UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SML INTELLIGENT INVENTORY SOLUTIONS LLC
and SML (USA) INC.,
Petitioners,

v.

ADASA,
Patent Owner.

Patent No. 9,798,967

DECLARATION OF MARIA P. GARCIA
UNDER 28 U.S.C. § 1746

I, Maria P. Garcia, hereby declare as follows:

1. I am making this declaration on behalf of SML Intelligent Inventory Solutions LLC and SML (USA) Inc. in the matter of the *inter partes* review of U.S. Patent No. 7,798,967 ("the Patent Proceeding"). Unless otherwise stated, the facts stated in this declaration are based on my personal knowledge.

2. I am the Intellectual Property Research Librarian at Jones Day, 555 South Flower Street, Fiftieth Floor, Los Angeles, California 90071-2300. I received a Bachelor of Science in Chemical Engineering from the University of Southern California in May 1989. I worked in the Circulation and Acquisition Department at the Education and Information Science Library at the University of Southern California form December 1983 to February 1989. I formerly worked at Lyon & Lyon, where I was responsible for all aspects of patent and trademark research.

3. I am familiar with library procedures for entering and indexing print and electronic sources in publicly available searchable databases such as the IEEE Xplore Digital Library, WorldCat, the U.S. Copyright Office, Inspec, Compendex, and the Library of Congress Catalog, among others.

4. I am also familiar with the Internet Archive, a digital library formally certified by the State of California as a public library. Among other services that the Internet Archive makes available to the general public is the Wayback Machine, an

online archive. The Internet Archive's Wayback Machine service archives webpages as of a certain capture date to track changes in the web over time. The Internet Archive has been in operation as a nonprofit library since 1996 and has hosted the Wayback Machine service since its inception in 2001. During my time as a librarian, I frequently used the Internet Archive's Wayback Machine for research and instruction purposes.

5. This includes using the Wayback Machine to research reference inquiries that require hard-to-find online resources. I consider the Internet Archive's records keeping to be as rigorous and detailed as other formal library records keeping practices such as MARC records or OCLC records.

I. Exhibit 1011

6. Exhibit 1011 in the Patent Proceeding is EPCglobal Tag Data Standards Version 1.3 (March 8, 2006) ("TDS").

7. Exhibit 1012 in the Patent Proceeding is the Affidavit of Elizabeth Rosenburg, a Records Request Processor at the Internet Archive.

8. Pages 104-200 of Exhibit 1012 is a complete PDF copy of the TDS, available for download at Internet Archive Wayback Machine record for a page entitled "Microsoft Word - TDS 1pt3 Ratified Spec March 8 2006.doc" as hosted on the EPCglobal website. This record for URL http://www.epcglobalinc.org/

standards_technology/Ratified%20Spec%20March%208%202006.pdf can be found at https://web.archive.org/web/20060701042844/http://www.epcglobalinc.org/standards_technology/Ratified%20Spec%20March%208%202006.pdf, as indicated on page 103 of Exhibit 1012. This page was captured by the Internet Archive as of July 1, 2006.

9. After comparing Exhibit 1011 to the PDF copy of the TDS, included at pages 104-200 of Exhibit 1012, it is my determination that Exhibit 1011 is a true and correct copy of the TDS. Given that the record preserved at pages 104-200 of Exhibit 1012 was captured as of July 1, 2006, it is my determination that the TDS was made available to the public as of July 1, 2006 if not earlier via the original EPCglobal website.

II. Exhibit 1013

10. Exhibit 1013 in the Patent Proceeding is excerpts from RFID for Dummies by Patrick J. Sweeney ("*Dummies*").

11. Appendix A to this declaration is a copy of excerpts from *Dummies* as held by the University of Akron library.

12. After comparing Exhibit 1013 to Appendix A, it is my determination that Exhibit 1013 is a true and correct copy of *Dummies*.

III. Exhibit 1014

13. Exhibit 1014 in the Patent Proceeding is David L. Brock, White Paper: The Electronic Product Code (EPC): A Naming Scheme for Physical Objects, Auto-ID Center, Massachusetts Institute of Technology (January 1, 2001) ("*MIT White Paper*").

14. A complete PDF copy of the *MIT White Paper* is available online at the Internet Archive Wayback Machine record for a page entitled "Research Paper Publ. Schedule" as hosted on the MIT Auto-ID Center website. This record for URL http://autoid.mit.edu/whitepapers/MIT-AUTOID-WH-002.PDF can be found at https://web.archive.org/web/20060906083130/http://autoid.mit.edu/whitepapers/MIT-AUTOID-WH-002.PDF. This page was captured by the Internet Archive as of September 6, 2006.

15. I accessed the URL identified above, and after comparing the PDF copy available at that address to Exhibit 1014, it is my determination that Exhibit 1014 is a true and correct copy of the *MIT White Paper*.

IV. Exhibit 1015

16. Exhibit 1015 in the Patent Proceeding is excerpts of David Tarnoff, Computer Organization and Design Fundamentals: Examining Computer Hardwar from the Bottom to the Top (Revised 1st Ed., July 2007) ("*Computer*

Fundamentals").

17. A complete PDF copy of *Computer Fundamentals* is available online from the Rose Hulman Institute of Technology's website, at URL https://www.rose-hulman.edu/class/csse/csse132/1819c/CODF_v02b.pdf.

18. I accessed the URL identified above, and after the comparing the PDF copy available at that address to Exhibit 1015, it is my determination that Exhibit 1015 is a true and correct copy of the *Computer Fundamentals*.

V. Exhibit 1016

19. Exhibit 1016 in the Patent Proceeding is Excerpts of Bill Glover, et al., RFID Essentials (February 28, 2006) ("RFID Essentials").

20. A complete PDF copy of RFID Essentials is available online from the Ommolketab Institute's website, at URL http://ommolketab.ir/aaf-lib/ralykv2kfq9burc6316v27zqqg1ncw.pdf.

21. I accessed the URL identified above, and after the comparing the PDF copy available at that address to Exhibit 1016, it is my determination that Exhibit 1016 is a true and correct copy of RFID Essentials.

VI. Exhibit 1017

22. Exhibit 1017 in the Patent Proceeding is excerpts of Klaus Finkenzeller, RFID HANDBOOK (John Wiley & Sons, Ltd., 2d ed. 2003) ("RFID Handbook").

23. Exhibit 1018 in the Patent Proceeding is RFID Handbook - English Edition [http://web.archive.org/web/20030604032620/http://www.rfid-handbook.de/english/index.html].

24. Exhibit 1018 is a screen capture of the Internet Archive Wayback Machine record for a page entitled "RFID Handbook – English edition" as hosted on the RFID Handbook website. This record for the URL http://www.rfid-handbook.de/english/index.html can be found at https://web.archive.org/web/20030604032620/http://www.rfid-handbook.de/english/index.html. This page was captured by the Internet Archive as of June 4, 2003.

25. Appendix B to this declaration is a copy of excerpts from the RFID Handbook as held by the South Dakota State University Library.

26. After comparing Exhibit 1017 to Appendix B, it is my determination that Exhibit 1017 is a true and correct copy of the RFID Handbook. Given that the record preserved at Exhibit 1018 was captured as of June 4, 2003, it is my determination that the RFID Handbook was made available to the public for sale as of June 4, 2003 if not earlier via the original RFID Handbook website.

VII. Exhibit 1019

27. Exhibit 1019 in the Patent Proceeding is 3Com Corporation, Understanding IP Addressing: Everything You Ever Wanted To Know (2001).

("Understanding IP Addressing").

28. A complete PDF copy of Understanding IP Addressing is available online from the Internet Archive's website, at URL https://archive.org/details/B-001-002-066. The URL includes bibliography information for Understanding IP Addressing, including a publication date of 2001.

29. I accessed the URL identified above, and after the comparing the PDF copy available at that address to Exhibit 1019, it is my determination that Exhibit 1019 is a true and correct copy of Understanding IP Addressing.

VIII. Exhibit 1020

30. Exhibit 1020 in the Patent Proceeding is Department of Defense, Radio Frequency Identification (RFID) Policy (July 30, 2004). ("DoD RFID Policy").

31. A complete PDF copy of the DoD RFID Policy is available online from the United States Transportation Command's website, at URL https://www.ustranscom.mil/cmd/associated/ait/files/20040730,_USD(AT&L)_Memo,_Radio_Frequency_Identification_(RFID)_Policy.pdf.

32. I accessed the URL identified above, and after the comparing the PDF copy available at that address to Exhibit 1020, it is my determination that Exhibit 1020 is a true and correct copy of the DoD RFID Policy.

IX. Exhibit 1021

33. Exhibit 1021 in the Patent Proceeding is Manohar Potdar, et al, Applications of RFID in Pharmaceutical Industry (Jan. 2007). ("Applications of RFID").

34. A complete PDF copy of Applications of RFID is available online for download from Curtin University's website, at URL https://espace.curtin.edu.au/handle/20.500.11937/17300.

35. I accessed the URL identified above and the download link contained therein. After the comparing the downloaded PDF copy to Exhibit 1021, it is my determination that Exhibit 1021 is a true and correct copy of Applications of RFID.

X. Exhibit 1027

36. Exhibit 1027 in the Patent Proceeding is ISO/IEC 15693-3:2001 (E), Identification cards—Contactless integrated circuit(s) cards—Vicinity cards—Part 3: Anticollision and transmission protocol (April 1, 2001) ("ISO 15693-3").

37. Appendix C to this declaration is a complete PDF copy of ISO 15693-3 purchased from the International Electrotechnical Commission's website, at URL https://webstore.iec.ch/en/publication/21286.

38. After comparing Exhibit 1027 to Appendix C, it is my determination that Exhibit 1027 is a true and correct copy of ISO 15693-3.

XI. Exhibit 1029

39. Exhibit 1029 in the Patent Proceeding is excerpts of EPCglobal Architectural Framework, EPCglobal Final Version, 1 July 2005 ("EPC Framework").

40. A complete PDF copy of the EPC Framework is available online at the Internet Archive Wayback Machine record for a page entitled "Microsoft Word - Final-epcglobal-arch-20050701.doc" as hosted on the EPCglobal website. This record for URL http://www.epcglobalinc.org/standards_technology/Final-epcglobal-arch-20050701.pdf can be found at https://web.archive.org/web/20060422193302/http://www.epcglobalinc.org/standards_technology/Final-epcglobal-arch-20050701.pdf. This page was captured by the Internet Archive as of April 6, 2006.

41. I accessed the URL identified above, and after comparing the PDF copy available at that address to Exhibit 1029, it is my determination that Exhibit 1029 is a true and correct copy of the EPC Framework.

I declare under penalty of perjury that the foregoing is true and correct. Executed on November 1, 2024, at Jones Day, 555 South Flower Street, Fiftieth Floor, Los Angeles, California 90071-2300.

/s/ Maria P. Garcia
Maria P. Garcia

SML Exhibit 1031

Appendix A

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Patrick J. Sweeney II heads ODIN Technologies, an RFID integration and software development company. He learned the technology at MIT and is considered an industry expert.

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About the Author

As you may have guessed by the dangling participles and misused gerunds, this is the first book by **Patrick J. Sweeney II** (despite Amazon's link to books on gynecology by an author of the same name). When not negotiating with his editor to push back book deadlines, he leads ODIN technologies as President and CEO.

ODIN technologies is a global RFID software and services company focusing on RFID infrastructure. Mr. Sweeney is well recognized as a visionary in the RFID industry with several RFID patents in various stages of approval. He has appeared in such publications as *CIO Magazine, The Washington Post, Fortune* magazine, *Internet Week,* and many others. He has been interviewed by ABC news and CNN, among others, and is a frequent speaker worldwide on all topics relating to RFID. He is also an active member of several standards bodies and regulatory groups helping to shape the evolution of the RFID industry.

Mr. Sweeney is a second-generation IT professional; his father was one of the first employees at Electronic Data Systems (EDS), where "Pops" entertained him and his brother on weekends by teaching them to read punch cards and other useful skills. Mr. Sweeney took that genetic proclivity toward data centers and started a successful, secure managed hosting company in the late 1990s, which he later sold. His brother took that same early training and started XS Speed Choppers, making custom motorcycles — go figure.

Mr. Sweeney finished second in the 1996 Olympic trials in the single scull, is an avid outdoorsman, enjoys helping other entrepreneurs, and is passionate about various Irish causes. He is a board member of Trinity College business school in Dublin, Ireland, and an Alumni Board member at the Darden School of Business at the University of Virginia. He graduated from Darden and received a Bachelor of Science degree from the University of New Hampshire. He is blessed with a great family—wife Christen, daughter Shannon, son P.J., and three dogs. They live in Middleburg, Virginia, in a house full of useless RFID gadgets.

Publisher's Acknowledgments

We're proud of this book; please send us your comments through our online registration form located at www.dummies.com/register/.

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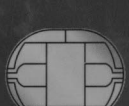
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Second Edition

Klaus Finkenzeller
Giesecke & Devrient GmbH, Munich, Germany

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Rachel Waddington
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Appendix C

INTERNATIONAL STANDARD

ISO/IEC 15693-3

First edition
2001-04-01

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.

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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.

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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 Nagaokakyo-City Kyoto 617-8510 Japan
US5793324 EP831618 EP837412 EP845751	Texas Instruments Deutschland GMBH TIRIS Haggarty Strasse 1 8050 Freising Germany

Subject Matter anticollision affecting Clause 8

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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.*

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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.

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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.

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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'.

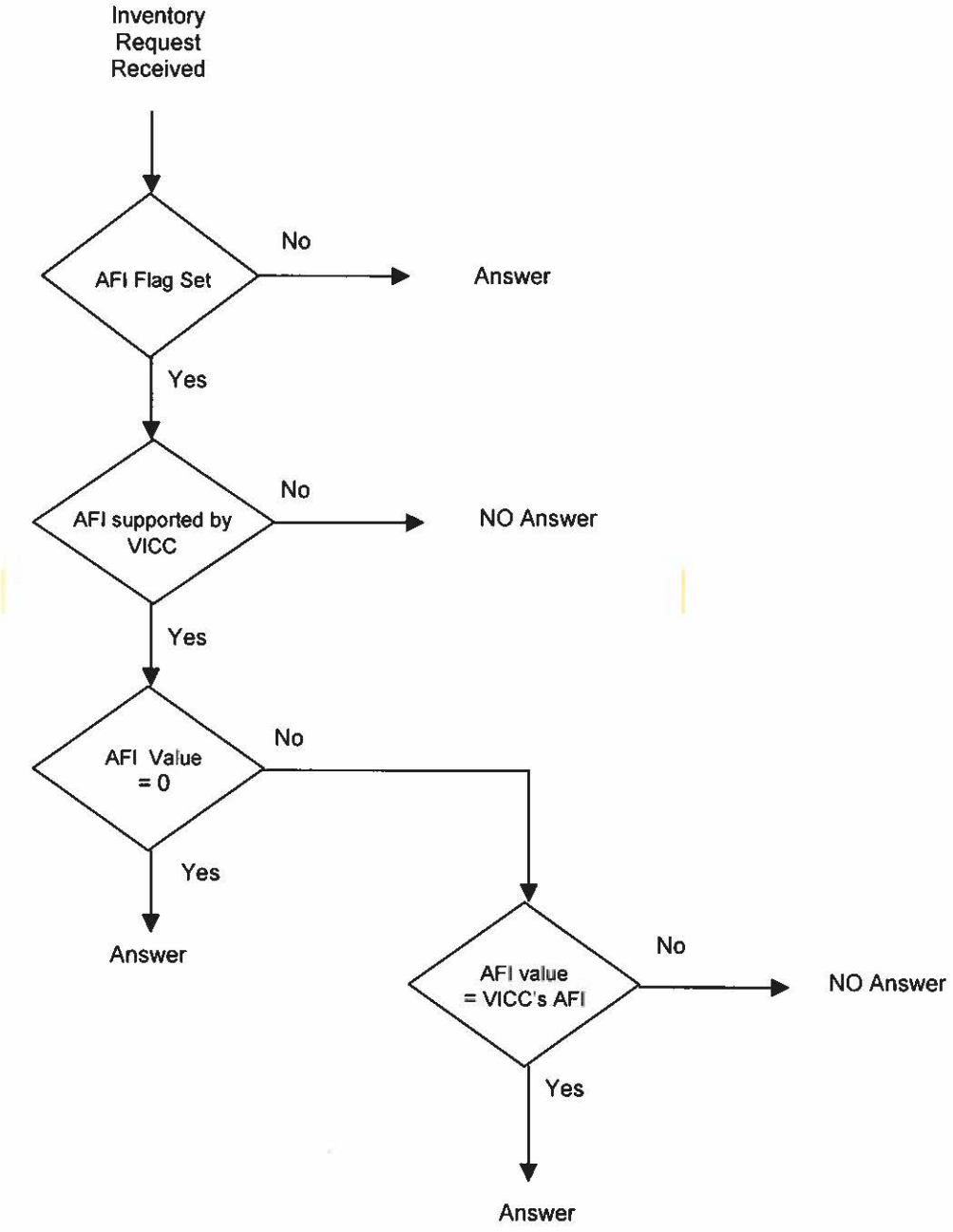
The support of AFI by the VICC is optional.

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.

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

Figure 2 — VICC decision tree for AFI

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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.

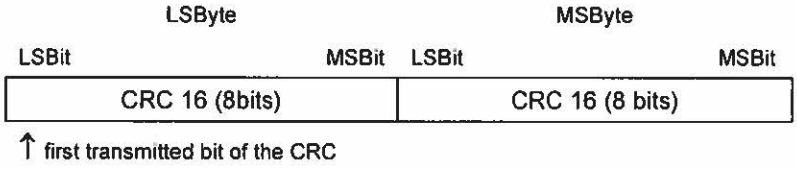


Figure 3 — CRC bits and bytes transmission rules

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).

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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

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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.

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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.

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Table 4 — Request flags 5 to 8 definition when inventory flag is NOT set

Bit	Flag name	Value	Description
b5	Select_flag	0	Request shall be executed by any VICC according to the setting of Address_flag
		1	Request shall be executed only by 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	Request is not addressed. UID field is not included. It shall be executed by any VICC.
		1	Request is addressed. 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	Meaning is defined by the command description. It shall be set to 0 if not otherwise defined by the command.
		1	Meaning is defined by the command description.
b8	RFU	0	

Table 5 — 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	Meaning is defined by the command description. It shall be set to 0 if not otherwise defined by the command.
		1	Meaning is defined by the command description.
b8	RFU	0	

7.4 Response format

The response consists of the following fields:

- Flags
- one or more parameter fields
- Data
- CRC (see 4.4)

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Figure 5 — General response format

7.4.1 Response flags

In a response, it indicates how actions have been performed by the VICC and whether corresponding fields are present or not.

It consists of eight bits.

Table 6 — Response flags 1 to 8 definition

Bit	Flag name	Value	Description
b1	Error_flag	0	No error
		1	Error detected. Error code is in the "Error" field.
b2	RFU	0	
b3	RFU	0	
b4	Extension_flag	0	No protocol format extension.
		1	Protocol format is extended. Reserved for future use.
b5	RFU	0	
b6	RFU	0	
b7	RFU	0	
b8	RFU	0	

7.4.2 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 7

If the VICC does not support specific error code(s) listed in table 7, it shall answer with the error code '0F' ("Error with no information given").

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Table 7 — Response error code definition

Error code	Meaning
'01'	The command is not supported, i.e. the request code is not recognised.
'02'	The command is not recognised, for example: a format error occurred.
'03'	The command option is not supported.
'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.
'A0' – 'DF'	Custom command error codes.
all others	RFU

7.5 VICC states

A VICC can be in one of the 4 following states:

- Power-off
- Ready
- Quiet
- Selected

The transition between these states is specified in figure 6.

The support of power-off, ready and quiet states is mandatory.

The support of selected state is optional.

7.5.1 Power-off state

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

7.5.2 Ready state

The VICC is in the Ready state when it is activated by the VCD. It shall process any request where the select flag is not set.

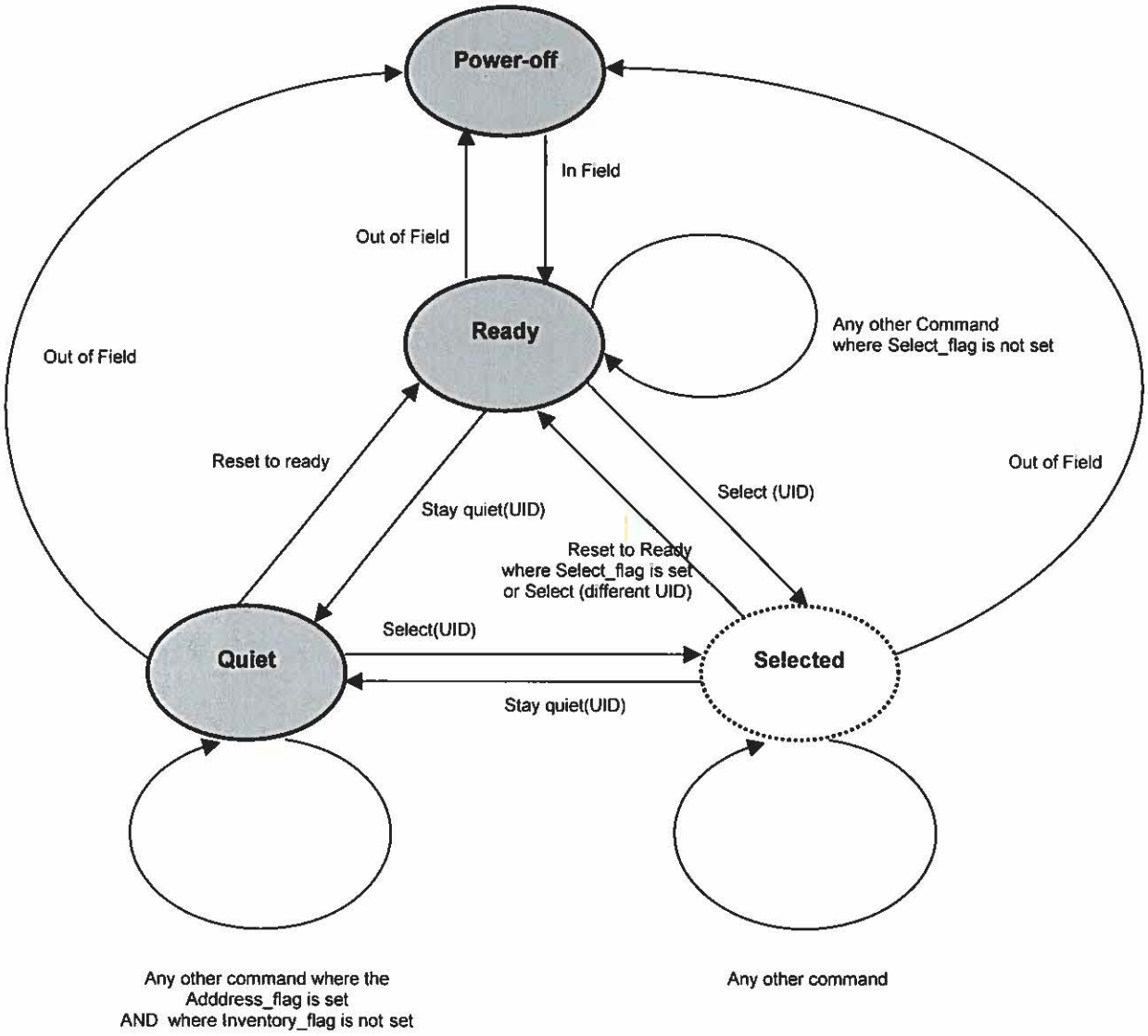
7.5.3 Quiet state

When in the quiet state, the VICC shall process any request where the Inventory_flag is not set and where the Address_flag is set.

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7.5.4 Selected state

Only a VICC in the selected state shall process requests having the Select_flag set.



NOTE 1 The intention of the state transition method is that only one VICC should be in the Selected state at a time.

NOTE 2 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.

NOTE 3 The Selected state is represented with a dotted line to show its support by the VICC is optional.

Figure 6 — VICC state transition diagram

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8 Anticollision

The purpose of the anticollision sequence is to make an inventory of the VICCs present in the VCD field by their unique ID (UID).

The VCD is the master of the communication with one or multiple VICCs. It initiates card communication by issuing the inventory request.

The VICC shall send its response in the slot determined or shall not respond, according to the algorithm described in clause 8.2.

8.1 Request parameters

When issuing the inventory command, the VCD shall set the Nb_slots_flag to the desired setting and add after the command field the mask length and the mask value.

The mask length indicates the number of significant bits of the mask value. It can have any value between 0 and 60 when 16 slots are used and any value between 0 and 64 when 1 slot is used. LSB shall be transmitted first.

The mask value is contained in an integer number of bytes. LSB shall be transmitted first.

If the mask length is not a multiple of 8 (bits), the mask value MSB shall be padded with the required number of null (set to 0) bits so that the mask value is contained in an integer number of bytes.

The next field starts on the next byte boundary.

SOF	Flags	Command	Mask length	Mask value	CRC16	EOF
	8 bits	8 bits	8 bits	0 to 8 bytes	16 bits	

Figure 7 — Inventory request format

MSB	LSB
0000	0100 1100 1111
Pad	Mask value

Figure 8 — Example of the padding of the mask

In the example of the figure 8, the mask length is 12 bits. The mask value MSB is padded with four bits set to 0.

The AFI field shall be present if the AFI_flag is set.

The pulse shall be generated according to the definition of the EOF in ISO/IEC 15693-2.

The first slot starts immediately after the reception of the request EOF.

To switch to the next slot, the VCD sends an EOF. The rules, restrictions and timing are specified in clause 9.

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8.2 Request processing by the VICC

Upon reception of a valid request, the VICC shall process it by executing the operation sequence specified in the following text in italics. The step sequence is also graphically represented in figure 9.

NbS is the total number of slots (1 or 16)

SN is the current slot number (0 to 15)

SN_length is set to 0 when 1 slot is used and set to 4 when 16 slots are used

LSB (value, n) function returns the n less significant bits of value

"&" is the concatenation operator

Slot_Frame is either a SOF or an EOF

SN= 0

if Nb_slots_flag then

NbS =1 SN_length=0

else NbS = 16 SN_length=4

endif

label1: if LSB(UID, SN_length + Mask_length) = LSB(SN, SN_length)&LSB(Mask, Mask_length) then

transmit response to inventory request

endif

wait (Slot_Frame)

if Slot_Frame= SOF then

Stop anticollision and decode/process request

exit

endif

if SN<NbS-1 then

SN = SN +1

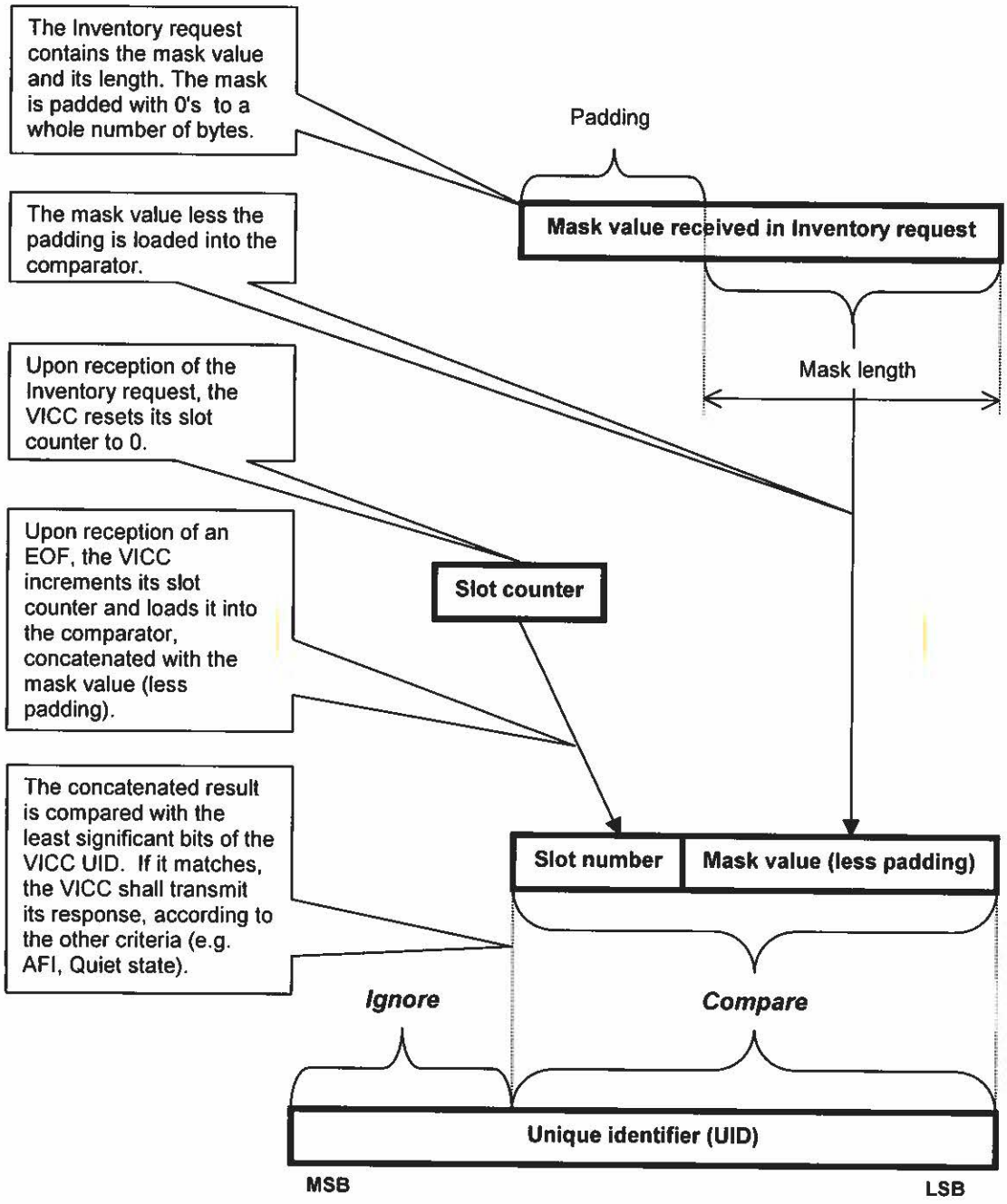
goto label1

exit

endif

exit

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NOTE When the slot number is 1 (Nb_slots_flag is set to 1), the comparison is made only on the mask (without padding).

Figure 9 — Principle of comparison between the mask value, slot number and UID

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8.3 Explanation of an anticollision sequence

Figure 10 summarises the main cases that can occur during a typical anticollision sequence where the number of slots is 16.

The different steps are:

a) the VCD sends an inventory request, in a frame, terminated by a EOF. The number of slots is 16.

b) VICC 1 transmits its response in slot 0. It is the only one to do so, therefore no collision occurs and its UID is received and registered by the VCD;

c) the VCD sends an EOF, meaning to switch to the next slot.

d) in slot 1, two VICCs 2 and 3 transmits their response, this generates a collision. The VCD detects it and remembers that a collision was detected in slot 1.

e) the VCD sends an EOF, meaning to switch to the next slot.

f) in slot 2, no VICC transmits a response. Therefore the VCD does not detect a VICC SOF and decides to switch to the next slot by sending a EOF.

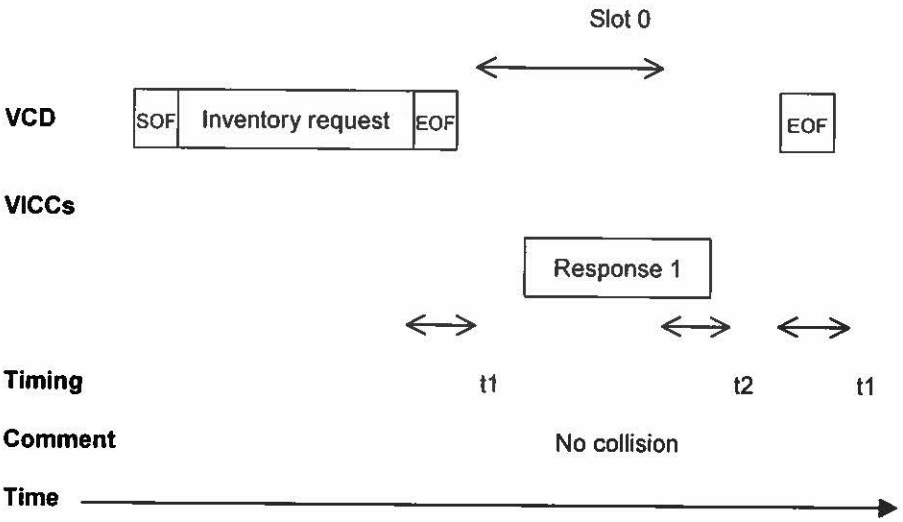
g) in slot 3, there is another collision caused by responses from VICC 4 and 5

h) the VCD then decides to send an addressed request (for instance a Read Block) to VICC 1, which UID was already correctly received.

i) all VICCs detect a SOF and exit the anticollision sequence. They process this request and since the request is addressed to VICC 1, only VICC1 transmit its response.

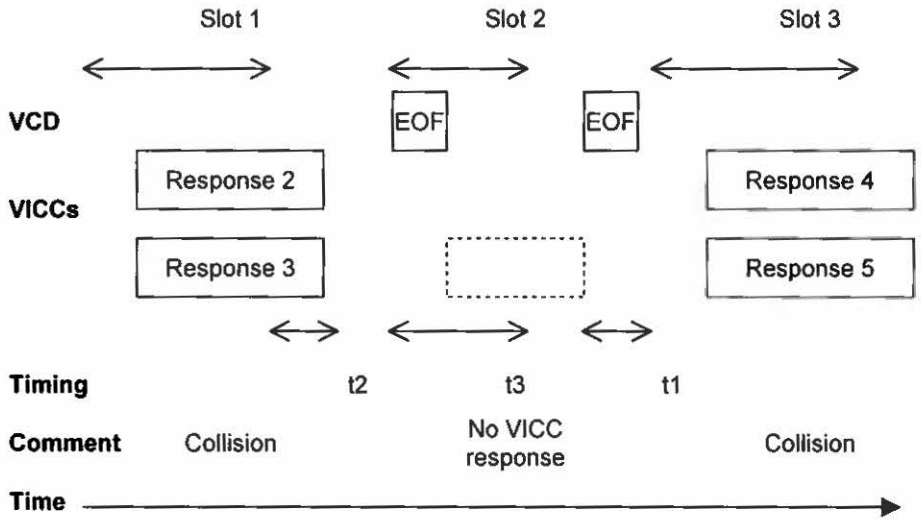
j) all VICCs are ready to receive another request. If it is an inventory command, the slot numbering sequence restarts from 0.

NOTE The decision to interrupt the anticollision sequence is up to the VCD. It could have continued to send EOF's till slot 15 and then send the request to VICC 1.

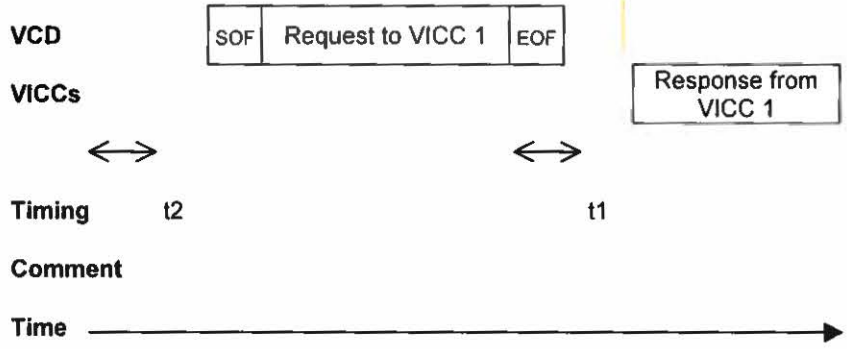


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Continued...



Continued...



NOTE t1, t2 and t3 are specified in clause 9.

Figure 10 — Description of a possible anticollision sequence

9 Timing specifications

The VCD and the VICC shall comply with the following timing specifications.

9.1.1 VICC waiting time before transmitting its response after reception of an EOF from the VCD

When the VICC has detected an EOF of a valid VCD request or when this EOF is in the normal sequence of a valid VCD request, it shall wait for a time t1 before starting to transmit its response to a VCD request or before switching to the next slot when in an inventory process (see 8.2 and 8.3)

t1 starts from the detection of the rising edge of the EOF received from the VCD (see ISO/IEC 15693-2:2000, 7.3.3).

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NOTE The synchronisation on the rising edge of the VCD-to-VICC EOF is needed for ensuring the required synchronisation of the VICC responses.

The minimum value of t1 is t1min= 4320/f_c (318,6 µs)

The nominal value of t1 is t1nom= 4352/f_c (320,9 µs)

The maximum value of t1 is t1max= 4384/f_c (323,3 µs)

t1max does not apply for Write alike requests. Timing conditions for Write alike requests are defined in the command descriptions.

If the VICC detects a carrier modulation during this time t1, it shall reset its t1 timer and wait for a further time t1 before starting to transmit its response to a VCD request or to switch to the next slot when in an inventory process.

9.1.2 VICC modulation ignore time after reception of an EOF from the VCD

When the VICC has detected an EOF of a valid VCD request or when this EOF is in the normal sequence of a valid VCD request, it shall ignore any received 10 % modulation during a time t_{mit}

t_{mit} starts from the detection of the rising edge EOF received from the VCD (see ISO/IEC 15693-2:2000, 7.3.3).

The minimum value of t_{mit} is t_{mit}min = 4384/f_c (323,3 µs) + t_{nrt}

where

- t_{nrt} is the nominal response time of a VICC.

t_{nrt} is dependent on the VICC-to-VCD data rate and subcarrier modulation mode (see ISO/IEC 15693-2:2000, 8.5, 8.5.1, 8.5.2).

NOTE The synchronisation on the rising edge of the VCD-to-VICC EOF is needed for ensuring the required synchronisation of the VICC responses.

9.1.3 VCD waiting time before sending a subsequent request

a) When the VCD has received a VICC response to a previous request other than Inventory and Quiet, it shall wait a time t2 before sending a subsequent request. t2 starts from the time the EOF has been received from the VICC.

b) When the VCD has sent a Quiet request (which causes no VICC response), it shall wait a time t2 before sending a subsequent request. t2 starts from the end of the Quiet request EOF (rising edge of the EOF plus 9,44 µs, see ISO/IEC 15693-2:2000, 7.3.3).

The minimum value of t2 is t2min = 4192/f_c (309,2 µs).

NOTE 1 This ensures that the VICCs are ready to receive this subsequent request (see ISO/IEC 15693-2:2000, 7.3).

NOTE 2 The VCD should wait at least 1 ms after it activated the powering field before sending the first request, to ensure that the VICCs are ready to receive it (see ISO/IEC 15693-2:2000, 7.3).

c) When the VCD has sent an Inventory request, it is in an inventory process. See 9.1.4.

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9.1.4 VCD waiting time before switching to the next slot during an inventory process

An inventory process is started when the VCD sends an Inventory request. (see 8.2, 8.3, 10.3.1),

To switch to the next slot, the VCD may send either a 10 % or a 100 % modulated EOF independent of the modulation index it used for transmitting its request to the VICC, after waiting a time specified in 9.1.4.1 and 9.1.4.2.

9.1.4.1 When the VCD has started to receive one or more VICC responses

During an inventory process, when the VCD has started to receive one or more VICC responses (i.e. it has detected a VICC SOF and/or a collision), it shall

- wait for the complete reception of the VICC responses (i.e. when a VICC EOF has been received or when the VICC nominal response time t_{nrt} has elapsed),
- wait an additional time t2
- and then send a 10 % or 100 % modulated EOF to switch to the next slot.

t2 starts from the time the EOF has been received from the VICC (see ISO/IEC 15693-2:2000, 8.5.3, 8.5.4).

The minimum value of t2 is t2min = $4192/f_c$ (309,2 µs).

t_{nrt} is dependent on the VICC-to-VCD data rate and subcarrier modulation mode (see ISO/IEC 15693-2:2000, 8.5, 8.5.1, 8.5.2).

9.1.4.2 When the VCD has received no VICC response

During an inventory process, when the VCD has received no VICC response, it shall wait a time t3 before sending a subsequent EOF to switch to the next slot.

t3 starts from the time the VCD has generated the rising edge of the last sent EOF.

a) If the VCD sends a 100 % modulated EOF,

the minimum value of t3 is t3min = $4384/f_c$ (323,3 µs) + t_{sof}

b) If the VCD sends a 10 % modulated EOF,

the minimum value of t3 is t3min = $4384/f_c$ (323,3 µs) + t_{nrt}

where

- t_{sof} is the time duration for a VICC to transmit an SOF to the VCD.
- t_{nrt} is the nominal response time of a VICC.

t_{nrt} and t_{sof} are dependent on the VICC-to-VCD data rate and subcarrier modulation mode (see ISO/IEC 15693-2:2000, 8.5, 8.5.1, 8.5.2).

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10 Commands

10.1 Command types

Four sets of commands are defined: mandatory, optional, custom, proprietary.

All VICCs with the same IC manufacturer code and same IC version number shall behave the same.

10.1.1 Mandatory

The command codes range from '01' to '1F'.

All VICCs shall support them.

10.1.2 Optional

The command codes range from '20' to '9F'.

VICCs may support them, at their option. If supported, request and response formats shall comply with the definition given in this standard.

If the VICC does not support an optional command and if the Address_flag or the Select_flag is set, it may return an error code ("Not supported") or remain silent. If neither the Address_flag nor the Select_flag is set, the VICC shall remain silent.

If a command has different options they may be supported by the VICC otherwise an error code shall be returned.

10.1.3 Custom

The command codes range from 'A0' to 'DF'.

VICCs support them, at their option, to implement manufacturer specific functions. The function of flags (including reserved bits) shall not be modified except the Option_flag. The only fields that can be customized are the parameters and the data fields.

Any custom command contains as its first parameter the IC manufacturer code. This allows IC manufacturers to implement custom commands without risking duplication of command codes and thus misinterpretation.

If the VICC does not support a custom command and if the Address_flag or the Select_flag is set, it may return an error code ("Not supported") or remain silent. If neither the Address_flag nor the Select_flag is set, the VICC shall remain silent.

If a command has different options they may be supported by the VICC otherwise an error code shall be returned.

10.1.4 Proprietary

The command codes range from 'E0' to 'FF'.

These commands are used by IC and VICC manufacturers for various purposes such as tests, programming of system information, etc. They are not specified in this standard. The IC manufacturer may at its option document them or not. It is allowed that these commands are disabled after IC and/or VICC manufacturing.

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10.2 Command codes

Table 8 — Command codes

Command code	Type	Function
'01'	Mandatory	Inventory
'02'	Mandatory	Stay quiet
'03' – '1F'	Mandatory	RFU
'20'	Optional	Read single block
'21'	Optional	Write single block
'22'	Optional	Lock block
'23'	Optional	Read multiple blocks
'24'	Optional	Write multiple blocks
'25'	Optional	Select
'26'	Optional	Reset to ready
'27'	Optional	Write AFI
'28'	Optional	Lock AFI
'29'	Optional	Write DSFID
'2A'	Optional	Lock DSFID
'2B'	Optional	Get system information
'2C'	Optional	Get multiple block security status
'2D' – '9F'	Optional	RFU
'A0' – 'DF'	Custom	IC Mfg dependent
'E0' – 'FF'	Proprietary	IC Mfg dependent

10.3 Mandatory commands

10.3.1 Inventory

Command code = '01'

When receiving the Inventory request, the VICC shall perform the anticollision sequence.

The request contains:

- The flags,
- The Inventory command code
- The AFI if the AFI flag is set
- The mask length
- The mask value
- The CRC

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The Inventory_flag shall be set to 1.

The meaning of flags 5 to 8 is according to table 5.

SOF	Flags	Inventory	Optional AFI	Mask length	Mask value	CRC16	EOF
	8 bits	8 bits	8 bits	8 bits	0 – 64 bits	16 bits	

Figure 11 — Inventory request format

The response shall contain:

- The DSFID
- The unique ID

If the VICC detects an error, it shall remain silent.

SOF	Flags	DSFID	UID	CRC16	EOF
	8 bits	8 bits	64 bits	16 bits	

Figure 12 — Inventory response format

10.3.2 Stay quiet

Command code = '02'

When receiving the Stay quiet command, the VICC shall enter the quiet state and shall NOT send back a response. There is NO response to the Stay quiet command.

When in quiet state:

- the VICC shall not process any request where Inventory_flag is set,
- the VICC shall process any addressed request

The VICC shall exit the quiet state when:

- reset (power off),
- receiving a Select request. It shall then go to the selected state if supported or return an error if not supported,
- receiving a Reset to ready request. It shall then go to the Ready state.

SOF	Flags	Stay quiet	UID	CRC16	EOF
	8 bits	8 bits	64 bits	16 bits	

Figure 13 — Stay quiet request format

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Request parameter:

UID (mandatory)

The Stay quiet command shall always be executed in Addressed mode (Select_flag is set to 0 and Address_flag is set to 1).

10.4 Optional commands

10.4.1 Read single block

Command code = '20'

When receiving the Read single block command, the VICC shall read the requested block and send back its value in the response.

If the Option_flag is set in the request, the VICC shall return the block security status, followed by the block value.

If it is not set, the VICC shall return only the block value.

SOF	Flags	Read single block	UID	Block number	CRC16	EOF
	8 bits	8 bits	64 bits	8 bits	16 bits	

Figure 14 — Read single block request format

Request parameter:

(Optional) UID

Block number

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

Figure 15 — Read single block response format when Error_flag is set

SOF	Flags	Block security status	Data	CRC16	EOF
	8 bits	8 bits	Block length	16 bits	

Figure 16 — Read single block response format when Error_flag is NOT set

Response parameter:

Error_flag (and Error code if Error_flag is set)if Error_flag is not set

Block security status (if Option_flag is set in the request)

Block data

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10.4.2 Write single block

Command code = '21'

When receiving the Write single block command, the VICC shall write the requested block with the data contained in the request and report the success of the operation in the response.

If the Option_flag is not set, the VICC shall return its response when it has completed the write operation starting after:

t1nom [4352/f_c (320,9 µs), see 9.1.1] + a multiple of 4096/f_c (302 µs) with a total tolerance of ± 32/f_c and latest after 20 ms upon detection of the rising edge of the EOF of the VCD request.

If it is set, the VICC shall wait for the reception of an EOF from the VCD and upon such reception shall return its response.

SOF	Flags	Write single block	UID	Block number	Data	CRC16	EOF
	8 bits	8 bits	64 bits	8 bits	Block length	16bits	

Figure 17 — Write single block request format

Request parameter:

(Optional) UID

Block number

Data

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

Figure 18 — Write single block response format when Error_flag is set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

Figure 19 — Write single block response format when Error_flag is NOT set

Response parameter:

Error_flag (and Error code if Error_flag is set)

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10.4.3 Lock block

Command code = '22'

When receiving the Lock block command, the VICC shall lock permanently the requested block.

If the Option_flag is not set, the VICC shall return its response when it has completed the lock operation starting after:

t1nom [4352/f_c (320,9 µs), see 9.1.1] + a multiple of 4096/f_c (302 µs) with a total tolerance of ± 32/f_c and latest after 20 ms upon detection of the rising edge of the EOF of the VCD request.

If it is set, the VICC shall wait for the reception of an EOF from the VCD and upon such reception shall return its response.

SOF	Flags	Lock block	UID	Block number	CRC16	EOF
	8 bits	8 bits	64 bits	8 bits	16 bits	

Figure 20 — Lock single block request format

Request parameter:

(Optional) UID

Block number

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

Figure 21 — Lock block response format when Error_flag is set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

Figure 22 — Lock block response format when Error_flag is NOT set

Response parameter:

Error_flag (and Error code if Error_flag is set)

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10.4.4 Read multiple blocks

Command code = '23'

When receiving the Read multiple block command, the VICC shall read the requested block(s) and send back their value in the response.

If the Option_flag is set in the request, the VICC shall return the block security status, followed by the block value sequentially block by block.

If the Option_flag is not set in the request, the VICC shall return only the block value.

The blocks are numbered from '00' to 'FF' (0 to 255).

The number of blocks in the request is one less than the number of blocks that the VICC shall return in its response.

EXAMPLE A value of '06' in the "Number of blocks" field requests to read 7 blocks. A value of '00' requests to read a single block.

SOF	Flags	Read multiple block	UID	First block number	Number of blocks	CRC16	EOF
	8 bits	8 bits	64 bits	8 bits	8 bits	16 bits	

Figure 23 — Read multiple blocks request format

Request parameter:

(Optional) UID

First block number

Number of blocks

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

Figure 24 — Read multiple blocks response format when Error_flag is set

SOF	Flags	Block security status	Data	CRC16	EOF
	8 bits	8 bits	Block length	16 bits	
		Repeated as needed			

Figure 25 — Read multiple block response format when Error_flag is NOT set

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Response parameter:

Error_flag (and Error code if Error_flag is set)

if Error_flag is not set (the following order shall be respected in the VICC response)

Block security status N (if Option_flag is set in the request)

Block value N

Block security status N+1 (if Option_flag is set in the request)

Block value N+1

etc.

where N is the first requested (and returned) block.

10.4.5 Write multiple blocks

Command code = '24'

When receiving the Write multiple block command, the VICC shall write the requested block(s) with the data contained in the request and report the success of the operation in the response.

If the Option_flag is not set, the VICC shall return its response when it has completed the write operation starting after:

t1nom [4352/f_c (320,9 µs), see 9.1.1] + a multiple of 4096/f_c (302 µs) with a total tolerance of ± 32/f_c and latest after 20 ms upon detection of the rising edge of the EOF of the VCD request.

If it is set, the VICC shall wait for the reception of an EOF from the VCD and upon such reception shall return its response.

The blocks are numbered from '00' to 'FF' (0 to 255).

The number of blocks in the request is one less than the number of blocks that the VICC shall write.

EXAMPLE A value of '06' in the "Number of blocks" field requests to write 7 blocks. The "Data" field shall contain 7 blocks. A value of '00' in the "Number of blocks" field requests to write 1 block. The "Data" field shall contain 1 block.

SOF	Flags	Write multiple block	UID	First block number	Number of blocks	Data	CRC16	EOF
	8 bits	8 bits	64 bits	8 bits	8 bits	Block length	16 bits	
						Repeated as needed		

Figure 26 — Write multiple blocks request format

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Request parameter:

(Optional) UID

First block number

Number of blocks

Block data (repeated as defined in figure 26)

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

Figure 27 — Write multiple blocks response format when Error_flag is set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

Figure 28 — Write multiple block response format when Error_flag is NOT set

Response parameter:

Error_flag (and Error code if Error_flag is set)

10.4.6 Select

Command code = '25'

When receiving the Select command:

- if the UID is equal to its own UID, the VICC shall enter the selected state and shall send a response.
- if it is different, the VICC shall return to the Ready state and shall not send a response.The Select command shall always be executed in Addressed mode. (The Select_flag is set to 0. The Address_flag is set to 1.)

SOF	Flags	Select	UID	CRC16	EOF
	8 bits	8 bits	64 bits	16 bits	

Figure 29 — Select request format

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Request parameter:

UID (mandatory)

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

Figure 30 — Select response format when Error_flag is set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

Figure 31 — Select block response format when Error_flag is NOT set

Response parameter:

Error_flag (and Error code if Error_flag is set)

10.4.7 Reset to ready

Command code = '26'

When receiving a Reset to ready command, the VICC shall return to the Ready state.

SOF	Flags	Reset to ready	UID	CRC16	EOF
	8 bits	8 bits	64 bits	16 bits	

Figure 32 — Reset to ready request format

Request parameter:

(Optional) UID

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

Figure 33 — Reset to ready response format when Error_flag is set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

Figure 34 — Reset to ready response format when Error_flag is NOT set

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Response parameter:

Error_flag (and Error code if Error_flag is set)

10.4.8 Write AFI

Command code = '27'

When receiving the Write AFI request, the VICC shall write the AFI value into its memory.

If the Option_flag is not set, the VICC shall return its response when it has completed the write operation starting after:

t1nom [4352/f_c (320,9 µs), see 9.1.1] + a multiple of 4096/f_c (302 µs) with a total tolerance of ± 32/f_c and latest after 20 ms upon detection of the rising edge of the EOF of the VCD request.

If it is set, the VICC shall wait for the reception of an EOF from the VCD and upon such reception shall return its response.

SOF	Flags	Write AFI	UID	AFI	CRC16	EOF
	8 bits	8 bits	64 bits	8 bits	16 bits	

Figure 35 — Write AFI request format

Request parameter:

(Optional) UID

AFI

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

Figure 36 — Write AFI response format when Error_flag is set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

Figure 37 — Write AFI response format when Error_flag is NOT set

Response parameter:

Error_flag (and Error code if Error_flag is set)

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10.4.9 Lock AFI

Command code = '28'

When receiving the Lock AFI request, the VICC shall lock the AFI value permanently into its memory.

If the Option_flag is not set, the VICC shall return its response when it has completed the lock operation starting after:

t1nom [4352/f_c (320,9 µs), see 9.1.1] + a multiple of 4096/f_c (302 µs) with a total tolerance of ± 32/f_c and latest after 20 ms upon detection of the rising edge of the EOF of the VCD request.

If it is set, the VICC shall wait for the reception of an EOF from the VCD and upon such reception shall return its response.

SOF	Flags	Lock AFI	UID	CRC16	EOF
	8 bits	8 bits	64 bits	16 bits	

Figure 38 — Lock AFI request format

Request parameter:

(Optional) UID

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

Figure 39 — Lock AFI response format when Error_flag is set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

Figure 40 — Lock AFI response format when Error_flag is NOT set

Response parameter:

Error_flag (and Error code if Error_flag is set)

10.4.10 Write DSFID command

Command code = '29'

When receiving the Write DSFID request, the VICC shall write the DSFID value into its memory.

If the Option_flag is not set, the VICC shall return its response when it has completed the write operation starting after:

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t1nom [4352/f_c (320,9 µs), see 9.1.1] + a multiple of 4096/f_c (302 µs) with a total tolerance of ± 32/f_c and latest after 20 ms upon detection of the rising edge of the EOF of the VCD request.

If it is set, the VICC shall wait for the reception of an EOF from the VCD and upon such reception shall return its response.

SOF	Flags	Write DSFID	UID	DSFID	CRC16	EOF
	8 bits	8 bits	64 bits	8 bits	16 bits	

Figure 41 — Write DSFID request format

Request parameter:

(Optional) UID

DSFID

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

Figure 42 — Write DSFID response format when Error_flag is set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

Figure 43 — Write DSFID response format when Error_flag is NOT set

Response parameter:

Error_flag (and Error code if Error_flag is set)

10.4.11 Lock DSFID

Command code = '2A'

When receiving the Lock DSFID request, the VICC shall lock the DSFID value permanently into its memory.

If the Option_flag is not set, the VICC shall return its response when it has completed the lock operation starting after:

t1nom [4352/f_c (320,9 µs), see 9.1.1] + a multiple of 4096/f_c (302 µs) with a total tolerance of ± 32/f_c and latest after 20 ms upon detection of the rising edge of the EOF of the VCD request.

If it is set, the VICC shall wait for the reception of an EOF from the VCD and upon such reception shall return its response.

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SOF	Flags	Lock DSFID	UID	CRC16	EOF
	8 bits	8 bits	64 bits	16 bits	

Figure 44 — Lock DSFID request format

Request parameter:

(Optional) UID

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

Figure 45 — Lock DSFID response format when Error_flag is set

SOF	Flags	CRC16	EOF
	8 bits	16 bits	

Figure 46 — Lock DSFID response format when Error_flag is NOT set

Response parameter:

Error_flag (and Error code if Error_flag is set)

10.4.12 Get system information

Command code = '2B'

This command allows for retrieving the system information value from the VICC.

SOF	Flags	Get system info	UID	CRC16	EOF
	8 bits	8 bits	64 bits	16 bits	

Figure 47 — Get system information request format

Request parameter:

(Optional) UID

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

Figure 48 — Get system information response when Error_flag is set

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SOF	Flags	Info flags	UID	DSFID	AFI	Other fields	CRC16	EOF
	8 bits	8 bits	64 bits	8 bits	8 bits	See below	16 bits	

Figure 49 — Get system information response format when Error_flag is NOT set

Response parameter:

Error_flag (and Error code if Error_flag is set)

if Error_flag is not set

Information flag

UID (mandatory)

Information fields, in the order of their corresponding flag, as defined in figure 49 and table 9, if their corresponding flag is set.

Table 9 — Information flags definition

Bit	Flag name	Value	Description
b1	DSFID	0	DSFID is not supported. DSFID field is not present
		1	DSFID is supported. DSFID field is present
b2	AFI	0	AFI is not supported. AFI field is not present
		1	AFI is supported. AFI field is present
b3	VICC memory size	0	Information on VICC memory size is not supported. Memory size field is not present.
		1	Information on VICC memory size is supported. Memory size field is present.
b4	IC reference	0	Information on IC reference is not supported. IC reference field is not present.
		1	Information on IC reference is supported. IC reference field is present.
b5	RFU	0	
b6	RFU	0	
b7	RFU	0	
b8	RFU	0	

Table 10 — VICC memory size information

MSB				LSB	
16	14	13	9	8	1
RFU		Block size in bytes		Number of blocks	

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Block size is expressed in number of bytes on 5 bits, allowing to specify up to 32 bytes i.e. 256 bits. It is one less than the actual number of bytes.

EXAMPLE A value of '1F' indicates 32 bytes, a value of '00' indicates 1 byte.

Number of blocks is on 8 bits, allowing to specify up to 256 blocks. It is one less than the actual number of blocks.

EXAMPLE A value of 'FF' indicates 256 blocks, a value of '00' indicates 1 block.

The three most significant bits are reserved for future use and shall be set to zero.

The IC reference is on 8 bits and its meaning is defined by the IC manufacturer.

10.4.13 Get multiple block security status

Command code = '2C'

When receiving the Get multiple block security status command, the VICC shall send back the block security status.

The blocks are numbered from '00 to 'FF' (0 to 255).

The number of blocks in the request is one less than the number of block security status that the VICC shall return in its response.

EXAMPLE A value of '06' in the "Number of blocks" field requests to return 7 Block security status. A value of '00' in the "Number of blocks" field requests to return a single Block security status.

SOF	Flags	Get multiple block security status	UID	First block number	Number of blocks	CRC16	EOF
	8 bits	8 bits	64 bits	8 bits	8 bits	16 bits	

Figure 50 — Get multiple block security status request format

Request parameter:

(Optional) UID

First block number

Number of blocks

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

Figure 51 — Get multiple block security status response format when Error_flag is set

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SOF	Flags	Block security status	CRC16	EOF
	8 bits	8 bits	16 bits	
		Repeated as needed		

Figure 52 — Get multiple block security status response format when Error_flag is NOT set

Response parameter:

Error_flag (and Error code if Error_flag is set)

if Error_flag is not set

Block security status (repeated as per figure 52)

10.5 Custom commands

The format of custom command is generic and allows unambiguous attribution of custom command codes to each VICC manufacturer.

The custom command code is the combination of a custom command code and of the VICC manufacturer code.

The custom request parameters definition is the responsibility of the VICC manufacturer.

SOF	Flags	Custom	IC Mfg code	Custom request parameters	CRC16	EOF
	8 bits	8 bits	8 bits	Custom defined	16 bits	

Figure 53 — Custom request format

Request parameter:

IC manufacturer code according to ISO/IEC 7816-6:1996/Amd.1.

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

Figure 54 — Custom response format when Error_flag is set

SOF	Flags	Custom response parameters	CRC16	EOF
	8 bits	Custom defined	16 bits	

Figure 55 — Custom response format when Error_flag is NOT set

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Response parameter:

Error_flag (and code if Error_flag is set)

if Error_flag is not set

Custom parameters

10.6 Proprietary commands

The format of these commands is not defined in this part of ISO/IEC 15693.

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Annex A
(informative)

Compatibility with other card standards

This part of ISO/IEC 15693 does not preclude the addition of other existing card standards on the VICC, such as ISO/IEC 7816 or others listed in the bibliography.

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Annex B
(informative)

VCD pseudo-code for anticollision

The following pseudo-code in italics describes how the anticollision could be implemented on the VCD, using recursivity. It does not describe the collision detection mechanism.

Algorithm for 16 slots

```
function push (mask, address)          ; pushes on private stack
function pop (mask, address)           ; pops from private stack
function pulse_next_pause              ; generates a power pulse
function store(VICC_UID)               ; stores VICC_UID
function poll_loop (sub_address_size as integer)

; address length must be four (4) bits.
pop (mask, address)
mask = address & mask                  ; generates new mask

; send the Request
mode = anticollision
send_Request(Request_cmd, mode, mask length, mask)

for address = 0 to (2^sub_address_size - 1)
     if no_collision_is_detected then  ; VICC is inventoried
          store (VICC_UID)
else                                   ; remember a collision was detected
     push(mask,address)
endif

pulse_next_pause

next sub_address
; if some collisions have been detected and not yet processed,
; the function calls itself recursively to process the last
; stored collision
if stack_not_empty then poll_loop (sub_address_size)

end poll_loop

main_cycle:
mask = null
address = null
push (mask, address)
poll_loop(sub_address_size)
end_main_cycle
```


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Annex C
(informative)

Cyclic Redundancy Check (CRC)

C.1 The CRC error detection method

The Cyclic Redundancy Check (CRC) is calculated on all data contained in a message, from the start of the flags through to the end of data. This CRC is used from VCD to VICC and from VICC to VCD.

Table C.1 — CRC Definition

CRC Definition					
CRC type	**Length**	**Polynomial**	**Direction**	**Preset**	**Residue**
ISO/IEC 13239	16 bits	$X^{16} + X^{12} + X^5 + 1$ = '8408'	Backward	'FFFF'	'F0B8'

To add extra protection against shifting errors, a further transformation is made on the calculated CRC. The value attached to the message for transmission is the one's complement of the calculated CRC. This transformation is included in the example below.

For checking of received messages the 2 CRC bytes are often also included in the re-calculation, for ease of use. In this case, for the expected value for the generated CRC the value of the residue is 'F0B8'.

The following text in italics is an example which illustrates one method in C language of calculating the CRC on a given set of bytes comprising a message.

```
#include <stdio.h>

#define  POLYNOMIAL    0x8408       // x^16 + x^12 + x^5 + 1
#define  PRESET_VALUE  0xFFFF
#define  CHECK_VALUE   0xF0B8
#define  NUMBER_OF_BYTES    4      // Example: 4 data bytes
#define  CALC_CRC          1
#define  CHECK_CRC         0

void main()
{
  unsigned int  current_crc_value;
  unsigned char array_of_databytes[NUMBER_OF_BYTES + 2] = {1, 2, 3, 4, 0x91, 0x39};
  int           number_of_databytes = NUMBER_OF_BYTES;
  int           calculate_or_check_crc;
  int           i, j;
  calculate_or_check_crc = CALC_CRC;
  // calculate_or_check_crc = CHECK_CRC;  // This could be an other example
  if (calculate_or_check_crc == CALC_CRC)
  {
     number_of_databytes = NUMBER_OF_BYTES;
  }
  else   // check CRC
  {
```

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```
    number_of_databytes = NUMBER_OF_BYTES + 2;
  }
  current_crc_value = PRESET_VALUE;
  for (i = 0; i < number_of_databytes; i++)
  {
    current_crc_value = current_crc_value ^ ((unsigned int)array_of_databytes[i]);
    for (j = 0; j < 8; j++)
    {
      if (current_crc_value & 0x0001)
      {
        current_crc_value = (current_crc_value >> 1) ^ POLYNOMIAL;
      }
      else
      {
        current_crc_value = (current_crc_value >> 1);
      }
    }
  }
  if (calculate_or_check_crc == CALC_CRC)
  {
    current_crc_value = ~current_crc_value;
    printf ("CRC-ISO/IEC 13239 of { 1, 2, 3, 4 } is '3991'\n");
    printf ("Generated CRC is '%04X'\n", current_crc_value);
      printf ("The Least Significant Byte (transmitted first) is: '%02X'\n",
        current_crc_value & 0xFF);
      printf( "The Most Significant Byte (transmitted second) is: '%02X'\n",
      (current_crc_value >> 8) & 0xFF);
    printf( "Executing this program when CHECK_CRC generates: 'F0B8'\n");
    // current_crc_value is now ready to be appended to the data stream
    // (first LSByte, then MSByte)
  }
  else   // check CRC
  {
    if (current_crc_value == CHECK_VALUE)
    {
      printf ("Checked CRC is ok (0x%04X)\n", current_crc_value);
    }
    else
    {
      printf ("Checked CRC is NOT ok (0x%04X)\n", current_crc_value);
    }
                                                    }
}
```

The above C-program generates the following printout when executed.

CRC-ISO/IEC 13239 of { 1, 2, 3, 4 } is '3991'
Generated CRC is '3991'
The Least Significant Byte (transmitted first) is: '91'
The Most Significant Byte (transmitted second) is: '39'
Executing this program when CHECK_CRC generates: 'F0B8'

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C.2 CRC calculation example

This example refers to a Read single block request for reading block '0B'.

The modes selected by the VCD are: single subcarrier, high VICC-to-VCD data rate, addressed.

The UID of the VICC is: 'E0 04 AB 89 67 45 23 01'

The request therefore consists of the following fields:

- the flags: '22'
- the command code: '20'
- the UID: 'E0 04 AB 89 67 45 23 01' where 'E0' is the most significant byte
- the block number: '0B'
- the CRC: 'BAE3' where 'BA' is the most significant byte.

The CRC is calculated on the request fields assembled in a frame according to the transmission rules defined in this standard:

'22' '20' '01' '23' '45' '67' '89' 'AB' '04' 'E0' '0B'

NOTE 1 The UID is transmitted least significant byte first.

NOTE 2 Table C.2 describes the different steps of the calculation.

The request is then transmitted as follows:

SOF '22' '20' '01' '23' '45' '67' '89' 'AB' '04' 'E0' '0B' 'E3' 'BA' EOF

NOTE 3 The CRC is transmitted least significant byte first.

NOTE 4 Each byte is transmitted least significant bit first.

Table C.2 — Practical example of CRC calculation

Step	Input	Calculated CRC in VCD	Calculated CRC in VICC for check
1	'22'	'F268'	'0D97'
2	'20'	'3EC6'	'C139'
3	'01'	'42F5'	'BD0A'
4	'23'	'4381'	'BC7E'
5	'45'	'7013'	'8FEC'
6	'67'	'C5AB'	'3A54'
7	'89'	'F2AD'	'0D52'
8	'AB'	'95BC'	'6A43'
9	'04'	'C92E'	'36D1'
10	'E0'	'DFC3'	'203C'
11	'0B'	'BAE3'	'451C'
12	'E3'		'0F3D'
13	'BA'		'F0B8'

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