



**BSI Standards Publication**

# **Cards and security devices for personal identification — Contactless proximity objects**

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Part 3: Initialization and anticollision

## National foreword

This British Standard is the UK implementation of ISO/IEC 14443-3:2018+A1:2021. It supersedes BS ISO/IEC 14443-3:2018+A2:2020, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to ISO/IEC text carry the number of the ISO/IEC amendment. For example, text altered by ISO/IEC amendment 1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee IST/17, Cards and security devices for personal identification.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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**Cards and security devices for  
personal identification — Contactless  
proximity objects —**

**Part 3:  
Initialization and anticollision**

*Cartes et dispositifs de sécurité pour l'identification personnelle —  
Objets sans contact de proximité —*

*Partie 3: Initialisation et anticollision*



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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This document was prepared by ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and security devices for personal identification*.

This fourth edition cancels and replaces the third edition (ISO/IEC 14443-3:2016), which has been technically revised.

The following are the main changes since the last edition:

- RFU handling rules and clarifications have been added;
- Annexes D and E have been removed.

A list of all the parts in the ISO/IEC 14443 series can be found on the ISO website.

## Introduction

The ISO/IEC 14443 series of standards describes the parameters for identification cards or objects for international interchange.

This document 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.

The ISO/IEC 14443 series of standards is intended to allow operation of proximity cards in the presence of other contactless cards or objects conforming to the ISO/IEC 10536 series of standards and the ISO/IEC 15693 series of standards and near field communication (NFC) devices conforming to ISO/IEC 18092 and ISO/IEC 21481.

# Cards and security devices for personal identification — Contactless proximity objects —

## Part 3: Initialization and anticollision

### 1 Scope

This document describes the following:

- 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;
- optional capability to allow a device to alternate between the functions of a PICC and a PCD to communicate with a PCD or a PICC, respectively. A device which implements this capability is called a PXD.

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 document is applicable to PICCs of Type A and of Type B (as described in ISO/IEC 14443-2), to PCDs (as described in ISO/IEC 14443-2) and to PXDs.

NOTE 1 Part of the timing of data communication is defined in ISO/IEC 14443-2.

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

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 7816-4, *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 13239, *Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures*

ISO/IEC 14443-2, *Cards and security devices for personal identification — Contactless proximity objects — Part 2: Radio frequency power and signal interface*

ISO/IEC 14443-4, *Cards and security devices for personal identification — Contactless proximity objects — 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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

#### 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

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 frame error

error on SOF, start and stop bits, parity bits, EOF

#### 3.6 higher layer protocol

protocol layer (not described in this document) that makes use of the protocol layer defined in this document to transfer information belonging to the application or higher layers of protocol that is not described in this document

#### 3.7 PCD Mode

mode in which a PXD operates as a PCD

#### 3.8 PICC Mode

mode in which a PXD operates as a PICC

#### 3.9 request command

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

#### 3.10 transmission error

frame error or CRC\_A or CRC\_B error

## 4 Symbols, abbreviated terms and notations

### 4.1 Symbols and abbreviated terms

|                                             |                                                                                  |
|---------------------------------------------|----------------------------------------------------------------------------------|
| 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 <sub>n</sub> check byte), Type A                   |
| CID                                         | Card Identifier                                                                  |
| CL <sub>n</sub>                             | cascade level <i>n</i> , 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                                             |
| <i>f<sub>c</sub></i>                        | carrier frequency                                                                |
| FO                                          | Frame Option, Type B                                                             |
| <i>f<sub>s</sub></i>                        | subcarrier frequency                                                             |
| FWI                                         | Frame Waiting time Integer                                                       |
| FWT                                         | Frame Waiting Time                                                               |
| $\boxed{A_1}$ <i>H</i> <sub>LP</sub>        | minimum requested field strength $\boxed{A_1}$                                   |
| HLTA                                        | halt command, Type A                                                             |
| HLTB                                        | halt command, Type B                                                             |
| $\boxed{A_1}$ <i>H</i> <sub>step, max</sub> | PCD maximum field strength step increase or step decrease $\boxed{A_1}$          |
| 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                                                 |
| $\langle A1 \rangle$ PLI <sub>ATQ</sub> | Power Level Indication in Answer to Request $\langle A1 \rangle$         |
| PUPI                                    | Pseudo-Unique PICC Identifier, Type B                                    |
| PXD                                     | proximity extended device                                                |
| 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                                                  |
| 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                                                   |
| $t_{cyc}$                               | maximum automatic mode alternation cycle time                            |
| $t_{diff}$                              | minimum time difference of PICC Mode durations                           |
| $t_{E, PICC}$                           | low EMD time, PICC                                                       |
| $t_{E, PCD}$                            | low EMD time, PCD                                                        |
| $\langle A1 \rangle t_{PL}$             | guard time for PCD power level change $\langle A1 \rangle$               |
| 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                          |

## 4.2 Notations

- (xxxxx)b data bit representation
- 'XY' hexadecimal notation, equal to XY to the base 16

## 5 General requirements

### 5.1 Alternating PICC and PCD support (PXD)

A proximity extended device (PXD) shall alternately support PICC requirements (PICC Mode) and PCD requirements (PCD Mode).

The alternation between the PICC Mode and the PCD Mode may be either automatic or a Mode (PICC Mode or PCD Mode) may be explicitly selected by the user.

The PICC Mode and the PCD Mode are defined as PICC and PCD in the ISO/IEC 14443 series of standards.

The automatic alternation is defined as follows:

- the PXD shall alternate between the PICC Mode and the PCD Mode with maximum cycle time  $t_{cyc} = 1$  s and shall stay in PICC Mode (ready for receiving REQA/WUPA or REQB/WUPB commands, except for the first 5 ms) longer than in PCD Mode (generating operating field), until a communication to either a PICC, a PCD or another PXD is established;
- the PXD shall randomly set the PICC Mode duration for each cycle to a value chosen from a set of at least two different values differing by at least  $t_{diff} = 5$  ms between each of them;
- in PICC Mode, after reception of a valid REQA/WUPA or REQB/WUPB command, the PXD shall not go in PCD Mode before a POWER-OFF state;
- when leaving the PCD Mode after processing of a PICC (or a PXD in PICC mode), the PXD shall resume its automatic mode alternation with the PICC Mode first.

The PXD may check the presence of external operating field to decide not to enter PCD Mode, i.e. to stay in PICC Mode for a further random PICC Mode duration.

The detection of the removal of a PICC (or PXD in PICC Mode) should be done by a PICC presence check method without switching off the operating field to keep the same UID/PUPI and to avoid PXD entering the PCD Mode.

### 5.2 Alternating between Type A and Type B commands

#### 5.2.1 Polling

In order to detect PICCs which are in the operating field, the 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 RF 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 RF 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 RF 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 RF 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 RF field.

**EXAMPLE 5**

When a PICC supporting Type A and Type B is exposed to field activation, it shall be able to accept a REQA (or WUPA) within 5 ms of unmodulated RF field.

**EXAMPLE 6**

When a PICC supporting Type A and Type B is exposed to field activation, it shall be able to accept a REQB (or WUPB) within 5 ms of unmodulated RF field.

In order to detect PICCs requiring 5 ms, the PCD should periodically present an unmodulated RF 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.

If the PICC supports Type A and Type B, then it shall be locked in the type of the first processed request command (after Answer to Request of one type, the other type is disabled until the PICC enters POWER-OFF state).

The PCD may need to adapt its polling cycle if it wants to detect such a PICC in the disabled type.

### **5.2.2 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 frame.

A PICC Type B should have the same behavior after receiving any frame of any other standard using the same carrier frequency.

### **5.2.3 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 frame. If the PICC Type A is in READY\* or ACTIVE\* state when receiving any Type B frame, it may also go to HALT state as described in [Figure 7](#).

A PICC Type A should have the same behavior after receiving any frame of any other standard using the same carrier frequency.

### 5.2.4 Transition to POWER-OFF state

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

### <sup>A2</sup> 5.2.5 PCD operating field reset

To reset the operating field the PCD shall switch off the operating field for at least 5,1 ms followed by presenting an unmodulated RF field for at least 5,1 ms. <sup>A2</sup>

## 5.3 RFU handling

For the purposes of this document, the following general rules apply.

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

## 6 Type A — Initialization and anticollision

### 6.1 etu

The value of the etu for each bit rate is defined in [Table 1](#).

**Table 1 — etu**

| Bit rate |                  | etu      |             |
|----------|------------------|----------|-------------|
| $fc/128$ | (~ 106 kbit/s)   | $128/fc$ | (~ 9,4 µs)  |
| $fc/64$  | (~ 212 kbit/s)   | $64/fc$  | (~ 4,7 µs)  |
| $fc/32$  | (~ 424 kbit/s)   | $32/fc$  | (~ 2,4 µs)  |
| $fc/16$  | (~ 848 kbit/s)   | $16/fc$  | (~ 1,2 µs)  |
| $fc/8$   | (~ 1,70 Mbit/s)  | $8/fc$   | (~ 0,59 µs) |
| $fc/4$   | (~ 3,39 Mbit/s)  | $4/fc$   | (~ 0,29 µs) |
| $fc/2$   | (~ 6,78 Mbit/s)  | $2/fc$   | (~ 0,15 µs) |
| $3fc/4$  | (~ 10,17 Mbit/s) | $4/fc$   | (~ 0,29 µs) |
| $fc$     | (~ 13,56 Mbit/s) | $4/fc$   | (~ 0,29 µs) |
| $3fc/2$  | (~ 20,34 Mbit/s) | $2/fc$   | (~ 0,15 µs) |
| $2fc$    | (~ 27,12 Mbit/s) | $2/fc$   | (~ 0,15 µs) |

### 6.2 Frame format and timing

This subclause 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 following 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.

For bit rates of  $fc/8$ ,  $fc/4$  and  $fc/2$ , the FDT starts at the end of the last modulation transmitted by the PCD.

For bit rates of  $3fc/4$ ,  $fc$ ,  $3fc/2$ , and  $2fc$ , the FDT starts at the end of the last phase modulation transmitted by the PCD.

[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.

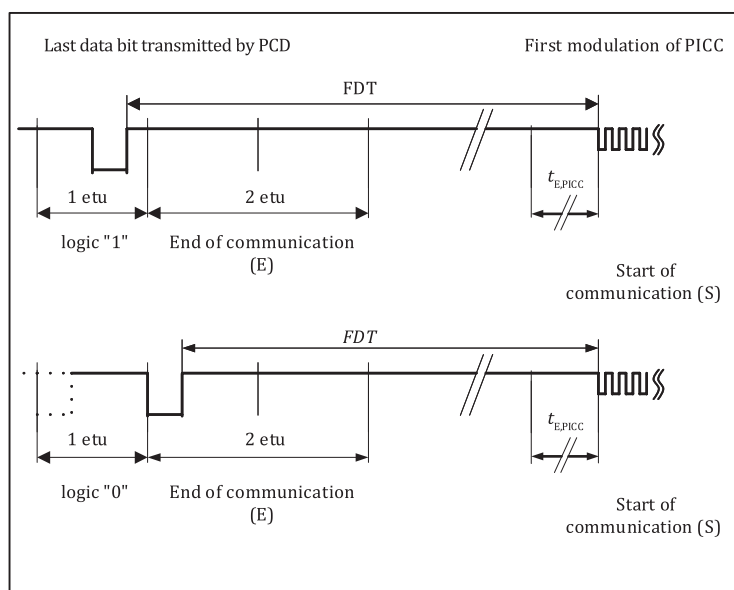


Figure 1 — Frame delay time PCD to PICC for bit rates up to  $fc/16$

NOTE  $t_{E, PICC}$  is specified in [Clause 8](#).

Table 2 — Frame delay time PCD to PICC

| Command type                                                                                                                        |                                                                      | <i>n</i> (integer value) | FDT                                             |                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------|-------------------------------------------------|-------------------------------------------------|
|                                                                                                                                     |                                                                      |                          | last bit = (1)b                                 | last bit = (0)b                                 |
| REQA command<br>WUPA command<br>ANTICOLLISION command<br>SELECT command                                                             |                                                                      | 9                        | $(n \times 128 + 84)/f_c$<br>[ = 1 236/ $f_c$ ] | $(n \times 128 + 20)/f_c$<br>[ = 1 172/ $f_c$ ] |
| <b>All other commands at bit rates</b>                                                                                              |                                                                      |                          |                                                 |                                                 |
| PCD to PICC                                                                                                                         | PICC to PCD                                                          |                          |                                                 |                                                 |
| $f_c/128$                                                                                                                           | $f_c/128$                                                            | $\geq 9$                 | $(n \times 128 + 84)/f_c$                       | $(n \times 128 + 20)/f_c$                       |
| $f_c/64$                                                                                                                            |                                                                      | $\geq 8$                 | $(n \times 128 + 148)/f_c$                      | $(n \times 128 + 116)/f_c$                      |
| $f_c/32$                                                                                                                            |                                                                      | $\geq 8$                 | $(n \times 128 + 116)/f_c$                      | $(n \times 128 + 100)/f_c$                      |
| $f_c/16$                                                                                                                            |                                                                      | $\geq 8$                 | $(n \times 128 + 100)/f_c$                      | $(n \times 128 + 92)/f_c$                       |
| $f_c/128$ or $f_c/64$ or<br>$f_c/32$ or $f_c/16$ or $f_c/8$<br>or $f_c/4$ or $f_c/2$ or $3f_c/4$<br>or $f_c$ or $3f_c/2$ or $2f_c$  | $f_c/64$ or $f_c/32$ or $f_c/16$<br>or $f_c/8$ or $f_c/4$ or $f_c/2$ | Not applicable           | $\geq 1\ 116/f_c$                               | $\geq 1\ 116/f_c$                               |
| For anticollision, all PICCs in the field shall respond in a synchronous way to the commands: REQA, WUPA, ANTICOLLISION and SELECT. |                                                                      |                          |                                                 |                                                 |

If a bit rate higher than  $f_c/16$  is selected for PCD to PICC communication, then a bit rate of  $f_c/128$  is not allowed for PICC to PCD communication, see ISO/IEC 14443-4. This restriction is required because the necessary precise FDT is not defined for PCD NRZ-L coding which is used for bit rates higher than  $f_c/16$ .

The FDT measurement starts at the beginning of the rising edge as specified and illustrated with small circles in the following figures of ISO/IEC 14443-2:—<sup>1)</sup>:

- Figure titled “PauseA for a bit rate of  $f_c/128$ ” for PCD to PICC bit rate of  $f_c/128$ ;
- Figure titled “PauseA for bit rates of  $f_c/64$ ,  $f_c/32$ , and  $f_c/16$ ” for PCD to PICC bit rates of  $f_c/64$ ,  $f_c/32$  and  $f_c/16$ ;
- Figure titled “Type B modulation waveform” for PCD to PICC bit rates of  $f_c/8$ ,  $f_c/4$  and  $f_c/2$ .

The measured FDT shall be between the value given in Table 2 and the value given in Table 2 + 0,4  $\mu$ s.

The PCD should accept a response with a FDT tolerance of  $-1/f_c$  to  $(+0,4\ \mu\text{s} + 1/f_c)$ .

### 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 modulation transmitted by the PCD and shall be at least  $1\ 172/f_c$ .

To enhance interoperability, an additional waiting time of  $100/f_c$  should be incorporated in the PCD operation.

### 6.2.2 Request Guard Time

The Request Guard Time is defined as the minimum time between the start bits of two consecutive REQA or WUPA commands. It has the value  $7\ 000/f_c$ .

To enhance interoperability, an additional waiting time of  $100/f_c$  should be incorporated in the PCD operation.

1) Fourth edition to be published.

6.2.3 Frame formats

The following frame types are defined:

- short frames;
- standard frames;
- bit oriented anticollision frame;
- PCD standard frames for bit rates of  $fc/8$ ,  $fc/4$  and  $fc/2$ .

6.2.3.1 Short frame

A short frame is used to initiate communication and consists of, in the following order as illustrated in [Figure 2](#):

- start of communication;
- 7 data bits transmitted LSB first (for coding see [Table 3](#));
- end of communication.

No parity bit is added.

|   |                      |     |   |
|---|----------------------|-----|---|
|   | LSB                  | MSB |   |
| S | b1 b2 b3 b4 b5 b6 b7 |     | E |

Figure 2 — Short frame

6.2.3.2 Standard frames

6.2.3.2.1 PCD standard frame for bit rates of  $fc/128$ ,  $fc/64$ ,  $fc/32$  and  $fc/16$  and PICC standard frame

Standard frames are used for data exchange and consist of, in the following order:

- start of communication;
- $n \times (8 \text{ data bits} + \text{odd parity bit})$ , with  $n \geq 1$ . 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.

The PCD standard frame for bit rates of  $fc/128$ ,  $fc/64$ ,  $fc/32$  and  $fc/16$  is illustrated in [Figure 3](#).

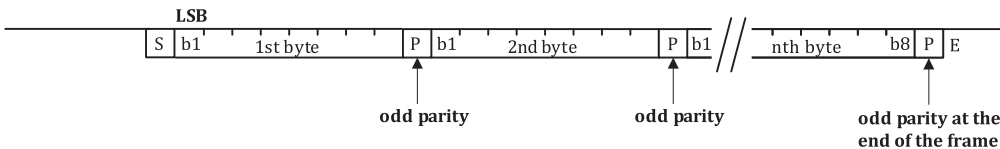


Figure 3 — PCD standard frame for bit rates of  $fc/128$ ,  $fc/64$ ,  $fc/32$  and  $fc/16$

As an exception, the last parity bit of a PICC standard frame shall be inverted if this frame is transmitted with a bit rate higher than  $fc/128$ . PICC standard frames are illustrated in [Figure 4](#).

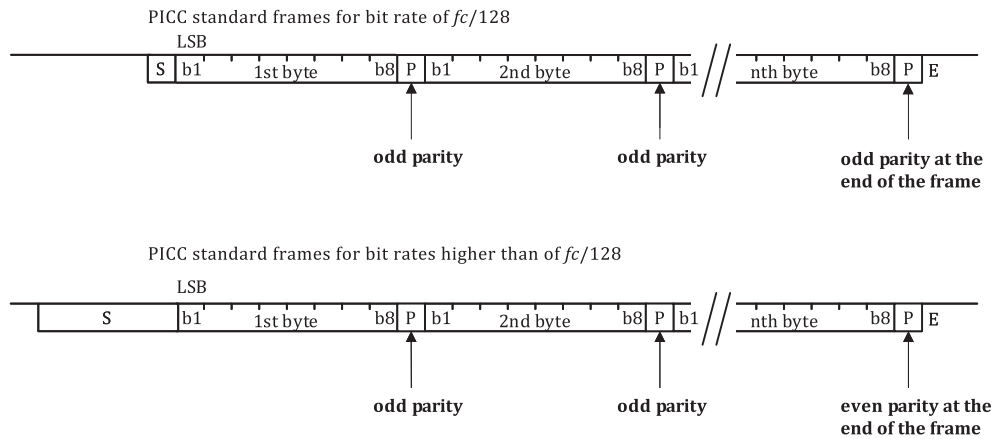


Figure 4 — PICC standard frames for all bit rates

#### 6.2.3.2.2 PCD standard frame for bit rates of $fc/8$ , $fc/4$ and $fc/2$

The character transmission format and character separation as defined in 7.1.1 and 7.1.2, respectively, shall be used.

The frame format is defined in 7.1.3.

#### 6.2.3.2.3 PCD standard frame for PCD to PICC bit rates of $3fc/4$ , $fc$ , $3fc/2$ and $2fc$

The standard frame format as defined in 6.2.3.2.1 shall be used.

Start and end of communication are specified in ISO/IEC 14443-2.

#### 6.2.3.3 Bit oriented anticollision frame

The PCD shall 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:—, 8.2.5.1).

Bit oriented anticollision frames shall only be used during bit frame anticollision loops and are standard frames with a length of 7 bytes, split into the following two parts:

- part 1 for transmission from PCD to PICC;
- part 2 for transmission from PICC to PCD.

For the length of part 1 and part 2, the following rules shall apply:

- Rule 1: The sum of data bits shall be 56.
- Rule 2: The minimum length of part 1 shall be 16 data bits.
- Rule 3: The maximum length of part 1 shall be 48 data bits.

Consequently, the minimum length of part 2 shall be 8 data bit and the maximum length shall be 40 data bits.

Since the split can occur at any bit position within a byte, the following two cases are defined:

- case FULL BYTE: Split after a complete byte. A parity bit is added after the last data bit of part 1;
- case SPLIT BYTE: Split within a byte. No parity bit is added after the last data bit of part 1.

The Block Check Characters (BCC) is calculated as exclusive-or over the four previous bytes.

The following examples for case FULL BYTE and case SPLIT BYTE define the bit organization and order of bit transmission, illustrated in [Figure 5](#) and [Figure 6](#).

NOTE These examples include proper values for NVB and BCC.

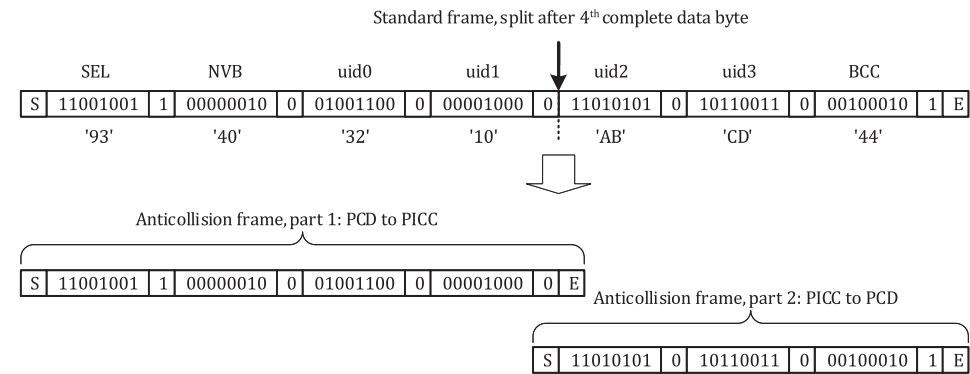


Figure 5 — Bit organization and transmission of bit oriented anticollision frame, case FULL BYTE

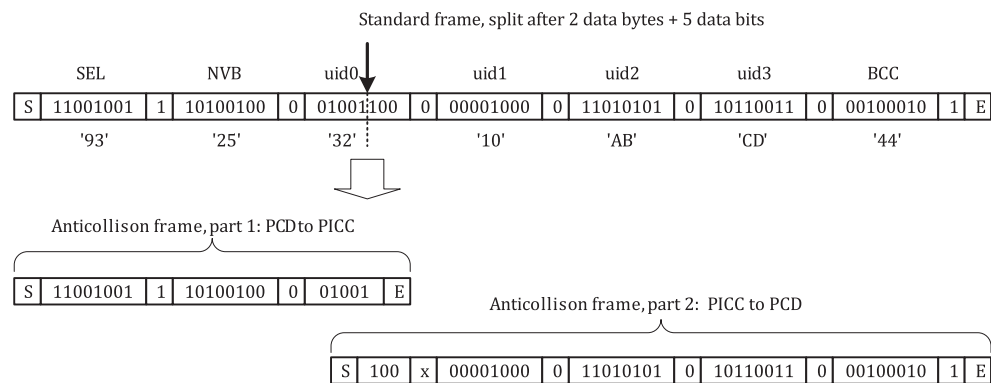


Figure 6 — Bit organization and transmission of bit oriented anticollision frame, case SPLIT BYTE

For a SPLIT BYTE, the PCD shall ignore the first parity bit of part 2.

6.2.4 CRC\_A

A frame that includes CRC\_A shall only be considered correct if it is received with a valid CRC\_A value.

The frame CRC\_A is a function of *k* data bits, which consist of all the data bits in the frame, excluding parity bits, S and E, and the CRC\_A itself. Since data is encoded in bytes, the number of bits *k* is a multiple of 8.

For error checking, the two CRC\_A bytes are sent in the standard frame, after the data bytes and before the E. The CRC\_A shall be as defined in ISO/IEC 13239 but the initial register content shall be '6363' and the register content shall not be inverted after calculation.

For examples, refer to [Annex B](#).

6.3 PICC states

The following subclauses provide descriptions of the states for a PICC Type A specific to the anticollision sequence.

The state diagram in [Figure 7](#) specifies all possible state transitions caused by commands of this part of ISO/IEC 14443. PICCs shall react to valid received frames only. No response shall be sent when transmission errors are detected except for PICCs in ACTIVE or ACTIVE\* state.

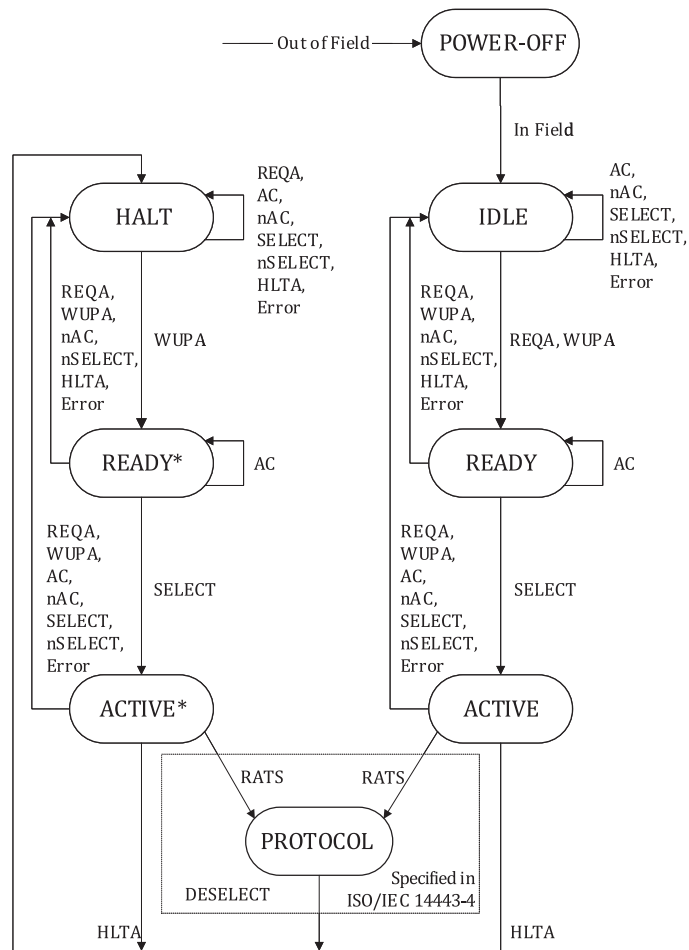


**Figure 7 — PICC Type A state diagram**

The following symbols apply for the state diagram shown in [Figure 7](#):

AC: ANTICOLLISION command (matched UID)

nAC: ANTICOLLISION command (not matched UID)

SELECT: SELECT command (matched UID)

nSELECT: SELECT command (not matched UID)

RATS: RATS command, defined in ISO/IEC 14443-4

DESELECT: DESELECT command, defined in ISO/IEC 14443-4

Error: transmission error detected or unexpected Type A command

PICCs being compliant with ISO/IEC 14443-3 but not selected with RATS from ISO/IEC 14443-4 may leave ACTIVE or ACTIVE\* state by proprietary commands.

### 6.3.1 POWER-OFF state

#### Description: