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Identification cards — Contactless integrated circuit cards — Proximity cards —

Part 3: Initialization and anticollision

Cartes d'identification — Cartes à circuit intégré sans contact — Cartes de proximité —
Partie 3: Initialisation et anticollision

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Foreword

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Identification cards and related devices*.

This third edition cancels and replaces the second edition (ISO/IEC 14443-3:2011), which has been technically revised. It also incorporates the Amendments ISO/IEC 14443-3:2011/Amd 1:2011, ISO/IEC 14443-3:2011/Amd 2:2012, ISO/IEC 14443-3:2011/Amd 3:2014 and ISO/IEC 14443-3:2011/Amd 6:2014.

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 anti-collision*

— *Part 4: Transmission protocol*

This corrected version of ISO/IEC 14443-3:2016 incorporates the following correction.

Figure 4 was corrected: The last parity bit of a PICC standard frame with bit rate higher than fc/128 was changed from “odd” to “even”.

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.

Identification cards — Contactless integrated circuit cards — Proximity cards —

Part 3: Initialization and anticollision

1 Scope

This part of ISO/IEC 14443 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 part of ISO/IEC 14443 is applicable to PICCs of Type A and of Type B (as described in ISO/IEC 14443-2) and 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 part of ISO/IEC 14443 are defined in ISO/IEC 10373-6.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *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
frame error
error on SOF, start and stop bits, parity bits, EOF

3.6
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

3.7
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 and abbreviated terms

For the purposes of this part of ISO/IEC 14443, the following symbols and abbreviated terms 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
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 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
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
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 part of ISO/IEC 14443, the following notations apply.

— (xxxxx)b data bit representation

— 'XY' hexadecimal notation, equal to XY to the base 16

5 Initial dialogs

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 ISO/IEC 14443.

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 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.

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 operating 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 operating field.

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.

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).

PCDs may need to adapt their polling cycles if they want 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 behaviour 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 behaviour 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 the POWER-OFF state no later than 5 ms after the operating field is switched off.

6 Type A — Initialization and anticollision

This Clause 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 etu

The value of the etu for each bit rate is defined in Table 1.

Table 1 — etu

Bit rates		etu	
fc/128	(~ 106 kbit/s)	128/*fc*	(~ 9,4 µs)
fc/64	(~ 212 kbit/s)	128/(2*fc*)	(~ 4,7 µs)
fc/32	(~ 424 kbit/s)	128/(4*fc*)	(~ 2,4 µs)
fc/16	(~ 848 kbit/s)	128/(8*fc*)	(~ 1,2 µs)
fc/8	(~ 1,70 Mbit/s)	128/(16*fc*)	(~ 0,59 µs)
fc/4	(~ 3,39 Mbit/s)	128/(32*fc*)	(~ 0,29 µs)
fc/2	(~ 6,78 Mbit/s)	128/(64*fc*)	(~ 0,15 µs)

For bit rates of 3*fc*/4, *fc*, 3*fc*/2 and 2*fc* see E.1.

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 3*fc*/4, *fc*, 3*fc*/2, and 2*fc* see E.2.1.1.

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.

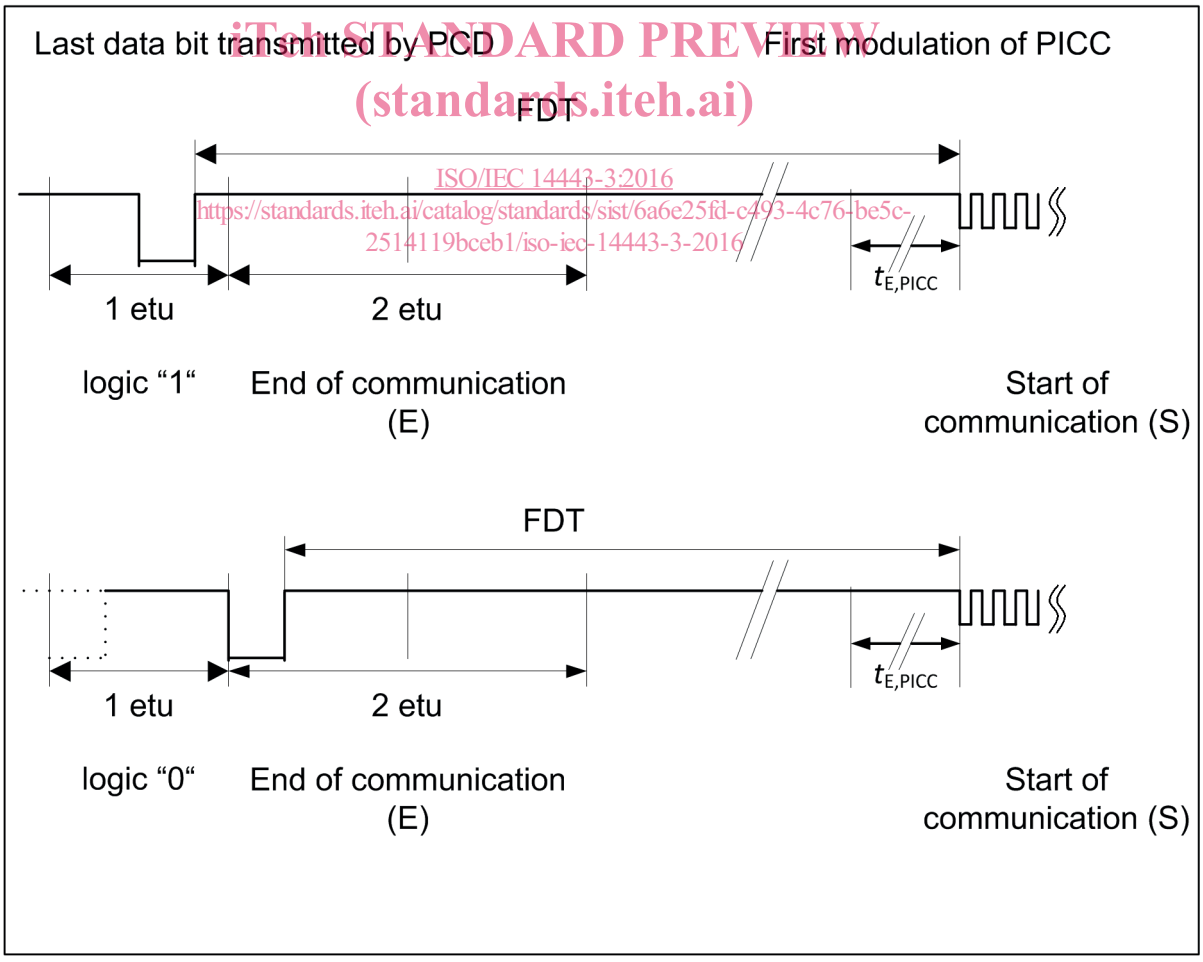

Figure 1 — Frame delay time PCD to PICC for bit rates up to *fc*/16

NOTE 1 $t_{E,\ PICC}$ is specified in Clause 8.

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* × 128 + 84)/*fc* [= 1 236/*fc*]	(*n* × 128 + 20)/*fc* [= 1 172/*fc*]
All other commands at bit rates				
PCD to PICC	PICC to PCD			
fc/128	*fc*/128	≥9	(*n* × 128 + 84)/*fc*	(*n* × 128 + 20)/*fc*
fc/64		≥8	(*n* × 128 + 148)/*fc*	(*n* × 128 + 116)/*fc*
fc/32		≥8	(*n* ×x 128 + 116)/*fc*	(*n* × 128 + 100)/*fc*
fc/16		≥8	(*n* × 128 + 100)/*fc*	(*n* × 128 + 92)/*fc*
fc/128 or *fc*/64 or *fc*/32 or *fc*/16 or *fc*/8 or *fc*/4 or *fc*/2 or 3*fc*/4 or *fc* or 3*fc*/2 or 2*fc*	*fc*/64 or *fc*/32 or *fc*/16 or *fc*/8 or *fc*/4 or *fc*/2	Not applicable	≥1 116/*fc*	≥1 116/*fc*
For anticollision, all PICCs in the field shall respond in a synchronous way to the commands: REQA, WUPA, ANTICOLLISION and SELECT.				

NOTE 2 If a bit rate higher than *fc*/16 is selected for PCD to PICC communication, then a bit rate of *fc*/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 coding which is used for bit rates higher than *fc*/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:

— Figure 3 for PCD to PICC bit rate of *fc*/128;

— Figure 6 for PCD to PICC bit rates of *fc*/64, *fc*/32 and *fc*/16;

— Figure 16 for PCD to PICC bit rates of *fc*/8, *fc*/4 and *fc*/2.

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

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 modulation transmitted by the PCD and shall be at least 1 172/*fc*.

To enhance interoperability, an additional waiting time of 100/*fc* 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/*fc*.

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

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* × (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.

The PCD standard frame for bit rates of *fc*/128, *fc*/64, *fc*/32 and *fc*/16 is illustrated in Figure 3.

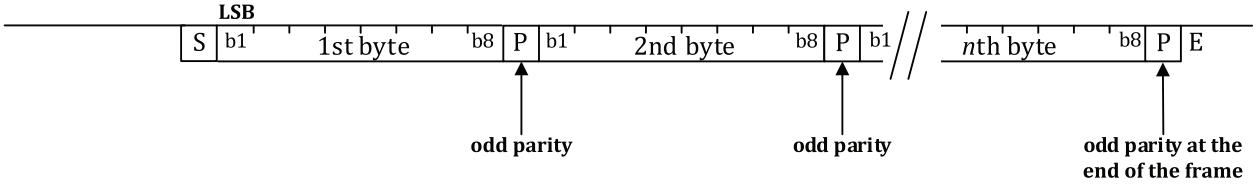

Figure 3 — PCD standard frame for bit rates of *fc*/128, *fc*/64, *fc*/32 and *fc*/16

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