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

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

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*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*

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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 second edition cancels and replaces the first edition (ISO/IEC 18000-3:2004), which has been technically revised.

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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 by ISO/IEC JTC 1, SC 31, WG 4, *Radio frequency identification for item management*, 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; to minimise software and implementation costs; and to enable system management and control and information exchange to be common as far as is possible.

This part of ISO/IEC 18000 has been 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 2 MODES of operation, intended to address different applications. Clause 8 of this part of ISO/IEC 18000 summarises the differences between MODE characteristics. 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 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 the ISO and IEC. Information may be obtained from the following companies.

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	DE69835452
	EP1048126
	AU2006202886
	AU785098
	US7248145
	US7259654
	US11/538,271
	US11/538/242
	JP2003 526148
	JP2006 344227
	DE60119910
EP1266458	
EP07013773	
EP1544782	
EP1544788	
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# 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 two non-interfering MODES.

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

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### 2 Conformance

#### 2.1 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'. 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 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 18000-3:2008(E)

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 — 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*

## 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

#### Phase Jitter Modulation

##### PJM

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

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## 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.

≈ MODE 1 - the value is a rounded value (e.g. ≈ 75,52 μs)

## 6 Requirements: Physical layer, collision management system and protocol values for 13,56 MHz systems

### 6.0 General and applicable to both Modes of this part of ISO/IEC 18000

#### 6.0.1 Presentation as determined in ISO/IEC 18000-1

The context, form and presentation of this part, which provides physical layer, collision management system and protocol value definitions for RFID systems for item identification operating at 13,56 MHz are in accordance with the requirements of ISO/IEC 18000-1.

#### 6.0.2 ISO/IEC 18000-3 Interoperability

This part of ISO/IEC 18000 specifies two MODES of operation at 13,56 MHz

These MODES are not interoperable, but they are expected to operate without causing any significant interference with each other. Any known causes of interference are listed in Annex B.

**NOTE** It is recommended that users select one MODE for any specific application.

**NOTE** Local national regulations may further limit either power, frequency or bandwidth allocations and such limitations may reduce the capability of a system within that country. Users shall have the responsibility to ensure that they use only systems that comply with these regulations. This implies a user responsibility to obtain proofs from manufacturers, and where appropriate have adequate tests carried out to assure that systems are in compliance.

**Informative Comment:** At the time of preparation of this part of ISO/IEC 18000, the interrogator to tag link and tag to interrogator link physical layer emissions may be subject to type approval or certification. It is therefore necessary to make

reference to local or regional radio regulations and radio standards in addition to this part of ISO/IEC 18000. All systems are required to comply with local radio regulations, which may affect performance.

### 6.0.3 ISO/IEC 18000-3 reader conformance/compliance

To claim compliance with this part of ISO/IEC 18000, an interrogator/ reader shall support either MODE 1 or MODE 2. The reader may support both modes as an option (the modes are not interoperable).

### 6.0.4 ISO/IEC 18000-3 tag compliance.

To claim compliance with this part of ISO/IEC 18000, a tag shall support either MODE 1 or MODE 2. The tag may support both modes as an option (the modes are not interoperable).

### 6.0.5 Command structure and extensibility

Clauses 6.1 and 6.2, include definition of the structure of command codes between an interrogator and a tag and indicate 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'. In accordance with ISO/IEC 18000-1, the clauses of this part of ISO/IEC 18000 make provision for 'custom' and 'proprietary' commands.

The types of permitted command options are defined in subclauses 6.0.6 to 6.0.9.

### 6.0.6 Mandatory commands

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

### 6.0.7 Optional commands

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Optional commands are commands that are specified within the International Standard. Interrogators shall be technically capable of performing all optional commands that are specified in the International Standard (although need not be set up to do so). Tags may or may not support optional commands.

If an interrogator or a tag implements an optional command, it shall implement it in the manner specified in this standard.

### 6.0.8 Custom commands

Custom commands may be enabled by an International Standard, but they shall not be specified in that International Standard.

A custom command shall not solely duplicate the functionality of any mandatory or optional command defined in the International Standard by a different method. An interrogator shall use a custom command only in accordance with the specifications of the tag manufacturer.

### 6.0.9 Proprietary commands

Proprietary commands may be enabled by an International Standard, but they shall not be specified in that International Standard.

A proprietary command shall not solely duplicate the functionality of any mandatory or optional command defined in the International Standard by a different method. Vendors shall not provide proprietary means to circumvent the protocol. Proprietary commands are intended for manufacturing purposes and shall not be used in field-deployed RFID systems.

## 6.1 Physical layer, collision management system and protocols for MODE 1 of this part of ISO/IEC 18000

MODE 1 is not interoperable with any other MODES defined within this International Standard.

### 6.1.1 Read/Write system

MODE 1 describes a read/write system using a "reader talks first" technique.

### 6.1.2 Normative Aspects

The physical, collision management and transmission protocols determined in this MODE are consistent with the approach taken in ISO/IEC 15693. See Annex G. Clauses 6.1.3 – 6.1.8 provide normative parts of MODE 1 by reference.

### 6.1.3 Conformance and performance measurement aspects

The performance and conformance measurement aspects for MODE 1 are given in the relevant clauses of Technical Reports (ISO/IEC TR 18046 and ISO/IEC TR 18047-3, respectively).

### 6.1.4 Physical Layer

The Physical layer for the MODE 1 air interface at 13,56 MHz shall be compliant with ISO/IEC 15693-2.

### 6.1.5 Protocol and collision management operating method

The collision management operating method for the MODE 1 air interface at 13,56 MHz shall be compliant with ISO/IEC 15693-3.

### 6.1.6 Commands

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The commands for the MODE 1 air interface at 13,56 MHz shall be compliant with ISO/IEC 15693-3.

### 6.1.7 Parameter tables for interrogator to tag link

The parameter tables for interrogator to tag link for the MODE 1 air interface at 13,56 MHz shall be compliant with ISO/IEC 15693-2.

### 6.1.8 Parameter tables for tag to interrogator link

The parameter tables for tag to interrogator link for the MODE 1 air interface at 13,56 MHz shall be compliant with ISO/IEC 15693-2.

## 6.2 MODE 2: Physical layer, collision management system and protocols for MODE 2 of this part of ISO/IEC 18000

MODE 2 is not interoperable with any other MODE defined in this part of ISO/IEC 18000.

MODE 2 is non-interfering with any other MODE defined in this part of ISO/IEC 18000.

The performance and conformance measurement aspects for MODE 2 shall be conformant with the relevant clauses of Technical Reports (ISO/IEC TR 18046 and ISO/IEC TR 18047-3, respectively).

### 6.2.1 Normative aspects: physical and media access control (MAC) parameters: interrogator to tag link

See Table 1 — Physical and media access control (MAC) parameters: interrogator to tag link and Figure 1 — Two possible command flags.

**Table 1 — Physical and media access control (MAC) parameters: interrogator to tag link**

Ref.	Parameter Name	Description
<b>M2-Int: 1</b>	<b>Operating frequency range</b>	13,56 MHz $\pm$ 7 kHz
M2-Int: 1a	Default operating frequency	13,56 MHz
M2-Int: 1b	Operating channels (for Spread spectrum systems)	N/A
M2-Int: 1c	Operating frequency accuracy	$\pm$ 100 parts per million Japan: $\pm$ 50 parts per million
M2-Int: 1d	Frequency hop rate (for Frequency Hopping [FHSS] systems)	N/A
M2-Int: 1e	Frequency hop sequence (for Frequency Hopping [FHSS] systems)	N/A
<b>M2-Int: 2</b>	<b>Occupied channel bandwidth</b>	The modulation sidebands are very low in amplitude but spread wide. They satisfy the ETSI, and FCC regulations. (Occupied channel bandwidth is not regulated in the Japan Radio Law).
M2-Int: 2a	Minimum receiver bandwidth	Suitable to receive tag channel or channels of interest.
M2-Int: 3	Interrogator transmit maximum EIRP	Not relevant parameter in 13,56 MHz systems Maximum EIRP depends on installation Compliant with ETSI and FCC maximum in Band allowed field strength. (Interrogator Transmit Maximum EIRP is not regulated in the Japan Radio Law).
<b>M2-Int: 4</b>	<b>Interrogator transmit spurious Emissions</b>	
M2-Int: 4a	Interrogator transmit spurious emissions, in-band (for Spread spectrum systems)	N/A
M2-Int: 4b	Interrogator transmit spurious emissions, out-of-band	Compliant with ETSI, ARIB STD-T82 and FCC maximum out of Band allowed field strength.
<b>M2-Int: 5</b>	<b>Interrogator transmitter spectrum mask</b>	Compliant with ETSI, ARIB STD-T82 and FCC maximum out of Band allowed field strength
<b>M2-Int: 6</b>	<b>Timing</b>	
M2-Int: 6a	Transmit to receive turn around time (the time between the end of a command and when the interrogator is first ready to receive a reply)	0 - 50 $\mu$ s
M2-Int: 6b	Receive to transmit turn around time (the time between the end of a reply and when the interrogator can transmit a command)	Greater than 0 $\mu$ s
M2-Int: 6c	Dwell time or Interrogator transmit power on ramp	0 - 10 $\mu$ s

Ref.	Parameter Name	Description
M2-Int: 6d	Decay time or Interrogator transmit power down ramp	0 - 10 $\mu$ s
<b>M2-Int: 7</b>	<b>Modulation</b>	PJM (Phase Jitter Modulation) min. level +/- 2,0 ° max. level +/- 4,0
M2-Int: 7a	Spreading sequence (for frequency hopping [FHSS] systems)	N/A
M2-Int: 7b	Chip rate (for Spread spectrum systems)	N/A
M2-Int: 7c	Chip rate accuracy (for Spread spectrum systems)	N/A
M2-Int: 7d	Modulation index	N/A - (System is not amplitude modulation)
M2-Int: 7e	Duty cycle	N/A
M2-Int: 7f	FM Deviation	N/A
<b>M2-Int: 8</b>	<b>Data coding</b>	Modified Frequency Modulation (MFM) (see Figure 4 — Command MFM encoding and timing of binary 000100)
<b>M2-Int: 9</b>	<b>Bit rate</b>	423,75 kbit/s
M2-Int: 9a	Bit rate accuracy	Synchronous to the carrier frequency.
<b>M2-Int: 10</b>	<b>Interrogator transmit modulation accuracy</b>	N/A
<b>M2-Int: 11</b>	<b>Preamble</b>	Includes an MFM encoding violation
M2-Int: 11a	Preamble length	16 bits
M2-Int: 11b	Preamble waveform	The command flag defines the start of a command and the bit interval timings. The flag comprises three parts: <ul style="list-style-type: none"> <li>• A synchronising string of 8 bits of valid MFM data.</li> <li>• An MFM encoding violation not present in normal MFM data. The violation consists of a sequence of 5 state changes separated by a 1 bit interval, 2 bit interval, a 1,5 bit interval and a 2 bit interval. The edge of the fifth (last) transition defines the beginning of a bit interval.</li> <li>• A trailing MFM 0 defining the end of a flag and the beginning of the command.</li> </ul> (See Figure 1 — Two possible command flags below)
M2-Int: 11c	Bit sync sequence	See M2 Int: 11b
M2-Int: 11d	Frame sync sequence	See M2 Int: 11b
<b>M2-Int: 12</b>	<b>Scrambling (for Spread spectrum systems)</b>	N/A
<b>M2-Int: 13</b>	<b>Bit transmission order</b>	LSB first
<b>M2-Int: 14</b>	<b>Wake-up process</b>	Reader Talks First (RTF) System. Tag cannot respond unless it receives valid command from interrogator.
<b>M2-Int: 15</b>	<b>Polarization</b>	N/A

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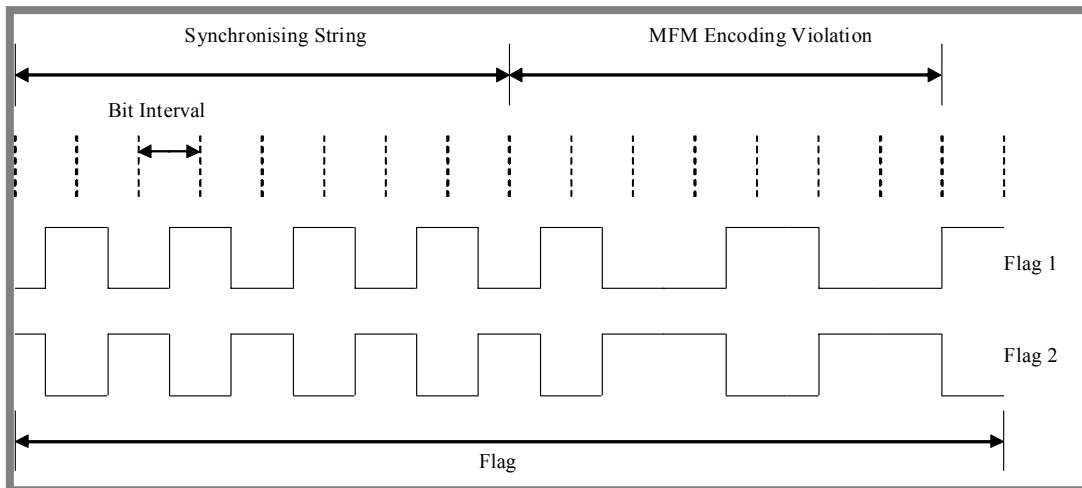


Figure 1 — Two possible command flags

6.2.2 Tag to interrogator link

See Table 2 — Tag to interrogator link and Figure 2 — Two possible reply flags.

Table 2 — Tag to interrogator link

Ref.	Parameter Name	Description																											
<b>M2-Tag:1</b>	<b>Operating frequency range</b>	13,56 MHz ± 3,013 MHz																											
M2-Tag: 1a	Default operating frequency	N/A – System does not rely on a Default Operating Frequency																											
M2-Tag: 1b	Operating channels (for Spread spectrum systems)	Multi-frequency operating system where tags can select from 8 reply channels. Tags transmit the whole of their reply using a selected channel. The tag may use one of eight subcarriers. The subcarriers are derived by division of the powering field's frequency. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Channel</th> <th>Frequency kHz</th> <th>Division Ratio</th> </tr> </thead> <tbody> <tr><td>A</td><td>969</td><td>14</td></tr> <tr><td>B</td><td>1233</td><td>11</td></tr> <tr><td>C</td><td>1507</td><td>9</td></tr> <tr><td>D</td><td>1808</td><td>7,5</td></tr> <tr><td>E</td><td>2086</td><td>6,5</td></tr> <tr><td>F</td><td>2465</td><td>5,5</td></tr> <tr><td>G</td><td>2712</td><td>5</td></tr> <tr><td>H</td><td>3013</td><td>4,5</td></tr> </tbody> </table>	Channel	Frequency kHz	Division Ratio	A	969	14	B	1233	11	C	1507	9	D	1808	7,5	E	2086	6,5	F	2465	5,5	G	2712	5	H	3013	4,5
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H	3013	4,5																											
M2-Tag: 1c	Operating frequency accuracy	Synchronous to the carrier frequency.																											
M2-Tag: 1d	Frequency hop rate (for Frequency hopping [FHSS] systems)	Tags transmit the whole of a reply on a selected channel																											
M2-Tag: 1e	Frequency hop sequence (for Frequency hopping [FHSS] systems)	Reply channel is randomly selected by the tag.																											
<b>M2-Tag: 2</b>	<b>Occupied channel bandwidth</b>	106 kHz for each of 8 reply channels																											
<b>M2-Tag: 3</b>	<b>Transmit maximum EIRP</b>	N/A																											