	122-Day+month x 256	not av.	121	-	
	123-Minutes + hours x 256	not av.	122	-	
	124-Filling rate of recording memory	not av.	123	%	
	125-Test measure = 12345	**E**	**124**	-	

1 = measures in reading 2 = configurable area 3 = measure in reading / writing

Adresses of the measure units : 1 reading (at the start) is enough.

	Decimal points and units of measures	Adr	Decimal pts / Possible units
	1-Decimal point (MSB) / Unit (LSB) U13	125	1,2,3 / 0,1
	2-Decimal point (MSB) / Unit (LSB) U12	126	1,2,3 / 0,1
	3-Decimal point (MSB) / Unit (LSB) U23	127	1,2,3 / 0,1
	4-Decimal point (MSB) / Unit (LSB) IL1	128	1,2,3 / 0,1
	5-Decimal point (MSB) / Unit (LSB) IL2	129	1,2,3 / 0,1
	6-Decimal point (MSB) / Unit (LSB) IL3	130	1,2,3 / 0,1
	7-Decimal point (MSB) / Unit (LSB) P	131	1,2,3 / 0,1,2
	8-Decimal point (MSB) / Unit (LSB) Q	132	1,2,3 / 0,1,2
	9-Decimal point (MSB) / Unit (LSB) S	133	1,2,3 / 0,1,2
	10-Decimal point (MSB) / Unit (LSB) F	134	2 / 0
	11-Decimal point (MSB) / Unit (LSB) COS	135	3 / 0
	12-Decimal point (MSB) / Unit (LSB) In	136	1,2,3 / 0
	13-Decimal point (MSB) / Unit (LSB) EA drawn –LSB	137	1,2,3 / 0,1,2,3
	14-Decimal point (MSB) / Unit (LSB) EA drawn –MSB	138	1,2,3 / 0,1,2,3
	15-Decimal point (MSB) / Unit (LSB) EA Supplied –LSB	139	1,2,3 / 0,1,2,3
	16-Decimal point (MSB) / Unit (LSB) EA Supplied –MSB	140	1,2,3 / 0,1,2,3
	17-Decimal point (MSB) / Unit (LSB) ER inductive–LSB	141	1,2,3 / 0,1,2,3
	18-Decimal point (MSB) / Unit (LSB) ER inductive–MSB	142	1,2,3 / 0,1,2,3
	19-Decimal point (MSB) / Unit (LSB) ER capacitive-LSB	143	1,2,3 / 0,1,2,3
1	20-Decimal point (MSB) / Unit (LSB) ER capacitive-MSB	144	1,2,3 / 0,1,2,3
	21-Decimal point (MSB) / Unit (LSB) UL1	145	1,2,3 / 0,1

	22-Decimal point (MSB) / Unit (LSB) UL2	146	1,2,3 / 0,1
	23-Decimal point (MSB) / Unit (LSB) UL3	147	1,2,3 / 0,1
	24-Decimal point (MSB) / Unit (LSB) PL1	148	1,2,3 / 0,1,2
	25-Decimal point (MSB) / Unit (LSB) PL2	149	1,2,3 / 0,1,2
	26-Decimal point (MSB) / Unit (LSB) PL3	150	1,2,3 / 0,1,2
	27-Decimal point (MSB) / Unit (LSB) QL1	151	1,2,3 / 0,1,2
	28-Decimal point (MSB) / Unit (LSB) QL2	152	1,2,3 / 0,1,2
	29-Decimal point (MSB) / Unit (LSB) QL3	153	1,2,3 / 0,1,2
	30-Decimal point (MSB) / Unit (LSB) COSL1	154	3 / 0
	31-Decimal point (MSB) / Unit (LSB) COSL2	155	3 / 0
	32-Decimal point (MSB) / Unit (LSB) COSL3	156	3 / 0
	33-Decimal point (MSB) / Unit (LSB) Tanφ	157	1 / 0
	34-Decimal point (MSB) / Unit (LSB) φ	158	1 / 0
	35-Decimal point (MSB) / Unit (LSB) CptH	159	1 / 0,1
	36-Decimal point (MSB) / Unit (LSB) Z	160	1,2,3 / 0,1
	37-Decimal point (MSB) / Unit (LSB) UL-L average	161	1,2,3 / 0,1
	38-Decimal point (MSB) / Unit (LSB) UL average	162	1,2,3 / 0,1
	39-Decimal point (MSB) / Unit (LSB) IL average	163	1,2,3 / 0,1
	40-Decimal point (MSB) / Unit (LSB) UC watching	164	1,2,3 / 0,1
	41-Decimal point (MSB) / Unit (LSB) UL watching	165	1,2,3 / 0,1
	42-Decimal point (MSB) / Unit (LSB) IL watching	166	1,2,3 / 0,1
	43-Decimal point (MSB) / Unit (LSB) IL1 maximum	167	1,2,3 / 0,1
	44-Decimal point (MSB) / Unit (LSB) IL2 maximum	168	1,2,3 / 0,1
	45-Decimal point (MSB) / Unit (LSB) IL3 maximum	169	1,2,3 / 0,1
	46-Decimal point (MSB) / Unit (LSB) P average	170	1,2,3 / 0,1,2
	47-Decimal point (MSB) / Unit (LSB) Q average	171	1,2,3 / 0,1,2
	48-Decimal point (MSB) / Unit (LSB) P average maximum	172	1,2,3 / 0,1,2
	49-Decimal point (MSB) / Unit (LSB) Q average maximum	173	1,2,3 / 0,1,2
	50-Decimal point (MSB) / Unit (LSB) Counting / external n°1	174	0 / 0
	51-Decimal point (MSB) / Unit (LSB) Counting / external n°2	175	0 / 0
	52-Decimal point (MSB) / Unit (LSB) Counting / external n°3	176	0 / 0
	53-Decimal point (MSB) / Unit (LSB) DC input n°1	177	0 / 0
	54-Decimal point (MSB) / Unit (LSB) DC input n°2	178	0 / 0
	55-Decimal point (MSB) / Unit (LSB) DC input n°3	179	0 / 0
	56-Decimal point (MSB) / Unit (LSB) Diagnosis	180	0 / 0
	57-Decimal point (MSB) / Unit (LSB) Free	181	0 / 0
2	**58-Decimal point (MSB) / Unit (LSB) Choice of measure 1**	182	-
	59-Decimal point (MSB) / Unit (LSB) Choice of measure 2	183	-
	...		
	69-Decimal point (MSB) / Unit (LSB) Choice of measure 12	193	-
3	70-Decimal point (MSB) / Unit (LSB) Harmonics channel	194	0 / 0
1	71-Decimal point (MSB) / Unit (LSB) THD	195	0 / 0
	72-Decimal point (MSB) / Unit (LSB) H2	196	0 / 0
	...		
	120-Decimal point (MSB) / Unit (LSB) H50	244	0 / 0
	121-Decimal point (MSB) / Unit (LSB) Year	245	0 / 0
	122-Decimal point (MSB) / Unit (LSB) Day+month x 256	246	0 / 0
	123-Decimal point (MSB) / Unit (LSB) Min+hours x 256	247	0 / 0
	124-Decimal point (MSB) / Unit (LSB) Memory filling	248	0 / 0
	125-Decimal point (MSB) / Unit (LSB) Test measure	249	2 / 1

1 / X = measure in resolution x 10 : example P = 2534 ½, = 253.4 MW

0 / x = measure without decimal point : example Memory filling rate = 98 0/0 , i.e. 98%

Decimal point : 0: xxxx. 1: xxx.x 2: xx.xx 3: x.xxx Unit : 0: x1 1: kilo 2: Mega 3: Giga

Example : TC ratio 5KA / 1A : display = 5.00 kA
Transmission = 5000 in the measure table, and 3/1 in the table of decimal points / units

4-4. Format of the measures

-Coding of an energy :

the energy is coded on 4 bytes (double integer) : [byte1-byte2-byte3-byte4] from LSB to MSB, this means Energy = byte1 + byte2.256 + byte3.256^2 + byte4.256^3

-Coding of the measures :

measures are coded on 2 bytes (signed integer) : [byte1-byte2] from LSB to MSB, this means measure = byte1 + byte2.256

The format of the measures transmitted by the digital output depends on the performed programming :

- **Format Nr1 2143**

-transmission of an energy : (Energy = byte1 + byte 2.256 + byte 3.256^2 + byte 4.256^3)

1st sent byte = byte 2 2nd sent byte = byte 1
3rd sent byte = byte 4 4th sent byte = byte 3

-transmission of the measures : (Measure = byte 1 + byte 2.256)

1st sent byte = byte 2 2nd sent byte = byte 1

- **Format Nr2 4321**

- transmission of an energy : (Energy = byte 1 + byte 2.256 + byte 3.256^2 + byte 4.256^3)

1st sent byte = byte 4 2nd sent byte = byte 3
3rd sent byte = byte 2 4th sent byte = byte 1

-transmission of the measures : (Measure = byte 1 + byte 2.256)

1st sent byte = byte 2 2nd sent byte = byte 1

- **Format Nr3 1234**

- transmission of an energy : (Energy = byte 1 + byte 2.256 + byte 3.256^2 + byte 4.256^3)

1st sent byte = byte 1 2nd sent byte = byte 2
3rd sent byte = byte 3 4th sent byte = byte 4

-transmission of the measures : (Measure = byte 1 + byte 2.256)

1st sent byte = byte 1 2nd sent byte = byte 2

- **Format Nr4 3412**

- transmission of an energy : (Energy = byte 1 + byte 2.256 + byte 3.256^2 + byte 4.256^3)

1st sent byte = byte 3 2nd sent byte = byte 4
3rd sent byte = byte 1 4th sent byte = byte 2

-transmission of the measures : (Measure = byte 1 + byte 2.256)

1st sent byte = byte 1 2nd sent byte = byte 2

Example in format 2 – 1 / 4 – 3 :

Measure = 2000 = 208 + 7 x 256 transmission = 7 and 208

Energy = 1503 in the LSB and 43461 in the MSB =

223 + 5 x 256 + 197 x 256^2 + 169 x 256^3 transmission = 5 – 223 – 169 – 197

The energy is transmitted with the same unit as total powers.

For harmonics, the harmonic value is coded in % a an integer between 0 and 100

Tables of decimal points / units : given for information if you do not want to read the 2nd MODBUS table

3-phase network with neutral

VT primary	UL-L	UL-N
10.0 – 57.7 V	2 / 0	2 / 0
57.8 – 99.9 V	1 / 0	2 / 0
100 – 577 V	1 / 0	1 / 0
578 – 999 V	3 / 1	1 / 0
1.00 – 5.77 kV	3 / 1	3 / 1
5.78 – 9.99 kV	2 / 1	3 / 1
10.0 – 57.7 kV	2 / 1	2 / 1
57.8 – 99.9 kV	1 / 1	2 / 1

without neutral

VT primary	UL-L
10.0 – 99.9 V	2 / 0
100 – 999 V	1 / 0
1.00 – 9.99 kV	3 / 1
10.0 – 99.9 kV	2 / 1
100 – 999 kV	1 / 1

All networks

CT primary	IL
1.00 – 9.99 A	3 / 0
10.0 – 99.9 A	2 / 0
100 – 999 A	1 / 0
1.00 – 9.99 kA	3 / 1
10.0 – 99.9 kA	2 / 1

Example :
For a 3-phase unbalanced 4 wire network (with neutral) 230Vac without external VT, CT 2500A / 5A
Programme as VT ratio : 230 / 230 as CT ratio : 2.50 kA / 5.0A
→The VT primary is 230
-which gives for the single voltage 1 / 0 (1 cipher after the decimal point in V)
-for the mesh voltage 1 / 0 (1 cipher after the decimal point in V)
→The CT primary is 2.50 kA
-which gives for the current 3 / 1 (3 ciphers after the decimal point in kA)

Calculation of the product of CT and VT primaries :
3-phase network with neutral

Product VT primary x CT primary	PL / QL	P / Q / S / Ener
10 W – 33.3 W	2 / 0	2 / 0
33.4 W – 99.9 W	2 / 0	1 / 0
100 W – 333 W	1 / 0	1 / 0
334 W – 999 W	1 / 0	3 / 1
1.00 kW – 3.33 kW	3 / 1	3 / 1
3.34 kW – 9.99 kW	3 / 1	2 / 1
10.0 kW – 33.3 kW	2 / 1	2 / 1
33.4 kW – 99.9 kW	2 / 1	1 / 1
100 kW – 333 kW	1 / 1	1 / 1
334 kW – 999 kW	1 / 1	3 / 2
1.00 MW – 3.33 MW	3 / 2	3 / 2
3.34 MW – 9.99 MW	3 / 2	2 / 2
10.0 MW – 33.3 MW	2 / 2	2 / 2
33.4 MW – 99.9 MW	2 / 2	1 / 2
100 MW – 333 MW	1 / 2	1 / 2
334 MW – 999 MW	1 / 2	3 / 3

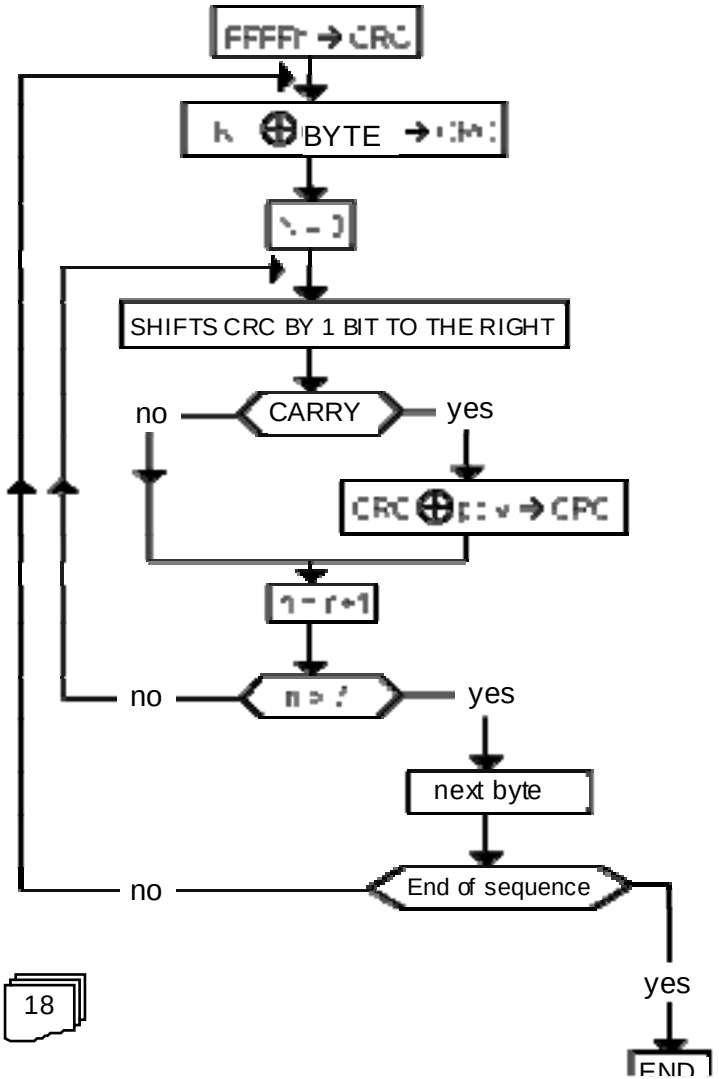
3-phase network without neutral

Product VT priamry x CT primary	P / Q / S / Ener
10 W – 57.7 W	2 / 0
57.8 W – 577 W	1 / 0
578 W – 5.77 kW	3 / 1
5.78 kW – 57.7 kW	2 / 1
57.8 kW – 577 kW	1 / 1
578 kW – 5.77 MW	3 / 2
5.78 MW – 57.7 MW	2 / 2
57.8 MW – 577 MW	1 / 2

Example :
Let us take previous example again :
→The product VT primary x CT primary = 575 kW
-which gives for powers per phase 1 / 0 (1 cipher after the decimal point in W)
-for total powers and energies 3 / 1 (3 ciphers after the decimal point in kW)

4-5. CRC16 calculation algorythm

- Note 1 : ⊕ = exclusive or
- Note 2 : poly = A001h
- Note 3 : the CRC16 calculation applies to all bytes in the pattern (except CRC16)
- Note 4 : CAUTION in the CRC16, the first sent byte is the LSB



Example :

Pattern 1 - 3 - 0 -75 - 0 - 2 - CRC16=180-29 (in decimal)

TECHNICAL FEATURES

1. GENERAL FEATURES

Case	Self-extinguishing in black UL94VO ABS
Format	(height x length x depth) = 96 x 49 x 112mm
Mounting	Latching on DIN rail
Protection	Case IP20 (with mounted terminals)
Connection	By plug-off screwed connectors (wire section : 2.5 mm²)
Indicators	1 to 4 LEDs
Programming	By PC

2. ELECTRICAL FEATURES

POWER SUPPLY	
Voltage	High or low voltage (Specify on order) 2 HT (high voltage): 90 to 270 VAC or 88 to 350VDC 3 BT (low voltage) : 20 to 40 VAC or 20 to 60VDC
Power draw	5 VA max.

INPUTS	
Voltages	2 programmable calibers Un=150VAC et 500VAC. Overloads 120% Un
Currents	2 programmable calibers 1A et 5A : In=1.2A et 6A. Overloads 120% In
Overload	Permanent : 750V, 10A During 10 s : 1000V, 50A
Power draws	Voltage inputs : 1MΩ resistance Current Inputs : < 0.2 VA
Test voltage	2KV, 50Hz /1min.
Frequency	45 ... 50 ... 65Hz (standard)
Network type	Single-phase, 3 phase balanced or unbalanced with or without neutral.
Thermic drifts	<200ppm

MEASURES	
Numbers of parameters	25 measurables parameters
Accuracy rating	In digital output grade 0.2 voltage/current , grade 0.5 powers (CEI688-1)
Measure cycle	55 ms for all types of networks
Measuring method	Fast simultaneous sampling of the voltages and currents Digital calculation on 32 bits Measuring of disturbed signals with a 800HZ pass-band
Harmonics analysis	Harmonics up to rank 50 on the 6 channels.
Digital filtering	Several levels on choice by programming.
Energies	Saved every 5 min. Caliber 5A grade 1 / caliber 1A grade 2 (CEI61036).

OPERATION AND TEST CONDITIONS	
Reference T°	23°C
Operating T°	0°C to 55°C (others on request) IEC 60068-2-1 and IEC 60068-2-2
... in damp area	40°C to 93% condensation free dampness IEC 60068-2-30
Storage T°	-25°C to 70°C IEC 60068-2-1 andIEC 60068-2-2
Storage T° gradiant	3°C/min from –20°C to +70°C IEC 60068-2-14
Relative dampness	5% to 95% condensation free IEC 60068-2-30
Rayed HF field	IEC 61000.4.3 level 3
Electrostatic discharge	IEC 61000.4.2 level 3
Conducted RF field	IEC 61000.4.6 level 3
Magnetic 50Hz field	IEC 61000.4.8 level 3
Shocwave 1,2/50µs	IEC 61000.4.5 level 3 mode series/common
Fast transient	IEC 61000.4.4 level 3 mode common
GSM RF field	ENV 50204
Generic standards :	immunity : IEC 61000-6-2 emissions : 61000-6-4 test standard : EN55011 class A
Vibration withstanding	+/-150µm from 10 to 57 Hz and +/-2G from 57Hz to 500Hz complies with IEC 60068-2-6
	CE marking

3. POSSIBLE OUTPUTS

The instrument can integrate :
- 1 digital RS422-RS485 output.

And 4 outputs on choice among :
- 2 pulse or setpoint outputs + 2 analog bidirectionnal ouputs
- 2 analog bidirectionnal outputs + 2 unidirectionnal analog outputs

The galvanic partition between outputs is 1kV.

▪ The relay outputs can be programmed either as alarm setpoint, or as energy pulse – option [R] .

Contact type : potential free, galvanic partition 2.5KV in relation to the inputs (or 4kV optional)
Rated load : 5A – 250VAC

- Pulse output – option [R] :

Width of pulse : 400 ms
Max count rate : 1 pulse / second
Pulse value : on choice, by programming.

- Setpoint output – option [R] :

Setting of setpoints : 0 to 100% of measure range by programming.
Switching hysteresis : 0 to 15% of setpoint by programming.
Time delay : 0 to 15s by programming.

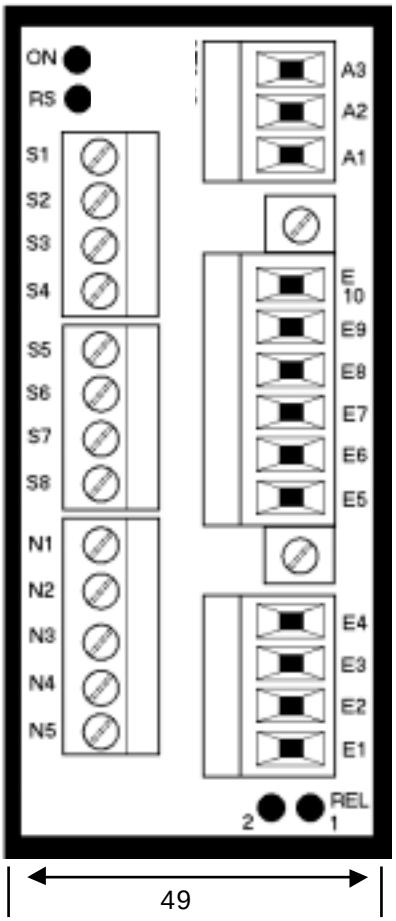
▪ Analog uni/bi-directionnal outputs – option [A] :

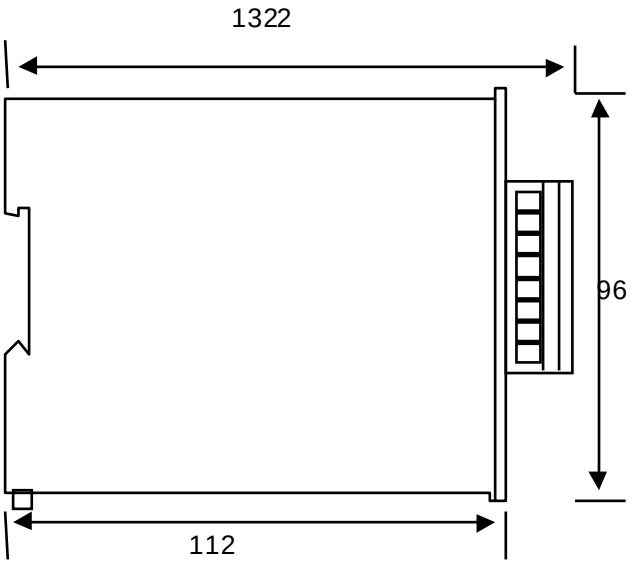
Galvanic partition : 2KV in relation to the inputs (or 4kV optional)
Output signal : Several combinaisons can be programmed (-/+20mA -/+10mA …).
Scale setting : 0 to 100% of the measure span, by programming
Admissible load : up to 600Ω (20mA)
Resolution : 24000 points
Accuracy : <0,1% of full scale on -/+20mA (in relation to display)
<0,2% on -/+5mA
Residual drift : -/+2,5mV (cc) on 50Ω load
Reponse time : 50ms for the output (<120ms input → output)
Thermic drift : <100ppm caliber –20/+20mA, <200ppm caliber 0/20mA

▪ Digital output RS422-RS485 :

Type : 2 or 4 wire (galvanic partition between inputs = 2KV, or 4kV optional).
Polarisation and terminaison : by 2 jumpers inside the casing.
Baud rate : 4800 / 9600 / 19200 bauds.
Protocole : Modbus/Jbus RTU 8 bits with or without parity, 1 or 2 stop bits.
Data format : integer 16 bits.

4. DIMENSIONS



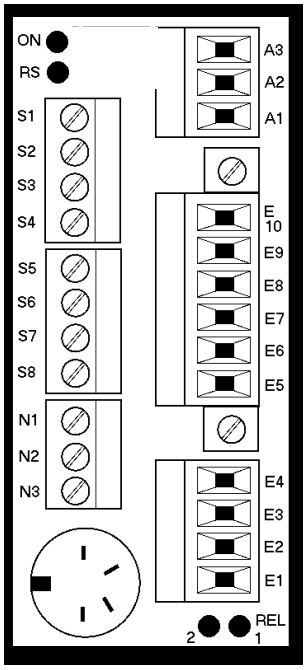


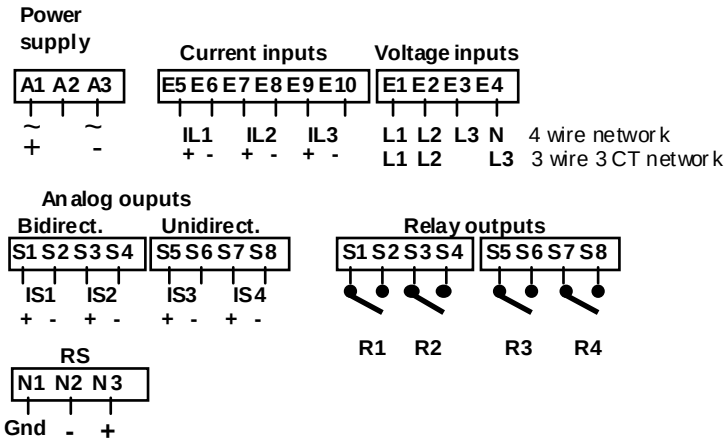
WIRING

1. WIRING RECOMMANDATIONS

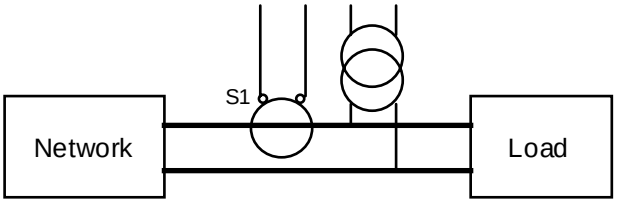
The input network (U and I) may carry significant disturbances, and the whole processing chain may be disturbed. In order to avoid this, the immunity from disturbances may be significantly improved by respecting following rules :

- Do not connect close to each other : the input network and the instrument power supply wires.
- Do not connect close to each other : the input network and the lot of instrument output wires (pulse or relay outputs...)
- Use for all outputs shielded cables connected to the GND on both extremities

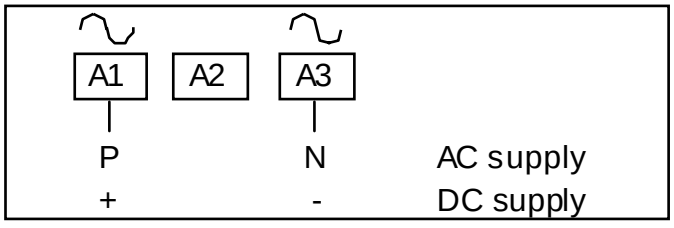




In order to avoid any influence of the current intake on the voltage measure, CTs must be connected before VTs.

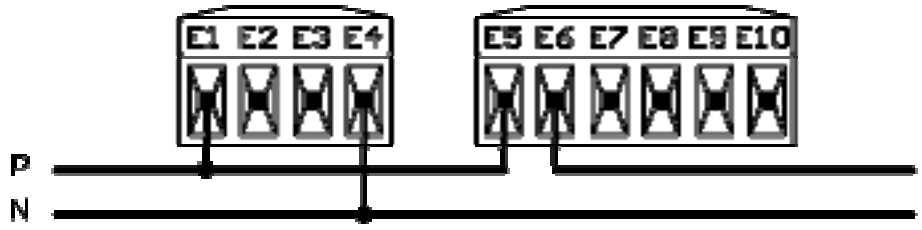


2. POWER SUPPLY WIRING



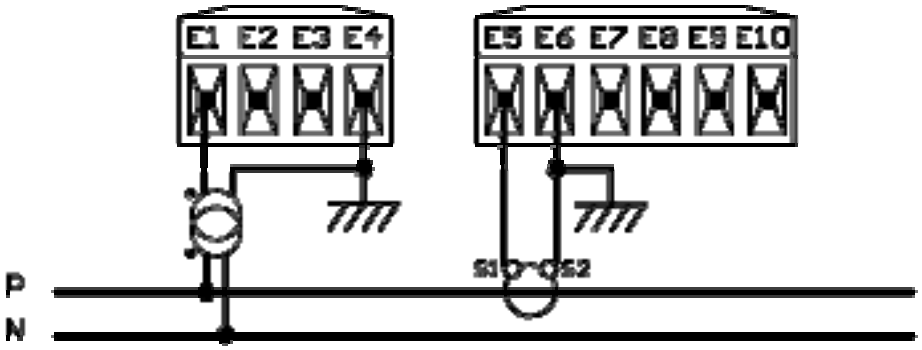
Note : connect the earth on A2.
For an AC supply, phase or neutral can be connected indiferrently on teminals A1 and A3.
For a DC supply, + and - can be connected indiferrently on A1 and A3.

3. WIRING OF A SINGLE-PHASE NETWORK : "MONO"



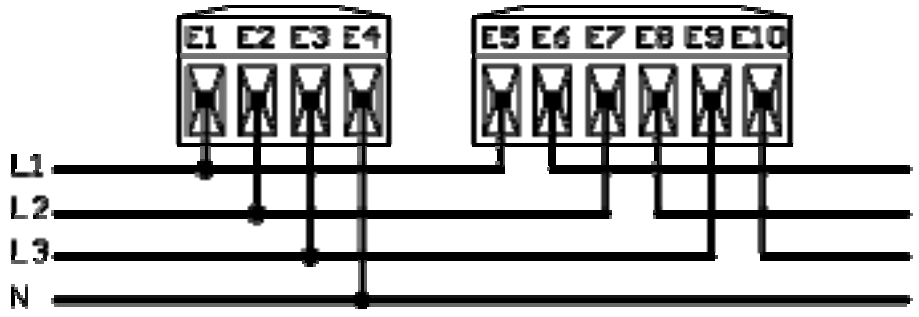
Without VT
Without CT

U max = 500V
I max = 5A



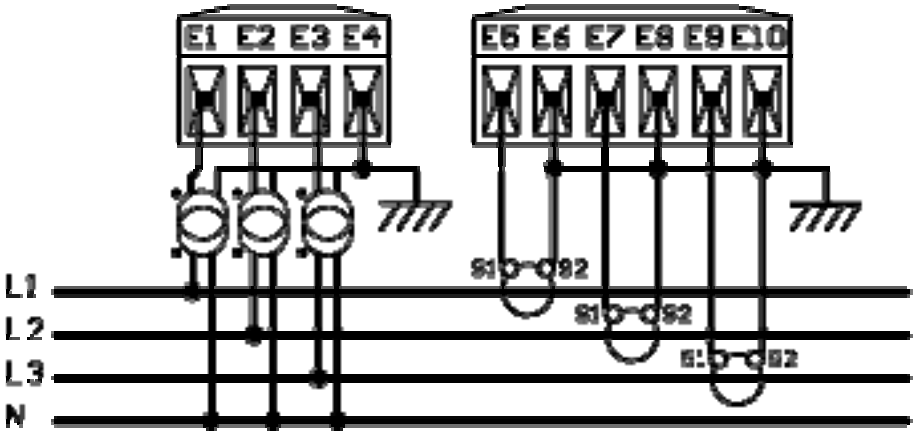
With VT
With CT

4. WIRING OF A 3-PHASE UNBALANCED NETWORK WITH NEUTRAL : "RES 4FIL nE"



without VT
without CT

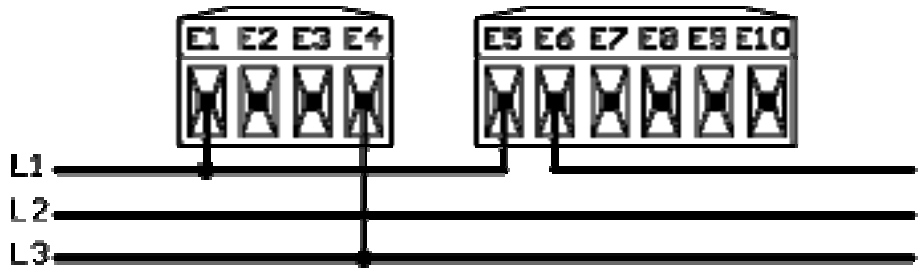
Umax = 500V
Imax = 5A



with VT
with CT

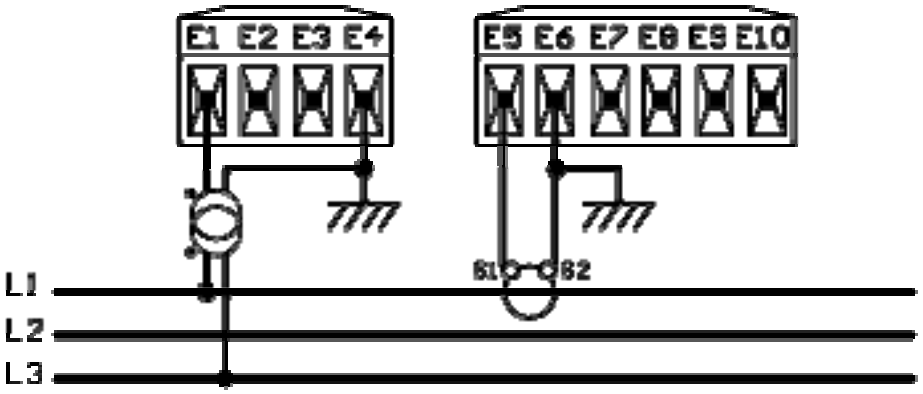
Respect wiring :
S1 corresponds to P1, and S2 corresponds to P2.
The CT and VT secondaries S2 must be connected to the earth. Connect this point to terminal 6 on the instrument.

5. WIRING OF A 3-PHASE BALANCED NETWORK WITHOUT NEUTRAL : "RES 3FIL E"



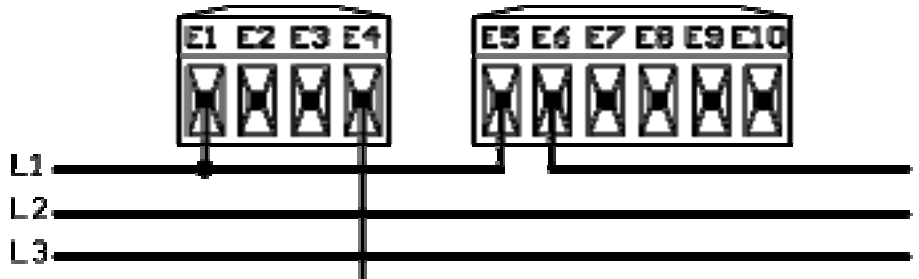
without VT
without CT

Umax = 500V
Imax = 5A



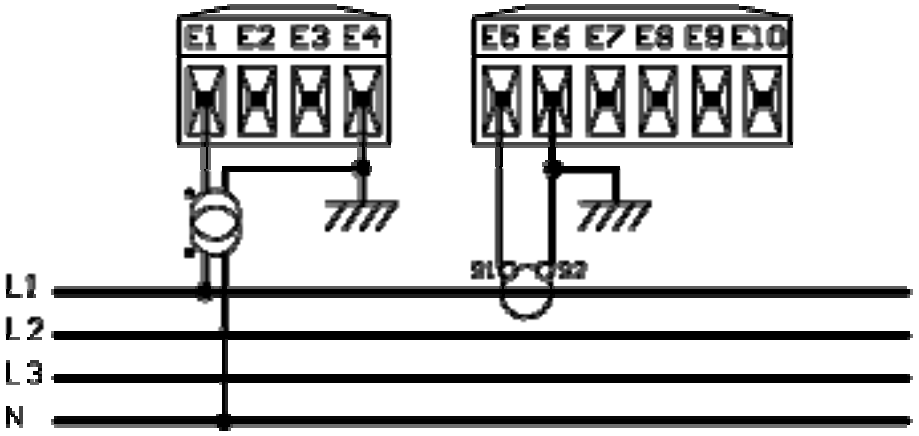
with VT
with CT

6. WIRING OF A 3-PHASE BALANCED NETWORK WITH NEUTRAL : "RES 4FIL E"



without VT
without CT

Umax = 500V
Imax = 5A

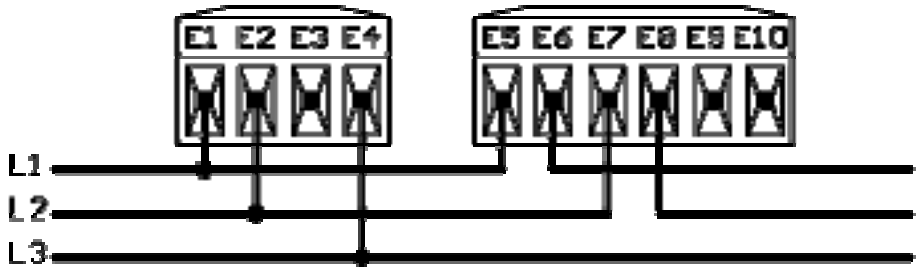


with VT
with CT

Respect wiring :
S1 corresponds to P1 and S2 corresponds to P2.
The CT and VT secondaries S2 must be connected to the earth. Connect this point to terminal 6 on the instrument.

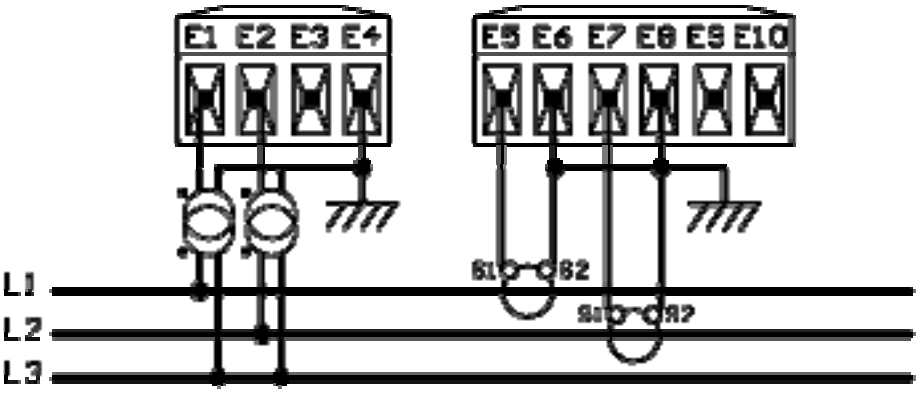
7. WIRING OF A 3-PHASE UNBALANCED NETWORK WITHOUT NEUTRAL, WITHOUT CURRENT LEAK :
"RES 3FIL nE.2C"

7-1. IL3 not connected



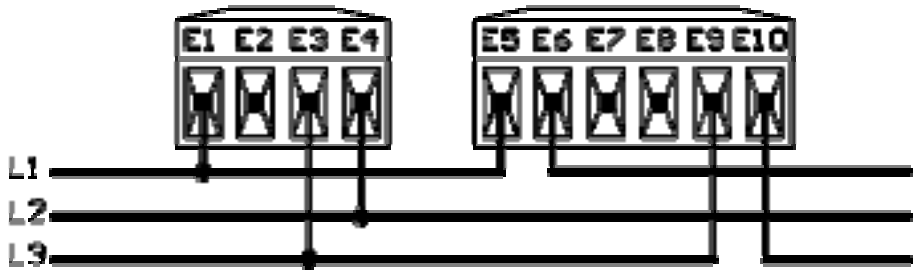
without VT
without CT

Umax = 500V
Imax = 5A



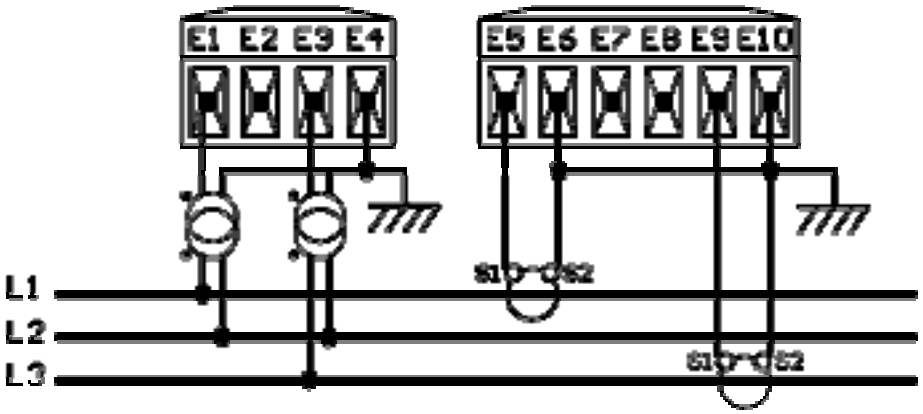
with VT
with CT

7-2. IL2 not connected



without VT
without CT

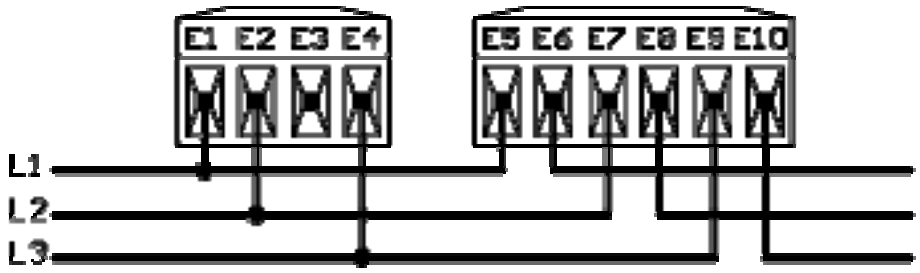
Umax = 500V
Imax = 5A



with VT
with CT

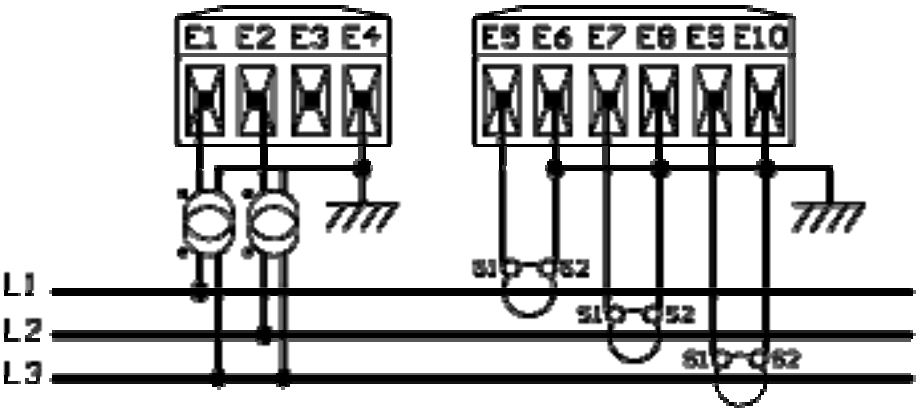
Respect wiring :
S1 corresponds to P1 and S2 corresponds to P2.
The CT and VT secondaries S2 must be connected to the earth. Connect this point to terminal 6 on the instrument.

8. WIRING OF A 3-PHASE UNBALANCED NETWORK WITHOUT NEUTRAL, MEASURING OF THE 3 CURRENTS : "RES 3FIL nE.3C"



without VT
without TC

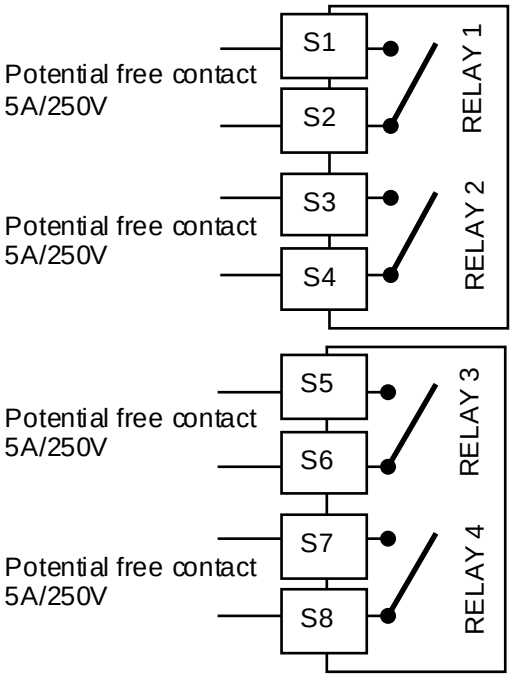
Umax = 500V
Imax = 5A



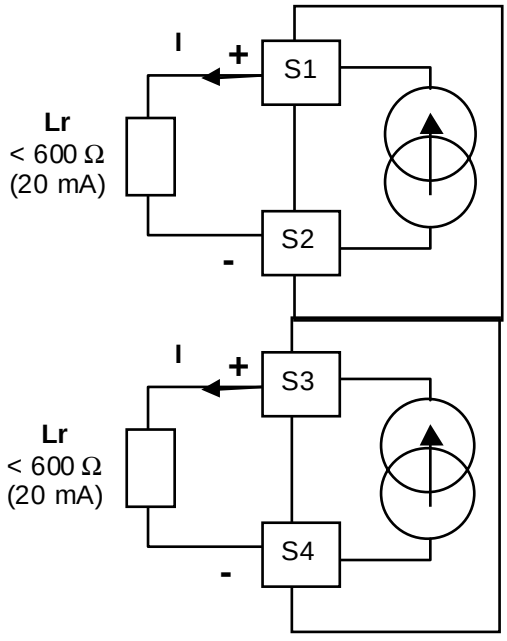
with VT
with CT

Respect wiring :
S1 corresponds to P1 and S2 corresponds to P2.
The CT and VT secondaries S2 must be connected to the earth. Connect this point to terminal 6 on the instrument.

9. WIRING OF THE RELAY OUTPUTS



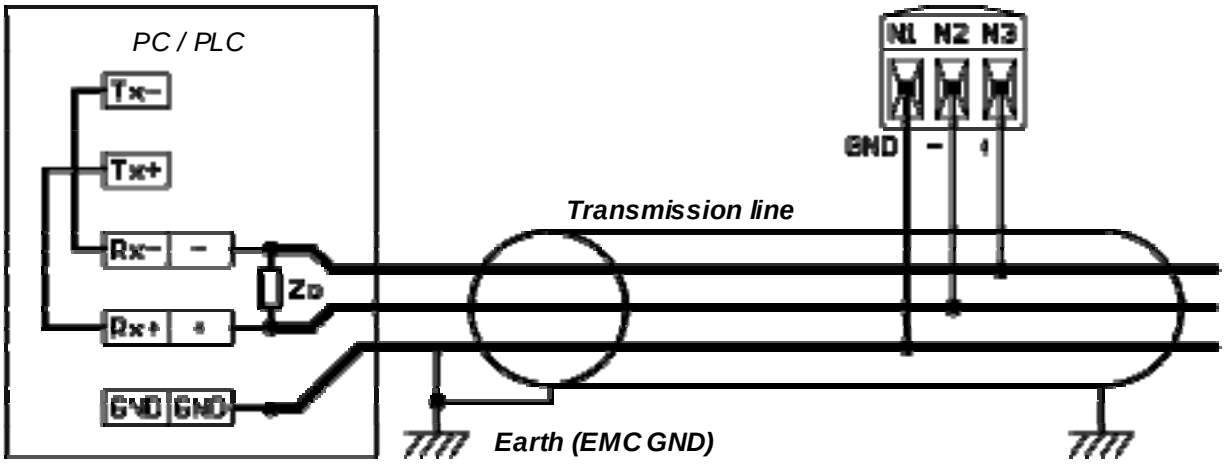
10. WIRING OF THE ANALOG OUTPUTS



Wiring identical in positions 3 and 4 (S5, S6 & S7, S8).

11. WIRING OF THE DIGITAL OUTPUT

- The end of line resistance Zo on the master reduces the influence of reflections in the lines.
  For speeds < 9600 bauds, the resistance is not necessary, from 1000m at 9600 bauds and 700m at 19200 bauds it is compulsory.
- Use shielded cables preferably to reduce the environment influence. Connect the earth to both extremities of the cable shielding, and the GND to one of the extremities.
- In case of communication problem : invert Rx and Tx polarities on the master. Check that the master emission arrives on the instrument wires.



Note :

- In 4 wire, the master emission driver must always be validated. This is performed either with the software if it has a selection 2/4 wires, or in the interface 485/422 using a micro-switch.
- In 2 wire, the master emission driver must be validated only if it is sending. This is performed with the software if it has a selection 4/2 wires, and in the interface RS485 using a microswitch which will validate the emission driver with the signal RTS (or DTR).

ANNEXE 1 : READING OF THE HARMONICS VIA THE DIGITAL DATA LINK

The retransmission of the harmonics on the digital output can be done in 2 different ways, according to the performed programming :

1. Programming 1CH/H50
TheTHD and the harmonics from rank 2 to rank 50 are transmitted for the selected channel to address 69
Selection of the channel :
The number of the channel is written (integer 0 or 3) at address 69
Integer=0 : UL1 harmonic Integer=3 : IL1 harmonic
The THD of the chosen channel can then be read at address 70, and the harmonic ranks from address 71.

L/E	Measure of the instrument	type	Adr	Measure units
L/E	**70-Selection of the harmonics channel (0:UL1 to 5:IL3)**	**EH**	**69**	**-**
L	**71- THD (selected channel)**	**EH**	**70**	**%**
L	**72- H2 (selected channel)**	**EH**	**71**	**%**
	…			
L	**120- H50 (selected channel)**	**EH**	**119**	**%**

After selecting a channel, wait for 6 seconds for the refreshing of the values

1. Programming 1CH/H50
The THD and the odd harmonics from rank 3 to rank 15 are transmitted for the 6 measure channels, no writing is necessary.

L/E	Measure of the instrument	type	Adr	Measure units
-	70-Not used		69	-
-	71-Not used		70	-
L	**72- THD UL1 (voltage channel 1)**	**EH**	**71**	**%**
L	**73- H3 UL1**	**EH**	**72**	**%**
L	**74- H5 UL1**	**EH**	**73**	**%**
L	**75- H7 UL1**	**EH**	**74**	**%**
L	**76- H9 UL1**	**EH**	**75**	**%**
L	**77- H11 UL1**	**EH**	**76**	**%**
L	**78- H13 UL1**	**EH**	**77**	**%**
L	**79- H15 UL1**	**EH**	**78**	**%**
L	**80- THD UL2 (voltage channel 2)**	**EH**	**79**	**%**
L	**81- H3 UL2**	**EH**	**80**	**%**
L	**82- H5 UL2**	**EH**	**81**	**%**
L	**83- H7 UL2**	**EH**	**82**	**%**
L	**84- H9 UL2**	**EH**	**83**	**%**
L	**85- H11 UL2**	**EH**	**84**	**%**
L	**86- H13 UL2**	**EH**	**85**	**%**
L	**87- H15 UL2**	**EH**	**86**	**%**
L	**88- THD UL3 (voltage channel 3)**	**EH**	**87**	**%**
L	**89- H3 UL3**	**EH**	**88**	**%**
L	**90- H5 UL3**	**EH**	**89**	**%**
L	**91- H7 UL3**	**EH**	**90**	**%**
L	**92- H9 UL3**	**EH**	**91**	**%**
L	**93- H11 UL3**	**EH**	**92**	**%**
L	**94- H13 UL3**	**EH**	**93**	**%**
L	**95- H15 UL3**	**EH**	**94**	**%**
L	**96- THD IL1 (current channel 4)**	**EH**	**95**	**%**
L	**97- H3 IL1**	**EH**	**96**	**%**
L	**98- H5 IL1**	**EH**	**97**	**%**
L	**99- H7 IL1**	**EH**	**98**	**%**
L	**100- H9 IL1**	**EH**	**99**	**%**
L	**101- H11 IL1**	**EH**	**100**	**%**
L	**102- H13 IL1**	**EH**	**101**	**%**

L	**103- H15 IL1**	**EH**	**102**	**%**
L	**104- THD IL2 (current channel 5)**	**EH**	**103**	**%**
L	**105- H3 IL2**	**EH**	**104**	**%**
L	**106- H5 IL2**	**EH**	**105**	**%**
L	**107- H7 IL2**	**EH**	**106**	**%**
L	**108- H9 IL2**	**EH**	**107**	**%**
L	**109- H11 IL2**	**EH**	**108**	**%**
L	**110- H13 IL2**	**EH**	**109**	**%**
L	**111- H15 IL2**	**EH**	**110**	**%**
L	**112- THD IL3 (current channel 6)**	**EH**	**111**	**%**
L	**113- H3 IL3**	**EH**	**112**	**%**
L	**114- H5 IL3**	**EH**	**113**	**%**
L	**115- H7 IL3**	**EH**	**114**	**%**
L	**116- H9 IL3**	**EH**	**115**	**%**
L	**117- H11 IL3**	**EH**	**116**	**%**
L	**118- H13 IL3**	**EH**	**117**	**%**
L	**119- H15 IL3**	**EH**	**118**	**%**
	120-Not used		119	-