PARTICULAR REQUIREMENTS FOR PREPAYMENT METERS

Title: Particular Requirements for Prepayment Meters

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Contents

1. Foreword....................................................................................................................... 2
2. Introduction ................................................................................................................... 2
3. Scope.......................................................................................................................... 2
4. Normative References ..................................................................................................... 2
5. Definitions and Abbreviations ......................................................................................... 3
6. Requirements ................................................................................................................... 5
   6.1 Construction................................................................................................................... 5
   6.2 Electrical .................................................................................................................... 8
   6.3 Interface..................................................................................................................... 9
   6.4 Disconnection ............................................................................................................. 11
   6.5 Token acceptance and decryption ........................................................................... 12
   6.6 Other requirements .................................................................................................... 14
   6.7 Additional requirements for prepayment meters with internal load switches .......... 15
   6.8 Quality assurance ..................................................................................................... 17
7. Revisions ...................................................................................................................... 18
8. Annexes ........................................................................................................................ 19
   8.1 A: Virtual Token Carrier interface (VTC) ................................................................. 19
   8.2 B: Virtual Address Configuration ............................................................................ 30
   8.3 C: Short Code Instructions ...................................................................................... 34
   8.4 D: Impact Assessment ............................................................................................. 35
1. Foreword

This specification was originally published in October 1993 as MC 171 Rev.1.0. Subsequent modifications to the specification took MC 171 to Rev.4.11 with additions like the meter interface port and standard indicator requirements.

MC171 has since been re-formatted and re-numbered in accordance with the Eskom Documentation System and issued as SCSSCAAA9 rev 0 with very minor modifications only.

SCSSCAAA9 rev 1 introduced an number of small additions, mainly some minimum requirements for split meters, three-phase meters. Later additions include a standard meter map for the VTC to replace the manufacturer meter map for the interface port as well as minimum requirements for split meters and three phase meters.

2. Introduction

SANS 1524-1 specifies the minimum requirements for a prepayment meter but it does not specifically deal with the product functionality. Many requirements in SANS 1524-1 incorporate various options and some requirements are currently only preferred options. The particular requirements in this specification are specified to achieve the standardization of prepayment meters within Eskom and to ensure that the equipment will fulfil Eskom's specific needs.

Since the original development of the Electricity Dispenser, various other concepts for prepayment meters have also been developed. This specification makes provision for Electricity Dispensers [ED] as well as for Electricity Control Units [ECU].

These requirements also apply for three phase prepaid meters as well as for split prepayment meters. However, since Eskom purchase only small quantities of such meter types, the enclosures and some of the electrical interfaces are not as rigorously specified as is the case for the single phase EDs and ECU with standard enclosure.

3. Scope

This document specifies particular requirements for Electricity Dispensers (ED) and Electricity Control Units (ECU) that are to be supplied to Eskom under the relevant Contracts. It also includes basic minimum requirements for split prepaid meters and multi phase prepaid meters.

4. Normative References

The following document(s) contain provisions that, through reference in the text, constitute requirements of this specification. At the time of publication, the documents indicated were valid. All controlled documents are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent edition of the document(s) listed below. Information on currently valid national and international standards and specifications can be obtained from the Information Centre and Eskom Documentation Centre at Megawatt Park.

IEC 62051, Electricity Metering - Glossary of terms

SANS 1524-1, Electricity payment systems - Part 1: Prepayment meters.

SANS 156, Moulded-case circuit-breakers.

SANS 10142-1, *The wiring of premises - Part 1: Low-voltage installations.*

IEC 62055-31, (To be published) *Electricity Metering – Payment Systems – Part 31: Particular requirements – Static payment meters for active energy (classes 1 & 2)*


NRS009-6-6, *Electricity sales systems - Part 6: Interface standards - Section 6: Standard Transfer Specification/credit dispensing unit - Electricity dispenser - Categories of token and transaction data fields*

NRS 009-6-7, *Electricity sales systems - Part 6: Interface standards - Section 7: Standard Transfer Specification/credit dispensing unit - Electricity dispenser token encoding and data encryption and decryption.*

NRS009-6-8, *Electricity sales systems - Part 6: Interface standards - Section 8: Standard Transfer Specification/disposable magnetic token technology token encoding format and physical token definition*

NRS009-6-9, *Electricity sales systems - Part 6: Interface standards - Section 9: Standard Transfer Specification/numeric token technology token encoding format and physical token definition*

SCSSCAAJ1, *Standard passive units for single-phase 230 V service connections.*

ESKASAAN2, *Standard for sealing metering equipment.*

SCSPVABB8, *Procedure for producing software process assessment documents.*

DISPVAEF1, *Procedure for the Request For Modification (RFM) on prepaid meters*

RES/RR/00/11740, *Accelerated Environmental Stress Test for Pre-payment metering*

5. Definitions and Abbreviations

In addition to the definitions in SANS 62051 and SANS 1524-1, the following shall apply to this document.

5.1 Definitions

1) **Active unit**: The metering unit that plugs into the passive unit (or socket). The Active unit may often (but not necessarily) include the User Interface Unit.

2) **Base**: The back cover of the active unit. The active unit will plug into a standard socket.

3) **Measurement Unit**: As defined in SANS 1524-1 with the additional meaning that the term measurement unit may also be used to describe a complete meter where the Measurement Unit and User Interface Unit are contained inside a single device.

4) **Overcurrent Protection**: A function provided by ECU to serve as a fault protection feature by disconnecting the load when a fault current is detected.
5) **Passive Unit**: Also called a socket (for conformity with IEC terminology). The service connection is terminated in the passive unit and the active unit plugs into the passive unit.

6) **Power Limiting**: An automatic load disconnection function provided in prepayment meters to limit the average power consumed, to the value programmed in the meter with the relevant STS management token. The average power consumed is calculated over a number of pulses and is therefore not suitable to serve as input for any protection feature.

7) **Prepayment Meter**: A generic term for prepayment devices encompassing ED, ECU, split ED and other metering devices. This term is also interchangeably used with the word "meter" in the same context.

8) **Socket**: The passive unit where the service connection is terminated. The active unit plugs into the socket.

9) **Token Carrier**: As defined in IEC 62055-31

10) **Token Carrier Interface**: As defined in IEC 62055-31

11) **User Interface Unit**: The portion of a meter that contains interfaces (input and/or output) to interact with the meter. The User Interface Unit is often included with the Measurement Unit to form a self contained meter, but it may also exist as a separate Unit e.g. in the implementation of a split meter.

### 5.2 Abbreviations

1) **APDU**: Application Protocol Data Unit (As defined in IEC 62055-41)

2) **ASCII**: American Standard Code for Information Interchange.

3) **BCD**: Binary Coded Decimal.

4) **ECU**: Electricity Control Unit; A prepayment meter with earth leakage and overcurrent protection built in. Category as defined in SANS 1524-1

5) **ED**: Electricity Dispenser. A prepayment meter without either earth leakage or overcurrent protection. Category as defined in SANS 1524-1

6) **HHU**: Hand Held Unit.

7) **MSN**: Most Significant Nibble.

8) **RAM**: Random Access Memory.

9) **ROM**: Read Only Memory.

10) **TCDU**: Transportation Class Data Unit (As defined in IEC 62055-41)

11) **UIU**: User Interface Unit

12) **VTC**: Virtual Token Carrier
6. Requirements

6.1 Construction

6.1.1 Enclosure

6.1.1.1 Single phase meters designed as a self contained unit

Single phase prepayment meters that are not designed as split meters shall be constructed in accordance with the requirements of drawing number D-DT-3171, sheets A, B, C, D, E and F that form part of SCSSCAAJ1.

The enclosure for the prepayment meter shall conform to the requirements of D-DT-3171, sheet B.

The internal components in the active part of the meter shall be protected against unintentional damage during handling and installation in the field.

Provision shall be made for the meter to plug into a standard socket as defined in D-DT-3171, sheet A.

The prepayment meter shall not encroach into the reserved volumes indicated in D-DT-3171, sheet D.

Prepayment meters that do not provide earth fault and overcurrent protection, shall be constructed in such a way that the active unit cannot be successfully inserted into the socket without first removing the extra tab, which is indicated in the relevant detail drawing in D-DT-3171, sheet A, section B-B.

It shall be possible to insert meters that incorporate earth fault and overcurrent protection, into the socket, with the tab indicated in the detail drawing, still in place.

6.1.1.2 Multi phase meters and meters designed as split meters

Multi phase prepayment meters, and all split prepayment meters shall be designed to adhere to any of the following three enclosure requirements.

1) The base of the measurement unit shall conform to the BS 5685 footprint and mounting arrangement. The meter shall be in a high impact resistant case. The terminals position and spacing shall be according to the same BS requirements. The meter cover shall be dust-proof and sealable. If a terminal block cover is provided, the cover shall be sealable independently from the meter cover.

2) The measurement unit enclosure shall conform to the standard miniature circuit breaker type enclosure that complies to the Din rail requirements or alternatively to dual-mount requirements.

3) The measurement unit shall comply to the plug-in enclosure as specified in the previous clause for single phase meters designed as a self contained unit.

6.1.2 Sealing

Provision shall be made for sealing the measurement unit with stainless steel seal wires in accordance with ESKASAAN2. Where the terminals are contained inside the enclosure, they may be sealed with the same seal(s) as the case.
The stainless steel seals shall be applied in such a way that it will not be possible to undo/loosen the mounting screws used to secure the measurement unit to the socket, without breaking these seals. It shall further be impossible to obtain access to the inside of the measurement unit or to the connection terminals without breaking the seals.

The stainless steel seals shall be applied in such a way that they will be easily visible when viewing an installed measurement unit from the front.

Any additional parts or cover plates that may be required to install or seal a meter, shall be supplied with the meter.

It shall be possible to install, remove and seal a meter without requiring any special tools, apart from the standard Eskom sealing pliers. (This requirement excludes standard Field Technician tools like screwdrivers, pliers, side cutters etc.)

6.1.3 Marking requirements on all meters

The meter number(s), complying with the requirements of NRS 009-6-7, shall be clearly visible from the front of the measurement unit enclosure. The barcode shall be applied in such a way that the code can be reliably read with a standard barcode scanner.

6.1.4 Additional marking required on ECU

The following minimum information shall be legibly and indelibly marked on the ECU. This information shall be visible on the front of the enclosure.

1) The designation “ECU”, in letters at least 4 mm high, (preferably larger).
2) The rated current in A.
3) The earth leakage protection unit sensitivity in mA.
4) The overcurrent breaking capacity in kA.
5) A message, located close to the earth leakage test button, with the legend: “Test often. If unit does not switch off, seek advice.” or similar.

6.1.5 Manufacturing and configuration information marked on all meters

The following minimum manufacture/configuration related information shall be visible from the outside of an uninstalled measurement unit. The information shall be protected in such a manner that it is not possible for a customer to delete, change or otherwise make illegible the information displayed on an installed measurement unit. It is therefore recommended that this information be applied to the back cover of the measurement unit.

1) Meter model/version number (as per RFM or meter approval.) Refer to document DISPVAEF1
2) Date of manufacture (a tolerance of two weeks will be allowed for this date)
3) Supply Group Code
4) Tariff index
5) Amp limit or Power limit
6) Calibration accuracy

6.1.6 Conformal coating

The prepayment meter shall be protected against malfunction due to the ingress of vermin, by conformal coating of the printed circuit boards in the meter.

6.1.7 Tamper sensor

A tamper sensor that senses entry into the measurement unit enclosure and disconnect the load, shall not be fitted. Alternatively, if a sensor is fitted, it shall be permanently disabled by the manufacturer. A configuration setting that can be enabled again by an engineering code is not a sufficient method of disabling.

Tamper or fraud detection measures that are automatically set and reset by meter sensors may optionally be provided. Some of such measures have been identified but specific implementation is left for the discretion of manufacturers. (Also see Annex B.1: Virtual Address Map)

6.1.8 Interface port

The prepayment meter shall have a port that may be used for connection to a HHU, meter configuration tool or other device. Access to the port of an installed meter shall only be possible after the Eskom approved seals have been broken.

Unconstrained access to the port of an uninstalled meter is preferred, to simplify meter encoding in Eskom stores.

The port configuration is detailed in Annex A.

It shall be possible to read and write the information through the port of the prepayment meter without having to apply power to the meter. It shall be possible to read the information even if the meter's user interface or power supply has failed.

It shall be possible to insert all the supported STS tokens via the port. It shall also be possible to read at least the following information directly through the port:

1) Meter serial number
2) Meter model / version number as required to identify the relevant meter map
3) Tariff index
4) Key revision number
5) Key type
6) Power limit
7) Available credit
8) Cumulative energy consumed to date
9) Supply group code. It is acknowledged that this is only a label that is entered into the meter and this field may show zero if the meter key has since been changed via a key change token. This field shall not contain any invalid code other than zero.
10) Tamper status (if supported).

Additional proprietary information may optionally be transferred through this port, but it shall not be possible to change any settings which are defined in STS or insert credit into the meter unless such information is encrypted as STS tokens.

6.1.9 Safety related requirements

In addition to the above requirements, the ECU shall also comply with the conditions of SANS 10142-1 since the protection features of the ECU form part of the electrical installation.

6.2 Electrical

6.2.1 Accuracy class

Prepayment meters shall be of accuracy class index 2 or better.

6.2.2 Current rating

The basic current for a single phase meters shall be 10 A or less. The basic current for multi phase meters shall be 20 A or less.

The rated current for a single phase ED shall be at least 60 A but not more than 80 A. The rated current for an ECU shall be 20 A. The rated current for a multi phase ED shall be at least 80 A but not more than 100 A.

Note that the rated current is in addition to any power limiting features that may be provided in the meter and which are configured via STS tokens. (See 6.4.1)

6.2.3 Power consumption

Conditions as specified in SANS 1524-1 shall apply

6.2.4 Start condition and starting current

Conditions as specified in SANS 1524-1 shall apply

6.2.5 Influence of supply voltage

6.2.5.1 Voltage withstand

The prepayment meter shall be able to withstand a 400 V r.m.s. supply for 48 h without causing any damage to or degrading of its operating life or causing changes of more than 0,01 kWh in its credit registers excluding the possible decrement of credit due to power being consumed.

6.2.5.2 Effects of voltage dips and short interruptions

In addition to the test for the effects of power failure or variation on the credit register as defined in SANS 1524-1, the meter shall not experience unspecified load switch disconnections or a change of credit in excess of 0,01 kWh in the credit registers, excluding the possible decrement of credit due to power being consumed, under the following conditions:

1) Reference (test) voltage shall be able to vary between 0 % and 115 % of the standard reference voltage. Where the test voltage falls outside of the range of operation of the
meter, it shall be acceptable for the meter to shut down provided the credit register change is limited to 0,01 kWh.

2) Load current shall be variable between 0 A and rated current.

3) Voltage interruption and dip time shall be variable, between 20 ms and 2 min.

4) Number of interruptions and dips shall be variable, between 1 and 30.

5) Switching of the load switch at random intervals with the adjusted reference (test) voltage shall be as specified above. Where internal load switches are employed, the isolation algorithm will govern the frequency and incidence of switching during this test.

The abovementioned tests are in addition to those in SANS 1524 and do not replace those tests.

6.3 Interface

All these interface requirements shall be displayed on the meter for a self contained unit, or on the user interface unit of a split meter. They may optionally be displayed on the measurement unit of a split meter as well.

The consumption rate indicator and some load status indication shall be displayed on the measurement unit of a split meter in addition to the display on the user interface unit.

The consumption rate indication on the user interface unit will not be used for calibration purposes and need only serve as an visual indication of approximate consumption rate.

6.3.1 Token entry

Prepayment meters, that operate with numeric tokens shall:

1) Display the numbers entered during token entry

2) Have the means to remove digits, one at a time, from the end of a partially entered number, for example, a "Backspace" button.

3) Have the means to clear a partially entered number, for example, a "Clear" or "Enter" button.

4) If a keypad is provided for token entry the standard telephone format layout will be preferred.

While it is not mandatory, there are often requests to provide tactile and/or audible feedback for blind people.

6.3.2 Token entry result indication

The prepayment meter shall uniquely indicate the following conditions:

1) Rejection of a token

2) Acceptance of a token. (A prominent indication of the token data content is acceptable)

3) Used (or duplicate) token.

4) Old (or expired) token
6.3.3 Load status indication

A unique indication that **either** power is supplied to the load circuit, or that the load circuit is switched on. For example, an illuminated indicator in the load circuit, or the circuit-breaker switch in the "on" position will both be sufficient. This indication shall be provided on the measurement unit of a split meter, in addition to the unique load indications as described below for all self contained meters and the user interface unit of split meters.

Prepayment meters shall provide unique indications if the load has been disconnected due to the following conditions:

1) No credit available

2) Power consumption exceeded the maximum power limit as set with an STS token.

3) The ECU shall provide an additional unique indication if the load has been disconnected due to the detection of an electrical fault, i.e. overcurrent or earth fault.

6.3.4 Generic display requirements

6.3.4.1 Consumption rate indicator

The consumption rate indicator light shall emit visible red light.

The output shall generate a signal with a radiation strength $E_T$ over an optically active area, at a distance of 10 mm ± 1 mm from the surface of the meter, with the following limiting values:

ON-condition: $E_T = 50 \mu W/cm^2$ to 1 000 $\mu W/cm^2$

OFF-condition: $E_T < 2.5 \mu W/cm^2$

This consumption rate indication shall be provided on the measurement unit of a split meter as well as on a self contained meter, for calibration purposes.

A similar indication shall be provided on the user interface unit of a split meter but such an indication does not have to provide the same accuracy or radiation strength as it will only be used for visual indication.

6.3.4.2 Power indicator

An obvious power indication shall be provided when power is supplied to the meter. An active display or regularly pulsed indicator (independent of any meter state, including 'no-load') shall be sufficient.

6.3.4.3 Credit display

The prepayment meter shall have a numeric credit display and shall indicate if more units are available than can be displayed, for example, by displaying all the numerals 9.

In the event that the available credit is decremented into negative values, the negative credit value shall be displayed as such on the normal credit display and registers of the meter.
6.4 Disconnection

6.4.1 Power Limit and Out of Credit disconnect

The prepayment meter shall have a power limiting function that will automatically disconnect the load when the average power consumed, exceeds the maximum allowed. This function is not intended as a system protection feature.

The disconnection device (for "Power Limiting" and "Out of Credit" conditions) may be single-pole and shall be adequately protected to ensure that disconnection of the load circuit cannot be prevented by external influences e.g. magnetic field interference or mechanical intrusion/damage. (See 6.4.4)

6.4.2 Protection disconnect

The ECU shall be provided with overcurrent protection at the rated current that complies with the requirements of SANS 156. This requirement is in addition to the Power Limit requirements of clause 6.4.1. The complete ECU will be treated as an overcurrent protection device when compliance to SANS 156 is determined.

The ECU shall be provided with earth leakage protection that complies with the requirements SANS 767-1. Earth leakage protection shall not be provided in an ED. The complete ECU will be treated as an earth leakage protection device when compliance with SANS 767-1 is determined.

6.4.3 General disconnect requirements

When the supply voltage is removed from the prepayment meter or falls below 80% of the rated voltage, the meter may disconnect the load, providing that the meter shall automatically re-connect the load when the supply voltage is restored to more than 80% of the rated voltage.

If an internal load switch is used as a disconnection device, the prepayment meter shall also comply with the additional requirements specified in SANS 1524-1 Annex A.

6.4.4 Effects of magnetic fields

It shall not be possible to influence the switching operation of the load switch by applying a magnet with the following characteristics, to any externally accessible part of the prepayment meter:

<table>
<thead>
<tr>
<th>Distance from magnet surface in mm</th>
<th>Magnetic field strength in Tesla</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1,20</td>
</tr>
<tr>
<td>20</td>
<td>0,43</td>
</tr>
<tr>
<td>40</td>
<td>0,17</td>
</tr>
</tbody>
</table>

Table 1 — Magnet characteristics
6.5 Token acceptance and decryption

6.5.1 General token decryption and acceptance

It shall be possible to transfer information to the prepayment meter through the Standard Transfer Specification (STS) as specified in the STS documents NRS 009-6 and NRS 009-7 series specifications.

All prepayment meters shall be capable of operating as uniquely coded units without requiring any modifications.

The prepayment meter shall at least be able to accept tokens of up to 6000 kWh and shall store at least a credit value of up to 10 000 kWh of available credit. The transfer of energy credit by tokens shall be in accordance with the STS specification.

The prepayment meter shall verify the "Manufacturer Number" in a "Non-Meter specific management token", before such a token is accepted to ensure this number is zero or for the specific Manufacturer.

The prepayment meter shall still accept at least all engineering tokens and Non-Meter specific tokens when in the power limiting or tampered state. (If tamper function implemented)

When a “Non-Meter specific management token” is executed and more than one output is required, e.g. for test number 0 in STS, the outputs shall be initiated in the order in which they are defined in the Short Code list as defined in Annex C. An optional test may be omitted if it is not implemented. A single test, e.g. test number 005, may provide more than one field of information.

In all cases where the prepayment meter provides configuration information, the “key type” shall be considered part of the “key revision number” information. The meter shall therefore always provide the “key type” information together with, or else directly after, the “key revision” information.

It shall be possible to set the prepayment meter into a test mode and allow the user to select individual tests manually via Short Code instructions. The Short Codes for these tests are defined in Annex C. This test mode shall be in addition to the “test all” token as described in the STS specification.

6.5.2 Token re-use prevention

All prepayment meters shall have a table to store the token identifiers (IDs) of used tokens. The token ID table shall hold a minimum of fifty token identifiers. The token ID is related to the date and time of the transaction and is calculated as specified in the STS specification. When a meter is manufactured or repaired, the token ID table must be filled with IDs that represent a recent date and time. This process is required to ensure that it shall not be possible to create or re-use old / historic tokens that will be accepted by the meter.

6.5.3 Key change processing

It shall be possible to enter the two key change tokens in any order to affect a successful key change.

It shall be possible to enter at least two other invalid tokens in any order along with key change tokens and still perform a successful key change.
It shall be possible to enter the same key change token more than once, if the key has not been changed already, and still perform a successful key change.

A time-out function shall be used to cancel a partially completed key change procedure after a duration of between 40 s and 10 min.

The prepayment meter shall uniquely indicate successful completion of a key change operation.

6.5.4 Default SGC key processing

The prepayment meter shall never accept any credit tokens that are encrypted under a default key.

A prepayment meter in the default state (i.e. with a default key in use) shall accept all the relevant "Non-Meter specific management tokens" as well as "Key change tokens" encoded under the default key.

6.5.5 Erasable token processing

Prepayment meters that operate with erasable tokens shall not erase the following tokens:

1) An expired (or old) "Credit token"
2) "Non-Meter specific management tokens"
3) The "Key change token" which is inserted first. (The "Key change token" which is inserted last, may optionally be erased upon successful completion of the key change operation.)

Prepayment meters that operate with erasable tokens shall be able to read and process the token (as well as erase it when required) on a single insertion without requiring further action from the user.

6.5.6 Token entry lockout

A token entry lockout function shall be implemented on each individual Token Carrier Interface to prevent entry of a token under certain conditions. Lockout on a specific Token Carrier Interface shall only affect that specific Token Carrier Interface, and not have any effect on other Token Carrier Interfaces of the meter.

When token entry lockout is active, that specific interface shall not decrypt any meter specific tokens. Non-meter specific tokens, short codes and direct address read requests shall still be accepted and processed as normal while in lockout mode.

The token entry lockout function shall be enabled for every independent interface under the following conditions:

1) Initial lockout period negligible. Double the lockout period after every incorrect entry so that the lockout period after five consecutive invalid entries is between 5 seconds and 10 seconds.
2) Continue to double the lockout period for further invalid entries up to a maximum lockout period. The maximum lockout period for manual entry interfaces may be limited to approximately 5 to 20 seconds but interfaces where automated token entry is possible, shall implement a maximum lockout of between 60 and 120 seconds.
3) Non-Meter specific tokens or short codes shall not have any effect on the lockout period that is currently active.

4) The lockout period shall be reset to its original non-lockout status after any meter specific token has been successfully accepted by the meter.

When token entry lockout is activated, the status shall be indicated accordingly in the Token Result (See 6.3.2).

When token entry lockout is active, the remaining lockout time shall be maintained in a relevant lockout time register. It is preferred that real time interfaces display the remaining lockout time in seconds when lockout is active. It shall further be possible to read the remaining lockout time for the Virtual Token Interface (Also see Annex B.1: Virtual Address Map).

6.5.7 Meter key recovery

The meter key often becomes unknown during meter maintenance in the field. It is therefore preferred that an acceptably secure means be provided to revert to the original meter key that was in use when the meter was dispatched from the manufacturer; (i.e. not necessarily the previous key in use.) This original key shall then be used by the meter for subsequent token decryption and processing.

6.6 Other requirements

Every prepayment meter shall be supplied with a meter card that complies with the requirements of NRS 009-4-1. Since Eskom does not make use of card expiry, these meter cards shall be programmed according to the ISO option that excludes the expiry date from track 2 data.

The prepayment meter shall be able to decrement the credit register past zero, into negative values, if the load is not successfully disconnected when the available credit has been consumed. the negative credit value shall then be subtracted from any new credit entered into the meter.

The prepayment meter shall store the remaining credit to non volatile memory at intervals of not greater than 25 (twenty five) kWh. This requirement shall be in addition to any other storage mechanisms that are employed.

The temperature ranges specified in SANS 1524-1 shall apply

No combination of influence quantities within the limits specified in this specification and in SANS 1524-1 shall cause the meter to supply un-metered electricity, fail to interrupt the load on expiry of credit or execute unspecified load interruptions (i.e. “nuisance tripping”).

When subjected to environmental stress tests, based on TRR/E/95/EL001 (Accelerated Life Test), a sample of prepayment meters shall demonstrate satisfactory operation equivalent to at least 10 years of continuous field operation.
6.7 Additional requirements for prepayment meters with internal load switches

The internal load switch shall comply to the requirements of SANS 1524-1 Annex A.

6.7.1 General switching criteria

The prepayment meter shall automatically switch the load switch to the "on" state when the supply to the meter is available and the following conditions exist:

1) There is credit available
2) The meter is not in a tampered state;
3) The meter is not in a power limiting state
4) There is not an earth fault or overload condition detected by the meter.

The meter shall not have an interface that will allow the user to manually switch the load switch to the "on" position, apart from the normal function to enter credit which may indirectly cause the load switch contacts to close. (Such a manual button/interface will provide an easy means for the user to switch into intentional faults in attempts to fuse the contacts together.)

6.7.2 Power limiting switch criteria

The following procedure shall be employed, to restrict the number of switching cycles, when the meter is disconnecting the load, in order to limit the average power consumed:

1) Reconnect the load up to five times with 30 s intervals, if the consumption is more than the programmed limit
2) After five attempts, wait for 30 min (the lockout period) if the consumption is still above the limit before repeating the procedure.

The meter shall give a clear indication if the load has been disconnected to limit the power. This indication shall exist for as long as the load switch is in the "off" state due to this condition.

A time-out procedure shall be implemented to reset the load limiting timers when no overload condition has been detected for approximately 30 min.

6.7.3 Influence of self-heating

The temperature rise for the load switch is not specified but the prepayment meter shall operate correctly without damage under the following conditions for 12 hours:

1) A fully operational meter mounted as it would be in normal use in a chamber with an ambient temperature of 55°C;
2) Supply voltage 115% of the rated voltage for the meter
3) Load current 100% of the rated current for the meter

During and after the test the meter shall operate correctly without sustaining any damage and the internal load switch shall successfully connect and disconnect, when tested with not less than 40 seconds per switching cycle.
6.7.4 Influence of short-time overcurrents

After conducting the test for as specified in clause 5.5 of SANS 1524-1, it shall be possible to open and close the load switch contacts normally through the use of STS tokens. There shall be no welding of contacts.

6.7.5 Switching into fault currents

The prepayment meter's capability to switch into fault currents shall be tested in accordance with the following test:

6.7.5.1 Medium fault current test

Connect the meter as it will be installed for normal operation with an SX 120 A curve 1 circuit-breaker and 15 m of 16 mm² cable on the supply side of the meter and an SA 20 A circuit-breaker with 1 m of 16 mm² cable on the load side of the meter. Create a low impedance short at the load side circuit-breaker. The selection of these particular circuit breakers are representative of a typical Eskom installation and will provide similar over current protection as would be experienced by a meter in the field.

1) Supply voltage: a.c. 230 V r.m.s.
2) Power factor: 0,8
3) Short-circuit currents: 500 A, 400 A, 300 A, 200 A (peak values in decreasing steps)

Switch the unit twice into each of the fault conditions with at least 40 s intervals between cycles.

It shall be possible to open the contacts, on the first attempt, after every fault current has been applied. It is also acceptable if the contacts open automatically when the fault current is applied, as long as the contacts do not weld and they can still be opened and closed normally after application of the fault current.

6.7.5.2 High fault current test

Connect the same unit as described above but without the SA 20 A circuit-breaker and with the short-circuit on the output side of the meter.

1) Supply voltage: a.c. 230 V r.m.s.
2) Power factor: between 0,8
3) Short-circuit currents: 600 A, 1100 A, 1600 A, 2100 A (peak values in increasing steps)

Switch the unit twice into each of the fault conditions with at least 40 s intervals between cycles:

It shall be possible to open the contacts, on the first attempt, after every fault current has been applied. It is also acceptable if the contacts open automatically when the fault current is applied, as long as the contacts do not weld and they can still be opened and closed normally after application of the fault current.
6.8 Quality assurance

Companies that manufacture prepayment meters for supply to Eskom, must comply with the requirements of SCSPVABS8.

Companies that manufacture prepayment meters for supply to Eskom, must not implement changes to any of the products on contract unless such changes have been approved by the relevant Eskom representatives according to the requirements of DISPVAEF1.
7. Revisions

Note that this is not a complete list of changes. Only the most significant changes are listed here.

<table>
<thead>
<tr>
<th>Date</th>
<th>Rev.</th>
<th>Compiler</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct '93,</td>
<td>1.0</td>
<td>J O'Kennedy</td>
<td>Originally published in October 1993 as MC 171 Rev.1.0. Includes interface port requirements developed based on input from Conlog</td>
</tr>
<tr>
<td>Apr 95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct '97,</td>
<td>0</td>
<td>J O'Kennedy</td>
<td>MC 171 has been re-formatted and re-numbered in accordance with the Eskom Documentation System and re-issued as SCSSCAA9 Rev.0 Amendment for common mode lightning impulse tests</td>
</tr>
<tr>
<td>Sep 00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May 05</td>
<td>1</td>
<td>J O'Kennedy</td>
<td>Revised to accommodate changes in SANS 1524 and IEC 62055. Added some minimum requirements for split meters and multi-phase meters. Including “Power On” indication on Measurement Unit (6.1.1.2, 6.3, 6.3.4.2) Included standard meter mapping and token lockout based on input from Actaris, CBI, Conlog and L+G (6.1.8, 8.1, 8.2) Additional VTC message “write label” (A.4.3) Many minor additional requirements</td>
</tr>
</tbody>
</table>
8. Annexes

8.1 Annex A: Virtual Token Carrier interface (VTC)

(Normative)

A.1 Introduction

This protocol specifies a communication interface for a Virtual Token Carrier (VTC), which would typically be a HHU, to be used across a range of meters developed by different manufacturers. The main design objective in establishing the protocol has been the requirement to reduce the complexity of the software that is needed to implement this protocol in the meter. This directly relates to a smaller ROM size that can be translated into a cost saving or the ability to include additional software features for a given ROM size.

The protocol is based on the IEC 62056-21 communication protocol and has been simplified by removing features from the IEC 62056-21 protocol, which are not required for the current requirements of data exchange between the VTC device and the meter.

In this protocol the VTC device is always the client and the meter is always the server.

Figure A.1 - Data flow process between a VTC client and a meter
The protocol is structured such that data may be written to or read from a virtual address in the meter. This document defines one virtual address value for loading a token into the meter and a second virtual address value for reading back the result after the meter has executed the instruction on the token. The meter essentially interprets each defined virtual address value as a specific command. In this way the protocol defines a generic write and read message structure in this standard, while leaving the meter manufacturers free to define their own additional proprietary commands by associating a virtual address with each such command.

### A.2 Physical layer

The client shall attach to the server through a directly connected cable, which will enable the client to communicate with the server even if the server is not connected to its normal source of power supply or when the user interface or power supply of the server has been damaged.

![Figure A.2](image1.png)

**Figure A.2** — Contact pads etched on front surface of the PCB (probe side)

![Figure A.3](image2.png)

**Figure A.3** — Section A-A indicating clearances required for client probe
### Table A.1 — Pin layout for client probe

<table>
<thead>
<tr>
<th>Pin number</th>
<th>Pin Function</th>
<th>Default state on reader</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manufacturer specific use (See A.3: Transmission Speed Option)</td>
<td>No connection in reader</td>
</tr>
<tr>
<td>2</td>
<td>Data to reader (Transmit)</td>
<td>Data 1</td>
</tr>
<tr>
<td>3</td>
<td>Data from reader (Receive)</td>
<td>Data 1</td>
</tr>
<tr>
<td>4</td>
<td>Prevent CPU reset / power down (Active low on probe.)</td>
<td>0 V</td>
</tr>
<tr>
<td>5</td>
<td>Common</td>
<td>0 V</td>
</tr>
<tr>
<td>6*</td>
<td>+5 V ± 0.2 V 60 mA max. consumption.</td>
<td>+5 V</td>
</tr>
<tr>
<td>7*</td>
<td>+15 V ± 0.5 V 60 mA max. consumption.</td>
<td>+15 V</td>
</tr>
<tr>
<td>8</td>
<td>Proprietary</td>
<td>No connection in reader</td>
</tr>
</tbody>
</table>

*Note: The stated figures above for “Pin Function” of pins 6 & 7 are the values that will be available to power up an uninstalled meter.

Manufacturers to state the voltage tolerance and current required to power up an uninstalled meter via these pins. Also state the current available via pin 6 and/or pin 7 to drive accessories while the meter is under normal operating conditions. (This will typically be used for a trickle charger to charge a small battery or capacitor)

### DIMENSIONS:
2 mm diameter pads etched onto the front surface of PC board (PCB). Spaced at 40º intervals on a centre-line-circle of 9 mm diameter. (The pads may also be implemented as 0.9 mm diameter through-hole plated holes with a 2mm pad size)

### CLEARANCE FOR PROBE:
15,5 mm diameter area from the PCB connection pads, up to a distance of 28 mm away from the PCB, and 21 mm diameter area for distances further than 28 mm from the PCB. (See Figure A.2). The 15,5mm diameter area on the PCB shall not be conformal coated.

Access shall be provided, to insert the probe through any permanent cover that might be installed on the meter. The probe shall also protrude 5 mm through the centre and reference holes in the PCB.

### BIT FORMAT:
In accordance with RS232-c format, with TTL threshold levels. Data 1 = high, Data 0 = low

### A.3 Character transmission

#### Transmission type
Asynchronous serial transmission - half duplex.

#### Transmission format
1 start bit, 7 data bits, even parity, 1 stop bit.
Transmission speed

Baud Rate = 2400 Bd (bits/s) (No Baud rate switch-over).

In addition to the 2400 Bd specified, a manufacturer may optionally implement proprietary support for baud rate negotiation in the meter, by sensing a voltage level on pin 1.

Character encoding

All data, which is in hexadecimal, is transmitted as ASCII data. Each byte of data is split into two nibbles. Each nibble is then converted to its ASCII representation before transmission (the most significant nibble is transmitted first). During data reception, each ASCII character received is converted to its numeric hexadecimal equivalent. Two such hexadecimal values make up a byte of data.

A.3.1 Message definitions

The various messages supported are listed below. Reference numbers below each character are used in table A.2 defining the detailed definition for each element.

Identification request message

The client sends the Identification Request message to request the server to “Identify” itself. This is the first message the server receives in a communication session.

```
/ ? ! CR LF
```

Identification response message

The server sends the Identification Response message in response to the Identification Request message from the client. The server identifies itself by sending the manufacturer code and version number of the meter (See table A.2).

```
/ M X X V V V V CR LF
```

Read command message

The client reads a specified number of bytes from a particular virtual address in the meter by sending a Read command to the server.

```
SOH R STX ADDR DL ETX BCC
```

NOTE: BCC is calculated on fields 9 to 13

Write command message

The client writes a number of bytes of data to a particular virtual address in the meter by sending a Write command to the server.
**Break command message**

The client terminates the communication session and forces the session back to the start state by sending a Break command to the server.

```
SOH B ETX BCC
8 19 13 14
```

NOTE: BCC is calculated on fields 19 to 13

**Acknowledge message**

The server returns a positive response by sending the Acknowledge message.

```
ACK
20
```

**Repeat-Request (error) message**

The server returns a negative response by sending the Repeat-Request (or Error) message.

```
NAK
21
```

**Data message**

The server sends a Data message in response to a Read command from the client.

```
STX ( D ) ETX BCC
10 16 17 18 13 14
```

NOTE: BCC is calculated on fields 16 to 13
A.3.2 Message contents

<table>
<thead>
<tr>
<th>Field Number</th>
<th>Context</th>
<th>Description</th>
<th>Value</th>
<th>Chars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Start character</td>
<td>ASCII Right-slash &quot;/&quot;</td>
<td>2Fh</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Identification Request command</td>
<td>ASCII Question mark &quot;?&quot;</td>
<td>3Fh</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>End character</td>
<td>ASCII Exclamation mark &quot;!&quot;</td>
<td>21h</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Completion character</td>
<td>ASCII Carriage return CR</td>
<td>0Dh</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Completion character</td>
<td>ASCII Line feed LF</td>
<td>0Ah</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Manufacturer code</td>
<td>2-digit hexadecimal representation of the manufacturer code as defined in NRS009-6-7</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Software version number</td>
<td>4-digit hexadecimal format (manufacturer specific)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Header character</td>
<td>ASCII Start of header SOH</td>
<td>01h</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Read command</td>
<td>ASCII &quot;R&quot;</td>
<td>52h</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Frame start character</td>
<td>ASCII Start of text STX</td>
<td>02h</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Virtual Address</td>
<td>4-digit address field in hexadecimal. It is the virtual location from which data must be read, or to which data must be written.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Data Length</td>
<td>1-digit data length field in hexadecimal. It represents the number of bytes to be read from the Virtual Address specified. Maximum data length is 10 bytes.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Frame end character</td>
<td>ASCII End of text ETX</td>
<td>03h</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>Block check character</td>
<td>Block check character (logical XOR of the characters starting with the first character following the first SOH or STX character in the message up to and including the ETX character, which terminates the message frame).</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Write command</td>
<td>ASCII &quot;W&quot;</td>
<td>57h</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>Open data block</td>
<td>ASCII Left-parenthesis &quot;(&quot;</td>
<td>28h</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>Data</td>
<td>Data field representing the data to be written (Write command) or read (Read command). The maximum data length is 10 bytes (20 digits in hexadecimal format).</td>
<td>1-20</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Close data block</td>
<td>ASCII Right-parenthesis &quot;)&quot;</td>
<td>29h</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>Break command</td>
<td>ASCII &quot;B&quot;</td>
<td>42h</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>Acknowledge character</td>
<td>ASCII Acknowledge ACK</td>
<td>06h</td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td>Repeat request character</td>
<td>ASCII Negative acknowledge NAK</td>
<td>15h</td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td>Manufacturer follows</td>
<td>ASCII &quot;M&quot; ; Indicates that Manufacturer details are contained in the next 6 characters of the message.</td>
<td>4Dh</td>
<td>1</td>
</tr>
</tbody>
</table>

Table A.2 — Message content details

NOTE: Each manufacturer specifies the Virtual Address and the number of bytes that can be read from the virtual location or written to the virtual location in accordance with the exact nature of the type of data that is to be exchanged. (Also see Annex B)
A.3.3 Protocol Flow Diagram

![Protocol Flow Diagram](image)

Figure A.4 – Client / Server protocol flow diagram

The above flow chart shows the communication flow sequence between a client and a server.

NOTES:

1. The inactivity time-out period for the server is 120 s after which the operation moves from any point to the start.

2. A Break message can be issued at any point. Operation then moves to the start after finishing the current operation.

3. The maximum data size to be written via a W command is limited to 10 bytes.

4. The maximum data length of a Read (R) command is limited to 10 bytes.

5. ACK and NAK are used for error diagnosis with the following definition:
   a. ACK is returned from the server if the command meets protocol requirements and a successful write operation has been performed within the meter (e.g. memory write). A successful read operation shall return the requested data instead.
b. NAK is returned from the server if the command does not meet protocol requirements or is not executed due to meter functionality (e.g. memory write protect, illegal command, etc.).

6. All other error diagnosis is done by time-out, i.e. if the server does not respond within 1500 ms of a command, there has been an error and the client should take appropriate action.

7. The BCC is calculated from the character immediately following the first SOH or STX character detected up to and including the ETX character which terminates the message. The BCC is calculated by performing a byte-wise XOR and is placed immediately following the ETX character.

8. A protocol error occurs when the parity or BCC or the message syntax is incorrect.

9. An address/data error occurs when the received address or command is unknown or the data set structure or content is incorrect. In this case the command cannot be performed.

10. An error refers to any type of error (protocol, address/data,...).

11. The “dead time” from the end of a message (e.g. transmission of a message) to the start of the next message (e.g. reception of message) is 20 ms.

12. W (Write) will be followed by an ACK or NAK.

13. R (Read) will be followed by a data message or a NAK.

14. Termination occurs either by a Break command (SOH B ETX BCC) or an in activity time-out period of 120s. Both these termination methods result in the server moving to the Start operation with no response being transmitted by the server.

15. If an error occurs during the reception of a message, the server ignores the rest of the message. The server waits until the end of message is encountered, which is defined as a 1500ms gap with no reception, transmits a NAK and returns to the Select Command state (See Figure A.6).

A.3.4 Reaction and monitoring times

Inter-Message and Inter-Character Timing

The time between the reception of a message and the transmission of an answer is:

$$20ms \leq T_r \leq 1500ms$$

The time between two characters in a character sequence is:

$$T_s \leq 1500ms$$
Error timing

If an error is detected, e.g. a framing error or an unsupported command error, the server ignores the rest of the message. The server waits for a 1500ms gap where no reception occurs and transmits a NAK before returning to the Select Command state.

A.4 Virtual address commands

The format of messages to and from the server follows the structure as discussed above with no special message type characters. The processing required by the server is simplified since messages are identified only by the particular virtual address being written to or read from.

The specific virtual addresses that are defined for VTC version 2 are shown in Annex B.

STS compliant meters shall support all the virtual address commands, except those that are indicated as optional.

It shall not be possible to write to any addresses except address FFFFh and addresses defined inside the writable/scratchpad area of the Virtual Address Map. (See Annex B.1)

A.4.1 Write(STS Token) command

To load a token into the meter, the client sends a Write command with the token in the data field and FFFFh in the address field of the message.

The server interprets the receipt of this value in the address field as indicating that the included data is a 20-digit STS token that is being “entered” into the meter.

The received 20 digits obtained from the included data are converted to a 66-bit binary number in accordance with the STS specification and then transferred to the Token Data field of the TCDU, where it is further processed in the Application Layer Protocol and in the Meter Application Process. The server returns an ACK to the client to indicate that the message was correctly received.

A.4.2 Read(Token Status) command

After receiving acknowledgement from the server, the client may read the result using a Read command with FFFEh in the address field and a data length of 1 byte to be read. The value of the returned byte (Token Status) will indicate the result from the last token instruction.

Once the Meter Application Process has executed the instruction on the entered token, the result is presented in the TCDU, which may now be obtained by the client by sending a Read command message to the server specifying the Token Status virtual address. The Token Status is calculated...
from the relevant TCDU data fields (Validation Result, Authentication Result and Token Result) and returned to the client in the Data field of the response message.

A.4.3 Write Label command

This command is only applicable to update labels or other non-risk information in the meter. This command shall not be supported to update any information that is defined by STS tokens.

There are only a limited number of writeable addresses defined in this version of the VTC and this command shall only be used to update addresses in this writeable block. For specific addresses that are writeable, see B.1.

To write information into the meter, the client sends a Write command with the label data in the data field and the specific address in the address field of the message.

The server interprets the receipt of this value in the address field as indicating that the included data is to be written to the specific writeable field. Existing data in that address is overwritten by the server without confirmation.

The server returns an ACK to the client to indicate that the message was correctly processed.

The Server returns NAK to the client if the address is not writeable or if the message could not be processed correctly.

The information at these writeable addresses shall be readable in the standard manner similar to all the other addresses defined in the VTC map.

A.4.4 Manufacturer-specific virtual address commands

The manufacturer-specific virtual address range of the meter is a 4-nibble (16-bit) linear map from 0000h to 3FFFh and 9000h to FFFDh. The details of the virtual address map and corresponding messages supported are product/manufacturer specific. The client must maintain these virtual address maps for the different products/manufacturers supported. Thus during the sign-on phase the Identification Response message from the meter provides the client with the necessary information in order to select the appropriate virtual address map. Upgrades are now simpler since no protocol changes are needed to support, for example, a new type of token or command. All that is needed is for a new product/manufacturer virtual address map to be added to the client’s database of virtual address maps.

It shall not be possible to write any data to any of the virtual addresses in the manufacturer-specific virtual address range, without the use of special access control measures such as client/server authentication protocols.

It shall not be possible to read any secret or sensitive information in the open, such as cryptographic key values, from any virtual address in the manufacturer-specific virtual address range.

The attributes of the data element that is associated with the virtual address shall be specified in the virtual address map provided by each manufacturer.

A.4.5 VTC Version

The table for the VTC version is shown in Annex B.

The version number in the range 0 to 255 that increments each time new functionality is added to the VTC interface specification. This number is independent from the Virtual Address Map version. (See B.3)

A client may read this address first to determine which VTC version is applicable.

If the server responds with a NAK then it is an implied version 1. The client then knows that it requires a manufacturer-specific map. (See B.3)
If the server responds with a value in the range 2 to 255, the client uses the relevant standard map. (See B.1) The server shall never respond with a value of 1.

**A.4.6 Virtual Address Map Version**

The table for the Virtual Address Map version is shown in Annex B.

The version number in the range 0 to 255 that increments each time new addresses are added to the standard virtual map.

New versions shall always remain backward compatible with previous versions where possible, but if there is a deviation, then the VTC version shall also be incremented.

The Virtual Address Map version is only relevant if VTC version is 2 to 255.

A client may read this address to determine which virtual address map version is applicable and then use the relevant version of the standard map.
## 8.2 Annex B: Virtual Address Configuration

(Normative)

### B.1 Virtual Address Map

<table>
<thead>
<tr>
<th>Address</th>
<th>Virtual address</th>
<th>Context</th>
<th>Bytes</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000h - 3FFFh</td>
<td>Manufacturer-specific</td>
<td>Reserved for manufacturer-specific addresses.</td>
<td>X</td>
<td>A.4.4</td>
</tr>
<tr>
<td>4000h</td>
<td>VTC Version</td>
<td>Version of the VTC standard;</td>
<td>1</td>
<td>A.4.5</td>
</tr>
<tr>
<td>4001h</td>
<td>Virtual Address Map Version</td>
<td>Version of this standard virtual address map;</td>
<td>1</td>
<td>A.4.6</td>
</tr>
<tr>
<td>4002h</td>
<td>Meter Number</td>
<td>As defined in as defined in Annex A of NRS 009-6-7; Format: 14-digit hexadecimal, left pad with zero Data returns in standard sequential format with most significant byte first.</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>4003h</td>
<td>Software Version</td>
<td>The 4 digit code as defined in field number 7 of the Message Content. Format: 4-digit hexadecimal (manufacturer specific) Data returns in standard sequential format with most significant byte first.</td>
<td>2</td>
<td>A.3.2</td>
</tr>
<tr>
<td>4004h</td>
<td>Primary Token Carrier Type</td>
<td>As defined by Token Technology in NRS 009-4-1. The main user token carrier interface normally used for credit token transfers. (type 07 defined as Virtual Token Carrier Type) Format: 8-bit binary</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4005h</td>
<td>Encryption Algorithm</td>
<td>As defined in NRS 009-6-7; Format: 8-bit binary</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4006h</td>
<td>Read VTC remaining lockout period</td>
<td>The remaining time in seconds that the token carrier interface will still remain in lockout status; Format: 16-bit binary Data returns in standard sequential format with most significant byte first.</td>
<td>2</td>
<td>6.5.6</td>
</tr>
<tr>
<td>4007h - 4010h</td>
<td>STS Reserved</td>
<td>Reserved for future STS defined use</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>4011h</td>
<td>Tariff Index</td>
<td>As defined in NRS 009-6-7; Format: 8-bit binary</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4012h</td>
<td>Key Revision and Key Type</td>
<td>As defined in NRS 009-6-7; Format: 2 digit hexadecimal; Key Revision Number (MSN); Key Type (LSN)</td>
<td>1</td>
<td>6.5.1, 6.5.4</td>
</tr>
<tr>
<td>4013h</td>
<td>Key Expiry Number</td>
<td>As defined in NRS 009-6-7; Format: 8-bit binary</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4014h</td>
<td>Maximum Power Limit</td>
<td>As defined in NRS 009-6-7; Format: 16-bit binary; 0 = not enabled Data returns in standard sequential format with most significant byte first.</td>
<td>2</td>
<td>6.4.1</td>
</tr>
<tr>
<td>4015h</td>
<td>Maximum Phase Power Unbalance Limit</td>
<td>As defined in NRS 009-6-7; optional Format: 16-bit binary; 0 = not supported Data returns in standard sequential format with most significant byte first.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Details</td>
<td>Revision</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>4016h</td>
<td>Tariff Rate</td>
<td>As reserved in NRS 009-6-7; only currency meters</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
| 4017h | Water Meter Factor                   | As defined in NRS 009-6-7; only water meters  
Format: 16-bit binary; 0 = not supported  
Data returns in standard sequential format with most significant byte first. | 2        |
| 4018h | Available Credit                     | Available credit as reflected by the accounting function in the meter;  
Format: 32-bit signed integer  
Data returns in standard sequential format with most significant byte first. | 4        |
| 4019h | Total Cumulative Units consumed      | The value of the register that records the cumulative kWh delivered by the meter;  
Format: 32-bit signed Integer  
Data returns in standard sequential format with most significant byte first. | 4        |
| 401Ah | Last Credit Token                    | The value of the last credit token that was accepted by the meter (not the token with most recent token ID);  
Format: 20-digit hexadecimal  
Data returns in standard sequential format with most significant byte first. | 10       |
| 401Bh | Last Credit Token ID                 | The Token ID of the last credit token that was accepted by the meter;  
Format: 24-bit binary  
Data returns in standard sequential format with most significant byte first. | 3        |
| 401Ch | Tamper Status                        | Optional - if supported by the meter;  
Format: 16-bit binary  
0 = not in tamper state  
Bit 1 = in tamper state (set by trigger signal, cleared by STS token)  
Bit 2 = bypass detected (set and cleared automatically by meter)  
Bit 3 = consumption irregularities detected (set and cleared automatically by meter)  
Bit 4 – 8 reserved  
Bit 9 – 16 manufacturer specific use | 2        |
| 401Dh | STS                                  | Reserved for future STS defined use                                                                                                                                                    | X        |
| 8FFCh | Reserved                             | Start of Writeable / Scratchpad area                                                                                                                                                    |          |
| 8FFDh | Latitude (Writeable address)         | Optional - if supported by the meter;  
Format: 10-digit hexadecimal in format XDDDmmss.ss (decimal point implied)  
X = 0 for “+” (North); X = 9 for “-” (South)  
DDD = Degrees, mm = minutes, ss.ss = Seconds  
Data in standard sequential format with most significant byte first. | 5        |
| 8FFEh | Longitude (Writeable address)        | Optional - if supported by the meter;  
Format: 10-digit hexadecimal in format XDDDmmss.ss (decimal point implied)  
X = 0 for “+” (East); X = 9 for “-” (West)  
DDD = Degrees, mm = minutes, ss.ss = Seconds  
Data in standard sequential format with most significant byte first. | 5        |
### Supply Group Code (Writeable address)

<table>
<thead>
<tr>
<th>Address</th>
<th>Description</th>
<th>Format</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>8FFFh</td>
<td>Not directly linked to the meter key. Simply a label that can be updated via the VTC: The meter shall automatically overwrite this label with 000000h when a key change is performed; Data in standard sequential format with most significant byte first.</td>
<td>6-digit hexadecimal</td>
<td>A.4.3</td>
</tr>
</tbody>
</table>

### Specific

<table>
<thead>
<tr>
<th>Address</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>9000h –</td>
<td>Reserved for manufacturer-specific use</td>
<td>X</td>
</tr>
<tr>
<td>FFFDh</td>
<td>End of Writeable / Scratchpad area</td>
<td>A.4.4</td>
</tr>
</tbody>
</table>

### Read Token Status

<table>
<thead>
<tr>
<th>Address</th>
<th>Description</th>
<th>Format</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFFEh</td>
<td>The server interprets the receipt of this value in the address field as indicating that the client wishes to “read” the value of the Token Status, being the result from the meter after executing the entered token. Format: 8-bit binary 0 = reserved 1 = token is rejected; 2 = token is accepted; 3 = token has already been used (duplicate); 4 = token is old (expired); 5 = Meter key has expired; 6 = Token Lockout is active; 7 to 255 reserved</td>
<td></td>
<td>A.4.2</td>
</tr>
</tbody>
</table>

### Write STS Token (Writeable address)

<table>
<thead>
<tr>
<th>Address</th>
<th>Description</th>
<th>Format</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFFFh</td>
<td>The server interprets the receipt of this value in the address field as indicating that the included data is a 20-digit STS token that is being “entered” into the meter. Format: 20-digit hexadecimal with the most significant digit positioned adjacent to the ADDR field</td>
<td></td>
<td>A.4.1</td>
</tr>
</tbody>
</table>

### NOTES:

1. Addresses 4000h to 401Dh and FFFEh are read-only. They are read by the client issuing a Read command, with the number of bytes to read as indicated in the above table, and then receive the result in the Data message. For further details on each of the specified address contents refer to the indicated references in the above table for Virtual Address Map.

2. If a client tries to read from address 4000h to 8FFFh on legacy meters that have not implemented address map version 2 or higher, it will return a NAK to the client. By this response the client is able to determine that it requires a manufacturer-specific virtual map in order to read the desired data element values.

3. Since there is no provision for decimal points in the data transfer, the Client must obtain the required conversion information via other means. This information will be hard coded for this VTC standard while manufacturer specific information may be obtained from the manufacturer’s address map in the client. This formatting option shall allow the client to ignore the decimal point, or to insert a decimal point one, two or three positions to the left or right from the end of data position. (i.e. Leave data as is, or multiply/divide by ten, hundred or thousand.)
### B.2 VTC Version

<table>
<thead>
<tr>
<th>Version</th>
<th>Context</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Reserved</td>
<td>8 bit binary</td>
</tr>
<tr>
<td>1</td>
<td>Legacy meters that do not support the version 2 or higher map, thus requires a manufacturer-specific map.</td>
<td>8 bit binary</td>
</tr>
<tr>
<td>2</td>
<td>The version for this standard release</td>
<td>8 bit binary</td>
</tr>
<tr>
<td>3 - 255</td>
<td>Reserved for future use</td>
<td>8 bit binary</td>
</tr>
</tbody>
</table>

### B.3 Virtual Address Map Version

<table>
<thead>
<tr>
<th>Version</th>
<th>Context</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Reserved</td>
<td>8 bit binary</td>
</tr>
<tr>
<td>1</td>
<td>The initial implied version of the virtual map that is implemented by legacy meters that do not support version 2 and higher map, thus requires a manufacturer-specific map.</td>
<td>8 bit binary</td>
</tr>
<tr>
<td>2</td>
<td>The version for this standard release</td>
<td>8 bit binary</td>
</tr>
<tr>
<td>3 - 255</td>
<td>Reserved for future use</td>
<td>8 bit binary</td>
</tr>
</tbody>
</table>
8.3 Annex C: Short Code Instructions

(Normative)

<table>
<thead>
<tr>
<th>Test/Display Description</th>
<th>Required</th>
<th>Short Code Instruction</th>
<th>Test No as defined in STS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard defined items</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dispenser test STS(0)</td>
<td>Mandatory</td>
<td>000</td>
<td>0</td>
</tr>
<tr>
<td>Test load switch</td>
<td>Mandatory</td>
<td>001</td>
<td>1</td>
</tr>
<tr>
<td>Test displays</td>
<td>Mandatory</td>
<td>002</td>
<td>2</td>
</tr>
<tr>
<td>Test input device</td>
<td>Optional</td>
<td>003</td>
<td>6</td>
</tr>
<tr>
<td>Accumulated energy consumed</td>
<td>Mandatory</td>
<td>004</td>
<td>3</td>
</tr>
<tr>
<td>Key Revision &amp; Key type</td>
<td>Mandatory</td>
<td>005</td>
<td>4</td>
</tr>
<tr>
<td>Tariff Index</td>
<td>Mandatory</td>
<td>006</td>
<td>5</td>
</tr>
<tr>
<td>Max power limit</td>
<td>Mandatory</td>
<td>007</td>
<td>7</td>
</tr>
<tr>
<td>Tamper status</td>
<td>Required if function exist</td>
<td>008</td>
<td>8</td>
</tr>
<tr>
<td>Available credit</td>
<td>Mandatory</td>
<td>009</td>
<td></td>
</tr>
<tr>
<td>Phase power unbalance</td>
<td>Required if function exist</td>
<td>010</td>
<td>11</td>
</tr>
<tr>
<td>STS reserved</td>
<td></td>
<td></td>
<td>011-029</td>
</tr>
<tr>
<td><strong>Manual configuration items</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Group Code</td>
<td>Mandatory</td>
<td>030</td>
<td></td>
</tr>
<tr>
<td>Manufacturer specific</td>
<td></td>
<td>031–049</td>
<td></td>
</tr>
<tr>
<td><strong>Status/measured items</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instantaneous power</td>
<td>Mandatory</td>
<td>050</td>
<td>9</td>
</tr>
<tr>
<td>STS reserved</td>
<td></td>
<td>051–069</td>
<td></td>
</tr>
<tr>
<td>Manufacturer specific</td>
<td></td>
<td>070–099</td>
<td></td>
</tr>
<tr>
<td><strong>Manufacturing configuration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meter number</td>
<td>Mandatory</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Firmware version</td>
<td>Mandatory</td>
<td>101</td>
<td>10</td>
</tr>
<tr>
<td>VTC mapping number</td>
<td>Mandatory</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>STS reserved</td>
<td></td>
<td>103–199</td>
<td></td>
</tr>
<tr>
<td><strong>Operational statistics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of last credit token entered (others optional)</td>
<td>Mandatory</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>ID of last credit token entered (others optional)</td>
<td>Mandatory</td>
<td>201</td>
<td></td>
</tr>
<tr>
<td>Value of 2nd last (to n) credit token entered (even numbers)</td>
<td>Optional</td>
<td>202–248</td>
<td></td>
</tr>
<tr>
<td>ID of 2nd last (to n) credit token entered (uneven numbers)</td>
<td>Optional</td>
<td>203–249</td>
<td></td>
</tr>
<tr>
<td>Manufacturer specific</td>
<td></td>
<td>250–299</td>
<td></td>
</tr>
<tr>
<td><strong>Water tariffs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water factor</td>
<td>Required if function exist</td>
<td>300</td>
<td>12</td>
</tr>
<tr>
<td>STS reserved</td>
<td></td>
<td>301–399</td>
<td></td>
</tr>
<tr>
<td><strong>Electricity tariffs (e.g. Currency, block &amp; TOU)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tariff rate</td>
<td>Required if function exist</td>
<td>400</td>
<td>13</td>
</tr>
<tr>
<td>Manufacturer specific</td>
<td></td>
<td>401–449</td>
<td></td>
</tr>
<tr>
<td>STS reserved</td>
<td></td>
<td>450–999</td>
<td></td>
</tr>
</tbody>
</table>
## 8.4 Annex D: Impact Assessment

(Informative)

### Impact assessment

<table>
<thead>
<tr>
<th>Activity</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What training is required to implement this document? (e.g. Awareness training, practical / on job, module.)</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>2. Who will require training? (State designations.)</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>3. What prerequisites are needed for students?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>4. What equipment will be required for training? (Computers etc.)</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>5. What special tools will be required for training?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>6. What special requirements are needed for the trainer?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>7. Time period for training to be completed?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>8. What special tools / equipment will be needed to be purchased by the Region to effectively implement?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>9. Are there stock numbers available for the new equipment?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>10. Does the document affect the budget?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>11. Time period for implementation of requirements after training is completed?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>12. Does the Buyers Guide or Buyers List need updating?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>13. What Buyer’s Guides have been created?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>14. Was Training &amp; Development consulted w.r.t training requirements?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>15. Were the critical points in the document determined?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>16. Is any training material available on the subject in this document?</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>17. Was the document SCSPVABE0 adhered to?</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total implementation period</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Total training cost</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Total cost of tools / equipment</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Total cost involved</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

**Comments:**

---

**Assessment Compiled by:**

<table>
<thead>
<tr>
<th>Name:</th>
<th>J O’Kennedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designation:</td>
<td>Senior Consultant</td>
</tr>
<tr>
<td>Dept:</td>
<td>Resources and Strategy</td>
</tr>
<tr>
<td>Date:</td>
<td>06 Oct 2004</td>
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**Recommended by (Functional Responsibility):**

<table>
<thead>
<tr>
<th>Name:</th>
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<thead>
<tr>
<th>Date:</th>
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</table>