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ISO/IEC 7816-3

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AMENDMENT 2
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Identification cards — Integrated circuit(s) cards with contacts —

Part 3:
Electronic signals and transmission protocols

AMENDMENT 2: Revision of protocol type selection

Cartes d'identification — Cartes à circuit(s) intégré(s) à contacts —

Partie 3: Signaux électroniques et protocoles de transmission

AMENDEMENT 2: Révision de la sélection du type de protocole

Reference number
ISO/IEC 7816-3:1989/Amd.2:1994(E)

Contents

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) together form a system for worldwide standardization as a whole. 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 JTC1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires at least 75 % approval by the national bodies casting a vote.

Amendment 2 to International Standard ISO/IEC 7816-3: 1989 was prepared by Joint Technical Committee ISO/IEC JTC1, *Information Technology*.

ISO/IEC 7816 consists of the following parts, under the general title *Identification card(s) — Integrated circuit(s) cards with contacts* :

— *Part 1: Physical characteristics*

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

— *Part 3: Electronic signals and transmission protocols*

— *Part 4: Inter-industry commands for interchange*

— *Part 5: Numbering system and registration procedure for application identifiers*

Introduction

Part 3 of ISO/IEC 7816 is one of a series of standards describing the parameters for integrated circuit(s) cards with contacts and the use of such cards for international interchange.

This amendment improves the protocol type selection. The improvement of the protocol type selection induces several clarifications in other clauses.

These cards are identification cards intended for information exchange negotiated between the outside and the integrated circuit in the card. As a result of an information exchange, the card delivers information (computation results, stored data), and/or modifies its content (data storage, event memorization).

Identification cards — Integrated circuit(s) cards with contacts —

Part 3 :
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AMENDMENT 2 : Revision of protocol type selection

Replace subclause 4.2.5 :

4.2.5 CLK

The actual value of the frequency, delivered by the interface device on CLK, is designated by *f*. For the range of values, see 6.1.4.4.

Duty cycle for asynchronous operation shall be between 45 % and 55 % of the period during stable operation.

When switching the frequency from one value to another, care shall be taken to ensure that no pulse is shorter than 45 % of the shorter period. Two different times are recommended for switching the frequency value :

— either immediately after the answer to reset,

— or immediately after a successful PTS procedure is completed.

No data transmission shall be performed when switching the frequency value.

Replace the first existing paragraphs in clause 5 :

5 Operating procedure for integrated circuit(s) cards

This operating procedure applies to every integrated circuit(s) card with contacts.

The dialogue between the interface device and the card shall be conducted through the consecutive operations :

— 1 — connection and activation of the contacts by the interface device ;

— 2 — reset of the card ;

— 3 — information exchange between the card and the interface device, always initiated by an Answer-to Reset sent by the card ;

— 4 — deactivation of the contacts by the interface device.

Those operations are specified in the following clauses.

NOTES

1 Operations 2 and 3 may be repeated.

2 An active state on VPP should only be provided and maintained when requested by the card.

Replace figure 1 :

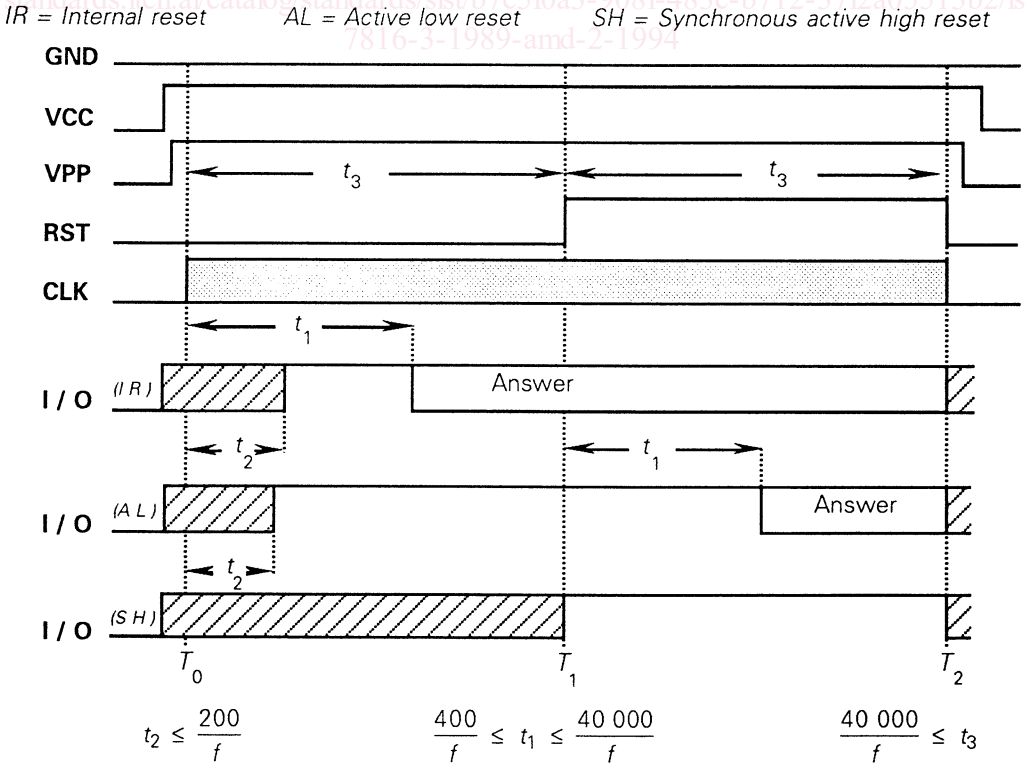


Figure 1 — Reset of the card

NOTE — The hatched area indicates a period when the state of I/O is undefined.

Replace subclause 5.3 :

5.3 Information exchange

The card answers after reset with a sequence defined in clause 6.

All information exchanged over the I/O circuit correspond to the execution of commands, including a possible PTS procedure as specified in clause 7.

The operating procedure of commands depends on the type of transmission (asynchronous or synchronous) and on the protocol type. The asynchronous half duplex character transmission protocol, with the interface device as the master, is specified in clause 8. The asynchronous half duplex block transmission protocol is specified in clause 9 (ISO/IEC 7816-3 : 1989/Amd.1 : 1992).

NOTES

1 Further protocol types between the card and the interface device are for further study.

2 The inter-industry commands for interchange are to be specified in the next part of ISO/IEC 7816. Other commands are specified either in existing standards or in additional standards to be defined.

Insert the following new paragraphs in clause 6.1 :

6.1 Answer-to-Reset in asynchronous transmission

After the answer to reset, the card is in one of the following two modes of operation :

— the negotiable mode,

— the specific mode.

Those two modes of operation are defined in 6.1.4.5. The indication of the mode is provided in the Answer-to-Reset.

Replace subclause 6.1.1 :

6.1.1 Bit duration

The nominal bit duration used on I/O is defined as one Elementary Time Unit (etu).

For cards having internal clock, the initial etu is $\frac{1}{9\,600}$ s.

For cards using the external clock, there is a linear relationship between the Elementary Time Unit used on I/O and the period provided by the interface device on CLK.

The initial etu is $\frac{372}{f}$ s where f is in hertz.

See also 6.1.4.1.

In order to read the initial character (TS), all cards shall initially be operated at least during the answer to reset with f in the range of 1 MHz to 5 MHz.

Any card operated with f in the range of 1 MHz to 5 MHz shall answer to reset.

Replace the existing paragraphs in subclause 6.1.4 :

6.1.4 Structure and content

A reset operation results in an answer from the card consisting of the initial character TS, followed by at most 32 characters in the following order :

— T0 ..... Format character .... Mandatory

— TA_i TB_i TC_i TD_i ....Interface characters .... Optional

— T1 T2 ...TK ..... Historical characters ... Optional

— TCK ..... Check character ..... Conditional

See 6.1.4.1 to 6.1.4.5 and figure 4.

NOTE — The use of TA_2 is conditioned by the mode of operation (see 6.1.4.5).

Replace figure 4 :

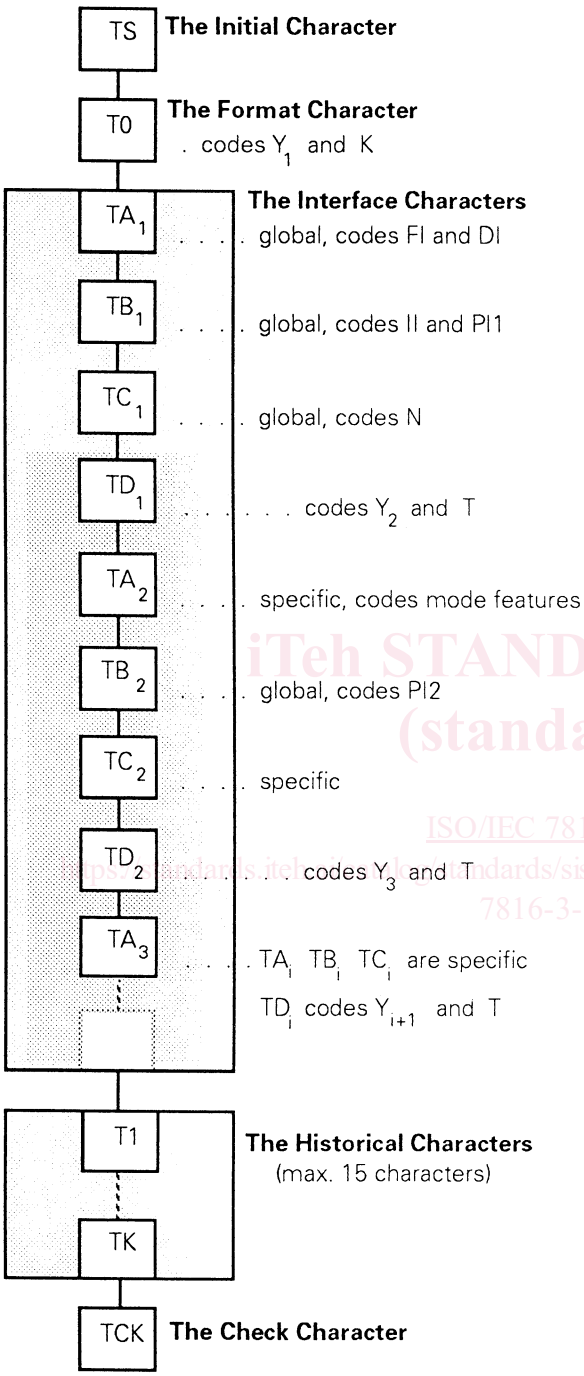


Figure 4 — General configuration of the Answer-to-Reset

Replace subclause 6.1.4.3 :

6.1.4.3 Protocol type T

The four least significant bits of any interface byte TD_i indicate a protocol type T, specifying rules to be used to process transmission protocols. When TD_1 is not transmitted, T=0 is used.

— T = 0 is the asynchronous half duplex character transmission protocol specified in clause 8.

— T = 1 is the asynchronous half duplex block transmission protocol specified in clause 9.

— T = 2 and T = 3 are reserved for future full duplex operations.

— T = 4 is reserved for an enhanced asynchronous half duplex character transmission protocol.

— T = 5 to T = 13 are reserved for future use.

— T = 14 is reserved for protocols not standardized by ISO.

— T = 15 is reserved for future extension.

TA_1 TB_1 TC_1 and TB_2 are the global interface bytes specified in 6.1.4.4. Those global interface bytes shall be interpreted in order to process any transmission protocol correctly.

TA_2 provides information on the specific mode of operation of the card as described in 6.1.4.5.

The other interface bytes TA_i TB_i TC_i are the specific interface bytes. Their interpretation depends on the protocol type indicated by T in TD_{i-1}.

If more than three interface bytes TA_i TB_i TC_i are defined for a specific protocol type and are to be sent in the Answer-to-Reset sequence, they shall be sent subsequently by using TD-bytes which all indicate the same protocol type.

If more than one protocol type is indicated and T=0 is one of them, T=0 shall be indicated first.

If only T=0 is indicated, TCK shall not be sent. In all other cases, TCK shall be sent.

When present, TD_1 shall indicate the first offered transmission protocol.

In subclause 6.1.4.4, replace the first two paragraphs and the paragraphs under "Parameters ...", "Programming voltage ..." and "Extra guardtime ..."; the paragraphs under "Integer values ..." and "Correspondence ..." remain unchanged. Replace tables 6, 7 and 8.

6.1.4.4 Specifications of the global interface bytes

Among the interface bytes possibly transmitted by the card in the Answer-to-Reset, this subclause defines only the global interface bytes TA_1 TB_1 TC_1 TB_2.

Those global interface bytes convey information to determine parameters that the interface device shall take into account.

Parameters F, D, I, P, N

In the negotiable mode, as specified in 6.1.4.5, the initial etu specified by the formulae given in 6.1.1 and repeated below remains valid until a PTS procedure has been successfully completed. The initial etu is replaced by the work etu immediately after a successful execution of the PTS procedure (explicit protocol type selection).

In the specific mode, as specified in 6.1.4.5, the initial etu is replaced by the work etu immediately after the answer to reset.

F is the clock rate conversion factor and D is the bit rate adjustment factor to determine the work etu.

For internal clock cards :

$$\text{Initial etu} = \frac{1}{9\,600} \text{ s} \qquad \text{Work etu} = \frac{1}{D} \times \frac{1}{9\,600} \text{ s}$$

For external clock cards :

$$\text{Initial etu} = \frac{372}{f} \text{ s} \qquad \text{Work etu} = \frac{1}{D} \times \frac{F}{f} \text{ s}$$

where f is in hertz.

The minimum value of f shall be 1 MHz.
The maximum value of f is given by table 6.

I and P define the active state at VPP.
— Maximum programming current : I_{PP} = I mA.
— Programming voltage : V_{PP} = P V.

N, when in the range from 0 to 254, is an extra guardtime requested by the card. Before receiving the next character, the card requires a delay of at least (12+N) etu from the start leading edge of the previous character. No extra guardtime is used to send characters from the card to the interface device. N=255 has a special meaning defined at the end of this subclause.

The default values of these parameters are
F = 372 ; D = 1 ; I = 50 ; P = 5 ; N = 0.

These parameters are described in greater detail at the end of this subclause under Integer Values to Parameters Correspondence.

Table 6 — Clock rate conversion factor F

FI	0000	0001	0010	0011	0100	0101	0110	0111
F	Internal Clock	372	558	744	1116	1488	1860	RFU
f (max) MHz	—	5	6	8	12	16	20	—

RFU = Reserved for Future Use

FI	1000	1001	1010	1011	1100	1101	1110	1111
F	RFU	512	768	1024	1536	2048	RFU	RFU
f (max) MHz	—	5	7,5	10	15	20	—	—

Table 7 — Bit rate adjustment factor D

DI	0000	0001	0010	0011	0100	0101	0110	0111
D	RFU	1	2	4	8	16	32	RFU

DI	1000	1001	1010	1011	1100	1101	1110	1111
D	12	20	1/2	1/4	1/8	1/16	1/32	1/64

Programming voltage factor P

PI1 from 5 to 25 gives the value of P in volts. PI1=0 indicates that VPP is not connected in the card which generates an internal programming voltage from VCC. Other values of PI1 are reserved for future use.

When PI2 is present, the indication of PI1 should be ignored. PI2 from 50 to 250 gives the value of P in 0,1 V. Other values of PI2 are reserved for future use.

Table 8 — Maximum programming current factor I

II	00	01	10	11
I	25	50	100	RFU

Extra guardtime N

N codes directly the extra guardtime, from 0 to 254 etu. N=255 indicates that the minimum delay between the start leading edges of two consecutive characters is the same in both directions of transmission. The value of this minimum delay is

— 12 etu for the T=0 asynchronous half-duplex character transmission protocol ;

— 11 etu for the T=1 asynchronous half-duplex block transmission protocol.

Insert the new following subclause and two figures :

6.1.4.5 Differentiation between the negotiable mode and the specific mode

In the **negotiable** mode of operation, the default values of parameters F and D (see 6.1.4.4) used during the answer to reset and the first offered protocol type given in the answer to reset shall apply until a successful PTS procedure is performed. The negotiable mode may be changed directly to the specific mode by use of the PTS function.

NOTE — A reset issued in the negotiable mode may switch the card into the specific mode.

In the **specific** mode of operation, the parameters F and D (see 6.1.4.4) and the protocol type required in the answer to reset shall apply directly after the answer to reset. A reset may be initiated by the interface device to invoke the negotiable mode in the card.

Selection and switching of modes of operation are shown in figure X.

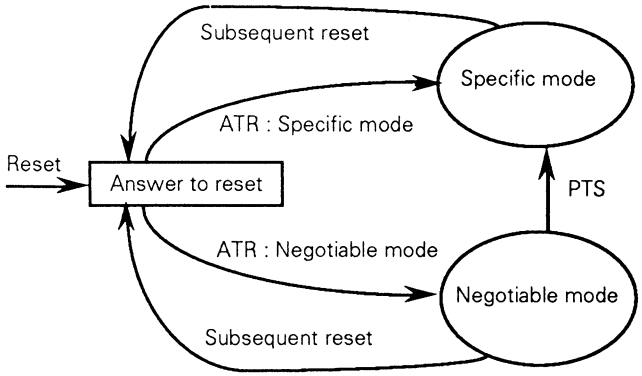


Figure X — Schematic representation of mode selection and switching

Implicit protocol type selection in negotiable mode

The first indicated protocol is applicable immediately after the answer to reset as long as the first character sent by the interface device to the card allows an unambiguous distinction between a PTS request and a command of the protocol.

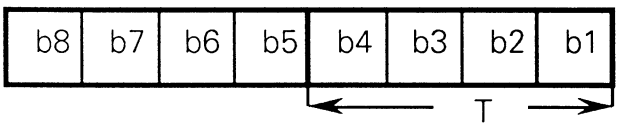
Consequently, cards supporting only one protocol and only the default values of the transmission parameters need not support the PTS procedure.

NOTE — If T=0 is present in a multi-protocol card, then T=0 shall be indicated first in the Answer-to-Reset. Therefore, in negotiable mode, only T=0 can be implicitly selected in this card.

Coding of TA_2, the specific mode byte in specific mode

When present, TA_2 indicates the specific mode of operation of the card and describes the relevant features. The negotiable mode of the card is denoted by the absence of TA_2.

The coding of TA_2 is according to figure Y.



b8 ..... Indicator of ability for changing the mode of operation
Capable to change when b8=0
Unable to change when b8=1
b7-b6 . RFU (00 when not used)
b5 ..... Indicator of definition of parameters
Defined by the interface bytes when b5=0
Implicitly defined, not by the interface bytes when b5=1
T..... Protocol type to be used in the specific mode

Figure Y — Coding of the specific mode byte

NOTES

1 When a card transmitting TA_2 is introduced in an interface device not aware of the existence of the specific mode, then the card cannot rely on an additional reset being provided by the interface device to switch to the negotiable mode.

2 When an interface device has detected a TA_2 byte, then the interface device should not issue a second reset before the answer to reset is completely received or the card has timed out.