

## Smart Ticketing Alliance - Certification Working Group



# STA Contactless Interface Certification for Public Transport Products Test Tools Validation Methodology

Author:

Editor:

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## REVISION LIST

Version	Date	Modifications
V1.0	20/10/2016	For publication after the CWG meeting on October 20 <sup>th</sup> 2016
V1.1	14/06/2017	Version applicable for PCD and PICC testing according CEN/TS 16794:2015
V2.0	06/07/2018	Version applicable for PCD and PICC testing according to CEN/TS 16794:2017
V2.1	16/11/2018	Version applicable for PCD and PICC testing according to CEN/TS 16794:2017 Updated for PCD testing
V2.2	19/06/2020	Correction of some minor mistakes Updated tolerance margin for PCD EMD testing



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## Acronyms

CWG	Certification Working Group
ICS	Implementation Conformance Statement
PCD	Proximity Coupling Device
PICC	Proximity Integrated Circuit Card
RF	Radio Frequency
STA	Smart Ticketing Alliance

## Terms and Definition

**Applicant Laboratory:** Any Test Laboratory which initiates an accreditation procedure in order to join the Smart Ticketing Alliance Certification program.

**Certification Body:** Third-party entity, member of the STA or sponsored by a STA member, in charge of the certification process as described in the ISO 17065:2012.

**Implementation Conformance Statement:** Document used for detailed identification of a product or system.

**Product:** Product, system or solution for which the certification of compliance with the Standard is requested.

**Reference Sample:** Sample of a Product under test to be delivered by STA to any Applicant Laboratory.

**Reference Test Results:** Measurements established after a first set of round robin tests of Reference Samples by chosen Test Laboratories. These measurements will be considered as the reference for future Applicant Laboratories.

**Round robin tests:** Tests performed independently by each Applicant Laboratory on the Reference Samples.

**Test Laboratory:** Entity performing the Evaluation of a Product.

**Test Report:** Report produced by the Test Laboratory as defined in clause 3.3 of the Technical Guidelines (see [REF4]).

**Test Results:** Set of measurements produced by the Test Laboratory after Product testing.

**Test Tools:** Set of test apparatus and test circuits used for testing the contactless communication of Products.

**Vendor:** Provider of the Product which is candidate for certification.



## 1 Scope

This document aims to define the process for validating the Test Tools of Applicant Laboratories part of the Smart Ticketing Alliance Certification program for contactless communication between fare media and ticketing equipment.

The document describes the Test Tools validation process, as well as the Reference Samples and the tests to be performed by the Applicant Laboratories to ensure a successful validation.

This version includes the definition of round robin tests for certification based on STA Technical Guidelines 2.0 and CEN/TS 16794:2017.



## 2 References

The following documents, in whole or in part, are referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendment) applies.

The STA documents are available in the STA repository ([www.smart-ticketing.org](http://www.smart-ticketing.org)).

**[REF1]** ISO/IEC 10373-6:2016, Identification cards — Test methods — Part 6: Proximity cards

**[REF2]** CEN/TS 16794-1:2017, Public transport — Communication between contactless readers and fare media — Part 1: Implementation requirements

**[REF3]** CEN/TS 16794-2:2017, Public transport — Communication between contactless readers and fare media — Part 2: Test plan for ISO/IEC 14443

**[REF4]** STA - Contactless Interface Certification for Public Transport Products - Technical Guidelines v2.0

**[REF5]** STA - Contactless Interface Certification for Public Transport Products - Certification Procedure v1.1

**[REF6]** ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories



### 3 Test Tools Definition

During the contactless test process, Products under test will communicate with a test bench. The test bench shall conform to the specifications set out in the ISO/IEC 10373-6 test methods [REF1].

In the present document, Test Tools are the test apparatus and test circuits making up such test bench and specified in the ISO/IEC 10373-6 test methods [REF1] for verifying the operation of a PICC or a PCD under test.

The Test Tools includes mainly:

- Measurement instruments
- Calibration coil
- Test PCD assembly
- Reference PICCs



## 4 Process for Defining the Reference Test Results

Prior to Test Tools validation by Applicant Laboratories, Reference Test Results need to be defined. It has been established that at least 2 recognized independent Test Laboratories will be asked to perform round robin tests on the Reference Samples. The choice of these Test Laboratories will be defined by STA CWG. Values obtained will be assessed for establishing a unique set of Reference Test Results for future Applicant Laboratories.

During the process for the establishment of Reference Test Results, STA CWG will act as the sole accountable authority for defining those Reference Test Results and as the holder of the Reference Samples.

Figure 1 shows the process for building and maintaining the Reference Test Results for each Reference Sample:

1. STA CWG successively sends the Reference Sample to each Test Laboratory, together with the corresponding ICS and required components in case of multicomponent Products.
2. Each Test Laboratory performs tests of the Reference Sample following STA Technical Guidelines [REF4].
3. Tests Report are sent to STA CWG, based on the template defined in Annex A of the CEN/TS 16794-2 test plan [REF3].
4. For this Reference Sample, STA CWG will collect and compare measurements of the Test Laboratories.
5. In case of divergent values between Test Laboratories, a joint investigation will be held for understanding the possible reasons. Corrective actions may be:
  - Clarifications in the CEN/TS 16794-2 test plan [REF3]
  - Modifications of testing tools or testing method by the relevant Test Laboratory.

Involved Test Laboratories may need to perform tests again.

6. If the values of each Test Laboratory are consistent, STA CWG will establish Reference Test Results for this Reference Sample.

The pool of experts of STA CWG will define in the Reference Test Results the uncertainty threshold applicable to each test.

**Reference Test Results are confidential and shall not be distributed outside STA CWG.**



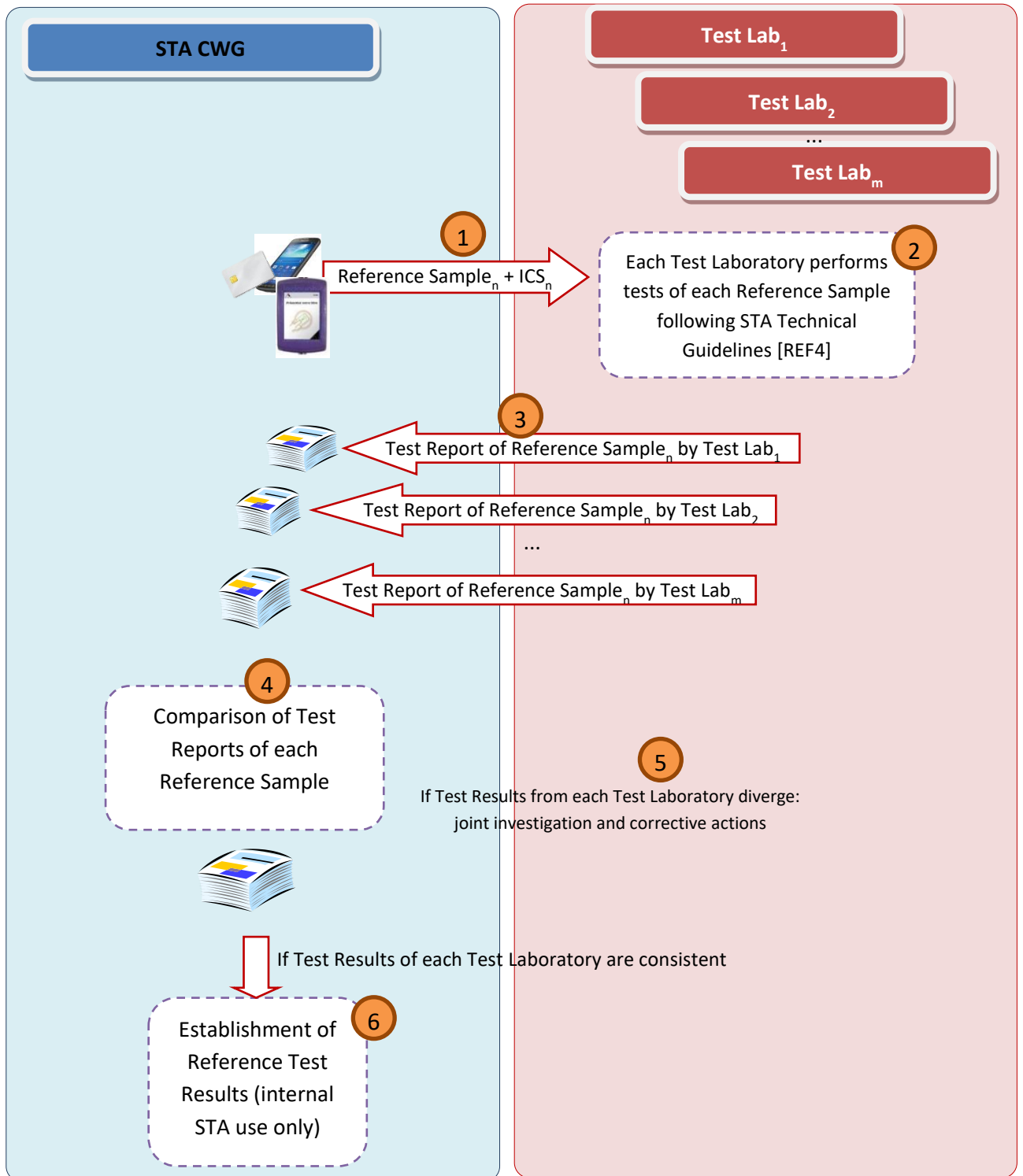


Figure 1: Process for Defining Reference Test Results



## 5 Process for Introducing a New Reference Sample

If a Ticketing Scheme wishes to submit a new Reference Sample to be included in STA CWG scope, STA CWG will decide upon its relevance.

If STA CWG decides to add new Products to its scope, it will provide Reference Samples to the Test Laboratories for defining the Reference Test Results following the process described in the previous section.



## 6 Test Tools Validation Process for a New Applicant Laboratory

A new Applicant Laboratory seeking to have its Test Tools validated should follow the process defined below:

1. The Applicant Laboratory will receive from STA Certification Body a set of Reference Samples listed in Annex A of this document. Those Reference Samples shall be the same items for any Applicant Laboratory, in order to get comparable measurement results. In case of multi component Products, the whole set of components will be provided.
2. Each Reference Sample is provided with an ICS (Implementation Conformance Statement) listing the characteristics of the Reference Sample to be tested. The ICS of Reference Samples are given in Annex C of this document.
3. For each Reference Sample, the Applicant Laboratory shall perform the tests listed in Section Annex B, according to the process defined in STA Technical Guidelines [REF4].
4. The Applicant Laboratory shall produce a Test Report, based on the template defined in Annex A of the CEN/TS 16794-2 test plan [REF3].
5. The Test Results shall be conformant to the Reference Test Results, which will have been previously defined by STA as described in section 4.
6. If the Test Results provided by the Applicant Laboratory diverge from the Reference Test Results, the Applicant Laboratory will be notified by the Certification Body. Where appropriate, the Applicant Laboratory may be required to re-perform some tests.
7. If the Test Results from the Applicant Laboratory for all the tested Reference Samples are consistent with the Reference Test Results - within the tolerance margin defined for each test - the Test Tools from the Applicant Laboratory will be stated by the Certification Body as validated. The Test Tools validation is granted to the Applicant Laboratory for a 3-year period.

The tolerance margin applicable for each test is defined in Annex D.

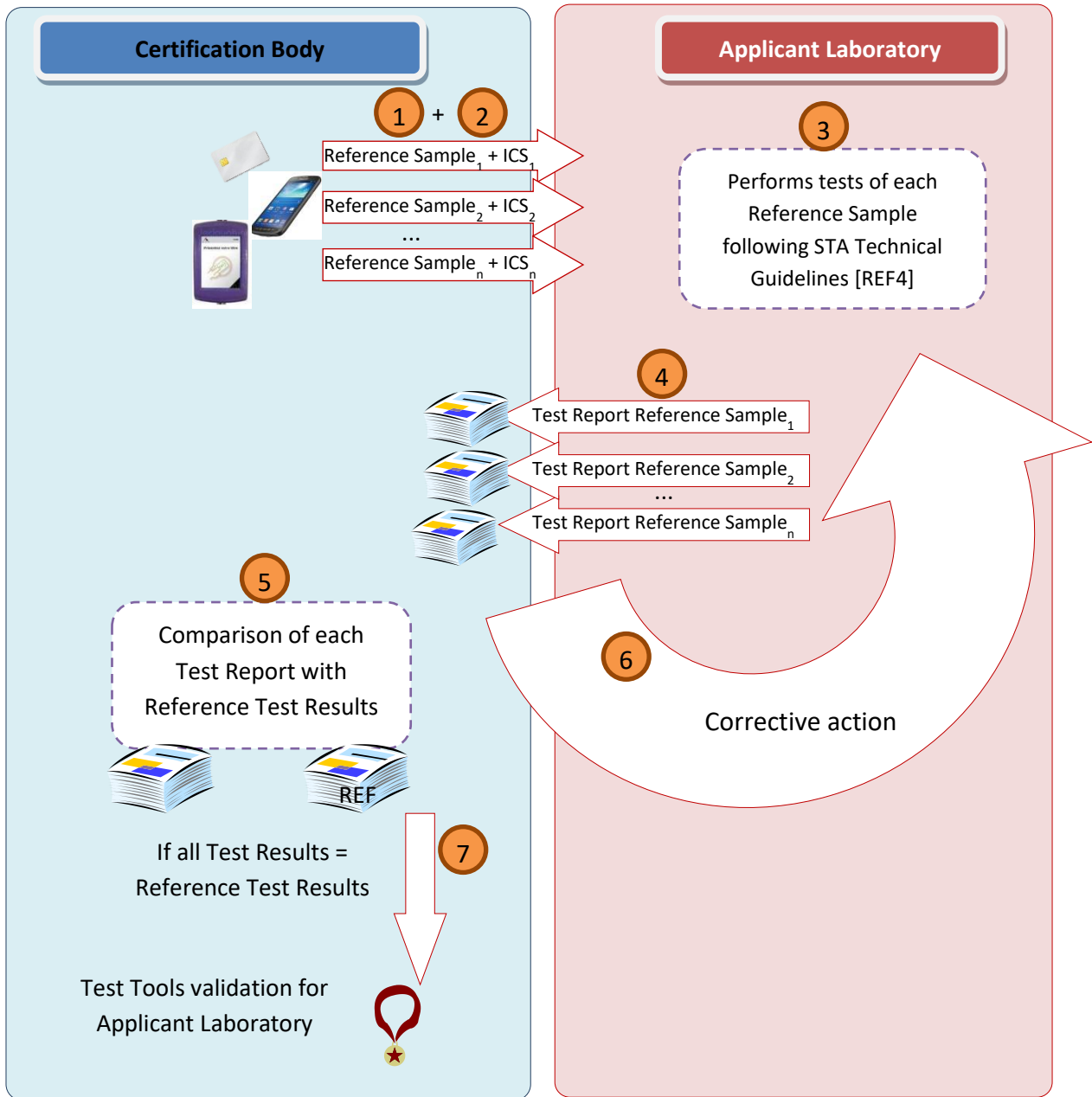


Figure 2: Process for STA Test Tool Validation

Please note that the tests aim at validating the Test Tools used by the Applicant Laboratory. The Test Tools validation process cannot be considered as a certification process for the tested Reference Samples.



## 7 Applicable Processes During Accreditation Period

As required in the STA Certification Procedure [REF5], Test Laboratories shall be ISO/IEC 17025 accredited for CEN/TS 16794.

The accreditation process taking some time; for Test Laboratories performing STA test evaluation which are not yet ISO/IEC 17025 accredited for CEN/TS 16794, the processes described in sections 7.1 and 7.2 shall apply.

These processes shall be replaced by ISO/IEC 17025 processes once the Test Laboratory becomes ISO/IEC 17025 accredited for CEN/TS 16794.

### 7.1 Modification of Test Tools

In the case of major hardware or software modification of any product composing the Test Tools of an Applicant Laboratory, the Test Tools validation process defined in Section 6 shall be re-executed, as ruled in the ISO/IEC 17025 requirements [REF6].

**NOTE** A major hardware or software modification of any product composing the Test Tools corresponds to a hardware or software change to this product that implies that its conformance with the ISO/IEC 17025 requirements [REF6] can no longer be guaranteed.

### 7.2 Maintenance of Test Tools

From time to time, each Test Laboratory shall run some validation tests to verify that its Test Tools are in proper configuration and provide the same Test Results for a set of Test Laboratory's PICC and PCD samples.

The following minimum subset of tests from the CEN/TS 16794-2 test plan [REF3] shall be run:

- For PICC:
  - Conformance of the PICC transmission tests described in §7.2.2, at ambient temperature, at  $H_{min}$  and at  $H_{max}$ , and bit rates of  $fc/128$
- For PCD:
  - Conformance of the PCD modulation waveform tests described in §6.3, at ambient temperature and at bit rates of  $fc/128$

The frequency for executing those tests is left at the convenience of the Test Laboratory, but in all cases, those tests shall have been successfully performed less than 3 months before the start date of a new test session.

Test Results shall be kept and registered in accordance with the ISO/IEC 17025 defined process.



## 8 Periodic Renewal of Test Tools Validation

Test Tools validation shall be automatically terminated after 3 years, unless the Test Laboratory has executed again and successfully the following validation process.

The Test Laboratory shall run validation tests to verify that its Test Tools are in proper configuration and provide Test Results for one PICC and one PCD Reference Samples which are consistent with the Reference Test Results.

This validation shall be executed on an applicable version of the Certification Process and, if successful, it will extend again for 3 years the validity of Test Tools validation of the Test Laboratory for that version.



## 9 Migrating from CEN/TS 16794:2015 to CEN/TS 16794:2017

An Applicant Laboratory seeking to have its Test Tools validated according to CEN/TS 16794:2017 and which has already had its Test Tools validated according to CEN/TS 16794:2015 should execute a test campaign using only the new or modified tests listed in the section 4.2 of the STA Technical Guidelines [REF4], and named hereafter “certification upgrade tests”.

For PCD tests, certification upgrade tests shall be performed on the Xerox Reference PCD.

For PICC tests, certification upgrade tests shall be performed on the CD 21 Rev. 3.2 and ITSO DESFire Reference PICC, at ambient temperature only.



## Annex A Reference Samples

The Reference Samples which will be sent to each Applicant Laboratory are listed in the table below:

	Product Name	Component	Type of product	Vendor	Comments
1	CD 21 Rev. 3.2	PICC	Contactless card	ST Microelectronics	Certified EMVCO L1 with Calypso rev. 3 application
2	ITSO DESFire	PICC	Contactless card	NXP	ITSO Application to Version 2.1.4
3	VPE 415	PCD	Bus validator	Xerox (now Conduent)	
4	Workabout Pro 3	PCD	Handheld terminal	Zebra (ex PSION)	

Table 1: Reference Samples for Applicant Laboratories Test Tools Validation





## Annex B Test Tables

The following tables show the tests to be performed for each Reference Sample. Implementation requirements are described in CEN/TS 16794-1 [REF2], and tests are detailed in CEN/TS 16794-2 [REF3]. For optimisation purposes, it is not required that Applicant Laboratories perform all the tests of the CEN/TS 16794-2 [REF3] on each Product.

The second row of the tables indicate the sections in the CEN/TS 16794-2 test plan [REF3] where the test to be executed are defined for each Reference Sample.

### B.1 PICC Tests

Tests to be performed:		Analog PICC tests (T° min)	Analog PICC tests (Ambient T°)	Analog PICC tests (T° max)	Protocol and Digital PICC tests
Corresponding section in [REF3]:		Sect. 7	Sect. 7	Sect. 7	Sect. 9
1	CD 21 Rev. 3.2	X	X	X	X
2	ITSO DESFire		X		X

Table 2: PICC tests to perform for testing tool validation

### B.2 PCD Tests

Tests to be performed:		Analog PCD tests (T° min)	Analog PCD tests (Ambient T°)	Analog PCD tests (T° max)	Protocol and Digital PCD tests
Corresponding section in [REF3]:		Sect. 6	Sect. 6	Sect. 6	Sect. 8
3	VPE 415	X	X	X	x
4	Workabout Pro 3		X		x

Table 3: PCD tests to perform for testing tool validation

The PCD shall be reset before performing the test “H.4.3 Error detection and recovery” mentioned in the CEN/TS 16794-2 test plan [REF3].



## Annex C ICS of Reference Samples used for Test Tools Validation

### C.1 ICS for Contactless Fare Media – PICC Calypso CD 21 Rev. 3.2

#### [PICC1] Administrative data

Vendor name: **ST Microelectronics**

[PICC1.1] Brand name: **ST23ZR08/QL, ST23ZR04/QL, ST23ZR02/QL**

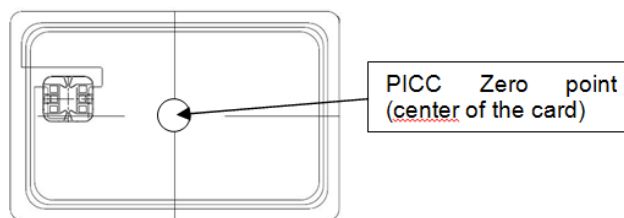
[PICC1.2] Trade name: **CD21-Rev3.2**

[PICC1.3] Serial number: **N/A**

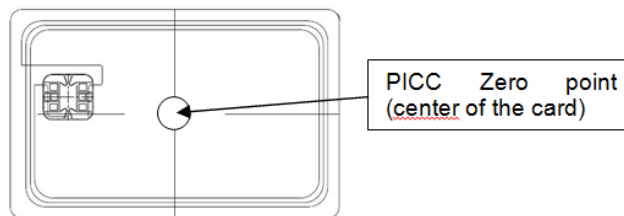
[PICC1.4] Hardware/Software version: **Calypso ROM version 10h**

#### [PICC2] General technical characteristics

[PICC2.1] Antenna diagram and position on the PT object under test:



[PICC2.2] Reference of PICC Zero Point (target ID-marked on sample or photo or diagram):



[PICC2.3] Operational temperature range supported:

Class A (Ambient)

Class I (-10 °C to + 50 °C)

[PICC2.4] Antenna class according to ISO/IEC 14443:

Unclassified  "Class 1"  "Class 2"  "Class 3"

#### [PICC3] Protocol characteristics

[PICC3.1] Supported communication signal interface(s) and protocol(s):

Type A  Type B  Other:

#### [PICC4] Type A (where applicable)

**This section is N/A.**

[PICC4.1] PCD -> PICC bit rates supported:  $f_c/128$  (~106 kbit/s)  Other:

[PICC4.2] PICC -> PCD bit rates supported:  $f_c/128$  (~106 kbit/s)  Other:

[PICC4.3] Only symmetrical bit rates supported: Yes  No



[PICC4.4] UID: Single size (4 bytes)  Double Size (7 bytes)  Triple size (10 bytes)

[PICC4.5] UID value: fixed number  random number

[PICC4.6] FWI:

[PICC4.7] SFGI:

[PICC4.8] FSCI:

[PICC4.9] CID support: Yes  No

[PICC4.10] NAD support: Yes  No

[PICC4.11] S(PARAMETERS) support: Yes  No

[PICC5] Type B (where applicable)

[PICC5.1] PCD -> PICC bit rates supported: *fc/128* (~106 kbit/s)  Other: **~212 and ~424 kbit/s**

[PICC5.2] PICC -> PCD bit rates supported: *fc/128* (~106 kbit/s)  Other: **~212 and ~424 kbit/s**

[PICC5.3] Only symmetrical bit rates supported: Yes  No

[PICC5.4] PUPI value: fixed number  random number

[PICC5.5] FWI: **7**

[PICC5.6] Maximum Frame Size Code in ATQB: **7 (128 bytes)**

[PICC5.7] CID support: Yes  No

[PICC5.8] NAD support: Yes  No

[PICC5.9] Extended ATQB support: Yes  No

If yes, SFGI: 0

[PICC5.10] S(PARAMETERS) support: Yes  No

[PICC5.11] All AFIs are supported: Yes  No

If not, indicate all supported AFI(s):



	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Unm.	Pass	Pass	Pass	Pass
1	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
2	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
3	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
4	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
5	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
6	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
7	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
8	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
9	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
A	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
B	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
C	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
D	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
E	Pass	Pass	Pass	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU
F	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU	RFU

[PICC5.12] REQB/WUPB with N > 1 support: Yes  No

[PICC6] Test parameters

[PICC6.1a] TEST\_COMMAND1 APDU definition (hexadecimal value): **00 A4 04 00 08 31 54 49 43 2E 49 43 41 00h**

[PICC6.1b] TEST\_COMMAND1 Answer to ADPU definition (hexadecimal value): **FCI data + status 90 00h**

[PICC6.1c] Precondition sequence for TEST\_COMMAND1: **None**

Is there a command which expects a response consisting of n chained I-blocks? Yes  No

[PICC6.2a] TEST\_COMMAND2 APDU definition (hexadecimal value): **00 8A 0B 39 04 11 22 33 44 00h**

[PICC6.2b] TEST\_COMMAND2 Answer to ADPU definition (hexadecimal value): **37 byte answer + status 90 00h**

[PICC6.2c] Precondition sequence for TEST\_COMMAND2:

**TEST\_COMMAND1 APDU definition: 00 A4 04 00 08 31 54 49 43 2E 49 43 41 00h**

**TEST\_COMMAND1 Answer to ADPU definition: FCI data + status 90 00h**

Is there a command which needs more than FWT time for execution? Yes  No



[PICC6.3a] TEST\_COMMAND3 APDU definition (hexadecimal value): **No TEST\_COMMAND3**

[PICC6.3b] TEST\_COMMAND3 Answer to ADPU definition (hexadecimal value): **N/A**

[PICC6.3c] Precondition sequence for TEST\_COMMAND3: **N/A**

[PICC6.4] TEST\_COMMAND\_SEQUENCE:

<b>TEST_COMMAND-SEQUENCE APDUs Command and Response</b>		
Select Application	Command	00 A4 04 00 08 31 54 49 43 2E 49 43 41 00h
	Expected response	FCI data + status 90 00h
Open Session	Command	00 8A 0B 39 04 11 22 33 44 00h
	Expected response (*)	37 bytes of response data + status 90 00h
Read Record 'event log'	Command	00 B2 01 44 1Dh
	Expected response	29 bytes of response data + status 90 00h
Read Record 'contracts list'	Command	00 B2 01 F4 1Dh
	Expected response	29 bytes of response data + status 90 00h
Read Record 'contract 1'	Command	00 B2 01 4C 1Dh
	Expected response	29 bytes of response data + status 90 00h
Append Record	Command	00 E2 00 40 1D 11 22 33 44 55 66 77 88 11 22 33 44 55 66 77 88 11 22 33 44 55h
	Expected response	status 90 00h
Close Session	Command	00 8E 00 00 04 11 22 33 44 00h
	Expected response	Error status 69 88h

*(\*) Depending on the created structure, the Open session command can be different.*

NOTE Usages of TEST\_COMMAND1, TEST\_COMMAND2 and TEST\_COMMAND3 for PICC tests are defined in ISO/IEC 10373-6.

If the PICC requires additional sequences to be ready to accept TEST\_COMMAND1, TEST\_COMMAND2 or TEST\_COMMAND3, those sequences should be described in the precondition sequence fields.

A test sequence (list of APDUs) shall be defined. The list shall contain at minimum 2 APDUs with their respective expected answer.

Since the use of cryptographic functions have a strong influence on the power consumption of the carrier medium and therefore on the parameters of its contactless interface, testing of the RF interface shall be conducted with those cryptographic functions that are employed by the specific application-to-application transactions.



## C.2 ICS for Contactless Fare Media – PICC ITSO DESFire

### [PICC1] Administrative data

Vendor name: **NXP**

[PICC1.1] Brand name: **MIFARE DESFire EV1**

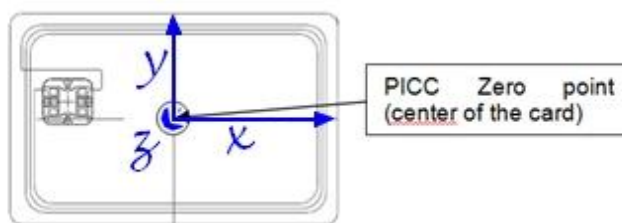
[PICC1.2] Trade name: **MF3ICD4101DUD/05**

[PICC1.3] Serial number: **N/A**

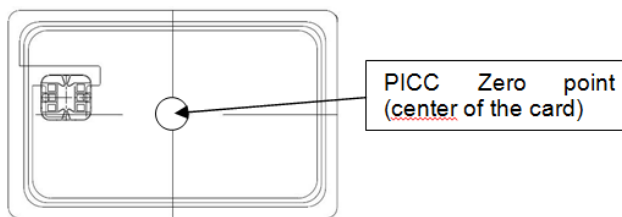
[PICC1.4] Hardware/Software version: **Hardware: 01 / Software: 05**

### [PICC2] General technical characteristics

[PICC2.1] Antenna diagram and position on the PT object under test:



[PICC2.2] Reference of PICC Zero Point (target ID-marked on sample or photo or diagram):



[PICC2.3] Operational temperature range supported:

Class A (Ambient)

Class I (-10 °C to + 50 °C)

[PICC2.4] Antenna class according to ISO/IEC 14443:

Unclassified  "Class 1"  "Class 2"  "Class 3"

### [PICC3] Protocol characteristics

[PICC3.1] Supported communication signal interface(s) and protocol(s):

Type A  Type B  Other:

### [PICC4] Type A (where applicable)

[PICC4.1] PCD -> PICC bit rates supported: *fc/128* (~106 kbit/s)  Other: **~212, ~424 and ~848 kbit/s**

[PICC4.2] PICC -> PCD bit rates supported: *fc/128* (~106 kbit/s)  Other: **~212, ~424 and ~848 kbit/s**

NOTE The other supported PCD -> PICC and PICC -> PCD bit rates are not tested in the scope of this document.



- [PICC4.3] Only symmetrical bit rates supported: Yes  No
- [PICC4.4] UID: Single size (4 bytes)  Double Size (7 bytes)  Triple size (10 bytes)
- [PICC4.5] UID value: fixed number  random number
- [PICC4.6] FWI: **0x8 (77.33 ms)**
- [PICC4.7] SFGI: **0x1 (604 μs)**
- [PICC4.8] FSCI: **0x5 (64 bytes)**
- [PICC4.9] CID support: Yes  No
- [PICC4.10] NAD support: Yes  No
- [PICC4.11] S(PARAMETERS) support: Yes  No

[PICC5] Type B (where applicable)

**This section is N/A.**

- [PICC5.1] PCD -> PICC bit rates supported:  $f_c/128$  (~106 kbit/s)  Other:
- [PICC5.2] PICC -> PCD bit rates supported:  $f_c/128$  (~106 kbit/s)  Other:
- [PICC5.3] Only symmetrical bit rates supported: Yes  No
- [PICC5.4] PUPI value: fixed number  random number
- [PICC5.5] FWI:
- [PICC5.6] Maximum Frame Size Code in ATQB:
- [PICC5.7] CID support: Yes  No
- [PICC5.8] NAD support: Yes  No
- [PICC5.9] Extended ATQB support: Yes  No
- If yes, SFGI:
- [PICC5.10] S(PARAMETERS) support: Yes  No
- [PICC5.11] All AFIs are supported: Yes  No
- If not, indicate all supported AFI(s):
- [PICC5.12] REQB/WUPB with  $N > 1$  support: Yes  No

[PICC6] Test parameters

- [PICC6.1a] TEST\_COMMAND1 APDU definition (hexadecimal value): **Select ITSO Application command (see table below)**
- [PICC6.1b] TEST\_COMMAND1 Answer to ADPU definition (hexadecimal value): **Select ITSO Application response (see table below)**
- [PICC6.1c] Precondition sequence for TEST\_COMMAND1: **N/A**

Is there a command which expects a response consisting of n chained I-blocks? Yes  No

- [PICC6.2a] TEST\_COMMAND2 APDU definition (hexadecimal value): **ReadData from the ITSO Shell command (see table below)**



[PICC6.2b] TEST\_COMMAND2 Answer to ADPU definition (hexadecimal value): **ReadData from the ITSO Shell command (see table below)**

[PICC6.2c] Precondition sequence for TEST\_COMMAND2: **Select ITSO Application**

Is there a command which needs more than FWT time for execution? Yes  No

[PICC6.3a] TEST\_COMMAND3 APDU definition (hexadecimal value): **No TEST\_COMMAND3**

[PICC6.3b] TEST\_COMMAND3 Answer to ADPU definition (hexadecimal value): **N/A**

[PICC6.3c] Precondition sequence for TEST\_COMMAND3: **N/A**

[PICC6.4] TEST\_COMMAND\_SEQUENCE:

<b>TEST_COMMAND-SEQUENCE APDUs Command and Response (hexadecimal value)</b>		
RATS	Command	E0 80 31 73
	Expected response (ATS)	06 75 77 81 02 80 02 F0
Select ITSO Application	Command	90 5A 00 00 03 16 02 A0 00
	Expected response	91 00
ReadData from the ITSO Shell	Command	90 BD 00 00 07 0F 00 00 00 00 00 00 00
	Expected response	20 31 63 35 97 00 71 00 00 00 19 07 04 01 21 04 40 10 08 07 FF FF FF FF FF FF FF FF FF FF A9 FC 91 00
Authenticate	Command	90 0A 00 00 01 01 00
	Expected response	11 24 E5 86 8B 60 29 59 91 AF

NOTE 1 RATS command may use a different FSDI value.

NOTE 2 Usages of TEST\_COMMAND1, TEST\_COMMAND2 and TEST\_COMMAND3 for PICC tests are defined in ISO/IEC 10373-6.

If the PICC requires additional sequences to be ready to accept TEST\_COMMAND1, TEST\_COMMAND2 or TEST\_COMMAND3, those sequences should be described in the precondition sequence fields.

A test sequence (list of APDUs) shall be defined. The list shall contain at minimum 2 APDUs with their respective expected answer.

Since the use of cryptographic functions have a strong influence on the power consumption of the carrier medium and therefore on the parameters of its contactless interface, testing of the RF interface shall be conducted with those cryptographic functions that are employed by the specific application-to-application transactions.





### C.3 ICS for Contactless Reader – PCD VPE 415

#### [PCD1] Administrative data

Vendor name: **Xerox**

[PCD1.1] Brand name: **Conduent**

[PCD1.2] Trade name: **VPE 415**

[PCD1.3] Serial number: **87 725 655 V01 AA**

[PCD1.4] Hardware/Software version: **N/A**

#### [PCD2] General technical characteristics

[PCD2.1] PT reader type:

IFM reader (full range A and B)

Common reader (limited range A and B)

[PCD2.2] Transaction supported when more than one PICC in the field: Yes  No

[PCD2.3] Operational temperature range supported:

Class A (Ambient)

Class D (-25 °C to + 55 °C)

[PCD2.4] List of supported PICC classes according to ISO/IEC 14443:

“Class 1”  “Class 2”  “Class 3”

[PCD2.5] PT readers with a continuously active RF field: Yes  No

If no, precise event triggering field activation:

[PCD2.6] Antenna diagram and position on the PT reader under test: **circle just under the circular plastic cover**

##### Range A:

[PCD2.7] Reference of the PCD Zero Point – Range A (target ID marked on sample or photo or diagram): **centre of the antenna**

[PCD2.8] Orientation of the Z-axis – Range A (photo or diagram): **normal to surface**

[PCD2.9] Height of the PCD Zero Point – Range A in relation to PT reader surface in the Z-axis – Range A (where applicable): **0 mm**

[PCD2.10] Positions of the X-axis and Y-axis of the Reference PICC above PCD Zero Point – Range A (photo or diagram): **N/A**

##### Range B:

[PCD2.11] Reference of the PCD Zero Point – Range B (target ID-marked on sample or photo or diagram): **centre of the antenna**

[PCD2.12] Orientation of the Z-axis – Range B (photo or diagram): **normal to surface**

[PCD2.13] Height of the PCD Zero Point – Range B in relation to PT reader surface in the Z-axis – Range B (where applicable): **0 mm**

[PCD2.14] Positions of the X-axis and Y-axis of the Reference PICC above PCD Zero Point – Range B (photo or diagram): **N/A**

#### [PCD3] Protocol characteristics



[PCD3.1] Other supported communication signal interface(s) or protocol(s): **Innovatron protocol**

[PCD3.2] CID support: Yes  No

[PCD3.3] NAD support: Yes  No

[PCD4] Type A

[PCD4.1] PCD -> PICC bit rates supported: *fc/128* (~106 kbit/s)

Other: **None**

[PCD4.2] PICC -> PCD bit rates supported: *fc/128* (~106 kbit/s)

Other: **None**

[PCD4.3] FSDI: **256 bytes**

[PCD5] Type B

[PCD5.1] PCD -> PICC bit rates supported: *fc/128* (~106 kbit/s)

Other: **None**

[PCD5.2] PICC -> PCD bit rates supported: *fc/128* (~106 kbit/s)

Other: **None**

[PCD5.3] Maximum Frame Size Code in ATTRIB: **256 bytes**

[PCD5.4] Extended ATQB support: Yes  No

[PCD5.5] "Minimum TR0" field of Param1 (2 bits) in ATTRIB: (00)b

[PCD5.6] "Minimum TR1" field of Param1 (2 bits) in ATTRIB: (00)b

[PCD5.7] "EOF/SOF" field of Param1 (2 bits) in ATTRIB: (00)b

[PCD6] Test parameters

[PCD6.1a] UT\_TEST\_COMMAND1 APDU definition (hexadecimal value): '**00 DA 00 00 0E AA AA F0 FF 04 05 06 07 08 09 0A 0B 0C 0D**'

[PCD6.1b] UT\_TEST\_COMMAND1 Answer to ADPU definition (hexadecimal value): **Any response sent in a valid I-block**

[PCD6.2a] UT\_TEST\_COMMAND2 APDU definition (hexadecimal value): '**00 DA 00 00 FF 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 ... FE FF**'

[PCD6.2b] UT\_TEST\_COMMAND2 Answer to ADPU definition (hexadecimal value): **Any response sent in a valid I-block**

[PCD6.2c] PCD internal output buffer size (used for Maximum size of UT\_APDU): **64 bytes for Type A and 256 bytes for Type B**

[PCD6.2d] PCD internal input buffer size (used for Maximum size of response UT\_APDU): **64 bytes for Type A and 256 bytes for Type B**

NOTE UT\_TEST\_COMMAND2 is set in accordance to [PCD6.2c] in order to test all the supported FSC / Maximum Frame Size values. Additionally, if loopback interface for PT reader testing is used, UT\_TEST\_COMMAND2 is also set in accordance to [PCD6.2d].

[PCD7] Proprietary test parameters

[PCD7.1] PROPRIETARY\_COMMAND APDU(s) definition(s) (hexadecimal value): **N/A**

[PCD7.2] PROPRIETARY\_COMMAND Answer to ADPU(s) definition(s) (hexadecimal value): **N/A**



NOTE Usages of UT\_TEST\_COMMAND1 and UT\_TEST\_COMMAND2 for PCD tests are defined in ISO/IEC 10373-6.

When the support of proprietary protocol(s) initiated by ISO/IEC 14443-3 polling commands is indicated in [PCD3.1] and when the PT reader may give priority to applications using such proprietary protocol compared to applications using Type A or Type B, in order to perform the testing of [Rdr8], the Vendor shall describe:

- in [PCD7.1], the proprietary command(s) used to select an application using a proprietary protocol initiated by ISO/IEC 14443-3 polling commands:
  - a) for ISO/IEC 14443-3 fully compliant products, the command(s) following the anticollision procedure;
  - b) for ISO/IEC 14443-3 partially compliant products, the command(s) following the request command;
- in [PCD7.2], the expected response(s) to these commands:
  - a) compliant with the proprietary protocol;
  - b) indicating that no suitable application is available.



## C.4 ICS for Contactless Reader – PCD Workabout Pro 3

### [PCD1] Administrative data

Vendor name: **Zebra**

[PCD1.1] Brand name: **Workabout PRO**

[PCD1.2] Trade name: **Workabout PRO 3 short**

[PCD1.3] Serial number: **(Label “VDV RR Sample 1” will be put on the Device)**

[PCD1.4] Hardware/Software version: **1.0**

### [PCD2] General technical characteristics

[PCD2.1] PT reader type:

IFM reader (full range A and B)

Common reader (limited range A and B)

[PCD2.2] Transaction supported when more than one PICC in the field: Yes  No

[PCD2.3] Operational temperature range supported:

Class A (Ambient)

Class D (-25 °C to + 55 °C)

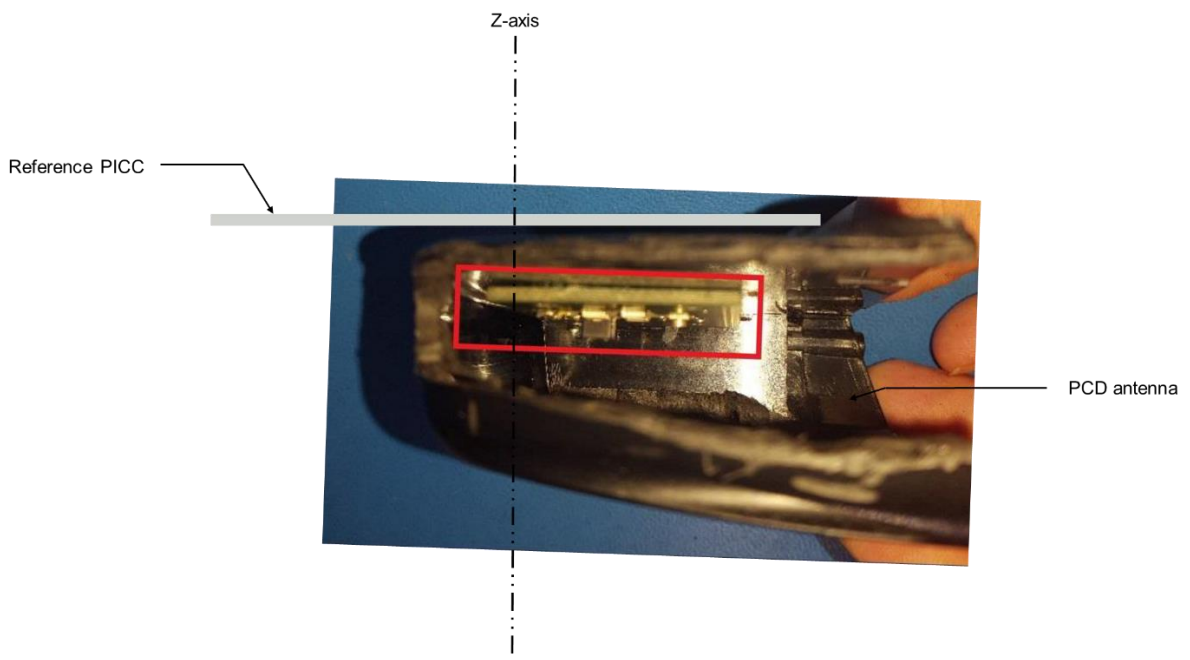
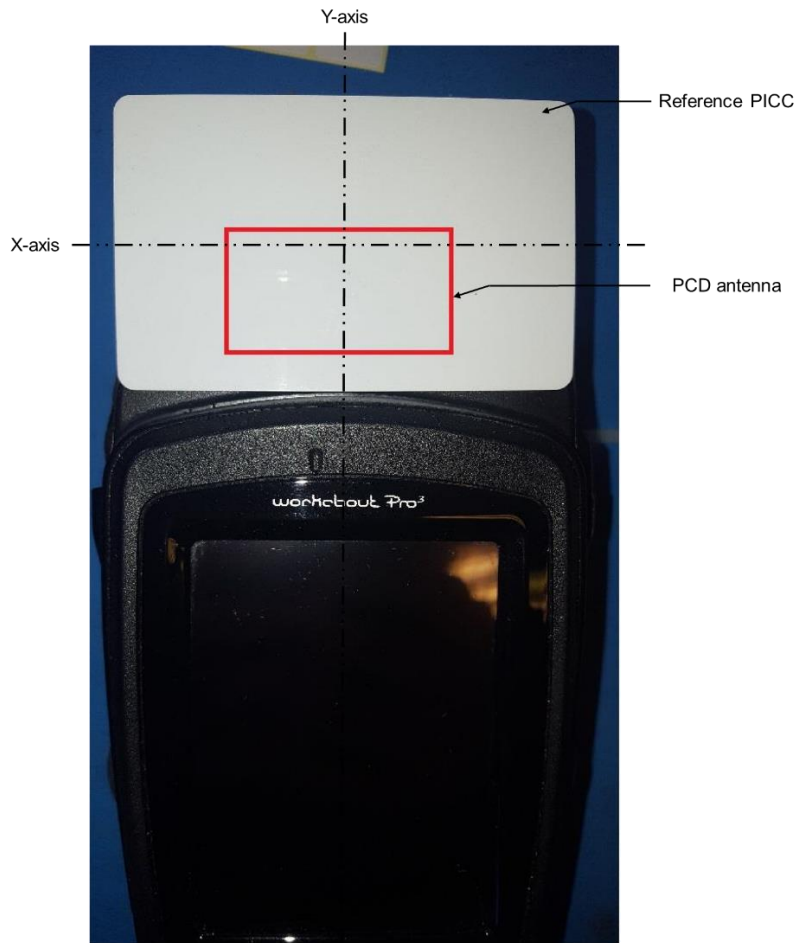
[PCD2.4] List of supported PICC classes according to ISO/IEC 14443:

“Class 1”  “Class 2”  “Class 3”

[PCD2.5] PT readers with a continuously active RF field: Yes  No

If no, precise event triggering field activation:

[PCD2.6] Antenna diagram and position on the PT reader under test: **see red rectangle on the photos**





Range A:

[PCD2.7] Reference of the PCD Zero Point – Range A (target ID marked on sample or photo or diagram): **see photos**

[PCD2.8] Orientation of the Z-axis – Range A (photo or diagram): **see 2<sup>nd</sup> photo**

[PCD2.9] Height of the PCD Zero Point – Range A in relation to PT reader surface in the Z-axis – Range A (where applicable): **0 mm (see 2<sup>nd</sup> photo)**

[PCD2.10] Positions of the X-axis and Y-axis of the Reference PICC above PCD Zero Point – Range A (photo or diagram): **see 1<sup>st</sup> photo**

Range B:

[PCD2.11] Reference of the PCD Zero Point – Range B (target ID-marked on sample or photo or diagram): **see photos**

[PCD2.12] Orientation of the Z-axis – Range B (photo or diagram): **see 2<sup>nd</sup> photo**

[PCD2.13] Height of the PCD Zero Point – Range B in relation to PT reader surface in the Z-axis – Range B (where applicable): **0 mm (see 2<sup>nd</sup> photo)**

[PCD2.14] Positions of the X-axis and Y-axis of the Reference PICC above PCD Zero Point – Range B (photo or diagram): **see 1<sup>st</sup> photo**

[PCD3] Protocol characteristics

[PCD3.1] Other supported communication signal interface(s) or protocol(s): **Innovatron protocol**

[PCD3.2] CID support: Yes  No

[PCD3.3] NAD support: Yes  No

[PCD4] Type A

[PCD4.1] PCD -> PICC bit rates supported: *fc/128* (~106 kbit/s)

Other: **None**

[PCD4.2] PICC -> PCD bit rates supported: *fc/128* (~106 kbit/s)

Other: **None**

[PCD4.3] FSDI: **256 bytes**

[PCD5] Type B

[PCD5.1] PCD -> PICC bit rates supported: *fc/128* (~106 kbit/s)

Other: **None**

[PCD5.2] PICC -> PCD bit rates supported: *fc/128* (~106 kbit/s)

Other: **None**

[PCD5.3] Maximum Frame Size Code in ATTRIB: **256 bytes**

[PCD5.4] Extended ATQB support: Yes  No

[PCD5.5] "Minimum TR0" field of Param1 (2 bits) in ATTRIB: 00b

[PCD5.6] "Minimum TR1" field of Param1 (2 bits) in ATTRIB: 00b

[PCD5.7] "EOF/SOF" field of Param1 (2 bits) in ATTRIB: 00b

[PCD6] Test parameters



The DUT provides a loopback interface (starting with the APDU “00 A4 04 0C 0A F0 43 45 4E 20 31 36 37 39 34 00”) which can be used to perform all Digital tests.

Alternatively, the following test command definitions can be used:

[PCD6.1a] UT\_TEST\_COMMAND1 APDU definition (hexadecimal value): **00 A4 04 0C 0A F0 43 45 4E 20 31 36 37 39 34 00h (SELECT Application)**

[PCD6.1b] UT\_TEST\_COMMAND1 Answer to ADPU definition (hexadecimal value): **<Arbitrary data> + 90 00h**

[PCD6.2a] UT\_TEST\_COMMAND2 APDU definition: **The DUT is not able to directly provide UT\_TEST\_COMMAND2, it always sends UT\_TEST\_COMMAND1 first. The response to this command is then used to form UT\_TEST\_COMMAND2:**

**Step 1) UT\_TEST\_COMMAND1: 00 A4 04 0C 0A F0 43 45 4E 20 31 36 37 39 34 00h**

**Step 2) Response: 00 A4 04 0C 25 00 .. 00 (38 occurrences of “00”) 90 00h**

**Step 3) UT\_TEST\_COMMAND2: 00 A4 04 0C 25 00 .. 00h (38 occurrences of “00”)**

Please note that the length of UT\_TEST\_COMMAND2 can be flexibly adopted (by modifying the response to UT\_TEST\_COMMAND1) in order to cover various chaining scenarios.

[PCD6.2b] UT\_TEST\_COMMAND2 Answer to ADPU definition (hexadecimal value): **<Arbitrary data> + 90 00h**

[PCD6.2c] PCD internal output buffer size (used for Maximum size of UT\_APDU): **1024 bytes (at least)**

[PCD6.2d] PCD internal input buffer size (used for Maximum size of response UT\_APDU): **1024 bytes (at least)**

NOTE UT\_TEST\_COMMAND2 is set in accordance to [PCD6.2c] in order to test all the supported FSC / Maximum Frame Size values. Additionally, if loopback interface for PT reader testing is used, UT\_TEST\_COMMAND2 is also set in accordance to [PCD6.2d].

[PCD7] Proprietary test parameters

[PCD7.1] PROPRIETARY\_COMMAND APDU(s) definition(s) (hexadecimal value): **N/A**

[PCD7.2] PROPRIETARY\_COMMAND Answer to ADPU(s) definition(s) (hexadecimal value): **N/A**

NOTE Usages of UT\_TEST\_COMMAND1 and UT\_TEST\_COMMAND2 for PCD tests are defined in ISO/IEC 10373-6.

When the support of proprietary protocol(s) initiated by ISO/IEC 14443-3 polling commands is indicated in [PCD3.1] and when the PT reader may give priority to applications using such proprietary protocol compared to applications using Type A or Type B, in order to perform the testing of [Rdr8], the Vendor shall describe:

- in [PCD7.1], the proprietary command(s) used to select an application using a proprietary protocol initiated by ISO/IEC 14443-3 polling commands:
  - a) for ISO/IEC 14443-3 fully compliant products, the command(s) following the anticollision procedure;
  - b) for ISO/IEC 14443-3 partially compliant products, the command(s) following the request command;
- in [PCD7.2], the expected response(s) to these commands:
  - a) compliant with the proprietary protocol;



b) indicating that no suitable application is available.





## Annex D Tolerance Margin Definition

### D.1 Tolerance Margin for PICC Analog Tests

<b>TC_PICC_A_LMA</b>	<p>If the Reference Sample is the PICC Calypso CD 21 Rev. 3.2:</p> <ul style="list-style-type: none"> <li>• If <math>H=1,5</math> A/m: LMA measurements shall not deviate from more than +10% or -10% from the Reference Test Results.</li> <li>• Else: LMA measurements shall not deviate from more than +5% or -5% from the Reference Test Results.</li> </ul> <p>If the Reference Sample is PICC ITSO DESFire:</p> <ul style="list-style-type: none"> <li>• LMA measurements shall not deviate from more than +5% or -5% from the Reference Test Results.</li> </ul>
<b>TC_PICC_A_EMD</b>	<p>For all Reference Samples: EMDs measurement shall not deviate from more than <math>2/3 * V_{E,PICC}</math> from the Reference Test Results.</p>

### D.2 Tolerance Margin for PCD Analog Tests

<b>TC_PCD_A_MinFS</b> <b>TC_PCD_A_MaxFS</b>	<p>For all Reference Samples:</p> <ul style="list-style-type: none"> <li>• The maximum deviation of each measurement shall be +25% or -25% from the Reference Test Results.</li> <li>• At least 75% of all TC_PCD_A_MinFS and TC_PCD_A_MaxFS measurements shall deviate by less than +15% or -15% from the Reference Test Results.</li> </ul>
<b>TC_PCD_A_TAMW</b> <b>TC_PCD_A_TBMW</b>	<p>At least 75% of all TC_PCD_A_TAMW and TC_PCD_A_TBMW measurements shall deviate by less than +5% or -5% from the Reference Test Results.</p>
<b>TC_PCD_A_TALMR</b> <b>TC_PCD_A_TBLMR</b>	<p>For all Reference Samples, at least 90% of all TC_PCD_A_TALMR and TC_PCD_A_TBLMR measurements shall deviate by less than +2 mV or -2 mV from the Reference Test Results.</p>
<b>TC_PCD_A_TAEI</b> <b>TC_PCD_A_TBEI</b>	<p>Measurement shall deviate by less than +1 mV or -1 mV from the Reference Test Results.</p>
<b>TC_PCD_A_ALF</b>	<p>Measurement shall deviate by less than +250 mV or -250 mV from the Reference Test Results.</p>

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