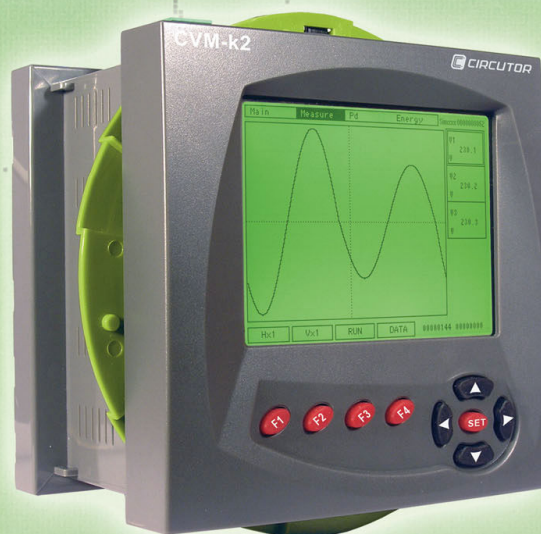# CVM k2

TECHNICAL BROCHURE
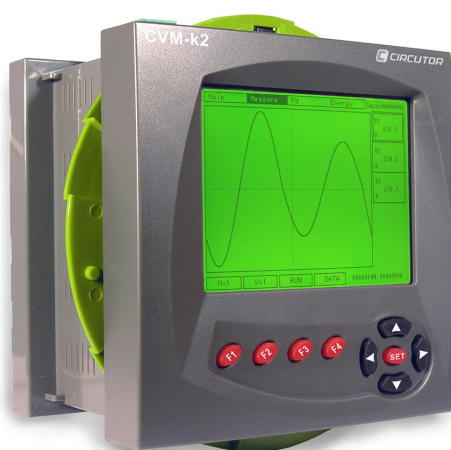
POWER ANALYZER CVMk2

October 2006

0.- Introduction

With more than 30 years of experience in the electrical control products, specially in the measuring range, Circutor has developed a new power analyzer that is going to revolution the market: the new CVMk2.

This power analyzer is the son of CVMk, the first power analyzer in the market that was launched 15 years ago by Circutor.

In a few words, CVMk2 is a modular power analyzer that not only includes all the features you can find in the best family of measurement centers in the market, but also the highest modularity you have ever imagined, in a device that will allow you to grow in a market in which the final price is a feature only comparable to the quality of the product.

Modularity, performance, simplicity, accuracy, quality, technology, reliability, … All these words define the new CVMk2.

CVMk2

1.- Description of the new power analyzer CVMk2

As can be seen, the power analyzer CVMk2 is thought for all that applications in which the knowledge of the electrical parameters of a certain installation is needed: voltage, current, frequency, power (active, reactive, apparent, demand, …), energy, power factor, and so on.

We all will agree in the fact that all this can be found in the market. However, it has been proved that sometimes the products that can be found not always are the most suitable. Let's see why:

- Analyzers that measure lots of parameters can be found, but with a low resolution display, or even worse, without a display. Others exchange the number of parameters by the simplicity of use. CVMk2 allows **SIMPLICITY**, **INFORMATION**, and **VISUALIZATION**.

- Analyzers that are limited in functionality, and cannot be expanded (expansion cards), can be easily found. Others include expansion cards with a few options. CVMk2 allows **MODULARITY**.

- In some applications, there is a need for a simple system, with no need for a display. In these cases, the customer must purchase lots of devices with display. CVMk2 allows **FLEXIBILITY**.

- The devices are sometimes limited in terms of interfaces and communication capabilities, not only because of the physical interfaces, but also because of the supported protocols. CVMk2 allows **COMMUNICATION**, **INTEGRABILITY**.

- The formats in the analyzers are presented sometimes are not suitable for the installations, panels or places to be installed. Which device in the market allows the installation in any format (DIN rail, round 4 inches format, panel mounting)? Only CVMk2 allows **EASE OF INSTALLATION**.

Forget all these situations, and think about a new device that is going to solve all of them in just one solution, a device that will avoid surprises in the moment of the installation. All these points are reached only with CVMk2.

The next are the features of CVMk2 that will solve all these situations:

- Uses two separate and modular units: display unit and measuring/interface device.

- Includes the following formats of installation in one device: 4 inches ANSI format, DIN rail, panel 96x96, panel 144x144.

- Allows to use up to 3 expansion cards at the same time in each CVMk2 measuring unit.

- The modularity of the device allows even to use expansion cards for different protocol implementations, which means ease of integration with SCADA applications or combination with PLC based projects.

- The big graphic display can show not only the list of electrical parameters, but also nice graphic waveforms (waveforms, unbalancement, frequency spectrum, …). The most nearest to the radiography of an installation.

- Different ways of managing the information: real-time polling, memory download, historical download, etc…

- To use a complete software prepared by Circutor that allows to use together with other devices or applications (DDE exportation, XML functions), or to include the device in other existing applications with other market SCADA softwares

Some views of CVMk2: DIN rail mounted, lateral and rear view of the display
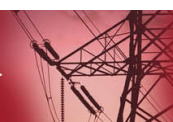
2.- A perfect product for the American market

In the market of the electronic measuring devices there are lots of analyzers, and even more companies that are well placed in this field. However, just a few of them have reached a good product that includes all the features that can be appreciated in any market of the world. Which of them includes all the features that are the most suitable for the American market?

After a deep marketing study, Circutor has concluded that these features in the American market are the following:

- Class 0.2 accuracy (class 0.5 on demand)
- 4 inches ANSI format (other optional formats)
- Communication capabilities (TCP/IP stack of protocols, serial and Ethernet physical interfaces)
- Graphic display
- Possibility of on-board memory
- Electrical parameters, harmonic decomposition and disturbances recording
- Universal power supply: AC power supply for 60Hz and 50Hz, 120Vac and 230Vac power supply, and DC current power supply
- Any kind of current transformer in one device: …/5Aac, …/1Aac
- UL listing

CVMk2 Is the product that joins all of them in one unique device.

However, there are other functionalities that make of CVMk2 a product totally suitable for the world market. You will discover all of them in the rest of the document. Pay attention…

3.- Technical description of the new CVMk2

3.1.- Physical description

The new CVMk2 power analyzer is composed by two parts:

Graphic display

300x240 pixels graphic display (¼ VGA), the display not only allows the user to show all the measured parameters in a size that will avoid visibility problems, but also to show other kinds of information, like waveforms, harmonic spectrums, scope captures for voltages and currents, unbalancement graphics,…. As you will find in the next photo, the display unit includes also a joystick that allows the user to move in the different menus that appear in the display, to program the different options in the Setup, and to select rapid functions by means of four specialized buttons (which function depends on the screen).

Front view of CVMk2 display unit

Measuring unit

The measuring unit includes the inputs or terminals for the voltage and current (external current transformers) connection to the device. Allow the customer to use …-/1A or …/5A current transformers, to be selected by Setup, and also allows the measuring of voltage in the secondary of power transformers, with different accuracy classes and including some slots for expansion cards.

Current and voltage inputs and expansion card slots

By joining the two components, a complete measuring unit with a nice graphic display result.

Measuring unit, graphic display and mounting system of the CVMk2

However, one of its new features is the ability to use or not use the screen, as sometimes it is not necessary, this is something that depends on the application. Each display unit has a built-in communications port that allows the display to show the measured values of different and remote measuring circuits.
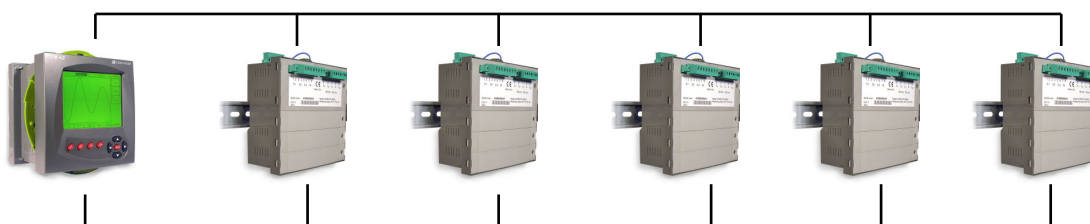
In applications in which the cost is a parameter to be optimized, the user has the option to use just one screen for a group of measuring circuits.

RS485 network

1 display in each measuring unit (typical scenario)

Display network

RS485 network

1 display for all the measuring units of the installation (new scenario)

One of the new features in CVMk2 is that the same device permits the customer to install it in any kind of mounting system:

- **4'' ANSI panel mounting**
- **96x96** or **144x144 panel mounting**
- **DIN rail mounting**

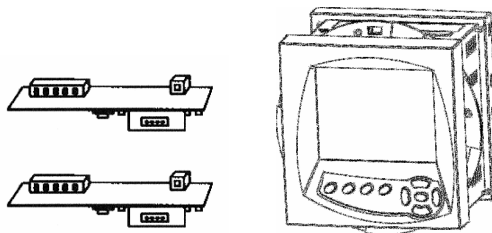This function is reached by the complement that is included in every CVMk2, the fixation unit:

Fixation unit for all mounting systems

3.2.- Components

The components of a CVMk2 may vary, and depend on the application. Let's know them:

- Measuring circuit (described before)
- Graphic display (described before)
- Fixation unit (described before)
- Expansion cards

The expansion cards define mainly the application that will be carried by the analyzer. Initially, each unit of CVMk2 includes the current and voltage inputs, which permit to measure all the typical electrical parameters (described below), as well as an independent serial port that is used only for graphic display of the measured parameters. This port is not used for communication purposes with external units (such as computers or PLC), is exclusively used in combination of a display unit.

However, each measuring unit includes **three expansion slots** that allow the user to use up to three expansion cards with different formats. Each of them allows the user to implement different applications, like the integration of analog parameters through analogue inputs, submetering applications through the use of digital outputs, some communications capabilities, on-board memory, and so on. The next are the expansion cards that have been developed for CVMk2:

- Expansion card CVMk2 with **Ethernet port and SD memory slot**: ideal for the integration of power analyzers with structured cabling installations, the most usual physical interface in terms of industrial communications. Why install a wiring network in a place which is equipped with an Ethernet one?

- Expansion card CVMk2 with **GSM/GPRS communications and SD memory slot**: the solution for communication capabilities in places where it's not easy to install a wired system. The main applications are the ones that require memory download at big distances.

- Expansion card CVMk2 with **SD memory slot**: for those cases in which is only needed a memory to be downloaded periodically, and to get the historic of the installations in a periodic basis.

- Expansion card CVMk2 with **8 mechanical input and 4 mechanical output** relays.

- Expansion card CVMk2 with **8 static digital inputs and 8 static digital outputs**: ideal for sub-metering applications. The static digital inputs are very useful for alarm activation or pulse concentration applications for energy quantification.

- Expansion card CVMk2 with **8 analogue inputs and 4 analogue outputs**: the best option when analogue parameters must be controlled in the same application or measuring device (temperature, pressure, salinity, wind intensity, …), and some of the parameters must be monitored also by other computers and PLCs.

### 3.3.- Measured parameters and power quality functions

The list of measured parameters by the CVMk2 is the following:

Parameters	L1	L2	L3
Voltage	X	X	X
Current	X	X	X
Frequency	X		
Active power	X	X	X
Reactive power L	X	X	X
Reactive power C	X	X	X
Apparent power		X	
Active energy		X	
Inductive energy		X	
Capacitive energy		X	
Power Factor	X	X	X
Voltage THD (odd, even and total)	X	X	X
Current THD (odd, even and total)	X	X	X
Voltage harmonic content	X	X	X
Current harmonic content	X	X	X
Type of voltage wave	X	X	X
Type of current wave	X	X	X
Neutral current		X	
Neutral-Earth voltage		X	
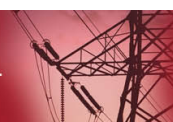
Parameters	L1	L2	L3
Flicker (PST)	X	X	X
Dip	X	X	X
Interruptions	X	X	X
Swell	X	X	X
Unbalance		X	
Phase diagram for voltages and currents		X	
Asymmetry		X	

For all these parameters, the CVMk2 is able of recording the **maximum** and **minimum values with timestamp**. In the case of SD memory slot use, the parameters are also recorded in the SD memory. If the memory is not used, the computer and software create the database of all the parameters for a later inspection.
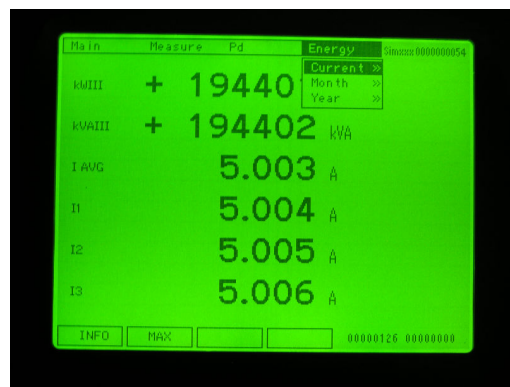

Some parameters and menus in the CVMk2 display

Regarding the energy recording, the analyzer is able to record up to **9 tariffs** of each energy (active, reactive and apparent), in any of the **4 quadrants** (exported and imported). This makes of CVMk2 the best option in terms of sub-metering applications.

As you will notice, the analyzer measures all the parameters that an installation would need to allow a perfect control and monitorization of the electrical behaviour. However, there are other applications that are reached by CVMk2 at the same time that the power analyzer function is done: the **power quality analysis**. In this side, CVMk2 is classified as a IEC 61000-4-30 measuring instrument, and this means that can perform quality analysis including the following functions:
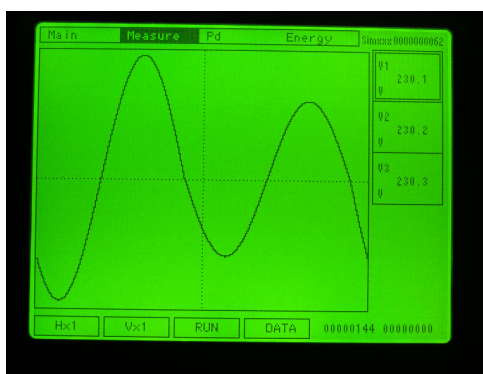
Waveform recording
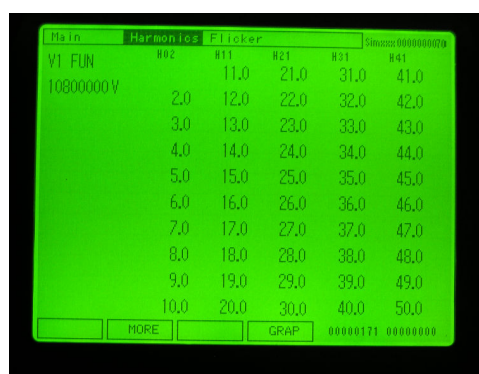
Harmonic decomposition

The **harmonic decomposition** is done until the **50th harmonic** in voltage and current. This allows the user of CVMk2 if the loads present in the installation generate this kind of disturbances.

Besides this, the software makes EN50160 analysis of the recorded data in the analyzer, such as: frequency, magnitude of the supply voltage, voltage variations, voltage dips, interruptions, long interruptions, transients, overvoltages, voltage unbalancement, voltage harmonics, and in general, any kind of disturbance referred to the power quality received in the installation.

Also the **flicker** is measured by CVMk2, according to IEC 61000-4-15 standard:
- Instantaneous flicker
- Short-term flicker (Pst)
- Long-term flicker (Plt)

Other kind of **disturbances can be detected** and recorded by CVMk2: ½ cycle events in currents and voltages, threshold definition by the user for event recording, timestamps included in the event recordings, … .

3.4.- Communication sollutions

As has been done in the whole CVM family of Circutor, not only the measuring and automation needs have been taken on account in order to cover all the needs of the current market. Also all types of communications have been developed in order to reach any kind of availability in time and space:

- Physical interfaces: all the physical interfaces have been prepared so that CVMk2 can be totally reachable in any physical way, with or without wires, and using any of the existing communication systems, not only for automation technologies, but also for wide are network solutions. Some examples are **RS232**, **RS485**, **USB**, **Ethernet**, **GSM/GPRS**, … .
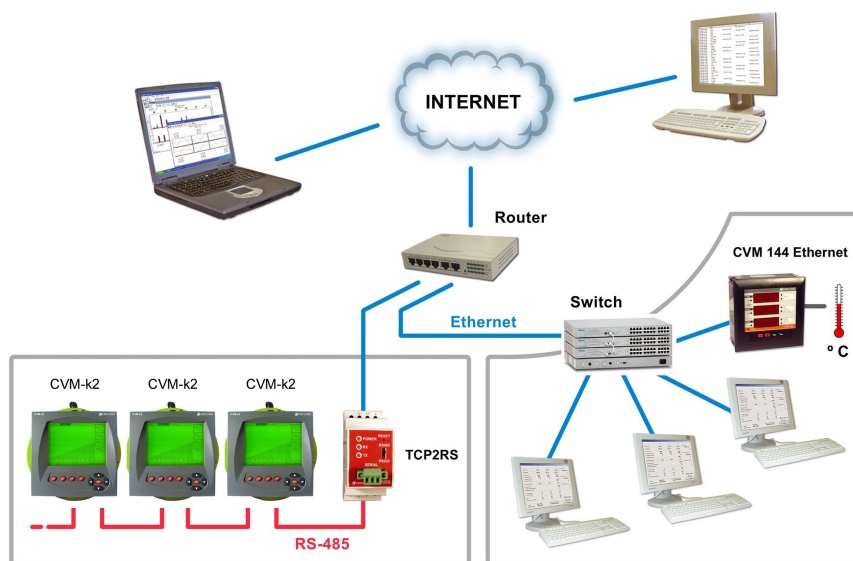
Application of CVMk2 in serial RS485 network

- Link and network protocols: besides the options for the physical interfaces, the necessary protocols are supported. Protocols like Cirbus, **Modbus RTU** and **Modbus TCP** can be selected for the link layer of the OSI stack of protocols, and also other options can be implemented (**Profibus**, **Johnson Controls**, …). Network protocols are also supported by the software that Circutor puts at your disposal: Power Studio. TCP/IP capabilities are reached by our device, so the communication for WAN and LAN networks or Internet Explorer applications are allowed by our solution. This includes also the implementation of **DDE and XML services** for data exportation, not only to other softwares and applications, but also to other sites of control.
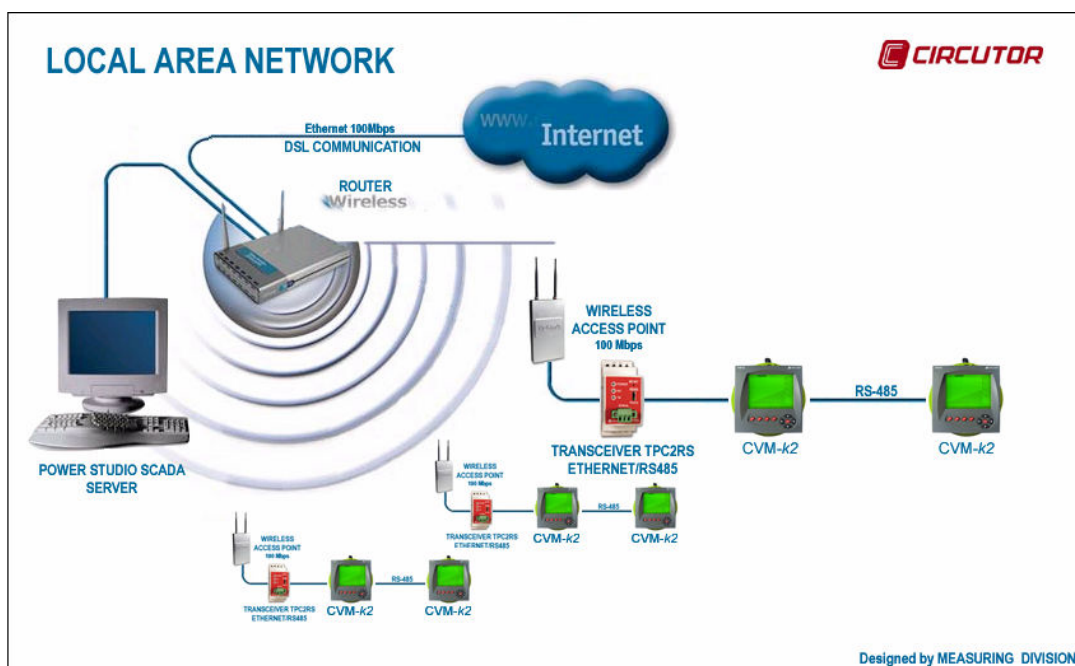
Application of CVMk2 in LAN (Local Area Network)

3.5.- Accessories

The wide range of electronic devices that Circutor offers is a good complement for the new CVMk2 power analyzer. Please find some of them:

- **Other power analyzers**: Circutor has developed a wide range of power analyzers that cover all the needs of any electrical installation to be supervised.

CVM k   *CVM 144*   *CVM 96*   *CVM NRG96*
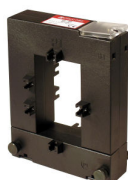

CVM BD   *CVM BC3*   *CVM BDM*   *CVM-Mini*

- **Current Transformers**: Circutor manufactures a wide range of current transformers, transformers with any size, any accuracy class, and for any required application.

- **Communications complements**: a range of communications accessories is available for any kind of situation, from serial communications, to Ethernet solutions, and even wireless communications (WiFi, GSM/GPRS, etc). Some examples are:
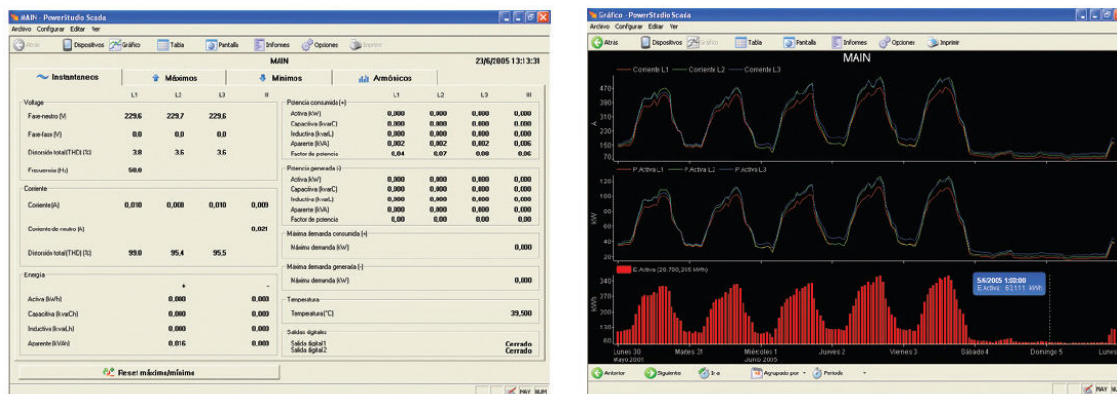

Serial converters   *Ethernet to serial converters*   *USB to serial converters*

- **Software Power Studio and Power Studio Scada**, the most suitable software for remote supervision and control of any installation, using any existing kind of communication, for small, medium, and large sized installations.

Some screens of Power Studio and Power Studio Scada

Some features of Power Studio and Power Studio Scada are:
- Easy **monitoring**, **configuration** and **data-logging** of the power analyzers developed by Circutor
- **Graphic representation** of all the data available by any electronic device in the CVM family (and others)
- **List and table representation** of all the readings in one easy screen
- Powerful tool for **TCP/IP and serial communications** in any of the existing formats
- **Data exportation** capability, via **DDE** to other local applications, or via **XML** to remote applications through TCP/IP technology
- Creation of **database**s for all the devices connected to the software
- **SCADA** screens graphic design and application creation from a simple and powerful environment

3.6.- Some standards and marks…

- CE marked
- IP 54 when mounted. The box is self-extinguishable V0 complying with UL 94
- Category III – 300Vac/520Vac
- IEC 801
- UL 94
- IEC 348
- IEC 571-1
- EN 61010-1
- EN 61000-6-2 :2000
- EN 61000-6-4 :2002
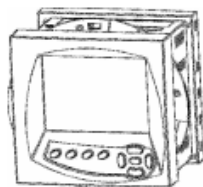- IEC 61000-4-30
- IEC 61000-4-15
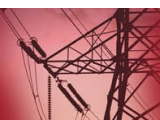
4.- Applications

The main applications of CVMk2 are the following:

- ***Electrical energy control and preventive supervision***: the most typical application in which a power analyzer is used, is to maintain a preventive supervision of an installation, avoiding any surprise because of unexpected harmonics, or excessive consumptions of energy in an undersized installation

- ***Industrial automation systems***: control of the electrical parameters in those installations in which, because of production demand, of the critical supplying systems or because of the processes used in the production plans, is so important to control electrical consumptions, power factor of the electrical energy, etc.

- ***Energy sub-metering installations***: in some installations, such as hotels, halls of residence, commercial or shopping centers, etc., it is needed to separate the electrical consumption of each department, shop, office, in order to know the exact consumption of each. A device like CVMk2, will permit not only to measure and store the consumptions, but also to display these values in separate tariffs in a remote basis.

- ***Electrical tariff selection***: a short-term study of the electrical consumption by means of a CVMk2 allow the election of the most suitable tariff for the end user. This is one of the most typical applications of our measurement centers. At the same time, the software Power Studio allows the user to create the simulation of electrical invoices. The device together with the software are the best solution in sub-metering applications.

- ***Process control installations***: some applications require the control of electrical parameters, and at the same time, of other parameters (temperature, pressure, pH, …) that are directly related to electrical consumptions or to the energy flow. CVMk2 is the best option, since the wide variety of expansion cards (analogue and digital inputs and outputs) makes of it the easiest device to be integrated in one installation.

- ***Remote electrical supervision*** systems: the centralization in one point of all the electrical parameters and status of different places is possible thanks to the communication capabilities of CVMk2, specially the TCP/IP solutions that the device offers.

- ***Integration*** of electrical measuring devices in SCADA projects: since different protocols are implemented in the new CVMk2, it's impossible to find a SCADA project in which CVMk2 cannot be directly connected to the control unit or to other PLC or automation systems. This is definitely the best and more universal choice in terms of integration.

- ***Control of the power supply in critic installations***: thanks to the power quality functions of the analyzer, any disturbance or event can be detected in any situation, and so, rectified and solved the fastest, in order to reduce to the minimum the quantity of time that the installation is not in service.

5.- Codes and references

		CVMk2 series													
Code	Type	Valid for /1 A and /5 A secondary	Three-phase 50...60 Hz	True RMS value	Insulated Current Inputs ITF	2 ports of communication (Display + RS485 Modbus RTU)	3 expansion slots	Harmonic analysis - 50°	Disturbance detection	Multitariff equipment - 9 tariffs	4 quadrants	Wave forms	Display features*	Class 0.5 (Power / Energy)	Class 0.2 (Power / Energy)
		Compact equipments (measurement equipment MCVMk2 + display)													
[*] M54400	CVMk2-ITF-405	●	●	●	●	●	●	●	●	●	●	●	●	●	
[*] M54402	CVMk2-ITF-402	●	●	●	●	●	●	●	●	●	●	●	●		●
		Measurement equipment													
[*] M54410	M-CVMk2-ITF-405	●	●	●	●	●	●	●	●	●	●	●		●	
[*] M54412	M-CVMk2-ITF-402	●	●	●	●	●	●	●	●	●	●	●			●

(*) Display features:	-Resolution 300x240 pixels	-Integrated joystick	-Drop down menus
	-8 MB recording memory	-Backlit LCD display	-Multi-equipment display

```
  M   5   X   X   X   X   0   0   X   X
```

Code		Internal code			

Power supply voltage (TA)	Standard 85...265 V a.c. / 95...300 V d.c. (*)	0
	SDC 24 ... 120 V d.c.	5

Voltage measurement (TM)	Standard 300/520 V a.c. (*)	0
	63,5 / 110 V a.c.	1
	500 / 866 V a.c.	3

* Not shown if there are no others

Expansion modules for CVMk2

	Code	Type	
	[*] M54501	1. Expansion card:	8I (potential free digital inputs)
			8O (digital outputs per opto-coupled transistor)
	[*] M54502	2. Expansion card:	8I (0...20 / 4...20 mA analogue inputs)
			4O (0...20 / 4...20 mA analogue inputs)
	[*] M54503	3. Expansion card:	4I (potential free digital inputs)
			4O (digital outputs per relay - 1 NO/NC switched relay-)
	[*] M54504	4. Expansion card:	Ethernet (Modbus/TCP) + SD memory expansion slot
	[*] M54505	5. Expansion card:	GSM / GPRS + SD memory expansion slot
	[*] M54506	6. Expansion card:	Memory expansion slot
	* Memory card not included for SD memory expansion slot cards		