INTERNATIONAL STANDARD

ISO 18185-5

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Freight containers — Electronic seals —

Part 5: Physical layer

Conteneurs pour le transport de marchandises — Scellés électroniques —

Partie 5: Couche physique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 18185-5 was prepared by Technical Committee ISO/TC 104, *Freight containers*, Subcommittee SC 4, *Identification and communication*.

ISO 18185 consists of the following parts, under the general title *Freight containers — Electronic seals*:

— *Part 1: Communication protocol*

— *Part 2: Application requirements*

— *Part 3: Environmental characteristics*

— *Part 4: Data protection*

— *Part 5: Physical layer*

Introduction

This part of ISO 18185 defines the physical layer for compliant electronic seals.

It has been created to ensure global adoption of ISO 18185, providing a standardized physical layer as developed in the RFID standards of ISO/IEC 18000 and ISO/IEC 24730.

Freight containers — Electronic seals —

Part 5: Physical layer

1 Scope

This part of ISO 18185 specifies the air interface between electronic container seals and Reader/Interrogators of those seals.

It is to be used in conjunction with the other parts of ISO 18185.

This part of ISO 18185 describes the physical layer for supply chain applications of RFID for freight containers in accordance with the ISO 18185 series and ISO 17363, since it is expected that the implementation of these standards will face the same international conditions. However, each of these standards has its own unique requirements other than the physical layer. It is expected that RFID Freight Container Identification (as specified in ISO 10374 and ISO 17363), and electronic seals (as specified in the ISO 18185 series) will be able to use the same infrastructure, while recognizing that that there may be requirements for different frequencies for passive devices as opposed to the active devices identified in this part of ISO 18185.

This part of ISO 18185 is applicable to all electronic seals used on freight containers covered by ISO 668, ISO 1496 (parts 1 to 5) and ISO 830 and should, wherever appropriate and practicable, be applied to freight containers other than those covered by the aforementioned International Standards.

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/PAS 17712, *Freight containers — Mechanical seals*

ISO 18185-3, *Freight containers — Electronic seals — Part 3: Environmental characteristics*

ISO/IEC 18000-7:—[1)], *Information technology — Radio frequency identification for item management — Part 7: Parameters for active air interface communications at 433 MHz*

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 2382-26, *Information technology — Vocabulary — Part 26: Open systems interconnection*

ISO/IEC 24730-2:2006, *Information technology — Real-time locating systems (RTLS) — Part 2: 2,4 GHz air interface protocol*

1) To be published. (Revision of ISO/IEC 18000-7:2004)

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17712, ISO/IEC 19762-1, ISO/IEC 19762-3 and the following apply.

3.1
electronic seal
eSeal
read-only, non-reusable freight container seal conforming to the high security seal defined in ISO 17712 and conforming to ISO 18185 (or revision thereof) that electronically evidences tampering or intrusion through the container doors

3.2
seal identification
seal ID
unique identification of each manufactured seal incorporating serial number (i.e. Tag ID) and manufacturer ID

NOTE The combination is called the seal ID.

3.3
Interrogator identification
Interrogator ID
code used to identify the source address during every communication session originated by the Interrogator

3.4
physical layer
in the Open Systems Interconnection reference model, the layer that provides the mechanical, electrical, functional, and procedural means to establish, maintain and release physical connections for transfer of bits over a transmission medium

[ISO/IEC 2382-26]

3.5
LF transmitter ID
code used to identify the LF transmitter

4 Physical layer for electronic seals

4.1 General

The ISO 18185 system consists of the three distinct components: eSeal, LF transmitter, and Reader. The main feature of the system is its dual frequency operation.

There are two types of physical layers:

— type A physical layer is the 433 MHz long-range Link and OOK LF short-range link;

— type B physical layer is the 2,4 GHz long-range link and FSK short-range link.

The eSeal shall support both types of air interfaces. The data link protocols are different for each physical layer. Interrogators and Reader devices may support one or both types of physical layers.

The eSeal shall be capable of communicating on two long-range RF links. The protocol for these two links is specified in 4.2.1 and 4.3.1. The e-seal shall also be capable of receiving LF magnetically coupled transmissions as specified in 4.2.2.1 and 4.3.2. Data may be transmitted from the LF transmitter to the eSeal(s) without acknowledgment (one-way link only).

A short-range, low-frequency link between LF transmitter and eSeal(s) is used to localize eSeal(s) inside the magnetically coupled transmitter antenna field of an LF transmitter. Data are transmitted from the LF transmitter to the eSeal(s) without LF acknowledgment. All eSeal(s) in the field of an LF transmitter receive the LF transmitter's data simultaneously; i.e. the LF transmitter takes the same amount of time to transmit its data to any number of eSeals.

The long range links (433,92 MHz or 2,4 GHz) are used by eSeal(s) to reply to the Reader with the location (i.e. LF transmitter ID), its own identification (eSeal ID), and eSeal Status data are transmitted from the eSeal(s) to the Reader(s).

To avoid collisions during UHF transmission, in type A operation mode, the eSeal operates according to the anti-collision algorithm specified in 4.2; in type B operation mode, the eSeals do not require an anti-collision protocol.

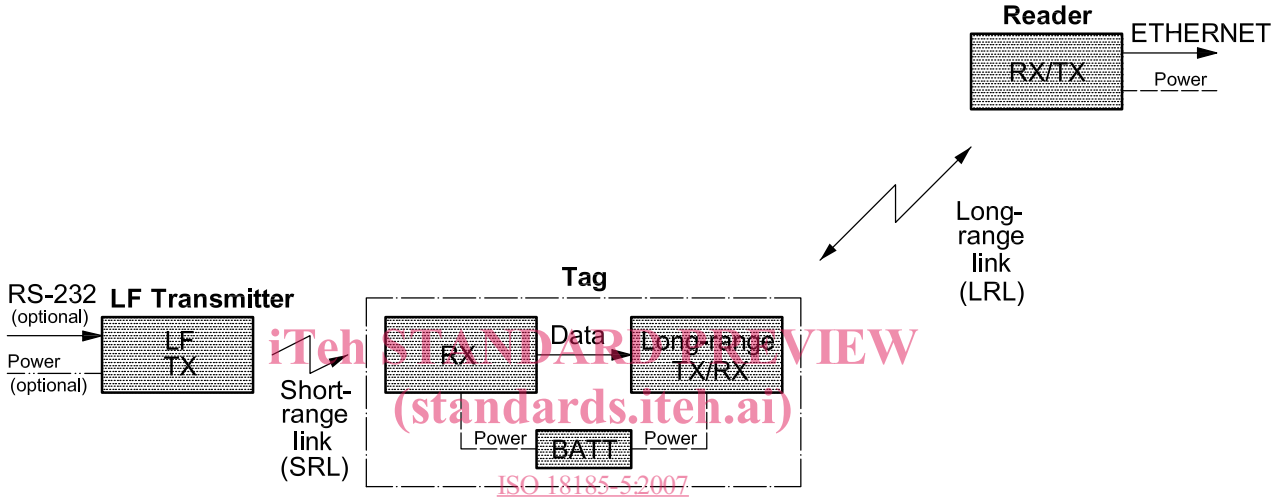

Figure 1 — System components

4.2 Type A physical layer protocol

4.2.1 433 MHz long-range link physical layer protocol

4.2.1.1 General

The collision arbitration uses a mechanism that allocates tag transmissions into slots within a specified collection round (or so-called window size). The window size parameter indicates the time an Interrogator will listen for tag responses during a current collection round. A collection round consists of a number of slots. Each slot has a duration long enough for the Interrogator to receive a tag response. The actual duration of a slot is determined by the Interrogator collection command type and is a function of the tag transmission time.

The Interrogator initiates a tag collection process by sending a Collection command. Tags receiving a Collection command randomly select a slot in which to respond, but do not immediately start transmitting. The number of slots in a current collection round is determined by the required field size based on the type of Collection command. Each Collection command requires a specific type and amount of data to be transmitted by the tag within a single slot time. Therefore, the size of each slot is determined by the length of time needed for a tag to provide the designated response indicated by the specific command. The number of available slots will be determined by dividing the window size by the time required for an individual tag response. During the subsequent collision arbitration process, the Interrogator dynamically chooses an optimum window size for the next collection round based on the number of collisions in the round. The number of collisions is a function of the number of tags present within the Interrogator communication range that participate in the current collection round.