
**Information technology — Radio
frequency identification for item
management —**

**Part 61:
Parameters for air interface
communications at 860 MHz to 960 MHz
Type A**

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

*Partie 61: Paramètres de communications d'une interface radio entre
860 MHz et 960 MHz, Type A*

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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 18000-61 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 General
- Part 61: Parameters for air interface communications at 860 MHz to 960 MHz Type A
- Part 62: Parameters for air interface communications at 860 MHz to 960 MHz Type B
- Part 63: Parameters for air interface communications at 860 MHz to 960 MHz Type C
- Part 64: Parameters for air interface communications at 860 MHz to 960 MHz Type D
- Part 7: Parameters for active air interface communications at 433 MHz

Introduction

This part of ISO/IEC 18000 describes a passive backscatter radio frequency identification (RFID) system that supports the following system capabilities:

- identification and communication with multiple tags in the field;
- selection of a subgroup of tags for identification or with which to communicate;
- reading from and writing to or rewriting data many times to individual tags;
- user-controlled permanently lockable memory;
- data integrity protection;
- Interrogator-to-tag communications link with error detection;
- tag-to-Interrogator communications link with error detection;
- support for both passive back-scatter tags with or without batteries.

This part of ISO/IEC 18000 specifies the physical and logical requirements for a passive-backscatter, RFID system operating in the 860 MHz to 960 MHz frequency range. The system comprises Interrogators, also known as readers, and tags, also known as labels.

An Interrogator transmits information to a tag by modulating an RF signal in the 860 MHz to 960 MHz frequency range. The tag receives both information and operating energy from this RF signal. Passive tags are those which receive all of their operating energy from the Interrogator's RF waveform. If tags maintain a battery then they may operate using some passive principles; however, they do not necessarily get all their operating energy from the Interrogator's RF waveform.

An Interrogator receives information from a tag by transmitting a continuous-wave (CW) RF signal to the tag; the tag responds by modulating the reflection coefficient of its antenna, thereby backscattering an information signal to the Interrogator. The system is Interrogator-Talks-First (ITF), meaning that a tag modulates its antenna reflection coefficient with an information signal only after being directed to do so by an Interrogator.

Interrogators and tags are not required to talk simultaneously; rather, communications are half-duplex, meaning that Interrogators talk and tags listen, or vice versa.

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.

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 on the declared patents may be obtained from:

Contact details	
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Information technology — Radio frequency identification for item management —

Part 61:

Parameters for air interface communications at 860 MHz to 960 MHz Type A

1 Scope

This part of ISO/IEC 18000 defines the air interface for radio frequency identification (RFID) devices operating in the 860 MHz to 960 MHz Industrial, Scientific, and Medical (ISM) band used in item management applications. It provides 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 for the growing RFID market in the international marketplace. It defines the forward and return link parameters for technical attributes including, but not limited to, operating frequency, operating channel accuracy, occupied channel bandwidth, maximum effective isotropic radiated power (EIRP), spurious emissions, modulation, duty cycle, data coding, bit rate, bit rate accuracy, bit transmission order, and, where appropriate, operating channels, frequency hop rate, hop sequence, spreading sequence, and chip rate. It further defines the communications protocol used in the air interface.

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This part of ISO/IEC 18000 specifies the physical and logical requirements for a passive-backscatter, Interrogator-Talks-First (ITF) systems. The system comprises Interrogators, also known as readers, and tags, also known as labels. An Interrogator receives information from a tag by transmitting a continuous-wave (CW) RF signal to the tag; the tag responds by modulating the reflection coefficient of its antenna, thereby backscattering an information signal to the Interrogator. The system is ITF, meaning that a tag modulates its antenna reflection coefficient with an information signal only after being directed to do so by an Interrogator.

In detail, this part of ISO/IEC 18000 contains Type A.

Type A is ITF. Type A uses Pulse-Interval Encoding (PIE) in the forward link and an adaptive ALOHA collision-arbitration algorithm.

This part of ISO/IEC 18000 specifies

- physical interactions (the signalling layer of the communication link) between Interrogators and tags,
- Interrogator and tag operating procedures and commands,
- the collision arbitration scheme used to identify a specific tag in a multiple-tag environment.

2 Conformance

2.1 Claiming conformance

To claim conformance with this part of ISO/IEC 18000, an Interrogator or tag shall comply with all relevant clauses of this part of ISO/IEC 18000, except those marked as "optional". The Interrogator or tag shall also operate within local radio regulations, which can further restrict operation.

Relevant conformance test methods are provided in ISO/IEC TR 18047-6.

Conformance can also require a license from the owner of any intellectual property utilized by said device.

2.2 Interrogator conformance and obligations

To conform to this part of ISO/IEC 18000, an Interrogator shall

- support Type A
- implement the mandatory commands defined in this part of ISO/IEC 18000;
- modulate/transmit and receive/demodulate a sufficient set of the electrical signals defined in the signalling layer of this part of ISO/IEC 18000 to communicate with conformant tags; and
- operate within the applicable local regulations.

To conform to this part of ISO/IEC 18000, an Interrogator may

- implement any subset of the optional commands defined in this part of ISO/IEC 18000, and
- implement any proprietary and/or custom commands in conformance with this part of ISO/IEC 18000.

To conform to this part of ISO/IEC 18000, the Interrogator shall not

- implement any command that conflicts with this part of ISO/IEC 18000 or any of the parts 62, 63 and 64, or
- require the use of an optional, proprietary, or custom command to meet the requirements of this part of ISO/IEC 18000.

2.3 Tag conformance and obligations

To conform to this part of ISO/IEC 18000, a tag shall:

- support Type A;
- operate over the frequency range from 860 MHz to 960 MHz, inclusive;
- implement the mandatory commands defined in this part of ISO/IEC 18000 for the supported types;
- modulate a backscatter signal only after receiving the requisite command from an Interrogator; and
- conform to local radio regulations.

To conform to this part of ISO/IEC 18000, a tag may

- implement any subset of the optional commands defined in this part of ISO/IEC 18000; and
- implement any proprietary and/or custom commands as defined in 6.9 and 6.10.

To conform to this part of ISO/IEC 18000, a tag shall not:

- implement any command that conflicts with this part of ISO/IEC 18000 or any of the parts 62, 63 and 64;
- require the use of an optional, proprietary, or custom command to meet the requirements of this part of ISO/IEC 18000; or
- modulate a backscatter signal unless commanded to do so by an Interrogator using the signalling layer defined in this part of ISO/IEC 18000.

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

4 Terms, definitions, symbols and abbreviated terms

4.1 Terms and definitions

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

4.1.1

collision arbitration

algorithm used to prepare for and handle a dialogue between an Interrogator and a tag

4.1.2

physical layer

data coding and modulation waveforms used in Interrogator-to-tag and tag-to-Interrogator signalling

4.1.3

battery assistance

battery support for radio frequency communication

4.1.4

battery assisted mode

working mode of battery-assisted tags with non-empty battery

4.1.5

passive mode

working mode of passive tags or battery assisted tags with battery drained below a manufacturer-specific threshold

4.2 Symbols

BAP	battery assisted passive
BLF	backscatter link frequency
Cht	carrier high-level tolerance
Cl _t	carrier low-level tolerance
D	modulation depth of data coding pulse
T _{aq}	quiet time
T _{apf}	pulse fall time
T _{apr}	pulse rise time
T _{apw}	pulse width
T _{ari}	reference time interval for a data-0 in Interrogator-to-tag signalling
T _{cf}	carrier fall time
T _{cr}	carrier rise time
T _{cs}	carrier steady state time
T _{f_{hf}}	carrier FHSS fall time
T _{f_{hr}}	carrier FHSS rise time
T _{f_{hs}}	carrier FHSS steady time
T _{rlb}	return link bit time
xxxx ₂	binary notation
xxxx _h	hexadecimal notation

4.3 Abbreviated terms

AFI	application family identifier
ASF	application sub family
BAP	battery assisted passive
CRC	cyclic redundancy check
CRC-16	sixteen bit CRC
CRC-5	five bit CRC
CW	continuous wave

DSFID	data storage format identifier
DSSS	direct sequence spread spectrum
EOF	end of frame
FCC	Federal Communications Commission
FHSS	frequency hopping spread spectrum
ITF	Interrogator-talks-first

NOTE The common usage is RTF (Reader-talks-first) but the more precise term is ITF, which is used throughout this part of ISO/IEC 18000.

LSB	least significant bit
MSB	most significant bit
PIE	pulse interval encoding
ppm	parts per million
RFU	reserved for future use
SOF	start of frame
SUID	sub unique identifier
TEL	tag excitation level

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5 Overview

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5.1 Parameter tables

Table 1, Table 2, Table 3 and Table 4 contain the parameters for Type A, in accordance with ISO/IEC 18000-1. Detailed description of the operating modes and parameters are specified in the subsequent clauses.

Table 1 — Interrogator to tag link parameters

Ref.	Parameter Name	Description
Int:1	Operating Frequency Range	860 MHz – 960 MHz, as required by the local regulations
Int:1a	Default Operating Frequency	In accordance with the local radio regulations.
Int:1b	Operating Channels (spread-spectrum systems)	In accordance with the local radio regulations.
Int:1c	Operating Frequency Accuracy	In accordance with the local radio regulations.
Int:1d	Frequency Hop Rate (frequency-hopping [FHSS] systems)	In accordance with the local radio regulations.
Int:1e	Frequency Hop Sequence (frequency-hopping [FHSS] systems)	In accordance with the local radio regulations.
Int:2	Occupied Channel Bandwidth	In accordance with the local radio regulations.
Int:2a	Minimum Receiver Bandwidth	In accordance with the local radio regulations.
Int:3	Interrogator Transmit Maximum EIRP	In accordance with the local radio regulations.

Ref.	Parameter Name	Description
Int:4	Interrogator Transmit Spurious Emissions	In accordance with the local radio regulations.
Int:4a	Interrogator Transmit Spurious Emissions, In-Band (spread-spectrum systems)	In accordance with the local radio regulations.
Int:4b	Interrogator Transmit Spurious Emissions, Out-of-Band	In accordance with the local radio regulations.
Int:5	Interrogator Transmitter Spectrum Mask	In accordance with the local radio regulations.
Int:6	Timing	See below Int: 6x.
Int:6a	Transmit-to-Receive Turn-Around Time	The Interrogator transmit/receive settling time shall not exceed 85 μ s.
Int:6b	Receive-to-Transmit Turn-Around Time	As determined by the communication protocol – refer Tag: 6a.
Int:6c	Dwell Time or Interrogator Transmit Power-On Ramp	1500 μ s, maximum settling time
Int:6d	Decay Time or Interrogator Transmit Power-Down Ramp	Maximum 1 ms.
Int:7	Modulation	Amplitude Modulation.
Int:7a	Spreading Sequence (direct-sequence [DSSS] systems)	Not applicable.
Int:7b	Chip Rate (spread-spectrum systems)	Not applicable.
Int:7c	Chip Rate Accuracy (spread-spectrum systems)	Not applicable.
Int:7d	Modulation Depth	Nominal 30 % to 100 %. See Table 11 and clause 7.1.1.
Int:7e	Duty Cycle	In accordance with the local regulations.
Int:7f	FM Deviation	Not applicable.
Int:8	Data Coding	Pulse Interval Encoding
Int:9	Bit Rate	33 kbit/s as constrained by the local radio regulations
Int:9a	Bit Rate Accuracy	100 ppm
Int:10	Interrogator Transmit Modulation Accuracy	Not applicable.
Int:11	Preamble	Has no preamble
Int:11a	Preamble Length	Not applicable.
Int:11b	Preamble Waveform(s)	Not applicable.
Int:11c	Bit Sync Sequence	Not applicable.
Int:11d	Frame Sync Sequence	Not applicable.
Int:12	Scrambling (spread-spectrum systems)	Not Applicable.
Int:13	Bit Transmission Order	MSB is transmitted first
Int:14	Wake-up process	Presence of an appropriate RF signal at the tag followed by a wake-up command as required by the tag type. See relevant clauses.
Int:15	Polarization	Interrogator dependent. Not defined in this part of ISO/IEC 18000.

Table 2 — Tag to Interrogator link parameters

Ref.	Parameter Name	Description
Tag:1	Operating Frequency Range	860 MHz – 960 MHz, inclusive
Tag:1a	Default Operating Frequency	The tag shall respond to an Interrogator signal within the frequency range specified in Tag: 1.
Tag:1b	Operating Channels (spread-spectrum systems)	The tag shall respond to an Interrogator signal within the frequency range specified in Tag: 1.
Tag:1c	Operating Frequency Accuracy	The tag shall respond to an Interrogator signal within the frequency range specified in Tag: 1.
Tag:1d	Frequency Hop Rate (frequency-hopping [FHSS] systems)	Not applicable.
Tag:1e	Frequency Hop Sequence (frequency-hopping [FHSS] systems)	Not applicable.
Tag:2	Occupied Channel Bandwidth	In accordance with the local regulations
Tag:3	Transmit Maximum EIRP	In accordance with the local regulations
Tag:4	Transmit Spurious Emissions	In accordance with the local regulations
Tag:4a	Transmit Spurious Emissions, In-Band (spread spectrum systems)	In accordance with the local regulations
Tag:4b	Transmit Spurious Emissions, Out-of-Band	In accordance with the local regulations
Tag:5	Transmit Spectrum Mask	In accordance with the local regulations
Tag:6a	Transmit-to-Receive Turn-Around Time	The tag shall open its receive command window within 2 bit periods of the end of its response.
Tag:6b	Receive-to-Transmit Turn-Around Time	Range from 150 to 1150 μ s (see clause 7.5.3 and Table 28)
Tag:6c	Dwell Time or Transmit Power-On Ramp	Not applicable.
Tag:6d	Decay Time or Transmit Power-Down Ramp	Not applicable.
Tag:7	Modulation	Bi-state amplitude modulated backscatter.
Tag:7a	Spreading Sequence (direct sequence [DSSS] systems)	Not applicable.
Tag:7b	Chip Rate (spread spectrum systems)	Not applicable.
Tag:7c	Chip Rate Accuracy (spread spectrum systems)	Not applicable.
Tag:7d	On-Off Ratio	The tag Delta RCS (Varying Radar Cross Sectional area) affects system performance. A typical value is greater than 0.005m ² .
Tag:7e	Subcarrier Frequency	Not applicable.
Tag:7f	Subcarrier Frequency Accuracy	Not applicable.
Tag:7g	Subcarrier Modulation	Not applicable.
Tag:7h	Duty Cycle	The tag shall transmit its response when commanded to do so by the Interrogator.
Tag:7i	FM Deviation	Not applicable.
Tag:8	Data Coding	Bi-phase space (FM0)