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Information technology — Radio frequency identification for item management —

Part 2: Parameters for air interface communications below 135 kHz

Technologies de l'information — Identification par radiofréquence (RFID) pour la gestion d'objets

Partie 2: Paramètres pour les communications d'une interface d'air à moins de 135 kHz

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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.

ISO/IEC 18000-2 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

ISO/IEC 18000 consists of the following parts, under the general title *Information technology — Radio frequency identification for item management*:

— *Part 1: Reference architecture and definition of parameters to be standardized*

— *Part 2: Parameters for air interface communications below 135 kHz*

— *Part 3: Parameters for air interface communications at 13,56 MHz*

— *Part 4: Parameters for air interface communications at 2,45 GHz*

— *Part 6: Parameters for air interface communications at 860 MHz to 960 MHz*

— *Part 7: Parameters for active air interface communications at 433 MHz*

Introduction

ISO/IEC 18000 is a series of International Standards describing common communications protocols for the purpose of Radio Frequency Identification for Item Management.

This part of ISO/IEC 18000 relates to systems operating at frequencies less than 135 kHz.

It has been developed in accordance with the requirements determined in ISO 18000-1, *Information technology — Radio frequency identification for item management — Reference architecture and definition of parameters to be standardized*.

The International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) draw attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning radio-frequency identification technology given in the table below.

ISO and IEC take no position concerning the evidence, validity and scope of these patent rights.

The holders of these patent rights have assured the ISO and IEC that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of the holders of these patent rights are registered with ISO and IEC.

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

Information technology — Radio frequency identification for item management —

Part 2: Parameters for air interface communications below 135 kHz

1 Scope

This part of ISO/IEC 18000 defines the air interface for radio frequency identification (RFID) devices operating below 135 kHz used in item management applications. Its purpose is to provide a common technical specification for RFID devices to allow for compatibility and to encourage inter-operability of products for the growing RFID market in the international marketplace. This part defines the forward and return link parameters for technical attributes including, but not limited to, operating frequency, operating channel accuracy, occupied channel bandwidth, spurious emissions, modulation, duty cycle, data coding, bit rate, bit rate accuracy, bit transmission order. It further defines the communications protocol used in the air interface.

This part contains two types. The detailed technical differences between the types are shown in the parameter tables.

This part of ISO/IEC 18000 specifies

- The physical layer that is used for communication between the interrogator and the tag.
- The protocol and the commands
- The method to detect and communicate with one tag among several tags (“anti-collision”)

It specifies two types of tags: Type A (FDX) and Type B (HDX). These two types differ only by their physical layer. Both types support the same anti-collision and protocol.

FDX tags are permanently powered by the interrogator, including during the tag-to-interrogator transmission. They operate at 125 kHz.

HDX tags are powered by the interrogator, except during the tag-to-interrogator transmission. They operate at 134,2 kHz. An alternative operating frequency is described in Annex B.

An optional anti-collision mechanism is described in Annex D.

2 Conformance

2.1 Tag

To claim conformance with this part of ISO/IEC 18000, a tag shall be of either Type A or B.

NOTE Nothing in this part of ISO/IEC 18000 prevents a tag to be of both types, although for technical reasons, it is unlikely that such tags are ever marketed.

2.2 Interrogator

To claim conformance with this part of ISO/IEC 18000, an interrogator shall support both Types A and B.

Depending on the application, it may be configured as Type A only, Type B only or Types A and B.

When configured in Types A and B, and when in the Inventory phase, the interrogator shall alternate between Type A and Type B interrogation. See Annex C.

NOTE The rules for RFID device (tag and interrogator) conformity evaluation will be given in a future Technical Report (ISO/IEC TR 18047-2).

3 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/IEC 7816-6, *Identification cards — Integrated circuit cards — Part 6: Interindustry data elements for interchange*

ISO/IEC 15418, *Information technology — EAN/UCC Application Identifiers and Fact Data Identifiers and Maintenance*

ISO 11784, *Radio frequency identification of animals — Code structure*

ISO 11785, *Radio frequency identification of animals — Technical concept*

ISO/IEC 15961, *Information technology — Radio frequency identification for item management — Data protocol: application interface*[1]

ISO/IEC 15962, *Information technology — Radio frequency identification for item management — Data protocol: data encoding rules and logical memory functions*[1]

ISO/IEC 18000-1, *Information technology — Radio frequency identification for item management — Part 1: Reference architecture and definition of parameters to be standardized*

ISO/IEC 19762 (all parts), *Information technology — Automatic identification and data capture techniques — Harmonized vocabulary*[1]

4 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms, definitions, symbols and abbreviated terms given in ISO/IEC 19762 (all parts) and the following apply.

4.1 Terms and definitions

4.1.1
anti-collision loop
algorithm used to prepare for and handle a dialogue between interrogator and one or more tags out of several in its energizing field

4.1.2
byte
8 bits of data designated b1 to b8, from the most significant bit (MSB, b8) to the least significant bit (LSB, b1)

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1) To be published.

4.2 Symbols

All symbols are expressed with a letter, followed by a upper case letter (A or B or D when referring respectively to the Type A or Type B or Annex D, p when referring to the protocol), followed by letters and/or numbers as appropriate. The main symbols are listed below, where X represents A or B or D. Timings are expressed with an upper case T and according to above rule. Other symbols specific to A, B or D are specified in the relevant clauses.

f_{Xc} Carrier frequency of the operating field

T_{Xd0} Period of Data Symbol "0"

T_{Xd1} Period of Data Symbol "1"

T_{Xc} Period of carrier frequency ($T_{Xc} = 1/f_{Xc}$)

T_{Xcv} Code Violation Duration

4.3 Abbreviated terms

ACL Allocation class

ASK Amplitude shift keying

AFI Application family identifier

BSS Block security status

BWP Block write protection

CRC Cyclic redundancy check

CRCT Response cyclic redundancy check flag

DSFID Data storage format identifier

EOF End of frame

FDX Full duplex

HDX Half duplex

IRC IC reference code

LSB Least significant bit

MFC Manufacturer code

MSB Most significant bit

MSN Manufacturer serial number

NOB Number of blocks

NOS Number of slots

NRZ Non return to zero

RF Radio frequency

RFU Reserved for future use

SOF Start of frame

SUID Sub unique identifier (includes MFC and MSN)

UID Unique Identifier (includes ACL, MFC and MSN)

5 Physical layer

5.1 Type A (FDX)

5.1.1 Power transfer

Power transfer to the tag is accomplished by radio frequency via coupling antennas in the tag and in the interrogator. The RF operating field supplies permanently power from the interrogator to the FDX tag. For communication between interrogator and tag, the field is modulated.

5.1.2 Frequency

The carrier frequency of the RF operating field is f_{Ac} = 125 kHz.

5.1.3 Communication signal interface interrogator to tag

5.1.3.1 Modulation

Communications between interrogator and tag takes place using ASK modulation with a modulation index of 100%.

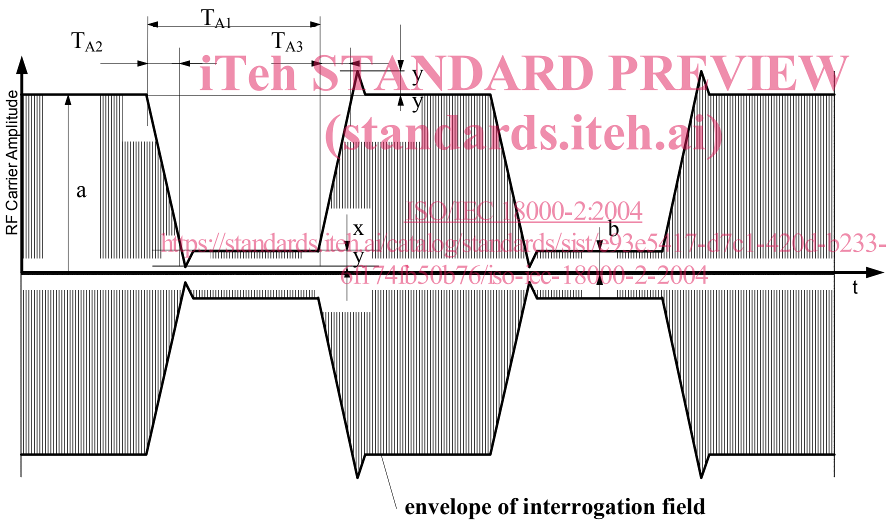

Figure 1 — Modulation details of data transmission from interrogator to tag

Table 1 — Modulation coding times

	Min	Max
m = (a-b)/(a+b)	90 %	100 %
T_{A1}	4 * T_{Ac}	10 * T_{Ac}
T_{A2}	0	0,5 * T_{A1}
T_{A3}	0	0,5 * T_{Ad0}
x	0	0,15 * a
y	0	0,05 * a

NOTE $T_{Ac} = 1/f_{Ac} \approx 8\mu s$

5.1.3.2 Data rate and data coding

The interrogator-to-tag communication uses Pulse interval encoding. The interrogator creates pulses by switching the carrier as described in Figure 1. The time between the falling edges of the pulses determines either the value of the data bit "0" and "1", a Code violation or a Stop condition.

Assuming equal distributed data bits "0" and "1", the data rate is in the range of 5,1 kbit/s.

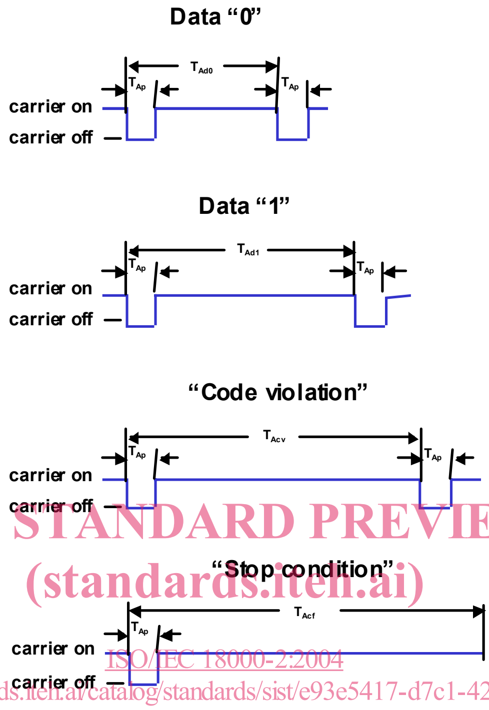

Figure 2 — Interrogator to tag: Pulse interval encoding

Table 2 — Data coding Times

Meaning	Symbol	min	max
"Carrier off" time	T_{Ap}	4 * T_{Ac}	10 * T_{Ac}
Data "0" time	T_{Ad0}	18 * T_{Ac}	22 * T_{Ac}
Data "1" time	T_{Ad1}	26 * T_{Ac}	30 * T_{Ac}
"Code violation" time	T_{Acv}	34 * T_{Ac}	38 * T_{Ac}
"Stop condition" time	T_{Asc}	$\geq$ 42 * T_{Ac}	n/a

NOTE $T_{Ac} = 1/f_{Ac} \approx 8\ \mu s$.

5.1.3.3 Start of frame pattern

The interrogator request starts always with a Start of frame pattern (SOF) for ease of synchronization. The SOF pattern consists of a data bit "0" pattern and a "Code violation" pattern.

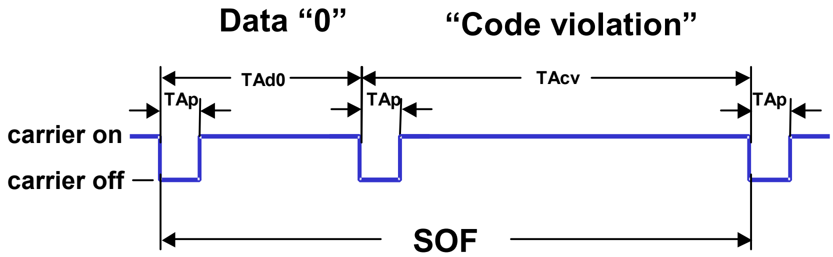

Figure 3 — Start of frame pattern

The tag shall be ready to receive a SOF from the interrogator within 1,2 ms after having sent a response to the interrogator.

The tag shall be ready to receive a SOF from the interrogator within 2,5 ms after the interrogator has established the powering field.

5.1.3.4 End of frame pattern

For slot switching during a multislot anti-collision sequence, the interrogator request is an EOF pattern. The EOF pattern is represented by a "Stop condition".

Figure 4 — End of frame pattern

5.1.4 Communication signal interface tag to interrogator

5.1.4.1 Data rate and data coding

The tag shall be capable to communicate with the interrogator via an inductive coupling, whereby the carrier is loaded with

- a 4 kbit/s Manchester coded data signal on the International Standard commands
- a 2 kbit/s dual pattern data coding on the INVENTORY command

NOTE The slower data rate used during the inventory process allows for improving the collision detection when several tags are present in the interrogator field, especially if some tags are in the near field and others in the far field.

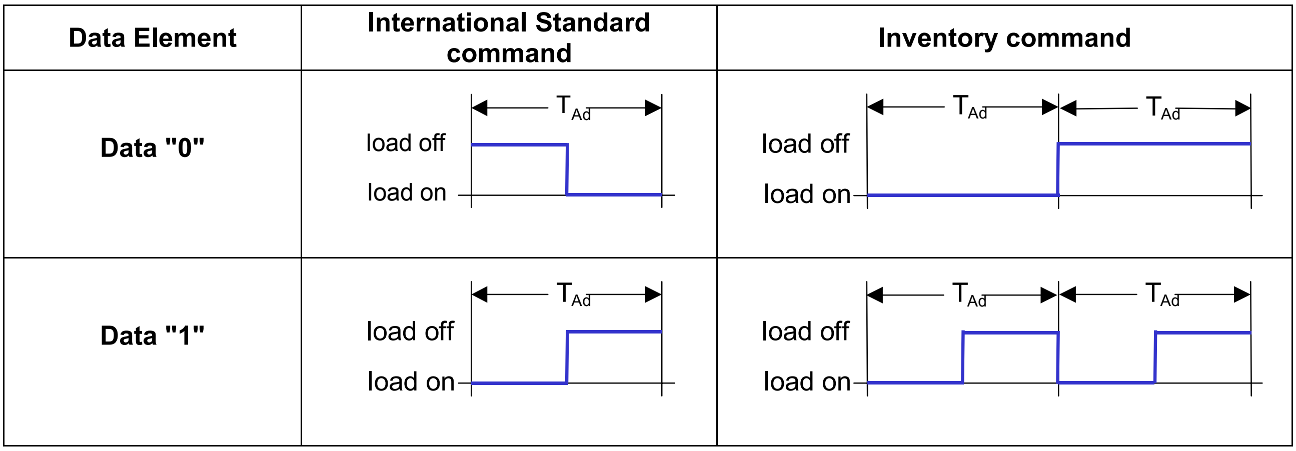

Figure 5 — Tag to interrogator: load modulation coding

5.1.4.2 Start of frame pattern

The tag response starts always with a Start of frame (SOF) pattern. The SOF pattern is a Manchester coded bit sequence of "110".

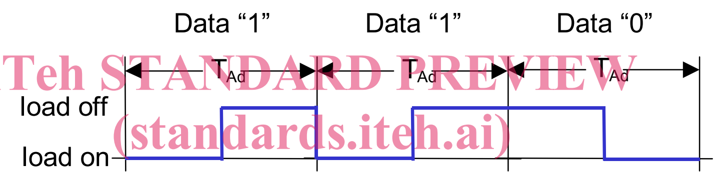

Figure 6 — Start of frame pattern

5.1.4.3 End of frame pattern

No EOF is used nor specified for the tag response.

5.2 Type B (HDX)

5.2.1 Power transfer

Power transfer to the tag is accomplished by radio frequency via coupling antennas in the tag and in the interrogator. The RF operating field supplies power at the beginning of the request from the interrogator to the HDX tag. For communication between interrogator and tag, the field is modulated.

5.2.1.1 Frequency

The carrier frequency of the RF operating field is f_{Bc} = 134,2 kHz or as described in Annex B.

5.2.2 Communication signal interface interrogator to tag

5.2.2.1 Modulation

Communication between interrogator and tag takes place using ASK modulation with a modulation index of 100%.