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Identification cards — Contactless integrated circuit(s) cards — Vicinity cards —

Part 3: Anticollision and transmission protocol

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

Partie 3: Anticollision et protocole de transmission

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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.

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.

Attention is drawn to the possibility that some of the elements of this part of ISO/IEC 15693 may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 15693-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Identification cards and related devices*.

ISO/IEC 15693 consists of the following parts, under the general title *Identification cards — Contactless integrated circuit(s) cards — Vicinity cards*:

— *Part 1: Physical characteristics*

— *Part 2: Air interface and initialization*

— *Part 3: Anticollision and transmission protocol*

— *Part 4: Extended command set and security features*

Annexes A to C of this part of ISO/IEC 15693 are for information only.

Introduction

ISO/IEC 15693 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 15693 describes the anticollision and transmission protocols

This International Standard does not preclude the incorporation of other standard technologies on the card.

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.

The International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) draw attention to the fact that it is claimed that compliance with this part of ISO/IEC 15693 may involve the use of patents.

ISO and IEC take no position concerning the evidence, validity and scope of these patent rights.

The holder of this patent right has assured ISO and IEC that he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO and IEC. Information may be obtained from:

JP 2561051 - Circuit Structure of Inductive Contactless Responding Unit

JP 2981517, JP 2129209 - Read to Verify Written Data

OMRON Corporation
Intellectual Property Group
20 Igadera, Shimokaiinji
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Identification cards — Contactless integrated circuit(s) cards — Vicinity cards —

Part 3: Anticollision and transmission protocol

1 Scope

This part of ISO/IEC 15693 describes:

- protocol and commands,
- other parameters required to initialize communications between a VICC and a VCD,
- methods to detect and communicate with one card among several cards ("anticollision"),
- optional means to ease and speed up the selection of one among several cards based on application criteria.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 15693. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO/IEC 15693 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 7816-5, *Identification cards — Integrated circuit(s) cards with contacts — Part 5: Numbering system and registration procedure for application identifiers*.

ISO/IEC 7816-6:1996, *Identification cards — Integrated circuit(s) cards with contacts — Part 6: Interindustry data element*, and its Amendment 1:2000, *IC manufacturer registration*.

ISO/IEC 10373-7, *Identification cards — Test methods — Part 7: Vicinity cards*.

ISO/IEC 13239, *Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures*.

ISO/IEC 15693-1, *Identification cards — Contactless integrated circuit(s) cards — Vicinity cards — Part 1: Physical characteristics*.

ISO/IEC 15693-2:2000, *Identification cards — Contactless integrated circuit(s) cards — Vicinity cards — Part 2: Air interface and initialization*.

3 Definitions, abbreviations and symbols

3.1 Definitions

3.1.1 Anticollision loop

Algorithm used to prepare for and handle a dialogue between a VCD and one or more VICCs from several in its energizing field.

3.1.2 Byte

A byte consists of 8 bits of data designated b1 to b8, from the most significant bit (MSB, b8) to the least significant bit (LSB, b1).

3.2 Abbreviations

AFI	Application family identifier
CRC	Cyclic redundancy check
DSFID	Data storage format identifier
EOF	End of frame
LSB	Least significant bit
MSB	Most significant bit
RFU	Reserved for future use
SOF	Start of frame
UID	Unique identifier
VCD	Vicinity coupling device
VICC	Vicinity integrated circuit card

3.3 Symbols

f_c	Frequency of operating field (carrier frequency)

4 Definition of data elements

4.1 Unique identifier (UID)

The VICCs are uniquely identified by a 64 bits unique identifier (UID). This is used for addressing each VICC uniquely and individually, during the anticollision loop and for one-to-one exchange between a VCD and a VICC.

The UID shall be set permanently by the IC manufacturer in accordance with figure 1.

MSB LSB

64 57	56 49	48 1
'E0'	IC Mfg code	IC manufacturer serial number

Figure 1 — UID format

The UID comprises

- The 8 MSB bits shall be 'E0',
- The IC manufacturer code, on 8 bits according to ISO/IEC 7816-6:1996/Amd.1,
- A unique serial number on 48 bits assigned by the IC manufacturer.

4.2 Application family identifier (AFI)

AFI (Application family identifier) represents the type of application targeted by the VCD and is used to extract from all the VICCs present only the VICCs meeting the required application criteria.

It may be programmed and locked by the respective commands.

AFI is coded on one byte, which constitutes 2 nibbles of 4 bits each.

The most significant nibble of AFI is used to code one specific or all application families, as defined in table 1.

The least significant nibble of AFI is used to code one specific or all application sub-families. Sub-family codes different from 0 are proprietary.

Table 1 — AFI coding

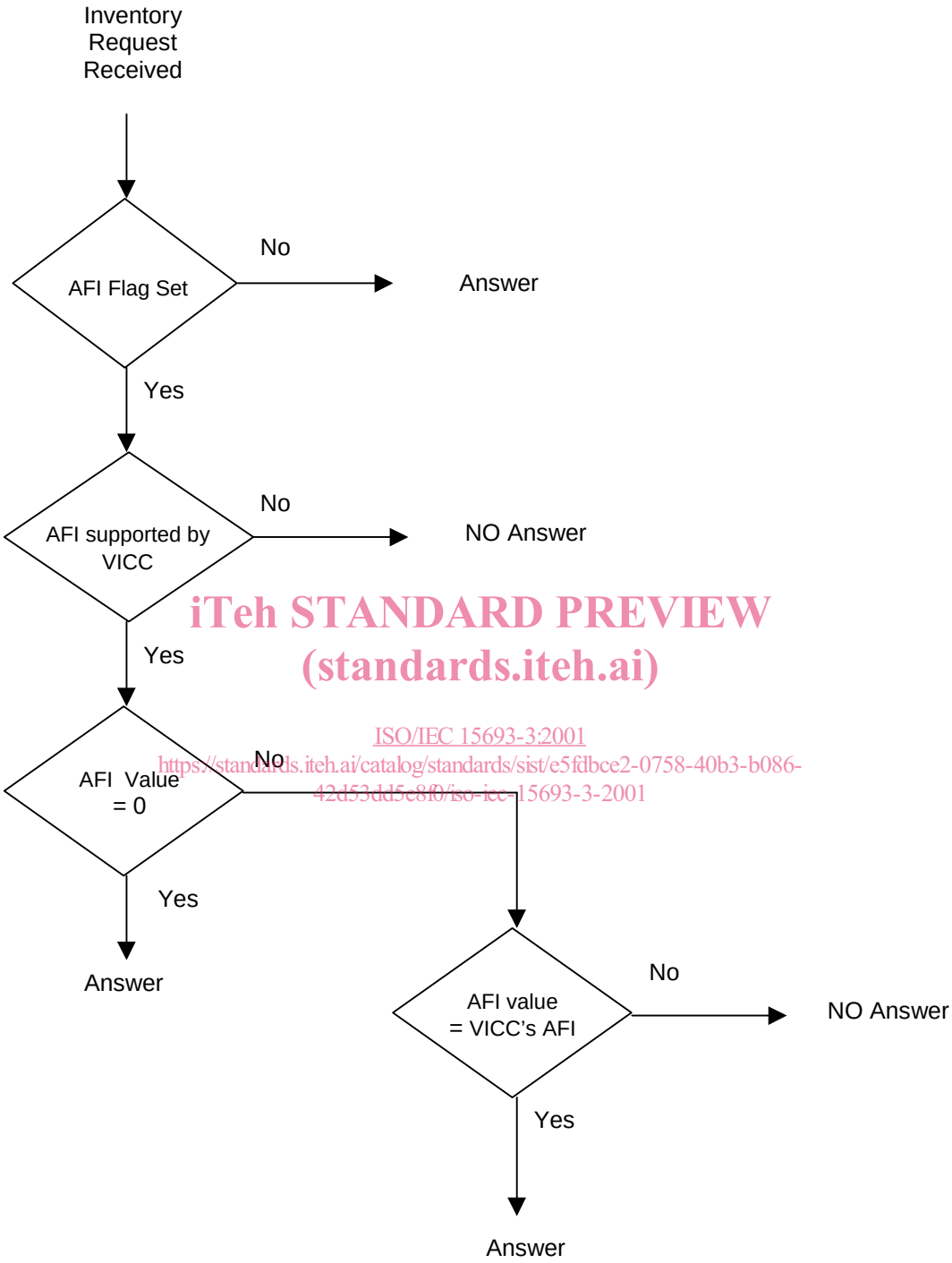
AFI most significant nibble	AFI least significant nibble	Meaning VICCs respond from	Examples / note
'0'	'0'	All families and sub-families	No applicative preselection
X	'0'	All sub-families of family X	Wide applicative preselection
X	Y	Only the Yth sub-family of family X	
'0'	Y	Proprietary sub-family Y only	
'1'	'0', Y	Transport	Mass transit, Bus, Airline
'2'	'0', Y	Financial	IEP, Banking, Retail
'3'	'0', Y	Identification	Access control
'4'	'0', Y	Telecommunication	Public telephony, GSM
'5'	'0', Y	Medical	
'6'	'0', Y	Multimedia	Internet services
'7'	'0', Y	Gaming	
'8'	'0', Y	Data storage	Portable files
'9'	'0', Y	Item management	
'A'	'0', Y	Express parcels	
'B'	'0', Y	Postal services	
'C'	'0', Y	Airline bags	
'D'	'0', Y	RFU	
'E'	'0', Y	RFU	
'F'	'0', Y	RFU	

NOTE X = '1' to 'F', Y = '1' to 'F'.

The support of AFI by the VICC is optional.

If AFI is not supported by the VICC and if the AFI flag is set, the VICC shall not answer whatever the AFI value is in the request.

If AFI is supported by the VICC, it shall answer according to the matching rules described in table 1.



NOTE "Answer" means that the VICC shall answer to the Inventory request.

Figure 2 — VICC decision tree for AFI

4.3 Data storage format identifier (DSFID)

The Data storage format identifier indicates how the data is structured in the VICC memory.

It may be programmed and locked by the respective commands. It is coded on one byte. It allows for instant knowledge on the logical organisation of the data.

If its programming is not supported by the VICC, the VICC shall respond with the value zero ('00').

4.4 CRC

The CRC shall be calculated in accordance with ISO/IEC 13239.

The initial register content shall be all ones: 'FFFF'.

The two bytes CRC are appended to each request and each response, within each frame, before the EOF. The CRC is calculated on all the bytes after the SOF up to but not including the CRC field.

Upon reception of a request from the VCD, the VICC shall verify that the CRC value is valid. If it is invalid, it shall discard the frame and shall not answer (modulate).

Upon reception of a response from the VICC, it is recommended that the VCD verify that the CRC value is valid. If it is invalid, actions to be performed are left to the responsibility of the VCD designer.

The CRC is transmitted least significant byte first.

Each byte is transmitted least significant bit first.

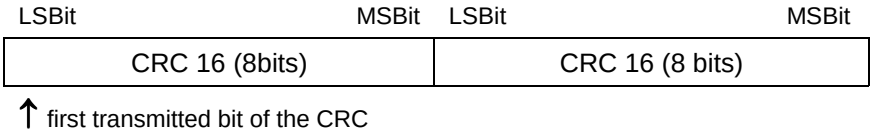


Figure 3 — CRC bits and bytes transmission rules

5 VICC memory organization

The commands specified in this standard assume that the physical memory is organized in blocks (or pages) of fixed size.

- Up to 256 blocks can be addressed.
- Block size can be of up to 256 bits.
- This leads to a maximum memory capacity of up to 8 kBytes (64 kBits).

NOTE The structure allows for future extension of the maximum memory capacity.

The commands described in this standard allow the access (read and write) by block(s). There is no implicit or explicit restriction regarding other access method (e.g. by byte or by logical object in future revision(s) of the standard or in custom commands).

6 Block security status

The block security status is sent back by the VICC as a parameter in the response to a VCD request as specified in clause 10 (e.g. Read single block). It is coded on one byte.

It is an element of the protocol. There is no implicit or explicit assumption that the 8 bits are actually implemented in the physical memory structure of the VICC.

Table 2 — Block security status

Bit	Flag name	Value	Description
b1	Lock_flag	0	Not locked
		1	Locked
b2 to b8	RFU	0	

7 Overall protocol description

7.1 Protocol concept

The transmission protocol (or protocol) defines the mechanism to exchange instructions and data between the VCD and the VICC, in both directions.

It is based on the concept of "VCD talks first".

This means that any VICC shall not start transmitting (i.e. modulating according to ISO/IEC 15693-2) unless it has received and properly decoded an instruction sent by the VCD.

a) the protocol is based on an exchange of

- a request from the VCD to the VICC
- a response from the VICC(s) to the VCD

The conditions under which the VICC sends a response are defined in clause 10.

b) each request and each response are contained in a frame. The frame delimiters (SOF, EOF) are specified in ISO/IEC 15693-2.

c) each request consists of the following fields:

- Flags
- Command code
- Mandatory and optional parameters fields, depending on the command
- Application data fields
- CRC

d) each response consists of the following fields:

- Flags
- Mandatory and optional parameters fields, depending on the command
- Application data fields
- CRC

e) the protocol is bit-oriented. The number of bits transmitted in a frame is a multiple of eight (8), i.e. an integer number of bytes.

f) a single-byte field is transmitted least significant bit (LSBit) first.

g) a multiple-byte field is transmitted least significant byte (LSByte) first, each byte is transmitted least significant bit (LSBit) first.

h) the setting of the flags indicates the presence of the optional fields. When the flag is set (to one), the field is present. When the flag is reset (to zero), the field is absent.

i) RFU flags shall be set to zero (0).

7.2 Modes

The term mode refers to the mechanism to specify in a request the set of VICC's that shall answer to the request.

7.2.1 Addressed mode

When the Address_flag is set to 1 (addressed mode), the request shall contain the unique ID (UID) of the addressed VICC.

Any VICC receiving a request with the Address_flag set to 1 shall compare the received unique ID (address) to its own ID.

If it matches, it shall execute it (if possible) and return a response to the VCD as specified by the command description.

If it does not match, it shall remain silent.

7.2.2 Non-addressed mode

When the Address_flag is set to 0 (non-addressed mode), the request shall not contain a unique ID.

Any VICC receiving a request with the Address_flag set to 0 shall execute it (if possible) and shall return a response to the VCD as specified by the command description.

7.2.3 Select mode

When the Select_flag is set to 1 (select mode), the request shall not contain a VICC unique ID.

The VICC in the selected state receiving a request with the Select_flag set to 1 shall execute it (if possible) and shall return a response to the VCD as specified by the command description.

Only the VICC in the selected state shall answer to a request having the select flag set to 1.

7.3 Request format

The request consists of the following fields:

- Flags
- Command code (see clause 10)
- Parameters and data fields
- CRC (see 4.4)

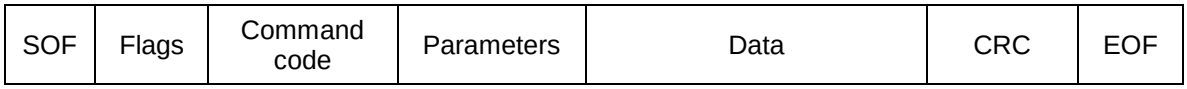


Figure 4 — General request format

7.3.1 Request flags

In a request, the field "flags" specifies the actions to be performed by the VICC and whether corresponding fields are present or not.

It consists of eight bits.

Table 3 — Request flags 1 to 4 definition

Bit	Flag name	Value	Description
b1	Sub-carrier_flag	0	A single sub-carrier frequency shall be used by the VICC
		1	Two sub-carriers shall be used by the VICC
b2	Data_rate_flag	0	Low data rate shall be used
		1	High data rate shall be used
b3	Inventory_flag	0	Flags 5 to 8 meaning is according to table 4
		1	Flags 5 to 8 meaning is according to table 5
b4	Protocol Extension_flag	0	No protocol format extension
		1	Protocol format is extended. Reserved for future use

NOTE 1 Sub-carrier_flag refers to the VICC-to-VCD communication as specified in ISO/IEC 15693-2.

NOTE 2 Data_rate_flag refers to the VICC-to-VCD communication as specified in ISO/IEC 15693-2.