BSI Standards Publication

Public transport — Communication between contactless readers and fare media

Part 2: Test plan for ISO/IEC 14443

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Public transport - Communication between contactless readers and fare media - Part 2: Test plan for ISO/IEC 14443

Transport Public - Système billettique interopérable -
Communication entre terminaux et objets sans contact -
Partie 2: Plan de test pour l'ISO/IEC 14443

Öffentlicher Verkehr - Kommunikation zwischen
berührungslosen Ladegeräten und Fahrscheinmedien - Teil
2: Prüfplan zur ISO/IEC 14443

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Foreword

This document (CEN/TS 16794-2:2015) has been prepared by Technical Committee CEN/TC 278 "Intelligent transport systems", the secretariat of which is held by NEN.

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Introduction

This test plan represents a necessary step in a process designed to ensure contactless communications interoperability between fare management system terminals and any fare media liable to be accepted by them. The end-purpose of this document is to provide the test conformance plan that needs to be performed to ensure compliancy of fare management system terminals and any fare media in accordance to CEN/TS 16794-1, *Public transport - Communication between contactless readers and fare media - Part 1: Implementation requirements for* ISO/IEC 14443.

This test plan is not designed to repeat or duplicate the referenced specifications and associated test method (essentially ISO/IEC 14443 and ISO/IEC 10373-6 standards) but to list the test conditions to be performed in addition to the ones already described in the ISO/IEC 10373-6 standard and to define their testing and use conditions.

This test plan includes the following key clauses:

— Clause 5 describes the test environment;

— Clause 6 sets out the analog test plan for fare management system terminals;

— Clause 7 sets out the analog test plan for contactless fare media;

— Clause 8 sets out the protocol and digital test plan for fare management system terminals;

— Clause 9 sets out the protocol and digital test plan for contactless fare media.

1 Scope

This Technical Specification comes as a complement to the technical requirements expressed in CEN/TS 16794-1, *Public transport - Communication between contactless readers and fare media - Part 1: Implementation requirements for* ISO/IEC 14443*,* for ensuring contactless communication interoperability between contactless fare management system terminals and contactless fare media hosting a transport ticketing application.

This test plan lists all the test conditions to be performed on a contactless reader or a contactless fare media in order to ensure that all the requirements specified in CEN/TS 16794-1 are met for the device under test.

This Technical Specification is then applicable to:

— any **contactless fare management system terminals** acting as a PCD **contactless reader** based on ISO/IEC 14443-series standards;

— any **contactless fare media** acting as a PICC **contactless object** based on ISO/IEC 14443-series standards.

This test plan applies solely to the contactless communication layers described in parts 1 to 4 of the ISO/IEC 14443- series of standards. Application-to-application exchanges executed once contactless communication has been established at RF level fall outside the scope of this test plan. However, a transport ticketing application will need to be used so as to make end-to-end transactions during tests on the RF communication layer.

This test plan does not duplicate the contents of ISO/IEC 14443- series or ISO/IEC 10373-6 standards. It makes reference to the ISO/IEC 10373-6 applicable tests methods, specifies the test conditions to be used and describes the additional specific test conditions that may be run.

The list of test conditions applicable to the device under test will be conditioned by the Information Conformance Statement (ICS) declaration made by the device manufacturer. For each test case, the test conditions are clearly specified in order to determine the pertinence to run or not the test case in accordance with the device capabilities or in accordance with the device manufacturer's choice.

In order to facilitate the test report issuance, a test report template is included in Annex A of the present test plan.

Although the present test plan aims at becoming the primary basis for certification of contactless communication protocol between contactless reader and contactless object, it does not describe any certification or qualification processes as such processes should be defined between local or global transit industry stakeholders and not within this CEN work group.

2 Normative references

The following documents, in whole or in part, are normatively 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 amendments) applies.

ISO/IEC 10373-6:2011, *Identification cards — Test methods — Part 6: Proximity cards*

ISO/IEC 10373-6:2011/Amd.1:2012, *Identification cards — Test methods — Part 6: Proximity cards / Amendment 1: Additional PICC classes*

ISO/IEC 10373-6:2011/Amd.2:2012, *Identification cards — Test methods — Part 6: Proximity cards / Amendment 2: Test methods for electromagnetic disturbance*

ISO/IEC 10373-6:2011/Amd.3:2012, *Identification cards — Test methods — Part 6: Proximity cards / Amendment 3: Exchange of additional parameters, block numbering, unmatched AFI and TR2*

ISO/IEC 10373-6:2011/Amd.4:2012, *Identification cards — Test methods — Part 6: Proximity cards / Amendment 4: Bit rates of fc/8, fc/4 and fc/2 and frame size from 512 to 4096 bytes*

ISO/IEC 10373-6:2011/Cor:2013, *Identification cards — Test methods — Part 6: Proximity cards / R2 value range, start of PICC transmission and program for EMD level measurement*

ISO/IEC 14443-1:2008, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 1: Physical characteristics*

ISO/IEC 14443-1:2008/Amd.1:2012, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 1: Physical characteristics / Amendment 1: Additional PICC classes*

ISO/IEC 14443-2:2010, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 2: Radio frequency power and signal interface*

ISO/IEC 14443-2:2010/Amd.1:2011, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 2: Radio frequency power and signal interface / Amendment 1: Limits of electromagnetic disturbance levels parasitically generated by the PICC*

ISO/IEC 14443-2:2010/Amd.2:2012, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 2: Radio frequency power and signal interface / Amendment 2: Additional PICC classes*

ISO/IEC 14443-2/Amd.3:2012, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 2: Radio frequency power and signal interface / Amendment 3: Bits rates of fc/8, fc/4 and fc/2*

ISO/IEC 14443-3:2011, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 3: Initialization and anticollision*

ISO/IEC 14443-3:2011/Amd.1:2011, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 3: Initialization and anticollision / Amendment 1: Electromagnetic disturbance handling and single-size unique identifier*

ISO/IEC 14443-3:2011/Amd.2:2012, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 3: Initialization and anticollision / Amendment 2: Bit rates of fc/8, fc/4 and fc/2, frame size from 512 bytes to 4 096 bytes and minimum TR0*

ISO/IEC 14443-4:2008, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 4: Transmission protocol*

ISO/IEC 14443-4:2008/Amd.1:2012, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 4: Transmission protocol / Amendment 1: Exchange of additional parameters*

ISO/IEC 14443-4:2008/Amd.2:2012, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 4: Transmission protocol / Amendment 2: Bit rates of fc/8, fc/4 and fc/2, protocol activation of PICC Type A and frame size from 512 bytes to 4 096 bytes*

CEN/TS 16794-1:2015, *Public transport — Communication between contactless readers and fare media — Part 1: Implementation requirements for ISO/IEC 14443*

3   Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
Reference PICC
Reference PICC card as defined in test method ISO/IEC 10373-6:2011

4   Symbols and abbreviations

The following abbreviated terms are used in this document.

AFI   Application Family Identifier, Type B

ATQA   Answer To Request, Type A

ATQB   Answer To Request, Type B

FWI   Frame Waiting time Integer

FSCI   Frame Size for proximity Card Integer

PCD   Proximity Coupling Device

PICC   Proximity IC Card

PUPI   Pseudo-Unique PICC Identifier, Type B

REQA   Request Command, Type A

REQB   Request Command, Type B

RF   Radio Frequency

SFGT   Start-up Frame Guard Time

UID   Unique Identifier, Type A

WUPA   Wake-UP Command, Type A

WUPB   Wake-UP Command, Type B

5   Description of the test environment

5.1   Test bench

The test bench shall conform to the specifications set out in Clause 5 of ISO/IEC 10373-6:2011 and ISO/IEC 10373-6:2011/Amd.2:2012.

5.2   Tolerances applicable to ambient-environment tests

Parameter	Unit	Absolute tolerance
Temperature	Degrees Celsius (°C)	± 3 °C
Relative humidity	Percentage (%)	± 5 %

5.3   PCD or PICC test conditions

Parameter	Unit	Value
Temperature	Degrees Celsius (°C)	Minimum Temperature and Ambient Temperature and Maximum Temperature

5.4   Positional tolerance

Parameter	Unit	Tolerance
PICC-to-PCD distance	Millimetres (mm)	± 1 mm, except at 0

5.5   Admissible tolerances on the measurements

Tolerances specified in ISO/IEC 10373-6:2011 shall be applied.

NOTE   Different tolerances for some parameters are being standardized in a draft amendment to ISO/IEC 10373-6:2011.

6   PCD – Analog test plan

6.1   PCD general test conditions

Unless otherwise specified, each test shall be executed:

—   with Reference PICCs 1, 2 and 3 at every position of range A (Position A1 to A5),

—   with Reference PICC 3 at every position of range B (Position B1 to B3),

which makes a total of 18 test conditions.

For Common Readers, the range A is limited from position A1 to A2 and the range B is limited from position B1 to B2. Consequently, for common readers, tests specified in several positions of range A and of range B shall be done only in positions A1, A2, B1 and B2.

As specified in CEN/TS 16794-1:2015, 9.2.3.2, if the measurements cannot be taken from Position A1 then the measurements shall be taken from Position A1' where the Reference PICC is in contact with the PCD device under test.

As specified in CEN/TS 16794-1:2015, 9.2.3.4, if the measurements cannot be taken from Position B1 then the measurements shall be taken from Position B1' where the Reference PICC is in contact with the PCD device under test.

6.2   Conformance of the PCD field strength

6.2.1   General

The maximum and minimum PCD field strength tests shall be done during an interval of time when the PCD produces a field. One possibility is to use an oscilloscope and measure the field strength during the interval of time preceding a request or wake-up command. If the PCD under test provides a specific "continuous unmodulated field" mode, another possibility is to use a voltmeter.

6.2.2   TC_PCD_A_MaxFS: PCD maximum field strength

6.2.2.1   Scope / purpose

This test verifies the maximum magnetic field strength in the PCD operating volume (range A and range B).

6.2.2.2   Test conditions

At ambient, minimum and maximum temperatures, Reference PICCs 1, 2 and 3 within range A and Reference PICC 3 within range B.

6.2.2.3   Test procedure

Perform the procedure for H_{max} test defined in ISO/IEC 10373-6:2011, 7.1.1.2 by moving the Reference PICCs in all the positions of the PCD operating volume defined in 6.2.2.2.

6.2.2.4   Test report

The test report shall give the maximum DC voltage measured at CON3 under the conditions applied.

Fill the TC_PCD_A_MaxFS row of test plan summary in accordance with the following table:

Table 1 — Result criteria for maximum PCD field strength test

Explanation	Test result
Only when the DC voltages at CON3 does not exceed 3 V in all 12 test conditions	PASS
When the DC voltages at CON3 exceeds 3 V in at least one of the 12 test conditions	FAIL

6.2.3   TC_PCD_A_ MinFS : PCD minimum field strength

6.2.3.1   Scope / purpose

This test verifies the minimum magnetic field strength in the PCD operating volume (range A and range B).

6.2.3.2   Test conditions

At ambient, minimum and maximum temperatures, Reference PICCs 1, 2 and 3 within range A and Reference PICC 3 within range B.

6.2.3.3   Test procedure

Perform the procedure for H_{min} test defined in ISO/IEC 10373-6:2011, 7.1.1.2 (amended by ISO/IEC 10373-6:2011/Amd.1:2012) by moving the Reference PICCs in all the positions of the PCD operating volume defined in 6.2.3.2.

In addition, perform the previous procedure, using the minimum field strength specified for range B instead of H_{min}, by moving the Reference PICC 3 in all the positions of range B.

6.2.3.4   Test report

The test report shall give the minimum DC voltage measured at CON3 under the conditions applied.

Fill the TC_PCD_A_ MinFS row of test plan summary in accordance with the following table:

Table 2 — Result criteria for minimum PCD field strength test

Explanation	Test result
Only when the DC voltages at CON3 exceeds V_{load} as defined in ISO/IEC 10373-6:2011/Amd.1:2012, Table 3 in all 12 test conditions	PASS
When the DC voltages at CON3 does not exceed V_{load} as defined in ISO/IEC 10373-6:2011/Amd.1:2012, Table 3 in at least one of the 12 test conditions	FAIL

6.3 Conformance of the PCD modulation waveform

6.3.1 TC_PCD_A_TAMW: Type A modulation waveform

6.3.1.1 Scope / purpose

This test verifies the Type A modulation waveform in the PCD operating volume (range A and range B).

6.3.1.2 Test conditions

At ambient, minimum and maximum temperatures, Reference PICCs 1 and 2 in Position A1, Reference PICC 3 in Position B1 and the calibration coil at an arbitrary position.

6.3.1.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011, 7.1.4.2 (amended by ISO/IEC 10373-6:2011/Amd.1:2012) for all the positions of the PCD operating volume defined in 6.3.1.2 and for all supported PCD to PICC bit rates.

6.3.1.4 Test report

The test report shall give the measured Type A modulation pulse, rise and fall times and overshoot values under the conditions applied.

Fill the TC_PCD_A_TAMW row of test plan summary in accordance with the following table for all supported PCD to PICC bit rates.

Table 3 — Result criteria for Type A modulation waveform test

Explanation	Test result
Only when the Type A modulation pulse, rise and fall times and overshoot values are compliant in all 12 test conditions	PASS
When at least one value is not compliant in at least one of the 12 test conditions	FAIL

6.3.2 TC_PCD_A_TBMW: Type B modulation index and waveform

6.3.2.1 Scope / purpose

This test verifies the Type B modulation index and the waveform in the PCD operating volume (range A and range B).

6.3.2.2 Test conditions

At ambient, minimum and maximum temperatures, Reference PICCs 1 and 2 in Position A1, Reference PICC 3 in Position B1 and the calibration coil at an arbitrary position.

6.3.2.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011, 7.1.4.2 (amended by ISO/IEC 10373-6:2011/Amd.1:2012) for all the positions of the PCD operating volume defined in 6.3.2.2 and for all supported PCD to PICC bit rates.

6.3.2.4　Test report

The test report shall give the measured type B modulation index, rise and fall times and overshoot values under the conditions applied.

Fill the TC_PCD_A_TBMW row of test plan summary in accordance with the following table for all supported PCD to PICC bit rates.

Table 4 — Result criteria for Type B modulation index and waveform test

Explanation	Test result
Only when the Type B modulation index, rise and fall times and overshoot values are compliant in all 12 test conditions	PASS
When at least one value is not compliant in at least one of the 12 test conditions	FAIL

6.4　Conformance of the PCD load modulation reception

6.4.1　TC_PCD_A_TALMR: Type A load modulation reception

6.4.1.1　Scope / purpose

This test verifies the Type A load modulation reception in the PCD operating volume (range A and range B).

6.4.1.2　Test conditions

At ambient temperature, see 6.1.

At minimum and maximum temperatures, only Reference PICC 1 in Position A2 and Reference PICC 3 in Position B2.

6.4.1.3　Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011, 7.1.5.2 (amended by ISO/IEC 10373-6:2011/Amd.1:2012) in all the defined positions of the PCD operating volume and for all supported PICC to PCD bit rates, except bit rates of fc/64 (~212 kbit/s), fc/32 (~424 kbit/s) and fc/16 (~848 kbit/s).

6.4.1.4　Test report

The test report shall give the PCD Type A load modulation sensitivity under the conditions applied.

Fill the TC_PCD_A_TALMR row of test plan summary in accordance with the following table for all supported PICC to PCD bit rates.

Table 5 — Result criteria for Type A load modulation reception test

Explanation	Test result
Only when the PCD Type A load modulation sensitivity is below the standard limit in all 44 test conditions	PASS
When the PCD Type A load modulation sensitivity is above the standard limit in at least one of the 44 test conditions	FAIL

6.4.2 TC_PCD_A_TBLMR: Type B load modulation reception

6.4.2.1 Scope / purpose

This test verifies the Type B load modulation reception in the PCD operating volume (range A and range B).

6.4.2.2 Test conditions

At ambient temperature, see 6.1.

At minimum and maximum temperatures, only Reference PICC 1 in Position A2 and Reference PICC 3 in Position B2.

6.4.2.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011, 7.1.5.2 (amended by ISO/IEC 10373-6:2011/Amd.1:2012) in all the defined positions of the PCD operating volume and for all supported PICC to PCD bit rates, except bit rates of fc/64 (~212 kbit/s), fc/32 (~424 kbit/s) and fc/16 (~848 kbit/s).

6.4.2.4 Test report

The test report shall give the PCD Type B load modulation sensitivity under the conditions applied.

Fill the TC_PCD_A_TBLMR row of test plan summary in accordance with the following table for all supported PICC to PCD bit rates.

Table 6 — Result criteria for Type B load modulation reception test

Explanation	Test result
Only when the PCD Type B load modulation sensitivity is below the standard limit in all 44 test conditions	PASS
When the PCD Type B load modulation sensitivity is above the standard limit in at least one of the 44 test conditions	FAIL

6.5 Conformance of the PCD sensitivity to electromagnetic disturbance

6.5.1 General

The following tests shall be performed on the first applicative command sent by the PCD.

6.5.2 TC_PCD_A_TAEI: Type A EMD immunity

6.5.2.1 Scope / purpose

This test verifies that the PCD is insensitive to any Type A load modulation amplitude below $V_{E,PCD}$.

6.5.2.2 Test conditions

At ambient temperature, only Reference PICC 1 in Position A1 and Position A2 of range A.

6.5.2.3   Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.6.2 for all the defined positions of the PCD operating volume defined in 6.5.2.2 and for all supported PICC to PCD bit rates.

6.5.2.4   Test report

The test report shall state whether the PCD was insensitive to any Type A load modulation amplitude below $V_{E,PCD}$ under the conditions applied.

The test report shall indicate the VEMD as obtained in accordance with step f) of ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.6.2 for all the defined positions of the PCD operating volume defined in 6.5.2.2 and for all supported PICC to PCD bit rates.

Fill the TC_PCD_A_TAEI row of test plan summary in accordance with the following table for all supported PICC to PCD bit rates.

Table 7 — Result criteria for Type A EMD immunity test

Explanation	Test result
Only when the PCD is insensitive to any Type A load modulation amplitude below $V_{E,PCD}$ in all 2 test conditions	PASS
When the PCD is not insensitive to any Type A load modulation amplitude below $V_{E,PCD}$ in at least one of the 2 test conditions	FAIL

6.5.3   TC_PCD_A_TBEI: Type B EMD immunity

6.5.3.1   Scope / purpose

This test verifies that the PCD is insensitive to any Type B load modulation amplitude below $V_{E,PCD}$.

6.5.3.2   Test conditions

At ambient temperature, only Reference PICC 1 in Position A1 and Position A2 of range A.

6.5.3.3   Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.6.2 for all the positions of the PCD operating volume defined in 6.5.3.2 and for all supported PICC to PCD bit rates.

6.5.3.4   Test report

The test report shall state whether the PCD was insensitive to any Type B load modulation amplitude below $V_{E,PCD}$ under the conditions applied.

The test report shall indicate the VEMD as obtained in accordance with step f) of ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.6.2 for all the positions of the PCD operating volume defined in 6.5.3.2 and for all supported PICC to PCD bit rates.

Fill the TC_PCD_A_TBEI row of test plan summary in accordance with the following table for all supported PICC to PCD bit rates.

Table 8 — Result criteria for Type B EMD immunity test

Explanation	Test result
Only when the PCD is insensitive to any Type B load modulation amplitude below $V_{E,PCD}$ in all 2 test conditions	PASS
When the PCD is not insensitive to any Type B load modulation amplitude below $V_{E,PCD}$ in at least one of the 2 test conditions	FAIL

6.5.4 TC_PCD_A_TAER: Type A EMD handling timing constraints

6.5.4.1 Scope / purpose

This test verifies that the PCD is not disturbed by a Type A test pattern sent $t_{E,PCD}$ before the Type A PICC answer.

6.5.4.2 Test conditions

At ambient temperature, only Reference PICC 1 in Position A2.

No test at minimum and maximum temperatures.

6.5.4.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.7.2 for all the positions of the PCD operating volume defined in 6.5.4.2 and only for initial PICC to PCD bit rate (106 kbit/s).

If the PCD is disturbed by a Type A test pattern sent $t_{E,PCD}$ before the Type A PICC answer, repeat the test procedure replacing $t_{E,PCD}$ with longer times, to determine if an EMD recovery algorithm is implemented and its recovery time (longer than the low EMD time $t_{E,PCD}$).

6.5.4.4 Test report

The test report shall state whether the PCD was not disturbed by a Type A test pattern sent $t_{E,PCD}$ before the PICC answer (or was able to recover from the test pattern) under the conditions applied.

In case, the PCD is disturbed by a Type A test pattern sent $t_{E,PCD}$ before the Type A PICC answer, the support of an EMD recovery algorithm and the recovery time shall be indicated in the test report.

Fill the TC TC_PCD_A_TAER row of test plan summary in accordance with the following table for all supported PICC to PCD bit rates.

Table 9 — Result criteria for Type A EMD recovery test

Explanation	Test result
Only when the PCD is not disturbed by a Type A test pattern sent $t_{E,PCD}$ before the Type A PICC answer	PASS
When the PCD is disturbed by a Type A test pattern sent $t_{E,PCD}$ before the Type A PICC answer	FAIL

6.5.5 TC_PCD_A_TBER: Type B EMD handling timing constraints

6.5.5.1 Scope / purpose

This test verifies that the PCD is not disturbed by a Type B test pattern sent $t_{E,PCD}$ before the Type B PICC answer.

6.5.5.2 Test conditions

At ambient temperature, only Reference PICC 1 in Position A2.

No test at minimum and maximum temperatures.

6.5.5.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.7.2 for all the positions of the PCD operating volume defined in 6.5.5.2 and only for initial PICC to PCD bit rate (106 kbit/s).

If the PCD is disturbed by a Type B test pattern sent $t_{E,PCD}$ before the Type B PICC answer, repeat the test procedure replacing $t_{E,PCD}$ with longer times, to determine if an EMD recovery algorithm is implemented and its recovery time (longer than the low EMD time $t_{E,PCD}$).

6.5.5.4 Test report

The test report shall report whether the PCD was not disturbed by a Type B test pattern sent $t_{E,PCD}$ before the PICC answer (or was able to recover from the test pattern) under the conditions applied.

In case, the PCD is disturbed by a Type B test pattern sent $t_{E,PCD}$ before the Type B PICC answer, the support of an EMD recovery algorithm and the recovery time shall be indicated in the test report.

Fill the TC_PCD_A_TBER row of test plan summary in accordance with the following table for all supported PICC to PCD bit rates.

Table 10 — Result criteria for Type B EMD recovery test

Explanation	Test result
Only when the PCD is not disturbed by a Type B test pattern sent $t_{E,PCD}$ before the Type B PICC answer	PASS
When the PCD is disturbed by a Type B test pattern sent $t_{E,PCD}$ before the Type B PICC answer	FAIL

7 PICC – Analog test plan

7.1 PICC general test conditions

Unless otherwise specified, each test shall be executed:

— at ambient temperature with field strengths of H_{min}, 2 A/m, 2,5 A/m, 3,5 A/m, 4,5 A/m, 6 A/m and H_{max} (in accordance with PICC class),

— at minimum and maximum temperatures with field strengths of H_{min} and H_{max} (in accordance with PICC class),

which makes a total of 11 test conditions (7 at ambient temperature, 2 at minimum temperature and 2 at maximum temperature).

7.2 Conformance of the PICC characteristics

7.2.1 TC_PICC_A_OFS: PICC operating field strength

7.2.1.1 Scope / purpose

This test verifies that the PICC operates as intended within H_{min} and H_{max} as defined in ISO/IEC 14443-2.

7.2.1.2 Test conditions

7.2.1.2.1 General test conditions

See 7.1.

When the test condition is both H_{max} and maximum temperature, the PICC shall be put in horizontal position and no ventilation shall be used during the test in order to limit the PICC's heat dissipation. The test shall be preceded by a one-minute PICC exposition to a field strength of H_{max} without any field shut-off and with no ventilation so that the PICC chip has reached its maximum temperature when the test starts. The air temperature value during test execution shall remain within required tolerances.

If necessary, the thermal inertia of the chamber may be increased (e.g. by adding water bottles and waiting for their thermal stabilisation) so that the air temperature value during test execution remain within required tolerances despite a shut-off of the climatic chamber.

7.2.1.2.2 Timing and waveform test conditions

For PICC Type A:

— Use the timing and waveform test condition 1 defined in ISO/IEC 10373-6:2011, 7.2.2.2.1 for a PCD to PICC bit rate of $fc/128$,

— Use the timing and waveform test condition 1 defined in ISO/IEC 10373-6:2011, 7.2.2.2.2 for PCD to PICC bit rates of $fc/64$, $fc/32$ and $fc/16$,

— Use the timing and waveform test condition 1 with minimum modulation index m defined in ISO/IEC 10373-6:2011/Amd.4:2012, 7.2.2.4 for PCD to PICC bit rates of $fc/8$, $fc/4$ and $fc/2$.

For PICC Type B:

— Use the timing and waveform test condition 1 with minimum modulation index m defined in ISO/IEC 10373-6:2011, 7.2.2.3 for PCD to PICC bit rates of $fc/128$, $fc/64$, $fc/32$ and $fc/16$,

— Use the timing and waveform test condition 1 with minimum modulation index m defined in ISO/IEC 10373-6:2011/Amd.4:2012, 7.2.2.4 for PCD to PICC bit rates of $fc/8$, $fc/4$ and $fc/2$.

7.2.1.3 Test procedure

For each test condition defined in 7.2.1.2 (i.e. each combination of a general test condition and a timing and waveform test condition), perform the following test procedure using the PICC-test-apparatus:

a) With the PICC in the DUT position, adjust the RF power delivered by the signal generator to the test PCD antenna to the required field strength as measured by the calibration coil.

b) Run the following sequence of commands:

1) For PICC Type A:

    i)   REQA command

    ii)   ANTICOLLISION and SELECT commands

    iii)   RATS command

    iv)   PPS command (*)

    v)   TEST_COMMAND_SEQUENCE

2) For PICC Type B:

    i)   REQB command

    ii)   ATTRIB command

    iii)   TEST_COMMAND_SEQUENCE

The definition of the TEST_COMMAND_SEQUENCE to apply is defined in the PICC ICS as indicated in CEN/TS 16794-1.

(*) Note that the PPS command is not applicable, if the default bit rate of fc/128 is used in both directions.

7.2.1.4　Test report

The test report shall confirm the intended operation at the mandatory fc/128 (~106 kbit/s) bit rate. For PICCs supporting one or more of the optional PCD to PICC bit rates the test report shall confirm the intended operation at the supported PCD to PICC bit rates. Used test conditions shall be mentioned in the test report.

Fill the TC_PICC_A_OFS row of test plan summary in accordance with the following table for all supported PCD to PICC bit rates.

Table 11 — Result criteria for PICC operating field strength test for each PCD to PICC bit rate supported by the PICC

Explanation	Test result
Only when the PICC responds correctly to the test sequence transmitted at each supported PCD to PICC bit rate in all 11 test conditions	PASS
If the PICC does not respond correctly to at least one step of the test sequence transmitted at at least one supported PCD to PICC bit rate in at least one of the 11 test conditions	FAIL

7.2.2　TC_PICC_A_LMA: PICC transmission

7.2.2.1　Scope / purpose

This test verifies that the load modulation amplitude of the PICC within the operating field range is as specified in ISO/IEC 14443-2.

7.2.2.2   Test conditions

7.2.2.2.1   General test conditions

See 7.1.

7.2.2.2.2   Timing and waveform test conditions

See 7.2.1.2.2.

7.2.2.3   Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011, 7.2.1 (amended by ISO/IEC 10373-6:2011/Amd.1:2012 and by ISO/IEC 10373-6:2011/Amd.4:2012) in all test conditions defined in 7.2.2.2 and for all supported PICC to PCD bit rates, except bit rates of *fc*/64 (~212 kbit/s), *fc*/32 (~424 kbit/s) and *fc*/16 (~848 kbit/s).

7.2.2.4   Test report

The test report shall give the measured peak amplitudes of the upper and lower sidebands at *fc* + *fs* and *fc* – *fs* under the conditions applied.

Fill the TC_PICC_A_LMA row of test plan summary in accordance with the following table for all supported PICC to PCD bit rates, except bit rates of *fc*/64 (~212 kbit/s), *fc*/32 (~424 kbit/s) and *fc*/16 (~848 kbit/s).

Table 12 — Result criteria for PICC load modulation amplitude test

Explanation	Test result
Only when the amplitudes of the upper and lower sidebands are above the defined limit in all 11 test conditions	PASS
If the amplitude of at least one sideband is below the defined limit in at least one of the 11 test conditions	FAIL

7.2.3   TC_PICC_A_Rec: PICC reception

7.2.3.1   Scope / purpose

This test verifies that the PICC is able to receive PCD commands.

7.2.3.2   Test conditions

7.2.3.2.1 General test conditions

See 7.1.

7.2.3.2.2 Timing and waveform test conditions

For PICC Type A:

— 3 timing and waveform test conditions are defined in ISO/IEC 10373-6:2011, 7.2.2.2.1 for a PCD to PICC bit rate of *fc*/128,

— 3 timing and waveform test conditions are defined in ISO/IEC 10373-6:2011, 7.2.2.2.2 for PCD to PICC bit rates of *fc*/64, *fc*/32 and *fc*/16,

— 6 timing and waveform test conditions are defined in ISO/IEC 10373-6:2011/Amd.4:2012, 7.2.2.4 for PCD to PICC bit rates of fc/8, fc/4 and fc/2.

For PICC Type B:

— 6 timing and waveform test conditions are defined in ISO/IEC 10373-6:2011, 7.2.2.3 for PCD to PICC bit rates of fc/128, fc/64, fc/32 and fc/16,

— 6 timing and waveform test conditions are defined in ISO/IEC 10373-6:2011/Amd.4:2012, 7.2.2.4 for PCD to PICC bit rates of fc/8, fc/4 and fc/2.

7.2.3.3   Test procedure

For PICC Type A, perform the test procedure defined in ISO/IEC 10373-6:2011, 7.2.2.2.3 (amended by ISO/IEC 10373-6:2011/Amd.4:2012) in all test conditions defined in 7.2.3.2 (i.e. each combination of a general test condition and a timing and waveform test condition) and for all supported PCD to PICC bit rates, using an I-block exchange at all supported bit rates, including fc/128.

For PICC Type B, perform the test procedure defined in ISO/IEC 10373-6:2011, 7.2.2.3.2 (amended by ISO/IEC 10373-6:2011/Amd.4:2012) in all test conditions defined in 7.2.3.2 (i.e. each combination of a general test condition and a timing and waveform test condition) and for all supported PCD to PICC bit rates, using an I-block exchange at all supported bit rates, including fc/128.

7.2.3.4   Test report

The test report shall confirm the intended operation at the mandatory fc/128 (~106 kbit/s) bit rate and at all the supported PCD to PICC bit rates. Used test conditions shall be mentioned in the test report.

Fill the TC_PICC_A_Rec row of test plan summary in accordance with the following table for all supported PCD to PICC bit rates.

Table 13 — Result criteria for PICC reception test for each PCD to PICC bit rate supported by the PICC

Explanation	Test result
Only when the PICC responds correctly to an I-Block transmitted at each supported PCD to PICC bit rate in all 33 or 66 test conditions	PASS
If the PICC does not respond correctly to an I-Block transmitted at each supported PCD to PICC bit rate in at least one of the 33 or 66 test conditions	FAIL

7.2.4   TC_PICC_A_LDE: PICC loading effect

7.2.4.1   Scope / purpose

This test verifies that the loading effect of the PICC is less than the loading effect of the corresponding Reference PICC at H_{min}.

7.2.4.2   Test conditions

This test shall only be done at ambient temperature with the H_{min} field strength defined for the PICC class.

7.2.4.3   Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011/Amd.1:2012, 7.2.4.

7.2.4.4 Test report

The test report shall give the value of the measured field strength.

Fill the TC_PICC_A_LDE row of test plan summary in accordance with the following table:

Table 14 — Result criteria for PICC loading effect test

Explanation	Test result
Only when the value of the measured field strength is higher than H_{min}	PASS
If the value of the measured field strength is lower than H_{min}	FAIL

7.2.5 TC_PICC_A_EMD: PICC EMD level and low EMD time

7.2.5.1 Scope / purpose

This test verifies that the electromagnetic disturbance generated by the PICC complies with amplitude and timing requirements defined in ISO/IEC 14443-2:2010/Amd.1:2011.

7.2.5.2 Test conditions

7.2.5.2.1 General test conditions

See 7.1.

7.2.5.2.2 Timing and waveform test conditions

See 7.2.1.2.2.

7.2.5.3 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011/Amd.2:2012, 7.2.2, in all test conditions and for all commands supported by the PICC.

7.2.5.4 Test report

The test report shall state whether the electromagnetic disturbance generated by the PICC complies with amplitude and timing requirements defined in ISO/IEC 14443-2:2010/Amd.1:2011.

The test report shall indicate the maximum amplitude measured during $t_{E,PICC}$.

Fill the TC_PICC_A_EMD row of test plan summary in accordance with the following table:

Table 15 — Result criteria for PICC EMD level and low EMD time test

Explanation	Test result
Only when the electromagnetic disturbance amplitude V_{EMD} is lower than $V_{E,PICC}$ during $t_{E,PICC}$ (with exceptions defined in ISO/IEC 14443-2:2010/Amd.1:2011) in all 11 test conditions	PASS
If the electromagnetic disturbance amplitude V_{EMD} is not lower than $V_{E,PICC}$ during $t_{E,PICC}$ (with exceptions defined in ISO/IEC 14443-2:2010/Amd.1:2011) in at least one of the 11 test conditions	FAIL

8 PCD – Protocol and digital test plan

8.1 PCD general test conditions

8.1.1 General

Each test shall be executed at ambient temperature with the PCD-test-apparatus and accessories defined in ISO/IEC 10373-6:2011, H.1.

8.1.2 List of test command sequences

The following sequence shall be applied for scenarios not needing PCD chaining:

Table 16 —Test command sequence for scenarios not needing PCD chaining

Step	Command
1	INITIALIZE_PCD_TEST_MODE
2	INITIATE_ANTICOLLISION
3	UT_TEST_COMMAND1
4	UT_TEST_COMMAND1

The following sequence shall be applied for scenarios dealing with PCD chaining:

Table 17 —Test command sequence for scenarios dealing with PCD chaining

Step	Command
1	INITIALIZE_PCD_TEST_MODE
2	INITIATE_ANTICOLLISION
3	UT_TEST_COMMAND2

8.2 PCD Digital conformance to ISO/IEC 14443- series

All the tests defined in ISO/IEC 10373-6:2011, Annex H and Annex I (amended by ISO/IEC 10373-6:2011/Amd.3:2012 and by ISO/IEC 10373-6:2011/Amd.4:2012) shall be passed.

NOTE   The following test procedures may reuse the results of the above listed tests from Annex H and I.

8.3 Conformance of the PCD characteristics

8.3.1 TC_PCD_D_TADT: PCD Type A detection time

8.3.1.1 Scope / purpose

This test verifies that the PCD detects and selects a Type A Reference PICC entering the field and indicating no SFGT needed, in less than t_{detect}, regardless of the moment when the Reference PICC is placed within range A or B of the contactless reader.

8.3.1.2 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011, H.2.7.2 with the following specificities:

— step b), the LT is disabled until a point of time t_s (start of timing measurement), which is randomly chosen, independently from the PCD polling cycle;

— step e), the point of time t_e (end of timing measurement) corresponds to the beginning of the SOF of the first I-block sent by the PCD;

— this test procedure is repeated at least 10 times to get the average value for the Reference PICC time-to-detection.

8.3.1.3   Test report

The test report shall give the average value for the Type A Reference PICC time-to-detection.

Fill the TC_PCD_D_TADT row of test plan summary in accordance with the following table:

Table 18 — Result criteria for PCD Type A detection time test

Explanation	Test result
Only when the average duration between the moment when the Type A Reference PICC is enabled and the beginning of the first I-block sent by the PCD is less than t_{detect}	PASS
Any other case	FAIL

8.3.2   TC_PCD_D_TBDT: PCD Type B detection time

8.3.2.1   Scope / purpose

This test verifies that the PCD detects and selects a Type B Reference PICC entering the field and indicating no SFGT needed, in less than t_{detect}, regardless of the moment when the Reference PICC is placed within range A or B of the contactless reader.

8.3.2.2   Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011, H.3.2.2 with the following specificities:

— step b), the LT is disabled until a point of time t_s (start of timing measurement), which is randomly chosen, independently from the PCD polling cycle; when enabled, the LT will answer to the first valid REQB/WUPB command frame using an AFI of 00h;

NOTE If the PCD's field is not continuously active, the point of time t_s is the moment when the field is started.

— step c), the LT answers with an ATQB not including the optional Extended ATQB byte (optional 4th byte of protocol info field) whatever the Extended ATQB support indicated by the PCD in its REQB/WUPB command frame

— step h), the point of time t_e (end of timing measurement) corresponds to the beginning of the SOF of the first I-block sent by the PCD;

— this test procedure is repeated at least 10 times to get the average value for the Reference PICC time-to-detection.

8.3.2.3   Test report

The test report shall give the average value for the Type B Reference PICC time-to-detection.

Fill the TC_PCD_D_TBDT row of test plan summary in accordance with the following table:

Table 19 — Result criteria for PCD Type B detection time test

Explanation	Test result
Only when the average duration between the moment when the Type B Reference PICC is enabled and the beginning of the first I-block sent by the PCD is less than t_{detect}	PASS
Any other case	FAIL

8.3.3 TC_PCD_D_AFI: AFI value sent by the PCD

8.3.3.1 Scope / purpose

This test verifies that the PCD uses an AFI of 00h when polling for Type B PICCs.

8.3.3.2 Test procedure

Perform the test procedure defined in 8.3.2.2 to verify that the PCD uses an AFI of 00h in at least some REQB/WUPB command frames.

8.3.3.3 Test report

The test report shall state whether the PCD was using an AFI of 00h in at least some REQB/WUPB command frames.

Fill the TC_PCD_D_AFI row of test plan summary in accordance with the following table:

Table 20 — Result criteria for AFI value sent by the PCD test

Explanation	Test result
Only when the PCD uses an AFI of 00h in at least one REQB/WUPB command frame in its polling sequence	PASS
Any other case	FAIL

8.3.4 TC_PCD_D_ATQB: PCD extended ATQB option

8.3.4.1 Scope / purpose

This test verifies whether the PCD supports or not the extended ATQB response and correctly deals with the SFGT when applicable.

8.3.4.2 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011, H.3.2.2 with the following specificities:

— step b), check if the extended ATQB option is supported or not by the PCD (bit 5 of REQB PARAM byte);

— step c), if the extended ATQB option is supported by the PCD then the LT answers with ATQB including the optional Extended ATQB byte (optional 4th byte of protocol info field) and indicating maximal SFGT (~4949 ms);

— step h), the PCD shall send the first I-block after a minimum delay of ~4949 ms.

8.3.5 Test report

The test report shall state whether the PCD supports or not the extended ATQB response and correctly deals with the SFGT when applicable.

Fill the TC_PCD_D_ATQB row of test plan summary in accordance with the following table:

Table 21 — Result criteria for PCD extended ATQB option test

Explanation	Test result
When the PCD either supports the extended ATQB response and correctly deals with the SFGT or does not support the extended ATQB response	PASS
Any other case	FAIL

8.3.6 TC_PCD_D_RFU: Recommendations on RFU bits and values reception test

8.3.6.1 Scope / purpose

This test verifies that the PCD complies with ISO/IEC 14443-series recommendations on reception of bits and values reserved for future use.

These recommendations in ISO/IEC 14443-3:2011 (amended by ISO/IEC 14443-3:2011/Amd.2:2012) are the following:

— Clauses 6 and 7: A PICC or PCD receiving RFU bits shall disregard the value of these bits and shall maintain and not change its function, unless explicitly stated otherwise.

— 6.5.2.1 (ATQA): A PCD receiving (b8,b7) = (11)b or (b16 to b13) <> (0000)b or b6 <> (0)b should ignore the values and should commence with the first step of the anticollision loop (see 6.5.3.1).

— 7.9.4.3 (FWI, Type B): Until the RFU value 15 is assigned by ISO/IEC, a PCD receiving FWI = 15 should interpret it as FWI = 4.

— 7.9.4.5 (Max_Frame_Size, Type B): Until the RFU values 'D' - 'F' are assigned by ISO/IEC, a PCD receiving Maximum Frame Size Code = 'D' - 'F' should interpret it as Maximum Frame Size Code = 'C' (4096 bytes).

— 7.9.4.6 (Bit_Rate_capability, Type B): Until the RFU values with b4 = (1)b are assigned by ISO/IEC, a PCD receiving Bit_Rate_capability with b4 = (1)b should interpret the Bit_Rate_capability byte as if (b8 to b1) = (00000000)b (only fc / 128 in both directions).

— 7.9.4.7 (SFGI, Type B): Until the RFU value 15 is assigned by ISO/IEC, a PCD receiving SFGI = 15 shall interpret it as SFGI = 0.

These recommendations in ISO/IEC 14443-4:2008 (amended by ISO/IEC 14443-4:2008/Amd.2:2012) are the following:

— 5.2.3 (FSCI, Type A): A PCD receiving value of FSCI = 'D'-'F' should interpret it as FSCI = 'C' (FSC = 4096 bytes).

— 5.2.5 (SFGI, Type A): A PCD receiving SFGI = 15 should interpret it as SFGI = 0.

— 5.2.5 (FWI, Type A): A PCD receiving FWI = 15 should interpret it as FWI = 4.

— 7.1.1.2 (CID, Type A and Type B): (b6,b5) <> (00)b shall be treated as a protocol error.

— 7.1.1.3 (NAD, Type A and Type B): b8 <> 0 and/or b4 <> 0 shall be treated as a protocol error.

— 7.2 (FWI, Type A and Type B): A PCD receiving FWI = 15 should interpret it as FWI = 4.

— 7.3 (WTXM, Type A and Type B): When receiving WTXM = 0 or WTXM = 60-63 the PCD shall treat it as a protocol error.

8.3.6.2   Test procedures

Perform the 3 test procedures defined in ISO/IEC 10373-6:2011, H.2.4.2.1, H.2.4.2.2 and H.2.4.2.3, with the following specificity:

— step c), the LT answers with ATQA = 'FFFF';

After the protocol activation procedure in accordance with ISO/IEC 10373-6:2011, H.1.8.2 for Type A or H.1.8.3 for Type B using FWI = 15, perform the test procedure defined in ISO/IEC 10373-6:2011, H.4.2.2.2 with WTXM set to 1, 3 and 59.

Perform the test procedure defined in ISO/IEC 10373-6:2011, H.3.2.2 with Maximum Frame Size Code set to 'D', 'E' and 'F'.

Perform the test procedure defined in ISO/IEC 10373-6:2011, I.2.2 with Bit_Rate_capability byte set to 'FF'.

Perform the test procedure defined in ISO/IEC 10373-6:2011, H.3.2.2 with the following specificities:

— step b), check if the extended ATQB option is supported or not by the PCD (bit 5 of REQB PARAM byte);

— step c), if the extended ATQB option is supported by the PCD then the LT answers with ATQB including the optional Extended ATQB byte (optional 4th byte of protocol info field) indicating SFGI = 15;

— step h), the PCD shall send the first I-block after a minimum delay of ~302 μs.

Perform the test procedure defined in ISO/IEC 10373-6:2011, H.2.7.2 with FSCI set to 'D', 'E' and 'F'.

Perform the test procedure defined in ISO/IEC 10373-6:2011, H.2.8.2 with the following specificities:

— step c), the LT answers with ATS including interface byte TB(1) equal '0F' indicating SFGI = 15;

— step e), the PCD shall send the first I-block after a minimum delay of ~302 μs.

After the protocol activation procedure in accordance with ISO/IEC 10373-6:2011, H.1.8.2 for Type A or H.1.8.3 for Type B using FWI = 1, perform the test procedure defined in ISO/IEC 10373-6:2011, H.4.2.2.1 with WTXM set to 0, 60 and 63.

8.3.6.3   Test report

The test report shall state whether the PCD complies with ISO/IEC 14443-series recommendations on reception of bits and values reserved for future use.

Fill the TC_PCD_D_RFU row of test plan summary in accordance with the following table:

Table 22 — Result criteria for recommendations on RFU bits and values reception test

Explanation	Test result
Only when the PCD complies with ISO/IEC 14443- series recommendations on reception of bits and values reserved for future use in each of the test procedures	PASS
Any other case	FAIL

8.3.7 TC_PCD_D_PRO: Proprietary protocols management by the PCD

8.3.7.1 Scope / purpose

This test verifies that the PCD comes back to applications using the ISO/IEC 14443-4 protocol when no suitable application using such a proprietary protocol is found.

8.3.7.2 Test procedure

For each supported proprietary protocol, perform the protocol activation procedure defined in ISO/IEC 10373-6:2011, H.1.8 with the following specificities:

— the LT answers only to the proprietary protocol, until the PCD decides no relevant application is available,

— the LT then enables the ISO/IEC 14443-4 protocol (in addition to the proprietary protocol), until the PCD activates the ISO/IEC 14443-4 protocol.

8.3.7.3 Test report

The test report shall state whether the PCD comes back to applications using the ISO/IEC 14443-4 protocol when no suitable application using such a proprietary protocol is found.

9 PICC – Protocol and digital test plan

9.1 PICC general test conditions

Each test shall be executed at ambient temperature with the PICC-test-apparatus and accessories defined in ISO/IEC 10373-6:2011, G.1.

The test shall be performed with TEST_COMMAND1, TEST_COMMAND2 and TEST_COMMAND3 indicated in the PICC ICS as defined in CEN/TS 16794-1.

9.2 PICC Digital conformance to ISO/IEC 14443- series

All the tests described in ISO/IEC 10373-6:2011, Annex G (amended by ISO/IEC 10373-6:2011/Amd.3:2012 and by ISO/IEC 10373-6:2011/Amd.4:2012) shall be passed.

NOTE   The following test procedures may reuse the results of the above listed tests from Annex G.

9.3 Conformance of the PICC characteristics

9.3.1 TC_PICC_D_ATQB: PICC support of REQB/WUPB allowing extended ATQB

9.3.1.1 Scope / purpose

This test verifies that the PICC Type B understands a REQB/WUPB indicating the extended ATQB support and answers this command by an ATQB (either basic or extended).

9.3.1.2 Test procedure

Perform the test procedure defined in ISO/IEC 10373-6:2011, G.4.4.2.2 using REQB(1) and WUPB(1) commands with b5 = (1)b and get the ATQB sent by the PICC.

9.3.1.3 Test report

The test report shall give the ATQB sent by the PICC.

Fill the TC_PICC_D_ATQB row of test plan summary in accordance with the following table:

Table 23 — PICC support of REQB/WUPB allowing extended ATQB

Explanation	Test result
Only when the ATQB sent by the PICC is either a valid basic ATQB or an extended ATQB	PASS
Any other case	FAIL

9.3.2 TC_PICC_D_RFU: Recommendations on RFU bits and values reception test

9.3.2.1 Scope / purpose

This test verifies that the PICC complies with ISO/IEC 14443-series recommendations on reception of bits and values reserved for future use.

These recommendations in ISO/IEC 14443-3:2011 (amended by ISO/IEC 14443-3:2011/Amd.2:2012) are the following:

— Clauses 6 and 7: A PICC or PCD receiving RFU bits shall disregard the value of these bits and shall maintain and not change its function, unless explicitly stated otherwise.

— 6.4.1 (REQA and WUPA commands): A PICC receiving an RFU value should consider the short frame as an error (see Figure 7) and should not send a response.

— 7.7.4 (REQB/WUPB command, PARAM): The PICC should ignore (b8 to b6) and its interpretation of any other field of the whole frame shall not change. Until the RFU values (101)b or (11x)b are assigned by ISO/IEC, a PICC receiving (b3 to b1) = (101)b or (11x)b should interpret it as (b3 to b1) = (100)b (16 slots).

— 7.10.3 (ATTRIB, Param 1, Type B): The PICC should ignore any value (b2,b1) and its interpretation of any other field of the whole frame shall not change.

— 7.10.3.1 (Minimum TR0, Type B): Until the RFU value (11)b is assigned by ISO/IEC, a PICC receiving (b8,b7) = (11)b should interpret it as (b8,b7) = (00)b, the default value.

— 7.10.3.2 (Minimum TR1, Type B): Until the RFU value (11)b is assigned by ISO/IEC, a PICC receiving (b6,b5) = (11)b should interpret it as (b6,b5) = (00)b, the default value.

— 7.10.4 (Maximum Frame Size, Type B): Until the RFU values 'D' - 'F' are assigned by ISO/IEC, a PICC receiving Maximum Frame Size Code = 'D' - 'F' should interpret it as Maximum Frame Size Code = 'C' (Maximum frame size = 4096 bytes).

— 7.10.5 (ATTRIB, Param 3, Type B): The PICC should ignore (b4 to b2) and the interpretation of any other field of the whole frame shall not change. The PICC should ignore and not answer the ATTRIB command when (b8 to b5) <> (0000)b.

— 7.10.6 (ATTRIB, Param 4, Type B): The PICC should ignore and not answer the ATTRIB command when received value of CID = 15 as any action in the PICC for CID = 15 may be decided in the future by ISO/IEC. The PICC should ignore (b8 to b5) and its interpretation of any other field of the whole frame shall not change.

These recommendations in ISO/IEC 14443-4:2008 (amended by ISO/IEC 14443-4:2008/Amd.2:2012) are the following:

— 5.1 (FSDI, Type A): Until the RFU values 'D' - 'F' are assigned by ISO/IEC, a PICC receiving value of FSDI = 'D' - 'F' should interpret it as FSDI = 'C' (FSD = 4096 bytes).

— 5.1 (CID, Type A): The value 15 is RFU. For PICC behaviour see 5.6.1.2 (c).

— 5.3.2 (PPS0, Type A): A PICC receiving (b4 to b1) <> (0001)b and/or receiving (b8 to b6) <> (000)b shall apply 5.6.2.2 (b).

— 5.3.3 (PPS1, Type A): A PICC receiving (b8 to b5) <> (0000)b shall apply 5.6.2.2 (b).

— 7.1.1.2 (CID, Type A and Type B): (b6,b5) <> (00)b shall be treated as a protocol error.

— 7.1.1.3 (NAD, Type A and Type B): b8 <> 0 and/or b4 <> 0 shall be treated as a protocol error.

9.3.2.2   Test procedures

For PICC Type A:

— Perform the test procedure defined in ISO/IEC 10373-6:2011, G.3.3.3.2, REQA row, with all short frame RFU values.

— Perform the test procedure defined in ISO/IEC 10373-6:2011, G.3.3.7.2, RATS row, with all RATS parameter byte RFU values (FSDI and CID RFU values).

— Perform the test procedure defined in ISO/IEC 10373-6:2011, G.3.3.13.2, PPS row, with all PPS0 RFU values.

— Perform the test procedure defined in ISO/IEC 10373-6:2011, G.3.3.13.2, PPS row, with all PPS1 RFU values.

For PICC Type B:

— Perform the test procedure defined in ISO/IEC 10373-6:2011, G.4.4.2.2, REQB rows, with all PARAM RFU values (including N RFU values).

— Perform the test procedure defined in ISO/IEC 10373-6:2011, G.4.4.4.2, ATTRIB row, with all Param 1 RFU values (including minimum TR0 and TR1 RFU values).

— Perform the test procedure defined in ISO/IEC 10373-6:2011, G.4.4.4.2, ATTRIB row, with all Param 2 RFU values (Maximum Frame Size Code in ATTRIB RFU values).

— Perform the test procedure defined in ISO/IEC 10373-6:2011, G.4.4.4.2, ATTRIB row, with all Param 3 RFU values.

— Perform the test procedure defined in ISO/IEC 10373-6:2011, G.4.4.4.2, ATTRIB row, with all Param 4 RFU values (including CID RFU value).

For PICC Type A or Type B:

— Perform the test procedure defined in ISO/IEC 10373-6:2011, G.5.4.2, with all CID field RFU values.

— Perform the test procedure defined in ISO/IEC 10373-6:2011, G.5.5.2, with all NAD field RFU values.

9.3.2.3 Test report

The test report shall state whether the PICC complies with ISO/IEC 14443-series recommendations on reception of bits and values reserved for future use.

Fill the TC_PICC_D_RFU row of test plan summary in accordance with the following table:

Table 24 — Result criteria for recommendations on RFU bits and values reception test

Explanation	Test result
Only when the PICC complies with ISO/IEC 14443- series recommendations on reception of bits and values reserved for future use in each of the test procedures	PASS
Any other case	FAIL

9.3.3 TC_PICC_D_TL: PICC type locking

9.3.3.1 Scope / purpose

This test checks that, if the PICC supports Type A and Type B, then it stays locked in the type of the first processed request command until POWER-OFF state (after Answer to Request of one type, the other type is disabled until the PICC enters POWER-OFF state).

9.3.3.2 Test procedure

Perform the following steps:

a) Place the PICC into the test position of the PICC-test-apparatus.

b) Switch the PICC-test-apparatus RF operating field on and wail at least 5 ms.

c) Send a WUPA and check there is a valid PICC response.

d) Keep the PICC-test-apparatus RF field on for more than 1 s.

e) Send a sequence of 10 WUPB and check there is no PICC response.

f) Switch the RF operating field off for a minimum time for resetting a PICC (see ISO/IEC 14443-3:2011, 5.4).

g) Switch the PICC-test-apparatus RF operating field on and wait at least 5 ms.

h) Send a WUPB and check there is a valid PICC response.

i) Keep the PICC-test-apparatus RF field on for more than 1 s.

j) Send a sequence of 10 WUPA and check there is no PICC response.

9.3.3.3   Test report

The test report shall confirm the PICC behaviour in steps c), e), h) and j).

Fill the TC_PICC_D_TL row of test plan summary in accordance with the following table:

Table 25 — Result criteria for PICC supported frame size in receiver mode test

Explanation	Test result
Only when all steps of the test procedure succeed	PASS
Any other case	FAIL

9.3.4   TC_PICC_D_RAMP: field ramp-ups and shut-offs

9.3.4.1   Scope / purpose

This test checks that PICC does not shut down or produce incorrect answers regardless of field rise time.

9.3.4.2   Test procedure

For Type A, re-run the scenario ISO/IEC 10363-6, G.3.2 Scenario G.1: Polling replacing step b) and c) with followings steps:

b)   Switch the RF operating field off at 1 A/m/s for a minimum time for resetting a PICC (see ISO/IEC 14443-3:2011, 5.4).

c)   Switch the RF operating field on at 1 A/m/s.

For Type B, re-run the scenario ISO/IEC 10363-6, G.4.2 Scenario G.21: Polling replacing step b) and c) with followings steps:

b)   Switch the RF operating field off at 1 A/m/s for a minimum time for resetting a PICC (see ISO/IEC 14443-3:2011, 5.4).

c)   Switch the RF operating field on at 1 A/m/s.

9.3.4.3   Test report

Fill the TC_PICC_D_RAMP row of test plan summary in accordance with the following table:

Table 26 — Result criteria for PICC concerning field ramp-ups and shut-offs

Explanation	Test result
Only when all steps of the test procedure succeed	PASS
Any other case	FAIL

Annex A
(informative)

Test report templates

This annex defines the table templates for registering the test results.

A.1 PCD – Test results summary

Clause	Title	Test result (PASS, FAIL or N/A)	Comments when FAIL or N/A
TC_PCD_A_MaxPFS	Maximum PCD field strength (ISO/IEC 10373-6:2011, 7.1.1.2)		
TC_PCD_A_ MinPFS	Minimum PCD field strength (ISO/IEC 10373-6:2011, 7.1.1.2)		
TC_PCD_A_TAMW	Type A modulation waveform (ISO/IEC 10373-6:2011 and ISO/IEC 10373-6:2011/Amd.1:2012, 7.1.4.2)		
TC_PCD_A_TBMW	Type B modulation index and waveform (ISO/IEC 10373-6:2011 and ISO/IEC 10373-6:2011/Amd.1:2012, 7.1.4.2)		
TC_PCD_A_TALMR	Type A load modulation reception (ISO/IEC 10373-6:2011 and ISO/IEC 10373-6:2011/Amd.1:2012, 7.1.5.2)		
TC_PCD_A_TBLMR	Type B load modulation reception (ISO/IEC 10373-6:2011 and ISO/IEC 10373-6:2011/Amd.1:2012, 7.1.5.2)		
TC_PCD_A_TAEI	Type A EMD immunity (ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.6.2)		Minimum amplitude curve provided in appendix
TC_PCD_A_TBEI	Type B EMD immunity (ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.6.2)		Minimum amplitude curve provided in appendix
TC_PCD_A_TAER	Type A EMD handling timing constraints (ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.7.2)		Recovery supported at $t_{e,PCD}$: Y/N If no recovery supported at $t_{e,PCD}$, implementation of an EMD recovery algorithm: Y/N and recovery time
TC_PCD_A_TBER	Type B EMD handling timing constraints (ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.7.2)		Recovery supported at $t_{e,PCD}$: Y/N If no recovery supported at $t_{e,PCD}$, implementation of an EMD recovery algorithm: Y/N and recovery time
H.2.1	Frame delay time PICC to PCD		
H.2.2	Request Guard Time		
H.2.3	Handling of bit collision during ATQA		
H.2.4	Handling of anticollision loop		
H.2.5	Handling of RATS and ATS		

Clause	Title	Test result (PASS, FAIL or N/A)	Comments when FAIL or N/A
H.2.6	Handling of PPS response		
H.2.7	Frame size selection mechanism		
H.2.8	Handling of Start-up Frame Guard Time		
H.2.9	Handling of the CID during activation by the PCD		
H.3.1	I/O transmission timing		
H.3.2	Frame size selection mechanism		
H.3.3	Handling of the CID during activation by the PCD		
H.4.1	Handling of the polling loop		
H.4.2	Reaction of the PCD to request for waiting time extension		
H.4.3	Error detection and recovery		
H.4.4	Handling of NAD during chaining		
H.5	Continuous monitoring of packets sent by the PCD		
TC_PCD_D_TADT	PCD Type A detection time		
TC_PCD_D_TBDT	PCD Type B detection time		
TC_PCD_D_AFI	AFI value sent by the PCD		
TC_PCD_D_ATQB	PCD extended ATQB option		
TC_PCD_D_RFU	Recommendations on RFU bits and values reception test		
TC_PCD_D_PRO	Proprietary protocols management by the PCD		

A.2 PCD – Analog test results (detailed)

| Test reference | Test Title | Test Conditions | | | | | Test result | Comments |
		Bit Rate PCD→PICC	Bit Rate PICC→PCD	Reference PICC resonance frequency	Temperature	Reference PICC	Measurement Positions		
TC_PCD_A_MaxFS	Maximum PCD field strength (ISO/IEC 10373-6:2011, 7.1.1.2)	N/A	N/A	19 MHz	Ambient	1	Range A		
						2	Range A		
						3	Range A		
							Range B		
					Minimum	1	Range A		
						2	Range A		
						3	Range A		
							Range B		
					Maximum	1	Range A		
						2	Range A		
						3	Range A		
							Range B		
TC_PCD_A_MinPFS	Minimum PCD field strength (ISO/IEC 10373-6:2011, 7.1.1.2)	N/A	N/A	13,56 MHz	Ambient	1	Range A		
						2	Range A		
						3	Range A		
							Range B		
					Minimum	1	Range A		
						2	Range A		
						3	Range A		
							Range B		
					Maximum	1	Range A		
						2	Range A		
						3	Range A		

Test reference	Test Title	Test Conditions						Test result	Comments
		Bit Rate PCD→PICC	Bit Rate PICC→PCD	Reference PICC resonance frequency	Temperature	Reference PICC	Measurement Positions		
							Range B		
TC_PCD_A_TAMW	Type A modulation waveform (ISO/IEC 10373-6:2011 and ISO/IEC 10373-6:2011/Amd.1:2012, 7.1.4.2)	All supported bit rates PCD→PICC	N/A	16,5 MHz	Ambient	1	Position A1		
						2	Position A1		
						3	Position B1		
						Cal. Coil	Arbitrary pos.		
					Minimum	1	Position A1		
						2	Position A1		
						3	Position B1		
						Cal. Coil	Arbitrary pos.		
					Maxnimum	1	Position A1		
						2	Position A1		
						3	Position B1		
						Cal. Coil	Arbitrary pos.		
TC_PCD_A_TBMW	Type B modulation waveform (ISO/IEC 10373-6:2011 and ISO/IEC 10373-6:2011/Amd.1:2012, 7.1.4.2)	All supported bit rates PCD→PICC	N/A	16,5 MHz	Ambient	1	Position A1		
						2	Position A1		
						3	Position B1		
						Cal. Coil	Arbitrary pos.		
					Minimum	1	Position A1		
						2	Position A1		
						3	Position B1		
						Cal. Coil	Arbitrary pos.		
					Maximum	1	Position A1		
						2	Position A1		
						3	Position B1		
						Cal. Coil	Arbitrary pos.		

Test reference	Test Title	Test Conditions						Test result	Comments
		Bit Rate PCD→PICC	Bit Rate PICC→PCD	Reference PICC resonance frequency	Temperature	Reference PICC	Measurement Positions		
TC_PCD_A_TALMR	Type A load modulation reception (ISO/IEC 10373-6:2011 and ISO/IEC 10373-6:2011/Amd.1:2012, 7.1.5.2)	N/A	All supported bit rates PICC→PCD, except bit rates of *fc*/64 (~212 kbit/s), *fc*/32 (~424 kbit/s) and *fc*/16 (~848 kbit/s).	13,56 MHz	Ambient	1	Position A1		
							Position A2		
							Position A3		
							Position A4		
							Position A5		
						2	Position A1		
							Position A2		
							Position A3		
							Position A4		
							Position A5		
						3	Position A1		
							Position A2		
							Position A3		
							Position A4		
							Position A5		
							Position B1		
							Position B2		
							Position B3		
					Minimum	1	Position A2		
						3	Position B2		
					Maximum	1	Position A2		
						3	Position B2		
				15 MHz	Ambient	1	Position A1		
							Position A2		
							Position A3		

Test reference	Test Title	Test Conditions						Test result	Comments
		Bit Rate PCD→PICC	Bit Rate PICC→PCD	Reference PICC resonance frequency	Temperature	Reference PICC	Measurement Positions		
							Position A4		
							Position A5		
						2	Position A1		
							Position A2		
							Position A3		
							Position A4		
							Position A5		
						3	Position A1		
							Position A2		
							Position A3		
							Position A4		
							Position A5		
							Position B1		
							Position B2		
							Position B3		
					Minimum	1	Position A2		
						3	Position B2		
					Maximum	1	Position A2		
						3	Position B2		
TC_PCD_A_TBLMR	Type B load modulation reception (ISO/IEC 10373-6:2011 and ISO/IEC 10373-6:2011/Amd.1:2012, 7.1.5.2)	N/A	All supported bit rates PICC→PCD, except bit rates of fc/64 (~212 kbit/s), fc/32 (~424 kbit/s)	13,56 MHz	Ambient	1	Position A1		
							Position A2		
							Position A3		
							Position A4		
							Position A5		
						2	Position A1		

Test reference	Test Title	Test Conditions						Test result	Comments
		Bit Rate PCD→PICC	Bit Rate PICC→PCD	Reference PICC resonance frequency	Temperature	Reference PICC	Measurement Positions		
			and fc/16 (~848 kbit/s).				Position A2		
							Position A3		
							Position A4		
							Position A5		
						3	Position A1		
							Position A2		
							Position A3		
							Position A4		
							Position A5		
							Position B1		
							Position B2		
							Position B3		
					Minimum	1	Position A2		
						3	Position B2		
					Maximum	1	Position A2		
						3	Position B2		
				15 MHz	Ambient	1	Position A1		
							Position A2		
							Position A3		
							Position A4		
							Position A5		
						2	Position A1		
							Position A2		
							Position A3		
							Position A4		

Test reference	Test Title	Test Conditions						Test result	Comments
		Bit Rate PCD→PICC	Bit Rate PICC→PCD	Reference PICC resonance frequency	Temperature	Reference PICC	Measurement Positions		
							Position A5		
						3	Position A1		
							Position A2		
							Position A3		
							Position A4		
							Position A5		
							Position B1		
							Position B2		
							Position B3		
					Minimum	1	Position A2		
						3	Position B2		
					Maximum	1	Position A2		
						3	Position B2		
TC_PCD_A_TAEI	Type A EMD immunity (ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.6.2)	N/A	All supported bit rates PICC→PCD	13,56 MHz	Ambient	1	Position A1		
							Position A2		
TC_PCD_A_TBEI	Type B EMD immunity (ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.6.2)	N/A	All supported bit rates PICC→PCD	13,56 MHz	Ambient	1	Position A1		
							Position A2		
TC_PCD_A_TAER	Type A EMD handling timing constraints (ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.7.2)	N/A	fc/128 (~106 kbit/s)	13,56 MHz	Ambient	1	Position A1		

Test reference	Test Title	Test Conditions						Test result	Comments
		Bit Rate PCD→PICC	Bit Rate PICC→PCD	Reference PICC resonance frequency	Temperature	Reference PICC	Measurement Positions		
TC_PCD_A_TBER	Type B EMD handling timing constraints (ISO/IEC 10373-6:2011/Amd.2:2012, 7.1.7.2)	N/A	fc/128 (~106 kbit/s)	13,56 MHz	Ambient	1	Position A1		

A.3 PCD – Protocol and digital test results (detailed)

Test reference	Test Title	Test result	Comments
H.2.1	Frame delay time PICC to PCD		
H.2.2	Request Guard Time		
H.2.3	Handling of bit collision during ATQA		
H.2.4	Handling of anticollision loop		
H.2.5	Handling of RATS and ATS		
H.2.6	Handling of PPS response		
H.2.7	Frame size selection mechanism		
H.2.8	Handling of Start-up Frame Guard Time		
H.2.9	Handling of the CID during activation by the PCD		
H.3.1	I/O transmission timing		
H.3.2	Frame size selection mechanism		
H.3.3	Handling of the CID during activation by the PCD		
H.4.1	Handling of the polling loop		
H.4.2	Reaction of the PCD to request for waiting time extension		
H.4.3	Error detection and recovery		
H.4.4	Handling of NAD during chaining		
H.5	Continuous monitoring of packets sent by the PCD		
TC_PCD_D_TADT	PCD Type A detection time		
TC_PCD_D_TBDT	PCD Type B detection time		
TC_PCD_D_AFI	AFI value sent by the PCD		
TC_PCD_D_ATQB	PCD extended ATQB option		
TC_PCD_D_RFU	Recommendations on RFU bits and values reception test		
TC_PCD_D_PRO	Proprietary protocols management by the PCD		

A.4 PICC – Test results summary

Clause	Title	Test result (PASS, FAIL or N/A)	Comments when FAIL or N/A
TC_PICC_A_OFS	PICC operating field strength		
TC_PICC_A_LMA	PICC transmission		
TC_PICC_A_RCPT	PICC reception		
TC_PICC_A_LDE	PICC Loading effect		
TC_PICC_A_EMD	PICC EMD level and low EMD time		Maximum amplitude curve provided in appendix
G.3.2	Polling		
G.3.3	Testing of the PICC Type A state transitions		
G.3.4	Handling of Type A anticollision		
G.3.5	Handling of PPS request		
G.3.6	Handling of FSD		
G.4.2	Polling		
G.4.3	PICC Reception		
G.4.4	Testing of the PICC Type B state transitions		
G.4.5	Handling of Type B anticollision		
G.4.6	Handling of ATTRIB		
G.4.7	Handling of Maximum Frame Size		
G.5.2	PICC reaction to ISO/IEC 14443-4 Scenarios		
G.5.3	Handling of PICC error detection		
G.5.4	PICC reaction on CID		
G.5.5	PICC reaction on NAD		
G.5.6	PICC reaction on S(PARAMETERS) blocks		
G.1.5.1	RFU values		
TC_PICC_D_ATQB	PICC support of REQB/WUPB allowing extended ATQB		
TC_PICC_D_RFU	Recommendations on RFU bits and values reception test		
TC_PICC_D_TL	PICC type locking		
TC_PICC_D_RAMP	field ramp-ups and shut-offs		

A.5 PICC – Analog test results (detailed)

Test reference	Test Title	Bit rate PICC→PCD	Bit rate PCD→PICC	Temperature	Magnetic Field	Waveform conditions	Test result	Comments
			All supported bit rates PCD→PICC	Ambient	$H = H_{min}$	see 7.2.1.2.2		
					$H = 2,0$ A/m	see 7.2.1.2.2		
					$H = 2,5$ A/m	see 7.2.1.2.2		
					$H = 3,5$ A/m	see 7.2.1.2.2		
					$H = 4,5$ A/m	see 7.2.1.2.2		
TC_PICC_A_OFS	PICC operating field strength	NA			$H = 6,0$ A/m	see 7.2.1.2.2		
					$H = H_{max}$	see 7.2.1.2.2		
				Minimum	$H = H_{min}$	see 7.2.1.2.2		
					$H = H_{max}$	see 7.2.1.2.2		
				Maximum	$H = H_{min}$	see 7.2.1.2.2		
					$H = H_{max}$	see 7.2.1.2.2		
				Ambient	$H = H_{min}$	see 7.2.1.2.2		
					$H = 2,0$ A/m	see 7.2.1.2.2		
					$H = 2,5$ A/m	see 7.2.1.2.2		
		All supported PICC→PCD bit rates, except bit rates of fc/64 (~212 kbit/s), fc/32 (~424 kbit/s) and fc/16 (~848 kbit/s).	$fc/128$ (~106 kbit/s)		$H = 3,5$ A/m	see 7.2.1.2.2		
					$H = 4,5$ A/m	see 7.2.1.2.2		
TC_PICC_A_LMA	PICC transmission				$H = 6,0$ A/m	see 7.2.1.2.2		
					$H = H_{max}$	see 7.2.1.2.2		
				Minimum	$H = H_{min}$	see 7.2.1.2.2		
					$H = H_{max}$	see 7.2.1.2.2		
				Maximum	$H = H_{min}$	see 7.2.1.2.2		
					$H = H_{max}$	see 7.2.1.2.2		

Test reference	Test Title	Test Conditions					Test result	Comments
		Bit rate PICC→PCD	Bit rate PCD→PICC	Temperature	Magnetic Field	Waveform conditions		
TC_PICC_A_RCPT	PICC reception	fc/128 (~106 kbit/s)	All supported bit rates PCD→PICC	Minimum	H = H_{min}	condition 1		
						condition 2		
						condition 3		
					H = H_{max}	condition 1		
						condition 2		
						condition 3		
		fc/128 (~106 kbit/s)	All supported bit rates PCD→PICC	Ambient	H = H_{min}	condition 1		
						condition 2		
						condition 3		
					H = 2,0 A/m	condition 1		
						condition 2		
						condition 3		
					H = 2,5 A/m	condition 1		
						condition 2		
						condition 3		
					H = 3,5 A/m	condition 1		
						condition 2		
						condition 3		
					H = 4,5 A/m	condition 1		
						condition 2		
						condition 3		
					H = 6,0 A/m	condition 1		
						condition 2		

Bit rate PICC→PCD	Bit rate PCD→PICC	Temperature	Magnetic Field	Waveform conditions	Test result	Comments
				condition 3		
				condition 1		
			$H = H_{max}$	condition 2		
				condition 3		
fc/128 (~106 kbit/s)	All supported bit rates PCD→PICC	Maximum	$H = H_{min}$	condition 1		
				condition 2		
				condition 3		
			$H = H_{max}$	condition 1		
				condition 2		
				condition 3		

Test Conditions								
Test reference	**Test Title**	**Bit rate PICC→PCD**	**Bit rate PCD→PICC**	**Temperature**	**Magnetic Field**	**Waveform conditions**	**Test result**	**Comments**
TC_PICC_A_LDE	PICC Loading effect	N/A	N/A	Ambient	$H = H_{min}$	nominal condition		
TC_PICC_A_EMD	PICC EMD level and low EMD time	fc/128 (~106 kbit/s)	fc/128 (~106 kbit/s)	Ambient	$H = H_{min}$	see 7.2.1.2.2		
					$H = 2,0$ A/m	see 7.2.1.2.2		
					$H = 2,5$ A/m	see 7.2.1.2.2		
					$H = 3,5$ A/m	see 7.2.1.2.2		
					$H = 4,5$ A/m	see 7.2.1.2.2		
					$H = 6,0$ A/m	see 7.2.1.2.2		
					$H = H_{max}$	see 7.2.1.2.2		
				Minimum	$H = H_{min}$	see 7.2.1.2.2		
					$H = H_{max}$	see 7.2.1.2.2		
				Maximum	$H = H_{min}$	see 7.2.1.2.2		
					$H = H_{max}$	see 7.2.1.2.2		

A.6 PICC – Protocol and digital test results (detailed)

Test reference	Test Title	Test result	Comments
G.3.2	Polling		
G.3.3	Testing of the PICC Type A state transitions		
G.3.4	Handling of Type A anticollision		
G.3.5	Handling of PPS request		
G.3.6	Handling of FSD		
G.4.2	Polling		
G.4.3	PICC Reception		
G.4.4	Testing of the PICC Type B state transitions		
G.4.5	Handling of Type B anticollision		
G.4.6	Handling of ATTRIB		
G.4.7	Handling of Maximum Frame Size		
G.5.2	PICC reaction to ISO/IEC 14443-4 Scenarios		
G.5.3	Handling of PICC error detection		
G.5.4	PICC reaction on CID		
G.5.5	PICC reaction on NAD		
G.5.6	PICC reaction on S(PARAMETERS) blocks		
G.1.5.1	RFU values		
TC_PICC_D_ATQB	PICC support of REQB/WUPB allowing extended ATQB		
TC_PICC_D_RFU	Recommendations on RFU bits and values reception test		
TC_PICC_D_TL	PICC type locking		
TC_PICC_D_RAMP	Field ramp-ups and shut-offs		

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