INTERNATIONAL STANDARD

ISO/IEC 18000-3

Third edition
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Information technology — Radio frequency identification for item management —

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

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

Partie 3: Paramètres de communications d'une interface d'air à 13,56 MHz

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 18000-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

This third edition cancels and replaces the second edition (ISO/IEC 18000-3:2008), 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

ISO/IEC 18000 has been developed in order to

— provide a framework to define common communications protocols for Internationally useable frequencies for radio frequency identification (RFID), and, where possible, to determine the use of the same protocols for all frequencies such that the problems of migrating from one to another are diminished;

— minimise software and implementation costs;

— enable system management and control and information exchange to be common as far as is possible.

This part of ISO/IEC 18000 was prepared in accordance with the requirements determined in ISO/IEC 18000-1.

ISO/IEC 18000-1 provides explanation of the concepts behind this part of ISO/IEC 18000.

This part of ISO/IEC 18000 has 3 MODES of operation, intended to address different applications. The detailed technical differences between the MODES are shown in the parameter tables.

This part of ISO/IEC 18000 relates solely to systems operating at 13,56 MHz.

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.

The 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 licenses 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 the ISO and IEC. Information may be obtained from the following companies.

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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. The latest IP submissions to ISO can be found at:

http://www.iso.org/patents

Information technology — Radio frequency identification for item management —

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

1 Scope

This part of ISO/IEC 18000 provides physical layer, collision management system and protocol values for RFID systems for item identification operating at 13,56 MHz in accordance with the requirements of ISO/IEC 18000-1.

This part of ISO/IEC 18000 provides definitions for systems for each MODE determined in Clause 6 below.

This part of ISO/IEC 18000 defines three non-interfering MODES.

— The MODES are not interoperable.

— The MODES, whilst not interoperable, are non-interfering.

2 Conformance

In order to claim conformance with this part of ISO/IEC 18000, it is necessary to comply with all of the relevant clauses of this part of ISO/IEC 18000 except those marked “optional”. It is also necessary to operate within the local national radio regulations (which may require further restrictions).

Relevant conformance test methods are defined in ISO/IEC TR 18047-3.

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 13239, *Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures*

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

ISO/IEC 15693 (all parts), *Identification cards — Contactless integrated circuit cards — Vicinity cards*

ISO/IEC 15961, *Information technology — Radio frequency identification (RFID) for item management — Data protocol: application interface*

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

ISO/IEC 15963, *Information technology — Radio frequency identification for item management — Unique identification for RF tags*

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 TR 18046, *Information technology — Automatic identification and data capture techniques — Radio frequency identification device performance test methods*

ISO/IEC TR 18047-3, *Information technology — Radio frequency identification device conformance test methods — Part 3: Test methods for air interface communications at 13,56 MHz*

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

EPCglobal *Tag Data Standards (Version 1.3 and above)*

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
cover-coded text
information that is cover-coded

4.2
cover-coding
method by which an interrogator obscures information that it is transmitting to a tag

4.3
full-duplex communications
communication of data while the transceiver transmits the activation field

4.4
half-duplex communications
data transmission in either direction, one direction at a time

4.5
handle
16-bit random number (RN16) that is used to authenticate tags in the open or secured state

4.6
PacketCRC
16-bit cyclic-redundancy check (CRC) code that a tag with nonzero-valued XPC indicator (XI) dynamically calculates over its protocol control (PC), extended protocol control (XPC), and unique item identifier (UII), and provides by loadmodulation during inventory

cf. **StoredCRC**

4.7
PacketPC
protocol-control information that a tag with nonzero-valued XPC indicator dynamically calculates and provides by loadmodulation during inventory

cf. **StoredPC**

4.8
phase jitter modulation
PJM
modulation technique that transmits data as very small phase changes in the powering field

4.9
physical layer
data coding and modulation waveforms used in interrogator-to-tag and tag-to-interrogator communication

4.10
pivot
average length of an interrogator-to-tag data symbol

NOTE See 6.3.3.3.1.2.8.

4.11
plaintext
information that is not cover-coded

4.12
recommissioning
significant altering of a tag's functionality and/or memory contents, as commanded by an interrogator

NOTE Recommissioning is typically in response to a change in the tag's usage model or purpose.

4.13
StoredCRC
16-bit cyclic-redundancy check (CRC) code that a tag calculates over its StoredPC and unique item identifier (UII) and stores in UII memory at power-up, and can backscatter during inventory

cf. **PacketCRC**

4.14
StoredPC
protocol-control information stored in unique item identifier (UII) memory that a tag with zero-valued XPC indicator provides by loadmodulation during inventory

cf. **PacketPC**

4.15
Tari
reference time interval for a data-0 in interrogator-to-tag communication

5 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO/IEC 18000-1, ISO/IEC 19762 and the following apply.

5.1 Symbols

DR	ASK Method: divide ratio PJM Method: bit 0 of the reply channel selection
F_c	carrier frequency
M(ASK)	tag reply modulation type
M_h	RF signal envelope ripple (overshoot)
M_l	RF signal envelope ripple (undershoot)
M(PJM)	bit 1 and bit 2 of the reply channel selection

M_s	RF signal level when OFF
Q	slot-count parameter (parameter that an interrogator uses to regulate the probability of tag response)
R	interrogator (also sometimes called reader)
R=>T	interrogator-to-tag
RTcal	interrogator-to-tag calibration symbol
T	tag
T_1	time from interrogator transmission to tag response
T_2	time from tag response to interrogator transmission
T_3	time an interrogator waits, after T_1, before it issues another command
T_4	minimum time between interrogator commands
T_f or $T_{f,10\text{-}90\%}$	RF signal envelope fall time
T_{pri}	link pulse-repetition interval (T_{pri} = 1/LF)
T_r or $T_{r,10\text{-}90\%}$	RF signal envelope rise time
TRext	ASK Method: chooses whether the T=R preamble is prefixed with a pilot tone PJM Method: bit 3 of the reply channel selection
T_s	RF signal settling time
T=>R	tag-to-interrogator
TRcal	tag-to-interrogator calibration symbol
X_{fp}	floating-point value
$xxxx_2$	binary notation
$xxxx_h$	hexadecimal notation
≈	MODE 1 - the value is a rounded value (e.g. ≈ 75,52 µs)

5.2 Abbreviated terms

ARIB	Association of Radio Industries and Businesses
AFI	application family identifier
AM	amplitude modulation
ASK	amplitude shift keying
BPSK	binary phase shift keying
CEPT	Conference of European Posts and Telecommunications
CFR	Code of Federal Regulations
CRC	cyclic redundancy check

NOTE: This specification uses two CRC algorithms: CRC-5 (5-bit CRC) and CRC-16 (16-bit CRC) and three different logical CRC-16s: StoredCRC, PacketCRC and CRC-16c.
For the UII bank word 0 or ACK the following two logical CRC-16s are used:
- StoredCRC = CRC-16 calculated at startup and mapped to UII word 0
- PacketCRC = CRC-16 calculated over the response data of the tag in case of the ACK command

For all other cases and commands the following logical CRC-16 is used:
- CRC-16c = CRC-16 calculated over the response data of the tag

CW	continuous wave
dBch	decibels referenced to the integrated power in the reference channel
DSB	double sideband
DSB-ASK	double-sideband amplitude shift keying

DR	divide ratio
ERC	European Radiocommunications Committee
ERM	electromagnetic compatibility and radio spectrum matters
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FT	frequency tolerance
ITF	interrogator talks first (reader talks first)
LF	link frequency (LF = $1/T_{pri}$)
MFM	modified frequency modulation
N/A	not applicable
NSI	numbering system identifier
PIE	pulse-interval encoding
PJM	phase jitter modulation
ppm	parts-per-million
PC	protocol control
RF	radio frequency
RFU	reserved for future use
RN16	16-bit random or pseudo-random number
RNG	random or pseudo-random number generator
SRD	short range devices
TDM	time-division multiplexing or time-division multiplexed (as appropriate)
TID	tag identification or tag identifier, depending on context
UII	unique item identifier
UMI	user-memory indicator
XI	XPC indicator
XPC	extended protocol control
XPC_W1	XPC word 1
XPC_W2	XPC word 2
XTID	extended TID indicator (see version 1.3 and above of the EPCglobal Tag Data Standards)

5.3 Notation

Mode 3 of this specification uses the following notational conventions:

- States and flags are denoted in bold. Example: **ready**.
- Commands are denoted in italics. Variables are also denoted in italics. Where there might be confusion between commands and variables, this specification shall make an explicit statement. Example: *BeginRound*.
- Procedures are shown as ***<u>italics underline</u>***
- Command parameters are underlined. Example: <u>Pointer</u>.
- For logical negation, labels are preceded by '~'. Example: If **flag** is true, then **~flag** is false.
- The symbol, R=>T, refers to commands or communications signal air interface from an interrogator to a tag (reader-to-tag).