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Information technology — Radio frequency identification for item management —

Part 6: Parameters for air interface communications at 860 MHz to 960 MHz

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

Partie 6: Paramètres pour les communications d'une interface d'air entre 860 MHz et 960 MHz

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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 18000-6 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 describes a passive backscatter 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.

In this RFID system, the interrogator powers and communicates with the tags that are within range. Tags receive data as amplitude modulation of the power/data signal from the interrogator. During the time that the tag responds to the interrogator, the interrogator transmits at a constant radio frequency power level, while the tag modulates the impedance of its radio frequency load attached to the tag antenna terminals. The interrogator then receives the data back from the tag as a variation in a reflection of its transmitted power.

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 given in the clauses identified below.

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 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:

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Koninklijke Philips Electronics N.V ATTN: Mr.Harald Röggla Intellectual Property & Standards, Triester Strasse 64 A-1101 Vienna Austria	EP 1034503B, JP 00-560535, US 09/352317, WO 00/04485, JP 03-502778, US 2002/0186789A1 and WO 02/099741 A1	7, 8
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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.

Information technology — Radio frequency identification for item management —

Part 6: Parameters for air interface communications at 860 MHz to 960 MHz

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. Its purpose 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 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.

This part of ISO/IEC 18000 contains one mode with two types. Both types use a common return link and are reader talks first. Type A uses Pulse Interval Encoding (PIE) in the forward link, and an adaptive ALOHA collision arbitration algorithm. Type B uses Manchester in the forward link and an adaptive binary tree collision arbitration algorithm. The detailed technical differences between the two types are shown in the parameter tables.

2 Conformance

2.1 Interrogator conformance and obligations

To conform to this part of ISO/IEC 18000, the interrogator shall support both communication types. It shall be able to switch from one type to the other.

The interrogator shall be locally programmable by the user to switch from one type to the other and to control the sequence and allocation of the ratio of time between the two types.

The proportion of the total time spent by the interrogator in addressing each type of tag shall be field-programmable from 0% to 100%.

Interrogators shall be set up to operate within local regulations.

2.2 Tag conformance and obligations

To conform to this part of ISO/IEC 18000, the tag shall support at least one type. It may optionally support both.

The tag shall operate over the frequency range of 860 MHz to 960 MHz.

NOTE Depending on the tag antenna characteristics, the operating performance (i.e. operating range) may vary depending on the actual frequency used in the 860-960 MHz band.

When the tag receives a modulated signal from the interrogator that it does not support or recognise, it shall remain silent.

2.3 Claiming 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' and it is also necessary to operate within the local national radio regulations (which may require further restrictions).

Relevant conformance test methods will be given in a future Technical Report (ISO/IEC TR 18047-6).

3 Normative references

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

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

4 Terms, definitions, symbols and abbreviated terms

4.1 Terms and definitions

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

4.1.1
collision arbitration loop
algorithm used to prepare for and handle a dialogue between an interrogator and a tag. This is also known as collision arbitration.

4.1.2
byte
8 bits of data designated b1 to b8, from the most significant bit (MSB, b8) to the least significant bit (LSB, b1).

4.2 Symbols

Cht Carrier high-level tolerance

Clt Carrier low-level tolerance

D Modulation depth of data coding pulse

f_c Frequency of operating field (carrier frequency)

M Modulation Index

Ma Modulation upper tolerance type B

Mb Modulation lower tolerance type B

1) To be published.

Taq Quiet time - type A

Tapf Pulse fall time - type A

Tapr Pulse rise time - type A

Tapw Pulse width - type A

Tari Reference interval time - type A

Tbmf Manchester fall time – type B

Tbmr Manchester rise time – type B

Tcf Carrier fall time

Tcr Carrier rise time

Tcs Carrier steady state time

Tf Fall time

Tfhf Carrier FHSS fall time

Tfhr Carrier FHSS rise time

Tfhs Carrier FHSS steady time

Tr Rise Time

Trlb Return link bit time

4.3 Abbreviated terms

AFI Application family identifier

CRC Cyclic redundancy check

CRC-5 Five bit CRC used in type a Interrogator to tag commands, used in Type A

CRC-16 Sixteen bit CRC used in both Type A and Type B commands and responses

DSFID Data storage format identifier

DSSS Direct Sequence Spread Spectrum

EOF End of frame

FHSS Frequency Hopping Spread Spectrum

LSB Least significant bit

MSB Most significant bit

NRZ Non Return to Zero

PIE Pulse interval encoding, used in Type A

RFU Reserved for future use

SOF Start of frame

SUID Sub unique identifier

TEL Tag excitation level

UID Unique identifier

5 Overview

5.1 General

This part of ISO/IEC 18000 specifies two communication types: Type A and Type B.

Figure 1, Figure 2, and Figure 3 show their architecture; Table 1 provides a comparison.

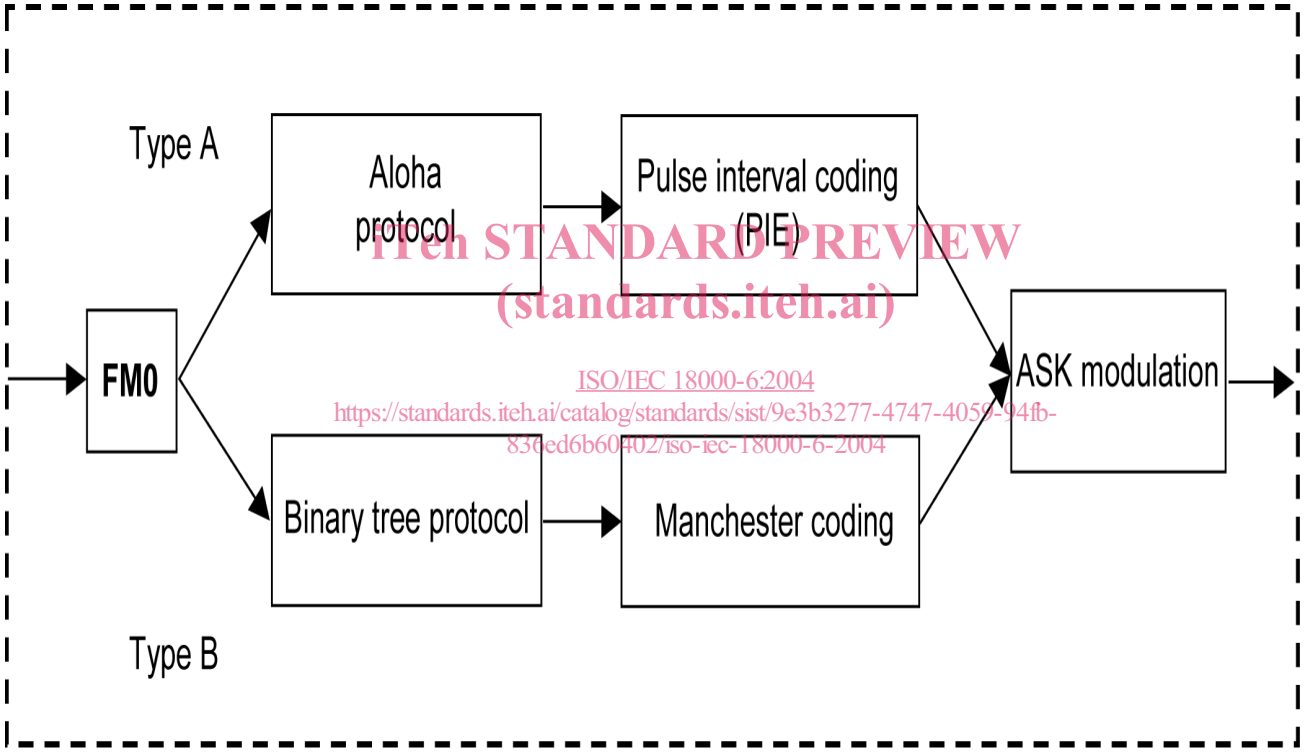

Figure 1 — Interrogator architecture

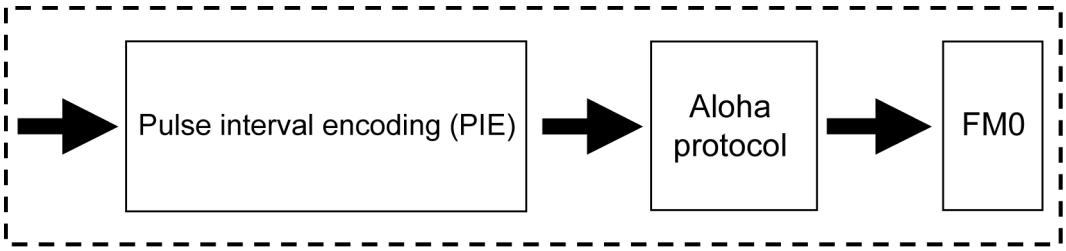

Figure 2 — Type A tag architecture

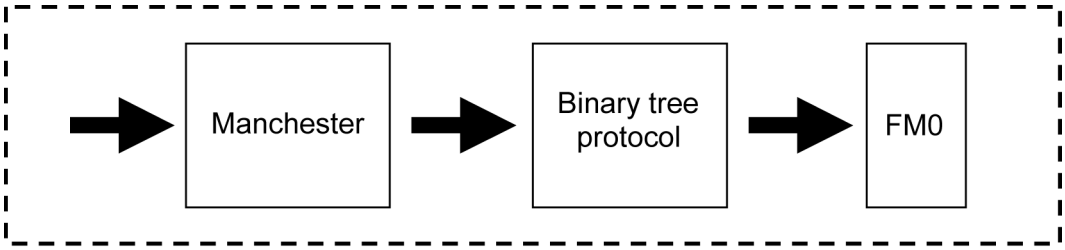

Figure 3— Type B tag architecture

Table 1 — Comparison of Type A and Type B

Parameter	Type A	Type B
Forward link encoding	PIE	Manchester
Modulation index	27% to 100%	18% or 100%
Data rate	33 kbit/s (mean)	10 or 40 kbit/s (according to local regulations)
Return link encoding	FM0	FM0
Collision arbitration	ALOHA	Binary Tree
Tag unique identifier	64 bits (40 bit SUID)	64 bits
Memory addressing	Blocks up to 256 bits	Byte blocks, 1,2,3 or 4 byte writes.
Error detection forward link	5 bit CRC for all commands (with an additional 16 bit CRC appended for all long commands)	16 bit CRC
Error detection return link	16 bit CRC	16 bit CRC
Collision arbitration linearity	Up to 250 tags	Up to 2^{256}

5.2 Parameter tables

Table 2, Table 3, Table 4 and Table 5 contain the parameters for both types A and B in accordance with ISO/IEC 18000-1. Detailed description of the operating modes and parameters are specified in the subsequent clauses.

Table 2 — Interrogator to tag link parameters

Interrogator to tag	Parameter name	Description
Int: 1	Operating frequency range	860 – 960 MHz The interrogator operating frequency range shall be determined by the radio regulations in force in a particular regulatory jurisdiction and by the type approval requirements of the particular jurisdiction. Before an interrogator may be used, it shall meet the local radio regulations of the country in which it is to be used. It is envisaged that there will be more than one version of interrogator having different frequency and power characteristics in order to comply with local regulations. NOTE Performance will vary according to bandwidth and power output permitted by local regulations.
Int: 1a	Default operating frequency	In accordance with the local radio regulations. See Int: 1
Int: 1b	Operating channels	In accordance with the local radio regulations. See Int: 1
Int: 1c	Operating frequency accuracy	In accordance with the local radio regulations See Int: 1
Int: 1d	Frequency hop rate (for frequency hopping [FHSS] systems)	Not applicable for single fixed frequency or channelized Adaptive Frequency Agile systems. Where FHSS is permitted, the hop rate shall be in accordance with the local radio regulations.
Int: 1e	Frequency hop sequence (for frequency hopping [FHSS] systems)	In accordance with the local radio regulations. Where not specified by such regulations a pseudo-random hopping sequence shall be used that ensures an even distribution of transmissions over the available channels.
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 transmitter maximum EIRP	In accordance with the local radio regulations
Int: 4	Interrogator transmitter spurious emissions	In accordance with the local radio regulations.
Int: 4a	Interrogator transmitter spurious emissions, in-band (for spread spectrum systems)	In accordance with the local radio regulations.
Int: 4b	Interrogator transmitter spurious emissions, out-of-band	In accordance with the local radio regulations.
Int: 5	Interrogator transmitter spectrum mask	As per Int: 2 and Int: 4a.
Int:6	Timing	See below Int: 6x.
Int: 6a	Transmit to receive turn around time	The interrogator transmit/receive settling time shall not exceed 85µs.
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	Maximum 1.5ms.
Int: 6d	Decay time of interrogator transmitter power down ramp	Maximum 1ms.

Table 2 *(continued)*

Interrogator to tag	Parameter name	Description
Int: 7	Modulation	Amplitude Modulation.
Int: 7a	Spreading sequence (for direct sequence [DSSS] systems)	Not applicable.
Int: 7b	Chip rate (for spread spectrum systems)	Not applicable.
Int: 7c	Chip rate accuracy (for spread spectrum systems)	Not applicable.
Int: 7d	Modulation index	**Type A**: Nominal 30 % to 100 %. See Table 11 and clause 7.1.1. **Type B**: Nominal 18% or 100% .
Int: 7e	Duty cycle	In accordance with local regulations.
Int: 7f	FM deviation	Not applicable.
Int: 7g	Transmitter modulation pulse shape (falling and rising slopes)	The modulation pulse fall and rise times shall conform to the detailed specifications in subsequent clauses. Type A see Figure 11 and Table 11, and Type B see Figure 20, Figure 21, Table 93 and Table 94.
Int: 8	Data coding	**Type A**: Pulse Interval Encoding **Type B**: Manchester bi-phase
Int: 9	Bit rate	**Type A**: 33 kbit/s as constrained by the local radio regulations **Type B**: 10 kbit/s or 40 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	**Type A** : has no preamble **Type B**: See clause 8.1.4.3
Int:11a	Preamble length	**Type A**: not applicable. **Type B**: 9 bits. See clause 8.1.4.3.
Int:11b	Preamble waveform	**Type A**: not applicable . **Type B**: See clause 8.1.4.3.
Int: 11c	Bit sync sequence	**Type A**: not applicable. **Type B**: see clause 8.1.4.3
Int: 11d	Frame sync sequence	Not applicable.
Int: 12	Scrambling (for spread spectrum systems)	Not Applicable
Int: 13	Bit transmission order	MSB 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.