International Standard ISO 6902

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

Information processing — Magnetic disk for data storage devices — 107 500 flux transitions per track, 266 mm (10.5 in) and 356 mm (14 in) diameter

Traitement de l'information — Disque magnétique pour unités de stockage des données — 107 500 transitions de flux par piste, diamètres 266 mm (10,5 in) *et* 356 mm (14 in)

First edition — 1984-12-15

UDC 681.327.63 **Ref. No. ISO 6902-1984 (E)**

Descriptors : data processing, information interchange, data storage devices, magnetic disks, specifications, dimensions, tests, physical properties, magnetic properties, surface properties, surface defects.

ISO 6902-1984 (E)

Price based on 14 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 6902 was prepared by Technical Committee ISO/TC 97, *Information processing systems*.

Printed in Switzerland

Contents

This page intentionally left blank

Information processing — Magnetic disk for data storage devices — 107 500 flux transitions per track, 266 mm (10.5 in) and 356 mm (14 in) diameter

1 Scope and field of application

This International Standard specifies the mechanical, physical and magnetic characteristics of a non-lubricated magnetic disk intended for mounting in data storage devices.

This International Standard defines the requirements for a disk to give satisfactory performance at 107 500 flux transitions per track.

When used at other densities, for example 161 250 flux transitions per track, equivalent performance may require changes to the mechanical, magnetic and electrical criteria.

Two types are specified, Type A and Type B, which have the same magnetic characteristics and are related to the same standard reference surface. They differ only with regard to their outer diameter and some related numeric values.

A disk is in conformance with this International Standard when it satisfies all requirements for Type A or all requirements for Type B.

NOTE — The original design of the subject of this International Standard was made using the Imperial measurement system. Some later developments, however, have been made using SI units. In the process of conversion into the alternative system, values may have been rounded. Therefore, the two sets of figures are consistent with, but not exactly equal to, each other. Either set may be used, but the two shall be neither mixed nor reconverted.

2 Reference

ISO 1302, *Technical drawings — Method of indicating surface texture on drawings.*

3 General requirements

3.1 Operation and storage environment

3.1.1 Operation

The operating temperature of the air surrounding the disk shall be within the range of 15 to 57 °C (59 to 135 °F) at a relative humidity of 8 to 80 %. The wet bulb temperature shall not exceed 26 °C (79 °F). The air surrounding the disk shall be of cleanliness class 100, as defined in annex A.

3.1.2 Storage

The storage temperature shall be within the range − 40 to + 65 °C (− 40 to + 150 °F) at a relative humidity of 8 to 80 %. The wet bulb temperature shall not exceed 30 °C (86 °F). Under no circumstances shall condensation on the disk be allowed to occur.

Storage under the extreme conditions of the above range is not recommended. A temperature gradient of more than 10 °C (18 °F) per hour should be avoided.

To prevent corruption of data, the ambient stray magnetic field intensity at the surface of the disk shall not exceed 4 000 A/m. When heads are present, the general ambient field shall be reduced to take account of the concentrating effect of the core of the head.

NOTE — This will usually require the limitation of the allowed ambient field to the range of 300 to 2 000 A/m.

3.2 Test conditions

Unless otherwise stated, measurements shall be carried out at 23 ± 3 °C (73 ± 5 °F), 40 to 60 % relative humidity after a period of acclimatization during which condensation on the disk shall not be allowed to occur. Tests requiring the use of heads shall be performed in air of cleanliness class 100.

3.3 Material

The disk may be constructed from any suitable material so long as the dimensional, inertial and other functional requirements of this International Standard are maintained.

3.4 Coefficient of thermal expansion

The coefficient of thermal expansion of the disk material shall be

$$\frac{\Delta L}{L\,\Delta t} = \frac{1}{L} \times \frac{L_{57} - L_{15}}{42}\ \mathrm{K}^{-1} = (24 \pm 1) \times 10^{-6}\ \mathrm{K}^{-1}$$

$$\left[\frac{\Delta L}{L\,\Delta t} = \frac{1}{L} \times \frac{L_{135} - L_{59}}{76}\ \text{per}\ {}^\circ\mathrm{F} = (13{,}3 \pm 0{,}5) \times 10^{-6}\ \text{per}\ {}^\circ\mathrm{F}\right]$$

The sample length L is equal to

$$\frac{L_{57} + L_{15}}{2} \left(\frac{L_{135} + L_{59}}{2}\right)$$

where L_{57} (L_{135}) and L_{15} (L_{59}) are the lengths at 57 °C (135 °F) and 15 °C (59 °F), respectively.

3.5 Surface identification

The direction of relative motion between head and disk shall be consistent. The disk surface that is to rotate counter-clockwise shall be identified.

4 Dimensions (see figures 1 to 3)

For measurement of the radii indicated hereafter, the disk shall be mounted on a reference hub (see figure 1) having a diameter, measured at 23 ± 0,5 °C (73 ± 1 °F), of

$$d_1 = 168{,}255\ {}^{\ \ 0}_{-0{,}010}\ \mathrm{mm}\ (6.624\,2\ {}^{\ \ 0}_{-0.000\,4}\ \mathrm{in})$$

and an outer radius

$$r_1 = 90{,}5 \pm 0{,}1\ \mathrm{mm}\ (3.563 \pm 0.004\ \mathrm{in})$$

All radii are referred to the axis of symmetry of this reference hub. The coefficient of thermal expansion of the material of the reference hub shall be that specified in 3.4.

4.1 Inner diameter

The inner diameter of the disk, measured at 23 ± 0,5 °C (73 ± 1 °F), shall be

$$d_2 = 168{,}280\ {}^{+0{,}051}_{\ \ 0}\ \mathrm{mm}\ (6.625\,2\ {}^{+0.002\,0}_{\ \ 0}\ \mathrm{in})$$

The circumference of the inner edge shall be contained between two concentric circles 25 µm (1 000 µin) apart.

4.2 Outer diameter

The outer diameter of the disk shall be

For Type A :

$$d_{3A} = 356{,}24 \pm 0{,}13\ \mathrm{mm}\ (14.025 \pm 0.005\ \mathrm{in})$$

For Type B :

$$d_{3B} = 266{,}70 \pm 0{,}13\ \mathrm{mm}\ (10.500 \pm 0.005\ \mathrm{in})$$

The circumference of the outer edge shall be contained between two concentric circles 25 µm (1 000 µin) apart.

4.3 Concentricity

The centre of the circumference of the outer edge of the disk shall be contained in a circle of diameter 50 µm (0.002 0 in) concentric with the centre of the circumference of the inner edge.

4.4 Thickness

The thickness of the disk shall be

$$e = 1{,}905 \pm 0{,}025\ \mathrm{mm}\ (0.075 \pm 0.001\ \mathrm{in})$$

4.5 Edge chamfer (figure 3)

For a distance

$$l \leqslant 1{,}3\ \mathrm{mm}\ (0.05\ \mathrm{in})$$

from the edges of the disk, the disk contour shall be relieved within the extended boundaries of the disk surfaces. In order to avoid unbalance, the chamfer shall be uniform at all points on the circumference.

4.6 Clamping area

On both sides of the disk, the clamping area shall be an area free of magnetic coating, limited by the inner edge and a radius r_2 :

$$r_2 \geqslant 91{,}0\ \mathrm{mm}\ (3.58\ \mathrm{in})$$

Between r_2 and the start of the chamfer, the variation of the disk thickness shall not exceed 7,5 µm (300 µin).

4.7 Location of magnetic surfaces

On both sides of the disk, the area of magnetic surface, over which heads may fly, shall extend from an inside radius r_3 to an outside radius r_4 :

$$r_3 \leqslant 94{,}0\ \mathrm{mm}\ (3.70\ \mathrm{in})$$

For Type A :

$r_{4A} \geqslant$ 176,0 mm (6.93 in)

For Type B :

$r_{4B} \geqslant$ 131,4 mm (5.17 in)

5 Physical characteristics

5.1 Moment of inertia

The moment of inertia of the disk shall not exceed :

For Type A :

8,0 g·m^2 (27.3 lb·in^2)

For Type B :

2,5 g·m^2 (8.53 lb·in^2)

5.2 Maximum rotational frequency

The disk shall be capable of withstanding the effect of stress at a rotational frequency of 4 000 r/min.

5.3 Runout

For measuring the axial runout and the velocity and the acceleration of axial runout, the disk shall be clamped and driven according to 5.3.1.

The requirements of 5.3.2, 5.3.3 and 5.3.4 shall be met at any radius between radii r_3 and r_4.

5.3.1 Test spindle requirements and clamping conditions (figure 1)

The disk shall be clamped on the reference hub by a force

F = 1 500 ± 200 N (340 ± 45 lbf)

evenly applied over an annular surface on the disk defined by

r_5 = 86,5 mm (3.41 in)

r_6 = 90,4 mm (3.56 in)

The finish of the surface of the reference hub on which the disk rests shall be of class N 5 [maximum arithmetical deviation 0,4 µm (16 µin)] as defined in ISO 1302.

At any rotational frequency up to the maximum frequency (see 5.2), the axial runout of the reference hub shall not exceed 1,0 µm (40 µin).

The radial runout of the reference hub, i.e. the total indicator reading, as referenced to the centre of rotation of the reference hub is included in the tolerance of r_1.

5.3.2 Axial runout

The axial runout at any rotational frequency up to the maximum frequency (see 5.2) shall not exceed 0,10 mm (0.004 in), total indicator reading. Moreover, every point of each surface of the disk shall be located between two planes perpendicular to the axis of the reference hub and distant from each other by 0,10 mm (0.004 in).

As this test is intended to measure the flatness of the disk, measures shall be taken to counteract the droop of the disk due to gravity.

5.3.3 Velocity of axial runout

With the disk revolving at 3 600 ± 36 r/min, the velocity of axial runout of the recording disk surfaces shall not exceed 51 mm/s (2.0 in/s). It shall be measured within the band width defined by a low-pass filter with a cutoff frequency of 2,2 kHz and a high frequency roll-off of 18 dB/octave. The probe diameter shall be 1,7 mm (0.067 in).

5.3.4 Acceleration of axial runout

With the disk revolving at 3 600 ± 36 r/min, the acceleration of axial runout shall not exceed 51 m/s^2 (2 000 in/s^2) within the measurement band-width defined by a low-pass filter with a cut-off frequency of 5 kHz and a high frequency roll-off of 18 dB/octave.

5.3.5 Radial runout

The radial runout of the disk depends on the concentricity (see 4.3) and circularity (see 4.1 and 4.2) of the inner and outer edges, as well as on the clamping conditions in the device in which it is mounted. It is therefore not specified by this International Standard.

5.4 Surface roughness

5.4.1 Magnetic surfaces

The finished magnetic surfaces shall have a surface roughness less than 0,035 µm (1.38 µin), arithmetic average, with a maximum deviation in height of 0,38 µm (15 µin) from the average, when measured with a stylus of radius 2,5 µm (100 µin) with a 0,5 mN load, and a 750 µm (0.03 in) upper cut-off range.

The finished magnetic surfaces shall have an undulation profile with a peak-to-peak amplitude of less than 0,15 µm (6.0 µin) when measured over a radial length of 4,8 mm (0.19 in) with a stylus of radius 2,5 µm (100 µin) with a 0,5 mN load, and a lower cut-off range of 250 µm (0.01 in).

5.4.2 Clamping area

The finished surface of the clamping area shall have a surface roughness less than 0,8 µm (30 µin), arithmetic average, with a maximum deviation in height of 2,0 µm (80 µin) from the average, when measured with a stylus of radius 2,5 µm (100 µin) with a 0,5 mN load, and a 750 µm (0.03 in) upper cut-off range.

5.5 Cleaning of the magnetic surfaces

The magnetic surfaces of the disk shall not be adversely affected by a 91 % solution of isopropyl alcohol (made from reagent grade isopropyl alcohol mixed with 9 % distilled or deionized water by volume) when used for cleaning.

5.6 Durability of the magnetic surfaces

The nature of the coating shall be such as to assure wear resistance under operating conditions and maintenance of adhesion and abrasive wear resistance.

5.7 Head/disk gliding requirements

The magnetic surface shall be free of surface defects which would cause head to disk contact when the head is flying at 0,61 µm (24 µin) minimum at radius r_3, and proportionally increasing in flying height to 0,84 µm (33 µin) minimum at radius r_4.

5.8 Discharge path

The disk shall allow flow of electrical charges from the magnetic surface to the clamping surface.

6 Testing of magnetic characteristics

6.1 General conditions

6.1.1 Rotational frequency

The rotational frequency shall be 3 600 ± 36 r/min in any test period.

6.1.2 Ambient stray magnetic field

The intensity of the ambient stray magnetic field shall not exceed 800 A/m.

6.2 Track and recording conditions

6.2.1 Width of tracks

The recorded track width shall be

51 ± 4 µm (2 000 ± 160 µin)

A suggested method of measuring the effective track width is contained in annex B.

6.2.2 Track spacing

For testing purposes, the track centreline spacing shall be

51 ± 2 µm (2 000 ± 80 µin)

6.2.3 Tested area

All functional tests and all track quality tests shall be performed between an innermost track located at a radius r_7 and an outermost track located at a radius r_8 :

r_7 = 101,2 mm (3.98 in)

For Type A :

r_{8A} = 166,4 mm (6.55 in)

For Type B :

r_{8B} = 124,7 mm (4.91 in)

6.2.4 Location of the line of access

The line of access shall be radial.

6.2.5 Recording offset angle

At the instant of writing or reading a magnetic transition, the transition may have an angle of 60′ maximum with the line of access.

6.3 Standard reference surface

6.3.1 Characteristics

The Standard reference surface shall be characterized at the three following test radii :

r_9 = 107,96 mm (4.250 in)

r_{10} = 124,00 mm (4.882 in)

r_{11} = 163,69 mm (6.445 in)

When recorded at $1f$ (see 6.9), using the test head, the track average amplitude (see 6.8) shall be

2,20 mV at radius r_9

2,75 mV at radius r_{10}

3,80 mV at radius r_{11}

When recorded at $2f$ (see 6.9), using the test head, the track average amplitude shall be

1,70 mV at radius r_9

2,15 mV at radius r_{10}

3,00 mV at radius r_{11}

6.3.2 Secondary standard reference surface

This is a surface the output of which shall be related to the standard reference surface via calibration factors C_{D1} (for $1f$), and C_{D2} (for $2f$).

These calibration factors C_D are defined as :

$$C_D = \frac{\text{Standard reference surface output}}{\text{Secondary standard reference surface output}}$$

The measurement for both C_{D1} and C_{D2} shall be made at radii r_9, r_{10} and r_{11}.

To qualify as a secondary standard reference surface, the calibration factors C_D for such disks shall satisfy $0{,}90 \leqslant C_D \leqslant 1{,}10$ at the measured tracks for both frequencies.

NOTE — It is expected that a standard reference surface for signal amplitude will be established by the Physikalisch-Technische Bundesanstalt (PTB), Lab. 5.11, D-3300 Braunschweig, Germany, F.R. Secondary signal amplitude reference surfaces or a calibration service would then also be made available.

6.4 Test head

The test head shall be calibrated to the standard reference surface, and used for amplitude measurements and testing of the magnetic surfaces.

NOTE — Information on suitable test heads may be obtained from the Secretariat of ISO/TC 97, or from the ISO Central Secretariat.

6.4.1 Gap width

The width of the recording gap (measured optically) shall be

50 ± 2,5 µm (1 970 ± 100 µin)

6.4.2 Gap length

The length of the recording gap shall be

2,54 ± 0,51 µm (100 ± 20 µin)

6.4.3 Gap offset angle

The angle between the recording gap in the ferrite core and the relevant mounting surface of the head may be 30′ maximum.

6.4.4 Flying height

When flying over the track at radius r_9, the test head shall have a flying height at the gap of

0,89 ± 0,05 µm (35 ± 2 µin).

6.4.5 Inductance

The total head inductance shall be 23 ± 2,3 µH measured in air at 1 MHz. Each leg shall have an inductance of 6 ± 0,6 µH.

6.4.6 Resonant frequency

As measured at the head cable connector, the resonant frequency of the total read/write coil of the head shall be 10,7 ± 1,3 MHz.

6.4.7 Resolution

The test head shall have a resolution of (76 ± 5) % at radius r_9 and (78 ± 5) % at radius r_{11}. Resolution is defined as

$$\frac{2f \text{ Amplitude}}{1f \text{ Amplitude}} \, 100 \, \%$$

6.4.8 Head loading force

The net head loading force shall be such as to achieve the flying height (see 6.4.4) and shall be

3,4 ± 0,4 N (0.764 ± 0.089 lbf)

6.4.9 Calibration factor

All measurements shall be taken with a suitable test head. To qualify as a test head its calibration factors C_{H1} at $1f$, C_{H2} at $2f$ shall satisfy $0{,}90 \leqslant C_{Hi} \leqslant 1{,}10$.

C_{Hi} is defined by

$$C_{Hi} = \frac{\text{Standard reference surface output}}{\text{Actual head voltage measured}}$$

when measured on a standard reference surface, or by

$$C_{Hi} = \frac{\text{Standard reference surface output}}{\text{(Actual head voltage measured)} \times C_D}$$

when measured on a secondary standard reference surface.

6.4.10 Overwrite capability

The overwrite capability of the head shall meet the following requirement :

6.4.10.1 Procedure

Write with $1f$ at radius r_{11} on a standard reference surface and measure the average amplitude of the $1f$-signal with a frequency-selective voltmeter. Without DC-erase, overwrite once at $2f$, measure the average amplitude of the residual $1f$-signal.

6.4.10.2 Result

The ratio

$$\frac{\text{Average amplitude of measured } 1f\text{-signal after overwrite with } 2f}{\text{Average amplitude of measured } 1f\text{-signal before overwrite with } 2f}$$

shall be 0,004 ± 0,001.

6.5 Conditions for test head measurements

6.5.1 Write current

The $2f$ write current shall conform to figure 4. The current amplitude measured at the head termination connector shall have seven values as shown in table 1.

Table 1

Radii		Write current ($I_{W+} + I_{W-}$)	
mm	in	mA	tolerance, %
166,5 to 157,1	6.55 to 6.19	130	± 1
157,1 to 147,8	6.19 to 5.82	123	± 1
147,8 to 138,5	5.82 to 5.45	115	± 1
138,5 to 129,2	5.45 to 5.09	108	± 1
129,2 to 119,9	5.09 to 4.72	100	± 1
119,9 to 110,5	4.72 to 4.35	93	± 1
110,5 to 101,2	4.35 to 3.98	90	± 1

The differences between the positive and negative amplitudes of the quiescent write current $|I_{W+} - I_{W-}|$ shall be less than 2 mA.

$T_R = 70 \pm 5$ ns

$T_F = 70 \pm 5$ ns

Overshoot :

(3,5 ± 1,5) % of I_W, where $I_W = 0,5\ (I_{W+} + I_{W-})$

Two consecutive half periods T_1, T_2 shall not differ from $\frac{T_1 + T_2}{2}$ by more than 2 %.

6.5.2 DC-erase current

The DC-erase current supplied to one of the two read/write coils when DC-erase is specified shall be as shown in table 2.

Table 2

Radii		Write current	
mm	in	mA	tolerance, %
166,5 to 157,1	6.55 to 6.19	65,0	± 1
157,1 to 147,8	6.19 to 5.82	61,5	± 1
147,8 to 138,5	5.82 to 5.45	57,5	± 1
138,5 to 129,2	5.45 to 5.09	54,0	± 1
129,2 to 119,9	5.09 to 4.72	50,0	± 1
119,9 to 110,5	4.72 to 4.35	46,5	± 1
110,5 to 101,2	4.35 to 3.98	45,0	± 1

6.6 Read channel

6.6.1 Input impedance

The differential input impedance of the read channel shall be 1 200 ± 60 Ω in parallel with 15 ± 3 pF, including the amplifier input impedance and all other distributed and lumped impedance measured at the head termination connector.

6.6.2 Frequency and phase characteristics

The frequency response shall be flat within ± 0,25 dB from 0,10 MHz to 6,45 MHz (0,06f to 4f).

The −3 dB roll-off point shall be at 9,675 MHz (6f).

The attenuation above 9,675 MHz shall not be less than that given by a line drawn through zero dB at 9,675 MHz with a slope of −18 dB/octave.

The phase shift shall be less than ± 5° between 0,10 MHz and 6,45 MHz (0,06f and 4f).

6.6.3 Transfer characteristics

For inputs between 0,3 mV peak-to-peak and 10,0 mV peak-to-peak the transfer characteristic shall be linear within ± 3 %, or 50 µV, whichever is larger.

6.7 Automatic gain controlled amplifier

The AGC-amplifier shall produce an output voltage V_{AGC} constant within ± 1 % for input voltages from $V_{in\ min.}$ = 0,3 mV peak-to-peak to $V_{in\ max.}$ = 10,0 mV peak-to-peak (see figure 5).

The AGC response time, T_R, shall be 3,4 ± 0,34 µs to recover 90 % of the nominal AGC signal output amplitude, V_{out}, when the input signal, V_{in}, is subjected to a 50 % amplitude step reduction.

All frequencies below 10 kHz shall be attenuated at a rate of 6 dB/octave.

6.8 Track average amplitude, V_{TA}

The track average amplitude, V_{TA}, is the average of the peak-to-peak values of the signals over one revolution of the disk, measured at the output of the test head when electrically loaded as described in 6.6.

6.9 Test signals

The recording frequencies specified as 1f and 2f shall be

$1f$ = (3 225 ± 3) 10^3 transitions/s

$2f$ = (6 450 ± 6) 10^3 transitions/s

6.10 DC-erase

Unless otherwise specified, all write operations shall be preceded by a DC-erase operation.

7 Surface tests

7.1 Amplitude test

7.1.1 Procedure

Write on any part of the surface at 2f, read back and measure the V_{TA}.

7.1.2 Result

The upper limit for the track average amplitude of the corrected test head output shall be 2,2 mV peak-to-peak at radius r_7 and shall increase linearly to the following peak-to-peak values at r_8 :

For Type A :

4,0 mV

For Type B :

2,7 mV

The lower limit for the track average amplitude shall be 1,2 mV peak-to-peak at radius r_7 and shall increase linearly to the following peak-to-peak values at r_8 :

For Type A :

2,2 mV

For Type B :

1,6 mV

(See figure 6.)

7.2 Resolution test

7.2.1 Procedure

On any part of the magnetic surface write at $1f$, read back and measure the V_{TA}. Then DC-erase, write at the same position at $2f$, read back and again measure the V_{TA}. The values of the measured V_{TA} shall be corrected by means of the appropriate head calibration factors (see 6.4.9).

7.2.2 Result

In all cases the ratio

$$\frac{\text{Corrected average track amplitude of } 2f\text{-signal}}{\text{Corrected average track amplitude of } 1f\text{-signal}}$$

shall be 0,75 ± 0,15.

7.3 Overwrite test

7.3.1 Procedure

Write at $1f$ at radius r_8 and measure the average amplitude of the $1f$-signal with a frequency-selective voltmeter. Without DC-erase, overwrite once at $2f$, measure the average amplitude of the residual $1f$-signal with the frequency-selective voltmeter.

7.3.2 Result

The ratio

$$\frac{\text{Average amplitude of } 1f\text{-signal after overwrite}}{\text{Average amplitude of } 1f\text{-signal before overwrite}}$$

shall be less than 0,01.

7.4 Residual noise test

7.4.1 Procedure

DC-erase a 5-track band with radius r_7 in its middle. Write at radius r_7 at $2f$, read back and measure the RMS value, V_{RMS}, using a true RMS-voltmeter with a band width of 10 MHz at the −6 dB point.

Then DC-erase at least five times, read back and measure the RMS value, V_{DCRMS}, unload the head and measure the RMS value of the noise due to all other noise sources, V_{NRMS}.

7.4.2 Result

The ratio

$$\frac{\sqrt{V^2_{DCRMS} - V^2_{NRMS}}}{V_{RMS}}$$

shall be less than 0,05.

8 Track quality tests

8.1 Positive modulation test

8.1.1 Procedure

Write on any track at $2f$, read back and measure the V_{TA}. With a delay of t_d = 1,55 ± 0,15 µs after detecting a read pulse exceeding 125 % of 0,5 V_{TA}, count all further such read pulses during a time period t_{pm} = 3,10 ± 0,15 µs (see figure 7).

8.1.2 Result

Positive amplitude modulation occurs if the number of the counted pulses exceeds 16.

8.2 Negative modulation test

8.2.1 Procedure

Write on any track at $2f$, read back and measure the V_{TA}. With a delay of t_d = 1,55 ± 0,15 µs after detecting a read pulse not reaching 75 % of 0,5 V_{TA}, count all further such read pulses during a time period t_{nm} = 60 ± 1 µs (see figure 7).

8.2.2 Result

Negative amplitude modulation occurs if the number of counted pulses exceeds 256.

8.3 Missing pulse test

8.3.1 Procedure

Write on each track at $2f$ and read back using the AGC-amplifier.