INTERNATIONAL STANDARD

ISO/IEC 10373-6

First edition
2001-05-15

AMENDMENT 7
2010-03-15

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

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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 °C ± 3 °C (73 °F ± 5 °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 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	*fc*/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	≤ 1,5 µs	Type A
t_4	400 ns	Type A
Overshoot	0 %	Type A and Type B
Rise time t_r, fall time t_f	≤ 1 µs	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 o 106 kbit/s o 212 kbit/s o 424 kbit/s o 848 kbit/s • from PICC to PCD o 106 kbit/s o 212 kbit/s o 424 kbit/s o 848 kbit/s • Receive/Transmit bit rates identical	
Random or fixed UID (Type A) or random or fixed PUPI (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 °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 °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.

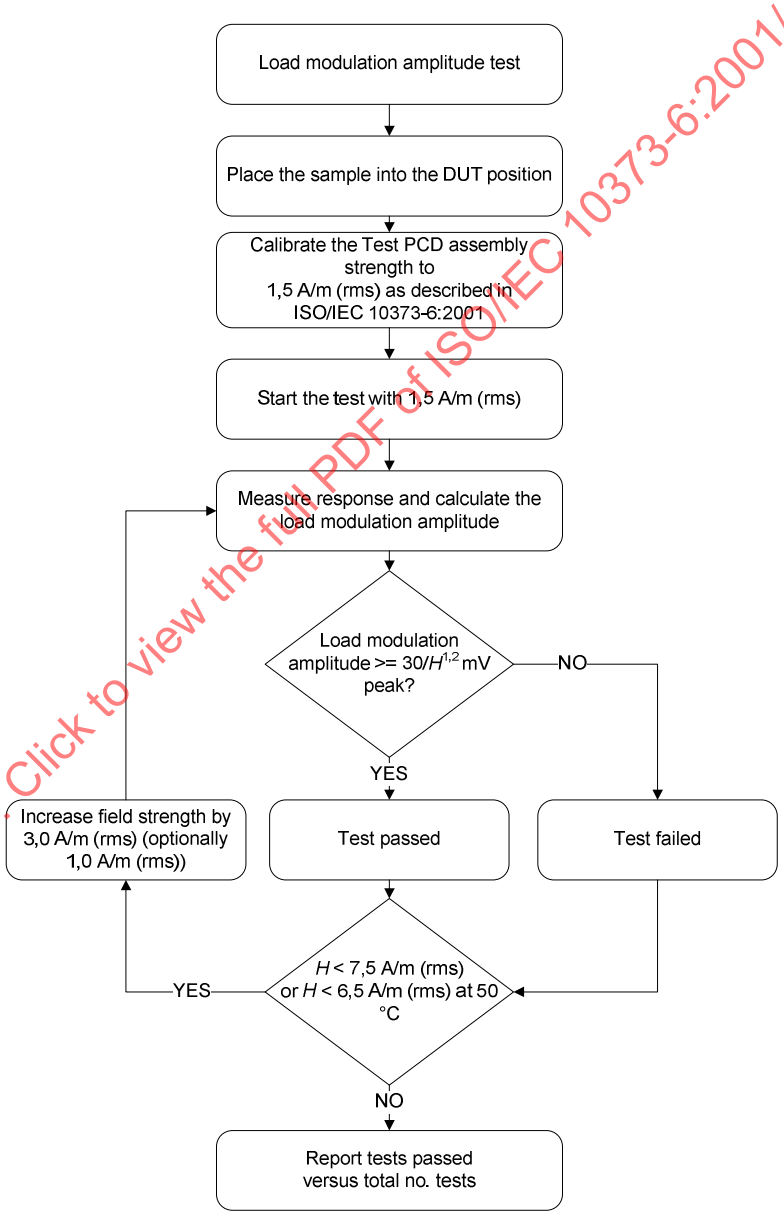

Figure L.1 — Test procedure for the load modulation amplitude test

NOTE 1 When executing the test at 50 °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 °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 °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 °C, RT, 50 °C

[a] As a minimum, all supported PICC bit rates with corresponding PCD bit rates shall be tested.

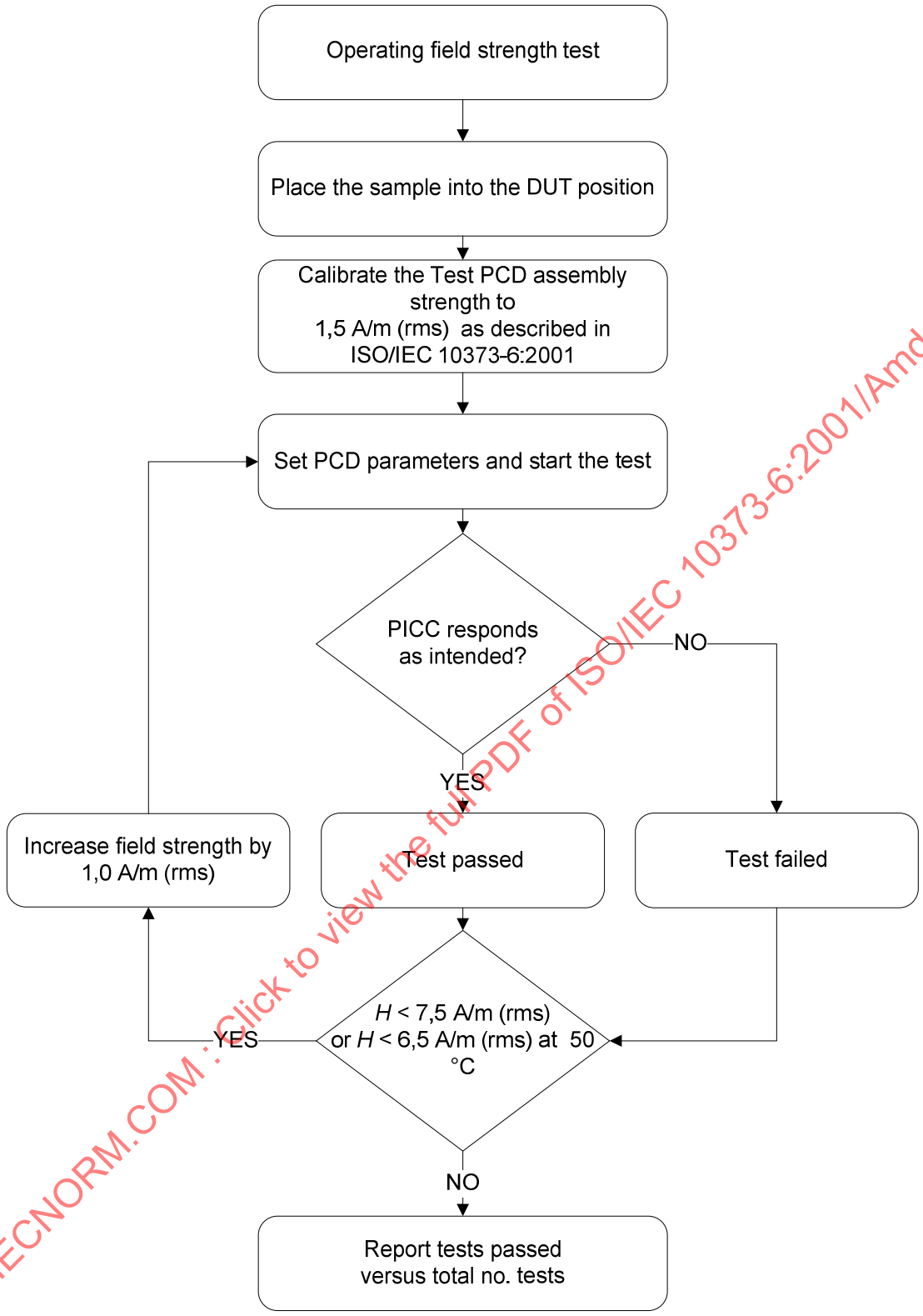

Figure L.2 — Test procedure for the operating field strength test

NOTE 1 When executing the test at 50 °C replace the condition *"H* < 7,5 A/m (rms)*"* with *"H* < 6,0 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 µs
t_2	0,5 µs
t_3	≤ 1,5 µs
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	≤ 1 µs
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	≤ 0,8 µs
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 °C and RT:

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

At temperature 50 °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	≤1,5	0,4	95
2	1,5	3	0,5	0,8	0,4	100
3	4,5	3	0,5	≤1,5	0,4	95
4	4,5	3	0,5	0,8	0,4	100
5	7,5	3	0,5	≤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*	≤ 0,05
3	4,5	20/*fc*	14/*fc*	6/*fc*	0,2
4	4,5	20/*fc*	16/*fc*	7/*fc*	≤ 0,05
5	7,5	20/*fc*	14/*fc*	6/*fc*	0,2
6	7,5	20/*fc*	16/*fc*	7/*fc*	≤ 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*	≤ 0,15
3	4,5	10/*fc*	6/*fc*	6/*fc*	0,35
4	4,5	10/*fc*	7/*fc*	7/*fc*	≤ 0,15
5	7,5	10/*fc*	6/*fc*	6/*fc*	0,35
6	7,5	10/*fc*	7/*fc*	7/*fc*	≤ 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*	≤ 0,3
3	4,5	5/*fc*	3/*fc*	6/*fc*	0,6
4	4,5	5/*fc*	3/*fc*	7/*fc*	≤ 0,3
5	7,5	5/*fc*	3/*fc*	6/*fc*	0,6
6	7,5	5/*fc*	3/*fc*	7/*fc*	≤ 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

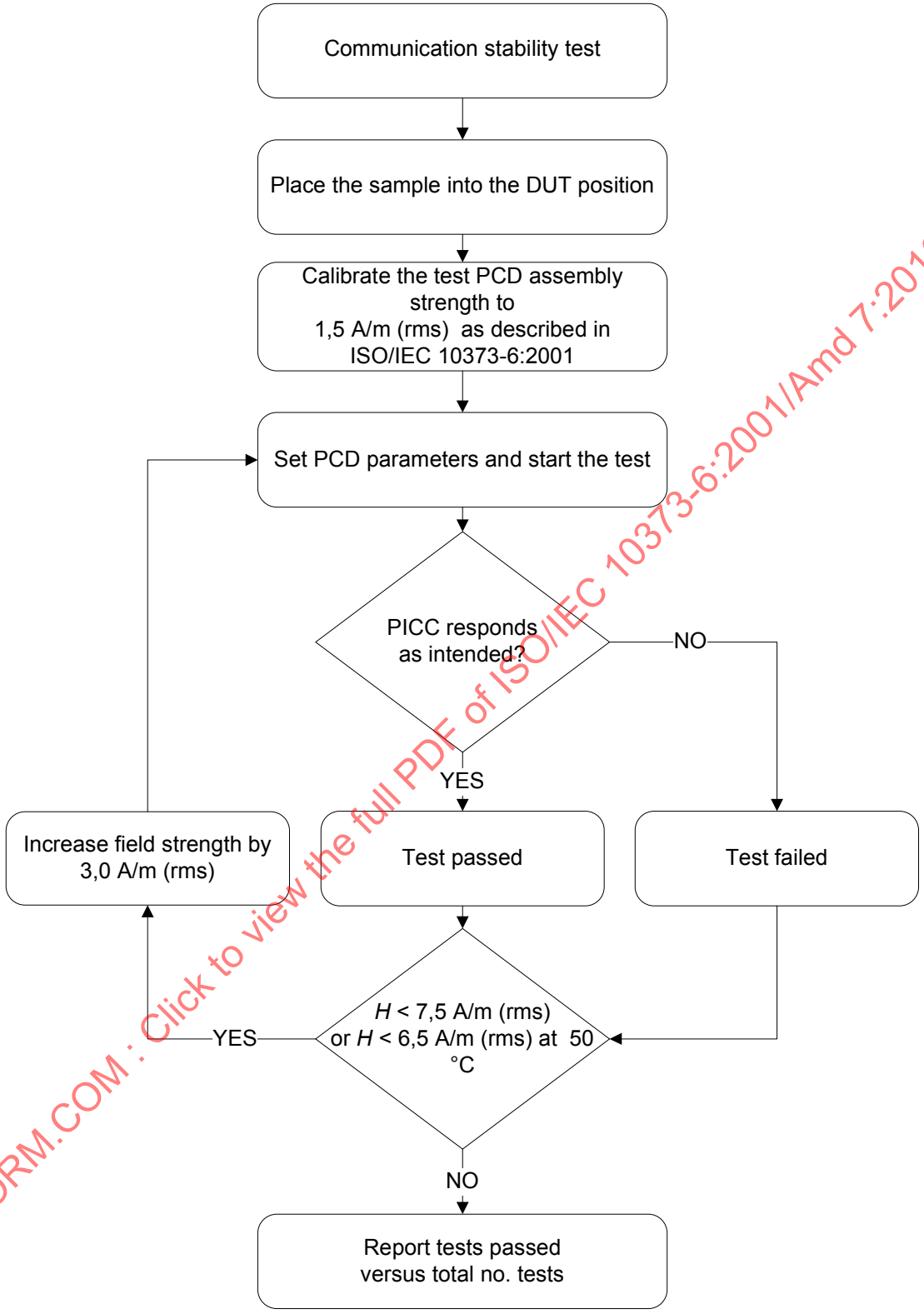

Figure L.3 — Test procedure for the communication stability test

NOTE 1 When executing the test at 50 °C replace the condition *"H* < 7,5 A/m (rms)*"* with *"H* < 6,0 A/m (rms)*"*, and the last step should be 6,0 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 alternatly 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 *fc*/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 *fc*/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 *fc*/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/*fc*
1	1236/*fc*

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 *fc*/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 *fc*/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 *fc*/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 *fc*/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 *fc*/128:

a) Place the PICC into the field.

b) Set the frame parameters of the test apparatus according to Table G.31 — Type B specific timing table and Table L.1 — Nominal values.

c) Send REQB(0).

d) After the ATQB do a delay of minimum TR2 as defined in [11].

e) Send ATTRIB(0,0) command.

f) 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.

L.5.8.3 Test reports

The test report shall state whether the PICC meets the minimum TR2 timing requirement for all samples.

L.6 Layer 3 and 4 protocol tests

These tests provide a basic set of tests to be performed to check the compliance to ISO/IEC 14443 protocol layers 3 and 4 ([6] ISO/IEC 14443-3:2001, ISO/IEC 14443-3:2001/Amd.1:2005 and ISO/IEC 14443-4:2008). All tests are based on and shall be evaluated according to the referenced versions of standards.

L.6.1 Test setup

The setup as defined for the electrical tests can be used also for protocol tests. However, the test laboratory can select an alternative setup for the protocol related tests, as long as the setup meets the specified parameters of the test signal. Independent 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 with 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.

For the test, commands that are typical for an application should be used. Therefore, refer to clause L.7 "List of test command sequences (informative)" for a list of TEST COMMANDS that should be used for testing the PICC.

RFU fields should be constantly monitored during the testing and should always be verified to contain the assigned default value in accordance with Annex G.1.5 "RFU fields".

The tests in this clause should be performed on one sample.

L.6.2 Type A activation

These tests shall ensure that the start-up and the activation of a Type A PICC are in accordance with ISO/IEC 14443-3:2001. These tests are split up to state transitions and the handling of RATS and PPS.

L.6.2.1 State transitions

L.6.2.1.1 Purpose

The purpose of this test is to check the correct behavior during state transitions as defined in ISO/IEC 14443-3:2001. Additionally possible proprietary paths of the "Select sequence flow chart" specified in ISO/IEC 14443-3:2001 shall not negatively affect the test.

L.6.2.1.2 Test procedure

Perform test as defined in Annex G.3.4 "Testing of the PICC type A state transitions". The tests specified in the subclause "Testing of the PICC Type A state transitions" of ISO/IEC 10373-6:2001/Amd.1:2007 shall be used. The detailed test procedure is not specified further herein.

L.6.2.1.3 Test report

The test report shall state whether the PICC responds as indicated in the procedures.

L.6.2.2 Handling of Type A anticollision

L.6.2.2.1 Purpose

The purpose of this test is to check the correct behavior during anticollision as defined in ISO/IEC 10373-6:2001/Amd.1:2007.

L.6.2.2.2 Test procedure

Perform test as defined in Annex G.3.5 "Handling of type A anticollision". The tests specified in the subclause ″Handling of type A anticollision″ of ISO/IEC 10373-6:2001/Amd.1:2007 shall be used. The detailed test procedure is not specified further herein.

L.6.2.2.3 Test report

The test report shall state whether the PICC responds as indicated in the procedures.

L.6.2.3 Handling of RATS

L.6.2.3.1 Purpose

The purpose of this test is to check the correct behavior of RATS as defined in ISO/IEC 14443-4:2008.

L.6.2.3.2 Test procedure

Perform test as defined in ISO/IEC 10373-6:2001/Amd.1:2007, Annex G.3.6 "Handling of RATS". The tests specified in the subclause ″Handling of RATS″ shall be used. The detailed test procedure is not specified further herein.

In addition, it shall be verified if the bit rates as defined in the interface byte TA(1) of the ATS are equal to the bit rates claimed in the implementation conformance statement.

L.6.2.3.3 Test report

The test report shall state whether the PICC responds as indicated in the procedures. It shall state if the ATS correctly encodes the bit rates.

L.6.2.4 Handling of PPS

L.6.2.4.1 Purpose

The purpose of this test is to check the correct behavior of RATS as defined in ISO/IEC 14443-4:2008.

L.6.2.4.2 Test procedure

Perform test as defined in Annex G.3.7 "Handling of PPS request". The tests specified in the subclause ″Handling of PPS request″ shall be used. The detailed test procedure is not specified further herein.

Test Scenario 17: PPS without PPS1 as defined in ISO/IEC 10373-6:2001/Amd.1:2007 shall not be performed.

L.6.2.4.3 Test report

The test report shall state whether the PICC responds as indicated in the procedures.

L.6.2.5 Handling of FSD

L.6.2.5.1 Purpose

The purpose of this test is to check if the PICC correctly handles FSD negotiated by the RATS as defined in ISO/IEC 14443-4:2008.

L.6.2.5.2 Test procedure

Perform test as defined in Annex G.3.8 "Handling of FSD". The tests specified in the subclause "Handling of FSD" shall be used. The detailed test procedure is not specified further herein.

L.6.2.5.3 Test report

The test report shall state whether the PICC responds as indicated in the procedures.

L.6.3 Type B activation

These tests shall ensure that the start-up and the activation of a Type B PICC are in accordance with ISO/IEC 14443-3:2001.

L.6.3.1 State transitions

L.6.3.1.1 Purpose

The purpose of this test is to verify the correct implementation of a Type B PICC's state machine.

L.6.3.1.2 Test procedure

Perform test as defined in Annex G.4.4 "Testing of the PICC Type B State Transition".

L.6.3.1.3 Test report

The test report shall state whether the PICC responds as indicated in the procedures.

L.6.3.2 Handling of Type B anticollision

L.6.3.2.1 Purpose

The purpose of this test is to verify the handling of a PICC Type B anticollision.

L.6.3.2.2 Test procedure

Perform test as defined in Annex G.4.5 "Handling of Type B Anticollision".

L.6.3.2.3 Test report

The test report shall state whether the PICC responds as indicated in the procedures.

L.6.3.3 Handling of ATTRIB

L.6.3.3.1 Purpose

The purpose of this test is to verify the behavior of the PICC Type B on ATTRIB command.

L.6.3.3.2 Test procedure

Perform test as defined in Annex G.4.6 "Handling of ATTRIB". In addition, it shall be verified if the bit rates as defined in the protocol info byte of the ATQB are equal to the bit rates claimed in the implementation conformance statement.

L.6.3.3.3 Test report

The test report shall state whether the PICC responds as indicated in the procedures. It shall state if the ATQB correctly encodes the bit rates.

L.6.3.4 Handling of maximum frame size

L.6.3.4.1 Purpose

The purpose of this test is to check if the PICC correctly handles FSD negotiated by the ATTRIB as defined in ISO/IEC 14443-3:2001.

L.6.3.4.2 Test procedure

Perform test as defined in Annex G.4.7 "Handling of Maximum Frame Size".

L.6.3.4.3 Test report

The test report shall state whether the PICC responds as indicated in the procedures.

L.6.4 Data exchange protocol tests

These tests shall ensure the logical operation is in accordance with ISO/IEC 14443-4:2008. They are valid for both, Type A and Type B, whereas the activation before running these tests is different and listed below.

L.6.4.1 Test procedure

All tests shall be performed with 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.

The activation for Type A shall be:

a) Activation using: REQA, ANTICOLLISION, SELECT commands (as defined in ISO/IEC 14443-3:2001).

b) Activation using: RATS command (as defined in ISO/IEC 14443-4:2008).

c) Check that activation has been correct (response has been correct for all commands).

The activation for Type B shall be:

a) Activation using: REQB command with number of timeslots set to 0 (as defined in ISO/IEC 14443-3:2001).

b) Activation using: ATTRIB command (as defined in ISO/IEC 14443-3:2001).

c) Check that activation has been correct (response has been correct for all commands).

L.6.4.2 Exchange of I-blocks

L.6.4.2.1 Purpose

The purpose of this test is to check the correct behavior of I-blocks as defined in ISO/IEC 14443-4:2008.

L.6.4.2.2 Test procedure

Perform tests as defined in Annex G.5.2 "PICC reaction to ISO/IEC 14443-4 Scenarios". These tests include both correct and erroneous transactions and are described in ISO/IEC 10373-6:2001/Amd.1:2007 and with the scenario caption *"Exchange of I-blocks"*. The general TEST_COMMAND1 as defined by ISO/IEC 10373-6:2001/Amd.1:2007 is specified in L.7 "List of test command sequences (informative)". The detailed test procedure is not specified further herein.

L.6.4.2.3 Test report

The test report shall state whether the response is in accordance with ISO/IEC 14443-4:2008. The report shall include the test commands used.

L.6.4.3 Chaining of I-blocks

L.6.4.3.1 Purpose

The purpose of this test is to check the correct behavior of chained I-blocks as defined in ISO/IEC 14443-4:2008. These tests are divided into two parts, the first one where the PCD (test apparatus) uses chaining and the second one where the PICC uses chaining.

L.6.4.3.2 PCD uses chaining

L.6.4.3.2.1 Purpose

The PCD chaining tests can be performed without knowing dedicated command behavior on the device under test. The purpose of this test is to check the correct behavior of chained I-blocks from PCD side as defined in [7].

L.6.4.3.2.2 Test procedure

Perform tests as defined in Annex G.5.2 "PICC reaction to ISO/IEC 14443-4 Scenarios". These tests include both correct and erroneous transactions (described in [7]) and with *"Scenario 35: PCD uses chaining"*. The general TEST_COMMAND1 is specified in L.7 "List of test command sequences (informative)". The detailed test procedure is not specified further herein.

L.6.4.3.2.3 Test report

The test report shall state whether the response is in accordance with [7]. The report shall include the test commands used.

L.6.4.3.3 PICC uses chaining (optional)

L.6.4.3.3.1 Purpose

The purpose of this test is to check the correct behavior of chained I-blocks from PICC side as defined in ISO/IEC 14443-4:2008.

L.6.4.3.3.2 Test procedure

Perform tests as defined in Annex G.5.2 "PICC reaction to ISO/IEC 14443-4 Scenarios". These tests include both correct and erroneous transactions (described in [7]) and are described in Annex G.5.2 and with ″Scenario 35: PICC uses chaining″. If applicable, the general TEST_COMMAND2 is specified in L.7 "List of test command sequences (informative)". The detailed test procedure is not specified further herein.

L.6.4.3.3.3 Test report

The test report shall state whether the response is in accordance with ISO/IEC 14443-4:2008. The report shall include the test commands used.

L.6.4.4 DESELECT

L.6.4.4.1 Purpose

The purpose of this test is to check the correct behavior of DESELECT command as defined in ISO/IEC 14443-4:2008.

L.6.4.4.2 Test procedure

Perform tests as defined in Annex G.5.2 "PICC reaction to ISO/IEC 14443-4 Scenarios". These tests include both correct and erroneous transactions (described in [7]) and with ″Scenario 34: DESELECT″. The general TEST_COMMAND1 is specified in L.7 "List of test command sequences (informative)". The detailed test procedure is not specified further herein.

L.6.4.4.2.1 Test report

The test report shall state whether the response is in accordance with ISO/IEC 14443-4:2008. The report shall include the test commands used.

L.6.4.5 Request for waiting time extension (conditional)

L.6.4.5.1 Purpose

The purpose of this test is to check the correct behavior of request waiting time extension command as defined in ISO/IEC 14443-4:2008.

If the PICC does not support a command, which by default responds with a waiting time extension, this test cannot be performed. Therefore, it is optional.

L.6.4.5.2 Test procedure

Perform tests as defined in Annex G.5.2 "PICC reaction to ISO/IEC 14443-4 Scenarios". These tests include both correct and erroneous transactions (described in [7]) and with the scenario caption ″Request for waiting time extension″. The general TEST_COMMAND3 is specified in L.7 "List of test command sequences (informative)" which by default responds with the waiting time extension command. The detailed test procedure is not specified further herein.

L.6.4.5.2.1 Test report

The test report shall state whether the response is in accordance with [7]. The report shall include the test commands used.

L.6.4.6 Handling of PICC error detection (optional)

L.6.4.6.1 Purpose

The purpose of this test is to check the correct behavior of the PICC's error detection as defined in [7].

L.6.4.6.2 Test procedure

Perform tests as defined in Annex G.5.3 "Handling of PICC error detection". These tests include both correct and erroneous transactions (described in [7]) and with the scenario caption "Handling of PICC error detection". The general TEST_COMMAND1 and TEST_COMMAND3 are specified in L.7 "List of test command sequences (informative)" which by default responds with the waiting time extension command. The detailed test procedure is not specified further herein.

Scenarios G 53 "Bad block number on I-Block" and G 54 "Bad block number on chained I-Block" should not be performed.

L.6.4.6.3 Test report

The test report shall state whether the response is in accordance with [7]. The report shall include the test commands used.

L.6.4.7 PICC reaction on CID

L.6.4.7.1 Purpose

The purpose of this test is to check the correct reaction of the PICC to CID coding as defined in [7]. This test can be applied to all PICCs even if they do not support CID.

L.6.4.7.2 Test procedure

Perform tests as defined in Annex G.5.4 "PICC reaction on CID". The general TEST_COMMAND1, TEST_COMMAND2 and TEST_COMMAND3 are specified in L.7 "List of test command sequences (informative)". The detailed test procedure is not specified further herein.

L.6.4.7.3 Test report

The test report shall state whether the response is in accordance with [7]. The report shall include the test commands used.

L.7 List of test command sequences (informative)

This section contains sequences of test commands on the application level that are employed in several test cases defined in this technical report, e.g. chaining in the frame protocol layer. Since the ISO/IEC 10373-6/Amd.1:2007 does only define generic test commands, this section provides mandatory test commands that are specific to the PICC's LDS application and its variants.

L.7.1 Test commands for PICC without access control (plain)

L.7.1.1 TEST_COMMAND_SEQUENCE1

TEST_COMMAND_SEQUENCE1 is the sequence of commands, used for tests described in clauses below:

— Operating field strength test, L.4.2 "Operating field strength test".

— Communication stability test, L.4.3 "Communication stability test".

TEST_COMMAND_SEQUENCE1 shall come after:

— PICC activation process described in Annex G.5.1.1 "PICC activation process" (RATS and PPS / ATTRIB are successfully performed).

APDU definition:

Step	Command	C-APDU
1	SELECT	'00 A4 04 0C 07 A0 00 00 02 47 10 01'
2	READ BINARY	'00 B0 82 00 80'

L.7.1.2 TEST_COMMAND1

TEST_COMMAND1 is the basic command, used for tests described in clauses below:

— Exchange of I-blocks, L.6.4.2 "Exchange of I-blocks".

— Chaining of I-blocks, L.6.4.3 "Chaining of I-blocks".

— DESELECT, L.6.4.4 "Exchange of I-blocks".

— Handling of PICC error detection, L.6.4.6 "Handling of PICC error detection (optional)".

— PICC reaction on CID, L.6.4.7 "PICC reaction on CID".

TEST_COMMAND1 shall come after:

— PICC activation process described in Annex G.5.1.1 "PICC activation process" shall be performed (RATS and PPS / ATTRIB are successfully performed).

APDU definition:

Step	Command	C-APDU
1	SELECT	'00 A4 04 0C 0C A0 00 00 02 47 10 01 00 00 00 00 00'[a]
[a] The application will not process this command successfully but it can be used for PCD chaining.		

L.7.1.3 TEST_COMMAND2

TEST_COMMAND2 is the basic command, used for tests described in clauses below:

— Chaining of I-blocks, L.6.4.3 "Chaining of I-blocks".

— Handling of PICC error detection, L.6.4.7 "PICC reaction on CID"..

TEST_COMMAND2 shall come after:

— PICC activation process described in Annex G.5.1.1 "PICC activation process" shall be performed (RATS and PPS / ATTRIB are successfully performed).

— LDS application (AID = 'A0 00 00 02 47 10 01') is successfully selected

APDU definition:

Step	Command	C-APDU
1	READ BINARY	'00 B0 82 00 80'

NOTE The maximum frame size should be set to 128 bytes (FSD=128) when two chained blocks are expected and 64 bytes (FSD=64) when 3 chained blocks are expected.

L.7.1.4 TEST_COMMAND3

TEST_COMMAND3 is the basic command, used for tests described in clauses below:

— Request for waiting time extension (conditional), L.6.4.5 "Request for waiting time extension (conditional)".

— Handling of PICC error detection, L.6.4.6 "Handling of PICC error detection (optional)".

— PICC reaction on CID, L.6.4.7 "PICC reaction on CID".

APDU definition:

— To be defined by applicant.

L.7.2 Test commands for PICC with BAC

L.7.2.1 TEST_COMMAND_SEQUENCE1

TEST_COMMAND_SEQUENCE1 is the sequence of commands, used for tests described in clauses below:

— Operating Field Strength Test, L.4.2 "Exchange of I-blocks".

— Communication Stability Test, L.4.3 "Chaining of I-blocks".

TEST_COMMAND_SEQUENCE1 shall come after:

— PICC activation process described in Annex G.5.1.1 "PICC activation process" shall be performed (RATS and PPS / ATTRIB are successfully performed).

APDU definition:

Step	Command	C-APDU
1	SELECT	'00 A4 04 0C 07 A0 00 00 02 47 10 01'
2	GET CHALLENGE	'00 84 00 00 08'
3	MUTUAL AUTHENTICATE	'00 82 00 00 28 <authentication token> 28'
4	READ BINARY	'0C B0 82 00 0D 97 01 80 8E 08 <mac> 00'

L.7.2.2 TEST_COMMAND1

TEST_COMMAND1 is the basic command, used for tests described in clauses below:

— Exchange of I-blocks, L.6.4.2 "Exchange of I-blocks".

— Chaining of I-blocks, L.6.4.3 "Chaining of I-blocks".

— DESELECT, L.6.4.4 "Exchange of I-blocks".

— Handling of PICC error detection, L.6.4.6 "Handling of PICC error detection (optional)".

— PICC reaction on CID, L.6.4.7 "PICC reaction on CID".

TEST_COMMAND1 shall come after:

— PICC activation process described in Annex G.5.1.1 "PICC activation process" shall be performed (RATS and PPS / ATTRIB are successfully performed).

APDU definition:

Step	Command	C-APDU
1	SELECT	'00 A4 04 0C 0C A0 00 00 02 47 10 01 00 00 00 00 00'[a]
[a] The application will not process this command successfully but it can be used for PCD chaining.		

L.7.2.3 TEST_COMMAND2

TEST_COMMAND2 is the basic command, used for tests described in clauses below:

— Chaining of I-blocks, L.6.4.3 "Chaining of I-blocks".

— Handling of PICC error detection, L.6.4.7 "PICC reaction on CID".

TEST_COMMAND2 shall come after:

— PICC activation process described in Annex G.5.1.1 "PICC activation process" shall be performed (RATS and PPS / ATTRIB are successfully performed).

— LDS application 'A0 00 00 02 47 10 01' is successfully selected.

— Basic access is granted.

APDU definition:

Step	Command	C-APDU
1	READ BINARY	'0C B0 82 00 0D 97 01 80 8E 08 <mac> 00'

NOTE The maximum frame size should be set to 128 bytes (FSD=128) when two chained blocks are expected and 64 bytes (FSD=64) when 3 chained blocks are expected.

L.7.2.4 TEST_COMMAND3

TEST_COMMAND3 is the basic command, used for tests described in clauses below:

— Request for waiting time extension (conditional), L.6.4.5 "Request for waiting time extension (conditional)".

— Handling of PICC error detection, L.6.4.6 "Handling of PICC error detection (optional)".

— PICC reaction on CID, L.6.4.7 "PICC reaction on CID"..

APDU definition:

— To be defined by applicant.

L.7.3 Test commands for PICC with AA

L.7.3.1 TEST_COMMAND_SEQUENCE1

TEST_COMMAND_SEQUENCE1 is the sequence of commands, used for tests described in clauses below:

— Operating Field Strength Test, L.4.2 "Operating field strength test".

— Communication Stability Test, L.4.3 "Communication stability test".

TEST_COMMAND_SEQUENCE1 shall come after:

— PICC activation process described in Annex G.5.1.1 "PICC activation process" shall be performed (RATS and PPS / ATTRIB are successfully performed).

APDU definition:

Step	Command	C-APDU
1	SELECT	'00 A4 04 0C 07 A0 00 00 02 47 10 01'
2	INTERNAL AUTHENTICATE	'00 88 00 00 08 F1 73 58 99 74 BF 40 C6 00'

L.7.3.2 TEST_COMMAND1

See TEST_COMMAND1 in L.7.1.2 "TEST_COMMAND_SEQUENCE1".

L.7.3.3 TEST_COMMAND2

See TEST_COMMAND2 in L.7.1.3 "TEST_COMMAND2".

L.7.3.4 TEST_COMMAND3

See TEST_COMMAND3 in L.7.1.4 "TEST_COMMAND3".

L.7.4 Test commands for PICC with BAC and AA

L.7.4.1 TEST_COMMAND_SEQUENCE1

TEST_COMMAND_SEQUENCE1 is the sequence of commands, used for tests described in clauses below:

— Operating Field Strength Test, L.4.2 "Operating field strength test".

— Communication Stability Test, L.4.3 "Communication stability test".

TEST_COMMAND_SEQUENCE1 shall come after:

— PICC activation process described in Annex G.5.1.1 "PICC activation process" shall be performed (RATS and PPS / ATTRIB are successfully performed).

APDU definition:

Step	Command	C-APDU
1	SELECT	'00 A4 04 0C 07 A0 00 00 02 47 10 01'
2	GET CHALLENGE	'00 84 00 00 08'
3	MUTUAL AUTHENTICATE	'00 82 00 00 28 <authentication token> 28'
4	INTERNAL AUTHENTICATE	'0C 88 00 00 20 87 11 01 <encrypted challenge> 97 01 00 8E 08 <mac> 00'
5	READ BINARY	'0C B0 82 00 0D 97 01 80 8E 08 <mac> 00'

L.7.4.2 TEST_COMMAND1

TEST_COMMAND1 is the basic command, used for tests described in clauses:

— Exchange of I-blocks, L.6.4.2 "Exchange of I-blocks".

— Chaining of I-blocks, L.6.4.3 "Chaining of I-blocks".

— DESELECT, L.6.4.4"Exchange of I-blocks".

— Handling of PICC error detection, L.6.4.6 "Handling of PICC error detection (optional)".

— PICC reaction on CID, L.6.4.7 "PICC reaction on CID".

TEST_COMMAND1 shall come after:

— PICC activation process described in Annex G.5.1.1 "PICC activation process" shall be performed (RATS and PPS / ATTRIB are successfully performed).

APDU definition:

Step	Command	C-APDU
1	SELECT	'00 A4 04 0C 0C A0 00 00 02 47 10 01 00 00 00 00 00'[a]
[a] The application will not process this command successfully but it can be used for PCD chaining.		

L.7.4.3 TEST_COMMAND2

TEST_COMMAND2 is the basic command, used for tests described in clauses below:

— Chaining of I-blocks, L.6.4.3 "Chaining of I-blocks".

— Handling of PICC error detection, L.6.4.7 "PICC reaction on CID".

TEST_COMMAND2 shall come after:

— PICC activation process described in Annex G.5.1.1 "PICC activation process" shall be performed (RATS and PPS / ATTRIB are successfully performed).

— LDS application 'A0 00 00 02 47 10 01' is successfully selected.

— Basic access is granted.

APDU definition:

Step	Command	C-APDU
1	READ BINARY	'0C B0 82 00 0D 97 01 80 8E 08 <mac> 00'

NOTE The maximum frame size should be set to 128 bytes (FSD=128) when two chained blocks are expected and 64 bytes (FSD=64) when 3 chained blocks are expected.

L.7.4.4 TEST_COMMAND3

TEST_COMMAND3 is the basic command, used for tests described in clauses below:

— Request for waiting time extension (conditional), L.6.4.5 "Request for waiting time extension (conditional)".

— Handling of PICC error detection, L.6.4.6 "Handling of PICC error detection (optional)".

— PICC reaction on CID, L.6.4.7 "PICC reaction on CID".

APDU definition:

— To be defined by applicant.

L.8 Functionality check test (informative)

L.8.1 Purpose

For potentially destructive tests such as mechanical and electrical (layer 1) stress tests, it is often required to check if the PICC "operates as intended". These tests are not defined further by the ISO/IEC standards, and thus they are left to the responsibility of the test laboratories.

Since there may be different requirements for performing functionality check tests, this section specifies two optional tests to verify the PICCs functionality on the electrical and on the application level without performing all these, sometimes time-consuming tests specified in this technical report.

On the electrical level, the functionality check tests require specialized equipment and may only be performed by test laboratories that have the necessary skills and equipment, whereas the application functionality check test may be performed with standard equipment.

L.8.1.1 Optional Procedure 1: Application functionality check test

L.8.1.1.1 Purpose

This test is a basic functionality check test.

The purpose of this test is to check if the PICC's mandatory LDS application data as specified in "Technical Report: Development of a Logical Data Structure - LDS for optional capacity expansion technologies, version 1.7" can be retrieved from the PICC. It shall be verified that this information has not been altered by the destructive tests.

L.8.1.1.2 Test setup

The test may be performed with standard PC/SC readers and any software that is able to send commands to the PICC and that can verify the integrity of the data retrieved.

L.8.1.1.3 Test procedure

The test procedure should be performed with all given samples as follows:

a) Put the PICC on the contactless reader of the tests setup.

b) Select the PICC using the initialization and anticollision procedure defined in [6].

c) Select the LDS application as specified in [1].

d) Perform basic access control as specified in [2] if indicated in the implementation conformance statement.

e) Read data of file EF.COM as specified in [1].

f) Read data of file EF.DG1 as specified in [1].

g) Read data of file EF.DG2 as specified in [1].

h) Read the document security object of file EF.SOD as specified in [1].

i) Verify the digital signature contained in the document security object as specified in [2].

L.8.1.1.4 Test report

The test report shall state whether the defined LDS application data can be retrieved and whether the data has been altered.

L.8.1.2 Optional Procedure 2: Electrical functionality check test

L.8.1.2.1 Purpose

The purpose of this test is to check the electrical functionality of the PICC and may be used in addition to the Optional Procedure 1: Application functionality check test specified in L.8.1.1 "PICC activation process".

L.8.1.2.2 Test setup

For this test, the test setup defined in the corresponding tests shall be used.

L.8.1.2.3 Test procedure

The test procedure should be performed with all given samples using at least one of the following methods:

— Apply the Resonance Frequency Test as specified in L.4.4 "Resonance frequency test (optional)".

— Apply the Operating Field Strength Test as specified in L.4.2 "Operating field strength test".

— Apply an alternative method comparing relative values of the threshold field strength before and after the mechanical or electrical stress test.

L.8.1.2.4 Test report

The test report shall state whether the resonance frequency is in the range specified in the implementation conformance statement or whether the PICC operates as intended for all combinations of temperatures and field strengths, see L.4.2 "Operating field strength test".

L.9 Bibliography

The following documentation serves as a reference for this annex:

[1] Technical Report: Development of a Logical Data Structure – LDS for optional capacity expansion technologies, version 1.7

[2] Technical Report: PKI for Machine Readable Travel Documents offering ICC Read-Only access, version 1.1

[3] RFC 2119, S. Bradner, "Key Words for Use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997

[4] ISO/IEC 14443-1:2000, Proximity Cards: Physical Characteristics

[5] ISO/IEC 14443-2:2001, Proximity Cards: Radio Frequency Power and Signal Interface

[6] ISO/IEC 14443-3:2001, Proximity Cards: Initialization and Anticollision

[7] ISO/IEC 14443-4:2008, Proximity Cards: Transmission protocol

[8] ISO/IEC 14443-2:2001/Amd.1:2005, Proximity Cards: Radio Frequency Power and Signal Interface (Amendment 2: Bit Rates of *fc*/64, *fc*/32 and *fc*/16)

[9] ISO/IEC 14443-3:2001/Amd.1:2005, Proximity Cards: Initialization and Anticollision (Amendment 1: Bit Rates of *fc*/64, *fc*/32, and *fc*/16)

[10] ICAO Doc 9303 Part 1 Volume 2, 6th edition, 2005.

[11] Defect Report and Technical Corrigendum 1 for - International Standard ISO/IEC 14443-3:2001/Amd.1: Identification cards – Contactless integrated circuit(s) cards – Proximity cards – Part 3: initialization and anticollision – Amendment 1: Bit rates for *fc*/64, *fc*/32 and *fc*/16

Annex M
(informative)

PCD test methods

M.1 Scope

This annex defines a test plan for the contactless part of the ePassport PCD. These tests are divided into tests of the electrical parameters, according to ISO/IEC 14443-2:2001 and tests of the initialisation & anticollision and the frame protocol according to ISO/IEC 14443-3:2001 and ISO/IEC 14443-4:2008.

In order for the PCD 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 PCD compliance testing, this annex is interpreted as mandatory.

M.2 Terms, definitions and abbreviations

For the purpose of this annex, the terms and definitions of ISO/IEC 14443-2:2001, ISO/IEC 14443-3:2001, ISO/IEC 14443-4:2008 and the following definitions apply.

LMA	Load modulation amplitude
Sample	A sample is one piece of the total number of PCDs required and presented for testing according to this specification
Room temperature	Room temperature (RT) is defined as any convenient temperature within the range of 23 °C ± 3 °C (73 °F ± 5 °F).

M.3 General Test Requirements

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

Tests for bit rates of *fc*/128 and *fc*/32 are mandatory and shall be applied. All other supported bit rates shall also be tested.

The PCD should support asymmetric communication speeds from/to the PICC if offered by the PICC to minimize transaction time.

The tolerance for the resonance frequency of the Reference PICC is ± 2 %.

All given temperature values may have a tolerance value of ± 0,5 °C.

All other value may have a tolerance value as specified in the base standards.

M.3.1 Test procedure

The test PCD assembly (test apparatus) that is defined in this standard is the basis for the physical and electrical tests. This test apparatus is used to calibrate the Reference PICC that is defined in

ISO/IEC 10373-6:2001, 6.2 "Test PCD assembly". This test PCD assembly is used to calibrate the Reference PICC that is defined in M.3.6 "Definition of the Reference PICC".

In addition to what is required by the base test standard, the samples shall provide the features as described in M.3.3 "General Test Requirements". The manufacturer provides a description how to switch the sample into the test mode and how to operate the sample for the test cases described in this document.

M.3.2 Implementation conformance statement

In order to set up the tests properly, an applicant shall provide the information specified in Table M.1 — Test precondition table "Information on the product".

Table M.1 — Test precondition table "Information on the product"

Information for test setup	Applicant declaration
PCD class	
Bit rates supported by the PCD • 106 kbit/s • 212 kbit/s • 424 kbit/s • 848 kbit/s	
Access control supported • Plaintext • Basic Access Control • Extended Access Control	
Authentication supported • Passive Authentication • Active Authentication	
Operating temperature range	

M.3.3 PCD test features

The test apparatus shall be capable of sending contiguous activation commands. For Type A, these commands are REQA, ANTICOLLISION, SELECT, RATS, and PPS. For Type B, these are REQB, the optional Slot-MARKER, and ATTRIB. If there is no response from the PICC, the communication type should be changed and the activation procedure shall start from the beginning. If this is not possible, the dedicated commands should be available to expose all commands to the upper tester as described in Annex H.1.2 " PCD-test-apparatus structure". Therefore, it is possible to start each command from host side if necessary.

Additionally the ISO/IEC 14443-4:2008 command set shall be available to exchange data. It shall also be possible to receive chained data, e.g. BlockExchange.

Errors shall be handled in the PCD and not in the upper tester or host. If possible, the final operating system shall be tested.

The test apparatus may be synchronized by probing the backscattered signal using an ISO pickup coil. Such a pickup coil shall not influence the field significantly. Alternatively the PCD may provide a test pin output.

The applicant may provide the PCD test interface specified in clause M.7 Measurement ".

M.3.4 Nominal values

Unless otherwise specified, the environment parameters and nominal values defined in Table M.2 — Environment parameters shall be used:

Table M.2 —Environment parameters

Parameter	Value	Applies to
Environment temperature	23 °C ± 3 °C (73 °F ± 5 °F)	Type A and Type B
Relative humidity	25 % to 75 %	Type A and Type B

Tests have to be done at the same temperature range as the PICC tests (−10 °C … 50 °C). The customer is free to specify a limited range (for example for indoor systems) in the implementation conformance statement.

M.3.5 Definition of measurement points

All layer 2 tests shall be performed over a certain set of points within the defined volume.

Volume definition:

Clause M.7 "Measurement ″ specifies volume dimensions, so called ″PCD design types″. If due to the construction and/or normal use of the PCD other dimension sizes are recommended by the manufacturer of the PCD, the test institute shall check if these dimension sizes are appropriate and define the dimensions of the volume accordingly.

Volume location:

The PCD manufacturer shall define the position of the volume in the technical documentation of the PCD. The volume shall be located with one surface exactly on the surface of the PCD.

Alternatively, the volume may be located within the PCD. In this case, the volume size definition shall be adopted accordingly.

PCDs shall be tested inside of their housing, exactly as they are used in border control applications.

Applying the PCD type concept, it is required to consider mechanical and optical constraints specific to a PCD. The test may be adapted to match these constraints. The report shall state the specific operating conditions during a particular test.

Measurement points:

Clause M.7 "Measurement " specifies measurement points.

Height Z = 0 mm: The measuring antenna shall be placed exactly at the bottom of the volume (at the surface of the scanner plate, if appropriate).

Height Z = x mm: The top surface of the test antenna shall be located in a distance of x mm of the bottom of the volume (in a distance of x mm from the surface of the scanner plate, if appropriate).

M.3.6 Definition of the Reference PICC

The Reference PICC introduced is based on Annex I with extended functionality for the load modulation reception testing. The coil layout is specified in Annex I.1.

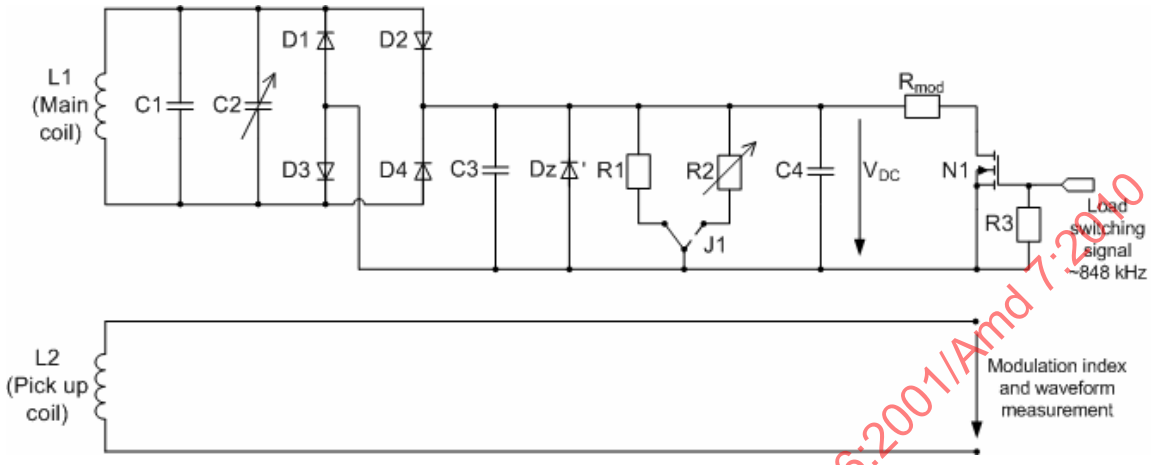

Figure M.1 — Reference PICC

The signal at pin 'load switching signal ~848 kHz' shall have an amplitude value between 0,0 and 4,0 V, for stable switching of the recommended transistor. In order to reduce common-mode current, a balun may be used between the signal generator and the Reference PICC.

Table M.3 — Reference PICC

Component	Value
L1, L2	See Annex I.1
R1	4,3 kΩ
R2	Adjustable, see Table M.4 — Values of Rmod and R2
R3	5 kΩ
R_{mod}	Adjustable, see Table M.4 — Values of Rmod and R2
C1	10 pF
C2	5 – 30 pF
C3	100 pF
C4	470 pF
D1, D2, D3, D4	Recommended: BAR43
Dz	Recommended: BZX84-C14 / T1, 300 mW, SMD 15 V
N1	N-MOS FET, 10 pF max. Output capacitance to ground. Recommended: BSS83

For X=30 and *H* = 2,0 A/m (rms) the load modulation amplitude ($X/H^{1,2}$) is 13,1 mV (peak).

Adjustment of the R2 and R_{mod} values shall be done in the test PCD assembly.

Adjustment of the Reference PICC load modulation amplitude level for V_{DC} = 6,0 V at field strength values from 2,0 A/m (rms) up to 6,0 A/m (rms) result in the following nominal modulation resistor values.

Table M.4 — Values of R_{mod} and R2

Load Modulation Amplitude mV (peak)	Resonance Frequency MHz	*H* A/m (rms)	R2 Ω	R_{mod} kΩ
13,1	15	2,0	705	1,118
13,1	15	2,5	525	1,047
13,1	15	3,0	437	0,966
13,1	15	3,5	370	0,898
13,1	15	4,0	320	0,845
13,1	15	4,5	285	0,800
13,1	15	5,0	255	0,765
13,1	15	5,5	230	0,745
13,1	15	6,0	210	0,732
13,1	18	2,0	5100	4,670
13,1	18	2,5	703	1,376
13,1	18	3,0	510	1,045
13,1	18	3,5	380	0,941
13,1	18	4,0	320	0,880
13,1	18	4,5	285	0,825
13,1	18	5,0	255	0,785
13,1	18	5,5	230	0,760
13,1	18	6,0	210	0,740

NOTE 1 These resistor values are nominal values and should be used as a guideline when adjusting R2 and R_{mod}.

NOTE 2 V_{DC} should be measured using Reference PICC when no ~848 KHz switching signal is applied to the probe.

M.3.7 Test report

The test report shall include the number of passed tests versus the total number of tests. A description of each test, the information if the test was pass or fail, the number of different samples and the date of the tests shall be included.

M.4 Layer 2 tests

M.4.1 Operating field strength test (Type A and Type B)

M.4.1.1 Purpose

The purpose of this test is to check if the PCD meets the energy performance requirements according to [5], 6.2 "Test PCD assembly" and 8.1 "PCD field strength". To include a margin of 0,5 A/m (rms) to the ISO limits, the field strength under loaded conditions shall be between 2,0 A/m (rms) (1,5 + 0,5) and 7,0 A/m (rms) (7,5 - 0,5) at all measurement positions defined in M.3.5 "Definition of measurement points".

M.4.1.2 Test procedure

As a measurement device, the Reference PICC, as defined in M.3.6 "Definition of the Reference PICC", shall be used. The test shall be performed at −10 °C, RT and 50 °C (see restriction in M.3.4 "Nominal values") on one sample at a bit rate of *fc*/128.

Additionally, the value of V_{DC} should be recorded for all positions..

For H_{min} perform the following steps:

a) Adjust the resonance frequency of the Reference PICC to 15 MHz as described in 8.1.2 "Power transfer PCD to PICC".

b) Put the Reference PICC into the test PCD assembly.

c) Adjust the resistor R2 to get a V_{DC} of 6,0 V at field strength of 2,0 A/m (rms).

d) At any measurement position defined in M.3.5 "Definition of measurement points" the V_{DC} shall be greater or equal to 6,0 V.

For H_{max} perform the following steps:

a) Adjust the resonance frequency of the Reference PICC to 18 MHz as described in 8.1.2 "Power transfer PCD to PICC".

b) Put the Reference PICC into the test PCD assembly.

c) Adjust the resistor R2 to get a V_{DC} of 6,0 V at field strength of 7,0 A/m (rms).

d) At any measurement position defined in M.3.5 "Definition of measurement points" the V_{DC} shall be less or equal to 6,0 V.

NOTE 1 This test includes field strength and power measurements, 8.1 "PCD field strength" and 8.2 "Power transfer PCD to PICC".

NOTE 2 H_{min} and H_{max} values are defined to keep a margin to the field strength range for the PICC test.

NOTE 3 Additional tests may be performed using a Reference PICC resonance frequency of 13,56 MHz for H_{min} and 19 MHz for H_{max}.

M.4.1.3 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 different samples and the date of the tests.

M.4.2 Load modulation reception test (Type A and Type B)

M.4.2.1 Purpose

The purpose of this test is to determine if the PCD is able to receive and demodulate signals with minimum load modulation amplitude. The PCD should provide a trigger signal (e.g. pulse at beginning or end of PCD command) to the load switching signal source (e.g. an arbitrary waveform generator) to send the response with required timings. The Reference PICC defined in M.3.6 "Definition of the Reference PICC" shall be used.

M.4.2.2 Test procedure

For minimum one sample and for each measurement position (as defined in clause M.7) and resonance frequency perform the following steps:

a) Adjust the resonance frequency of the Reference PICC to 15 MHz as described in 8.1.2 "Power transfer PCD to PICC".

b) Put the Reference PICC into the Test PCD assembly.

c) Adjust the resistor R2 to get a V_{DC} of 6,0 V at H = 2,0 A/m (rms) field strength.

d) Adjust the resistor R_{mod} to get the required load modulation amplitude of 13,1 mV (for nominal resistor values see Table in M.3.6 "Definition of the Reference PICC").

e) Put the Reference PICC to the measurement position defined in M.3.5 "Definition of measurement points".

f) Adjust the distance along z axis between the Reference PICC and PCD until V_{DC} reaches 6,0 V.

g) Check if the PCD is able to receive and demodulate a valid response with required bit rate.

h) Repeat steps b) to g) where the field strength should be increased in 0,5 A/m (rms) steps up to H_{max}.

i) Repeat steps a) to h) at Reference PICC resonance frequency of 18 MHz.

Table M.5 — Test parameters

Parameter	Value
Measurement position	as defined in clause M.7
Bit rate	*fc*/128, *fc*/64, *fc*/32, *fc*/16
Temperature	−10 °C, RT, 50 °C (see restriction in M.3.4 "Nominal Values")
Reference PICC resonance frequency	15 MHz, 18 MHz

M.4.2.3 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 different samples and the date of the tests.

NOTE For bit rates higher than *fc*/128, the 'Transmit Pattern and Receive 14443' command as specified in M.9.3.2 may be executed by the PCD.

M.4.3 Modulation index and waveform test

Digital amplitude demodulation shall be used for calculating the envelope of the modulated carrier amplitude, e.g. Hilbert transformation. For an example program of the Hilbert transformation, see Annex N.

M.4.3.1 Type A

M.4.3.1.1 Purpose

The purpose of this test is to determine the compliance of the PCD regarding waveform shapes. The Reference PICC defined in M.3.6 "Definition of the Reference PICC" shall be used in addition to the

calibration coil. A command with the required bit rate shall be sent by the PCD after activation of the bit rate receiver/transmit combination required for the test.

M.4.3.1.2 Test procedure

Perform the following steps:

a) Adjust the resonance frequency of the Reference PICC to 16,5 MHz as described in ISO/IEC 10373-6:2001/Amd.2:2003, 8.1.2.

b) Put the Reference PICC into position defined in clause M.7 "Measurement ".

c) Adjust the resistor R2 to get a V_{DC} of 6,0 V at current position.

d) Check if the waveform shapes are within the specified limits for all bit rates at current position.

Table M.6 — Test parameters

Parameter	Value
Measurement position	as defined in clause M.7
Bit rate	*fc*/128, *fc*/64, *fc*/32, *fc*/16
Temperature	−10 °C, RT, 50 °C (see restriction in M.3.4 "Nominal Values")
Reference PICC resonance frequency	16,5 MHz

M.4.3.1.3 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 different samples and the date of the tests.

NOTE 1 For better interoperability, a Reference PICC resonance frequency of 15 MHz should be used.

NOTE 2 For each bit rate, the corresponding table should be taken in account.

NOTE 3 For bit rates higher than *fc*/128, the ISO/IEC 14443-2 test command as specified in M.9.3.1 "ISO/IEC 14443-2 test command" may be executed with the PCD.

M.4.3.2 Type B

This test shall check if PCD meets the requirements concerning waveform shapes, i.e. rise and fall times, modulation index, and overshoots.

M.4.3.2.1 Purpose

The purpose of this test is to determine the compliance of the PCD regarding waveform shapes. The Reference PICC defined in M.3.6 "Definition of the Reference PICC" shall be used in addition to the calibration coil. A command with the required bit rate shall be sent by the PCD after activation of the bit rate receiver/transmit combination required for the test.

M.4.3.2.2 Test procedure

Perform the following steps:

a) Adjust the resonance frequency of the Reference PICC to 16,5 MHz as described in ISO/IEC 10373-6:2001/Amd.2:2003, 8.1.2.

b) Put the Reference PICC into position defined in clause M.7 "Measurement ".

c) Adjust the resistor R2 to get a V_{DC} of 6,0 V at current position.

d) Check at that position if the waveform shapes are within the specified limits for all bit rates, as defined in table below.

The ISO/IEC 14443-2 test command as specified in M.9.3.1 "ISO/IEC 14443-2 test command" may be executed with the PCD.

Table M.7 — Waveform shape requirements

Parameter	min	max
m = (a−b) / (a+b)	10 %	14 %
t_r, t_f	0 µs	0,8 µs
h_r, h_f	0	0,1 (a−b)

Table M.8 — Test parameters

Parameter	Value
Measurement position	as defined in clause M.7
Bit rate	*fc*/128, *fc*/64, *fc*/32, *fc*/16
Temperature	−10 °C, RT, 50 °C (see restriction in M.3.4 "Nominal Values")
Reference PICC resonance frequency	16,5 MHz

M.4.3.2.3 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 different samples and the date of the tests.

NOTE 1 For better interoperability a Reference PICC resonance frequency of 15 MHz should be used.

NOTE 2 For bit rates higher than *fc*/128, the ISO/IEC 14443-2 test command as specified in M.9.3.1 "ISO/IEC 14443-2 test command" may be executed with the PCD.

NOTE 3 A bit rate of *fc*/32 is mandatory for the PCD. Therefore, the rise/fall time requirement is valid for all bit rates.".

M.5 Layer 3 timing and framing tests

All tests shall be performed with one specific field strength between 2,0 A/m (rms) and 7,0 A/m (rms) within the operating volume of the PCD if not further specified.

All tests shall be performed at RT if not further specified.

M.5.1 Frame delay time (Type A only)

M.5.1.1 Frame delay time PICC to PCD

M.5.1.1.1 Purpose

This test shall check if the PCD can handle a FDT according to ISO/IEC 14443-3:2001. For this test, the same setup shall be used as for the load modulation reception test.

Modification done according to:

— Reference: ISO/IEC 14443-3:2001, 6.1.3 "Frame delay time PICC to PCD".

M.5.1.1.2 Test procedure

This test shall check if a PCD command after a PICC response is not sent before a minimum frame delay time of 1172/*fc* after the PICC has sent ATQA. After ATQA the PCD shall send an ANTICOLLISION frame.

Table M.9 — Test parameters

Parameter	Value
Bit rate	*fc*/128

M.5.1.1.3 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 different samples and the date of the tests.

NOTE If possible, this test should be done for all commands, even during the protocol test.

M.5.1.2 Frame delay time PCD to PICC

M.5.1.2.1 Purpose

This test shall check if the PCD can handle a FDT according to ISO/IEC 14443-3:2001. For this test, the same setup shall be used as for the load modulation reception test.

Modification done according to:

— Reference: ISO/IEC 14443-3:2001 (6.1.2 "Frame delay time PCD to PICC")

M.5.1.2.2 Test procedure

This test shall check if the PCD is able to receive a PICC response within the FDT limits.

Table M.10 —FDT limits

Last Bit	Min FDT	Max FDT
0	1172/*fc*	1172/*fc* + 0,4 µs
1	1236/*fc*	1236/*fc* + 0,4 µs

Table M.11 — Test parameters

Parameter	Value
Bit rate	*fc*/128

M.5.1.2.3 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 different samples and the date of the tests.

NOTE 1 The test should be done for a REQA/WUPA command and should be carried out with other commands, too (see ISO/IEC 14443-3:2001/Amd.1:2005).

NOTE 2 In order to improve interoperability, the following values should be used (ISO limits ± 1 carrier period):.

Table M.12 — Parameters for improved interoperability

Last Bit	Min FDT	Max FDT
0	1172/*fc* – 1/*fc*	1172/*fc* + 0,4 µs + 1/*fc*
1	1236/*fc* – 1/*fc*	1236/*fc* + 0,4 µs + 1/*fc*

M.5.2 Request guard time (Type A only)

This test shall check if the PCD can handle multiple REQA commands according to ISO/IEC 14443-3:2001. For this test, the same setup shall be used as for the load modulation amplitude test.

Modification done according:

— Reference: ISO/IEC 14443-3:2001, 6.1.4 "Request guard time".

M.5.2.1.1 Purpose

The purpose of this test is to determine the Request guard time of two consecutive REQA/WUPA commands.

Table M.13 — Test parameters

Parameter	Value
Bit rate	*fc*/128

M.5.2.2 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 different samples and the date of the tests.

NOTE This test is only relevant for PCD's, which send consecutive REQA/WUPA.

M.5.3 Bit boundaries (Type B only)

M.5.3.1 Purpose

The purpose of this test is to check whether the PCD meets the bit boundary requirements according to ISO/IEC 14443-3:2001/Amd.1:2005, 7.1.1.

Table M.14 — Test parameters

Parameter	Value
Bit rate	*fc*/128, *fc*/64, *fc*/32, *fc*/16

M.5.3.2 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 different samples and the date of the tests

M.5.4 Start-of-Frame & End-of-Frame-Timing (SOF & EOF) (Type B only)

M.5.4.1 Purpose

The purpose of this test is to check whether the PCD meets SOF & EOF requirements according to ISO/IEC 14443-3:2001, 7.1.4 and 7.1.5.

Table M.15 — Test parameters

Parameter	Value
Bit rate	*fc*/128, *fc*/64, *fc*/32, *fc*/16

M.5.4.2 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 different samples and the date of the tests.

M.5.5 Extra guard time (EGT) (Type B only)

M.5.5.1 Purpose

The purpose of this test is to check whether the PCD meets the EGT requirements according to ISO/IEC 14443-3:2001/Amd.1:2005, 7.1.2.

Table M.16 — EGT limits

	min	max
EGT	1 etu	6 etu

Table M.17 — Test parameters

Parameter	Value
Bit rate	*fc*/128, *fc*/64, *fc*/32, *fc*/16

M.5.5.2 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 different samples and the date of the tests.

M.5.6 Timing before PICC Start-of-Frame (TR0 & TR1) (Type B only)

M.5.6.1 Purpose

The purpose of this test is to check whether the PCD meets the TR0 and TR1 requirements according to ISO/IEC 14443-3:2001, 7.1.6.

Table M.18 — TR0 & TR1 limits

	min	max
TR0	64/*fs*	256/*fs*
TR1	80/*fs*	200/*fs*

Table M.19 — Test parameters

Parameter	Value
Bit rate	*fc*/128, *fc*/64, *fc*/32, *fc*/16

M.5.6.2 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 different samples and the date of the tests.

NOTE In order to improve interoperability, the following values should be used:

Table M.20 — TR0 & TR1 limits for improved interoperability

	min	max
TR0	60/*fs*	260/*fs*
TR1	76/*fs*	204/*fs*

M.5.7 Timing before PCD Start-of-Frame (TR2) (Type B only)

M.5.7.1 Purpose

The purpose of this test is to check whether the PCD meets the minimum TR2 requirements. TR2 limits are tested according to the [11].

Table M.21 — TR2 limits

b3	b2	minimum TR2	maximum TR2
0	0	10 etu + 32/*fs*	n/a
0	1	10 etu + 128/*fs*	n/a
1	0	10 etu + 256/*fs*	n/a
1	1	10 etu + 512/*fs*	n/a

The bits b2 and b3 are negotiated in the PICC ATQB 'Protocol Type' half byte.

Table M.22 — Test parameters

Parameter	Value
Bit rate	*fc*/128, *fc*/64, *fc*/32, *fc*/16

M.5.7.2 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 different samples and the date of the tests.

M.6 Layer 3 and layer 4 protocol tests

These tests provide a basic set of tests to be performed to check compliance to ISO/IEC 14443 protocol layers. All tests are based on and shall be evaluated according to the current standard.

For all test cases, make sure that the physical and electrical tests as mentioned in the clauses above have passed.

Test procedure:

Setup as defined for the electrical tests shall be used and is afterwards called "test apparatus". All tests shall be performed with one specific field strength between 2,0 A/m (rms) and 7,0 A/m (rms) within the operating volume of the PCD if not further specified.

All tests shall be performed at RT if not further specified.

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 CLK frequency, and be able to analyze the I/O-bit stream in accordance with the protocol.

The tests are based on the ISO/IEC 10373-6:2001/Amd.3:2006 specification. For the test commands typical commands should be used. This could be for example for TEST_COMMAND1 the READ BINARY command. Other commands specified dependent on their expected behavior might also be used. The command used may differ between different products and shall be documented in the report.

The functionality as described in M.3.1 "Test procedure" shall be used either with the final operating system (preferred way) or with dedicated test commands.

M.6.1 Type A activation

These tests shall ensure the start-up and the activation is according to ISO/IEC 14443-3:2001 clause 6. These tests are split up to collision handling, the handling of RATS and PPS, and the handling of CID during activation.

M.6.1.1 Handling of collisions

M.6.1.1.1 Purpose

The purpose of this test is to check the correct behavior on collisions as defined in ISO/IEC 14443-3:2001. The tests specified in Annex H.2.3 "Handling of bit collision during ATQA" and in Annex H.2.4 "Handling of anticollision loop" of ISO/IEC 10373-6:2001/Amd.3:2006 should be used. The detailed test procedure is not specified herein.

M.6.1.1.2 Test report

The test report shall state whether the response was according to ISO/IEC 14443-3:2001 respectively to ISO/IEC 10373-6:2001/Amd.3:2006 or not. Additionally possible proprietary paths of the "Select sequence flow chart" specified in ISO/IEC 14443-3:2001, 6.4.1, shall not negatively affect the report. The report shall include the number of samples tested and the date.

M.6.1.2 Handling of RATS (including frame size selection)

M.6.1.2.1 Purpose

The purpose of this test is to check the correct behavior of RATS and the handling of ATS as defined in ISO/IEC 14443-4:2008, 5.6.1.1. The tests specified in Annex H.2.5 "Handling of RATS and ATS" and Annex H.2.7 "Frame size selection mechanism" of ISO/IEC 10373-6:2001/Amd.3:2006 should be used. The detailed test procedure is not specified herein.

M.6.1.2.2 Test report

The test report shall state whether the response was according to ISO/IEC 14443-4:2008 respectively to ISO/IEC 10373-6:2001/Amd.3:2006 or not. The report shall include the number of samples tested and the date.

M.6.1.3 Handling of PPS

M.6.1.3.1 Purpose

The purpose of this test is to check the correct behavior on handling a PPS response as defined in ISO/IEC 14443-4:2008, 5.6.2.1. The tests specified in Annex H.2.6 "Handling of PPS response" of ISO/IEC 10373-6:2001/Amd.3:2006 should be used. The detailed test procedure is not specified herein.

M.6.1.3.2 Test report

The test report shall state whether the response was according to ISO/IEC 14443-4:2008 respectively to ISO/IEC 10373-6:2001/Amd.3:2006 or not. The report shall include the number of samples tested and the date.

M.6.1.4 Handling of CID during activation

M.6.1.4.1 Purpose

The purpose of this test is to check the correct behavior on handling CID during activation as defined in ISO/IEC 14443-4:2008, 5.6.3. The tests specified in Annex H.2.9 "Handling of the CID during activation by PCD" ISO/IEC 10373-6:2001/Amd.3:2006 of should be used. The detailed test procedure is not specified herein.

M.6.1.4.2 Test report

The test report shall state whether the response was according to [7] respectively to ISO/IEC 10373-6:2001/Amd.3:2006 or not. The report shall include the number of samples tested and the date.

M.6.2 Type B activation

M.6.2.1 Frame size selection

M.6.2.1.1 Purpose

The purpose of this test is to check the correct behavior of the frame size selection mechanism as defined in ISO/IEC 14443-3:2001, 7.9. The tests specified in Annex H.3.2 "Frame Size Selection Mechanism" of ISO/IEC 10373-6:2001/Amd.3:2006 should be used.

M.6.2.1.2 Test report

The test report shall state whether the response was according to the scenario defined in ISO/IEC 10373-6:2001/Amd.3:2006 Annex H.3.2 "Frame Size Selection Mechanism". The report shall include the number of samples tested and the date.

M.6.2.2 Bit rate selection

M.6.2.2.1 Purpose

The purpose of this test is to check the correct behavior of the bit rate selection mechanism as defined in ISO/IEC 14443-3:2001/Amd.1:2005. The tests specified in ISO/IEC 10373-6:2001/Amd.5:2007, Annex J should be used.

M.6.2.2.2 Test report

The test report shall state whether the behavior was according to ISO/IEC 14443-3:2001/Amd.1:2005 respectively ISO/IEC 10373-6:2001/Amd.3:2006. The report shall include the number of samples tested and the date.

M.6.2.3 Handling of CID during activation

M.6.2.3.1 Purpose

The purpose of this test is to check the correct behavior on handling CID during activation as defined in [7]. The tests specified in Annex H.3.3 "Handling of the CID during activation by the PCD" of ISO/IEC 10373-6:2001/Amd.3:2006 should be used.

M.6.2.3.2 Test report

The test report shall state whether the response was according to [7] respectively to ISO/IEC 10373-6:2001/Amd.3:2006 or not. The report shall include the number of samples tested and the date.

M.6.3 Handling of the polling loop (Type A and Type B)

M.6.3.1.1 Purpose

The purpose of this test is to check the correct behavior during polling for Type A and Type B PICC's as defined in ISO/IEC 14443-3:2001 (clause 5). The test specified in Annex H.4.1 "Handling of the polling loop" of ISO/IEC 10373-6:2001/Amd.3:2006 should be used. The detailed test procedure is not specified herein.

M.6.3.1.2 Test report

The test report shall state whether the response was according to ISO/IEC 14443-3:2001 respectively to ISO/IEC 10373-6:2001/Amd.3:2006 or not. The report shall include the command set used for testing.

M.6.4 Data exchange protocol tests (Type A and Type B)

Data exchange protocol tests shall ensure the logical operation of the PCD is according to ISO/IEC 14443-4:2008. These tests are valid for both, Type A, Type B whereas the activation before running these tests is different, and listed below. All tests are based on the currently available standards.

The activation for Type A shall be done according to the ISO/IEC 10373-6:2001/Amd.3:2006 Annex H.1.8.2 "Activation procedure for Type A protocol test methods".

The activation for Type B shall be done according to the ISO/IEC 10373-6:2001/Amd.3:2006 Annex H.1.8.3 "Activation procedure for Type B protocol test methods".

M.6.4.1 Error detection and recovery

The purpose of this test is to determine the behavior of PCD when a transmission error occurs according to ISO/IEC 14443-4:2008, 7.5.5. These tests specified in ISO/IEC 10373-6:2001/Amd.3:2006 cover standard communication blocks, blocks where the PCD uses chaining and blocks where the PICC uses chaining.

The PICC chaining tests could be performed without knowing dedicated command behavior on IUT. Any command could be divided into two parts e.g. the response to a READ BINARY could be sent in two chained packets.

The IUT chaining is harder to achieve. If the higher layer functionality is not known in detail or a chaining command is not used in the application these tests could not be performed. Therefore, it is optional.

M.6.4.1.1 Purpose

The purpose of this test is to determine the behavior of PCD when a transmission error occurs according to ISO/IEC 14443-4:2008, 7.5.5. These tests specified in ISO/IEC 10373-6:2001/Amd.3:2006 cover standard communication blocks, blocks where the PCD uses chaining and blocks where the PICC uses chaining. The detailed test procedure is not specified herein.

M.6.4.1.2 Test report

The test report shall state whether the response was according to ISO/IEC 14443-4:2008 respectively to ISO/IEC 10373-6:2001/Amd.3:2006. The report shall include the command set used for testing.

M.6.4.2 Request for waiting time extension

M.6.4.2.1 Purpose

The purpose of this test is to determine the behavior of the PCD when the PICC use a request for a waiting time extension (see ISO/IEC 14443-4:2008, 7.3). The mechanism of maintenance of WTX by the PCD is tested too. These tests specified in ISO/IEC 10373-6:2001/Amd.3:2006 Annex H.4.2 "Reaction of the PCD to request for waiting time extension". The detailed test procedure is not specified herein.

M.6.4.2.2 Test report

The test report shall state whether the response was according to ISO/IEC 10373-6:2001/Amd.3:2006 Annex H.4.2 "Reaction of the PCD to request for waiting time extension". The report shall include the command set used for testing.

M.7 Measurement positions

Table M.23 —PICC Application specific measurement points

PCD design type		Volume definition			Measurement points	
		X dimension	Y dimension	Z dimension mm	X-Y-plane	Height mm
1	Single step PCDs[a]	Twice ID3 + 20 % (of ID3) for the size of an open passport booklet (ID3) enlarged by 10 %	Size of a passport booklet (ID3) enlarged by 10 %	7,5	All four corners of both connected ID 3 + 10 % fields, additionally in the center of both fields	Z_0 = 0,0 Z_1 = 7,5 Z_{max} as specified by manufacturer (if Z_{max} > 7,5)
1a	Similar to PCD design type 1, but the two parts of the volume are arranged angularly, not in-line					
2	Full page PCDs[b]	ID3 + 10 % for the size of a passport booklet (ID3) enlarged by 10 %	Size of a passport booklet (ID3) enlarged by 10 %	7,5	All four corners of the ID 3 + 10 % field, additionally in the center of the field	Z_0 = 0,0 Z_1 = 7,5 Z_{max} as specified by manufacturer (if Z_{max} > 7,5)
99	Other PCDs	ID3 +10 % for the size of a passport booklet (ID3) enlarged by 10 %	Size of a passport booklet (ID3) enlarged by 10 %	20,0	All four corners of the ID 3 + 10 % field, additionally in the center of the field	Z_0 = 0,0 Z_1 = 7,5 Z_{max} = 20,0 or as specified by manufacturer (if Z_{max} > 20,0)

[a] Document PCDs that are able to read the entire data page of an opened passport and that are able to read the data from the PICC without any replacement of the passport on the PCD, independently from the location of the chip inside the passport document (i.e., front cover, back cover, data page, middle page)

[b] Document PCDs that are able to read the entire data page of an opened passport as well as the data contained in the PICC. A replacement of the passport may be required.

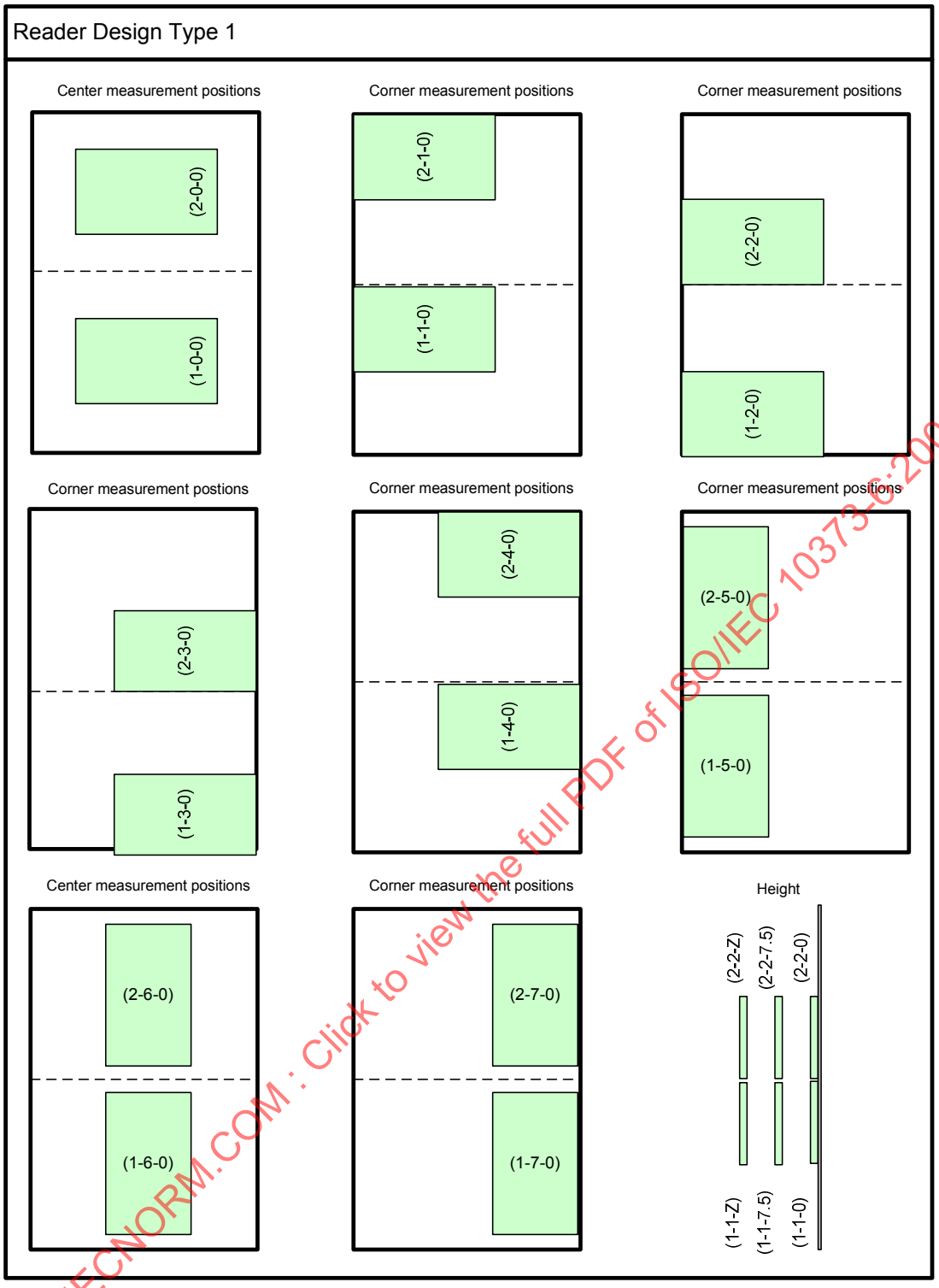

Figure M.2 — Measurement positions PICC PCD design type 1

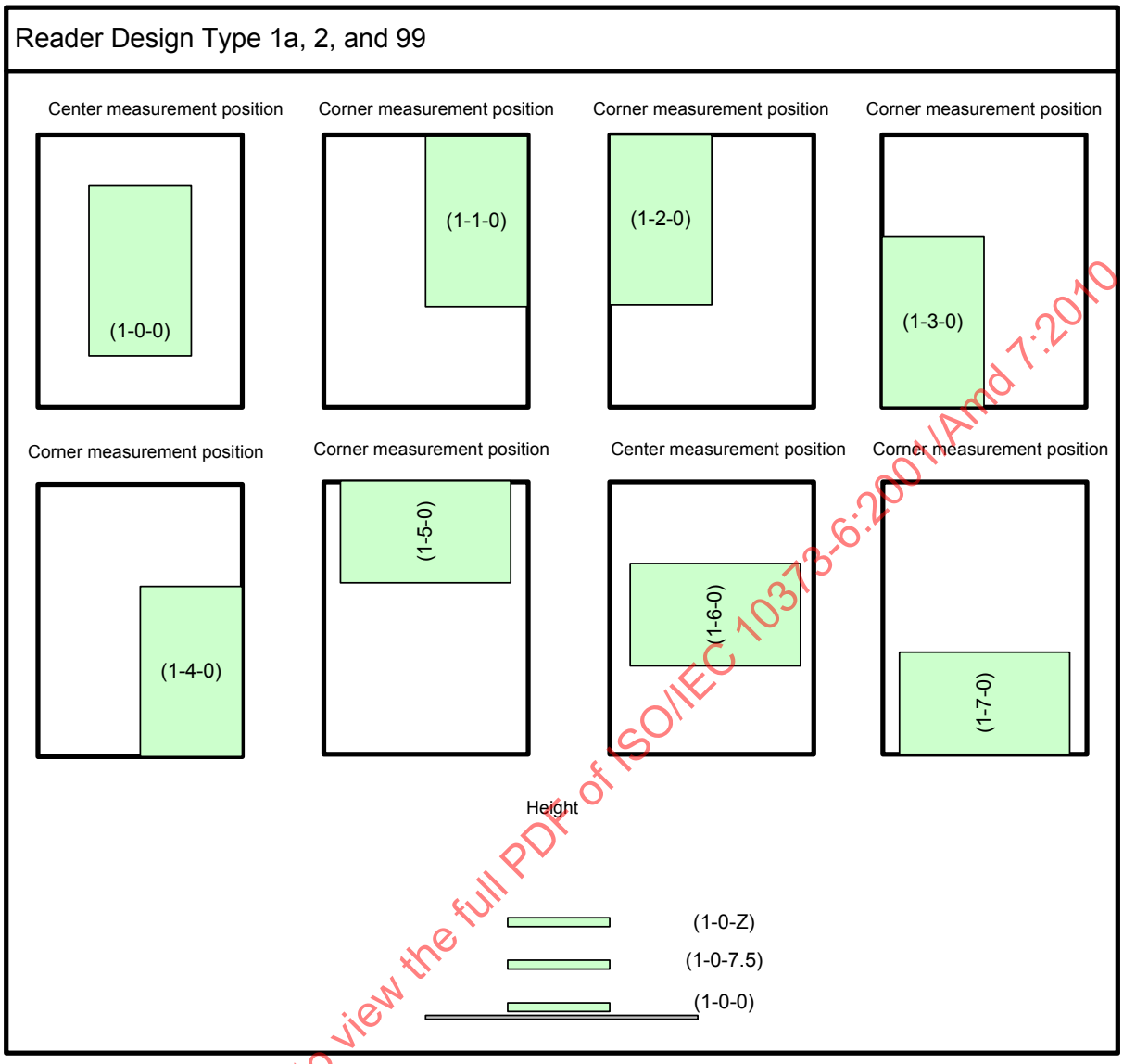

Figure M.3 Measurement positions PICC PCD design type 1a, 2, and 99

M.8 Comparison PCD – PICC test

Table M.24 — Comparison PCD – PICC Test

ISO Layer	Test description	PICC	PCD
1	Coil Dimension Check	Conditional	No
	Static Electricity (ESD) Tests	Yes	No
	X-Ray Tests	No	No
	UV Tests	No	No
	H_{max} (12 A/m (rms)) Test	Yes	No

ISO Layer	Test description	PICC	PCD
2	Load modulation amplitude	Check if the load modulation amplitude is higher than the limit.	Check if the PCD is able to handle the whole load modulation amplitude range.
	Operating field strength	Check the whole range from 1,5 A/m (rms) – 7,5 A/m (rms).	Check if the available power of the PCD is in-between 2,0 A/m (rms) and 7,0 A/m (rms).
	Communication stability.	Check the whole range of valid signal shapes, (modulation index, rising- and falling edges, overshoot and timings).	Check if the shape of the modulated field is in-between the valid limits (modulation index, rising- and falling edges, overshoot and timings).
	Threshold resonance frequency	Optional.	No.
3	Frame Delay Time (Type A)	Check if the response starts after the right time.	Check the whole range, −0 / +0,4 µs.
	Bit Boundaries (Type B)	No	Check if the bit boundaries are within the valid limits.
	Start-of-Frame & End-of-Frame Timings (SOF & EOF) (Type B)	Check if the SOF and EOF timings are within the valid limits.	Check if the SOF and EOF timings are within the valid limits.
	Extra Guard Time (EGT) (Type B)	Check if the EGT timing is within the valid limits.	Check if the EGT timing is within the valid limits.
	Timing Before PICC Start of Frame (TR0 & TR1) (Type B)	Check if the TR0 & TR1 timings are within the valid limits.	Check if the TR0 & TR1 timings are within the valid limits.
	Timing Before PCD Start of Frame (TR2) (Type B)	Check if the TR2 timing is within the valid limits.	Check if the TR2 timing is within the valid limits.

M.9 Interface definition of TM-PDUs

M.9.1 Scope

This clause specifies a test management protocol according to ISO/IEC 10373-6:2001 to be applied to an PCD during conformity evaluations. The test commands, called test management protocol data units (TM-DPU), follow the architecture described in the PC/SC Part 3: Requirements for PC-Connected Interface Devices, Revision 2.01.05.

These test commands are persistent in each certified PCD to perform tests in the field as well.

This PC/SC implementation is optional. Using the PC/SC framework, test houses can minimize their efforts to establish the evaluation environment. PCD providers can use universal test applications if there are any.

If a supplier provides a PC/SC implementation, it shall be compliant to the latest released version on the consortium website (http://www.pcscworkgroup.com/specifications/overview.php).

NOTE In this clause the bit notation used is {b7..b0} where b7 designates the most significant bit and b0 designates the least significant bit. The older notation of {b8..b1} is not used.

M.9.2 Command syntax and transportation

The structure of the TM-PDUs follows the byte sequential command structure for smart cards, so called APDUs (Application Protocol Data Unit) according to ISO/IEC 7816-4:2005. The APDUs are distinguished by their direction, to or from the PCD:

— Command-APDU (C-APDU)

— Response-APDU (R-APDU)

For each C-APDU sent to the PCD by the test application, an R-APDU will be returned as a confirmation. R-APDUs will not be confirmed by the PCD.

M.9.2.1 Command APDU

C-APDUs are byte sequences consisting of two parts: Header and Body.

Table M.25 — Structure of a C-APDU

<table>
<tr><td colspan="8"><C-APDU></td></tr>
<tr><td colspan="8">Length: 4 ... ((0 … 3) + Lc + (0 … 3))</td></tr>
<tr><td colspan="4">Header
mandatory</td><td colspan="4">Body
[optional]</td></tr>
<tr><td colspan="4">Length: 4</td><td colspan="4">Length: 0 ... ((0 ... 3) + Lc + (0 ... 3))</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td colspan="2">5 ... 7</td><td>((5 ... 7) + 1) ...
(Lc + ((5 ... 7) + 1))</td><td>(Lc + ((5 ... 7) + 2)) ...
(Lc + ((5 ... 7) + 2) + (1 ... 3))</td></tr>
<tr><td rowspan="2">CLA</td><td rowspan="2">INS</td><td rowspan="2">P1</td><td rowspan="2">P2</td><td colspan="2">[Lc]</td><td rowspan="2">[Data Field
<Lc Bytes of Data>]</td><td>[Le]</td></tr>
<tr><td colspan="2">Max. Value indicated by
Lc < = 65535</td><td>Max. Value indicated by
Le < = 65536</td></tr>
</table>

The header only (first four bytes) is mandatory. The body is optional and may contain data with prior length indicator and/or length indicator for expected R-APDU. The presence depends on the command and application case or context.

M.9.2.2 Response APDU

The response to a C-APDU will be returned in general as R-APDU. Optionally the R-APDU may contain data. The two status bytes SW1 and SW2 are mandatory.

Table M.26— Structure of the R-APDU

<table>
<tr><td colspan="3"><R-APDU></td></tr>
<tr><td>Body
[optional]</td><td colspan="2">Trailer
mandatory</td></tr>
<tr><td>Requested Information</td><td colspan="2">Status Word</td></tr>
<tr><td>Length: 0 ... [<Le> of C-APDU]</td><td colspan="2">Length: 2 Byte</td></tr>
<tr><td>Position: 1 ... (1 + [<Le> of C-APDU])</td><td>Pos.: 1 ... (1 + [<Le> of C-APDU])</td><td>Pos.: 2 ... (2 + [<Le> of C-APDU])</td></tr>
<tr><td>[Information Field]</td><td>SW1</td><td>SW2</td></tr>
</table>

The trailer of the R-APDU transports the result of an operation. It shall be interpreted byte wise. SW1 classifies the result in general and SW2 gives an exact value for the indicated error class. The following classes are defined:

Table M.27 — Return Code Classes

Class (SW1)	Description
'90'	Normal Processing
'62', '63', '6C'	Warning
'64', '65'	Execution Error
'67' to '6F'	Checking Error

The value of SW2 is class specific.

M.9.2.3 Common return codes

Table M.28 —Common return codes

	SW1	SW2	Description
Success	'90'	'00'	Command successful
Warning	'6C'	'XX'	Le and available data are not same; 'XX' is the number of available data. If Le= '00', all available data is returned.
Error	'64'	'00'	Timeout, expecting response from card but no response within the time
	'64'	'01'	Internal error
	'67'	'00'	Wrong length
	'68'	'00'	Class byte is not correct
	'6A'	'81'	INS not supported
	'6A'	'82'	Function is not supported
	'6B'	'00'	Wrong parameter P1-P2

M.9.2.4 Command transportation

The commands can be transported via any interface. The applicant shall enable the test house to issue the specified test commands.

The applicant may provide the test houses with PC/SC drivers. In this case, all commands will be transported using the SCARD_Transmit function.

A PCD (or its related driver) can distinct between PICC commands and PCD control commands via the class byte. The value 'FF' is reserved for other purposes and can never be used by an ISO compliant PICC. Therefore, the test commands can be sent on the same 'channel' as the PICC commands. In addition, there is no need for a special function call or address to indicate control commands.

Following this way, existing test equipment can be used to apply PCD test commands and real PICC commands in parallel for testing.

M.9.3 Commands for testing

The following commands may be used to test the PCD.

NOTE All RFU bits and bytes described here should be set to (0)b.

M.9.3.1 ISO/IEC 14443-2 test command

This command may be used to test the RF interface, the modulation index, framing and coding of the data, transmitted by the PCD. Testing with this command does not mandate the presence of a PICC but it may be inserted to the field in order to check the mutual induction to the magnetic field.

Table M.29 — C-APDU for ISO/IEC 14443-2 Test Command

Command	CLA	INS	P1	P2	Lc	Data in	Le
ISO/IEC 14443-2 Test	'FF'	'92'	'XX'	RFU	'XX'	'XX'	-

Table M.30 — R-APDU for ISO/IEC 14443-2 Test Command

Data out	SW1-SW2
-	'XXXX'

Table M.31 — P1-Subcarrier and Data Coding Parameter

b8	b7	b6	b5	b4	b3	b2	b1	Description
0	0	------						No carrier, RF is turned off
0	1	------						No sub-carrier, just carrier, RF is turned on
1	0	------						Carrier modulated with sub-carrier, if there are some bytes to transmit, Lc = n, n≠ 0
1	1	------						RFU
-----		RFU	0	-------				ISO/IEC 14443 Type A transmission[a]
-----		----	1	-------				ISO/IEC 14443 Type B transmission[a]
-----				RFU		0	0	Transmission at 106 kbit/s
-----						0	1	Transmission at 212 kbit/s
-----						1	0	Transmission at 424 kbit/s
-----						1	1	Transmission at 848 kbit/s

[a] The transmission according to the normal frame, which includes all framing e.g. start bit, stop bit, parity bit, SOF, EOF, CRC etc.

The following table lists the return codes in addition to the common return codes:

Table M.32 — Return Codes of ISO/IEC 14443-2 Test Command

SW1-SW2	Meaning
'6A83'	Transmission type not supported
'6A84'	Transmission speed is not supported

M.9.3.2 Transmit pattern and receive ISO/IEC 14443 command

This command transmits a bit pattern independent from any PICC command structure and coding. The pattern can be used to measure modulation index, rise and fall times, overshoots etc. This command can be used to test by using a PICC to receive any pattern by the PICC.

Table M.33 — C-APDU for Transmit Pattern and Receive ISO/IEC 14443

Command	CLA	INS	P1	P2	Lc	Data in	Le
Tx Pattern	'FF'	'94'	'XX'	'XX'	'XX'	Pattern	'XX'

Table M.34 — R-APDU for Transmit Pattern and Receive ISO/IEC 14443

Data out	SW1-SW2
-	'XXXX'

Table M.35 —P1 of Transmit Pattern and receive ISO/IEC 14443

b8	b7	b6	b5	b4	b3	b2	b1	Description
0	0	0	0	-	-	-	-	RFU
-	-	-	-	-	-	-	0	ISO/IEC 14443 Type A Transceive data coding
-	-	-	-	-	-	-	1	ISO/IEC 14443 Type B Transceive data coding
-	-	-	-	(xxx)b			-	No of bits of last byte will be transmitted, 0 means all bits will be transmitted

NOTE The data in the 'data in' field is not interrupted; the complete data is sent to the air. No framing, e.g. start bit, stop bit, CRC, SOF, EOF is not added.

Table M.36 — P2 of Transmit Pattern and Receive (bit rate) ISO/IEC 14443

b8	b7	b6	b5	b4	b3	b2	b1	Description
RFU		-	-	-	RFU	0	0	Transmit at 106 kbit/s
		-	-	-		0	1	Transmit at 212 kbit/s
		-	-	-		1	0	Transmit at 424 kbit/s
		-	-	-		1	1	Transmit at 848 kbit/s
		RFU	0	0	-	-	-	Receive at 106 kbit/s
			0	1	-	-	-	Receive at 212 kbit/s
			1	0	-	-	-	Receive at 424 kbit/s
			1	1	-	-	-	Receive at 848 kbit/s

Table M.37 —Return codes of Transmit Pattern and Receive ISO/IEC 14443

SW1-SW2	Meaning
'6A83'	Transmission type not supported
'6A84'	Transmission speed is not supported
'6A87'	Different bit rate is not supported
'6A8A'	Modulation index is not supported

M.9.3.3 ISO/IEC 14443-3 test command

This command transmits an ISO/IEC 14443-3 command and returns the data received from the PICC.

Table M.38 —C-APDU for ISO/IEC 14443-3 Test Command

Command	CLA	INS	P1	P2	L_C	Data in	Le
ISO/IEC 14443-3 Test	'FF'	'96'	'XX'	'XX'	'XX'	'XX'	'XX'

Table M.39 —R-APDU for ISO/IEC 14443-3:2001 Test Command

Data out	SW1-SW2
Response of the card	'XXXX'

Table M.40 — P1: Command byte

b8	b7	b6	b5	b4	b3	b2	b1	Description
--	--	--	0	ISO/IEC 14443 Type A command				
				0	0	0	1	REQA
				0	0	1	0	WUPA
				0	0	1	1	HLTA
				0	1	0	0	PCD does complete part 3 Type A, returns UID + SAK
				1	Anti-collision is handled by user			
					0	0	1	ANTICOLLISION Sel_level 1
					0	1	0	ANTICOLLISION Sel_level 2
					0	1	1	ANTICOLLISION Sel_level 3
					1	0	0	SELECT (Data in field: 70 + last 4-byte UID + BCC)
				Other values are RFU				
			1	ISO/IEC 14443 Type B command				
				0	0	0	1	REQB (P2 sets the number of slot)
				0	0	1	0	WUPB (P2 sets the number of slot)
				0	0	1	1	HLTB
				0	1	0	0	Slot-MARKER (slot number in P2)