
Information technology — 80 mm DVD — Read-only disk

*Technologies de l'information — Disque DVD de diamètre 80 mm — Disque
DVD à lecture seule*



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Foreword

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

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

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

This International Standard was prepared by JISC (as Standard JIS X 6242-1998) with document support and contribution from ECMA and was adopted, under a special “fast-track procedure”, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

Annexes A to H form a normative part of this International Standard. Annexes J to L are for information only.

Information technology — 80 mm DVD — Read-only disk

Section 1 - General

1 Scope

This International Standard specifies the mechanical, physical and optical characteristics of a 80 mm, read-only optical disk to enable the interchange of such disks. It specifies the quality of the recorded signals, the format of the data and the recording method, thereby allowing for information interchange by means of such disks. This disk is identified as DVD - Read-Only Disk.

This International Standard specifies

- four related but different Types of this disk (see clause 7),
- the conditions for conformance,
- the environments in which the disk is to be operated and stored,
- the mechanical and physical characteristics of the disk, so as to provide mechanical interchange between data processing systems,
- the format of the information on the disk, including the physical disposition of the tracks and sectors, the error correcting codes and the coding method used,
- the characteristics of the signals recorded on the disk, enabling data processing systems to read the data from the disk.

This International Standard provides for interchange of disks between disk drives. Together with a standard for volume and file structure, it provides for full data interchange between data processing systems.

2 Conformance

2.1 Optical Disk

A claim of conformance shall specify the Type of the disk. An optical disk shall be in conformance with this International Standard if it meets the mandatory requirements specified for its Type.

2.2 Generating system

A generating system shall be in conformance with this International Standard if the optical disk it generates is in accordance with 2.1.

2.3 Receiving system

A receiving system shall be in conformance with this International Standard if it is able to handle all four Types of optical disk according to 2.1.

3 Normative reference

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

IEC 950 (1991) *Safety of information technology equipment.*

4 Definitions

For the purposes of this International Standard, the following definitions apply.

4.1 adhesive layer: A layer of adhesive material bonding together the two parts of the disk.

4.2 Channel bit: The elements by which, after modulation, the binary values ZERO and ONE are represented on the disk by pits.

- 4.3 Clamping Zone:** The annular part of the disk within which a clamping force is applied by a clamping device.
- 4.4 Digital Sum Value (DSV):** The arithmetic sum obtained from a bit stream by allocating the decimal value 1 to bits set to ONE and the decimal value -1 to bits set to ZERO.
- 4.5 Disk Reference Plane:** A plane defined by the perfectly flat annular surface of an ideal spindle onto which the Clamping Zone of the disk is clamped, and which is normal to the axis of rotation.
- 4.6 Dual Layer disk:** A optical disk with one or two entrance surface(s), in which each entrance surface gives access to a different pair of recorded layers.
- 4.7 dummy substrate:** A layer which may be transparent or not, provided for the mechanical support of the disk and/or of a recorded layer.
- 4.8 entrance surface:** The surface of the disk onto which the optical beam first impinges.
- 4.9 optical disk:** A disk that accepts and retains information in the form of pits in a recorded layer that can be read by an optical beam.
- 4.10 physical sector number:** A serial number allocated to physical sectors on the disk.
- 4.11 read-only disk:** An optical disk in which the information has been recorded when manufacturing the disk. The information cannot be modified and can only be read from the disk.
- 4.12 recorded layer:** A layer of the disk on, or in, which data is recorded.
- 4.13 Reed-Solomon code:** An error detection and/or correction code for the correction of errors.
- 4.14 Reserved field:** A field set to all ZEROs unless otherwise stated, and reserved for future standardization.
- 4.15 sector:** The smallest part of a track in the Information Zone that can be accessed independently of other addressable parts.
- 4.16 Single Layer disk:** An optical disk with one or two entrance surface(s), in which each entrance surface gives access to a different recorded layer.
- 4.17 spacer:** In the case of Dual Layer disks, the transparent layer placed between the two recorded layers accessible through the same entrance surface.
- 4.18 substrate:** A transparent layer of the disk, provided for mechanical support of the recorded layer(s), through which the optical beam can access the recorded layer(s).
- 4.19 track:** A 360° turn of a continuous spiral.
- 4.20 track pitch:** The distance between the centrelines of a pair of adjacent physical tracks, measured in radial direction.
- 4.21 Zone:** An annular area of the disk.

5 Conventions and notations

5.1 Representation of numbers

A measured value is rounded off to the least significant digit of the corresponding specified value. For instance, it implies that a specified value of 1,26 with a positive tolerance of + 0,01 and a negative tolerance of - 0,02 allows a range of measured values from 1,235 to 1,275.

Numbers in decimal notations are represented by the digits 0 to 9.

Numbers in hexadecimal notation are represented by the hexadecimal digits 0 to 9 and A to F in parentheses.

The setting of bits is denoted by ZERO and ONE.

Numbers in binary notations and bit patterns are represented by strings of digits 0 and 1, with the most significant bit shown to the left.

Negative values of numbers in binary notation are given as Two's complement.

In each field the data is recorded so that the most significant byte (MSB), identified as Byte 0, is recorded first and the least significant byte (LSB) last.

In a field of $8n$ bits, bit $b_{(8n-1)}$ shall be the most significant bit (msb) and bit b_0 the least significant bit (lsb). Bit $b_{(8n-1)}$ is recorded first.

5.2 Names

The names of entities, e.g. specific tracks, fields, zones, etc. are given a capital initial.

6 List of acronyms

BCA	Burst-Cutting Area
BP	Byte Position
BPF	Band Pass Filter
CLV	Constant Linear Velocity
CPR_MAI	Copyright Management Information
DCC	DC Component (suppress control)
DL	Dual Layer
DPD	Differential Phase Detection
DSV	Digital Sum Value
ECC	Error Correction Code
EDC	Error Detection Code
EQ	Equalizer
FWHM	Full Width at Half Maximum
HF	High Frequency
ID	Identification Data
IED	ID Error Detection (code)
IR	Index of Refraction
LPF	Low-Pass Filter
LSB	Least Significant Byte
MSB	Most Significant Byte
NRZ	Non Return to Zero
NRZI	Non Return to Zero Inverted
OTP	Opposite Track Path
PBS	Polarizing Beam Splitter
PE	Phase Encoding
PI	Parity (of the) Inner (code)
PLL	Phase-Locked Loop
PO	Parity (of the) Outer (code)
PTP	Parallel Track Path
PUH	Pick-Up Head
RIN	Relative Intensity Noise
RS	Reed-Solomon (code)
RZ	Return to Zero
SL	Single Layer
SYNC Code	Synchronisation Code
lsb	least significant bit
msb	most significant bit

7 General description of the disk

The optical disk that is the subject of this International Standard consists of two substrates bonded together by an adhesive layer, so that the recorded layers are on the inside. The centring of the disk is performed on the edge of the centre hole of the assembled disk on the side currently read. Clamping is performed in the Clamping Zone. This International Standard specifies the following Types.

Type A consists of a substrate, a single recorded layer and a dummy substrate. The recorded layer can be accessed from one side only. The nominal capacity is 1,46 Gbytes.

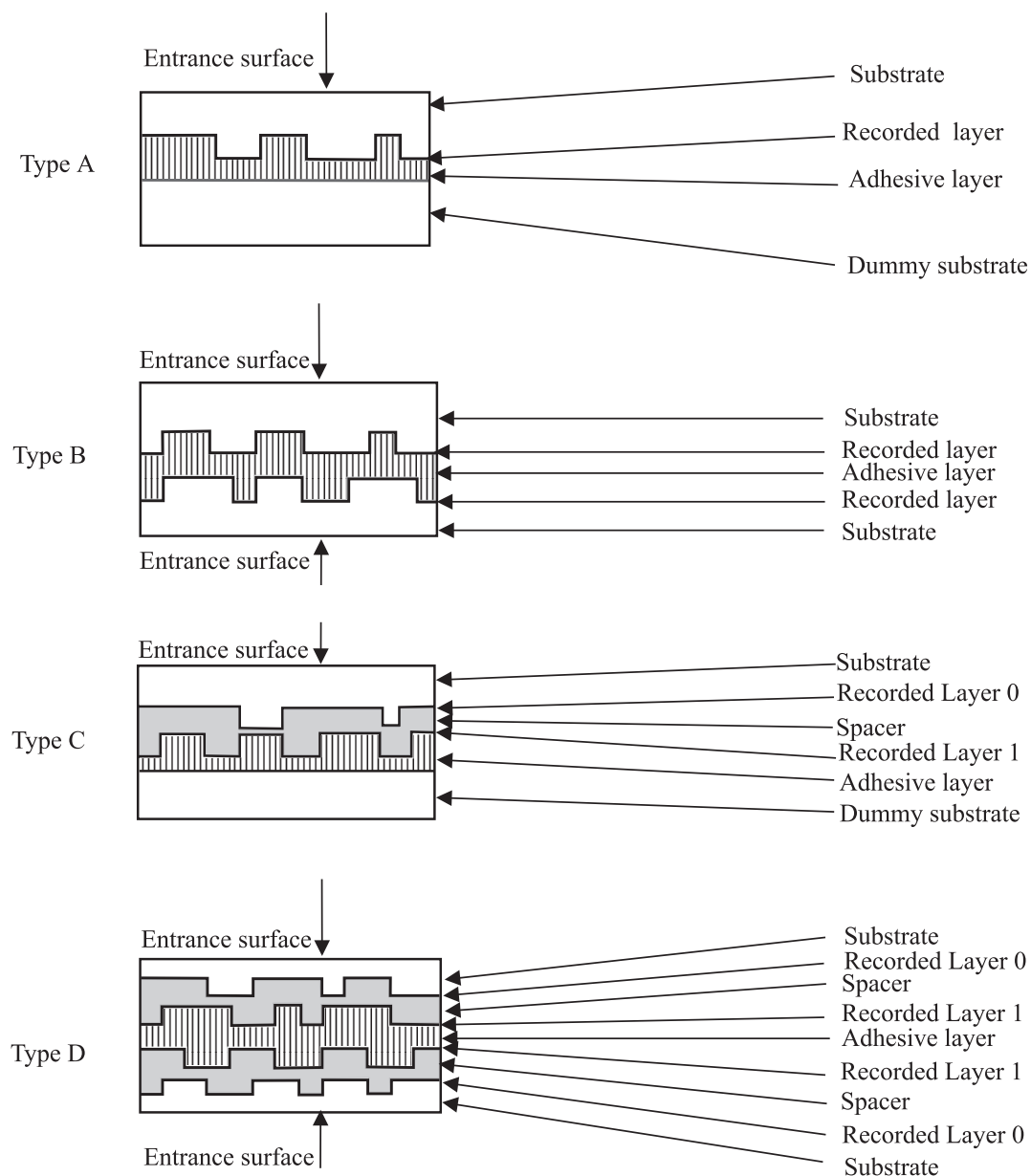
Type B consist of two substrates, and two recorded layers. From one side of the disk, only one of these recorded layers can be accessed. The nominal capacity is 2,92 Gbytes.

Type C consists of a substrate, a dummy substrate and two recorded layers with a spacer between them. Both recorded layers can be accessed from one side only. The nominal capacity is 2,66 Gbytes.

Type D consists of two substrates, each having two recorded layers with a spacer between these two recorded layers. From one side of the disk, only one pair of recorded layers can be accessed. The nominal capacity is 5,32 Gbytes.

Figure 1 shows schematically these four Types. Types A and B are Single Layer (SL) disks and Types C and D are Dual Layer (DL) disks. The two layers of DL disks are identified as Layer 0 and Layer 1. Layer 0 is the layer nearer to the entrance surface. Types A and C are 1-sided disks, Types B and D are 2-sided disks.

In Type C the function of the adhesive layer can be provided by the spacer between the two recorded layers where Layer 1 is placed, for instance embossed, on the dummy substrate.



96-0296-A

Figure 1 - Types of 80 mm DVD - Read-Only disks

8 General requirements

8.1 Environments

8.1.1 Test environment

The test environment is the environment where the air immediately surrounding the disk has the following properties.

a) For dimensional measurements

temperature : $23\text{ °C} \pm 2\text{ °C}$
 relative humidity : 45 % to 55 %
 atmospheric pressure : 86 kPa to 106 kPa

b) For other measurements

15 °C to 35 °C
 45 % to 75 %
 86 kPa to 106 kPa

Unless otherwise stated, all tests and measurements shall be made in this test environment.

8.1.2 Operating environment

This International Standard requires that an optical disk which meets all mandatory requirements of this International Standard in the specified test environment provides data interchange over the specified ranges of environmental parameters in the operating environment.

Disks used for data interchange shall be operated under the following conditions, when mounted in the drive supplied with voltage and measured on the outside surface of the disk.

The disk exposed to storage conditions shall be conditioned in the operating environment for at least two hours before operating.

temperature : -25 °C to 70 °C
 relative humidity : 3 % to 95 %
 absolute humidity : $0,5\text{ g/m}^3$ to 60 g/m^3
 sudden change of temperature : 50 °C max.
 sudden change of relative humidity : 30 % max.

There shall be no condensation of moisture on the disk.

8.1.3 Storage environment

The storage environment is the environment where the air immediately surrounding the optical disk shall have the following properties.

temperature : -20 °C to 50 °C
 relative humidity : 5 % to 90 %
 absolute humidity : 1 g/m^3 to 30 g/m^3
 atmospheric pressure : 75 kPa to 106 kPa
 temperature variation : 15 °C/h max.
 relative humidity variation : 10 %/h max.

8.1.4 Transportation

This International Standard does not specify requirements for transportation; guidance is given in annex J.

8.2 Safety requirements

The disk shall satisfy the requirements of IEC 950, when used in the intended manner or in any foreseeable use in an information system.

8.3 Flammability

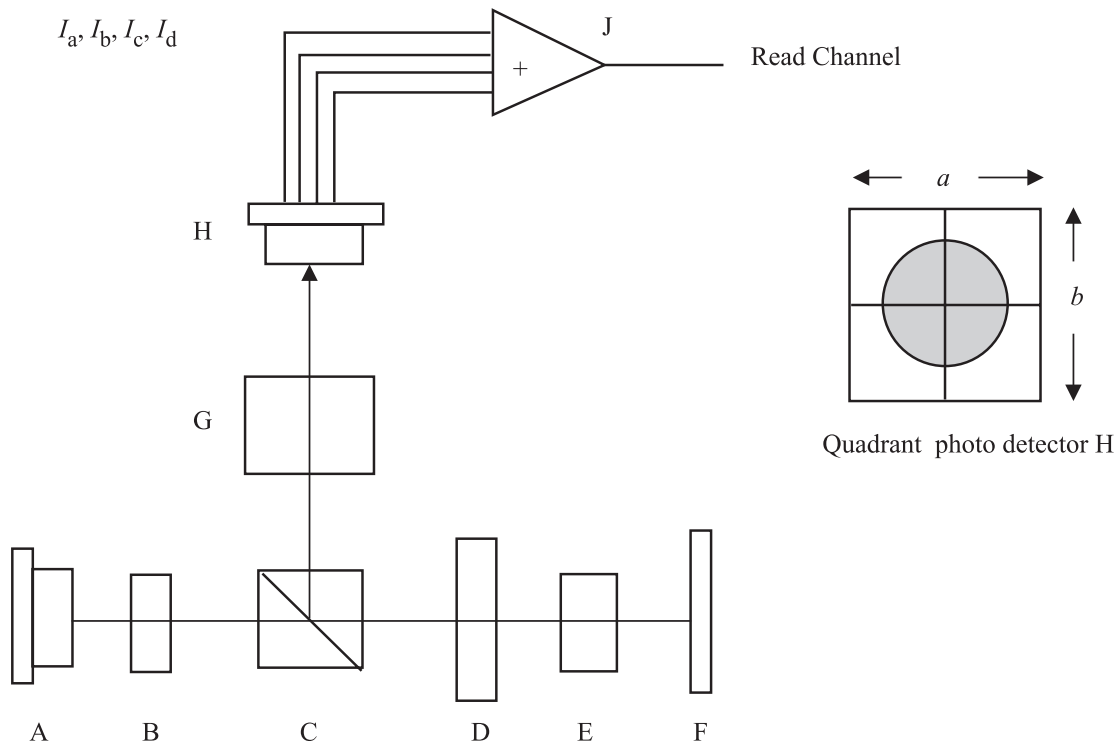
The disk shall be made from materials that comply with the flammability class for HB materials, or better, as specified in IEC 950.

9 Reference measurement devices

The reference measurement devices shall be used for the measurements of optical parameters for conformance with this International Standard. The critical components of these devices have specific properties defined in this clause.

9.1 Pick Up Head (PUH)

The optical system for measuring the optical parameters is shown in figure 2. It shall be such that the detected light reflected from the entrance surface of the disk is minimized so as not influencing the accuracy of measurement. The combination of the polarizing beam splitter C with the quarter-wave plate D separates the incident optical beam and the beam reflected by the optical disk F. The beam splitter C shall have a p-s intensity/reflectance ratio of at least 100. Optics G generates an astigmatic difference and collimates the light reflected by the recorded layer of the optical disk F for astigmatic focusing and read-out. The position of the quadrant photo detector H shall be adjusted so that the light spot becomes a circle the centre of which coincides with the centre of the quadrant photo detector H when the objective lens is focused on the recorded layer. An example of such a photo detector H is shown in figure 2. The dimensions *a* and *b* equal *M* times 10 μm to 12 μm, where *M* is the transversal magnification factor from the disk to its conjugate plane near the quadrant photo detector H.



97-0019-A

A	Laser diode	F	Optical disk
B	Collimator lens	G	Optics for the astigmatic focusing method
C	Polarizing beam splitter	H	Quadrant photo detector
D	Quarter-wave plate	I_a, I_b, I_c, I_d	Output from the quadrant photo detector
E	Objective lens	J	d.c. coupled amplifier

Figure 2 - Optical system for PUH

The characteristics of the PUH shall be as follows.

Wavelength (λ)	650 nm $\pm$ 5 nm
Polarization	circularly polarized light
Polarizing beam splitter	shall be used unless otherwise stated
Numerical aperture	0,60 $\pm$ 0,01
Light intensity at the rim of	

the pupil of the objective lens	60 % to 70 % of the maximum intensity level in radial direction, and over 90 % of the maximum intensity level in tangential direction
Wave front aberration	0,033 λ rms max.
Normalized detector size on a disk	$100 \mu\text{m}^2 < S / M^2 < 144 \mu\text{m}^2$ where S is the total surface of the photo detector of the PUH
Relative intensity noise (RIN)	- 134 dB/Hz max.
10 log [(a.c. light power density /Hz) / d.c. light power]	

9.2 Measurement conditions

The measuring conditions for operational signals shall be as follows.

Scanning velocity at a Channel bit rate of 26,15625 Mbits/s	for Single Layer disks: 3,49 m/s $\pm$ 0,03 m/s for Dual Layer disks: 3,84 m/s $\pm$ 0,03 m/s
Clamping force	2,0 N $\pm$ 0,5 N
Taper cone angle	40,0° $\pm$ 0,5°, see annex E
CLV servo characteristic	f (-3 dB), closed loop bandwidth : 5 Hz
Focusing method	astigmatic method
Tracking method	differential phase detection

9.3 Normalized servo transfer function

In order to specify the servo system for axial and radial tracking, a function H_s is used (equation I). It specifies the nominal values of the open-loop transfer function H of the Reference Servo(s) in the frequency range 23,1 Hz to 10 kHz.

$$H_s(i\omega) = \frac{1}{3} \times \left(\frac{\omega_0}{i\omega} \right)^2 \times \frac{1 + \frac{3i\omega}{\omega_0}}{1 + \frac{i\omega}{3\omega_0}} \quad (I)$$

where

$$\omega = 2\pi f$$

$$\omega_0 = 2\pi f_0$$

$$i = \sqrt{-1}$$

f_0 is the 0 dB crossover frequency of the open loop transfer function. The crossover frequencies of the lead-lag network of the servo are given by

$$\text{lead break frequency: } f_1 = f_0 \times 1/3$$

$$\text{lag break frequency } f_2 = f_0 \times 3$$

9.4 Reference Servo for axial tracking

For an open loop transfer function H of the Reference Servo for axial tracking, $|1+H|$ is limited as schematically shown by the shaded surface of figure 3.

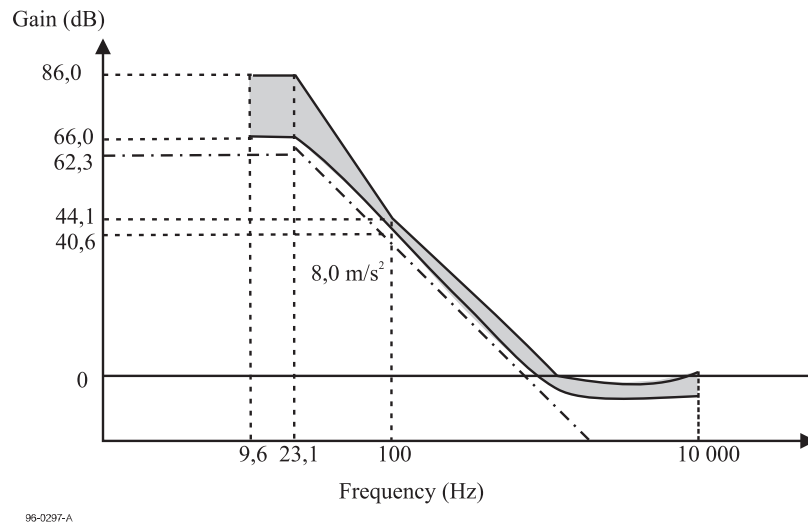


Figure 3 - Reference Servo for axial tracking

Bandwidth 100 Hz to 10 kHz

$|1 + H|$ shall be within 20 % of $|1 + H_s|$.

The crossover frequency $f_0 = \omega_0 / 2\pi$ shall be specified by equation (II), where $\alpha_{\max}$ shall be 1,5 times larger than the expected maximum axial acceleration of 8 m/s^2 . The tracking error $e_{\max}$ shall not exceed $0,23 \text{ }\mu\text{m}$. Thus the crossover frequency f_0 shall be

$$f_0 = \frac{1}{2\pi} \sqrt{\frac{3 \alpha_{\max}}{e_{\max}}} = \frac{1}{2\pi} \sqrt{\frac{8 \times 1,5 \times 3}{0,23 \times 10^{-6}}} = 2,0 \text{ kHz} \quad (\text{II})$$

The axial tracking error $e_{\max}$ is the peak deviation measured axially above or below the 0 level.

Bandwidth 23,1 Hz to 100 Hz

$|1 + H|$ shall be within the limits defined by the following four points.

40,6 dB at 100 Hz	($ 1 + H_s $ - 20% at 100 Hz)
66,0 dB at 23,1 Hz	($ 1 + H_s $ - 20% at 23,1 Hz)
86,0 dB at 23,1 Hz	($ 1 + H_s $ - 20% at 23,1 Hz add 20 dB)
44,1 dB at 100 Hz	($ 1 + H_s $ + 20% at 100 Hz)

Bandwidth 9,6 Hz to 23,1 Hz

$|1 + H|$ shall be between 66,0 dB and 86,0 dB.

9.5 Reference Servo for radial tracking

For an open-loop transfer function H of the Reference Servo for radial tracking, $|1 + H|$ is limited as schematically shown by the shaded surface of figure 4.

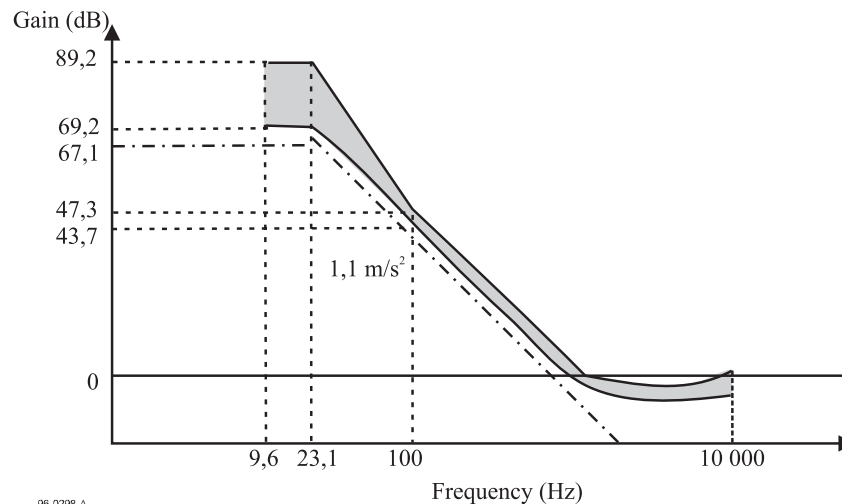


Figure 4 - Reference Servo for Radial Tracking

Bandwidth from 100 Hz to 10 kHz

$|1 + H|$ shall be within 20 % of $|1 + H_s|$.

The crossover frequency $f_0 = \omega_0 / 2\pi$ shall be specified by equation (III), where $\alpha_{\max}$ shall be 1,5 times larger than the expected maximum radial acceleration of 1,1 m/s². The tracking error $e_{\max}$ shall not exceed 0,022 μm . Thus the crossover frequency f_0 shall be

$$f_0 = \frac{1}{2\pi} \sqrt{\frac{3 \alpha_{\max}}{e_{\max}}} = \frac{1}{2\pi} \sqrt{\frac{1,1 \times 1,5 \times 3}{0,022 \times 10^{-6}}} = 2,4 \text{ kHz} \quad (\text{III})$$

The radial tracking error $e_{\max}$ is the peak deviation measured radially inwards or outwards the 0 level.

Bandwidth from 23,1 Hz to 100 Hz

$|1 + H|$ shall be within the limits defined by the following four points.

43,7 dB at 100 Hz	($ 1 + H_s $ - 20% at 100 Hz)
69,2 dB at 23,1 Hz	($ 1 + H_s $ - 20% at 23,1 Hz)
89,2 dB at 23,1 Hz	($ 1 + H_s $ - 20% at 23,1 Hz add 20 dB)
47,3 dB at 100 Hz	($ 1 + H_s $ + 20% at 100 Hz)

Bandwidth from 9,6 Hz to 23,1 Hz

$|1 + H|$ shall be between 69,2 dB and 89,2 dB.

Section 2 - Dimensional, mechanical and physical characteristics of the disk**10 Dimensional characteristics (figures 5 to 8)**

Dimensional characteristics are specified for those parameters deemed mandatory for interchange and compatible use of the disk. Where there is freedom of design, only the functional characteristics of the elements described are indicated. The enclosed drawings show the dimensional requirements in summarized form. The different parts of the disk are described from the centre hole to the outside rim.

The dimensions are referred to two Reference Planes P and Q.

Reference Plane P is the primary Reference Plane. It is the plane on which the bottom surface of the Clamping Zone (see 10.4) rests.

Reference Plane Q is the plane parallel to Reference Plane P at the height of the top surface of the Clamping Zone.

10.1 Overall dimensions

The disk shall have an overall diameter

$$d_1 = 80,00 \text{ mm} \pm 0,30 \text{ mm}$$

The centre hole of a substrate or a dummy substrate shall have a diameter

$$d_2 = 15,00 \text{ mm} \begin{matrix} + 0,15 \text{ mm} \\ - 0,00 \text{ mm} \end{matrix}$$

The diameter of the hole of an assembled disk, i.e. with both parts bonded together, shall be 15,00 mm min., see figure 6.

There shall be no burr on both edges of the centre hole.

The edge of the centre hole shall be rounded off or chamfered. The rounding radius shall be 0,1 mm max. The chamfer shall extend over a height of 0,1 mm max.

The thickness of the disk, including adhesive layer, spacer(s) and label(s), shall be

$$e_1 = 1,20 \text{ mm} \begin{matrix} + 0,30 \text{ mm} \\ - 0,06 \text{ mm} \end{matrix}$$

10.2 First transition area

In the area defined by d_2 and

$$d_3 = 16,0 \text{ mm min.}$$

the surface of the disk is permitted to be above Reference Plane P and/or below Reference Plane Q by 0,10 mm max.

10.3 Second transition area

This area shall extend between diameter d_3 and diameter

$$d_4 = 22,0 \text{ mm max.}$$

In this area the disk may have an uneven surface or burrs up to 0,05 mm max. beyond Reference Planes P and/or Q.

10.4 Clamping Zone

This zone shall extend between diameter d_4 and diameter

$$d_5 = 33,0 \text{ mm min.}$$

Each side of the Clamping Zone shall be flat within 0,1 mm. The top side of the Clamping Zone, i.e. that of Reference Plane Q shall be parallel to the bottom side, i.e. that of Reference Plane P within 0,1 mm.

In the Clamping Zone the thickness e_2 of the disk shall be

$$e_2 = 1,20 \text{ mm} \begin{matrix} + 0,20 \text{ mm} \\ - 0,10 \text{ mm} \end{matrix}$$

10.5 Third transition area

This area shall extend between diameter d_5 and diameter

$$d_6 = 44,0 \text{ mm max.}$$

In this area the top surface is permitted to be above Reference Plane Q by

$$h_1 = 0,25 \text{ mm max.}$$

or below Reference Plane Q by

$$h_2 = 0,10 \text{ mm max.}$$

The bottom surface is permitted to be above Reference Plane P by

$$h_3 = 0,10 \text{ mm max}$$

or below Reference Plane P by

$$h_4 = 0,25 \text{ mm max.}$$

10.6 Information Zone

The Information Zone shall extend from the beginning of the Lead-in Zone to diameter d_{10} the value of which is specified in table 1.

In the Information Zone the thickness of the disk shall be equal to e_1 specified in 10.1.

10.6.1 Sub-divisions of the Information Zone

The main parts of the Information Zone are

- the Lead-in Zone
- the Data Zone
- the Lead-out Zone

The area extending from d_6 to diameter

$$d_7 = 45,2 \text{ mm max.}$$

shall be used as follows

- it is the beginning of the Lead-in Zone for Types A and B, and each pair of layers for Type C and D in PTP mode and on Layer 0 in OTP mode,
- it is the end of the Lead-out Zone on Layer 1 for Types C and D in OTP mode.

In the first case, the Lead-in Zone shall end at diameter

$$d_8 = 48,0 \text{ mm} \begin{matrix} + 0,0 \text{ mm} \\ - 0,4 \text{ mm} \end{matrix}$$

which is the beginning of the Data Zone.

In the second case the Data Zone shall not extend toward the centre of the disk beyond d_8 . The Lead-out Zone shall start after the Data Zone and end between diameters d_6 and d_7 .

The Data Zone shall start after the Lead-in Zone at diameter d_8 , it shall extend up to diameter

$$d_9 = 76,0 \text{ mm max.}$$

The zone between diameters d_9 and d_{10} constitutes the Lead-out Zone in the cases Types A and B, and Types C and D in PTP mode and the Middle Zone in the case of Types C and D in OTP mode.

The Lead-out Zone in PTP mode and the Middle Zone shall start after the Data Zone and end at diameter d_{10} the value of which depends on the length of the Data Zone as shown in table 1.

Table 1 - End of the Information Zone

Length of the Data Zone	Value of diameter d_{10}
Less than 68,0 mm	70,0 mm min.
68,0 mm to 75,0 mm	Data Zone diameter + 2,0 mm min.
75,0 mm to 76,0 mm	77,0 mm min.

The zone extending from d_{11} to d_{12} shall be used for the Burst Cutting Area, if implemented (see annex H).

10.6.2 Track geometry

In the Information Zone tracks are constituted by a 360° turn of a spiral.

The track pitch shall be $0,74 \mu\text{m} \pm 0,03 \mu\text{m}$.

The track pitch averaged over the Data Zone shall be $0,74 \mu\text{m} \pm 0,01 \mu\text{m}$.

10.6.3 Track modes

Tracks can be recorded in two different modes called Parallel Track Path (PTP) and Opposite Track Path (OTP). Figure 5 shows examples of the PTP and OTP modes. In practice, the lengths of the Data Zones of both layers are independent from each other.

Types A and B shall be recorded in PTP mode only.

Types C and D may be recorded in either modes.

In PTP mode, tracks are read from the inside diameter of the Information Zone to its outside diameter, this applies to both Layer 0 and Layer 1 for Types C and D, see figure 5a. On both layers, the track spiral is turning from the inside to the outside.

In OTP mode, tracks are read starting on Layer 0 at the inner diameter of the Information Zone, continuing on Layer 1 from the outer diameter to the inner diameter. Thus, there is a Middle Zone at the outer diameter on both layers, see figure 5b. The track spiral is turning from the inside to the outside on Layer 0 and in the reverse direction on Layer 1.

The radial misalignment of the outer edge of the Information Zones between Layer 0 and Layer 1 shall be 0,5 mm max.

In OTP mode, the radial misalignment between the outer edge of the Data Zones of Layer 0 and Layer 1 shall be 0,5 mm max.

10.6.4 Channel bit length

The Information Zone shall be recorded in CLV mode. The Channel bit length averaged over the Data Zone shall be

- 133,3 nm $\pm$ 1,4 nm for Type A and Type B,
- 146,7 nm $\pm$ 1,5 nm for Type C and Type D

10.7 Rim area

The rim area shall be that area extending from diameter d_{10} to diameter d_1 (see figure 8). In this area the top surface is permitted to be above Reference Plane Q by

$$h_5 = 0,1 \text{ mm max.}$$

and the bottom surface is permitted to be below Reference Plane P by

$$h_6 = 0,1 \text{ mm max.}$$

The total thickness of this area shall not be greater than 1,50 mm, i.e. the maximum value of e_1 . The thickness of the rim proper shall be

$$e_3 = 0,6 \text{ mm min.}$$

The outer edges of the disk shall be either rounded off with a rounding radius of 0,2 mm max. or be chamfered over

$$h_7 = 0,2 \text{ mm max.}$$

$$h_8 = 0,2 \text{ mm max.}$$

10.8 Remark on tolerances

All heights specified in the preceding clauses and indicated by h_i are independent from each other. This means that, for example, if the top surface of the third transition area is below Reference Plane Q by up to h_2 , there is no implication that the bottom surface of this area has to be above Reference Plane P by up to h_3 . Where dimensions have the same - generally maximum - numerical value, this does not imply that the actual values have to be identical.

10.9 Runout

10.9.1 Axial runout

When measured by the PUH with the Reference Servo for axial tracking, the disk rotating at the scanning velocity, the deviation of the recorded layer from its nominal position in the direction normal to the Reference Planes shall not exceed 0,2 mm.

The residual tracking error below 10 kHz, measured using the Reference Servo for axial tracking, shall be less than 0,23 μm . The measuring filter shall be a Butterworth LPF, f_c (-3dB): 10 kHz, slope : -80 dB/decade.

10.9.2 Radial runout

The runout of the outer edge of the disk shall be less than 0,3 mm, peak-to-peak.

The radial runout of tracks shall be less than 100 μm , peak-to-peak.

The residual tracking error below 1,1 kHz, measured using the Reference Servo for radial tracking, shall be less than 0,022 μm . The measuring filter shall be a Butterworth LPF, f_c (-3dB) : 1,1 kHz, slope : -80 dB/decade.

The rms noise value of the residual error signal in the frequency band from 1,1 kHz to 10 kHz, measured with an integration time of 20 ms, using the Reference Servo for radial tracking, shall be less than 0,016 μm . The measuring filter shall be a Butterworth BPF, frequency range (-3dB) : 1,1 kHz, slope : +80 dB/decade to 10 kHz, slope : - 80 dB/decade.

10.10 Label

The label shall be placed on the side of the disk opposite the entrance surface for the information to which the label is related. The label shall be placed either on an outer surface of the disk or inside the disk bonding plane. In the former case, the label shall not extend over the Clamping Zone. In the latter case, the label may extend over the Clamping Zone. In both cases, the label shall not extend over the rim of the centre hole nor over the outer edge of the disk.

11 Mechanical parameters

11.1 Mass

The mass of the disk shall be in the range 6 g to 9 g.

11.2 Moment of inertia

The moment of inertia of the disk, relative to its rotation axis, shall not exceed 0,010 $\text{g}\cdot\text{m}^2$.

11.3 Dynamic imbalance

The dynamic imbalance of the disk, relative to its rotation axis, shall not exceed 0,0045 $\text{g}\cdot\text{m}$.

11.4 Sense of rotation

The sense of rotation of the disk shall be counterclockwise as seen by the optical system.

12 Optical parameters

12.1 Index of refraction

The index of refraction IR of the transparent substrate shall be $1,55 \pm 0,10$.

The index of refraction of the spacer shall be $(\text{IR} \pm 0,10)$.

12.2 Thickness of the transparent substrate

The thickness of the transparent substrate is specified as a function of its index of refraction.

Figure 9 specifies it for Types A and B and figure 10 for Types C and D.

12.3 Thickness of the spacer of Types C and D

For Types C and D, the thickness of the spacer shall be $55 \mu\text{m} \pm 15 \mu\text{m}$. Annex K shows two ways of measuring this thickness. On a disk, this thickness shall not vary by more than 20 μm . Within one revolution, it shall not vary by more than 8 μm .

12.4 Angular deviation

The angular deviation is the angle α between a parallel incident beam and the reflected beam. The incident beam shall have a diameter in the range 0,3 mm to 3,0 mm. This angle includes deflection due to the entrance surface and to unparallelism of the recorded layer, see figure A.1. It shall meet the following requirements when measured according to annex A.

In radial direction : $\alpha = 0,80^\circ \text{ max.}$

In tangential direction : $\alpha = 0,30^\circ \text{ max.}$

12.5 Birefringence of the transparent substrate

The birefringence of the transparent substrate shall be 100 nm max. when measured according to annex B.

12.6 Reflectivity

When measured according to annex D, the reflectivity of the recorded layer(s) shall be

- Types A and B : 45 % to 85 % (PUH with PBS)
- Types A and B: 60 % to 85 % (PUH without PBS)
- Types C and D : 18% to 30 % (PUH with PBS)

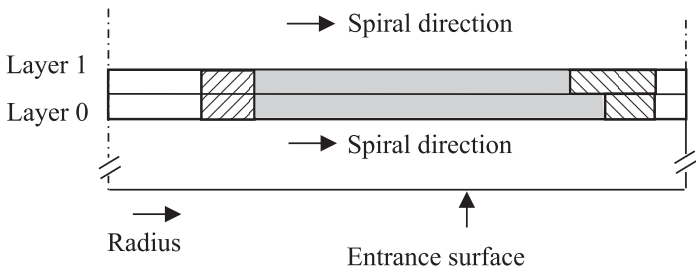


Figure 5a - Parallel Track Path (PTP)

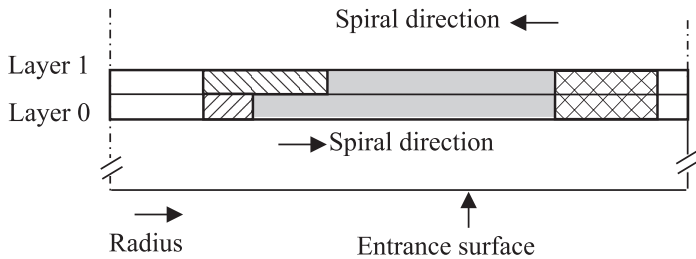


Figure 5b - Opposite Track Path (OTP)

- Layer 0 = The layer closer to the entrance surface
- Layer 1 = The layer farther from the entrance surface

- Data Zone :
- Lead-in Zone :
- Middle Zone :
- Lead-out Zone :

96-0299-A

Figure 5 - Examples of track paths for Types C and D



96-0291-A

Figure 7 - Areas of the disk

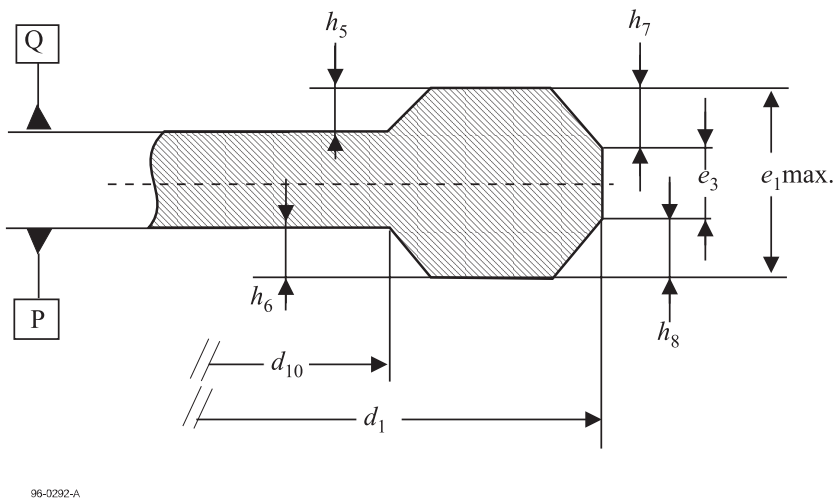


Figure 8 - Rim area

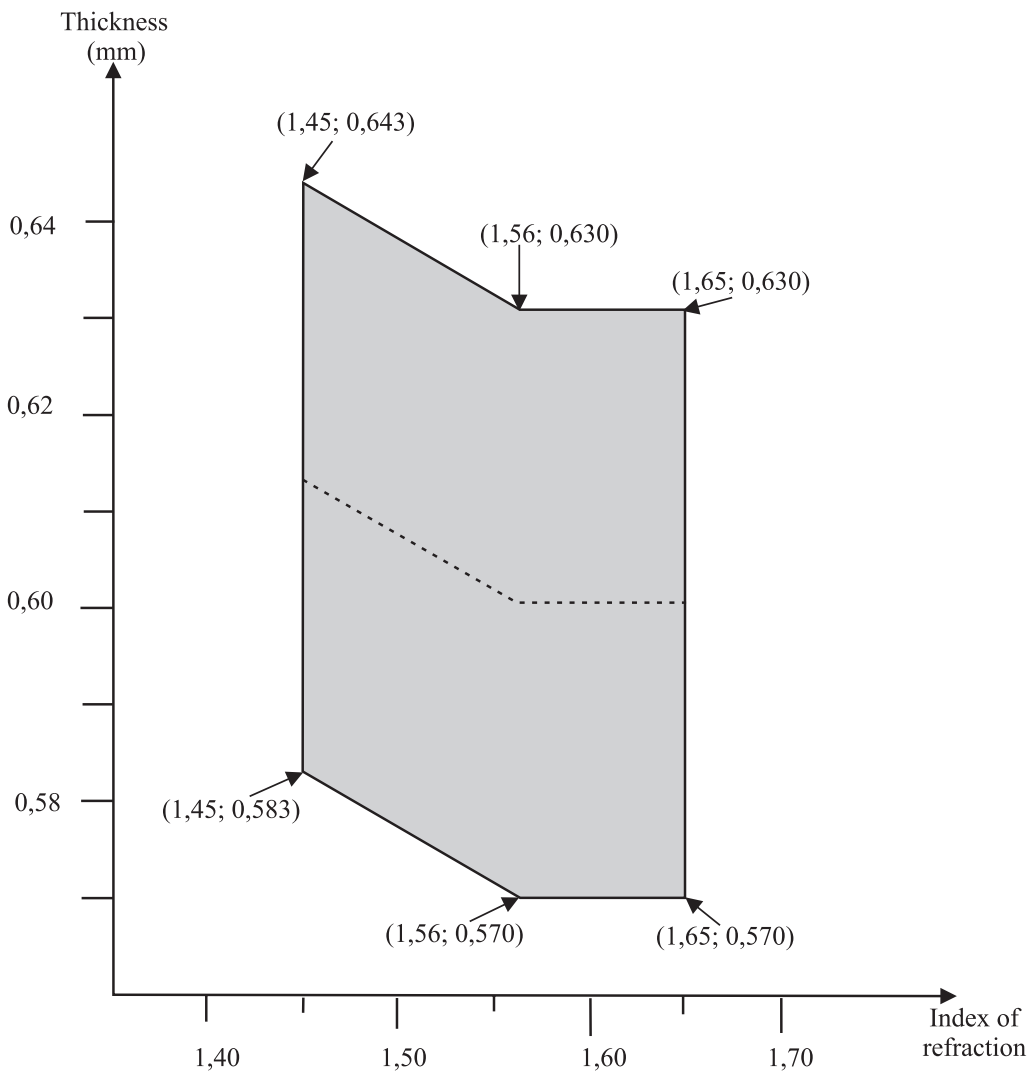
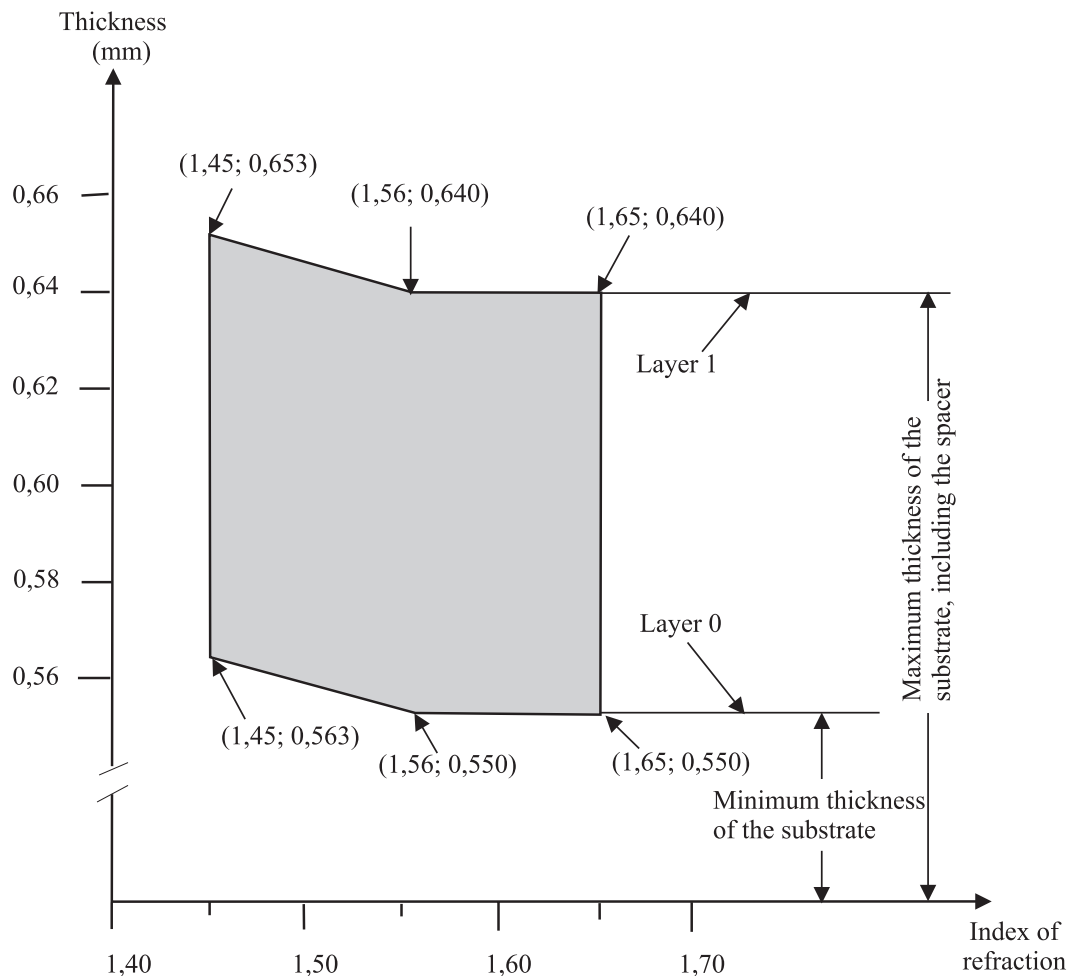


Figure 9 - Thickness of the substrate for Types A and B



99-0301-A

Figure 10 - Thickness of the substrate and spacer for Types C and D

Section 3 - Operational Signals

13 High frequency signals (HF)

The HF signal is obtained by summing the currents of the four elements of the photo detector. These currents are modulated by diffraction of the light beam at the pits representing the information on the recorded layer. Measurements, except for jitter, are executed to HF before equalizing.

13.1 Modulated amplitude

The modulated amplitude I_{14} is the peak-to-peak value generated by the largest pit and land length (figure 11).

The peak value I_{14H} shall be the peak value corresponding to the HF signal before high-pass filtering.

The peak-to-peak value of the shortest pit and land length shall be I_3 .

The 0 Level is the signal level obtained from the measuring device when no disk is inserted.

These parameters shall meet the following requirements.

$$I_{14} / I_{14H} = 0,60 \text{ min.}$$

$$I_3 / I_{14} = 0,15 \text{ min. for Types A and B}$$

$$I_3 / I_{14} = 0,20 \text{ min. for Types C and D}$$

The maximum value of $(I_{14H\max} - I_{14H\min}) / I_{14H\max}$ shall be as specified by table 2.

Table 2 - Maximum value of $(I_{14Hmax} - I_{14Hmin}) / I_{14Hmax}$

	Within one disk	Within one revolution
PUH with PBS	0,33	0,15
PUH without PBS with circular polarization	0,20	0,10

13.2 Signal asymmetry

The signal asymmetry shall meet the following requirement, see figure 11.

$$-0,05 \leq [(I_{14H} + I_{14L}) / 2 - (I_{3H} + I_{3L}) / 2] / I_{14} \leq 0,15$$

where

- $(I_{14H} + I_{14L}) / 2$ is the centre level of I_{14}
- $(I_{3H} + I_{3L}) / 2$ is the centre level of I_3 .

13.3 Cross-track signal

The cross-track signal shall be derived from the HF signal when low-pass filtered with a cut-off frequency of 30 kHz when the light beam crosses the tracks (see figure 12). The low-pass filter is a 1st order filter. The cross-track signal shall meet the following requirements.

$$I_T = I_H - I_L$$

$$I_T / I_H = 0,10 \text{ min.}$$

where I_H is the peak value of this signal and I_T is the peak-to-peak value.

13.4 Quality of signals

13.4.1 Jitter

Jitter is the standard deviation σ of the time variation of the digitized data passed through the equalizer. The jitter of the leading and trailing edges is measured to the PLL clock and normalized by the Channel bit clock period.

Jitter shall be less than 8,0 % of the Channel bit clock period, when measured according to annex F.

13.4.2 Random errors

A row of an ECC Block (see clause 18) that has at least 1 byte in error constitutes a PI error. In any 8 consecutive ECC Blocks the total number of PI errors before correction shall not exceed 280.

13.4.3 Defects

Defect are air bubbles and black spots. Their diameter shall meet the following requirements

- for air bubbles it shall not exceed 100 μm ,
- for black spots causing birefringence it shall not exceed 200 μm ,
- for black spots not causing birefringence it shall not exceed 300 μm .

In addition, over a distance of 80 mm in scanning direction of tracks, the following requirements shall be met

- the total length of defects larger than 30 μm shall not exceed 300 μm ,
- there shall be at most 6 such defects.

14 Servo signals

The output currents of the four quadrants of the split photo detector shown in figure 13 are identified by I_a , I_b , I_c and I_d .