INTERNATIONAL STANDARD

IEC 62403

First edition
2005-06

High density recording format on CD-R/RW disc systems – HD-BURN format

Reference number
IEC 62403:2005(E)

Publication numbering

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Международная Электротехническая Комиссия

PRICE CODE U

For price, see current catalogue

CONTENTS

1 Scope 6
2 Normative references 6
3 Terms and definitions 7
4 Convention and notations 8
4.1 Representation of numbers 8
4.2 Names 9
5 List of acronyms 9
6 General requirements 10
6.1 Environment 10
6.2 Unrecorded disc 11
6.3 Recorded disc 11
7 Mechanical and physical characteristics 11
7.1 Mechanical parameters 11
7.2 Optical parameters 11
7.3 Recording parameters 11
8 Disc format 11
8.1 Track format 11
8.2 Data frame format 13
8.3 ECC block format 13
8.4 Recording frames 13
8.5 Physical sectors 13
8.6 Sector number 13
8.7 Format of the inner area 13
8.8 Format of the user data area 22
8.9 Format of the lead-out area 22
9 File system 22

Annex A (normative) A standard disc 23
Annex B (normative) ATIP synchronization rule 29
Annex C (normative) General linking rules (ATIP) 30

Figure 1 – Track layout 12
Figure 2 – Sector structure 12
Figure 3 – PCA structure 13
Figure 4 – Lead-in (PMD) data structure 14
Figure 5 – Multi-session structure 14
Figure 6 – Lead-in (PMD) data structure 15
Figure A.1 – Read only optical pick up 23
Figure A.2 – Recorder optical pick up 24
Figure A.3 – Modulation amplitude and signal asymmetry 26
Figure A.4 – General system diagram for jitter measurement 26
Figure A.5 – Write strategy pulse 27
Figure A.6 – Write strategy pulse for CD-RW disc 28

Figure B.1 – ATIP synchronization rule 29
Figure C.1 – Write start for general linking rules (ATIP) 30
Figure C.2 – Write stop for general linking rules (ATIP) 30

Table 1 – PMA padding data format 14
Table 2 – TPMA structure-1 15
Table 3 – TPMA structure-2 15
Table 4 – TPMA structure-3 16
Table 5 – Initial data of PMD lead-in of disc information 16
Table 6 – Write type 17
Table 7 – Link size 17
Table 8 – PMD-1 18
Table 9 – PMD-1 item detail 19
Table 10 – PMD lead-in start address 19
Table 11 – Media information 20
Table 12 – Point field 20
Table 13 – PMD-2 20
Table 14 – PMD-3 21
Table 15 – PMD-4 21
Table 16 – PSI 21
Table 17 – PMD lead-in start address 22
Table 18 – Media information 22

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH DENSITY RECORDING FORMAT ON CD-R/RW DISC SYSTEMS – HD-BURN FORMAT

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The text of this standard is based on the following documents:

CDV	Report on voting
100/844/CDV	100/926/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

HIGH DENSITY RECORDING FORMAT ON CD-R/RW DISC SYSTEMS – HD-BURN FORMAT

1 Scope

This International Standard specifies the HD-BURN format applied to CD-R/RW discs. The HD-BURN system is capable of recording the information in double density compared to the conventional CD-R/RW disc. It enables the realization of products with high reliability, high speed and interchangeability, and is especially suitable for consumer applications with high cost-performance.

This document describes:

– the physical characteristics for the recording and playback;
– the track structure of a disc;
– the data structure in the track;
– logical format structure.

2 Normative references

The following references are indispensable for the application of this document. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60908, *Audio recording –Compact disc digital audio system*

ISO/IEC 16448:2002, *Information technology – 120 mm DVD – Read-only disk*

ISO/IEC 20563, I*nformation technology – 80 mm (1,23 Gbytes per side) and 120 mm (3,95 Gbytes per side) DVD-recordable disc (DVD-R)*

IEC 62291:2002, *Multimedia data storage – Application program interface for UDF based file systems*

ISO 9660:1988, *Volume and file structure of CD-ROM for Information Interchange*

ISO/IEC 13346-1:1995, *Information technology – Volume and file structure of write-once and rewritable media using non-sequential recording for information interchange – Part 1: General*

The Red Book: *Compact disk digital Audio System Description Version*, May 1999 Sony/Philips

The Orange Book part2: *Recordable compact disk systems, Part2 CD-R Version 3.1*, Sony/Philips

The Orange Book part 3: *Recordable compact disk system, Part3 CD-RW Volume 3*, Ultra-Speed Ver 1.0

NOTE The Red book and Orange book can be obtained from Sony/Philips.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
absolute time in pre-groove
ATIP
time-code information contained in the pre-groove with an additional modulation of the wobble

3.2
access guard area
AGA
preamble data area for reading the following ECC blocks

3.3
HD-BURN
high-density write system at CD-R/RW disc

3.4
land pre pit
LPP
pits embossed on the land during the manufacture of the disc substrate, which contain address information

3.5
multi-session
disc constituted by some sessions

3.6
non CD sector
sector, which has a different structure from the CD

3.7
physical sector number
PSN
serial number, which is allocated to physical sectors on the disc

3.8
pre-groove
guidance track in which clocking and time code information is stored by means of an FM modulated wobble

3.9
program memory data
PMD
information, which is described on the recording program of the disc, including information on each recording mode

3.10
program start information
PSI
start address of the first lead-in

3.11
Reed-Solomon product code
RSPC
method of an error correction code, which corrects errors by multiple bits

3.12
sector
smallest addressable part of a track in the information zone of a disc that can be accessed independently of other addressable parts

3.13
session
area on the disc consisting of lead-in area, program area and lead-out area

3.14
synchronization frame
group of 1488 channel bits, which is representing a synchronization pattern

3.15
temporary program memory area
TPMA
area, which is used for intermediate storage

3.16
track
path, which is followed by the focus of the optical beam during one revolution of the disc

4 Convention and notations

4.1 Representation of numbers

A measured value is rounded off to the least significant digit of the corresponding specified value. 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.

– Letters and digits in parentheses represent numbers in hexadecimal notation.
– The setting of a bit is denoted by ZERO or ONE.
– Numbers in binary notation and bit combinations are represented by strings of 0 and 1.
– Numbers in binary notation and bit combinations are shown with the most significant bit to the left.
– Negative values of numbers in binary notation are given in Two's complement.
– In each field the data is recorded so that the most significant byte (byte 0) is recorded first. Within each byte the least significant bit is numbered 0 and is recorded first, the most significant bit (numbered 7 in an 8-bit byte) is recorded last. This order of recording applies also to the data input of the error detection and correction circuits and to their output.

4.2 Names

The names of entities, for example specific tracks, fields, etc., are given with a capital letter.

5 List of acronyms

ADB	Address Data Bit
ALPC	Auto Laser Power Control
ASYM	Asymmetry
BCD	Binary Coded Decimal
BP	Byte Position
BPF	Band Pass Filter
CD-R	Compact Disk Recordable
CD-RW	Compact Disk ReWritable
CDS	Codeword Digital Sum
CD-WO	Compact Disk Write Once
CLV	Constant Linear Velocity
CRC	Cyclic Redundancy Check
DCB	Data Channel Bit
DSV	Digital Sum Value
DVD	Digital Versatile Disc
ECC	Error Correction Code
EDC	Error Detection Code
HDB	High Density Burn (= HD-BURN)
HF	High Frequency
ID	Identification Data
IED	ID Error Detection code
LOS	Lead-out Start Address
LPF	Low-Pass Filter
LSB	Least Significant Byte
MSB	Most Significant Byte
NRZI	Non Return to Zero Inverted
OPC	Optimum Power Control
PAD	Padding
PCA	Power Calibration Area
PI	Parity of Inner-code
PMA	Program Memory Area
PO	Parity of Outer-code
PUH	Pick Up Head
R/W	Rewritable
RID	Recorder Identifier
RS	Reed-Solomon

6 General requirements

6.1 Environment

6.1.1 Testing environment

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

	For dimensional measurements	For other measurements
temperature:	23 °C ± 2 °C	15 °C ± 35 °C
relative humidity:	45 % to 55 %	45 % to 75 %
atmospheric pressure:	60 kPa to 106 kPa	60 kPa to 106 kPa

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

6.1.2 Operating environment

6.1.2.1 Recorded and unrecorded discs

This International Standard requires that an optical disc 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.

Discs 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 disc. The disc exposed to storage conditions shall be conditioned in the operating environment for at least 2 h before operating.

temperature:	–25 °C to 70 °C
relative humidity:	3 % to 95 %
absolute humidity:	0,5 g/m^3 to 60,0 g/m^3
temperature gradient:	15 °C/h maximum
relative humidity gradient:	10 %/h maximum

There shall be no condensation of moisture on the disc.

6.1.2.2 Unrecorded disc environmental conditions during recording

The disc exposed to storage conditions shall be conditioned in the recording environment for at least 2 h before operating.

temperature:	–5 °C to 55 °C
relative humidity:	10 % to 95 %
absolute humidity:	0,5 g/m^3 to 30,0 g/m^3

There shall be no condensation of moisture on the disc.

6.1.2.3 Conditions of measurement

Measurements and mechanical checks shall be carried out within the following limits unless otherwise specified:

ambient temperature: 15 °C to 35 °C
relative humidity: 45 % to 75 %
air pressure: 86 kPa to 106 kPa

6.2 Unrecorded disc

6.2.1 Unrecorded CD-R disc

Unrecorded CD-R disc fulfils the requirements as written in the Disc Specification of the Orange Book, part 2.

6.2.2 Unrecorded CD-RW disc

Unrecorded CD-RW disc fulfils the requirements as written in the Disc Specification of the Orange Book, part 3.

6.3 Recorded disc

6.3.1 Recorded CD-R disc

Recorded CD-R disc fulfils the requirements as written in the Disc Specification of the Orange Book, part 2.

6.3.2 Recorded CD-RW disc

Recorded CD-RW disc fulfils the requirements as written in the Disc Specification of the Orange Book, part 3.

7 Mechanical and physical characteristics

7.1 Mechanical parameters

Refer to IEC 60908, Clause 5: Mechanical parameters

7.2 Optical parameters

Refer to IEC 60908, Clause 6: Optical parameters

7.3 Recording parameters

Refer to IEC 60908, Clause 7: Recording parameters

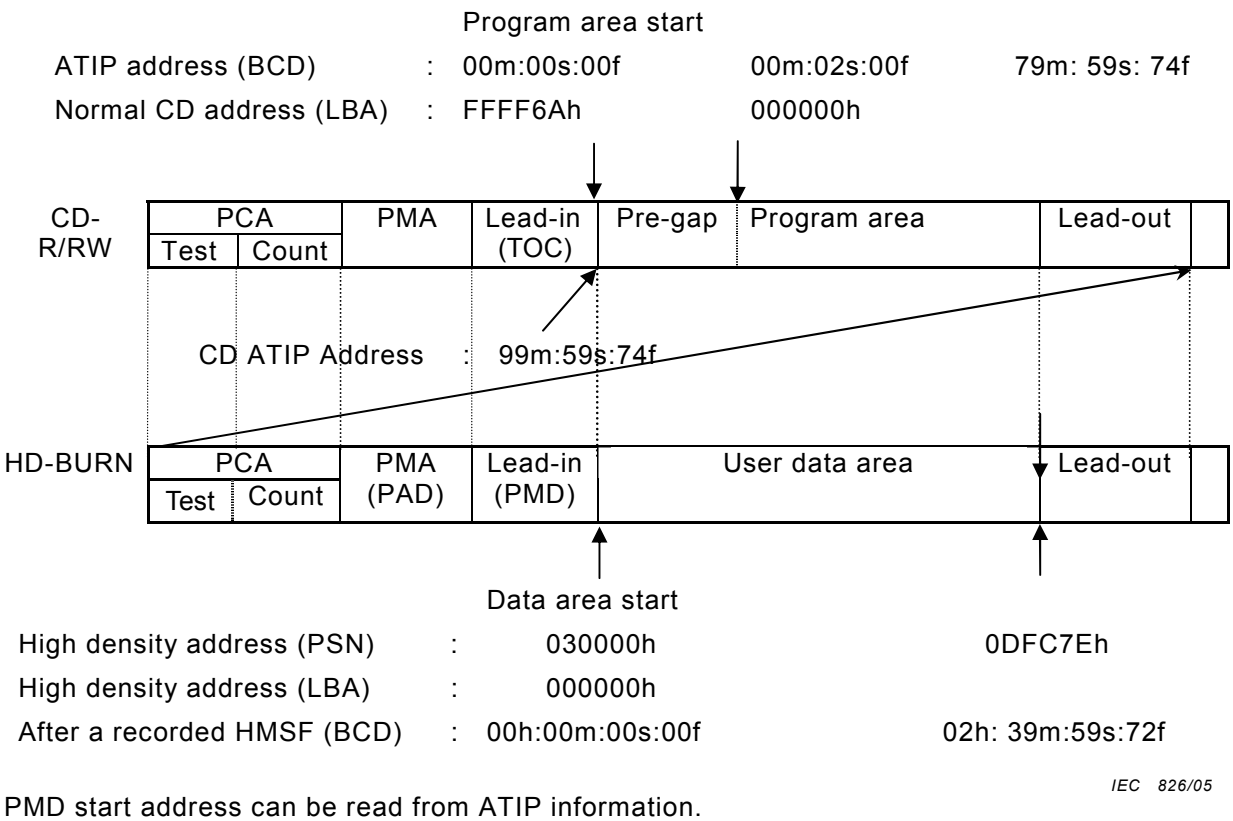
8 Disc format

8.1 Track format

8.1.1 General description of track format

The track structure of CD-R/RW disc and HD-BURN disc is shown in the Figure 1.

Example disc [Type80 (LOS)] for single session structure:



PMD start address can be read from ATIP information.

Figure 1 – Track layout

Lead-in and lead-out of the number, which is equal to the number of sessions, exist in the disc in case of the multisession structure.

8.1.2 HD-BURN sector allocation

Relations among CD-R/RW ATIP, HD-BURN physical sector and one ECC block are shown in Figure 2.

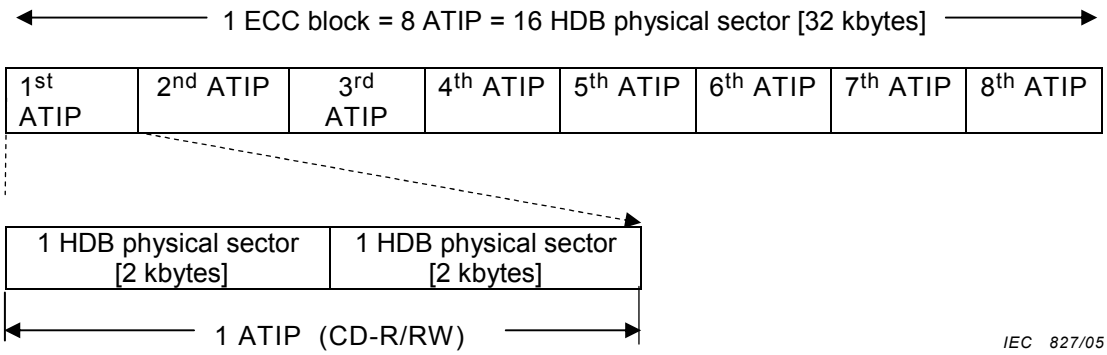


Figure 2 – Sector structure

8.2 Data frame format

Refer to ISO/IEC 16448, Clause 16.

8.3 ECC block format

Refer to ISO/IEC 16448, Clause 18.

8.4 Recording frames

Refer to ISO/IEC 16448, Clause 19.

8.5 Physical sectors

Refer to ISO/IEC 16448, Clause 21.

8.6 Sector number

Refer to ISO/IEC 16448, Clause 25.

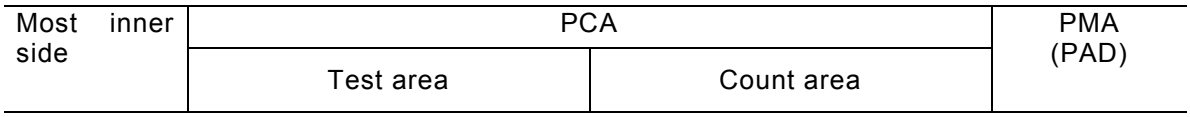
8.7 Format of the inner area

8.7.1 Format of the PCA

PCA (CD-R, RW media) should be handled as below.

Use the PCA of CD-R/RW as a PCA of the HD-BURN disc.

PCA for disc shall be used for OPC as well as CD writing. (See Figure 3.)



IEC 828/05

Figure 3 – PCA structure

Test area has 1 500 ATIP capacity.
(Refer to Orange Book, part 2 and part 3.)

1 500 ATIP allows 187 ECC Block to be included.

In the case of testing per 1 ECC, test is possible to be done up to 187 times.

8.7.2 Format of the PMA

PMA shall be padded with data as shown in Table 1 and the recording sector shall be ECC block (32KB).

In case of the non-formatted PMA, the HD-BURN drive does not handle as a HD-BURN disc.

NOTE In the case of the PMA filled with non CD sector, a usual CD-R/RW record device judges this disc as an incompatible medium.

Table 1 – PMA padding data format

PMA padding data			
BP	**Contents**	**Form**	**Byte**
00 ~ 31	Drive manufacturer ID	ASCII	32
32 ~ 39	Reserved	00	8
40 ~ 55	Model number	ASCII	16
56 ~ 63	Reserved	00	8
64 ~ 79	Serial number	ASCII	16
80 ~ 87	Reserved	00	8
88 ~ 103	Unique disc ID	->	16
104 ~ 111	Reserved	00	8
112 ~ 127	HD-BURN	Hexadecimal	1x16
128 ~2047	Reserved	00	1 920

BP	Contents	Form
2	Reserved	00
4	Year	ASCII
2	Month	ASCII
2	Date	ASCII
2	Time	ASCII
2	Minute	ASCII
2	Second	ASCII

Unique disc ID

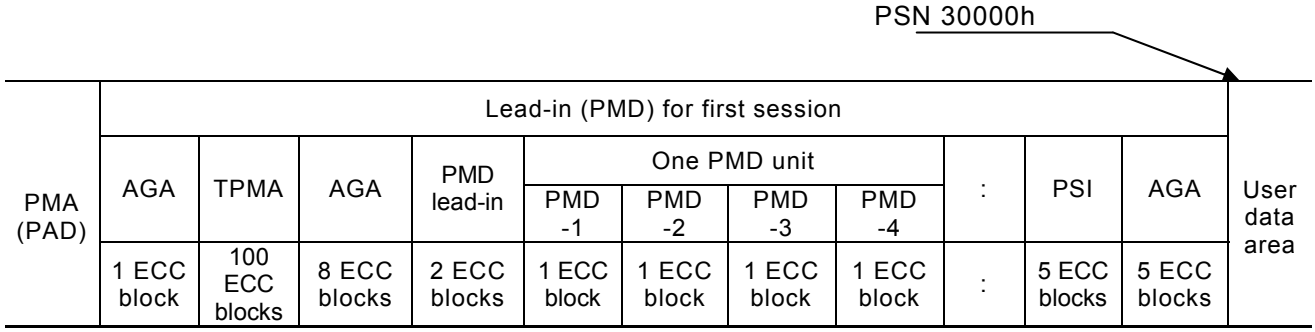
Value	Contents
00h	Reserved
01h	2x
Other	Reserved

HD-BURN

8.7.3 Format of the lead-in (PMD)

8.7.3.1 General

The data structure of the lead-in (PMD) for the first session is shown in the Figure 4.



IEC 829/05

Figure 4 – Lead-in (PMD) data structure

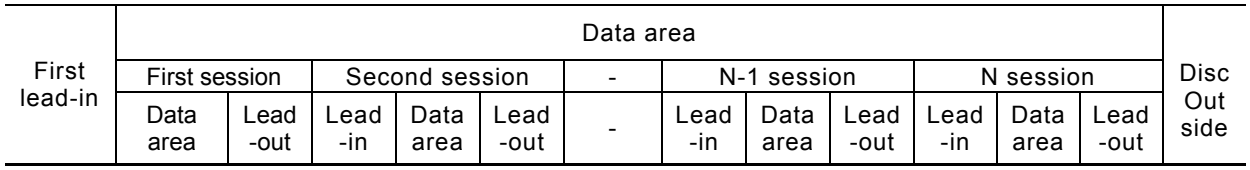
PMD shall be written when session is closed. The information about track written to data area shall be generated by each PMA data of TPMA.

Lead-in (PMD) should be specified by the following conditions;

- TPMA exists only in the first lead-in
- Each of PMD-1 ~ PMD-4 consists of one ECC block.

8.7.3.2 Multi-session

The multi-session structure in the HD-BURN writing is shown in the figure 5.



IEC 830/05

Figure 5 – Multi-session structure

The structure of the second session and after is shown in the Figure 6.

Previous session	Lead-in (PMD) for second session and after								Next session or next writable area
	AGA	PMD lead-in	One PMD unit				:	PSI	AGA	
			PMD -1	PMD-2	PMD-3	PMD-4				
	8 ECC blocks	2 ECC blocks	1 ECC block	1 ECC block	1 ECC block	1 ECC block	:	5 ECC blocks	5 ECC blocks	

IEC 831/05

Figure 6 – Lead-in (PMD) data structure

TPMA doesn't exist from the second session and after.

TPMA of the first session shall be used as TPMA of the second session and after.

PMD shall be written when session is closed. The information about track written to data area shall be generated by each PMA data of TPMA.

8.7.3.3 TPMA structure

TPMA is an area where each track information is temporally stored.
For DAO recording, TPMA shall be padded with 00h.
For TAO or incremental recording, TPMA is recorded at each completion or reservation of one data track.
A TPMA data shall be recorded by one ECC block (32 kbytes).

Table 2 – TPMA structure-1

AGA	TPMA					AGA	PMD lead-in
	PMA01	PMA02	:	PMA99	PMA100		
	1 ECC block	1 ECC block	:	1 ECC block	1 ECC block		

Table 3 – TPMA structure-2

PMA01~PMA100				
BP	Contents	Form	Byte	Detail
00 ~ 07	PMD number	Hexadecimal	1x8	10h
08 ~ 15	Marking	ASCII	1x8	HD-BURN
16 ~ 23	Reserved	00h	1x8	
24 ~ 35	Item 1	See structure-3	12	1 item + 1 byte
36 ~ 41	Reserved	00h	6	
42 ~ 53	Item 2	See structure-3	12	1 item + 1 byte
54 ~ 59	Reserved	00h	6	
60 ~ 71	Item 3	See structure-3	12	1 item + 1 byte
72 ~ 77	Reserved	00h	6	
78 ~ 89	Item 4	See structure-3	12	1 item + 1 byte
90 ~ 2047	Reserved	00h	1 958	

Table 4 – TPMA structure-3

	1 byte	1 byte		1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte
Item No	**SessionNo.**	**Control/ ADR**		**TNO**	**Point**	**Min**	**Sec**	**Frame**	**Hour**	**Phour**	**Pmin**	**Psec**	**Pframe**
1	Total N	4	1	00	D0	Number of total tracks				Next TPMA PSN address			
2	Current N	4	1	00	N	Stop time of track				Start time of track			
3	Current N	4	1	00	Last TNO	FF	FF	FF		Start time of lead-out			
4	Current N	4	2	00	Reserved	Disc identification					Reserved	Disc type	Reserved

The hatching field shall be converted to hexadecimal data by the drive if the disc contains a value between 0 and 99BCD.
D0 pointer: One D0 exists in each session.

8.7.3.4 PMD lead-in structure

The disc information of current session is recorded in PMD lead-in.

Table 5 – Initial data of PMD lead-in of disc information

PMD lead-in				
BP	**Contents**	**Form**	**Byte**	**Detail**
00 ~ 07	PMD number	Hexadecimal	1x8	10h
08 ~ 15	Marking	ASCII	1x8	HD-BURN
16 ~ 23	Reserved	00h	1x8	
24 ~ 31	Write type	Hexadecimal	1x8	DAO or TAO or incremental
32 ~ 39	Reserved	00h	8	
40 ~ 55	Link size	Hexadecimal	1x16	Zero-link or 32 KB-link
56 ~ 63	Reserved	00h	8	
64 ~ 79	Next session start address 1	Hexadecimal	4x4	PSN
80 ~ 87	Reserved	00h	8	
88 ~ 103	Next session start address 2	Hexadecimal	4x4	LBN (optional)
104 ~ 111	Reserved	00h	8	
112 ~ 127	Next session start address 3	BCD	4x4	HMSF (optional)
128 ~ 2047	Reserved	00h	1 920	

Next session address 1(PSN): 00 00 00 00h ~ FF FF FF FFh
Next session address 2(LBN): 00 00 00 00h ~ FF FF FF FFh
Next session address 3(HMSF): 00h00m00s00f ~ 09h59h59s74f

Table 6 – Write type

Value	Write type
00h	DAO-CD
01h	TAO-CD
02h	Incremental-CD
10h	SAO(DAO)-DVD
11h	Reserved
12h	Incremental-DVD
Other	Reserved

Table 7 – Link size

Value	Link size
00h	Zero-link
01h	32 KB-link
Other	Reserved

PMD lead-in shall be recorded with only two ECC blocks.
The entire capacity of PMD varies from one medium vender to another since PMD uses lead-in on the CD-R/RW media.

EXAMPLE

In the case of lead-in start address closest to program area address, the lead-in capacity is in the range of 97m50s00f ~ 99m59s74f and approximately 130 s.

In the above case, converted ATIP sector number 9 750 calculated by 130 s × 75 frames.

In the case of applying this status to the HD-BURN recording, available minimum lead-in capacity is as follows;

9 750 sectors/8 ATIP sectors = 1 218 ECC blocks, where all digits below the decimal point are dropped.

The capacity in the lead-in area varies in each disc model.

The above case shows a minimum capacity example.

8.7.3.5 PMD-1

PMD-1 is current session information.

TOC data are recorded in PMD-1.

Table 8 – PMD-1

PMD-1(current session information)				
BP	**Contents**	**Form**	**Byte**	**Detail**
00 ~ 07	PMD number	Hexadecimal	1x8	11h
08 ~ 15	Marking	ASCII	1x8	HD-BURN
16 ~ 19	Reserved	00h	4	
20 ~ 31	Item-01	See Table 9	12	“1 item of Table 9” + 1 byte”
32 ~ 35	Reserved	00h	4	
36 ~ 47	Item-02	See Table 9	12	“1 item of Table 9” + 1 byte”
48 ~ 51	Reserved	00h	4	
52 ~ 63	Item-03	See Table 9	12	“1 item of Table 9” + 1 byte”
64 ~ 67	Reserved	00h	4	
68 ~ 79	Item-04	See Table 9	12	“1 item of Table 9” + 1 byte”
80 ~ 83	Reserved	00h	4	
84 ~ 95	Item-05	See Table 9	12	“1 item of Table 9” + 1 byte”
96 ~ 99	Reserved	00h	4	
100 ~ 111	Item-06	See Table 9	12	“1 item of Table 9” + 1 byte”
112 ~ 115	Reserved	00h	4	
116 ~ 127	Item-07	See Table 9	12	“1 item of Table 9” + 1 byte”
127 ~ 135	Reserved	00h	8	
136 ~ 143	PMD lead-in start address	Hexadecimal	8	
144 ~ 197	Media information	See Table 10	54	
198 ~ 2047	Reserved	00h	1 848	

Table 9 – PMD-1 item detail

Item No	SES-NO 1 byte	CONT 4bit	ADR 4bit	TNO 1 byte	Point 1 byte	Min 1 byte	Sec 1 byte	Frame 1 byte	Hour 4bit	PHour 4bit	PMin 1 byte	PSec 1 byte	Pframe 1 byte
	0	1		2	3	4	5	6	7		8	9	10
1	N	4	1	00	01-63	ATIME (absolute time)				Start position of track			
2	N	4	1	00	A0	ATIME (absolute time)				00	00	First Track number	00
3	N	4	1	00	A1	ATIME (absolute time)				00	00	Last Track number	00
4	N	4	1	00	A2	ATIME (absolute time)				Start position of lead-out			
5	N	4	5	00	B0	Start time of next possible program in the recordable area of multi-session disc or F:FF:FF:FF				Maximum start time of outer-most lead-out area in the recordable area of multi-session disc			
6	N	4	5	00	C0	Copy of special information in ATIP			# of pointers in mode 5	Start time of the first lead-in area of the multi-session disc			
7	N	4	5	00	C1	Copy of additional information in ATIP			0000b	Set to 00h			

The hatching field shall be converted to hexadecimal data by the drive if the disc contains a value between 0 and 99BCD.

The session number field is shown in hexadecimal.

The non-hatching field shows raw data. It shall not be converted to hexadecimal by the drive.

Table 10 – PMD lead-in start address

PMD lead-in start address	8 bytes	Hexadecimal	PSN	

The value set to this field is limited to 00h or 02xxxxh.

The address is fixed to 029E60h when 00h is set to field.

Table 11 – Media information

Field name		Order		Description	Notice
Media type	2 bytes	Hexadecimal	00h	Read only media	Mandatory
			01h	Recordable media	
			02h	Rewritable media	
Recording density	2 bytes	Hexadecimal	00h	2x	Mandatory
			Other	Reserved	
Media name	32 bytes	ASCII		Reserved	Optional
Media version	16 bytes	Hexadecimal		Reserved	Optional
Data type	2 bytes	Hexadecimal	00h	Data	Optional
			01h	Audio	

Table 12 – Point field

ADR	Point	Description
1	01-63	Track number
1	A0	First track number in the current session
1	A1	Last track number in the current session
1	A2	Start location of the lead-out (current session)
5	B0	The start time for the next possible session's program area.
5	C0	Start time of the first lead-in area of the multi-session disc (only 1st session)
5	C1	Copy of additional information1 in ATIP

8.7.3.6 PMD-2

PMD-2 is an area to record copy protection information.
In the future, when this information is necessary, the value of reserved contents shall be assigned.

Table 13 – PMD-2

PMD-2 (copy protection information)				
BP	**Contents**	**Form**	**Byte**	**Detail**
00 ~ 07	PMD number	Hexadecimal	8	12h
08 ~ 15	Marking	ASCII	8	HD-BURN
16 ~ 2047	Reserved	00h	2 040	

8.7.3.7 PMD-3

PMD-3 is an area to record write strategy and over write information.
This information should be unique to each manufacturer.

Table 14 – PMD-3

PMD-3 (write strategy and overwrite information)				
BP	**Contents**	**Form**	**Byte**	**Detail**
00 ~ 07	PMD number	Hexadecimal	8	13h
08 ~ 15	Marking	ASCII	8	HD-BURN
16 ~ 2047	Reserved	00h	2 040	Vendor unique

8.7.3.8 PMD-4

PMD-4 is an area to record OPC history information.

Table 15 – PMD-4

PMD-4 (OPC history information)				
BP	**Contents**	**Form**	**Byte**	**Detail**
00 ~ 07	PMD number	Hexadecimal	8	14h
08 ~ 15	Marking	ASCII	8	HD-BURN
16 ~ 23	RID	Hexadecimal	8	Unique serial number
24 ~ 31	Reserved	00h	8	
32 ~ 159	OPC history	Hexadecimal	128	
160 ~ 2047	Reserved	00h	1 888	

In the case of CD-RW media, overwrite on the recorded portion is possible.

In the case of implementation of overwrite, the information of PMA and PMD should be rewritten, if it is necessary. However, the overwrite is applicable only for DAO recording and TAO recording, and should not be applied to any other types of recording.

8.7.3.9 PSI structure format

PSI is an area to record PMD start information.
This information should be recorded to the fixed address in every disc model because the first lead-in start address is different for each disc.

Table 16 – PSI

PSI (PMD start information)				
BP	**Contents**	**Form**	**Byte**	**Detail**
00 ~ 07	RRI ID	Hexadecimal	1x8	20h
08 ~ 15	Marking	ASCII	1x8	HD-BURN
16 ~ 23	Reserved	00h	8	
24 ~ 31	PMD lead-in start address	Hexadecimal	8	
32 ~ 87	Media information	See Table-18	56	
88 ~ 2047	Reserved	00h		

Table 17 – PMD lead-in start address

PMD lead-in start address	8 bytes	Hexadecimal	PSN	

The value set to this field is limited to 00h or 02xxxxh.
Address is fixed to 029E60h when 00h is set to this field.

Table 18 – Media information

Field name		Order		Description	Notice
Media type	2 bytes	Hexadecimal	00h	Read only media	Mandatory
			01h	Recordable media	
			02h	Rewritable media	
Recording density	2 bytes	Hexadecimal	00h	2x	Mandatory
			Other	Reserved	
Media name	32 bytes	ASCII		Reserved	Optional
Media version	16 bytes	Hexadecimal		Reserved	Optional
Data type	2 bytes	Hexadecimal	00h	Data	Optional
			01h	Audio	

8.8 Format of the user data area

See Figure 1 for start address of program area.

The position of PSN 030000h is the same position as that of 00minutes/00seconds/00frame.
A minimum record unit is one ECC block.

8.9 Format of the lead-out area

For the physical sector in the lead-out area, the attribute of the lead-out area shall be set in area type, which exists in the sector information.
The main-data of lead-out shall be recorded to 00h.

Calculate the size based on ATIP sector:

1 First session: For 90 s -> (90 s x 75 frames x 2) + 4 frames
= HD-BURN lead-out capacity

2 Second session and afterwards: For 30 s -> (30 s x 75 frames x 2) + 12 frames
= HD-BURN lead-out capacity

NOTE Lead-out exists in each session. The lead-out size of the first session is different from that of the second session and afterwards.

The lead-out structure is the same as that of CD/DVD's lead-out structure.

9 File system

The file system should be based on the following standards;

IEC 62291: 2002, ISO 9660:1988 and ISO/IEC 13346-1:1995.

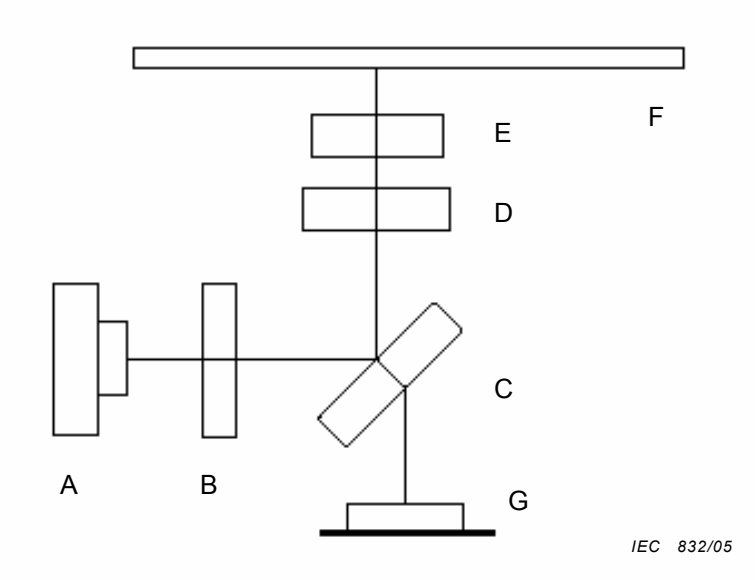
Annex A
(normative)

A standard disc

A.1 PUH

A.1.1 PUH for measuring recorded disc and read only disc

Figure A.1 shows the optical system of PUH, which is used for the performance evaluation of the recorded disc and the read-only disc.



Key

A	Laser diode	B	Grating lens
C	Half-mirror	D	Collimator lens
E	Objective lens	F	Optical disc
G	Split photodiode		

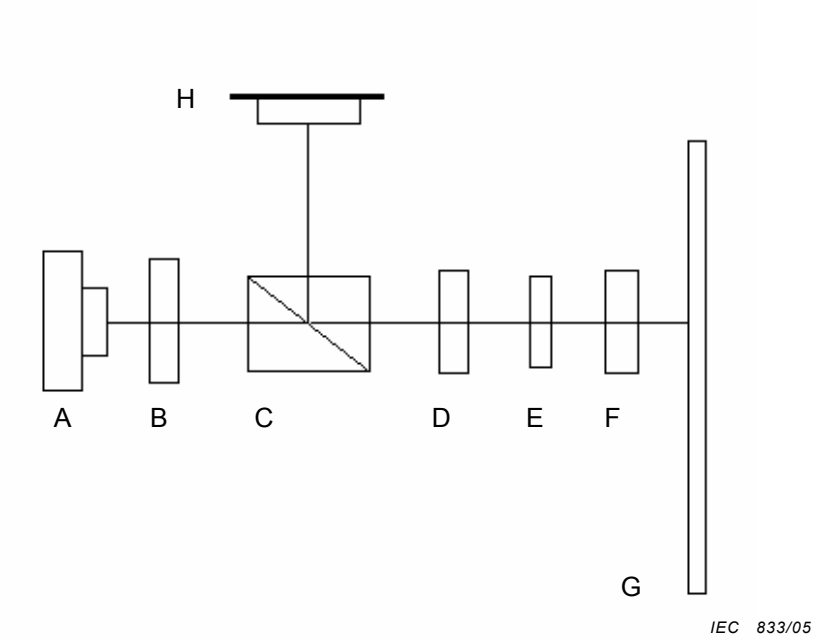
Figure A.1 – Read only optical pick up

The parameter of the optical system is indicated as follows:

a) Wavelength (λ):	780 nm ± 10 nm
b) Polarization:	Perpendicular to the track
c) Wavefront distortion:	< 0,05 λ (RMS value)
d) Numerical aperture:	0,47 ± 0,01
e) Rim intensities	
Tangential:	> 0,3
Radial:	> 0,3
f) Laser power	
Reading:	< 0,7 mW (continuous wave in the central spot)

A.1.2 PUH for recording

Figure A.2 shows the optical system of PUH, which is used for the writing performance evaluation.



Key

A	Laser diode	B	Grating lens
C	Polarizing beam splitter	D	Collimator lens
E	Optical quarter-wave plate	F	Objective lens
G	Optical disc	H	Split photodiode

Figure A.2 – Recorder optical pick up

The parameter of the optical system is indicated as follows:

a) Wavelength (λ): 785 nm ± 5 nm

b) Polarization: Circular

c) Wavefront distortion: < 0,05 λ (RMS value)

d) Numerical aperture: 0,50 ± 0,01

e) Rim intensities

- Tangential: 0,3
- Radial: 0,3

f) Laser power

- Reading: < 0,7 mW (continuous wave in the central spot)
- Writing: According to the write strategy, see Figure A.2.

A.2 Operational signals for recorded disc and read only disc

A.2.1 Measurement conditions

The scanning velocity should be 4,51 times that of the CD.

The measurement conditions shall be as specified in 6.1.1.

The HF signal equalizing for jitter measurement shall be as specified in ISO/IEC 20563 Annex F.

A.2.2 Read conditions

The power of the read spot shall not exceed 1,0 mW (continuous wave in the central spot).

A.2.3 Recorded disc HF signals

Refer to ISO/IEC 20563, 13.3.

A.2.3.1 Modulation

The peak-to-peak value generated by the longest recorded mark and space is I_{14}.

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

The peak-to-peak value generated by the shortest recorded mark and space is I_3.

The zero level is the signal level obtained when no disc is inserted.

These parameters shall satisfy the following requirements:

I_{14}/I_{14H} = 0,60 minimum,

I_3/I_{14} = 0,15 minimum.

A.2.3.2 Signal asymmetry

The value of asymmetry shall satisfy the following requirements when a DVD-R disc is recorded at the optimum recording power P0. (See Figure A.3.)

$-0{,}05 < ((I_{14H} + I_{14L})/2 - (I_{3H} + I_{3L})/2)/I_{14} < 0{,}15$,

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.

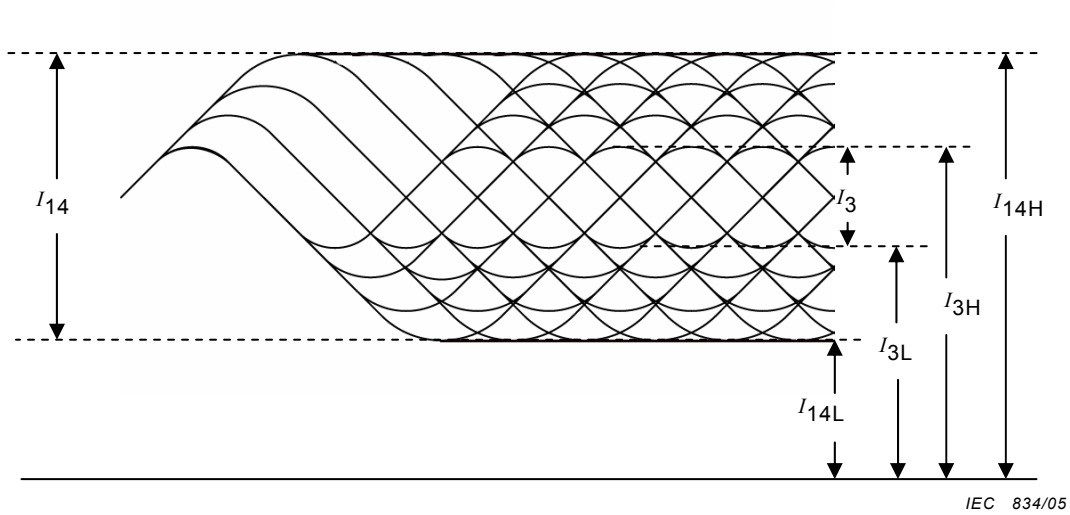


Figure A.3 – Modulation amplitude and signal asymmetry

A.2.3.3 Cross-track signal

Refer to ISO/IEC 20563, 13.3.3

A.2.4 Quality of signals

A.2.4.1 Jitter

Refer to ISO/IEC 20563, 13.4.1.

Jitter shall be less than 10,0 % of the channel bit clock period, when measured according to Figure A.4.

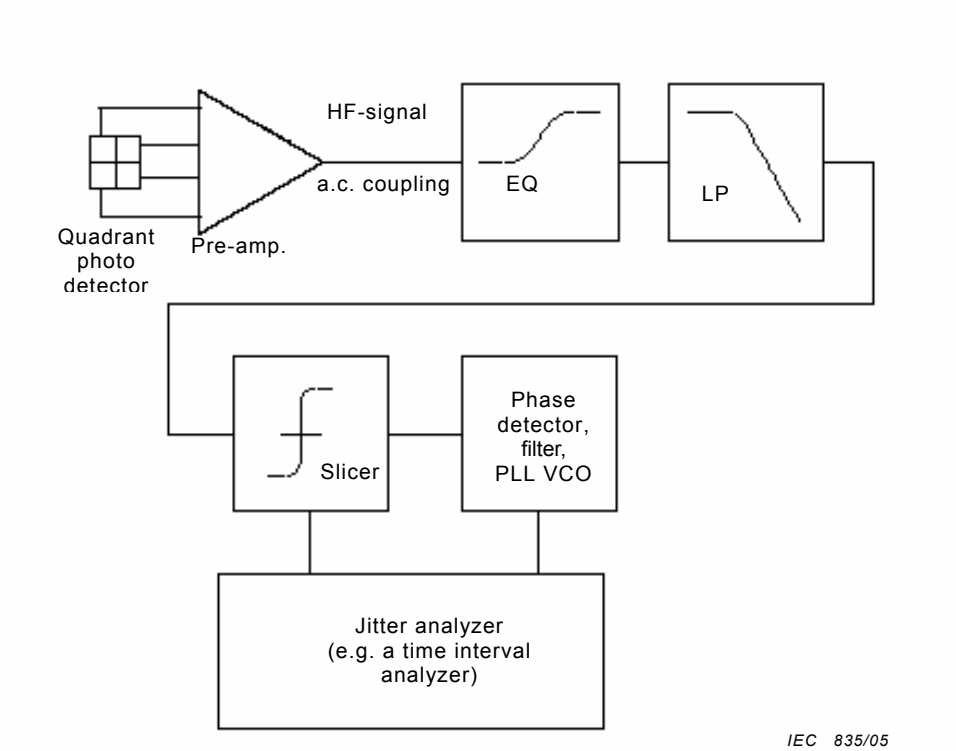


Figure A.4 – General system diagram for jitter measurement

A.2.4.2 Random errors

Refer to ISO/IEC 20563, 13.4.2.

A.2.4.3 Defects

Refer to ISO/IEC 20563, 13.4.3.

A.3 Write strategy for CD-R media testing

In the case of recording by this optical system indicated in Clause A.1 and Clause A.2, the write strategy pulse should be referred to Figure A.5.

NOTE Unstable optical power will influence the degree of modulation and jitter.

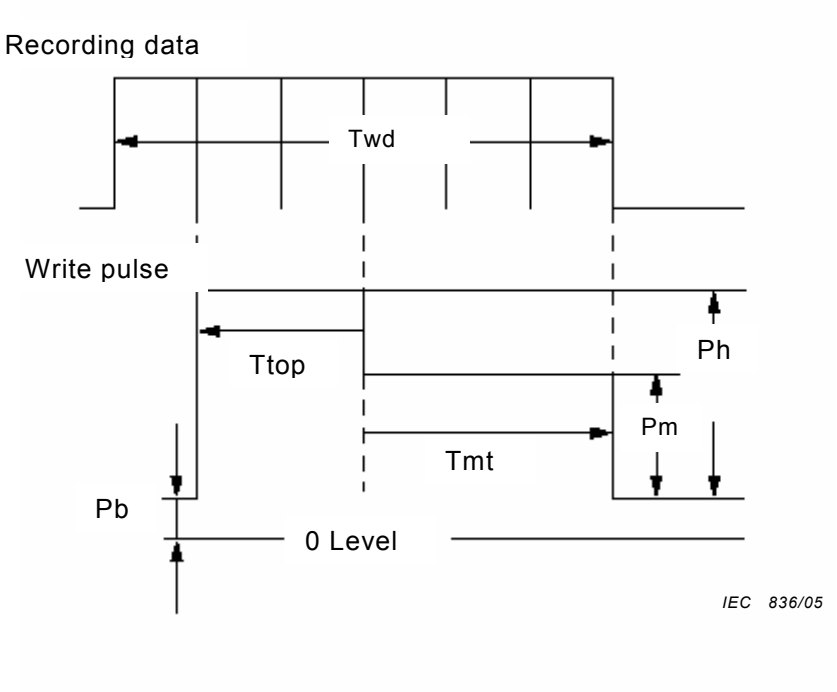


Figure A.5 – Write strategy pulse

Twd:	Recording signal width
Pb:	Playback power
Pm:	Write power
Ph:	Enhanced power
Pm+Pb:	Optimum recording power 5 mW ~ 10 mW at 3,57 m/s
Ttop:	2 T when Twd = 3 T, 5 T ~ 11 T and 14 T. (2 – 1/20) T when Twd= 4 T.
Tmt:	(N – 3) T
Ph/Pm:	1,08

A.4 Write strategy for CD-RW media testing

Example of the write pulse for CD-RW disc.

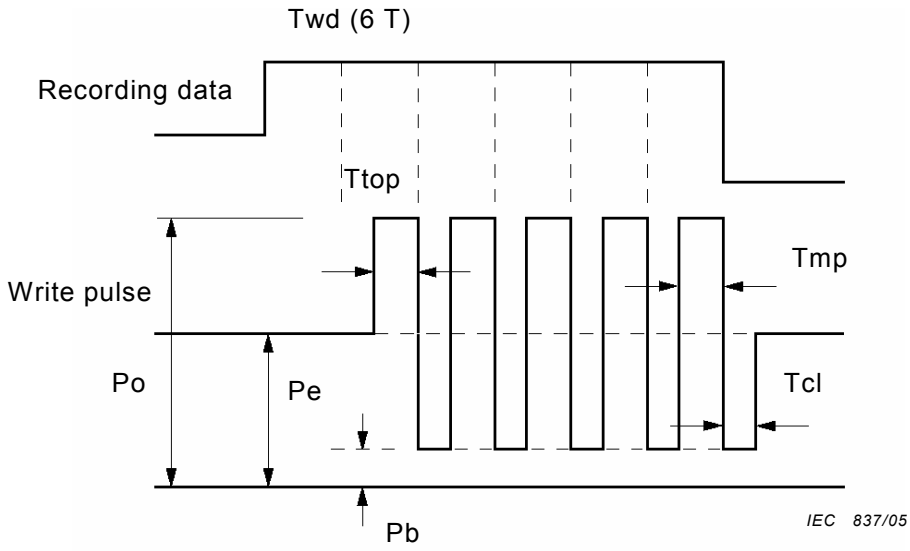


Figure A.6 – Write strategy pulse for CD-RW disc

Po:	Write power
	7 ~ 19 mW at 3,57 m/s
Pe:	Erase power
	3,5 ~ 7,5 mW at 3,57 m/s
Pb:	Playback power
Pe/Po:	0,43
Ttop:	0,5 T
Tmp:	0,5 T
Tcl:	0,2 T

Annex B
(normative)

ATIP synchronization rule

Over the entire disc, the position between the ATIP synchronization and the ECC synchronization should be 0 ± 2 synchronization frames.

The position of ATIP synchronization is defined as the position where synchronization can be recognized as a synchronization pattern from the reproduced signal; this position appears directly after the physical synchronization patterns on the disc.

The position of a synchronization frame is defined as the start position of the physical synchronization pattern on the disc. (See Figure B.1.)

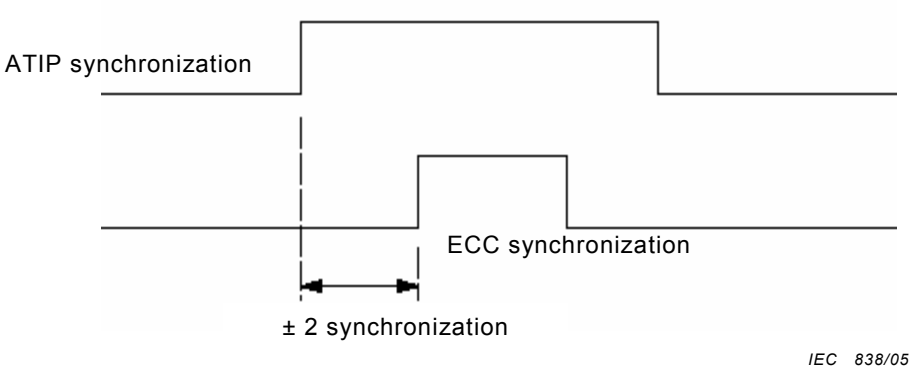


Figure B.1 – ATIP synchronization rule

Annex C
(normative)

General linking rules (ATIP)

The link position is the physical location on the disc where the recording of modulation signals is allowed to start and stop.

The nominal link position should be 30 T ± 10 T from the changing point in the first 14 T/4 T pattern of ECC synchronization.

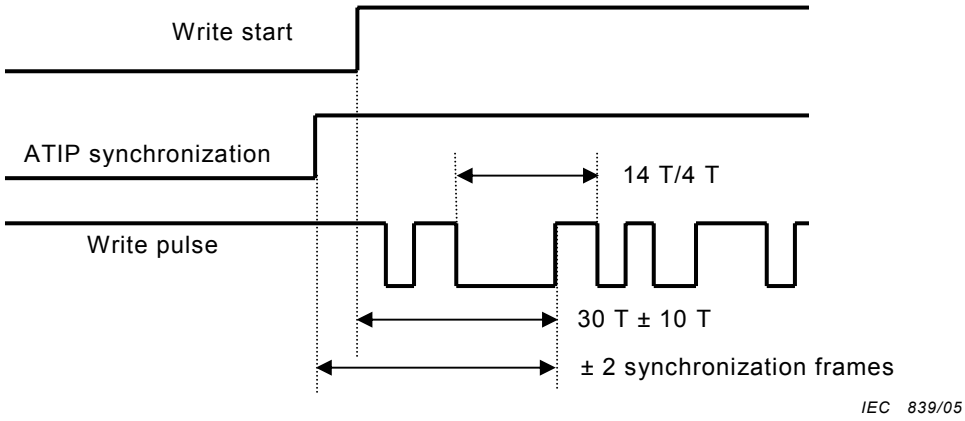
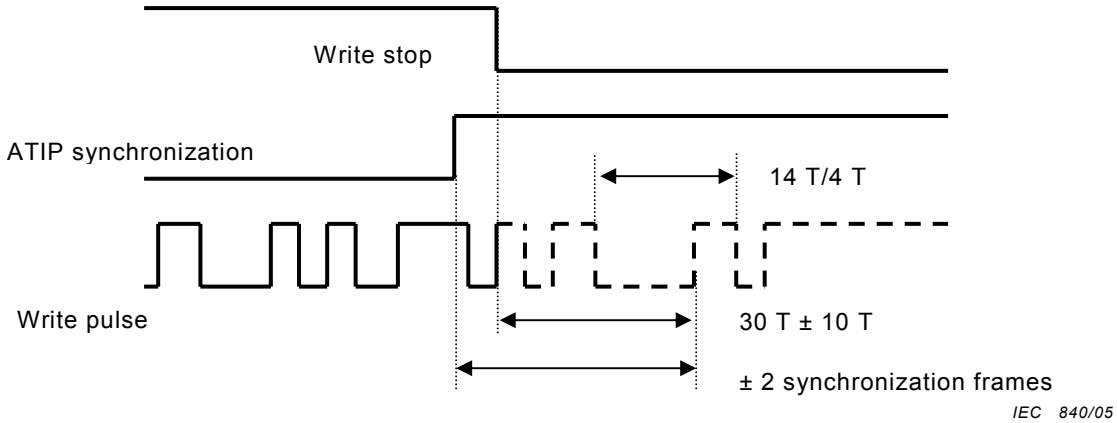


Figure C.1 – Write start for general linking rules (ATIP)

On the start point of record, the timing of 14 T of ECC block pattern of ATIP signal and a record signal serves as ± 2 synchronization frames.



NOTE The broken line indicates the waveform of write pulse, which is assumed to occur under continuous writing status. The drawing shows the timing.

Figure C.2 – Write stop for general linking rules (ATIP)

On the stop point of record, the timing between the changing point in the expected 14 T/4 T pattern if recording is continued and the ATIP synchronization point should be 30 T ± 10 T.

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ISBN 2-8318-8053-X

ICS 35.220.30

Typeset and printed by the IEC Central Office
GENEVA, SWITZERLAND