INTERNATIONAL STANDARD

ISO/IEC 7811-2

Second edition
1995-08-15

Identification cards — Recording technique —

Part 2: Magnetic stripe

Cartes d'identification — Technique d'enregistrement —
Partie 2: Raie magnétique

Reference number
ISO/IEC 7811-2:1995(E)

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

International Standard ISO/IEC 7811-2 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 7811-2:1985), of which it constitutes a technical revision.

ISO/IEC 7811 consists of the following parts, under the general title *Identification cards — Recording technique*:

— *Part 1: Embossing*

— *Part 2: Magnetic stripe*

— *Part 3: Location of embossed characters on ID-1 cards*

— *Part 4: Location of read-only magnetic tracks — Tracks 1 and 2*

— *Part 5: Location of read-write magnetic tracks — Track 2*

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Introduction

ISO/IEC 7811 is one of a series of standards describing the parameters for identification cards as defined in clause 4 and the use of such cards for international interchange.

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Identification cards — Recording technique —

Part 2:
Magnetic stripe

1 Scope

This part of ISO/IEC 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.

ISO/IEC 10373 specifies the test procedures used to check cards against the parameters specified in this part of ISO/IEC 7811.

This part of ISO/IEC 7811 specifies the requirements for cards used for identification. It takes into consideration both human and machine aspects and states minimum requirements.

NOTE — Numeric values in the SI and/or Imperial measurement system in this part of ISO/IEC 7811 may have been rounded off and therefore are consistent with, but not exactly equal to, each other. Either system may be used, but the two should not be intermixed or reconverted. The original design was made using the Imperial measurement system.

2 Conformance

An identification card is in conformance with this part of ISO/IEC 7811 if it meets all mandatory requirements specified herein.

A prerequisite for conformance with this part of ISO/IEC 7811 is conformance with ISO/IEC 7810.

3 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 7811. At the time of publication the editions indicated were valid. All standards are subject to revision and parties to agreements based on this part of ISO/IEC 7811 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 7810:1995, *Identification cards — Physical characteristics.*

ISO/IEC 7811-4:1995, *Identification cards — Recording technique — Part 4: Location of read-only magnetic tracks — Tracks 1 and 2.*

ISO/IEC 7811-5:1995, *Identification cards — Recording technique — Part 5: Location of read-write magnetic track — Track 3.*

ISO/IEC 10373:1993, *Identification cards — Test methods.*

4 Definitions

For the purposes of this part of ISO/IEC 7811, the definition of "identification card" given in ISO/IEC 7810 and the following definition apply.

4.1 primary standard: The primary standard is based on the Master Standard Reference Tape (computer amplitude reference) established by the United States National Institute of Standards and Technology (NIST).

NOTE — The relationship between the Master Standard Reference Tape and secondary reference tapes SRM 3200 is stated on the NIST certificate.

For the purposes of this part of ISO/IEC 7811, reference cards RM 7811-2 batch C equipped with SRM 3200 No. 18-67B are considered as primary standards defining not only the average signal amplitude at 8 flux transitions per mm (certified by NIST) but also that at 20 flux transitions per mm.

A group of such reference cards is held at the Physikalisch-Technische Bundesanstalt (PTB). They represent this primary standard.

4.2 secondary standard (reference card): Identification card with defined properties and equipped with a SRM 3200 or equivalent tape, the properties of which are known and stated in relation to the primary standard.

It is intended that reference cards be used for the calibration of tertiary standards for use in routine calibration.

NOTE — Reference cards, Part No. RM 7811/2 Batch D, can be ordered from Physikalisch-Technische Bundesanstalt, Lab. 1.41 - Bundesallee 100, D-38116 Braunschweig, Germany, as long as supplies are available (probably from 1995 to 2001).

4.3 unused un-encoded card: Card possessing all components required for its intended purpose, which has not been subjected to any personalization or testing operation. The card has been stored in a clean environment without more than 48 hour exposure to day-light at temperatures between 5 °C to 30 °C (41 °F to 86 °F) and humidity between 10 % to 90 % without experiencing thermal shock.

4.4 unused encoded card: Unused, unencoded card according to 4.3 which has only been encoded with all the data required for its intended purpose (e.g. magnetic encoding, embossing, electronic encoding).

The environmental conditions in which the unused encoded card experiences are to be the same as for the unused un-encoded card.

4.5 returned card: Embossed and/or encoded card after it has been issued to the card holder and returned for the purpose of testing.

4.6 flux transition: Location of the maximum magnetic flux component normal to the surface of the magnetic stripe.

4.7 reference current (I_R): Minimum recorded current amplitude which causes on the reference card, under the given test conditions, a readback voltage amplitude equal to 80 % of the reference signal amplitude U_R, (see figure 5) at a density of 8 flux transitions per mm (200 flux transitions per in).

4.8 test recording currents: Two test recording currents at 350 % (I_{min}) and 500 % (I_{max}) of the reference current (I_R) shall be used. $I_{min} = 3{,}5\ I_R$; $I_{max} = 5{,}0\ I_R$.

4.9 individual signal amplitude (U_i): Base-to-peak amplitude of a single readback voltage signal.

4.10 average signal amplitude (U_A): Average signal amplitude (U_A) is the sum of the absolute value of the amplitude of each signal peak (U_i) divided by the number of signal peaks (n).

$$U_A = \frac{\sum_{k=1}^{n} |U_{ik}|}{n}$$

4.11 reference signal amplitude (U_R): Maximum average signal amplitude of the reference card corrected to the primary standard.

4.12 physical recording density: Number of flux transitions recorded on a track per unit length.

NOTE — When testing with densities of 6 flux transitions per mm (150 flux transitions per in) and 16,6 flux transitions per mm (420 flux transitions per in) the correlation factors are:

$$\frac{U_A \text{ at 6 flux transitions per mm (150 flux transitions per in)}}{U_A \text{ at 8 flux transitions per mm (200 flux transitions per in)}} \bullet 100 = 100\ \%$$

$$\frac{U_A \text{ at 16,6 flux transitions per mm (420 flux transitions per in)}}{U_A \text{ at 20 flux transitions per mm (500 flux transitions per in)}} \bullet 100 = 105\ \%$$

4.13 bit density: Number of data bits stored per unit of length (bits per mm or bits per in).

4.14 bit cell: Distance between two clocking flux transitions.

4.15 sub interval: Bit cell divided by two.

5 Physical characteristics of the identification card

The identification card shall conform to the specifications given in ISO/IEC 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. Exposure of the card to an intense magnetic field is likely to destroy the recorded data. It should also be noted that any printing or screening placed on top of the magnetic stripe must not impair the function of the magnetic stripe.

6 Physical characteristics of the magnetic stripe

6.1 Height and surface profile of magnetic stripe

6.1.1 Surface profile of magnetic stripe

The transverse surface profile of the magnetic stripe area shall not show a vertical deviation (a) of more than:

a ≤ 9,5 µm (375 µin) for the minimum stripe width W = 6,35 mm (0,25 in)

a ≤ 15,4 µm (607 µin) for the minimum stripe width W = 10,28 mm (0,405 in)

and – 4 a/W < Slope < 4 a/W.

When the bending stiffness of the card is less than 20 mm (0,79 in) the vertical deviation (a) shall be:

a ≤ 6,7 µm (263 µin) for the minimum stripe width W = 6,35 mm (0,25 in)

a ≤ 12 µm (472 µin) for the minimum stripe width W = 10,28 mm (0,405 in)

See figures 1, 2 and 3.

6.1.2 Height of the magnetic stripe area

The vertical deviation (h) of the magnetic stripe area shown in figures 1 and 2 above the adjacent surface of the card shall be:

– 0,005 mm (– 200 µin) ≤ h
≤ 0,038 mm (1 500 µin)

Spiking in the profile caused by the material "squirt out" in hot stamping is not part of the stripe. It shall not extend above the magnetic stripe area height h as defined above.

Dimensions in millimetres (inches)

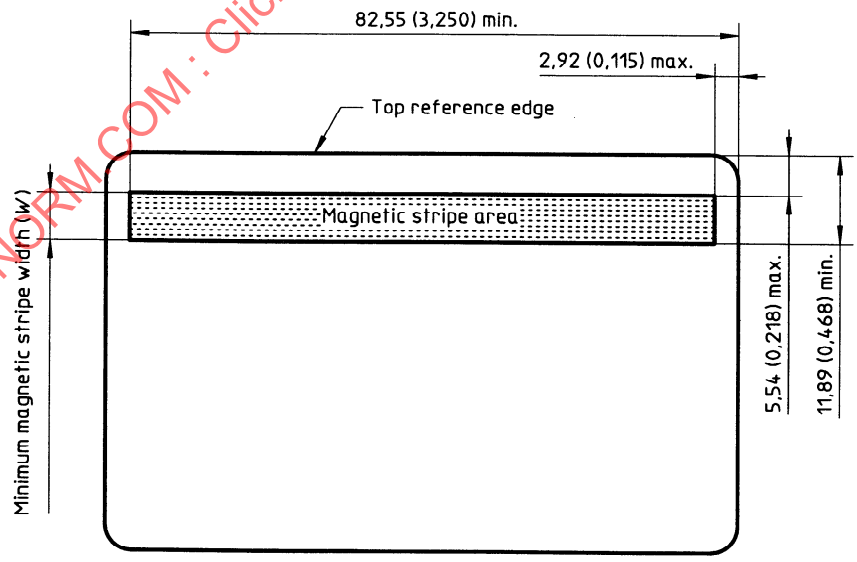


Figure 1 — Location of magnetic material for tracks 1 and 2 only on ID-1 type card

Dimensions in millimetres (inches)

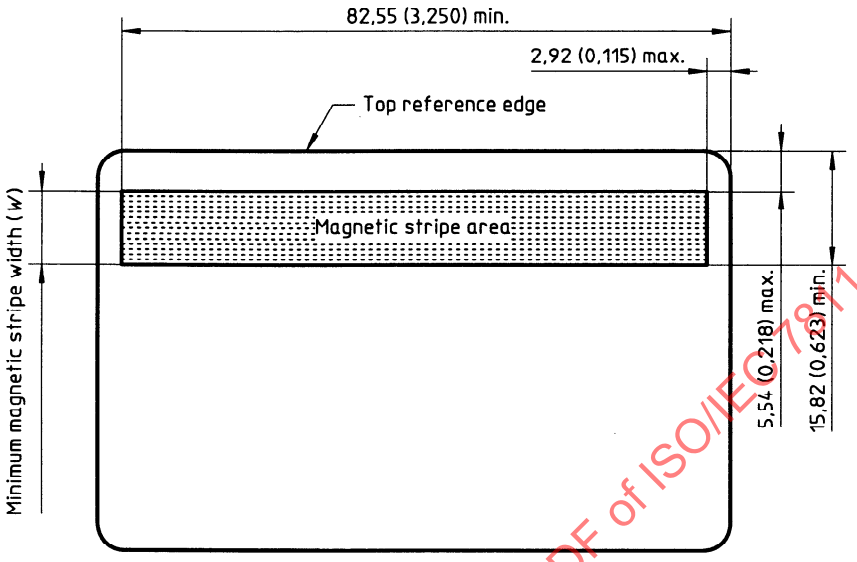


Figure 2 — Location of material for tracks 1, 2 and 3 on ID-1 type card

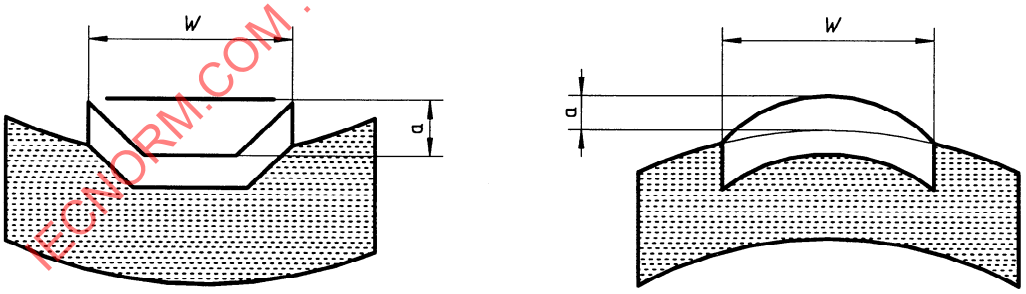
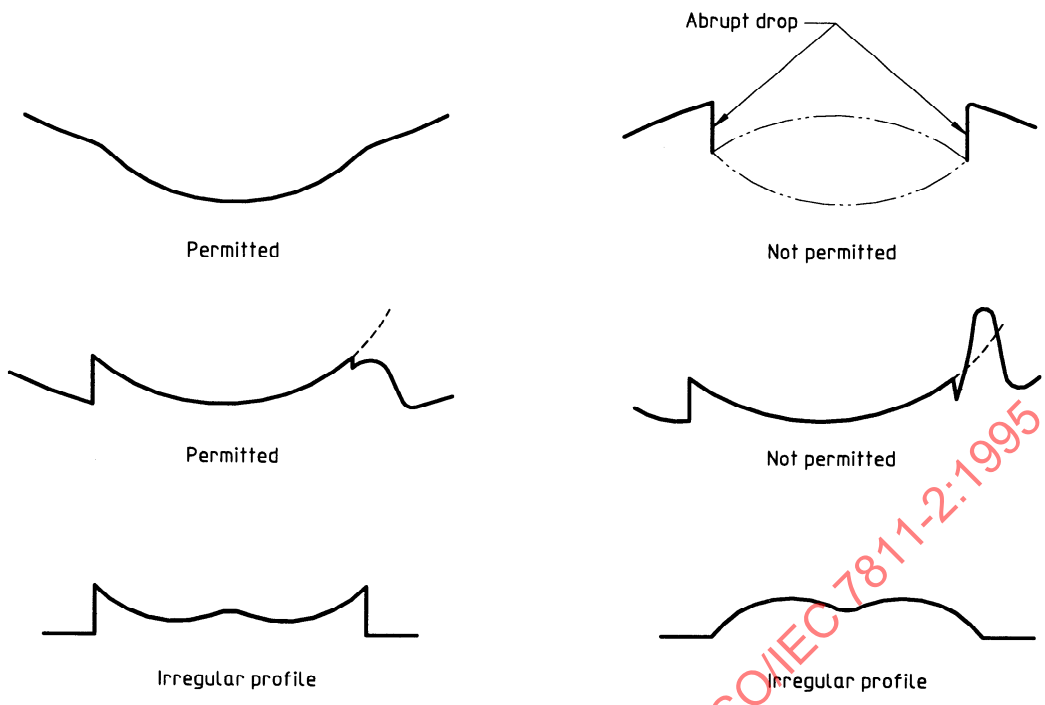


Figure 3 — Surface profile of magnetic stripe



NOTE — Irregular profiles as shown above may result in poor quality encoding.

Figure 4 — Profile examples

6.2 Surface roughness (R_a)

The surface irregularity of the magnetic surface shall not exceed 0,40 µm (15,9 µin) in both the longitudinal and transverse directions.

6.3 Adhesion of stripe to card

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

6.4 Wear from read/write head

Average signal amplitude (U_{A1}) and individual signal amplitude (U_{i1}) are measured before and after 2 000 head wear cycles and shall result in

U_{A3}, after ≥ 0,60 U_{A3}, before
U_{i2}, after ≥ 0,80 U_{A3}, after

6.5 Resistance to chemicals

Average signal amplitude (U_{A3}) and individual signal amplitude (U_{i2}) are measured before and after short term exposure (1 minute), as defined in the test method reference document.

U_{A3}, after ≥ 0,90 U_{A3}, before
U_{i2}, after ≥ 0,90 U_{A3}, after

Average signal amplitude (U_{A3}) and individual signal amplitude (U_{i2}) are measured before and after long term exposure (24 hours) to salt mist, acid and alkaline artificial perspiration, as defined in the test method reference document.

U_{A3}, after ≥ 0,90 U_{A3}, before
U_{i2}, after ≥ 0,90 U_{A3}, after

7 Performance characteristics for the magnetic material

The purpose of this clause is to enable magnetic interchangeability between card and processing systems.

7.1 General

This method uses a reference card whose material is traceable to the primary standard magnetic tape (see 4.1 and 4.2).

NOTE — This part of ISO/IEC 7811 does not specify any value for intrinsic coercivity.

7.2 Testing and operating environment

The testing environment for signal amplitude measurements is 23 °C ± 3 °C (73 °F ± 5 °F) and

40 % to 60 % relative humidity. When tested under otherwise identical conditions, the average signal amplitude measured at 8 flux transitions per mm (200 flux transitions per in) shall not deviate from its value in the above test environment by more than 15 % after 5 minutes exposure over the following operating environment range:

temperature:

– 35 °C to 50 °C (– 30 °F to 122 °F)

relative humidity:

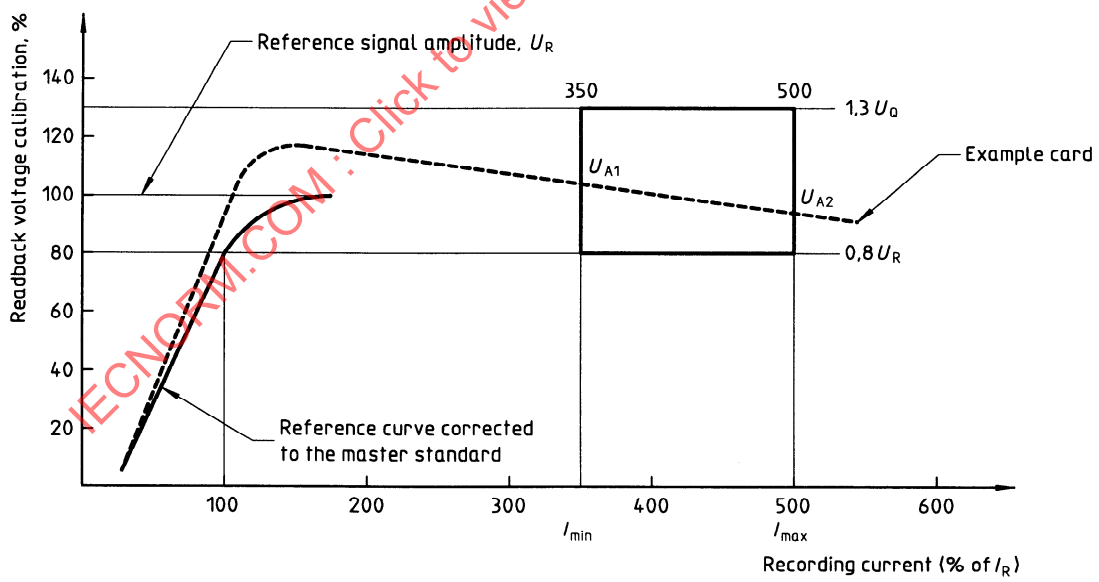
– 5 % to 95 % with a maximum wet bulb temperature of 25 °C (77 °F)

7.2.1 Signal amplitude requirements for magnetic material

The requirements for magnetic characteristics are shown in table 1 and figure 5.

Table 1 — Unused un-encoded cards

Parameter	Densities flux transitions		Test Rec. Current	Signal Amp. Result	Requirement
	per mm	per in			
Signal amp.	8	200	I_{min}	U_{A1}	$0{,}80\ U_R \le U_{A1} < 1{,}30\ U_R$
Signal amp.	8	200	I_{min}	U_{i1}	$U_{i1} \le 1{,}36\ U_R$
Signal amp.	8	200	I_{max}	U_{A2}	$0{,}80\ U_R \le U_{A2} \le U_{A1}$
Signal amp.	20	500	I_{max}	U_{i2}	$0{,}65\ U_R \le U_{i2}$
Resolution	20	500	I_{max}	U_{A3}	$U_{A3} \ge 0{,}7\ U_{A2}$
Erasure	0	0	$I_{min,DC}$	U_{A4}	$U_{A4} \le 0{,}03\ U_R$
Extra pulse	0	0	$I_{min,DC}$	U_{i4}	$U_{i4} \le 0{,}05\ U_R$
NOTE — The slope of the saturation curve shall never be positive between I_{min} and I_{max}.					



NOTE — The corrected reference curve depicted above may not meet the specifications defined in 7.2. 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.

Figure 5 — Saturation curve of reference card and tolerance area at 8 flux transitions per mm (200 flux transitions per in)

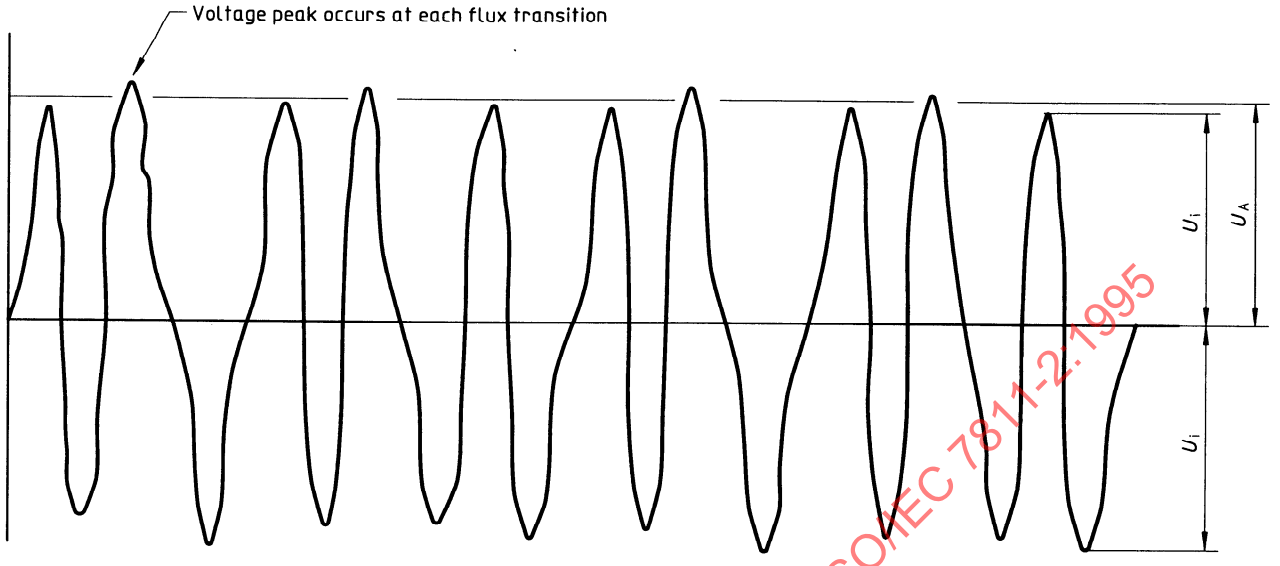
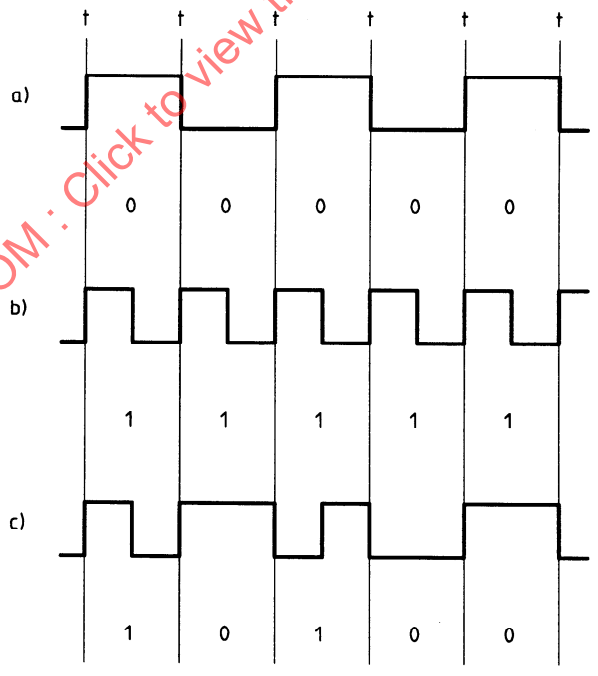


Figure 6 — Example of signal amplitude waveform tracks 1, 2 and 3



t indicates self-clocking (timing) intervals

Figure 7 — Example of two-frequency encoding

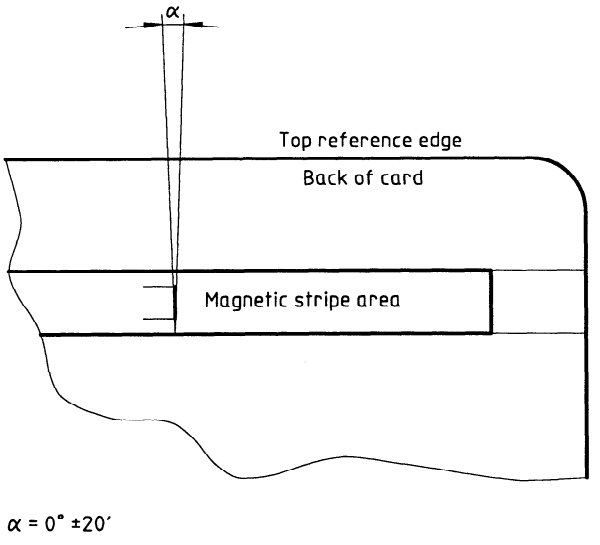


Figure 8 — Angle of recording

8 Encoding technique

The encoding technique is known as two-frequency recording. This method allows for serial recording of self-clocking data (on each track) (see figure 7).

The encoding comprises data and clocking transitions together. A flux transition occurring between clocks signifies that the bit is a "one" the absence of a flux transition between clocking transitions signifies that the bit is 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.

Recording with a write current which is less than I_{min} may result in a poor quality encoding.

9 Encoding specification, general

9.1 Angle of recording

The angle of recording (α) shall be normal to the top reference edge of the card parallel to the magnetic stripe with the tolerance of ± 20 minutes.

The angle of recording is determined by measuring the angle of the head gap when the reading amplitude is maximum (see figure 8).

9.2 Nominal bit density

The nominal bit density shall be:

Track 1: 8,27 bits per mm (210 bits per in)
Track 2: 2,95 bits per mm (75 bits per in)
Track 3: 8,27 bits per mm (210 bits per in)

9.3 Individual signal amplitude requirements for Tracks 1, 2 and 3

The requirements for individual signal amplitude on tracks 1, 2 and 3 for unused encoded cards, regardless of bit density, are as follows:

$$0{,}64\ U_R \leq U_i \leq 1{,}36\ U_R$$

The requirements for individual signal amplitude on tracks 1, 2 and 3 for returned cards, regardless of bit density, are as follows:

$$0{,}52\ U_R \leq U_i \leq 1{,}36\ U_R$$

NOTE — This shows only the limits within which cards will function normally, and does not imply any guarantee of signal amplitude during the authorised period for which the card is issued.

9.4 Bit configuration

In the bit configuration for each character on the magnetic stripe area, the least significant bit b_1 (see table 4 and 7) shall be encoded first and the parity bit last.

9.5 Direction of recording

The encoding shall begin from the right-hand side viewed from the side with the magnetic stripe where the stripe is on the top.

9.6 Clocking bits

The lead-in up to the first data bit shall be recorded with clocking bits (zeroes) and the space after the last bit shall also be recorded with clocking bits.

NOTE — It is recognized that zeroes prior to 3,30 mm (0,130 in) or after 82,17 mm (3,235 in) from the right hand side viewed from the side with the magnetic stripe where the stripe is on the top are not required to meet the specifications given herein.

10 Encoding specifications for read-only tracks

In addition to the relevant part of clause 9 the following specifications apply for read-only tracks.

10.1 Alphanumeric track, Track 1

10.1.1 Bit density

The average bit density (B_a) shall be 8,27 bits per millimetre (210 bits per inch) ± 8 % measured in a longitudinal direction parallel to the top reference edge.

10.1.2 Flux transition spacing variation

Flux transition spacing variations for individual bits (B_{in}) and sub intervals (S_{in}) are shown in table 2 for unused encoded cards and in table 3 for returned cards.

Table 2 - Flux transition lengths for unused encoded cards - Track 1

Description	Requirement	Variation
Average flux transition length B_a	0,11 mm ≤ B_a ≤ 0,13 mm (4 381 µin) (5 143 µin)	± 8 %
Individual flux transition length B_{in}	0,11 mm ≤ B_{in} ≤ 0,13 mm (4 381 µin) (5 143 µin)	± 8 %
Adjacent bit-to-bit variation B_{in+1}	1,08 B_{in} ≥ B_{in+1} ≥ 0,92 B_{in}	± 8 %
Sub interval S_{in}	0,054 mm ≤ S_{in} ≤ 0,066 mm (2 134 µin) (2 619 µin)	± 10 %
Sub interval S_{in+1}	1,10 $B_{in/2}$ ≥ S_{in+1} ≥ 0,90 $B_{in/2}$	± 10 %
NOTE — B_{in+1} and S_{in+1} are the flux transition lengths immediately following and adjacent to B_{in}.		

Table 3 - Flux transition lengths for returned cards - Track 1

Description	Requirement	Variation
Average flux transition length B_a	0,11 mm ≤ B_a ≤ 0,13 mm (4 381 µin) (5 143 µin)	± 8 %
Individual flux transition length B_{in}	0,10 mm ≤ B_{in} ≤ 0,14 mm (4 048 µin) (5 476 µin)	± 15 %
Adjacent bit-to-bit variation B_{in+1}	1,15 B_{in} ≥ B_{in+1} ≥ 0,85 B_{in}	± 15 %
Sub interval S_{in}	0,048 mm ≤ S_{in} ≤ 0,073 mm (1 905 µin) (2 857 µin)	± 20 %
Sub interval S_{in+1}	1,30 $B_{in/2}$ ≥ S_{in+1} ≥ 0,70 $B_{in/2}$	± 30 %
NOTES 1 B_{in+1} and S_{in+1} are the flux transition lengths immediately following and adjacent to B_{in}. 2 Table 3 shows only the limits within which cards will function normally, and does not imply any guarantee of flux transition spacing during the authorised period for which the card is issued.		

10.1.3 Coded character set

Table 4 — 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 characters are available for hardware control purposes only and cannot contain information characters.

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

(c) This character 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"

10.1.4 Maximum number of characters for ID-1 type card

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

10.2 Numeric track, Track 2

10.2.1 Bit density

The average bit density (B_a) shall be 2,95 bits per millimetre (75 bits per inch) ± 5 % measured in a longitudinal direction parallel to the top reference edge.

10.2.2 Flux transition spacing variation

Flux transition spacing variations for individual bits (B_{in}) and subintervals (S_{in}) are shown in table 5 for unused encoded cards and in table 6 for returned cards.

Table 5 — Flux transition length for unused encoded cards — Track 2

Description	Requirement	Variation
Average flux transition length B_a	0,32 mm ≤ B_a ≤ 0,36 mm (12 666 µin) (14 000 µin)	± 5 %
Individual flux transition length B_{in}	0,32 mm ≤ B_{in} ≤ 0,36 mm (12 666 µin) (14 000 µin)	± 5 %
Adjacent bit-to-bit variation B_{in+1}	1,08 B_{in} ≥ B_{in+1} ≥ 0,92 B_{in}	± 8 %
Sub interval S_{in}	0,164 mm ≤ S_{in} ≤ 0,181 mm (6 467 µin) (7 134 µin)	± 7 %
Sub interval S_{in+1}	1,10 $B_{in/2}$ ≥ S_{in+1} ≥ 0,90 $B_{in/2}$	± 10 %
NOTE — B_{in+1} and S_{in+1} are the flux transition lengths immediately following and adjacent to B_{in}.		

Table 6 — Flux transition length for returned cards — Track 2

Description	Requirement	Variation
Average flux transition length B_a	0,32 mm ≤ B_a ≤ 0,36 mm (12 666 µin) (14 000 µin)	± 5 %
Individual flux transition length B_{in}	0,29 mm ≤ B_{in} ≤ 0,39 mm (11 333 µin) (15 333 µin)	± 15 %
Adjacent bit-to-bit variation B_{in+1}	1,15 B_{in} ≥ B_{in+1} ≥ 0,85 B_{in}	± 15 %
Sub interval S_{in}	0,136 mm ≤ S_{in} ≤ 0,203 mm (5 334 µin) (8 000 µin)	± 20 %
Sub interval S_{in+1}	1,30 $B_{in/2}$ ≥ S_{in+1} ≥ 0,70 $B_{in/2}$	± 30 %
NOTES 1 B_{in+1} and S_{in+1} are the flux transition lengths immediately following and adjacent to B_{in}. 2 Table 6 shows only the limits within which cards will function normally, and does not imply any guarantee of flux transition spacing during the authorised period for which the card is issued.		

10.2.3 Coded character set

Table 7 — 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 characters 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)

10.2.4 Maximum number of characters for ID-1 type card

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

11 Encoding specifications for read-write track, Track 3

In addition to the relevant parts of clause 9, the following specifications apply to read-write track, Track 3.

11.1 Bit density

The average bit density shall be 8,27 bits per millimetre (210 bits per inch) ± 8 % measured in a longitudinal direction parallel to the top reference edge.

11.2 Flux transition spacing variation

Flux transition spacing variations for track 3 are as shown for track 1 in table 2 for unused encoded cards and in table 3 for returned cards.

11.3 Coded character set

The numeric coded character set in 10.2.3 shall be used.