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Part 1: Interference rejection performance test method between a tag as defined in ISO/IEC 18000-63 and a heterogeneous wireless system

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

A list of all parts in the ISO/IEC 23200 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

This document provides test procedures and method to evaluate the impact on tag as defined in ISO/IEC 18000-63 of interference generated by other wireless systems. The interference rejection test method of this document is different to ISO/IEC 18046-3:2012, 8.8. This document covers interference effect between the tags and heterogeneous wireless system, while ISO/IEC 18046-3 covers interference effect between tags and homogeneous wireless systems.

Ultra-high-frequency (UHF) radio frequency identification (RFID) is a wireless technology that connects billions of everyday items to the Internet of Things (IoT), enabling consumers and businesses to identify, locate, authenticate, and engage each item. IoT applications require a data connection between the physical and digital world, and UHF RFID is the ideal technology to bridge these realms with the ability to bring low cost, unique identification to everyday items. Low-power wide-area networks (LPWAN) operate at long read ranges of 2 km to 3 km. While LoRaWan devices have a very slow data-transfer rate, they are useful for transmitting sensor data. For example, LoRaWAN, WiFi-Halow (802.11ah), Sigfox, NB-IoT, WB-IoT, and LTE-M are representative technologies.

The frequencies used by LoRaWAN systems differ by region and country, as do the frequency bands designated for UHF RFID systems. In particular, LoRaWAN and RFID systems use different power levels and heterogeneous protocols in shared frequency bands. They are susceptible to interference generated by other wireless systems. This harsh signal propagation environment combined with interference from coexisting wireless technologies can lead to a degradation of the performance or even application failures. To evaluate possible interference on UHF RFID systems, industrial stakeholders make a constructive discussion on how to overcome interference problems.

Information technology — Radio frequency identification for item management —

Part 1: Interference rejection performance test method between a tag as defined in ISO/IEC 18000-63 and a heterogeneous wireless system

1 Scope

This document defines a test method to evaluate the interference rejection performance of tags covered by ISO/IEC 18000-63 and a heterogeneous wireless system using different access technologies, e.g. radio frequency identification and cell phone network.

It specifies the general requirements and test requirements.

The test method in this document makes it possible to compare the relative interference rejection performance among tags under a single wireless interference environment. In addition, this document can be used in a benchmarking test according to requirements in a given application or service.

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 19762, *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 provided in ISO/IEC 19762 apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Symbols and abbreviated terms

ANT_{TX}	T_X interrogator antenna in the bistatic test set-up
ANT_{RX}	R_X interrogator antenna in the bistatic test set-up
ANT_{TRX}	interrogator antenna in the monostatic test set-up
ANT_{INT}	antenna connected to the radio frequency interference source
CW	continuous wave

$D_{Interference}$	distance between the tag and the antenna connected to the RF interference source
$D_{Interrogator}$	distance between the tag and the interrogator antenna
DUT	device under test
G_{dBi}	antenna gain
GFSK	Gaussian frequency shift keying
LHCP	left hand circular polarization
OFDM	orthogonal frequency division multiplexing
P_{min}	minimum power required to activate a UHF RFID tag. P_{min} is the power at the position of a tag
$P_{min\_under\_int}$	P_{min} under a single wireless interference environment
PF_{iRej}	interference rejection performance between a UHF RFID tag and other wireless systems
QAM	quadrature amplitude modulation
RHCP	right hand circular polarization
R_X	receiver
SG	signal generator
TE	test equipment (RFID interrogator emulator)
T_X	transmitter

5 Conditions applicable to the test methods

5.1 Test environment

Unless otherwise specified, testing shall take place in an air environment with a temperature of 23 °C ± 3 °C (73 °F ± 5 °F) and relative humidity within the range of 40 % to 60 %.

5.2 Radio frequency (FR) environment

The tests shall be performed in a known RF environment.

For measurements of propagative tags (ISO/IEC 18000-63), an anechoic chamber is the recommended test environment.

5.3 Pre-conditioning

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

5.4 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).

5.5 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.

5.6 Test result reporting

Each test result shall be reported with the DUTs tested. Optionally, for statistical evaluation, minimum value, maximum value, mean value and standard deviation may be reported as well.

5.7 Test mounting material

For the tags, the tests may be performed with or without applying a mounting material. When the mounting material is defined by the tag manufacturer, the tests shall be performed with the specified mounting material in free air.

If the indicative dielectric parameter or other critical parameters of the material are known, they shall be mentioned in the test report.

5.8 Test communication parameters

All of the tests may be performed for various communication parameters (forward and return link).

The test conditions shall be recorded in the test report.

6 Test set-up

6.1 DUT placement

The DUT shall be placed in the far field according to Figure 1 or Figure 2. The distance, D, shall be as in Formula (1):

$$D = \frac{2L^2}{\lambda} \quad (1)$$

where

λ is the wavelength at the centre frequency of the interrogator;

L is the maximum dimension of the interrogator antenna.

6.2 Test setup for tag's R_X sensitivity power measurement under non-interference environment

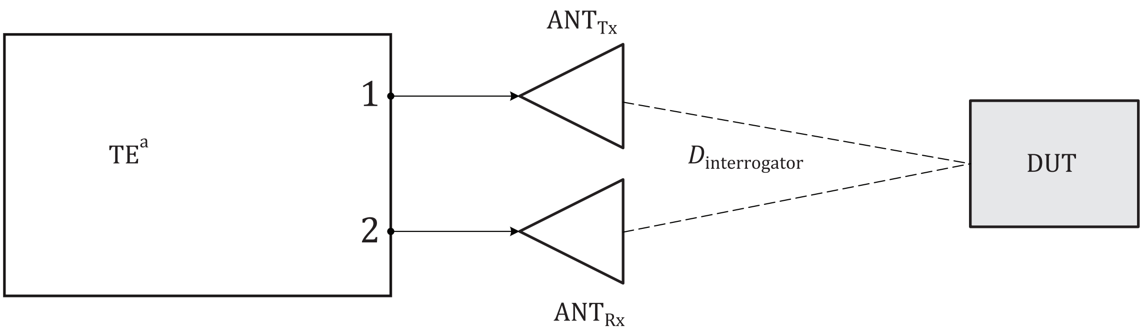
6.2.1 Test apparatus and test circuits

This subclause defines the test apparatus and test circuits to be used to validate the reference performance of a tag.

The test setup shall be as in Figure 1 or Figure 2 using test equipment (TE) like an interrogator emulator or similar means that is compliant with ISO/IEC 18000-63.

6.2.2 Setup of the devices

The test setup shall be either the bistatic test set-up shown in Figure 1 or the monostatic test setup shown in Figure 2. The test equipment shall be sensitive enough to be able to measure tag's receive sensitivity power level P_{min}.



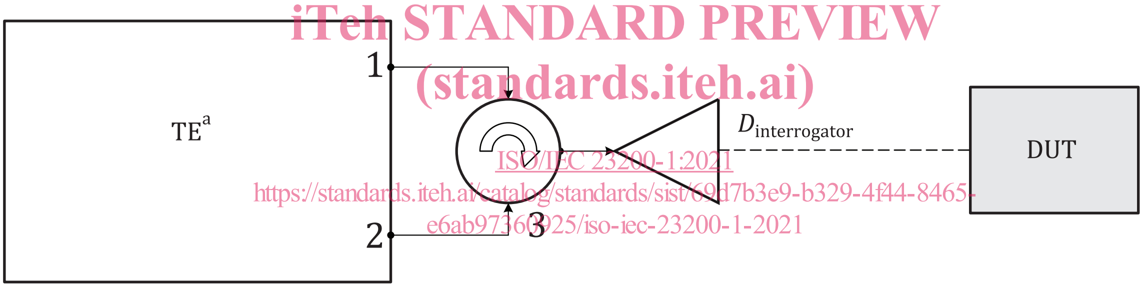
Key

1 T_X port

2 R_I port

[a] Interrogator simulator.

Figure 1 — Bistatic test setup



Key

1 T_X port

2 R_X port

3 circulator

[a] Interrogator simulator.

Figure 2 — Monostatic test setup

The DUT shall be mounted either on the material with a relative permittivity of approximately 1 or on the material provided by the client. In order to maximize the tag's receive sensitivity, the boresight of the DUT should be oriented toward the centre of the interrogator antenna.

The distance D shall be at least as defined in Formula (1) to do the measurements in the far field. $D_{interrogator}$ distance is recommended to be 50 cm.

6.2.3 Antenna polarization and requirements

For the tag sensitivity tests, a linear (vertical and horizontal) or circular polarized antenna should be used. However, in the case of the Bistatic test setup, there should be sufficient isolation between the T_X and R_X antennas of the interrogator.

The circulator (or directional coupler) used in the monostatic test setup should have sufficient isolation to prevent mutual interference.

6.3 Test setup for tag's R_X sensitivity power measurement under interference environment

6.3.1 Sub-1GHz wireless communications technologies

This clause defines the test apparatus and test circuits to be used to measure the changed performance of a DUT under the given interference environment.

The desired interference waveform shall be set to the required operating frequency, amplitude and modulation techniques by the signal generator (SG).

Table 1 summarizes key features of sub-1GHz wireless communications technologies (e.g. US). The radio frequency bands of the wireless communications technologies are managed independently by each country's regulatory authority. Most of these technologies use an operating frequency band of 902 MHz to 928 MHz, which is one of the industrial, scientific, and medical (ISM) bands.

Figure 3 and Figure 4 show the test setup arrangements for interference rejection measurement:

Table 1 — Key features of sub-1GHz wireless communications technologies (e.g. US)

Technologies	Frequency MHz	Modulation	Max. range m	Data rates kbps	Multi access	T_X power (without antenna gain) dBm
UHF RFID	902 to 28	ASK/PSK	10	26.7 to 128	Freq. Hopping SS	30
LoRa	902 to 928	GFSK	15 000 to 20 000	0.25 to 50	Chirp SS	30
SigFox	902 to 928	BPSK/GFSK	3 000 to 10000	0.1	Ultra Narrow Band	14
Wi-SUN	902 to 928	GFSK	1 000	50 to 300	OFDM	13
Z-Wave	908.42	GFSK	30	100	N.A.	0
IEEE 802.11ah	902 to 928	PSK/QAM	1 000	150 to 347 000	OFDM	30

6.3.2 Setup of the devices

The test setup shall be either the bistatic test set-up shown in Figure 3 or the monostatic test setup shown in Figure 4. The test equipment should be sensitive enough to be able to measure the tag's R_X sensitivity power level P_{min}. The interference antenna (ANT_{INT}) connected to the signal generator should be located in a straight line from the opposite side of the DUT. If it is located in other positions, the information shall be recorded in the test report.