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AMENDMENT 2
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Identification cards — Test methods —

Part 6: Proximity cards

AMENDMENT 2: Improved RF test methods

Cartes d'identification — Méthodes d'essai —

Partie 6: Cartes de proximité

AMENDEMENT 2: Méthodes d'essai RF améliorées

Reference number
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Amendment 2 to ISO/IEC 10373-6:2001 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and personal identification*.

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Identification cards — Test methods —

Part 6:
Proximity cards

AMENDMENT 2: Improved RF test methods

Page 2, 3.2

Add the following abbreviations and symbols:

fcm Frequency of the operating field during the PICC load modulation test

H Field strength of the PCD antenna field

m Modulation index as defined in 3.3 of ISO/IEC 14443-2

t1, t2 Pulse segments as defined in Figure 2 of ISO/IEC 14443-2

tr, tf Rise and fall times as defined in Figure 4 of ISO/IEC 14443-2

Page 5, 6.1.3

Replace the 2nd note with the following:

"NOTE At 13,56 MHz the approximate inductance is 250 nH and the approximate resistance is 0,4 Ω."

Page 6, 6.1.3

Add a note after the last note:

“NOTE The high impedance oscilloscope probe ground connection should be as short as possible, less than 20 mm or coaxial connection.”

Page 6, 6.2

In the 4th sentence, replace the value “50 Ω” for P1 with the value “10 Ω”.

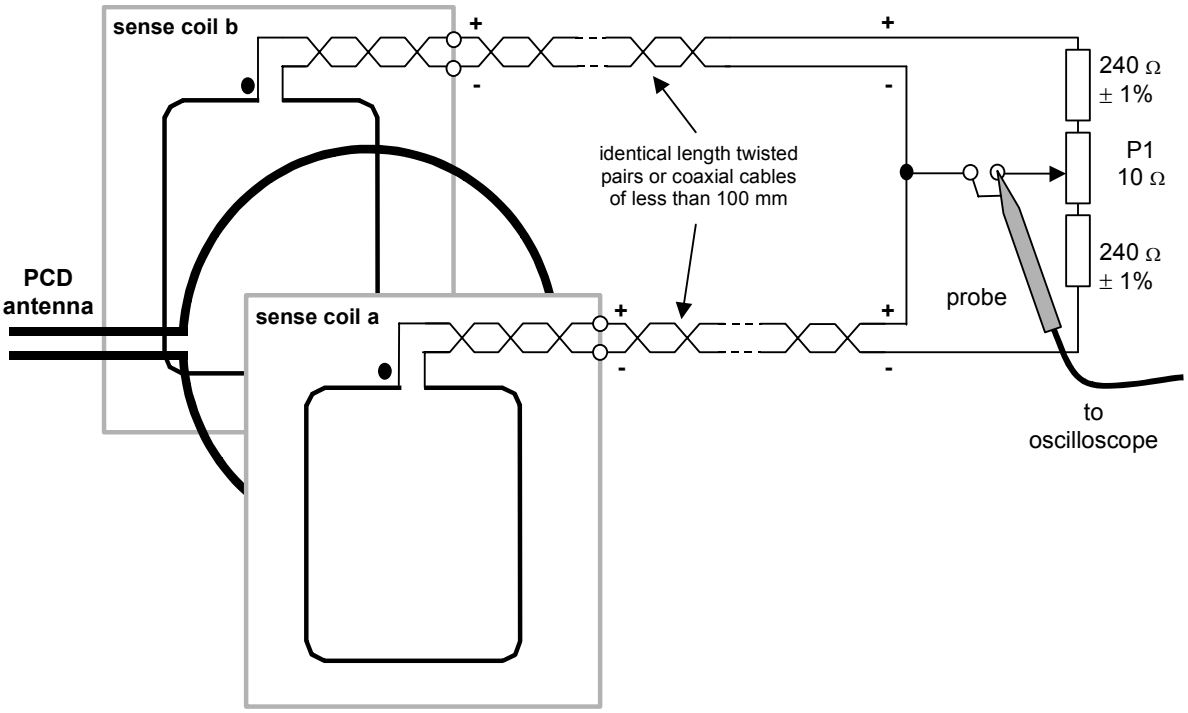
Page 6, Figure 4

Replace the figure with the following:

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NOTE 1 In order to avoid any unintended misalignment in case of an unsymmetrical set-up the tuning range of the potentiometer P1 is only 10 Ω. If the set-up cannot be compensated by the 10 Ω potentiometer P1 the overall symmetry of the set-up should be checked.

NOTE 2 The high impedance oscilloscope probe ground connection should be as short as possible, less than 20 mm or coaxial connection.

Figure 4 — Test set-up (principle)

Page 7, 6.2.3

Add the following sentence after the first sentence:

"The dimensional tolerance shall be better than ± 0,5 mm."

Pages 8 and 9, Clause 7

Replace 7.1, 7.2 and 7.3 with the following:

7.1 PICC load modulation amplitude

7.1.1 Purpose

The purpose of this test is to determine the amplitude of the PICC load modulation signal within the operating field range [H_{min}, H_{max}] as specified in the base standard. Also the functionality of the PICC for Type A and Type B within their corresponding modulation ranges as defined in the base standard shall be determined.

7.1.2 Test procedure

Step 1: The load modulation test circuit of Figure 4 and the Test PCD assembly of Figure 5 are used.

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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. Connect the output of the load modulation test circuit of Figure 4 to a digital sampling oscilloscope. The 10 Ω potentiometer P1 shall be trimmed to minimise the residual carrier. This signal shall be at least 40 dB lower than the signal obtained by shorting one sense coil.

Step 2: The PICC under test shall be placed in the DUT position, concentric with sense coil a. The RF drive into the test PCD antenna shall be re-adjusted to the required field strength.

Display a segment of at least two cycles of the waveform of the subcarrier load modulation on the digital sampling oscilloscope and store the sampled data in a file for analysis by a computer software programme (see Annex F).

NOTE 1 Care should be taken to apply a proper synchronization method for low amplitude load modulation.

Fourier transform exactly two subcarrier cycles of the sampled modulation waveform using suitable computer software. Use a discrete Fourier transformation with a scaling such that a pure sinusoidal signal results in its peak magnitude. In order to minimize transient effects, avoid to analyse a subcarrier cycle immediately following a non-modulating period or a phase shift of the subcarrier.

The resulting peak amplitudes of the upper and lower sidebands at $f_c + f_s$ and $f_c - f_s$ shall be above the value defined in the base standard.

A REQA or a REQB command sequence as defined in ISO/IEC 14443-3 shall be sent by the Test PCD to obtain a signal or load modulation response from the PICC.

The frequency *fcm* of the carrier delivered by the signal generator to the test PCD antenna shall be such that two subcarrier cycles correspond exactly to an integer number of samples. The frequency which fulfils this requirement (with common oscilloscope sampling rates) and which is the closest to the nominal carrier frequency *fc* defined in ISO/IEC 14443-2 is *fcm* = 13,559322 MHz.

The discrete Fourier transformation shall be done at the exact sidebands frequencies generated by the PICC under test, i.e. *fcm* $(1 - f_s/f_c)$ and *fcm* $(1 + f_s/f_c)$. If the programme given in Annex F is used it shall be modified to replace 13,56 MHz by the exact value of *fcm* during the test.

NOTE 2 In order to limit the worst case measurement error to approximately 5 % due to inexact frequencies the following tolerances apply:

— *fcm* = 13,559322 MHz, with a relative tolerance of $\pm 50 \times 10^{-6}$

— *fcm* measurement relative error + oscilloscope sampling rate relative error: $\pm 10 \times 10^{-6}$

(The oscilloscope sampling rate error may be compensated if the *fcm* measurement is done by the digital sampling oscilloscope. A better than $\pm 10 \times 10^{-6}$ relative uncertainty may be achieved by sampling more than 500 periods of unmodulated carrier and using interpolation to know precisely the time of the first and of the last rising edge of the carrier.)

NOTE 3 In order to limit the measurement error due to noise (quantization noise, PICC noise…) the following techniques may be used:

— increasing the oscilloscope sampling rate;

— increasing the number of subcarrier cycles used in the Fourier transformation.

NOTE 4 For type B PICC load modulation test, the oscilloscope FFT option may also be used on a large number of subcarrier cycles with neither transient effect nor phase shift (i.e. on a stable part of synchronization time TR1 as defined in ISO/IEC 14443-2:2001, 9.2.5, or on a stable part of SOF as defined in ISO/IEC 14443-3:2001, 7.1.4).

7.1.3 Test report

The test report shall give the measured peak amplitudes of the upper and lower sidebands at $f_c + f_s$ and $f_c - f_s$ and the applied fields and modulations.

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7.2 PICC reception

7.2.1 Purpose

The purpose of this test is to verify the ability of the PICC to receive the PCD message under the specified conditions given in Tables 1 and 2.

7.2.2 Conditions for type A

Table 1 defines the additional test conditions to be applied for type A.

Table 1 — Additional test conditions for type A

Condition	*H* A/m	t1 µs	t2 µs
1	1,5	3	0,5
2	1,5	2	0,7
3	4,5	3	0,5
4	4,5	2	0,7
5	7,5	3	0,5
6	7,5	2	0,7

7.2.2.1 Test procedure

Under the conditions defined in Table 1 the PICC shall answer to a REQA with ATQA.

7.2.2.2 Test report

The test report shall confirm the intended operation under the conditions defined in Table 1.

7.2.3 Conditions for type B

Table 2 defines the additional test conditions to be applied for type B.

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Table 2 — Additional test conditions for type B

Condition	*H* A/m	m %	tr µs	tf µs
1	1,5	8	1	1
2	1,5	8	2	2
3	1,5	14	1	1
4	1,5	14	2	2
5	4,5	8	1	1
6	4,5	8	2	2
7	4,5	14	1	1
8	4,5	14	2	2
9	7,5	8	1	1
10	7,5	8	2	2
11	7,5	14	1	1
12	7,5	14	2	2

7.2.3.1 Test procedure

Under the conditions defined in Table 2 the PICC shall answer to a REQB with ATQB.

7.2.3.2 Test report

The test report shall confirm the intended operation under the conditions defined in Table 2.

7.3 PICC resonance frequency (informative)

7.3.1 Purpose

The test may be used to measure the resonance frequency of a PICC.

When two or more PICCs are placed in the same PCD energizing field, the resonance frequency of each PICC decreases.

Care should be taken in designing each PICC resonance frequency.

7.3.2 Procedure

The resonance frequency of a PICC is measured by using an impedance analyser or a LCR-meter connected to a calibration coil. The coil of the PICC should be placed on the calibration coil as close as possible, with the axes of the two coils being congruent. The resonance frequency is that frequency at which the resistive part of the measured complex impedance is at maximum.

7.3.3 Test report

The test report shall give the PICC resonance frequency and the measurement conditions.

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Page 9, 8.1.2

Replace the step 2 of procedure for H_{max} test with the following:

"2. Tune the Reference PICC (Annex D) to 19 MHz:

a) Set jumper J1 to position a.

b) Drive the calibration coil directly from a signal generator set at 19 MHz.

c) Locate the calibration coil and the Reference PICC as close as possible with the axes of the two coils being congruent.

d) Adjust the Reference PICC capacitor C2 to maximum dc voltage at R1.

e) Assure final reading of about 3 V (dc) at R1 of the Reference PICC by adjusting the generator drive level.

f) Re-adjust the Reference PICC capacitor C2 to maximum dc voltage at R1, if necessary."

Page 10, 8.1.2

Replace the step 2 of procedure for H_{min} test with the following:

"2. Tune the Reference PICC (Annex D) to 13,56 MHz:

a) Set jumper J1 to position a.

b) Drive the calibration coil directly from a signal generator set at 13,56 MHz.

c) Locate the calibration coil and the Reference PICC as close as possible with the axes of the two coils being congruent.

d) Adjust the Reference PICC capacitor C2 to maximum dc voltage at R1.

e) Assure final reading of about 3 V (dc) at R1 of the Reference PICC by adjusting the generator drive level.

f) Re-adjust the Reference PICC capacitor C2 to maximum dc voltage at R1, if necessary."

Page 10, 8.2.2

Replace the paragraph with the following:

"1. Tune the Reference PICC (Annex D) to 19 MHz:

a) Set jumper J1 to position a.

b) Drive the calibration coil directly from a signal generator set at 19 MHz.

c) Locate the calibration coil and the Reference PICC as close as possible with the axes of the two coils being congruent.

d) Adjust the Reference PICC capacitor C2 to maximum dc voltage at R1.

e) Assure final reading of about 3 V (dc) at R1 of the Reference PICC by adjusting the generator drive level.

f) Re-adjust the Reference PICC capacitor C2 to maximum dc voltage at R1, if necessary."

2. Position the Reference PICC within the defined operating volume of the PCD under test. The voltage V_{DC} measured with a high impedance voltmeter across R1 shall exceed 3 V (dc)."

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Page 10, 8.3.2

Replace “at all positions” with “at an arbitrary position”.

Add a note after the paragraph:

“NOTE The selected position of the calibration coil within the operating volume is not expected to affect the results.”

Page 11, 8.4.2

Replace the paragraph with the following:

“Annex E describes a Reference PICC and calibration procedure which allows the sensitivity of a PCD to load modulation to be assessed. This Reference PICC does not emulate the shunt action of all types of PICC, therefore it shall be calibrated at a given field strength *H* in the Test PCD assembly. It shall be used in the PCD field at a position where the field has the same value of *H*. The measurement of C3 (dc) voltage shall be exactly the same for both Reference PICC calibration and PCD load modulation test.”

Page 12, Figure A.1

Add the following note:

“NOTE The layout of the impedance matching network is informative.”

Page 14, A.2

Replace the Note 1 with the following:

“The test PCD assembly as defined in 6.2 and in this Annex is intended to be used for time limited measurements, to avoid any overheating of the individual components. If the test is run continuously, heat dissipation shall be improved. Care shall be taken to keep maximum voltages and maximum heat dissipation within the specified limits of the individual components:

— C1, C2, C3 and C4 shall have a voltage rating of at least 200 V;

— Rext shall be able to sustain approximately 4 W at 7,5 A/m;

— Rext shall be able to sustain approximately 10 W at 12 A/m (if the test PCD assembly is used for testing the maximum alternating magnetic field as required in ISO/IEC 14443-1:2000, 4.3.5).

NOTE 1 If a heat sink is used Rext should be placed on the ground side of the antenna coil.”

Page 19, Figure D.1

Add the following note:

“NOTE In order to limit the reverse voltage across bridge rectifier at high field when the jumper is removed or if the value of R1 or of R2 is not low enough to load the voltage at C3 sufficiently, a Zener diode (Value 15 V) should be added in parallel to C3.”

Change R2 tuning range to 0 - 1 k Ω.

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