
Identification cards — Test methods —

Part 6:
Proximity cards

AMENDMENT 7: Test methods for
ePassport

Cartes d'identification — Méthodes d'essai —

Partie 6: Cartes de proximité

AMENDEMENT 7: Méthodes d'essai pour passeport électronique



Reference number
ISO/IEC 10373-6:2001/Amd.7:2010(E)

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Published in Switzerland

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Amendment 7 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*.

Identification cards — Test methods —

Part 6: Proximity cards

AMENDMENT 7: Test methods for ePassport

Page 2, 3.1

Add the following definitions and reorder alphabetically:

3.1.12
sample

one piece of the total number of PICCs required and presented for testing

3.1.13
room temperature
RT

convenient temperature within the range of $23\text{ °C} \pm 3\text{ °C}$ ($73\text{ °F} \pm 5\text{ °F}$)

3.1.14
threshold field strength

minimum field strength to operate the PICC as intended (operational mode)

3.1.15
AA

active authentication as defined in ISO/IEC 7501-1

Page 3, 3.2

Add the following abbreviations and symbols in alphabetical order:

BAC	Basic Access Control
EAC	Extended Access Control
LDS	Logical Data Structure

After Annex K

Add the following new annexes:

Annex L (informative)

ePassport PICC test methods

L.1 Scope

This annex defines a test plan for the PICC contactless part of the ePassport oriented PICC. These tests are divided into tests of the physical and electrical parameters according to ISO/IEC 14443-1:2000 and ISO/IEC 14443-2:2001, and tests of the initialization & anticollision and the transport protocol according to ISO/IEC 14443-3:2001 and ISO/IEC 14443-4:2008.

In order for the PICCs to operate correctly, many functional layers of technology should work together. The purpose of this annex is to define in depth the tests to be performed to minimize the probability that an error or fault remain undetected before the design is approved.

For ePassport compliance testing, this annex is normative.

L.2 General test requirements

The following subclauses specify the different test setups, the nominal values used for the tests, and a recommendation for the format of the test report.

Tests for bit rates of $fc/128$ and $fc/32$ are mandatory and shall be applied. Other bit rates, when indicated in the ATS/ATQB shall also be tested.

Depending on the implementation statement of the applicant, Type A or Type B tests shall be performed.

All tests are mandatory unless specified as "optional" or "conditional". Conditional tests shall be performed if they are applicable.

For tests of layers 1 and 2, the minimum number of samples provided for testing is three, unless explicitly defined otherwise. The applicant may request that a larger number of samples are tested. The samples provided by the applicant should be personalized.

L.2.1 Test setup

The test PCD assembly (test apparatus) that is defined in this standard is the basis for the physical and electrical tests. When testing at higher bit rates, the matching network in ISO/IEC 10373-6:2001/Amd.5:2007, A.2.2 "Impedance matching network for bit rates of $fc/64$, $fc/32$ and $fc/16$ ", is used together with the test PCD assembly.

For layer 2 tests (communication stability and operating field strength), the existing test PCD assembly shall be adapted to carry a PICC with the additional ability to center an ID-1 sized antenna of a PICC in the test PCD assembly.

The test PCD in the test setup is intended to be active in duration-limited measurements in order to avoid any overheating of the individual components (e.g. PICC). For all functional tests, the chip's self-heating effect should not exceed 25 °C over ambient temperature.

NOTE Some of the following tests are based on "Class 1" sized antenna as defined herein (see L.3.1 "Class 1" verification test (conditional)"). If the antenna does not comply with the "Class 1" specification, those tests might not generate accurate results.

L.2.2 Equipment

Most of the tests need some additional equipment, such as an arbitrary waveform generator and an RF amplifier. The oscilloscope probes shall have an input capacitance $C < 12 \text{ pF}$.

L.2.3 Nominal values

Unless otherwise specified, the following environmental parameters and nominal values shall be used:

Table L.1 — Nominal values

Parameter	Value	To be applied to
Environment temperature	RT	Type A and Type B
Relative humidity	25 % to 75 % ^a	Type A and Type B
Bit rate	$f_c/128$	Type A and Type B
Modulation	100 %	Type A
Modulation index m	12 %	Type B
t_1	3 μs	Type A
t_2	0,5 μs	Type A
t_3	$\leq 1,5 \mu\text{s}$	Type A
t_4	400 ns	Type A
Overshoot	0 %	Type A and Type B
Rise time t_r , fall time t_f	$\leq 1 \mu\text{s}$	Type B
Start Of Frame timing (SOF)	10,5 etu "0" followed by 2,5 etu "1"	Type B
End Of Frame timing (EOF)	10,5 etu "0"	Type B
Extra Guard Time (EGT)	1 etu	Type B
^a Any convenient relative humidity within the specified range.		

Nominal values define the parameters in accordance with ISO/IEC 14443-2:2001.

L.2.4 Test report

The test report shall include the number of successful evaluations versus the total number of evaluations for each sample and for each test. A description of each test, the information whether the result was a pass or a fail, and the date of the tests shall be included.

For all functionality check tests, the report shall state what tools and methods have been used to verify the functionality of the PICC.

L.2.5 Implementation conformance statement

In order to set up the tests properly, an applicant shall provide the information specified in Table L.2 — Test precondition table "Information on the product" below.

Table L.2 — Test precondition table "Information on the product"

Information for test setup	Applicant declaration
Location of antenna in PICC • which page • which area in the page	
Size of antenna • dimensions • compliance to "Class 1" definition of ISO/IEC 14443-1:2008	
Electrical parameters of antenna • resonance frequency range (if optional test is performed)	
Modulation type • Type A or Type B	
PICC shielded or not and how	
Bit rates supported as claimed by the ATS/ATQB • from PCD to PICC ○ 106 kbit/s ○ 212 kbit/s ○ 424 kbit/s ○ 848 kbit/s • from PICC to PCD ○ 106 kbit/s ○ 212 kbit/s ○ 424 kbit/s ○ 848 kbit/s • Receive/Transmit bit rates identical	
Random or fixed UID (Type A) or random or fixed PUPID (Type B)	
Access control applied • Plaintext • Basic Access Control • Extended Access Control	
Authentication supported • Passive Authentication • Active Authentication	
Commands supporting WTX	

L.2.6 Test sequence

In order to minimize efforts, it is recommended to perform the tests with all samples in the same order as mentioned in this test specification. If the tests for each layer are carried out separately or are carried out with different samples, additional tests will be necessary. For destructive tests such as mechanical and electrical (layer 1) stress tests, it is often required to check if the PICC "operates as intended". ISO standards do not define these tests further, and thus this specification leaves them to the responsibility of the test laboratories. Section L.8 "Functionality check test (informative)" specifies optional tests to verify the PICC's functionality on the electrical and on the application level.

L.3 Layer 1 tests

L.3.1 "Class 1" verification test (conditional)

L.3.1.1 Purpose

The purpose of this test is to check if the physical coil dimensions meet the requirements according to ISO/IEC 14443-1:2008.

This optional test shall be applied if the applicant claims compliance with "Class 1" in Table L.2 — Test precondition table "Information on the product".

A minimum of three samples shall be used.

L.3.1.2 Test procedure

Determine whether the PICC antenna coil is contained in the Inlay Coil Area as described in ISO/IEC 14443-1:2008.

L.3.1.3 Test report

The test report shall state whether the coil geometry of the antenna is in accordance with "Class 1" definition.

L.3.2 Static electricity (ESD) test

L.3.2.1 Purpose

The purpose of this test is to check the behavior of the PICC after an electrostatic discharge (ESD) on the test sample in accordance with this standard. The device under test is exposed to a simulated electrostatic discharge (ESD, human body model). Its basic operation is checked after the exposure.

The test shall be performed according to the procedures defined in ISO/IEC 10373-6:2001/Amd.4:2006, 5.3 "Static Electricity Test".

L.3.2.2 Test procedure

Apply this test on a minimum of three samples.

In case the physical size of the PICC is different than "Figure 2 — Test zones on PICC for ESD test" of 5.3 "Static electricity test", the test procedure shall be applied at the centers of a two-dimensional 1 cm by 1 cm mesh placed over the DUT.

L.3.2.3 Test report

In accordance with L.2.4 "Test report", the test report, passed/tested, shall combine L.8 "Functionality check test (informative)" results of all tested samples.

L.3.3 Alternating magnetic field test

L.3.3.1 Purpose

The purpose of this test is to check the behavior of the PICC in relation to alternating magnetic field exposure in accordance with this standard.

Alternating magnetic field test shall be carried out at 13,56 MHz. No tests are required at other frequencies.

L.3.3.2 Test procedure

The test PCD assembly according to this standard shall be used.

Perform the test according to the test procedure defined in 5.1.2 "Alternating magnetic field; 12,0 A/m test".

Apply the procedure of 5.1 "Alternating magnetic field test" on a minimum of three samples.

The test shall be conducted with a field alternating between 0,0 A/m (rms), 10,0 A/m (rms) and 12,0 A/m (rms) as required in Clause 5.1.

L.3.3.3 Test report

In accordance with L.2.4 "Test report", the test report, passed/tested, shall combine clause L.8 "Functionality check test (informative)" results of all tested samples.

L.4 Layer 2 tests

Combinations of the following layer 2 and 3 tests are possible, provided that the test coverage is not affected; e.g. combining the frame delay time test with the operating field strength test or the operating field strength test with testing the load modulation amplitude is possible.

L.4.1 Load modulation amplitude test

L.4.1.1 Purpose

The purpose of this test is to determine conformance of the load modulation amplitude of the PICC to ISO/IEC 14443-2:2001 by performing the procedure set in 7.1 "PICC load modulation amplitude" of this standard.

L.4.1.2 Test procedure

For this test, it is recommended to have signal patterns that start with the RF off, and then produce an unmodulated field with nominal 13,56 MHz carrier at the field level required by the test for 5 ms prior to modulating this field with a REQA or a REQB command according to the used type. The nominal 13,56 MHz carrier shall continue without modulation following the command for a recommended one second.

It is recommended to switch off the carrier for sufficient time before continuing at the next field level.

Perform the test according to Figure L.1 — Test procedure for the load modulation amplitude test below.

Perform 7.1 "PICC load modulation amplitude" test on a minimum of three samples at all three temperatures.

At temperatures $-10\text{ }^{\circ}\text{C}$ and RT:

- mandatory: 1,5 A/m (rms), 4,5 A/m (rms), 7,5 A/m (rms)
- optional : 2,5 A/m (rms), 3,5 A/m (rms), 5,5 A/m (rms), 6,5 A/m (rms)

At temperature $50\text{ }^{\circ}\text{C}$:

- mandatory: 1,5 A/m (rms), 4,5 A/m (rms), 6,0 A/m (rms)
- optional : 2,5 A/m (rms), 3,5 A/m (rms), 5,5 A/m (rms)

In case any of the mandatory tests fail to meet ISO/IEC 14443-2:2001, the tests with the optional field strengths should be carried out.

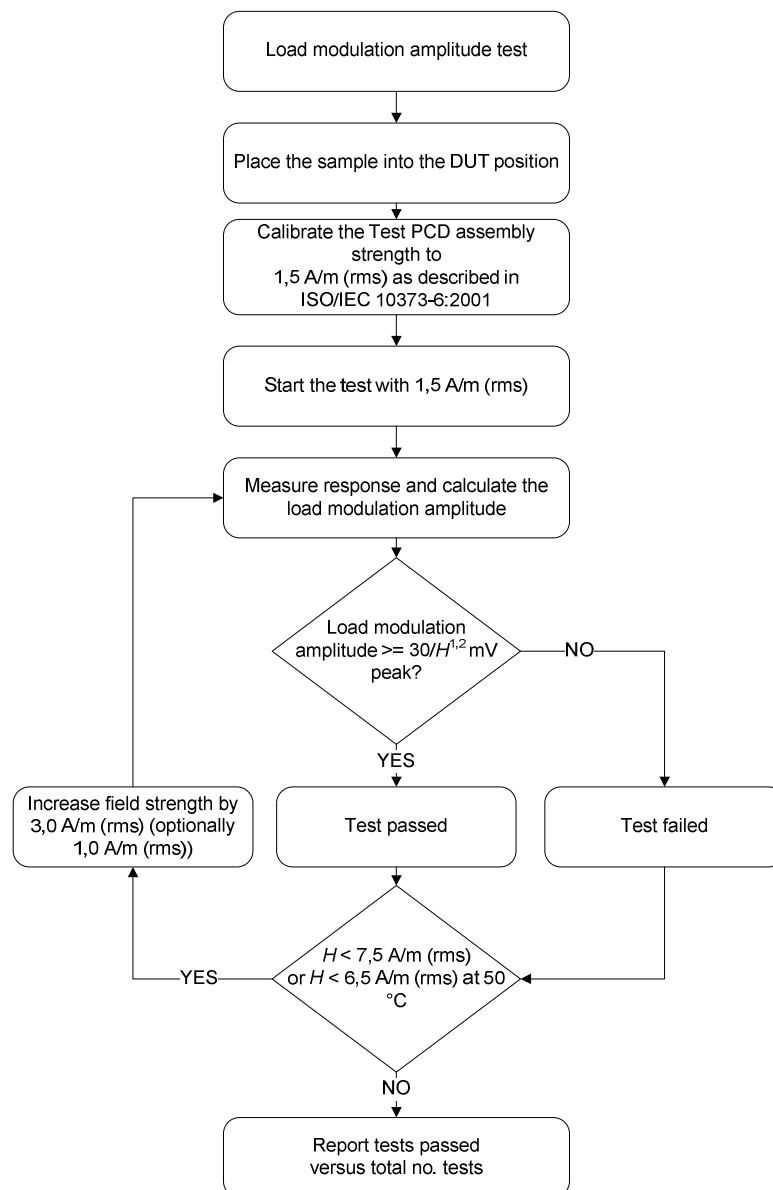


Figure L.1 — Test procedure for the load modulation amplitude test

NOTE 1 When executing the test at $50\text{ }^{\circ}\text{C}$ replace the condition " $H < 7,5$ A/m (rms)" with " $H < 6,0$ A/m (rms)", and the last step should be 6,0 A/m (rms).

NOTE 2 When any test fails, repeat the whole sequence for all temperatures with the optional field strengths if skipped.

L.4.1.3 Test report

The test report shall include the load modulation amplitudes, the number of passed tests versus the total number of tests, a test description and the number of samples and the date.

L.4.2 Operating field strength test

The operating field strength test for Type A and/or Type B may be combined with the following L.4.3 "Communication stability test". Since the operating field strength may be used as an isolated functionality check test, it is specified in a separate clause of this document.

L.4.2.1 Purpose

The purpose of this test is to check if the PICC meets the energy performance requirements according to ISO/IEC 14443-2:2001. The PICC shall operate as intended within $H_{\min}$ and $H_{\max}$, e.g. 1,5 A/m (rms) and 7,5 A/m (rms).

L.4.2.2 Test procedure

For this test, it is recommended to have signal patterns that start with the RF off, and then produce an unmodulated field with nominal 13,56 MHz carrier at the field level required by the test for 5 ms prior to modulating this field with the command sequences below. The nominal 13,56 MHz carrier shall continue without modulation following the final response of each sequence for a recommended one second.

It is recommended to switch off the carrier for sufficient time before continuing at the next field level and / or bit rate.

The following command sequence shall be executed at least five times for each combination of parameters and each sample:

For Type A the following command sequence shall be executed at least five times for each combination of parameters and each sample:

- a) REQA command (see ISO/IEC 14443-3:2001)
- b) ANTICOLLISION command (see ISO/IEC 14443-3:2001)
- c) SELECT command (see ISO/IEC 14443-3:2001)
- d) RATS command (see ISO/IEC 14443-4:2001/Amd.1:2006)
- e) PPS command (see ISO/IEC 14443-4:2001/Amd.1:2006)
- f) TEST_COMMAND_SEQUENCE1 (see clause L.7 "List of test command sequences (informative)")

For Type B the following command sequence shall be executed at least five times for each combination of parameters and each sample:

- a) REQB command (see ISO/IEC 14443-3:2001)
- b) ATTRIB command (see ISO/IEC 14443-3:2001)
- c) TEST_COMMAND_SEQUENCE1 (see clause L.7 "List of test command sequences (informative)")

See clause L.7 "List of test command sequences (informative)" for a list of possible test command sequences depending on the operation mode, e.g. plain text, BAC, AA, EAC.

Perform the test, according to Figure L.2 — Test procedure for the operating field strength test below, on a minimum of three samples at all three temperatures for each combination of parameters from Table L.3 — Specific environment parameters. For PICCs supporting both Type A and Type B repeat the procedure for both types on each sample.

Repeat the test each at temperature and field strength for every supported bit rates of $fc/128$, $fc/64$, $fc/32$, $fc/16$ and at least for both $fc/128$ and $fc/32$.

Table L.3 — Specific environment parameters for operating field strength test

Parameter	Value
Field strength (Mandatory) At temperatures $-10\text{ }^{\circ}\text{C}$ and RT	1,5 A/m (rms), 2,5 A/m (rms), 3,5 A/m (rms), 4,5 A/m (rms), 5,5 A/m (rms), 6,5 A/m (rms), 7,5 A/m (rms)
Field strength (Mandatory) At temperatures $50\text{ }^{\circ}\text{C}$	1,5 A/m (rms), 2,5 A/m (rms), 3,5 A/m (rms), 4,5 A/m (rms), 5,5 A/m (rms), 6,0 A/m (rms)
Bit rate	$fc/128$, $fc/64$, $fc/32$, $fc/16$ ^a
Signal waveform	For Type A: See Table L.4 — Fix Parameter Table for a bit rate of $fc/128$ and Table L.5 — Fix Parameter Table for bit rates of $fc/64$, $fc/32$, $fc/16$ For Type B: See Table L.6 — Fix parameter table for bit rates of $fc/128$ and $fc/64$ and Table L.7 — Fix parameter table for bit rates of $fc/32$ and $fc/16$
Temperature	$-10\text{ }^{\circ}\text{C}$, RT, $50\text{ }^{\circ}\text{C}$
^a As a minimum, all supported PICC bit rates with corresponding PCD bit rates shall be tested.	

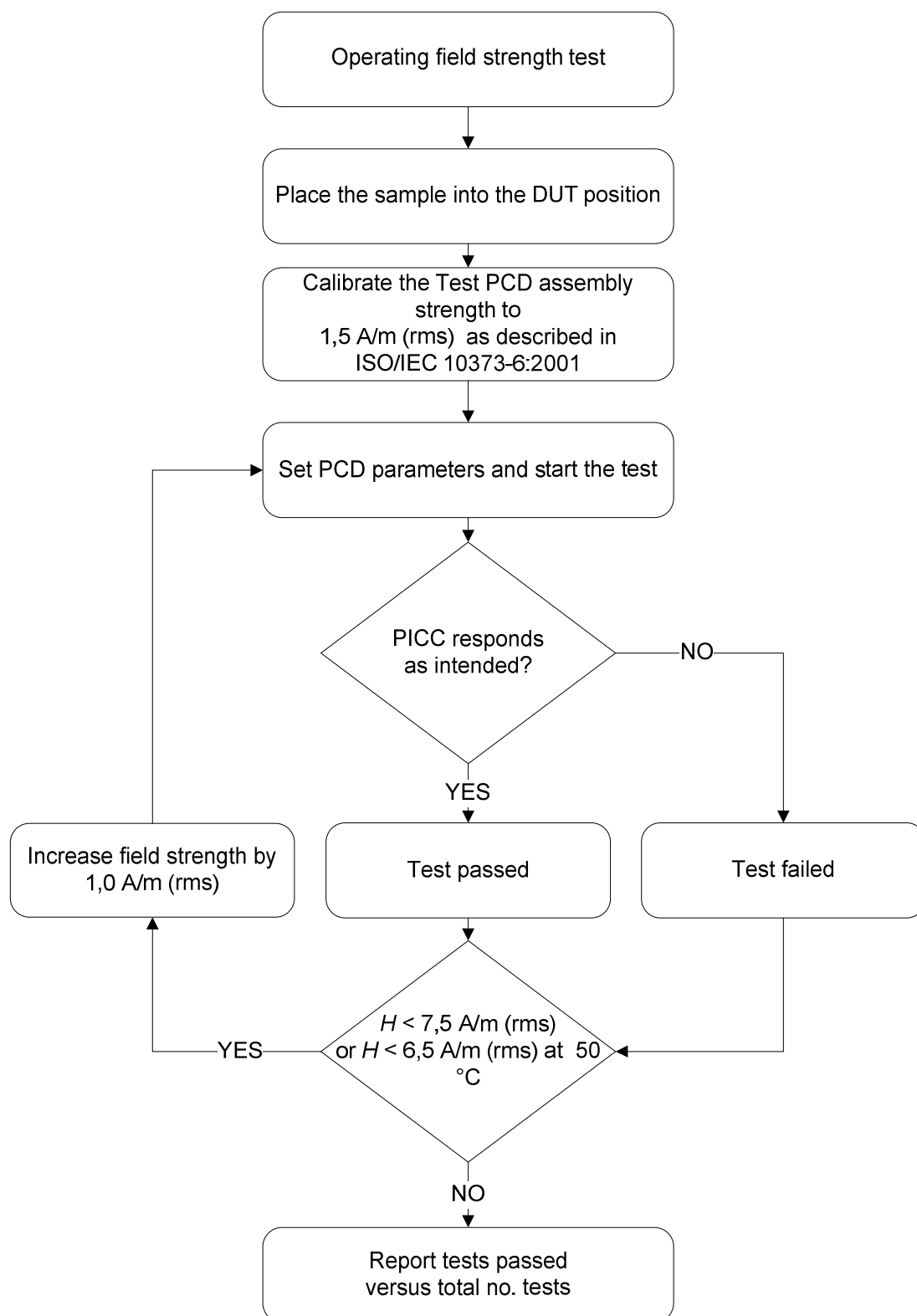


Figure L.2 — Test procedure for the operating field strength test

NOTE 1 When executing the test at 50 °C replace the condition " $H < 7,5 \text{ A/m (rms)}$ " with " $H < 6,0 \text{ A/m (rms)}$ ", and the last step should be 6,0 A/m (rms).

L.4.2.3 Signal waveforms for Type A

Table L.4 — Fix Parameter Table for a bit rate of $fc/128$

Parameter	Value
Modulation	100 %
Bit rate	$fc/128$
t_1	3 μ s
t_2	0,5 μ s
t_3	$\leq 1,5 \mu$ s
t_4	400 ns
Overshoot	0

Table L.5 — Fix Parameter Table for bit rates of $fc/64$, $fc/32$, $fc/16$

Parameter	Values		
Bit rate	$fc/64$	$fc/32$	$fc/16$
a	0,15	0,30	0,55
t_1	$20/fc$	$10/fc$	$5/fc$
t_2	$14/fc$	$6/fc$	$3/fc$
t_3	$6/fc$	$6/fc$	$6/fc$
Overshoot	0	0	0

NOTE 1 For each bit rate, the corresponding table should be taken into account.

NOTE 2 For all bit rates, the sequence of test commands defined above should be executed at the different magnetic field strengths and temperatures.

L.4.2.3.1 Signal waveforms for Type B

Table L.6 — Fix parameter table for bit rates of $fc/128$ and $fc/64$

Parameter	Value
Modulation index m	12 %
t_r , t_f	$\leq 1 \mu$ s
h_r , h_f	0

Table L.7 — Fix parameter table for bit rates of $fc/32$ and $fc/16$

Parameter	Value
Modulation index m	12 %
t_r , t_f	$\leq 0,8 \mu$ s
h_r , h_f	0

L.4.2.4 Test report

The test report shall include the number of passed tests versus the total number of tests, a test description and the number of samples and the date.

L.4.3 Communication stability test

L.4.3.1 Purpose

The purpose of this test is to determine the communication stability of Type A and/or Type B versus field strength and rise and fall times according to ISO/IEC 14443-2:2001, ISO/IEC 14443-2:2001/Amd.1:2005, ISO/IEC 10373-6:2001/Amd.4:2006 and ISO/IEC 10373-6:2001/Amd.5:2007.

L.4.3.2 Test setup

For this procedure, the Test PCD assembly shall be used as a PCD antenna. The calibration of the field strength shall be done in advance. Then, the PICC shall be placed at the DUT position. Afterwards, the field strength shall be readjusted.

The matching network as defined in ISO/IEC 10373-6:2001/AM5:2007 clause A.2.2, shall be used for testing together with the test PCD assembly.

The test PCD assembly (test apparatus) when used with a power amplifier necessary to establish the higher field levels does not have the possibility to test more than a request command. The test apparatus shall be augmented to provide a signal path for the responses to be routed to the controlling apparatus to enable two-way communication. The method used shall be documented in the test report.

Modifications done according:

- Reference ISO/IEC 10373-6:2001/Amd.2:2003
- Reference ISO/IEC 10373-6:2001/Amd.4:2006 - PICC reception - Conditions for Type B
- Reference ISO/IEC 10373-6:2001/Amd.5:2007
- Reference ISO/IEC 14443-2:2001
- Reference ISO/IEC 14443-2:2001/Amd.1:2005

L.4.3.3 Test procedure

For this test, it is recommended to have signal patterns that start with the RF off, and then produce an unmodulated field with nominal 13,56 MHz carrier at the field level required by the test for 5 ms prior to modulating this field with the command sequences below. The nominal 13,56 MHz carrier shall continue without modulation following the final response of each sequence for a recommended one second.

It is recommended to switch off the carrier for at least 5 ms before continuing at the next field level and / or bit rate.

For Type A the following command sequence shall be executed at least five times for each combination of parameters and each sample:

- a) REQA command (see ISO/IEC 14443-3:2001)
- b) ANTICOLLISION command (see ISO/IEC 14443-3:2001)
- c) SELECT command (see ISO/IEC 14443-3:2001)

- d) RATS command (see ISO/IEC 14443-4:2001/Amd.1:2006)
- e) PPS command (see ISO/IEC 14443-4:2001/Amd.1:2006)
- f) TEST_COMMAND_SEQUENCE1 (see clause L.7 "List of test command sequences (informative)")

For Type B the following command sequence shall be executed at least five times for each combination of parameters and each sample:

- a) REQB command (see ISO/IEC 14443-3:2001)
- b) ATTRIB command (see ISO/IEC 14443-3:2001)
- c) TEST_COMMAND_SEQUENCE1 (see clause L.7 "List of test command sequences (informative)")

See for clause L.7 for a list of possible test command sequences depending on the operation mode, e.g. plain text, BAC, AA, EAC.

Perform the test, according to Figure L.3 — Test procedure for the communication stability test below on a minimum of three samples at all three temperatures. For PICCs supporting both Type A and Type B repeat the procedure for both types on each sample.

At temperatures $-10\text{ }^{\circ}\text{C}$ and RT:

— mandatory: 1,5 A/m (rms), 4,5 A/m (rms), 7,5 A/m (rms)

At temperature $50\text{ }^{\circ}\text{C}$:

— mandatory: 1,5 A/m (rms), 4,5 A/m (rms), 6,0 A/m (rms)

Repeat the test at each temperature and field strength for the bit rates of $fc/128$, $fc/64$, $fc/32$, $fc/16$. For each bit rate apply the corresponding signal waveform as defined in the corresponding tables below. All PICC supported bit rates should be tested at least for $fc/128$ and $fc/32$.

Table L.8 — Specific environment parameters for communication stability test

Parameter	Value
Field strength (Mandatory) At temperatures -10 °C and RT	1,5 A/m (rms), 4,5 A/m (rms), 7,5 A/m (rms)
Field strength (Mandatory) At temperatures 50 °C	1,5 A/m (rms), 4,5 A/m (rms), 6,0 A/m (rms)
Bit rate	$fc/128$, $fc/64$, $fc/32$, $fc/16^a$
Signal waveform	For Type A see tables: L.9 — Test conditions for a bit rate of $fc/128$ (Type A), L.10 — Test conditions for a bit rate of $fc/64$ (Type A), L.11 — Test conditions for a bit rate of $fc/32$ (Type A), L.12 — Test conditions for a bit rate of $fc/16$ (Type A) For Type B see tables: L.13 — Test conditions for bit rates of $fc/128$ and $fc/64$ (Type B) L.14 — Test conditions for bit rates of $fc/32$ and $fc/16$ (Type B)
Temperature	-10 °C, RT, 50 °C
^a As a minimum, all supported PICC bit rates with corresponding PCD bit rates shall be tested.	

Table L.9 — Test conditions for a bit rate of $fc/128$ (Type A)

Condition	H A/m (rms)	t_1 μs	t_2 μs	t_3 μs	t_4 μs	modulation %
1	1,5	3	0,5	$\leq 1,5$	0,4	95
2	1,5	3	0,5	0,8	0,4	100
3	4,5	3	0,5	$\leq 1,5$	0,4	95
4	4,5	3	0,5	0,8	0,4	100
5	7,5	3	0,5	$\leq 1,5$	0,4	95
6	7,5	3	0,5	0,8	0,4	100

Table L.10 — Test conditions for a bit rate of $fc/64$ (Type A)

Condition	H A/m (rms)	t_1 μs	t_2 μs	t_3 μs	a
1	1,5	$20/fc$	$14/fc$	$6/fc$	0,2
2	1,5	$20/fc$	$16/fc$	$7/fc$	$\leq 0,05$
3	4,5	$20/fc$	$14/fc$	$6/fc$	0,2
4	4,5	$20/fc$	$16/fc$	$7/fc$	$\leq 0,05$
5	7,5	$20/fc$	$14/fc$	$6/fc$	0,2
6	7,5	$20/fc$	$16/fc$	$7/fc$	$\leq 0,05$

Table L.11 — Test conditions for a bit rate of $fc/32$ (Type A)

Condition	H A/m (rms)	t_1 μs	t_2 μs	t_3 μs	a
1	1,5	$10/fc$	$6/fc$	$6/fc$	0,35
2	1,5	$10/fc$	$7/fc$	$7/fc$	$\leq 0,15$
3	4,5	$10/fc$	$6/fc$	$6/fc$	0,35
4	4,5	$10/fc$	$7/fc$	$7/fc$	$\leq 0,15$
5	7,5	$10/fc$	$6/fc$	$6/fc$	0,35
6	7,5	$10/fc$	$7/fc$	$7/fc$	$\leq 0,15$

Table L.12 — Test conditions for a bit rate of $fc/16$ (Type A)

Condition	H A/m (rms)	t_1 μs	t_2 μs	t_3 μs	a
1	1,5	$5/fc$	$3/fc$	$6/fc$	0,6
2	1,5	$5/fc$	$3/fc$	$7/fc$	$\leq 0,3$
3	4,5	$5/fc$	$3/fc$	$6/fc$	0,6
4	4,5	$5/fc$	$3/fc$	$7/fc$	$\leq 0,3$
5	7,5	$5/fc$	$3/fc$	$6/fc$	0,6
6	7,5	$5/fc$	$3/fc$	$7/fc$	$\leq 0,3$

NOTE 1 For each bit rate, the corresponding table should be taken into account.

NOTE 2 For all bit rates the sequence of test commands defined above should be executed at the different magnetic field strengths, temperatures and waveforms.

Table L.13 — Test conditions for bit rates of $fc/128$ and $fc/64$ (Type B)

Condition	H A/m (rms)	m %	t_r, t_f μs
1	1,5	8	1
2	1,5	14	1
3	4,5	8	1
4	4,5	14	1
5	7,5	8	1
6	7,5	14	1

Table L.14 — Test conditions for bit rates of $fc/32$ and $fc/16$ (Type B)

Condition	H A/m (rms)	m %	t_r, t_f μs
7	1,5	8	0,8
8	1,5	14	0,8
9	4,5	8	0,8
10	4,5	14	0,8
11	7,5	8	0,8
12	7,5	14	0,8

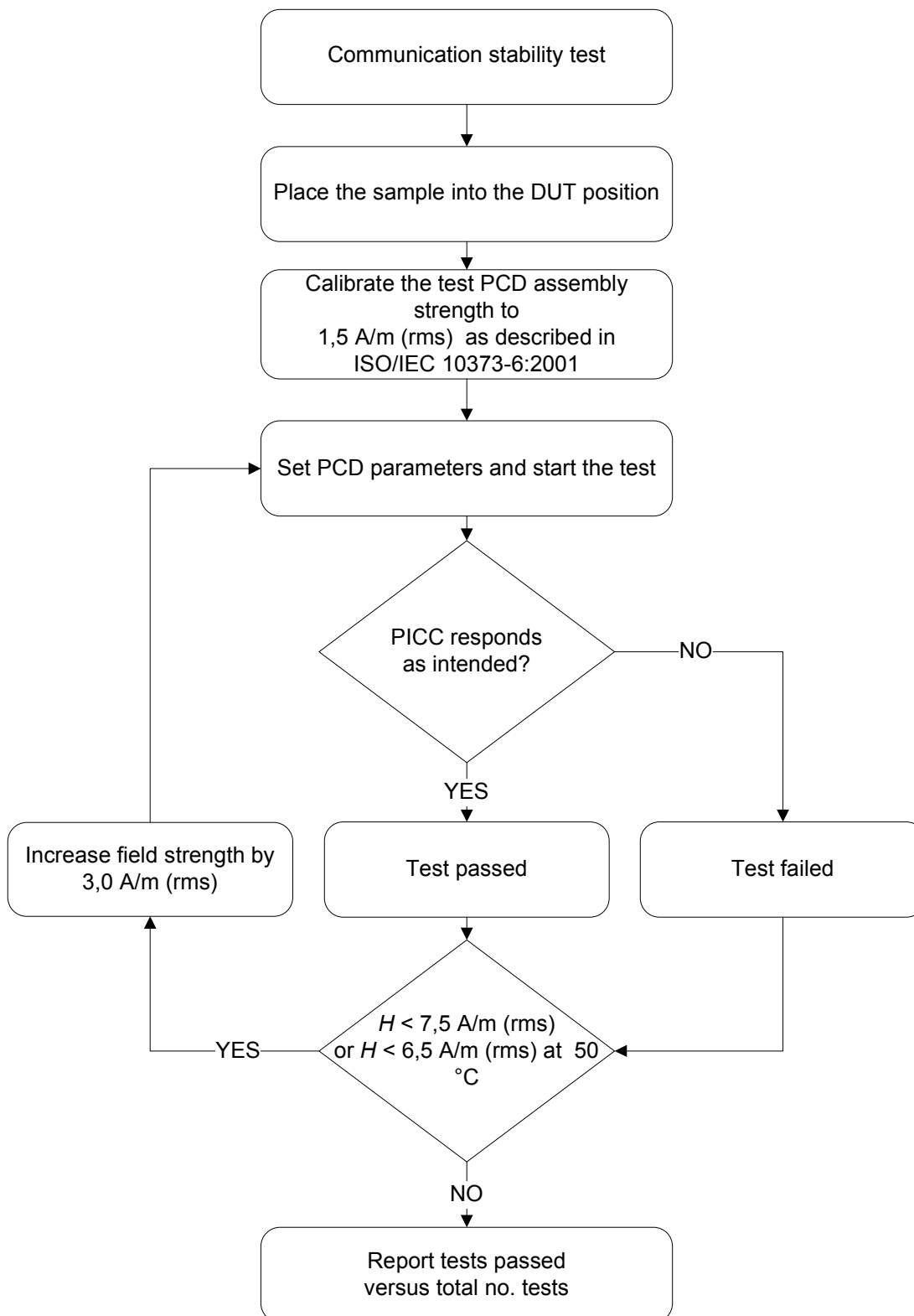


Figure L.3 — Test procedure for the communication stability test

NOTE 1 When executing the test at 50°C replace the condition " $H < 7,5 \text{ A/m (rms)}$ " with " $H < 6,0 \text{ A/m (rms)}$ ", and the last step should be $6,0 \text{ A/m (rms)}$.

L.4.3.4 Test report

The test report shall include the number of passed tests versus the total number of tests, a test description and the number of samples and the date.

L.4.4 Resonance frequency test (optional)

L.4.4.1 Purpose

The purpose of this test is to determine the resonance frequency of the PICC. The resonance frequency shall be within the range that has been specified in the implementation conformance specification.

L.4.4.2 Test setup

An LCR meter may be used: a coil that is connected to the device's output generates the magnetic field. The setup shall be calibrated in advance. The PICC coil shall be positioned in a close distance concentrically above the field-generating coil.

The resonance frequency is defined as the frequency where the real part of the field generating coil impedance reaches its maximum under threshold conditions of the PICC.

L.4.4.3 Test procedure

Apply the procedure of 7.3 "PICC resonance frequency (informative)" on a minimum of three samples at RT.

L.4.4.4 Test report

The test report shall include all individual test reports of 7.3 "PICC resonance frequency (informative)" and shall state whether the resonance frequencies measured are within the specified range of resonance frequencies.

L.5 Layer 3 timing and framing tests

L.5.1 Test setup

The test setup defined below in this subclause shall be used for all tests in this section.

The setup as defined for the electrical tests can be used also for timing and framing tests. However, the test laboratory can select an alternative setup for the timing and framing related tests, as long as the setup meets the specified parameters of the test signal. Independently of the selected test setup, the setup is called "test apparatus" in this subclause.

The test apparatus shall be able to emulate the protocol, to measure and monitor the timing of the logical Input/Receive line relative to the carrier frequency, and to be able to analyze the I/O-bit stream in accordance with the protocol.

All tests shall be performed at one specific field strength between 1,5 A/m (rms) and 7,5 A/m (rms) if not further specified. All tests shall be performed at RT if not further specified.

L.5.2 Start-up time – Polling

L.5.2.1 Type A

L.5.2.1.1 Purpose

The purpose of this test is to check the correct behavior after switching the RF field on and during alternately reception of REQB and REQA (polling).

L.5.2.1.2 Test procedure

Perform test as defined in Annex G.3.2 "Scenario 1: Polling", on at least three samples, at a bit rate of $f_c/128$ and change the time parameters in steps 4, 8 and 9 to 10ms.

The PICC shall respond to a REQA 10 ms after switching on the RF field and it shall respond to a REQA 10 ms after a REQB.

L.5.2.1.3 Test report

The test report shall state whether the PICC meets the start-up timing requirements for all samples.

L.5.2.2 Type B

L.5.2.2.1 Purpose

The purpose of this test is to check the correct behavior after switching the RF field on and during alternate receiving of REQB and REQA (polling).

L.5.2.2.2 Test procedure

Perform test as defined in Annex G.4.2 "Scenario 21: Polling", on at least three samples, at a bit rate of $f_c/128$, but change the time parameter in steps 4, 8 and 9 to 10 ms.

The PICC shall respond to a REQB 10 ms after switching on the RF field and it shall respond to a REQB 10 ms after a REQA.

L.5.2.2.3 Test report

The test report shall state whether the PICC meets the start-up timing requirements for all samples.

L.5.3 Frame delay time (Type A only)

L.5.3.1 Purpose

The purpose of this test is to determine the frame delay time (FDT) of the PICC and to check that the Frame Delay Time of the PICC conforms to the value indicated in the FDT column of Table L.15 —FDT values.

L.5.3.2 Test setup

Modifications done according:

- Reference ISO/IEC 14443-3:2001 Frame delay time PCD to PICC
- Reference ISO/IEC 14443-3:2001/Amd.1:2005

L.5.3.3 Test procedure

Perform test as defined in scenario 2 of Annex G.3.4 "Testing of the PICC type A state transitions" on a minimum of three samples at a bit rate of $f_c/128$. Check the FDT of the PICC response frame.

Depending on the last bit of the command the FDT shall be as follows:

Table L.15 — FDT values

Last Bit	FDT
0	$1172/f_c$
1	$1236/f_c$

L.5.3.4 Test report

The test report shall state whether the PICC meets the start-up timing requirements for all samples.

L.5.4 Start-Of-Frame and End-Of-Frame timing (Type B only)**L.5.4.1 Purpose**

The purpose of this test is to check whether the PICC meets the SOF and EOF timing requirements according to Annex G.

L.5.4.2 Test procedure

— Perform test for each condition as defined in Tables L.16 and L.17 on three samples at a bit rate of $f_c/128$.

Table L.16 — SOF test conditions

Condition	SOF "0" etu	SOF "1" etu
1	10	2
2	11	3

Table L.17 — EOF test conditions

Condition	EOF etu
1	10
2	11

Check the values SOF and EOF of the PICC response frame.

The values of SOF and EOF shall conform to the following:

- SOF logic 0 timing shall be between 10 and 11 etu.
- SOF logic 1 timing shall be between 2 and 3 etu.
- EOF logic 0 timing shall be between 10 and 11 etu.

L.5.4.3 Test report

The test report shall state whether the PICC meets the SOF and EOF timing requirements for all samples.

L.5.5 Extra guard time (Type B only)

L.5.5.1 Purpose

The purpose of this test is to check whether the PICC meets the EGT timing requirements according to ISO/IEC 14443-3:2001.

L.5.5.2 Test procedure

Perform test for each condition as defined in Table L.18 on three samples at a bit rate of $f_c/128$.

Table L.18 — EGT test conditions

Condition	EGT etu
1	1
2	3,4
3	6

Check, that the values of the EGT of the PICC response frame are equal or greater than 0 etu and less or equal than 2 etu.

L.5.5.3 Test reports

The test report shall state whether the PICC meets the requirements concerning EGT timing for all samples.

L.5.6 Timing before PICC SOF (TR0 and TR1) (Type B only)

L.5.6.1 Purpose

The purpose of this test is to check whether the PICC meets the TR0 and TR1 requirements according to ISO/IEC 14443-3:2001.

L.5.6.2 Test procedure

Perform test as defined in Annex G.4.3 "Scenario 22: PICC Reception" on three samples at a bit rate of $f_c/128$. Check the values of TR0 and TR1 before PICC SOF.

TR0 and TR1 shall be between the minimum and maximum values defined in Table L.19 — TR0 and TR1 boundaries.

Table L.19 — TR0 and TR1 boundaries

	Min	Max
TR0	64/fs	256/fs
TR1	80/fs	200/fs

L.5.6.3 Test reports

The test report shall state whether the PICC meets the requirements concerning TR0 and TR1 timing for all samples.

L.5.7 Timing after PICC EOF (subcarrier turn-off time) (Type B only)**L.5.7.1 Purpose**

The purpose of this test is to check whether the PICC meets the subcarrier turn-off time after PICC EOF.

L.5.7.2 Test procedure

Perform test as defined in Annex G.4.3 "Scenario 22: PICC Reception" on three samples at a bit rate of $f_c/128$. Check the subcarrier turn-off time.

The PICC shall turn off the subcarrier between 0 and 2 etu after PICC EOF.

L.5.7.3 Test reports

The test report shall state whether the PICC meets the requirements concerning subcarrier turn-off time after PICC EOF timing for all samples.

L.5.8 Timing after PICC EOF (TR2) (Type B only)**L.5.8.1 Purpose**

The purpose of this test is to check whether the PICC meets the minimum TR2 timing requirement as defined in the protocol byte of the PICC's ATQB, see ISO/IEC 14443-3:2001 [6], its amendment 1 [9] and the corresponding defect report [11].

L.5.8.2 Test procedure

Perform the test as follows on three samples at a bit rate of $f_c/128$:

- Place the PICC into the field.
- Set the frame parameters of the test apparatus according to Table G.31 — Type B specific timing table and Table L.1 — Nominal values.
- Send REQB(0).
- After the ATQB do a delay of minimum TR2 as defined in [11].
- Send ATTRIB(0,0) command.
- Record the presence, contents and timings of the PICC responses.

The PICC's response to the ATTRIB command shall be a valid Answer to ATTRIB.