Analizador de Red trifásico

ENERGY.3-DIS-RS

Manual de uso

Network Analyser User Manual

CE

Remberg®

Index

SAFETY WARNINGS

During the installation and operation of the instrument, proceed in accordance with the instructions below:

1) **The instrument should be installed by competent personnel**
2) **Follow the installation diagrams carefully**
3) **When connecting the instrument, always use TA x/5 A**
4) **The appliance should be installed in a panel from which no access can be gained to the terminals after installation**
5) **The terminals of the voltage and current circuits may be connected with a maximum rated voltage to earth of 300 V eff**
6) **The panel should be wired in accordance with the EN standards that apply**
7) **Do not power or connect the instrument if any part of it is damaged.**

■ **NOTE:**

- **Network analyser is designed to be used in locations with over-voltage category III and pollution level 2, in accordance with the EN 61010-1 standard**
- **The electrical system of the building in which the instrument is to be installed should have a switch or isolator fitted in the vicinity of the instrument in a place to which the operator has easy access.**
  A protective device against over-currents should be fitted.

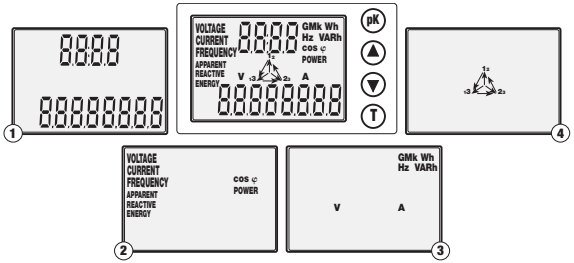
TECHNICAL SPECIFICATIONS

- Power supply: 230 VAC (-15%/+10%)
- Frequency: 50/60 Hz
- Maximum power consumption: 4 VA
- Indications: customised, rear lit LCD display
- Voltmeter inputs: max 550 V rms, 47÷63 Hz
- Ammetric inputs: max 6 A rms, 47÷63 Hz
- Scales: 1 voltage scale with max reading 550 V rms
  2 current scales with maximum readings of 2 A rms and 6 A rms
- Precision:
  - Voltage 0.5% of the end of scale value (for measurements between 10% and 100% of the end of scale)
  - Minimum signal measured 10 V
  - Current 0.5% of the end of scale value (for measurements between 10% and 100% of the end of scale)
  - Minimum signal measured 20 mA
  - Power 1% of the end of scale value
  - Frequency ±0.1 Hz (47÷63 Hz)
  - Active energy class 2 to standard EN 62052-21
  - Reactive energy class 3 to standard EN 62053-23

- TV selected: primary 1÷9999 V, secondary 230 V
- TA selected: primary 1÷9999 A, secondary 5 A
- Serial output: insulated RS-485 with MODBUS RTU protocol (max 9600 Baud)
- Operating temperature: 0 °C ÷ +50 °C
- Relative humidity: 10%÷90% non-condensing
- Container material in class V-0 in line with the UL 94 standard, 4 module DIN, colour RAL-7035 grey

INSTRUMENT DESCRIPTION

Display and messages



- ① Numerical fields for the display of the values measured
- ② Type of measurement taking place
- ③ Measurement unit
- ④ Phase symbols

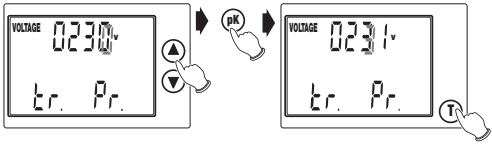
KEYS

- (▲) Scroll to the next page and set parameters
- (▼) Scroll to the previous page and set parameters
- (T) Display of the system values
- (pK) Display of the peak value and selection of parameters during programming

PARAMETER SETTING

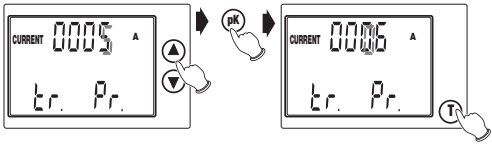
- Access to the programming menus takes place when the instrument is switched on by holding down the **"up" (▲)** and **"down" (▼)** keys at the same time.
- The following parameters can be programmed by the user in the order shown:
- Primary TV (fixed secondary 230 V)
- Primary TA (fixed secondary 5 A)
- Serial port configuration (3 screen displays) (not available in the spot version)
- Zeroing of active energy meter
- Zeroing of reactive energy meter
- Rear lighting handling
- For a new parameter setting, the power to the instrument has to be cut off and restored by pressing the **"up" (▲)** and **"down" (▼)** keys at the same time.

TV setting



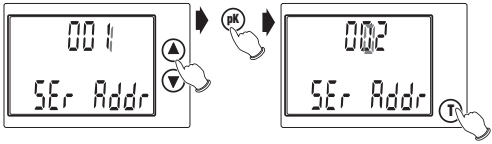
- Press the **"up" (▲)** or **"down" (▼)** keys to select the required value of the flashing figure
- To move to the next figure, press the **"pK"** key
- To confirm the value set and move to the next window, press **"T"**

TA setting

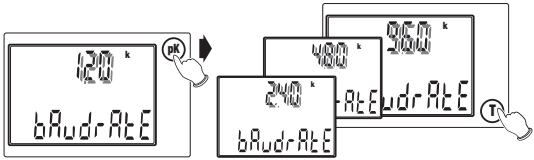


- The same as the TV setting procedure.
  Note: for the TV and TA primaries, any value from 0001 to 9999 can be set. If the value 0000 is set, the instrument will force this to 0001. The secondaries are set to 230 V and 5 A respectively.

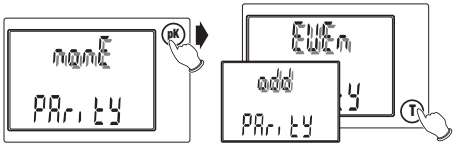
Serial port configuration



- **Setting the serial port address**: the same as the TV setting procedure

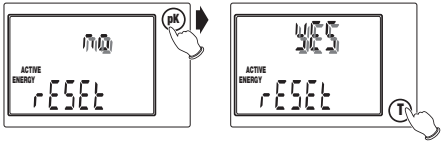


- **Setting the serial port speed**: press **"pK"** to select one of the 4 possible speeds **(1200, 2400, 4800 o 9600 Baud)**.
- To confirm the value set and move to the next window, press **"T"**.



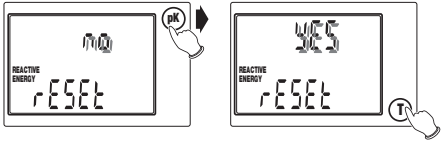
- **Setting the parity bit**: press **"pK"** to select one of the options **"NONE"**, **"ODD"** or **"EVEN"**, in order.
- To confirm the value set and move to the next window, press **"T"**.

Zeroing the active energy meter



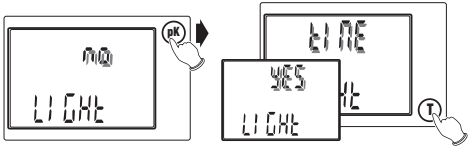
- Press **"pK"** to select the option **"YES"** or **"NO"**.
- To confirm the value set and move to the next window, press **"T"**.

Zeroing the reactive energy meter



- Same procedure as the zeroing of the active energy meter.

Rear lighting handling



- Press **"pK"** to select from the options **"NO"** (rear lighting off), **"YES"** (on) or **"TIME"** (on for approximately 60 seconds after a key is pressed).
- To confirm the value set and terminate the parameter setting procedure, press **"T"**.

■ When **"T"** is pressed, all the symbols in the display will come on for approximately 3 seconds, followed by the display of the main page.

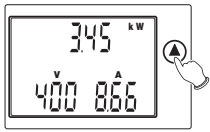
■ **Note: if the power is cut off during the programming procedure, the instrument will memorise all the settings in place at the instant when this occurs.**

DISPLAYING THE MEASUREMENT PAGE

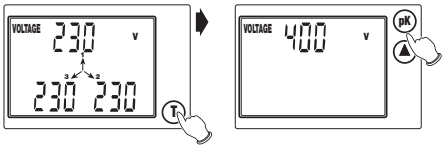
- When the instrument is switched on (or after the programming procedure) the main page is displayed after approximately 3 seconds when the display is fully operational.
- When **"up" (▲)** is pressed from the main page, the following are displayed: all the other measurement pages in sequence.
  When **"up" (▲)** is pressed from the last page, the system returns to the main page.
- If **V** is >999 or **I** is >999, the relevant measurement will flash to indicate that the unit is not complete (prefix **K** or **M** missing).

1) Main page

- **The system voltage, current**, and **active power** are displayed.

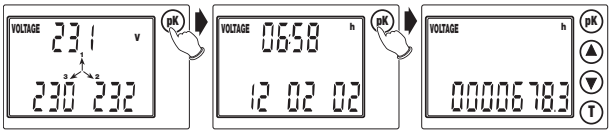


2) Phase voltage page



- The **phase voltages** are displayed. If the three phase system has no neutral, the voltages refer to a fictitious star delta centre.
- The **"T"** key is used to display the **system voltage** page.

2a) Peak phase voltage value page

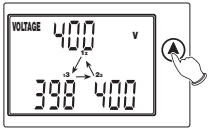


- If **"pK"** is pressed repeatedly from one of the two phase voltage pages, the following are displayed in order:
  - the peak voltage values (phase of system), with the **"V"** measurement unit flashing
  - the instant when the peak occurred (time and date)

- the number of hours lapsing between the start-up of the instrument and the occurrence of the peak (expressed in hours and tenths of an hour)

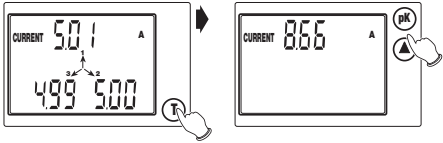
- To zero the peak values, simply press **"pK"** and **"T"** at the same time
- The **"up" (▲)** key can be pressed at any time to move to the next page.

3) Concatenating voltage page



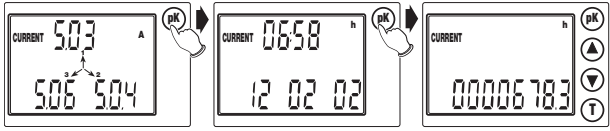
- The **concatenating voltages** between the phases are displayed.

4) Phase current page



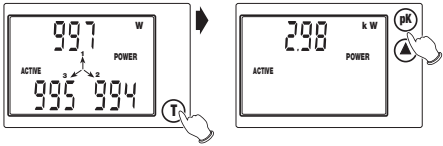
- The **phase currents** are displayed.
- The **"T"** key is used to display the **system current**.

4a) Peak phase current value page



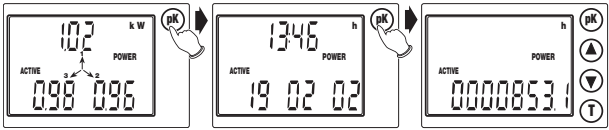
- The same procedure as that for the display of the peak phase voltage values.

5) Active phase power page



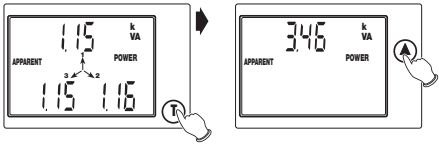
- The **active phase powers** are displayed.
- The **"T"** key is used to display the **active system power**.

5a) Peak active power value pages



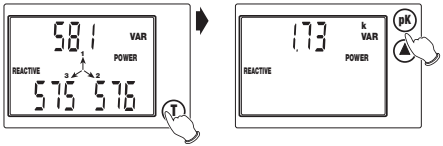
- The same procedure as that for the display of the peak phase voltage values.

6) Apparent phase power page



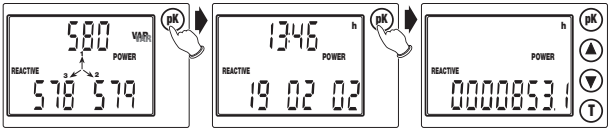
- The **apparent phase powers** are displayed.
- The **"T"** key is used to display the **apparent system power**.

7) Reactive phase power page



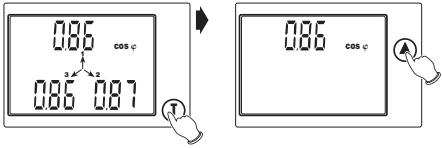
- The **reactive phase powers** are displayed.
- The **"T"** key is used to display the **reactive system power**.

7a) Reactive power peak value pages



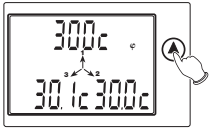
- The same procedure as that for the display of the peak phase voltage values.

8) Phase power factor page



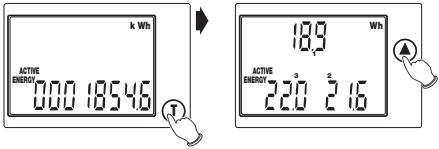
- The **phase power factors** are displayed.
- The **"T"** key is used to display the **system power factor**.

9) Voltage-current phase shift page



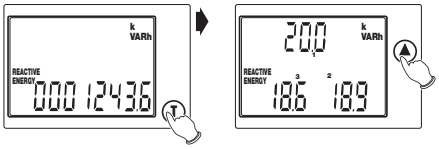
- The **voltage-current phase shifts** are displayed in sexagesimal degrees (the letter **"C"** indicates a capacitative phase shift, and **"L"** indicates an inductive phase shift).

10) Total active energy page



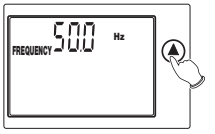
- The **total active energy** is displayed.
- The **"T"** key is used to display the **partial active energy** of the single phases (these energy readings are zeroed each time the total active energy is increased).

11) Total reactive energy page



- The **total reactive energy** is displayed.
- The **"T"** key is used to display the **partial reactive energy** readings for the single phases (these energy readings are zeroed each time the total reactive energy is increased).

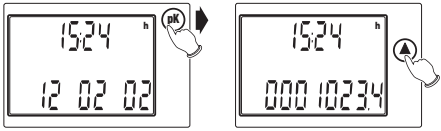
12) Frequency page



- The V1 voltage frequency is displayed.

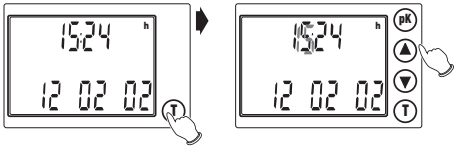
English

13) Time and date page



- The time and date are displayed in dd-mm-yy format.
- The **"pK"** key is used to move from the display of the time and date lapsed since the instrument was switched on (expressed in hours and tenths of an hour).
- The **"up" (▲)** key is used to return to the starting page.

13a) Setting the time and date



- When **"T"** is pressed from one of the time display pages, the time and date can be set
- Press the **"up" (▲)** or **"down" (▼)** keys to select the required value of the flashing number
- Press **"pK"** to move to the next number
- The **"T"** key can be pressed at any time to return to the time display page, with the memorisation of the modifications entered.

Note: up to the entry of the first setting, the time and date will flash.
The time and date will also flash in the peak value pages.

MEASUREMENT / CALCULATION METHOD

- The voltage and current measurements take place in (True RMS) by means of sampling and analogue-digital conversion.
- To calculate the system values, the following formulas are used:

System voltage $\mathbf{V} = \frac{V_1 + V_2 + V_3}{\sqrt{3}}$

System current $\mathbf{I} = \frac{I_1 + I_2 + I_3}{\sqrt{3}}$

Active system power $\mathbf{P} = P_1 + P_2 + P_3$

Reactive system power $\mathbf{Q} = Q_1 + Q_2 + Q_3$ (addition)

Apparent system power $\mathbf{A} = \sqrt{\mathbf{P}^2 + \mathbf{Q}^2}$

System power factor $\mathbf{PF} = \frac{\mathbf{P}}{\mathbf{A}}$

Total active energy $\mathbf{E} = E_1 + E_2 + E_3$

SERIAL COMMUNICATION

■ The reference document for all the aspects of the Modbus, as well as the only official specification of the protocol in question, is that found in the web site www.modbus.org. The data communication system based on the Modbus protocol makes it possible to connect up to 247 instruments to a common RS485 line. The communication takes place in half duplex, and only the master (PC/PLC) is able to initiate the question and answer type dialogue with the slaves (address 0) without obtaining any reply.

Characteristics of the Modbus protocol

- Type of Modbus coding: RTU (Remote Terminal Unit)
- Transmission speed (Baud rate): 9600, 4800, 2400, 1200 bps (selectable by the user)
- Byte format transmitted: 1 start bit, 8 data bits, parity bit: none odd, even (as selected), 1 stop bit.

Message structure

The message is structured in various fields (start, address, function, data, CRC check, end), made up of 1 or more characters each; the characters permitted for each field are the hexadecimals 0…9, A…F; the entire message has to be sent with no interruptions, and if there is a pause lasting more than a transmission time of 1.5 characters the receiver has to recognise the incomplete message condition and assume that the following byte is the start of a new message. The start and end of the message can be recognised by a silent interval of at least 3.5 characters. The message can be summed up as follows:

START	ADDRESS	FUNCTION	DATA	CRC CHECK	END
T1-T2-T3-T4	8 BITS	8 BITS	#X 8 BITS	16 BITS	T1-T2-T3-T4

Error check calculation procedure

The Cyclical Redundancy Check (CRC) field is made up of two bytes and contains a 16 bit binary value. This value is calculated by the transmitter device, which inserts the CRC in the message. The receiver device recalculates the CRC during the reception of the message and compares the value calculated with that received in the message. If the two values do not coincide, an error condition is generated.

Funzioni Modbus implementate

Read holding register	(03)
Read input register	(04)
Force multiple coil	(15)*
Preset multiple register	(16)*

* messaggi indirizzabili a tutti gli slave (slave address = 0)

- **Read holding register (03)**
  Function for the reading of the registers used to memorise the programmable parameters of the instrument. The registers are programmed by means of the 'preset multiple register' (16) function.

  The two bytes to indicate the register are obtained by removing the indicative and subtracting one from the register number. Es.: 40004 → 0004 → (0004-1) =0003

  List of holding registers (in hexadecimal format):

  40001: primary ammeter transformer (in Ampere)
  40002 primary voltmeter transformer (in Volt)
  40003 calendar: month – day
  40004 calendar: year – hours
  40005 calendar: minutes – seconds

Read input register (04): 30001...30067 single request (all)
Function for the reading of the registers in which the measurements are memorised.
The instrument obtains the value of all available measurements (33) with a single request

The measurements available are:

V	=	system voltage
I	=	system current
P	=	active system power
Q	=	reactive system power
A	=	apparent system power
PF	=	system power factor
Ea	=	total active energy
Er	=	total reactive energy
f	=	frequency (phase 1)
V12, V23, V31	=	concatenated voltage
Vn	=	phase voltage (n = 1, 2, 3)
In	=	phase current (n = 1, 2, 3)
Pn	=	active phase power (n = 1, 2, 3)
An	=	apparent phase power (n = 1, 2, 3)
Qn	=	reactive phase power (n = 1, 2, 3)
PFn	=	phase power factor (n = 1, 2, 3)
ϕn	=	phase shift between voltage and corresponding current (n = 1, 2, 3)
Vmax	=	maximum system voltage value
Imax	=	maximum system current value
Pmax	=	maximum system active power value
Qmax	=	maximum system reactive power value
TVmax	=	instant of maximum system voltage value
TImax	=	instant of maximum system current value
TPmax	=	instant of maximum system active power value

TQmax = instant of maximum system reactive power value
Vnmax = phase voltage value corresponding to the instant of TVmax (n = 1, 2, 3)
Inmax = phase current value corresponding to the instant of TImax (n = 1, 2, 3)
Pnmax = active phase power value corresponding to the instant of TPmax (n = 1, 2, 3)
Qnmax = reactive phase power value corresponding to the instant of TQmax (n = 1, 2, 3)

The two bytes to indicate the register are obtained by removing the indicative and subtracting one from the register number.
For example: 30009 → 0009 → (0009-1) =0008

List of register inputs: each pair of registers contains the value of an electrical dimension measured, expressed in IEEE floating point format. The two energy meters are expressed by means of an internal number in 32 bits.

set the pc terminal (ej. Modbus poll) as FLOAT INVERSE

Address	N. words	Dimension	Unit
30001	2	V	[V]
30003	2	I	[A]
30005	2	P	[W]
30007	2	A	[VA]
30009	2	Q	[var]
30011	2	PF	---
30013	2	f	[Hz]
30015	2	V12	[V]
30017	2	V23	[V]
30019	2	V31	[V]
30021	2	V1	[V]
30023	2	V2	[V]
30025	2	V3	[V]
30027	2	I1	[A]
30029	2	I2	[A]
30031	2	I3	[A]
30033	2	P1	[W]

Address	N. words	Dimension	Unit
30035	2	P2	[W]
30037	2	P3	[W]
30039	2	A1	[VA]
30041	2	A2	[VA]
30043	2	A3	[VA]
30045	2	Q1	[var]
30047	2	Q2	[var]
30049	2	Q3	[var]
30051	2	PF1	---
30053	2	PF2	---
30055	2	PF3	---
30057	2	ϕ1	°
30059	2	ϕ2	°
30061	2	ϕ3	°
30063	2	Ea	[kW/10]
30065	2	Er	[kvar/10]

Apart from the input register at address 0067, there are also the peak values memorised and their times.

Address	N. words	Dimension	Unit
30067	2	Vmax	[V]
30069	2	Imax	[A]
30071	2	Pmax	[W]
30073	2	Qmax	[var]
30075	3	TVmax	(*)
30078	3	TImax	(*)
30081	3	TPmax	(*)
30084	3	TQmax	(*)
30087	2	V1max	[V]
30089	2	V2max	[V]

Address	N. words	Dimension	Unit
30091	2	V3 max	[V]
30093	2	I1 max	[A]
30095	2	I2 max	[A]
30097	2	I3 max	[A]
30099	2	P1 max	[W]
30101	2	P2 max	[W]
30103	2	P3 max	[W]
30105	2	Q1 max	[var]
30107	2	Q2 max	[var]
30109	2	Q3 max	[var]

(*) The times are expressed in the month-day-year-hour-minutes-seconds format (1 byte for each field).

All the measurements contained in the input registers (with the exception of energy meters) are expressed in standard floating point numerical format IEEE-754, which encodes a floating point number of 32 bits, made up of: 1 sign bit, 8 exponent bits and 23 mantissa bits, arranged as follows:

Sign	Exponent	Mantissa
1 Bit	8 Bit	23 Bit
MSB		LSB

The value is encoded as:

$$-1^{s} * (1+m) * 2^{(e-127)}$$

s: sign bit. If the value is negative, this is equal to 1, if positive it is equal to 0.
e: exponent encoded at 8 bits, calculated with an offset of +127.
m: mantissa encoded at 23 bits, calculated by subtracting 1, in such a way as to obtain numbers always between 1 and 1.999999881 ($2-(2^{-23})$), which can be encoded in negative powers of 2.

Force multiple coil (15 = Fhex)
This function is used to carry out commands on the instrument. The commands are regarded as output coils.

List of coils (address):
COIL1: reset energy meters (0)
COIL2: reset peak values (1)

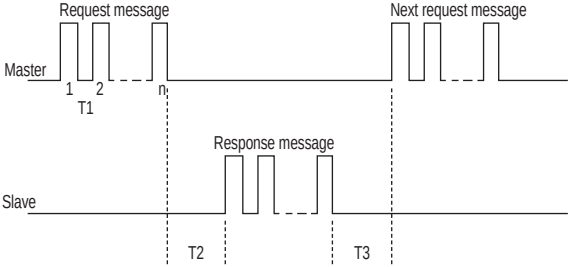
Preset multiple register (16 = 10hex)
Function used to programme a number of "holding" registers.
See list of holding registers in "Read holding register (3)" section.

Communication errors detected

"No response". Data format error, CRC error, etc (it is therefore not possible to be certain that the message is correctly addressed).
"Exception response". The possible error codes are:
01 – illegal function
02 – illegal data address
03 – illegal data value

Serial communication times

The communication protocol has no restrictions with regard to the response time of a slave device interrogated by a master (time T2), or with regard to time T3, that is, the time lapsing between the end of a response and the start of a new interrogation by the master.



However, these parameters take on particular importance in the setting up of a network made up of a large number of instruments, in fact if T2 and T3 are not restricted by determined maximum values, the time needed by the master (PC) to interrogate the entire rate may be excessive. It is also necessary to set the minimum values to avoid problems of conflict between different devices. The accepted values are listed inside this table:

Time	Description	Min/Typ/Max values
T1	Inter-character timeout: 1.5 (one character duration)	Max =12ms (a 1200bps) Max =6ms (a 2400bps) Max =3ms (a 4800bps) Max =1.5ms (a 9600bps)
T2	Slave response time	Min = 25ms Typ = 30ms Max =100ms
T3	Minimum time between two request messages from the Master	Min = 100ms Typ > 1s

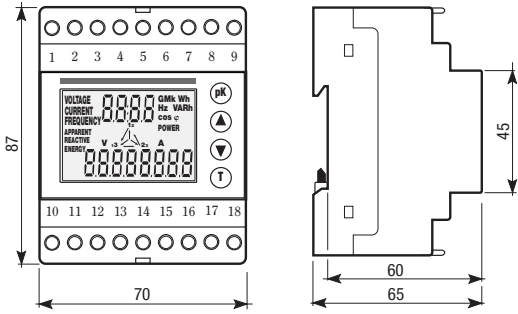
REFERENCE STANDARDS

Conformity to EC directives
2006/95/EC (LVD)
2004/108/EC (EMC)
is declared with reference to the following harmonised standards:

- **Safety**: EN 61010-1
- **Electromagnetic compatibility**: EN 61000-6-2 and EN 61000-6-4
- **Metering requirements**: EN 62052-21 and EN 62053-23

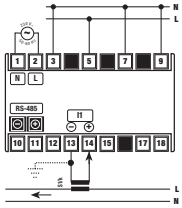

1 2 3 4 5 6 7 8 9
VOLTAGE
230
V
231
230
pK
T
10 11 12 13 14 15 16 17 18

DIMENSIONS

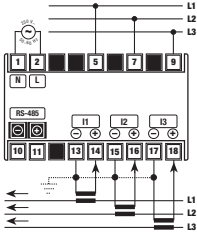

1 2 3 4 5 6 7 8 9
VOLTAGE
CURRENT
FREQUENCY
APPARENT
REACTIVE
ENERGY
GMk Wh
Hz VARh
cos
POWER
V
A
pK
T
10 11 12 13 14 15 16 17 18
87
70
45
60
65

CONNECTION DIAGRAMS

Single phase



Three phase



Three phase+N