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Information technology — Radio frequency identification for item management —

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

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

Partie 7: Paramètres de communications actives d'une interface d'air à 433 MHz

[Revision of third edition (ISO/IEC 18000-7:2009)]

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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.

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

ISO/IEC 18000-7 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, Automatic identification and data capture techniques.

This fourth edition cancels and replaces the second edition which has been technically revised and extended.

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 is intended to address radio frequency identification (RFID) devices operating in the 433 MHz frequency band, providing an air interface implementation for wireless, non-contact information system equipment for item management applications. Typical applications operate at ranges greater than one metre.

The RFID system includes a host system and RFID equipment (interrogator and tags). The host system runs an application program, which controls interfaces with the RFID equipment. The RFID equipment is composed of two principal components: tags and interrogators. The tag is intended for attachment to an item, which a user wishes to manage. It is capable of storing a tag serial number and other data regarding the tag or item and of communicating this information to the interrogator. The interrogator is a device, which communicates to tags in its RF communication range. The interrogator controls the protocol, reads information from the tag, directs the tag to store data in some cases, and ensures message delivery and validity. This system uses an active tag.

RFID systems defined by this part of ISO/IEC 18000 provide the following minimum features:

— identify tag in range;

— read data;

— write data or handle read-only systems gracefully;

— selection by group or address;

— graceful handling of multiple tags in the field of view;

— error detection.

This part of ISO/IEC 18000 consists of two modes, Base and Extended. The following simplified differences should be drawn between the two modes:

— Base Mode defined in clause 6 is backwards compatible and includes all features described in the last revision of this part of ISO/IEC 18000 (ISO/IEC 18000-7: 2009) with the addition of security features as described in clause 6.7.

— Extended Mode defined in clause 7 is new to this part of ISO/IEC 18000. Extended Mode presents a new communication protocol stack (PHY, MAC and Application layers) and provides an extended feature set that addresses more complex user and deployment requirements.

Substantive differences exist between Base Mode and Extended Mode across all layers of the communication protocol (PHY, MAC and Application). However, both modes may co-exist in any given physical environment.

All parties are directed to consider carefully their use model before determining the most appropriate mode.

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:
(EDITORIAL NOTE: The list will be filled in a later ballot stage)

Contact details
Patent Holder:
Legal Name
Contact for license application:
Name & Department
Address
Address
Tel.
Fax
E-mail
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The latest information on IP that may be applicable to this part of ISO/IEC 18000 can be found at www.iso.org/patents.

Information technology — Radio frequency identification for item management — Part 7: Parameters for active air interface communications at 433 MHz

1 Scope

This part of ISO/IEC 18000 defines the air interface for radio frequency identification (RFID) devices operating as an active RF tag in the 433 MHz band used in item management applications. It provides a common technical specification for RFID devices that can be used by ISO technical 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. This part of ISO/IEC 18000 defines the forward and return link parameters for technical attributes including, but not limited to, operating frequency, operating channel accuracy, occupied channel bandwidth, maximum power, 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. This part of ISO/IEC 18000 further defines the communications protocol used in the air interface.

2 Conformance

The rules for evaluation of RFID device conformity to this part of ISO/IEC 18000 are defined in ISO/IEC TR 18047-7.

2.1 RF emissions general population

Device manufacturers claiming conformance to this part of ISO/IEC 18000 shall declare on their own responsibility 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 which recommendation is to be cited for compliance, the manufacturer shall declare on their own responsibility to ICNIRP limits.

2.2 RF emissions and susceptibility health care setting

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

2.3 Command structure and extensibility

This part of ISO/IEC 18000 includes a definition of the structure of command codes between an interrogator and a tag and indicates how many positions are available for future extensions.

Command specification clauses provide a full definition of the command and its presentation.

Each command is labelled as being “mandatory” or “optional”.

The clauses of this part of ISO/IEC 18000 make provisions for “custom” and “proprietary” commands.

2.4 Mandatory commands

A mandatory command shall be supported by all tags that claim to be compliant and all interrogators which claim compliance shall support all mandatory commands.

2.5 Optional commands

Optional commands are commands that are specified as such within this part of ISO/IEC 18000. Interrogators shall be technically capable of performing all optional commands that are specified in this part of ISO/IEC 18000 (although they need not be set up to do so). Tags may or may not support optional commands.

If an optional command is used, it shall be implemented in the manner specified in this part of ISO/IEC 18000.

2.6 Custom commands

Custom commands may be permitted by those applying this part of ISO/IEC 18000, but they are not specified in this part of ISO/IEC 18000.

A custom command shall not solely duplicate the functionality of any mandatory or optional command defined in this part of ISO/IEC 18000 by a different method. An interrogator shall use a custom command only in accordance with the specifications of the tag manufacturer.

2.7 Proprietary commands

Proprietary commands may be permitted by those applying this part of ISO/IEC 18000, but they are not specified in this part of ISO/IEC 18000.

A proprietary command shall not solely duplicate the functionality of any mandatory or optional command defined in this part of ISO/IEC 18000 by a different method. All proprietary commands shall be disabled before the tag leaves the tag manufacturer. Proprietary commands are intended for manufacturing purposes and shall not be used in field-deployed RFID systems.

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 published edition of the referenced document (including any amendments) applies.

ISO/IEC 8859-1, *Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*

ISO/IEC 15459 (all parts), *Information technology — Unique identifiers*

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

ISO/IEC TR 18047-7 *Information technology — Radio frequency identification device conformance test methods — Part 7: Test methods 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)*

IEC 62369-1, *Ed. 1.0, 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*

ICNIRP Guidelines, *Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz),* International Commission on Non-Ionizing Radiation Protection

IEEE C95.1:2005, *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*

IEEE Std 802.15.4, *IEEE Standard for Local and metropolitan area networks Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)*

4 Terms and definitions

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

5 Symbols and abbreviated terms

For the purposes of this document, all symbols and abbreviated terms given in ISO/IEC 19762-1 and ISO/IEC 19762-3 shall apply.

AES	Advanced Encryption Standard
AES-CBC	Advanced Encryption Standard – Cipher Block Chaining
HMAC	Hash-based Message Authentication Code
LR-WPAN	Low-Rate Wireless Personal Area Network
PKI	Public Key Infrastructure
PMK	Pairwise Master Key
PSK	Pre-shared Key
SHA-1	Secure Hash Algorithm – 1
HB2-128	Hummingbird2 128-bit key cipher

6 433,92 MHz active narrowband specification

6.1 Physical layer

The RF communication link between interrogator and tag shall utilize a narrow band UHF frequency with the following nominal characteristics:

Carrier Frequency	433,92 MHz
Modulation Type	FSK
Frequency Deviation	+/- 50 kHz

Symbol LOW	fc +50 kHz
Symbol HIGH	fc -50 kHz
Data Modulation Rate	27,7 kHz
Wake up Signal	Modulation with 31,25 kHz square wave signal followed by modulation with 10 kHz square wave signal

For detailed physical layer specifications, see section 6.6.

The Wake Up Signal shall be transmitted by the interrogator for a minimum of 2,45 seconds to wake up all tags within communication range. The Wake Up Signal shall consist of a 2,35 to 4,8-second 31,25 kHz square wave modulated signal called the “Wake Up Header” immediately followed by a 0,1-second 10 kHz square wave modulated signal called the “Co-Header.” Upon detection and by completion of the Wake Up Signal all tags shall enter into the Ready state awaiting a command from the interrogator. See Figure 1. A tag has two states, awake/ready and asleep. During the ready state, the tags will accept the valid commands from interrogators and respond accordingly. When the tag is asleep, it will ignore all commands.

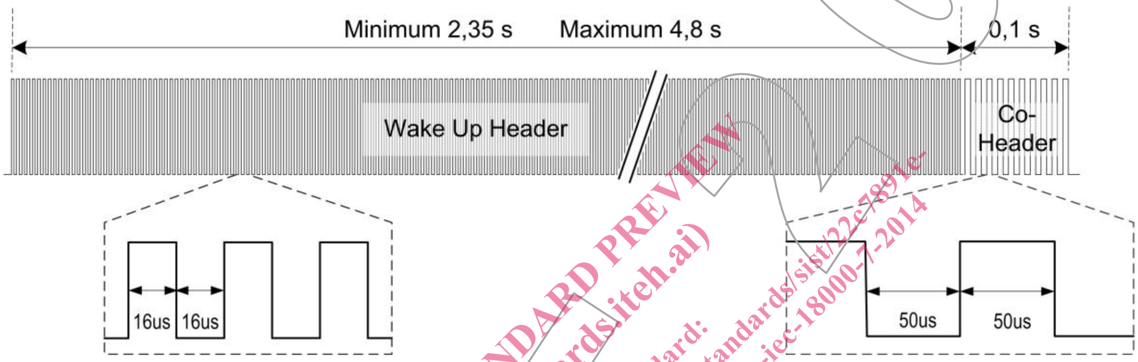


Figure 1 — Wake Up Signal

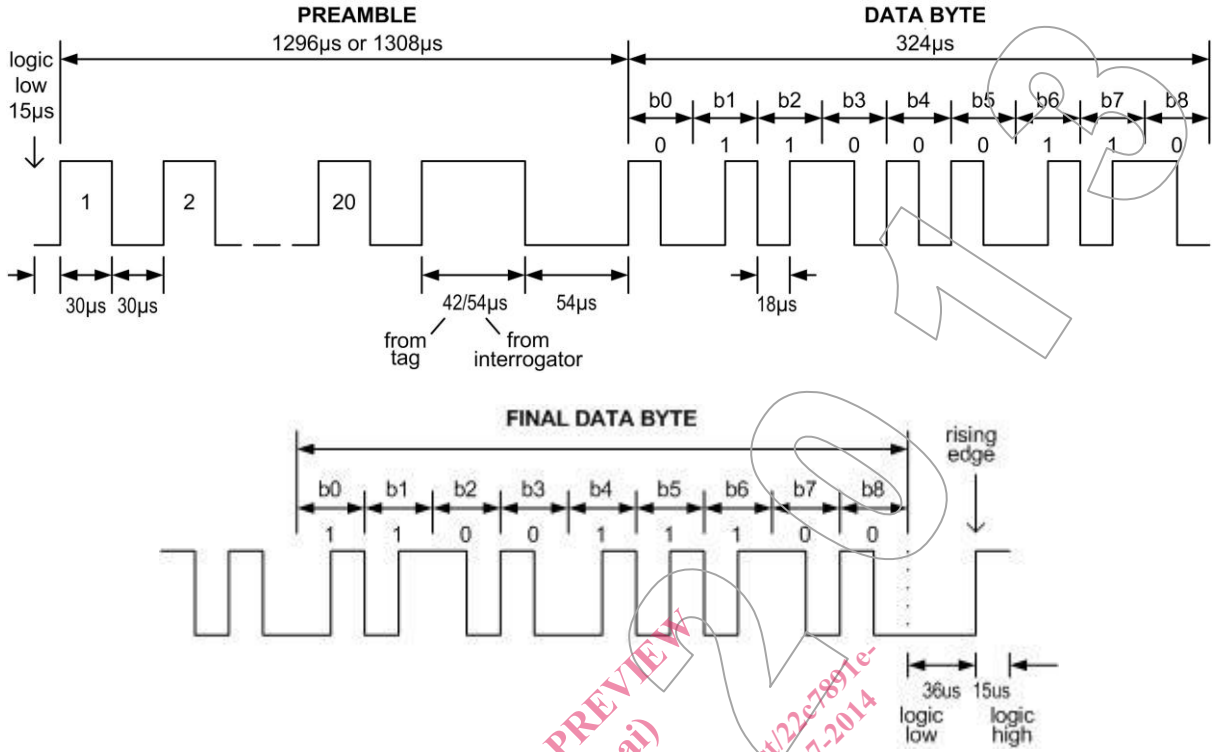
Once awoken, the tag shall stay awake for a minimum of 30 seconds after receipt of the last well-formed message packet consisting of a valid Protocol ID, command code, and CRC values, unless the interrogator otherwise commands the tag to sleep. If no well-formed command message is received within the 30 seconds, the tag will transition to the sleep state and SHALL no longer respond to command messages from Interrogators.

The communication between interrogator and tag shall be of the Master-Slave type, where the interrogator shall initiate communications and then listen for a response from a tag. Multiple response transmissions from tags shall be controlled by the collection algorithm described in 6.4.

6.2 Data Link layer

6.2.1 General

Data between interrogator and tag shall be transmitted in packet format. A packet shall be comprised of a preamble, data bytes and a final end period. The last two level changes of the preamble shall indicate the end of the preamble and beginning of the first data byte. The same two level changes of the preamble also indicate the originator of the data packet. Data bytes shall be sent in Manchester code format. Transmission order shall be most significant byte first; within a byte, the order shall be least significant bit first. Figure 2 illustrates the logic levels for the data communication timing of the preamble and the first byte of a packet.



NOTE Data byte transmitted order is most significant byte first; within each byte the order is least significant bit first. A 15 µs logic low level precedes the first preamble cycle. Byte shown is code 0xC6.

Figure 2 — Data communication timing

6.2.2 Preamble

The preamble shall be comprised of twenty (20) cycles of 60 µs period, 30 µs high and 30 µs low, followed by two final level changes which identifies the communication direction: 42 µs high, 54 µs low (tag to interrogator); or 54 µs high, 54 µs low (interrogator to tag). Refer to Figure 2 above.

6.2.3 Data bytes

Data bytes shall be in Manchester code format, each byte is comprised of 8 data bits and one stop bit. The bit period shall be 36 µs, the total byte period shall be 324 µs. A falling edge in the centre of the bit-time indicates a 0 bit, a rising edge indicates a 1 bit. The stop bit is coded as a zero bit.

6.2.4 Packet end period

A final period of 36 µs of continuous logic low, followed by a logic low to logic high transition, followed by continuous logic high for a minimum of 15 µs shall be transmitted after the last Manchester encoded bit within the packet.