International Standard 5654/2

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Information processing — Data interchange on 200 mm (8 in) flexible disk cartridges using two-frequency recording at 13 262 ftprad, 1,9 tpmm (48 tpi), on one side — Part 2 : Track format

Traitement de l'information — Échange de données sur cartouches à disquette de 200 mm (8 in) *utilisant un enregistrement à deux fréquences à* 13 262 ftprad, 1,9 tpmm (48 tpi), *sur une face — Partie 2 : Schéma de piste*

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This standard has been adopted for Federal Government use.

Details concerning its use within the Federal Government are contained in Federal Information Processing Standards Publication 114, 200 mm (8 in) Flexible Disk Cartridge Track Format Using Two-Frequency Recording at 6631 bprad on One Side — 1.9 tpmm (48 tpi) for Information Interchange. For a complete list of the publications available in the Federal Information Processing Standards Series, write to the Standards Processing Coordinator (ADP), Institute for Computer Sciences and Technology, National Bureau of Standards, Gaithersburg, MD 20899.

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 5654/2 was prepared by Technical Committee ISO/TC 97, *Information processing systems.*

ISO 5654/2 was first published in 1982. This second edition cancels and replaces the first edition, of which it constitutes a minor revision.

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.

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Information processing — Data interchange on 200 mm (8 in) flexible disk cartridges using two-frequency recording at 13 262 ftprad, 1,9 tpmm (48 tpi), on one side — Part 2 : Track format

0 Introduction

ISO 5654 specifies the characteristics of 200 mm (8 in) flexible disk cartridges recorded at 13 262 ftprad, 1,9 tpmm (48 tpi), on one side using two-frequency recording.

ISO 5654/1 specifies the dimensional, physical and magnetic characteristics of the cartridge, so as to provide physical interchangeability between data processing systems.

Together with the labelling scheme specified in ISO 7665, ISO 5654/1 and ISO 5654/2 provide for full data interchange between data processing systems.

1 Scope and field of application

This part of ISO 5654 specifies the quality of recorded signals, track layout and the track format to be used on the above-mentioned flexible disk cartridge which is intended for data interchange between data processing systems.

NOTE — Numeric values in the SI and/or Imperial measurement system in this part of ISO 5654 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 be neither intermixed nor re-converted.

The original design was made using the Imperial measurement system.

2 References

ISO 646, *Information processing — ISO 7-bit coded character set for information interchange.*

ISO 2022, *Information processing — ISO 7-bit and 8-bit coded character sets — Code extension techniques.*

ISO 4873, *Information processing — ISO 8-bit coded character set for information interchange.*

ISO 5654/1, *Information processing — Data interchange on* 200 mm (8 in) *flexible disk cartridges using two-frequency recording at* 13 262 ftprad, 1,9 tpmm (48 tpi), *on one side — Part 1 : Dimensional, physical and magnetic characteristics.*

ISO 7665, *Information processing — File structure and labelling of flexible disk cartridges for information interchange.*

3 General recording requirements

3.1 Mode of recording

The mode of recording shall be two-frequency where the start of every bit cell is a clock flux transition. A ONE is represented by a data flux transition between two clock flux transitions.

3.2 Track location tolerance of the recorded flexible disk cartridge

The centrelines of the recorded tracks shall be within ± 0,085 mm (0.003 3 in) of the nominal positions, when measured in the testing environment specified in ISO 5654/1. This tolerance corresponds to twice the standard deviation.

3.3 Recording offset angle

At the instant of writing or reading a magnetic transition, the transition may have an angle of 0° ± 18′ with the radius. This tolerance corresponds to twice the standard deviation.

3.4 Density of recording

3.4.1 The nominal density of recording shall be 13 262 ftprad, 1,9 tpmm (48 tpi). The resulting nominal spacing between two clock flux transitions, the nominal bit cell length, is 151 µrad.

3.4.2 The long-term average bit cell length shall be the average bit cell length measured over a sector. It shall be within ± 3 % of the nominal bit cell length.

NOTE — It is recognized that at extremes of supply frequency encountered on computer sites the deviation may be ± 5 % in exceptional circumstances. Successful data interchange may still then be possible provided that formatting of the cartridge and subsequent writing of data are not carried out at the opposite limits of this range.

3.4.3 The short-term average bit cell length, referred to a particular bit cell, shall be the average of the lengths of the preceding eight bit cells. It shall be within ± 8 % of the long term average bit cell length.

3.5 Flux transition spacing (see figure 1)

The instantaneous spacing between flux transitions may be influenced by the reading and writing process, the bit sequence recorded (pulse crowding effects), and other factors. The locations of the transitions are defined as the locations of the peaks in the signal when reading. Tests should be carried out using a peak-sensing read amplifier (see annex B).

3.5.1 The spacing between two clock flux transitions surrounding a data flux transition or between two data flux transitions surrounding a clock flux transition shall be between 90 % and 140 % of the nominal bit cell length.

3.5.2 The spacing between two clock flux transitions not surrounding a data flux transition or between two data flux transitions surrounding a missing clock flux transition shall be between 60 % and 110 % of the nominal bit cell length.

3.5.3 The spacing between a data flux transition and the preceding clock flux transition (when not missing) or between a clock flux transition and the preceding data flux transition (when not missing) shall be between 45 % and 70 % of the nominal bit cell length.

3.6 Average signal amplitude

The average signal amplitude on any non-defective track of the interchanged flexible disk cartridge shall be less than 160 % of the standard reference amplitude for track 00 and more than 40 % of the standard reference amplitude for track 76.

4 General format requirements

4.1 Byte

A byte is a group of eight bit-positions, identified B1 to B8, with B8 most significant and recorded first.

The bit in each position is a ZERO or a ONE.

4.2 Sector

All tracks are divided into 26 sectors.

4.3 Data capacity of a track

The data capacity of a track shall be 3 328 bytes.

4.4 Hexadecimal notation

Hexadecimal notation shall be used hereafter to denote the following bytes :

(00) for (B8 to B1) = 00000000

(FF) for (B8 to B1) = 11111111

(FC)* for (B8 to B1) = 11111100

where the clock transitions of B6 and B4 are missing

(FE)* for (B8 to B1) = 11111110

where the clock transitions of B6, B5 and B4 are missing

(FB)* for (B8 to B1) = 11111011

where the clock transitions of B6, B5 and B4 are missing

(F8)* for (B8 to B1) = 11111000

where the clock transitions of B6, B5 and B4 are missing.

4.5 Error detection characters (EDC)

The two EDC-bytes are hardware-generated by shifting serially the relevant bits, specified later for each part of the track, through a 16-bit shift register described by the generator polynomial

$$X^{16} + X^{12} + X^5 + 1$$

(See also annex A.)

4.6 Representation of characters

Characters shall be represented by means of the 7-bit coded character set (see ISO 646) and, where required, by its 7-bit or 8-bit extensions (see ISO 2022) or by means of the 8-bit coded character set (see ISO 4873).

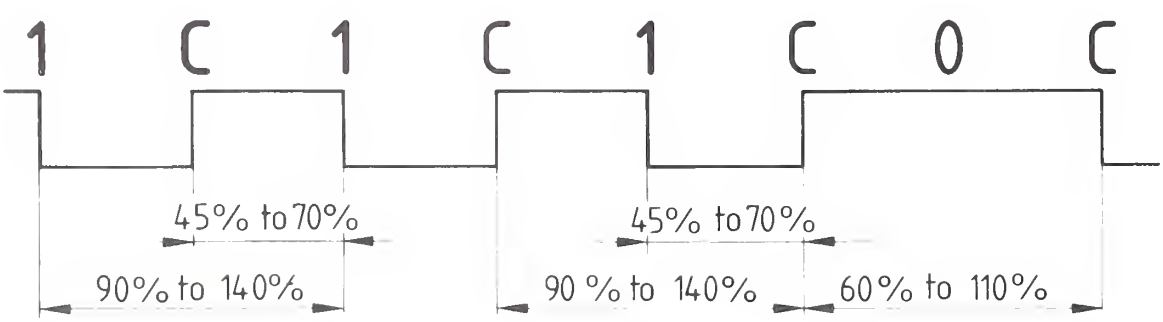


Figure 1

Each 7-bit coded character shall be recorded in bit-positions B7 to B1 of a byte; bit-position B8 shall be recorded with bit ZERO.

The relationship shall be as shown in figure 2

Bits of the 7-bit combination	0	b7	b6	b5	b4	b3	b2	b1
Bit-positions in the byte	B8	B7	B6	B5	B4	B3	B2	B1

Figure 2

Each 8-bit coded character shall be recorded in bit-positions B8 to B1 of a byte.

The relationship shall be as shown in figure 3

Bits of the 8-bit combination	b8	b7	b6	b5	b4	b3	b2	b1
Bit-positions in the byte	B8	B7	B6	B5	B4	B3	B2	B1

Figure 3

4.7 Track assignment

Track 00 shall be used for labels only. Of the remaining 76 tracks, only 74 may be used for the recording of data, leaving the possibility of one or two defective tracks.

5 Track layout after the first formatting

After the first formatting, the track layout shall be as shown in figure 4

5.1 Index gap

At nominal speed this field shall comprise 73 bytes as follows :

40 (FF)-bytes

6 (00)-bytes

1 (FC)*-byte

26 (FF)-bytes

Writing the index gap is started when the index hole is detected. Any of the first 20 bytes may be ill-defined due to subsequent overwriting.

5.2 Sector identifier

This field shall be as given in table 1.

Table 1

Identifier mark		Address identifier				
		T	2nd byte	S	4th byte	EDC
6 bytes (00)	1 byte (FE)*	1 byte	1 byte (00)	1 byte	1 byte (00)	2 bytes

5.2.1 Identifier mark

This field shall comprise 7 bytes

6 (00)-bytes

1 (FE)*-byte

5.2.2 Address identifier

This field shall comprise 6 bytes.

5.2.2.1 Track address (T)

The track address is the first byte of the address identifier. It shall represent in binary notation the track address from 00 for the outermost track to 74 for the innermost track.

5.2.2.2 Second byte of the address identifier

The second byte shall always be a (00)-byte.

5.2.2.3 Sector number (S)

The third byte shall represent in binary notation the sector number from 01 for the first sector to 26 for the last sector.

The 26 sectors shall be recorded in the natural order

1, 2, 3, ..., 25, 26.

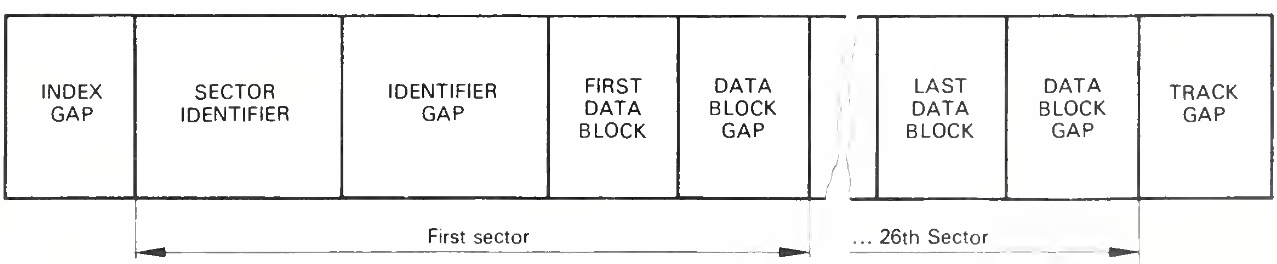


Figure 4

5.2.2.4 Fourth byte of the address identifier

The fourth byte shall always be a (00)-byte.

5.2.2.5 EDC

These two bytes shall be generated as defined in 4.5 using the bytes of the sector identifier starting with the (FE)*-byte (see 5.2.1) of the identifier mark and ending with the fourth byte (see 5.2.2.4) of the address identifier.

5.3 Identifier gap

This field shall comprise 11 initially recorded (FF)-bytes.

5.4 Data block

This field shall be as given in table 2

Table 2

Data mark		Data field	EDC
6 bytes (00)	1 byte (FB)*	128 bytes	2 bytes

5.4.1 Data mark

This field shall comprise

6 (00)-bytes

1 (FB)*-byte

5.4.2 Data field

This field shall comprise 128 bytes. No requirements are implied beyond the correct EDC for the content of this field (see also 6.4.2).

5.4.3 EDC

These two bytes shall be generated as defined in 4.5 using the bytes of the data block starting with the seventh byte of the data mark (see 5.4.1) and ending with the last byte of the data field (see 5.4.2).

5.5 Data block gap

This field shall comprise 27 initially recorded (FF)-bytes. It is recorded after each data block and it precedes the following sector identifier. After the last data block it precedes the track gap.

5.6 Track gap

This field shall follow the data block gap of the 26th sector. (FF) bytes are written until the index hole is detected, unless it has been detected during writing of the last data block gap, in which case there shall be no track gap.

6 Track layout of good tracks on a cartridge for interchange

6.1 Index gap

Description : see 5.1.

6.2 Sector identifier

6.2.1 Identifier mark

Description : see 5.2.1.

6.2.2 Address identifier

Description : see 5.2.2.

6.2.2.1 Track address (T)

The track address is the first byte of the address identifier. It shall represent in binary notation the track address from 00 for the outermost track to 74 for the innermost track.

NOTE — A unique track number is associated with each track. Two of these tracks are intended for use only when there are one or two defective tracks. Each good track possesses a unique track address; a defective track does not possess a track address. Track addresses are assigned consecutively to the good tracks in the ascending sequence of track numbers.

6.2.2.2 Second byte of the address identifier

Description : see 5.2.2.2.

6.2.2.3 Sector number (S)

The third byte shall represent in binary notation the sector number from 01 for the first sector to 26 for the last sector.

NOTES

1 Each column of table 3 is identified by a two digit number from 01 to 13. ISO 7665 specifies a field called Sector Sequence Indicator in character positions 77-78 of the Vol. 1 Label, in which this two-digit number identifying the order in which the sectors are recorded is to be entered.

2 Table 3 lists vertically the sector numbers of the sectors as they appear sequentially on the track. For example, for order 08, the first sector of the track bears sector number 01, the following one bears sector number 09, the third one bears sector number 17, and so on until the twenty-sixth sector which bears sector number 24.

Table 3 — Sequence of the sector numbers on the track

Position of the sectors on the track	Sector sequence indicator												
	01	02	03	04	05	06	07	08	09	10	11	12	13
	Sequence of the sector numbers												
1st	01	01	01	01	01	01	01	01	01	01	01	01	01
2nd	02	03	04	05	06	07	08	09	10	11	12	13	14
3rd	03	05	07	09	11	13	15	17	19	21	23	25	02
4th	04	07	10	13	16	19	22	25	02	02	02	02	15
5th	05	09	13	17	21	25	02	02	11	12	13	14	03
6th	06	11	16	21	26	02	09	10	20	22	24	26	16
7th	07	13	19	25	02	08	16	18	03	03	03	03	04
8th	08	15	22	02	07	14	23	26	12	13	14	15	17
9th	09	17	25	06	12	20	03	03	21	23	25	04	05
10th	10	19	02	10	17	26	10	11	04	04	04	16	18
11th	11	21	05	14	22	03	17	19	13	14	15	05	06
12th	12	23	08	18	03	09	24	04	22	24	26	17	19
13th	13	25	11	22	08	15	04	12	05	05	05	06	07
14th	14	02	14	26	13	21	11	20	14	15	16	18	20
15th	15	04	17	03	18	04	18	05	23	25	06	07	08
16th	16	06	20	07	23	10	25	13	06	06	17	19	21
17th	17	08	23	11	04	16	05	21	15	16	07	08	09
18th	18	10	26	15	09	22	12	06	24	26	18	20	22
19th	19	12	03	19	14	05	19	14	07	07	08	09	10
20th	20	14	06	23	19	11	26	22	16	17	19	21	23
21st	21	16	09	04	24	17	06	07	25	08	09	10	11
22nd	22	18	12	08	05	23	13	15	08	18	20	22	24
23rd	23	20	15	12	10	06	20	23	17	09	10	11	12
24th	24	22	18	16	15	12	07	08	26	19	21	23	25
25th	25	24	21	20	20	18	14	16	09	10	11	12	13
26th	26	26	24	24	25	24	21	24	18	20	22	24	26

NOTE — As after first formatting the sectors are recorded in the natural sequence, the use of the other 12 possible sequences requires reformatting.

6.2.2.4 Fourth byte of the address identifier

Description : see 5.2.2.4.

6.2.2.5 EDC

Description : see 5.2.2.5.

6.3 Identifier gap

This field shall comprise initially 11 (FF)-bytes. These bytes may have become ill-defined due to the overwriting process.

6.4 Data block

6.4.1 Data mark

This field shall comprise

6 (00)-bytes

1 byte

The seventh byte shall be

(FB)* indicating that the data is valid and that the whole data field can be read;

(F8)* indicating that only the first byte of the data field shall be read and interpreted according to ISO 7665.

6.4.2 Data field

This field shall comprise 128 bytes. If it comprises less than 128 data bytes, the remaining positions shall be filled with (00)-bytes.

Data fields in track 00 are reserved for operating system use, including labelling.

6.4.3 EDC

Description : see 5.4.3.

If the seventh byte of the data mark is (F8)* and the first character of the data field is CAPITAL LETTER F, the EDC may or may not be correct, as the sector contains a defective area. If the first character is CAPITAL LETTER D, then the EDC shall be correct.

On track 00 only CAPITAL LETTER D shall be allowed.

6.5 Data block gap

This field is recorded after each data block and it precedes the following sector identifier. After the last data block, it precedes the track gap.

It comprises initially 27 (FF)-bytes (see 5.5). These bytes may have become ill-defined due to the overwriting process.

6.6 Track gap

Description : see 5.6.

7 Track layout of a bad track on a cartridge for interchange

The fields of a bad track should have the following contents :

7.1 Index gap

This field should comprise 73 (FF)-bytes.

7.2 Sector identifier

This field should comprise an identifier mark and an address identifier.

7.2.1 Identifier mark

This field should comprise 7 bytes

6 (00)-bytes

1 (FE)*-byte

7.2.2 Address identifier

This field should comprise 6 bytes

4 (FF)-bytes

2 EDC-bytes

These two EDC bytes shall be generated as defined in 4.5 using the bytes of the sector identifier starting with the (FE)*-byte (see 7.2.1) of the identifier mark and ending with the above 4 (FF)-bytes.

7.3 Identifier gap

This field should comprise 11 (FF)-bytes.

7.4 Data block

7.4.1 Data mark

This field should comprise 7 (FF)-bytes.

7.4.2 Data field

This field should comprise 128 (FF)-bytes.

7.4.3 EDC

This field should comprise 2 (FF)-bytes.

7.5 Data block gap

This field should comprise 27 (FF)-bytes.

7.6 Track gap

Description : see 5.6.

7.7 Requirement for bad tracks

At least one of the sector identifiers of a bad track shall have the contents specified in 7.2. If this condition is not satisfied the cartridge shall be rejected. All other fields of such tracks may be ill-defined.

Annex A

EDC implementation

(This annex does not form part of the standard.)

Figure 5 shows the feedback connections of a shift register which may be used to generate the EDC bytes.

Prior to operation, all positions of the shift register are set to ONE. Input data are added (exclusive OR) to the contents of position C_{15} of the register to form a feedback. This feedback is in its turn added (exclusive OR) to the contents of position C_4 and position C_{11}.

On shifting, the outputs of the exclusive OR gates are entered respectively into positions C_0, C_5 and C_{12}. After the last data bit has been added, the register is shifted once more as specified above.

The register then contains the EDC bytes.

If further shifting is to take place during the writing of the EDC bytes, the control signal inhibits exclusive OR operations.

To check for errors when reading, the data bits are added into the shift register in exactly the same manner as they were during writing. After the data, the EDC bytes are also entered into the shift register as if they were data. After the final shift, the register contents will be all ZERO if the record does not contain errors.

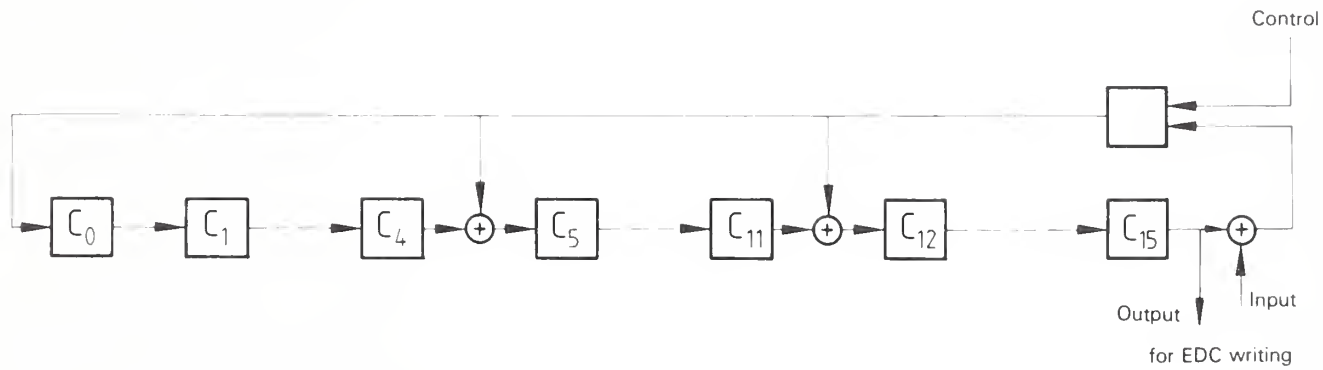


Figure 5

Annex B

Procedure and equipment for measuring flux transition spacing

(This annex does not form part of the standard.)

B.1 General

This annex specifies equipment and a procedure for measuring flux transition spacing on 200 mm (8 in) flexible disk cartridges using two-frequency recording at 13 262 ftprad on one side.

B.2 Format

The disk to be measured shall be written by the disk drive for data interchange use.

Testing shall be done on tracks 00, 43, 44 and 76.

Write current shall be switched as provided in ISO 5654/1.

The test patterns 00100000 (20) and 11101111 (EF) shall be written repeatedly on each test track.

B.3 Test equipment

B.3.1 Disk drive

The disk drive shall have a rotational speed of 360 r/min, with a tolerance of ± 3 r/min, averaged over one revolution. The average angular speed taken over 32 µs shall not deviate by more than 0,5 % from the speed averaged over one revolution.

B.3.2 Head

B.3.2.1 Resolution

The head shall have an absolute resolution of 55 % to 65 % at track 76 using the reference material RM 5654, applying the calibration factor of the reference material, and recording with the appropriate test recording current.

The resonant frequency of the head shall be at least 500 000 Hz.

The resolution shall not be adjusted by varying the load impedance of the head.

The resolution shall be measured at the output of the amplifier defined in B.3.3.1.

B.3.2.2 Offset angle

The head shall have a gap offset angle of 0° ± 6′ with the disk radius on the testing drive.

B.3.2.3 Contact

Care shall be taken that the heads are in good contact with the media during the tests.

B.3.3 Read channel

B.3.3.1 Read amplifier

The read amplifier shall have a flat response from 1 000 to 375 000 Hz within ± 1 dB, and amplitude saturation shall not occur.

B.3.3.2 Peak sensing amplifier

Peak sensing shall be carried out by a differentiating and limiting amplifier.

B.3.4 Time interval measuring equipment

The time interval counter shall be able to measure 2 µs to at least 5 ns resolution.

A triggering oscilloscope may be used for this purpose.

B.4 Procedure for measurement

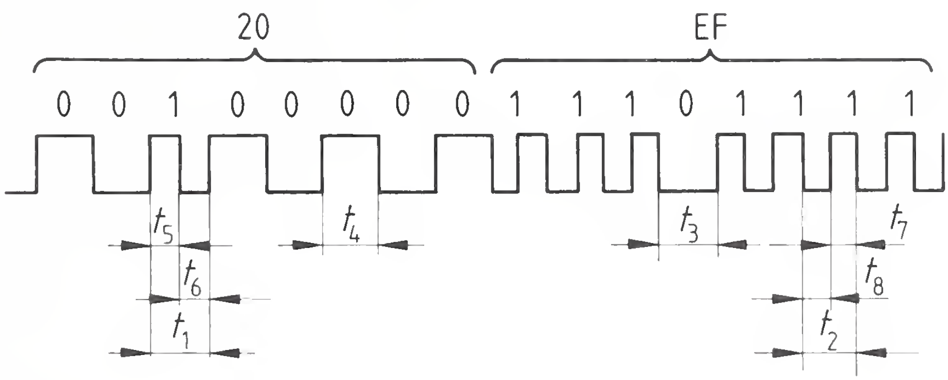
B.4.1 Flux transition spacing measurement

The transition locations shall be measured by the locations of the peaks in the signal when reading.

The flux transition spacing shall be measured by the pulse timing intervals after the read channel amplifier defined in B.3.3.

B.4.2 Flux transition spacing

Measure time intervals t_1 to t_8 as shown in figure 6.



Sub-clause 3.5.1 corresponds to t_1 and t_2

Sub-clause 3.5.2 corresponds to t_3 and t_4

Sub-clause 3.5.3 corresponds to t_5, t_6, t_7 and t_8

Figure 6