DVD+ReWritable DL

Multi-Media Command
Set Description for the DVD+RW
Double Layer Basic Format

Version 0.52

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DRAFT

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1 Scope

Double Layer DVD+RW is a form of DVD rewritable medium. Physically, it is constructed for fully random recording in the 32KB increments common to other DVD rewritable formats. Zero loss linking during ECC block recording allows streamed recording without skipping. A single logical format is defined for this medium: the Double Layer DVD+RW Basic Format.

This document includes descriptions and command support double layer discs in both 80 mm and 120 mm.

This document is created to match the structure of MMC-4:

1. Scope - This section.
2. References - A list of documents that may be needed by the reader for the correct understanding of this document.
3. Definitions, Abbreviations, and Acronyms - A glossary of terminology unique to this document. Basic definitions are in SPC-3. General Multimedia definitions are found in MMC-4.
4. Double Layer DD+RW Basic Format Model - Modeling for the various media oriented behaviors that the Host may witness from Double Layer DVD+RW devices provides an overview of internal Drive operation for the Host application developer.
5. Features and Profiles - Features describe Drive capabilities while Profiles exist to claim a collection of features.
6. Command Descriptions - Commands are described from the Host's point of view.
7. Mode Pages - Inputs required by the Drive are not always a part of a command. Inputs associated with mode of operation are readable and sometimes writable.

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2 References

2.1 Normative References

2.1.1 Approved References

The following are approved ANSI, approved international and approved regional publications (ISO, IEC, CEN/CENELEC, and ITUT), and may be obtained from the international and regional organizations that control them.

ANSI NCITS.351:2001	SCSI-3 Primary Commands (SPC-2)
ANSI INCITS 360:2002	SCSI-3 MultiMedia Command Set 3 (MMC-3)
ANSI NCITS.306:1998	SCSI-3 Block Command Set (SBC)
ANSI NCITS.361:2002	AT Attachment with Packet Interface 6 (ATA/ATAPI-6)
ECMA 167, 3rd Edition	Volume and File Structure for Write-Once and Rewritable Media using Non-Sequential Recording for Information Interchange

2.1.2 References Under Development

At the time of publication, the following referenced standards were still under development. For information on the current status of the document, or regarding availability, contact the relevant standards body or other organization as indicated.

INCITS T10/1416D	SCSI Primary Command Set - 3 (SPC-3)
INCITS T10/1417D	SCSI Block Command Set - 2 (SBC-2)
INCITS T13/1532D	AT Attachment with Packet Interface 7 (ATA/ATAPI-7)
INCITS T10/1545D	SCSI-3 MultiMedia Command Set 4 (MMC-4)

For more information on the current status of the above documents, contact INCITS Secretariat, 1250 Eye Street, NW Suite 200, Washington, DC 20005, Phone Number (202) 737-8888. To obtain copies of these documents, contact Global Engineering at (303) 792-2181 or INCITS Secretariat.

2.2 Other References

OSTA MultiRead Specifications for CD-ROM, CD-R, CD-R/RW, and DVD-ROM Devices, published by the Optical Storage Technology Association (OSTA), (for availability, consult www.osta.org).

DVD+ReWritable Dual Layer, 8,5 Gbytes Basic Format Specifications System Description part 2, volume 1; version 0.20 June 15, 2005; published by the DVD+RW Alliance (for availability, consult www.licensing.philips.com).

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3 Definitions, Abbreviations and Acronyms

3.1 General

The Definitions, Symbols, Abbreviations, and Conventions described in MMC-4 are valid within this document. The Definitions, Symbols, Abbreviations, and Conventions described in this clause are in addition to those found in MMC-4. In the event of duplication, this document shall rule.

3.2 Terms

3.2.1 Address in Pre-groove (ADIP)

Address In Pre-groove. Address and recording information encoded in the wobble groove on DVD+RW media.

3.2.2 Control Data Zone (CDZ)

This 3072 sector area contains information that is format compatible with the DVD-ROM standard.

3.2.3 De-Icing

When an ECC block on a DVD+RW medium is blank, no headers are present in any sector of the ECC block. This means that no sector within that ECC block can be located. This has been described as similar to sliding on ice until crashing into a written area. The process of insuring that each ECC block is written at least once to insure the presence of headers is called de-icing.

3.2.4 DVD-ROM

The medium specified by ISO/IEC 16448.

3.2.5 DVD-RAM

The medium specified by ISO/IEC 16824.

3.2.6 Data Zone (DZ)

On layer 0, the Data Zone is the area between the lead-in and the middle zone. On layer 1, the Data Zone is the area between the middle zone and the lead-out.

3.2.7 Drive

A Logical Unit that operates as a single MM disc accessing unit. e.g. a DVD+RW Drive.

3.2.8 Host

A SCSI device with the characteristics of a primary computing device, typically a personal computer, workstation, minicomputer, mainframe computer, or auxiliary computing device or server. A host includes one or more SCSI initiator devices.

3.2.9 Logical Block

A host addressable unit of data is a logical block. Each logical block on DVD+RW media is the user data of one of the 16 sectors within an ECC block.

3.2.10 Logical Block Address (LBA)

A host referenced mapping to a linear address space of logical blocks.

3.2.11 Logical Sector Number (LSN)

Logical Sector Numbers are assigned contiguously from LSN 0, starting from the first PSN (030000h) to the end of the Data Zone. On DL DVD+RW this is the same as Logical Block Address (LBA).

3.2.12 Physical Sector Number (PSN)

The first Physical Sector of the Data Zone shall be numbered 030000h. The PSNs increase by 1 for each next Physical Sector in the whole of the Information Zone.

3.3 Abbreviations

ADIP	Address in Pre-groove	DVD-ROM	DVD Read-only Memory
CDZ	Control Data Zone	DVD+RW	DVD ReWritable
DL DVD+R	Double Layer DVD Recordable	DZ	Data Zone
DL DVD+RW	Double Layer DVD ReWritable	LBA	Logical Block Address
DVD-R	DVD Recordable	LSN	Logical Sector Number
DVD-RAM	DVD Random Access memory	PSN	Physical Sector Number

4   Double Layer DVD+RW Basic Format Model

DL DVD+RW medium is designed to be physically consistent with single layer DVD+RW media and logically consistent with the DVD-ROM dual layer specifications.

4.1   Physical Overview

Each layer of DVD+RW media is either 8 or 12 centimeters in diameter and separated into zones as shown in Figure 1

R0 Center Hole	R4 3rd Transition Area
R1 1st Transition Area	R5 Information Zone
R2 2nd Transition Area	R6 Rim Area
R3 Clamping Zone	
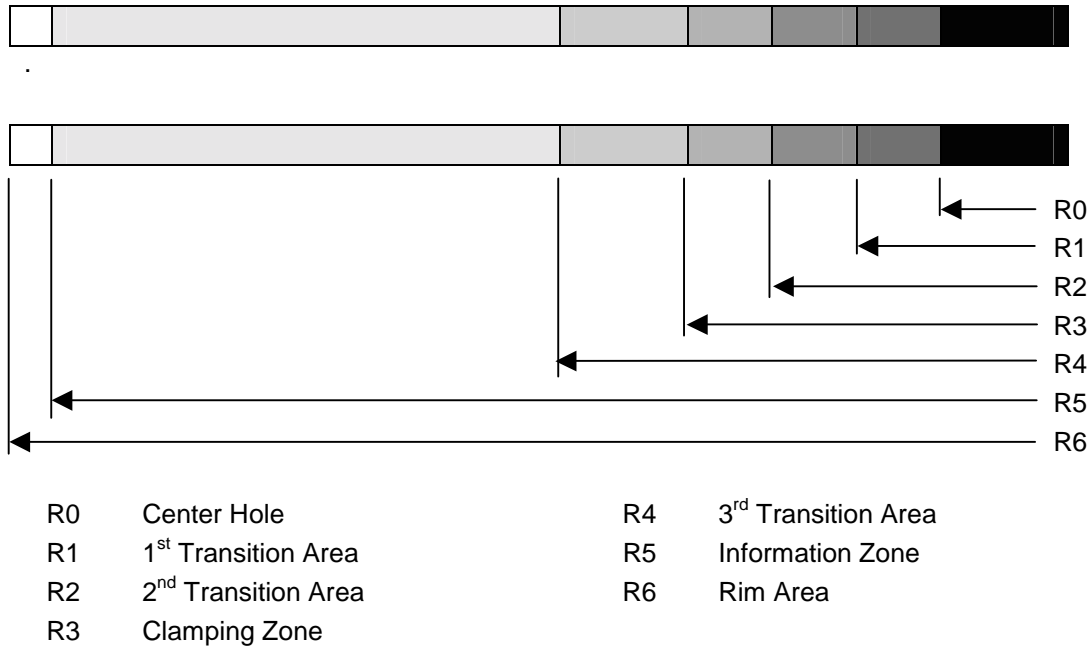
Figure 1 – The Zones of a DVD+RW Medium

The Center Hole, 1st Transition Area, 2nd Transition Area, Clamping Zone, and 3rd Transition Area are all part of the alignment and clamping mechanisms. These areas have no direct involvement with the writable areas of the medium.

The Information Zone is the area in which actual recording may occur. It contains the lead-in, the data area, and the lead-out. This area begins at a radius of 22 millimeters and proceeds to the outer radius. For 120-millimeter media, the information zone ends at a nominal radius of 58.5 millimeters. For 80-millimeter media, the information zone ends at a nominal radius of 38.5 millimeters.

The Rim Area is simply the area beyond the data groove. For 120-millimeter media, it typically ends at a radius of 60 millimeters. For 80-millimeter media, it typically ends at a radius of 40 millimeters.

4.2 Logical Overview

4.2.1 ECC Blocks

Each information zone is organized as a sequence of independently recorded units called ECC blocks. The definition of the ECC block has only small changes from the single layer DVD+RW. The DVD+RW ECC block is defined to be consistent with the DVD-ROM standard. A DVD+RW data sector contains 2 064 bytes, 2 048 bytes of main data and 16 bytes of additional information.

4.2.1.1 Sector Format

The logical layout of a DVD+RW data sector is shown in Figure 2.

4 bytes	2 bytes	6 bytes	2048 bytes	4 bytes
ID	IED	RSV	MAIN DATA	EDC
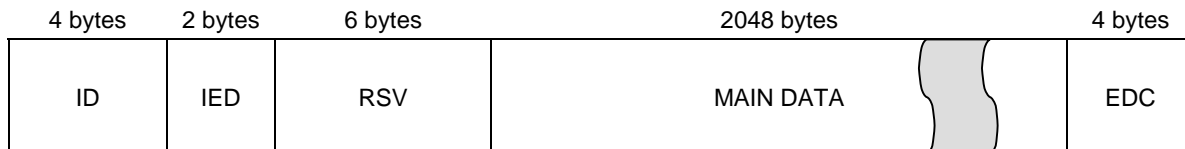
Figure 2 – Logical Layout of a DVD+RW Data Sector

The ID field is viewed as a 32-bit field as shown in Figure 3.

Sector Information Bits 31 thru 24	Physical Sector Number Bits 23 through 0					
Sector Format Type	Tracking Method	Reflectivity	Reserved	Zone Type	Data Type	Layer Number

Sector Information:

Sector Format Type (Bit 31)	is set to ZERO, indicating a CLD format
Tracking Method (Bit 30)	is set to ONE, indicating groove tracking
Reflectivity (Bit 29)	is set to ONE indicating that the reflectivity is less than 40 %
Reserved (Bit 28)	is set to ZERO
Zone Type (Bits 27 and 26)	is valued as: 00 when the sector is in the Data Zone
	01 when the sector is in the Disc Lead-in
	10 when the sector is in the Disc Lead-out
	11 when the sector in the middle zone
Data Type (Bit 25)	is set to ONE, indicating rewritable media
Layer Number (Bit 24)	is set to ZERO when the sector is on layer 0
	Is set to ONE when the sector is on layer 1

Physical Sector Number:

The least significant 24 bits (bits 23 through 0) contains the Physical Sector Number in binary notation. The Physical Sector Number of the first Physical Sector of an ECC Block shall be an integer multiple of 16.

Figure 3 - ID Field Details

IED contains 2 bytes of redundancy as an error detection code (EDC) for the ID field.

RSV is reserved and must be recorded with zeros.

MAIN DATA contains 2 048 bytes and has 2 possible sources. Except for format management overheads, the Host is the source of Main Data for the part of the Information Zone called the Data Zone. For all other areas, the Drive must generate the Main Data from information provided by the host according to the format requirements of *DVD+RW 8,5 Gbytes Basic Format Specifications.*

EDC contains 4 bytes of redundancy as an error detection code (EDC) for the entire sector.

A 2 064 byte sector is divided into 12 rows of 172 bytes each. Main data is scrambled similar to CD-ROM sectors. 16 sequential DVD sectors are packed into 192 rows, each with 172 bytes. Error correction for the ECC block is unchanged from the DVD standard.

4.2.1.2 Physical Addressing

Conceptually, if a sector has PSN = N on layer 0, the sector at the radially equivalent position on layer 1 has PSN = ~N, and vice versa. That is, the addresses are 1's complements of each other. Figure 4 shows sample ECC blocks at radially equivalent positions on each layer.

L0 ECC Block Sector Addresses			Radially Equivalent L1 ECC Block Sector Addresses
	030000h	FCFFFFh	
	030001h	FCFFFEh	
	030002h	FCFFFDh	
	….	….	
	03000Eh	FCFFF1h	
	03000Fh	FCFFF0h	

Figure 4 – Sample ECC block PSNs

Physical addresses begin on layer 0 prior to the inner disc area with a virtual (i.e. non-existent) PSN = 000000h. Actual addresses begin in the initial zone at a PSN << 024900h extending to some PSN >> 238000h after the outer disc area. Virtual addresses continue on layer 0 up until 7FFFFFh.

Physical addresses begin on layer 1 prior to the outer disc area with a virtual (i.e. non-existent) PSN = 800000h. Actual addresses begin prior to the outer disc zone at some PSN << DC8000h extending to some PSN >> FDB700h. Virtual addresses continue on layer 1 up until FFFFFFh.

This relationship between layers is shown in Figure 5.

Layer 1	FFFFFFh ···	Max > FDB700h	···	Min < DC8000h	··· 800000h	Layer 1
Inner Radius	**Virtual Addresses**		**Physical Addresses**		**Virtual Addresses**	Outer Radius
Layer 0	000000h ···	Min < 024900h	···	Max > 238000h	··· 7FFFFFh	Layer 0
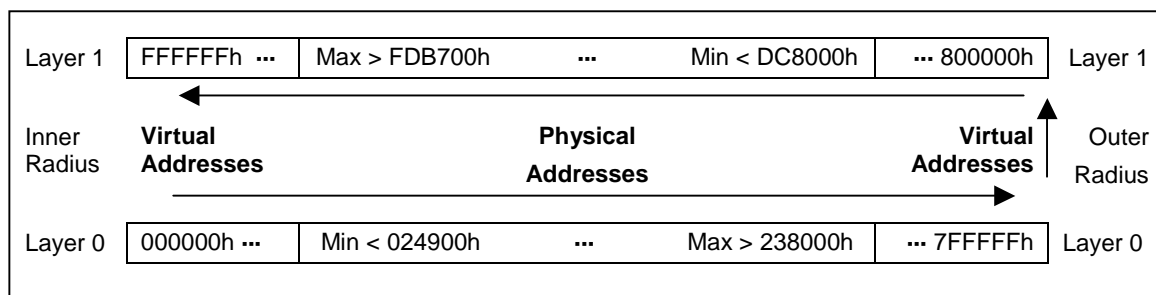
Figure 5 – Mirrored Physical Addresses on DL DVD+RW

4.2.2 Groove Layout

4.2.2.1 Logical Disc Layout

As shown in Figure 6, each layer of a DL DVD+RW disc has a layout that is similar to single layer DVD+RW.

	Layer 0			Layer 1	
Direction of L0 Spiral	**Lead-in**	Initial Zone		**Lead-out**	Final Zone
		Inner Disc Test Zone			Inner Disc Test Zone
		Guard Zone 1			Buffer Zone 4
		Reserved Zone 1			
		Reserved Zone 2			
		Inner Disc ID Zone			
		Reserved Zone 3			
		Reference Code Zone			
		Buffer Zone 1			
		Control Data Zone			
		Buffer Zone 2			
	Data	Data Zone (minimum size is 2 086 912 sectors)		**Data**	Data Zone (minimum size is 2 086 912 sectors)
	Middle Zone 0	Buffer Zone 3		**Middle Zone 1**	Buffer Zone 3
		Reserved Zone 4			Reserved Zone 4
		Guard Zone 2			Guard Zone 2
	Outer Drive Area	Reserved Zone 5		**Outer Drive Area**	Reserved Zone 5
		Outer Disc Test Zone			Outer Disc Test Zone
		Guard Zone 3			Guard Zone 3

Direction of L1 Spiral

Figure 6 — Layout of a DL DVD+RW Disc

4.2.2.1.1   Lead-in Zone

The Lead-in Zone is the innermost Zone of the Information Zone on Layer 0. The Lead-in Zone consists of several contiguous zones.

Initial Zone	The Main Data of the Data Frames in this Zone, when recorded, shall be set to all (00). The System Description does not specify the number of Physical Sectors in the Initial Zone. The Physical Sector Number of the first Physical Sector of the Data Zone is large enough so as to prevent a Physical Sector Number 0 to occur in the Initial Zone.
Inner Disc Test Zone	This zone is reserved for drive testing and OPC algorithm (see Annex I). This Zone shall be filled with Main Data set to (00).
Guard Zone 1	This Guard Zone is used as a protection for separating test writing zones from information zones containing user data. If recorded, this Zone shall be filled with Main Data set to (00).
Reserved Zone 1	If not used all bytes shall be set to (00).
Reserved Zone 2	If not used all bytes shall be set to (00).
Inner Disc ID Zone	This zone is reserved for information agreed upon by the data interchange parties. Each set of 16 Physical Sectors from one ECC Block is either a Disc Control Block (DCB) (see clause 24) or recorded with all (00) Main Data. Each ECC Block in this Zone following one recorded with all (00) Main Data shall also be recorded with all (00) Main Data.
Reserved Zone 3	If not used all bytes shall be set to (00).
Reference Code Zone	The recorded Reference Code Zone shall consist of the 32 Physical Sectors from two ECC Blocks which generate a specific Channel bit pattern on the disc. This shall be achieved by setting to (AC) all 2 048 Main Data bytes of each corresponding Data Frame. Moreover, no scrambling shall be applied to these Data Frames, except to the first 160 Main Data bytes of the first Data Frame of each ECC Block.
Buffer Zone 1	The Main Data of the Data Frames in this Zone shall be set to all (00).
Control Data Zone	This Zone shall consist of 3 072 Physical Sectors from 192 ECC Blocks. The content of the 16 Physical Sectors of each ECC Block is repeated 192 times, unless specified otherwise.
Buffer Zone 2	This recorded Zone shall consist of 512 Physical Sectors from 32 ECC Blocks. During use of the disc VCPS related information may be recorded to these 32 ECC Blocks, according to the specifications given in the VCPS System Description. If no VCPS related information is copied to these locations then the Main Data of the Data Frames in this Zone shall be set to all (00).

4.2.2.1.2   Data Zones

The start radius of the Data Zone on Layer 0 and Layer 1 is determined by the location of Physical ADIP Address (00C000) and (F74A00) respectively.

On a 120 mm disc, this zone contains two times 2 086 912 Physical Sectors for the storage of user data.

On an 80 mm disc, this zone contains two times 649 728 Physical Sectors for the storage of user data.

4.2.2.1.3   Middle Zones 0 and 1

Both layers have a Middle Zone located at the outer side of the disc. The Middle Zones shall be located opposite each other, meaning that the end address of the Middle Zone on Layer 1 (the

most inner PSN) is the inverse of the start address of the Middle Zone on Layer 0 (also the most inner PSN).

A Middle Zone consists of several contiguous zones.

Buffer Zones 3	The Main Data of the Data Frames in this Zone shall be set to all (00).
Reserved Zone 4	These 256 Physical Sectors are reserved and shall be set to (00).
Guard Zones 2	These Guard Zones are used as a protection for separating test writing zones from information zones containing user data. They also provide for a recorded area on the opposite layer, at any position within the Data Zone of each layer (to cope with radial misalignments of inner and outer diameters of the Data Zones). The Guard Zones 2 shall be filled with Main Data set to (00).

4.2.2.1.4 Outer Drive Areas

Both layers have an Outer Drive Area located at the outer side of the disc.   A Middle Zone consists of several contiguous zones.

Reserved Zone 5	4 096 Physical Sectors are reserved and shall be set all (00).
Outer Disc Test Zone	12 288 Physical Sectors reserved for drive testing and OPC algorithm. This Zone shall be filled with Main Data set to (00).
Guard Zone 3	This Zone shall be filled with Main Data set to (00) or may be left unrecorded.

4.2.2.1.5 Lead-out

The Lead-out Zone is located at the inner side of the disc on Layer 1. The Lead-in Zone consists of several contiguous zones.

Buffer Zone 4	This Zone shall consist of 9 088 Physical Sectors. The Main Data of the Data Frames in this Zone shall be set to all (00).
Inner Disc Test Zone	12 288 Physical Sectors reserved for drive testing and OPC algorithm. This Zone shall be filled with Main Data set to (00).
Final Zone	The Main Data of the Data Frames in this Zone, when recorded, shall be set to all (00).

4.2.2.2 ADIP

As with single layer DVD+RW, the DL DVD+RW blank groove has a fixed frequency wobble with information modulated into the wobble. Throughout most of the groove, the wobble information contains only address identification called Address In Pre-groove (ADIP). During the Lead-in Zone, additional information is interleaved between address information blocks. This additional information contains structural information and initial recording parameters.   Location information describes the limits of the data zone:

   a. First Sector of Layer 0 Data Zone – ADIP PSN of first sector of the L0 Data Zone

   b. Last Sector of Layer 0 Data Zone – ADIP PSN of last sector of the L0 Data Zone

   c. Last Sector of Layer 1 Data Zone – ADIP PSN of last sector of the L1 Data Zone

The last possible start PSN of the L0 middle zone is the Last Sector of Layer 0 Data Zone plus 1.

4.3   Using Double Layer DVD+RW Media

4.3.1   Reading

When recorded, DVD+RW medium is ECC block readable. An intelligent controller can separate individual sector data from a decoded ECC block. Thus for the host, DVD+RW media is 2 048 byte sector readable.

4.3.2   Writing

Since the host's perception is that the media is sector readable, then in order to maintain compatibility with other block devices, a DL DVD+RW Drive should be able to also write single sectors for its host.

The Drive is required to write DVD+RW media only in complete ECC blocks. So, the Drive should often perform a read/modify/write function in order to place the host's data in the correct position within the ECC block. That works when the ECC block to be written has already been written. When the ECC block has never been written and the Drive should write less than a full ECC block, then the Drive should create data. The correct method is to zero fill sectors for which no data is available.

If ECC block N is written, but the ECC block immediately preceding N is blank, then ECC block N may be unreadable. It is therefore important that the Drive ensure that a written ECC block precedes each ECC block written.

4.3.3   Formatting

4.3.3.1   Overview

Physically blank DVD+RW media has no data recorded in its groove, so RO devices can find no references on the surface of a blank DL DVD+RW disc. This problem is resolved by the formatting the disc.

When every ECC block in the Information Zone (lead-in, both data zones, both middle zones, and lead-out) of a DL DVD+RW disc has been recorded according to the *DVD+RW 8,5 Gbytes Basic Format Specifications*, the disc is "formatted".

The high capacity of DL DVD+RW means that completely formatting a disc requires more time than desired. Most of the format time is pushed into background time so that the user does not experience any significant delays. This is done by the Drive's control of use models in order to present to the Host an incompletely formatted media as if it is completely formatted. Since much of the formatting is deferred, the Host's use models must be adjusted to deal with different timings of some functions.

In order that the formatting process seem less intrusive, the DL DVD+RW Drive provides addition functions.

a. Format Start-up: A normal format start-up records the entire lead-in prior to starting the data zone recording. Normal format start-up can delay the start of user access, so a quick start is provided. The quick start option defers most of the lead-in recording until the end of the format process.

b. Write commands from the Host are accepted and executed. The Drive interrupts the format process to execute the Host write requests. The FDCBs contain bitmaps that permit the Drive to distinguish format written versus blank ECC blocks.

c. It is possible to stop the format process in a restartable way. The Quick Stop records only enough information to continue the format process at a future time. The Compatible Stop records (as necessary) the lead-in, captured blank ECC blocks in the data zones, and the lead-out. The Compatible Stop is intended to make the disc read compatible with RO devices.

4.3.3.2 The Double Layer Formatting Process

4.3.3.2.1 Normal Start Formatting

The FORMAT UNIT command may be issued requesting Normal Start Formatting. In Normal Start Formatting, the disc is first initialized by writing the area containing the Inner Disc Test Zone, Buffer Zone 2 and all zones between in the Lead-in, and by writing the Test Zone and the Buffer Zone in the Lead-out.

Once the initialization is completed, the FORMAT UNIT command may be terminated with GOOD status while the format process continues in background.

4.3.3.2.2 Quick Start Formatting

The FORMAT UNIT command may be issued requesting Quick Start Formatting. In Quick Start Formatting, format writing in the lead-in is minimized prior to beginning de-ice of the Data Zone. It is permitted to perform no recording in either the lead-in or the lead-out. The actual amount of format writing in the lead-in is vendor specific.

The lead-in recording typically includes the recording of all or part of Buffer Zone 2 (Figure 7).

Once the minimal writing is completed, the FORMAT UNIT command may be terminated with GOOD status while the format process continues in background.
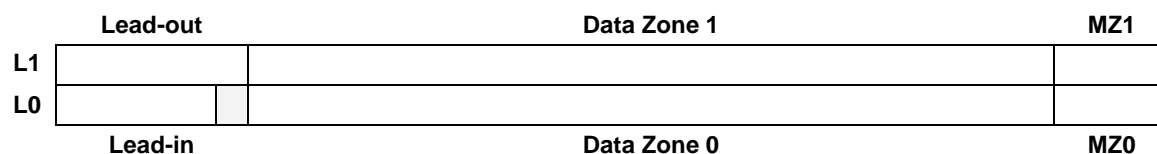
Figure 7 — Foreground part of the format process

4.3.3.2.3 Background Formatting

Formatting continues in background by recording one increment on layer 1 from LBA = CAPACITY-INCREMENT_SIZE until LBA = CAPACITY-1. Each ECC block is encoded as data and the user data areas are zero filled. The recommended increment size is 512 ECC blocks.
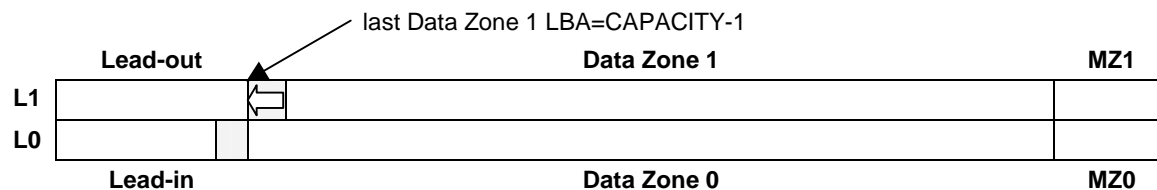
Figure 8 — Start Background part of format process

The incremental formatting continues, writing the previous increment (i.e. from LBA = CAPACITY-2*INCREMENT_SIZE until LBA = CAPACITY-INCREMENT_SIZE-1 (Figure 9).
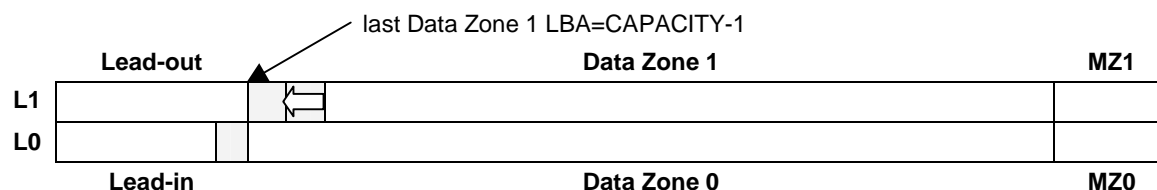
Figure 9 — Background part of format process

If not stopped, the format of layer 1 will complete and formatting shall continue on layer 0 in a similar, incremental way. Writes of user data shall always take precedence over the format writing process. The status of the format process is maintained in the FDCB, similar to the single layer format process. Unlike the single layer format process, the Last Written Address (LWA) is maintained for each layer.

Regardless of how the format was started (Quick vs Normal), the finished format should have the same appearance as defined in *DVD+RW 8,5 Gbytes Basic Format Specifications*.

When both data zones are fully recorded, the format process enters the finalization part of the format process (Figure 10): both middle zones are written, the lead-out is written, and the lead-in is completely written. If a comaptibility stop had been executed, the lead-in and lead-out have already been completely recorded, and only need to be updated.
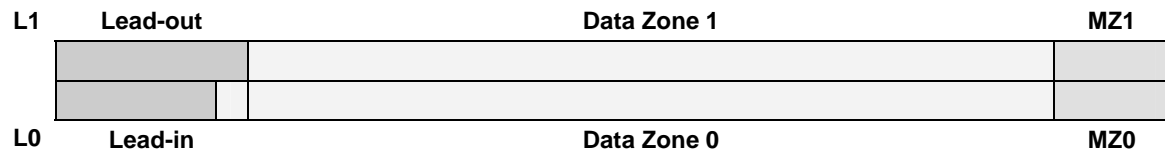
Figure 10 — Finalization part of the format process

4.3.3.3   Quick Stop

Quick Stop is defined as "quick" relative to normal background formatting. The lead-in area should be completely written and the FDCBs should be written with bit maps that reflect the actual written area of each Data Zone. No temporary middle zone is required. In the Data Zone, there may be unwritten ECC blocks prior to the last user written ECC block.

4.3.3.4   Compatiblity Stop

Compatibility Stop is defined for read compatibility with read-only devices. The lead-in area should be completely written. The data zone with the greatest radial distance of recording should be located. The example in Figure 11 shows that data zone 1 has the greatest radial distance of recording. This point is extended by 64 ECC blocks of zero fill data (area labelled A). Any remaining unrecorded ECC blocks from the end of A to the start of the lead-out shall be format written. The greatest radial distance of recording on data zone 0 shall be extended with format writing to match the radial distance of layer 1 (area labelled B). Any remaining unrecorded ECC blocks from the end of the lead-in to the start of area B shall be format written. The lead-out is written.

If the FDCB bit maps show that any of these areas is already written, then writing again is not required. See Figure 11.
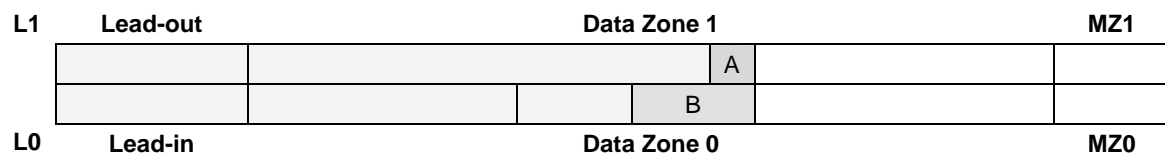
Figure 11 — Compatibility Stop Example

The CDZ is written to indicate that the capacity that is formatted. Consequently, if the Host chooses to write any L1 LBA in the unformatted area of the L1 Data Zone, the entire disc format must be completed during the Compatibility Stop processing.

4.3.3.5   Restarting

If a background format has been Compatibility Stopped, the format restart simply continues the background formatting as if no stop/restart sequence had happened.

4.3.3.6 Background Formatting Sequences

The formatting options have two background format possibilities, two methods for stopping the format, and consequently, two methods for restarting a stopped format. Different sequences within the Drive become many. Examples of these are shown in Table 1 through Table 7. Details of exact sequences may vary based on implementation.

Table 1 – Initial Sequence in Normal Background Formatting

Interface	Format Writing
FORMAT UNIT command received	Calibrate for writing
If immediate, terminate FORMAT UNIT command with GOOD status	Format write Inner Disc Test Zone through Reserved Zone 2
	Initialize and write FDCBs in Inner Disc ID zones
	Complete format writing of Inner Disc ID zone and continue through Buffer Zone 1
	Construct initial version and write Control Data Zone
	Write Buffer Zone 2
If not immediate, terminate FORMAT UNIT command with GOOD status	

Table 2 – Sequence in Quick Start Background Formatting

Interface Events	Format Writing Events
FORMAT UNIT command received	
If immediate, terminate FORMAT UNIT command with GOOD status	Calibrate for writing
	Perform vendor specific lead-in writing – if any
If not immediate, terminate FORMAT UNIT command with GOOD status	
	Initialize internal copies FDCB bit maps.

Table 3 — Background Format Writing

Interface Events	Format Writing Events
	If layer 1 is not completely written, FDCB1 is used to locate next increment boundary and Format write the unwritten ECC blocks of the data zone 1 increment. Continue to the next layer 1 increment. When layer 1 data zone is completely written, switch to layer 0 and continue the incremental format writing guided by FDCB0.
…	…
WRITE command received	Stop format writing. Write data as requested by host. Update internal copy of the appropriate FDCB. Continue format writing in data zone guided by the FDCBs.
…	…

Table 4 – Sequence when Compatibility Stopping a Normal Started Formatting

Interface Events	Format Writing Events
…	…
CLOSE TRACK SESSION command requesting compatibility stop received	
If immediate, terminate FORMAT UNIT command with GOOD status	Stop background format functions.
	Write any pending, cached host data and update internal copies of the FDCBs.
	Using FDCB0 bit map locate the written ECC block that has largest radial position, A.
	Format write all blank ECC blocks from LBA 0 to A.
	Switch to layer 1. Using FDCB1 bit map locate the written ECC block that has largest radial position, B. Format write all blank ECC blocks from B to start of lead-out.
	If the radial position of B is less than the radial position of A, continue format writing data zone 1 until the L1 position of formatted data is at or beyond the radial position of A.
	Pre-pend 64 ECC blocks. to currently written L1.
	Write the lead-out.
	Switch to layer 0. Append format writing on data zone zero until it is at least to the equivalent position as on layer 1.
	Update the lead-in structures.
If not immediate, terminate FORMAT UNIT command with GOOD status	

Table 5 – Sequence when Quick Stopping a Normal Background Formatting

Interface Events	Format Writing Events
…	…
CLOSE TRACK SESSION command requesting quick stop received	
If immediate, terminate FORMAT UNIT command with GOOD status	Stop background format functions.
	Write any pending, cached host data and update internal copies of FDCBs.
	Update FDCBs on both layers.
If not immediate, terminate FORMAT UNIT command with GOOD status	

Table 6 – Sequence when Compatibility Stopping a Quick Started Background Formatting

Interface Events	Format Writing Events
…	…
CLOSE TRACK SESSION command requesting compatibility stop received	
If immediate, terminate FORMAT UNIT command with GOOD status	Stop background format functions.
	Write any pending, cached host data and update internal copies of the FDCBs.
	Using FDCB0 bit map locate the written ECC block that has largest radial position, A.
	Format write all blank ECC blocks from LBA 0 to A.
	Switch to layer 1. Using FDCB1 bit map locate the written ECC block that has largest radial position, B. Format write all blank ECC blocks from B to start of lead-out.
	If the radial position of B is less than the radial position of A, continue format writing data zone 1 until the L1 position of formatted data is at or beyond the radial position of A.
	Pre-pend 64 ECC blocks. to currently written L1.
	Write the lead-out.
	Switch to layer 0. Append format writing on data zone zero until it is at least to the equivalent position as on layer 1.
	Update the lead-in structures.
	Construct initial version and write Control Data Zone
	Write Buffer Zone 2.
If not immediate, terminate FORMAT UNIT command with GOOD status	

Table 7 – Sequence when Quick Stopping a Quick Started Background Formatting

Interface Events	Format Writing Events
CLOSE TRACK SESSION command requesting quick stop received	
If immediate, terminate FORMAT UNIT command with GOOD status	Stop background format functions.
	Write any pending, cached host data and update internal copies of FDCBs.
	Format write Guard Zone 1 through Reserved Zone 2
	Write updated FDCB0 in Inner Disc ID zone 0. Complete format writing of Inner Disc ID zone 0 and continue through Buffer Zone 1.
	Switch to layer 1 and Write updated FDCB1 in Inner Disc ID Zone 1. Complete format writing of Inner Disc ID zone 1 and continue through Buffer Zone 1
	Construct initial version and write Control Data Zone
	Write Buffer Zone 2
If not immediate, terminate FORMAT UNIT command with GOOD status	

4.3.4   Disc Control Blocks

DL DVD+RW media format includes a generalized structure called the Disc Control Block (DCB). The DL DVD+RW basic format has only two defined DCBs: the Formatting DCB (FDCB) and the Write Inhibit DCB. The Drive is required to write and update the FDCB on each layer during the formatting process. The WDCB is only upon request by the host.

Both are readable using the READ DVD STRUCTURE command. Only the Write Inhibit DCB is Writable using the SEND DVD STRUCTURE command.

All DCBs include handling control for DVD+RW devices that have no specific understanding of the specific DCB: the Unknown Content Descriptor (UCD). This bit significant value in the DCB defines actions that the host may take (e.g. write the DCB, do not write the DCB, read the DCB, etc). In the event that the host attempts to violate the instructions of the UCD, the associated command shall be terminated with CHECK CONDITION status and sense shall be set to ILLEGAL REQUEST, ILLEGAL FUNCTION (05h/22h/00h).

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5   Features and Profiles

5.1   Feature 003Ah: Double Layer DVD+RW

A DL DVD+RW Drive shall report the DVD-ROM Profile (Profile 10h).

The presence of the DL DVD+RW Feature indicates that the Drive is capable of reading a recorded DL DVD+RW disc that is formatted according to *DVD+RW 8,5 Gbytes Basic Format Specifications.* Specifically, this includes the capability of reading DCBs. The DL DVD+RW Feature descriptor is shown in Table 8.

Table 8 – DL DVD+RW Feature Descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0	Feature Code = 003Ah							
1								
2	Reserved		Feature Version = 0000b				Persistent	Current
3	Additional Length = 4							
4	Reserved							Write
5	Reserved						Quick Start	Close Only
6	Reserved							
7	Reserved							

The Version field shall be set to 0000b.

The Persistent bit shall be set to zero, indicating that this Feature may change its current status.

The Current bit, when set to zero, indicates that this Feature is not currently active and that the Feature Dependent Data may not be valid. When set to one, this Feature is currently active and the Feature Dependent Data is valid.

> Note: When Current = 0, either no disc is mounted or the disc currently mounted is not a DL DVD+RW disc. When Current = 1, a disc is mounted and it is a DL DVD+RW disc.

The Additional Length field shall be set to 0Ch.

This feature may be present only to represent additional capability of the DVD-ROM Profile. If the Write bit is cleared to zero, then no additional capability is claimed. A device may report this feature only when Profile 10h (DVD-ROM) is reported.   No additional commands or mode parameters are required.

If the Write bit is set to one, then the Drive is also capable of background formatting DL DVD+RW discs according to *DVD+RW 8,5 Gbytes Basic Format Specifications* and is capable of writing DL DVD+RW discs that have been formatted according to *DVD+RW 8,5 Gbytes Basic Format Specifications.*

If the Close Only bit is cleared to zero, then the Drive supports both forms of background format stop. If the Close Only bit is set to one, then the Drive supports only the read compatibility stop.

If the Quick Start bit is zero, the FORMAT UNIT command does not support quick start formatting. If the Quick Start bit is set to one, the FORMAT UNIT command supports quick start formatting.

If a Drive reports this feature with the Write bit set to one and the Current bit is set to one, then it shall support the commands shown in Table 9.

Table 9 — Command Support Required by the DL DVD+RW Feature with Write

Op Code	Command Description	Reference
5Bh	Close Track/Session	6.1
04h	Format Unit	6.2
BFh	Send DVD Structure (format field = 05h, 30h)	6.19
2Ah	Write (10)	6.26
2Eh	Write and Verify (10)	6.28
AAh	Write (12)	6.27

5.2 Profile 002Ah: Double Layer DVD+RW

Drives identifying Profile 001A as current shall support the features listed in Table 10.

Table 10 – Mandatory Features for DVD+RW

Feature Number	Feature Name	Description
0000h	Profile List	A list of all Profiles supported by the device
0001h	Core	Mandatory behavior for all devices
0002h	Morphing	Device changes operational behavior due to events external to the Host
0003h	Removable Medium	The medium may be removed from the device
0010h	Random Readable, PP=1	Read ability for storage devices with random addressing
001Fh	DVD Read	The ability to read DVD specific structures
0020h	Random Writable	Write support for randomly addressed writes[1]
0023h	Formattable	Support for formatting of media[1]
002Ah	DVD+RW	Support for reading and optionally writing SL DVD+RW Basic Format
003Ah	DL DVD+RW	Support for reading and optionally writing DL DVD+RW Basic Format
0100h	Power Management	Host and device directed power management
0105h	Time-Out	Ability to respond to all commands within a specific time
0107h	Real-time Streaming	Ability to read and write using Host requested performance parameters
010Ah	Disc Control Blocks	The ability to read and optionally write DCBs.
[1]Current only when the Write bit in the DVD+RW Feature Descriptor is set to 1.		

The presence of the DL DVD+RW Profile indicates that the Drive is capable of reading a DL DVD+RW disc that has been formatted and recorded according to *DVD+RW 8,5 Gbytes Basic Format Specifications.*   In addition, the presence of the DL DVD+RW Profile indicates that the WRITE bit in the DL DVD+RW feature is set to one.

The features require that specific commands be implemented. A small number of commands are optional. Table 11 shows the decomposition of the DL DVD+RW Profile first into Features and then commands and mode pages.

Table 11 – DL DVD+RW Profile Decomposition

Features	Commands and Mode Pages
Core Feature	Get Configuration Command, Get Event Status Notification Command, Inquiry Command, Mode Select (10) Command, Mode Sense (10) Command, Request Sense Command, Test Unit Ready Command
Morphing Feature	Get Configuration Command, Get Event Status Notification Command, Prevent Allow Medium Removal Command
Removable Medium Feature	Mechanism Status Command, Prevent Allow Medium Removal Command, Start Stop Unit Command
Random Readable Feature	Read Capacity Command, Read (10) Command, Read/Write Error Recovery Mode Page
DVD Read Feature	Read (10) Command, Read (12) Command, Read DVD Structure Command, Read TOC/PMA/ATIP Command
Random Writable	Read Capacity Command, Write (10) Command, Write and Verify (10) Command, Synchronize Cache Command
Formattable	Format Unit Command, Read Formattable Capacities Command, Request Sense Command, Verify (10) Command
DVD+RW	Close Track/Session Command, Format Unit Command, Send DVD Structure Command, Write (10) Command, Write and Verify (10) Command, Write (12) Command
DL DVD+RW	Close Track/Session Command, Format Unit Command, Send DVD Structure Command, Write (10) Command, Write and Verify (10) Command, Write (12) Command
Real-time Streaming Feature	Get Performance Command, Read (12) Command, Read Buffer Capacity Command[1], Set CD Speed Command[1], Set Read Ahead Command, Set Streaming Command, Write (12) Command[C,] Capabilities and Mechanical Status Mode Page[1]
Power Management Feature	Get Event Status Notification Command, Start Stop Unit Command, Power Condition Page
Timeout Feature	Timeout and Protect Mode Page
[1]The command or mode page is conditional according to the feature description.	

5.3 Other Profiles and Features

A Drive that reports the DVD+RW Feature shall also claim the DVD-ROM Profile (0010h). Certainly, other media and consequently other profiles may be supported.

6   Command Descriptions

The commands described in this clause are defined uniquely for Multi-Media Drives or have a unique behavior when executed by a Multi-Media Drive.

The commands described in this clause are listed in Table 12. MMC-4 is the primary reference for the command descriptions. For a given command, modified/additional behavior necessary for the support of DL DVD+RW is described in the specified sub-clause.

Table 12 – Feature Specified Commands

Command	Op Code	Reference
CLOSE TRACK/SESSION	5Bh	6.1
FORMAT UNIT	04h	6.2
GET CONFIGURATION	46h	6.3
GET EVENT/STATUS NOTIFICATION	4Ah	6.4
INQUIRY	12h	6.5
MECHANISM STATUS	BDh	6.6
MODE SELECT (10)	55h	6.7
MODE SENSE (10)	5Ah	6.8
PREVENT/ALLOW MEDIA REMOVAL	1Eh	6.9
READ (10)	28h	6.10
READ (12)	A8h	6.11
READ BUFFER CAPACITY	5Ch	6.12
READ CAPACITY	25h	6.13
READ DISC INFORMATION	51h	6.14
READ DVD STRUCTURE	ADh	6.15
READ FORMATTABLE CAPACITIES	23h	6.16
READ TOC/PMA/ATIP	43h	6.17
REQUEST SENSE	03h	6.18
SEND DVD STRUCTURE	BFh	6.19
SET READ AHEAD	A7h	6.20
SET STREAMING	B6h	6.21
START/STOP UNIT	1Bh	6.22
SYNCHRONIZE CACHE	35h	6.23
TEST UNIT READY	00h	6.24
VERIFY (10)	2Fh	6.25
WRITE (10)	2Ah	6.26
WRITE (12)	AAh	6.27
WRITE AND VERIFY (10)	2Eh	6.28

6.1 CLOSE TRACK/SESSION COMMAND

The CLOSE TRACK/SESSION Command, Table 13, allows closure of either a track or a session. For the specific case of DL DVD+RW media with the Basic Format, this command is used to stop a background format in progress. The command description that follows is specific to DL DVD+RW. For other media types and formats, refer to MMC-4.

Table 13 – Close Track/Session Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (5Bh)							
1	Reserved							IMMED
2	Reserved				Close Function			
3	Reserved							
4	(MSB)			Track Number				
5								(LSB)
6	Reserved							
7	Reserved							
8	Reserved							
9	Control							

The IMMED bit allows execution of the close function as an immediate operation. If IMMED is zero, then the requested close operation is executed to completion prior to returning status. If IMMED is one, then status is returned once the close operation has begun.

The Close Function values are described in Table 14.

Table 14 — Close Functions

Close Function	Description
000b	Optional behavior for DL DVD+RW media is defined. If a background format is in progress and de-icing is not completed, the format de-icing operation shall be stopped after the next layer 1 increment format write has completed. If the formatting is Quick Start, then each ECC block of the lead-in beyond the Initial Zone should be initialized. No further writing shall occur. If the medium mounted is DL DVD+RW and there is no background format in progress, then no operation shall occur and this shall not be considered an error.
001b	Reserved
010b	If a background format is in progress, the format operation shall be stopped and the disc shall be structured for removal according to the *DVD+RW 8,5 Gbytes Basic Format Specifications* for the specific purpose of providing DVD-RO compatibility. The data zone shall be expanded to ensure that the total recorded area reaches at least a radius of 30 mm.
011b	If a DL DVD+RW background format is in progress, the format operation shall be stopped and the disc shall be structured for removal according to the *DVD+RW 8,5 Gbytes Basic Format Specifications* for the specific purpose of providing DVD-RO compatibility.
100b - 111b	Reserved

If the last session is blank and a Close Session is requested, no error shall be reported.

During a Close Track/Session operation that began with the IMMED bit set to one, the Drive shall respond to commands as follows:

    a) In response to all commands except REQUEST SENSE, INQUIRY, GET CONFIGURATION, GET EVENT STATUS NOTIFICATION, and TEST UNIT READY, the

Drive shall return CHECK CONDITION status and set SK/ASC/ASCQ to NOT READY/LOGICAL UNIT NOT READY/OPERATION IN PROGRESS.

b) In response to the TEST UNIT READY command, the Drive should return CHECK CONDITION status and set SK/ASC/ASCQ to NOT READY/LOGICAL UNIT NOT READY/OPERATION IN PROGRESS. Some legacy implementations allowed for a GOOD status response to a TEST UNIT READY command. This behavior is not recommended.

c) In response to the INQUIRY, GET CONFIGURATION, GET EVENT STATUS NOTIFICATION commands, the Drive shall respond as commanded.

d) In response to the REQUEST SENSE command, unless an error has occurred, the Logical

e) Unit shall return with SK/ASC/ASCQ values set to NOT READY/LOGICAL UNIT NOT READY/LONG WRITE IN PROGRESS or NOT READY/LOGICAL UNIT NOT READY/OPERATION IN PROGRESS, with the sense key specific bytes set for progress indication.

If the Drive changes to a not ready state during execution, an Operational Change Event shall be generated. When execution is completed and the state returns to ready, an Operational Change Event shall be generated. If the Closing a Track or Session results in one or more features changing currency, an additional Operational Change Event shall be generated.

6.2 FORMAT UNIT COMMAND

The FORMAT UNIT Command (Table 15) formats a medium into host addressable logical blocks per the host defined options. The medium may be certified and control structures created for the management of the medium and defects. There is no guarantee that the medium will not be altered.

Table 15 – Format Unit Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (04h)							
1	Reserved			FmtData	CmpList	Format Code		
2								
3	(MSB)			Interleave Size				
4								(LSB)
5	Control							

A FmtData bit of zero indicates that there is no parameter list. A FmtData bit of one indicates that a parameter list is available from the host. For CD-RW and DVD+RW FmtData shall be set to one.

A CmpList bit of zero indicates that the parameter list provided is in addition to those already available to the device. A CmpList bit of one indicates that the parameter list is complete and the device is to ignore any existing parameters. For CD-RW and DVD+RW, CmpList shall be cleared to zero.

Format Code is used by the device to identify the format descriptor from the host. Format Codes are defined for CD-RW in Table 16.

Table 16 – Format Descriptor Included

Format Code	Format Descriptor Included in Parameter Data
000b	Not defined for either CD or DVD devices.
001b	A Format Descriptor that is consistent with the READ FORMAT CAPACITIES Command is present.
010b – 110b	Not defined for either CD or DVD devices.
111b	The CD-RW specific descriptor (MMC1) is present.

Parameter data from the host is structured as shown in Table 17.

Table 17 – Format Unit Parameter List

Bit / Byte	7	6	5	4	3	2	1	0
0 – 3	Format List Header							
4 – n	Initialization Pattern Descriptor							
n+1 to n+8	Format Descriptor							

A DL DVD+RW compliant device shall support Format Code 1.

The Format List Header (Table 18) identifies any and all additional parameter data.

Table 18 – Format List Header

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	FOV	DPRY	DCRT	STPF	IP	TRY	IMMED	VS
2	(MSB)			Format Descriptor Length				
3								(LSB)

A Format Options Valid (FOV) bit of zero indicates that the CD-RW device shall use its default settings for the DPRY, DCRT, STPF, IP, TRY and IMMED bits. For a DL DVD+RW compliant device, the defaults shall be: DPRY = 0, DCRT = 0, STPF = 0, IP = 0, TRY = 0 and IMMED = 1.

If FOV is set to one, the CD-RW Drive shall examine the settings of the DPRY, DCRT, STPF, IP, TRY and IMMED bits. DPRY, STPF, IP and TRY are not used by a CD-RW Drive and should be cleared to zero. If any of these bits are not zero, the CD-RW Drive shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code shall be set to INVALID FIELD IN PARAMETER LIST.

For CD-RW and DVD+RW media, use of the DCRT bit is specific to the format type selected.

An immediate (IMMED) bit of zero indicates that status shall be returned after the format operation has completed. An IMMED bit of one indicates that the Drive shall return status as soon as the command descriptor block has been validated, and the entire Format Descriptor has been transferred.

The VS bit is used exclusively for vendor specific purposes.

The Format Descriptor Length field in the Format list header specifies the total length in bytes of the Format descriptors that follow and does not include the initialization pattern descriptor or initialization pattern, if any. The Format Descriptor Length shall be set to 8. If the value is not 8, the command shall be terminated with CHECK CONDITION status and sense values SK/ASC/ASCQ shall be set to ILLEGAL REQUEST/INVALID FIELD IN PARAMETER LIST.

6.2.1 Format Code 001b
If the Format Code in the CDB is 001b the host shall send a Format Descriptor as defined in Table 19.

Table 19 – Format Descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1	Number of Blocks							
2								
3								(LSB)
4	Format Type					Reserved		
5	Type Dependent Parameter							
6								
7								

6.2.1.1 Number of Blocks
The Number of Blocks field provides a method for specifying the number of addressable blocks that shall be formatted for the entire disc. The method of specification is dependent upon the Format Type.

6.2.1.2 Format Type

The Format Type field specifies the type of formatting. When a DL DVD+RW disc is present, Format Type 26h shall be supported. Other Format Types listed in MMC-4 are not associated with DL DVD+RW media.

6.2.1.3 Type Dependent Parameter

The definition of the Type Dependent Parameter field depends on Format Type.

6.2.2 Command Execution

Format Type = 26h, DVD+RW Basic Format, is mandatory when either the Write bit in DL DVD+RW Feature Descriptor is set to one. The Number of Blocks field shall be selected according to Table 20.

Table 20 – Number of Blocks Field

Number of Blocks	Value Used for Formatting
Value returned by the READ FORMAT CAPACITIES command format descriptor for format type 26h. The value is some X = 64*A where A is an integer.	X
0xFFFFFFFF	X
Any value (Y) that is less than or equal to X where Y = 64*B where B is an integer.	Y
Any other value	terminate the command with CHECK CONDITION status and set sense bytes (Sense Key/ASC/ASCQ) to ILLEGAL REQUEST/ILLEGAL VALUE IN PARAMETER BLOCK

Implementation of background format is mandatory.

The Type Dependent Parameter is shown in Table 21.

Table 21 – Type Dependent Parameter for Format Type 26h

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Reserved							
2	Reserved						Quick Start	Restart

If Quick Start is set to zero, the format operation shall initialize the lead-in according to x prior to declaring the format command complete.

If Quick Start is set to one, the format operation shall not initialize the entire lead-in prior to sending GOOD status for the format command. Note: The amount of the lead-in initialized by Quick Start formatting is vendor specific.

If Restart is set to zero, the Drive shall perform a new format.

If Restart is set to one, the DL DVD+RW Drive shall continue a suspended background format. All other fields in the Type Dependent Parameter shall be ignored. If there is no suspended background format to continue, the DL DVD+RW Drive shall terminate the command with CHECK CONDITION status and set sense data to ILLEGAL REQUEST COMMAND SEQUENCE ERROR.

DCRT has no meaning when formatting type 26h. The device ignores DCRT.

6.2.3 Background Formatting for Format Type 26h

The background formatting process is best illustrated in Figure 12.
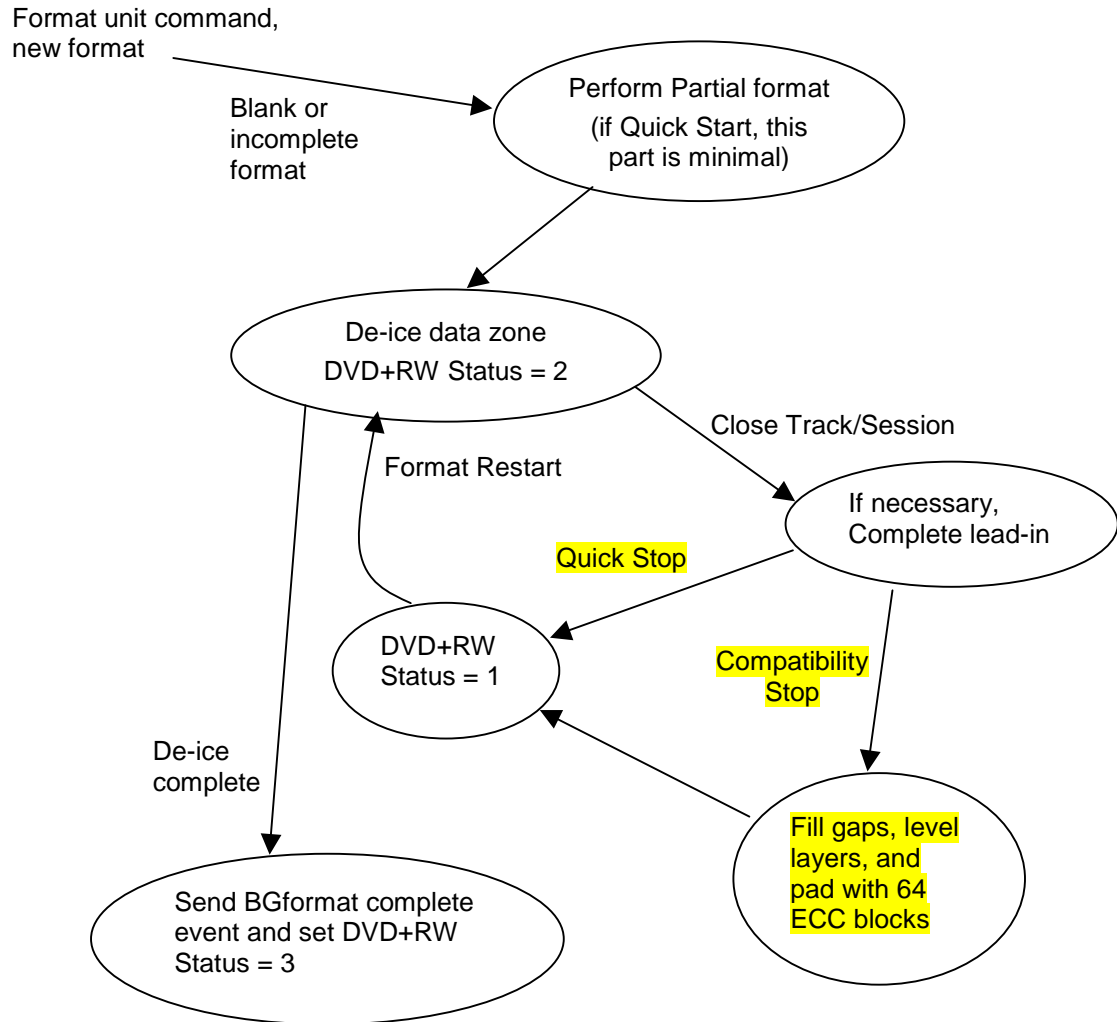
Figure 12 – Background Process Flow

6.2.3.1 Background Formatting: Getting Started

The *DVD+RW 8,5 Gbytes Basic Format Specifications* states: "The disc shall be considered partially formatted if the lead-in has been recorded from the Inner Disc Test Zone up to the Data Zone." Quick Start does not require a complete format written the lead-in. The amount of the lead-in initialized by Quick Start formatting is vendor specific.

Once the disc has completed the partial formatted state, the format operation may continue in background. That is, the FORMAT UNIT Command shall terminate.

All format write functions shall write only complete DVD+RW ECC blocks.

6.2.3.2 Background Formatting: Stopping the Format

If a format is executing in background:

a. The formatting process may be stopped by issuing the CLOSE TRACK/SESSION Command.

b. If the host sends a SCSI command block that requires the medium spin down, the Drive shall terminate the command with CHECK CONDITION status and set sense data to NOT READY, LOGICAL UNIT NOT READY/FORMAT IN PROGRESS. Example: START/STOP UNIT Command is issued with Start = 0.

c. If the host/Drive physical interface provides a command layer with commands that can cause the medium to spin down, then those commands will be terminated with the appropriate error status. For example if the interface is ATA and the command is IDLE or SLEEP, then the command shall be terminated with the status register ERROR bit set to true.

d. If any other command is issued to the Drive, it shall be executed normally.

Whenever a DL DVD+RW disc is mounted, the Drive shall examine the disc structures. The state of formatting is reported in the Disc Information Block as returned by the READ DISC INFORMATION Command.

6.2.3.3 Background Formatting: Restarting

If an incompletely formatted disc is mounted in a write capable DL DVD+RW Drive, formatting does not continue automatically.

The host may explicitly restart the format by sending the format command again with restart specified in the type dependent parameter of the format descriptor.

The host may implicitly restart the format by sending a write command requesting that some LBA beyond the currently formatted region be written. In this case, the Drive shall post the BGformatRestarted media event.

6.2.3.4 Background Formatting: Progress Reporting

If the IMMED bit is set to one, then the Format Unit Command will terminate with GOOD status and proceed with all format-writing functions performed in the background. If any media accessing command is issued while the initial areas are being formatted, the DL DVD+RW Drive shall terminate the command with CHECK CONDITION status and set sense data to NOT READY/LOGICAL UNIT NOT READY/FORMAT IN PROGRESS (02/04/04).

Regardless of the setting of IMMED, once the partial formatting has completed, background formatting begins. The host may monitor format progress. The response to a TEST UNIT READY Command shall be: the command shall be terminated with GOOD status and sense data shall be set to NO SENSE/ FORMAT IN PROGRESS, unless an error has occurred. The sense key specific bytes (Table 22) shall be set as a progress indicator.

Table 22 – Sense Key Specific Bytes in Sense Data

Bit Byte	7	6	5	4	3	2	1	0
0	SKSV	Reserved						
1	(MSB)	Progress Indication						
2								(LSB)

The progress indication field is a percent complete indication in which the returned value is the numerator that has 65536 (10000h) as its denominator. The progress indication shall be based upon the total operation.

Once the background format operation has completed, the DL DVD+RW Drive shall post a Background Format Completed Media Event. The response to a TEST UNIT READY Command shall then be: the command shall be terminated with GOOD status and sense data shall be set to NO SENSE,/NO ADDITIONAL SENSE,/NO ADDITIONAL SENSE QUALIFIER, and SKSV shall be cleared to zero. The REQUEST SENSE command shall report these values correctly whenever no error conditions exists. Thus, there is no pre-condition that the TEST UNIT READY command shall be sent first.

6.2.3.5   Background Formatting: Formatting Concurrently with Writing
Once the partial format has completed, the host may issue a write to any address that will exist after formatting has completed. It is possible for the Drive to locate and write the data as requested.

Suppose the host wishes to write a sector within an ECC block that has either been format written or written with data from the host. The Drive shall read the ECC block into its internal buffer, modify the content only with the host's new data, and then write the ECC block to the same location. This results in random write capability with 2048 byte sectors.

However, suppose some write request is made to a DL DVD+RW ECC block that is completely blank. When this occurs, the data shall be placed into the correct ECC block buffer positions and un-addressed sector positions within the buffer shall be zero filled. For example, suppose a write command requests to write only the fifth and sixth sectors within a DVD+RW ECC block. The Drive should load a 16-sector buffer as follows:

ECC Block Sector 0	Zero fill	ECC Block Sector 8	Zero fill
ECC Block Sector 1	Zero fill	ECC Block Sector 9	Zero fill
ECC Block Sector 2	Zero fill	ECC Block Sector 10	Zero fill
ECC Block Sector 3	Zero fill	ECC Block Sector 11	Zero fill
ECC Block Sector 4	User Data	ECC Block Sector 12	Zero fill
ECC Block Sector 5	User Data	ECC Block Sector 13	Zero fill
ECC Block Sector 6	Zero fill	ECC Block Sector 14	Zero fill
ECC Block Sector 7	Zero fill	ECC Block Sector 15	Zero fill

The difficulty is simply that this allows the blank area to become fragmented.

Important Note: All blank areas should be written either with host data or format patterns. The Drive should fill all blank fragments.

6.2.3.6   Background Formatting: Formatting Concurrently with Reading
If the host attempts to read the media, the result should be identical to the case where format has completed. Thus, written sectors shall return the data written in the sector. If the sector has not yet been de-iced, then the Drive shall return all zeros in the place of sector data.

6.2.3.7   Background Formatting: Early Eject

When the host wishes to stop the background format, it should first notify the Drive with the CLOSE TRACK/SESSION Command.

When the Close Function is 000b, the Drive shall stop the format at an ECC block boundary and record the formatting state in each layer FDCB. At that point, background formatting shall be stopped.

When Close Function is 010b, the Drive should first perform all ECC block format writes necessary to bring the disc to a state where exactly 2 zones exist: the inner zone is entirely written and the outer zone is entirely blank. A temporary lead-out is appended to assure that the disc will be readable in DVD read-only devices. The Drive should record the formatting state in the FDCB. Finally, the lead-in is updated to mark the restart point for the format continuation.

6.3 GET CONFIGURATION COMMAND

The Core Feature requires that this command be implemented. The DL DVD+RW Profile includes the Core Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.4 GET EVENT STATUS NOTIFICATION COMMAND

There is no need to modify the GET EVENT STATUS NOTIFICATION Command, however, a new Media Event has been added: Background Format Completed. We'll begin with a review of Media Events.

The data returned, with a class code 100b, is defined in Table 23.

Table 23 – Media Event Descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved				Media Event Code			
1	Media Status							
2	Start Slot							
3	End Slot							

The Media Event Code is defined in Table 24.

Table 24 – Media Event Codes

Code	Event	Description
0h	NoEvent	Media status is unchanged
1h	EjectRequest	The Drive has received a request from the user (usually through a mechanical switch on the Drive) to eject the specified slot or media.
2h	NewMedia	The specified slot (or the Drive) has received new media and is ready to access it.
3h	MediaRemoval	The media has been removed from the specified slot (or the Drive), and the CD-RW Drive is unable to access the media without user intervention.
4h	MediaChanged	The user has requested that the media in the specified slot (or the Drive's tray) be loaded.
5h	BGformatCompleted	A background format has completed
6h	BGformatRestarted	A background format was automatically restarted by the Drive.
6h – Fh	Reserved	-

Since DL DVD+RW compliant Drives are capable of generating more than one media event, such Drives should be capable of queuing media events. Events shall be reported in the order in which they occur.

The Media Status byte is defined in Table 25.

Table 25 – Media Status Byte

7	6	5	4	3	2	1	0
Reserved						Media Present	Door or Tray Open

The Media Present status bit indicates if there is media present in the Drive. A bit of 1 indicates that there is media present in the DL DVD+RW Drive. This bit is reported independently from the Door or Tray Open bit. If the DL DVD+RW Drive does not support the capability of reporting the media state while the door or tray is open, it shall set this bit to zero when the door or tray is open.

Door or Tray Open Status bit indicates if the Tray or Door mechanism is in the open state. A bit of 1 indicates the door/tray is open.

Start Slot field defines the first slot of a multiple slot DL DVD+RW Drive to which the media status notification applies. For DL DVD+RW Drives that do not support multiple slots, this field shall be reserved.

End Slot field defines the last slot of a multiple slot DL DVD+RW Drive to which the media status notification applies. For DL DVD+RW Drives that do not support multiple slots, this field shall be reserved

6.5   INQUIRY COMMAND

The Core Feature requires that this command be implemented. The DL DVD+RW Profile includes the Core Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.6   MECHANISM STATUS COMMAND

The Removable Medium Feature requires that this command be implemented. The DL DVD+RW Profile includes the Removable Medium Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.7   MODE SELECT (10) COMMAND

The Core Feature requires that this command be implemented. The DL DVD+RW Profile includes the Core Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.8   MODE SENSE (10) COMMAND

The Core Feature requires that this command be implemented. The DL DVD+RW Profile includes the Core Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.9   PREVENT/ALLOW MEDIA REMOVAL COMMAND

The Removable Medium Feature requires that this command be implemented. The DL DVD+RW Profile includes the Removable Medium Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.10 READ (10) COMMAND

The Random Readable Feature requires that this command be implemented. The DL DVD+RW Profile includes the Random Readable Feature.

When a DL DVD+RW background format in progress, the Drive shall respond to this command as if the format has completed. If any of the sector(s) to be read have not been initially written by the de-icing process, the Drive shall return all zeros as sector data.

If a sector contains an unrecoverable error and the RC bit in the Read/Write Error Recovery Mode Page is cleared to zero, this command shall be terminated with CHECK CONDITION status and sense data shall be set according to the specific error.

6.11 READ (12) COMMAND

The Random Readable Feature requires that this command be implemented. The DL DVD+RW Profile includes the Random Readable Feature.

When a DL DVD+RW background format in progress, the Drive shall respond to this command as if the format has completed. If any of the sector(s) to be read have not been initially written by the de-icing process, the Drive shall return all zeros as sector data.

If a sector contains an unrecoverable error, the streaming bit is switched off, and the RC bit in the Read/Write Error Recovery Mode Page is cleared to zero, this command shall be terminated with CHECK CONDITION status and sense data shall be set according to the specific error.

If a sector contains an unrecoverable error and the streaming bit is switched on, this command shall be executed as if the RC bit in the Read/Write Error Recovery Mode Page had been set to one.

6.12 READ BUFFER CAPACITY

The Real-time Streaming Feature requires that this command be implemented. The DL DVD+RW Profile includes the Real-time Streaming Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.13 READ CAPACITY

The READ CAPACITY command (Table 26) provides a means for the Host to request information regarding the capacity of the currently mounted medium. The command description that follows is specific to DL DVD+RW Basic format. For other media and format types, refer to MMC-4.

Table 26 – READ CAPACITY Command Descriptor Block

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (25h)							
1	Reserved							
2	(MSB)							
3	Logical Block Address							
4								
5								(LSB)
6	Reserved							
7	Reserved							
8	Reserved							PMI
9	Control							

The RelAdr, PMI bits, and Logical Block Address field shall be set to zero for MM Drives.

Eight bytes of READ CAPACITY response data (Table 27) shall be returned in response to the command.

Table 27 – READ CAPACITY Response Data

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1	Logical Block Address							
2								
3								(LSB)
4	(MSB)							
5	Block Size							
6	(00000800h)							
7								(LSB)

The Logical Block Address represents the last addressable LBA on the medium. If the currently mounted medium is recognized as a DL DVD+RW Basic formatted disc (i.e. fully formatted or format is in progress), the only valid response for Logical Block Address is the last addressable LBA when formatting has completed. If a DL DVD+RW disc is mounted and blank, then the response shall be 00000000h.

The Block Length shall always be reported, in bytes, as 2 048.

6.14 READ DISC INFORMATION COMMAND

The Read Disc Information Command (the CDB is unchanged and thus not shown) returns detailed information about the medium. This information is returned in the Disc Information Block. All fields currently defined in MMC-4 shall remain unchanged.

Additional information is needed. We need to know the state of the background format operation. There are 4 possible states. The appropriate value is placed in Disc Information Block in the Background Format Status field.

Table 28 – Disc Information Block

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			Disc Information				
1				Length				(LSB)
2	Reserved			Erasable	State of last Session		Disc Status	
3	Number of First Track on Disc							
4	Number of Sessions (LSB)							
5	First Track Number in Last Session (LSB)							
6	Last Track Number in Last Session (LSB)							
7	DID_V	DBC_V	URU	DAC_V	Reserved		Background Format Status	
8	Disc Type							
9	Number of Sessions (MSB)							
10	First Track Number in Last Session (MSB)							
11	Last Track Number in Last Session (MSB)							
12	(MSB)							
13				Disc				
14				Identification				
15								(LSB)
16	(MSB)							
17				Last Session Lead-in Start Time				
18				MSF				
19								(LSB)
20	(MSB)							
21				Last Possible Start Time for Start of Lead-out				
22				MSF				
23								(LSB)
24	(MSB)							
...				Disc Bar Code				
31								(LSB)
32	Disc Application Code							
33	Number of OPC Table Entries							
34 - n	OPC Table Entries							

Table 29 — Disc Information Block for DL DVD+RW Basic Format

DIB Field	Value	Meaning
Erasable	1b	DL DVD+RW is rewritable.
State of Last Session	Empty = 00b Complete=11b	The last session of a blank DL DVD+RW is always empty. The last session of a formatted DL DVD+RW is always complete.
Disc Status	Blank = 00b Formatted=11b	A blank DL DVD+RW is empty. A formatted DL DVD+RW is always finalized.
Number of First Track on Disc	0001h	Formatted DL DVD+RW has exactly 1 logical track.
Number of Sessions	0001h	Formatted DL DVD+RW has exactly 1 session.
First Track Number in Last Session	0001h	Formatted DL DVD+RW has exactly 1 logical track.
Last Track Number in Last Session	0001h	Formatted DL DVD+RW has exactly 1 logical track.
DID_V	0b	DL DVD+RW does not have a Disc ID
DBC_V	0b	DL DVD+RW does not have a disc bar code
URU	xb	Certain host applications may be restricted to writing only media that has a specific Disc Application Code (byte 32). If the media has one of those restricted use codes, then URU (UnRestricted Use) shall be zero. Otherwise, URU shall be set to one. See the appropriate media specification for restricted code values.
DAC_V	xb	Validity of the Disc Application Code in byte 32
BG Status	xxb	Background Format status: 00b Not any DVD+RW format. For each disc which cannot be identified as a DVD+RW format with status 01b, 10b, or 11b, DVD+RW status shall be set to 00b. For example, with a blank disc, the DVD+RW status is 00b. 01b DVD+RW background format was started but is not currently running and is not complete. 10b DVD+RW background format is in progress. A format has been started or restarted and is not yet completed. 11b DVD+RW formatting completed. When a completely DVD+RW formatted disc is mounted, DVD+RW status is set to 11b.
Disc Type	00h	DL DVD+RW has no CD equivalent type.
Disc Identification	00000000h	DL DVD+RW has no CD equivalent type.

Table 29 — Disc Information Block for DL DVD+RW Basic Format, Continued

DIB Field	Value	Meaning
Last Session Lead-in Start Address	00000000h	DL DVD+RW is single session.
Last Possible Lead-out Start Address	Capacity+1	DL DVD+RW is single track, single session.
Disc Bar Code	All zeros	DL DVD+RW does not have a disc bar code
Disc Application Code	xxh	Disc Application Code shall be the value discovered on the disc. If the disc has no Disc Application Code, then the contents shall be set to zero.
Number of OPC Table entries	2*N	Number of OPC Table Entries shall not exceed 26.
OPC Table		

6.15 READ DVD STRUCTURE COMMAND

A DL DVD+RW Drive should support all formats supported by DVD-ROM devices. This is simply a requirement of the DVD Read Feature.

A DL DVD+RW Drive shall support the format field codes shown in Table 30.

Table 30 – DL DVD+RW Format Code Support for Read DVD Structure Command

Format Code	Description
00h	Information in the DVD Lead-in area.
01h	The Copyright information from the DVD Lead-in area
03h	The BCA information on DVD media
04h	The Disc Manufacturing information from the DVD Lead-in area
05h	The Copyright Management Information written to DL DVD+RW media
11h	ADIP Information
30h	Disc Control Block identified by the Content Descriptor (DVD+RW specific)
C0h	Write Protection Status
FFh	A list of DVD Structures claimed present in the specified Layer

If a format is in progress, the Drive should respond as if the format had completed. Since the requested structure may not yet be written on the media, data fabrication may be required.

If the Drive chooses to not fabricate data and the structure does not yet exist on the disc, the command shall be terminated with CHECK CONDITION status and sense shall be set to ILLEGAL REQUEST/INVALID FIELD IN CDB.

6.15.1 Information from the Lead-in (Format Code = 00h)

Following the structure header, MMC-4 describes data formats for other DVD media types in a layer descriptor. For DL DVD+RW, the layer descriptor is shown in Table 31.

Table 31 – DL DVD+RW Layer Descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0 - 8	CDZ if written, else optionally, Copy of bytes 0 through 8 from ADIP information block							
9	If the CDZ sector PSN ≤ 2F2FFh, then this value shall be the PSN of last recorded sector in DZ0. Otherwise, this value may be either the PSN of last recorded sector in DZ0, or the last possible PSN in the DZ0. To maximize compatibility with RO devices, it is recommended that this value always be the last recorded sector in DZ0.							
10								
11								
12	00h							
13 - 15	PSN of last recorded sector in DZ0							
16 - 18	00h, 00h, 00h							
19 - 255	CDZ if written, else optionally, Copy of bytes 19 - 255 from ADIP information block							
256 - 2048	Reserved							

In the case of Quick Start formatting, some structures may not yet exist. If format is in progress, the Drive shall respond as if the format had completed.

If the medium is blank, it is recommended that the Drive fabricate the response data. Otherwise, the command shall be terminated with CHECK CONDITION status and sense shall be set to ILLEGAL REQUEST/INVALID FIELD IN CDB.

6.15.2 Copyright Management Information (Format Code = 05h)

The Copyright Management Information structure contains additional information since MMC-4 as shown in Table 32. MMC-4 information for DVD-ROM remains unchanged.

Table 32 – Copyright Management Information (FC = 5h)

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)			DVD STRUCTURE Data Length				
1								(LSB)
2	Reserved							
3	Reserved							
	Copyright Management Information							
0	Reserved				ADP_TY		Reserved	
1	Reserved							
2	Reserved							
3	Reserved							

The ADP_TY field, if set to 01b, this sector contains copyrighted video material. A value of 00b indicates that the data in this sector contains no copyrighted video material. All other values of ADP_TY are reserved.

6.15.3 ADIP Information (Format Code = 11h)

The information in this structure is formatted as in Format Code = 0, but uses unmodified ADIP information.

Table 33 – ADIP Information

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)			DVD STRUCTURE Data Length				
1								(LSB)
2	Reserved							
3	Reserved							
	ADIP Information							
0	ADIP Information Block (see *DVD+RW 8,5 Gbytes Basic Format Specifications*)							
1								
…								
255								

6.15.4 DCBs (Format Code = 30h)

A Disc Control Block is a structure on DL DVD+RW media that specifies format or use information. Each Disc Control Block is up to 16 sectors in length. The first 40 bytes of the block have a common definition, and the remaining bytes depend on the value of the Content Descriptor field (see Table 34). The Disc Control Blocks are defined in the *DVD+RW 8,5 Gbytes Basic Formats Specifications*.

Table 34 – Generic Disc Control Block

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
…			Content Descriptor					
3								(LSB)
4	(MSB)							
…			Unknown Content Descriptor Actions					
7								(LSB)
8 - 39				Vendor ID				
40 - 32 767				DCB Data				

The Address field of the READ DVD STRUCTURE command shall contain a Content Descriptor to identify the Disc Control Blocks (DCB) requested. Valid values are as shown in Table 35.

Table 35 – Content Descriptor

Content Descriptor	Definition
00000000h	Reserved
00000001h - FFFFFFFDh	The DCB with a matching Content Descriptor is returned
FFFFFFFEh	Reserved
FFFFFFFFh	Return a list of readable and writable DCB Content Descriptors

The Content Descriptor field identifies the contents of bytes 40 - 32 767.

The Unknown Content Descriptor Actions field contains a bit mask. This mask shall describe actions the Drive is allowed to perform if the Drive does not know the Content Descriptor. Each bit, when set to one, shall prohibit the corresponding action. When set to zero, the corresponding action is allowed.

Table 36 – Unknown Content Descriptor Actions

Bit	Actions
0	Recording within the user data area
1	Reading DCBs
2	Formatting of the medium
3	Modification of this DCB
4 -31	Reserved

The Vendor ID field contains 24 arbitrary bytes.

Disc Control Block data returned is formatted as shown in Table 37.

Table 37 – READ DVD STRUCTURE Data Format (Format field = 30h)

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)	DVD STRUCTURE Data Length						
1								(LSB)
2	Reserved							
3	Reserved							
	Specific Disc Control Block Information							
0 ... 32767	DCB							

The DVD STRUCTURE Data Length specifies the length in bytes of the following DVD STRUCTURE data that is available to be transferred to the Host. The DVD STRUCTURE Data Length value does not include the DVD STRUCTURE Data Length field itself.

If a Disc Control Block, with fewer than 32 768 bytes is read, the Drive shall pad the Disc Control Block with 00h bytes.

6.15.4.1 Formatting DCB (FDCB)
The FDCB is a 32 768 byte structure that aids the Drive during background formatting. There is a FDCB on each layer, identifying the written status on each layer. Refer to *DVD+RW 8,5 Gbytes Basic Formats Specifications* for specific content descriptions.

Note: The FDCB is read-only.

6.15.4.2 Write Inhibit DCB (WDCB)

The WDCB is a 32 768 byte structure as shown in Table 38.

Table 38 – WDCB Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 – 39	DCB Header							
40 – 43	WDCB Update Count							
44 – 47	Write Protect Actions							
48 – 63	Reserved							
64 – 95	WDCB Password							
96 – 32 767	Reserved							

The DCB header format is shown in Table 34:

The WDCB Update Count is set to zero when the WDCB is created and incremented each time the WDCB is updated.

The Write Protect Actions permit enable/disable of password protection of WDCB writing and 4 possibilities of write protection:

a) No write protection,

b) Write protect only the LBA space as defined by a defect management system (e.g. MRW),

c) Write protect only the data zone,

d) Write protect the entire disc.

The WDCB Password, when enabled, permits WDCB changes only when the correct password is supplied by the host during a SEND DVD STRUCTURE command with format code = 30h. In the case of the READ DVD STRUCTURE command with format code = 30h, the WDCB password shall always be zero filled before WDCB information is transferred to the host.

Refer to *DVD+RW 8,5 Gbytes Basic Formats Specifications* for specific field definitions.

6.15.4.3 DCB List

When Content Descriptor FFFFFFFFh (Table 39) is requested, the Drive shall generate a list of DCBs that may be read from and/or recorded on the current medium by the Host. If the Drive records DCBs that are generated internally, and those DCBs cannot be sent from the Host, the Drive shall not report those DCBs as recordable.

Table 39 – Disc Control Block (FFFFFFFFh)

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)							
…			Content Descriptor = FFFFFFFFh					
3								(LSB)
4 - 7	Reserved							
8 – 39	Vendor ID							
40	Reserved							
41	Number of Readable DCBs (= M)							
42	Reserved							
43	Number of Recordable DCBs (= N)							
44	(MSB)							
45			Readable DCB 0					
46								
47								(LSB)
....								
M * 4 + 40	(MSB)							
M * 4 + 41			Readable DCB M-1					
M * 4 + 42								
M * 4 + 43								(LSB)

Table 39 – Disc Control Block (FFFFFFFFh) cont.

Byte ＼ Bit	7	6	5	4	3	2	1	0
M * 4 + 44	(MSB)							
M * 4 + 45				Recordable DCB 0				
M * 4 + 46								
M * 4 + 47								(LSB)
....								
(M + N) * 4 + 40	(MSB)							
				Recordable DCB N – 1				
(M + N) * 4 + 43								(LSB)

The Content Descriptor field shall contain FFFFFFFFh.

The Unknown Content Descriptor Actions field shall be set to 0.

The Vendor ID field shall be set to the value the Drive uses for its own DCBs.

The Number of Readable DCBs field shall identify the number of entries in the Readable DCB list.

The Number of Recordable DCBs field shall identify the number of entries in the Recordable DCB list.

Each Readable DCB field shall contain a Content Descriptor of a DCB that may be read from the medium.

Each Recordable DCB field shall contain a Content Descriptor of a DCB that may be sent from the Host. If a DCB is both readable and recordable, the DCB shall appear in both lists. The Drive shall not record any DCB that it does not recognize.

6.15.5 Write Protection Status (Format Code = C0h)

Byte ＼ Bit	7	6	5	4	3	2	1	0
0	(MSB)			DVD STRUCTURE Data Length				
1								(LSB)
2	Reserved							
3	Reserved							
Write Protection Status								
0	Reserved				MSWI	CWP	PWP	SWPP
1	Reserved							
2	Reserved							
3	Reserved							

The DVD STRUCTURE Data Length field specifies the length in bytes of the following DVD STRUCTURE data that is available to be transferred to the host. The DVD STRUCTURE Data Length value does not include the DVD STRUCTURE Data Length field itself.

The Software Write Protection until Power down (SWPP) bit of one indicates that the software write protection is active. The SWPP bit of zero indicates that the software write protection is inactive. If the logical unit does not support SWPP, this bit shall be set to zero.

The Persistent Write Protection (PWP) bit of one indicates that the media surface is set to write protected status. The PWP bit of zero indicates that the media surface is set to write permitted status. If the medium and logical unit do not support PWP, this bit shall be set to zero. When a DL DVD+RW medium is mounted with a WDCB present with any write inhibits enabled, PWP shall be set to one.

The Media Cartridge Write Protection (CWP) bit of one indicates that the write protect switch/tabs on a cartridge is set to write protected state. DL DVD+RW media and devices do not support cartridge installation. Consequently, CWP shall be set to zero.

The Media Specific Write Inhibition (MSWI) bit of one indicates that any writing is inhibited by the media specific reason. The MSWI bit of zero indicates that writing is not inhibited by any media specific reason.

6.16 READ FORMATTED CAPACITIES COMMAND

The READ FORMAT CAPACITIES command (Table 40) allows the Host to request a list of the possible format capacities for an installed (and potentially) random-Writable media. This command also has the capability to report the capacity for a media when it is installed. If the command is required, by an implemented Feature it shall function independently of the state of that Feature's Current bit.

Table 40 – READ FORMAT CAPACITIES Command Descriptor Block

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (23h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	(MSB)			Allocation				
8			Length					(LSB)
9	Control							

The Allocation Length field specifies the maximum number of bytes that a Host has allocated for returned data. An Allocation Length of zero indicates that no data shall be transferred. This condition shall not be considered as an error. The Drive shall terminate the data transfer when Allocation Length bytes have been transferred or when all available data have been transferred to the Host, whatever is less. The returned data format is shown in Table 41.

Table 41 – Read Format Capacities Data Format

Byte \ Bit	7	6	5	4	3	2	1	0
0 – 3	Capacity List Header							
4 – 11	Current/Maximum Capacity Descriptor							

Format Capacity Descriptor(s)

Byte \ Bit	
0 ... 7	Format Capacity Descriptor #0
...	...
0 ... 7	Format Capacity Descriptor #n

The Capacity List Header is shown in Table 42. The Capacity List Length specifies the length in bytes of the Capacity Descriptors that follow. Each Capacity Descriptor is eight bytes in length, making the Capacity List Length equal to eight times the number of descriptors. Values of n * 8 are valid. Although it is possible that 64 descriptors are supported, we do not expect that any Drive will support so many.

Table 42 – Capacity List Header

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Reserved							
2	Reserved							
3	Capacity List Length							

The Current/Maximum Capacity Descriptor is shown in Table 43. The Number of Blocks indicates the number of addressable blocks for the capacity defined by each Descriptor Type.

The Descriptor Type field (Table 44) indicates the type of information the descriptor contains. The Block Length specifies the length in bytes of each logical block.

Table 43 – Current/Maximum Capacity Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				Number of				
2				Blocks				
3								(LSB)
4	Reserved						Descriptor type	
5								
6				Type Dependent Parameter				
7								

Table 44 – Descriptor Types

Descriptor Type	Description
00b	Reserved
01b	Unformatted Media. The reported value is for the maximum formatted capacity for this media. For DL DVD+RW medium, the value reported is the maximum possible when using Format Type 26h.
10b	Formatted Media. The reported value is the current media's capacity. This is the number of user addressable blocks. This value is exactly the value returned by the READ CAPACITY command minus 1.
11b	No Media Present. The reported value is for the maximum capacity of a media that the Drive is capable of reading.

The Formattable Capacity Descriptor format is shown in Table 45. The Number of Blocks field indicates the number of addressable blocks for the capacity defined by the Format Type.

Table 45 – Formattable Capacity Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				Number of				
2				Blocks				
3								(LSB)
4			Format Type				Reserved	
5								
6				Type dependent parameter				
7								

Format Type = 26h, DL DVD+RW Basic Format

The descriptor shall contain the maximum number of Data Zone addressable blocks. The Type Dependent Parameter is not used and shall be cleared to zero.

For all other Format Types, refer to MMC-4.

6.17 READ TOC/PMA/ATIP COMMAND

For all DVD media types, if the form field of the READ TOC/PMA/ATIP Command is neither zero nor one, then the command shall be terminated with CHECK CONDITION status and sense data shall be set to ILLEGAL REQUEST INVALID FIELD IN CDB (05/24/00).

If the media is DL DVD+RW, then exactly one track and exactly one session is reported which is the capacity as is expected when background format has completed. The Drive shall not report partial format capacities.

The fabrication of the TOC data for both LBA and MSF forms shall be as defined for DVD-ROM in MMC-4.

6.18 REQUEST SENSE COMMAND

The Core Feature requires that this command be implemented. The DL DVD+RW Profile includes the Core Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.19 SEND DVD STRUCTURE COMMAND

A DL DVD+RW Drive shall support the format field codes shown in Table 46, as required by the DL DVD+RW Feature description.

Table 46 – DL DVD+RW Format Code Support for Send DVD Structure Command

Format Code	Data Description
05h	Copyright Management Information
30h	DCB

The definition for the structure sent with format code 05h is described in the Read DVD Structure command description (6.15).

The Copyright Management Information is described in MMC-4.

There are two types of DCBs that may be written via the SEND DVD STRUCTURE command: User defined DCBs and the WDCB.

The definition for the structures sent with format code 30h is described in 6.15.4. Detailed format information is shown in *DVD+RW 8,5 Gbytes Basic Format Specifications.*

6.20 SET READ AHEAD COMMAND

The Real-time Streaming Feature requires that this command be implemented. The DL DVD+RW Profile includes the Real-time Streaming Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.21 SET STREAMING COMMAND

The Real-time Streaming Feature requires that this command be implemented. The DL DVD+RW Profile includes the Real-time Streaming Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.22 START/STOP UNIT COMMAND

The Removable Media Feature requires that this command be implemented. The DL DVD+RW Profile includes the Removable Media Feature.

The presence of the DL DVD+RW Feature has a small effect upon the host/Drive interface. When a background format is in progress and this command is issued requesting a media spin-down (Start = 0), the DL DVD+RW Drive shall terminate the command with CHECK CONDITION status and set sense data to NOT READY/LOGICAL UNIT NOT READY/FORMAT IN PROGRESS.

Otherwise, see MMC-4 for a description of this command.

6.23 SYNCHRONIZE CACHE COMMAND

The Random Writable Feature requires that this command be implemented. The DL DVD+RW Profile includes the Random Writable Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.24 TEST UNIT READY COMMAND

The Core Feature requires that this command be implemented. The DL DVD+RW Profile includes the Core Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.25 VERIFY (10) COMMAND

The Formattable Feature requires that this command be implemented. The DL DVD+RW Profile includes the Formattable Feature. From the Host's perspective, use of this command requires no special behavior from a Drive.

See MMC-4 for a description of this command.

6.26 WRITE (10) COMMAND

The Random Writable Feature requires that this command be implemented. The DL DVD+RW Profile includes the Random Writable Feature.

If the DL DVD+RW medium is blank (never formatted), then a WRITE (10) to any address shall be terminated with CHECK CONDITION status and sense data shall be set to ILLEGAL REQUEST/ MEDIUM NOT FORMATTED.

Otherwise, see MMC-4 for a description of this command.

6.27 WRITE (12) COMMAND

The Random Writable Feature requires that this command be implemented. The DL DVD+RW Profile includes the Random Writable Feature.

If the DL DVD+RW medium is blank (never formatted), then a WRITE (10) to any address shall be terminated with CHECK CONDITION status and sense data shall be set to ILLEGAL REQUEST/ MEDIUM NOT FORMATTED.

Otherwise, see MMC-4 for a description of this command.

6.28 WRITE AND VERIFY (10) COMMAND

The Random Writable Feature requires that this command be implemented. The DL DVD+RW Profile includes the Random Writable Feature.

If the DL DVD+RW medium is blank (never formatted), then a WRITE (10) to any address shall be terminated with CHECK CONDITION status and sense data shall be set to ILLEGAL REQUEST/ MEDIUM NOT FORMATTED.

Otherwise, see MMC-4 for a description of this command.

This page is intentionally blank

7 Mode Pages

Required features of the DL DVD+RW read/write device also dictate support of certain mode pages.

Table 47 – Feature Specified DL DVD+RW Mode Page Support

Description	Page Code	Reference
Read/Write Error Recovery Page	01h	MMC-4
Power Condition Page	1Ah	MMC-4
Fault/Failure Reporting Mode page	1Ch	MMC-4
Time-out and Protect Page	1Dh	MMC-4
Capabilities and Mechanism Status Page	2Ah	MMC-4

7.1 Read/Write Error Recovery Page

Since DL DVD+RW has no defect management system, ARRE and AWRE shall default to zero and cannot be set to one by the host.

Otherwise, DL DVD+RW requires no changes or additions.

7.2 Power Condition Page

DL DVD+RW requires no changes or additions.

7.3 Fault/Failure Reporting Mode page

DL DVD+RW requires no changes or additions.

7.4 Time-out and Protect Page

DL DVD+RW requires no changes or additions.

7.5 Capabilities and Mechanical Status Page

DL DVD+RW requires no changes or additions.

END