RW

DVD+ReWritable

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

Version 1.3

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DRAFT

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1 INTRODUCTION/SCOPE

DVD+RW is a new 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. At this point, a single logical format has been defined for this medium: the DVD+RW Basic Format. This Basic Format minimizes the rule base required for writing and reading the medium. For example, no defect management mechanism is defined. This tends to maximize compatibility with read-only devices.

Other devices that are functionally equivalent have preceded DVD+RW. For this reason, it is prudent to define the command set to be functionally equivalent. The differences will be highlighted here and solutions provided.

This document is organized to define changes and additions to a standard document such as the NCITS T10 Multi-Media Commands (MMC) standard:

Clause 1:   First, applicable references and definitions are covered.

Clause 2:   The DVD+RW Model describes the basic media format and shows a use model oriented toward producing discs in which DVD-RO device (DVD Video Player, DVD-ROM drive) compatibility is maximized.

Clause 3:   "Features and Profiles" provide a way by which the device is able to tell its host that it has a DVD+RW capability.

Clause 4:   Command descriptions are the primary reason for the existence of this document. The commands are described in terms of their differences from current operating definitions.

Clause 5:   As an extension of clause 4, Mode Pages define how the host may control command execution. These are presented separately.

1.1   References

1.1.1   References from Public Standards Organizations

SCSI Parallel Interface 3 (SPI-3) ANSI NCITS 336:2000

SCSI-3 Primary Commands 2 (SPC-2) ANSI NCITS 351:2001

SCSI-3 MultiMedia Command Set-3 (MMC-3), ANSI INCITS 360:2002

SCSI-3 Block Command Set (SBC) ANSI NCITS.306:1998

Serial Bus Protocol 2 (SBP-2) ANSI NCITS.325:1998

ATA/ATAPI-5 ANSI NCITS 340:2000

ISO/IEC 16448, 120mm DVD Read-Only-Media (DVD-ROM)

ISO/IEC 16449, 80mm DVD Read-Only-Media (DVD-ROM)

ISO/IEC 16824, 120 mm DVD Rewritable Disc (DVD-RAM)

IEEE High Performance Serial Bus, IEEE 1394-1999B.

1.1.2   References Under Development from Public Standards Organizations

SCSI-3 Primary Commands 3 (SPC-3) NCITS T10 Draft Standard 1416-D

SCSI-3 Block Command Set - 2 (SBC-2) NCITS T10 Draft Standard 1417-D

Serial Bus Protocol 3 (SBP-3) NCITS T10 Draft Standard 1467-D

ATA/ATAPI-6 NCITS T13 Draft Standard 1410-D

1.1.3   References from Private Sources

OSTA MultiRead Specifications for CD-ROM, CD-R, CD-R/RW, and DVD-ROM Devices, Revision 1.0 or higher.

DVD+RW 4.7 Gbytes Basic Format Specifications, Version 1.20, December 2002, Hewlett-Packard, Mitsubishi Chemical, Philips, Ricoh, Sony, Yamaha

1.2   Definitions, abbreviations and acronyms

ADIP

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

CDZ

Control Data Zone

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.

DVD-ROM

The medium specified by ISO/IEC 16448.

DVD-RAM

The medium specified by ISO/IEC 16824.

DZ

Data Zone

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.

Logical Block Address (LBA)

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

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 DVD+RW this is the same as Logical Block Address (LBA).

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.

2 DVD+RW Basic Format Model

The DVD+RW medium was originally defined according to a simple, basic requirement of compatibility: when a fully recorded DVD+RW medium is mounted on the spindle of a standard DVD player, the medium should be accepted as if it were a stamped DVD-ROM disc.

That was a good starting point, but the potential was greater, so the definition was expanded.

Meeting the original requirement means that the medium must have the physical characteristics to allow the DVD player to find the recording groove, track on the data, seek across the groove, and read and decode written data. Clearly, physical compatibility is important. Logical compatibility is also required, and that is where this document begins.

2.1 Physical Overview

DVD+RW media is either 8 or 12 centimeters in diameter and separated into zones as shown in .

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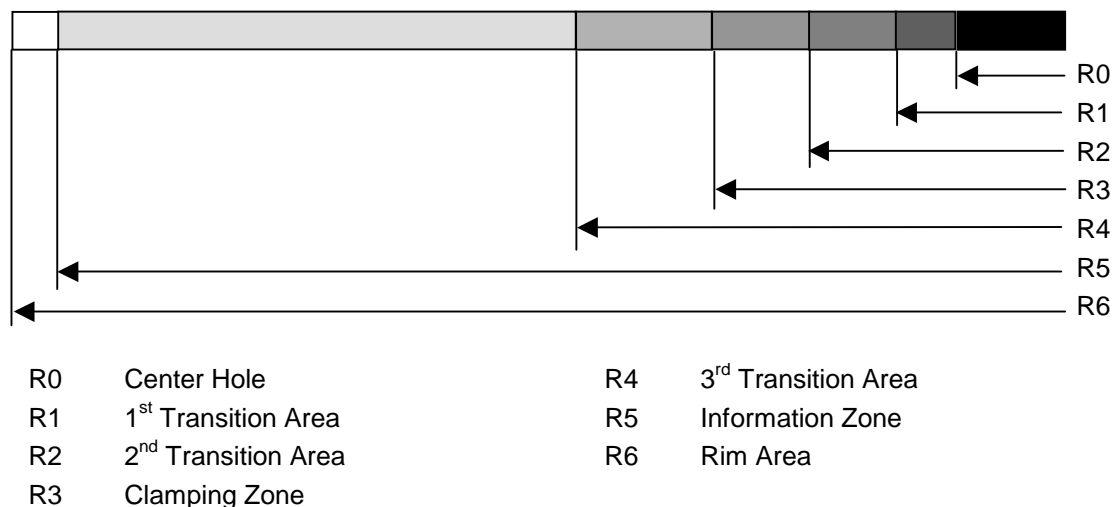
Figure 1 – The Zones of a DVD+RW Medium

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.

2.2 Logical Overview

The Information zone is organized as a sequence of independently recorded units called ECC blocks. Each ECC block contains 16 user sectors. Each sector is identified by its PSN and contains 2048 bytes of data.

The physical addresses advance incrementally beginning at the virtual address 00000000h. It is virtual, because the physical nature of a DVD+RW device guarantees that no drive will ever be able to reach the sector with PSN = 0. Similarly, the media is made with a zone of protection in the groove. Consequently, the first sector which is required to exist, has PSN = 1D830h. As with DVD-ROM, the first user accessible sector has PSN = 30000h. The DVD+RW 120-mm one-sided disc has 4.70GB available to the user, while the two-sided disc has 9.40GB. The DVD+RW 80-mm one-sided disc has 1.46GB available to the user, while the two-sided disc has 2.92GB.

2.2.1 The ADIP (Address in Pre-groove)

Like CD-RW media:

- DVD+RW media has a wobble structure which defines the groove
- Information is modulated onto the wobble
- Within the Information Zone, this information contains the address of the associated sector
- Within the lead-in, there is additional information about the disc

This is generally called Address-In-Pre-groove or ADIP.

2.2.2 The ECC Block

The DVD+RW ECC block is defined according to the DVD-ROM standard.

Unlike CD-RW media, adjacent sectors of DVD+RW media are not necessarily interleaved. An ECC block consists of 16 sectors with headers, EDC symbols, and ECC symbols. Individual sector data are interleaved in order to minimize the effects of a large media flaw. These ECC blocks are recorded serially on the medium.

2.2.2.1 The Structure of the Data Sector

A DVD+RW data sector contains 2064 bytes, 2048 bytes of main data and 16 bytes of additional information.

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

ID is a field that identifies the sector

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 2048 bytes and has 2 possible sources. The source is determined by the reference: *DVD+RW 4.7 Gbytes Basic Format Specifications.* Except for the formatting function, 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 provides by the host according to the format requirements of *DVD+RW 4.7 Gbytes Basic Format Specifications.*

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

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

Sector Information Bits 31 thru 24	Physical Sector Address Bits 23 through 0

Sector Format Type	Tracking Method	Reflectivity	Reserved	Zone Type	Data Type	Layer Number
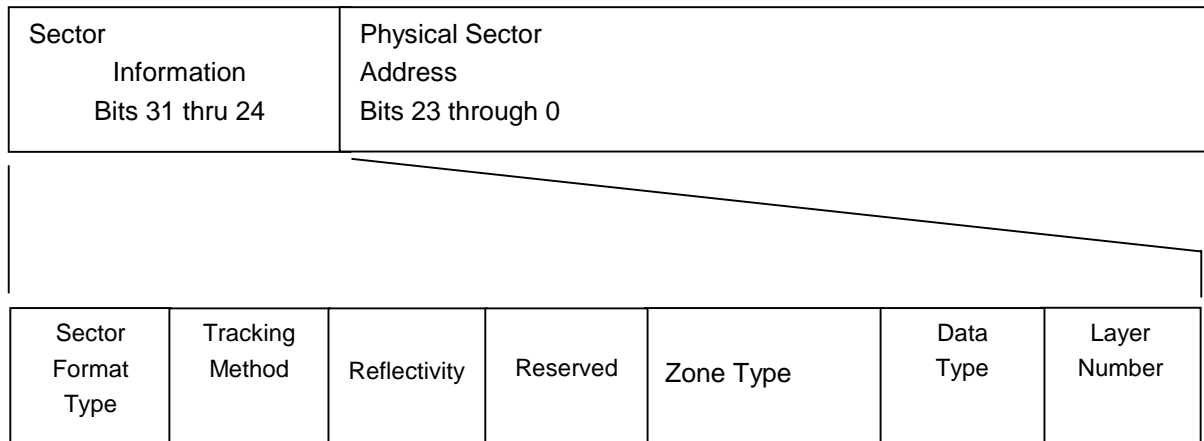
Figure 3 – ID Field Details

Sector Format Type (Bit 31)	is cleared to ZERO, indicating a CLV format
Tracking Method (Bit 30)	is set to ONE, indicating groove tracking
Reflectivity (Bit 29)	is set to ONE indicating that the reflectivity does not exceed 40 %
Reserved (Bit 28)	and must be cleared 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 Lead-in Zone
	10 when the sector is in the Lead-out Zone (This includes the temporary lead-out.)
Data Type (Bit 25)	is set to ONE, indicating Rewritable data.
Layer Number (Bit 24)	is cleared to ZERO, indicating that through an entrance surface only one recording layer can be accessed

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

2.2.2.2 The Structure of the ECC Block

A 2064 byte sector is divided into 12 rows of 172 bytes each. Main data is scrambled similar to CD-ROM data scrambling. Pack 16 sequential sectors in this way and there are 192 rows, each with 172 bytes. Error correction redundancy symbols are appended in order to produce 208 rows of 182 bytes each.

The organization of sector data and redundancy symbols within an ECC block is illustrated in Figure 4. Columnar symbols (Cx,y) are calculated and appended to rows, then Row symbols (Rx,y) are calculated and appended to columns. Columnar redundancy symbols are collectively known as Inner Parity (PI). Row redundancy symbols are collectively known as Outer Parity (PO).

		User Data				ECC Parity on Rows				
User Data	B1,0	B1,1	B1,2	…	B1,171	C1,0	C1,1	C1,2	…	C1,9
	B2,0	B2,1	B2,2	…	B2,171	C2,0	C2,1	C2,2	…	C2,9
	B3,0	B3,1	B3,2	…	B3,171	C3,0	C3,1	C3,2	…	C3,9
	…	…	…		…	…	…	…	…	…
	B190,0	B190,1	B190,2	…	B190,171	C190,0	C190,1	C190,2	…	C190,9
	B191,0	B191,1	B191,2	…	B191,171	C191,0	C191,1	C191,2	…	C191,9
ECC Parity	R0,0	R0,1	R0,2	…	R0,171	C192,0	C192,1	C192,2	…	C192,9
	R1,0	R1,1	R1,2	…	R1,171	C193,0	C193,1	C193,2	…	C193,9
	R2,0	R2,1	R2,2	…	R2,171	C194,0	C194,1	C194,2	…	C194,9
	…	…	…	…	…	…	…	…	…	…
	R15,0	R15,1	R15,2	…	R15,171	C207,0	C207,1	C207,2	…	C207,9

Figure 4 – ECC Block Structure

Each of the 16 sectors of an ECC block has a unique PSN. The PSNs are sequential such that if the smallest is N, then N+1, N+2, N+3, …, N+15 are also present in the ECC block. That is, the sectors are sequenced in an intuitively correct way.

2.2.3 The Groove Layout

The groove, when recorded, is a continuous sequence of ECC blocks. If ECC block E and E+1 are consecutive, then whenever N is the largest PSN in E, then N+1 is the smallest PSN in E+1. That is, the ECC blocks are sequenced in an intuitively correct way.

The rest of logical groove architecture is given by specific use of individual sectors.

The DVD+RW format provides only a continuous address space with no possibility of defect management. If defect management is desired, it is recommended that the host's system software provide the function.

Table 1 shows the zoned layout of the DVD+RW formatted groove.

Table 1 – DVD+RW Format Lay-out

Disc Area	Zone	120 mm Disc		80 mm Disc	
		Start PSN (h)	Length (d)	Start PSN (h)	Length (d)
LEAD-IN	Initial Zone	01D830h	nominal=52 304	01D830h	nominal=52 304
	Inner Disc Test Zone	02A480h	2 048	02A480h	2 048
	Inner Drive Test Zone	02AC80h	12 288	02AC80h	12 288
	Guard Zone 1	02DC80h	512	02DC80h	512
	Reserved Zone 1	02DE80h	4 096	02DE80h	4 096
	Reserved Zone 2	02EE80h	64	02EE80h	64
	Inner Disc Identification Zone	02EEC0h	256	02EEC0h	256
	Reserved Zone 3	02EFC0h	64	02EFC0h	64
	Reference Code Zone	02F000h	32	02F000h	32
	Buffer Zone 1	02F020h	480	02F020h	480
	Control Data Zone	02F200h	3 072	02F200h	3 072
	Buffer Zone 2	02FE00h	512	02FE00h	512
DATA	Data Zone	030000h	max=2 295 104	030000h	max=714 544
LEAD-OUT	Buffer Zone 3	max=260540h	768	max=0DE730h	768
	Outer Disc Identification Zone	max=260840h	256	max=0DEA30h	256
	Guard Zone 2	max=260940h	4 096	max=0DEB30h	4 096
	Reserved Zone 4	261940h	4 096	0DFB30h	4 096
	Outer Drive Test Zone	262940h	12 288	0E0B30h	12 228
	Outer Disc Test Zone	265940h	2 048	0E3B30h	2 048
	Guard Zone 3	266140h	nominal=24 400	0E4330h	nominal=7 936

Relative to the host, the Data Zone is the user space and should be addressed according to LSN. The physical to logical address mapping for DVD+RW is the same as that for DVD-ROM: When PSN represents a sector in the data zone, its LSN = PSN - 030000h.

2.3 Using DVD+RW Media

2.3.1 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.

NOTE: The function of locating and separating the data of one specific sector from the appropriate ECC block is typically an automated feature within a silicon sub-system. So, select any 2 sectors within the ECC block. There is virtually no difference in the times required to separate each sector's data from the ECC block. That is, there is no real performance difference.

2.3.2 Writing

Since the host's perception is that the media is sector readable, then in order to maintain compatibility with other block devices, a DVD+RW drive must 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 must 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 must write less than a full ECC block, then the drive must 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 each ECC block written is preceded by a written ECC block.

2.3.3 Formatting

When every ECC block in the Information Zone (lead-in, Data Zone, lead-out) of a DVD+RW has been recorded, the disc is "formatted". Clause 21 of *DVD+RW 4.7 Gbytes Basic Format Specifications*, additionally, defines specific data content for all sectors. This makes it DVD+RW formatted.

Write commands shall not be accepted prior to format of blank media.

Physically blank DVD+RW media has no data recorded in its groove, so those devices can find no references on the surface of a blank DVD+RW disc. This has been compared to trying to run on ice. There is no control. So, in order to assure read compatibility with DVD-RO devices, it is very important to have formatted media.

The high capacity together with the low (relative to HDD) write speeds means that completely formatting a disc requires more time than desired - today, about 30 minutes. This problem is not new with DVD+RW. The solution offered here is recycled from one of many for CD-RW: most of the format time is pushed into background time so that the user never experiences any significant delays. This is done by understanding use models and arranging for both the drive and the host to control those use models in order to make an incompletely formatted media appear to be completely formatted.

Background formatting has some controlling requirements:

- After some amount of lead-in formatting has been performed, the operation goes from foreground time to background time. The formatting operation in the drive must strive to maintain the Data Zone in two areas: the inner area written and the outer area unwritten. For data applications devices, the formatting bit map in the FDCB shall be implemented in order to minimize excessive reformatting associated with random writing. The host should modify its allocation algorithms to minimize blank area fragmentation.

- If the user wishes to remove the medium prior to format completion, the host must request that the drive stop formatting.

- In support of the previous requirement, the drive must provide a format re-start mechanism.

- The drive must always make current format status available to the host.

There are two types of background formatting: Normal and Quick Start. The difference is simply the sequence of events.

There are two methods for stopping a background format: Normal and Quick Stop.

Details of how background formatting operates relative to the host are to be found in the description of the FORMAT UNIT Command.

2.3.3.1 Normal Background Formatting

In normal background formatting, the area containing the Inner Disc Test Zone, Buffer Zone 2 and all zones between is entirely written prior to any format writing in the Data Zone. Once the lead-in area is written, the FORMAT UNIT command shall be terminated and the format process shall continue in background.

2.3.3.2 Quick Start Formatting

In the case of Quick Start formatting, format writing in the lead-in is minimized prior to beginning de-ice of the Data Zone. The actual amount of format writing in the lead-in is vendor specific.

2.3.3.3 Normal Stop

Normal Stop is defined for read compatibility with read-only devices. Thus, the lead-in area must be completely written, a temporary yet minimally acceptable lead-out must be written, and all data zone ECC blocks between the lead-in and the temporary lead-out must be written.

2.3.3.4 Quick Stop

Quick Stop is defined as "quick" relative to normal background formatting. The lead-in area must be completely written and the FDCB must be written with a bit map that reflects the actual written area of the Data Zone. No temporary lead-out is required. In the Data Zone, there may be unwritten ECC blocks prior to the last user written ECC block.

2.3.3.5 Format Completions

If not stopped, the format will complete. Regardless of how the format was started, the finished format should have the same appearance as defined in *DVD+RW 4.7 Gbytes Basic Format Specifications*.

2.3.3.6 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 2 through Table 7. Details of exact sequences may vary based on implementation.

Table 2 – 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 Guard Zone 1 through Reserved Zone 2
	Initialize and write initial FDCB in Inner Disc ID zone
	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	
	Initialize internal copy (RAM) of FDCB bit map and begin format writing in data zone guided by FDCB.
…	…
WRITE command received	Stop format writing.
	Write data as requested by host.
	Update internal (RAM) copy of FDCB.
	Continue format writing in data zone guided by FDCB.
…	…

Table 3 – 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 copy (RAM) of FDCB bit map and begin format writing in data zone guided by FDCB.
…	…
WRITE command received	Stop format writing.
	Write data as requested by host
	Update internal (RAM) copy of FDCB
	Continue format writing in data zone guided by FDCB.
…	…

Table 4 – Sequence when Normal Stopping Normal Background Formatting

Interface Events	Format Writing Events
…	…
CLOSE TRACK SESSION command requesting normal stop received	
If immediate, terminate FORMAT UNIT command with GOOD status	Stop background format functions.
	Write any pending, cached host data and update internal copy of FDCB.
	Determine first ECC block of temporary lead-out.
	Format write all blank ECC blocks from LBA 0 to temporary lead-out start.
	Write temporary lead-out.
	Write updated FDCB in Inner Disc ID zone
	Update Control Data Zone.
If not immediate, terminate FORMAT UNIT command with GOOD status	

Table 5 – Sequence when Quick Stopping 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 copy of FDCB.
	Update FDCB in Inner and Outer Disc ID zones.
If not immediate, terminate FORMAT UNIT command with GOOD status	

Table 6 – Sequence when Normal Stopping Quick Started Background Formatting

Interface Events	Format Writing Events
…	…
CLOSE TRACK SESSION command requesting normal stop received	
If immediate, terminate FORMAT UNIT command with GOOD status	Stop background format functions.
	Write any pending, cached host data and update internal copy of FDCB.
	Determine first ECC block of temporary lead-out.
	Format write all blank ECC blocks from LBA 0 to temporary lead-out start.
	Write temporary lead-out.
	Format write Guard Zone 1 through Reserved Zone 2
	Write updated FDCB in Inner Disc ID zone
	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 7 – Sequence when Quick Stopping 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 copy of FDCB.
	Format write Guard Zone 1 through Reserved Zone 2
	Write updated FDCB in Inner Disc ID zone
	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	

2.3.4 Disc Control Blocks

DVD+RW media format includes a generalized structure called the Disc Control Block (DCB). The basic DVD+RW 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 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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3 Features and Profiles

A DVD+RW drive might be capable of reading many different types of media. A DVD+RW drive might be capable of writing many different types of media. The response from the GET CONFIGURATION Command contains "how" to report each media capability. Rather than attempt to predict the combinations of supported profiles, this document shall only focus on the profiles required to support reading and writing DVD+RW media. The requirements for a read-only device can be extrapolated.

3.1 Feature 002Ah: DVD+RW

A DVD+RW device must report the DVD-ROM Profile (Profile 10h). The DVD Read Feature within the DVD-ROM Profile implies the physical capability of reading DVD+RW media, however, such a device may not recognize logical structures unique to the DVD+RW format (e.g. Disc Control Blocks).

The presence of the DVD+RW Feature indicates that the drive is capable of reading a recorded DVD+RW disc that is formatted according to *DVD+RW 4.7 Gbytes Basic Format Specifications.* Specifically, this includes the capability of reading DCBs. The DVD+RW Feature descriptor is shown in Table 8.

Table 8 – DVD+RW Feature Descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0	Feature Code = 002Ah							
1								
2	Reserved		Feature Version = 0001b				Persistent	Current
3	Additional Length							
4	Reserved							Write
5	Reserved						Quick Start	Close Only
6	Reserved							
7	Reserved							
Supported Media Types for Writing								
8	Reserved						4x Max	2.4x Max
9	Reserved							
10	Reserved							
11	Reserved							
Write Capabilities for Currently Mounted Medium								
12	Reserved						4x Max	2.4x Max
13	Reserved							
14	Reserved							
15	Reserved							

The Version field shall be set to 0001b.

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 DVD+RW disc. When Current = 1, a disc is mounted and it is a DVD+RW disc.

The Additional Length field shall be set to 0Ch.

This feature may be present only to represent additional capability to 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 formatting some DVD+RW discs according to *DVD+RW 4.7 Gbytes Basic Format Specifications* and is capable of writing some DVD+RW discs that have been formatted according to *DVD+RW 4.7 Gbytes Basic Format Specifications*. If a device reports this feature with the Write bit is set to one, then the drive shall support the commands shown in Table 9.

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

Op Code	Command Description	Reference
5Bh	Close Track/Session	4.1
04h	Format Unit	4.2
BFh	Send DVD Structure (format field = 05h, 30h)	4.21
2Ah	Write (10)	MMC3, 4.30
2Eh	Write and Verify (10)	SBC, 4.32
AAh	Write (12)	MMC3, 4.31

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.

The Read DVD Structure Command must support format field values 05h, 30h and FFh in addition to 0, 1, 3, and 4 required by the DVD Read Feature.

The Send DVD Structure Command must support format field values 05h and 30h.

Bytes 8 through 11 contain flag bits that show write capabilities of the drive. If the 2.4x Max bit is one, then the drive is capable of recording DVD+RW media that typically has a maximum recording speed of 2.4x. Otherwise, the drive does not claim the ability to write 2.4x Max media.

If the 4x Max bit is one, then the drive is capable of recording DVD+RW media that typically has a maximum recording speed of 4x. Otherwise, the drive does not claim the ability to write 4x Max media.

Bytes 12 through 15 contain flag bits that show maximum speed write capability of the drive with the currently mounted medium. If the 2.4x Max bit is one, then 2.4x is the maximum speed the drive is capable of recording the currently mounted medium. If the 4x Max bit is one, then the drive is capable of recording 4x DVD+RW media. Bytes 12 through 15 are valid only when the Current bit is set to one. If Current is zero, it is recommended that bytes 12 though 15 be set to zero.

If the host attempts to write the medium when no write capability exists, the command shall be terminated with CHECK CONDITION status and sense shall be set to NOT READY/CANNOT WRITE MEDIUM – UNSUPPORTED MEDIUM (02/30/11).

3.2   Write Protect Feature (0004h)

This Feature identifies reporting capability and changing capability for Write protection status of the media.   The Write Protect Feature descriptor response data to be returned to the Initiator is defined in Table 10.

Table 10 – Write Protect Feature Descriptor

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)			Feature Code = 0004h				
1								(LSB)
2	Reserved			Version = 0000h			Persistent	Current
3	Additional Length = 04h							
4	Reserved					WDCB	SPWP	SSWPP
5	Reserved							
6	Reserved							
7	Reserved							

The Feature Code field shall be set to 0004h.

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 one, indicates that drive is capable of changing PWP status on the medium surface. This bit shall be set to zero if the drive cannot change write protect status. The reporting capability of the Write Protect status is persistent and shall be supported regardless of the setting of the Current bit.

> Note: If the drive supports reporting Write Protection status but does not support changing, the drive returns this Feature descriptor. But Current bit is never set to one in the descriptor.

The Additional Length field shall be set to 04h.

The Supports SWPP (SSWPP) bit indicates that the Drive supports SWPP bit of Time-out & Protect Mode Page (1Dh). This bit does not affect Current bit of this Feature Descriptor. If SSWPP bit is set to one, the Drive shall support SWPP bit of Time-out & Protect Mode Page.

The Supports PWP (SPWP) bit indicates that the Drive supports set/release PWP status. If SPWP bit is set to one, the SEND DVD STRUCTURE command with Format = C0h shall be supported.

The WDCB bit is valid only for DVD+RW media. When WDCB is set to one, the drive is capable of recognizing Write Inhibit DCBs and is capable of changing the write permissions when the DVD+RW feature indicates that the drive is capable of writing. Otherwise, the drive is not capable of either recognizing or changing WDCBs. If WDCB is set to one, then SPWP shall be set to one.

Drives with installed medium that support this Feature shall implement the commands listed in

Table 11 – Write Protect Feature Commands

Op Code	Command Description	Reference
ADh	READ DVD STRUCTURE with Format code C0h when SPWP is oneand Format Code 30h when WDCB is one	4.16
BFh	SEND DVD STRUCTURE with Format code C0h when SPWP is set and Format Code 30h when WDCB is set	4.21

3.3   Profile 001Ah: DVD+RW

Drives identifying Profile 001A as current shall support the features listed in Table 12.

Table 12 – 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
0023h	Formattable	Support for formatting of media
002Ah	DVD+RW	Support for reading and optionally writing 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.

The presence of the DVD+RW Profile indicates that the drive is capable of reading a DVD+RW disc that has been formatted and recorded according to *DVD+RW 4.7 Gbytes Basic Format Specifications.* In addition, the presence of the DVD+RW Profile indicates that the WRITE bit in the DVD+RW feature is set to one.

3.4   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.

4   Command Descriptions

The features require that specific commands be implemented. A small number of commands are optional. Table 13 shows the decomposition of the DVD+RW Profile first into Features and then commands and mode pages.

Table 13 – DVD+RW Profile Decomposition

DVD+RW Profile	Core Feature	Get Configuration Command Get Event Status Notification Command Inquiry Command Mode Select (10) Mode Sense (10) Request Sense Test Unit Ready
	Morphing Feature	Get Configuration Command Get Event Status Notification Command Prevent Allow Medium Removal Command Send Event 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 Write (10) Write and Verify (10) Synchronize Cache
	Formattable	Format Unit Read Formattable Capacities Request Sense Verify (10)
	DVD+RW	Close Track/Session Format Unit Send DVD Structure Write (10) Write and Verify (10) Write (12)

Table 13 – DVD+RW Profile Decomposition, Continued

DVD+RW Profile		
	Real-time Streaming Feature	Get Performance Command Read (12) Command Read Buffer Capacity Command[C] Set CD Speed Command[C] Set Read Ahead Command Set Streaming Command Write (12) Command[C] Capabilities and Mechanical Status Mode Page[C]
	Power Management Feature	Get Event Status Notification Command Start Stop Unit Command Power Condition Page
	Timeout Feature	Timeout and Protect Mode Page
[C] marks a feature conditional command or mode page. All other commands and mode pages are mandatory.		

The decomposition shown in Table 13 results in the command list shown in Table 14.

Table 14 – Feature Specified Commands

Command	Op Code	Command	Op Code
CLOSE TRACK/SESSION	5Bh	READ FORMATTED CAPACITIES	23h
FORMAT UNIT	04h	READ TOC/PMA/ATIP	43h
GET CONFIGURATION	46h	REPORT KEY	A4h
GET EVENT/STATUS NOTIFICATION	4Ah	REQUEST SENSE	03h
GET PERFORMANCE	ACh	SEND DVD STRUCTURE	BFh
INQUIRY	12h	SEND EVENT	A2h
MECHANISM STATUS	BDh	SEND KEY	A3h
MODE SELECT (10)	55h	SET READ AHEAD	A7h
MODE SENSE (10)	5Ah	SET STREAMING	B6h
PREVENT/ALLOW MEDIA REMOVAL	1Eh	START/STOP UNIT	1Bh
READ (10)	28h	SYNCHRONIZE CACHE	35h
READ (12)	A8h	TEST UNIT READY	00h
READ BUFFER CAPACITY	5Ch	VERIFY (10)	2Fh
READ CAPACITY	25h	WRITE (10)	2Ah
READ DISC INFORMATION	51h	WRITE (12)	AAh
READ DVD STRUCTURE	ADh	WRITE AND VERIFY (10)	2Eh

4.1 CLOSE TRACK/SESSION COMMAND

The CLOSE TRACK/SESSION Command, Table 15, allows closure of either a track or a session. For the specific case of 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 DVD+RW. For other media types and formats, refer to MMC-3.

Table 15 – 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						Session	Track
3	Reserved							
4	(MSB)			Track				
5				Number				(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 Session and Track bits have the following meanings:

Session = 0, Track = 0

> Optional behavior for 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 at some DVD+RW ECC block boundary. If the formatting is Quick Start, then each ECC block of the lead-in beyond the Initial Zone must be initialized. No further writing shall occur.   If the medium mounted is DVD+RW and there is no background format in progress, then no operation shall occur and this shall not be considered an error. In this case, the drive shall support FDCB bit maps.

Session = 0, Track = 1

> For DVD+RW Basic format, this combination is reserved, not valid. If discovered, the drive shall terminate the command with CHECK CONDITION Status and set sense data to ILLEGAL REQUEST, INVALID FIELD IN CDB (5/24/00).

Session = 1, Track = 0

> If a 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 4.7 Gbytes Basic Format Specifications* for the specific purpose of providing DVD-RO compatibility. In general, this means that a [partial] lead-in shall be written, a [temporary] lead-out shall be appended and all unrecorded gaps between lead-in and lead-out shall be format written. The data zone shall be expanded to ensure that the total recorded area reaches at least a radius of 30 mm. i.e. PSN = 70DE0h (462 304).

Session = 1, Track = 1

> If a 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 4.7 Gbytes Basic Format Specifications* for the specific purpose of providing DVD-RO compatibility. In general, this means that a [partial] lead-in shall be written, a [temporary] lead-out shall be appended and all unrecorded gaps between lead-in and lead-out shall be format written.

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

During the Close operation, the DVD+RW Drive shall respond to commands as follows:

1. The drive may respond to commands that are allowed to return NOT READY sense by terminating the command with CHECK CONDITION Status and setting sense data to NOT READY, LOGICAL UNIT NOT READY, OPERATION IN PROGRESS.

2. In response to the INQUIRY, GET CONFIGURATION, and GET EVENT/STATUS NOTIFICATION commands, the drive shall respond as commanded.

3. Closing a Session shall cause a Class 1 Event when the command is issued if the drive becomes NOT READY. A Class 1 Event shall occur if the medium returns to READY or if the medium becomes not writable. Other Class 1 Events may occur due to closing a Track or Session.

4.2 FORMAT UNIT COMMAND

The FORMAT UNIT Command (Table 16) 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 16 – 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	Reserved							
3	(MSB)			Interleave				
4	Size							(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 17.

Table 17 – 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 18.

Table 18 – 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 DVD+RW compliant device shall support Format Code 1.

The Format List Header (Table 19) identifies any and all additional parameter data.

Table 19 – 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				
3				Length				(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 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 must 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. Any other value in this field shall return CHECK CONDITION with the Sense Key set to ILLEGAL REQUEST and the Sense Code set to INVALID FIELD IN PARAMETER LIST.

4.2.1 Format Code 001b

If the Format Code in the CDB is 001b the host shall send a Format Descriptor as defined in Table 20.

Table 20 – Format 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(s)				
7								

The Type Dependent Parameter contents are as specified for each Format Type. The DVD+RW Basic Format is type 26h. Other Format Types listed in MMC-3 are not associated with DVD+RW media.

Format Type = 26h, DVD+RW Basic Format, Mandatory when the Write bit in the DVD+RW
Feature Descriptor is set to one. The Number of Blocks field shall be set to either the value
returned by the READ FORMAT CAPACITIES command or 0xFFFFFFFF. The drive shall
accept either value. If the host sends any other value, then the drive shall 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								
2	Reserved						Quick Start	Restart

When Quick Start is zero, the format operation shall initialize the lead-in according to 2.3.3.1 prior to
declaring the format command complete. When Quick Start is 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.

When Restart is cleared to zero, the drive shall perform a new format.

When Restart is set to one, the 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 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.

4.2.2   Background Formatting for Format Type 26h

The background formatting process is best illustrated in Figure 5.

Format unit command,
new format

Blank or
incomplete
format

Perform Partial format
(if Quick Start, this
part is minimal)

De-ice data zone
DVD+RW Status = 2

Close Track/Session

Format Restart

If necessary,
Complete lead-in

Close wo/Temp
lead-out

DVD+RW
Status = 1

Close w/Temp
lead-out

De-ice
complete

Fill gaps and
Write Temp
Lead-out

Send BGformat complete
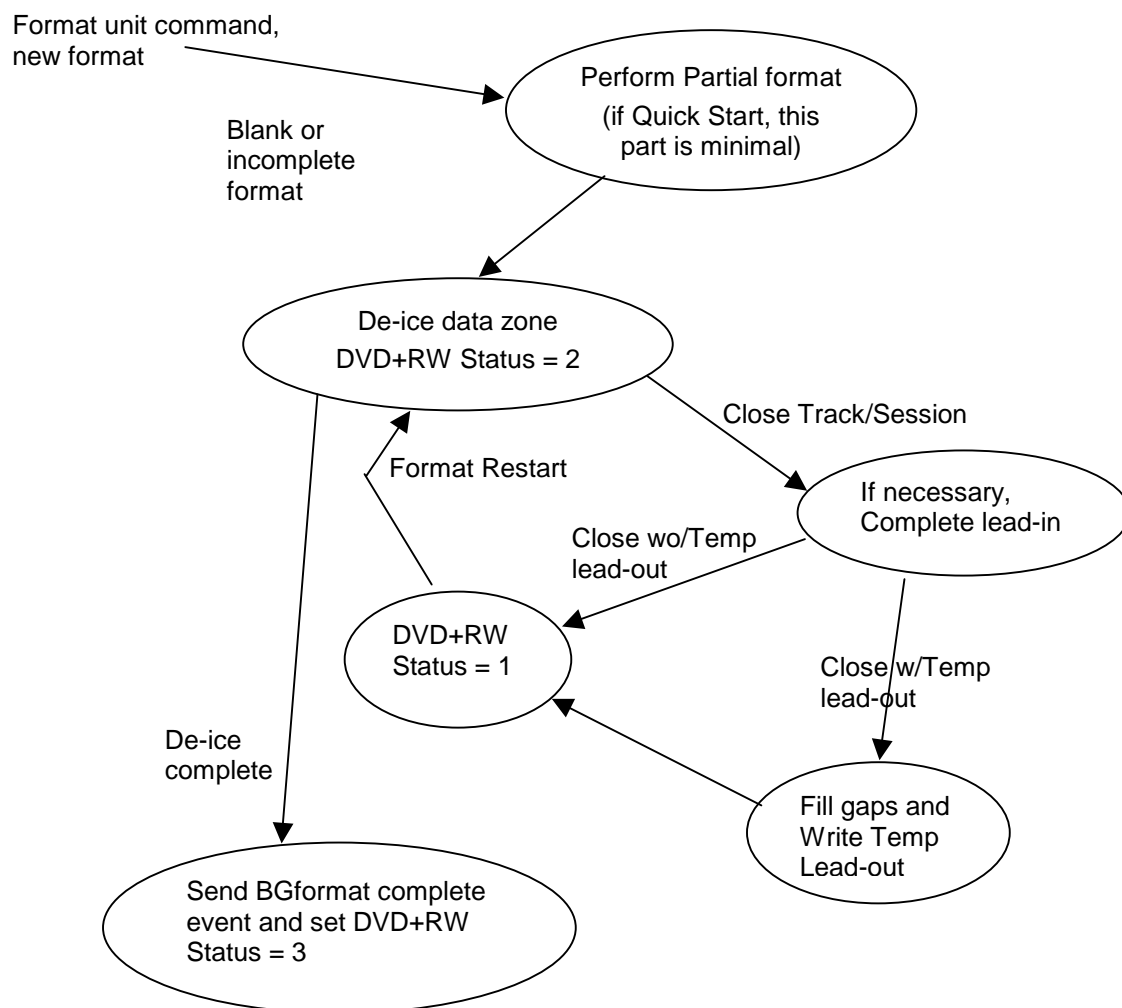event and set DVD+RW
Status = 3

Figure 5 – Background Process Flow

4.2.2.1 Background Formatting: Getting Started

The *DVD+RW 4.7 Gbytes Basic Format Specifications* tells us: "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 completely format writing 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.

4.2.2.2 Background Formatting: Stopping the Format

If a format is executing in background:

- The formatting process may be stopped by issuing the CLOSE TRACK/SESSION Command.
- If the host sends a SCSI command block which requires that 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 (02/04/04). Example: START/STOP UNIT Command is issued with Start = 0.

- 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.

- If any other command is issued to the drive, it shall be executed normally.

Whenever a 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.

4.2.2.3 Background Formatting: Restarting

If an incompletely formatted disc is mounted in a write capable DVD+RW drive, formatting will 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.

4.2.2.4 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 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 (00/04/04), 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
15	SKSV	Reserved						
16	(MSB)	Progress						
17		Indication						(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 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.

4.2.2.5   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 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 must 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 must be written either with host data or format patterns. The drive must fill all blank fragments.

4.2.2.6   Background Formatting: Formatting Concurrently with Reading

If the host attempts to read the media, the result must 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.

4.2.2.7   Background Formatting: Early Eject

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

When track = 0 and session = 0, the drive shall stop the format at an ECC block boundary and record the formatting state in the FDCB. At that point, background formatting shall be stopped.

When track = 0 and session = 1, the drive must 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 must record the formatting state in the FDCB. Finally, the lead-in is updated to mark the restart point for the format continuation.

4.3 GET CONFIGURATION COMMAND

Although a new feature has been defined, DVD+RW requires no modification to the behavior of this command.

4.4 GET EVENT STATUS NOTIFICATION COMMAND

There is no need to modify the GET EVENT STATUS NOTIFICATION Command, however, we do need to add a new Media Event: 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 DVD+RW compliant drives are capable of generating more than one media event, such drives must 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 DVD+RW Drive. This bit is reported independently from the Door or Tray Open bit. If the 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 DVD+RW Drive to which the media status notification applies. For 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 DVD+RW Drive to which the media status notification applies. For DVD+RW Drives that do not support multiple slots, this field shall be reserved

4.5 GET PERFORMANCE COMMAND

DVD+RW requires no changes or additions.

4.6 INQUIRY COMMAND

DVD+RW requires no changes or additions.

4.7 MECHANISM STATUS COMMAND

DVD+RW requires no changes or additions.

4.8 MODE SELECT (10) COMMAND

DVD+RW requires no changes or additions.

4.9 MODE SENSE (10) COMMAND

DVD+RW requires no changes or additions.

4.10 PREVENT/ALLOW MEDIA REMOVAL COMMAND

DVD+RW requires no changes or additions.

4.11 READ (10) COMMAND

The presence of the DVD+RW Feature has no effect upon the host/drive interface when there is no DVD+RW background format in progress. In that case, this command shall function as described in SBC and MMC-3.

When a 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.

4.12 READ (12) COMMAND

The presence of the DVD+RW Feature has no effect upon the host/drive interface when there is no DVD+RW background format in progress. In that case, this command shall function as described in SBC and MMC-3.

When a 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.

4.13 READ BUFFER CAPACITY

DVD+RW requires no changes or additions.

4.14 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 DVD+RW Basic format. For other media and format types, refer to MMC-3.

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							
4	Address							
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 Logical Units.

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							
2	Address							
3	(LSB)							
4	(MSB)							
5	Block Size							
6	(Shall be 2048d)							
7								(LSB)

The Logical Block Address represents the last addressable LBA on the medium. If the currently mounted medium is recognized as a 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 DVD+RW disc is mounted and blank, then the response shall be 00000000h.

The Block Length shall always be reported, in bytes, as 2048d.

4.15 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-3 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							

For DVD+RW Basic Format media:

- Disc Information Length shall be set to $32+8*N_{OPC}$, where N_{OPC} is the number of OPC table entries.
- Erasable shall be set to 1.
- State of last Session shall be set to 00b if the disc is blank. Otherwise, State of last Session shall be set to 11b.
- Disc Status shall be set to 00b if the disc is blank. Otherwise, Disc status shall be set to 11b.

- Number of First Track on Disc shall be set to 1.
- Number of Sessions shall be set to 1.
- First Track Number in Last Session is set to 1.
- Last Track Number in Last Session is set to 1.
- DID_V shall be cleared to zero.
- DBC_V shall be cleared to zero.
- 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 specifies the validity of the Disc Application Code in byte 32.
- The Background Format status is represented by bits 0 and 1 of byte 7. The value gives the DVD+RW format status of the mounted disc:

  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.

  When the DVD+RW status indicates that a format is in progress the disc size values are specified as if the format had completed.
- Disc Type shall be set to 00h,
- Disc Identification shall be cleared to zero,
- Last Session Lead-in Start Time shall be reported as a LBA or all zeros.
- Last Possible Start Time for Start of Lead-out shall be reported as a LBA or all zeros.
- Disc Bar Code shall be cleared to zero,
- 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 shall not exceed 27.

4.16 READ DVD STRUCTURE COMMAND

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

A DVD+RW drive shall support the format field codes shown in Table 29.

Table 29 – 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 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 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.

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

Following the structure header, MMC-3 describes data formats for other DVD media types in a layer descriptor. For DVD+RW, the layer descriptor is shown in Table 30.

Table 30 – 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 CDZ PSN $\leq$ 2F2FFh, then this value shall be the PSN of last recorded sector in DZ. Otherwise, this value may be either the PSN of last recorded sector in DZ, or the last possible PSN in the DZ. To maximize compatibility with RO devices, it is recommended that this value always be the last recorded sector in DZ.							
10								
11								
12 - 18	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.

4.16.2 Copyright Management Information (Format Code = 05h)

The Copyright Management Information structure contains additional information since MMC-3 as shown in Table 31. MMC-3 information for DVD-ROM remains unchanged.

Table 31 – Copyright Management Information (FC = 5h)

Bit Byte	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.

4.16.3 ADIP Information (Format Code = 11h)

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

Table 32 – ADIP Information

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

4.16.4 DCBs (Format Code = 30h)

A Disc Control Block is a structure on 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 33). The Disc Control Blocks are defined in the *DVD+RW 4.7 Gbytes Basic Formats Specifications*.

Table 33 – 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 34.

Table 34 – 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 Logical Unit is allowed to perform if the Logical Unit 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 35 – 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 36.

Table 36 – READ DVD STRUCTURE Data Format (Format field = 30h)

Byte \ Bit	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 Initiator. 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 Logical Unit shall pad the Disc Control Block with 00h bytes.

4.16.4.1 Formatting DCB (FDCB)

The FDCB is a 32 768 byte structure that aids the drive during background formatting. Refer to *DVD+RW 4.7 Gbytes Basic Formats Specifications* for specific content descriptions.

Note: The FDCB is read-only.

4.16.4.2 Write Inhibit DCB (WDCB)

The WDCB is a 32 768 byte structure as shown in Table 37.

Table 37 – WDCB Format

Bit Byte	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 33:

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:

- No write protection,
- Write protect only the LBA space as defined by a defect management system (e.g. MRW),
- Write protect only the data zone,
- 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 4.7 Gbytes Basic Formats Specifications* for specific field definitions.

4.16.4.3 DCB List

When Content Descriptor FFFFFFFFh (Table 38) is requested, the Logical Unit shall generate a list of DCBs that may be read from and/or recorded on the current medium by the Initiator. If the Logical Unit records DCBs that are generated internally, and those DCBs cannot be sent from the Initiator, the Logical Unit shall not report those DCBs as recordable.

Table 38 – 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 38 – Disc Control Block (FFFFFFFFh) cont.

Bit Byte	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)

	7	6	5	4	3	2	1	0
(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 Logical Unit 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 Initiator. If a DCB is both readable and recordable, the DCB shall appear in both lists. The Logical Unit shall not record any DCB that it does not recognize.

4.16.5 Write Protection Status (Format Code = C0h)

Bit Byte	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 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. 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.

4.17 READ FORMATTED CAPACITIES COMMAND

The READ FORMAT CAPACITIES command (Table 39) 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 39 – READ FORMAT CAPACITIES Command Descriptor Block

Bit / Byte	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 40.

Table 40 – Read Format Capacities Data Format

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

Format Capacity Descriptor(s)

Byte	
0	
...	Format Capacity Descriptor #0
7	

...

Byte	
0	
...	Format Capacity Descriptor #n
7	

The Capacity List Header is shown in Table 41. 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 41 – 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 42. The Number of Blocks indicates the number of addressable blocks for the capacity defined by each Descriptor Type.

The Descriptor Type field (Table 43) indicates the type of information the descriptor contains. The Block Length specifies the length in bytes of each logical block.

Table 42 – 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	Type Dependent Parameter							
6								
7								

Table 43 – Descriptor Types

Descriptor Type	Description
00b	Reserved
01b	Unformatted Media. The reported value is for the maximum formatted capacity for this media. For 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 44. The Number of Blocks field indicates the number of addressable blocks for the capacity defined by the Format Type.

Table 44 – 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	Type dependent parameter							
6								
7								

Format Type = 26h, 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-3.

4.18 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 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 TIME forms shall be as defined for DVD-ROM in MMC-3.

4.19 REPORT KEY COMMAND

DVD+RW requires no changes or additions.

4.20 REQUEST SENSE COMMAND

The presence of the DVD+RW Feature has no effect upon the host/drive interface, but some sense codes not now used by other DVD rewritable devices must be implemented by a write capable DVD+RW compliant drive.

4.21 SEND DVD STRUCTURE COMMAND

A DVD+RW drive shall support the format field codes shown in Table 45, as required by the DVD+RW Feature description.

Table 45 – 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 (4.16).

The Copyright Management Information is described in MMC-3.

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 4.16.4. Detailed format information is shown in *DVD+RW 4.7 Gbytes Basic Format Specifications*.

4.22 SEND EVENT COMMAND

This command is required only when the drive supports Event Notification Class 3 (external request). Generally, drives do not support Event Notification Class 3. It is recommended that this command not be supported by DVD+RW drives.

4.23 SEND KEY COMMAND

DVD+RW requires no changes or additions.

4.24 SET READ AHEAD COMMAND

DVD+RW requires no changes or additions.

4.25 SET STREAMING COMMAND

DVD+RW requires no changes or additions.

4.26 START/STOP UNIT COMMAND

The presence of the 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 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).

Otherwise, DVD+RW requires no changes or additions from the SBC standard.

4.27 SYNCHRONIZE CACHE COMMAND

DVD+RW requires no changes or additions.

4.28 TEST UNIT READY COMMAND

DVD+RW requires no changes or additions.

4.29 VERIFY (10) COMMAND

DVD+RW requires no changes or additions.

4.30 WRITE (10) COMMAND

If the 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 05/30/10, ILLEGAL REQUEST, MEDIUM NOT FORMATTED.

Otherwise, DVD+RW requires no changes or additions.

4.31 WRITE (12) COMMAND

If the DVD+RW medium is blank (never formatted), then a WRITE (12) to any address shall be terminated with CHECK CONDITION status and sense data shall be set to 05/30/10, ILLEGAL REQUEST, MEDIUM NOT FORMATTED.

Otherwise, DVD+RW requires no changes or additions.

4.32 WRITE AND VERIFY (10) COMMAND

If the DVD+RW medium is blank (never formatted), then a WRITE AND VERIFY (10) to any address shall be terminated with CHECK CONDITION status and sense data shall be set to 05/30/10, ILLEGAL REQUEST, MEDIUM NOT FORMATTED.

Otherwise, DVD+RW requires no changes or additions.

5 MODE PAGES

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

Table 46 – Feature Specified DVD+RW Mode Page Support

Description	Page Code	Reference
Read/Write Error Recovery Page	01h	MMC-3
Power Condition Page	1Ah	MMC-3
Fault/Failure Reporting Mode page	1Ch	MMC-3
Time-out and Protect Page	1Dh	MMC-3
Capabilities and Mechanism Status Page	2Ah	MMC-3

5.1 Read/Write Error Recovery Page

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

Otherwise, DVD+RW requires no changes or additions.

5.2 Power Condition Page

DVD+RW requires no changes or additions.

5.3 Fault/Failure Reporting Mode page

DVD+RW requires no changes or additions.

5.4 Time-out and Protect Page

DVD+RW requires no changes or additions.

5.5 Capabilities and Mechanical Status Page

DVD+RW requires no changes or additions.

THIS PAGE IS
INTENTIONALLY BLANK

6 Host Usage

Host usage of DVD+RW media is not nearly as complex as CD. A blank media must be formatted with the basic format before use. Once formatted, the media is randomly readable and randomly writable in 2 048 byte sectors. Special case usage is defined for streamed applications.

6.1 Media Recognition

It is presumed that the host has a continuous Get Event Status Notification poll operating in its background. The host is expected to take no additional action until a NewMedia Media Event is detected.

6.1.1 Discovering Blank DVD+RW Media

The GESN poll reports a NewMedia Media Event.

The GESN poll reports NoEvent (no additional Media Events to report).

The GET CONFIGURATION Command is issued, and reports DVD+RW Profile as current.

The READ DISC INFORMATION Command is issued.

It is discovered that the media is RW, BLANK, and the Background Format Status is 00b.

The host may now conclude that the media mounted is DVD+RW and blank.

6.1.2 Discovering DVD+RW Media with the Basic Format

The GESN poll reports a NewMedia Media Event.

The GESN poll reports NoEvent (no additional Media Events to report).

The GET CONFIGURATION Command is issued, and reports DVD+RW Profile as current.

The READ DISC INFORMATION Command is issued.

It is discovered that the media is RW and BLANK is zero.

The host may now conclude that the media mounted is DVD+RW on which a basic format has at least been started.

6.2 Formatting

If it is determined that the currently mounted medium is blank DVD+RW, and the user desires to format the medium, then:

The parameter list for a FORMAT UNIT command is initialized for Format Type 26h, basic DVD+RW. It is preferred to have the IMMED bit cleared to zero. The FORMAT UNIT Command is then issued. The FORMAT UNIT command should not terminate until the background format initialization (see *DVD+RW 4.7 Gbytes Basic Format Specifications*) has completed. This assures no waiting for additional action before writes are accepted. Note: When the host selects Quick Start formatting, the command sequence remains the same, however, the distribution of execution time may change.

The host writes file system structures for initialization, as required.

If the Format completes, the GESN poll will report a BGformatCompleted Media Event.

If our user wishes to remove the medium, and no BGformatCompleted Media Event has been seen, a CLOSE TRACK/SESSION Command is issued to stop the background formatting. It is recommended that the CLOSE TRACK/SESSION command be issued with session = 1 and track = 0 in order to maximize interchange compatibility.

6.3 Reading

When a basic formatted DVD+RW media has been identified, it is randomly readable in 2 048 byte sectors. The drive must emulate this capability by reading only ECC blocks and separating individual sector data in its buffer. In the event that an unrecoverable read error occurs (READ (10) or READ (12) with streaming = 0), the drive must terminate the command with CHECK CONDITION status and set sense data to reflect the appropriate error.

If the basic format has completed and the sector had not yet been written with host data, then the sector data will contain all zeros. If the host wishes to read that sector, then the host will receive the sector data - all zeros. If a background format is either incomplete or in progress and the host requests to read a sector that is in a blank ECC block, the drive shall return zero for each byte of the blank sector data. This ensures consistency in each case.

The DVD+RW basic format is best suited for streamed applications. In using the media for that purpose, the READ (12) command should be used with the streaming bit set to one. All unrecoverable read errors will be ignored by the drive and whatever data has been recovered will be delivered to the host.

6.4   Writing

Writing mirrors reading.

When a basic formatted DVD+RW media has been identified, it is randomly writable in 2 048 byte sectors. The drive must emulate this capability by writing only ECC blocks and editing individual sector data in its buffer using a read-modify-write process. In the event that an unrecoverable write error occurs (WRITE (10), WRITE and VERIFY (10) or WRITE (12) with streaming = 0), the drive must terminate the command with CHECK CONDITION status and set sense data to reflect the appropriate error.

Suppose the host wishes to write a single sector. The ECC block containing that sector must be checked for blank or non-blank. If not blank, the ECC block containing the addressed sector is read into the drive's buffer and the host's data is used to overwrite the appropriate buffer positions. This ECC block shall then be rewritten with the buffered data. If blank, an ECC block size of buffer shall be zero filled (the format pattern) and the host's data is used to overwrite the appropriate buffer positions. This ECC block shall then be written.

The DVD+RW basic format is best suited for streamed applications. In using the media for that purpose, the WRITE (12) command should be used with the streaming bit set to one. All unrecoverable write errors will be ignored by the drive.

7 Changes From Version 1.2 to 1.3

7.1 Quick Start Formatting

In model section (clause 2) added sub-clauses to 2.3.3 Formatting:

2.3.3.1 Normal Background Formatting

2.3.3.2 Quick Start Formatting

2.3.3.3 Normal Stop

2.3.3.4 Quick Stop

2.3.3.5 Format Completions

2.3.3.6 Background Formatting Sequences

In command descriptions (clause 4) modified text in figure 5 for Quick Start detail.

7.2 Media Capabilities

Updated DVD+RW Feature Descriptor (3.1) to include media sub-type write capabilities, both general and for currently mounted medium.

7.3 Write Inhibit

Added modified Write Protect Feature Descriptor (3.2).

Added new sub-clauses to READ DVD STRUCTURE command (4.16.4) to better describe reading DCBs on DVD+RW media.

Write Protect Status may also be reported by using the RED DVD STRUCTURE command with Format Code = C0h.

7.4 ADIP

Added format code 11h to READ DVD STRUCTURE command (4.16.3).

7.5 Errors in Previous Versions

An error in the version 1.2 description of the READ TOC/PMA/ATIP command was corrected. When MSF (TIME) bit is set in CDB, the drive shall fabricate form 0 and form 1 TOCs. Version 1.2 stated that an error should occur.

Clarifications and have been added. In some cases where optional behavior is permitted, recommendations have been added (e.g. Responses to READ DVD STRUCTURE).

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