Electricity Meters

Residential BS / MID

British Standard

E470 Tokenless Smart Prepayment Meter

User Manual & Technical Specification

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Issue	Date	Comments
1.0	21.05.07	Initial release for Approval bodies
1.1	19.06.07	Amendments to meet approvals specification
1.2	26.06.07	2nd round of amendments to meet approvals specification
1.3	20.07.07	Further addition to the data sheet to cover LVD requirements
1.4	03.08.07	Further additions at section 1.4 and to the data sheet to satisfy TUV requirements
1.5	04.09.07	Supply cabling specification added to section 1.7
1.6	24.10.07	Signal strength comments added at section 6.2
1.7	19.11.08	Revised manual to new branding guidelines and layout
1.8	14.09.09	Addition of features to support 5236J-Y functionality

Landis+Gyr

1 Lysander Drive,

Northfields Industrial Estate,

Market Deeping,

Peterborough

PE6 8FB

www.landisgyr.com

Table of Contents

1 Introduction

1.1 Scope

This user manual applies to the British Standard 5236J-Y SMS messaging Tokenless prepayment meter.

1.2 Purpose

This manual contains all information required for the application of the meters for the intended purpose. This includes:

- Characteristics, construction and functionality of the meters.
- Information about possible dangers, their consequences and measures on how to prevent them.
- A detailed description of the tasks to be performed during the entire life-cycle of the meters (configuration, installation, commissioning, operation, maintenance, and disposal).

1.3 Target Group

The contents of this user manual are intended for technically qualified personnel of energy supply companies responsible for system planning, installation and commissioning, operation, maintenance, decommissioning and disposal of the meters.

1.4 Intended Use and Installation

The 5236 meters record active energy consumption in single phase two wire networks. For this purpose they are directly installed in the supply line by the energy supply company and are read regularly for energy charging purposes. They are used according to the technical specifications stated in the respective data sheets and below.

The meter is intended for installation in a residential environment by qualified personnel. The meter conforms to British Standard in its mechanical specification and is suited to installation in any situation that also meets this standard. The meter must be installed away from powerful sources of electromagnetic interference.

There are no user serviceable parts within the meter and the meter must be returned to the manufacturer or an authorized partner for repair and/or maintenance. There are no permissible adjustments to meter installation procedure or meter operation outside those covered by the detailed operational instructions contained within this document.

If the equipment is used in a manner not specified by the manufacturer the protection provided by the equipment may be impaired.

2 Safety Information

Attention is drawn as follows in the individual chapters of this user manual with classified word symbols and pictographs to the relevant danger level, i.e. the severity and probability of any danger:

Definition of Danger

This symbol is used to indicate a possibly dangerous situation which could result in severe physical injury or a fatality.

Definition of Warning

This symbol is used to indicate a possibly dangerous situation which could result in minor physical injury or material damage.

Definition of Note

This symbol is used to indicate general details and other useful information.

In addition to the danger level, all safety information also describes the type and source of the danger, its possible consequences and measures to counteract the danger.

2.1 Responsibilities

The owner of the meters – normally the utility – is responsible that all persons engaged on work with meters:

- Have read and understood the relevant sections of the user manual.
- Are sufficiently qualified for the work to be performed.
- Strictly observe the safety regulations and the operating information in the individual chapters.

In particular, the owner of the meters bears responsibility for the protection of persons, prevention of material damage and the training of personnel (Landis+Gyr. provides training courses for this purpose on specific equipment; please contact the relevant agent if interested).

2.2 Safety Regulations

The following safety regulations must be observed at all times:

- This equipment does not contain a disconnection device. Means for disconnection from the supply must be provided as part of the building installation. Do not work on the equipment unless the supply is disconnected. If disconnection is done by removal of fuses or other cut-outs, the removed disconnection devices must be kept secure from replacement while work is performed. If disconnection is provided by a switch, the switch shall conform to the requirements of IEC 947-1 and IEC 947-3 or equivalent.
- This equipment does not contain an overcurrent protection device. Overcurrent protection must be provided as part of the building installation. Maximum overcurrent device rating is 100 Amp at 415 Volts, conforming to the requirements of BS1361, or equivalent.
- The maximum rating of the meter is 100A and requires connecting conductors of 25mm2. Failure to do so could result in irreparable damage to the meter. If smaller connecting conductors are used an appropriate mains fuse must be used.
- Only suitably trained and qualified personnel shall be allowed to work on the equipment. Local safety standards shall be observed and shall take precedence over these regulations in points of conflict.
- The meters must be held securely during installation. They can cause injuries if dropped.
- Meters that have fallen must not be installed, even if no damage is apparent, but must be returned for testing to the service and repair department responsible (or the manufacturer). Internal damage can result in functional disorders or short-circuits.
- The meters must on no account be cleaned with running water or with high-pressure devices. Water penetrating can cause short-circuits.
- The meter terminal cover should be secured in place before any load is supplied.

3 Functional Overview

3.1 Meter Description

The meter requires a single phase, two wire mains supply with a reference voltage of 230V, 50Hz. The meter is rated at 10, 15, or 20 – (100) Amps registering kWh to class B (MID). The meter's internal measurement coefficient is 1 and therefore does not affect the supply's phase angle.

The meter is fitted with a 100A contactor for the disconnection of supply operating automatically when prepay credit has expired or by manual command in the event of a change of tenancy, for instance.

The meter is fitted with a single pole, normally open, voltage free relay rated at 230V 2A at unity and 0.5pf. This relay is internally controlled by time-of-use switches and may be used to control an ancillary circuit.

The meter is fitted with a GSM modem and will use SMS messaging to receive credit transactions, tariff and configuration updates. It may provide periodic scheduled reads and additionally ad hoc reads of register values and other data on command.

The meter features energy registers for four rates and one total export energy register. The meter may be configured to maintain time-of-use tariffs, block tariffs or complex combinations of the two.

The meter is fitted with a standard IEC1107 optical port for factory and on site programming as necessary.

Additional features include but are not limited to:

- Half Hour Profiling – configurable on/off as required
- Prepayment accounting in £ and €
- Cost per hour & usage calculations + display
- Tamper reporting
- Display of data with a liquid crystal display (LCD).

3.2 Metrological Functions

The current measurement is based on shunt technology.

The microprocessor receives the measured analog signals (U and I) through an A/D-converter. It determines the energy direction and calculates the energy which is subsequently processed in accordance with the meter constant and fed to the relevant rate register determined by rate control. The microprocessor also controls the data communication with the display and serial interface and ensures a safe operation in the event of a voltage failure.

The entire meter's data is recorded in a Ferro-electric Random Access Memory (FRAM) under the control of the microprocessor. All kWh registers are stored in the FRAM and are updated every 1/100th of a kWh. The

FRAM is capable of a minimum of 10,000,000,000 write cycles and does not require power to maintain the stored data.

To indicate active energy usage the meter is fitted with a single red LED.

When registering energy the LED will flash at a rate of 1 pulse per Wh of energy recorded (1000 pulses kWh). Each pulse shall have an on time of 20 mS. The metrology LED will be configurable to show forward or reverse energy consumption for test purposes. The metrology LED will be permanently on when creep lock is active.

3.3 Temperature

The operating temperature range is –25°C to +55°C.

The storage temperature range is -30°C to +85°C.

3.4 Real Time Clock

The Meter has a real time clock, optionally configurable to synchronise to the mains frequency in normal operation. When the meter is configured for mains synchronisation, the clock shall maintain the same stability as that of the mains, i.e. within ±30 seconds/year.

During periods of power failure the time shall be maintained by an internal battery powered, crystal controlled clock. In battery backed mode the accuracy shall be maintained to within 15 minutes/year at a temperature of 20°C.

The time is displayed in 24-hour mode.

The meter operates on GMT with the option to operate with scheduled changes for British Summer Time (BST) applied to customer timed functions, i.e. Tariff Switching Times, No-Disconnect Period and the clock displays in Customer Displays.

The meter may be configured to remain in GMT throughout the year with no change for DST.

If configured to operate with DST changes, during the BST period the meter shall display the BST clock time, the rate-switching matrix and any timed events shall operate on the BST time clock.

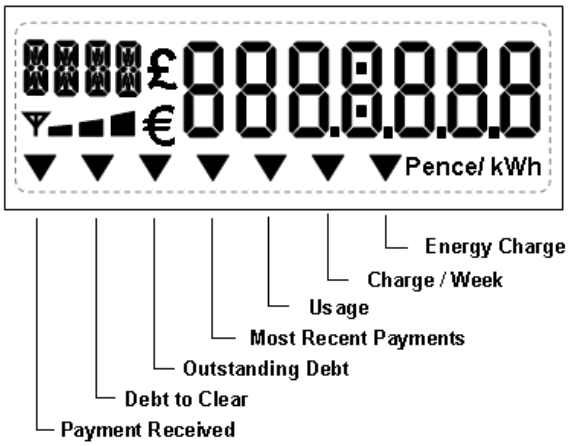
DST setting is configurable allowing standard European settings or any other combination of DST settings. Configurable settings:

- Start and end calendar month
- Start and end week, first –forth or last
- Start and end day
- Start and end time
- Adjustment hours

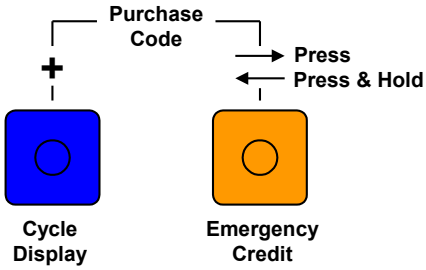
The real time clock may be set using the optical port.

3.5 Faceplate Details

In addition to meter type and metrological markings according to MID requirements, the meter faceplate will show register names below the triangle indicators on the display. The faceplate will show the following register names:



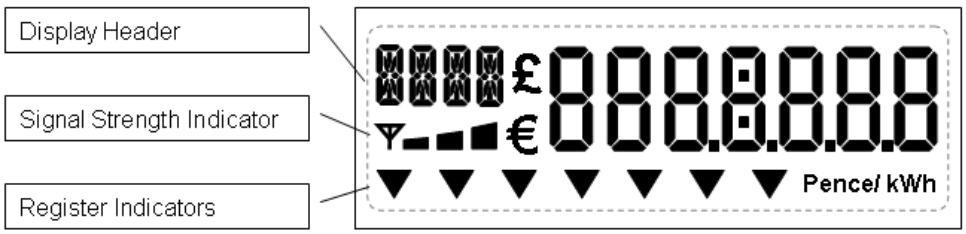
Additionally the functions of the two buttons fitted to the front of the meter are described:



The meters serial number and barcode will be laser marked onto the front of the meter case. Serial numbers are allowed with up to 16 characters.

3.6 Customer Display

The meter is fitted with a custom display providing 4 starburst characters and 7 seven-segment characters. The display has a backlight. Separate icon will indicate currency and kWh units. The display will provide an indication of GSM signal strength. Pointers along the bottom edge will link with the facia artwork to show which parameters are being displayed.



4 Meter Operation

4.1 Energy Registers

Display of energy registers is configurable to show 5 or 6 whole numbers. All energy registers are configurable to show between 0 and a maximum of 2 decimal places (up to 1 decimal place with 6 whole numbers).

All energy registers are displayed with leading zeros.

All energy registers will roll over from 99999.99 to 00000.00 kWh. (999999.9 to 000000.0 when set to 6 whole numbers.

All energy registers are incremented for every 1 Wh of forward energy consumed.

The meter will record reverse or export energy into an export energy register, [configurable option].

The meter has up to 4 time-of-use registers. Each TOU register will become active according to the TOU switching plan configured into the meter.

4.2 Push Button Operation

The meter is fitted with two push buttons as described in section 2.5. The left hand blue button is used for stepping thru the meters' display cycle. Each press will advance the configured display sequence by one display.

If the display sequence has been partially cycled and the push button is not pressed for 30 seconds the display sequence will revert to the default display.

The right hand orange push button shall be used to evoke the Emergency Credit feature.

4.2.1 Payment Code Entry

The transfer of payments is made by sending a 20 digit encrypted code to the meter. Normally this would be transferred by SMS messaging, however in cases such as the communication system is unable to send the top-up to the meter, a secondary method for transfer is available.

In normal commissioned operation the meter will allow the customer to enter the purchase code using the two push buttons on the meter. The entry process is detailed in the section Meter Displays 6.9.

When expecting a purchase code the meter allows a maximum of {20} digits to be entered.

If the code entered is successful the meter shows the value of the purchase on the display.

The meter will allow codes to be re-entered for up to 10 minutes and will allow the entry of 5 sets of invalid codes. If a valid code is not entered after a total of 10 minutes, or 5 invalid attempts are made during this period, the display will revert back to the Default Operating display. If 5 invalid entries are made the facility will be locked out until the next hour.

The meter will allow a maximum of 5 sets of Payment code entries in a 24hr period.

Example

1pm: Enter invalid code 5 times
Must wait until 2pm before allowed to re-enter code
2pm Enter invalid code 5 times
Must wait until 3pm before allowed to re-enter code
3pm Enter invalid code 5 times
Must wait until 4pm before allowed to re-enter code
4pm: Enter invalid code 5 times
Must wait until 5pm before allowed to re-enter code
5pm Enter invalid code 5 times
Facility locked out until 00:01 next day

If no button presses are detected after 60 seconds the display will revert back to the normal operating display.

4.2.2 Installation and Binding

A further use of the code entry mode is to instigate the binding process for external devices or an installation mode.

When instigating these processes a 6 digit pin is entered into the first 6 digits of the payment code. If the entered pin corresponds to one of the configured pins then the meter will enter the appropriate mode. See installation section.

4.3 Buzzer Operation

The meter uses an audible buzzer to indicate to the consumer the following events:

- Low Credit warning
- Valid Button press
- Incorrect Entry of Purchase Code.

4.3.1 Low Credit Warning

The Low credit warning will operate when the Present Balance register value falls below the Emergency Credit Availability point and Emergency credit is available.

If the Present Balance register falls below the Emergency Credit Availability point during a Non-Disconnection period, the Low credit warning will be suspended until the Non Disconnection period has ended.

For low credit warning the buzzer shall sound for 30 seconds followed by 2 second beeps every 30 seconds for total of 5 minutes.

The low credit warning is stopped if the Display Cycle button is pressed.

The Low Credit Warning is a configurable item and may be disabled.

4.3.2 Valid Button Press

The buzzer sounds a short beep each time a valid Display Cycle button press is made.

The valid button press beep is a configurable item and may be disabled.

4.3.3 Invalid Purchase Code

If an Invalid Purchase Code is entered, the meter will give a 1 second beep to signify the code is incorrect.

4.4 Tamper Detection

The meter includes several anti tamper features.

4.4.1 Reverse Energy Detection

If the meter is configured to operate in a reverse energy fraud detection mode the meter will alternate a warning message on the display should a fraud attempt be made by running current backwards through the meter. The reverse energy-warning message is triggered when the reverse power exceeds a programmable threshold level of between 1-10 Amps for a period of 10Wh. A reverse energy event can optionally be communicated to the utility information system immediately or returned with scheduled read meter status.

The meter will store the number of RED tamper events detected together with the time and date of the last recorded event.

Once triggered the reverse energy-warning message can only be reset by a command programmed either via the IEC 1107 port or by SMS message.

4.4.2 SIM Card Removal Detection

The meter is fitted with two detection devices to protect the SIM card fitted to the meter. An initial detection device monitors the opening of the flap covering the SIM aperture. A second detector monitors the movement of the SIM carriage outwards from the meter. The sim carriage detection circuit operates when on or off supply. On triggering of either detector, the meter stores the number of SIM tamper events together with the time and date of the last event. On the event of a tamper event the meter will enact all, any one or none [configurable] of the following actions:

- Visually display a tamper detection message; see Meter Display section.
- If the meter is on supply; the opening of the SIM flap may be reported to the utilities information system by instantly sending an SMS message.
- Optionally the meter may be configured to open the main contactor.

Resetting of the tamper flag/supply reconnection can be achieved by system command or using the meter optical port.

4.5 Normal SIM Card Removal

In normal operation the SIM card may be 'hot' swapped by the utility without disconnecting the supply to the meter and the customer. Upon opening the main SIM flap the meter may send a tamper message as described in Tamper detection (if configured); following the sending of the message the meter will power down the SIM ready for removal. The meter indicates that the SIM may be removed by flashing the signal strength symbols on the display. Upon replacement of the SIM and closure of SIM flap the meter will reenergise the device and the meter will send the new SIM number to the utilities information system. The message will consist of Meter serial number, SIM number and MPAN.

4.6 Operational modes

The E470 meter can be configured to operate in several different operational modes that can be implemented remotely. The following section details the operational modes that are supported by the meter.

4.6.1 Credit mode

The meter can be configured to operate in credit mode. In this mode of operation the meter will not open the contactor (unless instructed) and will ignore any credit values sent to the meter. When in credit mode the default operating meter display is the active register display.

4.6.2 Prepayment mode

The meter can be configured to operate in prepayment mode. In this mode of operation the meter will open the contactor when the credit value in the meter falls below a zero value. To close the contactor the meter requires a payment to be made to suffice any negative balance registered on the meter. When in prepayment mode the default operating meter display is the remaining credit display.

4.6.3 Single wallet mode

The meter can be configured to operate in a single wallet mode. In this mode of operation the meter will use the value of credit held in the present balance register for collection of both gas and electricity usage. The electricity meter reduces the present balance for gas usage on receipt of each ½ hour message from the gas meter using the gas cost today data.

When the present balance register falls to zero, the meter will send a pass through message to the gas meter to close its valve and disconnect the gas flow. The electricity meter will also open its own contactor.

Accounting in single wallet mode

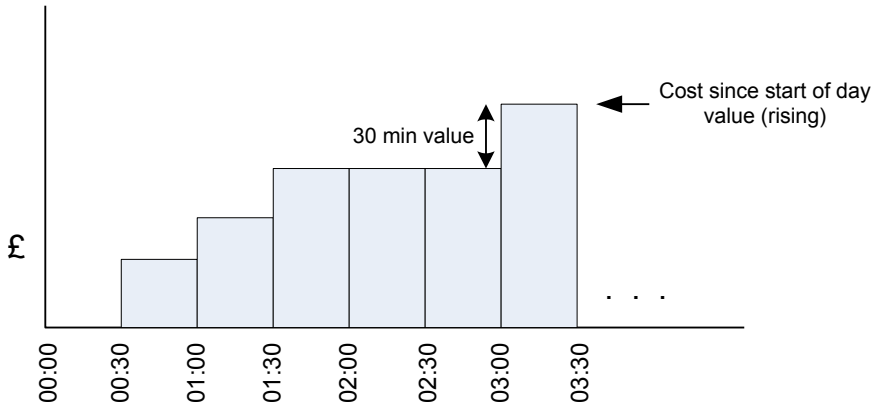
The meter receives cost data from the gas meter in the form of a Gas Cost since Start of Day on each ½ hour and daily in the form of a Day's Gas Cost value, received at midnight.

The meter uses the received Gas Cost since Start of Day value to reduce Present Balance for gas usage every ½ hour.

The Gas Cost since Start of Day value is a rising value of cost since the start of the day, reset each midnight.

Example:
the meter calculates a particular ½ hours usage in the following manner:

- The meter stores a value of the gas cost since start of the day
- At midnight the stored value will be reset
- When a new value is received the stored value is subtracted from the new value to gas the last 30 minutes usage. The present balance register is reduced by the calculated value.
- The original stored value is overwritten with the new value.



The meter records the total value collected from the Present balance register through ½ hourly messages, to enable reconciliation to the Day's Gas Cost value. This is recorded daily for a rolling 28 days, and ca recorded as extra data within the gas daily profile held within the electricity meter.

As there is the possibility of a ½ hourly message being missed a reconciliation process will be made against the Day's Gas Cost value received each day or as part of the data catch up process. The Day's Gas Cost value will be considered as the master value. On receipt of the Day's Gas Cost value the meter reconciles the amount for the appropriate day against the recorded amount collected through the ½ hourly messages.

Present balance register in single wallet mode

The present balance register within the electricity meter holds the credit or debt value for both gas and electricity usage. Electricity costs are taken in the normal way, gas costs are taken as described in 7.4.2. Emergency credit may be applied in the normal way.

Supply disconnect/reconnect in single wallet mode

After a disconnect and when credit is next added, sufficient to place the meters back into prepaid credit the following occurs:

- The meter will allow the customer to reconnect the electricity supply using the button on the front of the meter.
- The meter will generate a pass-through message for the gas meter to request instantaneous gas reconnect. The message will be passed on the next 30 minute boundary.
- The meter will cancel any unsent disconnect pass-through messages on receipt of a payment message, sufficient to place the meter back in prepaid credit.

4.6.4 PAYG mode

The meter can be configured to operate in pay-as-you-go (PAYG) mode. In this mode of operation the meter will not disconnect at zero but will allow the user to accumulate a certain amount of debt. Providing that the user keeps within an agreed amount of debt supply will remain connected for the customer.

To support this mode the meter can be configured to hold a PAYG disconnection value, the value has a range of 0 to -500 (debt).

When operating in PAYG mode, the meter will disconnect supply when the present value in the meter falls below the configured PAYG disconnection value.

Emergency credit operation is disabled by configuration when using the PAYG mode, debt recover will still operate as normal.

4.6.5 Gas Credit mode

The meter can be used to configure the operating mode of a paired gas meter. Using this mode the mode of the gas meter can be switched between prepayment and credit operation. A request to change the mode of operation for the gas meter can take upto ½ an hour as the request is dependant on a pass through message to perform the request.

4.7 Load limiting

The meter supports a load limiting function which when in operation will provide the user with only a limited supply.

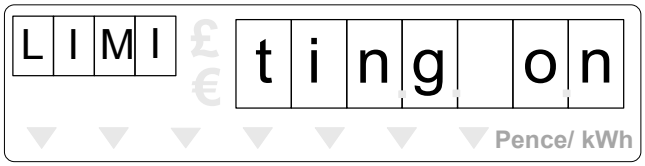
The meter is enabled to operate in Load Limit mode by configuration and may operate in conjunction with credit, prepayment or PAYG modes.

When enabled and while the meter is operating in Prepayment mode, load limiting shall only become active when the present balance falls below zero. When active the usual switching of supply is overridden by the load limiting function.

When operating in PAYG mode load limiting shall only become active when the present balance falls below the PAYG Disconnection value. Supply disconnection is overridden by the load limiting function.

The meter is configured with a Load limit value that has an operating range of 0 - 24.00kW

When load limiting is in operation the following display will be alternated with the normal operating displays:



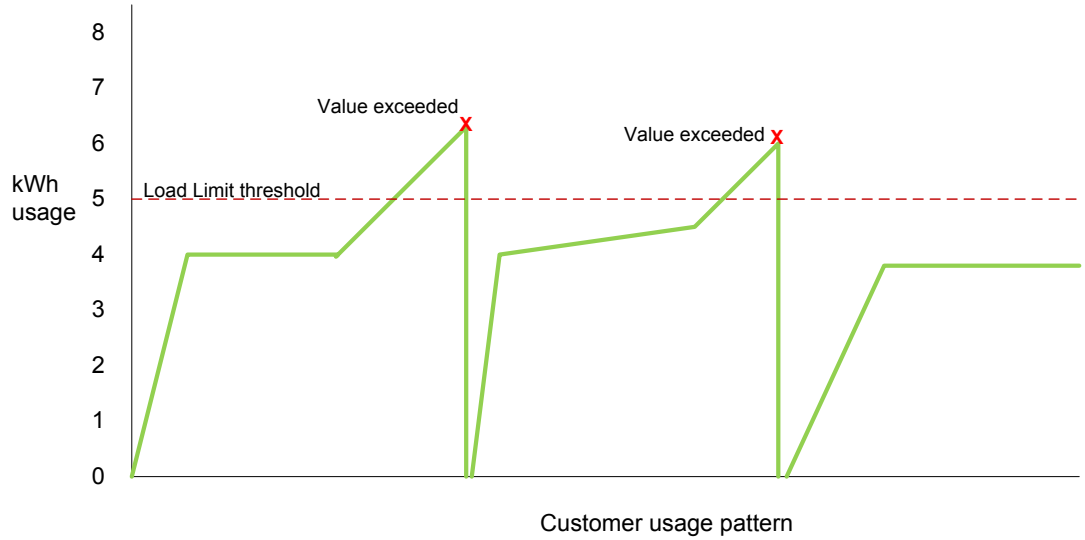
When Load limiting is enabled the meter will maintain the contactor in a closed position while the measured power (kW) is below the Load Limit value.

When the measured power exceeds the Load Limit value supply will be disconnected and contactor opened. On disconnection the display will show the OFF message for [5] seconds, followed by the PUSH BUTTON message. The supply will then be made available for reconnection.

On pressing the meters push button the contactor will be closed and supply reconnected. Load is again measured. If part of the load has been removed and remains under the Load Limit value the supply will remain connected. If the measured load again exceeds the Load Limit value supply will again be disconnected.

Load limiting example:

The load limit value for the customer is set at 5kW. When the customer exceeds the threshold value in the first instance power supply is cut. Customer reduces load and power can be reconnected. When the customer exceeds the value in the second instance, the customer again has to reduce household load to reconnect power.



5 Installation and Binding of External Devices

The installation process is in two parts; joining the metering components together by a binding process and notification of the metering system to the head End System. An automated notification process exists within the meter however this may not be supported by the HES. Where the automated process is not supported a manual method would be employed. This section describes the automated process only.

5.1 Binding Process

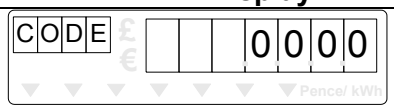
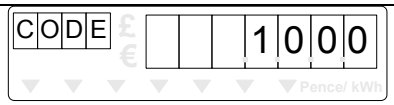
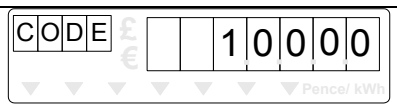
The binding process is used to join devices to the electricity meter. Once bound, the devices will ignore transmissions from any other meters within the vicinity. The units will remain in this state until rebound.

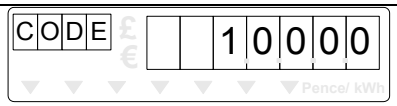
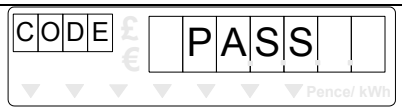
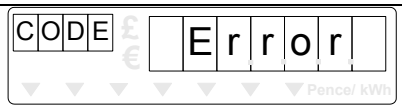
During the process the devices exchange communication addresses and security keys, logging serial number into the electricity meter. These serial numbers are in turn displayed on the In-home display to provide confirmation to the installer.

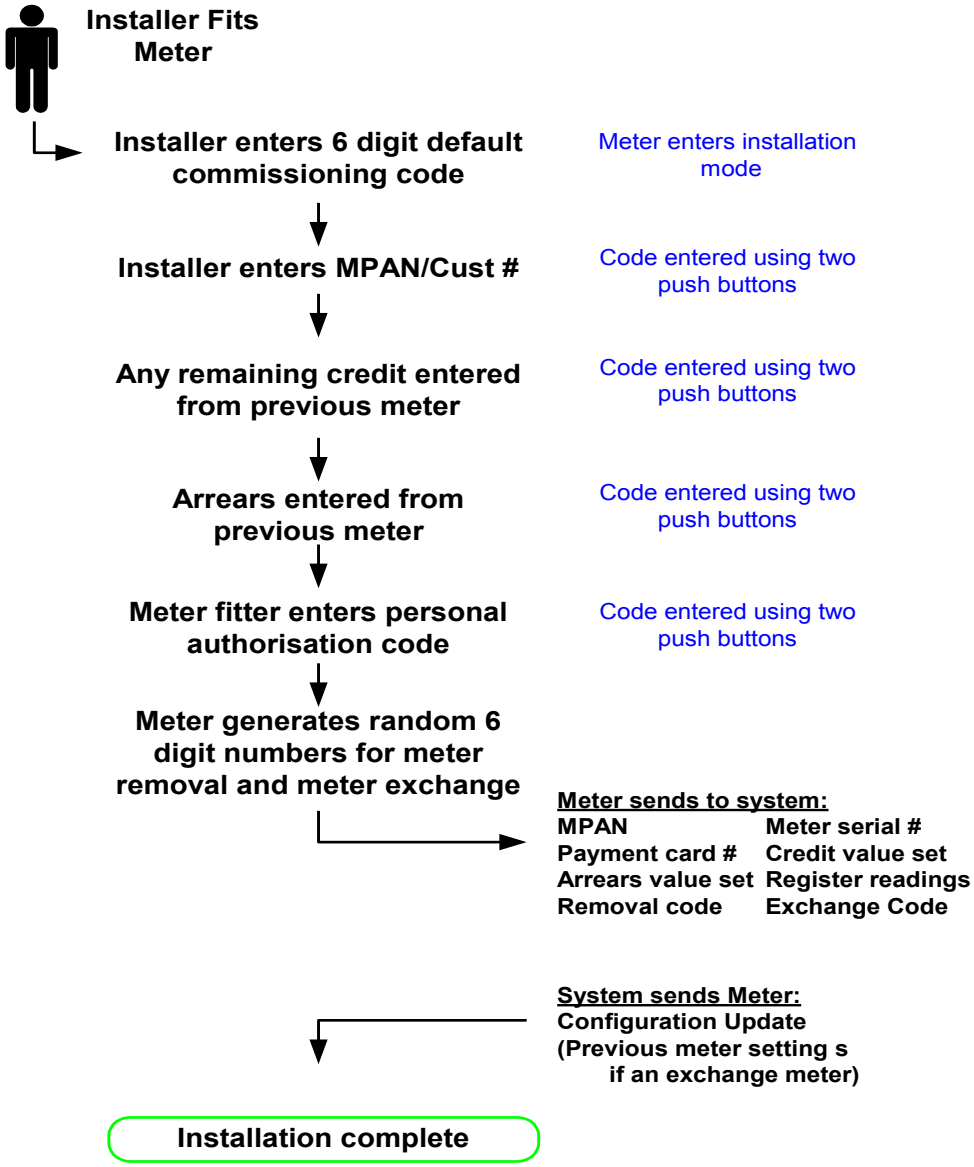
A remote process is available to prevent meters communicating when not required (i.e. loss of gas supply contract).

5.1.1 Binding and installation mode code entry

Both binding and automatic installation processes use a 6 digit PIN to instigate a particular process with the meter. The meter holds a record of 3 PIN's

Action	Display	Button Actions
Press and hold both push buttons on the front of the electricity meter until the display shows:		Hold both buttons.
The active number in the code sequence is shown as a flashing digit. To increment the number press the blue button, the number will increase from 0 though to 9 then back to 0		Press blue button to increment the number .
To move to the next number in the sequence, press the orange button. The sequence will move one digit to the left and the active digit shown flashing. If an error is made in entering a		Press orange button to move to next digit. Press and hold orange button to step backward to previous digit

particular number then the sequence can be moved back by pressing and holding the orange button.		
All binding and installation codes are 6 digits in length. Once the sixth digit has been entered then the code can be offered to the meter by pressing and holding both push buttons.		Press both buttons to offer code entered.
If the code matches a code pre-programmed code then a pass message is shown		
If not then and error message is shown.		



The meter will recognise and accept a default service code to allow the installer to enter the installation process. The default service code will be 6 digits in length and programmed during factory configuration. NOTE: it is expected the service code will be valid across all meters. Following completion of the commissioning process the Default service code operation will be disabled.

On acceptance of service code the meter will enter the installation process. The first parameter for entry will be the customer MPAN or customer number. See Display section.

The MPAN or customer number length will be configurable up to allow up to 16 digits to be entered. **NOTE**: Default length of MPAN - 13 digits.

The MPAN number is entered into the meter using the Purchase Code entry procedure but will allow only the configured number of digits to be entered. The meter will store the initial MPAN entered then require the number to be re-entered and checked against the original entry. If the two entries match then the MPAN is considered as correct and the process will move the next step.

Following successful MPAN entry the meter, a configurable option will allow entry of credit from a previous meter. The Present Balance register will be shown and the meters current value able to be edited using the two push buttons. See Display section 6.8.

Following the entry/editing of the Present balance register, a configurable option will allow an Arrears value to be transferred from a previous meter. The current Arrears Register will be shown and the value able to be edited using the two push buttons. See Display section 6.8.

Following the entry of the Arrears register the meter will ask for an Authorisation code to be entered. This code is an identifier for the meter installer.

The Authorisation Code will be 6-digits in length. See Display section 6.8.

Once installation data has been entered the meter will randomly generate two 6-digit codes. These codes will allow a decommission process to occur when entered at a later date by a meter engineer. The two codes have the following purposes:

- Meter removal Code – Used where the meter type is to be replaced completely, i.e. with a credit meter
- Meter exchange Code – Used to swap (clone) a meter such as in end of life exchange programme.

The two codes are sent to the system following the commissioning process. The operation of codes is explained in Decommissioning 3.11.

The two codes are stored in memory one against each of the processes.

Once commissioning is complete the meter will transmit the commissioning details to the system. The message will consist of:

Data Item	Returned in1	Details
Date and Time stamp	H	
Electricity Meter Status flags2	H	
Message ID	P	Message ID = INSTALL
MPAN/Customer #	P	
Meter Serial Number	P	
SIM Card Number	P	
Payment Card Number	P	
Credit Mode	P	Denotes credit or prepayment operating mode
Emergency credit flags	P	Denotes emergency credit taken or not
Present Balance Register	P	

Data Item	Returned in1	Details
Arrears Register	P	
Rate 1 kWh register	P	
Rate 2 kWh register	P	
Rate 3 kWh register	P	
Rate 4 kWh register	P	
Total kWh register	P	
Export energy register	P	
Meter Removal Code	P	
Meter Exchange code	P	
Meter Fitter Authorisation Code	P	

Return Data – Following the installation process the meter will be sent a full configuration set of operation data including tariffs etc, from the utilities information system. Additionally the meter may be sent Present balance data and Arrears data if the meter is a replacement meter subject to an exchange process.

5.2 Decommissioning

Decommissioning of a meter is achieved by entering one of the two decommissioning codes sent to the system at installation. NOTE: The meter engineer would be instructed of the codes by use of the system.

The entry of the Decommissioning Codes is achieved using the using the standard Purchase Code entry procedure - see display section. Once 6 digits have been entered the installer can offer the code to the meter by pressing and holding both buttons for 2 seconds. If the code does not match the either the removal code or exchange code held in memory, the meter will show ‘Error’ and clear the entry. Lock out procedure will apply according to the Purchase Code entry scheme.

5.2.1 Meter Exchange

When the meter exchange code is entered the meter will send a snapshot of meter data to the system. The information will include:

Data Item	Returned in1	Details
Date and Time stamp	H	
Electricity Meter Status flags2	H	
Message ID	P	Message ID = EXCHANGE
MPAN/Customer #	P	
Meter Serial Number	P	
Credit Mode	P	Denotes credit or prepayment operating mode
Emergency credit flags	P	Denotes emergency credit taken or not
Present Balance Register	P	
Arrears Register	P	
Rate 1 kWh register	P	
Rate 2 kWh register	P	
Rate 3 kWh register	P	

Data Item	Returned in1	Details
Rate 4 kWh register	P	
Total kWh register	P	
Export energy register	P	

NOTE: The transfer of all metering data to the system will allow all parameters to be sent back down to an exchange meter when the same MPAN is used in the new meter.

5.2.2 Meter Removal

When the meter removal code is entered, the meter will send a snapshot of metering data to allow a final read to be arranged. The information will include:

Data Item	Returned in1	Details
Date and Time stamp	H	
Electricity Meter Status flags2	H	
Message ID	P	Message ID = REMOVAL
MPAN/Customer #	P	
Meter Serial Number	P	
Credit Mode	P	Denotes credit or prepayment operating mode
Emergency credit flags	P	Denotes emergency credit taken or not
Present Balance Register	P	
Arrears Register	P	
Rate 1 kWh register	P	
Rate 2 kWh register	P	
Rate 3 kWh register	P	
Rate 4 kWh register	P	
Total kWh register	P	
Export energy register	P	

6 Commands and meter data

6.1 Ad hoc (Immediate) Reads

The meter will respond to requests for Ad hoc register reads. The meter will respond immediately with the requested data. The ad hoc read request may consist of any metering parameter held within meters memory.

As an example a standard request may consist of:

- MPAN/Cust #
- Electricity Meter Serial Number
- Rate 1 kWh register
- Rate 2 kWh register
- Rate 3 kWh register
- Rate 4 kWh register
- Total kWh register
- Export energy register.

Automatically the meter will return the following data in the return message header:

- Electricity Meter Status
- Date and Time stamp

The above data would fit within a single SMS message.

6.2 Change of Tenancy/Supplier

The meter is capable of handling changes in tenancy or supplier by zeroing or revaluing various registers within the meter upon receipt of a change of tenancy/supplier command (CoT/S) by the system.

A CoT/S command can be configured to operate either immediately or at some time in the future; the CoT/S command will contain an activation date and time for when the process should occur. The meter will only perform the operation at the configured date and time unless requested immediately.

The CoT/S command is able to change or zero the following registers/ features:

- Reset or overwrite Credit/Debt register, configurable from 0 to maximum top-up value.
- Where the meter is in emergency credit the EC and any DCLR value will be cleared.
- Reset or overwrite Total Debt register, configurable from 0 to maximum value.

- Clear credit transaction log.
- Option to open/close meters contactor. (shows OFF display second CoT/S command to close contactor).
- Option to Zero PPU tariff plan.
- Option to reset Billing Period.
- Zero Standing Charges.
- Zero total credit.
- Zero total payments.
- Option to clear any future tariffs.
- Clear Profile data log.

The CoT/S command will trigger a Snapshot of readings. The returned data includes data required for prepayment or credit operation and consists of:

Data Item	Returned in1	Details
Date and Time stamp	H	
Electricity Meter Status flags	H	See2 below
Message ID	P	Message ID = COTS
MPAN/Customer #	P	
Meter Serial Number	P	
Credit Mode	P	Denotes credit or prepayment operating mode
Emergency credit flags	P	Denotes emergency credit taken or not
Present Balance Register	P	
Arrears Register	P	
Rate 1 kWh register	P	
Rate 2 kWh register	P	

1 Returned In' column denotes whether the item is returned in the message header (H) or as part of the message payload.

2 Meter status information includes flags to indicate fault conditions/status of the electricity meter.

Flags will indicate the following:

Watchdog Error	Reverse energy detected
Real Time Clock Error	SIM card flap tamper
FRAM (memory) error	SIM carriage detected
Program download active	Fingerprint stats error
Meter in Emergency mode	Fingerprint other error

Rate 3 kWh register	P	
Rate 4 kWh register	P	
Total kWh register	P	
Export energy register	P	

Following a CoT/S the meter will be reprogrammed with new tariff plans, TOU switching as required.

6.3 Supply Restoration

When operating in credit mode a reconnection command may be issued to enable the electricity supply to be reinstated by the customer.

The command will consist of:

- Close electricity meter contactor
- Time and date for event or immediate
- Acknowledgement request.

At the designated time, and if requested, the electricity meter will allow the customer to close the contactor. The meter will scroll the message ‘Press Orange button for power’ as described in section 6.7. When the consumer presses the Emergency credit button the contactor will close and supply restored.

6.4 Profiling

The meter may be configured to record 30-minute electricity profiles; the meter will store up to 30 days of 30-minute profiles.

Half hourly profiling will commence following the receipt at the meter of a command from the utilities information system for them to begin. The command will consist of a profile request, a start and stop date or continuous. Between start and stop dates the meter will transfer profiles to the utilities information system at regular intervals [A single days’ worth of 30-minute profiles can be packed into a single SMS message].

If continuous profiles are requested the meter will continue to send profiles until a further command is received communicating a stop date.

If supply is lost to the meter, on reconnection of supply, the meter will record ‘power fail’ into the lost profile slots. If the power outage is greater than 3 days the meter will not attempt to ‘pad’ lost profiles and will clear the entire profile log.

6.5 Scheduled Reads

The meter will be able to 'Push' register readings back to the utilities information system at regular predefined intervals. The reading interval will be configurable by the system.

The data returned to the system will hold both credit and prepayment information for the meter. A scheduled read will be a single SMS message in length. The returned message format will be as follows:

Data Item	Returned in1	Details
Date and Time stamp	H	
Electricity Meter Status flags2	H	
Message ID	P	Message ID = SCHED_READ
MPAN/Customer #	P	
Meter Serial Number	P	
Credit Mode	P	Denotes credit or prepayment operating mode
Emergency credit flags	P	Denotes emergency credit taken or not
Present Balance Register	P	
Arrears Register	P	
Rate 1 kWh register	P	
Rate 2 kWh register	P	
Rate 3 kWh register	P	
Rate 4 kWh register	P	
Total kWh register	P	
Export energy register	P	

The meter-reading schedule may be configured around the following one of the following routines:

- Daily Read
- Weekly Read
- Monthly Read
- Billing Period Read.

In order to randomise the reading time and prevent all meters sending their data back to the CS at the same time, the meter will take a snapshot reading at the end of a random offset. The offset period shall be a maximum of 2 hours beginning from midnight; the meter will select a random offset within this period, the meter-reading schedule will therefore be as follows:

- Daily Read – A snapshot of registers taken between 00:00 and 02:00 and transferred to the system.
- Weekly Read – A snapshot of registers taken between 00:00 and 02:00 Monday morning each week and transferred to the system.

- Monthly Read – A snapshot of registers taken between 00:00 and 02:00 on the first day of each calendar month and transferred to the system.
- Billing Period Read - A snapshot of registers is taken between 00:00 and 02:00 at the end of a billing period, as defined in the billing period section, and transferred to the system.

The meter may be configured not to send scheduled reads.

The meter will additionally store the last sent scheduled read as a contingency in case of communication failures.

7 Tariff Features

The meter may operate a time-of-use tariff, a block tariff within a billing period or a combination of the two. This section describes the operation of the different tariff structures that may be applied to the meter.

7.1 Time-Of-Use Tariff

The TOU scheme will provide switching across four TOU rate registers. The scheme will hold up to 15 time switches; each time switch will allow switching to be applied to any day of the week. Additionally each time switch will enable the auxiliary control relay to be closed. Upon reaching a time switch with an auxiliary relay close command, the relay will close and remain closed until the next time switch.

The TOU tariff scheme will allow seasonal switching such that switching times can be different for summer and winter periods.

Seasons may be set to:

Summer (S)	Operate from last Sunday in March to last Sunday in October.
Winter (W)	Operate from last Sunday in October to last Sunday in March.
All Year (A)	Operates throughout the year without any seasonal changes

7.1.1 TOU Switching Scheme

A diagram of the full rate-switching scheme is given below.

Switch #	Season	Start Time	Rate	Applicable Days of operation							Auxiliary relay
				M	T	W	T	F	S	S	
1	S/W/A	HH:MM	1 to 4								Open/Closed
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											

7.1.2 TOU Switching Scheme – Example

Switch #	Season	Start Time	Rate	Applicable Days of operation							Auxiliary relay
				M	T	W	T	F	S	S	
1	S	00:00	1	Y	Y	Y	Y	Y			Closed
2	S	07:00	2	Y	Y	Y	Y	Y			Open
3	S	00:00	3						Y	Y	Closed
4	W	00:00	1	Y	Y	Y	Y	Y	Y	Y	Closed
5	W	07:00	2	Y	Y	Y	Y	Y	Y	Y	Open

The example above shows a seasonal weekday/weekend tariff. During the summer season the meter switches between rates one and two during weekdays in a seven hour on/off peak pattern. The aux relay is closed during the nightly off peak period. At weekends the meter switches to rate 3 and closes the off peak relay all day. During winter months the meter operates the seven-hour off peak pattern throughout the week.

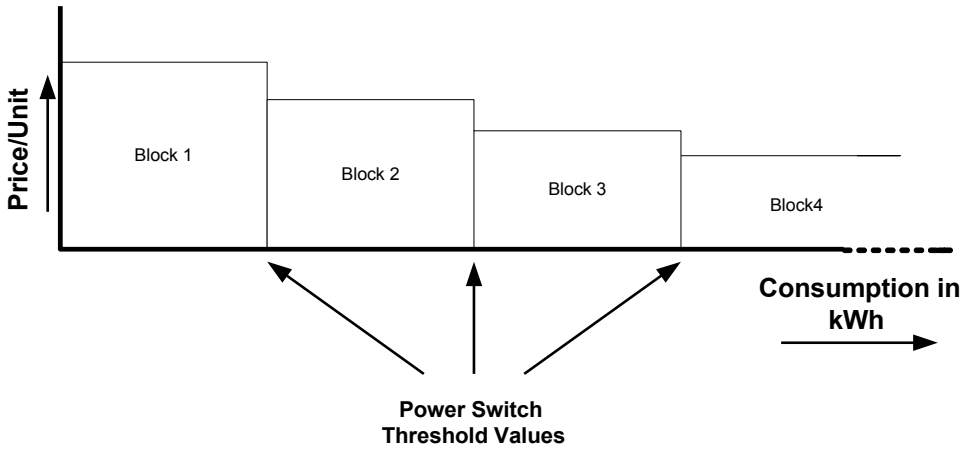
7.1.3 Holidays/Special Days

The meter may be configured with 15 dates to be used as special days. During a special day the meter may be configured to:

- Switch to and remain in a particular rate (1 to 4) all day, or remain in the normal switching scheme.
- Close the Auxiliary relay all day.
- Act in a 'Friendly Non-Disconnect' mode all day.

7.2 Block Tariff

The Block Tariff structure is shown diagrammatically below:



The meter will hold three Power switch threshold values; these values represent the value in kWh between blocks. The block tariff will begin at the start of a billing period.

From the start of a new billing period, the number of kWh's consumed will be recorded as a Billing Period Usage Value. When the recorded value

reaches a threshold value, the PPU tariff will be changed according to the price defined for the next block. Block four has no limit. When reaching block four the meter will continue to charge at the block four rate until a new billing period is reached. If a threshold value is not entered then the previous block will remain operative.

The Billing Period Usage value shall be calculated from any individual rate register (1 to 4) or the total register.

When operating a Combination tariff the meter will take a snapshot of all kWh registers upon reaching a Threshold Value. This will allow auditing of the credit value applied to the meter i.e. how many units were charged at which price.

7.2.1 Billing Periods

The Billing Period is the period in days or calendar months over which the Block Tariff is applied. In order to allow quarterly billing the Billing Period has a configurable start date and duration. The Billing Period duration may be configured as a number of days or calendar months. Billing periods roll-on unless reset for COT or COS.

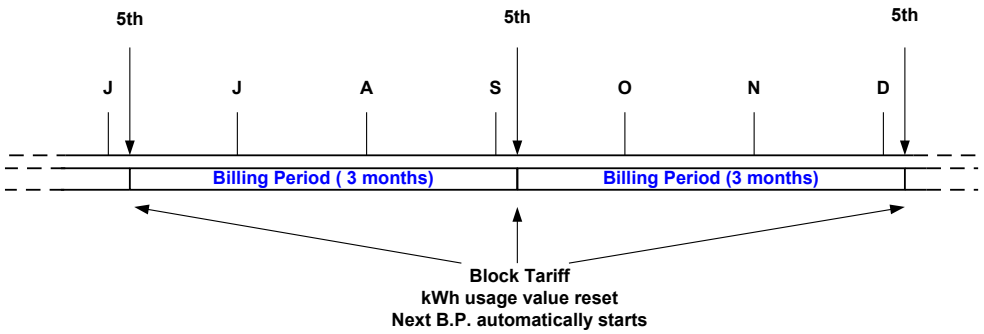
The Billing Period shall have duration defined in the range:

- 1 to 115 days; or
- 1-12 calendar months. [Start date between 1st and 28th day].

The Billing Period has a start date defined as DDMM. The Billing Period end date is calculated as the start date plus the number of days or calendar months of the Billing Period. Where a monthly period is applied the meter will use the day specified in the start date as the start day of the next period following the specified number of month's duration. The Billing Period shall end at 24:00 on the Billing Period end date and the next Billing Period shall start automatically.

Example 1

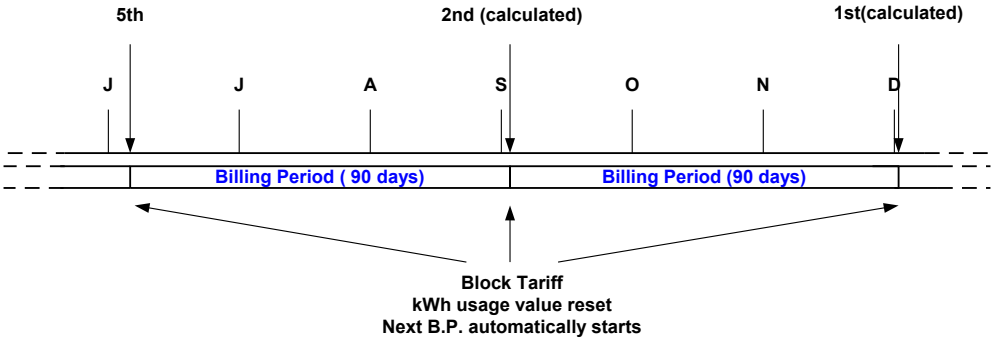
If a billing period is specified as 3 calendar month duration starting on the 5th June the billing period would operate as follows:



On the 5th of each 3rd month the Block tariff's billing period usage value is reset. As a result the block tariff resets and uses block 1 prices until the first power switch threshold is reached.

Example 2

If a billing period is specified as 90-day duration starting on the 5th June the billing period would operate as follows:



The billing period is calculated 90 days form the start date. After each 90 day period the Block tariff's billing period usage value is reset. As a result the block tariff resets and uses block 1 prices until the first power switch threshold is reached.

The meter holds information regarding the billing cycle held in the meter, this information uncludes the start of the next billing period, the start of the current billing period and what day of the current billing period the meter is in.

7.3 Price-Per-Unit Tariff Plan

The tariff prices applied by the meter can be complied from:

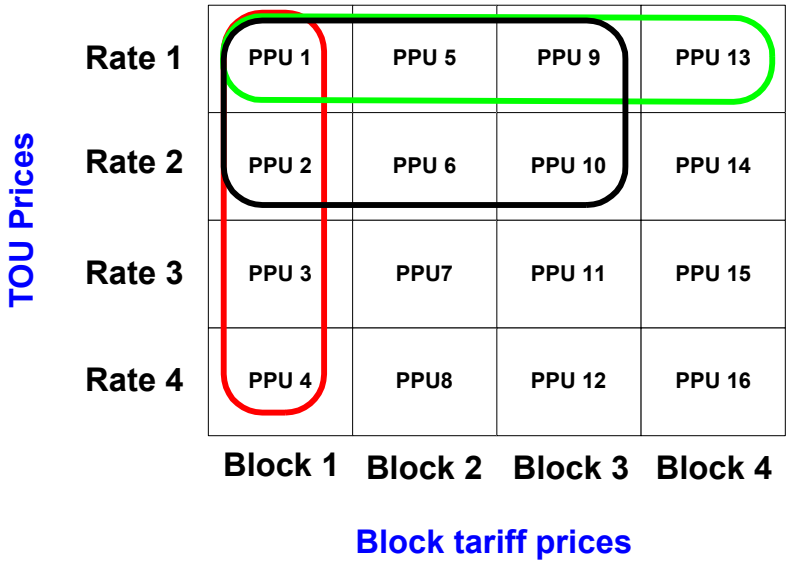
- TOU tariff
- Block tariff
- Combination of both

The tariff will consist of a matrix of up to 16 prices as shown diagrammatically below:

TOU Prices	Block 1	Block 2	Block 3	Block 4
Rate 1	PPU 1	PPU 5	PPU 9	PPU 13
Rate 2	PPU 2	PPU 6	PPU 10	PPU 14
Rate 3	PPU 3	PPU7	PPU 11	PPU 15
Rate 4	PPU 4	PPU8	PPU 12	PPU 16

Block tariff prices

7.4 Examples of Tariff types



TOU Only Tariff

When operating a TOU only tariff, the meter will use PPU values 1-4 only. The meter will charge at the corresponding PPU value according to the TOU rate the meter is switched to by the TOU switching scheme i.e. if scheme switches to Rate2, PPU2 is the chargeable kWh price.

Block Tariff (Single Rate)

When operating as a Block Tariff only, the meter will not change TOU rates. The meter will charge at PPU values 1, 5, 9 and 13 according to energy consumed and to which block the meter is in.

Combination Tariff

Example shows a Combination tariff using 2 TOU rates and 3 block tariff rates. Meter will dynamically change the PPU rate according to the energy consumed. When operating in Block 1 the meter will use PPU 1 and 2 for charging TOU Rates 1 and 2. When operating in Block 2, TOU Rates 1 and 2 will be charged at PPU 5 and 6.

7.5 Standing Charge

The meter will hold a Standing Charge value which is taken form the Present Balance register at regular intervals by dividing the value across a time period. Operation of the Standing Charge register is detailed in **Accounting Functions.**

The standing charge value will use the effective date as applied to the PPU Tariff Data.

7.6 Effective Date/ Future Tariff

The meter will be capable of holding a second [deferred] set of tariff data with a future activation date. Activation date will include day, month, and year.

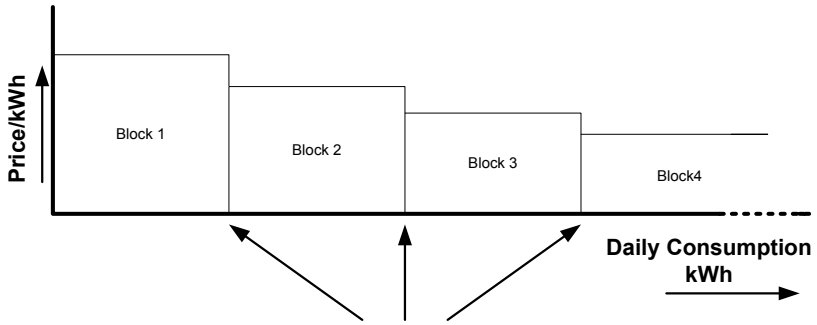
When the activation date applied to the future tariff is reached the future tariff will overwrite the present active tariff. The meter will use the new values from 00:00 on the activation date. A second Standing Charge Value may be a component of this deferred tariff data.

A future tariff may me sent to the meter in conjunction with a payment message.

7.7 Daily Resolved Block Tariffs

A Daily Resolved Block Tariff is block tariff that is applied on a daily basis. By resolving the block tariff daily the user does not receive a particular charge for kWh consumption at the beginning of the month (normally higher) followed by different pricing later, prices are in effect spread daily and costs smoothed throughout the billing period. As the usage during the billing period will vary, the meter will perform a daily reconciliation to ensure the correct amount of charge is made according to the set pricing blocks.

The Daily Block Tariff Threshold for each block will be calculated by dividing the Block Tariff Threshold by the number of days in the Billing Period.

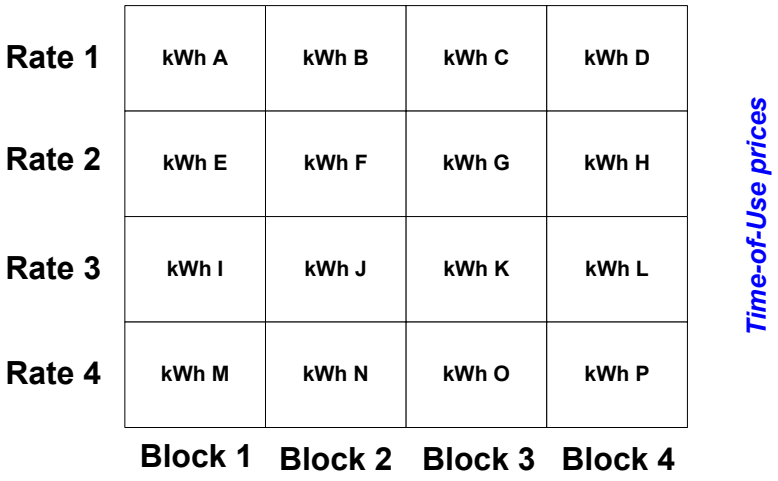


Daily Block Tariff Thresholds

At 00:00 the meter will reset and use Block 1 pricing to calculate costs from the kWh usage. The meter will continue to calculate with Block 1 pricing until consumption reaches the first Daily Block Tariff Threshold. When the days consumption becomes greater than the first block tariff threshold the meter will move to Block 2 pricing. The meter will continue to move forward in blocks until block 4 is reached; the meter will remain in this block until a midnight reset.

The meter will operate in a similar manner when moving between ToU rates and the configured pricing. [tbd: Register from which usage is defined]

From the start of the billing period, the meter will record kWh usage for each of the potential prices within the tariff table into a working log. 16 values will be stored. This is diagrammatically shown below:



Block (tier) tariff prices

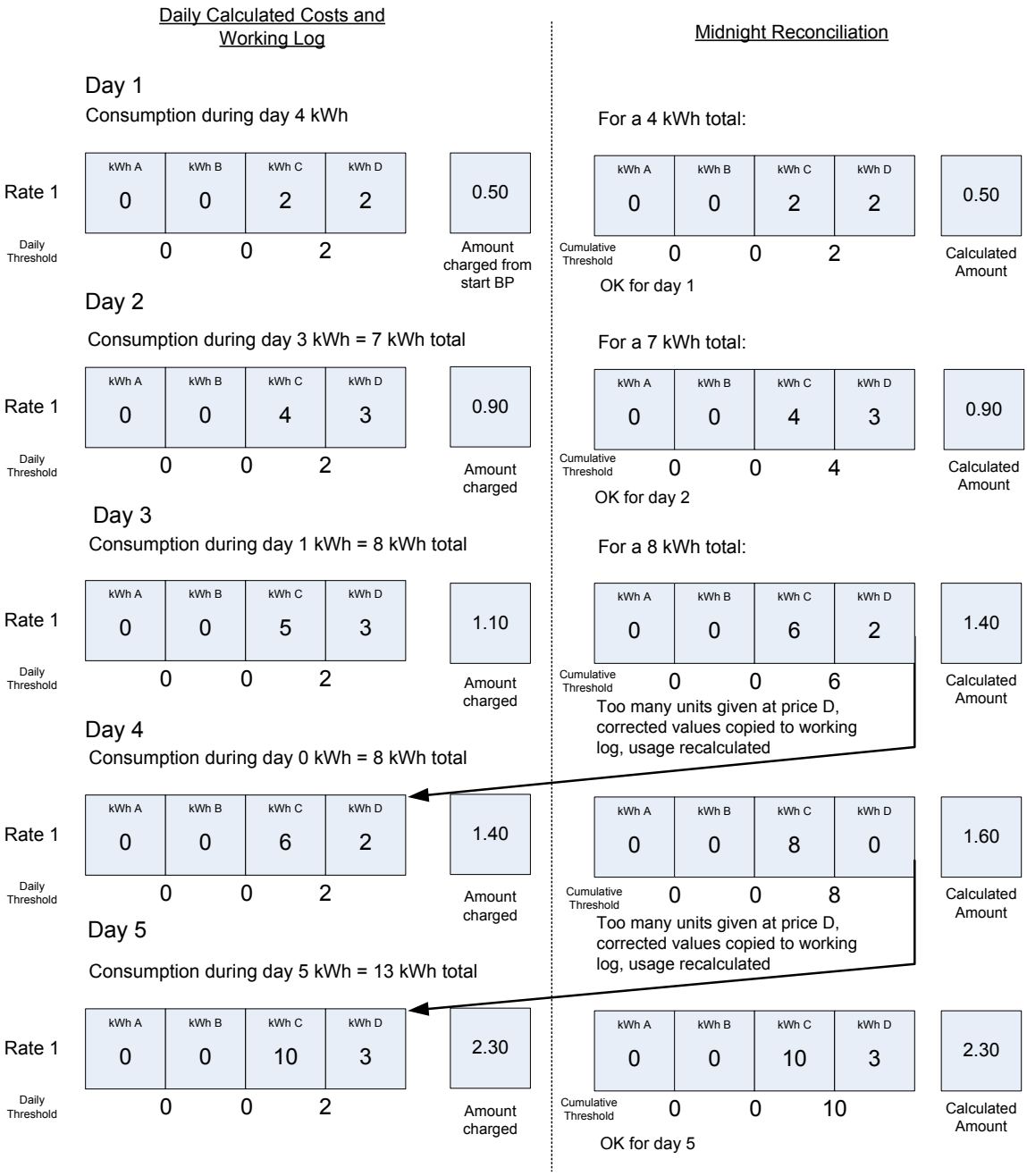
The meter records usage for every Wh registered.

At midnight each day the meter performs a reconciliation to ensure that charges made using the Daily Block Tariff Thresholds are accurate to the current position within the billing period. The meter will calculate the number of kWh's for each block from the total of kWh's consumed at each rate. A comparison of actual charges to calculated charges will be made. Where a discrepancy has occurred, the calculated values will be used and copied into the working log. A correction to the Present balance will be made either as a positive or negative credit adjust.

Example 1

The following example shows a usage pattern over the first 5 days of the billing period.

The example is based on a costs for kWh C = 0.20 and D 0.10. In the left hand column the working log is shown together with the cost calculated from usage during the day. The right hand column shows the 00:00 reconciliation. Where a discrepancy occurs between the amounts charged and the calculated costs, an adjustment process would be made at this time to the Present Balance register and the new values copied into the working log.



At the end of the billing period the meter resets the working log.

The meter is configurable to calculate either in a daily resolved or standard block tariff mode.

7.8 Climate Change levy

To enable the meter to be used against commercial tariffs it must be able to cope with the UK Climate Change Levy (CCL). At present the levy is applied to customers using over 3000 kWh's per quarter year (~33kWh per day). In addition to the levy higher rate VAT is applied to usage above this value.

The meter will hold a CCL charge value between 0.000 and 99.999 pence/kWh (present CCL charge 0.456 pence/kWh).

The meter will also hold two VAT values, VAT rate 1 and Vat rate 2. VAT rate 1 will be used to define the level of VAT already applied to the normal tariff prices within the tariff table. VAT rate 2 will hold the higher rate value.

The meter is capable of applying CCL and VAT rate 2 to usage above a configurable daily de-minimis value. The meter will hold values for both CCL and VAT 2 application. This will ensure future proofing in case future CCL and VAT application thresholds no longer coincided.

The meter records the monetary amount of charges taken from the Present Balance register from the start of the billing period. This is used for reconciliation purposes at the end of the billing period.

At 00:00, following a day's usage, the meter will calculate an average daily usage value using the total registered kWh's from the start of the billing period and the number of days lapsed.

If the calculated average daily amount is greater than the de-minimis value for CCL then the following day, the CCL charge will be applied to each kWh consumed.

If the calculated average daily amount is greater the de-minimis value for VAT rate 2 then the difference between VAT rate 1 and VAT rate 2 will be applied to each kWh consumed.

At the end of the billing period the monetary amount taken over the period will be stored together with a time stamp and the working value reset.

At the end of the billing period the meter will be reconciled against a billing read raised in the suppliers system. The system will require meter readings and monetary charges raised during the billing period and stored within the meter. Where a discrepancy occurs between billing and meter values a credit adjust value will be applied.

8 Prepayment and Accounting Functions

8.1 Credit Mode

The meter may be configured to operate in a credit mode. When operating in credit mode the meter will not open its contactor (unless instructed) and ignore any credit values set into the meter. The default operating display will be the active Rate Register display.

8.2 Present Balance Register

The Present Balance register is a continuously updated record of credit available for payment of energy consumption, standing charge collection and debt recovery. The Present Balance register will be reduced every time a kWh of energy is consumed. The meter will deduct one PPU value at the active rate each time the Active Rate register records a whole kWh of usage. Standing Charge and Debt Recovery will also periodically reduce the Present Balance register. The Present Balance register will record in both positive and negative values with negative values shown as Debt.

When receiving a Credit Top-up transaction, the Present Balance register will be incremented by the monetary value of transaction.

The Present Balance register values shall be in Pounds (€ following a currency conversion) and hold a maximum value of £999.99.

If the Present Balance register is exhausted, the supply shall be disconnected until the Present Balance register is brought back into credit, provided the meter is not in a Non-Disconnect period or Emergency Credit is evoked.

It shall be possible to alter the Present Balance register by a Credit Adjust command.

8.3 Payments Log

The Meter shall maintain a log of the last 20 payments received.

The log shall consist of:

- Date of payment received
- Value of payment received
- Flag to denote whether the payment was received by SMS or by customer button entry.

8.4 Total Credit Register

Total Credit Register that shall record the total value of purchased credit accepted by the Meter since it was commissioned. The value of each Credit Top-up will be added to the Total Credit register plus any credit adjustments made by a Credit Adjust Command.

The Total Credit Register shall be displayed in Pounds or Euros to 2 d.p (whole pence or cents) without leading zeros', and in the range £0.00 to £99999 with rollover to zero at £99999.99.

The Total Credit Register shall be reset to zero following:

- A Change of Tenancy (see Data Transfers)
- A Change of Currency (see Currency Conversions).

8.5 Cost Registers

The meter provides budgeting information to the customer in the form of cost per hour and cost today.

Cost per Hour is calculated on all charges normally applied within the last hour and is displayed from £0.01 to £99.99. The register is calculated on a three second average.

Cost Today stores the actual £ cost for the current day and includes all normal charges. The register will be updated whenever the main Present Balance register is adjusted.

Range from £0.01 to £99.99.

8.5.1 Total Number of Payments Register

The Meter shall maintain a Total Number of Payments Register that shall record the total number of times a valid Credit Top-up transaction was received by the meter since it was commissioned.

Each time a valid Credit Top-up is received the register will be incremented by one and will range 0 to 65535 with rollover to zero at 65535.

The Total Number of Payments Register shall be reset to zero following:

- A Change of Tenancy (see Data Transfers)
- A Change of Currency (see Currency Conversions).

8.6 Friendly Non-disconnect

The meter offers a facility to prevent disconnection of the contactor at certain times of the day even when prepaid credit falls below zero. Each day type (Mon to Sun) may be programmed with a start and end time for

the friendly period. Friendly periods may differ on each day type. If prepaid credit reaches zero during a friendly period the contactor will remain closed until the end of that period.

If prepaid credit reaches zero during a friendly period the meter will continue to charge for energy consumed at the appropriate PPU rate. Charges will be shown as a debt value in the present balance display.

The 'friendly' periods can be set either by the factory or configured by optical port or configuration SMS message.

8.7 Customer Cards

The prepayment mechanism for this meter is Tokenless. However for sake of convenience each utility customer will receive a magnetic card for means of account identification. The utilities information system will use the magnetic card to identify the meter and customer, i.e. when the customer purchases credit at a POS.

The card will contain a 19-digit number, which is programmed into the meter during factory configuration, and transferred to the system during installation.

8.8 Emergency Credit

The Emergency Credit (EC) facility provides the customer with a preset amount of credit to maintain supply for a short period after credit has been exhausted or is very low. The EC facility has two parameters; EC Availability Point [range £0 to £99.99] and EC value [range £0 to 99.99].

When the Present Balance register value in the meter falls below the EC Availability point, EC shall become available for use. The display will signify that EC is available by showing the character E at the end of the display, see Display section.

If EC is available and the EC button is pressed, the EC value is transferred to the Present Balance Register.

- If the Present balance register contained a positive value, the EC allowance shall be added to this value in the Present Balance register.
- If the present balance register contains a negative value (debt) the register will be reset and overwritten with the EC value. The Debt value will be written into the Debt to clear register. The meter will automatically display the debt to clear register as the first display in the display cycle.

When Emergency Credit is selected, energy consumption and standing charges shall be deducted from the Present Balance register and added to the debt to clear Register.

If credit is added while the meter is in EC and the value is insufficient to repay the Debt to clear register the meter will reduce the register by the credit value and remain in emergency credit.

If credit is added while the meter is in Emergency credit and the present Balance register is above the EC value i.e. Some credit is remaining from before the Emergency credit was evoked and the meter does not have a debt to clear value, the added value will be added with the to the remaining credit value (minus the EC value) and stored as the Present Balance register.

When Emergency Credit is exhausted, the main contactor will open and the Meter will transfer the amount in the Debt to Clear register into the Present Balance register. The Present Balance register shall show the total debt that shall be the sum of the Emergency Credit used plus any debt accrued from debt repayments.

The Debt to clear register will then be cleared and removed from the display cycle.

Before the meter will restore supply the value of debt must be repaid in full by adding credit greater than the debt value shown in the present balance register.

If credit is added which does not repay the debt value shown on the Present balance register the meter will reduce the debt and not offer Emergency credit availability. Emergency credit will only be offered once the Debt value is cleared and the present balance register falls below the EC threshold value once again.

It is possible to configure the meter such that Debt repayment shall not be collected from the EC value, see Debt recovery, or alternatively to disable the EC facility completely.

8.9 Standing Charge Register/Collection

Standing Charge is an amount that shall be deducted each week from the Meter's Present Balance register regardless of the energy consumed. The standing charge value shall be stored in the Meter's Standing Charge register and will be in the range £0.00 to £99.99.

The Standing Charge shall be collected in 100 instalments by subtracting 1/100 of the weekly value from the Present Balance register at every 1/100th of a week (1.68Hours).

Standing Charge will not be collected if the meter is powered down.

Standing Charge collection will be configurable and have the following options:

A. Standing Charge collection will be made at all times.

Or

B. Standing Charge collection is halted when the meter runs out of prepaid credit.

Additionally the above options can be combined with the following two options:

i. When running in emergency credit, standing charge collection will increase the Debt to Clear register but not reduce any EC amount in the Present Balance register.

Or

ii. When running in emergency credit, standing charge collection will increase the Debt to Clear register and reduce any EC amount in the Present Balance register.

8.10 Debt Repayment

The Meter shall have a facility to recover a preset debt based on regular deductions from the Present Balance register. Debt collection will be configurable in respect of total debt to be collected and repayment rate per week. The Total Debt Register shall contain the total debt amount the customer has to re-pay; and may have a maximum value of £9999.99.

The Debt/Wk repayment register shall contain the weekly repayment rate that shall be made to repay the debt. It may be in range of £0.01 to £99.99. The Debt/Wk repayment rate shall be recovered by 100 equal payments during the week; Debt repayments shall be deducted every 1.68Hours. Debt repayment shall cease when the Total Debt register reaches zero.

Debt Collection will be configurable and will have the following options:

A. Debt collection will be made at all times.

Or

B. Debt collection is halted when the meter runs out of prepaid credit.

Additionally the above options can be combined with the following two options:

i. When running in emergency credit, Debt collection will increase the Debt to Clear register but not reduce any EC amount in the Present Balance register.

Or

ii. When running in emergency credit, Debt collection will increase the Debt to Clear register and reduce any EC amount in the Present Balance register.

8.11 Currency Conversion

The Meter allows for the above accounting function to be carried out in Euros.

A currency change request will be sent as a message from the system. The message will contain:

- Date when the conversion is to take place
- Conversion factor
- Currency to be converted to (£ or €).

At 00:00 on the requested conversion date the meter will multiply the following registers by the conversion factor [conversion factor in the range 0.25 to 4]:

- Present balance register
- Arrears balance registers
- Charge/kWh values
- Standing charge
- Arrears recovery rate
- Emergency credit value
- Emergency credit availability value.

Following conversion the meter will change the currency symbol used on the display to the appropriate sign.

The meter will take a snapshot of readings before currency change, including:

- kWh registers
- Present balance register
- Arrears balance registers
- Total credit register.

When a Currency Conversion is implemented the Total Credit Register shall be reset to zero.

Following a conversion the meter will treat any payment messages received after the conversion date and time as in the new currency.

9 Meter Displays

9.1 General

The meter has a configurable display list with display items selectable from the following list:

Note:

PP = when meter is operational in prepayment mode

CR = when meter is operational in credit mode

Both = display is available in either mode.

Default Displays

- Present balance (PP)
- Active Rate display (CR)

Display Cycle

- Debt to Clear (only shown when EC is has been evoked) (PP)
- Rate 1 – 4 kWh charge (Both)
- All segments test (Both)
- Time (Both)
- Date (Both)
- Last 3 most recent payments (PP)
- Standing charge per week (Both)
- Arrears Recovery per week (PP)
- Total Arrears (PP)
- Total weekly charge (PP)
- Rates 1 – 4 kWh registers (Both)
- Total kWh register (Both)
- Emergency Credit Value (PP)
- Emergency Credit Threshold value (PP)
- Usage - Cost per hour (Both)
- Usage - Cost per day (Both)
- Emergency Credit value (PP)
- Emergency Credit Availability point (PP)

One Time and Special Mode Displays

- Credit received (PP)
- Power on message (push button for power) (Both)
- Purchase Code entry (PP)
- Installation
- MPAN/Customer number (Both)
- Present Balance (PP)
- Arrears (PP)
- Authorisation code (Both)
- Power OFF display (Both)

- Tamper detection
- SIM (Both)
- Reverse energy (Both)

It is possible to advance through the displays in sequence by pressing the display cycle button. At the end of the display list the meter shows the message ‘display end’ and reverts to the configured default display.

Optionally the meter can auto cycle the display list with a configurable interval between display changes of 1 and 20 seconds.

9.2 Icons

9.2.1 Currency

Customer displays include icons to display currencies in Pounds Sterling or Euros. The meter will show the currency in use using either £ or € signs.

9.2.2 GSM Network Signal Strength

The display will show a signal network strength indicator for installer and customer use. Optionally the signal strength indicator may be configured not to show after the meter is installed i.e. indicate to the installer only.

The indicator will show three levels of signal strength:

- Less than 5% signal strength — Antenna symbol only
- 5-25% signal strength- — One bar
- 25-75% signal strength - — Two bars
- Above 75% signal strength - — Three bars

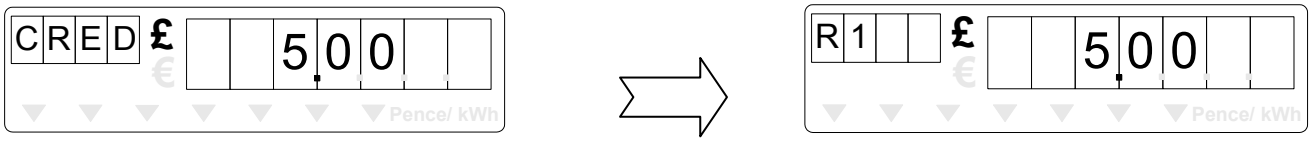
If a network is not present the  symbol will flash to warn that communication cannot be made. Reliable completion of the meters autonomous reporting, successful credit transaction and remote configuration is dependant on there being a single bar on display, i.e. >5% signal strength.

During SIM replacement the whole symbol  will flash to indicate power is removed to the SIM card reader and the SIM may be removed.

9.3 Present Balance Register

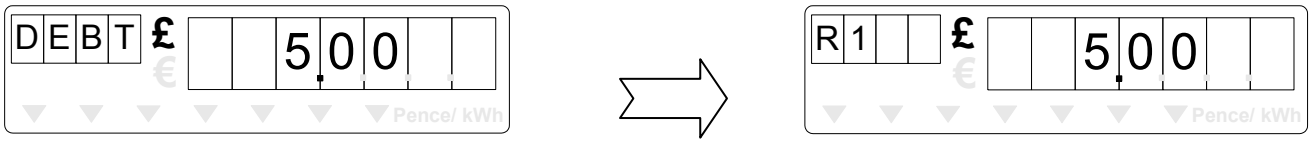
The Present Balance Register indicates the amount of prepaid credit remaining in the meter. The Present Balance Register may be positive (in Credit) or negative (in Debt). The Present Balance Register header will alternate with the active rate (and block if configured with a combination tariff).

When the meter is in normal prepaid credit the Present balance register will be shown as below. An example of the present balance display when the Meter is in credit to a value of £5 and R1 is active:



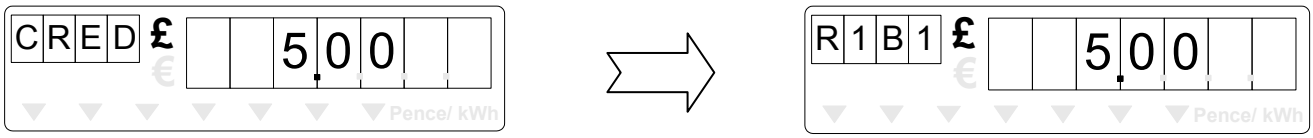
NOTE: Register header alternates between CRED and Rx where x is the active rate. The active rate and credit value is alternated at all times and is not dependant on whether the register is in credit, debt or EC evoked etc.

An example of the present balance display when the meter has run out of prepaid credit and is showing a negative value (Debt).



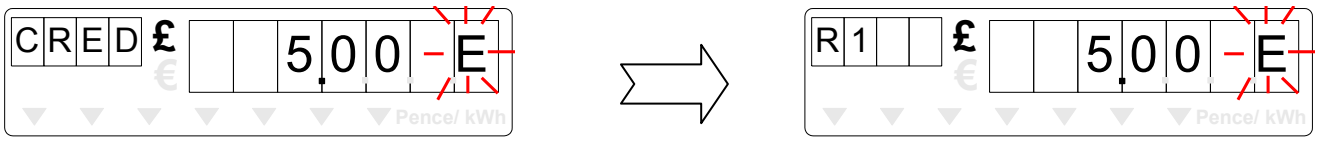
Where a combination tariff is applied the Present Balance display will indicate the active TOU rate plus the active tariff block the meter is currently charging at.

An Example of the present balance register when the meter has a credit of £5, the active TOU rate register is Rate 2 and the active block is block 1.

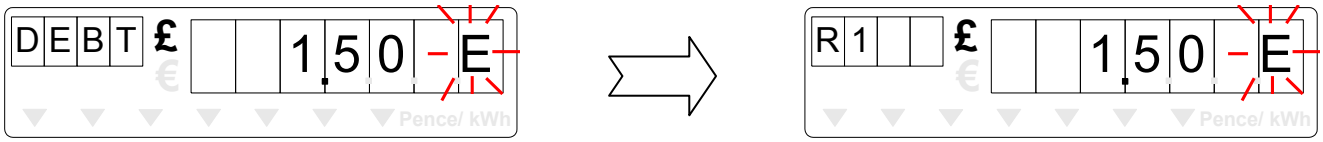


9.4 Present Balance, Emergency Credit Available

When the meter is in credit and the Present Balance has fallen below the EC Threshold the display will indicate Emergency Credit is available to the customer. When EC is available the letter E will be flashed on the display as in the example below.

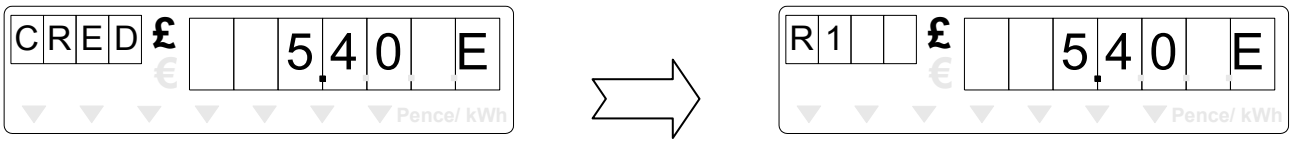


If the meter runs out of prepaid credit and EC has not been used the display will show the availability of EC by again flashing the letter E on the display as shown below.

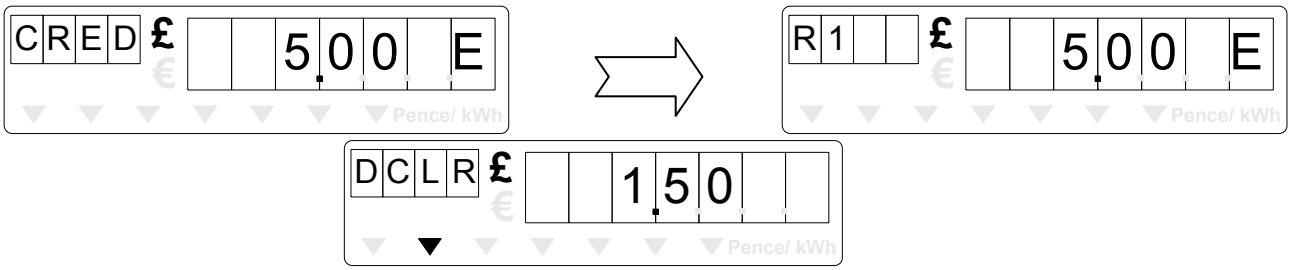


9.5 Present Balance, Emergency Credit in Use

When emergency credit has been evoked and the meter was in credit between the emergency Credit Threshold value and zero the meter will add the Emergency credit to the reaming credit. In the example below the meter had a remaining credit value of £0.40 and an emergency credit value of £5.00. When Emergency credit has been evoked the E symbol will remain steady on the display.



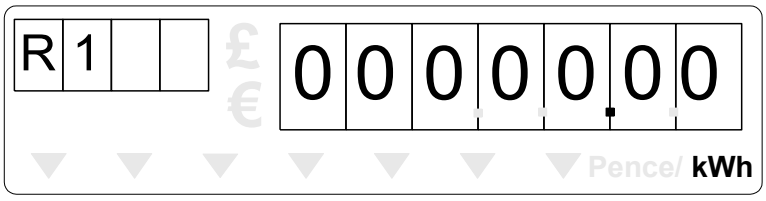
When the emergency credit facility has been evoked and the meter is in debt, the meter will display the (remaining) emergency credit value in the present balance display plus show the debt to be clear before the meter will return to credit in a second Debt to Clear register.



The debt to clear register will automatically appear as the first register in the display cycle

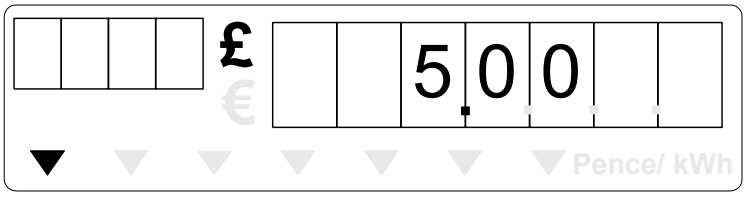
9.6 Active Rate Display

When the meter is in Credit mode the meter may be configured to show an active rate display as a default display. The display will automatically show the active rate register number and the present reading for the register.



9.7 Payment Received

When a valid payment is received, the display will show the value of the payment to the customer.



The Payment value will remain on the display until the customer presses the display cycle button.

If the meter is displaying a received payment and a second payment arrives the second payment value will overwrite the first payment value.

When credit in the meter is exhausted and the meter contactor is in an open state, if the received payment is sufficient to place the meter back into credit the meters will scroll the message across the 7 eight segment register displays:

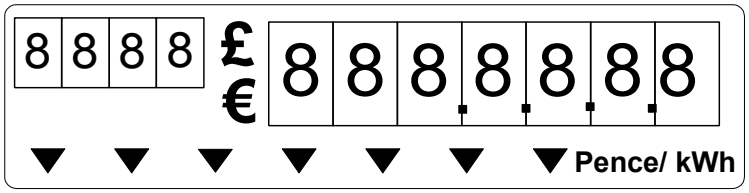
PUSH Button

When the consumer presses the Emergency credit button the contactor will be closed and power restored.

9.8 Display Cycle Options

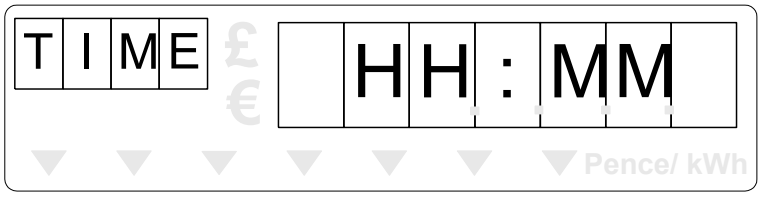
9.8.1 Test Display

An all segment test display is available. All segments and Icons will be shown.



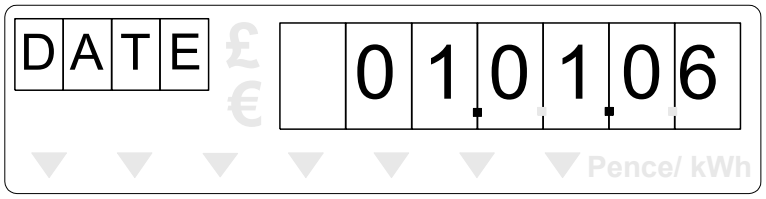
9.8.2 Time Display

The Time Display shows the time (corrected for daylight saving as necessary) in hours and minutes in the 24-hour format.



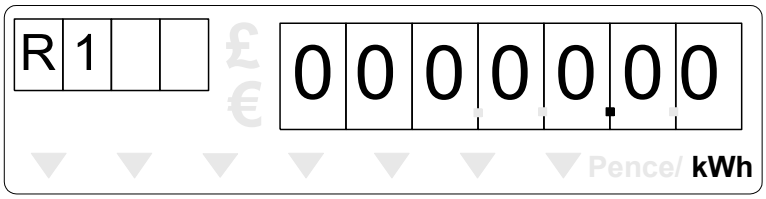
9.8.3 Date

The Date Display shows the date in a Day/Month/Year format DD.MM.YY.

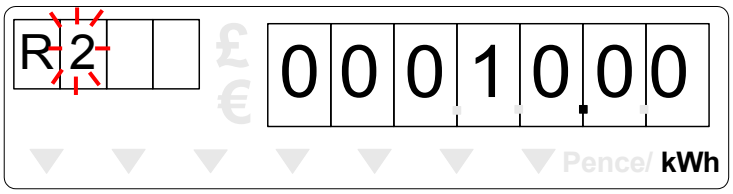


9.8.4 TOU Energy Registers 1-4

Energy registers shall show 5 whole numbers with the option of 0, 1 or 2 decimal places, unless configured to 3 decimal places of testing purposes via the optical port. The registers will roll over to zero after 99999.99.



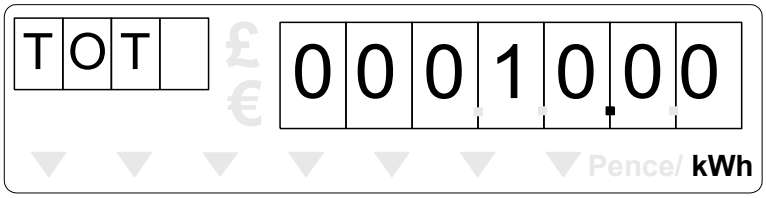
To indicate the active rate, the register number will be flashed on the appropriate rate register.



9.8.5 Total Energy Register

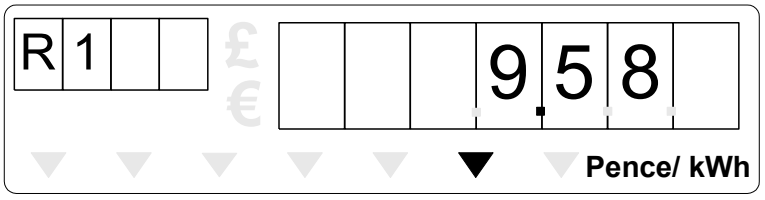
The total energy register displays the sum of rate 1 to 4 energy registers. The register will roll over to zero after 99999.99.

The Total register will have the same 0,1 or 2 decimal place resolution as the TOU energy registers.

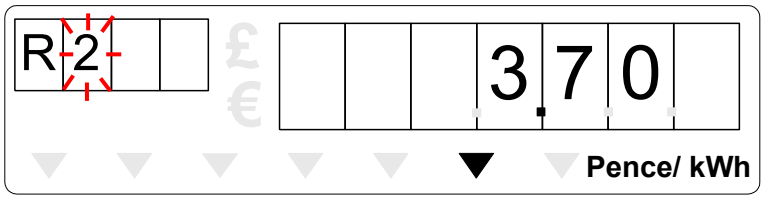


9.8.6 kWh Charge (PPU) Register

Energy cost per kWh is shown in the kWh charge register. The register is displayed in pence to two decimal places. The Pence/kWh legend is shown in the bottom right hand corner.



To indicate the current price energy is being charged at, the active rate number will be flashed on the appropriate rate register.

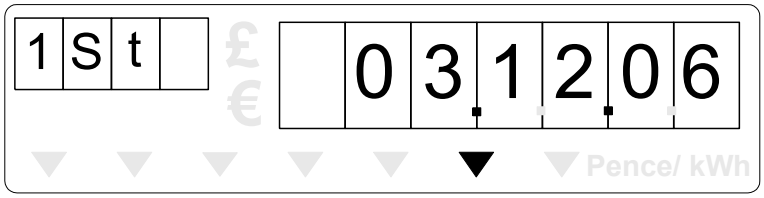


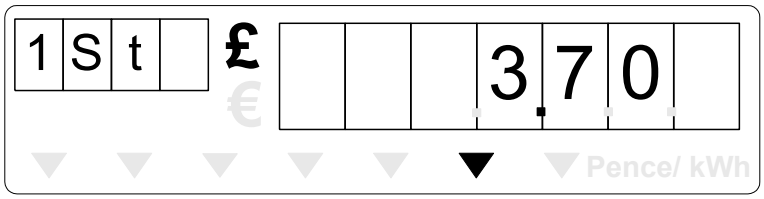
The register is in the range 0 – 99.99.

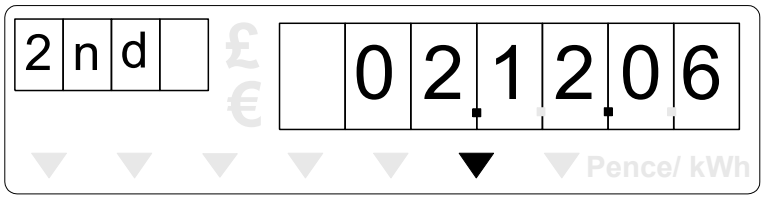
9.8.7 Most Recent Payments

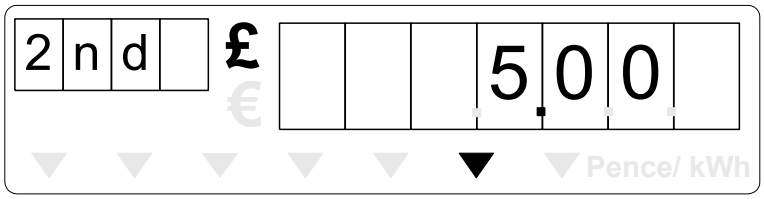
The last three most recent payments will be shown with payment value and date of payment receipt.

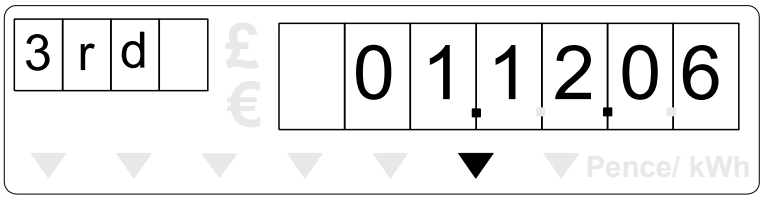
The register shall operate over six displays showing most recent payment first followed by second and third most recent payments.

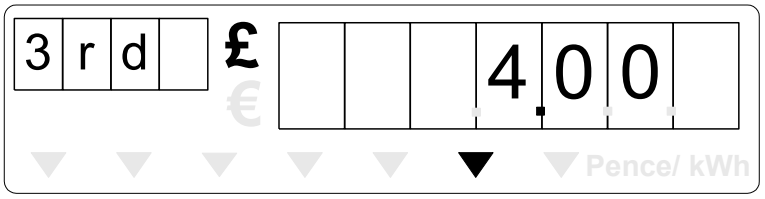










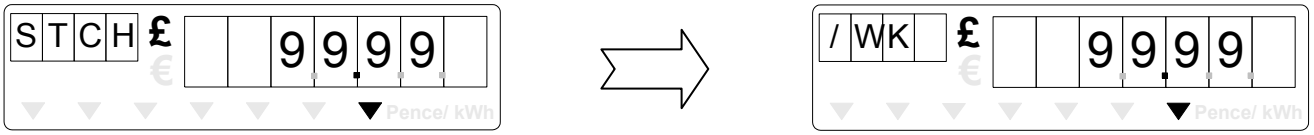


Where insufficient payments have been made to show three items, the meter will display blanks in place of data.

Date is in the format DD.MM.YY and the credit value is in the range 0-999.99.

9.8.8 Weekly Charges – Standing Charge

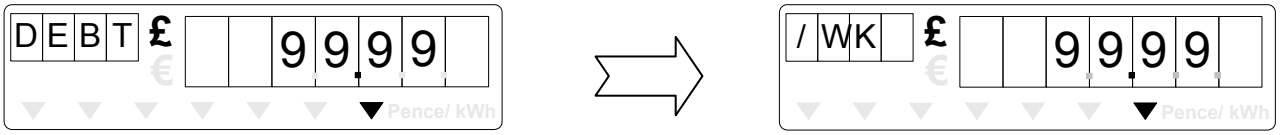
The standing charge register alternates between the STCH header and /Wk to signify the reading is a per week value.



The register is in the range 0- 99.99.

9.8.9 Weekly Charges – Debt Recovery

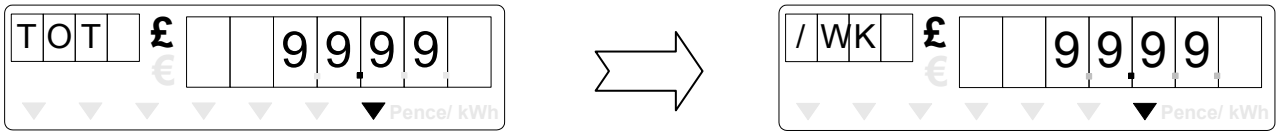
The Debt per week register alternates between the DEBT header and /Wk to signify the reading is a per week value. This will differentiate between this register and the Present balance debt.



The register is in the range 0- 99.99.

9.8.10 Weekly Charges – Total Charge

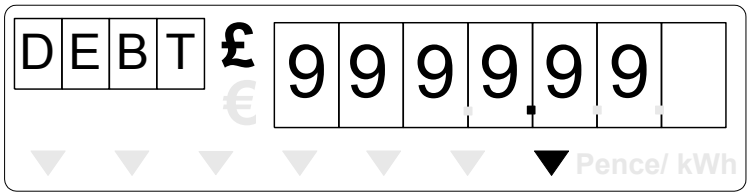
The Total Charge per week register is the addition of the standing charge and debt collection registers. The header alternates between TOT and /WK to signify the register is a per week value.



The register is in the range 0- 99.99.

9.8.11 Outstanding Debt

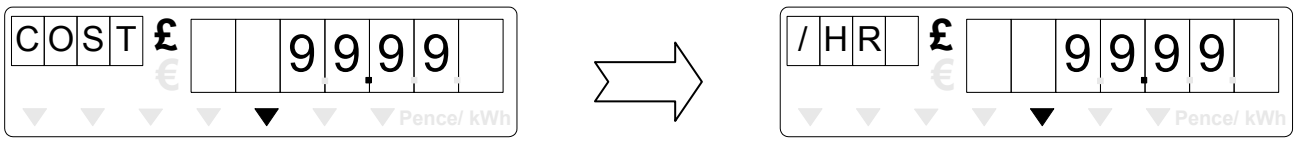
The Outstanding debt register shows the total amount outstanding for collection.



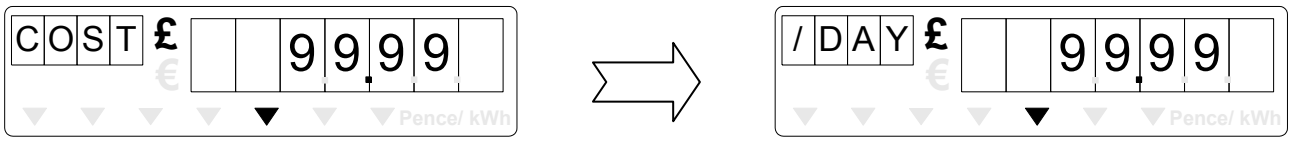
The register is in the range 0- 9999.99.

9.8.12 Usage

The meter can show the present cost per hour and cost today as described in section 3.6.



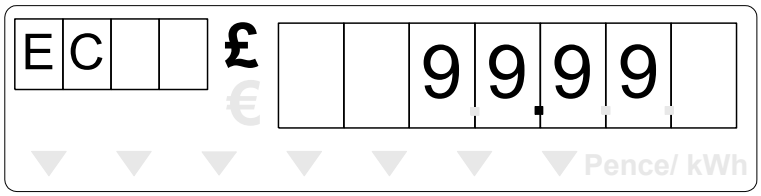
The register is in the range 0- 99.99.



The register is in the range 0- 99.99.

9.8.13 Emergency Credit Value

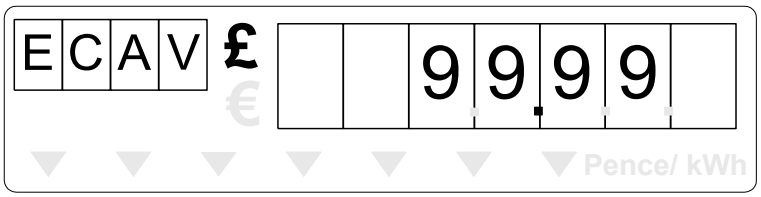
The meter can display the configured Emergency Credit value available to the customer.



The register is in the range 0- 99.99.

9.8.14 Emergency Credit Availability

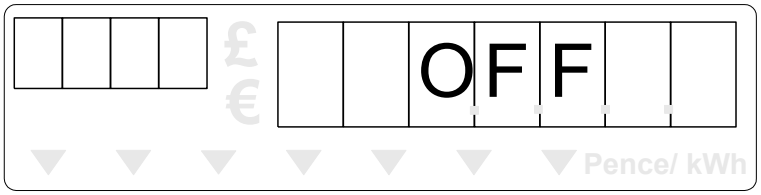
The meter can display the point at which the configured Emergency Credit value becomes available for use.



The register is in the range 0- 99.99.

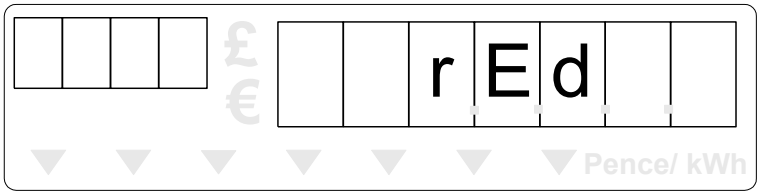
9.8.15 Supply Off Message

The supply OFF message may be shown following a Change of Tenancy command and the meters contactor has been opened.

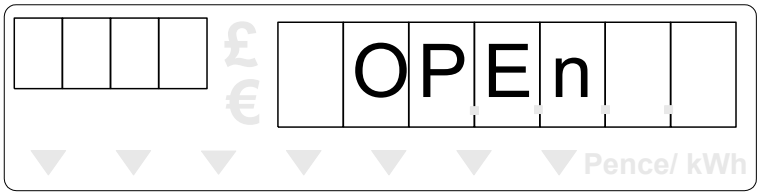


9.8.16 Tamper Messages

A configurable RED message may be shown following a reverse energy detection event. The RED message will alternate with the default operating display.



A configurable TAMPER message may be shown following the opening of the SIM holder.

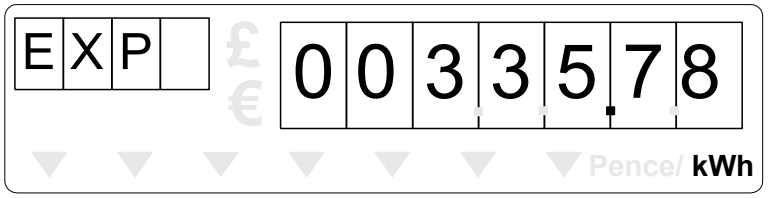


The message will alternate with the default display and only be shown when the SIM flap is in an open position. When closed the display will disappear.

9.8.17 Export Energy Register

The export energy register displays the amount of energy measured in reverse through the meter. The register will roll over to zero after 99999.99.

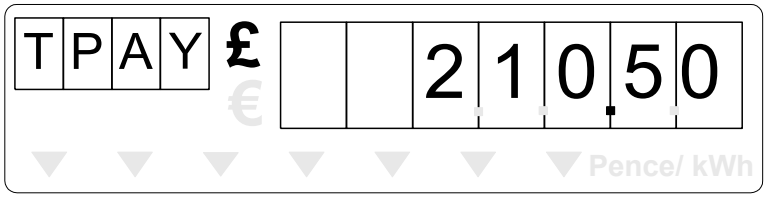
The export register will have the same 0,1 or 2 decimal place resolution as the TOU energy registers.



9.8.18 Total Credit Register

The Total Credit Register displays the total value of purchased credit. See section 5.3.

The Total Credit Register is displayed to 2 dp (whole pence/cents) without leading zero's.



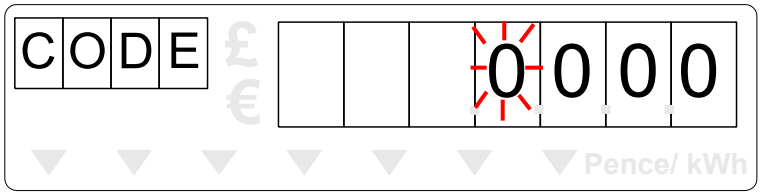
9.9 Purchase Code Entry

To enable the entry of various codes including installation, credit purchase etc, the meter will allow the user to enter such a code using the two push buttons fitted to the front of the meter.

The code entry sequence will operate the same for all types of code entry.

The code entry facility is entered using the Display Cycle (blue) and Emergency credit (orange) buttons by pressing and holding both buttons for 2 seconds. While in the code entry mode normal button operation is disabled.

When the facility has been entered the display will change from its normal operating mode to display shown below.



The flashing number is the active code digit, each press of the blue button will increment the code digit from zero through to nine, rolling over to zero again after nine is reached.

Each press and release of the orange button will move the code sequence one place to the left. The previously entered digit will be shown to the left of the active digit.

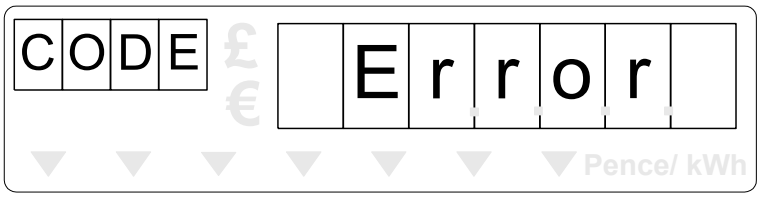
Once the expected code length has been reached the display will show blank characters to denote the end of the sequence.

Holding the orange button for 1 second will move the sequence one place to the right. The previous digit in the code will then become active and may be changed by pressing the blue button.

The code may be moved forwards or backwards as many times as required.

When all digits have been entered, pressing the orange button for a final time will offer the code to the meter; the meter will either accept or reject the code.

If the code is rejected the meter will state the error on the display:



On entering an erroneous code, the meter allows the code to be re-entered for up to 10 minutes. If a valid code is not entered after 10 minutes or if no button presses are detected after 60 seconds the display will revert back to the Default Operating display.

The meter will allow a maximum of 5 sets of code entries in a 24hr period.

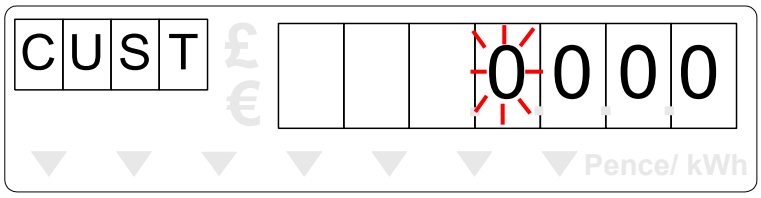
9.10 Installation

Following the successful entry of the Service Code the meter display will convert to an installation mode. The installation mode will allow the entry of several parameters, MPAN or Customer number, Credit balance from old meter, Arrears value from old meter, installers Authorisation Code. Details are entered as follows:

9.10.1 MPAN Entry

The entry of the MPAN or Customer number will use the same process for the entry purchase codes.

The code header will be changed as shown below:



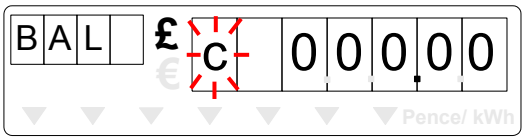
The length of MPAN/Customer number will be configurable. The meter will only allow the configured number of digits to be entered.

9.10.2 Balance Entry from Previous Meter

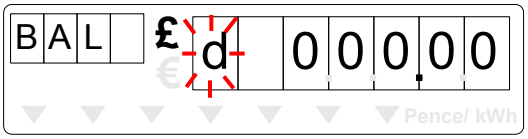
The balance from a previous meter may be entered during the installation process.

The transferred value may be entered as a credit or debt.

Initially the display will allow the sign of the value to be entered. The display will flash a ‘c’ to denote credit or ‘d’ to denote debt, pressing the display cycle button will change the parameter.



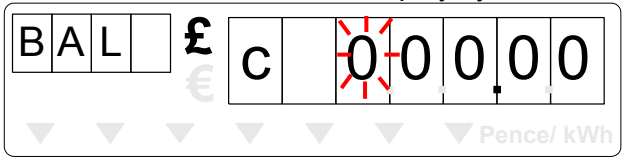
Blue Button Press



Once the sign has been selected the Emergency credit button is pressed to move to value entry.

Entry of value is made using the blue button to increment value, 0-9 then back to 0. Emergency credit button is used to move to next figure. Flashing character is the active character. Pressing both buttons for 1 second moves the active character back one place.

Display cycle button increments active character



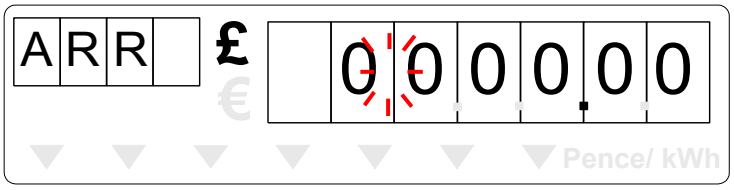
EC button move active character to right

When the EC button is pressed on the last far right character the process will move to the next stage.

9.10.3 Arrears Entry from Previous Meter

The Arrears balance from a previous meter may be entered during the installation process.

Entry of value is made using the blue button to increment value, 0-9 then back to 0. Emergency credit button is used to move to next figure. Flashing character is the active character. Pressing both buttons for 1 second moves the active character back one place.

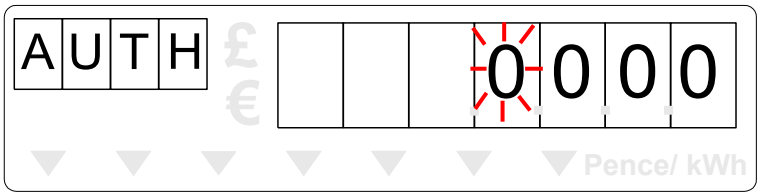


When the EC button is pressed on the last far right character the process will move to the next stage.

9.10.4 Authorisation Code Entry

The entry of the Authorisation code will use the same process for the entry purchase codes.

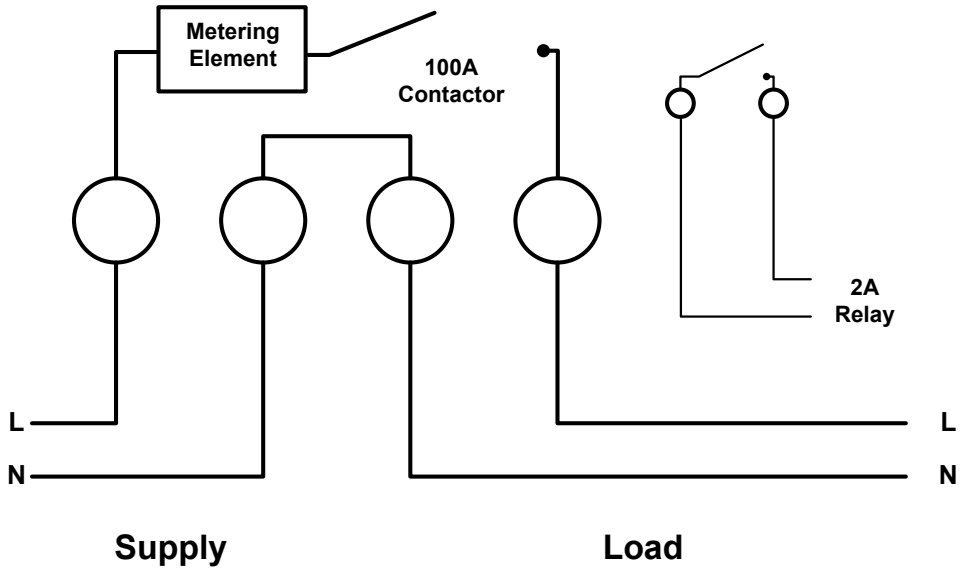
The code header will be changed as shown below:



The length of Authorisation Code will be 6-digits. The meter will only allow 6 digits to be entered.

10 Wiring Diagram

The wiring diagram seen below for the meter is fixed to the meter terminal cover:



Important

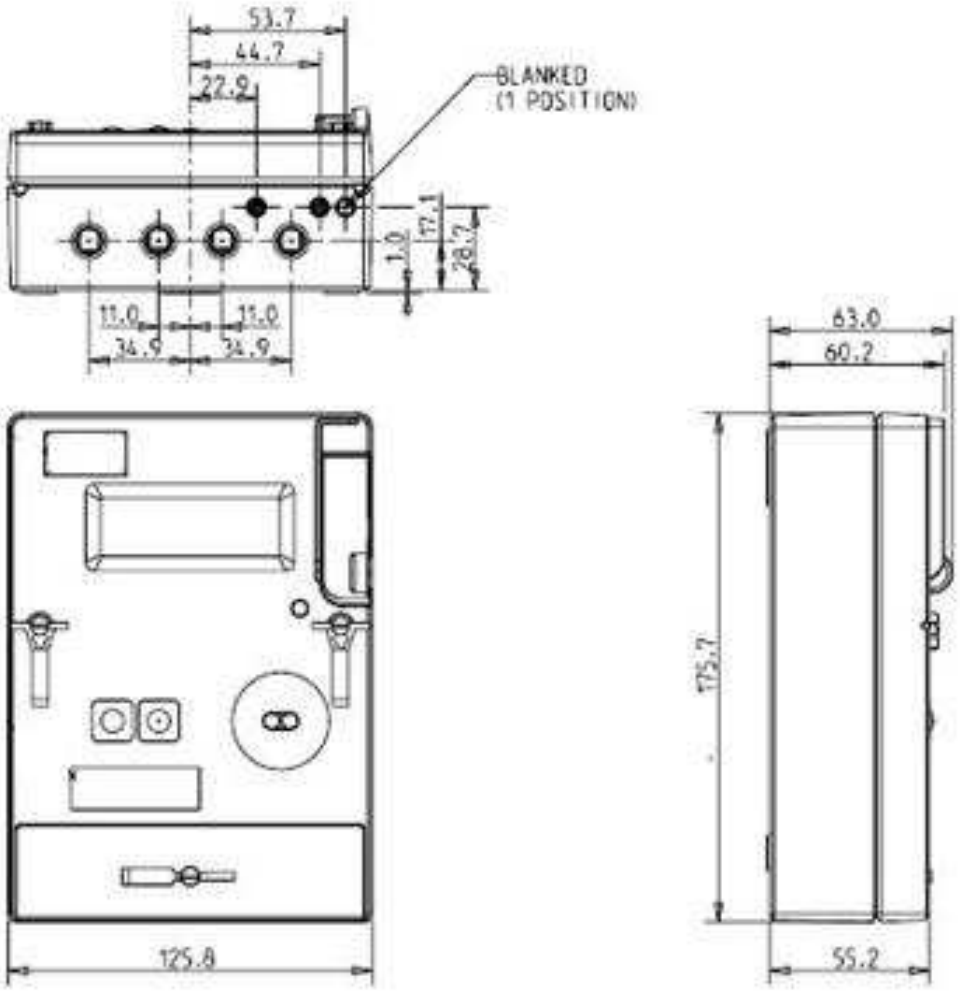
See section 1.4 Intended Use and Installation

See section 1.7 Safety Regulations

11 Data Sheet

System Voltage:	220 - 240V
Voltage Variation:	± 10%
Transient voltage category III	
Supply Frequency:	50Hz
Frequency Variation:	± 5%
Current	
Ist :	40mA
Imin :	500mA
Itr :	A
Iref :	10A
Imax :	100A
Measuring Range:	0,5 – 10(100)A
Measuring Accuracy:	Class B
Measurement Category III	
Burdens	
Voltage Circuit@230Vac:	<5W/25VA
Current Circuit at Iref :	<4VA
Environmental Conditions	
Temperature Range of Operation:	25°…+55°
Temperature Range of Storage:	30°…+85°
Altitude up to 2,000m	
Pollution Degree II	
Relative Humidity	
Annual mean	<75%
For 30 days, these days being spread in a natural manner over one year	95%
Occasionally on other days	85%
The meter is intended for installation as an indoor meter Meter Constant:	1000 impulses/kWh
Display:	125 segment STN LCD
Communications:	Locally via optical port & IEC62056-21 Remotely via encrypted SMS & Tri - band GSM modem
Quality:	ISO9001:2000
Reference Standards:	EN50470 – 1 EN50470 – 3
Construction:	Glass filled polycarbonate [V0 rated]
Terminal Arrangement:	BS/Solid brass conforming to BS5685
Terminal Size:	53mm2
Weight:	750g
Dimensions [mm]:	h175 x w126 x d55

12 Meter Drawing



13 Maintenance and Service

13.1 Meter Check

While it isn't necessary, under normal circumstances, to perform any maintenance on the installed meter, the following are check points that should be observed during scheduled periodic meter visits.

- Is the meter dry and clean, particularly the LCD display and the optical interface?
- Does the meter display a legible and sensible display? i.e. does the meter appear in a serviceable condition.
- Check all factory fitted and company fitted seals are in place secure and intact.
- Observe display for any error messages or notifications
- Confirm that the energy registers have changed to a reasonable degree since the last visit.
- If irregularities are found, continue as in section 12.

13.2 Meter Testing

The testing of meters, either random sample or on all meters, should be carried out periodically according to national regulations. The meter must be removed as described in section 12.3 and replaced with a meter of similar type for the duration of the tests.

13.3 Post Installation Configuration Changes

With the aid of a laptop computer a flag probe and Landis+Gyr specific software, it is possible to amend the factory configured options of the meter. It is beyond the scope of this manual to describe in any further detail the procedure. Landis+Gyr sales team would be happy to discuss specific requirements.

14 Measures in the Event of Faults

14.1 Operating Faults

If the LCD window is illegible or the data readout does not function, the following points should be checked.

Is the mains voltage present? – Are the preliminary fuses intact?

Has the minimum or maximum recommended ambient temperature been exceeded?

Is the LCD window clear of all debris? – Not misted over, painted over or soiled in any way.

If none of the above are causing the fault the meter should be disconnected as per section 12.2, replaced if required as detailed in section 4 and returned to Landis+Gyr as described in section 12.3.

14.2 Disconnecting the Meter

Remove preliminary fuses before continuing

The connecting conductors should not be Live when removing the meter. Electrically Live parts are a life threatening hazard. Preliminary fuses should be removed and kept in a safe place until all work is complete, where they cannot be replaced by anyone unnoticed.

Proceed as follows:

- Remove the company seal on the terminal cover (if fitted).
- Release the two terminal cover screws and remove terminal cover.
- Check with a suitable voltage testing device that the phase connections are not live. If they are live then remove the preliminary fuses and keep in a safe place until all work is complete, where they cannot be replaced by anyone unnoticed.
- Remove the signal inputs and outputs by releasing the auxiliary terminal screws.
- Remove the phase connections by releasing the main terminal screws.
- If required fit a suitable replacement meter as described in section 4.

14.3 Repairing the Meter

There are no user serviceable parts inside the meter. Breaking factory calibration seals will invalidate the calibration status of the meter. In the event of a meter requiring repair, proceed as follows.

- Remove the meter from the installation as detailed in section 12.2.

- Attach a label, which describes the fault as accurately as possible, to the meter and include name and contact details of person responsible in case of inquiries.
- Package the meter to ensure no further damage can occur during transit.
- Send the meter back to Landis+Gyr.

15 Decommissioning and Disposal

The procedure for the safe removal of the meter from the installation is described in section 12.3. Please ensure that ALL SAFETY PRECAUTIONS are met before proceeding.

Based on the environmental certificate ISO 14001, the components used to manufacture the meter can, in the main, be broken down into constituent parts and sent for suitable recycling or disposal.

The following are general guidelines and should NOT take priority over local disposal and environmental policies which should be adhered to without compromise.

Component Parts	Disposal
Printed Circuit Boards	
LCD Display	Treated as per disposal of Electronic Equipment
Metal Components	Sorted and delivered to collective recycling point
Plastic Components	Sorted and delivered for re-granulation if at all possible

16 Glossary of Terms and Standards

16.1 Acronyms

Acronym	Definition
BS	British Standard
DFS	Direct Field Sensor
DIN	Deutsches Institut für Normung (German Institute For Standardisation)
ECD	External Connection Diagram
EEPROM	Electrically Erasable Programmable Read Only Memory (E2)
IEC	International Electrotechnical Commission
ISO	International Standards Organisation
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MD	Maximum Demand
MID	Metering Industry Directive
NPR	No Power Read
OFGEM	The Office of Gas and Electricity Markets
PTR	Photo-transistor
RED	Reverse Energy Detected

16.2 Measurement Units

A	Ampere (unit of current)
Hz	Hertz (unit of frequency)
Iref	MID reference current
Kg	Kilogramme (unit of weight)
kVAh	Kilo Volt Ampere hour
kvarh	kilo Volt Amps reactive hour
kWh	kilo Watt-hour
mm	millimetre (unit of distance)
mO	milliohm (unit of resistance)
ms	millisecond
Nm	Newton meter (unit of torque)
^{o}C	Degree Celsius (unit of temperature)
UN	Rated supply voltage of meter
UT	Rated external switch voltage
V	Volt

17 Declaration of Conformity

We

Name	Ampy Metering Limited
Address:	1 Lysander Drive, Northfields Industrial Estate, Market Deeping, Peterborough, PE6 8FB

Declare that the product

Product Number:	5236
Product Name:	Tokenless Smart Prepayment Meter

Is in conformity with R&TTE Rules.

This equipment complies with the essential requirements for the Radio Equipment and Telecommunications Terminal Directive 199/EC

Quality Statement

R&TTE/CE/LVD approved & manufactured to ISO 9001:2000 Quality Assurance Standards and tested for compliance with European CE Certification.

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the users authority to operate the equipment

18 Glossary of Terms

Billing Cycle	The Billing Cycle is a period of days over which the Block Tariff for energy consumption is applied.
Block Tariff	A charging regime for energy in which the total energy consumed in the billing period is divided into blocks that are charged at specified rates.
Block Tariff Threshold	The Block Tariff Threshold is a value in kWh that defines the cumulative energy consumption within a Billing Period when the cost of energy changes from one rate to the next.
Currency Conversion Factor	The Currency Conversion Factor is a value by which the current monetary values in the meter are divided in order to convert them from £ to € or vice versa.
Debt to Clear	The minimum credit purchase that is required to clear the current debt and raise the meter into credit.
Debt Repayment Amount	An amount of debt transferred to the Meter to be repaid from the Present Balance register by instalments at regular intervals.
Debt Repayment Rate	A weekly amount that is paid by 100 regular instalments within the week, that repays the Debt Repayment Amount.
Emergency Credit Allowance	The Emergency Credit Allowance is an amount of Credit that is available as an overdraft facility and is transferred to the Meter's Present Balance register when Emergency Credit is selected.
Emergency Credit Threshold	The level of credit, below which, Emergency Credit shall be offered.
No-Disconnect Period	A period that can be defined on a daily basis wherein the Meter shall suspend opening the contactor if its credit is exhausted. Any charges applied during the No-disconnect period shall accrue as debt.
PPU	The price in pence (or cents if Euros are the selected currency) of each unit (kWh) of electrical energy consumed. PPU is the tariff rate.
Purchased Credit	Purchased Credit is the monetary credit value that is purchased at a Point of Sale terminal and transferred to the meter by SMS message.
Rate Switching Matrix	A regime of switching times that defines when one tariff rate changes to another.
Standing Charge	A service charge, expressed as a weekly amount, to be deducted from the Present Balance register. Standing charge shall be repaid as 100 instalments of the weekly value with a payment taken every 1.68 hours.
Switching Time	Switching Time is a time boundary within a Time-of-Use tariff when the cost of energy changes from one value to another.
Tariff Rate	A numeric identifier that selects one of 4 prices stored within the meter, to charge for electrical energy consumed. When a particular Tariff Rate is active energy is charged at the corresponding price per unit (PPU).
Weekly Repayment Charge	The combined value of Weekly Standing Charge and Weekly Debt Repayment Charge recovered by the meter and displayed as Total Charge/Week.
MPAN - Meter Point Administration Number	Provides a unique identity reference number for the meter and provides other information such as local distributor, profile type, meter time switch code etc.