# Interoperability Test System for EPC Compliant Class-1 Generation-2 UHF RFID Devices

INTEROPERABILITY TEST METHODOLOGY

Version 1.2.4

# Revision History

| Revision | Date | Comments |
|---|---|---|
| 0.1 | 2004-11-15 | First release |
| 2.0 | 2005-03-17 | Major changes |
| 3.0 | 2006-05-29 | Replaced sections 6 and 7, revising list of test cases and introducing scripting requirements as a means for rapid and thorough testing |
| 3.1 | 2006-06-02 | Merged all annexes and added printer requirements |
| 1.0 | 2006–06-09 | Restarted Revision Number - Removed CETECOM Logo Rearranged some sections |
| 1.1 | 2006-06-15 | Revised Document for Editorial and Structural Changes |
| 1.2 | 2006-06-27 | Updated section 6, clarifying and reorganizing test cases with some modifications made to the scripting syntax |
| 1.2.2 | 2006-07-26 | Put further clarification into the Lock/PermLock command set. Replaced PU_AP_L_1 and PU_AP_L_2 with PL_ AP_L_1 and PL_AP_L_2 because these commands were taken care of by other test cases. Added PU_E_PU, PU_T_PU and PU_U_PU to test these failing cases. Corrected SQ_E_S3_8 pointer. Updated SQ command. |
| 1.2.3 | 2006-08-03 | Revised Select/Query Test Cases table for pointer and length specs. |
| 1.2.4 | 2006-08-04 | Revised for editorial change to Select/Query Test Cases table. |

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## 1.0 Scope

This document specifies the design of an Interoperability test system for testing that end-to-end functionality between two communicating RFID hardware devices as required by "EPC™ Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID Protocol for Communications at 860 MHZ – 960 MHz. Version 1.0.9".

The RFID devices under test are interrogators, also known as readers, printers, also known as encoders, and one or more tags, also known as labels. Tags can be passive, meaning that they receive all of their operating energy from the interrogator's RF waveform. They can also be semi-passive, or active provided the utilized integrated circuit (IC) is compliant to the above referenced specification. The protocol is interrogator-talks-first (ITF), meaning that a tag modulates its antenna reflection coefficient with an information signal only after being directed to do so by an interrogator.

## 2.0 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] EPCglobal, Inc. "EPC™ Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID Protocol for Communications at 860 MHZ – 960 MHz. Version 1.0.9", December 2004.

[2] EPCglobal, Inc. "EPC™ Tag Data Standards"

[3] EPCglobal™ (2004): FMCG RFID Physical Requirements Document (draft)

[4] ISO/IEC 15961: Information technology-Radio frequency identification (RFID) for item management-Data protocol: application interface.

[5] ISO/IEC 15962: Information technology-Radio frequency identification (RFID) for item management-Data protocol: data encoding rules and logical memory functions.

[6] ISO/IEC 15963: Automatic Identification- Radio Frequency Identification for item management-Unique identification for RF tag.

[7] ISO/IEC 9646-1: Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts.

[8] ISO/IEC 9646-2: Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 2: Abstract Test Suite specification.

[9] ETSI ETS 300 406: Methods for Testing and Specification (MTS); Protocol and Profile Conformance Testing specifications; Standardization methodology.

[10] ETSI TS 102 237-1 v 4.1.1 (2003-12): Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; Interoperability test methods and approaches; Part 1: Generic approach to interoperability testing.

[11] Interoperability Test System for EPC compliant devices Class-1 Generation-2 UHF RFID devices. Requirements for the Interop tester v1.0 CETECOM

## 3.0 Definitions and Abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**Interoperability:** Ability of two or more systems or devices to exchange information using the same communication protocol.

**Interoperability testing:** Activity of testing end-to-end functionality between (at least) two communicating systems as required by the standard(s) on which those systems are based.

**Reference specification:** A standard, which specifies a base specification, or a set of base specifications, or a profile, or a set of profiles, and for conformance against which test specifications are written.

**Interrogator samples for interoperability testing:** A device which combines both transmission and reception capabilities within a single housing. Its components are an antenna, a RFID reader and suitable control software to evaluate interrogator performance.

**Tag samples for interoperability testing:** RFID tags contain an antenna and an electronic microchip to enable them to receive and respond to radio-frequency queries from an RFID transceiver. A minimum sample size is required to complete testing since some will be permanently altered in the course of testing.

**Test Purpose (TP)**: Easy-to-read description of each test, concentrating on the meaning of the test rather than detailing how it may be achieved. The Test Purpose is derived from the reference specification and focuses on testing a specific functionality of the EUT (Equipment Under Test i.e. reader or tag) that can be affected at the user interfaces offered by the SUT (System Under Test).

**Test Suite:** A major subset of the Gen2 protocol. A test suite is verified by running a number of like test cases. A simple scripting language can be used to sequence through the test cases. The script links to a reader application that issues commands and collects responses from the tag. Success/failure for each test case is determined by comparing the responses to the expected responses.

**Test Case:** A fundamental functionality within the Gen2 protocol, for instance, reading the Access password. Test cases are grouped in order to verify a test suite. All test cases within a test suite must be successful in order for the suite to be declared successfully verified. Test cases may require more than one reader command to be verified. For example, a Write test case is verified only after a subsequent Read. The Write and Read can be mated in a script to accomplish this.

**Interoperability Statement (IS):** A checklist of the capabilities/functionalities supported by the EUT is used to select and parameterize test cases and as an indicator of interoperability between different products.

**Implementation eXtra Information for Testing (IXIT):** Contains additional information (e.g., specific addresses, timer values, etc.) necessary for testing.

**Equipment Under Test (EUT):** An interrogator, a tag or a tag population. The subject of the test may be a single EUT, which is testing against a QE, or another EUT.

**Qualified Equipment (QE):** A device that has been shown, by rigorous and well-defined testing, to operate with other equipment and adhere to the protocol.

**System Under Test (SUT):** One or more EUTs and /or QEs. For the purposes of the present document, the SUT may comprise one or more QEs and a single EUT, or possibly two EUTs, depending on the selected test scenario. In all cases the test scenario shall be comprised of at least one interrogator and one tag.

## 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

| | |
|---|---|
| AFI | Application Family Identifier |
| AP | Access password |
| CRC | Cyclic Redundancy Check |
| E | EPC Memory |
| EN-RT | European Normative Requirements Table |
| EPC | Electronic Product Code |
| ETSI | European Telecommunications Standards Institute |
| Handle | 16-bit Tag-authentication number |
| I | Inventory |
| IS | Implementation Statement |
| ITF | Interrogator Talks First (Reader Talks First) |
| IXIT | Implementation eXtra Information for Testing |
| K | Kill |
| KP | Kill password |
| L | Locked |
| M | Mandatory, shall be implemented under all circumstances |
| MH | Multiple Homogeneous populations of tags |
| MM | Multiple Mixed population of tags |
| MTR | Message Transfer |
| NSI | Numbering System Identifier |
| O | Optional, may be provided, but if provided shall be implemented in accordance with the requirements |
| O.n | This status is used for mutually exclusive or selectable options among a set. The integer "n" shall refer to a unique group of options within the EN-RT. A footnote to the EN-RT shall explicitly state what the requirement is for each numbered group. For example, "It is mandatory to support at least one of these options", or, "It is mandatory to support exactly one of these options". |
| PC | Protocol Control |
| PL | Permanently locked (Permalocked) |
| PU | Permanently unlocked |
| R | Read |
| RFID | Radio-Frequency IDentification |
| RFU | Reserved for Future Use |
| RN16 | 16-bit Random or pseudo-Random Number |
| RNG | Random or pseudo-Random Number Generator |
| SI | Select/Inventory |
| SQ | Select/Query |
| SUT | System Under Test |
| T | TID memory |
| TBD | To Be Defined |
| TID | Tag-IDentification or Tag-Identifier, depending on context |
| TP | Test Purpose |
| TSS | Test Suite Structure |
| U | User memory |
| UHF | Ultra High Frequency |
| V | Valid |
| W | Write |
| Word | 16 bits |

# 4.0 Procedures

## 4.1 Procedures

Interoperability testing can be defined as the functional testing of a product against another operational product according to a set of test specifications. Interoperability tests are based on functionality as experienced by the user (i.e., they are not necessarily specified at the protocol level). Also the interoperability tests are performed at interfaces that offer normal user control and observation.

The described test system will provide the user's interfaces and other facilities for interoperability testing and reduce testing time. As a means of improving testing coverage, efficiency and consistency, a scripting language is specified that allows test cases to be concatenated and run automatically. An output file is created that contains the test results thereby easing documentation.

The test system procedures are:

1. The interoperability test system allows choosing between two options for testing:

    A. EUT - EUT (EUT against EUT)
    Both, reader and tag are EUTs and both devices are tested to interoperate.

    B. EUT - QE (EUT against QE)
    Qualified Equipment may be a reader, a tag or a population of tags depending on the device under test.

# 5.0 Test Suite Design

## 5.1 Test Suite Overview

Test Suites are created by assembling a group of test cases that exercise a major functionality subset of the Gen2 protocol. For interoperability coverage four Test Suites have been defined; Select/Inventory, Memory Access, Permalock/Kill, and Special. The set of Test Suites is run for a given reader/tag air interface condition. The set of parameters that define the air interface settings is called the mode. A mode defines the reader-to-tag characteristics (Modulation type, Tari, PIE) and the tag-to-reader characteristics (LF, M, DR, TRext). If a reader supports more than one mode, the bounding modes (longest and shortest Tari's) shall be tested. The pseudo-code below illustrates the testing hierarchy used to show interoperability.

```
Mode (Mod type/Tari/PIE/LF/M/DR/TRext)

    Select/Inventory (Non-select inventory, Select inventory)
        Multi-tag (homogeneous, mixed)
            Memory (EPC, TID, User)
        Single tag
            Memory (EPC, TID, User)
                Lock (Unlocked, Locked, Permaunlocked, Permalocked)
            Select/Query (memory bank, session flags, actions, mask, truncate)
    END Select/Inventory

    Memory access (unsecured, secured)
        Memory (Passwords, EPC, TID, User)
            Lock (Unlocked, Locked, Permaunlocked, Permalocked)

    Permalock/kill
        Memory (Passwords, EPC, TID, User)
            Lock (Permaunlocked, Permalocked)

    Special
        Slot counter (ACK, don't ACK)

END Mode
```

The Select/Inventory suite verifies that a sub-population of tags can be selectively inventoried and that the Select command elicits the proper response from the tag. Multi and single tag testing is performed to verify the Select and Inventory functions within the protocol.

The Memory Access suite confirms that tag memory can be appropriately accessed. Memory access through the secured and unsecured state diagram paths are exercised. Access is evaluated with memories pre-configured in the each of their possible four states; unlocked, locked, permaunlocked or permalocked.

The Permalock/Kill suite tests the memories in their permaunlocked and permalocked states. Once permalock testing is completed, the tag's Kill functionality is verified. This suite is separated so that the number of tags permanently altered is minimized.

The Special suite is reserved for miscellaneous tests that don't fall in the other suites. Once example is a test of the tag slot counter where it is assured that the tag responds only once within an inventory round and remains silent to continue QueryReps after it has been singulated. It is expected that additional tests will be discovered that fall within this important suite.

## 5.2 Test Cases

Read, Write, Lock, Select, and Inventory test cases are listed in the tables with this section. A test case identifier is assigned to each test case using the approximate syntax described in the following table. All of the test cases shall be exercised within at least one of the Test Suites for each mode to assure interoperability coverage.

**Approximate Test Case identifier naming convention scheme**

| Identifier: **<functionality under test>_<memory targeted>_<memory state>_<memory action>_<nn>** | |
|---|---|
| <functionality under test> | I (Inventory)<br>SI (Select then Inventory)<br>SQ (Select then Query)<br>W (Write)<br>L (Lock)<br>U (Unlock)<br>PL (Permalock)<br>PU (Permaunlock)<br>K (Kill)<br>R (Read) |
| <memory targeted> | AP (Access Password)<br>KP (Kill Password)<br>E (EPC Memory)<br>T (TID Memory)<br>U (User Memory)<br><br>MH (Multiple homogenous population)<br>MM (Multiple mixed population) |
| <memory state> | (Unlocked)<br>L (Locked)<br>PL (Permalocked)<br>PU (Permaunlocked)<br><br>P (Partial, change portion of memory)<br>C (Complete, change complete memory) |
| <memory action> | Z (Write zero value)<br>NZ (Write non-zero value) |
| <nn> | sequential number (1-99) |

**Table 1. Approximate Test Case Identifier**

| **Kill Password** | | **Verify kill password operations are correctly performed** |
|---|---|---|
| Test case | Lock | Action |
| R_KP | | Kill password |
| R_KP_L | L | Kill password |
| R_KP_PU | PU | Kill password |
| R_KP_PL_1 | PL | Kill password; Access password zero |
| R_KP_PL_2 | PL | Kill password; Access password non-zero |
| | | |
| W_KP_Z | | Kill password zero |
| W_KP_NZ | | Kill password non-zero |
| W_KP_L_NZ | L | Kill password non-zero |
| W_KP_PU_NZ | PU | Kill password non-zero |
| W_KP_PL_NZ_1 | PL | Kill password non-zero; Access password zero |
| W_KP_PL_NZ_2 | PL | Kill password non-zero; Access password non-zero |
| | | |
| L_KP | | Kill password |
| PU_KP | | Kill password |
| PL_KP | | Kill password; Same command as a L_KP and a PU_KP |
| U_KP_L | L | Kill password |
| PL_KP_L_1 | L | Kill password; Access password zero |
| PL_KP_L_2 | L | Kill password; Access password non-zero |
| U_KP_PU | PU | Kill password |
| L_KP_PU | PU | Kill password |
| PU_KP_PU | PU | Kill password |
| U_KP_PL_1 | PL | Kill password; Access password zero |
| U_KP_PL_2 | PL | Kill password; Access password non-zero |
| L_KP_PL_1 | PL | Kill password; Access password zero |
| L_KP_PL_2 | PL | Kill password; Access password non-zero |
| PU_KP_PL_1 | PL | Kill password; Access password zero |
| PU_KP_PL_2 | PL | Kill password; Access password non-zero |
| | | |
| K_Z | | Kill zero password |
| K_INZ | | Kill incorrect non-zero password |
| K_INZ_L | L | Kill incorrect non-zero password |
| K_INZ_PU | PU | Kill incorrect non-zero password |
| K_INZ_PL | PL | Kill incorrect non-zero password |
| K_NZ | | Kill non-zero password |
| | | |

**Table 2. Kill Password Test Cases**

| **EPC memory** | | **Verify EPC memory operations are correctly performed** |
|---|---|---|
| Test case | Lock | Action |
| R_E_C | | EPC complete |
| R_E_P | | EPC partial |
| R_E_L_P | L | EPC partial |
| R_E_PU_P | PU | EPC partial |
| R_E_PL_P_1 | PL | EPC partial; Access password zero |
| R_E_PL_P_2 | PL | EPC partial; Access password non-zero |
| | | |
| W_E_C | | EPC complete |
| W_E_P | | EPC partial |
| W_E_L_P | L | EPC partial |
| W_E_PU_P | PU | EPC partial |
| W_E_PL_P_1 | PL | EPC partial; Access password zero |
| W_E_PL_P_2 | PL | EPC partial; Access password non-zero |
| | | |
| L_E | | EPC memory |
| PU_E | | EPC memory |
| U_E_L | L | EPC memory |
| PL_E_L_1 | L | EPC memory; Access password zero |
| PL_E_L_2 | L | EPC memory; Access password non-zero |
| U_E_PU | PU | EPC memory |
| L_E_PU | PU | EPC memory |
| PU_E_PU | PU | EPC memory |
| U_E_PL_1 | PL | EPC memory; Access password zero |
| U_E_PL_2 | PL | EPC memory; Access password non-zero |
| L_E_PL_1 | PL | EPC memory; Access password zero |
| L_E_PL_2 | PL | EPC memory; Access password non-zero |
| PU_E_PL_1 | PL | EPC memory; Access password zero |
| PU_E_PL_2 | PL | EPC memory; Access password non-zero |

**Table 3. EPC Memory Test Cases**

| **TID memory** | | **Verify TID memory operations are correctly performed** |
|---|---|---|
| Test case | Lock | Action |
| R_T_C | | TID complete |
| R_T_P | | TID partial |
| R_T_L_P | L | TID partial |
| R_T_PU_P | PU | TID partial |
| R_T_PL_P_1 | PL | TID partial; Access password zero |
| R_T_PL_P_2 | PL | TID partial; Access password non-zero |
| | | |
| W_T_C | | TID complete |
| W_T_P | | TID partial |
| W_T_L_P | L | TID partial |
| W_T_PU_P | PU | TID partial |
| W_T_PL_P_1 | PL | TID partial; Access password zero |
| W_T_PL_P_2 | PL | TID partial; Access password non-zero |
| | | |
| L_T | | TID memory |
| PU_T | | TID memory |
| U_T_L | L | TID memory |
| PL_T_L_1 | L | TID memory; Access password zero |
| PL_T_L_2 | L | TID memory; Access password non-zero |
| U_T_PU | PU | TID memory |
| L_T_PU | PU | TID memory |
| PU_T_PU | PU | TID memory |
| U_T_PL_1 | PL | TID memory; Access password zero |
| U_T_PL_2 | PL | TID memory; Access password non-zero |
| L_T_PL_1 | PL | TID memory; Access password zero |
| L_T_PL_2 | PL | TID memory; Access password non-zero |
| PU_T_PL_1 | PL | TID memory; Access password zero |
| PU_T_PL_2 | PL | TID memory; Access password non-zero |

**Table 4. TID Memory Test Cases**

| **User memory** | | **Verify user memory operations are correctly performed** |
|---|---|---|
| Test case | Lock | Action |
| R_U_C | | User complete |
| R_U_P | | User partial |
| R_U_P_L | L | User partial |
| R_U_P_PU | PU | User partial |
| R_U_P_PL_1 | PL | User partial; Access password zero |
| R_U_P_PL_2 | PL | User partial; Access password non-zero |
| | | |
| W_U_C | | User complete |
| W_U_P | | User partial |
| W_U_L_P | L | User partial |
| W_U_PU_P | PU | User partial |
| W_U_PL_P_1 | PL | User partial; Access password zero |
| W_U_PL_P_2 | PL | User partial; Access password non-zero |
| | | |
| L_U | | User memory |
| PU_U | | User memory |
| U_U_L | L | User memory |
| PL_U_L_1 | L | User memory; Access password zero |
| PL_U_L_2 | L | User memory; Access password non-zero |
| U_U_PU | PU | User memory |
| L_U_PU | PU | User memory |
| PU_U_PU | PU | User memory |
| U_U_PL_1 | PL | User memory; Access password zero |
| U_U_PL_2 | PL | User memory; Access password non-zero |
| L_U_PL_1 | PL | User memory; Access password zero |
| L_U_PL_2 | PL | User memory; Access password non-zero |
| PU_U_PL_1 | PL | User memory; Access password zero |
| PU_U_PL_2 | PL | User memory; Access password non-zero |

**Table 5. User Memory Test Cases**

| **Access** | | **Verify access operations are correctly performed** | | |
|---|---|---|---|---|
| Test case | Lock | AP Action | AP State | AP |
| R_AP_1 | | - | zero | Correct |
| R_AP_2 | | - | zero | Incorrect |
| R_AP_3 | | - | non-zero | Correct |
| R_AP_4 | | - | non-zero | Incorrect |
| R_AP_5 | | - | non-zero | None |
| R_AP_L_1 | L | - | zero | Correct |
| R_AP_L_2 | L | - | zero | Incorrect |
| R_AP_L_3 | L | - | non-zero | Correct |
| R_AP_L_4 | L | - | non-zero | Incorrect |
| R_AP_L_5 | L | - | non-zero | None |
| R_AP_PU_1 | PU | - | zero | Correct |
| R_AP_PU_2 | PU | - | zero | Incorrect |
| R_AP_PU_3 | PU | - | non-zero | Correct |
| R_AP_PU_4 | PU | - | non-zero | Incorrect |
| R_AP_PU_5 | PU | - | non-zero | None |
| R_AP_PL_1 | PL | - | non-zero | Correct |
| R_AP_PL_2 | PL | - | non-zero | None |
| | | | | |
| W_AP_Z | | zero | non-zero | Correct |
| W_AP_NZ_1 | | non-zero | zero | Correct |
| W_AP_NZ_2 | | non-zero | non-zero | Correct |
| W_AP_NZ_3 | | non-zero | non-zero | Incorrect |
| W_AP_NZ_4 | | non-zero | non-zero | None |
| W_AP_L_NZ_1 | L | non-zero | zero | Correct |
| W_AP_L_NZ_2 | L | non-zero | zero | Incorrect |
| W_AP_L_NZ_3 | L | non-zero | non-zero | Correct |
| W_AP_L_NZ_4 | L | non-zero | non-zero | Incorrect |
| W_AP_L_NZ_5 | L | non-zero | non-zero | None |
| W_AP_PU_Z | PU | zero | non-zero | Correct |
| W_AP_PU_NZ_1 | PU | non-zero | zero | Correct |
| W_AP_PU_NZ_2 | PU | non-zero | non-zero | Correct |
| W_AP_PU_NZ_3 | PU | non-zero | non-zero | Incorrect |
| W_AP_PU_NZ_4 | PU | non-zero | non-zero | None |
| W_AP_PL_NZ_1 | PL | non-zero | non-zero | Correct |
| W_AP_PL_NZ_2 | PL | non-zero | non-zero | None |
| | | | | |
| L_AP_1 | | - | zero | Correct |
| L_AP_2 | | - | zero | Incorrect |
| L_AP_3 | | - | non-zero | Correct |
| L_AP_4 | | - | non-zero | Incorrect |
| L_AP_5 | | - | non-zero | None |
| PU_AP | | - | zero | Correct |
| U_AP_L_1 | L | - | zero | Correct |
| U_AP_L_2 | L | - | zero | Incorrect |
| U_AP_L_3 | L | - | non-zero | Correct |
| U_AP_L_4 | L | - | non-zero | Incorrect |
| PL_AP_L_1 | L | - | non-zero | Incorrect |
| PL_AP_L_2 | L | - | non-zero | None |
| PL_AP_L_3 | L | - | zero | Correct |
| L_AP_PU_1 | PU | - | zero | None |
| L_AP_PU_2 | PU | - | non-zero | Correct |
| L_AP_PU_3 | PU | - | non-zero | None |
| PU_AP_PU_1 | PU | - | zero | None |
| PU_AP_PU_2 | PU | - | non-zero | Correct |
| PU_AP_PU_3 | PU | - | non-zero | None |

| | | | | |
|---|---|---|---|---|
| U_AP_PL_1 | PL | - | zero | Correct |
| U_AP_PL_2 | PL | - | non-zero | Correct |
| U_AP_PL_3 | PL | - | non-zero | None |
| L_AP_PL_1 | PL | - | zero | Correct |
| L_AP_PL_2 | PL | - | non-zero | Correct |
| L_AP_PL_3 | PL | - | non-zero | None |
| PU_AP_PL_1 | PL | - | zero | Correct |
| PU_AP_PL_2 | PL | - | non-zero | Correct |
| PU_AP_PL_3 | PL | - | non-zero | None |

**Table 6. Access Test Cases**

| **Select/Inventory** | | |
|---|---|---|
| Test case | Lock | Action |
| **Multi-tag** | | **Verify ability to inventory all tags or a selected sub-population** |
| I_MH | | Non-select inventory homogeneous |
| SI_MH_E | | Select EPC complete homogeneous |
| SI_MH_T | | Select TID complete homogeneous |
| SI_MH_U | | Select User complete homogeneous |
| I_MM | | Non-select inventory mixed |
| SI_MM_E | | Select EPC complete mixed |
| SI_MM_T | | Select TID complete mixed |
| SI_MM_U | | Select User complete mixed |
| | | |
| **Single tag** | | **Verify ability to Select and Inventory with memories in various lock states** |
| I | | Non-select inventory |
| I_L | L | Non-select inventory |
| I_PU | PU | Non-select inventory |
| I_PL | PL | Non-select inventory |
| SI_E | | Select EPC complete |
| SI_E_L | L | Select EPC partial |
| SI_E_PU | PU | Select EPC partial |
| SI_E_PL | PL | Select EPC partial |
| SI_T | | Select TID complete |
| SI_T_L | L | Select TID partial |
| SI_T_PU | PU | Select TID partial |
| SI_T_PL | PL | Select TID partial |
| SI_U | | Select User complete |
| SI_U_L | L | Select User partial |
| SI_U_PU | PU | Select User partial |
| SI_U_PL | PL | Select User partial |

Note: Default for all tests is Target = SL flag, Action = 100, Pointer = 32 bits, Length = 96 bits, Mask passed as directive parameter, Truncate = Disable

**Table 7. Select/Inventory Test Cases**

| **Select/Query** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Test case | Target | Action | Pointer | Length | Truncate | Lock | Memory |
| SQ_E_S0_1 | S0 | 000 | 32 | 96 | 0 | | EPC |
| SQ_E_S0_2 | S0 | 001 | 34 | 64 | 0 | | EPC |
| SQ_E_S0_3 | S0 | 010 | 37 | 48 | 0 | | EPC |
| SQ_E_S0_4 | S0 | 011 | 43 | 24 | 0 | | EPC |
| SQ_E_S0_5 | S0 | 100 | 55 | 12 | 0 | | EPC |
| SQ_E_S0_6 | S0 | 101 | 79 | 6 | 0 | | EPC |
| SQ_E_S0_7 | S0 | 110 | 95 | 3 | 0 | | EPC |
| SQ_E_S0_8 | S0 | 111 | 127 | 1 | 0 | | EPC |
| | | | | | | | |
| SQ_E_S1_1 | S1 | 000 | 117 | 1 | 0 | L | EPC |
| SQ_E_S1_2 | S1 | 001 | 97 | 3 | 0 | L | EPC |
| SQ_E_S1_3 | S1 | 010 | 83 | 6 | 0 | L | EPC |
| SQ_E_S1_4 | S1 | 011 | 64 | 12 | 0 | L | EPC |
| SQ_E_S1_5 | S1 | 100 | 46 | 24 | 0 | L | EPC |
| SQ_E_S1_6 | S1 | 101 | 42 | 48 | 0 | L | EPC |
| SQ_E_S1_7 | S1 | 110 | 38 | 64 | 0 | L | EPC |
| SQ_E_S1_8 | S1 | 111 | 32 | 96 | 0 | L | EPC |
| | | | | | | | |
| SQ_E_S2_1 | S2 | 000 | 32 | 96 | 0 | | EPC |
| SQ_E_S2_2 | S2 | 001 | 32 | 95 | 0 | | EPC |
| SQ_E_S2_3 | S2 | 010 | 44 | 48 | 0 | | EPC |
| SQ_E_S2_4 | S2 | 011 | 56 | 30 | 0 | | EPC |
| SQ_E_S2_5 | S2 | 100 | 67 | 20 | 0 | | EPC |
| SQ_E_S2_6 | S2 | 101 | 75 | 6 | 0 | | EPC |
| SQ_E_S2_7 | S2 | 110 | 83 | 3 | 0 | | EPC |
| SQ_E_S2_8 | S2 | 111 | 126 | 1 | 0 | | EPC |
| | | | | | | | |
| SQ_E_S3_1 | S3 | 000 | 124 | 1 | 0 | L | EPC |
| SQ_E_S3_2 | S3 | 001 | 102 | 3 | 0 | L | EPC |
| SQ_E_S3_3 | S3 | 010 | 87 | 6 | 0 | L | EPC |
| SQ_E_S3_4 | S3 | 011 | 59 | 12 | 0 | L | EPC |
| SQ_E_S3_5 | S3 | 100 | 45 | 24 | 0 | L | EPC |
| SQ_E_S3_6 | S3 | 101 | 41 | 48 | 0 | L | EPC |
| SQ_E_S3_7 | S3 | 110 | 36 | 64 | 0 | L | EPC |
| SQ_E_S3_8 | S3 | 111 | 32 | 96 | 0 | L | EPC |
| | | | | | | | |
| SQ_E_SL_1 | SL | 000 | 126 | 2 | 1 | | EPC |
| SQ_E_SL_2 | SL | 001 | 63 | 64 | 1 | | EPC |
| SQ_E_SL_3 | SL | 010 | 127 | 1 | 1 | | EPC |
| SQ_E_SL_4 | SL | 011 | 63 | 8 | 1 | | EPC |
| SQ_E_SL_5 | SL | 100 | 58 | 12 | 1 | | EPC |
| SQ_E_SL_6 | SL | 101 | 81 | 16 | 1 | | EPC |
| SQ_E_SL_7 | SL | 110 | 32 | 5 | 1 | | EPC |
| SQ_E_SL_8 | SL | 111 | 124 | 3 | 1 | | EPC |
| SQ_E_SL_9 | SL | 000 | 32 | 96 | 1 | L | EPC |
| SQ_E_SL_10 | SL | 001 | 32 | 95 | 1 | L | EPC |
| SQ_E_SL_11 | SL | 010 | 44 | 48 | 1 | L | EPC |
| SQ_E_SL_12 | SL | 011 | 56 | 30 | 1 | L | EPC |
| SQ_E_SL_13 | SL | 100 | 67 | 20 | 1 | L | EPC |
| SQ_E_SL_14 | SL | 101 | 75 | 6 | 1 | L | EPC |
| SQ_E_SL_15 | SL | 110 | 95 | 13 | 1 | L | EPC |
| SQ_E_SL_16 | SL | 111 | 126 | 1 | 1 | L | EPC |
| | | | | | | | |
| SQ_T_S0_1 | S0 | 000 | 0 | Half | 0 | | TID |
| SQ_T_S0_2 | S0 | 001 | 0 | Full | 0 | | TID |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SQ_T_S1_1 | S1 | 010 | 0 | Half | 0 | L | TID |
| SQ_T_S1_2 | S1 | 011 | 0 | Full | 0 | L | TID |
| SQ_T_S2_1 | S2 | 100 | 0 | Half | 0 | | TID |
| SQ_T_S2_2 | S2 | 101 | 0 | Full | 0 | | TID |
| | | | | | | | |
| SQ_T_S3_1 | S3 | 110 | 0 | Half | 0 | L | TID |
| SQ_T_S3_2 | S3 | 111 | 0 | Full | 0 | L | TID |
| | | | | | | | |
| SQ_T_SL_1 | SL | 000 | 0 | Half | 0 | | TID |
| SQ_T_SL_2 | SL | 001 | 0 | Full | 0 | | TID |
| | | | | | | | |
| SQ_U_S0_1 | S0 | 000 | 0 | Half | 0 | | User |
| SQ_U_S0_2 | S0 | 001 | 0 | Full | 0 | | User |
| | | | | | | | |
| SQ_U_S1_1 | S1 | 010 | 0 | Half | 0 | L | User |
| SQ_U_S1_2 | S1 | 011 | 0 | Full | 0 | L | User |
| | | | | | | | |
| SQ_U_S2_1 | S2 | 100 | 0 | Half | 0 | | User |
| SQ_U_S2_2 | S2 | 101 | 0 | Full | 0 | | User |
| | | | | | | | |
| SQ_U_S3_1 | S3 | 110 | 0 | Half | 0 | | User |
| SQ_U_S3_2 | S3 | 111 | 0 | Full | 0 | | User |
| | | | | | | | |
| SQ_U_SL_1 | SL | 000 | 0 | Half | 0 | L | User |
| SQ_U_SL_2 | SL | 001 | 0 | Full | 0 | L | User |

**Table 8. Select/Query Test Cases**

Note: All test cases use a single tag. Each test case corresponds to four Query/Inventory (Q=0) command pairs as shown in the table below. For command pair 1, the Select mask is chosen to match the tag memory contents and the Query parameters are chosen consistent with the Select matching action such that the tag responds with its EPC. For command pair 2, the Query parameters are chosen to be inconsistent with the Select matching action in such a way that the tag fails to respond with its EPC. For command pair 3, the Select mask is chosen not to match the tag memory contents and the Query parameters are chosen to be consistent with the Select non-matching action such that the tag responds with its EPC. For command pair 4, the Query parameters are chosen to be inconsistent with the Select non-matching actions in such a way that the tag fails to respond with its EPC. All four command pairs must elicit the correct response for a test case to pass.

| Command Pair | Select | Query action elicited |
|---|---|---|
| 1 | Match | EPC returned |
| 2 | Match | No EPC response |
| 3 | Mismatch | EPC returned |
| 4 | Mismatch | No EPC response |

**Table 9. Select/ Query Action**

## 6.0 Scripting Language

### 6.1 Script Language Syntax

The Reader vendor should provide a PC application that runs a Script File and produces an Output File. This application is invoked using the following syntax, where “interop” is the call to the application and input file is the Script filename and output file is the Output filename.

interop <input file> <output file>

The input file (Script File) is a text file comprised of directives from a scripting language described below. The Script File shall be read by the application and each line executed in order. Results shall be written both to the screen and to the output file (Output File) for documentation and as inputs to the Software Manager for parsing and report generation. Examples of a Script and Output File are provided in section 7.2 and 7.3.

The scripting language is intended to be as simple as possible, both for the operator (in terms of being able to create powerful tests using simple building blocks) and for the application (in terms of being able to parse and understand the directives). The scripting language is line-oriented, meaning that individual directives within the testing language are separated by carriage returns. Blank lines are allowed and cause no actions to occur. Comments are indicated by a leading '#' character with the characters that follow having no operational influence. The comment character can occur anywhere on the line. Examples:

```
# This is a line with nothing but a comment
Disconnect # This is a comment coming after a sample directive
```

It is advised to use informative comments when creating the testing scripts. All comments, blank lines, and directives are echoed to the output file.

The result of each directive is printed to the screen and the output file whose name is specified. Each directive can individually either succeed or fail. For example, a write command may fail due to the memory being locked. Another means of failure is a mismatch with an expected data result. The application shall indicate failure for any directive where the actual pass/fail result mismatches the expectation. All directives must match their expected result for overall success to be declared for a Script File. The application shall declare "SUCCESS" at the end of the Output File if all directives matched expectation. "FAILURE" is declared if any one directive had an unexpected result.

The core functionality of the testing language comes from its interpretation of a number of test directives. The list of supported directives and their syntax is shown below. If the application encounters an out of order or unrecognisable directive (lack of necessary arguments, presence of invalid arguments, attempting to perform RFID operations before connecting to a reader, etc.), then the directive is ignored and a diagnostic message describing the error is printed to the screen and output file. The following is the full list of supported directives. Parameters in <..> are mandatory, those in [..] are optional.

**Inventory <expect> <n> [mask] [location]**

Description:

This directive attempts to inventory tags that are in the field of view of the reader using repetitive inventory rounds. The option exists to select a sub-population of tags prior to inventory. Selection occurs based on an optional mask parameter field. This directive will succeed if the reader is able to inventory n tags where the value n is specified as a parameter; and will fail otherwise.

Parameters:

**expect**

Must be equal to "pass" or "fail", depending upon whether this directive is expected to succeed or not.

**n**

The number of unique EPCs that are expected to be found by the reader. If, for example, 10 tags are in the field of view of the reader and an inventory directive is executed without selection, then 10 tags should be found and the directive will pass if n=10 was specified. If a sub-population is targeted using the mask option, then a lower n value may be specified even though 10 total tags are in the field of view.

**mask**

A hexadecimal string that the EPC must match for the select criteria to apply. String corresponds to a Select mask starting at the EPC MSB. If not specified, default is no Select mask, that is, complete population is inventoried.

**location**

Use "epc" for the EPC memory bank, "tid" for the TID memory bank, and "user" for the user memory bank. If not specified, default is epc.

Examples:

Inventory pass 1
Inventory fail 3 F3C5 user

Result:

Inventoried <count> unique tags.
*The count is the number of unique EPCs found.*
EPC result: <epc_value> <:count> (see following example)

```
30035A0001B4F449A720CD20        :33
30035A0001B4F449A720CD21        :30
30035A0001B4F449A720CD22        :25
```

*A hexadecimal list of EPCs found followed by the decimal number of times each was inventoried.*
Inventory <result>.
*The result is "SUCCESSFUL" if the directive matched the expectation, or "FAILED" if the directive mismatched the expectation. The number of unique tags found is compared to the number of expected tags to determine success/failure.*

**Read <expect> <data> <location>[,<offset>,<length>] [password]**

Description:

This directive attempts to read a particular memory location in the tag under test. The memory bank is specified in the location field. Optional offset and length parameters specify the start and length of data to read if a partial memory read is desired. If this field is omitted, the complete memory will be read. The data field contains the data expected to be return from the read. A dash in this field eliminates the requirement for a match with expected data to achieve success. The password field is used if a password is required to perform the operation. If the password is omitted, memory access will be attempted from the open state. This directive will succeed if the data can be read and it matches the expected data; and will fail otherwise.

Parameters:

**expect**

Must be equal to "pass" or "fail", depending upon whether this directive is expected to succeed or not.

**data**

A hexadecimal string that the read data will be matched against, or "-" to indicate that no matching should be performed.
**location**
Use "kpass" for the kill password, "apass" for the access password, "epc" for the EPC memory bank, "tid" for the TID memory bank, and "user" for the user memory bank.
**offset**
Decimal word offset (word is 16 bits) to start of data to written. If omitted, the starting location of the memory bank is used.
**length**
Decimal word length to read. If omitted, the all the words in the memory bank are read.
**password**
A hexadecimal string that will be used by the reader to perform a tag access from the secured state. If the password is omitted the tag access is performed from the open state.

Examples:
Read pass - tid
Read fail 1111 kpass,1,1 33334444

Result:
Read data: <data>
*The data is a hexadecimal string of the data that was read from tag memory, or "" if no data could be read.*
Read <result>.
*The result is "SUCCESSFUL" if the directive matched the expectation, or "FAILED" if the directive mismatched the expectation. If data is specified it is compared to the read result to determine success/failure.*

**Write <expect> <data> <location>[,<offset>] [password]**

Description:
This directive attempts to write a particular memory location in the tag under test. The memory bank is specified in the location field. An optional offset parameter specifies the starting position in the bank to write if a partial memory write is desired. If this field is omitted, the complete memory will be written. The data field contains the data to be written. The password field is used if a password is required to perform the operation. If the password is omitted, memory access will be attempted from the open state. This directive will succeed if the tag reports a successful write and the read results matches data if data is specified; and will fail otherwise.

Parameters:
**expect**
Must be equal to "pass" or "fail", depending upon whether this directive is expected to succeed or not.
**data**
A hexadecimal string that represents the data to be written. If it is shorter than the length of remaining memory then the higher-numbered rows will be left unmodified.
**location**
Use "kpass" for the kill password, "apass" for the access password, "epc" for the EPC memory bank, "tid" for the TID memory bank, and "user" for the user memory bank.
**offset**
Decimal word offset (word is 16 bits) to start of data to written. If omitted, the starting location of the memory bank is used.
**password**
A hexadecimal string that will be used by the reader to perform a tag access from the secured state. If the password is omitted the tag access is performed from the open state.

Examples:

Write pass 11112222 kpass
Write fail 1111 tid,1 33334444

Result:

Write result: <data>
*The data is "1" if the write operation was successful, or "0" if it was not successful.*
Write <result>.
*The result is "SUCCESSFUL" if the directive matched the expectation, or "FAILED" if the directive mismatched the expectation.*

**WrRd <expect> <data> <location>[,<offset>] [password]**

Description:

This directive attempts to write a particular memory location of the tag under test then read the same location to verify a successful write. The memory bank is specified in the location field. An optional offset parameter specifies the starting position in the bank to write if a partial memory write is desired. If this field is omitted, the complete memory will be written. The data field contains the data to be written. The password field is used if a password is required to perform the operation. If the password is omitted, memory access will be attempted from the open state. This directive will succeed if the tag reports a successful write and the read data matches what was written; and will fail otherwise.

Parameters:

**expect**
Must be equal to "pass" or "fail", depending upon whether this directive is expected to succeed or not.
**data**
A hexadecimal string that represents the data to be written. If it is shorter than the length of remaining memory then the higher-numbered rows will be left unmodified.
**location**
Use "kpass" for the kill password, "apass" for the access password, "epc" for the EPC memory bank, "tid" for the TID memory bank, and "user" for the user memory bank.
**offset**
Decimal word offset (word is 16 bits) to start of data to written. If omitted, the starting location of the memory bank is used.
**password**
A hexadecimal string that will be used by the reader to perform a tag access from the secured state. If the password is omitted the tag access is performed from the open state.

Examples:

WrRd pass 11112222 kpass
WrRd fail 1111 tid,1 33334444

Result:

WrRd write result: <data>
*The data is "1" if the write operation was successful, or "0" if it was not successful.*
WrRd read result: <data>
*The data is a hexadecimal string of the data that was read from tag memory, or "" if no data could be read. Note that this statement is omitted if the read operation is not done. This happens when the write operation mismatches the directive expectation.*
WrRd <result>

*The result is "SUCCESSFUL" if the directive matched the expectation, or "FAILED" if the directive mismatched the expectation. Data is compared to the read result to determine success/failure.*

**Lock <expect> <location> [password]**

**UnLock <expect> <location> [password]**

**PermLock <expect> <location> [password]**

**PermUnLock <expect> <location> [password]**

Description:

All four of these directives are used to change the lock state of the tag under test. These directives set and clear the lock bit, and they set the permalock bit in the location field of Table 6.40 in Gen 2 protocol specification. For example, if the tag memory is in the unlocked state (lock and permalock bits both zero) a PermLock directive will set the permalock bit to one and put the memory in a perma-unlocked state. Likewise, the tag memory must set the lock bit by issuing a Lock directive either prior or post to issuing a PermLock directive to put the tag memory in a permalock state. The PermUnLock directive attempts to deassert the permalock bit. The password field is used if an access password is required to perform the operation. If the password is omitted, memory access will be attempted from the open state. This directive will succeed if the tag reports a successful lock or unlock; and will fail otherwise.

Parameters:

**expect**
Must be equal to "pass" or "fail", depending upon whether this directive is expected to succeed or not.

**location**
Use "kpass" for the kill password, "apass" for the access password, "epc" for the EPC memory bank, "tid" for the TID memory bank, and "user" for the user memory bank.

**password**
A hexadecimal string that will be used by the reader to perform a tag access from the secured state. If the password is omitted the tag access is performed from the open state.

Examples:

Lock pass user 33334444
UnLock fail epc
PermLock fail user
PermUnLock pass epc 33334444

Result:

Lock result: <data>
UnLock result: <data>
PermLock result: <data>
PermUnLock result: <data>
*The data is "1" if the lock operation was successful, or "0" if it was not successful.*
Lock <result>.
UnLock <result>.
PermLock <result>.
PermUnLock <result>.
*The result is "SUCCESSFUL" if the directive matched the expectation, or "FAILED" if the directive mismatched the expectation.*

**Kill <expect> <kpassword>**

Description:

This directive attempts to kill the tag under test using the kill password specified in the password field. The directive succeeds if the tag reports a successful kill operation; and will fail otherwise.

Parameters:

**expect**
Must be equal to "pass" or "fail", depending upon whether this directive is expected to succeed or not.
**kpassword**
A hexadecimal string that specifies the kill password to be used for the kill operation.

Examples:

Kill pass FFFFFFFF

Result:

Kill result: <data>
*The data is "1" if the kill operation was successful, or "0" if it was not successful.*
Kill <result>.
*The result is "SUCCESSFUL" if the directive matched the expectation, or "FAILED" if the directive mismatched the expectation.*

**SQ <expect> <location> <epclength> <starget> <action> <pointer> <length> <mask> <truncate> <session> <sel> <qtarget>**

Description:

The Select/Query directive causes the reader to send a Select command followed immediately by a Query command to the tag. The parameter list contains many of the Select and Query parameters specified in the Gen 2 protocol specification. Parameters that are not included are determined by the reader mode which is set in the configuration directive. The Q value parameter in the Query command shall be defaulted to zero to assure an immediate response from the single tag that is being interrogated.

Parameters:

**expect**
Must be equal to "pass" or "fail", depending upon whether this directive is expected to succeed or not. Pass should be specified when a valid EPC is expected to be returned by the tag.
**location**
Use "epc" for the EPC memory bank, "tid" for the TID memory bank, and "user" for the user memory bank.
**epclength**
Decimal integer indicating the number of EPC bits supported by the tag-under-test. A typical value is 96 bits.
**starget**
The Select target parameter specifies which flag to modify if the select mask matches the tag memory value. Use "s0" for the inventoried S0 flag, "s1" for the inventoried S1 flag, "s2" for the inventoried S2 flag, "s3" for the inventoried S3 flag, and "sl" for the SL flag.
**action**
Action is a three digit binary number as defined in Table 6.19 of the Gen 2 protocol specification that defines the action the targeted flag takes when the mask matches and mismatches the value in the tag memory.
**pointer**
Decimal integer that specifies the memory offset at which the select mask is applied. The pointer is not in the extensible bit vector format used in the Gen 2 Select command.
**length**

Decimal integer that specifies the length of the select mask in bits, with the length being left justified for selecting the portion of the mask. For mask lengths that are not multiples of 4, the mask used will be padded with zeros for its remainder least significant bits. For example, if the mask is 7F, and the length is 7, the mask used will be 7E.

**mask**

A hexadecimal string indicating the bit pattern to be compared with the tag memory for purposes of selecting a sub-population of tags. If the mask length is not a multiple of four then the mask will be left justified with trailing zeros in the unused LSB's.

**truncate**

Use "1" to enable a truncated reply from tag and "0" for an un-truncated response.

**session**

The Query session parameter specifies which flag to use for inventorying. Use "s0" for the S0 flag, "s1" for the S1 flag, "s2" for the S2 flag, and "s3" for the S3 flag.

**sel**

A two digit binary number specifying the whether selected, unselected or all tags respond to a Query. See Table 6.20 in Gen 2 protocol specification for details.

**qtarget**

The Query target parameter. Use "A" to choose tags in A state to participate in inventory and "B" to choose B state tags for participation.

Examples:

SQ pass epc sl 000 45 30 B345FE14 0 s0 00 A
SQ fail user s0 000 32 64 123AB45FA125BC12 0 s0 00 B

Result:

SQ result: <data>

*The data is "1" if the tag responded with a valid EPC value, or "0" if there was no tag response.*

EPC result: <epc_value> (see following example)
30035A0001B4F449A720CD22

*The returned EPC if data=1; no output if data=0*

SQ <result>.

*The result is "SUCCESSFUL" if the directive matched the expectation, or "FAILED" if the directive mismatched the expectation.*

**Connect <address> <domain> <mode>**

Description:

This directive attempts to connect to the reader. The directive should be used before attempting any testing directives, and should not be used when already connected to a reader. The target reader is specified by the address parameter. The domain and mode parameters specify configuration information for that reader.

Parameters:

**address**

The address of the reader to connect to. This can either be an IP address or, if DNS resolution is available, the name of the reader.

**domain**

Use "FCC" for connecting to a reader operating within the FCC domain, and "ETSI" for connecting to a reader operating within the ETSI domain.

**mode**

An positive integer mode number that uniquely specifies the modulation type, Tari, PIE, LF, M, DR, and TRext used by the reader and commanded of the tag.

Examples:

Connect speedway0111 FCC 2
Connect 192.168.10.51 ETSI 0

**Disconnect**

Description:

This directive attempts to disconnect a connected reader. The directive should be used for reconnecting to a different reader in the midst of a test. It is not necessary to issue this directive at the end of the test.

Parameters:

Example:

Disconnect

**Power <power>**

Description:

This directive attempts to set the reader transmit power level as measured at the RF connector.

Parameters:

**power**
A floating-point value in the range between 15.0 and 30.0, inclusive. Units are dBm. The reader shall set the power level as closely as possible to the commanded value.

Example:

Power 15.0

**Antenna <m>**

Description:

This directive is used to select the active transmit antenna port. Only one transmit antenna port shall be active at a time during any interoperability testing.

Parameters:

**m**
An integer greater than or equal to 1.

Example:

Antenna 2

**Frequency <frequency>**

Description:

This directive attempts to set the operating frequency to be used by the reader. This directive applies only to readers designed for operation in a region allowing fixed frequency operation.

Parameters:

**frequency**
A floating-point value in the range between Fmin and Fmax representing the minimum and maximum channel frequencies for the particular regulatory region. Units are MHz. For ETSI the values are 865.7 and 867.5.

Example:

Frequency 866.3

## 6.2 Script File Example

The following Script File illustrates the use of a commented string of directives to test secured access of tag memory.

```
Connect speedway0022 FCC 2

# Read kill and access passwords.
Read pass - kpass
Read pass - apass

# Test partial writing of kill password.
WrRd pass 00000000 kpass
WrRd pass FFFF kpass,1
Read pass 0000FFFF kpass

# Write kill and access passwords.
WrRd pass AAAAAAAA kpass
WrRd pass BBBBBBBB apass

# Lock kill and access passwords.
Lock pass kpass BBBBBBBB
Lock pass apass BBBBBBBB

# Read kill and access passwords.
Read pass AAAAAAAA kpass BBBBBBBB
Read pass BBBBBBBB apass BBBBBBBB

# Fail to kill tag with wrong password.
Kill fail 11111111

# Unlock kill and access passwords.
UnLock pass kpass BBBBBBBB
UnLock pass apass BBBBBBBB

# Read EPC.
Read pass - epc

# Write EPC.
WrRd pass 1234567890ABCDEF12345678 epc

# Lock EPC
Lock pass epc BBBBBBBB

# Write EPC.
WrRd pass 111122223333444455556666 epc BBBBBBBB

# Unlock EPC.
UnLock pass epc BBBBBBBB

# Reset kill and access passwords.
WrRd pass 00000000 kpass
WrRd pass 00000000 apass

Disconnect
```

## 6.3 Output File Example

The following Output file shows the output from the Script File example from 6.2.

```
Connect speedway0022 FCC 2
  Connected to reader speedway0022, type 0, mode 2.

# Read kill and access passwords.
Read pass - kpass
  Read data: 00000000
  Read SUCCESSFUL.
```

```
Read pass - apass
   Read data: 00000000
   Read SUCCESSFUL.

# Test partial writing of kill password.
WrRd pass 00000000 kpass
   WrRd write result: 1
   WrRd read result: 00000000
   WrRd SUCCESSFUL.
WrRd pass FFFF kpass,1
   WrRd write result: 1
   WrRd read result: FFFF
   WrRd SUCCESSFUL.
Read pass 0000FFFF kpass
   Read data: 0000FFFF
   Read SUCCESSFUL.

# Write kill and access passwords.
WrRd pass AAAAAAAA kpass
   WrRd write result: 1
   WrRd read result: AAAAAAAA
   WrRd SUCCESSFUL.
WrRd pass BBBBBBBB apass
   WrRd write result: 1
   WrRd read result: BBBBBBBB
   WrRd SUCCESSFUL.

# Lock kill and access passwords.
Lock pass kpass BBBBBBBB
   Lock result: 1
   Lock SUCCESSFUL.
Lock pass apass BBBBBBBB
   Lock result: 1
   Lock SUCCESSFUL.

# Read kill and access passwords.
Read pass AAAAAAAA kpass BBBBBBBB
   Read data: AAAAAAAA
   Read SUCCESSFUL.
Read pass BBBBBBBB apass BBBBBBBB
   Read data: BBBBBBBB
   Read SUCCESSFUL.

# Fail to kill tag with wrong password.
Kill fail 11111111
   Kill result: 0
   Kill SUCCESSFUL.

# Unlock kill and access passwords.
UnLock pass kpass BBBBBBBB
   UnLock result: 1
   UnLock SUCCESSFUL.
UnLock pass apass BBBBBBBB
   UnLock result: 1
   UnLock SUCCESSFUL.

# Read EPC.
Read pass - epc
   Read data: 111122223333444455556666 0000
   Read SUCCESSFUL.

# Write EPC.
WrRd pass 1234567890ABCDEF12345678 epc
   WrRd write result: 1
   WrRd read result: 1234567890ABCDEF12345678
   WrRd SUCCESSFUL.
```

```
# Lock EPC
Lock pass epc BBBBBBBB
    Lock result: 1
    Lock SUCCESSFUL.

# Write EPC.
WrRd pass 111122223333444455556666 epc BBBBBBBB
    WrRd write result: 1
    WrRd read result: 111122223333444455556666
    WrRd SUCCESSFUL.

# Unlock EPC.
UnLock pass epc BBBBBBBB
    UnLock result: 1
    UnLock SUCCESSFUL.

# Reset kill and access passwords.
WrRd pass 00000000 kpass
    WrRd write result: 1
    WrRd read result: 00000000
    WrRd SUCCESSFUL.
WrRd pass 00000000 apass
    WrRd write result: 1
    WrRd read result: 00000000
    WrRd SUCCESSFUL.

Disconnect
    Disconnected.

    OVERALL RESULT: SUCCESS
```

## 7.0 Test Sites

This section introduces general characteristics of three test sites used to test the test cases defined in this document.

### 7.1 General Characteristics

The characteristics here described apply to all test cases detailed in the following sections:

- The test site shall be on a reasonably flat surface or ground.

- For inventory and access operations, the distance between the reader and tag shall be as specified by the tag manufacturer for the particular RFID application under evaluation. Reader transmit power shall be sufficient to provide the specified power to the tag over that range. In the case of a mixed population of tags, the distance will be set to the minimum tag distance requirement. Note that the distance requirement may be different for inventory, read, write, lock, and kill operations. To facilitate continuous testing via script, the minimum distance across all operations may be used for all tests

The next items describe general statements concerning the interrogator placement in all test sites:

- Interrogator shall be at fixed and stationary position.

- The interrogator antenna shall be placed vertical on a non-conducting support.

- The height of the interrogator antenna shall ensure the correct operation of the entire interrogator.

- If the interrogator can use two or more antennas simultaneously, just one antenna shall be operating and connected to the interrogator.

- For ensuring an interference free environment, no other devices or interrogators shall be operating, at the same frequency range as the SUT, inside the test site area.

### 7.2 Multiple-tag Setup

The multiple-tag setup may be a flat surface of a non-conducting material with maximum area of 1 m x 1 m. The multiple-tag setup contains a group of tags from the same (homogeneous) or different (mixed) label or inlay manufacturers. This tags shall contain a class 1 Gen 2 IC. The tags shall be evenly distributed and maintain a separation between them of not less than 10 cm. The maximum number of tags in the setup shall be 25. Figure 6 depicts the multiple-tag setup.

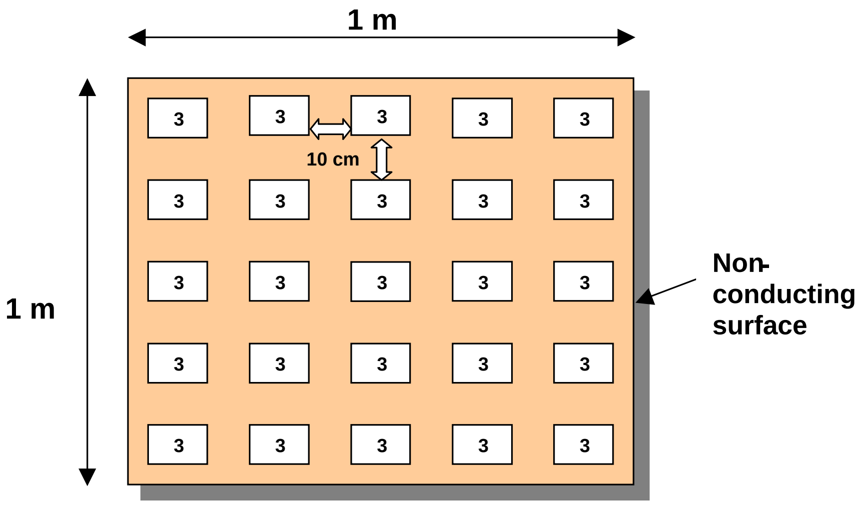
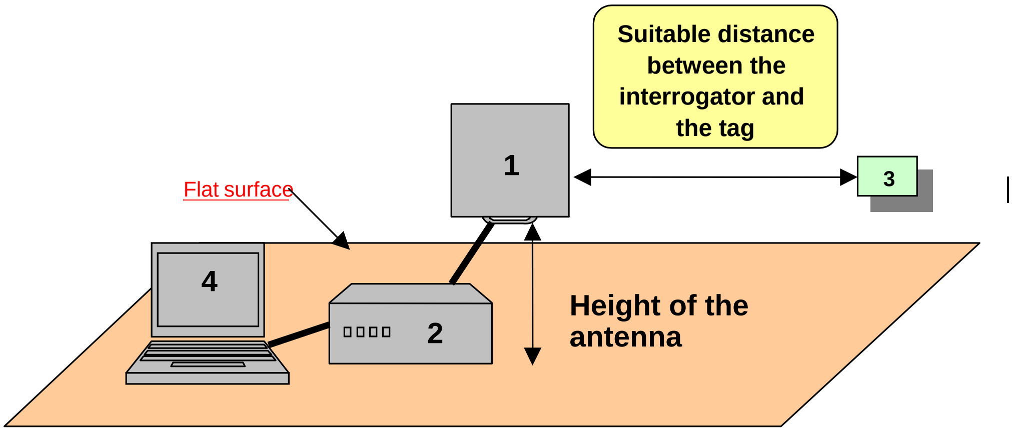



**Figure 1. Multi-tag Board**

## 7.3 Test Sites for Interoperability

**Test Site**




**1** Interrogator antenna
**2** Interrogator
**3** Tag
**4** Host

**Figure 2. Test Site 1**

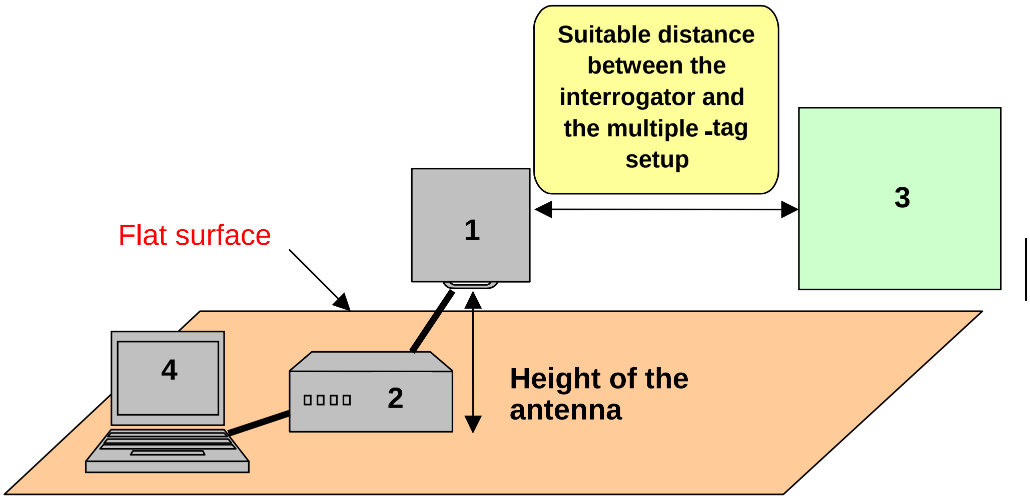
Description of the tag placement:

- The tag shall be at fixed and stationary position.

- The geometrical centre of the tag shall be aligned horizontally with the geometrical centre of the interrogator antenna and the tag orientation facing the antenna.

- Tag placement shall be on a non-conducting material, for example cardboard. Tags should be placed facing the interrogator antenna.

**Test Sites 2 and 3**




**1** Interrogator antenna
**2** Interrogator
**3** Multiple-tag setup
**4** Host

**Figure 3. Test Sites 2 and 3**

Description:

- The multiple-tag setup shall be at fixed and stationary position.

- The geometrical center of the multiple-tag setup shall be aligned horizontally with the geometrical center of the interrogator antenna and its orientation facing the antenna.

- Test Site 2 shall consist of a population of tags from the same vendor. This is referred to as a homogeneous multi-tag population.

- Test Site 3 shall consist of a population of tags from the different vendors. This is referred to as a mixed multi-tag population.

## 7.4 Qualified Equipment

In order to conduct interoperability tests a set of QE must be identified to used. QEs are standard commercial products that have been selected for the purpose of interoperability testing and shown to be fully compliant with reference standards.

When implementing the test cases the test operator can choose between two possible test scenarios:

- *Interrogator under test against tag under test*. There is not qualified equipment in this test scenario. Both, the interrogator and the tag are EUTs.

- *EUT tested against qualified equipment*. The qualified equipment will be an interrogator, a tag or a multiple-tag set-up depending on the device submitted for testing and the test purpose.

See Annex D for more information.

## 7.5 Test System Validation

The system validation will be carried out using an interrogator and a tag population with the following characteristics:

- The selected interrogator and the tag population shall belong to the same manufacturer, in order to assure proper communication between them.

- Both the interrogator and tag population shall have successfully passed the RF and Protocol conformance tests.

Each interoperability test case will be validated running it with the described devices and until a complete test campaign is completed. This can be accomplished by single stepping through each test case or by exercising a group of Script Files that accomplish the same task.

# ANNEX A
# IS and IXIT specification

## A.1 Scope

The present document provides the Implementation Statement (IS) proforma for the radio-frequency identification (RFID) system operating in the 860 MHz – 960 MHz frequency range defined in EPCglobal Class-1 Generation-2 UHF RFID Protocol V.1.0.9 in compliance with the relevant requirements, and in accordance with the relevant guidance given in ISO/IEC9646.

## A.2 References

[1] EPCglobal Class-1 Generation-2 UHF RFID Protocol V.1.0.9

[2] ISO/IEC 9646-1: "Information technology - Open systems interconnection - Conformance testing methodology and framework – Part 1: General concepts".

[3] ISO/IEC 9646-7: "Information technology - Open systems interconnection - Conformance testing methodology and framework – Part 7: Implementation Conformance Statements".

[4] ETSI TS 102 237-1 v 4.1.1 (2003-12): Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) Release 4; Interoperability test methods and approaches; Part 1: Generic approach to interoperability testing.

## A.3 Definitions

In particular, the following terms and definitions apply:

**Interoperability Statement (IS):** It is a checklist of the capabilities/functionalities supported by the Equipment Under Test. IS is used to select and parameterize test cases and as an indicator for basic interoperability between different products.

**IS proforma:** A document, in the form of a questionnaire, which when completed for an implementation or system becomes an IS.

**Implementation eXtra Information for Testing (IXIT):** It contains additional information (e.g., specific addresses, timer values, etc.) necessary for testing.

## A.4 Abbreviations

| | |
|---|---|
| IS | Implementation Statement |
| IUT | Implementation Under Test |
| SUT | System Under Test |

## A.5 Conformance to this IS proforma specification

If it claims to conform to the present document, the actual IS proforma to be filled in by a supplier shall be technically equivalent to the text of the IS proforma given in annex A, and shall preserve the numbering/naming and ordering of the proforma items.
An IS which conforms to the present document shall be a conforming IS proforma completed in accordance with the guidance for completion given in clause 1.1.

# IS proforma for EPCglobal Class-1 Generation-2 UHF RFID Protocol V.1.0.9. Interoperability Test Cases.

## A.6 Guidance for completing the IS proforma

### A.6.1 Purposes and structure

The purpose of this IS proforma is to provide a mechanism whereby a supplier of an implementation of the requirements defined in the specification “EPCglobal Class-1 Generation-2 UHF RFID Protocol” may provide information about the implementation in a standardized manner.
The IS proforma is subdivided into clauses for the following categories of information:

- Guidance for completing the IS proforma;
- Identification of the implementation;
- Identification of the <reference specification type>;
- Global statement of conformance;
- Instructions for completing the IS proforma;
- Identification of the implementation;
- Identification of the protocol;
- Global statement of conformance;
- Roles;
- Major capabilities;
- Timers
- Extra information for testing

### A.6.2 Abbreviations and conventions

Item column

The item column contains a number which identifies the item in the table.

Item description column

The item description column describes in free text each respective item (e.g. parameters, timers, etc.). It implicitly means "is <item description> supported by the implementation?".

Document reference column

The document reference column makes reference to EPCglobal Class-1 Generation-2 UHF RFID Protocol V.1.0.9 except where explicitly stated otherwise.

IS reference column

The IS reference contains the identifier of a particular item. It is used in the selection criteria of each test purpose.

Status column

The following notations, defined in ISO/IEC 9646-7, are used for the status column:

| | |
|---|---|
| m | mandatory - the capability is required to be supported. |
| o | optional - the capability may be supported or not. |
| n/a | not applicable - in the given context, it is impossible to use the capability. |
| x | prohibited (excluded) - there is a requirement not to use this capability in the given context. |
| o.i | qualified optional - for mutually exclusive or selectable options from a set. "i" is an integer which identifies an unique group of related optional items and the logic of their selection which is defined immediately following the table. |

Support column

The support column shall be filled in by the supplier of the implementation. The following common notations, defined in ISO/IEC 9646-7, are used for the support column:

| | |
|---|---|
| Y or y | supported by the implementation. |
| N or n | not supported by the implementation. |
| N/A, n/a or - | no answer required (allowed only if the status is n/a, directly or after evaluation of a conditional status). |

Values allowed column

The values allowed column contains the type, the list, the range, or the length of values allowed. The following notations are used:

- range of values: <min value> .. <max value>
  example: 5 .. 20

Values supported column

The values supported column shall be filled in by the supplier of the implementation. In this column, the values or the ranges of values supported by the implementation shall be indicated.

## A.6.3 Instructions for completing the IS proforma

The supplier of the implementation shall complete the IS proforma in each of the spaces provided. In particular, an explicit answer shall be entered, in each of the support or supported column boxes provided, using the notation described in clause

If necessary, the supplier may provide additional comments in space at the bottom of the tables or separately.
More detailed instructions are given at the beginning of the different clauses of the IS proforma.

## A.6.4 Identification of the implementation

Identification of the Implementation Under Test (IUT) and the system in which it resides (the System Under Test (SUT)) should be filled in so as to provide as much detail as possible regarding version numbers and configuration options.
The product supplier information and client information should both be filled in if they are different.

A person who can answer queries regarding information supplied in the IS should be named as the contact person.

**Date of the statement**

..........................................................................................................................................

**Implementation Under Test (IUT) identification**

IUT name:

..........................................................................................................................................

..........................................................................................................................................

IUT version:

..........................................................................................................................................

**System Under Test (SUT) identification**

SUT name:

..........................................................................................................................................

..........................................................................................................................................

Hardware configuration:

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

Operating system:

..........................................................................................................................................

**Product supplier**

Name:

..........................................................................................................................................

Address:

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

Telephone number:

..........................................................................................................................................

Facsimile number:

..........................................................................................................................................

E-mail address:

..........................................................................................................................................

Additional information:

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

**Client (if different from product supplier)**

Name:

..........................................................................................................................................

Address:

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

Telephone number:

..........................................................................................................................................

Facsimile number:

..........................................................................................................................................

E-mail address:

..........................................................................................................................................

Additional information:

..........................................................................................................................................

..........................................................................................................................................

**IS contact person**

(A person to contact if there are any queries concerning the content of the IS)

Name:

..........................................................................................................................................

Telephone number:
..........................................................................................................................................................
Facsimile number:
..........................................................................................................................................................
E-mail address:
..........................................................................................................................................................
Additional information:
..........................................................................................................................................................
..........................................................................................................................................................
..........................................................................................................................................................

**Identification of the specification**
This IS proforma applies to the Interoperability test cases of the following standard: EPCglobal Class-1 Generation-2 UHF RFID Protocol V.1.0.9

**Global statement of conformance**
Are all mandatory capabilities implemented? (Yes/No) ..................

NOTE: Answering "No" to this question indicates non-conformance to the specification. Non-supported mandatory capabilities are to be identified in the IS, with an explanation of why the implementation is non-conforming, on pages attached to the IS proforma.

## A.6.5. Roles

| Item | Role | Document Reference | IS Reference | Status | Support |
|---|---|---|---|---|---|
| **1** | Interrogator | 2.2.1 | A:1.1/1 | o.1 | |
| **2** | Tag | 2.2.2 | A:1.1/2 | o.1 | |

**Table A.1. Roles**

o.1 - It is mandatory to support exactly one of these items.

Comments:

**Interrogator Role**

| Item | Operation | Document Reference | IS Reference | Status | Support |
|---|---|---|---|---|---|
| **1** | Select | 6.3.2.6 | A:1.2/1 | m | |
| **2** | Inventory | 6.3.2.6 | A:1.2/2 | m | |
| **3** | Access | 6.3.2.6 | A:1.2/3 | m | |
| **4** | Interrogators supports 4 sessions (denoted S0, S1, S2, S3) | 6.3.2.2 | A:1.2/4 | m | |

**Table A.2. Basic operations and capabilities for managing tag populations**

Comments:

| Item | Command | Document Reference | IS Reference | Status | Support |
|---|---|---|---|---|---|
| **1** | Select | 6.3.2.10.1.1 | A:1.3/1 | m | |
| **2** | Query | 6.3.2.10.2.1 | A:1.3/2 | m | |
| **3** | QueryAdjust | 6.3.2.10.2.2 | A:1.3/3 | m | |
| **4** | QueryRep | 6.3.2.10.2.3 | A:1.3/4 | m | |
| **5** | ACK | 6.3.2.10.2.4 | A:1.3/5 | m | |
| **6** | NAK | 6.3.2.10.2.5 | A:1.3/6 | m | |
| **7** | Req_RN | 6.3.2.10.3.1 | A:1.3/7 | m | |
| **8** | Read | 6.3.2.10.3.2 | A:1.3/8 | m | |
| **9** | Write | 6.3.2.10.3.3 | A:1.3/9 | m | |
| **10** | Kill | 6.3.2.10.3.4 | A:1.3/10 | m | |
| **11** | Lock | 6.3.2.10.3.5 | A:1.3/11 | m | |
| **12** | Access | 6.3.2.10.3.6 | A:1.3/12 | o | |
| **13** | BlockWrite | 6.3.2.10.3.7 | A:1.3/13 | o | |
| **14** | BlockErase | 6.3.2.10.3.8 | A:1.3/14 | o | |

**Table A.3. Commands supported**

Comments:

### Tag Role

| Item | Memory bank | Document Reference | IS Reference | Status | Support |
|---|---|---|---|---|---|
| **1** | Reserved memory | 6.3.2.1 | A:1.4/1 | m | |
| **2** | EPC memory | 6.3.2.1 | A:1.4/2 | m | |
| **3** | TID memory | 6.3.2.1 | A:1.4/3 | m | |
| **4** | User memory | 6.3.2.1 | A:1.4/4 | o | |

**Table A.4. Memory banks supported**

Comments:

| Item | Password | Document Reference | IS Reference | Status | Support |
|---|---|---|---|---|---|
| **1** | Kill password | 6.3.2.1.1 | A:1.5/1 | o | |
| **2** | Access password | 6.3.2.1.2 | A:1.5/2 | o | |

**Table A.5. Stored passwords in Reserved memory bank**

Comments:

| Item | EPC Data | Document Reference | IS Reference | Status | Support |
|---|---|---|---|---|---|
| **1** | CRC-16 | 6.3.2.1 | A:1.6/1 | m | |
| **2** | PC (Protocol control) | 6.3.2.1 | A:1.6/2 | m | |
| **3** | Object identifier code | 6.3.2.1 | A:1.6/3 | m | |

**Table A.6. Stored data in EPC memory bank**

Comments:

| Item | Object identifier | Document Reference | IS Reference | Status | Support |
|---|---|---|---|---|---|
| **1** | EPC (EPCglobal members) | 6.3.2.1 | A:1.7/1 | o.1 | |
| **2** | Other object identifier code | 6.3.2.1 | A:1.7/2 | o.1 | |

**Table A.7. Object identifier type**

o.1: It is mandatory to support one of these items.
Comments:

| Item | TID Data | Document Reference | IS Reference | Status | Support |
|---|---|---|---|---|---|
| **1** | 8-bit ISO/IEC 15963 allocation class identifier | 6.3.2.1 | A:1.8/1 | m | |
| **2** | 12-bit tag mask-designer identifier | 6.3.2.1 | A:1.8/2 | c.1 | |
| **3** | 12-bit tag model number | 6.3.2.1 | A:1.8/3 | c.1 | |

**Table A.8. Stored data in TID memory bank**

c.1: Mandatory for EPCglobal members (A:3.1.3.2/1 in Table 1.7)
Comments:

| Item | States | Document Reference | IS Reference | Status | Support |
|---|---|---|---|---|---|
| **1** | Ready state | 6.3.2.10.1.1 | A:1.9/1 | m | |
| **2** | Arbitrate state | 6.3.2.10.2.1 | A:1.9/2 | m | |
| **3** | Reply state | 6.3.2.10.2.2 | A:1.9/3 | m | |
| **4** | Acknowledged state | 6.3.2.10.2.3 | A:1.9/4 | m | |
| **5** | Open state | 6.3.2.10.2.4 | A:1.9/5 | m | |
| **6** | Secured state | 6.3.2.10.2.5 | A:1.9/6 | m | |
| **7** | Killed state | 6.3.2.10.3.1 | A:1.9/7 | m | |

**Table A.9. States**

Comments:

| Item | Command | Document Reference | IS Reference | Status | Support |
|---|---|---|---|---|---|
| **1** | Select | 6.3.2.10.1.1 | A:1.10/1 | m | |
| **2** | Query | 6.3.2.10.2.1 | A:1.10/2 | m | |
| **3** | QueryAdjust | 6.3.2.10.2.2 | A:1.10/3 | m | |
| **4** | QueryRep | 6.3.2.10.2.3 | A:1.10/4 | m | |
| **5** | ACK | 6.3.2.10.2.4 | A:1.10/5 | m | |
| **6** | NAK | 6.3.2.10.2.5 | A:1.10/6 | m | |
| **7** | Req_RN | 6.3.2.10.3.1 | A:1.10/7 | m | |
| **8** | Read | 6.3.2.10.3.2 | A:1.10/8 | m | |
| **9** | Write | 6.3.2.10.3.3 | A:1.10/9 | m | |
| **10** | Kill | 6.3.2.10.3.4 | A:1.10/10 | m | |
| **11** | Lock | 6.3.2.10.3.5 | A:1.10/11 | m | |
| **12** | Access | 6.3.2.10.3.6 | A:1.10/12 | o | |
| **13** | BlockWrite | 6.3.2.10.3.7 | A:1.10/13 | o | |
| **14** | BlockErase | 6.3.2.10.3.8 | A:1.10/14 | o | |

**Table A.10. Commands supported**

Comments:

| Item | MemBank | Document Reference | IS Reference | Status | Support | Values | |
|---|---|---|---|---|---|---|---|
| | | | | | | Allowed | Supported |
| **1** | Reserved memory bank | 6.3.2.1 | B.1.11/1 | m | | 00 | |
| **2** | EPC memory bank | 6.3.2.1 | B.1.11/2 | m | | 01 | |
| **3** | TID memory bank | 6.3.2.1 | B.1.11/3 | m | | 10 | |
| **4** | User memory bank | 6.3.2.1 | B.1.11/4 | m | | 11 | |

**Table A.11. Logical partitioning of the memory banks**

Comments:

| Item | Data | Document Reference | IS Reference | Status | Support | Values | |
|---|---|---|---|---|---|---|---|
| | | | | | | Allowed | Supported |
| **1** | Kill password in Reserved memory | 6.3.2.1 | B.1.12/1 | c.1 | | $00_h$ - $1F_h$ | |
| **2** | Access password in Reserved memory | 6.3.2.1 | B.1.12/2 | c.2 | | $20_h$ - $3F_h$ | |
| **3** | CRC-16 in EPC memory | 6.3.2.1 | B.1.12/3 | m | | $00_h$ – $0F_h$ | |
| **4** | Protocol Control (PC) in EPC memory | 6.3.2.1 | B.1.12/4 | m | | $10_h$ – $1F_h$ | |
| **5** | Object identifier code in EPC memory | 6.3.2.1 | B.1.12/5 | m | | Above $1F_h$ | |
| **6** | ISO/IEC 15963 allocation class identifier in TID memory | 6.3.2.1 | B.1.12/6 | m | | $00_h$ - $07_h$ | |
| **7** | Other identifier information in TID memory | 6.3.2.1 | B.1.12/7 | m | | Above $07_h$ | |
| **8** | Tag mask-designer identifier in TID memory | 6.3.2.1 | B.1.12/8 | c.3 | | $08_h$ – $13_h$ | |
| **9** | Tag model number in TID memory | 6.3.2.1 | B.1.12/9 | c.3 | | $14_h$ – $1F_h$ | |

**Table A.12. Memory locations of stored data in each memory bank**

c.1: Mandatory for tags that implement the kill password (A:3.1.2/1 in Table 1.5)

c.2: Mandatory for tags that implement the access password (A:3.1.2/2 in Table 1.5)

c.3: Mandatory for EPCglobal members (A:3.1.3.2/1 in Table 1.7)

Comments:

# IXIT proforma for EPCglobal Class-1 Generation-2 UHF RFID Protocol V.1.0.9. Interoperability Test Cases.

## A.7 Operating Parameters

Is the prototype controlled by means of an external PC or terminal unit?
(Yes/No)

Does the prototype notify (e.g. by means of messages) if the operation has been executed correctly?
(Yes/No)

Main power characteristics:

(AC/DC)

Supply voltage:_____________________________________________________ _____

Supply current:_________________________________________________ _________

Operating frequency range:_______________________________________________

Implemented modulation format in Interrogator-to-Tag communication:____________

Implemented modulation format in Tag-to-Interrogator communication:____________

Implemented codification format in Tag-to-Interrogator communication:____________

Frequency sub-band:______________________________________________________

Number of channels:___________________________________________ __________

Channel width:___________________________________________________________

Interoperability test mode description:

# ANNEX B
# Test Report

*Report No.: #report number#*

**TEST NAME:** **#test name#**

| | | |
|---|---|---|
| **Product Name** | : | #product name# |
| **Trade Mark** | : | #trade mark# |
| **Product ID** | : | IUT_PRODUCT_ID |
| **Manufacturer** | : | MANUFAC_COMPANY |
| **Client** | : | CLIENT_COMPANY |
| **Standard(s)** | : | EPCglobal Class-1 Generation-2 UHF Protocol V1.0.9 |

This test report includes 4 annexes and therefore the total number of pages of this test report is x.

**IDENTIFICATION SUMMARY**

## B.1 Test Laboratory

| | |
|---|---|
| **Name:** | |
| **Address** | |
| **City:** | |
| **Postal code:** | |
| **Country:** | |
| **Telephone:** | |
| **Fax:** | |
| **URL:** | |
| **Contact person:** | |
| **Name:** | |
| **e-mail:** | |

**Competences and guarantees:**

MET Laboratories Inc. is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, MET Laboratories has a calibration and maintenance programme for its measuring equipment.

MET Laboratories guarantees the reliability of the data presented in this report, which is the result of measurements and tests performed to the item under test on the date and under the conditions stated on the report and is based on the knowledge and technical facilities available at MET Laboratories at the time of execution of the test.

MET Laboratories is liable to the client for the maintenance by its personnel of the confidentiality of all information related to the item under test and the results of the test.

## B.2 Client

| | |
|---|---|
| **NAME:** | |
| **V.A.T. :** | |
| **Address:** | |
| **City:** | |
| **Postal code:** | |
| **Country:** | |
| **Telephone:** | |
| **Contact person:** | |
| **Name:** | |
| **e-mail:** | |

## B.3 Manufacturer

| | |
|---|---|
| **NAME:** | |
| **V.A.T. :** | |
| **Address:** | |
| **City:** | |
| **Postal code:** | |
| **Country:** | |
| **Telephone:** | |
| **Contact person:** | |
| **Name:** | |
| **e-mail:** | |

## B.4 Implementation Under Test

| | |
|---|---|
| **PRODUCT NAME:** | |
| **Trademark:** | |
| **Product ID:** | |
| **Hw version:** | |
| **Sw version:** | |
| **Profiles supported:** | |
| **Protocol Specification(s):** | |
| **IS:** | SEE ANNEX A |
| **Description of IUT 1:** | |
| **Sample method:** | Samples undergoing test have been selected by: The Client |

## B.5 Implementation Under Test 2

| | |
|---|---|
| **PRODUCT NAME:** | |
| **Trademark:** | |
| **Product ID:** | |
| **Hw version:** | |
| **Sw version:** | |
| **Profiles supported:** | |
| **Protocol Specification(s):** | |
| **IS:** | SEE ANNEX A |
| **Description of IUT 2:** | |
| **Sample method:** | Samples undergoing test have been selected by: The Client |

## B.6 Testing Environment

| | |
|---|---|
| **IXIT:** | SEE ANNEX B |
| **Period of testing:** | |
| **Conformance log reference:** | SEE ANNEX C |
| **Retention date for log reference:** | 5 years |
| **Test Requested** | Interoperability testing for #IUT#. |

## B.7 Means of testing identification:

| | |
|---|---|
| **Hardware:** | RIDER INTEROP TESTER (HW SEE XX) |
| **Software:** | RIDER INTEROP TESTER (SW see xx) |
| **Test Setup:** | |
| **Test Procedures:** | |

## B.8 Test conditions:

**NOMINAL**

| | |
|---|---|
| TEMPERATURE IN THE RANGE 18ºC TO 27 ºC | |

**EXTREME**

| | MAX | NOMINAL | MIN |
|---|---|---|---|
| TEMPERATURE | | | |
| VOLTAGE | | | |

## B.9 Limits and reservations

The test results presented in this test report apply only to the implementations under test (IUT 1 & IUT 2) declared in section 1.4 of this report, for the functionality described in the relevant Implementation Statement (IS), as presented for test on the date(s) declared in section 1.5 and configured as declared in the relevant Implementation eXtra Information for Testing (IXIT).

This test report does not constitute or imply, by its own, to be an approval of the product by Qualification Bodies, Certification Bodies or competent Authorities.

This document is only valid if complete; no partial reproduction can be made without written approval of the Test Laboratory.

This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written approval of the Test Laboratory.

## B.10 Record of agreement

The following samples were used for testing.

| INTERNAL CONTROL NO.: | ELEMENT: | SERIAL NO.: | DATE OF RECEPTION: |
|---|---|---|---|
| xxxxx/13 | | | |
| xxxxx/05 | | | |

## B.11 Iut Conformance Status

These IUT 1 & IUT 2 have #NOT# been shown by conformance assesment to be non-conforming to the referenced specification(s).

| | |
|---|---|
| STATIC CONFORMACE ERRORS? | |
| Dynamic Conformance errors? | |

Number of test cases run

| | |
|---|---|
| PASSED: | |
| Failed: | |
| Inconclusive: | |
| Total: | |

## B.12 Static Conformance Summary

The IS(s) for IUT 1 & IUT 2 is #NOT# consistent with the static conformance requirements in the referenced base specification(s).

The qualified IS/IXIT menu of the test system was defined in accordance with the client.

## B.13 Dynamic Conformance Summary

The test campaign did #NOT# reveal errors in IUT 1 & IUT 2.

## B.14 Static Conformance Review Report

| | |
|---|---|
| IS CORRECT | |
| IS INCORRECT | |
| IS NOT FILLED | |

## B.15 Test Campaign Report

The abbreviations used in the header row of the test campaign report tables are:

Applicable: Indicates whether or not a test case has been selected for execution against IUTs identified in section 1.4 according to the analysis of the information in the IS and IXIT for IUT 1 & IUT 2.

Run: Indicate whether or not the corresponding test case has been run to completion.

Verdict: Records the verdict assigned to each test case run to completion. Following verdicts are possible:

Pass: If the test case passed
Fail: If the test case failed
Inc: If the test case is inconclusive.

Observations: Provides a reference to additional information relevant to the test presented in section 7.

| *Test Case Id* | *Role* | *Applicable* | *Run* | *Verdict* | *Observations* |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |

## B.16 Observations

# ANNEX C
# Interoperability Tests for Printers

## C.1 Manufacturer Data

Printer manufacturers integrate OEM interrogators into there various printers designs. Printer designs are diverse and consequently, interrogator performance in any given printer design is very carefully tuned by the printer manufacturer to yield optimal performance within that environment.

For optimal RFID supply performance the printer user is to carefully follow all of the manufactures recommendation regarding printer supply selection, and operation. This may require that only the printer manufacturers approved RFID label and tag supplies be used in a particular model of printer.

The basic function of the printer interrogator is to correctly program a previously blank tag with input data.

To perform this function the interrogator may use a sequence of internal commands to erase, verify and write to the transponder.

A read write operation must be directed only at the transponder that is intended for that operation. It is required that the transponder being programmed is correctly identified so as not to inadvertently program adjacent transponders (Adjacency control).

Tests of interoperability for the printer are defined as the ability of the printer interrogator to perform specified read write operations as defined in this document and more importantly for all RF transponders programmed by the printer to be read by any EPCglobal certified reader. The only exception is for transponders identified by the printer Interrogator as being unusable.

Unusable transponders are to be identified as defective.

## C.2 Manufacturer Identification

| | |
|---|---|
| Supplier | |
| Contact point for queries samples | |
| Product Name(s) and Version(s) (NOTE)1 | |
| Other information necessary for full inter op testing - e.g., mounting information; are parameters in table 2.1 in free air or mounted to material<br>PC controller | |

NOTE 1 The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g. Type, Series, Model).

| REF | Feature | Capability | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| | **EPCglobal™ Certified Interrogator Module** | | | | | |
| | North American regulatory compliance | | | | | |
| | European regulatory compliance | | | | | |
| | | | | | | |
| | Operating frequency | | | | | MHz |
| | Operating temperature | | | | | ºC |
| | Storage temperature | | | | | ºC |
| | Operating humidity | | | | | % |
| | **Supported EPCglobal Protocols** | | | | | |
| | Class 1 Generation 2 (C1G2) | | | | | |

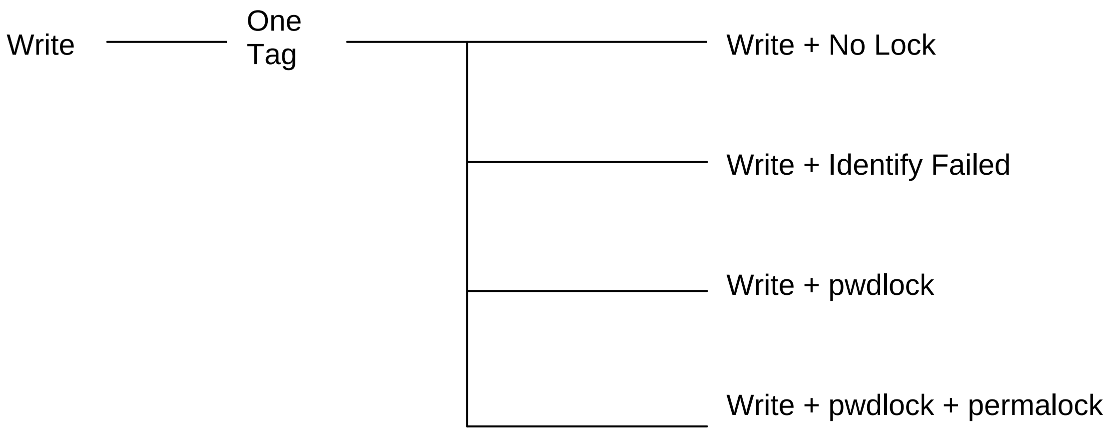
**Table C.1 Manufacturer product summary**

Notes: NC = Non-Condensing

## C.3 Reference from EPCglobal Gen 2 Specification

Reference to ISO/IEC Document 18000-6C Information technology – Radio frequency identification for item management- Part 6C Parameters for air interface communications at 860 MHz to 960MHz
Table 39 – Lock Action-field functionality

## C.4 Test Suit Structure




**Write**
EPC
Access
*Kill
User
TID
Proven on Exterenal Reader

**Write + Permalock**
EPC
Access
*Kill
User
TID
Proven on Exterenal Reader

**Write + Pwd Lock**
EPC
Access
*Kill
User
TID
Proven on Exterenal Reader

**Write +Pwd Lock+ Permalock**
EPC
Access
*Kill
User
TID
Proven on Exterenal Reader

* Test condition that does not apply to printer operation.
User & TID functions not yet implemented in available Gen 2 product

**Special Tests**
1. Read Tag - Ability to read and recognize EPC capable tag.
2. Seralized Batch - Ability to print 10 EPC tags with sequntial numbering.
3. Identify Failed - Ability to identify inoperative transponder.

| #n. | TC Id. | Test Purpose |
|---|---|---|
| #1 | TP/WR/ONE/BAS/BV-01 | The printer is able to write data to the EPC field. |
| #2 | TP/WR/ONE/BAS/BV-02 | The printer is able to write data to the Access password field |
| #3 | TP/WR/ONE/BAS/BV-03 | The printer is able to write data to the Kill password field. |
| #4 | TP/WR/ONE/IDE/BV-01 | The printer is able to identify inoperative transponders before writing. |
| #5 | TP/WR/ONE/PWD/BV-01 | The printer is able to write data to EPC and Access password fields locking both with pwdlock. |
| #6 | TP/WR/ONE/PWD/BV-02 | The printer is able to write data to Kill and Access password fields locking both with pwdlock. |

**Table C.2 Test Cases List Reference**

## C.5 TP Naming Convention

| Identifier: TP/**<main functionality>/<tag scenario>/<functionality subgroup>/<type>-<nn>** | |
|---|---|
| <main functionality> | WR (Write) |
| <tag scenario> | ONE (One Tag) |
| <functionality subgroup> | BAS (Basic = No Lock)<br>IDE (Identify Failed)<br>PWD (pwdlock)<br>PPL (pwdlock +permalock) |
| <type> | BV (Valid Behaviour)<br>BI (Invalid Behaviour) |
| <nn> | sequential number (01-99) |

**Valid Behaviour (BV) tests**: This subgroup provides testing to verify that the EUT reacts in conformity with the specified functionality.

**Invalid Behaviour (BI) tests**: This subgroup provides testing to verify that the EUT reacts in conformity with the specified functionality, after receipt of a syntactically, semantically or functionality invalid event.

## C.6 Test Case Procedures

| WRITE with NO LOCK | | | | |
|---|---|---|---|---|
| **TP Id**: TP/WR/ONE/BAS/BV-01<br>Version 0.3 | | **Selected**: Yes<br>No | | |
| **Test Purpose**: Show that the **printer** is able to **write** data to the **EPC field**. | | | | |
| **Step** | **Test description** | **Verdict** | | |
| | | **Pass** | **Fail** | |
| 1 | Thread the label roll and set up the printer to be ready for operation. | | | |
| 2 | Act on the printer to **write data with NO lock** to the **EPC field**. Length of the data shall be the same as the size of the memory bank. | | | |
| 3 | Fill the gap (in hexadecimal) with the written data to the EPC field.<br>________________________________________ | | | |
| 4 | **Verification of the test case:**<br>Verify the **Write with No lock** operation by reading the EPC memory bank with an external interrogator. | | | |
| 5 | Fill the gap (in hexadecimal) with the tag data reported by the **first external interrogator**.<br>________________________________________<br>Does the reported data match the previous written data in the EPC field? | Yes | No | |
| **Observations**: | | | | |
| **External interrogators used for the verification:** | | | | |
| Success criteria: | The read data by each external interrogator shall match the written data by the printer. | | | |

| DATE | PRINTER | TAG |
|---|---|---|
| | | |

| **WRITE with NO LOCK** | | | |
|---|---|---|---|
| **TP Id**: TP/WR/ONE/BAS/BV-02<br>Version 0.3 | | **Selected**: Yes<br>No | |
| **Test Purpose**: Show that the **printer** is able to **write** data to the **Access password field**. | | | |
| **Step** | **Test description** | **Verdict** | |
| | | **Pass** | **Fail** |
| 1 | Thread the label roll and set up the printer to be ready for operation. | | |
| 2 | Act on the printer to **write data with NO lock** to the **Access password field**. Length of the data shall be the same as the size of the Access password field. | | |
| 3 | Fill the gap (in hexadecimal) with the written data to the Access field.<br>________________________________________ | | |
| 4 | **Verification of the test case:**<br>Verify the **Write with No lock** operation by reading the Access password with an external interrogator. | | |
| 5 | Fill the gap (in hexadecimal) with the tag data reported by the **first external interrogator**.<br>________________________________________<br>Does the reported data match the previous written data in the Access field? | Yes | No |
| **Observations**: | | | |
| **External interrogators used for the verification:** | | | |
| Success criteria: | The read data by each external interrogator shall match the written data by the printer. | | |

| **DATE** | **PRINTER** | **TAG** |
|---|---|---|
| | | |

<table>
<tr><th colspan="4">WRITE with NO LOCK</th></tr>
<tr><td colspan="2">TP Id: TP/WR/ONE/BAS/BV-03<br>Version 0.3</td><td colspan="2">Selected: Yes<br>No</td></tr>
<tr><td colspan="4">Test Purpose: Show that the printer is able to write data to the Kill password field.</td></tr>
<tr><th rowspan="2">Step</th><th rowspan="2">Test description</th><th colspan="2">Verdict</th></tr>
<tr><th>Pass</th><th>Fail</th></tr>
<tr><td>1</td><td>Thread the label roll and set up the printer to be ready for operation.</td><td></td><td></td></tr>
<tr><td>2</td><td>Act on the printer to write data with NO lock to the Kill password field. Length of the data shall be the same as the size of the Kill password field.</td><td></td><td></td></tr>
<tr><td>3</td><td>Fill the gap (in hexadecimal) with the written data to the Kill password field.<br>____________________</td><td></td><td></td></tr>
<tr><td>4</td><td>Verification of the test case:<br>Verify the Write with No lock operation by reading the Kill password with an external interrogator.</td><td></td><td></td></tr>
<tr><td>5</td><td>Fill the gap (in hexadecimal) with the tag data reported by the first external interrogator.<br>____________________<br>Does the reported data match the previous written data in the Kill password field?</td><td>Yes</td><td>No</td></tr>
<tr><td colspan="4">Observations:</td></tr>
<tr><td colspan="4">External interrogators used for the verification:</td></tr>
<tr><td>Success criteria:</td><td colspan="3">The read data by each external interrogator shall match the written data by the printer.</td></tr>
</table>

| DATE | PRINTER | TAG |
|---|---|---|
| | | |

| WRITE + IDENTIFY FAILED | | | |
|---|---|---|---|
| **TP Id**: TP/WR/ONE/IDE/BV-01<br>Version 0.3 | | **Selected**: Yes<br>No | |
| **Test Purpose**: Show that the **printer** is able to **identify** inoperative transponders before writing. | | | |
| **Step** | **Test description** | **Verdict** | |
| | | **Pass** | **Fail** |
| 1 | Thread the label roll and set up the printer to be ready for operation. At least, five inoperative transponders shall be in the label roll. | | |
| 2 | Act on the printer to **write data with NO lock** to any tag memory field. Length of the data shall be the same as the size of the selected memory field. | | |
| 3 | Continue writing labels until at least five inoperative transponders have passed through the printer. | | |
| 4 | Has the printer identified as unusable all inoperative transponders? | Yes | No |
| **Observations**: | | | |
| Success criteria: | All unusable transponders are to be identified as defective by the printer. | | |

| DATE | PRINTER | TAG |
|---|---|---|
| | | |

| WRITE with PWDLOCK | | | |
|---|---|---|---|
| **TP Id**: TP/WR/ONE/PWD/BV-01<br>Version 0.3 | | **Selected**: Yes<br>No | |
| **Test Purpose**: Show that the **printer** is able to **write** data to the **EPC and Access** password fields **locking both with pwdlock**. | | | |
| **Step** | **Test description** | **Verdict** | |
| | | **Pass** | **Fail** |
| 1 | Thread the label roll and set up the printer to be ready for operation. | | |
| 2 | Act on the printer to **write data with pwdlock** to the **EPC and Access** password fields. Length of the data shall be the same as the size of the memory for each field. | | |
| 3 | Fill the gap (in hexadecimal) with the written data to the EPC field.<br>________________________________________ | | |
| 4 | Fill the gap (in hexadecimal) with the written data to the Access field.<br>________________________________________ | | |
| 5 | **Verification of the test case:**<br>Verify the **Write with pwdlock** operation by attempting to write the EPC field with an external interrogator. In a subsequent read operation, it is checked if a new EPC number has been programmed. | | |
| 6 | Arrange the external interrogator to write a different EPC number from the EPC number specified in step 3. | | |
| 7 | Perform a read operation over the EPC field using the external interrogator. | | |
| 8 | Fill the gap (in hexadecimal) with the tag data reported by the **external interrogator**.<br>________________________________________<br>Does the reported data match the previous written data in the EPC field? | Yes | No |
| 9 | Arrange the external interrogator to send an **Access command** followed by a **Write** operation. The Access password used in the Access command shall be the programmed value specified in step 4. The EPC number to be written shall be different from the one specified in step 3. | | |
| 10 | Perform a read operation over the EPC field using the external interrogator. | | |
| 11 | Fill the gap (in hexadecimal) with the tag data reported by the **external interrogator**.<br>________________________________________<br>Does the reported data match the previous written data in the EPC field? | No | Yes |

| | | |
|---|---|---|
| **Observations**: | | |
| **External interrogators used for the verification:** | | |
| Success criteria: | In the verification, an error should be obtained as result of the first write operation. Thus the read EPC data should match the programmed EPC by the printer. The second write operation should be successful so a different EPC number should be programmed. | |
| **DATE** | **PRINTER** | **TAG** |
| | | |

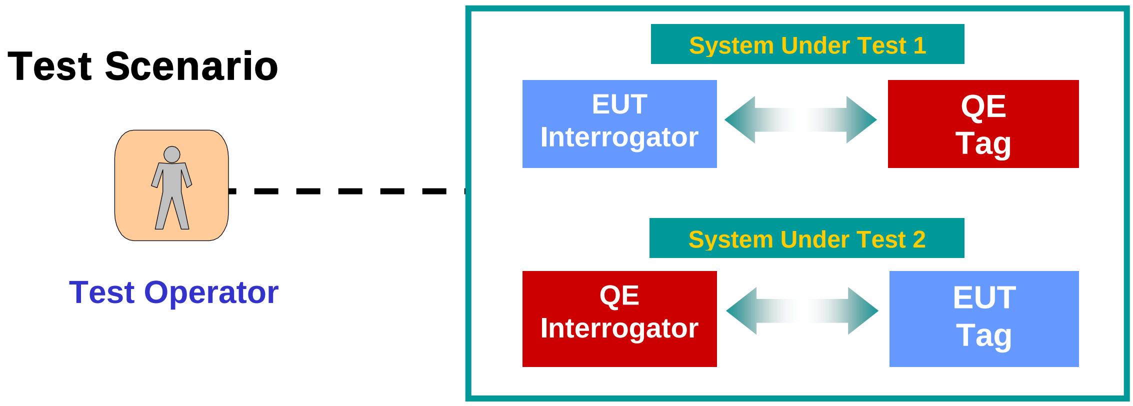
| WRITE with PWDLOCK | | | |
|---|---|---|---|
| **TP Id**: TP/WR/ONE/PWD/BV-02<br>Version 0.3 | | **Selected**: Yes<br>No | |
| **Test Purpose**: Show that the **printer** is able to **write** data to the **Kill and Access** password fields **locking both with pwdlock**. | | | |
| **Step** | **Test description** | **Verdict** | |
| | | **Pass** | **Fail** |
| 1 | Thread the label roll and set up the printer to be ready for operation. | | |
| 2 | Act on the printer to **write data with pwdlock** to the **Kill and Access** password fields. Length of the data shall be the same as the size of the memory for each field. | | |
| 3 | Fill the gap (in hexadecimal) with the written data to the Kill password field.<br>________________________________________ | | |
| 4 | Fill the gap (in hexadecimal) with the written data to the Access field.<br>________________________________________ | | |
| 5 | **Verification of the test case:**<br>Verify the **Write with pwdlock** operation by attempting to write the Kill password field with an external interrogator. In a subsequent read operation, it is checked if a new Kill password has been programmed. | | |
| 6 | Arrange the external interrogator to write a different Kill password from the data specified in step 3. | | |
| 7 | Perform a read operation over the Kill password field using the external interrogator. | | |
| 8 | Fill the gap (in hexadecimal) with the tag data reported by the **external interrogator**.<br>________________________________________<br>Does the reported data match the previous written data in the Kill password field? | Yes | No |
| 9 | Arrange the external interrogator to send an **Access command** followed by a **Write** operation. The Access password used in the Access command shall be the programmed value specified in step 4. The Kill password to be written shall be different from the one specified in step 3. | | |
| 10 | Perform a read operation over the Kill password field using the external interrogator. | | |
| 11 | Fill the gap (in hexadecimal) with the tag data reported by the **external interrogator**.<br>________________________________________<br>Does the reported data match the previous written data in the Kill password field? | No | Yes |

<table>
<tr><td colspan="3">Observations:</td></tr>
<tr><td colspan="3">External interrogators used for the verification:</td></tr>
<tr><td>Success criteria:</td><td colspan="2">In the verification, an error should be obtained as result of the first write operation. Thus the read Kill data should match the programmed Kill password by the printer. The second write operation should be successful so a different Kill password should be programmed.</td></tr>
<tr><td>DATE</td><td>PRINTER</td><td>TAG</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

# Annex D
# Qualified Equipment Selection and Test Equipment

## D.1 Qualified Equipment

In order to ensure that interoperability tests are repeatable and consistent, a set of products should be identified for use during interoperability testing – these products will be called Qualified Equipment (QE). QEs are standard commercial products that have been selected for the purpose of interoperability testing and shown to be fully compliant with reference standards.

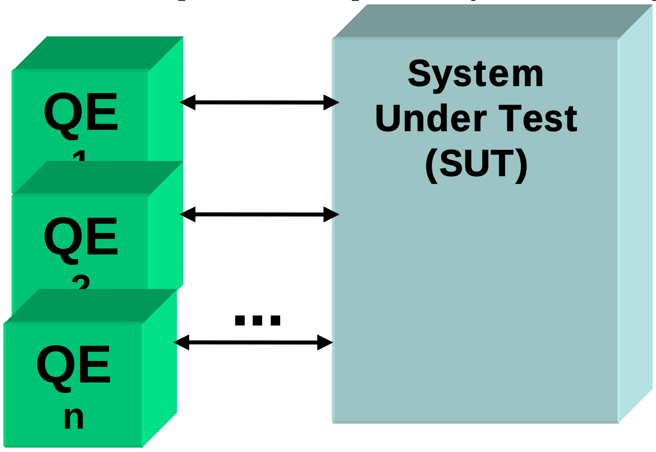


## D.2 Definitions of Interoperability Testing Terms:

**Interoperability testing:** Activity of proving that end-to-end functionality between (at least) two communicating systems is as required by the base standard(s) on which those systems are based.

**QE (Qualified Equipment):** Grouping of one or more devices that has been shown, by rigorous and well-defined testing, to interoperate with other equipment

**SUT (System Under Test):** It is a group of one or more devices that have not been shown to interoperate with a previously Qualified Equipment.



## D.3 Selection of QE

1. EPCglobal sends a Request to invite manufacturers to submit products or prototypes of both tags and interrogators to become QE.
2. A selection process takes place. The selection process involves:
   a. Evaluation of the characteristics of the products, including supported features.
   b. Testing of interoperability within the set of submitted equipment.
   c. Evaluation and Performance: Predictability of results and overall performance.
   d. Maximum representation of technologies and manufacturing process.
   e. Evaluation of usability and features to optimise testing such as short read times and consistent measurement distances.
   f. Life-time of product and maintenance.
3. The Test House will produce a report providing guidance and a recommendation for selection of two or more QE of both tags and interrogators.
4. MET Labs will provide a list of potential QE to EPCglobal for ratification of the selection. MET Labs nominates the equipment as Preliminary Qualified Equipment (Pre-QE).
5. Pre-QE is used in the Hardware Certification Testing Program to run interoperability testing.
6. If no problems are detected during operation and products successfully compliance EPCglobal Gen-2 Conformance Testing, Pre-QE officially becomes QE.
7. As the standard develops (changes, errata process, new features, etc.) the process to select new QE is performed again.

## D.4 Evaluation of the products

**For Interrogators:**

- The QE shall operate over all the declared frequency plans and sub-bands specified in the EPCglobal Gen-2 Protocol.
- The QE shall support the maximum number of combinations of modulation and codification formats, Tari/RTCal/TRCal values, etc.
- The QE shall implement a suitable combination of optional commands and optional features.
- The QE will employ an intuitive GUI that allows test operators to run Test Cases in customizable suites.

**For Tags:**

- The QE shall implement a suitable combination of optional commands, optional features and optional memory banks and/or passwords to cover the most significant implementations.

## D.5 Test Equipment

2. All information supplied such as client data, manufacturer data and EUT general data will be an input for the test system. IS and IXIT shall be filled prior to testing to determine the test cases that apply for the EUT. The IS information will be checked for consistency and in case of errors the test system will report the problems. (e.g., data filled without using the appropriate format). Static Conformance Review and the corresponding Test Case Mapping Table is derived from IS by the application. The result is the set of test cases applicable to the EUT. They can be run individually or as a batch using the scripting language.

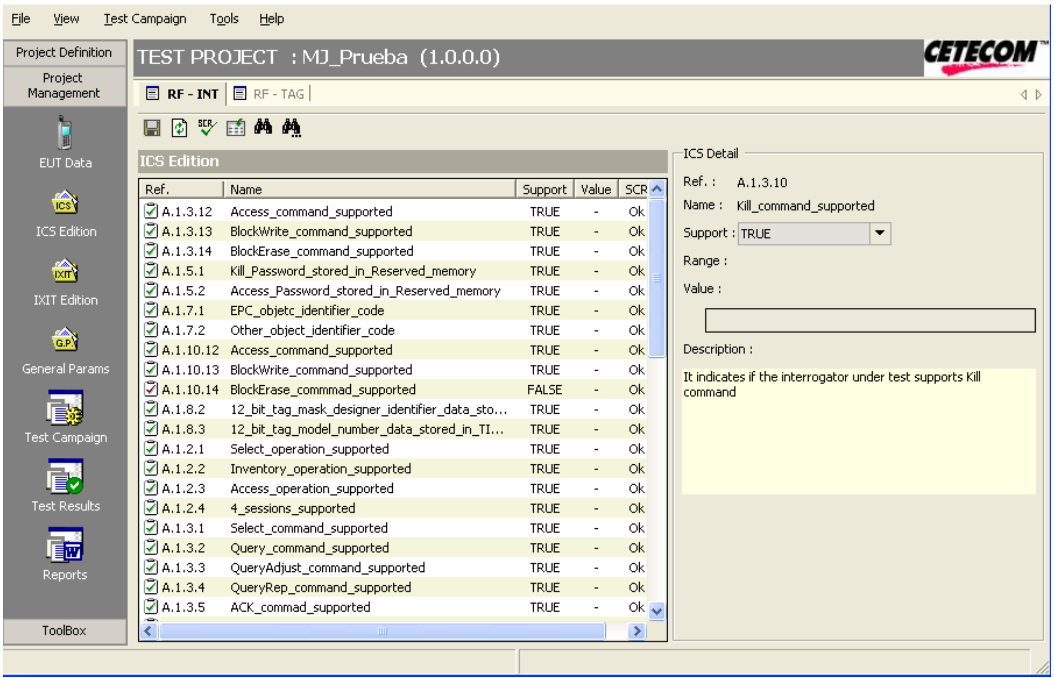



**Figure D.1. IS edition**

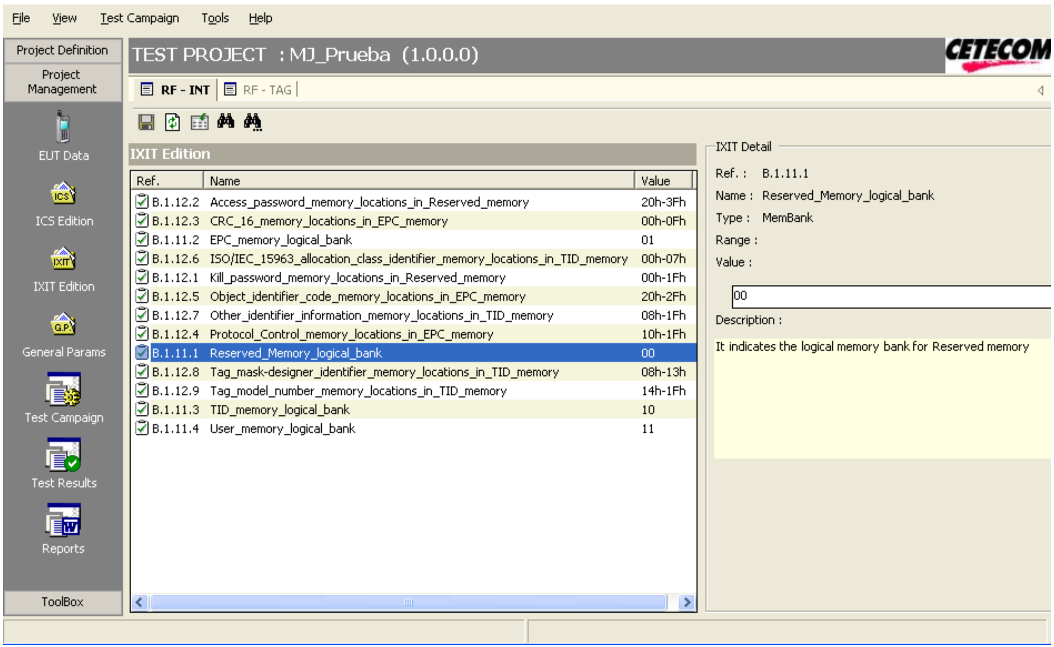



**Figure D.2. IXIT edition**

3. In the left hand side the window of icons show the different steps of the general procedure for a test campaign.

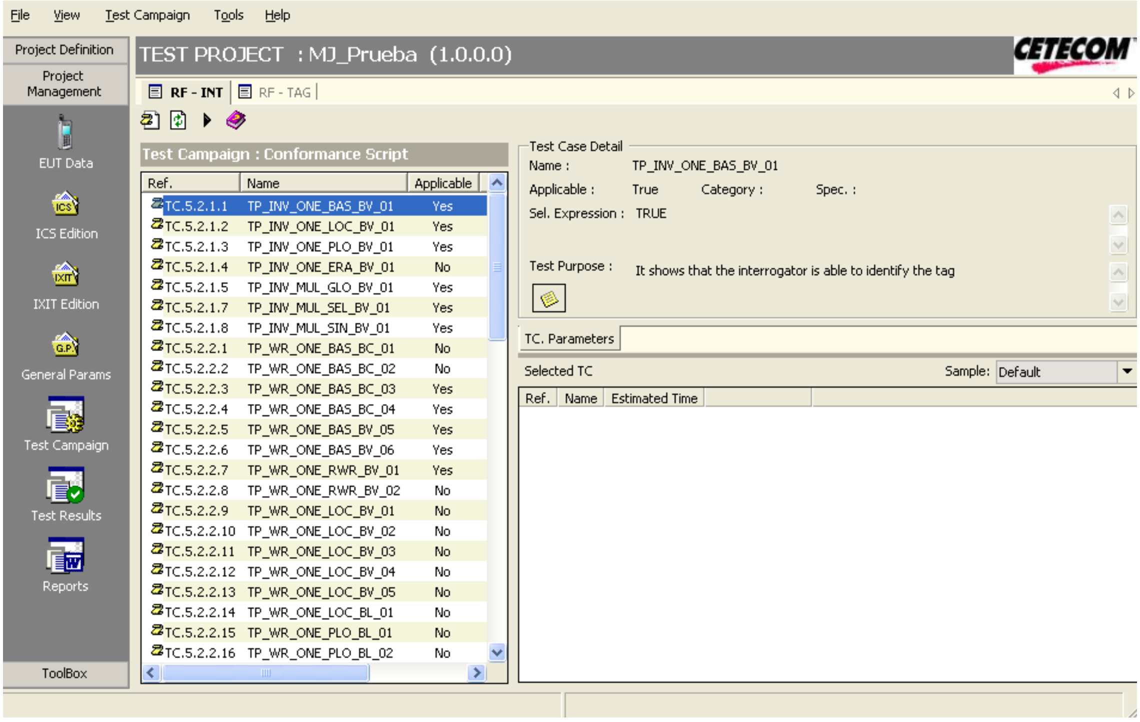



**Figure D.3. Test Campaign**

The applicable test cases are executed progressively. It is also possible to specify some items as number of executions, order of test cases execution and the values of the parameters used in each test case. These capabilities improve the interaction among test system and user.

9. A window with the instructions to be performed over the System Under Test (SUT) is shown for each test case. The operator manipulates EUTs and/or QE consistent with the test case instructions and verifies the behaviour of the SUT. The preferred means of exercising the test cases is by creating a script file in accordance with the requirements in this document and executing it. The resulting output file can be feed into the software manager to register the official results.  The operator can generate special script files to evaluate certain subsets of test cases as needed to achieve a final verdict.

9. Several test reports are generated from the verdicts of test cases executions. User may choose which reports shall be consulted and printed selecting filters defined in the application (see section 5 for detail information about test reports).

The following diagram presents an overview of the inputs and outputs for interoperability test system, including SUT behaviours observed by the operator which are partial results for final verdict.

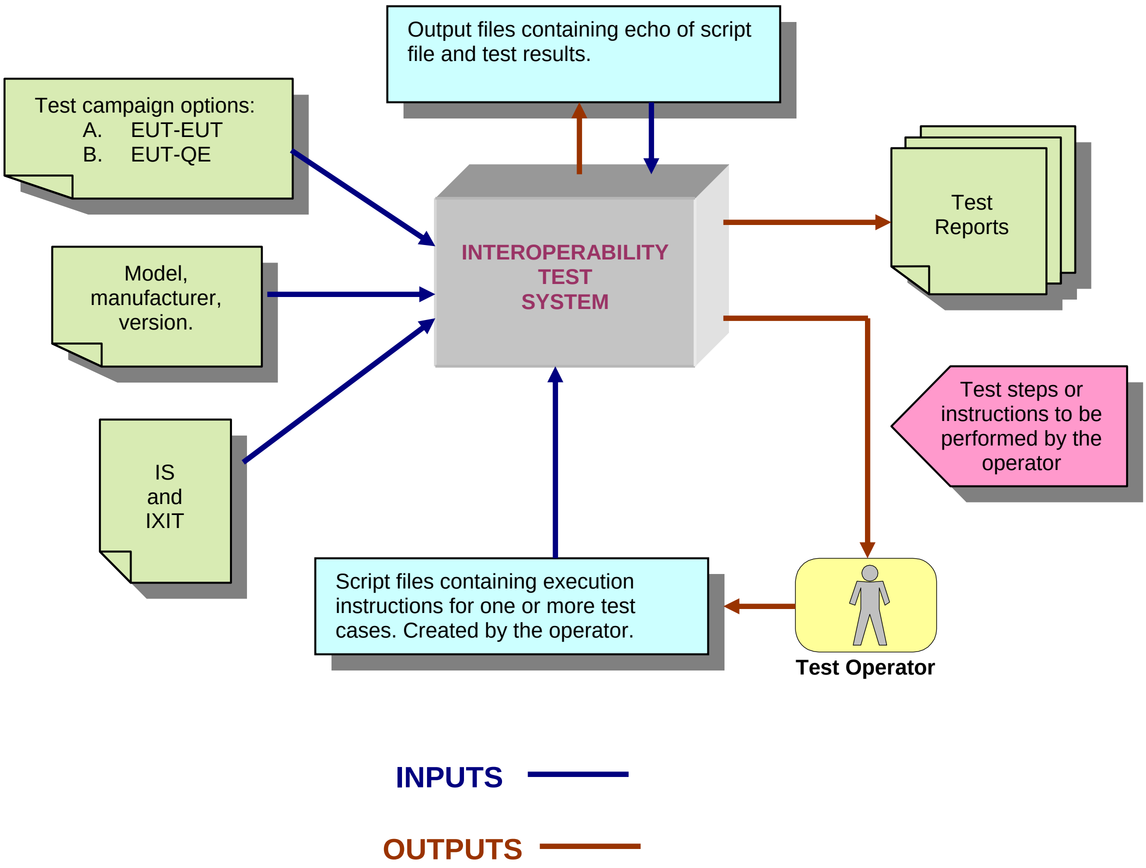



**Figure D.4. Overview of Interoperability Test System**

## D.6 Test Equipment

The Test Equipment has the following requirements:

- Hardware required:

  One PC with the requirements above:

  - Pentium® 4 Processor (2.80 GHz)
  - Hard Drive 80 GB
  - 512MB RAM
  - CD ROM
  - RS-232 and USB 2.0 ports.
  - Monitor with minimum resolution 1024x760
  - Ethernet interface

- Software required:
  - Microsoft Windows XP Professional-English version with the latest Service Pack installed.
  - Microsoft Office (English version)
  - Test Manager (User Interface in the Test System manufactured by CETECOM).
  - MS .NET Framework Runtime v1.1 or the .NET Framework SDK
  - Perl programming environment
  - Interrogator executables necessary to translate and run script text files

- Network switch or cross-over cable to connect PC to interrogator

- Additional physical and mechanical items needed for test cases execution

- Qualified equipments (see reference [11]):
  - Interrogator devices
  - Tag devices

## System Architecture
## D.7 Hardware Description

The hardware is composed of a PC, with the characteristics specified in section 4.3, and one of the test scenarios which are described in detail in [11]. The Interoperability Test System will be loaded and executed on the PC.

Inside the test scenario may be one or more Qualified Equipments, which are reference devices for the implementation of the interoperability test cases. While being part of the SUT, the QE is not have the main focus of the testing. The QE will have previously undergone conformance (certified equipement) and interoperability testing. A QE may be an interrogator or a tag, depending on the EUT.

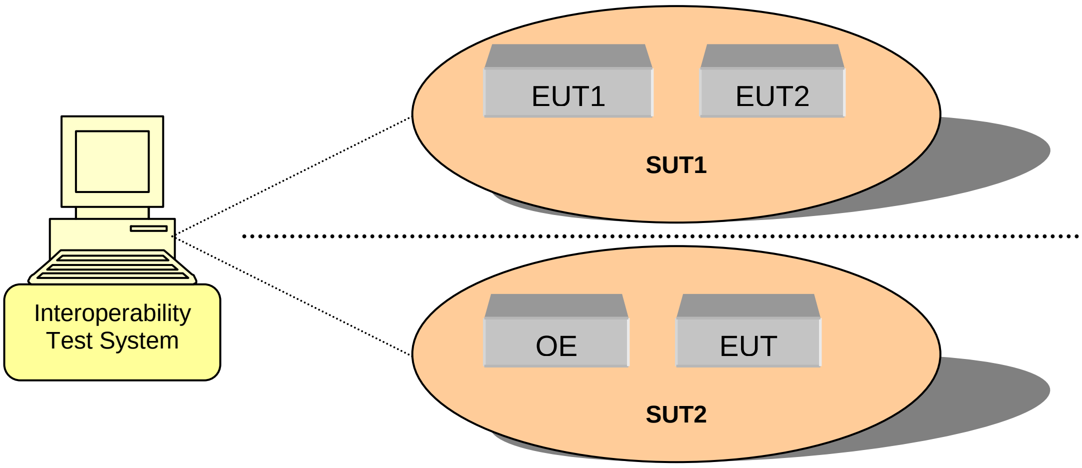
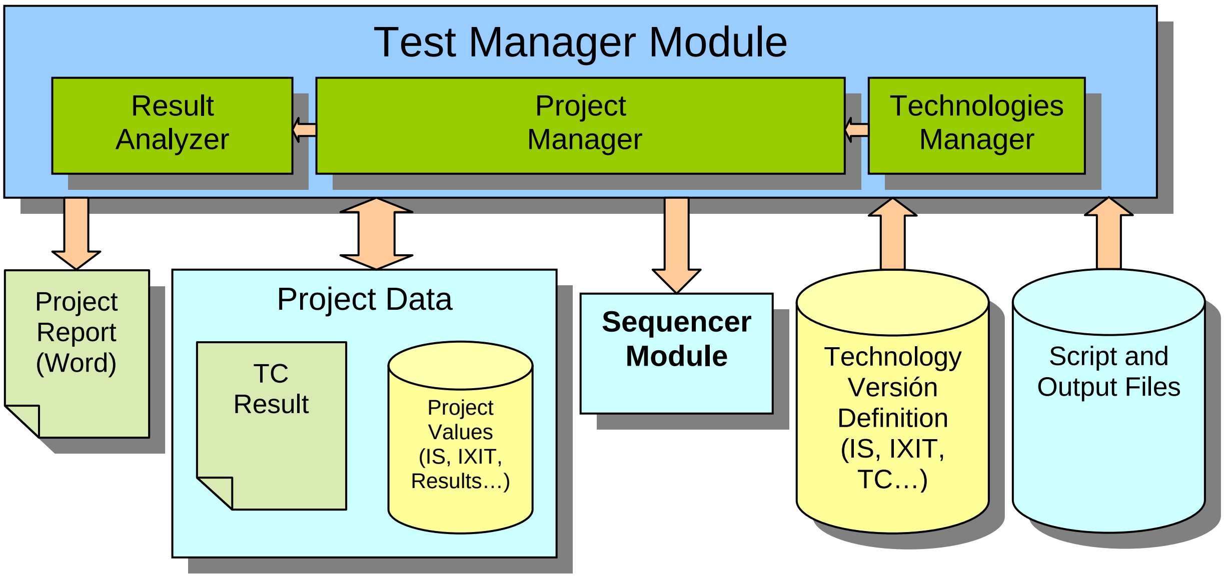



**Figure D.5. Hardware description**

## Software Description
## D.8 Test Manager and Sequencer Modules



**Test Manager Module**: Implements several management functions.
*Technology manager*: Controls the different versions of the test platform and test cases. Provides access to the technology database containing the IS, IXIT, test cases definition, etc., for the different technologies to test. It transfers the information to the Project Manager in order to allow test selection, IS, IXIT editing, etc.

*Project manager*:
The main characteristics are:

- This module is common to any technology.
- It performs the high level functions of the operation of the tester.
- It handles each individual test session,
- it controls the directories where the information will be stored,
- it allows the production of test reports or visualization of individual results,
- it drives the sequencer for the technology to be tested,
- it allows input of IS, IXIT and other session or device information (manufacturer, model, etc.),
- it performs the test case mapping (i.e., the selection of applicable test cases).

*Result analyser*: Records all verdicts providing filtering representation useful for debugging. This is a software module with different functions that allow presentation of results with different information filtering capabilities. I.e., view of produced test report, view of individual test cases verdicts, set different filtering options, etc.
It also generates automatically the test reports for each test session. The report files are Word documents.
These reports may contain:

- IS
- IXIT
- TEST CASE MAP
- STATIC CONFORMANCE REVIEW (SCR)
- TEST CASE RESULTS

The operator selects the desired reports to be generated and consulted.

*Project Data*: Typically the user will create a test project (for each EUT) where all the information related to the manufacturer of the equipment to be tested and the hardware/software versions will be stored. A database will allow easy registration and recovery of already performed test campaigns. Later the IS and IXIT information has to be entered and this provides the necessary information for performing the test case selection. The operator can fill in this data in a normal Microsoft Office Excel sheet (using a standardized sheet), which can be imported by the test system or directly in the test system.

The operator can create, delete, save and modify projects. The project data may contain the following information:

- **EUT Data**: All information that need to appear in the reports generated by the application such as model, serial number, manufacturer, etc.

- **IS Edition**: with the information of capabilities and profiles supported by the Equipment Under Test (EUT). The data edited into this area will affect to the list of applicable test cases. The SCR (Static Conformance Review) is also available for checking the proper IS edition.

- **IXIT Edition**: The data edited into this area will affect to the test cases execution. IXIT data may be imported from an Excel file.

- **General Parameters**: This list is composed by the common parameters used by all of the test cases.

- **Test Cases**: A test case is applicable or not applicable depending on the information stored in IS proforma. The manual execution of an individual test case generates several reports that can be checked by the operator.

- **Test Campaign**: A list of test cases to be sequentially executed by the operator. It can be configured and saved by the operator.

- **Script and Output Files**: Input script files contain a list of consecutive directives that configure and execute test cases on the interrogator. Each directive is echoed to the output file along with the results of the directives. The Output File is processed by the Test Manager to create a test report. The Script File can be created, edited and saved by the operator using any text editor.

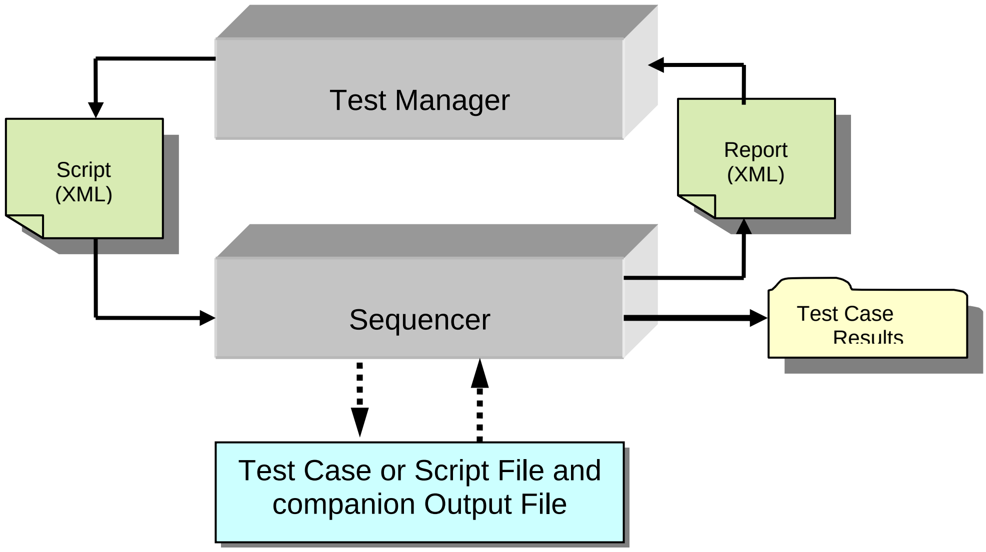
**Sequencer Module**: This module performs the sequencing of the different test steps of the individual test cases or processes the Output File. The Test Manager Module uses the Sequencer Module to execute an internal script. This script contains information about parameters and test cases to execute and has a XML file format.

By clicking on any applicable test case of the list, a new window will appear with the steps to execute the selected test case. The user can easily follow the execution flow with the help of this window. It is necessary that operator uses in parallel the interrogator device software (which shall be provided by the client) to execute the test case. Partial results and verdicts will need to fill in manually by the user.

For each individual test case is executed, the Sequencer will generate a session folder (the folder name contains the date and time of execution). In this folder will be stored the result files.

When the Sequencer finishes the script execution, generates a resume report file (in XML format) with data related to each test case execution (verdict, start time, duration, etc.).

While the Sequencer is active, the Test Manager Module remains in background until the user decides to exit from the Sequencer Module. At this point, Test Manager wakes up and reads the report script file in order to update the results database.



**Test Manager-Sequencer interface.**

1. Test Manager→ Sequencer

When Test Manager launches the Sequencer, it must specify an internal script to execute as an argument. This Sequencer argument will be the internal script full file path. The Test Manager generates the internal script with the information contained in the project database and the user selection. This XML file contains information about the test session, general parameters (IS, IXIT), and the test cases for running.

The internal script xml structure is shown in the following figure:

```
1   <?xml version="1.0" encoding="ISO-8859-1"?>
2   <TestSession EUTName=" "
3               ReportFilename=""
4               Layer=""
5               DemoMode="" >
6    <CommonParameters>
7     <Parameter Index=""
8                BlockID=""
9                Name=""
10               Caption=""
11               Type=""
12               Value=""
13               Second_Value=""
14               Unit=""
15               Visible=""
16               Printable="" />
17   </CommonParameters>
18   <TestCaseList>
19    <TestCase ID=""
20              Name=""
21              Title=""
22              ResultFilename=""
23              TesterFilename=""
24              EstimatedTime=""
25              Conformance="">
26     <Parameters><Parameters />
27     <Results></Results>
28    </TestCase>
29   </TestCaseList>
30  </TestSession>
```

Line 1: This is the xml document header.

**Tag: <TestSession>**

Line 2-5: This is the internal script root. These fields contain information about the current internal script.

**Tag: <CommonParameters>**

Line 6-17: This node contains a set of parameters used by all test cases in the internal script.

No fields are defined in this tag.

**Tag: <Parameter>**

Line 7-16: Defines a parameter item.

**Tag: <TestCaseList>**

Line 18-29: This node contains a set of test cases to be executed.

No fields are defined in this tag.

**Tag: <TestCase>**

Line 19-28: Defines a test case item.

2. Sequencer→ Test Manager

The sequencer generates two types of output files:

a) The internal script result file.

b) The test case result files.

Test Manager only needs to read the final internal script result file.

An example of the file structure is described below:

```
<?xml version="1.0" standalone="yes" ?>
<TESTCASELIST>
        <TESTCASE Ref="6.3.1.2.1"
                Date="2005-02-07T13:06:07"
                Duration='00:00:12'
                Verdict='PASS'
ResultPath="C:\Sequencer\Results\Session 2005-02-07 13.06.07\Result.6.3.1.2.1.xml" />
</TESTCASELIST>
```

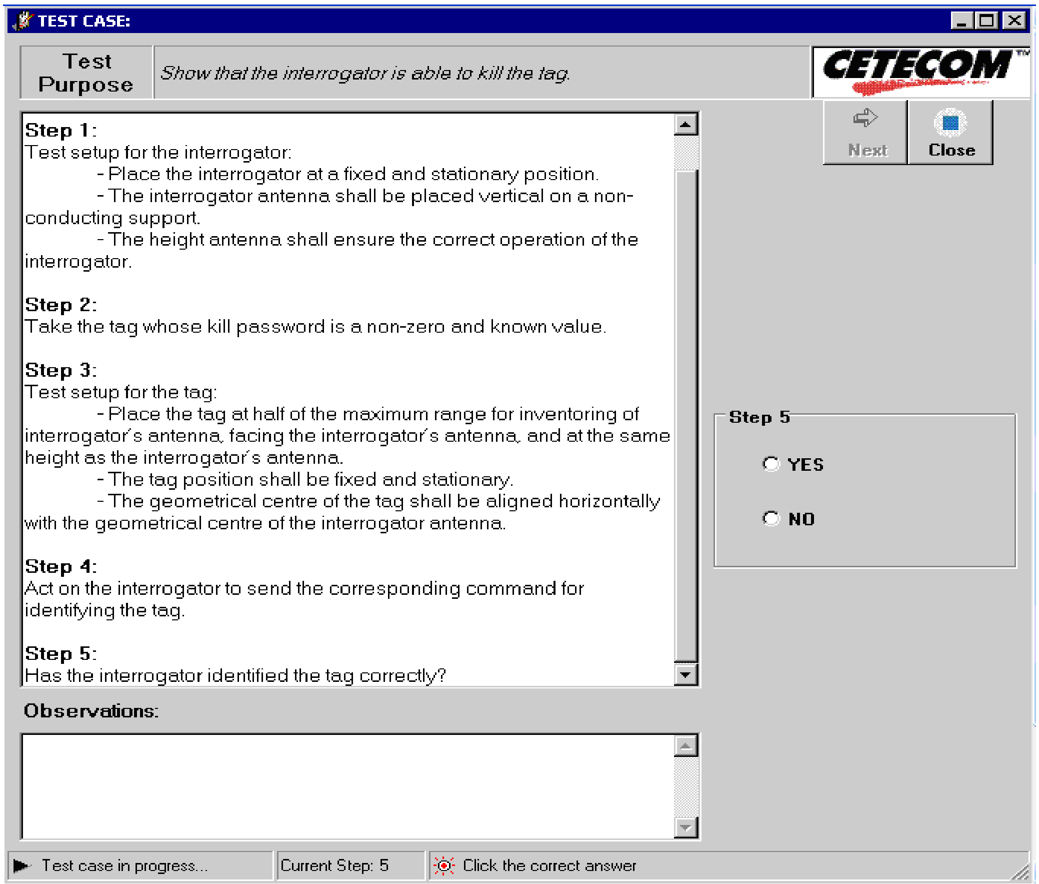
**<TESTCASELIST>** tag may contain many **<TESTCASE>** tags as test cases have in the internal script. Note that if a test case is executed more than once, only the last will be stored. In addition, if some test cases are not executed, their Verdict field will be empty.

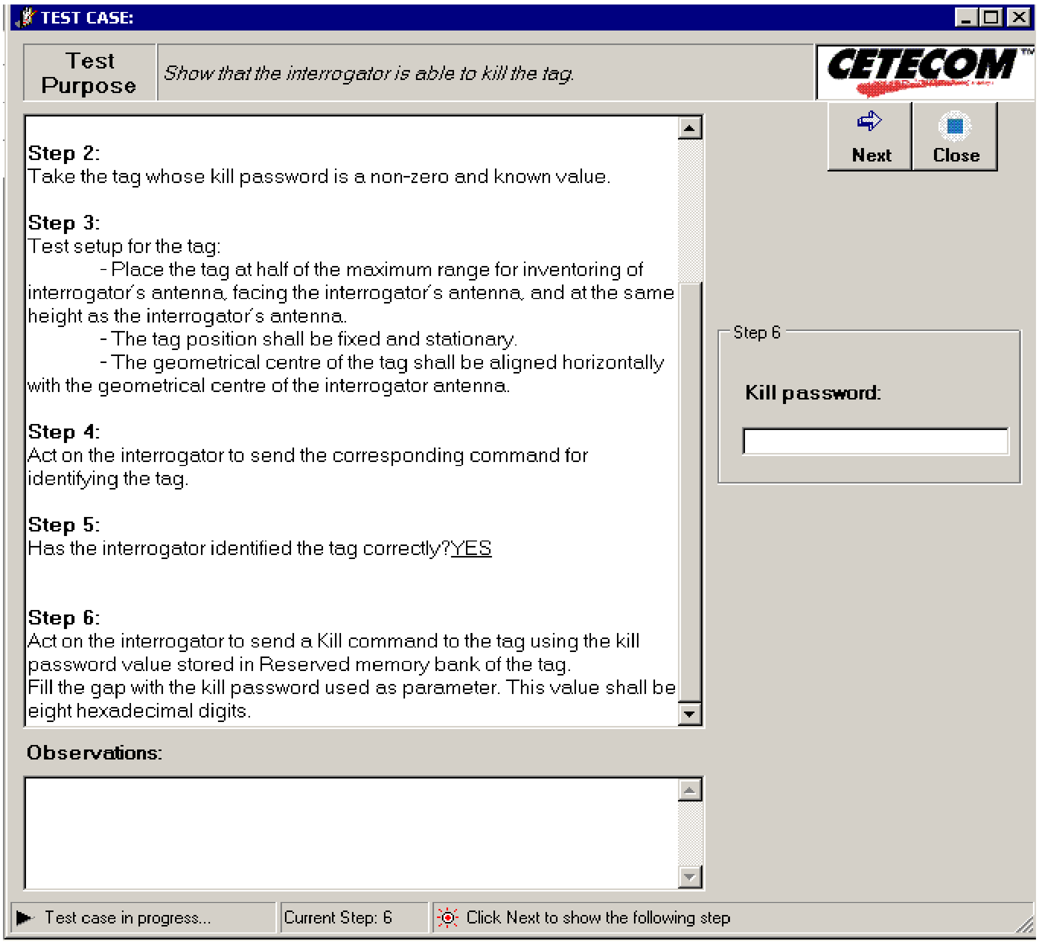
| | |
|---|---|
| Ref | This reference is assigned by CETECOM and it is only used by the Test Manager |
| Date | Test case execution start date and time. |
| Duration | Test case execution time in hh:mm:ss format. |
| Verdict | Test case final result. |
| ResultPath | Main test case result file. |

## D.9 Running Individual Test Cases

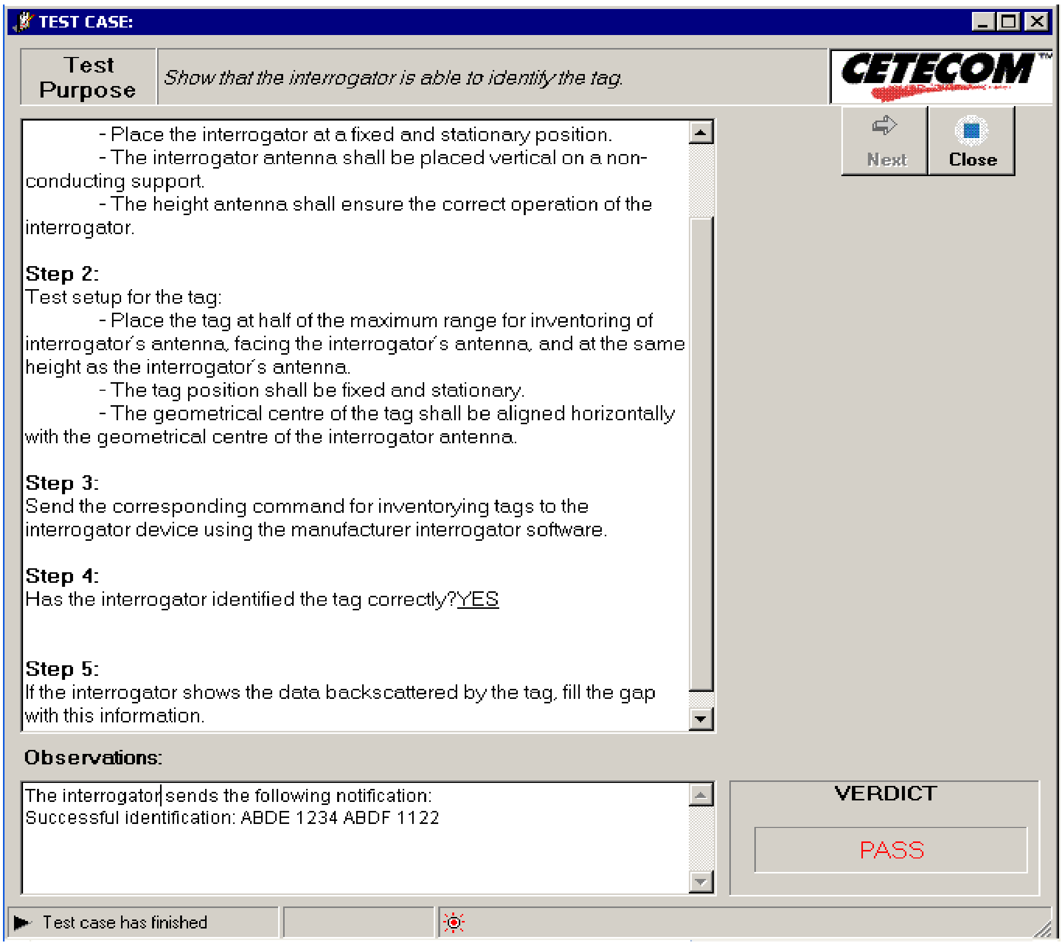
A Windows Application appears and takes the control of the tester system when sequencer launches an interoperability test case. In this window, the instructions to perform the selected test case will be successively shown as the operator clicks on the “Next” button of the application. These steps explain how the operator must to act on the devices.

During the test case execution, the operator may be required to answer a question or to insert a data. Comments and observations about the test case execution may be inserted, too. All the information as well as the answers remains on the left side of the window, in order to check the performed steps.


TEST CASE:
Test Purpose
Show that the interrogator is able to kill the tag.
CETECOM
Next
Close
Step 1:
Test setup for the interrogator:
- Place the interrogator at a fixed and stationary position.
- The interrogator antenna shall be placed vertical on a non-conducting support.
- The height antenna shall ensure the correct operation of the interrogator.
Step 2:
Take the tag whose kill password is a non-zero and known value.
Step 3:
Test setup for the tag:
- Place the tag at half of the maximum range for inventoring of interrogator´s antenna, facing the interrogator´s antenna, and at the same height as the interrogator´s antenna.
- The tag position shall be fixed and stationary.
- The geometrical centre of the tag shall be aligned horizontally with the geometrical centre of the interrogator antenna.
Step 4:
Act on the interrogator to send the corresponding command for identifying the tag.
Step 5:
Has the interrogator identified the tag correctly?
Step 5
YES
NO
Observations:
Test case in progress...
Current Step: 5
Click the correct answer


TEST CASE:
Test Purpose
Show that the interrogator is able to kill the tag.
CETECOM
Next
Close
Step 2:
Take the tag whose kill password is a non-zero and known value.
Step 3:
Test setup for the tag:
- Place the tag at half of the maximum range for inventoring of interrogator´s antenna, facing the interrogator´s antenna, and at the same height as the interrogator´s antenna.
- The tag position shall be fixed and stationary.
- The geometrical centre of the tag shall be aligned horizontally with the geometrical centre of the interrogator antenna.
Step 4:
Act on the interrogator to send the corresponding command for identifying the tag.
Step 5:
Has the interrogator identified the tag correctly?YES
Step 6:
Act on the interrogator to send a Kill command to the tag using the kill password value stored in Reserved memory bank of the tag.
Fill the gap with the kill password used as parameter. This value shall be eight hexadecimal digits.
Step 6
Kill password:
Observations:
Test case in progress...
Current Step: 6
Click Next to show the following step

When the test case has finished, the application elaborates the test case verdict, based on the information inserted by the operator. Clicking the "Close" button, the application returns the control to the sequencer module.




As result, the application generates a XML document with the information necessary to elaborate the reports. An example of this XML file is shown: