Confidential Information

DVD+ReWritable

DVD+MRW

Defect Management & Physical Formatting version 1.2

System Description

October 2004

approved by the Mount Rainier Promoters

DVD

Mount Rainier ReWritable

Defect Management & Physical Formatting

Version 1.2

October 2004

COPYRIGHT

DISCLAIMER

LICENSING

Subject to a non-disclosure agreement between your company and the “6C”, this document is available for informative purposes only; <u>not</u> for the manufacture and/or sale of DVD+RW products in which the techniques described in this document are being implemented.
Before the implementation in products, your company must conclude a license agreement with the Mount Rainier Promoters to obtain a license under the relevant intellectual property rights. Information about how to obtain such a license can be found at Philips’ website at the web-address mentioned below.

Apart from the free license in relation with this Mount Rainier specification, application of the SYSTEM DESCRIPTION DVD+RW, as referred to in this document, in both disc and equipment products requires a separate patent license from Philips and other parties owning and licensing relevant patents for the DVD+RW format.

NOTICE

For any further explanation of the contents of this document, or in case of any perceived inconsistency or ambiguity of interpretation, or for any information regarding the DVD+RW patent license program, please consult:

Royal Philips Electronics
Intellectual Property & Standards
Business Support
Building WAH-2
P.O. Box 220
5600 AE Eindhoven
The Netherlands

Fax.: +31 - 40 - 27 32113
Internet: http://www.licensing.philips.com
E-mail: info.licensing@philips.com

Table of Contents

List of illustrations

This page is intentionally left blank

I General

I.1 Scope

This document defines methods for Defect Management and Physical Background Formatting that can be applied to DVD+RW. Applying the procedures and formats described in this document will improve the performance of the DVD+RW system in a computer environment.

I.2 Main features

A DVD+MRW system according to the specifications in this document will offer the following features:

- full random access,
- the data transfer between host computer and drive is based on 2K User Data Frames,
- Defect Management handled by the drive (or by a dedicated Read-Only device driver),
- Physical formatting performed in background by the drive (without interaction with the host computer),
- the disc will be available for use immediately after insertion,
- ejecting the disc before the Background Formatting process is completed is possible.

I.3 References and conformance

DVD+MRW Defect Management and Physical Formatting conforms to the mandatory requirements specified in this document (referred to as DM&PF). All parts in this document are mandatory unless they are specially defined as recommended or optional or informative.
DVD+MRW Defect Management and Physical Formatting can be applied to DVD+RW discs according to the System Description DVD+RW 4.7 Gbytes, Basic Format Specifications.

Note: Due to advances in technology and market requirements, System Descriptions might need to be extended after some time. This could mean that new items, such as e.g.: new modes, new pointers, new formats, new data structures or definitions for reserved bits/bytes, may have to be added to a System Description.
System designers should take notice of this in the design of their products (e.g. check for version numbers).

DVD+MRW also conforms to the applicable parts of the System Descriptions or international standards that are listed below:

- DVD+RW: DVD+ReWritable, specified in the System Description DVD+RW 4.7 Gbytes, Basic Format Specifications, Hewlett-Packard Company, Mitsubishi Chemical Corporation, Royal Philips Electronics, Ricoh Company, Sony Corporation and Yamaha Corporation.
- ISO 646: Information processing
ISO 7-bit coded character set for information interchange.
Ref. No. ISO 646 : 1983 (E).
- ISO 9660: Information processing
Volume and file structure of CD-ROM for information interchange.
Ref. No. ISO 9660 : 1988 (E).
- “El Torito”: Bootable CD-ROM Format Specification,
version 1.0, January 25, 1995
Phoenix Technologies and IBM

I.4 Conventions and notations

I.4.1 Meaning of words

In this document the following words have a special meaning:

May: indicates an action or feature that is optional.

Optional: describes a feature that may or may not be implemented.
If implemented, the feature shall be implemented as described.

Shall: indicates an action or feature that is mandatory and must be implemented to claim compliance to this specification.

Should: indicates an action or feature that is optional, but its implementation is strongly recommended.

I.4.2 Representation of numbers

Numbers in decimal notations are represented by the digits 0 to 9. The decimal symbol is "." (dot). In large numbers the "," (comma) can be used as digit grouping symbol.

Numbers in hexadecimal notation are represented by the hexadecimal digits 0 to 9 and A to F followed by lowercase "h". The character x in hexadecimal numbers represents any digit 0 to 9 or A to F.

Numbers in binary notations and bit patterns are represented by strings of digits 0 and 1 followed by lowercase "b", with the most significant bit shown to the left. The character x in binary numbers represents a digit 0 or 1.
Negative values of numbers in binary notation are given as Two's complement.
In a pattern of n bits, bit $b_{[n-1]}$ shall be the most significant bit (msb) and bit b_0 shall be the least significant bit (lsb). Bit $b_{[n-1]}$ shall be recorded first.

In each data field, the data is recorded so that the most significant byte (MSB), identified as Byte 0, shall be 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 $b_{[8n-1]}$ shall be recorded first.

A range of values is indicated as x ~ y, where x and y are included in the range.
A list of integers is indicated as i..j. The list contains all numbers between i and j, including i and j (e.g. k = 0..3 means: k can adopt the values 0, 1, 2 or 3).
If the step size is different from 1, this is indicated as: i, [i+s]..j (e.g. k = 1, 4..16 means: k can adopt the values 1, 4, 7, 10, 13 or 16).
A group of parameters is indicated as Param m..n or P_m .. P_n. The group contains all parameters with an index between m and n, including m and n (e.g. byte 16..31, bit 7..4, Add_0 .. Add_{255}).

I.4.3 Names

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

I.5 Definitions

I.5.1 Definitions of terms

ADIP address code	:	The blank DVD+RW disc has a wobbled Pre-groove for tracking and addressing purposes. The wobble is phase modulated with an address code.
Blank	:	see unrecorded area
ECC Block	:	A group of 16 Frames to which error correction parity bytes have been added, according to a Reed-Solomon Product Code. An ECC Blocks is the smallest amount of information that can be recorded independently.
Frame	:	A unity of 2064 bytes as defined in the DVD+RW 4.7 Gbytes Book (page 18). 2048 bytes of the Frame are user data bytes. The other bytes are used for identification, addressing and error detection.
Ice	:	see unrecorded area
Packet	:	A Packet is a unit of 2 consecutive ECC Blocks, only defined for the storage of Defect Management information.
Physical Block Number	:	A number identifying each ECC Block, which number consists of the 20 most significant bits of the Physical Sector Numbers in the ECC Block (equivalent to the Physical Sector Number divided by 16).
Physical Sector Number	:	A 24-bit number identifying each 2K Frame.
Read-Modify-Write	:	The smallest addressable unit in DVD is a 2K Frame. The smallest unit that can be written is a 32K ECC Block, consisting of 16 Frames. If one or more (but less than 16) Frame(s) in an ECC Block have to be rewritten, the contents of the ECC Block is read from the disc, the contents of the (User Data) Frame(s) concerned is replaced and the full ECC Block is written back to the disc. This process is called “Read-Modify-Write”.
Recorded Information	:	Information, stored as marks on the disc during the recording or overwrite process of the DVD+RW disc.
Reserved	:	“Reserved” in relation to a value means: the specified value(s) shall not be used. In future standards, these value(s) can be assigned. "Reserved” in relation to a field means: the use of the field(s) is not specified and the value(s) in the field(s) must be set to zero, unless specified otherwise. In future standards, the use of these fields can be defined. Drives compliant with any version of this document shall ignore fields and values that were Reserved in the version of the document according to which the drive has been designed, but which fields and values have been assigned in more recent versions.

Unrecorded area	:	An area in which no signal has been recorded, or in which a previously recorded signal has been physically erased. The track (groove) is in the high-reflective state, also called “ice” or “blank”.
User Data Frame	:	2048 bytes of user data (see Frame).
Write_streaming	:	A method of recording real-time data (such as digital video).

I.5.2 List of acronyms

acronym	meaning
ADIP	ADdress In Pre-groove
BP	Byte Position
DA	Data Area
DM&PF	Defect Management & Physical Formatting (as reference to this document)
DOW	Direct OverWrite
DM	Defect Management
DTF	Defect Table Frame
FSS	File System Structure
GAA	General Application Area
LFA	Logical Frame Address
LI	Lead-in Zone
LO	Lead-out Zone
LSB	Least Significant Byte
lsb	least significant bit
LSN	Logical Sector Number
LVA	Last Verified Address
LWA	Last Written Address
MDT	Main Defect Table
MIP	Main Information Packet
MSB	Most Significant Byte
msb	most significant bit
MTA	Main Table Area
OPC	Optimum Power Control
OS	Operating System
PBN	Physical Block Number (= PSN / 16)
PSN	Physical Sector Number
PTP	Progress Tracking Pointer
R-M-W	Read-Modify-Write
RO	Read-Only
RSV	Reserved
SA	Spare Area
SDT	Secondary Defect Table
SIP	Secondary Information Packet
STA	Secondary Table Area
UD	User Data
UDA	User Data Area

II Introduction

Functionality

To exploit the full capabilities of DVD+MRW in a computer data storage environment, several conditions should be fulfilled:

1) the system needs full random access,
2) the data transfer between host computer and drive shall be based on 2K User Data Frames,
3) the system needs a method of Defect Management that can be handled by the drive or by a dedicated RO device driver,
4) physical formatting shall be performed by the drive in background without interaction with the host computer,
5) the disc should be available for use immediately after insertion,
6) the time to eject the disc shall be minimal.

Compatibility

To guarantee read compatibility with DVD-RO drives (or DVD recorders not compliant with this DM&PF), the following requirements have to be fulfilled:

- the disc shall have a Lead-in Zone, a Data Zone and a Lead-out Zone,
- all Data Zone between the Lead-in Zone and the Lead-out Zone shall be fully physical formatted,
- all data, including the Defect Management information and Replacement Areas shall be available inside the Data Zone (the original logically addressable space) of the disc (see Figure 1). The Defect Management then could be handled also by a dedicated RO device driver running in the host computer.

When a disc fulfils all these conditions, we call such a disc: **“ROM-compatible”**.

To facilitate the use of the disc by DVD-RO drives that do not support Defect Management, optional RO device drivers, which can add this functionality to the system, could be recorded on the disc.

Defect Management

The Defect Management system is based on a Main Table Area (MTA), a Secondary Table Area (STA) and Spare Areas (SA) at the beginning and at the end of the Data Zone of the disc. For the size of the Spare Areas, 2 options are available:

1) for **“normal use”**, with a fixed number of ECC Blocks corresponding to about 3% of the remaining data capacity on a 120 mm disc and to about 10% of the remaining data capacity on an 80 mm disc. This option is defined in detail in chapter IV.
2) for **“extensive use”** (on 120 mm discs only), with a fixed number of ECC Blocks corresponding to about 13% of the remaining data capacity. This option is defined in detail in chapter V.

The Main Table Area is located in the Lead-in Zone of the disc, the Secondary Table Area is located at the end of the Data Zone (see Figure 1).

Formatting

Generally the end-user of the system likes to have the disc ready for use within seconds after it has been inserted into the drive. A blank disc however has to be physical formatted before all it's capabilities can be exploited fully. Because the normal physical formatting process significantly delays the use, a background formatting procedure will be defined that initializes the disc with a minimum amount of information, after which it is available for recording. The Background Formatting process proceeds with the physical formatting during the time intervals when the drive is idle. The Background Formatting described in this document only defines the physical formatting of the disc, which is file-system independent.
A fully physical formatted disc is always in a ROM-compatible state. In this state, an eject command can be executed without delay.

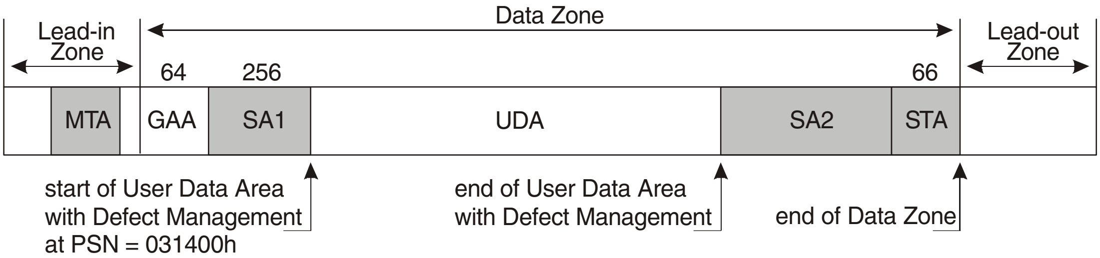
When an eject is requested before the disc has been fully physical formatted, a quick finishing process shall be executed to make the disc ROM-compatible before it leaves the recorder.

III Logical disc format

III.1 Basic lay-out of the disc

Recorders, compliant with this DM&PF, shall be able to access Defect Management information located in the Lead-in Zone.
Devices not compliant with this DM&PF are in general only able to address the Data Zone of the disc. Therefore, for reasons of compatibility with these types of devices, the Secondary Table Area and the Spare Areas are recorded in the Data Zone of the disc.
Additionally a General Application Area (GAA) has been defined, which can be used to further facilitate compatibility with non-compliant devices.
The Lead-in Zone contains the Main Table Area, to be used by recorders.

The general lay-out of the disc shall be as defined in Figure 1.



disc type	*UDA size*	*SA2 size*
80 mm	40433 ECC Blocks (16 Virtual Data Areas of 2528)	3840 ECC Blocks
120 mm normal use	139218 ECC Blocks (16 Virtual Data Areas of 8704)	3840 ECC Blocks
120 mm extensive use	126930 ECC Blocks (64 Virtual Data Areas of 1984)	16128 ECC Blocks

Figure 1 Basic disc lay-out

The General Application Area (GAA) shall consist of 64 ECC Blocks.

The first Spare Area SA1 shall consist of 256 ECC Blocks.

The second Spare Area SA2 shall consist of 3840 ECC Blocks (120 mm discs at "normal use" and 80 mm discs) or 16128 ECC Blocks (120 mm discs at "extensive use"). (See also chapter III.1.4).

The Secondary Table Area (STA) shall consist of 66 ECC Blocks.

The Main Table Area (MTA) has a variable size.

III.1.1 General Application Area

The GAA shall contain a basic File System Structure (FSS) compliant with all DVD-RO systems. This FSS can point to bootable programs, special drivers, or URL addresses from where drivers can be downloaded to make a system "Read-compatible" with the format described in this document. For further explanations see annex VII.1.

III.1.2 Main Table Area

The MTA is meant to store the Defect Tables generated by DVD recorders compliant with this DM&PF. Because the ECC Blocks in the MTA may be overwritten many times, the Defect Management system can assign substitute MTA Blocks in the Lead-in Zone. This guarantees sufficient replacement areas for Defect Tables over the life span of the disc.

III.1.3 Secondary Table Area

The STA is meant to be used for Defect Management during read-out by DVD-RO drives and DVD recorders, not compliant with this DM&PF. It is also a back-up in cases of failures in the MTA.
At eject of the disc, the information contained in the STA shall be equivalent to the information contained in the MTA.

III.1.4 Spare Areas and Defect Management capacity

The sizes of the Spare areas and the remaining User Data Area are fixed.

For the 120 mm disc at “normal use” the spare capacity is (256+3840)/(139218) ≈ 3%.
The remaining data capacity is $4.562*10^9$ bytes ≈ 4350 Mbytes (M = 2^{20}).

For the 120 mm disc at “extensive use” the spare capacity is (256+16128)/(126930) ≈ 13%.
The remaining data capacity is $4.159*10^9$ bytes ≈ 3967 Mbytes (M = 2^{20}).

For the 80 mm disc the spare capacity is (256+3840)/(40433) ≈ 10%.
The remaining data capacity is $1.325*10^9$ bytes ≈ 1264 Mbytes (M = 2^{20}).

In future, media with a different size/capacity might be defined, which media may need a different size for the Spare Area SA2.

III.2 Addressing Methods

For the addressing of the data written on the disc, two basic methods are defined:
- The Defect Management system and certain special utilities need easy access to the whole Data Zone (including the GAA, SA’s and STA) and the MTA. For the addressing of these contiguous areas, the usual Physical Sector Numbers (PSN) and Logical Sector Numbers (LSN) according to the DVD+RW System Description can be used.
- Applications need easy access to the User Data Area only. For the addressing of this Data Area a new block numbering, called Logical Frame Address (LFA) is defined.

III.2.1 LSN addressing for the whole Data Zone + MTA

The Logical Sector Numbers (LSN) can be calculated from the Physical Sector Numbers (PSN) by use of the flowing formula:

LSN = PSN – 30000h

III.2.2 LFA addressing for the User Data Area only

The Logical Frame Addresses can be calculated from the Physical Sector Numbers (PSN) by use of the flowing formula:

LFA = PSN – 31400h

	PSN	LSN	LFA
GAA Frame 1	030000h	0	excluded
:	:	:	
:	030010h	16	
:	:	:	
SA1 Frame 1	030400h	1024	excluded
:	:	:	
UDA Frame 1	031400h	5120	0
:	031401h	5121	1
:	:	:	:
:	031500h	5376	256
:	:	:	:
:	25111Fh	2,232,607	2,227,487
SA2 Frame 1	251120h	2,232,608	excluded
:	:	:	
STA Frame 1	260120h	2,294,048	excluded
:	:	:	

Figure 2 Example of PSN, LSN and LFA relations (120 mm disc at “normal use”)

This page is intentionally left blank

IV Defect Management (default parameters)

This chapter specifies the general structure for the Defect Management and the parameters for the 120 mm disc at normal use and 80 mm disc. Chapter V specifies the parameters that are different for the 120 mm disc at extensive use.

IV.1 General

The Defect Management of a recorder replaces complete ECC Blocks, which are found to be defective during writing and/or reading.
Detection of possible errors can be based on e.g. excessive servo signals, feedback from a “running OPC” during writing, or error flags from the error correction system during reading.

To reach the highest degree of commonality with CD-MRW, all Defect Management information is stored in units of 2 ECC Blocks, which corresponds with 1 Packet on CD-RW.

IV.2 Format of the MTA

The Main Table Area (MTA) consists of the Reserved Zones 1, 2 and 3 as defined in the DVD+RW System Description.
The Main Table Area (MTA) contains:

- 4 repetitions of 1 Main Information Packet (MIP), each Packet consisting of 2 ECC Blocks,
- 2 Main Defect Table Packets (MDT0 and MDT1), also consisting of 2 ECC Blocks each.
- The MTA may contain several invalid MDT Packets.

Figure 3 shows the lay-out of the MTA in the Lead-in Zone.

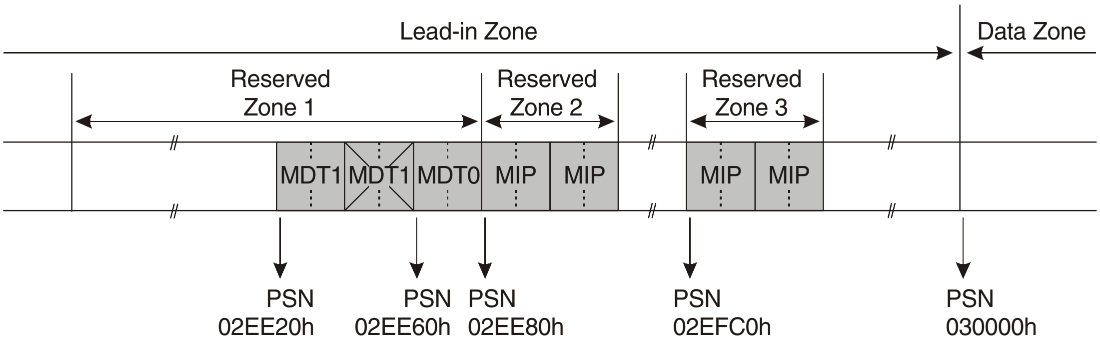


Figure 3 Basic lay-out of the MTA

The MIPs shall completely fill up the Reserved Zones 2 and 3.
The first User Data Frame of the MIP in Reserved Zone 2 shall be located at PSN 02EE80h.
The first User Data Frame of the MIP in Reserved Zone 3 shall be located at PSN 02EFC0h.

The complete Defect List is contained in 2 Packets (MDT0 and MDT1). Whenever an MDT Packet becomes defective, a substitution Packet is created just preceding the leading Packet in Reserved Zone 1 (see Figure 3, where, as an example, MDT1 has been substituted). The locations of the valid MDT Packets are administrated in the MIP and the SIP.

IV.3 Format of the STA

The Secondary Table Area (STA) contains:

- 1 Secondary Information Packet (SIP), consisting of 2 ECC Blocks, and
- 2 Secondary Defect Table Packets (SDT0 and SDT1), each consisting of 2 ECC Blocks.
- The STA may contain several invalid SDT Packets.

Figure 4 shows the lay-out of the STA.

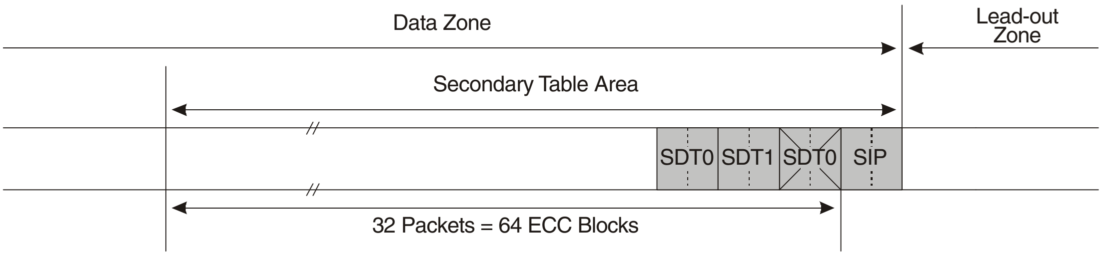


Figure 4 Basic lay-out of the STA

The SIP shall be located at a fixed position (the last and the last but one ECC Block before the start of the Lead-out Zone, with the first Data Frame of the SIP at PSN = actual start PSN of Lead-out – 32).

The complete Defect List is contained in 2 Packets (SDT0 and SDT1). Whenever an SDT Packet becomes defective, a substitution Packet is created just preceding the leading Packet in the Secondary Table Area (see Figure 4, where, as an example, SDT0 has been substituted). The locations of the valid SDT Packets are administrated in the MIP and the SIP.
All remaining Packets in the STA shall contain all AAh User Data bytes.

At eject of the disc, the information in each SDTi shall be made equivalent to the contents of MDTi.

IV.4 Virtual Data Areas

For commonality with CD-MRW and for easier Defect Table handling (see chapter IV.7.1), the User Data Area is virtually divided into 16 Data Areas.
On 120 mm discs these Data Areas consist of 8704 ECC Blocks, except the last one, which has 8658 ECC Blocks.
On 80 mm discs these Data Areas consist of 2528 ECC Blocks, except the last one, which has 2513 ECC Blocks.

IV.5 Format of the MIP and the SIP

The Main Information Packet (MIP) and the Secondary Information Packet (SIP) contain the basic information about the Defect Management structures on the disc. The Packets are always at a fixed location: 4 repetitions of the MIP in the Reserved Zones 2 and 3 in the Lead-in Zone, and the SIP at the end of the Data Zone, as the last Packet (last 2 ECC Blocks) before the Lead-out Zone. All information in the MIP/SIP shall be contained in a 2K User Data Frame, which Frame shall be repeated 32 times.
Logical Frame Addresses (LFA) as well as Physical Block Numbers (PBN = 20 msb of PSN) shall be recorded in binary notation.
When problems occur with the retrieval of the information contained in the MIP or SIP, the disc should be mounted as a read-only disc (see annex VII.2).

BP in Block	Contents 120 mm disc	80 mm disc *	Length in bytes
0	Signature of the MIP/SIP ("MIP" or "SIP")	=	3
3	Format (4 msb's) & Version (4 lsb's) number	=	1
4	Version information for recorders for reading	=	1
5	Version information for recorders for writing	=	1
6	Reserved	=	2
8	MIP/SIP update count	≈	4
12	Reserved	=	1
13	Last LFA in User Data Area (fully formatted)	-	3
16	Size of GAA = 64 ECC Blocks	=	2
18	Size of Spare Area 1 = 256 ECC Blocks	=	2
20	Size of Virtual Data Areas = 8704 ECC Blocks	- (2528)	2
22	Size of Spare Area 2 = 3840 ECC Blocks	=	2
24	Disc Status	≈	1
25	Last Written Address (LWA) Pointer	≈	3
28	Last Verified Address (LVA) Pointer	≈	3
31	Number of MDT/SDT Packets in use (2)	=	1
32	Location of MDT0	=	3
35	Location of MDT1	=	3
38	Reserved for locations of MDT2..7 (FFh)	=	6×3
56	Location of SDT0	-	3
59	Location of SDT1	-	3
62	Reserved for locations of SDT2..7 (FFh)	=	6×3
80	Reserved	=	1968

* "=" means: same definition, same fixed value
"-" means: same definition, different fixed value
"≈" means: same definition, variable value

Figure 5 Lay-out of the MIP/SIP Block for normal use

Byte 0..2: Signature

These 3 bytes shall be set to:
4D4950h, representing the characters "MIP", in each Frame of the MIP,
534950h, representing the characters "SIP", in each Frame of the SIP.

Byte 3: Format & Version number

The 4 most significant bits of this byte identify this DVD+MRW format. They shall be set to 0001b. The setting 0000b is reserved for CD-MRW, all other settings are reserved.
The 4 least significant bits of this byte specify the version number of the format, which number relates to the version number of this document. On discs compliant with this version of this document, these bits shall be set to 0011b (0000b identifies a disc according to version 0.9 of this document, 0001b identifies a disc according to version 1.0 of this document, 0010b identifies a disc according to version 1.1 of this document).

Bytes 4..5: Version information

These 2 bytes indicate the compatibility of this disc with different recorder versions. They shall be set to 00h. All other values are reserved.

Byte 6..7: Reserved: these 2 bytes are reserved and shall be set to 00h.

Byte 8..11: MIP/SIP update count

These 4 bytes shall indicate the total number of update operations on the MIP. This field shall be set to 00000000h during the initial creation of the MIP, and shall be incremented by one each time the MIP is re-written. When the count reaches the value 4,294,967,295, the count shall wrap to 0 at the next update.
Whenever the contents of the MIP is copied to the SIP, the update count of the SIP shall be set to the same value as the update count of the MIP.

Byte 12: Reserved: this byte is reserved and shall be set to 00h.

Byte 13..15: Last LFA of User Data Area

These 3 bytes shall specify the LFA relating to the last Data Frame of the last ECC Block in the User Data Area of the disc, reflecting the fully formatted situation.

Byte 13	**Byte 14**	**Byte 15**
bit 7..0	bit 7..0	bit 7..0
LFA of last User Data Frame of fully formatted disc		

Byte 16..17: Size of GAA

These 2 bytes indicate the number of ECC Blocks in the GAA as a binary value.
They shall be set to 0040h. All other values are reserved.

Byte 18..19: Size of Spare Area 1

These 2 bytes indicate the number of ECC Blocks in SA1 as a binary value.
They shall be set to 0100h. All other values are reserved.

Byte 20..21: Size of Virtual Data Areas

These 2 bytes indicate the number of ECC Blocks in each DA as a binary value.
On 120 mm discs they shall be set to 2200h.
On 80 mm discs they shall be set to 09E0h.
All other values are reserved.

Byte 22..23: Size of Spare Area 2

These 2 bytes indicate the number of ECC Blocks in SA2 as a binary value.
They shall be set to 0F00h. All other values are reserved.

Byte 24: Disc status

This byte contains flags for indicating the status of the disc. They are used for tracking the Background Formatting process or the Verification process and for failure detection purposes.

Byte 24			
Bit 7..5	Bit 4	Bit 3..1	Bit 0
Formatting status	*Verification status*	*Reserved and set to zero*	*Used Disc*

Formatting status:

bit 7,6 = 00b : disc is not physical formatted,
01b : disc has been partially physical formatted;
in this case the LWA is indicated by bytes 25..27,
10b : disc has been fully physical formatted by the user,
11b : disc has been fully physical formatted by the manufacturer.

Bit 5 is meant to be used as a "De-icing not ready" flag (see VI.3).

bit 5 = 1b : indicates that the disc has been recorded non-consecutively, and that there are blank areas between some recordings.

0b : indicates that all Packets between the start of the Data Zone and the last recorded User Data in the User Data Area (see Figure 1) have been recorded or physical formatted.

Before ejecting a disc with bit 5 set to 1b, the blank area(s) shall be physical formatted and bit 5 reset to 0b.

Verification status:

bit 4 = 0b : no Verification in progress,

1b : Verification in progress;
in this case the LVA is indicated by bytes 28..30.

Used Disc:

Bit 0 is meant to be used as an indication that the Formatting process is running on a disc that originally was not blank, and thus still can contain obsolete information from a previous use.

This bit shall be set to 1b whenever a Formatting process is started on a non-blank disc. Whenever a write is requested to a non-verified area on a Used Disc, the drive shall perform a verify-after-write, except in case of a "write_streaming" command.

Byte 25..27: Last Written Address (LWA) Pointer

These 3 bytes are used by the recorder to store the address at which the Background Formatting process has been interrupted. It shall specify the Physical Block Number (PBN) of the last ECC Block that has been recorded / physical formatted. Bit 7..4 of byte 25 are reserved and shall be set to zero.

Byte 25		**Byte 26**	**Byte 27**
bit 7..4	bit 3..0	bit 7..0	bit 7..0
Reserved	*PBN of last written ECC Block*		

Byte 28..30: Last Verified Address (LVA) Pointer

These 3 bytes are used by the recorder to store the address at which the Verification process has been interrupted. It shall specify the Physical Block Number (PBN) of the last ECC Block that has been verified. Bit 7..4 of byte 28 are reserved and shall be set to zero.

Byte 28		**Byte 29**	**Byte 30**
bit 7..4	bit 3..0	bit 7..0	bit 7..0
Reserved	*PBN of last verified ECC Block*		

Byte 31: Number MDT/SDT Packets in use

This byte specifies the number of MDT/SDT Packets that are actually in use.
It shall be set to 02h. All other values are reserved.

Byte 32..55: Locations of MDTi

Each group of three bytes indicates the location of a valid MDT in the Reserved Zone 1 in the Lead-in Zone. The locations are defined by the first PBN of each MDT Packet.
Bit 7..4 of byte [32 + i*3] are reserved and shall be set to zero.
For MDT's that are not in use (MDT2..7) and therefore not present, these three bytes shall be set to FFFFFFh.

Byte [32 + i*3]		**Byte [32 + i*3 + 1]**	**Byte [32 + i*3 + 2]**
bit 7..4	bit 3..0	bit 7..0	bit 7..0
Reserved	*first PBN of MDTi*		

Byte 56..79: Locations of SDTj

Each group of three bytes indicates the location of a valid SDT in the STA in the Data Zone. The locations are defined by the first PBN of each SDT Packet. Bit 7..4 of byte [56 + j∗3] are reserved and shall be set to zero.
For SDT's that are not in use (SDT2..7) and therefore not present, these three bytes shall be set to FFFFFFh.

Byte [56 + j*3]		**Byte [56 + j*3 + 1]**	**Byte [56 + j*3 + 2]**
bit 7..4	bit 3..0	bit 7..0	bit 7..0
Reserved	*first PBN of SDTj*		

Byte 80..2047: Reserved: these 1968 bytes are reserved and shall be set to 00h.

IV.6 Format of the Defect Tables (MDT and SDT)

Two types of Defect Tables are defined:
- the Main Defect Table (MDT), which shall be located in the Reserved Zone 1 in the Lead-in Zone,
- the Secondary Defect Table (SDT), which shall be located in the STA at the end of the Data Zone.

The complete Defect Tables are contained in 2 Packets: MDT0/MDT1, with copies in SDT0/SDT1, where each Packet consists of 2 ECC Blocks. Each of the Packets MDTi or SDTi contain 4 repetitions of 8 2K-Frames, in which the Defect Table information is stored. These 4 times 8 so-called Defect Table Frames (DTF0..7) shall be interleaved and stored in 2 ECC Blocks as defined in Figure 6, which sequence is the same as for CD-MRW.

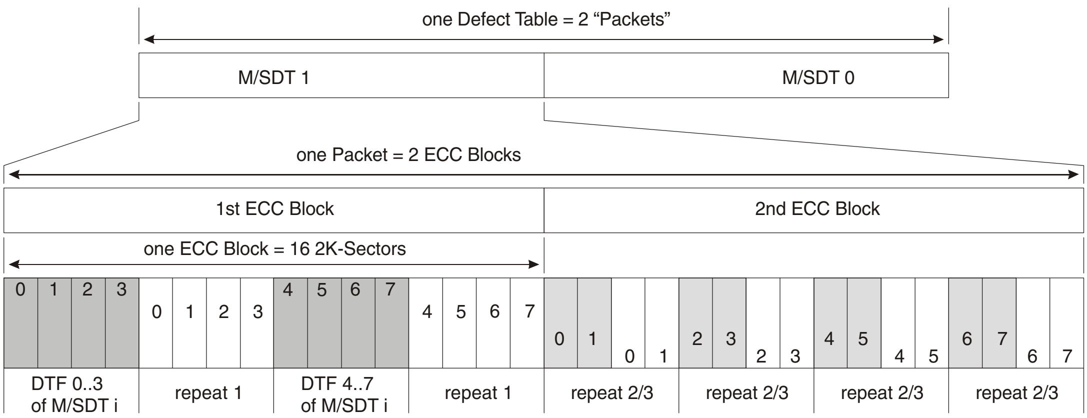


Figure 6 Composition of the Defect Tables for normal use

All Packets of the SDT shall have the same contents as the corresponding Packets of the MDT (except for the Signature fields, but inclusive the update count fields).

IV.6.1 Lay-out of the Defect Table Frames

Each Defect Table Frame (DTF) contains a list of ECC Blocks, which have been determined to be defective during verification or during use of the media, and a list of Spare ECC Blocks reserved for replacements. The defective ECC Block shall be linearly replaced by a reserved Spare ECC Block as assigned in the Defect Table.

Each DTF shall have the contents as defined in Figure 7.
Physical Block Numbers (PBN = 20 msb of PSN) shall be recorded in binary notation.

Three basic types of Entries are defined:

- Entries that identify a defective Block to which a replacement Block has been assigned. These Entries are called: **Reallocation Entries**.
- Entries that identify a replacement Block that has not yet been assigned to a defective Block. These Entries are called: **Free Entries**.
- Entries that identify a replacement Block that can not be used, e.g. because the replacement Block itself is defective. These Entries are called: **Unusable Entries**.

BP in Block	Contents	Length in bytes
0	Signature of the MDT/SDT (“MDT” or “SDT”)	3
3	MDT/SDT Packet number i (4 msb’s) & Defect Table Frame number k (4 lsb’s)	1
4	MDT/SDT Packet update count	4
8	Number of DT Entries in this DTF (n)	2
10	Location of first Free Entry in this DTF	2
12	Location of first Unusable Entry in this DTF	2
14	Tables Status	1
15	Straight Mapping flag bits	1
16	Reserved	1
17	PBN of first Reallocation Entry in this DTF	3
20	Reserved	1
21	PBN of last Reallocation Entry in this DTF	3
24	Reserved	1
25	PBN of first Free Entry in this DTF	3
28	Reserved	1
29	PBN of last Free Entry in this DTF	3
32	DT Entry 1	6
…	…	…
32 + (n-1)∗6	DT Entry n (n ≤ 256)	6
32 + n∗6	Unused DT Entries (all bytes 00h)	1536 – n∗6
1568	Reserved	480

Figure 7 Lay-out of a Defect Table Frame

Byte 0..2: Signature

These 3 bytes shall be set to:
4D4454h, representing the characters “MDT”, in each Block of an MDT,
534454h, representing the characters “SDT”, in each Block of an SDT.

Byte 3: MDT/SDT Packet number & Defect Table Frame number

The 4 most significant bits of this byte specify the MDT/SDT Packet number i as a binary value. i = 0 or 1, other values are reserved.
The 4 least significant bits of this byte specify the Defect Table Frame number k in the Packet as a binary value. k = 0..7, other values are reserved.

Byte 4..7: MDT/SDT Packet update count

These 4 bytes shall indicate the total number of update operations on this MDT Packet. This field shall be set to 00000000h during the initial creation of MDTi, and shall be incremented by one each time this MDTi is re-written. When the count reaches the value 4,294,967,295, the count shall wrap to 0 at the next update.
The update count field shall have the same value in all 2K-Blocks in one Packet.
Whenever the contents of the MDTi is copied to the SDTi, the update count fields of the SDTi shall be set to the same value as the update count fields of the MDTi.

Byte 8..9: Number of DT Entries
These 2 bytes shall indicate the total number of entries n in this DTF ($0 \leq n \leq 256$).

Byte 10..11: Location of first Free Entry
These 2 bytes shall point to the byte number in this DTF where the first Free Entry can be found (see chapter IV.6.1.2). If no Free Entries are available, bytes 10 and 11 shall be set to 0000h.

Note: the first Reallocation Entry is always located at byte 32, unless all Entries are free or unusable.

Byte 12..13: Location of first Unusable Entry
These 2 bytes shall point to the byte number in this DTF where the first Unusable Entry can be found (see chapter IV.6.1.2). If there are no Unusable Entries, bytes 12 and 13 shall be set 0000h.

Byte 14: Tables Status:
This byte contains flags for indicating the status of the Defect Tables. They are used for failure detection purposes.

Byte 14	
Bit 7..1	Bit 0
Reserved and set to zero	*Dirty Tables bit (in MDT0/SDT0 only; set to zero in MDT1 and SDT1)*

Dirty Tables bit:
Bit 0 of byte 14 is meant to be used as a “Dirty Tables” flag.

Bit 0 of byte 14 shall be set to 1b in all DTFs in MDT0 and SDT0, preceding the first update of any of the MDT0 or MDT1 Packets.

Bit 0 of byte 14 in all DTFs in SDT0 shall be reset to 0b, whenever all updated MDTs are copied to the related SDTs. After such an update of the SDTs, bit 0 of byte 14 in all DTFs in MDT0 shall be reset to 0b.

At “power-on” after a “bad power-down” (Dirty Tables bit = 1b in MDT0), the SDTs shall be updated.

Bit 0 of byte 14 in all DTFs in MDT1 and SDT1 shall be 0b.

Byte 15: Straight Mapping flag bits (see chapter IV.7.1)
Each single bit k (k = 0..7) of this byte reflects the mapping status of one of the DTF’s within this MDTi.
bit k = 0 : defects in the single Virtual Data Area DA[1+k+i∗8] may be registered in other DTF’s than MDTi/DTFk,
1 : all defects in Virtual Data Area DA[1+k+i∗8] are registered in MDTi/DTFk only (straight mapping).
Note: For Straight Mapping it is only relevant that all defects in a certain Virtual Data Area are registered in the related MDTi/DTFk. It is not relevant in which Spare Area the defect is actually reallocated.

Byte 16: Reserved: this byte is reserved and shall be set to 00h.

Byte 17..19: PBN of first Reallocation Entry

These 3 bytes shall be equal to the value of the PBN of Defective Block field of the first Reallocation Entry in this DTF. Bit 7..4 of byte 17 are reserved and shall be set to zero. If no Reallocation Entries are defined in this DTF, then these bytes shall be set to FFFFFFh. See also chapter IV.6.1.2.

Byte 20: Reserved: this byte is reserved and shall be set to 00h.

Byte 21..23: PBN of last Reallocation Entry

These 3 bytes shall be equal to the value of the PBN of Defective Block field of the last Reallocation Entry in this DTF. Bit 7..4 of byte 21 are reserved and shall be set to zero. If no Reallocation Entries are defined in this DTF, then these bytes shall be set to FFFFFFh. See also chapter IV.6.1.2.

Byte 24: Reserved: this byte is reserved and shall be set to 00h.

Byte 25..27: PBN of first Free Entry

These 3 bytes shall be equal to the value of the PBN of Replacement Block field of the first Free Entry in this DTF. Bit 7..4 of byte 25 are reserved and shall be set to zero. If no Free Entries are available in this DTF, then these bytes shall be set to FFFFFFh. See also chapter IV.6.1.2.

Byte 28: Reserved: this byte is reserved and shall be set to 00h.

Byte 29..31: PBN of last Free Entry

These 3 bytes shall be equal to the value of the PBN of Replacement Block field of the last Free Entry in this DTF. Bit 7..4 of byte 29 are reserved and shall be set to zero. If no Free Entries are available in this DTF, then these bytes shall be set to FFFFFFh. See also chapter IV.6.1.2.

Byte 32..1567: DT Entries

Each DT Entry consists of 6 bytes. The first three bytes indicate a Defective Block and the last three bytes identify the Replacement Block that has been assigned. The 4 most significant bits of byte m and byte m+3 are used to indicate the status of the replacement.

Unused DT Entries

All bytes in the range 32..1567 not occupied by DT Entries shall be set to 00h.

Byte 1568..2047: Reserved: these 480 bytes are reserved and shall be set to 00h.

IV.6.1.1 Format of the DT Entries

Byte m		**Byte m+1**	**Byte m+2**
bit 7..4	bit 3..0	bit 7..0	bit 7..0
Status 1	*PBN of Defective Block*		

Byte m+3		**Byte m+4**	**Byte m+5**
bit 7..4	bit 3..0	bit 7..0	bit 7..0
Status 2	*PBN of Replacement Block*		

The PBN of Defective Block field shall be equal to the PBN of the defective Block to be replaced.
The PBN of Replacement Block field shall be equal to the PBN of the Replacement Block assigned to hold the replaced Block. (The PBN of each Replacement Block in the Spare Areas shall occur exactly once in the Defect Table.)

Status 1	Status 2	Entry type	definition
0000b	000xb	Reallocation Entry	The entry identifies a valid replacement. All Frames in the replacement Block shall contain correct data.
0000b	100xb	Reallocation Entry	The entry identifies a replacement with only part of its content being valid. Some Frames of the Block could not be copied from the previous location and are filled with dummy data identified by a signature. (see annex VII.5)
0001b	0000b	Reallocation Entry	The entry identifies a defective Block that has not been recorded at it's replacement address.
0010b	0000b	Free Entry	The entry identifies a Replacement Block usable for future replacement, the PBN of Defective Block field shall be set to zero.
0011b	0000b	Unusable Entry	The entry identifies a Replacement Block unusable for future replacement, the value of the PBN of Defective Block field is undefined.
others	others	--	Reserved

Status 2	definition
xx00b	The original location has been recorded with the same data as the replacement location or the original location contains the most recently written information.
xx01b	The original location may contain different data as the replacement location.
xx1xb	Reserved for CD-MRW
1xxxb	During a R-M-W action some of the Frames could not be retrieved from the previous location and therefore have been filled with dummy data. * This dummy data shall be set to: - bytes 0 to 7: 52 4D 57 5F 4E 56 4C 44h, representing the characters "RMW_NVLD", - bytes 8: 00h, - bytes 9 to 11: the PSN representing the previous physical location of the data now allocated to this Frame of the actual replacement Block, - bytes 12 to 2047: all 00h.

* During read actions from replacements Blocks with Status 2 = 1xxxb, each individual Frame shall be checked on the presence of dummy data.
If a Frame contains dummy data, the drive has two options:
- generate an error message,
- do a read-retry from the previous location.

There shall be no hierarchical replacements: no PBN of Defective Block field is allowed to contain the same value as any PBN of Replacement Block field.

IV.6.1.2 Sorting of the Defect Table

The DT Entries shall be sorted over the full Defect Table, starting in MDT0/DTF0, continued in MDT0/DTF1, etc., and ending in MDT1/DTF7.
In this sorting algorithm the Reallocation Entries (with Status 1 = 0000b and 0001b) and the Free Entries (with Status 1 = 0010b) in each DTF shall be grouped and sorted in ascending order separately. The Unusable Entries (with Status 1 = 0011b) are grouped but need not to be sorted.

- Each DTF can contain all 3 types of entries. Within the DTF's the Reallocation Entries shall be placed first, followed by the Free Entries and at last the Unusable Entries are placed.
- The Reallocation Entries shall be sorted in order of their PBN of Defective Block field (ignoring the value of the Status 1 field).
- The Free Entries shall be sorted in order of their PBN of Replacement Block field (ignoring the value of the Status 2 field).

See Figure 8.

MDT	DTF	Status 1	PBN of Defective Block	Status 2	PBN of Replacement Block
0	0	0/1	0 31 80	x	x xx xx
		0/1	0 4F 75	x	x xx xx
		0/1	ascending values ⇓	x	x xx xx
		0/1	0 52 DE	x	x xx xx
		2	0 00 00	x	0 30 40
		2	0 00 00	x	0 30 41
		2	0 00 00	x	0 30 42
		2	0 00 00	x	ascending values ⇓
		2	0 00 00	x	0 31 3F
		3	x xx xx	x	0 31 1C
		3	x xx xx	x	arbitrary order ⇓
		3	x xx xx	x	0 30 5A
	1	0/1	> 0 52 DE	x	x xx xx
		0/1	ascending values ⇓	x	x xx xx
		:	:	:	:
		2	0 00 00	x	> 0 31 3F
		2	0 00 00	x	ascending values ⇓
		:	:	:	:
		3	x xx xx	x	x xx xx
		:	:	:	:
	2	0/1	etc.	x	x xx xx
		:	:	:	:
		2	0 00 00	x	etc.
		:	:	:	:
		3	x xx xx	x	x xx xx
		:	:	:	:

Figure 8 Sorting of the Defect Table
(example)

IV.7 The Defect Management procedure

IV.7.1 Handling of the Defect Tables

At Initialization (see VI.2) an MDT is created, containing a DT Entry for each Replacement Block, with Status 1 = 0010b, the PBN of Defective Block field set to 00000h and Status 2 = 0000b (all Free Entries).
The Main Defect Table shall be updated by a recorder each time a defect is reallocated.
When the disc is ejected from a recorder, the Secondary Defect Table shall have the same contents as the Main Defect Table.

To achieve a consistent way of handling the Defect Table by different drives, the following procedure for handling the Defect Table is recommended:

- At initialization all Replacement Blocks of both Spare Areas are registered in the 16 DTFs in clusters of 256 Blocks.
- All defects detected in Virtual Data Area DA[1+k+i∗8] are registered in MDTi/DTFk.
  As long as all defects in DA[1+k+i∗8] are registered in MDTi/DTFk only, this situation shall be indicated by the corresponding Straight Mapping flag bit (bit k of byte 15 in each DTF of MDTi).
- If all 256 replacements defined in one MDTi/DTFk have been used, a redistribution of the Entries over all or part of the DTF's can be done, whereby the one-to-one relation between a Virtual DA and a DTF can get lost (see Figure 9). In this case the corresponding Straight Mapping flag bit(s) shall be reset.
- The reserved space in the tables shall not be used.

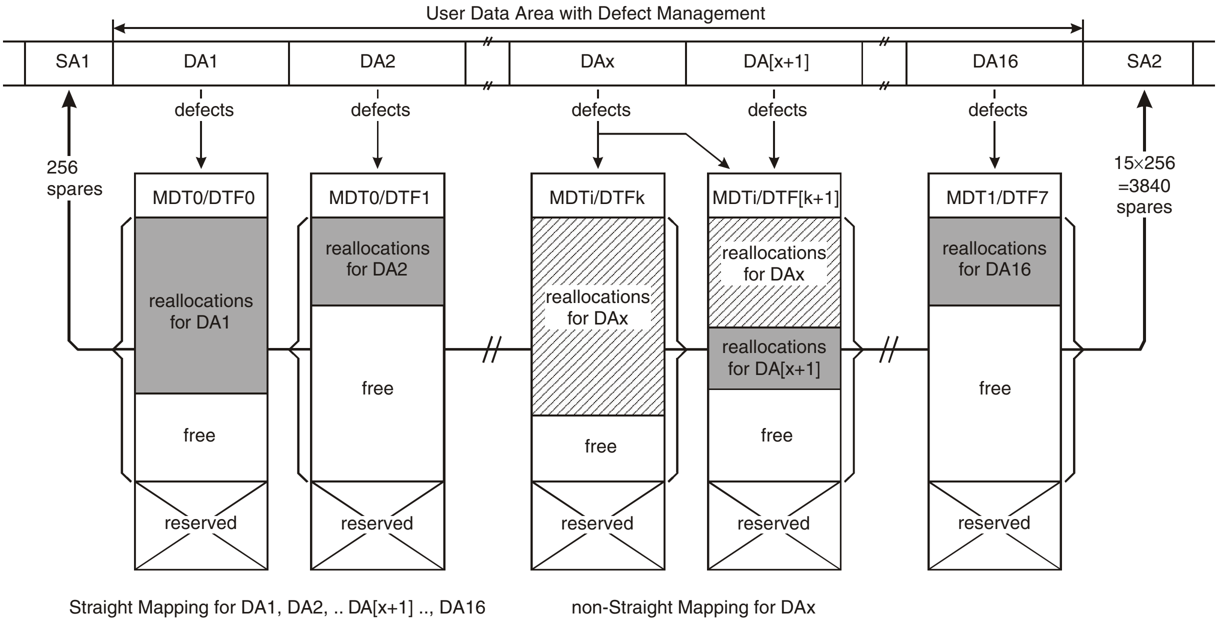


Figure 9 Example of Defect Table use

Note: To ensure compatibility with potential future defect allocation and formatting methods, it is required that drives and remapper device drivers (software in the PC to support the Mount Rainier system on non-compliant legacy drives) always correctly use the reallocations and free spares as registered in the Defect Tables for their read and write actions. Drives nor remapper device drivers should make any assumptions on the way or the order in which Replacement Blocks might have been assigned to Defective Blocks.

IV.7.2 Replacement of Blocks

If an error is detected in a Block during reading, the drive may replace the Block, mark the Block for replacement, or ignore the error for Defect Management. If the defective Block is to be replaced or marked for replacement, the drive shall assign a Replacement Block out of the set of Replacement Blocks with Status 1 = 0010b.

If the Block is replaced, then:
- the data from the original Block shall be recorded in the Block identified by the PBN of Replacement Block field,
- the Status 1 field of the DT Entry shall be set to 0000b, the Status 2 field shall be set accordingly,
- the Defect Table sort order shall be updated.

If the Block is being marked for later replacement, then:
- the Status 1 field of the DT Entry shall be set to 0001b,
- the Defect Table sort order shall be updated,
- future read requests shall be performed from the Block identified by the PBN of Defective Block field,
- future write requests shall be handled by writing to the Block identified by the PBN of Replacement Block field, changing the Status 1 field to 0000b, and updating the Defect Table sort order. The Status 2 field shall be set accordingly.

If a Replacement Block itself is found to be defective, it is indicated by Status 1 = 0011b. In this case the PBN of Defective Block field is undefined.

IV.7.3 Handling of streaming data

In case of a “write_streaming” command, the drive shall remove all defects with Status 1 = 0000b within the written address range(s) from the Defect Tables or change them to Status 1 = 0001b.

This page is intentionally left blank

V Defect Management for 120 mm disc at extensive use

V.1 General

The structure of the Defect Management for extensive use is the same as for normal use. Only a few parameters are different, which parameters are specified in this chapter.
All rules and parameters as specified chapter IV shall be used, unless specified differently in this chapter.

V.2 Format of the MTA

See chapter IV.2 except for the following:
Instead of containing 2 Defect Table Packets, the MTA now contais 8 Defect Table Packets (MDT0..7). The substitution procedure for defective MDT Packets is the same as in the normal use option.

V.3 Format of the STA

See chapter IV.3 except for the following:
Instead of containing 2 Defect Table Packets, the STA now contains 8 Defect Table Packets (SDT0..7). The substitution procedure for defective SDT Packets is the same as in the normal use option.

V.4 Virtual Data Areas

For commonality with CD-MRW and for easier Defect Table handling (see chapter V.7.1), the User Data Area is virtually divided into 64 Data Areas. All of these Data Areas consist of 1984 ECC Blocks, except the last one, which has 1938 ECC Blocks.

V.5 Format of the MIP and the SIP

See chapter IV.5 except for the following:

BP in Block	Contents	Length in bytes
0 to 17	see chapter IV.5	--
18	Size of Spare Area 1 = 256 ECC Blocks	2
20	Size of Virtual Data Areas = 1984 ECC Blocks	2
22	Size of Spare Area 2 = 16128 ECC Blocks	2
24 to 30	see chapter IV.5	--
31	Number of MDT/SDT Packets in use (8)	1
32	Location of MDT0	3
…	…	…
32 + i∗3	Location of MDTi	3
…	…	…
53	Location of MDT7	3
56	Location of SDT0	3
…	…	…
56 + j∗3	Location of SDTj	3
…	…	…
77	Location of SDT7	3
80	Reserved	1968

Figure 10 Lay-out of the MIP/SIP Block for extensive use

Byte 18..19: Size of Spare Area 1

These 2 bytes indicate the number of ECC Blocks in SA1 as a binary value. They shall be set to 0100h. All other values are reserved.

Byte 20..21: Size of Virtual Data Areas

These 2 bytes indicate the number of ECC Blocks in each DA as a binary value. They shall be set to 07C0h. All other values are reserved.

Byte 22..23: Size of Spare Area 2

These 2 bytes indicate the number of ECC Blocks in SA2 as a binary value. They shall be set to 3F00h. All other values are reserved.

Byte 31: Number MDT/SDT Packets in use

This byte specifies the number of MDT/SDT Packets that are actually in use. It shall be set to 08h. All other values are reserved.

Byte 32..55: Locations of MDTi

Each group of three bytes indicates the location of a valid MDT in the Reserved Zone 1 in the Lead-in Zone. The locations are defined by the first PBN of each MDT Packet. Bit 7..4 of byte [32 + i∗3] are reserved and shall be set to zero.

Byte [32 + i*3]		**Byte [32 + i*3 + 1]**	**Byte [32 + i*3 + 2]**
bit 7..4	bit 3..0	bit 7..0	bit 7..0
Reserved	*first PBN of MDTi*		

Byte 56..79: Locations of SDTj

Each group of three bytes indicates the location of a valid SDT in the STA in the Data Zone. The locations are defined by the first PBN of each SDT Packet. Bit 7..4 of byte [56 + j∗3] are reserved and shall be set to zero.

Byte [56 + j*3]		**Byte [56 + j*3 + 1]**	**Byte [56 + j*3 + 2]**
bit 7..4	bit 3..0	bit 7..0	bit 7..0
Reserved	*first PBN of SDTj*		

V.6 Format of the Defect Tables (MDT and SDT)

See chapter IV.6 except for the following:
The complete Defect Tables are contained in 8 Packets: MDT0..7, with copies in SDT0..7, where each Packet consists of 2 ECC Blocks. Each of the Packets MDTi or SDTi contain 4 repetitions of 8 2K-Frames, in which the Defect Table information is stored. These 4 times 8 so-called Defect Table Frames (DTF0..7) shall be interleaved and stored in 2 ECC Blocks as defined in Figure 11, which sequence is the same as for CD-MRW.

All Packets of the SDT shall have the same contents as the corresponding Packets of the MDT (except for the Signature fields, but inclusive the update count fields).

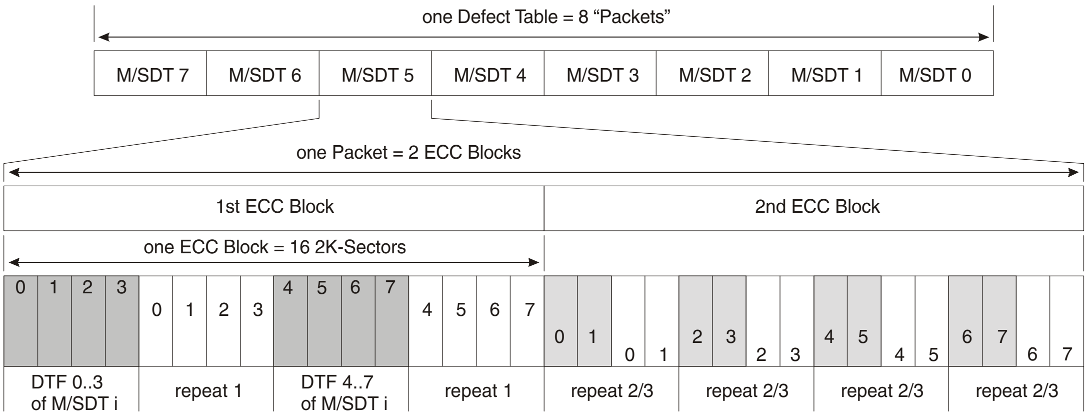


Figure 11 Composition of the Defect Tables for extensive use

V.6.1 Lay-out of the Defect Table Frames

See chapter IV.6.1 except for the following:
Each DTF shall have the contents as defined in Figure 12.

BP in Block	Contents	Length in bytes
0 to 2	see chapter IV.6.1	--
3	MDT/SDT Packet number i (4 msb's) & Defect Table Frame number k (4 lsb's)	1
4 to 2047	see chapter IV.6.1	--

Figure 12 Lay-out of a Defect Table Frame for extensive use

Byte 3: MDT/SDT Packet number & Defect Table Frame number

The 4 most significant bits of this byte specify the MDT/SDT Packet number i as a binary value. i = 0..7, other values are reserved.
The 4 least significant bits of this byte specify the Defect Table Frame number k in the Packet as a binary value. k = 0..7, other values are reserved.

V.6.1.1 Sorting of the Defect Table

See chapter IV.6.1.2

V.7 The Defect Management procedure

V.7.1 Handling of the Defect Tables

See chapter IV.7.1 except for the following:

- At initialization all Replacement Blocks of both Spare Areas are registered in the 64 DTFs in clusters of 256 Blocks (see Figure 13).

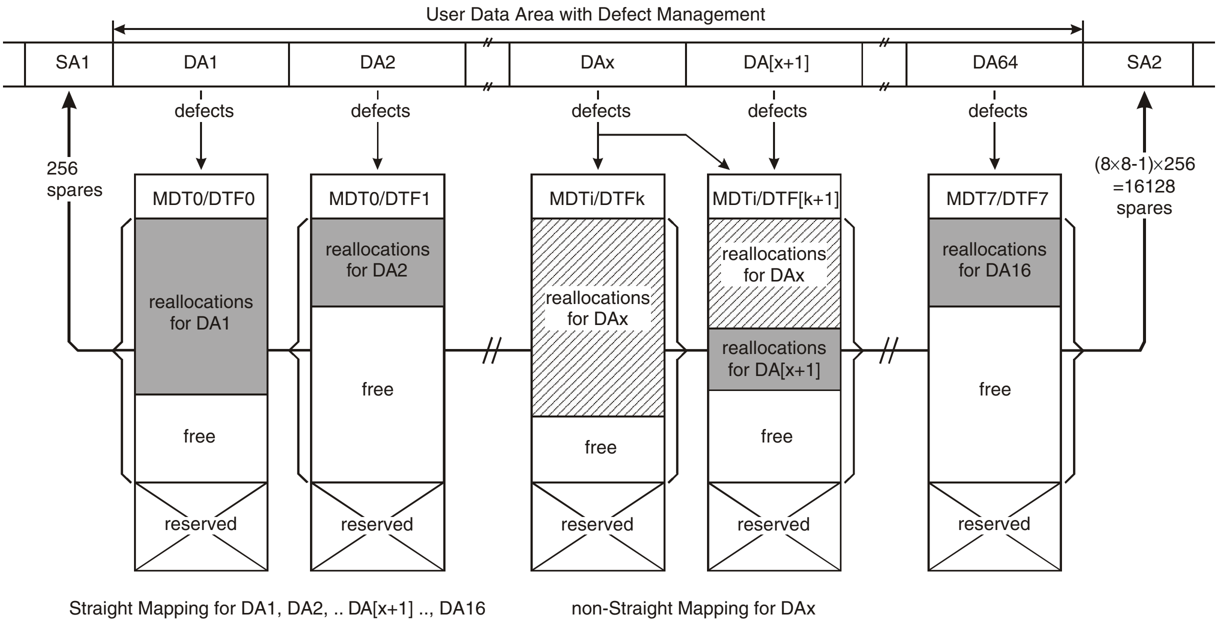


Figure 13 Example of Defect Table use

V.7.2 Replacement of Blocks

See chapter IV.7.2

VI Physical Formatting in Background

VI.1 Introduction

The disc shall be considered fully physical formatted if the Lead-in Zone, the maximally possible Data Zone and the Lead-out Zone have been recorded. During the Background Formatting process all blank areas in the Data Zone of the disc will be recorded with ECC Blocks containing 2K Frames with all user data bytes set to AAh.

The disc shall be considered partially physical formatted if at least the MIP & MDT's in the Lead-in Zone have been recorded.

The status of the disc shall be indicated by the Disc Status in the MIP. If partially physical formatted, the Last Written Address shall be recorded in the LWA field in the MIP.

If compatibility with DVD-RO drives is required, the disc shall contain a Lead-in Zone, a Lead-out Zone, and a Data Zone with no blank areas between the Lead-in and Lead-out Zones.

Physical formatting is the process to reach the status of DVD-RO compatibility. Physical formatting can be done in two different ways:

1) Pre-formatting, which is the conventional way of physical formatting used for many storage media. After the pre-formatting process, the disc is fully physical formatted. User data shall not be recorded to the disc until the pre-formatting process is complete.
This process generally consists of the following steps:

- writing the Lead-in Zone,
- writing the Data Zone,
- writing the Lead-out Zone,
- verification of the Data Zone and initialization of the Defect Management.

2) Background Formatting, which is a physical formatting process that runs in the background during use of the disc in a recorder. After the Background Formatting process has been completed, the disc is fully physical formatted. User data may be recorded to the disc during the Background Formatting process.
The Background Formatting process consists of the following steps:

- Initialization of the Defect Management
- De-icing of the Data Zone
- Finalization of the Lead-in and Lead-out Zones
- Early-eject finishing (if applicable)
- Restarting the Background Formatting on an early-ejected disc
- Verification (optionally selected by host computer)

Because the Pre-formatting process may be rather time consuming, Background Formatting can be a much more time-efficient solution for the user of the disc. During the initialization phase of the Background Formatting process only a minimum amount of data will be recorded onto the disc, after which the disc can be used by the application. A disc on which a Background Formatting process is active, may be formatted further by the DVD recorder in the background during the moments that the application is not accessing the disc.

VI.2 Initialization of the Defect Management

When a blank disc is inserted into a recorder, an initialization procedure is started by the host computer. This initialization creates an MTA in the Lead-in Zone with a MIP and sufficient MDT's to define all Spare Areas. All addresses given in the MIP and MDT's shall refer to the final locations.
As a result of the initialization procedure the following disc will exist:

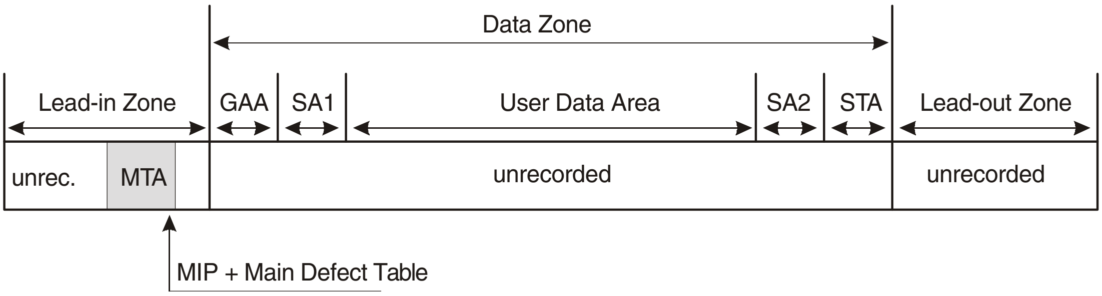


Figure 14 Status of the disc after initialization

Because of the very limited amount of data to be recorded, the initialization procedure will be finished just in seconds. The disc is now ready for data storage and can be released for use by the host computer.

In general, after the initialization, the host computer writes some initial File System Structures (FSS) to the disc. These File System Structures as well as the user data can be placed anywhere in the logically addressable space of the disc. In the following examples it is assumed that the disc is initially recorded sequentially.
The GAA can be recorded by the host computer at any time.

VI.3 De-icing of the Data Zone

De-icing is the process of recording all ECC Blocks in the Data Zone of the disc. During the De-icing phase, blank areas shall be filled with ECC Blocks containing 2K Frames with all AAh bytes or with user data when requested. The De-icing shall be performed by the drive itself, without interaction with the host computer.

During the time intervals when the drive is idle, the De-icing process can proceed in the background. When the host computer requests disc access, the De-icing process is suspended and the control of the disc is returned to the host.
Host requested writes in blank areas shall be registered by the drive and shall not be overwritten by the De-icing process.
The drive shall keep track of all areas that have been recorded or De-iced.
Every time after de-icing about 16000 ECC Blocks (≈ 500 Mbytes), the LWA field in the MIP should be updated. This reduces the recovery time in case of power failures during Background Formatting.

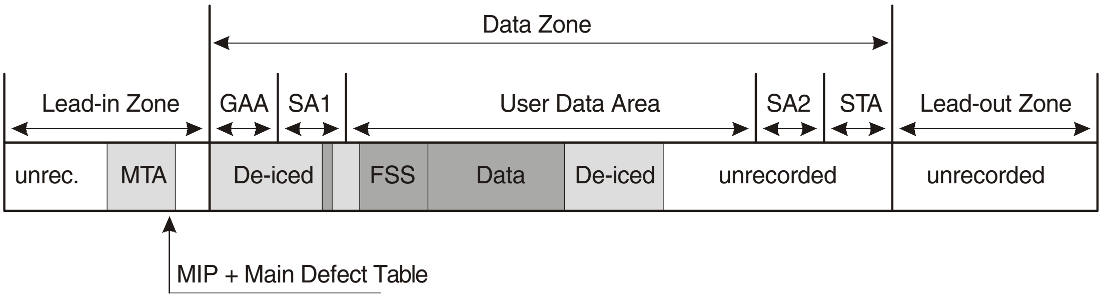


Figure 15 Example status of the disc after some De-icing and recording

VI.4 Finalization of the Lead-in and Lead-out Zones

After the full Data Zone has been recorded or De-iced, the Lead-in and Lead-out Zone are recorded. The contents of the ECC Blocks shall be according to the DVD+RW System Description.

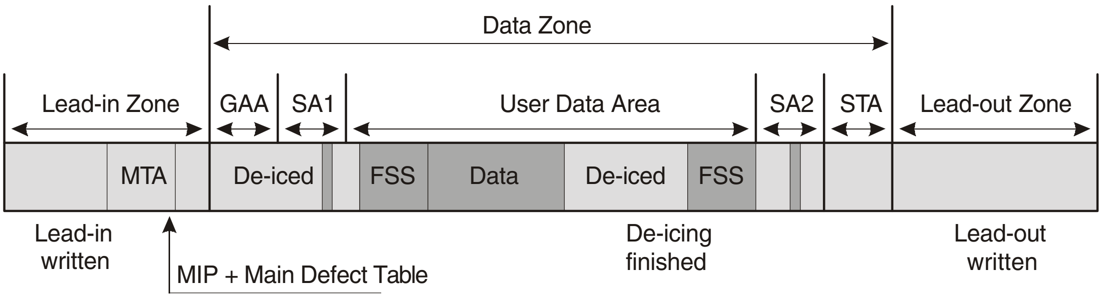


Figure 16 Example status of the disc after finalization

At the end of the finalization process the host computer can update the File System Structures and create additional File System Structures if needed.

VI.5 Eject

Before the disc is ejected from the recorder, the contents of the MTA Packets shall be copied to the STA Packets (with adapted signatures).

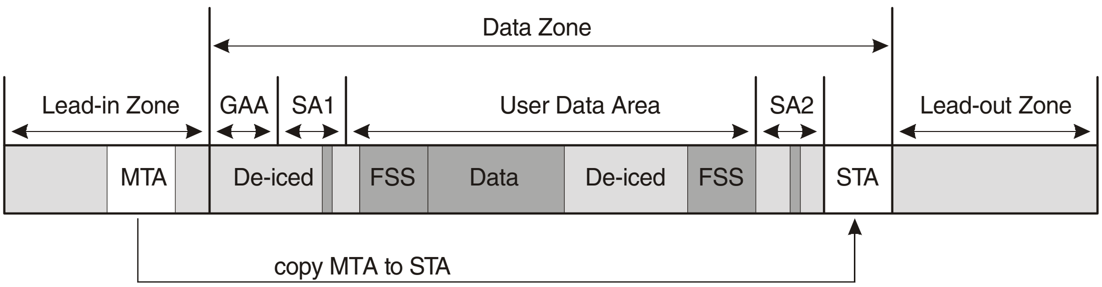


Figure 17 Example of final status of the disc

VI.6 Early-eject finishing

When the user pushes the eject button of the drive, he expects the disc to come out in the shortest possible time. However he also expects that the disc is “ROM-compatible”. This means that the disc shall have at least a Lead-in and a Lead-out Zone and no blank areas in the Data Zone.

If the Background Formatting process is not yet finished, the drive may decide to finish the De-icing and finalization processes in the normal way.
If the remaining physical formatting will take much time to finish, the drive may decide to finish the disc in a ROM-compatible way, for which the following steps are needed (see Figure 18 and Figure 19):

Drive actions to finish running tasks:

1) Pending write/read requests from the computer shall be completed.

Drive actions to finalize the disc:

2) The active background De-icing process shall be stopped.

3a) If recordings have been made in blank areas, all blank areas up to the last recorded ECC Block in the User Data Area shall be De-iced. (In case insufficient blocks are available between the last recorded ECC Block in the User Data Area and the start of the SA2 to perform step 3 and step 4, the formatting process shall be completed.)
3b) At least all Replacement Blocks in the final SA2 that are actually in use (all blocks indicated in the MDT with Status 1 = 0000b) shall be recorded with the User Data of the related Blocks to be replaced.
3c) The contents of the MTA Packets shall be copied to the STA Packets (with adapted signatures).

4a) At least all Replacement Blocks in the final SA2 that are actually in use (all blocks indicated in the MDT with Status 1 = 0000b) shall be copied to the location immediately following the last recorded ECC Block in the User Data Area.
4b) A temporary STA shall be recorded immediately following the last written ECC Block in the User Data Area. The SDT’s in the temporary STA shall contain the same information as the corresponding SDT’s in the final STA except for the Reallocation Entries, which entries shall point to the temporary Replacement Block concerned. The SIP in the temporary STA shall have the same information as the SIP in the final STA, except for the SDTj locations, which shall point to the temporary locations of the SDT’s.
4c) The LWA recorded in the LWA field in both the MIP and SIP shall be set to the last PBN of the temporary SIP Packet.

Note: The entries in the MDT shall not be changed (still pointing to the Replacement Blocks in the final SA2) and all other fields in the MIP/SIP and MDT/SDT’s shall be unchanged and reflect the values of the final disc after physical formatting has been fully completed.

5) A temporary Lead-out Zone of at least 64 ECC Blocks shall be recorded.

Note: Existing replacements in the final SA2 with Status 1 = 0000b shall not be overwritten by the temporary STA or temporary Lead-out or when the formatting process is continued.

The final SA2 is the primary spare area to be used by recorders, the temporary SA2 is only meant to facilitate compatibility with Read-Only devices.

6) The Lead-in Zone, with Control Data (see DVD+RW System Description) according to the actual situation of the disc, shall be recorded.

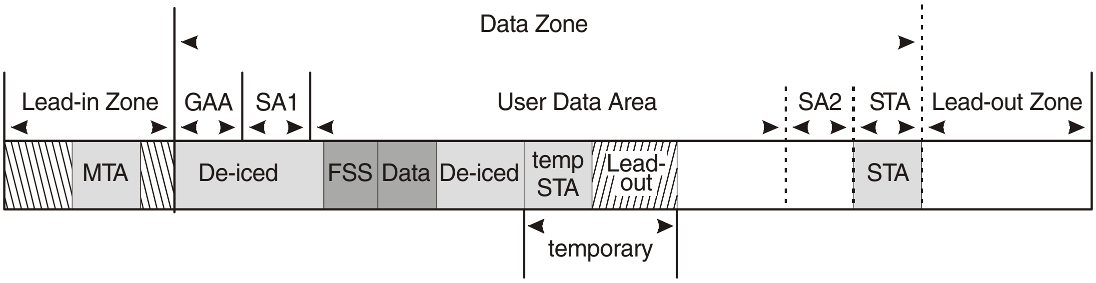


Figure 18 Early-eject status of the disc (example 1: no replacements in SA2)

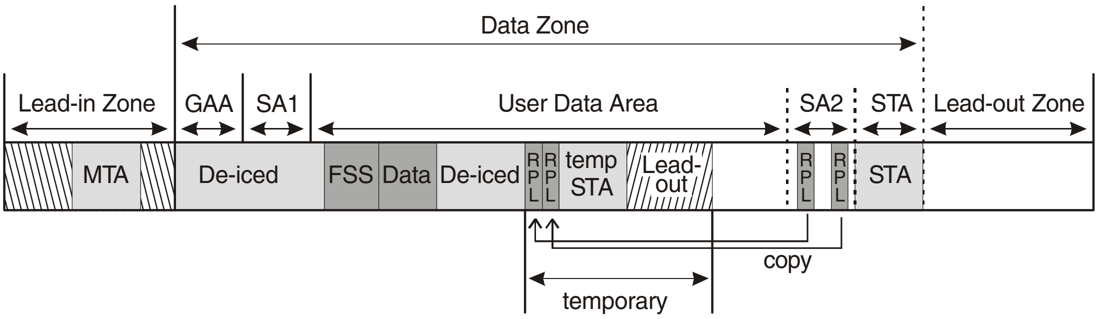


Figure 19 Early-eject status of the disc (example 2: with replacements in SA2)

Host actions:

7) If not previously completed, the Host computer shall write the GAA.

8) The host computer issues an “eject disc” command.

Drive actions to eject the disc:

9) The drive shall flush it’s cache.

10) The drive ejects the disc.

VI.7 Restarting the Background Formatting on an early-ejected disc

When an early-ejected disc is re-inserted into a recorder, this device will detect the “partially physical formatted” status and the host computer can initiate the continuation of the Background Formatting. De-icing shall restart from the position indicated by the LWA pointer (see Figure 20), thus starts overwriting the temporary Lead-out Zone. It will proceed until the full disc has been De-iced/finalized.
Possibly copied Replacement Blocks and the temporary STA are considered as being physical formatted. New write requests are allowed to overwrite these temporary blocks.
Before a next eject the drive shall update the Control Data in the Lead-in Zone.

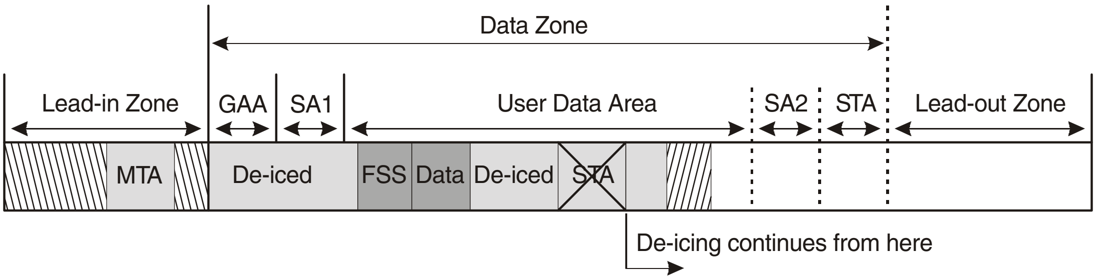


Figure 20 Status of an Early-ejected disc after restarting De-icing

VI.7.1 Automatic Background Formatting restart

The Background Formatting and Verification, if indicated accordingly by the Disc Status bits in the MIP/SIP, shall automatically restart when a write is requested with an LFA beyond the currently De-iced area. The Background Formatting shall be restarted prior to the processing of the write command.

VI.8 Verification

Verification is the process of reading and checking Blocks in the Data Zone of the disc. If the Verification process is interrupted, the Verification status bit in byte 24 shall be set to 1 and the Last Verified Address (LVA) shall be recorded in the LVA fields in the MIP/SIP.

After a disc has been physical formatted,
1) it shall be verified if so selected by the host via certification, or
2) it can be verified optionally.
The disc can also be verified at a later stage when there are doubts about the quality of the recordings on the disc.

If a Block is found unreliable, the PBN of that Block, together with the PBN of a Replacement Block can be added to the Defect Table. The user data in the defective Block should be copied to the new location as indicated by the Defect Table.

VI.9 Requirements for writing in Blank or Non-verified Areas

This chapter gives an overview of the behaviour of the drive in case of write requests to Blank or Non-verified areas on a disc where the Background Formatting process is active.
If a write error is detected or the verify fails, the drive shall use or create the Spare Areas as defined in this DM&PF document.

VI.9.1 Blank discs

If the host computer requests writing in a blank area, then (see chapter VI.3):
- the drive shall verify the recorded area if the host has directed the Background Formatting to also do a certification,
- the drive shall register the recorded area,
- de-icing shall not overwrite the recorded area.

VI.9.2 Used discs compliant with this DM&PF

If the host computer requests writing in a blank or non-verified area, then (see chapter VII.3.1):
- the drive shall verify the recorded area autonomously,
- if the recorded area is in a blank area then the drive shall register the recorded area,
- de-icing shall not overwrite the recorded area.

VI.9.3 Used discs not compliant with this DM&PF

If the host computer requests writing in a blank or non-reformatted (= de-iced) or non-verified area, then (see chapter VII.3.2):
- the drive shall verify the recorded area autonomously,
- if the recorded area is in a blank or non-reformatted area the drive shall register the recorded area,
- de-icing shall not overwrite the recorded area.

This page is intentionally left blank

VII Annexes

This page is intentionally left blank

VII.1 How to achieve Defect Management and File System compatibility

This annex gives some guidelines how to achieve (read)compatibility of DVD+MRW discs according to this DM&PF with drives not compliant with this specifications.
To reach such compatibility, the drive has to understand LFA addressing and shall apply Defect Management (DM) remapping.

Another complication, which is not directly related to DVD+MRW, might be that the host computer does not understand the applied File System. A recommendation for this case is given in annex VII.1.2

VII.1.1 Use of General Application Area (GAA) to achieve addressing and DM compatibility

The newly introduced LFA addressing prevents non-DVD+MRW-compliant drives from reading data from a DVD+MRW disc. Because such a non-compliant drive does not apply Defect Management, this data could have been corrupted data.

The following Figure 21 shows a schematic representation of an example of the use of the GAA. Drives not compliant with the DVD+MRW LFA addressing will find the ISO 9660 structure at LSN 16 in the GAA. This can point to a small piece of software, displaying a message with the URL address where the user can find drivers to make his non-compliant drive “read-compatible” with this DM&PF. The ISO 9660 structure at least shall have a “Read-me.txt” file with the content defined in annex VII.1.1.1 .

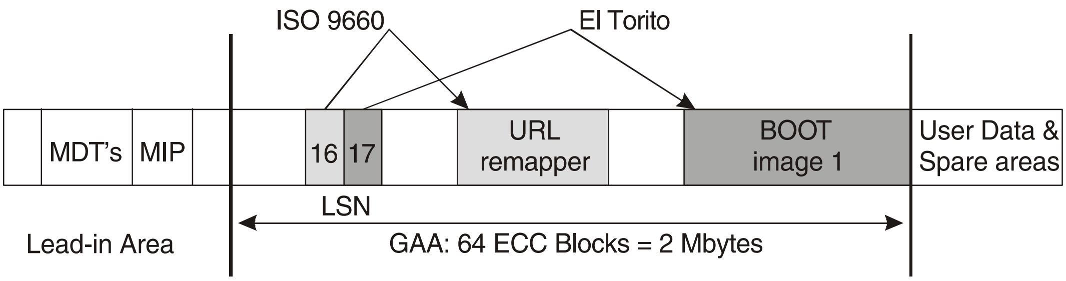


Figure 21 Example of the use of the GAA for achieving DM&PF compatibility

VII.1.1.1 Contents of Read-me.txt file

The Read-me.txt file shall have the following contents in ISO 646 format:
<start of text>

> This document is defined in size and content by the Mt. Rainier technical group, for the support of the DVD+MRW format. You are seeing this document, instead of the advertised contents of this disc because your system is not supporting the DVD+MRW format.
>
> If you have a system manufactured before 2002, you will need to contact your PC system or operating system manufacturer for appropriate software to read this format. Links to supporting software vendors can be found at: www.mt-rainier.org.
>
> If your systems optical drive carries the DVD+MRW logo, and you are seeing this content, please contact your PC system, or optical drive manufacturer directly.
>
> The Mt. Rainier Group

<end of text>

VII.1.2 Use of ISO 9660 structures in the Data Area to achieve File System compatibility

The DVD+MRW format is File System independent. It offers the host computer a linear addressing space over all it's User Data Areas identified by LFA's.
However if the File System on the disc is not supported by the host computer, the host will not be able to retrieve the data files on the disc identified by their names, although the system could read data blocks identified by their LFA's.
Because all DVD-ROM compatible systems understand the ISO 9660 File System, this particular system can be used to alert the user about possibly missing support on his computer for the specific File System applied to store data files on the disc.

The following Figure 22 shows a schematic representation of an example of the use of the ISO 9660 structure to achieve File System compatibility on systems that already can handle LFA addressing and Defect Management. If a system is not compliant with the actual File System applied on the disc, it will find the ISO 9660 structure at LFA 16.
This can point to a small piece of software, displaying a message with the URL address where the user can find a File System (FS) reader to make his non-compliant system "read-compatible" with the specific File System applied on the disc.

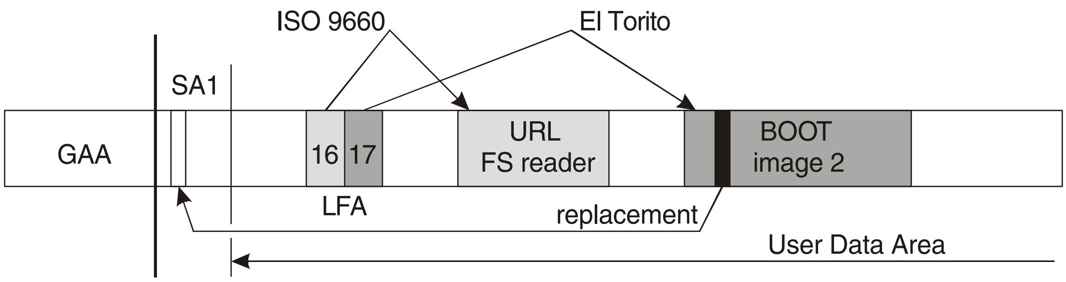


Figure 22 Example how to achieve File System compatibility

VII.1.3 Booting from a DVD+MRW disc

As an option the disc can contain an "El Torito" boot image in the GAA and/or in the User Data Area.

VII.2 Recognition of discs according to the DM&PF specifications

The following flowchart shows how discs according to this DM&PF can be recognized and how they should be handled by recorders in certain error situations.

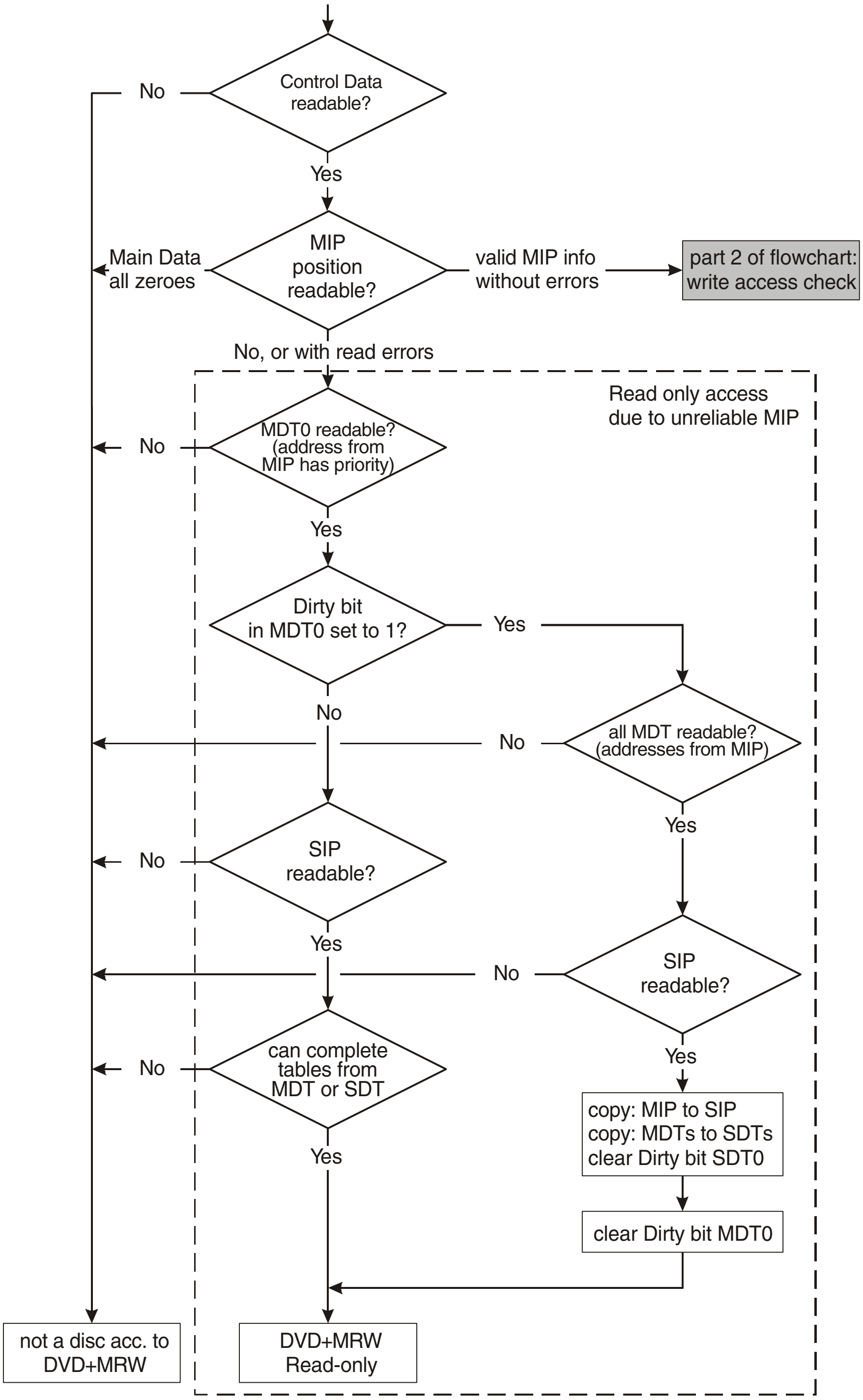


Figure 23 How to check a disc, part 1

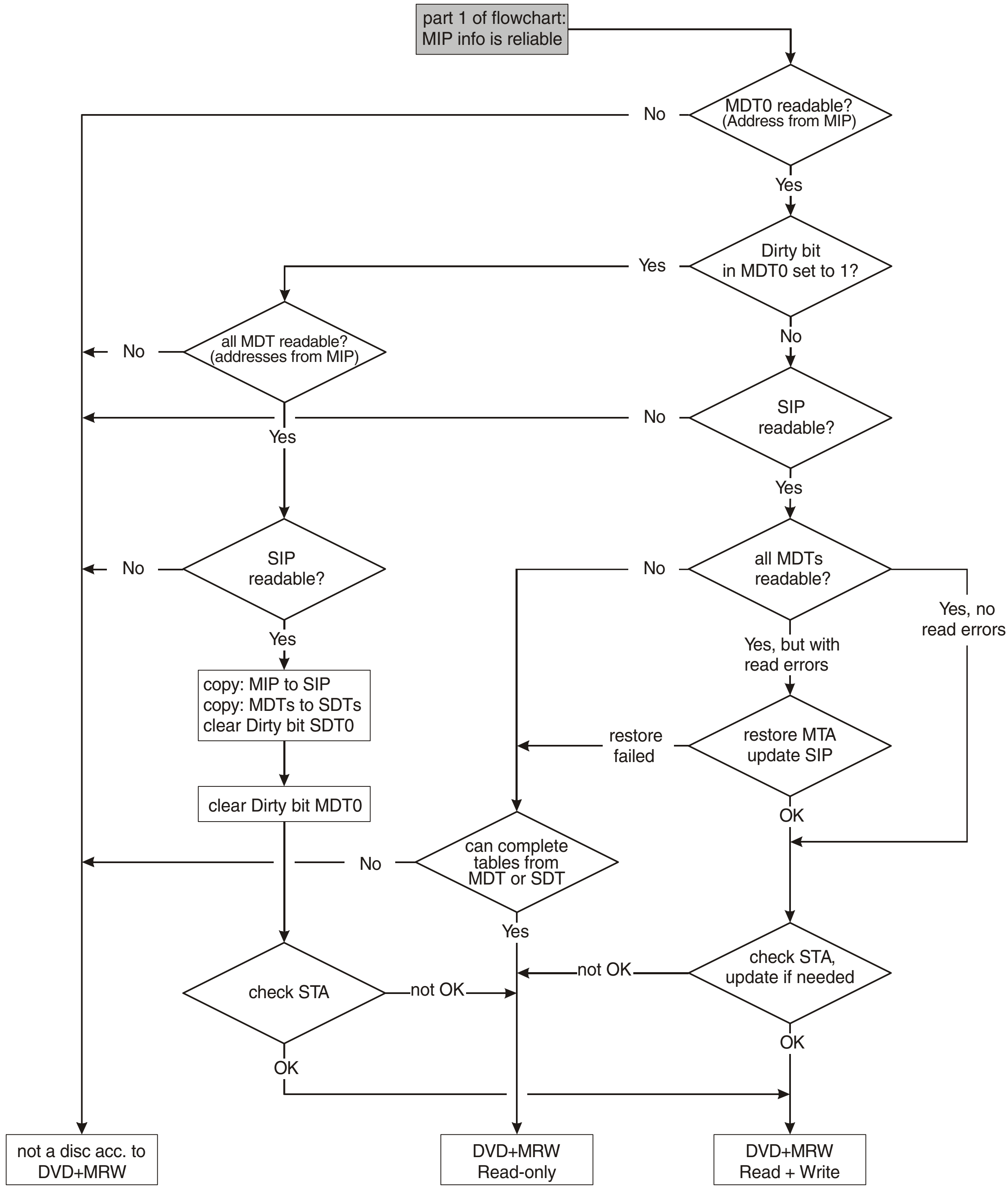


Figure 24 How to check a disc, part 2

VII.3 How to handle pre-formatted or used discs

VII.3.1 Reformatting discs compliant with this DM&PF

Discs formatted according to this DM&PF can be reformatted in the following way:

1) when the disc was previously fully formatted:
   - no de-icing needs to be applied. Instead of this a verification process will be executed in background.
   - write commands to a disc area that has not yet been verified, shall be followed by a verify.
   - the tracking of the process shall be stored in the LVA field in the MIP/SIP.
   - the Lead-in and Lead-out Zones shall be rewritten.

2) when the disc was previously partially formatted:
   - the part already formatted needs no de-icing. Instead of this a verification process will be executed in background.
   - the remainder of the disc shall be de-iced and verified after de-icing.
   - write commands to a disc area that has not yet been verified or de-iced, shall be followed by a verify.
   - the tracking of the process shall be stored in the LWA and LVA fields in the MIP/SIP.
   - the Lead-in and Lead-out Zones shall be rewritten.

VII.3.2 Formatting other used discs

Discs that have been used for formats other than this DM&PF, shall be formatted according to the normal rules for blank discs, with the following exceptions:

- de-icing overwrites the whole disc with ECC Blocks. After de-icing the ECC Blocks shall be verified.
- every write in the Data Zone or in the Lead-in Zone shall be followed by a verify.
- the tracking of the process shall be stored in the LWA and LVA fields in the MIP/SIP.
- the Lead-in and Lead-out Zones shall be rewritten.

This page is intentionally left blank

VII.4 The use of the FDCB (Formatting Disc Control Block)

When the disc is ejected from the recorder, the FDCB as defined in the DVD+RW System Description shall contain the following bit/byte settings:

Physical Sector 0 / bytes D_0 to D_3 – Content Descriptor:
as described in the DVD+RW System Description.

Physical Sector 0 / bytes D_4 to D_7 – Unknown Content Descriptor Actions:
as described in the DVD+RW System Description.

Physical Sector 0 / bytes D_8 to D_{39} – Drive ID:
as described in the DVD+RW System Description.

Physical Sector 0 / bytes D_{40} to D_{43} – FDCB update count:
as described in the DVD+RW System Description.

Physical Sector 0 / bytes D_{44} to D_{47} – Formatting status and mode:
byte D_{44} – Formatting status flags: as described in the DVD+RW System Description,
byte D_{45} – Verification status flags: 00h,
byte D_{46} – Recording status flags: as described in the DVD+RW System Description,
byte D_{47} – Reserved: 00h.

Physical Sector 0 / bytes D_{48} to D_{51} – Last Written Address:
as described in the DVD+RW System Description.

Physical Sector 0 / bytes D_{52} to D_{55} – Last Verified Address:
shall be set to 00 00 00 00h.

Physical Sector 0 / bytes D_{56} to D_{59} – Bitmap Start address:
shall be set to 00 00 00 00h.

Physical Sector 0 / bytes D_{60} to D_{63} – Bitmap Length:
shall be set to 00 00 00 00h.

Physical Sector 0 / bytes D_{64} to D_{95} – Disc ID:
as described in the DVD+RW System Description.

Physical Sector 0 / bytes D_{96} to D_{127} – Application dependent:
as described in the DVD+RW System Description.

Physical Sector 0 / bytes D_{128} to D_{2047} – Reserved:
shall be set to all 00h.

Physical Sector 1 to 9 / bytes D_0 to D_{2047} – Formatting bitmap:
shall be set to all 00h.

Physical Sector 10 to 15 / bytes D_0 to D_{2047} – Reserved:
shall be set to all 00h.

This page is intentionally left blank

VII.5 How to handle read-retries in case of reallocated defects

During Read-Modify-Write actions, the system can be confronted with defective Blocks. If in such a case, a Data Frame can not be retrieved from its original location and copied to the Replacement Block, the invalidity of the contents of this Data Frame in the Replacement Block shall be indicated by the signature in the dummy data in the related replacement Frame.
During later read actions from such a Data Frame, the system can generate an error message or the system can do one or more read-retries from the original location. This will work as long as the replacement is still the first replacement for the original location.

However when a replacement location goes defective and a new replacement is assigned, then it is not always clear if the latest user data can be found in the previous replacement location or still in the original location in the User Data Area. This even becomes worse if multi-level replacements have occurred (replacement of replacement of replacement, etc.). In the Defect Table there is only the direct link between the original location in the User Data Area and the latest replacement location. So all information about the in-between replacement locations would be lost.

To solve this problem the Previous Location Address shall be included in each Frame with dummy data in a Replacement Block. If some Data Frame in the latest Replacement Block is indicated to hold invalid data (byte 0 to 7 contain the signature “RMW_NVLD”), the Previous Location Address can be used to trace back that specific Data Frame down to the Replacement Block where the related Frame contains valid data or to the original Block.

In Figure 25 an example is given:

- step 1: there is a file A and free space,
- then Block N gets damaged,
- step 2: during recording of file B a replacement Block M will be created, the part of Block N belonging to file A can not be copied and thus shall be identified as “invalid” in Block M (signature in dummy data),
- when now accessing file A, a read retry can only be executed from the original Block N, the address of which is available from the Previous Location Address in Block M,
- step 3: when file A is overwritten with file A*, the part of Block M belonging to file A will be overwritten and the dummy data is removed,
- then Block M gets damaged,
- step 4: during recording of file B* a replacement Block K will be created, the part of Block M belonging to file A* can not be copied and thus shall be identified as “invalid” in Block K (signature in dummy data),
- when now accessing file A* a read retry can only be executed from Block M, the address of which is available from the Previous Location Address in Block K.

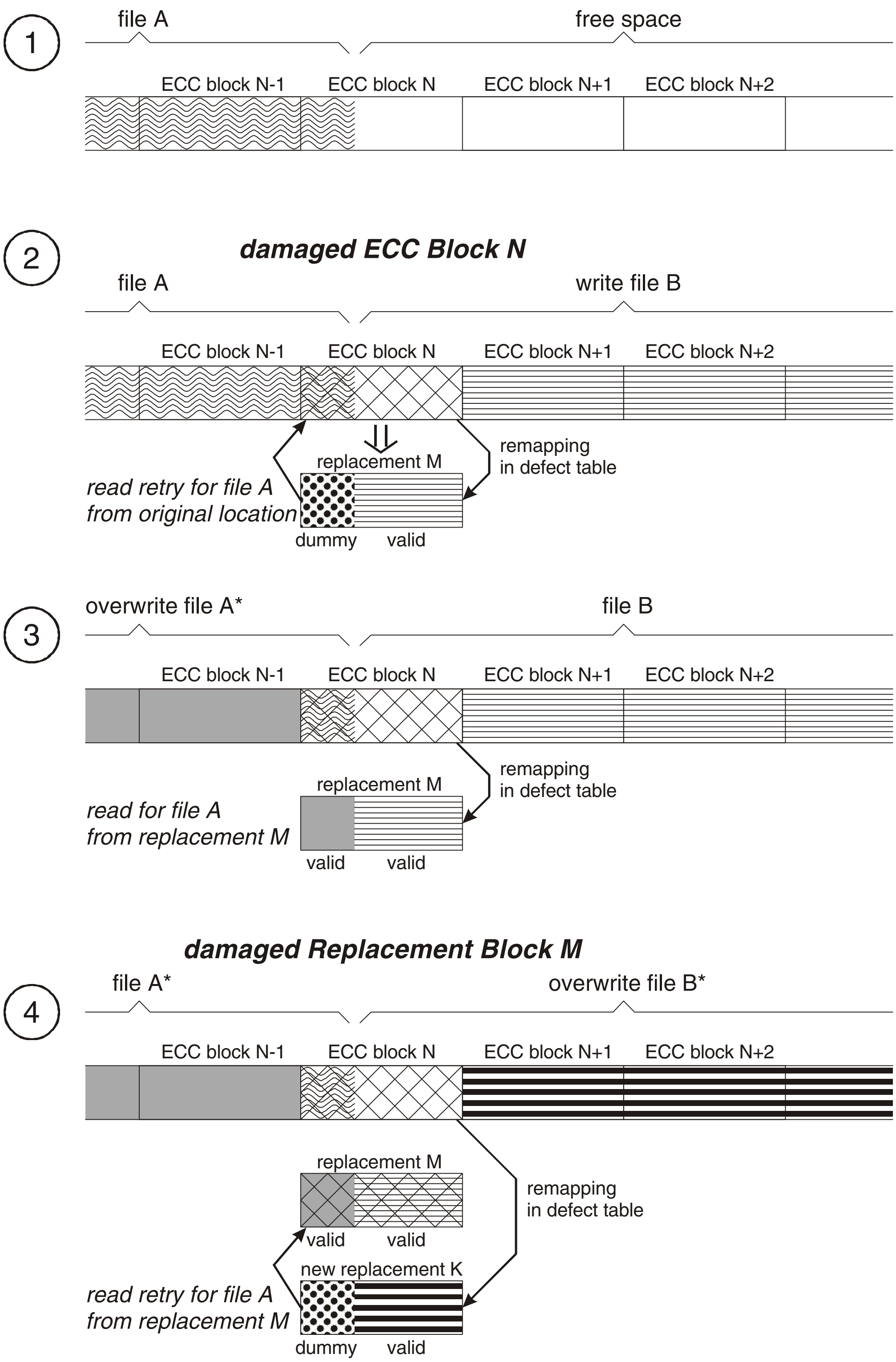


Figure 25 Example of replacement of replacement

VIII List of changes

Differences between
DVD+MRW, Defect Management & Physical Formatting, version 1.2, October, 2004
and DVD+MRW, Defect Management & Physical Formatting, version 1.1, October, 2002

Main Technical changes:
- limitation of number of Defect Table Entries to prevent compatibility problems between different drives,
- introduction of solution for a Read-Modify Write problem in case of defects.

page	chapter	version 1.2	version 1.1	remarks
3	I.5.1	**Read-Modify-Write** ...	---	new definition
4	I.5.2	R-M-W ...	---	new acronym
13	IV.5	**Byte 3: Format & Version number** ..., these bits shall be set to 0011b (0000b identifies a disc according to version 0.9 of this document, 0001b identifies a disc according to version 1.0 of this document, 0010b identifies a disc according to version 1.1 of this document).	**Byte 3: Format & Version number** ..., these bits shall be set to 0010b (0000b identifies a disc according to version 0.9 of this document, 0001b identifies a disc according to version 1.0 of this document).	new version number
17	IV.6.1	**Figure 7** 32+(n-1)∗6 │ DT Entry n (n≤256) │ 6	**Figure 7** 32+(n-1)∗6 │ DT Entry n (n≤336) │ 6	consistency of implementations
17	IV.6.1	**Figure 7** 32+n∗6 │ Unused DT Entries (all bytes 00h) │ 1536-n∗6	**Figure 7** 32+n∗6 │ Unused DT Entries (all bytes 00h) │ 2016-n∗6	consistency of implementations
17	IV.6.1	**Figure 7** 1568 │ Reserved │ 480	---	consistency of implementations
18	IV.6.1	**Byte 8..9: Number of DT Entries** These 2 bytes shall indicate the total number of entries n in this DTF (0 ≤ n ≤ 256).	**Byte 8..9: Number of DT Entries** These 2 bytes shall indicate the total number of entries n in this DTF (0 ≤ n ≤ 336).	consistency of implementations
19	IV.6.1	**Byte 32..1567: DT Entries** ... All bytes in the range 32..1567 not occupied by DT Entries shall be set to 00h.	**Byte 32..2047: DT Entries** ... All bytes in the range 32..2047 not occupied by DT Entries shall be set to 00h.	consistency of implementations
19	IV.6.1	**Byte 1568..2047: Reserved:** these 480 bytes are reserved and shall be set to 00h.	---	consistency of implementations

<table>
<tr><th>page</th><th>chapter</th><th>version 1.2</th><th>version 1.1</th><th>remarks</th></tr>
<tr><td>19</td><td>IV.6.1.1</td><td>IV.6.1.1 Format of the DT Entries</td><td>---</td><td>adapted chapter lay-out</td></tr>
<tr><td>19</td><td>IV.6.1.1</td><td>(The PBN of each Replacement Block in the Spare Areas shall occur exactly once in the Defect Table.)</td><td>---</td><td>clarification</td></tr>
<tr><td>20</td><td>IV.6.1.1</td><td>Status1½Status 2½Entry type
0000b | 000xb | Reallocation Entry | The entry identifies a valid replacement.
All Frames in the replacement Block shall contain correct data.</td><td>Status1½Status 2½Entry type
0000b | 000xb | Reallocation Entry | The entry identifies a valid replacement.</td><td>solution for R-M-W problem</td></tr>
<tr><td>20</td><td>IV.6.1.1</td><td>Status1½Status 2½Entry type
0000b | 100xb | Reallocation Entry | The entry identifies a replacement with only part of its content being valid.
Some Frames of the Block could not be copied from the previous location and are filled with dummy data identified by a signature.(see annex VII.5)</td><td>Status1½Status 2½Entry type
---</td><td>solution for R-M-W problem</td></tr>
<tr><td>20</td><td>IV.6.1.1</td><td>Status 2½definition
1xxxb | During a R-M-W action some of the Frames could not be retrieved from the previous location and therefore have been filled with dummy data. *
This dummy data shall be set to:
- bytes 0 to 7:
52 4D 57 5F 4E 56 4C 44h, representing the characters “RMW_NVLD”,
- bytes 8: 00h,
- bytes 9 to 11:
the PSN representing the previous physical location of the data now allocated to this Frame of the actual replacement Block,
-bytes 12 to 2047: all 00h.</td><td>Status 2½definition
---</td><td>solution for R-M-W problem</td></tr>
<tr><td>20</td><td>IV.6.1.1</td><td>* During read actions from replacements Blocks with Status 2 = 1xxxb, each individual Frame shall be checked on the presence of dummy data.
If a Frame contains dummy data, the drive has two options:
- generate an error message,
- do a read-retry from the previous location.</td><td>---</td><td>solution for R-M-W problem</td></tr>
</table>

page	chapter	version 1.2	version 1.1	remarks
22	IV.7.1	At initialization all Replacement Blocks of both Spare Areas are registered in the 16 DTFs in clusters of 256 Blocks.	At initialization all Replacement Blocks of both Spare Areas are registered in the 16 DTFs in clusters of 256 Blocks, leaving 80 Entries in each DTF empty.	consistency of implementations
22	IV.7.1	The reserved space in the tables shall not be used.	The empty space of 80 entries in the tables should be retained.	consistency of implementations
		Figure 9 Reserved	**Figure 9** 80 empty entries	consistency of implementations
23	IV.7.3	**IV.6.3 Handling of streaming data** In case of a “write_streaming” command, the drive shall remove all defects with Status 1 = 0000b within the written address range(s) from the Defect Tables or change them to Status 1 = 0001b.	(*moved from page 20*) In case of a “write_streaming” command, the drive shall remove all defects with Status 1 = 0000b within the written address range(s) from the Defect Tables or change them to Status 1 = 0001b.	adapted chapter lay-out
28	V.7.1	At initialization all Replacement Blocks of both Spare Areas are registered in the 64 DTFs in clusters of 256 Blocks.	At initialization all Replacement Blocks of both Spare Areas are registered in the 64 DTFs in clusters of 256 Blocks, leaving 80 Entries in each DTF empty.	consistency of implementations
47	VII.5	**VII.5 How to handle read-retries in case of reallocated defects**	---	solution for R-M-W problem, new annex

This page is intentionally left blank