

Prepayment Electricity Metering System

DOMESTIC

Landis+Gyr



GEMINI PLC2 SPLIT PREPAYMENT METER

USER GUIDE

Revision History

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Abstract

This document is the User Guide for the Cashpower Gemini PLC (Power Line Carrier) keypad prepayment meters, designed and developed by Landis+Gyr (Pty) Ltd., South Africa

Referenced Documents

None

Landis+Gyr (Pty) Ltd
60 Electron Avenue, Isando, Gauteng
P.O.Box 281, Isando, 1600, South Africa
Phone: +27 11 921 7900
Fax: +27 11 921 7901
Email: info@za.landisgyr.com
Internet: www.za.landisgyr.com

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1. ABBREVIATIONS

CIU:	Customer Interface Unit
EEPROM:	Electrically Erasable Programmable Read Only Memory
ID:	Identity
KWh:	Kilowatt hour
LCD:	Liquid Crystal Display
LED:	Light Emitting Diode
PLC:	Power Line Carrier
SELV:	Safe Extra Low Voltage
SGC:	Supply Group Code
STS:	Standard Transfer Specification

2. INTRODUCTION

The Cashpower Gemini PLC Split Meter is a single phase 80 Amp split prepayment meter in a British Standard housing that uses Power Line Carrier (PLC) communication technology between the meter and the customer interface unit

It is ideal for replacing conventional meters in existing apartment blocks and established dwellings/houses, where installation of a dedicated communications cable is not practical. The ability to use standard household wiring for communication between the meter and customer interface unit makes this an extremely attractive and cost effective technology.

The customer interface unit is fitted with a mains power cord, which is simply plugged into the standard electrical outlet in the house and once commissioned, automatically communicates with the meter outside. Using a PLC remote access terminal, the meter can be accessed remotely thereby combining reliable STS keypad technology with two-way communications for improved revenue protection.

This user guide covers the functionality of both the meter and the customer interface unit.



Figure 2: PLC Customer Interface Unit



Figure 1: Gemini PLC meter

3. OVERVIEW OF SYSTEM OPERATION

The Gemini PLC Split Prepayment Meter relies on signalling via the existing power line network to provide communication between the customer interface unit (fitted inside the customer's premises) and the meter (securely located in an area under the control of the utility and outside the customer's premises). The main advantage of this arrangement is to dispense with the installation of additional communication wires between the meter and customer interface unit.

The customer interface unit is plugged into any convenient socket outlet in the customer's premises and is powered via the mains supply under normal operating conditions. In the event of the customer's mains supply being disconnected as a result of prepayment credit expiry, internal batteries are provided, to *wake up* the customer interface unit at the press of a key. A new credit voucher may now be entered to restore the supply of electricity.

Provision is also made for upstream communication between the meter and the low-voltage distribution transformer or mini sub-station. This enables utilities to remotely interrogate a number of meters, all connected to the same low-voltage supply, via any appropriate communication backbone infrastructure e.g. GSM.

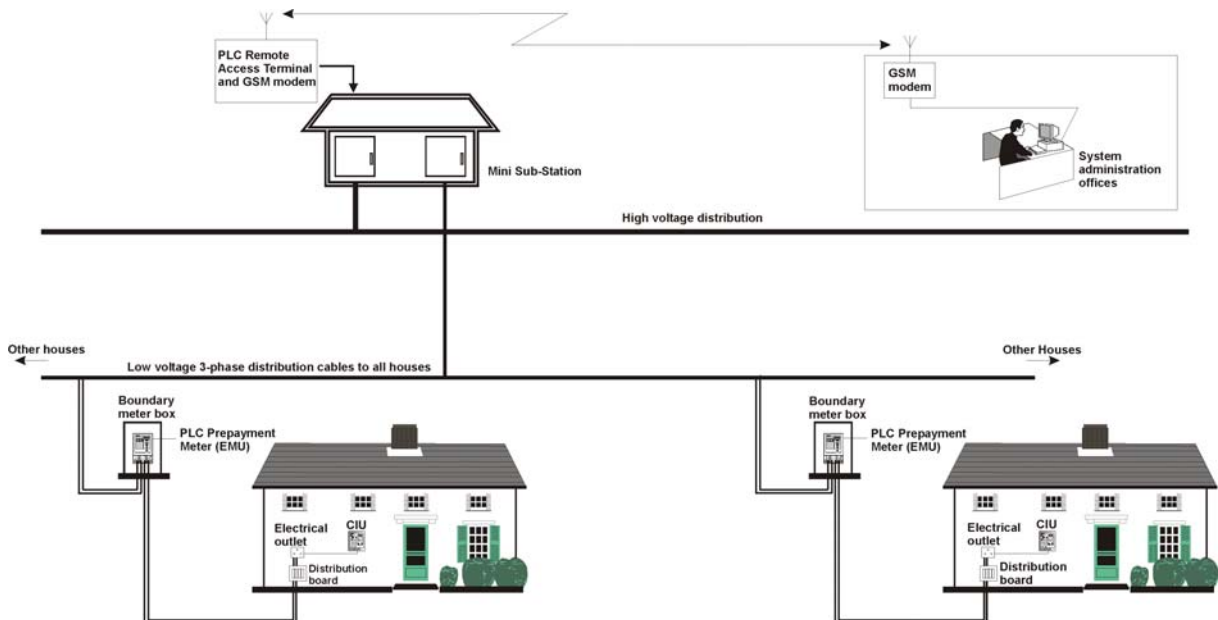


Figure 3: Typical PLC Metering Configuration

4. METER LAYOUT

Because all display and control functionality is at the customer interface unit, there is no local keypad on the Gemini PLC meter.

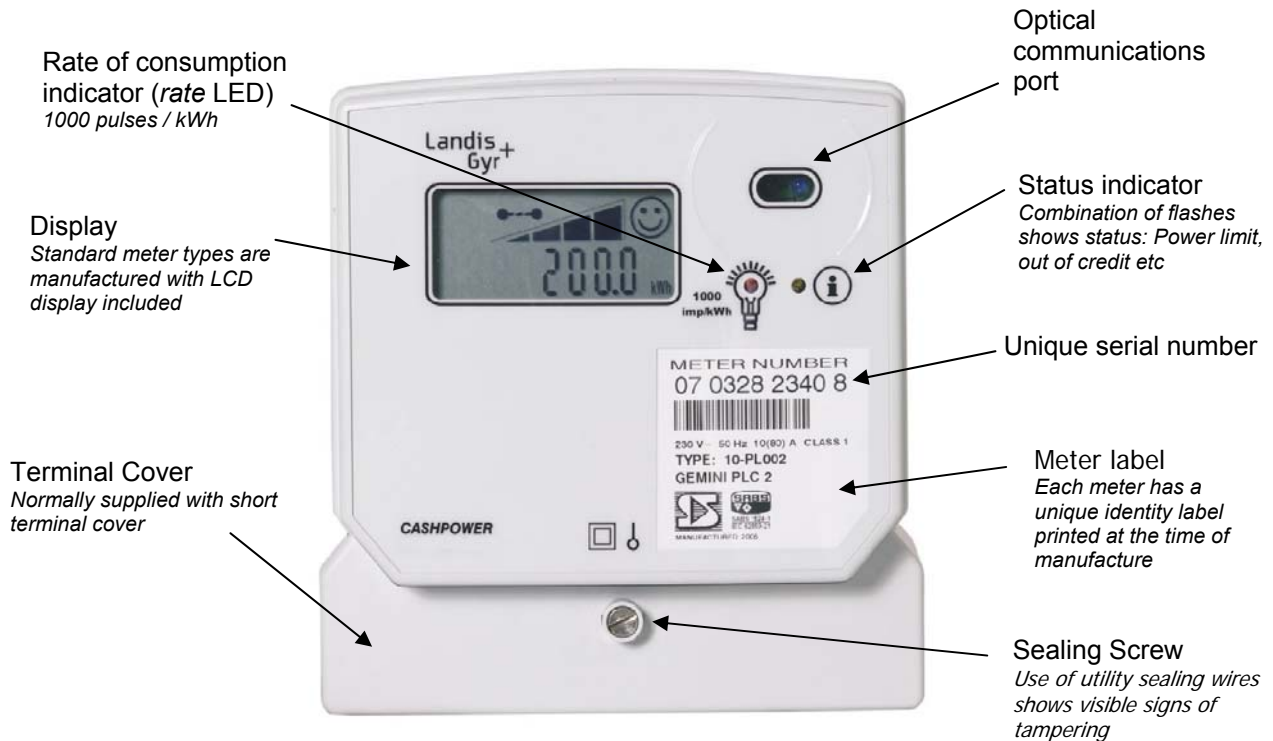


Figure 4: Gemini PLC Front Panel Features

4.1. Rate of Consumption Indicator (Rate LED)

This red LED provides the *reference* output for verifying the meter's metrological accuracy.

The *meter constant* for Gemini PLC is set to 1000 impulses/kWh. The *rate* LED will therefore flash 1000 times for every kWh of energy consumed.

4.2. Optical Communications Port

This port enables data to be transferred to and from the meter (e.g. the accessing of various registers or downloading of new parameters) using a portable interrogation device. The optical port's communication protocol complies with IEC 62056-21 Mode C.

4.3. Status Indicator

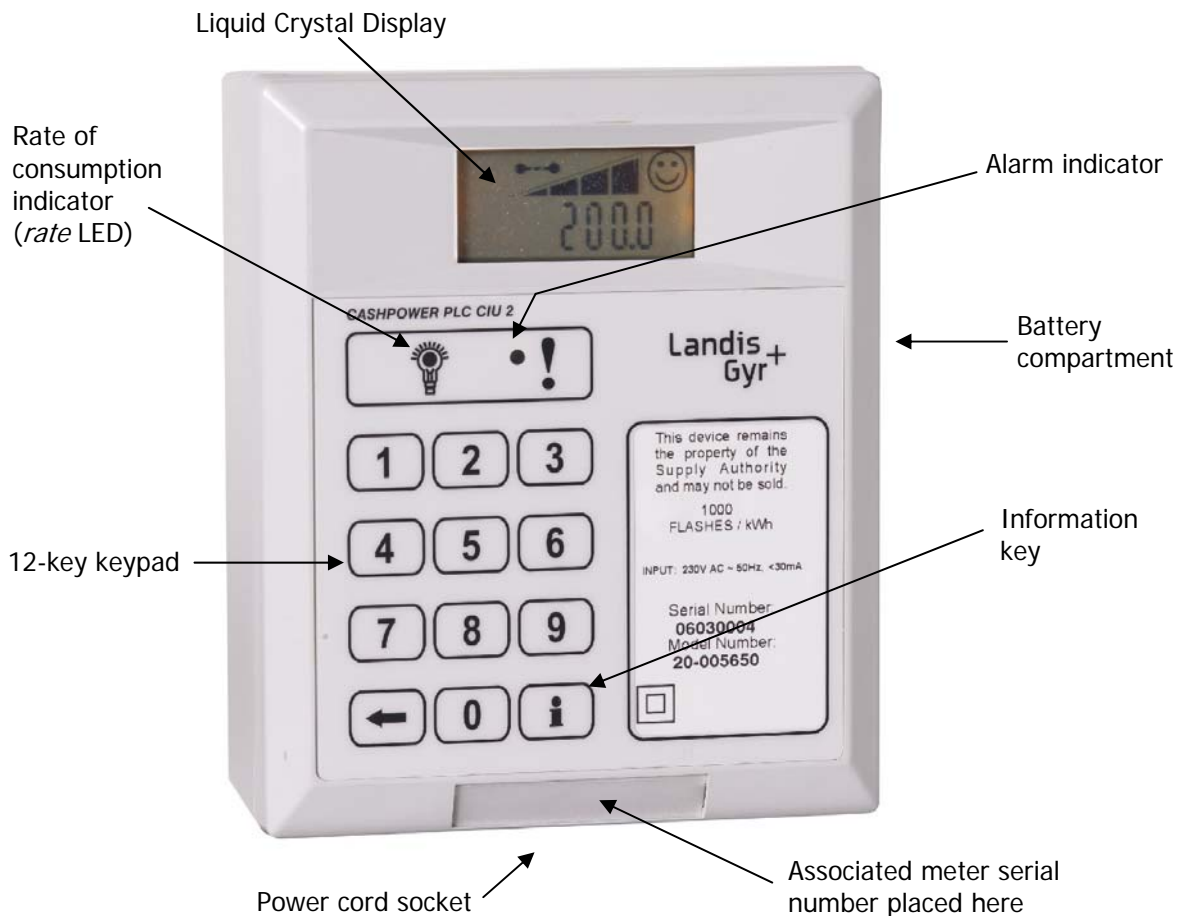
This yellow LED gives a quick visual indication of several important meter statuses and provides a useful diagnostic function to assist utility staff. During normal operation it flashes once every 5 seconds (effectively a *power on* indication). Other status conditions are indicated by two or more flashes at regular intervals as follows:

2 flashes	Meter error <i>This is a fault condition and requires a service call-out. The contactor will be open</i>	6 flashes	Meter not initialised <i>The meter will not accept credit until the appropriate vending keys are entered</i>
3 flashes	Meter tampered <i>The contactor will be open</i>	7 flashes	Meter decommissioned <i>The contactor will be open</i>
4 flashes	Meter out of credit <i>The contactor will be open</i>	8 flashes	Customer interface unit keypad locked out <i>The customer is temporarily inhibited from entering vouchers at the customer interface unit due to incorrect number entry on previous attempts</i>
5 flashes	Power limit exceeded <i>The contactor will be open</i>	9 flashes	Waiting for manual contactor closure <i>This indicates that the customer is required to press any key on the keypad of the customer interface unit to safely effect contactor closure</i>

NB: In section 7, where meter operation is described in detail e.g. the entering and processing of prepayment vouchers, all display and control functionality relates to the customer interface unit, as the meter has no keypad

However, all voucher processing is carried out at the meter, the customer interface unit effectively acting as a remote control and display panel only.

5. CUSTOMER INTERFACE UNIT LAYOUT



5.1. Keypad

The 12-key keypad enables the entry of vouchers and the accessing of various information functions. Key-presses are acknowledged with an audible beep.

5.2. Liquid Crystal Display (LCD)

The LCD normally displays *remaining credit* but also displays the scrolling in of keypad entries and viewing of various *information* functions. For details of the LCD icons refer to 6.

5.3. Rate of Consumption Indicator (Rate LED)

A red *rate of consumption* LED provides a visual indication of instantaneous power consumption. Note: The *rate* LED on the customer interface unit is not a *reference* output and cannot be used for verifying the associated meter's metrological accuracy. Its main function is to give a very visible indication of energy usage i.e. a fast flash rate signifies high usage.

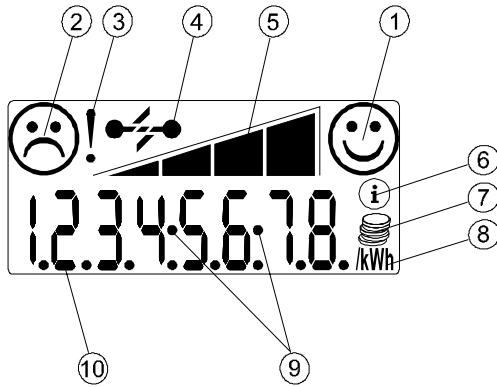
5.4. Alarm Indicator

A yellow alarm LED indicator duplicates the alarm indication on the LCD - 6.4. Its main function is to give the customer a very visible indication of critically low credit levels.

6. CUSTOMER INTERFACE UNIT LCD

6.1. LCD Layout (what the icons mean)

The LCD is designed to give a clear and unambiguous visual indication of important meter functions by means of language-independent pictograms:



- 1 - Happy face
- 2 - Sad Face
- 3 - Alarm indicator
- 4 - Contactor status indicator
- 5 - Remaining credit indicator
- 6 - Information mode indicator
- 7 - Credit metering mode indicator
- 8 - Power (kWh) function.
- 9 - Time display
- 10 - Eight X 7 segment digits

NB: The decimal points of the two left-most display digits, besides their normal function, are also used to indicate the reception and transmission of valid PLC data.

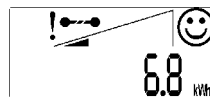
6.2. Typical Operational Displays

Normal Operation



Display shows *remaining credit* (kWh).
Contactor is closed and consumption *rate* indicator flashes at a rate proportional to the power being used.

Low Credit Warning



Credit running low. More credit must be purchased to avoid disconnection of the electricity supply.

Zero Credit



No credit and supply disconnected.

Credit Metering Mode



Display shows *total units* used (kWh).
Contactor is closed and consumption *rate* indicator flashes at a rate proportional to the power being used.

6.3. Happy and Sad Faces

These two icons are used in combination to give a quick visual indication of good and bad status. For example, if the meter is operating normally, the *happy face* will be on. However, if it is *tampered*, the *sad face* will come on. Similar responses apply during entry of the prepayment voucher e.g. entering an invalid voucher will result in the *sad face* flashing for a short period of time. Note that an *out of credit* condition is not considered to be a 'bad' status and the *happy face* will be on.

6.4. Alarm Indicator

This is a 'low credit' warning indicator that turns on if the *current credit register* value is greater than zero, but less than half the *low credit level*. Under these conditions it is displayed in conjunction with the smallest *credit wedge* icon - [11.9](#).

6.5. Contactor Status Indicator

This icon indicates the status of the *load-switch*. If it is closed, electricity is supplied to the customer. If it is open, the customer's electricity supply is disconnected.

Under normal operating conditions e.g. with the meter in credit, the *load switch* will be closed. It will open when credit expires.

6.6. Remaining Credit Indicator

This 4-segment 'wedge' provides a quick visual indication of the *remaining credit* in the meter and functions as follows:

- All four *credit wedge* icons are displayed if the value in the *credit register* is above the preset *high credit level*.
- The three smallest wedge icons are displayed if the value in the credit register is somewhere between the preset *low credit level* and *high credit level*.
- The two smallest wedge icons are displayed if the value in the *credit register* is somewhere between the preset *low credit level* and half of that level.
- The smallest wedge icon is displayed if the value in the *credit register* is somewhere between zero and half of the preset *low credit level*.
- All the *credit wedge* icons will be off when the meter runs out of credit (zero or negative values).

NB: The actual credit levels at which the individual bars in the 'wedge' icon toggle are personalised at the time of manufacture but can be changed at any time with an engineering voucher from the prepayment vending system.

6.7. Information Mode Indicator

This icon turns on in response to pressing the information key on the keypad. It indicates that the meter is in *information* mode and the contents of various registers can be viewed - [11](#). Note that the *information* mode automatically times out after a period of 1 minute in the absence of any further interrogation.

6.8. Credit Metering Mode Indicator

This icon is displayed in conjunction with the kWh indicator [6.9](#) to indicate clearly when the meter is operating in *credit metering* mode.

6.9. Power (kWh) Indicator

This icon is ON whenever the displayed units represent power (kWh). It applies to both the normal meter operating mode as well as when viewing registers via the *information* mode.

The *power (kWh)* icon will also flash on and off if no measurable energy is being consumed.

6.10. PLC Communication Data Indicator

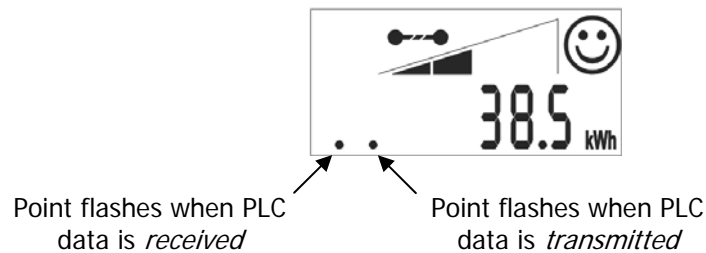
Reliable power line carrier communication is important to overall performance of the Gemini PLC prepayment system. Due to the variable nature of the medium (noise and attenuation from a variety of appliances connected to the AC mains supply), it is useful to have a visual indication of the communication functions i.e. when data is being received or transmitted.

The customer interface unit and meter will communicate at regular intervals:

- To ensure that the customer interface unit is regularly updated with changes that may be occurring at the meter e.g. changes in the *credit level* due to energy being consumed.
- To transfer data entered at the customer interface unit e.g. a credit voucher, to the meter.

Whenever a valid communication interchange takes place, a visual indication is given on the LCD by briefly flashing the decimal points of the two left-most display digits. When a customer interface unit or meter is receiving data, the left-most decimal point is flashed. When it is transmitting data, the second decimal point is flashed.

Note that the data indication will always be the inverse of the decimal point status. If the decimal point is permanently ON for a particular numeric display, the data indication will result in it flashing OFF briefly.



7. METER OPERATION - PREPAYMENT MODE

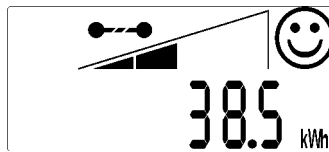
7.1. General

In this section the features and functionality of the prepayment meter is described in detail while all display and control functionality relates to the customer interface unit, as the meter is not configured with a keypad or display. However, all processing of prepayment vouchers, load control etc. is carried out at the meter.

Refer to section 10 for additional, customer interface unit-specific functionality.

7.2. LCD Functions During Normal Operation

During normal operation, with the customer interface unit plugged into an electrical socket outlet and switched on, the LCD provides the following functions:



- Displays the *current credit register* value to a resolution of 0.1 kWh.
- Permanently displays the *credit wedge* outline.
- Displays any combination of the *credit wedge* icons (0 to 4 segments depending on the actual *current credit level* in the meter).
- Displays the *happy face* icon, irrespective of the *credit register* value.
- Displays the *contact status* icon in either the closed or open position, depending on whether the meter is in or out of credit.
- The decimal points of the two left-most display digits will flash alternately at regular intervals (maximum of 5 minutes), to indicate the reception and transmission of valid data.

7.3. Entering Prepayment Vouchers via the Keypad

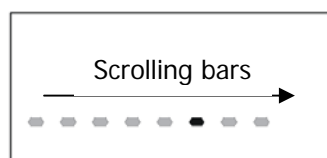
Prepayment vouchers are entered into the meter by keying in the numbers printed on the credit voucher via the keypad. The numbers entered are displayed on the LCD as they are being entered and scroll from right to left, with a decimal point displayed at every fourth digit for ease of viewing.

Visual feedback is provided by flashing the *happy face* icon with each key press.

Audible feedback is provided by a 'beep' on each key press.

Incorrect entries can be corrected with the backspace key, which removes the rightmost digit on the LCD with each press. Two backspace key presses in quick succession will clear the entire entry.

Acceptance of a valid prepayment voucher is automatic. Once a complete voucher has been entered, the customer interface unit locks the keypad and proceeds to transmit the voucher number via the PLC communication channel to the meter for processing. Whilst the transmission is in process, the LCD displays a 'busy' indication - a set of bars scrolling continuously from left to right. NB: For further details on the characteristics of PLC communication, refer to section 12.



On receipt of the prepayment voucher, the meter processes it and, when complete, submits the result back to the customer interface unit. Depending on the result, the customer interface unit displays one of the sequences described in - 7.4. Again, depending on what sequence is invoked, the keypad could remain locked for a variable period of time i.e. it will not respond in any way to further key presses.

An incomplete voucher entry will be timed-out after 30 seconds; where after the customer interface unit reverts to normal operation.

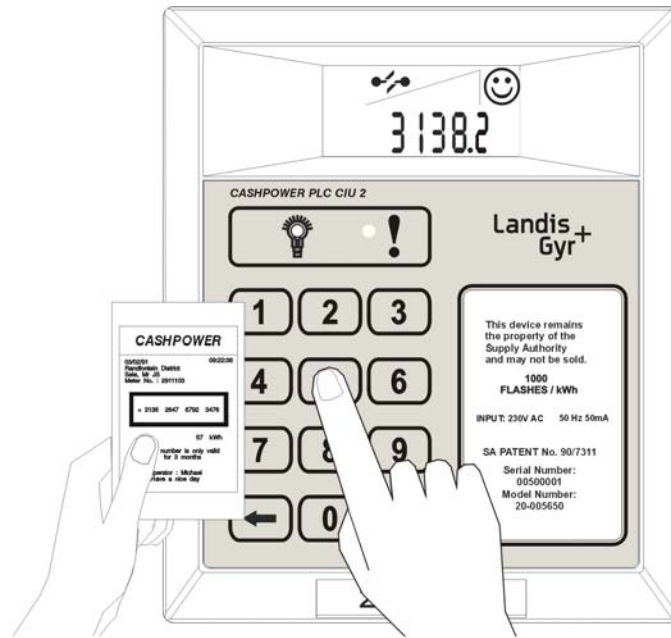


Figure 5: Entering a voucher into the keypad of the Customer Interface Unit

☹	☺	Normal operating mode (Includes zero credit and supply disconnected)
☹☀	☺	Number not recognized by meter
☹☀	☀	Number already used
☹☀	☺	Not enough digits entered (30-second timeout)
☹	☺	Meter tampered – call for service
☹	☺	Call for service
☹☹☹☺☺☺		Number expired
☐		Call for service

Figure 6: Typical results displayed

7.4. Prepayment Voucher Processing

Depending on the type of voucher entered into the meter, it will result in one of the display sequences described below. Note that with the exception of an 'incomplete voucher' - 7.4.1, the customer interface unit only displays these sequences on receipt of a valid response from the meter. Because there can be some delay in the PLC communication between the customer interface unit and the meter, the sequences are always preceded by the scrolling 'busy' display – refer to section 12 for more details on PLC communication:

7.4.1. Incomplete Voucher

A voucher entry is timed out if no key is pressed for more than 30 seconds. On time-out:

- The voucher number is cleared off the display.
- The *remaining credit* is displayed.
- The *happy face* icon is turned on.
- The *sad face* icon is flashed for 10 seconds.

7.4.2. Complete Voucher

If a complete voucher is entered, the meter:

- Locks the keypad.
- Proceeds to process the voucher number.

Once the voucher has been processed, the meter:

- Displays the remaining credit.

Then, depending on the result of the processing, one of the following sequences can occur. Refer to - 7.4.2.1 through - 7.4.2.6.

7.4.2.1. Voucher Accepted

The running ladder pattern on the credit wedge is displayed.

7.4.2.2. Voucher Accepted as a Valid STS Key Change Number (STS Only)

Note: Two vouchers are required for a STS key change.

- The running ladder pattern on the *credit wedge* is displayed.
- The *key revision* and *key type*, followed by the *tariff index*, is displayed during the above ladder sequence.

7.4.2.3. Voucher Overflow Rejection

This occurs if the voucher is valid, but rejected because the *current credit register* would overflow. The following is displayed:

- The *happy face* icon is flashed.
- The *sad face* icon is turned on for 10 seconds.

7.4.2.4. Incorrect Voucher

If the voucher is rejected, the following will be displayed:

- The *happy face* icon is turned off.
- The *sad face* icon is flashed for the *reject time*.

NB: The reject function is included to discourage the entry of random numbers in an attempt to defraud the meter. The *reject time* will eventually settle at a maximum time of 82.5 seconds.

7.4.2.5. Duplicate Voucher

If the voucher is rejected because it has previously been entered i.e. a duplicate voucher:

- Both the *happy face* and *sad face* icons are flashed simultaneously for 5 seconds.

7.4.2.6. Expired Voucher (STS Only)

If the voucher is rejected because it is older than the oldest voucher in the meter log i.e. 'expired':

- Both the *happy face* and *sad face* icons are alternately flashed for a period of 5 seconds.

7.5. Voucher Decryption and Processing

The meter will accept vouchers in either proprietary format or STS format. Both formats cannot, however, be active at the same time. The transfer specification is configured at the time of manufacture.

7.5.1. STS Algorithm

The meter accepts information transferred as specified in the *Standard Transfer Specification release 1.0:1995* with key typing included. Key expiry is not implemented.

STS vouchers comprise 20-digit numbers.

The following STS voucher types will be recognised and accepted:

- Electricity *credit* (meter-specific voucher) - [7.5.1.1](#).
- Set *1st dispenser key* (meter-specific voucher) - [7.5.1.2](#).
- Set *2nd dispenser key* (meter-specific voucher) - [7.5.1.3](#).
- Clear *tamper* (meter-specific voucher) - [7.5.1.4](#).
- Set maximum *power load* or *power limit* level (meter-specific voucher) - [7.5.1.5](#).
- Set *current credit levels* (meter-specific, proprietary voucher) - [7.5.1.6](#).
- Clear *credit* (meter-specific, proprietary voucher) - [7.5.1.7](#).
- Initiate *dispenser test* (non meter-specific voucher) - [7.5.1.8](#).
- *Commissioning voucher* (non meter-specific, proprietary voucher) - [7.5.1.9](#).
- *Commissioning* voucher (meter-specific, proprietary voucher) - [7.5.1.10](#).
- *Decommissioning* voucher (meter-specific, proprietary voucher) - [7.5.1.11](#).
- Set *credit-metering* mode (meter-specific, proprietary voucher) - [7.5.1.12](#).
- Set *prepayment-metering* mode (meter-specific, proprietary voucher) - [7.5.1.13](#).

7.5.1.1. Electricity Credit Voucher

The electricity credit voucher transfers a variable quantity of credit to the meter.

7.5.1.2. Set 1st Dispenser Key Voucher

Key changes are occasionally carried out to maintain the security of a pre-payment system. Unless the prepayment vending system and meter are both operating on the same key, vouchers vended from that system will not be accepted by the meter.

To effect a key change, two vouchers (set 1st dispenser key and set 2nd dispenser key) need to be issued and entered into the meter within a 5-minute period of each

other. NB: set 1st dispenser key and set 2nd dispenser key vouchers may be entered in any sequence i.e. the 2nd dispenser key voucher may be entered first.

Note: Various ancillary functions e.g. clearing the meter log may be embedded into the key-change process (refer to the STS specification).

7.5.1.3. Set 2nd Dispenser Key Voucher

Refer to - [7.5.1.2.](#)

7.5.1.4. Clear Tamper Voucher

If a meter has been *tampered*, normal operation can only be restored by entering a *clear tamper* voucher. Note that these vouchers also reset the *power-fail counter* and the *significant reverse energy* flag (if it had been set) - [11.18.](#)

7.5.1.5. Set Power Limit Voucher

This voucher sets the power limit level for the meter - [7.8.](#)

7.5.1.6. Set Credit Levels Voucher (Proprietary Voucher)

On accepting a power limit level number, the meter sets the appropriate high and low *credit levels*. These are the levels at which the segments in the 'wedge' of the LCD *credit indicator* toggle - [6.6.](#)

7.5.1.7. Clear Credit Voucher

On accepting a *clear credit* voucher, the meter clears any remaining credit to zero and opens the contactor, thus interrupting the electricity supply to the customer.

7.5.1.8. Initiate Dispenser Test Voucher (Meter Non-Specific Voucher)

There are a number of *non meter-specific* vouchers that can be used to test various functions on the meter. NB: These tests pertain to the meter and not the customer interface unit. They will only be visible on meters fitted with a local display.

On accepting an *initiate dispenser test* voucher, the meter executes all the tests that are embedded in that particular voucher. The following tests are supported:

Function	Voucher Number
Activate the <i>disconnection device</i> (internal latching contactor)	0000 0000 0001 5099 7584
HMI test - turns on all the <i>LED's</i> , displays all segments on the <i>LCD</i> , and activates the <i>buzzer</i>	0000 0000 0001 6777 4880
Display the <i>total units counter</i>	0000 0000 0002 0132 8896
Display the <i>key revision number</i> and <i>key type</i>	1844 6744 0738 4377 2416
Display the <i>tariff index</i>	3689 3488 1475 5332 2496
Display the <i>power limit</i> level	0000 0000 0012 0797 4400
Display the <i>tamper state</i>	0000 0000 0022 8172 8512
Display the <i>instantaneous power</i>	0000 0000 0044 2920 8064
Display the <i>software version</i> number	0000 0000 0087 2419 5840
<i>Test all</i> the above functions (tests run sequentially)	5649 3153 7254 5031 3471

In a test sequence (*test all*), each test has a duration of 2.5 seconds, and is performed in the above order. For a single test per voucher, the test has a duration of 5 seconds.

On completion of the test sequence, the meter returns to its normal mode of operation.

7.5.1.9. Commissioning Voucher (Non Meter-Specific, Proprietary Voucher)

This is a *non meter-specific* voucher i.e. it may be used in any STS meter:

1268 2136 5508 1001 3746

It is typically used to assist meter installation personnel by ensuring that the load remains disconnected and the *tamper* detect sensing switch function disabled (meter *decommissioned*). Once the installation is complete and the number entered, the contactor closes and the *tamper* detect sensing switch function is enabled.

7.5.1.10. Commissioning Voucher (Meter-Specific, Proprietary Voucher)

This is a *meter-specific* voucher but in all other aspects its operation is the same as described in [7.5.1.9](#).

7.5.1.11. Decommissioning Voucher (Meter-Specific, Proprietary Voucher)

On accepting a *decommissioning* voucher, the meter opens the contactor (load disconnected) and disables the *tamper* detect sensing switch function.

7.5.1.12. Set Credit Mode (Meter-Specific, Proprietary Voucher)

On accepting a *set credit metering mode* voucher, the meter commences operation.

7.5.1.13. Set Prepayment Mode (Meter-Specific, Proprietary Voucher)

On accepting a *set prepayment metering mode* voucher, the meter commences operation as described in - [7](#).

7.5.2. Proprietary Algorithm

The meter accepts information transferred according to the *Cashpower Transfer Specification*, which comprise 16-digit numbers.

On completion of entry of a 16-digit number (other than a *non meter-specific commissioning number*), the meter proceeds to decrypt the voucher - [7.4](#).

The following voucher types will be recognised and accepted:

- Credit transfer number - [7.5.2.1](#).
- Key change number - [7.5.2.2](#).
- Initial key change number - [7.5.2.3](#).
- Tamper reset - [7.5.2.4](#).
- Power limit level - [7.5.2.5](#).
- Set credit levels - [7.5.2.6](#).
- Reset meter (clear credit register) - [7.5.2.7](#).
- Clear log - [7.5.2.8](#).
- Non meter-specific initiate breaker test voucher - [7.5.2.9](#).
- Non meter-specific *commissioning* voucher - [7.5.2.10](#).
- Meter-specific *commissioning* voucher - [7.5.2.11](#).
- Meter-specific *decommissioning* voucher - [7.5.2.12](#).

7.5.2.1. Credit Transfer Voucher

This voucher transfers a variable quantity of credit to the meter.

7.5.2.2. Key Change

It is generally desirable to 'hide' a key-change sequence from the customer. To this end, some variable amount of credit is also embedded in the voucher. NB: This is a limited range of credit values i.e. a choice of 8 pre-defined values in 102.4kWh steps.

7.5.2.3. Initial Key Change Voucher

An *initial key change* number is treated in exactly the same way as a normal *key change* number - [7.5.2.2](#).

7.5.2.4. Tamper Reset Voucher

If a meter has been *tampered*, normal operation can only be restored by entering a *tamper reset* voucher. Note that these vouchers also reset the *power-fail counter* - [11.18](#).

7.5.2.5. Set Power Limit Level Voucher

Unlike STS, there are a limited number (16) of pre-defined *current limit* settings available on the proprietary algorithm:

0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70 and 100 Amps.

A value of 0 disables the *power limiting* function.

NB: These *current limit* values get converted to an equivalent *power limit* value based on the nominal system voltage personalized into the meter at the time of manufacture. Although the meter will disconnect the customer's load when the measured *power limit* threshold is exceeded, variations in line voltage will result in this happening at proportionately different *current* levels.

On accepting a *power limit* level number, the meter loads the appropriate *power limit* level in amps from the power limit table and converts it to Watts by multiplying by the nominal system voltage (as indicated on the meter label).

Note: It is possible to configure the meter at the time of manufacture to display the *power limit* setting in either Amps or Watts when viewed via the *information* registers - [11.11](#) and [11.15](#)

7.5.2.6. Set Credit Levels Voucher

On accepting a *set credit level* number, the meter sets the appropriate *high* and *low credit levels*. These are the levels at which the segments in the 'wedge' of the LCD *credit indicator* toggle - [6.6](#).

7.5.2.7. Reset Meter (Clear Credit Register) Voucher

On accepting a *reset meter* voucher, the meter clears any remaining credit to zero and opens the contactor, thus interrupting the supply to the customer.

7.5.2.8. Clear Log Voucher

On accepting a *clear log* number, the meter clears all existing log entries and the log starts afresh.

7.5.2.9. Non Meter-Specific Initiate Breaker Test Voucher

On accepting a *non meter-specific initiate breaker test* voucher, the meter opens the contactor for a short period of time (factory-defined setting of approximately 15 seconds) and then returns to normal operation.

The *non meter-specific initiate breaker test* voucher number is:

9999 9208 1566 9249

7.5.2.10. Non Meter-Specific Commissioning Voucher

This voucher is typically used to ease the meter installation process by ensuring that the load remains disconnected and the *tamper* detect sensing switch function disabled (meter *decommissioned*). Once the installation is complete and the number entered, the contactor closes and the *tamper* detect sensing switch function enabled.

The *non meter-specific commissioning* voucher number is:

9999 9999 9997 1939

7.5.2.11. Meter-Specific Commissioning Voucher

This is a *meter-specific* voucher but in all other aspects its operation is the same as described in [7.5.2.10](#).

7.5.2.12. Meter-Specific Decommissioning Voucher

On accepting a *decommissioning* voucher, the meter opens the contactor (load disconnected) and disables the *tamper* detect sensing switch function.

7.6. Commissioning and Decommissioning the Meter

The function of being able to set the meter into the *decommissioned* / *commissioned* mode offers several advantages to meter installation personnel.

In the case of the Gemini PLC meter, when setting the meter into the *decommissioned* mode, the following occurs:

- The *load switch* is set into the open state.
- The tamper facility is disabled

When setting the meter into the commissioned mode, the following occurs:

- The *load switch* operates as normal.
- The tamper facility is enabled
- The meter's *commissioned* / *decommissioned* status can be observed in the *meter state register* - [11.13](#).

7.7. Display Total Units or Remaining Credit at the Meter

This option (configurable at the time of manufacture) is provided for installations where the meter has a local display and is required to be visually read by a meter reader i.e. the only significant reading required would be the *total units* – not the normal *remaining credit*, which is only of interest to the customer. Only the meter display will show the total units. The customer interface unit will continue to reflect *remaining credit*.

The status of this function can be observed in the *meter option register* - [11.15](#).

7.8. Power Limiting

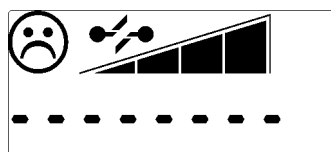
The power-limiting feature allows utilities to set the maximum load that can be drawn by customers. The setting can be changed when necessary via a *set power limit* voucher from the prepayment vending system.

Eskom specification DISSCAA9 makes specific reference to a *power-limiting* algorithm. This algorithm is included in the meter's software and is implemented as follows:

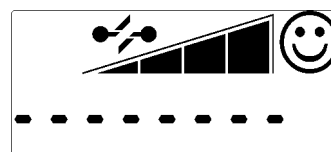
- If the preset *power limit* threshold is exceeded, the *load switch* will open for a period of 30s, after which it will re-close (either automatically or manually - [7.10](#)). If the *power limit* threshold continues to be exceeded, the above process is repeated. If, after 4 *power-limit* events within a 15-minute window, the limit is still being exceeded because of excessive energy consumption, the *load switch* will be opened for a period of 30 minutes (the *power limit lockout period*). At the end of the *lockout period*, the *load switch* will re-close (either automatically or via a manual operation on the keypad - [7.10](#)) and, unless the excessive loading has been removed, the process

will be repeated. Note that vouchers may be entered and the *information* modes accessed as normal during the *power limit lockout period*.

- If the power drawn by the customer is reduced in response to a *power limit* disconnect, the event will be ignored after 15 minutes has elapsed.



Display during 30-second
power limit periods



Display during 30-minute
power limit lockout period

NB: Power limiting is not a form of safety overload protection. It is designed to generally limit the overall usage of power in a particular area (possibly dictated by reticulation limitations or linked to a tariff allocation).

7.9. Reverse Power Detection and Metering

The metering circuitry can detect and measure reverse power. A filter ensures that short periods of reverse power are ignored e.g. as a result of a motor running down and only *significant reverse power* detected. A *significant reverse power* condition will be flagged when there has been a continuous reverse power measurement equivalent to 50Wh.

Under reverse power conditions, metering will continue as normal i.e. credit will continue to be decremented.

7.10. Automatic/Manual Load Reconnection

In some instances, local safety regulations require that the meter not automatically re-close the contactor after, for example, a *power limit* trip. Under these conditions, the contactor will remain in the open state until such time as a key is pressed on the keypad.

Using the example of a *power limit* trip – refer to 7.8, the contactor will open and remain open for a period of 30 seconds. At the end of this 30-second period, the display will return to normal but, instead of the contactor closing, the *contactor status* icon on the LCD will start to flash, toggling between an open and closed state. This is a visual indication that the contactor may now be *manually* closed, by pressing any key on the keypad.

In the event of the contactor opening due to expiry of credit, it will only be able to close again on entry of a valid credit voucher. The *manual* action of entering a credit voucher via the keypad, results in the contactor closing when the last digit of the voucher is entered and accepted by the meter.

Automatic/manual load reconnection is a configurable option, set at the time of manufacture - 11.15. It may also be changed at any stage with a suitable engineering voucher.

7.11. Disconnect on Power Failure

This option, configurable at the time of manufacture - 11.15) forces the meter's contactor to open whenever there is a power failure. The option can be invoked as a means of preventing the meter from being installed fraudulently with line and load connections reversed, in which case the meter will never power up once the contactor is open.

7.12. Optical Port

The Gemini PLC prepayment meter is provided with an optical interrogation port that allows meter data to be rapidly and safely extracted in the field using a portable interrogation device.

The communications protocol complies with IEC 62056-21 mode C.

7.13. Credit Reader Interface

This port is available via an optional removable plug at the rear of the meter and should only be accessed when the meter is disconnected from power. It allows for meter data such as *remaining credit* to be easily extracted in the event of an electronics failure.

NB: From a safety point of view, the meter must **not** be powered when accessing this port – the Credit Reader provides the necessary low-voltage supply to power the logic circuitry.

8. ANTI-TAMPER FEATURES

8.1. General

The Gemini PLC electronic circuitry is mechanically sealed at the time of manufacture by screw sealing plugs. The use of these sealing plugs ensures that there are visible signs of tampering if unauthorised entry to the meter is attempted

On installation, the Gemini PLC terminal cover is fitted to the meter with a single terminal cover screw. The screw is then sealed with utility-sealed wire seals. The use of the utility seal ensures that there is a visible sign of tampering from the front of the meter.

8.2. Anti-Tamper Switch

The Gemini PLC meter is fitted with a mechanical anti-tamper facility.

The tamper facility automatically detects if the meter terminal cover is removed. This condition will set the tamper state thereby causing the meter to disconnect power to the household – it will remain in the tampered state when the cover is re-fitted to the meter

The tamper detect function may be enabled or disabled during production, or by means of a Set Options Register token. The tampered condition may be monitored by using the information functions

8.3. Reverse Energy Detection

The meter includes a Significant Reverse Energy (SRE) detection feature. If the line and load wires are swapped during installation, the meter will continue to operate and decrement credit, however, the meter can be factory-programmed to tamper and disconnect the load should SRE be detected. The reverse energy condition may be monitored by using the information functions

8.4. Resetting a Tamper Condition

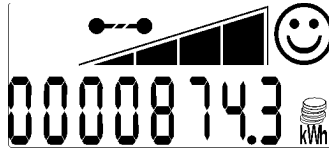
Before resetting a tamper condition, care must be taken to remove the cause of the condition, e.g. ensure that the meter is wired correctly and that the terminal cover is securely fitted to the meter and that the tamper switch is closed. Failing to do this will cause an immediate tamper condition.

Once the terminal cover is fitted to the meter, check that the tamper switch is fully depressed by checking the tamper switch status in the meter state registers. If a meter has been tampered, normal operation can only be restored by entering a clear tamper voucher.

9. METER OPERATION (CREDIT METERING MODE)

The *credit-metering* option is only available when using the STS algorithm. It is possible to toggle the meter between *prepayment* and *credit* modes of operation via engineering vouchers generated by the prepayment vending system.

When set to the *credit metering* mode of operation, the meter functions as follows:



Meter display format in
credit metering mode

- The default display is the *total register*, displayed with leading zeros. Note: In *information* mode, the *total* register may be viewed with a resolution of 10Wh - 11.27 with the most significant digit omitted e.g. **000874.36**.
- The *credit metering mode* icon is turned on.
- All other display digits and icons work as per the prepayment mode of operation.
- The contactor will remain in the closed position. NB: The contactor will open if the meter is *tampered*, *decommissioned* or in a *power limit lockout* state.
- The *total register* increments as metering takes place.
- The prepayment mode *credit register* does not decrement with metering pulses. It retains its value and, if a prepayment credit voucher is entered, will increment accordingly.

When toggling from *credit-metering* mode to *prepayment-metering* mode, normal *prepayment* operation resumes as per the state of the various meter registers e.g. if there is no credit in the *credit register*, the contactor will open.

10. CUSTOMER INTERFACE UNIT OPERATION

10.1. General

The customer interface unit effectively acts as a remote display and keypad for the meter. It does not implement any voucher decryption. The customer interface unit is a self-contained device that implements its own battery-backed power supply and PLC communications and it does have specific functionality that is of importance to the customer e.g. the indication of alarms for low credit or low battery conditions, communication to the meter etc.

10.2. Connection to the Mains Supply

For the customer interface unit to function correctly, it must be permanently connected to the customer's AC mains supply. Each customer interface unit is supplied with a standard mains power cord that may be plugged into any convenient socket outlet in the customer's premises. It is equally important that the supply remains switched on at all times for the following reasons:


- It allows the remaining credit level and energy consumption rate to be seen.
- In the event of credit expiring, the meter will disconnect the customer's electricity supply and also the mains supply to the customer interface unit.

To cater for the disconnection of mains power due to expiry of credit, the customer interface unit is fitted with batteries – 10.3 to enable supply reconnection after entering a valid credit voucher. NB: To avoid confusion under this *supply disconnected* condition, it is critical that the customer interface unit remains connected to the mains socket outlet, with the outlet

switch in the *on* position to allow PLC communications back to the meter via the electrical wiring of the house.

10.3. Batteries

Although the customer interface unit is normally connected to the customer's mains power supply - 10.2, it needs to have an alternate power source in the event of credit expiring and the meter disconnecting the load.

Each customer interface unit is provided with a pair of 1.5V, AA sized, leak proof, alkaline cells. Whenever the customer interface unit is disconnected from the mains supply, it continues to operate for another 30 seconds, at which point it stores the last known meter status before entering into *power-save* mode to conserve battery energy. It may be *woken up* at any stage by pressing and holding the  key on the keypad for a period of 3 seconds. Refer to section 10.10 for a detailed description of customer interface unit functionality whilst operating under battery power.

NB: Ensuring the availability of a reliable battery supply is extremely important. A clear and timeous warning is displayed if the battery capacity is getting low. Batteries must be replaced as soon as possible to avoid inconvenience.

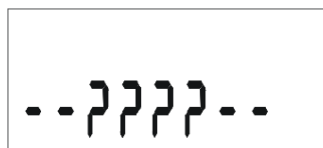


Low battery warning

10.4. Commissioning

Unlike the meter, the customer interface unit does not have a dedicated reference number and it is possible to use any customer interface unit with any meter. However, before it can be used with a particular meter, it is necessary to 'link' the customer interface unit with its associated meter to ensure that the correct device is being addressed. This process is known as *commissioning* the customer interface unit. *Commissioning* only needs to be done once, typically at the time of installation, and there is no need for the customer to be aware of the process. To this end it has been made deliberately obscure, to obviate inadvertent malfunctioning of the system as a result of the customer tampering with the customer interface unit.

To expedite the *commissioning* process, new customer interface units are delivered in a *decommissioned* mode. Immediately on powering up it will present with the following display.



Customer interface unit in
decommissioned mode

NB: It is important to ensure that batteries are fitted in the customer interface unit before commissioning can take place. If the batteries have been removed or are very flat, commissioning will be inhibited and an error message displayed (error 40).

The *commissioning* process is as follows:

- In the case of a CTS meter, enter the meter number and hold the last digit for 5 seconds or until a second beep is heard.
- In the case of an STS meter, enter the entire STS 11 digit meter number - no need to hold the last digit down for 5 seconds – the number is accepted after the last digit is entered.

- The meter number label is supplied with the packing kit of the meter and must be affixed to the customer interface unit at the time of installation for future reference.
- The scrolling *busy* display is shown.
- If the process is successful and the meter responds, the customer interface unit beeps once and the current meter status is displayed. The customer interface unit is now *commissioned*. NB: A configurable option at the time of manufacture - [11.14](#) can be set such that on successful *commissioning* the meter opens the load switch for a period of 10 seconds. This to give a positive indication that the correct meter is connected to the customer's premises.
- NB: *Caution may need to be exercised with this procedure because the brief power interruption could cause appliances such as refrigerators and air conditioners to trip. Also note that this contactor opening function would not occur if the meter was, for example, out of credit, and the contactor already open.*
- The *commissioning* process will fail if no communication with the target meter is established. This could take a couple of minutes due to multiple communication *retries*. The customer interface unit will then briefly display the *communication error* fault code (30) before reverting to the *decommissioned* display (????). Note that it is possible to terminate the communication *retries* at any stage by pressing and holding the backspace information key.

If, at any stage, it is required to connect the customer interface unit to another meter, it will be necessary to first *decommission* it - [10.5](#).

Once *commissioned*, the customer interface unit will communicate as required with its associated meter.

10.5. Decommissioning

In order to *decommission* a customer interface unit, it does not have to be in communication with a meter, nor does it need to be connected to the AC mains supply (it can be done under battery power).

The process of *decommissioning* is as follows:

- Press the information key continuously for 5 seconds until a second beep is heard.
- Enter the code **456**.
- The currently commissioned meter number stored in the customer interface memory is displayed.
- Enter the digit **0** eleven times.
- On the eleventh digit entry, one beep will be heard and the display reverts to (????).
- The customer interface unit is now *decommissioned*.

10.6. Audible Low-Credit Alarm

This function is provided to give customers the option of having a timeous audible warning that credit is low and disconnection of the electricity supply could occur soon.

The default factory setting of this function is *enabled*. If required, the customer can change it at any stage as follows:

- Press and hold key '0' on the keypad for 5 seconds. At the end of this period the buzzer beeps twice (alarm disabled) or once (alarm enabled).

The mode can be toggled any number of times. Note that the currently selected mode setting is retained even if power is removed from the customer interface unit.

The alarm is sounded when the *remaining credit* level in the meter reaches half of the *low credit* level - [6.6](#). At the same time, the *alert* icon is displayed on the LCD and the *alert* LED starts to flash. Pressing any key on the keypad will silence the alarm but the *alert* indications will continue to be displayed.

10.7. LCD Backlighting (On Customer Interface Unit)

The LCD backlighting turns on whenever keys on the keypad are pressed. It is possible to select backlighting to be permanently on, or only on for 30-second periods following a key press.

- Press and hold key '1' on the keypad for 5 seconds. At the end of this period the buzzer beeps once (backlighting disabled) or twice (backlighting enabled). Note that the currently selected mode setting is retained even if power is removed from the customer interface unit.

10.8. PLC Data Indicator

Refer to [6.10](#).

10.9. Operation on AC Mains Supply

Whenever the AC mains supply is connected to the customer interface unit, it will automatically display the current meter status. To minimise the amount of PLC network traffic, only *significant* changes in status at the meter are immediately updated to the customer interface unit. For example, the *remaining credit* display will only be updated when a significant digit changes. However, should an event such as a *low credit alarm* be activated, the customer interface unit will be notified immediately. Other functions that could change significantly in relatively short periods of time e.g. the flash rate of the *rate LED* in response to changes in the customer's load, have algorithms that progressively throttle the data update rate if they occur too frequently. Note that whenever an update occurs e.g. a change in the flash rate of the *rate LED*, all display data is simultaneously updated.

If there is little activity at the meter e.g. a steady load, data updates to the customer interface unit will only occur at 5-minute intervals. This is the maximum update time.

Credit vouchers may be entered in the usual way at any time, as can the accessing of the various *information* functions - [11](#).

In the event of no update being received from the meter after a period of 1 hour, the customer interface unit will automatically request an update. If it fails to get a response, it will display the *communications failure* error message (30). If at any stage after this, communication with the meter is re-established, normal operation resumes.

10.10. Operation on Internal Battery Supply

The customer interface unit will be required to operate on battery power under two conditions:

- Meter out of credit (and the load disconnected).
- A general power failure.

From the customer's point of view, it is not possible to differentiate between a general *power failure* condition and an *out of credit* condition – in both cases the AC mains supply is not available.

Whenever the customer interface unit is disconnected from the mains supply, it continues to operate for another 30 seconds, at which point it stores the last known meter status before entering into *power-save* mode to conserve battery energy. When in the *power-save* mode, the customer interface unit is completely switched off and there is no display or background activity. It may be *woken up* at any stage by pressing and holding the *information* key on the keypad for a period of 3 seconds.

On 'waking up', it will display the last known meter status. If the display indicates a *zero credit* condition and the contactor status as *open*, it is clear that the meter is *out of credit* and a new *credit voucher* will have to be entered in order to restore power. If, however, the display shows the contactor in the *closed* position and some amount of credit still available, it can be safely assumed that there is a general *power failure*.

Having 'woken up' and displayed the information as indicated above, the customer interface unit automatically proceeds to interrogate the meter for an updated status. Depending on the prevailing status, this will result in any one of the following responses:

- If there has been any change in the meter status, it will be reflected on the display.
- If there is a general power failure, the meter will not be able to respond i.e. there will be no communication possible with it. Under these conditions, the customer interface unit will evaluate the last known status of the meter contactor and do one of the following:
 - If the contactor indicates *closed*, it will assume a power failure, retain the existing display information and enter into *power-save* mode after 30 seconds.
 - If the contactor indicates *open*, it will display the *communications error (30)* after 30 seconds and shut down again. Note that this will now be the default display whenever the customer interface unit is again 'woken up'. It will only be cleared once AC power has been restored and communication with the meter re-established.
- In the absence of any further key-presses, the customer interface unit will enter into the *power-save* mode again after 30 seconds.

A credit voucher may be entered under battery power in the normal way, after the customer interface unit has been 'woken up' as described above.

Refer to - [10.3](#) for details of the battery condition indicator.

11. INFORMATION FUNCTIONS

Pressing the information key toggles the meter into *information* mode (the information icon on the LCD turns on and all digits display \equiv). The contents of various registers can now be viewed by entering the appropriate, 3-digit register code.

Once in *information* mode, toggling between different registers may be done on an ongoing basis by entering the appropriate 3-digit code i.e. the information key does not have to be pressed again.

Information mode may be exited by pressing the information key or, in the absence of any other key presses, automatically after a period of 1 minute.

Information Register Functions

Info Register Number	Function
000	Meter number
001	Instantaneous power
002	Current credit register
003	Total units counter
006	Current 24 hr. consumption
007	Previous 24 hr consumption
008	Current 30 day consumption
009	Previous 30 day consumption
012	Low credit level
013	High credit level
014	Power limit level
024	Extended meter number (STS only)
031	Meter (fixed) state register 0
033	Meter (fixed) option register 0
035	Meter (changeable) option register 0
037	Meter (display) state register 0
048	Software version number
050	Power-fail counter
053	Last voucher ID in time format (STS only)
054	Last voucher ID in date format (STS only)
055	Last credit voucher ID
056	Value of last credit voucher entered
057	Key revision and key type
058	Tariff index
059	Current credit register (10 Wh resolution)
060	SGC register (STS only)
061	Total units counter (10Wh resolution)

11.1. Meter Number (Register 000)

The meter displays the unique identity number personalised at the time of manufacture. It must match the number printed on the meter's front panel label. NB: This number excludes the manufacturer code ("07" in the case of Cashpower meters manufactured in S. Africa), check-digit (last digit of the serial number label) and leading zeros of the meter number. For example, meter number 07 0286 6860 1 will be displayed as 286 6860.

11.2. Instantaneous Power (Register 001)

The meter displays the instantaneous power being consumed by the connected load.

NB: Only one power reading will be displayed at a time i.e. the reading will not automatically be updated after the initial value displayed. To get another update, the 3-digit register code 001 must be entered again.

11.3. Current Credit Register (Register 002)

This register stores the *remaining credit* in the meter.

11.4. Total Units Counter (Register 003)

The meter displays the *total kWh* consumed since the meter was put into service.

11.5. Current 24-Hour Consumption (Register 006)

The meter displays the number of hours into the current 24-hour period, followed by the consumption (kWh) during this period. By pressing the information key twice in rapid succession, the hour counter and consumption value is reset to zero and a new cycle commences using this as the reference time.

Note: This does not affect the previous 24-hour period statistic or either of the 30-day statistics.

11.6. Previous 24-Hour Consumption (Register 007)

The meter displays the previous 24-hour period consumption (kWh).

11.7. Current 30-Day Consumption (Register 008)

The meter displays the number of days into the current 30-day period, followed by the consumption (kWh) during this period. By pressing the information key twice in rapid succession, the day counter and consumption value is reset to zero and a new cycle commences using this as the reference date.

Note: This does not affect the previous 30-day period statistic or either of the 24-hour statistics.

11.8. Previous 30-Day Consumption (Register 009)

The meter displays the previous 30-day period consumption (kWh).

11.9. Low Credit Level (Register 012)

The meter displays the level at which the lower two *credit wedges* on the LCD come into operation.

11.10. High Credit Level (Register 013)

The meter displays the level at which the upper two *credit wedges* on the LCD come into operation.

11.11. Power Limit Level (Register 014)

The meter displays the power level (in either Amps or Watts) at which the *load switch* will be opened, causing the supply to the customer to be interrupted.

11.12. Extended Meter Number (Register 024)

The 'extended meter number' displays the 'missing' three digits of an (STS only) meter number in the format '07- - - - n' where:

07 is the manufacturer code (07 for S. African manufactured Landis+Gyr meters).

n represents the check digit.

11.13. Meter (Fixed) State Register 0 (Register 031)

The meter displays the state in which the meter currently is. Note that these values are stored in the meter's EEPROM and will be maintained even if the meter is powered down:

Meter (Fixed) State Register 1	
Display	Function (bracketed values apply for bit set to 1)
1XXX XXXX	Contactor inhibit (power limit lockout mode – 30 minutes)
X1XX XXXX	Significant reverse energy metered
XX1X XXXX	Credit-metering enabled
XXX1 XXXX	Meter decommissioned
XXXX 1XXX	Meter NOT initialised (default key)
XXXX X1XX	Meter in power limit trip (30-seconds)
XXXX XX1X	Meter out of credit
XXXX XXX1	Meter tampered

11.14. Meter (Fixed) Option Register 0 (Register 033)

The meter displays functions personalised into the meter at the time of manufacture. They cannot be subsequently changed via a voucher:

Meter (Fixed) Option Register 0	
Display	Function (bracketed values apply for bit set to 1)
1XXX XXXX	Not used
X1XX XXXX	Not used
XX1X XXXX	Not used
XXX1 XXXX	Do not open (open) the meter contactor when commissioning a customer interface unit
XXXX 1XXX	Not used
XXXX X1XX	Disable (enable) creep detection
XXXX XX1X	Don't display (do display) negative credit
XXXX XXX1	(Enable) STS

11.15. Meter (Changeable) Option Register 0 (Register 035)

The meter displays the functions personalised at the time of manufacture. These functions can be subsequently changed via a voucher:

Meter (Changeable) Option Register 0	
Display	Function (bracketed values apply for bit set to 1)
1XXX XXXX	Not used
X1XX XXXX	Not used
XX1X XXXX	Tamper detect sensing switch (enabled)
XXX1 XXXX	Don't tamper (do tamper) on significant reverse energy
XXXX 1XXX	(Disconnect) load switch on power fail
XXXX X1XX	Amps (Watts) power limit display
XXXX XX1X	Automatic (non-automatic) contactor closing after power limit trip
XXXX XXX1	Display credit register or (display total register) on meter as default display

11.16. Meter (Display) State Register 0 (Register 037)

The meter displays various states that are determined each time the meter starts up or that occur during normal operation. They are not stored in EEPROM:

Meter (Display) State Register 0	
Display	Function
1XXX XXXX	Meter out of (in) creep lock
X1XX XXXX	Not used
XX1X XXXX	Not used
XXX1 XXXX	Tamper detect sensing switch state (open)
XXXX 1XXX	No EEPROM (EEPROM) error detected
XXXX X1XX	Not used
XXXX XX1X	50 (60) Hz mains frequency detected
XXXX XXX1	Not used

11.17. Software Version Number (Register 048)

The meter displays the software version number masked into the microprocessor.

11.18. Power-Fail Counter (Register 050)

The meter displays the number of power failures that have occurred. This register is cleared with the entry of a *tamper* reset voucher – 7.5.1.4.

11.19. Last (STS only) Voucher ID in Time Format (Register 053)

The meter displays the time of issue of the last CTN entered.

11.20. Last (STS only) Voucher ID in Date Format (Register 054)

The meter displays the date of issue of the last CTN entered.

11.21. Last Voucher Entered (Register 055)

For STS meters, the voucher identifier is displayed (0 – 16777215) i.e. number of minutes elapsed since 01:01:1993.

For CTS meters it is a sequence number.

11.22. Value of Last Voucher Entered (Register 056)

The meter displays the value (kWh) of the last CTN entered.

11.23. Key Revision and Key Type (Register 057)

Refer to the STS specification

11.24. Tariff Index (Register 058)

Refer to the STS specification

11.25. Current Credit Register - 10Wh Resolution (Register 059)

The meter displays the value of the *credit register* with a resolution of 0.01kWh. The most significant digit of the display (if in use) will be “pushed” off the display in this mode.

11.26. Supply Group Code (SGC) Register (Register 060)

This register will contain the initial SGC value, personalised at the time of manufacture. Once a successful STS meter key-change has been performed, the information is no longer valid and is, therefore, cleared. This option gives a quick indication of whether a key-change has been performed on the meter.

11.27. Total Units Counter - 10Wh Resolution (Register 061)

The meter displays the value of the *total units register* with a resolution of 0.01kWh. The most significant digit of the display (if in use) will be “pushed” off the display in this mode.

12. POWER LINE CARRIER (PLC) COMMUNICATION CONSIDERATIONS

The AC mains supply is subject to many forms of interference and attenuation that can affect the performance of PLC communication.

To help overcome problems, both the customer interface unit and meter implement multiple ‘retries’ of messages as necessary. This will be most noticeable at the customer interface unit, where there could be significant delays before a response to an action is seen (scrolling display and the keypad effectively ‘locked’). Typically there should be a less than 1-second response time to any request. Lengthy delays (up to 2 minutes) on a regular basis would indicate a poor communications environment.

Care must be exercised to ensure that a suitable location for the customer interface unit has been chosen so as to guarantee reliable communications with the meter on an ongoing basis. Once a meter has been successfully ‘commissioned’, it is unlikely that communications should fail.

In the event of a communications failure, the customer interface unit will display an error message (----- 30-----). The following options should be tried:

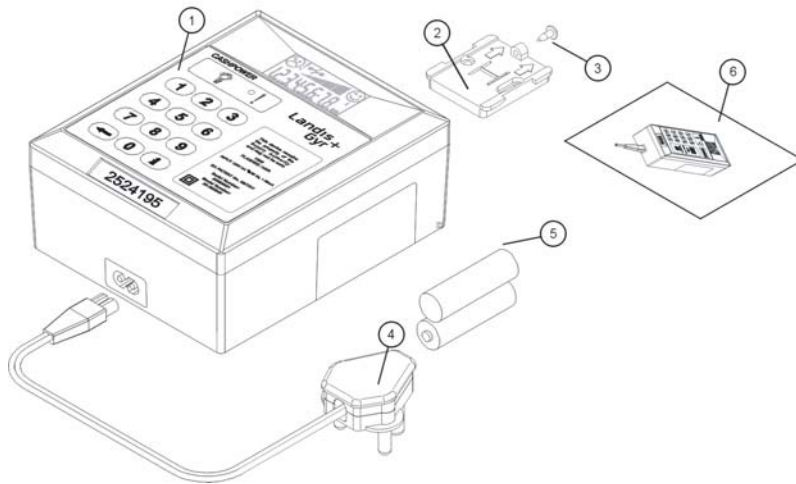
- If it happens during the *commissioning* process, ensure that the correct meter number has been entered (there is no differentiation between a communications failure resulting from loss of signal and a meter not responding because it has been incorrectly addressed).
- Unplug appliances adjacent to the customer interface unit.
- Plug the customer interface unit into an alternative power outlet socket inside the customer’s premises.
- Systematically disconnect other household appliances that are plugged in and switched on to see if any one in particular is causing a problem.
- Occasionally, faulty electrical circuits can generate a lot of interference that disrupts communications (*pay particular attention to compact fluorescent lamps (CFLs)*). Isolate as many circuits as possible to try and determine the source of the interference.

13. REMOTE ACCESS

The meter may be remotely accessed via other devices using the same PLC communication channel as the customer interface unit e.g. for interfacing to an Automatic Meter Reading system. These communications are totally independent and will have no effect on the operation of either the customer interface unit or the meter.

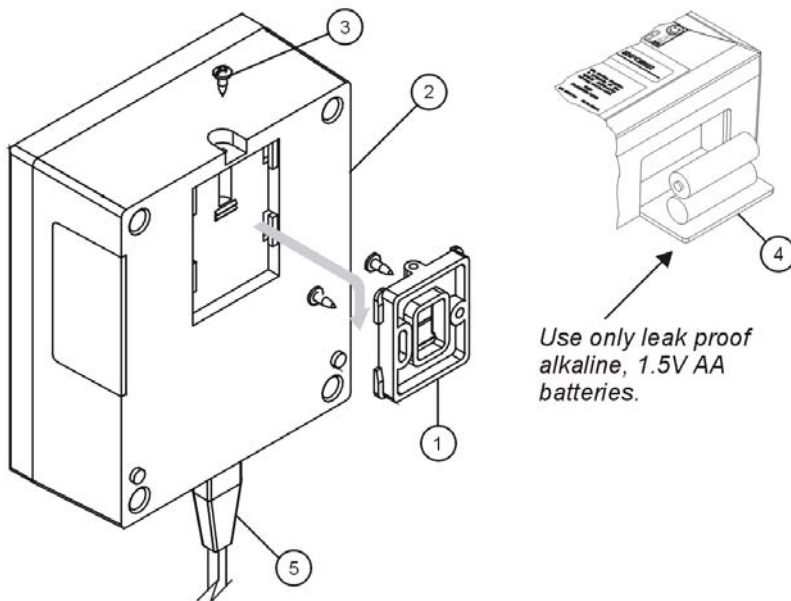
14. CUSTOMER INTERFACE UNIT INSTALLATION

The device is supplied as shown below.



- 1 CIU
- 2 Mounting Clip
- 3 Locking screw
- 4 AC power cord
- 5 2 x AA batteries
- 6 Instruction card

Choose a convenient location close to an AC supply outlet socket (maximum of 1m). The display should be clearly visible and the keypad easy to operate.



1. Fix mounting clip to wall with suitable size screws (not supplied)
2. Slide unit onto clip as shown
3. Secure into place with locking screw
4. Insert batteries with polarity as shown
5. Fit power cord and plug into an AC outlet

15. SAFETY

The meter does not constitute a safety risk whilst the meter cover is in place and the seals unbroken.

The communications interface is galvanically isolated from the mains supply (isolation specification is in excess of the requirements for SELV circuits as specified in SANS IEC 60950).

The customer interface unit is a very low voltage and low current (SELV) device and may be mounted in any convenient location inside a customer's residence.

16. METER DIMENSIONS

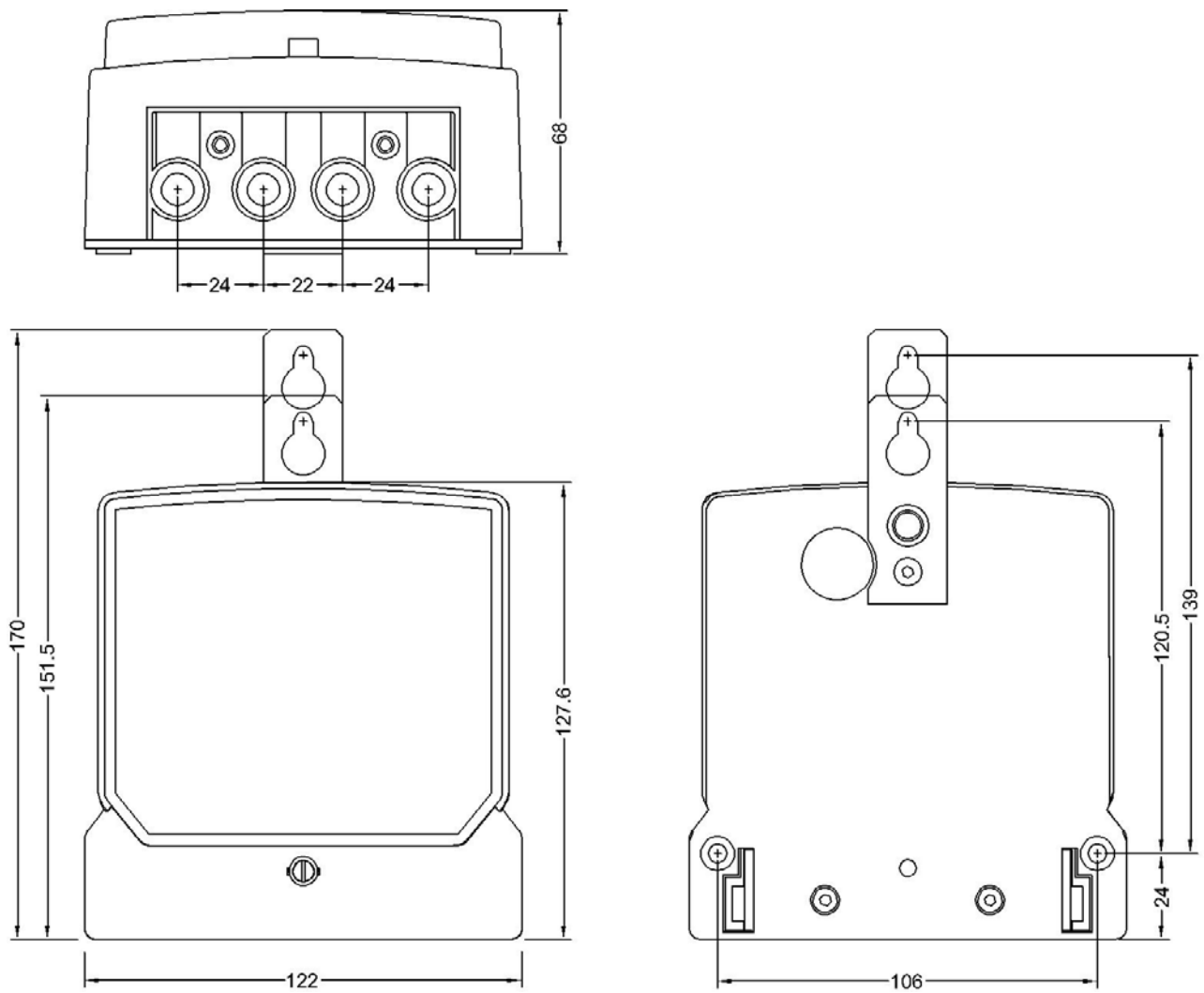


Figure 7: Gemini PLC meter with short terminal cover - Dimensions

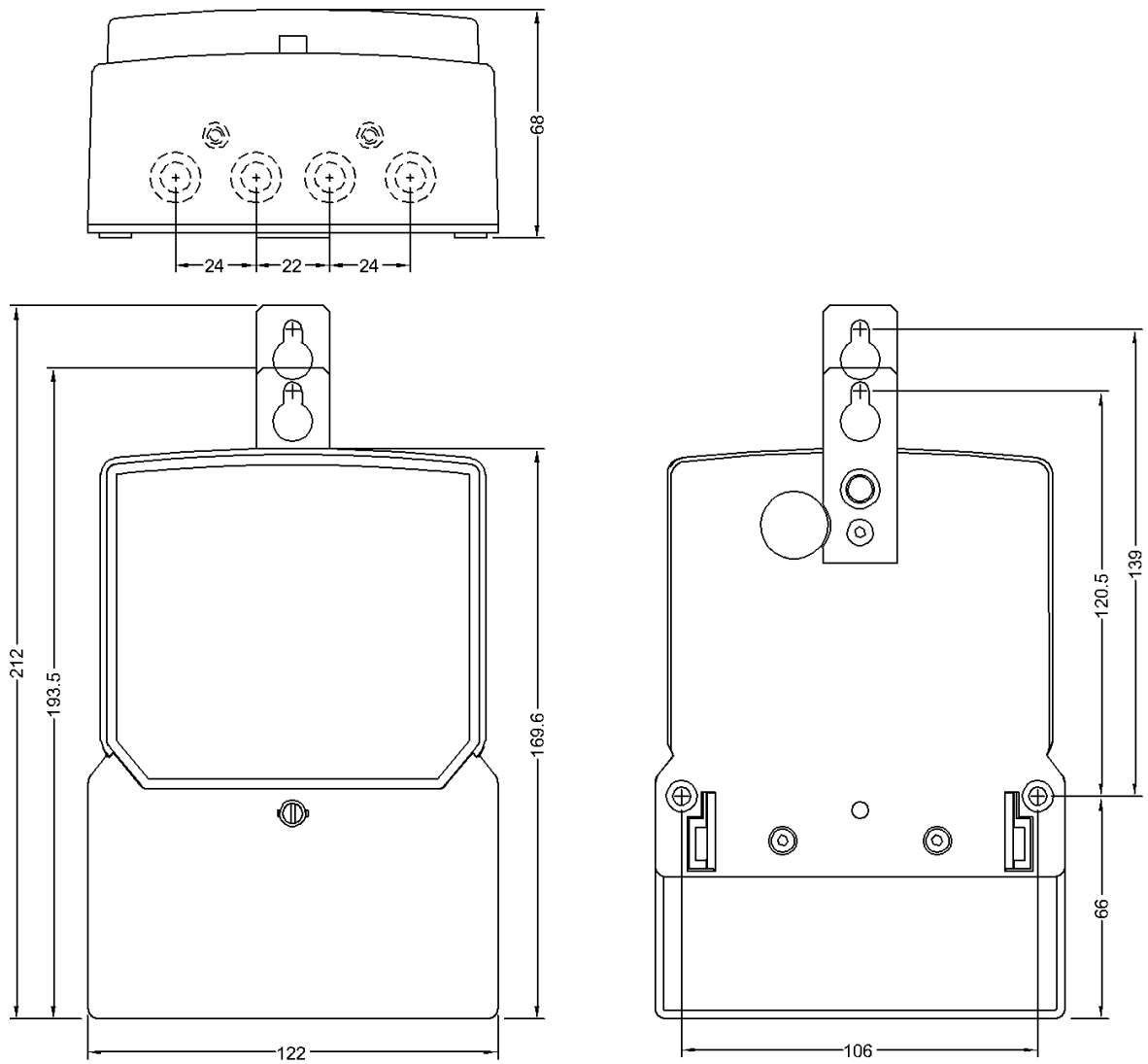


Figure 8: Gemini PLC meter with long terminal cover - Dimensions

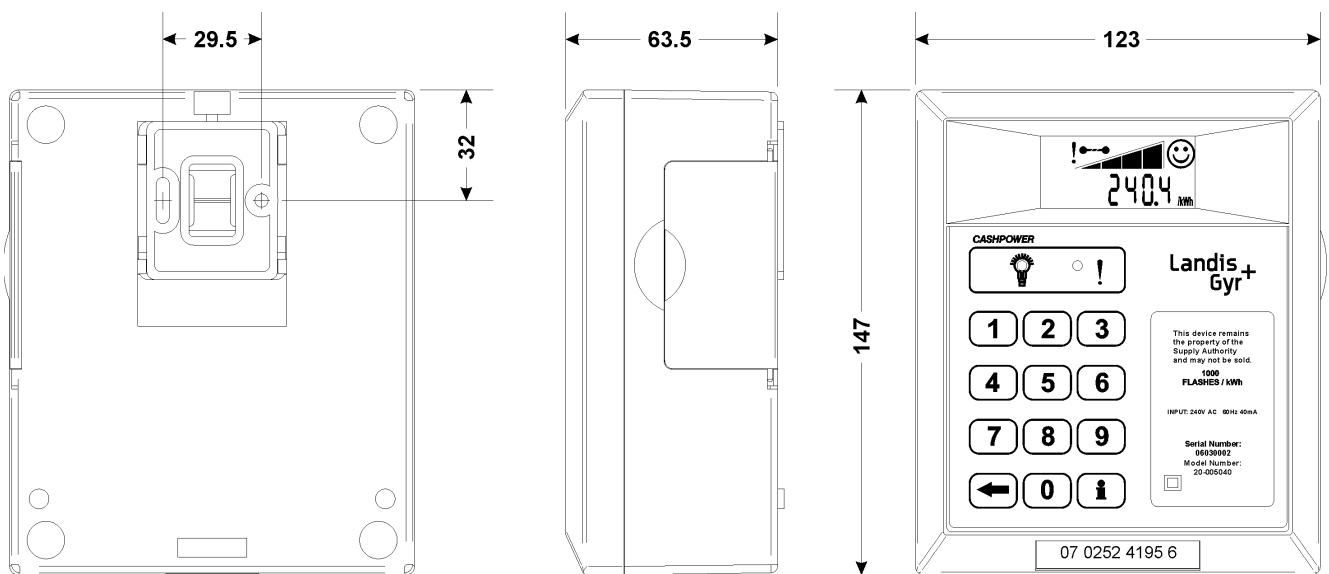


Figure 9: PLC Customer Interface Unit - Dimensions

17. METER SPECIFICATIONS

General Information	
Type	Single-Phase, 2-wire, direct connected prepayment meter.
Compatible network (s)	Single-Phase, 2-wire, earthed neutral ¹
Operation	
General	Prepayment and Credit Modes
Credit entry mechanism	Keypad; encrypted numbers
Encryption algorithms	STS Compliant ²
Applicable specifications	NRS009-1; NRS009-6-6; NRS009-6-7; ³
Electrical Ratings	
Nominal Voltage (U_n) - Rated Voltage	230 Volts AC rms (<i>other voltages available on request</i>)
Nominal frequency	50 Hz (<i>60Hz option available</i>)
Operating Voltage range	80% to 120% of U_n (184V – 276V)
Maximum Continuous Current (I_{max})	80 Amps (factory and field programmable to lower power limits)
Burden	
Voltage circuit	<1.4W / <9VA @ 230V
Current circuit	<2.5 VA @ Base Reference Current (I _b)
Protective class (according to IEC 62052-11)	Class II (double insulated)
Metrological Performance	
Measurement Direction	<i>Forward and reverse power detection and metering⁴ (Credit is decremented in both directions)</i>
Meter constant (LED flash rate)	1000 impulses / kWh
Basic reference current (I _b)	10A ⁵
Accurate metering range	0.05 I _b to 1.2 I _{max} ⁶
Starting current	≤ 0.005 I _b (For Class 2)
Power threshold	6.5W (approx 28mA @ 230V and cos(Φ) = 1) ⁷
Accuracy Class Index	<i>Class 1 and Class 2 meters available</i>
Maximum error	
Class 1	< ± 1% over range 0.1 I _b to I _{max} ; 0.5 ≤ cos(Φ) ≤ 1.0 (lead or lag) ⁸
Class 2	< ± 2% over range 0.1 I _b to I _{max} ; 0.5 ≤ cos(Φ) ≤ 1.0 (lead or lag)
Disconnection device	
Type	Single Pole latching contactor 100A.

Insulation; Overvoltage and Surge Protection	
Insulation system classification	Protective Class II (according to IEC 62052-11)
Insulation level	4kV rms for 1 minute
Overvoltage withstand	440VAC for 48 hours ⁹ 600VDC for 1 minute ¹⁰
Surge immunity	
Voltage impulse withstand	
Differential	6kV, 1.2/50μs, with 2Ω source impedance
Current impulse withstand	
Service rating	5 kA 8/20μs
Withstand rating	30 kA, 4/10μs
Specification compliance	SABS 1524-1, IEC 62052-11
Electromagnetic compatibility (EMC)	

¹ May be compatible with other network types as well – Consult Landis+Gyr

² STS = Standard Transfer Specification (Industry Standard)

³ NRS = National Rationalised Specification (South Africa)

⁴ Will accurately meter energy if Line and Load connections are reversed. Can also be configured to tamper on reverse energy detection.

⁵ Other Base Currents available on request.

⁶ The metering is accurate within the limits specified by IEC62053-21. Should a meter momentarily be operated outside its specified maximum current rating it will meter accurately up to 1.2 I_{max}.

⁷ The Power Threshold represents the minimum load power that the meter will register. This value is programmable, with the recommended level for a base 10A meter shown.

⁸ IEC 62053-21: 0.8 ≤ cos(Φ) ≤ 1.0 Leading, 0.5 ≤ cos(Φ) ≤ 1.0 Lagging

⁹ This higher specification (440V as opposed to 400V) has not yet formed part of the official specification

¹⁰ This higher end test is not a requirement of IEC 62052

Electrostatic discharge Immunity to HF fields Immunity to fast transient bursts Radio interference Specification compliance	15 kV air discharge 80 MHz to 2 GHz @ 10V/m with load, 80MHz to 2GHz @ 30V/m no load 4 kV Complies with requirements for CISPR 22 IEC 61000-4-2; IEC 61000-4-3; IEC 61000-4-4; IEC 61000-4-6 CISPR 22
Communication Circuitry	
Type Carrier frequency Protocol Specification compliance	Power line carrier 66kHz (FSK) Device Language Message Specification (DLMS). High-level data link control (HDLC). IEC61334-4-41 , ISO/IEC13239 and EN 50065
Communication Range	Typically > 200 m (network dependant)

Main Enclosure	
Type	Layout according to BS5685 footprint
Mounting	Two mounting screws bottom (spacing according to BS5685). Top mounting bracket available as an option
Rating	IP54 (IEC60529) ¹¹
Material Resistance to heat and fire Resistance to spread of fire	UV Stable Polycarbonate/ABS blend with flame-retardant <i>Complies with 960°C¹² glow-wire (IEC 60695-2-1) UL94-V0 rated @1.5mm. No toxic gases emitted: 'Green Material'¹³</i>
Dimensions	127.6mm(H) x 122mm(W) x 68mm(D) with short terminal cover ¹⁴
Mass	510 g
Terminals	
Layout	According to BS5685
Mains Terminals Type Material Maximum Cable Size	Double screw (M6), moving-cage terminal Mild steel, yellow passivated 25mm ²
Terminal Block Material Resistance to heat and fire Resistance to spread of fire	UV Stable Polycarbonate with flame-retardant <i>Complies with 960°C¹⁵ glow-wire (IEC 60695-2-1) UL94-V0 rated @1.5mm. No toxic gases emitted: 'Green Material'¹⁶</i>
Sealing	
Type Meter enclosure Terminal cover	Factory sealed with screw-sealing plugs Utility sealed with wire and crimped ferrule
Operating Environment	
Area of application	Indoor meter (according to IEC62052-11)
Operating temperature range	-10°C (+14°F) to +55°C (+131°F)
Storage temperature range	-25°C (-13°F) to +70°C (+158°F)
Relative humidity	Maximum ≤95%; Annual mean 75%
Man-Machine Interface (Basic Option)	
Rate of consumption indicator	Visible LED, 1000 pulses/kWh
Status Indication	Visible LED
Man-Machine Interface (LCD Option)	
Rate of consumption indicator	Visible LED, 1000 pulses/kWh

¹¹ Only IP51 rating is required by IEC 62052-11 for indoor meters

¹² Only 650°C called for by standard industry specification

¹³ No V-rating or 'Green' material called for by industry specifications

¹⁴ See diagram

¹⁵ Only 650°C called for by standard industry specification

¹⁶ No V-rating or 'Green' material called for by industry specifications

Liquid Crystal Display (LCD) Size Icon information Numeric information	9cm ² (45mm (W) x 20mm (H)), 8 digits + 11 icons Happy face, Sad face, Alert, Breaker status, Info, kWh, 4-segment credit wedge Optional default display of either Total kWh Consumed or Remaining Credit
External interfaces	
Standard Interrogation Port	8-pin interface according to ESKOM DISSCAAA9
Optical Communications Port	According to IEC 62056-21
Proprietary Interrogation Port	Data interface for Cashpower Powerscope
Specification compliance and Approvals	
IEC	IEC 62052-11; IEC 62053-21 IEC 62056-21 First Edition: 2002
SABS	SABS 1524-1 Edition 3
ESKOM Prepayment meters	ESKOM DISSCAAA9
BS	BS 5685: 1979

18. CUSTOMER INTERFACE UNIT SPECIFICATIONS

Electrical Ratings	
Nominal supply Voltage	230V AC (<i>other voltages available on request</i>)
Operating Voltage Range	184V – 276V
Nominal Supply Frequency	50Hz (<i>60Hz option available on request</i>)
Burden	<1.2W / <5VA @ 230V
Protective Class	Double insulated – SELV
Supply Connection	Detachable socket inlet
Batteries	2 X 1.5 Volt AA batteries (typical operating life - 2 years)
Communications Circuitry	
Type	Power line carrier
Carrier frequency	66kHz (FSK)
Protocol	Device Language Message Specification (DLMS). High-level data link control (HDLC).
Specification compliance	IEC61334-4-41, ISO/IEC13239 and EN 50065
Operating Environment	
Operating Temperature Range	-10°C (+14°F) to +55°C (+131°F)
Storage Temperature Range	-25°C (+12°F) to +70°C (+158°F)
Relative Humidity	Maximum ≤95%; Annual mean 75%
Enclosure	
Type	Wall mounted with plug-in AC power cord socket inlet and hinged battery compartment
Rating	IP 51
Material	UV Stable Polycarbonate/ABS blend with flame-retardant
Resistance to heat and fire	<i>Complies with 960°C¹⁷ glow-wire (IEC 60695-2-1)</i>
Resistance to spread of fire	<i>UL94-V0 rated @1.5mm. No toxic gases emitted: 'Green Material'¹⁸</i>
Dimensions	147mm(H) x 123mm(W) x 65mm(D)
Weight	500 g
Sealing	
Battery Compartment	Hinged door for battery replacement
Electronics Enclosure	Factory sealed - no user serviceable parts

Man-Machine Interface	
Type	Language-independent
Components	Pictographic/Numeric LCD display, keypad, LED rate of consumption indicator, audio feedback
Liquid Crystal Display (LCD)	
Size	9cm ² (45mm (W) x 20mm (H)), 8 digits + 11 icons
Icon information	Happy face, Sad face, Alert, Breaker status, Info, kWh, 4-segment credit wedge
Numeric information	Display of various meter information such as credit levels, number entry, etc.
Keypad	12-key, international standard layout including "Information" and "Backspace" keys
Buzzer	Audio feedback on key press, encrypted number Accept and Reject melodies, Low-credit alarms as a factory-programmable option
Rate of Consumption Indicator (Rate LED)	Rate of consumption indicator (Pulse rate proportional to current rate of consumption)
Alarm Indicator	Visible warning of critically low credit status
LCD Backlighting	Settable – On or Off
Diagnostic information	Meter parameters accessible via the "Information" key

¹⁷ Only 650°C called for by standard industry specification

¹⁸ No V-rating or 'Green' material called for by industry specifications