Three-phase power analyzer and power quality

CVM*k2*

INSTRUCTION MANUAL

(M98206501-03-08E)

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LIMITATION OF LIABILITY

CIRCUTOR, SA reserves the right to modify, without prior notification, the devices or device specifications included herein. **CIRCUTOR**, SA advises users to obtain the latest version of these devices' specifications.

DANGER

In order to safely use the equipment, the personnel in charge of installing or handling it must follow the safety guidelines indicated for handling electric devices and heed all warnings provided in the instruction manual.

This equipment should be installed and maintained by qualified personnel.

WARNING

Warning! Read the instruction manual before using this equipment.

If the instructions provided herein, are preceded by this symbol but are not followed or correctly executed, personnel injuries or equipment and/or facilities damaged may result.

If there are any concerns about the functionality of the equipment or possible breakdowns, communicate this with **CIRCUTOR After sales service (S.A.T.)**:

SPAIN: **902 449 459**

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BUREAU VERITAS Certification — ISO 9001 — ISO 14001 — OHSAS 18001

INDICE MANUAL

1. INTRODUCTION

This manual is intended to be used as a guide in the installation, configuration and operation of the **CVMk2** network analyzer, for optimising the system's benefits.

1.1 DESCRIPTION

CVMk2 measures, calculates and displays the primary electric parameters in balanced or unbalanced three-phase industrial networks.
True RMS values are measured using three alternating voltage inputs, two voltage references (neutral and ground), and four current inputs to measure secondaries …/1A or …/5A, coming from the outside current transformers. It should be considered that when secondary .../1 is selected, the calculation is made by the software.

The **CVMk2** network and power supply quality analyzer is a programmable measuring instrument. It offers a wide variety of uses, which can be selected from the instrument's configuration menus. Prior to using the analyzer, read the following sections carefully: power supply, connection and configuration. Then, choose the best operating method for obtaining the desired data.

CVMk2 permits viewing the electric parameters on a backlit 1/4 VGA graphical display. Real time, maximum or minimum electric parameters can be viewed by pressing the corresponding key.

The **CVMk2** internal processor shows more than 500 electric parameters via the display screen and communication. Said parameters may be fed from a single or three phase system.

The **CVMk2** has the following relevant characteristics:

- Outside dimensions 144x144x116 mm.
- Mounted on a DIN rail (measurement module) with display screen on panel (96x96 mm, 144x144 mm or 103 mm (4") diameter hole.
- True RMS value (TRMS) measurement.
- Class 0,2 or 0,5 in Power and Energy (*).
- Real time, maximum and minimum values for each parameter with date and time.
- 1/4 VGA graphical display.
- RS-485 (Modbus/RTU©) communication incorporated.
- Possible to configure the display screen as the MASTER for 32 measurement modules.
- Multi-tariff equipment (allows to program up to 9 tariff)
- Memory of present, month and annual energy consumed and generated.
- Graphical display of wave forms and voltage and current phasors.
- 8 digit (100 GW·h) counter to track energy consumed and energy generated.

- Recording of power supply quality events.
- Expandable with inputs/outputs expansion card.
- Implemented in the **CIRCUTOR** energy management software, **PowerStudio Scada**.
  http://powerstudio.circutor.com

(*) Depending on the type

CVMk2 HAS NO BATERY. WHEN SUPPLY FALLS DOWN THE ANALYZER DO NOT STORE THE QUALITY EVENTS. IS VERY IMPORTANT TO GUARANTEE THE SUPPLY OF THE THE DEVICE FROM AN INTERRUTED SOURCE (BATERY, SAI, ...)

1.2 TYPES AVAILABLE

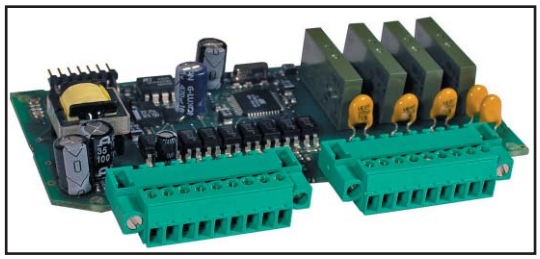
CODE	TYPE	VALID FOR .../5 AND .../1 A TRANSFORMERS	THREE PHASE 50...60HZ	TRUE RMS VALUE (TRMS)	INSULATED CURRENT INPUTS ITF	COMMUNICATION PORTS (*)	EXPANSION SLOTS	ANALYSIS OF VOLTAGE (50º) AND	DISTURBANCE DETECTION	MULTI-TARIFF EQUIPMENT (9 TARIFF)	4 QUADRANTS	VOLTAGE AND CURRENT WAVE FORMS	CLASS 0.5 (POWER AND ENERGY)	CLASS 0.2 (POWER AND ENERGY)	NETWORK PROTOCOL	COMMUNICATION PROTOCOL
M54400	**CVM*k2*-ITF-405**	•	•	•	•	2	3	•	•	•	•	•	•		RS485	Modbus-RTU
M54402	**CVM*k2*-ITF-402**	•	•	•	•	2	3	•	•	•	•	•		•	RS485	Modbus-RTU

Measurement modules (without display)

M54410	**M-CVM*k2*-ITF-405**	•	•	•	•	2	3	•	•	•	•	•	•		RS485	Modbus-RTU
M54412	**M-CVM*k2*-ITF-402**	•	•	•	•	2	3	•	•	•	•	•		•	RS485	Modbus-RTU

(*) COM1 to communicate only with the display and COM2 bus RS-485 Modbus/RTU

1.3 EXPANSION CARDS



CODIGO	I/O	DESCRIPCIÓN
M54501	**8I/8O**	8 opto-coupled digital inputs
		8 optocoupled transistor digital outputs
M54502	**8I/4O**	8 analogue inputs (0/4...20 mA)
		4 analogue outputs (0/4...20 mA)
M54503	**8I/4O**	8 opto-coupled digital inputs
		4 relay outputs (3 NO + 1 NO/NC)
M54504	Ethernet (Modbus/TCP) + SD Memory	
M54506	SD Memory	
M54507	**4O/4O**	4 analogue outputs of ± 5mA
		4 opto-coupled digital outputs
M5450A	Profibus DP	

1.4 CODING FOR OTHER PARAMETERS

CVMk2	M	5	X	X	X	X	0	0		
	Code						Internal code			
	Voltage supply (High Voltage)			85 ... 265 V a.c. 90 ... 300 V c.c					**0**	
				SDC 24...90 V c.c					**8**	
	Voltage measured (TM)			Standard 300 / 520 V a.c						**0**
				63,5 / 110 V a.c. (*)						**1**
				500 / 866 V a.c.						**3**

(*) Only for measure modules model 402.

Possible under demand external ITF

CODE	DESCRIPTION
M5ZZH1	Connector of CVMk2

To insure the system class, it is recommended to use type TCH high precision transformers. See the M7 family of current transformers.

1.5 ANALYSIS PARAMETERS

PARAMETER	UNIT	L1	L2	L3	N	III
Ph-N VOLTAGE	V	●	●	●	●	●
Ph-Ph VOLTAGE	V	●	●	●	●	
VOLTAGE V_{REF} (GND)-NEUTRAL	V				●	
CURRENT	A	●	●	●	●	
FREQUENCY	Hz	●				
ACTIVE POWER (Consumption and Generation)	kW	●	●	●		●
INDUCTIVE POWER (Consumption and Generation)	kvar L	●	●	●		●
CAPACITIVE POWER (Consumption and Generation)	kvar C	●	●	●		●
APPARENT POWER (Consumption and Generation)	kV·A	●	●	●		●
POWER FACTOR	PF	●	●	●		●
COS φ	Cos φ	●	●	●		●
MAXIMUM ACTIVE POWER DEMAND	Pd					●
MAXIMUM APPARENT POWER DEMAND	Pd					●
MAXIMUM CURRENT DEMAND	Pd	●	●	●		●
NEUTRAL LINE CURRENT	I_N					
VOLTAGE THD (RMS AND FUNDAMENTAL)	*U* THD	●	●	●	●	
CURRENT THD (RMS AND FUNDAMENTAL)	*I* THD	●	●	●	●	
VOLTAGE HARMONICS 2^{nd}...50^{th}	harm V	●	●	●	●	
CURRENT HARMONICS 2^{nd}...50^{th}	harm A	●	●	●	●	
ACTIVE ENERGY (Consumption and Generation)	kW·h					●
INDUCTIVE ENERGY (Consumption and Generation)	kvar·h L					●
CAPACITIVE ENERGY (Consumption and Generation)	kvar·h C					●
APPARENT ENERGY (Consumption and Generation)	kV·A·h					●
TOTAL ACTIVE ENERGY and Tariff (Consum. and Gen.)	kW·h					●
TOTAL INDUCT. ENERGY and Tariff (Consum. and Gen.)	kvar·h L					●
TOTAL CAPAC.. ENERGY and Tariff (Consum. and Gen.)	kvar·h C					●
TOTAL APPARENT ENERGY and Tariff (Consum. and Gen.)	kV·A·h					●
FLICKER (WA and PST)	Wa	●	●	●		
K-FACTOR (current)		●	●	●		
CREST FACTOR (voltage)		●	●	●		
UNBALANCE (voltage and current)		●	●	●		
ASYMMETRY (voltage and current)		●	●	●		
PHASE DIFFERENCE BETWEEN VOLTAGES						
PHASE DIFFERENCE BETWEEN CURRENTS						
PHASE DIFFERENCE BETWEEN VOLTAGES AND CURRENTS						

2. INSTALLATION

This manual provides information and warnings that the user should heed to guarantee that the system operates safely and is kept in good conditions for safe use.

If the system is handled in a way contrary to the manufacturer's specifications, it may not be protected.

2.1 ITEMS TO VERIFY UPON RECEPTION

Verify the following upon receiving the instrument:

- The device meets specifications in the order.
- The device was not damaged during transport.
- The instrument comes with the quick guide and/or the appropriate manuals.

In order to safely use the **CVMk2**, the personnel in charge of installing or handling it must follow the standard safety guidelines and heed all warnings provided in the instruction manual.
This analyzer should be installed and maintained by qualified personnel.

2.2 ASSEMBLY SITE

ENVIRONMENTAL CONDITIONS

To guarantee its optimal operation, it is recommended to use the system at between -10 and 50 ºC with relative humidity between 5 and 95%, but with no condensation.

CONSIDERATIONS

The **CVMk2** should be mounted in a distribution cabinet that protects the system from environmental contamination such as oil, moisture, dust, corrosive vapours or other volatile substances.

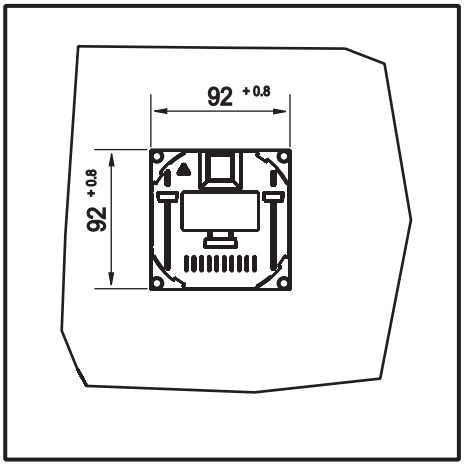
When it is likely that the system has lost its safety guards (due to visible damages), it should be disconnected from the auxiliary power supply and the input supplies. In this case, contact a qualified tech support representative.

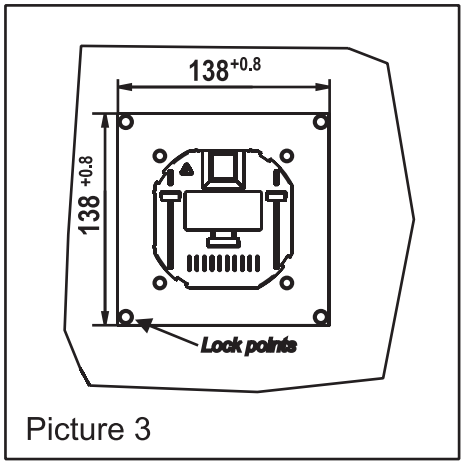
The system can be installed in one of two basic ways:

- As a compact system in a distribution cabinet, installing at the panel.
- As a modular system, installing the display on the panel and the measuring module on DIN 46277 (EN 50022) rail.

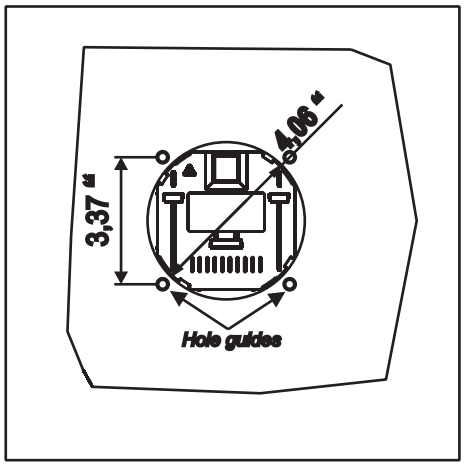
2.3 INSTALLATION METHODS

The figures illustrate the different installation possibilities, permitted by the display screen design. The system design facilitates screwing the panel on (92 $^{+0.8}$ + 92 $^{+0.8}$ mm, 138 $^{+0.8}$ + 138 $^{+0.8}$ mm and a 103 mm diameter hole).





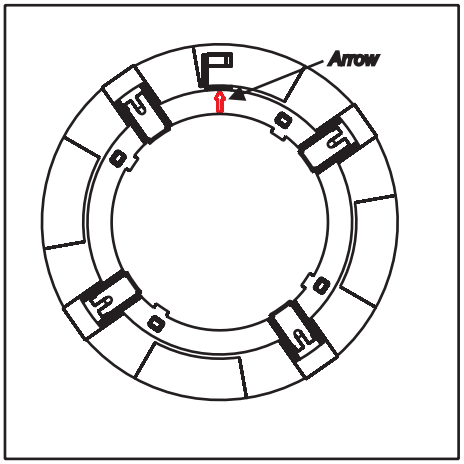
Picture 3



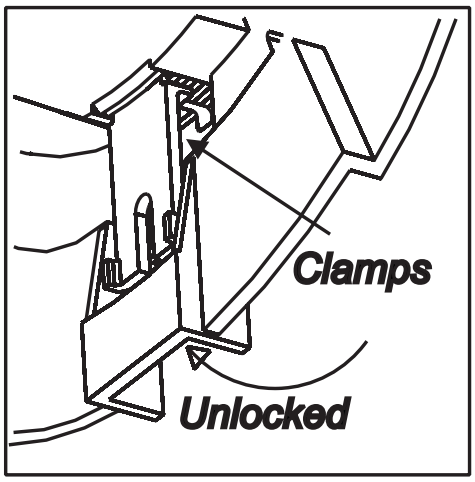
The figures illustrate how to mount the front part (display) in a 92x92 mm (3,62 x 3,62 in) hole, a 103 mm (4,06 in) diameter hole and in a 138x138 mm (5,43 in) hole.

After inserting the front part, install the mount ring, making sure that the tabs are not blocked (see procedure). Also, assure that the white arrow, which indicates the point where the communications cable and the RJ-45 display screen power supply cable run out, lines up with the arrow on the measuring equipment.

2.3.1 PROCEDURE

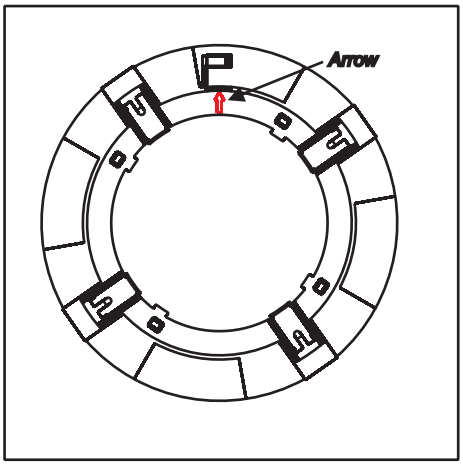


The tabs are components used to fasten the system to the panel. When mounting the system, the tabs must be free, and unblocked, so that as pressure is applied to the mount ring the tabs go over the clamp zipper teeth. Similarly, to dismount the panel display the tabs should be blocked, i.e. opened prior to dismounting.

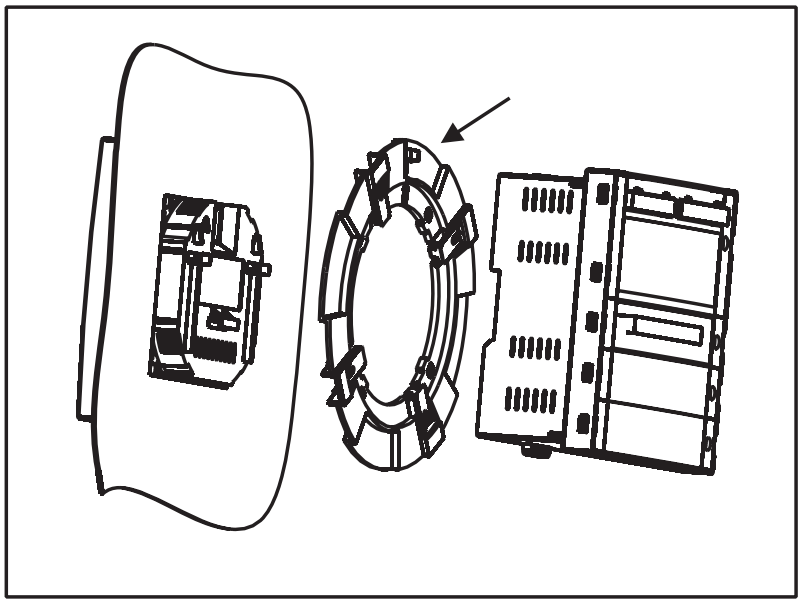


A zoomed view of the previous image is provided in the figure. It provides a detailed view of the movements necessary to lock and unlock **CVMk2** display screen mount ring.

As shown in the figure, the guide arrow should point upward and line up with the arrow found on the rear of the viewer or display screen. The arrow points to the position where the RJ-45 communications cable and the display screen power supply cables run out.



The mount diagram is shown in the following figure. The measuring unit can then be mounted on the ring behind the display screen, or it can be installed on a DIN rail and communicate with the display screen via a communication cable and transparent RJ-45 power supply. (See Table 3.1, physical description).



To install the screen in a panel as shows the 2.3 installations methods, you have to use a flat surface of a type 1 enclosure.

2.4 SYSTEM CONNECTION

Before connecting the equipment, the following points should be verified:

2.3.1 Auxiliary Power Supply Characteristics
2.3.2 Maximum Voltage in the Voltage Measuring Circuit
2.3.3 Maximum Current in the Current Measuring Circuit
2.3.4 Working Conditions
2.3.5 Safety

2.4.1 AUXILIARY POWER SUPPLY

Standard power supply	85...265 90...300	V a.c. V d.c.
Frequency	50...60	Hz
Optional power supply	24...90	V d.c.

2.4.2 RATED VOLTAGE IN VOLTAGE MEASURING CIRCUIT

Standard rated voltage (*)	300 / 520	V_{f-n} / V_{f-f}
Other voltages (*)	500 / 866	V_{f-n} / V_{f-f}

(*) Current limited. Máximum 0.6 V·A

Rated frequency	45,00...65,00	Hz

$U_{max} = U_N \times 1.2$

2.4.3 RATED CURRENT IN CURRENT MEASURING CIRCUIT

Secondaries .../5A (*)	5	A a.c.
Secondaries .../1A (*)	1	A a.c.

(*) limited in voltage

$I_{max} = I_N \times 1.2$

2.4.4 WORKING CONDITIONS

Operating temperature	-10...+50	ºC
Relative Humidity	5...95	%

2.4.5 SAFETY

Designed for CAT III 300/520 Vac installations in accordance with EN-61010.
Protected against electrical shock by class II double insulation.
Designed and identified by the distinctive CE markings.
Designed and identified by the distinctive CE markings.

To increase system capacity with expansion cards prior to handling, modify its connections or replace equipment; the power supply should be shut off and the inputs disconnected from the CVMk2. Handling the system while it is powered up is dangerous.

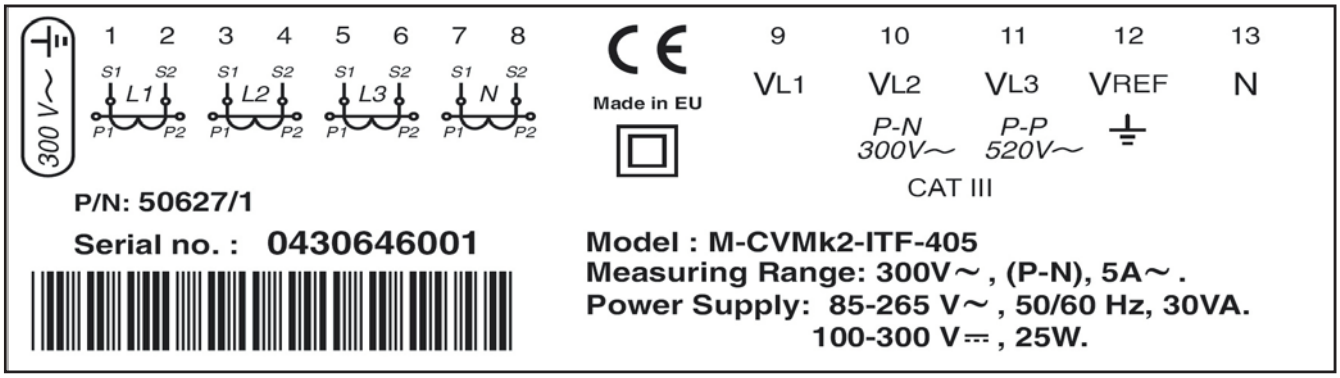
2.4.6 TECHNICAL CHARACTERISTICS

VOLTAGE INPUTS	
Measuring range	from 5 to 120% of *U*n for *U*n = 300 Vac (f-N)
	from 5 to 120% of *U*n for *U*n = 520 Vac (f-f)
Frequency	45…65 Hz
Maximum measured voltage	360 Vac
Acceptable overvoltage	750 Vac
Maximum Consumption (limited current)	< 0.6 V•A
CURRENT INPUTS	
Measuring range	from 1 to 120% of *I*n for *I*n = 5 A
Secondary for the TCs (*I*n)	1 or 5 A
Primary current measured	Programmable <30000A
Acceptable overload	6 A continuous, 100 A t<1 s
Consumption	< 0.45 V•A
AUXILIARY POWER SUPPLY	
Power supply	85 to 265 V ac (50...60 Hz) (consumption < 30 V·A)
	90 to 300 V dc (consumption < 25 W)
MECHANICAL	
Maximum torque	0.8 Nm
Maximum wire rigid diameter	4.5 mm^2

Keep in mind that with the system connected, it may be dangerous to touch the terminals. Additionally, dangerous parts may be exposed when covers are opened or when protective components are removed. The system should not be used until it is completely installed.

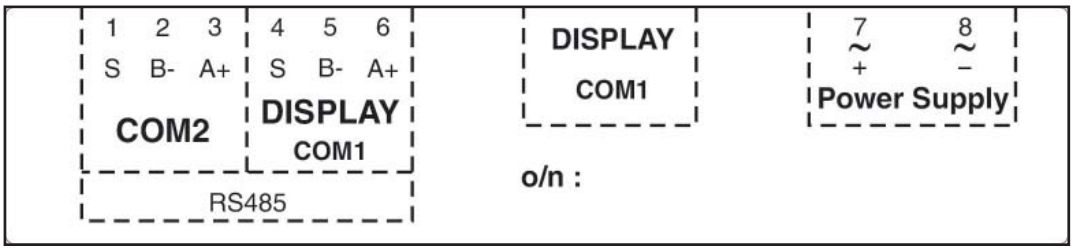
2.5 TERMINALS DESCRIPTION

2.5.1 TAG FOR VOLTAGE AND CT CONNECTIONS



	DESCRIPTION
1	Current transformer, L1 phase S1 connection
2	Current transformer, L1 phase S2 connection
3	Current transformer, L2 phase S1 connection
4	Current transformer, L2 phase S2 connection
5	Current transformer, L3 phase S1 connection
6	Current transformer, L3 phase S2 connection
7	Current transformer, neutral line S1 connection
8	Current transformer, neutral line S2 connection
9	L1 phase voltage input
10	L2 phase voltage input
11	L3 phase voltage input
12	Input voltage V_{REF} (GND)
13	Input voltage NEUTRAL LINE

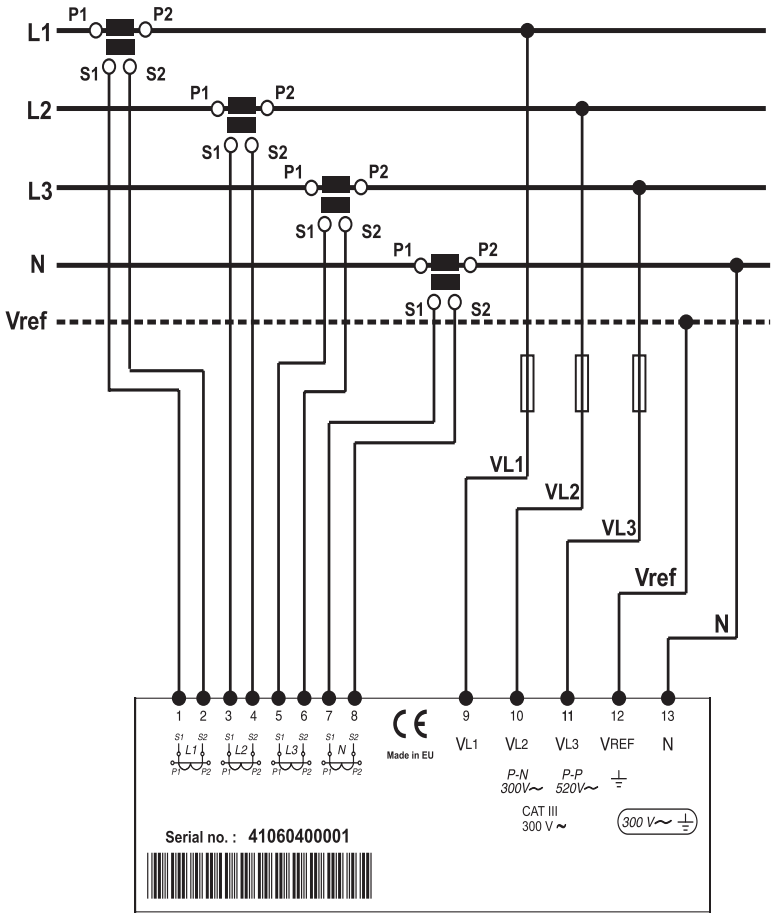
2.5.2 POWER SUPPLY AND COMMUNICATIONS TAG



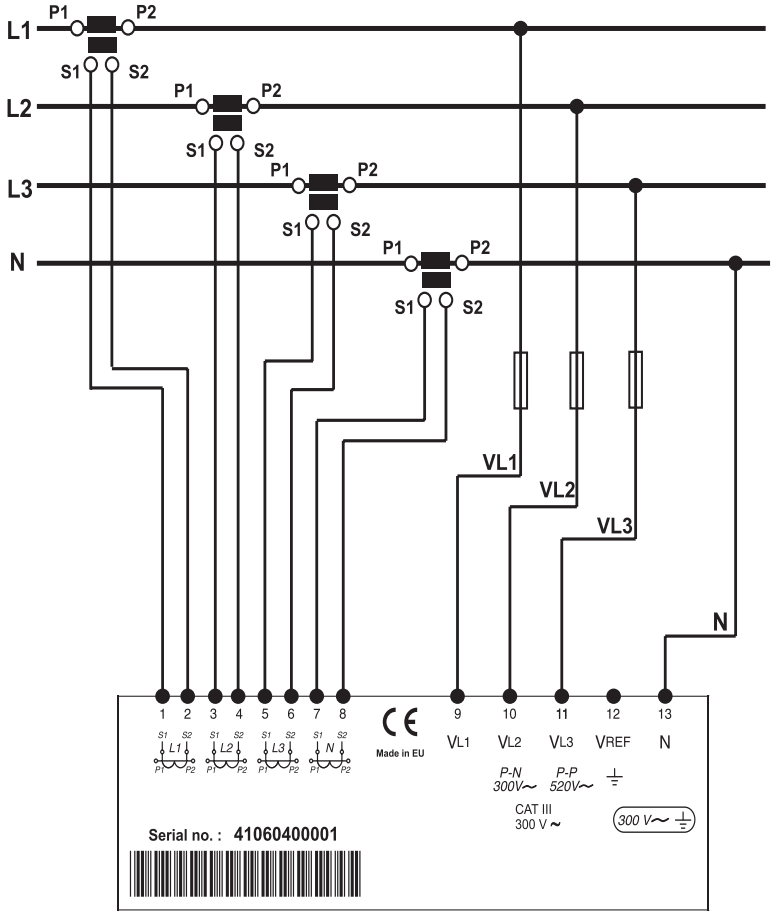
The system should be connected to a power supply circuit protected by fuses with current ratings between 0.5 and 1 A / 600 V (UL listed). It should be provided with a MCCB or equivalent device to switch off the system from the power supply circuit. The power supply and voltage measuring circuit is connected with cable minimum cross section of 1 mm² (AWG 17). The current transformer secondary side connection line should have a minimum cross section of 2 mm² (AWG 14) and with a minimum temperature rating of 60 ºC.

2.6 MEASURING INPUT CONNECTION DIAGRAMS

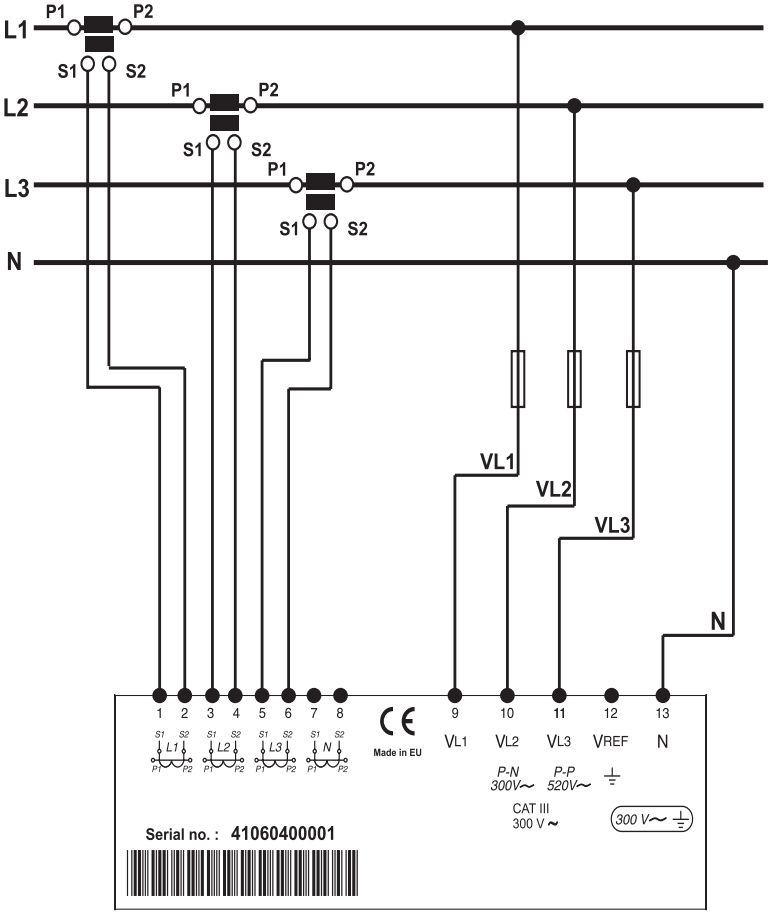
2.6.1 - 4 CT AND 5 VOLTAGE REFERENCES



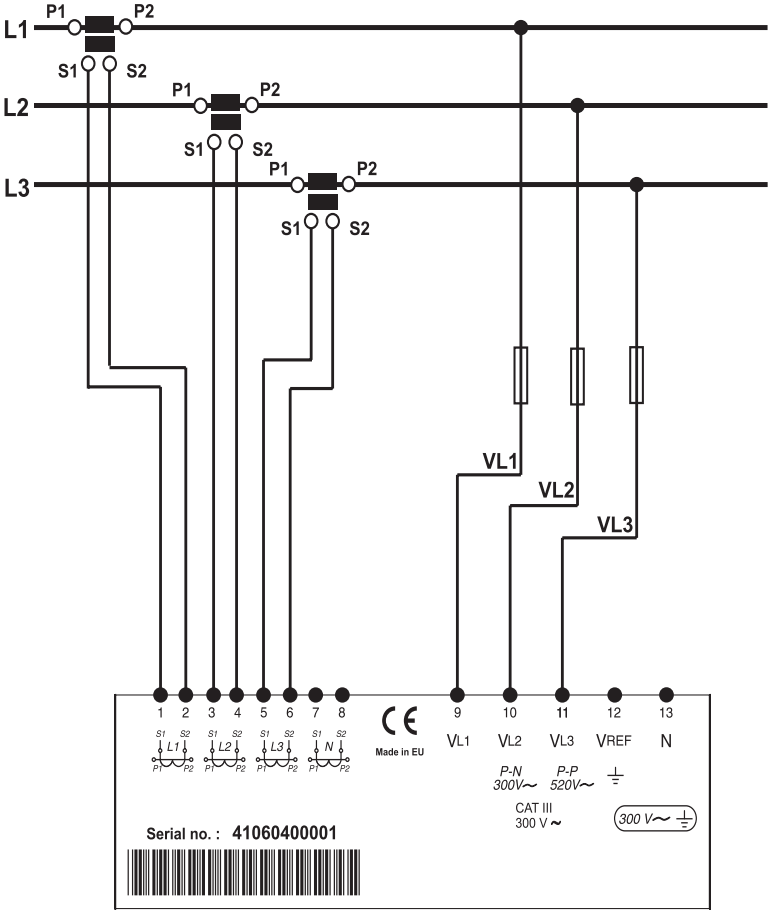
2.6.2 - 4 CT AND 4 VOLTAGE REFERENCES



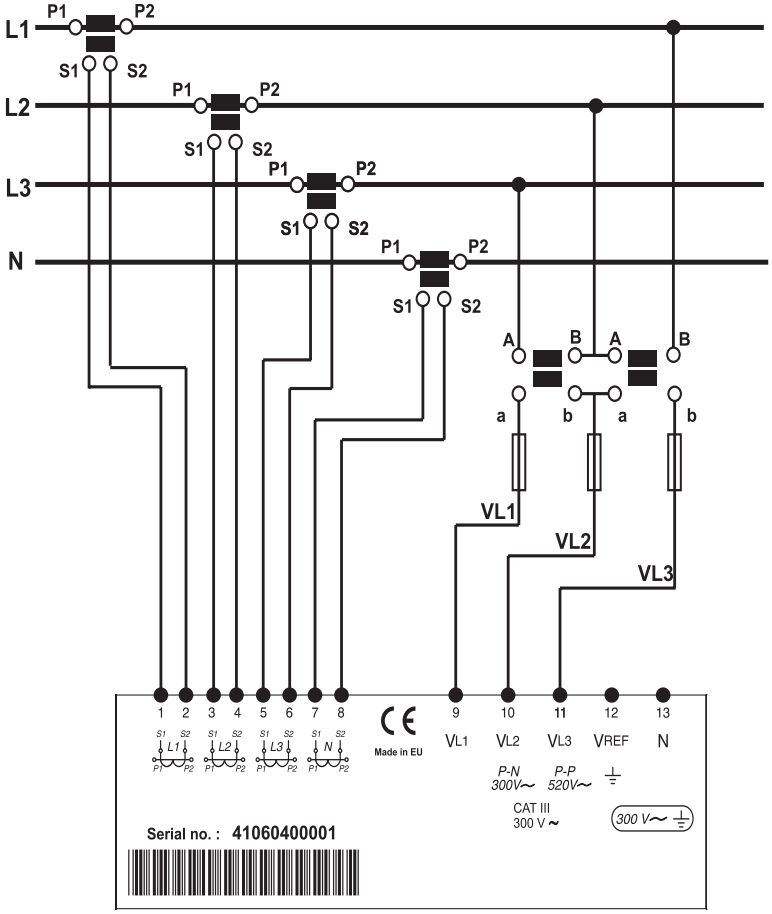
2.6.3 - 3 CT AND 4 VOLTAGE REFERENCES



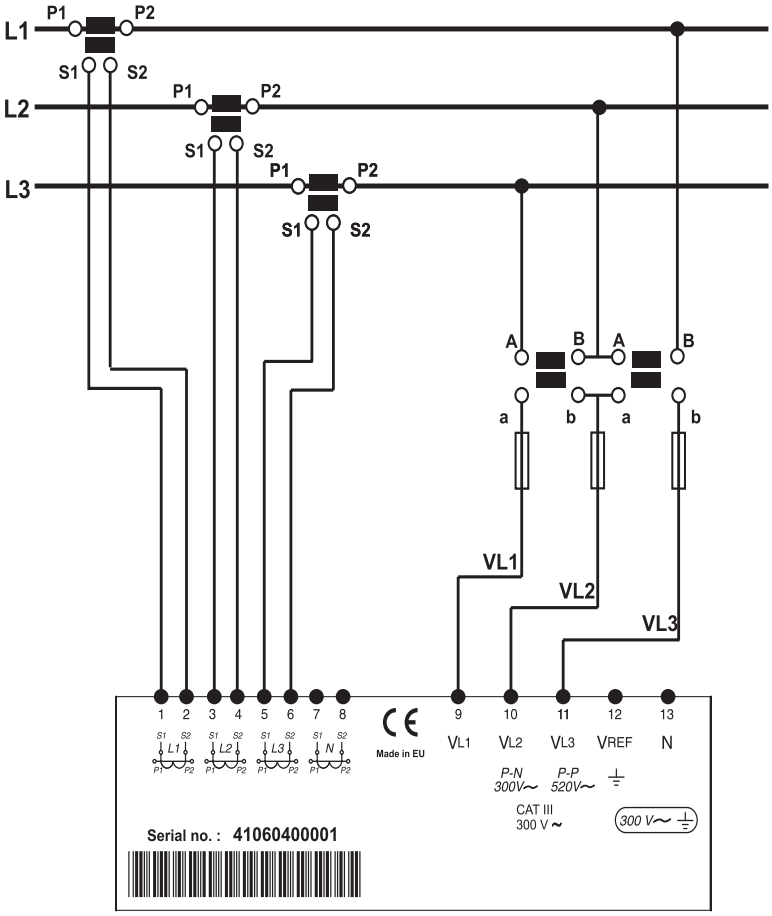
2.6.4 - 3 CT AND 3 VOLTAGE REFERENCES



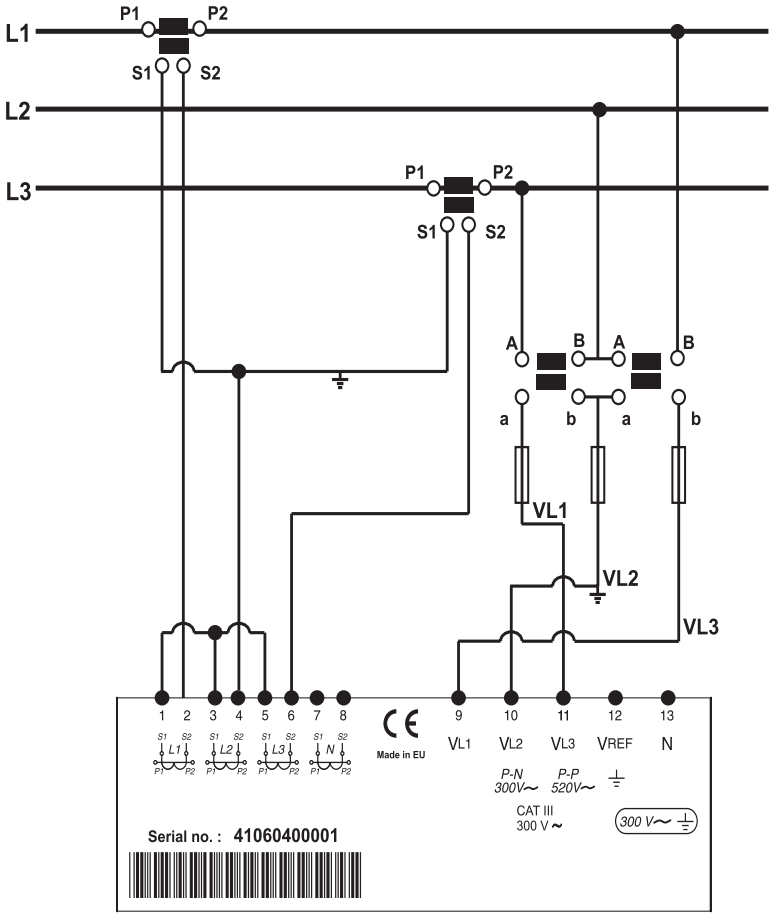
2.6.5 - 4 CT AND 2 VOLTAGE TRANSFORMERS



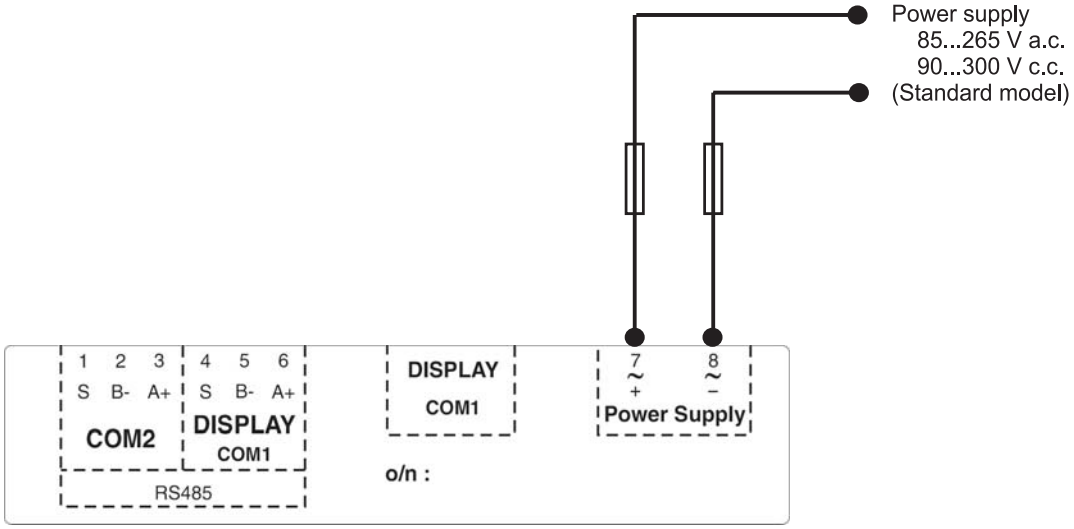
2.6.6 - 3 CT AND 2 VOLTAGE TRANSFORMERS



2.6.7 - 2 CT AND 2 VOLTAGE TRANSFORMERS



2.7 POWER SUPPLY CONNECTION DIAGRAM



The standard power supply for the **CVMk2** is a universal power supply that covers the following ranges:

85 ... 265 V a.c.
90 ... 300 V c.c.

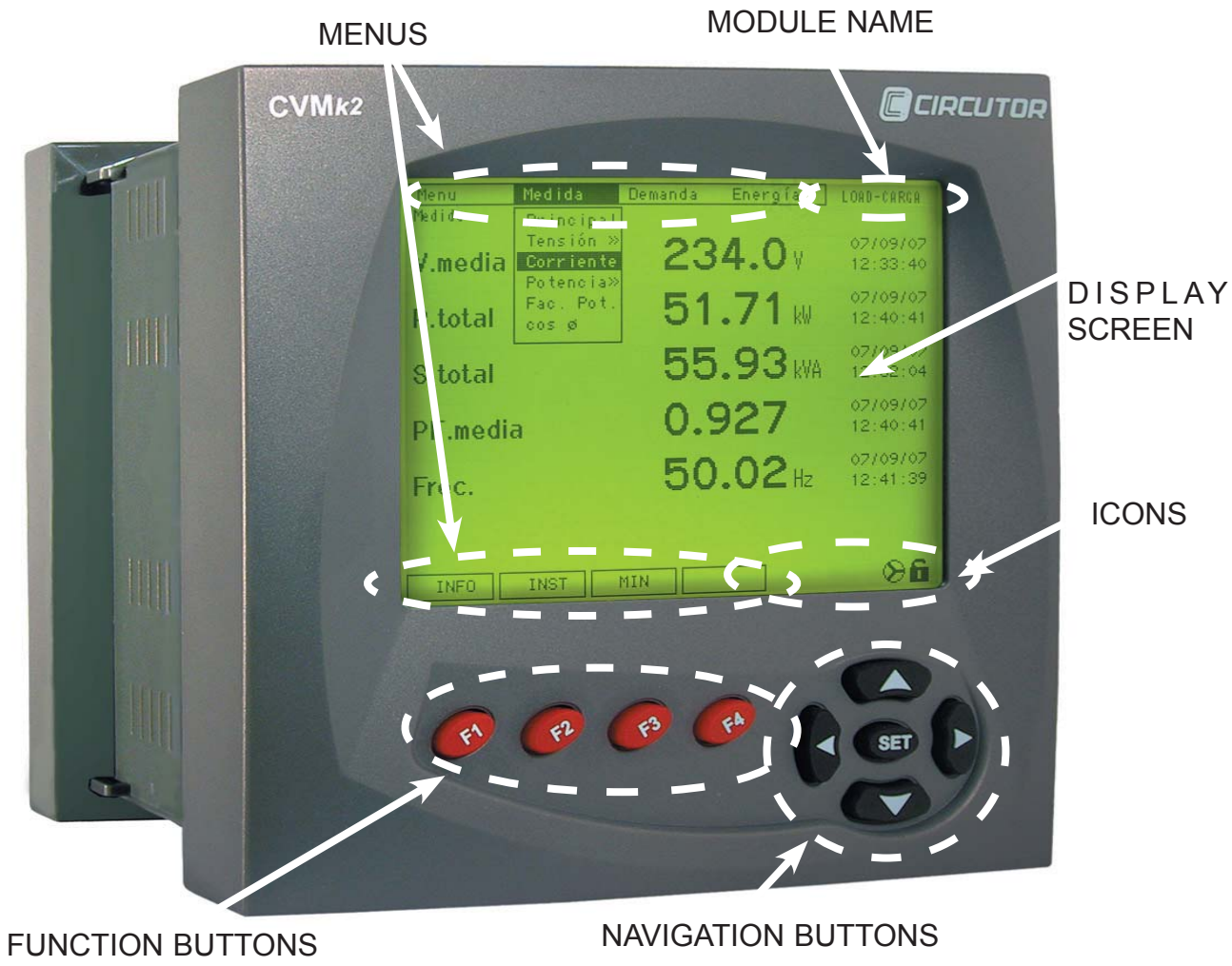
3. OPERATION

3.1 DESCRIPTION OF DEVICE

The external dimensions of the **CVMk2** network analyzer are 144 x 144 x 116 mm. It is comprised of a display screen and a measuring module. The display screen communicates with the measuring module via an RJ-45 line, which is "transparent" or direct. The wire layout is provided in the figure below:

DISPLAY SCREEN		MEASURING EQUIPMENT	
PIN	SIGNAL	SIGNAL	PIN
1	V+	V+	1
2	GND	GND	2
3	B (-)	B (-)	3
4	Shield	Shield	4
5	Shield	Shield	5
6	A (+)	A (+)	6
7	GND	GND	7
8	V -	V -	8

3.1.1 FRONTAL VIEW



The front is divided into several parts:

a) Display screen.
b) Function buttons.
c) Navigation buttons.
d) *SET* button.
e) Upper and lower menus.
f) Module name.
g) Icons.

3.1.1.a. Display

The **CVMk2** network analyzer incorporates a 320 x 240 pixel, backlit, 1/4 VGA (QVGA) LCD monitor. The monitor surface area is 90 x 70 mm^2 (4,5 in). The display screen has backlighting to facilitate reading the parameters when they are presented on the display screen in poor lighting conditions.

CVMk2 permits programming a timer used to shut off the backlighting after several seconds have passed. Said timer can be programmed for 10, 90 or 180 seconds. It is also possible to leave the backlighting always ON or always OFF.

To access the display screen properties configuration menu, use the left navigation button to navigate to *MENU*. Use the *SET* button or the down arrow button to open the drop-down menu. Select *SYSTEM--PREFERENCES--DISPLAY SCREEN*.

WARNING: The maximum working temperature for the 1/4 VGA display screen is 70 ºC. Operating the system above this temperature can quickly deteriorate the equipment or lead to permanent malfunctioning.

3.1.1.b. Function buttons

The system has 4 function buttons on the front side (F1, F2, F3 and F4). The function buttons are used to access the different menus that appear on the bottom of the display.

3.1.1.c. Navigation buttons

On the front side, the system has 4 arrow buttons used to navigate through the different menus that appear on the lower side of the screen. Press the left arrow button to exit at any time the current menu.

3.1.1.d. *SET* button

This button is used to access the menu that is selected with the cursor.

3.1.1.e. Upper and lower menus

The upper and lower menus change based on the current screen. A detailed description of all the menus and the options in each menu is provided in the upcoming chapters.

3.1.1.f. Module name

The measuring module currently being viewed is defined on this part of the display screen. This is important in facilities where measuring modules are communicating with one single display screen.

3.1.1.e. Icons

 Editable configuration menu (without password).

 Configuration menu locked with password.

 None of the voltages for the phases are connected, or they are not detected.

 Voltage is only detected at the phase 1 input.

 Voltage is only detected at the phase 2 input.

 Voltage is only detected at the phase 3 input.

 Voltage is only detected at the phase 1 and 2 inputs.

 Voltage is only detected at the phase 1 and 3 inputs.

 Voltage is only detected at the phase 2 and 3 inputs.

 Voltage is detected at the phase 1, 2 and 3 inputs.

 Correct SD memory status.

 Incorrect SD memory status.

 Extraction of SD card enabled.

 Short circuit or hole detected. This only appears during the event.

 Overvoltage detected. This only appears during the event.

 Switching detected. This only appears during the event.

 There is no consumption and no generation.

 Generation

 Consumption.

3.2. START-UP

Before power ON the device, make sure that all the cables are properly connected. A bad connection can cause serious injuries to the personnel that are working on the equipment and can damage the equipment.

When power supply is connected to the **CVMk2**, the system will show an initial presentation and initialize its internal software indicating the firmware version on the display screen. After a time of searching, it will also display the firmware versions of the modules that are connected to the COM 1 DISPLAY port as well as the cards that are inserted in each one of the modules.

If there is any system failure or error during start-up or operation of the **CVMk2**, see Appendix A or contact the **CIRCUTOR** technical support group.

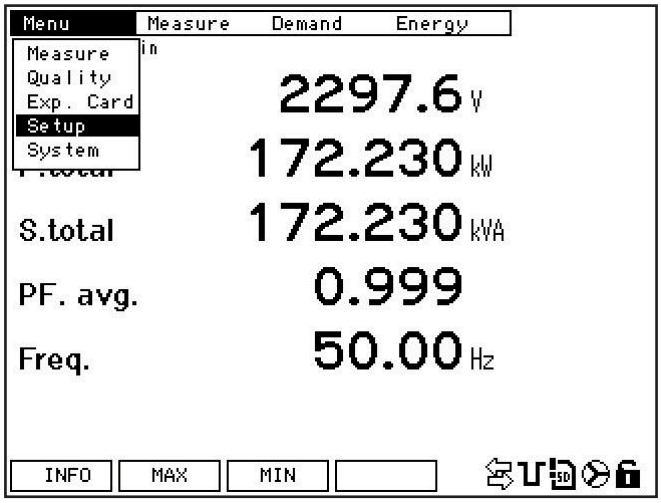
Once initialization is complete, the **CVMk2** will display the switched module's real time values on the main screen.

The **CVMk2** principal screen changes. This is because the system will keep a memory the last screen that was viewed for more than 20 seconds before disconnected. This screen will be displayed the next time the display is turn on

4. CONFIGURATION

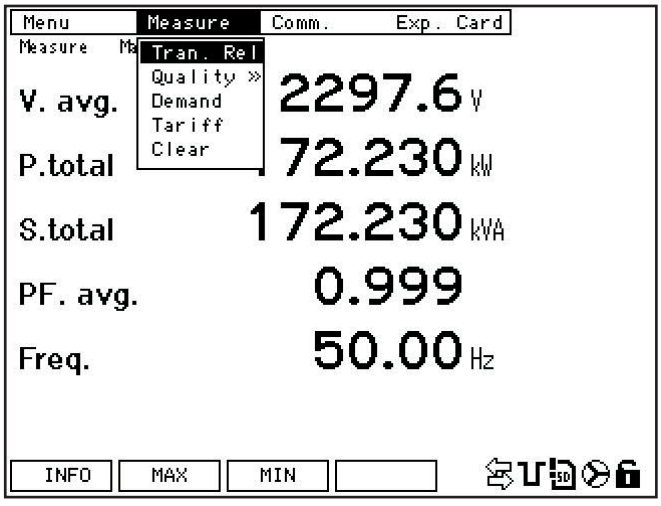
Measurement, communication and expansion card parameters (if available) can be modified from the configuration menu.

To access the configuration inside the *MENU*, select *CONFIG* and confirm with the *SET* key.
The menu on the top of the screen will appear as seen in the following figure.

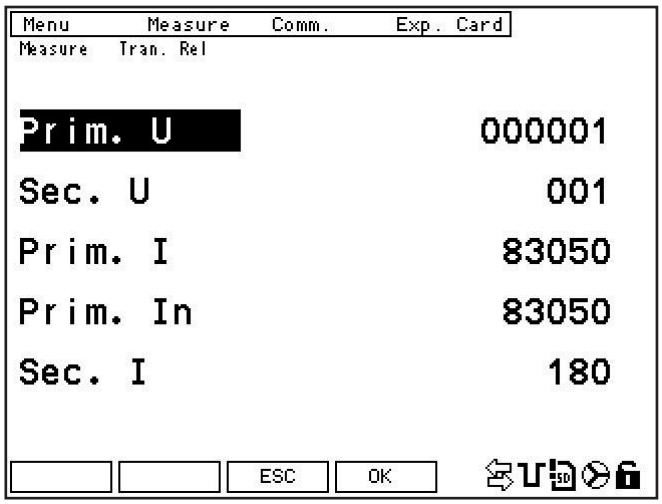


4.1 MEASURING

In the *MEASURE* menu, the list of voltage and current transformers can be accessed. To modify the transformer configuration parameters, press the *EDIT* button (F4).



Position the cursor in the first line of parameters (in this case, voltage primary). Use the up-down arrow buttons to move the cursor to the desired parameter. Press *SET* to enter the numeric value to be modified. The cursor will be positioned over the first digit, corresponding to the largest value. Use the left/right arrow buttons to navigate from one digit to another and the up/down arrow buttons to increase/decrease the value of the digit.



The analyzer does not store programming changes that are made until programming is complete. These changes are confirmed by pressing the *OK* button. If the system is reset before said programming is complete or if the user exits the menu using the *ESC* button, the configuration settings will not be stored in memory. To access to the configuration menu, refer to Chapter 4.

Parameters that can be configured on this screen follow:

- *PRIM. U.*: Primary on the voltage transformers. If it does not exist, program *1*. The maximum configurable value is *999999*.
- *SEC. U.*: Secondary on the voltage transformers. If it does not exist, program *1*. The maximum configurable value is a 3 digit number *999*.
- *PRIM. I.*: Primary on the current transformer. The maximum configurable value is *30000*.
- *PRIM. IN.*: Primary on the current transformer for the neutral line. The maximum configurable value is *30000*.
  The default value is *5*. If it is desirable for the **CVMk2** to show the neutral line current that is calculated, configure *0*.
- *SEC. I.*: Secondary on the current transformer. It is possible to program *5* or *1*.

To save the modified parameters to memory, press *OK* (F4) before exiting. If saving the changes is not desired, press *ESC* (F3).

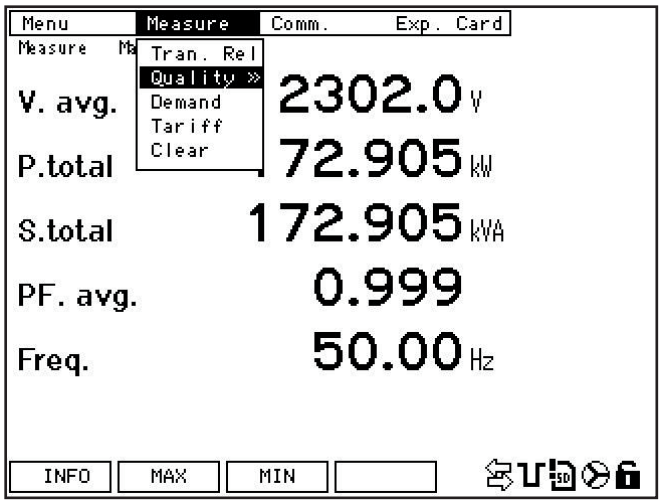
WARNING: The CVMk2 power calculation is limited according to the following formula:

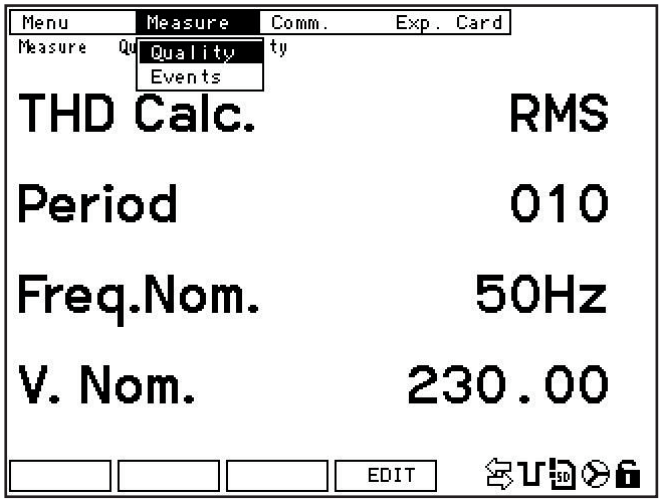
(Prim V) x (Prim I) < 45.000.000

4.2. QUALITY

CVMk2 HAS NO BATERY. WHEN SUPPLY FALLS DOWN THE ANALYZER DO NOT STORE THE QUALITY EVENTS. IS VERY IMPORTANT TO GUARANTEE THE SUPPLY OF THE THE DEVICE FROM AN INTERRUTED SOURCE (BATERY, SAI, ...)

To access the power supply quality parameters configuration screen, position the cursor over *QUALITY* and press *SET*. Two options are provided in the quality menu, *QUALITY* and *EVENTS*.

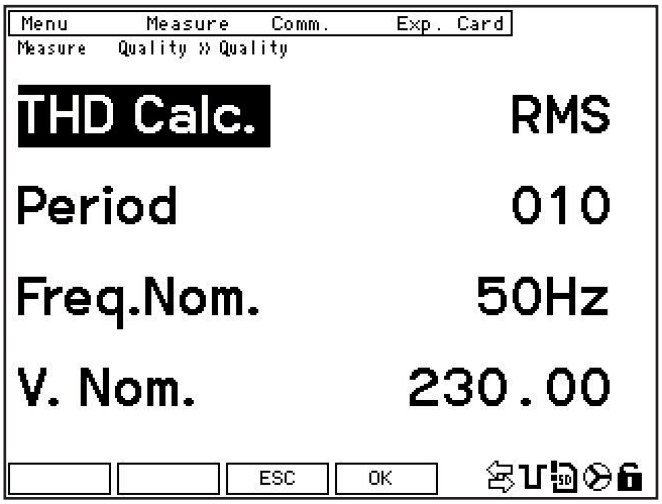




4.2.1. QUALITY

To access the quality parameters configuration menu, go to the *QUALITY* menu, in the main configuration menu, and select *QUALITY*. From the two options provided, select *QUALITY*.

Parameters that can be configured on this screen are:



• *THD CALC*: To calculate the harmonic distortion rate based on the fundamental, select *FUND*. On the contrary, select *RMS* to make the calculation based on the RMS value.

• *PERIOD*: Enter the period over which the variables should be recorded. This is only valid if the system has an external SD memory expansion card. Values from *1* to *240* minutes are acceptable.

Period is considered as the integration window configuration time (in minutes).

• *NOM. FREQ.*: Enter the network rated frequency value. This is used in the flicker calculation.

• *NOM. V.*: Enter the network rated phase-neutral voltage value. If using a voltage transformer, enter the transformer secondary value. If there is no neutral line, enter the voltage value as if there was one. This is used for quality events calculations.

To modify the current values, press *EDIT* (F4). The cursor will be positioned in the first line of parameters. Use the up-down arrow buttons to move the cursor to the desired parameter. Press *SET* to enter the corresponding numeric value.

Position the cursor over the first digit, corresponding to the largest value. Use the left/right arrow buttons to navigate from one digit to another and the up/down arrow buttons to increase/decrease the value of the digit where the cursor is currently positioned.

To save the modified parameters to memory, press *OK* (F4) before exiting. If saving the changes is not desired, press *ESC* (F3).

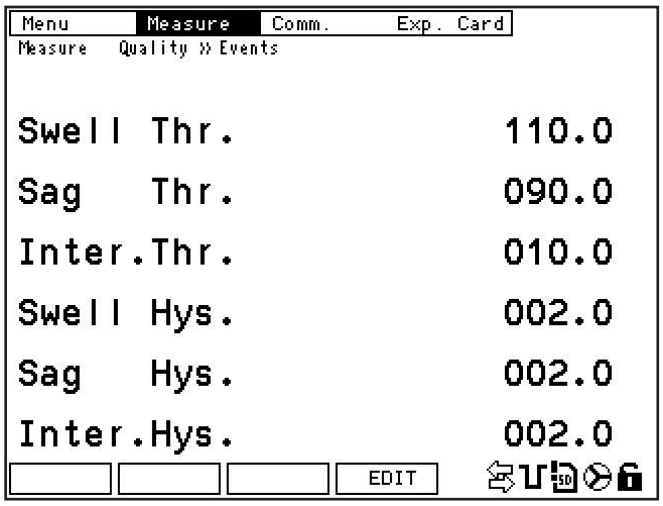
If values entered are not within the acceptable range or are not valid, the modifications will not be recorded. The values used prior to the modification will be restored.

4.2.2. EVENTS

To access the event margins configuration menu, go to the *MEASURE* menu in the main configuration menu. Then, select *EVENTS* in the quality *MENU*.

Parameters configured on this screen are in % with respect to the *NOM. V.* from the previous screen (*QUALITY*).

Thus, the % value that should be configured for the overvoltage threshold must always be greater than 100% of the value configured for the *NOM V.* variable on the previous screen (4.2.1. QUALITY).



Parameters that can be configured on this screen follow:

• *OVER V THD*: This corresponds to the threshold value, as a %, to detect an overvoltage event.

• *HOLE THD*: This corresponds to the threshold value, as a %, to detect a hole event.

• *SHORT CIRCUIT THD*: This corresponds to the threshold value, as a %, to detect a short circuit event.

• *OVER V HYS*: Hysteresis, as a %, over the programmed value in the detection threshold.

• *HOLE HYS*: Hysteresis, as a %, over the programmed value in the detection threshold.

• *SHORT CIRCUIT HYS*: Hysteresis, as a %, over the programmed value in the detection threshold.

The value of the hysteresis is always, in part, more restrictive. It is not a symmetric hysteresis. The detection value is over the programmed value, as a %. The hysteresis applies in the disconnection or the disappearance of the event. If the event is for a maximum (*OVER V THD*), the hysteresis will be applied when the signal drops. If the event is for a minimum (*HOLE THD* and *SHORT CIRCUIT THD*), the hysteresis will be applied when the signal increases again.

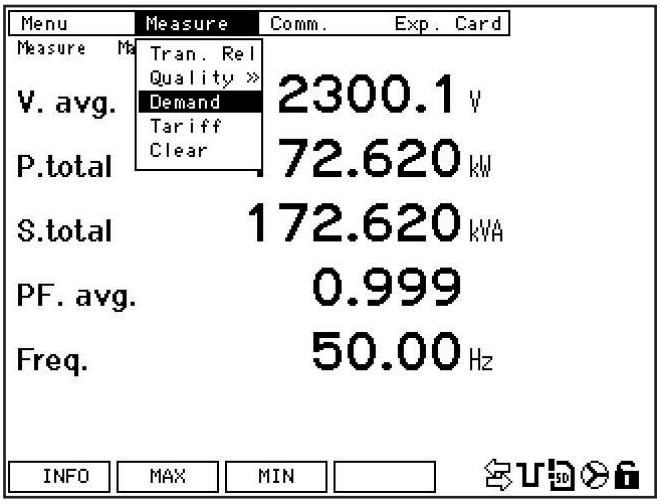
To modify the current values, press *EDIT* (F4). The cursor will be positioned in the first line of parameters. Use the up-down arrow buttons to move the cursor to the desired parameter. Press *SET* to enter in the corresponding numeric value.

The cursor will be positioned over the first digit, corresponding to the largest value. Use the left/right arrow buttons to navigate from one digit to another and the up/down arrow buttons to increase/decrease the value of the digit where the cursor is currently positioned.
To save the modified parameters to memory, press *OK* (F4) before exiting. If saving the changes is not desired, press *ESC* (F3).

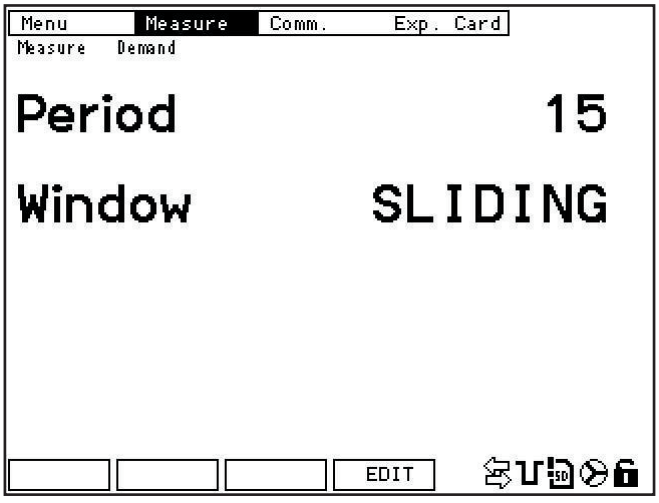
If values entered are not within the acceptable range or are not valid, the modifications will not be recorded. The values used prior to the modification will be restored.

4.3. DEMAND

To access the maximum demand control parameters configuration screen, position the cursor over *DEMAND* and confirm by pressing *SET*.



To access the maximum demand control parameters configuration screen, position the cursor over *DEMAND* and confirm by pressing *SET*.



Parameters that can be configured on this screen follow:

PERIOD: Integration window minutes used calculating the maximum demand. Values can be programmed from *1* up to a maximum of *60*.

WIN. TYPE: It is possible to select between two window types to calculate the maximum demand. These are:

- *FIXED*: Each period duration initializes the maximum demand value. If programmed for 15 minutes, the measured values are integrated every 15 minutes, and the values for the next 15 minutes are set to zero.

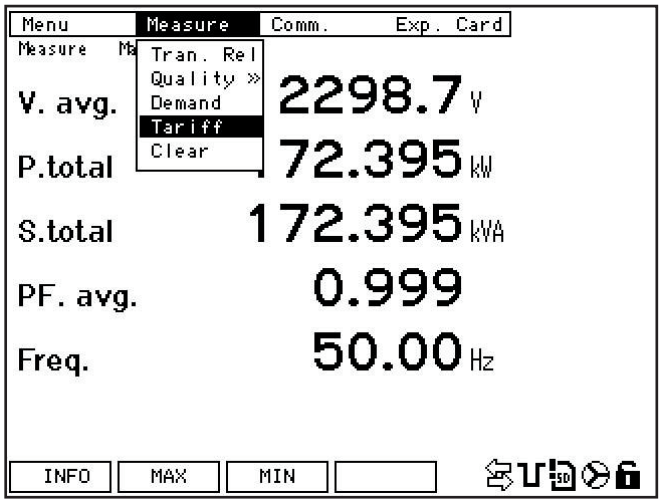
• *MOVING*: The beginning and end of the integration period moves with each sample collected. The calculation for maximum demand is made with the values, in the integration time, each time a new sample is recorded.

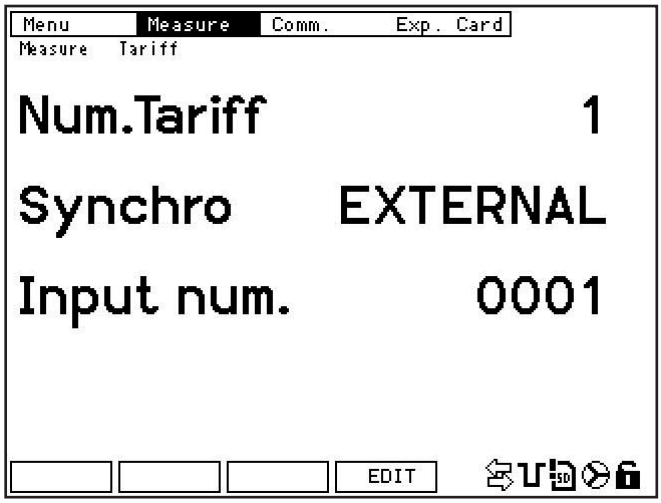
To save the modified parameters to memory, press *OK* (F4) before exiting. If saving the changes is not desired, press *ESC* (F3).

4.4 TARIFFS

WARNING: CVMk2 has an internal clock that you have to configure. The device will work with this local hour but, if you communicate the device with Power Studio the local time of the device will be changed to UTC hour.

CVMk2 permits configuring up to 9 tariff. To access the tariff configuration screen, position the cursor over *TARIFF* and press *SET.*





Parameters that can be configured on this screen follow:

• *NO. OF TARIFF.*: The number of tariff. Specify how many different tariff are going to be configured.

• *SYNCH.*: Use the internal clock or calendar to manage tariff, select the *CLOCK* option. To use an external signal to change tariff (activating static inputs for a **CVMk2** expansion card), select the *EXTERNAL* option.

It is possible to load a yearly fee calendar to the memory. This calendar can only be saved from the **CIRCUTOR** POWER STUDIO SCADA software. The calendar is stored in the memory and is synchronised with the internal clock.

• *NO. IN.*: If *EXTERNAL* was selected in the previous option, *SYNCH.*, specify the input(s) for the expansion card, which will receive the pulse for each one of the tariff

Since the **CVMk2** expansion cards can be inserted in different positions, four digits have been reserved to configure the inputs. The digits that occupy the most memory indicate the position in which the inputs card is inserted in the **CVMk2** measurement module.
The last digits correspond to the input number to be programmed for tariff 2.
Numbers *100X* correspond to the digital inputs for the expansion card inserted in slot 1. Numbers *200X* correspond to the digital inputs for the expansion card inserted in slot 2, and Numbers *300X* correspond to the digital inputs for the expansion card inserted in slot 3.

Example:

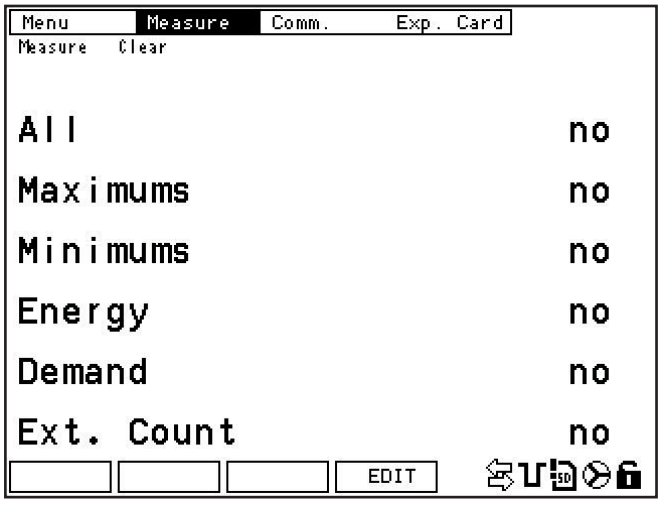
You wish to configure 5 tariff and assign them to **CVMk2** inputs 3, 4, 5 and 6. One expansion card with static digital inputs is available and inserted in position 2 of the measure module.

Activate 5 tariff and configure the input corresponding to fee 2 in input *2003*. Accordingly, input 3 in slot 2 will be defined as that which corresponds to fee 2. The following tariff are configured in the input: 4, 5 and 6, consecutively.

WARNING: The consecutive tariffs are automatically assigned to the inputs subsequent to the one configured for fee 2

4.5 DELETE

CVMk2 has a screen from which parameters, stored to the memory, can be deleted. To access this display screen, go to the *CONFIG* menu. In this *MENU*, access the *MEASURE* drop-down menu. Position the cursor over *DELETE* and confirm by pressing *SET*.



The following entries can be deleted in this menu:

• *ALL*.: Delete all stored values. Values that are deleted with this option include: maximums, minimums, energy meters, maximum demand and input pulse meters for all of the expansion cards.

• *MAXIMUMS*: This deletes maximum values stored with the corresponding date and time.
• *MINIMUMS*: This deletes minimum values stored with the corresponding date and time.

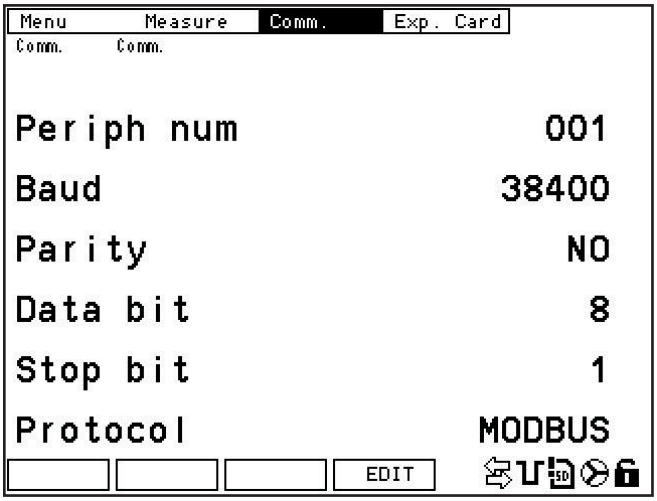
• ENERGY.: Zero the accumulated energy meters, including those for different tariff in the current, monthly and yearly meters.
• DEMAND.: Zero the maximum demand values, including those for different tariff.

• EXT. CONT.: Zero accumulated pulse values for the inputs from all static digital input expansion cards.

4.6 COMMUNICATIONS

To access the **CVMk2** communications configuration, select CONFIG inside the MENU.

Once inside the configuration menu, select COM and press SET to enter the menu. In this screen, configure the COM2 port to communicate the analyzer with the master PC or PLC.



The following entries can be edited in this menu:

• PERIPH. NO.: Peripheral number to be assigned to the device. The value should be between 1 and 255.

• BAUDS: Communication speed assigned to the COM2 serial port. The speeds that can be configured are: 9600, 19200, 38400 or 57600 bps.

• PARITY: Choose between NO, PAR, IMPAR.

• DATA BIT: 8; this cannot be modified (in Modbus/RTU protocol).

• STOP BIT: It is possible to choose 1 OR 2.

• PROTOCOL: MODBUS; this cannot be modified.

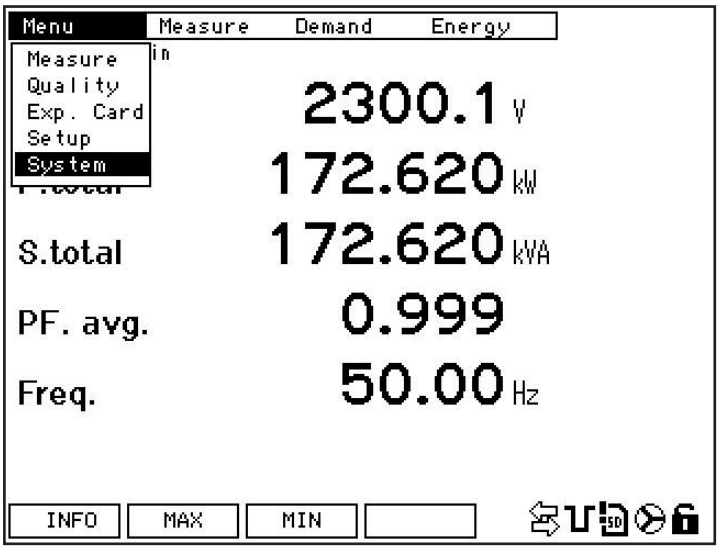
The communications configuration on this screen only affects the COM2 port of the measurement module. The changes on this screen do not affect the other communications or the rest of the system.

5. OTHER SYSTEM CONFIGURATIONS

5.1 PREFERENCES

5.1.1 SCREEN

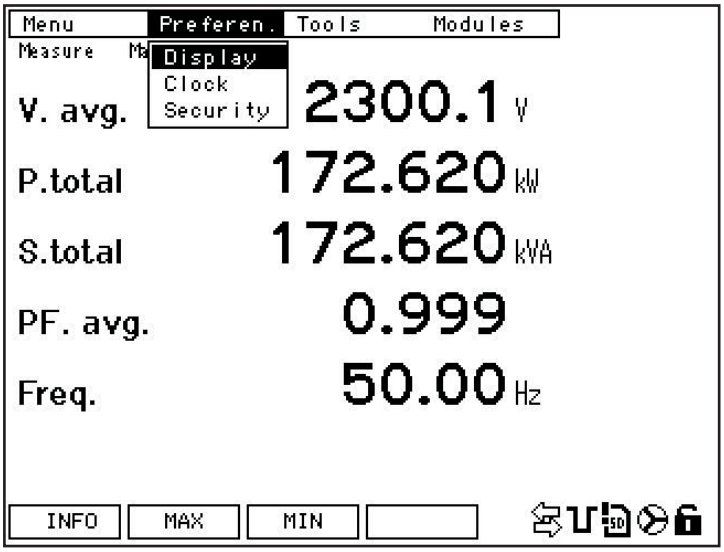
To configure the screen display preferences, select the *SYSTEM* option on the *MENU*. In *SYSTEM*, drop down the *PREFERENCES* menu and select *SCREEN*.



To modify the current values, press *EDIT* (F4). The cursor will be positioned in the first line of parameters. Use the up-down arrow buttons to move the cursor to the desired parameter. Press *SET* to enter configuration mode for the desired value.

Use the left/right arrow buttons to navigate from one digit to another and the up/down arrow buttons to increase/decrease the value of the digit where the cursor is currently positioned.

To save the modified parameters, press *OK* (F4) before exiting. If it is not desired to modify the parameters, press *ESC* (F3).



Parameters that can be modified on this screen follow:

CONTRAST: It is possible to change the contrast of the digits displayed on the screen and to adapt the screen to better suit the lighting in the facility. Values that can be entered can vary from *00* to *99*.

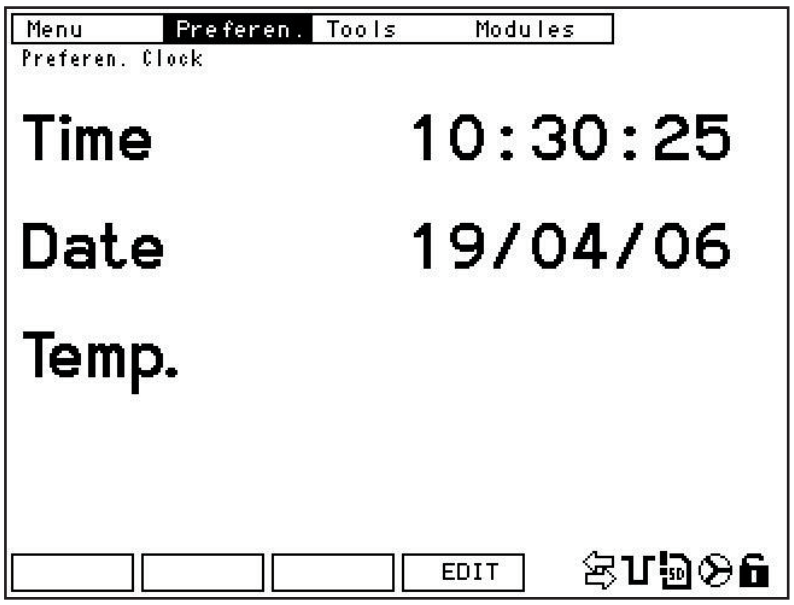
LCD OFF: Choose between *YES* and *NO*. If *YES* is selected, the screen switchs off is activated to save energy. The screen disconnection time is automatically configured for 5 minutes.

LIGHT FOR: Enter the time (in seconds) over which the screen backlighting should be activated. Select on of the following: *10*, *90* or *180*. It is possible to select *ON* or *OFF*.
If *ON* is selected, backlighting is always on. If *OFF* is selected, backlighting is always off.

LANGUAGE: This indicates the system interface language to be used on screens and menus. It is currently possible to select Spanish, English, French or German.

5.1.2 CLOCK / TEMPERATURE

To configure the internal system clock, go to *SYSTEM* in *MENU*. In *SYSTEM*, drop down the *PREFERENCES* menu and select *CLOCK*.



To modify the current values, press *EDIT* (F4). The cursor will be positioned in the first line of parameters. Use the up-down arrow buttons to move the cursor to the desired parameter. Press *SET* to enter edit mode for the desired value.

Use the left/right arrow buttons to navigate from one digit to another and the up/down arrow buttons to increase/decrease the value of the digit where the cursor is currently positioned. Parameters that can be modified on this screen follow:

TIME: Enter the local time in the system.

DATE: Enter the current date into the system with the format: DAY / MONTH / YEAR.

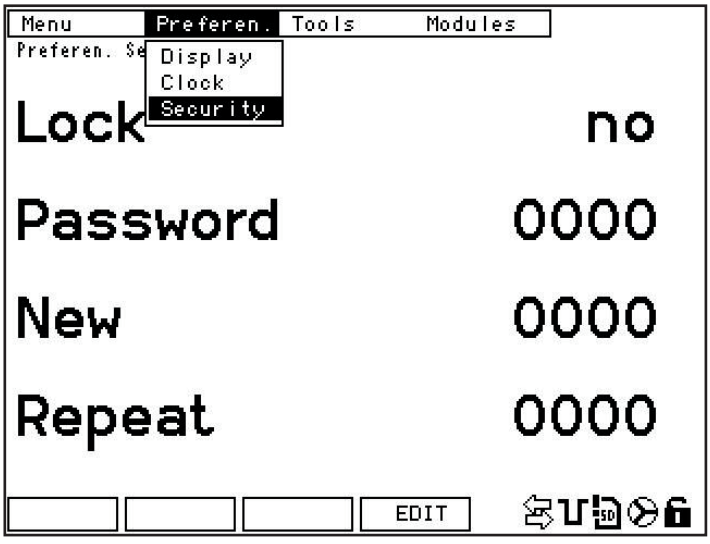
TEMPERATURE: Select the unit for displaying the temperature. It is possible to choose between *ºC* (Celsius) or *ºF* (Fahrenheit).

To save the modified parameters, press *OK* (F4) before exiting. If it is not desired to save the changes, press *ESC* (F3).

WARNING: CVMk2 has an internal clock that you have to configure. The device will work with this local hour but, if you communicate the device with Power Studio the local time of the device will be changed to UTC hour.

5.1.3 SECURITY

To enter a security password for disabling the system's configuration menu, choose the *SYSTEM* option from the *MENU*. In *SYSTEM*, access the *PREFERENCES* drop down menu and select *SECURITY*.



To modify the current values, press *EDIT* (F4). The cursor will be positioned in the first line of parameters. Use the up-down arrow buttons to move the cursor to the desired parameter. Press *SET* to enter configuration mode for the desired value.

Use the left/right arrow buttons to navigate from one digit to another and the up/down arrow buttons to increase/decrease the value of the digit where the cursor is currently positioned.

Parameters that can be modified on this screen follow:

BLOCK: Select whether the password should be activated (*YES*) or deactivated (*NO*).

PASSWORD: Enter the system password in order to make the changes (by default *0000*). The new password should be a four digit number between *0001* and *9999*.

NEW: Enter the new system password. The password should be a four digit number between *0001* and *9999*.

REPEAT: Enter the password again to confirm it.

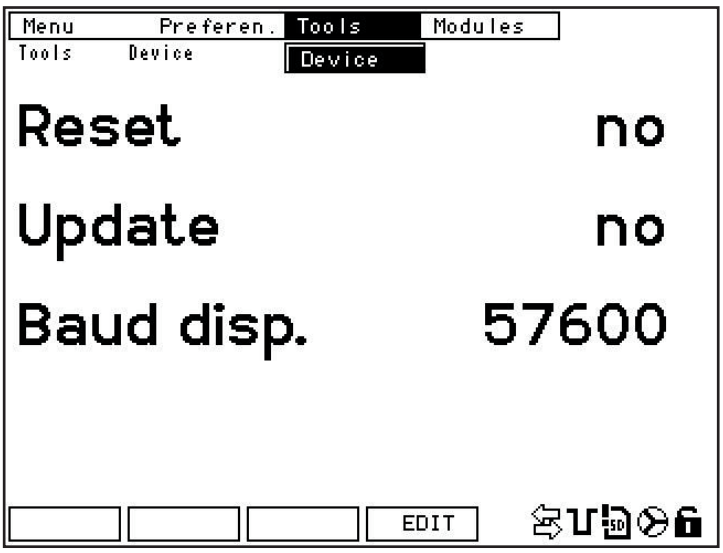
To save the modified parameters, press *OK* (F4) before exiting. If it is not desired to save the changes, press *ESC* (F3).

WARNING: Changing the password disables the screen, thus not blocking access to the system configuration menus.

5.2. TOOLS

5.2.1 SYSTEM

To change the configuration parameters for communication between the screen and the connected module(s), choose the *SYSTEM* option on *MENU*. In *SYSTEM*, access the *TOOLS* drop down menu and select *SYSTEM*.



To modify the current values, press *EDIT* (F4). The cursor will be positioned in the first line of parameters. Use the up-down arrow buttons to move the cursor to the desired parameter. Press *SET* to enter edit mode for the desired value.

WARNING: Changing the screen's communication speed can cause communication to be lost with the module(s) that are not connected to the screen at the time the change is made.

Use the left/right arrow buttons to navigate from one digit to another and the up/down arrow buttons to increase/decrease the value of the digit where the cursor is currently positioned.

Parameters that can be modified on this screen follow:

RESET: Select *YES* to restart the screen and start to automatically search for the connected modules.

UPDATE: Select *YES* to leave the screen in standby mode in order to receive the firmware update through the measurement system COM1 port (display).

BAUD PANT: By default 5760. It is recommended not to change this parameter since this could cause communication to be lost with the module(s) that are not connected to the screen.

When the screen indicates that there is a communication error with the module(s), it is recommended to check the communication speed between the screen and the module(s). Over very long distances, it may be necessary to change the speed between the screen and the measurement modules.

WARNING: Beforr changing the speed, make sure that all the modules are properly connected and functioning. For the modules that are not connected when screen speed is modified, this parameter should be changed individually.

To save the modified parameters, press *OK* (F4) before exiting. If it is not desired to save the changes, press *ESC* (F3).

5.3 MODULES

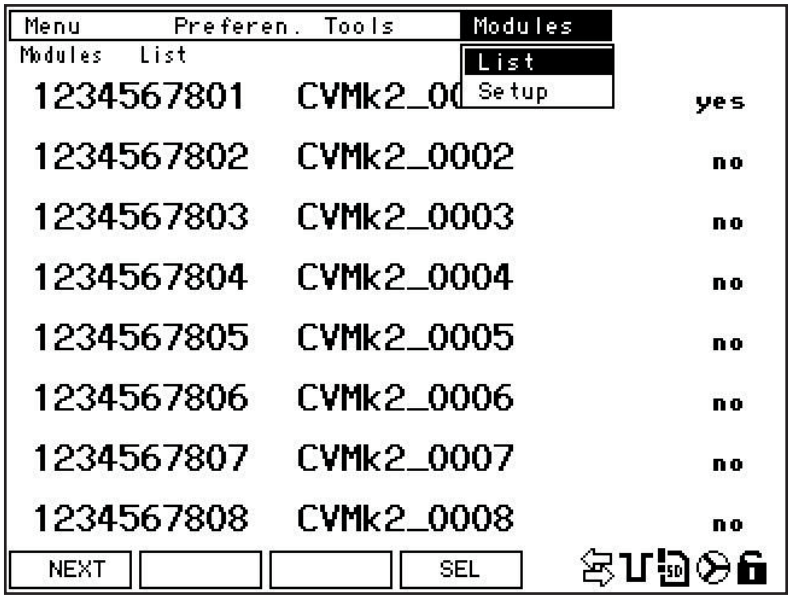
The **CVMk2** screen automatically recognises the modules that are connected. To begin detecting modules, restart the display screen. Said screen can be restarted by disconnecting it from the power supply (disconnecting the RJ-45 communications connector and the power supply from the display screen) or by resetting it. To do this, access the *SYSTEM* menu in the *TOOLS* option (See chapter 5.2.1 herein) and select *YES* in the *RESET* option. Confirm using the *OK* button.

5.3.1 LIST

The **CVMk2** display screen will generate a list with the serial numbers of the systems it detects when it restarts. This list will always be the same as long as no new systems are entered in the display communications BUS, identified with COM1 on the tag.

The modules detected by the display screen will be assigned an informative peripheral number (*PER. NUM.*). This is an automatically generated number between 1 and 32.

To change the module that is viewed on the display, choose *SYSTEM* from the *MENU*. In *SYSTEM*, access the *MODULES* drop down menu and select the *LIST* option. Then, confirm with the *SET* button.



To view another measurement module, press the *SEL* (F4) button and access the list of connected modules. The cursor will be positioned over the first line, which corresponds with the first module configured in the list.
Use the up-down arrow buttons to move the cursor to the desired module. Press *SET* to enter the desired value.

On the screen a list will outline all measurement modules that have been configured and entered on the screen. The list shows the following parameters.

0123456789 ABCDEFGHIJ YES/NO

0123456789: This is the serial number of the module detected by the screen.

ABCDEFGHIJ: This is the name configured for this module.

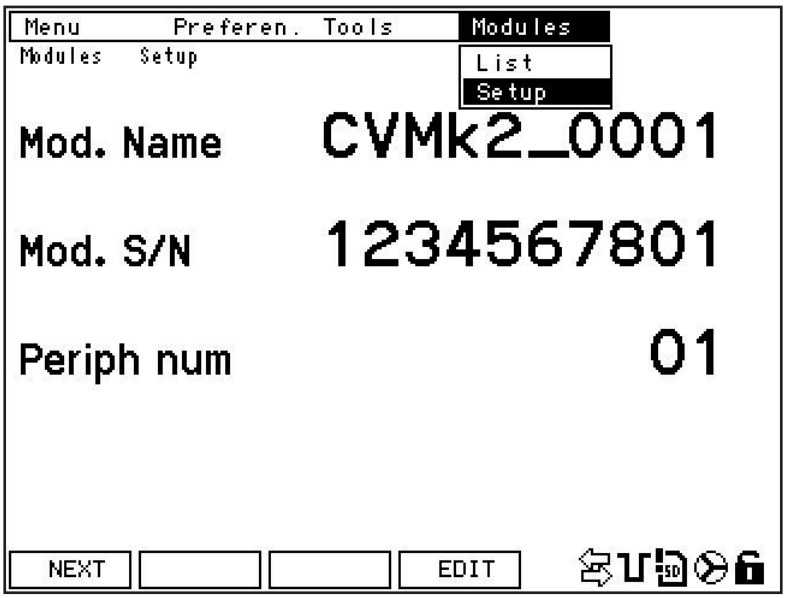
YES/NO: This indicates the module selected to be viewed on the screen.

The name of the module selected is displayed on the upper right hand side of the screen. If another module is selected, the name will change to indicate the measurement module that corresponds with the values currently displayed at any time.

To view the parameters of another module in the list, navigate to the module using the arrow buttons. When the cursor is over the desired module, select it by pressing *SEL* (F4) in order to change the menu option to *YES* and then confirm with *OK*.

5.3.2 SETUP

To change the modules' configuration parameters, choose the *SYSTEM* option on *MENU*. In the *SYSTEM* menu, access the *MODULES* drop down menu and select the *SETUP* option. Then, confirm with the *SET* button.



To modify the current values, press *EDIT* (F4). The cursor will be positioned in the first line of parameters. Use the up-down arrow buttons to move the cursor to the desired parameter and press *SET* to enter edit mode.

Use the left/right arrow buttons to navigate from one digit to another and the up/down arrow buttons to increase/decrease the value of the digit where the cursor is currently positioned.

Parameters that can be viewed on this screen follow:

MOD. NAME: Current name or name to be given to the measurement module. When the parameters of this module are displayed, this name is also displayed in the upper right hand corner of the screen.

MODULE S/N: The module serial number. This number is only informative, not editable.

PER. NUM.: By default, this is 1 when there is only one measurement module connected. This number is automatically generated. It is only informative and cannot be edited. It also indicates the order in which the modules will appear on the *LIST* display screen discussed in Section 5.3.1.

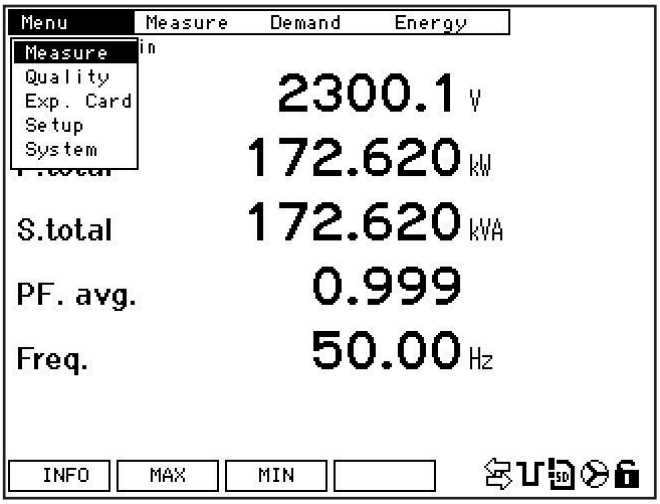
If more than one module is connected, other modules can be modified by pressing the *NEXT* button (F1). This advances the user to the next module in the list, where names can be edited without exiting the edit screen.

6. DISPLAY SCREENS

6.1 MEASURING

6.1.1 MAIN

To access the main display screen from which parameters can be viewed in real time, choose the *MEASUREMENT* option from the *MENU*.



The following variables are displayed on the main measurement screen.

MEAN V.: Mean value of the three phase-neutral voltages.

TOTAL P.: Sum of the real time active power values of the three phases.

TOTAL S.: Sum of the real time apparent power values of the three phases.

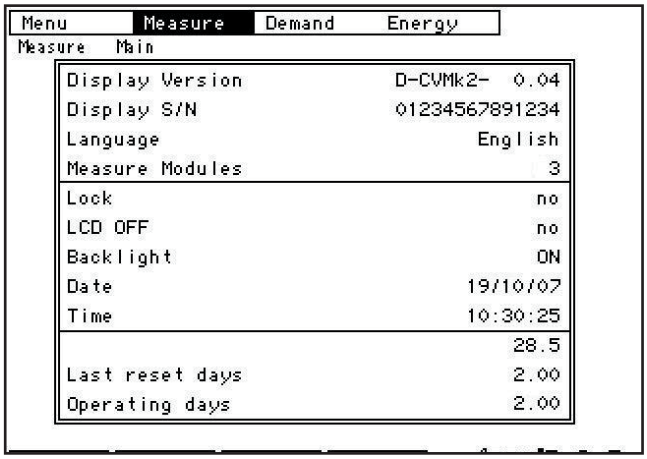
MEAN 3-P: Three phase power factor

FREQ: Frequency measured for phase 1.

6.1.1.1. System information

The function buttons permit the following:

INFO : (F1) System Information.
The first window gives information on the parameters configured in the display screen and in the memory.



MAXIMUMS : (F2) This displays the maximum parameters stored in the system memory since the last time the maximum values were reset or since the system was put into operation. (See Section 6.1.1.2, Maximums Button)

MINIMUMS : (F3) This displays the minimum parameters stored in the system memory since the last time the minimum values were reset or since the system was put into operation. (See Section 6.1.1.3, Minimums Button)

The following information appears on the screen:

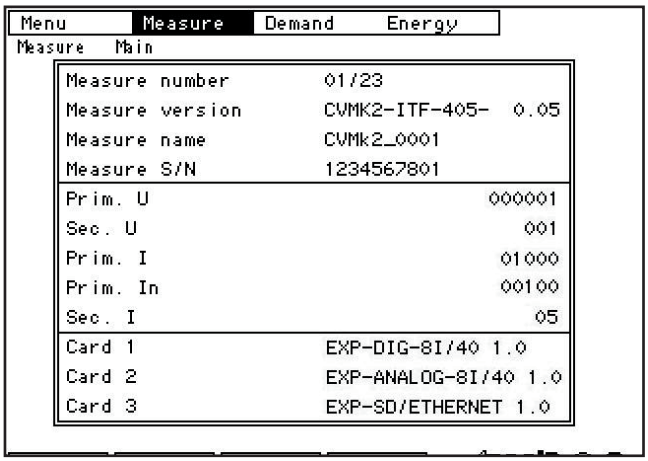
TEXT	VALUE	DESCRIPTION
Display Version	D-**CVMk2**-xxx	Firmware version stored in the display screen.
S/N Display	**********	Display screen serial number.
Language	Spanish	Language selected.
Measurement modules	01	Number of modules detected by the display screen.
Block	NO	Display screen is or is not password protected.
LDC OFF	NO	Display screen turns off with the lighting.
Light for	ON	Selected time over which backlighting will be on.
Date	**/**/**	Date configured in the module.
Time	**:**:**	Time configured in the module.
Temperature	**.*	Measurement module's internal temperature.
Days since reset	*.**	Days since the last reset was performed.
Days in operation	*.**	Total days the system has been in operation.

It is important to refer to this screen, because it provides a summary of the display screen configuration. Accordingly, it is not necessary to navigate through the configuration menus to verify the system's configuration.

The menus that appear above the function buttons are the following:

EXIT : (F1) Use this button to exit the system information screens. Press this button to return to the main measurement screen from which the current screen was accessed.

MED : (F2) System Information.
This button is used to display the measurement module configuration screen.



The following information is shown on the measurement system's information display screen.

TEXT	VALUE	DESCRIPTION
Measurement number	01 / 01	Module number / total modules connected.
Version measured	**CVMk2**-ITF-405-***	Module type and firmware version of the same.
Measurement name	GENERAL	Edited name for the measurement module.
S/N measured	**********	Module serial number.
Prim. U	0000001	Primary for the programmed voltage transformer.
Sec. U	001	Secondary for the programmed voltage transformer.
Prim. I	00500	Primary for the programmed current transformer.
Prim. In	00005	Primary for the programmed neutral line current transformer.
Sec. I	5	Secondary for the programmed current transformer.
Card 1	NONE*********-	No card is detected in slot 1.
Card 2	EXP-DIG-8I/4O 1.0	Digital inputs/relay outputs card detected.
Card 3	EX-SD/ETHERNET 1.0	SD memory and Ethernet card detected.

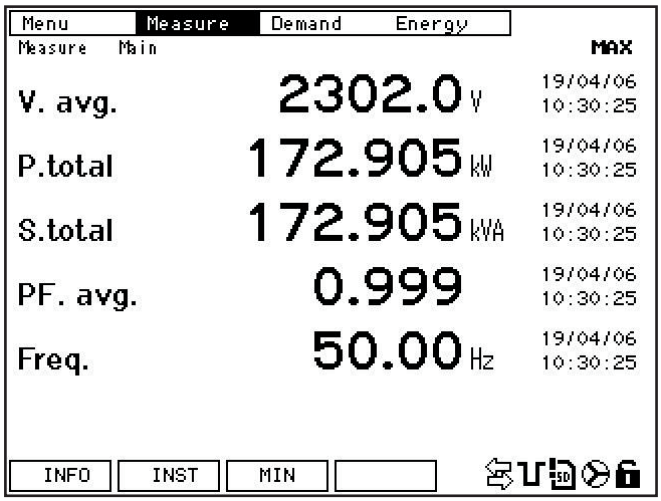
The menus that appear above the function buttons on this screen are the following:

EXIT : (F1) Use this button to exit the system information screens. Press this button to return to the main measuring screen from which the current screen was accessed.

DISP : (F2) Press this button to return to the previous screen where the display screen configuration parameters are shown.

6.1.1.2. Maximums

The maximum values are displayed on the screen, along with the date and time when they were recorded for the real time variables.



The following variables are displayed on the maximum values screen:

MEAN V.: Maximum value for the mean of the three phase voltages.

TOTAL P.: Maximum value of the sum of the real time power values of the three phases.

TOTAL S.: Maximum value of the sum of the real time apparent power values of the three phases.

MEAN PF: Maximum value for the mean of the three phase power factor.

FREQ: Maximum line frequency (referenced from the maximum phase 1 frequency).

When the maximum values are displayed, the exact time and date when they were recorded is displayed with each one of them. These maximum values are referenced to the date when the system was connected. If the maximum values have been deleted, these values make reference to the period since the date when the last deletion was performed.

The menus that appear above the function buttons on this screen are the following:

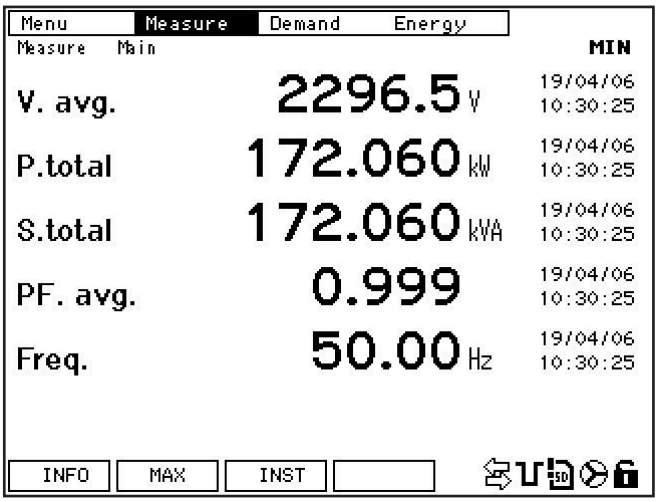
INFO : (F1) Press this button to return to the system information screen (section 6.1.1.1. System Information

REAL T.: (F2) Press this button to return to the screen on which the variables' real time values are displayed. (See Section 6.1.1. Main)

MIN : (F3) Press this button to exit the maximum values screen and to enter the minimum values screen (See Section 6.1.1.3.).

6.1.1.3. Minimums

This screen displays the minimum values for the variables in real time, along with the date and the time when they were recorded.



The following variables are displayed on the minimum values screen:

MEAN V.: Minimum value for the mean of the three phase voltages.

TOTAL P.: Minimum value of the sum of the real time power values of the three phases.

TOTAL S.: Minimum value of the sum of the real time apparent power values of the three phases.

MEAN PF: Minimum value for the mean of the three phase power factor.

FREQ: Minimum line frequency (referenced from the minimum phase 1 frequency).

When the minimum values are displayed, the exact time and date when they were recorded is displayed with each one of them.

These minimum values are referenced to the date when the system was connected. If the minimum values have been deleted, these values make reference to the period since the date when the last deletion was performed.

The menus that appear above the function buttons on this screen are the following:

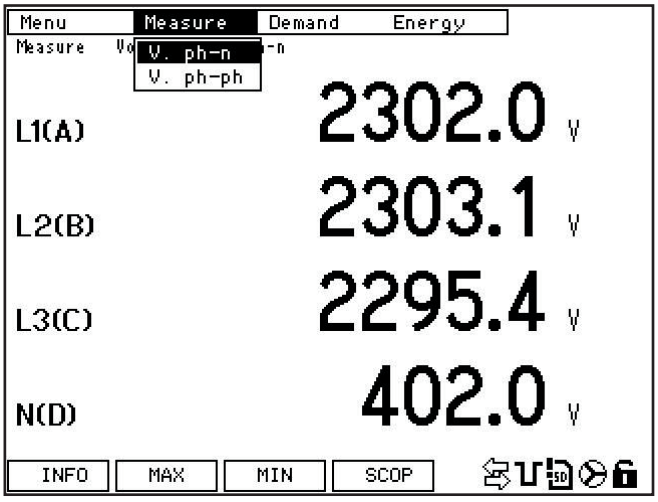
INFO : (F1) Press this button to return to the system information screen (Section 6.1.1.1., System Information).

MAX: (F2) Press this button to access the screen that displays the maximum values stored (See section 6.1.1.2.).

REAL T.: (F3) Press this button to return to the previous screen from which the current screen was accessed. The previous screen that displays real time values for the variables. (See Section 6.1.1. Main)

6.1.2 PHASE-NEUTRAL VOLTAGE

Simple voltages referenced to the neutral of each one of the phases are listed on this screen.



The bottom menu offers the following options:

INFO : Press this button to access the system information screen (Section 6.1.1.1., System Information).

MAX: Press this button to access the screen that displays the maximum values stored. Maximum values for each variable recorded since the last deletion, along with the date and time of the registry, are displayed on this screen.

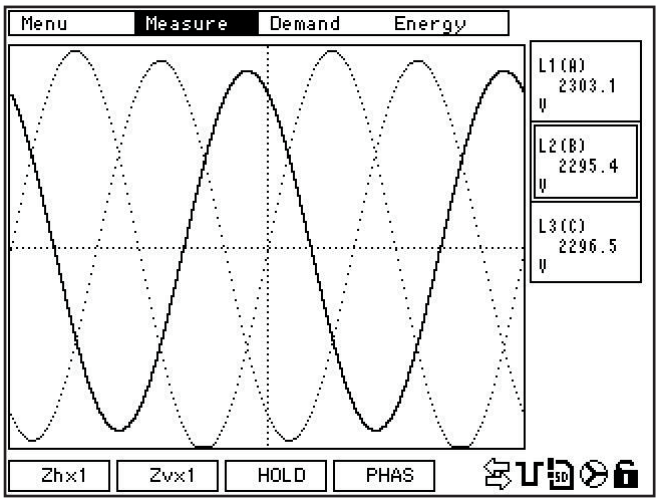
On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

MIN : Press this button to access the screen that displays the minimum values stored. Minimum values for each variable recorded since the last deletion, along with the date and time of the registry, are displayed on this screen.

On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

WAVE: Pressing this button will access the screen for the wave form of the voltage between the phases and neutral.

6.1.2.1. Voltage waveform display



The simple or phase-neutral voltage waveform is displayed on this screen. The up/down arrow buttons can be used to navigate inside the screen between the L1, L2 and L3 phases.

Upon accessing the screen, the cursor is situated over L1 and is activated by default. To view the phases, place the cursor over the desired phase and press *SET*. If the phase selected was already activated, pressing *SET* will deactivate it and said phase will no longer be displayed.

Accordingly, the three waveforms on the three phase line can be simultaneously viewed. They can also be grouped according to preference.

The boxes situated on the right side of the screen, which correspond to each phase, provide the RMS value of the simple voltage for each one of the phases.

WARNING: Refreshing screens that display graphics such as waveforms and phasors takes one second. If there is any event that last less than one second or that is not cyclic, it will not be displayed.

The buttons that appear on the bottom menu include:

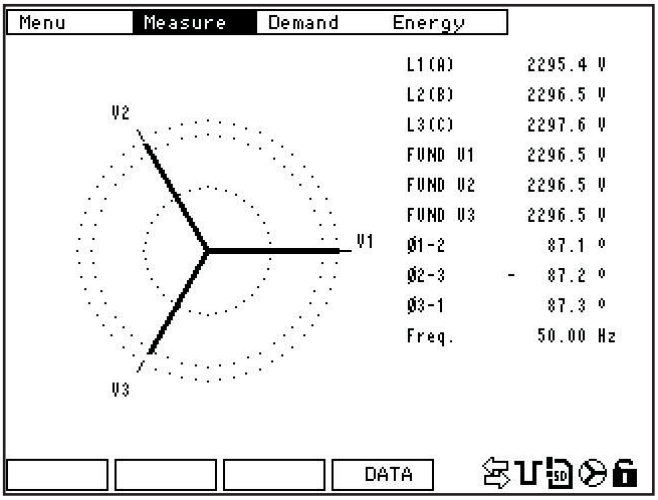
*Z*hx1: This button can be pressed to horizontally zoom in on the waveform displayed. This is a cyclic zoom with x1, x2 and x4 options, which then returns to normal.

Zvx1: This button can be pressed to vertically zoom in on the waveform displayed. This is a cyclic zoom with x1, x2, x4 and x8 options, which then returns to normal.

HOLD: This option takes a screen shot of the waveform currently being viewed. The *RUN* button allows returning to the continuous waveform display mode.

PHASE: This accesses the phasors graphical display screen. The phasors display screen only gives the *DATA* (F4) option on the bottom menu. Pressing *DATA* will return the user to the screen that displays the variables' real time numeric values. (See Section 6.1.2.)

6.1.2.2 Voltage phasors display



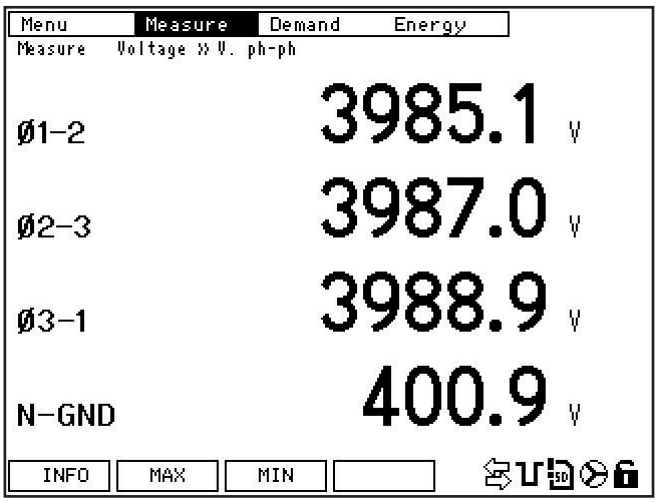
Phasors are graphically displayed on this screen. A table of the most representative numeric values is also displayed on this screen.

TEXT	VALUE (EX..)	DESCRIPTION
L1	240.0	RMS value for VL1
L2	239.8	RMS value for VL2
L3	240.1	RMS value for VL3
V1 FUND	230.2	Value of the phase 1 fundamental.
V2 FUND	230.0	Value of the phase 2 fundamental.
V3 FUND	230.4	Value of the phase 3 fundamental.
Ø 1-2	120.4 º	Angular difference between phases 1 and 2.
Ø 2-3	120.4 º	Angular difference between phases 2 and 3.
Ø 3-1	119.2 º	Angular difference between phases 3 and 1.
Freq:	50.14	Phase 1 frequency.

WARNING: It is only possible to navigate through the top menu using the right/left arrow buttons in the numeric display screen (Section 6.1.2.).

6.1.3 PHASE-PHASE VOLTAGE

The values of the compound voltages are displayed on this screen, which are the values of voltage between phases.



The menus that appear above the function buttons on this screen are the following:

INFO : Press this button to access the system information screen (Section 6.1.1.1., System Information).

MAX: Press this button to access the screen that displays the maximum values stored. Maximum values for each variable recorded since the last deletion, along with the date and time of the registry, are displayed on this screen.

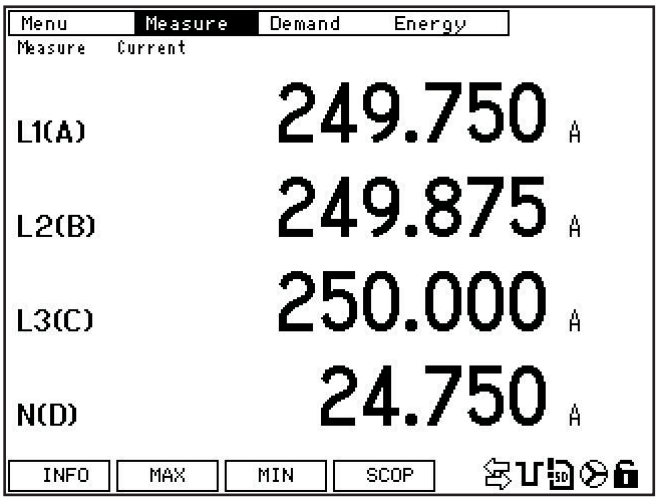
On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

MIN : Press this button to access the screen that displays the minimum values stored. Minimum values for each variable recorded since the last deletion, along with the date and time of the registry, are displayed on this screen.

On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

6.1.4 CURRENT

Real time values for the currents of each phase and the neutral are displayed on this screen.



NOTE: The neutral line current is that which is measure by the **CVMk2** if a neutral transformer is configured and connected. If no transformer is connected, the system can be programmed to calculate the neutral current.

On this screen, the following options are shown above the function buttons:

INFO : Press this button to access the system information screen (Section 6.1.1.1., System Information).

MAX: Press this button to access the screen that displays the maximum values stored. Maximum values for each variable recorded since the last deletion along with the date and time of the registry are displayed on this screen.

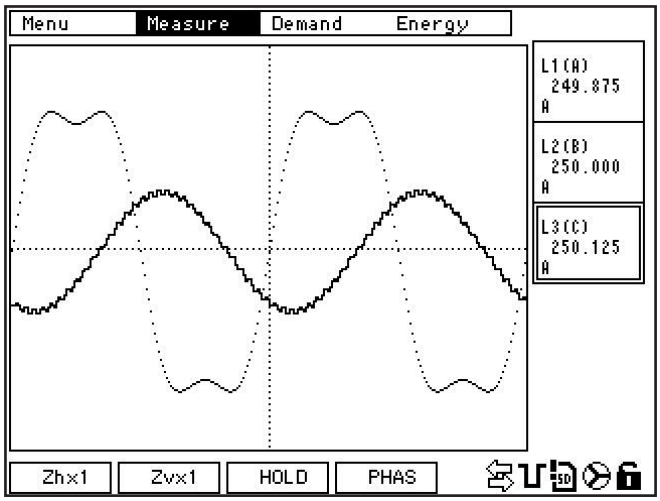
On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

MIN : Press this button to access the screen that displays the minimum values stored. Minimum values for each variable recorded since the last deletion along with the date and time of the registry are displayed on this screen.

On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

WAVE: Pressing the Wave *BUTTON* will access the waveform screen for the currents of the phases.

6.1.4.1. Current waveform display



The current waveform is displayed on this screen. The up/down arrow buttons can be used to navigate inside the screen to select or deselect each one of the L1, L2 and L3 phases.

Upon accessing the screen, the cursor is situated over L1 and is activated by default. To view the other phases, place the cursor over the desired phase and press *SET*. If the phase selected was already activated, pressing *SET* will deactivate it.

Accordingly, the three waveforms on the three phase line can be simultaneously viewed. They can also be grouped according to preference.

The boxes situated on the right side of the screen, which correspond to each phase, provide the RMS value of the current for each one of the phases.

WARNING: Refreshing screens that display graphics such as waveforms and phasors takes one second. If there is any event that last less than one second or that is not cyclic, it will not be displayed.

The menus that appear above the function buttons on this screen are the following:

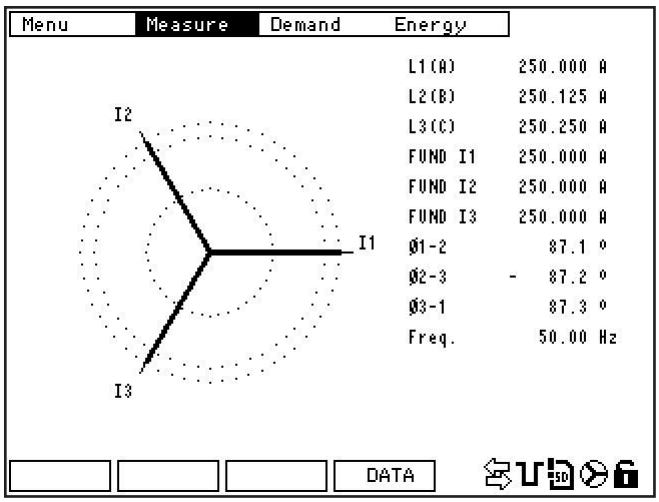
*Z*hx1: Horizontally zoom in on the waveform displayed. This is a cyclic zoom with x1, x2 and x4 options, which then returns to normal.

*Z*vx1: This button can be pressed to vertically zoom in on the waveform displayed. This is a cyclic zoom with x1, x2, x4 and x8 options, which then returns to start.

HOLD: This option takes a screen shot of the waveform currently being viewed.
The *RUN* button permits returning to the continuous waveform display mode.

PHASE: This access the phasors graphical display screen. The phasors display screen only gives the *DATA* (F4) option on the bottom menu. Pressing *DATA* will return the user to the screen that displays the variables' real time numeric values. (See Section 6.1.4.)

6.1.4.2 Current phasors display



Phasors are graphically displayed in this figure. A table of the most representative numeric values is also displayed on this screen.

TEXT	VALUE (EX..)	DESCRIPTION
L1	240.0	RMS value for line 1.
L2	239.8	RMS value for line 2.
L3	240.1	RMS value for line 3.
I1 FUND	235.2	Value of the phase 1 fundamental.
I2 FUND	233.5	Value of the phase 2 fundamental.
I3 FUND	235.6	Value of the phase 3 fundamental.
Ø 1-2	120.4 º	Angular difference between phases 1 and 2.
Ø 2-3	120.4 º	Angular difference between phases 2 and 3.
Ø 3-1	119.2 º	Angular difference between phases 3 and 1.
Freq:	50.14	Frequency of the phases (phase 1).

WARNING: It is only possible to navigate through the top menu using the right/left arrow buttons in the numeric display screen (6.1.4.).

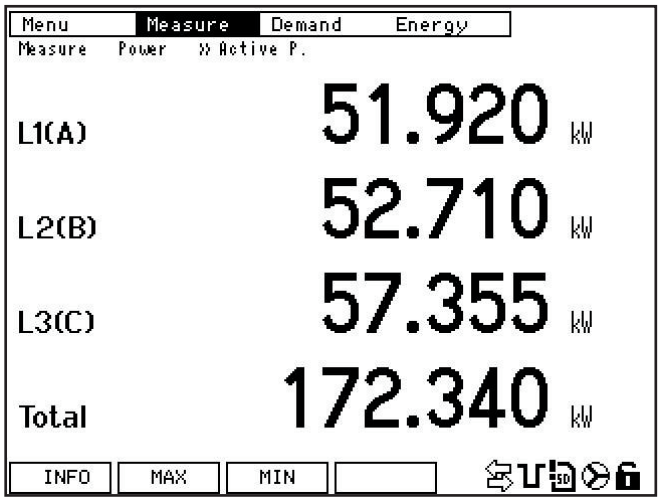
6.1.5 POWERS

WARNING: The CVMk2 power calculation is limited according to the following formula:

(Prim V) x (Prim I) < 45.000.000

6.1.5.1 Active power

Real time values for the active powers of each phase and the three phase active power (kW) are displayed on this screen.



On this screen, the following options are shown above the function buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

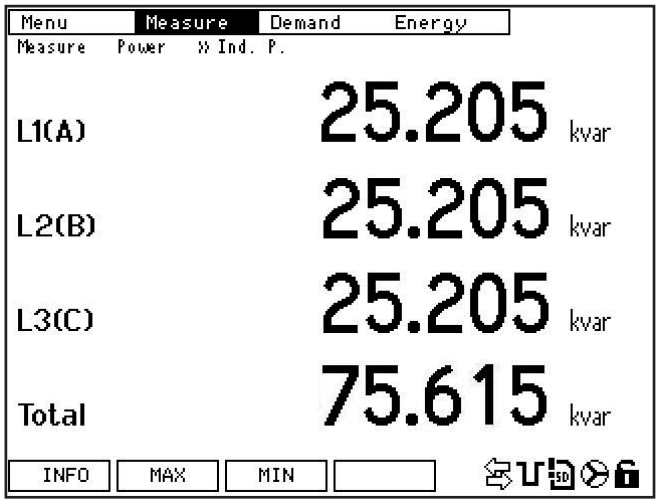
On the *MAX* screen, appears the *REAL T.* option, which can be used to return to the screen that displays the real time variables.

MIN : This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

On the *MIN* screen, appears the *REAL T.* option, which can be used to return to the screen that displays the real time variables.

6.1.5.2 Inductive power

Real time values for the inductive powers of each phase and the three phase inductive power (kvar) are displayed on this screen.



On this screen, the following options are shown above the function buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

MAX.: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

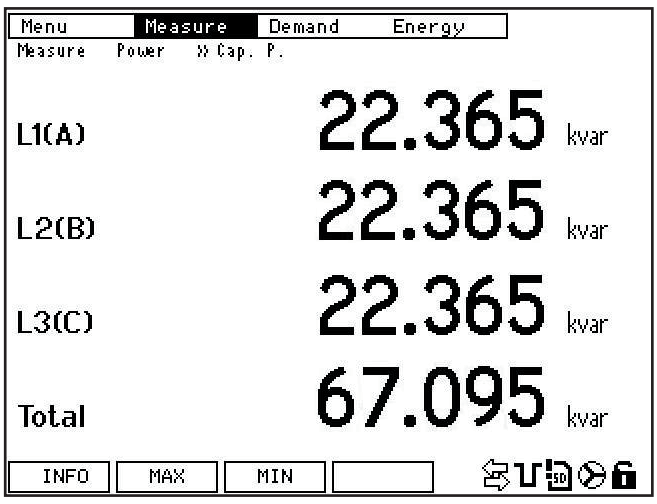
On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen. that displays the real time variables.

MIN : This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen. that displays the real time variables.

6.1.5.3 Capacitive power

Real time values for the capacitive powers of each phase and the three phase capacitive power (kvar) are displayed on this screen.



On this screen, the following options are shown above the function buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

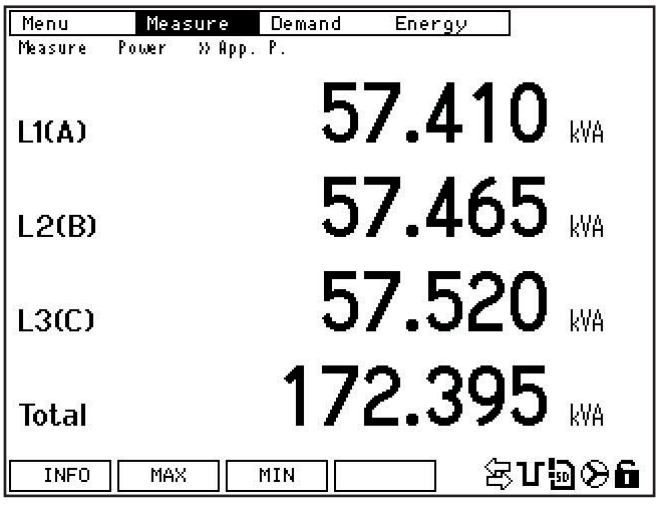
On the *MAX* screen, appears the *REAL T.* option, which can be used to return to the screen that displays the real time variables.

MIN : This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

On the *MIN* screen, appears the *REAL T.* option, which can be used to return to the screen that displays the real time variables.

6.1.5.4 Apparent power

Real time values for the apparent powers of each phase and the three phase apparent power (kV·A) are displayed on this screen.



On this screen, the following options are shown above the function buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

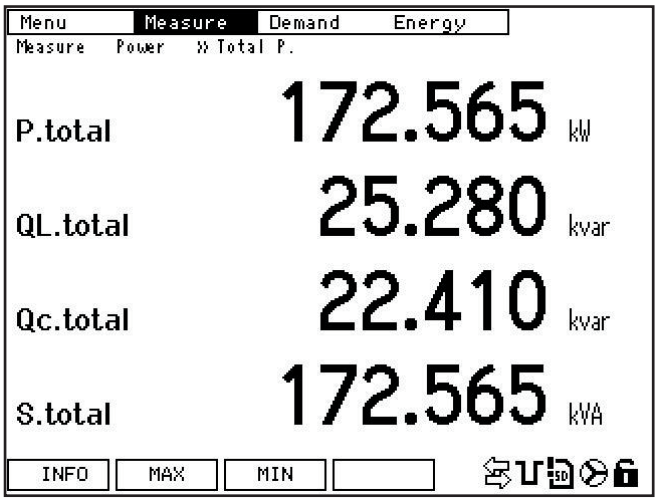
On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen. that displays the real time variables.

MIN : This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen. that displays the real time variables.

6.1.5.5 Total power

The values of the three phase power are displayed on this screen.



On this screen, the following options are shown above the function buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen, along with the date and time of registry.

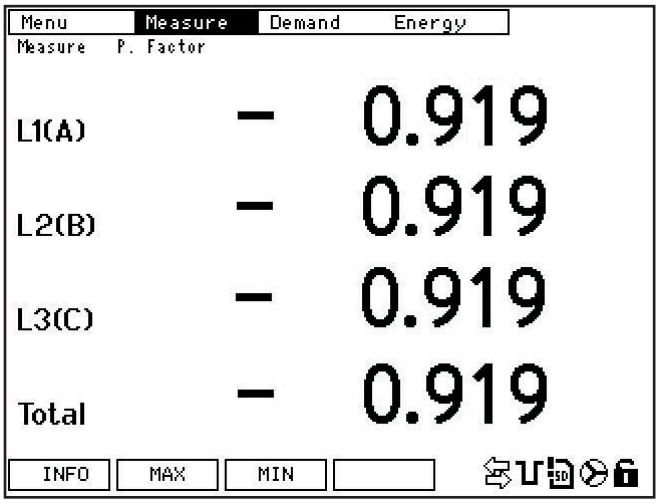
On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen. that displays the real time variables.

MIN : This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen, along with the date and time of registry.

On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen. that displays the real time variables.

6.1.6, POWER FACTOR

Real time values for the power factor corresponding to each phase and the total power factor are displayed on this screen.



On this screen, the following options are shown above the function buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen, along with the date and time of registry.

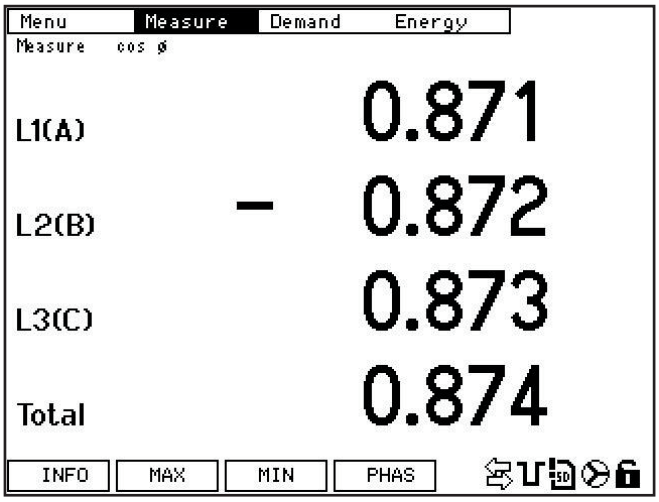
On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

MIN : This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen, along with the date and time of registry.

On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

6.1.7 COS φ

Real time values for the cos φ value for each phase and the total cos φ are displayed on this screen.



On this screen, the following options are shown above the function buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

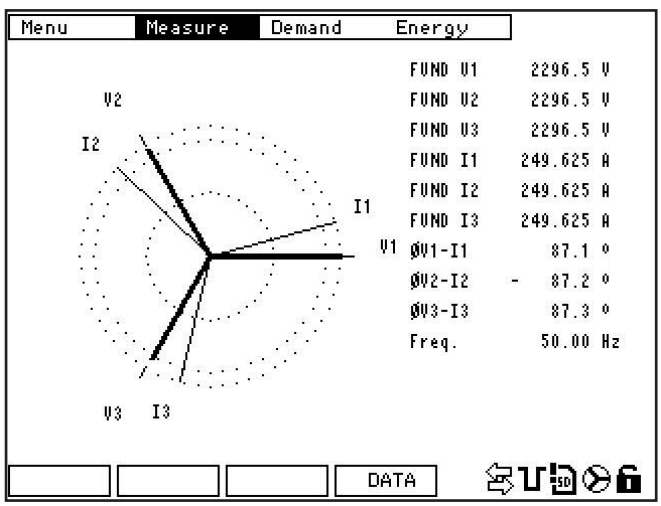
MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

MIN : This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

PHASE: This accesses the phasors graphical display screen. The phasors display screen only gives the *DATA* (F4) option on the bottom menu. Pressing *DATA* will return the user to the screen that displays the variables' real time numeric values. (See Section 6.1.6)



Phasors are graphically displayed on this screen along with a table of the most representative numeric values.

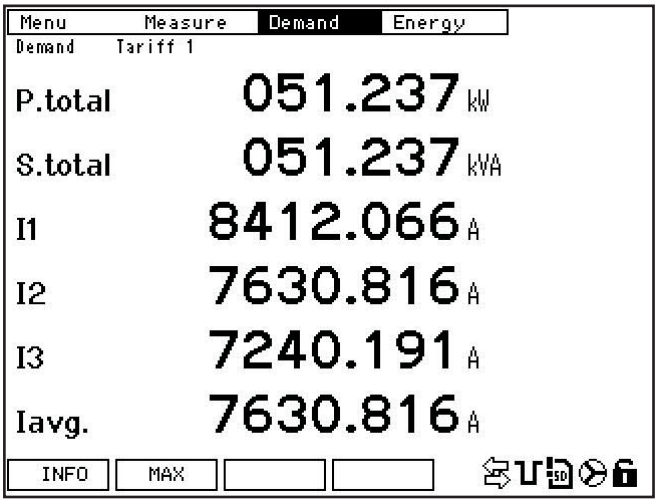
TEXT	VALUE	DESCRIPTION
V1 FUND	240.0	Value of the phase 1 voltage fundamental.
V2 FUND	239.8	Value of the phase 2 voltage fundamental.
V3 FUND	240.1	Value of the phase 3 voltage fundamental.
I1 FUND	235.2	Value of the phase 1 current fundamental.
I2 FUND	233.5	Value of the phase 2 current fundamental.
I3 FUND	235.6	Value of the phase 3 current fundamental.
Ø V1-I2	120.4 º	Angular difference between phase 1 voltage and current.
Ø V2-I3	120.4 º	Angular difference between phase 2 voltage and current.
Ø V3-I1	119.2 º	Angular difference between phase 3 voltage and current.
Freq:	50.14	Frequency of the phases (phase 1).

6.2. DEMAND

On the *DEMAND* screen, the user can select the *DEMAND* to be displayed. This corresponds to the desired fee from among all those that are configured.
If no fee has been configured, fee 1 will be chosen by default.

The following parameters are displayed for all tariff on the *DEMAND* screen.

TOTAL P.: Total active power for the fee.
TOTAL S.: Total apparent power for the fee.
I1: Phase 1 current
I2: Phase 2 current
I3: Phase 3 current
MEAN I: Mean for the three phase currents.



On this screen, the following options are shown above the function buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

The maximum demand values stored in memory are displayed on the MAX screen.

6.3 ENERGY

The energy menu has the following options:

CURRENT: This is the energy accumulated to date. Within this option it is possible to break down the tariff or to display a total for all the tariff.

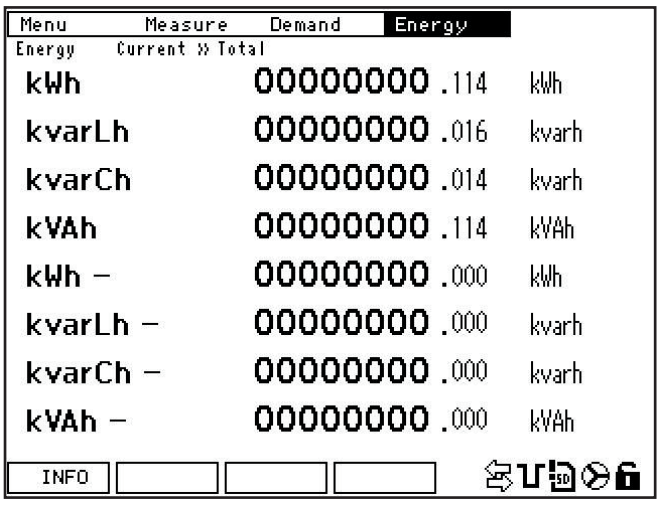
MONTHLY: The **CVMk2** stores the closing data for energy consumed during the previous month in its internal memory. This energy data stored from the previous month can also be broken down by tariff, or the total counter can be displayed.

YEARLY: Along the same lines, the **CVMk2** saves data to its memory relating to the energy consumed up to the previous year. This data can be broken down by tariff, or the total counter can be displayed.

The energy data display screen is the same for all options displayed in the energy menu.

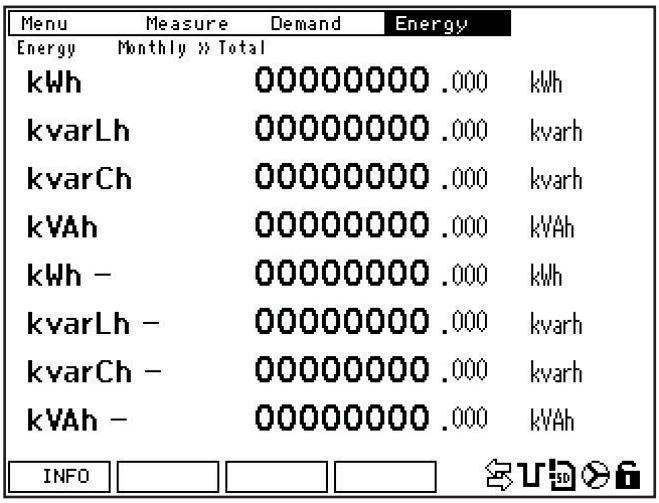
Consumption and generation values are displayed for all energy that is measured by the analyzer.

6.3.1 PRESENT ENERGY



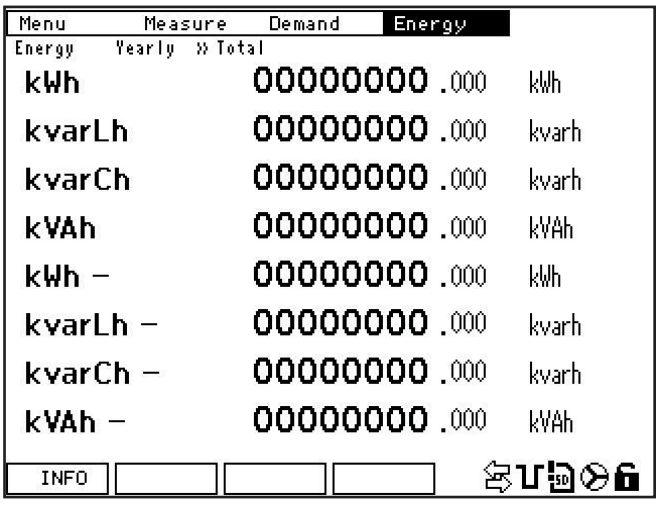
All energy accumulated, being generated and being consumed is displayed on the screen. The user can select total, which will display the total energy accumulated in all counters, or the user can select each fee schedule separately.

6.3.2 MONTH ENERGY



CVMk2 stores the energy value accumulated up to the last day of the previous month. This stored energy value is kept in a totaling meter and in the partial meter for all tariff that have been configured.

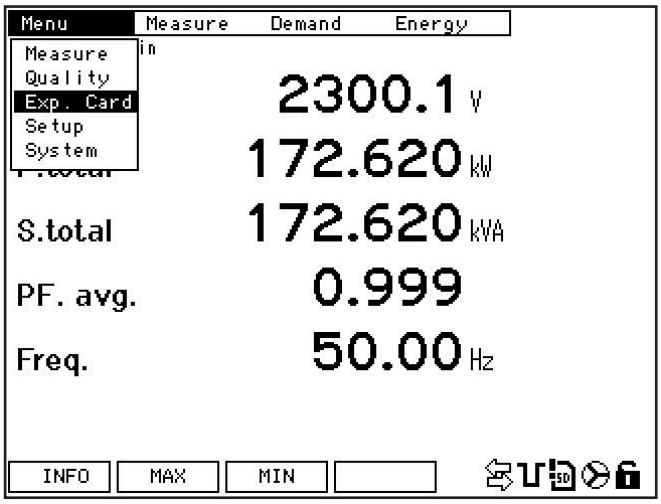
6.3.3 ANNUAL ENERGY



CVMk2 stores the energy value accumulated up to the previous year. This stored energy value is kept in a totaling meter and in the partial meter for all tariff that have been configured.

6.4 EXPANSION CARDS

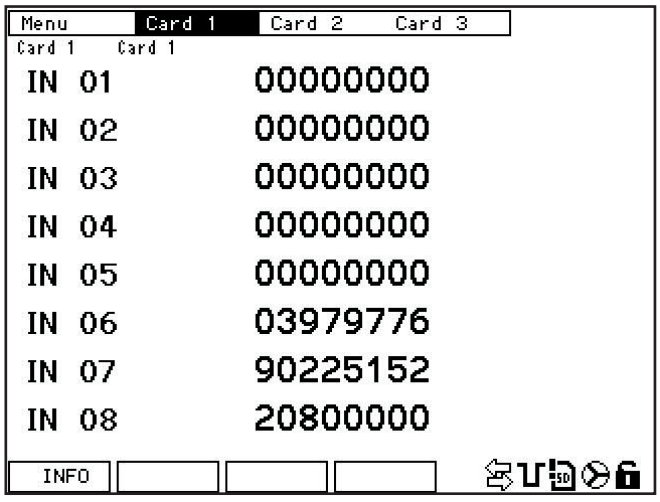
In order to view the status of the expansion card inputs or outputs, navigate to *CARDS* on the *MENU*, and select the *CARDS* option. Then, select the appropriate option on the top menu (card 1, card 2 or card 3), depending on the position in which the card to be displayed is inserted.



If there is no card inserted in the position selected or the card is not recognised, the *NO CARD* message will be displayed.

6.4.1 CARD WITH 8 DIGITAL INPUTS / 8 OUTPUTS

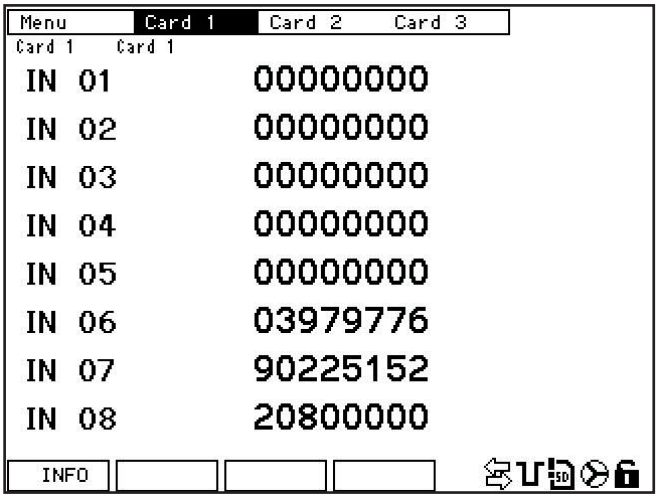
If a position is selected in which a static digital input / output card is inserted, the following screen will be displayed.



The figure provides the status of the digital inputs or the number of pulses received in each one of the inputs, depending on how the inputs were configured.
It is possible to edit the name and units for the digital inputs so as to differentiate them in case they are used to centralise pulses from other systems.

6.4.2 CARD WITH 8 RELAY INPUTS / 4 OUTPUTS

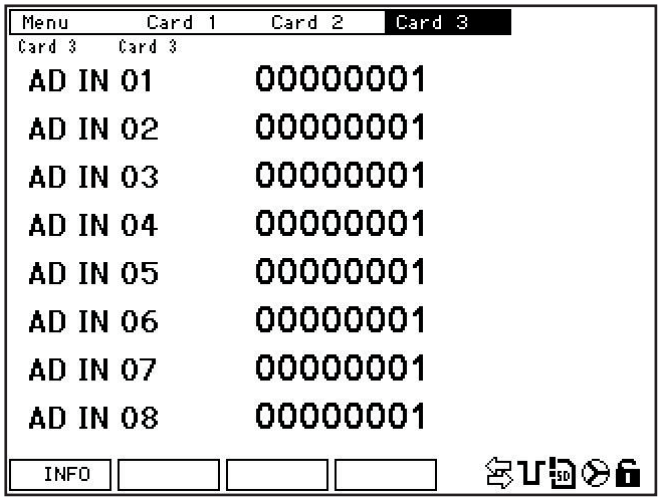
If a position is selected in which a static relay input / output card is inserted, the following screen will be displayed.



The figure provides the status of the digital inputs or the number of pulses received in each one of the inputs, depending on how the inputs were configured.
It is possible to edit the name and units for the digital inputs so as to differentiate them in case they are used to centralise pulses from other systems.

6.4.3 CARD WITH 8 ANALOGUE INPUTS / 4 OUTPUTS

If a position is selected in which a analogue input / output card is inserted, the following screen will be displayed.

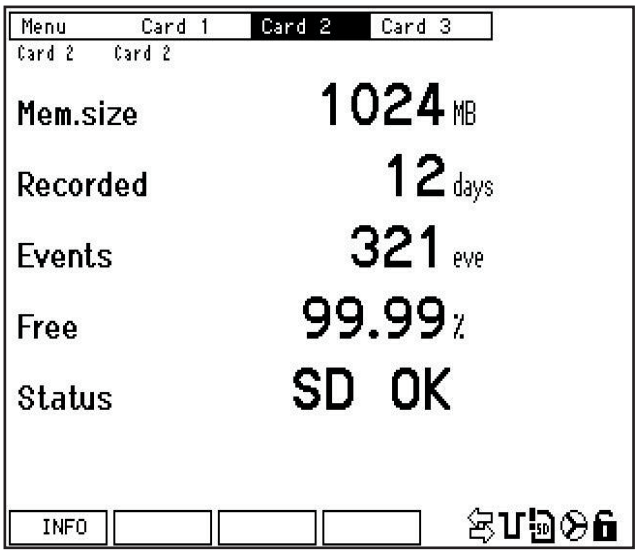


The status of the analogue inputs is displayed on the screen along with the values configured in the configuration menu.

It is possible to edit a name for the analogue inputs to facilitate identifying them.

6.4.4 SD-ETHERNET AND SD MEMORY CARD

If a position is selected in which an Ethernet communication and SD memory card is inserted, the following screen will be displayed.



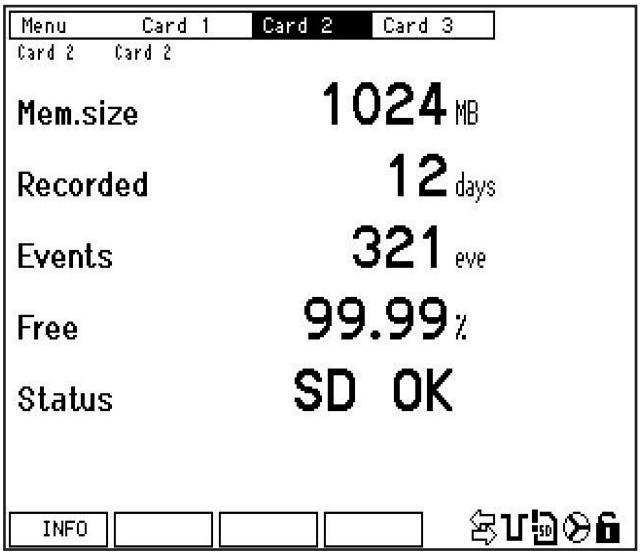
The memory card status and registry values such as the following are displayed on the screen:

MEMORY SPACE: Real capacity of the SD card.
REGISTRY: Days recorded since start or from the last format.
EVENTS: Number of voltage events detected since start or since the last format.
FREE: Percentage of free memory space.
STATUS: Memory status.

a) *SD OK*: The card is functioning properly
b) *NO SD*: There is no card inserted.
c) *WRITE PROT*: The card is write protected.
d) *ERROR*: There is a problem with the SD card memory, and it should be formatted.

6.4.5 SD MEMORY CARD

If a position is selected in which an SD memory card is inserted, the following screen will be displayed.



The memory card status and registry values such as the following are displayed on the screen:

MEMORY SPACE: Real capacity of the SD card.
REGISTRY: Days recorded since start or from the last format.
EVENTS: Number of voltage events detected since start or since the last format.
FREE: Percentage of free memory space.
STATUS: Memory status.

a) *SD OK*: The card is functioning properly
b) *NO SD*: There is no card inserted.
c) *WRITE PROT*: The card is write protected.
d) *ERROR*: There is a problem with the SD card memory, and it should be formatted.

6.4.6 ANALOGUE ± 5 MA AND STATIC OUTPUTS CARD

If a position is selected in which an analogue and static outputs card is inserted, the following screen will be displayed. *CARD OK* when the card is working correctly and *CARD NOK* when there is any problem

6.4.7 PROFIBUS COMMUNICATIONS CARD

If a position is selected in which a profibus communications card is inserted, the following messages will be displayed in the screen.

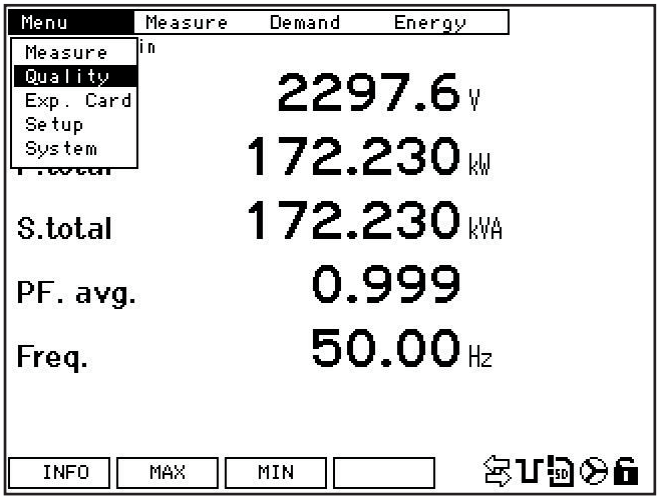
PERIPH. NUM	0
BUS STATUS	ACTIVE / INACTIVE.

The peripheral number is 0, but when the communications starts this value changes to the slave number configured by the user (See chapter 4.7.7.3).

The status bus shows if the bus is working or not.

7. QUALITY

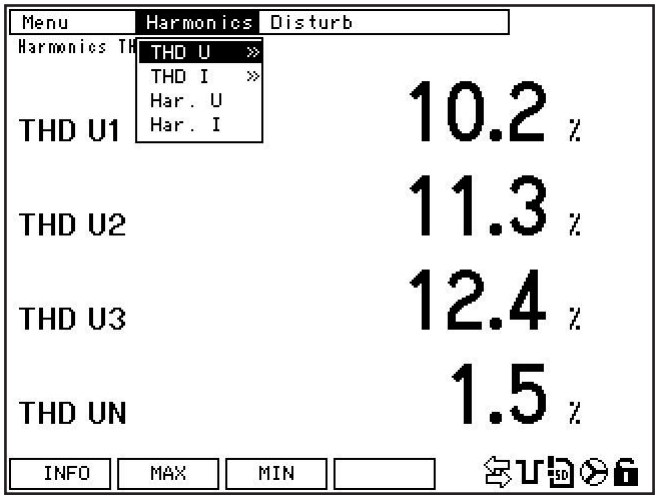
To access and display the parameters from the quality menu, navigate to *QUALITY* in the main *MENU*.



This quality menu is divided in two parts: harmonics and disturbances.

7.1 HARMONICS

There are two large parts of the harmonics menu: one for voltage and another for current. These two large blocks are then subdivided into harmonic distortion rate and harmonic decomposition rate.



7.1.1 VOLTAGE THD

Depending on how the values are set to be displayed or on which values are to be displayed, various options can be chosen in the U THD menu.

The possible option in the voltage THD menu follow:

THD: This displays the total harmonic distortion for voltage as a % for each one of the phases and the neutral.

ODDS: The displays the voltage THD value as a % for all phases and the neutral, but it only displays odd harmonics

EVENS: The displays the voltage THD value as a % for all phases and the neutral, but it only displays even harmonics

On this screen, the following options are shown above the function buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen, along with the date and time of registry.

On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

MIN : This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen, along with the date and time of registry.

On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

7.1.2 CURRENT THD

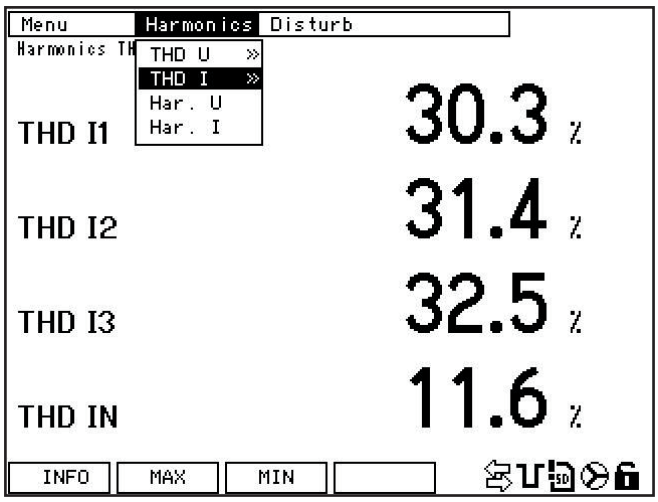
The harmonics menu is also divided in two blocks: one for voltage and one for current. These parts include the voltage and current harmonic distortion rate and the harmonic decomposition for both.

The possible option in the current THD menu follow:

THD: This displays the total harmonic distortion for current as a % for each one of the phases and the neutral.

ODDS: This displays the current THD value as a % for all phases and the neutral, but it only displays odd harmonics

EVENS: This displays the current THD value as a % for all phases and the neutral, but it only displays even harmonics



On this screen, the following options are shown above the function buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen, along with the date and time of registry.

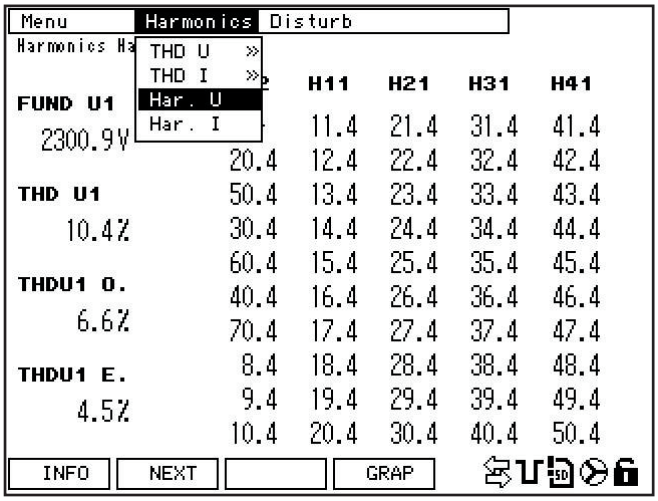
On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

MIN : This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen, along with the date and time of registry.

On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

7.1.3 VOLTAGE HARMONICS

In the voltage harmonic decomposition screen, numerical values are shown for the phase 1 harmonic decomposition.



The values are displayed in columns of 10, and the most important values are shown on the left side of the screen as a %. These values are :

U1 FUND: Value of the phase 1 fundamental.

U1 THD: Value of the phase 1 harmonic distortion rate expressed as a %.

ODD U1 THD: Value of the harmonic distortion rate for the phase 1 odd harmonics, expressed as a %.
EVEN U1 THD: Value of the harmonic distortion rate for the phase 1 even harmonics, expressed as a %.

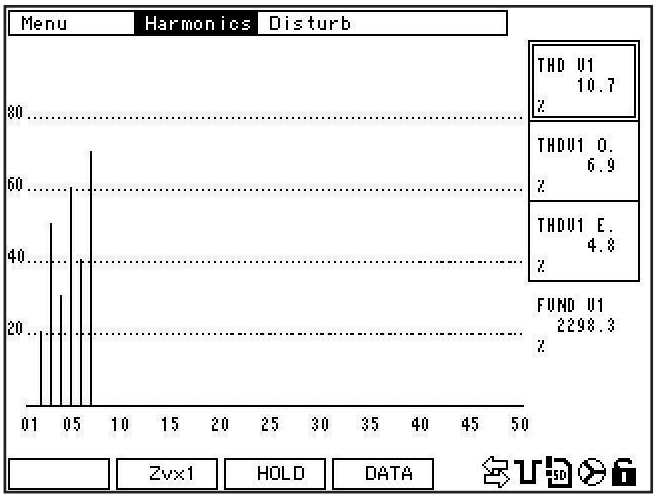
The bottom menu offers the following buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

NEXT: This displays the screen of values corresponding with the next phase. This is a rotating menu that contains phase 1, phase 2, phase 3 and neutral.

Values provided on this screen are real time values that correspond using the mean value calculated from the signal samples.

GRAP: This graphically displays the harmonics spectrum.
The phase displayed on the graphical interface corresponds to the one that was selected for numerical values on the previous screen. The options permitted by the graphical interface include: changing between viewing all harmonic values, odd harmonic values and even harmonic values.



The graphics screen menu has the following options.

*Z*vx1: This button can be pressed to vertically zoom in on the graphic displayed.
This is a cyclic zoom with x1, x2, x4 and x10 options, which then returns to normal.

HOLD: This keeps the screen from refreshing. When this button is pressed, the menu on the bottom of the screen will change. Specifically, the button *RUN* (F3).
The *RUN* button permits returning to the continuous graphical display.

DATA: Pressing *DATA* will return the user to the screen that displays the real time harmonic decomposition values. (See Section 7.1.3.)

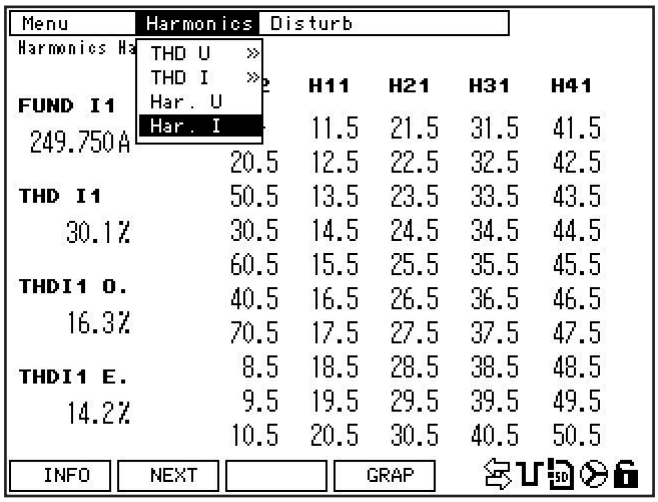
To select total, odd or even harmonics on the graphical interface, use the up/down arrow buttons to navigate between the three options on the right side of the screen.

The bottom menu on the graphical display is the same for all three options. The menu can only be changed by returning to the screen of numerical values and pressing *DATA*.

If the user desires to view the values for the harmonics of another phase in graphical form, he or she should navigate to the numerical values screen, change to the preferred phase using the *NEXT* button and access the graphical interface by pressing *GRAP*.

7.1.4 CURRENT HARMONICS

In the current harmonic decomposition screen, numerical values are shown for the phase 1 harmonic decomposition.



The values are displayed in columns of 10, and the most important values are shown on the left side of the screen as a %. These values are :

I1 FUND: Phase 1 fundamental value.

I1 THD: Phase 1 harmonic distortion rate value, expressed as a %.

ODD I1 THD: Value of the harmonic distortion rate for the phase 1 odd harmonics, expressed as a %.
EVEN I1 THD: Value of the harmonic distortion rate for the phase 1 even harmonics, expressed as a %.

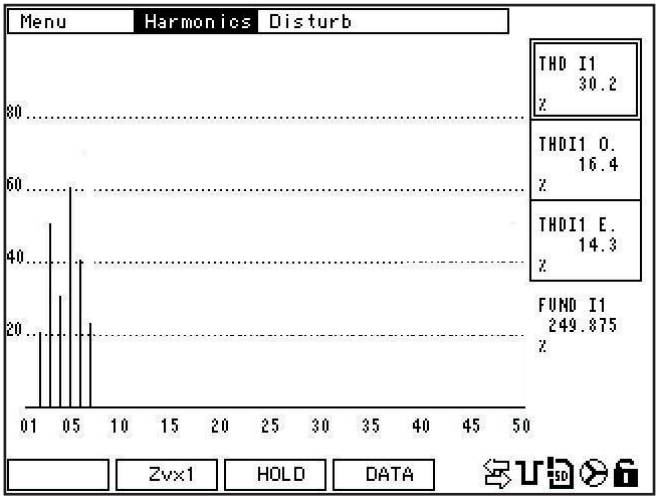
The bottom menu offers the following options:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

NEXT: This displays the screen of values corresponding with the next phase. This is a rotating menu that contains phase 1, phase 2, phase 3 and neutral.

Values provided on this screen are real time values that correspond using the mean value calculated from the signal samples.

GRAP: This graphically displays the harmonics spectrum.
The phase displayed on the graphical interface corresponds to the one that was selected for numerical values on the previous screen. The options permitted by the graphical interface include: changing between viewing all harmonic values, odd harmonic values and even harmonic values.



The graphics screen menu has the following options.

*Z*vx1: This button can be pressed to vertically zoom in on the graphic displayed.
This is a cyclic zoom with x1, x2, x4 and x10 options, which then returns to normal.

HOLD: This keeps the screen from refreshing. Pressing this button will change the bottom of the screen. Specifically, the *RUN* button (F3).
The *RUN* button permits returning to the continuous graphical display.

DATA: Pressing *DATA* will return the user to the screen that displays the numerical values for real time harmonic decomposition. (See Section 7.1.4.)

To select total, odd or even harmonics on the graphical interface, use the up/down arrow buttons to navigate between the three options on the right side of the screen.

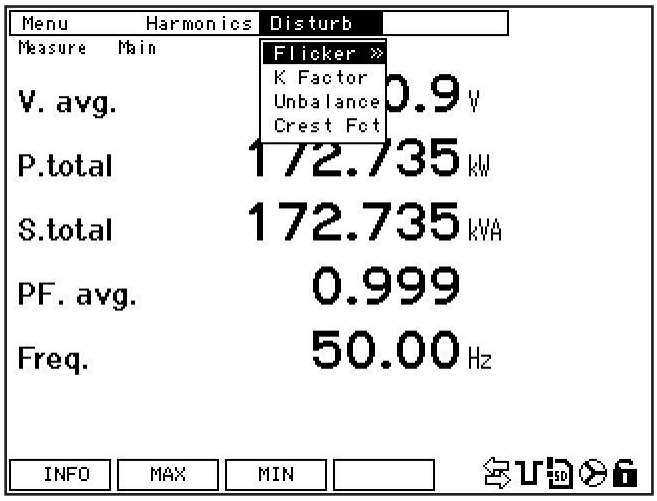
The bottom menu on the graphical display is the same for all three options. The menu can only be changed by returning to the screen of numerical values and pressing *DATA*.

If the user desires to view the values for the harmonics of another phase in graphical form, he or she should navigate to the numerical values screen, change to the preferred phase using the *NEXT* button and access the graphical interface by pressing *GRAP*.

7.2. DISTURBANCES

To access and display the variables from the quality menu, navigate to *QUALITY* in the main menu

In the *QUALITY* menu, select the *DISTURBANCES* option.



The disturbances menu allows configuring the following options:

FLICKER: Flicker calculation. Weighted average and PST.

K FACTOR: Calculation of the K factor for the currents.

IMB.: Imbalance and asymmetry for voltages and currents.

CREST F.: Calculation of the crest factor for the voltages.

7.2.1 FLICKER

Flicker measures the low frequency voltage fluctuations (between 5 and 25 Hz).

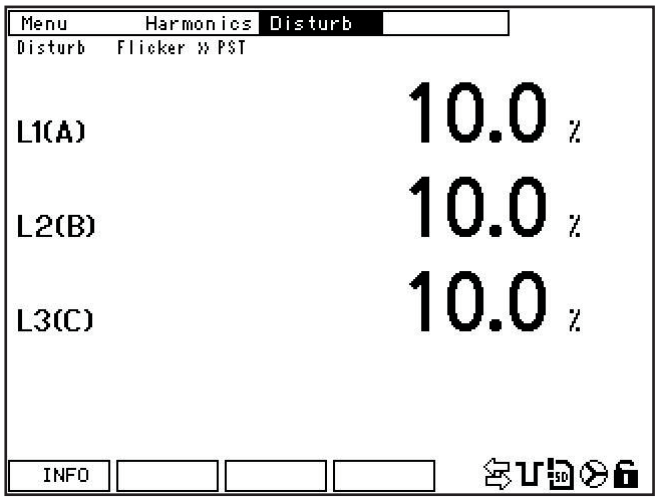
The *FLICKER* menu permits selecting one of two methods for displaying the calculated values.

The options are PST calculation and real time calculation.

7.2.1.1 PST Calculation

The flicker PST value is calculated by integrating the real time perceptibility every 10 minutes. The power supply standards recommend a value of less than 1.

The result is provided as a % in reference to the three phases.



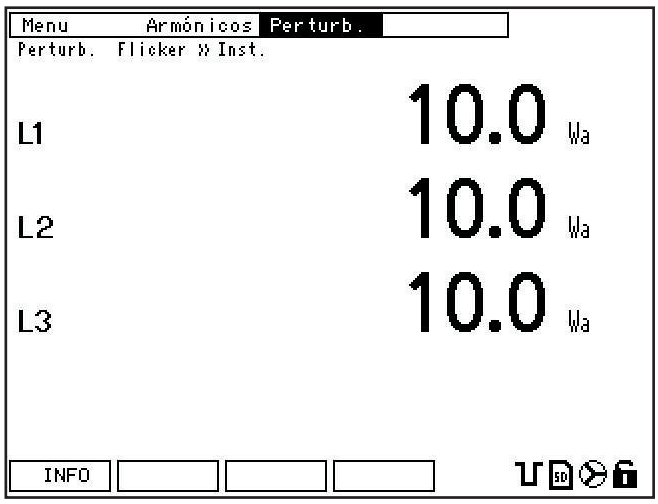
The bottom menu offers the following options:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

7.2.1.2 Real Time Weighted Average Calculation

The real time flicker calculation is made using a weighted average (WA) of the real time values.

The result is given in real time weighted average values from which the PST is calculated.



The bottom menu offers the following options:

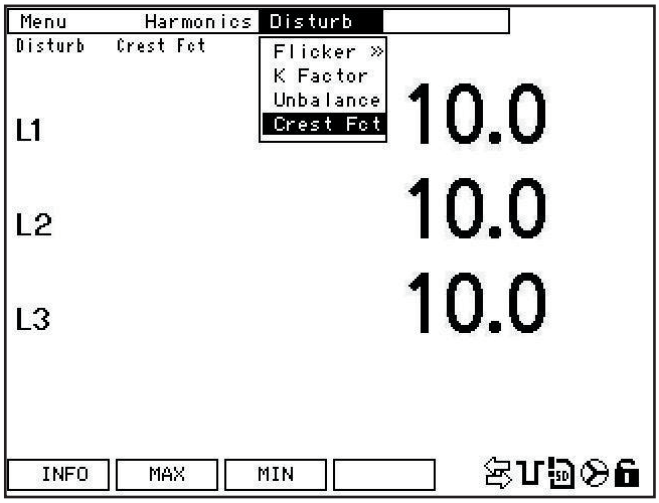
INFO : This displays the system information screen (Section 6.1.1.1, System Information).

7.2.2 K FACTOR

The K factor is calculated in accordance with the ANSI C57.110 standard.

This parameter indicates the additional power required or power lost by the transformer due to the current harmonics produced by the non-linear loads that are connected.
This factor is related to the main transformer and its power efficiency, indicating if is necessary expansion or reduction.

For linear loads, the normal K factor value is 1.



The bottom menu offers the following options:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen, along with the date and time of registry.

On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time values.

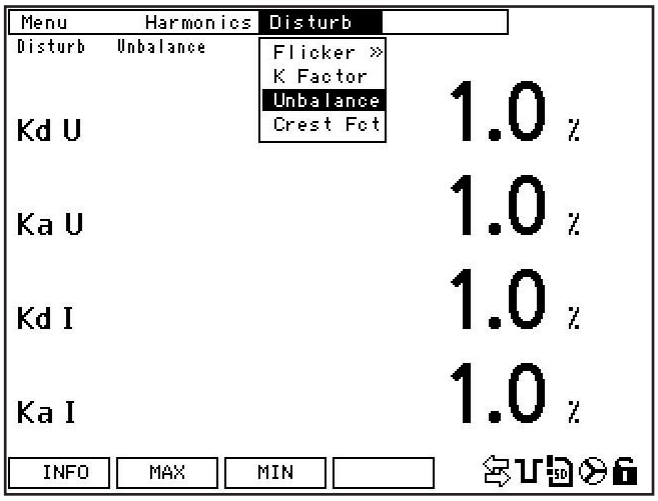
MIN : This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen, along with the date and time of registry.

On the *MIN* screen, appears the *REAL T.* option, which can be used to return to the screen that displays the real time values.

7.2.3 IMBALANCE AND ASYMMETRY

Imbalance is calculated by applying the Fortescue and Stokvis symmetric components method. These values represent how imbalanced the facility is and the correct connection of the phases.

These values are displayed on the screen as a %. The following variables are displayed on the screen.



Kd U: Voltage imbalance coefficient.
Ka U: Voltage asymmetry coefficient.
Kd I: Current imbalance coefficient.
Ka I: Current asymmetry coefficient.

On this screen, the following options are shown above the function buttons:

INFO: This displays the system information screen (Section 6.1.1.1., System Information).

MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

MIN: This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

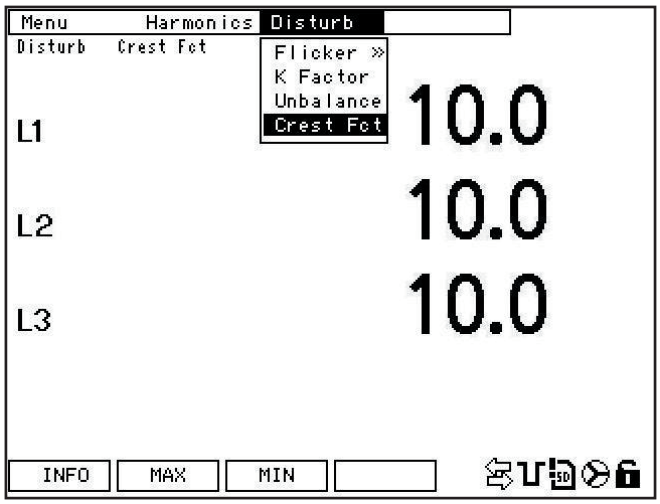
On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

7.2.4 CREST FACTOR

The crest factor calculation is the ratio between peak and RMS values.
When the signal is sinusoidal, the crest factor value is 1.41 (square root of 2).

The crest factor calculation is used to detect periodic voltage disturbances that cannot be detected with the THD.

These values are displayed on the screen as a %. The following variables are displayed on the screen.



On this screen, the following options are shown above the function buttons:

INFO : This displays the system information screen (Section 6.1.1.1., System Information).

MAX: This displays the screen with the maximum values stored. The maximum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

On the *MAX* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

MIN : This displays the screen with the minimum values stored. The minimum values for each variable recorded since the last deletion are displayed on the screen along with the date and time of registry.

On the *MIN* screen, the *REAL T.* option appears, which can be used to return to the screen that displays the real time variables.

8. COMMUNICATIONS

8.1. MODBUS/RTU PROTOCOL ©

CVMk2 uses the Modbus/RTU © as the communications protocol on the COM2 port. This is a question-response based protocol. The question frame format is:

NPAAXXXXYYYY CRC.

PN: The number of the peripheral configured for the system.
AA: Modbus function to be executed.
XXXX: System's memory position where the function should be begin. (Example: If AA=04 the function is read only).
YYYY: Read positions, from the XXXX position, to be read or written. (This depends on the AA function).
CRC: Code for detecting 16 bit errors. (automatically generated).

The response format is

NPAABBCCCC..CRC

PN: Number of the peripheral that responds
AA: Function that responds.
BB: Number of bytes in the response.
CCCC: Registry value.
...
CRC: Error detection registry.

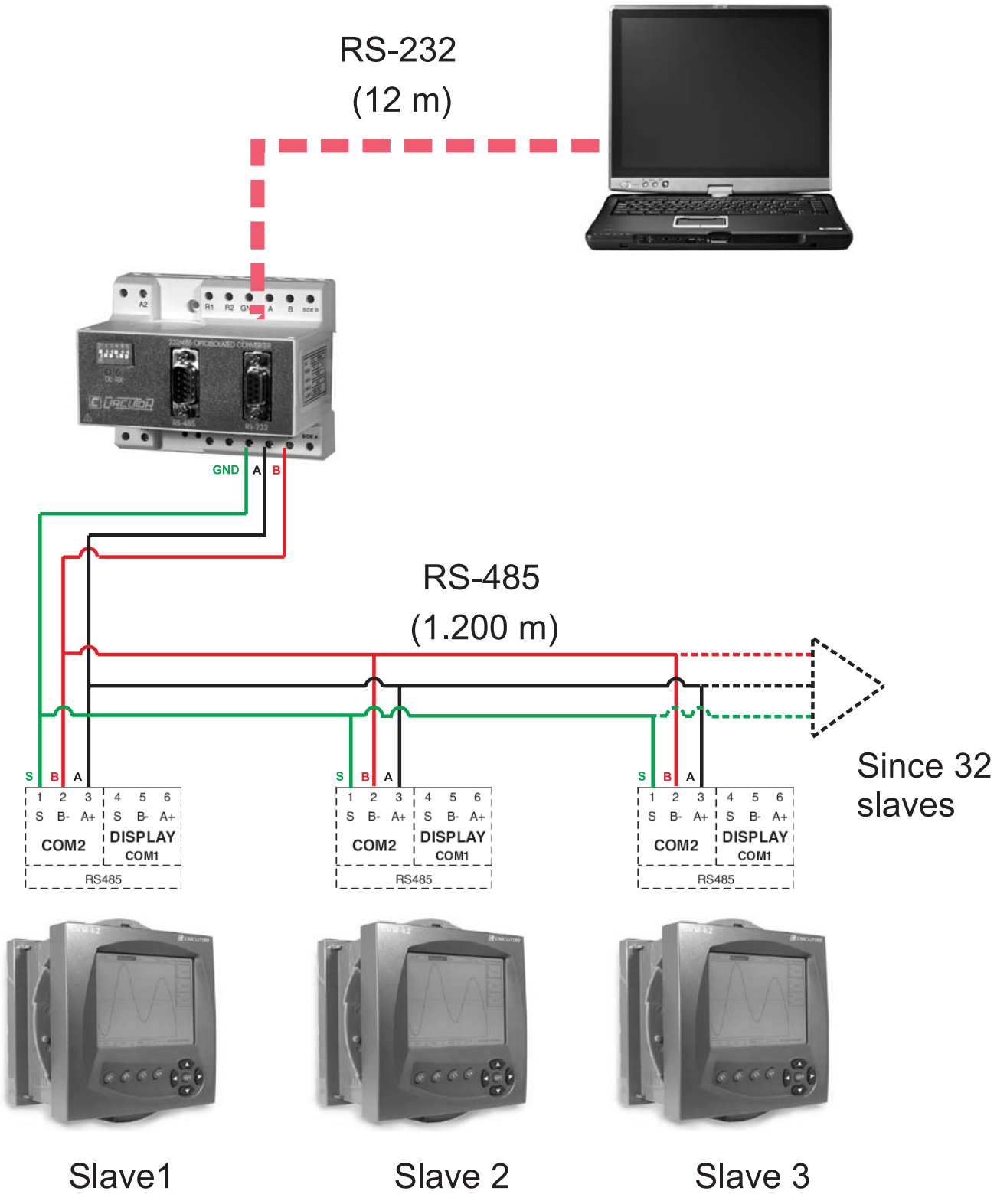
For more information, see the standard Modbus© protocol..

8.2. CONNECTION DIAGRAM

8.2.1. CIRCUTOR INTELLIGENT CONVERTER

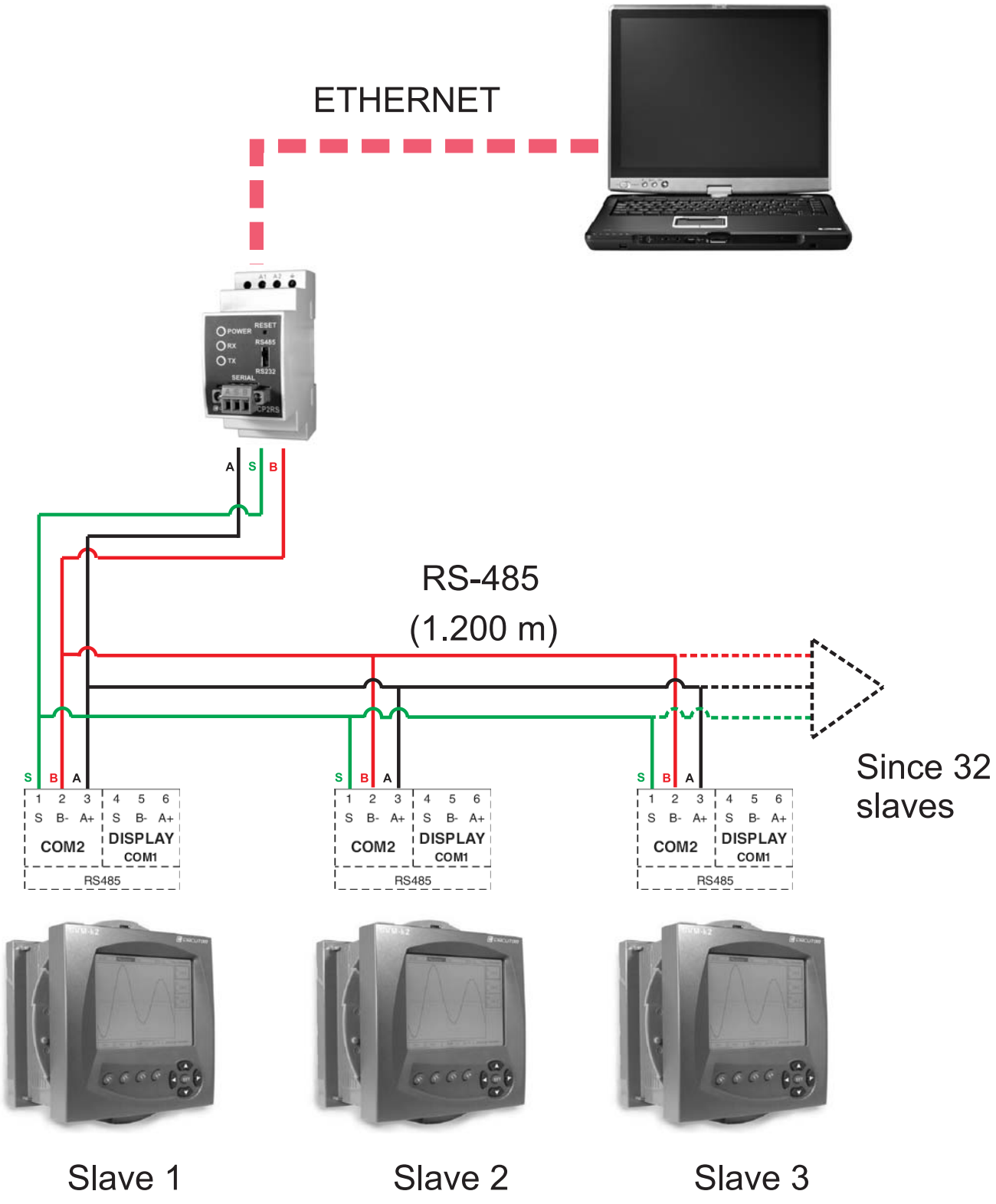
CVMk2 has an RS-485 port with Modbus/RTU protocol communications. This port is to communicate the master or PC with the measurement module.

The connection with the measurement module using a intelligent converter is displayed in the figure.



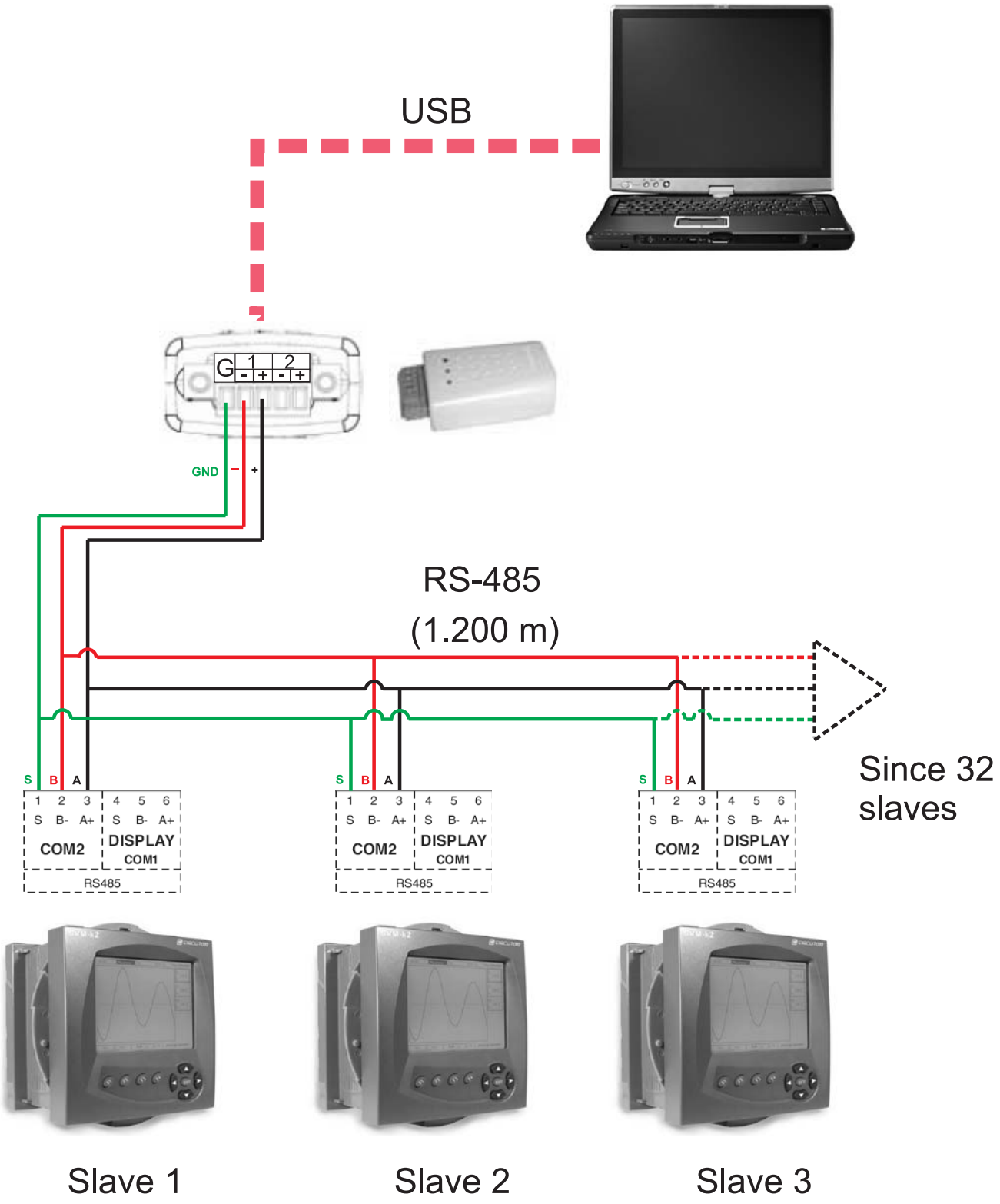
8.2.2. TCP2RS CONVERTER

The connection with the measurement module using an Ethernet converter is displayed in the figure. This converter permits using the Modbus/TCP protocol.



8.2.3. USB CONVERTER

The connection between the PC and the measurement module using a USB to RS-485 converter is showed in the figure below.

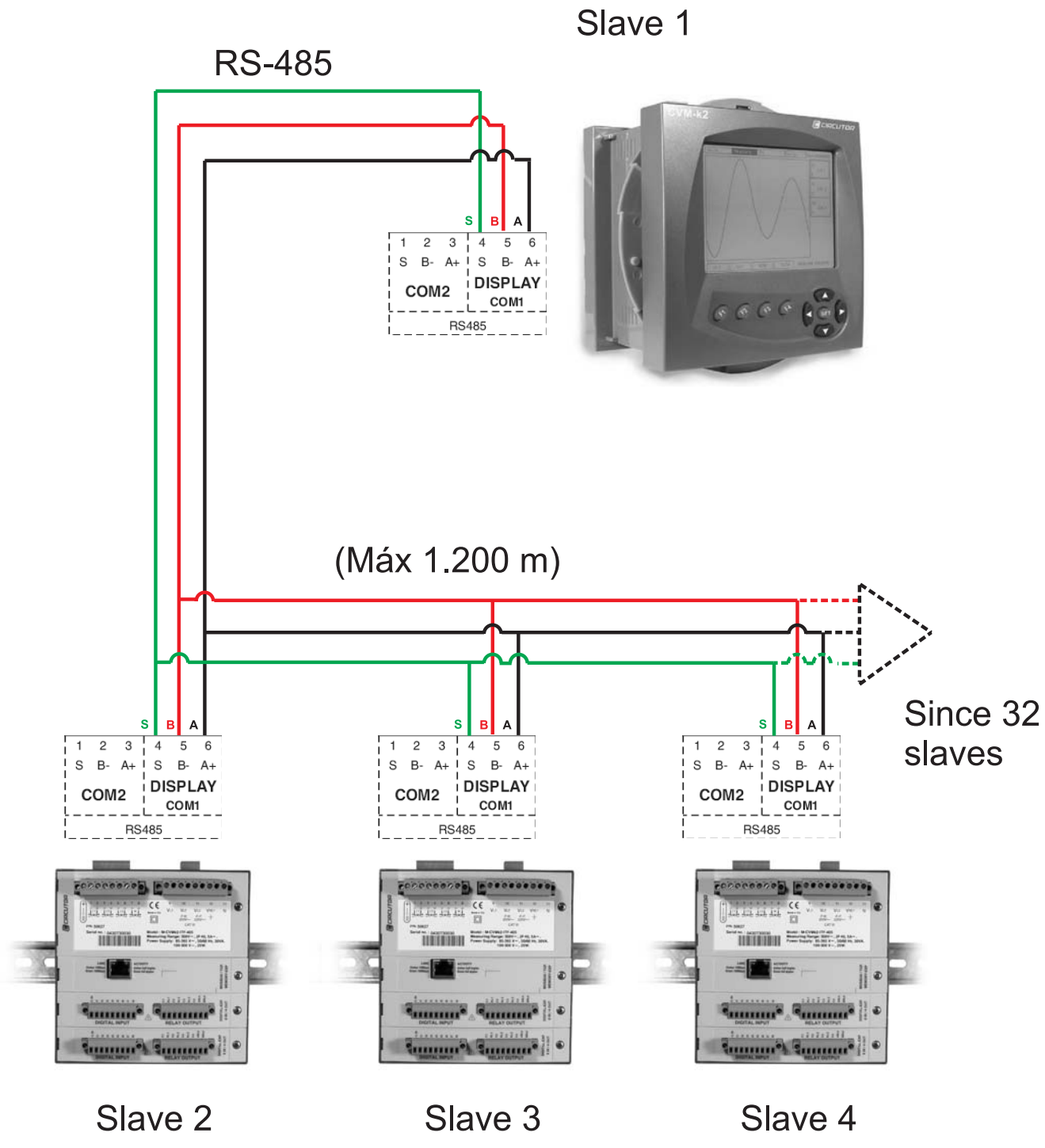


The USB converter output pins are described in the following table.

PIN		DESCRIPTION
1	+	RS-485 -
	-	RS-485 +
2	+	RS-485 -
	-	RS-485 +
G		Ground

8.2.4 SCREEN-MODULES COMMUNICATIONS BUS

The other communications bus is set up by the COM1 port (DISPLAY). This bus allows the communications between the screen (master) and modules, and has the same characteristics as the RS-485. One important consideration is the maximum distance of 1.200 m from the master (in this case the display) to the last slave and the number of measurement modules (slaves) that can be connected to the bus, which is 32.
This communication between display and measure modules uses proprietary communications protocol.



8.3. MODBUS/RTU © MEMORY MAP

8.3.1 ELECTRIC VARIABLES

MODBUS ELECTRICAL VARIABLES						
VARIABLE	**SYMBOL**	**COD**	**INST.**	**MAX.**	**MIN.**	**UNIT**
PHASE 1						
Phase voltage	V 1	1	00-01	100-103	300-303	V x100
Current	A 1	2	02-03	104-107	304-307	mAx10
Active power	kW 1	3	04-05	108-10B	308-30B	Wx10
Inductive reactive power	KvarL 1	4	06-07	10C-10F	30C-30F	Wx10
Capacitive reactive power	KvarC 1	5	08-09	110-113	310-313	Wx10
Apparent power	kV·A1	6	0A-0B	114-117	314-317	VAx10
Power factor	PF 1	7	0C-0D	118-11B	318-31B	x1000
Cos φ	Cos φ 1	8	0E-0F	11C-11F	31C-31F	x1000
PHASE 2						
Phase voltage	V 2	9	10-11	120-123	320-323	V x100
Current	A 2	10	12-13	124-127	324-327	mAx10
Active power	kW 2	11	14-15	128-12B	328-32B	Wx10
Inductive reactive power	KvarL 2	12	16-17	12C-12F	32C-32F	Wx10
Capacitive reactive power	KvarC 2	13	18-19	130-133	330-333	Wx10
Apparent power	kV·A2	14	1A-1B	134-137	334-337	VAx10
Power factor	PF 2	15	1C-1D	138-13B	338-33B	x1000
Cos φ	Cos φ 2	16	1E-1F	13C-13F	33C-33F	x1000
PHASE 3						
Phase voltage	V 3	17	20-21	140-143	340-343	V x100
Current	A 3	18	22-23	144-147	344-347	mAx10
Active power	kW 3	19	24-25	148-14B	348-34B	Wx10
Inductive reactive power	KvarL 3	20	26-27	14C-14F	34C-34F	Wx10
Capacitive reactive power	KvarC 3	21	28-29	150-153	350-353	Wx10
Apparent power	kV·A3	22	2A-2B	154-157	354-357	V·A x10
Power factor	PF 3	23	2C-2D	158-15B	358-35B	x1000
Cos φ	Cos φ 3	24	2E-2F	15C-15F	35C-35F	x1000
NEUTRAL						
Neutral voltage	U_N	25	30-31	160-163	360-363	V x100
Neutral line current	I_N	26	32-33	164-167	364-367	mAx10
Frequency (L1)	Hz	27	34-35	168-16B	368-36B	Hzx100
L1-L2 ph voltage	V12	28	36-37	16C-16F	36C-36F	V x100
L2-L3 ph voltage	V23	29	38-39	170-173	370-373	V x100
L3-L1 ph voltage	V31	30	3A-3B	174-177	374-377	V x100
Average phase voltage	U_{n_AVG}	31	3C-3D	178-17B	378-37B	V x100
Average line voltage	U_{p_AVG}	32	3E-3F	17C-17F	37C-37F	V x100
Average current	I_{AVG}	33	40-41	180-183	380-383	mAx10
Three phase active power	kW III	34	42-43	184-187	384-387	Wx10

VARIABLE	SYMBOL	COD	INST.	MAX.	MIN.	UNIT
Three phase inductive power	KvarL III	35	44-45	188-18B	388-38B	Wx10
Three phase capacitive power	KvarC III	36	46-47	18C-18F	38C-38F	Wx10
Three phase apparent power	KvaIII	37	48-49	190-193	390-393	Wx10
Three phase power factor	PFIII	38	4A-4B	194-197	394-397	x1000
Cos φ three phase	Cos φ III	39	4C-4D	198-19B	398-39B	x1000
THD *U 1*	THD *U*1	40	4E-4F	19C-19F	39C-39F	%x10
THD *U 2*	THD *U*2	41	50-51	1A0-1A3	3A0-3A3	%x10
THD *U 3*	THD *U*3	42	52-53	1A4-1A7	3A4-3A7	%x10
THD U_N	THD U_N	43	54-55	1A8-1AB	3A8-3AB	%x10
THD *I 1*	THD *I 1*	44	56-57	1AC-1AF	3AC-3AF	%x10
THD *I 2*	THD *I 2*	45	58-59	1B0-1B3	3B0-3B3	%x10
THD *I 3*	THD *I 3*	46	5A-5B	1B4-1B7	3B4-3B7	%x10
THD I_N	THD I_N	47	5C-5D	1B8-1BB	3B8-3BB	%x10
THD-*U 1* Even	THD U*1*-E	48	5E-5F	1BC-1BF	3BC-3BF	%x10
THD-*U* 2 Even	THD U*2*-E	49	60-61	1C0-1C3	3C0-3C3	%x10
THD-*U* 3 Even	THD U*3*-E	50	62-63	1C4-1C7	3C4-3C7	%x10
THD-U_N Even	THD U_N-E	51	64-65	1C8-1CB	3C8-3CB	%x10
THD-*I* 1 Even	THD *I*1 E	52	66-67	1CC-1CF	3CC-3CF	%x10
THD-*I* 2 Even	THD *I*2 E	53	68-69	1D0-1D3	3D0-3D3	%x10
THD-*I* 3 Even	THD *I*3 E	54	6A-6B	1D4-1D7	3D4-3D7	%x10
THD-I_N Even	THD I_N E	55	6C-6D	1D8-1DB	3D8-3DB	%x10
THD-*U 1* Odd	THDU*1*-O	56	6E-6F	1DC-1DF	3DC-3DF	%x10
THD-*U* 2 Odd	THDU*2*-O	57	70-71	1E0-1E3	3E0-3E3	%x10
THD-*U* 3 Odd	THDU*3*-O	58	72-73	1E4-1E7	3E4-3E7	%x10
THD-U_N Odd	THD U_N-O	59	74-75	1E8-1EB	3E8-3EB	%x10
THD-*I* 1 Odd	THD *I*1 O	60	76-77	1EC-1EF	3EC-3EF	%x10
THD-*I* 2 Odd	THD *I*2 O	61	78-79	1F0-1F3	3F0-3F3	%x10
THD-*I* 3 Odd	THD *I*3 O	62	7A-7B	1F4-1F7	3F4-3F7	%x10
THD-I_N Odd	THD I_N O	63	7C-7D	1F8-1FB	3F8-3FB	%x10
U *Unbalance*	Kd *U*	64	7E-7F	1FC-1FF	3FC-3FF	%x10
U *Asymmetry*	Ka *U*	65	80-81	200-203	400-403	%x10
I *Unbalance*	Kd *I*	66	82-83	204-207	404-407	%x10
I *Asymmetry*	Ka *I*	67	84-85	208-20B	408-40B	%x10
Temperature	T	68	86-87	20C-20F	40C-40F	ºCx10
V1 WA real time flicker	WA_V1	69	88-89	210-213	410-413	%x10
V2 WA real time flicker	WA_V2	70	8A-8B	214-217	414-417	%x10
V3 WA real time flicker	WA_V3	71	8C-8D	218-21B	418-41B	%x10
V1 PST statistical flicker	PST_V1	72	8E-8F	21C-21F	41C-41F	%x10
V2 PST statistical flicker	PST_V2	73	90-91	220-223	420-423	%x10
V3 PST statistical flicker	PST_V3	74	92-93	224-227	424-427	%x10
K Factor I1	K-Fac_I1	75	94-95	228-22B	428-42B	x100
K Factor I2	K-Fac_I2	76	96-97	22C-22F	42C-42F	x100

K Factor I3	K-Fac_I3	77	98-99	230-233	430-433	x100
Crest Factor V1	Cr-Fac_V1	78	9A-9B	234-237	434-437	x100
Crest Factor V2	Cr-Fac_V2	79	9C-9D	238-23B	438-43B	x100
Crest Factor V3	Cr-Fac_V3	80	9E-9F	23C-23F	43C-43F	x100
Reactive Power L1	Kvar1	81	A0-A1	240-243	440-443	varx10
Reactive Power L2	Kvar2	82	A2-A3	244-247	444-447	varx10
Reactive Power L3	Kvar3	83	A4-A5	248-24B	448-44B	carx10
Potencia Reactiva III	kvar III	84	A6-A7	24C-24F	44C-44F	varx10
Reactive Power Consum. L1	kvar_c_1	85	A8-A9	250-253	450-453	varx10
Reactive Power Consum. L2	kvar_c_2	86	AA-AB	254-257	454-457	varx10
Reactive Power Consum. L3	kvar_c_3	87	AC-AD	258-25B	458-45B	varx10
Reactive Power Consum. III	kvar_c_III	88	AE-AF	25C-25F	45C-45F	varx10
Reactive Power Gener. L1	kvar_g_1	89	B0-B1	260-263	460-463	varx10
Pot. Reactiva generada L2	kvar_g_2	90	B2-B3	264-267	464-467	varx10
Pot. Reactiva generada L3	kvar_g_3	91	B4-B5	268-26B	468-46B	varx10
Pot. Reactiva generada III	kvar_g_III	92	B6-B7	26C-26F	46C-46F	varx10

8.3.2. CURRENT ENERGY VARIABLES

CURRENT ENERGY MODBUS VARIABLES				
VARIABLE	**SYMBOL**	**CODE**	**KW·H**	**W·H**
TARIFF 1				
Active energy	kW·h III	129	500-501	502
Inductive reactive energy	kvar·h L III	130	503-504	505
Capacitive reactive energy	kvar·h C III	131	506-507	508

Three phase apparent energy	kV·A·hIII	132	509-50A	50B
Active energy generated	kW·hIII (-)	133	50C-50D	50E
Inductive energy generated	kvar·h LIII (-)	134	50F-510	511
Capacitive energy generated	kvar·h CIII (-)	135	512-513	514
Apparent energy generated	kV·A·hIII (-)	136	515-516	517
TARIFF 2				
Active energy	kW·h III	137	518-519	51A
Inductive reactive energy	kvar·h L III	138	51B-51C	51D
Capacitive reactive energy	kvar·h C III	139	51E-51F	520
Three phase apparent energy	kV·A·hIII	140	521-522	523
Active energy generated	kW·hIII (-)	141	524-525	526
Inductive energy generated	kvar·h LIII (-)	142	527-528	529
Capacitive energy generated	kvar·h CIII (-)	143	52A-52B	52C
Apparent energy generated	kV·A·hIII (-)	144	52D-52E	52F
TARIFF 3				
Active energy	kW·h III	145	530-531	532
Inductive reactive energy	kvar·h L III	146	533-534	535
Capacitive reactive energy	kvar·h C III	147	536-537	538
Three phase apparent energy	kV·A·hIII	148	539-53A	53B
Active energy generated	kW·hIII (-)	149	53C-53D	53E
Inductive energy generated	kvar·h LIII (-)	150	53F-540	541
Capacitive energy generated	kvar·h CIII (-)	151	542-543	544
Apparent energy generated	kV·A·hIII (-)	152	545-546	547
TARIFF 4				
Active energy	kW·h III	153	548-549	54A
Inductive reactive energy	kvar·h L III	154	54B-54C	54D
Capacitive reactive energy	kvar·h C III	155	54E-54F	550
Three phase apparent energy	kV·A·hIII	156	551-552	553
Active energy generated	kW·hIII (-)	157	554-555	556
Inductive energy generated	kvar·h LIII (-)	158	557-558	559
Capacitive energy generated	kvar·h CIII (-)	159	55A-55B	55C
Apparent energy generated	kV·A·hIII (-)	160	55D-55E	55F
TARIFF 5				
Active energy	kW·h III	161	560-561	562
Inductive reactive energy	kvar·h L III	162	563-564	565
Capacitive reactive energy	kvar·h C III	163	566-567	568
Three phase apparent energy	kV·A·hIII	164	569-56A	56B
Active energy generated	kW·hIII (-)	165	56C-56D	56E
Inductive energy generated	kvar·h LIII (-)	166	56F-570	571
Capacitive energy generated	kvar·h CIII (-)	167	572-573	574
Apparent energy generated	kV·A·hIII (-)	168	575-576	577
TARIFF 6				
Active energy	kW·h III	169	578-579	57A

Inductive reactive energy	kvar·h L III	170	57B-57C	57D
Capacitive reactive energy	kvar·h C III	171	57E-57F	580
Three phase apparent energy	kV·A·hIII	172	581-582	583
Active energy generated	kW·hIII (-)	173	584-585	586
Inductive energy generated	kvar·h LIII (-)	174	587-588	589
Capacitive energy generated	kvar·h CIII (-)	175	58A-58B	58C
Apparent energy generated	kV·A·hIII (-)	176	58D-58E	58F
TARIFF 7				
Active energy	kW·h III	177	590-591	592
Inductive reactive energy	kvar·h L III	178	593-594	595
Capacitive reactive energy	kvar·h C III	179	596-597	598
Three phase apparent energy	kV·A·hIII	180	599-59A	59B
Active energy generated	kW·hIII (-)	181	59C-59D	59E
Inductive energy generated	kvar·h LIII (-)	182	59F-5A0	5A1
Capacitive energy generated	kvar·h CIII (-)	183	5A2-5A3	5A4
Apparent energy generated	kV·A·hIII (-)	184	5A5-5A6	5A7
TARIFF 8				
Active energy	kW·h III	185	5A8-5A9	5AA
Inductive reactive energy	kvar·h L III	186	5AB-5AC	5AD
Capacitive reactive energy	kvar·h C III	187	5AE-5AF	5B0
Three phase apparent energy	kV·A·hIII	188	5B1-5B2	5B3
Active energy generated	kW·hIII (-)	189	5B4-5B5	5B6
Inductive energy generated	kvar·h LIII (-)	190	5B7-5B8	5B9
Capacitive energy generated	kvar·h CIII (-)	191	5BA-5BB	5BC
Apparent energy generated	kV·A·hIII (-)	192	5BD-5BE	5BF
TARIFF 9				
Active energy	kW·h III	193	5C0-5C1	5C2
Inductive reactive energy	kvar·h L III	194	5C3-5C4	5C5
Capacitive reactive energy	kvar·h C III	195	5C6-5C7	5C8
Three phase apparent energy	kV·A·hIII	196	5C9-5CA	5CB
Active energy generated	kW·hIII (-)	197	5CC-5CD	5CE
Inductive energy generated	kvar·h LIII (-)	198	5CF-5D0	5D1
Capacitive energy generated	kvar·h CIII (-)	199	5D2-5D3	5D4
Apparent energy generated	kV·A·hIII (-)	200	5D5-5D6	5D7
TOTAL TARIFF				
Active energy	kW·h III	201	5D8-5D9	5DA
Inductive reactive energy	kvar·h L III	202	5DB-5DC	5DD
Capacitive reactive energy	kvar·h C III	203	5DE-5DF	5E0
Three phase apparent energy	kV·A·hIII	204	5E1-5E2	5E3
Active energy generated	kW·hIII (-)	205	5E4-5E5	5E6
Inductive energy generated	kvar·h LIII (-)	206	5E7-5E8	5E9
Capacitive energy generated	kvar·h CIII (-)	207	5EA-5EB	5EC
Apparent energy generated	kV·A·hIII (-)	208	5ED-5EE	5EF

8.3.3. ENERGY VARIABLES FROM PREVIOUS PERIODS

PREVIOUS MONTH MODBUS ENERGY VARIABLES			
VARIABLE	**SYMBOL**	**KW·H**	**W·H**
TARIFF 1			
Active energy	kW·h III	600-601	602
Inductive reactive energy	kvar·h L III	603-604	605
Capacitive reactive energy	kvar·h C III	606-607	608
Three phase apparent energy	kV·A·hIII	609-60A	60B
Active energy generated	kW·hIII (-)	60C-60D	60E
Inductive energy generated	kvar·h LIII (-)	60F-610	611
Capacitive energy generated	kvar·h CIII (-)	612-613	614
Apparent energy generated	kV·A·hIII (-)	615-616	617
TARIFF 2			
Active energy	kW·h III	618-619	61A
Inductive reactive energy	kvar·h L III	61B-61C	61D
Capacitive reactive energy	kvar·h C III	61E-61F	620
Three phase apparent energy	kV·A·hIII	621-622	623
Active energy generated	kW·hIII (-)	624-625	626
Inductive energy generated	kvar·h LIII (-)	627-628	629
Capacitive energy generated	kvar·h CIII (-)	62A-62B	62C
Apparent energy generated	kV·A·hIII (-)	62D-62E	62F
TARIFF 3			
Active energy	kW·h III	630-631	632
Inductive reactive energy	kvar·h L III	633-634	635
Capacitive reactive energy	kvar·h C III	636-637	638
Three phase apparent energy	kV·A·hIII	639-63A	63B
Active energy generated	kW·hIII (-)	63C-63D	63E
Inductive energy generated	kvar·h LIII (-)	63F-640	641
Capacitive energy generated	kvar·h CIII (-)	642-643	644
Apparent energy generated	kV·A·hIII (-)	645-646	647
TARIFF 4			
Active energy	kW·h III	648-649	64A
Inductive reactive energy	kvar·h L III	64B-64C	64D
Capacitive reactive energy	kvar·h C III	64E-64F	650
Three phase apparent energy	kV·A·hIII	651-652	653
Active energy generated	kW·hIII (-)	654-655	656
Inductive energy generated	kvar·h LIII (-)	657-658	659
Capacitive energy generated	kvar·h CIII (-)	65A-65B	65C
Apparent energy generated	kV·A·hIII (-)	65D-65E	65F
TARIFF 5			
Active energy	kW·h III	660-661	662
Inductive reactive energy	kvar·h L III	663-664	665

Capacitive reactive energy	kvar·h C III	666-667	668
Three phase apparent energy	kV·A·hIII	669-66A	66B
Active energy generated	kW·hIII (-)	66C-66D	66E
Inductive energy generated	kvar·h LIII (-)	66F-670	671
Capacitive energy generated	kvar·h CIII (-)	672-673	674
Apparent energy generated	kV·A·hIII (-)	675-676	677
TARIFF 6			
Active energy	kW·h III	678-679	67A
Inductive reactive energy	kvar·h L III	67B-67C	67D
Capacitive reactive energy	kvar·h C III	67E-67F	680
Three phase apparent energy	kV·A·hIII	681-682	683
Active energy generated	kW·hIII (-)	684-685	686
Inductive energy generated	kvar·h LIII (-)	687-688	689
Capacitive energy generated	kvar·h CIII (-)	68A-68B	68C
Apparent energy generated	kV·A·hIII (-)	68D-68E	68F
TARIFF 7			
Active energy	kW·h III	690-691	692
Inductive reactive energy	kvar·h L III	693-694	695
Capacitive reactive energy	kvar·h C III	696-697	698
Three phase apparent energy	kV·A·hIII	699-69A	69B
Active energy generated	kW·hIII (-)	69C-69D	69E
Inductive energy generated	kvar·h LIII (-)	69F-6A0	6A1
Capacitive energy generated	kvar·h CIII (-)	6A2-6A3	6A4
Apparent energy generated	kV·A·hIII (-)	6A5-6A6	6A7
TARIFF 8			
Active energy	kW·h III	6A8-6A9	6AA
Inductive reactive energy	kvar·h L III	6AB-6AC	6AD
Capacitive reactive energy	kvar·h C III	6AE-6AF	6B0
Three phase apparent energy	kV·A·hIII	6B1-6B2	6B3
Active energy generated	kW·hIII (-)	6B4-6B5	6B6
Inductive energy generated	kvar·h LIII (-)	6B7-6B8	6B9
Capacitive energy generated	kvar·h CIII (-)	6BA-6BB	6BC
Apparent energy generated	kV·A·hIII (-)	6BD-6BE	6BF
TARIFF 9			
Active energy	kW·h III	6C0-6C1	6C2
Inductive reactive energy	kvar·h L III	6C3-6C4	6C5
Capacitive reactive energy	kvar·h C III	6C6-6C7	6C8
Three phase apparent energy	kV·A·hIII	6C9-6CA	6CB
Active energy generated	kW·hIII (-)	6CC-6CD	6CE
Inductive energy generated	kvar·h LIII (-)	6CF-6D0	6D1
Capacitive energy generated	kvar·h CIII (-)	6D2-6D3	6D4
Apparent energy generated	kV·A·hIII (-)	6D5-6D6	6D7
TOTAL TARIFF			

Active energy	kW·h III	6D8-6D9	6DA
Inductive reactive energy	kvar·h L III	6DB-6DC	6DD
Capacitive reactive energy	kvar·h C III	6DE-6DF	6E0
Three phase apparent energy	kV·A·hIII	6E1-6E2	6E3
Active energy generated	kW·hIII (-)	6E4-6E5	6E6
Inductive energy generated	kvar·h LIII (-)	6E7-6E8	6E9
Capacitive energy generated	kvar·h CIII (-)	6EA-6EB	6EC
Apparent energy generated	kV·A·hIII (-)	6ED-6EE	6EF

8.3.4. ENERGY VARIABLES FOR THE PREVIOUS YEAR

PREVIOUS YEAR MODBUS ENERGY VARIABLES			
VARIABLE	**SYMBOL**	**KWH**	**WH**
TARIFF 1			
Active energy	kW·h III	700-701	702
Inductive reactive energy	kvar·h L III	703-704	705
Capacitive reactive energy	kvar·h C III	706-707	708
Three phase apparent energy	kV·A·hIII	709-70A	70B
Active energy generated	kW·hIII (-)	70C-70D	70E
Inductive energy generated	kvar·h LIII (-)	70F-710	711
Capacitive energy generated	kvar·h CIII (-)	712-713	714
Apparent energy generated	kV·A·hIII (-)	715-716	717
TARIFF 2			
Active energy	kW·h III	718-719	71A
Inductive reactive energy	kvar·h L III	71B-71C	71D
Capacitive reactive energy	kvar·h C III	71E-71F	720
Three phase apparent energy	kV·A·hIII	721-722	723
Active energy generated	kW·hIII (-)	724-725	726
Inductive energy generated	kvar·h LIII (-)	727-728	729
Capacitive energy generated	kvar·h CIII (-)	72A-72B	72C
Apparent energy generated	kV·A·hIII (-)	72D-72E	72F
TARIFF 3			
Active energy	kW·h III	730-731	732
Inductive reactive energy	kvar·h L III	733-734	735
Capacitive reactive energy	kvar·h C III	736-737	738
Three phase apparent energy	kV·A·hIII	739-73A	73B
Active energy generated	kW·hIII (-)	73C-73D	73E
Inductive energy generated	kvar·h LIII (-)	73F-740	741
Capacitive energy generated	kvar·h CIII (-)	742-743	744
Apparent energy generated	kV·A·hIII (-)	745-746	747
TARIFF 4			
Active energy	kW·h III	748-749	74A
Inductive reactive energy	kvar·h L III	74B-74C	74D
Capacitive reactive energy	kvar·h C III	74E-74F	750

Three phase apparent energy	kV·A·hIII	751-752	753
Active energy generated	kW·hIII (-)	754-755	756
Inductive energy generated	kvar·h LIII (-)	757-758	759
Capacitive energy generated	kvar·h CIII (-)	75A-75B	75C
Apparent energy generated	kV·A·hIII (-)	75D-75E	75F
TARIFF 5			
Active energy	kW·h III	760-761	762
Inductive reactive energy	kvar·h L III	763-764	765
Capacitive reactive energy	kvar·h C III	766-767	768
Three phase apparent energy	kV·A·hIII	769-76A	76B
Active energy generated	kW·hIII (-)	76C-76D	76E
Inductive energy generated	kvar·h LIII (-)	76F-770	771
Capacitive energy generated	kvar·h CIII (-)	772-773	774
Apparent energy generated	kV·A·hIII (-)	775-776	777
TARIFF 6			
Active energy	kW·h III	778-779	77A
Inductive reactive energy	kvar·h L III	77B-77C	77D
Capacitive reactive energy	kvar·h C III	77E-77F	780
Three phase apparent energy	kV·A·hIII	781-782	783
Active energy generated	kW·hIII (-)	784-785	786
Inductive energy generated	kvar·h LIII (-)	787-788	789
Capacitive energy generated	kvar·h CIII (-)	78A-78B	78C
Apparent energy generated	kV·A·hIII (-)	78D-78E	78F
TARIFF 7			
Active energy	kW·h III	790-791	792
Inductive reactive energy	kvar·h L III	793-794	795
Capacitive reactive energy	kvar·h C III	796-797	798
Three phase apparent energy	kV·A·hIII	799-79A	79B
Active energy generated	kW·hIII (-)	79C-79D	79E
Inductive energy generated	kvar·h LIII (-)	79F-7A0	7A1
Capacitive energy generated	kvar·h CIII (-)	7A2-7A3	7A4
Apparent energy generated	kV·A·hIII (-)	7A5-7A6	7A7
TARIFF 8			
Active energy	kW·h III	7A8-7A9	7AA
Inductive reactive energy	kvar·h L III	7AB-7AC	7AD
Capacitive reactive energy	kvar·h C III	7AE-7AF	7B0
Three phase apparent energy	kV·A·hIII	7B1-7B2	7B3
Active energy generated	kW·hIII (-)	7B4-7B5	7B6
Inductive energy generated	kvar·h LIII (-)	7B7-7B8	7B9
Capacitive energy generated	kvar·h CIII (-)	7BA-7BB	7BC
Apparent energy generated	kV·A·hIII (-)	7BD-7BE	7BF
TARIFF 9			
Active energy	kW·h III	7C0-7C1	7C2

Inductive reactive energy	kvar·h L III	7C3-7C4	7C5
Capacitive reactive energy	kvar·h C III	7C6-7C7	7C8
Three phase apparent energy	kV·A·hIII	7C9-7CA	7CB
Active energy generated	kW·hIII (-)	7CC-7CD	7CE
Inductive energy generated	kvar·h LIII (-)	7CF-7D0	7D1
Capacitive energy generated	kvar·h CIII (-)	7D2-7D3	7D4
Apparent energy generated	kV·A·hIII (-)	7D5-7D6	7D7
TOTAL TARIFF			
Active energy	kW·h III	7D8-7D9	7DA
Inductive reactive energy	kvar·h L III	7DB-7DC	7DD
Capacitive reactive energy	kvar·h C III	7DE-7DF	7E0
Three phase apparent energy	kV·A·hIII	7E1-7E2	7E3
Active energy generated	kW·hIII (-)	7E4-7E5	7E6
Inductive energy generated	kvar·h LIII (-)	7E7-7E8	7E9
Capacitive energy generated	kvar·h CIII (-)	7EA-7EB	7EC
Apparent energy generated	kV·A·hIII (-)	7ED-7EE	7EF

8.3.2. MAXIMUM DEMAND VARIABLES

MAXIMUM DEMAND MODBUS VARIABLES					
MAXIMUM DEMAND VARIABLE	**SYMBOL**	**CODE**	**REAL T.**	**MAX**	**UNIT**
TARIFF 1					
Three phase active power	Pd_kWIII	300	800-801	900-903	W
Three phase apparent power	Pd_kVAIII	301	802-803	904-907	V·A
Three-phase current (average)	Pd_I_AVG	302	804-805	908-90B	mA
Phase 1 current	Pd_I1	303	806-807	90C-90F	mA
Phase 2 current	Pd_I2	304	808-809	910-913	mA
Phase 3 current	Pd_I3	305	80A-80B	914-917	mA
TARIFF 2					
Three phase active power	Pd_kWIII	306	80C-80D	918-91B	W
Three phase apparent power	Pd_kVAIII	307	80E-80F	91C-91F	V·A
Three-phase current (average)	Pd_I_AVG	308	810-811	920-923	mA
Phase 1 current	Pd_I1	309	812-813	924-927	mA
Phase 2 current	Pd_I2	310	814-815	928-92B	mA
Phase 3 current	Pd_I3	311	816-817	92C-92F	mA
TARIFF 3					
Three phase active power	Pd_kWIII	312	818-819	930-933	W
Three phase apparent power	Pd_kVAIII	313	81A-81B	934-937	V·A
Three-phase current (average)	Pd_I_AVG	314	81C-81D	938-93B	mA
Phase 1 current	Pd_I1	315	81E-81F	93C-93F	mA
Phase 2 current	Pd_I2	316	820-821	940-943	mA
Phase 3 current	Pd_I3	317	822-823	944-947	mA

TARIFF 4					
Three phase active power	Pd_kWIII	318	824-825	948-94B	W
Three phase apparent power	Pd_kVAIII	319	826-827	94C-94F	V·A
Three-phase current (average)	Pd_I_AVG	320	828-829	950-953	mA
Phase 1 current	Pd_I1	321	82A-82B	954-957	mA
Phase 2 current	Pd_I2	322	82C-82D	958-95B	mA
Phase 3 current	Pd_I3	323	82E-82F	95C-95F	mA
TARIFF 5					
Three phase active power	Pd_kWIII	324	830-831	960-963	W
Three phase apparent power	Pd_kVAIII	325	832-833	964-967	V·A
Three-phase current (average)	Pd_I_AVG	326	834-835	968-96B	mA
Phase 1 current	Pd_I1	327	836-837	96C-96F	mA
Phase 2 current	Pd_I2	328	838-839	970-973	mA
Phase 3 current	Pd_I3	329	83A-83B	974-977	mA
TARIFF 6					
Three phase active power	Pd_kWIII	330	83C-83D	978-97B	W
Three phase apparent power	Pd_kVAIII	331	83E-83F	97C-97F	V·A
Three-phase current (average)	Pd_I_AVG	332	840-841	980-983	mA
Phase 1 current	Pd_I1	333	842-843	984-987	mA
Phase 2 current	Pd_I2	334	844-845	988-98B	mA
Phase 3 current	Pd_I3	335	846-847	98C-98F	mA
TARIFF 7					
Three phase active power	Pd_kWIII	336	848-849	990-993	W
Three phase apparent power	Pd_kVAIII	337	84A-84B	994-997	V·A
Three-phase current (average)	Pd_I_AVG	338	84C-84D	998-99B	mA
Phase 1 current	Pd_I1	339	84E-84F	99C-99F	mA
Phase 2 current	Pd_I2	340	850-851	9A0-9A3	mA
Phase 3 current	Pd_I3	341	852-853	9A4-9A7	mA
TARIFF 8					
Three phase active power	Pd_kWIII	342	854-855	9A8-9AB	W
Three phase apparent power	Pd_kVAIII	343	856-857	9AC-9AF	V·A
Three-phase current (average)	Pd_I_AVG	344	858-859	9B0-9B3	mA
Phase 1 current	Pd_I1	345	85A-85B	9B4-9B7	mA
Phase 2 current	Pd_I2	346	85C-85D	9B8-9BB	mA
Phase 3 current	Pd_I3	347	85E-85F	9BC-9BF	mA
TARIFF 9					
Three phase active power	Pd_kWIII	348	860-861	9C0-9C3	W
Three phase apparent power	Pd_kVAIII	349	862-863	9C4-9C7	V·A
Three-phase current (average)	Pd_I_AVG	350	864-865	9C8-9CB	mA
Phase 1 current	Pd_I1	351	866-867	9CC-9CF	mA
Phase 2 current	Pd_I2	352	868-869	9D0-9D3	mA
Phase 3 current	Pd_I3	353	86A-86B	9D4-9D7	mA

8.3.6. VOLTAGE HARMONICS VARIABLES

VARIABLE	SYMBOL	U_1	U_2	U_3	U_N	UNIT
Fundamental	V_fund	0A28-0A29	0A5B-0A5C	0A8E-0A8F	0AC1-0AC2	Vx10
Harmonic 2	H2	0A2A	0A5D	0A90	0AC3	%x10
Harmonic 3	H3	0A2B	0A5E	0A91	0AC4	%x10
Harmonic 4	H4	0A2C	0A5F	0A92	0AC5	%x10
Harmonic 5	H5	0A2D	0A60	0A93	0AC6	%x10
Harmonic 6	H6	0A2E	0A61	0A94	0AC7	%x10
Harmonic 7	H7	0A2F	0A62	0A95	0AC8	%x10
Harmonic 8	H8	0A30	0A63	0A96	0AC9	%x10
Harmonic 9	H9	0A31	0A64	0A97	0ACA	%x10
Harmonic 10	H10	0A32	0A65	0A98	0ACB	%x10
Harmonic 11	H11	0A33	0A66	0A99	0ACC	%x10
Harmonic 12	H12	0A34	0A67	0A9A	0ACD	%x10
Harmonic 13	H13	0A35	0A68	0A9B	0ACE	%x10
Harmonic 14	H14	0A36	0A69	0A9C	0ACF	%x10
Harmonic 15	H15	0A37	0A6A	0A9D	0AD0	%x10
Harmonic 16	H16	0A38	0A6B	0A9E	0AD1	%x10
Harmonic 17	H17	0A39	0A6C	0A9F	0AD2	%x10
Harmonic 18	H18	0A3A	0A6D	0AA0	0AD3	%x10
Harmonic 19	H19	0A3B	0A6E	0AA1	0AD4	%x10
Harmonic 20	H20	0A3C	0A6F	0AA2	0AD5	%x10
Harmonic 21	H21	0A3D	0A70	0AA3	0AD6	%x10
Harmonic 22	H22	0A3E	0A71	0AA4	0AD7	%x10
Harmonic 23	H23	0A3F	0A72	0AA5	0AD8	%x10
Harmonic 24	H24	0A40	0A73	0AA6	0AD9	%x10
Harmonic 25	H25	0A41	0A74	0AA7	0ADA	%x10
Harmonic 26	H26	0A42	0A75	0AA8	0ADB	%x10
Harmonic 27	H27	0A43	0A76	0AA9	0ADC	%x10
Harmonic 28	H28	0A44	0A77	0AAA	0ADD	%x10
Harmonic 29	H29	0A45	0A78	0AAB	0ADE	%x10
Harmonic 30	H30	0A46	0A79	0AAC	0ADF	%x10
Harmonic 31	H31	0A47	0A7A	0AAD	0AE0	%x10
Harmonic 32	H32	0A48	0A7B	0AAE	0AE1	%x10
Harmonic 33	H33	0A49	0A7C	0AAF	0AE2	%x10
Harmonic 34	H34	0A4A	0A7D	0AB0	0AE3	%x10
Harmonic 35	H35	0A4B	0A7E	0AB1	0AE4	%x10
Harmonic 36	H36	0A4C	0A7F	0AB2	0AE5	%x10
Harmonic 37	H37	0A4D	0A80	0AB3	0AE6	%x10
Harmonic 38	H38	0A4E	0A81	0AB4	0AE7	%x10
Harmonic 39	H39	0A4F	0A82	0AB5	0AE8	%x10
Harmonic 40	H40	0A50	0A83	0AB6	0AE9	%x10
Harmonic 41	H41	0A51	0A84	0AB7	0AEA	%x10

Harmonic 42	H42	0A52	0A85	0AB8	0AEB	%x10
Harmonic 43	H43	0A53	0A86	0AB9	0AEC	%x10
Harmonic 44	H44	0A54	0A87	0ABA	0AED	%x10
Harmonic 45	H45	0A55	0A88	0ABB	0AEE	%x10
Harmonic 46	H46	0A56	0A89	0ABC	0AEF	%x10
Harmonic 47	H47	0A57	0A8A	0ABD	0AF0	%x10
Harmonic 48	H48	0A58	0A8B	0ABE	0AF1	%x10
Harmonic 49	H49	0A59	0A8C	0ABF	0AF2	%x10
Harmonic 50	H50	0A5A	0A8D	0AC0	0AF3	%x10

The fundamental variable should be requested independently from the rest of the voltage harmonics variables.

8.3.7. CURRENT HARMONICS VARIABLES

VARIABLE	SYMBOL	I_1	I_2	I_3	I_N	UNIT
Fundamental	I_fund	0B54-0B55	0B87-0B88	0BBA-0BBB	0BED-0BEE	mA
Harmonic 2	H2	0B56	0B89	0BBC	0BEF	%x10
Harmonic 3	H3	0B57	0B8A	0BBD	0BF0	%x10
Harmonic 4	H4	0B58	0B8B	0BBE	0BF1	%x10
Harmonic 5	H5	0B59	0B8C	0BBF	0BF2	%x10
Harmonic 6	H6	0B5A	0B8D	0BC0	0BF3	%x10
Harmonic 7	H7	0B5B	0B8E	0BC1	0BF4	%x10
Harmonic 8	H8	0B5C	0B8F	0BC2	0BF5	%x10
Harmonic 9	H9	0B5D	0B90	0BC3	0BF6	%x10
Harmonic 10	H10	0B5E	0B91	0BC4	0BF7	%x10
Harmonic 11	H11	0B5F	0B92	0BC5	0BF8	%x10
Harmonic 12	H12	0B60	0B93	0BC6	0BF9	%x10
Harmonic 13	H13	0B61	0B94	0BC7	0BFA	%x10
Harmonic 14	H14	0B62	0B95	0BC8	0BFB	%x10
Harmonic 15	H15	0B63	0B96	0BC9	0BFC	%x10
Harmonic 16	H16	0B64	0B97	0BCA	0BFD	%x10
Harmonic 17	H17	0B65	0B98	0BCB	0BFE	%x10
Harmonic 18	H18	0B66	0B99	0BCC	0BFF	%x10
Harmonic 19	H19	0B67	0B9A	0BCD	0C00	%x10
Harmonic 20	H20	0B68	0B9B	0BCE	0C01	%x10
Harmonic 21	H21	0B69	0B9C	0BCF	0C02	%x10
Harmonic 22	H22	0B6A	0B9D	0BD0	0C03	%x10
Harmonic 23	H23	0B6B	0B9E	0BD1	0C04	%x10
Harmonic 24	H24	0B6C	0B9F	0BD2	0C05	%x10

Harmonic 25	H25	0B6D	0BA0	0BD3	0C06	%x10
Harmonic 26	H26	0B6E	0BA1	0BD4	0C07	%x10
Harmonic 27	H27	0B6F	0BA2	0BD5	0C08	%x10
Harmonic 28	H28	0B70	0BA3	0BD6	0C09	%x10
Harmonic 29	H29	0B71	0BA4	0BD7	0C0A	%x10
Harmonic 30	H30	0B72	0BA5	0BD8	0C0B	%x10
Harmonic 31	H31	0B73	0BA6	0BD9	0C0C	%x10
Harmonic 32	H32	0B74	0BA7	0BDA	0C0D	%x10
Harmonic 33	H33	0B75	0BA8	0BDB	0C0E	%x10
Harmonic 34	H34	0B76	0BA9	0BDC	0C0F	%x10
Harmonic 35	H35	0B77	0BAA	0BDD	0C10	%x10
Harmonic 36	H36	0B78	0BAB	0BDE	0C11	%x10
Harmonic 37	H37	0B79	0BAC	0BDF	0C12	%x10
Harmonic 38	H38	0B7A	0BAD	0BE0	0C13	%x10
Harmonic 39	H39	0B7B	0BAE	0BE1	0C14	%x10
Harmonic 40	H40	0B7C	0BAF	0BE2	0C15	%x10
Harmonic 41	H41	0B7D	0BB0	0BE3	0C16	%x10
Harmonic 42	H42	0B7E	0BB1	0BE4	0C17	%x10
Harmonic 43	H43	0B7F	0BB2	0BE5	0C18	%x10
Harmonic 44	H44	0B80	0BB3	0BE6	0C19	%x10
Harmonic 45	H45	0B81	0BB4	0BE7	0C1A	%x10
Harmonic 46	H46	0B82	0BB5	0BE8	0C1B	%x10
Harmonic 47	H47	0B83	0BB6	0BE9	0C1C	%x10
Harmonic 48	H48	0B84	0BB7	0BEA	0C1D	%x10
Harmonic 49	H49	0B85	0BB8	0BEB	0C1E	%x10
Harmonic 50	H50	0B86	0BB9	0BEC	0C1F	%x10

The fundamental variable should be requested independently from the rest of the current harmonics variables.

8.3.8. DIGITAL INPUT EXPANSION CARD VARIABLES

CARD POSITION	VARIABLE	SYMBOL	CODE	MODBUS ADDRESS
CARD 1	Input 1 meter	IN_1001	400	0C80-0C81
	Input 2 meter	IN_1002	401	0C82-0C83
	Input 3 meter	IN_1003	402	0C84-0C85
	Input 4 meter	IN_1004	403	0C86-0C87
	Input 5 meter	IN_1005	404	0C88-0C89
	Input 6 meter	IN_1006	405	0C8A-0C8B
	Input 7 meter	IN_1007	406	0C8C-0C8D
	Input 8 meter	IN_1008	407	0C8E-0C8F

CARD 2	Input 1 meter	IN_2001	408	0C90-0C91
	Input 2 meter	IN_2002	409	0C92-0C93
	Input 3 meter	IN_2003	410	0C94-0C95
	Input 4 meter	IN_2004	411	0C96-0C97
	Input 5 meter	IN_2005	412	0C98-0C99
	Input 6 meter	IN_2006	413	0C9A-0C9B
	Input 7 meter	IN_2007	414	0C9C-0C9D
	Input 8 meter	IN_2008	415	0C9E-0C9F
CARD 3	Input 1 meter	IN_3001	416	0CA0-0CA1
	Input 2 meter	IN_3002	417	0CA2-0CA3
	Input 3 meter	IN_3003	418	0CA4-0CA5
	Input 4 meter	IN_3004	419	0CA6-0CA7
	Input 5 meter	IN_3005	420	0CA8-0CA9
	Input 6 meter	IN_3006	421	0CAA-0CAB
	Input 7 meter	IN_3007	422	0CAC-0CAD
	Input 8 meter	IN_3008	423	0CAE-0CAF

8.3.9. ANALOGUE INPUT EXPANSION CARD VARIABLES

CARD POSITION	VARIABLE	SYMBOL	CODE	MODBUS ADDRESS
CARD 1	Analogue input 1	AD_1001	424	0CB2-0CB3
	Analogue input 2	AD_1002	425	0CB4-0CB5
	Analogue input 3	AD_1003	426	0CB6-0CB7
	Analogue input 4	AD_1004	427	0CB8-0CB9
	Analogue input 5	AD_1005	428	0CBA-0CBB
	Analogue input 6	AD_1006	429	0CBC-0CBD
	Analogue input 7	AD_1007	430	0CBE-0CBF
	Analogue input 8	AD_1008	431	0CC0-0CC1
CARD 2	Analogue input 1	AD_2001	432	0CC2-0CC3
	Analogue input 2	AD_2002	433	0CC4-0CC5
	Analogue input 3	AD_2003	434	0CC6-0CC7
	Analogue input 4	AD_2004	435	0CC8-0CC9
	Analogue input 5	AD_2005	436	0CCA-0CCB
	Analogue input 6	AD_2006	437	0CCC-0CCD
	Analogue input 7	AD_2007	438	0CCE-0CCF
	Analogue input 8	AD_2008	439	0CD0-0CD1
CARD 3	Analogue input 1	AD_3001	440	0CD2-0CD3
	Analogue input 2	AD_3002	441	0CD4-0CD5
	Analogue input 3	AD_3003	442	0CD6-0CD7
	Analogue input 4	AD_3004	443	0CD8-0CD9
	Analogue input 5	AD_3005	444	0CDA-0CDB
	Analogue input 6	AD_3006	445	0CDC-0CDD
	Analogue input 7	AD_3007	446	0CDE-0CDF
	Analogue input 8	AD_3008	447	0CE0-0CE1

8.4. RS-485 NETWORK CHARACTERISTICS

The RS-485 connection is made with screened but flexible twisted pair communication cable with a minimum of three wires. Maximum distance between the master and the last peripheral device is 1.200 metres.

For short RS-485 connection (< 5m), non-screened parallel cable can be used. On the contrary, for connections that extend over longer distances or that are in environments with hi level of disturbances, twisted screened cable should always be used.

RECOMMENDED CABLE

Flexible category 5 cable, 4 conductors x 0.5 mm2 (AWG 20) shield. The shield should be connected to ground in order to discharge noise that it may be induce. This cable can also use conductors with 0.22 mm^2 cross sections (AWG 24), although the 0.25 mm^2 or higher, (AWG 23) is recommended.
No. OF PERIPHERAL DEVICES:

A maximum of 32 peripheral devices can be connected to the network, and amplifiers can be used to extend the bus 1.200 additional metres.

Other considerations:

- Install the RS-485 BUS far away from electrical power lines.
- In facilities with long distances of RS-485 BUS, it is recommended to install components to protect against overvoltages in the BUS (voltages induced in the BUS by atmospheric discharges or ground potential differences).
- Do not make a star connection for the RS-485 BUS; i.e., do not make branches off the bus. The connection between a group of 485 peripherals and the BUS should be as short as possible.
- The analyzers GND should not be connected in the 485 BUS, i.e. system GNDs should not be connected one to another in order to avoid currents circulating between grounds at different potentials.
- The systems GND should neither be connected to the cable screen nor to the facility's ground.

9 . MAINTENANCE AND CALIBRATION

9.1 MAINTENANCE

CVMk2 does not require maintenance work since it is a completely static instrument. Nonetheless, it is recommended to verify that the terminals are properly tightened.

To increase the system's capacity with expansion cards before handling, modify its connections or replace equipment; **CVMk2** must be power OFF.
Handling the system while it is powered up is dangerous for the personnel and the equipment.

10. CHARACTERISTICS

10.1. STANDARDS

- CE Marking
- CAT III - 300 / 520 Vac in accordance with EN-61010 Standard.
- Protected against electrical shock by class II double insulation.
- Mounted on the DIN 46227 rail in accordance with EN50022 Standard.

10.2. TECHNICAL CHARACTERISTICS

VOLTAGE INPUTS	
Minimum measurable voltage	10 V a.c
Measuring range	from 5 to 120% of *U*n for *U*n = 300 V a.c. (f-N)
	from 5 to 120% of *U*n for *U*n = 520 V a.c (f-f)
Frequency	45…65 Hz
Maximum measured voltage	360 Vac
Acceptable overvoltage	750 Vac
Consumption	< 0.6 V•A
CURRENT INPUTS	
Minimum measurable current	20 mA
Measuring range	from 1 to 120% of *I*n for *I*n = 5 A
Secondary for the TCs (In)	1 or 5 A
Primary current measured	Programmable < 30.000 A
Acceptable overload	6 A continuous, 100 A t<1 s
Consumption for (.../5 and .../1)	< 0.45 V•A
AUXILIARY POWER SUPPLY	
Power supply	85 to 265 Vac (50-60 Hz) (consumption < 30 V·A)
	90 to 300 Vdc (consumption < 25 W)
Digital inputs (TON or counter pulse)	
Use voltage	24 to 60 Vdc ± 20%
Minimum signal width	30 ms
Consumption (each input)	< 0.5 W
Precision (type 402)	
Currents I	± 0.2% from 10% to 120% of *I*n
Voltages	± 0.2% from 20% to 120% of *U*n
Active power P	± 0.2% from 10% to 120% of *I*n
Reactive power Q	± 0.5% from 10% to 120% of *I*n
Apparent power S	± 0.5% from 10% to 120% of *I*n
Frequency F	± 0.01 Hz from 45 to 65 Hz
Active energy	± 0,2%
Reactive energy	± 0,5%
Apparent energy	± 0,5%

DIGITAL PULSE OUTPUTS	
Type:	Optocoupler
Use voltage	24 V d.c
Maximum power (per output)	0.8 W
Máximum RON	35 Ω
RELAY DIGITAL OUTPUTS	
Type:	Mechanical relay
Use voltage	250 V a.c
Maximum current (resistive charge)	3 A
ANALOGUE OUTPUT	
Scale	from 0 …. 20 mA or 4 ... 20 mA
Maximum acceptable charge	500 Ω
Response time	< 2 s
Output range points	4000
COMMUNICATIONS	
Network protocol	RS-485
Communication protocol	Modbus/RTU
Speed (configurable)	9600, 19200, 38400, 57600 baud
Parity	even, odd or no parity
Stop bits	1 or 2
ETHERNET OUTPUT	
Network protocol	RJ-45 ETHERNET
Communication protocol	Modbus/TCP
Speed	10baseT / 100baseTx compatible
ENVIRONMENT	
Operating temperature	- 10…+ 50 °C
Storage temperature	- 20… + 65ºC
Relative Humidity	95% with no condensation
Facility category	CAT III in accordance with CEI 61010
Degree of contamination	2 in accordance with IEC 61010
Protection index	IP51 front - IP20 rear
MECHANICAL	
Connection	Terminal board with screws for rigid 2.5 mm (4.5 mm^2) or flexible wires (AWG 11)
STANDARDS	
EMC	61000-4-2, 61000-4-3, 61000-4-11, 61000-4-4, 61000-4-5
c UL us LISTED	Listed for industrial control equipment miscellaneous device. FILE: NMTR E227534

10.3. OTHER CONCEPTS

The **CVMk2** applies the symmetric components method conceived by Fortescue and Stokvis to make network quality calculations.

This method makes a vector comparison of phasors, taking the phase difference and the module into consideration. It is used for voltage and current alike.

To indicate the degree of imbalance in a system, two coefficients are used.

10.3.1 UNBALANCE COEFFICIENT (KD)

The unbalance coefficient (Kd) is the ratio between the amplitude of the components in the direct and inverse sequence.

10.3.1 ASYMMETRY COEFFICIENT (KA)

The asymmetry coefficient (Ka) is the ratio between the amplitude of the components in the direct and homopolar sequence. The components of the homopolar sequence are zero if there is not a neutral.

10.3.3 FLICKER

Flicker is considered to be the low frequency disturbances or variations in amplitude of the voltage between 0.5 and 25 Hz. (f<2,500Hz).

The measurement is taken via a parameter known as perceptibility (P).

- For short time frames (10 minutes) it is defined as P_{ST}.
- For long time frames (10 minutes) it is defined as P_{IT}.

A flicker is considered to be perceivable if $P_{ST} > 1$.

10.3.4. K FACTOR

The K Factor is considered to be a transformer power reduction factor.
Losses generated by the harmonics are taken into consideration to calculate the K factor.

The unit is always higher in facilities with non-linear loads.

11. SOFTWARE

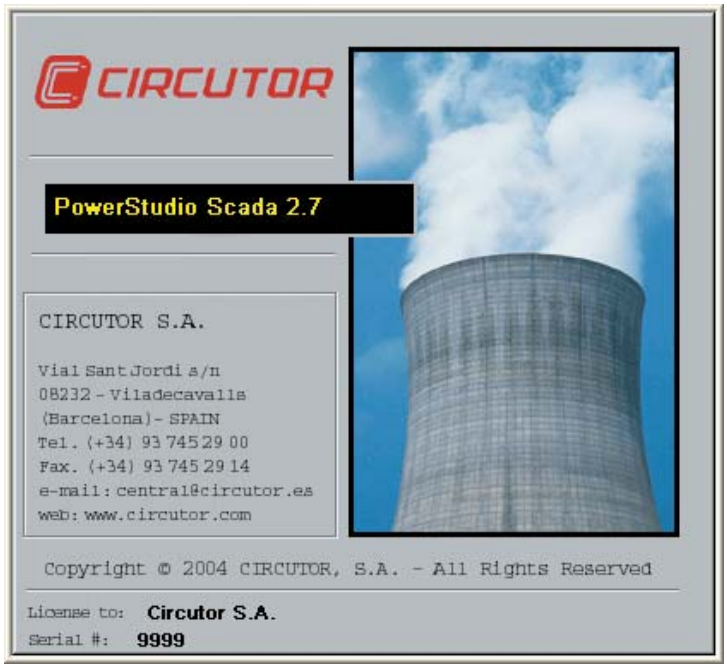
http://powerstudio.circutor.com

SOFTWARE

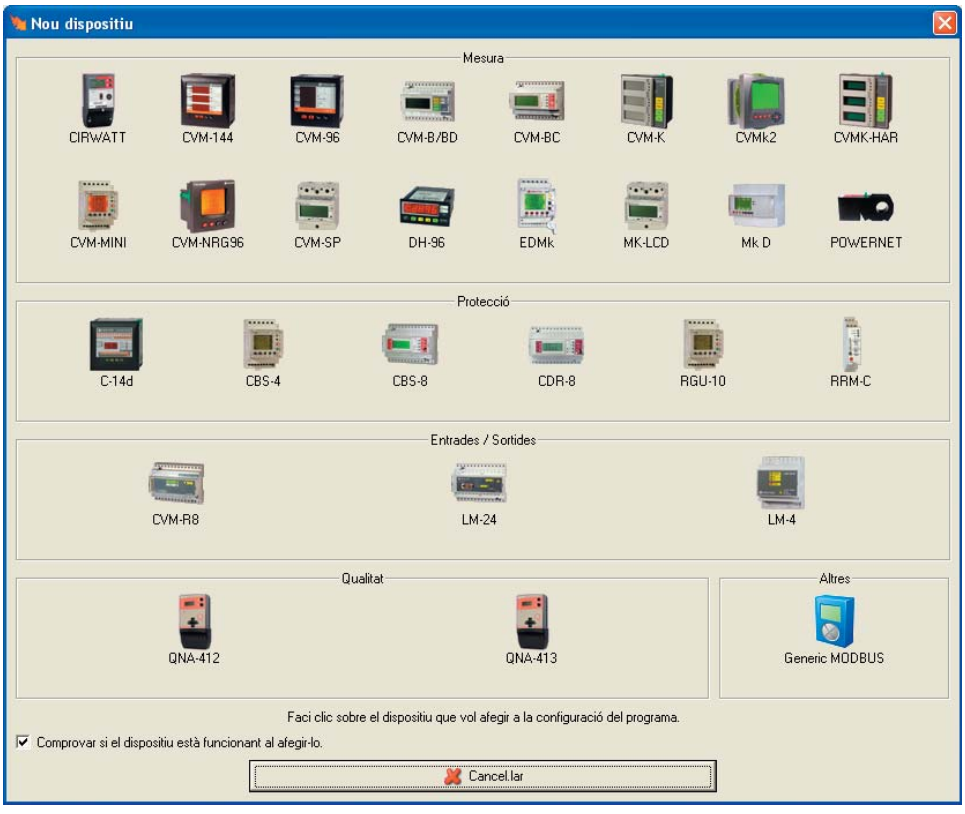
Power studio .circutor.com SCADA

11.1 POWER STUDIO SCADA.

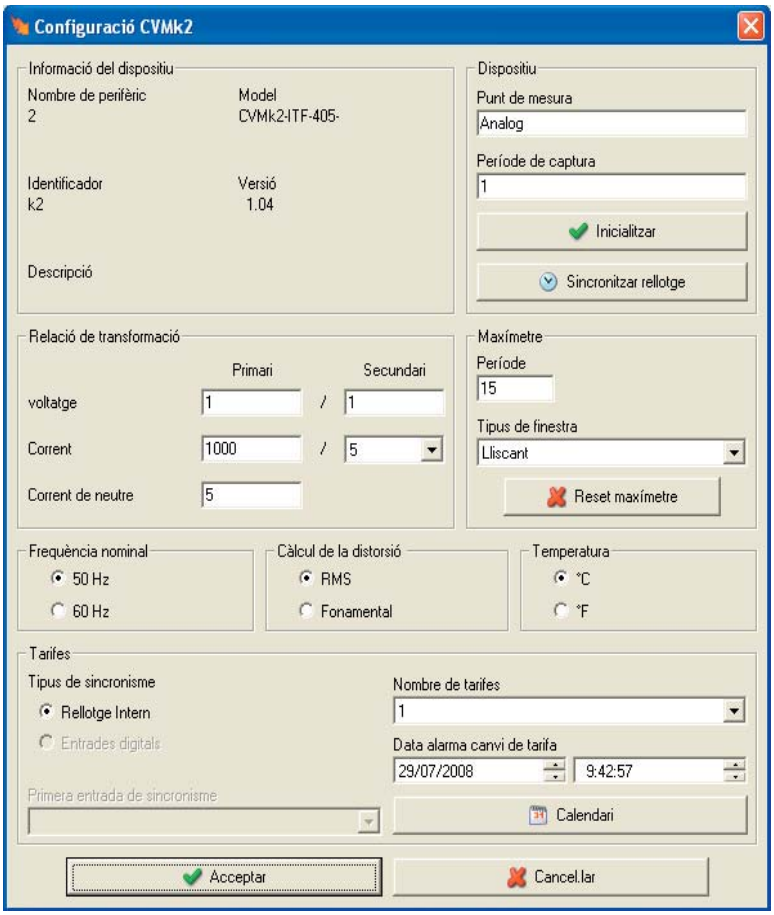
As many other **CIRCUTOR** systems, the **CVMk2** system drivers are managed by the Power Studio and **PowerStudio Scada** energy management software.



This software makes it possible to constantly communicate with the **CVMk2** network analyzer(s) (as well as with many other analyzer models), and to generate databases in a PC in order to graphically display all the parameters.

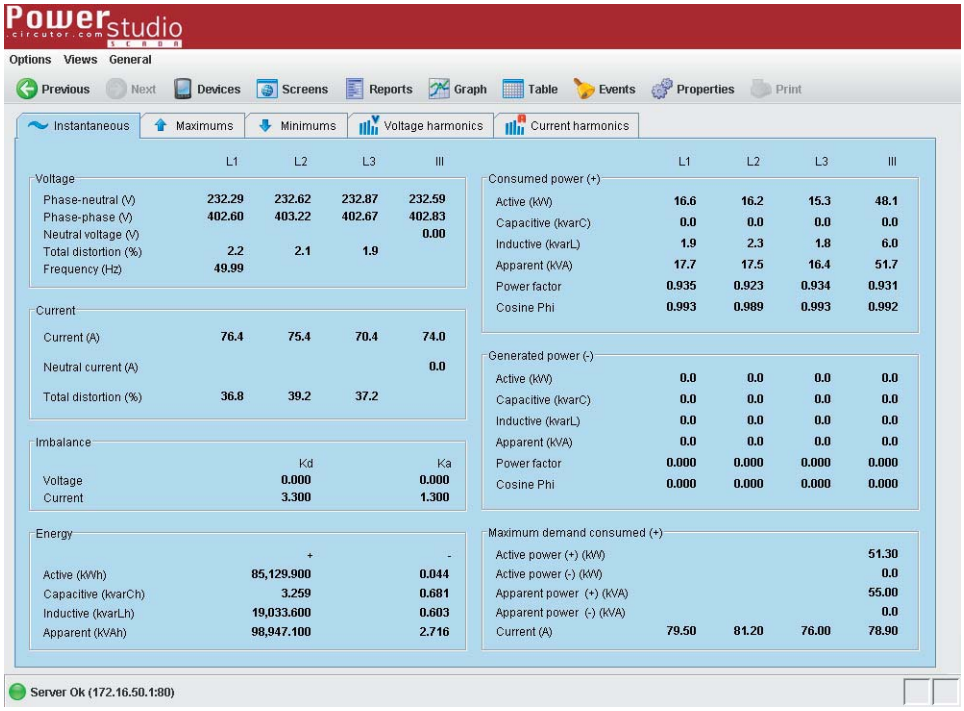


All the **CVMk2** parameters can be configured in real time using the **PowerStudio Scada** or **Power Studio**

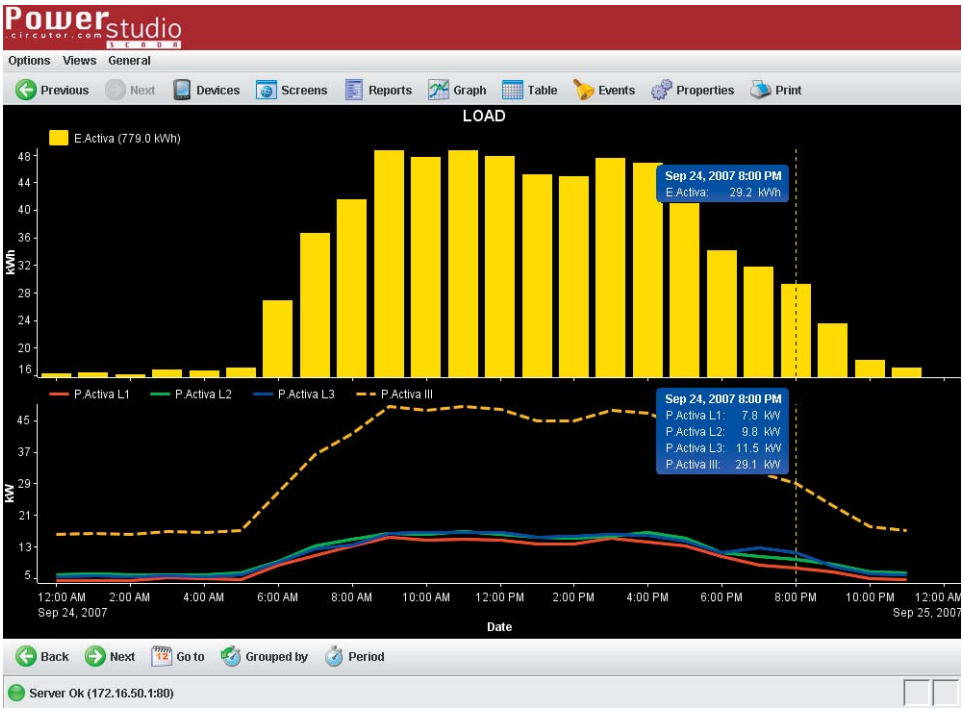


To integrate **CVMk2** parameters into others Scada is possible to use the OPC Server of the **PowerStudio Scada** or **Power Studio.**

All the **CVMk2** variables can be displayed in real time in the **PowerStudio Scada**. It also displays maximum, minimum and harmonic values for voltage and current.



All the **CVMk2** variables stored in the database can be graphically displayed or displayed in tables and exported to other software.
Power Studio and **PowerStudio Scada** are DDE and XML servers, which allow exporting data and communicating with other programs.



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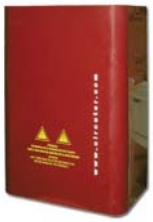

http://eficienciaenergetica.circutor.es

http://powerstudio.circutor.com

In case of any equipment failure or any operational queries please contact the technical service of CIRCUTOR S.A. **(S.A.T.)**:

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email:	**sat1@circutor**

Technical assistance
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