

DVD+R – A WRITE-ONCE OPTICAL RECORDING SYSTEM FOR VIDEO AND DATA APPLICATIONS

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ABSTRACT

This paper discusses the Digital Versatile Disc plus Recordable (DVD+R) system, which can create non-erasable DVD discs perfectly compatible with the installed base of players and computer drives. The physical and logical formats of DVD+R media are very similar to those of the Digital Versatile Disc plus ReWritable (DVD+RW). It is for this reason that the users of DVD+RW data drives and video recorders can easily upgrade their equipment by software means. The DVD+R systems operate with an increased accuracy of linking data in multisession mode, which makes them suitable for appending video files when building large archives.

INTRODUCTION

Since its market introduction in 1996, the Digital Versatile Disc has experienced a tremendous sales boost, with more and more people discovering the advantages of this high-capacity optical disc medium. DVD-Video, in particular, has attracted the public attention due to the superb audio and video quality it offers. Recordable DVD systems, on the other hand, have struggled during the last years to obtain a status on the consumer electronics market.

One of the key features of a recordable DVD system must be its backward compatibility with the existing DVD-Video and DVD-ROM players, which also means that only one recordable disc is required for consumer electronics as well as data markets. The compatibility feature should be regarded as the ability of the DVD players and computer drives to read out the newly developed DVD+R media, irrespective of the type and brand of the DVD+R equipment on which the disc was recorded. In addition, it is required to provide a unified recording technology that is capable of writing DVD+R as well as DVD+RW discs, making therefore use of the same physical format and allowing the user to store 4.7 billion bytes (i.e., 4.38 GB) on either type of media. The introduction of the DVD+R format [4] represents one more step toward compatibility with installed

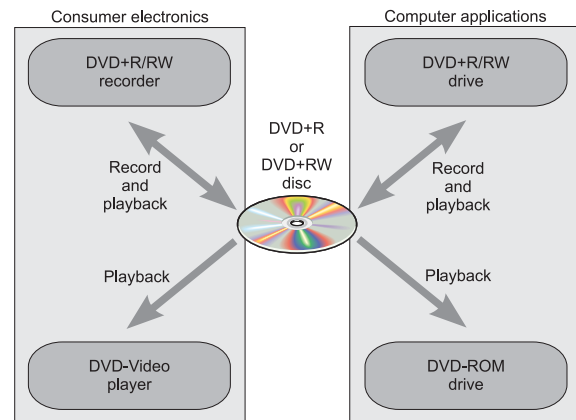


Figure 1 Compatibility of DVD+R media with the installed base DVD players and DVD+RW recorders.

DVD players and offers, in addition, the possibility of archiving video and computer data in a manner that complements the features already available for DVD+RW [5]. This 2-way compatibility on both the video consumer electronics and computer markets is illustrated in Fig. 1.

PHYSICAL COMPATIBILITY

From the viewpoint of the physical disc format, a similar compatibility issue was previously solved for the Compact Disc Recordable/ReWritable (CD-R/RW) and for DVD+RW media. The DVD+R disc uses a thin organic dye film stacked within a typical DVD sandwich-like structure (see Fig. 2). The recording takes place along an interrupted wobbled groove arranged in a continuous spiral, which extends from the inner to the outer disc radius. Data is recorded as a series of marks produced by heating locally the dye with a laser beam, followed by irreversible modifications of the dye physical and chemical structure that occur during cooling. The groove, which does not disturb the readout process in read-only DVD systems, provides means for radial tracking, addressing any location on the blank disc to correctly position the recording laser spot, and for exact synchronization and alignment between old data blocks on disc and new data to be written. The latter two issues are dis-

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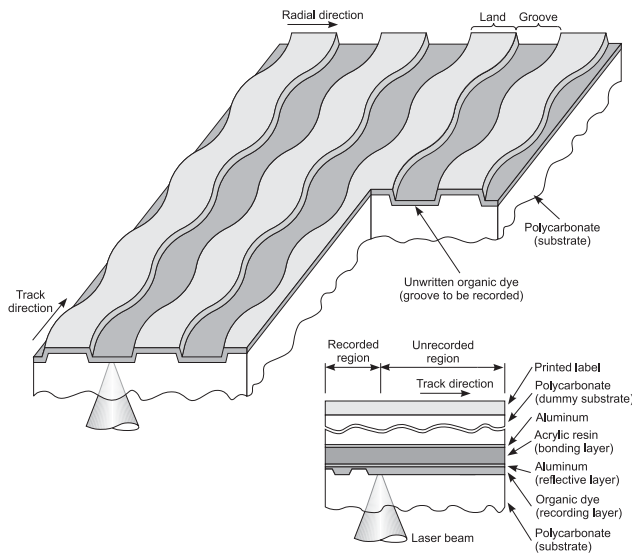


Figure 2 Cross section through a DVD+R disc.

cussed with more details in [6]. The groove parameters, like its wobble frequency and phase modulation, do not differ from those of the DVD+RW grooves, which means that DVD+R and DVD+RW media can be both written with the same recorder.

The compatibility between DVD+R and DVD-Video (or DVD-ROM) discs has been achieved by preserving the essential physical parameters [1] of the existing read-only media. An overview of several parameters is given in Table 1.

Another physical compatibility issue regards the continuity of the data stream on the DVD+R disc. Basically, it is always possible to add new data arranged in fragments to an open session or add up to 191 sessions to disc. Such processes can take place as depicted in Fig. 3 and with the same

Parameter	DVD+R	DVD+RW	DVD-Video
Laser wavelength [nm]	650 . . . 665		645 . . . 655
NA (recorder/player)	0.65 ± 0.01		0.60 ± 0.01
Capacity [$\times 10^9$ bytes]		4.70	
Track pitch [μm]		0.74 ± 0.03	
Channel bit length [nm]		131.9 . . . 134.7	
Reference velocity [m/s]		3.49 ± 0.03	
Reflectivity [%]	45 . . . 85	18 . . . 30	45 . . . 85
Track-cross modulation		> 0.10	
RF modulation		> 0.6	
Asymmetry		-0.05 . . . 0.15	
Clock-to-data jitter [%]		< 9	< 8
Wobble frequency [kHz]		817.4	-
Peak write power [mW]	6 . . . 15	8 . . . 15	-
Read power [mW]		0.7 ± 0.1	
Recording overspeed	1X or 2.4X	1X . . . 2.4X	-

Table 1 Several physical parameters of the DVD+R/RW and single-layer DVD-Video (or DVD-ROM) systems.

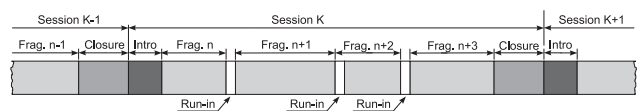


Figure 3 Bit-accurate DVD+R recording with sessions and fragments.

lossless linking accuracy [6] as in the case of the DVD+RW format, leading thereby to discs that are compatible with the existing DVD-Video and DVD-ROM media.

LOGICAL COMPATIBILITY

The DVD-Video standard also includes specifications for the file system [2] as well as for the video format [3]. At this logical level, the compatibility is guaranteed by reserving fragments within a session in advance, filling those unrecorded with zero data when closing a session, and writing the lead-in and lead-out information when finalizing the disc. Since the specifications [2, 3] remain fulfilled, a closed session as well as the finalized disc can be read out in legacy DVD players

CONCLUSION

The DVD+R physical and logical optical disc formats fully comply with both DVD+RW and read-only DVD specifications. It is therefore possible for the existing DVD-Video players and DVD-ROM drives to play back the newly developed DVD+R disc, immediately after the latter has been recorded. In addition, the DVD+RW recorder firmware can easily be upgraded to allow the writing on DVD+R media.

REFERENCES

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