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

**Part 6:
Test methods for air interface
communications at 860 MHz to 960
MHz**

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

*Partie 6: Méthodes d'essai pour des communications d'une interface
d'air à 860 MHz et jusqu'à 960 MHz*



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by 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 18047-6:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

- Tag demodulation test setup now includes a monostatic setup with the use of a circulator;
- new tests for Tag link timings T5, T6 and T7 (defined in ISO/IEC 18000-63:2015 and related to delayed and in-process tag reply); and
- new tests related to ISO/IEC 18000-63:2015 like Tag memory overruns, Kill command, unauthorized write commands and optional commands that involve C-flag, ResponseBuffer, security features and untraceability.

Introduction

ISO/IEC 18000 series defines the air interfaces for radio frequency identification (RFID) devices used in item management applications. ISO/IEC 18000-61, ISO/IEC 18000-62, ISO/IEC 18000-63 and ISO/IEC 18000-64 define the air interface for these devices operating at frequencies from 860 MHz to 960 MHz.

ISO/IEC 18047 series provides test methods for conformance with the various parts of the ISO/IEC 18000 series.

Each part of ISO/IEC 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 this document, each interrogator and each tag needs to support at least one of the types A or B or C or D.

NOTE Test methods for interrogator and tag performance are covered by ISO/IEC 18046 series.

[Clause 5](#) describes all necessary conformance tests for ISO/IEC 18000-61.

[Clause 6](#) describes all necessary conformance tests for ISO/IEC 18000-62.

[Clause 7](#) describes all necessary conformance tests for ISO/IEC 18000-63.

[Clause 8](#) describes all necessary conformance tests for ISO/IEC 18000-64.

[Clause 9](#) describes all necessary conformance tests for ISO/IEC 18000-63:2015, Clause 7.

[Clause 10](#) describes all necessary conformance tests for ISO/IEC 18000-63:2015, 7.5.

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Information technology — Radio frequency identification device conformance test methods —

Part 6:

Test methods for air interface communications at 860 MHz to 960 MHz

1 Scope

This document defines test methods for determining the conformance of radio frequency identification (RFID) devices (tags and interrogators) for item management with the specifications given in ISO/IEC 18000-61, ISO/IEC 18000-62, ISO/IEC 18000-63 and ISO/IEC 18000-64, 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, are verified. This can, in appropriate circumstances, be supplemented by further, application-specific functionality criteria that are not available in the general case.

The interrogator and tag conformance parameters in this document are the following:

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

Parameters that are already included in regulatory test requirements are not included in this document.

Unless otherwise specified, the tests in this document are intended to be applied exclusively to RFID tags and interrogators defined in ISO/IEC 18000-61, ISO/IEC 18000-62, ISO/IEC 18000-63 and ISO/IEC 18000-64.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 18000-61:2012, *Information technology — Radio frequency identification for item management — Part 61: Parameters for air interface communications at 860 MHz to 960 MHz Type A*

ISO/IEC 18000-62:2012, *Information technology — Radio frequency identification for item management — Part 62: Parameters for air interface communications at 860 MHz to 960 MHz Type B*

ISO/IEC 18000-63:2015, *Information technology — Radio frequency identification for item management — Part 63: Parameters for air interface communications at 860 MHz to 960 MHz Type C*

ISO/IEC 18000-64, *Information technology — Radio frequency identification for item management — Part 64: Parameters for air interface communications at 860 MHz to 960 MHz Type D*

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

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.2 Symbols

For the purposes of this document, the symbols given in ISO/IEC 19762 and the following apply.

D	modulation depth of data coding pulse
d_1	distance between the interrogator and test antenna
d_2	distance between test antenna and DUT tag
d_s	distance between the interrogator antenna and sense antenna
$d_{T,IA}$	interrogator antenna to tag distance
$d_{T,MA}$	measurement antenna to tag distance
d_{TE}	distance between the interrogator antenna and tag emulator
G_{IA}	gain of interrogator antenna
G_{MA}	gain of measurement antenna
I_{cir}	isolation of a circulator
K	calibration factor
L	maximum interrogator antenna dimension
M	modulation index
P_I	delivered power at the carrier frequency
P_M	measured power at the carrier frequency
T_f	fall time
T_r	rise time

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3.3 Abbreviated terms

For the purposes of this document, the abbreviated terms given in ISO/IEC 19762 and the following apply.

BLF	backscatter-link frequency (BLF = $1/T_{\text{pri}} = \text{DR}/\text{TR}_{\text{cal}}$)
DUT	device under test
RCS	radar cross-section
ΔRCS	change in radar cross-section
RBW	resolution bandwidth
VBW	video bandwidth

4 Default conditions applicable to the test methods

4.1 Test environment

Unless otherwise specified, testing shall take place in an environment of temperature (23 ± 3) °C and of non-condensing humidity from 40 % to 60 %.

4.2 Pre-conditioning

4.2.1 General

The interrogators and tags to be tested shall be conditioned to the test environment for a period of 24 h before testing.

4.2.2 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).

4.2.3 Noise floor at test location

Noise floor at test location shall be measured for at least 1 min with the spectrum analyser using the same conditions as for the measurement of the DUT.

The maximum of the measured noise amplitude measured in a 10 kHz bandwidth shall be -60 dB from 0,5 GHz to 2 GHz and -90 dBm around the frequency of the main signal of the tag backscatter signal.

Special attention has to be given to spurious emissions, e.g. insufficiently shielded computer monitors. The electromagnetic test conditions of the measurements shall be checked by performing the measurements with and without a tag in the field.

4.2.4 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.

5 Setup of test equipment

5.1 Setup of test equipment for interrogator tests

5.1.1 General

The DUT shall be an interrogator including an antenna.

All conformance measurements and setups shall be done in an anechoic chamber as defined in [Annex A](#).

All measurements shall be done at one of the test frequencies in [Table 1](#).

Table 1 — Test frequencies

Test carrier frequency	Comment
866 MHz	Recommended for tests under European regulations
915 MHz	Recommended for tests under Japan, Korean, Australian or US regulations

NOTE With the test frequencies specified in [Table 1](#), all frequencies of the entire band from 860 MHz to 930 MHz are within $\pm 2,9\%$ of one of the test frequencies. All practically used frequencies in the frequency bands 860 MHz to 870 MHz, 900 MHz to 930 MHz are within $\pm 1,7\%$ of the test frequencies.

5.1.2 Sense antenna

Where applicable, tests shall be carried out using a sense antenna, which shall be a substantially non-reactive, non-radiating load of $50\ \Omega$ equipped with an antenna connector. The voltage standing wave ratio (VSWR) at the $50\ \Omega$ connector shall not be greater than $2 : 1$ over the frequency range of the measurement.

5.1.3 Test apparatus and test circuits for ISO/IEC 18000-61, ISO/IEC 18000-62 and ISO/IEC 18000-63 interrogator

5.1.3.1 Interrogator modulation test setup

For this test, the sense antenna shall always be placed and orientated for optimum field strength reception in the direction of the major power radiation of the DUT interrogator antenna according to [Figure 1](#) at a distance, d_s , of 0,8 m to 1,1 m.



Figure 1 — Interrogator modulation test setup

5.1.3.2 Interrogator demodulation and turn-around time test setup

For this test, the tag emulator as defined in [Annex D](#) shall be placed and orientated for optimum field strength reception in the direction of the major power radiation of the DUT interrogator antenna according to [Figure 2](#) at a distance, d_{TE} , of 0,8 m to 1,1 m.

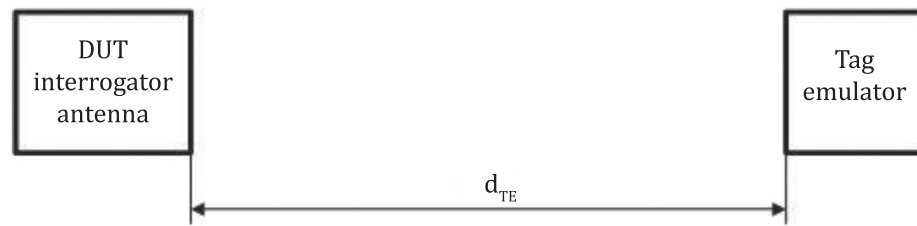


Figure 2 — Interrogator demodulation and turn-around test setup

5.2 Setup of test equipment for tag tests

5.2.1 General

The DUT shall be a tag including all means in order to be capable to communicate with an interrogator.

When tests require use of an interrogator, this shall be a measurement equipment that fulfills the requirements in order to act as interrogator and in particular it shall support the minimum tag response to interrogator command turn-around time.

All conformance measurements and setups shall be done in an anechoic chamber as defined in [Annex A](#).

All measurements shall be done at one of the test frequencies in [Table 1](#).

5.2.2 Test apparatus and test circuits for ISO/IEC 18000-61, ISO/IEC 18000-62, ISO/IEC 18000-63 and ISO/IEC 18000-64 tags

5.2.2.1 Tag demodulation and turn-around time test setup

For this test, the tag shall be placed and oriented for optimum field strength reception in the direction of the major power radiation of the interrogator.

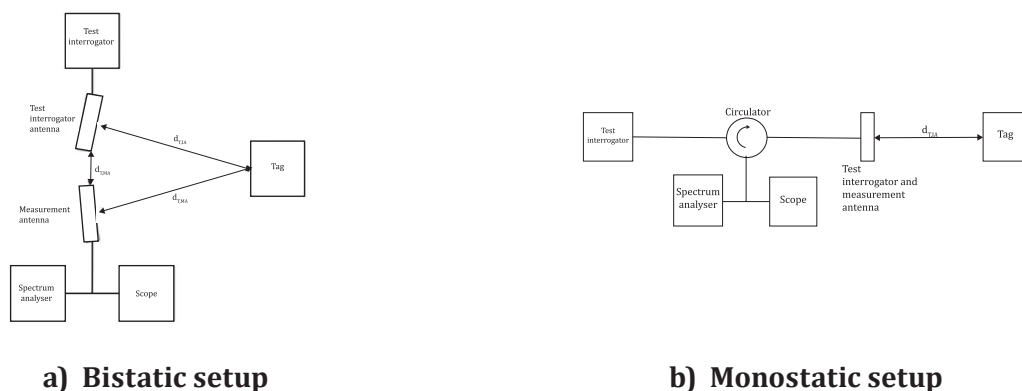


Figure 3 — Tag demodulation test setup

5.2.2.2 Tag backscatter test setup

For this test, two different setups may be used.

In a first one [see [Figure 3 a](#)], the test interrogator antenna setup (the interrogator may alternately also be realized with a signal generator according [Annex C](#)) shall consist of a set of two mechanically assembled antennas specifically designed to reduce the signal coupling between each other. One shall be used as interrogator antenna while the second shall be used as measurement antenna and shall be

connected either to a spectrum analyser or to an oscilloscope as specified in [Annex C](#). The tag under test shall be placed at this focal point and oriented for optimum field strength reception. The distances between the tag and the antennas are $d_{T,IA}$ and $d_{T,MA}$, respectively [see [Figure 3 a](#)].

The tag backscatter test setup parameters are defined in [Table 2](#).

Table 2 — Tag backscatter setup parameters

Symbol	Name	Description
$d_{T,IA}$	Interrogator antenna to tag distance	0,8 m to 1,1 m
$d_{T,MA}$	Measurement antenna to tag distance	0,8 m to 1,1 m
G_{IA}	Gain of interrogator antenna	The maximum 3 dB beam width shall be $\pm 35^\circ$
G_{MA}	Gain of measurement antenna	The maximum 3 dB beam width shall be $\pm 35^\circ$
I_{cir}	Isolation of the circulator	The minimum isolation of the circulator shall be 20 dB

In a second one [see [Figure 3 b](#)]), the test interrogator antenna setup (the interrogator may alternately also be realized with a signal generator according [Annex C](#)) shall consist of a single antenna specifically designed to transmit the signal from the interrogator and to receive the signal backscattered from the tag under test. This antenna shall be connected to the interrogator and to either a spectrum analyser or an oscilloscope as specified in [Annex C](#) via a circulator. The tag under test shall be oriented for optimum field strength reception. The distance between the tag and the antenna is $d_{T,IA}$ [see [Figure 3 b](#)].

The tag backscatter test setup parameters are defined in [Table 2](#).

5.2.2.3 Tag response time

The setup for this test shall be as described in [5.2.2.1](#).

5.2.2.4 Tag bit rate accuracy test setup

The setup for this test shall be as described in [5.2.2.1](#).

5.2.2.5 Tag state storage time test setup

The setup for this test shall be as described in [5.2.2.1](#).

6 Conformance tests for ISO/IEC 18000-61

6.1 Functional tests of interrogator

6.1.1 Interrogator modulation test

6.1.1.1 Test objective

The objective of this test is to verify that the interrogator provides the appropriate modulation waveform required for operation of tags.

6.1.1.2 Test procedure

The interrogator shall transmit an **Init_round_all** command at the maximum power of the selected carrier frequency for testing.

In case the interrogator is intended for operation of non-overlapping RF bands, then this test shall be done for each RF band.

A digital oscilloscope as specified in [Annex C](#) and the sense antenna shall be used to record the waveform provided by the interrogator.

6.1.1.3 Test report

The test report shall give the measured values of the parameters according to [Table 3](#). The pass/fail condition is determined whether the measured values are within the requirements as specified in ISO/IEC 18000-61. Furthermore, the DUT and the sense antenna orientation and position, as well as the used interrogator output power, and the used operation frequency shall be recorded.

Table 3 — Measurements to be made

Parameter	Conditions
D	Default modulation operation mode
T _{apr}	Default modulation operation mode
T _{apf}	Default modulation operation mode

6.1.2 Interrogator demodulation and turn-around time

6.1.2.1 Test objective

The objectives of this test are to verify whether the interrogator is capable of

- demodulating signals from the tags, and
- receiving the data transmitted by the tag emulator after the minimum specified turn-around time.

6.1.2.2 Test procedure

The interrogator shall transmit an **Init_round_all** command (see [B.1.1](#)) at the maximum power of the selected carrier frequency for testing.

After the command provided by the interrogator has been sent and after the minimum turn-around time, a tag emulator as specified in [Annex D](#) shall transmit a typical response to the **Init_round_all** command at a minimum Δ RCS specified in ISO/IEC 18000-61. The tag emulator does not need to demodulate the command, but shall only detect its end to respond after the minimum turn-around time.

When the interrogator is intended for operation of non-overlapping RF bands, this test shall be done for each RF band.

Measurements shall be done for both the minimum and maximum tag response data rate, i.e. the turn-around time from interrogator command to tag response.

In case the interrogator is designed for shorter communication distances, then the distance d_{TE} may be decreased and the actual used value shall be mentioned in test report.

The interrogator (digital) demodulator shall accept the tag response including verification of the CRC.

6.1.2.3 Test report

The test report shall contain the tag emulator distance to the interrogator and the Δ RCS value setup in the tag emulator. Furthermore, also the set up turn-around time from the tag emulator, the DUT and the tag emulator orientation and position, as well as the used interrogator output power and the used operation frequency shall be recorded.