

ISO/IEC 10373-6:2020 (E)

Cards and security devices for personal identification — Test methods — Part 6: Contactless proximity objects

Contents

	Foreword
1	Scope
2	Normative references
3	Terms, definitions, symbols and abbreviated terms
3.1	Terms and definitions
3.2	Symbols and abbreviated terms
4	Default items applicable to the test methods
4.1	Test environment
4.2	Pre-conditioning
4.3	Setup tolerances
4.4	Spurious inductance
4.5	Measurement uncertainty
4.6	DUT position
4.7	Test conditions for PCD
4.8	Test conditions for PICC
5	Apparatus and circuits for test of ISO/IEC 14443-1 and ISO/IEC 14443-2 parameters
5.1	Overview
5.2	Minimum requirements for measurement instruments — Oscilloscope
5.3	Calibration coils
5.3.1	General
5.3.2	Size of the calibration coil card
5.3.3	Thickness and material of the calibration coil card
5.3.4	Coil characteristics
5.4	Test PCD assembly
5.4.1	General
5.4.2	Test PCD antenna
5.4.3	Sense coils
5.4.4	Assembly of Test PCD
5.5	Reference PICC and Active Reference PICC
5.5.1	General
5.5.2	Reference PICC
5.5.2.1	Introduction
5.5.2.2	Dimensions of the Reference PICC
5.5.2.3	Reference PICC construction
5.5.2.4	Reference PICC resonance frequency tuning
5.5.3	Active Reference PICC
5.5.3.1	General
5.5.3.2	Dimensions of the Active Reference PICC
5.5.3.3	Active Reference PICC construction
5.6	PICC transmission test setup
5.6.1	General description
5.6.2	Phase stability precondition test
5.6.2.1	Purpose
5.6.2.2	Test procedure
5.6.2.3	Test report
5.7	EMD test setup
5.7.1	General description
5.7.2	Computation of power versus time

- 5.7.3 Noise floor precondition test
- 5.7.3.1 Purpose
- 5.7.3.2 Procedure
- 5.7.3.3 Test report
- 6 Test of ISO/IEC 14443-1 parameters
 - 6.1 PCD tests
 - 6.1.1 Alternating magnetic field
 - 6.1.1.1 Purpose
 - 6.1.1.2 Procedure
 - 6.1.1.3 Test report
 - 6.2 PICC tests
 - 6.2.1 Alternating magnetic field
 - 6.2.1.1 Purpose
 - 6.2.1.2 Apparatus
 - 6.2.1.3 Procedure
 - 6.2.1.4 Test report
 - 6.2.2 Void
 - 6.3 PXD tests
- 7 Test of ISO/IEC 14443-2 parameters
 - 7.1 PCD tests
 - 7.1.1 PCD field strength
 - 7.1.1.1 Purpose
 - 7.1.1.2 Procedure
 - 7.1.1.2.1 Procedure for Hmax test
 - 7.1.1.2.2 Procedure for Hmin test
 - 7.1.1.3 Test report
 - 7.1.2 Void
 - 7.1.3 Void
 - 7.1.4 Modulation index m and waveform
 - 7.1.4.1 Purpose
 - 7.1.4.2 Procedure
 - 7.1.4.3 Test report
 - 7.1.5 Phase stability test
 - 7.1.5.1 Purpose
 - 7.1.5.2 Test procedure
 - 7.1.5.3 Test report
 - 7.1.6 Load modulation reception for PICC to PCD bit rates of $f_c/128$, $f_c/64$, $f_c/32$ and $f_c/16$
 - 7.1.6.1 Purpose
 - 7.1.6.2 General description
 - 7.1.6.3 Precondition test
 - 7.1.6.4 Test conditions
 - 7.1.6.4.1 General
 - 7.1.6.4.2 Test conditions for Type A for a PICC to PCD bit rate of $f_c/128$
 - 7.1.6.4.3 Test conditions for Type B for a PICC to PCD bit rate of $f_c/128$ and for Type A and Type B for optional PICC to PCD bit rates of $f_c/64$, $f_c/32$ and $f_c/16$
 - 7.1.6.5 Test procedure 1
 - 7.1.6.6 Test procedure 2
 - 7.1.6.7 Test report
 - 7.1.7 Load modulation reception for PICC to PCD bit rates of $f_c/8$, $f_c/4$ and $f_c/2$
 - 7.1.7.1 Purpose
 - 7.1.7.2 Procedure
 - 7.1.7.3 Test report
 - 7.1.8 PCD EMD immunity test
 - 7.1.8.1 Purpose
 - 7.1.8.2 Procedure
 - 7.1.8.3 Test report
 - 7.2 PICC tests
 - 7.2.1 PICC transmission
 - 7.2.1.1 Purpose
 - 7.2.1.2 Conditions
 - 7.2.1.3 Procedure
 - 7.2.1.4 Test report

- 7.2.2 PICC EMD level and low EMD time test
 - 7.2.2.1 Purpose
 - 7.2.2.2 Noise requirements
 - 7.2.2.3 Test commands
 - 7.2.2.4 Procedure
 - 7.2.2.5 Test report
- 7.2.3 PICC reception
 - 7.2.3.1 Purpose
 - 7.2.3.2 General conditions
 - 7.2.3.3 PICC Type A for PCD to PICC bit rates of $fc/128$, $fc/64$, $fc/32$ and $fc/16$
 - 7.2.3.3.1 Test conditions
 - 7.2.3.3.2 Procedure
 - 7.2.3.4 PICC Type B for PCD to PICC bit rates of $fc/128$, $fc/64$, $fc/32$ and $fc/16$
 - 7.2.3.4.1 Test conditions
 - 7.2.3.4.2 Procedure
 - 7.2.3.5 PICC Type A or Type B for PCD to PICC bit rates of $fc/8$, $fc/4$ and $fc/2$
 - 7.2.3.5.1 Test conditions
 - 7.2.3.5.2 Procedure
- 7.2.3.6 PICC Type A or Type B for PCD to PICC bit rates of $3fc/4$, fc , $3fc/2$ and $2fc$
 - 7.2.3.7 Test report
- 7.2.4 PICC resonance frequency
 - 7.2.4.1 Purpose
 - 7.2.4.2 Procedure
 - 7.2.4.3 Test report
- 7.2.5 PICC maximum loading effect
 - 7.2.5.1 Purpose
 - 7.2.5.2 Procedure
 - 7.2.5.3 Test report
- 7.2.6 PICC operating field strength test
 - 7.2.6.1 Purpose
 - 7.2.6.2 Conditions
 - 7.2.6.3 Procedure
 - 7.2.6.4 Test report
- 7.3 Test methods for bit rates of $3fc/4$, fc , $3fc/2$ and $2fc$ from PCD to PICC
- 7.4 PXD tests

8 Test of ISO/IEC 14443-3 and ISO/IEC 14443-4 parameters

- 8.1 PCD tests
 - 8.1.1 PCD EMD recovery test
 - 8.1.1.1 Purpose
 - 8.1.1.2 Procedure
 - 8.1.1.3 Test report
 - 8.1.2 Additional PCD tests
- 8.2 PICC tests
- 8.3 PXD tests
 - 8.3.1 PCD and PICC Modes
 - 8.3.2 Automatic mode alternation
 - 8.3.2.1 General
 - 8.3.2.2 PCD Mode and PICC Mode alternation cycle
 - 8.3.2.2.1 Purpose
 - 8.3.2.2.2 Conditions
 - 8.3.2.2.3 Procedure
 - 8.3.2.2.4 Test report
 - 8.3.2.3 PCD Mode
 - 8.3.2.3.1 Polling
 - 8.3.2.3.1.1 Purpose
 - 8.3.2.3.1.2 Conditions
 - 8.3.2.3.1.3 Procedure
 - 8.3.2.3.1.4 Test report
 - 8.3.2.3.2 End of PCD Mode
 - 8.3.2.3.2.1 Purpose
 - 8.3.2.3.2.2 Conditions
 - 8.3.2.3.2.3 Procedure
 - 8.3.2.3.2.4 Test report

- 8.3.2.4 PICC Mode
 - 8.3.2.4.1 Reaction to polling
 - 8.3.2.4.1.1 Purpose
 - 8.3.2.4.1.2 Conditions
 - 8.3.2.4.1.3 Procedure 1
 - 8.3.2.4.1.4 Procedure 2
 - 8.3.2.4.1.5 Test report
 - 8.3.2.4.2 PICC Mode duration and exit conditions
 - 8.3.2.4.2.1 Purpose
 - 8.3.2.4.2.2 Conditions
 - 8.3.2.4.2.3 Procedure
 - 8.3.2.4.2.4 Test report

Annex A (normative) Test PCD antennas

- A.1 Test PCD antenna 1 layout including impedance matching network
- A.2 Impedance matching network
 - A.2.1 General
 - A.2.2 Impedance matching network for a bit rate of $f_c/128$
 - A.2.3 Impedance matching network for bit rates higher than $f_c/128$
- A.3 Test PCD antenna 2
 - A.3.1 Test PCD antenna 2 layout including impedance matching network
 - A.3.2 Impedance matching network 2

Annex B (informative) Test PCD Antenna tuning

Annex C (normative) Sense coil

- C.1 Sense coil layout
 - C.1.1 Sense coil 1 layout
 - C.1.2 Sense coil 2 layout
 - C.1.3 Sense coil assembly

Annex D (normative) Reference PICCs and Active Reference PICCs

- D.1 Reference PICCs
 - D.1.1 Reference PICC 1 coil layouts
 - D.1.2 Reference PICC 2 coil layouts
 - D.1.3 Reference PICC 3 coil layouts
 - D.1.4 Reference PICC 4 coil layouts
 - D.1.5 Reference PICC 5 coil layouts
 - D.1.6 Reference PICC 6 coil layouts
- D.2 Active Reference PICCs
 - D.2.1 Active Reference PICC 1 coil layouts
 - D.2.2 Active Reference PICC 2 coil layouts
 - D.2.3 Active Reference PICC 3 coil layouts
 - D.2.4 Active Reference PICC 4 coil layouts
 - D.2.5 Active Reference PICC 5 coil layouts
 - D.2.6 Active Reference PICC 6 coil layouts

Annex E (normative) PCD modulation index m and waveform analysis tool

- E.1 Overview
- E.2 Sampling
 - E.2.1 Sampling for PCD to PICC bit rates of $f_c/128$, $f_c/64$, $f_c/32$ and $f_c/16$
 - E.2.2 Sampling for PCD to PICC bit rates of $f_c/8$, $f_c/4$ and $f_c/2$
- E.3 Filtering
 - E.3.1 Filtering for PCD to PICC bit rates of $f_c/128$, $f_c/64$, $f_c/32$ and $f_c/16$
 - E.3.2 Filtering for PCD to PICC bit rates of $f_c/8$, $f_c/4$ and $f_c/2$
- E.4 Envelope generation
- E.5 Envelope smoothing
 - E.5.1 Envelope smoothing for PCD to PICC bit rates of $f_c/128$, $f_c/64$, $f_c/32$ and $f_c/16$
 - E.5.2 Envelope smoothing for PCD to PICC bit rates of $f_c/8$, $f_c/4$ and $f_c/2$
- E.6 Modulation index m determination
- E.7 Timing determination
- E.8 Overshoot and undershoot determination
- E.9 Program of the PCD modulation index m and waveform analysis tool
 - E.9.1 General

E.9.2	structures.h
E.9.3	fftrm.h
E.9.4	hilbert.h
E.9.5	hilbert.c
E.9.6	functs.c

Annex F (informative) Program for the evaluation of the load modulation amplitude

Annex G (normative) Additional PICC test methods

G.1	PICC-test-apparatus and accessories
G.1.1	General
G.1.2	Emulating the I/O protocol
G.1.3	Generating the I/O character timing in reception mode
G.1.4	Measuring and monitoring the RF I/O protocol
G.1.5	Protocol Analysis
G.1.6	RFU fields and values
G.1.7	Measuring timing
G.1.7.1	Timing measurements
G.1.7.2	Timing measurement report
G.2	General considerations
G.2.1	Use of test commands (possible additional PICC responses)
G.2.1.1	General
G.2.1.2	Rules on TEST_COMMAND1 and TEST_RESPONSE1
G.2.1.3	Rules on TEST_COMMAND2 and TEST_RESPONSE2
G.2.1.4	Rules on TEST_COMMAND3 and TEST_RESPONSE3
G.2.2	Relationship of test methods versus base standard requirement
G.3	Test method for initialization of the PICC Type A
G.3.1	General
G.3.2	Scenario G.1: Polling
G.3.2.1	Scope
G.3.2.2	Procedure
G.3.2.3	Test report
G.3.3	Testing of the PICC Type A state transitions
G.3.3.1	Scope
G.3.3.2	General test outline
G.3.3.2.1	General
G.3.3.2.2	Functions for putting the PICC in the Test Initial State (TIS)
G.3.3.2.3	Functions for checking the validity of the Test Target State (TTS)
G.3.3.3	Scenario G.2: Behavior of the PICC Type A in the IDLE state
G.3.3.3.1	Scope
G.3.3.3.2	Procedure
G.3.3.3.3	Test report
G.3.3.4	Scenario G.3: Behavior of the PICC Type A in the READY(1) state
G.3.3.4.1	Scope
G.3.3.4.2	Procedure
G.3.3.4.3	Test report
G.3.3.5	Scenario G.4: Behavior of the PICC Type A in the READY(2) state
G.3.3.5.1	Scope
G.3.3.5.2	Procedure
G.3.3.5.3	Test report
G.3.3.6	Scenario G.5: Behavior of the PICC Type A in the READY(3) state
G.3.3.6.1	Scope
G.3.3.6.2	Procedure
G.3.3.6.3	Test report
G.3.3.7	Scenario G.6: Behavior of the PICC Type A in the ACTIVE state
G.3.3.7.1	Scope
G.3.3.7.2	Procedure
G.3.3.7.3	Test report
G.3.3.8	Scenario G.7: Behavior of the PICC Type A in the HALT state
G.3.3.8.1	Scope
G.3.3.8.2	Procedure
G.3.3.8.3	Test report
G.3.3.9	Scenario G.8: Behavior of the PICC Type A in the READY*(1) state
G.3.3.9.1	Scope

- G.3.3.9.2 Procedure
- G.3.3.9.3 Test report
- G.3.3.10 Scenario G.9: Behavior of the PICC Type A in the READY*(2) state
 - G.3.3.10.1 Scope
 - G.3.3.10.2 Procedure
 - G.3.3.10.3 Test report
- G.3.3.11 Scenario G.10: Behavior of the PICC Type A in the READY*(3) state
 - G.3.3.11.1 Scope
 - G.3.3.11.2 Procedure
 - G.3.3.11.3 Test report
- G.3.3.12 Scenario G.11: Behavior of the PICC Type A in the ACTIVE* state
 - G.3.3.12.1 Scope
 - G.3.3.12.2 Procedure
 - G.3.3.12.3 Test report
- G.3.3.13 Scenario G.12: Behavior of the PICC Type A in the PROTOCOL state
 - G.3.3.13.1 Scope
 - G.3.3.13.2 Procedure
 - G.3.3.13.3 Test report
- G.3.4 Scenario G.13: Handling of Type A anticollision
 - G.3.4.1 Scope
 - G.3.4.2 Procedure
 - G.3.4.3 Test report
- G.3.5 Handling of RATS
- G.3.6 Handling of PPS request
 - G.3.6.1 Scope
 - G.3.6.2 Procedure
 - G.3.6.3 Test report
- G.3.7 Scenario G.20: Handling of FSD
 - G.3.7.1 Scope
 - G.3.7.2 Procedure
 - G.3.7.3 Test report
- G.3.8 Handling of Frame Delay Time PICC to PCD and SFGT
 - G.3.8.1 Scope
 - G.3.8.2 Procedure
 - G.3.8.3 Test report
- G.3.9 Scenario G.72: PICC bit rates capability
 - G.3.9.1 Scope
 - G.3.9.2 Procedure
 - G.3.9.3 Test report
- G.4 Test method for initialization of the PICC Type B
 - G.4.1 General
 - G.4.2 Scenario G.21: Polling
 - G.4.2.1 Scope
 - G.4.2.2 Procedure
 - G.4.2.3 Test report
 - G.4.3 Scenario G.22: PICC framing and bit rates capability
 - G.4.3.1 Scope
 - G.4.3.2 Procedure
 - G.4.3.3 Test report
 - G.4.4 Testing of the PICC Type B state transitions
 - G.4.4.1 General
 - G.4.4.2 General test outline
 - G.4.4.2.1 General
 - G.4.4.2.2 Functions to set the PICC in Test Initial State (TIS)
 - G.4.4.2.3 Functions for checking the validity of the Test Target State (TTS)
 - G.4.4.3 Scenario G.23: Behavior of the PICC Type B in the IDLE state
 - G.4.4.3.1 Scope
 - G.4.4.3.2 Procedure
 - G.4.4.3.3 Test report
 - G.4.4.4 Scenario G.24: Behavior of the PICC Type B in the READY-REQUESTED sub-state
 - G.4.4.4.1 General
 - G.4.4.4.2 Scope
 - G.4.4.4.3 Procedure
 - G.4.4.4.4 Test report

- G.4.4.5 Scenario G.25: Behavior of the PICC Type B in the READY-DECLARED sub-state
 - G.4.4.5.1 Scope
 - G.4.4.5.2 Procedure
 - G.4.4.5.3 Test report
- G.4.4.6 Scenario G.26: Behavior of the PICC Type B in the HALT state
 - G.4.4.6.1 Scope
 - G.4.4.6.2 Procedure
 - G.4.4.6.3 Test report
- G.4.4.7 Scenario G.27: Behavior of the PICC Type B in the PROTOCOL state
 - G.4.4.7.1 Scope
 - G.4.4.7.2 Procedure
 - G.4.4.7.3 Test report
- G.4.5 Scenario G.28: Handling of Type B anticollision
 - G.4.5.1 Scope
 - G.4.5.2 Procedure
 - G.4.5.3 Test report
- G.4.6 Handling of ATTRIB
 - G.4.6.1 Scope
 - G.4.6.2 Procedure
 - G.4.6.3 Test report
- G.4.7 Scenario G.31: Handling of Maximum Frame Size
 - G.4.7.1 Scope
 - G.4.7.2 Procedure
 - G.4.7.3 Test report
- G.4.8 Handling of TR2 and SFGT
 - G.4.8.1 Scope
 - G.4.8.2 Procedure
 - G.4.8.3 Test report
- G.5 Test methods for logical operation of the PICC Type A or Type B
 - G.5.1 General
 - G.5.1.1 General
 - G.5.1.2 PICC activation process
 - G.5.1.2.1 General
 - G.5.1.2.2 Activation of the PICC Type A
 - G.5.1.2.3 Activation of the PICC Type B
 - G.5.2 PICC reaction to ISO/IEC 14443-4 scenarios
 - G.5.2.1 Scope
 - G.5.2.2 Procedure
 - G.5.2.3 Test report
 - G.5.3 Handling of PICC error detection
 - G.5.3.1 Scope
 - G.5.3.2 Procedure
 - G.5.3.3 Test report
 - G.5.4 PICC reaction on CID
 - G.5.4.1 Scope
 - G.5.4.2 Procedure
 - G.5.4.3 Test report
 - G.5.5 PICC reaction on NAD
 - G.5.5.1 Scope
 - G.5.5.2 Procedure
 - G.5.5.3 Test report
 - G.5.6 PICC reaction on S(PARAMETERS) blocks
 - G.5.6.1 Scope
 - G.5.6.2 Procedure
 - G.5.6.3 Test report
 - G.5.7 PICC supporting Type A and Type B
 - G.5.7.1 Purpose
 - G.5.7.2 Conditions
 - G.5.7.3 Procedure
 - G.5.7.4 Test report
- G.6 Reported results

Annex H (normative) Additional PCD test methods

- H.1 PCD-test-apparatus and accessories

H.1.1	General
H.1.2	Test method
H.1.3	PCD-test-apparatus structure
H.1.4	PCD-test-apparatus interface
H.1.5	Emulating the I/O protocol
H.1.6	Generating the I/O character timing in transmission mode
H.1.7	Measuring and monitoring the RF I/O protocol
H.1.7.1	Timing measurements
H.1.7.2	Timing measurement report
H.1.8	Protocol analysis
H.1.9	Protocol activation procedure
H.1.9.1	Activation procedure for anticollision test methods
H.1.9.2	Activation procedure for Type A protocol test methods
H.1.9.3	Activation procedure for Type B protocol test methods
H.1.10	Scenario
H.1.10.1	Description
H.1.10.2	Scenario example
H.1.11	UT, LT and PCD behavior
H.1.12	Relationship of test methods versus base standard requirement
H.2	Type A specific test methods
H.2.1	Frame Delay Time PICC to PCD
H.2.1.1	Scope
H.2.1.2	Apparatus
H.2.1.3	Procedure
H.2.1.4	Test report
H.2.2	Request Guard Time
H.2.2.1	Scope
H.2.2.2	Apparatus
H.2.2.3	Procedure
H.2.2.4	Test report
H.2.3	Handling of bit collision during ATQA
H.2.3.1	Scope
H.2.3.2	Apparatus
H.2.3.3	Procedure
H.2.3.4	Test report
H.2.4	Handling of anticollision loop
H.2.4.1	Scope
H.2.4.2	Apparatus
H.2.4.3	Procedure
H.2.4.3.1	General
H.2.4.3.2	Procedure 1 (single size UID)
H.2.4.3.3	Procedure 2 (double size UID)
H.2.4.3.4	Procedure 3 (triple size UID)
H.2.4.3.5	Procedure 4 (Full Bitwise Anticollision, single size UID)
H.2.4.4	Test report
H.2.5	Handling of RATS and ATS
H.2.5.1	Scope
H.2.5.2	Apparatus
H.2.5.3	Procedure
H.2.5.3.1	General
H.2.5.3.2	Procedure 1
H.2.5.3.3	Procedure 2
H.2.5.3.4	Void
H.2.5.3.5	Procedure 4
H.2.5.4	Test report
H.2.6	Handling of PPS response
H.2.7	Frame size selection mechanism
H.2.7.1	Scope
H.2.7.2	Apparatus
H.2.7.3	Procedure
H.2.7.4	Test report
H.2.8	Handling of Start-up Frame Guard Time
H.2.8.1	Scope
H.2.8.2	Apparatus

H.2.8.3	Procedure
H.2.8.4	Test report
H.2.9	Handling of the CID during activation by the PCD
H.2.9.1	Scope
H.2.9.2	Apparatus
H.2.9.3	Procedure
H.2.9.4	Test report
H.2.10	Handling of parity bit
H.2.10.1	Scope
H.2.10.2	Apparatus
H.2.10.3	Procedure
H.2.10.4	Test report
H.3	Type B specific test methods
H.3.1	Void
H.3.2	Frame size selection mechanism
H.3.2.1	Scope
H.3.2.2	Apparatus
H.3.2.3	Procedure
H.3.2.4	Test report
H.3.3	Handling of the CID during activation by the PCD
H.3.3.1	Scope
H.3.3.2	Apparatus
H.3.3.3	Procedure
H.3.3.3.1	General
H.3.3.3.2	Procedure 1
H.3.3.3.3	Procedure 2
H.3.3.4	Test report
H.3.4	Frame Delay Time PICC to PCD (TR2)
H.3.4.1	Scope
H.3.4.2	Apparatus
H.3.4.3	Procedure
H.3.4.4	Test report
H.3.5	Handling of Start-up Frame Guard Time
H.3.5.1	Scope
H.3.5.2	Apparatus
H.3.5.3	Procedure
H.3.5.4	Test report
H.3.6	Type B PCD framing tests
H.3.6.1	Scope
H.3.6.2	Apparatus
H.3.6.3	Procedure
H.3.6.4	Test report
H.4	Test method for logical operations of the PCD
H.4.1	General
H.4.2	Handling of the polling loop
H.4.2.1	Scope
H.4.2.2	Apparatus
H.4.2.3	Procedure
H.4.2.4	Test report
H.4.3	Reaction of the PCD to request for waiting time extension
H.4.3.1	Scope
H.4.3.2	Apparatus
H.4.3.3	Procedure
H.4.3.4	Test report
H.4.4	Error detection and recovery
H.4.4.1	Scope
H.4.4.2	Apparatus
H.4.4.3	Procedure
H.4.4.3.1	General
H.4.4.3.2	Procedure 1 (ISO/IEC 14443-4:2018, Annex B, Scenario 12)
H.4.4.3.3	Procedure 2 (ISO/IEC 14443-4:2018, 7.5.5.2 rule 4)
H.4.4.3.4	Procedure 3 (ISO/IEC 14443-4:2018, 7.5.5.2 rule 4)
H.4.4.3.5	Procedure 4 (ISO/IEC 14443-4:2018, 7.5.5.2 rule 7)

- H.4.4.3.6 Procedure 5 (with chaining) (ISO/IEC 14443-4:2018, 7.5.5.2 rule 5, ISO/IEC 14443-4:2018, Annex B, Scenario 23)
- H.4.4.3.7 Procedure 6 (ISO/IEC 14443-4:2018, 7.5.5.2)
- H.4.4.3.8 Procedure 7 (ISO/IEC 14443-4:2018, 7.5.7, Annex B, Scenario 14)
- H.4.4.3.9 Procedure 8 (ISO/IEC 14443-4:2018, 7.5.7, Annex B, Scenario 17)
- H.4.4.3.10 Procedure 9 (with chaining) (see ISO/IEC 14443-4:2018, Annex B, Scenario 20)
- H.4.4.3.11 Procedure 10 (with chaining) (see ISO/IEC 14443-4:2018, Annex B, Scenario 21)
- H.4.4.3.12 Procedure 11 (with chaining) (see ISO/IEC 14443-4:2018, Annex B, Scenario 24)
- H.4.4.3.13 Procedure 12 (ISO/IEC 14443-4:2018, 7.5.5.2 rule 8)
- H.4.4.4 Test report
- H.4.5 Handling of NAD during chaining
 - H.4.5.1 Scope
 - H.4.5.2 Apparatus
 - H.4.5.3 Procedure
 - H.4.5.4 Test report
- H.5 Continuous monitoring of packets sent by the PCD
 - H.5.1 Scope
 - H.5.2 RFU fields
 - H.5.3 RFU values
 - H.5.4 R-block
 - H.5.5 S-block
 - H.5.6 PCB
 - H.5.7 Type A initialization frames
 - H.5.8 Apparatus
 - H.5.9 Procedure
 - H.5.10 Test report
- H.6 Reported results

Annex I (normative) High bit rate selection test methods for PCD

- I.1 Scope
- I.2 Apparatus
- I.3 Procedure
 - I.3.1 Procedure for Type A
 - I.3.1.1 General
 - I.3.1.2 Test report
 - I.3.2 Procedure for Type B
 - I.3.2.1 General
 - I.3.2.2 Test report
 - I.3.3 Procedure for bit rate selection using S(PARAMETERS) blocks
 - I.3.3.1 General
 - I.3.3.2 Test report

Annex J (informative) Program for EMD level measurements

Annex K (normative) Test methods for bit rates of 3fc/4, fc, 3fc/2 and 2fc from PCD to PICC

- K.1 Overview
- K.2 Test of ISO/IEC 14443-2 parameters
 - K.2.1 PCD Tests
 - K.2.1.1 General
 - K.2.1.2 PCD phase range and waveform characteristics
 - K.2.1.2.1 Purpose
 - K.2.1.2.2 Procedure
 - K.2.1.2.3 Test report
 - K.2.2 PICC Tests
 - K.2.2.1 PICC reception
 - K.2.2.1.1 Purpose
 - K.2.2.1.2 Conditions
 - K.2.2.1.3 Procedure
 - K.2.2.1.4 Test report
- K.3 PCD waveform characteristics analysis tool for bit rates of 3fc/4, fc, 3fc/2 and 2fc
 - K.3.1 Overview
 - K.3.2 Sampling
 - K.3.3 Anti-aliasing filtering
 - K.3.4 Homodyne demodulation

- K.3.5 Subsampling
- K.3.6 De#rotation
- K.3.7 Notch-filtering
- K.3.8 etu grid alignment
- K.3.9 Phase range measurement
- K.3.10 Intersymbol interference measurement
- K.3.11 Normalized differential phase noise measurement
- K.3.12 Program of the PCD waveform characteristics analysis tool for bit rates of $3f_c/4$, f_c , $3f_c/2$ and $2f_c$
- K.3.13 Example test report
- K.4 PCD signal creation for PICC reception tests
- K.4.1 General
- K.4.2 ISIm and ISId test signal creation
- K.4.3 Normalized differential phase noise test signal creation
- K.4.4 PCD signal creation tool

Annex L (normative) Frame with error correction test methods

- L.1 Frame format selection
 - L.1.1 PCD tests
 - L.1.1.1 Scope
 - L.1.1.2 Apparatus
 - L.1.1.3 Procedure
 - L.1.1.4 Test report
 - L.1.2 PICC tests
 - L.1.2.1 Scope
 - L.1.2.2 Apparatus
 - L.1.2.3 Procedure
 - L.1.2.4 Test report
- L.2 Error correction mechanism
 - L.2.1 PCD test
 - L.2.1.1 Scope
 - L.2.1.2 Apparatus
 - L.2.1.3 Procedure
 - L.2.1.4 Test report
 - L.2.2 PICC test
 - L.2.2.1 Scope
 - L.2.2.2 Apparatus
 - L.2.2.3 Procedure
 - L.2.2.4 Test report
- L.3 Logical operation of PICC when frame with error correction is activated
 - L.3.1 PICC reaction to ISO/IEC 14443-4 scenarios when frame with error correction is activated
 - L.3.1.1 Scope
 - L.3.1.2 Procedure
 - L.3.1.3 Test report
 - L.3.2 Reduction of bit rate during chaining when frame with error correction is activated
 - L.3.2.1 Scope
 - L.3.2.2 Procedure
 - L.3.2.3 Test report

Annex M (normative) PCD phase stability analysis tool

- M.1 Overview
- M.2 Sampling
- M.3 Band pass filtering
- M.4 Homodyne demodulation
- M.5 De-rotation
- M.6 Low pass filtering
- M.7 Phase computation
- M.8 Program of the PCD phase stability analysis tool
 - M.8.1 General
 - M.8.2 main_phase_stability_tool.m
 - M.8.3 phase_stability.m
 - M.8.4 correct_f_error.m

Annex N (normative) PICC amplitude and phase drift analysis tool

- N.1 Overview
- N.2 Sampling
- N.3 Band pass filtering
- N.4 Determination of f_c
- N.5 Resampling
- N.6 Homodyne demodulation and notch-filtering
- N.7 Low pass filtering
- N.8 PICC response detection
- N.9 MS1/MS2 state detection and state duration computation
 - N.9.1 MS1/MS2 state detector
 - N.9.1.1 General
 - N.9.1.2 Signal power evaluation of the complex base band
 - N.9.1.3 Correlation with an ideal rectangular subcarrier period during a phase transition
 - N.9.1.4 Correlation with ideal rectangular subcarrier period
 - N.9.1.5 Phase transitions verification
 - N.9.1.6 Symbol assignment
 - N.9.2 State duration
- N.10 Amplitude computation
- N.11 Phase drift computation
- N.12 Program of the amplitude and phase drift analysis tool
 - N.12.1 General
 - N.12.2 readme.txt
 - N.12.3 main_PDA_tool.m
 - N.12.4 processing_and_conditioning.m
 - N.12.5 sliding_lma.m
 - N.12.6 subcarrier_analysis.m
 - N.12.7 phase_drift_computation.m
 - N.12.8 signal_decoding.m
 - N.12.9 compute_phase_drift.m
 - N.12.10 correct_f_error.m
 - N.12.11 extract_state_samples.m
 - N.12.12 evaluate_signal_power.m
 - N.12.13 get_encoding_parameters.m
 - N.12.14 get_subcarrier_states_Type_A_106.m
 - N.12.15 get_subcarrier_states_Type_B_A_not_106.m
 - N.12.16 get_Vlma_limit.m
 - N.12.17 make_periodic_frame.m
 - N.12.18 new_findpeaks.m
 - N.12.19 peak_envelope.m
 - N.12.20 phase_drift_within_and_over_state.m
 - N.12.21 plot_time_continuous_const_plot.m
 - N.12.22 Type_A_not_106_decoding.m
 - N.12.23 Type_B_decoding.m
 - N.12.24 envelope_postprocessing.m
 - N.12.25 LMA_over_time.m

Annex O (normative) Conformance test plan

- O.1 PCD conformance test plan
 - O.1.1 Test command sequences
 - O.1.1.1 General
 - O.1.1.2 Examples of test commands
 - O.1.1.2.1 UT_TEST_COMMAND1
 - O.1.1.2.2 UT_TEST_COMMAND2
 - O.1.1.3 Default test command sequence
 - O.1.1.4 Test_command_sequence_1
 - O.1.1.5 Test_command_sequence_2
 - O.1.2 Test of ISO/IEC 14443-1 PCD parameters
 - O.1.3 Test of ISO/IEC 14443-2 PCD parameters
 - O.1.4 Test of ISO/IEC 14443-3 PCD parameters
 - O.1.5 Test of ISO/IEC 14443-4 PCD parameters
- O.2 PICC conformance test plan
 - O.2.1 Test command sequences

- O.2.2 Test of ISO/IEC 14443-1 PICC parameters
- O.2.3 Test of ISO/IEC 14443-2 PICC parameters
- O.2.4 Test of ISO/IEC 14443-3 PICC parameters
- O.2.5 Test of ISO/IEC 14443-4 PICC parameters

Annex P (normative) PICC Type A Frame Delay Time (FDT) determination method

- P.1 Overview
- P.2 Capturing
- P.3 Determination of the Start of FDT
- P.4 Determination of the End of FDT
 - P.4.1 General
 - P.4.2 Band pass filter
 - P.4.3 Resampling
 - P.4.4 Demodulation
 - P.4.5 Notch filter
 - P.4.6 Correlation
- P.5 Program of the FDT determination method
 - P.5.1 General
 - P.5.2 fdt.m
 - P.5.3 main_FDT_tool.m

Page count: 459