INTERNATIONAL STANDARD

ISO/IEC 18000-7

First edition
2004-08-15

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 pour les communications actives d'une interface d'air à 433 MHz

Reference number
ISO/IEC 18000-7:2004(E)

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Published in Switzerland

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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 18000-7 was prepared by 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

This part of ISO/IEC 18000 is intended to address 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 meter.

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 ID 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

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 a patent concerning radio-frequency identification technology given in sub-clause 6.2.

ISO and IEC take no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has 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 statement of the holder of this patent right is registered with ISO and IEC. Information may be obtained from the following companies.

Contact details	Patent holder	Patent title	Patent number	Affected subclause in this part of ISO/IEC 18000
Ravi Rajapaksi, Chief Technology Officer, Savi Technology, Inc., 615 Tasman Dr., Sunnyvale, CA 94089 USA	Savi Technology	Communication System for Communicating with Tags	US 5640151	6.2.6
	Savi Technology	Communication System for Communicating with Tags	US 5686902	6.2.6
	Savi Technology	Method and Apparatus for Radio Identification and Tracking	EP 0467036	6.2.6
Rob Sokohl, Sterne, Kessler, Goldstein & Fox P.L.L.C., 1100 New York Avenue NW, Washington, DC 20005-3934 USA	Matrics Technology	System and method for electronic inventory	US 6002344	6.2

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 or IEC shall not be held responsible for identifying any or all such patent rights.

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. The purpose of this part of ISO/IEC 18000 is to provide a common technical specification for RFID devices that may 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. 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 RFID device conformity evaluation will be given in a future Technical Report (ISO/IEC TR 18047-7).

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

ISO/IEC 19762-1, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 1: General terms relating to AIDC*[1)]

ISO/IEC 19762-3, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary — Part 3: Radio frequency identification (RFID)*[1)]

1) To be published.

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, the symbols and abbreviated terms given in ISO/IEC 19762-1 and ISO/IEC 19762-3 apply.

6 433,92 MHz active narrowband specification

6.1 Physical layer

The RF communication link between interrogator and tag utilizes narrow band UHF frequency with the following characteristics:

Carrier Frequency	433,92 MHz ± 20 ppm
Modulation Type	FSK
Frequency deviation	± 50 kHz
Symbol LOW	fc +50 kHz
Symbol HIGH	fc –50 kHz
Modulation rate	27,7 kHz
Wake up Signal	30 kHz

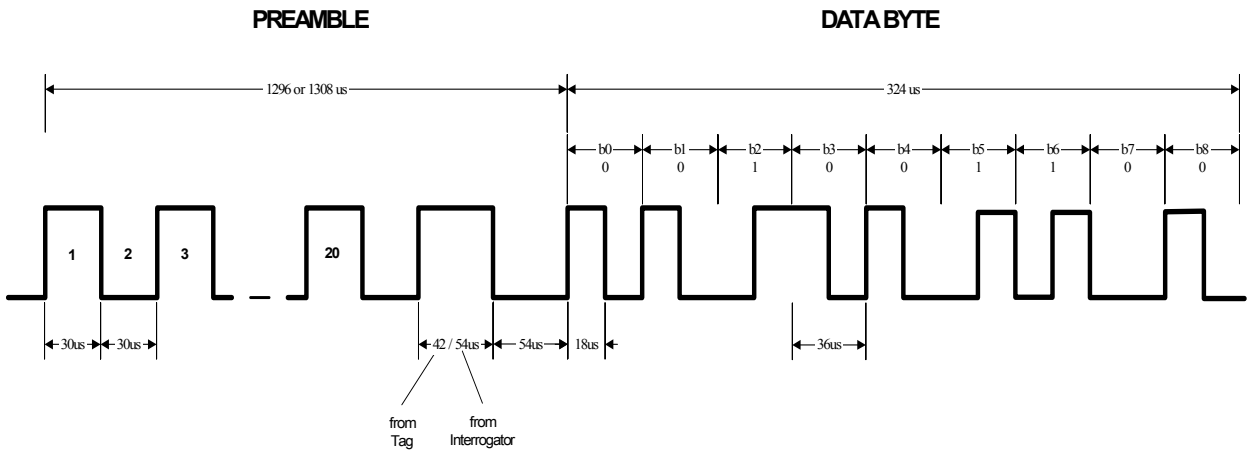
The Wake up signal is transmitted by interrogator for minimum of 2,5 seconds to wake up all tags within communication range. The wake up signal is a 30 kHz sub-carrier tone for 2,5 to 2,7 seconds. Upon detection of the Wake up signal all tags will enter into Ready state awaiting command from the interrogator.

The communication between interrogator and tag is of Master-Slave type, where the interrogator always initiates communications and then listens for response from a tag. Multiple response transmissions from the tags are controlled by collection algorithm described in section “Tag Collection and Collision Arbitration”.

6.2 Data Link layer

6.2.1 General

Data between interrogator and tag is transmitted in packet format. A packet is comprised of a preamble, data bytes and a final logic low period. The end of preamble and beginning of the first data byte is indicated by the last two pulses of the preamble. The same two pulses of the preamble also indicate the originator of the data packet. Data bytes are sent in Manchester code format. Transmission order is most significant byte first; within a byte, the order is least significant bit first. Figure 1 illustrates the data communication timing of the preamble and the first byte of a packet.



Pulse width in microseconds. Data byte transmitted significant bit first. Byte shown is code 0x64.

Figure 1 — Data communication timing

6.2.2 Preamble

The preamble is comprised of twenty pulses of 60 µs period, 30 µs high and 30 µs low, followed by a final sync pulse which identifies the communication direction: 42 µs high 54 µs low (Tag to Interrogator); 54 µs high 54 µs low (Interrogator to Tag).

6.2.3 Data byte format

Data bytes are in Manchester code format, comprised of 8 data bits and one stop bit. The bit period is 36 µs, the total byte period is 324 µs. A falling edge in the center 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 CRC bytes

A CRC checksum is calculated as a 16-bit value, initialized with all ones ('FFFF'), over all data bytes (excluding preamble) according to the CCITT polynomial ($x^{16} + x^{12} + x^5 + 1$). The CRC is appended to the data as two bytes. Reference: "The CCITT Red Book", Volume VIII, International Telecommunications Union, Geneva, 1986. Recommendation V.41, "Code-Independent Error Control System."

6.2.5 Packet end period

A final period of 36 µs of continuous logic low is transmitted for each packet after the CRC bytes.

6.2.6 Interrogator to tag message format

Tags shall recognize the following message format:

Table 1 — Interrogator to tag message format

Optional fields depending on the Command Type — *Optional field depending on the Command Type*

MSB LSB

Command Prefix	Command Type	Owner ID	Tag ID	Interrogator ID	Command Code	Parameters	CRC
1 byte ('31')	1 byte (8 bits)	3 bytes	4 bytes	2 bytes	1 byte	N bytes	2 bytes

The Owner ID, Tag ID and Parameters fields are present as required by the Command Type and Command code described in the following sections.

6.2.6.1 Command type

Table 2 — Command type field

Bit 7	6	5	4	3	2	1	0
Reserved	Reserved	Reserved	Reserved	Reserved	1	0= Broadcast (Tag Id not present) 1= Point to Point (Tag ID present)	0= Owner ID not present 1= Owner ID present

The Command Type field is used to indicate the presents of Tag ID and Owner ID fields within the current data packet. If Interrogator wishes to address a single tag by specifying its Tag ID, Bit 1 of the Command Type field needs to be set, indicating point-to-point communication. In the case Interrogator wants to address all the tags within its RF communication range, Bit 1 of the Command Type field needs to be cleared to indicate broadcast message. A broadcast message does not use Tag ID field and is omitted from the data packet.

The Bit 0 of the Command Type field indicates whether Owner ID is included in Interrogator to Tag message. If the Owner ID is included in the message all tags within Interrogator's RF communication range that belongs to the same Owner ID will respond back. All other tags shall ignore such message.

6.2.6.2 Owner ID

The Owner ID field allows Interrogator to communicate with only those tags that belong to a specific owner ID group. The Owner ID can be arbitrarily programmed and subsequently changed within each tag's non-volatile memory. If the tag is not programmed with Owner ID or its value is set to zero tag shall respond to any Interrogator command that does not include Owner ID in the command message.

6.2.6.3 Tag ID

The Tag ID is a 32-bit integer number that is uniquely assigned to each individual tag during manufacturing. This number cannot be changed and is read only. The Tag ID number has no structure and does not contain any information besides uniquely identifying a tag. The Tag ID cannot be reused. Issuance of the Tag IDs may be managed and administered by UCC/EAN, ISO 14816, ISO 6346, or some comparable international organization on behalf of the associated manufacture and is regulated by provision of agreement. ISO/IEC 15963 describes the structure of the Tag ID.

6.2.6.4 Interrogator ID

The Interrogator ID is 16 bits integer number programmed into the Interrogator non-volatile memory. The Interrogator ID can be changed without any restrictions and is used to efficiently route tag responses through Interrogators network. The Interrogators that receive a tag message not addressed to them shall not pass the message to the system.

6.2.6.5 Command codes

The Command codes and their function as a Read and / or Write command are summarized below. The least significant 7 bits of a command identify its base function, the eighth (MS) bit is set '0' for a Read function and '1' for a Write function. Codes not identified are reserved.

Table 3 — Command codes

Command code (R / W)	Command name	Command type	Description
'10' / NA	Collection	Broadcast	Collect all Tag IDs within interrogator RF communication range
'11' / NA	Collection with Data	Broadcast	Collect all Tag IDs including specified data from tag's non-volatile memory
'14' / NA	Collection with User ID	Broadcast	Collect all Tag IDs including tag's User ID
NA / '15'	Sleep	Point to Point	Put Tag to sleep
'01' / NA	Status	Point to Point	Retrieve Tag status
'07' / '87'	User ID length	Point to Point	Sets length of the User ID (in bytes, 1 – 16)
'13' / '93'	User ID	Point to Point	Sets User assigned ID (1 – 16 bytes)
'09' / '89'	Owner ID	Point to Point	Set Owner ID (3 bytes)
'0C' / NA	Firmware revision	Point to Point	Set by manufacturer
'0E' / NA	Model Number	Point to Point	Set by manufacturer
'60' / 'E0'	Read/Write Memory	Point to Point	Memory data
NA / '95'	Set Password	Point to Point	Sets Tag Password (4 bytes long)
'17' / '97'	Set Password Protect	Point to Point	Sets and Clears Tag Secure bit which enables or disables password protected access to the tag
NA/'96'	Unlock	Point to Point	Unlocks password protected tag

The Command Type column indicates whether the command is broadcast (does not include Tag ID in the message) or point-to-point (includes Tag ID in the message).

6.2.7 Tag to interrogator message format

The Tag to Interrogator message has two different formats depending on the type of message being transmitted to the Interrogator.

There are two possible formats:

- Broadcast response message format
- Point-to-Point response message format