MULTI-PURPOSE
SINGLE PHASE METER
CIRWATT Series
TYPE A

TECHNICAL REPORT

(Revision 1.2)

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

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1. INTRODUCTION

The A Type CIRWATT is a multi-purpose, digital meter with class 1.0 in active energy measurement.

It has been especially designed for installations where the electro-mechanical meters do not meet the current requirements. It is specifically for those installations that require a meter with a tariff system.

The CIRWATT meets the existing standards applied to electronic meters and has an independent data retention system that avoids data loss in the absence of power supply.

Therefore, it allows readings via the display and via the optical port (IEC61107 Protocol) in the absence of any power supply.

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Below are some of the main features that will be more fully described later:

- **Power supply:** It has been designed so that the equipment always operates when there is voltage between phase and neutral, with a margin of +/-20% (self-supplied).
- **Voltage measurement:** Guarantees the measurement class with system voltages between 230V +/- 20% (127V +/- 20% according to model).
- **Current measurement:** This can be done via direct connection with a maximum effective range of 120A.
- **Operating frequency:** The self-detecting system frequency allows it to operate in any 50Hz or 60Hz system.
- **Accuracy:** The CIRWATT has accuracy class 1.0 in active energy (IEC 61036).
- **Data memory:** It has a RAM memory and its information is kept thanks to a lithium battery.
- **Events memory, set-up and calibration:** These parameters are stored in the FLASH memory guaranteeing them to be kept even without the lithium battery.
- **Clock:** The CIRWATT has a real time clock using the quartz of the microprocessor and a synchronisation system with the system frequency. In both cases an error below 0.5 seconds/day at 25 ºC is guaranteed.
- **Battery:** The clock and the RAM memory work off a lithium battery with a working life of 10 years (at 25°C). It cannot be replaced without breaking the official seals.
- **Communications:** It has 1 channel for transmitting information using the optical port with IEC 61107 protocol.
- **Digital outputs:** It has one digital output for active energy pulse outputs with a cadence of 1,000 pulses/kWh.
- **Impulse LEDs:** These are used to verify active energy. The cadence is 1,000 pulses/kWh for active energy measurement.
- **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. It also has an intrusion detection system to detect when the terminal cover has been opened even when the equipment is switched off.
- **Construction features:** The casing has been designed to meet the DIN 43859 standard and its size to meet DIN 43857.

2. METER MODELS

Below are the configuration options for each installation:

CIRWATT 2__ - _ __ - _ _ _ - __

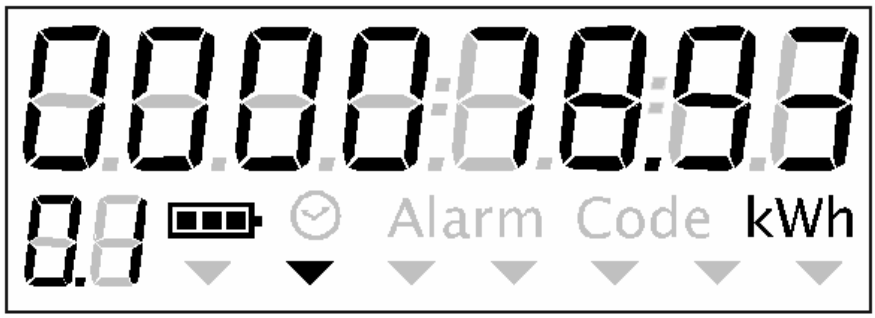
2 wires	**2**	**Connection mode**
Class 1 Active	**10**	**Accuracy**
127 V	**N**	**Voltage measured**
230 V	**Q**	
5 (60) A	**D2**	**Current measured**
10 (120) A	**D3**	
Without communications	**0**	**Communications**
1 output (24 V optocoupler)	**1**	**Expansion**
Basic domestic	**A**	**Model**
Revision	**00**	

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 display that has been especially designed for this application. Here all information is displayed, for example: energy meters, electrical parameters, status indicators, etc.



3.2. BUTTON

The equipment has a button that allows the CIRWATT's display and parameters to be managed.

The other button is completely accessible to the user and allows the different information screens to be browsed.

They operate by using the short press-long press system. A short press is one that lasts for less than 2 seconds. While a long press lasts more than 2 seconds

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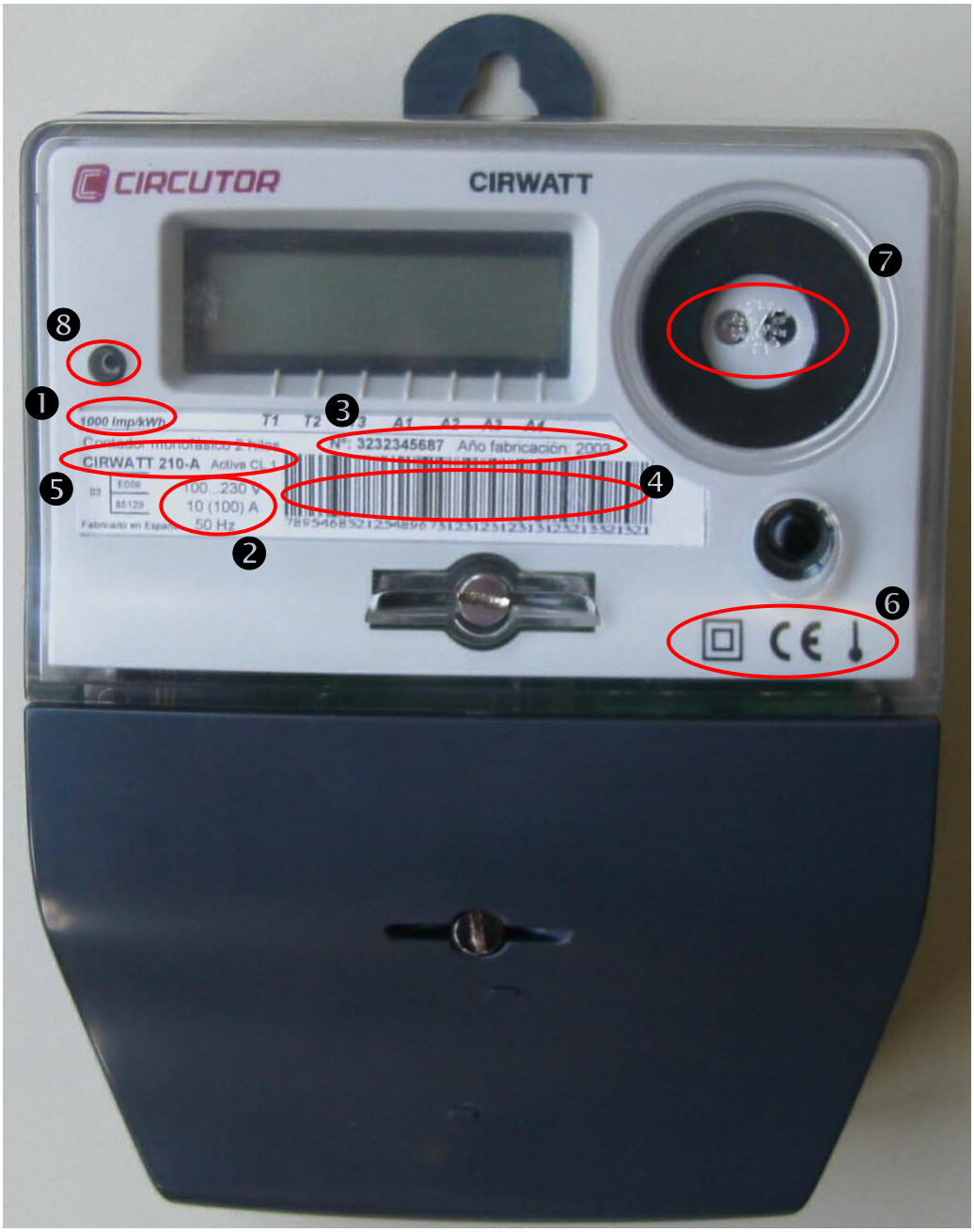
3.3. TECHNICAL DETAILS LABEL

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

- **Active energy pulse ratios ❶:** This defines the frequency at which the LED flash. This ratio is 1,000 impulse/kWh.
- **Operating features ❷:** This part of the label describes: the operating voltage, frequency, nominal current and accuracy of the active energy measurement.
- **Year of manufacture ❸:** The year in which the meter was manufactured.
- **Series number ❸:** The unique identity number for each meter.
- **Bar code ❹:** Bar code to identify the meter. Its specifications have been defined by UNESA.
- **Model identifier ❺:** 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 ❻:** Symbols showing conformity to EC double isolation and standards on single-phase measurement methods.
- **Optical port ❼:** This complies with the mechanical and electrical specifications of the IEC 61107 standard.
- **Active energy verification LED ❽:** This flashes with a cadence of 1,000 impulses/kWh. When the meter has no load or is below the start up current, the LED remains lit.



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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 is a printed circuit board where all parts related to electricity measurement, communications (optical port), the protection, all electronic processors, the optical interface and the optional output are located.

3.4. 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.
- **RAM data memory:** This memory stores all the useful information for control and billing.
- **FLASH data memory:** This memory stores the set-up, calibration and events.

3.4.1. Measurement/power supply circuit

The meter is supplied via voltage inputs (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 +/-20% voltage from the nominal will not affect the proper working of the meter and the measurements made are guaranteed to be correct.
- **Power supply:** The meter will always continue working when the Phase-Neutral voltage is up to 20% less than the minimum nominal operating voltage.

3.4.2. Measurement calculation

Processing voltage and current signals is done via a 16-bit sigma-delta converter and a microprocessor based on DSP. These parts offer high power, speed and accurate calculations.

The equipment has a system of meters to calculate energy. These meters add up the energy consumed and generated by the installation

The equipment also measures the following electrical parameters:

- Voltage.
- Current.
- Frequency.
- Power factor.
- Active power.
- Reactive power.
- Apparent power.

3.5. DIGITAL OUTPUT MODULE

This is an optional fitting and is not necessary for the proper working of the meter. The CIRWATT A may have 1 digital, free of potential output. The output will be optocoupled with the following features:

- Maximum operating voltage: 24 V DC.
- Maximum operating current: 50 mA DC.
- Mechanical life: unlimited.
- Switch speed: up to 1000 impulses/KWh.

3.6. SECURITY LEVELS

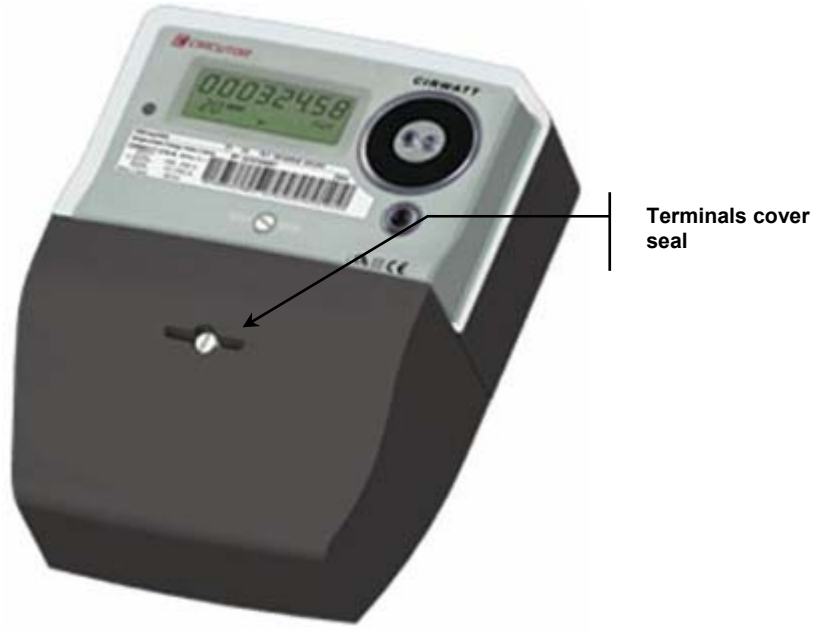
The CIRWATT three-phase meter has the necessary seals to guarantee that no part of the meter is used by any unauthorised person.

3.6.1. Manufacturers' seal

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.

3.6.2. Terminals cover seal

This seal is attached once the equipment has been fitted. This seal will prevent the modification of the meter's connection.



3.6.3. Intrusion detector

The equipment will generate an event whenever the cover on the equipment is lifted and the alarm activated. The alarm can only be deactivated by protocol. The minimum time between two intrusion events is 60 seconds. For the first start up, the meter waits for two hours before generating an event to avoid activation while it is being installed by the authorised installer.

3.6.4. Inverse consumption detector

Generated energy will be stored in a total recording. An event will also be generated each time the energy direction changes from consumed to generated for a period of 20 seconds. This is because there are some motors that produce small, generated energy peaks when they are started. The alarm will also be set off. This can only be deactivated by protocol.

3.6.5. Protection of information stored in the memory

All communications access to the meter's memory is protected by reading and writing passwords.

These passwords have a huge number of combinations, making the meter highly protected against the alteration of recorded information.

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

There are two Screen Display modes:

- STANDBY mode.
- READING mode.

STANDBY mode is always the default mode whenever the READING mode is not activated by pressing the corresponding reading button.

READING mode is activated by a long press on the reading button. Once 60 seconds have passed after the last press in READING mode, the display will return to STANDBY mode.

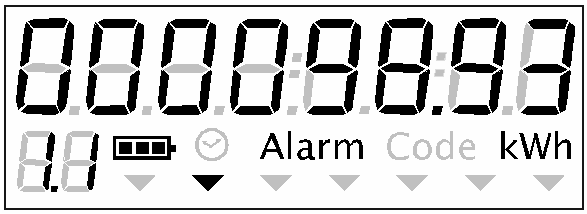
There are three different types of screens:

- Standby screen.
- Information screen.

4.1.1. Standby screen

The standby screen shows information without the need to use the buttons on the equipment. It is used to show the customer the necessary information for him to control measurement in the easiest possible way.

On this screen, all lines of information on this screen are ROTATING, with a rotation time of 6 seconds. In the event of a serious alarm being shown the word “ALARM” appears on the display.



A short press freezes the rotation and subsequent short presses advance or display different lines on the screen. At the end of 60 seconds it returns to ROTATING mode.

The following parameters are displayed in rotating mode:

- Energy in tariff 1, activating the first cursor in the lower section, the “1.1” sign in the two code digits and the symbol “kWh”.
- Energy in tariff 2, activating the first cursor in the lower section, the “2.1” sign in the two code digits and the symbol “kWh”.
- Date, activating the clock symbol.
- Time, activating the clock symbol.

4.1.2. Information screen

The Information screen shows information on a certain group of data. It can only be used in READING mode.

Browsing between Information screens is done using the button: a short press advances the cursor to the following line and if it is on the last screen it advances to the first screen. A long press on any of the screens will return to the screen to standby mode.

The parameters that can be displayed are:

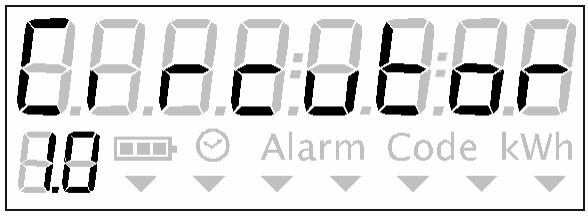
- Total energy consumed.
- Total negative energy.
- Recorder link address.
- Voltage.
- Current.
- Active power.
- Reactive power.
- Power factor.

4.2. SCREEN DESCRIPTION

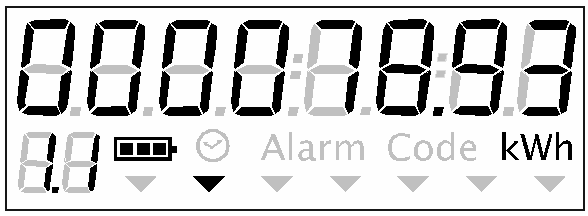
4.2.1. Standby screen mode

4.2.1.1. Start screen

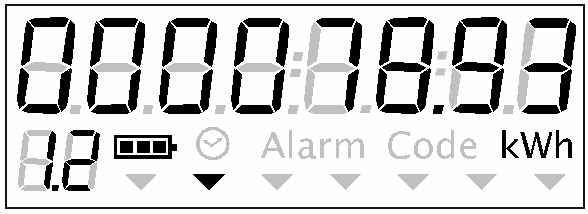
Shows the version of the firmware installed.



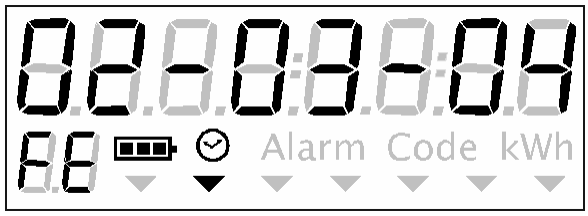
4.2.1.2. Energy in tariff 1



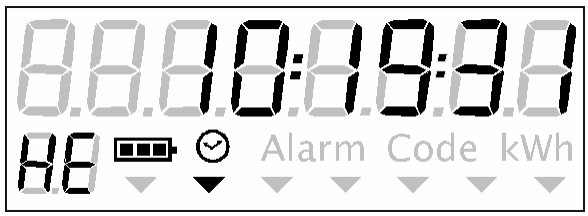
4.2.1.3. Energy in tariff 2



4.2.1.4. Date

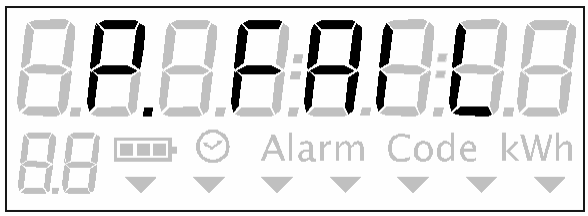


4.2.1.5. Time



4.2.1.6. Final screen

Appears when the voltage drops below the minimum operating voltage for the meter.

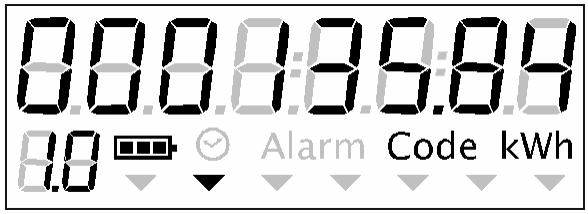


4.2.2. Information screen mode

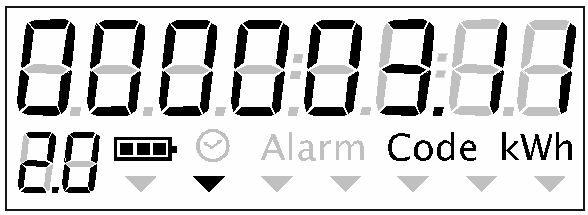
The key has to be pressed for more than 2 seconds to access this screen. Screens in Information mode are characterised by the word “Code” appearing on the

display. This display mode only operates when the equipment is supplied with power. The sequence of the screens is as follows:

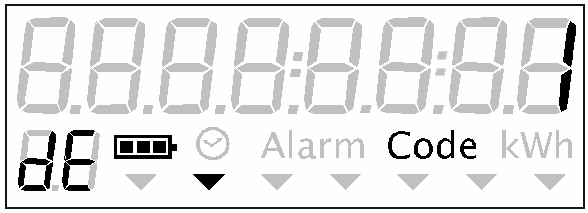
4.2.2.1. Total energy consumed



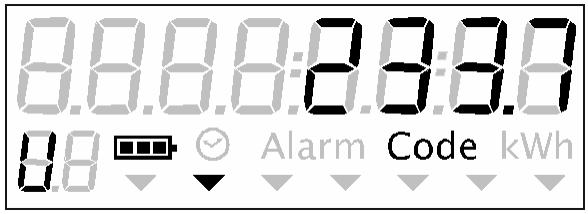
4.2.2.2. Total energy generated



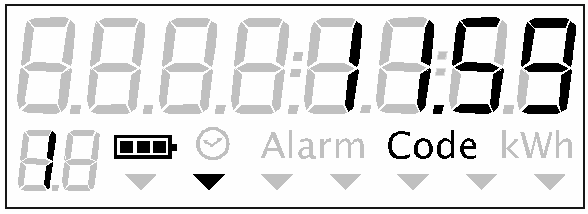
4.2.2.3. Link address of the recorder



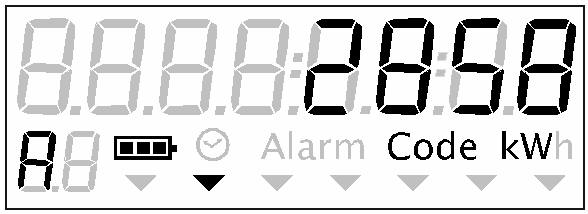
4.2.2.4. Voltage



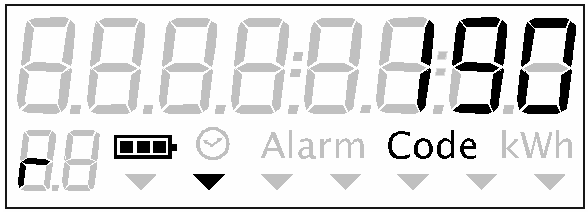
4.2.2.5. Current



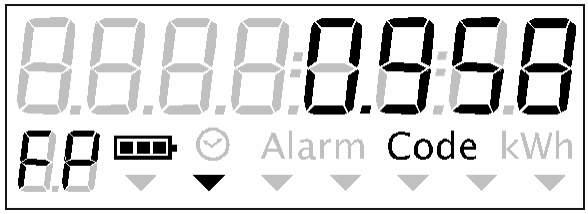
4.2.2.6. Instant active power



4.2.2.7. Instant reactive power



4.2.2.8. Power factor



4.3. CONTRACTS IN CIRWATT

As well as basic measurements, it is necessary that the equipment makes a set of calculations to allow a proper invoicing with the type of contract on it.

It is understood by contract, the set of parameters that structure the measurement made by the logger so as to reflect the contractual billing agreements.

4.3.1. Number and assignation of contracts

In the basic, single phase Cirwatt there is only one contract.

4.3.2. Parameters of a contract

It is considered that a parameter is defined if it has an assigned value. It is not defined if this is blank.

A parameter that is not used will not be able to have a value assigned from previous parameter settings and therefore will remain undefined.

4.3.2.1. Types of days

The days of the year are classified as:

- Working days.
- Holidays and weekends.

Working days are Monday, Tuesday, Wednesday, Thursday and Friday. All have the same tariff rate.

Holidays are Saturday and Sunday and other days considered to be holidays. All have the same tariff rate. The maximum number of holidays is 15.

Working days are assigned profile 1 and holidays and weekends have profile 2.

4.3.2.2. Tariff periods

Each block of hours to which a predetermined tariff is to be applied, is called a tariff period. There is a maximum of 2 tariffs.

4.3.2.3. Powers

Each tariff period has a power associated with it corresponding to the value of the contracted power in each period.

4.3.3. Maximum demand

This indicates the number of minutes during which the contracted power has been exceeded. It is not necessary to reset the maximum demand system, because there are no bill closures. The meter can be started and the contracted power set via IEC61107. The maximum demand meter can only be increased when there is contracted power in at least one tariff period.

4.3.4. Returning a meter – recorder to zero

This deletes all pre-set parameters and stored data. The totalisers return to zero. The date and time, the battery status and the parameters set by the manufacturer are kept.

The default parameters included are as follows:

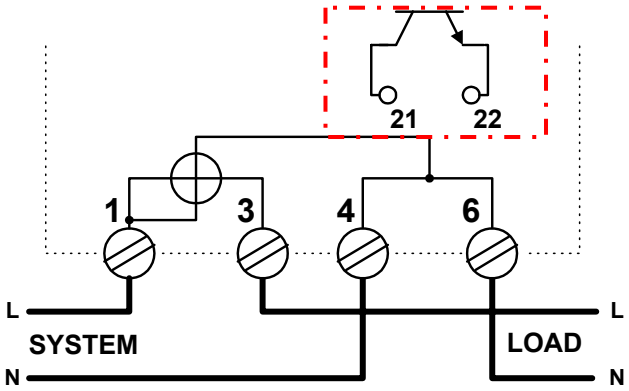
Link address	1
Password	1234
Configuration	7E1
Seasonal change	Automatic

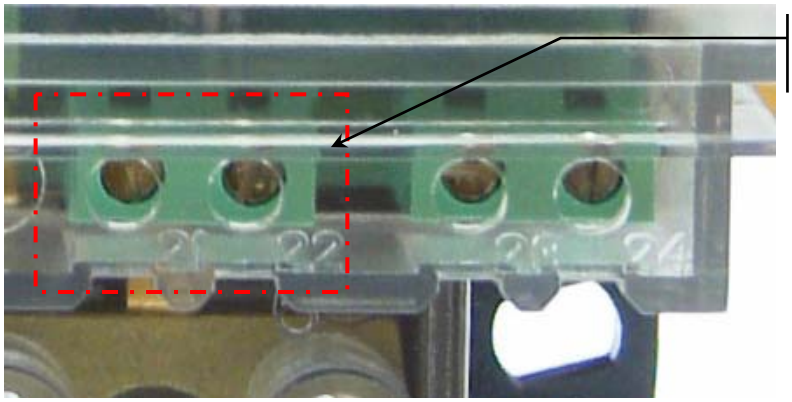
This function is always done on site, is protected by a password and generates an event.

4.4. DIGITAL OUTPUT

The equipment has one digital output. It is called the device's digital output; because using a potential free contact it can transmit electrical signals out from the meter. This type of output is used as a pulse emitter for active energy taken from the system.

The output is optocoupled and it is important to remember that it is polarised working in DC in voltages up to 24 V.





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4.5. FILES

There is only one events file where the dates of the set-up changes, time changes, bill closures, intrusion, phase turn, etc are stored (up to a maximum of 64). The events that may be recorded are as follows:

- Restarting the system losing data.
- Start up after power supply failure, keeping data.
- Power supply fault, time of the drop in supply.
- Time change, previous time.
- Time change, new time.
- Intrusion incident.
- Energy inversion detection.
- Default set-up.
- Default calibration.

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.

4.6. FUNCTIONS OF THE BUTTON

The functions of the keyboard are defined below. It is based on a single key and a long press/short press system. A short press is one lasting less than 2 seconds. On the other hand a long press is one that lasts longer than 2 seconds.

A short press will freeze the rotation and the following short presses moves through the display of the different lines on the screen. On the other hand a long press moves on to the information screen options.

4.7. OFFICIAL TIME CHANGE

The meter will automatically change the official time. In the event that the equipment is not receiving any power at that time, the change will be made on restarting the equipment and restoring the power supply.

Official time changes are fixed at the last Sunday in March at 2 am and for the last Sunday in October at 3 am, moving the time forward and backward one hour respectively.

5. VERIFICATION (IMPULSE LED)

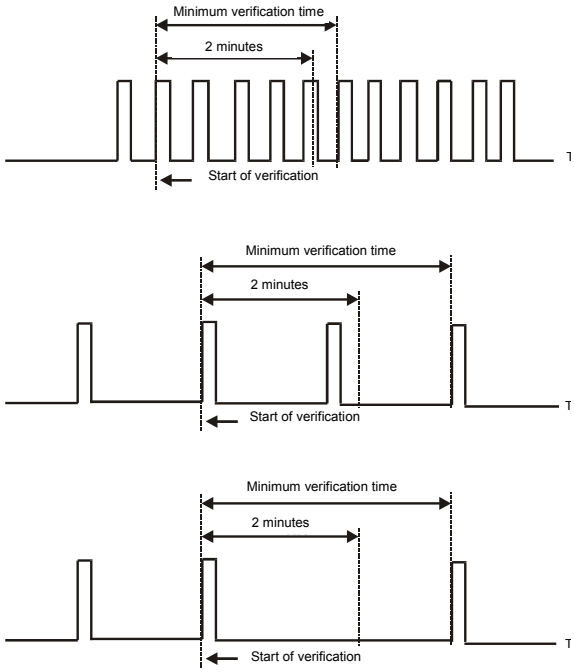
On the front of the meter there is an LED used to give impulses proportional to the active energy, thereby verifying the measurement.

This LED has a fixed cadence printed on the features label on the meter.

Its value is 1,000 pulses per kWh for measuring active energy. 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 only has one communications channel based on an **optical interface,** complying with the electrical and mechanical specifications in the IEC 61107 standard.

The communications protocol will be IEC 61107. To be able to communicate it will be necessary to enter the correct address of the recorder and the password. Using the IEC61107 protocol it will be able to read:

- Consumed energy in all tariffs and the total.
- The inverse connection energy.
- Voltage, current, power factor and frequency.
- Active, reactive and apparent power.
- The seconds where contracted power has been exceeded.
- The software version and the operating times.
- Alarms that have been set off in the equipment.

It will be able to read and write:

- The time on the equipment.
- Clock change mode.
- Profiles and contracted powers.
- Recorder address.
- Recorder password.
- Synchronisation via the system.

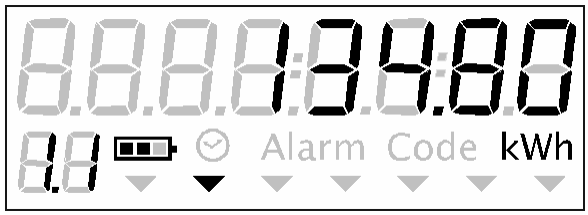
7. REAL TIME CLOCK

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

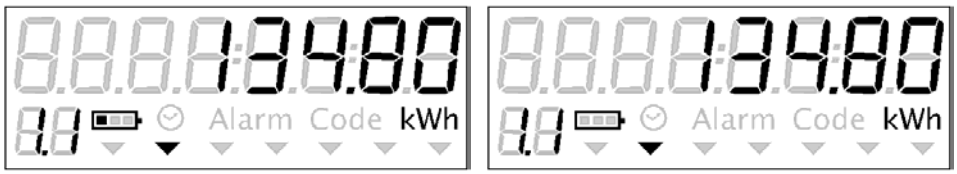
The real time clock may be set by quartz or the electrical system. In both cases, the clock is accurate to less than 0.5 seconds per day at 25 ºC.

8. LITHIUM BATTERY

The battery life will be 12 years from its installation. Every 4 years a small square in the battery on the display disappears. After 12 years when all squares have gone, the battery indicator will flash on the display.



The battery indicator will flash when the display is switched on by pressing and the equipment is not being supplied with power.



Battery life may be shortened if the communications and/or the display are used a lot without the power supply on.

When the equipment is not being supplied with power, the lithium battery will allow the following operations:

- Entry to rotating mode to display energies and the date.
- Reading recordings via communications.

The key has to be pressed to enter this operating mode. The required information appears on the screen but with the battery indicator flashing. This shows that the equipment is being powered by the lithium battery and not the mains.

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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:	127V or 230V (according to model)
Consumption:	< 2W 10W
Frequency:	50/60Hz no difference
Operating temperature:	-20 ºC to + 60 ºC
Voltage Measured:	
Connection:	Symmetrical or asymmetrical
Reference voltages:	127V or 230V (according to model)
Frequency:	Automatic (50/60Hz no difference)
Current Measured:	
Currents: (In)	5A Direct (Max. 60A) 10 A Direct (Max. 120A)
Maximum current:	12·In
Accuracy:	
Active Energy:	Class 1.0 (IEC 62053-21)
Calculations and Process:	
Micro-processor:	Based on DSP
Converter:	16 bits
Memory:	
Data	RAM backed up by lithium battery
Set-up and events	Non volatile FLASH memory
Battery:	
Type	Lithium
Life	> to 10 years
Clock:	
Type	Quartz oscillator System frequency
Accuracy	< 0.5 seconds/day at 25 ºC

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Digital Outputs:	Free of potential
Type:	Opto-coupled
LED output:	
Maximum cadence:	1000 pulses / kW.h
Safety:	Category III (110 V) according to EN-61010
Construction features:	
Casing:	According to DIN 43859 standard
Sizes:	According to DIN 43857 standard
Protection grade	IP 51
Optical Reader:	IEC-1107 for on-site access
Tests/Standards:	
EN 61036 (EN 62053-21)	Standards for static, active energy meters for alternating current, class 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

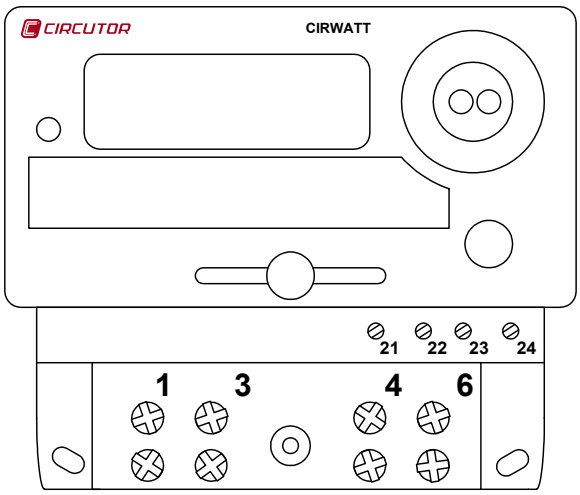
10.1. INSTALLING THE EQUIPMENT

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. DIRECT METER TERMINAL RATIOS (SEE LABEL ON TERMINAL COVER)



No.	***Terminal description***
	Lower Board
1	*Current input IL – S1*
4	*Measurement UL*
3	*Current output IL – S2*
6	*Neutral*
	Upper Board
21	*Opto-coupled output (collector)*
22	*Opto-coupled output (emitter)*
23	Not connected
24	Not connected

NB: The current inputs are isolated.

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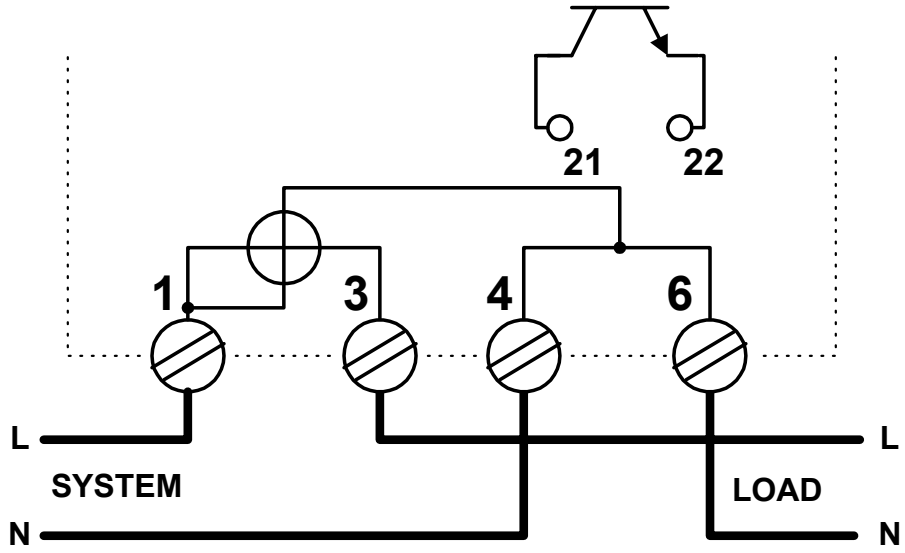
10.3. METER CONNECTION DIAGRAMS



The required connections are shown on the inside of the terminal cover.

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11. MECHANICAL PLANS

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12. REPORTS ON TESTS MADE

Requested by:	Written by:	
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