INTERNATIONAL STANDARD

ISO/IEC 18000-2

Second edition
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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 de communications d'une interface d'air à moins de 135 kHz

Reference number
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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*.

This second edition cancels and replaces the first edition (ISO/IEC 18000-2:2004), which has been technically revised.

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

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.

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

The holders of these patent rights have assured 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. Information may be obtained from the following companies.

Patent number	Patent title	Patent holder	Contact	Affected sub clause
		ATMEL Germany GmbH	Leo Merken, Director of Intellectual Property 2325 Orchard Parkway, San Jose, CA, 95131 USA Phone 408-436-4251 Fax 408-487-2615 Email leo.merken@atmel.com	
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US 6 177 858 Application 96 402556.3-Patent EP 0 777 194 CA 2 191 787 CA 2 191 788 US 5 923 251 Application 96 402554.8 Patent EP 0 777 192 US 5 808 550 Appication 96 402555.5- Patent EP 0 777 193		Winstead Assets Ltd	Craig Cook, director 12, rue des Petits Ruisseaux, 91370 Verrières le Buisson, France Phone +33(0) 169 752 170 Fax +33(0) 160 110 031 contact@spacecode-rfid.com	

CA 2 191 794 Application 90 909459.1-Patent EP 0 476 026 US 5426423 CA 2058 947				
EP 0640939,US 5430447,DE P69428309 EP831618, US5929801 (claims 1-15 and corresponding claims of other patents based on this patent) US 5793324 US 5053774 excluding claims 14-17 and 20 (and corresponding claims of other patents based on this patent)	Protection Against Manipulation of Batteryless Read/Write Transponders Method for Repeating Interrogations Until Failing to Receive Unintelligible Responses to Identify Plurality of Transponders by an Interrogator Transponder Signal Collision Avoidance System Transponder Arrangement	Texas Instruments Inc	Robby Holland Licensing Manager, Law Department P.o. Box 660199, MS 3999 Dallas, TX 75266-0199 Phone 1-972-917-4367 Fax 1-972-917-4418 Email r-holland3@ti.com	

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. The purpose of this part of ISO/IEC 18000 is to provide a common technical specification for RFID devices that can be used by ISO committees developing RFID application standards. This part of ISO/IEC 18000 is intended to allow for compatibility and to encourage inter-operability of products in the international marketplace. This part of ISO/IEC 18000 defines the physical layer used for communication between the interrogator and the tag and further defines the communications protocol used in the air interface.

Two types of tag are defined by this part of ISO/IEC 18000: Type A and Type B, which differ only by their physical layer. Both support the same inventory (anti-collision) and protocol.

Type A tags are permanently powered by the interrogator, including during the tag-to-interrogator transmission, and operate at 125 kHz.

Type B tags are powered by the interrogator, except during the tag-to-interrogator transmission, and operate at 125 kHz or 134,2 kHz.

2 Conformance

In order to claim conformance, it is necessary to comply to all of the relevant clauses of this specification, except those marked ‘optional’. It is also necessary to operate within the local national radio regulations (which may require further restrictions).

The rules for RFID device conformity evaluation are defined in ISO/IEC TR 18047-2.

The tag shall be of either Type A or B.

NOTE Nothing in this International Standard prevents a tag from being of both types, although for technical reasons, it is unlikely that such tags are ever marketed.

The interrogator shall support both Types A and B.

The interrogator may be configured as Type A only, Type B only or Types A and B.

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

2.1 RF emissions general population

Device manufacturers claiming conformance to this part of ISO/IEC 18000 shall certify that RF emissions do not exceed the maximum permitted exposure limits recommended by either IEEE C95.1:2005 or ICNIRP according to IEC 62369-1. If a device manufacturer is unsure as to which recommendation is to be cited for compliance, the manufacturer shall certify to ICNIRP limits.

2.2 RF emissions and susceptibility health care setting

Device manufacturers claiming conformance to this part of ISO/IEC 18000 shall certify that RF emissions and susceptibility comply with IEC 60601-1-2.

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.

IEC 62369-1, *Evaluation of human exposure to electromagnetic fields from short range devices (SRDs) in various applications over the frequency range 0 GHz to 300 GHz — Part 1: Fields produced by devices used for electronic article surveillance, radio frequency identification and similar systems*

IEC 60601-1-2, *Medical electrical equipment — Part 1-2: General requirements for basic safety and essential performance — Collateral standard: Electromagnetic compatibility — Requirements and tests*

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

4 Terms and definitions

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

4.1
anti-collision sequence
algorithm used to prepare for and handle a dialogue between interrogator and one or more tags out of several in its energizing field

4.2
bit rate
number of bits transmitted per second

4.3
byte
8 bits of data designated b1 to b8, from the most significant bit (MSB, b8) to the least significant bit (LSB, b1)

4.4
carrier off time
time interval when the interrogation field is switched off

4.5
charge up time
time to charge the capacitor of the HDX tag

4.6
commands
interrogator to tag communication

4.7
differential bi-phase encoding
method of encoding in which data bit 0 is represented by a mid-bit transition, data bit 1 is represented by no transition, and in which there is always a transition in between two bits

4.8
down-link
communication process from the interrogator to the tag

4.9
encoding
one-to-one relationship between basic information elements and modulation patterns

4.10
FDX
communication protocol for Type A or FDX tags

4.11
frequency shift keying
form of frequency modulation in which binary information is superimposed onto an electromagnetic field carrier by shifting between discrete frequencies of the field

4.12
full duplex
communication protocol in which information is exchanged while the interrogator transmits the interrogation field

4.13
half duplex
communication protocol in which information is exchanged after the interrogator has stopped transmitting the interrogation field (sequential method)

4.14
HDX
communication protocol for Type B or HDX tags

4.15
interrogation field
magnetic field generated by an interrogator to activate a tag and to transfer data to an advanced tag

4.16
interrogation frequency
frequency of the magnetic field generated by the interrogator

4.17
interrogation period
time duration the magnetic field is present

4.18
interrogator request
bit pattern transmitted to the advanced tag to modify the tag status or to read and write information

4.19
manchester encoding
method of encoding in which data bit 0 is represented by a positive mid-bit transition and data bit 1 is represented by a negative mid-bit transition

4.20
modulation
method of superimposing information onto an interrogation field by means of varying a specific parameter of the field

4.21
non-return to zero encoding
method of encoding in which data bit 1 is a high signal and data bit 0 is a low signal

4.22
pulse interval encoding
method of data encoding in which the transmitted information is represented by the time between the falling edges of fixed length pulses

NOTE The number of received carrier cycles defines data bit values or other code conditions.

4.23
interrogator
device used to communicate with a tag

4.24
tag
electronic device which is activated by the interrogator and communicates with it

4.25
unique item identifier
identification that uniquely identifies a specific entity during its life

5 Symbols and abbreviated terms

5.1 Symbols

NOTE All symbols are expressed with a letter, followed by an upper case letter (A or B or C when referring respectively to Type A or Type B or Annex C, 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 C. Timings are expressed with an upper case T and according to the above rule. Other symbols specific to A, B or C 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

T_{Apx} Tag wait time before transmitting response after end of frame

T_{Ad} Modulation Coding Time where $T_{Ad} = 32 / f_{Ac}$

etu elementary time unit (1 etu = 16/62,5 kHz)

5.2 Abbreviated terms

AFI application family identifier

ASK amplitude shift keying

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 (pattern)

FDX full duplex – Type A tag

HDX half duplex – Type B tag

ICR IC reference number

kbps unit for transmission speed: 1000 bit/s or 1000 Baud

LSB least significant bit

MFC manufacturer code

MSB most significant bit

MSN manufacturer serial number

NOB number of blocks-1

NOS number of slots (in the anti-collision mode)

NRZ non return to zero

RF radio frequency

RFID radio frequency identification

RFU reserved for future use

SOF start of frame (pattern)

UII unique item identifier (includes ICR, MFC and MSN)

UMS user data memory structure

6 Physical layer

6.1 Type A (FDX)

6.1.1 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.

6.1.2 Frequency

The carrier frequency of the RF operating field is f_{Ac} = 125 ±0,1 kHz.

6.1.3 Communication signal interface interrogator to tag

6.1.3.1 Modulation

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

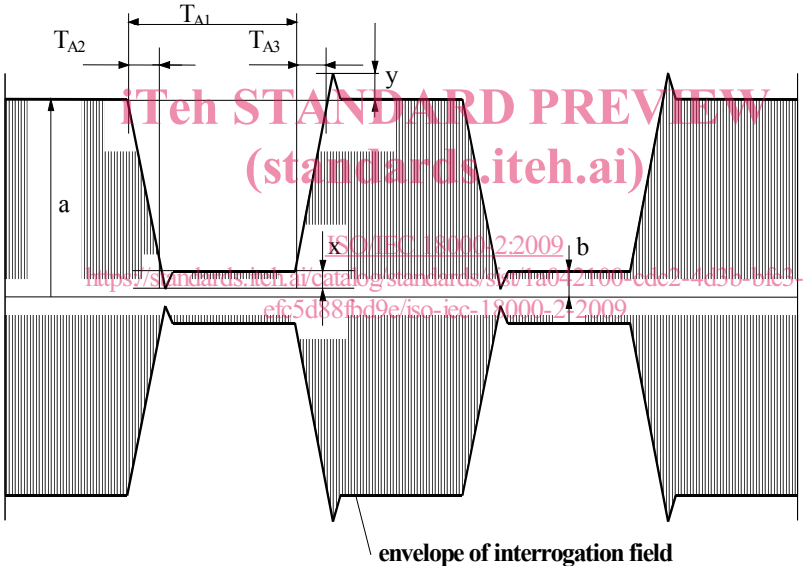

Figure 1 — Modulation details of data transmission from interrogator to tag

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	0,05 * a
y	0	0,05 * a

Notes:

$T_{A1}+T_{A3}+3*T_c < T_{Ad0}$

$T_{Ac} = 1/f_{Ac}$ = 8µs

6.1.3.2 Data rate and data coding

The interrogator-to-tag communication uses Pulse Interval Encoding (Figure 2). 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.(note: with equal distributed data bits "0" and "1", the data rate is in the range of 5,1 kbps). Data coding Times are shown in Table 2.

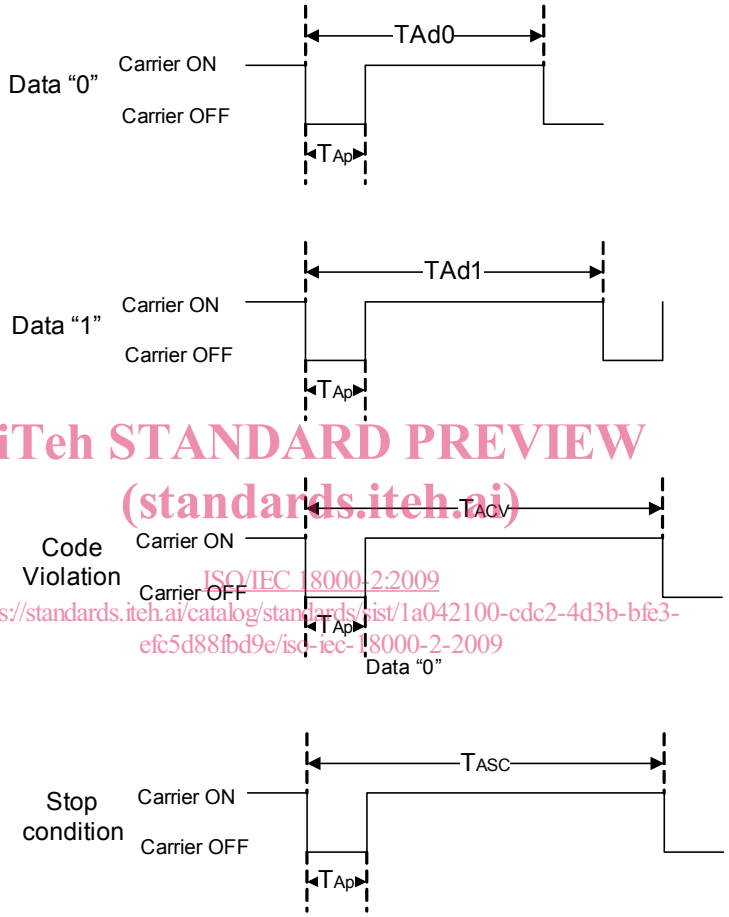

Figure 2 — Interrogator to tag: Pulse interval encoding

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}	≥ 42 * T_{Ac}	n/a

NOTE $T_{Ac}=1/f_{Ac}$ = 8 µs.