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Information technology — Real-time locating system (RTLS) device performance test methods —

Part 62: High rate pulse repetition frequency Ultra Wide Band (UWB) air interface

Technologies de l'information — Méthodes d'essai des performances du dispositif des systèmes de localisation en temps réel (RTLS) —

Partie 62: Méthodologie de test de interface aérienne ultra large bande (UWB) à impulsions haute fréquence de répétition

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Contents

Page

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 meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

ISO/IEC 24770 consists of the following parts, under the general title *Information technology — Real-time locating systems (RTLS) device conformance test methods*:

— *Part 61: Low rate pulse repetition frequency Ultra Wide Band (UWB) air interface*

— *Part 62: High rate pulse repetition frequency Ultra Wide Band (UWB) air interface*

The following part is under preparation:

— *Part 5: Chirp Spread Spectrum (CSS) at 2,4 GHz air interface*

Introduction

ISO/IEC 24730-62 defines an air interface for Real Time Locating Systems (RTLS) devices used in asset management applications.

This International Standard provides test methods for measuring performance of equipment compliant with ISO/IEC 24730-62.

ISO/IEC IS 24769-62 contains all measurements required to be made on a product in order to establish whether it conforms to ISO/IEC 24730-62.

Information technology — Real-time locating system (RTLS) device performance test methods —

Part 62: High rate pulse repetition frequency Ultra Wide Band (UWB) air interface

1 Scope

This International Standard defines the test methods for determining the performance characteristics of Ultra Wide Band (UWB) real time locating system (RTLS) equipment including tags and readers which are applicable to the selection of equipment that conforms to ISO/IEC 24730-62 for specific applications. This International Standard does not apply to the testing in relation to regulatory or similar requirements.

The RTLS equipment performance parameters included in this International Standard only include the Ultra Wide Band (UWB) radio frequencies link between tags and readers. Unless otherwise specified, the tests in this International Standard apply exclusively to RTLS equipment defined in ISO/IEC 24730-62.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 19762-1, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 1: General terms relating to AIDC*

ISO/IEC 19762-3, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 3: Radio frequency identification (RFID)*

ISO/IEC 24730-62, *Information technology — Real time locating systems (RTLS) — Part 62: High rate pulse repetition frequency Ultra Wide Band (UWB) air interface*

ISO/IEC 24769-62, *Information technology — Real Time Locating System (RTLS) device conformance test methods — Part 62: High rate pulse repetition frequency Ultra Wide Band (UWB) air interface*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762-1 and ISO/IEC 19762-3 apply.

3.2 Abbreviated terms

PRF pulse repetition frequency

RF radio frequency

RFID radio frequency identification

RTLS real time locating system

TDOA time difference of arrival

TOA time-of-arrival

UWB ultra wide band

4 General

4.1 Performance requirements

4.1.1 Preface

This part of ISO/IEC 24770 specifies a series of tests to determine the performance characteristics of RTLS equipment relative to the ISO/IEC 24730-62 air interfaces. The results of these tests can be used to determine the suitability of RTLS equipment for applications.

4.1.2 Location accuracy

The primary function of RTLS equipment is to locate tags within the area covered by the readers. Location accuracy determines the primary performance criteria of an RTLS. Location accuracy can be characterized by comparing the system's calculated location for a given set of tags to the actual location of the tags. The system must be able to locate tags to within the applications allowable error. The location tests specified in this standard are confined to line-of-sight situations. Although this will not be applicable to all applications, the complexity of all the variations of blockage and partial blockage are beyond the scope of this test.

4.1.3 Tag capacity

A RTLS must typically locate a large number of tags. The number of tag blinks per second that can be processed and located through the readers can be used to determine a system's tag capacity. The system must be able to provide location information for an applications peak tag blink density.

4.1.4 Location latency

The latency between when the tag blink is transmitted and when the RTLS equipment can provide accurate location information determines the suitability of the equipment for the application.

4.1.5 Tag orientation

The ability of an RTLS to provide real time location information should be independent of the orientation of the tag. The location reported by the RTLS should not change as the tag is rotated in any orientation relative to the readers.

4.1.6 System range and packet error rates

The length of the tag-reader link determines the reader density requirements and also affects system capacity. The packet error rate will determine how often the equipment can successfully provide accurate location information for the tag.

The range determines the usability of the system in meeting the applications requirements.

4.2 Default conditions applicable to the test methods

4.2.1 Preface

These conditions apply to all tests.

4.2.2 Test environment

Testing shall take place in an environment typical to that of the desired application. Testing can be performed indoors or outdoors with temperature and humidity profiles similar to that expected in the desired application. The RF noise floor at the test location should also represent typical conditions expected within the desired application.

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 and the test method procedures.

4.2.4 System Logging

The RTLS should provide sufficient data logging to allow determination of the number of packets received and sent, but this is not absolutely required.

5 Performance tests for ISO/IEC 24730-62

5.1 System locate performance

5.1.1 Preface

Subclause 5.1 includes tests for location performance.

5.1.2 Test objective

The objective of this test is to evaluate the system locate performance characteristics of the ISO/IEC 24730-62 equipment.

5.1.3 Test set up

The readers shall be connected to antennas with adequate width of field to cover the test area with 4 readers. It is preferred that the RTLS locate performance characteristics be evaluated with the system installed as it would for the desired application. If that is not possible, then the equipment shall be configured as shown in Figure 1, with four readers at the corners of a square. The size of this square as defined by diagonal (D) is dependent on the operating mode of the devices.

In a TDOA system the separation of the fixed (anchor) reader nodes is dependent on the ability of their receivers to receive the tags transmissions. This is not a direct feature of the air interface protocol but is rather the result of the implementation in the receiver of the physical layer protocol. The size of diagonal then should be chosen to be the range of successful tag-to-anchor communications. For ISO/IEC 24730-62 compliant tags this will depend on data rate and preamble length choices, on operating channel and bandwidth, and on implementation choices in the receiver. As a guideline to choosing diagonal (D) Table 1 gives an example of some typical maximum ranges that might be expected. In testing the performance of a particular system the equipment manufacturer should be able to advise the maximum expected operating range for the system operating mode being tested.

Table 1 — some typical operating ranges

Data Rate	Typical max ranges
110 kbps	150 m to 250 m
850 kbps	90 m to 150 m
6,81 Mbps	25 m to 55 m

In addition to standalone tags, several tags mounted on the application's locatable assets (or items of comparable size and composition) shall be used to evaluate locate performance.

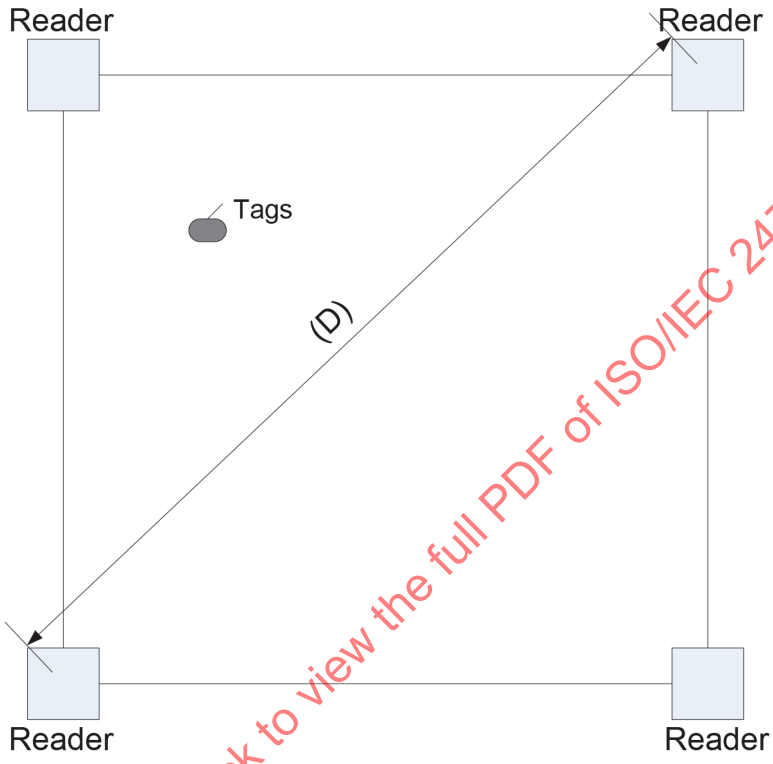

Figure 1 — Setup of equipment for RTLS locate accuracy test

5.1.4 Test procedure

The tag shall be configured to transmit at the desired UWB signalling mode as defined in ISO/IEC 24730-62.

The test shall include an evaluation of the total blink capacity as a function of blink rate for the test tags within the test area. In order to be greater than the maximum expected capacity, a test tag blink rate should be computed. This blink rate is given by the formula:

$$tbr = \frac{ta}{tt} \times mabr \times 1{,}5$$

where

tbr is the test tag blink rate;

ta is the total tags to be in the equivalent application area;

tt is the total tags in the test area;

mabr is maximum blink rate expected in the application.

Unless otherwise indicated, the tags shall be configured to blink at computed test tag blink rate. The tags shall be attached to assets such as to reproduce the conditions of the desired application. Additional procedures specific to individual tests are outlined in the test measurements and requirements.

5.1.5 Test measurements and requirements

5.1.5.1 Location accuracy

Tags, or sets of tags, shall be distributed throughout the area of coverage at between 2 m to 10 m spacing as shown in Figure 2. The spacing being decided on the basis of the tag supported density and the size of the diagonal (D), both of which are dependent on the tag operating mode. The actual location of all tags shall be recorded, as precisely as possible to the nearest centimetre. The test shall be run long enough to capture a minimum of 250 tag blinks from each tag. The total number of tag locates calculated during the test shall be divided by expected number of blinks from all the tags included in the test for the duration of the test using the formula: [(N tags) * (test duration)/(tag blink interval)]. Each location calculation shall be compared to appropriate tag's actual location to produce the location error. The location accuracy shall be represented as a percentage of all locations calculated by the system in which the errors fall within the specified maximum error divided by the total number of locations calculated. The radius of acceptable error shall be determined by the requirements of the application.

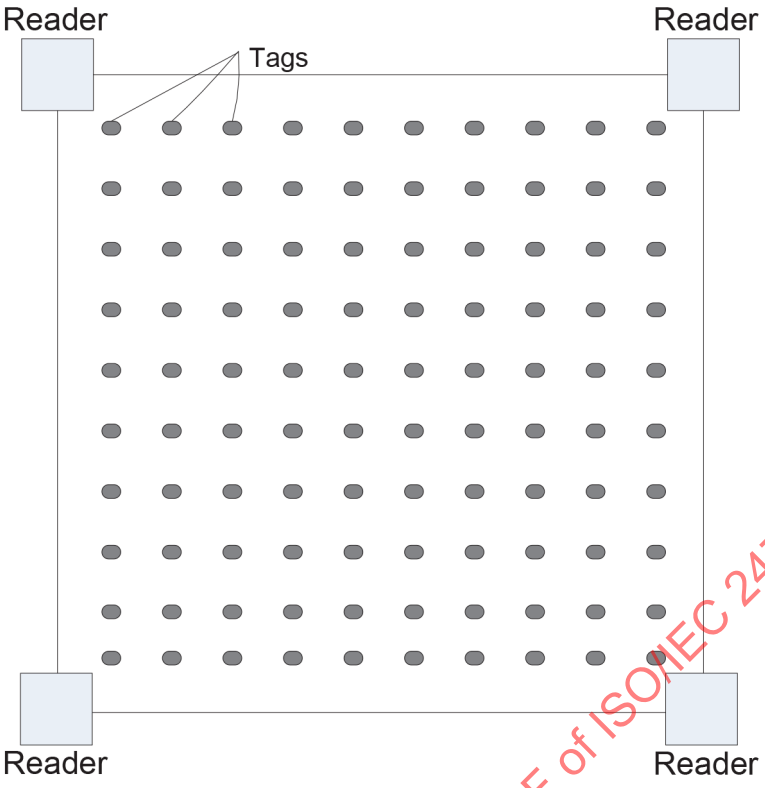

Figure 2 — Setup of equipment showing tag spacing

5.1.5.2 Location reporting latency

The test shall include at least 50 tag location changes of at least 2 m to capture a statistically significant sample. Tags, or groups of tags, shall be moved from one known location to another known location throughout the test. The exact time of each actual move shall be logged, as well as the exact time of reported location change. Record the difference between the time of reception and the time of the location report which location is within the maximum error allowed by the application.

5.1.5.3 Tag capacity

The tags shall be configured at a blink interval such that the total number of blinks per second during the test is at least 1,5 times the expected blinks per second in the application as computed in 5.1.4 of this standard. This ensures that the system will continue to perform at times when tag blinks cluster in time. The test shall then be repeated at half of this computed blink rate. The location accuracy and locate latency at these two different rates shall be compared to determine performance degradation.

5.1.5.4 Tag orientation

This test is required only for applications where the tag orientation when attached to the asset is not predictable. For the duration of the test, compare the errors in the calculated location as the tag is rotated through all three axes. Changes in location accuracy as a result of orientation should be noted in the test report quantitatively.

5.1.6 Test report

The test report shall contain location accuracy statistics evaluating the percentage of tag blinks located to within the applications required locate error radius. The report shall also contain the maximum tag blinks per second the system can handle and still meet the required location accuracy and locate latency.

