



## PORTABLE NETWORK ANALYZER

# AR5



## INSTRUCTIONS MANUAL

(M98230801-03-12B)



## Security warnings


**ADVERTENCIAS / SÍMBOLOS**

<p><b>PELIGRO</b></p> 	<p>Una conexión incorrecta del equipo puede producir la muerte, lesiones graves y riesgo de incendio. Lea y entienda el manual antes de conectar el equipo. Observe todas las instrucciones de instalación y operación durante el uso de este instrumento.</p> <p>La instalación, operación y mantenimiento de este instrumento debe ser efectuado por personal cualificado solamente. El Código Eléctrico Nacional define a una persona cualificada como "una que esté familiarizada con la construcción y operación del equipo y con los riesgos involucrados".</p> <p>Utilice siempre el equipo de protección individual necesario.</p>
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<p><b>ATENCIÓN</b></p> 	<p><b>Consultar el manual de instrucciones antes de utilizar el equipo</b></p> <p>En el presente manual, si las instrucciones precedidas por este símbolo no se respetan o realizan correctamente, pueden ocasionar daños personales o dañar el equipo y /o las instalaciones.</p>
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**WARNINGS / SYMBOLS**

<p><b>DANGER</b></p> 	<p>Death, serious injury, or fire hazard could result from improper connection of this instrument. Read and understand this manual before connecting this instrument. Follow all installation and operating instructions while using this instrument.</p> <p>Installation, operation, and maintenance of this instrument must be performed by qualified personnel only. The National Electrical Code defines a qualified person as "one who has the skills and knowledge related to the construction and operation of the electrical equipment and installations, and who has received safety training on the hazards involved."</p> <p>Always use personal protective equipment required</p>
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<p><b>WARNING</b></p> 	<p><b>Consult the instruction manual before using the equipment.</b></p> <p>In this manual, if the instructions preceded by this symbol are not met or done correctly, can cause personal injury or equipment damage and / or facilities.</p>
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**AVERTISSEMENT**

/

**SYMBOLES**

<p><b>DANGER</b></p> 	<p>Un branchement incorrect de l'appareil peut entraîner la mort ou des lésions graves et peut provoquer un incendie. Avant de brancher votre appareil, lisez attentivement le manuel et assurez-vous de bien avoir compris toutes les explications données. Respectez toutes les instructions concernant le mode d'installation de l'appareil et son fonctionnement.</p> <p>L'installation, le fonctionnement et la maintenance de cet appareil doivent être réalisés uniquement par du personnel qualifié. Le code électrique national définit en tant que personne qualifiée «toute personne connaissant le montage et le fonctionnement de l'appareil ainsi que les risques que ceux-ci comportent».</p> <p>Toujours utiliser des équipements de protection individuelle nécessaire.</p>
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<p><b>ATTENTION</b></p> 	<p><b>Consulter le manuel d'instructions avant d'utiliser l'appareil</b></p> <p>Si les instructions suivantes, précédées dans le manuel d'un symbole, ne sont pas respectées ou sont réalisées incorrectement, elles pourront provoquer des dommages personnels ou abîmer l'appareil et/ou les installations.</p>
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**WARNHINWEISE /**
**SYMBOLE**

<p><b>GEFAHR</b></p> 	<p>Durch einen nicht sachgemäßen Anschluss der Anlage können Tod, schwere Verletzungen und Brandrisiko hervorgerufen werden. Bevor Sie die Anlage anschließen, lesen Sie bitte das Handbuch durch und machen Sie sich dessen Inhalt klar. Beachten Sie bei Einsatz dieses Instrumentes sämtliche Installations- und Betriebshinweise.</p> <p>Installation, Betrieb und Wartung dieses Instrumentes müssen ausschließlich von entsprechend qualifiziertem Personal vorgenommen werden. Von dem nationalen Elektrocode wird eine qualifizierte Person als jemand definiert, "der mit der Konstruktion und dem Betrieb einer Anlage und der damit verbundenen Risiken vertraut ist".</p> <p>Verwenden Sie stets persönliche Schutzausrüstung erforderlich.</p>
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<p><b>ACHTUNG</b></p> 	<p><b>Vor Inbetriebnahme der Anlage ist das Handbuch zu lesen.</b></p> <p>Werden die in dem vorliegenden Handbuch mit diesem Symbol versehenen Hinweise nicht beachtet oder falsch verstanden, können Personenschäden und Schäden an der Anlage und/oder den Installationen verursacht werden.</p>
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## **P** ADVERTÊNCIAS / SÍMBOLOS

<p><b>PERIGO</b></p> 	<p>Uma ligação incorrecta do equipamento pode provocar a morte, lesões graves e risco de incêndio. Leia e compreenda o manual antes de ligar o equipamento. Observe todas as instruções de instalação e operação durante o uso deste aparelho.</p> <p>A instalação, operação e manutenção deste aparelho devem ser levadas a cabo exclusivamente por pessoal qualificado. O Código Eléctrico Nacional define uma pessoa qualificada como "uma pessoa que se encontre familiarizada com a construção e operação do equipamento assim como com os riscos inerentes".</p> <p>Sempre use equipamentos de proteção individual necessários</p>
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<p><b>ATENÇÃO</b></p> 	<p><b>Consultar o manual de instruções antes de utilizar o equipamento</b></p> <p>No presente manual, se as instruções que precedem este símbolo não forem respeitadas ou realizadas de forma correcta, podem ocorrer ferimentos pessoais ou danos no equipamento e/ou nas instalações.</p>
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## **I** AVVERTENZE / SIMBOLI

<p><b>PERICOLO</b></p> 	<p>Un collegamento errato del dispositivo può provocare morte, lesioni gravi nonché rischio di incendio. Prima di collegare il dispositivo leggere attentamente il manuale. Osservare tutte le istruzioni relative all'installazione e all'operatività durante l'uso di questo strumento.</p> <p>L'installazione, operatività e manutenzione di questo strumento devono essere realizzate solamente da personale qualificato. Il Codice Elettrico Nazionale definisce una persona qualificata come "colui che ha familiarità con la costruzione e operatività del dispositivo e con i rischi che ne possano derivare".</p> <p>Utilizzare sempre dispositivi di protezione individuale necessari.</p>
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<p><b>ATTENZIONE</b></p> 	<p><b>Consultare il manuale di istruzioni prima di utilizzare il dispositivo</b></p> <p>Qualora le istruzioni riportate nel presente manuale precedute da questo simbolo non vengano osservate o realizzate correttamente, possono provocare danni personali o danneggiare il dispositivo e/o gli impianti.</p>
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### Liability limitations

**CIRCUTOR, SA** reserves the right to make changes, without previous notice, to devices or specifications of analyzers shown in this manual.

The term of the CIRCUTOR guarantee is two years from the date of purchase and is limited to refund of the purchase price, repair free of charge, or replacement of defective equipment that is returned to CIRCUTOR post-sales service within the term of the guarantee.

**CIRCUTOR, SA** makes the latest versions of its device specifications and the most up to date manuals available to its clients on its web site [www.circutor.es](http://www.circutor.es) and [www.circutor.com](http://www.circutor.com).

### Recommendations prior to use



In order to use the *analyzer* safely, it is critical that individuals who handle it follow the safety measures set out in the standards of the country where it is being used, use the personal protection equipment necessary, and pay attention to the various warnings set forth in this instruction manual.

Before handling, modifying the connection or replacing the analyzer, the power supply must be switched off, and the AR6 meter disconnected. Handling the analyzer while it is connected is hazardous for individuals.

It is important to use only the connection cables and accessories that are delivered along with the analyzer. These products are specially designed for use with this apparatus and comply with current safety standards. Also, it is critical to keep the cables in perfect condition in order to avoid accidents, personal injury and damage to installations.

The manufacturer of the equipment is not responsible for any damages resulting from failure by the user or installer to heed the warnings and/or recommendations set out in this manual, nor for damages resulting from the use of non-original products or accessories or those made by other manufactures.

We recommend using only the original material delivered with the equipment in order to ensure the safety of individuals who handle it and the integrity of the equipment itself.

In the event an anomaly or malfunction is detected in the equipment, refrain from using it to make any measurements.

Inspect the work area before making any measurements. Do not use the meter in dangerous areas or where there is a risk of explosion.

Avoid using the meter in wet areas

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# 1 GENERAL OVERVIEW

## 1.1 INITIAL TESTING

Upon receiving the instrument, test the following points:

- That the device meets the specifications of your order
- That it has not been damaged during shipping.
- That it is equipped with the accessories requested from the manufacturer.

## 1.2 STANDARD COMPONENTS AND ACCESSORIES

The AR6 analyzer comes with the following:

- AR6 portable power analyzer
- 100 - 240Vac / 12 Vdc 3.33 A (40 W max) power supply
- AR6 battery
- 5 voltage measuring cables
- Bag with coloured ties for voltage cables
- 5 alligator clips
- USB communication cable
- 4 coloured adhesive front panels
- Power Vision plus software CD
- Manufacturer's Certificate of Production
- Complete Manual.
- FAT 32 SD memory (inserted in the device)

## 1.3 ICONS AND SYMBOLS



Impedance protected Double insulation Protection class identifier.



Made in EU Manufactured in Europe. Under European standards.



These products have been designed and manufactured with top quality components that can be recycled and reused.

Electrical and electronic products contain substances that can harm the environment if they are not adequately treated.

This symbol means that the electrical and electronic equipment should not be disposed of with other household waste at the end of its useful life.

Please take the obsolete products being replaced to a waste collection point or contact your local government.

The European Union has established specific collection systems for electronic and electrical equipment waste.

REI-RAEE Record No.: **3338**

## 2 DESCRIPTION OF THE DEVICE

### 2.1 INTRODUCTION

This manual contains all the information necessary for safe use of the model **AR6** portable analyzer and will help you get the best performance results from it. This equipment incorporates the latest technology and offers the most advanced service on the market in the area of measurement and recording of electrical parameters in industrial or residential networks.

**Read this manual carefully before connecting the equipment** in order to avoid incorrect use that may cause it permanent damage.

### 2.2 DESCRIPTION

The **AR6** is a portable analyzer for measuring electrical network parameters. It is the latest version of the CIRCUTOR S.A. AR 4 and AR 5 portable analyzer series.

It is a digital measuring instrument that takes samples of voltage waves and current and calculates effective voltage and current values with a specific TMP averaged time. It includes a 1 GB internal memory for storing the data recorded at different installations measured. The positioning of each one of the buttons mentioned is shown in the figure.

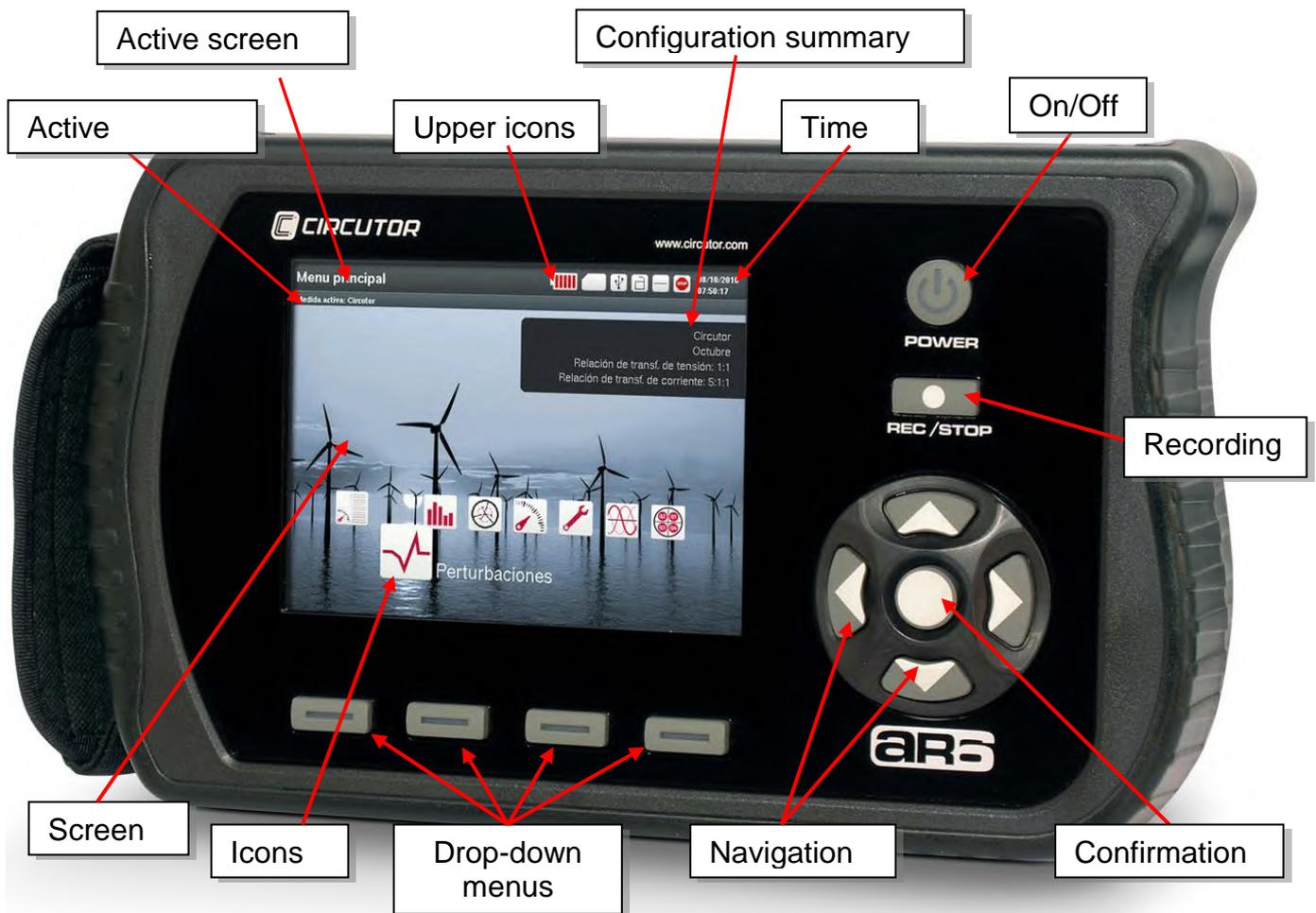


Image 1

### 2.2.1 Active measurement

Beneath the name of the screen displayed, the name of the active measurement of the AR6 analyzer over which the recording is made is shown, in case the user requires it.

### 2.2.2 Active screen

The name of the screen currently being displayed is shown.

### 2.2.3 Upper icons

The equipment status information icons are located here. For more information see the chapter entitled Upper icons

### 2.2.4 Configuration summary

On this part of the screen the equipment displays a summary window with its current configuration, so the user may, at any time, verify that the configuration of the equipment and the active measurement are correct for the measurements and recordings of the installation.

### 2.2.5 Time

Displays the time at which the equipment is configured.

### 2.2.6 On/Off

To switch the analyzer on or off, you must press the on/off button and confirm the action on the menu that appears on the screen.

The button will light up either red or green in colour. The colour green indicates the equipment is on and, if flashing, that it is in energy saving mode, with the screen off. Intermittent red indicates that it is connected to the network and that the battery is charging, and if the LED is off, that the analyzer is switched off.

### 2.2.7 Recording

Once the user has configured and connected the equipment, its correct connection must be verified by checking the values displayed by the equipment. If the connection is verified as correct, the user may begin recording data by pressing this button. Likewise, once the desired recording is finished, this button must be pressed by the user in order to stop the recording.

### 2.2.8 Confirmation

The confirmation key serves to run the operation selected among the various options from the configuration and display screens, or dynamic drop-down menu. It is referred to in this manual with the ● icon.

### 2.2.9 Navigation

There are four navigation keys for facilitating movement through the various menus and options of the equipment. These keys have arrow points drawn on their upper parts, which indicate the direction of cursor movement.

In this manual these keys are referred to with the ▲/▼, ◀/▶ icons.

### 2.2.10 Drop-down menus

The analyzer function keys are mobile or "dynamic". The options displayed on dropping down the menus for each of the function keys is different depending on the current screen.

### 2.2.11 Icons

The main menu icons help the user quickly and easily access the configuration, system information and display screens. For more information on each of the direct access icons see the chapter entitled MAIN MENU

### 2.2.12 Screen

For perfect display of the values or graphics, it has a 5.7" VGA LCD screen, on which the data from 9 channels may be displayed simultaneously:  $U_1$ ,  $U_2$ ,  $U_3$ ,  $U_N$ ,  $U_{EARTH}$ ,  $I_1$ ,  $I_2$ ,  $I_3$ ,  $I_N$ ,  $I_K$ .

## 2.3 DESCRIPTION OF CONNECTORS

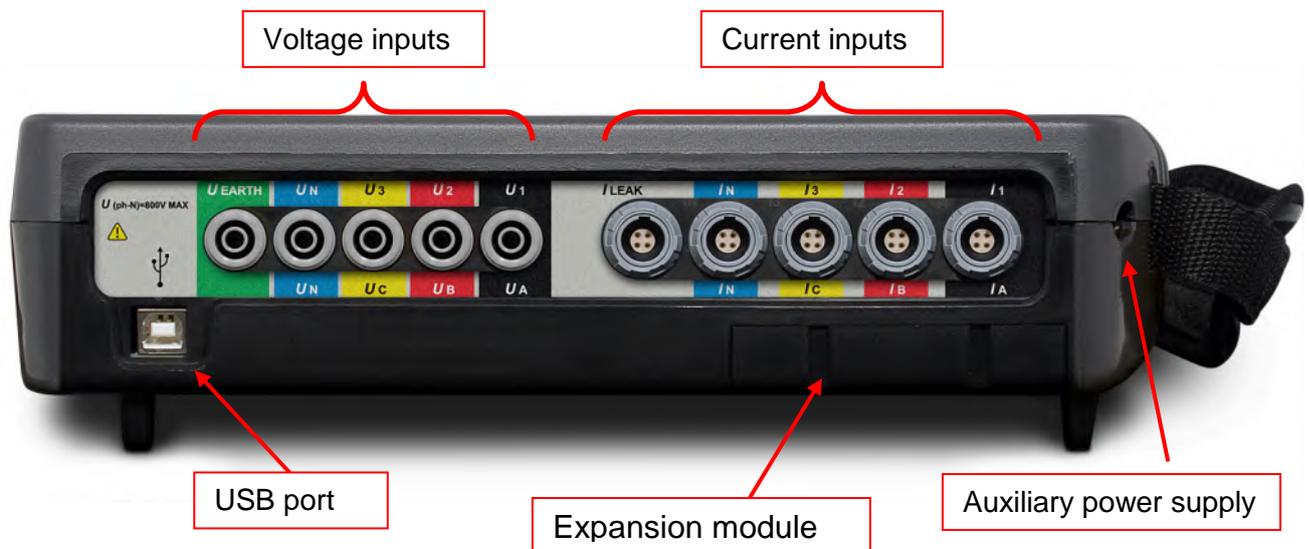


Image 2

### 2.3.1 Voltage inputs

The voltage inputs of the AR6 are available on the front part of the equipment, as shown in figure 2. They are marked with the symbols  $U_1$  ( $U_A$ ),  $U_2$  ( $U_B$ ),  $U_3$  ( $U_C$ ),  $U_N$  ( $U_N$ ) and  $U_{EARTH}$  and identified with various colours (based on the model of identifier adhesive chosen by the user).

### 2.3.2 Current inputs

The current inputs of the analyzer are likewise available on the front panel of the analyzer as shown in image 2. The current indicators are identified with the symbols  $I_1$  ( $I_A$ ),  $I_2$  ( $I_B$ ),  $I_3$  ( $I_C$ ),  $I_N$  ( $I_N$ ) and  $I_{LEAK}$ . The identification colours depend upon the identifier adhesive chosen by the user.

### 2.3.3 USB port

Type B USB port, used for downloading data recorded by the analyzer. When the analyzer is connected to a computer it is recognized as an external drive, so it is not necessary to communicate with the equipment in order to download stored files, simply move the files to the desired directory of the computer or download with Powr vision plus software.

### 2.3.4 Expansion module

This module does not come with the basic equipment. The positioning of the expansion module on the equipment is shown. In case the user may have acquired a special custom module

or special features to extend the features of the analyzer, this is where expansion modules are installed. The features of each one of the expansion modules are found in their respective individual manuals.

### 2.3.5 Auxiliary power supply

This is the slot for the AR6 power supply connector. See the power supply features in the chapter entitled TECHNICAL SPECIFICATIONS.

## 3 INSTRUCTIONS FOR USE

The **AR6 analyzer** is a configurable measuring instrument that may be employed in a number of ways, which the user may select via the functions of the different icons of the main menu. It allows configuration of various measuring diagrams, recording times and conditions, snapshots, averages, rebooting maximum and minimum values, displaying wave shapes, rate of harmonic distortion, active and reactive power, both inductive and capacitive, energy consumed and generated, among many other parameters.

In order to ensure correct operation, carefully read the instructions given in this manual before beginning measurements.



**WARNING: Read this manual before using the analyzer.**  
If the analyzer is used in a manner other than that specified by the manufacturer, its protection may be compromised.

## 4 TECHNICAL SPECIFICATIONS

The most important features of all the AR6 analyzer components are described in this chapter.

### 4.1 EXTERNAL POWER SUPPLY

An external alternating current power supply comes with the equipment. It is used to power the equipment while recording or to recharge the battery.

Nominal voltage	100...240 Vac.
Power supply frequency	50...60 Hz
Output voltage	12 Vdc
Current	3.33 A
Max power	40 W

### 4.2 POWER SUPPLY OF THE EQUIPMENT

Nominal voltage	12 Vdc
Current	2 A
Maximum power	24 W
Consumption	30 VA

## 4.3 BATTERY

The **AR6** is equipped with an NiMH battery as the main power supply of the equipment, which gives it operation and recording autonomy. It also has an internal Lithium battery, the function of which is to permanently power the equipment clock, even while the analyzer is switched off.

### 4.3.1 Rechargeable main power supply battery

BATTERY	NiMH (Nickel Metal Hydride)
Voltage	6 V
Capacity	4.200 mAh
Charge time	2 ... 3 h
Battery life while in use	4hrs with LCD on
	8hrs with LCD off

### 4.3.2 Clock power supply internal battery

Lithium battery	CR2025
Voltage	3 V
Capacity	600 mA/h
Battery life without charger	10 years

## 4.4 CURRENT INPUT SPECIFICATIONS

Inputs for current measurement	<i>I1 I2 I3 IN ILeak</i>
Input voltage	0...2 V
Measurement margin	from 1 to 120% of <i>In</i>
Primary current measurement <i>In</i>	Depends on clamp
Allowable overload	3 <i>In</i>
Consumption	$\leq 0.0004$ VA
Special features	Leakage current measurement via low-pass filter option activated/deactivated
Input impedance	10 k $\Omega$

## 4.5 VOLTAGE INPUT SPECIFICATIONS

Features of the voltage reference measurement cable inputs.

### 4.5.1 Voltage inputs

Inputs for voltage measurement	<i>U1 U2 U3 UN Earth</i>
Input margin	$U_n = 10$ to 800 Vrms phase-neutral
Number of inputs	5
Peak voltage	2,500 Vpeak
Bandwidth	3.2 kHz
Input impedance	10 M $\Omega$
Permanent overvoltage	1.000 Vrms
Transient overvoltage <1s	2.500 Vpeak

Absolute maximum voltage	6 kV
Consumption	≤0.04 VA
Maximum voltage in the voltage measurement circuit	
	1000 V CAT III / 600 V CAT IV for altitudes lower than 2000 m.
	1000 V CAT II / 600 V CAT III / 300 V CAT IV for above 2000 m

## 4.6 ENVIRONMENTAL CONDITIONS

Operating temperature	0...+50°C
Storage temperature	-10...+60°C
Altitude	2,000 m
Humidity without condensation	5...95%

## 4.7 MECHANICAL FEATURES

Outside dimensions	283 x 168 x 80 mm
Weight	1.640 kg

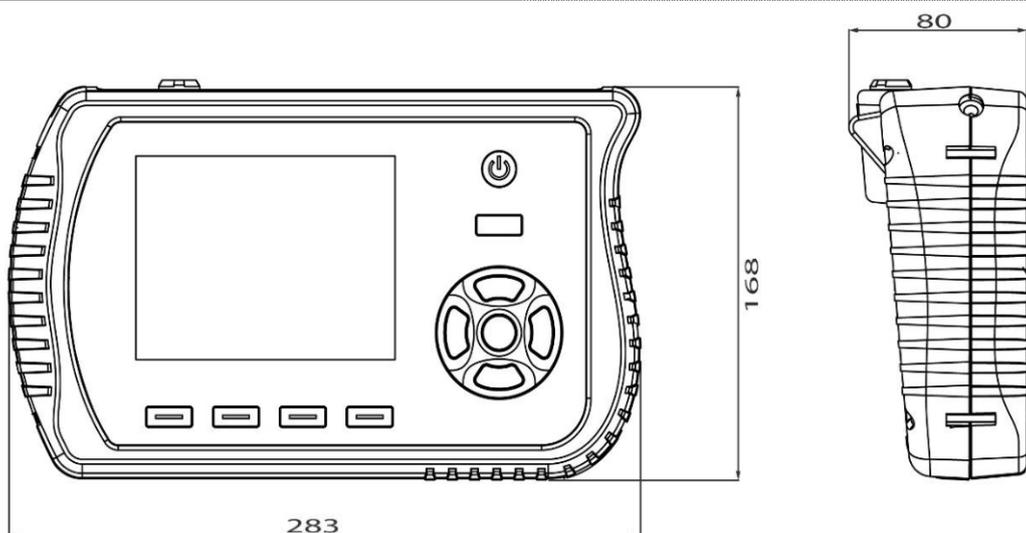


Image 3

## 4.8 SCREEN

### 4.8.1 LCD features

Panel size	5.7" (diagonal)
Active area of the LCD	Width 116.16 mm x Height 87.12 mm
No. of Pixels	Horizontal (640x3) x Vertical 480
Resolution type	VGA
Pixel size	Horiz. 0.1815mm x Vert. 0.1815 mm
Pixel colour	RGB vertical lines
Display colour	White
No. of colours	262K
Back lighting	LED

## 4.9 MEMORY



The internal memory must be handled with all possible cautions to prevent internal files corrupted. Before remove, turn off the device.

### 4.9.1 SD memory Features

The device has an internal SD memory. The user has not extract the SD card from the unit because can acced to and download the registered data through the USB communication port. Anyway the user can exchange the internal memory card to a higher capacity if it's necessary. **It is very important that the memory card has the same folder structure than the original and format FAT32.**

The table shows the list of some valid cards and features.

Model	Features
SD	Stándar specification 1.10 Capability up to 32 GB
SDHC	Specification 2.0, class 4 Minimum tranference speed 4MB/s Capability up to 32 GB

## 4.10 ACCURACY

Variable	Resolution	Accuracy	Range
Currents* (2V inputs)	0,1 mA	± 0,5%	10% ... 120% of $I_n$
Voltages	0,01 V	± 0,5%	20% ... 120% of $U_n$
Active power	0,1 W	± 0,5%	
Reactive power	0,1 VAr	± 0,5%	
Apparent power	0,1 VA	± 0,5%	
Frequency	0,01 Hz	± 0.01 Hz	45 ... 65 Hz
Active energy	1 W·h	± 0,5%	
Reactive energy	1 VAr·h	± 0,5%	
THD Voltage	% x 10	± 0.5%	10% ... 120% of $U_n$
THD Current	% x 10	± 0.5%	20% ... 120% of $I_n$
PST Flicker	% x 10	± 0.2%	
PLT Flicker	% x 10		
Voltage Umbalance	% x 10		
Voltage Asymmetry	% x 10		
Crest Factor	x100	± 0.5%	1,0...1,875

\* The current analyzer error does not include the error of the clamps connected.

## 5 START-UP

### 5.1 BATTERY INSTALLATION

The analyzer comes without the battery installed in order to ensure its good condition. The user must install the battery before taking any other step. To do this, the procedure below must be followed.

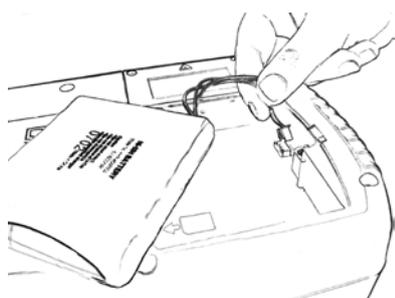
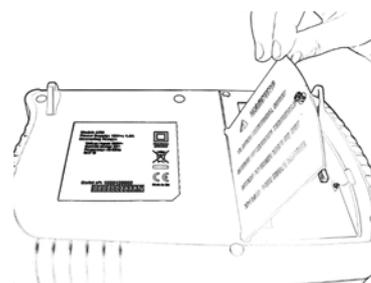
Once installed it is recommended to do fully charge for 24 hours.

	<p><b>In order to install the battery, the equipment must be disconnected from any voltage and current source, both in the power supply and the meter.</b></p>
--	--



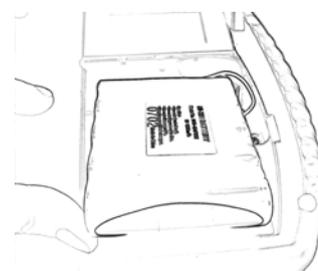
1.) Remove the screw from the battery cover.

2.) Lift the cover to make the battery compartment accessible.



3.) Insert the battery overhead connector in the receptacle indicated for connecting the battery. Make sure it is positioned correctly, and do not force it.

4.) Once the battery is connected to the equipment, position it so that the power supply cables are not stretched, compressed, and will not be damaged by the cover.



5.) Install the cover after verifying that none of the cables have been damaged and that the battery is firmly in place.

6.) Lock down the cover again with the screw



Image 4

## 5.2 POWER ON

Once the battery has been installed, press the POWER key and hold it down for a few seconds. The analyzer begins the system start-up and displays the access to the main screen.



## 6 DROP-DOWN MENUS AND KEYBOARD

In order to change the value of a field, place the cursor inside it and press ● to open the virtual keyboard or the possible configuration options for the field. This option allows the user to enter any value or text, as the case may be. The keys or options displayed will be different depending upon the field to be configured.

Alphanumeric:



Numeric:



Date:



Hour:



Selection:



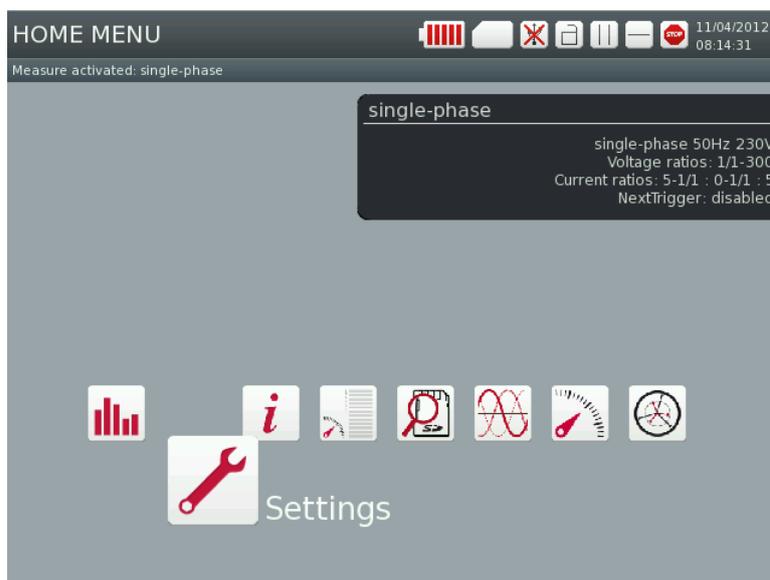
The arrow keys ◀/ ▶ and ▼/ ▲ move the selection cursor to the desired menu option. The ● button is used to confirm the selection and change to the desired display screen.

Confirmation or delete options values entered is done with the function buttons in the lower portion of the corresponding screen.



## 7 MAIN MENU

The main menu of the AR6 has various icons that indicate to the user the different configuration and display options available in a simple and intuitive manner.



The main menu icons are:



[MEASURE MANAGER](#)



[MEASURE ANALYSIS](#)



[HARMONICS](#)



[PHASORS](#)



[WAVEFORM](#)



[QUADRANTS](#)



[SETTINGS](#)



[SYSTEM INFORMATION](#)



[MEASURE](#)

For equipment configuration the user must select the measurement Administrator icon.

## 7.1 MEASURE MANAGER



The measurement administrator screen allows the user to create some standard presets in order to configure the equipment simply and rapidly for making recordings.

MEASURES LIST	
h2AM54cond	
hw2a_22_neutre1000	
lifasa	
monophasic33	
single-phase	
t5	
test	<input checked="" type="checkbox"/>
three-phase_4wires	

Sample table

The screen displays a list of the various measurement configurations created on the equipment. Only one of these measurements may be active in any given moment. One measurement allows configuration of the analyzer for measuring and recording in various electrical installations. A measurement may be created, modified or deleted.

The options on the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
	<ul style="list-style-type: none"> <li>Create</li> <li>Modify</li> <li>Clean</li> <li>Remove</li> <li>Activate</li> </ul>	The options of this menu are those of creating new measurements, modifying existent ones, deleting files associated with an already existing measurement, or deleting the measurement permanently.

### 7.1.1 Create

Measure name:

Reference file	Description
defconf1.xml	monophasic 50Hz
defconf3.xml	biphasic 50Hz
defconf5.xml	triphasic 3 wires 50Hz
defconf7.xml	triphasic 3 wires aron 50Hz
defconf9.xml	triphasic 4 wired 50Hz
defconf2.xml	monophasic 60Hz
defconf4.xml	biphasic 60Hz
defconf6.xml	triphasic 3 wires 60Hz
defconf8.xml	triphasic 3 wires aron 60Hz
defconf10.xml	triphasic 4 wires 60Hz

Enables the creation of a new measurement.

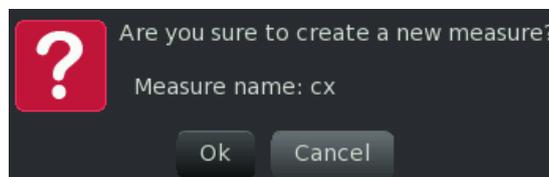
In order to create a measurement, a name must be assigned to it, and a selection made from the list, the preset base that most closely fits the installation to be analyzed.

The options on the lower menu of this screen are:

Key	Function	Description
	BACK	Brings up the previous screen.
	Create	Enables confirmation of the creation of a measurement.

Once a name for the new measurement has been entered, select CREATE. The analyzer displays a confirmation window before creating the measurement.

Once created, the current clamps and voltage transformers relationship configuration screen is displayed.

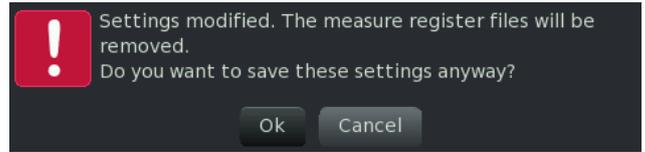


### 7.1.2 Modify

The equipment allows modification of the measurements created at any time, whether it is the active measurement or another from the list of measurements.

	<p>Edition of the active measurement implies deletion of the files previously generated by it. (The analyzer will ask for confirmation of the edition process in order to prevent the user from deleting data)</p>
--	--

Upon attempting to modify the active measurement, the equipment warns the user via the following confirmation message; and it is important to read the warnings, given that they imply deletion of data stored in the memory of that measurement.



The lower menu of all the modification screens is is:

Key	Function	Description
	BACK	Brings up the previous screen.
		Select in order to save the changes
	<ul style="list-style-type: none"> <li>Transformers ratios</li> <li>Measure Setup</li> <li>Variable selection</li> <li>EVQ Setup</li> <li>Transient</li> <li>Trigger Interval</li> <li>Periodic Trigger</li> <li>Photo Conditions</li> </ul>	<ul style="list-style-type: none"> <li>• TRANSFORMATION RATIOS: Ratios of transformers used</li> <li>• MEASUREMENT CONFIGURATION: Circuit, recording time, THD calculation and Maximum Demand.</li> <li>• VARIABLE SELECTION: To select the variables to register</li> <li>• CONFIGURATION OF EVENTS: Detection of quality events *.EVQ</li> <li>• TRANSIENT: Transient detection</li> <li>• RECORDING INTERVALS: Recording period (start and stop time)</li> <li>• PERIODIC RECORDING: Repeated periodic recordings</li> <li>• SNAPSHOT CONDITIONS: Conditions for snapshot capture *.PHO</li> </ul>

### 7.1.2.1 TRANSFORMATION RATIO

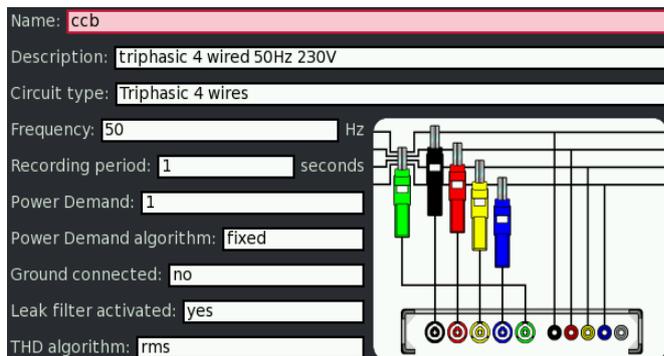


#### Configurable Parameters:

- Primary and secondary voltage
- Scale of the clamp installed on the phase meter.
- Scale of the clamps on neutral meter.
- Scale of the leakage clamps

By detecting the connection of current measurement sensor, the device displays the configuration screen voltage transformers and current sensors. The device detects the ratios of the connected sensors and displays the scale. When connecting sensors of various scales, you must select one. The analyzer displays a default value. These ratios can be modified in the event that the user is measured in the transformer secondary with 5 Amp clamps, but needs to display the values referred to the primary installation. The same form the voltage transformers ratios. If not, should not modify the default ratio 1/1.

### 7.1.2.2 MEASUREMENT CONFIGURATION



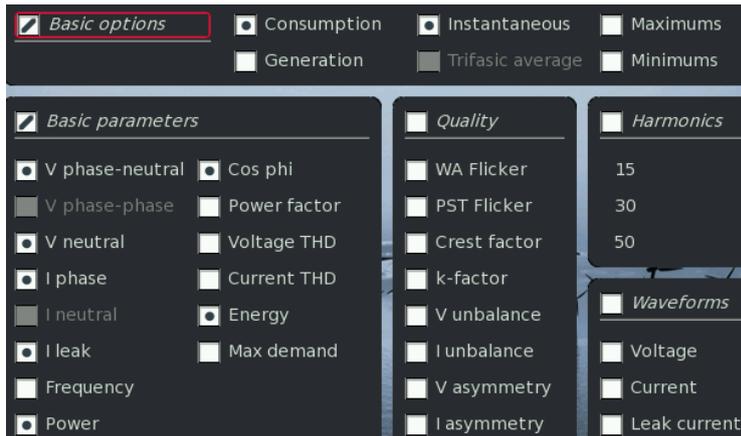
- Configurable Parameters:**
- Measurement name
  - Measurement notes
  - Nominal frequency
  - Recording period in minutes
  - Measurement demand calculation time
  - Maximum demand calculation method
  - Connection to earth.
  - Filter connection.
  - (THD) calculation algorithm
  - Type of measurement circuit.

The configurable fields on the Measurement screen are:

Option	Description
Name	Name of measurement.
Notes	Description added to the name in order to facilitate finding or referencing the measurement.
Nominal frequency [50 / 60 Hz]	Nominal frequency of the installation. Used for the recording of electrical parameters and quality events. Select between 50 or 60 Hz.
Recording period 1...7.200 seconds	Period desired to calculate the measurement and record the electrical parameters.
Maximum demand [n x periods]	Period configured in order to calculate Maximum Demand.
Earth connected	Select if the measurement is made with the grounding cable connected or not. Incorrect configuration could cause errors in the measurement.
Leakage filter connected	Activates a high frequency filter in the measurement. Useful for seeing the difference in value of leakages seen through a filtered earth leakage relay (such as those manufactured by CIRCUTOR) or without the filter.
THD Algorithm [RMS or base]	Select the form of calculation desired for the rate of harmonic distortion.
Circuit types	<ul style="list-style-type: none"> <li>• Single-phase</li> <li>• Two-phase</li> <li>• Three-phase 3 wires</li> <li>• ARON three-phase 3 wires</li> <li>• Three-phase 4 wires</li> </ul>

### 7.1.2.3 EVENTS CONFIGURATION

This screen allows the selection of variables that the user wants to register



- Basic options
- Basic parameters

The analyzer records the variables selected by the user from this screen. It is very important that you make sure to select the variables you want to register. The options presented this screen are:

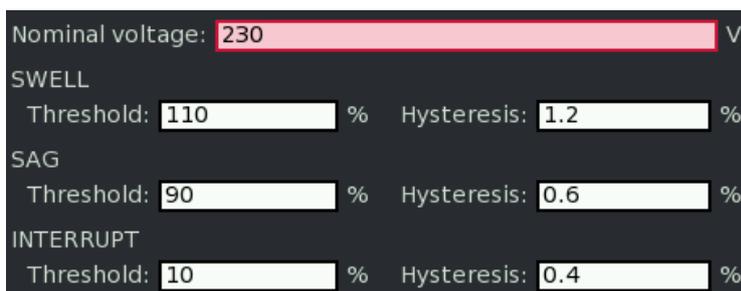
**Basic options:** Options that affects the other parameters such as registration of consumption or consumption and generation, instantaneous, maximum and minimum.

**Basic parameters:** Are individual variables. The user can select specific variables to be registered as voltage, current, quality parameters, waveforms and harmonic degree required.

Using the ◀ / ▶ move between basic options, basic parameters, quality, harmonic waveforms while the arrows ▼ / ▲ moves between all fields of variables to select. The ● button is for enable / disable the variable or group.

#### 7.1.2.4 EVENTS CONFIGURATION

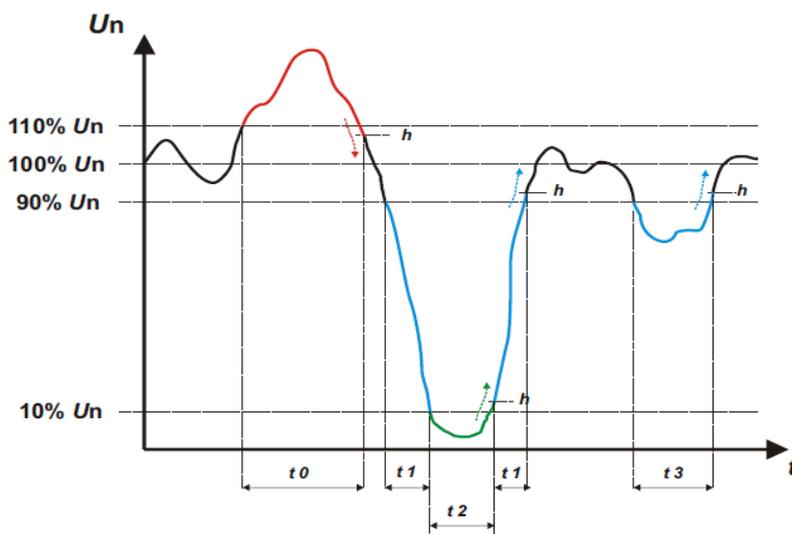
Events recorded by the AR6 are based on this configuration screen.



**Configurable Parameters:**

- Nominal voltage
- Peak threshold
- Peak hysteresis
- Gap threshold
- Gap hysteresis
- Cut threshold
- Cut hysteresis

The way to detect events is shown in the following example:

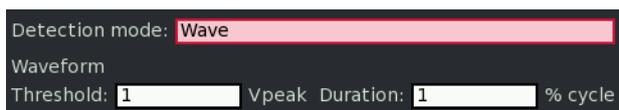


The graphic shows a quality event of overvoltage within a time interval of  $t_0$ . The duration of the overvoltage event is equal to the time that the signal is above the value configured for detecting overvoltages (equal to 110% of nominal Voltage) plus the time it takes for the signal to drop below the programmed hysteresis value (normally 2%).

Other events shown on the graphic fall within  $t_1$  and  $t_3$ . These events correspond to some gaps. The general gap is configured at 90% of nominal Voltage, and is thus recorded until it falls below 10% (in this case a cut is recorded, represented in the graphic in the  $t_2$  interval, or again goes above the 90% configured, plus the 2% of hysteresis).

Quality events recorded by the AR6 must last a minimum of 10ms. If the event does not last this long it is not recorded as such, although it does affect the calculated average value of that period.

### 7.1.2.5 TRANSIENTS



#### Configurable Parameters:

- The desired transient detection method.
- Vrms distortion threshold or corresponding configuration parameter

The configuration of transients detection of this screen is used by the AR6 for their detection and recording. The configuration screen varies depending on the method of selection used.

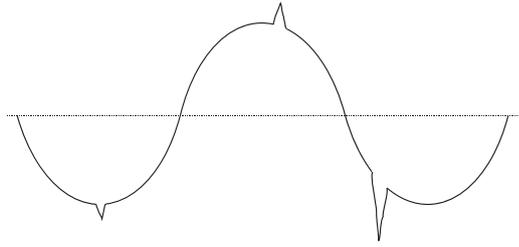
The options that the device allows are:

#### PEAK

The transient detection by the peak value, is performed when the absolute value of a voltage sample in a cycle exceeds the set value.

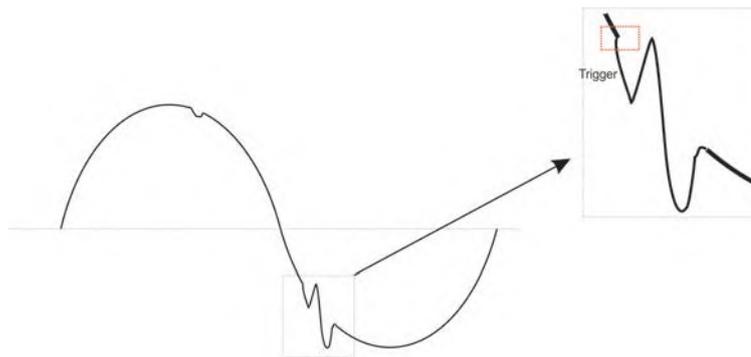
The peak value setting must correspond to the maximum value of a voltage sample we wish to detect and record.

You must configure the maximum phase to neutral value. If you do not have neutral must set the maximum value of phase-phase voltage /  $\sqrt{3}$



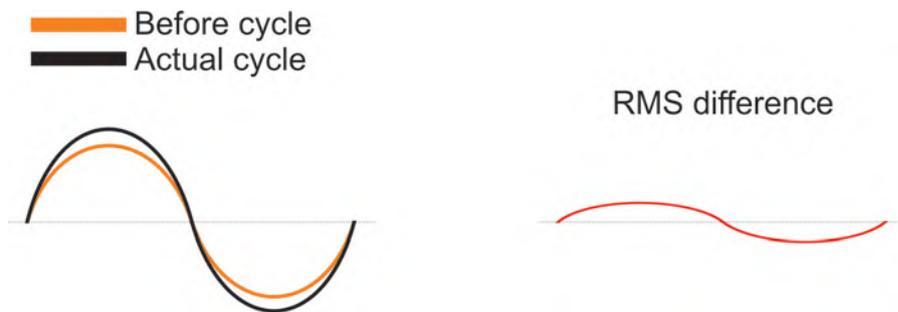
**7.1.2.5.1 WAVE**

Detection of transients by the waveform is performed when there is a defect in the waveform that exceeds the value set by the user in the *Threshold* field and longer than the % cycle duration specified in *Duration* fiel.



**7.1.2.5.2 RMS Values**

The transient detection based on the RMS values is done by comparing the RMS value of each cycle of each channel, with the previous RMS value of the same channel. If the difference exceeds the user-configured, there is a defect of the current cycle an recorded as transient.



**7.1.2.6 TRIGGER INTERVALS**

START RECORDING	
Date:	30/08/2007
Time:	08:00:00
STOP RECORDING	
Date:	30/09/2007
Time:	08:00:00

**Configurable Parameters:**

- Date and time recording is started
- Date and time recording ends.

### 7.1.2.7 PERIODIC RECORDING

START TIME:	00:00:00
STOP TIME:	00:00:00
DAYS OF WEEK TRIGGERED	
Monday:	no
Tuesday:	no
Wednesday:	no
Thursday:	no
Friday:	no
Saturday:	no
Sunday:	no

#### Configurable Parameters:

- Recording start time
- Recording end time.
- Day of the week the previous recording condition must be applied.

After configure a range of trigger interval or periodic recording should enable these settings through the enable option into ACTIONS menu.

When enabled the condition of registration, the user must press the ● (REC/STOP)

Under these conditions, the analyzer waits for the condition is satisfied to start the record showing the icon. .

### 7.1.2.8 SNAPSHOT CONDITIONS

Allows configuration of logical equations with electrical measured parameters, which will take a snapshot (instantaneous recording of all the variables measured by the analyzer, including wave shapes).



The device has a limit of 10 different photo conditions. After reaching that limit, does not allow to create any further condition.



To set the analyzer to record automatically trigger intervals, periodic recording or transients, you must press the record button ● (REC / STOP) after setting the desired conditions.

#### PHOTO CONDITION LIST

V (PN, L3) < 230 AND A (I, L123) < 65

V (PN, L1) <= 50

kW (kW+, L123) >= 500

Hz >= 45

#### Parameters displayed:

The screen displays the list of snapshot conditions created. Active snapshot conditions are shown in the colour pink.

Upon selecting the create new or edit existing condition option, the following screen is displayed, in which the user may create the trigger conditions needed and may combine them with other trigger operations using the logical functions AND or OR.

Units: <b>V</b>	<b>AND</b>	Units: <b>A</b>
Variable: <b>PN</b>		Variable: <b>I</b>
Phase: <b>L3</b>		Phase: <b>L123</b>
Comparator: <b>&lt;</b>		Comparator: <b>&lt;</b>
Value: <b>230</b>		Value: <b>65</b>

Photo condition formula built: V (PN, L3) < 230 AND A (I, L123) < 65

The snapshot conditions screen menu is:

Key	Function	Description
	BACK	Brings up the previous screen.
<b>ACTIONS</b>	<ul style="list-style-type: none"> <li>Save</li> <li>Builder</li> <li>Modify</li> <li>Remove</li> <li>Enable</li> <li>Disable</li> </ul>	This menu is used to save changes, create new conditions, enable or disable existing ones, edit ones created or delete the conditions from the list.
<b>GO TO</b>	<ul style="list-style-type: none"> <li>Transformers ratios</li> <li>Measure Setup</li> <li>Variable selection</li> <li>EVQ Setup</li> <li>Transient</li> <li>Trigger Interval</li> <li>Periodic Trigger</li> <li>Photo Conditions</li> </ul>	<ul style="list-style-type: none"> <li>• TRANSFORMATION RATIOS: Ratios of transformers used</li> <li>• MEASUREMENT CONFIGURATION: Circuit, recording time, THD calculation and Maximum Demand.</li> <li>• VARIABLE SELECTION: To select the variables to register</li> <li>• CONFIGURATION OF EVENTS: Detection of quality events *.EVQ</li> <li>• TRANSIENT: Transient detection</li> <li>• RECORDING INTERVALS: Recording period (start and stop time)</li> <li>• PERIODIC RECORDING: Repeated periodic recordings</li> <li>• SNAPSHOT CONDITIONS: Conditions for snapshot capture *.PHO</li> </ul>

### 7.1.3 Delete

Erases all files contained in the SD memory of the analyzer that may have been generated with the name of the selected measurement.

## 7.2 MEASURE ANALYSIS



Screen that shows the variables, photos or disturbances registered in each measure.

MEASURES LIST	
h2AM54cond	
hw2a_22_neutre1000	
lifasa	
monophasic33	
single-phase	
t5	
test	<input checked="" type="checkbox"/>
three-phase_4wires	

Example table

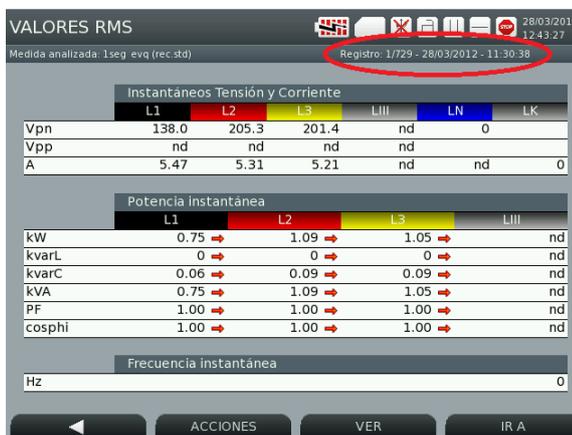
The screen displays a list of measures created on the device. Only one measure can be active. Through the gray cursor the user can scroll to the measure to analyze. In order to analyze any measure, the record should be STOP. After selecting the measure, pull down the menu to select ACTIONS.

The options on the lower menu of this screen are:

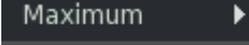
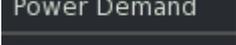
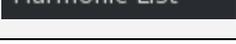
Key	Function	Description
	Home	Brings up the main menu
	<ul style="list-style-type: none"> <li>Records</li> <li>Photos</li> <li>Disturbances</li> </ul>	<ul style="list-style-type: none"> <li>Records: Displays the STD registered parameters</li> <li>Photos: Displays the Photo registered in the measure selected.</li> <li>Disturbances: Displays the disturbances detected in the measure selected.</li> </ul>

### 7.2.1 Records.

The records are displayed in the same visual screen than the instantaneous parameters. The difference is that on top of the screen displays the date and time of record time.



The options on the lower menu of this screen are:

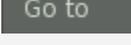
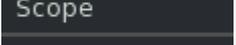
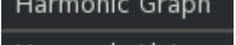
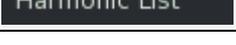
Key	Function	Description
	BACK	Brings up the previous screen.
		Allows selection of a date and time to view the recorded parameters on the screen.
	  	Allows the display to be switched between instantaneous, maximum and minimum values and between consumed and generated values.
	      	Allows selection between different display options shown in the menu. RMS Values, Quality, Energy, Maximum Demand, waveform, graph and list of harmonics.

Within each options listed, you can open the menu "Go to" to select the date and time display desired.

### 7.2.2 Photos.

The registered information of the photos is showed in the RMS instantaneous tables. In the tables are showed the instantaneous value of each variable at the moment of the photo was taken.

The options on the lower menu of this screen are:

Key	Function	Description
	BACK	Brings up the previous screen.
		Allows selection of a date and time to view the recorded parameters on the screen.
	    	Allows selection between different display options shown in the menu. RMS Values, Quality, waveform, graph and list of harmonics.

### 7.2.3 Disturbances

Disturbances recorded by the analyzer appear on the table, in which all information about each one is displayed. The information is preceded by an acknowledgement icon for each transient and its numerical information as an average voltage value, previous value, final value and duration.



**Parameters displayed:**

- Various types of disturbances detected
- The phase affected by the disturbance
- The date and time the disturbance was produced.
- The duration of the transient in milliseconds.

Network	Phase	Date	Time	ms
Sag	L1	27.12.2010	11:54:17.043	10
Interrupt	L1	27.12.2010	11:54:18.095	1520
Sag	L1	27.12.2010	11:54:18.095	10
Transient		27.12.2010	11:54:22	
Transient		27.12.2010	11:54:30	
Sag	L1	27.12.2010	11:54:34.032	10
Transient		27.12.2010	11:54:37	

On this screen, besides the wave shape, the user can see the type of transient detected, the phase affected, the date and time of occurrence, and its duration in milliseconds.

The transient screen menu is:

Key	Function	Description
	Home	Brings up the main menu

There are several types of transients that the analyzer can detect. They are identified with different icons to make them more quickly identifiable by the user. Each one corresponds to the user configuration to the snapshot capture and EVQ events recording configuration page.

OVERVOLTAGE



GAPS



CUTS



TRANSIENT

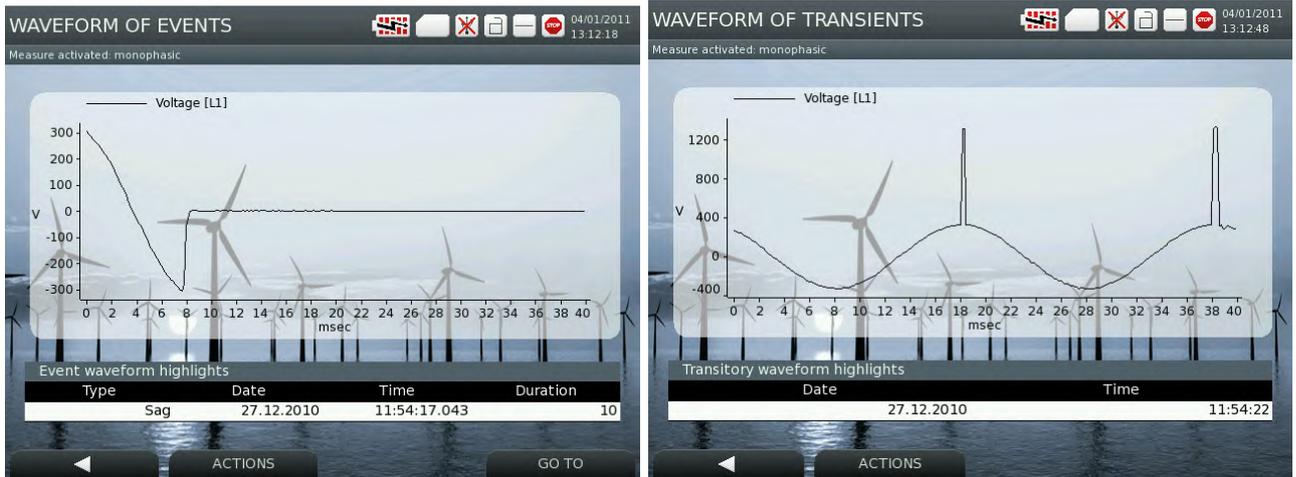


The user can move through the various transients displayed in the table by using the keys ▼/ ▲ movement keys. Once the cursor is over the desired transient, a window corresponding to the wave shape of the selected event can be accessed using the confirmation key ●.

#### 7.2.3.1 Transient wave shape

This is the graphic screen in which the wave shape of the event selected from the recorded disturbances list table is displayed.

Within this screen, as with the rest of the graphics screens, it is possible to zoom in on its different areas.

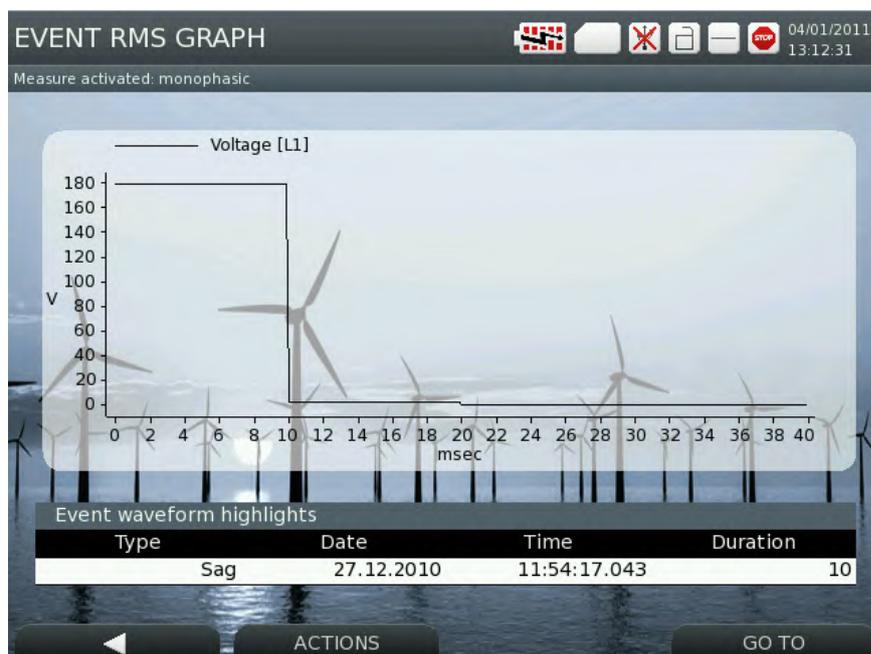


The transient graphic screen menu is:

Key	Function	Description
	BACK	Brings up the previous screen.
	Zoom in Zoom out	The selected part of the signal can be magnified using the ZOOM IN option. The ZOOM OUT option cancels the magnification of the image displayed.
	Waveform Event RMS Event	Allows the selected transient display to be switched between wave shape and RMS graphic and vice versa.

### 7.2.3.2 Transient RMS graphic

Likewise, it is possible to see the RMS values of the selected event in graphic form.



The transient RMS graphic screen is:

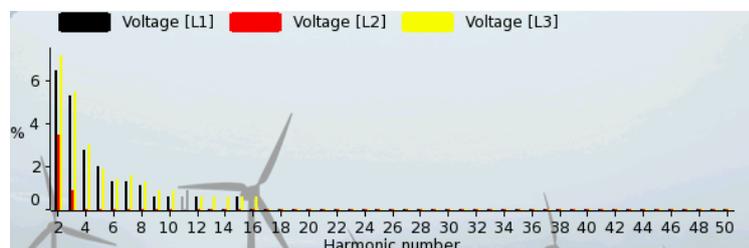
Key	Function	Description
	BACK	Brings up the previous screen.
	Zoom in Zoom out	The selected part of the signal can be magnified using the ZOOM IN option. The ZOOM OUT option cancels the magnification of the image displayed.
	Waveform Event RMS Event	Allows the selected transient display to be switched between wave shape and RMS graphic and vice versa.

### 7.3 HARMONICS



This screen allows display of the harmonics of the measured signal in graphic form, which permits the harmonic that most distorts the signal to be seen.

You may also move through the spectrum using the ◀/ ▶ keys in order to select the various harmonics. Selecting a harmonic changes it to dark grey and its values are displayed in the table on the lower portion of the screen.



**Parameters displayed:**

- Harmonic distortion.
- THD according to selection
- THD of even harmonics
- THD of odd harmonics
- Base
- Base %.

	VOLTAGE SELECTED HARMONIC		
	L1	L2	L3
THD-V [%]	9.4	3.6	10.3
THD-V even [%]	7.3	3.5	8.1
THD-V odd [%]	5.9	0.9	6.3
Fundamental	154.9	156.2	155.2
Harmonic selected [%]: 11	0.6	0	0.9

The options on the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
	Photo Pause Run	Allows "freezing" of the variable values on the screen with the "Pause" function or seeing instantaneous values again. With the snapshot option, all instantaneous values measured by the analyzer are captured along with the voltage and current wave shapes.

<p><b>VIEW</b></p>		<p>Allows voltage and current displays to be selected and viewed individually.</p>
<p><b>GO TO</b></p>		<p>Allows the graphic display of harmonics to be changed to table format and the harmonics to be displayed in graphic form.</p>

The values can reference voltage or current values, and the “L1, L2, L3, LIII, LN” phase or phases can be selected using the VIEW option. The representation of the harmonics measured and the table with their values is always displayed in real time, but the display may be stopped using the pause option of the ACTIONS menu. The Play option displays it in real time again.

Besides displaying the harmonics in graphic form, they may also be displayed in table form using the Harmonics List option from the GO TO option. The harmonics table from grade 2 up to grade 50 is displayed in the upper table. The user may select a specific harmonic by moving the cursor over it.

The values of the specific harmonic selected in the upper table are displayed in the lower table.

	L1	L2	L3
Harmonic 2	41.0	79.0	58.0
Harmonic 3	15.0	48.0	12.0
Harmonic 4	11.0	30.0	23.0
Harmonic 5	6.0	16.0	12.0
Harmonic 6	9.0	20.0	11.0
Harmonic 7	6.0	16.0	6.0
Harmonic 8	0	15.0	6.0
Harmonic 9	6.0	11.0	6.0

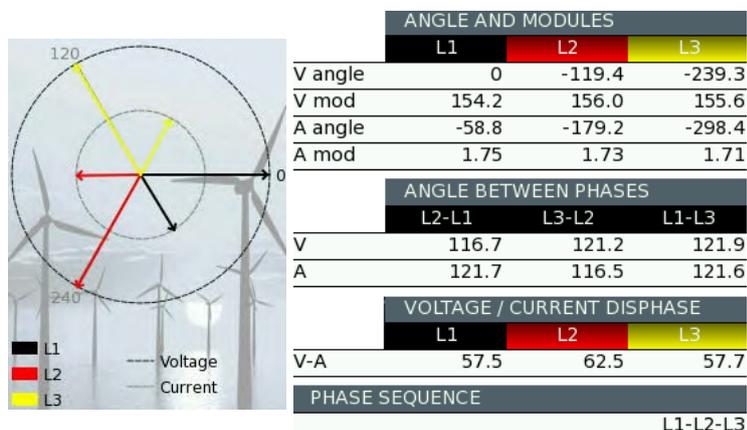
VOLTAGE SELECTED HARMONIC			
	L1	L2	L3
THD-V [%]	4.7	10.7	6.8
THD-V even [%]	4.3	9.0	6.4
THD-V odd [%]	1.9	5.7	2.1
Fundamental	160.4	147.5	159.8
Harmonic selected [%]	6.0	16.0	12.0

The menu for this screen is identical to that of the harmonics graphic screen.

## 7.4 PHASORS



The screen displays a phase representation of the voltage and current. “U” and “I” of each phase and phase angle between phases.



### Parameters displayed:

- Phasors of “U” and “I”
- Angle and value of the “U” and “I” module
- Phase angle of “U” and “I” between phases L1-L2, L2-L3 and L1-L3
- Phase angle between “U” and “I” by phase.
- Phase sequence.

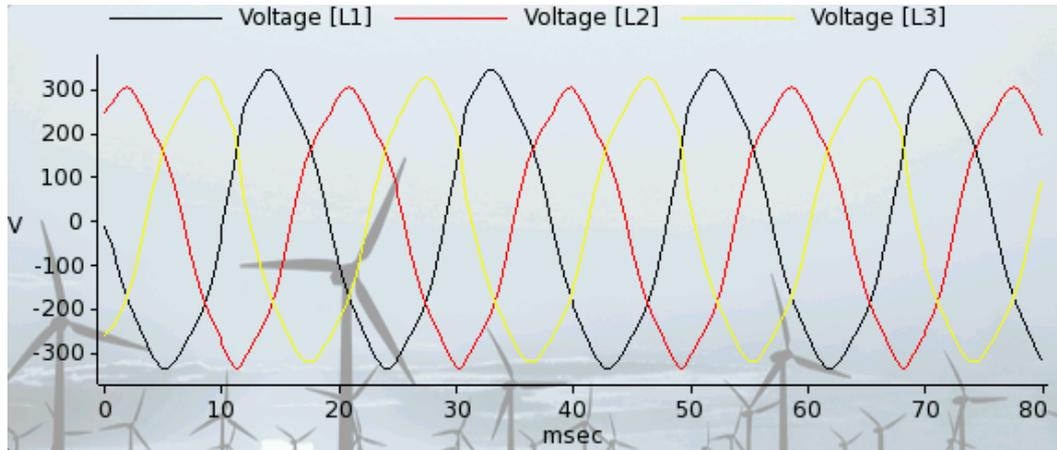
The options on the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
	  	Allows "freezing" of the variable values on the screen with the "Pause" function or seeing instantaneous values again. With the snapshot option, all instantaneous values measured by the analyzer are captured along with the voltage and current wave shapes.
	   	Allows selection among L1, L2, L3 in order to display them individually or simultaneously

### 7.5 WAVEFORM



The WAVE SHAPES screen graphically displays the voltage and current signals “U”, “I” or “VI” from L1, L2, L3, LIII or LN



Instantaneous Voltage and/or Current			
	L1	L2	L3
Vpn	230.6	222.2	232.4
Vpp	388.0	390.6	407.6
A			

The options on the lower menu of this screen are:

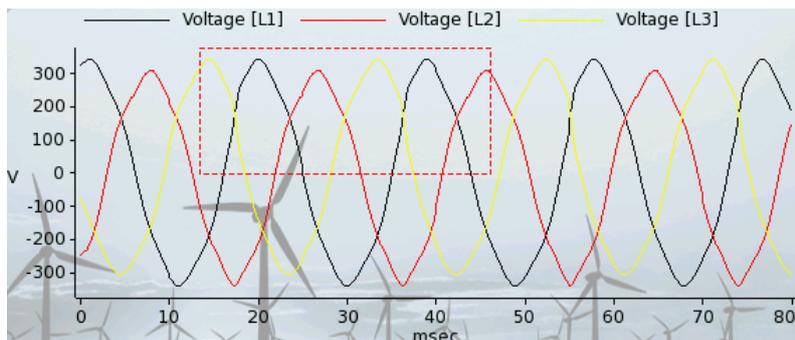
Key	Function	Description
	Home	Brings up the main menu
	<ul style="list-style-type: none"> <li>Photo</li> <li>Pause</li> <li>Run</li> <li>Zoom in</li> <li>Zoom out</li> </ul>	The image may be "frozen" using Pause. When paused, the selected part of the signal can be magnified using the ZOOM IN option. The ZOOM OUT option cancels the magnification of the image displayed. The Play option returns the display of values to real time.
	<ul style="list-style-type: none"> <li>L1</li> <li>L2</li> <li>Voltage ▶ L3</li> <li>Current ▶ L123</li> <li>Voltage Current ▶ LN</li> <li>LK</li> </ul>	Allows selection among L1, L2, L3, L123 or LN phases in order to display the wave shapes individually.

### 7.5.1 Zoom

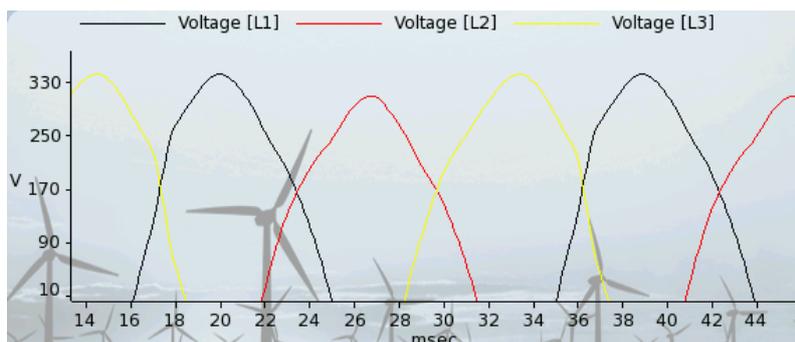
The analyzer allows magnification of the image on the wave shapes screen. In order to do this, the image must be paused. Use the ▼/ ▲ buttons to move the cursor to the "Pause" option of the ACTIONS menu.

Then select Zoom Image, and a white box with a dashed border appears on the graphics screen. This is the zoom area.

Use the ◀/ ▶ and ▼/ ▲ buttons to move the box to the desired area. Using the ● button the position of the box is confirmed and changes to the colour red.



Once the position is locked, the size of the selection box may be changed using the ◀/ ▶ and ▼/ ▲ buttons. To run zoom, press ●.



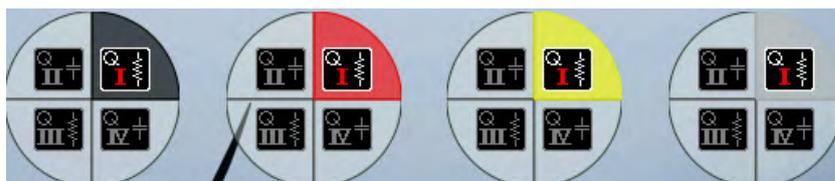
Once pressed, the selected area is magnified. Use the ◀/ ▶ and ▼/ ▲ keys to select Zoom Out and press ● to undo the zoom

### 7.6 QUADRANTS

Besides the power quadrants, the power values of each one of the phases and the total power are displayed.

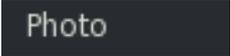
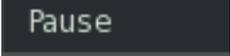


- Active power *kW*
- Inductive reactive power *kvarL*
- Capacitive reactive power *kvarC*
- Power factor *PF*
- Cos phi *Cos φ*



	POWER			
	L1	L2	L3	L123
kW	0.34	0.28	0.27	0.89
kvarL	0	0	0	0
kvarC	0.46	0.47	0.47	1.41
kVA	0.60	0.58	0.57	1.75
PF	0.56	0.48	0.48	0.51
cosphi	0.59	0.50	0.51	0.53

The options of the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
	  	Allows "freezing" of the variable values on the screen with the "Pause" function or display of instantaneous values again. With the snapshot option, all instantaneous values measured by the analyzer are captured along with the voltage and current wave shapes.

## 7.7 CONFIGURATION



The setup menu allows the user to configure the parameters of the analyzer that affect recording and display of the measured and calculated parameters. The menu comprises two screens:

- The desired date and time format screen
- The variables decimal configuration screen.

### 7.7.1 BIOS Configuration

The BIOS screen allows configuration of the most important aspects of the equipment. This configuration is kept in all screens and recordings.



#### 7.7.1.1 Language

The language desired for the equipment menus and messages is defined using this field.

#### 7.7.1.2 Time to switch off the display

Enter the time desired in minutes, during which the screen will remain on. At the end of this time the screen will switch off and pass into sleep mode in order to extend the analyzer battery time. In this state, the Power key will flash green

#### 7.7.1.3 Contrast

In this field you must enter the % contrast required by the user for proper display visualization. Proper setting allows extend the autonomy of the analyzer.

#### 7.7.1.4 Time to lock keyboard

Enter a time desired, in minutes, after which the keyboard will lock or, if this function is not desired, a zero (0) value must be entered in this field.

#### 7.7.1.5 Password

Enter a 4-digit password for unlocking the equipment keyboard after the time configured in the lock delay field has passed.

#### 7.7.1.6 Phase colours

The AR6 has some phase colour presets configured, so the user may very easily define the colours desired for each one of them. The names of the configured options, and the corresponding colours of each one of them, is shown in the following table:

	L1 / A	L2 / B	L3 / C	LN / N	LK / K	earth
EU	black	red	yellow	blue	grey	green
UK	red	yellow	blue	black	grey	green
CA	red	black	blue	White	grey	green
USA	black	red	blue	white	grey	green

#### 7.7.1.7 Screen background

The user can change the screen background using the options of this menu. The background selected will be that which the equipment will have on all configuration and display screens.

The options on the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
	 	Allows changes made to the configuration of the analyzer to be saved or the initial values to be restored.

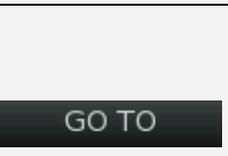
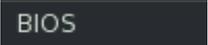
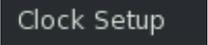
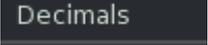
#### 7.7.2 Clock configuration

Formato de fecha:	dd/MM/yyyy
Fecha:	15/10/2010
Formato de hora:	HH:mm:ss
Hora:	08:58:22

#### **Displayed parameters:**

Allows configuration of the equipment date format and entering the current date. Likewise, allows configuration of the time format and entering the local time.

The options on the lower menu of this screen are:

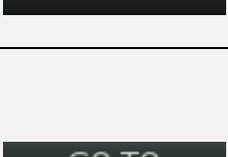
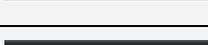
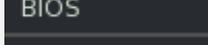
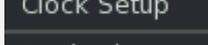
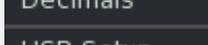
Key	Function	Description
	Home	Brings up the main menu
		Allows changes made to the configuration to be applied.
	   	Allows the screen to be changed between the clock configuration and the decimal configuration.

### 7.7.3 Decimals

<p>Voltage: <b>V</b> Decimals: 1</p> <p>Frequency: Hz Decimals: 2</p> <p>Current: A Decimals: 2</p> <p>Harmonic: % Decimals: 1</p> <p>Distortion: % Decimals: 1</p>	<p>Active Power: kW Decimals: 2</p> <p>Apparent Power: kVA Decimals: 2</p> <p>Capacitive Power: kvarC Decimals: 2</p> <p>Inductive Power: kvarL Decimals: 2</p> <p>PF: PF Decimals: 2</p> <p>Cos(phi): cosphi Decimals: 2</p>	<p>Active Energy: kWh Decimals: 2</p> <p>Apparent Energy: kVAh Decimals: 2</p> <p>Capacitive Energy: varCh Decimals: 2</p> <p>Inductive Energy: kvarLh Decimals: 2</p>	<p>The units of measure as well as the number of decimals may be selected using this adjustment screen.</p>
---	---	--	---

**NOTE:** Note that in the harmonic option is selectable between % (to see the percentage of each harmonic over the fundamental) or V/I (to see the voltage or current value that represents by each harmonic)

The options on the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
		Allows changes made to the configuration to be applied.
	   	Allows the screen to be changed between the BIOS, clock configuration, decimal configuration variables and the USB communication port.

#### 7.7.4 Secure access to memory

The unit has an internal memory card which stores data and configurations parameters of the different measures created by the user. For secure access to the information of the internal memory should proceed as follows:

1. Enable USB-B port on the analyzer from the USB Setup menu (**The USB has to be activated and in file mode**)
2. Connect the USB cable between the PC and the analyzer
3. Access from your computer to the memory information.
4. Unplug / eject safely from the computer the analyzer disk drive.
5. Disconnect the USB wire
6. Disconnect the USB-B port of the analyzer (from USB Setup menu)  
*\* The device disconnects the file mode automatically when you leave this screen.*



Do not remove safely the memory unit of the analyzer from the computer, can cause irreparable damage to the information contained in the internal memory or lock the device until you restart again.

## 7.8 SYSTEM INFORMATION



The screen shows a summary of the most relevant information of the equipment, information such as serial number, memory status and internal firmware versions.

Serial number:	1031234567 (Rev.2)
Upgrade version:	upgrade-2.5.5
GUI version:	2.2.4-0
GUI language version:	2.3.3-0
DSP version:	2.0.2.16
PWS version:	2.0.2.02
Linux version:	2.6.35-3
Battery level:	65 %
SD Mbytes:	3766.00 MB (3763.91MB free)

### **Displayed parameters:**

- Analyzer serial number
- Upgrade version installed
- Microprocessor versions (GUI, DSP and PWS)and languages.
- Software version (Linux)
- Battery charge level
- Total and available system memory

The options on the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
<b>ACTIONS</b>	<ul style="list-style-type: none"> <li>Upgrade</li> <li>Format SD</li> </ul>	To start the update process or format the SD expansion card

### 7.8.1 Upgrade

When “Update” is selected the analyzer starts the file transfer \*.bin of the new firmware to save on the device. The upgrade process shows a status bar at the analyzer screen.

### 7.8.2 Format SD

The analyzer performs some actions to restore the factory settings of the memory card and internal memory. The actions performed by the analyzer are:

- Delete SD memory card partitions
- Generate new partitions
- Format the card to FAT32
- Restore the internal memory.

## 7.9 MEASURE



Measured parameters may be displayed on different screens in table format.

- RMS values screen.
- Network quality values screen.
- Energy screen.
- Power maximum demand screen.

### 7.9.1 RMS screen

On this screen the effective RMS values of the basic electrical parameters are displayed. There are three basic display modes: instantaneous, Maximums and Minimums

### 7.9.2 Instantaneous Screen

Displays the RMS values of electrical parameters. Power consumed is indicated with a red arrow  $\rightarrow$  and power generated by a green arrow  $\leftarrow$ .

Instantaneous Voltage and Current						
	L1	L2	L3	L123	LN	LK
Vpn	230.9	222.3	232.0	228.4	0	
Vpp	388.8	390.2	407.5	395.5		
A	2.61	2.59	2.44	2.55	0	0

Instantaneous Power				
	L1	L2	L3	L123
kW	0.34 $\rightarrow$	0.28 $\rightarrow$	0.27 $\rightarrow$	0.89 $\rightarrow$
kvarL	0.46 $\rightarrow$	0.47 $\rightarrow$	0.47 $\rightarrow$	1.41 $\rightarrow$
kvarC	0 $\rightarrow$	0 $\rightarrow$	0 $\rightarrow$	0 $\rightarrow$
kVA	0.60 $\rightarrow$	0.58 $\rightarrow$	0.57 $\rightarrow$	1.75 $\rightarrow$
PF	0.56 $\rightarrow$	0.48 $\rightarrow$	0.48 $\rightarrow$	0.51 $\rightarrow$
cosphi	0.59 $\rightarrow$	0.50 $\rightarrow$	0.51 $\rightarrow$	0.53 $\rightarrow$

Instantaneous frequency	
Hz	0

#### Displayed parameters:

- Phase-neutral voltage
- Phase-phase voltage
- A current
- Active power kW
- Reactive power, kvarL
- Reactive power, kvarC
- Apparent power, kVA
- Power factor, PF
- Cos phi angle  $\varphi$
- Frequency

The options on the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
	<ul style="list-style-type: none"> <li>Photo</li> <li>Pause</li> <li>Run</li> <li>Reset Maximum</li> <li>Reset minimum</li> </ul>	Allows "freezing" of the variable values on the screen with the "Pause" function. With the snapshot, all instantaneous values measured by the analyzer are captured along with the voltage and current wave shapes. This SNAPSHOT is recorded in a .PHO file on the SD card with the name of the active measurement. Allows maximum values to be deleted and minimum values to be stored.
	<ul style="list-style-type: none"> <li>Maximum <math>\rightarrow</math></li> <li>Minimum <math>\rightarrow</math></li> <li>Instantaneous</li> </ul>	Allows the display to be switched between instantaneous, maximum and minimum values and between consumed and generated values.
	<ul style="list-style-type: none"> <li>RMS Values</li> <li>Quality</li> <li>Energy</li> <li>Power Demand</li> </ul>	Displays the electrical parameters calculated with respect to the network quality, power demand, energy consumed or generated and RMS instantaneous values.

### 7.9.3 Maximum / Minimum screen

Displays the maximum or minimum values (according to selection) of the basic electrical parameters. Through  $\nabla / \blacktriangle$  is possible display the value, date and time when the maximum

or minimum occurs and indicates power consumed with a red arrow → and power generated with a green arrow ←.

Maximums Voltage and Current						
	L1	L2	L3	L123	LN	LK
Vpn	230.6	222.1	232.4	228.4	0	
Vpp	388.1	390.5	407.7	395.4		
A	2.61	2.59	2.44	2.55	0	0

Maximum Power Consumed				
	L1	L2	L3	L123
kW	0.34 →	0.27 →	0.28 →	0.89 →
kvarL	0.46 →	0.47 →	0.47 →	1.41 →
kvarC	0 →	0 →	0 →	0 →
kVA	0.60 →	0.57 →	0.57 →	1.75 →
PF	0.56 →	0.48 →	0.49 →	0.51 →
cosphi	0.59 →	0.50 →	0.51 →	0.53 →

Maximum frequency	
Hz	0

**Displayed parameters:**

- Phase-neutral voltage
- Phase-phase voltage
- A current
- Active power kW
- Reactive power, kvarL
- Reactive power, kvarC
- Apparent power, kVA
- Power factor, PF
- Cos phi angle  $\varphi$
- Frequency

The options on the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
	<ul style="list-style-type: none"> <li>Photo</li> <li>Pause</li> <li>Run</li> <li>Reset Maximum</li> <li>Reset minimum</li> </ul>	Allows "freezing" of the variable values on the screen with the "Pause" function. With the snapshot, all instantaneous values measured by the analyzer are captured along with the voltage and current wave shapes. This SNAPSHOT is recorded in a .PHO file on the SD card with the name of the active meter. Allows maximum values to be deleted and minimum values to be stored.
	<ul style="list-style-type: none"> <li>Maximum ▶</li> <li>Minimum ▶</li> <li>Instantaneous</li> </ul>	Allows the display to be switched between instantaneous, maximum and minimum values and between consumed and generated values.
	<ul style="list-style-type: none"> <li>RMS Values</li> <li>Quality</li> <li>Energy</li> <li>Power Demand</li> </ul>	Displays the electrical parameters calculated with respect to the network quality, power demand, energy consumed or generated and RMS instantaneous values.

**7.9.4 Quality Screen**

On this screen the parameters most relevant to the quality of the measured network are displayed

**7.9.5 Instantaneous Screen**

Displays the RMS values of the basic electrical parameters with respect to network quality.

Quality Instantaneous values				
	L1	L2	L3	LN
Inst Flicker [WA]	58.8	60.9	58.3	
Flicker PST [%]	35.5	35.5	35.5	
Crest Factor	1.43	1.48	1.42	
K Factor	1.30	1.15	1.01	
THD-V [%]	7.9	4.5	10.9	0
THD-V even [%]	6.3	4.2	8.7	0
THD-V odd [%]	4.8	1.6	6.5	0
THD-A [%]	11.0	8.1	5.3	0
THD-A even [%]	8.8	6.5	4.6	0
THD-A odd [%]	6.6	4.9	2.6	0

Unbalanced and Assymetry Instantaneous values			
	Kd	Ka	
V [%]		3.9	0.3
A [%]		4.4	0.2

**Displayed parameters:**

- Instantaneous flicker (WA)
- PST Flicker
- Crest factor
- K-Factor
- THD V, THD V odd, THD V even
- THD A, THD A odd, THD A even
- Imbalance V, A
- Asymmetry V, A

The options on the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
	<ul style="list-style-type: none"> <li>Photo</li> <li>Pause</li> <li>Run</li> <li>Reset Maximum</li> <li>Reset minimum</li> </ul>	Allows "freezing" of the variable values on the screen with the "Pause" function. With the snapshot, all instantaneous values measured by the analyzer are captured along with the voltage and current wave shapes. This SNAPSHOT is recorded in a .PHO file on the SD card with the name of the active meter. Allows maximum values to be deleted and minimum values to be stored.
	<ul style="list-style-type: none"> <li>Maximum</li> <li>Minimum</li> <li>Instantaneous</li> </ul>	Allows the display to be switched between instantaneous, maximum and minimum values and between consumed and generated values.
	<ul style="list-style-type: none"> <li>RMS Values</li> <li>Quality</li> <li>Energy</li> <li>Power Demand</li> </ul>	Displays the electrical parameters calculated with respect to the network quality, power demand, energy consumed or generated and RMS instantaneous values.

**7.9.6 Maximums or minimums screen**

Displays the minimum or maximum values (according to selection) of the described quality parameters. Cycles through a display of the value, date and time when the maximum or minimum were produced.

The options on the lower menus of this screen are the same as those of the quality instantaneous values screen.

**7.9.7 Energy Screen**

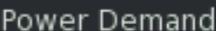
On this screen instantaneous energy consumed and/or generated since the last reset is displayed. Energy consumed is displayed with a red arrow → and energy generated with a green arrow ←.

**Displayed parameters:**

TOTAL ENERGY			
	CONSUMED		GENERATED
kWh	6.28 →		0
kvarCh	0.46 →		0
kvarLh	9.88 →		0
kVAh	10.47 →		0

- Consumed and Generated Active energy, kW h
- Consumed and Generated capacitive reactive energy, KvarL h
- Consumed and Generated inductive reactive energy, KvarL h
- Consumed and Generated apparent energy, kvah

The options on the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
	   	Allows "freezing" of the variable values on the screen with the "Pause" function. With the snapshot, all instantaneous values measured by the analyzer are captured along with the voltage and current wave shapes. Allows the value of cumulative energy to be reset.
	   	Displays the electrical parameters calculated with respect to the network quality, power demand, energy consumed or generated and RMS instantaneous values.

**7.9.8 Maximum Demand Screen**

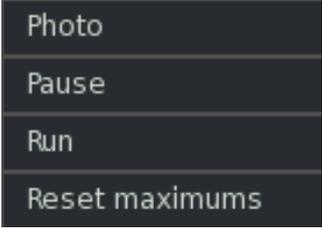
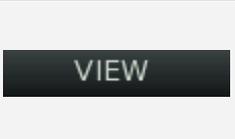
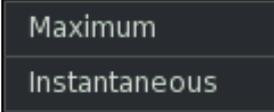
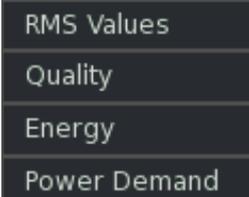
On this screen the maximum energy demand or instantaneous values are measured.

**Displayed parameters:**

Instantaneous values of Power Demand				
	L1	L2	L3	L123
kW				0
kVA				0
A	0	0	0	0

- Total active power [kW] of LIII
- Total apparent power [kVA] of LIII
- Total current by phase [A] of LIII, L1, L2, L3.

The options on the lower menu of this screen are:

Key	Function	Description
	Home	Brings up the main menu
		Allows "freezing" of the variable values on the screen with the "Pause" function. With the snapshot, all instantaneous values measured by the analyzer are captured along with the voltage and current wave shapes. Allows the stored maximum value to be deleted.
		Allows the display to be switched between instantaneous values and the maximums.
		Displays the electrical parameters calculated with respect to the network quality, power demand, energy consumed or generated and RMS instantaneous values.

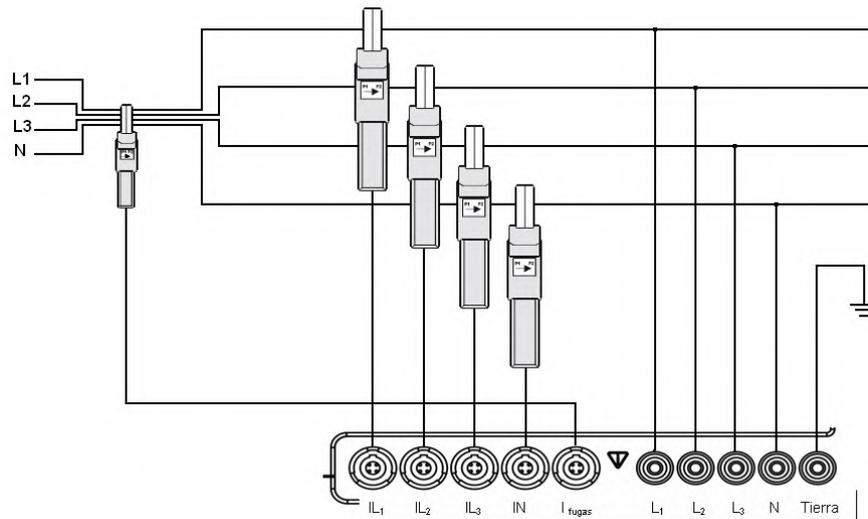
## 8 CONNECTION DIAGRAMS



*“For connections requiring connection of the ground wire, the menu option of the corresponding active measurement must be correctly configured”*

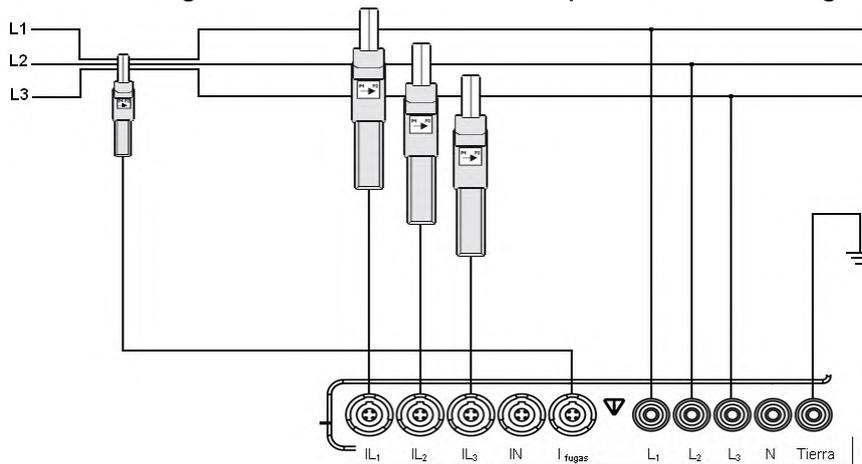
### 8.1 THREE-PHASE CONNECTION WITH NEUTRAL

Measurement of the voltage and current of the three phases and the neutral, voltage between neutral and ground, and leakage current.



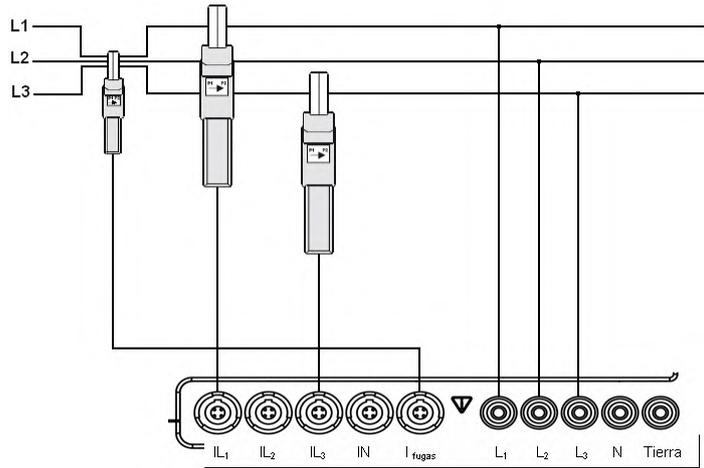
### 8.2 THREE-PHASE CONNECTION WITHOUT NEUTRAL

Measurement of the voltage and current of the three phases and leakage current.



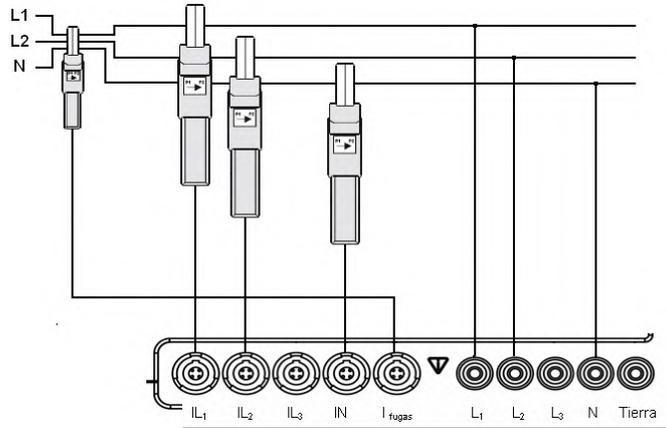
### 8.3 ARON THREE-PHASE CONNECTION

Measurement of the voltage of the three phases. Measurement of the phase current L1-L3 and calculation of current from L2. Measurement of leakage current.



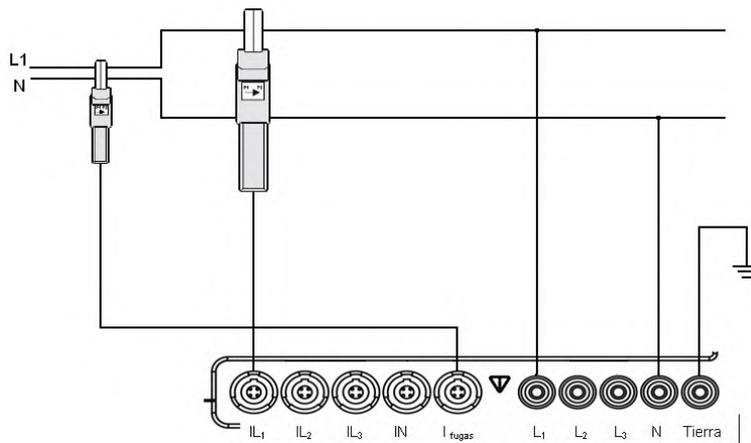
### 8.4 TWO-PHASE CONNECTION

Measurement of voltage and current between the two phases and leakage current.



### 8.5 SINGLE-PHASE CONNECTION

Measurement of the voltage and current between phase and neutral, voltage between neutral and earth and leakage current.



## 8.6 ELECTRICAL PARAMETERS ACCORDING TO CONNECTION

THREE-PHASE CONNECTION 4 WIRES								
Display Variables	L1	L2	L3	LN	LIII	LK	Max	Min
Phase-Neutral Voltage	X	X	X	X	X		X	X
Phase-Phase Voltage	X	X	X		X		X	X
Current	X	X	X	X	X	X	X	X
Consumed Active Power	X	X	X		X		X	X
Consumed Inductive Power	X	X	X		X		X	X
Consumed Capacitive Power	X	X	X		X		X	X
Consumed Apparent Power	X	X	X		X		X	X
Consumed Power Factor (*)	X	X	X		X		X	X
Consumed Cos Phi (*)	X	X	X		X		X	X
Generated Active Power	X	X	X		X		X	X
Generated Inductive Power	X	X	X		X		X	X
Generated Capacitive Power	X	X	X		X		X	X
Generated Apparent Power	X	X	X		X		X	X
Generated Power Factor (*)	X	X	X		X		X	X
Generated Cos Phi (*)	X	X	X		X		X	X
Crest factor	X	X	X				X	X
K - Factor	X	X	X				X	X
THD Voltage	X	X	X	X			X	X
THD Voltage even	X	X	X	X			X	X
THD Voltage odd	X	X	X	X			X	X
THD Current	X	X	X	X			X	X
THD Current even	X	X	X	X			X	X
THD Current odd	X	X	X	X			X	X
WA Inst. Flicker	X	X	X	X				
PST Flicker	X	X	X	X				
Frequency	X						X	X
Voltage Imbalance					X		X	X
Voltage Asymmetry					X		X	X
Current Imbalance					X		X	X
Current Asymmetry					X		X	X
Voltage Harmonics (1-50)	X	X	X	X				
Current Harmonics (1-50)	X	X	X	X				
Active Power Maximum Demand					X		X	
Apparent Power Maximum Demand					X		X	
Average Currents Maximum Demand					X		X	
Currents L1, L2, L3 Maximum Demand	X	X	X				X	
Consumed Active energy					X			
Consumed Inductive Energy					X			
Consumed Capacitive Energy					X			
Consumed Apparent Energy					X			
Generated Active energy					X			
Generated Inductive Energy					X			
Generated Capacitive Energy					X			
Generated Apparent Energy					X			
Wave shapes	X	X	X	X	X	X		
Phasor representation	X	X	X	X	X	X		

(\*) The Cos and Power Factor angle are by default = 1 when there is no measure for the calculation

THREE-PHASE CONNECTION 3 WIRES / ARON THREE-PHASE 3 WIRES								
Display Variables	L1	L2	L3	LN	LIII	LK	Max	Min
Phase-Neutral Voltage								
Phase-Phase Voltage	X	X	X		X		X	X
Current	X	X	X		X	X	X	X
Consumed Active Power	X	X	X		X		X	X
Consumed Inductive Power	X	X	X		X		X	X
Consumed Capacitive Power	X	X	X		X		X	X
Consumed Apparent Power	X	X	X		X		X	X
Consumed Power Factor (*)	X	X	X		X		X	X
Consumed Cos Phi (*)	X	X	X		X		X	X
Generated Active Power	X	X	X		X		X	X
Generated Inductive Power	X	X	X		X		X	X
Generated Capacitive Power	X	X	X		X		X	X
Generated Apparent Power	X	X	X		X		X	X
Generated Power Factor (*)	X	X	X		X		X	X
Generated Cos Phi (*)	X	X	X		X		X	X
Crest factor	X	X	X				X	X
K - Factor	X	X	X				X	X
THD Voltage	X	X	X				X	X
THD Voltage even	X	X	X				X	X
THD Voltage odd	X	X	X				X	X
THD Current	X	X	X				X	X
THD Current even	X	X	X				X	X
THD Current odd	X	X	X				X	X
WA Inst. Flicker	X	X	X					
PST Flicker	X	X	X					
Frequency	X						X	X
Voltage Imbalance					X		X	X
Voltage Asymmetry					X		X	X
Current Imbalance					X		X	X
Current Asymmetry					X		X	X
Voltage Harmonics (1-50)	X	X	X					
Current Harmonics (1-50)	X	X	X					
Active Power Maximum Demand					X		X	
Apparent Power Maximum Demand					X		X	
Average Currents Maximum Demand					X		X	
Currents L1, L2, L3 Maximum Demand	X	X	X				X	
Consumed Active Energy					X			
Consumed Inductive Energy					X			
Consumed Capacitive Energy					X			
Consumed Apparent Energy					X			
Generated Active Energy					X			
Generated Inductive Energy					X			
Generated Capacitive Energy					X			
Generated Apparent Energy					X			
Wave shapes	X	X	X		X	X		
Phasor representation	X	X	X		X	X		

(\*) The Cos and Power Factor angle are by default = 1 when there is no measure for the calculation

<b>TWO-PHASE CONNECTION</b>								
<b>Display Variables</b>	<b>L1</b>	<b>L2</b>	<b>L3</b>	<b>LN</b>	<b>LIII</b>	<b>LK</b>	<b>Max</b>	<b>Min</b>
Phase-Neutral Voltage	X	X		X	X		X	X
Phase-Phase Voltage	X				X		X	X
Current	X	X		X	X	X	X	X
Consumed Active Power	X	X			X		X	X
Consumed Inductive Power	X	X			X		X	X
Consumed Capacitive Power	X	X			X		X	X
Consumed Apparent Power	X	X			X		X	X
Consumed Power Factor (*)	X	X			X		X	X
Consumed Cos Phi (*)	X	X			X		X	X
Generated Active Power	X	X			X		X	X
Generated Inductive Power	X	X			X		X	X
Generated Capacitive Power	X	X			X		X	X
Generated Apparent Power	X	X			X		X	X
Generated Power Factor (*)	X	X			X		X	X
Generated Cos Phi (*)	X	X			X		X	X
Crest factor	X	X					X	X
K - Factor	X	X					X	X
THD Voltage	X	X		X			X	X
THD Voltage even	X	X		X			X	X
THD Voltage odd	X	X		X			X	X
THD Current	X	X		X			X	X
THD Current even	X	X		X			X	X
THD Current odd	X	X		X			X	X
WA Inst. Flicker	X	X		X				
PST Flicker	X	X		X				
Frequency	X						X	X
Voltage Imbalance					X		X	X
Voltage Asymmetry					X		X	X
Current Imbalance					X		X	X
Current Asymmetry					X		X	X
Voltage Harmonics (1-50)	X	X		X				
Current Harmonics (1-50)	X	X		X				
Active Power Maximum Demand					X		X	
Apparent Power Maximum Demand					X		X	
Average Currents Maximum Demand					X		X	
Currents L1, L2, L3 Maximum Demand	X	X					X	
Consumed Active Energy					X			
Consumed Inductive Energy					X			
Consumed Capacitive Energy					X			
Consumed Apparent Energy					X			
Generated Active Energy					X			
Generated Inductive Energy					X			
Generated Capacitive Energy					X			
Generated Apparent Energy					X			
Wave shapes	X	X		X	X	X		
Phasor representation	X	X		X	X	X		

(\*) The Cos and Power Factor angle are by default = 1 when there is no measure for the calculation

SINGLE-PHASE CONNECTION								
Display Variables	L1	L2	L3	LN	LIII	LK	Max	Min
Phase-Neutral Voltage	X			X			X	X
Phase-Phase Voltage								
Current	X			X	X	X	X	X
Consumed Active Power	X				X		X	X
Consumed Inductive Power	X				X		X	X
Consumed Capacitive Power	X				X		X	X
Consumed Apparent Power	X				X		X	X
Consumed Power Factor (*)	X				X		X	X
Consumed Cos Phi (*)	X				X		X	X
Generated Active Power	X				X		X	X
Generated Inductive Power	X				X		X	X
Generated Capacitive Power	X				X		X	X
Generated Apparent Power	X				X		X	X
Generated Power Factor (*)	X				X		X	X
Generated Cos Phi (*)	X				X		X	X
Crest factor	X						X	X
K - Factor	X						X	X
THD Voltage	X			X			X	X
THD Voltage even	X			X			X	X
THD Voltage odd	X			X			X	X
THD Current	X			X			X	X
THD Current even	X			X			X	X
THD Current odd	X			X			X	X
WA Inst. Flicker	X			X				
PST Flicker	X			X				
Frequency	X						X	X
Voltage Imbalance					X		X	X
Voltage Asymmetry					X		X	X
Current Imbalance					X		X	X
Current Asymmetry					X		X	X
Voltage Harmonics (1-50)	X			X				
Current Harmonics (1-50)	X			X				
Active Power Maximum Demand					X		X	
Apparent Power Maximum Demand					X		X	
Average Currents Maximum Demand					X		X	
Currents L1, L2, L3 Maximum Demand	X						X	
Consumed Active Energy					X			
Consumed Inductive Energy					X			
Consumed Capacitive Energy					X			
Consumed Apparent Energy					X			
Generated Active Energy					X			
Generated Inductive Energy					X			
Generated Capacitive Energy					X			
Generated Apparent Energy					X			
Wave shapes	X			X	X	X		
Phasor representation	X			X	X	X		

(\*) The Cos and Power Factor angle are by default = 1 when there is no measure for the calculation

## 9 SCREEN INFORMATION

Information about the analyzer screen and location of the various icons that appear on the upper bar of the analyzer menu are described below. Some icons change status based on programming, recording, memory or battery conditions.

### 9.1 UPPER ICONS

The icons on the upper menu of the screen indicate the status of the equipment on all screens. The location of each one of them on the screen is shown in the figure.



#### 9.1.1 Battery charge



The equipment is battery powered and warns when the charge level drops to critical. The user must immediately connect the auxiliary power supply.



This icon indicates to the user that the equipment is powered by the battery and also reports its charge status.



This icon indicates to the user that the equipment is powered by the auxiliary power supply and that the battery is in the process of charging.

#### 9.1.2 Keyboard lock



Indicates that the equipment does not have keyboard password protection enabled



Indicates that the equipment is locked with a password to prevent other users from changing its configuration.

### 9.1.3 Phases connection



Indicates that the analyzer is well connected.



Indicates that the analyzer is bad connected.

### 9.1.4 Event detection



Indicates that the analyzer is not detecting any event or transient based on the configuration established by the user.



Indicates that the equipment is detecting an event at the moment, based on the configuration established by the user.

### 9.1.5 Recording status



Indicates to the user that the analyzer is in display mode. This icon allows the equipment configuration parameters to be modified.



REC indicates to the user that the equipment is in recording mode.



Indicates that the equipment has a trigger programmed for an automatic recording

There are two types of triggers for making controlled recordings of data. The time interval trigger and the repetitive or periodic. The trigger operates only when the analyzer is in the record (REC) mode

- **Time interval trigger:** Allows recording of the electrical parameters in a programmed time interval.
- **Periodic trigger:** Allows periodic recording of the electrical parameters in a programmed time interval.

### 9.1.6 Memory capacity



Indicates that the internal memory of the analyzer is empty



Indicates that 60% of the equipment memory is free.



Indicates that the memory is full and the user must clear it in order to make new recordings.

### 9.1.7 USB connection



Indicates that the USB port of the equipment is not in use.



Indicates that the equipment is connected via the USB port. In that case the device can't register parameters.

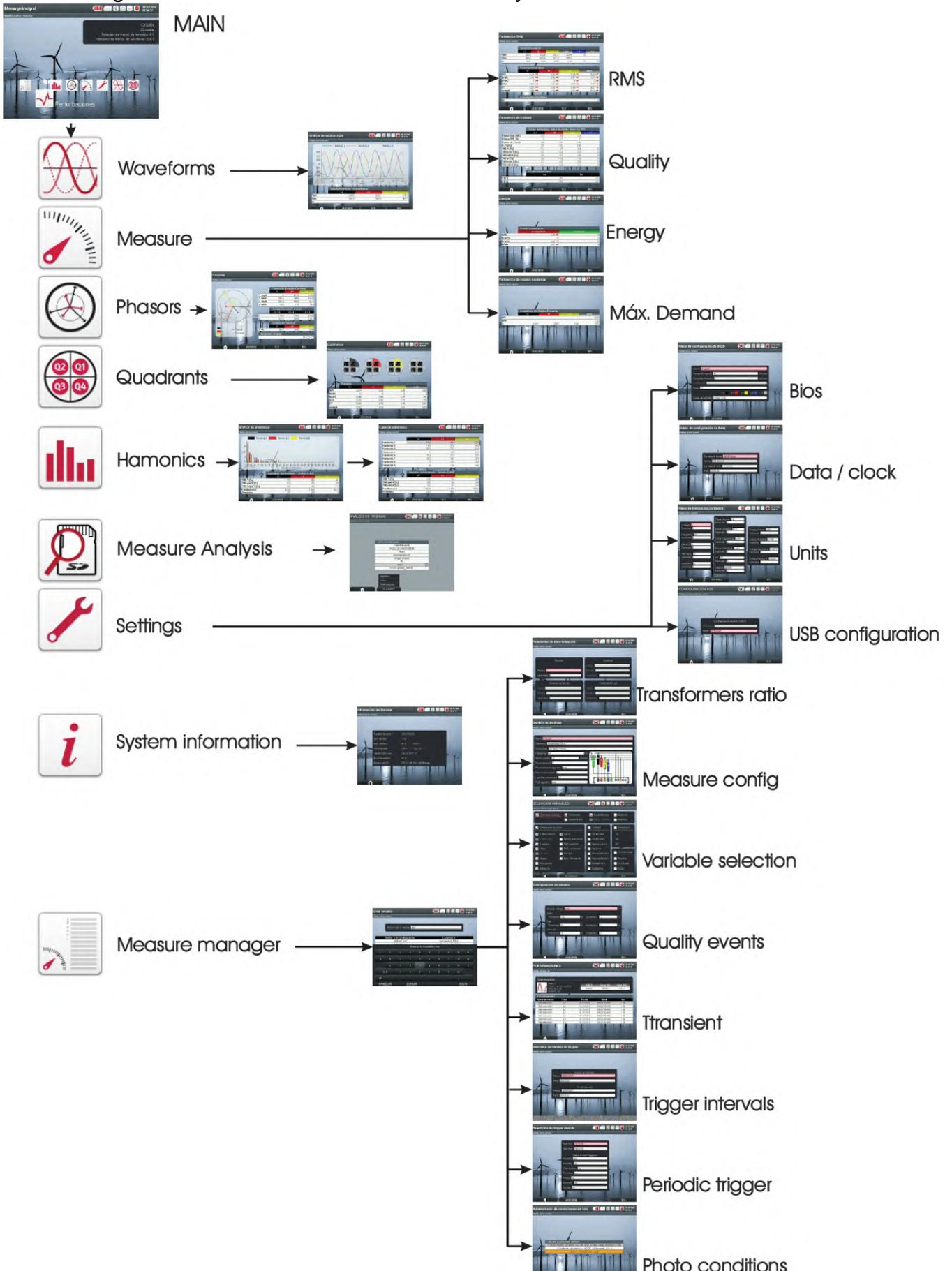
### 9.1.8 Snapshot



Indicates that the analyzer is in the process of capturing the instantaneous parameters and waveform of the measure.

## 9.2 SCREEN DIAGRAMS

This diagram shows the location of different analyzer screens.



### 9.2.1 Menu navigation

Navigation through the configuration screens and meter is done via function keys. With help from the ◀/▶ cursors, the desired operation is selected from the menus and confirmed via the central ● button.

### 9.2.2 Switching off the analyzer

If the POWER button is pressed a message appears warning that the system will be shut down. This warning also appears when the battery charge level is critical, and advises the user to connect the analyzer to the external power supply in order to charge the battery.



## 10 TYPES OF FILES GENERATED

### 10.1 \*.TRN

Recording of voltage transients from the three voltage channels L1, L2 and L3 at the moment of occurrence. Transient detection is configurable.

The various transients that are detected in the electrical network being analyzed are stored in this file. From each one of the transients the following data is stored.

- **Date of Transient:** This is the date the transient occurred. This date is accurate to the configuration of the cycle.
- **Wave shape from 2 cycles of the transient:** The analyzer stores a record of the half cycle before detection of the event, continuing through one and one-half cycles after it ends, leaving it perfectly delimited, showing its complete envelope, and in this way improving its analysis.

## 10.2 \*.STD

Mean value of the integration of the instantaneous RMS values during the configured recording period. The variables recorded with this file extension vary depending on the measured circuit configured (Three-phase Connection 4 Wires, Three-phase 3 Wires / ARON Three-phase 3 Wires, Two-phase or Single-phase) and are displayed in the following tables.

THREE-PHASE CONNECTION 4 WIRES								
STD recording variables	L1	L2	L3	LN	LIII	LK	Max	Min
Phase-Neutral Voltage	X	X	X	X	X		X	X
Phase-Phase Voltage	X	X	X		X		X	X
Current	X	X	X	X	X	X	X	X
Consumed Active Power	X	X	X		X		X	X
Consumed Inductive Power	X	X	X		X		X	X
Consumed Capacitive Power	X	X	X		X		X	X
Consumed Apparent Power	X	X	X		X		X	X
Consumed Power Factor	X	X	X		X		X	X
Consumed Cos Phi	X	X	X		X		X	X
Generated Active Power	X	X	X		X		X	X
Generated Inductive Power	X	X	X		X		X	X
Generated Capacitive Power	X	X	X		X		X	X
Generated Apparent Power	X	X	X		X		X	X
Generated Power Factor	X	X	X		X		X	X
Generated Cos Phi	X	X	X		X		X	X
Crest factor	X	X	X				X	X
Factor K	X	X	X				X	X
THD Voltage	X	X	X	X			X	X
THD Current	X	X	X	X			X	X
WA Inst. Flicker	X	X	X	X				
PST Flicker	X	X	X	X				
Frequency	X						X	X
Voltage Imbalance					X		X	X
Voltage Asymmetry					X		X	X
Current Imbalance					X		X	X
Current Asymmetry					X		X	X
Voltage Harmonics (1-50)	X	X	X	X				
Current Harmonics (1-50)	X	X	X	X				
Active Power Maximum Demand					X			
Apparent Power Maximum Demand					X			
Average Currents Maximum Demand					X			
Currents L1, L2, L3 Maximum Demand	X	X	X					
Consumed Active Energy					X			
Consumed Inductive Energy					X			
Consumed Capacitive Energy					X			
Consumed Apparent Energy					X			
Generated Active Energy					X			
Generated Inductive Energy					X			
Generated Capacitive Energy					X			
Generated Apparent Energy					X			

THREE-PHASE CONNECTION 3 WIRES / ARON THREE-PHASE 3 WIRES								
STD recording variables	L1	L2	L3	LN	LIII	LK	Max	Min
Phase-Neutral Voltage								
Phase-Phase Voltage	X	X	X		X		X	X
Current	X	X	X		X	X	X	X
Consumed Active Power	X	X	X		X		X	X
Consumed Inductive Power	X	X	X		X		X	X
Consumed Capacitive Power	X	X	X		X		X	X
Consumed Apparent Power	X	X	X		X		X	X
Consumed Power Factor	X	X	X		X		X	X
Consumed Cos Phi	X	X	X		X		X	X
Generated Active Power	X	X	X		X		X	X
Generated Inductive Power	X	X	X		X		X	X
Generated Capacitive Power	X	X	X		X		X	X
Generated Apparent Power	X	X	X		X		X	X
Generated Power Factor	X	X	X		X		X	X
Generated Cos Phi	X	X	X		X		X	X
Crest factor	X	X	X				X	X
Factor K	X	X	X				X	X
THD Voltage	X	X	X				X	X
THD Current	X	X	X				X	X
WA Inst. Flicker	X	X	X					
PST Flicker	X	X	X					
Frequency	X						X	X
Voltage Imbalance					X		X	X
Voltage Asymmetry					X		X	X
Current Imbalance					X		X	X
Current Asymmetry					X		X	X
Voltage Harmonics (1-50)	X	X	X					
Current Harmonics (1-50)	X	X	X					
Active Power Maximum Demand					X			
Apparent Power Maximum Demand					X			
Average Currents Maximum Demand					X			
Currents L1, L2, L3 Maximum Demand	X	X	X					
Consumed Active Energy					X			
Consumed Inductive Energy					X			
Consumed Capacitive Energy					X			
Consumed Apparent Energy					X			
Generated Active energy					X			
Generated Inductive Energy					X			
Generated Capacitive Energy					X			
Generated Apparent Energy					X			

TWO-PHASE CONNECTION								
STD recording variables	L1	L2	L3	LN	LIII	LK	Max	Min
Phase-Neutral Voltage	X	X		X	X		X	X
Phase-Phase Voltage	X				X		X	X
Current	X	X		X	X	X	X	X
Consumed Active Power	X	X			X		X	X
Consumed Inductive Power	X	X			X		X	X
Consumed Capacitive Power	X	X			X		X	X
Consumed Apparent Power	X	X			X		X	X
Consumed Power Factor	X	X			X		X	X
Consumed Cos Phi	X	X			X		X	X
Generated Active Power	X	X			X		X	X
Generated Inductive Power	X	X			X		X	X
Generated Capacitive Power	X	X			X		X	X
Generated Apparent Power	X	X			X		X	X
Generated Power Factor	X	X			X		X	X
Generated Cos Phi	X	X			X		X	X
Crest factor	X	X					X	X
Factor K	X	X					X	X
THD Voltage	X	X		X			X	X
THD Current	X	X		X			X	X
WA Inst. Flicker	X	X		X				
PST Flicker	X	X		X				
Frequency	X						X	X
Voltage Imbalance					X		X	X
Voltage Asymmetry					X		X	X
Current Imbalance					X		X	X
Current Asymmetry					X		X	X
Voltage Harmonics (1-50)	X	X		X				
Current Harmonics (1-50)	X	X		X				
Active Power Maximum Demand					X			
Apparent Power Maximum Demand					X			
Average Currents Maximum Demand					X			
Currents L1, L2, L3 Maximum Demand	X	X						
Consumed Active Energy					X			
Consumed Inductive Energy					X			
Consumed Capacitive Energy					X			
Consumed Apparent Energy					X			
Generated Active energy					X			
Generated Inductive Energy					X			
Generated Capacitive Energy					X			
Generated Apparent Energy					X			

SINGLE-PHASE CONNECTION								
STD recording variables	L1	L2	L3	LN	LIII	LK	Max	Min
Phase-Neutral Voltage	X			X	X		X	X
Phase-Phase Voltage								
Current	X			X	X	X	X	X
Consumed Active Power	X				X		X	X
Consumed Inductive Power	X				X		X	X
Consumed Capacitive Power	X				X		X	X
Consumed Apparent Power	X				X		X	X
Consumed Power Factor	X				X		X	X
Consumed Cos Phi	X				X		X	X
Generated Active Power	X				X		X	X
Generated Inductive Power	X				X		X	X
Generated Capacitive Power	X				X		X	X
Generated Apparent Power	X				X		X	X
Generated Power Factor	X				X		X	X
Generated Cos Phi	X				X		X	X
Crest factor	X						X	X
Factor K	X						X	X
THD Voltage	X			X			X	X
THD Current	X			X			X	X
WA Inst. Flicker	X			X				
PST Flicker	X			X				
Frequency	X						X	X
Voltage Imbalance					X		X	X
Voltage Asymmetry					X		X	X
Current Imbalance					X		X	X
Current Asymmetry					X		X	X
Voltage Harmonics (1-50)	X			X				
Current Harmonics (1-50)	X			X				
Active Power Maximum Demand					X			
Apparent Power Maximum Demand					X			
Average Currents Maximum Demand					X			
Currents L1, L2, L3 Maximum Demand	X							
Consumed Active Energy					X			
Consumed Inductive Energy					X			
Consumed Capacitive Energy					X			
Consumed Apparent Energy					X			
Generated Active energy					X			
Generated Inductive Energy					X			
Generated Capacitive Energy					X			
Generated Apparent Energy					X			

### 10.3 \*.PHO

Records or captures the instantaneous electrical parameters of the analyzer. A snapshot can be recorded by:

- **Manual activation** All data display screens allow a snapshot to be taken manually using the SNAPSHOT option of the ACTIONS menu.
- **Snapshot conditions:** By configuration of snapshot trigger conditions according to the values of electrical variables measured by the analyzer.

The various snapshots made using a single measurement are stored in this file. All variables measured by the AR6 analyzer are recorded instantaneously, along with the wave shapes from 10 cycles of signal from all channels.

## 10.4 \*.EVQ

Recording of quality events from the 3 voltage channels L1, L2, and L3. Events detection is configurable.

- Voltage gaps
- Overvoltage
- Voltage interruption

The various events that are detected in the electrical network being analyzed are stored in this file. The following data is stored from each one of the events.

- **Date of Event:** This is the date the event occurred. This date is accurate to the configuration of the cycle.
- **Type of Event:** The event is stored if it is an interruption, gap, or overvoltage. The phase in which it was produced is also identified, defined according to the programming made on the AR6.
- **Duration of the Event:** Duration in milliseconds.
- **Minimum and maximum voltage of the Event:** When an interruption or gap is produced, the minimum RMS $\frac{1}{2}$ \* voltage value obtained during the event is stored. In the case of overvoltage the maximum value is stored.
- **Mean voltage of the Event:** This is the average RMS $\frac{1}{2}$ \* voltage value obtained during the duration of the transient recorded.
- **Voltage previous to the Event:** The RMS $\frac{1}{2}$ \* voltage value just before the event was produced.
- **Wave shape from 2 cycles of the event:** The analyzer stores a record of the half cycle before detection of the event, continuing through one and one-half cycles after it ends, leaving it perfectly delimited, showing its complete envelope, and in this way improving its analysis.

## 10.5 \*.EVA

AR6 records a file called EVA which keep the device events. Event is defined as all those device configuration changes as they affect to the STD header files as power off or power on of device, transformers ratios modifications, battery status, maximums or other parameters delete. The full list of events is shown in the table below.

Nombre de Evento	Descripción
BAT_OFF	Power off device by battery level <=20%
CLEAR_ENERGY	Energy erased.
CLEAR_MAX_MIN	Maximum, minimum o both erased.
CLEAR_MAX_DEMAND	Maximum Demand erased.
SETUP_CHANGED	Some setting changed different to relation transformers.
SETUP_TRANS_RATIO_CHANGED	Relations transformers modification.

SETUP_TIME_CHANGED	Data and/or time modification.
TRIGGER_ON	Generated when enter in the time window of a trigger (is associated with the generation immediately subsequent REC_START event)
TRIGGER_OFF	It leaves the time window of a trigger (is associated with the generation immediately subsequent REC_STOP event)
DELETED_STD_FILE	Measure configuration cleaned.
POWER_ON	Power on the device.
POWER_OFF	Power off the device.
REC_STOP	Stop register (manual or by trigger)
REC_START	Start register (manual or by trigger)

## 10.6 LOCATION OF RECORDINGS

The recording files are located in the internal memory of the analyzer, in the subdirectory called DB\_Measures.

Subdirectories as well as measurements/configurations that may have been created are both found in this subdirectory.

The AR6 analyzer always measures, calculates and records according to an active measurement configuration (see CONFIGURATION), thus the recording files stored in the subdirectory corresponding to the measurement active at the time of recording.

## 10.7 DOWNLOAD FILE

Turn on the analyzer and activate the USB communications in the USB activating screen. Connect the analyzer to the computer by USB wire and the computer will detect the device as an external drive.

Recover files in the folder of the corresponding measure of external drive.



**Should not leave the USB activation screen to communicate with the analyzer. The device changes the port settings when leave this screen.**

## **11 STANDARDS**

The analyzer meets the following standards.

### **11.1 ELECTRICAL SAFETY**

- IEC / EN61010-1-2001.
- CAN / CSA C22.2 N° 61010-1-04
- UL (pending)
- Electrical analyzer safety requirements for measurement, control and laboratory use, part 1: general requirements.
- IP protection degree: 30
- Installation category: 1000V CAT III or 600V CATIV
- Double insulation
- Contamination grade: 2
- Assigned voltage: Vrms

### **11.2 MECHANICAL PROTECTIONS**

- Operating position: Any
- Rigidity : according to EN 61010-1
- Shock: per EN 61010-1
- Falls: according to EN 61010-1

### **11.3 ELECTROMAGNETIC EMISSIONS**

- EN 61000-3-2
- EN 61000-3-3
- EN 61000-6-4:2001
- EN 55011: (1998/A2:2002): Lead (EN 55022 – Class B)
- EN 55011: (1988/A2:2002): Issued (EN 55022 – Class A)

### **11.4 ELECTROMAGNETIC IMMUNITY**

- EN 61000-4-2 electrostatic discharge.
- IEC 61000-4-3:2006
- EN 61000-4-4
- EN 61000-4-5
- EN 61000-4-8
- EN 61000-4-11
- IEC 61000-6-2:2005
- IEC 61000-6-1:1997 MOD
- UNE-ENV 50141:1996.

### **11.5 QUALITY STANDARDS**

The AR6 is a power quality analyzer that meets the quality standards of UNE-EN 61000-4-30 (class B).

## 12 CE certification



VIAL SANT JORDI, S/N  
08232 VILADECALLS (BARCELONA)  
ESPAÑA / SPAIN



Web: [www.circutor.com](http://www.circutor.com)

E-mail: [central@circutor.es](mailto:central@circutor.es)

Tel: (+34) 93 745 29 00

Fax: (+34) 93 745 29 14

**DECLARACION DE CONFORMIDAD CE**  
**CE DECLARATION OF CONFORMITY**  
**DECLARATION DE CONFORMITE CE**

Por la presente **CIRCUTOR, S.A.**  
We hereby  
Par le présent

Con dirección en: **Vial Sant Jordi, s/n**  
With address in: **08232 VILADECALLS (Barcelona)**  
Avec adresse à: **ESPAÑA**

Declaramos bajo nuestra responsabilidad que el producto:  
We declare under our responsibility that the product:  
Nous déclarons sous notre responsabilité que le produit:

**Analizador de redes eléctricas**

**Serie: AR6**

**Marca CIRCUTOR**

**Siempre que sea instalado, mantenido y usado en la aplicación para la que ha sido fabricado, de acuerdo con las normas de instalación aplicables y las instrucciones del fabricante,**

*Provided that it is installed, maintained and used in application for which it was made, in accordance with relevant installation standards and manufacturer's instructions,*

*Toujours qu'il soit installé, maintenu et utilisé pour l'application par laquelle il a été fabriqué, d'accord avec les normes d'installation applicables et suivant les instructions du fabricant,*

**Cumple con las prescripciones de la(s) Directiva(s):**

*Complies with the provisions of Directive(s):*

*Accomplie avec les prescriptions de la (les) Directive(s):*

**2006/95/CE**  
**2004/108/CE**  
**2006/42/CE**

**Está en conformidad con la(s) siguiente(s) norma(s) u otro(s) documento(s) normativo(s) :**

*It is in conformity with the following standard(s) or other normative document(s) :*

*Il est en conformité avec la (les) norme(s) suivante(s) ou autre(s) document(s) normatif (ves) :*

**IEC 61010-1 :2001**  
**IEC 61000-6-3 :2006**  
**IEC 61000-6-1 :2005**

**Año de colocación del marcado "CE": 2010**

*Year of affixing "CE" marking:*

*An de mise en application du marquage "CE":*

**Revisado en Viladecavalls**

**Fecha:02/03/2010**

**Nombre y Firma :**

*Name and signature*

*Nom et signature :*

**Francisco Rosique Gil**

*General Manager*




## 13 UPGRADE

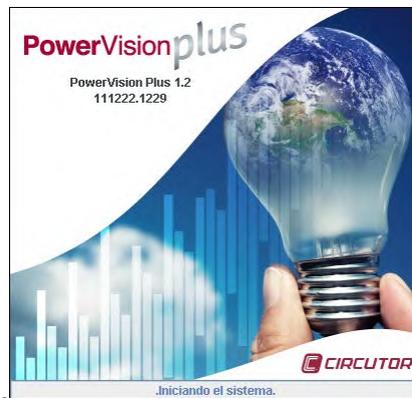


The upgrade deletes the \*.EVQ, \*.PHO and \*.REC files due a change in their internal estructura. Be sure that you download the data stored in the Data folder before update the portable analyzer.

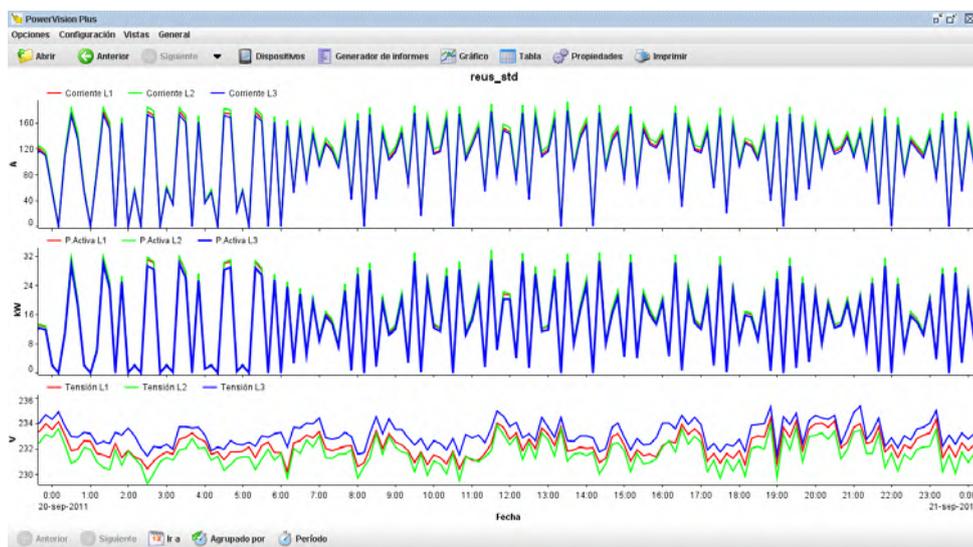
To upgrade the analyzer AR6 download the firmware versions of the website CIRCUTOR [http://www.circutor.com/noticias/ar6-new-firmware\\_n\\_1046.aspx](http://www.circutor.com/noticias/ar6-new-firmware_n_1046.aspx)  
Follow the steps in the update manual. The steps could be different depending on the version of the device.

## 14 POWER VISION PLUS

Power Vision Plus is the software for download and management data recorded by the AR6 network analyzer.



It is a tool that helps users to analyze data using graphs and tables.



Essential for creating reports and audits because allows export images to attach to documents.

For more information, download the complet manual of PowerVision Plus from web of CIRCUTOR, [www.circutor.com](http://www.circutor.com)

## 15 CALCULUS OF PARAMETERS

In order to make calculations of the different parameters and be able to represent them, the AR6 analyzer makes a series of calculations by applying the formulas detailed below.

### 15.1.1 Calculation of average power according to the number of samples

$$\text{Formula: } WATT = \frac{1}{N} \sum_{n=1}^N V_n I_n$$

$N$  = Number of samples

$V_n$  = Sample voltage

$I_n$  = Sample current

### 15.1.2 Calculation of apparent power

$$\text{Formula: } VA = V_{RMS} I_{RMS}$$

### 15.1.3 Calculation of RMS effective voltage

$$\text{Formula: } V_{rms} = \sqrt{\frac{\sum_{n=1}^n V_n^2}{n}}$$

### 15.1.4 Calculation of RMS effective current

$$\text{Formula: } I_{rms} = \sqrt{\frac{\sum_{n=1}^n I_n^2}{n}}$$

### 15.1.5 Calculation of base apparent power

$$\text{Formula: } VA = V_{fund} I_{fund}$$

### 15.1.6 Calculation of base power

$$\text{Formula: } WATT = VA_{fund} \cos \theta$$

### 15.1.7 Calculation of reactive power

$$\text{Formula: } VAR_{fund} = VA_{fund} \sin \theta$$

### 15.1.8 Calculation of power factor

$$\text{Formula: } PF = \left| \frac{WATT}{VA} \right|$$

### 15.1.9 Calculation of total power

$$\text{Formula: } WATT_{Tot} = WATT_A + WATT_B + WATT_C$$

### 15.1.10 Calculation of base total power

$$\text{Formula: } WATT_{Tot fund} = WATT_{A fund} + WATT_{B fund} + WATT_{C fund}$$

### 15.1.11 Calculation of base total reactive power

$$\text{Formula: } VAR_{Tot\ fund} = VAR_{A\ fund} + VAR_{B\ fund} + VAR_{C\ fund}$$

### 15.1.12 Calculation of total apparent power

$$\text{Formula: } VA_{Tot} = VA_A + VA_B + VA_C$$

### 15.1.13 Vector calculation of total apparent power

$$\text{Formula: } VA_{Vector\ Tot} = \sqrt{WATT_{Tot}^2 + VAR_{Tot\ fund}^2}$$

### 15.1.14 Calculation of total base apparent power

$$\text{Formula: } VA_{Tot\ fund} = VA_{A\ fund} + VA_{B\ fund} + VA_{C\ fund}$$

### 15.1.15 Vector calculation of base total apparent power

$$\text{Formula: } VA_{Vector\ Tot\ fund} = \sqrt{WATT_{Tot\ fund}^2 + VAR_{Tot\ fund}^2}$$

### 15.1.16 Calculation of total power factor

$$\text{Formula: } PF_{Tot} = \left| \frac{WATT_{Tot}}{VA_{Tot}} \right|$$

### 15.1.17 Vector calculation of total power factor

$$\text{Formula: } PF_{Vector\ Tot} = \left| \frac{WATT_{Tot}}{VA_{Vector\ Tot}} \right|$$

### 15.1.18 Calculation of total power factor movement

$$\text{Formula: } DPF_{Tot} = \left| \frac{WATT_{Tot}}{VA_{Tot\ fund}} \right|$$

### 15.1.19 Vector calculation of total power factor movement

$$\text{Formula: } DPF_{Vector\ Tot} = \left| \frac{WATT_{Tot\ fund}}{VA_{Vector\ Tot\ fund}} \right|$$

### 15.1.20 Calculation of imbalance coefficient

The imbalance coefficient  $Kd$  is the ratio between the amplitudes of the direct and inverse sequence components.

$$\text{Formula: } Kd \% = \frac{|U\ i|}{|U\ d|} \cdot 100$$

### 15.1.21 Calculation of asymmetry coefficient

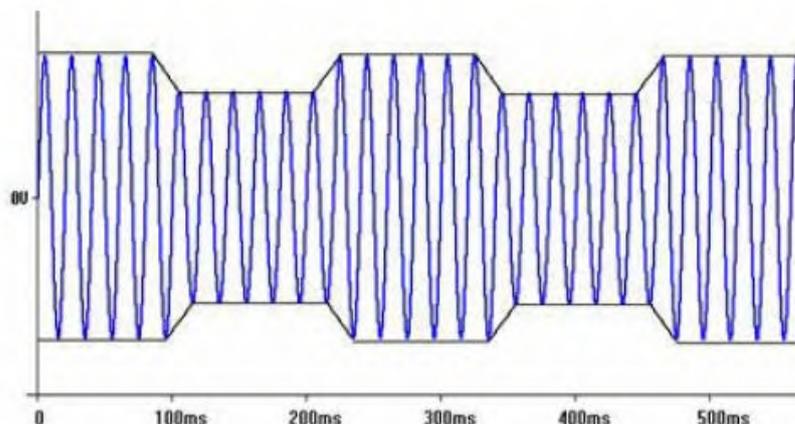
The asymmetry coefficient  $Ka$  is the ratio between the amplitudes of the direct sequence and homopolar components. The homopolar sequence components are zero if there is no neutral.

$$\text{Formula: } Ka \% = \frac{|U\ 0|}{|U\ d|} \cdot 100$$

### 15.1.22 Calculation of Flicker effect perceptibility

By Flicker effect, we mean the variation of the effective value or amplitude of the voltage, within a range of 10% less than nominal value. This variation in voltage amplitude produces a fluctuation of the luminous flux in bulbs, at the same time inducing a sensation of visual instability (visual flashing effect).

Flicker depends in principle on the amplitude, frequency and duration of the voltage variations and is expressed as a variation of the RMS voltage divided by the RMS average.



Perceptibility  $P$  is calculated according to the duration of the Flicker

For short times (10 minutes) it is denominated  $Pst$

#### 15.1.22.1 Calculation of short duration perceptibility

Formula:  $Pst = \sqrt{0,0314P_{0,1} + 0,0525P_1 + 0,0657P_3 + 0,28P_{10} + 0,08P_{50}}$

For times long times (2 hours) it is denominated  $Plt$

The Flicker effect may occur within a frequency range that goes from 0.5 a 25 Hz. The eye is very sensitive to modulating frequencies within the range of 8 to 10 Hz, as has been demonstrated through testing, with voltage variations in the range of 0.3 to 0.4% of the magnitude of these frequencies.

### 15.1.23 Calculation of the K-Factor

Calculation of the overdimension factor of one voltage transformer due to losses from eddy currents.

$$K = \sum_{h=2}^{h=\infty} h^2 I_h^2$$

Formula:

Where:

$h$  = number of harmonics

$I_h$  = the fraction of the total charge of effective current in the harmonic  $h$

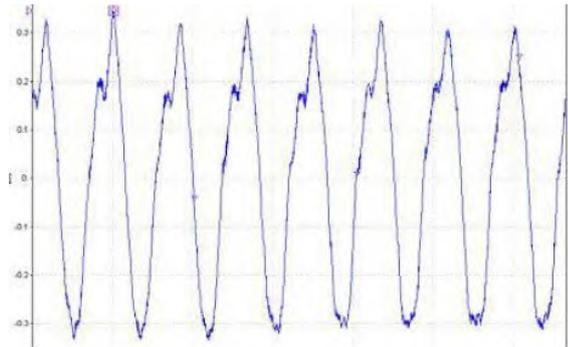
Once the K-Factor is known, it is easy to select a transformer with a K-rating greater following the standard ranges of 4, 9, 13, 20, 30, 40, 50.

### 15.1.24 Calculation of the Crest Factor

The crest factor is equal to the amplitude of the wave shape peak, divided by the RMS value. The purpose of this calculation is to exaggerate the concept of the problem that may be occurring in the wave shape, which is usually associated with mechanical problems such as, worn roller bearings, pump cavitation, worn gear teeth in transmissions, etc.

Formula: 
$$C.F = \frac{U_{pic}}{U_{RMS}}$$

The crest factor is one of the important measurements of the status of the machine, and is an analysis of the wave shape that would be visible only with the calculation of the rate of harmonic distortion.



In a perfect sine wave, with an amplitude value of 1, the RMS value or effective value is 0.707 and the crest factor is equal to 1.41. If the crest factor is detected to be greater than this value, it would then signify that some problem exists that is prejudicial to the form factor.

## 16 FAQ

### 16.1.1 ¿Can I expand the internal memor of the analyzer?

The user can change the internal SD memory. The SD has had FAT32 format and is possible until 32GB capacity.

### 16.1.2 The keyboard does not respond. What can happen and how can I fix it?

Usually the blockage is caused by pressing a key sequence. To unlock, press the shutdown button briefly. The device has to react to other keys.

### 16.1.3 What register the analyzer with the function PHOTO?

EI analyzer register 10 cycles of the 9 channels waveform with 128 samples resolution, also the RMS values of the instantaneous variables, the harmonics, phasors and energy, maximums, minimums values, quality parameters and Maximum Demand.

### 16.1.4 ¿What do the analyzere register at an EVENT?

Registers 2 cycles of the waveform, ½ cycle befote and 1½ cycles after the event detection with 128 samples resolution.

### 16.1.5 ¿Which software may I ise to analyze the recorded data?

To analyze the recorded data you have to use the Power Vision plus.

## 17 IN CASE OF MALFUNCTION

In the event of questions or concerns regarding operation or malfunction of the analyzer, notify **Technical Assistance Service (S.A.T.) of CIRCUTOR, SA.**

SPAIN	902 449 459
INTERNATIONAL	(+34) 93 745 29 00

**Technical assistance** Post-sales Department

Vial Sant Jordi, s/n –

08232 – Viladecavalls

Barcelona – Spain

e-mail: [sat@circutor.es](mailto:sat@circutor.es)

Web: [www.circutor.es](http://www.circutor.es)