TECHNICAL REPORT

ISO/IEC TR 18047-7

Second edition
2010-07-01

Information technology — Radio frequency identification device conformance test methods —

Part 7: Test methods for active air interface communications at 433 MHz

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

Partie 7: Méthodes d'essai pour des communications d'interface d'air active à 433 MHz

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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

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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.

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 18047-7, which is a Technical Report of type 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 18047-7:2005), which has been technically revised.

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 18000-7:2009 defines the active air interface for these devices operating in the 433,92 MHz Industrial, Scientific, and Medical (ISM) band.

ISO/IEC TR 18047 provides test methods for conformance with the various parts of ISO/IEC 18000. This part of ISO/IEC TR 18047 contains the compliance measurements required to be fulfilled by a product in order to be compliant to ISO/IEC 18000-7:2009.

Information technology — Radio frequency identification device conformance test methods —

Part 7: Test methods for active air interface communications at 433 MHz

1 Scope

This part of ISO/IEC TR 18047 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 18000-7, 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.

The interrogator and tag conformance parameters in this part of ISO/IEC TR 18047 are the following:

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

The following are not included in this part of ISO/IEC TR 18047:

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

Unless otherwise specified, the tests in this part of ISO/IEC TR 18047 are to be applied exclusively to RFID tags and interrogators defined in ISO/IEC 18000-7.

2 Normative references

The following referenced documents are indispensable for the application of this part of ISO/IEC TR 18047. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 18000-7:2009, *Information technology — Radio frequency identification for item management — Part 7: Parameters for active air interface communications at 433 MHz*

ISO/IEC 19762 (all parts), *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 (all parts) and the following apply.

3.1.1
Reference Interrogator
RFID interrogator, or device that emulates an RFID interrogator, that has been tested as compliant to both ISO/IEC 18000-7:2009 and ISO/IEC TR 18047-7:2010, and is used as a reference for testing tags

3.1.2
Reference Tag
RFID tag, or device that emulates an RFID tag, that has been tested as compliant to both ISO/IEC 18000-7:2009 and ISO/IEC TR 18047-7:2010, and is used as a known reference for testing interrogators

3.2 Symbols and abbreviated terms

RSSI Receiver Signal Strength Indicator

4 Physical Conformance Tests

4.1 General

This clause specifies the tests to determine whether interrogators and tags conform to ISO/IEC 18000-7:2009 at the physical level. The Physical Conformance Tests include measurements relating to signal quality (frequency, modulation, bandwidth, timing, etc.) of the transmitter and receiver, and the proper interaction of interrogators and tags to the signals.

4.2 Default items applicable to the test methods

4.2.1 Test environment

Unless otherwise specified, testing shall take place in an environment of temperature 23 °C ± 3 °C (73 °F ± 5 °F) and relative humidity of 40% to 60%. Tested equipment is to maintain performance limits stated herein in this environment. In addition to this minimum requirement, manufacturers may specify for their products an operational temperature range over which they intend to maintain performance limits stated in their specifications.

4.2.2 Pre-conditioning

Where pre-conditioning is required by the test method, the tags and interrogators to be tested shall be conditioned to the test environment by a method specified by the manufacturer before testing.

4.2.3 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).

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.

4.2.5 Test Report Format

Test reports shall be prepared individually for each tag or interrogator tested. Values measured for parameters in each subclause of clause 4.5 for interrogators and clause 4.6 for tags shall be recorded.

4.3 Test set-up and measurement equipment

4.3.1 General

The RFID system specified in ISO/IEC 18000-7:2009 is designed for long-range operation. Therefore a good receiver characteristic on both interrogator and tag is useful. The range of an RFID system also depends on the output power of the interrogator, which is set according to regulatory limits and application needs.

This clause defines the test set-up and measurement equipment for verifying the operation of a tag or an interrogator according to ISO/IEC 18000-7:2009.

Test results shall not be influenced by the set-up method of the test.

Test set-ups include:

- Test set-up for interrogator testing (see 4.3.2)
- Test set-up for tag testing (see 4.3.3)
- Test equipment (see 4.3.4)

4.3.2 Test set-up for interrogator testing

The conformance tests are designed to verify compliance with the basic radio-frequency parameters of the interrogator and tag while undergoing bi-directional communication.

Measurements are to be conducted with equipment configured to provide a high signal to noise ratio over the air interface. To achieve this, an interrogator with integral antenna(s) may be equipped with temporary antenna connector(s). Alternatively, a coupling device such as a sense antenna may be used to connect to the test equipment. Such an antenna should be selected with consideration for polarization and range to reduce measurement variations. Engineering judgment may be applied to select test equipment to support the variety of specific design features offered by different manufacturers. The antenna type, polarization, height and distance shall be recorded in the test report.

A control computer with appropriate software and user documentation provided by the vendor is expected to perform the control of all tests. All interrogator commands defined for this conformance testing are defined in ISO/IEC 18000-7:2009 Command codes.

To set up an interrogator with the appropriate test pattern and operational modes, one of the two methods shall be used (combinations shall also be possible):

- A pre-programmed, semi-automatic test mode implemented at the manufacturer's option through test code internal to the product. The operation of such code may require special purpose commands or connections beyond the scope of this Standard.
- A reference tag with which the interrogator may execute Link Layer operations.

The air interface parameter in a test mode shall behave the same as the air interface parameter during normal usage.

Unless otherwise stated the frequency of the reference carrier shall be set to 433,92 MHz.

The implementation of the test mode shall be in accordance with the air interface parameters and timing specified herein. If not stated herein, consult ISO/IEC 18000-7:2009.

The frequency of the interrogator transmitter shall be within the tolerance specified herein. The output power shall be set according to the manufacturer's instructions, not to exceed the maximum allowed by local regulatory rules taking into consideration the antenna gain. A control computer is required to set up and trigger all interrogator activity, as shown in Figure 1. The RF test equipments in the figure include RF receiver (including a sense antenna with or without an FM demodulator), spectrum analyser and logic analyser.

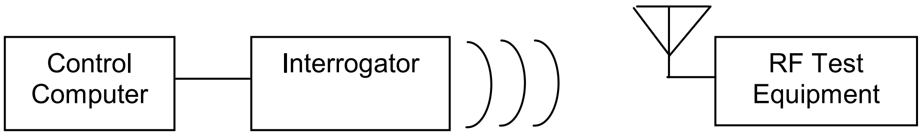

Figure 1 — Interrogator test system

4.3.3 Test set-up for tag testing

The conformance tests are designed to verify compliance with the basic radio-frequency parameters of the tag.

Measurements are to be conducted with equipment configured to provide a high signal to noise ratio over the air interface. To achieve this, an interrogator with integral antenna(s) may be equipped with temporary antenna connector(s). Alternatively, a coupling device such as a sense antenna may be used to connect to the test equipment. Such an antenna should be selected with consideration for polarization and range to reduce measurement variations. The antenna type, polarization, height and distance shall be recorded in the test report.

To set-up a tag with the test pattern and operational modes, one of the two methods shall be used (combinations shall also be possible):

- A pre-programmed, internal self-test mode in the tag. Note that design of this optional self-test mode is specific to each manufacturer. Special purpose over-the-air commands outside of ISO/IEC 18000-7:2009 or external connections may be required to operate in this mode.

- A reference interrogator for which the tag may execute Link Layer operations.

If no internal self-test mode is implemented in the tag, the conformance tests shall be performed during RF traffic between the tag and reference interrogator. For R/W tags without a test mode, a reference interrogator for initializing the appropriate operational mode shall be used. In this RFID system the interrogator is a master which initiates air interface activity and the tag only transmits in response to interrogator commands.

If a built-in test mode is incorporated in the tag, all air interface parameters shall behave the same as the air interface parameter during normal usage.

A control computer and reference interrogator are required to set up and trigger all tag activities as shown in Figure 2.

The RF test equipments in Figure 2 may include an RF receiver (including a sense antenna with or without an FM demodulator), a spectrum analyser, a logic analyser, or other similar instruments.

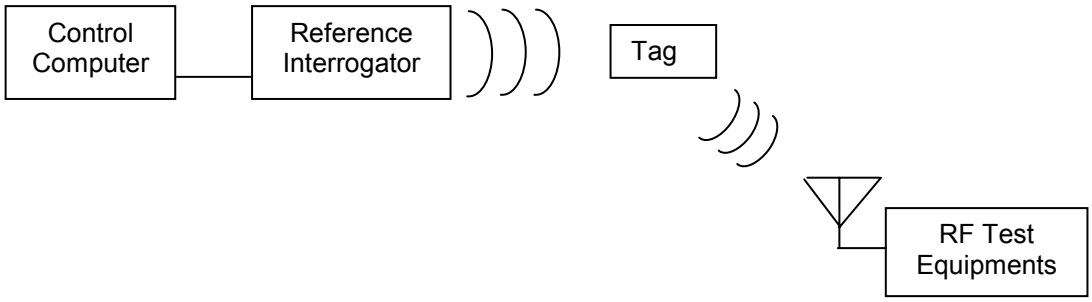

Figure 2 — Tag test system setup

4.3.4 Test equipment

All tests shall be done with commercial test equipment. Numerous types of RF measurement instruments are available with extended features for spectrum analysis, modulation analysis and data recording. The instruments listed below are examples of suitable equipment. Other variants may be used which are capable of making the measurements to the necessary degree of accuracy. All test equipment shall be calibrated by a nationally certified calibration laboratory within 12 months preceding the date of test.

Additional equipment such as power supplies, splitters, combiners and cables may be used as required.

The RF signal reference port for all measurements shall be either an antenna connector, or an appropriate coupling device such as a probe antenna. The reference port location shall be identified in the test report.

4.3.4.1 Spectrum analyser

A spectrum analyser or other instrument with equivalent features is required. The instrument requires internal triggering with the capability of capturing the RF signal leading edges, or an external triggering device.

4.3.4.2 Modulation analyser

A means of detecting and analyzing the data bit stream encoded on the RF signal is required. An example of a suitable instrument is a modulation analyser with the capability of analysing the signal's central frequency and frequency deviation. Instruments with other combinations of features may be employed.

4.3.4.3 Signal generator

It is necessary to emulate the interrogator Wake Up Signal over the frequency range required for the tag to detect it and respond. For this purpose, a modulated signal generator for the 433 MHz band may be used. The signal level for the tests shall be within the operational range of the receiver input of the tag. The input level shall be specified by the tag manufacturer and shall be documented in the test report.

4.3.4.4 Logic analyser

Instrumentation is required to capture and verify data transmission timing and correctness. An example of such equipment is a logic analyser with memory. The analyser should be capable of sampling at a rate of at least 100 mega-samples per second with a resolution of at least 8 bits at optimum scaling.

4.4 Physical Layer Parameter Values and Limits

Table 1 and Table 2 below list the critical parameters to be measured and verified in the subclauses listed in the first column. These tables refer to values in ISO/IEC 18000-7:2009 Table 117 and Table 118, or to clause numbers in that standard. The first column identifies the corresponding ISO/IEC 18000-7:2009 entry in parentheses as "(Ref.)".

Table 1 — Interrogator Parameter Values and Limits

Subclause (Ref.)	Parameter	Min	Nominal	Max
4.5.1 (Int. 1)	Interrogator Tx Centre Frequency @ 23° C +/- 3° C	433,906983 MHz (-30 ppm)	433,920 MHz	433,933018 MHz (+30 ppm)
4.5.2 (Int. 7f)	Interrogator Tx FSK Frequency Deviation (RMS)	40 kHz (-20%)	50 kHz	60 kHz (+20%)
	Interrogator Tx FSK Frequency Deviation (Peak)	30 kHz (-40%)	50 kHz	70 kHz (+40%)
4.5.3 (Int. 2)	Interrogator Tx Modulation Bandwidth containing 99% of RF Power			200 kHz
4.5.4 (6.1)	Interrogator Wakeup Header Duration	2,35 s		4,80 s
4.5.4 (6.1)	Interrogator Wakeup Header Square Wave Period	2x15,68 µs (-2%)	2x16 µs	2x16,32 µs (+2%)
4.5.4 (6.1)	Interrogator Wakeup Header Square Wave Frequency	30,625 kHz (-2%)	31,25 kHz	31,875 kHz (+2%)
4.5.5 (6.1)	Interrogator 100ms Co-Header Square Wave Period	2 x 49 µs (-2%)	2 x 50 µs	2 x 51 µs (+2%)
4.5.5 (6.1)	Interrogator Co-header Tx Duration	98 ms	100 ms	102 ms
4.5.6 (6.2)	Preamble Start (Low Period)	15 µs		
4.5.6 (Int.11; 6.2)	Interrogator Tx Preamble Square Wave Period, 20 cycles duration.	2 x 29,4 µs (-2%)	2 x 30 µs	2 x 30,6 µs (+2%)
4.5.6 (Int.11; 6.2)	Preamble Terminator Cycle Timing	53 µs (-2%) 53 µs (-2%)	54 µs high 54 µs low	55 µs (+2%) 55 µs (+2%)
4.5.7 (Int.8; 6.2)	Interrogator Data Tx Bit Interval	2x17,64 µs(-2%)	2x18 µs	2x18,36 µs (+2%)
4.5.7 (Int.8; 6.2)	Interrogator Data Bit Rate	27,222 kbps (-2%)	27,778 kbps	28,334 kbps (+2%)
Not Specified	FSK rise time or fall time.			6 µs between +/- 30 kHz, Fig 3
4.5.7 (6.2)	Packet Terminator (Low Period)	35.28 µs	36.00 µs	36.72 µs
4.5.7 (6.2)	Packet Terminator (High Period)	15 µs		
4.5.8 (Int.2a)	Interrogator Rx Bandwidth @ -3dB	300 kHz		