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Cards and security devices for personal identification — Test methods —

Part 6:
Contactless proximity objects

Cartes et dispositifs de sécurité pour l'identification personnelle — Méthodes d'essai —

Partie 6: Objets sans contact de proximité

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Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, SC 17, *Cards and security devices for personal identification*.

This fourth edition cancels and replaces the third edition (ISO/IEC 10373-6:2016), which has been technically revised. It also incorporates the Amendment ISO/IEC 10373-6:2016/Amd.3:2018.

The main changes compared to the previous edition are as follows:

— enhancement of test methods for PCD load modulation reception and PICC transmission including introduction of Active Reference PICC and PICC amplitude and phase drift analysis tool;

— introduction of PICC Type A Frame Delay Time (FDT) determination method;

— extension of frame with error correction test methods.

A list of all the parts in the ISO/IEC 10373 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Cards and security devices for personal identification — Test methods —

Part 6:
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1 Scope

The ISO/IEC 10373 series defines test methods for characteristics of identification cards according to the definition given in ISO/IEC 7810. Each test method is cross-referenced to one or more base standards, which can be ISO/IEC 7810 or one or more of the supplementary standards that define the information storage technologies employed in identification card applications.

NOTE 1   Criteria for acceptability do not form part of the ISO/IEC 10373 series, but can be found in the International Standards mentioned above.

This document defines test methods which are specific to proximity cards and objects, proximity coupling devices and proximity extended devices, defined in ISO/IEC 14443-1, ISO/IEC 14443-2, ISO/IEC 14443-3 and ISO/IEC 14443-4.

NOTE 2   Test methods defined in this document are intended to be performed separately. A given proximity card or object, proximity coupling device or proximity extended device, is not required to pass through all the tests sequentially.

ISO/IEC 10373-1 defines test methods which are common to one or more integrated circuit card technologies and other parts in the ISO/IEC 10373 series deal with other technology-specific tests.

The conformance test plan defined in Annex O specifies the list of tests applicable for each part of the ISO/IEC 14443 series.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 7810, *Identification cards — Physical characteristics*

ISO/IEC 14443-1:2018, *Cards and security devices for personal identification — Contactless proximity objects — Part 1: Physical characteristics*

ISO/IEC 14443-2:2020, *Cards and security devices for personal identification — Contactless proximity objects — Part 2: Radio frequency power and signal interface*

ISO/IEC 14443-3:2018, *Cards and security devices for personal identification — Contactless proximity objects — Part 3: Initialization and anticollision*

ISO/IEC 14443-4:2018, *Cards and security devices for personal identification — Contactless proximity objects — Part 4: Transmission protocol*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 14443-1, ISO/IEC 14443-2, ISO/IEC 14443-3, ISO/IEC 14443-4 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
base standard
standard to which the *test method* (3.1.8) is used to verify conformance

3.1.2
CascadeLevels
number of cascade levels of the PICC

3.1.3
Command Set
set describing the PICC commands during initialization and anticollision

Note 1 to entry: See ISO/IEC 14443-3:2018, 6.4 for PICC Type A and ISO/IEC 14443-3:2018, 7.5 for PICC Type B.

3.1.4
loading effect
change in PCD antenna current caused by the presence of PICC(s) in the field due to the mutual coupling modifying the PCD antenna resonance and quality factor

3.1.5
Mute
no response within a specified timeout

EXAMPLE   Expiration of FWT.

3.1.6
scenario
defined typical protocol and application specific communication to be used with the *test methods* (3.1.8) defined in this document

3.1.7
Test Initial State
TIS
element from PICC states that is the PICC state before performing a specific PICC command from *Command Set* (3.1.3)

3.1.8
test method
method for testing characteristics of identification cards for the purpose of confirming their compliance with International Standards

3.1.9
Test Target State
TTS
element from PICC states that is the PICC state after performing a specific PICC command from *Command Set* (3.1.3)

3.2 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO/IEC 14443-1, ISO/IEC 14443-2, ISO/IEC 14443-3, ISO/IEC 14443-4 and the following apply.

NOTE   Elements in bold square brackets **[ ]** are optional definitions.

Answer to ATTRIB(cid)	Answer to ATTRIB, i.e. (MBLI = mbli, CID = cid, CRC_B), with mbli an arbitrary hex value (see ISO/IEC 14443-3:2018, 7.11)
ATTRIB(cid, fsdi)	Default ATTRIB command with PUPI from ATQB, CID = cid and Maximum Frame Size Code value = fsdi, i.e. ('1D' PUPI cid fsdi '01 00' CRC_B)
DUT	Device under test
$I(c)_n$**(**inf **[,**CID = cid**] [,**NAD = nad**] [,**~CRC**])**	ISO/IEC 14443-4 I-block with chaining bit $c \in \{1,0\}$, block number $n \in \{1,0\}$ and information field inf. By default no CID and no NAD will be transmitted. If CID = cid$\in\{0...15\}$ is specified, it will be transmitted as second parameter. If NAD = nad$\in\{0...'FF'\}$ is specified, it will be transmitted as third parameter (or second parameter if no CID is transmitted). If the literal '~CRC' is not specified, a valid CRC corresponding to the communication signal interface of the PICC will be transmitted by default (i.e. CRC_A or CRC_B)
IUT	Implementation Under Test (ISO/IEC 9646); within the scope of this document, IUT represents the PCD under the test
LT	Lower Tester (ISO/IEC 9646), the PICC-emulation part of the PCD-test-apparatus
N/A	Not applicable
PPS(cid, dri, dsi)	Default PPS request with CID = cid, DRI = dri and DSI = dsi, i.e. ('D' + cid '11' dsi × 4 + dri CRC_A)
$R(ACK$ **[,**CID = cid**] [,**~CRC**])**$_n$	ISO/IEC 14443-4 R(ACK) block with block number n. The definition of the optional CID and ~CRC symbols is as described in the $I(c)_n$ block above
$R(NAK$ **[,**CID = cid**][,**~CRC**])**$_n$	ISO/IEC 14443-4 R(NAK) block with block number n. The definition of the optional CID and ~CRC symbols is as described in the $I(c)_n$ block above
RATS(cid, fsdi)	Default RATS command with CID = cid and FSDI value = fsdi i.e. ('E0' fsdi × 16 + cid CRC_A)
READY(I)	READY state in cascade level I, $I \in \{1, 2, 3\}$; e.g. READY(2) is a PICC cascade level 2
READY*(I)	READY* state in cascade level I, $I \in \{1, 2, 3\}$; e.g. READY*(2) is a PICC cascade level 2
REQB(N)	REQB command with N as defined in ISO/IEC 14443-3:2018, 7.7
S(WTX)(WTXM **[,**CID = cid**][,**~CRC**])**	ISO/IEC 14443-4 S(WTX) block with parameter WTXM. The definition of the optional CID and ~CRC symbols is as described in the $I(c)_n$ block above

S(DESELECT [,CID = cid] [,~CRC])	ISO/IEC 14443-4 S(DESELECT) block. The definition of the optional CID and ~CRC symbols is as described in the $I(c)_n$ block above
SAK(cascade)	the SELECT(I) answer with the cascade bit (bit 3) set to (1)b
SAK(complete)	the SELECT(I) answer with the cascade bit (bit 3) set to (0)b
SEL(c)	Select code of level c (i.e. SEL(1) = '93', SEL(2) = '95', SEL(3) = '97')
SELECT(I)	SELECT command of cascade level I, i.e.
	SELECT(1) = ('93 70' $UIDTX_1$ BCC CRC_A)
	SELECT(2) = ('95 70' $UIDTX_2$ BCC CRC_A)
	SELECT(3) = ('97 70' $UIDTX_3$ BCC CRC_A)
SLOTMARKER(n)	Slot-MARKER command with slot number n, i.e. $(16 \times (n - 1) + 5$ CRC_B)
TB-PDU	Transmission Block Protocol Data Unit, which consists of either I-block, R-block or S-block
TEST_COMMAND_SEQUENCE1	Sequence of commands used for several PICC tests.
	NOTE Its definition depends on applicative layer and represents a standard transaction of the application supported by the DUT. The applicant may also provide a specified set of commands.
TEST_COMMAND1(1)	Default test command consisting of one unchained I-block
	NOTE This command depends on the negotiated maximum frame size value of the PICC.
TEST_COMMAND1(n), n > 1	Default test command consisting of n chained I-blocks (PCD chaining)
	NOTE This command depends on the negotiated maximum frame size value of the PICC.
TEST_COMMAND1(n)$_k$	INF field of k'th I-block chain of TEST_COMMAND1(n)
	NOTE This command depends on the negotiated maximum frame size value of the PICC.
TEST_COMMAND2(n), n > 1	Default test command which expects a response consisting of n chained I-blocks
	NOTE This command depends on the negotiated maximum frame size value of the PCD.
TEST_COMMAND3	Default test command consisting of one I-block which needs more than FWT time for execution
TEST_COMMAND4	Default test command which expects a response of one I-block complying with the PICC transmission minimum frame length required for the PICC transmission test
TEST_RESPONSE1(n)	INF field of the response to TEST_COMMAND1(n)
	NOTE This response is assumed to be always unchained.

TEST_RESPONSE2(n)	Response to TEST_COMMAND2(n)
	NOTE This response depends on the negotiated maximum frame size value of the PCD.
TEST_RESPONSE2(n)$_k$	INF field of k'th I-block chain of TEST_RESPONSE2(n)
	NOTE This response depends on the negotiated maximum frame size value of the PCD.
TEST_RESPONSE3	Response I-block to TEST_COMMAND3
	NOTE This response is always assumed to be unchained.
TEST_RESPONSE4	Response I-block to TEST_COMMAND4
TM-PDU	Test Management Protocol Data Unit (ISO/IEC 9646-1, PDU)
t_{START}	Start of PICC transmission
UIDTX$_I$	Transmitted UID 32-bit data at cascade level I (see Table 1)
UT	Upper Tester (ISO/IEC 9646), the master part of the PCD-test-apparatus
UT_APDU	Upper Tester Application Protocol Data Unit: a packet of data to be sent by the PCD to the LT through the RF interface
V_{load}	DC voltage measured at connector CON3 of the Reference PICC
WUPB(N)	WUPB command with N as defined in ISO/IEC 14443-3:2018, 7.7
~X	Bit sequence consisting of the inverted bits of bit sequence X or any other bit sequence different from X
X[[a...b]]	Bit subsequence of bit sequence X consisting of the bits between position a and b included. If a > b then the sequence is empty
X[[n]]	Bit at position n of bit sequence X. First bit is at position 1
X[n]	Byte at position n of bit sequence X. First byte is at position 1 (i.e. X[n] = X[[(n − 1) × 8 + 1...n × 8]])

Table 1 — Mapping from UID to UIDTX

Cascade level	Single UID PICC	Double UID PICC	Triple UID PICC
UIDTX$_1$	UID0 UID1 UID2 UID3	'88' UID0 UID1 UID2	'88' UID0 UID1 UID2
UIDTX$_2$	—	UID3 UID4 UID5 UID6	'88' UID3 UID4 UID5
UIDTX$_3$	—	—	UID6 UID7 UID8 UID9

4   Default items applicable to the test methods

4.1   Test environment

Unless otherwise specified, testing shall take place in an environment of temperature 23 °C ± 3 °C (73 °F ± 5 °F) and of relative humidity 25 % to 75 %.

4.2   Pre-conditioning

No environmental pre-conditioning of PICCs or PCDs is required by the test methods in this document.

4.3 Setup tolerances

The following absolute tolerances shall be used when adjusting the Test PCD assembly modulation waveform:

1) for timings (t_1, t_2, t_3, t_5, t_6, t_r, t_f):

    a) $\pm 1/f_c$ for a PCD to PICC bit rate of $f_c/128$

    b) $\pm 0{,}5/f_c$ for a PCD to PICC bit rate of $f_c/64$

    c) $\pm 0{,}3/f_c$ for PCD to PICC bit rates higher than $f_c/64$

2) for envelope overshoot, Type A, PCD to PICC bit rate of $f_c/128$: $\pm 1\ \%$ of H_{INITIAL}

3) for envelope overshoot, Type A, PCD to PICC bit rates higher than $f_c/128$: $\pm 0{,}01 \times (1\text{-}a)$

4) for envelope overshoot and undershoot, Type B: $\pm 0{,}01 \times (1\text{-}b)$

5) for the modulation index m: $\pm 0{,}5\ \%$

6) for the pulse shape factor a: $\pm 0{,}02$

7) for PCD field envelope during 60 % of t_2: $\pm 0{,}5\ \%$ of H_{INITIAL}

Unless otherwise specified, a tolerance of ±5 % shall be applied to the quantity values given to specify the characteristics of the test equipment (e.g. linear dimensions) and the test method procedures (e.g. test equipment adjustments).

4.4 Spurious inductance

Resistors and capacitors should have negligible inductance.

4.5 Measurement uncertainty

The measurement uncertainty for each quantity determined by these test methods shall be stated in the test report.

Basic information is given in ISO/IEC Guide 98-3.

4.6 DUT position

Unless otherwise specified, the PICC and Reference PICC antennas shall be centered on the sense coil a of the test PCD assembly.

4.7 Test conditions for PCD

Unless otherwise specified, the test conditions defined in Table 2 shall be applied.

Table 2 — Test conditions for PCD

Conditions	Values
Type	Type A and Type B
Test positions	Position 0: See Table 3
	Position Z_{max}: See Table 3
Reference PICCs	Reference PICC 1, Reference PICC 2 and Reference PICC 3
	In accordance with the support of optional PICC classes as declared by the PCD manufacturer in Table 3:
	— Reference PICC 4 if PICC Class 4 is supported,
	— Reference PICC 5 if PICC Class 5 is supported,
	— Reference PICC 6 if PICC Class 6 is supported.

The information defined in Table 3 shall be provided by the PCD manufacturer.

Table 3 — PCD manufacturer information

Parameter	Description	Unit
Position 0	Position and orientation of the Reference PICCs on the PCD surface. This position may be PICC classes dependent.	
Position Z_{max}	Position with maximum operating distance on the Z axis[a]. This position may be PICC classes dependent.	
Temperature range	Minimum and maximum temperature values.	°C
Optional PICC classes	List of supported optional PICC classes (4 and/or 5 and/or 6).	
PCD to PICC supported bit rates	List of supported optional PCD to PICC bit rates.	
PICC to PCD supported bit rates	List of supported optional PICC to PCD bit rates.	
Maximum frame size supported	Maximum frame size in reception.	bytes
PCD to PICC frame with error correction supported	Frame with error correction from PCD to PICC.	
PICC to PCD frame with error correction supported	Frame with error correction from PICC to PCD.	
[a] Z axis shall be perpendicular to the PCD surface through Position 0. If the PCD surface is not flat, Z axis shall correspond to the axis along which PICCs would habitually be held to the PCD and shall be coherent with PCD ergonomics; if not, the test laboratory may choose to redefine it (directionally).		

Unless otherwise specified, the values defined in Table 4 shall be used to adjust PCD-test-apparatus parameters.

Table 4 — Values of the PCD-test-apparatus parameters unless otherwise specified

Parameter	Value	Applies to
PCD to PICC and PICC to PCD bit rates	$f_c/128$	Type A and Type B
Load modulation amplitude	More than 20 mV at H_{min}	Type A and Type B
Reference PICCs resonance frequency	16,5 MHz	Type A and Type B
J1 setting	position 'a'	Type A and Type B
J2 setting	position 'a'	Type A and Type B
Reference PICCs position	Position Z_{max}	Type A and Type B
Start Of Frame (SOF) timing	10 etu "0" followed by 2 etu "1"	Type B
End Of Frame (EOF) timing	10 etu "0"	Type B
Extra Guard Time (EGT) timing	0 etu	Type B
TR0 for ATQB and DESELECT	$200/f_s$	Type B

Table 4 *(continued)*

Parameter	Value	Applies to
Frame waiting time	Any value as specified in ISO/IEC 14443-4:2018, 7.2	Type A and Type B
UID	Any of the size and contents as specified in ISO/IEC 14443-3:2018, 6.5.4	Type A
TR1	$140/f_s$	Type B
FSCI	8	Type A
Maximum Frame Size Code in ATQB	8	Type B

4.8 Test conditions for PICC

Unless otherwise specified, the test conditions defined in Table 5 shall be applied:

Table 5 — Test conditions for PICC

Conditions	Values	
Field strength[a]	For PICC Class 1:	1,5 A/m, 2,5 A/m, 4,5 A/m and 7,5 A/m
	For PICC Class 2 and Class 3:	1,5 A/m, 2,5 A/m, 4,5 A/m and 8,5 A/m
	For PICC Class 4:	2 A/m, 4 A/m, 7 A/m and 12 A/m
	For PICC Class 5:	2,5 A/m, 4,5 A/m, 8 A/m and 14 A/m
	For PICC Class 6:	4,5 A/m, 7 A/m, 11 A/m and 18 A/m
[a] Any additional field strength values between H_{min} and H_{max} may be applied.		

The information defined in Table 6 shall be provided by the PICC manufacturer.

Table 6 — PICC manufacturer information

Parameter	Description	Unit
Location of the external rectangle/circle of the claimed PICC class[a]	Drawing with dimensions of PICC outside shape and the position of the external rectangle/circle of the claimed PICC class.	
PICC class (optional)[a]	Claimed PICC class.	
Resonance frequency range (optional)	Minimum and maximum resonance frequency.	MHz
Communication signal interface	Supported communication signal interface(s): — Type A — Type B — Type A and Type B	
Temperature range	Minimum and maximum operating temperature	°C
PCD to PICC supported bit rates	List of supported optional PCD to PICC bit rates	
PICC to PCD supported bit rates	List of supported optional PICC to PCD bit rates	
Same bit rate for both directions	Indication if only same bit rate from PCD to PICC and from PICC to PCD is supported	
Random or fixed UID (Type A) or PUPI (Type B)	Indication whether the UID (Type A) or PUPI (Type B) is random or fixed	
Maximum frame size supported	Maximum frame size in reception	bytes
[a] If not provided, test methods for PICC Class 1 shall be used.		