INTERNATIONAL STANDARD

ISO/IEC 16824

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Information technology — 120 mm DVD rewritable disk (DVD-RAM)

Technologies de l'information — Disque à réécriture DVD de diamètre 120 mm *(DVD-RAM)*

Reference number
ISO/IEC 16824:1999(E)

Contents

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 6243-1998) 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 — 120 mm DVD rewritable disk (DVD-RAM)

Section 1 - General

1 Scope

This International Standard specifies the mechanical, physical and optical characteristics of a 120 mm optical disk to enable 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. The data can be written, read and overwritten many times using the phase change method. This disk is identified as DVD-RAM.

This International Standard specifies

- two related but different Types of this disk (see clause 7),
- the conditions for conformance,
- the environments in which the disk is to be tested, operated and stored,
- the mechanical, physical and dimensional 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,
- the characteristics of the signals recorded on the disk, thus enabling data processing systems to read the data from the disk.

This International Standard provides for the interchange of disks between optical disk drives. Together with a standard for volume and file structure, it provides for full data interchange between data processing systems. The optical disks specified by this International Standard may be enclosed in cases according to ISO/IEC 16825 as specified therein.

2 Conformance

2.1 Optical Disk

A claim of conformance with this International Standard shall specify the Type implemented. An optical disk shall be in conformance with this International Standard if it meets all mandatory requirements specified for this 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 both Types of optical disk according to 2.1.

3 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 950:1991, *Safety of information technology equipment.*

ISO/IEC 16825:1999, *Information technology — Case for 120 mm DVD-RAM disks.*

4 Definitions

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

4.1 Case: The housing for an optical disk, that protects the disk and facilitates disk interchange.

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

4.3 Digital Sum Value (DSV): The arithmetic sum obtained from a bit stream by allocating the decimal value 1 to Channel bits set to ONE and the decimal value -1 to Channel bits set to ZERO.

4.4 Disk Reference Plane: A plane defined by the perfectly flat annular surface of an ideal spindle onto which the clamping area of the disk is clamped, and which is normal to the axis of rotation.

4.5 Dummy substrate: A layer which may be transparent or not, provided for the mechanical support of the disk and/or a recording layer.

4.6 Embossed mark: A mark so formed as to be unalterable by optical means.

4.7 Entrance surface: The surface of the disk onto which the optical beam first impinges.

4.8 Land and Groove: A trench-like feature of the disk, applied before the recording of any information, and used to define the track location. The groove is located nearer to the entrance surface than the land. The recording is made either on the centre of the groove or on the centre of the land.

4.9 Mark: A feature of the Recording layer which may take the form of an amorphous domain, a pit, or any other type or form that can be sensed by the optical system. The pattern of marks and spaces represents the data on the disk.

4.10 Phase change: A physical effect by which the area of a recording layer irradiated by a laser beam is heated so as to change from an amorphous state to a crystalline state and vice versa.

4.11 Polarization: The direction of polarization of an optical beam is the direction of the electric vector of the beam.

Note - The plane of polarization is the plane containing the electric vector and the direction of propagation of the beam. The polarization is right-handed when to an observer looking in the direction of propagation of the beam, the end-point of the electric vector would appear to describe an ellipse in the clockwise sense.

4.12 Recording layer: A layer of the disk on, or in, which data is written during manufacture and/or use.

4.13 Sector: The smallest addressable part of a track in the Information Zone of a disk that can be accessed independently of other addressable parts.

4.14 Space: A feature of the recording layer which may take the form of a crystalline domain, a non-pit or any other type or form that can be sensed by the optical system. The pattern of marks and spaces represents the data on the disk.

4.15 Substrate: A transparent layer of the disk, provided for mechanical support of the recorded layer(s), through which the optical beam can access a recording layer.

4.16 Track: A 360° turn of a continuous spiral.

4.17 Track pitch: The distance between centrelines of adjacent tracks (a groove and a land), measured in a radial direction.

4.18 ZCLV: A disk format requiring Zoned Constant Linear Velocity operations.

4.19 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 8*n* 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.

A binary digit which can be set indifferently to ZERO or to ONE is represented by “x”.

5.2 Names

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

6 List of acronyms

AM	Address Mark	NRZ	Non Return to Zero
BCA	Burst Cutting Area	NRZI	Non Return to Zero Inverted
BPF	Band Pass Filter	PA	Postamble
DC	Direct Current	PDL	Primary Defect List
DCC	DC Component Suppress Control	PED	P(ID) Error Detection code
DDS	Disk Definition Structure	PI	Parity of Inner-code
DMA	Defect Management Area	PID	Physical Identification Data
DSV	Digital Sum Value	PLL	Phase Locked Loop
ECC	Error Correction Code	PO	Parity of Outer-code
EDC	Error Detection Code	PS	Pre-Synchronous code
FRM	Forced Reassignment Marking	RS	Reed-Solomon code
HF	High Frequency	SDL	Secondary Defect List
ID	Identification Data	SYNC Code	Synchronous Code
IED	ID Error Detection code	VFO	Variable Frequency Oscillator
LPF	Low Pass Filter	ZCLV	Zoned Constant Linear Velocity
LSN	Logical Sector Number		

7 General description of the optical 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 recording layer(s) is 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 provides for two Types of such disks.

Type 1S consists of a substrate, a single recording layer and a dummy substrate. The recording layer can be accessed from one side only. The nominal capacity is 2,6 Gbytes.

Type 2S consists of two substrates and two recording layers. From one side of the disk, only one of these recording layers can be accessed. The nominal capacity is 5,2 Gbytes.

Alternatively, in Type 1S, the recording layer may be placed, for instance embossed, on the dummy substrate.

When used with the case specified in International Standard ISO/IEC 16825, a disk of Type 1S may be enclosed in either of the three case Types; a disk of Type 2S is to be enclosed only in a Type 1 case.

Data can be written onto the disk as marks in the form of amorphous spots in the crystalline recording layer and can be overwritten with a focused optical beam, using the phase change effect between amorphous and crystalline states. The data can be read with a focused optical beam, using phase change effect as the reflective difference between amorphous and crystalline states. The beam accesses the recording layer through a transparent substrate of the disk.

Part of the disk contains read-only data for the drive in the form of pits embossed by the manufacturer. This data can be read using the diffraction of the optical beam by the embossed pits.

Figure 1 shows schematically the two Types.

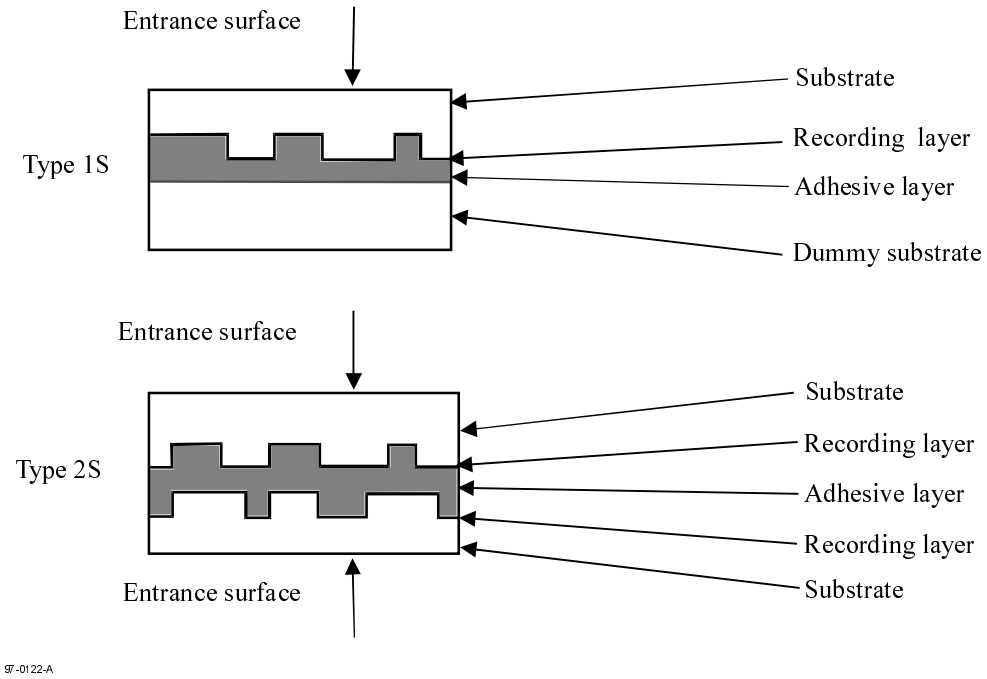


Figure 1 - Types of 120 mm DVD-RAM disks

8 General requirements

8.1 Environments

8.1.1 Test environment

In the test environment, the air immediately surrounding the disk shall have the following properties.

Temperature	: 23 °C ± 2 °C
Relative humidity	: 50 % ± 5 %
Atmospheric pressure	: 86 kPa to 106 kPa

No condensation on or in the disk shall occur. Before testing, the disk shall be conditioned in this environment for 48 hours minimum. It is recommended that, before testing, the entrance surface of the optical disk shall be cleaned according to the instructions of the manufacturer of the disk.

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

8.1.2 Operating environment

This International Standard requires that a disk which meets all requirements of this International Standard in the specified test environment shall provide data interchange over the specified ranges of environmental parameters in the operating environment.

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

Temperature	: 5 °C to 60 °C
Relative humidity	: 3 % to 85 %
Absolute humidity	: 1 g/m^3 to 30 g/m^3
Temperature gradient	: 10 °C/h max.
Relative humidity gradient	: 10 %/h max.

No condensation on the disk shall occur. If the disk has been exposed to conditions outside those specified above, it shall be acclimatized in the operating environment for at least 2 h before use.

8.1.3 Storage environment

The storage environment is defined as an environment where the air immediately surrounding the disk shall have the following properties.

Temperature	: -10 °C to 50 °C
Relative humidity	: 3 % to 85 %
Absolute humidity	: 1 g/m^3 to 30 g/m^3
Atmospheric pressure	: 75 kPa to 106 kPa
Temperature gradient	: 10 °C/h max.
Relative humidity gradient	: 10 %/h max.

No condensation on the disk shall occur.

8.1.4 Transportation

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

8.2 Safety requirement

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

8.3 Flammability

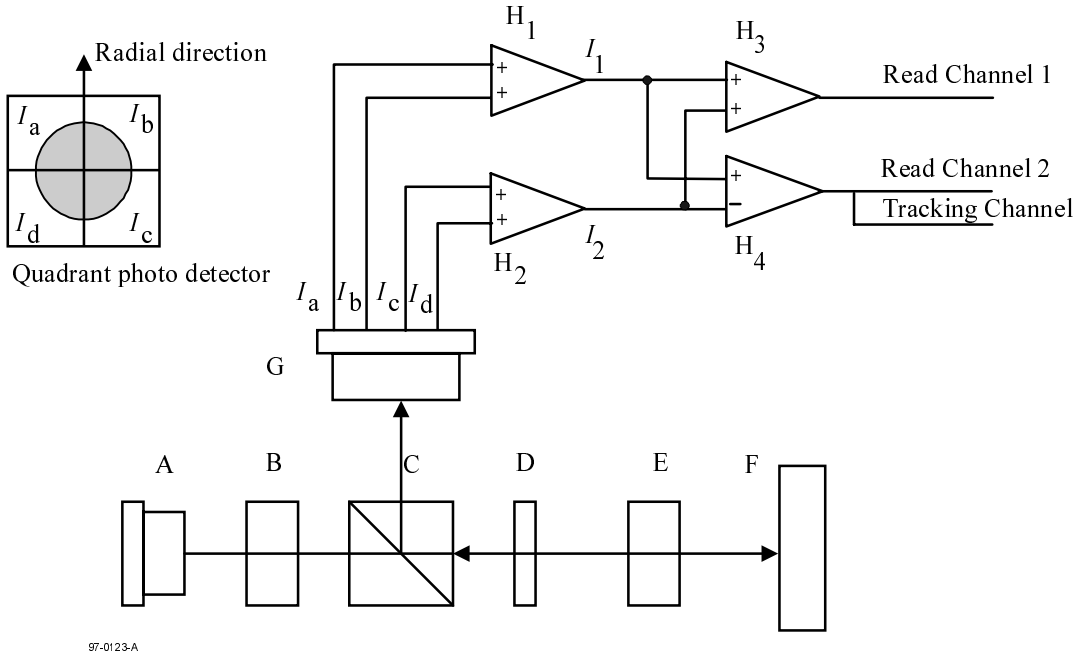
The disk shall be made from materials that comply with the flammability class for HB materials, or better, as specified in IEC 950.

9 Reference Drive

The Reference Drive shall be used for the measurement of optical parameters for conformance with the requirements of this International Standard. The critical components of this device have the characteristics specified in this clause.

9.1 Optical Head

The basic set-up of the optical system of the Reference Drive used for measuring the overwrite and read parameters are shown in figure 2. Different components and locations of components are permitted, provided that the performance remains the same as that of the set-up in figure 2. The optical system shall be such that the detected light reflected from the entrance surface of the disk is minimized so as not to influence the accuracy of the measurements.



A	Laser diode	F	Optical disk
B	Collimator lens	G	Quadrant photo detector
C	Polarizing beam splitter	H_1, H_2, H_3, H_4	d.c.-coupled amplifier
D	Quarter-wave plate	I_a, I_b, I_c, I_d	Output currents from the quadrant photo detector
E	Objective lens		

Figure 2 - Optical system of the Reference Drive

The combination of polarizing beam splitter C and a quarter-wave plate D shall separate the entrance optical beam from a laser diode A and the reflected optical beam from an optical disk F. The beam splitter C shall have a p-s intensity reflectance ratio of at least 100.

The focused optical beam used for writing and reading data shall have the following properties :

a)	Wavelength (λ)	$650\ ^{+10\ nm}_{-5\ nm}$
a)	Polarization	circularly polarized light
b)	Polarizing beam splitter	shall be used unless otherwise stated.
c)	Numerical aperture	0,60 ± 0,01
d)	Light intensity at the rim of the pupil of the objective lens	30 % to 55 % of the maximum intensity level
a)	Wave front aberration	0,033 λ rms max.

b) Relative Intensity Noise (RIN) of the laser diode
10 log [(a.c. power density/Hz) / d.c. light power] -134 dB/Hz max.

9.2 Read channels

A Read channel 1 shall detect the total amount of light in the exit pupil of the objective lens.
A Read channel 2 shall detect the differential output of the quadrant photo detectors.
Frequency characteristics of the equalizer, characteristics of the PLL, slicer etc. are specified in annex F.

9.3 Rotation speed

The actual rotation speed shall be within 1 % of the nominal rotation speed(s) specified in table 3.

9.4 Disk clamping

Clamping force : 2,0 N ± 0,5 N

Tapered cone angle : 40,0° ± 0,5° (see annex E)

9.5 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.

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

where

$\omega = 2\pi f$

$\omega_o = 2\pi f_o$

$i = \sqrt{-1}$

f_o 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

lead break frequency $f_1 = f_o \times 1/3$

lag break frequency $f_2 = f_o \times 3$

9.6 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.

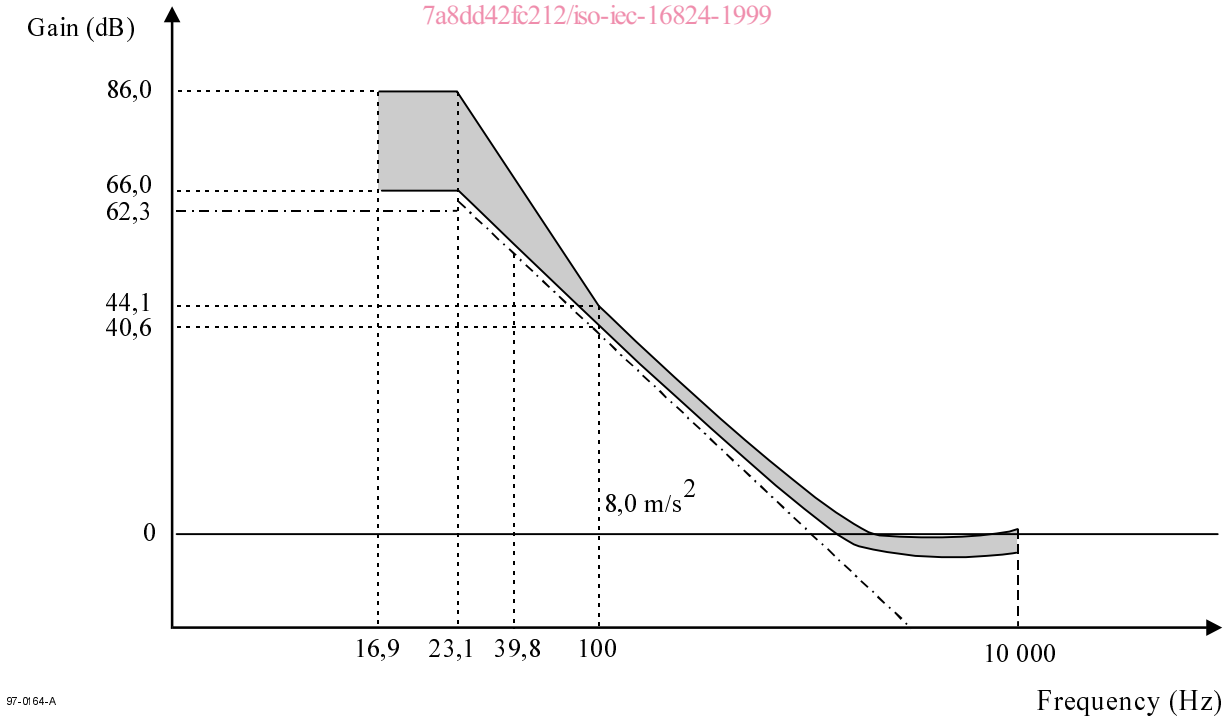


Figure 3 - Reference Servo for axial tracking