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**Identification cards — Optical memory  
cards — Linear recording method —**

**Part 4:  
Logical data structures**

*Cartes d'identification — Cartes à mémoire optique — Méthode  
d'enregistrement linéaire —  
Partie 4: Structures de données logiques*

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## Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO/IEC 11694 may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 11694-4 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 17, *Identification cards and related devices*.

This second edition cancels and replaces the first edition (ISO/IEC 11694-4:1996), which has been technically revised.

ISO/IEC 11694 consists of the following parts, under the general title *Identification cards — Optical memory cards — Linear recording method*:

- *Part 1: Physical characteristics*
- *Part 2: Dimensions and location of the accessible optical area*
- *Part 3: Optical properties and characteristics*
- *Part 4: Logical data structures*

Annexes A and B form a normative part of this part of ISO/IEC 11694.

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## Introduction

This part of ISO/IEC 11694 is one of a series of standards describing the parameters for optical memory cards and the use of such cards for the storage and interchange of digital data.

The standards recognize the existence of different methods for recording and reading information on optical memory cards, the characteristics of which are specific to the recording method employed. In general, these different recording methods will not be compatible with each other. Therefore, the standards are structured to accommodate the inclusion of existing and future recording methods in a consistent manner.

This part of ISO/IEC 11694 is specific to optical memory cards using the linear recording method. Characteristics which apply to other specific recording methods shall be found in separate standards documents.

This part of ISO/IEC 11694 defines the logical data structures and the extent of compliance with, addition to, and/or deviation from the relevant base document ISO/IEC 11693.

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# Identification cards — Optical memory cards — Linear recording method —

## Part 4: Logical data structures

### 1 Scope

This part of ISO/IEC 11694 specifies the logical data structures for optical memory cards necessary to allow compatibility and interchange between systems using the linear recording method.

### 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 11694. 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 11694 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 11693:2000, *Identification cards — Optical memory cards — General characteristics*

ISO/IEC 11694-1:2000, *Identification cards — Optical memory cards — Linear recording method — Part 1: Physical characteristics*

ISO/IEC 11694-2:2000, *Identification cards — Optical memory cards — Linear recording method — Part 2: Dimensions and location of the accessible optical area*

ISO/IEC 11694-3:2001, *Identification cards — Optical memory cards — Linear recording method — Part 3: Optical properties and characteristics*

### 3 Terms and definitions

For the purposes of this part of ISO/IEC 11694, the terms and definitions given in ISO/IEC 11693, ISO/IEC 11694-1, ISO/IEC 11694-2, ISO/IEC 11694-3 and the following apply.

#### 3.1 data bit

area which represents data on an optical memory card; mark which has a different reflectivity and/or phase difference from the background reflectivity

NOTE One mark can define one or two data transitions dependent on the modulation method selected.

**3.2  
data track**

area located between adjacent track guides where data are written and/or read

**3.3  
error correction code (ECC)**

code designed to correct certain kinds of errors in data

**3.4  
error detection and correction (EDAC)**

family of methods in which redundancy is added to a message block, at the time the message block is recorded, in known fashion; upon read back, a decoder removes the redundancy and uses the redundant information to detect and correct erroneous channel symbols

**3.5  
modulation code**

system for coding which transforms information bits into some physical representation for recording onto the optical memory card

**3.6  
pitch**

distance between corresponding points on adjacent data spots

**3.7  
sector**

minimum unit of data that can be accessed on a card for any read and/or write command

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**4 Reference points**

The reference track and reference edges defined in ISO/IEC 11694-2 apply unless otherwise specified.

**4.1 First data bit**

The first data bit shall be located on the reference track and is part of the track ID. The location may vary dependent on the track layout selected. See annex A or annex B.

**5 Track layout**

Track layout information shall be preformatted on cards during manufacture and/or written to cards prior to use.

The total number of tracks may vary dependent on the application requirements; however, in all cases, tracks shall be arranged in order, and numbered sequentially, beginning with the reference track. See annex A or annex B for actual track layouts and numbering sequences.

**5.1 Track layout options**

See annex A or annex B for information concerning data structures that support the optional card layouts described in ISO/IEC 11694-2.

**6 Track guides**

Track guides shall be uniformly spaced across the card and shall extend the length of the accessible optical area. The accumulated tolerances across the width of all track guides shall be less than or equal to 0,01 % at 25 °C. See annex A or annex B for specific dimensions.



## 7 Guard tracks

There shall be 20 guard tracks, ten located directly above and ten directly below the user data area to enable the optics to locate the user data tracks and prevent the optical head from overrunning the accessible optical area if auto-tracking is lost.

Guard tracks may contain data relating to card type, physical data format, specific application and/or card drive autodiagnosis and calibration. See annex A or annex B.

## 8 Data tracks

Written and/or preformatted data shall be located within data tracks and centred between adjacent track guides to a tolerance of  $\pm 0,5 \mu\text{m}$  in the y-axis. See annex A or annex B.

## 9 Track ID

Written and/or preformatted track ID shall identify the physical address of each data track. See annex A or annex B for specific configuration and location.

## 10 Sectors

Sectors are defined by the amount of user data in bytes and the number of sectors which can be written to a single data track. See annex A or annex B for specific types/sizes.

All sectors within a given track shall be identical in type and partially written tracks shall only be appended with sectors of the same type as those previously written on the track unless otherwise specified in annex A or annex B.

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NOTE Sector types/sizes have been defined to maximize the efficiency of data storage on a track and may vary by modulation code.

## 11 Data encoding

To encode data requires the use of a modulation code. See annex A or annex B for acceptable modulation codes.

NOTE The user data on any single optical card shall only be encoded using one modulation code.

## Annex A (normative)

### 8-10 NRZI modulation code, PWM recording method

#### A.1 Scope

This annex defines the logical data structures specific to optical cards using a pulse width modulation recording method and an 8-10 NRZI modulation code.

#### A.2 Terms and definitions

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

##### A.2.1

##### **carrier/burst modulation code**

form of FM modulation code which makes 1,0 information correspond to a different frequency

##### A.2.2

##### **NRZI**

non-return-to-zero-inverse; a specific modulation method to make 1 corresponding to inverse and 0 to non-inverse

##### A.2.3

##### **Reed-Solomon code**

byte error detection and/or correction code which is generally used in optical and magnetic storage

#### A.3 Reference points

The first bottom guard track (*LPT9*) is the reference track and shall be located  $5,4 \text{ mm} \pm 0,3 \text{ mm}$  from the horizontal reference edge.

NOTE This dimension is tighter yet still falls within the tolerance range specified by dimension *D* of ISO/IEC 11694-2.

##### A.3.1 First data bit

The first data bit closest to the left edge of the card shall be located at  $12,50 \text{ mm} \pm 0,40 \text{ mm}$  in the x-axis. The distance between the first data bit closest to the left edge of the card and the first data bit closest to the right edge of the card shall be  $60,6 \text{ mm} \pm 0,1 \text{ mm}$  in the x-axis.

#### A.4 Track layout

Tracks shall be arranged in order beginning with the reference track and shall be numbered sequentially beginning with track -10, the reference track.

Track Description	Track No.	Hex
Guard track LPT9 (first bottom)	-10	FFF6
:	:	:
:	:	:
Guard track LPT0 (last bottom)	-1	FFFF
First user data track	0	0000
:	:	:
:	:	:
Last user data track	n	
Guard track UPT0 (first top)	n+1	
:	:	:
:	:	:
Guard track UPT9 (last top)	n+10	

NOTE Because the total number of tracks may vary dependent on the application requirements, the last user data track and the top guard tracks are expressed in parametric form.

## A.5 Track layout examples

This section provides information concerning data structures that support the optional card layouts described in ISO/IEC 11694-2.

### A.5.1 Cards with moderate data capacity

This layout shall contain 2520 data tracks, of which 2500 shall be user data tracks. Tracks shall be numbered sequentially beginning with track –10, the reference track.

NOTE This layout supports the inclusion of a magnetic stripe and/or signature panel.

### A.5.2 Cards with small data capacity

This layout shall contain 1128 data tracks, of which 1108 shall be user data tracks. Tracks shall be numbered sequentially beginning with track –10, the reference track.

NOTE This layout supports the inclusion of a magnetic stripe, IC chip with contacts, embossing and/or signature panel.

### A.5.3 Cards with maximum data capacity

This layout shall contain 3593 data tracks, of which 3573 shall be user data tracks. Tracks shall be numbered sequentially beginning with track –10, the reference track.

NOTE This layout supports the inclusion of a magnetic stripe and/or signature panel.

## A.6 Track guides

The width of the track guides shall be  $2,3 \mu\text{m} \pm 0,3 \mu\text{m}$ . The distance from the centre of one track guide to the centre of an adjacent track guide shall be  $12,0 \mu\text{m} \pm 0,2 \mu\text{m}$ .

No track guides shall have any breaks exceeding  $180 \mu\text{m}$ .

## A.7 Guard tracks

All guard tracks shall contain preformatted track-ID and card-type data and/or card-ID field data. Cards shall not be issued with these tracks left blank nor shall these tracks be made available to the application for writing.

Each guard track shall contain two track ID areas, one to the left, the other to the right of the card-type data and/or card-ID field. See A.10.

NOTE It is expected that card drive units will have the ability to read guard tracks whether preformatted with card-type data or pre-recorded with card-ID field data.

### A.7.1 Card-type data

Card-type data are pre-set indicia that denote the physical data format, the number and location of tracks and/or a specific type application. There shall be two blocks per track each containing the same card-type pattern repeated eight times. See Figure A.1 and Table A1.

Card-type data shall be preformatted using a carrier/burst modulation code. These tracks shall not be made available to the application for writing nor shall cards be issued with these tracks left blank.

The carrier/burst pattern shall consist of an *L*-pattern (denotes 0 data) and an *S*-pattern (denotes 1 data), the only difference between patterns being the pattern-pitch. The *L*-pattern pitch shall be  $240\ \mu\text{m} \pm 5\ \mu\text{m}$  and the *S*-pattern pitch shall be  $120\ \mu\text{m} \pm 5\ \mu\text{m}$ . See A.12.2, Figure A.1 and Table A.1.

The length, or x-axis dimension, of preformatted data bits shall be  $6,0\ \mu\text{m} \pm 0,6\ \mu\text{m}$ ; the width, or y-axis dimension, shall be  $2,5\ \mu\text{m} \pm 0,5\ \mu\text{m}$ ; the bit pitch shall be  $12,0\ \mu\text{m} \pm 0,3\ \mu\text{m}$ . See Figure A.1.

The distance between the first data bit of the left track ID closest to the left edge of the card and the first data bit of the card type pattern closest to the left edge of the card shall be  $14,9\ \text{mm} \pm 0,1\ \text{mm}$  in the x-axis.

### A.7.2 Unique card identification (ID) field

For those applications requiring unique card serialization, guard tracks *LPT1* (track -2) and *LPT0* (track -1) shall be used as a card-ID field. If using this option, information related to the application and other issuer information may be included in these tracks along with the card serialization data.

Card-ID field data shall be pre-recorded during the manufacturing process. These tracks shall not be made available to the application for writing nor shall cards be issued with these tracks left blank.

There are two types of card identification (ID) field data described in A.7.2.1.1 (card-type 0 to 14) and A.7.2.1.2 (card-type 15).

#### A.7.2.1 Content

Figure A.2 shows the structure and data content of the card-ID field. Data shall be pre-recorded using a type-2 sector as defined in A.11.1 and Table A.2. The same information shall be repeated in each sector of each track, that is four times in two tracks.

NOTE 1 It is not permissible to set all data fields to *OFF* hex.

NOTE 2 If no components of the card-ID field are used, these two tracks must be preformatted with card-type data. See A.7.1.

Field components are described in both A.7.2.1.1 and A.7.2.1.2.

#### A.7.2.1.1 Card-type 0 to 14

- **Application identifier (AID):** The AID shall consist of 16 bytes of alpha/numeric data, which data shall be agreed to by the card manufacturer and card issuer. If the AID is not implemented, these 16 bytes shall be set to *OFF* hex.

NOTE Card manufacturers shall have the responsibility to manage the information to ensure AID's are not duplicated between different card issuers.

- **Unique identifier (UID):** The UID shall consist of six bytes, one byte containing the card manufacturer identifier (CMID), and five bytes containing a unique card identifier (UCID). If the UID is not implemented, these six bytes shall be set to *OFF* hex.

NOTE 1 The card manufacturer shall have the responsibility to ensure only one UID is contained in their card products.

NOTE 2 Since different card manufacturers can use the same UCID, it is recommended that the entire UID (CMID + UCID) be used.

- **Number of issuer data bytes (NID):** The NID shall consist of two bytes which specify the number of bytes used in the ISSUER portion of the card-ID field. If the NID is not implemented, these two bytes shall be set to *OFF* hex.
- **Optional issuer data (ISSUER):** The ISSUER shall consist of 488 bytes and shall be reserved for the exclusive use of the card issuer. Any unused bytes in this area shall be set to *OFF* hex.

NOTE Since card-ID field data are pre-recorded, the ISSUER data must be pre-recorded at the time of card manufacture.

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#### A.7.2.1.2 Card-type 15

- **Application identifier (AID):** Same with A.7.2.1.1.
- **Unique identifier (UID):** Same with A.7.2.1.1.
- **Number of issuer data bytes (NID):** Same with A.7.2.1.1.
- **Format identifier (FID):** The FID shall consist of six bytes of alpha/numeric data, which specify the format classification. "SIOC01" shall be recorded for the current international standard.
- **Card type (CTYPE):** The CTYPE shall be one byte data which is same with the card-type data. In this case, it shall be *0F* hex.
- **Track pitch (PITCH):** The PITCH shall be one byte data, which is ten-times value of track pitch. For 12  $\mu$ m track pitch, it shall be *78* hex.
- **Number of user track (NUMBER):** The NUMBER shall consist of two bytes which specify the user track number in the card. It shall be recorded the most significant byte first.
- **Media type (MTYPE):** The MTYPE shall be one byte which specifies the media type which is under control of the card manufacturer.
- **Contacts for IC chip (CONTACT):** The CONTACT shall be one byte which specifies the presence/absence of contacts for IC chip. This byte is optional, and *OFF* hex shall be recorded in no use.

*00* hex : No IC contacts

*10* hex : Contacts on the same side with AOA (Accessible Optical Area)

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20 hex : Contacts on the opposite side with AOA

others : Reserved

- **Contactless IC chip (CLIC):** The CLIC shall be one byte which specifies the presence/absence of contactless IC chip. This byte is optional, and *OFF* hex shall be recorded in no use.

00 hex : No IC chip

10 hex : Includes inductive coupling IC chip

20 hex : Includes capacitive coupling IC chip

others : Reserved

- **Magnetic stripe (MS):** The MS shall be one byte which specifies the presence/absence of magnetic stripe. This byte is optional, and *OFF* hex shall be recorded in no use.

00 hex : No magnetic stripe

10 hex : Magnetic stripe on the same side with AOA

20 hex : Magnetic stripe on the opposite side with AOA

30 hex : Magnetic stripe on both sides

others : Reserved

- **Embossing (EMBOSS):** The EMBOSS shall be one byte which specifies the presence/absence of embossing. This byte is optional, and *OFF* hex shall be recorded in no use.

00 hex : No embossing

10 hex : With embossing

others : Reserved

- **Optional issuer data (ISSUER):** The ISSUER shall consist of 472 bytes and shall be reserved for the exclusive use of the card issuer. Any unused bytes in this area shall be set to *OFF* hex.

NOTE Since card-ID field data are pre-recorded, the ISSUER data must be pre-recorded at the time of card manufacture.

## A.8 Data tracks

Each data track can contain a maximum of 60,7 mm of written and/or preformatted data, including the gaps between sectors.

### A.8.1 Data bits

Use of the 8-10 NRZI modulation code requires that written and/or preformatted data bits consist of four different sizes. The length, or x-axis dimension, shall be  $3,0 \mu\text{m} \pm 0,6 \mu\text{m}$ ,  $6,0 \mu\text{m} \pm 0,6 \mu\text{m}$ ,  $9,0 \mu\text{m} \pm 0,6 \mu\text{m}$  or  $12,0 \mu\text{m} \pm 0,6 \mu\text{m}$ ; the width, or y-axis dimension, shall be  $2,5 \mu\text{m} \pm 0,5 \mu\text{m}$ .

The minimum distance from the centre of one data bit to the centre of an adjacent data bit shall be  $6,0 \mu\text{m} \pm 0,3 \mu\text{m}$ .

## A.9 Track components

### A.9.1 Preamble (PRE)

A series of 60 consecutive bits laid out from the left edge direction of the card. The PRE bit-pattern shall be 1010101010... or 0101010101... See Figure A.3.

NOTE The PRE generates the data clock required by the card drive's phase-lock-loop (PLL) circuit when an optical card is read from left to right.

### A.9.2 Sync marker

A specific 10-bit pattern which does not show up as a read-output signal when the 8-10 NRZI modulation code is implemented on the track ID and/or user data.

NOTE When asynchronization occurs during reading, data can be re-synchronized after sensing successive sync markers.

The sync marker shall be set on the border of the data matrix, created when implementing the Reed-Solomon code, to divide the user data into multiple blocks. See Figure A.4.

The first sync marker from the left edge of the card, in every sector and in both track ID's, shall be 1100010001 prior to NRZI modulation. All other sync markers shall be either 1100010001 or 0100010001 prior to NRZI modulation.

Thus all written sync markers shall become either 1000011110 or 0111100001 after NRZI modulation.

### A.9.3 Post-amble (PST)

A series of 60 consecutive bits laid out from the left edge direction of the card. The PST bit-pattern shall be 0101010101... or 1010101010... See Figure A.3.

NOTE The PST generates the data clock required by the card drive's PLL circuit when an optical card is read from right to left.

## A.10 Track ID

Track ID shall be preformatted at the right and left side of each data track. See Figures A.3 and A.5.

NOTE The structure allows the track ID to be read from either direction, that is from left to right or right to left.

### A.10.1 Content

The track ID shall consist of 75 bytes of information and the length shall be  $2,25 \text{ mm} \pm 0,02 \text{ mm}$ . The track ID shall consist of the PRE, sync markers, track numbers, ECC and the PST. See A.12.3 and Figure A.3.

The track number itself shall be repeated twice per track ID with the most significant bit (MSB) positioned closest to the left edge of the card.

## A.11 Sectors

Every sector shall contain a PRE, sync markers, user data, ECC and a PST and shall be separated from adjoining sectors by a gap, that is an unrecorded area. See Figures A.4 and A.5.

User data shall be written within a sector and arranged from left to right regardless of the writing direction implemented.