FINAL
DRAFT

AMENDMENT

ISO/IEC 14443-2:2010 FDAM 5

ISO/IEC JTC **1**/SC **17**

Secretariat: **BSI**

Voting begins on:
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Identification cards — Contactless integrated circuit cards — Proximity cards —

Part 2: Radio frequency power and signal interface

AMENDMENT 5: Bit rates of 3fc/4, fc, 3fc/2 and 2fc from PCD to PICC

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

Partie 2: Interface radiofréquence et des signaux de communication

AMENDEMENT 5: Débits binaires de 3fc/4, fc, 3fc/2 et 2fc de PCD à PICC

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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*, SC 17, *Card and personal identification*.

Identification cards — Contactless integrated circuit cards — Proximity cards —

Part 2: Radio frequency power and signal interface

AMENDMENT 5: Bit rates of 3fc/4, fc, 3fc/2 and 2fc from PCD to PICC

Page 2, Clause 4

Add the following new symbols to the list in alphabetical order:

AP	actual phase value
ACP	actual constellation point
EPI	elementary phase interval
etu	elementary time unit
ISI	inter symbol interference
ISI_d	inter symbol interference angle
ISI_m	inter symbol interference magnitude
NP	nominal phase value
P_H	complex constellation point of the maximum NP
P_L	complex constellation point of the minimum NP
PNP	previous nominal phase
PR	phase range
PSK	phase shift keying
#	number

Page 6, 8.1.1

Replace the subclause with the following:

"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),

— *fc*/64 (~212 kbit/s),
— *fc*/32 (~424 kbit/s),
— *fc*/16 (~848 kbit/s),
— *fc*/8 (~1,70 Mbit/s),
— *fc*/4 (~3,39 Mbit/s),
— *fc*/2 (~6,78 Mbit/s),
— *3fc*/4 (~10,17 Mbit/s),
— *fc* (~13,56 Mbit/s),
— 3*fc/2* (~20,34 Mbit/s),
— 2*fc* (~27,12 Mbit/s)."

Page 14

Add new subclause 8.1.2.4:

"**8.1.2.4 Modulation for bit rates of 3*fc*/4, *fc*, *3fc*/2 and 2*fc***

See A.1."

Page 15

Add new subclause 8.1.3.3:

"**8.1.3.3 Bit representation and coding for bit rates of 3*fc*/4, *fc*, 3*fc*/2 and 2*fc***

See A.2."

Page 15, 8.2.1

Replace the paragraph with the following:

"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),
— *fc*/64 (~212 kbit/s),
— *fc*/32 (~424 kbit/s),
— *fc*/16 (~848 kbit/s),
— *fc*/8 (~1,70 Mbit/s),
— *fc*/4 (~3,39 Mbit/s),
— *fc*/2 (~6,78 Mbit/s),"

Pages 17 to 18, 9.1.1

Replace: "— *fc*/2 (~6,78 Mbit/s)." with the following:

"— *fc*/2 (~6,78 Mbit/s),

— *3fc*/4 (~10,17 Mbit/s),

— *fc* (~13,56 Mbit/s),

— *3fc/2* (~20,34 Mbit/s),

— 2*fc* (~27,12 Mbit/s)."

Page 23, 9.1.2

Insert the following new subclause title:

"**9.1.2.1 Modulation for bit rates of *fc*/128, *fc*/64, *fc*/32, *fc*/16, *fc*/8, *fc*/4 and *fc*/2**"

Insert the following new subclause 9.1.2.2 title and text:

"**9.1.2.2 Modulation for bit rates of 3*fc*/4, *fc*, 3*fc*/2 *and* 2*fc***

See A.1."

Page 24, 9.1.3

Insert the following new subclause title:

"**9.1.3.1 Bit representation and coding for bit rates of *fc*/128, *fc*/64, *fc*/32, *fc*/16, *fc*/8, *fc*/4 and *fc*/2**"

Insert the following new subclause 9.1.3.2 title and text:

"**9.1.3.2 Bit representation and coding for bit rates of 3*fc*/4, *fc*, 3*fc*/2 *and* 2*fc***

See A.2."

Page 24, 9.2.5

At the end of the document, following 9.2.5, add the following new Annexes A, B and C.

Annex A
(normative)

Bit rates of 3*fc*/4, *fc*, 3*fc*/2 and 2*fc* from PCD to PICC

A.1 Modulation for bit rates of 3*fc*/4, *fc*, 3*fc*/2 and 2*fc*

For communication from PCD to PICC using bit rates of 3fc/4, fc, 3fc/2 and 2fc information is encoded by PSK modulation of RF carrier of the operating field.

For bit rates of 3*fc*/4, *fc*, 3*fc*/2 and 2*fc*, information is encoded by PSK modulation of the RF carrier. The RF carrier is phase modulated with a NP at each etu. For each bit rate, the length of an etu and the number of NPs are specified in Table A.1.

Table A.1 — etu and # of NPs

Bit rate	etu	# of NP
3*fc*/4 (approximately 10,17 Mbit/s)	4/*fc*	8
fc (approximately 13,56 Mbit/s)	4/*fc*	16
3*fc*/2 (approximately 20,34 Mbit/s)	2/*fc*	8
2*fc* (~27,12 Mbit/s)	2/*fc*	16

The difference between two consecutive NPs is defined as EPI, specified in Table A.2 and illustrated in Figure A.2.

Table A.2 — EPI

Bit rate	EPI
3*fc*/4 (approximately 10,17 Mbit/s)	8°
fc (approximately 13,56 Mbit/s)	4°
3*fc*/2 (approximately 20,34 Mbit/s)	8°
2fc (~27,12 Mbit/s)	4°

The difference between the angle of P_H and the angle of P_L defines the phase range PR as illustrated in Figure A.1.

The PCD and PICC shall respect the PR limits as specified in Table A.3 and Table A.4.

Table A.3 — PR for PCD transmission

Bit rate	Minimum PR	Maximum PR
3*fc*/4, 3*fc*/2	54°	58°
fc, 2*fc*	58°	62°

Table A.4 — PR for PICC reception

Bit rate	Minimum PR	Maximum PR
3*fc*/4, 3*fc*/2	52°	60°
fc, 2*fc*	56°	64°

A.1.1 NP tolerances

Due to the limited bandwidth channel, the intended NP phase modulation is affected by inter symbol interference (ISI) resulting in an ACP at the end of each etu. The angle of the ACP is defined as AP. This is described in a constellation diagram with ISI_m and ISI_d as specified below and illustrated in Figure A.2.

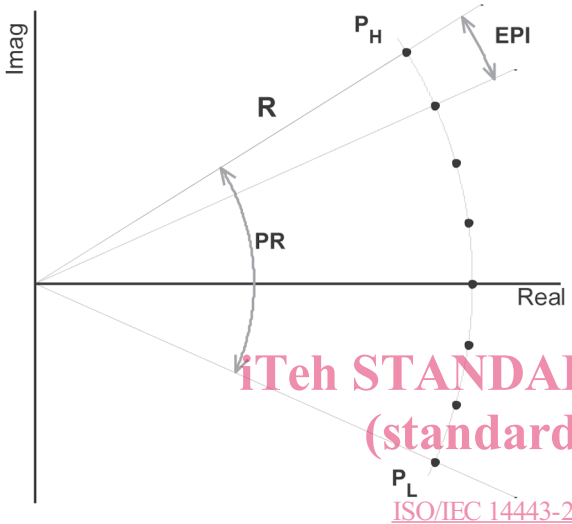

Figure A.1 — Nominal constellation points

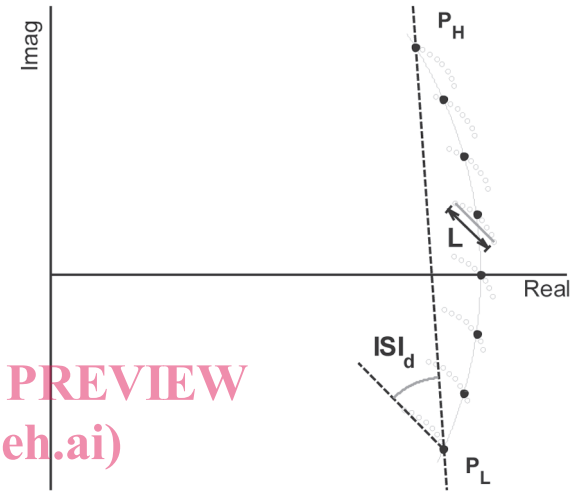

Figure A.2 — Actual constellation points

NOTE 1 NPs are indicated with small filled spots. ACPs are indicated with small circles.

NOTE 2 See Annex A for explanation on constellation diagrams. See Annex B for explanation on ISI.

L is the maximum distance of any two ACPs related to the same NP.

R is the signal amplitude.

ISI_d is the rotation of all ACPs modulations related to one NP phase modulation.It is defined as the angle between the line through PH,PL and the line through any 2 ACPs with maximum distance related to the same NPV.

ISI_m is the ISI magnitude normalized to the EPI. ISI_m = arcsin(L/R)/EPI.The PCD and PICC shall respect ISI_m limits for all ACPs as a function of ISI_d as specified in Table A.5, and Table A.6, and illustrated in Figure A.3.

Table A.5 — ISI_m limits for PCD transmission

	Condition	Min	Max
ISI_m	$abs(ISI_d) \leq 90°$	0	$1.5 - abs(ISI_d)/90°$
	$abs(ISI_d) > 90°$	0	0,5

Table A.6 — ISI_m limits for PICC reception

	Condition	Min	Max
ISI_m	$abs(ISI_d) \leq 90°$	0	$1.6 - abs(ISI_d)/90°$
	$abs(ISI_d) > 90°$	0	0,6

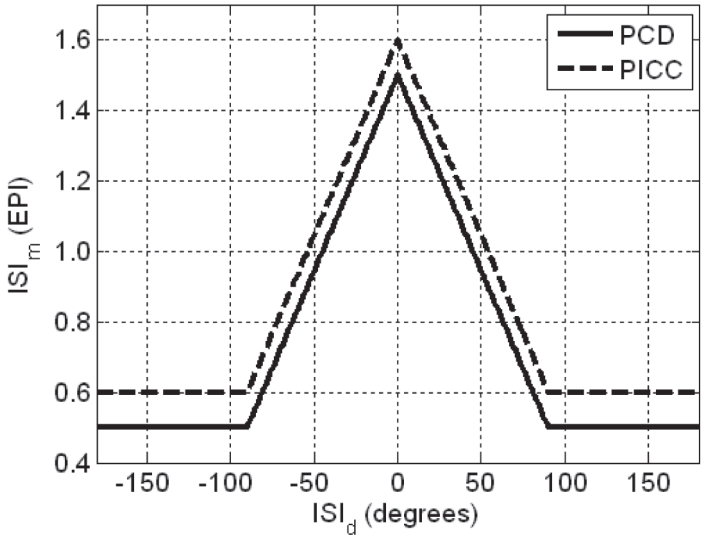

Figure A.3 — Maximum ISI_m limits for PCD and PICC

NOTE 3 Future revisions of ISO/IEC 14443 and ISO/IEC 10373-6 may specify new NP tolerance values with corresponding test methods.

A.1.2 Phase noise

APs may also vary randomly due to phase noise.

The instantaneous phase error caused by noise is defined as the difference between the AP and the NP of 0° of an unmodulated signal sampled at the end of each etu.The differential phase error is defined as the difference of two consecutive instantaneous phase errors.

The normalized differential phase noise is the rms value of the differential phase error divided by EPI.

The normalized differential phase noise shall be lower than 0,033 for PCD transmission and lower than 0,035 for PICC reception.

NOTE Future revisions of ISO/IEC 14443 and ISO/IEC 10373-6 may specify new phase noise values with corresponding test methods.

A.2 Bit representation and coding for bit rates of 3*fc*/4, *fc*, 3*fc*/2 and 2*fc*

For bit rates 3*fc*/4 and 3*fc*/2 binary information shall be transmitted from PCD to PICC in units of 8 logic levels, building an information symbol of 3 bits. The 8 logic levels are represented by 8 NPs. The formation of 3 bit symbols from Bytes is illustrated in Figure A.4.

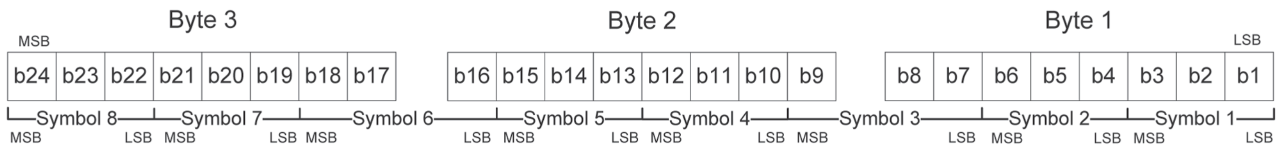

Figure A.4 — Binary information from PCD to PICC transmission for bit rates 3*fc*/4 and 3*fc*/2

For bit rates *fc* and 2*fc* binary information shall be transmitted from PCD to PICC in units of 16 logic levels, building an information symbol of 4 bits. The 16 logic levels are represented by 16 NPs. The formation of 4 bit symbols from Bytes is illustrated in Figure A.5.

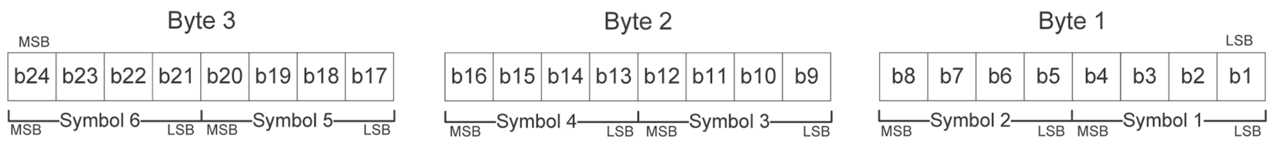

Figure A.5 — Binary information from PCD to PICC transmission for bit rates *fc* and 2*fc*

If the last transmitted symbol is incomplete, it shall be stuffed with one or two (0)b.

For end of communication, the PCD shall generate a sequence of 8 NPs of −180°. After the end of communication the PCD shall generate an unmodulated RF carrier with a NP of 0°.

A.2.1 Bit representation and coding for bit rates of 3*fc*/4 and 3*fc*/2

For start of communication the PCD shall generate a sequence of 140 NPs starting with NP of etu #1 as specified in Table A.7. The phase of the unmodulated RF carrier is defined as NP = 0°.

