INTERNATIONAL STANDARD

ISO/IEC 10373-3

Second edition
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Identification cards — Test methods —

Part 3: Integrated circuit 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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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.

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

ISO/IEC 10373-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and personal identification*.

This second edition cancels and replaces the first edition (ISO/IEC 10373-3:2001), which has been technically revised.

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

— *Part 1: General characteristics*

— *Part 2: Cards with magnetic stripes*

— *Part 3: Integrated circuit cards with contacts and related interface devices*

— *Part 5: Optical memory cards*

— *Part 6: Proximity cards*

— *Part 7: Vicinity cards*

— *Part 8: USB-ICC*

The following part is under preparation:

— *Part 9: Optical memory cards: Holographic recording method*

Identification cards — Test methods —

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

1 Scope

This part of ISO/IEC 10373 defines test methods for characteristics of integrated circuit 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 can be ISO/IEC 7810 or one or more of the supplementary International Standards that define the information storage technologies employed in identification card applications.

NOTE Criteria for acceptability do not form part of this part of ISO/IEC 10373 but will be found in the International Standards mentioned above.

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

Test methods defined 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 defined in this part of ISO/IEC 10373 are based on ISO/IEC 7816-3.

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

This part of ISO/IEC 10373 does not define any test to establish the complete functioning of integrated circuit cards. The test methods require only that the minimum functionality be verified. Minimum functionality is defined as follows.

— Any integrated circuit present in the card continues to show an Answer to Reset response which conforms to the base standard.

— Any contacts associated with any integrated circuit present in the card continue to show electrical resistance which conforms to the base standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 7810:2003, *Identification cards — Physical characteristics*

ISO/IEC 7816-3:2006, *Identification cards — Integrated circuit cards — Part 3: Cards with contacts — Electrical interface and transmission protocols*

ISO/IEC 7816-4:2005, *Identification cards — Integrated circuit cards — Part 4: Organization, security and commands for interchange*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
card
integrated circuit card with contacts as defined in ISO/IEC 7816

3.2
DUT
device under test
card or IFD that is subject to testing

3.3
etu-factor
parameters negotiable by protocol and parameters selection (PPS), described in ISO/IEC 7816-3:2006, 6.3.1

3.4
IFD
interface device related to integrated circuit cards with contacts as defined in ISO/IEC 7816-3

3.5
normal use
use as an identification card, as defined in ISO/IEC 7810:2003, 4.1, involving equipment processes appropriate to the card technology and storage as a personal document between equipment processes

3.6
test method
method for testing characteristics of identification cards and related interface devices for the purpose of confirming their compliance with International Standards

3.7
test scenario
defined typical protocol and application specific communication to be used with the test methods defined in this part of ISO/IEC 10373

3.8
typical protocol and application specific communication
communication between a DUT and the corresponding test-apparatus based on protocol and application implemented in the DUT and representing its normal use

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 °C ± 3 °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 Selection of test methods

Tests shall be applied as required to test the attributes of the card defined by the relevant base standard (see 4.8).

4.4 Default tolerance

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

4.5 Total measurement uncertainty

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

4.6 Conventions for electrical measurements

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

4.7 Apparatus

4.7.1 Apparatus for testing the integrated circuit cards with contacts (card-test-apparatus)

4.7.1.1 Generating the VCC voltage (U_{CC}) and timing

Table 1 — voltage and timing for VCC

Parameter	Operating Condition	Range	Accuracy
U_{CC}	Class A, B, C	-1 V to 6 V	± 20 mV
t_R, t_F	Class A, B, C	0 µs to 500 µs	± 100 µs

4.7.1.2 Measuring ICC

Table 2 — I_{CC} parameters

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 µA to 200 µA	± 10 µA	Averaged over 1 ms

4.7.1.3 Generating SPU (C6) voltage

See 5.5 and ISO/IEC 7816-3.

4.7.1.4 Generating the RST voltage and timing

Table 3 — RST voltage and timing

Parameter	Operating Condition	Range	Accuracy
U_{IH}, U_{IL}	Class A, B	-1 V to 6 V	± 20 mV
U_{IH}	Class C	-1 V to 2 V	± 20 mV
U_{IL}	Class C	-1 V to 1 V	± 20 mV
t_R, t_F		0 µs to 2 µs	± 20 ns
NOTE t_R and t_F are generated between 10% and 90% of V_H min and V_L max values.			

4.7.1.5 Measuring the RST current

Table 4 — RST current

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

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

Table 5 — I/O voltage and timing

Parameter	Mode	Operating Condition	Range	Accuracy
U_{IH}, U_{IL}	Card: Reception, Apparatus: Transmission	Class A, B	-1 V to 6 V	± 20 mV
U_{IH}	Card: Reception, Apparatus: Transmission	Class C	-1 V to 2 V	± 20 mV
U_{IL}	Card: Reception, Apparatus: Transmission	Class C	-1 V to 1 V	± 20 mV
t_R, t_F	Card: Reception, Apparatus: Transmission		0 µs to 2 µs	± 100 ns
NOTE — t_R and t_F are generated between 10% and 90% of V_H min and V_L max values.				

4.7.1.7 Measuring the I/O current in reception mode

Table 6 — I/O current (reception mode)

Parameter	Mode	Range	Accuracy	Resolution
I_{IH}	Card: Reception, Apparatus: Transmission	-300 µA to 30 µA	± 10 µA	100 ns
I_{IL}	Card: Reception, Apparatus: Transmission	-1,5 mA to -0,2 mA	± 50 µA	100 ns
	Card: Reception, Apparatus: Transmission	-200 µA to 30 µA	± 10 µA	100 ns

4.7.1.8 Generating the I/O current

Table 7 — I/O current

Parameter	Mode	Range	Accuracy	Stabilization time after level is reached
I_{OH}	Card: Transmission Apparatus: Reception	20 kΩ pull-up to VCC or equivalent circuit	± 200 Ω	
I_{OL}	Card: Transmission Apparatus: Reception	0 mA to 1,5 mA	± 50 µA	< 100 ns

4.7.1.9 Measuring the I/O voltage and timing

Table 8 — I/O voltage and timing

Characteristic	Operating Condition	Range	Accuracy	Resolution
U_{IH}, U_{IL}	Class A, B, C	-1 V to 6 V	± 20 mV	20 ns
t_R, t_F		0 µs to 2 µs	± 20 ns	
NOTE — t_R and t_F are measured between 10% and 90% of V_H min and V_L max values.				

4.7.1.10 Generating the CLK voltage

Table 9 — CLK voltage

Parameter	Operating Condition	Range	Accuracy	Resolution
U_{IH}, U_{IL}	Class A, B	-1 V to 6 V	± 20 mV	20 ns
U_{IH}	Class C	-1 V to 2 V	± 20 mV	20 ns
U_{IL}	Class C	-1 V to 2 V	± 20 mV	20 ns

4.7.1.11 Generating the CLK waveforms (single cycle measurement)

Table 10 — CLK waveforms

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_{IH} (100%) min and V_{IL} (0%) max.		

4.7.1.12 Measuring the CLK current

Table 11 — CLK current

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

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

Table 12 — Contact capacitance

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.		

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

Table 13 — Activation and deactivation

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

4.7.1.15 Emulating the I/O protocol

The card-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 card applications.

NOTE — If a specific functionality is not implemented in the card, the card-test-apparatus is not required to have the corresponding test-capability (e.g. T=1 protocol not implemented in the card).

4.7.1.16 Generating the I/O character timing in reception mode

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

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

Table 14 — I/O character timing (reception mode)

Symbol	Parameter	Accuracy
ε_t	all timing parameters	± 4 CLK cycles

4.7.1.17 Measuring and monitoring the I/O protocol

The card-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.

Table 15 — Timing characteristics

Characteristic	Accuracy
all timing characteristics	± 2 CLK cycles

4.7.1.18 Protocol Analysis

The card-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 and extract the logical data flow for further protocol and application verifications.

NOTE If a specific functionality is not implemented in the card, the card-test-apparatus is not required to have the corresponding test-capability (e.g. T=1 protocol not implemented in the card). Conversely, an apparatus may need extended capabilities, e.g. being able to generate any case 2 command (see ISO/IEC 7816-4:2005) if a card does not support the standard READ BINARY.

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

4.7.2.1 Generating the VCC current (I_{CC})

Table 16 — VCC current

Parameter	Mode	Range	Accuracy	Stabilization time after level is reached
I_{CC}	Spike Generation	0 mA to 120 mA	± 2 mA [b]	< 100 ns
	Active mode	0 mA to 70 mA	± 1 mA	< 100 ns
	Idle mode (CLK-Stop)	0 mA to 1,2 mA	± 10 µA	< 100 ns
	Inactive [a]	-1,2 mA to 0 mA	± 10 µA	< 100 ns
t_R, t_F		100 ns	± 50 ns	
pulse length		100 ns to 500 ns	± 50 ns	
pause length frequently		100 ns to 1000 ns	± 50 ns	
pause length randomly		10 µs to 2000 µs	± 1 µs	

[a] The maximum output voltage shall be limited to 5 V.

[b] Dynamic conditions for spike generation.

4.7.2.2 Measuring the VCC voltage (U_{CC}) and timing

Table 17 — VCC voltage and timing

Characteristic	Operating Condition	Range	Accuracy	Resolution
U_{CC}	Class A, B, C	- 1 V to 6 V	± 20 mV	10 ns

4.7.2.3 Measuring the SPU (C6) voltage (U_{CC}) and timing

Table 18 — SPU voltage and timing

Characteristic	Operating Condition	Range	Accuracy	Resolution
U_{CC}	Class A, B, C	- 1 V to 6 V	± 20 mV	10 ns

4.7.2.4 Generating the RST current

Table 19 — RST current

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

4.7.2.5 Measuring RST voltage and timing

Table 20 — RST voltage and timing

Characteristic	Operating Condition	Range	Accuracy	Resolution
U_{IH}, U_{IL}	Class A, B, C	-1 V to 6 V	± 20 mV	20 ns
t_R, t_F		0 µs to 2 µs	± 20 ns	
NOTE — t_R and t_F are measured between 10% and 90% of V_H min and V_L max values.				

4.7.2.6 Generating the I/O currents

Table 21 — 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 µA to 50 µA	± 5 µA	< 100 ns
I_{IL}	Apparatus: Reception IFD: Transmission and Reception	0 mA to 1,5 mA	± 10 µA	< 100 ns
I_{OL}	IFD: Reception	0 µA to 1200 µA	± 10 µA	< 100 ns
I [a]	Inactive	- 1,2 mA to 0 mA	± 10 µA	< 100 ns
[a] The output voltage shall be limited to -0,5 V to 5,5 V.				