International Standard 7811/2

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Identification cards — Recording technique — Part 2: Magnetic stripe

Cartes d'identification — Technique d'enregistrement — Partie 2: Magnétique

First edition — 1985-12-15

UDC 681.178.5 : 681.327.65

Ref. No. ISO 7811/2-1985 (E)

Descriptors : information interchange, data recording, identity cards, magnetic cards, magnetic recording, coded character sets, characteristics.

Price based on 8 pages

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7811/2 was prepared by Technical Committee ISO/TC 97, *Information processing systems*.

The following International Standards cancel and replace ISO 2894 and ISO 3554, of which they constitute a technical revision:

ISO 7810, ISO 7811/1, ISO 7811/2, ISO 7811/3, ISO 7811/4, ISO 7811/5, ISO 7812, ISO 7813.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Printed in Switzerland

Identification cards — Recording technique — Part 2: Magnetic stripe

0 Introduction

This International Standard is one of a series of standards describing the parameters for identification cards as defined in clause 3 below and the use of such cards for international interchange.

1 Scope and field of application

This part of ISO 7811 specifies characteristics for a magnetic stripe (including any protective overlay) on an identification card, the encoding technique and coded character sets. The magnetic recordings are intended for machine reading.

2 References

ISO 7810, *Identification cards — Physical characteristics.*

ISO 7811, *Identification cards — Recording technique*

- *Part 4: Location of read-only magnetic tracks — Tracks 1 and 2.*
- *Part 5: Location of read-write magnetic track — Track 3.*

3 Definitions

For the purpose of this part of ISO 7811, the definition of "identification card" given in ISO 7810 and the following definitions apply.

3.1 **primary standard:** The NBS Master Standard Magnetic Tape (computer amplitude reference) kept in repository at the United States National Bureau of Standards (NBS).

NOTE — The relationship (correction factor) between the Master Standard and reference tape SRM 3200 is given by the NBS certificate supplied with the tape.

3.2 **reference card**[1]: A reference card, which shall be considered a secondary standard, comprises an ID card with a magnetic stripe consisting of secondary standard magnetic tape (computer amplitude reference) SRM 3200.

NOTE — The secondary reference card should be corrected to the master standard first using the correction factor provided by the supplier. Then the location of the window is calculated (see figure 5).

3.3 **flux transition:** The location of the maximum of the magnitude of the magnetic flux component normal to the surface of the magnetic stripe.

3.4 **reference current** (I_R): The minimum recording current amplitude (square wave) which causes on the reference card, under the given test conditions, a readback voltage amplitude equal to 80 % of the maximum amplitude (see figure 5) at a density of 8 ftpmm (flux transitions per millimetre) [200 ftpi (flux transitions per inch)].

3.5 **test recording currents:** Two test recording currents (square wave) at 350 % and 500 % of the reference current (I_R) shall be used.

3.6 **average signal amplitude:** The readback voltage, measured peak-to-peak, averaged over the total recording area of a card when recorded with the test recording current at the specified recording density.

3.7 **reference signal amplitude:** The maximum average signal amplitude of the reference card corrected to the master standard.

3.8 **individual signal amplitude:** The peak-to-peak amplitude of a single readback voltage signal.

3.9 **test density:** Densities of 8 ftpmm (200 ftpi) and 20 ftpmm (500 ftpi) which may be used for testing.

NOTE — When testing with the reference card, densities of 6 ftpmm (150 ftpi) and 16,6 ftpmm (420 ftpi) may be used. The correlation factors are:

$$\frac{\text{amplitudes 6 ftpmm (150 ftpi)}}{\text{amplitudes 8 ftpmm (200 ftpi)}} \times 100 = 100\ \%$$

$$\frac{\text{amplitudes 16,6 ftpmm (420 ftpi)}}{\text{amplitudes 20 ftpmm (500 ftpi)}} \times 100 = 105\ \%$$

1) These cards can be ordered from Physikalisch-Technische Bundesanstalt, Lab. 1.41 — Bundesallee 100, D-3 300 Braunschweig, Germany, F.R. as long as available.

4 Physical characteristics of the identification card

The identification card shall conform to the specifications given in ISO 7810.

WARNING — The attention of card issuers is drawn to the fact that information held on the magnetic stripe may be rendered ineffective through contamination by contact with dirt and certain commonly used chemicals including plasticizers. Further, exposure of the card to an intense magnetic field is likely to destroy the recorded data.

5 Physical characteristics of the magnetic material

5.1 Thickness

The height of the reading surface above the back surface of the card, when profiled with a stylus of between 0,38 mm (0.015 in) and 2,54 mm (0.100 in) radius, shall be

0 mm min. (0 in min.)

0,038 mm max. (0.001 5 in max.)

5.2 Surface roughness

The average surface irregularity of the magnetic surface shall not exceed 0,404 µm (15.9 µin) CLA (centreline average) in both the longitudinal and transverse directions, when using a cut-off wavelength of 0,25 mm (0.01 in) or 0,76 mm (0.03 in) and a stylus of radius 2,54 µm max. (100 µin max.)

5.3 Surface profile

The average profile of the minimum magnetic stripe width (see figures 1 and 2) when measured parallel to the height of the card with a probe having a radius of 0,38 mm (0.015 in) to 2,54 mm (0.100 in) shall not show a vertical deviation from a straight line connecting the minimum strip width of more than 3,8 µm (150 µin) for every 2,54 mm (0.100 in) of stripe width (see figure 3).

During the measurement the back (magnetic stripe side) of the card shall be held parallel to the surface by means of a 2,2 N (0.51 lbf) load evenly distributed over the back of the measurement area.

NOTES

1 Spiking in the profile caused by material "squirt-out" in hot stamping is not part of the stripe. It should not extend above the projected stripe surface (see figure 4).

2 Locating the magnetic material on top of printing is not recommended. When edge bleed (ink covering the overlay seal) is present, the card is more susceptible to fray and delamination problems.

3 It is necessary to have a defined method of measuring the surface profile in order to ensure uniformity. Methods of measurement are being evaluated and an agreed procedure will be added in this International Standard at the earliest opportunity.

5.4 Adhesion of stripe to card

The stripe shall not separate from the card under normal use.

6 Performance characteristics of the magnetic material for newly manufactured identification cards

6.1 General

This method uses a certified reference card whose magnetic material is traceable to a primary standard magnetic tape.

The test does not guarantee any minimum or maximum value of intrinsic coercivity H_{ci}. The specification of this parameter (if required) is left to the individual card purchasers. In general, higher coercivities provide greater resistance to erasure at increased cost.

6.2 Track 1, 2 and 3 (read only or read/write)

All measurements shall be made using the same device and under the same conditions.

6.2.1 Signal amplitude

When the magnetic material with any protective coatings in place is recorded with the test recording currents (see 3.5) at 8 ftpmm (200 ftpi) the signal amplitude shall be within 80 % to 130 % of the reference signal amplitude (see figure 5).

The signal amplitude obtained at this density, after recording with a test recording current of 500 % I_R, shall not exceed the signal amplitude obtained at the same density with a recording current of 350 % of I_R. The slope of the saturation curve shall never be positive between these two points.

When recorded with the same test recording currents (see 3.5) at 20 ftpmm (500 ftpi) and with all other parameters identical, the signal amplitude shall be not less than 70 % of that obtained at 8 ftpmm (200 ftpi) i.e.

$$\frac{\text{amplitude 20 ftpmm (500 ftpi)}}{\text{amplitude 8 ftpmm (200 ftpi)}} \times 100\ \% = 70\ \%$$

NOTE — The resolution of the read head sub-system (head amplifier) should be in the range of 90 % to 100 % when defined as

$$\frac{\text{amplitude 20 ftpmm (500 ftpi)}}{\text{amplitude 8 ftpmm (200 ftpi)}} \times 100\ \% = 90 \ldots 100\ \%$$

Dimensions in millimetres
(dimensions in inches in parentheses)

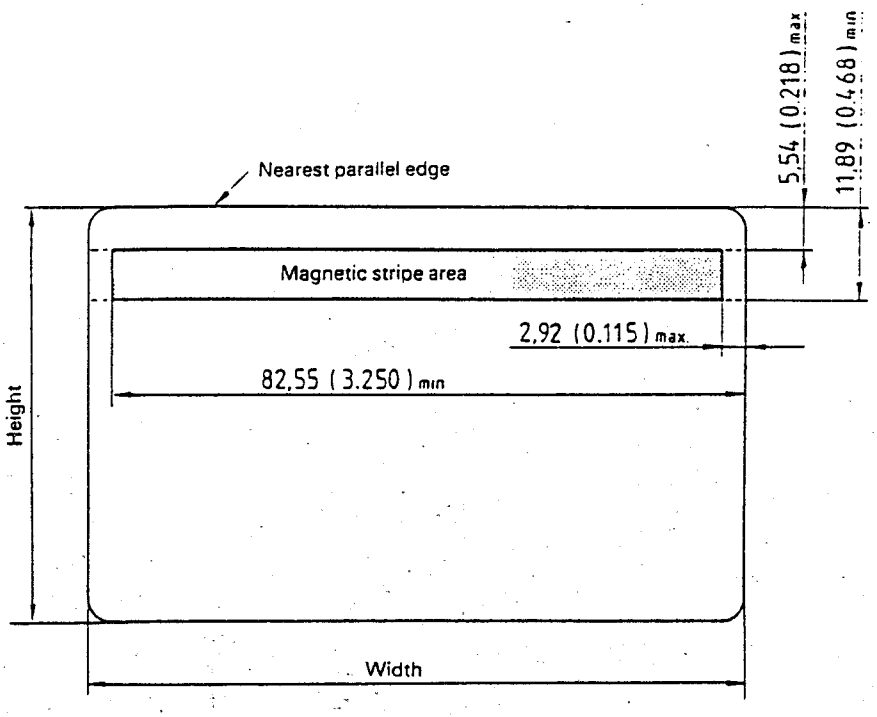


Figure 1 — Location of magnetic material for tracks 1 and 2 only on ID-1 type card

Dimensions in millimetres
(dimensions in inches in parentheses)

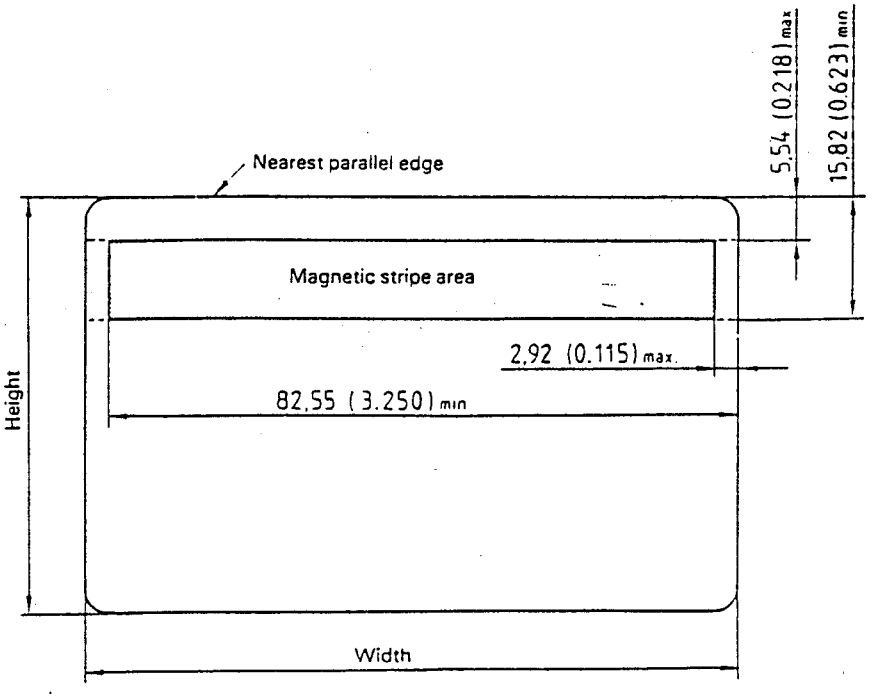
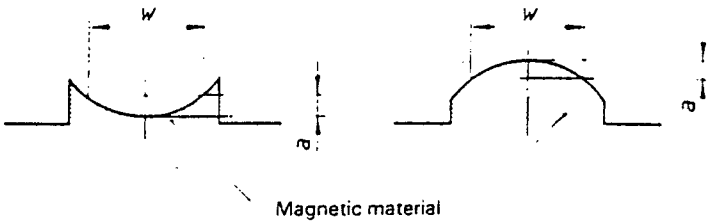


Figure 2 — Location of magnetic material for tracks 1, 2 and 3 on ID-1 type card

NOTE — While these dimensions state the maximum and minimum distance from the nearest parallel edge, the magnetic material areas are not precluded from covering a greater area than indicated.



$$a < 3{,}8 \left(\frac{w}{2.54}\right) \mu m \left[150 \left(\frac{w}{0.1}\right) \mu in\right]$$

where

w = minimum stripe width
= 6,35 mm (0.25 in) for tracks 1 and 2
= 10,28 mm (0.405 in) for tracks 1, 2 and 3

Figure 3 — Surface profile

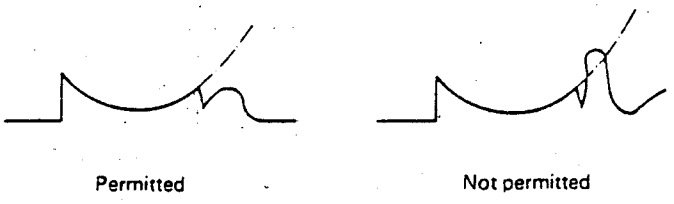


Figure 4 — Projected stripe surface

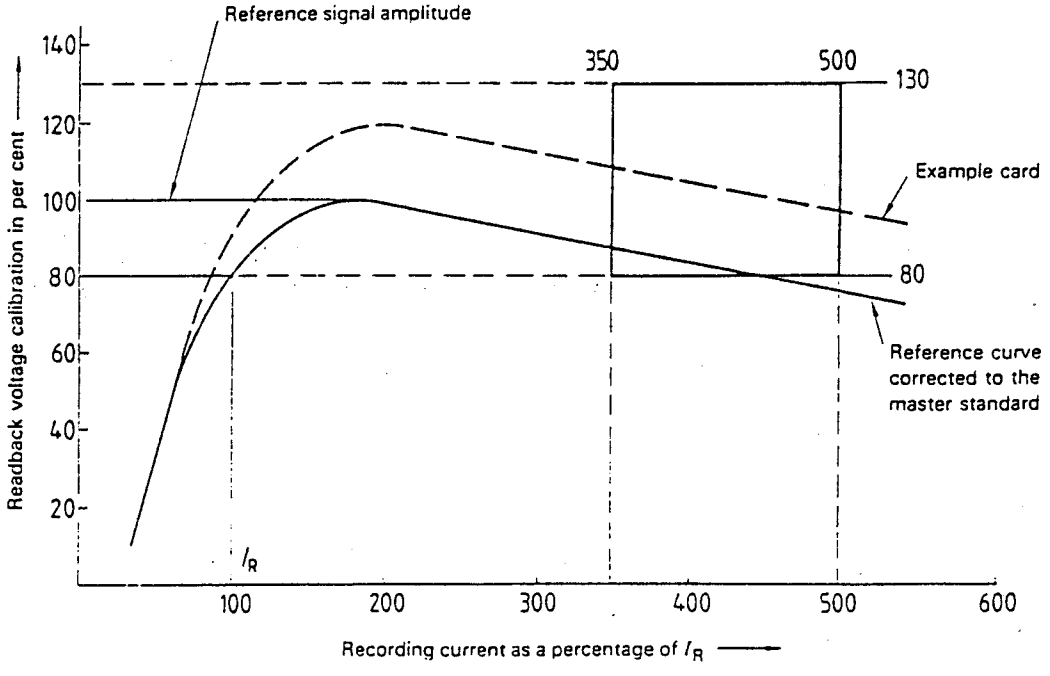


Figure 5 — Saturation curve of reference card and tolerance area at 8 ftpmm (200 ftpi)

NOTE — The corrected reference curve depicted above may not meet the specifications defined in 6.2. The curve defines the master standard response (on a card). The window parameters are defined to produce a card that will be functional in the machine readable environment.

6.2.2 Erasure

The magnetic material shall be capable of being erased by a DC write current equal to 350 % of I_R to a level of 3 % or less of the reference signal amplitude.

6.3 Testing and operating environment

The testing environment for signal amplitude measurements is 23 ± 3 °C (73 ± 5°F) and 40 % to 60 % relative humidity.

When tested under otherwise identical conditions, the signal amplitude from the magnetic stripe shall not deviate from its value in the above test environment by more than 15 % after 5 min of card exposure over the following operating environment range:

temperature: −35 to 50°C (−30 to 122 °F)

relative humidity: 5 % to 95 % with a maximum wet bulb temperature of 25 °C (77 °F)

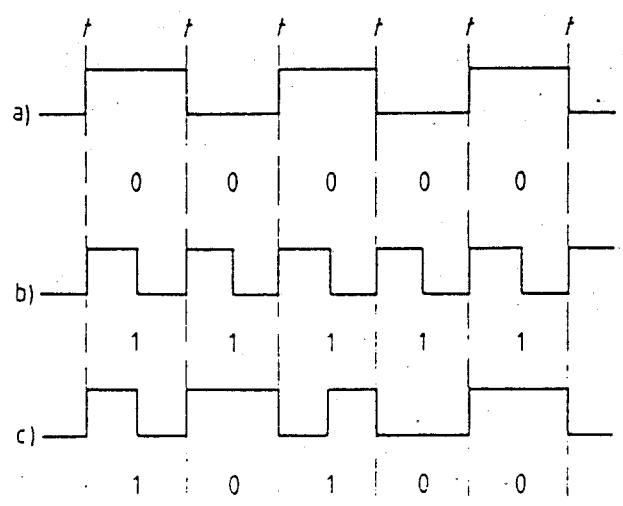
6.4 Testing specifications

The read head used shall have a gap of 0,025 mm (0.001 in) or less.

When making the above measurements, the signal amplitude shall be measured after the encoding has stabilized. The stabilization criteria will be met if all measurements are taken under the same experimental conditions (i.e. taken after the same number of passages before magnetic head gap).

7 Encoding technique

The encoding technique is known as two-frequency coherent phase recording. This method allows for serial recording of self-clocking data (on each track) (see figure 6).



t, indicates self-clocking (timing) intervals

Figure 6 — Example of two-frequency coherent phase encoding

The data comprise data and clocking bits together. A flux transition occurring between clocks signifies a "one" the absence of a flux transition signifies a "zero".

The data shall be recorded as a synchronous sequence of characters without intervening gaps.

Recording shall be in a saturation mode with magnetization parallel to a line in the plane of the track. The direction is determined by the recording angle.

8 Encoding specification, general

8.1 Angle of recording

The angle of recording shall be normal to the nearest edge of the card parallel to the magnetic stripe with the following tolerances:

Read-only track with 8,3 bpmm (210 bpi) (Track 1) ± 20'

Read-only track with 3 bpmm (75 bpi) (Track 2) ± 20'

Read-write track with 8,3 bpmm (210 bpi) (Track 3) ± 20'

The angle of recording (α) is determined by measuring the angle of the head gap when the reading amplitude is maximum (see figure 7).

8.2 Bit configuration

In the bit configuration for each character on the magnetic area, the least significant bit (b_1) shall be encoded first and the parity bit last.

8.3 Direction of recording

The encoding shall begin from the right-hand side viewed from the side with the magnetic stripe and with the stripe at the top

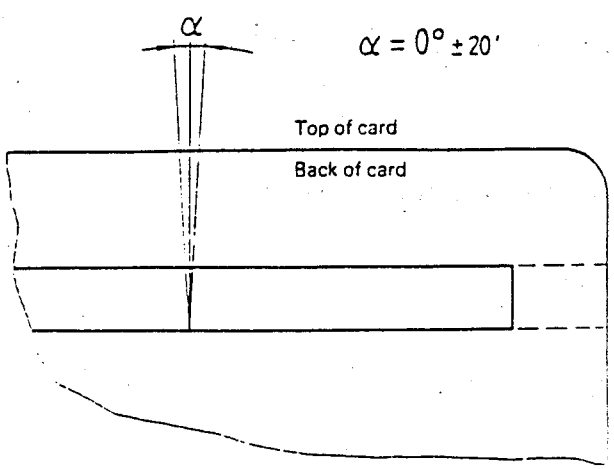


Figure 7 — Angle of recording

8.4 Clocking bits

The lead-in up to the first data bit shall be recorded with clocking bits (zeros) and the space from the last data bit to the end of the recording shall also be recorded with clocking bits (see the note).

NOTE — It is recognized that zeros prior to 2,9 mm (0.114 in) or after 82,55 mm (3.250 in) from the right edge of the card when viewed from the back may not meet the specifications given herein; however, only zeros should be encoded in this area.

9 Encoding specification for read-only tracks

In addition to the relevant part of clause 8 the following specifications apply for read-only tracks.

9.1 Alphanumeric track, Track 1

9.1.1 Bit density

The nominal bit density of the recorded signal shall be 8,3 bits per millimetre (210 bits per inch) ± 5 % when measured along the line parallel to the longitudinal centreline of the track. The spacing between adjacent flux transitions shall be 0,121 ± 0,006 mm (4 762 ± 238 µin) ± 5 % for a "zero" and 0,06 ± 0,004 mm (2 381 ± 167 µin) ± 7 % for a "one". For a sequence of recorded "ones" the density corresponds to a nominal 16,5 ftpmm (420 ftpi).

9.1.2 Coded character set

The following character codes, which are alphanumeric and have 6 bit character sets with odd parity, shall be used:

Table 1 — Coded character set for track 1

				b_6	0	0	1	1
				b_5	0	1	0	1
b_4	b_3	b_2	b_1	Column / Row	0	1	2	3
0	0	0	0	0	SP	0	(a)	P
0	0	0	1	1	(a)	1	A	Q
0	0	1	0	2	(a)	2	B	R
0	0	1	1	3	(c)	3	C	S
0	1	0	0	4	$	4	D	T
0	1	0	1	5	% (d)	5	E	U
0	1	1	0	6	(a)	6	F	V
0	1	1	1	7	(a)	7	G	W
1	0	0	0	8	(	8	H	X
1	0	0	1	9	)	9	I	Y
1	0	1	0	10	(a)	(a)	J	Z
1	0	1	1	11	(a)	(a)	K	(b)
1	1	0	0	12	(a)	(a)	L	(b)
1	1	0	1	13	—	(a)	M	(b)
1	1	1	0	14	.	(a)	N	(d)
1	1	1	1	15	/	? (d)	O	(a)

(a) These character positions are available for hardware control purposes only and cannot contain information characters.

(b) These character positions are reserved for additional national characters when required. They are not to be used internationally.

(c) This character position is reserved for optional additional graphic symbols.

(d) These characters shall have the following meanings for this application:

Position 0/5 % represents "start sentinel".

1/15 ? represents "end sentinel".

3/14 ^ represents "separator".

9.1.3 Maximum number of characters for ID-1 type card

The data characters, the control characters and the longitudinal redundancy check character shall together not exceed 79 characters, including start and end sentinels.

9.2 [redacted]eric track, Track 2

9.2.1 Bit density

The nominal bit density of the recorded signal shall be 3 bits per millimetre (75 bits per inch) ± 3 % when measured along the line parallel to the longitudinal centreline of the track. The spacing between adjacent flux transitions shall be 0,339 ± 0,010 mm (13 333 ± 400 µin) i.e. ± 3 % for a "zero" and 0,169 ± 0,007 mm (6 667 ± 267 µin) i.e. ± 4 % for a "one". For a sequence of recorded "ones" the density corresponds to a nominal 6,0 ftpmm (150 ftpi).

9.2.2 Coded character set

The character code, which is numeric only, shall be a BCD 4 bit code with odd parity (P) as shown in table 2.

Table 2 — Coded character set for track 2 and 3

Bits					Row	Character
P	b_4	b_3	b_2	b_1		
1	0	0	0	0	0	0
0	0	0	0	1	1	1
0	0	0	1	0	2	2
1	0	0	1	1	3	3
0	0	1	0	0	4	4
1	0	1	0	1	5	5
1	0	1	1	0	6	6
0	0	1	1	1	7	7
0	1	0	0	0	8	8
1	1	0	0	1	9	9
1	1	0	1	0	10	(a)
0	1	0	1	1	11	(b^1)
1	1	1	0	0	12	(a)
0	1	1	0	1	13	(b^2)
0	1	1	1	0	14	(a)
1	1	1	1	1	15	(b^3)

(a) These character positions are available for hardware control purposes only and cannot contain information characters (data content).

(b^1) Start sentinel (start character)

(b^2) Separator

(b^3) End sentinel (stop character)

9.2.3 Maximum number of characters for ID-1 type card

The data characters, the control characters and the longitudinal redundancy check character shall together not exceed 40 characters, including start and end sentinels.

10 Encoding specifications for read-write track, track 3

In addition to the relevant parts of clause 8, the following specifications apply to read-write track, track 3.

10.1 Bit density

The nominal bit density of the recorded signal shall be 8,3 bits per millimetre (210 bits per inch) ± 8 % when measured along the line parallel to the longitudinal centreline of the track. The spacing between adjacent flux transitions shall be 0,121 ± 0,010 mm (4 762 ± 381 µin) i.e. ± 8 % for a "zero" and 0,060 ± 0,006 mm (2 381 ± 238 µin) i.e. ± 10 % for a "one". For a sequence of recorded "ones" the density corresponds to a nominal 16,5 ftpmm (420 ftpi).

10.2 Coded character set

The numeric coded character set in 9.2.2 shall be used.

10.3 Maximum number of characters for ID-1-type card

10.3.1 ID-1-type card

The data characters, the control characters and the longitudinal redundancy check character shall together not exceed 107 characters, including start and end sentinels.

11 Error detection

Two techniques of error detection, as described below, shall be encoded. In both techniques, the clocking bits recorded are used for synchronization and shall not be regarded as data characters.

11.1 Parity

A parity bit for each encoded character shall be used. The value of the parity bit is defined such that the total quantity of one bits recorded, for a character, including the parity bit, shall be odd.

11.2 Longitudinal redundancy check (LRC)

A longitudinal redundancy check (LRC) character shall appear for each data message. The LRC character shall be encoded so that it immediately follows the end sentinel when the card is read in a direction giving the start sentinel first, followed by data and the end sentinel. The bit configuration of the LRC character shall be identical to the bit configuration of the data characters.

The LRC character shall be calculated using the following procedure:

The value of each bit in the LRC character, excluding the parity bit, is defined such that the total count of one bits encoded in the corresponding bit location of all characters of the data message, including the start sentinel, data, end sentinel, and LRC characters, shall be even.

The LRC characters parity bit is not a parity bit for the individual parity bits of the data message, but is only the parity bit for the LRC character encoded as described in 11.1.