BS ISO/IEC 15693-3:2019

BSI Standards Publication

Cards and security devices for personal identification — Contactless vicinity objects

Part 3: Anticollision and transmission protocol

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 15693-3:2019

National foreword

This British Standard is the UK implementation of ISO/IEC 15693-3:2019. It supersedes BS ISO/IEC 15693-3:2009+A4:2017, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee IST/17, Cards and security devices for personal identification.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2019
Published by BSI Standards Limited 2019

ISBN 978 0 580 98399 3

ICS 35.240.15

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2019.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 15693-3:2019

INTERNATIONAL STANDARD

ISO/IEC 15693-3

Third edition
2019-04

Cards and security devices for personal identification — Contactless vicinity objects —

Part 3: Anticollision and transmission protocol

Cartes et dispositifs de sécurité pour l'identification personnelle — Objets sans contact de voisinage —

Partie 3: Anticollision et protocole de transmission

Reference number
ISO/IEC 15693-3:2019(E)

Documents
Document Sharing Hub
© ISO/IEC 2019

Full document details: BS ISO/IEC 15693-3:2019

COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO/IEC 2019 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO/IEC 15693-3:2019

Contents

Page

Foreword ... **vi**

Introduction ... **vii**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms, definitions, symbols and abbreviated terms ... **1**
3.1 Terms and definitions ... 1
3.2 Symbols and abbreviated terms ... 2

4 Definition of data elements ... **3**
4.1 UID ... 3
4.2 AFI ... 3
4.3 DSFID ... 5
4.4 CRC ... 5
4.5 Security framework ... 6

5 VICC memory organization ... **6**

6 Block security status ... **6**

7 Overall protocol description ... **7**
7.1 Protocol concept ... 7
7.2 Modes ... 8
7.2.1 General ... 8
7.2.2 Addressed mode ... 8
7.2.3 Non-addressed mode ... 8
7.2.4 Select mode ... 8
7.3 Request format ... 9
7.3.1 General ... 9
7.3.2 Request flags ... 9
7.4 Response format ... 10
7.4.1 General ... 10
7.4.2 Response flags ... 11
7.4.3 Response error code ... 11
7.4.4 In-process reply response formats ... 12
7.4.5 Waiting time extension request formats ... 13
7.5 VICC states ... 13
7.5.1 General ... 13
7.5.2 Power-off state ... 14
7.5.3 Ready state ... 14
7.5.4 Quiet state ... 14
7.5.5 Selected state ... 14
7.5.6 Selected Secure state ... 15

8 Anticollision ... **16**
8.1 General ... 16
8.2 Request parameters ... 16
8.3 Request processing by the VICC ... 16
8.4 Explanation of an anticollision sequence ... 18

9 Timing specifications ... **20**
9.1 General ... 20
9.2 VICC waiting time before transmitting its response after reception of an EOF from the VCD ... 20
9.3 VICC modulation ignore time after reception of an EOF from the VCD ... 20
9.4 VCD waiting time before sending a subsequent request ... 20
9.5 VCD waiting time before switching to the next slot during an inventory process ... 21
9.5.1 General ... 21

© ISO/IEC 2019 – All rights reserved

AVA Documents
Document Sharing Hub

Full document details: BS ISO/IEC 15693-3:2019

9.5.2 When the VCD has started to receive one or more VICC responses ... 21
9.5.3 When the VCD has received no VICC response ... 21
9.6 Clarification of use of Option_flag in Write alike commands ... 22
9.7 Security timeout as used in the CS ... 22
9.8 VICC replies as used in CS or extended functionalities ... 22
9.8.1 General ... 22
9.8.2 Immediate VICC reply ... 22
9.8.3 In-process reply ... 23
9.9 Waiting time extension reply ... 25

10 Commands ... 26
10.1 Command types ... 26
10.1.1 General ... 26
10.1.2 Mandatory ... 26
10.1.3 Optional ... 26
10.1.4 Custom ... 26
10.1.5 Proprietary ... 26
10.2 Command codes ... 27
10.3 Mandatory commands ... 28
10.3.1 Inventory ... 28
10.3.2 Stay quiet ... 29
10.4 Optional commands ... 29
10.4.1 Read single block ... 29
10.4.2 Write single block ... 30
10.4.3 Lock block ... 31
10.4.4 Read multiple blocks ... 31
10.4.5 Write multiple blocks ... 32
10.4.6 Select ... 33
10.4.7 Reset to ready ... 34
10.4.8 Write AFI ... 34
10.4.9 Lock AFI ... 35
10.4.10 Write DSFID command ... 36
10.4.11 Lock DSFID ... 36
10.4.12 Get system information ... 37
10.4.13 Get multiple block security status ... 38
10.4.14 Fast read multiple blocks ... 39
10.4.15 Extended read single block ... 41
10.4.16 Extended write single block ... 42
10.4.17 Extended lock block ... 43
10.4.18 Extended read multiple block ... 43
10.4.19 Extended write multiple blocks ... 44
10.4.20 Extended get multiple block security status ... 45
10.4.21 Fast extended read multiple blocks ... 46
10.4.22 Authenticate ... 48
10.4.23 KeyUpdate ... 49
10.4.24 Challenge ... 50
10.4.25 ReadBuffer ... 51
10.4.26 Extended get system information ... 51
10.5 Custom commands ... 55
10.6 Proprietary commands ... 56

11 Secured Communication ... 56
11.1 General ... 56
11.2 AuthComm ... 56
11.3 SecureComm ... 57

Annex A (informative) **Compatibility with other card standards ... 59**

Annex B (informative) **VCD pseudo-code for anticollision ... 60**

Annex C (informative) **Cyclic redundancy check (CRC) ... 61**

© ISO/IEC 2019 – All rights reserved

AVA Documents Document Sharing Hub

Full document details: BS ISO/IEC 15693-3:2019

Annex D (informative) **Examples of crypto command sequence** **64**
Annex E (normative) **List of legacy commands** **67**
Bibliography **68**

© ISO/IEC 2019 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see http://patents.iec.ch).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and security devices for personal identification*.

This third edition cancels and replaces the second edition (ISO/IEC 15693-3:2009) which has been technically revised. It also incorporates the Amendments ISO/IEC 15693-3:2009/Amd 2:2015, ISO/IEC 15693-3:2009/Amd 3:2015 and ISO/IEC 15693-3:2009/Amd 4:2017.

The main changes compared to the previous edition are as follows:

— RFU bits;

— fast response data rates.

A list of all parts in the ISO 15693 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO/IEC 2019 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

Introduction

ISO/IEC 15693 (all parts) 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 document describes the anticollision and transmission protocols.

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

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

© ISO/IEC 2019 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

Cards and security devices for personal identification — Contactless vicinity objects —

Part 3: Anticollision and transmission protocol

1 Scope

This document specifies:

— protocols and commands;

— other parameters required to initialize communications between a vicinity integrated circuit card and a vicinity coupling device;

— 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.

This document does not preclude the incorporation of other standard technologies on the card as described in Annex A.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 13239, *Information technology — Telecommunications and information exchange between systems — High-level data link control (HDLC) procedures*

ISO/IEC 15693-1, *Cards and security devices for personal identification — Contactless vicinity objects — Part 1: Physical characteristics*

ISO/IEC 15693-2, *Cards and security devices for personal identification — Contactless vicinity objects — Part 2: Air interface and initialization*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 15693-1, ISO/IEC 15693-2 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

© ISO/IEC 2019 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

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

3.1.3
payload
part of the message data which conveys information relating to the use of the security commands defined in this document

Note 1 to entry: The message data is defined in the ISO/IEC 29167 series.

3.1.4
ResponseBuffer
VICC memory area where the result of a cryptographic operation is stored which may be retrieved using a ReadBuffer command

3.1.5
Write alike
command or request resulting in a non-volatile change to the contents of the VICC memory

3.2 Symbols and abbreviated terms

f_c	frequency of operating field (carrier frequency)
AFI	application family identifier
CRC	cyclic redundancy check
CS	Cryptographic Suite
CSI	Cryptographic Suite Identifier
DSFID	data storage format identifier
EOF	end of frame
LSB	least significant bit
LSByte	least significant byte
MSB	most significant bit
MSByte	most significant byte
RFU	reserved for future use
SOF	start of frame
UID	unique identifier
VCD	vicinity coupling device
VICC	vicinity integrated circuit card

© ISO/IEC 2019 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

4 Definition of data elements

4.1 UID

The VICCs are uniquely identified by a 64 bits 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 Table 1.

Table 1 — UID format

MSB		LSB
64 — 57	**56 — 49**	**48 — 1**
'E0'	IC Mfg code	IC manufacturer serial number

The UID comprises:

— the MSByte (bits 64 – 57) which shall be 'E0';

— the IC manufacturer code (bits 56 – 49) defined in ISO/IEC 7816-6;

— a unique serial number (bits 48 – 1) assigned by the IC manufacturer.

4.2 AFI

The AFI 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.

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

The most significant nibble of the AFI is used to code one specific or all application families, as defined in Table 2.

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

Table 2 — AFI coding

AFI most significant nibble	AFI least significant nibble	Meaning VICCs respond from	Examples/comments
‘0’	‘0’	All families and subfamilies	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
NOTE X = ‘1’ to ‘F’, Y = ‘1’ to ‘F’.			

© ISO/IEC 2019 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

Table 2 *(continued)*

AFI most significant nibble	AFI least significant nibble	Meaning VICCs respond from	Examples/comments
'9'	'0', Y	EAN-UCC system for Application Identifiers	
'A'	'0', Y	Data Identifiers as defined in ISO/IEC 15418	
'B'	'0', Y	UPU (Universal Postal Union)	
'C'	'0', Y	IATA (International Air Transport Association)	
'D'	'0', Y	RFU	
'E'	'0', Y	RFU	
'F'	'0', Y	RFU	
NOTE X = '1' to 'F', Y = '1' to 'F'.			

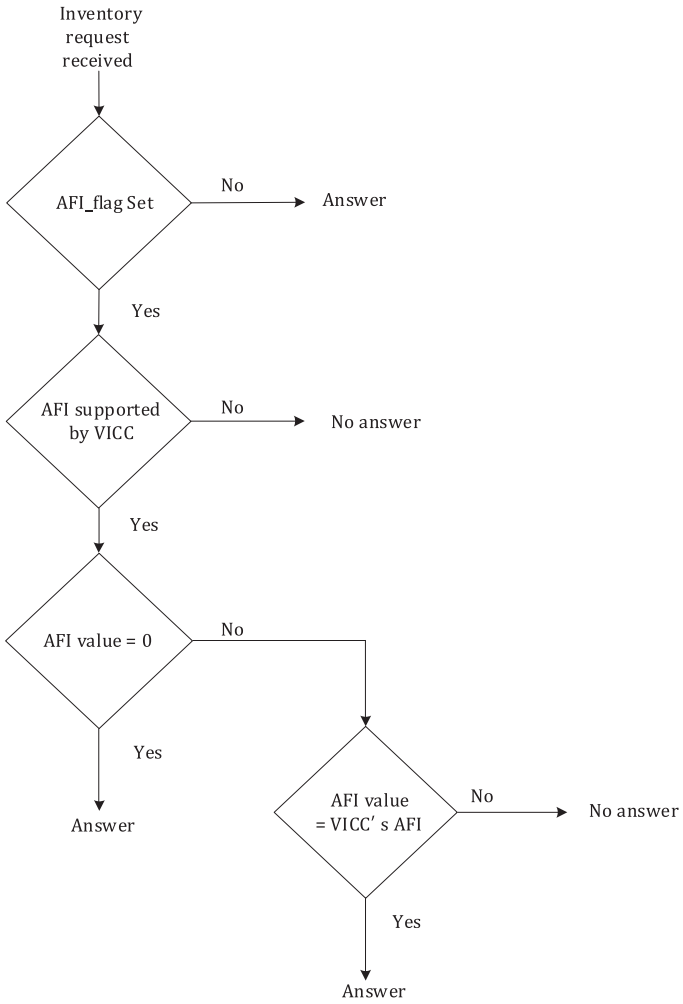
The support of the AFI by the VICC is optional.

If the 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 the AFI is supported by the VICC, it shall answer according to the matching rules described in Table 2.

Figure 1 shows the VICC decision tree for the AFI.

© ISO/IEC 2019 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019



NOTE "Answer" means that the VICC answers to the Inventory request.

Figure 1 — VICC decision tree for the AFI

4.3 DSFID

The DSFID 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'.

For examples, refer to Annex C.

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).

© ISO/IEC 2019 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

Upon reception of a response from the VICC, it is recommended that the VCD verifies 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 (see Table 3).

Each byte is transmitted least significant bit first.

Table 3 — CRC bits and bytes transmission rules

LSByte		MSByte	
LSB	MSB	LSB	MSB
CRC 16 (8 bits)		CRC 16 (8 bits)	
↑ first transmitted bit of the CRC			

NOTE The probability that CRC 16 detects an error depends on the frame length and bit error rate. With a bit error rate of 1E-4 the maximum frame length is less than 512 bytes.

4.5 Security framework

The security framework provides an interface to the crypto suites defined in the ISO/IEC 29167 series. Crypto suites are identified by an 8-bit CSI defined in ISO/IEC 29167-1.

The security framework includes optional security features such as VICC or VCD Authentication, Mutual Authentication, key update or secure messaging.

5 VICC memory organization

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

— Up to 65 536 blocks can be addressed.

— The block size can be of up to 256 bits.

— This leads to a maximum memory capacity of up to 2 MBytes (16 MBits).

The commands described in this document 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 this document 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 currently coded on one byte but may be coded in 2, 4 and 8 as defined in future revisions of this document (see Table 4).

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 4 — Block security status

Bit	Flag name	Value	Description
b1	Lock_flag	0	Not locked
		1	Locked
b2 to b5	Proprietary	X	Not defined in this document

© ISO/IEC 2019 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

Table 4 *(continued)*

Bit	Flag name	Value	Description
b6		0	Unless otherwise specified in future revisions of this document
		1	See warning for legacy commands listed in Annex E.
b7		0	Unless otherwise specified in future revisions of this document
		1	See warning for legacy commands listed in Annex E.
b8		0	Unless otherwise specified in future revisions of this document
		1	See warning for legacy commands listed in Annex E.
b9 to b16		RFU	Only present if specified in future revisions of this document and the block security status length_flag is set to (0,1)b
b9 to b32		RFU	Only present if specified in future revisions of this document and the block security status length_flag is set to (1, 0)b
b9 to b64		RFU	Only present if specified in future revisions of this document and the block security status length_flag is set to (1, 1)b

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) shall be implemented as specified in ISO/IEC 15693-2. The maximum frame length is 8 192 bytes.

c) Each request consists of the following fields:

— flags;

— command code;

— mandatory and optional parameters fields, depending on the command;

© ISO/IEC 2019 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

— 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 LSB first.

g) A multiple-byte field is transmitted LSByte first, each byte is transmitted LSB 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).

VICC or VCD receiving RFU bits set incorrectly shall disregard the command or response except for commands listed in Annex E. The VICC may respond with an error code.

7.2 Modes

7.2.1 General

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

7.2.2 Addressed mode

When the Address_flag is set to 1 (Addressed mode), the request shall contain the 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.

7.2.3 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.

7.2.4 Select mode

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

© ISO/IEC 2019 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

The VICC in the Selected state or Selected Secure 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 or Selected Secure state shall answer to a request having the Select flag set to 1.

7.3 Request format

7.3.1 General

The request consists of the following fields (see Figure 2):

— flags;

— command code (see Clause 10);

— parameters and data fields;

— CRC (see 4.4).

SOF	Flags	Command code	Parameters	Data	CRC	EOF

Figure 2 — General request format

7.3.2 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. Table 5 to Table 7 show the Request flags definition.

It consists of eight bits.

Table 5 — 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 unless specified otherwise in the definition of the command.
		1	High data rate shall be used unless specified otherwise in the definition of the command.
b3	Inventory_flag	0	The meaning for flags 5 to 8 is according to Table 6.
		1	The meaning for flags 5 to 8 is according to Table 7.
b4	Protocol Extension_flag	0	No protocol format extension.
		1	Protocol format is extended. — See warning for legacy commands listed in Annex E. — Reserved for future use for all other commands.
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.			

© ISO/IEC 2019 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

Table 6 — Request flags 5 to 8 definition when Inventory_flag is not set

Bit	Flag name	Value	Description
b5	Select_flag	0	The request shall be executed by any VICC according to the setting of Address_flag.
		1	The request shall be executed only by the VICC in Selected state. The Address_flag shall be set to 0 and the UID field shall not be included in the request.
b6	Address_flag	0	The request is not addressed. The UID field is not included. It shall be executed by any VICC.
		1	The request is addressed. The UID field is included. It shall be executed only by the VICC whose UID matches the UID specified in the request.
b7	Option_flag	0	The meaning is defined by the command description. It shall be set to 0 if not otherwise defined by the command.
		1	The meaning is defined by the command description.
b8		0	Unless otherwise specified in the command definition.
		1	See warning for legacy commands listed in Annex E.

Table 7 — Request flags 5 to 8 definition when Inventory_flag is set

Bit	Flag name	Value	Description
b5	AFI_flag	0	AFI field is not present.
		1	AFI field is present.
b6	Nb_slots_flag	0	16 slots.
		1	1 slot.
b7	Option_flag	0	The meaning is defined by the command description. It shall be set to 0 if not otherwise defined by the command.
		1	The meaning is defined by the command description.
b8		0	Unless otherwise specified in the command definition.
		1	See warning for legacy commands listed in Annex E.

7.4 Response format

7.4.1 General

The response consists of the following fields (see Figure 3):

— flags;

— one or more parameter fields;

— data;

— CRC (see 4.4).

SOF	Flags	Parameters	Data	CRC	EOF

Figure 3 — General response format

© ISO/IEC 2019 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

7.4.2 Response flags

The eight bit response flags field indicates how actions have been performed by the VICC and whether corresponding fields are present or not. Table 8 shows the Response flags definition.

Where the value "1b" for bits b2 to b8 may be used see warning for the legacy commands listed in Annex E.

Table 8 — Response flags 1 to 8 definition

<table>
<tr><th>Bit</th><th>Flag name</th><th>Value</th><th colspan="4">Description</th></tr>
<tr><td rowspan="2">b1</td><td rowspan="2">Error_flag</td><td>0</td><td colspan="4">No error.</td></tr>
<tr><td>1</td><td colspan="4">Error detected. Error code is in the "Error" field.</td></tr>
<tr><td rowspan="2">b2</td><td rowspan="2">ResponseBuffer Validity_flag</td><td>0</td><td colspan="4">In any response if the ResponseBuffer does not contain a valid result of a (cryptographic) calculation or if the ResponseBuffer is not supported.</td></tr>
<tr><td>1</td><td colspan="4">In any response if the ResponseBuffer contains a valid result of a (cryptographic) calculation.</td></tr>
<tr><td rowspan="2">b3</td><td rowspan="2">Final response_flag</td><td>0</td><td colspan="4">In the Final response of an In-process reply if this reply does not contain the result of a (cryptographic) calculation.</td></tr>
<tr><td>1</td><td colspan="4">In the Final response of an In-process reply if this reply contains the result of a (cryptographic) calculation.</td></tr>
<tr><td rowspan="2">b4</td><td rowspan="2">Extension_flag</td><td>0</td><td colspan="4">No protocol format extension.</td></tr>
<tr><td>1</td><td colspan="4">Protocol format is extended. Reserved for future use.</td></tr>
<tr><td rowspan="5">b5
b6</td><td rowspan="5">Block security status length_flag</td><td rowspan="5"></td><td>b5</td><td>b6</td><td colspan="2">Block security status Length</td></tr>
<tr><td>0</td><td>0</td><td colspan="2">1 byte</td></tr>
<tr><td>0</td><td>1</td><td>2 bytes</td><td rowspan="3">These values shall not be used unless the content of the additional bytes of the block security status is defined in future revisions of this document.</td></tr>
<tr><td>1</td><td>0</td><td>4 bytes</td></tr>
<tr><td>1</td><td>1</td><td>8 bytes</td></tr>
<tr><td rowspan="2">b7</td><td rowspan="2">Waiting time extension request_flag</td><td>0</td><td colspan="4">No Waiting time extension request.</td></tr>
<tr><td>1</td><td colspan="4">Waiting time extension request.</td></tr>
<tr><td>b8</td><td>RFU</td><td>0</td><td colspan="4"></td></tr>
</table>

The ResponseBuffer Validity_flag shall be set or reset as specified in the command description.

For each of the following commands, block security status b5 and b6 in Table 8 shall be set to zero (1 byte).

— Read single block with option flag = 1

— Read multiple blocks with option flag = 1

— Extended Read single block with option flag = 1

— Extended Read multiple blocks with option flag = 1

— Get multiple block security status

— Extended get multiple block security status

7.4.3 Response error code

When the Error_flag is set by the VICC, the error code field shall be included and provides information about the error that occurred. Error codes are defined in Table 9.

If the VICC does not support specific error code(s) listed in Table 9, it shall answer with the error code '0F' ("Error with no information given").

© ISO/IEC 2019 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

Table 9 — Response error code definition

Error code	Meaning
'01'	The command is not supported, i.e. the request code is not recognized.
'02'	The command is not recognized, for example, a format error occurred.
'03'	The command option is not supported.
'04'	The command cannot be processed in time.
'0F'	Error with no information given or a specific error code is not supported.
'10'	The specified block is not available (doesn't exist).
'11'	The specified block is already locked and thus cannot be locked again.
'12'	The specified block is locked and its content cannot be changed.
'13'	The specified block was not successfully programmed.
'14'	The specified block was not successfully locked.
'15'	The specified block is protected.
'40'	Generic cryptographic error.
'A0' – 'DF'	Custom command error codes.
all others	RFU.

7.4.4 In-process reply response formats

7.4.4.1 Barker field

The Barker field contains the Done flag and a Barker code.

7.4.4.2 Barker code

The Barker code is included to facilitate the synchronisation between the VCD and the VICC. It is a fixed 7-bit value as defined in Table 10.

Table 10 — Barker field

b8	b7	b6	b5	b4	b3	b2	b1
X	0	1	0	0	1	1	1
Done flag	Barker code						

7.4.4.3 Done flag

The Done flag indicates whether the VICC is still processing a command. Done flag = 0 means the VICC is still processing a command; Done flag = 1 means that the VICC has finished the command processing.

7.4.4.4 Barker response

If no error occurs and the Done flag is set to 0, the Barker response contains the fields defined in Table 11.

Table 11 — Barker response

SOF	Flags	Barker field	CRC16	EOF
	8 bits	8 bits	16 bits	

If an error occurs, the response contains the error code and is the Final response (see Table 13).

© ISO/IEC 2019 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

7.4.4.5 Final response

If no error occurs and the Done flag is set to 1, the Final response contains the fields defined in Table 12.

Table 12 — Final response

SOF	Flags	Barker field	Data	CRC16	EOF
	8 bits	8 bits	multiple of 8 bits	16 bits	

The Data field shall be padded with least significant 0 bits as required to a minimum multiple of 8 bits or not be present.

If an error occurs, the Final response contains the fields defined in Table 13.

Table 13 — Final response if error flag is set

SOF	Flags	Error code	CRC16	EOF
	8 bits	8 bits	16 bits	

7.4.4.6 Initial response

If no error occurs and the Done flag is set to 0, the Initial response contains the fields defined in Table 14.

Table 14 — Initial response

SOF	Flags	Barker field	Data	CRC16	EOF
	8 bits	8 bits	16 bits	16 bits	

The Done flag is set to 0. The Data field contains the timing information. Timing information is coded as a binary integer multiple of 4 096/f_c (302 µs), a value of 0 indicates that the feature is not supported.

If an error occurs, the response contains the error code and is the Final response (see Table 13).

7.4.5 Waiting time extension request formats

If no error occurs, the VICC Waiting time extension request contains the fields defined in Table 15.

Table 15 — Waiting time extension request

SOF	Flags	Data	CRC16	EOF
	8 bits	16 bits	16 bits	

The Waiting time extension request_flag shall be set to 1.

The Data field contains the Waiting time extension delay information. Waiting time extension delay is coded as a binary integer multiple of 4 096/f_c (302 µs).

If an error occurs, the response shall use the format described in the command description.

7.5 VICC states

7.5.1 General

A VICC can be in one of the 5 following states:

— Power-off;

© ISO/IEC 2019 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

— Ready;

— Quiet;

— Selected;

— Selected Secure.

The transition between these states is specified in Figure 4.

The support of the Power-off, Ready and Quiet states is mandatory.

The support of the Selected and Selected Secure states is optional as represented with a dotted line in Figure 4.

The VICC state transition diagram shows only valid transitions. In all other cases the current VICC state remains unchanged. When the VICC cannot process a VCD request (e.g. CRC error, etc.), it shall stay in its current state.

The intention of the state transition method is that only one VICC should be in the Selected or Selected Secure state at a time.

NOTE The case where one VICC is in a Selected state and another is in a Selected Secure state can happen if a first VICC is selected, and a second VICC moves in the Selected Secure state when the VCD does a VCD or Mutual Authentication. Only the VCD can prevent this situation to occur by deselecting the first VICC before doing the VCD or Mutual Authentication with the second one.

7.5.2 Power-off state

The VICC is in the Power-off state when it cannot be activated by the VCD.

7.5.3 Ready state

The VICC is in the Ready state when it is activated by the VCD. It shall process any request unless otherwise specified in the command definition where the Select_flag is not set.

In a Ready state, a VCD can perform a VICC Authentication by a successful Challenge, ReadBuffer or Authenticate command sequence. After a VICC Authentication, the VICC remains in the Ready state.

For a transition from the Ready state to the Selected Secure state, perform a VCD Authentication or Mutual Authentication in Addressed mode containing the correct UID as specified by the crypto suites.

See Annex D for additional information on crypto command sequence.

7.5.4 Quiet state

When in the Quiet state, the VICC shall process any request unless otherwise specified in the command definition where the Inventory_flag is not set and where the Address_flag is set.

For a transition from the Quiet state to the Selected Secure state, perform a VCD Authentication or Mutual Authentication in Addressed mode containing the correct UID as specified in the crypto suites.

7.5.5 Selected state

The VICC in the Selected state shall process any request unless otherwise specified in the command definition where the Select_flag is set.

For a transition from the Selected state to the Ready state, a VCD shall perform:

— Reset to Ready command with the Select_flag set;

— Select command with different VICC UID.

© ISO/IEC 2019 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019

For a transition from the Selected state to the Quiet state, a VCD shall perform a Stay quiet command with the correct UID number.

For a transition from the Selected state to the Selected Secure state, perform a VCD Authentication or Mutual Authentication as specified by the crypto suites with the Select_flag set.

7.5.6 Selected Secure state

A VICC may execute any optional commands and the mandatory Stay quiet command. All commands shall be executed with the Select_flag set except the Stay quiet or Select commands which shall be executed in Addressed mode.

For a transition from the Selected Secure state to the Ready state, a VCD shall perform:

— Reset to Ready command with the Select_flag set;

— Challenge command;

— any Authenticate command starting a new authentication process;

— Select command with different VICC UID.

In addition the VICC shall return to the Ready state in case of cryptographic errors as specified in the crypto suites.

For a transition from the Selected Secure state to the Quiet state, a VCD shall perform a Stay quiet command with the correct UID number.

For a transition from the Selected Secure state to the Selected state, the VCD shall perform a Select command in Addressed mode containing the correct UID.

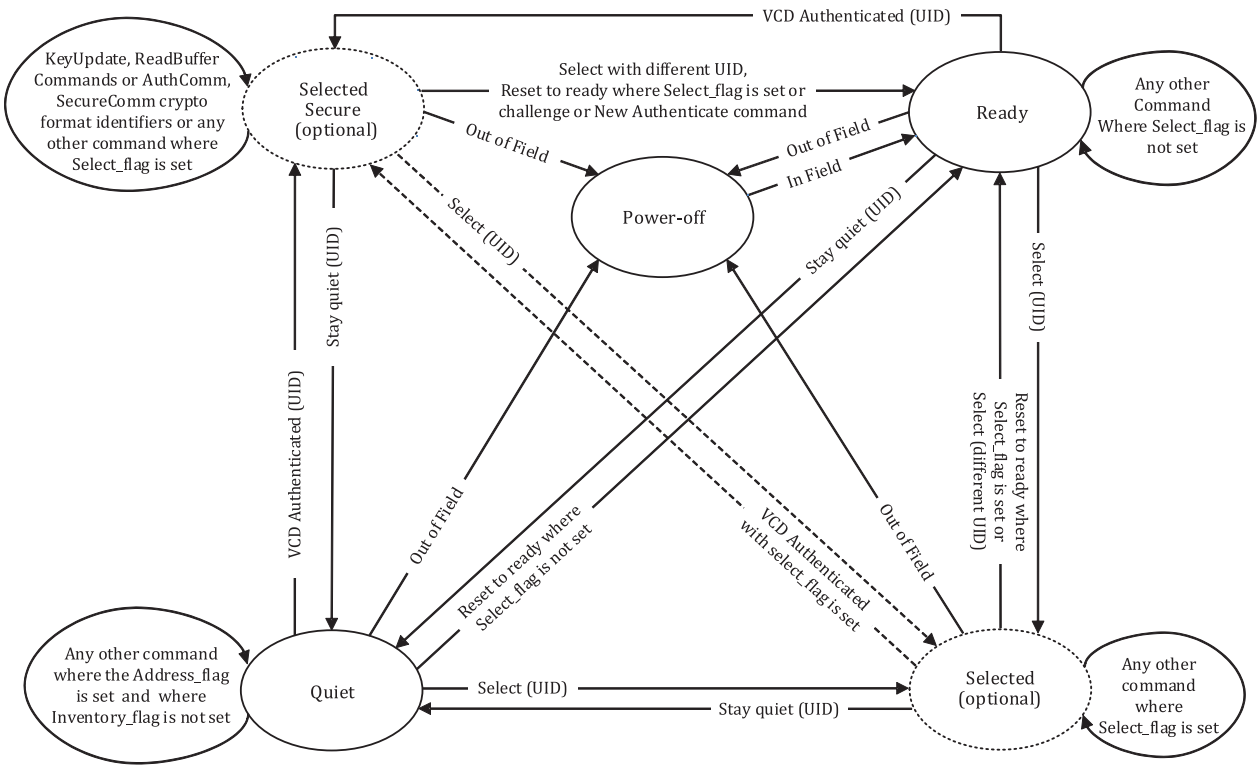


Figure 4 — VICC state transition diagram

© ISO/IEC 2019 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO/IEC 15693-3:2019