

Prepayment Electricity Metering System

**DOMESTIC**

Landis+Gyr



**CASHPOWER SABRE MK 5**

**USER'S GUIDE**

# Revision History

Revision	Date	Name/phone	Comment
a	2007-12-05	Paul Moolman	Document creation
0.0	2008-11-06	Dave Tarr	Updated for new Landis+Gyr branding and update of product pictures

## Abstract

This document is the User Guide for the Cashpower Sabre Mk5 Common Base keypad prepayment meters, designed and developed by Landis+Gyr (Pty) Ltd., South Africa

## Referenced Documents

None

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## 1. INTRODUCTION

Cashpower Sabre ED Mk5 is a single phase “common base” prepayment meter specially designed to meet Eskom's prepayment metering requirements. This meter is most suited to new reticulation and is directly and easily interchangeable with meters from other manufacturers using the standard common base.

The plug-in base, which also conforms to Eskom's specifications, allows the commissioning of the meter to be done after the installation of the base, thereby adding flexibility and installation convenience. Included with the base is a Metal Oxide Varistor (MOV), which ensures that the meter complies with the stringent Eskom specifications for the protection of prepayment meters.

The base is optional and can be supplied separately to the meter.

Cashpower Sabre has an optional tamper facility, which will enable the meter to detect when it is being drawn out of the common base.



*Figure 1: The Cashpower Sabre Prepayment Meter*

## 2. ABBREVIATIONS

LCD	Liquid Crystal Display
LED	Light Emitting Diode
ED	Electricity Dispenser

### 3. FRONT PANEL LAYOUT

The Sabre front panel comprises a non-tactile, 12-key keypad with audible feedback for the entry of tokens and accessing of various information registers, and a custom Liquid Crystal Display

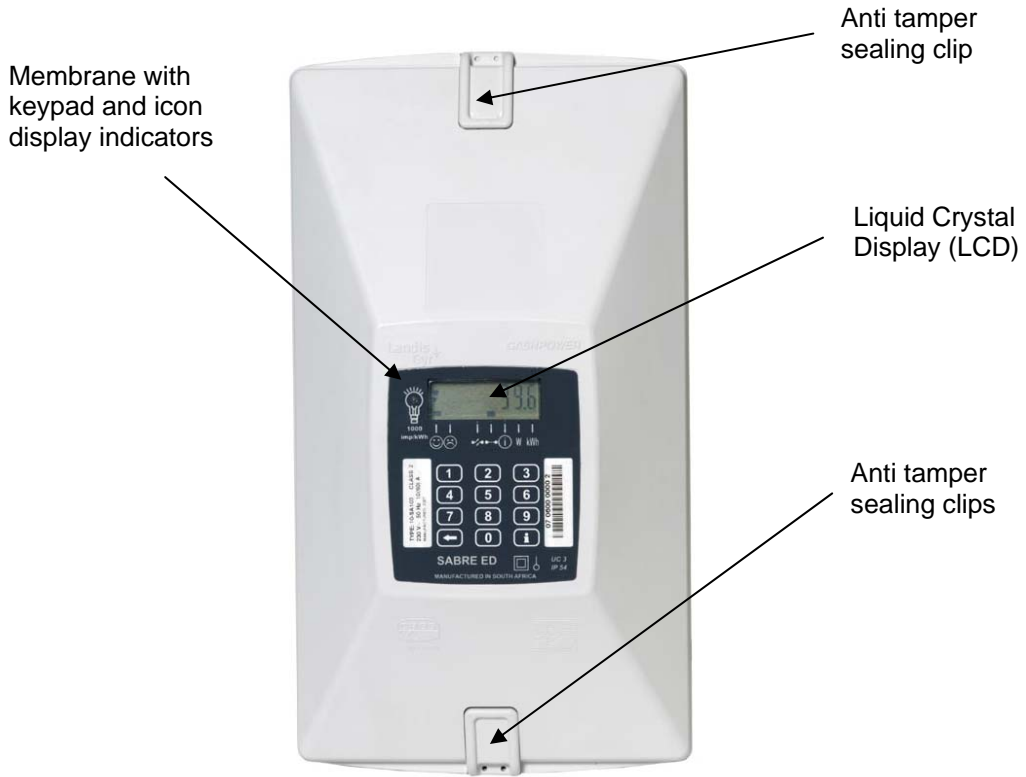


Figure 2: Cashpower Sabre Front Panel Features

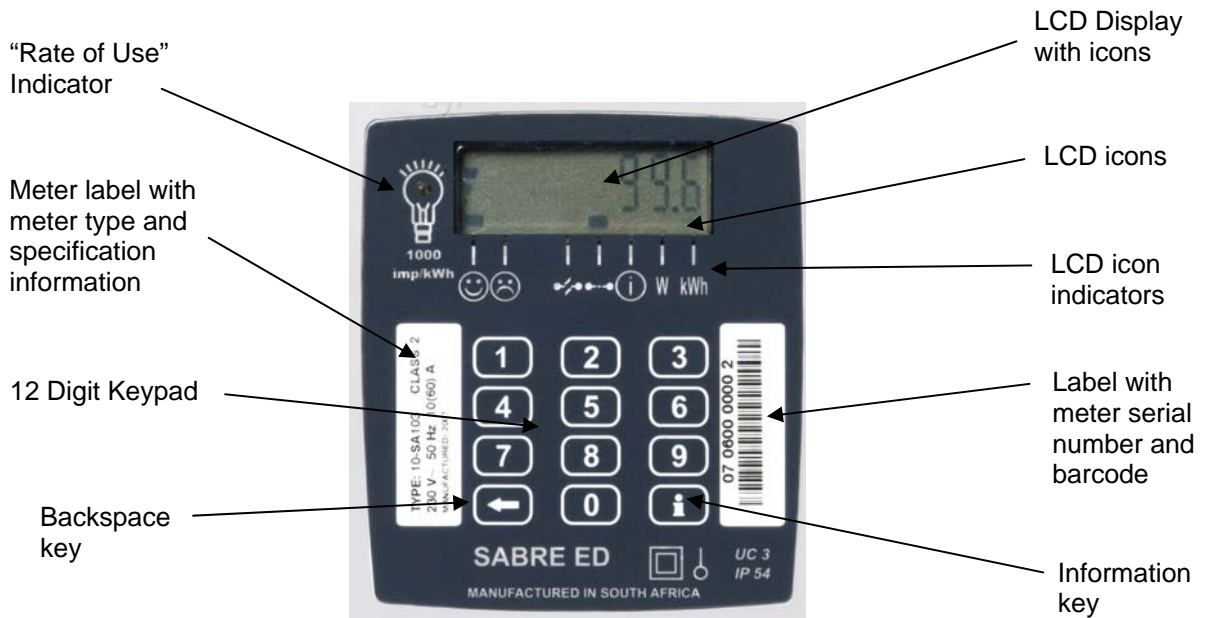


Figure 3: Close-up of the Cashpower Sabre membrane and LCD display features

### **3.1. Keypad**

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

### **3.2. Liquid Crystal Display (LCD)**

The LCD normally displays remaining credit. The LCD also displays the scrolling in of keypad entries and various information functions. For details of the LCD icons, refer to paragraph 4.

### **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 rate of power consumption.

The meter constant for the Sabre ED meter is set to 1000 impulses/kWh. The rate LED will therefore flash 1000 times for every kWh of energy consumed.

### **3.4. Meter Label Set**

The meter label set shows the unique meter numbers, type number, and its associated parameters. The label on the right hand side of the keypad contains the meter serial number and bar code while the label on the left hand side of the keypad contains the meter type number and technical specifications such as voltage, maximum current, frequency etc. Anti-tamper sealing clips

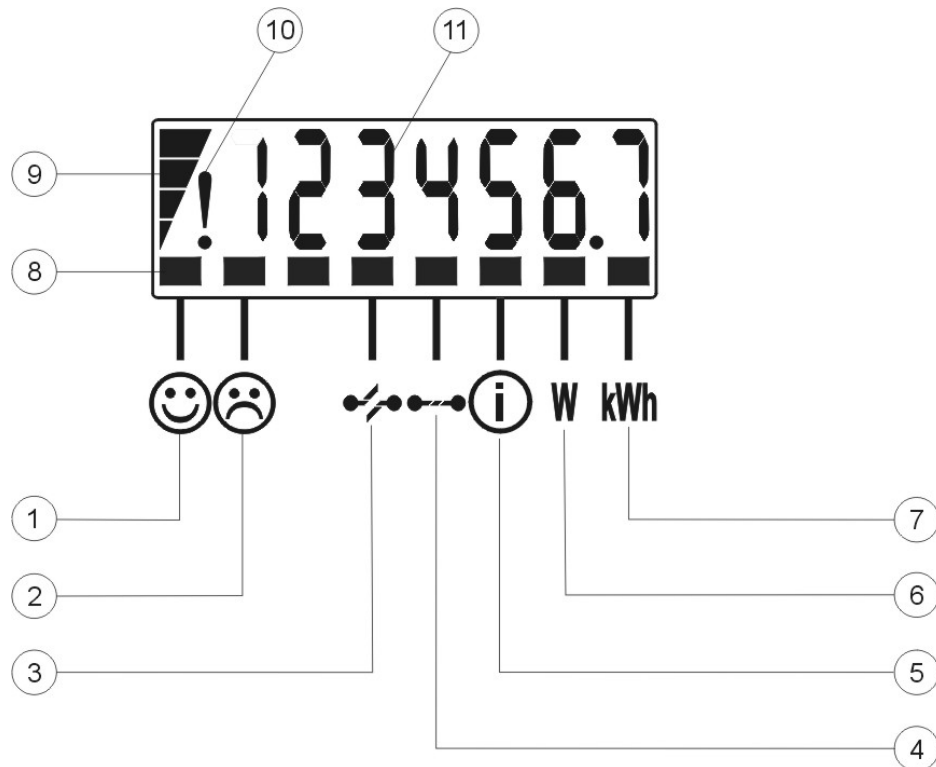
### **3.5. Anti-tamper sealing clips**

On installation, the Sabre is secured to its socket base with two screws. These screws are then covered with a plastic anti tamper clip and finally sealed with utility-sealed wire seals on the front of the meter. The use of these utility seals ensures that there are visible signs of tampering from the front of the meter.

## 4. LIQUID CRYSTAL DISPLAY (LCD)

### 4.1. Layout (what the icons mean)

The LCD is designed to give a clear and unambiguous visual indication of the important meter functions by means of language-independent pictograms. The LCD has three functional blocks: a numerical display for displaying various values such as remaining credit and power limit level, various pictograms such as the credit wedge, and pointers which point to pictograms on the membrane.



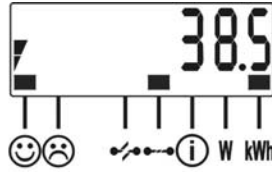
#### Legend:

1. Happy Face
2. Sad Face
3. Contactor 'Open' Indicator
4. Contactor 'Closed' Indicator
5. Information Mode Indicator
6. Power Indicator (W)
7. Power Indicator (kWh)
8. Icon Pointers
9. Remaining Credit Indicator (Credit Wedge)
10. Alarm Indicator
11. Numerical Display



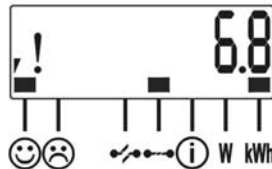
## 4.2. Typical Operational Displays

### Normal Operation



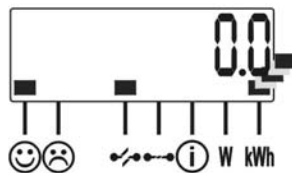
The display shows the remaining credit (kWh), displays (a portion of) the credit wedge, the happy face, contactor closed and kWh icons.

### Low Credit Warning



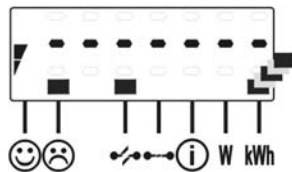
The credit is running low and more needs to be purchased to avoid disconnection of supply. Notice that only the smallest part of the credit wedge is displayed, in conjunction with the alarm.

### Zero Credit



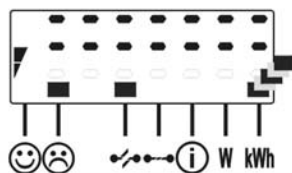
The supply is disconnected, whilst the happy face icon is displayed, indicating that the meter is functioning normally. The kWh icon flashes to indicate that no power is being supplied to the consumer.

### Power Limit Lockout



The supply is disconnected. The sad face icon is displayed to indicate an error condition, and the kWh icon will flash, as no power is supplied to the consumer. The center bar is displayed to indicate Power Limit Lockout.

### Magnetic Trip Lockout



The supply is disconnected. The sad face icon is displayed to indicate an error condition, and the kWh icon will flash, as no power is supplied to the consumer. The two top bars are displayed to indicate Power Limit Lockout.

## 4.3. 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 were operating normally, the happy face would be on. However, if it were to be tampered, the sad face would come on. Similar responses would apply during token entry e.g. entering an invalid CTN would result in the sad face flashing for a short period of time.

## 4.4. Contactor Status Indicators

Two icons are used to indicate the status of the load-switch (an internal latching relay).

Under normal operating conditions i.e. with the meter in credit, the load switch will be 'closed' and power is supplied to the consumer. A second 'open' indicator is used to indicate that the latch is open, e.g. when credit expires.

#### 4.5. Information Mode Indicator

This icon turns on in response to pressing the i-key on the keypad. It indicates that the meter is in information mode and the contents of various registers can be viewed. Refer to paragraph 6.

#### 4.6. Power Indicator (W)

This function is used whenever the displayed units represent power (W), such as instantaneous power, or power limit setting. It applies to both normal meter operation as well as when viewing registers via the information mode.

#### 4.7. Power Indicator (kWh)

This function is used whenever the displayed units represent power (kWh). It applies to both normal meter operation as well as when viewing registers via the information mode.

The icon can be OFF or flashing. The icon will be ON when the latch is closed and the load exceeds the minimum creep load (typically 40mA)

The icon will be flashing when the latch is open and there is no load

#### 4.8. Remaining Credit Indicator

This 'wedge' provides a quick visual indication of the remaining credit in the meter.

**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 a maintenance token (refer to paragraphs 6.8 and 6.9 for details of viewing the credit level settings).

The indicator functions as follows:

- All four *credit wedge* icons are displayed if the value in the *current credit register* is above the preset *high credit level*.
- The three smallest wedge icons are displayed if the value in the *current 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 *current 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 *current 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:** When the *remaining credit* level reaches zero, the numeric display indicates **0.0** kWh. If, for any reason, the credit level is decremented below zero i.e. negative, the display indicates **0.** kWh. This is the case if the meter has been personalised not to *display negative credit* – refer to paragraph 6.13. Although there is no negative value displayed, it gives a quick visual indication that a negative value is present (it is a requirement of some utilities to not show a negative credit value to consumers because in all likelihood it indicates tampering with the meter).

#### 4.9. 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.

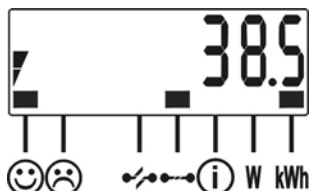
## 5. METER OPERATION

### 5.1. General

In this section the features and functionality of the prepayment meter are described in detail.

### 5.2. LCD Indications During Normal Operation

During normal operation, the LCD provides the following indications:



- Displays the *current credit register* value to a resolution of 0.1 kWh.
- 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.
- Flashes the 'kWh' icon if the meter is Creep mode (no power or very little power is consumed).

### 5.3. 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 space 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.

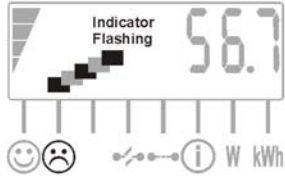
Incorrect entries can be corrected with the backspace key (left arrow key), which removes the rightmost digit on the LCD with each press. Two backspace key presses in quick succession will clear the entire entry.

Acceptance of a valid prepayment voucher is automatic. Once a complete voucher has been entered, the meter processes it and, depending on the result, displays one of the sequences described in paragraph 5.4. 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.

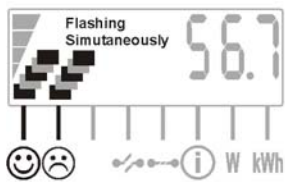
An incomplete voucher entry will be timed-out after 30 seconds, after which the LCD reverts to normal operation.



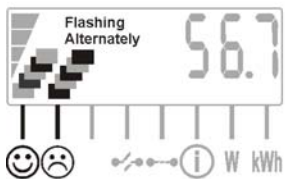
Normal Operation



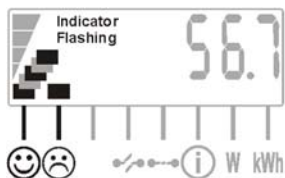
Wrong Number entered



Used Number entered



Expired Number entered



Meter already full

Figure 4: Typical Happy & Sad face combinations

## 5.4. Voucher Processing

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

### 5.4.1. 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.

## 5.4.2. Complete Voucher

If a complete voucher is entered, the meter:

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

Depending on the result of the processing, one of the following sequences can occur:

### 5.4.2.1. Voucher Accepted

- A scrolling *credit wedge* is displayed.

### 5.4.2.2. Voucher Accepted as a Valid Key Change Number

Note: Two vouchers are required for a 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.

### 5.4.2.3. Voucher Not Accepted By Meter

If the meter does not accept the voucher, it is rejected, and 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.

### 5.4.2.4. 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.

### 5.4.2.5. Expired Voucher

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.

### 5.4.2.6. 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.

## 5.5. Voucher Decryption and Processing

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 of 20-digit numbers.

The following STS voucher types will be recognised and accepted:

- Electricity *credit* (meter-specific voucher) – refer to paragraph 5.5.1.1.
- Set *1st dispenser key* (meter-specific voucher) - refer to paragraph 5.5.1.2.
- Set *2nd dispenser key* (meter-specific voucher) - refer to paragraph 5.5.1.3.
- Clear *tamper* (meter-specific voucher) - refer to paragraph 5.5.1.4.
- Set maximum *power load* or *power limit* level (meter-specific voucher) - refer to paragraph 5.5.1.5.
- Set *current credit levels* (meter-specific, proprietary voucher) - refer to paragraph 5.5.1.6.
- Clear *credit* (meter-specific, proprietary voucher) - refer to paragraph 5.5.1.7.
- Initiate *dispenser test* (non meter-specific voucher) - refer to paragraph 5.5.1.8.
- *Commissioning voucher* (non meter-specific, proprietary voucher) - refer to paragraph 5.5.1.9.
- *Commissioning* voucher (meter-specific, proprietary voucher) - refer to paragraph 5.5.1.10.
- *Decommissioning* voucher (meter-specific, proprietary voucher) - refer to paragraph 5.5.1.11.
- *Set Options Register* (meter-specific, proprietary voucher) – Refer to paragraph 5.5.1.12 below.

### 5.5.1.1. Electricity Credit Voucher

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

### 5.5.1.2. Set 1<sup>st</sup> 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 1<sup>st</sup> dispenser key* and *set 2<sup>nd</sup> dispenser key*) need to be issued and entered into the meter within a 5-minute period of each other. NB: *set 1<sup>st</sup> dispenser key* and *set 2<sup>nd</sup> dispenser key* vouchers may be entered in any sequence i.e. the *2<sup>nd</sup> 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).

### 5.5.1.3. Set 2<sup>nd</sup> Dispenser Key Voucher

Refer to paragraph 5.5.1.2 above.

### 5.5.1.4. 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*.

Note: the "TAMPER DETECT" function in the meter is NOT set as for previous versions of meter software.

#### 5.5.1.5. Set Power Limit Voucher

This voucher sets the power limit level for the meter – refer to paragraph 5.7.

#### 5.5.1.6. Set Credit Alarm Levels Voucher (Proprietary Voucher)

On accepting a credit alarm 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 – refer to paragraph 4.8 above.

*Note: If any of the credit levels transferred via the token is zero, the token is accepted, but the respective credit level is not updated.*

*Note: The set credit levels token is not defined in the STS specification. It is a CASHPOWER specific feature, and it uses one of the proprietary dispenser specific management token subclasses.*

#### 5.5.1.7. 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.

#### 5.5.1.8. 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.

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'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
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 duration is 5 seconds.

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

#### 5.5.1.9. Commissioning Voucher (Non Meter-Specific, Proprietary Voucher)

This is a *non meter-specific* voucher i.e. it can only be used on Landis+Gyr 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.

*Note: An already commissioned meter rejects a commissioning token.*

*Note: The commissioning token is a supplier specific STS voucher.*

#### 5.5.1.10. 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 paragraph 5.5.1.9.

*Note: An already commissioned meter rejects a commissioning token.*

#### 5.5.1.11. 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.

*Note: An already decommissioned meter rejects a commissioning token.*

#### 5.5.1.12. Set Options Register (Meter-Specific, Proprietary Voucher)

On accepting this voucher, the “Changeable Options Register 0” is set according to the 8-bit value in the token. Care must be taken when using this feature, as the operator would not know the settings in the meter, and various parameters could be set/reset. The parameters are as follows:

Enable/Disable Tamper Function

Tamper / Do Not Tamper on Significant Reverse Energy

Disconnect / Do Not Disconnect on Power-Fail

Non Automatic / Automatic Latch Reconnect

Refer to paragraph 6.14 for more detail.

### 5.6. 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* - refer to paragraph 6.11.

### 5.7. 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 DISCAA9 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 30 seconds (*power limit trip period*), after which it will re-close (either automatically or manually - refer to paragraph 5.8). 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 (*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 - refer to paragraph 5.8) 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.
- The LCD will display the following during the two conditions:

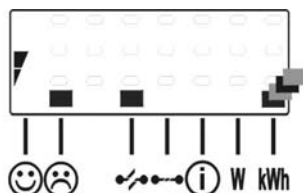


Figure 5: LCD Showing "Power Limit Trip" - Disconnection for a 30 second period

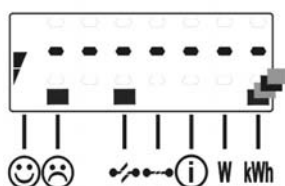


Figure 6: LCD Showing "Power Limit Lockout" - Disconnection for a 30 minute period

**NB:** *Power Limit* 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).

## 5.8. 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 paragraph 5.7, 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 – refer to paragraph 6.14. It may also be changed at any stage with a suitable engineering voucher.

## 5.9. Disconnect on Power Failure

This option, configurable at the time of manufacture, refer to paragraph 6.14, 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.

## 5.10. Anti-tamper Features

### 5.10.1. General

The Sabre meter is mechanically sealed against tampering through the use of a factory-sealed screw plugs on the rear panels and a utility-sealed wire seal on the front of the meter.

The use of these mechanical seals ensures that there are visible signs of tampering if unauthorised entry to the system is attempted.

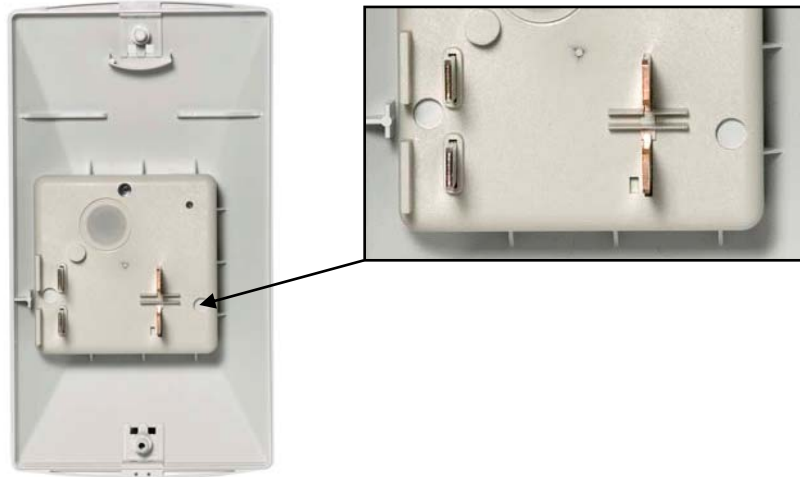


Figure 7: Factory sealed screw plugs

In addition to the factory-sealed screw plugs on the rear panels, there is a facility for two utility wire seals on the front of the meter. The use of these utility seals also ensures that there are visible signs of tampering.

Once the meter has been securely fitted to the common base and secured with the screws supplied, the anti-tamper seals are clipped in place and utility seals are fitted into the holes as shown below.

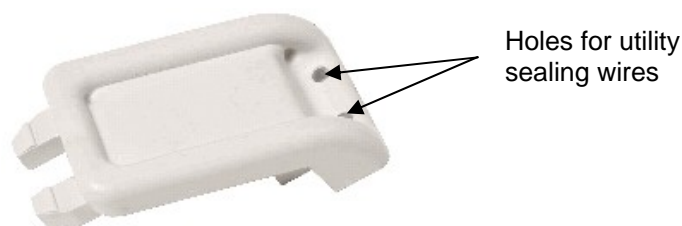


Figure 8: Anti-tamper sealing clip

### 5.10.2. Anti-Tamper Switch

Sabre meters with mechanical anti-tamper facility fitted are available on request.

The tamper facility automatically detects if the meter is removed from the common base. This condition will set the tamper condition thereby opening the latching relay when the meter is re-fitted to the base.

The Tamper Detect function may be enabled or disabled during production, or by means of a Set Options Register token – refer to paragraph 5.5.1.12 and paragraph 6.14 for more detail.

The tampered condition may be monitored by using the information functions – refer to paragraph 6.12 – or by using the initiate dispenser test voucher (display the tamper state) as described in paragraph 5.5.1.8.

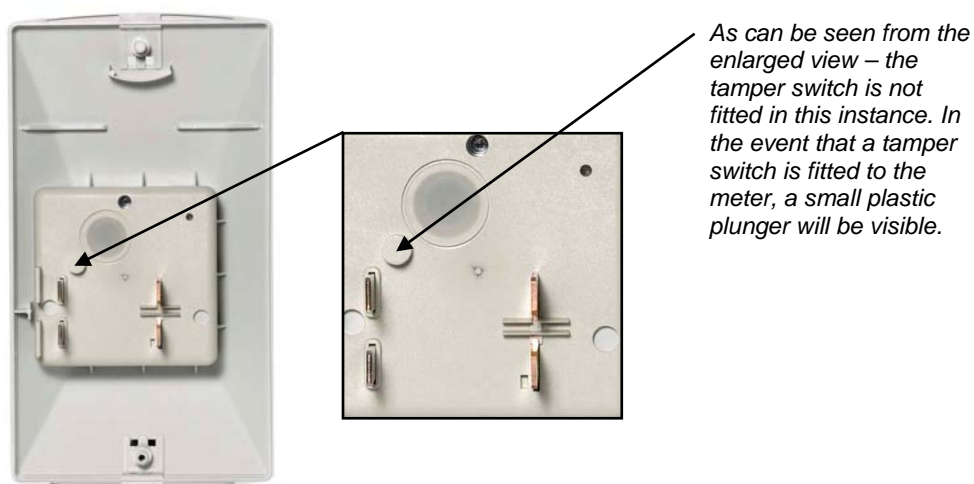


Figure 9: Anti-tamper switch

### 5.10.3. 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 – refer to paragraph 6.12.

### 5.10.4. Magnetic Tamper Detection

This new generation meter now incorporates a magnetic tamper detector. When the meter senses a magnetic field strength above a pre-programmed threshold level, it disconnects the supply to the consumer.

As with the power limit trip condition, the magnetic tamper condition opens the internal latching relay for 30 seconds. Should magnetic interference be detected more than 5 times in a 15 minute window, the latching relay will open for 30 minutes.

The Magnetic Tamper state may be monitored by using the information functions – refer to paragraph 6.15.

### 5.10.5. Resetting a Tamper Condition

Before resetting a tamper condition, care must be taken to remove the cause of the condition, eg ensure that the tamper switch is closed. Failing to do this will cause an immediate tamper condition.

If a meter has been *tampered*, normal operation can only be restored by entering a *clear tamper* voucher.

### 5.11. Virtual Token Carrier (VTC) 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.



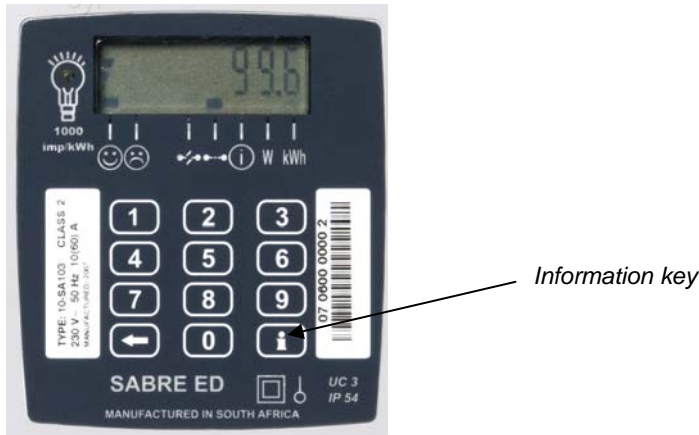
Figure 10: Virtual Token Carrier (VTC) port

## 6. INFORMATION FUNCTIONS

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

Once in *information* mode, toggling between different registers may now be done on an ongoing basis by entering the appropriate three-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 1 minute.



Information Register Functions	
Info Register Number	Function / Meter Parameter
000	11-Digit Electricity Dispenser Number
001	Instantaneous Power
002	Current Credit Register
003	Total Units Counter
005	Accumulated Credit Register
008	Current 30-day Consumption
009	Previous 30-day Consumption
012	Low Credit Level
013	High Credit Level
014	Power Limit Level
030	Meter State Register – Upper
031	Meter State Register – Lower
032	(Fixed) Option Register – Upper (Not used)
033	(Fixed) Option Register – Lower

Information Register Functions	
Info Register Number	Function / Meter Parameter
034	Changeable Option Register – Upper (Not used)
035	Changeable Option Register – Lower
036	Volatile Meter State Register – Upper
037	Volatile Meter State Register – Lower
048	Software Version Number
050	Power-fail Counter
054	Last Credit Token 20-Digit Transfer Number and ID in date/time format
055	Last Credit Token ID
056	Value of Credit for Last Credit Token entered
057	Key Revision and Key Type
058	Tariff Index
059	Current Credit Register (10 Wh resolution)
060	Supply Group Code Register
061	Total Units Counter (10 Wh resolution)
301	Last Token's 20-Digit Transfer Number and ID in Date/Time Format
302	2 <sup>nd</sup> Last Token's 20-Digit Transfer Number and ID in Date/Time Format
...	...
350	50 <sup>th</sup> Last Token's 20-Digit Transfer Number and ID in Date/Time Format
600	Enter Customer Information Mode (Refer to section 6.28)

### 6.1. Meter Number (Register 000)

The meter displays the unique identity number personalised at the time of manufacture. The serial number scrolls on the display from right to left. It must match the number printed on the meter's front panel label.

### 6.2. Instantaneous Power (Register 001)

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

### 6.3. Current Credit Register (Register 002)

This register stores the remaining credit in the meter. This register has a minimum value of -99 999.99 kWh, and a maximum value of 9 999 999.99 kWh.

Note: When more than seven digits are to be displayed (e.g. 1234567.8), the decimal digits are dropped.

Note: The remaining credit can be decremented past zero (0) into negative values if the load is not disconnected. This negative credit value will be subtracted from any new credit entered into the meter.

#### **6.4. Total Units Counter (Register 003)**

The meter displays the total kWh consumed since the meter was put into service. This register will have a value of between 0 kWh and 9'999'999.99 kWh.

#### **6.5. Accumulated Credit Register (Register 005)**

The meter displays the total kWh entered into the meter, via tokens. This register will have a value of between 0 kWh and 9'999'999.99 kWh.

#### **6.6. Current 30-Day Consumption (Register 008)**

The meter displays the number of days into the current 30-day period, followed by the consumption in kWh. By pressing the information-key twice in quick succession, the day counter and consumption is reset to zero.

The display is days (on left hand side) and consumption (on right hand side)

#### **6.7. Previous 30-Day Consumption (Register 009)**

The meter displays the previous 30-day period consumption.

#### **6.8. Low Credit Level (Register 012)**

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

The meter could have a value of between 6.4 kWh and 1 632 kWh, with a 6.4 kWh resolution.

#### **6.9. High Credit Level (Register 013)**

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

The meter could have a value of between 128 kWh and 32 640 kWh, with a 128 kWh resolution.

#### **6.10. Power Limit Level (Register 014)**

The meter displays the power level at which the load switch will be opened, causing the supply to the consumer to be interrupted. The value of this register could be between 0 and 65'535 Watt.

### 6.11. Meter State Register UPPER (Register 030)<sup>1</sup>

The meter displays the most significant eight bits of the meter state register. This register indicates the current state of the following meter functions:

Meter State Register – Upper	
Display	Function
1xxx xxxx	Not Used
x1xx xxxx	Not used
xx1x xxxx	Not used
Xxx1 xxxx	Not used
Press '030' to toggle between UPPER set and LOWER sets of 4 numbers	
xxxx 1xxx	Not used
xxxx x1xx	Not used
xxxx xx1x	Not used
xxxx xxx1	Waiting for Keypress (if non-auto latch reconnect enabled)

### 6.12. Meter State Register LOWER (Register 031)<sup>1</sup>

The meter displays the least significant eight bits of the meter state register. This register indicates the current state of the following meter functions:

Meter State Register – Lower	
Display	Function
1xxx xxxx	Latch Inhibit
X1xx xxxx	Significant reverse power metered
xx1x xxxx	Not used
Xxx1 xxxx	Meter decommissioned
Press '031' to toggle between UPPER set and LOWER sets of 4 numbers	
xxxx 1xxx	Meter NOT initialised (default key)
xxxx x1xx	Meter in power limit trip
xxxx xx1x	Meter out of credit
xxxx xxx1	Meter tampered

<sup>1</sup> Because eight digits need to be displayed, but only 7 digits are available on the display, the number to be displayed is grouped into two sets of four numbers each. The upper set is displayed on the left hand side of the display, whilst the lower set is displayed on the right hand side. To toggle between the upper and lower sets, re-enter the three digit code for that register (without pressing the information-key).



### 6.13. Fixed Option Register (Register 033)

The meter displays the least significant eight bits of the *meter fixed option register*. The contents of this register are determined at the time of manufacture and cannot be subsequently changed via a token:

Fixed Option Register – Lower	
Display	Function
1xxx xxxx	Not used
x1xx xxxx	Not used
xx1x xxxx	Not used
Xxx1 xxxx	Not used
Press '033' to toggle between UPPER set and LOWER sets of 4 numbers	
xxxx 1xxx	Not used
xxxx x1xx	Enable creep lock
xxxx xx1x	Display negative credit
xxxx xxx1	Reserved - must be set to 1

### 6.14. Changeable Option Register (Register 035)

The meter displays the least significant eight bits of the *meter changeable option register*. The contents of this register are determined at the time of manufacture and cannot be subsequently changed via a token:

Changeable Option Register – Lower	
Display	Function
1xxx xxxx	Not used
x1xx xxxx	Not used
xx1x xxxx	Tamper function enabled
Xxx1 xxxx	Tamper on significant reverse power
Press '035' to toggle between UPPER set and LOWER sets of 4 numbers	
xxxx 1xxx	Disconnect on power fail
xxxx x1xx	Not used
xxxx xx1x	Non-auto latch reconnect
xxxx xxx1	Not used

### 6.15. Volatile Meter State – Upper (Register 036)

The meter displays the most significant eight bits of the *volatile meter state register*. This register indicates the current state of the following meter functions:

Volatile Meter State Register – Upper	
Display	Function
1xxx xxxx	Not Used
x1xx xxxx	Not used
xx1x xxxx	Not used
Xxx1 xxxx	Not used
Press '036' to toggle between UPPER set and LOWER sets of 4 numbers	
xxxx 1xxx	Production Engineering Mode Enable
xxxx x1xx	Not used
xxxx xx1x	Reason for latch hold-back: Overload / Magnetic trip
xxxx xxx1	Phase direction indicator

### 6.16. Volatile Meter State – Lower (Register 037)

The meter displays the least significant eight bits of the *volatile meter state register*. This register indicates the current state of the following meter functions:

Meter State Register – lower	
Display	Function
1xxx xxxx	Meter Creep Lock Condition
x1xx xxxx	Not used
xx1x xxxx	Not used
Xxx1 xxxx	Tamper Switch State
Press '037' to toggle between UPPER set and LOWER sets of 4 numbers	
xxxx 1xxx	Not Used
xxxx x1xx	Not used
xxxx xx1x	DC Magnetic Field Detected
xxxx xxx1	DC Magnetic Field Trip State

### **6.17. Software Version Number (Register 048)**

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

### **6.18. Power-Fail Counter (Register 050)**

The meter displays the number of power failures that have occurred since installation. This register is cleared with the entry of a tamper reset token.

### **6.19. TN and ID Number of Last CTN Entered (Register 054)**

The meter scrolls the last Credit Transfer Number and the *Token Identifier* on the LCD.

### **6.20. ID Number of Last CTN Entered (Register 055)**

The *token identifier* is displayed (0 – 16777215) i.e. number of minutes elapsed since 01:01:1993.

### **6.21. Value of Last CTN Entered (Register 056)**

The meter displays the value (kWh) of the last Credit Transfer Number entered.

### **6.22. Key Revision and Key Type (Register 057)**

Refer to the STS specification

### **6.23. Tariff Index (Register 058)**

Refer to the STS specification

### **6.24. 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.

### **6.25. 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.

### **6.26. Total Units Counter (10 Wh Resolution) (Register 061)**

The meter displays the total kWh consumed, with a resolution of 0.01kWh, since the meter was put into service.

### **6.27. Last fifty 20 digit numbers entered into the meter**

Meter stores the last 50 STS numbers entered into the meter in 50 separate registers. As follows:

- Register 301 Last 20 digit voucher entered
- Register 302 2<sup>nd</sup> Last 20 digit voucher entered
- Register 303 to Register 349 – 3<sup>rd</sup> last to 49<sup>th</sup> last vouchers
- Register 350 50<sup>th</sup> last voucher entered

## 6.28. Customer Information Mode

The Customer Information Mode is entered via info-register 600. On entering the Customer Information Mode, meter will display as follows:

- All lines on the display (typical information mode display)
- Information mode icon flashing

Now enter the register number in the table below

Code	Function
000	test all
001	open the disconnect-device
002	switch all LCD segments on and flash the rate LED
004	display total units counter
005	display key revision and key type
006	display tariff index
007	display power limit level
008	display the meter tamper status
009	display available credit
030	display the meter supply group code
050	instantaneous power
100	display the meter number
101	display the software version number
102	display the VTC mapping number
200	display value of last credit token
201	display id of last credit token