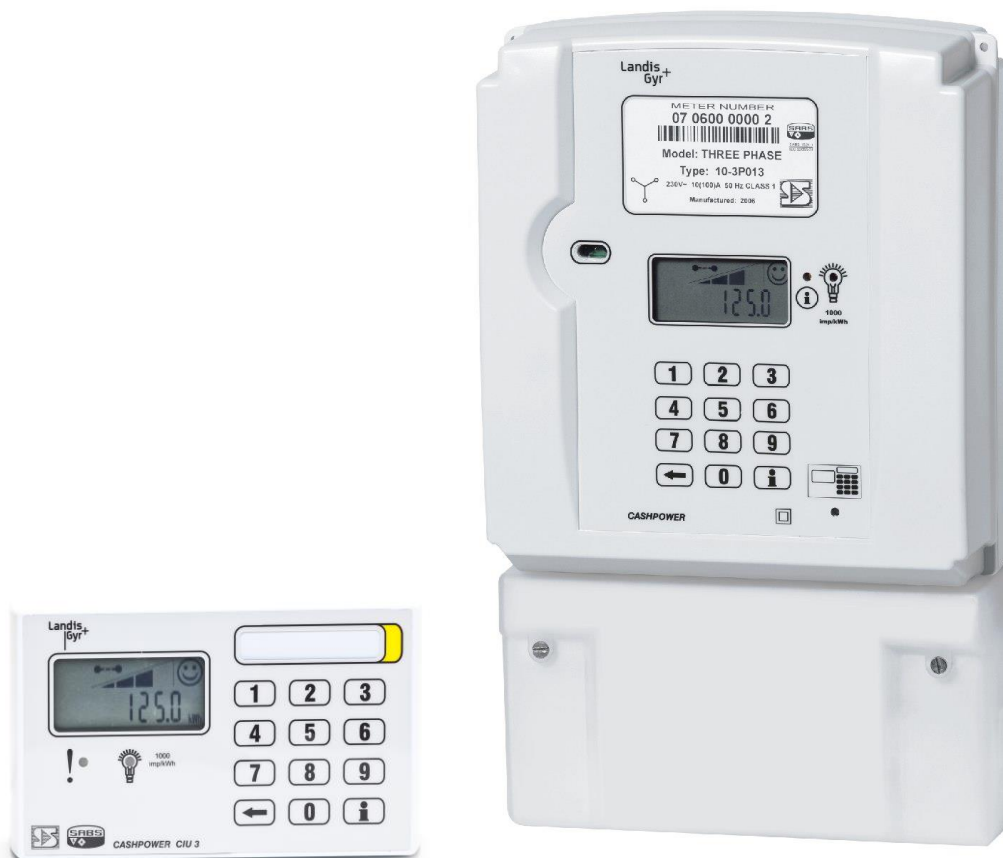


Cashpower Prepayment Metering
Cashpower Three Phase
Version 11 Firmware
User Guide



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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

SELV: Safe Extra Low Voltage

SGC: Supply Group Code

STS: Standard Transfer Specification

2 Introduction

The Cashpower Three Phase is a three phase, four-wire, 100 Amp per phase, split prepayment meter in a compact BS housing. The meter is suitable for residential, commercial and light industrial environments. It features a host of standard Cashpower software features, including the ability to operate in credit metering mode. The meter has a display and keypad and can be used as a stand-alone meter or can be converted into a split prepayment meter by simply fitting the customer interface unit with a dedicated two-core communications wire. The meter features a dedicated diagnostics indicator which shows the status of communications to the remote customer interface unit.

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



Figure 1: Three Phase Prepayment Meter



Figure 2: Customer Interface Unit

3 Meter Front Panel Features

The Three Phase meter makes use of a non-tactile, 12-key keypad with audible feedback for the entry of tokens and accessing of various management functions, and a custom LCD for the display of remaining credit, the scrolling in of keypad entries and various meter status and management functions. There are also 2 LED indications and an optical communications port, details of which are provided below.

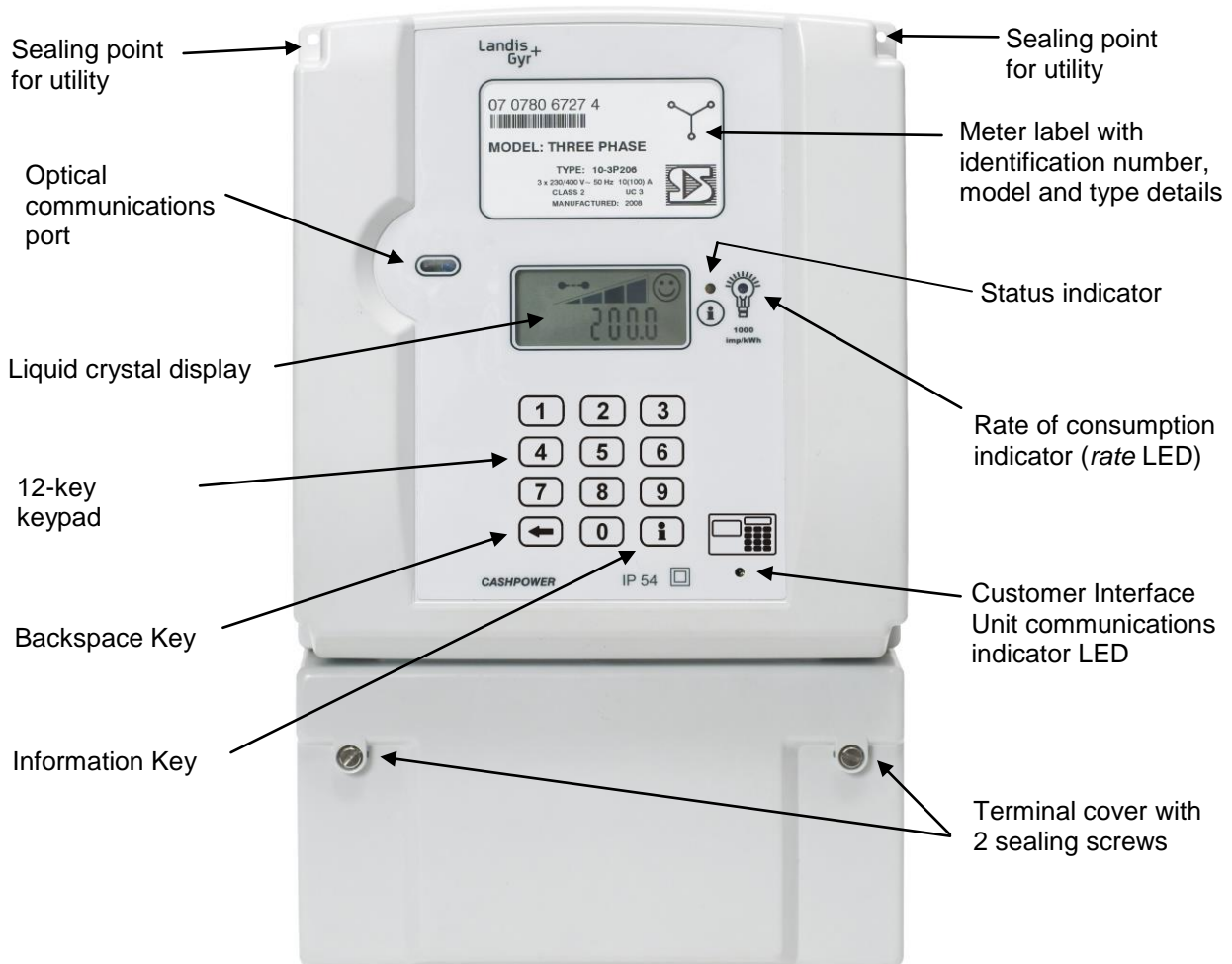


Figure 3: Three Phase Meter - Front Panel Features

3.1 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.

3.2 Liquid Crystal Display (LCD)

The LCD normally displays *remaining credit*. It can, however, be personalised to display the *total units consumed* - refer to 6.7. The LCD also displays the scrolling in of keypad entries and various *information* functions. For details of the LCD icons, refer to 5.

3.3 Rate of Consumption Indicator (Rate LED)

This red LED provides the *reference* output for verifying the meter's metrological accuracy. It also provides a visual indication of instantaneous power consumption.

The *meter constant* for the 3-Phase meter is set to 1000 impulses/kWh. The *rate* LED will therefore flash 1000 times for every kWh of energy consumed.

3.4 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.

3.5 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). Two or more flashes occurring at regular intervals indicate other status conditions as follows:

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

3.6 Customer Interface Unit Communications Indicator

This green LED gives a visual indication of communication status with a remotely connected customer interface unit:

- During normal operation, with a customer interface unit connected to the energy management unit, this LED flickers continuously at the transmitted data rate.
- If there is no communication with a customer interface unit, the LED glows steadily. This would be the case if the customer interface unit were faulty or the communications lines broken (open circuit).
- If the communication line is short-circuited, the LED is off.

4 Customer Interface Unit Front Panel Features

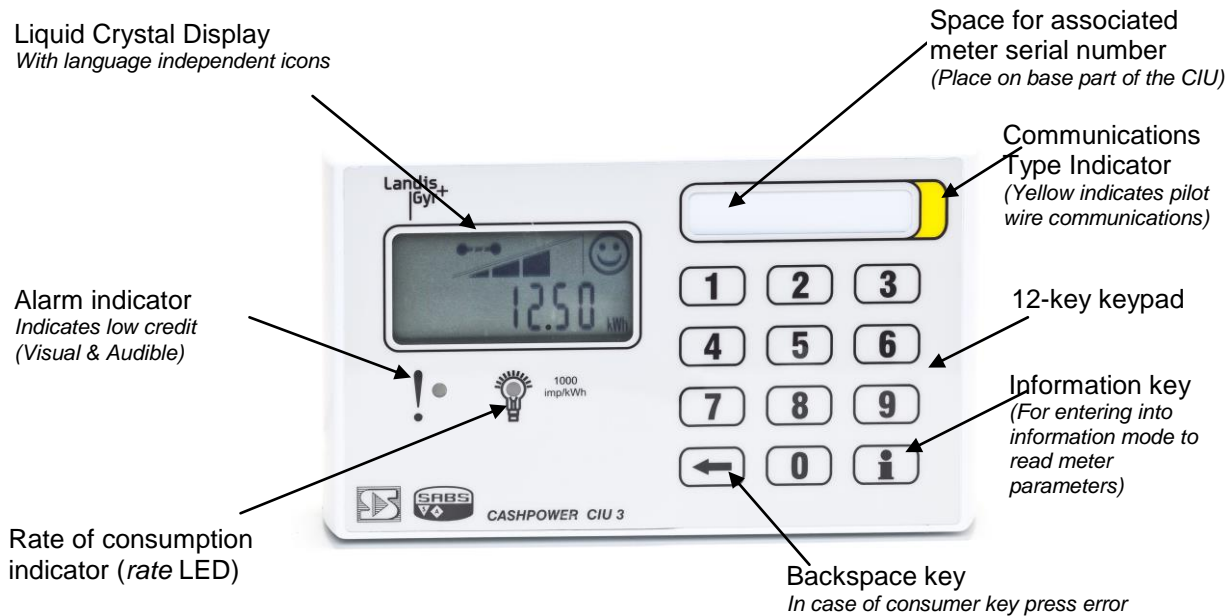


Figure 4: Customer Interface Unit front Panel indications

4.1 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.

4.2 Liquid Crystal Display (LCD)

The LCD normally displays *remaining credit* but also displays the scrolling in of keypad entries and allows for the viewing of various *information* functions. For details of the LCD icons, refer to 5.

4.3 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 visible indication of energy usage i.e. a fast flash rate signifies high usage.

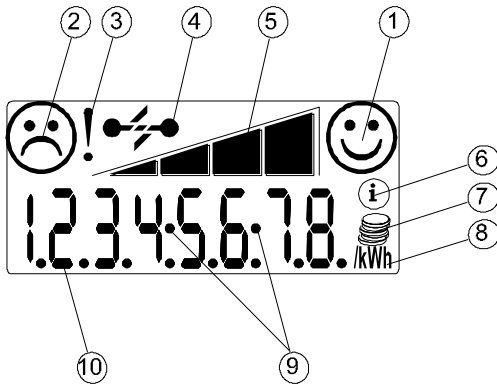
4.4 Alarm Indicator

A yellow alarm LED indicator duplicates the alarm indication on the LCD – 5.4. Its main function is to give the customer a visible indication of critically low credit levels.

5 LCD display

5.1 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 - Alert indicator
- 4 - Load switch status indicator
- 5 - Remaining credit indicator
- 6 - Information mode indicator
- 7 - Credit metering mode indicator
- 8 - Power (kWh) function.
- 9 - Time function (where used).
- 10 - Eight x 7 segment digits

5.2 Typical Operational Displays

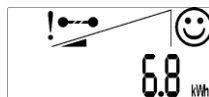
Normal Operation (Prepayment Mode)



Display shows *remaining credit* (kWh).

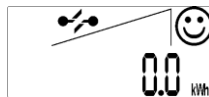
Load switch is closed and consumption *rate* indicator flashes at a rate proportional to the power being used.

Low Credit Warning (Prepayment Mode)



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

Zero Credit (Prepayment Mode)



No credit and supply disconnected.

Credit Metering Mode



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

5.3 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.

5.4 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 – 10.9.

5.5 Load switch 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.

5.6 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.

5.7 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 – 10. Note that the *information* mode automatically times out after a period of 1 minute in the absence of any further interrogation.

5.8 Credit Metering Mode Indicator

This icon is displayed in conjunction with the kWh indicator 5.9 to indicate when the meter is operating in *credit metering* mode.

5.9 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 Meter Operation - Prepayment Mode

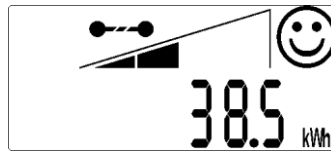
6.1 General

In this section the features and functionality of the prepayment meter are described in detail. Note that display and keypad entry functions pertain largely to both the energy management unit and customer interface unit. However, all processing of prepayment vouchers, load control etc. is carried out at the energy management unit.

Refer to section 8 for additional, customer interface unit-specific functionality.

6.2 LCD Functions During Normal Operation

During normal operation, 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 *load switch status* icon in either the closed or open position, depending on whether the meter is in or out of credit.

6.3 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 \square , 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 meter processes it and, depending on the result, displays one of the sequences described in – 6.4. 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.

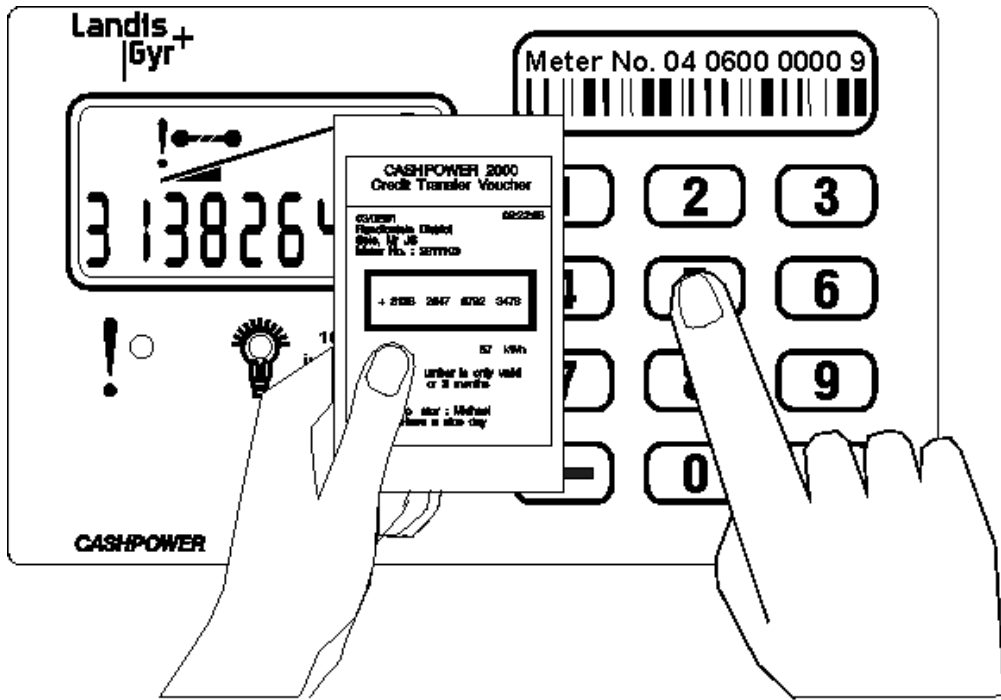


Figure 5: Entering vouchers via the Customer Interface Unit

☹️	😊	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

6.4 Prepayment Voucher Processing

Depending on the type of voucher entered into the meter, it will result in one of the display sequences described below:

6.4.1 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.

6.4.2 Complete Voucher

If a complete voucher is entered, the meter:

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

Depending on the result of the processing, one of the following sequences can occur. Refer to – 6.4.2.1 through – 6.4.2.6.

6.4.2.1 Voucher Accepted

- A scrolling *credit wedge* is displayed.

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

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

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

6.4.2.3 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.

NB: The voucher can be re-used at a later stage.

6.4.2.4 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.

6.4.2.5 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.

6.4.2.6 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.

6.5 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.

6.5.1 STS Format

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) – 6.5.1.1.
- Set *1st dispenser key* (meter-specific voucher) – 6.5.1.2.
- Set *2nd dispenser key* (meter-specific voucher) – 6.5.1.3.
- Clear *tamper* (meter-specific voucher) – 6.5.1.4.
- Set maximum *power load* or *power limit* level (meter-specific voucher) – 6.5.1.5.
- Set *current credit levels* (meter-specific, proprietary voucher) – 6.5.1.6.
- Clear *credit* (meter-specific, proprietary voucher) – 6.5.1.7.
- Initiate *dispenser test* (non meter-specific voucher) – 6.5.1.8.
- *Commissioning voucher* (non meter-specific, proprietary voucher) – 6.5.1.9.
- *Commissioning voucher* (meter-specific, proprietary voucher) – 6.5.1.10.
- *Decommissioning voucher* (meter-specific, proprietary voucher) – 6.5.1.11.
- Set *credit-metering* mode (meter-specific, proprietary voucher) – 6.5.1.12.
- Set *prepayment-metering* mode (meter-specific, proprietary voucher) – 6.5.1.13.

6.5.1.1 Electricity Credit Voucher

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

6.5.1.2 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).

6.5.1.3 Set 2nd Dispenser Key Voucher

Refer to – 6.5.1.2.

6.5.1.4 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* – 10.22.

6.5.1.5 Set Power Limit Voucher

This voucher sets the power limit level for the meter – 6.8.

6.5.1.6 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 – 5.6.

6.5.1.7 Clear Credit Voucher

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

6.5.1.8 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
Open the load switch	0000 0000 0001 5099 7584
HMI test - turns on all the <i>LED</i> 's, 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
Test all 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.

6.5.1.9 Commissioning Voucher (Non Meter-Specific, Proprietary Voucher)

This is a *non meter-specific* voucher i.e. it may be used on 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 load switch closes and the *tamper* detect sensing switch function is enabled.

6.5.1.10 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 6.5.1.9.

6.5.1.11 Decommissioning Voucher (Meter-Specific, Proprietary Voucher)

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

6.5.1.12 Set Credit Mode (Meter-Specific, Proprietary Voucher)

On accepting a *set credit metering mode* voucher, the meter commences operation as described in 7.

6.5.1.13 Set Prepayment Mode (Meter-Specific, Proprietary Voucher)

On accepting a *set prepayment metering mode* voucher, the meter commences operation as described in – 6.

6.5.2 Proprietary Format

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 – 6.4.

The following voucher types will be recognised and accepted:

- Credit transfer number - 6.5.2.1.
- Key change number - 6.5.2.2.
- Initial key change number - 6.5.2.3.
- Tamper reset - 6.5.2.4.
- Power limit level - 6.5.2.5.
- Set credit levels - 6.5.2.6.
- Reset meter (clear credit register) – 6.5.2.7.
- Clear log - 6.5.2.8.
- Non meter-specific initiate load switch test voucher – 6.5.2.9.
- Non meter-specific *commissioning* voucher – 6.5.2.10.
- Meter-specific *commissioning* voucher – 6.5.2.11.
- Meter-specific *decommissioning* voucher – 6.5.2.12.

6.5.2.1 Credit Transfer Voucher

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

6.5.2.2 Key Change Voucher

As part of a key change, some variable amount of credit is embedded in the voucher. NB: Because of the additional functionality of this voucher, there is a limited range of credit values available i.e. a choice of 8 pre-defined values in 102.4 kWh steps.

6.5.2.3 Initial Key Change Voucher

An *initial key change* number is treated in exactly the same way as a normal *key change* number – 6.5.2.2.

6.5.2.4 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 - 10.22.

6.5.2.5 Set Power Limit Level Voucher

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

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 – 10.11 and 10.19

6.5.2.6 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 – 5.6.

6.5.2.7 Reset Meter (Clear Credit Register) Voucher

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

6.5.2.8 Clear Log Voucher

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

6.5.2.9 Non Meter-Specific Initiate Load Switch Test Voucher

On accepting a *non meter-specific initiate breaker test* voucher, the meter opens the load switch 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

6.5.2.10 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 load switch closes and the *tamper* detect sensing switch function enabled.

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

9999 9999 9997 1939

6.5.2.11 Meter-Specific Commissioning Voucher

This is a *meter-specific* voucher but in all other aspects its operation is the same as described in 6.5.2.10.

6.5.2.12 Meter-Specific Decommissioning Voucher

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

6.6 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. If power is applied to the meter during installation and the meter terminal cover not yet in place, the meter will detect this and enter into the *tampered* mode, thereby disconnecting the supply to the customer. A meter-specific *tamper reset* voucher then needs to be generated at the vending system to rectify the situation.

When setting the meter into the *decommissioned* mode, the following occurs:

- The *tamper* detect sensing switch function is disabled.
- The *load switch* is set into the open state.
- When setting the meter into the *commissioned mode*, the following occurs:
- The *tamper* detect sensing switch function may be either enabled or disabled.
- The *load switch* operates as normal.
- The meter's *commissioned* / *decommissioned* status can be observed in the *meter state register* – 10.17.

6.7 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* – 10.19.

6.8 Power Limiting

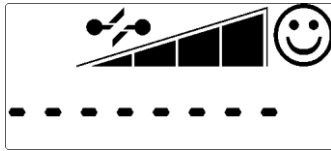
The power-limiting feature allows utilities to set the maximum load that can be drawn by customers. The setting can be changed when necessary via a *set power limit* voucher from the prepayment vending system.

Eskom specification SCSSCAA9 makes specific reference to a *power-limiting* algorithm. This algorithm is included in the meter's software and is implemented as follows:

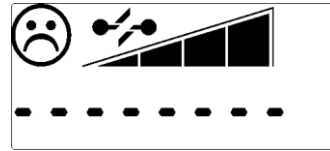
- If the preset *power limit* threshold is exceeded, the *load switch* will open for a period of 30s, after which it will re-close (either automatically or manually 6.9). If the *power limit* threshold continues to be exceeded, the above process is repeated. If, after 4 *power-limit* events within a 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 – 6.9) 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 works on a per phase basis. It 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).

If you set a maximum power limit of 20'000 W, this will translate to 20'000 W per phase, or a total of 60'000 W on all 3 phases if they are accurately balanced.

As soon as any phase exceeds 20'000 W, the meter will disconnect. So, if you are only drawing power on one phase, you will only have 20'000 W available. It is important that the phases are reasonably well balanced in a consumer's installation.

6.9 Automatic/Manual Load Reconnection

In some instances, local safety regulations require that the meter not automatically re-close the load switch after, for example, a power limit trip. Under these conditions, the load switch 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 6.8, the load switch 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 load switch closing, the load switch status icon on the LCD will start to flash, toggling between an open and closed state. This is a visual indication that the load switch may now be manually closed, by pressing any key on the keypad.

In the event of the load switch 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 load switch 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 – 10.19. It may also be changed at any stage with a suitable engineering voucher.

6.10 Disconnect on Power Failure

This option, configurable at the time of manufacture – 10.19, forces the meter's load switch 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 load switch is open.

6.11 Credit Reader Interface

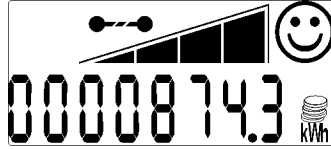
This port is available via a removable plug at the rear of the meter and should only be accessed when the meter is disconnected from power. It allows for meter data such as *remaining credit* to be extracted in the event of an electronics failure.

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.

7 Meter Operation (Credit Metering Mode)

The *credit-metering* option is only available when using the STS format. It is possible to toggle the meter between *prepayment* and *credit* modes of operation via proprietary 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 – 10.30 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 load switch will remain in the closed position. NB: The load switch 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 load switch will open.

8 Customer Interface Unit – Specific Functions

8.1 General

The customer interface unit effectively acts as a remote display and keypad for the meter. It does not implement any voucher decryption but does implement some local functions independently as described below.

8.2 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).

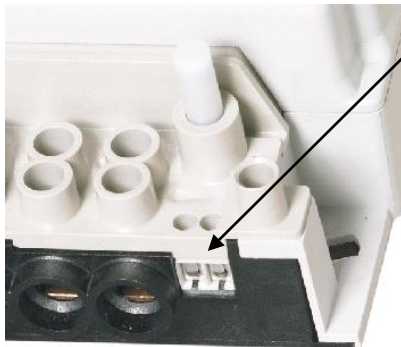
The mode can be toggled any number of times. NB: If the default setting of the alarm is changed via the keypad, it will revert to the default status every time power is removed from the customer interface unit.

The alarm is sounded when the *remaining credit* level in the meter reaches half of the *low credit* level - 5.6. 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.

8.3 Other Audible Tones

The customer interface unit generates a variety of tones in response to token entries e.g. there are two distinctly different tones to indicate TNA or TNR sequences.

8.4 Connecting the Customer Interface to the meter



Customer Interface Unit Terminals

The meter is connected to the customer interface unit by a two core communications wire up to a distance of 130 metres.

Communication wires to the customer interface unit are non-polarised.

NOTE: For improved lightning protection, it is recommended that one of the communications wires are connected to earth.

Figure 7: Close-up picture showing the Customer Interface Unit connection terminals

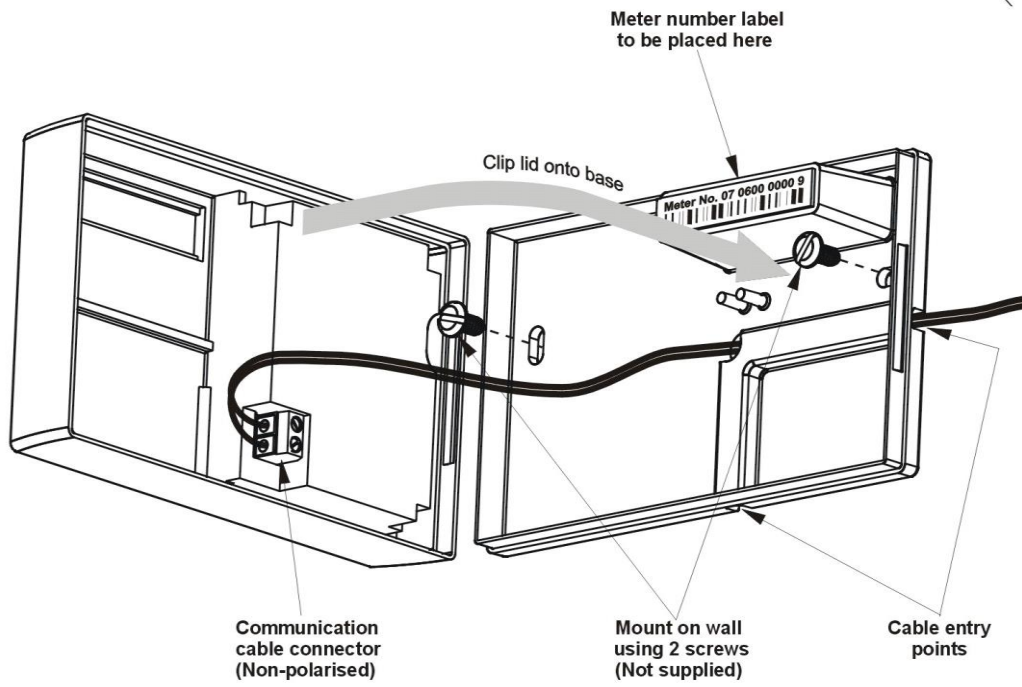


Figure 8: Rear view of the Customer Interface Unit

9 Anti-tamper Features

9.1 General

The Three Phase 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 Three Phase terminal cover is fitted to the meter with two terminal cover screws. The screws are 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.

9.2 Anti-Tamper Switch

The Three Phase 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



Figure 9: Three Phase Meter - Tamper Switch

9.3 Reverse Energy Detection

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.

The feature of *tampering on significant reverse power* is always disabled in the Cashpower Three Phase meters.

9.4 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.

10 Information Functions

Pressing the information key toggles the meter into *information* mode (the information icon on the LCD turns on and all digits display =====). 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 (all phases combined)
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
015	Instantaneous power (phase 1)
016	Instantaneous power (phase 2)
017	Instantaneous power (phase 3)
018	Creep lock indication
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
054	Last voucher ID in date/time 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)

10.1 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 South 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.

10.2 Instantaneous Power (Register 001)

The meter displays the instantaneous, combined power on all phases being consumed by the connected load.

10.3 Current Credit Register (Register 002)

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

10.4 Total Units Counter (Register 003)

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

10.5 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 backspace 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.

10.6 Previous 24-Hour Consumption (Register 007)

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

10.7 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 backspace 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.

10.8 Previous 30-Day Consumption (Register 009)

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

10.9 Low Credit Level (Register 012)

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

10.10 High Credit Level (Register 013)

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

10.11 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.

10.12 Instantaneous power on Phase 1 (Register 015)

The meter displays the instantaneous power being consumed by the connected load on phase 1 only.

10.13 Instantaneous power on Phase 2 (Register 016)

The meter displays the instantaneous power being consumed by the connected load on phase 2 only.

10.14 Instantaneous power on Phase 3 (Register 017)

The meter displays the instantaneous power being consumed by the connected load on phase 3 only.

10.15 Creep Lock Indication

This is the threshold below which no metering takes place. When in *creep lock* i.e. no energy being measured, the *power (kWh)* icon (5.1) on the LCD flashes on and off. When the creep threshold is exceeded and metering becomes active, the icon assumes a steady state.

10.16 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 South African manufactured Landis+Gyr meters).

n represents the check digit.

10.17 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 0	
Display	Function (bracketed values apply for bit set to 1)
1XXX XXXX	Load switch 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)

10.18 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	Not used
XXXX 1XXX	Not used
XXXX X1XX	Disable (enable) creep detection
XXXX XX1X	Don't display (do display) negative credit
XXXX XXX1	Disable (Enable) STS

10.19 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 disabled (enabled)
XXX1 XXXX	Don't tamper (do tamper) on significant reverse energy
XXXX 1XXX	Don't disconnect (disconnect) load switch on power fail
XXXX X1XX	Amps (Watts) power limit display
XXXX XX1X	Automatic (non-automatic) load switch closing after power limit trip
XXXX XXX1	Display credit register or (display total register) on meter as default display

10.20 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 (bracketed values apply for bit set to 1)
1XXX XXXX	Meter out of (in) creep lock
X1XX XXXX	Not used
XX1X XXXX	Not used
XXX1 XXXX	Tamper detect sensing switch state closed (open)
XXXX 1XXX	No EEPROM (EEPROM) error detected
XXXX X1XX	Not used
XXXX XX1X	50 (60) Hz mains frequency detected
XXXX XXX1	Not used

10.21 Software Version Number (Register 048)

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

10.22 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 – 6.5.1.4.

10.23 Last (STS only) Voucher ID in Date/Time Format (Register 054)

The meter displays the date of issue of the last credit voucher entered.

10.24 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 meters using the proprietary format, it is a sequence number.

10.25 Value of Last Voucher Entered (Register 056)

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

10.26 Key Revision and Key Type (Register 057)

Refer to the STS specification

10.27 Tariff Index (Register 058)

Refer to the STS specification

10.28 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.

10.29 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 an indication of whether a key-change has been performed on the meter.

10.30 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.