INTERNATIONAL STANDARD

ISO/IEC 10373-6

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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
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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

G.3.4.4 Scenario 3: Behaviour of the PICC type A in the READY(1) state

G.3.4.4.1 Scope

This test is to determine the behaviour of the PICC type A in the READY state on cascade level 1 according to ISO/IEC 14443-3:2001, 6.2.3.

G.3.4.4.2 Procedure

Perform the following steps for all PICCs and every row of Table G.8 — Transitions from READY(1) state:

1: Put the PICC into READY(1) 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.8 — Transitions from READY(1) state

Transition	PICC-test-apparatus		PICC	FDT	TTS
REQA	REQA	→			IDLE
		←	Mute		
WUPA	WUPA	→			IDLE
		←	Mute		
HLTA	HLTA	→			IDLE
		←	Mute		
AC (split at 0-bit)	('93' NVB $UIDTX_1[[1..n_1]]$) [a]	→			
		←	if n1=32 then (BCC) else ($UIDTX_1[[n_1+1..32]]$ BCC) [a]	1172/*fc*	READY(1)
AC (split at 1-bit)	('93' NVB $UIDTX_1[[1..n_2]]$) [b]	→			
		←	if n2=32 then (BCC) else ($UIDTX_1[[n_2+1..32]]$ BCC) [b]	1236/*fc*	READY(1)
nAC (wrong UID)	('93' NVB ~$UIDTX_1[[1..n_3]]$) [f]	→			IDLE
		←	Mute		
SELECT	SELECT(1)	→			TTS [e]
		←	SAK [d]	FDT [c]	
nSELECT (wrong UID)	('93 70' ~$UIDTX_1$ BCC CRC_A)	→			IDLE
		←	Mute		

Transition	PICC-test-apparatus		PICC	FDT	TTS
Error condition	(‘93 70’ $UIDTX_1$ BCC ~CRC_A)	⟶			IDLE
		⟵	Mute		
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	⟶			IDLE
		⟵	Mute		
DESELECT	S(DESELECT)	⟶			IDLE
		⟵	Mute		
RATS	RATS(0,0)	⟶			IDLE
		⟵	Mute		
PPS	PPS(0,0,0)	⟶			IDLE
		⟵	Mute		

[a] Let $1 \le n1 \le 32$, UIDTX1[[n1]] = 0. If such a number does not exist, the test can be skipped.

[b] Let $1 \le n2 \le 32$, UIDTX1[[n2]] = 1 If such a number does not exist, the test can be skipped.

[c] FDT is 1172/fc (~86,43 μs) if last bit = (0)b and 1236/fc (~91,15 μs) if last bit = (1)b. (see margin in the base standard).

[d] Cascade bit of SAK shall be zero for single size UID PICCs and one for double and triple size UID PICCs.

[e] Single size UID PICC shall be in ACTIVE state; double and triple size UID PICCs shall be in READY state.

[f] Let $1 \le n3 \le 32$.

G.3.4.4.3 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

G.3.4.5 Scenario 4: Behaviour of the PICC type A in the READY(2) state

G.3.4.5.1 Scope

This test is to determine the behaviour of the PICC type A in the READY state on cascade level 2 according to ISO/IEC 14443-3:2001, 6.2.3. This test is only for PICCs with double or triple size UID.

G.3.4.5.2 Procedure

Perform the following steps for all PICCs with double and triple size UID and every row of Table G.9 — Transitions from READY(2) state:

1: Put the PICC into READY(2) 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.9 — Transitions from READY(2) state

Transition	PICC-test-apparatus		PICC	FDT	TTS
REQA	REQA	⟶			IDLE
		⟵	Mute		
WUPA	WUPA	⟶			IDLE
		⟵	Mute		
HLTA	HLTA	⟶			IDLE
		⟵	Mute		
AC (split at 0-bit)	('95' NVB $UIDTX_2[[1..n_1]]$) [a]	⟶		1172/*fc*	READY(2)
		⟵	if n1=32 then (BCC) else ($UIDTX_2[[n_1+1..32]]$ BCC) [a]		
AC (split at 1-bit)	('95' NVB $UIDTX_2[[1..n_2]]$) [b]	⟶		1236/*fc*	READY(2)
		⟵	if n2=32 then (BCC) else ($UIDTX_2[[n_2+1..32]]$ BCC) [b]		
nAC (wrong UID)	('95' NVB ~$UIDTX_2[[1..n_3]]$) [f]	⟶			IDLE
		⟵	Mute		
SELECT	SELECT(2)	⟶		FDT [c]	TTS [e]
		⟵	SAK [d]		
nSELECT (wrong UID)	('95 70' ~$UIDTX_2$ BCC CRC_A)	⟶			IDLE
		⟵	Mute		
Error condition	('95 70' $UIDTX_2$ BCC ~CRC_A)	⟶			IDLE
		⟵	Mute		
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	⟶			IDLE
		⟵	Mute		
DESELECT	S(DESELECT)	⟶			IDLE
		⟵	Mute		
RATS	RATS(0,0)	⟶			IDLE
		⟵	Mute		

Transition	PICC-test-apparatus	PICC	FDT	TTS
PPS	PPS(0,0,0)	⟶		IDLE
		⟵ Mute		

a Let 1 ≤ n1 ≤ 32, UIDTX2[[n1]] = 0. If such a number does not exist, the test can be skipped.

b Let 1 ≤ n2 ≤ 32, UIDTX2[[n2]] = 1 If such a number does not exist, the test can be skipped.

c FDT is 1172/fc (~86,43 μs) if last bit = (0)b and 1236/fc (~91,15 μs) if last bit = (1)b, (see margin in the base standard).

d Cascade bit of SAK shall be zero for double size UID PICCs and one for triple size UID PICCs.

e Double size UID PICCs shall be in ACTIVE state; triple size UID PICCs shall be in READY state.

f Let 1 ≤ n3 ≤ 32.

G.3.4.5.3 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 has a single size UID	Not applicable (NA)
If the PICC has a double or triple size UID and responded as indicated in the procedure	Pass
Any other case	Fail

G.3.4.6 Scenario 5: Behaviour of the PICC type A in the READY(3) state

G.3.4.6.1 Scope

This test is to determine the behaviour of the PICC type A in the READY state according to ISO/IEC 14443-3:2001, 6.2.3. This test is only for PICCs with triple size UID.

G.3.4.6.2 Procedure

Perform the following steps for all PICCs with triple size UID and every row of Table G.10 — Transitions from READY(3) state:

1: Put the PICC into READY(3) 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.10 — Transitions from READY(3) state

Transitions	PICC-test-apparatus		PICC	FDT	TTS
REQA	REQA	⟶			IDLE
		⟵	Mute		
WUPA	WUPA	⟶			IDLE
		⟵	Mute		
HLTA	HLTA	⟶			IDLE
		⟵	Mute		
AC (split at 0-bit)	('97' NVB $UIDTX_3[[1..n_1]]$) [a]	⟶			
		⟵	if n1=32 then (BCC) else ($UIDTX_3[[n_1+1..32]]$ BCC) [a]	1172/*fc*	READY(3)
AC (split at 1-bit)	('97' NVB $UIDTX_3[[1..n_2]]$) [b]	⟶			
		⟵	if n2=32 then (BCC) else ($UIDTX_3[[n_2+1..32]]$ BCC) [b]	1236/*fc*	READY(3)
nAC (wrong UID)	('97' NVB ~$UIDTX_3[[1..n_3]]$) [d]	⟶			
		⟵	Mute		IDLE
SELECT	SELECT(3)	⟶			
		⟵	SAK (complete)	FDT [c]	ACTIVE
nSELECT (wrong UID)	('97 70' ~$UIDTX_3$ BCC CRC_A)	⟶			
		⟵	Mute		IDLE
Error condition	('97 70' $UIDTX_3$ BCC ~CRC_A)	⟶			
		⟵	Mute		IDLE
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	⟶			
		⟵	Mute		IDLE
DESELECT	S(DESELECT)	⟶			
		⟵	Mute		IDLE
RATS	RATS(0,0)	⟶			
		⟵	Mute		IDLE
PPS	PPS(0,0,0)	⟶			
		⟵	Mute		IDLE

[a] Let $1 \leq n1 \leq 32$, UIDTX3[[n1]] = 0. If such a number does not exist, the test can be skipped.

[b] Let $1 \leq n2 \leq 32$, UIDTX3[[n2]] = 1 If such a number does not exist, the test can be skipped.

[c] FDT is 1172/fc (~86,43 μs) if last bit = (0)b and 1236/fc (~91,15 μs) if last bit = (1)b, (see margin in the base standard).

[d] Let $1 \leq n3 \leq 32$.

G.3.4.6.3 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 has a single or double size UID	Not applicable (NA)
If the PICC has a triple size UID and responded as indicated in the procedure	Pass
Any other case	Fail

G.3.4.7 Scenario 6: Behaviour of the PICC type A in the ACTIVE state

G.3.4.7.1 Scope

This test is to determine the behaviour of the PICC type A in the ACTIVE state according to ISO/IEC 14443-3:2001, 6.2.4.

G.3.4.7.2 Procedure

Perform the following steps for every row of Table G.11 — Transitions from ACTIVE state:

1: Put the PICC into ACTIVE 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 is as indicated in the FDT column.

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

Table G.11 — Transitions from ACTIVE state

Transition	PICC-test-apparatus		PICC	FDT	TTS
REQA	REQA	→			IDLE
		←	Mute		
WUPA	WUPA	→			IDLE
		←	Mute		
AC	(‘93' NVB $UIDTX_1$[[1..n_1]]) [a]	→			IDLE
		←	Mute		
nAC	(‘93' NVB ~$UIDTX_1$[[1..n_1]]) [a]	→			IDLE
		←	Mute		
HLTA	HLTA	→			HALT
		←	Mute		
SELECT	SELECT(1)	→			IDLE
		←	Mute		
nSELECT	(‘93 70’ ~$UIDTX_1$ BCC CRC_A)	→			IDLE
		←	Mute		

Transition	PICC-test-apparatus		PICC	FDT	TTS
RATS	RATS(0,0)	⟶		<65536/*fc*	PROTOCOL
		⟵	ATS		
Error condition	('E0 00' ~CRC_A)	⟶			IDLE
		⟵	Mute		
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	⟶			IDLE
		⟵	Mute		
DESELECT	S(DESELECT)	⟶			IDLE
		⟵	Mute		
PPS	PPS(0,0,0)	⟶			IDLE
		⟵	Mute		
[a] Let $1 \leq n1 \leq 32$.					

G.3.4.7.3 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

G.3.4.8 Scenario 7: Behaviour of the PICC Type A in the HALT state

G.3.4.8.1 Scope

This test is to determine the behaviour of the PICC Type A in the HALT state according to ISO/IEC 14443-3:2001, 6.2.5.

G.3.4.8.2 Procedure

For every row of Table G.12 — Transitions from HALT perform the following steps:

1: Put the PICC into HALT 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 is as indicated in the FDT column.

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

Table G.12 — Transitions from HALT

Transition	PICC-test-apparatus		PICC	FDT	TTS
REQA	REQA	⟶			HALT
		⟵	Mute		
WUPA	WUPA	⟶		1236/*fc*	READY*(1)
		⟵	ATQA		
HLTA	HLTA	⟶			HALT
		⟵	Mute		
AC	(‘93’ NVB $UIDTX_1$[[1..n_1]]) [a]	⟶			HALT
		⟵	Mute		
nAC	(‘93’ NVB ~$UIDTX_1$[[1..n_1]]) [a]	⟶			HALT
		⟵	Mute		
SELECT	SELECT(1)	⟶			HALT
		⟵	Mute		
nSELECT	(‘93 70’ ~$UIDTX_1$ BCC CRC_A)	⟶			HALT
		⟵	Mute		
RATS	RATS(0,0)	⟶			HALT
		⟵	Mute		
Error condition	(‘52’) in the standard frame	⟶			HALT
		⟵	Mute		
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	⟶			HALT
		⟵	Mute		
DESELECT	S(DESELECT)	⟶			HALT
		⟵	Mute		
PPS	PPS(0,0,0)	⟶			HALT
		⟵	Mute		

[a] Let $1 \leq n1 \leq 32$.

G.3.4.8.3 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

G.3.4.9 Scenario 8: Behaviour of the PICC type A in the READY*(1) state

G.3.4.9.1 Scope

This test is to determine the behaviour of the PICC type A in the READY* state of cascade level 1 according to ISO/IEC 14443-3:2001, 6.2.6.

G.3.4.9.2 Procedure

Perform the following steps for every row of Table G.13 — Transitions from READY*(1) state:

1: Put the PICC into READY*(1) 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 that the PICC is in the state TTS.

Table G.13 — Transitions from READY*(1) state

Transition	PICC-test-apparatus		PICC	FDT	TTS
REQA	REQA	→			HALT
		←	Mute		
WUPA	WUPA	→			HALT
		←	Mute		
HLTA	HLTA	→			HALT
		←	Mute		
AC (split at 0-bit)	(‘93’ NVB $UIDTX_1$[[1..n_1]]) [a]	→		1172/*fc*	READY*(1)
		←	if n1=32 then (BCC) else ($UIDTX_1$[[n_1+1..32]] BCC) [a]		
AC (split at 1-bit)	(‘93’ NVB $UIDTX_1$[[1..n_2]]) [b]	→		1236/*fc*	READY*(1)
		←	if n2=32 then (BCC) else ($UIDTX_1$[[n_2+1..32]] BCC) [b]		
nAC (wrong UID)	(‘93’ NVB ~$UIDTX_1$[[1..n_3]]) [f]	→			HALT
		←	Mute		
SELECT	SELECT(1)	→		FDT [c]	TTS [e]
		←	SAK [d]		
nSELECT (wrong UID)	(‘93 70’ ~$UIDTX_1$ BCC CRC_A)	→			HALT
		←	Mute		
Error condition	(‘93 70’ $UIDTX_1$ BCC ~CRC_A)	→			HALT
		←	Mute		

Transition	PICC-test-apparatus		PICC	FDT	TTS
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	⟶			HALT
		⟵	Mute		
DESELECT	S(DESELECT)	⟶			HALT
		⟵	Mute		
RATS	RATS(0,0)	⟶			HALT
		⟵	Mute		
PPS	PPS(0,0,0)	⟶			HALT
		⟵	Mute		

[a] Let $1 \leq n1 \leq 32$, UIDTX1[[n1]] = 0. If such a number does not exist, the test can be skipped.

[b] Let $1 \leq n2 \leq 32$, UIDTX1[[n2]] = 1 If such a number does not exist, the test can be skipped.

[c] FDT is 1172/fc (~86,43 μs) if last bit = (0)b and 1236/fc (~91,15 μs) if last bit = (1)b, (see margin in the base standard).

[d] Cascade bit of SAK shall be zero for single size UID PICCs and one for double and triple size UID PICCs.

[e] Single size UID PICCs shall be in ACTIVE state; double and triple size UID PICCs should be in READY state.

[f] Let $1 \leq n3 \leq 32$.

G.3.4.9.3 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

G.3.4.10 Scenario 9: Behaviour of the PICC type A in the READY*(2) state

G.3.4.10.1 Scope

This test is to determine the behaviour of the PICC type A in the READY* state of cascade level 2 according to ISO/IEC 14443-3:2001, 6.2.6. This test only applies to PICCs with double or triple size UID.

G.3.4.10.2 Procedure

Perform the following steps for every row of Table G.14 — Transitions from READY*(2) state:

1: Put the PICC into READY*(2) 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.14 — Transitions from READY*(2) state

Transition	PICC-test-apparatus		PICC	FDT	TTS
REQA	REQA	⟶			HALT
		⟵	Mute		
WUPA	WUPA	⟶			HALT
		⟵	Mute		
HLTA	HLTA	⟶			HALT
		⟵	Mute		
AC (split at 0-bit)	('95' NVB $UIDTX_2[[1..n_1]]$) [a]	⟶			
		⟵	if n1=32 then (BCC) else ($UIDTX_2[[n_1+1..32]]$ BCC) [a]	1172/*fc*	READY*(2)
AC (split at 1-bit)	('95' NVB $UIDTX_2[[1..n_2]]$) [b]	⟶			
		⟵	if n2=32 then (BCC) else ($UIDTX_2[[n_2+1..32]]$ BCC) [b]	1236/*fc*	READY*(2)
nAC (wrong UID)	('95' NVB ~$UIDTX_2[[1..n_3]]$) [f]	⟶			
		⟵	Mute		HALT
SELECT	SELECT(2)	⟶			
		⟵	SAK [d]	FDT [c]	TTS [e]
nSELECT (wrong UID)	('95 70' ~$UIDTX_2$ BCC CRC_A)	⟶			
		⟵	Mute		HALT
Error condition	('95 70' $UIDTX_2$ BCC ~CRC_A)	⟶			
		⟵	Mute		HALT
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	⟶			
		⟵	Mute		HALT
DESELECT	S(DESELECT)	⟶			
		⟵	Mute		HALT
RATS	RATS(0,0)	⟶			
		⟵	Mute		HALT
PPS	PPS(0,0,0)	⟶			
		⟵	Mute		HALT

[a] Let $1 \le n1 \le 32$, UIDTX2[[n1]] = 0. If such a number does not exist, the test can be skipped.

[b] Let $1 \le n2 \le 32$, UIDTX2[[n2]] = 1 If such a number does not exist, the test can be skipped.

[c] FDT is 1172/fc (~86,43 μs) if last bit = (0)b and 1236/fc (~91,15 μs) if last bit = (1)b, (see margin in the base standard).

[d] Cascade bit of SAK shall be zero for double size UID PICCs and one for triple size UID PICCs.

[e] Double size UID PICCs shall be in ACTIVE state; triple size UID PICCs shall be in READY state.

[f] Let $1 \le n3 \le 32$.

G.3.4.10.3 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 has a single size UID	Not applicable (NA)
If the PICC has a double or triple size UID and responded as indicated in the procedure	Pass
Any other case	Fail

G.3.4.11 Scenario 10: Behaviour of the PICC type A in the READY*(3) state

G.3.4.11.1 Scope

This test is to determine the behaviour of the PICC type A in the READY* state of cascade level 3 according to ISO/IEC 14443-3:2001, 6.2.6. This test is only for PICCs with triple size UID.

G.3.4.11.2 Procedure

Perform the following steps for every row of Table G.15 — Transitions from READY*(3) state:

1: Put the PICC into READY*(3) 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.15 — Transitions from READY*(3) state

Transition	PICC-test-apparatus		PICC	FDT	TTS
REQA	REQA	⟶			HALT
		⟵	Mute		
WUPA	WUPA	⟶			HALT
		⟵	Mute		
HLTA	HLTA	⟶			HALT
		⟵	Mute		
AC (split at 0-bit)	('97' NVB $UIDTX_3[[1..n_1]]$) [a]	⟶			
		⟵	if n1=32 then (BCC) else ($UIDTX_3[[n_1+1..32]]$ BCC) [a]	1172/*fc*	READY*(3)

Transition	PICC-test-apparatus		PICC	FDT	TTS
AC (split at 1-bit)	('97' NVB $UIDTX_3[[1..n_2]]$) [b]	⟶		1236/*fc*	READY*(3)
		⟵	if n2=32 then (BCC) else ($UIDTX_3[[n_2+1..32]]$ BCC) [b]		
nAC (wrong UID)	('97' NVB ~$UIDTX_3[[1..n_3]]$) [d]	⟶			HALT
		⟵	Mute		
SELECT	SELECT(3)	⟶			ACTIVE*
		⟵	SAK (complete)	FDT [c]	
nSELECT (wrong UID)	('97 70' ~$UIDTX_3$ BCC CRC_A)	⟶			HALT
		⟵	Mute		
Error condition	('97 70' $UIDTX_3$ BCC ~CRC_A)	⟶			HALT
		⟵	Mute		
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	⟶			HALT
		⟵	Mute		
DESELECT	S(DESELECT)	⟶			HALT
		⟵	Mute		
RATS	RATS(0,0)	⟶			HALT
		⟵	Mute		
PPS	PPS(0,0,0)	⟶			HALT
		⟵	Mute		

[a] Let $1 \le n_1 \le 32$, $UIDTX_3[[n_1]] = 0$. If such a number does not exist, the test can be skipped.

[b] Let $1 \le n2 \le 32$, UIDTX3[[n2]] = 1 If such a number does not exist, the test can be skipped.

[c] FDT is 1172/fc (~86,43 μs) if last bit = (0)b and 1236/fc (~91,15 μs) if last bit = (1)b, (see margin in the base standard).

[d] Let $1 \le n3 \le 32$.

G.3.4.11.3 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 has a single or double size UID	Not applicable (NA)
If the PICC has a triple size UID and responded as indicated in the procedure	Pass
Any other case	Fail

G.3.4.12 Scenario 11: Behaviour of the PICC type A in the ACTIVE* state

G.3.4.12.1 Scope

This test is to determine the behaviour of the PICC type A in the ACTIVE* state according to ISO/IEC 14443-3:2001, 6.2.7.

G.3.4.12.2 Procedure

Perform the following steps for every row of Table G.16 — Transitions from ACTIVE* state:

1: Put the PICC into ACTIVE 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 is as indicated in the FDT column.

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

Table G.16 — Transitions from ACTIVE* state

Transition	PICC-test-apparatus		PICC	FDT	TTS
REQA	REQA	→			HALT
		←	Mute		
WUPA	WUPA	→			HALT
		←	Mute		
HLTA	HLTA	→			HALT
		←	Mute		
AC	('93' NVB $UIDTX_1$[[1..n_1]]) [a]	→			HALT
		←	Mute		
nAC	('93' NVB ~$UIDTX_1$[[1..n_1]]) [a]	→			HALT
		←	Mute		
SELECT	SELECT(1)	→			HALT
		←	Mute		
nSELECT	('93 70' ~$UIDTX_1$ BCC CRC_A)	→			HALT
		←	Mute		
RATS	RATS(0,0)	→			PROTOCOL
		←	ATS	< 65536/*fc*	
Error condition	('E0 00' ~CRC_A)	→			HALT
		←	Mute		
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	→			HALT
		←	Mute		
DESELECT	S(DESELECT)	→			HALT
		←	Mute		
PPS	PPS(0,0,0)	→			HALT
		←	Mute		

[a] Let $1 \leq n1 \leq 32$.

G.3.4.12.3 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

G.3.4.13 Scenario 12: Behaviour of the PICC type A in the PROTOCOL state

G.3.4.13.1 Scope

This test is to determine the behaviour of the PICC type A in the **PROTOCOL** state according to ISO/IEC 14443-4:2001. This test shall ensure that the activated PICC does not respond to any anticollision or initialisation command

G.3.4.13.2 Procedure

For every row of Table G.17 — Transitions from PROTOCOL state perform the following steps:

1: Put the PICC into PROTOCOL 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 is as indicated in the FDT column.

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

Table G.17 — Transitions from PROTOCOL state

Transition	PICC-test-apparatus		PICC	FDT	TTS
REQA	REQA	⟶			PROTOCOL
		⟵	Mute		
WUPA	WUPA	⟶			PROTOCOL
		⟵	Mute		
AC	(‘93’ NVB $UIDTX_1[[1..n_1]]$) [a]	⟶			PROTOCOL
		⟵	Mute		
nAC	(‘93' NVB ~$UIDTX_1[[1..n_1]]$) [a]	⟶			PROTOCOL
		⟵	Mute		
HLTA	HLTA	⟶			PROTOCOL
		⟵	Mute		
SELECT	SELECT(1)	⟶			PROTOCOL
		⟵	Mute		

Transition	PICC-test-apparatus		PICC	FDT	TTS
nSELECT	('93 70' ~UIDTX$_1$ BCC CRC_A)	⟶			PROTOCOL
		⟵	Mute		
RATS	RATS(0,0)	⟶			PROTOCOL
		⟵	Mute		
Error condition	('93 70' UIDTX$_1$ BCC ~CRC_A)	⟶			PROTOCOL
		⟵	Mute		
DESELECT	S(DESELECT)	⟶			
		⟵	S(DESELECT)	65536/*fc* as specified in 8.1 of 14443-4	HALT
PPS	PPS(0,0,0)	⟶			PROTOCOL
		⟵	Mute, or PPS response[b]		
ISO/IEC 14443-4 command	I(0)$_0$(TEST_COMMAND1(1))	⟶		< FWT	PROTOCOL
		⟵	I(0)$_0$(TEST_ RESPONSE1(1))		

[a] Let $1 \leq n1 \leq 32$.

[b] PPS response is returned if the PICC supports PPS

G.3.4.13.3 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

G.3.5 Scenario 13: Handling of type A anticollision

G.3.5.1 Scope

This test is to perform a full bitwise anticollision loop according to ISO/IEC 14443-3:2001, 6.4.3.

G.3.5.2 Procedure

1: Put the PICC into the field.

2: Put the PICC into READY(1) state.

3: Execute AnticollisionA.

4: Put the PICC into READY*(1) state.

5: Execute AnticollisionA.

Pseudocode: Type A anticollision procedure

```
1  Procedure AnticollisionA
2  // TPDUSend and TPDURecv are PCD specific functions
3  // to send and receive frames
4
5  for c = 1 to CascadeLevels do
6
7    // anticollision over UID bits
8    for p = 1 to 31[a] do
9      // enter desired cascade level
10     if c ≥ 2 then TPDUSend(SELECT(1))
11     if c = 3 then TPDUSend(SELECT(2))
12     // anticollision with matched bit
13     NVB[[1..4]] = (p + 16) mod 8
14     NVB[[5..8]] = (p + 16) div 8
15     TPDUSend (SEL(c) NVB UIDTXc[[1..p]])
16     if TPDURecv() ≠ (UIDTXc[[p+1..32]] BCC) then return FAIL
17     // anticollision with unmatched bit
18     TPDUSend(SEL(c) NVB UIDTXc[[1..p-1]] ~UIDTXc[[p]])
19     if TPDURecv() ≠ Mute then return FAIL
20     // re-enter READY(1) (resp. READY*(1)) state
21     TPDUSend (WUPA)
22   end for
23 end for
24 return PASS
```

[a] The value 31 may change to 32 at the upcoming revision of the standard

G.3.5.3 Test report

Fill the appropriate row in “Table G.32 — Reported Results for type A specific test methods” with test result according the following:

Explanation	Test result
If each AnticollisionTest procedure has returned PASS	Pass
If at least one AnticollisionTest procedure has returned the value FAIL	Fail

G.3.6 Handling of RATS

G.3.6.1 Scope

This test is to determine the handling of RATS and ATS by the PICC type A according to ISO/IEC 14443-4:2001, 5.6.1.

G.3.6.2 Procedure

For the scenarios given in G.3.6.4 the following sequence applies:

1: Put the PICC into ACTIVE state.

2: Send the command sequence as described in the PICC-test-apparatus.

3: Check that the response of the PICC conforms to the one given in the PICC column.

4: For scenario 14 check that the PICC is in the IDLE state and for scenario 15 check that the PICC is in the PROTOCOL state.

G.3.6.3 Test report

Fill the appropriate rows 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

G.3.6.4 Scenarios

Scenario 14: RATS after bad RATS

PICC-test-apparatus		PICC
(‘E0 00’ ~CRC_A)	—/→	
	←	Mute
RATS(0)	→	
	←	Mute

Scenario 15: RATS after RATS

PICC-test-apparatus		PICC
RATS(0,0)	→	
	←	ATS
RATS(0,0)	→	
	←	Mute

G.3.7 Handling of PPS request

G.3.7.1 Scope

This test is to determine the handling of the PPS request by the PICC type A according to ISO/IEC 14443-4:2001, 5.6.2.2.

G.3.7.2 Procedure

For each scenario under G.3.7.4 perform the following steps:

1: Put the PICC in PROTOCOL state.

2: Send the command as described under the PICC-test-apparatus column in the table below.

3: Check that the response of the PICC conforms to the one given in the PICC column.

4: Check if the PICC is in PROTOCOL state.

G.3.7.3 Test report

Fill the appropriate rows 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

G.3.7.4 Scenarios

Scenario 16: PPS without parameter change

PICC-test-apparatus		PICC
PPS(0,0,0)	⟶	
	⟵	Mute or (‘D0’ CRC_A) [a]
[a] Response depends on whether the PICC supports PPS or not. If the PICC does not support any changeable parameters it may not support the PPS request because the PCD shall not send PPS to such a PICC (see 14443-4:2001, 5, 6th dash)		

Scenario 17: PPS without PPS1

PICC-test-apparatus		PICC
(‘D0 01’ CRC_A)	⟶	
	⟵	Mute or (‘D0’ CRC_A)[a]
[a] Response depends on whether the PICC supports PPS or not. If the PICC does not support any changeable parameters it may not support the PPS request because the PCD shall not send PPS to such a PICC (see 14443-4:2001, 5, 6th dash)		

Scenario 18: PPS after PPS

PICC-test-apparatus		PICC
PPS(0,0,0)	⟶	
	⟵	Mute or ('D0' CRC_A) [a]
PPS(0,0,0)	⟶	
	⟵	Mute

[a] Response depends on whether the PICC supports PPS or not. If the PICC does not support any changeable parameters it may not support the PPS request because the PCD shall not send PPS to such a PICC (see 14443-4:2001, 5, 6th dash)

Scenario 19: PPS after unreceived PPS

PICC-test-apparatus		PICC
('D0 01' ~CRC_A)	⟶	
	⟵	Mute
PPS(0,0,0)	⟶	
	⟵	Mute

G.3.8 Scenario 20: Handling of FSD

G.3.8.1 Scope

This test is to determine if the PICC type A respects the FSD value as negotiated by the RATS according to ISO/IEC 14443-4:2001, 5.1.

G.3.8.2 Procedure

Perform the following steps for each FSDI = 0 to 8:

1: Put the PICC into ACTIVE state.

2: Send the RATS(0, fsdi) command with parameter fsdi as in the particular test.

3: Check that the PICC answer is a valid ATS and that its size is ≤ FSD.

4: Send the I-block $I(0)_0$(TEST_COMMAND2(2)).

5: Check that the size of the I-block sent by the PICC is ≤ FSD.

G.3.8.3 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

G.4 Test method for initialisation of the PICC of type B

G.4.1 Introduction

This chapter is to test if the PICC of type B conforms to the ISO/IEC 14443-3:2001 standard.

G.4.2 Scenario 21: Polling

G.4.2.1 Scope

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

G.4.2.2 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 in accordance with ISO/IEC14443-3:2001/Amd.1, 5.4.

3: Switch the RF operating field on.

4: Wait 5 ms and send a valid REQB(0) 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 in accordance with ISO/IEC14443-3:2001/Amd.1, 5.4.

7: Switch the RF operating field on.

8: Wait 5 ms and send a valid REQA Command frame (with type A modulation).

9: Wait 5 ms and send a valid REQB(0) Command frame.

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

G.4.2.3 Test report

Fill the appropriate row in “Table G.33 — Reported Results for type B specific test methods” according to the test results as follows:

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

G.4.3 Scenario 22: PICC Reception

G.4.3.1 Scope

This test is to determine the behaviour of a Type B PICC when receiving PCD messages according to ISO/IEC 14443-3:2001, 7.1.1, 7.1.2, 7.1.4 and 7.1.5.

G.4.3.2 Procedure

Perform the following steps for each row of Table G.18 — Type B frame parameters:

1: Place the reference PICC into the field.

2: Set the frame parameters of the PICC-test-apparatus according to Table G.31 — Type B specific timing table.

3: Send a REQB command.

4: Record the presence, content and timing of the PICC response.

5: Check that the frame format of the PICC response conforms to the following:

- The PICC response shall be a valid ATQB.
- The SOF logic 0 timing shall be between 10 and 11 etu.
- The SOF logic 1timing shall be between 2 and 3 etu.
- The EOF logic 0 timing shall be between 10 and 11 etu.
- The TR0 timing shall be in the range $64/fs \leq TR0 \leq 256/fs$.
- The TR1 timing shall be in the range $80/fs \leq TR1 \leq 200/fs$.
- The PICC shall be turn off the subcarrier between 0 and 2 etu after end EOF.

Table G.18 — Type B frame parameters

EGT	SOF (logic 0)	SOF (logic 1)	EOF
0 µs	10 etu	2 etu	10 etu
57 µs	10 etu	2 etu	10 etu
0 µs	11 etu	2 etu	10 etu
0 µs	10 etu	3 etu	10 etu
0 µs	10 etu	2 etu	11 etu

G.4.3.3 Test report

Fill the appropriate row in “Table G.33 — Reported Results for type B 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

G.4.4 Testing of the PICC Type B State Transitions

These tests are to verify the correct implementation of the PICC type B state machine as described in ISO/IEC 14443-3:2001, 7.4.1.

G.4.4.1 General Test Outline

This is the same procedure as described for the PICC type A (see G.3.4.2)

G.4.4.1.1 Functions to set the PICC in Test Initial State (TIS)

Putting the PICC into the State TIS will be done by a sequence of transition commands specified in “Table G.20 — State Transition 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.19 — State Transition Sequence Table”. Then successively apply the state transitions described in this column by looking up the corresponding commands in the State Transition Table. Always check the content and integrity of the PICC response.

Table G.19 — State Transition Sequence Table

TIS	State Transition Sequence
POWER_OFF	---
IDLE	POWER_OFF →IDLE
READY REQUESTED	POWER_OFF →IDLE → READY REQUESTED
READY DECLARED	POWER_OFF →IDLE → READY DECLARED
ACTIVE	POWER_OFF →IDLE → READY DECLARED → ACTIVE
HALT	POWER_OFF →IDLE → READY DECLARED → HALT

Table G.20 — State Transition Table

State → Next State	PICC-test-apparatus		PICC
POWER_OFF → IDLE	Power On (RF operating Field on)	⟶	
		⟵	Mute
IDLE → READY REQUESTED	REQB(4)	⟶	
		⟵	Mute [a]
IDLE → READY DECLARED	REQB(0)	⟶	
		⟵	ATQB
READY DECLARED → HALT	HLTB	⟶	
		⟵	'00' CRC_B
READY DECLARED → ACTIVE	ATTRIB(0,0)	⟶	
		⟵	ATA(0)

[a] In case the PICC has selected slot 1, the REQB command shall be reissued until the PICC doesn't answer ATQB. If the PICC does not support Slot-MARKER command (option 1) the READY REQUESTED sub-state does not exist.

G.4.4.1.2 Functions for checking the validity of the Test Target State (TTS)

The following “Table G.21 — Checking the TTS” 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. ATQB...) should be thoroughly checked for conformance.

Note: The tests may cause the PICC to change state.

Table G.21 — Checking the TTS

TTS	PICC-test-apparatus		PICC
IDLE	REQB(0)	⟶	
		⟵	ATQB
READY REQUESTED	SLOTMARKER (n) [a]	⟶	
		⟵	ATQB
READY DECLARED	ATTRIB(0,0)	⟶	
		⟵	ATA(0)
ACTIVE	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE1(1))
HALT	REQB(0)	⟶	
		⟵	Mute
	WUPB(0)	⟶	
		⟵	ATQB

[a] Since the selected PICC slot is unknown, the Slot-MARKER command shall be reissued with differnet slot values until a ATQB is received. If the PICC does not support Slot-MARKER command (option 1) the READY REQUESTED sub-state does not exist.

G.4.4.2 Scenario 23: Behaviour of the PICC type B in the IDLE state

G.4.4.2.1 Scope

This test is to determine the behaviour of the PICC type B in the IDLE state according to ISO/IEC 14443-3:2001, 7.4.4.

G.4.4.2.2 Procedure

Perform the following steps for every row of Table G.22 — 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: Check if the PICC is in the state TTS.

Table G.22 — Transitions from IDLE state

Transition	PICC-test-apparatus		PICC	TTS
REQB	REQB(0)	⟶		READY DECLARED
		⟵	ATQB	
WUPB	WUPB(0)	⟶		READY DECLARED
		⟵	ATQB	
REQB (wrong CRC)	('05 00 00' ~CRC_B)	⟶		IDLE
		⟵	Mute	
WUPB (wrong CRC)	('05 00 08' ~CRC_B)	⟶		IDLE
		⟵	Mute	
HLTB	HLTB	⟶		IDLE
		⟵	Mute	
ATTRIB	ATTRIB(0,0)	⟶		IDLE
		⟵	Mute	
Slot-MARKER	SLOTMARKER(n) [a]	⟶		IDLE
		⟵	Mute	
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	⟶		IDLE
		⟵	Mute	
DESELECT	S(DESELECT)	⟶		IDLE
		⟵	Mute	

[a] n shall run through all values $2 \leq n \leq 16$.

G.4.4.2.3 Test report

Fill the appropriate row in “Table G.33 – Reported Results for type B 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

G.4.4.3 Scenario 24: Behaviour of the PICC type B in the READY REQUESTED sub-state

G.4.4.3.1 Scope

This test is to determine the behaviour of the PICC type B in the READY REQUESTED sub-state according to ISO/IEC 14443-3:2001, 7.4.5.

This test only applies to PICC supporting the Slot-MARKER command (option 2).

G.4.4.3.2 Procedure

Perform the following steps for every row of Table G.23 — Transitions from READY REQUESTED sub-state:

1: Put the PICC into READY REQUESTED sub-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: Check if the PICC is in the state TTS.

Table G.23 — Transitions from READY REQUESTED sub-state

Transition	PICC-test-apparatus		PICC	TTS
REQB	REQB(0)	→		READY DECLARED
		←	ATQB	
WUPB	WUPB(0)	→		READY DECLARED
		←	ATQB	
REQB (wrong CRC)	('05 00 00' ~CRC_B)	→		READY REQUESTED
		←	Mute	
WUPB (wrong CRC)	('05 00 08' ~CRC_B)	→		READY REQUESTED
		←	Mute	
HLTB	HLTB	→		READY REQUESTED
		←	Mute	
ATTRIB	ATTRIB(0,0)	→		READY REQUESTED
		←	Mute	
Slot-MARKER	SLOTMARKER(n) [a]	→		READY DECLARED
		←	ATQB or Mute	
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	→		READY REQUESTED
		←	Mute	
DESELECT	S(DESELECT)	→		READY REQUESTED
		←	Mute	

[a] n shall run through all values $2 \leq n \leq 16$. The PICC shall respond ATQB at exactly one value of n, else Mute.

G.4.4.3.3 Test report

Fill the appropriate row in “Table G.33 — Reported Results for type B 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

G.4.4.4 Scenario 25: Behaviour of the PICC type B in the READY DECLARED sub-state

G.4.4.4.1 Scope

This test is to determine the behaviour of the PICC type B in the READY DECLARED sub-state according to ISO/IEC 14443-3:2001, 7.4.6.

G.4.4.4.2 Procedure

Perform the following steps for every row of Table G.24 — Transitions from READY DECLARED SUB-state:

1: Put the PICC into READY DECLARED SUB-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: Check if the PICC is in the state TTS.

Table G.24 — Transitions from READY DECLARED SUB-state

Transition	PICC-test-apparatus		PICC	TTS
REQB	REQB(0)	⟶		READY DECLARED
		⟵	ATQB	
WUPB	WUPB(0)	⟶		READY DECLARED
		⟵	ATQB	
REQB (wrong CRC)	('05 00 00' ~CRC_B)	⟶		READY DECLARED
		⟵	Mute	
WUPB (wrong CRC)	('05 00 08' ~CRC_B)	⟶		READY DECLARED
		⟵	Mute	
HLTB	HLTB	⟶		HALT
		⟵	('00' CRC_B)	
ATTRIB	ATTRIB(0,0)	⟶		ACTIVE
		⟵	ATA(0)	
Slot-MARKER	SLOTMARKER(n) [a]	⟶		READY DECLARED
		⟵	Mute	
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	⟶		READY DECLARED
		⟵	Mute	
DESELECT	S(DESELECT)	⟶		READY DECLARED
		⟵	Mute	

[a] n shall run through all values $2 \leq n \leq 16$

G.4.4.4.3 Test report

Fill the appropriate row in “Table G.33 — Reported Results for type B 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

G.4.4.5 Scenario 26: Behaviour of the PICC type B in the HALT state

G.4.4.5.1 Scope

This test is to determine the behaviour of the PICC type B in the HALT state according to ISO/IEC 14443-3:2001, 7.4.8.

G.4.4.5.2 Procedure

Perform the following steps for every row of Table G.25 — Transitions from HALT state:

1: Put the PICC into HALT 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: Check if the PICC is in the state TTS.

Table G.25 — Transitions from HALT state

Transition	PICC-test-apparatus		PICC	TTS
REQB	REQB(0)	→		HALT
		←	Mute	
WUPB	WUPB(0)	→		READY DECLARED
		←	ATQB	
WUPB (wrong CRC)	('05 00 08' ~CRC_B)	→		HALT
		←	Mute	
HLTB	HLTB	→		HALT
		←	Mute	
ATTRIB	ATTRIB(0,0)	→		HALT
		←	Mute	
Slot-MARKER	SLOTMARKER(n) [a]	→		HALT
		←	Mute	
ISO/IEC 14443-4 command	$I(0)_0$(TEST_COMMAND1(1))	→		HALT
		←	Mute	
DESELECT	S(DESELECT)	→		HALT
		←	Mute	

[a] n shall run through all values $2 \leq n \leq 16$

G.4.4.5.3 Test report

Fill the appropriate row in “Table G.33 — Reported Results for type B 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

G.4.4.6 Scenario 27: Behaviour of the PICC type B in the ACTIVE state

G.4.4.6.1 Scope

This test is to determine the behaviour of the PICC type B in the ACTIVE state according to ISO/IEC 14443-4:2001. This test shall ensure that the activated PICC does not respond to any initialisation command.

G.4.4.6.2 Procedure

Perform the following steps for every row of Table G.26 — Transitions from ACTIVE state:

1: Put the PICC into ACTIVE 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: Check if the PICC is in the state TTS.

Table G.26 — Transitions from ACTIVE state

Transition	PICC-test-apparatus		PICC	FDT	TTS
REQB	REQB(0)	⟶			ACTIVE
		⟵	Mute		
WUPB	WUPB(0)	⟶			ACTIVE
		⟵	Mute		
REQB (wrong CRC)	('05 00 00' ~CRC_B)	⟶			ACTIVE
		⟵	Mute		
WUPB (wrong CRC)	('05 00 08' ~CRC_B)	⟶			ACTIVE
		⟵	Mute		
HLTB	HLTB	⟶			ACTIVE
		⟵	Mute		
ATTRIB	ATTRIB(0,0)	⟶			ACTIVE
		⟵	Mute		
Slot-MARKER	SLOTMARKER(n) [a]	⟶			ACTIVE
		⟵	Mute		

Transition	PICC-test-apparatus		PICC	FDT	TTS
ISO/IEC 14443-4 command	I(0)0(TEST_COMMAND1(1))	⟶			
		⟵	$I(0)_0$(TEST_RESPONSE 1(1))	< FWT	ACTIVE
DESELECT	S(DESELECT)	⟶			
		⟵	S(DESELECT)		HALT
[a] n shall run through all values $2 \leq n \leq 16$					

G.4.4.6.3 Test report

Fill the appropriate row in "Table G.33 — Reported Results for type B 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

G.4.5 Scenario 28: Handling of type B anticollision

G.4.5.1 Scope

The purpose of this test is to determine the handling of a PICC type B anticollision according to ISO/IEC 14443-3:2001, 7.4.1.

The core of this test is the procedure AnticollisionB(N, outparam T, outparam chi2) which is defined in the pseudo code below. The procedure performs 256 REQB(N) commands and following Slot-MARKER commands and counts how many times each of the 2^N slots has been selected by the PICC. Depending on whether the Slot-MARKER command works or not, the procedure decides if the PICC uses the probabilistic approach (option 1) or the timeslot approach (option 2). If the PICC uses the timeslot approach then the procedure checks if the PICC has mapped each REQB(N) request to exactly one slot. If this is not the case the test returns FAIL.

Since type B anticollision is based on random selection of the slots, statistical methods shall be used for verification. As it is the nature of all statistical tests, this test can fail even in the case the PICC behaves correctly. This failure is called a "Type I error" in statistical terms. This error cannot be completely avoided. Instead, the probability of its occurrence can be controlled by the so called "significance value" α. This means, the smaller α, the less probable the "Type I error". However, this does not mean that one should select α as small as possible. This is because the smaller α is, the more probable is that the test passes a bad PICC (i.e. a PICC that doesn't select the slots with the right probability). In statistical terms this is called a "Type II error". For this reason it is crucial to select an appropriate significance value α.

Regardless of the used anticollision method (i.e. probabilistic or timeslot), the PICC shall select slot number one with probability $1/2^N$. In order to verify this, a statistical binomial test on slot number 1 shall be performed. The result of this test is the value T which shall be compared against the $\phi_{\alpha/2}$ quintile.

If the PICC uses the timeslot approach, then the PICC shall additionally select each of the 2^N slots with equal probability (i.e. $1/2^N$). In order to verify this, the statistical χ^2-test on all slots shall be performed. The result of this test is the value chi2 which shall be compared against the $\chi^2_{N-1,\,\alpha}$ quintile.

G.4.5.2 Procedure

Due to the reasons explained above, it shall be the responsibility of the test lab to choose an appropriate significance value α. Also, if one of the statistical tests fails in step 5, the test lab may choose to rerun the test for this parameter N, maybe also with another significance level. On the other hand, the test unconditionally fails in case the AnticollisionB procedure returns FAIL (step 4).

Perform the following steps for each value N = 1,2,3,4:

1: Choose a significance level $\alpha \in \{0{,}1, 0{,}05, 0{,}01, 0{,}005\}$ and lookup from Table G.27 — a-quintile values, the corresponding $\chi^2_{N-1,\alpha}$ and $\phi_{\alpha/2}$ quintile.

2: Reset the PICC

3: Execute AnticollisionB(N, T, chi2)

4: If AnticollisionB returns FAIL, fail the test

5: If chi2 $\leq \chi^2_{N-1,\alpha}$ and T $\leq \phi_{\alpha/2}$ then pass the test Else fail the test

Table G.27 — a-quintile values

α	$\phi_{\alpha/2}$	$\chi^2_{N-1,\alpha}$			
		$\chi^2_{1,\alpha}$	$\chi^2_{3,\alpha}$	$\chi^2_{7,\alpha}$	$\chi^2_{15,\alpha}$
0.1	1.645	2.706	6.351	12.017	22.307
0.05	1.960	3.841	7.815	14.067	24.996
0.01	2.576	6.635	11.345	18.475	30.578
0.005	2.81	7.879	12.838	20.278	32.801

Pseudocode: Type B anticollision procedure

```
1  Procedure AnticollisionB(N, T, chi2)
2
3    // TPDUSend and TPDURecv are PCD specific functions
4    // to send and receive TPDU frames
5
6    // probability for selecting slot
7    p = 2^-N
8
9    // clear slot counters
10   for i from 1 to 2^N do
11     Slots[i] = 0
12   endfor
13
14   // variable indicating the anticollision
15   // OPTION of the PICC approach
16   option = 1
17
```

```
18   // collect data
19   for i from 1 to 256 do
20     TPDUSend (REQB(N))
21     if TPDURecv() = ATQB then
22       Slots[1] = Slots[1]+1
23     else
24       for j from 2 to 2^N do
25         TPDUSend (SLOTMARKER(j))
26         if TPDURecv () = ATQB then
27           Slots[j] = Slots[j]+1
28           Option = 2
29         endif
30       endfor
31     endif
32   endfor
33
34   // if PICC uses timeslot approach, check that exactly
35   // one slot has been selected at each run
36   if option = 2 then
37     cnt = 0
38     for i from 1 to 2^N do
39       cnt = cnt + Slots[i]
40     endfor
41     if cnt ≠ 256 then
42       return FAIL
43     endif
44   endif
45
46   // perform binomial statistic test for slot #1
47   T = abs((Slots[1] - p*256) / 16*sqrt(p*(1-p)))
48
49   chi2 = 0
50   // perform chi-square statistic test for PICCs of Option 2
51   if option = 2 then
52     for i from 1 to 2^N do
53       chi2 = chi2 + Slots[i]*Slots[i]
54     endfor
55     chi2 = chi2*2^N/256 - 256
56   endif
57 return PASS
```

G.4.5.3 Test report

Fill the appropriate row in “Table G.33 — Reported Results for type B specific test methods” according to the test results as follows:

Explanation	Test result
If each AnticollisionTest procedure has returned PASS	Pass
If at least one AnticollisionTest procedure has returned the value FAIL	Fail

G.4.6 Handling of ATTRIB

G.4.6.1 Scope

This test is to determine the behaviour of the PICC type B on ATTRIB command according to ISO/IEC 14443-3:2001, 7.10.2.

G.4.6.2 Procedure

Perform the following steps for each scenario listed under clause G.4.6.3:

1: Put the PICC into READY DECLARED sub-state.

2: Send the command sequence as described in the PICC-test-apparatus.

3: Check that the response of the PICC conforms with the one given in the PICC column.

4: Check if the PICC is in ACTIVE state.

G.4.6.3 Scenarios

Scenario 29: ATTRIB with wrong PUPI

PICC-test-apparatus		PICC
(‘1D’ ~PUPI '00 00 01 00' CRC_B)	→	
	←	Mute
ATTRIB(0,0)	→	
	←	ATA(0)

Scenario 30: ATTRIB after bad ATTRIB

PICC-test-apparatus		PICC
(‘1D’ PUPI '00 00 01 00' ~CRC_B)	→	
	←	Mute
ATTRIB(0,0)	→	
	←	ATA(0)

G.4.6.4 Test report

Fill the appropriate row in “Table G.33 — Reported Results for type B 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

G.4.7 Scenario 31 Handling of Maximum Frame Size

G.4.7.1 Scope

This test is to determine if the PICC type B respects the FSD size according to ISO/IEC 14443-4:2001, 7.10.4.

G.4.7.2 Procedure

Perform the following steps for each FSDI = 0 to 8:

1: Put the PICC into READY DECLARED SUB- state as described in G.4.4.1.1

2: Send the ATTRIB(0, fsdi) command with parameter fsdi as in the particular test

3: Check if the PICC answer is ATA(0)

4: Send the I-block $I(0)_0$(TEST_COMMAND2(2)_)

5: Check if the size of the I-block response of the PICC response is ≤ FSD

G.4.7.3 Test report

Fill the appropriate row in “Table G.33 — Reported Results for type B 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

G.5 Test methods for logical operation of the PICC of Type A/B

G.5.1 Introduction

This chapter contains tests verifying that the activated PICC conforms to the ISO/IEC 14443-4. This chapter applies to PICC of type A and type B.

G.5.1.1 PICC activation process

PICC activation is the process of putting the PICC in the state where protocol blocks defined in ISO/IEC 14443-4:2001 may be exchanged. This process is dependent on the PICC type and the name of the state also depends on the PICC type (PROTOCOL for type A PICC and ACTIVE for type B PICC)

G.5.1.1.1 Activation of the PICC type A

1: Put the PICC into ACTIVE state as described in G.3.4.2.1.

2: Send RATS(cid, fsdi).

3: Check that the PICC response is a valid ATS.

G.5.1.1.2 Activation of the PICC type B

1: Put the PICC into READY DECLARED sub-state as described in G.4.4.1.1.

2: Send ATTRIB(cid, fsdi).

3: Check that the PICC response is a valid ATA.

G.5.2 PICC reaction to ISO/IEC 14443-4 Scenarios

G.5.2.1 Scope

This test is to determine the reaction of the PICC in different protocol scenarios. These tests are concrete implementations of the protocol scenarios of ISO/IEC 14443-4:2001 Annex B

G.5.2.2 Procedure

Perform the following steps for each scenario listed in this subclause:

1: Activate the PICC as described in G.5.1.1, use CID=0 and FSDI=0

2: For each Step in the Scenario do

3: Send the command as described in the PICC-test-apparatus column

4: Check that the PICC response matches the one of the PICC column.

5: End for

Scenario 32: Exchange of I-blocks

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE1(1))
2	$I(0)_1$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(1))

Scenario 33: Request for waiting time extension

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND3)	⟶	
		⟵	S(WTX) (n)
2	S(WTX) (n)	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE3)
3	$I(0)_1$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(1))

Scenario 34: DESELECT

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE1(1))
2	S(DESELECT)	⟶	
		⟵	S(DESELECT)
3	REQA or REQB(0) [a]	⟶	
		⟵	Mute
4	WUPA or WUPB(0) [a]	⟶	
		⟵	ATQA or ATQB [a]

[a] For the PICC type A, the left option shall be used. For the PICC type B, the right option shall be used.

Scenario 35: PCD uses chaining

Step	PICC-test-apparatus		PICC
1	$I(1)_0$ (TEST_COMMAND1$(2)_1$)	⟶	
		⟵	$R(ACK)_0$
2	$I(0)_1$(TEST_COMMAND1$(2)_2$)	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(2))
3	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE1(1))

Scenario 36: PICC uses chaining

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND2(2))	⟶	
		⟵	$I(1)_0$ (TEST_RESPONSE2$(2)_1$)
2	$R(ACK)_1$	⟶	
		⟵	$I(0)_1$ (TEST_RESPONSE2$(2)_2$)
3	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE1(1))

Scenario 37: Start of protocol

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND1(1), ~CRC)	⟶	
		⟵	Mute
2	$R(NAK)_0$	⟶	
		⟵	$R(ACK)_1$
3	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE1(1))
4	$I(0)_1$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(1))

Scenario 38: Exchange of I-Blocks

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$ (TEST_RESPONSE1(1))
2	$I(0)_1$ (TEST_COMMAND1(1), ~CRC)	⟶	
		⟵	Mute
3	$R(NAK)_1$	⟶	
		⟵	$R(ACK)_0$
4	$I(0)_1$ (TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(1))
5	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE1(1))

Scenario 39: Exchange of I-Blocks 1

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$ (TEST_RESPONSE1(1))
2	$R(NAK)_0$	⟶	
		⟵	$I(0)_0$ (TEST_RESPONSE1(1))
3	$I(0)_1$ (TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(1))

Scenario 40: Exchange of I-blocks 2

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$ (TEST_RESPONSE1(1))
2	R(NAK, ~CRC) $_0$	⟶	
		⟵	Mute
3	R(NAK) $_0$	⟶	
		⟵	$I(0)_0$ (TEST_RESPONSE1(1))
4	$I(0)_1$ (TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(1))

Scenario 41: Request for waiting time extension

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND3)	⟶	
		⟵	S(WTX)(n)
2	$R(NAK)_0$	⟶	
		⟵	S(WTX)(n)
3	S(WTX)(n)	⟶	
		⟵	$I(0)_0$ (TEST_RESPONSE3)
4	$I(0)_1$ (TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(1))

Scenario 42: Request for waiting time extension

Step	PICC-test-apparatus		PICC
1	$I(0)_0$ (TEST_COMMAND3)	⟶	
		⟵	S(WTX)(n)
2	$R(NAK, \sim CRC)_0$	⟶	
		⟵	Mute
3	$R(NAK)_0$	⟶	
		⟵	S(WTX)(n)
4	S(WTX)(n)	⟶	
		⟵	$I(0)_0$ (TEST_RESPONSE3)
5	$I(0)_1$ (TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(1))

Scenario 43: Request for waiting time extension

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND3)	⟶	
		⟵	S(WTX)(n)
2	S(WTX)(n, ~CRC)	⟶	
		⟵	Mute
3	$R(NAK)_0$	⟶	
		⟵	S(WTX)(n)
4	S(WTX)(n)	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE3)
5	$I(0)_1$ (TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(1))

Scenario 44: Request for waiting time extension

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND3)	⟶	
		⟵	S(WTX)(n)
2	S(WTX)(n)	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE3)
3	$R(NAK)_0$	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE3)
4	$I(0)_1$ (TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(1))

Scenario 45: Request for waiting time extension

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND3)	⟶	
		⟵	S(WTX)(n)
2	S(WTX)(n)	⟶	
		⟵	$I(0)_0$ (TEST_RESPONSE3)
3	$R(NAK, \sim CRC)_0$	⟶	
		⟵	Mute
4	$R(NAK)_0$	⟶	
		⟵	$I(0)_0$ (TEST_RESPONSE3)
5	$I(0)_1$ (TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$(TEST_RESPONSE1(1))

Scenario 46: DESELECT

Step	PICC-test-apparatus		PICC
1	$I(0)_0$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_0$(TEST_RESPONSE1(1))
2	S(DESELECT, ~CRC)	⟶	
		⟵	Mute
3	S(DESELECT)	⟶	
		⟵	S(DESELECT)
4	REQA or REQB(0) [a]	⟶	
		⟵	Mute
5	WUPA or WUPB(0) [a]	⟶	
		⟵	ATQA or ATQB [a]

[a] For the PICC type A, the left option shall be used. For the PICC type B, the right option shall be used.

Scenario 47: PCD uses chaining

Step	PICC-test-apparatus		PICC
1	$I(1)_0$(TEST_COMMAND1(3)$_1$)	⟶	
		⟵	$R(ACK)_0$
2	$R(NAK)_0$	⟶	
		⟵	$R(ACK)_0$
3	$I(1)_1$(TEST_COMMAND1(3)$_2$)	⟶	
		⟵	$R(ACK)_1$
4	$I(0)_0$(TEST_COMMAND1(3)$_3$)	⟶	
		⟵	$I(0)_0$ (TEST_RESPONSE1(3))
5	$I(0)_1$(TEST_COMMAND1(1))	⟶	
		⟵	$I(0)_1$ (TEST_RESPONSE1(1))