INTERNATIONAL STANDARD

ISO/IEC 14443-2

Second edition
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Identification cards — Contactless integrated circuit cards — Proximity cards —

Part 2: Radio frequency power and signal interface

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

Partie 2: Interface radiofréquence et des signaux de communication

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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 14443-2 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 14443-2:2001), Clauses 6, 8 and 9 of which have been technically revised and Clause 10 removed. It also incorporates the Amendment ISO/IEC 14443-2:2001/Amd.1:2005 and the Technical Corrigendum ISO/IEC 14443-2:2001/Amd.1:2005/Cor.1:2007.

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 the electrical characteristics of two types of contactless interface between a proximity card and a proximity coupling device. The interface includes both power and bi-directional communication. It is intended to be used in conjunction with other parts of ISO/IEC 14443.

Contactless card standards cover a variety of types as embodied in ISO/IEC 10536 (close-coupled cards), ISO/IEC 14443 (proximity cards) and ISO/IEC 15693 (vicinity cards). These are intended for operation when very near, nearby and at a longer distance from associated coupling devices, respectively.

Identification cards — Contactless integrated circuit cards — Proximity cards —

Part 2:
Radio frequency power and signal interface

1 Scope

This part of ISO/IEC 14443 specifies the characteristics of the fields to be provided for power and bi-directional communication between proximity coupling devices (PCDs) and proximity cards or objects (PICCs).

This part of ISO/IEC 14443 does not specify the means of generating coupling fields, nor the means of compliance with electromagnetic radiation and human exposure regulations, which can vary according to country.

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 10373-6, *Identification cards — Test methods — Part 6: Proximity cards*

ISO/IEC 14443-1, *Identification cards — Contactless integrated circuit cards — Proximity cards — Part 1: Physical characteristics*

ISO/IEC 14443-3, *Identification cards — Contactless integrated circuit(s) cards — Proximity cards — Part 3: Initialization and anticollision*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
bit duration
time during which a logic level is defined, at the end of which a new bit starts

3.2
binary phase shift keying
phase shift keying where the phase shift is 180°, resulting in two phase state possibilities

3.3
modified Miller
method of bit coding whereby a logic level during a bit duration is represented by the position of a pulse within the bit frame

3.4
modulation index, *m*
[1 − *b*] / [1 + *b*], where *b* is the ratio between the modulated amplitude and the initial signal amplitude

NOTE The value of the index may be expressed as a percentage.

3.5
NRZ-L
method of bit coding whereby a logic level during a bit duration is represented by one of two defined physical states of a communication medium

3.6
subcarrier
signal of frequency *fs* used to modulate a carrier of frequency *fc*

3.7
Manchester
method of bit coding whereby a logic level during a bit duration is represented by a sequence of two defined physical states of a communication medium, the order of the physical states within the sequence defining the logical state

3.8
TR0
guard time between the end of a PCD transmission and the start of the PICC subcarrier generation

3.9
TR1
synchronization time between the start of the PICC subcarrier generation and the start of the PICC subcarrier modulation

4 Symbols and abbreviated terms

ASK	amplitude shift keying
BPSK	binary phase shift keying
NRZ-L	non-return to zero, (L for level)
OOK	on/off keying
PauseA	PCD modulation pulse, Type A
PCD	proximity coupling device
PICC	proximity card or object
RF	radio frequency
a	pulse shape factor, Type A
b	ratio between the modulated and initial signal amplitude, Type B
fc	frequency of operating field (carrier frequency)
fs	frequency of subcarrier
H	equivalent homogenous magnetic field strength

$H_{INITIAL}$	field strength of the unmodulated RF field
h_{ovs}	envelope overshoot for bit rates of *fc*/16, *fc*/32, *fc*/64, Type A
h_f	envelope undershoot, Type B
h_r	envelope overshoot, Type B
Ø0	initial phase of the subcarrier
t_1	PauseA length
t_2	PauseA "Low" time for a bit rate of *fc*/128
t_3	PauseA rise time for a bit rate of *fc*/128
t_4	PauseA rise time section for a bit rate of *fc*/128
t_5	PauseA "Low" time for bit rates of *fc*/64, *fc*/32 and *fc*/16
t_6	PauseA rise time for bit rates of *fc*/64, *fc*/32 and *fc*/16
$t_{6,\ max,\ PCD}$	maximum value of t_6 for PCD transmission
$t_{6,\ max,\ PICC}$	maximum value of t_6 for PICC reception
t_b	bit duration, Type A
t_f	envelope fall time, Type B
$t_{f,\ max,\ PCD}$	maximum fall time for PCD transmission, Type B
$t_{f,\ max,\ PICC}$	maximum fall time for PICC reception, Type B
t_r	envelope rise time, Type B
$t_{r,\ max,\ PCD}$	maximum rise time for PCD transmission, Type B
$t_{r,\ max,\ PICC}$	maximum rise time for PICC reception, Type B
t_x	pulse position, Type A
V_{LMA}	load modulation amplitude

5 Initial dialogue for proximity cards

The initial dialogue between the PCD and the PICC shall be conducted through the following consecutive operations:

— activation of the PICC by the RF operating field of the PCD,

— the PICC shall wait silently for a command from the PCD,

— transmission of a command by the PCD,

— transmission of a response by the PICC.

These operations shall use the RF power and signal interface specified in the following clauses.

6 Power transfer

The PCD shall produce a high frequency alternating magnetic field. This field inductively couples to the PICC to transfer power and is modulated for communication.

6.1 Frequency

The frequency *fc* of the RF operating field shall be 13,56 MHz ±7 kHz.

6.2 Operating field strength

The PCD shall generate a field strength of at least H_{min} and not exceeding H_{max} at manufacturer specified positions (operating volume) under unmodulated conditions, as defined in Table 1.

Table 1 — PCD field strength

PCD	
H_{min}	H_{max}
1,5 A/m (rms)	7,5 A/m (rms)

In addition, the PCD shall be capable of powering any single reference PICC (defined in ISO/IEC 10373-6) at manufacturer specified positions (operating volume).

The PCD shall not generate a field strength higher than the value specified in ISO/IEC 14443-1:2008, 4.4 (alternating magnetic field) in any possible PICC position and orientation.

Test methods for the PCD operating field strength are defined in ISO/IEC 10373-6.

The PICC shall operate as intended continuously between H_{min} and H_{max}, as defined in Table 2. This includes all PICC requirements defined in this standard and processing of the manufacturer specified set of commands.

Table 2 — PICC operating field strength

PICC	
H_{min}	H_{max}
1,5 A/m (rms)	7,5 A/m (rms)

NOTE Margins are effectively included by the test methods as specified in ISO/IEC 10373-6.

7 Signal interface

The PCD modulates the amplitude of the alternating magnetic field strength with modulation pulses in order to transmit data from the PCD to the PICC.

The PICC loads the alternating magnetic field with a modulated subcarrier signal (load modulation) in order to transmit data from the PICC to the PCD.

Within manufacturer specified operating volume the PCD shall generate modulation pulses as described in the following clauses and shall be capable of receiving the minimum load modulation amplitude.

NOTE As an indication of the operating volume, the manufacturer may give the operating range (e.g. 0 to X cm) within which all ISO/IEC 14443-2 requirements are fulfilled.

Test methods for the PCD communication signal interface are defined in ISO/IEC 10373-6.

Two communication signal interfaces, Type A and Type B, are described in the following clauses. The PCD shall alternate between modulation methods when idling before detecting the presence of a PICC of Type A or Type B.

Only one communication signal interface may be active during a communication session until deactivation by the PCD or removal of the PICC. Subsequent session(s) may then proceed with either modulation method.

Figures 1 and 2 illustrate the concepts described in the following clauses.

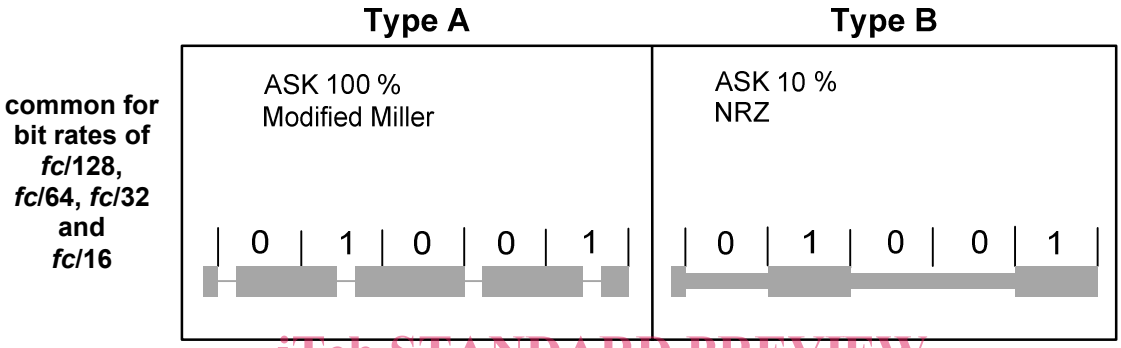

Figure 1 — Example PCD to PICC communication signals for Type A and Type B interfaces

NOTE For the coding of modified Miller, see 8.1.3.

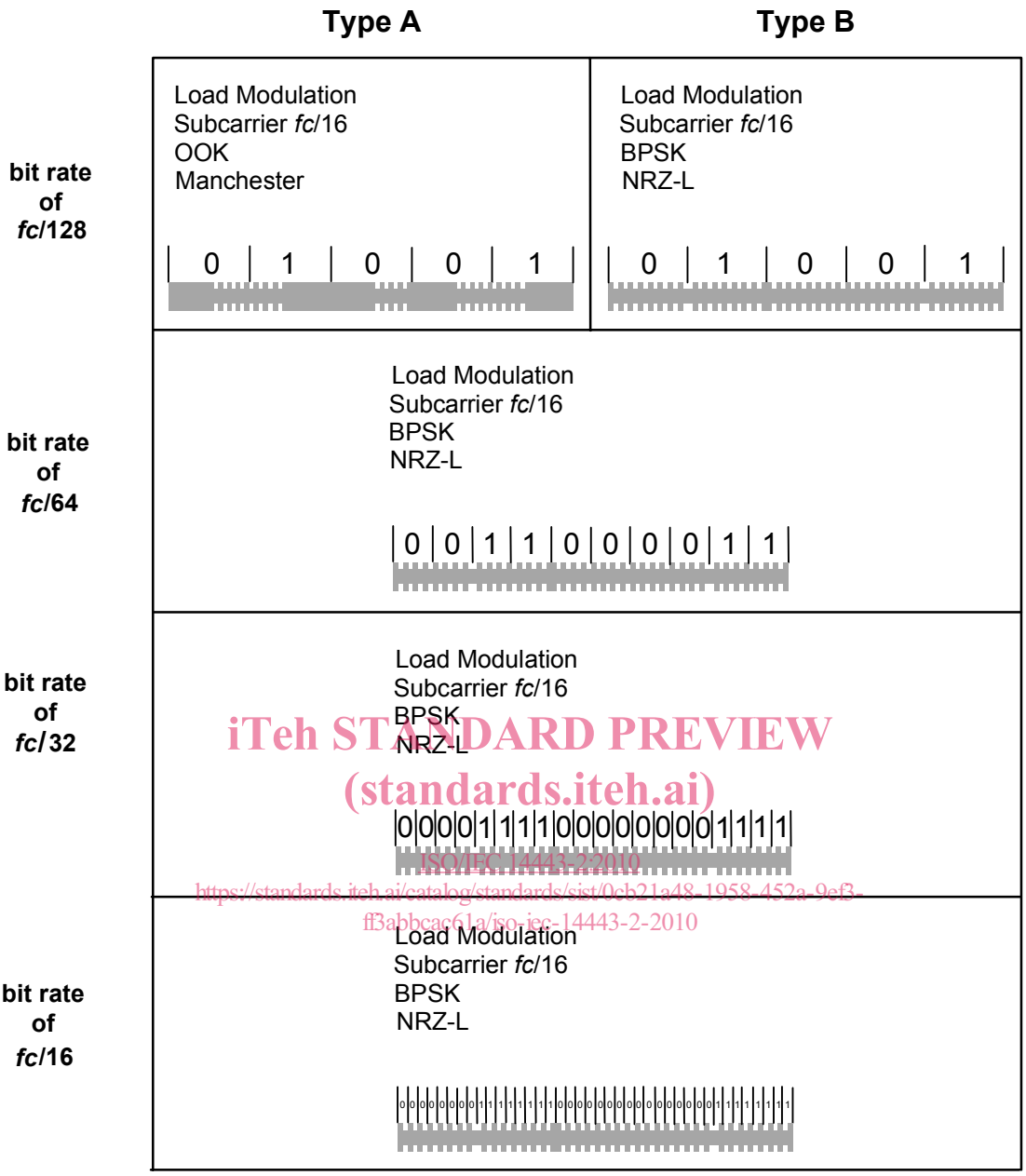

Figure 2 — Example PICC to PCD communication signals for Type A and Type B interfaces

8 Communication signal interface Type A

8.1 Communication PCD to PICC

8.1.1 Bit rate

The bit rate for the transmission during initialization and anticollision shall be *fc*/128 (~106 kbit/s).

The bit rate for the transmission after initialization and anticollision shall be one of the following:

— *fc*/128 (~106 kbit/s),