INTERNATIONAL STANDARD

ISO/IEC 14443-3

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Identification cards — Contactless integrated circuit(s) cards — Proximity cards —

Part 3: Initialization and anticollision

Cartes d'identification — Cartes à circuit(s) intégré(s) sans contact — Cartes de proximité —

Partie 3: Initialisation et anticollision

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. 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.

International Standard ISO/IEC 14443-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Identification cards and related devices*.

ISO/IEC 14443 consists of the following parts, under the general title *Identification cards — Contactless integrated circuit(s) cards — Proximity cards*:

— *Part 1: Physical characteristics*

— *Part 2: Radio frequency power and signal interface*

— *Part 3: Initialization and anticollision*

— *Part 4: Transmission protocol*

Annexes A, B, C and D of this part of ISO/IEC 14443 are for information only.

Introduction

ISO/IEC 14443 is one of a series of International Standards describing the parameters for identification cards as defined in ISO/IEC 7810, and the use of such cards for international interchange.

This part of ISO/IEC 14443 describes polling for proximity cards entering the field of a proximity coupling device, the byte format and framing, the initial Request and Answer to Request command content, methods to detect and communicate with one proximity card among several proximity cards (anticollision) and other parameters required to initialize communications between a proximity card and a proximity coupling device. Protocols and commands used by higher layers and by applications and which are used after the initial phase are described in ISO/IEC 14443-4.

ISO/IEC 14443 is intended to allow operation of proximity cards in the presence of other contactless cards conforming to ISO/IEC 10536 and ISO/IEC 15693.

The International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) draw attention to the fact that it is claimed that compliance with this part of ISO/IEC 14443 may involve the use of patents.

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

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 patent rights are registered with the ISO and IEC. Information may be obtained from:

Patent holder	Details
CASIO General Manager Intellectuall property Centre Casio Computer Co. Ltd Hamura R & D Center 2-1 Sakae-cho 3Chome Hamura-Shi Tokyo 205-8555 Japan	US Patent 4,810,862 and JP 2564480 "System for judging propriety of use of an integrated circuit card with a card terminal", issued on March 07, 1989 Japan Patent No. 2564480 US Patent No. 4810862 British Patent No. 209092 German Patent No. P 3689089.8 French Patent No. 209092 Swiss Patent No. 209092 Canadian Patent No. 1301891 Netherlands Patent No. 209092 Italian Patent No. 209092 Austrian Patent No. 209092 Australian Patent No. 568457 Belgian Patent No. 209092 Swedish Patent 86109530.5 EPO Patent No. 209092
FRANCE TELECOM Branch Développement Centre National d'Etudes des Télécommunications 38-40 rue de Général Leclerc 92794 Issy-les-Molineaux Cedex 9 France	US Patent US5359323

INNOVOTRON Philippe le Clech Director of International Operations Innovotrol 1 Rue Danton 75006 Paris France	WO 9936877A1 Europe 0 901 670 French Patent App 97.02501 Int Pat App PCT/FR98/00132 Innovatron Electronique / RATP sub clause 7.3, 7.6 and 7.7 French Patent App 98.00383 Int Pat App PCT/FR99/00079 Innovatron Electronique / RATP sub clause 7.3, 7.4.5, 7.6, 7.7, 7.8
MOTOROLA Motorola ESG 207 route de Ferney P O Box 15 1218 Grand-Saconnex Geneva Switzerland	Details not available.
ON-TRACK INNOVATIONS Z.H.R. Industrial Zone P O Box 32 Rosh-Pina 12000 Israel	Patent EP 0 492 569 B1 A system and method for the non-contact transmission of data.
PHILIPS Director Philips Corporate Intellectual Property Koninklijke Philips Electronics N.V. P. O. Box 220 5600 AE Eindhoven The Netherlands	PHO 94.520 EP-PS 066 9591 (BE,CH,DE,DK,ES,FR,GB,IT,NL,SE) AT-PS 401 127 Related to “anticollision” as specified in ISO/IEC 14443-3

The following companies may hold patents relating to this part of ISO/IEC 14443 but have not provided details of the patents or agreed to provide licences.

Patent holder	**Details**
WAYNE S FOLETTA 4760 Castlewood Drive San Jose, California CA 9512 USA	US 4 650 981
JOHN W HALPERN C/O Vincent M DeLuca Rothwell, Figg, Ernst & Kurz, p.c. 555 Thirteenth Street, N.W. Suite 701 East Tower Washington, D.C. 20004	US Patent No. 4, 661,691
MAGELLAN CORPORATION 8717 Research Drive Irvine CA 92618 USA	WO 89 05549 A

Attention is drawn to the possibility that some of the elements of this part of ISO/IEC 14443 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.

Identification cards — Contactless integrated circuit(s) cards — Proximity cards —

Part 3: Initialization and anticollision

1 Scope

This part of ISO/IEC 14443 describes:

— polling for proximity cards (PICCs) entering the field of a proximity coupling device (PCD);

— the byte format, the frames and timing used during the initial phase of communication between PCDs and PICCs;

— the initial Request and Answer to Request command content;

— methods to detect and communicate with one PICC among several PICCs (anticollision);

— other parameters required to initialize communications between a PICC and PCD;

— optional means to ease and speed up the selection of one PICC among several PICCs based on application criteria.

Protocol and commands used by higher layers and by applications and which are used after the initial phase are described in ISO/IEC 14443-4.

This part of ISO/IEC 14443 is applicable to PICCs of Type A and of Type B (as described in ISO/IEC 14443-2).

NOTE Part of the timing of data communication is defined in ISO/IEC 14443-2.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 14443. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO/IEC 14443 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 7816-3:1997, *Information technology — Identification cards — Integrated circuit(s) cards with contacts — Part 3: Electronic signals and transmission protocols*.

ISO/IEC 7816-5, *Identification cards — Integrated circuit(s) cards with contacts — Part 5: Numbering system and registration procedure for application identifiers*.

ISO/IEC 7816-6:1996/Amd.1:2000, *Identification cards — Integrated circuit(s) cards with contacts — Part 6: Interindustry data elements — Amendment 1: IC manufacturer registration*.

ISO/IEC 13239, *Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures*.

ISO/IEC 14443-2, *Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 2: Radio frequency power and signal interface*.

ISO/IEC 14443-4, *Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 4: Transmission protocol*.

ITU-T X.25, *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit*.

ITU-T V.41, *Code-independent error-control system*.

ITU-T V.42, *Error-correcting procedures for DCEs using asynchronous-to-synchronous conversion*.

3 Terms and definitions

For the purposes of this part of ISO/IEC 14443, the terms and definitions given in ISO/IEC 14443-2, ISO/IEC 7816-3 and the following apply.

3.1
anticollision loop
algorithm used to prepare for dialogue between PCD and one or more PICCs out of the total number of PICCs responding to a request command

3.2
bit collision detection protocol
anticollision method for PICCs of Type A, employing collision detection at bit level within a frame

3.3
byte
8 bits of data designated b8 to b1, from the most significant bit (MSB, b8) to the least significant bit (LSB, b1)

3.4
collision
transmission by two PICCs in the same PCD energizing field and during the same time period, such that the PCD is unable to distinguish from which PICC the data originated

3.5
elementary time unit
etu
for this part of ISO/IEC 14443, one etu is defined as 1 etu = 128/*fc* (i.e. 9,4 µs nominal)

3.6
frame
sequence of data bits and optional error detection bits, with frame delimiters at start and end

3.7
higher layer protocol
protocol layer (not described in this part of ISO/IEC 14443) that makes use of the protocol layer defined in this part of ISO/IEC 14443 to transfer information belonging to the application or higher layers of protocol that is not described in this part of ISO/IEC 14443

3.8
timeslot protocol
method whereby a PCD establishes logical channels with one or more PICCs of Type B, which makes use of timeslot allocation for PICC response

3.9
request command
command requesting PICC of the appropriate type to respond if they are available for initialization

4 Symbols and abbreviated terms

For the purposes of this part of ISO/IEC 14443, the following abbreviations are used:

ADC	Application Data Coding, Type B
AFI	Application Family Identifier. Card preselection criteria by application, Type B
APf	Anticollision Prefix f, used in REQB/WUPB, Type B
APn	Anticollision Prefix n, used in Slot-MARKER Command, Type B
ATQA	Answer To Request, Type A
ATQB	Answer To Request, Type B
ATTRIB	PICC selection command, Type B
BCC	UID CLn check byte, calculated as exclusive-or over the 4 previous bytes, Type A
CID	Card IDentifier
CLn	Cascade Level n, Type A
CT	Cascade Tag, Type A
CRC_A	Cyclic Redundancy Check error detection code A
CRC_B	Cyclic Redundancy Check error detection code B
E	End of communication, Type A
EGT	Extra Guard Time, Type B
EOF	End Of Frame, Type B
etu	Elementary time unit.
FDT	Frame Delay Time, Type A
fc	Carrier frequency
FO	Frame Option
fs	Subcarrier frequency
FWI	Frame Waiting time Integer
FWT	Frame Waiting Time
HLTA	Halt Command, Type A
HLTB	Halt Command, Type B

ID	IDentification number, Type A
INF	INFormation field belonging to higher layer, Type B
LSB	Least Significant Bit
MBL	Maximum Buffer Length, Type B
MBLI	Maximum Buffer Length Index, Type B
MSB	Most Significant Bit
N	Number of anticollision slots or PICC response probability in each slot, Type B
n	Variable integer value as defined in the specific clause
NAD	Node ADdress
NVB	Number of Valid Bits, Type A
P	Odd Parity bit, Type A
PCD	Proximity Coupling Device
PICC	Proximity Card
PUPI	Pseudo-Unique PICC Identifier, Type B
R	Slot number chosen by the PICC during the anticollision sequence, Type B
REQA	Request Command, Type A
REQB	Request Command, Type B
RFU	Reserved for Future ISO/IEC Use
S	Start of communication, Type A
SAK	Select AcKnowledge, Type A
SEL	SELect code, Type A
SELECT	Select Command, Type A
SOF	Start Of Frame, Type B
TR0	Guard Time as defined in ISO/IEC 14443-2, Type B
TR1	Synchronization Time as defined in ISO/IEC 14443-2, Type B
UID	Unique Identifier, Type A
uid*n*	Byte number *n* of Unique IDentifier, $n \geq 0$
WUPA	Wake-UP Command, Type A
WUPB	Wake-UP Command, Type B

For the purposes of this part of ISO/IEC 14443, the following notation applies:

— (xxxxx)b Data bit representation;

— 'XY' Hexadecimal notation, equal to XY to the base 16.

5 Polling

In order to detect PICCs which are in the operating field, a PCD shall send repeated Request commands. The PCD shall send REQA and REQB described herein in any sequence and in addition may send other commands as described in Annex C.

When a PICC is exposed to an unmodulated operating field (see ISO/IEC 14443-2) it shall be able to accept a request within 5 ms.

EXAMPLE 1 When a PICC Type A receives any Type B command it shall be able to accept a REQA within 5 ms of unmodulated operating field.

EXAMPLE 2 When a PICC Type B receives any Type A command it shall be able to accept a REQB within 5 ms of unmodulated operating field.

6 Type A – Initialization and anticollision

This section describes the initialization and collision detection protocol applicable for PICCs of Type A.

The PCD shall be designed to detect a collision that occurs when at least two PICCs simultaneously transmit bit patterns with one or more bit positions in which at least two PICCs transmit complementary values. In this case the bit patterns merge and the carrier is modulated with the subcarrier for the whole (100%) bit duration (see ISO/IEC 14443-2).

6.1 Frame format and timing

This section defines the frame format and timing used during communication initialization and anticollision. For bit representation and coding refer to ISO/IEC 14443-2.

Frames shall be transferred in pairs, PCD to PICC followed by PICC to PCD, using the sequence:

— PCD frame:

  — PCD start of communication

  — information and, where required, error detection bits sent by the PCD

  — PCD end of communication

— Frame delay time PCD to PICC

— PICC frame:

  — PICC start of communication

  — information and, where required, error detection bits sent by the PICC

  — PICC end of communication

— Frame delay time PICC to PCD

The frame delay time (FDT) from PCD to PICC overlaps the PCD end of communication.

6.1.1 Frame delay time

The frame delay time FDT is defined as the time between two frames transmitted in opposite directions.

6.1.2 Frame delay time PCD to PICC

This is the time between the end of the last pause transmitted by the PCD and the first modulation edge within the start bit transmitted by the PICC and shall respect the timing defined in Figure 1, where *n* is an integer value.

Table 1 defines values for *n* and FDT depending on the command type and the logic state of the last transmitted data bit in this command.

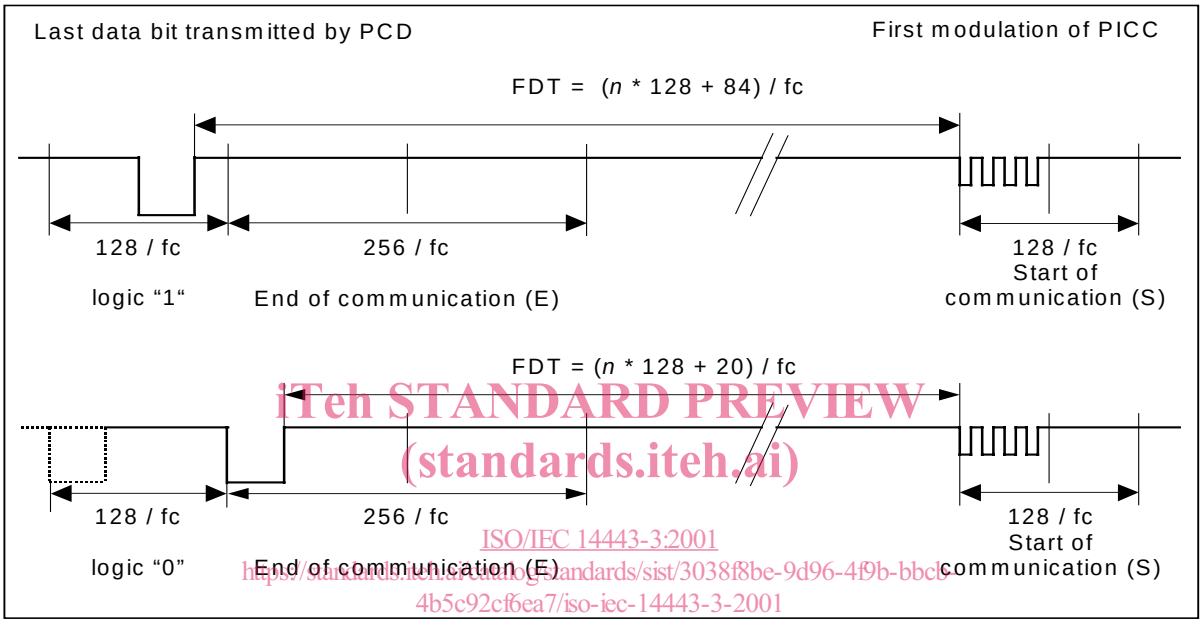

Figure 1 — Frame delay time PCD to PICC

Table 1 — Frame delay time PCD to PICC

Command type	*n* (integer value)	FDT	
		last bit = (1)b	last bit = (0)b
REQA Command WUPA Command ANTICOLLISION Command SELECT Command	9	1236 / *fc*	1172 / *fc*
All other commands	≥ 9	(*n* * 128 + 84) / *fc*	(*n* * 128 + 20) / *fc*

The value *n* = 9 means that all PICCs in the field shall respond in a synchronous way which is needed for anticollision.

For all other commands the PICC shall ensure that the first modulation edge within the start bit is aligned to the bit-grid defined in Figure 1.

6.1.3 Frame delay time PICC to PCD

This is the time between the last modulation transmitted by the PICC and the first pause transmitted by the PCD and shall be at least 1172 / *fc*.

6.1.4 Request Guard Time

The Request Guard Time is defined as the minimum time between the start bits of two consecutive REQA commands. It has the value 7000 / *fc*.

6.1.5 Frame formats

The following frame types are defined:

— short frames for commands defined in Table 2;

— standard frames for regular commands;

— bit oriented anticollision frame for anticollision command.

6.1.5.1 Short frame

A short frame is used to initiate communication and consists of, in the following order:

— start of communication;

— 7 data bits transmitted LSB first (for coding see Table 2);

— end of communication.

No parity bit is added.

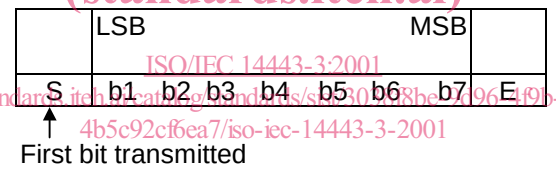

Figure 2 — Short frame

6.1.5.2 Standard frame

Standard frames are used for data exchange and consist of:

— start of communication;

— n * (8 data bits + odd parity bit), with n ≥ 1. The LSB of each byte is transmitted first. Each byte is followed by an odd parity bit. The parity bit P is set such that the number of 1s is odd in (b1 to b8, P);

— end of communication.

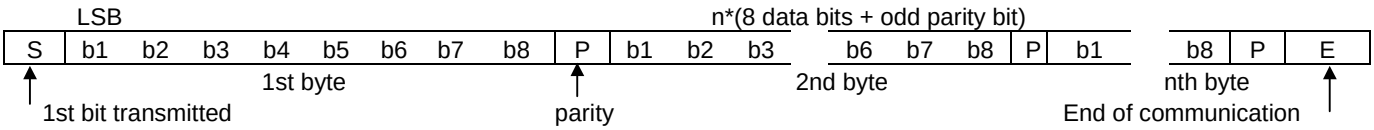

Figure 3 — Standard Frame

6.1.5.3 Bit oriented anticollision frame

A collision is detected when at least two PICCs transmit different bit patterns to the PCD. In this case the carrier is modulated with the subcarrier for the whole bit duration for at least one bit.