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ISO/IEC 18000-3

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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 pour les communications d'une interface d'air de 13,56 MHz

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
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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*.

ISO/IEC 18000 consists of the following parts, under the general title *Information technology — Radio frequency identification for item management*:

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— *Part 1: Reference architecture and definition of parameters to be standardized*

— *Part 2: Parameters for air interface communications below 135 kHz*

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— *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*

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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.

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The ISO and IEC take no position concerning the evidence, validity and scope of these patent rights.

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NOTE Abstracts of these patents may be found in ISO 18000-1, Annex E.

Contact details	Patent number	Affected subclause(s) in this part of ISO/IEC 18000
Dr. Bertram Koch Leiter Patentabteilung OP31 ATMEL Germany GmbH Theresienstrasse 2 D-74072 Heilbronn Germany Tel: +49-7131-67-3254 Fax: +49-7131-67-2789	US005257288	6.1
Magellan Technology Pty Ltd. (ABN 93 009 137 393) 65 Johnston Street Annandale NSW 2038 Australia Tel: +61 2 9518 7011 Fax: +61 2 9518 7620	US5302954, WO8905549, EP0390822, DE3854478D, SG37971, US5485154, 09/582341 USA, 09/611658 USA, WO9934526, EP1048126, JP2002500465T, AU1654099, 10/204159 USA, WO0165712, EP1266458, 2001-654480 Japan, AU3711301	6.2

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Contact details	Patent number	Affected subclause(s) in this part of ISO/IEC 18000
Matrics Technology 8850 Stanford Blvd Suite 3000 Columbia 21045 USA Tel: +1 410 872 0300 Fax: +1 443 782 0230	US 6002344	6.1, 6.2
Koninklijke Philips Electronics N.V. Groenewoudseweg 1 NL 5621 BA Eindhoven Netherlands Tel: +43 1 60 101-14 69 Fax: +43 1 60 101-11 01	CN 1277695, EP 831618, EP845751, EP-PS 0998792, EP-PS 1098257, IN/PCT/00/00034, JP 00-551498, JP 00-561579, US 5,793,324, US 5,929,801, US09/357270, US2001-0013022, WO 98/08328, WO99/62196, WO00/05673	6.1
Spacecode/Intercode 12 rue des petits Ruisseaux 91370 Verrières Le Buisson France Tel: +33 1 69 75 21 70 Fax: +33 1 30 11 00 31	US 5808550, EP 96402555.5, CN 2191794	6.1.3.5.1
	US6177858 B1, EP 96402554.8, CN 21911788	6.1.7.4.2
	US 5426423, EP 90909459.1, CN 2058947	Annex B
Tagsys Australia 212 Pirie St Adelaide SA 5000 Australia Tel: +61 8 8100 8324 Fax: +61 8 8232 3720	EP 0 578 701 B1, AUS 664,544, PCT AU 00 01493, PCT AU 98 00017, US 5,523,749, PCT AU 01 01676, FR 00 01704	6.1.9 - 6.1.11
Texas Instruments 34 Forest Street Attleboro MA USA Tel: +1 508 236 3314 Fax: + 1 508 236 1960	EP1 038257, US 09/315708, JP 00-560700, EP 1 034644, US 6442215, CN 1273730A, WO00/04686, EP 0669591B, AT-PS 401127	6.1

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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

1.1 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

1.2 This part of ISO/IEC 18000 provides definitions for systems for each MODE determined in Clause 6 below.

1.3 This part of ISO/IEC 18000 defines 2 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 to 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 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(s) cards — Vicinity cards*

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 18047-3, *Information technology — Radio frequency identification device conformance test methods — Part 3: Test methods for air interface communications at 13,56 MHz*

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ISO/IEC 19762 (all parts), *Information technology — Automatic identification and data capture techniques — Harmonized vocabulary*[1)]

EN 300 330, *Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Technical Characteristics and test methods for Radio equipment in the frequency range 9 kHz to 30 MHz*

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

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)

PJM Phase Jitter Modulation

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

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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 to local radio regulations, which may affect performance.

1) To be published.

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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

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

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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 optional command is used, it shall be implemented in the manner specified in the International 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.

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.

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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 talk 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.

Clause 6.1.9 determines an optional protocol extension compliant with, but an extension to, ISO/IEC 15693.

6.1.3 Conformance and performance measurement aspects

The performance and conformance measurement aspects for MODE 1 will be given in the relevant clauses of future 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, 2000.

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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.

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6.1.6 Commands

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.

6.1.9 Protocol extension

6.1.9.1 Protocol extension optional

The protocol extension is optional, tags may support it. If supported request and response shall comply with the definition given in Clauses 6.1.9 - 6.1.11.

If the tag does not support the protocol extension it shall not return an error code and shall remain silent.

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The request consists of the following fields:

- Flags (see Table 1: Bit 4 set to 1 for protocol extension, Bit 5 - Bit 8 shall be set to 0: RFU)
- Protocol extension byte (Bit 1 and Bit 2 of the Protocol extension byte are reserved for future protocol extensions and have to be set to 0).
- CRC

6.1.9.2 Request flags

The request flags are shown in Table 1.

Table 1 — Request flags 1 to 4 definition

Bit Nb	Flag name	State	Description/limits
Bit 1	Sub-carrier_flag	0	A single sub-carrier frequency shall be used by the RF tag
		1	Two sub-carriers shall be used by the RF tag
Bit 2	Data_rate_flag	0	Low data rate shall be used
		1	High data rate shall be used
Bit 3	Response_flag	0	Optional protocol response as specified in 6.1.10.18 & 6.1.10.19, if the tag does not support this response, it shall remain silent.
		1	Optional protocol response as specified in G.8.4.1 Read single block command, and the response format in Figure G33, using coding dependant upon bits 1 and 2 above. If the tag does not support this response, it shall remain silent.
Bit 4	Protocol_Extension_ Flag	1	Protocol format is extended
Bit 5	RFU	0	RFU
Bit 6	RFU	0	RFU
Bit 7	RFU	0	RFU
Bit 8	RFU	0	RFU

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6.1.9.3 Request format

Figure 1 only refers to Protocol extension commands if Bit 1 and Bit 2 of the Protocol extension byte are 0.

SOF	Flags	Protocol extension byte	CRC	EOF
	8 bits	8 bits	16 bits	

Figure 1 — Protocol extension request format

6.1.10 Protocol extension- description of collision management method

6.1.10.1 Collision management in protocol extension

This protocol extension contains two major branches: the non-slotted non-terminating multiple tag reading branch, described in 6.1.10.2 and the slotted terminating adaptive round multiple tag reading branch described in 6.1.10.3.

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6.1.10.2 Non-slotted non-terminating multiple tag reading protocol

In the non-slotted non-terminating aloha protocol, a Wake-up command shall cause the RF tags to reply at random, with self-determined intervals, as long as they continue to be in the energising field. In this protocol, interrogators will receive, detect and report all replies which arrive without collisions, but will not try to influence the interrogation process other than through the issuing of additional wake-up signals to introduce newly arriving tags into the reply process. Programming is performed with 1 RF tag in the field.

This implementation:

- only requires a Wake-up command
- uses a default reply length (length may be programmed by user)
- performs well when one or only a small number of tags are in the interrogation field at one time.

After a Wake-up command the interrogator listens for RF tags. The type of tag forms part of the preamble of the main reply and is thus signalled to the interrogator which will not try to signal any other commands to a non-slotted non-terminating tag. It is recommended that the default-reply-time to non-reply-time approximately forms the ratio 1 to 10.

Figure 2 shows 3 tags working in the non-slotted non-terminating tag protocol.

- The interrogator issued a Wake-up command and all 3 tags responded resulting in a collision.
- Next RF tag 1 and RF tag 3 responded after a varying hold off time resulting in a collision.
- Next RF tag 2 responded alone and was decoded.
- Next RF tag 1 responded alone and was decoded.
- Next RF tag 2 and RF tag 3 responded resulting in a collision.
- Next RF tag 1 and RF tag 2 responded resulting in a collision.
- Finally RF tag 3 responded and was decoded.

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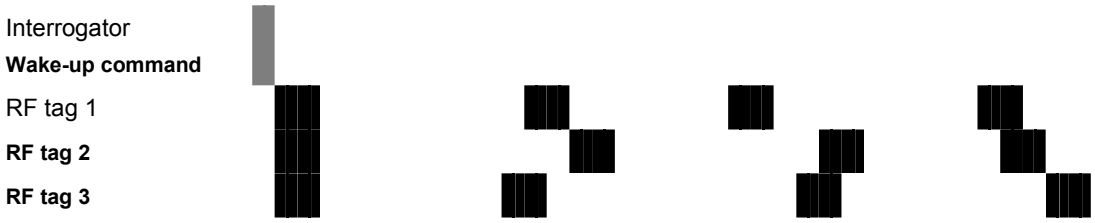

Figure 2 — Example of RF tag response in non-slotted non-terminating multiple tag reading protocol

6.1.10.3 RF tag states in non-slotted, non-terminating adaptive round protocol

The Power-off and Ready states are the same as in the normal protocol.

The transition from the Ready state to the active state occurs as the result of a protocol extension non-terminating/non-slotted Wake-up command (Protocol Extension_flag is set).

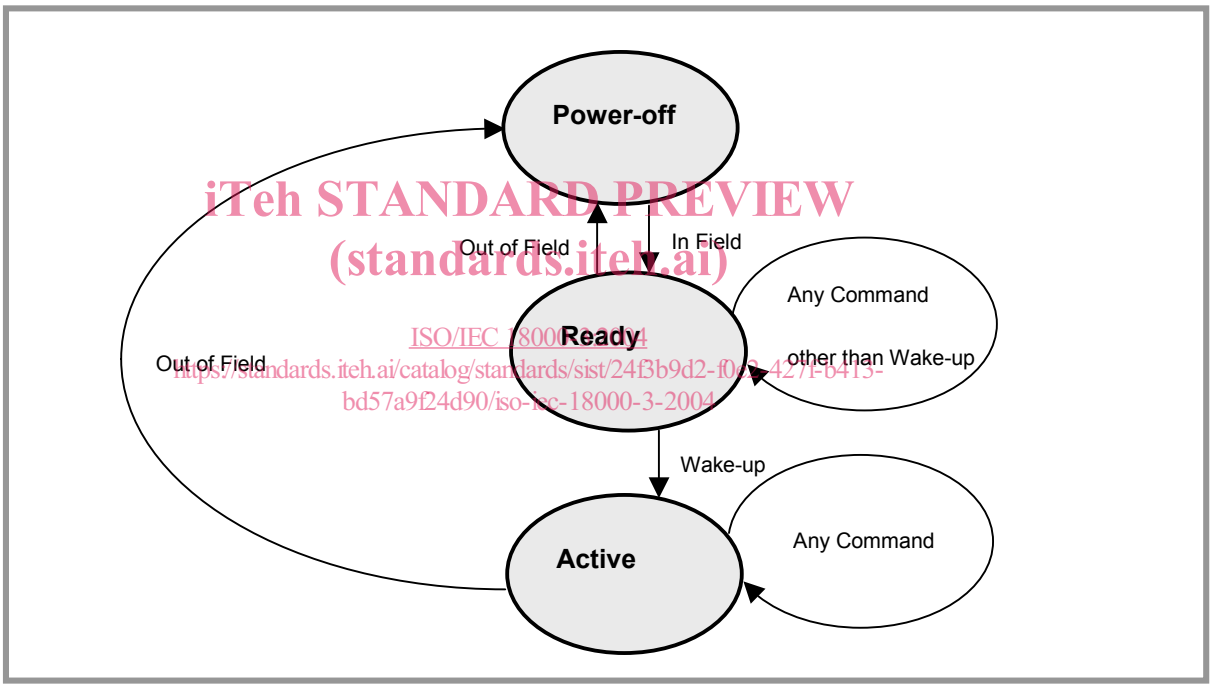

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Figure 3 — Tag states in non-slotted non-terminating multiple tag reading protocol

6.1.10.4 Slotted terminating adaptive round multiple tag reading protocol

In the slotted terminating adaptive round protocol, after Wake-up and during the interrogation cycle, there is a continuing dialogue between tags and the interrogator/reader, and a tag shall not continue to reply indefinitely.

The Reader Talks First (RTF) Wake-up can be given frequently for highly dynamic populations. Within a large population of tags, there will be a diminishing number of tags replying, until all have been read.

In this protocol tags will select a random slot number, from a maximum slot number, in which to offer a reply. The maximum slot number is set in the tag as a default value, which may be temporarily over-ridden by an interrogator command. The interrogator signals the start of each slot. The tag keeps track of the number of the current slot timed from the Wake-up command responsible for it waking and subsequent transition to the active state. After responding the RF tag will automatically transition from the active state to the quiet state. If the tag is in the active state when the current slot number equals the maximum slot number, an increment in the current slot number shall cause the tag to reset its current slot value back to one and recalculate the

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