

SS9007 Mini CT Meter

User Manual – Version 4 – Std HA Release (build 5977+)



Table of Contents

1	Safety Notices	3
2	Quick Reference	4
3	Product Overview	5
4	Technical Specifications	6
5	Commissioning and Installation Instructions.....	7
5.1	Before Installation.....	7
5.2	Installation	7
5.3	Commissioning.....	11
6	Switching.....	12
7	Metering	13
8	Device Clusters and Attributes.....	14
8.1	Basic Cluster	14
8.2	On/Off Cluster.....	14
8.3	Simple Metering Cluster	15
9	Troubleshooting.....	16

1 Safety Notices

This manual does not comprehensively cover all safety measures for installation and operation of the device, since local code requirements and special operating conditions may necessitate further measures. This manual does however contain important safety information pertaining to the correct installation and usage of the device, and should be read carefully before attempting to install and use the device.

Qualified Personnel

This device should be installed by technically qualified personnel. Failure to install in compliance with national and local electrical codes and according to Saturn South recommendations may result in electrical shock or fire hazard, unsatisfactory performance, or equipment failure.

This product is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience or knowledge, unless they have been given supervision or instruction concerning use of the product by a person responsible for their safety.

Children should be supervised to ensure that they do not play with the product.

Maintenance

Do not rely on this product to provide galvanic isolation to a circuit. If maintenance is being performed on the connected circuit, disconnect the power by means of a primary protection device such as a circuit breaker or mains switch in accordance with local regulations.

Servicing of this device in the field is not possible and should not be attempted. If servicing is required, please return this device to Saturn South or an authorised distributor. Opening the product enclosure, for any reason, will render the Product Warranty void.

2 Quick Reference

SS9007 Mini CT Meter – Std HA Release



Green	Amber	Connectivity	Switch	Comment
Fast, continuous blinking between Green and Amber.		N/A	N/A	When device is in the Factory Reset state
Four blinks of amber, four blinks of green, repeating.		Connected	N/A	When device is set to <i>Locate</i> Mode
Off	Off	Not connected	Open	Not Connected, switch open
Off	On	Not connected	Closed	Not Connected, switch closed
Short blink every 4s	Off	Connected	Open	Connected, switch open
Short blink every 4s	On	Connected	Closed	Connected, switch closed
On (up to 10s)	Off	Attempting to connect	N/A	While device is attempting to join network
Fast Blink (3s)	Off	Joined or re-joined successfully	N/A	Indicates successful network join or re-join attempt
Off	Fast Blink (3s)	Failed to join or re-join	N/A	Indicates unsuccessful network join or re-join attempt
Slow blink between green and amber at ~1Hz		Connected	N/A	Indicates that the device is being remotely updated

Button LED Indication Quick Reference

Note: The LEDs will automatically dim to one third brightness after 15 seconds of inactivity.

Feature Name	Button Action	Resulting Action
Association Join	5 second press and release	Device will join any ZigBee HA network with 'Permit Joining' mode enabled. When the button is pressed the button colour will change to yellow, and then begin to rapidly blink green once it has been held long enough to trigger an Association Join. At this point the button should be released, and the button will shine solid green while it scans for a suitable network. The button will then blink green if the join operation is successful, or blink amber on failure.
Factory Reset	Press and hold button for at least 10 seconds	Returns the device to its factory reset state. When the button is pressed, the button colour will change to yellow, and after 10 seconds the button will begin to blink rapidly between green and amber indicating that the device has been factory reset. The user should wait about 5 seconds before attempting another Association Join following a Factory Reset.
Manual Switch	Press the button briefly (<1 second)	Manually switches the device relay. Has no effect on non-switching variants of this device.

Button Command Quick Reference

3 Product Overview

The SS9007 Mini CT Meter is a compact power metering and load switching device that can be used to monitor and control single phase electrical loads. Designed to sit on a standard switchboard DIN rail, the SS9007 has the same form factor as a standard Miniature Circuit Breaker, and accepts a wide range of external Current Transformers.

The SS9007 Mini CT Meter is suitable for a range of applications including sub-metering, Demand Management, autonomous load shedding, and site automation.

The SS9007 Mini CT Meter is designed to meter and switch a wide range of single phase loads at up to 240VAC. Load switching is performed by an internal isolated relay that can be used to trigger an external third-party contactor or relay. Designed to function in all major electrical networks, the Mini CT Meter boasts a high measurement accuracy (Class 1) with a customizable reporting frequency of up to 1Hz. Import/export energy accumulations and true signed power measurements make the SS9007 an ideal choice for monitoring renewable generation sources and energy storage devices.

High-resolution waveform sampling features provide unique insight into the behaviour and condition of monitored loads, yielding detailed information for load profiling and classification purposes.

Once installed, the Mini CT Meter can receive important software updates over the network, reducing the cost of network maintenance and guaranteeing an up-to-date feature set for all devices in the field.

The SS9007 Mini CT Meter communicates to other Saturn Energy devices using the ZigBee communications standard in the 2.4GHz ISM band. All wireless communications to and from the device are secured with AES-128 encryption using standards based technologies to ensure privacy and data integrity.

Important:

The SS9007 Mini CT Meter is not rated as a protection device, and must be placed downstream of an approved protection device.

4 Technical Specifications

Type: Single Phase Meter and Switch with External Current Transformer

Model: SS9007

Operational Voltage Range: 70-240VAC

Operational Frequency Range: 40-90Hz

Operating Temperature Range: -20°C to +65°C

Storage Temperature Range: -25°C to +80°C

Relative Humidity: 10-95% non-condensing

Average Power Consumption: <1W

Mass: 0.080kg

Dimensions: 60.5 x 90 x 17.5mm

Wire gauge: 0.1mm² min - 1.5mm² (stranded) or 2.5mm² (solid core) max

IP Rating: IP20

Switch Rating: 5A, 240V (on switching variant)

Measurement Accuracy: 1% voltage & current (absolute transfer ratio)

Number of Switching Operations: > 10,000 cycles (5A, resistive load) on switching variant

Standards and Approvals:

- AS/NZS 3100
- AS/NZS 61000.6.3:2007 and AS/NZS 4268:2003
- Certificate of Suitability

5 Commissioning and Installation Instructions

5.1 Before Installation

The individual performing the installation must have access to the commissioning tools provided by the Energy Services Company (ESCo).

An SS9002 ESBox or other compatible ZigBee network coordinator device must be present at the site, and be authorised to communicate with a control server provided by the ESCo.

The radio environment at the location of installation may be tested to ensure the new device will be able to connect to the existing ZigBee network. For more information on radio environment test equipment and procedures, please contact Saturn South.

There are two stages to device installation:

1. **Installation** - Identify the circuit in which the device will be used, confirm that there is sufficient space to mount the device.
2. **Commissioning** - Wire the device into the switchboard as per the guidelines below and apply power.

5.2 Installation

The SS9007 Mini CT Meter is designed to be straightforward to install into a standard domestic or commercial switchboard.

The following steps should be followed to install the device:

1. Identify the circuit that is to be monitored by the device. Note the major appliance or load that the circuit is connected to for future reference, and if necessary make a note of the device's HAN address.
2. Ensure that there is adequate mounting space for the device within the switchboard.

The SS9007 Mini CT Meter requires a phase and neutral connection to the device, both to power the device and to provide a reference for high accuracy voltage measurements. The reference phase connected to the device must be the same phase from which the load current is to be sensed by the supplied clip-on Current Transformer, and must be drawn downstream from an existing or dedicated protection device (e.g. MCB or RCD).

IMPORTANT:

- Ensure the source of the reference phase is isolated before performing these steps.
- The SS9007 Mini CT Meter is not rated as a protection device and may only be connected to a circuit that is protected up-stream by an approved circuit breaker.

3. Mount the device in the switchboard.
4. Wire the Current Transformer (CT) to the device, taking care to match the CT leads with the appropriate "CT Black" and "CT White" terminals.
5. Clip the CT on to the target load conductor, ensuring that the arrow on the CT points towards the load or generator (**away from the grid**).

Connect the output of a MCB, RCD, or other protection device to the "Live" terminal of the Mini CT Meter, and a neutral line to the "Neutral" terminal. The protection device used for this purpose need not necessarily be on the same circuit that the device will be monitoring (i.e. the circuit to which the CT is connected), although care should be taken to ensure the current source and voltage share the same phase.

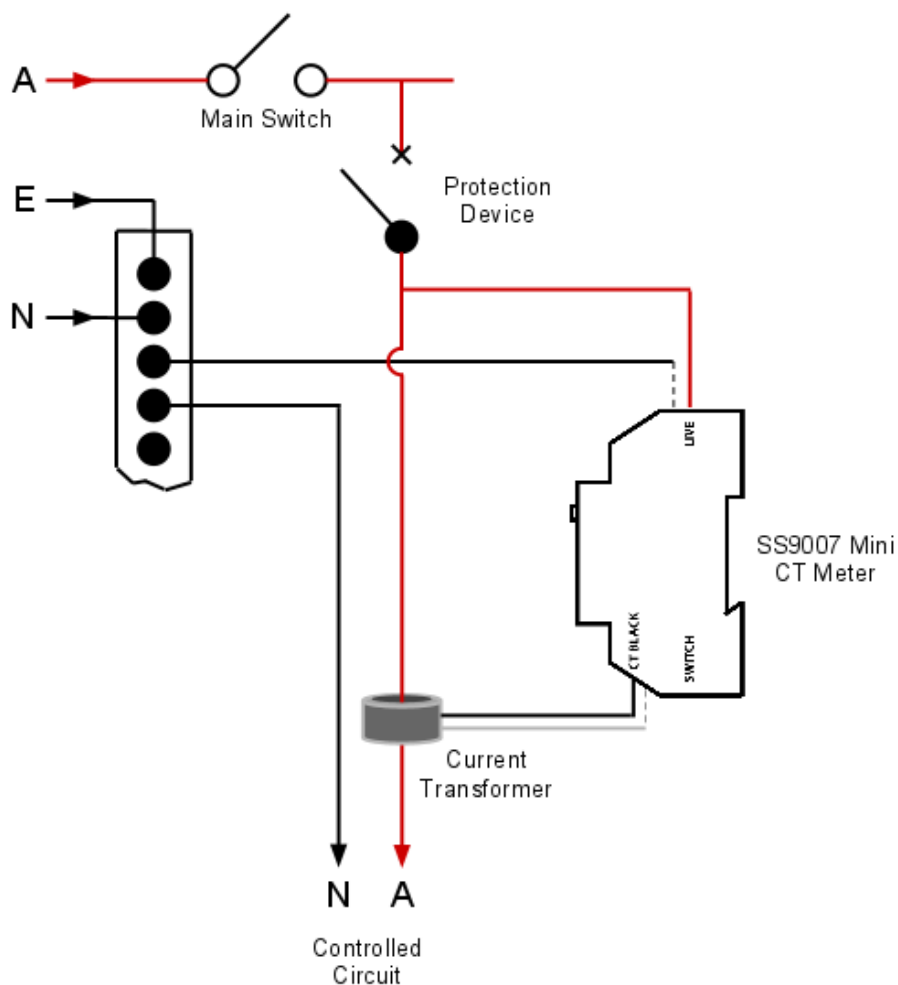


Figure 1: Wiring diagram showing a typical installation of an SS9007

IMPORTANT:

- The phase used to power the Mini CT Meter must match the phase being monitored by the CT, or the meter will not generate accurate measurements.

6. Cable of minimum cross section 0.1mm^2 and maximum cross section 1.5mm^2 (stranded) or 2.5mm^2 (solid core) may be used.

The device must be connected in the correct polarity to ensure proper operation. The Live terminal, Neutral terminal, two Current Transformer (CT) terminals ("CT BLACK" and "CT WHITE"), and two SWITCH terminals are marked on the side of the device enclosure.

If the circuit being monitored is connected to a protected neutral (e.g. via an RCD), ensure that the Mini CT Meter is also connected to the same protected neutral, and not to the main neutral link.

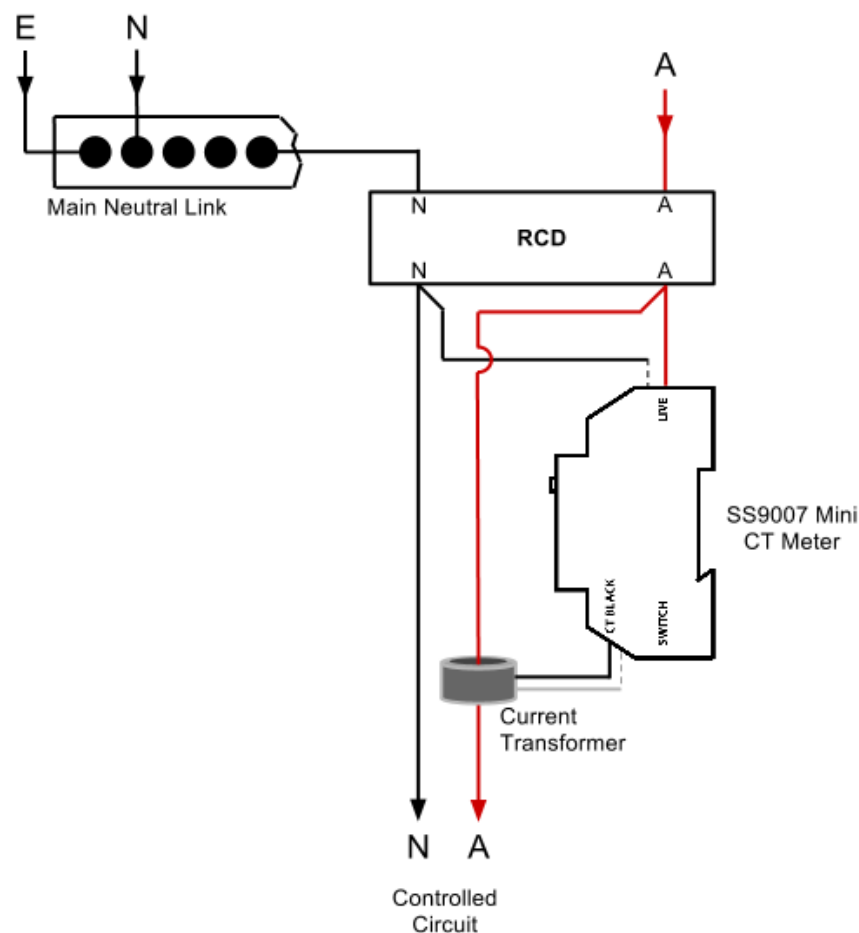


Figure 2: Mini CT Meter connected to RCD protected live and neutral

IMPORTANT:

- If multiple SS9007s are being used to monitor a polyphase phase load, care must be taken to ensure each SS9007 is powered by the corresponding phase.

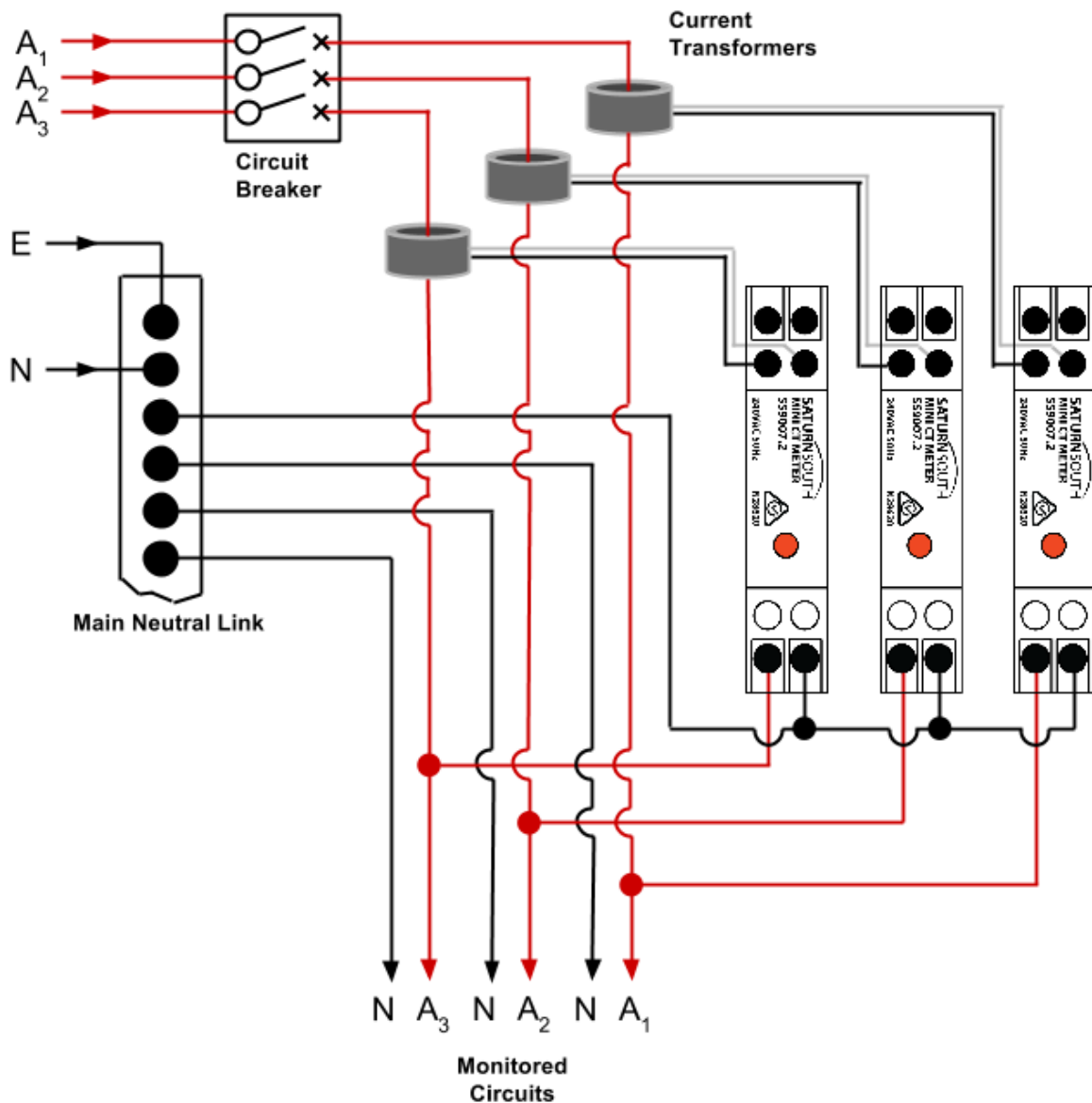


Figure 3: Example three phase installation. Note that each Mini CT Meter is powered by the circuit it is monitoring.

7. If your Mini CT Meter has switching capability, the two terminals marked 'SWITCH' are connected internally to an isolated relay rated for 5A at 240V. The front panel button will glow amber to indicate that the relay is closed. This relay can be used to switch an external relay, contactor, or control system. Refer to the relevant documentation when connecting this Mini CT Meter to a third party control device. See Section 6 **Switching** for more information.

8. Apply power to the device. The button will blink continuously between green and amber to indicate that the device is in factory reset state. If the device is not in its factory reset state when it is initially powered up, it can be reset by pressing and holding the front panel button for at least 10 seconds, until the button starts to blink continuously between green and amber.

5.3 Commissioning

To complete the installation process, the SS9007 Mini CT Meter must be joined to an existing ZigBee network. The following instructions apply specifically to networks based on the Saturn South ESBox Ethernet-ZigBee Gateway device, however the process will be very similar when using third party ZigBee coordinators.

1. Set the site's ESBox to 'Permit Joining' mode using the LSSS button sequence on the button on the back panel of the ESBox (see the SS9002 ESBox LT documentation for more information). When Permit Joining mode is successfully enabled, the EBox's ZigBee LED will blink green for 120 seconds. During this 120 second window devices may be joined to the network by repeating step 2.

If this site is being commissioned for the first time it is recommended that a factory reset be performed on the ESBox before activating the first device using the Factory Reset (LLLSS) button sequence.

2. Instruct the new Mini CT Meter to join the network by pressing and holding the front panel button for 5 seconds and then releasing it. The button will glow solid green to indicate that the device is scanning for available networks. The device will then spend up to 10 seconds attempting to join the ZigBee network. If the device joins the network successfully, the button will flash green for 6 seconds. If the device fails to join the network, the button will flash amber for 6 seconds. Please see the Troubleshooting section for more information on debugging connection issues.

When joining multiple devices, perform the Association Join button sequence on each device in turn, rather than entering the sequence on multiple devices at once.

3. If the device successfully joins the network, as indicated in step 2, verify that the device appears as 'connected' in the out-of-band secure EScO web management interface, and that it is reporting power metrics.

6 Switching

Switching variants of the SS9007 Mini CT Meter can be used to switch loads of arbitrary size indirectly using an inbuilt 5A 240VAC latching relay. If your device is marked with an R on its variant label (e.g. "120A/R"), the two terminals marked 'SWITCH' are connected internally to an isolated relay.

The internal relay would typically be used to control a third party external contactor or to signal a control system. Because the relay contacts are isolated, the SS9007 Mini CT Meter can be connected directly to a digital IO on a control device such as a PLC.

The example below shows a SS9007 Mini CT Meter being used to control an external contactor with a 240V coil by switching the active input to the contactor's control coil.

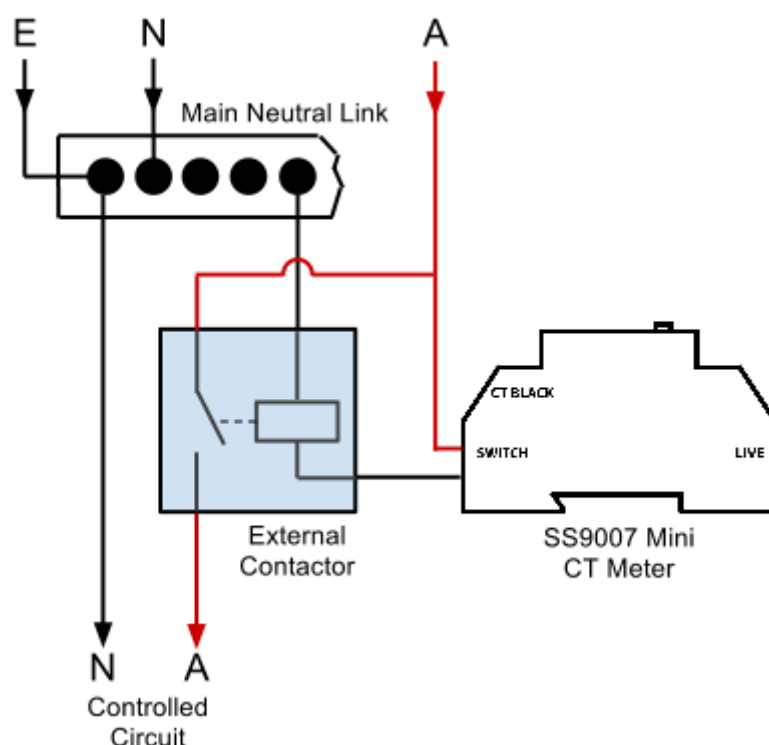


Figure 4: External contactor wired to SS9007 Mini CT Meter

The internal relay in the SS9007 Mini CT Meter is rated for over 20000 switching operations of a 5A load at unity power factor. The relay is limited to one switch state transition per second (e.g. the device cannot be switched on and off at a rate faster than 0.5Hz).

A value of 1 in the 'Switch State' attribute of the On/Off Cluster indicates that the relay is closed (connected), and a value of 0 indicates that the relay is open (disconnected).

7 Metering

As shown in Section 5, the circuit being monitored is connected directly to the SS9007 Mini CT Meter, providing a power supply for the device as well as enabling high accuracy voltage measurements. Current is measured using a clip-on current transformer (CT), with nominal primary current ratings of 40A and 120A available as standard.

Each individual Saturn South meter is calibrated in the final stage of the production process. The calibration procedure matches each device to a particular CT variant, meaning that measurements will not be accurate if a device calibrated for a 120A CT is used with a 40A CT. Furthermore, given the wide range of secondary current ratings available for CTs, the SS9007 Mini CT Meter must only be used with the supplied CT.

IMPORTANT: Attaching a third party CT to the device can damage the device and will void the product warranty.

SS9007 Mini CT Meter devices have a 'variant label' on the front panel that describes the rated primary current (and hence the CT variant to use), as well as indicating whether or not the device has an internal relay. For example:

"120A" – Device is rated for a 120A nominal primary current.

"40A/R" – Device is rated for a 40A nominal primary current and includes an internal relay.

Max calibrated voltage error	0.1%
Max calibrated current error	0.5%
Typical absolute transfer ratio error for 120A CT	< 0.5%
Typical absolute transfer ratio error for 40A CT	< 0.5%
Region of linearity for 120A CT (<1% error)	8% to >110% of rated primary current
Region of linearity for 40A CT (<1% error)	15% to >150% of rated primary current

Figure 5: Measurement accuracy specification

For a full list of measured attributes delivered by the SS9007 Mini CT Meter, please refer to Section 8.

8 Device Clusters and Attributes

The following Clusters are supported in the Std HA release of the SS9007 Mini CT Meter:

- Basic
- On/Off
- Simple Metering

This section lists the available attributes in each supported cluster.

A maximum of 11 attributes can be configured for reporting at once. There is only one timer for attribute reports, and attributes will be reported at the interval specified in the most recent report configuration message. Because ZigBee attributes have a variable size however, it may not be possible for a device to send 11 attributes in a single report. If the total size of the report exceeds the maximum payload size (60 bytes), some attributes will be excluded from the report. The device will not automatically follow up with the remaining attributes if this is the case, and any missing attributes must be requested separately.

8.1 Basic Cluster

Cluster ID: 0x0000 (0)

Manufacturer ID: 0x0000 (0)

Attr ID	Attr ID (Hex)	Attribute Name	Writeable
0	0	ZigBee Cluster Library Version	N
1	1	Application Version	N
2	2	Stack Version	N
3	3	Hardware Version	N
4	4	Manufacturer Name	N
5	5	Model Identifier	N
6	6	Date Code	N
7	7	Power Source	N
16	10	Location Description	Y
18	12	Device Enabled	N

8.2 On/Off Cluster

Cluster ID: 0x0006 (6)

Manufacturer ID: 0x0000 (0)

Standard ‘turn on’, ‘turn off’, and ‘toggle’ functionality is provided by the On/Off Cluster.

Attr ID	Attr ID (Hex)	Attribute Name	Writeable
0	0	Switch State	N

8.3 Simple Metering Cluster

Cluster ID: 0x0702 (1794)

Manufacturer ID: 0x0000 (0)

Saturn South devices expose an expanded set of attributes in a non-standard range within the Simple Metering Cluster.

Attr ID	Attr ID (Hex)	Attribute Name	Units	Divisor	Writeable
57610	e10a	Voltage 1 RMS Mean	"V"	100	N
57628	e11c	Current 1 RMS Mean	"A"	100	N
57646	e12e	Power 1 Active Mean	"W"	1	N
57649	e131	Power 1 Reactive Mean	"var"	1	N
57655	e137	Power Factor 1 Mean		1000	N
57664	e140	Accumulated Energy 1 Active Import	"Wh"	1	N
57665	e141	Accumulated Energy 1 Reactive Import	"varh"	1	N
57667	e143	Frequency 1 Mean	"Hz"	100	N
57676	e14c	Temperature 1 Mean	"C"	100	N
57721	e179	Accumulated Energy 1 Active Export	"Wh"	1	N
57722	e17a	Accumulated Energy 1 Reactive Export	"varh"	1	N

9 Troubleshooting

Issue:

There is no indication from the device when power is applied, and no response to pressing the front panel button.

Actions:

- Verify that the device is wired according to the instructions in Section 5.2. Ensure that the live source is disconnected before connecting the meter.
- Verify that all upstream switches and protection devices are in their closed configuration.
- If one or more other devices are to be installed in the same location, install another device to compare. If other devices function correctly, remove the non-functioning device.

Issue:

When performing the steps outlined in the Commissioning section of the Commissioning and Installation Instructions, the device does not successfully connect (indicated by button flashing amber for several seconds).

Actions:

- Ensure that 'Permit Joining' mode is enabled on the ZigBee Coordinator (If using an ESBox, use the LSSS button sequence on the ESBox to enable 'Permit Joining' mode).
- Try to join the device again – Saturn South metering devices will initially scan a reduced subset of the full range of available ZigBee channels. If the network is on a channel that is not in the 'preferred channels' list, the meter will initially fail to locate the network. A second join attempt will then cause the meter to scan the full set of channels.
- Check the RF environment to ensure the ESBox and Mini CT Meter can communicate - contact Saturn South for more information.

Issue:

Device stops communicating to the site ESBox.

Actions:

- Verify that other nearby devices are still communicating successfully with the site ESBox (normally, this can be done by checking for recent data in the EScO client or management tools)
- If this is a standalone device, or if other nearby devices are also not functioning, perform a radio test in the deployment environment to verify that the device is in range of the ESBox radio.
- **If the device exhibits abnormal behaviour (e.g. device does not respond to button presses, does not give button LED indications described in the Quick Reference guides in this manual) please contact Saturn South.**