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Editor: D.Baddeley, Motorola.
E-mail: tte001@email.sps.mot.com

Final Committee Draft

ISO/IEC 14443-2

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

Part 2: Radio frequency power and signal interface

Cartes d'identification — Cartes à circuit(s) intégrés sans contacts — Cartes de Proximité — Partie 2:

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Contents

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 organizations 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 14443-2 was prepared by Joint Technical Committee ISO/IEC/JTC1/SC17, 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 protocols

The Annexe A of this part of ISO/IEC 14443 is 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 the electrical characteristics of two types of contactless interface between a proximity card and a proximity coupling device. The interface includes power and bi-directional communication.

This part of ISO/IEC 14443 does not preclude the incorporation of other standard technologies on the card, such as those referenced in the Bibliography.

Contactless Card Standards cover a variety of types as embodied in ISO/IEC 10536 (Close coupled cards), ISO/IEC 14443 (Proximity cards), 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(s) cards - Proximity cards

Part 2:

Radio frequency power and signal interface

1 Scope

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

This part of ISO/IEC 14443 shall be used in conjunction with other parts of ISO/IEC 14443.

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 standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 14443. At the time of publication, the editions indicated were valid. All standards are subject to revision, and 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 standards listed below. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 14443, *Identification cards - Contactless integrated circuit(s) cards - Proximity cards*

ISO/IEC 10373, *Identification cards - Test methods*

ISO/IEC 7816-2, *Identification cards - Integrated circuit(s) cards with contacts - Part2: Dimensions and location of the contacts*

3 Terms and definitions

For the purposes of this International Standard, the definitions given in ISO/IEC 14443-1 and the following definitions apply:

3.1
Bit duration
Time during which a logical state 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
Modulation Index
Defined as [a-b]/[a+b] where a and b are the peak and minimum signal amplitude respectively.

3.4
NRZ-L
Method of bit coding whereby a logical state during a bit duration is represented by one of two defined physical states of a communication medium.

3.5
Subcarrier
RF signal produced by modulation of a carrier frequency fc with a frequency fs.

4 Abbreviations and Symbols

ASK	Amplitude shift keying
BPSK	Binary phase shift keying
NRZ-L	Non-return to zero, (L for level)
PCD	Proximity coupling device
PICC	Proximity card
RF	Radio frequency
fc	Frequency of operating field (carrier frequency)
fs	Frequency of subcarrier modulation

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
- PICC waits silently for a command from PCD
- transmission of a command by PCD
- transmission of a response by PICC

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

6 Power transfer

The PCD shall produce an energizing RF field which couples to the PICC to transfer power and which shall be 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

The minimum unmodulated operating field shall be Hmin and has a value of 1,5 A/m (rms).
The maximum unmodulated operating field shall be Hmax and has a value of 7,5 A/m (rms).
A PICC shall operate as intended continuously between Hmin and Hmax.

A PCD shall generate a field of at least Hmin and not exceeding Hmax at manufacturer specified positions (operating volume).

In addition the PCD shall be capable of powering any single reference PICC (defined in the test methods) at manufacturer specified positions (operating volume).

The PCD shall not generate a field higher than the value specified in ISO/IEC 14443-1 (Alternating magnetic field) in any possible PICC position.

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

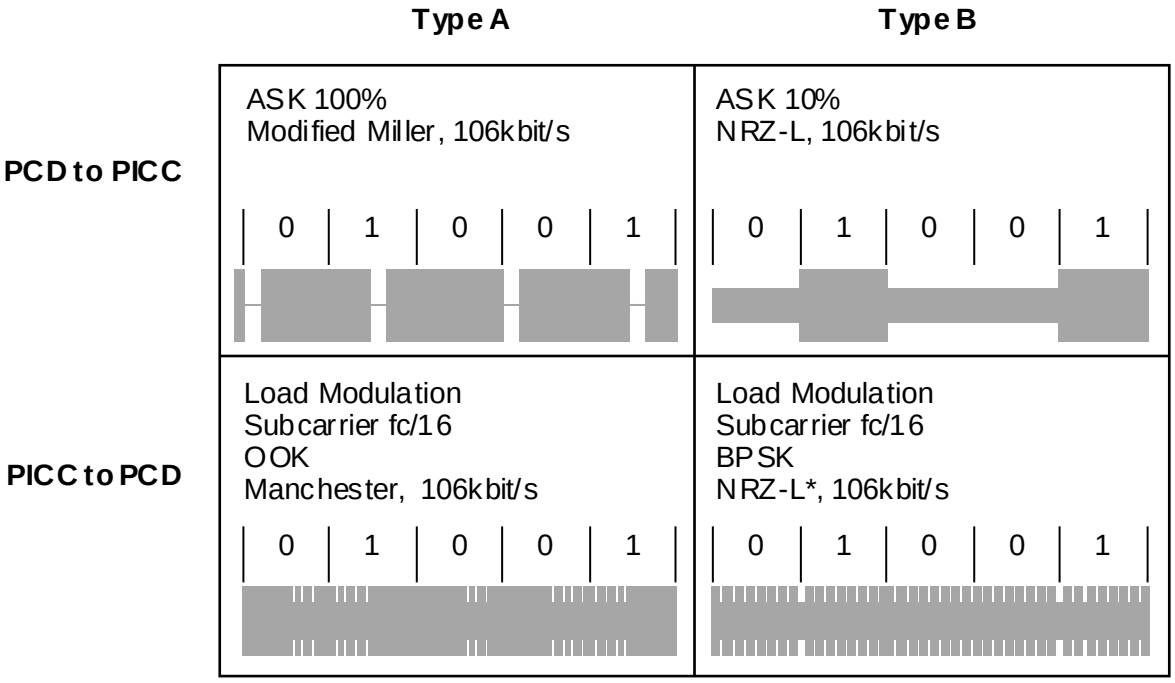
7 Signal interface

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 using either modulation method.

Figure 1 is an illustration of the concepts described in the following clauses.



* Inversion of data is also possible

Figure 1 –- Example communication signals for Type A and Type B interfaces

8 Communication signal interface Type A

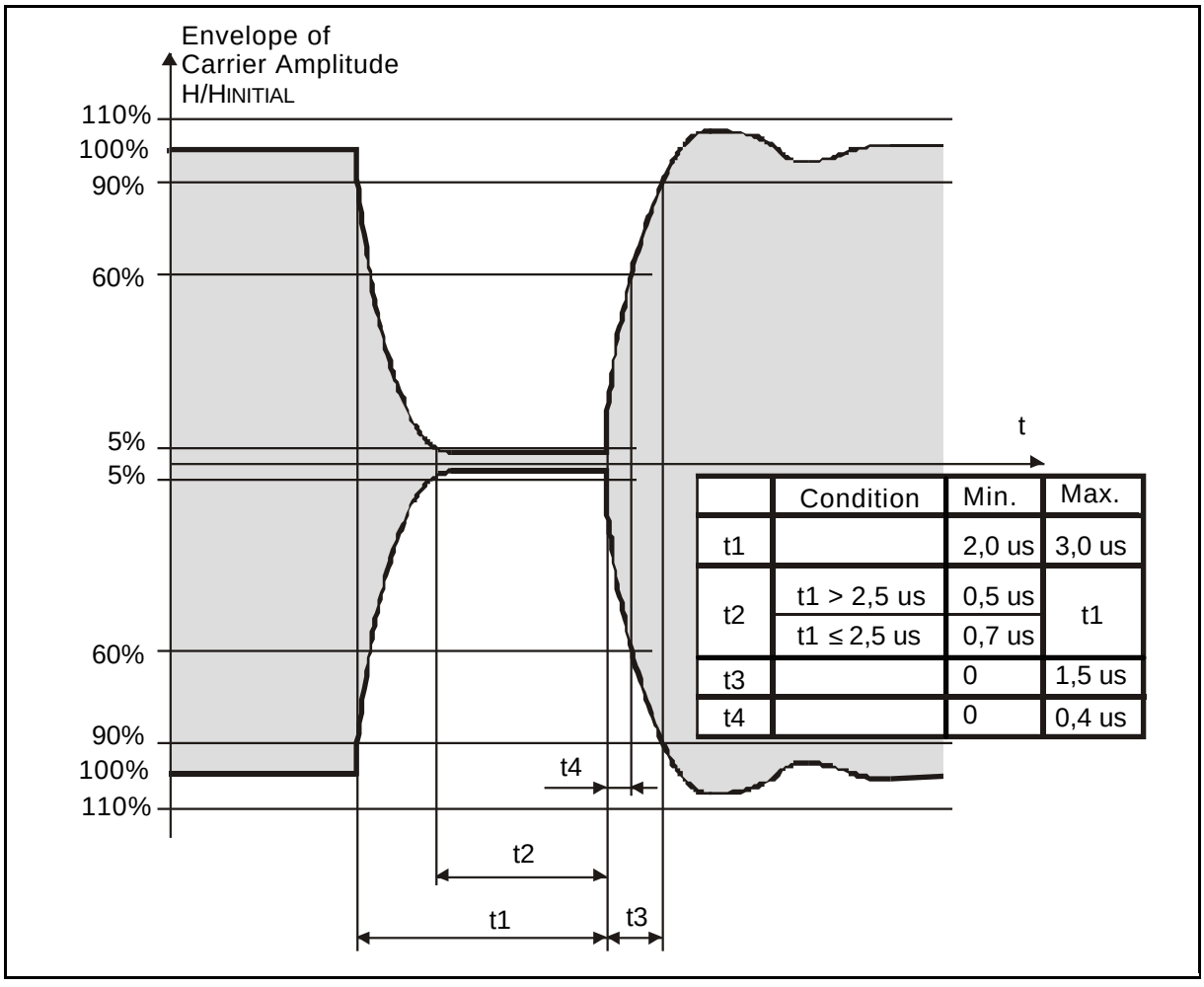
8.1 Communication PCD to PICC

8.1.1 Data rate

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

8.1.2 Modulation

Communication between PCD and PICC takes place using the modulation principle of ASK100% of the RF operating field to create a “pause” as shown in Figure 2.



	Condition	Min.	Max.
t1		2,0 us	3,0 us
t2	t1 > 2,5 us	0,5 us	t1
	t1 ≤ 2,5 us	0,7 us	
t3		0	1,5 us
t4		0	0,4 us

Figure 2 -– Pause

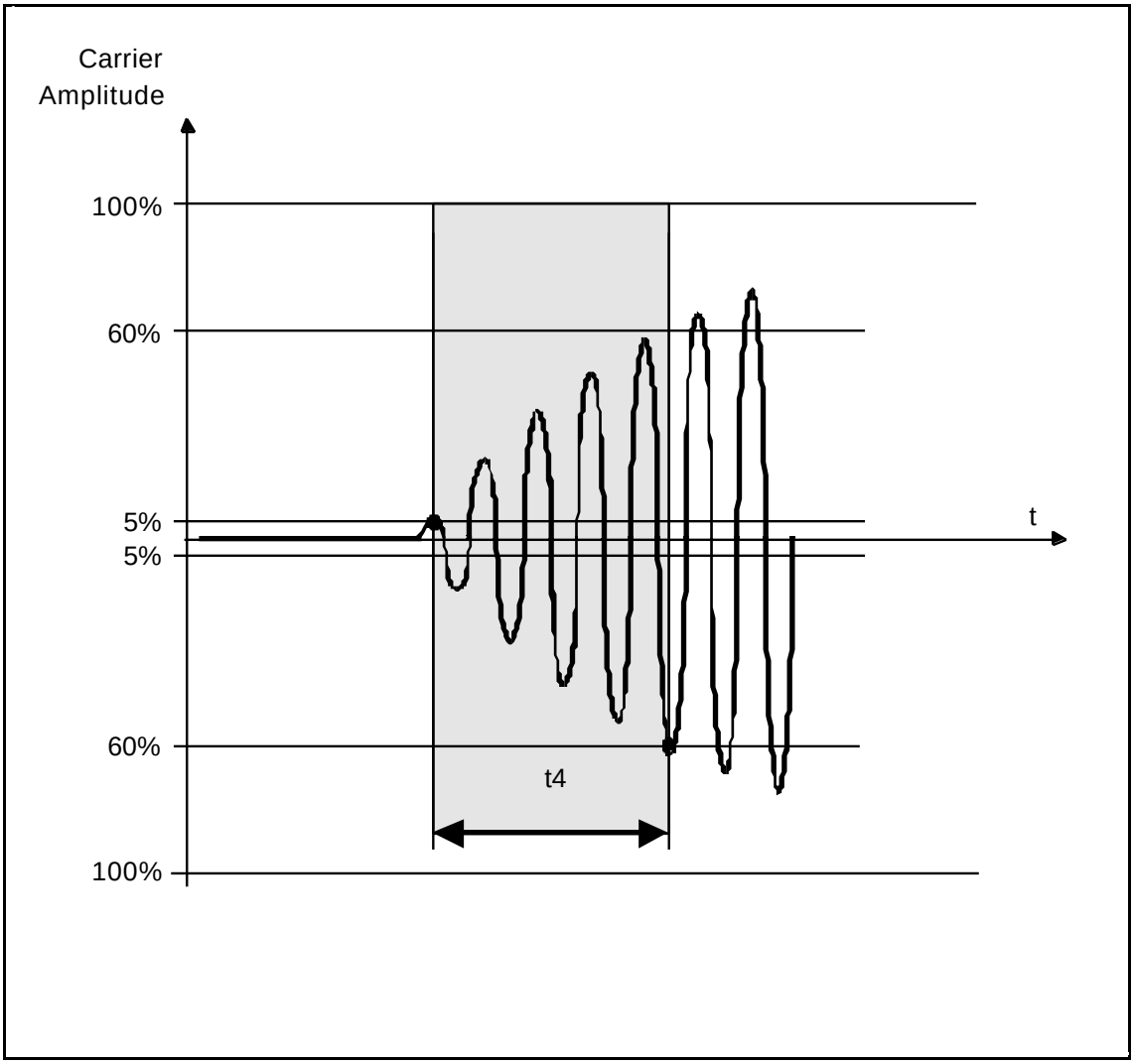
The envelope of the PCD field shall decrease monotonically to less than 5% of its initial value $H_{INITIAL}$ and remain less than 5% for more than t2. This envelope shall comply to Figure 2.

If the envelope of the PCD field does not decrease monotonically, the time between a local maximum and the time of passing the same value before the local maximum shall not exceed 0,5 µs. This shall only apply if the local maximum is greater than 5% of $H_{INITIAL}$.

Overshoots shall remain within 90% and 110% of $H_{INITIAL}$.

The PICC shall detect the ”End of Pause” after the field exceeds 5% of $H_{INITIAL}$ and before it exceeds 60% of $H_{INITIAL}$.

Note: In systems designed to handle only one card at a time, t4 need not be respected.



Note: This definition applies to all modulation envelope timings.

Figure 3 –– Definition of End of Pause

8.1.3 Bit representation and coding

The following sequences are defined:

sequence X	after a time of 64/fc a “pause” shall occur
sequence Y	for the full bit duration (128/fc) no modulation shall occur
sequence Z	at the beginning of the bit duration a “pause” shall occur

The above sequences are used to code the following information :

logic “1”	sequence X
logic “0”	sequence Y with the following two exceptions: i) If there are two or more contiguous “0”s, sequence Z shall be used from the second “0” on ii) If the first bit after a “start of frame” is “0” , sequence Z shall be used to represent this and any “0”s which follow directly thereafter
Start of communication	sequence Z
End of communication	logic “0” followed by sequence Y
No information	at least two sequences Y

8.2 Communication PICC to PCD

8.2.1 Data rate

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

8.2.2 Load modulation

The PICC shall be capable of communication to the PCD via an inductive coupling area where the carrier frequency is loaded to generate a subcarrier with frequency fs. The subcarrier shall be generated by switching a load in the PICC.

The load modulation amplitude shall be at least $30/H^{1.2}$ mV (peak) when measured as described in the test methods, where H is the (rms) value of magnetic field strength in A/m.

Test methods for PICC load modulation are defined in international standard ISO/IEC 10373.

8.2.3 Subcarrier

The frequency fs of the subcarrier shall be fc/16 (~847 kHz). Consequently, during initialization and anticollision, one bit duration is equivalent to 8 periods of the subcarrier.

8.2.4 Subcarrier modulation

Every bit period starts with a defined phase relation to the subcarrier. The bit period starts with the loaded state of the subcarrier.

The subcarrier shall be modulated using on/off keying with the sequences defined in 8.2.5.

8.2.5 Bit representation and coding

Bit coding shall be Manchester with the following definitions:

sequence D	the carrier shall be modulated with the subcarrier for the first half (50%) of the bit duration
sequence E	the carrier shall be modulated with the subcarrier for the second half (50%) of the bit duration
sequence F	the carrier is not modulated with the subcarrier for one bit duration
logical “1”	sequence D
logical “0”	sequence E
Start of communication	sequence D
End of communication	sequence F
No information	no subcarrier

9 Communication signal interface Type B

9.1 Communication PCD to PICC

9.1.1 Data rate

The data bit rate for the transmission during initialization and anticollision shall be nominally fc/128 (~106 kbit/s). Tolerance and bit boundaries are defined in ISO/IEC 14443-3.

9.1.2 Modulation

Communication between PCD and PICC takes place via ASK 10% amplitude modulation of the RF operating field.

The modulation index shall be a minimum of 8 % and a maximum of 14 %.

The modulation waveform shall comply to Figure 4. The rising and falling edges of the modulation shall be monotonic.

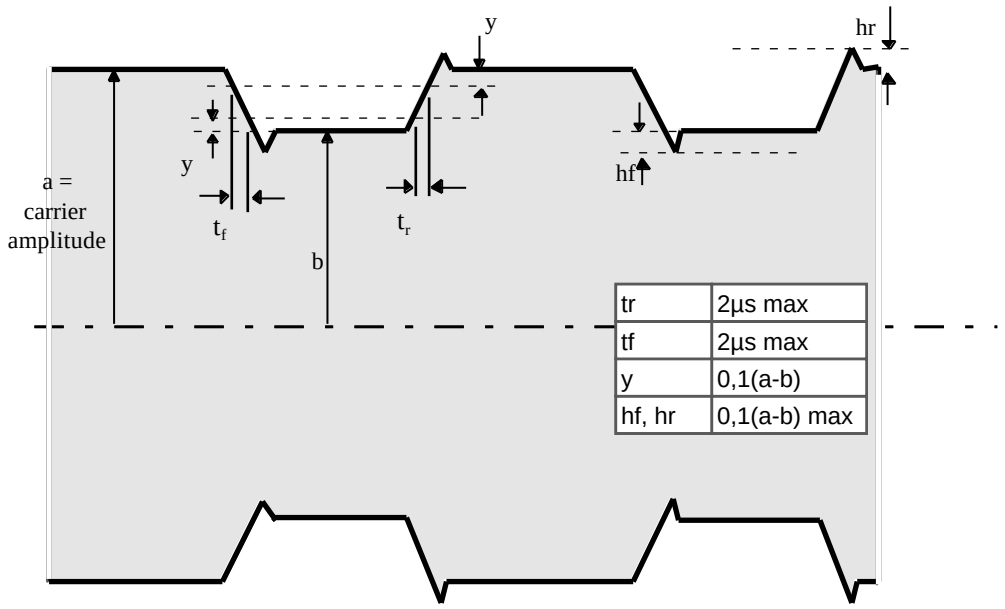


Figure 4 -– Type B modulation waveform

9.1.3 Bit representation and coding

Bit coding format shall be NRZ-L with logic levels defined as follows:

logic “1” carrier high field amplitude (no modulation applied).

logic “0” carrier low field amplitude.

9.2 Communication PICC to PCD

9.2.1 Data rate

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

9.2.2 Load modulation

The PICC shall be capable of communication to the PCD via an inductive coupling area where the energizing field is loaded to generate a subcarrier with frequency fs. The subcarrier shall be generated by switching a load in the PICC.

The load modulation amplitude shall be at least $30/H^{1.2}$ mV (peak) when measured as described in the test methods, where H is the (rms) value of magnetic field strength in A/m.

Test methods for PICC load modulation are defined in international standard ISO/IEC 10373.

9.2.3 Subcarrier

The frequency fs of the subcarrier shall be fc/16 (~847 kHz). Consequently, during initialization and anticollision, one bit duration is equivalent to 8 periods of the subcarrier.

The PICC shall generate a subcarrier only when data is to be transmitted.

9.2.4 Subcarrier modulation

The subcarrier shall be BPSK modulated as described in 9.2.5. Phase shifts shall only occur at nominal positions of rising or falling edges of the subcarrier.

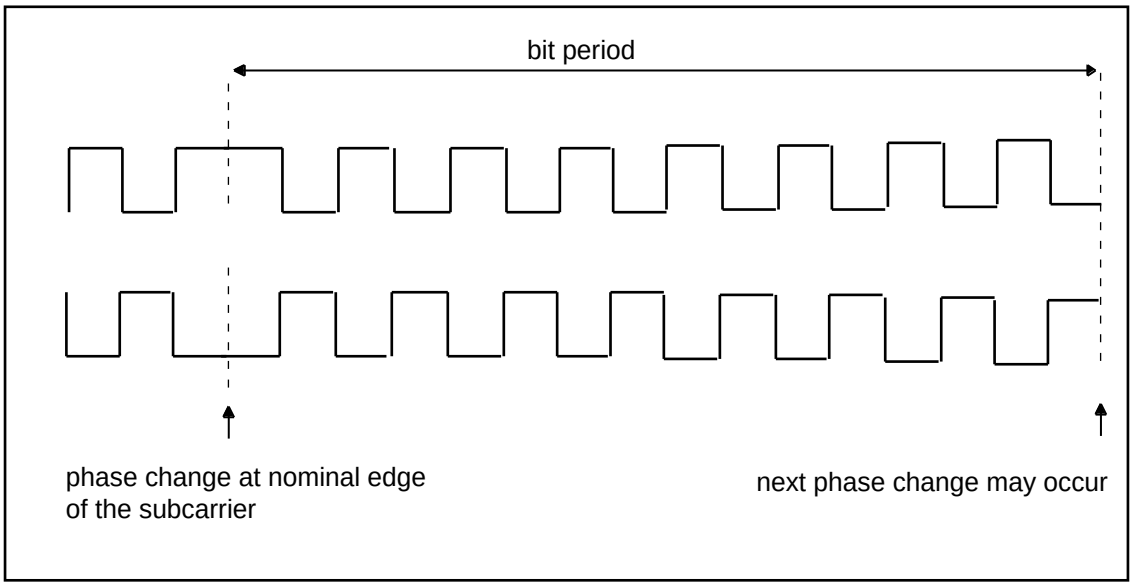


Figure 5 –– Allowed phase shifts (PICC internal subcarrier load switching)

9.2.5 Bit representation and coding

Bit coding shall be NRZ-L where a change of logic state shall be denoted by a phase shift (180°) of the subcarrier.

The initial logic level for NRZ-L at the start of a PICC frame shall be established by the following sequence:

After any command from the PCD a guard time TR0 shall apply in which the PICC shall not generate a subcarrier. TR0 shall be greater than 64/fs.

The PICC shall then generate a subcarrier with no phase transition before a delay TR1 establishing a subcarrier phase reference Ø0. TR1 shall be greater than 80/fs.

This initial phase state Ø0of the subcarrier shall be defined as logical “1” so that the first phase transition represents a change from logical “1” to logical “0”.

Subsequently the logic state shall be defined according to the subcarrier phase reference:

Ø0	logic state 1
Ø0 + 180°	logic state 0

10 PICC minimal coupling zone

The PICC coupling antenna may have any form and location but shall encircle the zone shown in Figure 6.

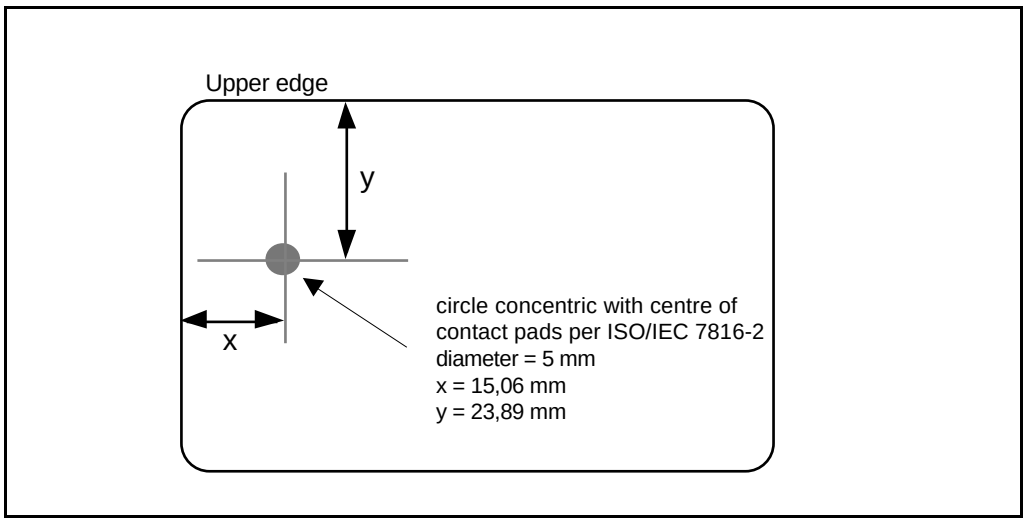


Figure 6 -– PICC minimal coupling zone

Annex A
(informative)

Compatibility with other Card Standards

This standard does not preclude the addition of other existing card standards on the PICC, such as those listed as follows:

ISO/IEC 7811, Identification cards - Recording technique -

ISO/IEC 7812, Identification cards - Identification of issuers.

ISO/IEC 7813, Identification cards - Financial transaction cards.

ISO/IEC 7816, Identification cards - Integrated circuit(s) cards with contacts.

ISO/IEC 10536, Identification cards - Contactless integrated circuit(s) cards close-coupled cards.

ISO/IEC 15693, Identification cards - Contactless integrated circuit(s) cards Vicinity cards.