INTERNATIONAL STANDARD

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Identification cards — Integrated circuit cards —

Part 12: Cards with contacts — USB electrical interface and operating procedures

Cartes d'identification — Cartes à circuit intégré —

Partie 12: Cartes à contacts — Interface électrique USB et procédures de fonctionnement

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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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

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

ISO/IEC 7816-12 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Cards and personal identification*.

ISO/IEC 7816 consists of the following parts, under the general title *Identification cards — Integrated circuit cards*:

— *Part 1: Cards with contacts — Physical characteristics*

— *Part 2: Cards with contacts — Dimensions and location of the contacts*

— *Part 3: Cards with contacts — Electrical interface and transmission protocols*

— *Part 4: Organization, security and commands for interchange*

— *Part 5: Registration of application providers*

— *Part 6: Interindustry data elements for interchange*

— *Part 7: Interindustry commands for Structured Card Query Language (SCQL)*

— *Part 8: Commands for security operations*

— *Part 9: Commands for card management*

— *Part 10: Cards with contacts — Electronic signals and answer to reset for synchronous cards*

— *Part 11: Personal verification through biometric methods*

— *Part 12: Cards with contacts — USB electrical interface and operating procedures*

— *Part 15: Cryptographic information application*

ISO/IEC 10536[2] specifies access by close coupling. ISO/IEC 14443[3] and 15693[4] specify access by radio frequency. Such cards are also known as contactless cards.

Introduction

ISO/IEC 7816 is a series of documents specifying integrated circuit cards and the use of such cards for interchange. These cards are identification cards intended for information exchange negotiated between the outside world and the integrated circuit in the card. As a result of an information exchange, the card delivers information (computation result, stored data), and / or modifies its content (data storage, event memorization).

— Five parts are specific to cards with galvanic contacts and three of them specify electrical interfaces.

- ISO/IEC 7816-1 specifies physical characteristics for cards with contacts.
- ISO/IEC 7816-2 specifies dimensions and location of the contacts.
- ISO/IEC 7816-3 specifies electrical interface and transmission protocols for asynchronous cards.
- ISO/IEC 7816-10 specifies electrical interface and answer to reset for synchronous cards.
- ISO/IEC 7816-12 specifies electrical interface and operating procedures for USB cards.

— All the other parts are independent from the physical interface technology. They apply to cards accessed by contacts and / or by radio frequency.

- ISO/IEC 7816-4 specifies organization, security and commands for interchange.
- ISO/IEC 7816-5 specifies registration of application providers.
- ISO/IEC 7816-6 specifies interindustry data elements for interchange.
- ISO/IEC 7816-7 specifies commands for structured card query language.
- ISO/IEC 7816-8 specifies commands for security operations.
- ISO/IEC 7816-9 specifies commands for card management.
- ISO/IEC 7816-11 specifies personal verification through biometric methods.
- ISO/IEC 7816-15 specifies cryptographic information application.

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

WO 00/16255, *Data transmission method and card therefor*, 23 March 2000

Declared for ISO/IEC 7816-2

WO 01/69881, *A method of communication between a smart card and a host station*, 20 September 2001

WO 01/57684 A1, *Conveying protocol units for portable electronic objects via a protocol for microcomputer peripherals*, 9 August 2001

0001399 / France, *Transport d'unités de protocole d'objet électronique portable par protocole pour péripheriques de micro-ordinateur*

09/775668 / USA, *Conveying protocol units for portable electronic objects via a protocol for microcomputer peripherals*

1904043 / Europe, *Transport d'unités de protocole d'objet électronique portable par protocole pour péripheriques de micro-ordinateur*

1804474 / China, *Conveying protocol units for portable electronic objects via a protocol for microcomputer peripherals*

PCT / FR01 / 00326, *Transport d'unités de protocole d'objet électronique portable par protocole pour péripheriques de micro-ordinateur*

US 6148354*, Architecture for a universal serial bus-based PC flash disk*

US 6763399, *USB key apparatus for interacting with a USB host via a USB port*

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

The holders of these patent rights have assured the ISO and IEC that they are willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statements of the holders of these patent rights are registered with the ISO and IEC. Information may be obtained from:

Contact	Patent number
Schlumberger Systèmes, France	WO 00/16255 WO 01/69881
GEMPLUS, France	WO 01/57684 A1 0001399 / France / Granted 09/775668 / USA / Pending 1904043 / Europe / Pending 1804474 / China / Pending PCT / FR01 / 00326 / Pending
M-Systems, Israel	US 6148354
Aladdin Knowledge Systems, USA	US 6763399

Infineon Technologies has not identified any patents but confirms that it is prepared to license its patents, both granted and pending, which may be deemed necessary to manufacture, use, and sell implementations of ISO/IEC 7816-12 on reasonable and non-discretionary terms and conditions.

The following companies may hold patents relating to this part of ISO/IEC 7816 but have not provided details of the patents or agreed to provide licenses:

Orga Kartensysteme GmbH, Germany	AU 752627
Renesas, Japan	US 20050052924 US 20040070952
ST Microelectronics	US 6769622 WO 02/317161

Attention is drawn to the possibility that some elements of the document may be the subject of patent rights other than those identified above. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Identification cards — Integrated circuit cards —

Part 12:
Cards with contacts — USB electrical interface and operating procedures

1 Scope

This part of ISO/IEC 7816 specifies the operating conditions of an integrated circuit card that provides a USB interface. Figure 1 shows the assignment of the contact fields for a USB interface and – to illustrate interoperability – the assignment as used in ISO/IEC 7816-3.

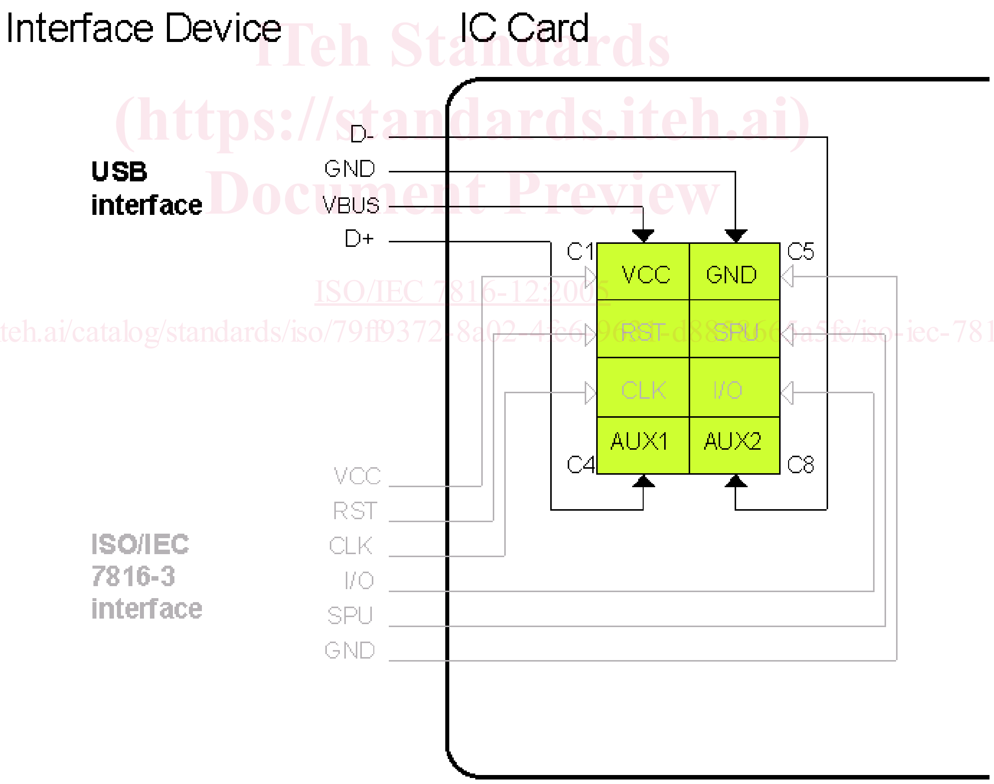

Figure 1 — Assignment of contacts for a USB integrated circuit card

2 Normative references

The following referenced documents are indispensable for the application 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 7816-2:1999/Amd.1:2004, *Identification cards — Integrated circuit cards — Part 2: Cards with contacts — Dimensions and location of the contacts — Amendment 1: Assignment of contacts C4 and C8*

ISO/IEC 7816-3, *Identification cards — Integrated circuit cards — Part 3: Cards with contacts — Electrical interface and transmission protocols*

Universal Serial Bus Specification Revision 2.0, April 27, 2000
USB Implementers Forum
Available at <http://www.usb.org/developers/docs>

Universal Serial Bus, Device Class Specification for
USB Chip/Smart Card Interface Devices , Revision 1.00, March 20, 2001
USB Implementers Forum, Device Working Group: Smart Card
Available at <http://www.usb.org/developers/devclass_docs>

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Device

3.1.1
interface device
terminal communication device or machine to which the card is electrically connected during operation [ISO/IEC 7816-3]

3.1.2
USB connection device
device providing an electrical connection path between a USB-ICC and a USB host or hub

3.2 Terms and definitions used in other specifications

For the purposes of this document, the terms and definitions given in the USB specification and the CCID specification (see Clause 4) apply.

NOTE The relevant terms used in this document are listed in informative Annexes C and D.

4 Abbreviations and notation

For the purposes of this document, the following abbreviations apply.

Protocol T=0, Protocol T=1 [ISO/IEC 7816-3]
D+, D- [Universal Serial Bus Specification Revision 2.0]

USB specification
Referencing to Universal Serial Bus Specification Revision 2.0 (see clause 2).

CCID
Chip Card Interface Device. Designates an interface device controlled via USB.

CCID specification
Reference to the Device Class Specification for USB Chip/Smart Card Interface Devices (see clause 2).

USB-ICC
USB Integrated Circuit Card. An integrated circuit card providing a USB interface.

5 Electrical characteristics of the contacts

The assignment of the contacts for USB operating conditions is given in ISO/IEC 7816-2:1999 and ISO/IEC 7816-2:1999/Amd.1:2004.

An interface device will provide a USB connection to a USB-ICC through VCC, GND, AUX1 and AUX2 respectively VBUS, GND, D+ and D- defined by the USB specification.

Cards designed for ISO/IEC 7816-3 operating conditions shall not be damaged when activated under USB conditions. Conversely, cards designed for USB operation shall not be damaged when activated under ISO/IEC 7816-3 operating conditions (by definition, a damaged card no longer operates as specified or contains corrupt data).

6 USB-ICC operated by an interface device

A USB-ICC that only provides a USB interface shall have electrically connected C1, C5, C4 and C8. All other contact fields shall be electrically isolated. This type of USB-ICC can be operated by a USB connection device. The USB connection device shall establish an electrical connection to C1, C5, C4 and C8 only, following the electrical characteristics and protocol given in the USB specification.

An interface device that does not support a USB interface shall have AUX1 and AUX2 electrically isolated or ensure that the voltage applied at these contact fields shall remain between –0,3V and Vcc + 0,3V.

7 USB Descriptors

7.1 Standard Descriptors

The standard descriptors described in the USB specification constitute a way for the host software to identify a new USB device attached, and to load one or more appropriate drivers for this new USB device. The standard descriptors are read by the host software during the enumeration process. In addition, the descriptors can also be retrieved by the host software using standard USB requests.

NOTE This document uses for hexadecimal values the notation xxh as used in the USB specification. This is different from the notation 'xx' which is used in other parts of this standard series. The notation xxh is used here to avoid possible confusion when reading this document and the related USB documents.

In the following tables of standard descriptors the character asteriks (*) in the column **Value** indicates that this value(s) is defined by ISO/IEC, taken from the set of possible values given in the USB specification. All other values are standard USB entries.

The transmission direction from the host to the USB-ICC is designated as OUT. The transmission direction from the USB-ICC to the host is designated as IN.

7.1.1 The Standard Device Descriptor

Table 1 — Standard device descriptor for a USB-ICC

Offset	Field	Size	Value	Description
0	*bLength*	1	12h	Size of this descriptor in bytes.
1	*bDescriptorType*	1	01h	DEVICE Descriptor Type.
2	*bcdUSB*	2	0200h	USB Specification Release Number.
4	*bDeviceClass*	1	00h*	Indicates that the device class is specified in the interface descriptor of the device.
5	*bDeviceSubClass*	1	00h	Reset to zero as *bDeviceClass* is reset to zero.
6	*bDeviceProtocol*	1	00h*	The device does not use class-specific protocols on the device basis. Instead, it uses class-specific protocols on the interface level.
7	*bMaxPacketSize0*	1		Maximum packet size for endpoint zero. The size may be 8,16,32,64. For low speed functions the value shall be 8.
8	*idVendor*	2		Vendor ID, (assigned by the USB-IF).
10	*idProduct*	2		Product ID, (assigned by the manufacturer). Definition of the value of this field is out of the scope of this document.
12	*bcdDevice*	2		Device release number in binary coded decimal. Definition of the value of this field is out of the scope of this document.
14	*iManufacturer*	1		Index of string descriptor describing manufacturer. Definition of the content of this string is out of the scope of this document.
15	*iProduct*	1		Index of string descriptor describing the product. Definition of the content of this string is out of the scope of this document.
16	*iSerialNumber*	1		Index of string descriptor describing the devices serial number.
17	*bNumConfigurations*	1		Number of possible configurations.

7.1.2 The Standard Configuration Descriptor

Table 2 — Standard configuration descriptor for a USB-ICC

Offset	Field	Size	Value	Description
0	*bLength*	1	09h	Size of this descriptor in bytes.
1	*bDescriptorType*	1	02h	CONFIGURATION Descriptor Type.
2	*wTotalLength*	2		Total length of data returned for this configuration. includes the combined length of all descriptors (configuration, interface, endpoint, and class-specific) returned by this configuration.
4	*bNumInterfaces*	1		The number of interfaces supported by this configuration.
5	*bConfigurationValue*	1		Value to use as an argument to the SetConfiguration() request to select this configuration. This value shall be non-zero.
6	*iConfiguration*	1		Index of string descriptor describing this configuration. Definition of the content of this string is out of the scope of this document.
7	*bmAttributes*	1		Configuration characteristics for the USB-ICC: Bit 4…0: Reserved (reset to zero) Bit 5 Remote Wakeup Bit 6. Self-powered Bit 7 Reserved (set to one) For a bus-powered USB-ICC that does not support remote wake-up, *bmAttributes* shall have the value 80h
8	*MaxPower*	1		Maximum power consumption of the USB-ICC from the bus when the device is fully operational. Expressed in 2mA units.

7.1.3 The Standard Interface Descriptor

Table 3 — Standard interface descriptor for a USB-ICC

Offset	Field	Size	Value	Description
0	*bLength*	1	09h	Size of this descriptor in bytes.
1	*bDescriptorType*	1	04h	INTERFACE Descriptor Type.
2	*bInterfaceNumber*	1		Number of the interface. Zero-based value identifying the index in the array of concurrent interfaces supported by this configuration.
3	*bAlternateSetting*	1	00h*	Value used to select alternate setting for the interface identified in the prior field. Alternate settings are not supported.
4	*bNumEndpoints*	1	00h* 01h* 02h* 03h*	Number of endpoints for a USB-ICC used by this interface (excluding endpoint zero). 00h does not use further endpoints 01h uses interrupt-IN 02h uses bulk-IN and bulk-OUT 03h uses bulk-IN, bulk-OUT and interrupt-IN NOTE 01h indicates that the control endpoints are used for data transmission and interrupt-IN for notification of card specific events sent from the USB-ICC to the host.
5	*bInterfaceClass*	1	0Bh FFh	Class code for the Smart Card device class (0Bh) or the interface class is vendor specific (FFh). NOTE A product not using a class specific driver can be ISO 7816-12 compliant. In this case, the driver will be chosen using the information given by the vendor, the manufacturer and the product ID (see Table 1).
6	*bInterfaceSubClass*	1	00h	Subclass code.
7	*bInterfaceProtocol*	1	00h 01h 02h	Protocol code. The Smart Card device class offers the following interface protocols for a USB-ICC: - 00h USB-ICC messages using bulk (optional interrupt) - 01h USB-ICC specific requests using control transfer Version A (no interrupt) - 02h USB-ICC specific requests using control transfer Version B (optional interrupt) The given value indicates the transfer mode which is used for the communication between host and USB-ICC
8	*iInterface*	1		Index of string descriptor describing this interface. Definition of the content of this string is out of the scope of this document.

7.1.4 The Standard Endpoint Descriptors

A USB-ICC may either communicate with the host using the default control pipe only or it may communicate over message pipes using bulk-IN and bulk-OUT. Optionally, a USB-ICC may provide an interrupt-IN endpoint which allows the USB-ICC to indicate specific events to the host. A USB-ICC may have one of the following configurations:

Table 4 — Configuration of endpoints for a USB-ICC

Endpoints for data transmission	Using control transfers		Using bulk transfers
	Version A	Version B	
Default control pipe	yes	yes	yes
Bulk-IN	no	no	yes
Bulk-OUT	no	no	yes
Interrupt-IN	no	optional	optional

The following tables describe the endpoint descriptors:

Table 5 — Endpoint descriptor bulk-OUT

Offset	Field	Size	Value	Description
0	*bLength*	1	07h	Size of this descriptor in bytes.
1	*bDescriptorType*	1	05h	ENDPOINT descriptor type.
2	*bEndpointAddress*	1	01-0Fh	The address of this endpoint on the USB-ICC. This address is an endpoint number between 1 and 15. Bit 3…0 Endpoint number Bit 6…4 Reserved, must be 0 Bit 7 0 = OUT
3	*bmAttributes*	1	02h	This is a bulk endpoint.
4	*wMaxPacketSize*	2	00xxh	Maximum data transfer size. May be 8, 16, 32, 64.
6	*bInterval*	1	00h	Does not apply to bulk endpoints.

Table 6 — Endpoint descriptor bulk-IN

Offset	Field	Size	Value	Description
0	*bLength*	1	07h	Size of this descriptor in bytes.
1	*bDescriptorType*	1	05h	ENDPOINT descriptor type.
2	*bEndpointAddress*	1	81-8Fh	The address of this endpoint on the USB-ICC. This address is an endpoint number between 1 and 15. Bit 3…0 Endpoint number Bit 6…4 Reserved, must be 0 Bit 7 1 = IN
3	*bmAttributes*	1	02h	This is a bulk endpoint.
4	*wMaxPacketSize*	2	00xxh	Maximum data transfer size. May be 8, 16, 32, 64.
6	*bInterval*	1	00h	Does not apply to bulk endpoints.

Table 7 — Endpoint descriptor interrupt-IN

Offset	Field	Size	Value	Description
0	*bLength*	1	07h	Size of this descriptor in bytes.
1	*bDescriptorType*	1	05h	ENDPOINT descriptor type.
2	*bEndpointAddress*	1	81-8Fh	The address of this endpoint on the USB-ICC. This address is an endpoint number between 1 and 15. It shall be different from the bulk-IN endpoint address. Bit 3…0 Endpoint number Bit 6…4 Reserved, must be 0 Bit 7 1 = IN
3	*bmAttributes*	1	03h	This is an interrupt endpoint.
4	*wMaxPacketSize*	2	00xyh	Packet size for USB-ICC. The minimum value shall be 02h.
6	*bInterval*	1	xyh	Interval for polling endpoint data transfers. Expressed in milliseconds. The value shall be in the range from 1 to 255. In order to save bandwidth, the recommended value is 255.

7.2 The Class Specific Descriptor

The Smart Card device class uses the class specific descriptor as described in the CCID specification (see Annex D (informative)). In the context of a chip card interface device, a USB-ICC represents a configuration of a single slot interface device with a permanently inserted card. The possible values for the class specific descriptor reflect this device configuration. Fields containing *bReserved* or *dwReserved* signify parameters that are not relevant for a USB-ICC. Although not relevant, it is mandatory that a USB-ICC uses exactly these values for *bReserved* and *dwReserved* in order to maintain compatibility with the CCID specification.

Table 8 — Class specific descriptor for a USB-ICC

Offset	Field	Size	Value	Description
0	*bLength*	1	36h	Size of this descriptor, in bytes.
1	*bDescriptorType*	1	21h	CCID Functional Descriptor type.
2	*bcdCCID*	2		CCID Specification Release Number in binary coded decimal. The current version 1.0 is 0100h. CCID Specification Release Number 1.0 will be updated by the USB-DWG Smart Card.
4	*bMaxSlotIndex*	1	00h	Index of the highest available slot. A USB-ICC is regarded as single slot.
5	*bReserved*	1	01h	This value shall be 01h.
6	*dwProtocols*	4	0000 0001h 0000 0002h	Indicates the supported protocol types: 00000001h = Protocol T=0 00000002h = Protocol T=1 NOTE The USB-ICC supports APDU level exchanges for T=1 or character level exchanges for T=0. Other combinations of *dwProtocols* and *dwFeatures* are not supported by the USB-ICC. This applies for bulk transfer mode and for control transfer mode.

