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

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

iTeh STANDARD PREVIEW

*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*

[https://standards.iteh.ai/catalog/standards/sist/34228167-0c21-414a-870e-
d55d9f82bb3d/iso-iec-tr-18047-3-2004](https://standards.iteh.ai/catalog/standards/sist/34228167-0c21-414a-870e-d55d9f82bb3d/iso-iec-tr-18047-3-2004)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO/IEC TR 18047-3:2004](https://standards.iteh.ai/catalog/standards/sist/34228167-0c21-414a-870e-d55d9f82bb3d/iso-iec-tr-18047-3-2004)

<https://standards.iteh.ai/catalog/standards/sist/34228167-0c21-414a-870e-d55d9f82bb3d/iso-iec-tr-18047-3-2004>

© ISO/IEC 2004

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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.....	9
5.4.1 General.....	9
5.4.2 Test apparatus and test circuits.....	10
5.4.3 Functional test – tag	11
5.4.4 Functional test – interrogator	12
Annex A (normative) Test setup parameters and dimensions for tags smaller than or equal to an ISO/IEC 7810 ID-1 outline	13
Annex B (normative) Guideline for RFID tags larger than ISO/IEC 7810 ID-1 size	15
Annex C (normative) Test interrogator antenna.....	19
Annex D (informative) Test interrogator antenna tuning.....	22
Annex E (normative) Sense coil.....	24
Annex F (normative) Reference tag for interrogator power test	26
Annex G (informative) Reference tag for load modulation test	28
Annex H (informative) Program for evaluation of the spectrum.....	29
Bibliography	33

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.

In exceptional circumstances, the joint technical committee may propose the publication of a Technical Report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, 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).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

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, which is a Technical Report of type 2, was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

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

- *Part 3: Test methods for air interface communications at 13,56 MHz*
- *Part 4: Test methods for air interface communications at 2,45 GHz*

Test methods for air interface communications below 135 kHz, at 860 MHz to 960 MHz, and at 433 MHz will form the subjects of future Parts 2, 6 and 7, respectively.

Introduction

ISO/IEC 18000 defines the air interfaces for radio frequency identification (RFID) devices used in item management applications. Part 3 of ISO/IEC 18000 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 with 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 or for Mode 2.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO/IEC TR 18047-3:2004](https://standards.iteh.ai/catalog/standards/sist/34228167-0c21-414a-870e-d55d9f82bb3d/iso-iec-tr-18047-3-2004)

<https://standards.iteh.ai/catalog/standards/sist/34228167-0c21-414a-870e-d55d9f82bb3d/iso-iec-tr-18047-3-2004>

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO/IEC TR 18047-3:2004](https://standards.iteh.ai/catalog/standards/sist/34228167-0c21-414a-870e-d55d9f82bb3d/iso-iec-tr-18047-3-2004)

<https://standards.iteh.ai/catalog/standards/sist/34228167-0c21-414a-870e-d55d9f82bb3d/iso-iec-tr-18047-3-2004>

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 the corresponding part of ISO/IEC 18000, 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 may, 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; and
- 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; and
- high-level data encoding conformance test parameters (these are specified in ISO/IEC 15962).

Clause 5 describes all necessary conformance tests, while clause 5.3 applies to Mode 1 products only and clause 5.4 applies to Mode 2 products 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*¹⁾

ISO/IEC 18000-3, *Information technology — Radio frequency identification for item management — Part 3: Parameters for air interface communications at 13,56 MHz*¹⁾

ISO/IEC 19762 (all parts), *Information technology — Automatic identification and data capture techniques — Harmonized vocabulary*¹⁾

1) To be published.

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 or tag under test conforms.

Unless otherwise specified, the tests in this document shall be applied exclusively to RFID tags and interrogators defined in ISO/IEC 18000 Part 3 Mode 1 and Mode 2.

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 Guide to the Expression of Uncertainty in Measurement", ISBN 92-67-10188-9, 1993.

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 containing a single turn coil concentric with the tag outline.

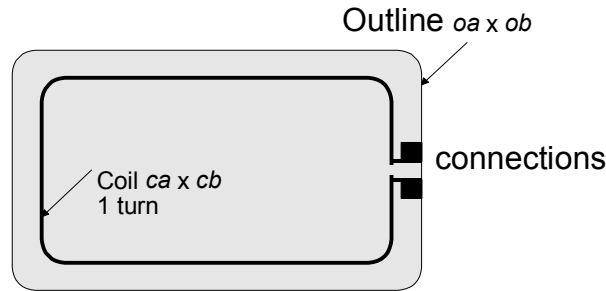


Figure 1 — Example calibration coil

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 with a corner radius c_c .

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. 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 14pF.

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

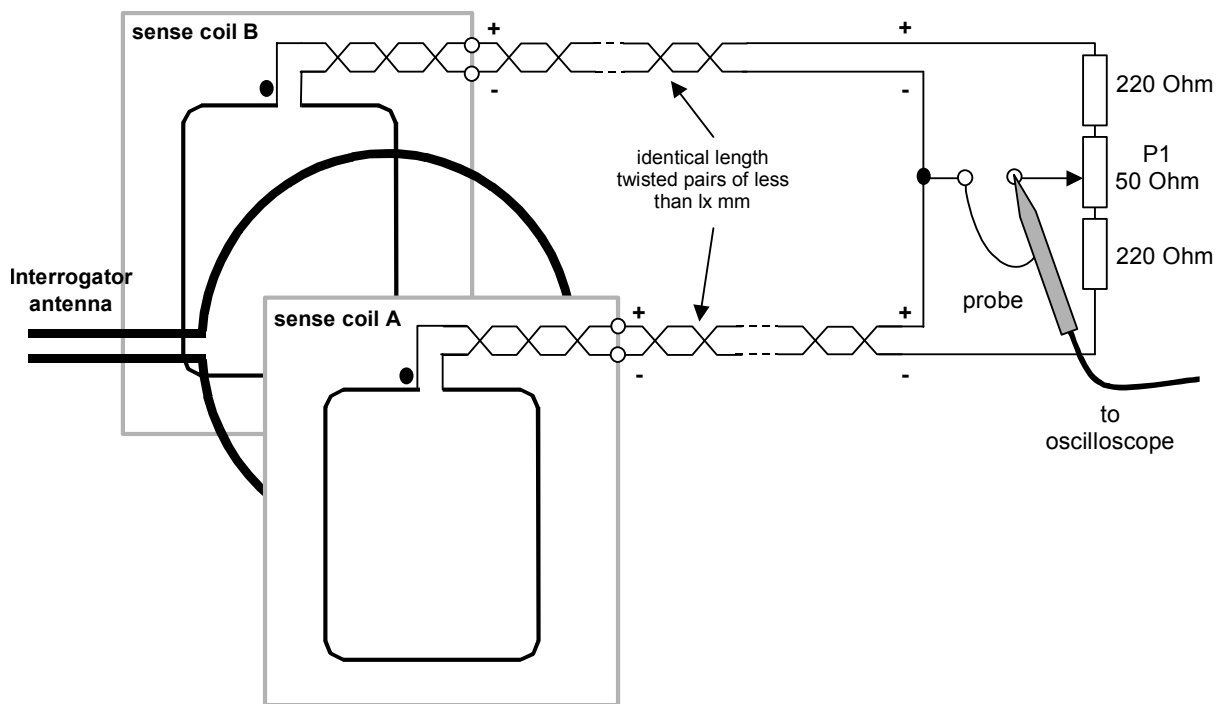


Figure 2 — Example test set-up

5.3.2.2.1 Test interrogator antenna

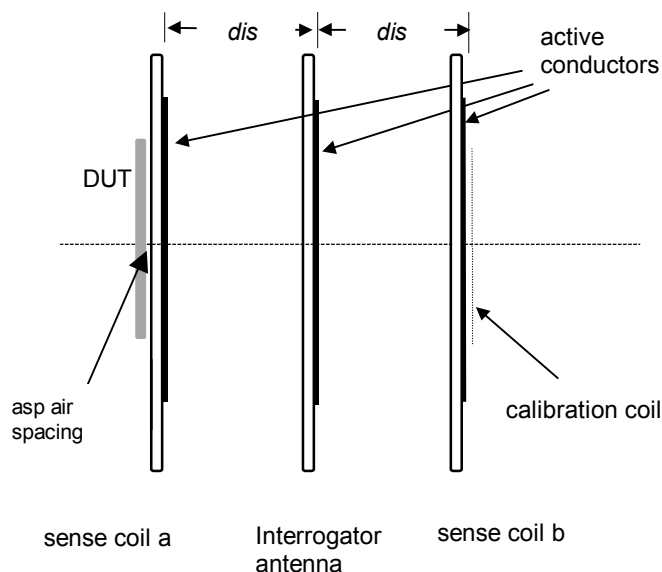
The test interrogator antenna shall have a diameter and a construction conforming with the drawings in Annex C. The tuning of the antenna may be accomplished with the procedure given in Annex D.

5.3.2.2.2 Sense coils

The size and the sense coil construction shall conform with 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. 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 The asp air spacing avoids parasitic effects such as detuning by closer spacing or ambiguous results due to noise and other environmental effects.

Figure 3 — Test interrogator assembly

5.3.2.4 Reference tags

Reference tags are defined

iTeh STANDARD PREVIEW
(standards.iteh.ai)

- 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.

ISO/IEC TR 18047-3:2004
<https://standards.iteh.ai/catalog/standards/sist/34228167-0c21-414a-870e-d55d9f82bb3d/iso-iec-tr-18047-3-2004>

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 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.

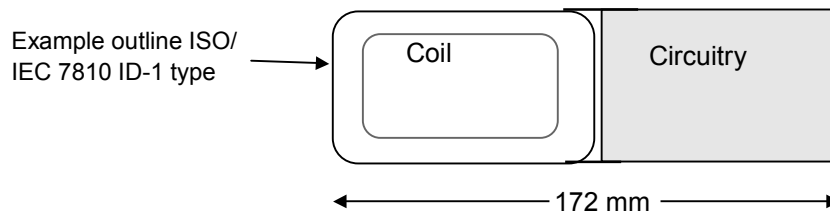


Figure 4 — Example of an ISO card sized reference tag

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 μ m copper.

Track width shall be wr and spacing shall be sr .

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 programmes. An example of the programme 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 and the test interrogator assembly of Figure 3 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 is connected to a digital sampling oscilloscope. The 50 Ω potentiometer P1 shall be trimmed to minimise the residual carrier. This signal shall be at least 40 dB lower than the signal obtained by shorting one sense coil.

Step 2: The tag under test shall be placed in the DUT position, concentric with sense coil A. The RF drive into the test interrogator antenna shall be re-adjusted to the required field strength.

IMPORTANT Care should be taken to apply a proper synchronization method for low amplitude load modulation.

Exactly two sub-carrier cycles of the sampled modulation waveform shall be Fourier transformed. A discrete Fourier transformation with a scaling such that a pure sinusoidal signal results in its peak magnitude shall be used. To minimize transient effects, a sub-carrier cycle immediately following a non-modulating period must