



SGM1400-B Series Smart Meter Single Phase User Manual - SMETS2

Y20974-TUM
Revision B
www.Aclara.com

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COMPLIANCE WITH STANDARDS AND EUROPEAN DIRECTIVES



Meters are marked with the European CE mark in accordance with the Marking Directive 93/68/EEC to indicate compliance with the requirements of the EMC directive and Measuring Instruments Directive 2004/24/EC.

Safety requirements for meters are addressed in specific metering standards outlined below.

BS EN 50470-1:2006

General Requirements

BS EN 50470-3:2006

Active Energy Class A or Class B

IEC 62052-11:2003

General Requirements

IEC 62053-21:2003

Active Energy Class 1 or Class 2

IEC 62053-23:2003

Reactive Class 2 or Class 3

BS 7856:2013

BS Meter Dimension

IEC 60529

Ingress Protection

IEC 62056-21:2002

Hardware Description for local meter data exchange

The SGM1400-B Series smart meter complies with the general requirements of EN 50470 Parts 1 and Parts 3 and complies with Class M2 Mechanical environment.

WARNINGS AND CAUTIONS



Electrical equipment contains hazardous voltages and may cause death, serious personal injury, or equipment damage.

Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Aclara reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawing or supplementary material or both, the latter shall take precedence.

The equipment in this manual must be operated only from the power source specified.

The successful operation of this equipment depends upon proper handling, installation, and operation. Neglecting fundamental installation requirements may lead to personal injury as well as damage to electrical equipment or other property.

All electronic components within the meter are susceptible to damage from electrostatic discharge. To prevent damage when handling this product, use approved static control procedures.

Hazardous voltages can cause shock, burns, or death. To prevent exposure to hazardous voltages, disconnect and lock out all power sources before servicing and removing components.

If the meter is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.

Unauthorized changes or modifications made to the unit could void the warranty.

Qualified Personnel

For the purpose of this manual, a qualified person is one who is familiar with the installation, configuration, or operation of the equipment and the hazards involved. In addition, the person is:

- trained and authorized to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety procedures;
- trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc. in accordance with established safety practices; and
- trained in rendering first aid.

Any work on or near energized meters, meter sockets, or other metering equipment presents the danger of electrical shock. All work on these products must be performed by qualified industrial electricians and metering specialists only. All work must be done in accordance with local utility safety practices and procedures.

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CHAPTER**1**

INTRODUCTION

The purpose of this document is to provide qualified metering personnel with product description; operating, maintenance, and upgrading instructions; site analysis guides; and diagrams for the SGM1400-B Series smart meter family. It is not intended to replace the extensive training necessary to install or remove meters from service. Any work on or near energized meters, meter sockets, or other metering equipment presents the danger of electrical shock. All work on these products must be performed by qualified industrial electricians and metering specialists only. All work must be done in accordance with local utility safety practices and procedures.

Aclara Support

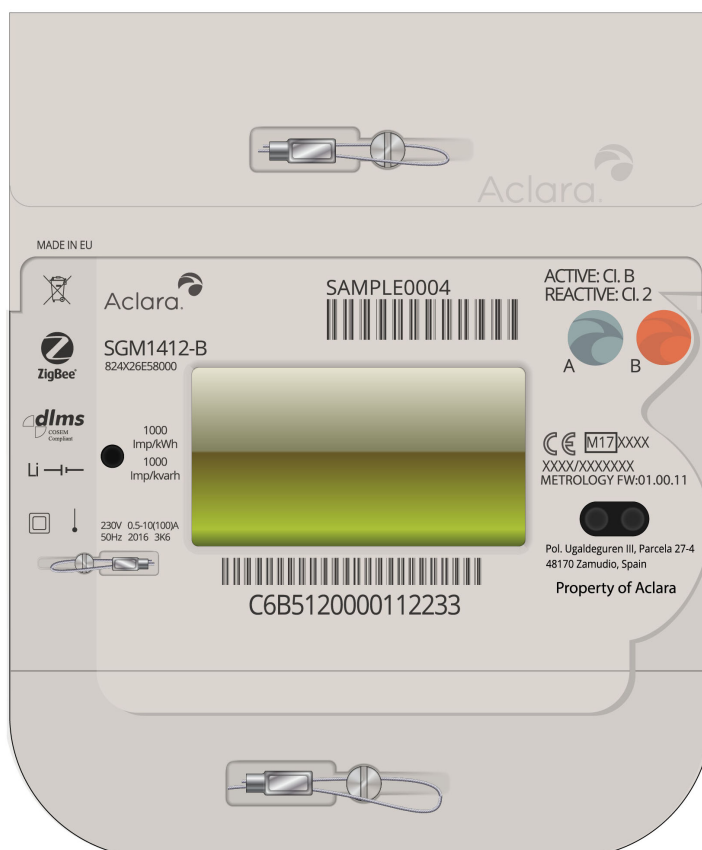
If you have questions, an issue, or would like to speak with Aclara's Support personnel, please contact Aclara using one of the following methods.

Technical Support

Email support@aclara.com or call 1-800-892-9008 to speak with an Aclara representative.

CHAPTER**2****PRODUCT DESCRIPTION**

The SGM1400-B meter from Aclara is an advanced modular designed family of products for domestic and small commercial installations. The SGM1400-B is available in both single phase and dual element variants, and it forms an integral part of a complete two-way, secure, end-to-end solution.



The SGM1400-B has been designed to offer flexibility and the choice of home area network (HAN) and wide area network (WAN) communications. As standard, the SGM1400-B supports different AMI technologies, including the UK CSP communications hub solution. The communications hub mechanically connects directly to the electricity meter. The hub communicates with the meter using the ZigBee communication protocol. A manufacturing option that provides direct communications via a hardwired interface is also available.

The on-board ZigBee RF interface uses industry standard Smart Energy Profile for HAN communications to the UK communications hub and in-home display (IHD) respectively.

The standard meter is supplied with an integrated 100A switch for connect/disconnect of the consumer supply. Certain models of the SGM1400-B Series meter offer an optional 2 A load control relay, whilst others support an additional 100 A contactor for control of other ancillary devices such as night storage heating, pumps, etc.

The meters also support a comprehensive tariff developed in association with the UK Great Britain Companion Specifications Standard and supports both Seasonal Time of Day (STOD) and block tariffs.

Additionally, the meters offer storage for two years of load profile data and support independent profiling of instrumentation values, typically line voltage, current, frequency, etc. The SGM1400-B Series meter also provides, as standard, enhanced power quality features offering support of sag/swell, under/over voltage, and max and min.

Designed with installation in mind, the SGM1400-B Series meter offers a means for a quick and secure deployment. A custom-designed LCD provides added value information. For example, when ZigBee is used, information such as HAN pairing progress, notification of pairing complete, local signal strengths for HAN, etc. is displayed to improve the installation experience. Refer to *Installation* on page 71 for more information on installing an SGM1400-B Series meter.

All SGM1400-B Series meters have a common layout for buttons, optical port, display, and pulse indicators. The communications hub interface is also standardized across all meter models. The SGM1400-B Series meter can be customized with optional variants and extras, including the following:

- Back-lit LCD
- Hardwired Communications Interface
- Magnetic Detection
- Removal of the HAN

General Information

The key features of the SGM1400-B Series meters include:

- Product life of 20 years
- Single phase direct connected (whole current)
- Single phase dual element
- Optional 2 A auxiliary relay
- Optional 100 A contactor
- A field-replaceable CSP communications hub that prevents disruption of service
- Comprehensive metrology-active, reactive and apparent energy, import and export
- Extensive tariff capability:
 - 48 x standard time of day TOU registers and 4 x 8 block tariff
 - 4 x standard time of day TOU registers (specific for meters with a secondary element, notably SGM1415-B, SGM1416-B, and SGM1422-B)

- Two years of load profile data storage
- Three months instrumentation profile data
- Daily, weekly, and monthly billing data
- Voltage sag/swell, under and over voltage
- Over and Under Frequency
- Power Factor Threshold
- Comprehensive Event Logging with over 100 unique event codes, as well as Security, Power Event, Standard Event, and ALCS Logs for event storage
- Enhanced physical and electronic security (tamper, password levels)
- HAN support of industry standard Smart Energy Profile
- GPRS wide area network for remote retrieval of data to a headend system via CSP communications hub
- DLMS COSEM compliant via the optical port
- Firmware Over-the-Air (FOTA) Full Upgrades
- Change of tenancy and supplier - CoT and CoS
- Dual firmware versions - Firmware rollback feature during firmware update
- Extensive data storage
- Simultaneous local and remote communication without performance loss
- Enhanced power quality monitoring including voltage, frequency, and power factor
- Control of external loads via auxiliary relay
- Short terminal cover
- Tariff Structure (primary element):
 - Active and Deferred Tariffs
 - 48 Time-of-Use Registers
 - 4 x 8 Block Tariffs
 - 4 Seasons
 - 5 Week Profiles
 - 16 Day Profiles
 - 50 Special Days
 - 200 Switching Times
 - 13 End of Month Billing Dates
 - 5 Weekly Billing Dates
 - 31 Daily Billing Sets

- Tariff Structure (secondary element):
 - 50 Special Days
 - 4 Time-of-Use Registers
 - 4 Seasons
 - 4 Week Profiles
 - 16 Day Profiles

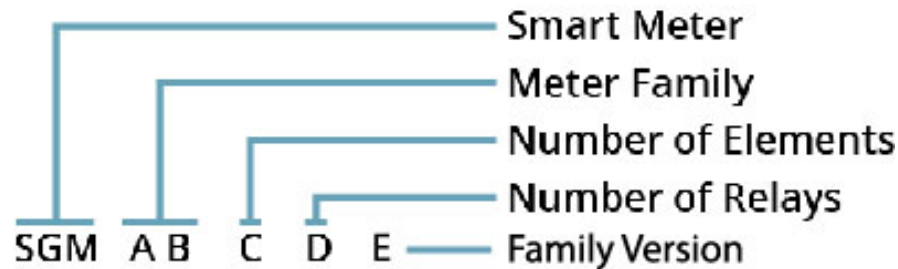
Features

The SGM1400-B Series smart meter family has the following main features:

- 640 kB of RAM temporary data storage, 164 MB of Serial Flash Memory for non-volatile data storage, and 1.5 MB of Internal (on-chip) program memory
- Configurable display with auto and manual scroll lists and user defined fields
- Independent communication ports: Local optical port, AMI interface port (GPRS as standard), and ZigBee HAN port
- Configurable time-of-use (TOU) operation to support full flexibility tariffing
- Flexible calendar definition that supports up to 48 daily time periods, 16 day types, four week types, 50 designated holidays or special days, and four seasons
- Configurable measurement profile with independent measurements for each measuring element (applicable to SGM1422-B)
- Select demand measurement for demand calculation including selected measurement profile and selectable demand interval
- Prepayment mode of operation
- Field-replaceable CSP communications hub that provides flexibility for HAN and WAN communications
- Tamper detection
- Terminal overheating detection - manufacturing option for SGM1415/16/22-B

Models

The SGM1400-B Series smart meter family is made up of meters of common physical characteristics and functionality. The nomenclature of the meter models indicates the following:

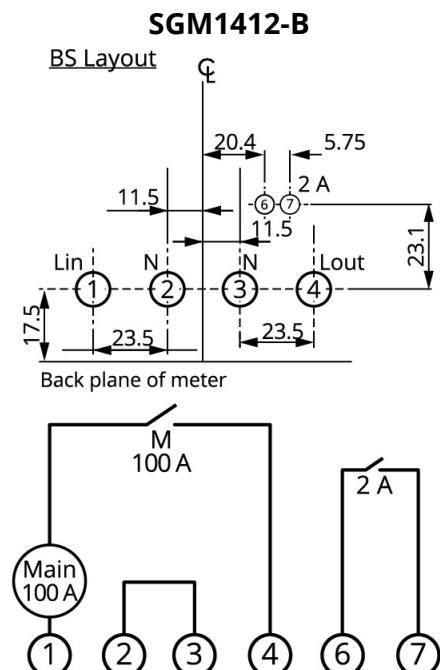
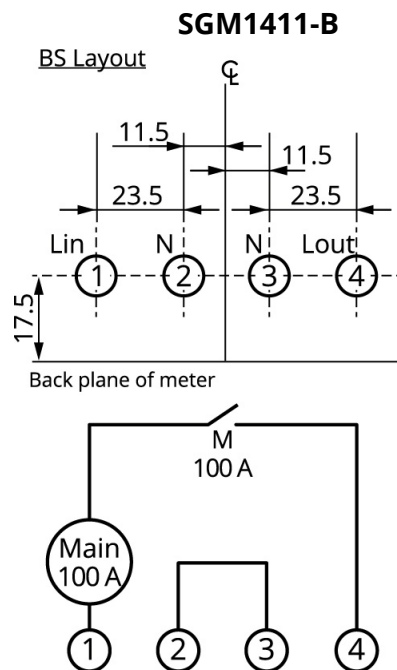


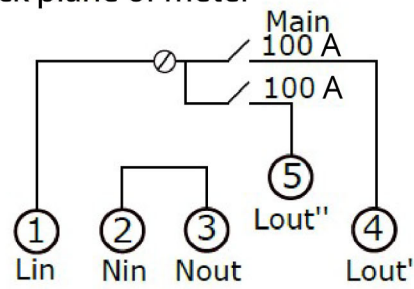
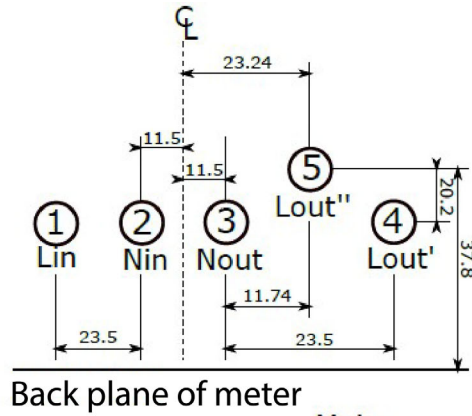
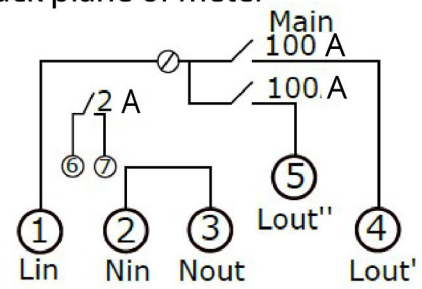
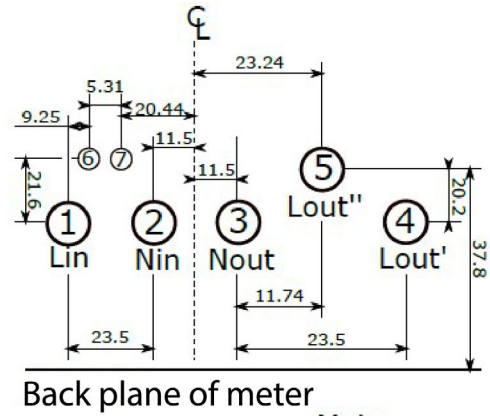
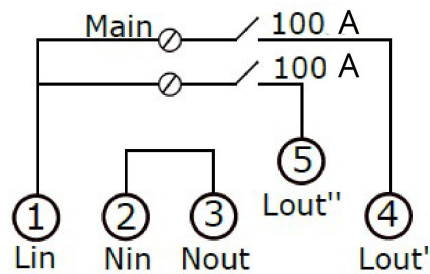
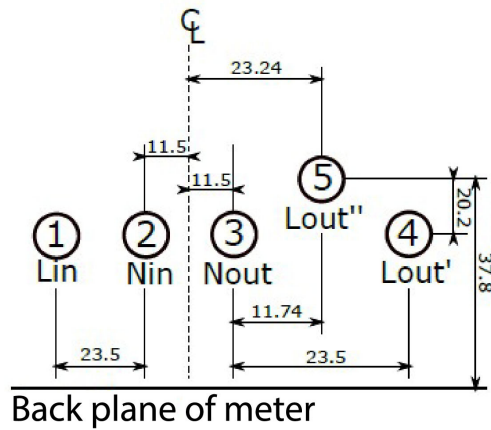
The following models are currently available in the SGM1400-B smart meter family:

Model	Connect Type	Phase	Current Elements	100 A Primary Contactor	100 A Secondary Contactor	2 A Auxiliary Relay	Itr - Iref (I _{max})
SGM1411-B	Direct	Single	1	Yes	No	No	1-10 (100 A)
SGM1412-B	Direct	Single	1	Yes	No	Yes	1-10 (100 A)
SGM1415-B	Direct	Single	1	Yes	Yes	No	1-10 (100 A)
SGM1416-B	Direct	Single	1	Yes	Yes	Yes	1-10 (100 A)
SGM1422-B	Direct	Single	2	Yes	Yes	No	1-10 (100 A)

Terminal Arrangements

The SGM1400-B single phase meters conform to the British Standard Institute code of practice (BS 7856:2013).



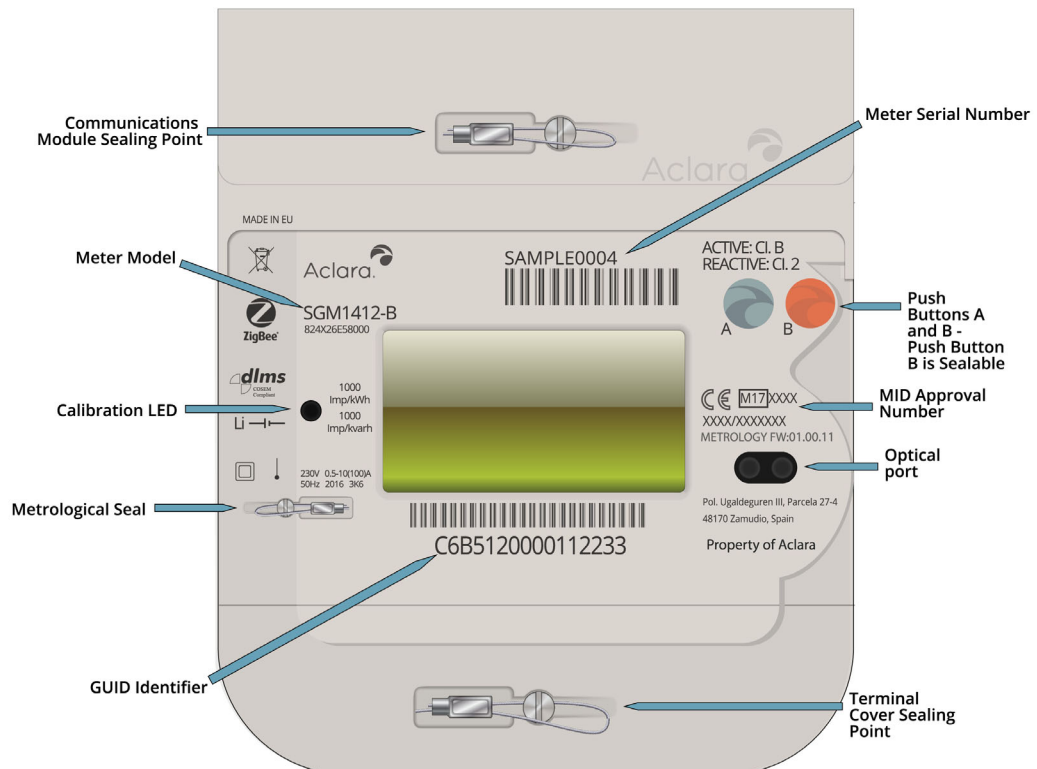
SGM1415-B**SGM1416-B****SGM1422-B**

CHAPTER

3

PHYSICAL COMPONENTS

The SGM1400-B Series smart meter family comprises of a single phase and single phase with 2 A relay output. The main physical features of a SGM1400-B Series meter are shown below.



Enclosure and Covers

The SGM1400-B Series meters use a thermally stable, UV-protected polycarbonate enclosure that is double insulated to protective Class II. The enclosure provides an Ingress Protection Rating of IP54 in accordance with IEC 60529. The following cover segments are constructed of Polycarbonate 10% GF (Grade Lexan 503RS):

- **Meter cover** - When the meter is fully installed, the main cover cannot be removed while the terminal cover is fitted to the meter.
- **Terminal cover** - Protects the terminal screws from external contact. Inside the terminal cover is a diagram identifying the connections on the terminal block. This includes a schematic diagram and description of all physical elements on the terminal block, the arrangement of active and neutral terminals for the conductors, and an identifying number defining the specific variant of terminal.

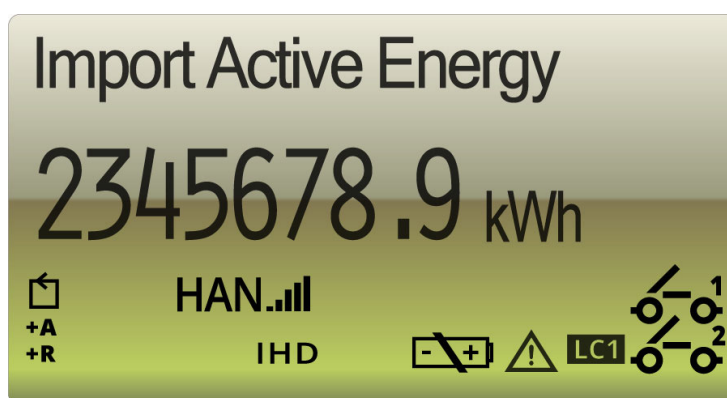
Cover Seals

The meter cover and terminal cover are secured by standard single sealing screws. The torque value for the sealing screw is 0.6-0.9 Nm. The screw head has a recessed hole and slot to accommodate a 0.914 mm diameter thread wire seal. The sealing wire is crimped close to the body of the meter using a tool with die indents.

As a manufacturing option, the meter can also be supplied with an ultrasonic permanent seal.

Display

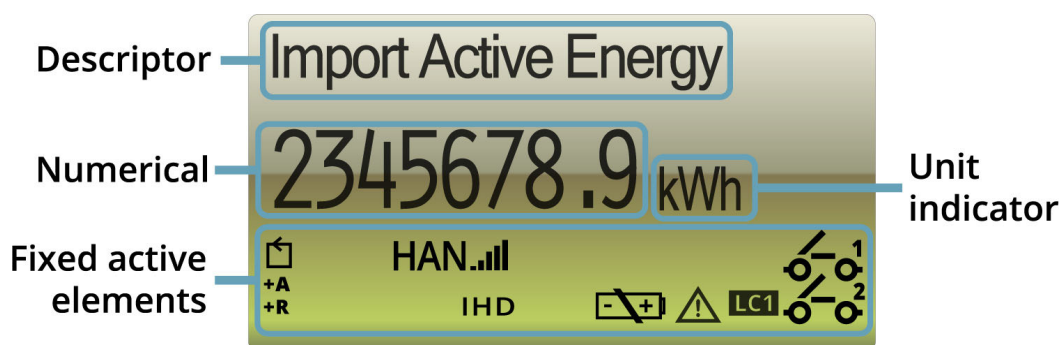
The SGM1400-B Series meter provides a backlit Liquid Crystal Display (LCD) located on the meter face. The display consists of graphical elements and segments. The graphical section displays the meter status in quantities up to eight digits, including the unit of measure. It can also display end user instructions to advise installation teams that commissioning is complete. The LCD backlight will illuminate the display when a button is pressed. The automatic scroll duration, manual scroll timeout, backlight duration, and contrast adjustment are configurable via the display settings object.



The display shows the following:

- Units of measure
- Constant display of the meter status
- State of the primary supply contactor
- State of the secondary contactor (applicable to SGM1415-B, SGM1416-B, and SGM1422-B)
- State of the auxiliary control relay (applicable to SGM1412-B and SGM1416-B)
- Signal strength as reported by the HAN module
- Communication status of the HAN network
- Direction of energy (for example, flowing from the premise to the network)
- Battery status
- Various data values, meter status, and indications
- Current and historical energy and demand registers

There are four basic types of indicators on the display: descriptor, numerical, unit indicator, and fixed active elements. Each are described in the following sections.



Descriptor, Numerical, and Unit Indicators

The top line descriptor supports 32 characters. The numerical line supports up to eight digits along with a decimal and other separators. The unit indicator is always to the right of the numerical line.

The following items are available for display on the different meter variants.

Description in SGM1400-B Manual	SGM1400-B Variants - LCD Items Supported		
	SGM1411-B/ SGM1412-B	SGM1415-B/ SGM1416-B	SGM1422-B
Active Power Import			X
Active Power Import - Primary	X	X	X
Active Power Import - Secondary			X
Active Power Export			X
Active Power Export - Primary	X	X	X
Active Power Export - Secondary			X
Reactive Power Import (Q1+Q2)			X
Reactive Power Import (Q1+Q2) - Primary	X	X	X
Reactive Power Import (Q1+Q2) - Secondary			X
Reactive Power Export (Q3+Q4)			X
Reactive Power Export (Q3+Q4) - Primary	X	X	X
Reactive Power Export (Q3+Q4) - Secondary			X
Reactive Power (Q1)			X
Reactive Power (Q1) - Primary	X	X	X
Reactive Power (Q1) - Secondary			X
Reactive Power (Q2)			X
Reactive Power (Q2) - Primary	X	X	X
Reactive Power (Q2) - Secondary			X
Reactive Power (Q3)			X
Reactive Power (Q3) - Primary	X	X	X
Reactive Power (Q3) - Secondary			X
Reactive Power (Q4)			X

Description in SGM1400-B Manual	SGM1400-B Variants - LCD Items Supported		
	SGM1411-B/ SGM1412-B	SGM1415-B/ SGM1416-B	SGM1422-B
Reactive Power (Q4) - Primary	X	X	X
Reactive Power (Q4) - Secondary			X
Apparent Power Import			X
Apparent Power Import - Primary	X	X	X
Apparent Power Import - Secondary			X
Apparent Power Export			X
Apparent Power Export - Primary	X	X	X
Apparent Power Export - Secondary			X
Current (I) - Primary	X	X	X
Current (I) - Secondary			X
Voltage (V)	X	X	X
Power Factor			X
Power Factor - Primary	X	X	X
Power Factor - Secondary			X
Supply Frequency - Hz	X	X	X
Active Energy Import (QI+QIV)			X
Active Energy Import (QI+QIV) - Primary	X	X	X
Active Energy Import (QI+QIV) - Secondary			X
Active Energy Export (QII+QIII)			X
Active Energy Export (QII+QIII) - Primary	X	X	X
Active Energy Export (QII+QIII) - Secondary			X
Reactive Energy Import (QI+QII)			X
Reactive Energy Import (QI+QII) - Primary	X	X	X
Reactive Energy Import (QI+QII) - Secondary			X
Reactive Energy Export (QIII+QIV) - ΣLi			X
Reactive Energy Export (QIII+QIV) - Primary	X	X	X
Reactive Energy Export (QIII+QIV) - Secondary			X
Reactive Energy (Q1)	X	X	X
Reactive Energy (Q2)	X	X	X
Reactive Energy (Q3)	X	X	X
Reactive Energy (Q4)	X	X	X
Apparent Energy Import	X	X	X
Apparent Energy Export	X	X	X
SecondaryTariffTOU[1]RegisterMatrix			X
SecondaryTariffTOU[2]RegisterMatrix			X
SecondaryTariffTOU[3]RegisterMatrix			X
SecondaryTariffTOU[4]RegisterMatrix			X

	SGM1400-B Variants - LCD Items Supported		
Description in SGM1400-B Manual	SGM1411-B/ SGM1412-B	SGM1415-B/ SGM1416-B	SGM1422-B
SecondaryActiveTariffPrice			X
SecondaryActiveTariff			X
Max Demand Active Power Import kW	X	X	X
Max Demand Active Power Export kW	X	X	X
Primary TariffTOU(X) where X is Rate 1 - 48	X	X	X
Primary Block Tariff (4 x 8)	X	X	X
Time (hh:mm:ss)	X	X	X
Date (dd/mm/yy)	X	X	X
Segment Test	X	X	X
Meter Serial Number (YYM1234567)	X	X	X
Meter Balance (£)	X	X	X
Standing Charge (p)	X	X	X
MPAN	X	X	X
Customer Identification Number (CIN)	X	X	X
Energy Supplier Contact Details: name and telephone number	X	X	X
Active Tariff Price	X	X	X
Set/Enable Privacy PIN	X	X	X
Disable Privacy PIN	X	X	X
Temp Disable Privacy Pin	X	X	X
Network Join	X	X	X
Supplier Message	X	X	X
Event Logs:			
Event Log	X	X	X
Power Event Log	X	X	X
Security Log	X	X	X
Prepayment Displays:			
Mode of Operation: Credit or Prepayment Mode	X	X	X
Meter Balance (£)	X	X	X
Emergency Credit Menu	X	X	X
Last Five Credits	X	X	X
Standing Charge (p)	X	X	X
Accumulated Debt	X	X	X
Payment-based Debt	X	X	X
Time-based Debt	X	X	X
Available Credit	X	X	X
Debt to Clear	X	X	X
Aggregated Debt	X	X	X

	SGM1400-B Variants - LCD Items Supported		
Description in SGM1400-B Manual	SGM1411-B/ SGM1412-B	SGM1415-B/ SGM1416-B	SGM1422-B
Enter UTRN - Mandatory for Prepayment	X	X	X
Costs:			
Cost of Instantaneous Active Power Import	X	X	X

Active Elements


The active elements icons indicate status of current flow, network connection signal strength, contactor and load control relay status, low battery voltage, and other warnings. The function of each icon is described in the following sections.


Current Status

The four arrows represent the current flow of the meter. The current flow of the meter is portrayed as follows:

Horizontal Arrows


The horizontal arrows indicate the direction of the flow of active energy.


When  is illuminated, energy is being consumed from the grid.

When  is illuminated, energy is being generated at the premise and received by the network.

Vertical Arrows

The vertical arrows indicate the presence of reactive energy.

When  is illuminated, there is a lagging condition.

When  is illuminated, there is a leading condition.

The possible states are described in the following table.

Symbol	Description
+R	Import Reactive Energy
+A	Import Active Energy
-R	Export Reactive Energy
-A	Export Active Energy

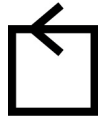
The icons below are the possible permutations that can be exhibited on the LCD:

Illuminated Icons	Description
+A +R	First Quadrant
-A +R	Second Quadrant

-A	Third Quadrant
-A	
+A	Fourth Quadrant
-A	

Reverse Run

If the meter is configured to measure import energy only and detects reverse (export) energy, the reverse run icon will appear until the event is cleared at the headend.



If the Reverse Run icon is visible, reverse energy has been detected. The reverse run indication can only be cleared by a command via one of the communications ports.

The reverse run icon is enabled by setting the appropriate bit in the COSEM error register filter; the status icon represents the current state of the reverse run bit in the error register, respectively.

HAN Signal Status

AMI communication signal strength is portrayed through five bars.



From low to high, these signal strength indications are:

- No signal
- Very Low signal strength
- Low signal strength
- Medium Low signal strength
- Medium signal strength
- Medium High signal strength
- High signal strength




The connection status and signal strength for each connected device will be cycled. A solid device icon indicates the device is connected, while a flashing icon indicates a fault with the particular device. Only connected devices will be shown in the cycle.

Contactors

The display indicates whether the primary (main supply) contactor is open or closed or whether the contactor is armed and ready for closing. The main supply open/close indicator is visible at all times.



The icon will indicate three possible states of the contactors.

Icons	Description
	Contactor is open.
	Contactor is closed.
 (Flashing)	Contactor is armed.

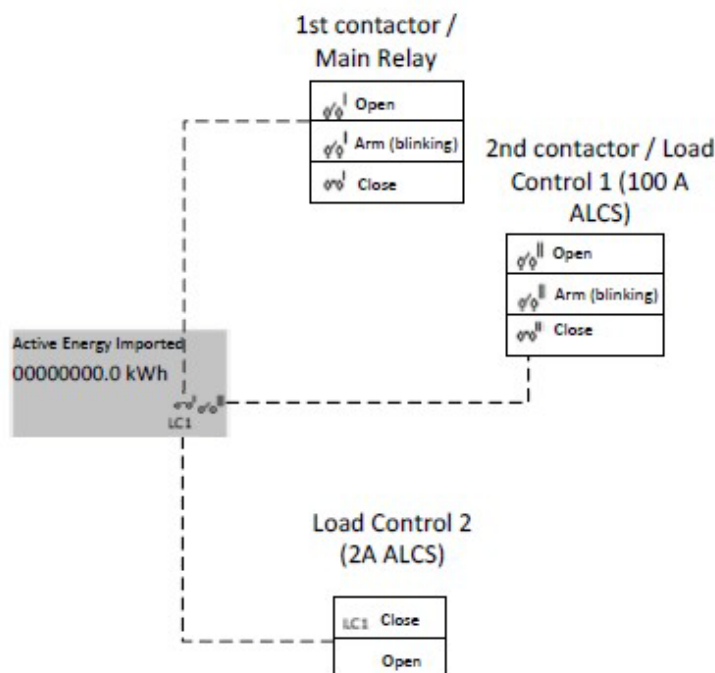
A secondary contactor is also available to control loads such as night storage heating. The same behaviour as defined for contactor 1 is also applied to contactor 2.

Load Control Relay

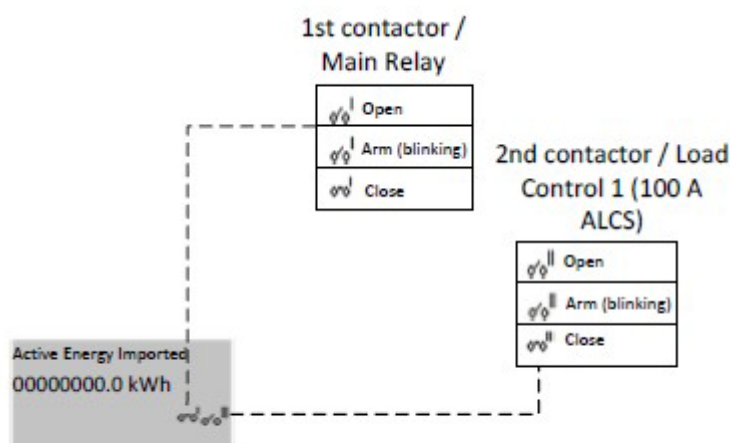
The LC1 icon represents the state of the load control relay. When LC1 is illuminated, the load control relay is closed and the load is connected. If LC1 is not present on the display, the load control relay is open and the load is disconnected.

LC1

SGM1415-B/SGM1416-B LCD Icons - Contactor and Aux Relay



SGM1422-B LCD Icons - Contactors



Battery

The battery icon indicates battery status as follows:

- **Low Battery** - Strike-through icon blinking
- **Dead Battery** - Icon permanent

When the voltage of the backup battery has fallen below a critical threshold, the icon will appear, and the meter will create an event log entry.



Warning

The warning icon indicates a warning condition has been detected by the meter.



Display Modes

The SGM1400-B Series meter supports eight different display modes for the UK:

- Primary
- Alternate 1
- Alternate 2
- Alternate 3 (prepayment menu)
- Engineering Menu
- HAN Signal Strength
- Active TOU
- Privacy PIN

The display also shows the status during HAN pairing and relay reconnection. Each display mode is configurable via the corresponding display configuration object list. Configuration involves programming the OBIS code, interface class, and formatting information into the list. Items appear on the screen in the same order as the list. The total number of display items in each user-configurable display mode is 50.

The display supports both automatic and manual scrolling through display items. The automatic scroll duration, manual scroll timeout, backlight duration, and contrast adjustment are configurable via the display settings. Please refer to *Push Buttons* on page 20 for more information on scrolling through display items.

Display Configuration

The following aspects of the display may be configured by the utility.

Auto-Scroll Duration

This setting defines the amount of time each display item will remain on the screen during an auto-scroll operation.

Default	20 seconds
Minimum	5 seconds
Maximum	60 seconds
Disable	0 seconds

Manual Operation Timeout

This setting defines the inactivity period for the manual-scroll mode. While operating in manual-scroll mode, if no buttons are pressed, the display will revert back to auto-scroll mode.

Default	10 seconds
Minimum	1 second
Maximum	60 seconds

Backlight Timeout

This setting defines the period of time the backlight will remain lit following an action which triggered the illumination. The following actions will trigger backlight illumination:

- Pressing of the pushbuttons
- Optical Port activity
- Insertion of a WAN device

Default	300 seconds (5 minutes)
Minimum	1 second
Maximum	300 seconds

Display Item Configuration

The following display items may be configured as described in the following sections.

OBIS Code

The DLMS Object Identification System code for the display item.

Interface Class

The DLMS Interface Class for the display item.

Number of Digits

This specifies the number of digits to display when leading zeros are enabled.

Default	0
Minimum	0
Maximum	8

Number of Decimal Places

This specifies the number of decimal places to display,

Default	0
Minimum	0
Maximum	2

Additional Information

This specifies the additional information for the following unique display items.

- For prepayment data, this field is configured with the Attribute ID.
- For serial numbers, this field must be configured with:

Meter serial number	0
COMM module serial number	1
All other display items	2

For details on Prepayment Attribute IDs, refer to the Meter Config Tool software.

Push Buttons

Two push buttons (A and B) on the meter face grant the customer a means to restore supply and manual cycle through the display screens.

Push Button A

Push button A is used to manually scroll through custom display items within the user-configurable display modes. Each button press manually advances to the next item in the display. The manual scroll mode will revert back to automatic scrolling after a number of seconds have elapsed without button A being pressed. This pre-set period of time is known as the manual scroll timeout. This button is also used to acknowledge successful, failed, or timed-out HAN join events when prompted by the LCD display.

Push Button B - Sealable

Push button B, when not sealed, is used to navigate through the various display modes. Each press of this button will advance to the next display mode.

- | | |
|----------------------------------|---|
| 1. Primary | 5. Engineering Menu |
| 2. Alternate 1 | 6. HAN Signal Strength |
| 3. Alternate 2 | 7. Active TOU
(specific firmware versions) |
| 4. Alternate 3 (prepayment menu) | 8. Privacy PIN |

Push Buttons A and B

Together, these buttons are used to restore the consumer supply. The end customer must press buttons A and B simultaneously for a configured number of seconds (the default is 5 seconds) when prompted by the LCD display.

Configuration

The following sections describe the available options for the A and B push buttons.

Supply Reconnection

This setting adjusts the amount of time the push buttons must be depressed (simultaneously) in order to reconnect the supply.

Default	5 seconds
Minimum	2 seconds
Maximum	10 seconds

Audible Indicators

This setting enables or disables audible indications when the push buttons are pressed.

Default	Disabled
Disabled	0
Enabled	1

Optical Port

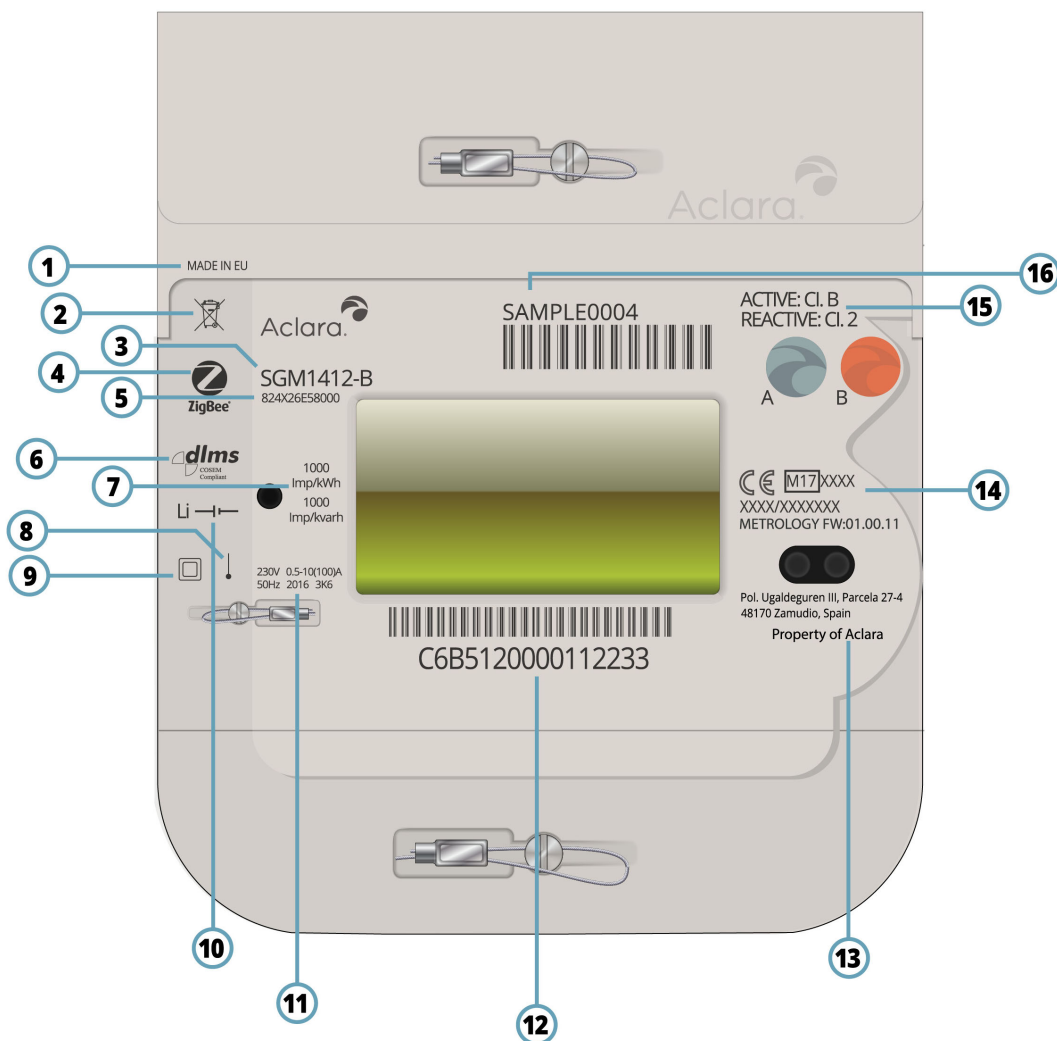
The SGM1400-B Series meter has an optical port for local communication. It supports the IEC 62056-21 optical communication interface standard with a baud rate of 9,600 bps. The optical port is disabled on meters deployed in field.

LED Indicator

The LED indicator flashes when measuring the consumers load. The LED as default will flash to indicate forward and reverse kWh but can be reconfigured to show kVArh.

Nameplate

This section describes the various possible markings on the face of the meter.



- | | |
|--|--|
| 1) Country of manufacture | 9) Class II (double-insulated) |
| 2) WEEE compliance | 10) Internal lithium battery |
| 3) Meter model | 11) Meter specifications |
| 4) ZigBee Smart Energy interoperability | 12) Global Unique Identifier (GUID) number and barcode |
| 5) Meter catalog number | 13) Ownership |
| 6) DLMS/COSEM compliance | 14) MID approval number |
| 7) Active/Reactive energy metering constants | 15) Accuracy class |
| 8) Single-phase, two-wire | 16) Customer serial number & barcode |

CSP Communications Hub Interface

The SGM1400-B Series meter has been designed to be compliant with the DCC intimate communications hub standard. The standard covers both the mechanical and electrical interface for support of a CSP communications hub.

Contactors and Relay Terminals

The SGM1400-B Series meters are available in a variety of supply disconnect contactor and auxiliary relay configurations. The primary and secondary supply disconnect / reconnect contactors have a maximum rated current of 100 A.

The SGM1412-B and SGM1416-B models may be customized with a 2 A relay for management of an external supply contactor. The 2 A relay is voltage-free and electrically isolated from the meter's line and neutral. The torque value for the 2 A terminal screws is 0.2-0.3 Nm.

Status Indicator

The LCD also provides icons that show whether the main and secondary supply contactors are open, closed, or armed and ready for closing. The status of the auxiliary load control relay is indicated by the LCD.

Terminal Screws

The specifications of SGM1400-B terminal screws are as follows:

Contactor Terminals

Contactor terminal screws are M6 slotted / Phillips combination head screws with a bore diameter of 8.2 mm.

Relay Terminals

Relay terminal screws are M2.5 slotted head screws with a bore diameter of 3 mm.

Lithium Battery

The SGM1400-B Series meter includes a lithium battery backup with sufficient capacity to maintain the meter's real-time clock for up to two years. The battery has a 20 year lifespan that is designed in line with the product life.

Meter Security

Along with hardware seals, the SGM1400-B Series firmware will also detect and record the following tamper incidents:

- When the terminal cover is removed from the meter (Event)
- When the terminal cover is replaced (Event)
- When the meter cover is removed from the meter (Event)
- When the meter cover is replaced (Error)

- When the communications hub cover is removed from the meter (Event)
- When the communications hub cover is replaced (Event)

When a tamper is detected, the corresponding Event Code will be entered into the Fraud Detection Log. For more information on how to access this log, refer to *Event Logging and Errors/Alarms* on page 48.

Magnetic Detection

The SGM1400-B Series meter supports a mechanism to detect external DC magnets of 300 Gauss near the load side terminals. The Fraud Detection log will report a Strong Magnetic Field followed by a Strong Magnetic Field Not Longer (Event) when the magnetic field ceases. For more information on how to access this log, refer to *Event Logging and Errors/Alarms* on page 48. Refer to the *Catalogue Codes* on page 87 for details on ordering this variant.

Memory

SGM1400-B Series meters have non-volatile memory for storage of all measurement data and basic meter information. The meters utilize three main types of memory:

Random Access Memory (RAM)

The SGM1400-B Series meters have 640 kB of RAM, primarily for temporary data storage during operation.

Internal Flash Memory

The SGM1400-B Series meters have 1.5 MB of internal flash memory for storage of the main meter firmware and bootloader.

Serial Flash Data Memory

The SGM1400-B Series meters have 16 MB of serial flash data memory, which maintains configuration and recorded data.

Firmware

The firmware is the critical portion of the system that sits between the headend system, the metrological sensors, and the devices on the HAN.

Firmware Variants

The SGM1400-B meter has a separate firmware module for the metrology processor and for the application processor.

A single metrology firmware build is used for the single phase (SGM1411-B and SGM1412-B) and five-terminal meter variants (SGM1415-B, SGM1416-B, and SGM1422-B).

The following table summarizes the firmware resident on the various meter models.

Model	Phase	Connect	Element	100 amp	2 amp	Application Processor	Metrology Processor
SGM1411-B	1	Direct	1	1	—	Application firmware	Single phase firmware
SGM1412-B	1	Direct	1	1	1	Application firmware	Single phase firmware
SGM1415-B	1	Direct	1	2	—	Application firmware	Single phase firmware
SGM1416-B	1	Direct	1	2	1	Application firmware	Single phase firmware
SGM1422-B	1	Direct	2	2	—	Application firmware	Single phase firmware

Firmware Components

All firmware source code is securely stored in a standard repository and subject to common practices of configuration management, version control, and release management.

All firmware is identified by version number. Firmware version numbers are defined in DLMS as an octet-string[7], or seven bytes. Release versions use three bytes as represented below:

[Major Version] . [Minor Revision] . [Build Number].

- Major Version indicates a significant update from the previous release.
- Minor Revision indicates a new sub-system or other minor release for integration.
- Build Number increments with each release to Aclara Product Validation on a given series.

The SGM1400-B meter is made up of the firmware components outlined below.

Metrology

One area in the repository contains this firmware, isolated from the application code, and does not change after certification.

Bootloader

The Bootloader firmware is integral to the application, but, like metrology, it does not change once it is released.

Application

The meter firmware application can be upgraded via firmware over-the-air.

Firmware Specifications

The SGM1400-B Series meters have two main processors: the metrology processor and the application processor.

The metrology processor provides the real-time clock and the measurement and calculation of energy values. The application processor provides functionality such as load profile and time-of-use, relay control, communications support, and Smart Energy Profile.

The meter performs both cyclic redundancy check (CRC) validation and cryptographic signature validation for the firmware running on the SGM1400-B. This ensures storage to the meter hardware and that the firmware is an authentic released image and has not been tampered with in transport.

The SGM1400-B Series meter provides customers with the majority of the above specified functionality, regardless of whether a communications module is installed or not. The core of this functionality resides on the metrology and application processors.

The meter maintains and verifies the checksum of data (such as billing data, load profile data, TOU data, event log data, etc.) stored in non-volatile memory. The meter also ensures continuous operation of firmware by means of a watchdog timer. The meter checks the proper operation of the measurement chip periodically and takes necessary action to recover from an error condition.

The meter maintains the checksum for calibration and configuration data and checks its integrity after power returns. During the manufacturing process, Aclara stores the resultant calibration data for each meter. For MID certification, calibrated meters were provided to the approved test house for accuracy and other tests as required.

Metrology Firmware and Data

In accordance with the Guide for Measuring Instruments Directive 2004/22/EC and WELMEC 7.2, the core metrology firmware and data of the meter are explicitly isolated from the applications firmware to ensure that the metrology can in no way be updated or changed.

The meter is designed, constructed, tested, and certified as a European Union MID approved product. Test reports prepared for submission to, or received from, the relevant certifying bodies as part of the MID certification process will be made available to customers upon request.

The meters include the metrology suffix after the CE mark per the requirements listed in the MID.

Firmware Release Notes Process

Firmware release notes will be provided to the customer. The release note details are generated from the Aclara software configuration management (SCM) system.

All defects and enhancements are tracked and documented through the Aclara SCM system.

The customer release notes will include the following information:

- Description of all changes, listed by ID
- Compatibility information for firmware versions across the solution (e.g., electricity meter, gas meter, and in-home displays (IHDs)) including details on supported firmware upgrade paths
- Known issues and other relevant information

Firmware Upgrade

The SGM1400-B Series meters support application firmware upgrades through the local communication port and through the AMI communication interface. The metrology firmware cannot be upgraded. The meter supports firmware upgrades via DLMS/COSEM and follows WELMEC guidelines.

All metering components that are capable of firmware upgrades will have the ability to do so remotely and independently of each other, activating a new image immediately or at a future date.

In the event of a failure to upgrade, the firmware will revert to the previous version automatically.

Following a firmware upgrade, the meter will:

- automatically restart without the need for a site visit,
- confirm the status to the headend system at configurable points throughout the process, and
- confirm correct operation to the headend system.

Firmware Security

In order to maintain integrity and assurance of the firmware, Aclara cryptographically signs the firmware image with an Aclara-controlled private key as part of the Aclara release process and configuration management.

Prior to image activation, the system will perform a signature validation to ensure the firmware image to be activated has not been tampered with.

If the cryptographic signature fails to verify, the meter reverts to the last verified firmware (held in the actively running bank), and the new firmware will not be allowed to boot into the off-line bank.

After power returns to the meter, the bootloader, which is kept in immutable user boot flash space, will also perform a cryptographic signature check of the image. If it matches, the bootloader will continue to boot that image. If it fails, the bootloader will perform a cryptographic signature check of the off-line image in order to revert back to it.

The logical devices within the SGM1400-B Series meter will allow specific roles to upgrade specific network elements. For example, Electricity Meter Firmware Update Client may upgrade the E-Meter Firmware.

There are unique unicast encryption and authentication keys provided for each role of each logical device, including the Firmware Update Client, when connecting to each logical device within the meter. Each stakeholder for each logical device may independently and privately access the Firmware Upgrade client for their interested logical device. Each logical device is managed by its own master key. Master keys can encrypt new lower-level keys for each role securely and independently of the other logical devices.

Power Outages

The SGM1400-B meter has a configurable timer (t1) which is programmed to distinguish the time between a long and normal power outage (the default value for a long power outage is three minutes or greater).

Upon re-energization of the meter, t1 will determine if the power outage period was greater than the value associated with a normal power outage. If it was, the meter will update the Power Failure Event Log with Event ID long power outage.

For a standard power outage, the Power Failure Event Log will be updated with Event ID.

The long power outage feature can be enabled and disabled through configuration. If disabled, the meter will only update the normal power outage event.

Example 1

9:01:00 a.m. Power Down (477) Event

9:01:45 a.m. Power Up (478) Event (short off time)

The meter will update the Power Failure Event Log.

Example 2

9:01:00 a.m. Power Down (477) Event

9:05:45 a.m. Power Up (478) Event (long off time)

The meter will update the Long Power Failure Event Log.

CHAPTER**4**

COMMUNICATIONS

The SGM1400-B Series meter has been designed to support the industry standard DCC Intimate Communications Hub Interface Specification (ICHIS), which defines the hardware interface for connectivity to CSP sourced communications hubs and the supply levels to provide power to any mating communications hub.

The meter also supports a home area network (HAN) that establishes ZigBee protocol connections between two devices, notably an in-home display (IHD) and the communications hub. The HAN is established on digital radios compliant with the IEEE802.15.4 standard.

The SGM1400-B establishes secure HAN links to the:

- CSP communications hub,
- in-home display, and
- prepayment meter interface device (PPMID).

The meter also supports a bi-directions IEC 62056-21 optical communications port which is used during manufacture and for warranty purposes. Please note, per NCSC requirements, the optical port is disabled for meters deployed in field installations.

Any communications from the headend system will require support of a CSP communications hub which will be intimately connected to the electricity meter.

Communications between the headend system and meter will be based on the UK GB companion specification supporting remote party messages.

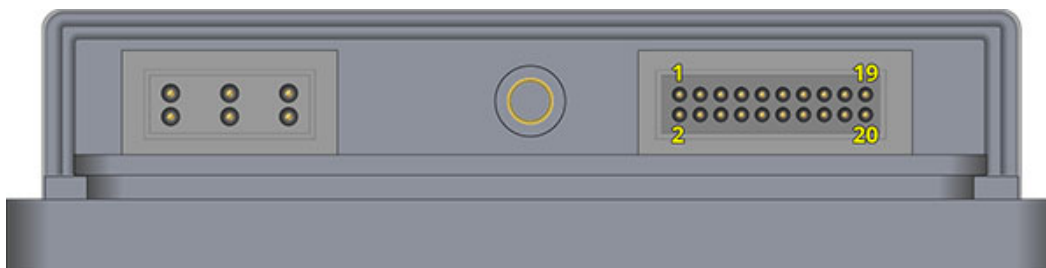
Communication Interfaces

The following sections describe the available communication interfaces of the SGM1400-B Series meter.

ICHIS Interface

The ICHIS interface includes a 20 pin connector and an optional AC mains connector.

20 Pin Connector



Pin	Name	Symbol	Input/ Output	Pull-up	Function
1	+12 V	+12 V	–	–	12 V DC power supply rail
2	+12 V	+12 V	–	–	12 V DC power supply rail
3	Common	COM	–	–	Common DC power supply rail
4	Common	COM	–	–	Common DC power supply rail
5	Device Present	CH_PR	Input	Y	Active low (communications hub present)
6	Host Present	MT_PR	Output	Y	Active low (host present)
7	Transmit Data (Tx)	TX_MT	Output	Y	Serial NRZ line code, logic 0 = high
8	Receive Data (Rx)	RX_MT	Input	Y	Serial NRZ line code, logic 0 = high
9	AC Lost	AC LO	Output	Y	Active high (No AC present)
10	Reserved	CSP_A	NC	N	For use by CSP
11	Reserved	CSP_B	NC	N	For use by CSP
12	Reserved	CSP_C	NC	N	For use by CSP
13	Reserved	RMM_B	NC	N	For future use by ESME manufacturer
14	Reserved	RMM_C	NC	N	For future use by ESME manufacturer
15	Reserved	RMM_D	NC	N	For future use by ESME manufacturer
16	Reserved	RMM_E	NC	N	For future use by ESME manufacturer
17	Reserved	RMM_F	NC	N	For future use by ESME manufacturer
18	Reserved	CSP_D	NC	N	For use by CSP
19	Reserved	CSP_E	NC	N	For use by CSP
20	Reserved	CSP_F	NC	N	For use by CSP

Optional AC Mains Connector



L_{supply}

This connection provides line voltage (i.e., 230 V) directly from the un-metered, live supply connection terminal.

N - N_{supply}

This connects directly to the neutral connection terminal.

L_{load}

This connects directly to the live load main connection of the electricity meter for the use of PLC HAN when a site is disconnected.

Care should be taken when the meter is powered up and the communications module removed from the meter.

NOTE The AC pins are no longer populated on the SGM1400-B family of products. This is specifically attributed to meters that are deemed RF noise compliant against the latest version of ICHIS V2.1.

Home Area Network (HAN)

The SGM1400-B Series meter provides HAN functionality for two-way secure communication to other peripheral products such as IHDs, PPMIDs, etc. The HAN supports the ZigBee 2.4 GHz RF interface and Smart Energy Profile. The HAN interface is located on board the SGM1400-B and communicates via the ZigBee communication protocol with the CSP communications hub.

Manufacturing Client

The Manufacturing Client is used for reading and programming factory objects. Access with a password or authentication and/or encryption keys is required.

Advanced Metering Infrastructure (AMI)

The SGM1400-B Series meters have an AMI communication interface containing two independent communication ports.

The SGM1400-B Series meters support a modular communications architecture that offers customers a choice of AMI communication modules. The meters have the capability to integrate with many different technologies.

The meters provide the means to configure selected errors, cautions, diagnostics, and events for reporting through the AMI interface.

CHAPTER**5****METROLOGY FUNCTIONALITY**

The SGM1400-B Series meter supports an extensive feature set comprising metrology related functions, support of tariffs, load profile, power quality data, etc. The meter is similar to a complete energy meter (not just an electricity meter) when coupled with appropriate ZigBee communication devices for metering gas.

Multipurpose Energy Metering

The SGM1400-B Series meter supports the storage and operation of multiple energy types that are measured directly by the meter. Electrical observables are measured directly by the meter.

Preferred measurements can be selected to be defined and stored independently for each storage operation. These measurements include:

- demand calculations,
- time-of-use storage, and
- load profile storage.

Instantaneous Measurements

The SGM1400-B Series meter supports measurement of multiple electrical parameters. The following instantaneous measurements are available for each measuring element. These instantaneous data values are calculated and updated every momentary interval (approximately one second).

Number	Instantaneous Measurement
1	Active Power Import – kW (Primary)
2	Active Power Import – kW (Secondary)
3	Total Active Power Import – kW (Prim+Sec SGM1422-B)
4	Active Power Export – kW (Primary)
5	Active Power Export – kW (Secondary)
6	Total Active Power Export – kW (Prim+Sec SGM1422-B)
7	Reactive Import Power – kVAr (Primary)
8	Reactive Import Power – kVAr (Secondary)
9	Total Reactive Import Power – kVAr (Prim+Sec SGM1422-B)
10	Reactive Export Power – kVAr (Primary)
11	Reactive Export Power – kVAr (Secondary)
12	Total Reactive Export Power – kVAr (Prim+Sec SGM1422-B)
13	Reactive Power Q1 – kVAr (Primary)

Number	Instantaneous Measurement
14	Reactive Power Q1 – kVAr (Secondary)
15	Total Reactive Power Q1 – kVAr (Prim+Sec SGM1422-B)
16	Reactive Power Q2 – kVAr (Primary)
17	Reactive Power Q2 – kVAr (Secondary)
18	Total Reactive Power Q2 – kVAr (Prim+Sec SGM1422-B)
19	Reactive Power Q3 – kVAr (Primary)
20	Reactive Power Q3 – kVAr (Secondary)
21	Total Reactive Power Q3 – kVAr (Prim+Sec SGM1422-B)
22	Reactive Power Q4 – kVAr (Primary)
23	Reactive Power Q4 – kVAr (Secondary)
24	Total Reactive Power Q4 – kVAr (Prim+Sec SGM1422-B)
25	Apparent Import Power – kVA (Primary)
26	Apparent Import Power – kVA (Secondary)
27	Total Apparent Import Power – kVA (Prim+Sec SGM1422-B)
28	Apparent Export Power – kVA (Primary)
29	Apparent Export Power – kVA (Secondary)
30	Total Apparent Export Power – kVA (Prim+Sec SGM1422-B)
31	Line Voltage
32	Line Current (Primary)
33	Line Current (Secondary)
34	Frequency
35	Power Factor (Primary)
36	Power Factor (Secondary)
37	Power Factor (Prim+Sec SGM1422-B)

Frequency of Supply

The SGM1400-B Series meter supports measurement of the frequency of the main supply.

Cumulative Registers

The SGM1400-B Series meter supports the following cumulative observables for each measuring element as well as total. The data is internally stored in milliunits.

Number	Cumulative Register
1	Total Active Import – kWh (Primary)
2	Total Active Import – kWh (Secondary)
3	Total Active Import – kWh (Prim+Sec SGM1422-B)
4	Total Active Export – kWh (Primary)
5	Total Active Export – kWh (Secondary)
6	Total Active Export – kWh (Prim+Sec SGM1422-B)

Number	Cumulative Register
7	Total Reactive Import – kWh (Primary)
8	Total Reactive Import – kWh (Secondary)
9	Total Reactive Import – kWh (Prim+Sec SGM1422-B)
10	Total Reactive Export – kWh (Primary)
11	Total Reactive Export – kWh (Secondary)
12	Total Reactive Export – kWh (Prim+Sec SGM1422-B)
13	Reactive Energy Q1 – kVAh
14	Reactive Energy Q2 – kVAh
15	Reactive Energy Q3 – kVAh
16	Reactive Energy Q4 – kVAh
17	Total Apparent Import Energy – kVAh
18	Total Apparent Export Energy – kVAh

Power Quality Measurements

The SGM1400-B Series meters are capable of supporting power quality events and functionality including over/under voltage, sags or swells, over/under frequency, over current, and power factor. The meter may be configured to perform the following when the threshold parameters are met for over/under voltage, sags or swells, over/under frequency, and over current events:

- Update the event log
- Open the load switch
- Send an alert to the headend

For power factor events, the meter may be configured to update the event log or send an alert to the headend when the threshold parameters are met.

The configuration of these power quality events are described in more detail in the following sections.

Over Voltage/Under Voltage

The SGM1400-B Series meter includes support for two over voltage and two under voltage thresholds. The over/under voltage thresholds will be configurable along with the duration to activate the event.

The following parameters are configurable:

- Two upper voltage thresholds limits for the over voltage events (1st threshold and extreme threshold)
- Two lower voltage thresholds limits for the under voltage events (1st threshold and extreme threshold)
- The duration for which the threshold limit must be exceeded to trigger the event (voltage under/over monitoring period)

The event log will record the time and date stamp for the start and end of the event and the total number of events.

Sag and Swell

The SGM1400-B Series meters can be configured to identify when voltage sag/swell events have occurred. The event thresholds are configurable in terms of when the voltage is below or greater than a defined voltage threshold for a configurable period of time. The configurable thresholds include the following:

- The high voltage threshold
- The duration (in seconds) that triggers a high voltage event/alarm
- The low voltage threshold
- The duration (in seconds) that triggers a low voltage event/alarm

The voltage sag/swell alarm event is defined as follows:

- The event occurs when the RMS voltage exceeds the high voltage threshold (180-300 V) for 1-300 seconds.
- The event occurs when the RMS voltage drops below the low voltage threshold (180-300 V) for 1-300 seconds.

Over Frequency and Under Frequency

The SGM1400-B Series meters have configurable over frequency and under frequency thresholds and durations. The thresholds can be configured as follows:

- Over frequency threshold
- Duration (in seconds) that triggers an over frequency event/alarm
- Under frequency threshold
- Duration (in seconds) that triggers an under frequency event/alarm

The event log will record the time and date stamp for the start and end of the event and the total number of events.

Over Current

The SGM1400-B Series meter has a configurable over current threshold and duration (in seconds) to activate the event. The event log will record the time and date stamp for the start and end of the event and the total number of events. Additionally, the disconnecter can be configured to open on an over current event.

The SGM1422-B has separate monitoring functions per element with their own thresholds and time period settings. The 2nd relay on the SGM1422-B also has a limiter for current.

Power Factor Threshold

The SGM1400-B Series meters have a configurable power factor threshold and duration (in seconds) to activate the event. The meter may be configured to update

the event log or send an alert to the headend when the threshold parameters for a power factor event are met. The event log shall record the time and date stamp for the start and end of the event and the total number of events.

NOTE Power factor monitoring on single phase installations is not recommended due to the significant number of alerts generated.

Voltage Quality Measurements

The SGM1400-B Series meters may be configured to support Average RMS Over/Under Voltage, RMS Extreme Over/Under Voltage, RMS Voltage Sag, RMS Voltage Swell, and Supply Outage quality measurements.

Average RMS Voltage

The meter is capable of calculating the average value of RMS voltage over a configurable period as defined in the Average RMS Voltage Measurement Period. It will also record the values calculated (including the universal time coordinated (UTC) time and date at the end of the period to which the values relate) in the Average RMS Voltage Profile Data Log.

Over Voltage Threshold

If the calculated value is above the Average RMS Over Voltage Threshold, it will record the number of such occurrences in the Average RMS Over Voltage Counter. If the calculated value of the previous period is below the Average RMS Over Voltage Threshold, the meter will generate a corresponding entry in the Power Event Log and send an alert to the HAN interface.

If the calculated value is below the Average RMS Over Voltage Threshold and the calculated value of the previous period was above the Average RMS Over Voltage Threshold, the meter will generate a corresponding entry in the Power Event Log and send an alert to the HAN interface.

Under Voltage Threshold

If the calculated value is below the Average RMS Under Voltage Threshold, the meter will record the number of such occurrences in the Average RMS Under Voltage Counter. If the calculated value of the previous period was above the Average RMS Under Voltage Counter, the meter will generate a corresponding entry in the Power Event Log and send an alert to the HAN interface.

If the calculated value is above the Average RMS Under Voltage Threshold and the calculated value of the previous period was below the Average RMS Under Voltage Threshold, the meter will generate a corresponding entry in the Power Event Log and send an alert to the HAN interface.

RMS Extreme Over Voltage

If the RMS voltage rises above the RMS Extreme Over Voltage Threshold for a duration longer than specified in the configured measurement period, the meter will generate a corresponding entry in the Power Event Log and send an alert to the HAN interface.

If the RMS voltage returns to a value below the RMS Extreme Over Voltage Threshold longer than the configured measurement period, the meter will generate a corresponding entry in the Power Event Log and send an alert to the HAN interface.

RMS extreme Under Voltage

If the RMS voltage falls below the RMS Extreme Under Voltage Threshold for a duration longer than the configured measurement period, the meter will generate a corresponding log entry and send an alert to the HAN interface.

When the RMS voltage returns to a value above the RMS Extreme Under Voltage Threshold for a duration longer than the configured measurement period, the meter will generate a corresponding log entry and send an alert to the HAN interface.

RMS Voltage Sag

If the RMS voltage falls below the RMS Voltage Sag Threshold for a duration longer than the configured measurement period, the meter will generate a corresponding entry in the Power Event Log and send an alert to the HAN Interface.

When the RMS voltage returns to a value above the RMS Voltage Sag Threshold for a duration longer than the configured measurement period, the meter will generate a corresponding log entry and send an alert to the HAN interface.

RMS Voltage Swell

If the RMS voltage rises above the RMS Voltage Swell Threshold for a duration longer than the configured measurement period, the meter will generate a corresponding entry and send an alert to the HAN interface.

When the RMS voltage returns to a value below the RMS Voltage Swell Threshold for a duration longer than the configured measurement period, the meter will generate a corresponding log entry and send an alert to the HAN interface.

Supply Outage Reporting

The meter may be configured to record the date and UTC when the supply is interrupted and when it is restored. Once configured, the meter will generate a corresponding entry in the Power Event Log. Once the supply has been restored, the meter will send an alert to the HAN interface that includes the date and UTC of both the interruption and restoration.

Profiles

The SGM1400-B Series meter supports non-volatile recording of two profiles of a number of quantities (channels) at discrete time intervals (periods).

These two profiles are load profile (profile 1) and instrumentation profile (profile 2). These profiles are usually defined by the quantity type captured in each profile:

demand quantities for load profile (LP) and average instrumentation quantities for instrumentation profile (IP).

Load Profile

Load profile is traditionally configured to record a number of demand quantities (channels) at discrete time intervals (periods).

Four load profile channels are supported and are defaulted to the following:

- Import Active Energy
- Export Active Energy
- Import Reactive Energy
- Export Reactive Energy

These channels can be easily expanded (or contracted); however, the modification will be detrimental to the overall storage capacity.

When reconfiguring the channels, the energy supplier must retrieve all load profile data prior to the change, as changes will initiate a reset of the profiles.

Voltage Profile Log

The SGM1400-B Series meter offers profiling of the average RMS voltage.

By default, the only channel that is configured is for RMS Voltage (Default Channel 1: Voltage Profile Data Log).

Interval Times

The following time intervals, as a minimum, are supported for both load and instrumentation profiles and are independent of each other:

- 60 minute
- 30 minute (default for standard load profile data)
- 15 minute
- 10 minute (default for instrumentation profile data)
- 5 minute
- 1 minute

Interval Time Changes

In the event of a change of profile interval time, the energy supplier must retrieve all load profile data prior to the change, as changes will initiate a reset of the profiles.

This eliminates the possibility of the headend system reading across different profile periods, where the system assumes homogeneous buffer entries (all entries have the same size and structure).

Data Storage

The SGM1400-B Series meter's data storage includes load profile, instrumentation profile, time-of-use, and block tariff metering.

Load Profile

By default, the SGM1400-B Series meter can store a minimum of four channels of load profile demand data, at an interval of 30 minutes, for a period of 24 months.

The number of channels is reconfigurable. For example, the meter memory can store ten channels of load profile energy data, at an interval of 30 minutes, but only for a maximum period of 210 days (7 months).

Instrumentation Profile

By default, the SGM1400-B Series meters can store a minimum of four channels of load profile demand data, at an interval of thirty 30 minutes, for a period of 3 months.

Memory Overwrite

The meter will overwrite the oldest load profile data first in the event that all memory allocated to the profiles is consumed. It is the responsibility of the energy supplier to ensure that all data is retrieved punctually.

Power Outages

Flags set in the status data of profile interval periods around power outages determine where power outages have occurred. The energy supplier will need to reconstruct the data based on these flags and time stamp data. No holes are left in the data where these outages have occurred.

Time-of-Use (TOU)

The meters support multiple TOU registers. The minimum quantity of TOU registers are as follows:

- 48 rates (for Import Active Energy only)
- 6 day types per week
- 16 day profiles
- 5 week profiles
- 4 season profiles
- 50 special day profiles

Additionally, the SGM1422-B dual element meter supports the following TOU registers intended for second element tariffs:

- 4 rates (for Import Active Energy only)
- 6 day types per week

- 16 day profiles
- 5 week profiles
- 4 season profiles
- 50 special day profiles

Block Tariffs

There are four block thresholds for each of the eight TOU rates, resulting in a 4x8 price matrix.

Maximum Demand

The SGM1400-B Series meter provides four maximum demand (MD) registers. The meter also records the time and date stamp of the MD. The MD is recorded as the largest demand during the current billing period.

Billing Data

The SGM1400-B supports daily, monthly and asynchronous billing. The daily and monthly billing is accessible via any of the communications ports present on the meter, and the data is overwritten based on the first in/first out method.

Daily Billing Data

The SGM1400-B Series meter stores 31 daily billing data sets before overwriting occurs.

The snapshot will automatically occur on the crossover of the midnight boundary.

The daily billing data includes the following:

- Tariff TOU Register Matrix
- Tariff Block Counter Matrix
- Total Active Import Register
- Time and date stamp in the Daily Read Log
- Total Active Export Register

If the meter is in prepayment mode, the data below will be captured at the end of each billing period:

- Meter Balance
- Emergency Credit Balance
- Accumulated Debt Register

- TBC1 - 2 and PB Debt Payments:
 - Last Collection Time
 - Last Collection Amount
 - Total Amount Remaining
- Emergency Credit Status
- Disconnect Switch Status
 - Primary Element

Each daily data set includes a time and date stamp for when the snapshot occurred.

In the event of a power outage over the midnight boundary, the meter will perform the daily billing snapshot once power returns after the midnight boundary. The Daily Billing Snapshot feature can be enabled or disabled through configuration.

Monthly Billing Data

The SGM1400-B Series meter stores 13 end-of-billing data sets before overwriting occurs.

The billing period is specified monthly. The end-of-month billing date can be specified as the last day of the month or a date specified for each month. In the case of a specified date, each month can be configured with a different date.

At the end of each billing period, the meter will store copies of the current cumulative/consumption registers into non-volatile memory.

The data includes the following:

- Tariff TOU Register Matrix
- Secondary Tariff TOU Register Matrix (SGM1422-B only)
- Tariff Block Counter Matrix
- Total Active Import Register
- Secondary Total Active Import Register

If the meter is in prepayment mode, the data below will be captured at the end of each billing period:

- Meter Balance
- Emergency Credit Balance
- Accumulated Debt Register
- TBC1 - 2 and PB Debt Payments:
 - Last Collection Time
 - Last Collection Amount
 - Total Amount Remaining

Each set of historical data contains a time and date stamp when the billing reset occurred.

The meter will record the source that activated the end of billing period, such as automatic end of month, forced billing reset from the headend system, etc.

Asynchronous Billing

Asynchronous billings typically occur in the following situations:

- Automatic billing reset via pre-configured dates
- Ad-hoc on demand via headend system - This may update either of the sets.

These are managed by the predefined or programmable actions associated with change of tenancy/supplier or by direct execution of scripts from the headend system.

NOTE The invocation of billing scripts is not automatic within the meter and is subject to the correct configuration of the schedules and scripts.

CHAPTER**6**

ADVANCED FEATURES

This chapter provides information on the advanced features of the SGM1400-B, such as supply connection and disconnection, auxiliary load relay, clock, and event and error logging.

Supply Disconnect and Reconnect

All SGM1400-B Series meters have supply disconnection and reconnection (SDR) functionality. This provides the means to disconnect the load-side terminals from the line-side terminals by actuating a contactor that is controlled by the meter. The contactor may be controlled directly by commands or through applications such as supply limiting and prepayment. The meter will generate an event log entry when the supply is manually disconnected.

The configuration parameters for the supply disconnect/reconnect meter relay are stored in non-volatile memory. All configuration options for the supply disconnect/reconnect relay can be configured locally via the optical port or remotely via the AMI interface. This section contains the firmware functional specifications related to the supply disconnect/reconnect functionality. The contactor and relay options are shown in the *Models* table on page 7.

Supply Contactor Visual Status

The LCD segment will remain on when the supply disconnect/reconnect contactor is in the connected state, and it will remain off when the supply disconnect/reconnect contactor is in the disconnected state.

The LCD segment will flash with a 50% duty cycle during periods when the meter is armed. When the LCD segment is blinking, the contactor is physically in the open state until the reconnection is activated.

Scheduled Disconnection/Reconnection

The SGM1400-B Series meters support disconnection and reconnection of all contactors and relays on a schedule. A common approach to schedule management applies to the supply disconnect/reconnect functionality and to the auxiliary load control functionality.

The SGM1400-B Series meters support a definition of a series of relay state change instructions for changing the state of any of the meter relays on a schedule.

Automatic Disconnection/Reconnection

The SGM1400-B Series meters support multiple methods by which the supply relay can be automatically disconnected and subsequently reconnected.

Load Limiting

The SGM1400-B Series meters support automatic disconnection of supply if the delivered power from the network to the customer exceeds a predefined average threshold over a predefined period of time.

When this functionality is enabled, the service will be disconnected if the average consumption over the configured period of time exceeds the configured threshold. The service will be reestablished once the power does not exceed the threshold during that period of time.

Under/Over Frequency

The SGM1400-B Series meters support disconnection of service if the supply frequency goes above an upper limit or below a lower limit.

When this functionality is enabled, the contactor will be disconnected until the supply frequency is no longer above/below the limit.

Sag/Swell

The SGM1400-B Series meters support disconnection of service if the supply voltage goes above an upper limit or below a lower limit.

When this functionality is enabled, the contactor will be disconnected for a defined period of time if the average voltage over a configured period of time exceeds either of the configured thresholds.

Under/Over Voltage

The SGM1400-B Series meters support disconnection of service if the supply voltage goes above an upper limit or below a lower limit for an extended period.

When this functionality is enabled, the contactor will be disconnected for a defined period of time if the average voltage over a configured period of time exceeds either of the configured thresholds.

Over Current

The SGM1400-B Series meters support automatic disconnection of supply if the measured current exceeds a predefined average threshold over a predefined period of time.

When this functionality is enabled, the service will be disconnected for a defined period of time if the average current over the configured period of time exceeds the configured threshold.

For the SGM1422-B, the second element can be independently monitored.

Power Factor

The SGM1400-B Series meters support automatic disconnection of supply if the calculated power factor goes below a predefined average threshold over a predefined period of time.

When this functionality is enabled, the service will be disconnected if the average consumption over the configured period of time is less than the configured threshold. The service will be reestablished once the calculated power factor is no longer below the threshold.

Overheating

The overheating event feature is application- and customer-specific.

Tamper Detection

The SGM1400-B meter has the capability to open the load switch when detecting a tamper condition.

Arming and Disarming

The SGM1400-B Series meters support a supply arming function to provide a safer means of reconnecting supply to a premise, especially when activating supply remotely. The meter can be armed or disarmed locally or remotely; however, supply will not be connected to the premise until the reconnection buttons are physically pressed on the meter. An end user can access the physical reconnection button without requiring an authorized technician.

When the meter is in the armed state, the LCD icon for the particular contactor will blink indicating that the contactor is open but armed. When the reconnection buttons are pressed on the meter, the main supply contactor will close for supply to be reconnected to the premise. The arming state can be canceled locally via the optical port or remotely via the AMI interface.

Auxiliary Load Relay

The SGM1412-B and SGM1416-B meters contain a 2 A voltage-free contact relay to allow switching of an external contactor. The 2 A relay can be controlled remotely or scheduled to open or close at specific times of the day to control auxiliary loads such as water or under-floor heating. An LCD segment indicates if the 2 A relay is connected (see *Display* on page 10).

Real-Time Clock

All SGM1400-B Series meters have an internal clock mechanism to maintain the time and date. There are two time base options: line frequency based time and crystal oscillator based time.

NOTE Time accuracy will not be affected by high or low voltage operation, regardless of whether the time is being maintained by line frequency or crystal oscillator.

The crystal oscillator based time mechanism is based on an internal 32.768 kHz crystal oscillator. The crystal oscillator is used to maintain the meter time when the supply voltage is not present or when the meter is configured to use oscillator based time.

If the meter is configured to use the line frequency based synchronization, the meter will switch to crystal based time when the main supply is unavailable (i.e., the meter is powered down). The time keeping method will revert to line synchronization upon the supply being re-energized.

Event Logging and Errors/Alarms

The SGM1400-B Series meters continually monitor for conditions that have been configured to be recorded upon occurrence. These events, errors, and alarms can be read locally via the optical port and a supported handheld/laptop device. They can also be read remotely over the AMI system back to the headend or other allowable remote devices.

Events, errors, and alarms are comprised of a variety of different conditions, including the following:

- Serious error conditions (e.g., battery failure)
- Exceptional operational conditions (e.g., Power Up / Power Down)
- Normal configuration (e.g., clock time set)
- Normal billing events (e.g., asynchronous billing)
- Control of meter state (e.g., manual connection of SDR relay)
- Tamper conditions (e.g., meter cover removal)

Refer to *Event Codes* on page 89 for a complete list.

Event Logs

As events are raised, they are filtered into a series of event logs based on the configuration of the meter. The SGM1400-B Series meter supports the following event logs:

Log	Description
Event Log	This is used to log standard or general events.
Security Log	This log is specifically for events that may be evidence of attempts to commit fraud or theft by tampering with the meter. This includes removal of the meter cover, removal of the battery cover, use of an incorrect High Level Security Key, etc.
Power Event Log	This log deals with any event that has been triggered by the power quality functionality on the meter.
ALCS Log	This log records the status of the auxiliary load control switch and the device to which it relates.

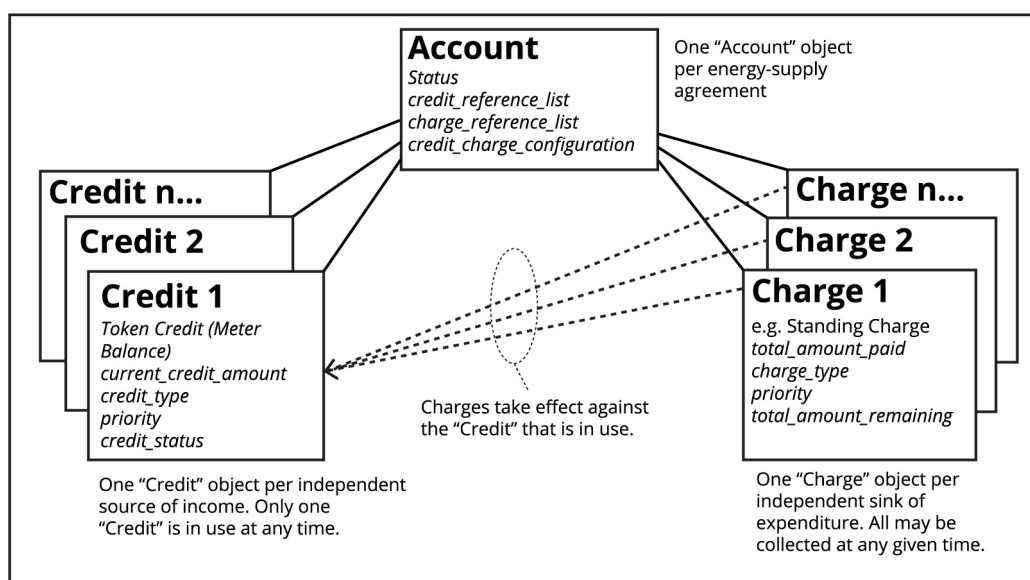
Prepayment Solution

Overview

The SGM1400-B Series meter family supports SMETS2 prepayment functionality in firmware versions 5.x.x. SMETS2 prepayment adopts the account model as defined in the *DLMS Blue Book (12th Edition)*.

Account Model

The account contains the summary information relating to the credits and charges that are pertinent to a given consumer.



The SGM1400-B Series meter family supports a single account for electricity import.

Credit Object Types

A SGM1400-B Series meter account may include a combination of the following credit object types, depending on the payment mode of operation (Credit or Prepayment):

- **Token Credit Object (Meter Balance):** Credit object controlling the amount of credit either owed by the consumer (Credit mode; a negative amount) or credit which is transferred to the payment meter, normally in the form of UTRNs, or tokens, after deductions (Prepayment mode; a positive amount when in credit, a negative amount when owing monies).
- **Emergency Credit Object (EMC):** Credit object which is released when available and other types of credit are exhausted. The amount of emergency credit used is recovered from subsequently purchased credit tokens. A positive amount indicating the amount of emergency credit remaining. Emergency credit object is used in Prepayment mode only.
- **Accumulated Debt Object:** Credit object specifically for accumulating debt incurred when emergency credit is in use and suspension of debt collection is configured. This will always be a negative amount when accruing. Accumulated debt object is used in Prepayment mode only.

Charge Object Types

The SGM1400-B meter account may include a combination of the following charge types:

- **Time-based Charge Object:** Describes charges collected regularly according to the passage of time, independent of consumption in that period. For example, standing charges and/or debt charges to be paid off over a period of time (e.g., daily).

- **Payment-based Charge Object:** Describes charges that are collected from every top-up (credit payment via UTRN) and put towards debts in repayment. This is a percentage-based charge, where a set portion of the total amount of top-up credit received is taken to pay off that debt (i.e., with every payment, 20% of the payment is applied to the debt amount, thus reducing the amount of debt in this charge). Payment-based charge object is used in Prepayment mode only.
- **Consumption-based Charge Object:** Describes charges that are collected according to the amount of energy consumption which has occurred either in a time-of-use tariff (time-based tariff charge) or a block tariff (consumption-based tariff charge). A price per unit is assigned to each subdivision of the consumed energy register.

Payment Modes

The SGM1400-B Series meter family can operate in one of the two following payment modes:

- Credit Mode
- Prepayment Mode

Credit Mode

In Credit mode, the SGM14000-B Series meters utilize the credits and charges detailed below.

Credits

1. **Token Credit Object (Meter Balance)**
 - In Credit mode, meter balance represents the amount of monies the consumer owes.
 - Initially at zero (after a billing period reset or change from Prepayment mode), this amount goes negative internally as energy is consumed and charges are imposed. Outwardly, this is represented as a positive amount on the display.

Charges

1. **Consumption Charge Object**
 - A charge calculated and collected every second.
 - The charge is determined upon energy consumption within a given TOU period and its associated unit price.
 - Unit prices are configurable.
2. **Standing Charge Object**
 - A singular charge imposed periodically - daily by default.
 - This is a particular configuration of a time-based charge object (a continuous charge that does not terminate).
 - The charge amount is configurable.

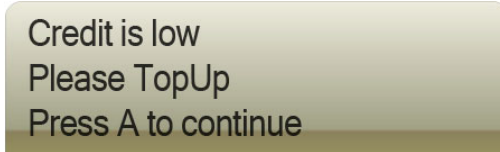
Prepayment Mode

In Prepayment mode, the SGM1400-B Series meters utilize the credits and charges detailed below.

Credits

1. Token Credit Object (Meter Balance)

- In Prepayment mode, the meter balance represents the amount of credit the consumer either currently has available (positive amount) or currently owes (negative amount).
- Normally, when in credit, this amount will be positive and will reduce as energy is consumed and charges are imposed.
- The meter balance is exhausted when the amount falls below the Disablement Threshold, where the supply will be disconnected except under the following circumstances:
 - 1 Emergency credit is selected by the consumer.
 - 2 A non-disconnect (friendly disconnect) period is in force.
- A Low Credit Warning message will be displayed when the meter balance falls below the Low Credit Threshold, informing the consumer that they should top-up. The Low Credit Warning Threshold for meter balance is £2 by default, but it is configurable.

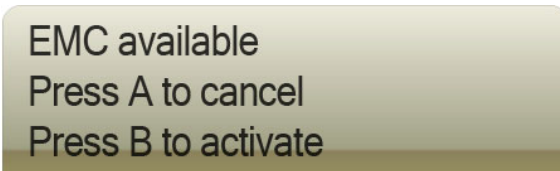


Credit is low
Please TopUp
Press A to continue

- When top-ups are applied, this credit (meter balance) will increase, but the amount will depend on any debts recovered first (i.e., any amount of emergency credit used, accumulated debt accrued, and payment-based debt, where configured).

2. Emergency Credit Object

- The emergency credit (a configurable amount) is made available when the meter balance falls below the configurable Emergency Credit Threshold. The consumer may activate the emergency credit at that point OR at any time after that (via the Prepayment Menu or Prepayment Interface Device (PPMID), if available).



EMC available
Press A to cancel
Press B to activate

- When activated, the emergency credit becomes 'In-Use' immediately after the meter balance is exhausted.
- A Low Credit Warning message will be displayed to inform the consumer that they should top-up when the emergency credit runs low. The threshold used is the same as that configured for the meter balance.
- The emergency credit becomes exhausted when the value reaches zero. Thereafter, consumption and charges will recommence being levied off the

meter balance. If the value is, or falls, below the Disablement Threshold, the supply will be disconnected except under the circumstance that a non-disconnect (friendly disconnect) period is in force.

- When top-ups are applied, any emergency credit used will be taken from the payment. The remainder will be added to the meter balance, but the amount will depend on any debts recovered first (i.e., any accumulated debt accrued and payment-based debt, where configured).

3. Accumulated Debt Object

- In this payment mode, the accumulated debt represents the amount of debt accrued (collection of standing charge and time-based debts, where configured) only when suspend debt emergency is configured. For example, debts are suspended from being collected from the emergency credit but accrued in the accumulated debt.
- Initially at zero, this amount goes negative internally as charges are imposed. Outwardly, this is represented as a positive amount on the display.
- When top-ups are applied, any accumulated debt accrued will be taken from the payment after any payment-based debt collection but before any is used to pay off any emergency credit used. The remainder will be added to the meter balance.

Charges

1. Consumption Charge Object

- A charge calculated and collected every second.
- The charge is determined upon energy consumption within a given TOU period and its associated unit price.
- Unit prices are configurable.

2. Standing Charge Object

- A singular charge imposed periodically - daily by default.
- A particular configuration of a time-based charge object - a continuous charge that does not terminate.
- The charge amount is configurable.

3. Time-based Charge Object #1 - *optional*

- A singular charge imposed periodically.
- Debt recovery period is configurable.
- Charges collected for this debt will terminate once the debt has been paid off.
- Initial debt and debt recovery rate (amount collected each period) are configurable.
- The debt, debt recovery rate, and debt recovery period can be updated at any time.

4. Time-based Charge Object #2 - *optional*

- A singular charge imposed periodically.
- Debt recovery period is configurable.

- Charges collected for this debt will terminate once the debt has been paid off.
- Initial debt and debt recovery rate (amount collected each period) are configurable.
- The debt, debt recovery rate, and debt recovery period can be updated at any time.

5. **Payment-based Charge Object - *optional***

- A charge imposed per top-up.
- A configurable percentage of the top-up.
- Charges collected for this debt will terminate once the debt has been paid off.
- Initial debt is configurable.
- The debt and top-up percentage recovery can be updated at any time.
- The absolute maximum payment provision (cap) imposed over a provision period is configurable. The provision period is also configurable - typically one week defined as Monday to Sunday.

For example:

- 1 The percentage of a payment is set to 10%.
- 2 Payment Max Provision (cap) is set to £5.
- 3 Provision Period is set to 1 week (typical).
- 4 The consumer makes £10 payments every day of the week.

Monday through Friday, £1 is taken off each payment towards the payment-based debt, totaling £5. Only £9, on these days, goes towards paying off:

- the consumer's accumulated debt,
- any meter balance less than the disablement threshold,
- any emergency credit used,
- and the remainder added to the meter balance.

On Saturday and Sunday, after the £5 cap is reached, no percentage of the payment is taken. The full £10 goes towards paying off:

- the consumer's accumulated debt,
- any meter balance less than the disablement threshold,
- any emergency credit used,
- and the remainder added to the meter balance.

Changing Payment Modes

SGM1400-B Series meters with firmware 5.0.0 and later will be supplied with a default of Credit mode. Also, consumption charges (tariff prices) or standing charges will not be set up - they will contain zero charge values. The headend system must set up these charges as part of the initial installation and commissioning process.

Changing modes requires a sequence of commands that are governed by a request of the supplier.

During a change of mode, the previously configured tariff prices and standing charge will be maintained, but they can optionally be updated before or after the change of mode.

When prompted to change the payment mode, the electricity smart metering solution (ESME) records a snapshot (maximum of 12 entries that rollover on a first in, first out basis) of the following data that can be read by the headend system:

- Timestamp of Snapshot
- Active Import (A+) Energy Register
- Secondary Active Import (A+) Energy Register (Twin Element Only)
- Tariff TOU Register Matrix A+ [1 to 48]
- Secondary Tariff TOU Register Matrix A+ [1 to 4] (Twin Element Only)
- Block 1 Register Matrix [1 to 8]
- Block 2 Register Matrix [1 to 8]
- Block 3 Register Matrix [1 to 8]
- Block 4 Register Matrix [1 to 8]
- Emergency Credit Balance
- Meter Balance
- Payment-based Debt Register
- Time-based Debt Register 1
- Time-based Debt Register 2
- Accumulated Debt Register

Changing to Credit Mode

The headend system will send one simple command to change the payment mode to Credit. Upon activation (determined by an activation date in the command), the following is actioned:

- Snapshot of billing data, as laid out above
- Reset of the meter balance
- Any debts are cleared
- The non-disablement calendar configuration is cleared
- Suspend debt configuration is cleared

Changing to Prepayment Mode

The headend system will send the commands listed below to change the payment mode to Prepayment.

1. Update Prepayment Configuration

This command configures the following for use in Prepayment mode:

- *Non-disablement Calendar* – Up to 5 day profiles.
- *Non-disablement Special Days* – Maximum of 20 specific dates where non-disablement is active all day (e.g., Xmas Day and Boxing Day).
- *Maximum Meter Balance* – A parameter to limit the maximum amount of credit allowed on the ESME; defined in milli-pence.
- *Maximum Credit Threshold* – A parameter to limit the applied credit to the ESME in a single top-up; defined in milli-pence.
- *Debt Recovery Cap* – Defined in whole currency (e.g., GBP).
- *Debt Recovery Cap period* – Defined in seconds, but set to a week.
- *Low Credit Threshold* – Applicable to meter balance and emergency credit balance; defined in milli-pence.
- *Emergency Credit Limit* – A parameter that determines the initial emergency credit available to the consumer when activated; defined in milli-pence.
- *Emergency Credit Threshold* – A parameter that determines when emergency credit becomes available; defined in milli-pence.
- *Activation date* – A parameter to determine when the above parameters can be activated.

This command can be used at anytime to update the above parameters, even when already in Prepayment mode.

2. Switch to Prepayment Mode

This command switches the ESME to Prepayment mode, where the above parameters come into force and the following are configured:

- *Suspend Debt Disabled* – When configured, this will optionally suspend the collection of debts (standing charge and time-based debts) from being collected when the supply is disabled.
- *Suspend Debt Emergency* – When configured, this will optionally suspend the collection of debts (standing charge and time-based debts) from being collected off the emergency credit (when in use). This will accrue these debts in the accumulated debt register.
- *Disablement Threshold* – A parameter to determine when the supply will be disabled due to insufficient credit; defined in milli-pence.
- *Activation date* – A parameter to determine when the switch will be activated.

Upon activation (determined by an activation date in the command), the following is actioned:

- Snapshot of the billing data, as laid out above
- Reset of the meter balance

- Activation of emergency credit with amount (emergency credit limit) as set in the Update Prepayment Configuration command

3. Manage Debt on the ESME – *optional*

This command is optional and configures the debts and their collection parameters. This command can only be executed once the ESME is in Prepayment mode, and it is used to update the imposed debts on the consumer as determined by the supplier.

This command can be used to update the following parameters:

- *Time-based Debt 1*
 - Debt recovery amount and scalar with respect to whole currency (e.g., GBP). For example, -2 implies pence.
 - Debt recovery period, defined in seconds.
 - Debt amount remaining (can add or subtract); defined in milli-pence.
- *Time-based Debt 2*
 - Debt recovery amount and scalar with respect to whole currency (e.g., GBP). For example, -2 implies pence.
 - Debt recovery period, defined in seconds.
 - Debt amount remaining (can add or subtract); defined in milli-pence.
- *Payment-based Debt*
 - Percentage of top-up (e.g., 10% – defined as 1000).
 - Debt amount remaining (can add or subtract); defined in milli-pence.

Non-Disablement

In Prepayment mode, the ESME supports the non-disablement calendar. This calendar allows the supplier to define periods of the day and/or special days for non-disablement of the supply switch. If the credit were to become exhausted during these periods, the supply switch would not disconnect. It must be noted, however, that if the credit status still exists (i.e., exhausted) upon exit of a non-disablement period, the supply switch will disconnect. These periods are often termed ‘friendly credit.’

Display Indication

If the credit becomes exhausted while in the non-disablement period and would normally disconnect, an inverted ‘ND’ symbol will be shown on the display.



Non-Disablement Calendar

The periods of non-disablement within the calendar are specified below.

Days

Up to five days can be individually configured to have non-disablement and disablement periods. One is specifically used to define a profile for special days (non-disablement all day), and the other four are used for the week profiles. Only two days which are configured to have non-disablement/disablement periods may be used each week.

Weeks

Two week profiles are available, and each of these can be configured using two day profiles.

Seasons

Three seasons can be configured as specified by date ranges, where each season can have two week profiles.

Special Days - Holidays

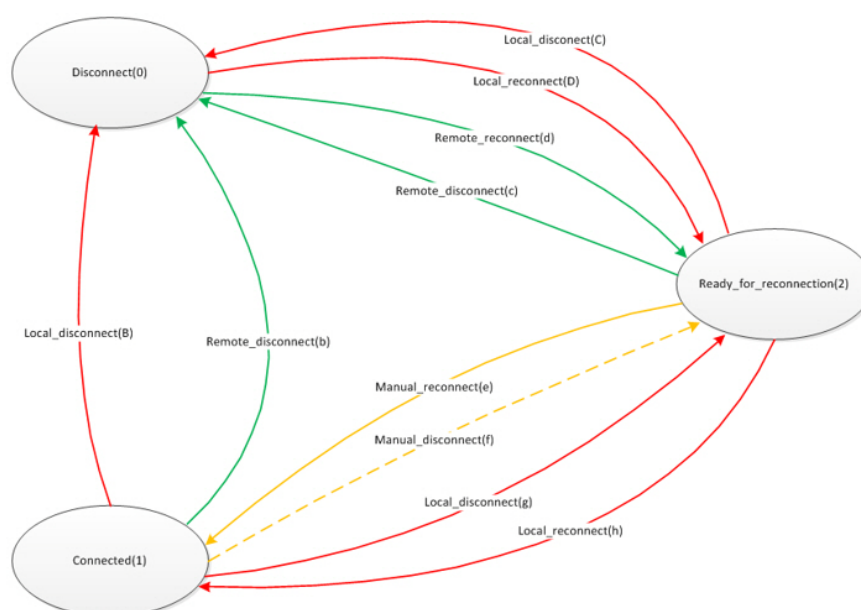
As well as the periods defined in the previous section, whole days can be specified as friendly credit holidays – special days. Up to 20 individual dates can be specified (e.g., Xmas Day and Boxing Day).

Special days override any period configuration specified by the days within the week.

Disconnecter Control Mode

For the prepayment function to operate the disconnect switch effectively, the Disconnecter Control mode is defaulted to Mode 200.

This allows for internal disconnection (in the event of credit exhaustion) and re-arming where sufficient credit has been added to the meter to allow re-connection. The illustration below depicts Mode 200 state transitions.



Top-Ups

Credit top-ups are applied to a consumer account using a unique transaction number (UTRN), sometimes referred to as a ‘token.’

UTRN (Token) Overview

The UTRN is constructed from the 19-digit Prepayment Token Decimal (PPTD) appended with a further Check Digit, resulting in a 20-digit UTRN.

Prepayment Token Decimal (PPTD)

The Prepayment Token Decimal (PPTD) is a 19-digit decimal integer.

The most significant two digits of the PPTD are between 73 and 96, this being the result of the addition of 7,394,156,990,786,306,048 (the K-Class 5 Offset) to the decimal representation of the binary Prepayment Top-up Token (PTUT) to distinguish it from other standard transfer specification (STS) defined tokens.

Prepayment Top-up Token (PTUT)

In binary form, the PTUT is an unsigned 64-bit integer (8 octets), constructed as shown in the table below.

PTUT Format - Bit Assignments			
PTUT Component	Value	Bits	Note
PTUT Lead	0b000	63–61	Fixed value
PTUT Sub Class	0b0000	60–57	Fixed value
PTUT Truncated Originator Counter	Bits 41-32 of the Originator Counter	56–47	Used for anti-replay purposes
PTUT Value Class	0b00 if PTUT Value is to be interpreted as multiples of 1/100 of currency unit OR 0b01 if PTUT Value is to be interpreted as multiples of currency unit	46–45	If currency unit is set to GB pounds on the ESME or GSME: 0b00 means PTUT Value will be interpreted as GB pennies; 0b01 means PTUT Value will be interpreted as GB pounds.
PTUT Value	The quantum of the PTUT expressed as an unsigned binary number of 13 bits in length, so with leading binary zeros where required	44–32	Thus, the maximum value is either: £81.91 if PTUT Value Class = 0b00; OR £8,191.00 if PTUT Value Class = 0b01.
PTUT Supplier MAC	See next slide	31–0	

Class 5 Token

This format does not overlap with the framework provided by the existing STS specification and indeed is a new domain of operation outside that of STS token classes 0, 1, 2, and 3.

Token K Classes			
Constant	Value - Decimal	Value - Hex	Purpose
K_Class 0_1_2_3_MIN	00 000 000 000 000 000 000	0x0 0000 0000 0000 0000	MIN Class 0, 1, 2, 3 token value
K_Class 0_1_2_3_MAX	73 786 976 294 838 206 463	0x3 FFFF FFFF FFFF FFFF	MAX Class 0, 1, 2, 3 token value
K_Class_4_MIN	73 786 976 294 838 206 470	0x4 0000 0000 0000 0006	MIN Class 4 token value
K_Class_4_MAX	73 941 569 907 863 060 479	0x4 0225 3A12 6CE3 FFFF	MAX Class 4 token value
K_Class 5_OFFSET (19 digit)	7 394 156 990 786 306 048	0x669D 529B 714A 0000	Constant to add on to Class 5 token
K_Class_5_MIN	73 941 569 907 863 060 480	0x4 0225 3A12 6CE4 0000	MIN Class 5 token value
K_Class_5_MAX	96 999 999 999 999 999 999	0x5 4225 3A12 6CE3 FFFF	MAX Class 5 token value
K_Class_6_MIN	97 000 000 000 000 000 000	0x5 4225 3A12 6CE4 0000	MIN Class 6 token value
K_Class_6_MAX	99 999 999 999 999 999 999	0x5 6BC7 5E2D 630F FFFF	MAX Class 6 token value

There are a number of departures from the currently specified IEC 62055-41 that are required for the Class 5 Token, which are mainly the ability to have an unencrypted token and secondly the ability to have a built-in MAC for token authentication.

Consumer UTRN Token — 20-Digit Decimal

Under normal circumstances, the consumer will provide the ESME ID and purchase credit for their meter. A UTRN token is generated, and the request is sent to the ESME over the WAN communications to the communications hub and then on to the ESME over the HAN.

Should the WAN communications channel be off-line, the consumer must manually enter the UTRN token via the ESME UI or, if available, the PPMID UI.

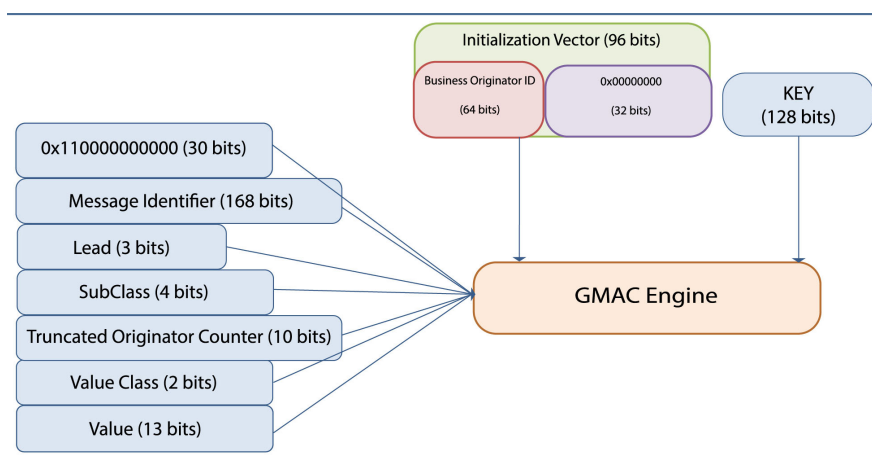
Check Digit — 20th Digit

The Check Digit is used to verify the correct entry of the preceding 19-digit PPTD in instances where it is entered manually. This verifies accuracy of the entry, reducing human error.

The Check Digit adopts the Verhoeff algorithm. Erroneous entries detected by the Verhoeff algorithm aren't penalized as invalid entries – the lockout counter isn't incremented (see *UTRN Entry Lockout* on page 62).

UTRN Token – MAC

The message authentication code (MAC) is GMAC based on a 128-bit symmetric key (prepayment key) that is derived each time a UTRN token is generated. The following diagram gives an overview of the data elements involved in that generation.



Prepayment Key

The secret 128-bit prepayment key used in the MAC generation and UTRN validation is written to the ESME under the control of the headend system when the Update Security Credentials command is sent.

Upon a successful execution of this command, the ESME will reset its internal UTRN counter cache.

UTRN Counter Cache

The ESME holds and maintains a UTRN counter cache to prevent ‘replay’ of previously processed UTRNs. The UTRN counter cache can hold 100 processed UTRNs (first in, first out order) and contains entries of the 32 most significant bits of the originator counter (64 bits) of successfully processed UTRNs.

The ESME checks that the UTRN counter is strictly numerically greater than the lowest numerical value in the UTRN counter cache and is not equal to any value in the UTRN counter cache. If the UTRN counter was **not** numerically greater than the lowest numerical value in the UTRN counter cache, it would be considered to be old. If the UTRN counter **was** equal to any value in the UTRN counter cache, it would be considered to be a duplicate.

The UTRN counter cache updates under the following conditions:

- UTRN is successfully processed by the ESME; as such, a new entry is added
- Reset upon Update of Security Credentials command

UTRN - Manual Entry

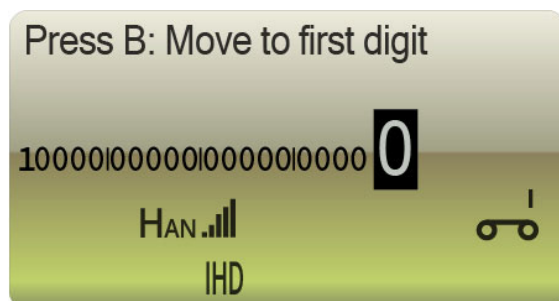
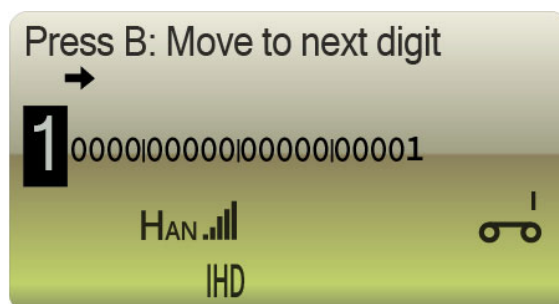
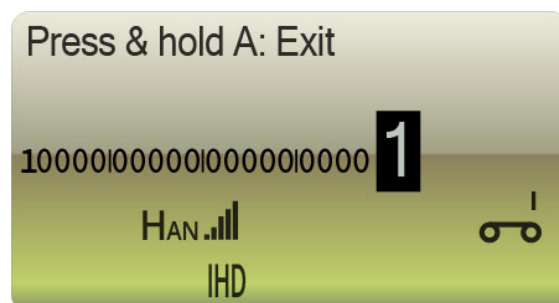
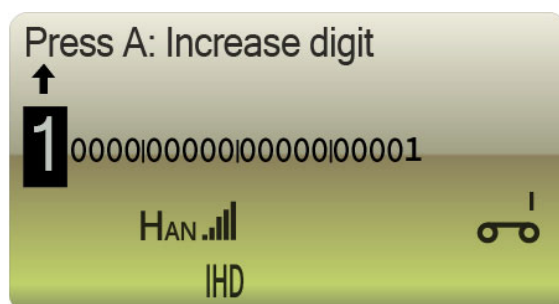
Manual entry of a UTRN can only be done via the Prepayment menu by pressing Button A until the **Enter Top-up Code** item is shown.

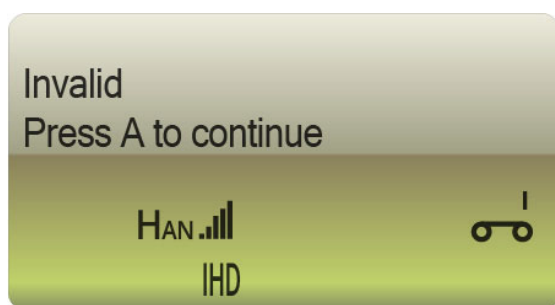
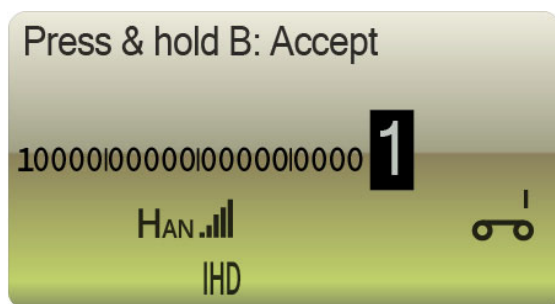
Press and hold Button A to enter the UTRN Top-up screen, where the following can be used to enter the top-up code:

Enter UTRN Menu Options	
Button	Action
A Button Press	Increases the value of the digit selected by the cursor by one
A Button Hold	Exits the Enter UTRN display

Enter UTRN Menu Options	
Button	Action
B Button Press	Moves the cursor to the next digit
B Button Hold	Accepts the current 20-digit UTRN for validation

See the images below for display examples.





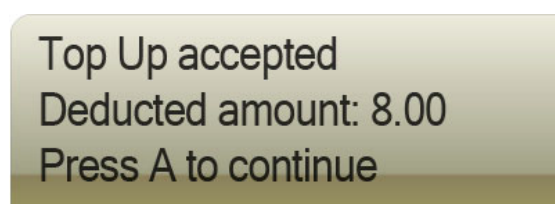
UTRN Entry Responses

Every entry of a UTRN token will generate a response, whether accepted or rejected, which in turn is logged within the ESME. These responses will either be alerts or events; see *Prepayment Events and Alerts* on page 64. Successful UTRNs and their top-up amounts are logged in the following billing logs:

- **Payment-based Debt Payments** (log of what payment has been made towards the payment-based debt)
- **Prepayment Credits** (log of what credit has been accepted – full top-up amount)

UTRN Entry Accepted

When the ESME successfully processes a UTRN (top-up), a message will appear on the ESME display to indicate that a top-up was accepted. This message will also indicate how much has been deducted.



UTRN Entry Lockout

THE ESME supports a UTRN lockout feature where certain responses to UTRN entries will be regarded as fraudulent/invalid attempts to enter a UTRN and will be penalized by a count towards a potential lockout.

The rules for the lockout feature are detailed in the following table.

UTRN Token Lockout Conditions		
Lockout Counter	Reason	Lockout State
Increments, but still < 10	Invalid UTRN entry received.	OFF
Resets (= 0)	Lockout State is OFF and a valid UTRN entry is received OR top-of-the-hour is crossed.	OFF
= 10	Ten consecutive invalid UTRN entries are received within the current clock hour.	ON
Resets (= 0)	Lockout State is ON and top-of-the-hour is crossed.	OFF

When a lockout state is ON, no further UTRN entries are allowed. Any such entries will be rejected until the next top-of-the-hour is crossed.

Maximum Meter Balance

The maximum meter balance is the absolute maximum amount of credit that is allowed to be credited to the meter balance.

If a top-up via a UTRN takes the credit above this threshold, the UTRN token will be rejected, but the consumer will be able to apply that UTRN again when the meter balance has sufficiently dropped to allow that top-up.

Maximum Credit Threshold

The maximum credit threshold is the absolute maximum amount of credit from a single transaction that is allowed to be added to the meter.

If a top-up via a UTRN exceeds this vend amount, an invalid response will be generated, and the UTRN token will be rejected.

Debt to Clear

The ESME will display the minimum amount of monies required to clear the current debt to achieve the following two goals:

1. Allow the consumer to get back on supply if previously disconnected
2. Allow the consumer to have EMC available again if previously used

NOTE Consumers can 'live' in EMC.

The determination of the debt to clear is as follows:

Debt to Clear = ((Disablement Threshold – Meter Balance) + EMC Used + |Accumulated Debt|) * 100/(100%)

NOTE % is the payment recovery off a top-up.

However, the amount of payment recovery is also limited by the following (whichever is the smallest):

- Amount of payment debt remaining
- Weekly cap amount remaining

Order of Recovery of Debts

When a top-up is applied, any outstanding debts are recovered prior to adding any remaining monies to the meter balance.

The order of debt recovery has the following priority (highest first):

1. Payment-based charge (if applicable),
2. Accumulated debt,
3. Payback of any negative meter balance up to the disablement threshold,
4. Emergency credit used,
5. and any remaining credit is added to the meter balance.

Prepayment Events and Alerts

Below is a list of events and alerts pertinent to the prepayment function of the ESME.

MB ≥ Meter Balance, EMB ≥ Emergency Credit Balance.

Prepayment Events and Alerts					
ID (hex)	Description	When Triggered	Alert Sent	HAN Device Notification	Logged
810D	Combined Credit below Low Credit Threshold	MB + EMB < Threshold	Yes	Yes	No
810E	Credit added locally	UTRN entered via UI	Yes	No	No
8119	Emergency Credit has become available	MB < EMC Threshold	Yes	Yes	No
8168	Supply Disabled then Armed – Activate Emergency Credit triggered	EMC Activated after Supply is Disabled	Yes	Yes	No
81A7	Debt Collection Completed – Time Debt 1	Time Debt 1 is Paid Off	Yes	No	Yes – Event Log
81A8	Debt Collection Completed – Time Debt 2	Time Debt 2 is Paid Off	Yes	No	Yes – Event Log
81A9	Debt Collection Completed – Payment Debt	Payment Debt is Paid Off	Yes	No	Yes – Event Log
81AA	Emergency Credit Exhausted	EMC is Used Up	Yes	Yes	Yes – Event Log
81AB	Emergency Credit Activated	Activation of EMC	Yes	Yes	Yes – Event Log

Prepayment Events and Alerts					
ID (hex)	Description	When Triggered	Alert Sent	HAN Device Notification	Logged
81C4	UTRN Manual Entry Suspended	10 Invalid UTRN entries within Current Hour	Yes	Yes	Yes – Event Log
81C5	UTRN Rejected as Locked Out	After Suspension until next top-of-hour	Yes	No	Yes – Event Log
8F0F	Combined Credit Below Disablement Threshold	MB + EMB < Threshold	Yes	No	No
8F47	Credit would cause Meter Balance to exceed Maximum Meter Balance Threshold	Top-up would result in MB > MB Threshold	No	No	Yes – Security Log
8F51	Duplicate UTRN Entered	Previously used UTRN Entered	No	No	Yes – Security Log
8F5B	UTRN exceeds Maximum Credit Threshold	Top-up is > Max Credit Threshold	No	No	Yes – Security Log
8F63	UTRN not Authentic	Invalid UTRN (e.g., MAC incorrect)	No	No	Yes – Security Log
8F64	UTRN not for this Device	Invalid UTRN (e.g., wrong Business Target ID)	No	No	Yes – Security Log
8F32	Supply Armed	Credit is now > Disablement Threshold or ECS44	Yes	Yes	No
8F70	Update Security Credentials	Update Security Credentials command Successfully Processed	Yes	No	Yes – Security Log
8F83	Disablement of Supply due to Insufficient Credit – has been Suspended	Credit Exhausted while in ND Period	Yes	No	No

Prepayment Logs

The following logs are recorded in the ESME and available for the headend system to retrieve:

1. Prepayment Daily Read Log

- Data:
 - Timestamp of when log recorded
 - Emergency Credit Balance
 - Meter Balance
 - Payment Debt Register – amount remaining

- Time-based Debt Registers 1 and 2 – amounts remaining
- Accumulated Debt Register
- Recorded daily at the end of each day
- Depth = 31

2. Billing Data – Change of Mode Triggered

- Data:
 - Timestamp of snapshot
 - Active Import (A+) Energy Register
 - Secondary Active Import (A+) Energy Register (twin element only)
 - Tariff TOU Register Matrix A+ [1 to 48]
 - Secondary Tariff TOU Register Matrix A+ [1 to 4] (twin element only)
 - Block 1 Register Matrix [1 to 8]
 - Block 2 Register Matrix [1 to 8]
 - Block 3 Register Matrix [1 to 8]
 - Block 4 Register Matrix [1 to 8]
 - Emergency Credit Balance
 - Meter Balance
 - Payment-based Debt Register
 - Time-based Debt Register 1
 - Time-based Debt Register 2
 - Accumulated Debt Register
- Recorded upon change of mode
- Depth = 12

3. Billing Data – Debt Payments

- Data:
 - Timestamp of snapshot
 - Payment made towards debt recovery
- Recorded upon every successful payment (processing of UTRN) where some debt has been repaid
- Depth = 10

4. Billing Data - Prepayment Credits

- Data:
 - Timestamp of snapshot
 - Credit Amount (before deductions)
- Recorded upon every successful payment (processing of UTRN)
- Depth = 5

Prepayment Menu – Display

In Prepayment mode, the ESME displays a Prepayment menu. This menu allows the consumer to access various prepayment-related quantities such as meter balance, emergency credit balance, etc.

Pressing Button B will cycle the display through the various menus, but an additional menu is available in Prepayment mode, as shown in the table below.

Sequencing	Configurable	Comments
Prepayment Menu (Alt3)	Yes – up to 50 items	Only visible in Prepayment mode
		
Primary Menu	Yes – up to 50 items	Always visible
		
Alt1 Menu	Yes – up to 50 items	Visible when > 0 entries
		
Alt2 Menu	Yes – up to 50 items	Visible when > 0 entries
		
Engineering Menu	Yes – up to 50 items	Always visible
		
Alt4 Menu	Yes – up to 50 items	Visible when > 0 entries
		
Signal Strength	No (signal strength of HAN (dBm))	Always visible
		
Active TOU	No (currently active TOU rate)	Always visible
		
Privacy PIN Menu	No (controls PIN access)	Always visible

Once in the Prepayment menu, pressing Button A will give the consumer access to the supplier-defined (as defined in the customer configuration card) list under the Prepayment menu. The supplier can define and reorder the list items outlined below during meter configuration (when thresholds, profiles, events and alarms, etc. are programmed).

Typical Prepayment Menu Structure	
ID	Item
0	Meter Balance
1	Emergency Credit Balance

Typical Prepayment Menu Structure	
ID	Item
2	Emergency Credit Status
3	Last Five Credits
4	Accumulated Debt
5	Prepayment-based Debt
6	Time-based Debt
7	Available Credit
8	Debt to Clear
9	Aggregated Debt
10	Enter UTRN
11	Audible Alert Settings

Mandatory Prepayment Menu Items

Although the Prepayment Item List may be customised by the supplier, the following line items cannot be removed from the list for functionality purposes:

- Emergency Credit Status – to allow for Emergency Credit activation
- Enter UTRN – to allow for manual entry of a UTRN

Prepayment Menu – Item Structure and Access

The table below outlines the features and navigation of the Prepayment menu.

Prepayment Menu Operations			
Item	Upon Selecting	Press Button A	Press Button B
Meter Balance	Balance Value	Next Prepayment Item	Exits Prepayment Menu
Emergency Credit Balance	Emergency Credit Balance Remaining Balance (In-use or Selected), 0 if not available	Next Prepayment Item	Exits Prepayment Menu
Emergency Credit Status	Emergency Credit: In-use Remaining Balance	Next Prepayment Item	Exits Prepayment Menu
	Emergency Credit: Invoked Remaining Balance	Next Prepayment Item	Exits Prepayment Menu
	EMC Available Press A to cancel Press B to activate	Rejects Emergency Credit – returns to Next Prepayment Item	Emergency Credit is Successfully Selected <i>Activated</i>
	Emergency Credit is Exhausted	Next Prepayment Item	Exits Prepayment Menu
	Emergency Credit is not Available	Next Prepayment Item	Exits Prepayment Menu
Last Five Credits	Press A and hold to Enter	HOLD A – Enters Credit History	Exits Prepayment Menu

Prepayment Menu Operations			
Item	Upon Selecting	Press Button A	Press Button B
Last Five Credits – once entered	<i>Credit 1 Amount</i>	<i>Exits Last Five Credits</i>	<i>Repeated presses cycle around the following (x = 1 to 5):</i> <ul style="list-style-type: none"> • <i>Credit x Amount</i> • <i>Credit x Date</i> • <i>Credit x Time</i> • <i>Credit x UTRN</i>
Accumulated Debt	Accumulated Debt Amount	Next Prepayment Item	Exits Prepayment Menu
Prepayment-based Debt	Press A and hold to Enter	HOLD A – Enters Payment Debt	Exits Prepayment Menu
Prepayment-based Debt – once entered	<i>Payment-based Debt – Amount Remaining</i>	<i>Exits Payment Debt</i>	<i>Repeated presses cycle around the following:</i> <ul style="list-style-type: none"> • <i>Payment-based Debt – Amount Remaining</i> • <i>Payment-based Percent</i>
Time-based Debt	Press A and hold to Enter	HOLD A – Enters Time-based Debt	Exits Prepayment Menu
Time-based Debt – once entered	<i>Time-based Debt 1 – Amount Remaining</i>	<i>Exits Time-based Debt</i>	<i>Repeated presses cycle around the following (x = 1 to 2):</i> <ul style="list-style-type: none"> • <i>Time-based Debt x – Amount Remaining</i> • <i>Recovery Rate x</i> • <i>Collection Frequency x</i>
Available Credit	Available Credit on Meter: Meter Balance + Emergency Credit Balance (if activated)	Next Prepayment Item	Exits Prepayment Menu
Debt to Clear	The Minimum Amount to pay to Clear the Debt accrued on the ESME – Exclusive of Time-based and Payment-based Debts	Next Prepayment Item	Exits Prepayment Menu
Aggregated Debt	Sum of Debts Remaining (Time-based and Payment-based)	Next Prepayment Item	Exits Prepayment Menu
Enter UTRN	Press A and hold to Enter	See <i>UTRN - Manual Entry</i> on page 60.	Exits Prepayment Menu
Audible Alert Settings	Press A and hold to Enter	HOLD A – Enters Audible Alert Options	Exits Prepayment Menu
Audible Alert Settings – once entered	<i>Press A: Mute Alerts</i> <i>Press B: Unmute Alerts</i>	<i>Mutes Alerts and Exits Audible Alert Settings</i>	<i>Unmutes Alerts and Exits Audible Alert Settings</i>

CHAPTER**7****INSTALLATION**

The following sections provide basic information for installing a SGM1400-B Series meter by a qualified individual.

Terminal Connections

The following sections describe and illustrate the terminal connections of each meter in the SGM1400-B Series meter family.

Terminal Block

The SGM1400-B Series meters have several terminal block configurations. The terminal block can be accessed by removing the terminal cover. Meter terminal configurations are shown in the *Models* table on page 7.

Terminal Arrangements

The SGM1400-B single phase meters conform to British Standard Institute (BS 7856:2013). Please refer to the images in the *Terminal Arrangements* section on page 7 for more information.

SGM1411-B Terminals

The SGM1411-B meter has two line and two neutral terminals. The terminals align horizontally when viewing the meter terminal block at the bottom of the meter.

SGM1412-B Terminals

The SGM1412-B meter has two line terminals, two neutral terminals, and two auxiliary relay terminals. The 2 A relay terminals are located on the right side of the meter above the main terminals.

SGM1415-B Terminals

The SGM1415-B meter has three line terminals and two neutral terminals. The terminals align horizontally when viewing the meter terminal block at the bottom of the meter (with the exception of the 5th terminal that is located above terminals 4 and 5).

SGM1416-B Terminals

The SGM1416-B meter has three line terminals, two neutral terminals, and two auxiliary relay terminals. The 2 A relay terminals are located on the left side of the meter above terminals 1 and 2. The 5th terminal is located above terminals 3 and 4.

SGM1422-B Terminals

The SGM1422-B meter has three line terminals and two neutral terminals. The terminals align horizontally when viewing the meter terminal block at the bottom of the meter (with the exception of the 5th terminal that is located above terminals 3 and 4).

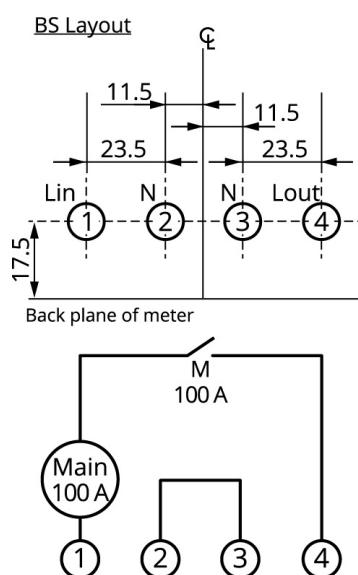
Installation Procedures

UK Installation

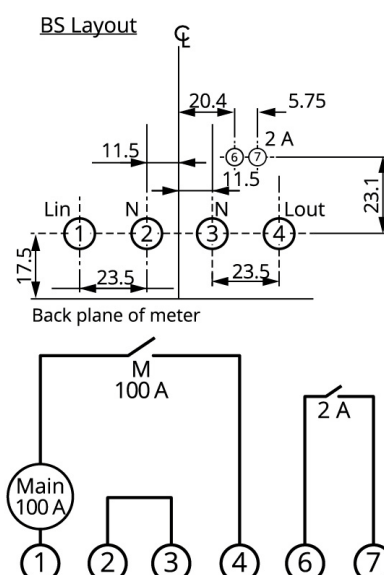
To install the SGM1400-B Series meters, make sure that the following minimum installation steps are performed:

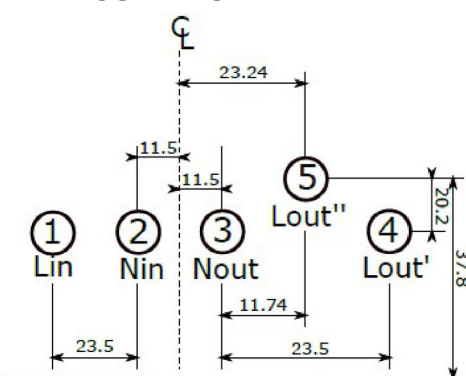
1. Perform specific safety and work area analysis.
2. Take the last meter read on the existing meter and de-energize all live meter circuits.
3. Remove the old meter for recycling.
4. Assess wall or panel space available for the SGM1400-B Series meter.
5. Prepare all incoming wire cables for connection to the meter. Take care to specifically identify neutral conductors and check the integrity of conductors.
6. Take the following steps to install the SGM1400-B Series meter.
 - Position and affix the meter to the space identified. It is recommended that you use hard plastic screws to avoid the accidental exposure of a live screw head.
 - Connect wiring to meter terminals as specified below. The torque value is 2.5-3.5 Nm.

SGM1411-B

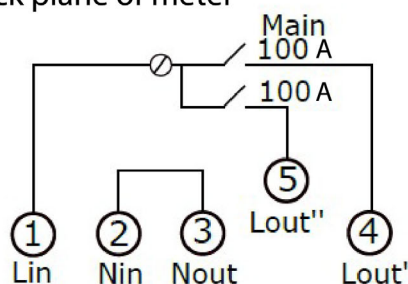
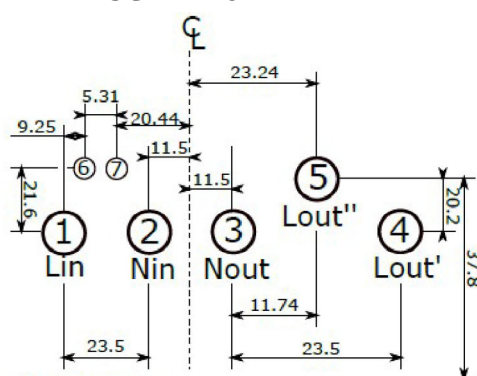


SGM1412-B

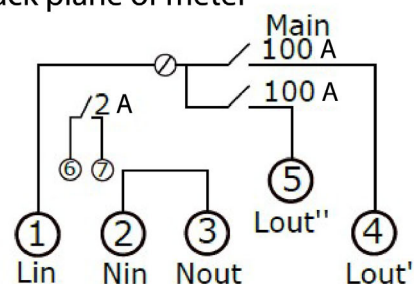
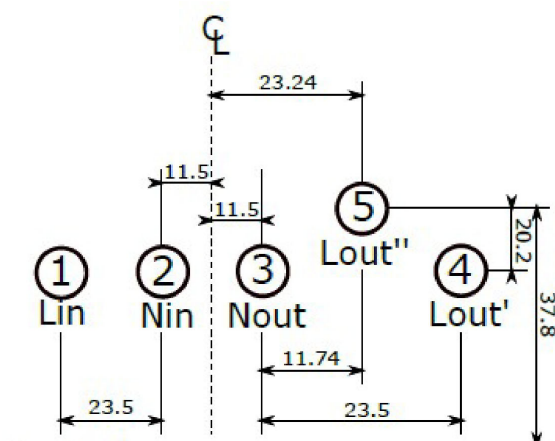


SGM1415-B

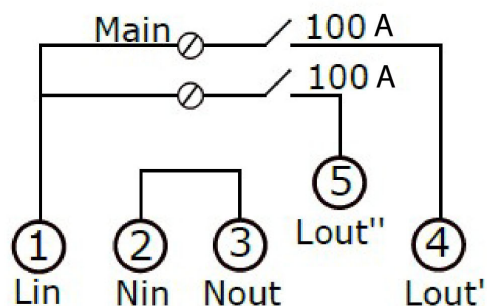
Back plane of meter

**SGM1416-B**

Back plane of meter

**SGM1422-B**

Back plane of meter



- Attach the terminal cover to the meter and attach seal. The torque value is 0.6-0.9 Nm.

NOTE Do not over-tighten the screw.

7. Remove the communications blanking plate and fix the CSP supplied communications module to the meter communications interface.
8. Ensure all sealing screws and meter equipment is sealed.
9. Upon completing both the installation of the meter and the completion of safety checks, re-energize the supply circuits.

Installation Screwdrivers

To install the SGM1400-B Series meters, consideration must be given to the type of screw that was defined as part of the meter configuration for manufacturing.

Aclara offers support for the following types of screws:

- Phillips cross-recessed combination type metal screw



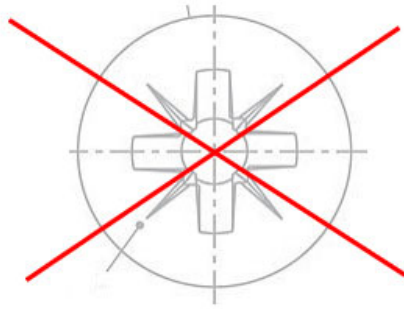
- Slotted head type metal screw



Due to the nature of those screws, installers must use the correct screwdriver in order to generate sufficient torque and not cause damage to the head of the screws. PH2 screwdrivers are recommended for use with the combination screws. Slotted head screwdrivers are also adequate for this purpose, but it is important to use the correct size during installation. Only the following blade widths are recommended:

- (7.0 mm)
- (5.5 mm)
- (4.0 mm)

PZ2 screwdrivers are **not** recommended for this purpose because damage is likely to be caused to the screw head.



Backup Power Supply

The SGM1400-B Series meters have an internal backup power battery that is not replaceable in the field. It is designed for a 20 year lifetime.

Mounting Template

The SGM1400-B Series meters support a three screw mounting arrangement that is typically used on IEC energy meters. The meter meets all dimensional requirements of BS 7856:2013.

The meter mounting holes support screws with a thread diameter of up to 5.2 mm, and the two lower mounting holes are oval shaped to allow for some flexibility when mounting to an existing installation.

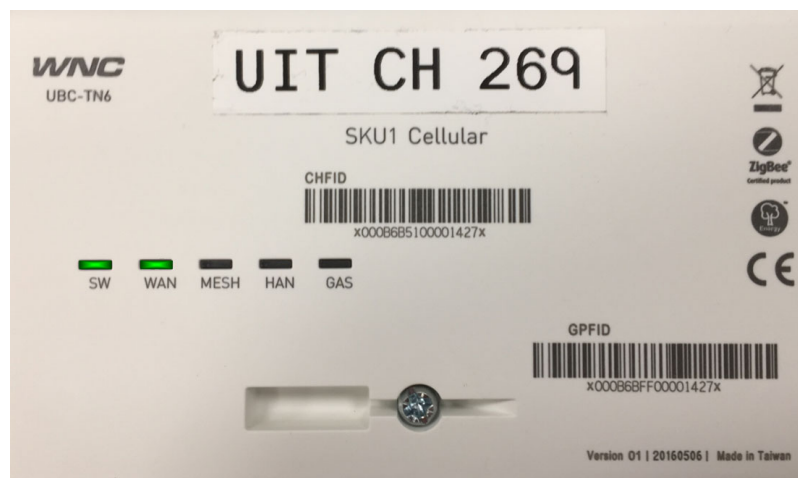
The top mounting hole is not accessible when the meter is mounted. The lower two mounting holes are located beneath and sealed by the terminal cover.

Connect SGM1400-B to the CSP Communications Hub

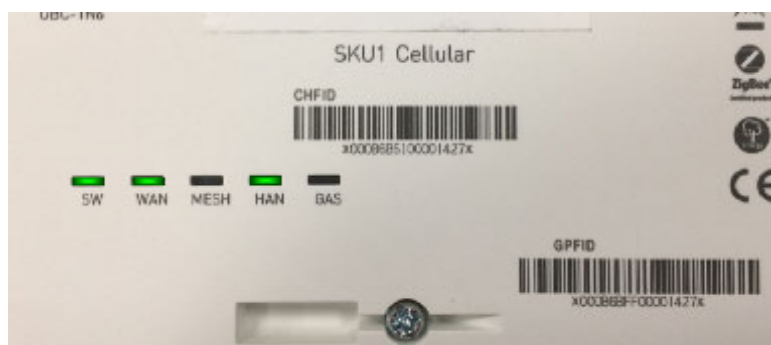
Use the following procedure to pair the SGM1400-B ZigBee communication protocol radio with the CSP-supplied communication hub.

1. Remove the communications cover plate and physically connect the communications hub CH to the SGM1400-B electricity meter.
2. Power up the SGM1400-B electricity meter.

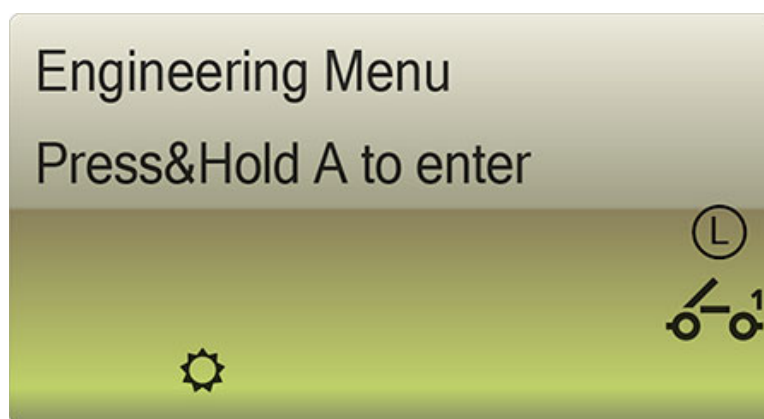
3. After several minutes, the communications hub will connect its wide area network (WAN) to the cellular network. The SW and WAN LEDs will flash every five seconds.



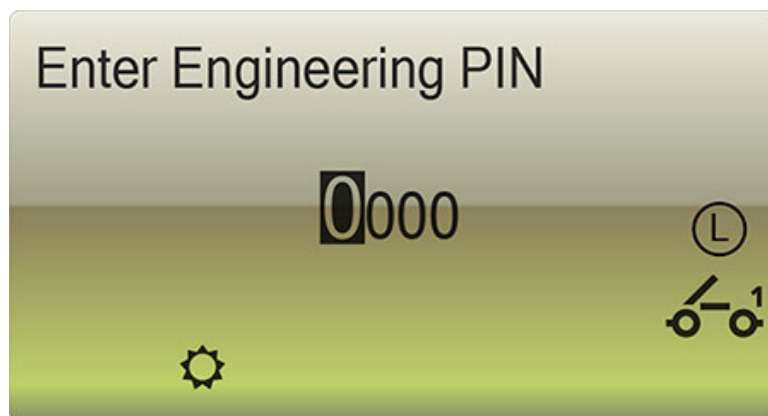
4. The installer initiates a process to pair (connect) the SGM1400-B meter to the communications hub.
5. The DSP sends the SGM1400-B Series meter credentials to the communications hub, and the HAN LED will flash every 5 seconds when the credentials have been added to the device log.



6. When the HAN LED is flashing on the communications hub, navigate to the Engineering Menu on the SGM1400-B meter. Press and hold the A button to enter the Engineering Menu.



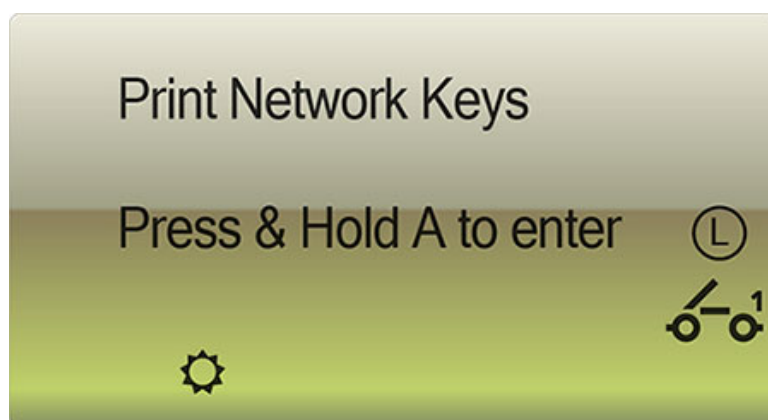
7. Use the **A** and **B** buttons to enter the correct PIN.



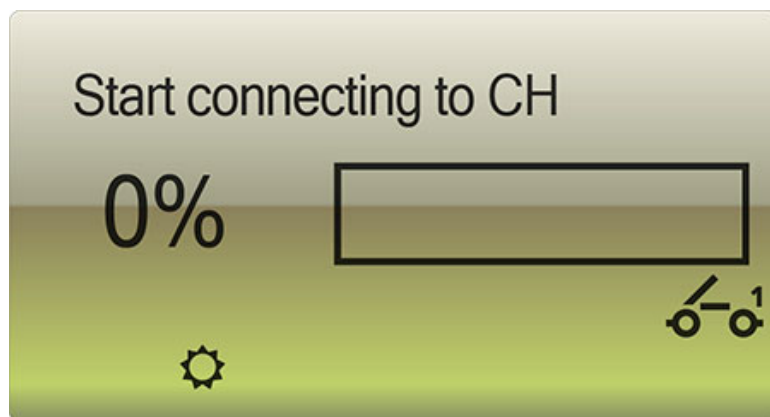
8. Press and hold the **B** button to submit the PIN.



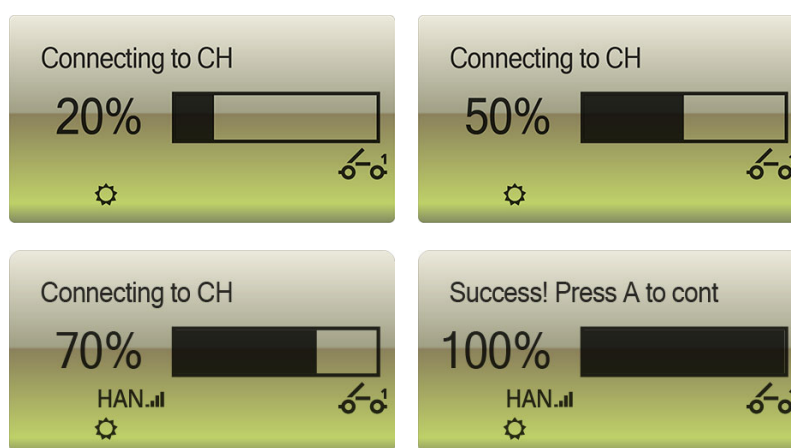
9. Press and hold the **A** button to Join Network.



10. The meter will now start searching for a network to join.



11. The connection progress will be displayed during the process.



12. Once the meter has successfully joined the communications hub, press the **A** button to continue.

The remaining commands in the installation and commissioning process will be sent to the SGM1400-B meter. Typically, the meter will be configured using the Electricity Meter Commissioning Service Requests. The exact order and sequence of the service requests is dependent on the individual energy supplier.

Notifications to Installers and Utilities

WARNING Although the clock in the electricity meter is set at manufacturing, the user (utility) must ensure that the SET CLOCK command (ECS70) is sent to the meter as soon as possible after registration, and certainly before the first time-based command is sent. Until this command is successfully completed, the meter will record unsynchronized data.

WARNING The security log has only 100 entries. After this, it will overwrite the oldest item (i.e., it is a circular buffer). The user (utility) must read the security log frequently enough to prevent the loss of data.

It is advised that the user (utility) ensures that they use appropriate checks on the data they receive from the meters to ensure that messages/responses are consistent with the expected data. For example, responses should correlate with commands which were known to have been sent, and the meter cumulative registers should never go backward (i.e., reduce).

It is advised that the user (utility) includes in their customer guidance literature and training the following:

If the meter is situated such that other people can easily read the meter, then the user should change the privacy PIN from the default of "0000" to their own 4-digit code.

When entering the code, the customer should always take care to shield their entry from the view of others.

The chosen 4-digit code should not be easily guessable, so it should not be part of the meter serial number or be the same digit repeated.

We would like to remind the user (utility) that although the meters are delivered with security credentials already installed, it is the user's obligation to ensure these are changed according to the DCC terms (within the time set in the requirements) using the Update Device Certificates on Device Command. The utility must issue an Issue Security Credentials command to ensure the meter generates new key pairs.

WARNING The meter will perform checks to ensure: 1) Repeat UTRNs are not accepted. 2) Multiple retries are not attempted - the meter will block entry for a period of 1 hour to prevent this. 3) Wrongly formatted UTRNs are not accepted.

However, it is the user (utility) that must reconcile the issued UTRNs with the used UTRNs and is responsible for the security on UTRN issuing, etc.

Tamper Seals

The meter has two tamper evident seals, one located on the meter terminal cover and one on the CSP communications module. Installers and maintenance engineers should inspect the seals for integrity and report any sign of tampering. Additionally, there is an MID certification seal. Any evidence of this being broken or tampered with should be reported.

Confidential Data Security

It is the responsibility of the utility to protect the confidential data for its end customers. Aclara recommends the following:

1. Before removing a meter, the utility should always perform a change of tenancy (CoT), which will restrict the confidential data.
 - For meters returned to the factory, Aclara can remove all of the confidential data (e.g., if it was impossible to perform a CoT before the meter was removed from the premise).
2. The utility should always issue a CoT after the departure of a tenant to ensure that access to personal data for a previous tenant is restricted.
3. The utility should ensure that all sensitive data is removed prior to meter installation.
4. The utility should ensure that procedures are in place for the secure disposal of meters that are not to be re-installed or are deemed end of life.
 - For end of life meters that are returned to the factory, Aclara can remove all data.

Security Credentials

Please note, there are no security credentials on the meter that will allow access to any other devices. This meter only contains its own security credentials.

Connection to other Devices

The meter will only connect to other devices on the HAN. There are no other channels to allow connection. For any other device to be present on the HAN they will have to have the correct addresses and signatures.

Non-operational Interfaces

In accordance with UK SMETS2 Security requirements, all non-operational interfaces are disabled prior to shipment from the manufacturing plant. There is no expectation on the utility or the installers to disable any non-operational interface.

Engineering PIN

If required, the meter can be supplied with an Engineering PIN that is used to protect the data of specific interest to installation engineers only. If required, the PIN is defined by the utility and is set during the manufacturing process. The PIN is static and cannot be changed once the meter leaves the manufacturing environment. Please note, if enabled, it is the responsibility of the utility to ensure that installation teams are aware of the PIN.

CHAPTER**8**

TESTS PROCEDURES AND MAINTENANCE

SGM1400-B Series meters are equipped with a pulse output LED as well as test indicators on the display.

Pulse Output LED

The SGM1400-B Series meters are equipped with an LED indicator for absolute active energy.

In reactive energy mode, the LED will pulse for reactive (kVArh) energy (for all four quadrants) and remain illuminated to indicate reactive energy anti-creep mode. Anti-creep is defined as when no current is flowing through the meter or when the current is less than the defined starting current of the meter.

The uniformity of the indicator is sufficient to allow verification of calibration. It is possible through a suitable number of pulse values to check the accuracy of the meter over the entire current range.

The indicator is configurable to provide support for both active and reactive functionality by use of an appropriate command through any of the communication ports.

The pulse rate is fixed at 1,000 pulses per kWh/kVArh.

The LED indicator reverts to active energy functionality when a cancel command is received or after a configurable period has elapsed. Note that cycling power alone will not cause the LED indicator to revert to active energy.

Calibration

The pulse output LED emits calibration pulses. The LED pulses at the rate denoted on the meter cover and is directly proportional to the current active power (W) or reactive power (var). The duration of each output pulse is approximately 25 milliseconds.

The default unit for the calibration pulses is active energy, or watt hours (Wh). The meter may be switched to reactive energy or var-hour (varh) calibration pulses via the optical port.

Test Display

The LCD has annunciators for quadrant and energy flow indication. The annunciators provide valuable information during the testing process. Please refer to the *Display* section on page 10 for more information.

Test Procedures

The following sections describe the requirements and steps for performing various tests.

Field Accuracy Test

Test mode allows the meter to be tested for accuracy in the field without disturbing any billing data. In order to check the accuracy of the meter in the field, a portable standard and a phantom load generator is required.

Connect to voltages of the source, the reference meter, and the test meter in parallel. Connect the current of each in series.

1. Verify that the parameters/ranges in the reference meter are set separately from the test meter.
2. Apply voltage in accordance with the meter's nameplate marking to the reference meter, test the meter through phantom load, and warm up for 20 minutes.
3. Enter the meter constant in the reference meter (for example, 1000imp/kWh).
4. Apply current to the meter (e.g., 10 amps) and unity power factor (UPF) for direct connected meters rated to 100 amps.
5. Set or hold the optical sensor connected to the reference meter on the calibration LED/pulse LED of the test meter.
6. Take accuracy for pulses calculated for 25 seconds for I_{ref} (10A for direct connect meters).
7. Take accuracy for pulses calculated for 120 seconds for below I_{ref} (10A for direct connect meters) loads and configure the reference meter for 120 seconds.
8. Start an accuracy check on the reference meter.
9. After the configured test duration, the reference meter will show the accuracy of the meter.

If a meter fails to yield the desired accuracy, it may need to be recalibrated or replaced.

Watt-Hour Test

1. Note the meter test constant value listed on the nameplate.
2. Select the desired voltage (in accordance with the meter's nameplate marking) and current level(s) on the test equipment.
3. Install the meter in a test panel that is wired and configured for the meter.
4. Begin testing according to standard test procedures. Allow 15 seconds of settling time after applying voltage before making accuracy measurements.

Check the meter calibration under three load conditions:

- full load
- light load
- full load with lagging power factor

A minimum test time of 30 seconds is needed to reduce test uncertainty. (Check the instruction book for your test board or standard to determine the actual minimum test time. Heavily filtered inputs may require longer test times.)

Maintenance and Repairs

The SGM1400-B Series meters are factory calibrated and routine maintenance is not required. Because of the high component density of the PC boards and the integrated design, any repairs should be performed by Aclara. Please contact *Aclara Support* to schedule and return meters for repairs.

Cleaning

Use the following guidelines when cleaning an SGM1400-B Series meter:

- Take care during cleaning not to damage or contaminate any gold-plated contacts of the connectors.
- If necessary, use compressed air to remove any accumulated dust.
- Do not immerse the meter in any liquid.
- Do not use abrasive cleaners on the covers.
- Do not use chlorinated hydrocarbon or ketone solvents on the covers.
- Wipe the enclosure with a damp cloth and a nonabrasive cleaning solution.

Disposal

The lithium battery must be removed before meter disposal. Disposal of a SGM1400-B meter and its remaining components must be done in accordance with the waste electrical and electronic equipment directive (WEEE Directive).

Battery Disposal

The lithium battery is internal and not replaceable in the field. Contact your local meter supplier to obtain a material safety data sheet (MSDS) or for recycling information.

In accordance with the European Directive 2006/66/EC, batteries and accumulators are marked with the crossed out wheeled bin, which indicates that they cannot be disposed of as unsorted municipal waste in the European Union.

The marking may also include a chemical symbol (e.g., Pb for Lead, Hg for Mercury, etc.) indicating that the battery contains substances classified as hazardous by the European Commission. Users of batteries must use the collection points available to customers for the return, recycling, and treatment of batteries.

- When discarding batteries, insulate the + and – terminals with insulation tape. Without insulation, lithium batteries may short, causing them to become hot, burst, or ignite.
- This product cannot be disposed of as unsorted municipal waste in the European Union.

CHAPTER

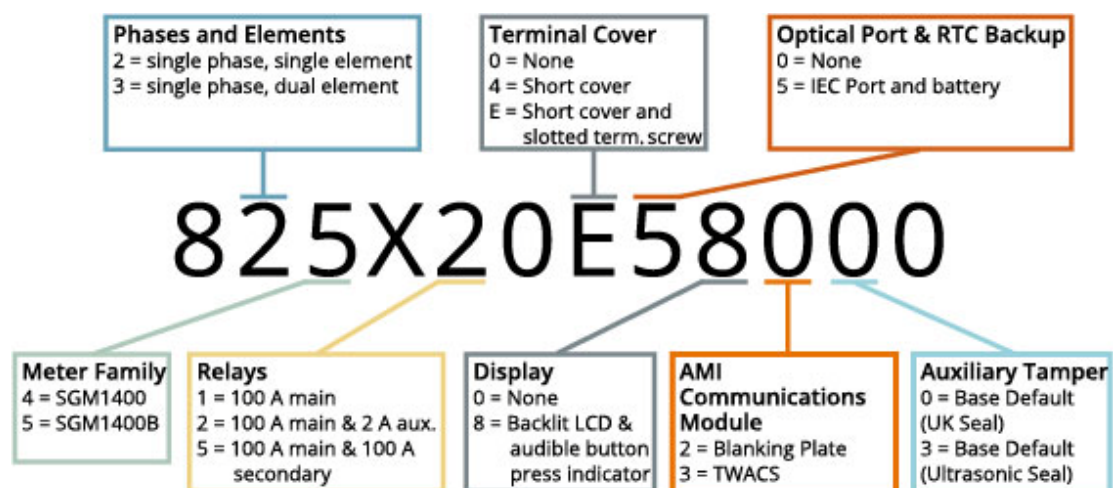
9

SPECIFICATIONS

Parameter	Specification
Phase / Connection	Single phase, single element (SGM1411-B, SGM1412-B, SGM1415-B, SGM1416-B) Single phase, dual element (SGM1422-B)
Current (I_{tr} - I_{ref} (I_{max}))	0.5–10 A (100 A)
Voltage Rating	-20% to +15%
Starting Current	40 mA
Frequency	50 Hz \pm 2%
Accuracy (active / reactive)	Class A or B active energy=BS EN50470-1/3 Class 2 or 3 reactive energy = IEC 62053-23
Power Consumption	2 W / 4 VA (with intimate comm. hub in idle state)
Relays	SGM1411-B = 100 A main contactor SGM1412-B = 100 A main contactor and 2 A aux relay SGM1415-B = 100 A main contactor and 100 A secondary contactor SGM1416-B = 100 A main contactor and 100 A secondary contactor plus additional 2 A aux relay SGM1422-B = 100 A main contactor and 100 A secondary contactor
Display	128 x 32 backlit LCD (\leq 8 digits plus decimal point)
Ports	AMI interface
Terminals	SMG1411-B = 4 primary SGM1412-B = 4 primary and 2 voltage free SGM1415-B = 5 primary SGM1416-B = 5 primary and 2 voltage free SGM1422-B = 5 primary
Protocols	DLMS / COSEM
Optical Port	IEC 62056-21 (physical)
HAN	2.4 GHz ZigBee communication protocol / Smart Energy 1.2
TOU Rates	Primary element - 48 TOU and 4 x 8 block tariff Secondary element - 4 TOU rates
Load Profile	< 4 channel, configurable interval (memory stores more than 2 years of 4 channel 30 minute interval data)
Data Storage	32 Mb serial flash
Firmware Size	Dual image (1 MB + 1 MB)
Operating Temperature	-20 °C to +70 °C
Storage Temperature	-25 °C to +70 °C

Parameter	Specification
Operating & Storage Humidity	95% non-condensing
Enclosure Ingress Protection	IP54 (IEC 60529)
Insulation Class	Protective Class II
Dimensions	114 mm H x 130 mm W x 65 mm D
Weight	SGM1411-B = 500 grams SGM1412-B = 600 grams SGM1415-B = 715 grams SGM1416-B = 720 grams SGM1422-B = 715 grams
Agency Approval	MID approved R&TTE and RED compliant
Vibration and Shock	Class M1 (as defined by Guide for Measuring Instruments Directive 2004/22/EC)
Electromagnetic	Class E2 (as defined by Guide for Measuring Instruments Directive 2004/22/EC)
Metrology Standards	
General	BS EN 50470 - 1 BS EN 50470 - 3 Class B BS EN / IEC 62053-21 Class 1 IEC 62053-23 Class 2 VARh
Timekeeping	BS EN / IEC 62054-21
Load Control	BS EN / IEC 62052-21
Optical Port (physical)	IEC 62056-21
Pulse Output	IEC 62053-31
Metering Standards	
General	IEC 62052-11 IEC 62053-21 Class 1 kWh IEC 62053-23 Class 2 kVARh IEC 62054-21
Optical Port	IEC 62056-21
Communication	DLMS certified
Regulatory	RoHS, WEEE

Catalogue Codes



APPENDIX**A****EVENT CODES****UK SMETS2**

The event codes supported by the SGM1400-B are described in the tables on the following pages. The only distinction between an event and an error/alarm is whether it is filtered to the event log or the error/alarm register. The logs in which a code appears is determined by the filter configuration for each log. Each event has a unique counter of occurrences independent of the event log/error/alarm registers. (Please refer to *Event Logging and Errors/Alarms* on page 48 for more information on event logs, errors, and alarms.)

Code	Description	Critical / Non-Critical	Mandated / Enable or Disable	Alert WAN	Alert HAN	Security Log	Event Log	Power Event Log	ALCS Event Log	Contains Sensitive Data	ESIVIE / GSIVIE Alert On	Remote Party
0x8F01	Active power import above load limit threshold	Critical	Mandated	Y ¹	Y	N	Y	N	N	N	Y	Supplier
0x8002	Average RMS voltage above average RMS over voltage threshold	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8006	Average RMS Voltage < Average RMS Under Voltage Threshold (current value below threshold; previous value above threshold)	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8F0A	Billing Data Log Updated	Critical	Mandated	Y ²	N	N	N	N	N	Y	Y	Supplier
0x8F0C	Clock not adjusted (adjustment greater than 10 seconds)	Critical	Mandated	Y ¹	N	Y	N	N	N	N	Y	Supplier
0x810D	Combined Credit Below Low Credit Threshold (prepayment mode)	Non-Critical	Mandated	Y ¹	Y	N	N	N	N	N	N	Supplier
0x810E	Credit Added Locally	Non-Critical	Mandated	Y ¹	N	N	N	N	N	N	N	Supplier
0x8F0F	Credit Below Disablement Threshold (prepayment mode)	Critical	Mandated	Y ¹	N	N	N	N	N	N	Y	Supplier

Code	Description	Critical / Non-Critical	Mandated / Enable or Disable	Alert WAN	Alert HAN	Security Log	Event Log	Power Event Log	ALCS Event Log	Contains Sensitive Data	ESIVIE / GSIVIE Alert On	Remote Party
0x8119	Emergency Credit Has Become Available (prepayment mode)	Non-Critical	Mandated	Y ¹	Y	N	N	N	N	N	N	Supplier
0x811A	Failure in changing or maintaining HCALCS or ALCS state	Non-Critical	Mandated	Y ¹	N	N	N	N	Y	N/A	N/A	Supplier
0x8F1C	Firmware Verification Failed	Critical	Mandated	Y ²	N	Y	N	N	N	N	Y	Supplier
0x8F1E	Integrity check of content or format of command failed	Critical	Mandated	Y ¹	N	Y	N	N	N	N	Y	WAN Provider, Access Control Broker, or Supplier
0x8020	RMS Voltage above Extreme Over Voltage Threshold*	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8024	RMS Voltage above Voltage Swell Threshold *	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8028	RMS Voltage < Extreme Under Voltage Threshold *	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x802C	RMS Voltage < Voltage Sag Threshold *	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8F30	Source Does not have Authority for Command	Critical	Mandated	Y ¹	N	N	N	N	N	N	Y	WAN Provider, Access Control Broker, or Supplier
0x8131	Success in changing or maintaining HCALCS or ALCS state	Non-Critical	Mandated	N	N	N	N	N	Y	N/A	N/A	N/A
0x8F32	Supply Armed	Critical	Mandated	Y ¹	Y	N	N	N	N	N	Y	Supplier and Network Operator
0x8F33	Supply Disabled then Armed - Load Limit triggered	Critical	Mandated	Y ¹	Y	N	N	N	N	N	Y	Supplier and Network Operator

Code	Description	Critical / Non-Critical	Mandated / Enable or Disable	Alert WAN	Alert HAN	Security Log	Event Log	Power Event Log	ALCS Event Log	Contains Sensitive Data	ESIVIE / GSIVIE Alert On	Remote Party
0x8F34	Supply Enabled after Load Limit	Critical	Mandated	Y ¹	Y	N	N	N	N	N	Y	Supplier and Network Operator
0x8F35	Supply Outage Restored	Critical	Mandated	Y ²	N	N	N	Y	N	N	Y	Network Operator
0x8F36	Supply Outage Restored - Outage >= 3 minutes	Critical	Mandated	Y ²	N	N	N	Y	N	N	Y	Network Operator
0x8F3D	Trusted Source Authentication Failure	Critical	Mandated	Y ¹	N	N	N	N	N	N	Y	WAN Provider, Access Control Broker, or Supplier
0x8F3E	Unauthorized Communication Access attempted	Critical	Mandated	Y ¹	N	Y	N	N	N	N	Y	WAN Provider, Access Control Broker, or Supplier
0x8F3F	Unauthorised Physical Access Tamper Detected	Critical	Mandated	Y ¹	N	Y	N	N	N	N	Y	WAN Provider, Access Control Broker, or Supplier
0x8F43	Change in the executing Firmware version	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8145	Clock adjusted (within tolerance)	N/A	Mandated	N	N	N	Y	N	N	N/A	N/A	N/A
0x8F47	Credit would cause meter balance to exceed maximum meter balance threshold	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F48	Device joining failed	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F49	Device joining succeeded	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F4A	Device Unjoining failed	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F4B	Device Unjoining succeeded	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F4C	Device Digital Signing Certificate replacement failed	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A

Code	Description	Critical / Non-Critical	Mandated / Enable or Disable	Alert WAN	Alert HAN	Security Log	Event Log	Power Event Log	ALCS Event Log	Contains Sensitive Data	ESIVIE / GSIVIE Alert On	Remote Party
0x8F4D	Device Digital Signing Certificate replacement succeeded	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F4E	Device Key Agreement Certificate replacement failed	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F4F	Device Key Agreement Certificate replacement succeeded	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F51	Duplicate UTRN entered	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F52	Event Log Cleared	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F53	Failed Authentication or Authorisation not covered by other codes	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8154	Immediate HAN Interface Command Received and Successfully Actioned	N/A	Mandated	N	N	N	Y	N	N	N/A	N/A	Supplier
0x8155	Immediate HAN Interface Command Received but not Successfully Actioned	N/A	Mandated	N	N	N	Y	N	N	N/A	N/A	Supplier
0x8157	Supply interrupted	N/A	Mandated	N	N	N	N	Y	N	N/A	N/A	Supplier
0x8F5B	UTRN exceeds Maximum Credit Threshold	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F60	Unusual numbers of malformed, out-of-order or unexpected Commands received	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8161	User Interface Command Input and Successfully Actioned	N/A	Mandated	N	N	N	Y (Boost)	N	N	N/A	N/A	Supplier
0x8162	User Interface Command Input but not Successfully Actioned	N/A	Mandated	N	N	N	Y (Boost)	N	N	N/A	N/A	Supplier
0x8F63	UTRN not Authentic	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A
0x8F64	UTRN not for this Device	N/A	Mandated	N	N	Y	N	N	N	N/A	N/A	N/A

Code	Description	Critical / Non-Critical	Mandated / Enable or Disable	Alert WAN	Alert HAN	Security Log	Event Log	Power Event Log	ALCS Event Log	Contains Sensitive Data	ESIVIE / GSIVIE Alert On	Remote Party
0x8F66	Future - date HAN Interface Command Successfully Actioned	Critical	Mandated	Y ²	N	N	N	N	N	N	Y	Supplier or WAN Provider
0x8F67	Future - date HAN Interface Command not Successfully Actioned	Critical	Mandated	Y ²	N	N	N	N	N	N	Y	Supplier or WAN Provider
0x8168	Supply Disabled then Armed - Activate Emergency Credit triggered	Non-Critical	Mandated	N	N	N	N	N	N	N	Y	N/A
0x8F69	Device commissioned	Critical	Mandated	Y ¹	N	N	N	N	N	N	Y	Supplier
0x8F70	Update Security Credentials	Critical	Mandated	N	N	Y	N	N	N	N	Y	Supplier
0x8F72	Firmware Verification Successful	Critical	Mandated	Y ²	N	Y	N	N	N	N	Y	Supplier
0x8F74	Unauthorised Physical Access - Meter Cover Removed	Critical	Mandated	Y ¹	N	Y	N	N	N	N	Y	Supplier or Supplier and Network Operator
0x8F75	Unauthorised Physical Access - Strong Magnetic field	Critical	Mandated	Y ¹	N	Y	N	N	N	N	Y	WAN Provider or Supplier and Network Operator
0x8F76	Unauthorised Physical Access - Terminal Cover Removed	Critical	Mandated	Y ¹	N	Y	N	N	N	N	Y	Supplier and Network Operator
0x8F78	Unauthorised Physical Access - Other	Critical	Mandated	Y ¹	N	Y	N	N	N	N	Y	Access Control Broker, WAN Provider, Network Operator, or Supplier
0x8183	Device joined SMHAN	Non-Critical	Mandated	Y ¹	N	N	Y	N	N	N	N	Supplier
0x8085	Average RMS Voltage below Over Voltage Threshold	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8089	Average RMS Voltage above Under Voltage Threshold	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x808D	RMS Voltage above Extreme Over Voltage Threshold	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8091	RMS Voltage above Voltage Swell Threshold	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator

Code	Description	Critical / Non-Critical	Mandated / Enable or Disable	Alert WAN	Alert HAN	Security Log	Event Log	Power Event Log	ALCS Event Log	Contains Sensitive Data	ESIVIE / GSIVIE Alert On	Remote Party
0x8095	RMS Voltage below Extreme Under Voltage Threshold	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8099	RMS Voltage below Voltage Sag Threshold	Non-Critical	Mandated	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8F1B	Firmware Verification Failed At Power On	Critical	Mandated	Y ¹	N	Y	N	N	N	N	Y	Supplier / WAN Provider
0x81A2	CH Connected to ESME	N/A	Enable or Disable	Y ¹	N	N	N	N	N	N/A	N/A	N/A
0x81A3	CH Disconnected from ESME	N/A	Enable or Disable	Y ¹	N	N	N	N	N	N/A	N/A	N/A
0x81A4	Close Tunnel Command Rejected	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81A5	Communication From Local Port (i.e., Optical)	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81A6	Customer Acknowledged Message on HAN Device	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81A7	Debt Collection Completed - Time Debt 1	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81A8	Debt Collection Completed - Time Debt 2	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81A9	Debt Collection Completed - Payment Debt	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81AA	Emergency Credit Exhausted	Non-Critical	Enable or Disable	Y ¹	Y	N	Y	N	N	N	N	Supplier
0x81AB	Emergency Credit Activated	Non-Critical	Enable or Disable	Y ¹	Y	N	Y	N	N	N	N	Supplier
0x81AC	Error Measurement Fault	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81AD	Error Metrology Firmware Verification Failure	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier

Code	Description	Critical / Non-Critical	Mandated / Enable or Disable	Alert WAN	Alert HAN	Security Log	Event Log	Power Event Log	ALCS Event Log	Contains Sensitive Data	ESIVIE / GSIVIE Alert On	Remote Party
0x81AE	Error Non-Volatile Memory	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81B2	Error Unexpected Hardware Reset	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81B3	Error Watchdog	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81B8	Incorrect Polarity	Non-Critical	Enable or Disable	Y ¹	N	N	N	Y	N	N	N	Supplier
0x81B9	Meter Cover Closed	Non-Critical	Enable or Disable	Y ¹	N	N	N	N	N	N	N	Supplier
0x8010	Over Current	Non-Critical	Enable or Disable	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8014	Power Factor Threshold Below	Non-Critical	Enable or Disable	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8015	Power Factor Threshold OK	Non-Critical	Enable or Disable	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x81BA	Request Tunnel Command Rejected	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81BB	Reverse Current	Non-Critical	Enable or Disable	Y ¹	N	N	N	Y	N	N	N	Supplier
0x81BC	Strong Magnetic Field Removed	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81BE	Supply Disabled Then Locked - Supply Tamper State Cause	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81C1	Terminal Cover Closed	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier
0x81C4	UTRN Manual Entry Suspended	Non-Critical	Enable or Disable	Y ¹	Y	N	Y	N	N	N	N	Supplier
0x81C5	UTRN rejected as locked out	Non-Critical	Enable or Disable	Y ¹	N	N	Y	N	N	N	N	Supplier

Code	Description	Critical / Non-Critical	Mandated / Enable or Disable	Alert WAN	Alert HAN	Security Log	Event Log	Power Event Log	ALCS Event Log	Contains Sensitive Data	ESIVIE / GSIVIE Alert On	Remote Party
0x8F83	Disablement of Supply (suspended due to insufficient credit)	Non-Critical	Mandated	Y ¹	Y	N	Y	N	N	N	N	Supplier
0x81A0	Smart Meter Integrity Issue - Warning (This event is triggered for temperature overheating.)	Optional	Enable	Y ¹	N	N	N	Y	N	N	N	Network Operator
0x8F57	Supply Interrupted	Non-Critical	Mandated	N	N	N	N	Y	N	N/A	N/A	Supplier

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