ZCX310

# E470 Series 3 SMETS2 100 mm

User Manual and Functional Description

**ISSUE 1.2**

# Revision history

| Version | Date | Comments |
|---------|------|----------|
| 1.0 | 04.07.2017 | First version of Series 3 (100mm) document |
| 1.1 | 01.02.2018 | Corrected discrepancy in the reactive energy unit in section 5.2.2, the IST mode timing specification in section 15, the sequence of actions required to access the Service menu in section 19 and consumer message handling in section 24. |
| 1.2 | 02.05.2018 | Further revisions applied which include: |
| | | IST mode – decimal places |
| | | Consumer message text |
| | | Section 13 – Table 9 – completely rewritten.(new functionality in 38.03.06.00) |
| | | LCD examples are updated to show better representations against actual (formatting and positioning of displayed characters). |
| | | Corrections to default display screen to reflect latest changes introduced from firmware 38.03.06.00. |

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# About this document

**Scope**
This User Manual and Functional Description document describes the functionality provided by the **E470 Series 3 SMETS2 Smart Electricity Meter**.

This version of the hardware and firmware provides functionality as specified in the second version of the UK's Smart Metering Equipment Technical Specifications (SMETS2).

**Purpose**
This manual contains information required for the application of the meters for their intended purpose as defined in the section "Intended use and installation" below. This includes:

- Characteristics, construction, and functionality of the meters.

- Information about possible dangers, their consequences, and measures to prevent them.

- A detailed description of the tasks to be performed during the entire life-cycle of the meters (configuration, installation, commissioning, operation, maintenance, and disposal).

- Guidance on the functions provided by the meter.

**Target group**
The contents of this user manual are intended for technically qualified personnel responsible for system planning, testing, installation and commissioning, operation, maintenance, decommissioning and disposal of the meters.

**Intended use and installation**
The meters record four quadrant energy consumption in single phase two wire networks. For this purpose, they are directly installed in the supply line by the energy supply company and provide readings for energy charging and other purposes.

The meter is intended for installation by qualified personnel. The meter conforms to British Standards and is suited to installation in environments that also align to British Standards. The meter must be installed away from powerful sources of electromagnetic interference.

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

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

**Reference documents**
The following document provides further information related to the subject of this document:

- E470 SMETS2 Events and Alerts

**Terms and abbreviations**
A list of terms and abbreviations used in this document is available at the end of this document.

# 1    Safety

## 1.1    Safety information

The following symbols are used to draw your attention to the relevant danger level, i.e. the severity and probability of any danger, in the individual sections of this document.

**Danger**
This symbol is used to indicate a possible dangerous situation which could result in severe physical injury or death.

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

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

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

## 1.2    Responsibilities

The owner of the meters – usually the utility company – is responsible for assuring that all persons engaged in working with meters:

- Have read and understood the relevant sections of the user manual.

- Are appropriately qualified for the work to be performed.

- Strictly observe the safety regulations (laid down in *section 1.4*) and the operating instructions as specified in the individual sections.

The owner of the meters bears responsibility for the protection of persons, prevention of material damage and the training of personnel.

For this purpose, Landis+Gyr provides training on a variety of products and solutions. Contact your local Landis+Gyr representative for more information.

## 1.3    Meter Operator Code of Practice

The E470 must be installed in accordance with the Meter Operation Code of Practice Agreement (MOCOPA®), defining safety, technical and business interface requirements regarding the provision of meter operation services.

For more information see https://www.mocopa.org.uk/.

## 1.4     Safety regulations

The following safety regulations must be observed at all times:

- This meter does not contain a disconnection device. Means for disconnection from the supply must be provided as part of the building installation. Do not work on the equipment unless the supply is disconnected. If disconnection is done by removal of fuses or other cut-outs, the removed disconnection devices must be kept secure from replacement while work is performed. If disconnection is provided by a switch, the switch shall conform to the requirements of IEC 947-1 and IEC 947-3 or equivalent.

- This meter does not contain an overcurrent protection device. Overcurrent protection must be provided as part of the building installation. Maximum overcurrent device rating is 100 A at 415 V, conforming to the requirements of BS1361 or equivalent.

- This meter has a maximum current rating of 100 A and a single fault overload rating of 145 A. The meter terminals accept cables up to 35 mm$^2$. Use with smaller diameter cables without corresponding derating of the mains fuse may degrade the meter.

- Local safety regulations must be observed and shall take precedence over these regulations in the event of a conflict. Only technically qualified and appropriately trained personnel are authorised to install the meters.

- Only appropriate tools shall be used for the job. This means, e.g. that the screwdriver must be of the correct size for the screws, and the handle of the screwdriver must be insulated.

- The meters must be held securely during installation. They can cause injuries if dropped.

- Meters that have been dropped must not be installed, even if no damage is apparent, but must be returned to the service and repair department (or the manufacturer) for testing. Internal damage may result in malfunctions or short-circuits.

- The meters must not be cleaned under running water or with compressed air. Water ingress can cause short-circuits.

- The meter terminal cover should be secured in place before any load is supplied.

**Risks of not covering the intimate communications hub interface**
If the meter is supplied without a manufacturer supplied intimate communications hub interface (ICHI) cover, there are potential safety risks of installing the product and not fitting a cover, including accidental contact with an energy source.  Such a product should not be installed without an appropriate cover fitted over the ICHI connector (being a separately supplied ICHI cover or a communications hub) and the manufacturer shall not be liable for any consequences associated with the failure to fit such a cover.

# 2 Compliance to SMETS2

The E470 meter satisfies the following sections of the Smart Metering Equipment Technical Specifications (SMETS2):

- Section 5: "Electricity Smart Metering Equipment Technical Specifications
  - Part A – Single Element Electricity Metering Equipment
  - Part D – Auxiliary Load Control Switch
  - Part E – Boost function

The E470 meter also satisfies the Great Britain Companion Specification (GBCS) as specified in SMETS2.

The E470 meter meets the Commercial Product Assurance (CPA) compliance requirements.

# 3      Functional overview

## 3.1    Main characteristics

The meter requires a single phase, two wire mains supply with a reference voltage of 230 V, 50 Hz. The meter is rated at reference currents of 5, 10 or 20 – (100) A registering kWh to class B (MID).

The meter is fitted with a single pole 100 A supply control switch for the disconnection of supply. The supply control switch, which conforms to IEC 62052-31 UC3, can operate automatically, for example when prepay credit has expired, through load limiting or by remote command.

The meter is fitted with an internal relay which is controlled by time-of-use switches and may be used to control an auxiliary load control switch (ALCS)

The meter features multiple import rate energy registers and one total export energy register. The meter may be configured with time-of-use tariffs (up to 48 rates), individual block tariffs (up to 4 blocks) or combinations of the two (up to 8 time-of-use rates each with up to 4 blocks).

The core features of the meter include but are not limited to:

- Metrology

- Time-of-use and block tariffs

- Logging of data in profiles, event logs, etc.

- Credit or prepayment modes of operation

- Load limiting operation

- Remote firmware update

- Remote or meter controlled disconnect/reconnect (reconnect requires customer action)

- Support for auxiliary load control switches (ALCS) including home area network (HAN) connected auxiliary load control switches (HCALCS)

- Voltage quality measurements

## 3.2    Technical details

**Accuracy class**

- Class 1 (IEC), Class B (MID) for active energy
- Class 2 (IEC) for reactive energy

**Standards and requirements**

- Active energy: MID, EN 50470-1, EN 50470-3, EN 62052-11, BS7856:2013
- Reactive energy: IEC 62053-23
- Safety: EN 61010-1, BS EN 60950-1, IEC 62052-31, BS EN 50470-1 class II
- EMC: EN 301 489-1, EN 301 489-17

**Voltage**

- Un = 220, 230, 240 VAC
- Specified operating range: ±10% of Un
- Extended operating range: -20%, +15% of Un
- Long-term overvoltage: 1.9 x Un

**Power consumption**

- Typical 0.9 W @ 230VAC (excludes ICHI power consumption)

**Case**

- Protection class II
- IP53
- Antistatic polycarbonate glass filled 10%

**Dimensions**

- Overall: 121 mm (h) x 130 mm (w) x 68 mm (d)
- Height: 98 mm, not including Intimate Communications Hub Interface (ICHI)
- Weight: 1 kg (approx.)

**Supported interfaces**

- ZigBee® HAN utilising SEP 1.2 at 2.4 GHz
- GBCS tunnelled over the HAN to/from communications hub
- DCC compliant Intimate Communications Hub Interface (ICHI) providing 12 VDC / 6 W power, Comms Hub Present and Meter Present pins.

**Control buttons**

- One button for scrolling display
- Second button for the control of the Disconnector (used for reconnection of supply) and also available as a control of display operations.

**LCD display**

- 16 starburst (14 segment) characters
- 7 digits for showing register values
- In Service Test (IST) mode shows 2 dp
- Indication of units, currency, signal strength, energy direction and supply status

**LED**

- Pulsing red LED indicating measured energy
- Continuous illumination indicating anti-creep

**Clock**

- Quartz crystal synchronized real time clock
- Maximum deviation 6ppm
- Battery back-up

**Measurement**

- Four quadrant measurement
- 1 phase 2 wire single phase

**Current**

- Reference current Iref = 5 A, 10 A, 20 A
- Maximum current Imax = 100 A
- Minimum current Imin = 0.25 A, 0.5 A, 1.0 A
- Starting current Ist = 0.4% of Iref ≤20 mA, 0.04 mA, 0.08 mA

**Tamper detection**

- Main cover and terminal cover removal
- Strong DC magnet
- Sealing for main cover and terminal cover

**ZigBee® module**

- 2.4 GHz IEEE 802.15.4 transceiver
- 32-bit microprocessor
- 192 KB Flash Memory/12 KB RAM

**Relay outputs**

- Single pole voltage free, non-latching relay rated at 230 V 2 A at unity and 0.5 pf.

**Supply control switch**

- For disconnection of energy supply
- Can be controlled remotely or locally for prepayment and load limiting functions in conjunction with the push button.
- Max. switching current 100 A
- Conforms to EN 62052-21 UC3

**Temperature and humidity**

- Operating temperature: -25 °C to +55 °C
- Storage temperature: -40 °C to +70 °C
- LCD operating temperature: -20 °C to +55 °C
- Relative humidity 30% to 95%, non-condensing

**Insulation strength**

- Insulation voltage: 4 kV at 50 Hz for 1 min
- Impulse voltage 1.2/50 μs:
- 6 kV according to IEC62052-11

**Frequency**

- 50 Hz ± 0.5 %

**Security**

- Random Number Generator (RNG)
- AES-128
- Internal firewall for secure separation/access

*Table 1      Technical details*

## 3.3     Type designation

The exact hardware configuration of the E470 meter is expressed in a type designation code. The type designation is used for ordering purposes and can be read by the metering system.

**Type designation:**                                    ZCX S   3  10   H  U0 L2   D1. 4   1  S3

**Type of meter**

ZCX   1-phase 2-wire network (C-circuit, single phase)

**Build option**

S     SMETS

**Connection type**

3     Direct connection 100 A

**Accuracy class**

10    Combined meter active energy class 1 (IEC); B (MID),
      reactive energy class 2 (IEC); A (MID

**System interface**

H     Intimate hub (SMETS2 firmware)

**User interface**

U0    No optical interface
U1    Optical interface

**Local interface**

L0    No local interface
L2    ZigBee

**Supply control switch**

D1    1-pole supply control switch (live only)

**Relay outputs**

4     2 A / 230 VAC non-latching potential free

**Other options**

1     Terminal cover and main cover removal detection

**Meter variant**

S2    SMETS1/2 Series 2 (120mm) hardware
S3    SMETS2 Series 3 (100mm) hardware

*Table 2      Type designation*

## 3.4    Metrological functions

An independent measurement chip and current shunt integrated into the live phase supply control switch assembly comprise the energy measurement system.

Energy values measured by the measurement chip are acquired once per second. Received energy values are added to the corresponding register.

The meter is capable of 4 quadrant measurement. The following energy quantities will be measured and recorded:

- Active import and export energy (+A, Wh), (-A, Wh)

- Summation of active import and export energy ([+A] + [-A], Wh)

- Net of active Import and export energy ([+A] – [-A], Wh)

- Reactive energy import and export (+R, varh), (-R, varh)

- Reactive energy per quadrant:

  – Reactive inductive import and export energy (+Ri (QI), and -Ri (QIII), varh)
  – Reactive capacitive import and export energy (-Rc (QII) and -Rc (QIV), varh)

- Apparent energy import and export (+VA, -VA)


The meter monitors the following instantaneous values:

- Phase voltage U (V)

- Phase current I (A)

- Network frequency fn (Hz)

- Active power P (W)

- Reactive power Q (VAr)

- Apparent power S (VA)

## 3.5    Clock information

The E470 contains an internal clock which can be used for various functions within the meter including:

- time indication on the meter display ;

- to control the time-of-use rate and (HC)ALCS switching;

- for the timestamps in profiles, registers and event logs;

- for the implementation of future-dated commands.


In SMETS2 installations the master time reference is taken from the communications hub at the time the meter is commissioned and time synchronisation with the communications hub is then performed on power-up and every 24 hours.

### 3.5.1　Accuracy

The calendar clock uses an internal crystal as time base.

The crystal features a maximum deviation of 0.5 s per day (<6 ppm) i.e. maximum deviation of the calendar clock is 15 seconds after 30 days.

The clock maintains its accuracy in accordance with the requirements of SMETS2 and GBCS.  The calendar clock can only be set with the GBCS command ECS70 "Set Clock on ESME" and will automatically synchronise with the communications hub every 24 hours and on power-up. The setting of the time is recorded in the standard event log.

The approach is as follows:

- The energy supplier sends a Set Clock command with the supplier's current time and a future time (reflecting a time tolerance) in the command; and

- if, when the meter receives the command, the communications hub's time is within tolerance of the energy supplier's time, the meter aligns itself to the communications hub's time and treats its time as reliable.  Otherwise the meter treats its time as unreliable.

Note that mains frequency synchronisation is not employed in the E470.

### 3.5.2　Date and time

Time and date within the meter is based on normal time (UTC in the UK). When communicating with the meter the date and time is shown (set) as normal time. Time and date is always shown as local time on the display (incorporating DST time shift).

The following formats are supported:

- day [dd], month [mm], year [yy] on LCD, e.g. 10.01.07

- hour [hh], minute [mm], second [ss] e.g. 12:30:55

Only 24-h format is supported for time. Midnight is shown as 00:00. Other time information such as day of week is not supported.

### 3.5.3　Validity

The calendar clock is designed to generate valid calendar data (including leap years) between 1.1.2000 and 31.12.2059.

### 3.5.4　Daylight saving time

Daylight savings time settings are only used by the meter for display of local time on the meter display.  Changeover to daylight saving time (DST) and back to normal time is performed automatically per the DST settings configured in the meter. Start and end of daylight saving time can be set per the European standard or the user can define their own specification.

By selecting the EU standard, the meter will be set to start the daylight-saving time on Sunday the 25th of March or on the first Sunday after the 25th of March. On that day, the local time is advanced from 01:00h to 02:00h.

Daylight saving time ends on Sunday the 25th of October or on the first Sunday after the 25th of October. On that day, the local time is set back from 02:00h to 01:00h.

When configuring a specific daylight saving time the DST parameters must be set from the following:

| Start of Daylight Saving Time | Enter the month, the weekday and the earliest possible day on which the daylight saving time must be activated. |
|---|---|
| | Also enter the switching time (usually 01:00h) and the time shift (usually +1h). |
| End of Daylight Saving Time | Enter the month, the weekday and the earliest possible day on which the daylight saving time must be deactivated. |
| | Also enter the switching time (usually 02:00h). The time shift is the same as defined for activating the daylight saving but in the opposite direction. |

*Table 3 DST parameters*

### 3.5.5 Deviation to GMT

The deviation of normal time to GMT for other time zones can be set in 30 minute increments in range from -720 min to 720 min. Setting the deviation does not affect the internal device clock. The deviation is simply added to the device clock to form the normal time for the relevant time zone.

If the time and date is adjusted the deviation value will remain unchanged.

## 3.6 Battery backup

A leak-resistant battery provides back-up power for the calendar clock. The battery is rated to provide sufficient capacity for the life of the meter without the need for replacement.

Battery life is dependent on the following main factors:

- Normal Current drain from the clock circuit
- Loss of capacity due to internal resistance of cell
- Loss due to temperature
- Effective loss due to lowest working voltage of clock circuit

The battery installed in the SMETS2 E470 has a capacity of 540mAh. When using the above factors, and assuming an extended lifetime of 20 years, the remaining battery capacity is calculated to be around 40% at the end of this period. The battery shall therefore not require changing in its operating lifetime.

## 3.7 Operational modes

The E470 meter can be operated in the following operational modes:

- Credit mode
- Prepayment mode

### 3.7.1 Credit mode

In credit mode, the meter can:

- Receive commissioning messages
- Send and receive data via the communications hub
- Record electricity consumption and accounting.

This mode supports full credit functionality as described in SMETS2/GBCS.

In credit mode, the default display that is normally shown on the display is the total meter index in kWh for active import:
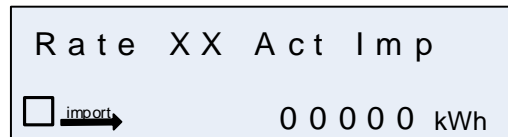
```
Rate XX Act Imp
☐ import→          0 0 0 0 0 kWh
```

The meter is either configured to be in this mode as a factory default or it is commanded to enter this mode by a GBCS message.

For more detailed information, see section *14 "Credit mode"*.

### 3.7.2 Prepayment mode

In prepayment mode, the meter can:

- Receive any remaining commissioning messages

- Support the prepayment functionality described in SMETS2/GBCS including:
  - Receipt of local and remote credit top ups
  - Debt management (time based and vend based debt collection and emergency credit)

In prepayment mode, the default display will be the total meter index, as in credit mode. Prepayment displays or PIN entry to view displays will be initiated after the first button process.

The meter is either configured to be in this mode as a factory default or it is commanded to enter this mode by a GBCS message. Note the standard factory default configuration is for the meter to be set to Credit Mode when it leaves the factory.

For more detailed information, see section *15 "Prepayment mode"*.

## 3.8 Load limiting

Load limit parameters can be set on the meter in either credit or prepayment mode. These allow the meter to control the supply to the consumer.

Where the instantaneous usage exceeds the load limiting threshold for a defined period of time it is registered as a load limiting event.

As defined in SMETS2 the meter provides indication of a load limiting event, raises alerts and can be configured to disconnect supply as well as subsequently restoring supply after a configurable restoration period.

For more detailed information, see section 16.

## 3.9 Customer privacy PIN

When operating in credit or prepayment mode, the meter allows for the protection of personal data items that may otherwise appear on the display.

The customer privacy PIN may be enabled, changed or disabled by the user. For details see section 12.

## 3.10 Non-Disablement calendar

When operating in prepayment mode, the supplier may configure a calendar on the meter which defines non-disablement periods of time when the meter will not disconnect the customer premises due to lack of credit even if all available credit expires during that non-disablement period. For details see section 10.

## 3.11 Rolling register displays

The rolling registers are used to provide the customers with a selection of data that is not available on the default display cycle. These registers are accessed by pressing and holding button A (≥ 2 s) whilst viewing the credit or prepayment status display. The first register is then displayed.

Pressing button A again advances the display to the next register etc. until the end of the list is reached.

After a timeout period of 30 seconds with no button presses the display reverts to the default display. Some registers can only be viewed in certain modes of operation.

If a customer privacy PIN is enabled then displays in the rolling register sequence that are considered personal data will not be shown (they will be skipped), unless the correct customer privacy PIN value has been entered at the beginning of the session.

## 3.12 Boost function

The E470 meter supports a boost function where if enabled can be managed via the meter display. The boost function allows management of the ALCS for additional time periods outside of the ALCS calendar settings.

The activate boost function will cause the ALCS configured as under control of the boost function to close for 15,30,45 or 60 minutes, and then revert to normal operation in accordance with the ALCS calendar.

The meter supports the cancelling of a boost period where the ALCS will revert to normal operation in accordance with the ALCS calendar.

The meter also supports the extending an existing boost period where the ALCS will remain closed for up to a maximum of 60 minutes for any single active boost period.

## 3.13 Remote commands

The E470 meter supports remote communication over a ZigBee SEP interface. This allows the meter to be controlled and monitored per the protocols defined in the Great Britain Companion Specification (GBCS) in accordance with SMETS2 operation.

## 3.14   Environmental performance

### 3.14.1   General environment

The meter is intended for indoor applications.

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.

The meter is intended to be installed in electromagnetic environment "E2", as per 2004/22/EC Directive.

### 3.14.2   Temperature and humidity

The operating temperature range: -25 ºC to +55 ºC

The storage temperature range: -40 °C to +70 °C.

LCD operating temperature range: -20 °C to +55 °C

Relative air humidity range: 30 % to 95 %, non-condensing.

### 3.14.3   Mechanical strength of meter case

The meter has been designed to pass spring hammer testing in accordance with BS EN 50470-1:2006 clause 5.2.2.1 under the following conditions:

- Meter mounted in its normal working position

- Spring hammer acting on the outer surfaces of the meter case and on the terminal cover with a kinetic energy of 0.2 J ± 0.2 J.

The meter has been designed to pass shock testing in accordance with BS EN 50470-1:2006 clause 5.2.2.2 under the following conditions:

- Meter in non-operating condition, without the packing

- Half-sine pulse

- Peak acceleration: 30 gn (300 m/s²)

- Duration of pulse: 18 ms


The meter has been designed to pass vibration tests in accordance with BS EN 50470-1:2006 clause 5.2.2.3 under the following conditions:

- Meter in non-operating condition, without the packing

- Frequency range: 10 Hz to 150 Hz

- Transition frequency: 60 Hz

- f <60 Hz, constant amplitude of movement 0.075 mm

- f >60 Hz, constant acceleration, 1 gn (10 m/s²)

- Single point control

- Number of sweep cycles per axis: 10

# 4 Physical description

## 4.1 Meter construction

The internal construction of the meter is not being described within this document. It is not permitted to open the meter after delivery, since this will automatically render void the calibration and the certification of the meter.

The meter case is made of antistatic polycarbonate plastic glass filled 10%.

The top part of the meter houses an intimate communications hub interface (ICHI).

The middle part of the meter – the meter faceplate area – comprises the user interface with the LCD display, the metrology LED and the display buttons A and B.

The lower part of the meter – the terminal area – includes the main electricity ingress and egress terminals in addition to auxiliary connections and is protected by a removable terminal cover.
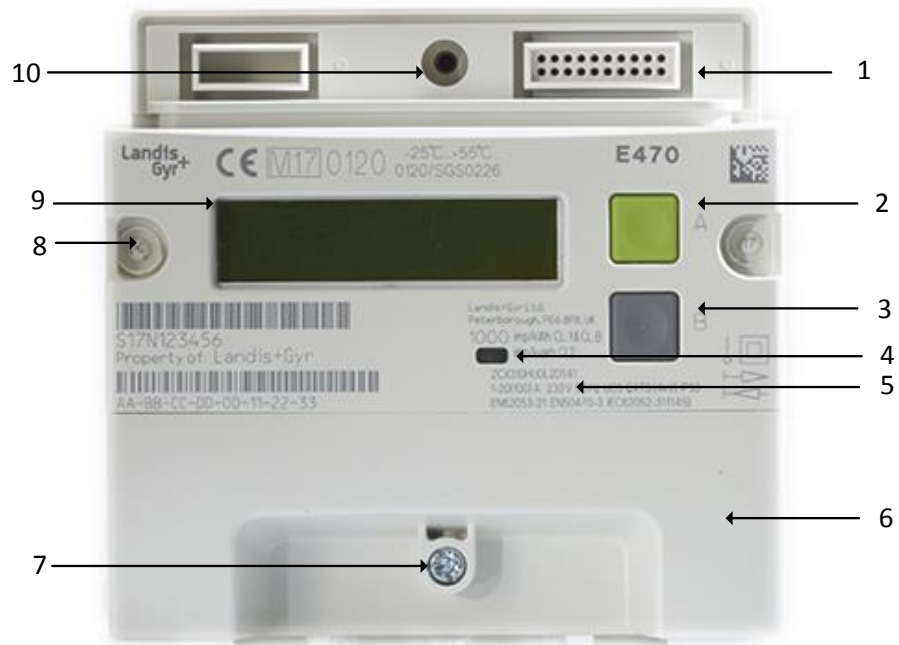


*Figure 1    Front view of meter*

1   Intimate communications hub interface (ICHI)
2   Display button A
3   Display button B
4   Metrology LED (red)
5   Faceplate: see Figure 4 for details
6   Terminal cover
7   Terminal cover sealing point: wire rope and ferrule
8   Meter case sealing (left and right side): ultrasonic stakes printed with the manufacturer's name (L+G) and the year of manufacture
9   Liquid crystal display (LCD)
10  ICHI sealing: secured by comms hub screw

## 4.2    Intimate communications hub interface (ICHI)

The intimate communications hub interface (ICHI) allows for the attachment of an intimate communications hub which, together with the meter, can support smart metering applications in accordance with the UK SMETS2 specification for smart metering.

Where the ICHI is not used (e.g. for install and leave applications), the meter must be fitted with a cover to restrict access to the ICHI. This is secured using a one-time tamper-resistant screw **and must be employed if the communications hub is not fitted due to the presence of dangerous voltage levels on the ICH interface.**

For SMETS2 operation, the ICHI provides power to an intimate communications hub in accordance with the ICHI specification promulgated by DCC. Note that power line communications (PLC) is not used in this model. Figure 2 shows the ICHI connectors.



*Figure 2    ICHI connections on front of meter*

1    ICHI PLC signalling connector location (not used)
2    ICHI power supply and digital signalling connector

Information about the pin allocation of the two ICHI connectors and further details about the ICHI can be found in the "Intimate Communications Hub Interface Specification" issued by DCC.

## 4.3    Meter faceplate

The user interface of the meter comprises the user interface with the LCD display, the metrology LED and the display buttons A and B.



| 1 | Display button A |
| 2 | Display button B |
| 3 | Metrology LED (red) |
| 4 | Liquid crystal display (LCD) |
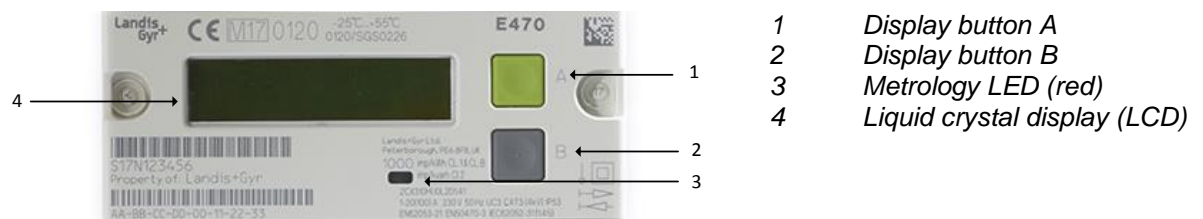
*Figure 3 User interface*

The following information markings are permanently laser etched directly onto the meter front.  Figure 4 shows an example layout.
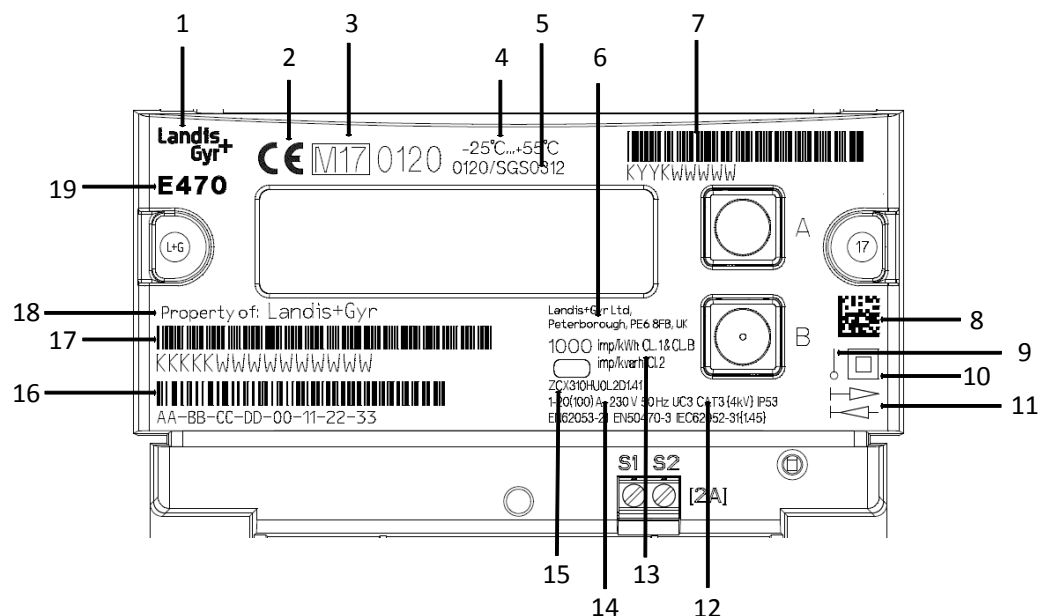


*Figure 4     Example Faceplate information markings*

1 - Manufacturer

2 - CE conformity symbol

3 - Year of manufacture

4 - Operating temperature range

5 -  Approval number

6 -  Manufacturer's address

7 - Serial number and barcode

8 - Manufacturing number (QR code)

9 - Type circuit symbol (single-phase two-wire network)

10 - Double protective insulation symbol

11 - Two energy direction symbol

12 - Utilisation classification of supply control switch

13 - Pulse constant of metrology LED and class for active and reactive measurement

14 - Nominal connection values

15 - Meter type designation

16 - Globally unique identifier (GIUD) and barcode

17 - Supplier asset tag and barcode (optional)

18 - Property designation

19 - Meter family designation

## 4.4 Control elements

The E470 meter features two push buttons (see Figure 3):

- Display button A (green) primarily used for scrolling through configured menus configured for the meter and selecting functions.

- Display button B (grey) used for locally re-connecting the supply and other display menu functions.

## 4.5 Metrology LED

The E470 features a single red colour metrology LED for indicating active or reactive energy pulses. The pulse constant (number of pulses per energy unit measured) of the metrology LED and class for active and reactive measurement is laser etched on the face plate above the metrology LED.

By default, the metrology LED will be set to the following conditions (during manufacture):

- The pulse constant is set as 1000 imp/kW(Var)h (in accordance with MID Class B; IEC Class 1)

- The pulse length is set to 20 ms.

By default, the metrology LED indicates active energy.

Below starting current, the metrology LED is permanently lit to indicate that the meter is in an 'anti-creep' status and the registers do not increment. The LED remains lit until the meter current is increased in a forward direction beyond the starting current.

## 4.6 LCD display

The E470 meter features a custom segmented liquid crystal display (LCD, see Figure 5.
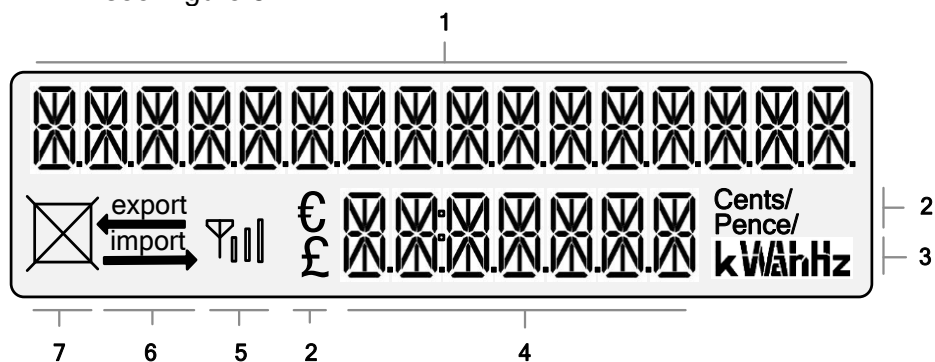


*Figure 5    Basic layout of the liquid crystal display (LCD)*

1   16 starburst (14 segment) characters for showing display headers and meter status
2   Currency indication including £, €, pence and cents per unit
3   Indication of units W, kW, Wh, kWh, var, kVar, Varh, VA, V, A, Hz
4   Maximum of 7 digits for showing register values
5   HAN signal indicator, showing when the device has joined a HAN and the signal strength of the wireless link (see section 6.4).
6   Energy direction indication (import, export)
7   Icon for supply control switch / supply status

The LCD display is fitted with a back light to illuminate the display. The back light operates following any button press for a time-period of 80

seconds following the last button press. The backlight is also illuminated on power up.

The meter can display messages built from the following character set. All display messages are defined using these characters (full ASCII set from 0x20 through to 0x7F plus special characters).

The following figures and characters can be shown. Unknown characters are shown as <space>.

| Hex | Dec | ASCII | LCD | Hex | Dec | ASCII | LCD |
|-----|-----|-------|-----|-----|-----|-------|-----|
| 20 | 32 | <space> | | | | | |
| 30 | 48 | 0 | | | | | |
| 31 | 49 | 1 | | | | | |
| 32 | 50 | 2 | | | | | |
| 33 | 51 | 3 | | | | | |
| 34 | 52 | 4 | | | | | |
| 35 | 53 | 5 | | | | | |
| 36 | 54 | 6 | | | | | |
| 37 | 55 | 7 | | | | | |
| 38 | 56 | 8 | | | | | |
| 39 | 57 | 9 | | | | | |
| 41 | 65 | A | | 61 | 97 | a | |
| 42 | 66 | B | | 62 | 98 | b | |
| 43 | 67 | C | | 63 | 99 | c | |
| 44 | 68 | D | | 64 | 100 | d | |
| 45 | 69 | E | | 65 | 101 | e | |
| 46 | 70 | F | | 66 | 102 | f | |
| 47 | 71 | G | | 67 | 103 | g | |
| 48 | 72 | H | | 68 | 104 | h | |
| 49 | 73 | I | | 69 | 105 | i | |
| 4A | 74 | J | | 6A | 106 | j | |

| Hex | Dec | ASCII | LCD | Hex | Dec | ASCII | LCD |
|---|---|---|---|---|---|---|---|
| 4B | 75 | K | | 6B | 107 | k | |
| 4C | 76 | L | | 6C | 108 | l | |
| 4D | 77 | M | | 6D | 109 | m | |
| 4E | 78 | N | | 6E | 110 | n | |
| 4F | 79 | O | | 6F | 111 | o | |
| 50 | 80 | P | | 70 | 112 | p | |
| 51 | 81 | Q | | 71 | 113 | q | |
| 52 | 82 | R | | 72 | 114 | r | |
| 53 | 83 | S | | 73 | 115 | s | |
| 54 | 84 | T | | 74 | 116 | t | |
| 55 | 85 | U | | 75 | 117 | u | |
| 56 | 86 | V | | 76 | 118 | v | |
| 57 | 87 | W | | 77 | 119 | w | |
| 58 | 88 | X | | 78 | 120 | x | |
| 59 | 89 | Y | | 79 | 121 | Y | |
| 5A | 90 | Z | | 7A | 122 | z | |

*Table 4     Display Character Set*

The following table shows the standard and special characters that can be used in the meter display.

| Standard ASCII Characters | | | | Special Characters | | | |
|---|---|---|---|---|---|---|---|
| **Hex** | **Dec** | **ASCII** | **LCD** | **Hex** | **Dec** | **ASCII** | **LCD** |
| **21** | 33 | ! | | 7F | 127 | **All segments** | |
| **23** | 35 | # | | A3 | 163 | **£** | |
| **25** | 37 | % | | BA | 186 | **Antenna** | |
| **28** | 40 | ( | | E2 | 226 | **Quadrant 1** | |
| **29** | 41 | ) | | E3 | 227 | **Quadrant 2** | |
| **2A** | 42 | * | | E4 | 228 | **Quadrant 3** | |
| **2B** | 43 | + | | E5 | 229 | **Quadrant 4** | |
| **2D** | 45 | - | | F7 | 247 | **Down arrow** | |
| **2F** | 47 | / | | F8 | 248 | **Up arrow** | |
| **3D** | 61 | = | | F9 | 249 | **Right arrow** | |
| **3F** | 63 | ? | | FA | 250 | **Left arrow** | |
| **40** | 64 | @ | | | | | |

*Table 5 Display standard and special characters*

## 4.7    Terminal area

The terminal area is protected by the terminal cover which can be removed only after breaking any protective seal that may have been applied. It includes the main electricity Supply ($L_{supply}$, $N_{supply}$) and Load($L_{load}$, $N_{load}$) terminals in addition to auxiliary connections (S1, S2).



*Figure 6     Front view of meter with removed terminal cover*

1    Auxiliary load control switch relay output S1 and S2
2    Terminal connections

The terminals have the following designations:
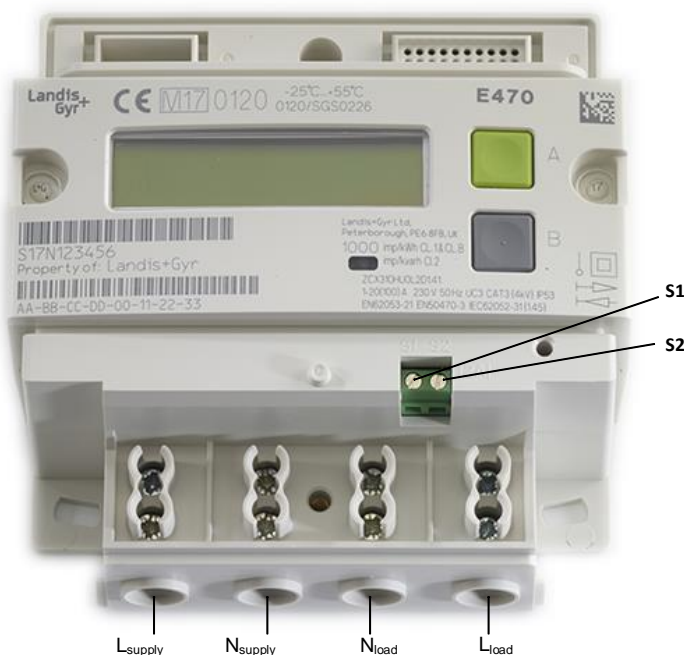


*Figure 7     Terminal designations*

### 4.7.1    Connection diagram

The following figure shows the connection diagram of the E470 meter.
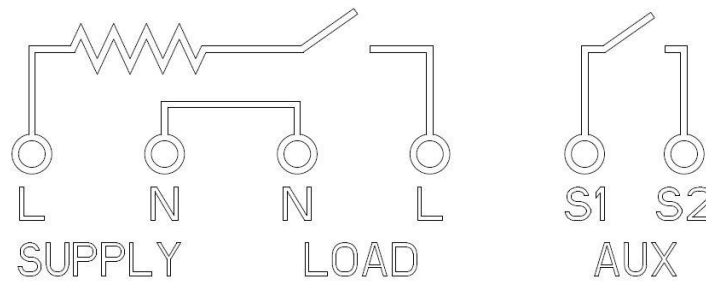


*Figure 8    Connection diagram*

The connection diagram is provided on the inside of the terminal cover.

### 4.7.2    Auxiliary load control switch relay output

The E470 meter has a single auxiliary load control switch (ALCS) relay output (terminals S1 and S2), for control of ancillary circuits such as off-peak heating.

The ALCS relay output is located at the right side of the meter directly above the main connection terminals (see *Figure 6*).

This output is a single pole voltage free non-latching relay rated at 230 V 2 A at unity and 0.5 pf.

The relay can be controlled by the following sources:

- ALCS calendar (time of use, using scripts in the independently controlled scheduler)

- GBCS messages (sent from outside the meter via the DCC)

These options are shown in *Figure 9*.

There are no specific priorities on the sources concerning the control; i.e. any new switch command, independent of its source, overrides the previous one.
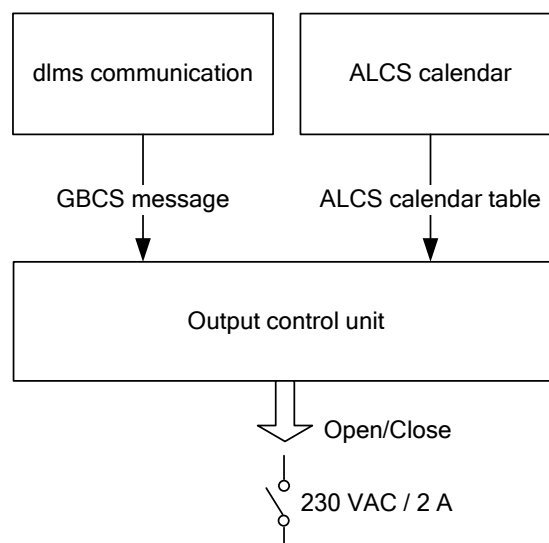


*Figure 9    Output control unit*

### 4.7.3    Dimensions

The meter dimensions and weight are detailed as:

Height:          98.1mm not including ICH interface

                     121.0mm including ICH interface

Width:          130.3mm

Depth:          68.3mm

Weight:         1 kg

Figure 10 displays details all the key dimensions of the meter.
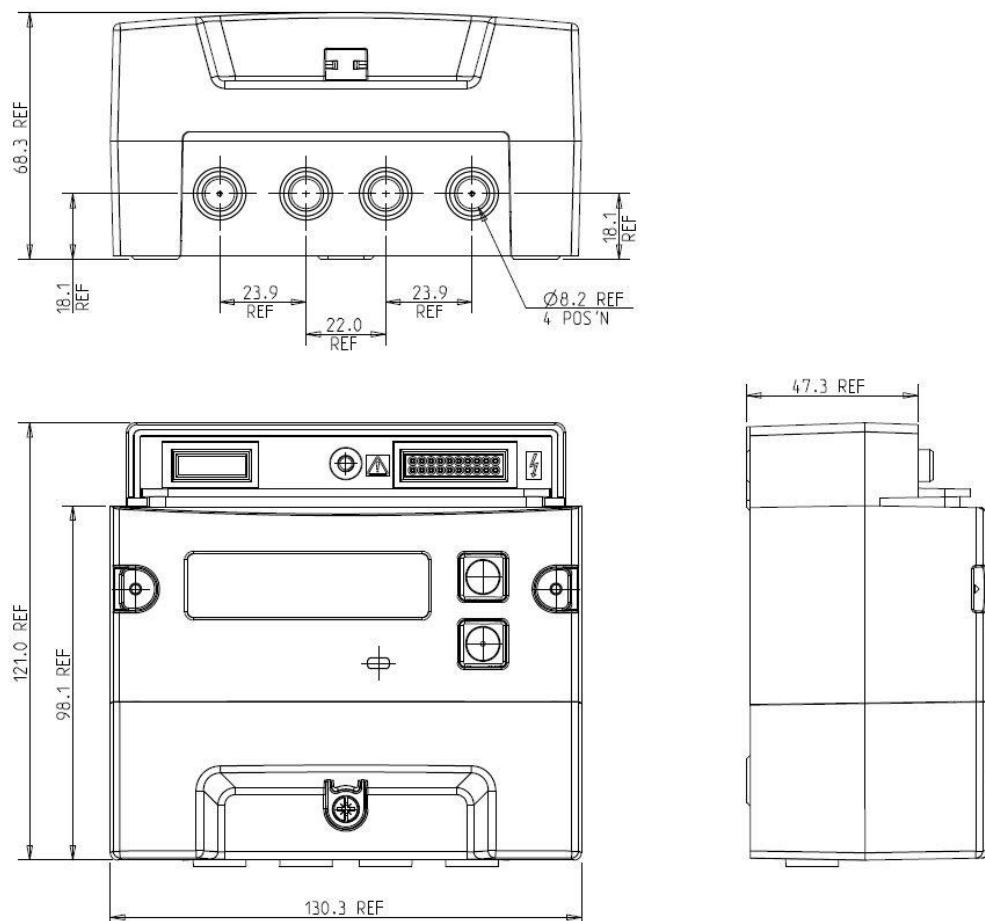


*Figure 10 Meter Dimensions*

### 4.7.4    Auxiliary cable strain relief method

To avoid unnecessary strain and possible damage to the auxiliary connector it is recommended that a strain relief solution is added as illustrated below:

*Figure 11 Auxiliary cable strain relief*

# 5 Meter Displays

## 5.1 Display and navigation structure

The E470 SMETS2 meter has a display structure which provides end users with information relating to the meter's operation. The structure is consistent between the two operational accounting modes, "Credit" and "Prepayment".

## 5.2 Display examples

The following section details the typical displays that are supported by the meter and includes the following:

- Time/date displays

- Total register displays

- Rate register displays

- Instantaneous value displays

### 5.2.1 Time displays

The meter supports the following time and date displays which always display local time.

| | |
|---|---|
| D a t e<br><br> 0 1 . 0 1 . 1 0 | The date is shown in the value field in format DD.MM.YY. |
| T i m e<br> 0 0 : 0 0 : 0 0 | The time is shown in the value field in format HH:MM:SS |

### 5.2.2 Total registers

The following is a list of display formats for total energy registers. Examples are shown with 5 significant figures and no decimal places, as per the meter display resolution (see section 8.2).

| | |
|---|---|
| T O T A L  A c t  I m p o r t<br>import→<br>  0 0 0 0 0 kWh | Total active import energy |
| T O T A L  A c t  E x p o r t<br>←export<br>  0 0 0 0 0 kWh | Total active export energy |
| T o t a l  ( s u m )<br>←export<br>import→<br>  0 0 0 0 0 kWh | Total active energy (sum) (import + export) |

| | |
|---|---|
| T o t a l   ( n e t )<br><br>export ←<br>import →                   0 0 0 0 0  kWh | Total active energy (net)<br>(import – export) |
| T o t a l   ( i n d . )   Q 1<br><br>0 0 0 0 0  kvarh | Total reactive energy quadrant 1<br>(import inductive) |
| T o t a l   ( c a p . )   Q 2<br><br>0 0 0 0 0  kvarh | Total reactive energy quadrant 2<br>(import capacitive) |
| T o t a l   ( i n d . )   Q 3<br><br>0 0 0 0 0  kvarh | Total reactive energy quadrant 3<br>(export inductive) |
| T o t a l   ( c a p . )   Q 4<br><br>0 0 0 0 0  kvarh | Total reactive energy quadrant 4<br>(export capacitive) |
| T o t a l   R e a   I m p o r t<br><br>import →                   0 0 0 0 0  kvarh | Total reactive import energy<br>(kvarh) |
| T o t a l   R e a   E x p o r t<br><br>export ←                   0 0 0 0 0  kvarh | Total reactive export energy<br>(kvarh) |
| T o t a l   A p p   I m p o r t<br><br>0 0 0 0 0  kVAh | Total apparent import energy<br>(kVah): +VA (QI+QIV) |
| T o t a l   A p p   E x p o r t<br><br>0 0 0 0 0  kVAh | Total apparent export energy<br>(kVah):  +VA (QII+QIII) |

### 5.2.3   Rate registers

The meter displays time of use (TOU) rates and block rated registers.

| | |
|---|---|
| R a t e   X X<br><br>import →                   0 0 0 0 0  kWh | TOU Rate xx - active import<br>energy (kWh)<br>(rates 1 to 48) |

```
┌─────────────────────────────┐
│  B l o c k   X X   T O U   X X │
│                               │
│  import→                      │
│              0 0 0 0 0  kWh   │
└─────────────────────────────┘
```

Block xx TOU Rate xx – active import energy (kWh) (Block 01 to 04, TOU Rate 01 to 08)

The import and export representation arrow is for Active energy only.

### 5.2.4    Instantaneous values

The meter displays instantaneous values for power, power factor, voltage, current, frequency and meter balance.

```
┌─────────────────────────────┐
│  P o w e r   A c t i v e      │
│                               │
│         x x x x x . x x  kW    │
└─────────────────────────────┘
```

Instantaneous Active Power (kW)

```
┌─────────────────────────────┐
│  P o w e r   R e a c t i v e  │
│                               │
│         x x x x x . x x   kVar │
└─────────────────────────────┘
```

Instantaneous Reactive Power (kvar)

```
┌─────────────────────────────┐
│  P o w e r   A P P A R E N T  │
│                               │
│      x x . x x         kVA     │
└─────────────────────────────┘
```

Instantaneous Apparent Power (kVA)

```
┌─────────────────────────────┐
│  P o w e r   F a c t o r      │
│                               │
│      x x x x . x x x           │
└─────────────────────────────┘
```

Power Factor

```
┌─────────────────────────────┐
│  V o l t a g e                │
│                               │
│      x x x x x x . x     V      │
└─────────────────────────────┘
```

Voltage (V)

```
┌─────────────────────────────┐
│  C u r r e n t                │
│                               │
│      x x x x x . x x     A      │
└─────────────────────────────┘
```

Current (A)

```
┌─────────────────────────────┐
│  F r e q u e n c y            │
│                               │
│      x x x x x x . x     Hz     │
└─────────────────────────────┘
```

Mains Frequency (Hz)

```
┌─────────────────────────────┐
│  C r e d i t   M o d e   B a l │
│                               │
│       £       x . x x          │
└─────────────────────────────┘
```

Meter Balance (Credit Mode)

### 5.2.5    Active firmware version

The meter can display the currently active firmware version of the meter. The top line shows the actual meter firmware version while the bottom line is for internal use. The current firmware version is also displayed on start up for approximately 2 seconds.

```
V X X . X X . X X . X X

   X X X X X
```
Active Firmware Version

### 5.2.6    MID displays

The meter can display the approved and calculated checksums (CRC).

```
A P P R   X X X X X X X

     M I D   C R C
```
Approved CRC

```
C A L C   X X X X X X X

     M I D   C R C
```
Calculated CRC

### 5.2.7    Charge displays

The meter can display the standing charge.

```
S t a n d i n g   C h a r g e

     £       x . x x
```
Standing charge
(pounds and pence)

## 5.3    Credit mode status displays

The following section details the displays that can be seen in the varying status that are supported when in credit mode of operation

### 5.3.1    Credit mode balance

Meter in credit mode, Supply On, Credit meter balance shown.

```
C r e d i t   M o d e   B a l

☐ import➔        £   0 . 0 0
```
Credit mode balance

### 5.3.2    Supply armed ready for reconnection

Meter in credit mode, Supply Armed ready for reconnection.

```
C R   P r e s s   B   f o r

⊠ import➔              E l e c
```
Press B for electricity reconnection

### 5.3.3    Supply disabled due to remote disconnection

Meter in credit mode, Supply disabled due to remote disconnection command.

```
┌─────────────────────────────────┐
│                                 │
│   C R   R e m o t e   c u t      │
│                                 │
│  ✕ import→              o f f    │
│                                 │
└─────────────────────────────────┘
```
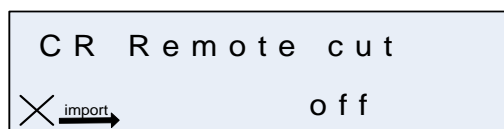
Supply disabled

### 5.3.4 Customer PIN enabled but not entered

Display when customer PIN enabled but not entered.  Supply status could be any of off, arm or on.

```
┌─────────────────────────────────┐
│                                 │
│   E l e c   S u p p l y          │
│                                 │
│  ⊠ import→         h h : m m     │
│                                 │
└─────────────────────────────────┘
```
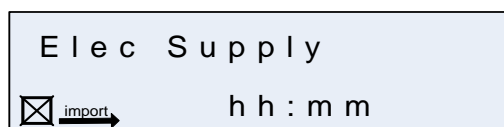
PIN enabled but not entered

### 5.3.5 Load limit exceeded

Display when customer has exceeded load limit Supply status armed.

```
┌─────────────────────────────────┐
│                                 │
│   L o a d   L i m i t            │
│                                 │
│  ▨ import→        P r e s s   B  │
│                                 │
└─────────────────────────────────┘
```
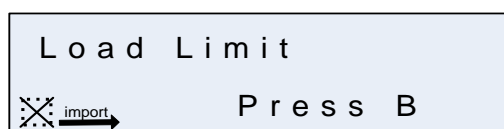
When load limit is exceeded the supply control switch box symbol flashes

## 5.4 Prepayment displays

The following section details the supported prepayment displays and the various scenarios that define the operation of the meter.

### 5.4.1 Remaining credit

```
┌─────────────────────────────────┐
│                                 │
│   B a l a n c e                  │
│                                 │
│            £   2 7 . 0 6         │
│                                 │
└─────────────────────────────────┘
```

### 5.4.2 Credit low

The meter can show when the remaining credit has fallen below the low credit level.

```
┌─────────────────────────────────┐
│                                 │
│   C r e d i t         L O W      │
│                                 │
│          £   x x . x x           │
│                                 │
└─────────────────────────────────┘
```
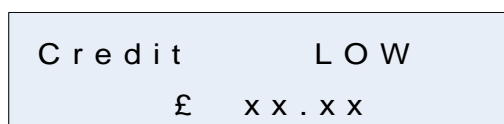
Credit Low

### 5.4.3 Credit exhausted and emergency credit available

Shown where the meter has exhausted its remaining credit and emergency credit is available for use.

```
┌─────────────────────────────────┐
│                                 │
│   O w e d             E m C r    │
│                                 │
│          £     0 . 0 0           │
│                                 │
└─────────────────────────────────┘
```

Emergency credit available, no remaining credit

### 5.4.4 Emergency credit available with remaining credit

The meter can display that emergency credit is available when the meter balance is above zero

```
Credit          EmCr
        £   01.51
```

Emergency credit available with remaining credit

### 5.4.5 Emergency credit accepted

When the user has chosen to accept emergency credit the meter will show a confirmation action to accept or reject emergency credit.

```
EC  Accept    A=NO
        B=  Yes
```

Accept emergency credit

### 5.4.6 Emergency credit accepted but not in use

Where the user has confirmed to accept emergency credit, but the meter balance has not fallen below the activation point the meter will display an alternating message between the accepted screen and the remaining credit screen.

```
Credit
        £   01.57
```

Emergency credit accepted but not in use

```
EmCr  Accepted
        £   05.00
```

### 5.4.7 Emergency credit accepted and in use

Once the meter has begun to use emergency credit the meter display will alternate the displayed information between the amount of emergency credit used and the amount that is remaining.

```
Owed
        £   01.51
```

Emergency credit in use

```
EmCr  Remaining
        £   03.49
```

### 5.4.8 Emergency credit low and owed

Where the emergency credit used has fallen below a low credit remaining value the meter will alternate between the value of emergency credit used and indicate low remaining emergency credit.

```
 O w e d

        £    0 4 . 0 0
```

Low remaining emergency credit

```
 E m C r           L o w

        £    0 1 . 0 0
```

### 5.4.9    Emergency credit exhausted and owed

Once the meter has exhausted its emergency credit amount, it will alternate its display with a zero-emergency credit remaining value and the amount of emergency credit owed.

```
 O w e d

        £    0 5 . 0 0
```

Emergency credit exhausted

```
 E m C r   R e m a i n i n g

        £    0 0 . 0 0
```

### 5.4.10   Prepayment displays with active non-disablement

Where the meter is in a non-disablement period the meter will display the character 'F' for the duration of the non-disablement period. The prepayment displays will operate in the same manner as described above. Examples of these can be seen below.

```
 C r e d i t                F

        £    x x . x x
```

Remaining credit – active non-disablement period

```
 C r e d i t     L O W      F

        £    x x . x x
```

Low credit – active non-disablement period

### 5.4.11   Emergency credit in use – active non-disablement period

```
 E m C r   R e m a i n i n g   F

        £    0 1 . 5 1
```

(alternating between remaining and used).

```
 O w e d                    F

        £    0 3 . 4 9
```

## 5.5    Debt management displays

The meter supports two types of debt collection, payment based and time based.

The following details the meter displays that support each debt operation.

### 5.5.1    Payment based debt displays

#### 5.5.1.1    Debt remaining

Where the meter is set up to perform payment based debt collection it will display the amount of debt that the customer has outstanding.

```
D E B T 3   R E M A I N I N G
      £    1 5 . 1 0
```
Debt remaining

#### 5.5.1.2    Debt collection percentage

The meter will display that amount of debt that will be collected from each top-up that will be performed (detailed as a percentage per payment).

```
D E B T 3   %   P E R   P M N T
           1 0   %
```
Debt collection percentage per payment

#### 5.5.1.3    Maximum debt collection per week

The meter will detail the maximum amount of debt that it will be able to collect per week from payment top-ups received.

```
D E B T 3   M A X   P E R   W K
      £    5 0 . 0 0
```
Maximum debt collection per week

#### 5.5.1.4    Debt amount paid

The meter will detail the total amount of debt that has been paid based on the payments that have been processed by the meter.

```
D E B T 3   A M N T   P A I D
      £    2 0 . 1 2
```
Amount of debt paid

### 5.5.2    Time based debt displays

#### 5.5.2.1    Debt remaining

Where the meter is set up to perform time based debt collection it will display the amount of debt that the customer has outstanding.

```
D E B T 1   R E M A I N I N G
      £    2 0 . 1 2
```
Amount of debt remaining

### 5.5.2.2    Debt collection interval

The meter will display that amount of debt that will be collected; detailing the time-period for each collection and the amount of money that will be collected at each interval.

```
D E B T 1  /      1 4 4 0 m i n

        £    0 0 . 4 0
```

Debt collection period

(One hour or one day)

### 5.5.2.3    Debt collection not configured

The meter will display a 'not configured' notification if it has not been set up to collect a time-based debt.

```
D E B T 1   N O T   C O N F I G

        £    0 0 . 0 0
```

Debt collection not configured

### 5.5.2.4    Debt amount paid

The meter will detail the total amount of debt that has been paid based on the payments that have been processed by the meter.

```
D E B T 1   A M N T   P A I D

        £    1 5 . 1 0
```

Amount of debt paid

# 6      Installation and Commissioning

**Do not touch live parts**
Dangers can arise from live electrical installations to which the meters are connected. Touching live parts is dangerous to life. All safety information should therefore be strictly observed.

## 6.1     Before installation

Before installation, the meter should be examined to check that the case and seals are intact. Should any damage be evident, the problem must be reported to a Landis+Gyr sales representative as soon as possible.

**Dangerous voltage on conductors**
The connecting wires at the place of installation must not be live when fitting the meter. Touching live parts is dangerous to life. The mains fuses should be removed and kept in a safe place until work is completed, so that they cannot be replaced by anyone unnoticed.

**Risks of not covering the intimate communications hub interface**
If the meter is supplied without a manufacturer supplied intimate communications hub interface (ICHI) cover, there are potential safety risks of installing the product and not fitting a cover, including accidental contact with an energy source.  Such a product should not be installed without an appropriate cover fitted over the ICHI connector (being a separately supplied ICHI cover or a communications hub) and the manufacturer shall not be liable for any consequences associated with the failure to fit such a cover.

**No over current protection and automatic disconnection**
As the meter has no internal overcurrent protection and no method of disconnection from the mains, this must be provided by the end installation.

**Protect supply control switch against overcurrent**
In case the meter has a supply control switch: as the supply control switch is not equipped with a thermal and/or short circuit protection device, it needs to be protected with an external fuse or oversupply control switch.

## 6.2    Mounting the meter

The meter should be mounted as follows on the meter board or similar device provided for this purpose.

1.  Find the correct meter position for mounting the meter.

2.  Define the desired form of fixing.

3.  Remove the main fuses and keep them in a safe place until installation is completed.  Ensure the connecting wires are NOT live and check this using a phase tester or universal measuring instrument.

4.  Mark the three fixing points (see the illustration below) on the mounting surface:

    -   Horizontal base of location points = 105 mm

    -   Height of suspension point = 110 mm
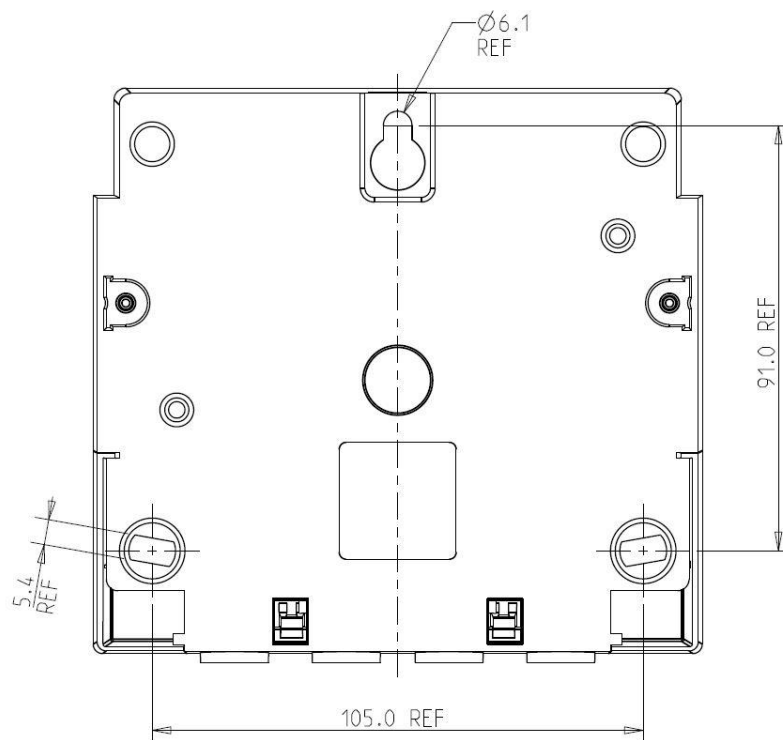


*Figure 12   Mounting points*

5.  Unscrew the meter terminal cover.

6.  Fit the meter with the three fixing screws.

## 6.3    Connecting the meter

### 6.3.1    Connecting the phase and neutral connection wires

1. Referring to *Figure 13*, cut and strip the connecting wires to the required length and then strip them.

---

⚠ **Insulate to correct length**
The insulation of the connecting line must extend as far as the terminal indentation, i.e. there must be no further bare part of the connecting line visible above the terminal edge. The stripped part of the connecting wire should be shortened if necessary.

---
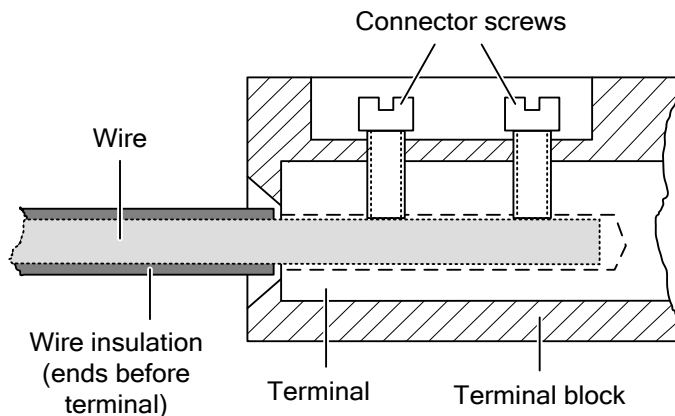


*Figure 13   Terminal connection*

2. Insert the phase connecting wires in the relevant terminals (see connection diagram *Figure 8*) and tighten the terminal screws firmly (torque max. 3 Nm). Do not overtighten the terminal screws.

   - For wires with small conductor cross-sections ($\leq 6$ mm$^2$) the connecting line must be placed carefully in the middle of the terminal, so that it cannot move sideways when tightening the terminal screws. When tightening, ensure that the connecting line remains between the copper inside the terminal and the screws.

   - It is recommended that the beginning and end of the relevant conductors are identified using a suitable test unit (e.g. buzzer) to ensure that the right consumer is connected to the meter output.

---

⚠ **Power losses at the terminals**
Failure to tighten terminal screws sufficiently can lead to power loss and heating.

---

ⓘ **Note**
A contact resistance of 1 m$\Omega$ causes a power loss of 10 W at 100 A.

---

⚠ **Damage to terminals**
Never withdraw connecting wires with the terminal closed, as this can damage the terminal.

---

### 6.3.2    Connecting a separate auxiliary load control switch

The auxiliary load control switch (ALCS) requires physical connection to the meter. This is performed by securing the two wires on the ALCS cable to the terminal block situated above the main connection terminals of the meter. An example of the ALCS connection can be seen in *Figure 14.*



*Figure 14   ALCS connection*

The following steps detail how to connect an ALCS to the electricity meter.

1. Ensure that the distribution fuse to the meter has been removed and the terminal cover is removed from the meter. Check that no power is present at the meter.

2. If not already done, remove the break-out points from the terminal cover to allow the cover to be reapplied without damaging the cable(s).

3. Unscrew the two screws within the ALCS terminal connection.

4. Place each wire into an associated terminal as shown in *Figure 14.*

5. Ensuring the cable is correctly positioned tighten up each terminal screw with a screwdriver until tight (torque 0.6 - 0.5 Nm.)

6. Ensure that the wires cannot be removed from the terminal arrangement.

7. Replace the terminal cover ensuring that the cable is not pinched, stretched or obstructed by the cover.

### 6.3.3    Connecting the intimate communications hub to the meter

The intimate communications hub is located on the top of the meter directly above the meter display.

To connect the hub to the meter the steps below should be followed:

1. Ensure that the connection points on top of the meter are free from any obstructions.  Remove any intimate communications hub interface cover that may be attached to the meter.

2.   Align the edges of the communication hub with the top of the main meter body.

3.   Slide the communication hub along the guides positioned on top of the meter to ensure that the two connection points are met.

4.   Continue to move the communications module towards the back of the meter until no further movement is possible.

5.   Securely tighten, but do not overtighten, the communication hub fixing screw following any guidance or instructions provided by the supplier of the communications hub.

## 6.4    Commissioning and functional check

**Dangerous voltage on conductors**
The mains fuses must be re-inserted before commissioning and functional check of the meter. Therefore, if the terminal cover is not screwed tight, there is a danger of contact with mains voltage at the connection terminals.

**Prerequisites for commissioning and functional check**
If no mains voltage is present, commissioning and functional check must be performed later.
Connectivity via WAN to the DCC and supplier systems is assumed to be available.

The installed meter should be commissioned into service and checked per the following procedure:

1.    Check smart meter WAN coverage at install site.

2.    Install meter communications hub as per section 6.3.3.

3.    Insert the mains fuses removed for installation. The meter is powered up in credit mode and the default display is initialised as shown below:

```
┌──────────────────────────────┐
│  R a t e   X X   A c t   I m p │
│                               │
│  ☐ import➜      0 0 0 0 0 kWh │
└──────────────────────────────┘
```

Active import display

4.    The communications hub is also powered and joins WAN. The address mappings are recorded on DCC system.

5.    Utility sends command 'CCS01 – Add Device to CHF Device Log' to the communications hub, to allow the meter to join the HAN. This command must contain the meter's MAC address, the install code for the device and an active time period during which the meter must find the HAN or the join will fail and the CCS01 command must be repeated.

## 6.5    HAN joining process

**Dangerous voltage on conductors**
The mains fuses must be re-inserted before commissioning and functional check of the meter. Therefore, if the terminal cover is not screwed tight, there is a danger of contact with mains voltage at the connection terminals.
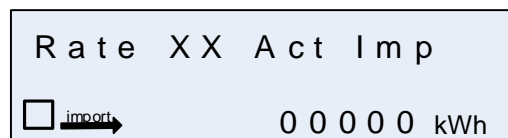
**Prerequisites for commissioning and functional check**
If no mains voltage is present, commissioning and functional checks must be performed later.
Connectivity via WAN to the DCC and supplier systems is assumed to be available.

The meter should be installed and the terminal cover must in place.

The meter provides two main methods of joining or re-joining the HAN:

Option 1 – Automatic process for initial installation (Preferred)

Option 2 – Manual process for use during initial installation

### 6.5.1    Option 1 - Automatic process (Recommended)

This is the recommended process for joining the HAN to enable successful commissioning of the E470 SMETS2 device.  The pairing & commissioning process will be initiated by the installer using the supplier systems and has been designed to be fully automated thereafter, assuming that there are no communication issues or other failures during the end-to-end process.

The steps shown below describe the 'happy path' installation and show the meter display at each point.  A combination of indications on the meter display and additional cues on the engineers' field hand held devices will provide updates on progress throughout the installation process. This document also describes how the installation engineer can validate that a meter has been properly commissioned and configured after the process has been completed.

### 6.5.1.1    HAN Join & Commissioning Steps

| Step number | Step entry action | Step Description | Associated Service Request Number | Display |
|---|---|---|---|---|
| 1 | Apply power | Powers up in credit mode default display (not service mode) | N/A | Rate XX Act Imp  import  0 0 0 0 0 kWh |
| 2 | Auto-scan for HAN | Meter automatically scans for the availability of a HAN on which the device has been whitelisted for 1 hour (60 minutes). | N/A | Rate XX Act Imp  import  0 0 0 0 0 kWh |
| 3 | Initiate Installation | Field engineer initiates the installation process on the Hand Held device which triggers a message from Supplier systems to whitelist the ESME device | SR8.11 – Update HAN Device Log | Rate XX Act Imp  import  0 0 0 0 0 kWh |

| 4 | Valid HAN Network Found | When the HAN is found the HAN signal indicator is shown on the display | N/A | R a t e   X X   A c t   I m p  ☐ import, 📶  0 0 0 0 0 kWh |
| 5 | Meter Notifies Supplier Systems of Successful Join | When the meter joins the HAN it notifies the Supplier systems via an I0 Response | SR8.11  I0 Response | R a t e   X X   A c t   I m p  ☐ import, 📶  0 0 0 0 0 kWh |
| 6 | Supplier Issues Commissioning Request | On receipt of an I0 response a commissioning request is sent to the meter | SR8.1.1 | R a t e   X X   A c t   I m p  ☐ import, 📶  0 0 0 0 0 kWh |
| 7 | Synchronise Clock with Comms Hub | On successful processing of the commissioning request, the meter will synchronise clocks with the comms hub | SR8.1.1 | R a t e   X X   A c t   I m p  ☐ import, 📶  0 0 0 0 0 kWh |
| 8 | Meter Notifies Supplier Systems of Successful Commissioning Request | When the meter synchronises its clock with the comms hub, it will notify the Supplier systems via an I0 response | SR8.1.1  I0 Response | R a t e   X X   A c t   I m p  ☐ import, 📶  0 0 0 0 0 kWh |

On successfully processing of SR8.1.1, the meter is commissioned and is capable of being configured with Supplier, Premise and Customer specific data via a series of commands issued as Service Requests from the Supplier systems.

1. Display and alerts

   a. If the HAN signal indicator persists on the display following a power cycle or HAN Join, then it means that the meter has successfully completed certificate based key exchange (CBKE) with the communications hub. If CBKE has not been completed, then the symbol will disappear from the display following a power cycle of the meter or HAN Join command. The signal strength indicator bars provide a guide to the signal present at the meter but do not give a calibrated indication of signal strength.

   b. On successful joining to the HAN the meter will immediately send an alert (0x8F69) via its WAN interface (if the organisational certificates in the meter are not registered to a supplier then this will not happen and the commissioning will cease at that point.)

    c. The meter will continue to search for a network for one hour. If in that time it fails to find a valid network to join then it will cease searching until a power cycle is applied or the 'HAN Join' function is activated from the meter front panel.

2. The meter sends a commissioning ping.

3. The supplier signs and submits commissioning request.
   The DCC inventory and mapping status is updated to "Commissioned".

4. The meter authenticates the commissioning request.

5. The meter synchronises to communications hub time. This can be checked by navigating to the time display (see figure below and refer to section 14.10).

| | |
|---|---|
| D a t e<br><br>    2 1 . 0 1 . 1 7 | The date is shown in the value field in format DD.MM.YY. |
| T i m e<br><br>    1 5 : 2 0 : 5 5 | The time is shown in the value field in format HH:MM:SS |

6. The meter sends a commissioning confirmation to the data service provider and to the network operator.

7. The utility sends a command to configure the meter (e.g. for tariffs, alert thresholds).

### 6.5.2 Option 2 – Manual HAN Join & Commissioning Process

It is recommended that the automatic process as described in Section 6.5.1 is used to join the meter to the HAN and commission the device.  In the event that the device is not successfully joined to the HAN during the 60 minute period that it automatically scans for a valid network, then the steps described below can be followed to manually complete the process.

Note that it is also possible to leave and join the HAN using the Service Menu – see section 19.2 for details.

### 6.5.3 HAN Join & Commissioning Steps

The installed meter should be joined to a HAN and checked per the following procedure once the communications hub has been installed as per Section 6.3.3:

| Step number | Step entry action | Step Description | Display |
|---|---|---|---|
| 1 | Issue SR8.11 (CCS01) Command | Issue the Service Request to the comms hub to whitelist the relevant device(s) | Not applicable |

| 2 | Apply power | Powers up in credit mode default display (not service mode) | R a t e   X X   A c t   I m p<br><br>☐ import ➔                    0 0 0 0 0 kWh |
| 3 | Press A | All segment display check | (All segment display check) |
| 4 | Press A | This offers the installer a chance to unlock PIN protected items. This is not necessary for commissioning.  This will only be offered if a PIN has previously been set. | E n t e r   P I N ?     A = N o<br><br>B = Y e s |
| 5 | Press A | Credit mode status display | C r e d i t   M o d e   B a l<br><br>☐ import         £   0 . 0 0 |
| 6 | Hold B | Customer Menu -> Manage PIN dialogue | M a n a g e   P I N ?   A = N o<br><br>B = Y e s |
| 7 | Press A | View event Log? | E v e n t s   L o g ?   A = N o<br><br>B = Y e s |
| 8 | Press A | View power log? | P o w e r   L o g ?   A = N o<br><br>B = Y e s |
| 9 | Press A | Manage ALCS | A L C S ?           A = N o<br><br>B = Y e s |
| 10 | Press A | Manage HAN | H A N ?             A = N o<br><br>B = Y e s |
| 11 | Press B | Re-join (Join) HAN? | R e j o i n   H A N ?   A = N o<br><br>B = Y e s |
| 12 | Press B | 'HAN Joining' message | H A N   J o i n i n g . . . |

| | | | |
|---|---|---|---|
| **13** | Wait few seconds | Meter may display 'HAN Join Failed' because CBKE has not completed within time limit (few seconds). However, CBKE process will continue. Next step is to check if this has actually completed. | H A N   J o i n   F a i l e d |
| **14** | Wait few seconds | Default Customer Menu display is displayed | M a n a g e   P I N ?   A = N o    B = Y e s |
| **15** | Wait 30 seconds | The meter returns to the Default Credit mode display after 30 seconds. | R a t e   X X   A c t   I m p    import ▸ ▾ⁱ||      0 0 0 0 0  kWh |
| **16** | Retry HAN Join | If the 'HAN Join Failed' Repeat steps 3 to 11 to retry the join process | See Steps 3 to 11 |
| **16** | Wait few seconds | Wait a few seconds without pressing any buttons to return to the Customer Menu -> Manage PIN dialogue | M a n a g e   P I N ?   A = N o    B = Y e s |
| **17** | Wait 30 seconds | Wait for 30 seconds to return to the default Credit mode  display . | R a t e   X X   A c t   I m p    import ▸ ▾ⁱ||      0 0 0 0 0  kWh |
| **18** | Meter Notifies Supplier Systems of Successful Join | When the meter joins the HAN it notifies the Supplier systems via an I0 Response (Join Success) | R a t e   X X   A c t   I m p    import ▸ ▾ⁱ||      0 0 0 0 0  kWh |
| **19** | Supplier Issues Commissioning Request | On receipt of successful join response a commissioning request is triggered to the meter | R a t e   X X   A c t   I m p    import ▸ ▾ⁱ||      0 0 0 0 0  kWh |
| **20** | Synchronise Clock with Comms Hub | On successful processing of the commissioning request, the meter will synchronise clocks with the comms hub | R a t e   X X   A c t   I m p    import ▸ ▾ⁱ||      0 0 0 0 0  kWh |
| **21** | Meter Notifies Supplier Systems of Successful Commissioning Request | When the meter synchronises its clock with the comms hub, it will notify the Supplier systems a success response | R a t e   X X   A c t   I m p    import ▸ ▾ⁱ||      0 0 0 0 0  kWh |

## 6.5.4    Meter Commissioned Check

Examples of the types of information that can be passed to the meter during initial commissioning and configuration of the device and subsequently checked using the display on the meter are as follows:

- Meter Commissioned Check
- Active Tariff Price
- MPXN Check
- Supplier Contact Details

The meter display does not change, or provide any feedback to the field service agent whilst the configuration is applied, but it is expected that they will receive confirmation that it has all been applied successfully via their hand held unit.  On receipt of such confirmation, the field service agent can check that the meter has been successfully commissioned and all configurations have been properly applied by querying the meter via a series of button presses.  The actions that can be taken are described below.

This check can be performed either by entering the Customer Menu on the meter or by accessing the Service Menu (requires removal of terminal cover seal). Both methods are described below.

### 6.5.4.1  Commissioned Check via Customer Menu

Note that the following sequence does not include any dialogues associated with entering the Privacy PIN on the meter as it is assumed that the privacy pin will not have been set immediately following device installation and commissioning.  If the PIN had subsequently been set then the PIN entry dialogue would appear after step 2 below.

| Step number | Step entry action | Step Description | Display |
|---|---|---|---|
| 1 | Start at the default Total Active Import Display | The normal default display of Total Active Import should be displayed on the meter. | R a t e   X X   A c t   I m p <br> import 📶  0 0 0 0 0  kWh |
| 2 | Navigate to All Segment Display Check | Press button A briefly (< 2 s) from the default display. All segments of the LCD are lit (display check). | (all segments lit display check) |
| 3 | Navigate to Credit Mode Status Display | Press button A briefly (< 2 s). To access the credit mode status display. | C r e d i t   M o d e   B a l <br> import  £  0 . 0 0 |
| 4 | Access the Customer Menu | Press and hold button B longer (≥ 2 s) to access the Customer Menu on the meter.  The first menu item is Manage Pin? | M a n a g e   P I N ?   A = N o <br> B = Y e s |

| 5 | Navigate to Rejoin HAN item | Scroll through the Customer Menu items with short presses of button A until the Rejoin HAN option is shown. | R e j o i n   H A N |
|---|---|---|---|
| 6 | Select Rejoin HAN menu item | Press button B to select the Rejoin HAN option | R e j o i n   H A N ?  A =  n o<br><br>B = y e s |
| 7 | Confirm selection to Rejoin HAN | Press button B to confirm that rejoining of the HAN. | H A N   J o i n i n g .  .<br><br>( c ) |
| 5 | Check Commissioned Status | The installation agent can determine if the meter has been properly commissioned by check for the presence of a lower case 'c' in brackets in the bottom right hand corner of the display. **NB: This symbol is displayed on the meter when it has successfully synchronised clocks with the comms hub** | H A N   J o i n   O K<br><br>( c ) |
| 6 | Meter returns to top of Customer Menu | After 3 seconds the meter will return to the top of the Customer Menu to show the first item which is "Manage PIN". | M a n a g e   P I N ?   A = N o<br><br>B = Y e s |
| 7 | Exit Customer Menu | Scroll through the customer menu using button A until the Exit Menu option is reached and press button B to leave the customer menu. | E x i t   M e n u |

### 6.5.4.2 Commissioned Check via Service Menu

| Step number | Step entry action | Step Description | Display |
|---|---|---|---|
| 1 | Access Service Menu | Remove the terminal cover screw until the Service Menu is activated. The first item in the Service Menu (In Service Test or IST mode option) will be shown when the terminal cover tamper switch is activated – if this has not happened when the screw is fully loosened sliding the terminal cover out by a small amount may be needed to activate the tamper switch.  Note, the terminal cover should not be fully removed at this point. | I S T ?                    A = N o<br><br>B = Y e s |

| 2 | Navigate to HAN? Menu item | Press button A briefly (< 2 s) to show the HAN? menu item | H A N ?                A = N o<br><br>                   B = y e s |
| 3 | Select HAN? option | Press button B briefly (<2 s) to select the HAN option | L e a v e   H A N ?   A = N o<br><br>                   B = Y e s |
| 4 | Choose leave HAN option | Press button B longer (< 2 s) to select the Leave HAN option. The (c) commissioned indicator will appear if the meter has been previously and properly commissioned. | H A N   L e a v i n g . .<br><br>                   ( c ) |
| 5 | Check Commissioned Status | The installation agent can determine if the meter has been properly commissioned by check for the presence of a lower case 'c' in brackets in the bottom right hand corner of the display. **NB: This symbol is displayed on the meter when it has successfully synchronised clocks with the comms hub** | H A N   L e f t   O K<br><br>                   ( c ) |
| 6 | Meter returns to top of Service Menu | After 3 seconds the meter will return to the top of the Customer Menu to show the first item which is "IST?". | I S T ?                A = N o<br><br>                   B = Y e s |
| 7 | Exit Service Mode | The meter will automatically timeout and return to the total active import display after 5 minutes. | T o t a l   A c t   I m p o r t<br><br>☐  ▼ıll              0 0 0 0 0 kWh |

## 6.5.4.3   Active Tariff Price

Note that the following sequence does not include any dialogues associated with entering the Privacy PIN on the meter as it is assumed that the privacy pin will not have been set immediately following device installation and commissioning. The all test display has also been omitted although it may be shown depending on the status of the display and previous button presses.

| Step number | Step entry action | Step Description | Display |
|---|---|---|---|
| 1 | Access the credit mode status display | The normal default display of Total Active Import should be displayed on the meter. | R a t e   X X   A c t   I m p<br><br>☐ import, ▼ıll        0 0 0 0 0  kWh |

| 2 | Navigate to Credit Mode Status Display | Press button A briefly (< 2 s). To access the credit mode status display (example shown). | C r e d i t   M o d e   B a l<br><br>□ import →            £   0 . 0 0 |
| 3 | Navigate to Active Tariff Price | From the default Rolling Register Display Screen (credit display shown) Press Button A (for <2 seconds) several times until the Active Tariff Price is displayed. The Active Tariff Price display will show the pence per unit rate for the current active tariff.  In the case of a single rate tariff there will only be one tariff.  For a multi-rate tariff, the display will default to the rate that is applicable at that time i.e. the day rate will be shown during the daylight hours and the night rate during the night hours. The installation engineer can use this function to check that a tariff and prices has successfully been applied | A c t v   T a r i f f   P r i c e<br><br>□ import →            £   0 . 0 0 |
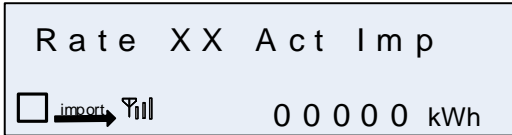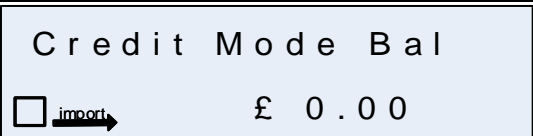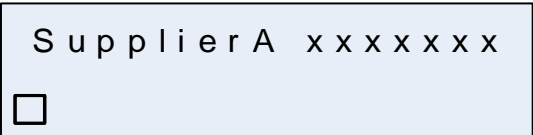
### 6.5.4.4    MPAN Check

Note that the following sequence does not include any dialogues associated with entering the Privacy PIN on the meter as it is assumed that the privacy pin will not have been set immediately following device installation and commissioning.  The all test display has also been omitted although it may be shown depending on the status of the display and previous button presses.

| Step number | Step entry action | Step Description | Display |
| --- | --- | --- | --- |
| 1 | Total Active Import | The normal default display of Total Active Import should be displayed on the meter. | R a t e   X X   A c t   I m p<br><br>□ import → ▒▒▒         0 0 0 0 0  kWh |
| 2 | Navigate to the Credit Mode Status display | Press button A briefly (< 2 s). To access the credit mode status display (example shown). | C r e d i t   M o d e   B a l<br><br>□ import →            £   0 . 0 0 |
| 3 | Access rolling register display list | From the status display press and hold Button A (for >2 seconds) to access the rolling register display list.  Then press button A several times to navigate to the MPAN Display The installation agent can check that the correct MPAN has been configured on the meter during the installation process | M P A N<br><br>□ |

### 6.5.4.5 Supplier Contact Details Check

Note that the following sequence does not include any dialogues associated with entering the Privacy PIN on the meter as it is assumed that the privacy pin will not have been set immediately following device installation and commissioning. The all test display has also been omitted although it may be shown depending on the status of the display and previous button presses.

| Step number | Step entry action | Step Description | Display |
|---|---|---|---|
| 1 | Total Active Import | The normal default display of Total Active Import should be displayed on the meter. | R a t e   X X   A c t   I m p<br><br>☐ import Yıl                 0 0 0 0 0  kWh |
| 2 | Navigate to the Credit Mode Status display | Press button A briefly (< 2 s). To access the credit mode status display (example shown). | C r e d i t   M o d e   B a l<br><br>☐ import              £   0 . 0 0 |
| 3 | Access rolling register display list | From the status display Press and hold Button A (for >2 seconds) to access the rolling register display list. Then press button A several times to navigate to the Supplier Contact Details Display The installation agent can check that the correct supplier details have been configured on the meter during the installation process | S u p p l i e r A   x x x x x x x<br><br>☐ |

NB: A change request is being raised that will move the Supplier Contact Details display to the main credit display sequence, immediately after the Active Tariff and Active energy import (+A) Total displays. This document must be updated on delivery of the change to reflect the new position.

# 7    Security aspects

## 7.1    General

The E470 meter meets all SMETS2 requirements, including security requirements, which include the following aspects:

- Commercial Product Assurance (CPA) Compliance

- Management and protection of security credentials, personal data and integrity of other devices connected to the meter

- Rejection of commands other than those specified by GBCS

- Integrity of meter firmware

- Logging of any security-related events in a protected security log

- Cryptographic protection of commands, responses and alerts sent to and from the meter using public key encryption including unique keys for each meter

- Role-based access control for restricting authorisation to execute commands and of issuing alerts per the role permissions

- A secure method for updating firmware

- Protection of all meter interfaces against unauthorised access

- Protection against replay attacks

## 7.2 Tamper protection

The meter features the following tamper protection measures:

1. Sealing: The meter case, the terminal cover and the ICHI are protected by means of seals.

2. Fraud detection: The meter detects strong magnetic fields and removal of main cover and terminal cover and such events are recorded in the meter security log.

3. Security log: The security log contains all events related to the detection of fraud attempts e.g. removal of terminal cover, removal of meter main cover, credential update, unauthorised GBCS access, etc.

### 7.2.1 Sealing

The meter sealing points are shown in *Figure 1* in section *4 "Physical description"*.

### 7.2.2 Fraud detection

The meter supports the following fraud detection features:

- Detection of terminal cover removal

- Detection of main cover removal

- Detection of strong DC (magnetic) field

If a terminal cover removal, main cover removal or strong magnetic field is detected, the corresponding event is triggered and stored in the security log.

The detection of a strong magnetic field is achieved using the on-board measurement chip. Since magnetic fraud is detected by the measurement chip, the detection can only be done when the meter is properly powered from mains.

The meter can also be configured to disconnect the supply load switch on detection of a tamper event. Where disconnection has been configured the contactor state is changed to ready-for-reconnection.

## 7.3    Calendar clock accuracy and settings

For information regarding calendar clock accuracy and settings please see section 3.5.

## 7.4    Security log

The supplier is advised to regularly review the security log for unexpected entries, frequently enough that all log entries are read before being over-written (the security log has a size of 100 entries and the content of the logs are available to view on the meter LCD display or remotely).

In case of a security event, the security log can be read on-site on the LCD via the Service Menu display after corresponding navigation using the buttons A and B as shown in *Figure 22* in section 14.2.

Note that access to the security log requires a breach of the meter terminal cover to enable the Service Menu.

The security log can also be read by the remote parties using GBCS command ECS35b "Read ESME Security Log".

The security log is protected against deletion and filtering out of security events.

## 7.5    Communication with other devices

The meter is fitted with an internal ZigBee communication module for the transmission and receipt of data to and from the separate communications hub device.

Communication with an external head end system (HES) gives the energy utility the ability to remotely program individual or multiple meter points, including tariff plans and configuration details

Support of Over the Air (OTA) firmware upgrades allows new functionality to be sent to the meter. OTA ensures that the meter is future proofed and mitigates the need to visit the meter when essential changes are required.

ZigBee Low Power Radio communication is also used to communicate with other smart devices connected via the HAN including the in-home-display (IHD) which allows the consumer to view real-time usage and pricing information.

## 7.6    Data reconciliation

It is recommended that the energy utility regularly reconciles data read from the meter with data expected to be present because of commands sent e.g. meter account information and available credit.

## 7.7    Unique transaction reference number (UTRN)

Each Add Credit Command contains a unique transaction reference number (UTRN). The authentication components of the UTRN acceptance are detailed below:

- If during the execution of an Add Credit Command, the UTRN in the command has already been entered (when compared to the last 100 verified Prepayment top-up transactions (PTUT)), then a "Duplicate UTRN entered" event is triggered and stored in the security log.

- If the value of the UTRN in any Add Credit Command is greater than the Maximum Credit Threshold, then a "UTRN exceeds Maximum Credit Threshold" event is triggered and stored in the security log.

- If the authentication of any UTRN processed as part of an Add Credit Command fails, then a "UTRN not Authentic" event is triggered and stored in the security log.

- If during the processing of any UTRN as part of an Add Credit command it is determined that the meter is not the intended recipient of the UTRN, then a "UTRN not for this Device" event is triggered and stored in the security log.

## 7.8    Security credentials

The meter uses a combination of public/private keys, certificates and identification numbers to ensure the security of the smart meter system.

The security credentials of the meters will be produced and configured in the meter as follows during manufacturing:

1. Landis+Gyr applies MAC and ZigBee certificates to meter.

2. Landis+Gyr initialises meter and inserts organisational certificates. This includes all the configuration data required as part of the meter manufacturing process.

3. Landis+Gyr generates meter private and public key pairs.

4. Landis+Gyr confirms that correct credentials are loaded onto the meter and issues certificate signing requests (CSR) to the energy supplier.

5. Landis+Gyr issues the public certificates.

6. The energy supplier sends the CSR received to the Smart Metering Key Infrastructure (SMKI) of DCC. The supplier will manage this step, using DCC Pre-Installation Notification Service (GBCS CS02 command).

7. SMKI returns the approved certificates back to the energy supplier (this could take up to 7 days).

8. The energy supplier sends the approved certificates to Landis+Gyr.

9. Landis+Gyr updates its CSR store, customises the meter and delivers it to the supplier.

# 8   Energy Registers

## 8.1   Overview

SMETS2 E470 meters record 12 total energy registers, one for each of the metered quantities.  In addition, there are 80 energy registers that can be used for charging as follows: 48 for time-of-use charging, and 32 for 8 time-of-use with 4 consumption block charging.

Up to 12 measured quantities (ME1 to ME12) can be recorded in the 12 total energy registers. The meter can collect 2 average demand registers running through the integration period and 2 average demand registers from the last integration period (ME1 and ME2).  These registers can be read and stored in the various profiles.
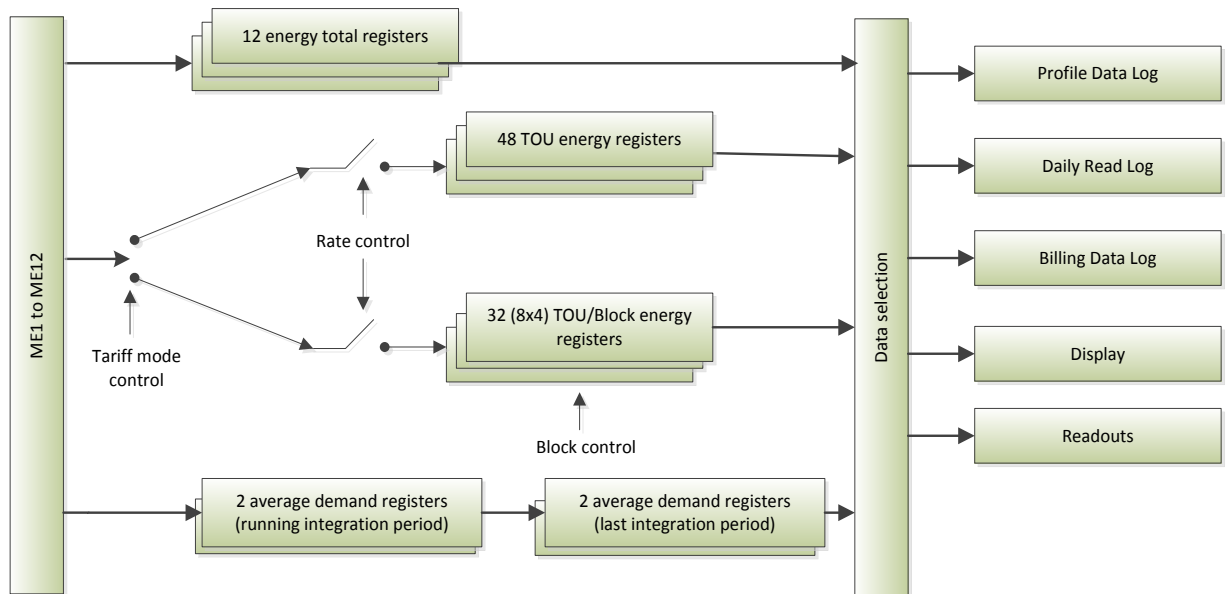


*Figure 15 Energy register overview*

The 12 measured quantities ME1 to ME12 are defined in the table below:

| Ref | Metrology |
|---|---|
| ME1 | Total active import energy:  +A(QI+QIV) |
| ME2 | Total active export energy: -A(QII+QIII) |
| ME3 | Total active energy (combined, import + export): [+A] + [-A] |
| ME4 | Total active energy (combined, import – export): [+A] - [-A] |
| ME5 | Total reactive energy (import inductive): R (QI), + Ri |
| ME6 | Total reactive energy (import capacitive): R (QII), + Rc |
| ME7 | Total reactive energy (export inductive): RQIII), - Ri |
| ME8 | Total reactive energy (export capacitive): R (QIV), - Rc |
| ME9 | Total reactive export energy: +R (QI+QII) |
| ME10 | Total reactive import energy: -R (QIII+QIV) |
| ME11 | Total apparent import energy: +VA (QI+QIV) |
| ME12 | Total apparent export energy: +VA (QII+QIII) |

## 8.2 Resolution

The internal meter energy registers have a resolution of 1 Wh (VArh, VAh) with a range from 000,000.000 to 999,999.999 kWh.

In normal operation, the energy registers are displayed using 5 digits on the lower line of the display and no decimal places. However, energy registers can also be displayed with 2 decimal places when in IST display mode (see section 14.12.1).

In normal operation, the energy registers are displayed truncated to 0 decimal places. This leads to the loss of the un-displayed digits, hence the value displayed is slightly less than that stored. Accurate register display is achieved by putting the meter into IST mode.

## 8.3 Accuracy

The measurement accuracy of the meter is in accordance with the following standards:

- MID Class B for active energy (kWh) (within 1% accuracy)
- IEC Class 2.0 for reactive energy (kVArh) (within 2% accuracy)

## 8.4 Total energy registers

The SMETS2 E470 device features 12 total energy registers containing active, reactive and apparent energy for both import and export. Combined totals are also provided in some cases.

All the registers are updated with values from the measurement system at a maximum of once per second.

All registers contain cumulative values in Wh, VArh or VAh. The representation is settable per energy registers group – in Wh (VArh, VAh) or in kWh (kvarh, kVAh) with up to 3 decimal places.

The total energy registers can be stored in profiles, read out via communication or shown on display.

## 8.5 Rated energy registers

The SMETS2 E470 device features 48 active imports rated registers for use with time-of-use tariffs and 32 (8x4) active import rated registers for use with time-of-use with consumption block tariffs.

All rated energy registers contain values in Wh, VArh or VAh. The representation is settable per energy registers group – in Wh (VArh, VAh) or in kWh (kvarh, kVAh) with up to 3 decimal places.

The rated energy registers can be stored in profiles, read out via communication or shown on display.

## 8.6 Average and maximum demand

Every 30 minutes the meter calculates the demand (average power). If the latest calculated demand is greater than a stored maximum, then the maximum is updated.

There are four registers for average demand of active import and active export over the current half-hourly integration period and the previous half-hourly integration period.

There are three maximum demands: maximum demand for active import power, maximum demand for active export power and maximum demand for active import power (with a configurable time window).

If T is the period and E the energy consumed during this period, then the demand at the end of the period should be: $D = E * 3600 / T$

T in seconds, E in Wh, D in Watts.

The demand register associated to the maximum demand (configurable time) object runs in background all the time. However, the maximum is updated only during a certain period of the time each day.

# 9      Configuration

## 9.1     Introduction

The configuration defines the functional range of the meter as well as the physical hardware.

For the E470 SMETS2 meter a standardised default configuration is used for all customers. Only the following features can be specified by the customer at order time using the corresponding order document:

- Firmware version (if not the latest issue)

- Laser etched property information on faceplate

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ⓘ      **Part of configuration can be altered in the field**
Certain items are remotely configurable via the DCC.

---

## 9.2     Default hardware configuration

The E470 SMETS2 meter has the following default hardware configuration:

- Accuracy: Class 1 (IEC) B (MID), for active energy; Class 2 (IEC) for reactive energy

- Voltage range: 1 x 230 V

- Current Ibase (Imax): 20 (100) A

- Measured quantities active or reactive: bidirectional, 4Q reactive energy

- Voltage inscription on faceplate: 230 V

- Current inscription on faceplate: 1-20 (100) A.

- Terminal cover screws: Posi-drive combi

## 9.3     Default software configuration

The E470 SMETS2 meter has the following default software configuration:

| Configuration item | Description | Default configuration | Unit / Type | Remotely configurable via DCC |
|---|---|---|---|---|
| **Display Settings** | | | | |
| Decimal Point Configuration | How meter readings are displayed on the meter's display in terms of the number of digits displayed before and after the decimal point | 5 digits before the decimal point and 0 after | No. of most significant digits/No of least significant digits | No |
| Privacy PIN Protection | A four-digit number used by the consumer to enable temporary access to a specified set of display items and commands via the meter's user interface. | Disabled | Enabled/ Disabled | Yes (PIN protection can be disabled remotely) |
| **Daylight Saving Time Settings** | | | | |
| UK Standard DST settings | Specifies the DST settings that are used by the meter for generating local time. | UK Standard DST settings are used. | UK Standard DST settings | No |

| Configuration item | Description | Default configuration | Unit / Type | Remotely configurable via DCC |
|---|---|---|---|---|
| **Payment Mode** | | | | |
| Payment Mode | The payment mode in operation on the meter which is either Credit or Prepayment. | Credit Mode | Credit/ Prepayment | Yes |
| **Tariff and Charges Settings** | | | | |
| Currency Units | The currency units currently used by the meter, which shall be either GB Pounds or European Central Bank Euro | GB Pounds | GBP/Euros | Yes |
| Tariff Matrix in Use | The type of tariff matrix that is active on the meter at point of manufacture, either Tariff TOU Register Matrix or Tariff TOU Block Register Matrix | Tariff Time of Use Register Matrix | Tariff ToU Register Matrix or Tariff TOU Block Register Matrix | Yes |
| Number of Rates and Blocks | The number of rates configured (if TOU only) or the number of rates and blocks (if TOU with Block tariff). | Single rate | Number of rates or rates and blocks | Yes |
| Tariff Rate | The Active tariff price per kWh | £0.00 | currency per kWh | Yes |
| Standing Charge | The charge to be levied per unit of time on the meter (credit and prepayment mode) | £0.00 | currency per unit time | Yes |
| Season Profile | The season table allows definition of up to 4 seasons. It defines, for each season, the week profile to be used during that part of the year. | Single season across the year | OCTET-STRING defining up to 4 seasons and associated week tables | Yes |
| Week Profile | The week table defines which Day Profile to be used on each of the days of the week. | The same day profile allocated on each of the days Monday to Sunday | INTEGER defining the day table to be used on each day of the week | Yes |
| Day Profiles | The Day table defines how consumption is allocated to tariff registers and switching points to be used throughout a day profile. Up to 16 tariff day profiles can be defined. | Single day profile specifying a single rate to be used throughout the day | Table Identifier | Yes |
| Special Days | Up to 50 tariff special days can be defined either specific dates in the year or recurring dates using wildcards | Array of Zero Entries (no special days defined for the tariff calendar) | Dates including wildcards/day profile identifier | Yes |
| **Prepayment Settings** | | | | |
| **Emergency Credit Threshold** | The threshold in currency units below which Emergency Credit may be activated, when the meter is operating in Prepayment Mode | £0.00 | Currency units | Yes |

| Configuration item | Description | Default configuration | Unit / Type | Remotely configurable via DCC |
|---|---|---|---|---|
| Disablement Threshold | The threshold in currency units for controlling when to disable the supply in Prepayment Mode | £0.00 | Currency units | Yes |
| Emergency Credit Limit | The amount of Emergency Credit in currency units to be made available to a Consumer where Emergency Credit is activated | £0.00 | Currency units | Yes |
| Low Credit Threshold | The threshold in currency units below which a low credit alert is signalled | £0.00 | Currency units | Yes |
| Maximum Credit Threshold | The maximum credit which can be applied by any Add Credit Command | £100.00 | Currency units | Yes |
| Maximum Meter Balance Threshold | The meter balance threshold in currency units above which an Add Credit Command is rejected | £3000.00 | Currency units | Yes |
| Non-disablement calendar | A switching table comprising a set of rules specifying periods during which the supply will not be disabled due to insufficient credit balance on the meter in Prepayment Mode. The calendar defines which of 5 Day Profiles should be used during up to 20 Special Days | Array of Zero Entries (no special days defined for the tariff Non-Disablement calendar) | Dates including wildcards/day profile identifier | Yes |
| Debt Recovery per Payment | The percentage of a payment to be recovered against debt when operating Payment based Debt Recovery in Prepayment Mode | 0% | % | Yes |
| Debt Recovery Rate Cap | The maximum amount in currency units per unit time that can be recovered through payment based debt recovery when operating in Prepayment Mode | £0.00 | Currency units | Yes |
| Debt Recovery Rate 1 | The debt recovery rate in currency units per unit time for Time Based Debt 1 in Prepayment Mode | £0.00/0000 | Currency units/seconds | Yes |
| Debt Recovery Rate 2 | The debt recovery rate in currency units per unit time for Time Based Debt 2 in Prepayment Mode | £0.00/0000 | Currency units/seconds | Yes |
| Suspend Debt Disabled | A setting controlling whether standing charge and debt should be collected when the meter is operating in Prepayment Mode and Supply is Disabled. | Enabled - i.e. Do not collect debt/SC when supply disabled | Enabled/Disabled | Yes |
| Suspend Debt Emergency | A setting controlling whether standing charge and debt should be deducted from the Emergency Credit Balance when the meter is operating in Prepayment Mode and Emergency Credit is in use. | Enabled - i.e. Do not collect debt/SC from Emergency Credit Balance | Enabled/Disabled | Yes |

| Configuration item | Description | Default configuration | Unit / Type | Remotely configurable via DCC |
|---|---|---|---|---|
| **Billing Calendar Settings** | | | | |
| Billing Calendar | The date-time of the first billing calendar snapshot and the periodicity of following ones after that (where periodicity can be 1=daily; 2=weekly and 3=monthly) | midnight on first day of each month | "Start date Time/ Periodicity (1=daily,2=weekly, 3=monthly) | Yes |
| **Load Limit Settings** | | | | |
| Load Limit Period | The length of time in seconds which the Active Power Import needs to continuously exceed the Load Limit Power Threshold before a load limiting event is deemed to have occurred | 30 | seconds | Yes |
| Load Limit Power Threshold | the Active Power threshold in kW above which the measurement of a load Limit Period is commenced | 1000 | kW | Yes |
| Load Limit Restoration Period | The length of time in seconds after the Supply has been Armed following a Load Limiting Event before the supply is Enabled by the meter | 31536000 | Seconds | Yes |
| Load Limit Supply State | The setting which controls the state of the Supply in the case of load limiting occurring, being Disabled or unchanged | unchanged | disabled/ unchanged | Yes |
| **Alert Settings** | | | | |
| Alerts Configuration Settings | Settings to control whether to generate and send an alert when certain events occur in the meter.  NOTE:  See separate Events and Alerts section. | By default, all mandatory alerts designated by GBCS to be "always on" are enabled, all other alerts switched off. | Alerts Configuration Settings | Yes |
| **Network Settings** | | | | |
| Average RMS Over Voltage Threshold | The average RMS voltage above which an over voltage condition is reported. | 258 | Volts | Yes |
| Average RMS Under Voltage Threshold | The average RMS voltage below which an under-voltage condition is reported. | 212 | Volts | Yes |
| Average RMS Voltage Measurement Period | The length of time in seconds over which the RMS voltage is averaged | 1800 | Seconds | Yes |
| RMS Extreme Over Voltage Measurement Period | The duration in seconds used to measure an extreme over voltage condition. | 180 | Seconds | Yes |

| Configuration item | Description | Default configuration | Unit / Type | Remotely configurable via DCC |
|---|---|---|---|---|
| RMS Extreme Over Voltage Threshold | The RMS voltage above which an extreme over voltage condition is reported. | 265 | Volts | Yes |
| RMS Extreme Under Voltage Measurement Period | The duration in seconds used to measure an extreme under voltage condition. | 180 | Seconds | Yes |
| RMS Extreme Under Voltage Threshold | The RMS voltage below which an extreme under voltage condition is reported | 190 | Volts | Yes |
| RMS Voltage Sag Measurement Period | The duration in seconds used to measure a voltage sag condition | 180 | Seconds | Yes |
| RMS Voltage Swell Measurement Period | The duration in seconds used to measure a voltage swell condition. | 180 | Seconds | Yes |
| RMS Voltage Sag Threshold | The RMS voltage below which a sag condition is reported. | 190 | Volts | Yes |
| RMS Voltage Swell Threshold | The RMS voltage above which a swell condition is reported. | 265 | Volts | Yes |
| Maximum Demand Configurable Time-Period | A single time-period of up to 24 hours comprising a number of half-hour periods (commencing at the start of minutes 00 and 30 in each hour) during which recording to the Maximum Demand (Configurable Time) Active Power Import Value is active. | 16:00 - 20:00 | Time-period | Yes |
| **ALCS/HCALCS Settings** | | | | |
| Auxiliary Load Control Switch Calendar | A Switching Table containing a set of rules for setting the commanded state of up to five Auxiliary Load Control Switches or HAN Connected Auxiliary Load Control Switches as open and closed. Including up to 20 Special Days | None Described | Switching table, special days | Yes |
| Auxiliary Load Control Switch Descriptions | For each Auxiliary Load Control Switch or HAN Connected Auxiliary Load Control Switch, a description of the type of controlled load connected, the switch type and, for HAN Connected Auxiliary Load Control Switches, the HCALCS Identifier | None Described | | Yes |
| **Ambient Power Thresholds** | | | | |
| Low Medium Power Threshold | A value in kW defining the threshold between an indicative low and medium Active Power Import level. | 1 | kW | Yes |

| Configuration item | Description | Default configuration | Unit / Type | Remotely configurable via DCC |
|---|---|---|---|---|
| Medium High Power Threshold | A value in kW defining the threshold between an indicative medium and high Active Power Import level. | 4 | kW | Yes |
| **Miscellaneous** | | | | |
| Randomised Offset Limit | A value in seconds in the range 0 to 1799 used in the calculation of the Randomised Offset - which is used to delay the Tariff Switching Table times, the ALCS switching times and the HCALCS switching times. | 600 | Integer | Yes |
| Contact Details | The name and contact telephone number of the supplier | blank | Text | Yes |
| Customer Identification Number | A number issued to the ESME for display on the User Interface | blank | number | Yes |
| Device Log | The Security Credentials for each of the Type 1 Devices and Type 2 Devices with which meter can establish Communications Links. | empty | Security credentials | Yes |
| Meter Point Administration Number (MPAN) | The reference numbers identifying an electricity metering point for Import and Export | blank | MPAN numbers | Yes |
| Supplier Message | A message issued to, and held on, the meter for provision to the Consumer | blank | Message text | Yes |
| Supply Tamper State | A setting to control the state of the supply in the case of unauthorised physical access being detected, being Locked or unchanged | Unchanged | Locked/ unchanged | Yes |
| Supply State | The state of the supply being Enabled, Disabled or Armed | Enabled | Enabled/ Disabled/ Armed | Yes |

*Figure 16 Configuration*

# 10    Prepayment functionality

The meter accepts payments supplied in the form of a 'token' which represents a monetary credit to be added to the meter. A payment token is only accepted when the meter account is operating in prepayment mode.

## 10.1    Prepayment supply control switch status cycle

The meter in prepayment mode manages end customer consumption by disconnect and allowing re-connecting the customer premises by means of the built-in supply control switch depending on the credit/debt position of the meter.

The supply control switch can be in one of three conditions:

- ON – The supply control switch is closed.
  This condition is maintained whilst the meter has some available credit, either prepaid credit or released emergency credit, or if the meter is in a period of non-disablement after the meter entered that period with the supply control switch closed.

- OFF – The supply control switch is open.
  The supply control switch is open because there is no credit available, or the supply was already disabled when the non-disablement period was entered. The customer must either release emergency credit if not already released or purchase a credit top up sufficient to restore the meter balance to, at least, zero (see accumulated debt register and OWED register).

- ARM – The supply control switch is open.
  The meter has received sufficient credit via top up or release of emergency credit to restore the meter balance to, at least, zero. The meter will show an icon to denote that reconnection is possible. The customer may then initiate the supply control switch reconnection process using button B. The supply control switch can also be in the arm position where Load Limiting is in operation, the load limit value has been exceeded and the meter is configured to disable supply upon a load limit event.

## 10.2    Accumulated debt register

The accumulated debt register contains the debt resulting from the collection of standing charge and/or time-based debt when emergency credit is in use, as configured by suspend debt emergency settings, when operating in prepayment mode.

## 10.3    OWED register (debt to clear)

The OWED register is only displayed when the customer prepaid credit has expired and there is an amount to repay. The OWED register then replaces the meter balance display.

The OWED register is the sum of the following:

- The emergency credit used

- The accumulated debt register

- The negative meter balance. (Negative meter balance can arise from friendly credit and from negative credit adjustments).

- The payment based debt to be recovered from the payment

The total of these values will be the minimum amount to repay to set the meter balance to zero.

In the case of payment based debt to be collected, it is based on the listed items and takes account of the amount remaining in the Payment Debt Register, the payment-based debt payments in the Billing Data Log and the Debt Recovery Rate Cap.

## 10.4   Credit top ups

Users must purchase credit top ups to maintain a positive meter balance. Top ups may be purchased through several channels and will generally be delivered to the meter using the secure WAN and HAN networks.

In the event of HAN or WAN outage preventing the top up from being automatically received by the meter the user may enter the top up code (20 digits) directly into the meter using the two push buttons.

Top ups that have been accepted by the meter previously will not be accepted a second time. An event will be logged in the meter.

If only the WAN is unavailable then the meter is able to accept credit top ups via an authorised Prepayment Interface Device (PPMID) as long as the HAN is available.

## 10.5   Manual entry of a credit top up code

Credit top up codes are 20 decimal digits and, as a fall back option, may be entered manually into the meter using the two buttons on the meter face plate. This process is detailed in Figure 17.
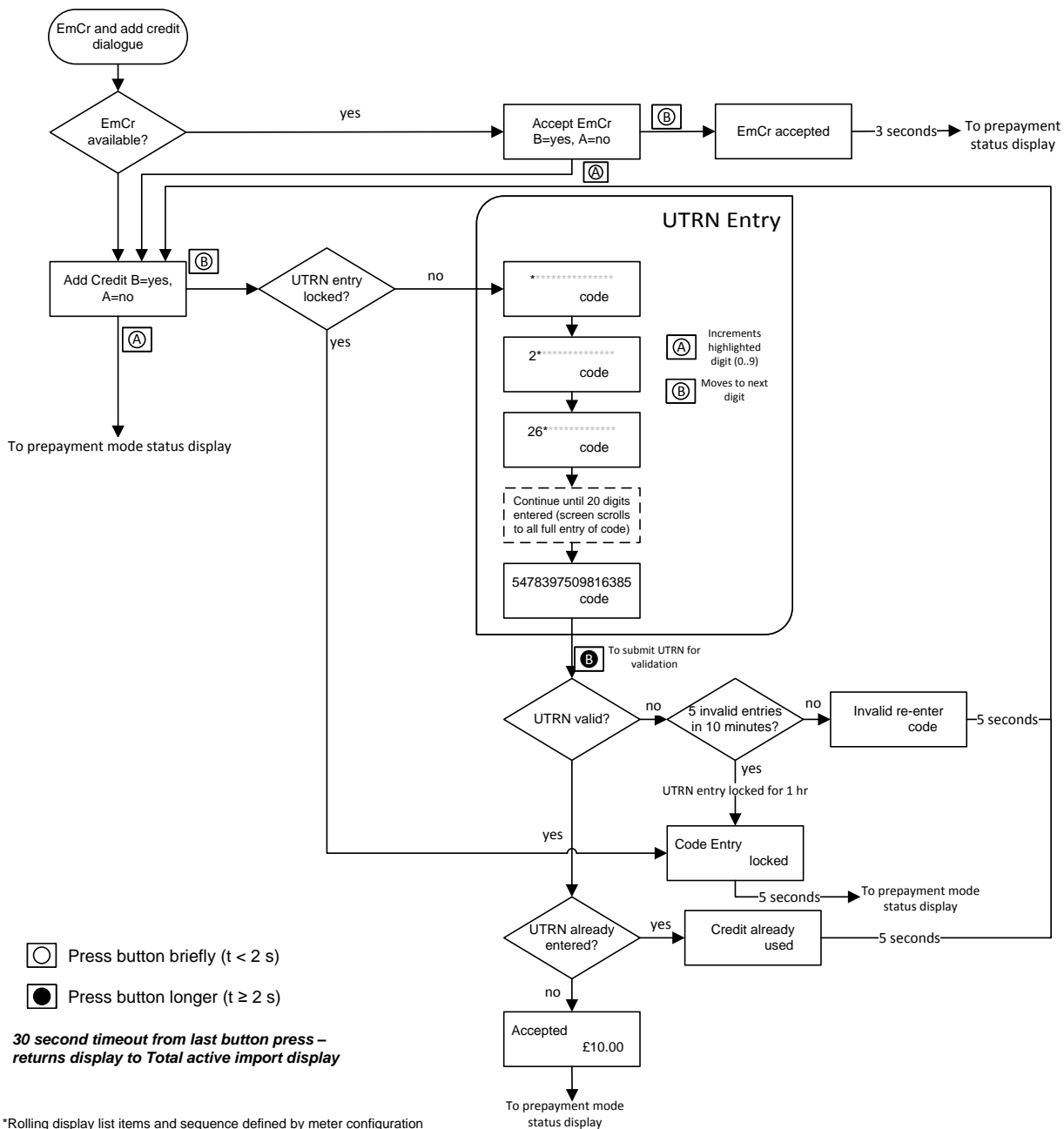
*Figure 17 Manual entry of a credit top-up code*

## 10.5.1   Emergency credit

Emergency credit is a short-term loan that the meter can offer to the user if configured to do so.

The emergency credit set up command defines the emergency credit limit and the emergency credit availability threshold.

The emergency credit limit is the amount of the short-term loan that the meter will provide.

The emergency credit availability threshold is the level of the remaining user prepaid credit at which the meter will begin to offer the emergency credit short term loan.

When the emergency credit threshold is reached the meter display will advise that emergency credit is available. The user then has the option of accepting the emergency credit if they wish. The emergency credit will

remain available until either it has been accepted, or the user has purchased sufficient prepaid credit to take the prepaid credit balance above the emergency credit threshold.

If the emergency credit limit is set to zero, the meter will not offer the emergency credit facility.

### 10.5.2 Credit deductions from prepaid credit or emergency credit

The meter deducts credit from available credit in the following order:

| Prepaid credit | Emergency credit | Non-disablement period | Result |
|---|---|---|---|
| Yes | Not available | No | Uses prepaid credit |
| Yes | Accepted | No | Uses prepaid credit |
| No | Accepted | No | Uses emergency credit |
| No | Expired or not accepted | No | Supply control switch opened |
| Yes | Not available | Yes | Uses prepaid credit |
| Yes | Accepted | Yes | Uses prepaid credit |
| No | Accepted | Yes | Uses emergency credit |
| No | Expired or not accepted | Yes | Increases OWED register balance by making the meter balance more negative |

*Table 6 Meter credit deduction example*

### 10.5.3 Non-Disablement calendar

The non-disablement calendar is a set of defined periods of time where the meter will not open the supply control switch if credit runs out.

Note that if a meter has its supply control switch opened when the non-disablement period begins it will not be possible to close the supply control switch without first providing sufficient credit to pay the OWED value or by accepting emergency credit if available.

Non-disablement periods are defined by means of a switching table which consists of a schedule and special day table.

All switching schedules are controlled by the calendar clock; the maximum settable parameters are:

- Up to 20 special days
- 1 schedule table supporting up to 22 switching actions

An example of this can be seen in the following table.

| | | | | | | Schedule Table | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index | Enable | Script Selector | Switch_Time | Validity | WeekDay | | | | | Special Day | | | | Date Range | |
| | | | | | Mo | Tu | We | … | Su | S1 | S2 | …. | S20 | Begin_date | End_Date |
| 1 | yes | xxxx:yy | 06:00 | 0xFFFF | Mo | Tu | We | … | Su | S1 | S2 | …. | S20 | Begin_date | End_Date |
| 2 | yes | xxxx:yy | 22:00 | 0xFFFF | x | x | x | | | x | | | | xx-04-01 | xx-09-30 |
| 3 | yes | xxxx:yy | 12:00 | 0xFFFF | x | x | x | | | | x | | | | |
| | | | | | | | | | | | | | | | |

*Table 7 Non-disablement schedule table*

The special day table would appear as:

| Week ID W1 | | |
|---|---|---|
| Index | Date | Day Id |
| 1 | 01.01.xxxx | S3 |
| 2 | 25.12.xxxx | S2 |
| 3 | 26.12.xxxx | S3 |
| 4 | 15.03.xxxx | S4 |

*Table 8 Special day table operation*

### 10.5.3.1 Current and future non-disablement switching tables

There are two complete sets of non-disablement switching tables– current and future.

Current non-disablement switching tables (schedule + Special day) are the ones currently being used.

Futures non-disablement switching tables are configured in the background for later use.

Two future dated commands control the activations of future switching tables; one for the non-disablement schedule, and other for the associate special day.

Future switching tables will be activated when the current date becomes newer than the activation date.

### 10.5.3.2 Non-disablement switching parameters

To configure a complete non-disablement switching parameters, a new set of (future) switching tables must be created along with the following data:

- Future schedule Table for non-disablement
- Future Special Day for non-disablement
- Future Dated command for non-disablement schedule
- Future Dated command for Special day for non-disablement Table.

## 10.6 Debt management

The meter supports two methods of debt collection.

- Payment based debt: A debt to be recovered as a percentage of payment
- Time based debt: A debt to be recovered over a period of time

### 10.6.1 Payment based debt collection

A payment based debt collection takes place when the meter accepts a new credit top-up via a token. It is taken as a percentage of the value added to the credit.

The charge percentage collected can be configured at manufacture or via HES command.

The meter has active and passive payment based debt registers, this allows a new payment based charge object to be configured for use when a new meter account is activated.

The debt register may be set to collect a debt amount through the payment based collection process.

This form of debt collection does not deduct from the credit remaining in the meter but takes an amount from the value of the payment value when it is accepted by the meter.

When setting the debt, the following parameters are required:

- Debt amount to be recovered

- Percentage of the payment to be collected

- Weekly collection cap value

**Example:** £100 to be collected at 10% of the payment value with a weekly cap of £5.

Three payments are made in the same week. Note: The week starts on a Monday.

Payment 1 = £20. Amount taken = £2. Debt remaining £98

Payment 2 = £20. Amount taken = £2. Debt remaining £96

Payment 3 = £20. Amount taken = £1. Debt remaining £95

The third payment only produces a recovery of £1 so as not to exceed the weekly cap value.

If any further payments are made during the same week there will be no further deductions made from the vends for Debt 3.

- The maximum debt that can be collected is £21,000

- The maximum percentage of the vend is 100%

If the debt to be collected is more than the total amount remaining, then only the amount remaining will be deducted from the top up.

Note: Payment based debt collection is not controlled by the suspend debt emergency or the suspend debt disabled flags.

### 10.6.2  Time based debt collection

A time-based debt charge is made on a regular time basis. The time period and the charge to be applied can be configured at any time

Two time-based debt objects are provided to allow for two different debts to be handled concurrently. For each of these two debts the meter has only an active register.

The collection is limited by the total amount remaining on the time-based debt charge, as well as by the amount of credit that is left to be taken in the credit register.

Time-based Debt collection will not take place if the meter clock is invalid.

If the amount of debt to be collected is more than the total amount remaining, then only the amount remaining will be collected.

The meter can display the outstanding debt amount for Debt 1 and Debt 2, it can also display when the debt will be collected, and the amount of debt that has been paid.

### 10.6.3  Suspend debt emergency

When the emergency credit is in use then either:

- Debt collection (standing charge and/or time based debt) will continue and reduce any emergency credit available, or

- Debt collection is halted; standing charge and/or time based debt shall be added to the accumulated debt register during this time.

## 10.6.4  Suspend debt disabled flag

When the supply has self-disconnected due to a lack of credit then either:

- Debt collection will continue; standing charge and time based debt shall continue to be deducted from then meter balance (i.e. added to the OWED register), or

- Time based debt collection is halted; standing charge shall continue to be deducted from the meter balance (i.e. added to the OWED register).

## 10.6.5  Maximum Meter Balance

The Maximum Meter Balance is a threshold in Currency Units above which an Add Credit Command is rejected. Where the meter receives a payment transaction and the value will exceed the threshold, then the meter rejects the command.

# 11 Supply control switch

## 11.1 Overview

The meter is fitted with an integrated supply control switch to connect or disconnect the supply to the consumer's premises. The supply control switch can be operated manually via push button when in an 'armed' state, remotely by commands, or locally through control functions integrated in the meter itself.

The supply control switch control is designed so that it enables the utility to use the supply control switch as:

- a switch for disconnecting the premises when the customers move away or when grid maintenance is required;

- a prepayment-mode supply control switch such that consumers may be disconnected when prepaid credit runs out and reconnected when prepaid credit is topped-up;

- a load-limiting supply control switch where supply can be disconnected if the consumer exceeds the load limit power threshold (Active power threshold in kW). Reconnection can be maintained by ensuring that consumer usage is below the disablement threshold.

ⓘ **No overcurrent protection/automatic disconnection**
The supply control switch is not equipped with a thermal and/or short circuit protection device. Do not use the supply control switch as an isolator.

To properly control the behaviour of the supply control switch under all operating conditions a control unit is implemented. It is triggered by the following sources:

- Supply control switch push button B on the meter's face plate

- Remote commands

- Internal commands

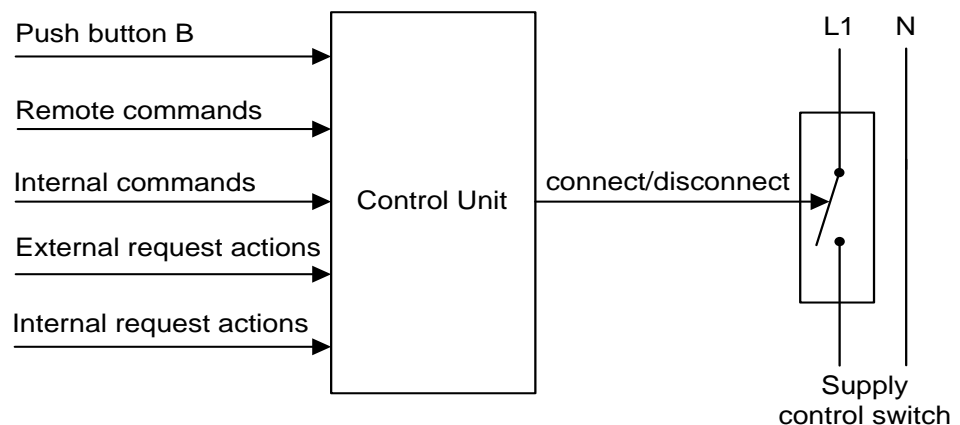- External request actions

- Internal request actions



*Figure 18   Supply control switch control*

The EN62052-21 and EN62053-21 compliant supply control switch is powered from the meter power supply. It can switch currents up to 100 A.

## 11.2   Supply control switch states

The control unit allows several states (not only ON/OFF state) and can set the supply control switch to one of the following operations:

- Customer premises connected

- Customer premises connected but load limiting threshold exceeded

- Customer premises disconnected due to load limiting threshold condition (armed)

- Customer premises enabled for manual reconnection (armed)

- Customer premises disconnected

The current state of the control unit as well as the state of the premises is indicated in the device status register. Additionally, there is a symbol displayed on the meter display (a square and a cross) to indicate whether the premises are connected or not (see picture below).
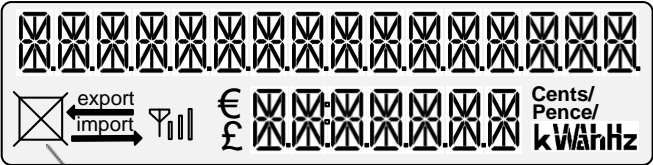
| | | |
|---|---|---|
| | | Supply control switch symbol |
| □ | **Premises connected** | Only the square is turned on. |
| ⬚ (dotted line indicates flashing box) | **Premises connected but load limiting threshold exceeded** | The square is flashing to indicate load limit threshold has been exceeded but supply is still connected. |
| ⊠ (dotted line indicates flashing box) | **Premises Disconnected and Armed (due to Load Limiting)** | Square is flashing to indicate that the disconnection is due to load limiting.  X (with the square) indicates that supply is armed ready for reconnection attempt. |
| ⊠ | **Premises Disconnected and Armed (due to remote reconnect command or sufficient prepayment credit added)** | The square and cross are both turned on indicating the supply is armed and ready for reconnection (solid, NOT flashing) |
| ✕ | **Premises Disconnected and Not Armed** | Only the cross is turned on.  Supply is disconnected and NOT armed -  either due to a remote disconnect command or insufficient credit in prepayment mode |

*Figure 19   State indication on the LCD*

## 11.3    Reconnection procedure

The meter typically requires manual intervention when the supply control switch is to be switched on to reconnect the customer premises. This involves following a sequence of instructions displayed on the LCD.
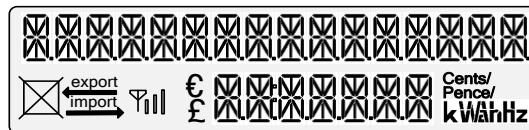
Two types of reconnection procedure can be supported

- Normal reconnection process
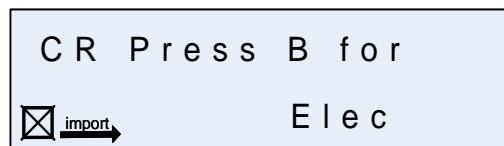- PIN protected reconnection process

### 11.3.1    Normal reconnection process (Credit mode)

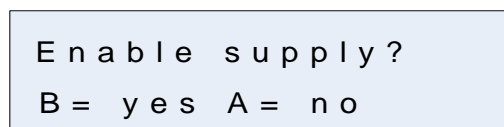The steps below detail the normal reconnection process

1. Press button A briefly (< 2 s) from the default display.
   All segments of the LCD are lit (display check).



2. Press button A briefly (< 2 s) from the all segment display.

   The Credit mode status display will be shown.



3. Press button B briefly (< 2 s) from the credit status screen.

   The Enable Supply display will be shown



4. Press and hold button B longer (≥ 2 s).
   The customer premises are reconnected by switching on the supply control switch. A reconnect message appears.



### 11.3.2    PIN protected reconnection process (Credit mode)

Where Pin protection has been enabled on the meter the following steps are required to complete the reconnection process.

1. Press button A briefly (< 2 s) from the default display.
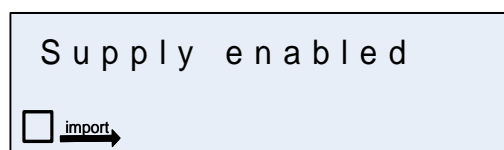   All segments of the LCD are lit (display check).

2. Press button A briefly (< 2 s) again.
   The PIN entry dialogue is then displayed.

```
Enter PIN

A = i g n o r e   B = y e s
```

3. Press button B briefly (< 2 s).

```
Enter  PIN

X X X X
```

Enter your customer privacy PIN, (the A button increments the highlighted digit, the B button moves to the next digit) offer the pin entry by pressing and holding button B longer (≥ 2 s).

On successful PIN entry, the Credit mode status display will be shown.

4. Press the B button briefly (<2s) from the credit status screen.

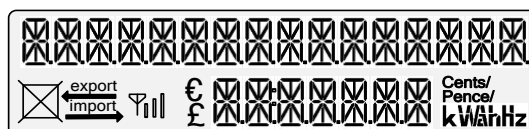   The Enable Supply display will be shown

```
C R   P r e s s   B   f o r

⊠ import                E l e c
```

5. Press and hold button B longer (≥ 2 s).

```
E n a b l e   s u p p l y ?
B =   y e s   A =   n o
```

6. The customer premises are reconnected by switching on the supply control switch. A reconnect message appears.

```
S u p p l y   e n a b l e d

□ import
```

### 11.3.3 Reconnection when in prepayment mode

The processes described above are also applicable when the meter is in prepayment mode of operation. The only difference to observe will be the Prepayment Status display rather than the Credit status display as described.

## 11.4 Load limit restoration period

Where Load Limiting has been initiated then the meter can perform reconnection without manual intervention if a load limit restoration period has been configured.

The load limiting restoration period is the length of time in seconds after the Supply has been armed following a load limiting event before the supply is enabled.

# 12    Customer privacy PIN

When operating in the credit or prepayment mode, the meter allows for the protection of personal data items and certain interface commands that may otherwise appear on the display.

The PIN (if enabled) also restricts or protects certain user interface command such as;

- Activate emergency credit
- Add credit
- Allow access to user interface
- Enable supply
- Disable PIN protection
- Set privacy PIN

The customer privacy PIN may be enabled, changed or disabled by the user.

If enabled, then the customer privacy PIN will be a 4-digit sequence set by the user on the meter display and pressing buttons A and B.

If the customer privacy PIN is enabled, then the meter will offer the PIN entry dialogue (see section *12.1*) when the display check is activated by briefly pressing button A and then button A is pressed briefly again. The user may then enter the PIN or not as they choose. If the correct PIN is entered, then all applicable displays will be available to the user. If an incorrect PIN or the entry is skipped, then all displays containing personal data will not be included in the display sequence.

The default on delivery of a meter is for the customer privacy PIN to be disabled. Once commissioned, or later during the service of the meter, a customer privacy PIN may be enabled and set using the PIN edit dialogue (see section *12.2*).

**Note**
Following entry of a correct customer privacy PIN, then all displays containing personal data will be available for a period of 30 seconds following the last button press.

## 12.1 PIN entry dialogue

The PIN entry dialogue can be reached by pressing button A briefly when the display check is activated by briefly pressing button A from the default display.

The privacy PIN entry dialogue structure is shown in Figure 20 as follows:
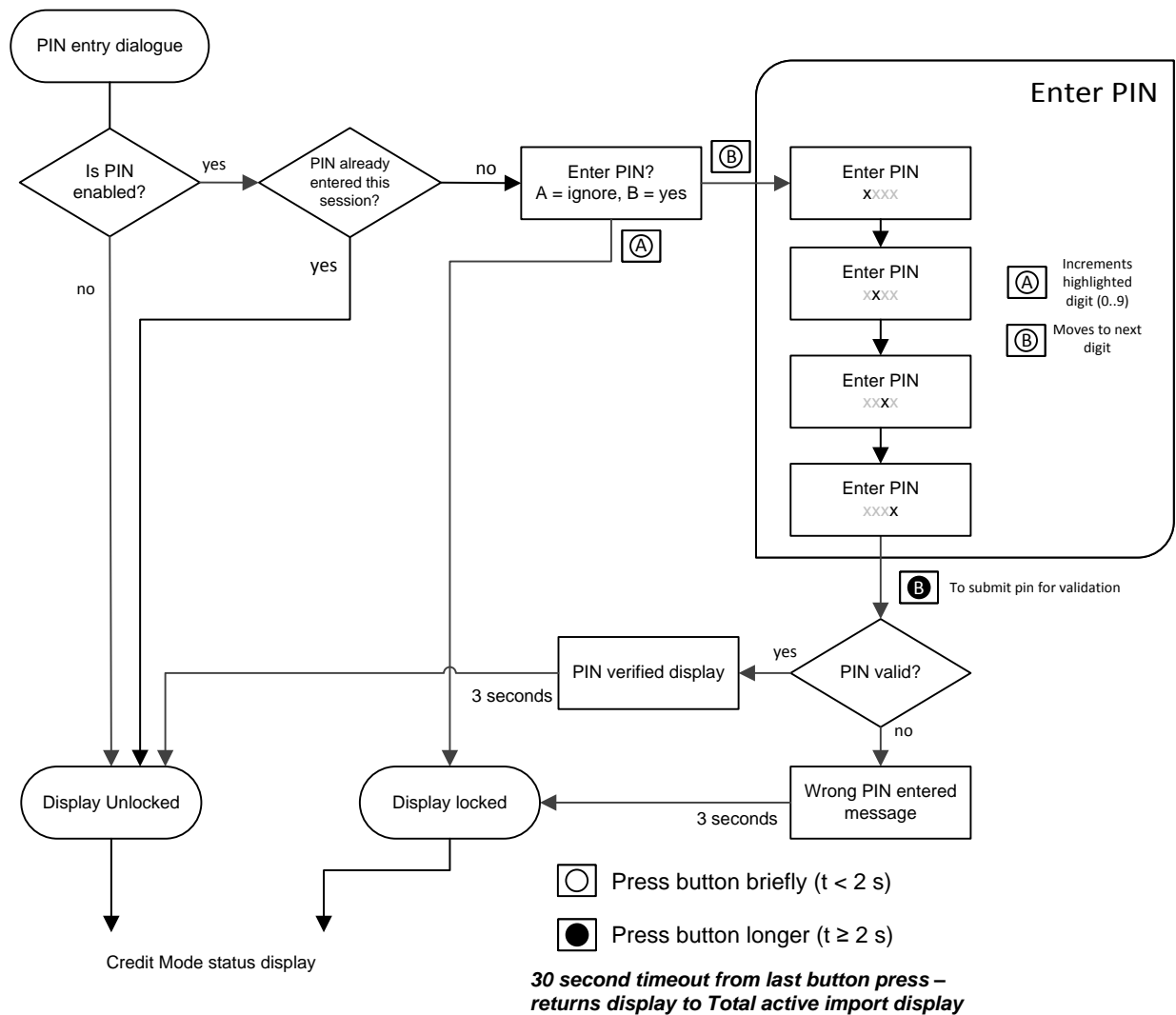


*Figure 20  Privacy PIN entry dialogue structure*

## 12.2   PIN edit dialogue

The PIN edit dialogue can be reached from the credit status display (see section *14*) or the prepayment status display (see section *15*) by pressing and holding button B (≥ 2 s).

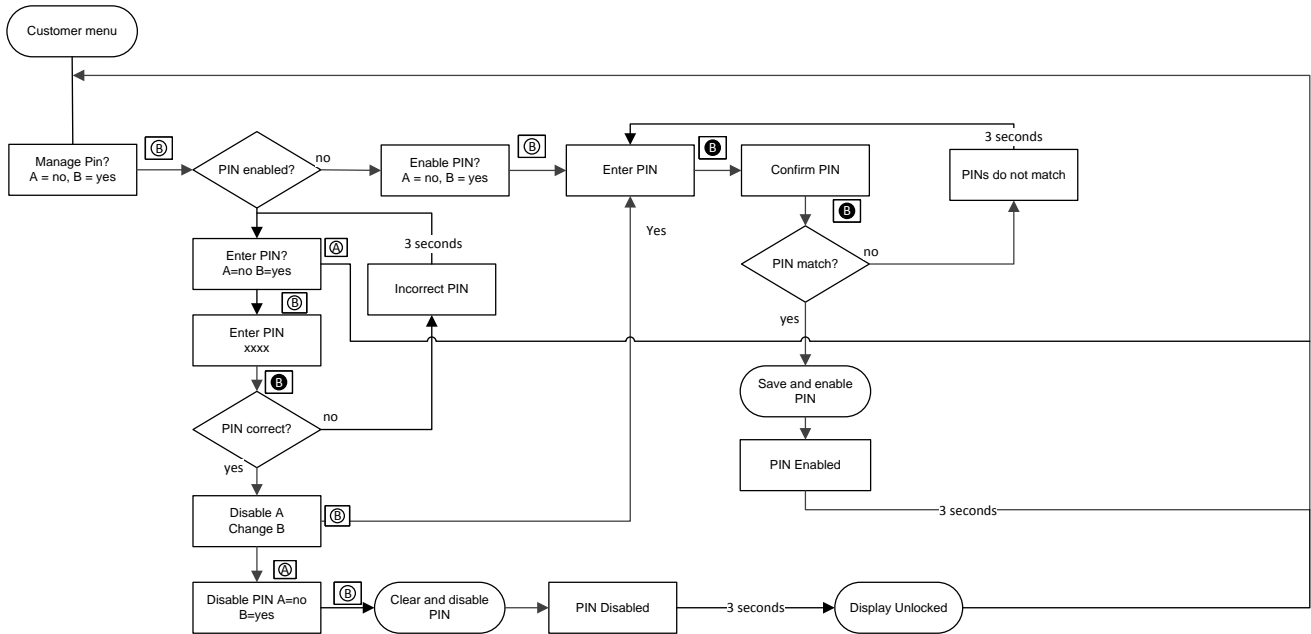The PIN edit dialogue structure is shown in Figure 21 as follows:



*Figure 21   Privacy PIN edit dialogue structure*

# 13　Rolling registers

The meter has a set of displays that may be shown to the user during normal operation.

Not all displays are relevant to all modes of operation and may be suppressed if the mode in operation does not support them (e.g. prepayment displays will not be shown in credit mode).

Registers which have not been initialised or which have not accumulated any consumption will be skipped in the display to prevent the user having to scroll through unused register displays.

**Accessing the rolling registers**

The rolling register displays listed in *Table 9* below may contain information considered to be personal data. Those registers may be suppressed from the rolling register sequence unless the user has "unlocked" them with a personal PIN code (see section *12 "Customer privacy PIN"*).

The rolling registers may be accessed when the meter is in the credit status display or prepayment status display by pressing and holding button A.

**Effect of customer privacy PIN function**

If the customer privacy PIN **is not enabled,** then all the rolling registers available to the meter per its mode in *Table 9* "Unlocked" column may be viewed.

If the customer privacy PIN **is enabled and the user enters the PIN correctly** then all the rolling registers available to the meter per its mode in *Table 9* "Unlocked" column may be viewed.

If the customer privacy PIN **is enabled but is not entered**, or entered incorrectly, then the display sequence is limited to those items in the "Locked" column for that mode of operation.

| Display items | Order of credit mode displays | | Order of prepayment mode displays | | PIN protected |
|---|---|---|---|---|---|
| | Locked | Unlocked | Locked | Unlocked | |
| Payment Mode | | 3 | | 4 | Y |
| Active energy import (+A) Total | 4 | 8 | 1 | 1 | N |
| Active energy export (−A) Total | 5 | 9 | 5 | 23 | N |
| Meter Balance | | 10 | | 9 | Y |
| Owed Amount | | | | 11 | Y |
| Customer Identification Number | | 11 | | 22 | Y |
| Emergency Credit Balance | | | | 10 | Y |
| Time Based Debt 1 – Recovery amount per time period | | | | 13 | Y |
| Time Based Debt 1 – Amount remaining | | | | 12 | Y |
| Time Based Debt 1 – Total amount paid | | | | 14 | Y |
| Time Based Debt 2 – Recovery amount per time period | | | | 16 | Y |
| Time Based Debt 2 – Amount remaining | | | | 15 | Y |

| Display items | Order of credit mode displays | | Order of prepayment mode displays | | PIN protected |
|---|---|---|---|---|---|
| | Locked | Unlocked | Locked | Unlocked | |
| Time Based Debt 2 – Total amount paid | | | | 17 | Y |
| Payment Based Debt - % of each vend | | | | 19 | Y |
| Payment Based Debt – Amount remaining | | | | 18 | Y |
| Payment Based Debt – Total amount paid | | | | 20 | Y |
| Accumulated Debt | | | | 24 | Y |
| Standing Charge | | 5 | | 7 | Y |
| MPAN | | 6 | | 8 | Y |
| Current Local Time | 1 | 1 | 2 | 2 | N |
| Current Local Date | 2 | 2 | 3 | 3 | N |
| Supplier Contact Details | 3 | 7 | 4 | 21 | N |
| Current Price/kWh | | 4 | | 6 | Y |
| Event Log | | | | | N |
| Power Event Log | | | | | N |
| Prepayment – Last 5 vends | | | | 5 | Y |
| Active Firmware Version | 6 | 12 | | 25 | N |
| Approved MID CRC – Required for WELMEC | 7 | 13 | | 26 | N |
| Calculated CRC – Required for WELMEC | 8 | 14 | | 27 | N |
| Active energy (\|+A\|+\|-A\|) Combined Total | 9 | 15 | | 28 | N |
| Active energy (\|+A\|-\|-A\|) Combined Total | 10 | 16 | | 29 | N |
| Reactive energy import (+R) (QI+QII) Total | 11 | 17 | | 30 | N |
| Reactive energy export (-R) (QIII+QIV) Total | 12 | 18 | | 31 | N |
| Reactive energy QI (+Ri) | 13 | 19 | | 32 | N |
| Reactive energy QII (+Rc) | 14 | 20 | | 33 | N |
| Reactive energy QIII (-Ri) | 15 | 21 | | 34 | N |
| Reactive energy QIV (-Rc) | 16 | 22 | | 35 | N |
| Apparent energy import (+VA) (QI+QIV) | 17 | 23 | | 36 | N |
| Apparent energy export (-VA) (QII+QIII) | 18 | 24 | | 37 | N |
| VRMS | 19 | 25 | | 38 | N |
| IRMS | 20 | 26 | | 39 | N |

| Display items | Order of credit mode displays | | Order of prepayment mode displays | | PIN protected |
|---|---|---|---|---|---|
| | Locked | Unlocked | Locked | Unlocked | |
| Power Factor | 21 | 27 | | 40 | N |
| Mains Frequency | 22 | 28 | | 41 | N |
| Instantaneous Power | 23 | 29 | | 42 | N |
| Reactive Power (kVar) | 24 | 30 | | 43 | N |

*Table 9 Rolling register listings*

# 14    Credit mode

## 14.1    Display and navigation structure in credit mode

*Figure 22* shows the top-level credit mode display and navigation structure. An overview of the main components of the display structure are:

**Default display** – In credit mode the default display is the total meter index in kWh for active import (see section 14.3).

**All segment display** – After viewing the initial default the next display shown in the sequence is the all segment display check (see section 14.4).

**Tariff display list** – The tariff display list is accessed from the default display by holding button B and then navigating through the individual items by further presses of button A. The tariff list displays information for tariff TOU registers, tariff block counters and tariff TOU block registers (see section 14.5).

**PIN enabled** – The PIN display if configured requires the users previously configured PIN to be entered to gain access to further displays held by the meter. This is a feature to ensure consumer data privacy if enabled (see section 14.6).

**Credit status display** – Accessible from the all segment display using button A. (NOTE that access can also be PIN protected). The display will show the status of the meter (see section 14.7).

**Boost menu –** The boost menu is accessed via a short press of the B button when viewing the total active import display (see section 14.8).

**Customer menu** – The customer menu is accessed via a long press of the B button when viewing the credit status display. The customer menu contains the following functionality (see section 14.9);

- PIN management

- Viewing of Event Log

- Viewing of Power Log

- ALCS management

**Rolling display list** – a list of meter values (rolling registers and PIN displays) accessible from the credit status display holding button A and then navigating through the individual items by further presses of button A (see section 14.10).

**Supply control** – The supply control switch management can be accessed from the credit status display by pressing the B button. The credit status will define this access (see section 14.11). If PIN protection is enabled, then PIN entry is required before access is granted (see privacy PIN entry dialogue structure shown in *Figure 20*).

**Service Menu –** The service menu is only accessible by removal and replacement of the meter terminal cover, and is only for the access of the utility meter or test engineers (see section 14.12).

The service menu allows the following actions to be performed:

- Enter In Service Test Mode

- HAN Join / Unjoin management

- View the Security Log for the meter

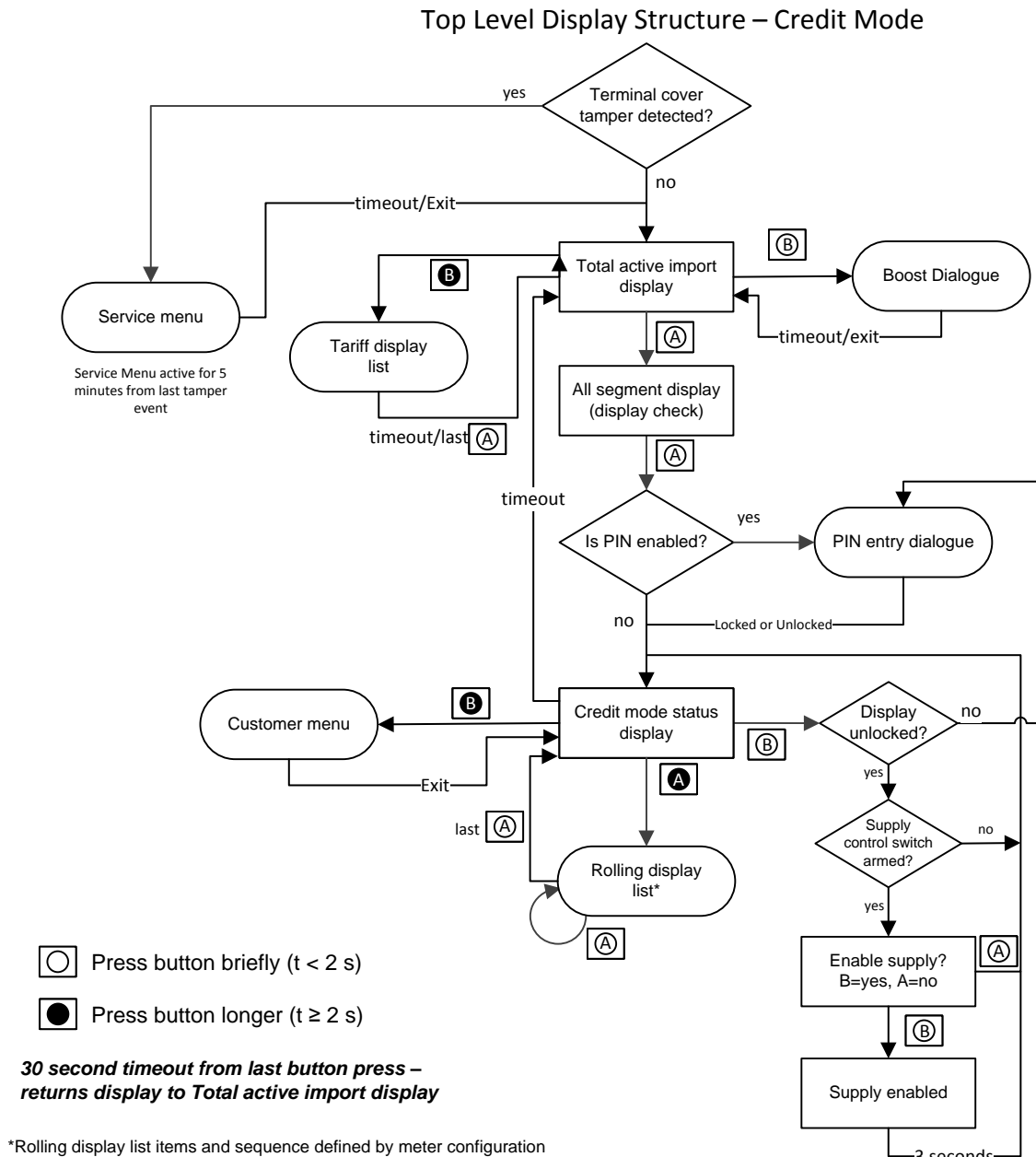## 14.2 Top level display structure – credit mode

Top Level Display Structure – Credit Mode



*Figure 22 Credit mode display and navigation structure*

## 14.3 Default display

The default display of the meter in credit mode will show the total active import energy information. This will be:

a) the Active Import energy consumed in the currently active rate when the meter is configured with a TOU tariff, or

b) the Active Import energy consumed in the currently active Block x TOU y register when the meter is configured with a Block TOU tariff.

Selecting the A button will direct the user to the All Segment display

Pressing and holding the B button for >2s will direct the user to the Tariff Display List.

## 14.4    All segment display

The all segment display is shown immediately after the default display.

Selecting the A button will direct the user to the Credit Mode Status display.

If PIN entry has been enables selecting the A button will direct the user to the PIN Entry display.

## 14.5    Tariff display list

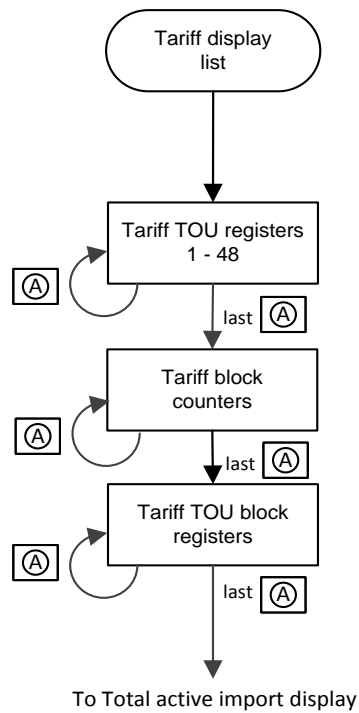The tariff display list will show the information for the following registers:

- TOU Registers

- Block Counters

- TOU Block Registers

Pressing and holding the B button will direct the user to the Tariff registers.

The first display shown is the Tariff TOU register, pressing the A button will display the details of the configured registers, continuing to press the A button will direct the user to the Tariff Block counters, again using the A button to scroll through the details will direct the user to the Tariff TOU Block registers.

The last press of the A button will direct the user back to the Total Active Import display.

NOTE: The Tariff display screens will timeout 30 seconds from the last button press and return to the total active import display.

*Figure 23 Tariff display list*

## 14.6   PIN entry

If PIN entry has been enabled, then after selecting the A button on the all segment display the user is taken to the PIN entry screen

From the PIN entry screen the user is required to enter a pre-entered 4-digit code.

The pin is entered using the A and B buttons

The A button is used to increment the numbers through 0-9

The B button moves to the next digit

Holding the B button for 1s offers the entered PIN details to the meter

After 3 seconds if a valid Pin entry has been accepted by the meter, then the user can access the protected displays of the meter.

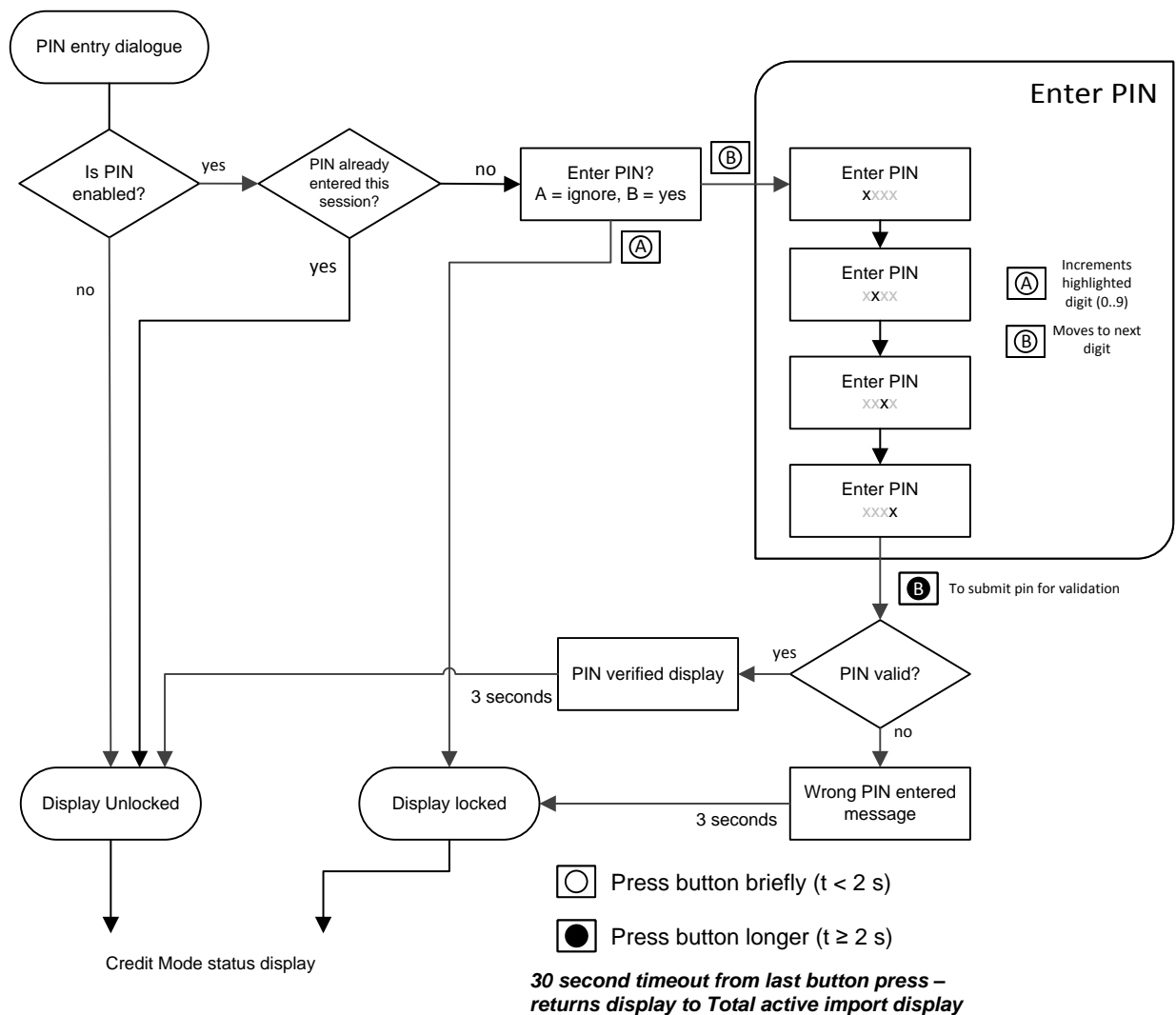If an invalid PIN has been entered the user must repeat the sequence detailed above.

*Figure 24 PIN entry process*

## 14.7 Credit mode status

The credit mode status display is accessed after the all segment display; if PIN entry is enabled then this must be entered before the display can be accessed.

Once the screen is accessed it will indicate the current status of the meter; the display will show one of the following screens in relation to the status:
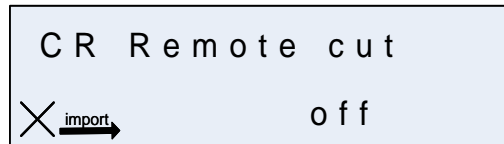
- Credit mode balance – This display details that the meter is in credit mode, the supply is on and the credit meter balance is shown.
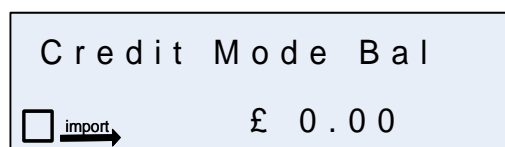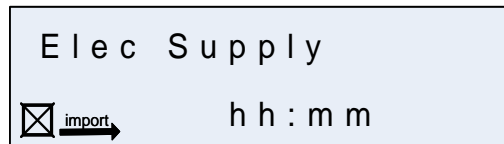
- CR press B for Elec – This display details that the meter is in credit mode and that supply control switch is armed ready for reconnection.

```
CR Press B for

⊠ import➞          Elec
```
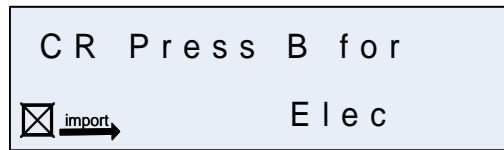
- CR remote cut off – This display details that the meter is in credit mode and the supply is in a disabled state due to a remote disconnection command.

```
CR Remote cut

✕ import➞          off
```

- Elec Supply – This display details that the meter is in credit mode and the PIN is enabled but has not been entered, the supply status at this point could be any of the modes e.g. On, Off or Armed.

```
Elec Supply

⊠ import➞          hh:mm
```

- Load limit press B – This display details that the meter is in credit mode and the customer has exceeded the load limit value, the supply status will be Armed.
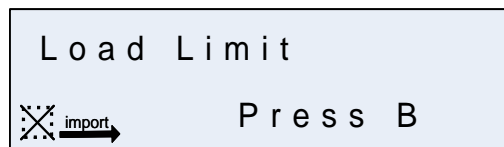
```
Load Limit

⨯ import➞          Press B
```

The credit mode status display also allows the user to navigate to other display functions including the supply reconnection, the rolling display list and customer menu. Access to each function is detailed below.

- The supply control switch is accessed by selecting the B button

- The customer menu is accessed by selecting the B button >2s

- The rolling display menu is accessed by selecting the A button >2s

## 14.8   Boost function

The boost function is accessed via the selection of the B button from the Total Active Import display.

*Figure 25 Extend boost menu function*

### 14.8.1  ALCS boost support
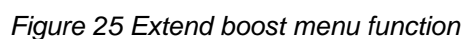
The meter will define whether the supported ALCS are boost enabled. If not available, the user is directed back to the customer menu.

If the ALCS are boost enabled and are not controlled by the ALCS calendar, then the meter will check whether a boost period is currently active.

(Note if the ALCS are calendar controlled then the user is directed back to the Customer Menu).

### 14.8.2   Activating the boost period

If the boost period is not currently active and does not require activation then the A button should be selected. If the user wished to activate the boost function, then the B button should be selected.

### 14.8.3   Boost activation period

From the selection of the B button the user can define the active period in the following manner;

User is presented with a 15-minute activation period – select B button to accept or A button for further options.

User is presented with a 30-minute activation period – select B button to accept or A button for further options.

User is presented with a 45-minute activation period – select B button to accept or A button for further options.

User is presented with a 60-minute activation period – select B button to accept or A button to cancel activation for further options. The user will then be directed back to the customer menu.

On selection of a time option the boost function will be operational for the selected time.

### 14.8.4   Currently active boost period

If a boost period is currently active the meter will determine whether the current boost period duration is <60 minutes. If this is not the case, then the user is directed back to the customer menu.

If the current boost period is less than 60 minutes, then the user can extend the boost period.

### 14.8.5   Cancel boost period

The user can cancel an active boost period; from accessing the customer menu the boost function is displayed select the B button, if the meter is in a currently active boost period the user is directed to the cancel boost screen, from this screen the user can select the B button to cancel the operation.

### 14.8.6   Extending the boost period

The user can extend the period of an active boost period in the following manner; from accessing the customer menu the boost function is displayed select the B button, if the meter is in a currently active boost period the user is directed to the cancel boost screen, from the cancel boost screen select the A button, the user is then directed to the Extend Boost screen, from this screen select the B button.

The meter will then determine the time remaining for the current boost selection and will present options associated with the current boost period, as detailed below.

**Current boost period = 45 mins**

Select A button to exit function

Select B button to add 15 minutes

**Current boost period = 30 mins**

Select B button to add 15 minutes

Select A button for more options

- *Next sequence if A button more options has been selected -*

Select B button to add 30 minutes

Select A button to exit function

**Current boost period = 15 mins**

Select B button to add 15 minutes

Select A button for more options

- *Next sequence if A button more options has been selected -*

Select B button to add 30 minutes

Select A button more options

- *Next sequence if A button more options has been selected -*

Select B button to add 45 minutes

Select A button to exit function

Selecting the exit function option in any of the above scenarios will direct the user back to the total active import display.

## 14.9   Customer menu

The customer menu is accessed by >2s press of the B button from the credit mode status screen. On access to the customer menu the user is presented with the following options:

- Manage PIN
- View event log
- View power log
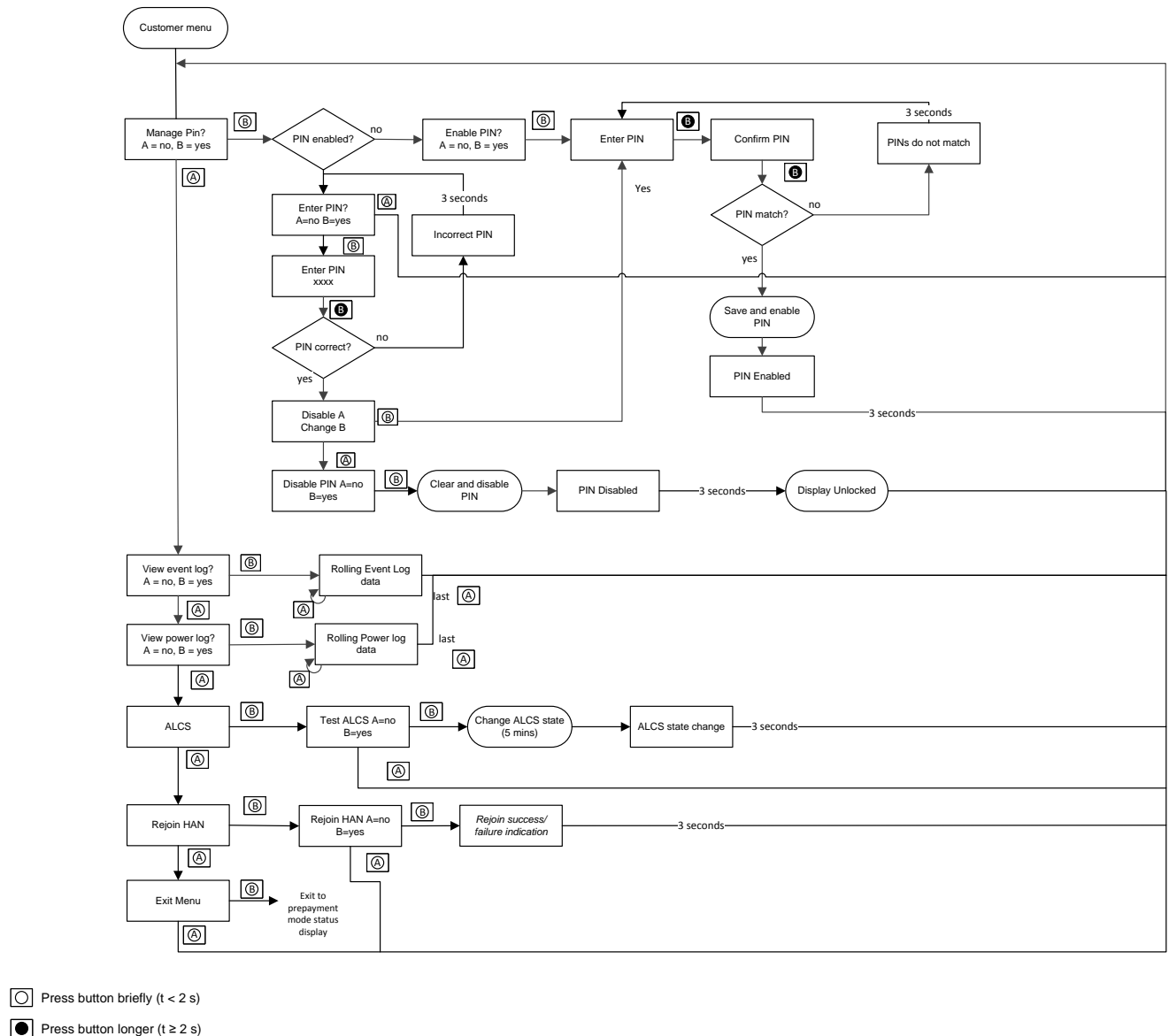- ALCS management
- Leave / join HAN

*Figure 26 Customer menu*

### 14.9.1 Manage PIN

On initial access to the customer menu selecting the A button will direct the user to the PIN management function.

The user is asked to confirm whether a PIN is already enabled or not.

If the PIN is enabled the user is asked to enter the PIN 4-digit number. After

Correct PIN entry the user the can choose to Disable the PIN (A button) or change the PIN (B button).

If the user chooses the disable option (A button) the display will confirm the action, clear and disable the PIN and return the user to the customer menu.

If the user chooses the change option (B button) the display will direct the user to the Enter PIN screen. The user should enter the required 4-digit PIN at this point followed by the A button, the user is then asked to enter the 4-digit PIN a second time to confirm that they match, if the Pins match the meter will save the details and notify that the PIN has been enabled and return the user to the customer menu.

If no PIN has been enabled the user can Enable a PIN if the user chooses not to create the PIN at this point, then the B buttons should be selected which will return the user to the customer menu.

If the user wishes to enable the PIN then the A button should be selected, the display will then direct the user to the Enter PIN screen. The user should enter the required 4-digit PIN at this point followed by the A button, the user is then asked to enter the 4-digit PIN a second time to confirm that they match, if the Pins match the meter will save the details and notify that the PIN has been enabled and return the user to the customer menu.

### 14.9.2 View event log

From the customer menu if the user selects the A button twice they are directed to the View Event Log display; selecting the B button will enable the Rolling Event Log Data where the meter will display the recorded event details.

### 14.9.3 View power log

From the customer menu if the user selects the A button three times they are directed to the View Power Log display; selecting the B button will enable the Rolling Power Log Data where the meter will display the recorded event details.

### 14.9.4 Manage ALCS

From the customer menu if the user selects the A button four times they are directed to the ALCS display; selecting the B button will enable the testing of the ALCS setting.

Selecting the A button will direct the user to the Exit Menu where they can be directed back to the credit mode status display.

**Test ALCS –** on access to the test ALCS display the user is presented with a yes and no option, selecting the A button will exit the function, selecting the B button a change to the ALCS state will be applied for 5 minutes, after activation the user is directed back to the customer menu.

### 14.9.5 Join HAN

This provides the option to join a HAN (but not leave a HAN) as described in section 14.12.2.

## 14.10 Rolling display list

The Rolling Display List is accessible from the Credit Mode Status display by pressing the A button for >2s.

The content and order of the normal display list is indicated in *Table 9 "Rolling register listings"*.
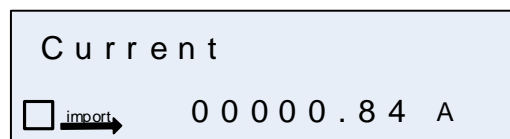
The user can step through the list of display items in the rolling display list using button A. For example, total active Import, voltage and current, would display as follows.



Press button A to navigate to the next item.

```
 V o l t a g e

 [□] import        0 0 0 2 3 0 . 2  V
```

A further press of button A will navigate to the next item.

```
 C u r r e n t

 [□] import        0 0 0 0 0 . 8 4  A
```

Once the end of the list has been reached the A button press will navigate the user to the credit status.

At any point the display will revert to the default display after a timeout period of 30 seconds from the last button press.

**Note**
Display items that are configured in this list but are designated as PIN protected will only be shown if a PIN has NOT been set or, if a PIN has been set and the correct PIN has been entered by the user.

## 14.11 Reconnect supply load switch

The user may require to access the enable supply display where a system initiated disable of supply has been performed, or if the meter entered a load limiting state.

Where PIN protection is not enabled the user is directed to the reconnect display with a short press of button A, from the Credit Mode Status display.

If PIN is enabled by the meter configuration the meter will require the entering of the PIN in the PIN entry dialogue before allowing access to the Credit Mode Status display.

If the user chooses not to reconnect the supply, then the A button should be selected and the user is returned to the credit mode status display.

For the reconnection of the supply the B button should be selected, the meter will then reconnect the supply load switch and indicate the action with a temporary reconnect message.
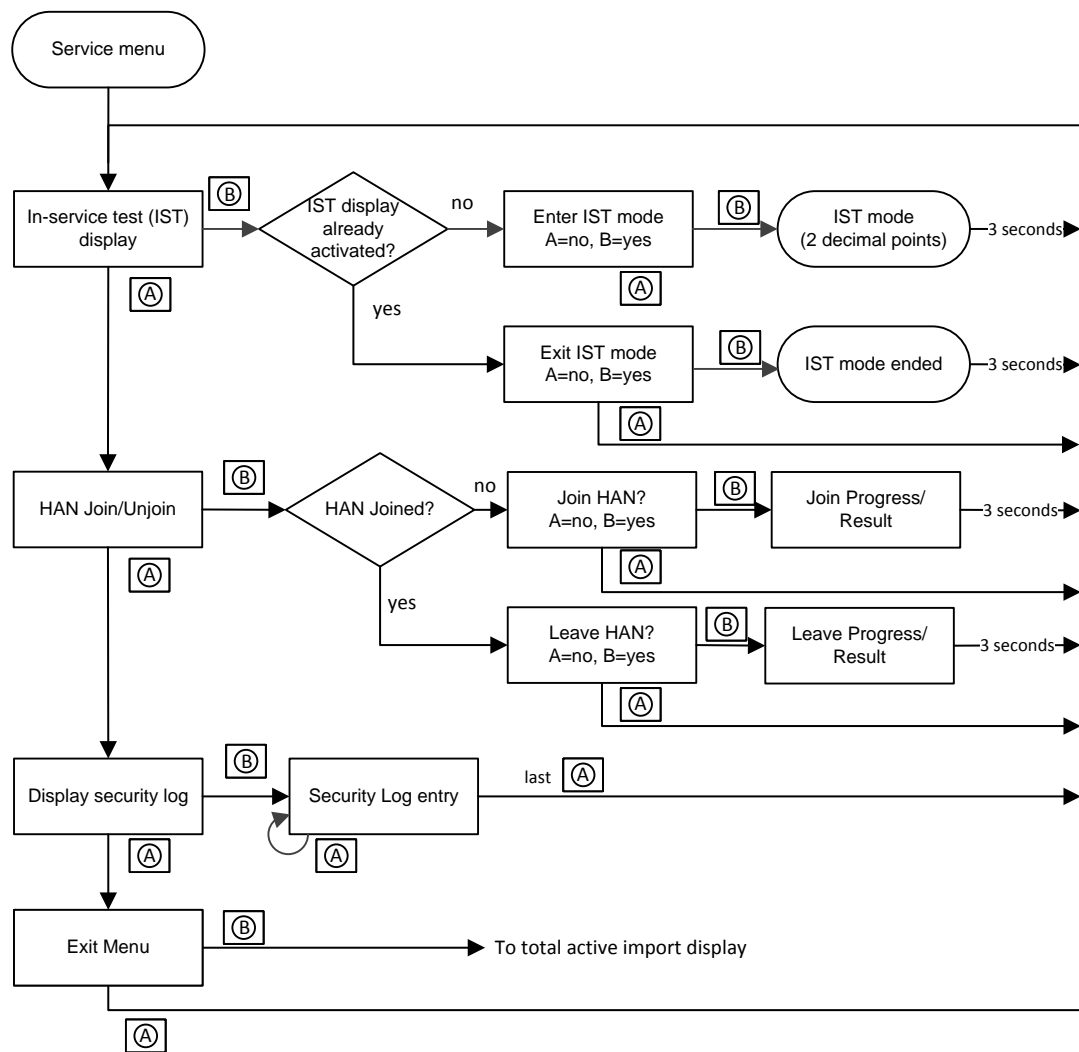
## 14.12 Service menu

The Service Menu provides utility engineers with the access to meter functions that are not for general consumer use.

The service menu can only be accessed by performing a removal and reconnection of the meter terminal cover (as detailed in section 19.)

The service menu allows the following actions to be performed.

- Enter In Service Test Mode
- HAN Join / Unjoin management
- View the Security Log for the meter

*Figure 27 Service menu*

## 14.12.1 In-Service test mode

The In-Service Test (IST) mode is accessible by selecting the B button from the service menu. The user can then select the B button to enable the IST mode. In IST mode the meter registers are displayed with 4 digits to the left and 3 digits to the right of the decimal point. This mode allows for calibration of the meter using less energy than would be possible using the normal display resolution. The IST mode is active for 4 hours. Therefore, if enabled, IST will remain in force for 4 hours, even though the service menu will be exited after 5 minutes of no user interaction. Should the meter be power cycled during the 4 hour period that IST is in operation, then on power up, the meter will 'remember' that IST was in operation at the point of power down, so will reinstate it. However, the 4 hour IST timeout duration will begin from the point of power up, not from the point when it was originally enabled.

If the user chooses not to enter IST mode, then the A button should be selected.

The user can exit IST mode by selecting the B button from the service menu followed by the A button.

### 14.12.2 Leave/join HAN

From In-Service Test (IST) display a press of button A leads to the leave HAN display (if meter is currently joined to the ZigBee network) or to the join HAN display (if meter is currently un-joined from the ZigBee network).

Selecting the B button, leaves or joins the ZigBee network, respectively. The user is shown a progress / result confirmation before returning to the IST display.

By selecting the A button, the user is choosing not to join or leave the ZigBee network and is directed back to the IST display.

### 14.12.3 Display security log

From In-Service Test (IST) display two presses of button A leads to the Display Security Log display, pressing button B will display the security log entries, which can be scrolled using the A button at the last entry and selection a further selection of the A button the display is directed back to the IST display.

### 14.12.4 Exit service menu

The engineer can exit the service menu by selecting the A button four times from the In-Service Test (IST) display, or waiting 5 minutes for the meter to exit the service menu.

# 15    Prepayment mode

## 15.1    Display and navigation structure in prepayment mode

### 15.1.1  Overview

Figure 28 shows the prepayment mode display and navigation structure. The main components of the display structure are:

**Default display** – In prepayment mode the default display is the total meter index in kWh for active import (see section 15.3).

**All segment display** – After viewing the initial default the next display shown in the sequence is the all segment display check (see section 15.4).

**Tariff display list** – The tariff display list is accessed from the default display by holding button B and then navigating through the individual items by further presses of button A. The tariff list displays information for tariff TOU registers, tariff block counters and tariff TOU block registers (see section 15.5).

**PIN enabled** – The PIN display if configured requires the user's previously configured PIN to be entered to gain access to further displays held by the meter. This is a feature to ensure consumer data privacy if enabled (see section 15.6).

**Prepayment mode status** – Accessible from the all segment display using button A. (NOTE that access can also be PIN protected). The display will show the current prepayment status of the meter (see section 15.7).

**Boost menu –** The boost menu is accessed via a short press of the B button when viewing the total active import display (see section 15.8).

**Customer menu** – The customer menu is accessed via long press of the B button when viewing the credit status display. The customer menu enables the following functionality;

- PIN management

- Viewing of Event Log

- Viewing of Power Log

**Rolling display list** – a list of meter values (rolling registers and PIN displays) accessible from the credit status display holding button A and then navigating through the individual items by further presses of button A.

**Supply control** – The supply control switch management can be accessed from the prepayment status display by pressing the B button. The credit status will define this access (see section 14.11). If PIN protection is enabled, then PIN entry is required before access is granted (see privacy PIN entry dialogue structure shown in *Figure 20*).

**Emergency credit / add credit –** The emergency credit and add credit entry screens are accessed from the prepayment status menu, the user can invoke emergency credit or enter a payment code.

**Service Menu –** The service menu is only accessible by removal and replacement of the meter terminal cover, and is only for the access of the utility meter or test engineers.

The service menu allows the following actions to be performed:

- Enter In-Service Test Mode
- HAN Join / Unjoin management
- View the Security Log for the meter

## 15.2   Top level display structure – prepayment mode
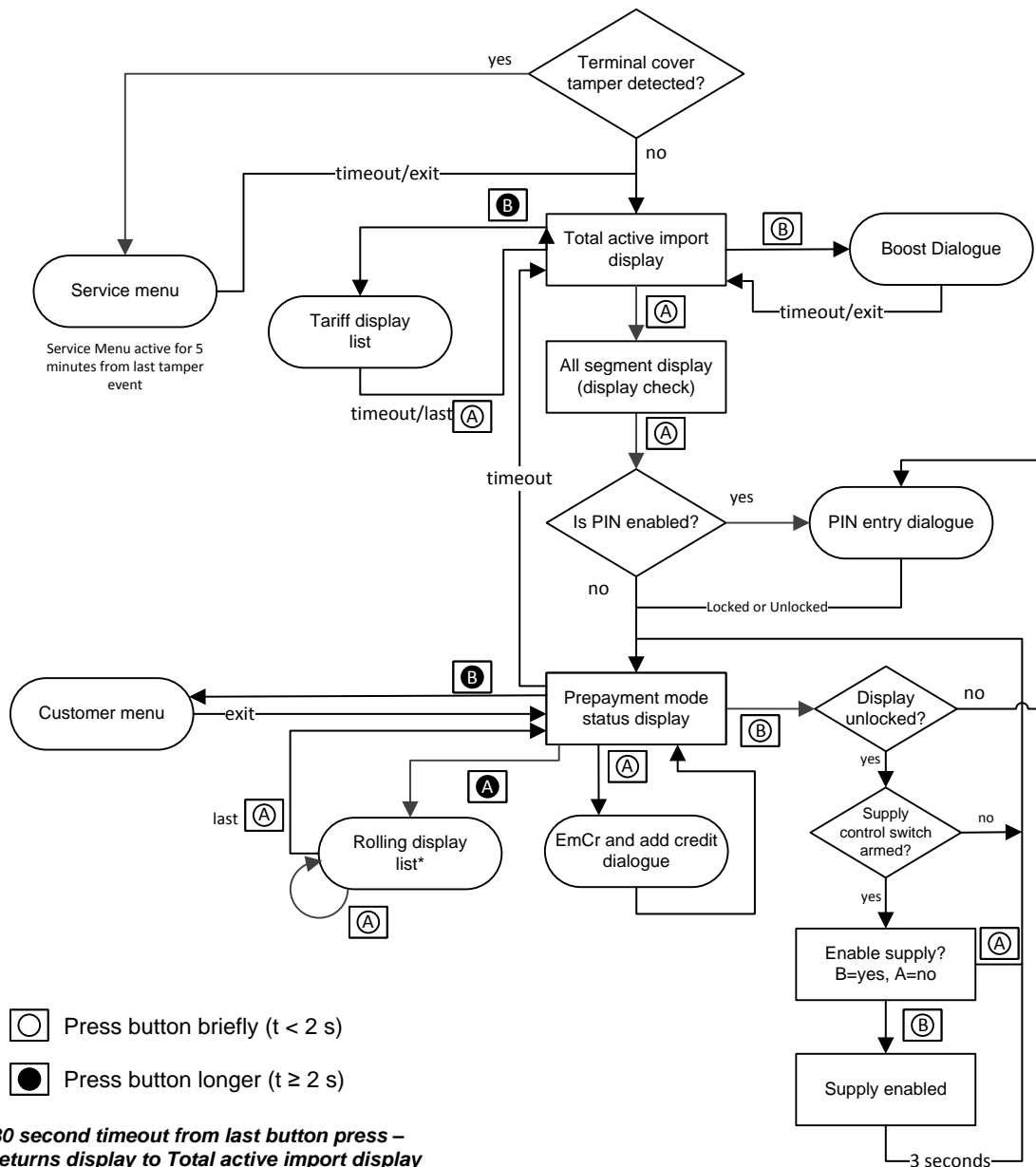


*Figure 28   Prepayment mode display and navigation structure*

## 15.3   Default display

The default display of the meter in credit mode will show the total active import energy information. This will be:

a) the Active Import energy consumed in the currently active rate when the meter is configured with a TOU tariff, or

b) the Active Import energy consumed in the currently active Block x TOU y register when the meter is configured with a Block TOU tariff.

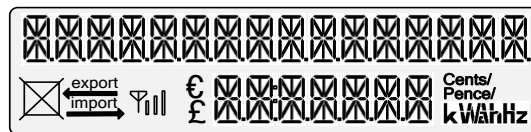Selecting the A button will direct the user to the All Segment display

Pressing and holding the B button for >2s will direct the user to the Tariff Display List.

## 15.4　All segment display

The all segment display is shown immediately after the default display.

Selecting the A button will direct the user to the Prepayment Mode Status display.

If PIN entry has been enables selecting the A button will direct the user to the PIN Entry display.



## 15.5　Tariff display list

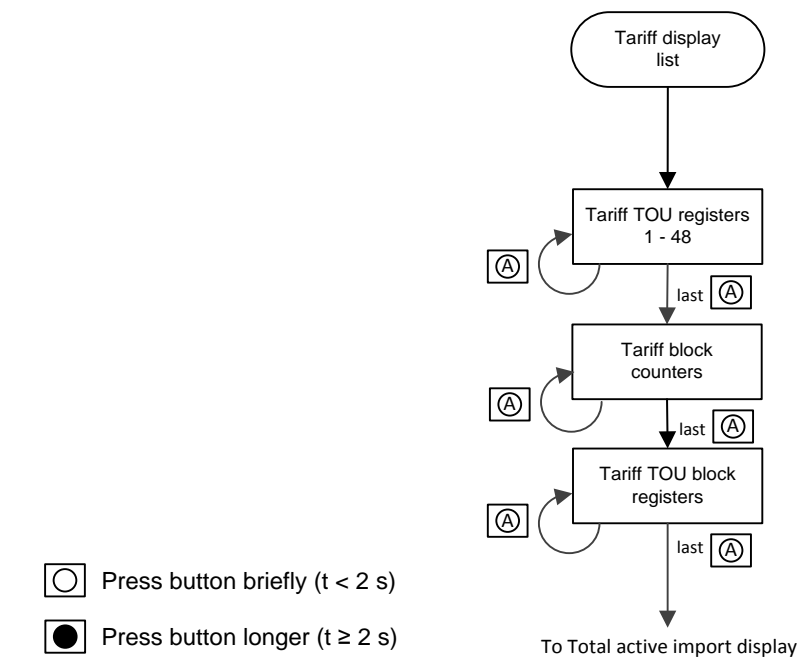The tariff display list will show the information for the following registers:

- TOU Registers
- Block Counters
- TOU Block Registers

Pressing and holding the B button will direct the user to the Tariff registers.

The first display shown is the Tariff TOU register, pressing the A button will display the details of the configured registers, continuing to press the A button will direct the user to the Tariff Block counters, again using the A button to scroll through the details will direct the user to the Tariff TOU Block registers.

The last press of the A button will direct the user back to the Total Active Import display.

NOTE: The Tariff display screens will timeout 30 seconds from the last button press and return to the total active import display.

*Figure 29 Tariff display list*

## 15.6   PIN entry

If PIN entry has been enabled, then after selecting the A button on the all segment display the user is taken to the PIN entry screen

From the PIN entry screen the user is required to enter a pre-entered 4-digit code.

The pin is entered using the A and B buttons

The A button is used to increment the numbers through 0-9

The B button moves to the next digit

Holding the B button for a long press (greater than 2 seconds) offers the entered PIN details to the meter

After 3 seconds if a valid Pin entry has been accepted by the meter, then the user can access the protected displays of the meter.

If an invalid PIN has been entered the user must repeat the sequence detailed above.
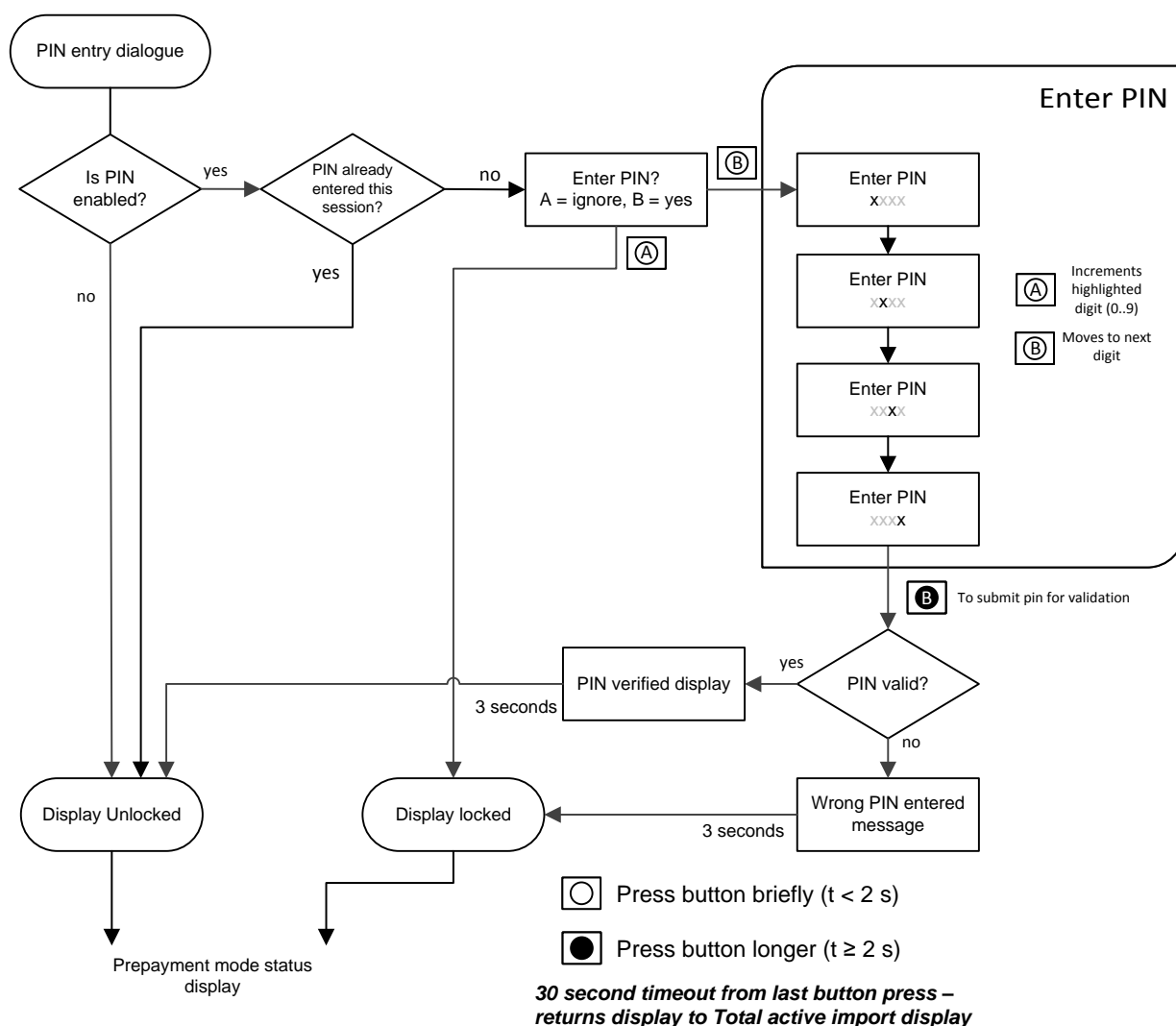
*Figure 30 PIN entry process*

## 15.7 Prepayment mode status

The prepayment mode status display is access after the all segment display; if PIN entry is enabled then this must be entered before the display can be accessed.

Once the screen is accessed it will indicate the status of the meter; the display will show one of the following screens in relation to the meter's status:

- Prepayment mode meter balance – This display details the remaining credit; it can also display low credit and owed (debt) information relating to the financial state of the meter.

```
Credit
        £   27.06
```

- Emergency Credit Available – These displays detail the status of emergency credit before it has been accepted. It can display that emergency credit is available and the amount of credit remaining, and emergency credit is available and the remaining credit has expired. It can also display the accept Emergency Credit activation.

```
C r e d i t          E m C r
        £   0 1 . 5 1
```

- Emergency credit accepted – These displays detail that operational state of emergency credit once it has been accepted. It can display the following scenarios:

    o Emergency credit has been accepted but is not in use

    o Emergency credit is accepted, in use and the amount owed

    o Emergency credit is low and the amount owed

    o Emergency credit expired and the amount owed

```
E m C r   R e m a i n i n g
        £   0 3 . 4 9
```

- Remote cut off – This display details that the meter supply is in a disabled state due to a remote disconnection command.

```
      R e m o t e   c u t
✕ import              o f f
```

- Elect Supply – This display details that the PIN is enabled but has not been entered, the supply status at this point could be any of the modes e.g. On, Off or Armed.

```
E l e c   S u p p l y
⊠ import       h h : m m
```

- Load limit press B – This display details that the meter is in load limit mode and the customer has exceeded the load limit value, the supply status will be Armed.

```
L o a d   L i m i t
⊠ import        P r e s s   B
```

The prepayment mode status display also allows the user to navigate to other display functions including the supply reconnection, the rolling display list and customer menu. Access to each function is detailed below.

- The supply control switch is accessed by selecting the B button

- The customer menu is accessed by selecting the B button >2s

- The rolling display menu is accessed by selecting the A button >2s

- The emergency credit / add credit displays by selecting the A button

## 15.8   Boost function

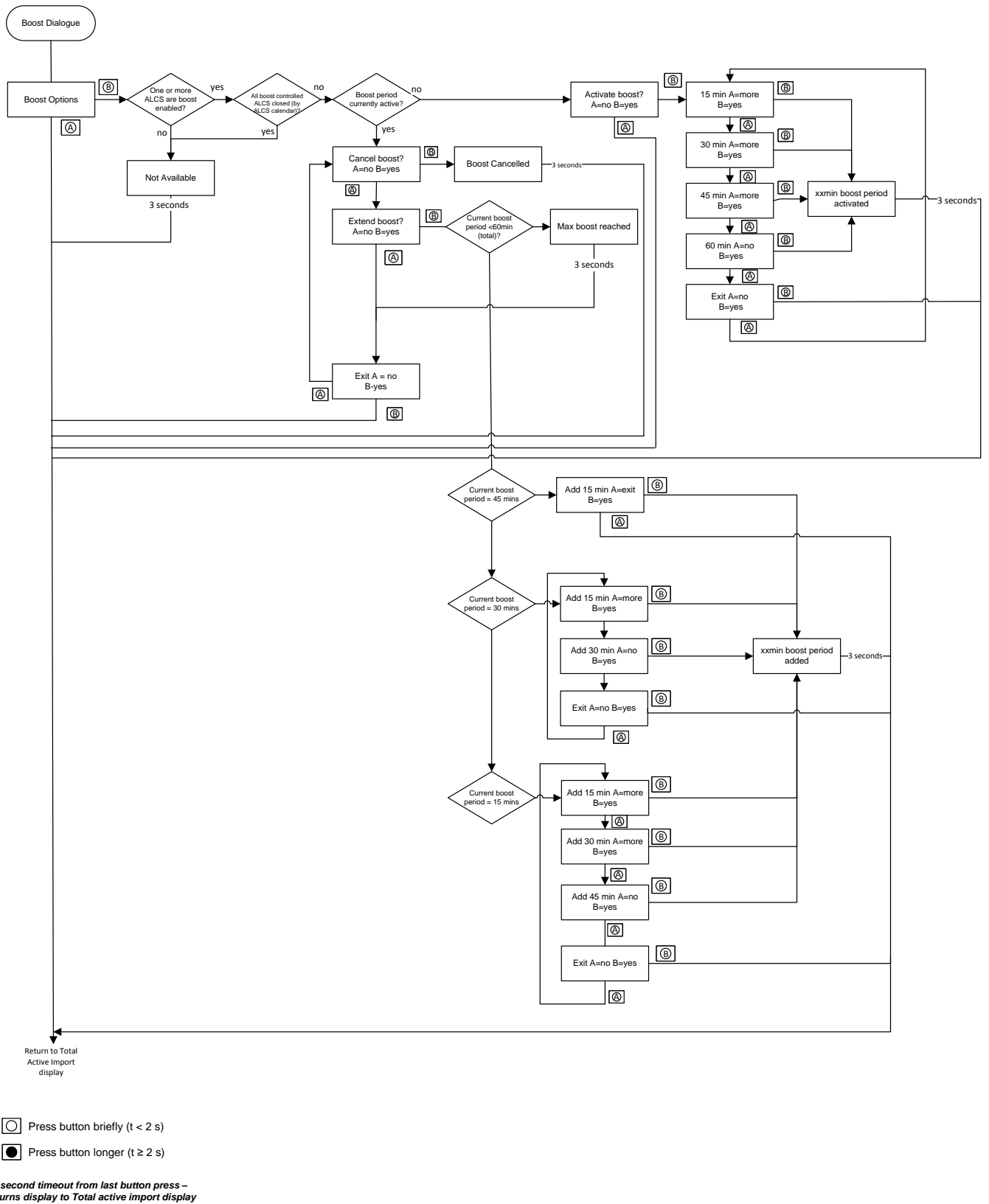The boost function is accessed via the selection of the B button from the Total Active Import display.



*Figure 31 Extend boost menu function*

### 15.8.1  ALCS boost support

The meter will define whether the supported ALCS are boost enabled. If not available, the user is directed back to the customer menu.

If the ALCS are boost enabled and are not controlled by the ALCS calendar, then the meter will check whether a boost period is currently active.

(Note if the ALCS are calendar controlled then the user is directed back to the Customer Menu).

### 15.8.2  Activating the boost period

If the boost period is not currently active and does not require activation then the A button should be selected. If the user wished to activate the boost function, then the B button should be selected.

### 15.8.3  Boost activation period

From the selection of the B button the user can define the active period in the following manner;

User is presented with a 15-minute activation period – select B button to accept or A button for further options.

User is presented with a 30-minute activation period – select B button to accept or A button for further options.

User is presented with a 45-minute activation period – select B button to accept or A button for further options.

User is presented with a 60-minute activation period – select B button to accept or A button to cancel activation for further options. The user will then be directed back to the customer menu.

On selection of a time option the boost function will be operational for the selected time.

### 15.8.4  Currently active boost period

If a boost period is currently active the meter will determine whether the current boost period duration is <60 minutes. If this is not the case, then the user is directed back to the customer menu.

If the current boost period is less than 60 minutes, then the user can extend the boost period.

### 15.8.5  Cancel boost period

The user can cancel an active boost period; from accessing the customer menu the boost function is displayed select the B button, if the meter is in a currently active boost period the user is directed to the cancel boost screen, from this screen the user can select the B button to cancel the operation.

### 15.8.6  Extending the boost period

The user can extend the period of an active boost period in the following manner; from accessing the customer menu the boost function is displayed select the B button, if the meter is in a currently active boost period the user is directed to the cancel boost screen, from the cancel boost screen select the A button, the user is then directed to the Extend Boost screen, from this screen select the B button.

The meter will then determine the time remaining for the current boost selection and will present options associated with the current boost period, as detailed below.

**Current boost period = 45 mins**

Select A button to exit function

Select B button to add 15 minutes

**Current boost period = 30 mins**

Select B button to add 15 minutes

Select A button for more options

- *Next sequence if A button more options has been selected -*

Select B button to add 30 minutes

Select A button to exit function

**Current boost period = 15 mins**

Select B button to add 15 minutes

Select A button for more options

- *Next sequence if A button more options has been selected -*

Select B button to add 30 minutes

Select A button more options

- *Next sequence if A button more options has been selected -*

Select B button to add 45 minutes

Select A button to exit function
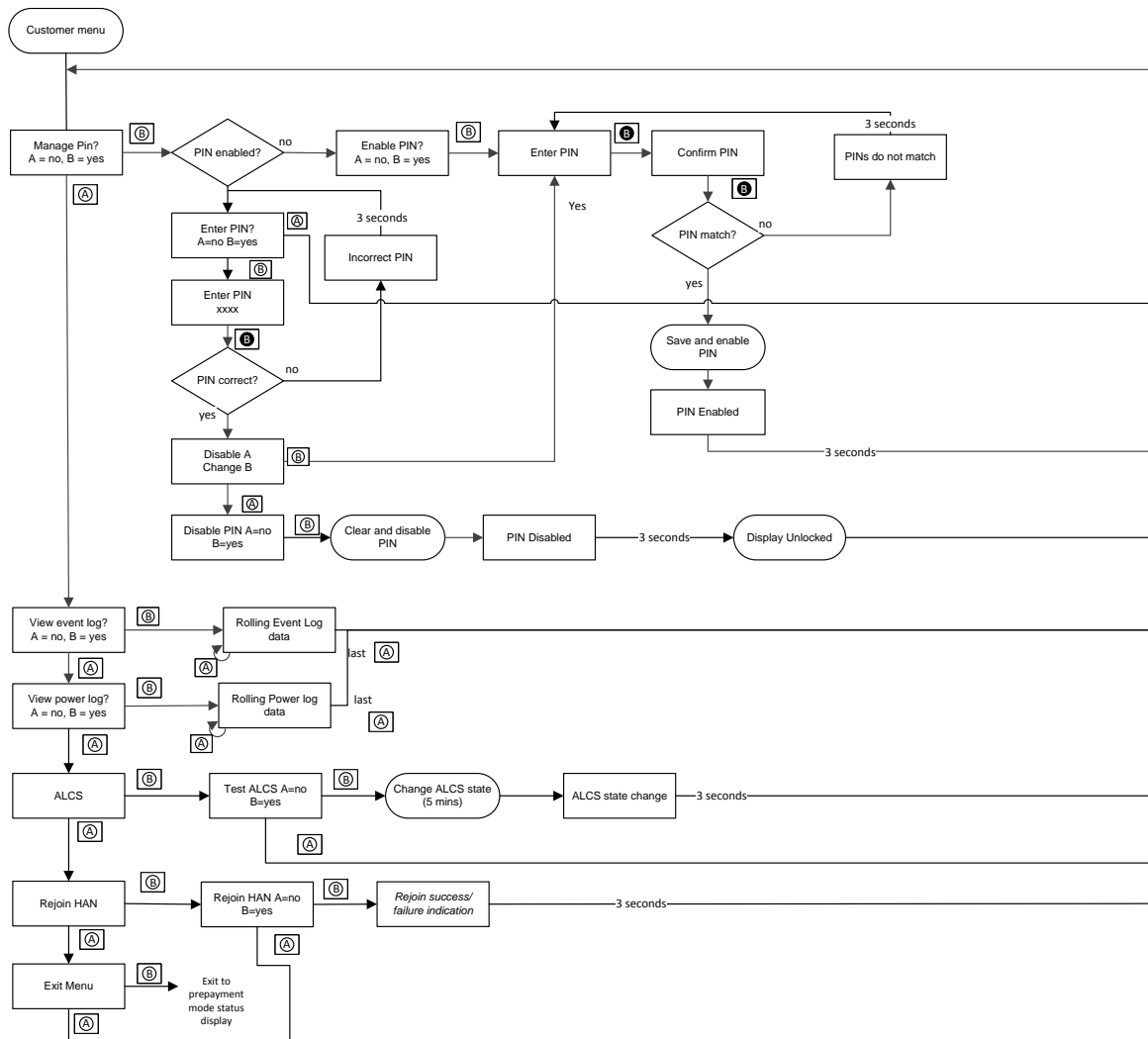
Selecting the exit function option in any of the above scenarios will direct the user back to the total active import display.

## 15.9   Customer menu

The customer menu is accessed by >2s press of the B button from the credit mode status screen. On access to the customer menu the user is presented with the following options:

- Manage PIN
- View event log
- View power log
- ALCS management

*Figure 32 Customer menu*

## 15.9.1 Manage PIN

On initial access to the customer menu selecting the A button will direct the user to the PIN management function.

The user is asked to confirm whether a PIN is already enabled or not.

If the PIN is enabled the user is asked to enter the PIN 4-digit number. After

Correct PIN entry the user the can choose to Disable the PIN (A button) or change the PIN (B button).

If the user chooses the disable option (A button) the display will confirm the action, clear and disable the PIN and return the user to the customer menu.

If the user chooses the change option (B button) the display will direct the user to the Enter PIN screen. The user should enter the required 4-digit PIN at this point followed by the A button, the user is then asked to enter the 4-digit PIN a second time to confirm that they match, if the Pins match the meter will save the details and notify that the PIN has been enabled and return the user to the customer menu.

If no PIN has been enabled the user can Enable a PIN if the user chooses not to create the PIN at this point, then the B buttons should be selected which will return the user to the customer menu.

If the user wishes to enable the PIN then the A button should be selected, the display will then direct the user to the Enter PIN screen. The user should enter the required 4-digit PIN at this point followed by the A button, the user is then asked to enter the 4-digit PIN a second time to confirm that they match, if the Pins match the meter will save the details and notify that the PIN has been enabled and return the user to the customer menu.

### 15.9.2  View event log

From the customer menu if the user selects the A button twice they are directed to the View Event Log display; selecting the B button will enable the Rolling Event Log Data where the meter will display the recorded event details.

### 15.9.3  View power log

From the customer menu if the user selects the A button three times they are directed to the View Power Log display; selecting the B button will enable the Rolling Power Log Data where the meter will display the recorded event details.

### 15.9.4  Manage ALCS

From the customer menu if the user selects the A button four times they are directed to the ALCS display; selecting the B button will enable the testing of the ALCS setting.

Selecting the A button will direct the user to the Exit Menu where they can be directed back to the credit mode status display.

Test ALCS – on access to the test ALCS display the user is presented with a yes and no option, selecting the A button will exit the function, selecting the B button a change to the ALCS state will be applied for 5 minutes, after activation the user is directed back to the customer menu.

### 15.9.5  Join HAN

This provides the option to join a HAN (but not leave a HAN) as described in section 14.12.2.

## 15.10  Rolling display list

The Rolling Display List is accessible from the Prepayment Mode Status display by pressing the A button for >2s.

The content and order of the normal display list is indicated in *Table 9 "Rolling register listings"*.
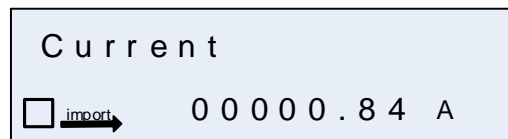
The user can step through the list of display items in the rolling display list using button A. For example, total active Import, voltage and current, would display as follows.

```
 T o t a l   A c t   I m p o r t

 ☐ import▸          0 0 2 2 2 kWh
```

Press button A to navigate to the next item.

```
┌─────────────────────────────────┐
│                                 │
│  V o l t a g e                  │
│                                 │
│  ☐ import      0 0 0 2 3 0 . 2  V │
│                                 │
└─────────────────────────────────┘
```

A further press of button A will navigate to the next item.

```
┌─────────────────────────────────┐
│                                 │
│  C u r r e n t                  │
│                                 │
│  ☐ import      0 0 0 0 0 . 8 4  A │
│                                 │
└─────────────────────────────────┘
```

Once the end of the list has been reached the A button press will navigate the user to the credit status.

At any point the display will revert to the default display after a timeout period of 30 seconds from the last button press.

**Note**
Display items that are configured in this list but are designated as PIN protected will only be shown if a PIN has NOT been set or, if a PIN has been set and the correct PIN has been entered by the user.

## 15.11  Reconnect supply load switch

The user may require to access the enable supply display where a system initiated disable of supply has been performed, or if the meter entered a load limiting state.

Where PIN protection is not enabled the user is directed to the reconnect display with a short press of button A, from the prepayment mode status display.

If PIN is enabled by the meter configuration the meter will require the entering of the PIN in the PIN entry dialogue before allowing access to the prepayment mode status display.

If the user chooses not to reconnect the supply, then the A button should be selected and the user is returned to the prepayment mode status display.

For the reconnection of the supply the B button should be selected, the meter will then reconnect the supply load switch and indicate the action with a temporary reconnect message.

## 15.12  Emergency credit and add credit dialogue

The emergency credit and add credit dialogues allow the activation of emergency credit (when available) and the entry of a UTRN (payment code).

### 15.12.1 Emergency credit activation

When emergency credit is available selecting the A button from the prepayment mode status display will direct the user to the emergency credit display. If emergency credit is available for selection then the B button should be pressed to accept emergency credit, the display will show that emergency credit has been accepted and direct the user back to the prepayment mode status display.

Selecting the A button will direct the user back to the add credit display.

### 15.12.2 Add credit

The add credit option allows the user to enter the details of a 20-digit payment code. This is to provide a back-up mechanism where the WAN or HAN network is not available, or a network fault has stopped a payment getting to the meter.

Selecting the A button from the prepayment mode status display will direct the user to the add credit screen, selecting the B button will direct the user to the UTRN entry display, providing the display has not been locked out due to invalid code entry.

On access to the UTRN screen the user can enter the 20-digit UTRN code from the customer receipt or other mechanism.

The pin is entered using the A and B buttons

The A button is used to increment the numbers through 0-9

The B button moves to the next digit

Holding the B button for >1s offers the entered UTRN details to the meter

The meter will then validate the UTRN firstly to ensure that the UTRN has been entered correctly, and then secondly will validate that the UTRN has not been entered previously. If the validation checks are passed the value of credit within the UTRN is applied to the meter, and the meter display returns to the prepayment mode status display.

### 15.12.3 Invalid / already used UTRN entry

If the user has entered an invalid UTRN then the meter will display 'Invalid re-enter code' the user is directed back to the add credit display where they can repeat the process.

The meter allows 5 invalid attempts to be made within a 10-minute period, if the meter records the 5 entries within the time window then the UTRN entry is locked out for 1 hour, the display will show 'code entry locked' and return to the prepayment mode status display.

If the meter sees a repeat attempt of an already processed UTRN then the display will show 'credit already used' and return the user back to the add credit display.
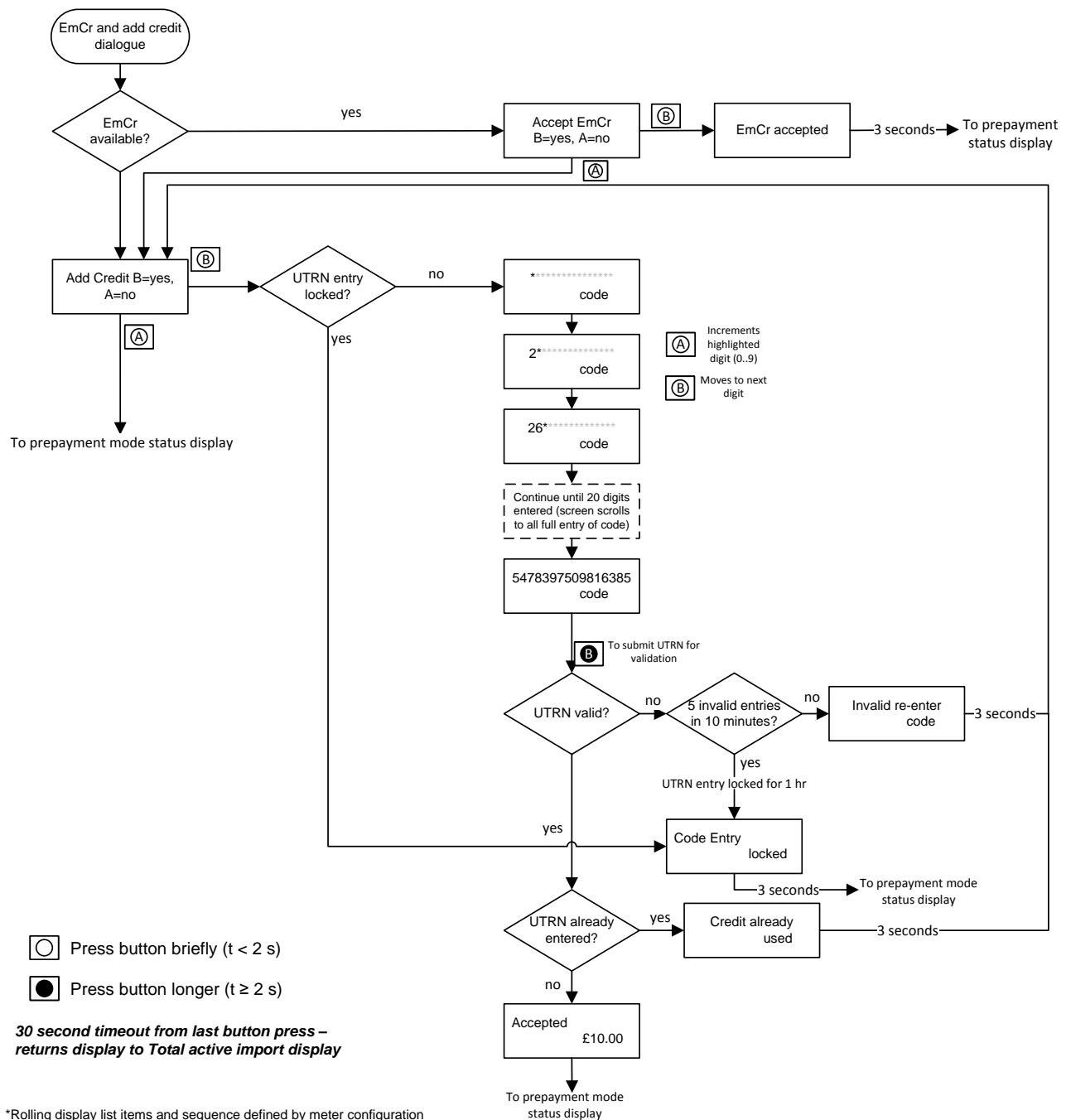
*Figure 33 Emergency credit and add credit management*

## 15.13  Service menu

The Service Menu provides utility engineers with the access to meter functions that are not for general consumer use.

The service menu can only be accessed by performing a removal and reconnection of the meter terminal cove terminal cover (as detailed in section 19).

The service menu allows the following actions to be performed.

- Enter In Service Test Mode

- HAN Join / Unjoin management

- View the Security Log for the meter

### 15.13.1 In-Service test mode

The In-Service Test (IST) mode is accessible by selecting the B button from the service menu. The user can then select the B button to enable the IST mode. In IST mode the meter registers are displayed with 4 digits to the left and 3 digits to the right of the decimal point. This mode allows for calibration of the meter using less energy than would be possible using the normal display resolution. The IST mode is active for 4 hours. Therefore, if enabled, IST will remain in force for 4 hours, even though the service menu will be exited after 5 minutes of no user interaction. Should the meter be power cycled during the 4 hour period that IST is in operation, then on power up, the meter will 'remember' that IST was in operation at the point of power down, so will reinstate it. However, the 4 hour IST timeout duration will begin from the point of power up, not from the point when it was originally enabled.

If the user chooses not to enter IST mode, then the A button should be selected.

The user can exit IST mode by selecting the B button from the service menu followed by the A button.

### 15.13.2  Leave/join HAN

From In-Service Test (IST) display a press of button A leads to the leave HAN display (if meter is currently joined to the ZigBee network) or to the join HAN display (if meter is currently un-joined from the ZigBee network).

Selecting the B button, leaves or joins the ZigBee network, respectively. The user is shown a progress / result confirmation before returning to the IST display.

By selecting the A button, the user is choosing not to join or leave the ZigBee network and is directed back to the IST display.

### 15.13.3 Display security log

From In-Service Test (IST) display two presses of button A leads to the Display Security Log display, pressing button B will display the security log entries, which can be scrolled using the A button at the last entry and selection a further selection of the A button the display is directed back to the IST display.

### 15.13.4 Exit service menu

The engineer can exit the service menu by selecting the A button four times from the In-Service Test (IST) display, or waiting 5 minutes for the meter to exit the service menu.

*Figure 34 Service menu*
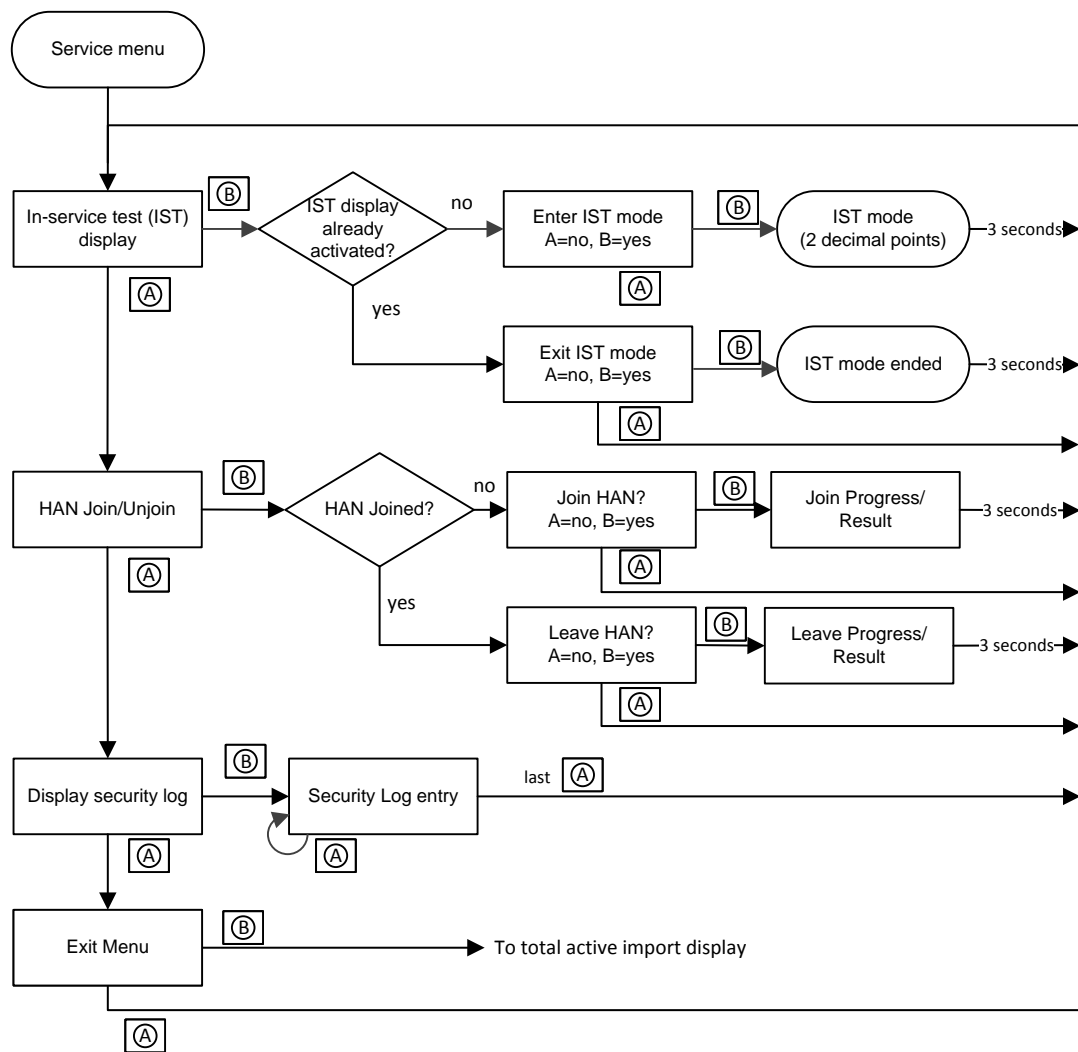
⬜ Press button briefly (t < 2 s)

⬛ Press button longer (t ≥ 2 s)

***30 second timeout from last button press –
returns display to Total active import display***

# 16    Load limiting operation

The meter can be configured to support load limiting operation.

To support load limiting the following values need to be configured:

- The load limit power threshold (W)
- The load limit period (seconds)
- Load limit state change
- The load limit restoration period (seconds)

## 16.1    Load limit power threshold

This is a configurable value where once the instantaneous usage (kW) is exceeded the meter will register the load limiting event.

The meter status may change depending on the load limit state that has been detected. Typically, the meter will either display an indication that the threshold has been exceeded or disconnect supply to the consumer.

## 16.2    Load limit period

Where load limiting is enabled the meter can also be configured to support a load limiting period. The load limiting period (defined in seconds) is used as a guard time to denote when the load limiting action will be implemented.

For example; If the load limiting was configured to 30 seconds; then the instantaneous usage would have to be exceeded for more than 30 seconds before the action was implemented.

## 16.3    Load limit state change

The load limit state supports two conditions that can be configured for the support of load limiting.

The first state is to disconnect supply to the consumer, followed by immediately arming the supply for reconnection either by manual intervention, or by restoration period.

The second state is to remain unchanged, where the meter will display that load limiting has been exceeded and generate the sending of an alert indicating the change in state via its HAN Interface.

## 16.4    Load limit restoration period

After a load limit action, has occurred the supply control switch is immediately set to armed state to allow the consumer to reconnect the supply.

The load limit restoration period can be configured (in seconds) to perform an automatic reconnection of supply after the specified time period. The use of this function is to enable reconnection without the consumer having to go to the meter and press the button to reconnect the supply control switch.

The meter can be configured to support load limiting as a factory default or via commanded to enter this mode by a GBCS message.

Load limiting events will be recorded in the event log, and will send an alert via the HAN to the user interface.

# 17    Tariffs and accounting

## 17.1    Tariff structure in credit and prepayment modes

The meter holds a tariff pricing scheme to allow energy usage costs to be calculated, displayed and notified over the HAN. In addition, a daily standing charge may be applied.

The tariff data can be updated remotely via remote command.

A tariff scheme can be configured which becomes active at a predetermined date and time. If that date is in the past, then the meter will activate the tariff immediately. If that date is in the future the meter will activate the tariff when that date arrives.

## 17.2    Energy accumulation

The meter accumulates energy in tariff registers per time-of-use (TOU) and energy consumption.

Consumption or 'block' pricing is always implemented as a combination of TOU and block pricing. The energy values accumulated in these registers are multiplied by price information held in the price matrix to determine the energy charge.

There is a total of 80 tariff energy registers used to determine prices.

These are made up of 48 TOU registers and 32 combined Block/TOU registers (comprising 8 TOU rates with 4 consumption blocks per TOU rate).

In addition to the 32 total Block/TOU registers there are 32 rising block counters.

The total registers are never reset; they accumulate energy for the lifetime of the meter.

The rising block counters are reset at the end of the block period.

### 17.2.1    Current and future tariffs

Two tariff schemes are held – current and future.

The current scheme is the one currently being utilised. Future tariff schemes are configured in the background for later use. The activation of future tariffs is controlled by an activation date.

The future tariff scheme will be activated if the current date becomes newer than the activation date. When activating the future tariff scheme, the currently active tariff is overwritten and the future tariff scheme is cleared.

### 17.2.2    Tariff types

The meter may be configured with the following tariffs:

- TOU only tariffs (up to 48 rates),
- TOU with block tariffs (up to 8 rates each with up to 4 blocks).

### 17.2.3  ToU only tariffs

The meter applies TOU pricing per the active rate determined by the settings held within the TOU switching tables.

On the switch to a TOU rate, the meter will apply the pricing set for that rate.

| TOU 1 | TOU 2 | TOU 3 | … | TOU 48 |
|-------|-------|-------|---|--------|
| Rate 1 | Rate 2 | Rate 3 | … | Rate 48 |

*Table 10    TOU tariff structure*

### 17.2.4  ToU with block tariffs

Where TOU with block pricing is required, the rate switching matrix is used to specify TOU switching times in combination with block thresholds as shown in Table 11

| TOU 1 | | | | … | TOU 4 | | | |
|-------|-------|-------|-------|---|-------|-------|-------|-------|
| Block 1 | Block 2 | Block 3 | Block 4 | … | Block 1 | Block 2 | Block 3 | Block 4 |
| **Rate 1** | **Rate 2** | **Rate 3** | **Rate 4** | **…** | **Rate 1** | **Rate 2** | **Rate 3** | **Rate 4** |

*Table 11    TOU with block tariff structure.*

The meter applies TOU pricing per the active rate determined by the settings held within the TOU switching tables. In addition, multiple individual rates can be defined that may have up to 3 block thresholds applied. Each rate can either have different prices per block, which apply as consumption on that rate moves through the block thresholds or have a single flat rate.

**Example:** The following example shows a 2-rate TOU with block tariff.

The tariff provides a higher day price for the first 500 kWh of usage. Night prices are the same throughout the billing period. This gives a variable rate per consumption level during the day and a flat rate irrespective of consumption during the night.

At the start of the billing period, the billing period usage will have been reset to zero for all rates. To implement this tariff structure, Rate 1 Block 1 threshold should be set to 500 kWh and Rate 1 Block 2 threshold will be set to a value that effectively equates to infinity. For the first 500 kWh of consumption during the day, Rate 1 Block 1 pricing of 20 p per unit is applied. Once 500 kWh of usage at Rate 1 is exceeded, Rate 1 Block 2 pricing will be applied. In the example below, the price reduces from 20 pence to 10 pence as Rate 1 Block 1 threshold of 500 kWh is passed.
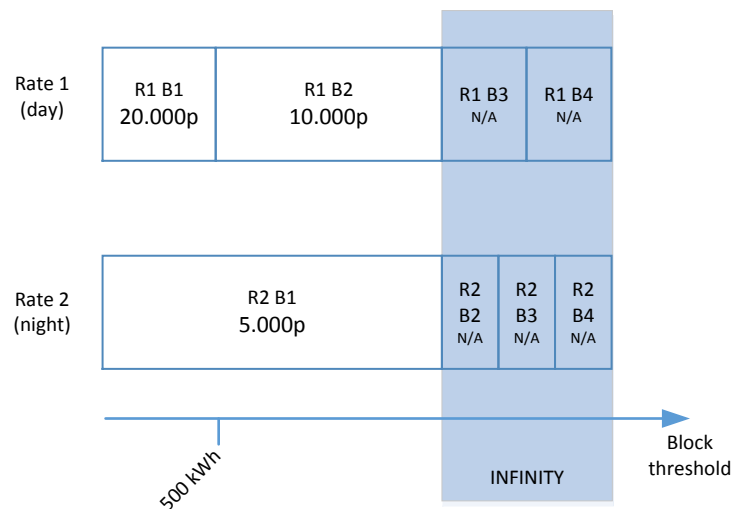
*Figure 35   2- rate TOU with block pricing example*

### 17.2.5 Permitted value ranges for rates and blocks

|  | Block 1 | Block 2 | Block 3 | Block 4 |
|---|---|---|---|---|
| **Cost** | £0.00001 - £99.99999 per kWh | £0.00001 - £99.99999 per kWh | £0.00001 - £99.99999 per kWh | £0.00001 - £99.99999 per kWh |
| **Threshold** | 0.001 to 999999.999 kWh | 0.001 to 999999.999 kWh | 0.001 to 999999.999 kWh | infinite |

*Table 12    Permitted value ranges for rates and blocks*

### 17.2.6 Display of pricing

The cost of energy usage is shown on the IHU.

The IHU is provided with pricing data via the ZigBee SE profile 1.x Pricing cluster. This information combined with usage profile enable costs to be calculated over various periods.

Additionally, the meter calculates a cost value since the start of billing period from kWhs used and the price matrix.

### 17.2.7 Additional tariff related data items

| Item | Description | Units |
|---|---|---|
| Standing charge | Daily charge 0 – 32767 | Configurable to millipence, pence or pounds |
| Activation date | Date on which tariff will be first applied. It is also the start of the first billing period. | Date |

*Table 13 Additional tariff related items*

## 17.3 Switching calendar

The TOU tariff is controlled by a switching table which supports up to:

- 4 season profiles

- 4 week profiles

- 16 day profiles each allowing 48 switching times per day

- 50 special day entries

## 17.4 Billing calendar

Billing calendar is a calendar defining billing dates for the storage of billing related information in the Billing Data Log. The calendar is controlled by a table which defines the dates and times of up to 14 billing events. Recurring billing events (e.g. monthly or annual events) may be specified by the use of the 'FFFF' wildcard in the billing calendar.

# 18 Voltage Quality Measurements

## 18.1 Average RMS Voltage

The meter calculates and records the average RMS voltage in the Average RMS Voltage Profile Data log. The log captures the averaged RMS voltage for each measurement period which is defined by the Average RMS voltage measurement period. The meter contains a Profile_AverageVoltage object which captures the averaged values. Based on a default average capture time of 10 minutes and a size of 4349 log entries the meter can capture entries covering more than 720 hours.

### 18.1.1 Average RMS Over Voltage

The meter detects when the Average RMS value recorded is greater than the Average RMS Over Voltage Threshold and, on detection:
- Generates an entry in the Power Quality Event Log (0x00DF Voltage Over 3)
- Counts the number of such events

If the above event is also configured in the Alarm Filter object the meter this can be used, with a compatible external communications hub, to send an alert to a remote Head End System.

An event is also captured in the Power Quality Event Log when the Average RMS voltage falls back below the threshold.

### 18.1.2 Average RMS Under Voltage

The meter detects when the Average RMS value recorded is less than the Average RMS Under Voltage Threshold and, on detection:
- Generates an entry in the Power Quality Event Log (0x00E1 Voltage Under 3)
- Counts the number of such events

If the above event is also configured in the Alarm Filter object the meter this can be used, with a compatible external communications hub, to send an alert to a remote Head End System.

An event is also captured in the Power Quality Event Log when the Average RMS voltage rises back above the threshold.

## 18.2 RMS Extreme Over Voltage

The meter detects when the RMS voltage rises above the RMS Extreme Over Voltage Threshold for longer than the RMS Extreme Over Voltage Measurement Period and, on detection:
- Generates an entry in the Power Quality Event Log (0x00D9 Voltage Over 2)

If the above event is also configured in the Alarm Filter object the meter this can be used, with a compatible external communications hub, to send an alert to a remote Head End System.

An event is also captured in the Power Quality Event Log when the RMS voltage falls back below the threshold.

## 18.3   RMS Extreme Under Voltage

The meter detects when the RMS voltage falls below the RMS Extreme Under Voltage Threshold for longer than the RMS Extreme Under Voltage Measurement Period and, on detection:

- Generates an entry in the Power Quality Event Log (0x00DD Voltage Under 2)

If the above event is also configured in the Alarm Filter object the meter this can be used, with a compatible external communications hub, to send an alert to a remote Head End System.

An event is also captured in the Power Quality Event Log when the RMS voltage rises back above the threshold.

## 18.4   RMS Voltage Sag Detection

The meter detects when the RMS voltage falls below the RMS Voltage Sag Threshold for longer than the RMS Voltage Sag Measurement Period and, on detection:

- Generates an entry in the Power Quality Event Log (0x00DB Voltage Under 1)

If the above event is also configured in the Alarm Filter object the meter this can be used, with a compatible external communications hub, to send an alert to a remote Head End System.

An event is also captured in the Power Quality Event Log when the RMS voltage rises back above the threshold.

## 18.5   RMS Voltage Swell Detection

The meter detects when the RMS voltage rises above the RMS Voltage Swell Threshold for longer than the RMS Voltage Sag Measurement Period and, on detection:

- Generates an entry in the Power Quality Event Log (0x00D7 Voltage Over 1)

If the above event is also configured in the Alarm Filter object the meter this can be used, with a compatible external communications hub, to send an alert to a remote Head End System.

An event is also captured in the Power Quality Event Log when the RMS voltage falls back below the threshold.

# 19    Service menu

The meter supports service operations without the use of a field service tool.

The service menu is accessed when the tamper boundary is breached, i.e. the terminal cover is removed.

The following possibilities exist in service menu:

- Switching on/off the in-service test mode

- Leaving/joining the HAN

- Commissioned indicator

- Displaying the security log entries

To ensure that safe working conditions are applied the engineer should perform the following steps to access the IST mode.

---

NOTE: The meter must be in a live capacity to activate this function, extra care should be taken when attempting to access and lift the terminal cover.

---

1. Remove the terminal cover seal (if in place)

2. Undo the terminal cover screw

3. Gently lift the terminal cover until it breaks contact with the meter main meter structure

4. Wait for the display to change to the Service menu, which takes a few seconds

5. Reapply the terminal cover and tighten the terminal cover screw

## 19.1   Switching on/off the in-service test mode

In the in-service test mode, the consumption register always displays three decimal places for in-service testing (IST).

Proceed as follows to switch the in-service test mode on or off.

1. Lift and replace the terminal cover in order to activate the terminal cover tamper. This is required to get access to the service menu.

2. Press  button B briefly (< 2 s). The In-service test (IST) display appears.

```
Enter  IST?      A=No

            B=Yes
```

3. Press button B (< 2 s). The IST mode is switched on.

4. Perform the intended work in the IST mode.

5. Press button B briefly (< 2 s). The In-service test (IST) display appears.

```
Exit  IST?       A=No

            B=Yes
```

6.   To switch off the IST mode again press button B briefly (<2 s).

7.   Attach and seal the terminal cover again.

## 19.2   Leaving/joining HAN

The leave HAN option will cause the meter to disconnect from the local HAN (ZigBee network) and the join HAN option will cause the meter to rescan for a communications hub.

Proceed as follows to leave or join the HAN.

1.   Lift and replace the terminal cover in order to activate the terminal cover tamper. This is required to get access to the service menu.

2.   Press button A briefly (< 2 s) from the default display.
     All segments of the LCD are lit (display check).
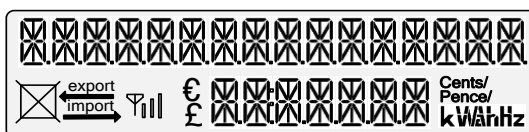


3.   Press button A briefly (< 2 s). The In-service test (IST) display appears.

```
I S T ?                 A = N o

              B = Y e s
```
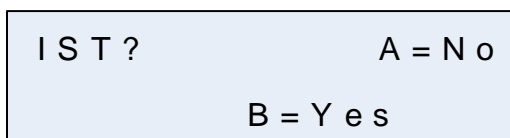
4.   Press button A briefly (< 2 s). The HAN display appears.

```
H A N ?                 A = N o

              B = Y e s
```
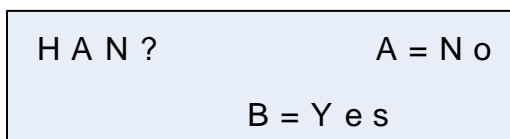
5.   Press button B briefly (< 2 s). If the meter is currently joined, the Leave HAN display appears.

```
L e a v e   H A N ?   A = N o

              B = Y e s   ( c )
```
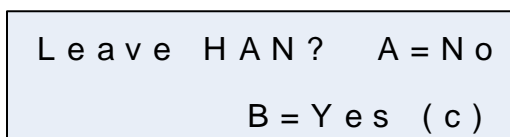
If the meter is currently un-joined, the Join HAN display appears.

```
J o i n   H A N ?       A = N o

              B = Y e s   ( c )
```
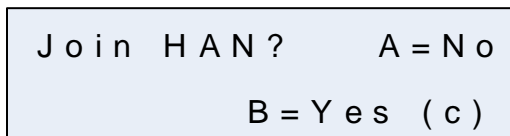
6.   Press button B briefly (< 2 s). The HAN is left or joined, respectively.

If the HAN is joined, attach and seal the terminal cover again.

## 19.3   Commissioned indicator

If the meter has previously been commissioned then the commissioned indicator symbol (c) appears on the Leave/Join HAN display indicating that the meter may require refurbishment before being redeployed to a new premise.

## 19.4   Displaying security log entries

The security log can be displayed on site on the meter LCD display. The
following describes how to display and view security log entries.

1.   Lift and replace the terminal cover in order to activate the terminal
     cover tamper. This is required to get access to the service menu.

2.   Press button A briefly three times (< 2 s) from the default display.
     All segments of the LCD are lit (display check).
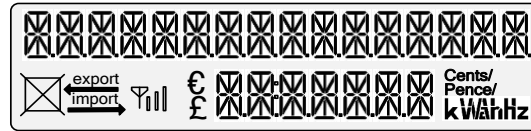
3.   Press button A briefly (< 2 s).

     The first security log entry is displayed.

4.   Press button B briefly (< 2 s) to scroll through the security log entries of
     the security log. After the last entry, the default display appears again.

5.   Attach and seal the terminal cover again.

# 20    Instantaneous values

The instantaneous values measured by SMETS2 E470 devices are listed in the table below:

| Measured Quantities | | | Resolution |
|---|---|---|---|
| Active power | P | Sum, combined \|QI+QIV\|+\|QII+QIII\| | XXXXX.XX kW |
| Reactive power | Q | Sum, combined | XXXXX.XX kVAr |
| Apparent power | S | Sum (true RMS, S=U*I, instantaneous value) | XXXXX.XX kVA |
| Power factor (only as P/S)[1] | +PF | Instantaneous | XXXX.XXX |
| | | Integration period average value (not available to customer) | |
| | | Minimum during the last billing period (not available to customer) | |
| Voltage (RMS) | U | Instantaneous per phase | XXXXXX.X V |
| | | Current average over $t_{avr}$ | |
| Current (RMS) | I | Instantaneous per phase | XXXXX.XX A |
| | | Current average over $t_{avr}$ | |
| Network frequency | fn | Instantaneous | XXXXXX.X Hz |
| | | Current average over $t_{avr}$ | |

*Table 14 Instantaneous values table*

The instantaneous values are updated every second (tsampling=1sec)

Instantaneous registers are NOT settable; registers always appear as shown in the table above. The same settings apply for showing the value on the display or reading via communication.

All the registers can be read at any time as well as stored in various profiles.

---

[1] Import only. No export.

# 21 Profiles

## 21.1 Overview

There are four different load profiles available in the SMETS2 E470:

**13 Month Profile Data Log**

A profile for storing 13 months of half hourly data: total import consumption,

**3 Month Profile Data Log**

A profile for storing 3 months of half hourly data: active energy export, reactive energy import and reactive energy export.

**3 Month Profile Data Log**

A profile for storing 3 months of half hourly data: reactive energy import.

**Daily Consumption Data Profile**

A profile for storing 182 months of daily data: active energy import.

**Daily Read Data Log**

A profile for storing 1 months of daily data: Active Energy Import register, TOU total rate and Block/TOU total register values.

**Daily Read Export Data Log**

A profile for storing 1 months of daily data: Active Energy export register.

**Daily Prepayment Read Data Log**

A profile for storing 1 months of daily data: Current Credit Amount on Emergency Credit object, Available Credit on Current Account, Total Amount Paid on Payment Based Debt object, Total Amount Paid on Time Based Debt 1 object, Total Amount Paid on Time Based Debt 2 object, Current Credit Amount on Accumulated Debt object.

NOTE: Profiles are not accessible via the meter display

## 21.2 Structure

Each entry consists of the timestamp, a status and a selectable set of measured values (registers). The entries are stored in the order they occur, so the most recent entry is stored last. When reading the profile, the entries are given out in the same way (oldest entry first).

The timestamp is set to the point in time at which the entry was captured.

The capture period is the regular period after which a profile entry is created and added to the profile storage. For the Profile Data Logs this period is set to 30 minutes. For the Daily Read Log, this period is set to 86400 seconds (1 day).

# 22    Events and alerts

The meter, as a minimum, supports all the relevant mandatory events and alerts according SMETS2/GBCS plus those required for certification under the Measuring Instruments Directive (MID).

These events and alerts are set out in the separate document **«E470 SMETS2 Events and Alerts»**.

## 22.1    Event logs

The meter records events into several event logs, sets and clears the corresponding errors and triggers the corresponding alarms.

An event log is a profile in which events are stored asynchronously in the order they occur. It is used as a logbook to track the behaviour of the meter.

If an event occurs, the point in time as well as the event number and the current device status is stored in the event log.

The event logs are organised as circular buffers. Once the buffer is full, the oldest entry will be overwritten by the most recent one.

The event log entries can be read via communication.

The meter supports the following event logs:
- Security Log
- Event Log
- Power Event Log
- Auxiliary Load Control Switch (ALCS) Log

The classification of an event is grouped into one of the following categories:
I – Information – For information and input to the relevant DCC User's business processes.
E – Exception – An exception may have occurred on the meter – which should be monitored for repeat occurrences and may require further investigation or action.
F – Fault – A potential meter fault which requires follow up action and possible meter replacement.

## 22.2    Alerts

The meters support the management of Alerts in the following manner.

- Type (1) Alerts – Alerts communicate the alert code and date/timestamp,

- Type (2) Alerts – Alerts communicate the alert code, date/timestamp plus additional payload data relevant to the alert.

- Whether it is a Wide Area Network (WAN) alert sent via the DCC

- Whether it is a Home Area Network (HAN) alert sent via HAN devices

- Whether it is 'Always On' or is configured by the responsible user

- If it is configurable, who the relevant responsible party is for configuration of the alert

- If required, the payload data that is sent with the alert if it is a type (2) alert.

# 23 Power-up/power-down procedure

This section describes the detection and the handling of total power failures. A total power failure is detected directly from the power supply of the device and works independently of the voltage measurement.

## 23.1 Power-down (PD)

After a power failure, the internal power supply voltage starts decreasing. As soon as the 'power-down' threshold is reached, all functions of the device are disabled and the power-down procedure is initiated.
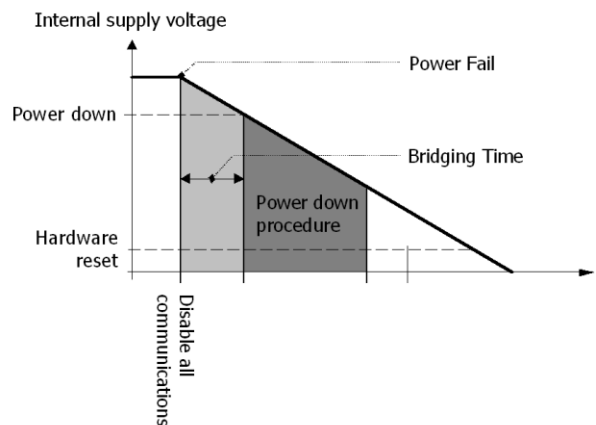
*Figure 36* Power-down procedure

The meter can communicate via any communication channel only until the power fail threshold is reached.

### 23.1.1 Bridging time

The device allows a time of up to 0.5 s within which the power failure will have no effect except restrictions in communication (bridging time per IEC). Thus, the device will retain its full functionality (also restore communications) if power is restored within this time.

### 23.1.2 Power-down procedure

If the power-down threshold is reached, the power-down procedure is initiated and the device stops handling the inputs, outputs and all non-disabled communication interfaces. Now the device saves all relevant data, such as:

- Time and date
- All energy registers
- All status registers
- Power-down time

Once the power-down procedure has started it cannot be interrupted. Therefore, the device will complete the procedure even if the voltage is restored shortly after the data storage was initiated. In this case, however, the device will restart immediately after the power-down procedure is completed.

## 23.2    Power-up (PU)

When the internal supply voltage has reached its nominal value, the power-up procedure is initiated. All data is restored and communication is enabled.

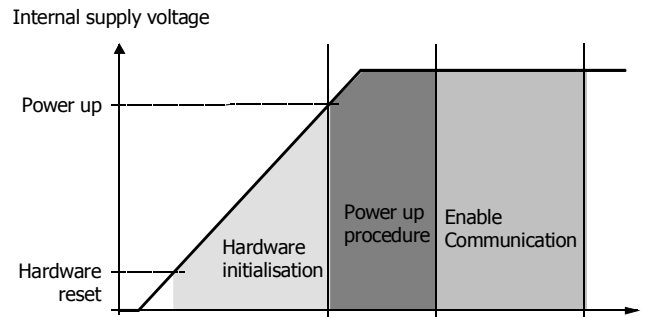After a maximum of 5 s the device has regained its full functionality.



*Figure 37* Power-up procedure

### 23.2.1   Hardware Initialisation

When the hardware reset threshold is reached, the microcontroller is started and the internal hardware, including test output LED, is initialised. No further functions are enabled until the power-up threshold is reached.

### 23.2.2   Power-up procedure

When the power-up threshold is reached, the power-up procedure is started. During the power-up procedure, the following actions are performed:

- The device reads the saved data (energy and status registers, clock) and restores the status as it was before the power-down

- The device reads the current time from real-time clock

- If the power reserve has been exhausted during the power failure the clock invalid bit is set and the corresponding event is stored in the event log.

- The device stores a power-up event in the event log. The event number depends on the duration of the voltage failure. If the duration is longer than the long power fail threshold, the long power fail counter is incremented

- All inputs, outputs and communication interfaces are enabled

Once the power-up procedure has started, it cannot be interrupted. Therefore, the device will complete the procedure even if the voltage fails shortly after the power-up procedure has started. In this case, however, the device will power-down immediately after the power-up procedure is completed.

The power-up threshold is higher than the power-down threshold to guarantee enough power reserve to perform a complete power-up procedure followed by an immediate power-down.

### 23.2.3   Enable communication

After completion of the power-up procedure the meter is ready to update all registers and to detect a meter change during power-down.

## 23.3   Behaviour of outputs at PU/PD

The auxiliary relay will lose its state during a power failure. This will be restored on power-up.

## 23.4   Logging of supply interruption

An interruption to the meter power supply triggers a 'Supply Interrupted' event which gets logged together with the timestamp in the Power Event Log.

# 24    Sending consumer messages

The meter can publish messages from the utility to the IHU connected to the HAN.

Message may be sent to the meter using ECS10. Further information may be found in the GBCS specification.

Sending an empty message to the meter will clear the message buffer.

There is no need to reset the message since the message gets overwritten by the next message sent from the system. However, sending an empty message to the meter will clear the message buffer.

# 25 Maintenance and service

## 25.1 Meter check

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

- Is the meter dry and clean, particularly the LCD display?

- Does the meter display a legible and sensible display? I.e. does the meter appear in a serviceable condition?

- Check all factory fitted and company fitted seals are in place secure and intact.

- Observe display for any error messages or notifications

- Confirm that the energy registers have changed to a reasonable degree since the last visit.

## 25.2 Meter testing

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

# 26    Measures in the event of faults

## 26.1    Operating faults

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

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

Has the minimum or maximum recommended ambient temperature been exceeded?

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

If none of the above are causing the fault the meter should be disconnected, replaced if required and returned to the supplier triage centre.

## 26.2    Disconnecting the meter

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

Proceed as follows:

- Remove the company seals on the terminal cover (if fitted).

- Release the terminal cover screws and remove terminal cover.

- Check with a suitable voltage testing device that the phase connections are not live. If they are live then remove the preliminary fuses and keep in a safe place until all work is complete, where they cannot be replaced by anyone unnoticed.

- Remove the signal inputs and outputs by releasing the auxiliary terminal screws.

- Remove the phase connections by releasing the main terminal screws.

## 26.3    Triage

Smart meters can be returned for many reasons including damage, a failed installation or errors in the installation process to the energy supplier triage centre. The steps detailed below should be performed to determine the correct actions for returned meters:

**Inspection:**

- Inspect the outer casework of the for signs of damage, loose casework, missing parts and terminal and case fixtures.

- Tighten the terminal screws and terminal cover screw.  Shake the meter gently to determine whether any components or items are loose inside the meter.

- Inspect the terminal entry apertures for signs of damage.

- Check the meter main cover seals are intact, if these are damaged or removed it could indicate a tamper attempt.

**Testing:**

(note, this should only be attempted if this can be done safely with a suitable test stand or jig)

- Power up meter and perform functional check.
  Checks that the display and buttons work and that the meter can measure energy.

- Check the display illuminates on power up.

- Check the date and time is correct on the meter.

- Briefly loosen the terminal cover screw sufficiently to activate the terminal cover tamper switch thus activating the Service Menu on the meter giving access to the "HAN unjoin" function.

- Check that the meter has NOT been previously commissioned (as indicated by the (c) symbol on the HAN display).
  If previously commissioned then the meter may contain sensitive data (e.g. personal data, consumption data, security credentials, firmware code) and must be returned to Landis+Gyr for refurbishment. To display the commissioned indicator refer to section 6.5.4.2.

- Check that a privacy PIN has NOT been set – if it has then then the meter may contain sensitive data (e.g. personal data, consumption data, security credentials, firmware code) and must be returned to Landis+Gyr for refurbishment. To display the commissioned indicator refer to section 6.5.4.2.

- Perform "HAN unjoin" function to unjoin the meter from the HAN, clearing the ZigBee bindings and thus allowing it to join another HAN in the future.

- Return meter to the field or if meter has been commissioned, or a privacy PIN has been set, then return it to Landis+Gyr for refurbishment.

- Check and note the firmware version running on the meter to determine if this is suitable for re-use.

- Check meter logs for unexpected entries or repeating patterns.

- Check security log (accessible via service menu) for any security events or tamper attempts.

**Recording:**

- Maintain records of meters that have been through triage keeping records, where possible, of

  - Meter history

  - Any commands or service requests sent from customer systems

  - Failure information

- Check for meters that have been through the triage process on multiple occasions but are still not displaying an obvious fault (no fault found).   These meters should be flagged as potentially faulty and may need to be returned to Landis+Gyr.

## 26.4   Repairing the meter

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

- Remove the meter from the installation

- Attach a label, which describes the fault as accurately as possible, to the meter and include name and contact details of person responsible in case of inquiries.

- Package the meter to ensure no further damage can occur during transit.

- Send the meter back to Landis+Gyr for refurbishment or repair.

# 27   Decommissioning and disposal

The procedure for the safe removal of the meter from the installation is described in section *26.2*. Please ensure that ALL SAFETY PRECAUTIONS are met before proceeding.

**Electronic waste treatment**
This product must not be disposed of in regular waste. Use a professional electronic waste treatment process.

Based on the environmental certificate ISO 14001, the components used to manufacture the device can, in the main, be broken down into constituent parts and sent to an appropriate recycling or disposal facility. When the product is removed from use, the whole product must be sent to a professional electronic waste treatment process. The waste treatment and disposal plants must be approved by local regulatory authorities.

The end processing of the product and recycling of its components must always be carried out in accordance with the rules and regulations of the country where the end processing and recycling are done.

**Sensitive data**
Previously commissioned meters may contain sensitive data (e.g. personal data, consumption data, security credentials, firmware code). The supplier is responsible for handling deployed meters with sensitive data such that this data cannot be misused by other parties. The following two options are available to achieve this:

1. Send the meter to Landis+Gyr for secure disposal
   (Landis+Gyr is certified by the relevant authorities to do this).

2. Destroy the meter to ensure that access to its data is impossible and dispose of the remaining components as explained below.

On request, Landis+Gyr will provide more information about the environmental impact of the product.

**Disposal and environmental protection regulations**
The following are general guidelines and should NOT take priority over local disposal and environmental policies which should be adhered to without exception.

| Components | Disposal |
| --- | --- |
| Printed circuit boards, LCD display | Delivered to recycling plants |
| Metal components | Sorted and delivered to metal recycling plants |
| Plastic components | Sorted and delivered to re-granulation if possible |
| Batteries | Removed from meter and delivered to specialised recycling plants |

# 28    Terms and abbreviations

## 28.1    Acronyms

| Term | Description |
|---|---|
| **ALCS** | Auxiliary Load Control Switch |
| **BS** | British Standard |
| **CSR** | Certificate Signing Request |
| **DCC** | Data Communications Company in UK |
| **ESME** | Electricity Smart Meter Equipment |
| **GBCS** | Great Britain Companion Specification |
| **HAN** | Home Area Network |
| **HCALCS** | HAN Connected Auxiliary Load Control Switch |
| **HES** | Head End System |
| **ICHI** | Intimate Communications Hub Interface |
| **IEC** | International Electrotechnical Commission |
| **IHU** | In Home Unit |
| **ISO** | International Standards Organisation |
| **IST** | In Service Test |
| **LCD** | Liquid Crystal Display |
| **LED** | Light Emitting Diode |
| **MID** | Metering Industry Directive |
| **OTA** | Over the Air |
| **PTUT** | Prepayment Top-Up Transaction |
| **RNG** | Random Number Generator |
| **SMKI** | Smart Metering Key Infrastructure |
| **UTC** | Universal Time Coordinated |
| **WAN** | Wide Area Network |

## 28.2   Units of measurement

| Unit | Description |
|------|-------------|
| **A** | Ampere (unit of current) |
| **Hz** | Hertz (unit of frequency) |
| **I$_{ref}$** | MID reference current |
| **Kg** | Kilogramme (unit of weight) |
| **kVAh** | kilo Volt Ampere hour |
| **kvArh** | kilo Volt Ampere reactive hour |
| **kWh** | kilo Watt-hour |
| **mm** | millimetre (unit of distance) |
| **ms** | millisecond |
| **Nm** | Newton meter (unit of torque) |
| **°C** | Degree Celsius (unit of temperature) |
| **V** | Volt |

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