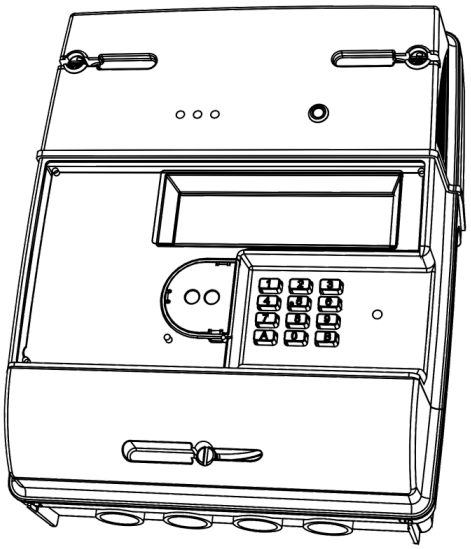
Liberty 100 Smart Electricity Meter



Technical Reference Manual

BGX501-767-R02

CE	**CE MARKING DECLARATION OF CONFORMITY**
Liberty 100 Electricity Meter and Skyline-i 510 intimate communications hub conform to all the essential requirements of EU R&TTE Directive (1999/5/Emergency Credit), Measuring Instrument Directive 2004/22/Emergency Credit, WEEE Directive 2002/96/Emergency Credit.	

Commercial and Confidential

As part of Secure Meter's continuous endeavour to improve product design, specifications mentioned are liable to change.

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1 About the Manual

This manual is intended for technical users and installers of Secure Meters' Liberty 100 single-phase single-element electricity meter. It describes functions and features of the meter (application firmware version P4X2G04) and the Skyline-i 510 communication hub. The features and the displays may differ between application firmware versions.

1.1 Maintenance and Environment

1. There is no maintenance, repair or adjustment intended for this meter. There are no interchangeable or serviceable parts other than the communications hub.
2. The meter is intended to be installed in a mechanical environment 'M1', with shock and vibrations of low significance, as per 2004/22/EC Directive and in electromagnetic environment 'E2', as per 2004/22/EC Directive.
3. A visual inspection should be performed before installing the meter. The following should be checked, as a minimum:
   - No evidence of external damage or missing parts
   - No missing or damaged wiring
   - No evidence of overheating

1.2 Radio and EMC

1. This meter and the communications hub have been designed to operate with and are certified for use with external antennas that have a maximum gain of 3 dBi. Antennas that have a gain greater than 3 dBi should not be used with this device.
2. The meter or external antenna (if fitted) must be installed so that a minimum distance of 20 cm is maintained between it and the consumer. The antenna must not be co-located or operate in conjunction with any other transmitter.

2 Product Overview and Operating Principle

Liberty 100 is a single phase, single-element electricity meter that supports both Credit and Prepayment modes of operation for GB Smart Metering. It is used with a Skyline-i 510 intimate modular communications hub.

The hub is mounted at the top of, and is powered by the meter. It serves as the communication gateway to the Head End System (HES) via a Wide Area Network (WAN) and other smart metering devices via a Home Area Network (HAN), and is a data mirror for the gas meter. The modular hub design provides the flexibility to upgrade or change the meter's communication technology without the need to remove the meter or break metrological seals. The Skyline-i 510 hub contains GPRS WAN and ZigBee® low power radio HAN communication modules. The GPRS module connects the meter to the HES over the WAN providing remote data transfer between the meter and HES on request or when scheduled. The ZigBee module connects the hub with other HAN devices – Gas Meter, In Home Display (IHD), Prepayment Interface Device (PPMID) and/or User Access Device (CAD).

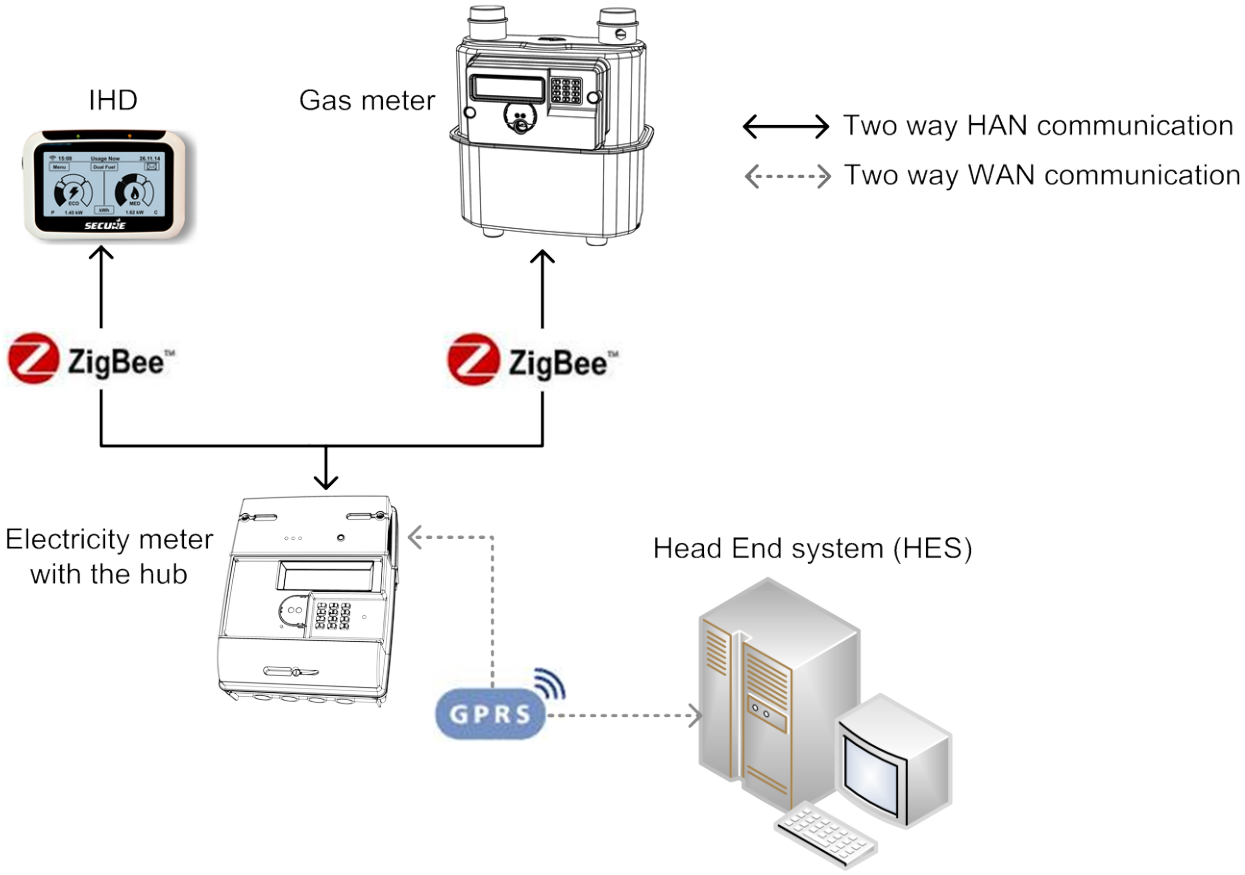


Figure 1: Two-way HAN and WAN communication

Additional communication interfaces are provided by an IEC 1107 optical communication port for local communications and a user interface comprising of a custom LCD display and 12-key keypad. The user interface allows selecting and displaying data, acknowledging alarms and alerts and provides a means of manually entering prepayment Unique Transaction Reference Numbers (UTRNs) in the absence of the WAN and/or HAN.

Commands or changes of configuration can be delivered to the meter in the form of authorised messages or UTRNs. UTRNs are encrypted codes and are valid only for the meter for which they are generated (see also Engineering Codes described later).

An internal switch is provided for supply disconnection/reconnection controlled by both the meters business logic and remotely over the WAN/HAN. A battery-backed internal clock maintains the meter's date and time. Removal of terminal cover, main cover and communications module is detected and logged in both power on and off conditions.

Internal sensors monitor external magnetic fields allowing abnormal operating conditions to be logged and reported.

3 Product Description

3.1 Liberty 100 Main Features

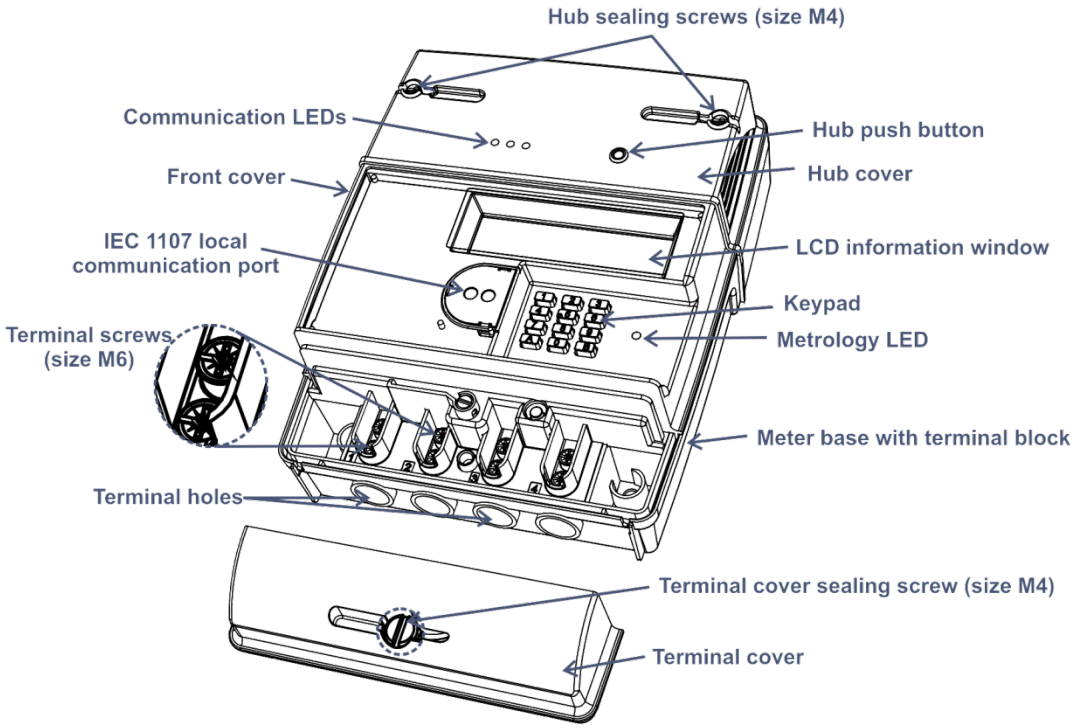


Figure 2: Liberty 100 electricity meter

The integrity of the meter seals should be checked periodically.

LCD information window

Liberty 100 has a backlit, monochrome LCD for displaying metering data, alerts and other relevant information.

Keypad

12 keys, each 3.8 mm x 6.8 mm in size arranged in a 3x4 array provide the user interface for viewing data, acknowledgment of alarms and alerts and the means of manually entering prepayment UTRNs if the GPRS interface is not working. The keypad has ten 0-9 numeric keys and two special keys marked 'A' (blue) and 'B' (red). Key '5' has a raised dot to help visually impaired users to navigate.

Local communication port

Local communication is provided by an IEC 1107 port supporting a maximum data rate of up to 9600 baud which is the default.

Metrology LED

The red LED adjacent to the meters keypad flashes at a rate proportional to the instantaneous active power. Over time, the flashes correspond to the amount of energy registered by the meter. The metrology LED emits 3200 flashes for each kWh measured.

Power and hub communication LEDs

The LED on the left indicates power, the middle LED indicates WAN network activity and the LED on the right HAN network activity. See Section 6 ‘Communication Hub (Skyline-i 510)’ for details. The flashing frequency indicates the current activity of the hub.

Hub pair button

The hub has a push button which is used for HAN pairing with in-home devices (only used when operating in external mode i.e. not integrated with a Liberty 100 meter).

3.1.1 Front Cover

The meters front cover is manufactured from polycarbonate with a transparent window to view the display and a flange to protect the meter from dust and moisture ingression. Two sealable screws, one at the top beneath the communication module the other at the bottom beneath the sealable terminal cover secure the cover to the meter base. The enclosure is designed to IP52. Provision is provided for front cover open detection in power on and off conditions.

Information on the front cover

The following figure shows information available on the front cover of Liberty 100 meter:

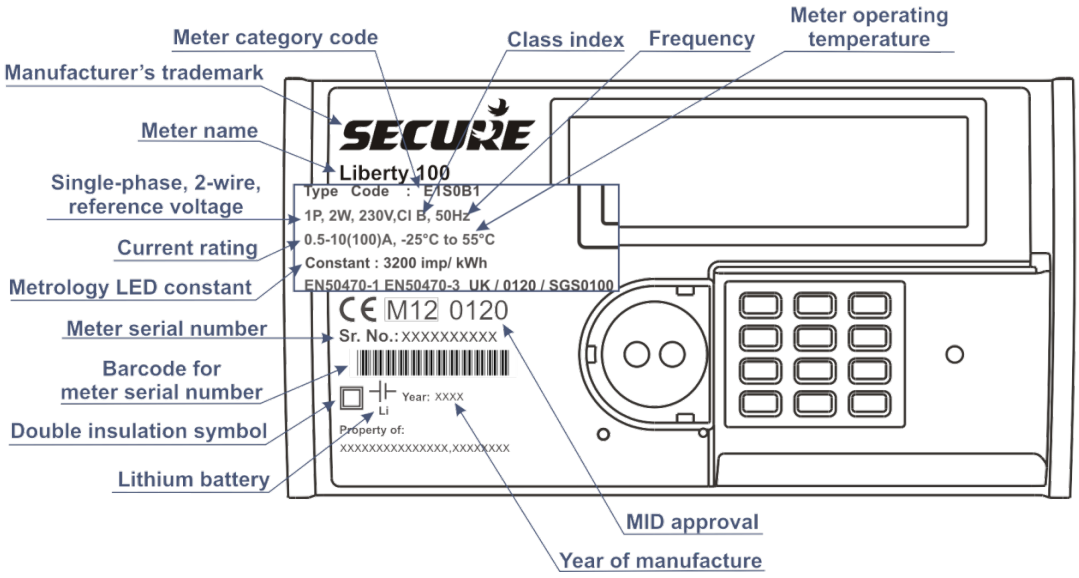


Figure 3: Liberty 100 name plate

3.1.2 Communication Module

The communications module cover is manufactured from opaque polycarbonate inside which the communication hub is mounted. Access to the hub is necessary to insert or change the GPRS/GSM SIM card. Changing the communications technology is simply a matter of exchanging one communications module for another.

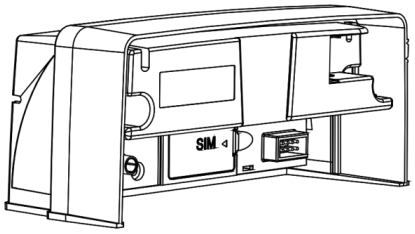


Figure 4: GPRS/ZigBee hub fitted inside the hub cover

Communication Module Sealing

The communication module has two (2) sealing screws on either side of the module. Removal of the module and access to the meters front cover for any reason requires the seals to be broken and the screws undone.

3.1.3 Meter Base with Terminal Block

The meter base and terminal block are manufactured from glass-filled polycarbonate. The terminal block is part of the meter base and comprises four (4) tunnel type terminal bores for the termination of meter service cables. The terminals are manufactured from brass with an internal bore diameter of 9.5 mm and can accommodate service cables with a cross-sectional area of 35 mm^2, 25 mm^2 or 16 mm^2. Service cables are secured with two M6 conductor screws made from mild steel (Zinc plated). The screw heads are combination slotted and cross head. A securing torque of 3.5 Nm is recommended.

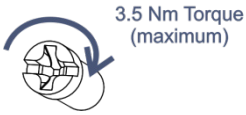


Figure 5: M6 Conductor screw

3.1.4 Terminal Cover

The meter is supplied with a short terminal cover which is manufactured from opaque polycarbonate and is secured with a single sealable screw. The terminal cover must be removed to access the meters terminals and lower main front cover seal. Provision is provided for terminal cover removal detection in power on and off conditions. The connection diagram is marked on the inside of the terminal cover.

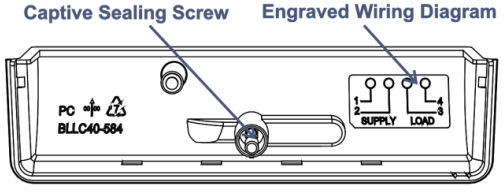


Figure 6: Inside of short terminal cover

3.1.5 Metrology Seal

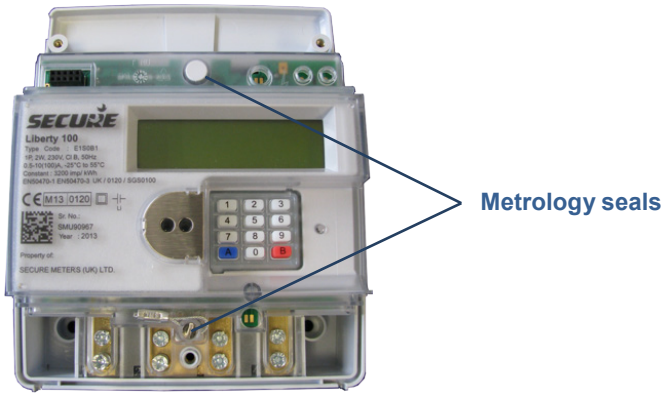


Figure 7: Metrology seals in Liberty 100

3.2 Power Supply

3.2.1 Switch Mode Power Supply

Mains supply provides power to the meters peripherals, its main controller circuit, switch control and the hub. In the absence of mains supply the hub has optional backup power supply capacitor to support a supply loss 'last gasp' message.

Voltage: 230 V AC (Vnominal)

Operating range of power supply: +30% to -40% of $V_{nominal}$

Peak power capability for communication module: 5.6 W (4 V @ 1.4 A)

Minimum power requirement for communication module: less than 2.5 W (4.2 V @ 500 mA)

Power requirement for meter: 0.9 W (6 V @ 100 mA + 24 V @ 12 mA)

SMPS power rating: 6.5 W

Supply withstand voltage: 460 V for up to 48 hours

3.2.2 Backup Battery

The meter has an internal non-rechargeable battery with an operational life of 20 years to support the following minimum meter functionality in the absence of mains power:

- Internal clock
- Front cover and terminal cover open detection
- Communication module removal detection
- Maintenance of data held in RAM and NVRAM

The battery will support the meter for two years in absence of mains power.

Note: The battery is not field-replaceable.

3.2.3 Power Supply Loss

When the supply voltage drops below the guaranteed metrology voltage the meter will switch to battery mode. When this happens the meters microcontroller sends a supply loss signal to the communications module so that a ‘last gasp’ (supply loss) message can be sent (if configured).

A last gasp message will only be sent if the meter is configured to do so and if optional backup power supply is fitted. Multiple mains power outage within a 10 minutes window could affect the meters ability to send a ‘last gasp’ message.

3.2.4 Internal and External Communications Module Power Supply

For internal (intimate) and external communications module the meter will provide a power supply of 4 V, 1.4 A.

3.3 Using the Display

Liberty 100 uses a custom LCD display which supports a ten (10) character, alphanumeric starburst display along with icons for other relevant information. The height of the main characters is 7mm. The figure below shows the illuminated segments during Display Test.

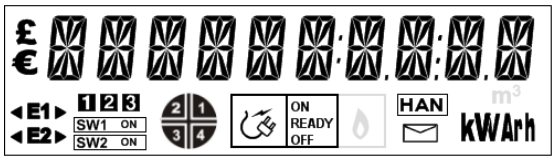


Figure 8: Meter display in ‘Test Mode’

The meter is programmed to display information relating to its current mode of operation. The display list comprises two types of display - Auto Scroll and Manual Mode. Auto Scroll is the default display mode which automatically cycles through a configured display list.

Auto Scroll Mode

The Auto Scroll Mode displays information specific to the meter’s current mode of operation. Prepayment, credit and default modes will have different display sequences and sets of displayed parameters. At the end of a complete sequence the display enters ‘sleep mode’ (turns blank) and returns to the first display when key ‘B’ is pressed. The meter will suspend its Auto Scroll display when a message relating to supply restoration is to be displayed.

Manual Mode

Manual Mode is entered by pressing a numeric key on the meter keypad. In this mode sets of information relating to a function are grouped together on each numeric key. Pressing a key interrupts the Auto Scroll mode and triggers the display to cycle through the configured set of parameters. Repeated pressing of the same key manually jumps the display through the configured display list. Pressing key ‘B’ manually allows the displays to go backwards.

A user can still view manual mode displays by means of the keypad when a supply restoration message is displayed. If there is no user interaction after the last parameter is displayed, the meter displays a set of parameters relating to its mode of operation before going into sleep mode. The supply restoration message will be redisplayed only after any key is pressed on the meter keypad.

3.3.1 Display Icons

The following table lists the icons displayed on the meter LCD and their significance:

Display icon	Significance
88888.8.8.8	Displays numeric data such as energy consumption or a UTRN token number during token entry or an alert or message.
£ €	Indicates currency in use
kWArh	Indicates unit of energy
◄E1►	Indicates single current element and energy flow direction - into (import) or out of (export) the household ► Symbol for import ◄ Symbol for export
ON READY OFF	Indicates the supply status – ON, READY, OFF
HAN	Indicates ZigBee connection status
2 1 3 4	Indicates energy quadrants

Table 1: Description of LCD icons

HAN connection status:

A steady HAN icon indicates that the meter is connected to HAN.

A flashing HAN icon indicates that the meter is waiting to join HAN

E1 icon and energy direction icons:

As Liberty 100 is a single-element meter the E1 icon will always be displayed.

The energy flow icon is displayed to indicate the flow of energy into (Import) or out of (Export) the household.

Export flow

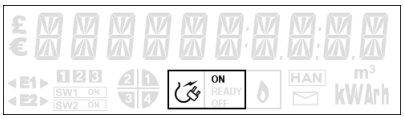
Import flow

Supply status icon:

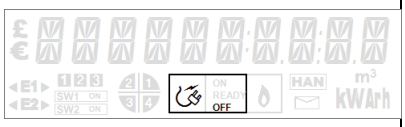
By default, **Supply ON** icon is displayed which indicates that user's supply is connected.

Supply OFF icon is displayed when the user's supply is disconnected.

Supply ON



Supply OFF



Supply READY icon is displayed when the user is allowed to restore the supply.	**Supply READY** 

Table 2: Interpretation of LCD icons

3.3.2 Financial Display

Financial information is displayed in pounds and pence. Most numerical displays use the decimal points predefined in the display graphics as shown below:

Displays with text on the right-hand side will use a hyphen ('–') as a decimal point. For example, the numeric display in the following example should be read as '000.000 pence'.

3.3.3 Display Timing

When the meter is powered, its display will cycle through a sequence of information by default. The keypad can be used to view specific information. Display timings are preconfigured for each data item in a display sequence with each item being preceded by a relevant title as shown in the following examples.

Auto Scroll display timing:

In auto scrolling display mode, the title and data are each displayed for two (2) seconds. After completing a cycle, the display will enter sleep mode. Auto display is resumed by pressing key 'B' from sleep mode.

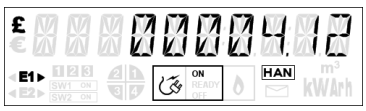
*Displayed for **2** seconds*

*Displayed for **2** seconds*

Manual display timing:

In manual mode, a title is displayed for two (2) seconds followed by the data for four (4) seconds followed by the next set of information. At the end of a complete cycle the display will return to its default auto scrolling display mode.

*Displayed for **2** seconds*



*Displayed for **4** seconds*

Note: Default configurations in Auto Scroll and Manual Mode displays for Credit, Prepayment and Default operating modes are detailed in **Annexe-I: Meter Displays**.

3.4 Liberty 100 Keypad Functions

The keypad keys of the Liberty 100 electricity meter are configurable to match supplier's requirements. The default configuration of each key at manufacture is given below:

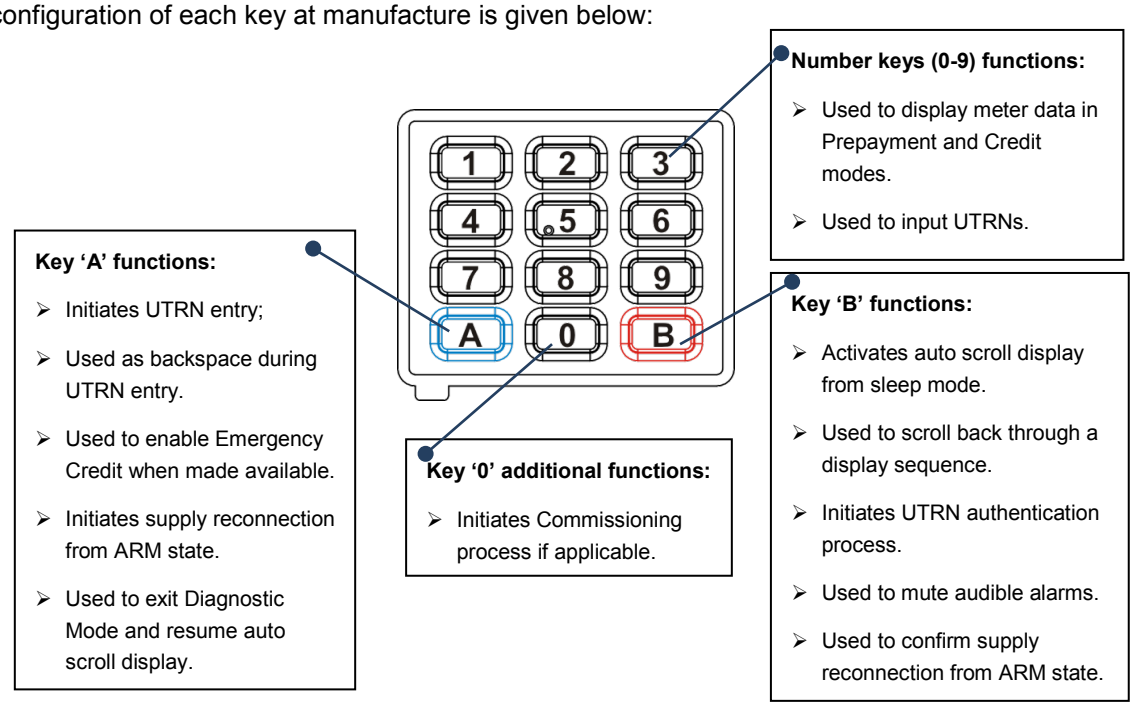


Figure 9: Meter Keypad Functions

Specific use of various keys in different operating modes is detailed separately in **Annexe-I: Meter Displays**. The following table summarises the displays associated with the twelve (12) keys in each of the three operating modes:

Keys	Prepayment Mode	Credit Mode	Default Mode
1	Displays cost of consumption and units consumed on the current day and previous day.		Displays 'Not Used'
2	Displays cost of consumption in the current week and previous week.		Displays 'Not Used'
3	Displays cost of consumption in the current month and previous month.		Displays 'Not Used'
4	Displays historical data comprising monthly units consumed and cost of consumption.		Displays 'Not Used'
5	Displays debt information	Displays 'Not Used'	Displays 'Not Used'
6	Displays tariff name, standing charge per day, active rate register(s) along with the consumption and cost per unit recorded in each rate register.		Displays 'Not Used'
7	Displays if Emergency Credit can be enabled. If it is not available or is already enabled then it displays the current status and balance.	Displays 'Not Used'	Displays 'Not Used'

8	Displays Friendly Credit status and the associated switching date and time.	Displays ‘Not Used’	Displays ‘Not Used’
9	Displays total import and export register values and high resolution display.		Displays ‘Not Used’
0	Performs display check and then displays date, time, load and CO_2 data of the current hour and current day, yesterday, last week and last month.		Initiates commissioning process
A	Switches the display to UTRN entry mode; serves as backspace key during UTRN entry; enables Emergency Credit when made available; initiates supply reconnection from ‘READY' state; used to exit diagnostic mode.		
B	Activates auto scroll display from sleep mode; used to scroll back through a display sequence; initiates UTRN authentication process; mutes alarm; used to confirm supply reconnection from ‘READY’ state.		Displays ‘Not Used’

Table 3: Summary of Keypad functions

3.5 Firmware

Firmware in the meter is in two parts:

- Metrology firmware

  Metrology firmware controls the measurement functions. It also provides an operating system for the application firmware. This firmware is fixed and cannot be upgraded.

- Application firmware

  Application firmware controls the functions of the meter outside of metrology. It is possible to remotely upgrade this firmware to change the meter operation. Upgrade can be made locally via IEC 1107 optical port or remotely over the air (OTA) via the communication module (hub). Upgrading or updating the firmware will not affect the meter data unless the update involves changing the parameters of such data. Information related to load survey, transactions, account balance, events and storage or contents in billing registers such as prepayment balance are not affected during these upgrades.

Note: The current firmware name and version are available in meter readings and are also available on the meter’s Diagnostic display.

4 Meter Specifications

4.1 General Specification

Specification	Description	
Mechanical	Dimension (in mm)	146 x 64 x 178
	Weight (in kg)	1.0 approx.
	Front cover	Transparent fire-retardant polycarbonate material - V0 grade
	Hub cover	Opaque polycarbonate material
	Meter base with terminal block	Opaque 10% glass filled fire-retardant polycarbonate material - V0 grade
	Terminals	Brass material; tunnel type each with minimum internal bore diameter of 10.0 mm
	Short terminal block	Opaque fire-retardant polycarbonate material - V0 grade
	Sealing provisions	2 seals on the front cover, 2 seals on the hub cover and 1 seal on the terminal block cover
	Display	LCD with backlight, 10 starburst character (7mm high) with icons. Display visibility angles: Vertical: 30 degrees up and 35 degrees down from normal (straight on) Horizontal: 30 degrees left and right from normal Display operating temperature range from -20^0C to $+55^0$C.
	Keypad	Silicon material
Electrical	Meter Type	1 phase, 2 wire
	Voltage measuring element	Voltage divider
	Current measuring element	Shunt
	Rated voltage	230 V AC, ± 20% (L–N)
	Rated current	0.5-10(100) A The meter can withstand 460 V supply voltage and 120 A current for 48 hours with no degradation in metrology.
	I_{min}	0.5 A
	I_{tr}	1.0 A
	I_{ref}	10 A
	I_{max}	100 A
	Frequency	50 Hz ± 5%
	Burden Current circuit Voltage circuit	 < 0.1 VA < 2 W ,< 4 VA average (with Skyline-i 510 fitted)
	Metrology LED	Red LED, 3200 pulses/kWh
	Contactor	Integral, 100A, UC3 (IEC 62055-31)

	EMC/Electric Surge	BS EN 50470-1, 50470-3
Compliance	Metrology	Active Energy - BS EN 50470-1, 50470-3 Class B Reactive Energy - IEC 62053-21, Class 1.0
	Power consumption	BS EN 50470-1, 50470-3
	Meter mounting, size and terminal arrangements	BS 7856
	Power source RTC backup source Battery life (typical) Minimum shelf-life (typical)	Mains supply Lithium battery 20 years 2 years
	Data retention Unpowered	 20 years
	Display format Image area Life expectancy	Alphanumeric with icons 80 x 24 20 years
Environmental	Operating temperature Storage temperature Operating humidity Ingress protection	- 25 °C to + 55 °C - 25 °C to + 70 °C Up to 95% non-condensing IP52

4.2 Handling, Storage and Operating Conditions

Liberty 100 meter is an electronic device containing delicate components, and should be handled carefully during transit, storage and installation. The meter should be protected from physical vibration and shocks. Wherever possible the meter should be kept in its original packaging until it is installed at the customer's site. Temperature and humidity must be maintained within the limits expressed in the above table.

Proper installation and removal procedures should be followed, in order to prevent damage or injury. Physical damage to the meter's case could indicate damage to internal components. Under no circumstances should an attempt be made to install a damaged meter.

Ideally the meter should be stored and operated in a dry, well ventilated, climate-controlled building. Rapid changes in temperature and humidity should be avoided.

4.3 Liberty 100 Dimension

The following diagram shows the outer dimensions of the Liberty 100 with the hub. All dimensions are in millimetres (mm):

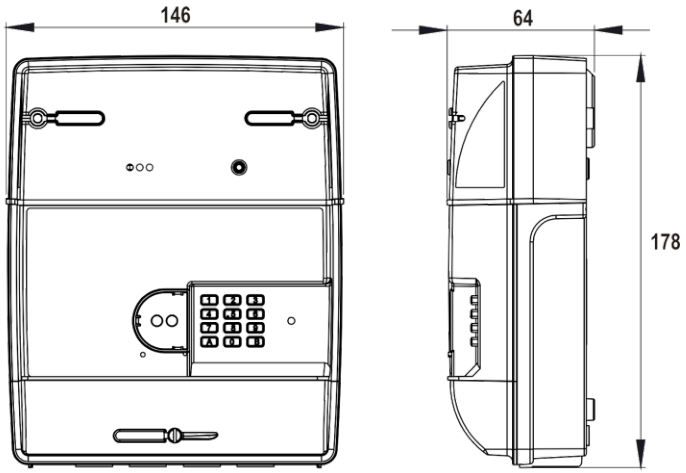


Figure 10: Liberty 100 front and side views

The following diagram shows the terminal bore diameter, the distance between each terminal and the distance between the outer terminals:

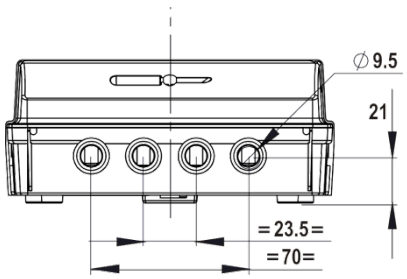


Figure 11: Liberty 100 terminal bores at the bottom

Note: For wiring convenience, terminal numbers are moulded from 1 through 4 at the front on the meter base near the terminal block area.

4.4 Connection Diagram

The following connection diagram is also marked on the inside of the terminal block cover (refer to Figure 6).

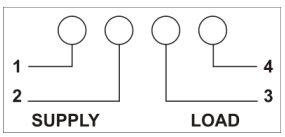


Figure 12: Liberty 100 connection diagram

4.5 Standards and External Certification

The Liberty 100 meter with intimate hub conforms to the following standards:

Electrical requirements	EN 50470-1, EN50470-3
MID approval	0120/SGS0100
Environmental	EN 60068-2-6
	EN 60068-2-75
	EN 60068-2-27
	EN60529 IP52
Resistance to Heat and Fire	EN 60695-2-10
	EN 60695-2-11
ZigBee Module related:	
EMC and Radio Spectrum Matters	EN 300 328
	EN 301 489-01 with performance criteria from EN 301 489-17
ZigBee Certification	ZigBee ZSEP1.1
GSM/GPRS Module related:	
GSM	EN 301 511
EMC and Radio Spectrum Matters	EN 301 489-01 with performance criteria from EN301 489-07
	BS EN 50360
	BS EN 50371

5 Functional Specification

The following functional features of Liberty 100 are described in this section:

1. Meter operating modes
2. Registers, Load Profile and Snapshots
3. Metrology LED
4. Time keeping
5. Accounting
6. UTRN Transaction
7. Meter mode changing operation
8. Meter configuration and functionality
9. Alerts and Messages
10. Supply Voltage Quality Monitoring
11. Ambient power threshold status
12. Load limiting
13. Change of supplier
14. Change of tenancy
15. Meter switch state
16. Detecting and logging events
17. Communication channels
18. Meter reading data
19. Upgrading meter firmware
20. Engineering Codes

5.1 Meter Operating Modes

Liberty 100 meters can be pre-configured at manufacture to operate in one of the following modes as per the supplier request:

a) Default mode
b) Credit mode
c) Prepayment mode

In addition, there are two functional modes that allow authorised users to view additional data and change some of the configurations in the meter locally:

a) Diagnostic mode
b) Commissioning mode

The meter supports both local and remote runtime switching of operating modes. Switching to Default mode is done via a service UTRN and to other operating modes via a tariff configuration change. Meter mode switching is detailed in Section 5.7. Mode change and settings are downloaded once the meter becomes part of a Smart Metering System and is connected via the WAN to the Head End System.

5.1.1 Default Mode

Unless otherwise specified, Liberty 100 is shipped with its default operating mode enabled which supports the following minimum features:

- Credit mode with single rate tariff

- Remote disconnection and reconnection ('READY' state) of switch
- Events and tamper detection
- Scheduled transfer of profiles, alerts, meter readings and messages
- Load profiling

In default mode the meter will reject all vend UTRNs and does not perform any scheduled billing, and supports only default mode displays.

5.1.2 Credit Mode

In Credit mode the meter will perform billing actions as detailed in 'Billing Snapshot' in Section 5.2.4.2 and displays the total import kWh register, total export kWh (if applicable), tariff registers and credit balance. The credit balance comprises consumption cost and standing charges. On billing, the credit balance resets to zero. The meter activates the following functionality when operating in this mode:

- Multiple tariff structure – Time of Use (TOU), Slab or Block and Hybrid tariff (48 x 1 or 8 x 8 tariff options)
- Load profiling
- Load limiting
- Remote disconnection and reconnection ('READY' state) of switch
- Events and tamper detection
- Scheduled transfer of profiles, alerts, meter readings and messages

5.1.3 Prepayment Mode

In Prepayment mode the meter will perform billing actions as detailed in Section 5.2.4.2 'Billing Snapshot'. Prepayment mode supports four different accounting zones as detailed in Section 5.5.4 'Accounting Zones in Prepayment Mode' and generates account specific visual alerts and audible alarms. In addition, this mode supports the following features:

- Adding or deducting credit from the meters account manually, locally and remotely.
- Displaying account specific messages.
- Emergency Credit and Friendly Credit.
- Meter switch operation based on the account state, Friendly Credit and Emergency Credit configurations.

The meter activates the following functionality when operating in this mode:

- Multiple tariff structure: Time of Use (TOU), Slab or Block and Hybrid tariff (48 x 1 or 8 x 8 tariff options)
- Load profiling
- Load limiting
- Remote disconnection and reconnection ('READY' state) of switch
- Event and tamper detection
- Scheduled transfer of profiles, alerts, meter readings and messages
- Prepayment features:
    - Sending alerts when the meters account becomes low
    - Updating, activating and repaying Emergency Credit
    - Updating Friendly Credit days/hours
    - Adding credit to the meter manually via UTRN entry at the meter or remotely via HES or IHD.
    - Disconnecting and reconnecting supply
    - Debt recovery
    - Displaying latest five payment history

- Maintaining payment and time based debt payment history event log

5.1.4 Diagnostic Mode

Only authorised users can access this mode by entering a 6-digit Engineering Code (common for all Liberty 100 meters) at the meter keypad. The meter can display the following information in diagnostic mode:

- The current application firmware name and version
- Metrology firmware name and version
- The number of times the switch has opened and closed
- Maximum demand along with logged date and time
- GPRS signal strength
- Load Limit value
- Number of hours the meter has been without mains power (i.e. running on battery)
- Number of times the supply has gone Off and On
- Maximum Emergency Credit limit
- The number of accepted and rejected UTRNs (in Prepayment mode). This includes all vending UTRNs and supply disconnection/reconnection UTRNs that are entered manually or sent over the WAN. All accepted vend UTRNs will have additional details such as transaction amount, date and time of vend etc.

The Engineering Code can be entered at the meter's keypad in the same way as for UTRN entry. A short press of key 'A' will initiate the code entry mode. Once in this mode key 'A' changes to a backspace function to delete the last entered digits, deleting all digits will redisplay 'Vend Code'. At the end of code entry, a short press of key 'B' or waiting 20 seconds will initiate the code authentication process.

Once in diagnostic mode, each numeric key press will display associated diagnostic displays as configured. A short press of key 'A' or no key press for 120 seconds (2 minutes) will return the meter to its default Auto scroll mode displays. Key 'B' in this mode is used to scroll backwards through the current display list. Refer to **Annexe-II: Diagnostic Mode Displays** to see the various diagnostic displays associated with each numeric key for both Prepayment and Credit modes.

Note: This mode cannot be used to change the meter's operating mode such as Default, Prepayment or Credit mode.

5.1.5 Commissioning Mode

After physically installing the meter the commissioning process is carried out to join other devices to the HAN and WAN system as well as register them with the HES. The commissioning process is automatically initiated by the electricity meter when it is powered up for the first time at a premise. The In Home Display, if present, can also be used for the commissioning process.

If carried out correctly and there is sufficient ZigBee and GPRS signal strength then the entire commissioning process should take less than ten (10) minutes.

5.2 Registers, Load Profile and Snapshots

5.2.1 Main Energy Registers

Liberty 100 measures, records and displays metered energy values for import and export active and reactive energy. The following four cumulative energy registers are configured as energy channels for the measuring element:

a) Active Total Import (i.e. fundamental + harmonics)
b) Active Total Export
c) Reactive Import
d) Reactive Export

The meter maintains current and historical energy registers separately for each assigned energy type. The cumulative value of each energy register is made available on the meter display as well as in meter reading snapshots.

Note: Energy registers are configured at manufacture and cannot be reset locally or remotely.

5.2.2 Maximum Demand (MD) Registers

Liberty 100 calculates Maximum Demand (MD) for Active Import and Active Export (if configured) energies. The MD value in the MD register is updated whenever the average demand over the programmed Maximum Demand Integration Period (DIP) exceeds the currently stored MD value. The new MD value is recorded in the meter along with the date and time of its occurrence. For example, if the currently stored MD value is 2 kW and an average demand calculated over the next DIP is 3 kW then the new 3 kW MD value which is stored in the MD register along with the DIP start time.

For this version of the software the default DIP is thirty (30) minutes with the MD register resetting automatically on every billing action.

Note: Import MD register values are available on the meter display from Diagnostic mode and can also be communicated locally or remotely.

5.2.3 Load Profile

Load Profile survey data comprises the energy consumption recorded by the meter at the end of fixed intervals for a predefined number of days. Liberty 100 can be configured to store 395 days of half-hourly load profile data, 197 days of 15 minutes load profile data or 792 days of hourly load profile data for each energy channel on a first-in-first-out (FIFO) roll over basis. The data is stored in non-volatile memory which can be read locally via the ‘1107’ port or sent to the HES on request via the Hub over GPRS.

The meter supports load survey logging for the following energy types:

a) Active Total Import (i.e. fundamental + harmonics)
b) Active Total Export
c) Reactive Import
d) Reactive Export

The meter will maintain the configured parameters with a resolution of 1 Wh/VArh with any residual fraction being carried forward into the next period.

Note: Load survey data is not available on the meter display.

5.2.4 Energy Snapshot Logging

Liberty 100 logs the following four types of snapshots:

a) Midnight snapshot
b) Billing snapshot
c) Audit snapshot
d) Current snapshot (available only on request and not stored in the meter)

The snapshot data consists of the following information as per its configuration:

- Basic information consisting of the snapshot time, last billing snapshot time, the cause of snapshot and site ID.
- Device information consisting of the supplier ID, meter serial number, meter firmware name, commodity type and the meter type.
- Current tariff information consisting of the tariff type, tariff ID, tariff label and the meter mode.
- Cumulative energy register values for active import, reactive import, active export and reactive export.
- Time of use (TOU) energy rate register values based on the tariff type and charging scheme.
- Maximum demand values for active import and active export energy along with its time of occurrence.
- Prepayment and Credit mode information consisting of currency code,- meter account balance, total vend added to date, cost of consumption and standing charges since last billing, and outstanding debt at the time of snapshot.
- TOU energy rate register advance values based on the tariff type and charging scheme of the current active tariff.
- New tariff information (i.e. tariff type, tariff ID, tariff label and the meter mode) which is available when the current tariff or price have been changed.
- Debt account information (i.e. accumulated debt register values and outstanding debt types).

All snapshots have a date and time stamp, snapshot reason and the last billing date and time. Snapshot data is available for all configured energy types.

5.2.4.1 Midnight Snapshot

Liberty 100 takes a daily snapshot of the energy registers at every midnight and stores the data for the last fourteen (14) days. The meter does not record midnight snapshots for any complete days when power was off for the complete day. The snapshot data is updated daily on FIFO basis.

Note: The stored data can be sent remotely to the HES.

5.2.4.2 Billing Snapshot

The meter will take a snapshot of its energy registers for billing purpose for any of the following actions:

- Change of tariff
- Price change
- Scheduled billing date
- On-demand billing
- Change of meter operating mode
- Occurrence of an abnormal event, for example, corruption of energy register
- Change of Supplier
- Change of Tenancy

The meter stores a total of 13 billing snapshots. Billing snapshot data is updated on a FIFO basis.

On change of tariff and meter operating mode, a billing snapshot is performed before the event.

a) Change of tariff – the meter takes a billing snapshot before activation of a new tariff configuration. Change of tariff comprises the following:

   - Change of tariff scheme
   - Tariff type
   - TOU seasonal calendar and
   - Block reset duration

b) Price change – the meter takes a billing snapshot before the price change in the meter and then the meter balance is reset. However, the meter balance will not reset when there is a price change in the meters operating in Credit mode.
c) Scheduled billing date – the meter takes a billing snapshot on the scheduled billing date. The billing period can be configured in days, weeks or months. If the meter is in a power off state at the scheduled billing time then it will take the snapshot when power is resumed, this will not affect the next billing date.
d) On-demand billing – the meter takes a billing snapshot on receipt of a request for an on-demand bill. The snapshot data recording will depend on the billing reference which can be configured either as immediate or at midnight. If the billing reference is configured for midnight then the previous midnight snapshot is taken as the billing snapshot.
e) Change of meter operating mode – a billing snapshot is taken when the meter's operating mode is changed from Credit or Prepayment mode to Default mode, a second snapshot is taken after the change has taken place. Any of the following change of mode is part of a tariff configuration change and is treated as a change of tariff snapshot:
    - Default to Prepayment or Credit
    - Credit to Prepayment or
    - Prepayment to Credit
f) Change of Supplier – on change of supplier the meter performs a billing action and a billing snapshot is taken before the change of supplier.
g) Change of Tenancy – on change of tenancy the meter performs a billing action and a billing snapshot is taken before the change of tenancy.

5.2.4.3 Audit Snapshot

Liberty 100 takes an audit snapshot when any of the following actions are performed:

a) Meter time setting
b) Block reset
c) Over the air (OTA) firmware change. In this case two snapshots are taken, one before and the other after the firmware change.

The meter stores ten (10) audit snapshots on a FIFO basis.

5.2.4.4 Current Snapshot

The meter will record the current value of its energy registers which is sent to the HES on receipt of a current snapshot request.

5.3 Metrology LED

Liberty 100 has a metrology LED which is set to flash at a rate proportional to the instantaneous power. Over time, the number of flashes corresponds to the amount of energy registered by the meter. The metrology LED emits 3200 flashes for each kWh measured.

The default source energy register for the LED is assigned at manufacture from the list of supported main energy registers.

5.4 Time Keeping

Liberty 100 clock maintains time in hours, minutes, and seconds format.

All data logging (e.g. load survey data, events data, maximum demands and snapshots) and scheduled task activation (e.g. rate register switching, Friendly Credit timing, standing charge deduction etc.) take place using the standard time whereas tariff operations and displayed date and time use local time (i.e. standard time + DST offset). Tariff and rate registers can be configured to use standard time or local time.

When the meter's time is invalid for any reasons an RTC failure event is logged and an alert is sent to the HES (if configured). The following activities that rely on meter time for their correct operation are affected or suspended:

- Rate Register switching (the meter continues with the last active rate price)
- Maximum demand updates
- Scheduled billing actions
- Delayed or scheduled meter configurations
- DST activation or deactivation
- Standing charge deduction for missing days
- Load survey operation
- Events logging will be as per the meter's current time
- The date and time on the meter display will appear as '--------'
- Midnight snapshots will be taken with standard time

The following two methods can be used to adjust a meter's invalid time:

- Time setting from the HES
- Time synchronisation from the hub

In order to distinguish time set events between time synchronisation from the hub and time setting from HES, the issuer ID in the case of time synchronisation is logged as '0' which is the same as at manufacturing.

5.4.1 Setting Time from the HES

Meter time can be set forward or backward to an absolute value via an authenticated command from HES. In the case of forward time setting, the missing SIP values for load profile and voltage profile are initialised with 'FFFFFF' which is an invalid SIP and is similar to those for power off. In the case of backward time setting, the meter treats it as extended SIP and will cancel all upcoming SIP data whether it is on the current day or outside the current day and will log new SIP data as normal.

5.4.2 Synchronising Time from the Hub

The meter time synchronisation sent from the communication hub via time synchronisation command will take place only when the time drift, i.e. the time difference between the meter time and the hub time is between a minimum (3 seconds) and maximum (50 seconds) time synchronisation thresholds. The time synchronisation is always implemented within a demand or survey integration period boundary (whichever is less) and so the adjustment is delayed until the next DIP or SIP.

When the time drift is less than the minimum time synchronisation threshold the meter will accept the time synchronisation request but will not implement the change.

When the time drift is greater than the maximum time synchronisation threshold the meter will reject the time synchronisation request and will allow time adjustment using time setting to an absolute value from the HES.

5.5 Accounting

5.5.1 Standing Charge Deduction

Liberty 100 operating in Prepayment mode can be configured to deduct a specified amount of standing charge from its current account and Emergency Credit account (if applicable); this deduction takes place daily at midnight (00:00 GMT) irrespective of the amount of energy consumed or the meter's account status. It is therefore possible for arrears to accrue on a current account even after credit expires and the meter's supply disconnects.

The per day standing charge deduction amount can be viewed by pressing key '6' on the meter's keypad. In the event of a power failure the meter will remember the number of days for which the charge has not been collected and will deduct the amount when the power is restored.

The following are configurable in Liberty 100 with respect to standing charges:

- Enable or disable standing charge deduction for Prepayment and Credit mode.
- Enable or disable standing charge deduction when the Emergency Credit is in use.
- Enable or disable standing charge deduction during a self disconnected period. The meter can be configured not to deduct standing charges during a self disconnected period if the meter's account balance is zero or negative.

5.5.2 Emergency Credit

Liberty 100 operating in Prepayment mode supports Emergency Credit functionality which if enabled will prevent immediate supply disconnection during defined times of the day and days of the week when the meter account becomes zero or negative. Emergency Credit is made available to users when their meter account passes the Low Credit threshold and is enabled by pressing key 'A' on the meter keypad or a displayed button on the IHD. Users can also enable Emergency Credit after supply disconnection. A visual indication on the meter's display as well as on the IHD will indicate the availability of Emergency Credit.

The default Emergency Credit allowance can be changed via a tariff change UTRN. The allowance, when used up, must be repaid in full before Emergency Credit is made available for use again.

Standing charges can be deducted from Emergency Credit if configured; otherwise, the meter will maintain in a separate register, the standing charge amount that would have otherwise been deducted during this period. If configured, then the accrued standing charge will be recovered in full from the top-up amount before Emergency Credit is made available for use again.

5.5.3 Friendly Credit

Friendly Credit is a configurable non-disconnection regime that overrides account-related supply disconnection at certain times of the day, days of the week or on defined dates in the year such as public holidays. Liberty 100 operating in Prepayment mode supports this feature.

In a Friendly Credit period if the meter's account balance becomes zero and Emergency Credit is not enabled or is used up then the supply will not disconnect because a grace period of x minutes is configured at the end of Friendly Credit period which interrupts supply disconnection. The default value of grace period is set to 60 minutes. If Emergency Credit is not enabled or the meter's account is not credited with the appropriate amount

of credit before the end of the grace period then the supply will disconnect unless the grace period is configured such that the supply never disconnects.

In Friendly Credit period the meter will continue to manage its account in accordance with its configuration, tariff and debt settings. Debts accrued during a Friendly Credit period are deducted from user's top-up with only the balance being added to the meter's account.

Friendly Credit periods are configurable locally as well as remotely by authorised users. The following combinations can be configured for Friendly Credit periods:

a) Start and end time (hh:mm) which will apply every day
b) Day of the week (1 through 7; Monday=1, Sunday=7)
c) Specific dates (DD:MM:YYYY) up to a maximum of 30 days
d) Seasonal (i.e. periods more than a day), start and end dates (DD:MM) up to a maximum of 10 seasonal periods.

Except for (a) in the list above, all configured Friendly Credit periods start at 00:00:00 hours on the start date and end at 23:59:59 hours on the end date. If multiple Friendly Credit periods overlap, the longest period will apply as shown in the following example:

	Friendly Credit Start time		**Friendly Credit End time**	
Configured Friendly Credit periods	Sunday (HH:MM)	**19:00**	Monday (HH:MM)	08:00
	Monday (HH:MM)	00:00	Monday (HH:MM)	**23:59**
Friendly Credit period in force:		**19:00 (Sunday)**		**23:59 (Monday)**

At the end of each Friendly Credit period the meter triggers audible and visual alerts that will be available locally to the user and remotely to HES.

An alarm suppression period, which is independent of Friendly Credit period, can also be configured in the meter to suppress account status related audible alarms but not the visual alerts or logging of associated events.

5.5.4 Accounting Zones in Prepayment Mode

Liberty 100 meters operating in Prepayment mode will have the following four accounting zones:

- Credit zone
- Low Credit zone
- Emergency Credit zone
- No Credit zone

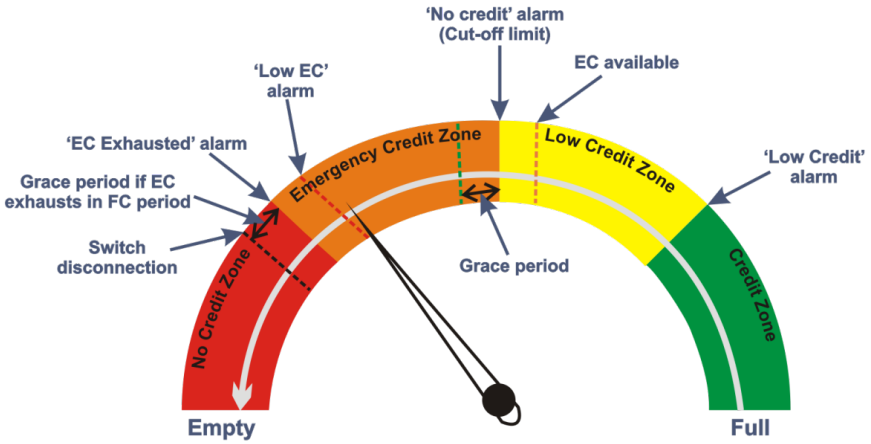


Figure 13: Liberty 100 Accounting zones in Prepayment mode

In Prepayment mode the meter maintains two internal accounts: the main account and the Emergency Credit account. Standing charges are deducted each day or as configured in the meter.

Each time the meter account passes through a credit zone threshold it sends an alert to the HAN and/or HES (depending on the configured rule), and generates a visual and audible alert for the user subject to the alarm suppression restrictions detailed in the Friendly Credit Section **5.5.3.**

'Low Credit' threshold and 'Low Emergency Credit' threshold values can be configured remotely for Liberty 100 meters.

In Prepayment mode the meter will provide the following information on Emergency Credit:

a) When Emergency Credit is available for selection
b) When Emergency Credit is in use
c) When Emergency Credit has been fully used
d) The minimum amount of credit needed to restore the supply and repay the used Emergency Credit amount.

5.5.4.1 Credit Zone

In the Credit Zone the value of the meters account, after a reduction, is checked against the meter's Low Credit threshold. No action is taken if the value is above the threshold. When the value passes below the threshold the meter sends an alert to the IHD and generates a local visual and audible alert to the user subject to restrictions that apply in alarm suppression period as detailed in the Friendly Credit Section **5.5.3**.

5.5.4.2 Low Credit Zone

In the Low Credit Zone the value of the meter account, after a reduction, is checked against the meter's cut-off threshold. No action is taken if the value is above the cut-off threshold. In this zone Emergency Credit is made available to the User before the value reaches the cut-off threshold. A visual indicator on the meter's display as well as on the IHD indicates that Emergency Credit is available. While the meter is operating in this zone, if Emergency Credit is made available, the user can enable it by pressing key 'A' on the meter's keypad or from the IHD to prevent supply disconnection.

When the value reaches the cut-off threshold, the meter sends an alert to the IHD and generates a local visual and audible alert to the user subject to restrictions that apply in alarm suppression period as detailed in the Friendly Credit Section of this manual.

If Emergency Credit is enabled when the meter account is in the Low Credit Zone the meter will automatically start operating in Emergency Credit mode once the Zero Credit threshold is crossed, otherwise, it will continue to operate in grace period offered by the supplier. The grace period is a limited time given to Users so that they can add credit or enable Emergency Credit. At the end of the grace period the supply will be disconnected if Emergency Credit is not enabled or credit has not been added to the meters account, provided the meter is not operating in a Friendly Credit period. To reconnect the supply after a supply disconnection, the User must either enable Emergency Credit (if not already used) by pressing key 'A' on the meter keypad or the appropriate button on the IHD or add more credit to the meter. Enabling Emergency Credit or adding more credit after a supply disconnection will change the meter's switch to a 'READY' state. The meter displays the message 'PRESS A' to begin the supply restoration process. Pressing key 'A' on the meter's keypad causes the meter to display the message 'PRESS B'. Pressing key 'B' on the meter's keypad confirms the supply restoration process resulting in the switch being closed. During the period for which the supply is disconnected, standing charges will apply and accrue if configured to do so. The accrued standing charges, if disabled, will not be deducted from the Emergency Credit allowance thus allowing the user to have use of all the Emergency Credit. They will however accrue and will be deducted when the meters account is above the Zero Credit threshold.

5.5.4.3 Emergency Credit Zone

In the Emergency Credit Zone the value of the meter account, after a reduction, is checked against the meter's Low Emergency Credit threshold. No action is taken if the value is above the threshold. A visual indicator on the meter display as well as on the IHD will indicate when Emergency Credit is in use. In addition, the meter provides information on the Emergency Credit amount remaining. If the meter is configured not to collect standing charges from Emergency Credit, the meter will maintain, in a separate register, the standing charge amount that would have otherwise been deducted during this period. The accrued standing charge will be recovered in full from the top-up amount before Emergency Credit is made available for use again.

When the value reaches the Low Emergency Credit threshold or the entire Emergency Credit allowance is used up, the meter will send an alert to the IHD and if configured generate a local visual and audible alert to the user subject to restrictions detailed in the Friendly Credit section of this manual.

If the entire Emergency Credit allowance is used up but the meter is operating in Friendly Credit period, the supply will remain On till Friendly Credit ends. At the end of Friendly Credit, if no credit has been added to the meter's account the User is given an Emergency Credit grace period to add more credit to the meter's account after which the supply is disconnected and will not reconnect even at the start of the next Friendly Credit period. The meter will display the top-up amount to be repaid which will include the full Emergency Credit amount together with additional applicable standing charges and any unpaid debt. The user must add sufficient credit to put the meter's account into positive balance before supply restoration is permitted.

Note: Standing charges and unpaid debts will be deducted from the Emergency Credit allowance if the meter is configured to do so.

5.5.4.4 No Credit Zone

In the No Credit Zone there is no Emergency Credit left to be used by the user; therefore, the supply will remain disconnected until the User tops up the meter's account sufficiently to repay the used Emergency Credit including any unpaid standing charges, leaving the meter's account in credit.

Note: Users can mute audible alerts by pressing key 'B' on the meter or acknowledging them on the IHD.

5.5.5 Debt Recovery Methods

Liberty 100 meters operating in Prepayment mode can be configured to collect outstanding debts by two methods:

- Payment based
- Time based

The meters can be configured to maintain a maximum of three debt registers from the following combinations:

1. One payment-based debt register
2. One time-based debt register
3. One payment-based debt register and one time-based debt register
4. Two time-based debt register
5. Two time-based and one payment-based debt register

Note: Retailers can cancel outstanding debt via an authenticated command.

5.5.5.1 Payment-based Debt Collection Method

For this method the meter is configured to collect a debt amount from the outstanding debt when users add credit to the meter. The debt deduction amount is a defined percentage of the credit added to the meter and will have a debt recovery rate cap for a defined period (days/weeks/months). The following example further explains this method:

A meter is configured to deduct 10% of the credit added towards debt collection and is defined with a debt recovery cap of £15 for debt recovery period of 1 week. If the meter has £35 of initial outstanding debt, the deductions will be as follows:

1. When £100 credit is sent to the meter, £10 will be deducted towards debt collection and the balance £90 is added to the meter account.
2. When £100 credit is sent to the meter a second time in the same week, £5 will be deducted towards debt collection and the balance £95 is added to the meter account.
3. When £100 credit is sent to the meter a third time in the same week, there will be no deductions towards debt collection and the entire £100 is added to the meter account.

The remaining £20 of outstanding debt will be deducted in the similar way when credit is sent to the meter in subsequent weeks until the full debt amount is recovered.

5.5.5.2 Time-based Debt Collection Method

For this method the meter is configured to collect a defined debt amount daily at midnight against the outstanding debt. If the meter has insufficient credit balance at the time of debt deduction, the uncollected debt deduction amount will be collected during the subsequent credit top-up by the customer. Time-based debt deduction conforms to the following rules:

- If the meter is configured not to collect debt amount from outstanding debts when the user is using Emergency Credit then this amount is stored in the debt register and the debt collection starts only after credit top-up.
- No debt will be deducted or stored when the meter account balance is zero or negative and during the supply disconnection period.

Configurable time-based debt deduction rules are summarised in the following table:

Deduction type	Meter account in credit zone	EC in use	Supply disabled	EC expired in FC zone (i.e. the meter account is zero or negative)
Debt	Deduction allowed	Deduction allowed	Stored in debt register	Stored in debt register
Debt	Deduction allowed	Deduction not allowed	Deduction not allowed	Stored in debt register
Standing charge	Deduction allowed	Deduction allowed	Stored in debt register	Stored in debt register
Standing charge	Deduction allowed	Deduction not allowed	Deduction not allowed	Stored in debt register

5.6 UTRN Transactions

A Unique Transaction Reference Number (UTRN) is an encrypted code used for changing a meter's account, changing the meter's switch state or changing the meter's configuration. There are five (5) types of UTRNs:

a) Vend UTRN: used for adding, deducting, or setting the meter's account to an absolute value either locally or remotely with immediate effect; a vend UTRN will have information such as the date and time of the transaction, transaction source, amount and currency code.
The meter can hold a maximum credit balance of up to the limit defined in the Prepayment configuration which must not exceed £21,474.00; if a vend amount is sent to the meter either locally or remotely causing the meter's account to exceed its maximum credit limit then the meter will reject the vend.

b) Supply connection UTRN: used for disconnecting the supply or changing the switch state to 'READY'; a supply UTRN contains information such as the date and time of the transaction, transaction source, activation time and intended supply state.

c) Engineering service UTRN: used for the following services in the meter with immediate effect:
   - switching the meter operating mode to Default mode
   - enable or disable the local optical port
   - enable or disable HAN joining
   - leave the HAN
   - clear event logs
   - clear Site ID and Payment Card ID
   - clear load profile data and snapshot data

   An engineering service UTRN will have the date and time of the transaction, transaction source and the type of service performed.

d) Vend + additional Tariff UTRN: used for sending a tariff with an account vend and will have information similar to that of a Vend UTRN. This UTRN type is also accepted by meters in Credit mode in order to change the meter's operating mode from Credit to Prepay. At manufacture the meter is configured to always maintain one set of prepayment limits and a Friendly Credit calendar which will be applied at the time of mode change from Credit to Prepay via a UTRN. The following information can be updated using the UTRN:

- Rate price (maximum 4 rates)
- Block (slab) threshold - maximum 3 blocks [(monthly (30 days), bi-monthly (61 days), quarterly (91 days), half-yearly (182 days) and yearly (365 days)].
- Block threshold in 1 kWh resolution
- Tariff resolution period (block period or daily)
- Block period activation (calendar month reference is 1st January or the tariff activation date)
- Standing Charges
- Activation of tariff (immediate or delayed on respective date midnight)

e) Retain Credit UTRN: used for retaining credit in a meter after a refund and contains information such as the date and time of the transaction, refund amount, transaction source, the new account balance, currency and encrypted transaction code.

UTRNs can be uploaded to the meter via the WAN Interface, entered and sent over the HAN from an IHD or entered using the meter's keypad.

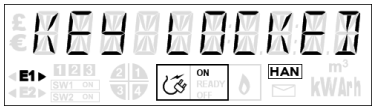
The meter will reject UTRNs if they fail authentication and are invalid. Each time a UTRN is rejected the meter displays a failure message along with a failure reason such as 'invalid UTRN', 'UTRN already processed', 'incorrect format', etc. The date and time of transaction, the transaction source, transaction number, UTRN type and the result code of the transaction are stored for each rejected UTRN.

Validation and authentication of remote top-up commands include verification of the meter operating mode, command source and whether the UTRN has already been processed before or has a correct format. Failure to validate or authenticate a UTRN will result in the meter sending a rejection alert.

Instructions for entering UTRNs can be found in Section 7.3 (Credit Mode) and Section 7.6 (Prepayment Mode). When entering a UTRN via the meter's keypad, there is a timeout period of 20 seconds after which time, if no key has been pressed the meter will begin automatic authentication of the UTRN. During UTRN entry via the meter's keypad, key 'A' can be used to delete the last entered digits.

The meter allows five (5) successive incorrect UTRN entries after which it locks key 'A' (key 'A' is used for initiating UTRN entry) for 30 seconds with a 'KEY LOCKED' message on its display as shown below. Thereafter, the lock period doubles with each incorrect UTRN until the 10th attempt is reached when the lock period is 16 minutes. Acceptance of a correct UTRN resets the incorrect UTRN counter and the lock period to zero and takes necessary action based on the UTRN type.

UTRN attack message :



The meter keeps a record of the last 100 accepted and rejected UTRNs. The retailer can configure to send alerts to HES for each success or failure with a snapshot of the meter status at the time of the update, before and after the UTRN was accepted.

5.7 Meter Mode Changing Operation

Liberty 100 supports local and remote runtime switching of its operating modes via the engineering service UTRN or on receipt of an authenticated command. It can be configured either with immediate effect or for a future date. Switch mode requests for future dates can be cancelled remotely by authorised users. If power is off during the scheduled date and time, the switchover will occur when power is restored.

Scheduling of the meter mode change for a future date will not disturb the current settings in the meter until the specified date and time is reached. If power is off during the scheduled date and time, the switchover will occur when power is restored.

The meter performs the following activities when it receives a command to switch from Credit to Prepayment mode or Prepayment to Credit mode:

- Performs a billing snapshot at the time of mode switching.
- Changes the meter operating mode and sends the information to the HES or, if the mode switching command is for a future date sends an acknowledgement on receipt of the command. However, if the received command is recognised as invalid or the meter is unable to implement the mode switching command then it will reject it and record the reason for rejection and if configured to do so, will notify the HES.
- During mode switching process from Credit to Prepayment the meter will not interrupt the user's supply. If the meter account has no credit during this switching process then as part of configuration, the retailer can either add a credit amount or immediately activate the Emergency Credit in the meter.
- When the meter is operating in Credit or Prepayment mode and the supply is disabled due to account expiry, switching its operating mode will change the meter's switch to 'READY' state. A meter with 'READY' switch state will restore the supply by user interaction at the meter or IHD. A command to change the meter to Prepayment will initiate the following: activate Emergency Credit on change or add a credit amount to the account to ensure the user is not disconnected; set Emergency Credit settings; set Friendly Credit; set date and time for mode switching.
- When a meter in Prepayment mode receives the command to switch to credit mode, it resets all the Prepayment account balances, outstanding debts and settings after changing the mode.

5.8 Meter Configuration and Functionality

The meter verifies and authenticates the commands it receives over WAN before executing them. If authentication fails, the meter will reject the command. The meter sends acknowledgement on receiving configuration commands having schedules and actions to be performed on a future date and will execute the command on the intended date and if configured will send event notification to HES. These future dated commands can be cancelled or overwritten by a new command.

The following parameters are configurable in Liberty 100 meters via authenticated commands:

- Tariff type
- Tariff rates and tiers
- Price
- Block reset for block tariffs
- DST
- Prepayment settings – Low Credit, Emergency Credit threshold, cut-off value, Emergency Credit limit
- Non-interrupt periods (Friendly Credit calendar) and vulnerable Users (supply interrupt is permanently disabled).
- Mode of operation
- Site ID
- Supplier information
- Maximum possible credit balance
- Prepayment PAN (Payment Card ID)
- Billing period
- Standing charge (daily)
- Password configuration

- Credit addition
- Event configuration
- 'Vend + tariff' type UTRN in order to update tariff into meter under No WAN scenario.
- Debt setting which can be configured for a maximum three types of debt when the meter is running in Prepayment mode. The debt limit can be added or subtracted from the existing outstanding debt register or a new debt value can be set.
- Reset Counter
- Data disclosure setting in order to enable or restrict data on the meter display
- Demand limit configuration
- Change of supplier or tenancy
- Cancel delayed configuration. This will cancel all delayed configuration including scheduled meter configuration, scheduled switch activation and scheduled COT or COS.

Note: Each of the above configurations can have different treatment rules for meter operation.

5.8.1 Tariff Configuration

Liberty 100 can be configured with tariff regimes for the following three (3) energy types:

1. Import
2. Export
3. Import and Export

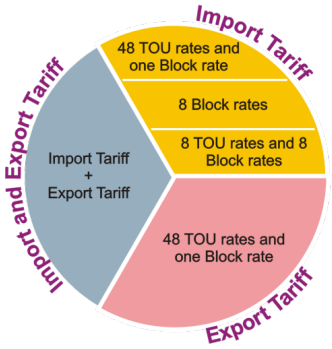


Figure 14: Tariff Regime

The meter can be configured with tariff rates for kWh consumption for different times of the day and seasons. The tariff activation date can be configured either with immediate effect or for a later date and time. The following parameters are configurable:

- Tariff configuration information
- Time of use (TOU) calendar
- Tariff price matrix
- Block (Tier) labels
- Block thresholds
- Block reset period
- Billing period

Note: Sending tariff files with a new set of billing dates that has a schedule activation date earlier than the current date will trigger a billing on the next day and the billing thereafter will be as per the new billing dates.

5.8.1.1 Import Tariff

An import tariff can be configured to one of the following three types of tariff:

a) TOU:
Up to 48 TOU registers can be assigned allowing a different TOU register to be used every half hour. Each TOU register can have its own rate.
b) Block (or Slab):
Up to 8 block registers can be assigned. Switching between Blocks happens when defined consumption thresholds are exceeded.
c) Combined TOU and Block (Hybrid):
Up to 8 TOU registers can be assigned with each having up to 8 block registers. A different TOU register can be used every half hour.

Time of use (TOU) tariff registers

Users are charged different tariff prices at different times of the day. An example is shown below:

TOU	Time pattern	Rate charged
TOU1	00:00 – 07:00	R1
TOU2	14:00 – 20:00	R2
TOU3	20:00 – 00:00	R3

Liberty 100 meters supports configuration of TOU tariff structure for 4 seasons, 4 weeks, 17 days, 12 switching points per day and 50 special dates.

Block tariff registers

Users are charged different tariff prices for different predefined kWh unit blocks of electricity. An example is shown below for four block rates throughout a year:

kWh Blocks	Block threshold	Rate charged
Block 1	0 – 10 kWh	R1
Block 2	11 – 25 kWh	R2
Block 3	26 – 45 kWh	R3
Block 4	46 kWh onwards	R4

Hybrid tariff registers

Users are charged different tariff prices at different times of the day and for different predefined kWh unit blocks of electricity. An example is shown below for a hybrid tariff having two TOU rates and two Block rates throughout a year:

	kWh Blocks	Rate charged
TOU1 (Night)	Block 1	R1
TOU2 (Day)	Block 1 (below the configured threshold)	R2
	Block 2 (above the configured threshold)	R3

Note: The above time patterns and thresholds are used as example for this manual. R1 – R4 are different rate prices in pence.

5.8.1.2 Export Tariff

The meter supports the following two types of export tariff configuration:

a) TOU:
   Up to 48 TOU registers can be assigned allowing a different TOU register to be used every half hour. Each TOU register can have its own rate.
b) Block (or Slab):
   Up to 8 block registers can be assigned. Switching between Blocks happens when defined consumption thresholds are exceeded.

5.8.1.3 Import and Export Tariff

Import and Export tariffs will have a combined tariff for import and export. In this case, both import and export tariffs can be configured to use a shared TOU calendar.

5.8.2 Data Disclosure

Data disclosure restrictions can be applied or removed by sending an authenticated command to the meter over WAN.

5.8.3 Resetting Counters

The following counters can be reset via authenticated commands:

- Time set count
- Power On count
- Terminal cover open count
- Main cover open count
- Communication Module removal count
- Average Over Voltage exceed count
- Average Under voltage exceed count
- Load limit exceed count

5.8.4 Demand Limit Configuration

Demand limit configuration for load limiting (i.e. supply capacity control) and power thresholds can be sent to the meter via an authenticated command.

5.9 Alerts and Messages

5.9.1 Account-based Prepay Alerts

Liberty 100 operating in Prepayment mode displays visual alerts and sends audible alerts (see Figure 13) under the following circumstances based on the state of its account:

- ‘Low credit’ alert if the credit level in the meter’s account reaches or passes below the configured low credit threshold.
- ‘Emergency Credit available’ alert if the credit level in the meter’s account reaches or passes below the configured Emergency Credit threshold thereby making the users aware of the availability of Emergency Credit.

- ‘No credit’ alert if the credit level in the meter’s account reaches or passes below zero credit threshold.
- ‘Supply disconnect’ alert if Emergency Credit is not enabled and the cut-off grace period expires.
- ‘Low Emergency Credit’ alert if Emergency Credit level in the meter reaches or passes below the configured low Emergency Credit threshold.
- ‘Emergency Credit exhausted’ alert if there is no Emergency Credit left in the meter.
- ‘Grace period’ alert at the start of the grace period in Friendly Credit and non-Friendly Credit.

Users can mute audible alert by pressing key ‘B’ on the meter keypad or appropriate button on the IHD. Account related audible alerts are suppressed during the configured quiet period (e.g. at night).

5.10 Supply Voltage Quality Monitoring

Liberty 100 supports monitoring, logging and profiling of the power supply voltage.

The meter measures the average RMS voltage over a defined monitoring period which is configurable in 1, 2, 3, 4, 5, 6, 10, 12, 15, 20 or 30 minutes via an authenticated command.

Average RMS voltage profiling and monitoring:

The meter logs the average voltage at the end of the monitoring period and compares it with the preconfigured Over and Under Voltage thresholds. If the average voltage is above the Over Voltage threshold then it is logged as an Over Voltage event and if the average voltage is less than Under Voltage threshold then it is logged as an Under Voltage event. The meter maintains a counter for Over Voltage and Under Voltage event occurrence. The counter can be reset by using an authenticated command. When the existing monitoring period for voltage profile is changed the meter automatically clears old profile data.

The meter is able to detect and record occurrence of the following voltage related events if they persist longer than the configured monitoring period:

- Excessive Over Voltage when the RMS voltage exceeds the extreme Over Voltage threshold.
- Voltage Swell when the RMS voltage exceeds the Voltage Swell threshold.
- Excessive Under Voltage when the RMS voltage is below the extreme Under Voltage threshold.
- Voltage Sag when the RMS voltage is below the Voltage Sag threshold.

Note: The meter logs the voltage profile as ‘0x-FFFF’ during power off, which signifies invalid or no data.

5.11 Ambient Power Threshold Status

The meter compares the active import power against configured thresholds and displays the load as detailed below:

Active import power	Load displayed on pressing key ‘0’ in Prepay and Credit mode
Less than or equal to low medium power threshold	Low
Higher than the low medium power threshold and equal to or less than the medium high power threshold	Medium
Higher than the medium high power threshold	High

The power thresholds are configurable using an authenticated command.

5.12 Load Limiting

Liberty 100 meters support the following two types of load limiting when operating in Prepayment mode:

1. Supply capacity control
2. Reduced Emergency Credit load

Load limiting for a SIP is skipped if there is a load limit configuration change, time setting, time synchronisation or power interruption during the averaging period.

5.12.1 Supply Capacity Control

Supply Capacity Control restricts the user from drawing more power than the defined load limit. This is done using the demand value, which is calculated from the energy consumed within the defined monitoring period (configurable monitoring period is 30 to 3600 seconds).

The meter when operating in Credit or Prepayment mode will disconnect the supply if the demand is above the defined load limit and will display an 'OVERLOAD' message for 20 seconds on the meter display after which the meter puts the switch into 'READY' state and displays instructions for reconnecting supply. If configured, the meter will send a supply disconnection alert to the IHD and HES as well as log the occurrence of overload as an event and increment the load limit occurrence counter (the counter can be reset by sending an authenticated command).

5.12.2 Reduced Emergency Credit Load

Reduced Emergency Credit load provides a longer Emergency Credit period by reducing allowed load when Emergency Credit is in use.

5.13 Change of Supplier (COS)

On receipt of a COS request any delayed COS request will be cancelled and the meter will perform one or more of the following actions, depending on the configuration:

- Performs a billing action before and after change of supplier.
- Takes a billing snapshot before and after change of supplier; if the meter is operating in Credit mode then the meter balance is also reset.
- Resets Credit and Debt registers (in Prepayment mode the Credit register will automatically start using the Emergency Credit allowance, if available).
- Resets tariff to its Default mode value.
- Clears snapshot registers, historical load profile information, payment card ID, UTRN log, prepayment log, account log, hardware log, configuration log, supply quality log, operating condition log, supply log and tamper log.
- Changes the meter's switch state to 'Off' or 'READY' state.

After COS activation the meter logs an event, together with the date and time of COS activation, and then performs the following actions:

- Cancels all delayed tariffs having the old supplier ID.
- Updates the current active tariff with the new supplier ID and supplier name.
- Makes all consumption history, payment history and profile data available for the IHD and meter display.
- Communicates all meter data over WAN.

5.14 Change of Tenancy (COT)

On receipt of a COT request any delayed COT request will be cancelled and the meter will perform one or more of the following actions, depending on the configuration:

- Performs a billing action before and after change of tenancy.
- Takes a billing snapshot before and after change of tenancy; if the meter is operating in Credit mode then the meter balance is also reset.
- Resets Credit and Debt registers (in Prepayment mode the Credit register will automatically start using EC allowance, if available).
- Resets tariff to its Default mode value.
- Clears snapshot registers, historical load profile information, payment card ID, UTRN log, prepayment log, account log, hardware log, configuration log, supply quality log, operating condition log, supply log and tamper log.
- Changes the meter's switch state to 'Off' or 'READY' state.

After COT activation the meter logs an event, together with the date and time of COT activation, and then makes the following information available for display:

- Load profile data from the SIP of effective COT time.
- Daily and weekly energy consumption data from the effective COT date.
- Monthly consumption data not more than 45 days from the effective COT date.
- Up to five accepted historical vend UTRNs from the effective COT date.

In the case of change of tenancy the following three situations may occur:

1. The tenant has left the premise without notification,
2. The tenant notifies that he is leaving the premise immediately, or
3. The tenant notifies that he will leave the premise on a future date.

For the three cases listed above the actions taken at the meter on receiving a COT request are:

Case 1: On receipt of the above information from the new tenant, the supplier sends a COT request to the meter immediately. On receipt of this request the meter performs all the actions listed above immediately and stores the following information related to the new tenant that will be made available on the meter display and on the IHD:

- The last 5 accepted vend UTRN history
- Daily, weekly and monthly kWh consumption, as well as cost of consumption figures
- Load profile data

Case 2: On receipt of the above information, the supplier sends a COT request to the meter immediately. On receipt of this request the meter performs all the actions listed above immediately.

Case 3: On receipt of the above information, the supplier sends a delayed COT request to the meter which will be performed on the day the tenant leaves the premise. On receipt of this request the meter will schedule all the actions listed above to be performed on the specified date.

5.15 Meter Switch State

The meters switch has three states – On, Off and READY and is driven to these states by the following events:

a) Account related (valid in Prepayment mode) – the switch will open when the account balance reaches the cut-off threshold or Emergency Credit is exhausted and will change to ‘READY’ state if sufficient credit is added.
b) Tamper related (valid for Prepayment and Credit mode) – the switch will open (if configured to do so) when the meter detects tamper related events.
c) Back-office instructions (valid for Prepayment and Credit mode) – the switch can be opened or changed to ‘READY’ state remotely from the supplier back-office.
d) Load limit exceed - the switch will open (if configured to do so) when Load exceeds a defined threshold and returns to ‘READY’ state.
e) Change of supplier or change of tenancy.

The switch is actively driven to its intended state, thereafter it will change depending on the above events. In power outage event, the meter will resume the same state it was in before the power outage when the supply is restored.

5.15.1 ‘READY’ state

For safety reasons a ‘READY’ state is supported between the supply off and on states. This gives the User the control to reconnect their supply from the meter or IHD when it is safe to do so (e.g. appliances are off). When the meter’s switch is in ‘READY’ state, the ‘READY’ icon will illuminate on the LCD and an appropriate message will be displayed which signifies that the meter is ready to reconnect supply and is waiting for the user to press the correct key sequence on the meter’s keypad or IHD.

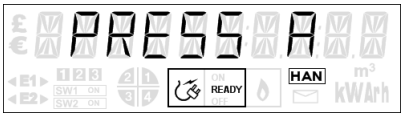
5.15.2 Closing the switch from the ‘READY’ state

When the switch is in the ‘READY’ state, the ‘READY’ icon will illuminate on the meter’s LCD followed by the messages ‘PRESS A’ and ‘CONNECT’. Pressing key ‘A’ on the meter displays ‘Press B’ followed by ‘CONFIRM’. Pressing key ‘B’ within 30 seconds of pressing key ‘A’ closes the switch and reconnects the supply otherwise it will stay in the ‘READY’ state and the meter’s display reverts back to ‘PRESS A’ followed by ‘CONNECT’ display sequence.

5.15.3 Supply switch connection displays

1. READY mode display cycle

When the meter’s switch is in the READY state, the following display sequence will be shown for the user to connect their supply.

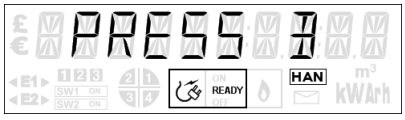


followed by

Acknowledge the above message by pressing key ‘A’ within 10 seconds, otherwise the display goes into sleep mode and will return by pressing any key on the meter’s keypad.

2. Confirmation display cycle

After pressing key ‘A’, the following confirmation display cycle will be shown for 30 seconds:



followed by

If the user confirms the action by pressing key ‘B’ within 30 seconds of pressing key ‘A’ the switch will close and the default display of the current mode will resume otherwise the display will revert to the Ready mode display cycle.

Note: The supply switch connection displays are not shown during the switch cycle test in commissioning mode.

5.15.4 Account Events

Liberty 100 is programmed to disconnect the supply outside of Friendly Credit periods (see Section **5.5.3**) when its account balance is insufficient and Emergency Credit (see Section 5.5) is not enabled or has been exhausted. Once disconnected, the supply cannot be restored unless sufficient credit is added to the meter’s account to drive the switch to the READY state.

After supply disconnection, the meter’s switch can be returned to the READY state by either enabling Emergency Credit (provided Emergency Credit is not exhausted) or adding sufficient credit to bring the meter’s account above its Zero Credit threshold. Once in the READY state the user can close the switch from the meter keypad or IHD.

Unless configured, Friendly Credit does not stop the Low Credit, Zero Credit or Zero Emergency Credit alerts from being given.

5.15.5 Connecting/Disconnecting Supply Remotely

Liberty 100 will accept remote requests for supply disconnection from an authorised source even if the supply is in an off state due to another reason such as no credit in the meter. When this occurs the switch will not change to a ‘READY’ state even if a user vends to the meter’s account and puts it back into credit if a switch open command from the authorised source has not been rescind. Supply restoration is only possible when there is no reason for the main switch to be open.

A retailer can remotely operate the meter’s switch by sending an authenticated supply UTRN to the meter. The meter’s switch can be remotely changed from On to Off state or from Off to READY state either immediately or at a scheduled later date and time (in 30 minutes resolution); the scheduled date must be within 365 days (compile time configurable) from the current date. The meter will not accept a supply UTRN for any scheduled date which is more than the configured number of days.

Once disconnected, the supply can only be restored by user interaction at the meter or IHD when notified that the meter’s switch has been put into a ‘READY’ state. The meter will confirm supply restoration with a visual and audible alert. Alerts or change of the meter’s switch state (On, Off or READY) are also communicated to the IHD and HES (if configured).

5.16 Detecting and Logging Events

The meter events should be checked periodically.

Liberty 100 detects the following events and stores a maximum of one hundred (100) of each type on a rolling first in first out (FIFO) basis in separate storage groups:

- Hardware events
- Quality of supply events
- Tamper events
- Prepayment events
- UTRN events

- Credit account events
- Switch operation events
- Security events
- Configuration events
- Communication security events

Event	Persistence Time	Threshold
Presence of magnetic field	10 Sec	--
Removal of magnetic field	10 Sec	--
Over voltage*	1 Min	>110% of Nominal voltage
Under voltage*	1 Min	<90% of Nominal voltage
No voltage /outage	1 Min	<80% of Nominal voltage
Switch welding	180 Sec	

* The normal voltage is above 95% and below 105% of Nominal voltage.

Table 4: Event Persistence Time and Threshold value

Each event is recorded along with its date and time of occurrence. The meter will retain event data after decommissioning, un-pairing or change of supply. Event logs are cleared by using an Engineering service UTRN.

Note: Alerts for event logging and acknowledgment is configured via authorised command.

5.16.1 Hardware Events

Occurrence of hardware events in the meter such as low battery or battery failure, non-volatile memory (NVM) error, program fault, clock invalid or switch welding or switch failure are logged in the meter's hardware event log along with the date and time of their occurrence.

If configured, the meter can send alerts for such events to the HES.

5.16.2 Quality of Supply (QoS) Events

Occurrence of supply loss, supply restoration, under voltage, over voltage, voltage swell and voltage sag events are recorded in the meter's QoS event log together with the date and time of their occurrence. The default minimum threshold voltage is 180 V.

Supply loss and restoration are notified to the HES.

5.16.3 Tamper Events

Liberty 100 can be configured to disconnect the supply when it detects a tamper event and send alerts for such events to the HES. The meter is programmed to record the following as tamper events together with the date and time of their occurrence:

- Removal or restoration of the meter main cover, terminal cover or communications module.
- Presence of magnetic field.
- Occurrence or restoration of reverse current flow with load exceeding 20 amps (set as default) and persisting for at least 60 seconds.
- Inducing or removing a DC magnetic field.
- UTRN attack (i.e. repeated attempt to enter invalid codes).

If the supply is disconnected due to any of the above events then restoration of such event resets the tamper flag and drives the supply switch to its READY state from where a user can reconnect their supply by using the meter keypad or IHD to acknowledge the displayed message. The tamper event counter resets to zero when the supply is restored.

5.16.4 Prepayment Events

The following events are recorded in the meter's prepayment event log together with the date and time of their occurrence:

- Low credit condition or credit exhausted.
- Emergency credit offered, enabled, in use, low or exhausted.
- Friendly Credit about to expire or expired.

If configured, the meter can send alerts for such events to the HES.

5.16.5 UTRN Events

The following UTRN transaction events are recorded in the meter's UTRN event log along with their date and time of occurrence:

- Vend UTRN.
- Supply connection UTRN.
- Engineering service UTRN for switching the meter to default mode, enabling or disabling the local communication port, clearing data logs or clearing the site ID and payment card ID.
- Retained credit UTRN.
- Rejected UTRNs with reason for rejection.

If configured, the meter can send alerts for such events to the HES.

5.16.6 Credit Account Events

Account updates due to debt setting or account top-ups are recorded in the meter's credit account event log along with their date and time of occurrence. If configured, the meter can also send alerts for such events to HES.

5.16.7 Switch Operation Events

Each time the meter's switch state is changed (OFF, READY, ON) either locally or remotely, the event is recorded in the meter's switch operation event log together with the date and time of their occurrence. For switch arming, the meter records the 'READY' to connect reason code too.

If configured, the meter can send alerts for such events to the HES.

5.16.8 Security Events

The following activities are recorded in the security events register:

Password change, meter lock or unlock, key change, HES public key change, security clearance grant or release, excessive firmware upgrades (more than twice per day) and excessive switch operations (more than ten per day).

5.16.9 Configuration Events

The meter records the following changes in its configuration event log:

- Receipt or activation of meter configuration
- Change of operating modes - Prepay or Credit
- Profile configuration
- Configuration of events
- Time setting
- Cancellation of delayed meter configuration
- Configuration, enabling or disabling of DST*
- Setting the payment card ID and Site ID
- Receipt or activation of meter firmware
- On demand billing
- Completion of installation
- Change in System Parameter setting
- Counter reset
- Data restriction setting
- Demand limit configuration
- Debt setting
- Receipt or activation of change of supplier request
- Receipt or activation of change of tenancy request

* Supply failure will interrupt the recording of DST configurations.

If configured, the meter can send alerts to the HES for all the above events.

5.16.10 Communication Security Events

The following attempts made from unauthorised source are recorded in the communication security event log along with their start date and time:

- Commands sent with a wrong authenticator.
- Requests for authorisation with a wrong password.
- Data requests sent without authorisation.

The meter records the number of unauthorised attempts. In every 15 minutes, the meter will log persisting unauthorised attempts and if configured, can send alerts for such events to the HES.

The meter will resume its normal operating mode and begin processing commands if no unauthorised attempts are detected for 15 minutes.

5.17 Communication Channels

Liberty 100 with the Skyline-i 510 communication hub has the following communication channels:

- IEC 1107 optical port - this port, fitted on the meter is designated as Port-1 and is used to communicate with the meter locally. The port supports a maximum data rate of up to 9600 baud and can be used during the installation process, for downloading a tariff into the meter or reading consumption data and other information locally with an 1107 probe. This port can be enabled or disabled using a service UTRN.
- ZigBee module - the ZigBee 2.4 GHz low-power radio facilitates communication between other HAN devices such as a gas meter or IHD. ZigBee ZSEP1.1 with SSWG extensions is supported.

- GPRS WAN module- for communication to HES.

5.18 Meter Reading Data

The following information can be read from the meter using the supported communication protocol:

- Meter date and time
- Application firmware name and version
- Metrology firmware name and version
- Current credit level
- Unique identifiers such as meter serial number, MPAN, electricity supplier information, electricity meter ID, meter type and its description, meter activation date and time (commissioning time), activation status, meter removal date and time (decommissioning time), cumulative energy, rate registers and blocks (or tiers).
- Mode of operation (Prepay or Credit)
- Configuration details
- Tariff structure and tariff information
- Snapshot data and midnight data
- Meter diagnostic data
- Events, tampers, faults and alerts
- Load profile
- Supplier information (supplier ID, name, start date and site ID)

5.19 Upgrading Meter Firmware

The firmware in the meter can be updated to change its operation. This can be done either locally using the IEC 1107 optical port or remotely over the air (OTA) via the communication module (hub). Upgrading the firmware will not affect the meter data unless the update involves changing the parameters of such data. Information related to load survey, transactions, account balance, events and storage or contents in billing registers such as prepayment balance are not affected during these upgrades.

Note: Current firmware name and version are available in meter readings and also on the meter's display.

5.20 Engineering Codes

Engineering codes are used for changing the meter's audible alarm suppression period or to enable the meter's Diagnostic Mode displays.

The alarm suppression period is the time during which audible alarms arising from any defined conditions will not sound although visible alerts (if any) will be displayed on the meter's display and the IHD (see Section **5.5.3**).

Diagnostic mode displays are displays to aid local diagnosis of the meter's operation and are not accessible to users. See **Annexe-II: Diagnostic Mode Displays**.

5.20.1 Changing the Alarm Suppression Period

The following Engineering Code is used to suppress the alarm:

< 00000-0xxxx-yyyy >

Where ‘xxxx’ is replaced with the alarm suppression start time (HH:MM) and ‘yyyy’ with the alarm suppression end time (HH:MM).

For example, the code ‘00000-02030-0630’ will suppress the alarm between 20:30 and 6.30.

5.20.2 Enabling Diagnostic Displays

A 6-digit Engineering Code which is common for all Liberty 100 meters is used to enable the meter’s diagnostic display.

If there is no user interaction with the meter in this mode, auto scroll display will resume in the current operating mode after the configured timeout period. See **Annexe-II: Diagnostic Mode Displays** for further details.

6 Communication Hub (Skyline-i 510)

The communication hub is fitted inside the meter's communication module and serves as the communication gateway to the Head End System (HES) via a Wide Area Network (WAN) and other smart metering devices via a Home Area Network (HAN). The hub is powered by the meter and consumes less than 2.5 W under normal operation. It communicates with electricity meter via an UART.

The hub provides the flexibility to upgrade or change the meter's communication technology without the need to remove the meter or break metrological seals. Liberty's default hub contains GPRS WAN and ZigBee HAN communication modules. The GPRS module connects the meter to the HES over the WAN providing remote data transfer between the meter and HES on request or as scheduled. The hub acts as coordinator for ZigBee HAN, managing connection with other HAN devices – e.g. In Home Display (IHD) and gas meter.

The hub has an internal antenna for WAN communication. It also has provision for connecting an external antenna to support GPRS communication if the meter has to be installed in a location with poor signal strength.

Information on the Hub front cover

Figure 3 shows information available on the front cover of Skyline-i 510 hub:

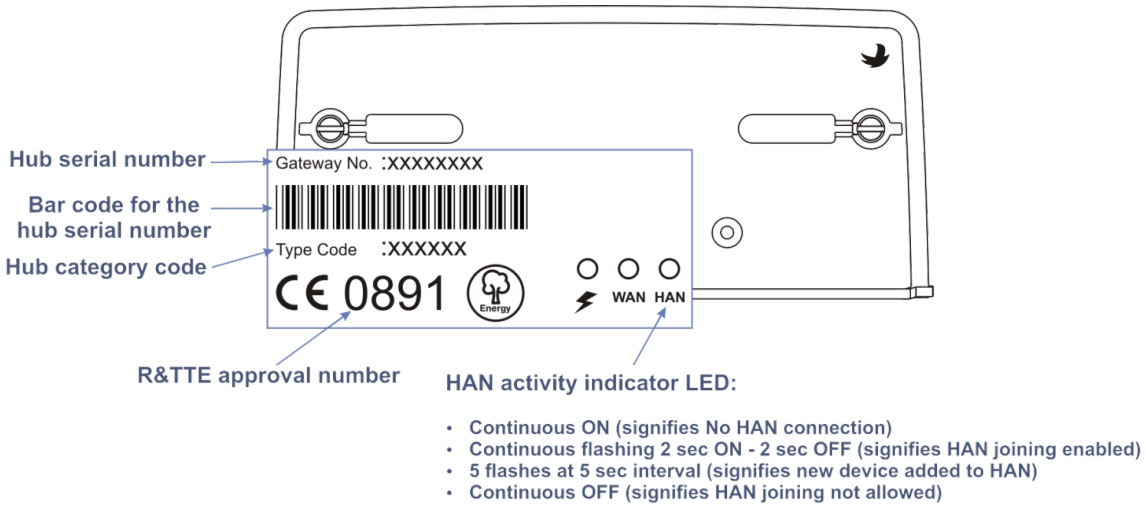


Figure 15: Skyline-i 510 front cover printings

Significance of LEDs on the Hub

: Power LED – flashes once when the meter is powered

WAN : WAN activity and GPRS signal strength indicator LED

- Continuous quick flashing signifies WAN activity
- 5 or less flashes at 2 sec interval signifies GPRS signal strength – more flashes indicates better signal strength, 5 is maximum
- Continuous OFF signifies no signal

HAN : HAN activity indicator LED

- Continuous ON signifies HAN joining is allowed.
- Continuous OFF signifies HAN joining is not allowed.

6.1 Functions of the Hub

The hub has the following interfaces:

- ZigBee Module - a ZigBee 2.4 GHz low-power radio facilitates communication between other HAN devices such as a gas meter or IHD.
- GPRS WAN Module- for communication to HES.

It provides the following functions:

- Communication to/from HES via WAN
  - Sends meter readings and status as scheduled or on demand
  - Sends notification of events (including connection status) if configured
  - Accepts commands from HES for Electricity meter or HAN devices
    - Including payment mode, financial configuration, configuration of reading schedule, tariffs, change of supplier/tenancy, adding credit, arming/disconnecting switch/valve, clearing event log, synchronise clock.
- Communication to/from HAN devices
  - Forwarding of commands to HAN devices
    - Including payment mode, financial configuration, configuration of reading schedule, tariffs, change of supplier/tenancy, adding credit, arming/disconnecting switch/valve, clearing event log, synchronise clock.
  - Receiving data and status from HAN devices
- Mirrors gas meter data for the IHD and HES
- Manages firmware update for meter and HAN devices
- Notifies alerts from HAN devices to HES via GPRS
- Sends last gasp message to HES (if configured) when the meter indicates that supply voltage is below the threshold.

Note: Last gasp message will be sent only if configured and if optional backup power supply is fitted. Multiple mains power outage within a 10 minute window could affect the meters ability to send a ‘last gasp’ message.

6.2 The Hub Rear View

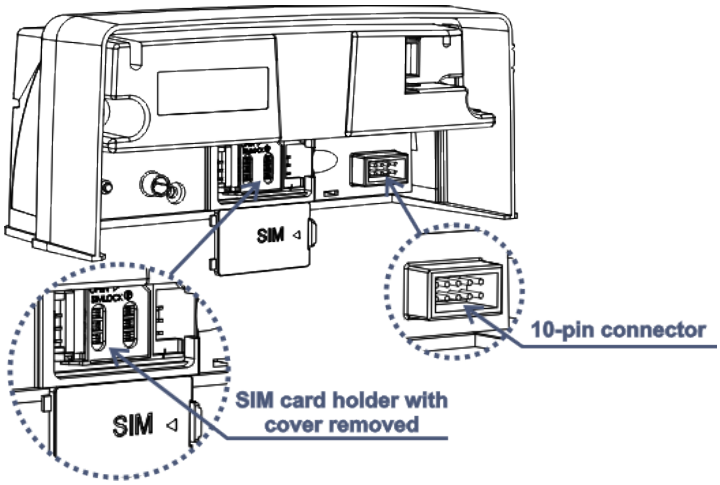


Figure 16: Inside of the Communication hub

6.2.1 10-Pin Interface Connector Details

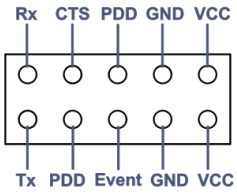


Figure 17: The hub interface connector details

Pin	Name	Function
1	VCC	Isolated 4 V @ 1.4 A supply to the hub
2	VCC	Isolated 4 V @ 1.4 A supply to the hub
3	GND	Isolated ground for the hub
4	GND	Isolated ground for the hub
5	PDD	Power Down Signal to the hub (Digital or 100 Hz of mains zero crossing signal).
6	Service/Event	Event notification pin, output from the meter micro controller.
7	CTS/Meter Busy	Signal from meter to the hub for communication traffic control. Signals are configurable through firmware.
8	3.3 V	3.3 V from the hub
9	Rx	Receive signal from the meter micro controller.
10	Tx	Transmit signal to the meter micro controller.
Note	PLC	Two contacts are provided as standard to interface Base Meter with Hub for future PLC variants

Table 5: Functions of hub interface connector PINs

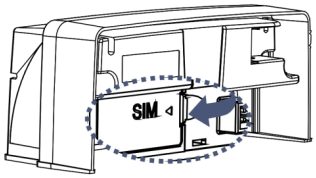
6.3 Replacing the Communication Hub and Fitting a SIM card

The hub is mounted inside the communication module and is connected to the meter by a 10-pin interface connector. The hub can be replaced without interrupting the power supply to the electricity meter. To replace the hub:

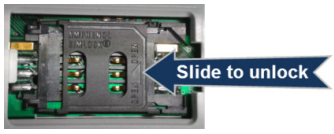
1. Break seals and unscrew the two screws on the hub cover.
2. Hold and gently pull the hub cover forwards to separate it from the meter's 10-pin socket.
3. Replacement of the hub is the reverse of the above process.

The following steps illustrate how to fit a SIM card:

1. Remove the SIM cover located on the left-hand side of the 10-pin interface connector and keep aside safely.

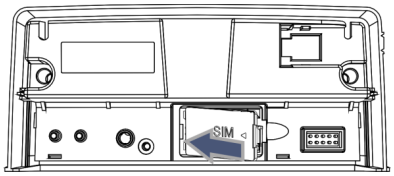


2. Open the SIM holder lock by sliding it to the left as shown in the following diagram until a click is heard.

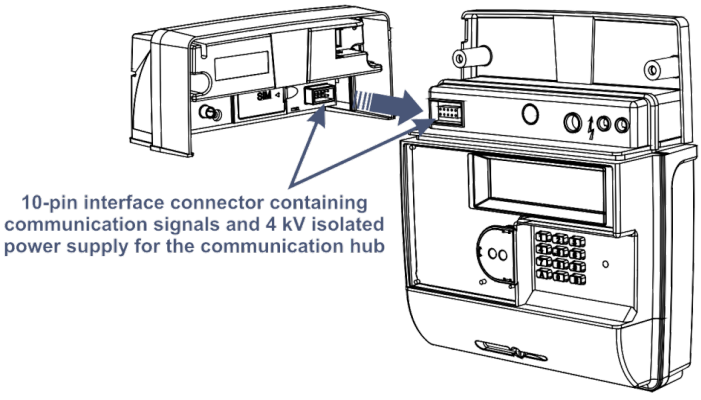


3. Insert the SIM card in the SIM holder with the gold coloured contacts facing down.
4. Close and slide the SIM holder to right to lock it in place as shown in the following diagram.

5. A click sound will confirm the SIM holder is locked. Replace the SIM cover as shown in the following diagram.



6. Align the 10-pin interface connector with the meter pin socket and carefully press to connect with the meter.



7. Tighten the two screws on the communications module to secure it to the hub with the meter's base and seal.

6.4 Future Hub Variants

The meter's modular design gives the flexibility to upgrade or change the meter's communication technology without changing the base meter or breaking the metrological seals. Depending on the need, the communications module can be hot-swapped with other compatible variants.

7 Annexe-I: Meter Displays

This section illustrates the displays that can be configured in the Liberty 100 meter operating in different modes.

7.1 Auto Scroll Display in Credit Mode

The default display will show pertinent information relating to the meter's credit mode of operation. For each display the timeout is two (2) seconds. The following display cycle is configured by default when the meter is operating in 'Credit' mode. These can be configured as per energy retailer's requirement.

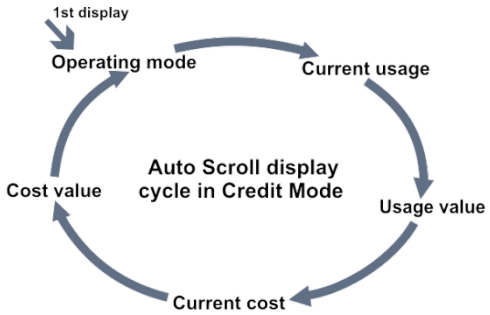


Figure 18: Credit mode auto scroll display cycle

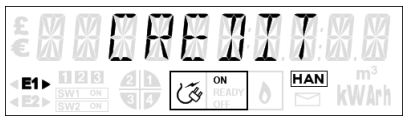
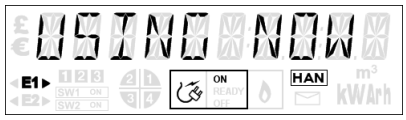
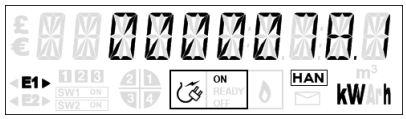
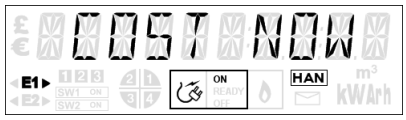
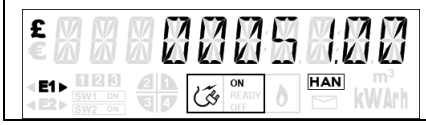
Operating mode:  Followed by	The 1st display indicating the meter is currently operating in 'Credit' mode.
Title: Current usage  Followed by **value**  Followed by	The 2nd display indicating the user's total electricity consumption since the last billing date. The example display shows that **78.1 kWh** have been used.
Title: Current cost  Followed by **value**  	The 3rd display indicating the total cost of electricity consumed since the last billing date. The example display shows that **£51.00** is the current bill amount.

Table 6: Auto scroll display in Credit mode

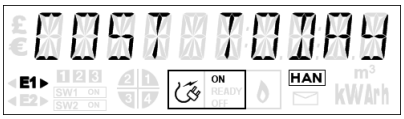
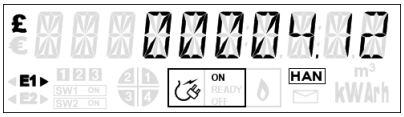
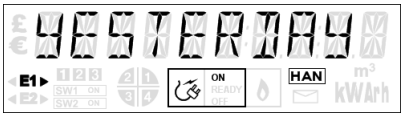
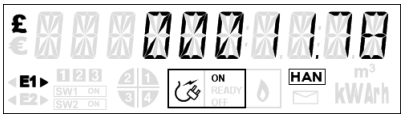
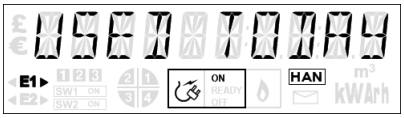
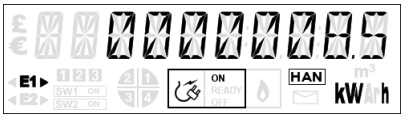
7.2 Manual Display in Credit Mode

The keypad of the meter is used to view information specific to the meter's current operating mode. In 'Credit' mode each numeric key is assigned to display a set of information; key 'A' and key 'B' are assigned to perform additional functions as described in the subsequent content.

In a display cycle, data is preceded by its title; default timeout for each title display is two (2) seconds and for the data its four (4) seconds. The following displays are configured at the manufacture and can be changed by a configuration change.

Key 1: Current day and previous day cost of consumption

A short press of key '1' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title 1: Current day's cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 1 to advance to the next display	The 1st set of displays associated with key 1 indicating the cost of electricity used today since midnight (00:00 GMT). The example shows that **£4.12** is the current cost of electricity used.
Title 2: Previous day's cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 1 to advance to the next display	The 2nd set displays the cost of electricity used yesterday. The example shows that **£11.78** was the cost of electricity used.
Title 3: Current day usage  *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)*	The 3rd set displays the electricity consumption today since midnight. The example shows that **8.5 kWh** has been used today.

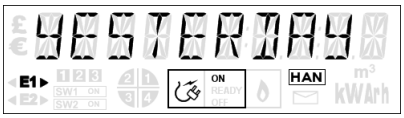
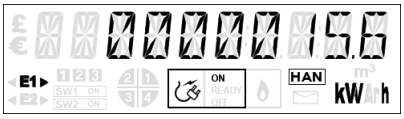
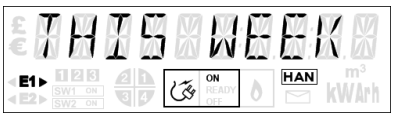
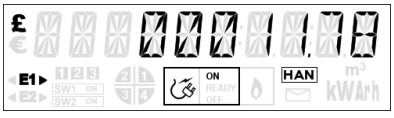
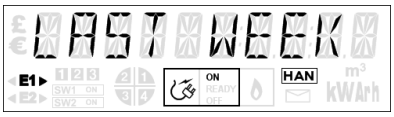
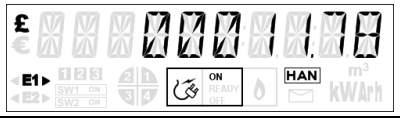
 Press key 1 to advance to the next display	
Title 4: Previous day usage  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 1 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 4th set displays yesterdays' electricity consumption. The example shows that **15.6 kWh** was used.

Table 7: Key '1' display in Credit mode

Key 2: Current week and previous week's cost of consumption

A short press of key '2' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title 1: Current week's cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 2 to advance to the next display	The 1st set of display associated with key 2 indicating the cost of electricity used in the current week. The example shows that **£11.78** is the current cost of electricity used.
Title 2: Previous week's cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*	The 2nd set display the cost of electricity used in the previous week (Monday to Sunday). The example shows that **£11.78** is the cost of electricity used.

 Press key 2 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	

Table 8: Key '2' display in Credit mode

Key 3: Current month and previous month's cost of consumption

A short press of key '3' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

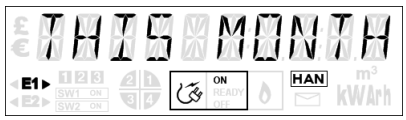
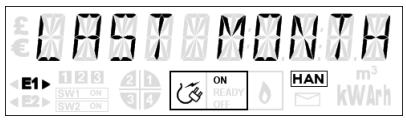
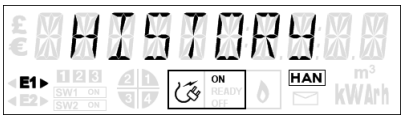
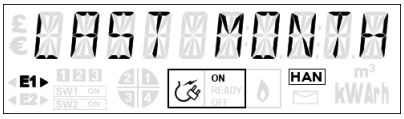
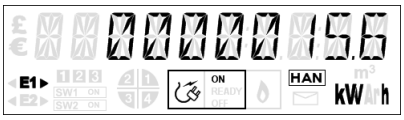
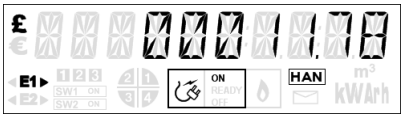
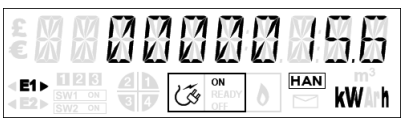
Title 1: Current month's cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 3 to advance to the next display	The 1st set of displays associated with key 3 indicating the cost of electricity used since the 1st of the current month. The example shows that **£11.78** is the cost of electricity used.
Title 2: Previous month's cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 3 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 2nd set displays the cost of electricity used in the previous month. The example shows that **£11.78** is the cost of electricity used.

Table 9: Key '3' display in Credit mode

Key 4: Historical monthly consumption data

A short press of key '4' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

The display will sroll forward through tweleve (12) months historical consumption data starting with the last month which is the same as the 'LAST MONTH' in the above Key 3 sequence. For example, if the current month is 'August' the last month will be 'July' so the data sequence will begin from 'July' and end with 'August'.

Title 1: Historical monthly consumption data  *(timeout 2 secs)*  Press key 4 to advance to the next display	The 1st display associated with key 4 indicating that the key is assigned to display historical monthly consumption for the past twelve (12) months.
Title 2: Last month's consumption and its cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 4 to advance to the next display	The 2nd set displays consumption data for the last month. The example shows that **15.6 kWh** was used last month and its associated cost was **£11.78**.
…  Press key 4 to advance to the next display	The displays will continue to cycle through each previous month's consumption data.
Title 3: Consumption and cost in 'August'  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*	The last display in the sequence indicating consumption data in the month of 'August'. The example shows that **15.6 kWh** was used in the month and its associated cost is **£11.78**.

Error! Not a valid result for table.Manual Display in Credit

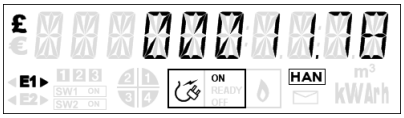
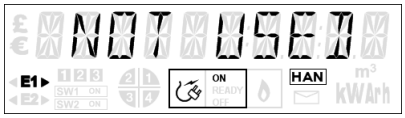
Followed by **value**   Press key 4 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	

Table 10: Key '4' display in Credit mode

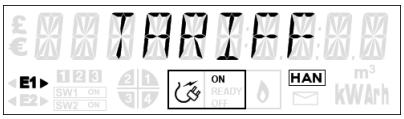
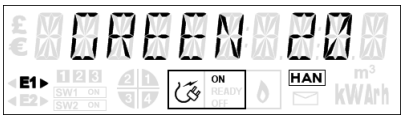
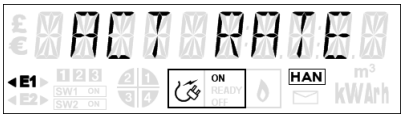
Key 5: No function allocated

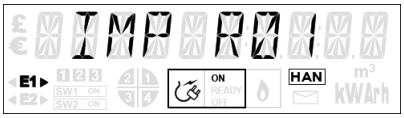
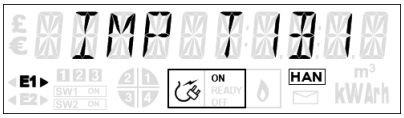
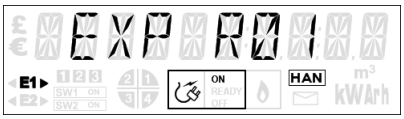
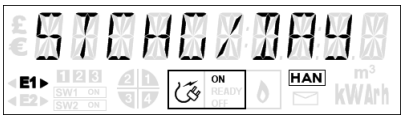
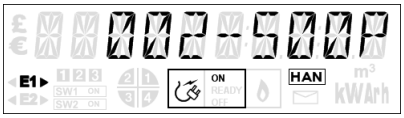
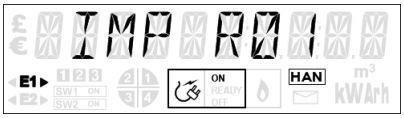
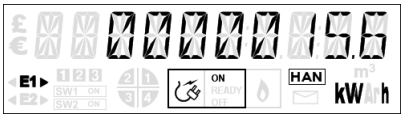
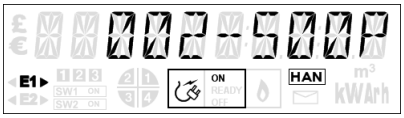
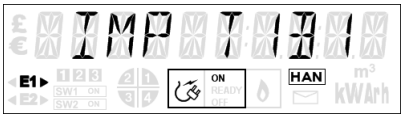
For credit mode no functions are allocated to this key. A short press will display 'Not Used' as shown below:



Key 6: Tariff name, active rate register, tariff rates and costs

A short press of key '6' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title 1: Tariff name  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to advance to the next display	The 1st set of displays associated with key 6 indicating the currently active tariff name. The example shows that '**Green 20**' is the name of the currently active tariff.
Title 2: Active rate register  *(timeout 2 secs)* Followed by **value**	The 2nd set displays the active rate register currently applicable. The example shows that **IMP R01** is the active import TOU rate register. In the case of a hybrid tariff the active import hybrid

 Or  *(timeout 4 secs)* Followed by **value** (if export rate register is applicable)  *(timeout 4 secs)*  Press key 6 to advance to the next display	tariff rate register will be displayed here. **IMP T1B1** signifies import hybrid tariff (tier 1 block 1) rate register. **EXP R01** is the active rate register for energy export.
Title 3: Standing charge  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to advance to the next display	The 3rd set displays the standing charge applicable per day. The example shows that **2.50 pence** is the daily applicable standing charge.
Title 4: Current TOU tariff rate register for energy import  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)* Or **Title 4:** Current hybrid tariff rate register for energy import  *(timeout 2 secs)* Followed by **value**	The 4th set displays the import TOU tariff rate register currently applicable and its cumulative value. The example shows that **15.6 kWh** have been recorded in this register and **2.50 pence** is the current R01 cost per kWh Or In the case of a hybrid tariff this set of displays will be replaced with the hybrid tariff rate register data and its cumulative value.

Error! Not a valid result for table.Manual Display in Credit

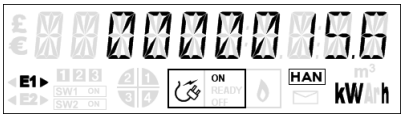
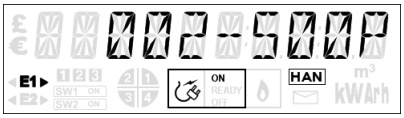
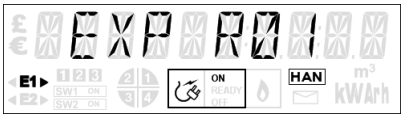
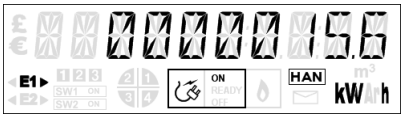
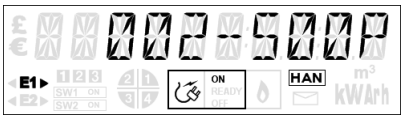
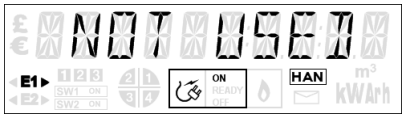
 *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to advance to the next display	The example display shows that **15.6 kWh** have been recorded in this register and **2.50 pence** is the current Rate1, Block1 cost per kWh.
Title 5: Current TOU tariff rate register for energy export  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 5th set displays the export TOU tariff rate register currently applicable and its cumulative value. The example shows that **15.6 kWh** have been recorded in this register and **2.50 pence** is the current R01 cost per kWh.

Table 11: Key '6' display in Credit mode

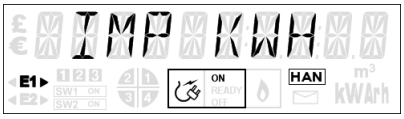
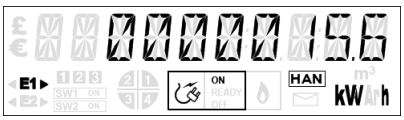
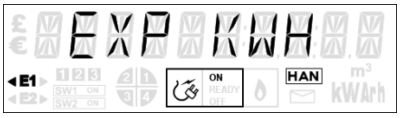
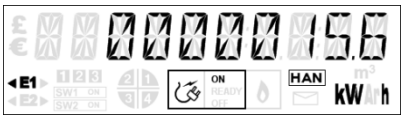
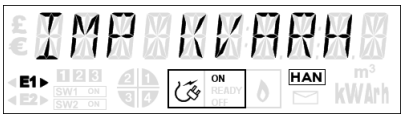
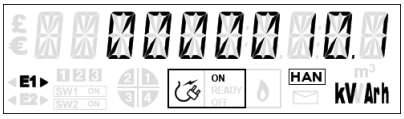
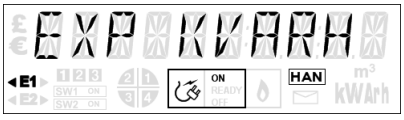
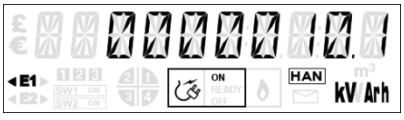
Key 7 and Key 8: No function allocated

For credit mode no functions are allocated to these key. A short press will display 'Not Used' as shown below:



Key 9: Total Import and Export registers

A short press of key '9' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title 1: Cumulative import active rate register  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display	The 1st set of displays associated with key 9 indicating the cumulative energy value recorded in the import active rate register since manufacture. The example shows that **15.6 kWh** have been recorded.
Title 2: Cumulative export active rate register  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display	The 2nd set displays the cumulative energy value recorded in the export active rate register since manufacture. The example shows that **15.6 kWh** have been recorded.
Title 3: Cumulative import reactive rate register  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display	The 3rd set displays the cumulative energy value recorded in the import reactive rate register since manufacture. The example shows that **10.1 kVArh** have been recorded.
Title 4: Cumulative export reactive rate register  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display	The 4th set displays the cumulative energy value recorded in the export reactive rate register since manufacture. The example shows that **10.1 kVArh** have been recorded.

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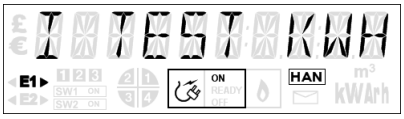
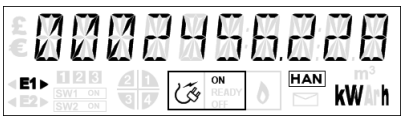
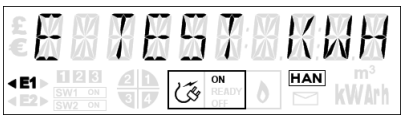
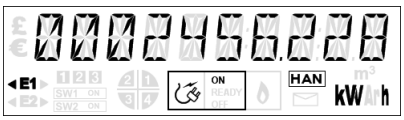
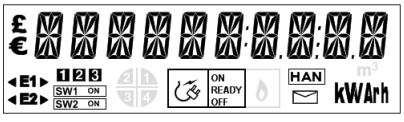
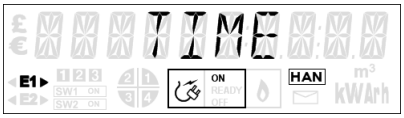
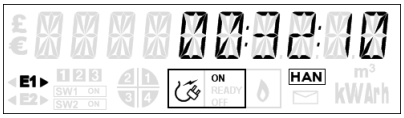
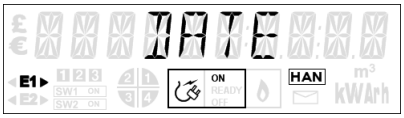
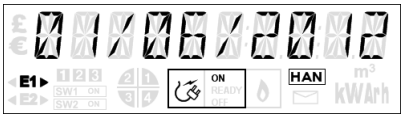
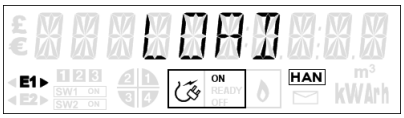
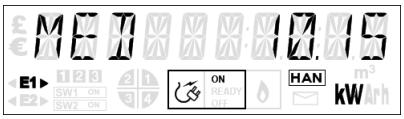
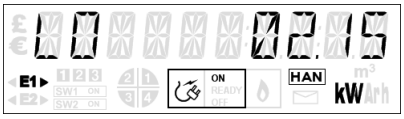
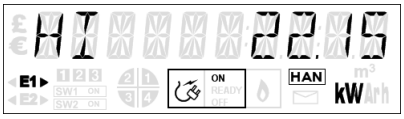
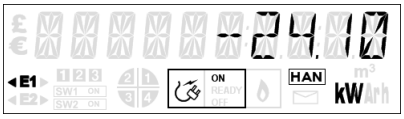
Title 5: Import register test display  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display	The 5th set displays high resolution import register test display. The example shows that **2456.228 kWh** have been recorded.
Title 6: Export register test display  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 6th set displays high resolution export register test display. The example shows that **2456.228 kWh** have been recorded.

Table 12: Key '9' display in Credit mode

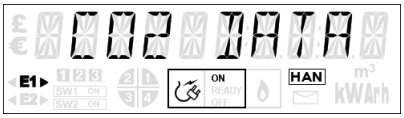
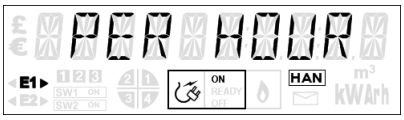
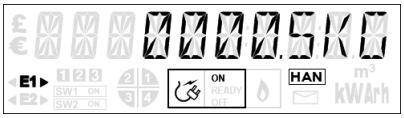
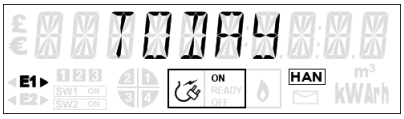
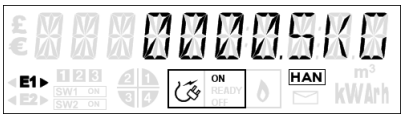
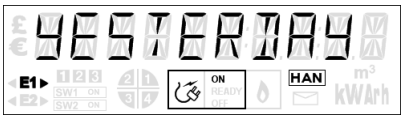
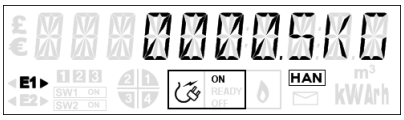
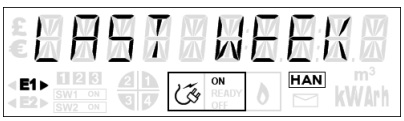
Key 0: Display check, Time, Date, Load and Carbon emission data

A short press of key '0' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Test Display:  *(timeout 2 secs)*  Press key 0 to advance to the next display.	The 1st display associated with key 0 shows the test display.
Title 2: Current time	The 2nd set displays the current time in the meter. In the example the time in the meter is **00:32:10**.

 *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display.	
Title 3: Current date  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display.	The 3rd set displays current date. In the example the date in the meter is **1st June 2012**.
Title 4: Current load  *(timeout 2 secs)* Followed by **value**  Or  Or  Or  *(timeout 4 secs)*  Press key 0 to advance to the next display.	The 4th set displays the current load and its status. The examples indicate the following: The current load **10.15 kW** is in-between the low and high active import power thresholds. The current load **2.15 kW** is below the low active import power threshold. The current load **22.15 kW** is above the high active import power threshold. **24.10 kW** is the power currently being exported.
Title 5: CO_2 emission data	The 5th set initiates CO_2 emission data display.

Error! Not a valid result for table.Manual Display in Credit

 *(timeout 2 secs)*  Press key 0 to advance to the next display	
Title 6: Current hour's CO_2 emission data  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display	The 6th set displays the current hour's CO_2 emission data. The example shows that **0.5 kg** was the current hour's CO_2 emission.
Title 7: Today's CO_2 emission data  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display	The 7th set displays today's CO_2 emission data since midnight (00:00 GMT). The example shows that **0.5 kg** was today's CO_2 emission.
Title 8: Yesterday's CO_2 emission data  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display	The 8th set displays yesterdays' CO_2 emission data. The example shows that **0.5 kg** was yesterday's CO_2 emission.
Title 9: Last week's CO_2 emission data  *(timeout 2 secs)* Followed by **value**	The 9th set displays last week's CO_2 emission data. The example shows that **0.5 kg** was last week's CO_2 emission.

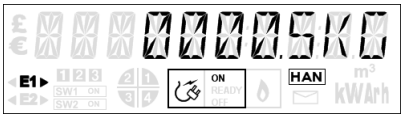
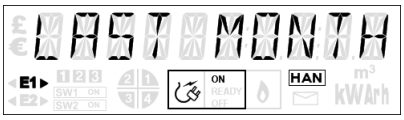
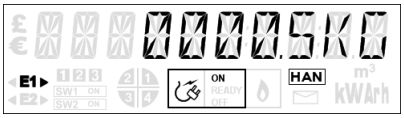
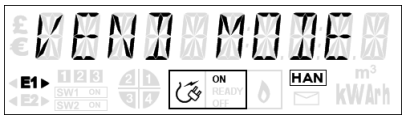
 *(timeout 4 secs)*  Press key 0 to advance to the next display	
Title 10: Last month's CO_2 emission data  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 10th set displays last month's CO_2 emission data. The example shows that **0.5 kg** was last month's CO_2 emission.

Table 13: Key '0' display in Credit mode

7.3 UTRN Entry from Credit Mode

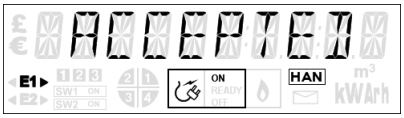
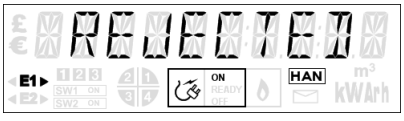
A valid UTRN entry from this mode can be used to change the meter's main switch state from On to Off or vice versa.

A short press of key 'A' will initiate the UTRN entry process and the following display indicates that the meter is in UTRN entry mode:



Once in UTRN entry mode, the function of key 'A' changes to backspace; each press of key 'A' will delete the digit on the left, after deleting all digits the 'Vend Mode' display will return.

At the end of the UTRN entry, either a short press of key 'B' or waiting for 20 seconds will initiate the code authentication process which will be followed by any one of the following displays:

 Or	Displayed if the UTRN is valid.
 Followed by	Displayed if the UTRN is rejected followed by the reason for rejection.

Error! Not a valid result for table.Manual Display in Credit

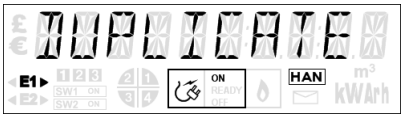
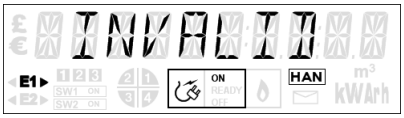
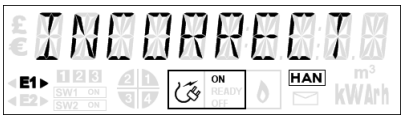
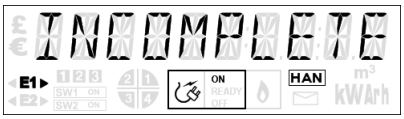
 Or  Or  Or  Or 	‘Duplicate’ indicates UTRN is rejected because a used UTRN is re-entered. ‘Invalid’ indicates UTRN is rejected because the UTRN is not meant for the meter. ‘Incorrect’ indicates UTRN is rejected because it is a wrong UTRN. ‘Incomplete’ indicates UTRN is rejected because it is not in multiples of 20-digit. The display ‘Key Locked’ indicates that five (5) consecutive invalid UTRN have been entered which locks key ‘A’ for the configured timeout period.

Table 14: UTRN entry from Credit mode

7.4 Auto Scroll Display in Prepayment Mode

The default display will show pertinent information relating to the meter’s Prepayment mode of operation. For each display the timeout is two (2) seconds. The following display cycle is configured by default when the meter is operating in Prepayment mode. These can be configured as per energy retailer’s requirement.

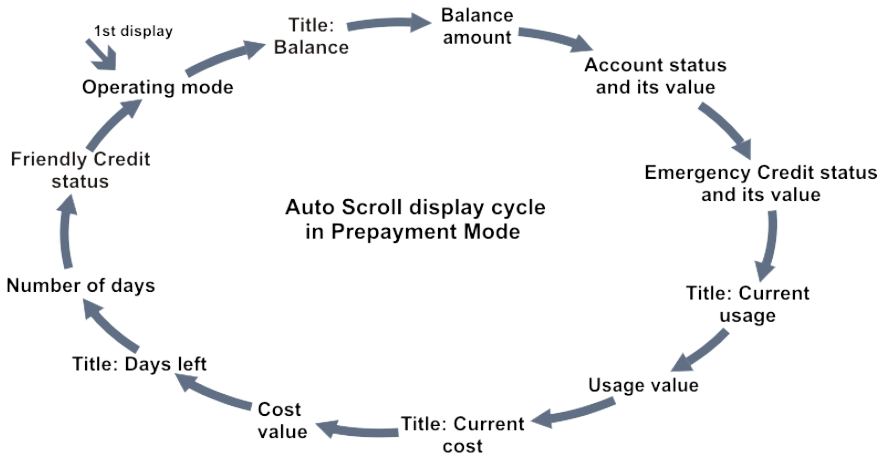
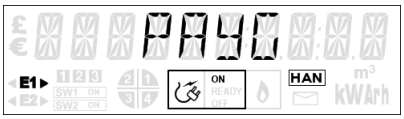
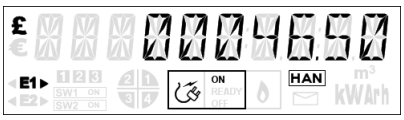
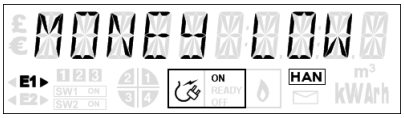
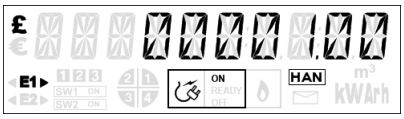
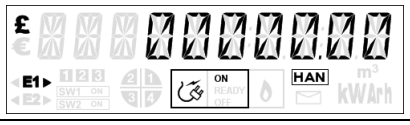
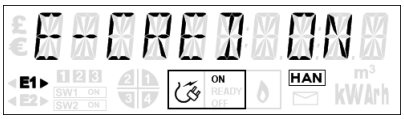
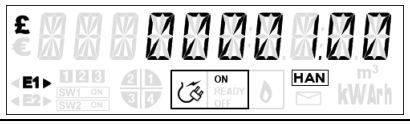
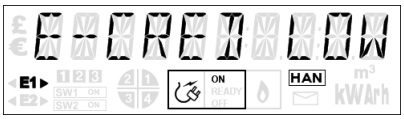
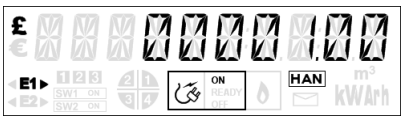
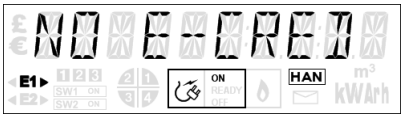
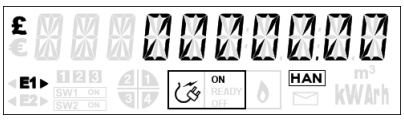
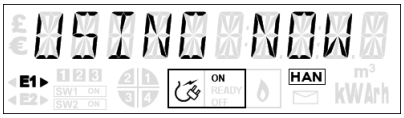
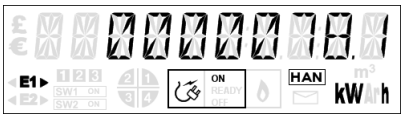
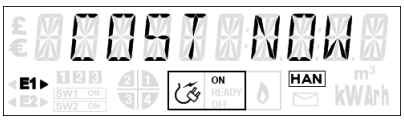
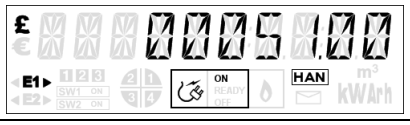
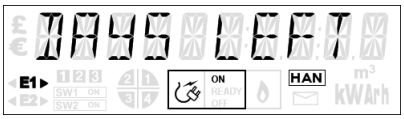
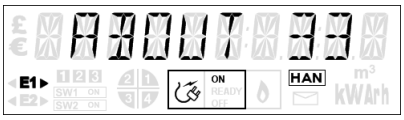
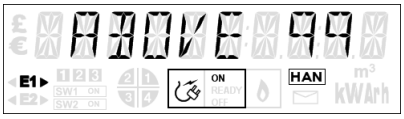
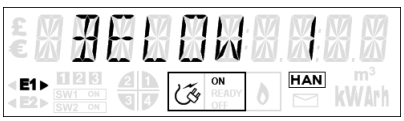


Figure 19: Auto scroll display cycle in Prepayment mode

Operating Mode:  Followed by	The 1st display indicating the meter is currently operating in Prepayment mode.
Title: Account	The 2nd set displays the meter’s current account balance. The example shows that **£46.50** is the current account balance.

 Followed by **value**  Or	
Title: Alert messages (if any)  Followed by **value**  Or	This set of displays will only appear when money in the account is less than the configured low credit threshold. The example display shows that **£1.00** is the account balance.
Title: No credit  Followed by **value**  Or	This set of displays will only appear when there is no money left in the meter account. The example display shows **£0.00** i.e. there is no credit in the meter.
Title: Emergency Credit is in use  Followed by **value**  Or	This set of displays will only appear when Emergency Credit (Emergency Credit) is in use. The example display shows that **£1.00** is currently available for Emergency Credit.
Title: Emergency Credit is low  Followed by **value**  Or	This set of displays will only appear when the Emergency Credit account is less than the low Emergency Credit threshold configured in the meter. The example display shows that **£1.00** is the Emergency Credit account balance.
Title: No Emergency Credit left	This set of displays will only appear when Emergency Credit account is exhausted. The example display shows **£0.00** (no Emergency Credit left

 Followed by **value**  Followed by	in the meter account).
Title: Current usage  Followed by **value**  Followed by	The 3rd set displays the current electricity consumption. The example shows that **78.1 kWh** of electricity is currently being used.
Title: Current cost  Followed by **value**  Followed by	The 4th set displays the current cost of electricity consumption. The example shows that **£51.00** is the current cost of consumption.
Title: Number of days left  Followed by **value**  Or  Or  Or  Or	The 5th set displays the number of days left before the credit in the meter is exhausted. The example display shows the following: 33 days left or more than 99 days left or less than one day left or there is no credit left in the meter account. 'No Data' will be displayed when the meter is unable to predict the number of days left; for example, if there is no consumption after the meter has been installed then the 'Days Left' title will be followed by the 'No Data' value.

Auto Scroll Display in Prepayment Mode

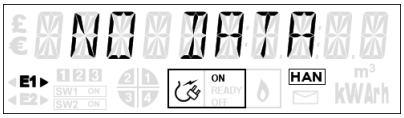
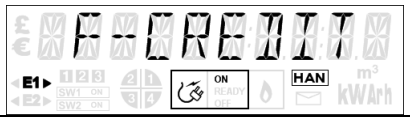
 Followed by	
Title: Friendly credit period (when active) 	This display only appears in the display list when a Friendly Credit period is active.

Table 15: Auto scroll display in Prepayment mode

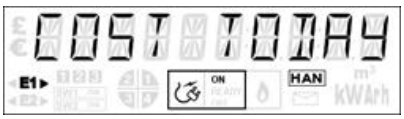
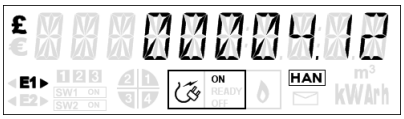
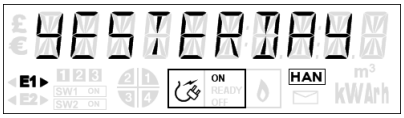
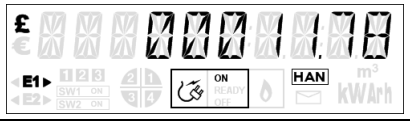
7.5 Manual Display in Prepayment Mode

The keypad of the meter is used to view a particular information specific to the meter's current operating mode. In Prepayment mode each numeric key is assigned to display a set of information; key 'A' and key 'B' are assigned to perform additional functions as described in the subsequent content.

In a display cycle, data is preceded by its title; default timeout for each title display is two (2) seconds and for data the display timeout is four (4) seconds. The following displays are configured at manufacture and can be changed by a configuration change.

Key 1: Current day and previous day cost of consumption

A short press of key '1' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title 1: Current day's cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 1 to advance to the next display	The 1st set of displays associated with key 1 indicating the cost of electricity used today since midnight (00:00 GMT). The example shows that **£4.12** is the current cost of electricity used.
Title 2: Previous day's cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*	The 2nd set displays the cost of electricity used yesterday. The example shows that **£11.78** was the cost of electricity used.

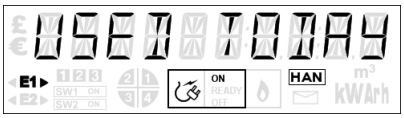
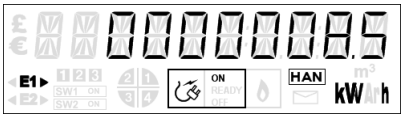
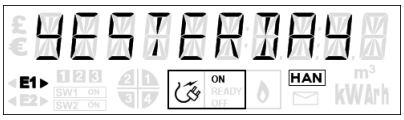
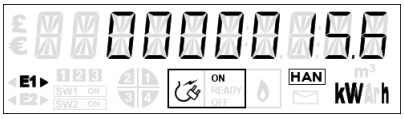
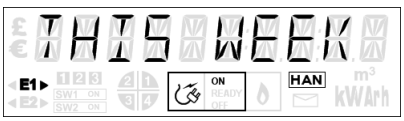
Press key 1 to advance to the next display	
Title 3: Current day usage  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Press key 1 to advance to the next display	The 3rd set displays electricity consumption today since midnight. The example shows that **8.5 kWh** has been used.
Title 4: Previous day usage  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Press key 1 to return to the 1st display. Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 4th set displays yesterday's electricity consumption. The example shows that **15.6 kWh** was used.

Table 16: Key '1' display in Prepayment mode

Key 2: Current week and previous week's cost of consumption

A short press of key '2' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title 1: Current week's cost  *(timeout 2 secs)* Followed by **value**	The 1st set of displays associated with key 2 indicating the cost of electricity used in the current week. The example shows that **£11.78** was the cost of electricity used.

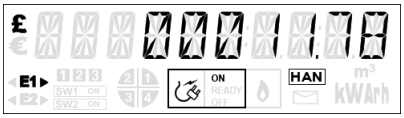
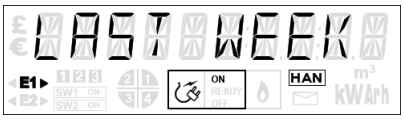
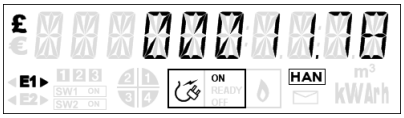
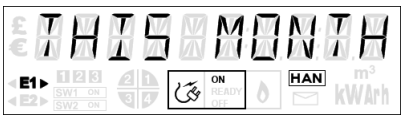
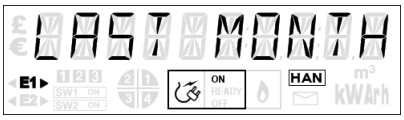
 *(timeout 4 secs)*  Press key 2 to advance to the next display	
Title 2: Previous week's cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 2 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 2nd set displays the cost of electricity used in the previous week. The example shows that **£11.78** was the cost of electricity used.

Table 17: Key '2' display in Prepayment mode

Key 3: Current month and previous month's cost of consumption

A short press of key '3' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title 1: Current month's cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 3 to advance to the next display	The 1st set of displays associated with key 3 indicating the cost of electricity used since the 1st of the current month. The example shows that **£11.78** was the cost of electricity used.
Title 2: Previous month's cost  *(timeout 2 secs)*	The 2nd set displays the cost of electricity used in the previous month. The example shows that **£11.78** was the cost of electricity used.

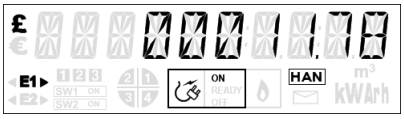
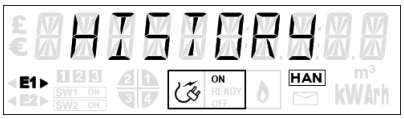
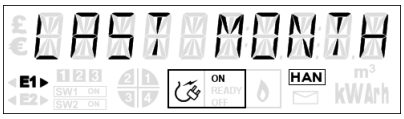
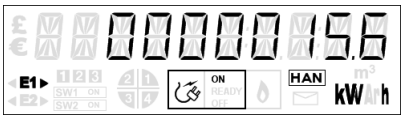
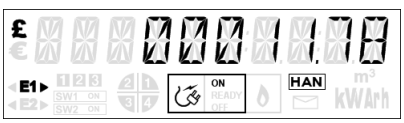
Followed by **value**  *(timeout 4 secs)*  Press key 3 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	

Table 18: Key '3' display in Prepayment mode

Key 4: Historical monthly consumption data

A short press of key '4' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

The display will scroll forward through twelve (12) months historical consumption data starting with the last month which is the same as the 'LAST MONTH' in the above Key 3 sequence. For example, if the current month is 'August' the last month will be 'July' so the data sequence will begin from 'July' and end with 'August'.

Title 1: Historical monthly consumption data  *(timeout 2 secs)*  Press key 4 to advance to the next display	The 1st display associated with key 4 indicating that the key is assigned to display historical monthly consumption for the past twelve (12) months.
Title 2: Last month's consumption and its cost  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 4 to advance to the next display	The 2nd set displays last month's consumption. The example shows that **15.6 kWh** was used last month and its associated cost was **£11.78**.

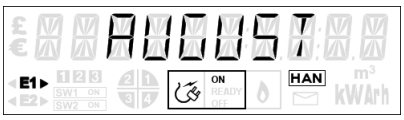
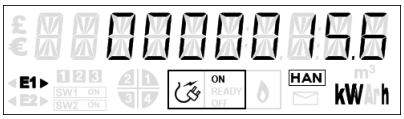
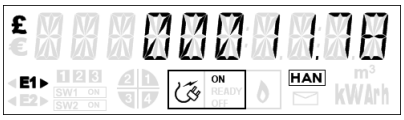
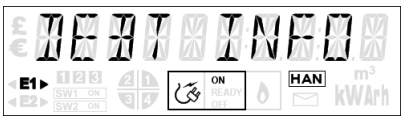
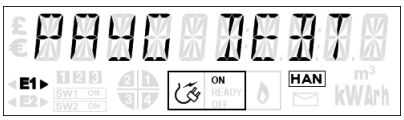
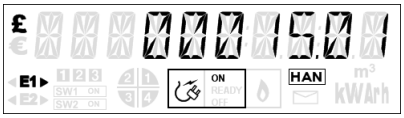
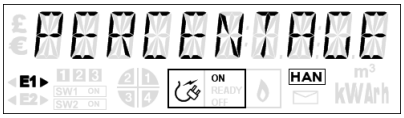
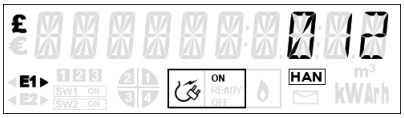
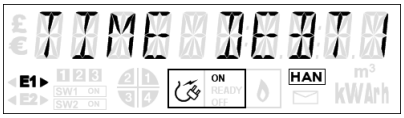
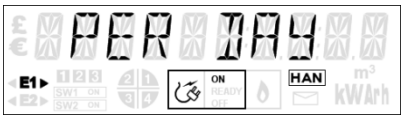
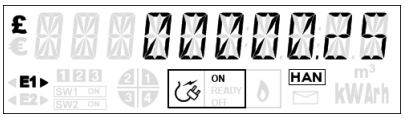
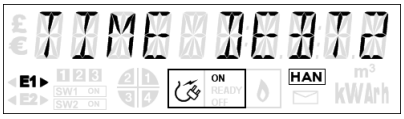
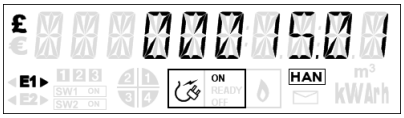
…  Press key 4 to advance to the next display	The displays will continue to cycle through each previous month's consumption data.
Title 13: Consumption and cost in 'August'  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Followed by **value**   Press key 4 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The last display in the sequence indicating consumption data in the month of 'August'. The example shows that **15.6 kWh** was used in the month and its associated cost was **£11.78**.

Table 19: Key '4' display in Prepayment mode

Key 5: Debt account information

A short press of key '5' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title: Debt account information  *(timeout 2 secs)*  Press key 5 to advance to the next display.	The displays associated with key 5 indicating debt account information. Refer to Section 5.5.5 'Debt Recovery Methods' for further details.
Title: Payment based debt register  *(timeout 2 secs)* Followed by **value**	If **payment based debt deduction** method is configured in the meter then **PAYG DEBT** is displayed here followed by the outstanding debt amount and the percentage of debt to be deducted from the credit added by the customer.

 *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 5 to advance to the next display.	In the example, the 1st set of display following the title shows that **£15.01** is the outstanding debt and the 2nd set shows that **12%** of the top-up amount will be deducted towards debt collection.
Title: Time based debt register 2  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 5 to advance to the next display.	If **time based debt deduction** method is configured then **TIME DEBT1** is displayed followed by the outstanding debt amount and the daily debt deduction amount. In the example, the 1st set of display following the title shows that **£15.01** is the outstanding debt and the 2nd set shows that **£0.25** will be deducted daily until the entire debt is paid off.
Title: Time based debt register 2  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Followed by **value**	If more than one time based debt register is configured then it will be displayed as **TIME DEBT2** as shown here in the example.

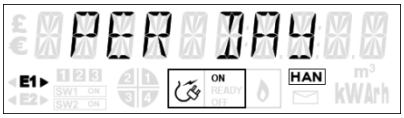
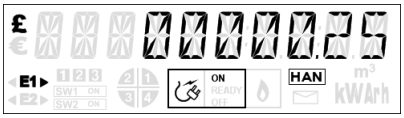
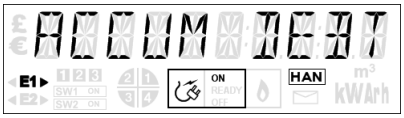
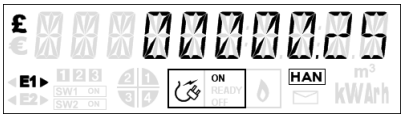
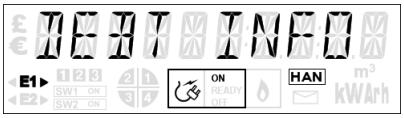
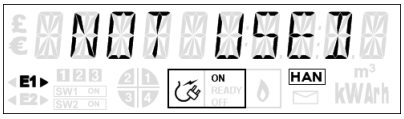
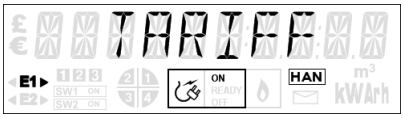
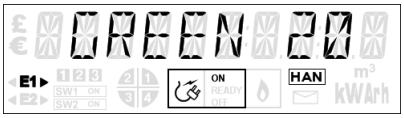
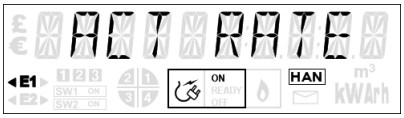
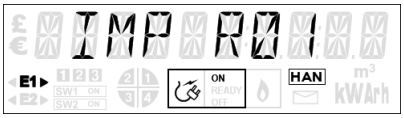
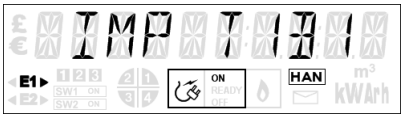
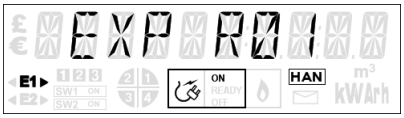
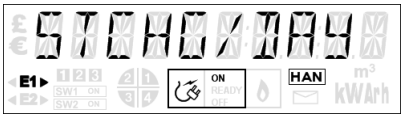
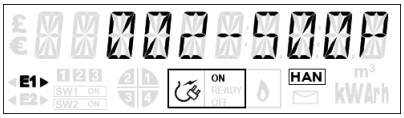
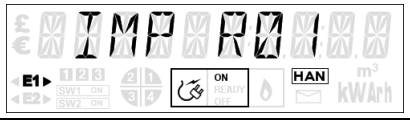
 *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 5 to advance to the next display.	
Title: Accumulated debt  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Or  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 5 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The debt amount that couldn't be deducted for the reasons specified in Section 5.5.5.2 will be shown as **ACCUM DEBT** for accumulated debts. **NOT USED** is displayed if there is no outstanding debt or debt registers are not configured.

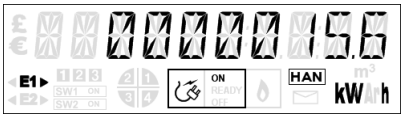
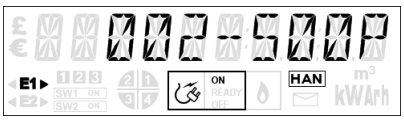
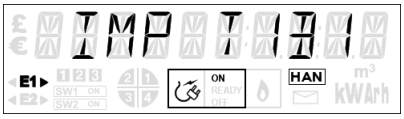
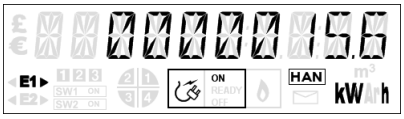
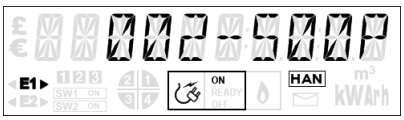
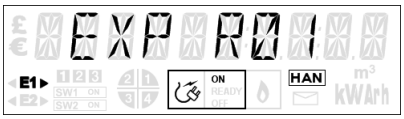
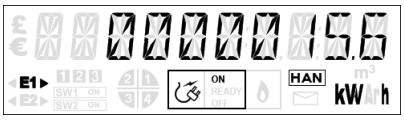
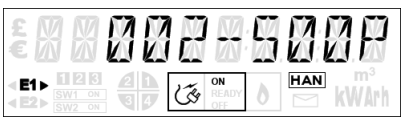
Table 20: Key '5' display in Prepayment mode

Key 6: Tariff name, active rate register, standing charge, tariff rates and costs

A short press of key '6' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title 1: Tariff name	The 1st set of display associated with key 6 indicating the currently active tariff name. The example shows that '**Green 20**' is the name of

 *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to advance to the next display	the currently active tariff.
Title 2: Active rate register  *(timeout 2 secs)* Followed by **value**  Or  *(timeout 4 secs)* Followed by **value** (if export rate register is applicable)  *(timeout 4 secs)*  Press key 6 to advance to the next display	The 2nd set displays the active rate register currently applicable. The example shows that **IMP R01** is the active import TOU rate register. In the case of a hybrid tariff the active import hybrid tariff rate register will be displayed here. **IMP T1B1** signifies import hybrid tariff (tier 1 block 1) rate register. **EXP R01** is the active rate register for energy export.
Title 3: Standing charge  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to advance to the next display	The 3rd set displays the standing charge applicable per day. The example shows that **2.50 pence** is the daily applicable standing charge.
Title 4: Current TOU tariff rate register for energy import  *(timeout 2 secs)*	The 4th set displays the import TOU tariff rate register currently applicable and its cumulative value. The example shows that **15.6 kWh** have been recorded in this register and **2.50 pence** is the

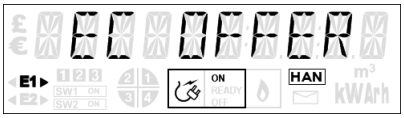
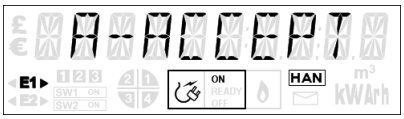
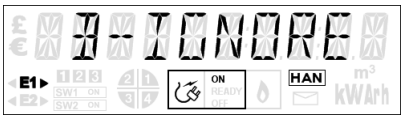
Followed by **value**  *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)* Or **Title 4:** Current hybrid tariff rate register for energy import  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to advance to the next display	current R01 cost per kWh. Or In the case of a hybrid tariff this set of displays will be replaced with the hybrid tariff rate register data and its cumulative value. The example shows that **15.6 kWh** have been recorded in this register and **2.50 pence** is the current Rate 1, Block 1 cost per kWh.
Title 5: Current TOU tariff rate register for energy export  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to return to the 1st display.  Press key B to scroll back up the display list.	The 5th set displays the export TOU tariff rate register currently applicable and its cumulative value. The example shows that **15.6 kWh** have been recorded in this register and **2.50 pence** is the current R01 cost per kWh.

No key press at the end of this display sequence will cause the auto-cycle display to resume.	

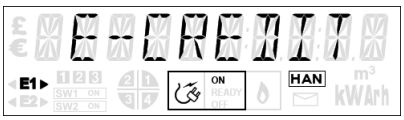
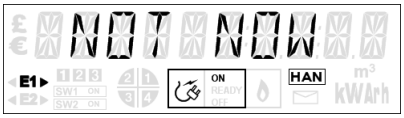
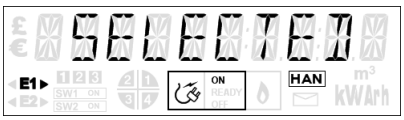
Table 21: Key '6' display in Prepayment mode

Key 7: Emergency Credit status and value

A short press of key '7' allows Users to see if Emergency Credit is made available to them; if available then the following displays will allow enabling the Emergency Credit.

Title: Emergency Credit available  Followed by  Followed by  *(timeout 4 secs)*	The display indicates that Emergency Credit is now available for use. Press key 'A' on the meter keypad to enable Emergency Credit or press key 'B' to ignore. If the Emergency Credit offer message is not acknowledged in 10 seconds then the display goes into sleep mode and will return by pressing any key on the meter's keypad.

When Emergency Credit allowance is not made available or is enabled, a short press of key '7' will initiate the display sequence comprising Emergency Credit status and Emergency Credit balance. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title: Emergency Credit status  *(timeout 2 secs)* Followed by **value**  Or  Or  Or	The 1st set of displays associated with key 7 indicating the Emergency Credit status and Emergency Credit allowance balance. The examples indicate the following: Emergency Credit cannot be enabled now, Emergency Credit is enabled, Emergency Credit is currently being used,

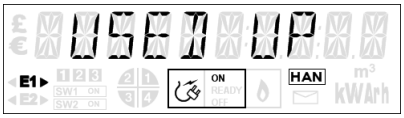
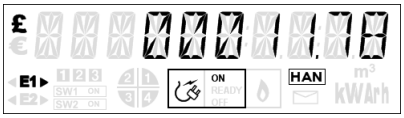
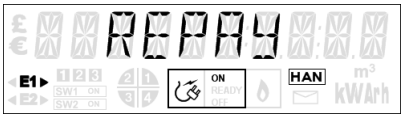
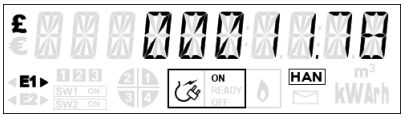
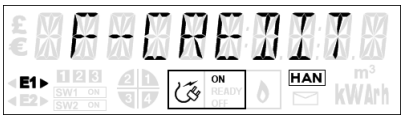
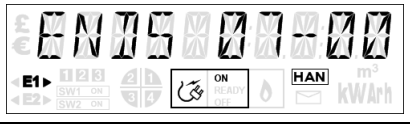
 *(timeout 4 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 7 to advance to the next display	Emergency Credit has been completely used. **£11.78** is the current Emergency Credit balance.
Title: Emergency Credit amount Repayable  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 7 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 2nd set displays the minimum repayable amount required to bring the meter account above the cut-off value. The example indicates **£11.78** is the amount.

Table 22: Key '7' display in Prepayment mode

Key 8: Friendly Credit

A short press of key ‘8’ will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title 1: Friendly Credit status  Followed by **value**  Followed by **value** 	This is the only set of display associated with key 8 indicating the current status of Friendly Credit and the time at which it ends or starts depending upon its current state. In the example the 1st set of display indicates that the Friendly Credit period is currently on and will end at 7:00 on 01/06/2012.

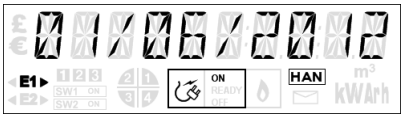
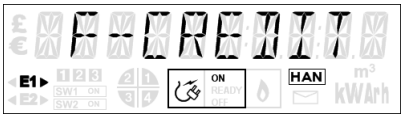
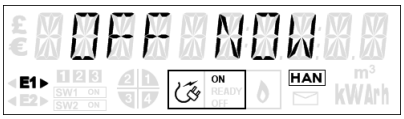
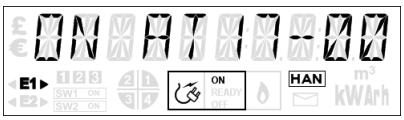
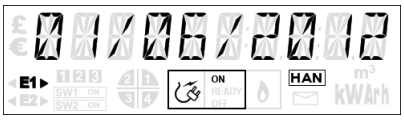
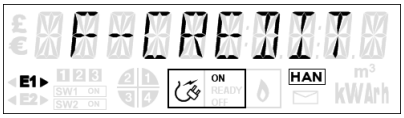
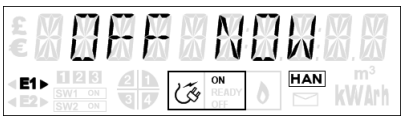
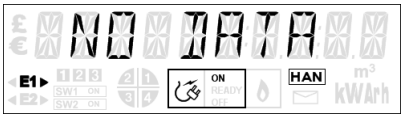
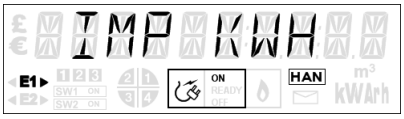
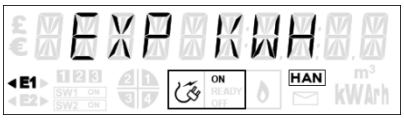
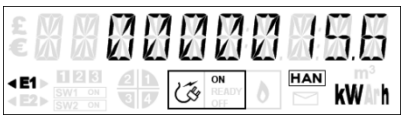
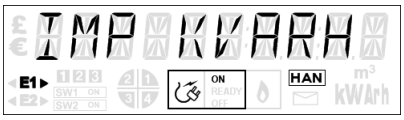
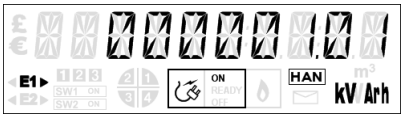
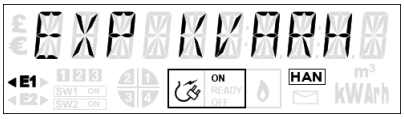
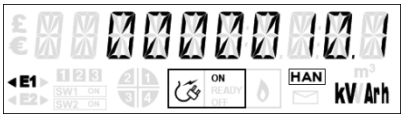
Followed by **value**  Or  Followed by **value**  Followed by **value**  Followed by **value**  Or  Followed by **value**  Followed by **value**  *(timeout 4 secs)*  Press key 8 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 2nd set of display indicates that Friendly Credit is off and will start at 17:00 on 01/06/2012. The 3rd set will be displayed if the meter time is invalid or the meter is not configured for Friendly Credit.

Table 23: Key '8' display in Prepayment mode

Key 9: Total Import and Export registers

A short press of key ‘9’ will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Title 1: Cumulative import active rate register  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display	The 1st set of displays associated with key 9 indicating the cumulative energy value recorded in the import active rate register since manufacture. The example shows that **15.6 kWh** have been recorded.
Title 2: Cumulative export active rate register  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display	The 2nd set displays the cumulative energy value recorded in the export active rate register since manufacture. The example shows that **15.6 kWh** have been recorded.
Title 3: Cumulative import reactive rate register  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display	The 3rd set displays the cumulative energy value recorded in the import reactive rate register since manufacture. The example shows that **10.1 kVArh** have been recorded.
Title 4: Cumulative export reactive rate register  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display	The 4th set displays the cumulative energy value recorded in the export reactive rate register since manufacture. The example shows that **10.1 kVArh** have been recorded.

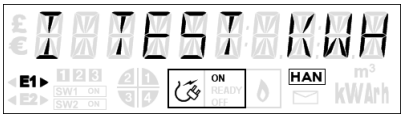
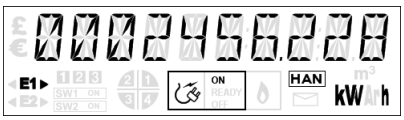
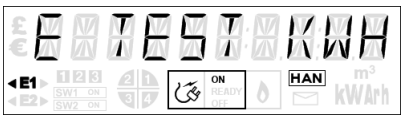
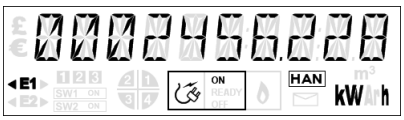
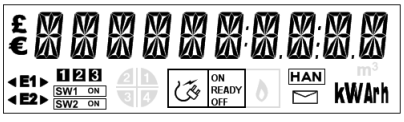
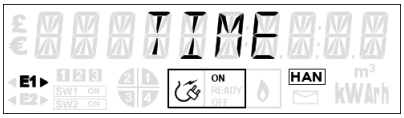
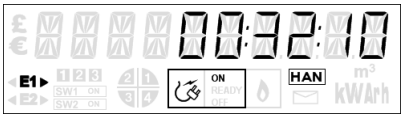
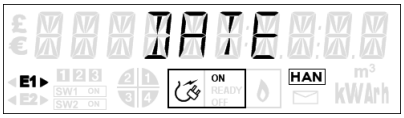
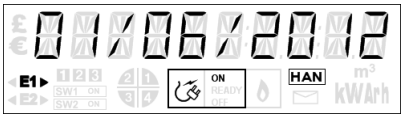
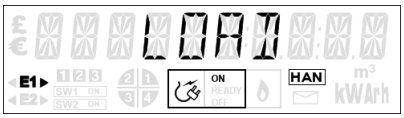
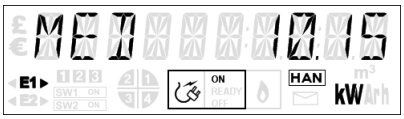
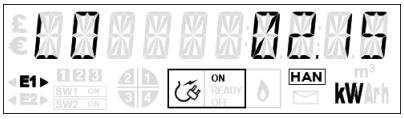
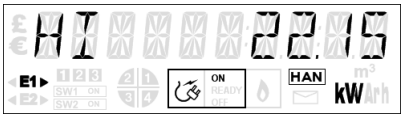
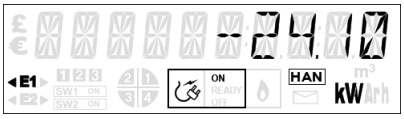
Title 5: Import register test display  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display	The 5th set displays high resolution import register test display. The example shows that **2456.228 kWh** have been recorded.
Title 6: Export register test display  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 6th set displays high resolution export register test display. The example shows that **2456.228 kWh** have been recorded.

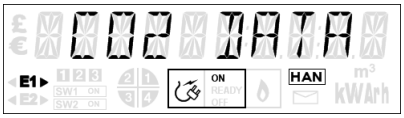
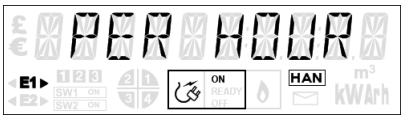
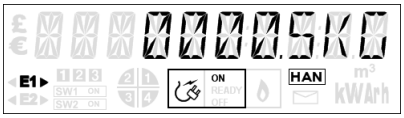
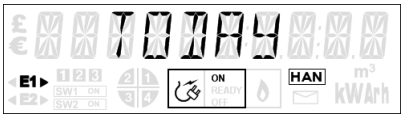
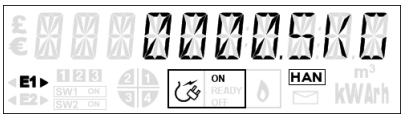
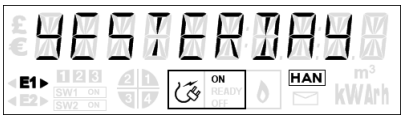
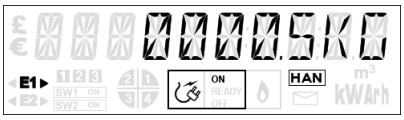
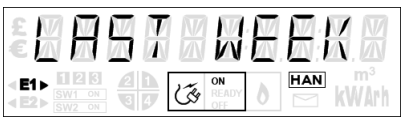
Table 24: Key '9' display in Prepayment mode

Key 0: Display check, Time, Date, Load, Carbon emission data and Refund code

A short press of key '0' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Test Display:  *(timeout 2 secs)*  Press key 0 to advance to the next display.	The 1st display associated with key 0 shows the test display.
Title 2: Current time	The 2nd set displays the current time in the meter. In the example the time in the meter is **00:32:10**.

 *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display.	
Title 3: Current date  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display.	The 3rd set displays current date. In the example the date in the meter is **1st June 2012**.
Title 4: Current load  *(timeout 2 secs)* Followed by **value**  Or  Or  Or  *(timeout 4 secs)*  Press key 0 to advance to the next display.	The 4th set displays the current load and its status. The examples indicate the following: The current load **10.15 kW** is in-between the low and high active import power thresholds. The current load **2.15 kW** is below the low active import power threshold. The current load **22.15 kW** is above the high active import power threshold. **24.10 kW** is the power currently being exported.
Title 5: CO_2 emission data	The 5th display associated with key 0 initiates CO_2 emission data.

 *(timeout 2 secs)*  Press key 0 to advance to the next display	
Title 6: Current hour's CO_2 emission data  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display	The 6th set displays the current hour's CO_2 emission data. The example shows that **0.5 kg** was the current hour's CO_2 emission.
Title 7: Today's CO_2 emission data  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display	The 7th set displays today's CO_2 emission data since midnight (00:00 GMT). The example shows that **0.5 kg** was today's CO_2 emission.
Title 8: Yesterday's CO_2 emission data  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display	The 8th set displays yesterday's CO_2 emission data. The example shows that **0.5 kg** was yesterday's CO_2 emission.
Title 9: Last week's CO_2 emission data  *(timeout 2 secs)* Followed by **value**	The 9th set displays last week's CO_2 emission data. The example shows that **0.5 kg** was last week's CO_2 emission.

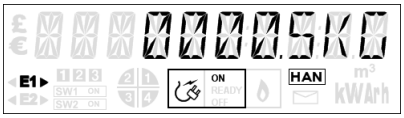
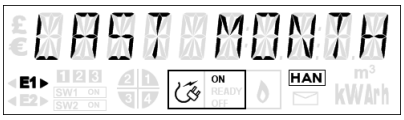
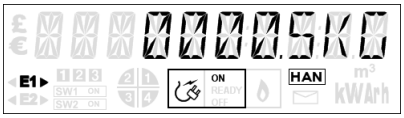
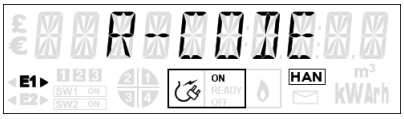
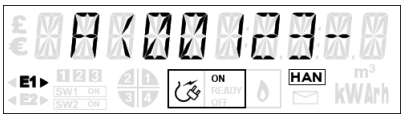
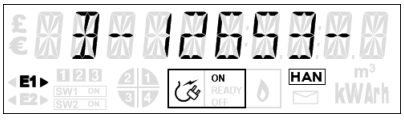
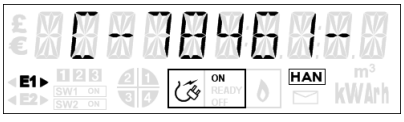
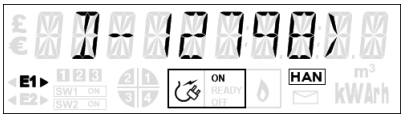
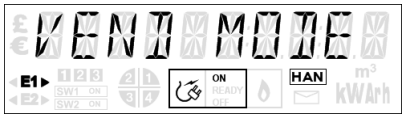
 *(timeout 4 secs)*  Press key 0 to advance to the next display.	
Title 10: Last month's CO_2 emission data  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display.	The 10th set displays last month's CO_2 emission data. The example shows that **0.5 kg** was last month's CO_2 emission.
Title 11: Refund code  *(timeout 2 secs)* Followed by **value**     *(timeout 4 secs)*  Press key 0 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 11th set displays the refund code if present. **20-digit UTRN** The UTRN is displayed in blocks of five digits. The first character indicates the block of the code (A, B, C, and D). The start of a code is indicated by a '<' and the end by a '>'. A '-' is inserted after each block as a separator. Each subsequent press of button '0' will display the next block of code till all have been displayed.

Table 25: Key '0' display in Prepayment mode

7.6 UTRN Entry in Prepayment Mode

A valid vend UTRN from this mode can be used to add or deduct a vend amount from the meter's account and a valid switch UTRN can be used to change the meter's main switch state from On to Off or vice versa.

A short press of key 'A' will initiate the UTRN entry process and the following display indicates that the meter is in UTRN entry mode:

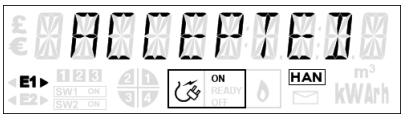
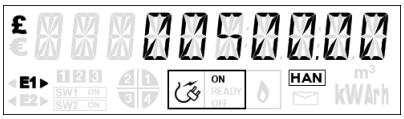
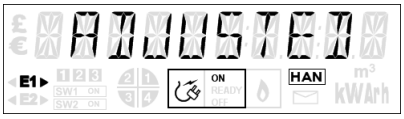
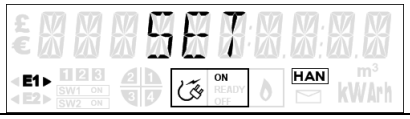


Once in UTRN entry mode, the function of key 'A' changes to backspace; each press of key 'A' will delete the digit on the left , after deleting all digits the 'Vend Mode' display will return.

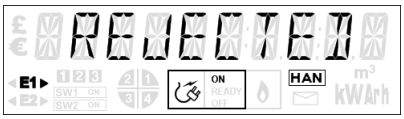
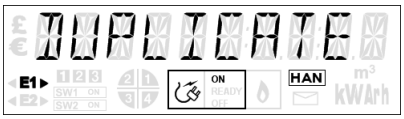
At the end of the UTRN entry, either a short press of key 'B' or waiting for 20 seconds will initiate the code authentication process which will be followed by its corresponding displays.

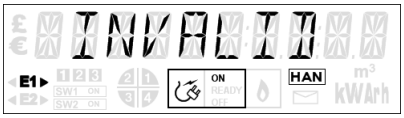
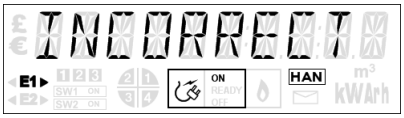
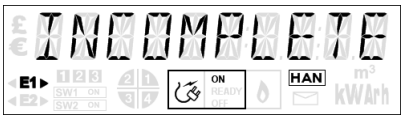
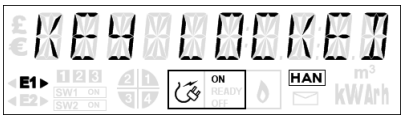
The displays followed by vend UTRN:

A valid vend UTRN will display the following sequence four (4) times and then the default auto-cycle display will resume.

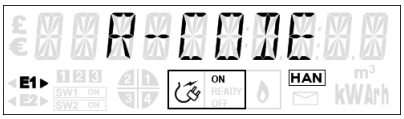
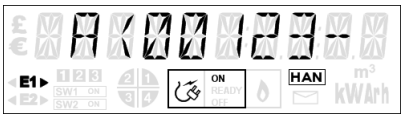
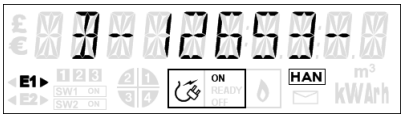
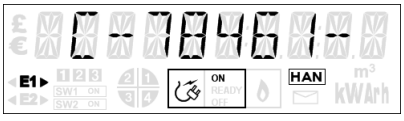
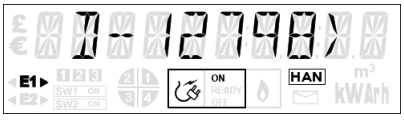
 Followed by  Followed by  Or  Or 	Displayed if the vend UTRN is valid. This is followed by the vend amount value. The example shows that the vend amount is **£500.00**. The vend amount is followed by the message 'Added' which indicates the amount is added to the meter account or the message 'Adjusted' which indicates the amount is deducted from the meter account or the message 'Set' which indicates that the amount is set as the current credit in the meter account.

An invalid vend UTRN entry will display the following sequence four times (except the 'key locked' message which will timeout after 20 seconds) and then resumes the default auto-cycle display:

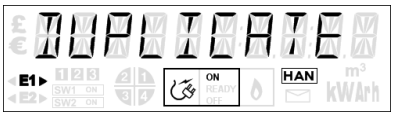
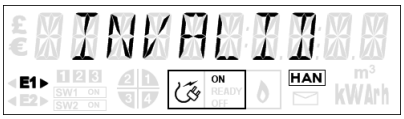
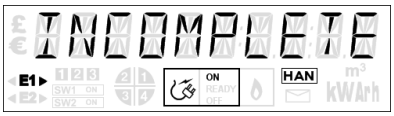
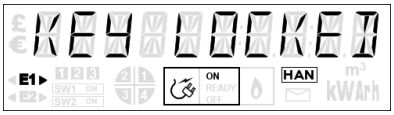
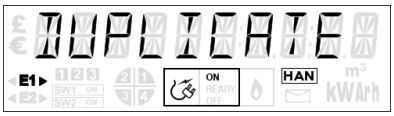
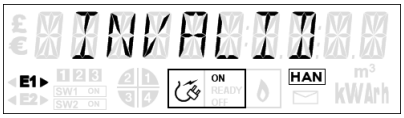
 Followed by  Or	The display 'Rejected' indicates that the vend UTRN is rejected and will be followed by the reason for rejection. 'Duplicate' indicates UTRN is rejected because a used UTRN is re-entered.

 Or  Or  Or  Or  *(timeout 4 secs)* Or  *(timeout 20 secs)*	'Invalid' indicates UTRN is rejected because the UTRN is not meant for the meter. 'Incorrect' indicates UTRN is rejected because it is a wrong UTRN. 'Incomplete' indicates UTRN is rejected because it is not in multiples of 20-digit. 'Account High' indicates UTRN is rejected because the vend amount exceeds the maximum credit the meter can hold. 'Account Low' indicates UTRN is rejected because the vend amount is not sufficient to run the meter. The display 'Key Locked' indicates that the user has entered five (5) consecutive invalid UTRN and this locks key 'A' for the configured timeout period.

The displays followed by refund UTRN:

 Followed by  Followed by    	The display 'Accepted' indicates that the refund UTRN is valid. This is followed by the refund UTRN.

An invalid refund UTRN will display any one of the displays shown below followed by the 'key locked' message which will timeout after 20 seconds and then resumes the default auto-cycle display:

 Followed by  Or  Or  Or  Or  *(timeout 4 secs)* Or  *(timeout 20 secs)*	The display 'Rejected' indicates that the refund UTRN is invalid and will be followed by the reason for rejection. 'Duplicate' indicates UTRN is rejected because a used UTRN is re-entered. 'Invalid' indicates UTRN is rejected because the UTRN is not meant for the meter. 'Incorrect' indicates UTRN is rejected because it is a wrong UTRN. 'Incomplete' indicates UTRN is rejected because it is not in multiples of 20-digit. 'Account Low' indicates UTRN is rejected because the vend amount is not sufficient to run the meter. The display 'Key Locked' indicates that the user has entered five (5) consecutive invalid UTRN and this locks key 'A' for the configured timeout period.
The displays followed by switch UTRN: A valid switch UTRN from this mode will change the meter's main switch state to READY or Off; if it is already on then the UTRN will switch it off and vice versa. The UTRN authentication will be followed by any one of the following displays:	
 Or	The display 'Accepted' indicates that the switch UTRN is valid and thus changes the meter's main switch state to on or off depending on its current state.
 Followed by  Or  Or	The display 'Rejected' indicates that the switch UTRN is invalid and will be followed by the reason for rejection. 'Duplicate' indicates UTRN is rejected because a used UTRN is re-entered. 'Invalid' indicates UTRN is rejected because the UTRN is not meant for the meter.

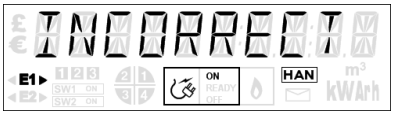
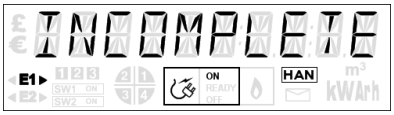
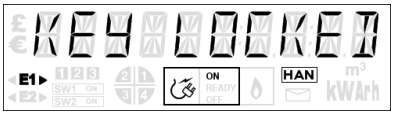
 Or  *(timeout 4 secs)* Or  *(timeout 20 secs)*	'Incorrect' indicates UTRN is rejected because it is a wrong UTRN. 'Incomplete' indicates UTRN is rejected because it is not in multiples of 20-digit. The display 'Key Locked' indicates that the user has entered five (5) consecutive invalid UTRN and this locks key 'A' for the configured timeout period.

Table 26: UTRN entry from Prepayment mode

7.7 Auto Scroll Display in Default Mode

The meter's operating mode can be changed to default mode remotely (or locally if the rule permits). This mode operates in credit mode with only total cumulative active import and export kWh registers.

The default display will show pertinent information relating to the meter's default mode of operation. For each display the timeout is two (2) seconds. The following display cycle is configured by default when the meter is operating in 'Default' mode. These can be configured as per energy retailer's requirement.

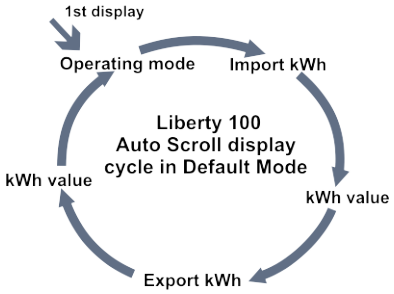
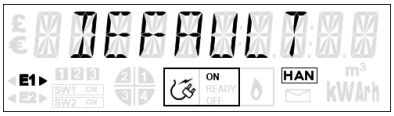
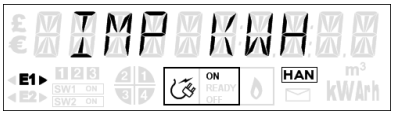
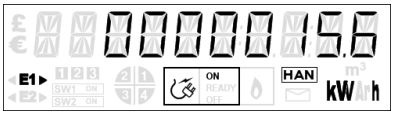


Figure 20: Auto scroll display cycle in Default mode

Operating Mode:  Followed by	This is the 1st display indicating the meter is currently operating in 'Default' mode.
Title: Cumulative import active rate register  Followed by **value**  Followed by	The 2nd set displays the cumulative energy value recorded in import active rate register since manufacture. In the example display the title 'Import kWh' is followed by **15.6 kWh** which is the cumulative consumption value in import active rate register.
Title: Cumulative export active rate register	The 3rd set displays the cumulative energy value recorded in export active rate register since manufacture. This display set will not be displayed for import only meters.

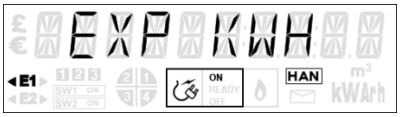
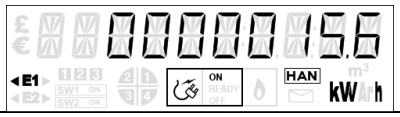
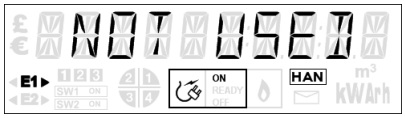
 Followed by **value** 	In the example displays the title 'Export kWh' is followed by **15.6 kWh** which is the cumulative consumption value in export active rate register.

Table 27: Auto scroll display in Default mode

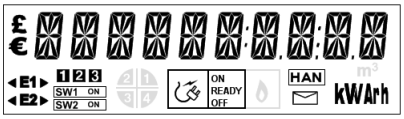
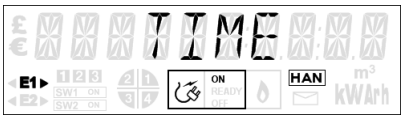
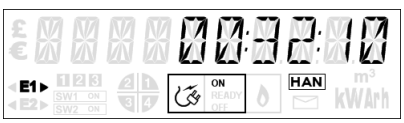
7.8 Manual Display in Default Mode

Default mode is a simple credit meter that supports only single import and if configured single export registration. In this mode numerical keys '1' to '9' and key 'B' are not assigned any functions, with key '0' being used for display testing, date and time display, and load (same as in Credit mode) or to initiate the meter's commissioning mode if commissioning has not been performed in the meter; key 'A' initiates the UTRN code entry process.

1 to 9 and B displays 

Key 0: Display check, Time, Date and Load

A short press of key '0' will initiate the associated display sequence. After each set of information comprising a title followed by its data, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below:

Test Display:  *(timeout 2 secs)* 0 Press key 0 to advance to the next display.	The 1st display associated with key 0 shows the test display.
Title 2: Current time  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)* 0 Press key 0 to advance to the next display.	The 2nd set displays the current time in the meter. In the example the time in the meter is **00:32:10**.
Title 3: Current date	The 3rd set displays the current date.

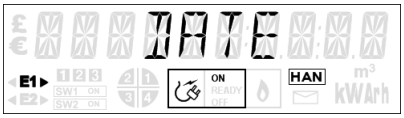
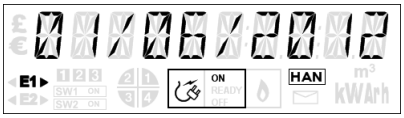
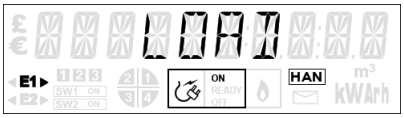
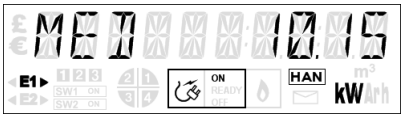
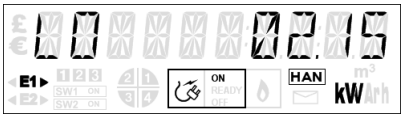
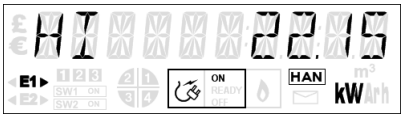
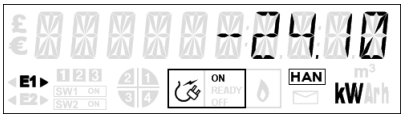
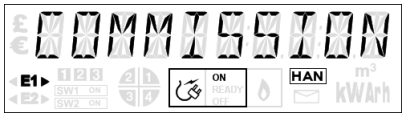
 *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 0 to advance to the next display.	In the example the date in the meter is **1st June 2012**.
Title 4: Current load  *(timeout 2 secs)* Followed by **value**  Or  Or  Or  *(timeout 4 secs)*  Press key 0 to return to the 1st display.  Press key B to scroll back up the display list. No key press at the end of this display sequence will cause the auto-cycle display to resume.	The 4th set displays the current load and its status. The examples indicate the following: The current load **10.15 kW** is in-between the low and high active import power thresholds. The current load **2.15 kW** is below the low active import power threshold. The current load **22.15 kW** is above the high active import power threshold. **24.10 kW** is the power currently being exported.

Table 28: Key '0' display in Default mode (once the meter is commissioned)

If commissioning is not performed in the meter then a short press of key ‘0’ will display the following indicating that the meter is in commissioning mode:



7.9 UTRN Entry from Default Mode

A valid UTRN entry from this mode can be used to change the meter's main switch state from On to Off or Off to READY.

A short press of key 'A' will initiate the UTRN entry process and the following display indicates that the meter is in UTRN entry mode:

Once in UTRN entry mode, the function of key 'A' changes to backspace; each press of key 'A' will delete the digit on the left, after deleting all digits the 'Vend Mode' display will return.

At the end of UTRN entry, either a short press of key 'B' or a short wait for the configured period will initiate the code authentication process which will be followed by any one of the following displays:

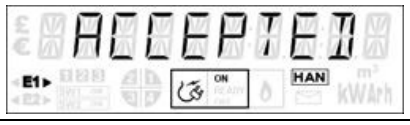
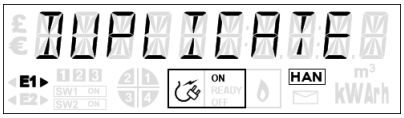
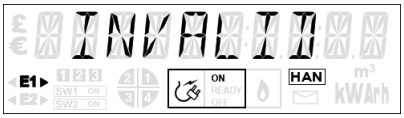
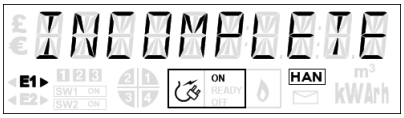
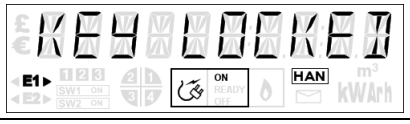
 Or	Displayed if the UTRN is valid.
 Followed by  Or  Or  Or  *(timeout 4 secs)* Or  *(timeout 20 secs)*	Displayed if the UTRN is invalid followed by the reason for rejection. 'Duplicate' indicates UTRN is rejected because a used UTRN is re-entered. 'Invalid' indicates UTRN is rejected because the UTRN is not meant for the meter. 'Incorrect' indicates UTRN is rejected because it is a wrong UTRN. 'Incomplete' indicates UTRN is rejected because it is not in multiples of 20-digit. The display 'Key Locked' indicates that the user has entered five (5) consecutive invalid UTRN and this locks key 'A' for the configured timeout period.

Table 29: UTRN entry from Default mode

8 Annexe-II: Diagnostic Mode Displays

Diagnostic information from the meter can be only accessed by an authorised person from its diagnostic display mode; such information cannot be displayed outside of this mode. This mode is enabled by using a 6-digit Engineering Code common for all Liberty 100 meters.

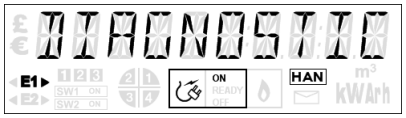
Accessing the Diagnostic mode:

followed by <xxxxx-y> followed by

(or wait for the configured timeout period)

A short press of key ‘A’ will initiate the code entry process. Once in code entry mode, the function of key ‘A’ changes to backspace; each press of key ‘A’ will delete the digit on the left, deleting all digits the ‘Vend Mode’ display will return. At the end of the code entry, either a short press of key ‘B’ or waiting for 20 seconds will initiate the code authentication process.

A correct UTRN will display the following which indicates that the meter is now in diagnostic mode:

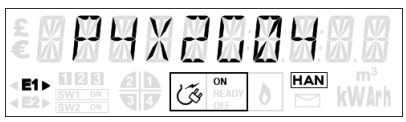


From this mode, the meter’s numeric keys can be used to access the diagnostic information; each numeric key is configured with a group of diagnostic displays. Except for a few additional displays in Prepayment mode, all other displays are similar for Credit and Prepayment modes. Each numeric key pressed will show the associated diagnostic displays in sequence as configured; a short press of key ‘A’ or no key press for 120 seconds (2 minutes) will end the diagnostic display sequence and resume the Auto Scroll display; key ‘B’ can be used to scroll back up the display list of the current key.

8.1 Diagnostic Displays in Credit Mode

In this mode a short press of a numeric key will initiate the associated display sequence. After each set of information comprising a title followed by its value, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Key 1: Application firmware identification

Title 1: Program name  *(timeout 2 secs)* Followed by  *(timeout 4 secs)*	The 1st set of displays associated with key 1 identifies the meter application firmware. The example shows that **P4X2G04** is the current application firmware in which ‘02’ is the version number.

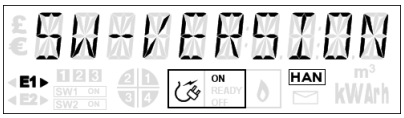
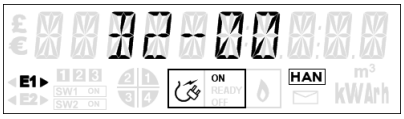
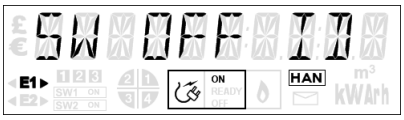
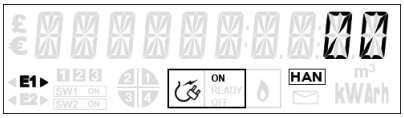
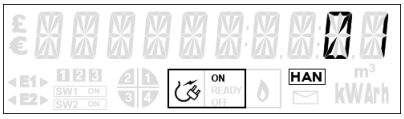
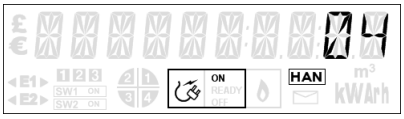
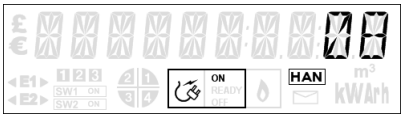
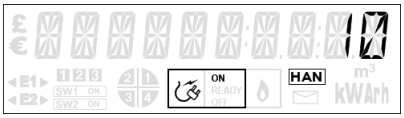
 Press key 1 to advance to the next display	
Title 2: Software version  *(timeout 2 secs)* Followed by  *(timeout 4 secs)*  Press key 1 to return to the 1st display.  Press key B to scroll back up the display list.  Press key A to resume the auto-cycle display.	The 2nd set of displays identifies the metrology firmware and version. The example shows that **B2–00** is the metrology firmware in which '00' is the version number.

Table 30: Key '1' Diagnostic display in Credit mode

Key 2: Switch Off reason and switch On/Off counter

Title 1: Switch On/Off reason code  *(timeout 2 secs)* Followed by **value**  Or  Or  Or  Or  Or	The 1st set of displays associated with key 2 display the reason code for the switch being open. There are 7 different switch open reason codes, the reason associated with each code are given below: 00: switch close. 01: supply disconnected manually. 04: supply off due to overload. 08: supply off due to an event. 10: supply disconnected via supply UTRN.

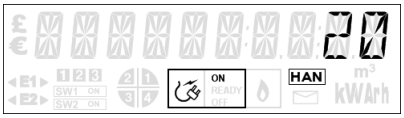
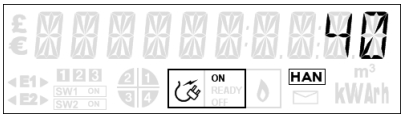
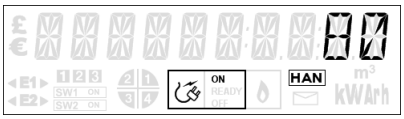
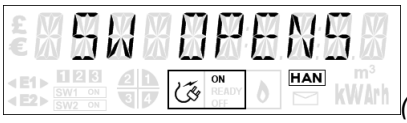
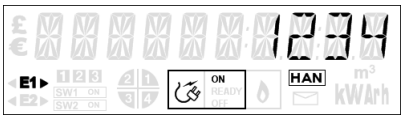
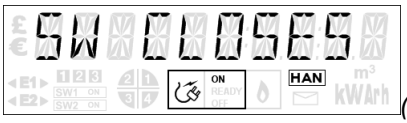
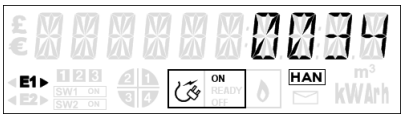
 Or  Or  *(timeout 4 secs)*  Press key 2 to advance to the next display.	20: supply off due to a remote command. 40: supply off due to change of tenancy. 80: supply off due to change of supplier.
Title 2: Switch On counter  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 2 to advance to the next display.	The 2nd set displays the number of times the meter has disconnected the supply.
Title 3: Switch Off counter  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 2 to return to the 1st display.  Press key B to scroll back up the display list.  Press key A to resume the auto-cycle display.	The 3rd set displays the number of times the meter has reconnected the supply.

Table 31: Key '2' Diagnostic display in Credit mode

Key 3: Maximum demand value and logging date and time

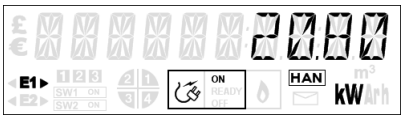
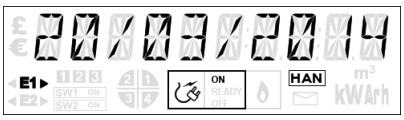
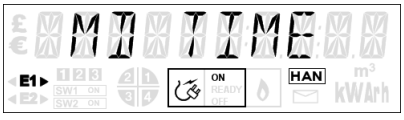
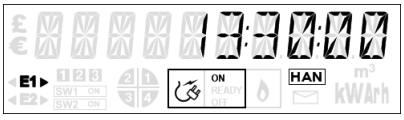
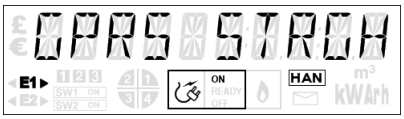
Title 1: Maximum demand value  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 3 to advance to the next display	The 1st set of displays associated with key 3 indicating the maximum demand (MD) value so far in the current billing period. The example shows that **20.80 kW** is the MD value.
Title 2: Maximum demand logging date  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 3 to advance to the next display.	The 2nd set displays the date on which the maximum demand was recorded. The example shows that **20/03/2014** is the current MD logging date.
Title 3: Maximum demand logging time  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 3 to return to the 1st display.  Press key B to scroll back up the display list.  Press key A to resume the auto-cycle display.	The 3rd displays the time when the maximum demand was recorded. The example shows that **13:30:00** is the current MD logging time.

Table 32: Key '3' Diagnostic display in Credit mode

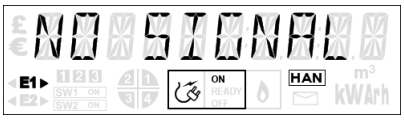
Key 4: GPRS signal strength

Title 1: GPRS Signal Strength

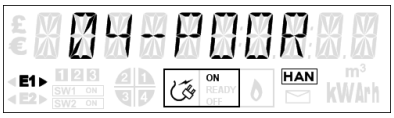


(timeout 2 secs)

Followed by **value**

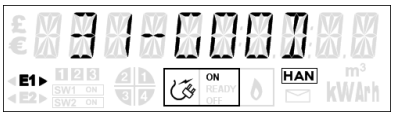


Or



Or

Or



(timeout 4 secs)

Press key 4 to advance to the next display.

The display associated with key 4 indicates the current GPRS signal strength which is updated at every minute.

The four signal strength categories are shown below:

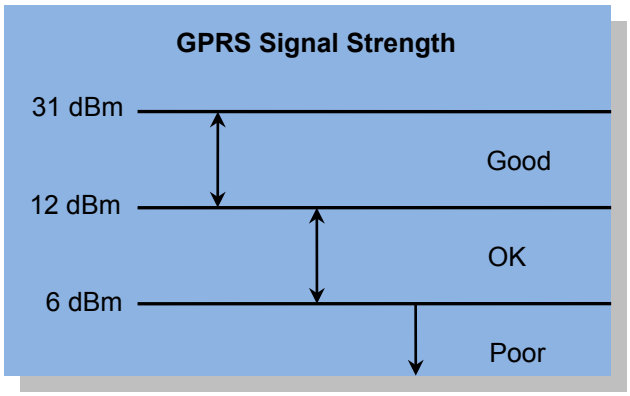
00 to 05 – Poor signal

06 to 11 – Signal is OK

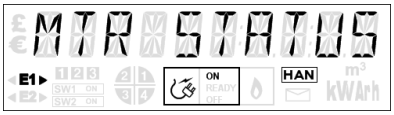
12 to 31 – Good signal strength

Above 31 or unregistered – No Signal; indicates that there is no GRPS signal available for the hub to communicate with the HES.

The example shows the number which reveals the GPRS signal strength.

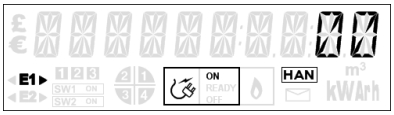


Title 2: Meter status



(timeout 2 secs)

Followed by **value**



Or

Or

Or

Or

The 2nd set displays the meter status.

The example shows the code which reveals the meter status.

‘00’ indicates the meter status is good.

‘01’ indicates the memory failure.

‘02’ indicates the clock is invalid.

‘04’ indicates the battery charge is low.

‘08’ indicates the battery failure.

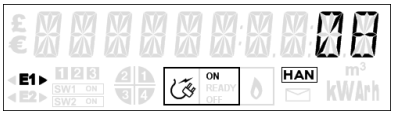
 *(timeout 4 secs)*  Press key 4 to return to the 1st display.  Press key B to scroll back up the display list.  Press key A to resume the auto-cycle display.	

Table 33: Key '4' Diagnostic display in Credit mode

Key 5: Load limit threshold

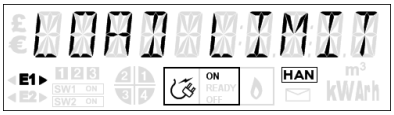
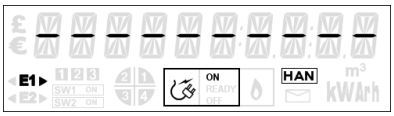
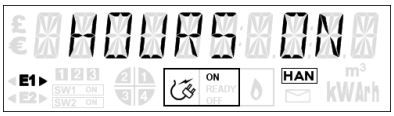
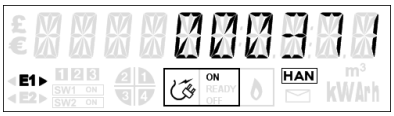
Title 1: Load limit threshold  *(timeout 2 secs)* Followed by **value**  Or  *(timeout 4 secs)*  Press key A to resume the auto-cycle display.	The display associated with key 5 indicates the current load limit kW threshold. If load limit feature is disabled then it will display '----------'.

Table 34: Key '5' Diagnostic display in Credit mode

Key 6: Power On/Off hours and counter

Title 1: Power On/Off hours  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to advance to the next display	The 1st set of displays associated with key 6 indicating the number of hours the electricity meter has been without mains power i.e. running on battery. The example shows that the meter has been on power for **371** hours.
Title 2: Power up counter	The 2nd set displays the number of times the meter has been powered up.

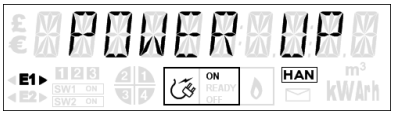
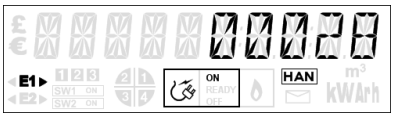
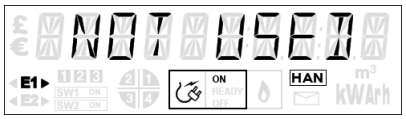
 *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to return to the 1st display.  Press key B to scroll back up the display list.  Press key A to resume the auto-cycle display.	The example shows that the meter has been powered up **28** times.

Table 35: Key '6' Diagnostic display in Credit mode

Key 7, Key 8, Key 9 and Key 0: No functions allocated

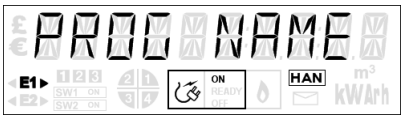
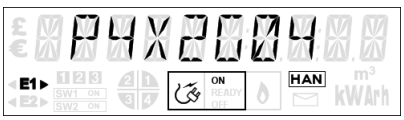
No functions are allocated to these three keys when the meter is operating in Credit mode. A short press of any of these key will display ‘Not Used’ as shown below:



8.2 Diagnostic Displays in Prepayment Mode

In this mode a short press of a numeric key will initiate the associated display sequence. After each set of information comprising a title followed by its value, either a four (4) seconds wait or short press of the key will advance the display to the next set of information as described below.

Key 1: Application firmware identification

Title 1: Program name  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 1 to advance to the next display	The 1st set of displays associated with key 1 identifies the meter application firmware (CLEM). The example shows that **P4X2G04** is the current application firmware in which ‘04’ is the version number.

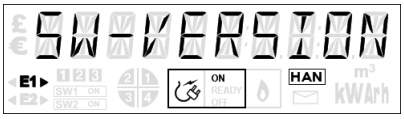
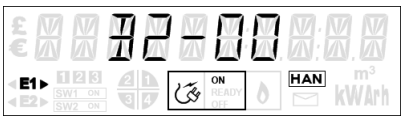
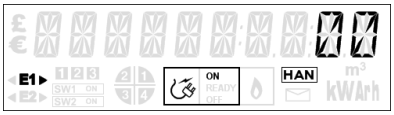
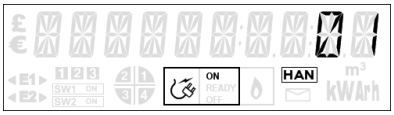
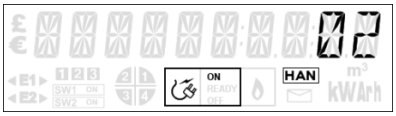
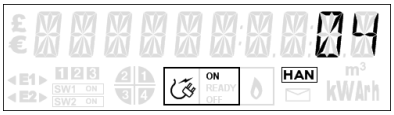
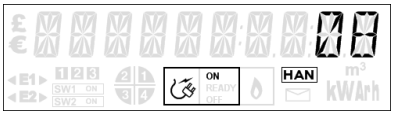
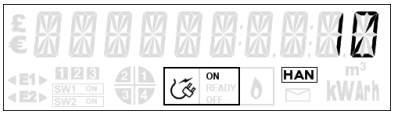
Title 2: Software version  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 1 to return to the 1st display.  Press key B to scroll back up the display list.  Press key A to resume the auto-cycle display.	The 2nd set of displays identifies the metrology firmware and version. The example shows that **B2–00** is the metrology firmware in which '00' is the version number.

Table 36: Key '1' Diagnostic display in Prepayment mode

Key 2: Switch Off reason and switch On/Off counter

Title 1: Switch On/Off reason code  *(timeout 2 secs)* Followed by **value**  Or  Or  Or  Or  Or  Or	The 1st set of displays associated with key 2 reveals the reason for the switch being open. There are in total 15 different switch off reason codes, the reason associated with each code are given below: 00: switch closed. 01: supply is disconnected manually. 02: supply off due to no credit in the account. 04: supply off due to overload. 08: supply off due to an event. 10: supply disconnected via supply UTRN.

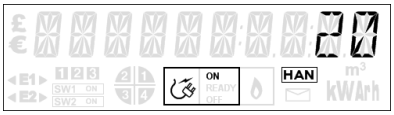
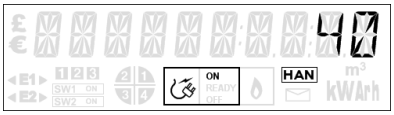
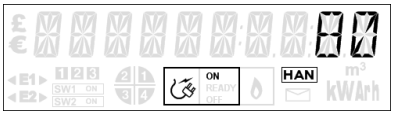
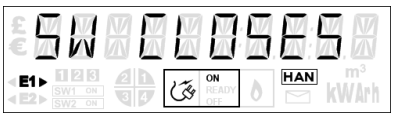
 Or  Or  *(timeout 4 secs)*  Press key 2 to advance to the next display	20: supply off due to a remote command. 40: supply off due to change of tenancy. 80: supply off due to change of supplier.
Title 2: Switch On counter  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 2 to advance to the next display.	The 2nd set displays the number of times the meter has disconnected the supply.
Title 3: Switch Off counter  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 2 to return to the 1st display.  Press key B to scroll back up the display list.  Press key A to resume the auto-cycle display.	The 3rd set displays the number of times the meter has reconnected the supply.

Table 37: Key '2' Diagnostic display in Prepayment mode

Key 3: Maximum demand value and logging date and time

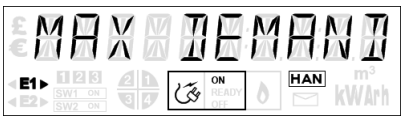
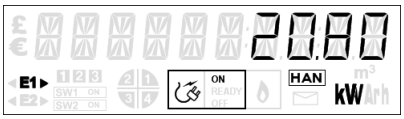
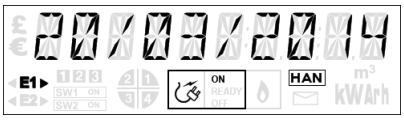
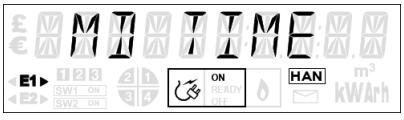
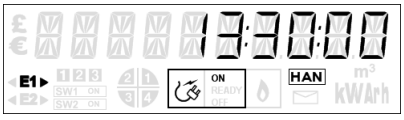
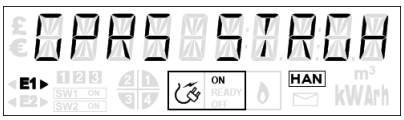
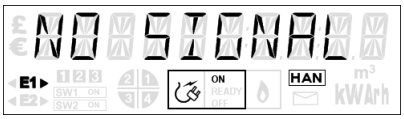
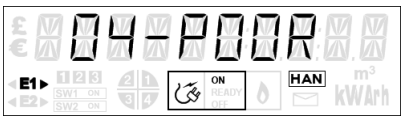
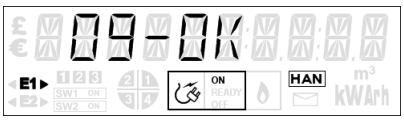
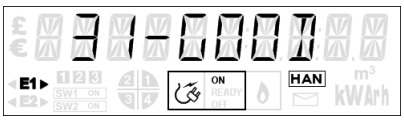
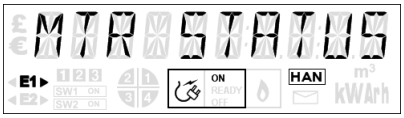
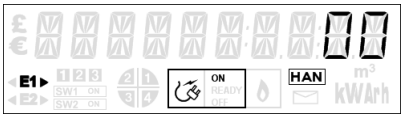
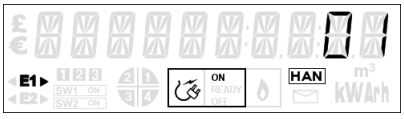
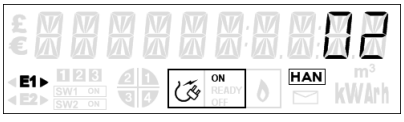
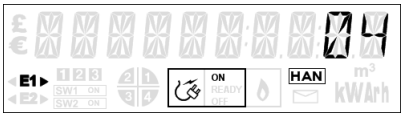
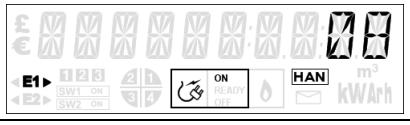
Title 1: Maximum demand value  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 3 to advance to the next display	The 1st set of displays associated with key 3 indicating the current maximum demand (MD) value. The example shows that **20.80 kW** is the current MD value.
Title 2: Maximum demand logging date  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 3 to advance to the next display.	The 2nd set displays the maximum demand logging date. The example shows that **20/03/2014** is the current MD logging date.
Title 3: Maximum demand logging time  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 3 to return to the 1st display.  Press key B to scroll back up the display list.  Press key A to resume the auto-cycle display.	The 3rd set displays indicating the maximum demand logging time. The example shows that **13:30:00** is the current MD logging time.

Table 38: Key '3' Diagnostic display in Prepayment mode

Key 4: GPRS signal strength

Title 1: GPRS Signal Strength  *(timeout 2 secs)* Followed by **value**  Or  Or  Or  *(timeout 4 secs)*  Press key 4 to advance to the next display.	The displays associated with key 4 indicates the current GPRS signal strength which is updated at every minute. Given below are the four signal strength categories: See the graph shown on page 102. 00 to 05 – Poor signal 06 to 11 – Signal is OK 12 to 31 – Good signal strength Above 31 or unregistered – No Signal; indicates that there is no GPRS signal available for the hub to communicate with the HES.
Title 2: Meter status  *(timeout 2 secs)* Followed by **value**  Or  Or  Or  Or  *(timeout 4 secs)*	The 2nd set displays the meter status. The example shows the code which reveals the meter status. ‘00’ indicates the meter status is good. ‘01’ indicates the memory failure. ‘02’ indicates the clock is invalid. ‘04’ indicates the battery charge is low. ‘08’ indicates the battery failure.

 Press key A to resume the auto-cycle display.	

Table 39: Key '4' Diagnostic display in Prepayment mode

Key 5: Load limit threshold

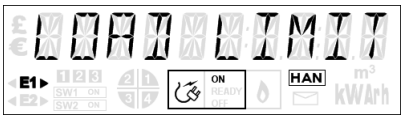
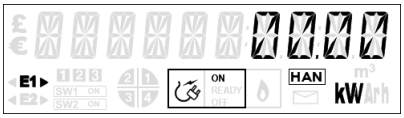
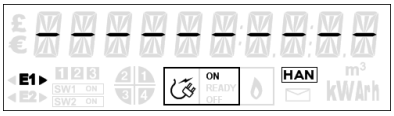
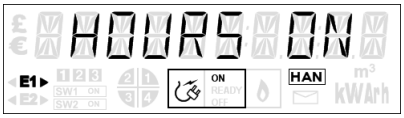
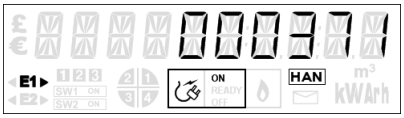
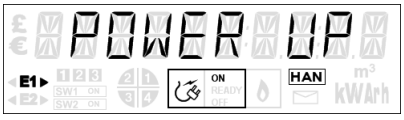
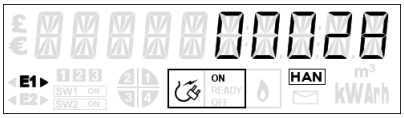
Title 1: Load Limit threshold  *(timeout 2 secs)* Followed by **value**  Or  *(timeout 4 secs)*  Press key A to resume the auto-cycle display.	The display associated with key 5 indicates the load limiting kW value. If load limit feature is disabled then it will display '----------'.

Table 40: Key '5' Diagnostic display in Prepayment mode

Key 6: Power On/Off hours and counter

Title 1: Power On/Off hours  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to advance to the next display	The 1st set of displays associated with key 6 indicating the number of hours the electricity meter has been without mains power i.e. running on battery. The example shows that the meter has been on power for **371** hours.
Title 2: Power up counter  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 6 to return to the 1st display.	The 2nd set displays the number of times the meter has been powered up. The example shows that the meter is powered up **28** times.

 Press key B to scroll back up the display list.  Press key A to resume the auto-cycle display.	

Table 41: Key '6' Diagnostic display in Prepayment mode

Key 7: Total cash added

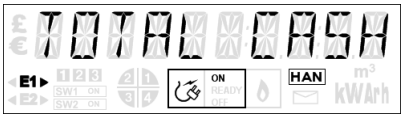
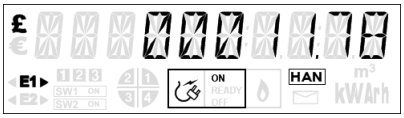
Title 1: Total Cash added to the meter account in the current transaction  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 7 to return to the 1st display.  Press key B to scroll back up the display list.  Press key A to resume the auto-cycle display.	Key 7 displays the total cash added to the meter's account. The example shows that **£11.78** has been added to the meter's account to date.

Table 42: Key '7' Diagnostic display in Prepayment mode

Key 8: Emergency Credit limit

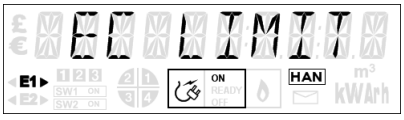
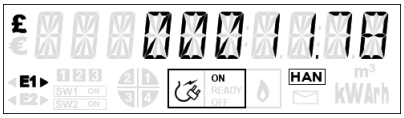
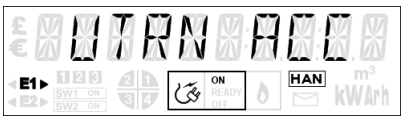
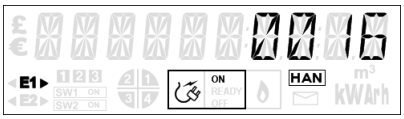
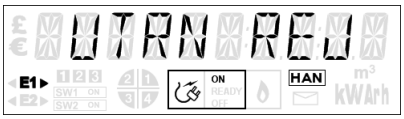
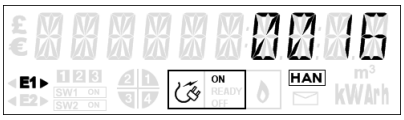
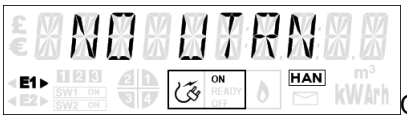
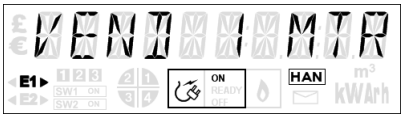
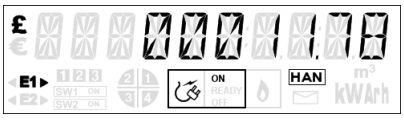
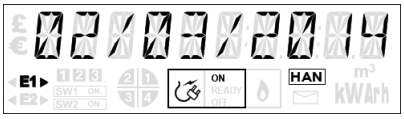
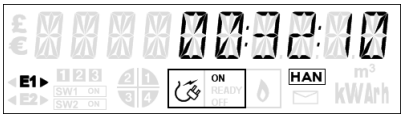
Title 1: Emergency Credit  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 8 to return to the 1st display.  Press key B to scroll back up the display list.  Press key A to resume the auto-cycle display.	Key 8 displays the Emergency Credit limit. The example shows that **£11.78** is the current Emergency Credit limit.

Table 43: Key '8' Diagnostic display in Prepayment mode

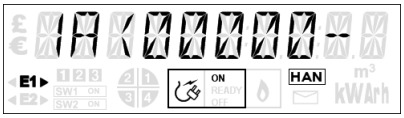
Key 9: UTRN history

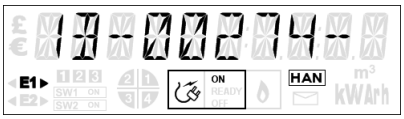
Title 1: Number of accepted UTRNs  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display.	The 1st set of displays associated with key 9 displays the number of UTRNs accepted. The example shows that the meter has accepted **16** UTRNs since manufacture.
Title 2: Number of rejected UTRNs  *(timeout 2 secs)* Followed by **value**  *(timeout 4 secs)*  Press key 9 to advance to the next display.	The 2nd set displays the number of UTRNs rejected. The example shows that the meter has rejected **16** UTRNs since manufacture.
Title 3: Vend UTRN Details  Or  *(timeout 2 secs)* Followed by **Subtitle:** Vend 1 transaction  *(timeout 2 secs)* Followed by **vend amount**  *(timeout 2 secs)* Followed by **vend date**  *(timeout 2 secs)* Followed by **vend time**	The 3rd set displays 'No UTRN' if there are no vend UTRNs. If there are vend UTRNs then it shows the vend UTRN transaction details such as vend amount, vend date, vending time and the UTRN number. The list displays the last five (5) historical UTRN details. The example shows the following displays: **Vend 1 Meter Transaction** is the latest vend UTRN. **£11.78** is the vend amount. **02/03/2014** is vend input date. **00:32:10** is vend input time.

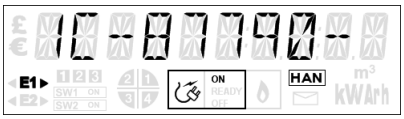


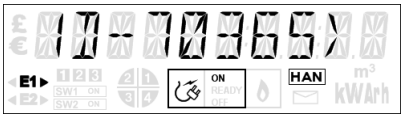
(timeout 4 secs)

Followed by **UTRN**

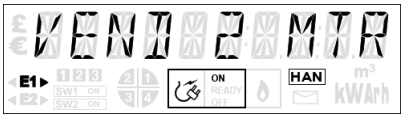






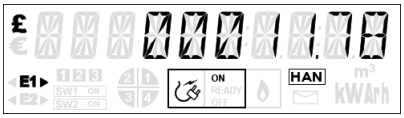


Subtitle: Vend 2 transaction (if there are any)



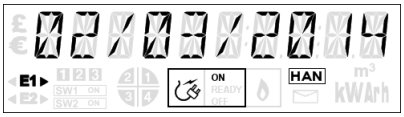
(timeout 2 secs)

Followed by **vend amount**



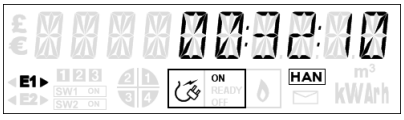
(timeout 2 secs)

Followed by **vend date**



(timeout 2 secs)

Followed by **vend time**



(timeout 4 secs)

The UTRN is then displayed as above.


Press key 9 to return to the 1st display.


Press key B to scroll back up the display list.


Press key A to resume the auto-cycle display.

20-digit UTRN

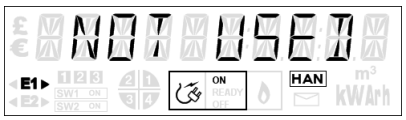
Each press of the button will display the last five vend codes accepted by the meter starting with the most recent. Each code is displayed in blocks of five digits. The first two characters on the left are for reference. The first character indicates the number of the code (1, 2, 3, 4, or 5) the second the block of code (A, B, C, and D) for a 20-digit code and A, B, C, D, E, F, G and H for a 40-digit code and A, B, C, D, E, F, G, H, I, J K and L for a 60-digit code. The start of a code is indicated by a '<' and the end by a '>'. A '-' is inserted after each block as a separator. Each subsequent press of button '4' will display the next block of code till all have been displayed.

If there are more than one historical UTRN then pressing key 9 again will reveal the subsequent UTRN's details as shown in the example.

Table 44: Key '9' Diagnostic display in Prepayment mode

Key 0: NOT USED

No function is allocated to key 0 when the meter is operating in Prepayment mode. A short press of this key will display ‘Not Used’ as shown below:



8.3 Diagnostic Displays in Default Mode

In this mode keys 3, 7, 8, 9 and 0 are not assigned with any functions hence will display ‘NOT USED’. All other keys have the same function as in ‘Credit Mode’ (see Section 8.1 Diagnostic Displays in Credit Mode).

9 Default Minimum and Maximum Values

9.1 Default Minimum and Maximum Values

Parameter	Maximum	Minimum	Resolution	Default	Remark
Credit limit	£21000	£0	£1	£1000	
Single vend	£21000		1 p	£500	
Emergency Credit limit	£21000	£0	1 p	£10	
Low Credit alarm threshold	£21000	£0	1 p	£1	Must be higher or equal to EC Threshold
Emergency Credit threshold (if available)	£21000	£0	1 p	£1	Must be less or equal to Low credit alarm threshold
Cut-off value	£0	-£21000	1 p	£0	
Low Emergency Credit alarm threshold	£21000	£0	1 p	£8	Must be less then EC limit
Standing charge	<10	0 p	0.001 p	0 p	Per Day
Rate 1 price (incl. VAT)	9999.999 p	0 p	0.001 p	20 p/kWh	
Rate 2 price (incl. VAT)	9999.999 p	0 p	0.001 p	15 p/kWh	
Domestic fuel tax rate	100%	0%	0.1%	5%	
Cut-off grace period	255 Minute	0 Minute	1 Minute	60 Minute	
Emergency Credit grace period	255 Minute	0 Minute	1 Minute	30 Minute	
Friendly Credit warning	255 Minute	0 Minute	1 Minute	10 Minute	
CO_2 factor	9.9999 kg/kWh	0	0.0001	0.5246	
Block threshold	9999.9 kWh	0.1 kWh	0.1 kWh	237 kWh	
Future switch activation period	365 Days	0	30 Minute		
Initial Credit amount	£21000	£0	£1	£0	
Load Limit	30 kW	0	1 W	Disabled	

Quite Time	Start Time	End Time	Steps	Default	
Audible Alarm	00:00	24:00	1 Minute	Enabled	

9.2 Energy Resolution

Parameter	Meter Display	On Comms	Billing Data	Snapshots
Cumulative Energy	0.1 kWh	0.1 kWh	0.1 kWh	0.1 kWh
TOD Energy (Cumulative)	0.1 kWh	0.1 kWh	0.1 kWh	0.1 kWh
Max Demand	1 W	1 W	1 W	1 W
Load Profile (Consumption)	---	1 Wh	---	---
High Resolution Energy (Cumulative)	1 Wh	---	---	---
Accounts Calculation	0.05 kWh	---	---	---

10 Glossary

Cut-off threshold /limit	:	This is the state when the meter's account has no credit.
DIP	:	Demand Integration Period
DST	:	Daylight Saving Time
EC	:	Emergency Credit
FC	:	Friendly Credit
GMT	:	Greenwich Mean Time
GPRS	:	General Packet Radio Service
Grace period	:	Grace period is a very limited time given to users at the end of Friendly Credit period if their meter account balance has become zero or negative during the Friendly Credit period. This feature allows users to top-up their meter account or enable Emergency Credit in the meter to prevent sudden supply disconnection.
HAN	:	Home Area Network
HES		Head End System
IHD	:	In Home Display unit that gives users a near real-time feedback of their energy consumption.
Liberty 100	:	ZigBee certified smart electricity meter with a display and a keypad.
Liberty EG4v 10	:	Smart gas meter with a display and a keypad.
Local disconnection	:	self-disconnection of meter's supply switch due to load limit or no credit reasons.
Manual connection	:	connecting supply using the meter keypad.
MD	:	Maximum Demand
MPAN	:	Meter Point Administration Number
MPRN	:	Meter Point Reference Number
Remote connection/ disconnection	:	connecting/disconnecting supply using remote commands.
Skyline-i 510	:	Internal communication hub mounted inside the hub cover of Liberty 100 electricity meter. The manual refers to it as the hub.
UTRN	:	Unique Transaction Number
WAN	:	Wide Area Network

Notes

Notes

Notes

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