

Identification cards — Test methods —

Part 3: Integrated circuit(s) cards with contacts and related interface devices

ICS 35.240.15

National foreword

This British Standard reproduces verbatim ISO/IEC 10373-3:2001 and implements it as the UK national standard.

The UK participation in its preparation was entrusted to Technical Committee IST/17, Identification cards and Related Devices, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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This British Standard, having been prepared under the direction of the DISC Board, was published under the authority of the Standards Committee and comes into effect on 15 July 2001

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Identification cards — Test methods —
Part 3:
Integrated circuit(s) cards with contacts
and related interface devices

Cartes d'identification — Méthodes d'essai —

Partie 3: Cartes à circuit(s) intégré(s) à contacts et dispositifs d'interface assimilés

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Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO/IEC 10373 may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 10373-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Identification cards and related devices*.

ISO/IEC 10373 consists of the following parts, under the general title *Identification cards — Test methods*:

- *Part 1: General characteristics tests*
- *Part 2: Cards with magnetic stripes*
- *Part 3: Integrated circuit(s) cards with contacts and related interface devices*
- *Part 4: Contactless integrated circuit cards*
- *Part 5: Optical memory cards*
- *Part 6: Proximity cards*
- *Part 7: Vicinity cards*

Annex A of this part of ISO/IEC 10373 is for information only.

Identification cards — Test methods —

Part 3:

Integrated circuit(s) cards with contacts and related interface devices

1 Scope

This part of ISO/IEC 10373 defines test methods for characteristics of integrated circuit(s) cards with contacts and related interface devices according to the definition given in ISO/IEC 7816. Each test method is cross-referenced to one or more base standards, which may be ISO/IEC 7810 or one or more of the supplementary standards that define the information storage technologies employed in identification card applications.

NOTE 1 Criteria for acceptability do not form part of this International Standard but will be found in the International Standards mentioned above.

This part of ISO/IEC 10373 deals with test methods, which are specific to integrated circuit technology with contacts. ISO/IEC 10373-1 deals with test methods which are common to one or more card technologies and other parts deal with other technology-specific tests.

Test methods described in this part of ISO/IEC 10373 are intended to be performed separately and independently. A given card is not required to pass through all the tests sequentially. The test methods described in this part of ISO/IEC 10373 are based on specifications defined or to be defined in ISO/IEC 7816.

Conformance of ICCs and IFDs determined using the test methods defined in this part of ISO/IEC 10373 do not preclude failures in the field. Reliability testing is outside the scope of this part of ISO/IEC 10373.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 10373. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO/IEC 10373 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 7810:1995, *Identification cards — Physical characteristics*.

ISO/IEC 7816-1:1998, *Identification cards — Integrated circuit(s) cards with contacts — Part 1: Physical characteristics*.

ISO/IEC 7816-2:1999, *Information technology — Identification cards — Integrated circuit(s) cards with contacts — Part 2: Dimensions and location of the contacts*.

ISO/IEC 7816-3:1997, *Information technology — Identification cards — Integrated circuit(s) cards with contacts — Part 3: Electronic signals and transmission protocols*.

ISO/IEC 7816-4:1995, *Information technology — Identification cards — Integrated circuit(s) cards with contacts — Part 4: Interindustry commands for interchange*.

ISO/IEC 10373-1:1998, *Identification cards — Test methods — Part 1: General characteristics tests*.

United States of America, Department of Defense, Test Method Standard, Microcircuits, MIL-STD-883, Version E, 31 December 1996, Method 3015.7 'Electrostatic discharge sensitivity classification'.

3 Terms and definitions

For the purposes of this part of ISO/IEC 10373, the following terms and definitions apply.

3.1 test method

method for testing characteristics of identification cards and related interface devices for the purpose of confirming their compliance with International Standards

3.2 testably functional

has survived the action of some potentially destructive influence to the extent that:

- a) any magnetic stripe present on the card shows a relationship between signal amplitudes before and after exposure that is in accordance with the base standard;
- b) any integrated circuit(s) present in the card continues to show an Answer to Reset response¹ which conforms to the base standard;
- c) any contacts associated with any integrated circuit(s) present in the card continue to show electrical resistance which conforms to the base standard;
- d) any optical memory present in the card continue to show optical characteristics which conform to the base standard

3.3 normal use

use as an Identification card (see clause 4 of ISO/IEC 7810:1995), involving equipment processes appropriate to the card technology and storage as a personal document between equipment processes

3.4 ICC

integrated circuit(s) card with contacts as defined in the ISO/IEC 7816 series of standards

3.5 IFD

interface device related to integrated circuit(s) cards with contacts as defined in the ISO/IEC 7816 series of standards

3.6 DUT

device under test; within the scope of this document the ICC or the IFD subject to testing

¹ This part of ISO/IEC 10373 does not define any test to establish the complete functioning of integrated circuit(s) cards. The test methods require only that the minimum functionality (testably functional) be verified. This may, in appropriate circumstances, be supplemented by further, application specific functionality criteria which are not available in the general case.

3.7**typical protocol and application specific communication**

any communication between a DUT and the corresponding test-apparatus based on protocol and application implemented in the DUT and representing its normal use

3.8**Test Scenario**

a defined typical protocol and application specific communication to be used with the test methods defined in this document

4 General items applicable to the test methods**4.1 Test environment**

Unless otherwise specified, testing of physical, electrical and logical characteristics shall take place in an environment of temperature $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, of relative humidity 40 % to 60 %.

4.2 Pre-conditioning

Where pre-conditioning is required by the test method, the identification cards to be tested shall be conditioned to the test environment for a period of 24 h before testing unless otherwise specified.

4.3 Default tolerance

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

4.4 Total measurement uncertainty

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

4.5 Conventions for electrical measurements

Potential differences are defined with respect to the GND contact of the ICC and currents flowing to the ICC are considered positive.

4.6 Apparatus**4.6.1 Default ICC-holder, reference axes and default measurement position**

When required by the test-method, the ICC shall be positioned in the default measurement position as subsequently defined.

The default measurement position requires the ICC to be positioned in an ICC-holder and flattened by a flattening plate. All Measurements using this default measurement position shall be relative to the reference axes defined in Figure 1.

4.6.1.1 Default ICC-holder and reference axes:

The default ICC holder shall comply with Figure 1:

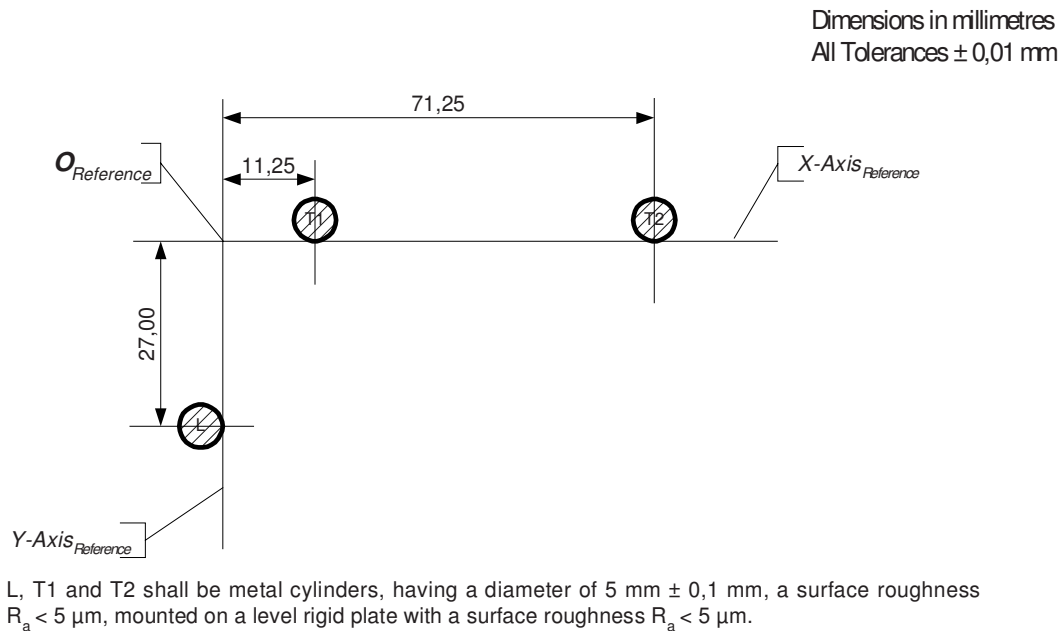
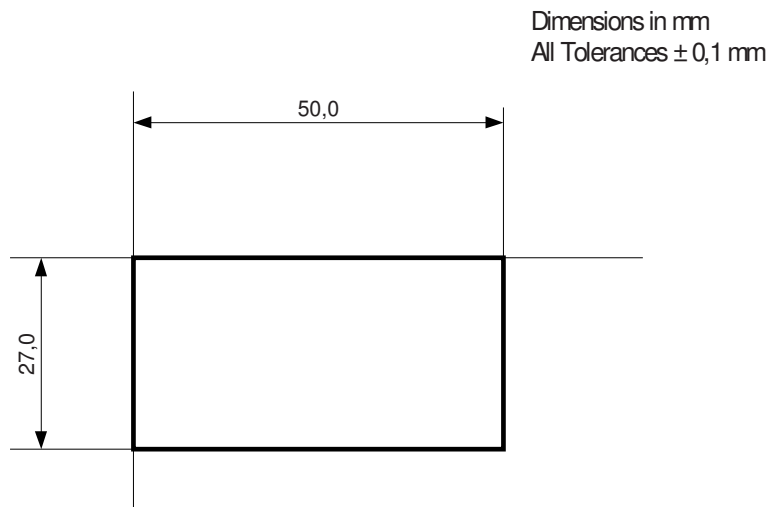


Figure 1 — ICC-holder

4.6.1.2 Flattening Plate

The flattening plate shall comply with Figure 2:

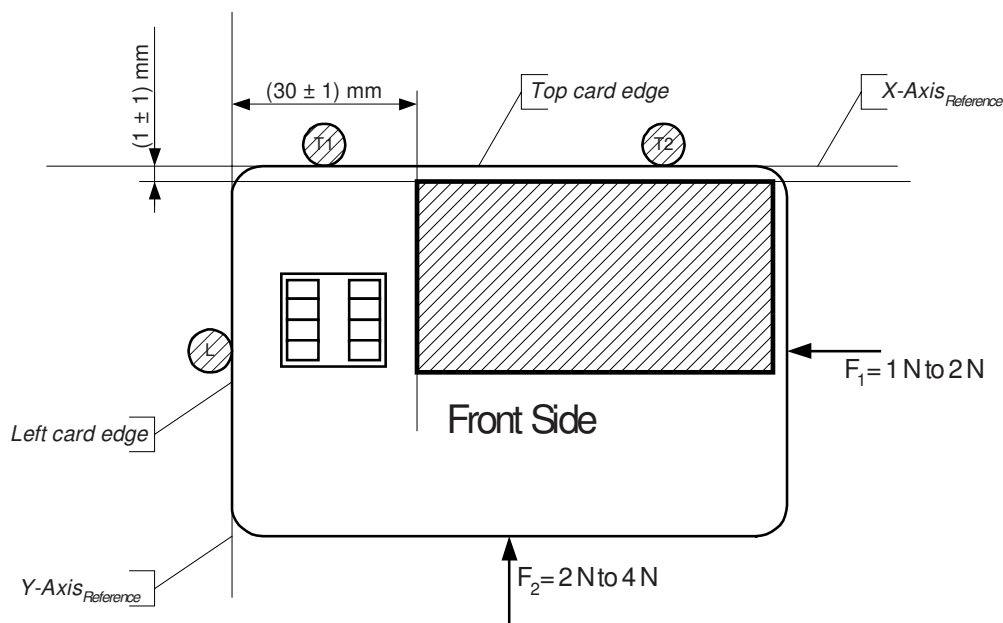


The surface roughness of the flattening plate shall be $R_a < 5\text{ }\mu\text{m}$.

Figure 2 — Flattening plate

4.6.1.3 Default Measurement Position

The ICC and the flattening plate shall be mounted on the ICC-holder as shown in Figure 3:



F_1 and F_2 are forces applied to the center of the right and the bottom edge of the card respectively to fix the card in the card-holder.

The flattening plate shall apply a force of $2,2 \text{ N} \pm 0,2 \text{ N}$ to the surface of the card

Figure 3 — Position of ICC and flattening plate on ICC-holder

4.6.2 Apparatus for testing the integrated circuit(s) cards with contacts (ICC-test-apparatus)

4.6.2.1 General

All relative voltage definitions (e.g. $0,7 \times V_{CC}$, $0,15 \times V_{CC}$ or $V_{CC} + 0,3 \text{ V}$) shall be determined relative to GND and checked against the simultaneously measured value of V_{CC} .

4.6.2.2 Generating the VCC voltage (V_{CC}) and timing

Parameter	ICC class	Range	Accuracy
V_{CC}	Class A	-1 V to 6 V	$\pm 50 \text{ mV}$
	Class B	-1 V to 4 V	$\pm 30 \text{ mV}$
t_R, t_F	Class A, Class B	500 μs	$\pm 100 \mu\text{s}$

4.6.2.3 Measuring the VCC current (I_{CC})

Characteristic	Mode	Range	Accuracy	Resolution
I_{CC}	Spike Measurement	0 mA to 200 mA	± 2 mA	20 ns
	Active mode	0 mA to 100 mA	± 1 mA	Averaged over 1 ms
	Clock stop	0 mA to 1 mA	± 10 μ A	Averaged over 1 ms

4.6.2.4 Generating the VPP voltage (V_{PP}) and timing

Parameter	ICC class	Range	Accuracy	Resolution
V_{PP}	Class A	-1 V to 26 V	± 50 mV	20 ns
t_R, t_F	Class A	1 μ s to 220 μ s	± 1 μ s	

NOTE 1 t_R and t_F are measured between 10% and 90% of V_H min and V_L max values.

NOTE 2 Certain functionality may not be implemented into the application in the ICC, hence in such circumstances the ICC-test-apparatus is not required to have the corresponding test-capability (e.g. V_{PP})

4.6.2.5 Measuring the VPP current (I_{PP})

Characteristic	Mode	Range	Accuracy	Resolution
I_{PP}	active (Programming State)	0 mA to 100 mA	± 1 mA	100 ns
	inactive (Pause)	0 mA to 100 mA	± 1 mA	100 ns

NOTE Certain functionality may not be implemented into the application in the ICC, hence in such circumstances the ICC-test-apparatus is not required to have the corresponding test-capability (e.g. I_{PP}).

4.6.2.6 Generating the RST voltage and timing

Parameter	ICC class	Range	Accuracy
V_{IH}	Class A	2 V to 6 V	± 50 mV
	Class B	2 V to 4 V	± 30 mV
V_{IL}	Class A	-1 V to 2 V	± 50 mV
	Class B	-1 V to 2 V	± 30 mV
t_R, t_F		0 μ s to 2 μ s	± 20 ns
NOTE t_R and t_F are generated between 10% and 90% of V_H min and V_L max values.			

4.6.2.7 Measuring the RST current

Characteristic	Mode	Range	Accuracy	Resolution
I_{IH}	Active	-30 μ A to 200 μ A	± 10 μ A	100 ns
I_{IL}	Active	-250 μ A to 30 μ A	± 10 μ A	100 ns

4.6.2.8 Generating the I/O voltage and timing in reception mode

Parameter	Mode	ICC class	Range	Accuracy
V_{IH}	ICC: Reception, Apparatus: Transmission	Class A	2 V to 6 V	± 50 mV
		Class B	2 V to 4 V	± 30 mV
V_{IL}	ICC: Reception, Apparatus: Transmission	Class A	-1 V to 2 V	± 50 mV
		Class B	-1 V to 2 V	± 30 mV
t_R, t_F	ICC: Reception, Apparatus: Transmission		0 μ s to 2 μ s	± 100 ns
NOTE t_R and t_F are generated between 10% and 90% of V_H min and V_L max values.				

4.6.2.9 Measuring the I/O current in reception mode

Parameter	Mode	Range	Accuracy	Resolution
I_{IH}	ICC: Reception, Apparatus: Transmission	-350 μ A to 30 μ A	$\pm 1 \mu$ A	100 ns
I_{IL}	ICC: Reception, Apparatus: Transmission	-1,5 mA to 30 μ A	$\pm 10 \mu$ A	100 ns

4.6.2.10 Generating the I/O current

Parameter	Mode	Range	Accuracy	Stabilization time after level is reached
I_{OH}	ICC: Transmission Apparatus: Reception	20 k Ω pull-up to VCC or equivalent circuit	$\pm 200 \Omega$	
I_{OL}	ICC: Transmission Apparatus: Reception	0 mA to 1,5 mA	$\pm 10 \mu$ A	< 100 ns

4.6.2.11 Measuring the I/O voltage and timing

Characteristic	ICC class	Range	Accuracy	Resolution
V_{IH} , V_{IL}	Class A	-1 V to 6 V	± 50 mV	20 ns
V_{IH} , V_{IL}	Class B	-1 V to 4 V	± 30 mV	20 ns
t_R , t_F		0 μ s to 2 μ s	± 20 ns	
NOTE t_R and t_F are measured between 10% and 90% of V_H min and V_L max values.				

4.6.2.12 Generating the CLK-voltage

Parameter	ICC class	Range	Accuracy	Resolution
V_{IH}	Class A	2 V to 6 V	± 50 mV	20 ns
	Class B	2 V to 4 V	± 30 mV	20 ns
V_{IL}	Class A	-1 V to 2 V	± 50 mV	20 ns
	Class B	-1 V to 2 V	± 30 mV	20 ns

4.6.2.13 Generating the CLK-waveforms (single cycle measurement)

Parameter	Range	Accuracy
Duty cycle	35 % to 65 % of period	± 5 ns
Frequency	0,5 MHz to 5,5 MHz	± 5 kHz
Frequency	5 MHz to 20,5 MHz	± 50 kHz
t_R, t_F	1 % to 10 % of period	± 5 ns
NOTE t_R and t_F are generated between 10% and 90% of V_H (100%) min and V_L (0%) max.		

4.6.2.14 Measuring the CLK current

Characteristic	Mode	Range	Accuracy	Resolution
I_{IH}	active	-30 μ A to 150 μ A	± 10 μ A	20 ns
I_{IL}	active	-150 μ A to 30 μ A	± 10 μ A	20 ns

4.6.2.15 Measuring the contact capacitance of RST, CLK and I/O

Characteristic	Range	Accuracy
C	0 pF to 50 pF	± 5 pF
The contact capacitance of a contact shall be measured between the contact and the GND contact.		

4.6.2.16 Generating the sequence of the activation and deactivation of the contacts

Range of switching the signals	Accuracy
0 s to 1 s	± 200 ns (or 1 clk period, whichever is smaller)

4.6.2.17 Emulating the I/O protocol

The ICC-test-apparatus shall be able to emulate the protocol T=0 and T=1 and IFD applications which are required to run the typical application specific communications corresponding to the ICC applications.

NOTE Certain functionality may not be implemented into the application in the ICC, hence in such circumstances the ICC-test-apparatus is not required to have the corresponding test-capability (e.g. T=1 protocol not implemented in the ICC)

4.6.2.18 Generating the I/O character timing in reception mode

The ICC-test-apparatus shall be able to generate the I/O bit stream according to ISO/IEC 7816-3:1997.

All timing parameters like start bit length, guardtime, error signaling etc. shall be configurable.

Parameter	Accuracy
all timing parameters	± 4 CLK cycles

4.6.2.19 Measuring and monitoring the I/O protocol

The ICC-test-apparatus shall be able to measure and monitor the timing of the logical low and high states of the I/O-line relative to the CLK-frequency.

Characteristic	Accuracy
all timing characteristics	± 2 CLK cycles

4.6.2.20 Protocol Analysis

The ICC-test-apparatus shall be able to analyze the I/O-bit stream in accordance to T=0 and T=1 protocol according to ISO/IEC 7816-3:1997 and extract the logical data flow for further protocol and application verifications.

NOTE Certain functionality may not be implemented into the application in the ICC, hence in such circumstances the ICC-test-apparatus is not required to have the corresponding test-capability (e.g. T=1 protocol not implemented in the ICC). Conversely, an apparatus may need extended capabilities, e.g. being able to generate any case 2 command (see ISO/IEC 7816-4:1995) if an ICC does not support the standard READ BINARY.

4.6.3 Apparatus for testing the interface device (IFD-test-apparatus)

4.6.3.1 General

All relative voltage definitions (e.g. $0,7 \times V_{CC}$, $0,15 \times V_{CC}$ or $V_{CC} + 0,3 \text{ V}$) shall be determined relative to GND and checked against the simultaneously measured value of V_{CC} .

4.6.3.2 Generating the VCC current (I_{CC})

Parameter	Mode	Range	Accuracy	Stabilization time after level is reached
I_{CC}	Spike Generation	0 mA to 120 mA	$\pm 2 \text{ mA}^b$	< 100 ns
	Active mode	0 mA to 70 mA	$\pm 1 \text{ mA}$	< 100 ns
	Idle mode (clk-Stop)	0 mA to 1,2 mA	$\pm 10 \mu\text{A}$	< 100 ns
	Inactive ^a	-1,2 mA to 0 mA	$\pm 10 \mu\text{A}$	< 100 ns
t_R, t_F		100 ns	$\pm 50 \text{ ns}$	
pulse length		100 ns to 500 ns	$\pm 50 \text{ ns}$	
pause length frequently		100 ns to 1000 ns	$\pm 50 \text{ ns}$	
pause length randomly		10 μs to 2000 μs	$\pm 1 \mu\text{s}$	
^a The maximum output voltage shall be limited to 5 V.				
^b Dynamic conditions for Spike generation.				

4.6.3.3 Measuring the VCC voltage (V_{CC}) and timing

Characteristic	ICC class	Range	Accuracy	Resolution
V_{CC}	Class A	- 1 V to 6 V	$\pm 50 \text{ mV}$	20 ns
	Class B	- 1 V to 4 V	$\pm 30 \text{ mV}$	20 ns

4.6.3.4 Generating the VPP current (I_{PP})

Parameter	Mode	Range	Accuracy	Stabilization time after level is reached
I_{PP}	active	0 mA to 100 mA	± 1 mA	< 100 ns
	inactive ^a	- 1,2 mA to 0 mA	± 10 μ A	< 100 ns
^a The output voltage shall be limited from - 0,5 V to V_{PP}				

4.6.3.5 Measuring the VPP voltage (V_{PP}) and timing

Characteristic	ICC class	Voltage range	Accuracy	Resolution
V_{PP}	Class A	- 1 V to 25 V	± 50 mV	20 ns
t_R , t_F	Class A	1 μ s to 220 μ s	± 1 μ s	
NOTE t_R and t_F are measured between 10% and 90% of V_H min and V_L max values.				

4.6.3.6 Generating the RST current

Parameter	Mode	Range	Accuracy	Stabilization time after level is reached
I_{IH}	active	- 30 μ A to 200 μ A	± 10 μ A	< 100 ns
I_{IL}	active	- 250 μ A to 30 μ A	± 10 μ A	< 100 ns
I^a	inactive	- 1,2 mA to 0 mA	± 10 μ A	< 100 ns
^a The output voltage shall be limited from -0,5 V to 5,5 V.				

4.6.3.7 Measuring RST voltage and timing

Characteristic	ICC class	Range	Accuracy	Resolution
V_{IH}	Class A	2 V to 6 V	± 50 mV	20 ns
	Class B	2 V to 4 V	± 30 mV	20 ns
V_{IL}	Class A	- 1 V to 2 V	± 50 mV	20 ns
	Class B	- 1 V to 2 V	± 30 mV	20 ns
t_R, t_F		0 μ s to 2 μ s	± 20 ns	
NOTE t_R and t_F are measured between 10% and 90% of V_H min and V_L max values.				

4.6.3.8 Generating the I/O currents

Parameter	Mode	Range	Accuracy	Stabilization time after level is reached
I_{IH}, I_{OH}	Apparatus: Reception and Transmission IFD: Transmission and Reception	-400 μ A to 50 μ A	± 5 μ A	< 100 ns
I_{IL}	Apparatus: Reception IFD: Transmission and Reception	0 mA to 1,5 mA	± 10 μ A	< 100 ns
I_{OL}	IFD: Reception	0 μ A to 1200 μ A	± 10 μ A	< 100 ns
I^a	Inactive	- 1,2 mA to 0 mA	± 10 μ A	< 100 ns
^a The output voltage shall be limited to -0,5 V to 5,5 V.				

4.6.3.9 Measuring the I/O voltage and timing

Characteristic	ICC class	Range	Accuracy	Resolution
V_{IH}	Class A	2 V to 6 V	± 50 mV	20 ns
	Class B	2 V to 4 V	± 30 mV	20 ns
V_{IL}	Class A	- 1 V to 2 V	± 50 mV	20 ns
	Class B	- 1 V to 2 V	± 30 mV	20 ns
t_R, t_F		0 μ s to 2 μ s	± 20 ns	
NOTE t_R and t_F are measured between 10% and 90% of V_H min and V_L max values.				

4.6.3.10 Generating the I/O voltage and timing in transmission mode

Parameter	ICC class	Range	Accuracy
V_{OH}	Class A	2 V to 6 V	± 50 mV
	Class B	2 V to 4 V	± 30 mV
V_{OL}	Class A	- 1 V to 2 V	± 50 mV
	Class B	- 1 V to 2 V	± 30 mV
t_R, t_F		0 μ s to 2 μ s	± 20 ns
NOTE 1 V_{OH} only needs to be generated because of the rising edge generation mechanism and shall be switched off at least 10 μ s after the rising edge.			
NOTE 2 t_R and t_F are generated between 10% and 90% of V_H min and V_L max values.			

4.6.3.11 Measuring the I/O current in transmission mode

Parameter	Mode	Range	Accuracy	Resolution
I_{OL}	Transmission	0 μ A to 1200 μ A	± 10 μ A	20 ns
I^a	Inactive	0 mA to 1,2 mA	± 10 μ A	20 ns
^a The output voltage shall be limited to - 0,5 V to 5,5 V.				

4.6.3.12 Generating the CLK current

Parameter	Mode	Range	Accuracy	Stabilization time after level is reached
I_{IH}	active	-30 μ A to 150 μ A	$\pm 10 \mu$ A	< 20 ns
I_{IL}	active	-150 μ A to 30 μ A	$\pm 10 \mu$ A	< 20 ns
I^a	inactive	-1,2 mA to 0 mA	$\pm 10 \mu$ A	< 100 ns
^a The output voltage shall be limited to -0,5 V to 5,5 V.				

4.6.3.13 Measuring the CLK-voltage and timing

Characteristic	ICC class	Range	Accuracy	Resolution
V_{IH}	Class A	2 V to 6 V	± 50 mV	20 ns
	Class B	2 V to 4 V	± 30 mV	20 ns
V_{IL}	Class A	-1 V to 2 V	± 50 mV	20 ns
	Class B	-1 V to 2 V	± 30 mV	20 ns

4.6.3.14 Measuring the CLK-waveforms (single cycle measurement)

Characteristic	Range	Accuracy
Duty cycle ^a	35 % to 65 % of period	$\pm 2,5$ % of period
Frequency ^b	0,5 MHz to 20,5 MHz	$\pm 2,5$ % of period
t_R, t_F ^c	1 % to 10 % of period	$\pm 2,5$ % of period
The IFD-test-apparatus shall be able to check every cycle during the measurement.		
^a Duty cycle shall be measured from 50% to 50% of V_H min (100%) and V_L max (0%) rising edge to rising edge.		
^b Frequency shall be measured from 50% to 50% of the leading edges of two adjacent clock-cycles of V_H min (100%) and V_L max (0%) rising edge to rising edge.		
^c t_R and t_F shall be measured between 10% and 90% of V_H (100%) min and V_L (0%) max.		

4.6.3.15 Measuring the contact capacitance between GND and I/O

Characteristic	Range	Accuracy
C	0 pF to 50 pF	± 5 pF

4.6.3.16 Emulating the I/O protocol

The IFD-test-apparatus shall be able to emulate the protocol T=0 and T=1 and ICC applications which are required to run the Test Scenario.

NOTE Certain functionality may not be implemented into the application in the ICC, hence in such circumstances the IFD-test-apparatus is not required to have the corresponding test-capability (e.g. T=1 protocol not implemented in the ICC)

4.6.3.17 Generating the I/O character timing in transmission mode

The Test IFD-test-apparatus shall be able to generate the I/O bit stream according to ISO/IEC 7816-3:1997 relative to the CLK-frequency.

All timing parameters like start bit length, guardtime and error signaling etc. shall be configurable.

Parameter	Accuracy
all timing parameters	± 4 CLK cycles

4.6.3.18 Measuring and monitoring the I/O protocol

The IFD-test-apparatus shall be able to measure and monitor the timing of the logical low and high states of the I/O-line relative to the CLK-frequency.

Characteristic	Accuracy
all timing characteristics	± 2 CLK cycles

4.6.3.19 Protocol Analysis

The Test IFD-test-apparatus shall be able to analyze the I/O-bit stream in accordance to T=0 and T=1 protocol according to ISO/IEC 7816-3:1997 and extract the logical data flow for further protocol and application verifications.

NOTE Certain functionality may not be implemented into the application in the ICC, hence in such circumstances the IFD-test-apparatus is not required to have the corresponding test-capability (e.g. T=1 protocol not implemented in the ICC)

4.6.3.20 Overall Impedance (current and voltage sources inactive)

Contact	Resistance	Accuracy	Capacity	Accuracy
VCC	10 k Ω	± 1 k Ω	30 pF	± 6 pF
VPP	50 k Ω	± 5 k Ω	30 pF	± 6 pF
I/O	50 k Ω	± 5 k Ω	30 pF	± 6 pF
RST	50 k Ω	± 5 k Ω	30 pF	± 6 pF
CLK	50 k Ω	± 5 k Ω	30 pF	± 6 pF

4.6.4 Test Scenario

Testing of the DUT as defined in clauses 6, 7, 8 and 9 requires a Test Scenario to be executed. This Test Scenario is a 'typical protocol and application specific communication', dependent from the protocol and application specific functionality foreseen for the normal use of and implemented in the DUT.

The Test Scenario shall be defined by the entity carrying out these tests and shall be documented with the test-results. The Test Scenario shall encompass a representative subset or preferably, if practical, the full functionality of the DUT expected to be utilized during normal use. The Test Scenario shall have a duration of at least 1 second.

NOTE The testing entity may require information about the implemented protocol and functionality as well as the intended use of the DUT to enable the testing entity to define a Test Scenario.

4.7 Relationship of test methods versus base standard requirements

Table 1 — Test methods for physical characteristics of ICCs with contacts

Test method from ISO/IEC 10373-3		Corresponding Requirement	
Clause	Name	Base Standard	Clause(s)
5.1	Dimension and Location of Contacts	ISO/IEC 7816-2:1999	3, 4
5.2	Static electricity	ISO/IEC 7816-1:1998	4.2.8
5.3	Electrical surface resistance of contacts		
5.4	Surface profile of contacts	ISO/IEC 7816-1:1998	4.2.3

Table 2 — Test methods for electrical characteristics of ICCs with contacts

Test method from ISO/IEC 10373-3		Corresponding Requirement	
Clause	Name	Base Standard	Clause(s)
6.1	VCC contact	ISO/IEC 7816-3:1997	4.3.2
6.2	I/O contact	ISO/IEC 7816-3:1997	4.3.3
6.3	CLK contact	ISO/IEC 7816-3:1997	4.3.4
6.4	RST contact	ISO/IEC 7816-3:1997	4.3.5
6.5	VPP contact	ISO/IEC 7816-3:1997	4.3.6

Table 3 — Test methods for logical operations of ICCs with contacts — Answer to Reset (ATR)

Test method from ISO/IEC 10373-3		Corresponding Requirement	
Clause	Name	Base Standard	Clause(s)
7.1.1	Cold Reset and Answer-to-Reset (ATR)	ISO/IEC 7816-3:1997	5.2, 5.3.2, 6.3
7.1.2	Warm Reset	ISO/IEC 7816-3:1997	5.3.3
7.1.3	Selection of the operation class A	ISO/IEC 7816-3:1997	4.2.2

Table 4 — Test methods for logical operations of ICCs with contacts — T=0 Protocol

Test method from ISO/IEC 10373-3		Corresponding Requirement	
Clause	Name	Base Standard	Clause(s)
7.2.1	I/O transmission timing for T=0 protocol	ISO/IEC 7816-3:1997	6.3.1, 6.3.2, 8.2
7.2.2	I/O character repetition for T=0 protocol	ISO/IEC 7816-3:1997	6.3.3, 8.2
7.2.3	I/O reception timing and error signaling for T=0 protocol	ISO/IEC 7816-3:1997	6.3.1, 6.3.2, 6.3.3, 8.2

Table 5 — Test methods for logical operations of ICCs with contacts — T=1 Protocol

Test method from ISO/IEC 10373-3		Corresponding Requirement	
Clause	Name	Base Standard	Clause(s)
7.3.1	I/O transmission timing for T=1 protocol	ISO/IEC 7816-3:1997	6.3.1, 6.3.2, 6.5.3, 9.3, 9.4, 9.5.2, 9.5.3
7.3.2	I/O reception timing for T=1 protocol	ISO/IEC 7816-3:1997	6.3.1, 6.3.2, 6.5.3, 9.3, 9.4, 9.5.2, 9.5.3
7.3.3	ICC Character Waiting Time (CWT) behavior	ISO/IEC 7816-3:1997	9.5.3.1
7.3.4	ICC-reaction to IFD exceeding character waiting time (CWT)	ISO/IEC 7816-3:1997	9.5.3.1
7.3.5	Block Guardtime (BGT)	ISO/IEC 7816-3:1997	9.5.3.3
7.3.6	Block sequencing by the ICC	ISO/IEC 7816-3:1997	9.7.3
7.3.7	Reactions of the ICC to protocol errors	ISO/IEC 7816-3:1997	9.7.3
7.3.8	Recovery of a transmission error by the ICC	ISO/IEC 7816-3:1997	9.7.3
7.3.9	Resynchronization	ISO/IEC 7816-3:1997	9.7.3
7.3.10	IFSD negotiation	ISO/IEC 7816-3:1997	9.5.2
7.3.11	Abortion by the IFD	ISO/IEC 7816-3:1997	9.7.3