

A STORAGE DEVICE WITH WRITE PROTECTION

BACKGROUND OF INVENTION

5

1. Field of Invention

The present invention relates to optical recording and/or reproduction for recording digital data on a disc and/or reproducing the data therefrom, and more particularly, to a write protection method for protecting data recorded by a user on a write-once or rewritable medium from unwanted overwriting or erasing, and a recording medium for storing the write protection information.

15 2. Description of the Related Art

A DVD-R (Digital Versatile Disc-Recordable) standard and a WORM (Write Once Read Many) standard are standards for a write-once disc, and a DVD-RAM (Digital Versatile Disc Random Access Memory) standard and a DVD-RW (Digital Versatile Disc-Rewritable) standard are standards for a rewritable disc.

According to the DVD-RAM standards published in July of 1997, DVD Specifications for Rewritable Disc, Part 1 Physical Specifications Version 1.0, a DVD-RAM adopts a cartridge containing a disc, and discs from Type 2 and Type 3 cartridges can be used, after removal from the cartridge, as bare discs.

Three types of cartridges for a DVD-RAM are defined as follows. In the Type 1 cartridge, a single sided disc or double sided disc is installed in

the cartridge and the installed disc can not be taken out of the case. In the Type 2 cartridge, a single sided disc is installed and the installed disc can be taken out of the case. However, when the disc is taken out of the case once, a sensor hole capable of sensing the removal of the disc is permanently changed into an open state, so that the sensor hole cannot be changed into a closed state again. Thus, it can be determined whether or not the disc has been taken out of the case. Also, in the Type 3 cartridge, a sensor hole capable of determining whether or not a disc has been taken out of the case is open at the early stage, so the disc can be taken out of or put into the case without restrictions.

Also, the cartridge has a write-inhibit hole (alternatively called "recognition switch for write protection") and according to the standard at page PH-69 page writing is possible when the write-inhibit hole is closed and is impossible when the write-inhibit hole is open. That is, when a user intends to protect data written by the user from unwanted overwriting or erasing, the corresponding write-inhibit hole in a closed state is changed into an open state, such that a recording apparatus cannot record to the disc of the corresponding cartridge.

20

However, in the case of using the Type 2 or Type 3 cartridge, a bare disc can be used without the case as described above. This is so the disc can be used in a thin recording/reproducing apparatus such as a laptop computer which cannot adopt a cartridge. However, the above specifications do not define any write-protect means other than the write-inhibit hole attached to the case of the cartridge.

25

For example, when a user, after removing a disc installed in a case that protects from writing, inserts the disc into to a thin recording/reproducing

3

apparatus that cannot accept a cartridge, the write protection by the write-inhibit hole is no longer effective.

Also, there are many DVD related specifications such as DVD-ROM specification (DVD specification for Read Only Memory), DVD-R specification (DVD specification for Recordable Disc). Also, many specifications for rewritable DVD, which are not established yet, can be considered, e.g., DVD specification for rewritable and readable disc, which is very similar to the DVD-R specification, and DVD specification for disc with enhanced density. Such a series of specifications with the prefix of DVD are called "DVD family".

Also, a computer operating system adopts various attributes, e.g., read-only and write protection, which is capable of preventing an arbitrary change in written data using attributes of a file that stores the data. However, when a disc is managed at a level lower than that of a file system for managing file, for example, when the recording and reproduction are directly performed, not via the file system, when the disc is initialized, where the entire file system may not be referred, or in the case that attributes of each file cannot be considered, such a method is not a perfect protection method. A method of protecting data of a bare DVD-RAM from unwanted overwriting or erasing has not yet been introduced.

In the case of a DVD-RAM, a disc can be used in a bare state as well as with the case on. However, in the case of DVD-R or DVD-RW, a disc in a case cannot be used, so that the need to protect the bare disc from unwanted overwriting or erasing has increased. However, when a bare disc taken out of a case is used, it is not possible to utilize the write-inhibit hole, so the write protection must be provided on the disc itself.

In the DVD-R specification, a 3.95GB specification (Version 1.0) and a 4.7GB specification (final draft, Version 1.9) do not mention a write protection method for a bare disc. Meanwhile, DVD-RW specifications are being prepared based on the DVD-R specification, and particularly, Version 1.9 defines the use of a bare disc without a case. However, if a future specification defines the use of a disc in a case (for example, extension of application), there will be no write protection method to be applied to a bare disc since the conventional write protection method, which has been applied to a DVD-RAM using the write-inhibit hole, is used.

If the DVD-RW specification allows the use of a case, writing can be prevented using a write-inhibit hole as in the DVD-RAM. However, if a user forgets to change the write-inhibit hole into a write-inhibit position, unwanted erasing or overwriting of data can occur.

SUMMARY OF THE INVENTION

The present invention discloses a storage device, comprising:

a recordable and/or rewritable recording medium including a Lead-in area, a Lead-out area; and a user data area;

a cartridge having a case which receives the recording medium, wherein the recording medium stores write protection information to protect the data recorded on the recording medium from unwanted overwriting or erasing; and

wherein the recording medium is a DVD-RAM (Digital Versatile Disc - Random Access Memory).

5

The case of the storage device may have a recognition switch for write protection.

5 The case of the storage device may not have a recognition switch for write protection.

10 Preferably, the recording medium of the storage device stores write protection information to protect the data recorded on the recording medium from unwanted overwriting or erasing with the write protection information being stored in physically separate locations of the recording medium.

15 Preferably the recording medium of the storage device is a disc, and the write protection information is stored in the Lead-in area at a plurality of times.

20 Preferably, the write protection information is stored four times.

Preferably, the length of the write protection information is at least one byte.

25 The invention also discloses a storage device, comprising:

recordable and/or rewritable recording medium including: a Lead-in area; a Lead-out area; and a user data area; and

30 a cartridge having a case which receives the recording medium, wherein the recording medium redundantly stores write protection information in the Lead-in area to protect the data recorded on the recording medium from unwanted overwriting or erasing, and wherein the recordable and/or rewritable recording medium is a DVD-RAM.

Preferably, the write protection information is stored four times.

Preferably, the length of the write protection information is at least one byte.

5 BRIEF DESCRIPTION OF THE DRAWINGS

The above objects and advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the attached drawings in which:

10

FIG. 1 is a perspective view of a cartridge for a DVD-RAM (Digital Versatile Disc Random Access Memory), having a write-inhibit hole;

FIG. 2 shows the structure of a general DVD-RAM;

15 FIGs. 3A and 3B show the data structure of a defect management area (DMA) of a general DVD-RAM;

FIGs. 4A and 4B show examples of the data structure of the DMA of a DVD-RAM, for storing write protection information, according to the present invention;

20 FIGs. 5A and 5B show further examples of the data structure of the DMA of a DVD-RAM, for storing write protection information, according to the present invention;

FIG. 6 is a flowchart illustrating a write protection method according to a preferred embodiment of the present invention;

25 FIG. 7 is a flowchart illustrating a method of updating write protection information according to the present invention;

FIG. 8 shows the structure of the disc identification zone for storing the write protection information according to the present invention;

FIG. 9 shows the data structure of the write protection information stored in the disc identification zone of FIG. 8;

FIG. 10 shows the structure of a disc satisfying general DVD-R and DVD-RW specifications;

FIG. 11 shows the structure of the Lead-in area shown in FIG. 10;

FIG. 12 shows the structure of the control data zone shown in FIG.

5 11;

FIG. 13 shows the contents of the RMD (Recording Management data) field of an RMA (Recording Management Area) according to the DVD-R and DVD-RW specifications;

FIG. 14 shows the contents of the conventional RMD field 0 shown in
10 FIG.13;

FIG. 15 shows the contents of the RMD field 0 for storing the write protection information according to the present invention; and

FIG. 16 is a flowchart illustrating a write protection method according to another embodiment of the present invention.

15

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, where the write-inhibit hole of a cartridge according to the DVD-RAM specification is shown, reference numeral 1
20 represents a write-inhibit hole and a reference numeral 2 represents a sensor hole used to determine whether a disc has been taken out of a case.

In FIG. 1, the closed write-inhibit hole 1 indicates that writing is allowed, and an open write-inhibit hole 1 indicates that writing is prohibited.
25 Thus, when the write-inhibit hole 1 is opened, in the corresponding DVD-RAM recording/ reproducing apparatus, writing of data to a disc is prohibited even if a write command is input from the outside, so that information written on the disc can be protected from unwanted overwriting.

FIG. 2 shows the structure of a disc according to the DVD-RAM specification. The disc is comprised of three parts, i.e., a Lead-in area, a user data area and a Lead-out area, in the aspect of function. Also, the disc can be classified into a rewritable area and an unwritable area. In particular, the Lead-in area contains a read-only zone in the innermost part, which is an unwritable embossed data zone having pits, and a rewritable data zone following the read only zone, in which both recording and playback are possible. Meanwhile, the Lead-out area and the user data area comprise only the rewritable data zone. The read-only zone of the Lead-in area contains information about physical specifications of the disc. The rewritable data zone of the Lead-in area and the Lead-out area contain four defect management areas DMA 1, DMA 2, DMA 3 and DMA 4 in which information about disc defects is written, a disc test zone for use by a disc manufacturer in checking the status of the disc, a drive test zone for testing recording and reproduction operations in a recording/reproducing apparatus, a guard track zone for connecting each zone, and a disc identification zone.

In the DVD-RAM specification version 1.0, the purpose in use of the disc identification zone and the content thereof are not yet clearly described.

20

FIGs. 3A and 3B show the data structure in the defect management area (DMA) described at pages PH-155 through PH-158 of the DVD-RAM specification, particularly, and in particular, they show the data structure of a disc certification flag and a group certification flag respectively, in a disc definition structure (DDS) area.

25

A total of four defect management areas DMA 1, DMA 2, DMA 3 and DMA 4 are present in the Lead-in area and the Lead-out area of a disc, wherein DMA 1 and DMA 2 exist in the Lead-in area and DMA 3 and DMA 4 exist in the Lead-out area, and identical information relating to disc defects

30

and initialization of the disc is stored in each area. Writing such identical information in different areas, i.e., in two areas DMA 1 and DMA 2 of the Lead-in area and in two areas DMA 3 and DMA 4 in the Lead-out area, is done to prevent the problem of data becoming unusable due to disc defects.

5

In the byte position 3, i.e., BP3, of the disc definition structure (DDS), a disc certification flag as shown in FIG. 3A is present, and the disc certification flag comprises "In Process" information indicating the initialization state of the disc, a "User certification" flag indicating whether the disc is certified by a user, and a "Disc manufacturer certification" flag indicating whether the corresponding disc is certified by a disc manufacturer, and flag information written in the byte position BP3 is information about the entire disc.

Also, in the byte positions 16 to 39, BP16~BP39, each byte has a group certification flag as shown in FIG. 3B in an identical configuration. The byte positions BP16~BP39 have initialization information about 24 recordable areas, i.e., a group, defined in the DVD-RAM specification version 1.0. That is, each group certification flag has "in Process" information indicating the initialization state of the corresponding group and a "User certification" flag indicating whether the disc is certified by a user. Here, the group refers to specific recordable areas of the disc.

FIGs. 4A and 4B are examples of the data structures of a disc certification flag and a group certification flag of the disc definition structure (DDS) area of the defect management area (DMA) that stores write protection information according to the present invention. In the data structure of the disc certification flag shown in FIG. 4A, "Disc write protection" information is stored in bits b4 and b3 of a reserved disc

10

certification flag "Reserved", in contrast to the data structure of the disc certification flag shown in FIG. 3A, and is defined as follows.

Disc write protection

5

b4, b3 = 00b: Disc is not write protected
 10b: Disc is write protected
 Entire disc shall not be written to except
 for drive test area, and DMA area
 11b: Disc is write protected
 Entire disc shall not be written to
 These bits shall not be modified to other
 values
 Others: Reserved

10

15

In the same manner, the data structure of the group certification flag shown in FIG. 4B stores "Group write protection" information in bits b4 and b3 of a reserved group certification flag "Reserved", in contrast to the data structure of the group certification flag shown in FIG. 3B, and is defined as follows.

20

Group write protection

b4, b3 = 00b: Group is not write protected
 10b: Group is write protected. User data shall
 not be written to this block
 Others: Reserved

25

The states of the bits b4 and b3 of the disc certification flag, and those of the bit b4 and b3 of the group certification flag are shown in Table 1.

30

Table 1

Disc Certification Flag		Group Certification Flag		States
b4	b3	b4	b3	
0	0	0	0	No write protection
0	0	1	0	Given group is write protected
1	0	Don't Care		Soft write protected on entire disc
1	1			Hard write protected on entire disc

In the above Table 1, soft write protection means that write protection
 5 can be released, that is, that the write protection state can be changed to a rewritable state by setting the corresponding bit b4 to "0". Also, hard write protection means that write protection is applied to the Lead-out area as well as to the Lead-in area, so that the write protection state can not be restored to the rewritable state.

10

In the hard write protection for the group, making a part of the disc hard write-protected does not provide advantages to a user in use, rather than in a technical aspect, and particularly there is a problem of processing in the corresponding group when the entire disc is reinitialized. Thus, it is
 15 unfavourable to set the hard write protection for the group.

As shown in the data structure of FIGS. 4A and 4B, the write protection information of the disc is written in the disc definition structure (DDS) of the defect management area (DMA), and identical write protection
 20 information is written four times to the same disc, so that robustness of the write protection information on the disc is enhanced.

When a bare disc that is write protected is inserted for use into a case, the write-inhibit hole of which is in a rewritable state, or if a bare disc that is not write protected is inserted into a case, the write-inhibit hole of which is in a write protection state, the write inhibition information stored on
5 the disc cannot match the state of the write-inhibit hole of the case.

In such a case, if either one of the disc or the case is write protected, it is preferable to operate to be suitable for the write protection state. This is
10 because in the user's position it is preferable that the content of data is checked again without overwriting rather than the important data being damaged through overwriting.

FIGs. 5A and 5B are further examples of the data structures of the disc certification flag and the group certification flag, respectively, of the disc
15 definition structure (DDS) area of the defect management area (DMA) that stores the write protection information according to the present invention.

In the case where the write protection information is in the disc certification flag shown in FIG. 5A, only one bit b4 can be used regardless of
20 whether the write protection information is for the hard write protection or for the soft write protection, which is defined as follows.

Disc write protection

25

b4 = 0b: Disc is not write protected

1b: Disc is write protected

Entire disc shall not be written to except for drive
test area, and DMA area

30

13

The group test flag shown in FIG. 5B can store the write protection information using only one bit b4, which is defined as follows.

Group write protection

5

b4 = 0b: Group is not write protected

1b: Group is write protected

User data shall not be written to this block

10 In this case, preferably bit b4 of the disc certification flag and the bit b4 of the group certification flag are used. However, instead of using the bit b4 of the disc certification flag or group certification flag, any "Reserved" bits can be used.

15 Also, the bit b4 of the group certification flag, that is, "Group write protection" flag, may not be used. This is effective in a disc in which only a specific group is not write protected, and in this case the bit b4 of the group certification flag is "Reserved" as in the conventional specifications.

20 The present invention can be applied to a case without a write-inhibit hole, and information on the disc can be efficiently protected in this case using the write protection information stored on the disc.

FIG. 6 is a flowchart illustrating a write-protection method according to
25 a preferred embodiment of the present invention. First, it is checked whether a disc is installed in a case (step S101), and if the disc is installed in the case, the state of the write-inhibit hole of the case is checked (step S102). That is, when the write-inhibit hole is closed, it means that cartridge is not write protected. When the write-inhibit hole is open, it means that the
30 cartridge is write protected.

If it is determined in step S101 that the disc is not installed in the case, or after the state of the write-inhibit hole is checked in step S102, a write protection flag of the disc is checked (step S103). That is, write
5 protection flags within the disc certification flag and the group certification flag are checked.

It is determined whether the write protection information of the disc matches the state of the write-inhibit hole of the case (step S104). That is,
10 when write protection information is written on the disc and the write-inhibit hole of the case is open, it is determined whether the write protection flag of the disc certification flag is set to a "write protection" state (step S105). Otherwise, a user is informed of that the write protection information of the disc does not match the state of the write-inhibit hole of the case (step
15 S106).

If the write protection flag of the disc certification flag is set as a write protection state in the step S105, or if one of either the disc or the case indicates the write protection state even though both the write-protection
20 states of the disc and the case do not match in the step S106, it is checked whether the disc is set to a "hard write protection" state (step S107). If the disc is set to the "hard write protection" state, data writing to the entire disc including the Lead-in area and the Lead-out area other than the user data area is prohibited (step S108). Otherwise, data writing in the user data area
25 other than the drive test area and the defect management area (DMA) is prohibited (step S109).

If it is determined in the step S105 that the write protection flag of the disc certification flag is not set to the "writing protection" state, it is checked
30 whether the write protection flag of the group certification flag is set to the

15

"write protection": state (step S110). If the write protection flag of the group certification flag is set to a "write protection" state, writing data in the corresponding group is prohibited (step S111). Otherwise, data writing is allowed in the rewritable area (step S112).

5

The write protection method illustrated in FIG. 6 corresponds to the case of using the disc certification flag containing the hard write protection flag shown in FIG. 4A, and the group certification flag shown in FIG. 4B. When the disc certification flag of FIG. 5A and the group certification flag of FIG. 5B are used, the steps S107 and S108 illustrated with reference to FIG. 6 are not performed. When the disc certification flag is set to the "write protection" state in the step S105, writing data in the user data area is prohibited in step S109.

15 FIG. 7 is a flowchart illustrating a method of setting a rewritable disc to the write protection state or of changing the write protection state of the disc to a rewritable state. A method of updating the write protection information will now be described with reference to the flowchart of FIG. 7.

20 In FIG. 7, when a disc or a cartridge is inserted into a recording/reproducing apparatus, the write protection information is checked (step S201). Then, it is determined whether the write protection information has been input by a user (step S202) and when the write protection information is input by the user, it is determined whether information set by the user is for write protection (step S203). If the information set by the user is write protection information, the corresponding write protection flag of the disc is set to the write protection state (step S204).

When the information set by the user is not write protection information in step S203, it is determined whether the information set by the

30

user is write protection release information (step S205). If the information set by the user is the write protection release information, it is determined whether the current disc is in a hard write protection state (step S206). If the current disc is in the hard write protection state, the user is informed of that write protection cannot be released (step S207). If it is determined in step S206 that the disc is not in the hard write protection state, the corresponding write protection flag of the disc is set to the rewritable state (step S208).

Also, when the setting of the write protection or the release of the write protection of the disc is completed, that is, the step S204, S207 or S208 is completed, and the disc is installed in a case, it is determined in step S209 that the state of the write-inhibit hole of the case matches the write protection information stored in the disc. If the state of the write-inhibit hole of the case does not match the state of the disc, the user is informed of such difference (step S210), and then the procedure is completed.

The method of updating the write-protection information, illustrated in FIG. 7, can be performed when a bare disc is inserted or a disc in a case is inserted, and can be performed after the write-protection is controlled using the write protection information as illustrated with reference to FIG. 6.

In the preferred embodiment of the present invention, the write protection information of the disc is written in the defect management area of the disc. However, the disc identification zone of FIG. 2 can be used instead of the defect management area of the disc. The disc identification zone is present both in the lead-in area and the Lead-out area, like the defect management area of the disc. Thus, writing identical information two or more times to the disc identification zones located in the Lead-in area and

the Lead-out area can ensure robustness as strong as in the defect management area of the disc.

Since the disc identification zone is not presently used for a specific purpose, there is an advantage that the disc identification zone does not conflict with the information written in the defect management area of the disc. In particular, information of the defect information area relates to only the DVD-RAM, it is difficult to maintain consistency between discs for optical recording/ reproduction. Meanwhile, since the disc identification zone is not restricted to a specific disc, the disc identification zone can maintain consistency with another disc satisfying the similar specifications.

An example of storing the write protection information using the disc identification zone will be described with reference to FIGs. 8 and 9.

15

As shown in FIG. 8, in the structure of a disc identification zone that stores write protection information for a bare disc, four flags for write protection are concurrently written to the disc identification zone, and two or more normal flags of the four flags are read. If the contents of the read flags matches each other, it is regarded that the write protection is set for the disc.

For example, the four flags are written in only the disc identification zone of the Lead-in area, and disc identification information of 1 block length (=1 byte) is successively written four times in the four blocks from the start of the disc identification zone of the Lead-in area, and all the first bytes of disc identification information contain a write protection flag. The disc identification information of 1 block length is summarized as shown in Table 2.

30 Table 2

BP	Contents	Number of bytes
0	Write protection information	1 byte
1 to 32767	Reserved	32767 bytes

The write protection flag of the disc identification information corresponds to the most significant bit (MSB) of the first byte as shown in FIG. 9. When the flag (indicated by "WP") value is 1b (binary), it means that the entire area of disc is write protected except for the disc identification zone and the drive test zone. Also, when the flag value is 0b, it means that the entire area of disc is rewritable. That is, "WP" of FIG. 9 is defined as follows.

10

WP = 1b: Entire area of disc is write protected except for Drive test zone and Disc identification zone.
 = 0b: Entire area of disc is not write inhibited

The reason why only two normal flags are read from the four written write protection flags is as follows. In the case where only one write protection flag is written, an error can be generated in the area in which the corresponding flag is written, so that the area cannot be used. Also, in the case where only reading and not writing is allowed, there is a possibility of abnormal operation such that no information can be written to the disc permanently by erroneously reading the corresponding flag.

Meanwhile, when writing write protection information in a plurality of locations, there is a problem in that the time required for reading the corresponding information gets longer. That is, the time required for a series of processes from the insertion of a disc, including reading various

information from the disc and recognizing the information required for the control of the disc by a microcontroller, can become longer.

However, in the case of updating the write protection information, operation only for the updating is performed. That is, because information is not read, the writing time in units of several hundreds milliseconds is barely worth consideration. Thus, writing is performed in four locations in consideration of the robustness of information, and error correction capability is taken into account during the recording. That is, if two errors are not generated, or normally corrected flags are read and two of them match each other, the write protection state of the disc is set without reading the remaining flags, thereby increasing the operating speed.

The write protection method suggested above is not limited to only the DVD-RAM, and can be applied to a disc that has specifications physically the same as DVD-R/RW and similar to the DVD specifications, which will now be described.

FIG. 10 shows the structure of a disc according to general DVD-R and DVD-RW specifications. The disc is roughly divided into two parts with respect to functionality, including an R (Recording)-information area and an information area. The R-information area is divided into a PCA (Power Calibration Area) for calibrating power, and an RMA (Recording Management Area) including general information relating to recording, i.e., information about the recording mode of a disc, recording state, optimal power control and border zone, and the information area is divided into a Lead-in area, data recordable area in which data is recordable by a user and a Lead-out area that is not defined yet in the DVD-R and DVD-RW specifications.

Here, as shown in FIG. 11, the Lead-in area comprises an Initial zone (contents: 00h) for which a specific purpose is not defined, a reference code zone (channel bit pattern: 3T-6T-7T) used to control an equalizer for a radio frequency signal in a drive, first and second buffer zones (contents: 00h) and a control data zone containing the contents shown in FIG. 12.

In FIG. 12, physical format information of the control data zone is about types and versions of the specifications, disc size, maximum transmission rate, disc structure (single/dual), recording density and data region allocation, and the disc manufacturing information is unrelated to compatibility.

FIG. 13 shows the content of an RMD (Recording Management Data) field of the RMA according to the DVD-R and DVD-RW specifications. The RMA comprises a RMA Lead-in area including a system reserved field (contents: 00h) and a unique ID field, and RMD fields. As shown in FIG. 13, one RMD field consists of 16 sectors, in which the first sector is allocated as a linking-loss area, general information of the disc is stored in RMD Yield 0, Optimum Power Control (OPC) related information is stored in RMD field 1, user specific data (contents: 00h) is stored in RMD field 2, and border zone information is stored in RMD field 3. Also, in the case of a DVD-R disc according to the specifications of version 1.9, Rzone (Recording Zone) information including recording items is stored in RMD field 4 through RMD field 12 whenever the recording is performed, and RMD field 13 and RMD field 14 are reserved.

In the case of rewritable and erasable DVD-RW disc the specifications of which are not yet defined, Rzone information is stored in RMD field 4, and RMD field 5 and RMD field 12 are allocated to store defect management & certification related information taking reliability, certification

before the disc is used and management of defect in use into consideration. Also, RMD field 13 and RMD field 14 are reserved.

FIG. 14 shows the contents of the general information of a disc stored in the RMD field 0 of FIG. 13. In FIG. 14, byte positions BPO and BP1 stores information about RMD format (recorded only with 0001 h), byte position BP2 stores information about the disc status, and byte position BP3 is reserved. The byte positions BP4 through BP21 store unique disc identifier information that stores the recording date and time of the data as ASCII code. Pre-pit information is copied over the byte positions BP22 through BP85, and the remaining byte positions BP86 through BP2047 are reserved. Here, in the DVD-R disc the disc status information stored in the byte position BP2 is defined as follows.

(BP2) Disc status

00b: Indicates that disc is empty

01b: Indicates that disc is in Disc-at-once recording mode

02b: Indicates that disc is in incremental recording mode

03b: Indicates that disc is finalized where incremental recording is used

Others: Reserved

FIG. 15 is an example of a table showing the state where the write protection information is stored on the disc adopting the DVD-R and DVD-

RW specifications according to the present invention using the general information of a disc stored in RMD field 0 of FIG. 13.

That is, by defining the following using the reserved byte position BP3
5 of RMD field 0, information that the current disc is write protected can be transmitted to a drive.

(BP3) Disc write protection flag

10 00b: Indicates that disc is not write protected

01b: Indicates that disc is write protected (hard)

02b: Indicates that disc is write protected (soft)

15

Entire disc shall not be written to except for PCA, etc.

In the write protection information according to the present invention,
00b indicates that the disc is not write protected, 01 b indicates that the
20 entire disc is write protected (hard write protection), and 02b indicates that
the entire disc except for a part of the disc (e.g., the PCA) is write protected
(soft write protection). In the present embodiment, the write-protection
information indicates that the entire disc is write protected or is not write
protected. However, the RMD field of FIG. 13 is written connected to the
25 previous data whenever new data is written, so that the write-protection can
be set for only the written data corresponding to the RMD.

For example, even though write protection information is stored in the
byte position BP3 of RMD field 0, the write protection information on a bare
30 disc can be written using the Lead-in area and the Lead-out area shown in

FIG. 10 in addition to the RMD area. Also, the byte position BP2 of RMD field 0 stores the disc status information, so that write protection information can be stored in the byte position BP2 of RMD.

5 Since the write protection information cannot be updated in the once-writable DVD-R, in consideration of the consistency with the DVD family, write protection information can be indicated through finalization that means the writing on the defined Lead-in area and Lead-out area. That is, that the finalization is completed indicates the DVD-R is write-protected. Otherwise,
10 it means that there is no write protection.

Also, as in the defect management area DMA 1, DMA 2, DMA 3 and DMA 4 of the DVD-RAM, the same content is recorded multiple times to cope with errors, thereby ensuring robustness. In the DVD-R/RW, such
15 robustness is ensured by grouping RMDs of the RMA and providing the RMDs belonging to one group with the same content.

A disc must include format information informing whether the current disc is a DVD-R or a DVD-RW, such that a DVD-R disc and a DVD-RW disc
20 is compatible in the same drive. As shown in FIG. 15, the RMD format can be defined using the byte positions BPO and BP1 of RMD field 0 as follows.

(BP 0,1) RMD format

25 0001 h for R

0002h for RW

0003h for R/RW compatible mode

FIG. 16 is a flowchart illustrating a write protection method according to another embodiment of the present invention, in consideration of application extension to a DVD-RW contained in a case.

5 First, it is determined whether a disc is installed in a case (step S301). If the disc is installed in the case, the state of a write-inhibit hole of the case is checked (step 302). That is, if the write-inhibit hole is closed, it means that cartridge is not write protected, and if the write-inhibit hole is open, it means that the cartridge is write protected.

10

When the disc is not installed in the case in step S301, or when the state of the write-inhibit hole is checked in step S302, the write-protection flag of the disc is checked (step S303). That is, a write protection flag within RMD field 0 is checked.

15

Then, it is determined whether the write protection information of the disc matches the state of the write-inhibit hole of the case (step S304). That is, when the write protection information is written on the disc and the write-inhibit hole of the case is opened, it is determined that the write protection
20 flag is in a "write protection" state (step S305). Otherwise, the user is informed of that the write protection information of the disc does not match the state of the write-inhibit hole of the case (step S306).

If the write protection flag of the disc is set to the "write protection" state in step S305, or after the step 306, that is, if either the disc or the case
25 is in a "write protection" state even though the write protection information of the disc does not match the state of the write-inhibit hole of the case, it is determined whether the disc is set to the "hard write protection" state (step S307). If the disc is in the "hard write protection" state, the entire disc
30 including the user data area is write prohibited (step S308). Otherwise, only

the user data area is write protected (step S309). Also, in the step S305 if the write protection flag is not in the "write protection" state, the disc is not write-protected (step S310).

- 5 In recordable and/or rewritable medium according to the present invention, e.g., disc satisfying the DVD specifications, e.g., DVD-RAM, DVD-R and DVD-RW, data of a bare disc that is not contained in a case can be efficiently protected. Also, when either the case or the disc is in the write protection state, the writing of data is prohibited and the user is allowed to
- 10 check the state of a disc or a cartridge. As a result, the data recorded in the disc can be protected efficiently from unwanted overwriting or erasing.

CLAIMS

1. A storage device, comprising:
a recordable and/or rewritable recording medium including:
5 a Lead-in area;
a Lead-out area; and
a user data area;
a cartridge having a case which receives the recording medium; and
wherein the cartridge or the case has a write inhibit hole for write protection
10 and the recording medium stores write protection information, and the protection of
the data recorded on the recording medium from unwanted overwriting or erasing is
performed based on the state of write protection information the recording medium
and the state of the write inhibit hole.
- 15 2. The storage device of claim 1, wherein the writing of data on the recording
medium is prohibited based on the recording medium and/or the state of the write
inhibit hole being set to a write protection state after the state of write protection
state and the state of write inhibit hole.
- 20 3. The storage device of claim 1, wherein the write protection information is
stored in an area of the recording medium other than the user data area,
4. The storage device of claim 1, wherein the recording medium stores write
protection information to protect the data recorded on the recording medium from
25 unwanted overwriting or erasing with the write protection information being stored
in physically separate locations of the recording medium.
5. The storage device of claim 4, wherein the recording medium is a disc, and
the write protection information is stored in the Lead-in area at a plurality of times.
30
6. The storage device of claim 5, wherein the write protection information is
stored four times.

27

7. The storage device of claim 6, wherein the length of the write protection information is at least one byte,

8. The storage of claim 1,

5 wherein the recording medium redundantly stores write protection information, at the same time, in the Lead-in area to protect the data recorded on the recording medium from unwanted overwriting or erasing based at least on a matching of at least two of the write protection information, read without error, and wherein the recordable and/or rewritable recording medium is a DVD-RAM.

10

9. A write protection method for a recording and/or reproducing apparatus, wherein a recording medium, including a Lead-in area, a Lead-out area and a user data area, is set to a write protection state ensuring the protection of data recorded on the recording medium from unwanted overwriting or erasing, comprising:

15 checking a state of the recording medium provided by write protection information stored on the recording medium, and a write protection state of a write inhibit hole of a case or cartridge positioning the recording medium therein; and prohibiting writing of data on the recording medium based on the state of the recording medium and/or the state of the write inhibit hole being set to a write
20 protection state.

10. The write protection method of claim 9, wherein the write protection information is stored in an area of the recording medium other than the user data area.

25