INTERNATIONAL STANDARD

ISO/IEC 14443-3

Second edition
2011-04-15

Identification cards — Contactless integrated circuit 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. 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 14443-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and personal identification*.

This second edition cancels and replaces the first edition (ISO/IEC 14443-3:2001), which has been technically revised.

It also incorporates the Amendments ISO/IEC 14443-3:2001/Amd.1:2005 and ISO/IEC 14443-3:2001/Amd.3:2006, and the Technical Corrigendum ISO/IEC 14443-3:2001/Amd.1:2005/Cor.1:2006.

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

— *Part 1: Physical characteristics*

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

— *Part 3: Initialization and anticollision*

— *Part 4: Transmission protocol*

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 document may involve the use of patents.

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

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

Patent holder	Details
FRANCE TELECOM Orange Labs 38-40 rue de Général Leclerc 92794 Issy-les-Moulineaux France	US Patent US5359323
INNOVOTRON 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 subclause 7.3, 7.6 and 7.7 French Patent App 98.00383 Int Pat App PCT/FR99/00079 Innovatron Electronique / RATP subclause 7.3, 7.4.5, 7.6, 7.7, 7.8
MOTOROLA Motorola ESG Now: Freescale Semiconductor Inc. 6501 William Cannon Drive West Austin, Texas 78735 USA	Details not available.

PHILIPS	PHO 94.520
Philips Intellectual Property & Standards	EP-PS 066 9591
High Tech Campus 44	(BE,CH,DE,DK,ES,FR,GB,IT,NL,SE)
5656 AE Eindhoven	AT-PS 401 127
The Netherlands	Related to “anticollision” as specified in ISO/IEC 14443-3

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.

Identification cards — Contactless integrated circuit cards — Proximity cards

Part 3: Initialization and anticollision

1 Scope

This part of ISO/IEC 14443 describes:

— polling for proximity cards or objects (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 1 Part of the timing of data communication is defined in ISO/IEC 14443-2.

NOTE 2 Test methods for this International Standard are defined in ISO/IEC 10373-6.

2 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 13239, *Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures*

ISO/IEC 7816-4:2005, *Identification cards — Integrated circuit cards — Part 4: Organization, security and commands for interchange*

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 14443-2 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
byte
byte consisting of 8 bits of data designated b8 to b1, from the most significant bit (MSB, b8) to the least significant bit (LSB, b1)

3.3
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

3.4
frame
sequence of data bits and optional error detection bits, with frame delimiters at start and end

3.5
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 not described in this part of ISO/IEC 14443

3.6
request command
command requesting PICCs of the appropriate type to respond if they are available for initialization

4 Symbols, abbreviated terms and notation

For the purposes of this document, the following symbols, abbreviated terms and notation apply.

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	Block Check Character (UID CL*n* check byte), Type A
CID	Card IDentifier
CL*n*	Cascade Level *n*, Type A
CT	Cascade Tag, Type A
CRC_A	Cyclic Redundancy Check error detection code, Type A
CRC_B	Cyclic Redundancy Check error detection code, Type B
D	Divisor
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 PCD to PICC, Type A
fc	carrier frequency
FO	Frame Option, Type B
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, 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 or object
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 Use by ISO/IEC
S	Start of communication, Type A
SAK	Select AcKnowledge, Type A
SEL	SELect code, Type A
SELECT	SELECT command, Type A
SFGI	Start-up Frame Guard time Integer
SFGT	Start-up Frame Guard Time
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
TR2	Frame delay Time PICC to PCD, Type B
UID	Unique IDentifier, Type A
UID CL*n*	Unique IDentifier of CL*n*, 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 document, the following notation applies:

— (xxxxx)b Data bit representation;

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

5 Alternating between Type A and Type B commands

5.1 Polling

In order to detect PICCs which are in the operating field, a PCD shall send repeated Request commands. The PCD shall send REQA (or WUPA) and REQB (or WUPB) in any sequence using an equal or configurable duty cycle when polling Type A and Type B. In addition the PCD 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 (or WUPA) 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 (or WUPB) within 5 ms of unmodulated operating field.

EXAMPLE 3 When a PICC Type A is exposed to field activation it shall be able to accept a REQA (or WUPA) within 5 ms of unmodulated operating field.

EXAMPLE 4 When a PICC Type B is exposed to field activation it shall be able to accept a REQB (or WUPB) within 5 ms of unmodulated operating field.

NOTE In order to detect PICCs requiring 5 ms, PCDs should periodically present an unmodulated field of at least 5,1 ms duration (prior to both Type A and Type B Request commands), but may poll more rapidly because PICCs may react faster.

5.2 Influence of Type A commands on PICC Type B operation

A PICC Type B shall either go to IDLE state (be able to accept a REQB) or be able to continue a transaction in progress after receiving any Type A command.

5.3 Influence of Type B commands on PICC Type A operation

A PICC Type A shall either go to IDLE state (be able to accept a REQA) or be able to continue a transaction in progress after receiving any Type B command.

5.4 Transition to POWER-OFF state

The PICC shall be in the POWER-OFF state no later than 5 ms after the operating field is switched off.

6 Type A – Initialization and anticollision

This section describes the initialization and anticollision sequence applicable for PICCs of Type A.

A PICC or PCD sending RFU bits shall set these bits to the value indicated herein or to (0)b if no value is given. A PICC or PCD receiving RFU bits shall disregard the value of these bits and shall maintain and not change its function, unless explicitly stated otherwise.

6.1 Bit rates

Communication between PCD and PICC can be achieved with four different bit rates.

Bit rates of *fc* / 64, *fc* / 32 and *fc* / 16 are optional and may be independently supported by PCD and PICC in each communication direction, defined in Table 1.

Table 1 — Bit rates

Divisor D	etu	Bit rate
1	128 / *fc* (~ 9,4 µs)	*fc* / 128 (~ 106 kbit/s)
2 (optional)	128 / (2 *fc*) (~ 4,7 µs)	*fc* / 64 (~ 212 kbit/s)
4 (optional)	128 / (4 *fc*) (~ 2,4 µs)	*fc* / 32 (~ 424 kbit/s)
8 (optional)	128 / (8 *fc*) (~ 1,2 µs)	*fc* / 16 (~ 848 kbit/s)

NOTE The initial bit rate is *fc* / 128. This applies for the whole initialization and anticollision sequence.

6.2 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

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

6.2.1 Frame delay time

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

6.2.1.1 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 and Table 2 where *n* is an integer value.

Table 2 defines values for *n* and FDT depending on the command type and the logic state of the last transmitted data bit in this command.

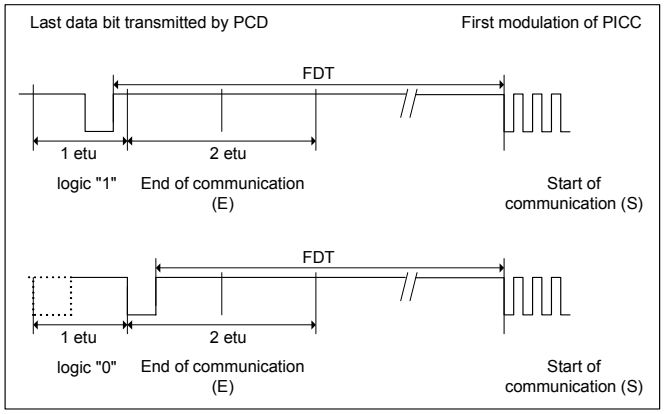

Figure 1 — Frame delay time PCD to PICC

Table 2 — 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	(*n* x 128 + 84) / *fc* [= 1236 / *fc*]	(*n* x 128 + 20) / *fc* [= 1172 / *fc*]
All other commands at bit rates				
PCD to PICC	PICC to PCD			
fc / 128	*fc* / 128	≥ 9	(*n* x 128 + 84) / *fc*	(*n* x 128 + 20) / *fc*
fc / 64		≥ 8	(*n* x 128 + 148) / *fc*	(*n* x 128 + 116) / *fc*
fc / 32		≥ 8	(*n* x 128 + 116) / *fc*	(*n* x 128 + 100) / *fc*
fc / 16		≥ 8	(*n* x 128 + 100) / *fc*	(*n* x 128 + 92) / *fc*
fc / 128 or *fc* / 64 or *fc* / 32 or *fc* / 16	*fc* / 64 or *fc* / 32 or *fc* / 16	Not applicable	≥ 1116 / *fc*	≥ 1116 / *fc*
For anticollision, all PICCs in the field shall respond in a synchronous way to the commands: REQA, WUPA, ANTICOLLISION and SELECT.				

The FDT measurement starts at the beginning of the rising edge as specified in ISO/IEC 14443-2 and illustrated with small circles in Figure 3 for *fc* / 128 and Figure 6 for other bit rates.

The measured FDT shall be between the value given in Table 2 and the value given in Table 2 + 0,4 µs.

NOTE The PCD should accept a response with a FDT tolerance of –1 / *fc* to (+0,4 µs + 1 / *fc*).

6.2.1.2 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*.