MULTI-PURPOSE THREE PHASE METER
CIRWATT Series

TECHNICAL REPORT

(M 981 CIR / 02B)

Requested by:	Written by:	
CIRCUTOR, S.A.	**Ramón Comellas Fusté** Collegiate no.: 5354	

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1.-INTRODUCTION

CIRWATT is a four quadrant, multi-purpose, three-phase digital meter with the following accuracy classes:

CIRWATT Model	ACTIVE Class	REACTIVE Class
02	0.2S	0.5
05	0.5S	1.0
10	1.0	2.0

The main feature of CIRWATT is its great versatility allowing it to meet the needs of the user.

It is especially designed for installations where electro-mechanical meters do not match the actual requirements. It is specifically for those installations requiring a meter with a tariff system or where electrical energy billing is done using load profiles.

CIRWATT complies with the existing standards applicable to electronic meters and has an independent system of data storage to avoid data loss in the event of power loss.

Below are some of the main features, which will be described later:

- **Power supply:** It is designed to always operate whenever there is voltage between the two system wires (self-supplying).
- **Voltage measurement:** There are several voltages available according to the model, for example: 3x63.5/110V, 3x127/220V, 3x110V, etc.
- **Current measurement:** This may be done via current transformers, for example: /5A, /1A, 80A, etc.
- **Operating frequency:** This may be 50 or 60 Hz according to model.
- **Accuracy:** The CIRWATT has the following accuracy classes: class 0.2S in active energy (IEC 60687) and class 0.5 in reactive energy, class 0.5S in active energy (IEC 60687) and class 1 in reactive energy, class 1 in active energy (IEC 61036) and class 2 in reactive energy (IEC 61268).
- **Data memory:** It has a FLASH memory (no batteries required) and is configuration is rotating (once full, it writes over the oldest data). The memory is organised into three files: load profiles, tariffs and events.
- **Clock:** The CIRWATT has a real time clock. There are two different models: one with conventional quartz oscillator (accurate to 3 minutes per year) and the other more accurate, temperature correcting clock (accurate to 1 minute per year).
- **Battery:** The clock and RAM memory run off a lithium battery with a working life of 10 years (at 25°C). It has to be highlighted that it is easy to replace

without the need to disconnect the equipment. It also has a super-capacitor able to store data for 24 hours without the battery.

- **Communications:** It has 3 channels for transmitting information, meaning that the meter can be adapted to any type of situation: on site reading or remote reading. The first port is an optical interface and the second is a RS-232 and the third can either be RS-232 or RS-485 according to the model.
- **Digital inputs and outputs:** It has digital inputs and outputs that allow the uses of the meter to be expanded.
- **Impulse LEDs:** These are used to verify active and reactive energy and for indirect meters with a cadence of 20,000 pulses/kWh and 20,000 pulses/kvarh respectively. For direct meters (without external transformers) the cadence is 1,000 pulses/kWh.
- **Safety:** The equipment has been designed with the necessary seals to ensure against it being handled by unauthorised persons. It meets all safety, immunity and emission standards.
- **Construction features:** The casing has been designed to meet the DIN 43859 standard and its size to meet DIN 43857.

2.- METER MODELS

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Below are the configuration options for each installation:

Meter version: **CIRWATT □□□-□□□□-□□□-□□**

3 wires	**3**	**Connection mode**
4 wires / 3 wires	**4**	
Class 0.2S active / Class 0.5 reactive	**02**	**Accuracy**
Class 0.5S active / Class 1 reactive	**05**	
Class 1 active / Class 2 reactive	**10**	
3x100 V (3 w)	**G**	**Voltage measured**
3x110 V (3 w)	**H**	
3x220 V (3 w)	**I**	
3x57/100 V (4 w)	**L**	
3x63.5/110 V (4 w)	**M**	
3x127/220 V (4 w)	**N**	
3x220/380 V (4 w)	**O**	
3x230/400 V (4 w)	**Q**	
3x110/190 V (4 w)	**T**	
/5 A threephase	**T5**	**Current measured**
/5 A Aron	**A5**	
/1 A threephase	**T1**	
/1 A Aron	**A1**	
10 A Direct	**D1**	
50 Hz	**A**	**Frequency**
60 Hz	**B**	
RS-232 / RS-232	**1**	**Communications company / user**
RS-232 / RS-485	**2**	
Without card	**0**	**Expansion card**
3 inputs	**1**	
4 outputs (optomos)	**2**	
4 outputs (relay)	**3**	
3 inputs +4 outputs (optomos)	**4**	
3 inputs +4 outputs (relay)	**5**	
3 inputs +4 outputs (optomos)+ Auxiliary supply input 12..50 V DC.	**6**	
3 inputs +4 outputs (relay)+ Auxiliary supply input 12..50 V DC.	**7**	
4 outputs + communications	**8**	
Meter	**A**	**Mode**
Meter + Power demand meter	**B**	
Meter + Tariff setter + Power demand meter	**C**	
Meter + Tariff setter + Power demand meter + Logger	**D**	
Version and/or protocols		**Revision**

The following over-range factors are available: 1.2 In, 1.5 In, 2In, 8In and 9In (the last two only in direct).

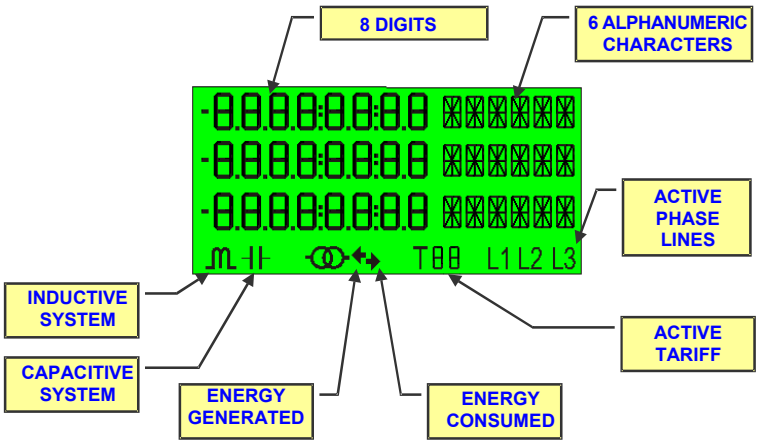
3.-PHYSICAL DESCRIPTION OF THE METER

Below is a physical description of the different parts in the CIRWATT:

3.1.- Display

Data is presented via a LCD display with three lines especially designed for the CIRWATT. Here all previously set information is displayed, for example: energy generated and consumed meters (4 quadrants), electrical parameters, active phases, active tariff, etc. It can also undertake a manual check of the meter's settings.

Each of these lines consists of 8 numerical digits to show sizes and 6 alphanumeric digits used to display the units.



The display also has a status line with indicators giving system information:

- **Energy direction:** This informs the user at any determined moment, if it is consuming energy or generating it. This indicator is of great use in those installations where there is co-generation.
- **Inductive/capacitive system:** This is used to show whether the installation has inductive or capacitive consumption. It may be used to find out if its reactive energy correction is working correctly.
- **Active tariff:** This shows the tariff for the accumulated energy being consumed at that time. It is useful for those contracts that are invoiced on a different hourly basis.

- **Active phases:** This shows the existence of an electrical supply in the voltage phases. By doing so problems may be detected in any of them.

Information displayed by the meter is configurable from PC software and the following information may be personalised:

- **Variables displayed:** Information that will appear on the meter's screen may be selected.
- **Units and formats of the variables:** The format of the meter's energy variables may be set. The options are shown in the following table:

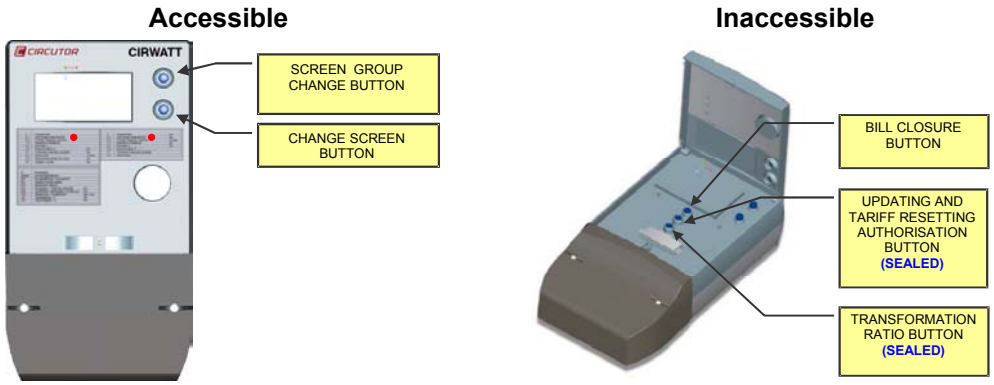
Units	Decimals
kW	0.1 or 2
MW	0.1 or 2

- **Texts for the variables:** The different texts that must accompany the variables when they are displayed, may be defined.
- **Language:** The text for the keyboard functions may be selected (Spanish or English).

3.2.- Keyboard

The equipment has five buttons that allow the CIRWATT's display and set-up parameters to be managed.

These may be divided into two groups: accessible and inaccessible to the user, as shown in the following diagram.



Accessible to the user:

There are two buttons that may be directly accessed from the outside given that they are not protected by any seal. They are used to manage the different display screens.

- **Changing the group of screens:** This allows the user to move between the different information groups.
- **Changing screens:** This allows the screen to advance.

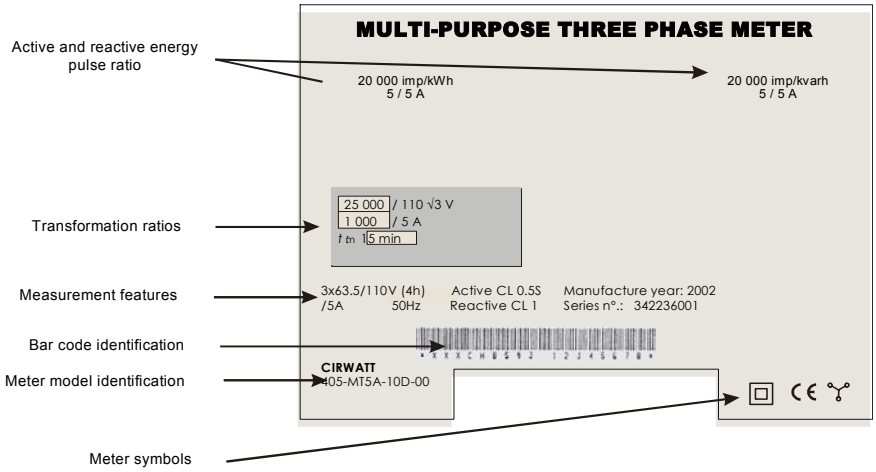
Inaccessible to the user:

These are not directly accessible from the outside since they are located below the meter's cover. Once the cover seal is removed three buttons are seen:

- **Bill closure button:** This does not have a seal and is used to close the billing period.
- **Setting button:** This allows the tariffs and the timing to be configured. This button is sealed to ensure that unauthorised people does not use it.
- **Laboratory setting button:** This is used to set the voltage and current transformer ratios as well as the energy display scale. It is also sealed.

3.3.- Technical details label

On the front of the meter is the technical details label, showing the following information:



- **Active and reactive energy pulse ratios:** This defines the frequency at which the two LEDs (active and reactive energy) flash. For indirect meters this ratio is 20,000 impulse/kWh and 20,000 impulses/kvarh. The 5/5 A sign shows that this ratio is defined in respect to the power it is measuring in the transformer secondary. In 80A direct meters the ratio is 1,000 impulses/kWh and 1,000 impulses/kvarh.
- **Operating features:** This part of the label describes: the operating voltage, frequency, nominal current and accuracy of the active and reactive energy measurement.
- **Measurement features:** The measurement transformers used for connecting to the installation are described. These values correspond to the programs in the meter. It will also show the integration period of maximum demand (if used).
- **Year of manufacture:** The year in which the meter was manufactured.
- **Series number:** The unique identity number for each meter.
- **Bar code:** Bar code to identify the meter. Its specifications have been defined by UNESA.
- **Model identifier:** Manufacturer's code to identify the model. By using this code its configuration may be known: power supply, current measured, measurement system, if it has an expansion card and the model, etc.
- **Meter symbols:** Symbols showing conformity to EC isolation and measurement method standards.

3.4.- Mechanical design

The CIRWATT casing comes under the DIN 43859 standard and its size complies with the DIN 43857standard.

The internal design of the CIRWATT is notable for its great strength and simplicity. It comprises three printed circuit boards:

- **Base board:** On the board there are all the components for electrical measurement and communications.
- **Logic board:** all processing, control and display electronics are contained here. There are also the buttons and optical interface. It is a multi-layer board that makes it highly immune to electro-magnetic interference. Its SMD assembly also increases the reliability of the equipment.
- **Input/output board:** This is optional and is used to increase the meter's functions. It can also include an external power supply and communications.

3.5.- Data storage

To store data, the CIRWATT two, completely differentiated memory areas:

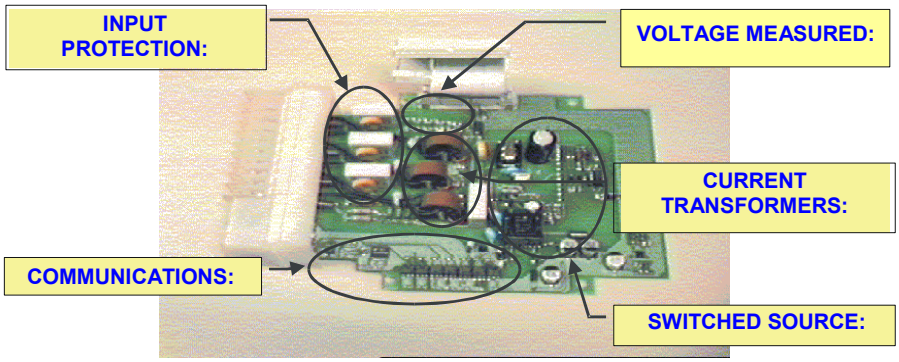
- **Program memory:** The CIRWATT program is recorded on the internal FLASH memory of the microprocessor.
- **Data memory:** This memory stores all the useful information for control and billing. The energy meters (bill closures), load profiles and events are stored here. This memory is also a FLASH memory and ensures that data is kept when there is no power supply.

3.6.- Measurement system

The measurement system for the CIRWATT multi-purpose three-phase meter is described below.

3.6.1.- Base board (power supply and measurement)

This printed circuit board houses the measurement and power supply for the meter as well as the communications and input protection:



3.6.2.- Measurement/power supply circuit

The meter is supplied via a voltage input (self-supplying). Many of the measurement features also affect the power supply.

- **Measurement:** It has a high degree of protection against external events. This protection prevents the meter suffering any damage from transients, voltage surges or overloads in the current circuit. A +/-25% voltage from the nominal will not affect the proper working of the meter and the measurements made are guaranteed to be correct. It may be installed in 50 Hz or 60Hz electrical systems depending on the CIRWATT model.
- **Power supply:** The meter will always continue working when the Phase-Neutral or voltage between phases is up to 25% less than the minimum nominal voltage.

Example:

	4 wire three-phase system
Nominal voltage	110 V (Phase-Neutral)
Minimum voltage supplied	V (Phase-Phase)= 83 V or V (Phase-Neutral)= 83 V

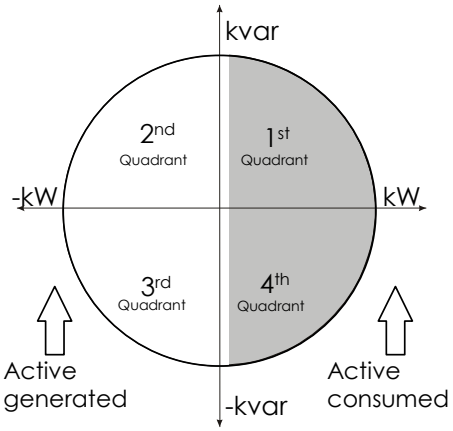
3.6.3.- Measurement calculation

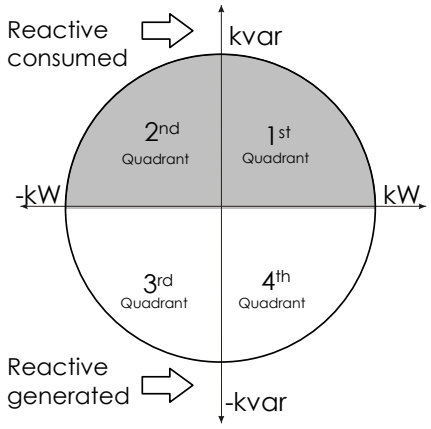
Processing voltage and current signals is done via a 16-bit converter (± 32768 points), a DSP and a 16 bit at 16 MHz microprocessor. These parts offer high power, speed and accurate calculations.

As well as voltage and current inputs, the meter has a system that first samples (analogue-digital converter) and then calculates (DSP) all electrical values on the system (voltage, current, frequency, power, PF and energy).

The equipment has a system of meters to calculate energy. These meters add up the energy consumed and generated by the installation. There are 6 energy totalisers (3 for consumption and 3 for generation). This information is detailed per phase and three phase:

- 4 active energy generated meters (L1, L2, L3 y III)
- 4 active energy consumed meters (L1, L2, L3 y III)
- 4 inductive energy generated meters (L1, L2, L3 y III)
- 4 inductive energy consumed meters (L1, L2, L3 y III)
- 4 capacitive energy generated meters (L1, L2, L3 y III)
- 4 capacitive energy consumed meters (L1, L2, L3 y III)





The equipment also calculates the following electrical parameters:

- Phase voltage 1, 2 and 3.
- Phase current 1, 2 and 3.
- Frequency.
- Power factors in phases 1, 2 and 3.
- Active power in phases 1, 2, 3 and three phase.
- Reactive power in phases 1, 2, 3 and three phase.
- Apparent power in phases 1, 2, 3 and three phase.

3.7.- Input/output board

This board is optional and is not necessary for the proper working of the meter.

3.7.1.- Digital outputs

The CIRWATT has 4 digital outputs. There are two relays that may be fitted onto this board:

Mechanical relays. The features of these are the following:

- Maximum operating power: 1,500 W.
- Maximum operating voltage: 400 V AC.
- Maximum operating current: 6 A AC.
- Mechanical life: $30 \cdot 10^6$ operations.
- Switch speed: low.

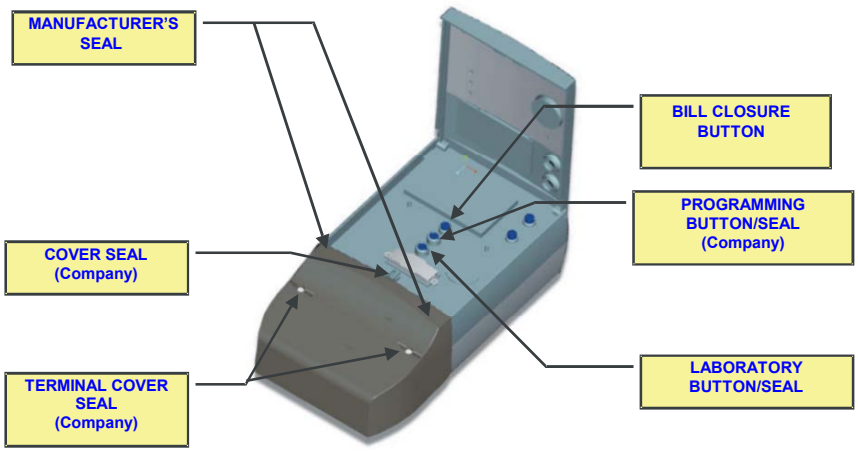
- **Solid state relays (optomos types).**
  - Maximum operating voltage: 400 V AC.
  - Maximum operating current: 150 mA AC.
  - Mechanical life: unlimited.
  - Switch speed: high.

3.7.2.- Digital inputs

The CIRWATT has 3 digital inputs that are independent of each other and are opto-isolated.

3.8.- Security levels

The CIRWATT three-phase meter has the necessary seals to guarantee that any unauthorised person uses no part of the meter.



The majority of these seals are hierarchical, which means that some are inaccessible if one from an upper level has not been removed.

3.8.1.- Manufacturer's seals

Once the meter is manufactured and checked, the manufacturer attaches these seals to prevent any of the meter's electronics being used. To reach this seal it is necessary to first unseal the terminal cover.

3.8.2.- Terminal cover seals

These seals are attached once the equipment has been fitted. These seals will prevent the modification of the meter's connection.

3.8.3.- Meter cover seal

This seal protects the bill closures and clock battery changing. It also blocks access to the setting and laboratory seals.

3.8.4.- Setting seal

This seal blocks any setting that may affect the meter recording data, for example: tariff selection, timing calendar configuration, clock setting, recording period to obtain load curve, etc.

3.8.5.- Laboratory seal

In authorised or factory laboratories the transformation ratios used in the installation are set. These may only be changed if this seal is removed.

The setting for the energy units displayed are also only able to be changed by removing this seal.

3.8.6.- Setting protection

The CIRWATT program is protected against any change by an internal security system. It can only be reset by removing the manufacturer's seals.

4.- DESCRIPTION OF THE OPERATION OF THE METER

This section shall describe how the equipment behaves from an operational point of view. That is to say, it shall explain how all the information provided is handled, as well as how the different functions of the system are configured.

The description sections will be divided as follows:

- Display system.
- Tariff control system.
- Inputs and outputs.
- Files.
- Keyboard functions.

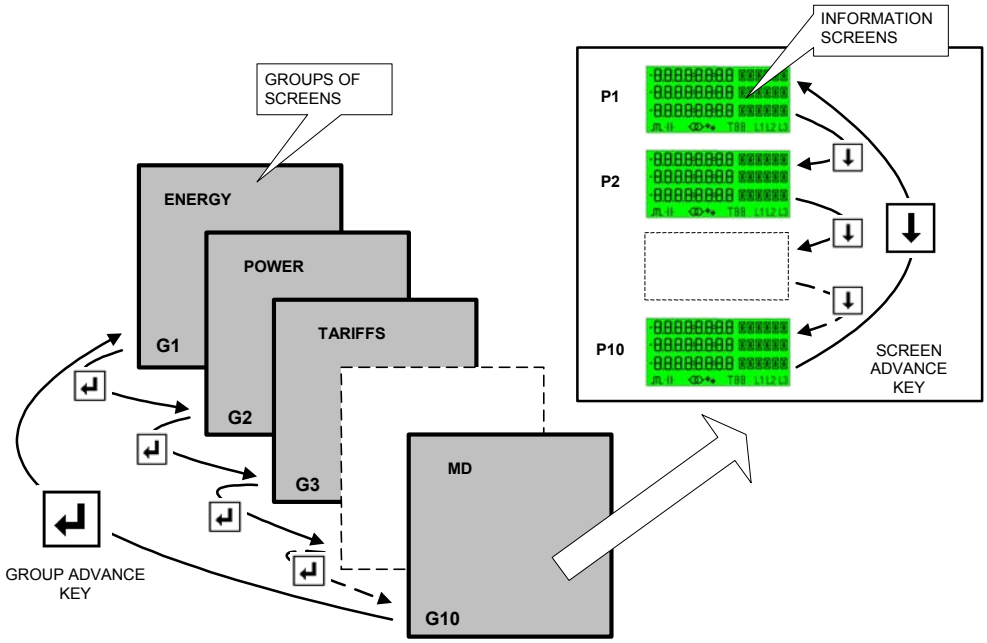
4.1.- Display system

One of the main problems with this type of equipment is the large amount of information it can supply (more than 150 variables). This means a very complex display when this information is accessed via a limited size display. To combat this the **CIRWATT** uses a configurable screen system that allows the user to work with only that information considered necessary. To do this there is the option to select the following parts:

- **Screen**: This is all the information that may appear on the display at the same time. The variables and the wording to be shown on each line may be selected. Also the different display functions may be activated or deactivated (intermittency, rotating, ...).

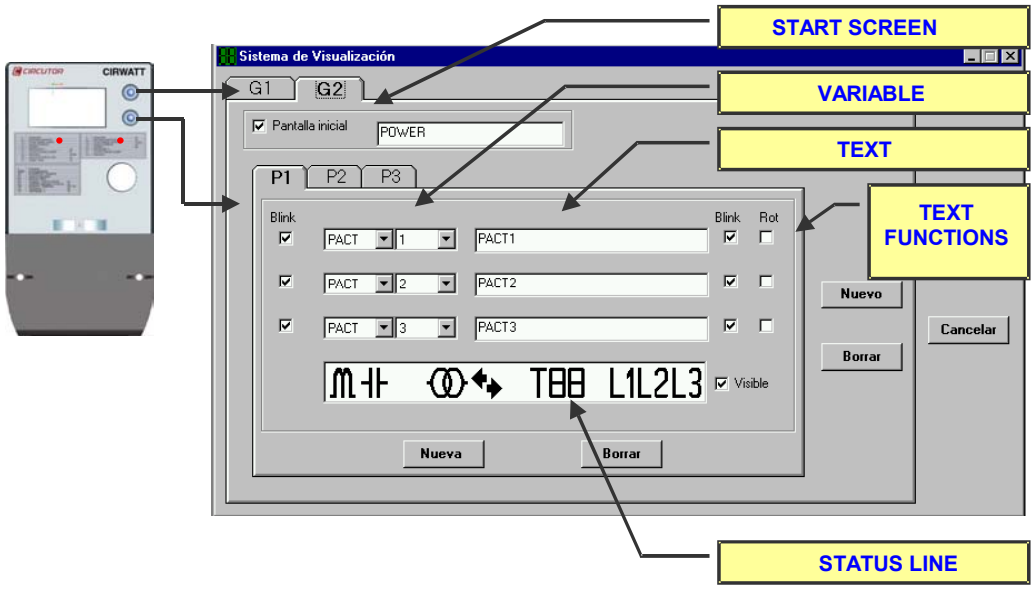
- **Group**: This is the logical grouping of screens, for example a group of screens with information on energy, or maximum demand values, etc.

From the diagram it can be noted that there are different groups of screens up to a maximum of 10. Also, by using the *advance group* key we may move from one to another. It can also be seen that each group may consist of a maximum of 10 screens and with the help of the *advance screen* key it is possible to display the following:



The equipment has PC software that allows the easy and rapid setting of all the display system. The manufacturer can also reset it by customer request.

As the diagram shows, these keys are used to operate the display. The upper one changes the group and the lower moves on to the next screen.



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When a group is first created, there is the option to select a maximum 18-character wording. This will appear for 3 seconds in the alphanumeric section when the change group key is pressed. The wording is used to differentiate the different information groupings. These may be for example:

- Energy.
- Tariff.
- Maximum demand.
- Etc.

Then the information to appear on each of the three lines can be selected:

- **In the numerical digits**, one of the more than 150 available variables may be selected. There is also the option to chose if this variable appears intermittently or not.
- **In the alphanumerical digits,** a text associated with the variable may be written. As previously, it may be displayed intermittently if programmed to do so. As there are only six digits, there is the option to configure a 14-character wording that may appear sequentially.

Finally, a line where the status of the installation appears, may be chosen (connected voltage phases, quadrant, tariff, etc).

This display system can easily adapt the alphanumeric display to any language, making the equipment suitable for the needs of every country.

4.2.- Tariff control system

The configuration method for the tariffs, all their variables and their management, is described below.

Two complete annual calendars can be set in the equipment. This way, it facilitates the transition from one year to the next without the presence of undefined tariff periods. In each calendar the year may be independently selected so that the equipment will compare it with its internal clock and select the most suitable one. In the event that neither agrees with the equipment, it will work with the nearest and will indicate the anomaly by recording it in the events file.

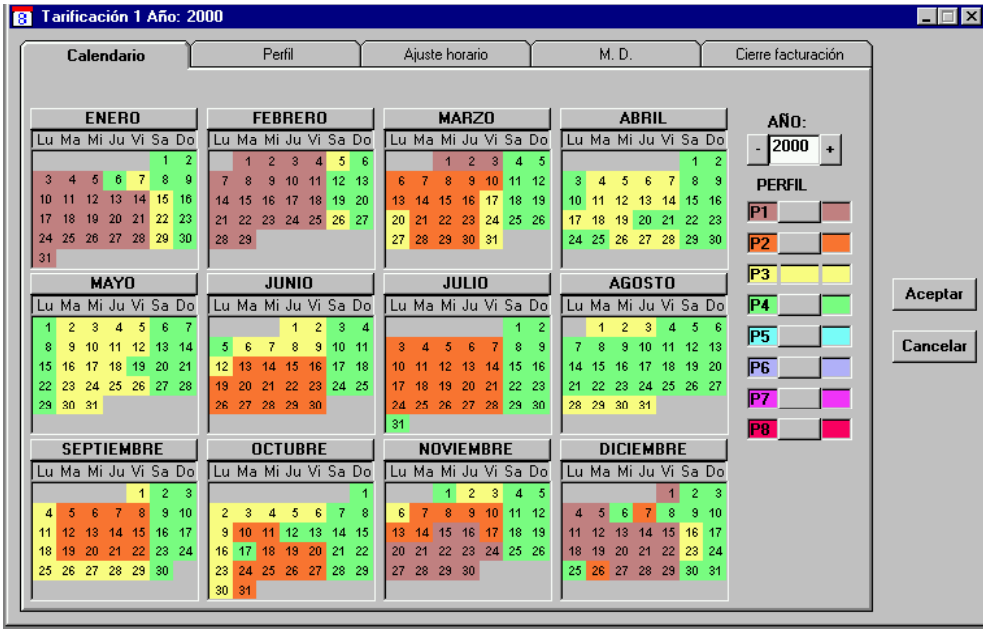
4.2.1.- Configuration of the tariffs

Profile calendar:

One of eight possible profiles can be set for each day of the year. In this way the annual calendar will be easily and accurately defined.

In the diagram below the configuration of the calendar via PC software can be seen. In this case it is for the year 2000 and the assigned profiles are the following:

- Profile 1 : Peak.
- Profile 2 : High.
- Profile 3 : Medium.
- Profile 4 : Low.



Profile definition:

Eight different profile types may be defined on the equipment, each having a 15-minute interval. Any of the 9 system tariffs may be selected for each profile.

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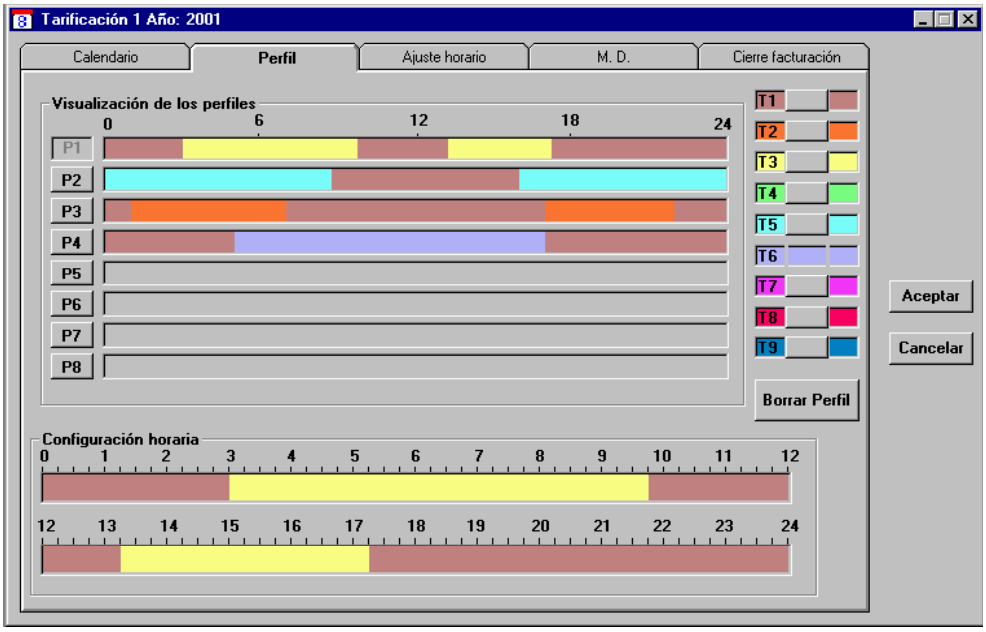
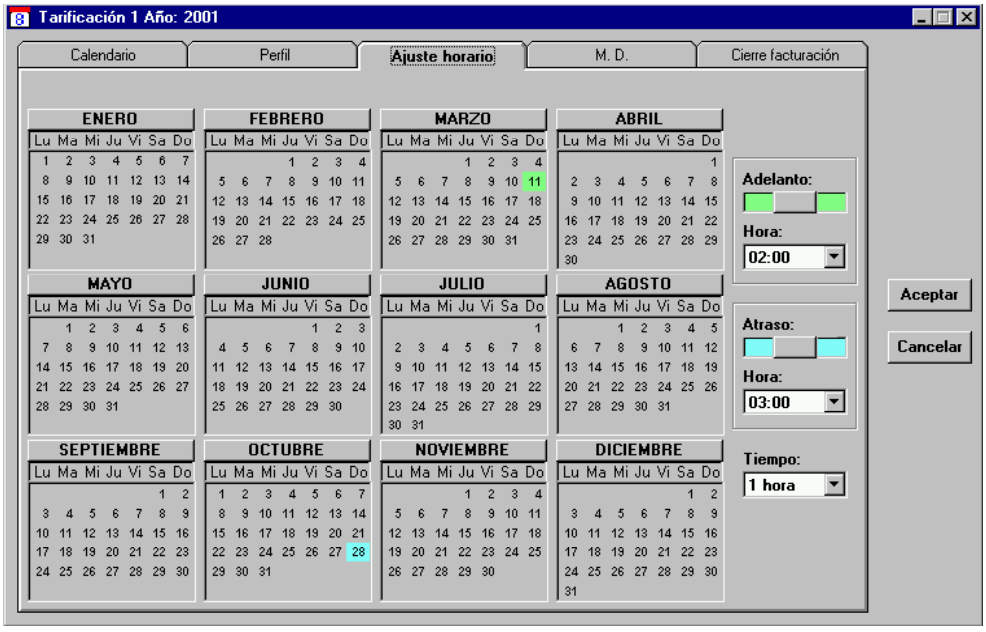


Time setting:

The equipment can be programmed for the day, hour and minute when the changeover to winter-summer and vice versa timings will be made, depending on the country where it is operating. It can also select if the interval will be hourly or higher.



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4.2.2.- Operation of the tariffs

There are nine energy accumulators, one for each tariff plus one for the total accumulated. The system checks what is the active tariff for that time every second and accumulates energy for that period in its own meter, as well as adding it to the general meter.

The equipment handles in a different way the information that will appear on the display and that will finally go to make up the file produced when closing the bill.

Display information:

Energy information for each of the tariff totalisers plus the accumulated total for each of the following energy types may be displayed:

- Active energy consumed.
- Active energy generated.
- Reactive energy in the first quadrant.
- Reactive energy in the second quadrant.
- Reactive energy in the third quadrant.
- Reactive energy in the fourth quadrant.

The counters are absolute, that is to say they only return to zero when the maximum that can be displayed is reached.

File information:

In the tariff file, the energy information for each tariff totaliser is recorded, as well as the accumulated total for the following energy types:

- Active energy consumed.
- Reactive energy in the first quadrant.
- Reactive energy in the second quadrant.

There are two types of energy counters, absolute (the same as the display type) and incremental which only accumulate energy consumed during the billing period. When it is closed it returns to zero.

4.2.3.- Maximum demand configuration

With maximum demand, the maximum power consumed may be checked and at what point in each of the nine tariffs. These values are started each time there is a bill closure, presupposing the start of a new control period.

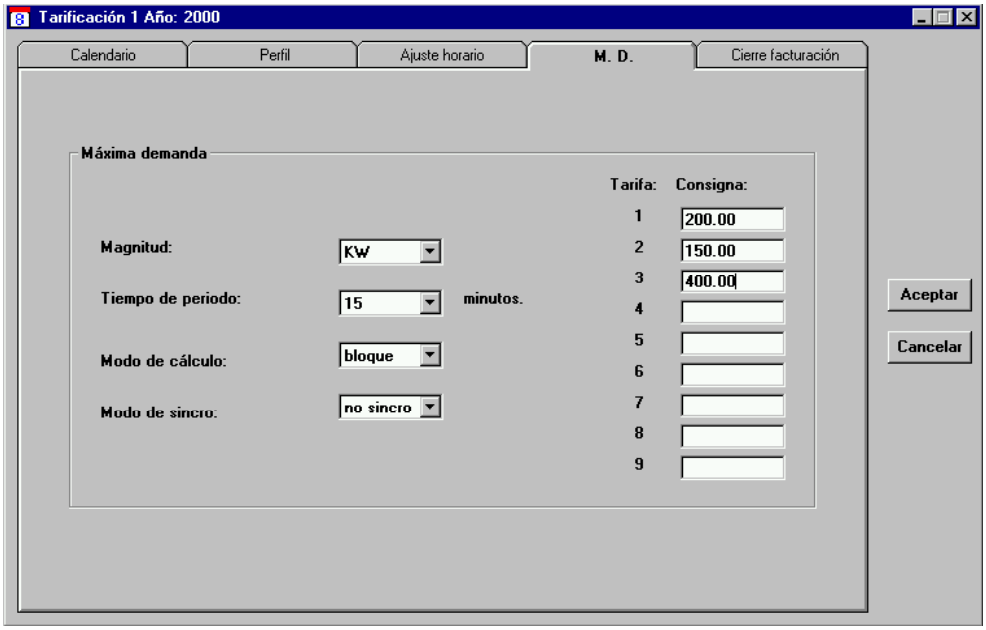
The following parameters may be set for the maximum demand system:

- **Reference magnitude:** This shows if the equipment will calculate the maximum demand on the basis of active or apparent power.
- **Recording time:** This is the integration period for measurement up to obtaining a maximum value.
- **Calculation mode:** This allows the form of calculation to be selected, either in block mode of by the sliding window system.
- **Synchronisation mode:** Selecting this controls if the integration periods are synchronised with the clock or not.

The following table shows the possible values that may be assigned to the maximum demand configuration parameters:

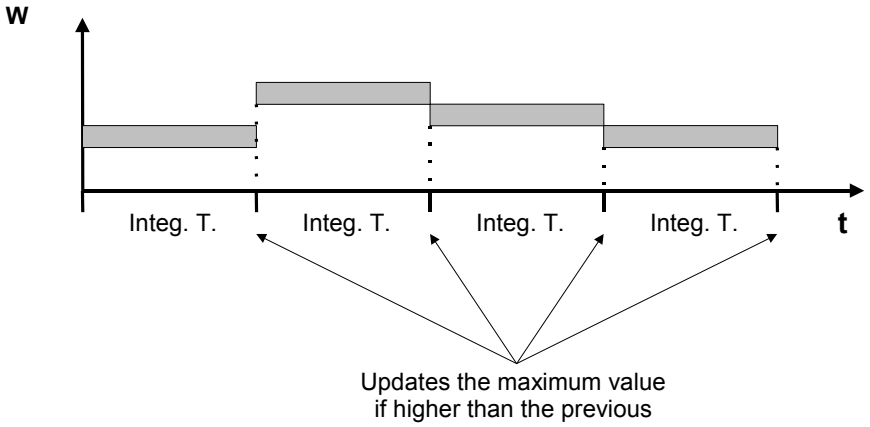
PARAMETERS	VALUE
Magnitude	KW or kVA
Integration time	5 / 10 / 15 / 20 / 30 / 60 minutes
Calculation mode	Block or sliding
Synchronisation mode	Synchronised or non synchronised

The previously mentioned parameters may be seen on the screen, as well as the maximum demand alarm commands for each tariff. This value must be directly related to the magnitude of the selected reference. In the following example only the alarms for tariffs 1,2,3 have been set. In the event of being associated with an alarm output, this will be activated if the power value exceeds the pre-set value. The tariff will also intermittently appear on the status line of the display.



Fixed window:

If the selected maximum demand calculation method is per block, it will operate according to the diagram below:



The power will be accumulated during the integration period and will be compared the previous maximum value at the end. In this way if it exceeds the previous maximum, This and the integration period in which it occurred will be updated.

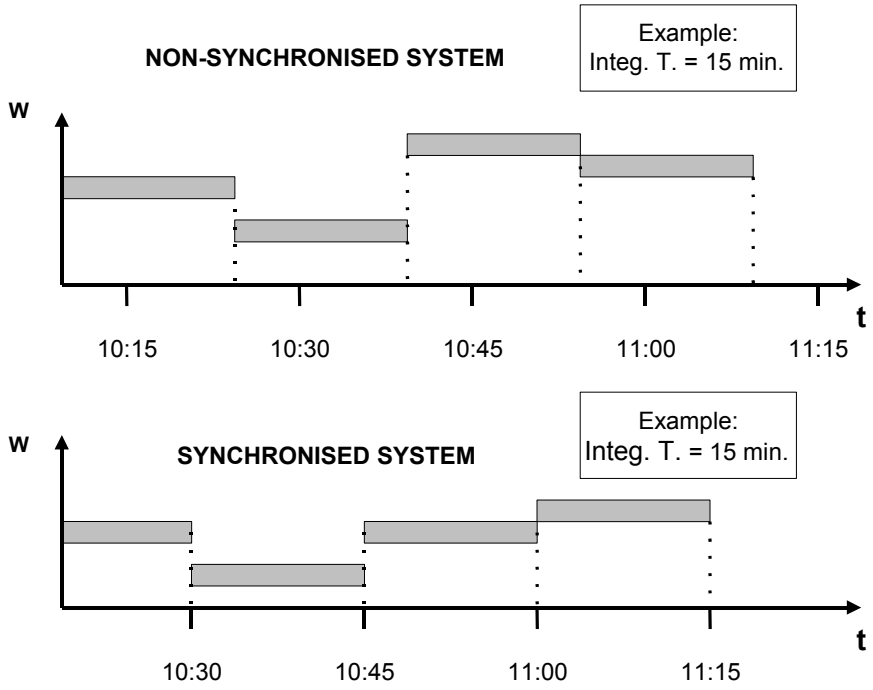
The integration period may or may not be synchronised with the time according to configuration. If it is not synchronised, when the equipment is

started, it will wait for an integration period before having the first maximum power value. When it is synchronised, the size of the first period will adjust to the first entire multiple of the integration period.

Some examples are shown in the following table:

Synchronisation type	Integ. T.	Start time	First maximum
NON SYNCH	15'	10 : 36	10 : 51
SYNCH	15'	10 : 36	10 : 45
NON SYNCH	30'	12 : 20	12 : 50
SYNCH	30'	12 : 20	12 : 30

The following diagrams show the difference between a synchronised and non-synchronised block maximum demand system with an integration period of 15 minutes.



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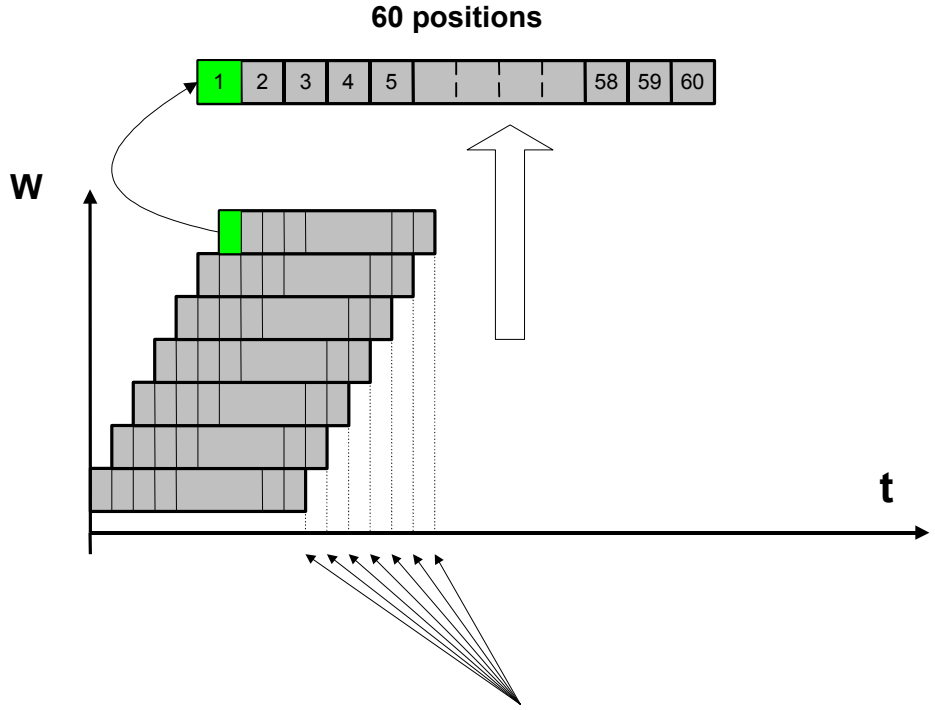
Sliding window:

In the sliding window system the integration period is divided into 60 intervals. In this system there is the average value for the interval being accumulated, together with the 59 previous intervals. This produces a sliding filter effect.

In the following diagram it can be seen how the window slides, providing a new value each time in each bow has been exceeded.



In this table, several examples of integration times and the frequency of updating the maximum can be seen:

Integration T.	Interval time	Maximum updating time
5 min.	(5 min * 60 s) / 60 intervals	5 s
15 min.	(15 min * 60 s) / 60 intervals	15 s
30 min.	(30 min * 60 s) / 60 intervals	30 s

The sliding window format can also select if the integration period is to be synchronised with the equipment's clock. However in this case, what will be set

against the clock multiples, will be the revision time for the maximum instead of the integration time.

4.2.4.- Bill closure

Four types of operation that can act simultaneously may be set for bill closures:

- **Manual**: Once the upper seal on the equipment is removed, the unsealed button is accessed. Once this is pressed it starts the whole bill closure process. The wording for the process and the current time will appear on the display.
- **Automatic**: Once the day, hour and minute are set, the equipment will check every second during this period. When it detects that there is a coincidence with its internal clock it will automatically starts the bill closure.
- **Via communications**: It is also possible to produce a bill closure remotely using a communications command.
- **Digital input**: Finally there is the option to select one of the digital inputs to create a closure.

The table below shows the available protection for each of the different types:

	Manual	Automatic	Remote	Digital input
Protection	Seal on the upper cover	Authorisation form the setting	Password	Seals on the terminal covers

There is a security period for all possible closure types (5 minutes) stopping any other closure happening. The display will show the time if an attempt is made.

A bill closure consists of the following processes:

- A record of the absolute and incremental totals for each tariff in the tariff file.
- Returning to zero the incremental totals for each tariff.
- Recording in the file the maximum demand value and the time when it occurred in each tariff.
- Starting the maximum demand value at the beginning of the new billing period.
- A record in the events file.

4.3.- Inputs and outputs

The equipment has the option of an expansion card for inputs and outputs. The functions of this card can be very different depending on its configuration.

4.3.1.- Input configuration

The expansion card inputs may be configured to undertake the following functions:

- **Tariffs:** Each of the inputs may be set to indicate the active tariff to external equipment. If the tariff system has been set using the internal clock, the tariff value indicated by the inputs will have priority. It is also possible to select whether the tariff value is given by a binary combination or directly from the inputs.
- **Power demand meter synchronisation:** Using an input, it is possible to indicate the integration period for the power demand meter. As above, it can operate in conjunction with the internal system linking the clock to outside. However it is this system that will always have priority.
- **Bill closure:** Finally, the input may be programmed to produce a bill closure when it detects a pulse to do so. All possible closure systems have the same priority and work within the same security time.

The table below describes the parameters that have to be set for each of the input functions:

Function	Setting		
	Binary or direct	T. ON (0.01-9.99)s	Side (increase, decrease)
Tariff	Programmable		
Power demand meter synch.		Programmable	Programmable
Bill closure		Programmable	Programmable

For synchronisation and closure, the time for the signal to remain active may be set. This is also the same for changing the level that will set off the function.

4.3.2.- Output configuration

Outputs on the expansion card may be configured to perform the following functions:

- **Emitting active and reactive impulses:** The equipment may be set so that it generates impulses proportional to the active or reactive energy consumed or generated. One of the possible applications for this function would be to group together the consumption by different meters.
- **Tariff outputs:** It is possible to assign an output to each of the tariffs. Up to four tariffs can be shown if it is direct or up to nine if the binary combination is selected.
- **External power demand meter synchronisation impulse:** If an output with this function is selected, when each integration period has finished, a pulse with a programmable length is generated.
- **Maximum demand alarm:** An output that is associated with a tariff or anything else may be programmed to set off an alarm when the command configured in maximum demand is exceeded.

The table below describes the parameters that have to be programmed for each of the output functions:

Function	Setting					
	Imp / kWh or kVArh (100-20000)	Imported/ Exported Energy	Binary or Direct	Tariff	T. ON (0.01-9.99)s	N.Open or N.Closed
Impulse emission	Prog.	Prog.				Prog.
Tariff			Prog.			Prog.
Power demand meter synch.						Prog.
MD Alarm				Prog.		Prog.

4.4.- Files

Data is organised into three different types of file Each one has an area of this memory reserved for it, so that each of these memory areas can only be used to store data for that file:

- **Load profile records:** Energy consumption is periodically recorded.
- **Tariff records:** When a bill closure is made, all tariffs are recorded from the meter readings. These records are only made from energy consumed (2 quadrants).
- **Event register:** All dates of the set-up modifications, battery changes, time changes, bill closures etc are recorded.

Type		Size	No. of Records	Time
Events		12 bytes	>600	
Tariff		1024 bytes	64	> 5 years (1 contract)
Load profiles	**Hourly**	64 bytes	5120	> 200 days
	Quarter hourly	64 bytes	5120	> 50 days

Data in each of the files is organised on a rotating basis. This means that once the memory is full, new data is stored instead of the oldest data. This system ensures that the meter always has updated information and has the most recent data obtained.

4.5.- Functions of the keyboard

The functions of the keyboard are defined below.

4.5.1.- Set-up

By pressing the screen change and group change buttons at the same time, the set-up parameters are displayed. These are grouped in the following way:

- First year tariffs.
  - Profile calendar.
  - Tariff definition.
  - Clock setting.
  - Maximum demand.
  - Bill closure
- Second year tariffs.
  - Profile calendar.
  - Tariff definition.
  - Clock setting.
  - Maximum demand.
  - Bill closure.
- Recording time.
- Date.
- Display contrast adjustment.
- Transformation ratios.
  - Voltage.
  - Current.
  - Scale.
- Communications.
  - Optical channel.
  - User channel.
  - Company channel.
- Inputs and outputs.
  - Output 1.
  - Output 2.
  - Output 3.
  - Output 4.
  - Input 1.
  - Input 2.
  - Input 3.

- Battery status.
- Version.
  - Series number
  - Software version.
  - Calibration date.
  - Meter model.

In set-up mode, all of the previous parameters are for consultation purposes only (they cannot be modified from the keyboard), except for the display contrast.

4.5.2.- Bill closure button

This key allows the bill to be manually closed so that the totals from the different tariffs are transferred to the corresponding file.

4.5.3.- Update/setting button

This key has two functions:

- Updating the meter.
- Authorising set-up mode, to modify via PC software the equipment's configuration.

4.5.4.- Transformation ratios button

This button allows access to the configuration of the voltage and current transformation ratios. It also allows the energy scale to be selected.

5.- VERIFICATION (IMPULSE LEDs)

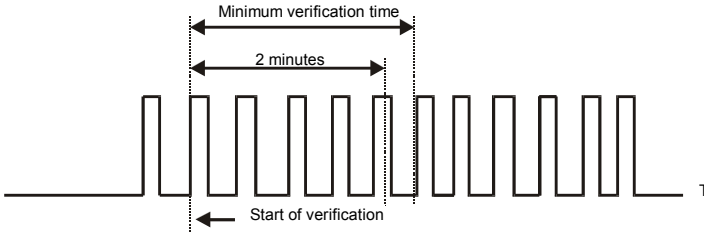
On the front of the meter there are two LEDs use to give impulses proportional to the consumed and generated active and reactive energy, thereby verifying the measurement.

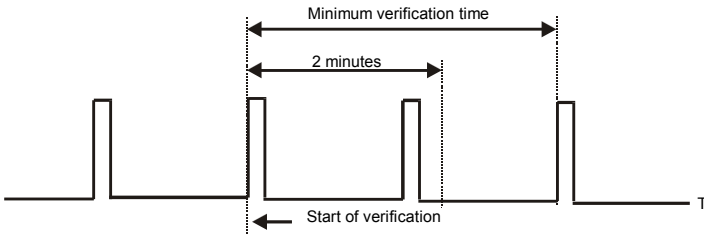
These LEDs have a fixed cadence printed on the features label on the meter.

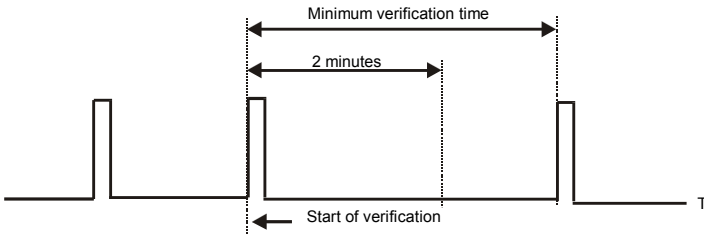
Its maximum value is 20,000 pulses for kWh and for kvarh, for measuring active and reactive energy respectively. This pulse ratio is connected to the voltage and nominal current of the meter.

To verify the meter, a minimum time has been defined determined by the following pulse that arrives after a minimum of 120 seconds from the start of verification.

Verification must always start and finish when an impulse arrives.







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6.- COMMUNICATIONS

The equipment has three communications channels:

- **Optical interface:** This complies with the electrical and mechanical specifications in the IEC 61107 standard. It is used for on-site meter reading and setting.
- **Company RS-232:** This channel is reserved for the electricity supply company and allows the equipment to be configured and the extraction of files. It connects directly and also via a telephone modem for remote communication.
- **User RS-232/RS-485:** This channel is reserved for the user. It is used as a RS-232 whenever long distance, point to point communication via a telephone modem is required. It is used as a RS-485 when it is necessary to have a multi-point connection with distances up to 1200 m.

The protocols that the meter can implement are:

- **IEC 870-5-102:** For data extraction.
- **MODBUS-RTU:** For meter reading and configuration.
- **ZMODEM:** Exclusively for file extraction.
- **IEC 61107:** For setting the equipment and file extraction.

7.-REAL TIME CLOCK

By using this clock, the official date and time of the recordings are obtained. It also handles time and period changes.

Quartz or the electrical system may set the real time clock. In both cases, the clock is accurate to less than 3 minutes per year at 25 ºC.

For applications that require more accuracy, there is the option to attach a temperature-corrected clock that is accurate to less than 1 minute per year.

When there is no power supply, the clock works off a lithium battery. It also has a supercondenser to increase battery life, supplying the necessary power for the first 12 hours.

8.- LITHIUM BATTERY

The lithium battery that keeps the real time clock and the equipment's RAM working, ensures a 50% charge for 10 years under normal operating conditions.

If the meter suffers long periods of storage or extreme environmental conditions, the battery life will be changed.

The battery is located on the front of the equipment, protected by the terminal cover. Changing it is an event that is recorded in the corresponding file.

It is noted that the battery can be replaced with the meter receiving voltage, because there is no contact at any time with dangerous voltages.

The equipment also has a super-condenser to supply the necessary energy to keep information during the first 24 hours without power supply and allows the battery to be changed without the clock having to be reset.

9.-TECHNICAL FEATURES

The CIRWATT electrical and mechanical design has incorporated all of the standards applicable to electronic meters. It also has included operational details (handling and maintenance).

Power supply:	Self-supplied		
Nominal voltage:	According to model: e.g. 4 wire: 3x63.5/110 V		
Consumption:	< 2W		
Frequency:	50 Hz or 60 Hz (according to model)		
Operating temperature	-20 ºC to + 60 ºC		
Voltage measured:			
Voltage:	According to model: e.g. 4 wire: 3x63.5/110 V		
Other voltages:	Via transformers		
Frequency:	50 Hz or 60 Hz		
Current measured:			
Other currents:	Via current transformers (.../5A or .../ 1A)		
Maximum current:	1.2 * In /1.5 In / 2 In		
Accuracy:			
Active energy:	Class 0.2 S	Class 0.5 S	Class 1.0
Reactive energy:	Class 0.5	Class 1.0	Class 2.0
Calculations and Process:			
Micro-processor:	16 bits - 16 MHz		
Converter:	16 bits		
Data Memory:			
Type:	FLASH (No battery required)		
Configuration:	Rotating		
File size:	- Events: 8 Kbytes - Tariffs: 64 Kbytes - Programmable load curve: 384 Kbytes - Programmable load curve: 384 Kbytes		
Independent operating life:	Events: More than 600 Tariffs: > 5 years (1 contract) Load curve (15 Minutes): > 50 days Load curve (Hourly): > 200 days		

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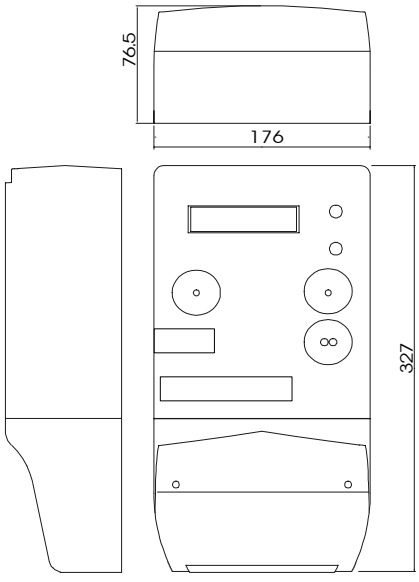
Battery:	
Type:	Lithium
Life:	50% of its capacity after 10 years
Battery changing time:	Maximum 12 hours without power supply
Clock:	
Type:	Quartz oscillator
Accuracy:	Conventional oscillator: - Less than 3 minutes per year at 25 ºC Temperature correct oscillator: - Less than 1 minute per year, between –40 ºC and +80 ºC
Digital Inputs:	Free of potential: 60-300 V AC.
Digital Outputs:	Free of potential
Type:	Mechanical or optomos (According to model)
LED output:	
Maximum cadence:	20000 pulses / kW.h or kvar.h 1000 pulses / kW.h or kvar.h (direct measurement)
Safety:	Category III (110 V) according to EN-61010
Construction features:	
Casing:	According to DIN 43859 standard
Sizes:	According to DIN 43857 standard 

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Optical Reader:	Reading/writing IEC-1107 for on-site access.
Series Port:	
User:	CHANNEL RS-232 or RS-485 Reading only
Company:	CANAL RS-232 Reading/writing
Tests/Standards:	
EN 60687 EN 61036 EN 61268	Standards for static, active energy meters for alternating current, class 0.5S and 1.0. Standards for static, reactive energy meters for alternating current, class 0.5S and 1.0.
EN 55022	- Conducted emissions: Class B - Radiated emissions: Class B
EN 61000-4-6	- Immunity to RF fields coupled to cables (common mode): 10 V
EN 61000-4-8	- Immunity to magnetic fields at system frequency: 30 A/m

10.- INSTALLATION AND START UP

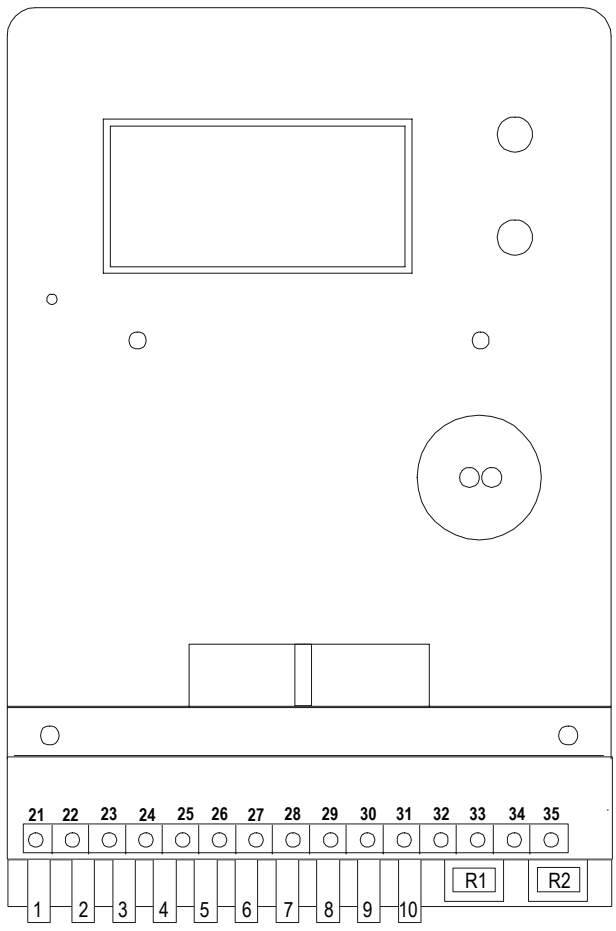
10.1.- Installing the equipment

The meter has been designed to comply with the DIN 43857 standard defining the size and fixing points.

It must be remembered that all connections must remain under the terminal cover.

Remember that when the equipment is connected, the terminals may be dangerous if touched. Opening the covers or removing parts may access parts, which are dangerous when touched. The equipment must not be used until it is finally installed.

10.2.- Meter terminal ratios (see label on terminal cover)



No.	*Terminal description*
	Lower board
1	*Current input IL1 – S1*
2	*Measurement UL1*
3	*Current input IL1 – S2*
4	*Current input IL2 – S1*
5	*Measurement UL2*
6	*Current input IL2 – S2*
7	*Current input IL3 – S1*
8	*Measurement UL3*
9	*Current input IL3 – S2*
10	*Neutral Measurement*
R1	*RS-232 or RS-485 communications*
R2	*RS-232 communications*
	Upper board
21	*Relay Output 1*
22	*Relay Output 1*
23	*Relay Output 2*
24	*Relay Output 2*
25	*Relay Output 3*
26	*Relay Output 3*
27	*Relay Output 4*
28	*Relay Output 4*
29	*Contact input 1*
30	*Contact input 1*
31	*Contact input 2*
32	*Contact input 2*
33	*Contact input 3*
34	*Contact input 3*
35	*Not used*

NB: The .. /5A current inputs are isolated.

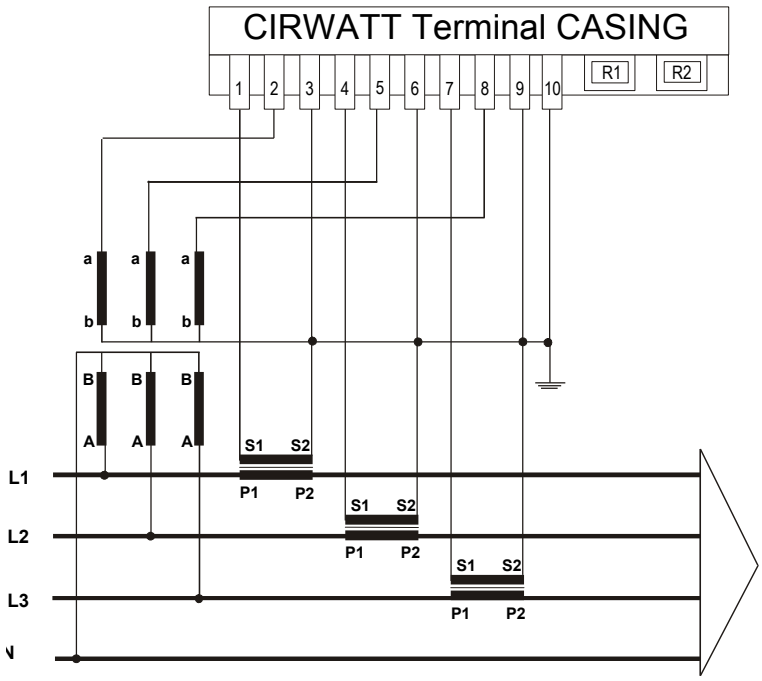
10.3.- Meter connection diagram

Each CIRWATT model is designed for different types of three phase systems. The connection diagram will change.

The required connections are shown in the diagram on the inside of the terminal cover

10.3.1.- 4 wire connection

Three voltage transformers and three current transformers:



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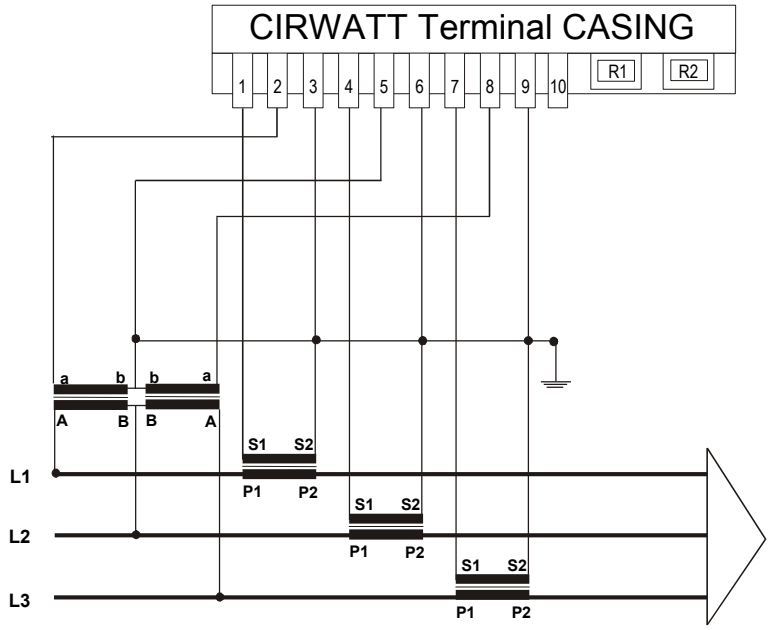
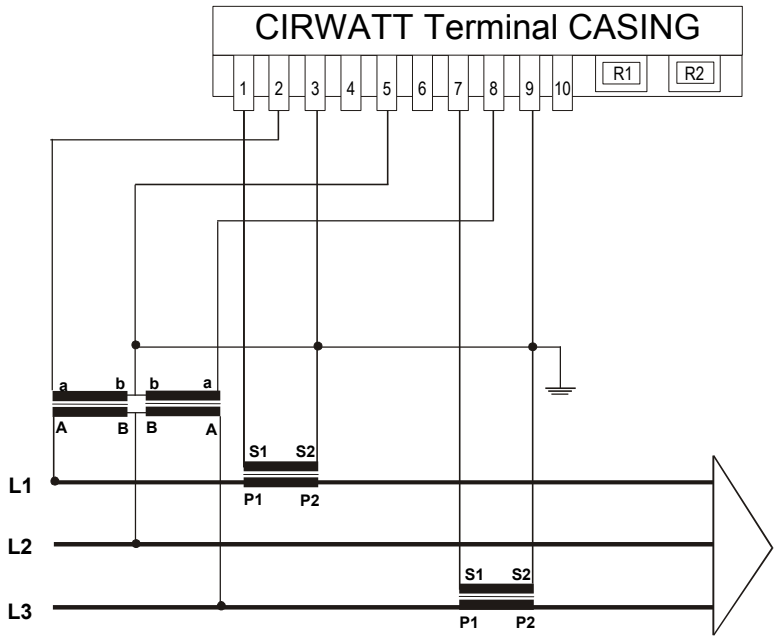
10.3.2.- 3 wire connection

Two voltage transformers and three current transformers:



10.3.3.- 3 wire ARON connection

Two voltage transformers and two current transformers:



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11.- APPENDIX: PLANS

- **Base.**
- **Upper cover.**
- **Middle cover.**
- **Battery cover.**
- **Terminal cover.**
- **Terminal box.**
- **Button.**
- **Sealed button.**
- **M4 seal screw.**
- **Terminal flap.**
- **Single pressure clamp.**
- **Double pressure clamp.**
- **M4 clamp screw.**

12.- REPORTS ON TESTS MADE

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