
**Information technology — Radio
frequency identification device
conformance test methods —**

**Part 3:
Test methods for air interface
communications at 13,56 MHz**

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*Technologies de l'information — Méthodes d'essai de conformité du
dispositif d'identification de radiofréquence —*

*Partie 3: Méthodes d'essai pour des communications d'une interface
d'air à 13,56 MHz*

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Contents

Page

Foreword	iv
Introduction.....	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Symbols and abbreviated terms	2
5 Conformance tests for ISO/IEC 18000-3 — 13,56 MHz	3
5.1 General	3
5.2 Default conditions applicable to the test methods	3
5.2.1 Test environment.....	3
5.2.2 Pre-conditioning	3
5.2.3 Default tolerance	3
5.2.4 Spurious inductance	3
5.2.5 Total measurement uncertainty	3
5.3 Conformance tests for ISO/IEC 18000-3 Mode 1.....	3
5.3.1 General	3
5.3.2 Test apparatus and test circuits	3
5.3.3 Functional test – tag.....	7
5.3.4 Functional test — interrogator.....	8
5.4 Conformance tests for ISO/IEC 18000-3 Mode 2.....	10
5.4.1 General	10
5.4.2 Test apparatus and test circuits.....	10
5.4.3 Functional test – tag.....	11
5.4.4 Functional test – interrogator.....	12
5.5 Conformance tests for ISO/IEC 18000-3 Mode 3 (mandatory ASK part).....	13
5.5.1 General	13
5.5.2 Test apparatus and test circuits	13
5.5.3 Functional test – tag.....	17
5.5.4 Functional test — interrogator.....	18
Annex A (normative) Test setup parameters and dimensions for tags smaller than or equal to an ISO/IEC 7810 ID-1 outline.....	20
Annex B (normative) Guideline for RFID tags larger than ISO/IEC 7810 ID-1 size.....	23
Annex C (normative) Test interrogator antenna	27
Annex D (informative) Test interrogator antenna tuning	30
Annex E (normative) Sense coil	32
Annex F (normative) Reference tag for interrogator power test.....	34
Annex G (informative) Reference tag for load modulation test.....	36
Annex H (informative) Program for evaluation of the spectrum	37
Bibliography.....	41

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.

In exceptional circumstances, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide to publish a Technical Report. A Technical Report is entirely informative in nature and shall be reviewed every five years in the same manner as an International Standard.

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 TR 18047-3, was prepared by Joint Technical Committee ISO/IEC JTC 1, Information technology, Subcommittee SC 31, Automatic identification and data capture techniques.

This second edition cancels and replaces the first edition (ISO/IEC TR 18047-3:2004), which has been technically revised. It also incorporates the Technical Corrigendum ISO/IEC TR 18047-3:2004/Cor.1:2007.

ISO/IEC TR 18047 consists of the following parts, under the general title *Information technology — Radio frequency identification device conformance test methods*:

- Part 2: Test methods for air interface communications below 135 kHz
- Part 3: Test methods for air interface communications at 13,56 MHz
- Part 4: Test methods for air interface communications at 2,45 GHz
- Part 6: Test methods for air interface communications at 860 MHz to 960 MHz
- Part 7: Test methods for active air interface communications at 433 MHz

Introduction

ISO/IEC 18000 defines the air interfaces for radio frequency identification (RFID) devices used in item management applications. ISO/IEC 18000-3 defines the air interface for these devices operating in the 13,56 MHz Industrial, Scientific, and Medical (ISM) band and used in these applications.

The purpose of ISO/IEC TR 18047 is to provide test methods for conformance with the various parts of ISO/IEC 18000.

Each part of ISO/IEC TR 18047 contains all measurements required to be made on a product in order to establish whether it conforms to the corresponding part of ISO/IEC 18000. For ISO/IEC TR 18047-3, each product needs to be assessed following either the procedure defined for Mode 1, for Mode 2 or for Mode 3.

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Information technology — Radio frequency identification device conformance test methods —

Part 3: Test methods for air interface communications at 13,56 MHz

1 Scope

This part of ISO/IEC TR 18047 defines test methods for determining the conformance of radio frequency identification devices (tags and interrogators) for item management with the specifications given in ISO/IEC 18000-3, but does not apply to the testing of conformity with regulatory or similar requirements.

The test methods require only that the mandatory functions, and any optional functions which are implemented, be verified. This can, in appropriate circumstances, be supplemented by further, application-specific functionality criteria that are not available in the general case.

This part of ISO/IEC TR 18047 includes the following interrogator and tag conformance parameters:

- mode-specific conformance parameters including nominal values and tolerances;
- parameters that apply directly affecting system functionality and inter-operability.

This part of ISO/IEC TR 18047 does not include the following:

- parameters that are already included in regulatory test requirements;
- high-level data encoding conformance test parameters (these are specified in ISO/IEC 15962).

Clause 5 describes all necessary conformance tests, while 5.3 applies to Mode 1 products only, 5.4 applies to Mode 2 products only and 5.5 applies to Mode 3 (mandatory ASK part) only.

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, *Identification cards — Physical characteristics*

ISO/IEC 18000-1, *Information technology — Radio frequency identification for item management — Part 1: Reference architecture and definition of parameters to be standardized*

ISO/IEC 18000-3, *Information technology — Radio frequency identification for item management — Part 3: Parameters for air interface communications at 13,56 MHz*

ISO/IEC 19762 (all parts), *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762 (all parts) apply.

4 Symbols and abbreviated terms

<i>ar</i>	reference tag width
<i>asp</i>	air spacing
<i>br</i>	reference tag height
<i>ca</i>	calibration coil width
<i>cb</i>	calibration coil height
<i>co</i>	calibration coil corner radius
<i>dis</i>	distance between test interrogator antenna and sense coils
DUT	device under test
<i>fc</i>	frequency of the operating field
<i>fs</i>	frequency of sub-carrier
<i>H_{max}</i>	maximum field strength of the interrogator antenna field
<i>H_{min}</i>	minimum field strength of the interrogator antenna field
<i>lx</i>	length of test interrogator assembly connection cable
<i>lya</i>	test interrogator and sense coil PCB width
<i>lyb</i>	test interrogator and sense coil PCB height
<i>lyd</i>	test interrogator coil diameter
<i>lyw</i>	test interrogator coil track width
<i>nr</i>	number of turns of reference tag
<i>oa</i>	calibration coil outline width
<i>ob</i>	calibration coil outline height
PCB	printed circuit board
<i>rs</i>	sense coil corner radius
<i>sa</i>	sense coil width
<i>sb</i>	sense coil height
<i>sr</i>	reference tag track spacing
<i>wr</i>	reference tag track width

5 Conformance tests for ISO/IEC 18000-3 — 13,56 MHz

5.1 General

This part of ISO/IEC TR 18047 specifies a series of tests to determine the conformance of interrogators and tags. The results of these tests shall be compared with the values of the parameters specified in ISO/IEC 18000-3 to determine whether the interrogator-under-test or tag-under-test conforms.

Unless otherwise specified, the tests in this part of ISO/IEC TR 18047 shall be applied exclusively to RFID tags and interrogators defined in ISO/IEC 18000-3 Mode 1, Mode 2 and Mode 3.

5.2 Default conditions applicable to the test methods

5.2.1 Test environment

Unless otherwise specified, testing shall take place in an environment of temperature 23 °C +/- 3 °C (73 °F +/- 5 °F) and of relative humidity 40 % to 60 %.

5.2.2 Pre-conditioning

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

5.2.3 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).

5.2.4 Spurious inductance

Resistors and capacitors should have negligible inductance.

5.2.5 Total measurement uncertainty

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

NOTE Basic information is given in ISO/IEC Guide 98-3:2008.

5.3 Conformance tests for ISO/IEC 18000-3 Mode 1

5.3.1 General

The conformance tests for ISO/IEC 18000-3 mode 1 are described independent of the tag size. For tests of tags smaller or equal to ID-1 (as defined in ISO/IEC 7810) all dimensions are specified in Annex A, while Annex B applies to larger tags.

5.3.2 Test apparatus and test circuits

This clause defines the test apparatus and test circuits for verifying the operation of a tag or an interrogator according to the base standard, ISO/IEC 18000-3. The test apparatus includes:

- Calibration coil (see 5.3.2.1)
- Test interrogator assembly (see 5.3.2.2)

- Reference tag (see 5.3.2.4)
- Digital sampling oscilloscope (see 5.3.2.5).

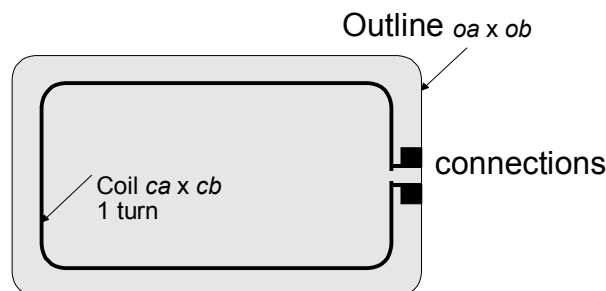
These are described in the following clauses.

5.3.2.1 Calibration coil

This clause defines the size, thickness and characteristics of the calibration coil PCB.

5.3.2.1.1 Size of the Calibration coil

The calibration coil PCB consists of an area, which has the height and width defined in Figure 1 — Example calibration coil containing a single turn coil concentric with the tag outline.



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Figure 1 — Example calibration coil

5.3.2.1.2 Thickness and material of the calibration coil substrate

The thickness of the calibration coil PCB shall be 0,76 mm +/- 10 %. It shall be constructed of a suitable insulating material such as FR4 or equivalent.

5.3.2.1.3 Coil characteristics

The coil on the calibration coil PCB shall have one turn. The outer size of the coil shall be as defined in Figure 1 — Example calibration coil with a corner radius c_o .

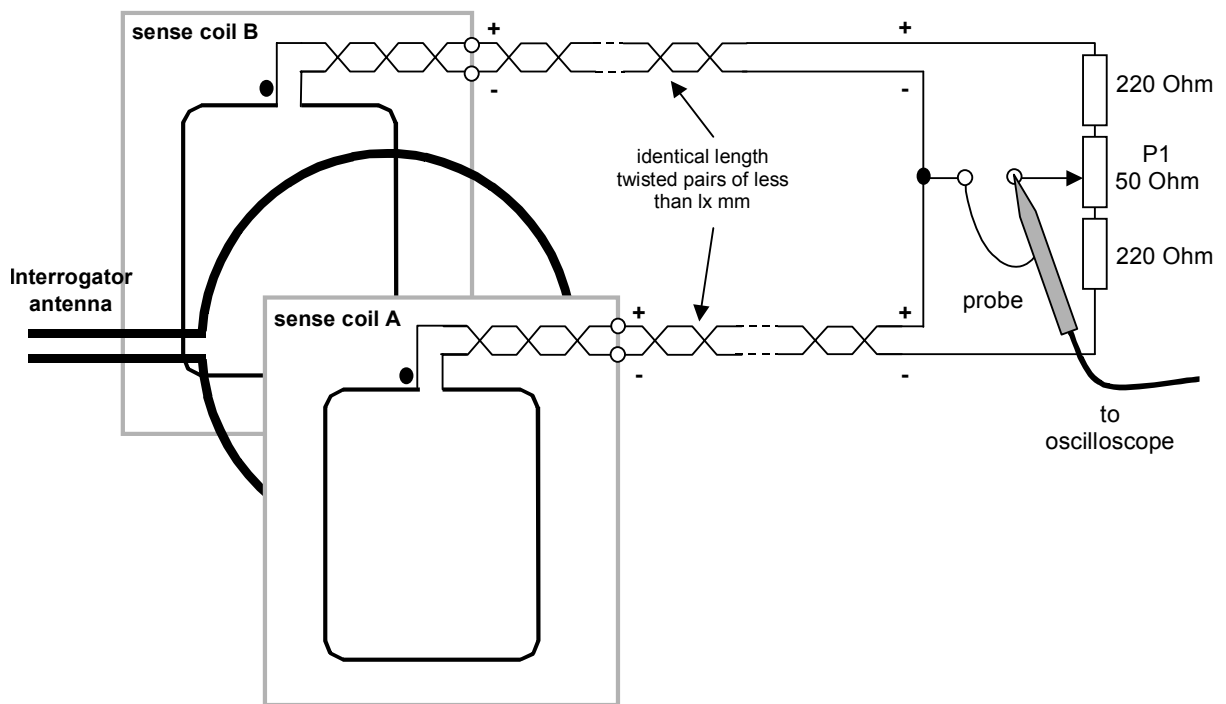
The coil is made as a printed coil on PCB plated with 35 μ m copper. Track width shall be 500 μ m +/- 20 %. The size of the connection pads shall be 1,5 mm x 1,5 mm.

A high impedance oscilloscope probe (e.g. >1 M Ω , <14 pF) shall be used to measure the open circuit voltage in the coil. The resonant frequency of the whole set (calibration coil, connecting leads and probe) shall be above 60 MHz.

5.3.2.2 Test interrogator assembly

The test interrogator assembly for load modulation consists of an interrogator antenna and two parallel sense coils: sense coil A and sense coil B. The test set-up is shown in Figure 2 — Example test set-up. The sense coils are connected such that the signal from one coil is in opposite phase to the other. The 50 Ω potentiometer P1 serves to fine adjust the balance point when the sense coils are not loaded by a tag or any magnetically coupled circuit. The capacitive load of the probe including its parasitic capacitance shall be less than 14 pF.

IMPORTANT The capacitance of the connections and oscilloscope probe should be kept to a minimum for reproducibility.



NOTE The values for the parameters are listed in Table A.2 – Definition of test interrogator for ID-1 or smaller.

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Figure 2 — Example test set-up

5.3.2.2.1 Test interrogator antenna ISO/IEC TR 18047-3:2011 <https://standards.iteh.ai/catalog/standards/sist/b3732140-a728-41c1-8cc4-ad0815229929/iso-iec-tr-18047-3-2011>

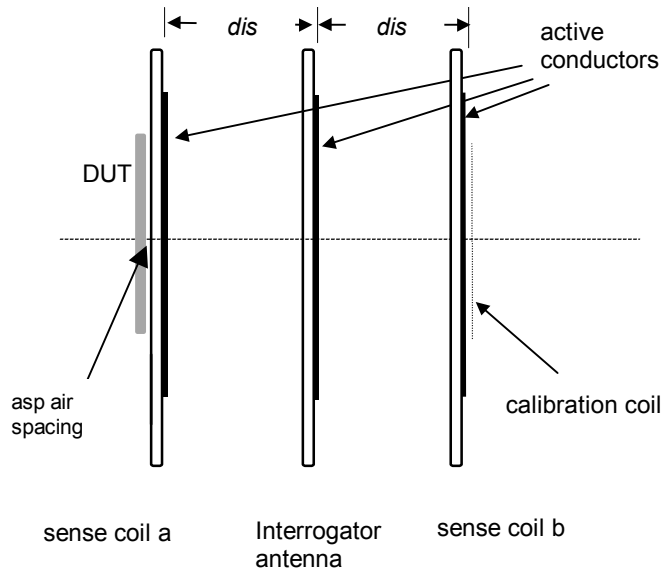
The test interrogator antenna shall have a diameter and a construction conforming to the drawings in Annex C. The tuning of the antenna may be accomplished with the procedure given in Annex D.

5.3.2.2.2 Sense coils

The size and the sense coil construction shall conform to the drawings in Annex E.

5.3.2.3 Assembly of test interrogator

The sense coils and test interrogator antenna shall be assembled parallel to each other. The sense and antenna coils shall be coaxial and the distance between the active conductors shall be as defined in Figure 3 — Test interrogator assembly. The distance between the coil in the DUT and the coil of the test interrogator antenna shall be equal to the distance between the calibration coil and the coil of the test interrogator antenna.



NOTE 1 The asp air spacing avoids parasitic effects such as detuning by closer spacing or ambiguous results due to noise and other environmental effects.

NOTE 2 The values for the parameters are listed in Table A.2 — Definition of test interrogator for ID-1 or smaller.

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Figure 3 — Test interrogator assembly
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5.3.2.4 Reference tags

Reference tags are defined

- to test H_{min} and H_{max} produced by an interrogator (under conditions of loading by a tag) and thus to test the ability of an interrogator to power a tag
- to generate the minimum tag reply load modulation signal.

5.3.2.4.1 Reference tag for interrogator power

The schematic for the power test is shown in Annex F. Power dissipation can be set by the resistor R1 or R2, in order to measure H_{min} and H_{max} respectively as defined in clause 5.3.4.1.2. The resonant frequency can be adjusted with C2.

5.3.2.4.2 Reference tag for load modulation reception test

A suggested schematic for the load modulation reception test is shown in Annex G. The load modulation can be chosen to be resistive or reactive.

This reference tag is calibrated by using the test interrogator assembly as follows:

The reference tag is placed in the position of the DUT. The load modulation signal amplitude is measured as described in clause 5.3.3. This amplitude should correspond to the minimum amplitude at all values of field strength required by the base standard, ISO/IEC 18000-3.

5.3.2.4.3 Dimensions of the reference tags

The reference tag which is used for the measurements has to be described in the measurement report. Figure 4 — Example of an ISO card sized reference tag shows as an example an ISO card sized reference tag which consists of an area containing a coil which has the same height and width as those defined in ISO/IEC 7810 for ID-1 type.

An area external to this, containing the circuitry that emulates the required tag functions, is appended so as to allow insertion into the test set-ups described below and so as to cause no interference to the tests.

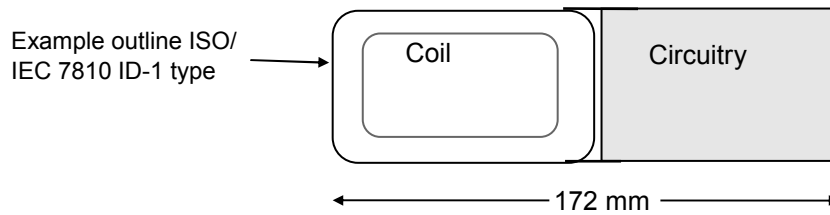


Figure 4 — Example of an ISO card sized reference tag

5.3.2.4.4 Thickness of the reference tag board

The thickness of the reference tag active area shall be 0,76 mm +/- 10 %.

5.3.2.4.5 Coil characteristics

The coil in the active area of the reference tag shall have nr turns and shall be concentric with the area outline.

The outer size of the coils shall be $ar \times br$.

The coil is printed on PCB plated with 35 μm copper.

Track width shall be wr and spacing shall be sr .

NOTE The values for the parameters are listed in Table A.3.

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5.3.2.5 Digital sampling oscilloscope

The digital sampling oscilloscope shall be capable of sampling at a rate of at least 100 million samples per second with a resolution of at least 8 bits at optimum scaling. The oscilloscope should have the capability to output the sampled data as a text file to facilitate mathematical and other operations such as windowing on the sampled data using external software programs. An example of the program is shown in Annex H.

5.3.3 Functional test – tag

5.3.3.1 Purpose

The purpose of this test is to determine the amplitude of the tag load modulation signal within the operating field range $[H_{\min}, H_{\max}]$ as specified in the base standard, ISO/IEC 18000-3 and the functionality of the tag with the modulation under emitted fields as defined in ISO/IEC 18000-3 parameter table for tag to interrogator link (reference M1-Tag:7).

5.3.3.2 Test procedure

Step 1: The load modulation test circuit of Figure 2 — Example test set-up and the test interrogator assembly of Figure 3 — Test interrogator assembly are used.

The RF power delivered by the signal generator to the test interrogator antenna shall be adjusted to produce the required field strength (H_{\min} and H_{\max}) and modulation waveforms defined in ISO/IEC 18000-3 as measured by the calibration coil without any tag. The output of the load modulation test circuit of Figure 2 — Example test set-up is connected to a digital sampling oscilloscope. The 50 Ω potentiometer P1 shall be trimmed to minimize the residual carrier. This signal shall be at least 40 dB lower than the signal obtained by shorting one sense coil.