INTERNATIONAL STANDARD

ISO/IEC 10373-6

First edition
2001-05-15

AMENDMENT 1
2007-04-01

Identification cards — Test methods —

Part 6: **Proximity cards**

AMENDMENT 1: Protocol test methods for proximity cards

Cartes d'identification — Méthodes d'essai —

Partie 6: Cartes de proximité

AMENDEMENT 1: Méthodes d'essai du protocole pour cartes de proximité

Reference number
ISO/IEC 10373-6:2001/Amd.1:2007(E)

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Published in Switzerland

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NOTE The table of contents is given for convenience only and should not be inserted in the amended standard.

Foreword

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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.

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Amendment 1 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 1: Protocol test methods for proximity cards

Page 1, Clause 2

Add the following to the list of normative references:

"ISO/IEC 14443-4, *Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 4: Transmission protocol*"

Page 2, Clause 3

Replace the first sentence with the following:

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

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

Page 2, Subclause 3.1

Add the following terms and definitions:

3.1.4
CascadeLevels
number of cascade levels of the PICC

3.1.5
Command Set
set describing the PICC commands during initialization and anticollision

NOTE See ISO/IEC 14443-3:2001, 6.3 for PICC type A and ISO/IEC 14443-3:2001, 7.5 for PICC type B.

3.1.6
Mute
no response within a specified timeout, e.g. expiration of FWT

3.1.7
PICC States
different PICC states during initialization and anticollision

NOTE See ISO/IEC 14443-3:2001, 6.2 for PICC type A and ISO/IEC 14443-3:2001, 7.4 for PICC type B.

3.1.8
Scenario
defined typical protocol and application specific communication to be used with the test methods defined in this part of ISO/IEC 10373

3.1.9
Test Initial State
TIS
element from PICC States that is the PICC state before performing a specific PICC command from Command Set

3.1.10
Test Target State
TTS
element from PICC States that is the PICC state after performing a specific PICC command from Command Set

Page 2, Subclause 3.2

Add the following alphabetically to the list of abbreviations and symbols:

ATA(cid)	Answer to ATTRIB, i.e. (mbli+cid CRC_B), with mbli an arbitrary hex value (see ISO/IEC 14443-3:2001, 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)
SELECT(l)	SELECT command of cascade level l, 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)
READY(l)	READY state in cascade level l, l ∈ {1, 2, 3}; i. e. READY(2) is a PICC cascade level 2
READY*(l)	READY* state in cascade level l, l ∈ {1, 2, 3}; i. e. READY*(2) is a PICC cascade level 2
REQB(s)	REQB command with slot parameter s, s codes N as defined in ISO/IEC 14443-3:2001, 7.7.4 i.e. ('05 00' s CRC_B)
WUPB(s)	WUPB command with slot parameter s, s codes N as defined in ISO/IEC 14443-3:2001, 7.7.4 i.e. ('05 00' 8+s CRC_B)
SLOTMARKER(n)	Slot-MARKER command with slot number n, i.e. (16*(n-1)+5 CRC_B)
RATS(cid, fsdi)	Default RATS command with CID=cid and FSDI value = fsdi i.e. (' E0' fsdi*16+cid CRC_A)
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)
SEL(c)	Select code of level c (i.e. SEL(1) = '93', SEL(2) = '95', SEL(3) = '97')
SAK(cascade)	the SELECT(l) answer with the cascade bit (bit 3) set to 1
SAK(complete)	the SELECT(l) answer with the cascade bit (bit 3) set to 0
$UIDTX_n$	transmitted UID 32-bit data at cascade level n (see Table 1 — Mapping from UID to UIDTX)
WUPB(s)	WUPB command with slot parameter s, s codes N as defined in ISO/IEC 14443-3:2001, 7.7.4 i.e. ('05 00' 8+s CRC_B)

~X	Bit sequence consisting of the inverted bits of bit sequence X or any other bit sequence different from X.
X[[n]]	Bit at position n of bit sequence X. First bit is at position 1
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]	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]])
X[a..b]	Bit subsequence of bit sequence X consisting of the bits between position a*8 and b*8, with bit b*8 not included. (i.e. X[a..b] = X[[(a-1)*8+1..(b-1)*8+1]])
$I(c)_n$(inf **[**,CID=cid**]** **[**,NAD=nad**]** **[**,~CRC**])**	ISO/IEC 14443-4 I-Block with chaining bit c∈{1,0}, block number n∈{1,0} and information field inf. By default no CID and no NAD will be transmitted. If CID=cid∈{0...15} is specified, it will be transmitted as second parameter. If NAD=nad∈{0...'FF'} is specified it will be transmitted as third parameter. If the literal '~CRC' is not specified, a valid CRC corresponding to the type of the PICC will be transmitted by default (i.e. CRC_A or CRC_B).
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.
S(WTX)(n **[**,CID=cid**][**,~CRC**])**	ISO/IEC 14443-4 S(WTX) block with parameter WTXM= n. 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.
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 I-block depends on the negotiated maximum frame size value of the PICC
TEST_RESPONSE1(n)	INF field of the response to TEST_COMMAND1(n). This response is assumed to be always unchained.
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_RESPONSE2(n)	Response to TEST_COMMAND2(n) Note: This I-block 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 I-block depends on the negotiated maximum frame size value of the PCD.
TEST_COMMAND3	Default test command consisting of one I-block which needs between n*FWT and (n+1)*FWT time for execution
TEST_RESPONSE3	Response I-block to TEST_COMMAND3. This response is always assumed to be unchained.

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

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Add the following annex after Annex F:

Annex G
(normative)

Additional PICC test methods

G.1 PICC-test-apparatus and accessories

This clause defines the test apparatus and test circuits for verifying the operation of a PICC according to ISO/IEC 14443-3:2001. The test apparatus includes:

— Calibration coil (see 6.1 of ISO/IEC 10373-6)

— Test PCD assembly (see 6.2 of ISO/IEC 10373-6)

— Digital sampling oscilloscope (see 6.4 of ISO/IEC 10373-6)

Care shall be taken to ensure that the results are not affected by the RF performance of the test circuits.

G.1.1 Emulating the I/O protocol

The PICC-test-apparatus shall be able to emulate the protocol type A, type B, which are required to test a PICC.

G.1.2 Generating the I/O character timing in reception mode

The PICC-test-apparatus shall be able to generate the I/O bit stream according to ISO/IEC 14443-3:2001. Timing parameters: start bit length, guard time, bit width, request guard time, start of frame width, end of frame width shall be configurable.

G.1.3 Measuring and monitoring the RF I/O protocol

The PICC-test-apparatus shall be able to measure and monitor the timing of the logical low and high states of the RF Input/Receive line relative to the CLK frequency. The PICC-test-apparatus shall be able to monitor the PICC subcarrier.

G.1.4 Protocol Analysis

The PICC-test-apparatus shall be able to analyse the I/O-bit stream in accordance with protocol type A and type B as specified in ISO/IEC 14443-3,4 and extract the logical data flow for further protocol analysis.

G.1.5 RFU fields

RFU fields should be constantly monitored during the testing and shall always be verified to contain the assigned default value. A test shall fail and the tested PICC declared non-compliant in case an RFU field is not set to its default value at any time.

G.1.5.1 RFU values

Functional fields should be constantly monitored during the testing and shall always be verified to contain only functional values documented in the standard or proprietary values documented in the standard. A test shall fail and the tested PICC be declared non-compliant in case a functional field is not set to said values (and thus is set to an RFU or restricted value) at any time.

G.1.5.2 Timing measurements

The PICC-test-apparatus shall continuously monitor the following frame format and timing values:

For PICC Type A:

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

— Frame formats (see ISO/IEC 14443-3:2001, 6.1.5)

— Frame waiting time (see ISO/IEC 14443-4:2001, 7.2)

For PICC Type B:

— Character, frame format and timing (see ISO/IEC 14443-3:2001, 7.1)

— Frame waiting time (see ISO/IEC 14443-4:2001, 7.2)

A test shall fail and the tested PICC be declared non-compliant in case one of the listed timing constraints is violated.

G.1.5.3 Timing measurement report

Fill out Table G.30 — Type A specific timing table for PICC type A and/or Table G.31 — Type B specific timing table for PICC type B with the measure timing values

G.2 Relationship of test methods versus base standard requirement

Tests in “Table G.1 — Test methods for logical operation of the PICC type A protocol” shall apply to Type A PICCs.

Tests in “Table G.2 — Test methods for logical operation of the PICC type B protocol” shall apply to Type B PICCs.

Tests in “Table G.3 — Test methods for logical operation of PICC of type A/B” shall apply both to Type A and Type B PICCs.

The ISO/IEC 14443-4:2001 PICC should also comply with ISO/IEC 14443-3:2001 and should be subjected to both the part 3 and part 4 tests for the applicable Type.

A PICC compliant with ISO/IEC 14443-3:2001 but not with ISO/IEC 14443-4:2001 and in ACTIVE or ACTIVE* state (see G.3.4.7, G.3.4.12 and G.4.4.6) may respond with any frame (including mute) to frames not related to ISO/IEC 14443-3:2001.

Table G.1 — Test methods for logical operation of the PICC type A protocol

Test method from ISO/IEC 10373-6		Corresponding requirement	
Clause	**Name**	**Base standard**	**Clause(s)**
G.3.2	Polling	ISO/IEC 14443-3:2001	5
G.3.4	Testing of the PICC type A state transitions	ISO/IEC 14443-3:2001	6.2, 6.3,6.4
G.3.5	Handling of type A anticollision	ISO/IEC 14443-3:2001	6.3.2
G.3.6	Handling of RATS	ISO/IEC 14443-4:2001	5.6.1
G.3.7	Handling of PPS request	ISO/IEC 14443-4:2001	5.6.2
G.3.8	Handling of FSD	ISO/IEC 14443-4:2001	5.1

Table G.2 — Test methods for logical operation of the PICC type B protocol

Test method from ISO/IEC 10373-6		Corresponding requirement	
Clause	**Name**	**Base standard**	**Clause(s)**
G.4.2	Polling	ISO/IEC 14443-3:2001	5
G.4.3	PICC Reception	ISO/IEC 14443-3:2001	7.1
G.4.4	Testing of the PICC Type B State Transitions	ISO/IEC 14443-3:2001	7.4 – 7.12
G.4.5	Handling of type B anticollision	ISO/IEC 14443-3:2001	7.4 – 7.12
G.4.6	Handling of ATTRIB	ISO/IEC 14443-3:2001	7.10
G.4.7	Scenario 31 Handling of Maximum Frame Size	ISO/IEC 14443-3:2001	7.10.4

Table G.3 — Test methods for logical operation of PICC of type A/B

Test method from ISO/IEC 10373-6		Corresponding requirement	
Clause	**Name**	**Base standard**	**Clause(s)**
G.5.2	PICC reaction to ISO/IEC 14443-4 Scenarios	ISO/IEC 14443-4:2001	7
G.5.3	Handling of PICC error detection	ISO/IEC 14443-4:2001	7
G.5.4	PICC reaction on CID	ISO/IEC 14443-4:2001	7.1.1.2
G.5.5	PICC reaction on NAD	ISO/IEC 14443-4:2001	7.1.1.3

G.3 Test method for initialisation of the PICC of type A

G.3.1 Introduction

The tests in this chapter determine whether a PICC of type A conforms to the ISO/IEC 14443-3 standard and the activation sequence of ISO/IEC 14443-4:2001, 5.

G.3.2 Scenario 1: Polling

G.3.2.1 Scope

This test is to determine the behaviour of the PICC type A on receiving REQA commands according to ISO/IEC 14443-3:2001, 5.

G.3.3 Procedure

Perform the following steps for 3 different operating fields of 1,5, 4,5 and 7,5 A/m:

1: Place the PICC into the field and adjust it.

2: Switch the RF operating field off for a minimum time for resetting a PICC (see ISO/IEC 14443-3:2001/Amd.1, 5.4).

3: Switch the RF operating field on.

4: Do delay of 5 ms and send a valid REQA Command frame.

5: Record the presence and the content of the PICC response.

6: Switch the RF operating field off for a minimum time for resetting a PICC (see ISO/IEC14443-3:2001/Amd.1, 5.4).

7: Switch the RF operating field on.

8: Wait 5 ms and send a valid REQB Command frame (using type B modulation and bit coding).

9: Wait 5 ms and send a valid REQA Command frame.

10: Record the presence and the content of the PICC response.

G.3.3.1 Test report

Fill the appropriate row in “Table G.32 — Reported Results for type A specific test methods” according to the test results as follows:

Explanation	Test result
If the PICC’s response is a valid ATQA in steps 5 and 10	Pass
If the PICC’s response isn’t a valid ATQA in steps 5 or 10	Fail

G.3.4 Testing of the PICC type A state transitions

G.3.4.1 Scope

These tests verify the correct implementation of the PICC type A state machine as described in ISO/IEC 14443-3:2001, 6.2.

G.3.4.2 General test outline

For an exhaustive test of the PICC type A state machine the correctness of every possible state transition at every state shall be verified. Verifying a specific state using a specific state transition will be done as follows:

First, reset the PICC and place it in the test initial state (TIS). This is one of the states from StateSet where the transitions (T) have to be verified. Then execute a transition (T) from TransitionSet. After execution of the state transition, check if the PICC is in the expected target state TTS. There is a difficulty in how to perform this check, because it is impossible to directly inspect the state machine of the PICC. The solution to this problem is to make some additional state transitions and checking the answer of the PICC. The transitions for this purpose are selected in such way that the state can be determined from the PICC answers as precisely as possible.

G.3.4.2.1 Functions for putting the PICC in the Test Initial State (TIS)

Putting the PICC into the State TIS will be done by a sequence of transition commands specified in the following table. The general method is as follows:

In order to put the PICC into State TIS, lookup the corresponding state transition sequence in Table G.4 — State Transition Sequence Table. Then successively apply the state transitions described in the State Transition Sequence column by looking up the corresponding commands in Table G.5 — State Transition Table. Always check the content and integrity of the PICC response.

Table G.4 — State Transition Sequence Table

TIS	State Transition Sequence
POWER_OFF	---
IDLE	POWER_OFF →IDLE
READY(1)	POWER_OFF →IDLE → READY(1)
READY(2)	POWER_OFF →IDLE → READY(1) → READY(2)
READY(3)	POWER_OFF →IDLE → READY(1) → READY(2) → READY(3)
ACTIVE	POWER_OFF →IDLE→ READY(1) → … → READY(CascadeLevels)→ ACTIVE
PROTOCOL	POWER_OFF →IDLE→ READY(1) → … → READY(CascadeLevels) → ACTIVE → PROTOCOL
HALT	POWER_OFF →IDLE → READY(1) → …→READY(CascadeLevels) → ACTIVE → HALT
READY*(1)	POWER_OFF →IDLE→ READY(1) → …→ READY(CascadeLevels) → ACTIVE → HALT → READY*(1)
READY*(2)	POWER_OFF →IDLE → READY(1) → … → READY(CascadeLevels) → ACTIVE → HALT → READY*(1) → READY*(2)
READY*(3)	POWER_OFF →IDLE → READY(CascadeLevels) → ACTIVE → HALT → READY*(1) → READY*(2) → READY*(3)
ACTIVE*	POWER_OFF →IDLE → READY(1) → …→ READY (CascadeLevels)→ ACTIVE → HALT → READY*(1) → …→ READY*(CascadeLevels) → ACTIVE*

Table G.5 — State Transition Table

State → Next State	PICC-test-apparatus		PICC
POWER_OFF → IDLE	Power On (RF Field on)	→ ←	Mute
IDLE → READY(1)	REQA	→ ←	ATQA
READY(1) → READY(2)	SELECT(1)	→ ←	SAK (cascade)
READY(2) → READY(3)	SELECT(2)	→ ←	SAK (cascade)
READY(CascadeLevels) → ACTIVE	SELECT (CascadeLevels)	→ ←	SAK (complete)
ACTIVE → PROTOCOL	RATS(0,0)	→ ←	ATS
ACTIVE → HALT	HLTA	→ ←	Mute
HALT→ READY*(1)	WUPA	→ ←	ATQA
READY*(1) → READY*(2)	SELECT(1)	→ ←	SAK (cascade)
READY*(2) → READY*(3)	SELECT(2)	→ ←	SAK(cascade)
READY*(CascadeLevels) →ACTIVE*	SELECT (CascadeLevels)	→ ←	SAK (complete)

G.3.4.2.2 Functions for checking the validity of the test target state (TTS)

The following table describes the state transitions, which are used to check whether the PICC is in the state S. The content of the PICC answer (i.e. ATQA, SAK, ...) should be thoroughly checked for ISO conformance. Please note, that these tests may cause the PICC to change state.

The READY(n)/ READY*(n) states and the ACTIVE/ACTIVE* states cannot be distinguished with one test run. In order to distinguish the "*"-states from the non-"*"-states perform the following steps:

1: Rerun the test a second time, without checking the TTS.

2: Send REQA command. The PICC response shall be Mute.

3: Send REQA command.

4: If the PICC response is Mute then the PICC state was a "*"-state.

5: Else the PICC was a non-"*"-state.

The HALT state cannot be distinguished from READY*(n) state and from ACTIVE* state with one test run. In order to distinguish the HALT state perform the following steps:

1: Rerun the test a second time, without checking the TTS.

2: Send WUPA command. The PICC response shall be ATQA.

Table G.6 — Checking the TTS

State S	PICC-test-apparatus		PICC
IDLE	REQA	⟶	
		⟵	ATQA
READY(n), n < CascadeLevels	SELECT (n)	⟶	
		⟵	SAK (cascade)
READY(n), n = CascadeLevels	SELECT (n)	⟶	
		⟵	SAK (complete)
ACTIVE	RATS (0,0)	⟶	
		⟵	ATS
PROTOCOL	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE1(1))
HALT	REQA	⟶	
		⟵	Mute
	WUPA	⟶	
		⟵	ATQA
READY*(n), n < CascadeLevels	SELECT (n)	⟶	
		⟵	SAK (cascade)
READY*(n), n = CascadeLevels	SELECT (n)	⟶	
		⟵	SAK (complete)
ACTIVE*	RATS(0,0)	⟶	
		⟵	ATS

G.3.4.3 Scenario 2: Behaviour of the PICC type A in the IDLE state

G.3.4.3.1 Scope

This test is to determine the behaviour of the PICC type A in the IDLE state according to ISO/IEC 14443-3:2001, 6.2.2.

G.3.4.3.2 Procedure

Perform the following steps for every row of Table G.7 — Transitions from IDLE state:

1: Put the PICC into IDLE state.

2: Perform the state transition by sending the command as indicated in the PICC-test-apparatus column.

3: Check if the PICC response is as indicated in the PICC column.

4: If the PICC response is not Mute, check that the Frame Delay Time of the PICC conforms with the value indicated in the FDT column.

5: Check if the PICC is in the state TTS.

Table G.7 — Transitions from IDLE state

Transition	PICC-test-apparatus		PICC	FDT	TTS
REQA	REQA	→			
		←	ATQA	1172/*fc*	READY(1)
WUPA	WUPA	→			
		←	ATQA	1236/*fc*	READY(1)
HLTA	HLTA	→			
		←	Mute		IDLE
AC	('93' NVB UIDTX$_1$[[1..n$_1$]]) [a]	→			
		←	Mute		IDLE
nAC	('93' NVB ~UIDTX$_1$[[1.. n$_1$]]) [a]	→			
		←	Mute		IDLE
SELECT	SELECT(1)	→			
		←	Mute		IDLE
nSELECT	('93 70' ~UIDTX$_1$[[1..32]] BCC CRC_A)	→			
		←	Mute		IDLE
RATS	RATS(0,0)	→			
		←	Mute		IDLE
PPS	PPS(0,0,0)	→			
		←	Mute		IDLE
ISO/IEC 14443-4 command	I(0)$_0$(TEST_COMMAND1(1))	→			
		←	Mute		IDLE
DESELECT	S(DESELECT)	→			
		←	Mute		IDLE
Error condition	('26') [b]	→			
		←	Mute		IDLE

[a] Let 1 ≤ n1 ≤ 32

[b] The value is sent in a standard frame and not in a short frame

G.3.4.3.3 Test report

Fill the appropriate row in "Table G.32 — Reported Results for type A specific test methods" according to the test results as follows:

Explanation	Test result
If the PICC responded as indicated in the procedure	Pass
Any other case	Fail