

TOSHIBA

CD-ROM

SCSI-2 INTERFACE SPECIFICATIONS

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TOSHIBA CORPORATION

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CHAPTER 1 PREFACE

This specification describes the SCSI interface implementation of TOSHIBA CD-ROM drive.

SCSI (Small Computer System Interface) is an interface which was established by ANSI (American National Standard Institute) to specify the interface between host computers and intelligent peripheral devices.

SCSI IDs are assigned to each SCSI devices and up to 8 SCSI devices can be connected to SCSI bus.

TOSHIBA CD-ROM drive complies with ANSI standard X3.131-1986 SCSI (SCSI-1) and also complies with SCSI-2 working draft X3T9.2/86-109 Revision 10c issued March, 1990.

However as of September, 1990, the SCSI-2 is still under discussion at ANSI committee, therefore this CD-ROM SCSI specification is subject to change to the final SCSI-2 specification.

The CD-ROM device is newly defined in SCSI-2 and several CD-ROM unique commands (mainly audio playback control command) are specified in it.

As well as new device and/or command sets, SCSI-2 defines high performance data transfer mode such as wide data bus or fast transfer mode as optional requirements.

This specification covers following TOSHIBA CD-ROM drives (September, 1990).

XM-3301B series

XM-8100B series

These drives are designed to support not only traditional CD-ROM data format but also CD-ROM XA format.

Namely ECC (Error Correction Code) for XA format is handled inside the CD-ROM and error correction is carried out if necessary.

The CD-ROM XA standard is an extended standard adopting traditional CD-ROM Mode-2 format and consistent with ISO 9660 standard which defines the volume and file structure of CD-ROM.

The traditional CD-ROM has adopted Mode-1 format, mostly handling character data, on the other hand, CD-ROM XA standard enables a long-time (Up to 16 hours) ADPCM (Adaptive Differential Pulse Code Modulation) audio recording and simultaneous playback of text, graphics, images and audio.

It is expected that CD-ROM XA will realize multi-media application through CD-ROM on the personal computer.

CHAPTER 2 PHYSICAL CHARACTERISTICS

2-1 INTERFACE CONNECTOR

TOSHIBA CD-ROM drive uses a 50-conductor connector consisting of two rows that complies with SCSI.

It uses single-ended driver/receiver alternatives and it allows a maximum cumulative cable length of 6 meter.

Table 2-1.1 shows the single-ended contact assignments.

The minus sign (-) next to the signal shows "Active low".

Contact Number	Signal Name	Contact Number	Signal Name
1	GROUND	26	- DB(0)
2	GROUND	27	- DB(1)
3	GROUND	28	- DB(2)
4	GROUND	29	- DB(3)
5	GROUND	30	- DB(4)
6	GROUND	31	- DB(5)
7	GROUND	32	- DB(6)
8	GROUND	33	- DB(7)
9	GROUND	34	- DB(P)
10	GROUND	35	GROUND
11	GROUND	36	GROUND
12	GROUND	37	GROUND
13	OPEN	38	TERMPWR
14	GROUND	39	GROUND
15	GROUND	40	GROUND
16	GROUND	41	- ATN
17	GROUND	42	GROUND
18	GROUND	43	- BSY
19	GROUND	44	- ACK
20	GROUND	45	- RST
21	GROUND	46	- MSG
22	GROUND	47	- SEL
23	GROUND	48	- C/D
24	GROUND	49	- REQ
25	GROUND	50	- I/O

Table 2-1.1 Single-Ended Contact Assignments

2-2 ELECTRICAL DESCRIPTION

There are three kinds of signals, driven by the initiator, driven by the target, driven the initiator and target at once.

Each signal driven by the SCSI device must have following output characteristics.

- TRUE: V (Low-level output voltage) = 0.0 to 0.5 volts dc at 48 mA sinking
OL
- FALSE: V (High-level output voltage) = 2.5 to 5.25 volts dc
OH

SCSI device shall meet following electrical characteristics on each signal.

- TRUE: V (Low-level input voltage) = 0.0 to 0.8 volts dc
 IL
 I (Low-level input current) = -0.4 mA Max (0.5 volts dc)
 IL
 FALSE: V (High-level input voltage) = 2.0 to 5.25 volts dc
 IH
 HYSTERISIS: 0.2 Volts dc minimum

All signals except for GROUND, OPEN and TERMPWR shall be terminated at both ends of the SCSI cable.

The termination of each signal should consist of 220 ohms (to +5V) and 330 ohms (to GROUND) which is defined in SCSI.

2-3 SCSI ID

Communication on the SCSI bus is always performed between two SCSI devices. One device acts as an initiator which originates an operation with sending commands and the other device acts as a target which receives the command and executes it. Each SCSI device has a SCSI ID bit assigned as shown in below. SCSI ID = 7 has the highest priority and 0 has the lowest.

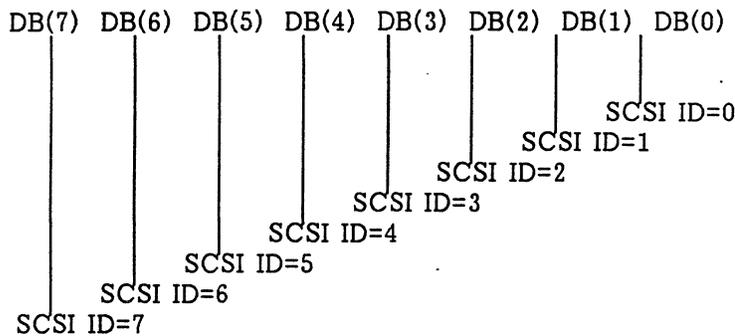


Fig 2-3.1 SCSI ID Bits

2-4 SCSI BUS SIGNALS

There are a total of 18 signals, 9 of which are used for control signal lines and the remaining 9 are used for data signal lines.

As each signal is active low on the SCSI bus, hereafter, "1" stands for low(true) and "0" stands for high(false).

SCSI signals are described as follows.

(1) DB(7) to DB(0), DB(P) <Data Bus>

Bidirectional eight data-bit (DB(7) to DB(0)) plus an odd parity bit (DB(P)).

DB(7) is the most significant bit (MSB) and DB(0) is the LSB.

The meaning of data bus differs from each phase and defined as follows.

(a) ARBITRATION phase

To gain the control of SCSI bus, the SCSI device asserts a single bit corresponding to its SCSI ID.

DB(7) has the highest priority during this phase and the priority decreases downward to DB(0).

During ARBITRATION phase, DB(P) is not valid.

(b) SELECTION and RESELECTION phase

Used to output the SCSI ID of initiator and/or target.

(c) INFORMATION TRANSFER phase

Used to transfer command, status and message between initiator and target.

DB(P) is an odd parity bit used to confirm the propriety of transfer data.

(2) BSY <Busy>

Used by either initiator and target to indicate that the SCSI bus is being busy.

(3) SEL <Select>

Used by the initiator to select a target and used by the target to reselect an initiator.

(4) C/D <Control/Data>

Used by the target to indicate whether the information is a control data (command, status and message) or data.

"1" shows control and "0" shows data.

(5) I/O <Input/Output>

Used by the target to indicate the direction of data transfer with respect to the initiator.

"1" shows direction from the target to initiator and "0" shows direction from the initiator to target.

Also this signal is used to distinguish between SELECTION and RESELECTION phase.

"0" means SELECTION phase and "1" means RESELECTION phase.

(6) MSG <Message>

Used by the target to indicate the MESSAGE phase.

"1" shows the MESSAGE phase.

(7) REQ <Request>

Driven by the target used for the request of REQ/ACK handshake.

(8) ACK <Acknowledge>

Driven by the initiator used for the acknowledge of REQ/ACK handshake.

(9) ATN <Attention>

Used by the initiator to indicate the ATTENTION condition.

(10) RST <Reset>

An OR-tied signal that indicates the RESET condition.

2-5 SIGNAL SOURCES IN EACH PHASE

Table 2-5.1 shows the SCSI devices as signal source for each phase on the SCSI bus.

BUS PHASE	SIGNALS				
	BSY	SEL	C/D, I/O, MSG REQ	ATN ACK	DB(7), DB(0) DB(P)
BUS FREE	NONE	NONE	NONE	NONE	NONE
ARBITRATION	ALL	WIN	NONE	NONE	SCSI ID
SELECTION	INIT & TARG	INIT	NONE	INIT	INIT
RESELECTION	INIT & TARG	TARG	TARG	INIT	TARG
COMMAND	TARG	NONE	TARG	INIT	INIT
DATA IN	TARG	NONE	TARG	INIT	TARG
DATA OUT	TARG	NONE	TARG	INIT	INIT
STATUS	TARG	NONE	TARG	INIT	TARG
MESSAGE OUT	TARG	NONE	TARG	INIT	INIT
MESSAGE IN	TARG	NONE	TARG	INIT	TARG

NONE : Not used by any SCSI device
 ALL : Driven by all SCSI devices arbitrating
 WIN : Driven by the SCSI device which wins the ARBITRATION phase
 SCSI ID : DATA BUS bits corresponding to the SCSI ID in ARBITRATION
 INIT & TARG : Used by initiator, target, or both
 INIT : Used by initiator device
 TARG : Used by target device

Table 2-5.1 Bus Phase and Signal Sources

CHAPTER 3 LOGICAL CHARACTERISTICS

3-1 SCSI BUS PHASES

There are eight phases defined below, however note that no more than one phase shall occur at any time.

In the following descriptions, signals are "0" (false) unless otherwise notes.

Phase (5) through (8) are termed the INFORMATION TRANSFER phase.

- (1) BUS FREE phase
- (2) ARBITRATION phase
- (3) SELECTION phase
- (4) RESELECTION phase
- (5) COMMAND phase
- (6) DATA phase
- (7) STATUS phase
- (8) MESSAGE phase

3-1.1 BUS FREE Phase

This phase is used to indicate that the SCSI bus is not being used by any SCSI devices. The SCSI device shall detect BUS FREE phase when the RST, BSY and SEL signals are both "0" for at least 400 ns (BUS SETTLE DELAY).

When BUS FREE phase is detected, the SCSI device must release all asserting signals (set to "0") within 800 ns (BUS CLEAR DELAY).

If the SCSI device requires more than 400 ns to detect the BUS FREE phase, the SCSI device must release all signals within 800 ns (BUS CLEAR DELAY) minus BUS FREE detection time plus 400 ns (BUS SETTLE DELAY).

Namely the maximum time to clear the SCSI bus is 1.2 us (BUS SETTLE DELAY + BUS CLEAR DELAY) from detecting BUS FREE phase.

The CD-ROM normally shifts to BUS FREE phase after one of following occurrences.

- a. After RESET condition
- b. After BUS DEVICE RESET message is received by the CD-ROM
- c. After ABORT message is received by the CD-ROM
- d. After DISCONNECT message is transferred from the CD-ROM to the initiator
- e. After COMMAND COMPLETE message is transferred from the CD-ROM to the initiator

However note that at any time, the CD-ROM may release BSY signal and start BUS FREE phase to indicate a fatal error condition (unexpected disconnect).

In this case, it is recommended that the initiator should issue REQUEST SENSE command to obtain sense data of which the CD-ROM may hold.

3-1.2 ARBITRATION Phase

This phase determines which SCSI device gains control of the SCSI bus to become the initiator or target.

Although this phase is optional, it shall be implemented if multiple initiators are connected and/or the system used the DISCONNECT process.

The ARBITRATION procedure is as follows.

- 1) Wait for the BUS FREE phase to occur.
- 2) After detecting BUS FREE phase, the SCSI device asserts both BSY signal and its own SCSI ID during 800 ns (BUS FREE DELAY) to 1.8 us (BUS SET DELAY). Note that only one DATA BUS bit (Corresponding to its SCSI ID) shall be asserted and other seven DATA BUS bits should be released (not driven). The DB(P) (parity) is not valid during this phase and may be released or driven to true value.

- 3) After at least 2.2 us (ARBITRATION DELAY) from asserting BSY signal, examine the DATA BUS.
 - a. If a higher priority SCSI ID is detected, the SCSI device immediately releases all signals and returns to step (1). (Lost ARBITRATION)
 - b. If no higher priority SCSI ID is detected, the SCSI device asserts SEL signal to indicate that it gains the control of SCSI bus. (Win ARBITRATION)
 - c. If the SEL signal becomes "1", the SCSI device executing ARBITRATION phase must release all signals within 800 ns (BUS CLEAR DELAY) and should return to step (1). (Lost ARBITRATION)
- 4) The SCSI device which wins the ARBITRATION waits at least 1.2 us (BUS CLEAR DELAY + BUS SETTLE DELAY) after asserting SEL signal before proceeding to next phase and then completes the ARBITRATION phase.

3-1.3 SELECTION Phase

This phase is used by the initiator to select a target.

During this phase, I/O signal should be set to "0" to distinguish this phase from RESELECTION phase.

When ARBITRATION phase is not used, the SELECTION procedure should be as follows.

- 1) The initiator waits for the BUS FREE phase to occur and then waits more than 800 ns (BUS FREE DELAY).
- 2) The initiator sets the DATA BUS to a values that corresponds to target's SCSI ID.
To identify its own SCSI ID, the initiator's SCSI ID might be output together with the target's SCSI ID.
Note that the initiator shall drive all DATA BUS bits unlike the ARBITRATION phase.
Also the initiator must assure the DB(P) signal if the parity check is permitted.

When ARBITRATION phase is used, the SELECTION procedure should be as follows.

- 1) After completion of ARBITRATION phase (the initiator must wait at least 1.2 us after asserting BSY and SEL signals), the initiator set the DATA BUS to an OR value of the target and own SCSI ID.
It is not an error to set only target's SCSI ID if there is a single initiator and if DISCONNECT process is not used.
- 2) The initiator waits at least 90 ns (two DESKEW DELAYs) and releases the BSY signal.
- 3) The initiator examines the response from the target after 400 ns (BUS SETTLE DELAY) from releasing the BSY signal.

The target responds to the SELECTION phase as described below regardless the implementation of ARBITRATION phase.

- 1) The target checks whether the SEL signal and its SCSI ID bit on DATA BUS is set to "1" and the BSY and I/O signal are set to "0" for at least 400 ns (BUS SETTLE DELAY).
The selected target then examines the DATA BUS to determine the SCSI ID of the selecting initiator.
- 2) The target asserts the BSY signal to respond to the initiator within a maximum of 200 us (SELECTION ABORT TIME).
If more than two SCSI ID bits are detected on the DATA BUS or a parity error is detected, the target does not respond to the SELECTION phase.
- 3) After at least 90 ns (two DESKEW DELAYs) after detecting the BSY signal set to "1", the initiator sets the SEL signal to "0" and completes the SELECTION phase.

3-1.4 RESELECTION Phase

This phase is used by the target to reconnect (select) the initiator to resume the suspended operation.

During this phase, I/O signal should be set to "1" to distinguish this phase from SELECTION phase.

The target first executes ARBITRATION phase to gain the control of the SCSI bus and then performs following procedure.

- 1) Completing the ARBITRATION phase (the target waits at least 1.2 us after asserting BSY and SEL signals), the target sets the DATA BUS to an OR value of the initiator and its own SCSI ID.

At the same time, the target asserts the I/O signal to indicate RESELECTION phase.

- 2) The target waits at least 90 ns (two DESKEW DELAYs) and releases the BSY signal.

The initiator should respond to the RESELECTION phase as described below.

- 1) The initiator checks whether the SEL and I/O signal and its SCSI ID bit on DATA BUS is set to "1" and the BSY signal is set to "0" for at least 400 ns (BUS SETTLE DELAY).

The reselected initiator then examines the DATA BUS to determine the SCSI ID of the reselecting target.

- 2) The initiator asserts the BSY signal to respond to the target within a maximum of 200 us (SELECTION ABORT TIME).

If more than two SCSI ID bits are detected on the DATA BUS or a parity error is detected, the initiator should not respond to the RESELECTION phase.

- 3) After detecting the BSY signal set to "1", the target also asserts the BSY signal and waits at least 90 ns (two DESKEW DELAYs) and then sets the SEL signal to "0".

- 4) After the initiator detects the BSY signal set to "0", it releases the BSY signal. Hereafter, the BSY signal is asserted by the target until SCSI bus link is completed.

If no response is detected for 250 ms (recommended SELECTION TIME-OUT DELAY) from the initiator, the CD-ROM shifts to BUS FREE phase and then retries the RESELECTION phase.

3-1.5 INFORMATION TRANSFER Phase

This phase allows to transfer command, data, status and message via DATA BUS. Types and directions of the information is distinguished by the C/D, I/O and MSG signals which are driven by the target as shown in Table 3-1.5.1.

Signal			Phase Name	Direction of transfer
MSG	C/D	I/O		
0	0	0	DATA OUT	Initiator to Target
0	0	1	DATA IN	Target to Initiator
0	1	0	COMMAND	Initiator to Target
0	1	1	STATUS	Target to Initiator
1	0	0	Reserved	
1	0	1	Reserved	
1	1	0	MESSAGE OUT	Initiator to Target
1	1	1	MESSAGE IN	Target to Initiator

Table 3-1.5.1 INFORMATION TRANSFER phase

INFORMATION TRANSFER phase uses REQ/ACK handshakes to control the information transfer and the CD-ROM supports asynchronous information transfer mode.

During INFORMATION TRANSFER phase, the BSY signal is set to "1" and the SEL signal is set to "0".

Three control signals, C/D, I/O and MSG, are valid for 400 ns (BUS SETTLE DELAY) before the assertion of first REQ signal and they are maintained until the negation of the last ACK signal.

The target controls the direction of data transfer by the I/O signal.

If the I/O signal is "1" (target to initiator), the procedure shall be as follows.

- a. The target drives the DATA BUS to desired value.
- b. The target waits at least 55 ns (DESKEW DELAY + CABLE SKEW DELAY) and then asserts the REQ signal.
- c. The initiator reads the DATA BUS after the REQ signal goes to "1" and then asserts the ACK signal after a minimum of 10 ns after detection of the REQ signal set to "1" to respond to the target.
- d. The target sets the REQ signal to "0" when the ACK signal goes to "1".
The target may change the DATA BUS signal at this point and so the initiator should read the DATA BUS before asserting the ACK signal.
- e. The initiator negates the ACK signal after minimum of 10 ns after detection of the REQ signal negation.
After the ACK signal is set to "0", the target may return to step a) above and may continue data transfer.

If the I/O signal is "0" (initiator to target), the procedure shall be as follows.

- a. The target asserts the REQ signal to request the initiator to transfer data.
 - b. The initiator drives the DATA BUS to desired value.
 - c. The initiator waits at least 55 ns (DESKEW DELAY + CABLE SKEW DELAY) and then asserts the ACK signal to respond to the target.
 - d. The target reads the DATA BUS after the ACK signal goes to "1" and then negates the REQ signal to respond to the initiator.
 - e. The initiator sets the ACK signal to "0" after a minimum 10 ns from detecting the negation of the REQ signal.
- After the ACK signal is set to "0", the target may return to step a) above and may continue data transfer.

The CD-ROM implements following REQ/ACK handshake time-out procedure.

During any INFORMATION TRANSFER phase, if the CD-ROM waits about 30 seconds after asserting of REQ signal and there has been no ACK signal response (assertion) from the initiator, it aborts the command and shifts to BUS FREE phase (unexpected disconnect).

In this case, the CD-ROM prepares a sense data of INTERNAL TARGET FAILURE.

The following restrictions are applied to the SCSI bus signals between two INFORMATION TRANSFER phases.

- 1) The BSY, SEL, REQ and ACK signals shall not change.
- 2) The C/D, I/O, MSG and DATA BUS signals may change.
- 3) The ATN and RST signal may change within the range specified in each section.

3-2 SCSI BUS CONDITION

There are two asynchronous conditions, ATTENTION condition and RESET condition, and they can force to change the phase sequence.

3-2.1 ATTENTION Condition

ATTENTION condition indicates that the initiator has a message to inform the target. The initiator can create this condition by asserting the ATN signal at any time except ARBITRATION and BUS FREE phase.

Upon detection of the ATN signal assertion, the target enters MESSAGE OUT phase to receive the message.

To transfer more than one message byte, the initiator shall keep the ATN signal asserted until the last byte.

Normally the initiator should negate the ATN signal while the REQ signal is "1" and the ACK signal is "0" during the last REQ/ACK handshake of the MESSAGE OUT phase.

Basically the target continues MESSAGE OUT phase until the ATN signal goes to "0", except message rejection.

If the CD-ROM receives all message successfully, it shifts to any INFORMATION TRANSFER phase other than MESSAGE OUT phase or shifts to BUS FREE phase immediately.

Regarding message parity error handling, refer to 4-2 COMMENTS ON MESSAGE CONTROL.

The CD-ROM responds to the MESSAGE OUT phase as follows.

- 1) If the ATN signal goes true during SELECTION phase, the CD-ROM enters MESSAGE OUT phase after SELECTION phase.
- 2) If the ATN signal goes true during RESELECTION phase, the CD-ROM enters MESSAGE OUT phase after it has sent its IDENTIFY message to the initiator.

- 3) If the ATN signal goes true during COMMAND or STATUS phase, the CD-ROM enters MESSAGE OUT phase after transferring all COMMAND/STATUS data.
- 4) If the ATN signal goes true during DATA phase except DATA IN phase due to READ command execution (burst mode DATA IN phase), the CD-ROM executes DATA IN phase until last byte and then enters MESSAGE OUT phase.
- 5) If the ATN signal goes true during DATA IN phase due to READ command execution (burst mode DATA IN phase), the CD-ROM enters MESSAGE OUT phase on block boundary.
- 6) If ATN signal goes true during MESSAGE IN phase, the CD-ROM enters MESSAGE OUT phase before it sends another message.

3-2.2 RESET Condition

The RESET condition has the highest priority over any phases and conditions and it resets all SCSI devices and clears the SCSI bus.

Any SCSI device can create this condition by asserting the RST signal for a minimum 25 us (RESET HOLD TIME) and all SCSI device shall shift to BUS FREE phase by releasing all SCSI bus signals except the RST signal.

Upon the detection of RESET condition, the CD-ROM implements "Hard Reset" alternative as the SftRe bit of INQUIRY data indicates and it implements;

- 1) Abort the current command execution and clear the command queue if exist.
- 2) Release all reservations.
- 3) Sets all operation mode to their default value.

Namely the CD-ROM implements exactly same operation as power-on reset.

3-3 SCSI BUS PHASE SEQUENCE

Basically the phase transition is controlled by the target except the ATTENTION and RESET condition.

The RESET condition has the highest priority and it aborts any phase and the BUS FREE phase follows always.

The initiator can create ATTENTION condition at any time by asserting the ATN signal.

In the case of NON-ARBITRATION system (SCSI-2 does not recommend), the normal progression is from BUS FREE phase to SELECTION phase, from SELECTION phase to one or more INFORMATION TRANSFER phases.

In the case of ARBITRATION system, phase shifts from BUS FREE phase to ARBITRATION phase, then shifts to either SELECTION or RESELECTION phase and one or more INFORMATION TRANSFER phases follow.

In both cases, there are no restriction on the phase transition during INFORMATION TRANSFER phase, so the same phase may be implemented repeatedly.

Normally, the final INFORMATION TRANSFER phase is MESSAGE IN phase where DISCONNECT or COMMAND COMPLETE message is transferred and the BUS FREE phase follows.

However note that the CD-ROM may shift to BUS FREE phase from any phase upon a detection of fatal error (unexpected disconnect error).

CHAPTER 4 MESSAGE

The message system (bidirectional information) is used to control the SCSI bus phase sequence between the initiator and the target.

Message is transferred during either MESSAGE IN phase or MESSAGE OUT phase and it may be one, two, or multiple bytes in length.

The first byte of the message is called message code and it indicates the function of the message.

Table 4.1 shows the message format and Table 4.2 shows the message code/name that Toshiba CD-ROM supports.

Message Code	Message Format
00h	One-byte message (COMMAND COMPLETE)
01h	Extended message
02h - 1Fh	One-byte message
20h - 2Fh	Two-byte message
30h - 7Fh	Reserved
80h - FFh	One-byte message (IDENTIFY)

Table 4.1 Message Format

Code	Message Name	Target to Initiator	Initiator to Target
00h	COMMAND COMPLETE	Yes	
01h	EXTENDED MESSAGE		Yes
02h	SAVE DATA POINTER	Yes	
03h	RESTORE POINTERS	Yes	
04h	DISCONNECT	Yes	
05h	INITIATOR DETECTED ERROR		Yes
06h	ABORT		Yes
07h	MESSAGE REJECT	Yes	Yes
08h	NO OPERATION		Yes
09h	MESSAGE PARITY ERROR		Yes
0Ah	LINKED COMMAND COMPLETE	Yes	
0Bh	LINKED COMMAND COMPLETE (WITH FLAG)	Yes	
0Ch	BUS DEVICE RESET		Yes
0Dh - 11h	Not supported one-byte message		
12h - 1Fh	Reserved one-byte message		
20h - 23h	Not supported two-byte message		
24h - 2Fh	Reserved two-byte message		
30h - 7Fh	Reserved		
80h - FFh	IDENTIFY	Yes	Yes

Table 4.2 Message Code/Name List

4-1 DETAILS OF MESSAGES

This section describes the messages that the CD-ROM supports in detail.

Meaning of symbols used in this section is as follows.

I → T : Message sent from initiator to CD-ROM

I ← T : Message sent from CD-ROM to initiator

I ↔ T : Message sent bidirectionally between initiator and target

4-1.1 COMMAND COMPLETE Message (I <-- T)

Sent from the CD-ROM to the initiator to indicate that the execution of a single command or the last command of a series of linked commands has completed and valid status has been transferred to the initiator.

The status byte transferred prior to this message shows whether the command has been completed successfully or not.

After sending this message, the CD-ROM goes to BUS FREE phase by releasing the BSY signal and terminates the command execution.

4-1.2 EXTENDED Message (I <-> T)

Table 4-1.2.1 shows the EXTENDED message format and Table 4-1.2.2 shows the EXTENDED message code/name.

Byte	Value	Description
00	01h	Message code
01	N	Extended message length
02	y	Extended message code
03 - N+1	x	Extended message arguments

Table 4-1.2.1 EXTENDED Message Format

Extended (y) Message Code	Message Name	Target to Initiator	Initiator to Target
00h	MODIFY DATA POINTER	(Yes)	
01h	SYNCHRONOUS DATA TRANSFER REQUEST	(Yes)	Yes
02h	Reserved (EXTENDED IDENTIFY)	(Yes)	(Yes)
03h	WIDE DATA TRANSFER REQUEST	(Yes)	Yes
04h - 7Fh	Reserved		
80h - FFh	Vendor Specific (Not used)		

Table 4-1.2.2 EXTENDED Message Code/Name List

- 1) MODIFY DATA POINTER Message (I <-- T)
The CD-ROM does not send this message.
- 2) SYNCHRONOUS DATA TRANSFER REQUEST Message (I <-> T)
Since the CD-ROM only supports asynchronous data transfer mode, it returns MESSAGE REJECT message after receiving all bytes of this message.
- 3) EXTENDED IDENTIFY (I <-> T) .. (SCSI-1 Only)
This message is only defined in SCSI-1 and deleted in SCSI-2.
The CD-ROM returns MESSAGE REJECT message to this message.
- 4) WIDE DATA TRANSFER REQUEST (I <-> T)
Since the CD-ROM only supports eight-bit data transfer mode, it returns MESSAGE REJECT message after receiving all bytes of this message.

4-1.3 SAVE DATA POINTER Message (I <-- T)

Used by the CD-ROM to direct the initiator to store the active data pointer into the saved data pointer prepared for CD-ROM.

Normally the CD-ROM sends this message prior to sending DISCONNECT message during READ command execution.

However note that it does not send this message for first disconnection (after COMMAND phase) since the active data pointer is equal to the saved data pointer at this moment.

The CD-ROM may request the initiator to restore the active data pointer from the saved data pointer by sending RESTORE POINTERS message.

Also the active data pointer should be restored from the saved pointer for IDENTIFY message sent from the CD-ROM during reconnection (implied RESTORE POINTERS).

4-1.4 RESTORE POINTERS Message (I <-- T)

Used by the CD-ROM to direct the initiator to restore the active pointers from most recently saved pointers prepared for CD-ROM (command pointer, status pointer and data pointer).

Command and status pointer shall be restored to the beginning value of current command being executed.

Data pointer shall be restored to the most recently saved value which was stored by last SAVE DATA POINTER message or to the beginning value of current command being executed if SAVE DATA POINTER message has not been issued.

This message is only sent if the initiator has sent IDENTIFY message after SELECTION phase.

For further details, refer to 4-2 COMMENTS ON MESSAGE CONTROL.

4-1.5 DISCONNECT Message (I <-- T)

Used by the CD-ROM to notify the initiator to disconnect current SCSI bus connection, but later the CD-ROM will reconnect to complete the suspended command execution.

After sending this message successfully, the CD-ROM releases the BSY signal and goes to BUS FREE phase.

However note that this message does not direct the initiator to save the active pointers.

Regarding disconnect process, refer to 5-1.2 DISCONNECT and RECONNECT Process.

4-1.6 INITIATOR DETECTED ERROR Message (I --> T)

Used by the initiator to inform that an error occurred during INFORMATION TRANSFER phase and to request retry operation.

Upon receiving this message and if a retry operation is possible, the CD-ROM normally sends RESTORE POINTERS message at first and then re-execute the SCSI bus phase preceding this MESSAGE OUT phase.

For further details, refer to 4-2 COMMENTS ON MESSAGE CONTROL.

The initiator should restore pointers upon the receipt of RESTORE POINTER message. The CD-ROM may reject this request by sending MESSAGE REJECT message if a retry operation is not possible.

4-1.7 ABORT Message (I --> T)

Used by the initiator to request the CD-ROM to abort active command operation plus queued command (if exist).

The CD-ROM shifts to BUS FREE phase following receipt of this message and status or message are not returned.

The CD-ROM only clears the operation related to the initiator which sends this message, that is, the operations related to other initiators are not cleared.

4-1.8 MESSAGE REJECT Message (I <-> T)

Sent from either the initiator or the CD-ROM to indicate that the last received message was invalid or impossible to implement.

If the initiator intends to send this message, it shall assert the ATN signal before the ACK signal of the last message byte is set to "0".

Then the CD-ROM detects this ATTENTION condition and proceeds to MESSAGE OUT phase.

When the CD-ROM intends to send this message in response to the message from the initiator, it shifts to MESSAGE IN phase after negation of the ACK signal during MESSAGE OUT phase.

Note that during multiple-message transfer such as EXTENDED message, the MESSAGE OUT phase may be aborted immediately (start MESSAGE IN phase) when the CD-ROM decides to reject the message.

4-1.9 NO OPERATION Message (I --> T)

Used by the initiator to notify that the initiator currently has no valid message to send.

4-1.10 MESSAGE PARITY ERROR Message (I --> T)

Used by the initiator to indicate that the last received message had a parity error.

If the initiator intends to send this message, it must assert the ATN signal prior to the negation of the ACK signal for which a parity error was detected.

The CD-ROM enters MESSAGE OUT phase in response to the ATTENTION condition, so the initiator can send MESSAGE PARITY ERROR message.

Then the CD-ROM re-executes MESSAGE IN phase to transfer entire same message to the initiator.

Note that the initiator should not send this message following an INFORMATION TRANSFER phase other than MESSAGE IN phase.

In this case, the CD-ROM goes to BUS FREE phase (unexpected disconnect).

4-1.11 LINKED COMMAND COMPLETE Message (I <-- T)

Used by the CD-ROM to indicate that the execution of a linked command (Link bit = 1) with Flag bit set to zero has completed and valid status byte has been sent to the initiator.

The initiator shall confirm the status bytes and then updates the pointers to the initial value for the next linked command.

4-1.12 LINKED COMMAND COMPLETE (WITH FLAG) Message (I <-- T)

Used by the CD-ROM to indicate that the execution of a linked command (Link bit = 1) with Flag bit set to one has completed and valid status byte has been sent to the initiator.

The initiator shall confirm the status bytes and then updates the pointers to the initial value for the next linked command.

4-1.13 BUS DEVICE RESET Message (I --> T)

Used by the initiator to direct the CD-ROM to abort the current operation and to do reset.

Upon receipt of this message, the CD-ROM clears all operations for all initiators and shifts to BUS FREE phase.

All status or message information are lost and the CD-ROM performs the same operation as RESET condition (hard RESET alternative).

For further details, refer to 3-2.2 RESET Condition.

4-1.14 IDENTIFY Message (I <-> T)

Used by either the initiator or the CD-ROM to establish the SCSI bus route between them.

Table 4-1.14.1 shows the IDENTIFY message format.

	7	6	5	4	3	2	1	0
00	1	DiscPriv	LUNTAR	Reserved		LUNTRN		

Table 4-1.14.1 IDENTIFY Message Format

The DiscPriv (Disconnect Privilege) bit of one indicates that the initiator grants the CD-ROM the privilege of disconnecting.

The DiscPriv bit of zero indicates that the CD-ROM shall not perform disconnect.

This bit is only defined for the initiator and it is set to zero when the CD-ROM sends this message to the initiator.

LUNTAR (Logical unit target) bit is not used and shall be set to zero.

LUNTRN (Logical unit number target routine number) field specifies a logical unit number.

Regarding the response on LUNTRN, refer to 5-1.5 Selection of Invalid Logical Unit.

The initiator may send one or more IDENTIFY messages during a connection, however it should not send a second IDENTIFY message with a different value in LUNTRN field. (It is allowed to change DiscPriv bit.)

If the CD-ROM receives such invalid message, it goes to BUS FREE phase (unexpected disconnect).

Normally this message is used as shown in below.

1) Used by the initiator

During the SELECTION phase, the initiator asserts the ATN signal to request MESSAGE OUT phase.

Then the CD-ROM enters MESSAGE OUT phase and the initiator sends IDENTIFY message (DiscPriv bit set to one or zero).

2) Used by the CD-ROM

The CD-ROM sends IDENTIFY message (DiscPriv bit set to zero) during the MESSAGE IN phase following the RESELECTION phase.

The initiator should restore the active pointers from the saved pointer upon receipt of this message. (Implied RESTORE POINTERS)

When the initiator is busy and it can not accept the reconnect request from the CD-ROM, it can postpone the request by following procedure. (TOSHIBA unique)

- a. The initiator asserts the ATN signal before the negation of the ACK signal of IDENTIFY message from the CD-ROM.
- b. The CD-ROM enters MESSAGE OUT phase and the initiator sends MESSAGE REJECT message during this phase.
- c. The CD-ROM shifts to BUS FREE phase and then retries reconnect process later.

4-2 COMMENTS ON MESSAGE CONTROL

The mandatory message for initiator in SCSI-1 was COMMAND COMPLETE message. An initiator that supports only COMMAND COMPLETE message can control the CD-ROM and SCSI-1 allows such initiator, while SCSI-2 requires that following message should be supported by the initiator.

COMMAND COMPLETE
 INITIATOR DETECTED ERROR
 MESSAGE REJECT
 MESSAGE PARITY ERROR
 IDENTIFY

The initiator indicates its ability to accommodate messages other than COMMAND COMPLETE by asserting ATN signal during SELECTION phase.

The CD-ROM indicates its ability by responding to this ATTENTION condition.

The first message sent by the initiator after SELECTION phase shall be IDENTIFY, ABORT or BUS DEVICE RESET message.

If the first message is IDENTIFY message, it may be immediately followed by other messages such as SYNCHRONOUS DATA TRANSFER REQUEST message.

If any other message is sent as first message, the CD-ROM goes to BUS FREE phase immediately (unexpected disconnect).

On the other hand, after RESELECTION phase, the CD-ROM always sends IDENTIFY message to establish the physical path again.

The CD-ROM only sends COMMAND COMPLETE, LINKED COMMAND COMPLETE or LINKED COMMAND COMPLETE WITH FLAG message when the IDENTIFY message is not received.

Upon the detection of parity error, the CD-ROM executes followings in accordance with the phase in which the parity error was detected.

a) MESSAGE OUT phase

The CD-ROM continues to receive entire messages until the negation of the ATN signal and then re-asserts the REQ signal without changing the phase.

The initiator shall transfer all messages same as previous and when re-sending multiple messages, it shall assert the ATN signal prior to the first ACK signal assertion.

If this retry operation fails (i.e. detect parity error again), the CD-ROM creates CHECK CONDITION status when the CD-ROM knows the addressed LUN through IDENTIFY message or CDB at this moment.

If the LUN is not known, the CD-ROM goes to BUS FREE phase (unexpected disconnect).

b) COMMAND phase

When the IDENTIFY message is sent, the CD-ROM shifts to MESSAGE IN phase and sends RESTORE POINTERS message and then creates COMMAND phase again.

The initiator shall restore the command pointer and shall send the entire command same as previous.

If retry operation fails, the CD-ROM returns CHECK CONDITION status with additional sense code set to SCSI Parity Error.

When the IDENTIFY message is not sent, the CD-ROM goes to BUS FREE phase immediately since it is not allowed to send RESTORE POINTERS message and it does not know the LUN in this case.

c) DATA OUT phase

When the IDENTIFY message is sent, the CD-ROM shifts to MESSAGE IN phase and sends RESTORE POINTERS message and then creates DATA OUT phase again.

The initiator shall restore the data pointer and shall send the data again.

If retry operation fails, the CD-ROM returns CHECK CONDITION status with additional sense code set to SCSI Parity Error.

When the IDENTIFY message is not sent, the CD-ROM also returns CHECK CONDITION status since LUN is recognized through CDB.

CHAPTER 5 COMMAND

An operation request to the CD-ROM is originated by a command transferred from the initiator to the CD-ROM during the COMMAND phase.

The CD-ROM normally sends one status byte to the initiator after completion of the requested operation and this status byte indicates whether the command completed successfully or not.

Especially when the CHECK CONDITION status is returned, the initiator can investigate the detailed error information by issuing the REQUEST SENSE command.

SCSI-2 (SCSI-1) defines reserved bits, field, bytes for each command respectively. The initiator shall issue a command with reserved bit set to zero and if the CD-ROM receives a command in which reserved bit is not zero, it returns CHECK CONDITION status with sense key set to ILLEGAL REQUEST.

The command consists of several bytes called CDB (Command Descriptor Block). First byte of the CDB is a operation code which consists of a group code field and a command code field.

The three bit group code specifies the group of command codes (eight groups) and it specifies the length of the CDB as well.

The CD-ROM supports following command groups.

- Group 0 command -- six bytes command
- Group 1 command -- ten bytes command
- Group 2 command -- ten bytes command
- Group 5 command -- twelve bytes command
- Group 6 command -- ten byte command (Vendor specific command)

Table 5.1 through 5.4 show the typical format of each command group.

	7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Unit Number			(MSB)				
02	Logical Block Address (if required)							
03	(LSB)							
04	Transfer Length (if required) Parameter List Length (if required) Allocation Length (if required)							
05	Control Byte							

Table 5.1 Group 0 Command Typical Format

	7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Unit Number			Reserved			RelAdr	
02	(MSB)							
03	Logical Block Address (if required)							
04								
05								
06	Reserved							
07	(MSB)							
08	Transfer Length (if required) Parameter List Length (if required) Allocation Length (if required)							
09	(LSB)							
09	Control Byte							

Table 5.2 Group 1, 2 Command Typical Format

	7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Unit Number			Reserved			RelAdr	
02	(MSB)							
03	Logical Block Address (if required)							
04								
05								
06	(MSB)							
07	Transfer Length (if required) Parameter List Length (if required) Allocation Length (if required)							
08	(LSB)							
09	Reserved							
10	Reserved							
11	Control Byte							

Table 5.3 Group 5 Command Typical Format

	7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Unit Number			Reserved			Parameter Bit	
02	(MSB)							
03	Object Address (if required)							
04								
05								
06	Reserved							
07	Reserved							
08	Reserved							
09	Control Byte							

Table 5.4 Group 6 Command Typical Format

Operation Code

The three bit are used for group code and five bit are used for command code. Thus eight groups and thirty-two codes are specified and a total of 256 operation codes exist.

Logical Unit Number

This field assigns an encoded identifier for the logical unit which is defined as a peripheral device addressable through the target.

The CD-ROM ignores the logical unit number specified in CDB if an IDENTIFY message was received.

Since the SCSI controller of the CD-ROM is embedded for each device, the CD-ROM does not support the logical unit, so basically this field should be set to 000b.

Logical Block Address

This field indicates the logical block address defined for CD-ROM.

Group 0 command (six-byte command) contains 21 bits addressing and group 1, 2, 5 and 6 command (ten-byte and twelve-byte command) contains 32 bits addressing.

The definition is as follows.

The physical address of CD-ROM is subcode-Q address or CD-ROM header address which is called MSF address (Min, Sec, Frame).

Since the initial 150 blocks (pre-gap area) are not accessible, 00:02:00 in physical expression is defined as the logical beginning of medium and defined as logical block zero.

Also as several blocks lengths are available for CD-ROM, the logical block address is expressed as following formula.

Regarding block length, refer to 5-3.8 MODE SELECT command.

Especially note that in the case of Toshiba vendor unique command (group 6 command) regarding audio, the block length (size) specified with MODE SELECT command is ignored and the Block_Size factor of the formula is set to 1.

$$\text{Logical Block Address} = (\text{Min} \times 60 \times 75 + \text{Sec} \times 75 + \text{Frame} - 150) \times \text{Block_Size}$$

RelAdr Bit (Relative Address Bit)

Set to one indicates that the logical block address is a relative address expressed in two's complement displacement to the previous address.

Note that this bit is only available for several commands in a series of command link.

Transfer Length

This field specifies the amount of data to be transferred between the initiator and CD-ROM, usually the number of logical blocks.

However for several commands, this field has another definition, so see each command description for further information.

Up to 256 blocks can be assigned for six-byte command, and a value of zero indicates maximum 256 blocks.

Up to 65535 (FFFFh) blocks can be transferred by ten-byte command and up to 4294967295 (FFFFFFFFh) blocks can be assigned for twelve-byte command.

In these commands that uses multiple bytes for transfer length, a transfer length of zero indicates that the command shall terminate immediately without error and no data shall be transferred.

Parameter List Length

This field indicates the number of bytes to be transferred during the DATA OUT phase.

The length of zero indicates that no data shall be transferred.

Allocation Length

This field specifies the maximum number of bytes that the initiator has allocated for returned data to be transferred during DATA IN phase.

An allocation length of zero indicates that no data shall be transferred.

The CD-ROM terminates the data transfer when allocation length bytes have been transferred or when all available bytes have been transferred, whichever is less.

Parameter Bit

Several group 6 commands use this field to specify unique function.

For further details, refer to the description of individual commands.

Control Byte

This byte is the last byte of CDB and Table 5.5 shows its format.

	7	6	5	4	3	2	1	0
Last	(TYPE)		Reserved				Flag	Link

Table 5.5 Control Byte Format

a) Bit 0: Link

Link = 0 : Indicates a single command or the last command in series of command linking.

Link = 1 : Indicates a linking command.

The CD-ROM goes to COMMAND phase to execute next linking command after sending INTERMEDIATE status when the current command completed successfully.

b) Bit 1: Flag

Flag bit specifies which message the CD-ROM shall return when a linking command completes without error.

If the Link bit is set to one, the CD-ROM sends one of following messages.

Flag = 0 : LINKED COMMAND COMPLETE message

Flag = 1 : LINKED COMMAND COMPLETE WITH FLAG message

c) Bit 6,7: TYPE

Several commands use this field as Toshiba unique specification.
For further information, refer to the description of individual commands.

5-1 OPERATIONS OF CD-ROM IN SCSI

5-1.1 Command Operation Type

All CD-ROM SCSI commands are classified by the operation in SCSI system into following four groups, TYPE 1 through TYPE 4.

- TYPE 1: Operation which does not implement DISCONNECT and RECONNECT process during command execution and does not implement data transfer phase (DATA IN/OUT phase).
- TYPE 2: Operation which does not implement DISCONNECT and RECONNECT process during command execution and implements data transfer phase.
- TYPE 3: Operation which implements DISCONNECT and RECONNECT process during command execution and does not implement data transfer phase.
- TYPE 4: Operation which implements DISCONNECT and RECONNECT process during command execution and implements data transfer phase.

5-1.2 DISCONNECT and RECONNECT Process

The CD-ROM may execute DISCONNECT and RECONNECT process if the initiator grants the privilege of disconnecting.

DISCONNECT process means that the CD-ROM goes to BUS FREE phase temporary when the CD-ROM determines that there will be a delay to execute the requested command.

On the other hand, RECONNECT process stands for that the CD-ROM tries to reconnect the initiator to resume (complete) the suspended operation.

Owing to these processes, the system throughput is improved since the SCSI bus becomes free and it allows other SCSI devices to use the bus.

The CD-ROM executes following operations for DISCONNECT process.

- 1) Shifts to MESSAGE IN phase and sends DISCONNECT message to inform that current connection is going to be broken.
- 2) Releases the BSY signal and goes to BUS FREE phase.

The RECONNECT process is as follows.

- 1) Performs ARBITRATION phase and gains the control of SCSI bus.
- 2) Performs RESELECTION phase to reconnect the initiator.
- 3) Goes to MESSAGE IN phase and sends IDENTIFY message.

The initiator should restore the active pointers from the saved pointers upon receipt of this message. (implied RESTORE POINTERS)

Note that the CD-ROM executes DISCONNECT process when following conditions are met.

- 1) During SELECTION phase, the initiator identified its SCSI ID by setting the DATA BUS to a value which is the OR of its and target's SCSI ID.
- 2) The initiator sent IDENTIFY message with DiscPriv bit set to one.
- 3) The CD-ROM determines that there will be a delay such as READ command execution which requires physical head positioning.

Usually the CD-ROM executes DISCONNECT process after COMMAND phase, however it may do DISCONNECT again after transferring a part of data.

For instance, the CD-ROM executes DISCONNECT process when the data buffer in the CD-ROM becomes empty or when total amount of transferred data exceeds the specified maximum burst size.

In this case, the CD-ROM sends SAVE DATA POINTER message and DISCONNECT message sequentially and then goes to BUS FREE phase.

5-1.3 TYPE 4 Command Operation

Following shows an example of TYPE 4 command implementation.

- 1) The initiator performs ARBITRATION phase and gains the control of SCSI bus .
- 2) The initiator shifts to SELECTION phase and selects the CD-ROM.
Once the CD-ROM is selected, the CD-ROM controls the phase sequence of SCSI bus except ATTENTION and RESET condition.
- 3) During SELECTION phase, the initiator asserts the ATN signal to inform the CD-ROM that the initiator desires to send a message.
The CD-ROM goes to MESSAGE OUT phase to respond to the ATTENTION condition and the initiator sends IDENTIFY message with DiscPriv bit set to one to grant the privilege of disconnecting.
- 4) The CD-ROM proceeds to COMMAND phase and receives command descriptor blocks (CDB) from the initiator.
- 5) The CD-ROM shifts to MESSAGE IN phase and sends DISCONNECT message.
- 6) The CD-ROM releases the BSY signal and goes to BUS FREE phase while it starts the operation requested by the command.
- 7) After the completion of the operation, the CD-ROM performs ARBITRATION phase.
- 8) Winning the ARBITRATION phase, the CD-ROM goes to RESELECTION phase to select the initiator.
- 9) The CD-ROM goes to MESSAGE IN phase and sends IDENTIFY message.
The initiator should restore the active pointers from the saved pointers upon receipt of this message.
- 10) The CD-ROM shifts to DATA IN phase and transfer required data.
As mentioned in 5-1.2 DISCONNECT and RECONNECT Process, the CD-ROM may execute DISCONNECT process during data transfer.
- 11) The CD-ROM goes to STATUS phase and returns status byte to the initiator.
This status byte shows the results whether the command completed successfully or not.
- 12) The CD-ROM shifts to MESSAGE IN phase and sends COMMAND COMPLETE message.
- 13) After sending the message, the CD-ROM releases the BSY signal to create BUS FREE phase and terminates the operation of TYPE 4 command.

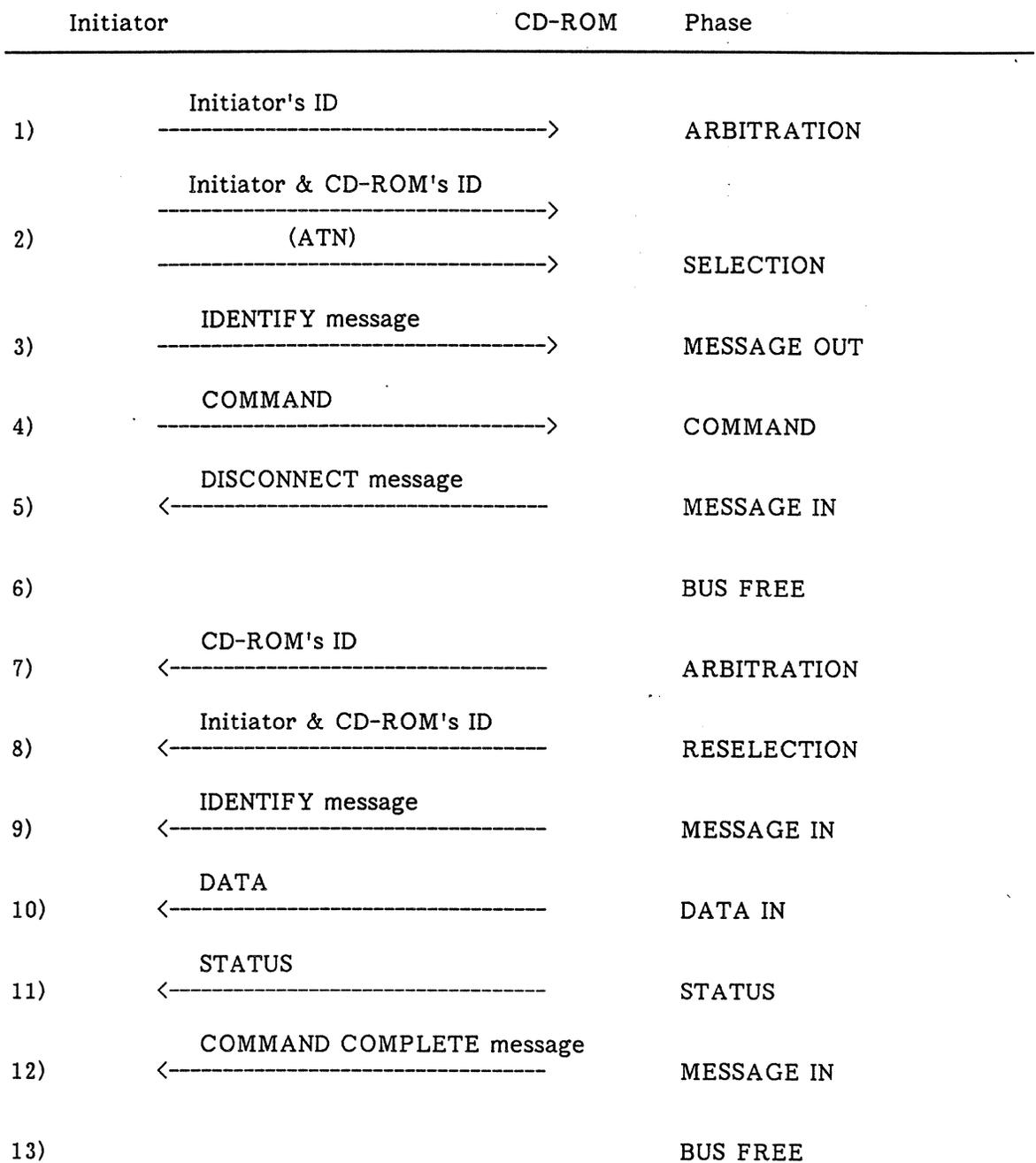


Fig 5-1.3.1 TYPE 4 Command Operation Example

5-1.4 Linked Command Operation

The command link function provides a means to execute multiple commands successively and also relative addressing is available for a linking command. Upon the completion of current linked command, the CD-ROM automatically proceeds to COMMAND phase to execute next linked command.

RelAdr (Relative address) bit of one indicates relative addressing which means that the logical block address in current CDB is defined as a relative block address to the last logical block address.

LINKED COMMAND COMPLETE or LINKED COMMAND COMPLETE WITH FLAG message is sent to the initiator to indicate that a linked command completes successfully.

If a linked command does not complete successfully, the CD-ROM executes followings.

- 1) Goes to STATUS phase and sends CHECK CONDITION status instead of INTERMEDIATE status.
- 2) Goes to MESSAGE IN phase and sends COMMAND COMPLETE message regardless of the Flag bit.
- 3) Goes to BUS FREE phase and does not execute subsequent linking command.

Following shows an example of linked command (two TYPE 1 command) implementation.

- 1) The initiator performs ARBITRATION phase and gains the control of SCSI bus .
- 2) The initiator shifts to SELECTION phase and selects the CD-ROM.
Once the CD-ROM is selected, the CD-ROM controls the phase sequence of SCSI bus except ATTENTION and RESET condition.
- 3) During SELECTION phase, the initiator asserts the ATN signal to inform the CD-ROM that the initiator desires to send a message.
The CD-ROM goes to MESSAGE OUT phase to respond the ATTENTION condition and the initiator sends IDENTIFY message with DiscPriv bit set to one to grant the privilege of disconnecting.
- 4) The CD-ROM proceeds to COMMAND phase and receives command descriptor blocks (CDB) from the initiator.
Suppose the Link bit in CDB is set to one in this case.
- 5) The CD-ROM starts the operation requested by the command.
- 6) Upon completing the command successfully, the CD-ROM goes to STATUS phase and returns INTERMEDIATE status byte to the initiator.
- 7) The CD-ROM shifts to MESSAGE IN phase and sends LINKED COMMAND COMPLETE or LINKED COMMAND COMPLETE WITH FLAG message.
The initiator should update the pointers and set to the initial value for next linked command upon receipt of this message.
- 8) After sending message, the CD-ROM proceeds to COMMAND phase again and receives next CDB from the initiator.
Suppose the Link bit is set to zero in this case.
- 9) The CD-ROM starts the operation requested by the command.
- 10) Upon completing the command, the CD-ROM goes to STATUS phase again and returns status byte to the initiator.
This status byte shows the results whether the command completed successfully or not.
- 11) The CD-ROM shifts to MESSAGE IN phase and sends COMMAND COMPLETE message which indicates that the execution of command chain completes.
- 12) After sending the message, the CD-ROM releases the BSY signal to create BUS FREE phase and terminates the operation of linked commands.

5-1.5 Selection of Invalid Logical Unit

As the CD-ROM does not support the logical unit, the logical unit number other than zero is invalid basically.

In response to INQUIRY command, the CD-ROM executes the command and returns INQUIRY data with the peripheral qualifier/device type field set to 7Fh.

In response to REQUEST SENSE command, the CD-ROM executes the command and returns sense data of additional sense code set to LOGICAL UNIT NOT SUPPORTED.

In response to other commands, the CD-ROM returns CHECK CONDITION status and does not execute the command.

5-1.6 Command Queue

The CD-ROM supports untagged queuing which means that the CD-ROM accepts a command from an initiator while a command from another initiator is being executed. The CD-ROM is able to accept one command for each 7 initiators.

When the CD-ROM receives a command from same initiator while executing the command, it returns BUSY status and aborts the command.

Also the CD-ROM returns BUSY status to a command issued from another initiator if the disconnect privilege is not granted and the command is not the one which completes immediately.

5-1.7 Unit Attention Condition

The CD-ROM generates unit attention condition whenever one of following events occurs.

- 1) The CD-ROM has been reset by power-on reset, RESET condition or BUS DEVICE RESET message.
- 2) The MODE SELECT parameters (block length and/or page parameters) for the initiator have been changed by another initiator.
- 3) Medium (Caddy) may have been changed.

If a unit attention condition occurs before the previous unit attention condition is cleared, the previous unit attention condition is queued.

Then the unit attention condition will be reported in following order of significance.

- 1) Power-on, RESET condition and BUS DEVICE RESET message (06/29/00)
- 2) MODE SELECT parameter changed (06/2A/00)
- 3) Medium changed (06/28/00)

The unit attention condition is persisted for each initiator until that initiator clears the condition.

When command is issued under pending unit attention condition, the CD-ROM performs following operations.

- 1) INQUIRY command
Performs the command and does not clear the unit attention condition
- 2) REQUEST SENSE command
Report the unit attention sense key with appropriate additional sense code/qualifier and clears the unit attention condition.
- 3) Command other than INQUIRY and REQUEST SENSE
Reports CHECK CONDITION status and does not execute the command unless higher priority status exists.

When command is issued after the CD-ROM returns CHECK CONDITION status, the CD-ROM performs following operations.

- 1) INQUIRY command
Clear the unit attention condition and executes the command.
- 2) REQUEST SENSE command
Report the unit attention sense key with appropriate additional sense code/qualifier and clears the unit attention condition.
- 3) Command other than INQUIRY and REQUEST SENSE
Clears the unit attention condition and performs the command if no other unit attention condition is pending.

5-1.8 Command Execution Enable Condition

READY condition of the CD-ROM is defined as the status when the CD-ROM is ready to accept a command which requires access operation.

In other words, after completing of Caddy loading and initializing (turning on servo etc.), the CD-ROM becomes to be READY condition.

IDLE condition is defined as the status other than READY condition.

For instance, it is IDLE condition when the Caddy is ejected.

Command execution enable condition for each command is defined as either of following conditions.

- 1) READY condition only
- 2) IDLE condition only
- 3) READY and IDLE condition (that is, any time)

5-2 LIST OF COMMANDS

Op-Code	Command Name	SCSI	Type	Section	
Group 0					
0k00h	TEST UNIT READY	M	1	5-3.1	
0k01h	REZERO UNIT	O	3	5-3.2	
03h	REQUEST SENSE	M	2	5-3.3	
08h	READ (6)	O	4	5-3.4	
0Bh	SEEK (6)	O	3	5-3.5	
0Dh	NO OPERATION	V	1	5-3.6	
0k12h	INQUIRY	M	2	5-3.7	
15h	MODE SELECT	O	2	5-3.8	
16h	RESERVE	M	1	5-3.9	
17h	RELEASE	M	1	5-3.10	
1Ah	MODE SENSE	O	2	5-3.11	
0k1Bh	START/STOP UNIT	O	3	5-3.12	
1Ch	RECEIVE DIAGNOSTIC RESULTS	O	2	5-3.13	
1Dh	SEND DIAGNOSTIC	M	3	5-3.14	
0k1Eh	PREVENT/ALLOW MEDIUM REMOVAL	O	1	5-3.15	
Group 1					
0k25h	READ CD-ROM CAPACITY	M	4	5-3.16	
0k28h	READ (10)	M	4	5-3.17	
0k2Bh	SEEK (10)	O	3	5-3.18	
2Fh	VERIFY (10)	O	3	5-3.19	
34h	PRE-FETCH	O	3	5-3.20	
Group 2					
• Sub Q Addr Field Qualifier → ?	42h	READ SUB-CHANNEL	O	2	5-3.21
	0k43h	READ TOC	O	2	5-3.22
	44h	READ HEADER	O	4	5-3.23
	45h	PLAY AUDIO (10)	O	3	5-3.24
	0k47h	PLAY AUDIO MSF	O	3	5-3.25
	48h	PLAY AUDIO TRACK/INDEX	O	3	5-3.26
	49h	PLAY AUDIO TRACK RELATIVE (10)	O	3	5-3.27
	0k4Bh	PAUSE/RESUME	O	1	5-3.28
Group 5					
	A5h	PLAY AUDIO (12)	O	3	5-3.29
	A8h	READ (12)	O	4	5-3.30
	A9h	PLAY AUDIO TRACK RELATIVE (12)	O	3	5-3.31
Group 6					
	C0h	AUDIO TRACK SEARCH	V	3	5-3.32
	C1h	TOSHIBA PLAY AUDIO	V	1	5-3.33
	C2h	STILL	V	1	5-3.34
	C3h	SET STOP TIME	V	1	5-3.35
	C4h	CADDY EJECT	V	3	5-3.36
	C6h	READ SUBCODE-Q DATA & PLAYING STATUS	V	2	5-3.37
	C7h	READ DISC INFORMATION	V	2	5-3.38
	C8h	READ CD-ROM MODE	V	2	5-3.39

NOTE) M: Mandatory O: Optional V: Vendor Unique

Audio CTL
C4 (STS)
C9 (CTL)

5-3 DETAILED DESCRIPTION OF COMMANDS

5-3.1 TEST UNIT READY Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 00h)								00h
01	0	0	0	Reserved					00h
02	Reserved								00h
03	Reserved								00h
04	Reserved								00h
05	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Check if the CD-ROM is ready, however, this is not a request for self test.

<Command Type> : TYPE 1

<SCSI Type> : Mandatory

<Execution Status> : IDLE, READY condition

[DESCRIPTION]

When the CD-ROM is in READY status (Caddy with medium is loaded correctly and the CD-ROM can accept an appropriate medium-access command without returning CHECK CONDITION status), the CD-ROM returns GOOD status to this command.

When the CD-ROM is in IDLE status (other than READY status), it returns CHECK CONDITION status with an appropriate sense key.

5-3.2 REZERO Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 01h)								01h
01	0	0	0	Reserved					00h
02	Reserved								00h
03	Reserved								00h
04	Reserved								00h
05	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Turn off the laser, stop the spindle motor and move the pickup head to the innermost bound.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

[DESCRIPTION]

Turn off the laser, stop the spindle motor and move the pickup head to the innermost bound.

Note that the CD-ROM only accept this command when it is in READY condition.

The CD-ROM returns CHECK CONDITION status for this command when the CD-ROM is not READY such as when Caddy is ejected.

5-3.3 REQUEST SENSE Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 03h)								03h
01	Logical Unit Number			Reserved					
02	Reserved								00h
03	Reserved								00h
04	Allocation Length								
05	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to transfer sense data to the initiator.

<Command Type> : TYPE 2

<SCSI Type> : Mandatory

<Execution Status> : IDLE, READY condition

<Allocation Length> : Maximum number of bytes that the initiator has allocated for returned sense data

[DESCRIPTION]

This command requests the CD-ROM to transfer the sense data held in the CD-ROM to the initiator that issued the command resulting in the CHECK CONDITION status. The sense data is preserved by the CD-ROM for each initiator until receiving the REQUEST SENSE command or until receipt of any other command.

The CD-ROM only returns CHECK CONDITION status to report fatal errors during the execution of REQUEST SENSE command.

When this command is issued with no valid sense data, sense data with NO SENSE sense key is transferred.

Note that NO SENSE sense key but with appropriate additional sense code qualifier which shows the play operation status may be returned during audio playback operation.

The allocation length field specifies the maximum number of bytes that the initiator has allocated for returned sense data to be sent during the DATA IN phase followed COMMAND phase.

The CD-ROM terminates the DATA IN phase when allocation length bytes have been transferred or when all available sense data have been transferred to the initiator, whichever is less.

Namely followings are transferred to the initiator;

Allocation length = 00d : No sense data is transferred and the command terminates immediately without error

Allocation length = 01d to 17d : Specified bytes from top of the sense data

Allocation length = 18d or greater : All sense data consisting of 18 bytes

The CD-ROM supports extended sense data format (Error code = 70h or 71h), 18 bytes long.

Error code 71h (Deferred error) indicates that the error is not due to the current command and it is used to report the error termination of audio playback operation as follows.

The CD-ROM returns status as soon as it starts audio playback operation due to PLAY AUDIO commands with Immed bit set to one.

Audio playback operation continues and may complete without notification to the initiator, however if the audio playback stops due to error, the CD-ROM returns CHECK CONDITION status to the next command (except for REQUEST SENSE and INQUIRY command).

Deferred error code is used to indicate such condition.

For more details on the sense data, refer to Chapter 7 Sense Data.

5-3.4 READ(6) Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 08h)								08h
01	0	0	0	(MSB)					
02	Logical Block Address								
03									(LSB)
04	Transfer Length								
05	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to transfer read data specified by the logical block address and transfer length field to the initiator.

<Command Type> : TYPE 4

<SCSI Type> : Optional

<Execution Status> : READY condition

<Logical Block Address>: The logical block address at which the read operation shall begin

<Transfer Length> : The number of logical blocks to be transferred

[DESCRIPTION]

This command requests the CD-ROM to transfer data specified by logical block address and transfer length field to the initiator.

The logical block address (byte 01 to 03) specifies the logical block at which the read operation shall begin.

If the requested logical block is not in data track, the CD-ROM terminates the command and returns CHECK CONDITION status.

The sense key is set to BLANK CHECK and the additional sense code is set to ILLEGAL MODE FOR THIS TRACK.

The transfer length (byte 04) specifies the number of logical blocks of data to be transferred during DATA IN phase.

A transfer length of zero indicates that 256 logical blocks shall be transferred.

The transfer data format (Block length, CD-ROM XA selection etc.) or error recovery parameters are specified by the MODE SELECT command issued prior to the READ command.

Regarding these parameters, refer to 5-3.8.MODE SELECT command.

5-3.5 SEEK(6) Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 0Bh)								0Bh
01	0	0	0	(MSB)					
02	Logical Block Address								
03	(LSB)								
04	Reserved								00h
05	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to seek to the specified logical block.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

<Logical Block Address>: The logical block address at which the seek operation shall be executed

[DESCRIPTION]

This command requests the CD-ROM to seek to the specified logical block.

Generally the seek operation of CD-ROM is defines as the operation to seek to the specified address while reading the header address in data track.

However if the requested address is in audio track, the CD-ROM seeks to the address converted into the subcode-Q address.

(Cf. CHECK CONDITION status is returned for READ command.)

The logical block address (byte 01 to 03) specifies the logical block at which the seek operation shall be executed.

5-3.6 NO OPERATION Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 0Dh)								0Dh
01	0	0	0	Reserved					00h
02	Reserved								00h
03	Reserved								00h
04	Reserved								00h
05	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Leaves the CD-ROM operation mode unchanged.

<Command Type> : TYPE 1

<SCSI Type> : Vendor Unique

<Execution Status> : IDLE, READY condition

[DESCRIPTION]

GOOD status is immediately returned and this command does not change any operation mode.

Sense data is not cleared through the execution of this command.

5-3.7 INQUIRY Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 12h)								12h
01	Logical Unit Number			Reserved			EVPD(0)		
02	Page Code (= 00h)								00h
03	Reserved								00h
04	Allocation length								
05	0	0	Reserved			Flag	Link		Control

[COMMAND FUNCTION]

Transfer the INQUIRY data that is the information regarding several parameters of the CD-ROM to the initiator.

<Command Type> : TYPE 2

<SCSI Type> : Mandatory

<Execution Status> : IDLE, READY condition

<Allocation Length>: Maximum number of bytes that the initiator has allocated for the returned INQUIRY data

[DESCRIPTION]

This command requests the CD-ROM to transfer standard INQUIRY data which shows the attribute of the CD-ROM.

The INQUIRY data of the CD-ROM consists of 96 bytes and the transferred length is specified by the allocation length field (byte 04).

The CD-ROM terminates the DATA IN phase when the allocation length bytes have been transferred or when all available data have been transferred to the initiator, whichever is less.

That is, followings are transferred to the initiator;

Allocation length = 00d : No INQUIRY data is transferred and the command terminates immediately without error

Allocation length = 01d to 96d : Specified bytes from top of the INQUIRY data

Allocation length = 97d or greater : All INQUIRY data consisting of 96 bytes

If this command is received from the initiator with a pending UNIT ATTENTION condition, the CD-ROM performs the INQUIRY command and does not clear the unit attention condition.

Table 5-3.7.1 shows the standard INQUIRY data format of the CD-ROM.

	7	6	5	4	3	2	1	0	NOTE	
00	Peripheral Device Type/Qualifier								05/7Fh	
01	RMB(1)	Device Type Qualifier							80h	
02	ISO Version		ECMA Version			ANSI Approved Version			02h	
03	AENC(0)	Reserved			Response Data Format				02h	
04	Additional Length (= 5Bh, 91d)								5Bh	
05	Reserved								00h	
06	Reserved								00h	
07	Re1Adr 1	WBus32 0	WBus16 0	Sync 0	Linked 1	Reserve 0	CmdQue 0	SftRe 0	88h	
08 - 15	(MSB) --	Vendor Identification (in ASCII)						-- (LSB)	-	-
16 - 31	(MSB) --	Product Identification (in ASCII)						-- (LSB)	-	-
32 - 35	(MSB) --	Product Revision Level (in ASCII)						-- (LSB)	-	-
36 - 43	(MSB) --	SCSI Firmware Date (in ASCII)						-- (LSB)	-	-
44 - 55	--	Vendor Specific (= 00h)						--	-	00h -
56 - 95	--	Reserved (= 00h)						--	-	00h -

Table 5-3.7.1 Standard INQUIRY Data Format

- 1) Byte 00: Peripheral Device Type/Qualifier
05h - Indicates CD-ROM device.
If the logical unit number other than 000b is specified, this field is set to 7Fh which indicates that the CD-ROM does not support logical unit.
- 2) Byte 01:
Bit 7: RMB (Removal Medium)
1b - Indicates medium is removable.
Bit 6-0: Device Type Qualifier
00 - The CD-ROM does not support this feature.
- 3) Byte 02: Version
02h - Indicates that the implemented version of SCSI is SCSI-2 working draft Rev 10c.
- 4) Byte 03: Response Data Format
02h - Indicates that the data is in the format specified in SCSI-2 working draft Rev 10c.
- 5) Byte 04: Additional Length
5Bh - Specifies the length in bytes of the parameters to be followed.

6) Byte 07:

Bit 7: RelAdr (Relative Addressing)

1b - Indicates that the CD-ROM supports relative addressing function.

Bit 6: WBus32 (Wide bus 32)

0b - The CD-ROM does not support wide data transfer mode.

Bit 5: WBus16 (Wide bus 16)

0b - The CD-ROM does not support wide data transfer mode.

Bit 4: Sync (Synchronous Transfer)

0b - Indicates that the CD-ROM does not support synchronous data transfer.

Bit 3: Linked (Linked Command)

1b - Indicates that the CD-ROM supports command link function.

Bit 1: CmdQue (Command Queuing)

0b - The CD-ROM does not support this feature.

Bit 0: SftRe (Soft Reset)

0b - Indicates that the CD-ROM responds to the RESET condition with hard reset alternative.

7) Byte 08 - 15: Vendor Identification

This field contains eight bytes of ASCII data identifying the vendor of the product.

T	O	S	H	I	B	A	20h
54h	4Fh	53h	48h	49h	42h	41h	20h

8) Byte 16 - 31: Product Identification

This field contains sixteen bytes of ASCII data identifying the product.

C	D	-	R	O	M	D	R	I	V	E	:	X	M	20h	
43h	44h	2Dh	52h	4Fh	4Dh	20h	44h	52h	49h	56h	45h	3Ah	58h	4Dh	20h

9) Byte 32 - 35: Product Revision Level

This field contains four bytes of ASCII data identifying the revision of the product.

3	4	3	3
33h	34h	33h	33h

10) Byte 36 - 43: SCSI Firmware Date (Vendor Unique)

This field contains eight bytes of ASCII data identifying the created date of the firmware.

m	m	/	d	d	/	y	y
?	?	2Fh	?	?	2Fh	?	?

Where: mm: month, dd:day, yy:year

5-3.8 MODE SELECT Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 15h)								15h
01	0	0	0	PF	Reserved			SP(0)	
02	Reserved								00h
03	Reserved								00h
04	Parameter List Length								
05	0	0	Reserved			Flag	Link	Control	

[COMMAND FUNCTION]

This command provides a means for the initiator to specify following parameters.

Block Descriptor (Density Code and Block Length)

Page 01 (Error Recovery parameters)

Page 02 (Disconnect/Reconnect Control parameters)

Page 0D (CD-ROM parameters)

Page 0E (Audio Control parameters)

<Command Type> : TYPE 2

<SCSI Type> : Optional

<Execution Status> : IDLE, READY condition

<PF bit> : PF(Page Format) bit of one indicates that the MODE SELECT parameters following the header and block descriptor are specified in SCSI-2 working draft Rev 10c.

To specify page parameters, this field should be set to one.

<Parameter List Length>: This field specifies the length in bytes of the MODE SELECT parameter list that shall be transferred from the initiator during the DATA OUT phase.

[DESCRIPTION]

This command is used to specify above-mentioned parameters.

As the CD-ROM also supports MODE SENSE command (1Ah), the initiator can examine the supported pages, page length etc. by issuing MODE SENSE command prior to MODE SELECT command.

The CD-ROM generates a UNIT ATTENTION condition for all initiator except for the one which issued the MODE SELECT command, when the MODE SELECT parameters have been changed.

As the CD-ROM does not support saving pages function, it returns CHECK CONDITION status when the SP bit is set to one.

The parameter list length field specifies the length in bytes of the MODE SELECT parameter list that shall be transferred during the DATA OUT phase.

A parameter list length of zero indicates that no data shall be transferred (DATA OUT phase shall not be executed) and the command terminates immediately. (Any parameter is not changed.)

The MODE SELECT parameter list (Table 5-3.8.1) contains four bytes header, followed by zero or eight bytes block descriptor and zero or more pages.

	7	6	5	4	3	2	1	0	NOTE
00	Reserved								00h
01	Medium Type (= 00h)								00h
02	Device Specific Parameter (= 00h)								00h
03	Block Descriptor Length (= 00h or 08h)								00/08h
Block Descriptor(s)									
00	Density Code								
01	(MSB)								00h
02	Number of Blocks (= 00h)								00h
03									(LSB) 00h
04	Reserved								00h
05	(MSB)								
06	Block Length								
07									(LSB)
Page Descriptor(s)									
00	PS(0)	Reserve	Page Code						
01	Page Length								
02 -- NN	--	Page Parameter (Refer to each page)						--	- -

Table 5-3.8.1 MODE SELECT Parameter List

Header

- 1) Byte 02: CD-ROM Device Specific Parameter
00h - All bits (WP, Cache, EBC) are reserved.
- 2) Byte 03: Block Descriptor Length
This field specifies the length in bytes of all block descriptors.
Valid block descriptor lengths of the CD-ROM are either 00h or 08h.
00h shows that the block descriptor is not included in the parameter list.
If other length is specified, CHECK CONDITION status is reported.

Block Descriptor(s)

- 1) Byte 00: Density Code
This field specifies the error detection/correction mode to distinguish CD-ROM Yellow book mode from the CD-ROM XA mode.

CD-ROM XA track is recorded in compliance with CD-ROM Mode-2 format and one sector(2352 bytes) consists of Sync(12 bytes), Header (4 bytes), Subheader (8 bytes) and Data field (2328 bytes).

Two Forms (Form-1 and Form-2) are defined just as Mode-1 and Mode-2 of Yellow book.

ECC(Error Correction Code) is available for Form-1 format and it will be used as data sectors, compressed video sectors, while Form-2 format is used as ADPCM audio sectors and/or video sectors.

The definition of density code is as follows.

00h : Default density code for the CD-ROM.

The CD-ROM uses either Mode-1 ECC based algorithm for Mode-1 sector or uses CIRC based algorithm (CD audio level) for Mode-2 sector.

Note that CD-ROM XA Form-1 ECC is not applied but CIRC based algorithm is only applied even for Form-1 sector since it is treated as Mode-2 sector.

81h : CD-ROM XA support mode.

The CD-ROM uses Form-1 ECC based algorithm for Form-1 (Mode-2) sector.

When Form-2 (Mode-2) sector with EDC field set to zero (no EDC) is read, no error detection is performed.

When Form-2 (Mode-2) sector with EDC field set to non-zero (EDC available) is read, the CD-ROM checks the propriety of the sector with calculating EDC.

If an EDC error is found, the CD-ROM returns CHECK CONDITION status after exhaustion of the all requested transfer length (Post error).

Namely erroneous data may be transferred in the case of XA mode.

When Mode-1 sector or Mode-2 sector other than XA format is read, the CD-ROM returns CHECK CONDITION status with additional sense code set to ILLEGAL MODE FOR THIS TRACK.

83h : CD-ROM Mode-1 and CD-ROM XA Form-1 support mode.

When either Mode-1 sector or Form-1 sector is read, the CD-ROM selects Mode-1 ECC or Form-1 ECC based algorithm automatically and transfers the user data area.

When other sector, Mode-2 or Form-2, is read, the CD-ROM returns CHECK CONDITION status with additional sense code set to ILLEGAL MODE FOR THIS TRACK.

2) Byte 05-07: Block Length

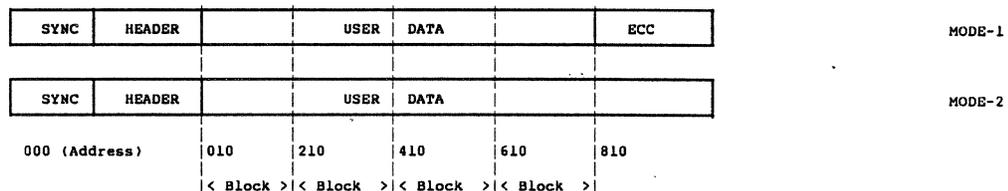
This field specifies the length in bytes of each logical block when the data is transferred to the initiator by the execution of READ, READ(10) and READ(12) command.

Followings shows the available combination of the density code and block length. If any other combination is specified, CHECK CONDITION status is returned.

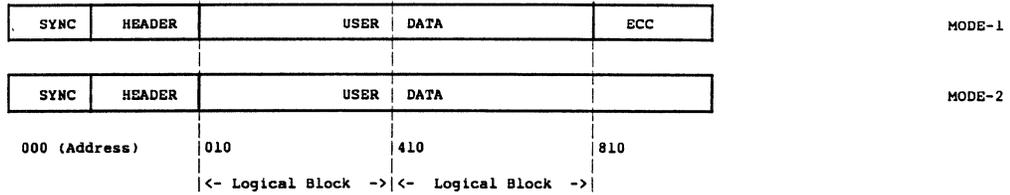
The default density code and block length is 00h/2048d (800h) that is equivalent to Mode-1 user data transfer mode.

a-1) Density Code = 00h, Block Length =512d (200h)

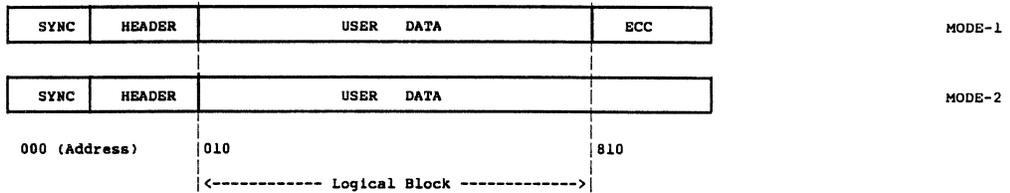
--> Block Size =04



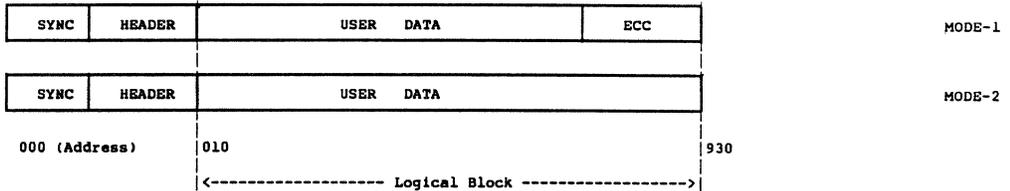
a-2) Density Code = 00h, Block Length =1024d (400h)
 --> Block Size =02



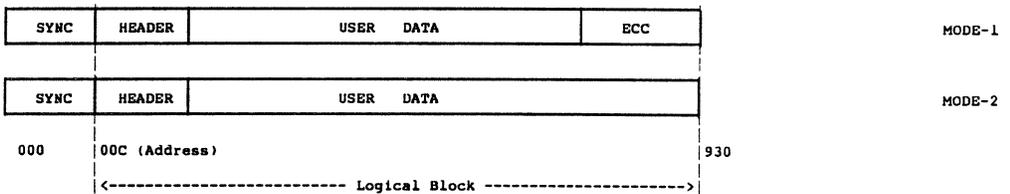
a-3) Density Code = 00h, Block Length =2048d (800h)
 --> Block Size =01



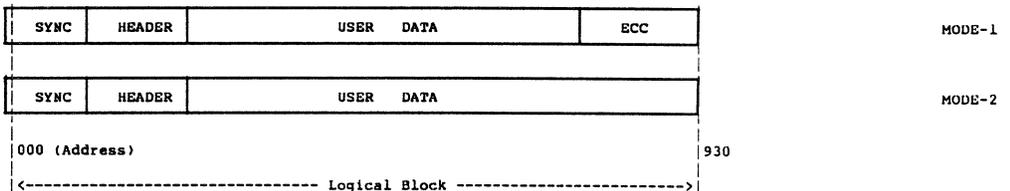
a-4) Density Code = 00h, Block Length =2336d (920h)
 --> Block Size =01



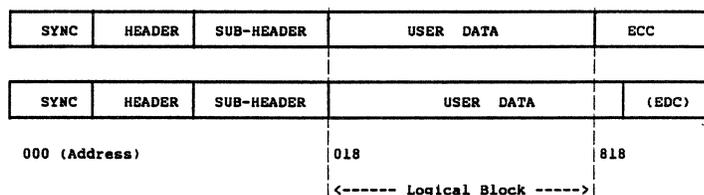
a-5) Density Code = 00h, Block Length =2340d (924h)
 --> Block Size =01



a-6) Density Code = 00h, Block Length =2352d (930h)
 --> Block Size =01



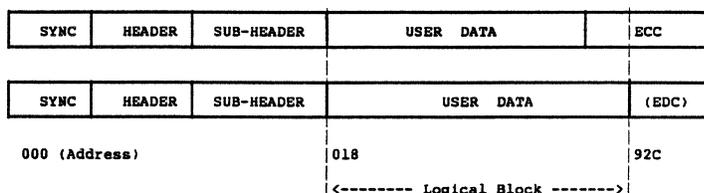
b-1) Density Code = 81h, Block Length =2048d (800h)
 --> Block Size =01



FORM-1

FORM-2

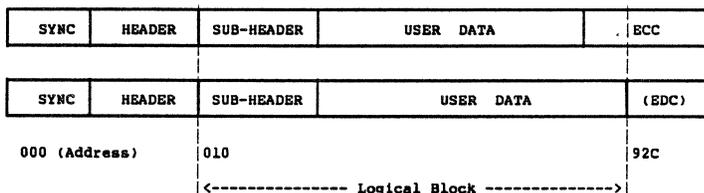
b-2) Density Code = 81h, Block Length =2324d (914h)
 --> Block Size =01



FORM-1

FORM-2

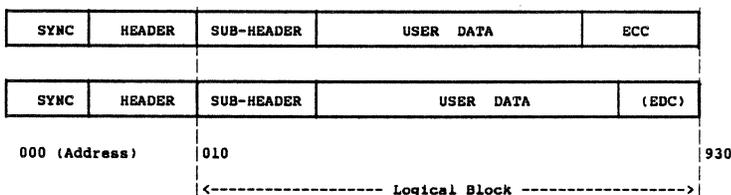
b-3) Density Code = 81h, Block Length =2332d (91Ch)
 --> Block Size =01



FORM-1

FORM-2

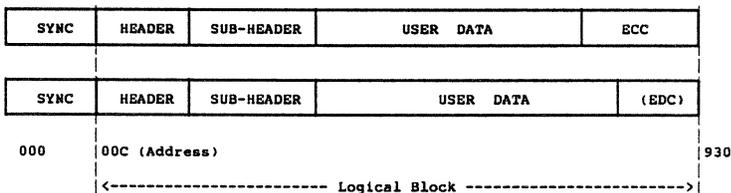
b-4) Density Code = 81h, Block Length =2336d (920h)
 --> Block Size =01



FORM-1

FORM-2

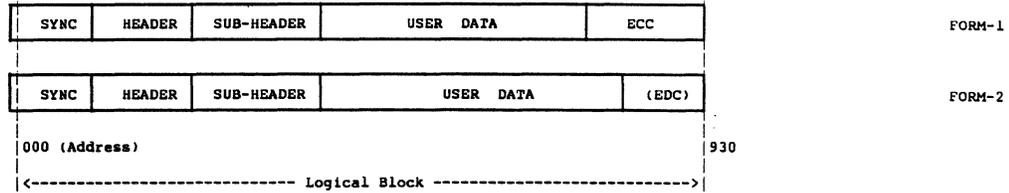
b-5) Density Code = 81h, Block Length =2340d (924h)
 --> Block Size =01



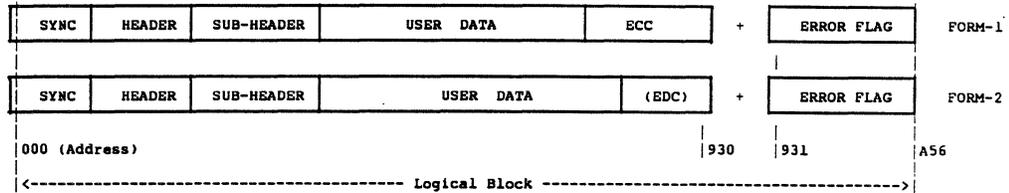
FORM-1

FORM-2

b-6) Density Code = 81h, Block Length =2352d (930h)
 --> Block Size =01



b-7) Density Code = 81h, Block Length =2646d (A56h)
 --> Block Size =01



Where ;

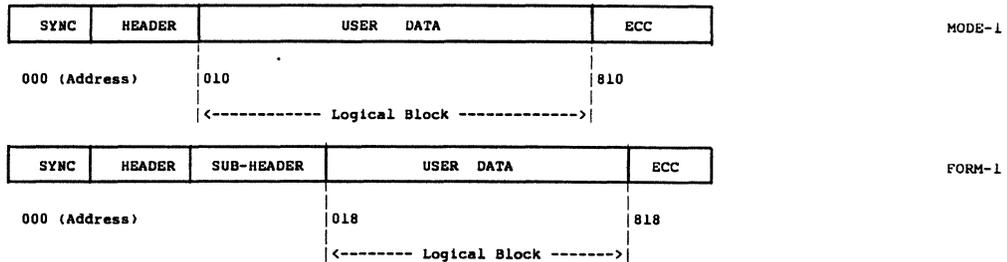
ERROR FLAG : Error information that indicates which of data byte (2352 bytes) are in error.

ERROR FLAG bits are ordered from bit 7 to 0 and byte 931h bit 7 indicates the error flag for data byte 0 (first byte of sync pattern).

This information consists of $2352 / 8 = 294$ bytes.

This raw data mode is prepared for the system configuration that the ADPCM processor in host system implements unique error compensation algorithm with ERROR FLAGS.

c-1) Density Code = 83h, Block Length =2048d (800h)
 --> Block Size =01



Page Descriptor(s)

1) Byte 00: Page Code

This field specifies the format and parameters for that Page defined in SCSI-2. The CD-ROM supports following Pages.

- Page 01 ... Error Recovery parameters
- Page 02 ... Disconnect/Reconnect Control parameters
- Page 0D ... CD-ROM parameters
- Page 0E ... Audio Control parameters

2) Byte 01: Page Length

This field specifies the length in bytes of the following page descriptors. The Page Length of each Page is as follows, and if other length is specified, the CD-ROM returns CHECK CONDITION status.

- Page 01 ... 06h
- Page 02 ... 0Eh (Note that this field was 0Ah in CCS definition)
- Page 0D ... 06h
- Page 0E ... 0Eh

3) Byte 02 to NN: Page Parameter

Indicates the parameters for each Pages defined below.

a) Page 01 (Error Recovery parameters)

	7	6	5	4	3	2	1	0	NOTE
00	PS(0)	Reserve	Page Code (= 01h)						01h
01	Page Length (= 06h)								06h
02	Reserve	Reserve	TB	RC	Reserve	PER	DTE	DCR	
03	Retry Count								
04	Reserved								00h
05	Reserved								00h
06	Reserved								00h
07	Reserved								00h

Table 5-3.8.2 Error Recovery Parameters Page

Error Recovery parameters page specifies the error recovery parameters that the CD-ROM uses during the read operation due to READ, READ(10) and READ(12) command execution.

This parameter is also used as the Verify Recovery parameters that the CD-ROM uses during the verify operation due to VERIFY command execution.

Table 5-3.8.3 shows the available bit setting and its interpretation for CD-ROM. If another combination is specified, CHECK CONDITION status is reported.

Note that Toshiba CD-ROM which complies to the SCSI interface specification ver. 3.0 or 4.0 supported EEC (Enable Early Correction) bit of Byte 02 Bit 3.

From compatibility viewpoint, the CD-ROM of current version is designed to ignore this bit and CHECK CONDITION is not reported if this bit is set to one.

TB	RC	PER	DTE	DCR	Description
0	0	0 (00h) << Default >>	0	0	Uses both ECC and retry. If an uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is not transferred. Recovered error is not reported.
0	0	0 (01h)	0	1	Uses only retry. If an CIRC uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is not transferred. Recovered error is not reported.
0	0	1 (04h)	0	0	Uses both ECC and retry. If an uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is not transferred and the information byte in sense data gives the address where the error was detected. If a recovered error occurs, data transfer is not terminated, however CHECK CONDITION status is reported at command completion. The sense key is RECOVERED ERROR and the information byte gives the address of the last recovered block.

Table 5-3.8.3 Error Recovery Parameter (00h - 04h)

TB	RC	PER	DTE	DCR	Description
0	0	1 (05h)	0	1	Uses only retry. If an CIRC uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is not transferred and the information byte in sense data gives the address where the error was detected. If a recovered error occurs, data transfer is not terminated, however CHECK CONDITION status is reported at command completion. The sense key is RECOVERED ERROR and the information byte gives the address of the last recovered (retried) block.
0	0	1 (06h)	1	0	Uses both ECC and retry. If an uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is not transferred and the information byte in sense data gives the address where the error was detected. If a recovered error occurs, data transfer is terminated with CHECK CONDITION status. The recovered block is not transferred and the sense key is RECOVERED ERROR and the information byte gives the address of the recovered block.
0	0	1 (07h)	1	1	Uses only retry. If an CIRC uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is not transferred and the information byte in sense data gives the address where the error was detected. If a recovered error occurs, data transfer is terminated with CHECK CONDITION status. The recovered block is not transferred and the sense key is RECOVERED ERROR and the information byte gives the address of the recovered (retried) block.
0	1	0 (10h)	0	0	Uses only ECC to maintain data transfer rate. If uncorrectable error occurs, data transfer is not terminated, however CHECK CONDITION status is reported at command completion. The information byte in sense data gives the address of first uncorrectable block. Note that erroneous data may be transferred in this mode. Recovered error is not reported.
0	1	0 (11h)	0	1	Uses no error recovery operation to maintain data transfer rate. If uncorrectable error occurs, data transfer is not terminated, however CHECK CONDITION status is reported at command completion. The information byte in sense data gives the address of first uncorrectable block. Note that erroneous data may be transferred in this mode. Recovered error does not occur and is not reported.
0	1	1 (14h)	0	0	Uses only ECC to maintain data transfer rate. If uncorrectable error occurs, data transfer is not terminated, however CHECK CONDITION status is reported at command completion. The information byte in sense data gives the address of first uncorrectable block. Note that erroneous data may be transferred in this mode. If a recovered error occurs, data transfer is not terminated, however CHECK CONDITION status is reported at command completion. The sense key is RECOVERED ERROR and the information byte gives the address of the last recovered block.
0	1	1 (15h)	0	1	Same as 11h.
1	0	0 (20h)	0	0	Uses both ECC and retry. If uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is transferred and the information byte in sense data gives the address where the error was detected. Recovered error is not reported.

Table 5-3.8.3 Error Recovery Parameter (05h - 20h)

TB	RC	PER	DTE	DCR	Description
1	0	0 (21h)	0	1	Uses only retry. If an CIRC uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is transferred and the information byte in sense data gives the address where the error was detected. Recovered error is not reported.
1	0	1 (24h)	0	0	Uses both ECC and retry. If uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is transferred and the information byte in sense data gives the address where the error was detected. If a recovered error occurs, data transfer is not terminated, however CHECK CONDITION status is reported at command completion. The sense key is RECOVERED ERROR and the information byte gives the address of the last recovered block.
1	0	1 (25h)	0	1	Uses only retry. If an CIRC uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is transferred and the information byte in sense data gives the address where the error was detected. If a recovered error occurs, data transfer is not terminated, however CHECK CONDITION status is reported at command completion. The sense key is RECOVERED ERROR and the information byte gives the address of the last recovered (retried) block.
1	0	1 (26h)	1	0	Uses both ECC and retry. If an uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is transferred and the information byte in sense data gives the address where the error was detected. If a recovered error occurs, data transfer is terminated with CHECK CONDITION status. The recovered block is transferred and the sense key is RECOVERED ERROR and the information byte gives the address of the recovered block.
1	0	1 (27h)	1	1	Uses only retry. If an CIRC uncorrectable error occurs, data transfer is terminated with CHECK CONDITION status. The erroneous block is transferred and the information byte in sense data gives the address where the error was detected. If a recovered error occurs, data transfer is terminated with CHECK CONDITION status. The recovered block is transferred and the sense key is RECOVERED ERROR and the information byte gives the address of the recovered (retried) block.
1	1	0 (30h)	0	0	Same as 10h.
1	1	0 (31h)	0	1	Same as 11h.
1	1	1 (34h)	0	0	Same as 14h.
1	1	1 (35h)	0	1	Same as 15h.

Table 5-3.8.3 Error Recovery Parameter (21h - 35h)

Retry Count field (Byte 03) specifies the maximum number of times that the CD-ROM should attempt its retry operation.

Retry operation up to 254d (FEh) can be specified with this field.

Retry Count of zero indicates that the retry operation is not allowed, and 255 (FFh) indicates that retry operation is allowed limitlessly.

The default value of CD-ROM is five(5) times.

b) Page 02 (Disconnect/Reconnect Control parameters)

	7	6	5	4	3	2	1	0	NOTE
00	PS(0)	Reserve	Page Code (= 02h)						02h
01	Page Length (= 0Eh)								0Eh
02	Buffer Full Ratio								
03	Buffer Empty Ratio (= 00h)								00h
04	(MSB)	Bus Inactivity Limit						(LSB)	00h
05									00h
06	(MSB)	Disconnect Time Limit						(LSB)	00h
07									00h
08	(MSB)	Connect Time Limit						(LSB)	00h
09									00h
10	(MSB)	Maximum Burst Size						(LSB)	
11									
12	Reserved						DTDC		
13	Reserved								00h
14	Reserved								00h
15	Reserved								00h

Table 5-3.8.4 Disconnect/Reconnect Control Parameters

Disconnect/Reconnect Control parameters page specifies the performance (restriction) of the SCSI bus.

Buffer Full Ratio field (Byte 02) indicates how full the buffer shall be prior to reconnect during the READ, READ(10) and READ(12) command execution and it is the numerator of a fractional multiplier that has 256 as its denominator.

The number of blocks vs Buffer Full Ratio is specified in Table 5-3.8.5.

Table b) is applicable for the combination of Density code set to 81h and the block length set to A56h (2646d).

For other combination, block length is less than 2352 byte, Table a) is applied.

Buffer Full Ratio of zero (**) indicates that the CD-ROM shall not disconnect once the data transfer of the command has started. (Toshiba unique definition)

The default of the Buffer Full Ratio is 09h which means 1 block.

a) Block Length is less than 2352 bytes			
Buffer Full Ratio	Number of Blocks	Buffer Full Ratio	Number of Blocks
00h	(**)	77h - 80h	14
01h - 09h	1	81h - 89h	15
0Ah - 12h	2	8Ah - 92h	16
13h - 18h	3	93h - 98h	17
1Ch - 24h	4	9Ch - A4h	18
25h - 2Dh	5	A5h - ADh	19
2Eh - 36h	6	A Eh - B6h	20
37h - 40h	7	B7h - C0h	21
41h - 49h	8	C1h - C9h	22
4Ah - 52h	9	CAh - D2h	23
53h - 58h	10	D3h - DBh	24
5Ch - 64h	11	DCh - E4h	25
65h - 6Dh	12	E5h - FFh	26
6Eh - 76h	13		

Table 5-3.8.5 Buffer Full Ratio

b) Density Code = 81h, Block Length = A56h			
Buffer Full Ratio	Number of Blocks	Buffer Full Ratio	Number of Blocks
00h	(**)		
01h - 12h	1		
13h - 24h	2		
25h - 36h	3		
37h - 49h	4		
4Ah - 5Bh	5		
5Ch - 6Dh	6		
6Eh - 80h	7		
81h - 92h	8		
93h - A4h	9		
A5h - B6h	10		
B7h - C9h	11		
CAh - FFh	12		

Table 5-3.8.5 Buffer Full Ratio

Maximum Burst Size field (Byte 10 and 11) indicates the maximum amount of data that the CD-ROM shall transfer during a DATA IN phase before disconnecting. This value is expressed in increments of 512 bytes.

A value of zero means that there is no limit on the amount of data transferred per connection and this is the default of the CD-ROM.

Note that this field is only effective when the initiator permitted disconnecting.

DTDC (Data Transfer Disconnect Control) field specifies further restriction of data transfer as follows (Refer to Table 5-3.8.6).

If DTDC field is not zero and Maximum Burst Size field is not zero, the CD-ROM returns CHECK CONDITION status.

DTDC	Description
00b	Disconnect is controlled by other field in this page.
01b	The CD-ROM shall not disconnect once the data transfer has started until all requested block has been transferred. This function is same as the definition of Buffer Full Ratio set to zero.
10b	Reserved
11b	The CD-ROM shall not disconnect once the data transfer has started until the command is completed.

Table 5-3.8.6 DTDC (Data Transfer Disconnect Control) Field

Following shows the READ command implementation algorithm when the disconnecting is allowed by the initiator and DTDC field is set to 00b.

- 1) The initiator sends READ command with DiscPriv bit in IDENTIFY message set to one.
- 2) The CD-ROM sends DISCONNECT message and goes to BUS FREE phase.
- 3) The CD-ROM seeks to the requested block and starts to write data into the buffer.
- 4) The CD-ROM waits for the stored data amount to exceed either the Buffer Full Ratio or the remaining transfer length, whichever is less.
- 5) The CD-ROM executes ARBITRATION phase and RESELECTION phase to reselect the initiator.
- 6) The CD-ROM sends IDENTIFY message to the initiator.
The initiator should restore the active pointers from the saved pointer.

- 7) The CD-ROM goes to DATA IN phase and transfers data stored in buffer to the initiator.
The data transfer will continue until either of following events occurs.
 - a) The remaining transfer length is zero.
 - b) The buffer is empty.
Note that empty here means that the data in the buffer is less than one physical block of the CD-ROM.
 - c) The amount of transferred data during one DATA IN phase exceeds Maximum Burst Size.
- 8) If the remaining transfer length is zero (condition (a)), the CD-ROM sends status byte and message to the initiator and terminates the READ command.
- 9) If the remaining transfer length is not zero (condition (b) and (c)), the CD-ROM sends SAVE DATA POINTER message and DISCONNECT message to the initiator and goes to BUS FREE phase.
The CD-ROM repeats step 4) to 9) until all transfer length is exhausted.

c) Page 0D (CD-ROM parameters)

	7	6	5	4	3	2	1	0	NOTE
00	PS(0)	Reserve	Page Code (= 0Dh)						0Dh
01	Page Length (= 06h)								06h
02	Reserved								00h
03	Reserved				Inactivity Timer Multiplier				
04	Number of MSF - S Units per MSF - M Unit								00h
05									3Ch
06	Number of MSF - F Units per MSF - S Unit								00h
07									4Bh

Table 5-3.8.7 CD-ROM Parameters

CD-ROM parameters page specifies the CD-ROM unique parameters. Inactivity Timer Multiplier field (Byte 03) indicates the length of time that the CD-ROM shall remain in hold-track mode after completion of seek, read, audio playback and/or initializing operation before shifting STOP status (turning off the spindle motor and laser beam).

During hold-track mode, the CD-ROM attempts to keep the optical pickup head around the position where the previous operation has terminated.

Table 5-3.8.8 shows the Inactivity Timer Multiplier.

Default of the CD-ROM is 09h (32 seconds).

Inactivity Timer Multiplier	Minimum Time in Hold-Track Mode
00h	62 milliseconds
01h	125 milliseconds
02h	250 milliseconds
03h	500 milliseconds
04h	1 second
05h	2 seconds
06h	4 seconds
07h	8 seconds
08h	16 seconds
09h	32 seconds
0Ah	1 minute
0Bh	2 minutes
0Ch	4 minutes
0Dh	8 minutes
0Eh	16 minutes
0Fh	32 minutes

Table 5-3.8.8 Inactivity Timer Multiplier Value

d) Page 0E (Audio Control parameters)

	7	6	5	4	3	2	1	0	NOTE
00	PS(0)	Reserve	Page Code (= 0Eh)						0Eh
01	Page Length (= 0Eh)								0Eh
02	Reserved				Immed	SOTC	Reserve		
03	Reserved								00h
04	Reserved								00h
05	APRVal	Reserved			Format of LBAs / Sec.				00h
06	(MSB)	Logical Blocks per Second of Audio Playback							00h
07							(LSB)	00h	
08	Reserved				Output Port 0 Channel Control				
09	Output Port 0 Volume								
10	Reserved				Output Port 1 Channel Control				
11	Output Port 1 Volume (Should be same as byte 09)								
12	Reserved				Output Port 2 Channel Control				00h
13	Output Port 2 Volume								00h
14	Reserved				Output Port 3 Channel Control				00h
15	Output Port 3 Volume								00h

Table 5-3.8.9 Audio Control Parameter

The CD-ROM Audio Control parameters page specifies the audio playback mode and output control mode during audio playback operation.

Immed (Immediate) bit (Byte 02, Bit 2) set to zero indicates that the CD-ROM shall not send audio playback completion status until the audio playback operation is terminated.

Immed bit set to one indicates that the CD-ROM shall send GOOD status as soon as the audio playback operation has been initiated.

SOTC(Stop On Track Crossing) bit (Byte 02, Bit 1) set to zero indicates that the CD-ROM only terminates the audio playback operation when the requested transfer length is satisfied.

Audio silence (Index 0) is also played and multiple track may be played as necessary.

SOTC bit set to one indicates that the CD-ROM terminates the audio playback operation either when the beginning of next track (Index 0 or 1) is encountered or when the requested transfer length is satisfied.

Default setting of the CD-ROM is Immed bit set to one and SOTC bit set to zero.

The CD-ROM does not support APRVal (Audio Playback Rate Valid) bit and format of logical blocks addresses per second field.

These fields should be set to zero.

The Output Port x Channel Control field (Byte 08 and 10) specifies the audio channels from the disc to which this output port should be connected. The CD-ROM support 2 channel control (Channel 0 and 1) and following table shows the available combination and its function for each channel. Namely 16 patterns are available and if any other combination is specified, CHECK CONDITION status is reported. The default of the CD-ROM is so-called stereo mode (Byte 8 set to 01h and Byte 9 set to 02h).

Channel Selection	Function
0000b (00h)	Output muted
0001b (01h)	Connect channel 0 to this output port
0010b (02h)	Connect channel 1 to this output port
0011b (03h)	Connect channel 0 and 1 to this output port

Table 5-3.8.10 Output Port Channel Selection

Output Port x Volume field (Byte 09 and 11) specifies the relative volume level for this audio port. A value of zero means output port muted and FFh means the maximum volume level. The default value of the CD-ROM is 25% (3Fh). Note that channel 2 and 3 should be zero and channel 0 and 1 should be same value since the CD-ROM only controls both channel simultaneously.

5-3.9 RESERVE Command

	7	6	5	4	3	2	1	0	NOTE	
00	Operation Code (= 16h)								16h	
01	0	0	0	3rdPty	Third Party Device ID		Extent			
02	Reservation Identification								00h	
03	(MSB)	Extent List Length								00h
04									00h	
05	0	0	Reserved				Flag	Link	Control	

[COMMAND FUNCTION]

Reserve the CD-ROM for exclusive use of an initiator. The CD-ROM supports following three reservation modes.
 Logical Unit Reservation
 Third Party Reservation
 Superseding Reservation
 <Command Type> : TYPE 1
 <SCSI Type> : Mandatory
 <Execution Status> : IDLE, READY condition
 <3rdPty Bit> : 3rdPty(Third Party) bit of one indicates Third Party Reservation request.
 <Third Party Device ID> : This field is used to identify the SCSI ID for Third Party Reservation request.

[DESCRIPTION]

This command is used to reserve the CD-ROM for exclusive use of an initiator. Under reservation status, if any other initiator sends any command other than an INQUIRY, REQUEST SENSE, ALLOW MEDIUM REMOVAL, RELEASE command (ignored), the CD-ROM returns RESERVATION CONFLICT status and does not execute the requested command.

Note that the initiator shall identify its SCSI ID during SELECTION phase.

If the initiator outputted only CD-ROM's SCSI ID during SELECTION phase, the CD-ROM rejects the RESERVE command with CHECK CONDITION status.

The reservation shall remain in effect until following events occur.

- 1) Release by a RELEASE command from the initiator that made the reservation.
- 2) BUS DEVICE RESET message is issued from any initiator.
- 3) RESET condition is created by any SCSI device.
- 4) Reservation is superseded by another RESERVE command from the initiator that made the reservation.

The CD-ROM supports above mentioned three kinds of reservation and does not support Extent Reservation request.

If a RESERVE command with the Extent bit (Byte 01, Bit 0) is set to one is received, the CD-ROM reports CHECK CONDITION status with sense key set to ILLEGAL REQUEST.

1) Logical Unit Reservation

If the Extent and 3rdPty bit is set to zero, this request is to reserve the CD-ROM for exclusive use of the initiator that issued this RESERVE command.

It is not an error to reserve the CD-ROM that is currently reserved by that initiator.

2) Third Party Reservation

If the 3rdPty bit is set to one, the CD-ROM reserves itself for the SCSI device which is specified in the Third Party Device ID field (Byte 01).

That is, this reservation request provides a means for an initiator to reserve the CD-ROM for another SCSI device and it intends to use for the execution of a COPY command.

3) Superseding Reservation

It is permitted for an initiator that holds current reservation to modify that reservation by issuing another RESERVE command.

This superseding RESERVE command releases the previous reservation and establishes new reservation status.

5-3.10 RELEASE Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 17h)								17h
01	0	0	0	3rdPty	Third Party Device ID			Extent	
02	Reservation Identification								00h
03	Reserved								00h
04	Reserved								00h
05	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Release the current reservation status of the CD-ROM.

The CD-ROM supports following two release modes.

Logical Unit Release

Third Party Release

<Command Type> : TYPE 1

<SCSI Type> : Mandatory

<Execution Status> : IDLE, READY condition

<3rdPty Bit> : 3rdPty(Third Party) bit of one indicates Third Party Release request.

<Third Party Device ID> : This field is used to identify the SCSI ID for Third Party Release request.

[DESCRIPTION]

This command is used to release previously reserved CD-ROM.

It is not an error for an initiator to release the CD-ROM that is not currently reserved.

In this case, the CD-ROM returns GODD status without changing any other reservation.

Note that the initiator shall identify its SCSI ID during SELECTION phase.

If the initiator outputed only CD-ROM's SCSI ID during SELECTION phase, the CD-ROM rejects the RELEASE command with CHECK CONDITION status.

The CD-ROM supports above mentioned two kinds of release and does not support Extent Release request.

If a RELEASE command with the Extent bit (Byte 01, Bit 0) is set to one is received, the CD-ROM reports CHECK CONDITION status with sense key set to ILLEGAL REQUEST.

1) Logical Unit Release

If the Extent and 3rdPty bit is set to zero, this request is to release non-third-party reservation.

2) Third Party Release

If the 3rdPty bit is set to one, the CD-ROM releases the reservation if the reservation was made using a Third Party Reservation by the initiator that is requesting the release for the same SCSI device as specified in the Third Party Device ID field (Byte 01).

That is, this release request provides a means for an initiator to release the CD-ROM that was reserved for another SCSI device and it intends to use for the execution of a COPY command.

5-3.11 MODE SENSE Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 1Ah)								1Ah
01	0	0	0	Reserve	DBD	Reserved			
02	PC		Page Code						
03	Reserved								00h
04	Allocation Length								
05	0	0	Reserved			Flag	Link		Control

[COMMAND FUNCTION]

This command reports the current, changeable and default value of page parameters and also block length.

This command is complementary to the MODE SELECT command.

<Command Type> : TYPE 2

<SCSI Type> : Optional

<Execution Status> : IDLE, READY condition

<DBD bit> : DBD (Disable Block Descriptors) bit (Byte 01, Bit 3) of one specifies that the CD-ROM shall not return block descriptor field in the returned MODE SENSE data

<PC bit> : PC (Page Control) field (Byte 02) defines the type of parameters to be returned

<Page Code> : Specifies which page or pages to return

<Allocation Length> : Maximum number of bytes that the initiator has allocated for returned MODE SENSE data

[DESCRIPTION]

This command provides a means for the CD-ROM to report current (specified with MODE SELECT command), changeable and default value of page parameters and also block length.

DBD (Disable Block Descriptors) bit (Byte 01, Bit 3) of zero indicates that the CD-ROM returns block descriptors in the returned MODE SENSE data. (Refer to Table 5-3.11.3)

DBD bit of one indicates that the CD-ROM shall not return block descriptors.

PC (Page Control) field (Byte 02) specifies the type of parameters to be returned (Refer to Table 5-3.11.1).

As the CD-ROM does not support saving page function, it returns CHECK CONDITION status with the additional sense code set to SAVING PARAMETERS NOT SUPPORTED for the request of PC field set to 3h.

Bit 7	Bit 6	Type of parameters to be returned
0	0	Current values
0	1	Changeable values
1	0	Default values
1	1	Saved values (invalid for the CD-ROM)

Table 5-3.11.1 PC(Page Control) Field

The page code specifies which page or pages to return defined as follows.

Page Code = 01h : Transfer page 01

Page Code = 02h : Transfer page 02

Page Code = 0Dh : Transfer page 0D

Page Code = 0Eh : Transfer page 0E

Page Code = 3Fh : Transfer page 01, 02, 0D and 0E

If the initiator issues a MODE SENSE command with specifying not-supported page, the CD-ROM returns CHECK CONDITION status.

Page Code of 3Fh indicates that all pages shall be returned in ascending order.

The returned parameters are as follows.

1) Current Values (PC = 0h)

The current values are reported to the initiator.

The current value means either the value that was set by the last MODE SELECT command or the default value when a MODE SELECT command has not been issued.

2) Changeable Values (PC = 1h)

The changeable values (Changeable mask) are reported to the initiator.

All corresponding parameter bits that are changeable through MODE SELECT command are set to one and all corresponding parameter bits that is not allowed to be changed are set to zero.

If the initiator issues a MODE SELECT command with non-changeable bit set to one, CHECK CONDITION status is reported.

3) Default Values (PC = 2h)

The default values are reported to the initiator.

The allocation length field (Byte 04) specifies the maximum number of bytes that the initiator has allocated for returned MODE SENSE data to be sent during DATA IN phase.

The CD-ROM terminates the DATA IN phase when allocation length bytes have been transferred or when all available MODE SENSE data have been transferred to the initiator, whichever is less.

If the allocation length field is equal or less than 12d with DBD bit set to zero, the maximum number of bytes to be transferred is 12 bytes.

If the allocation length field is equal or less than 4d with DBD bit set to one, the maximum number of bytes to be transferred is 4 bytes.

Otherwise, the maximum number of bytes to be transferred is depended upon the DBD bit and Page Code as follows.

Page Code	DBD	Maximum Length	Page Code	DBD	Maximum Length
01h	0	20 bytes	01h	1	12 bytes
02h	0	28 bytes	02h	1	20 bytes
0Dh	0	20 bytes	0Dh	1	12 bytes
0Eh	0	28 bytes	0Eh	1	20 bytes
3Fh	0	60 bytes	3Fh	1	52 bytes

Table 5-3.11.2 Maximum Transferred Length

The MODE SENSE data (Table 5-3.11.3) contains 4 bytes header followed by zero or 8 bytes block descriptors and zero or more pages.

	7	6	5	4	3	2	1	0	NOTE
00	Mode Data Length								
01	Medium Type (= 00h)								00h
02	Device Specific Parameter (= 00h)								00h
03	Block Descriptor Length (= 00h or 08h)								00/08h
Block Descriptor(s)									
00	Density Code								
01	(MSB)								
02	Number of Blocks (= 00h)								00h
03									(LSB)
04	Reserved								00h
05	(MSB)								
06	Block Length								
07									(LSB)
Page Descriptor(s)									
00	PS(0)	Reserve	Page Code						
01	Page Length								
02 -- NN	--	Page Parameter (Refer to each page)						--	- -

Table 5-3.11.3 MODE SENSE Data

Sense Data Length field (Byte 00) specifies the length in bytes of the following data that is available to be transferred.

Block Length field (Byte 05 to 07 in block descriptors) indicates the data length of each logical block that has been currently set by a MODE SELECT command.

For further details regarding these parameters, refer to 5-3.8 MODE SELECT command.

The page parameters to be returned depends upon the PCF bits.

For the page parameter contents, refer to 5-3.8 MODE SELECT command.

Page 01 (Error Recovery parameters page)			
Bytes	PC =00 (Current)	PC =01(Changeable)	PC =10 (Default)
00d	01h	01h	01h
01d	06h	06h	06h
02d	???	3Fh	00h
03d	???	FFh	05h
04- 07d	00h	00h	00h

Table 5-3.11.4 MODE SENSE Data (Page 01)

Page 02 (Disconnect/Reconnect parameters page)			
Bytes	PC =00 (Current)	PC =01(Changeable)	PC =10 (Default)
00d	02h	02h	02h
01d	0Eh	0Eh	0Eh
02d	???	FFh	09h
03- 09d	00h	00h	00h
10d	???	FFh	00h
11d	???	FFh	00h
12d	???	03h	00h
13-15d	00h	00h	00h

Table 5-3.11.5 MODE SENSE Data (Page 02)

Page 0D (CD-ROM parameters page)			
Bytes	PC =00 (Current)	PC =01(Changeable)	PC =10 (Default)
00d	0Dh	0Dh	0Dh
01d	06h	06h	06h
02d	00h	00h	00h
03d	???	0Fh	09h
04d	00h	00h	00h
05d	3Ch	00h	3Ch
06d	00h	00h	00h
07d	4Bh	00h	4Bh

Table 5-3.11.6 MODE SENSE Data (Page 0D)

Page 0E (Audio Control parameters page)			
Bytes	PC =00 (Current)	PC =01(Changeable)	PC =10 (Default)
00d	0Eh	0Eh	0Eh
01d	0Eh	0Eh	0Eh
02d	???	06h	04h
03- 07d	00h	00h	00h
08d	???	0Fh	01h
09d	???	FFh	3Fh
10d	???	0Fh	02h
11d	???	FFh	3Fh
12-15d	00h	00h	00h

Table 5-3.11.7 MODE SENSE Data (Page 0E)

5-3.12 START/STOP UNIT Command

	7	6	5	4	3	2	1	0	NOTE	
00	Operation Code (= 1Bh)								1Bh	
01	0	0	0	Reserved			Immed			
02	Reserved								00h	
03	Reserved								00h	
04	Reserved					LoEj		Start		
05	0	0	Reserved			Flag		Link		Control

[COMMAND FUNCTION]

Request the CD-ROM to go to SET-UP status or STOP status or CADDY-EJECT.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

<Immed bit> : Immed(Immediate) bit of one indicates that the status shall be returned as soon as the operation is initiated.

Immed bit of zero indicates that the status shall be returned after the operation completes.

<LoEj bit> : LoEj (Load/Eject) bit of one requests to take an action regarding Caddy load/unload operation.

<Start bit> : Start bit of one requests the CD-ROM to go to SET-UP status. Start bit of zero requests the CD-ROM to go to STOP status or CADDY-EJECT status.

[DESCRIPTION]

This command requests the CD-ROM to go to SET-UP status or STOP status or CADDY-EJECT status.

Immed (Immediate) bit (Byte 01, Bit 0) of one indicates that the CD-ROM shall return GOOD status as soon as the operation is initiated upon receipt of CDBs and no status shall be returned after completion of the operation.

Immed bit of zero indicates that the status shall be returned after completion of the operation.

LoEj bit (Load/Eject) bit (Byte 04, Bit 1) of zero indicates that no action shall be taken regarding Caddy load/unload(eject) operation.

LoEj bit of one requests to unload the Caddy (to go to CADDY-EJECT status) if the Start bit is set to zero.

However note that the CD-ROM only goes to STOP status (Caddy does not eject) if prevent medium removal bit is set to one.

LoEj bit and Start bit both set to one is invalid combination and CHECK CONDITION status is reported.

Start bit of one (LoEj bit of zero) requests the CD-ROM to go to SET-UP status by executing following sequence.

- 1) Rotate the spindle motor
- 2) Turn on the laser beam, focusing servo and tracking servo
- 3) Enter hold-track (pause) mode

Typically it takes about 0.9 sec to execute this function.

However note that it is not necessary to issue this command prior to each READ command even if the CD-ROM is in STOP status since the CD-ROM implements same sequence described above automatically.

Start bit of zero (LoEj bit of zero) requests the CD-ROM to go to STOP status by executing following sequence.

- 1) Stop the spindle motor
- 2) Turn off the laser beam, focusing servo and tracking servo
- 3) Move the optical pickup head to the innermost position

Typically it takes about 0.7 sec to execute this function.

5-3.13 RECEIVE DIAGNOSTIC RESULTS Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 1Ch)								1Ch
01	0	0	0	Reserved					00h
02	Reserved								00h
03	(MSB) Allocation Length (LSB)								
04									
05	0	0	Reserved			Flag	Link	Control	

[COMMAND FUNCTION]

Request the CD-ROM to return analysis data to the initiator after completion of a SEND DIAGNOSTIC command.

<Command Type> : TYPE 2

<SCSI Type> : Optional

<Execution Status> : IDLE, READY condition

<Allocation Length> : Maximum number of bytes that the initiator has allocated for the diagnostic data to be received

[DESCRIPTION]

This command requests the CD-ROM to transfer the analysis data which shows the test results that was executed by the SEND DIAGNOSTIC command.

The allocation length field specifies the maximum number of bytes that the initiator has allocated for the diagnostic data to be sent during DATA IN phase.

The CD-ROM shall terminate the DATA IN phase when the allocation length bytes have been transferred or when all available diagnostic data have been transferred to the initiator, whichever is less.

An allocation length of zero indicates that no data shall be transferred.

5-3.14 SEND DIAGNOSTIC Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 1Dh)								1Dh
01	0	0	0	PF	Reserve	SelfTs	DevOf1	UnitOf1	
02	Reserved								00h
03	(MSB) Parameter List Length (LSB)								
04									
05	0	0	Reserved			Flag	Link	Control	

[COMMAND FUNCTION]

Request the CD-ROM to perform diagnostic test on itself.

Self-Test feature is the mandatory requirement of SCSI-2.

<Command Type> : TYPE 3

<SCSI Type> : Mandatory

<Execution Status> : IDLE, READY condition

<PF bit> : PF (Page Format) bit of one indicates that SEND DIAGNOSTIC parameters conform to SCSI-2 definition.

PF bit of zero indicates that all parameters are vendor specific.

<SelfTest bit> : SelfTest (Self-Test) of one directs the CD-ROM to perform its default (predefined) diagnostic self test.

SelfTest bit of zero indicates that the operation is specified by the parameter list.

<Parameter List Length> : The length in bytes of the parameter list that shall be transferred from the initiator .

[DESCRIPTION]

This command requests the CD-ROM to perform diagnostic test on itself specified by the SelfTest bit or parameter list.

As the CD-ROM does not support DevOf1 (Device off-line) and UnitOf1 (Unit off-line) bit, it should be set to zero.

SelfTest (Self-Test) bit of one directs the CD-ROM to perform its default diagnostic self test.

In this case, the Parameter List Length field should be zero and DATA OUT phase shall not be executed.

If this self diagnostic test successfully passes, the command will be terminated with GOOD status, otherwise, the command will be terminated with CHECK CONDITION status if any error was detected.

SelfTest bit of zero indicates that the CD-ROM should perform the diagnostic test specified in parameter list.

There are several diagnostic tests prepared for manufacturing, however we can not disclose its contents because of Toshiba confidential and also we suppose it is not necessary for the customer to implement these tests.

5-3.15 PREVENT ALLOW MEDIUM REMOVAL Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 1Eh)								1Eh
01	0	0	0	Reserved					00h
02	Reserved								00h
03	Reserved								00h
04	Reserved							Prevent	
05	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to enable or disable the medium removal.

<Command Type> : TYPE 1

<SCSI Type> : Optional

<Execution Status> : IDLE, READY condition

<Prevent bit> : Prevent bit of one directs to inhibit the removal of the Caddy.
Prevent bit of zero directs to allow removal.

[DESCRIPTION]

This command requests the CD-ROM to enable or disable the medium (Caddy) removal. Prevent bit (Byte 04, Bit 0) of one directs the CD-ROM to inhibit the medium removal. The prevention status begins when any initiator issues a PREVENT ALLOW MEDIUM REMOVAL command with Prevent bit set to one.

The prevention status shall remain in effect until following events occurs.

- 1) BUS DEVICE RESET message is issued from any initiator.
- 2) RESET condition is created by any SCSI device.
- 3) After all initiators that have medium removal prevented issue a PREVENT ALLOW MEDIUM REMOVAL command with Prevent bit set to zero.

5-3.16 READ CD-ROM CAPACITY Command

	7	6	5	4	3	2	1	0	NOTE	
00	Operation Code (= 25h)								25h	
01	0	0	0	Reserved			RelAdr			
02	(MSB) _____ Logical Block Address _____ (LSB)									
03										
04										
05										
06	Reserved								00h	
07	Reserved								00h	
08	Reserved							PMI		
09	0	0	Reserved			Flag		Link	Control	

[COMMAND FUNCTION]

Request the CD-ROM to transfer the information regarding the capacity of the medium and block length.

<Command Type> : TYPE 2 and TYPE 4

<SCSI Type> : Mandatory

<Execution Status> : READY condition

<RelAdr bit> : RelAdr (Relative Address) bit set to one indicates that the Logical Block Address field is a relative address (two's complement)

<Logical Block Address> : Specifies the minimum logical block address for PMI option

<PMI bit> : PMI (Partial Medium Indicator) bit of one indicates that the CD-ROM should return the last logical block address after which a substantial delay will be encountered.

[DESCRIPTION]

This command requests the CD-ROM to transfer the information regarding the capacity of the medium and also the current block length.

PMI (Partial Medium Indicator) bit (Byte 08, Bit 0) of zero indicates that the returned information (READ CAPACITY data) shall be the last logical block of the medium. This block is last one for seek operation, however it may not be readable or playable block since it may be in a transition area.

The last logical block address can be calculated from following formula with TOC (Table Of Contents) data that is prescribed in CD standard.

$$\text{Last Logical Block Address} = (\text{MIN_leadout} * 60 * 75 + \text{SEC_leadout} * 75 + \text{FRAME_leadout} - 150) * \text{Blksize} - 1$$

Where Blksize =
 4 for block length = 512 byte
 2 for block length = 1024 byte
 1 for other block length

Accordingly, if a medium consists of only CD-ROM data track, this last logical block address shows the total data capacity except for the first pre-gap area (150 physical blocks).

However note that this address does not show the correct data capacity when a medium contains CD-ROM data and CD audio track.

PMI bit of one indicates that the information should be the last logical block address after which a substantial delay in data transfer will be encountered.

This logical block address is greater than or equal to the Logical Block Address field (Byte 02 to 05).

On CD-ROM, this definition is interpreted to be the last readable or playable address of the information area containing or immediately following the specified logical block address.

For instance, if the specified logical block address is in CD-ROM data track, the CD-ROM seeks the transition address from CD-ROM data track to CD audio track.

If there is no transition area beyond the specified address, the CD-ROM returns same logical block address with PMI bit set to zero.

RelAdr (Relative Address) bit (Byte 01, Bit 0) of one indicates that the logical block address field is interpreted as relative address.

When this command is issued as a linking command with other READ or SEEK commands, it is possible to specify the logical block address as a relative address which is expressed as two's complement displacement to the logical block address of the previous command.

Table 5-3.16.1 shows the READ CAPACITY data format consisting of eight bytes which is transferred during DATA IN phase.

The Block Length field indicates the current logical block length in bytes being specified by the latest MODE SELECT command.

For further details, refer to 5-3.8 MODE SELECT command.

	7	6	5	4	3	2	1	0	NOTE
00 (MSB)	Logical Block Address								
01									
02									
03 (LSB)									
04 (MSB)	Block Length								
05									
06									
07 (LSB)									

Table 5-3.16.1 READ CAPACITY Data Format

5-3.17 READ (10) Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 28h)								28h
01	0	0	0	DPO(0)	FUA	Reserved		RelAdr	
02	(MSB)								
03	READ Object Block Address								
04									
05									(LSB)
06									Reserved
07	(MSB)								
08	Transfer Length								(LSB)
09	TYPE		Reserved			Flag		Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to transfer CD-ROM data specified by the READ object block address and transfer length.

<Command Type> : TYPE 4

<SCSI Type> : Mandatory

<Execution Status> : READY condition

<FUA bit> : FUA(Force Unit Access) bit of one indicates that the CD-ROM shall access the medium to perform the command.
FUA bit of zero indicates that the CD-ROM may transfer data from its buffer memory directly without implementing physical seek operation.

<RelAdr bit> : RelAdr (Relative Address) bit set to one indicates that the READ object block address field is a relative address (two's complement)

<READ Block Address> : Specifies the block address at which the read operation shall begin.

The definition varies with Toshiba unique TYPE bit.

<Transfer Length> : The number of logical blocks to be transferred.

<TYPE bit> : Specifies the block addressing mode as follows.

00b : Logical Block Address

01b : CD-ROM Header Address

10b : CD-ROM Track Number (TNO) Address

11b : Not Used

[DESCRIPTION]

This command requests the CD-ROM to transfer CD-ROM data specified by the READ object block address and transfer length.

FUA(Force Unit Access) bit (Byte 01, Bit 3) of one indicates that the CD-ROM shall access the medium (shall implement physical seek operation) to perform the READ command.

FUA bit of zero indicates that the CD-ROM may transfer data from its buffer memory directly, if the requested data is contained in the buffer memory.

Namely the CD-ROM may not implement any physical seek operation to perform the READ command.

The READ Object Block Address field (Byte 02 to 05) specifies the block address at which the read operation shall begin.

If the requested block is not in data track, the CD-ROM terminates the command and returns CHECK CONDITION status.

The sense key is set to BLANK CHECK and the additional sense code is set to ILLEGAL MODE FOR THIS TRACK.

The definition varies with the TYPE bit (Byte 09, Bit 7 & 6) as follows.

1) TYPE = 00b

Specified with Logical Block Address just as READ(6) command.

	7	6	5	4	3	2	1	0	NOTE
02	(MSB)								
03	Logical Block Address								
04									
05									

2) TYPE = 01b

Specified with CD-ROM header address which is the physical address of CD-ROM prescribed in CD-ROM standard.

Address data is BCD data consisting of MIN = 00h to 99h, SEC = 00h to 59h and BLOCK = 00h to 74h.

Note that this definition is Toshiba unique and it is similar but slightly different from MSF address of SCSI-2.

For instance, the block (ten minutes, one seconds, two block) is expressed;

10h : 01h : 02h or 16d : 01d : 02d ... Toshiba unique address

10d : 01d : 02d or 0Ah : 01h : 02h ... SCSI MSF address

The Toshiba CD-ROM drive uses the Toshiba unique address for Toshiba vendor unique command/function and uses SCSI-2 address for SCSI-2 standard audio command.

	7	6	5	4	3	2	1	0	NOTE
02	(MIN)								
03	CD-ROM Header Address								(SEC)
04									(BLOCK)
05	Reserved								00h

3) TYPE = 10b

Specified with CD-ROM track number (TNO) which is also physical address of CD-ROM prescribed in CD-ROM standard.

TNO is BCD data (01h to 99h) and it may be viewed as a partition of a CD-ROM. As well as header address mode, this definition is slightly different from the one of SCSI-2.

For instance, the tenth track number is expressed;

10h or 16d ... Toshiba unique definition

10d or 0Ah ... SCSI definition

	7	6	5	4	3	2	1	0	NOTE
02	CD-ROM TNO (Track Number)								
03	Reserved								00h
04	Reserved								00h
05	Reserved								00h

RelAdr (Relative Address) bit (Byte 01, Bit 0) of one indicates that the READ Object Block Address field is interpreted as a relative address.

When this command is issued as a linking command with other READ or SEEK commands, it is possible to specify the READ Object Block Address as a relative address which is expressed as two's complement displacement to the logical block address of the previous command.

However note that this function is only available for the definition of logical block address mode (TYPE = 00b).

The CD-ROM returns CHECK CONDITION status when the RelAdr bit is set to one and TYPE bit is not 00b.

The transfer length field (Byte 07 and 08) specifies the number of logical blocks of data to be transferred during DATA IN phase.

A transfer length of zero indicates that no data shall be transferred.

The transfer data format (Block length, CD-ROM XA selection etc.) or error recovery parameters are specified by the MODE SELECT command issued prior to the READ (10) command.

Regarding these parameters, refer to 5-3.8 MODE SELECT command.

5-3.18 SEEK (10) Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 2Bh)								2Bh
01	0	0	0	Reserved				RelAdr	
02	SEEK Object Block Address								
03									
04									
05									(LSB)
06	Reserved								00h
07	Reserved								00h
08	Reserved								00h
09	TYPE		Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to seek to the specified SEEK object block address.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

<RelAdr bit> : RelAdr (Relative Address) bit set to one indicates that the SEEK object block address field is a relative address (two's complement)

<SEEK Block Address> : Specifies the block address at which the seek operation shall be executed.

The definition varies with Toshiba unique TYPE bit.

<TYPE bit> : Specifies the block addressing mode as follows.

00b : Logical Block Address

01b : CD-ROM Header Address

10b : CD-ROM Track Number (TNO) Address

11b : Not Used

[DESCRIPTION]

This command requests the CD-ROM to seek to the specified SEEK object block address.

For seek operation of CD-ROM, refer to 5-3.5 SEEK(6) command.

The SEEK Object Block Address field (Byte 02 to 05) specifies the block address at which the seek operation shall be executed.

The definition varies with the TYPE bit (Byte 09, Bit 7 & 6) as follows.

1) TYPE = 00b

Specified with logical block address just as SEEK(6) command.

2) TYPE = 01b

Specified with header address prescribed in CD-ROM standard.

3) TYPE = 10b

Specified with track number (TNO) prescribed in CD-ROM standard.

For further details, refer to 5-3.17 READ(10) command.

RelAdr (Relative Address) bit (Byte 01, Bit 0) of one indicates that the SEEK Object Block Address field is interpreted as a relative address.

When this command is issued as a linking command with other READ or SEEK commands, it is possible to specify the SEEK Object Block Address as a relative address which is expressed as two's complement displacement to the logical block address of the previous command.

However note that this function is only available for the definition of logical block address mode (TYPE = 00b).

5-3.19 VERIFY (10) Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 2Fh)								2Fh
01	0	0	0	DPO(0)	Reserve	BlkVfy	BytChk	RelAdr	
02	(MSB)								
03	VERIFY Object Block Address								
04									
05									(LSB)
06	Reserved								00h
07	(MSB)								
08	Verification Length								
									(LSB)
09	TYPE		Reserved			Flag		Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to verify the CD-ROM data on the medium.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

<BlkVfy bit>, <BytChk bit> : Should be set to zero.

<RelAdr bit> : RelAdr (Relative Address) bit set to one indicates that the VERIFY object block address field is a relative address (two's complement)

<VERIFY Block Address> : Specifies the block address at which the verify operation shall begin.

The definition varies with Toshiba unique TYPE bit.

<Verification Length> : The number of logical blocks to be verified.

<TYPE bit> : Specifies the block addressing mode as follows.

00b : Logical Block Address

01b : CD-ROM Header Address

10b : CD-ROM Track Number (TNO) Address

11b : Not Used

[DESCRIPTION]

This command requests the CD-ROM to verify the CD-ROM data on the installed CD-ROM medium.

BlkVfy (Blank Verify) bit indicates a verification that the blocks are blank, and BytChk (Byte Check) bit indicates a byte-by-byte compare of the data on the medium with the data transferred from the initiator, however these bits should be zero for the CD-ROM.

The CD-ROM supports a medium (quality) verification to be performed with no data comparison.

During verification, the CD-ROM executes same operation as READ command execution except that no data is transferred but only status byte is transferred after verification.

The CD-ROM may execute error recovery operation (ECC, retry) if necessary and if allowed.

The read recovery parameters page (Page 01) of MODE SELECT command is used as the verification criteria as well.

For further details, refer to 5-3.8 MODE SELECT command.

The VERIFY Object Block Address field (Byte 02 to 05) specifies the block address at which the verify operation shall begin.

The definition varies with the TYPE bit (Byte 09, Bit 7 & 6) as follows.

- 1) TYPE = 00b
Specified with logical block address just as READ(6) command.
- 2) TYPE = 01b
Specified with header address prescribed in CD-ROM standard.
- 3) TYPE = 10b
Specified with track number (TNO) prescribed in CD-ROM standard.

For further details, refer to 5-3.17 READ(10) command.

RelAdr (Relative Address) bit (Byte 01, Bit 0) of one indicates that the VERIFY Object Block Address field is interpreted as relative address.

When this command is issued as a linking command with other READ or SEEK commands, it is possible to specify the VERIFY Object Block Address as a relative address which is expressed as two's complement displacement to the logical block address of the previous command.

However note that this function is only available for the definition of logical block address mode (TYPE =00b).

The verification length field (Byte 07 and 08) specifies the number of logical blocks of data to be verified.

A verification length of zero indicates that no data shall be verified.

5-3.20 PRE-FETCH Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 34h)								34h
01	0	0	0	Reserved			Immed	RelAdr	
02	(MSB) _____								
03	PRE-FETCH Object Block Address _____								
04									
05									(LSB) _____
06	Reserved								00h
07	(MSB) _____								
08	Transfer Length _____								(LSB) _____
09	TYPE		Reserved			Flag	Link		Control

[COMMAND FUNCTION]

Request the CD-ROM to transfer the specified blocks into the buffer memory.
No data is transferred to the initiator.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

<Immed bit> : Immed (Immediate) bit of one indicates that the status shall be returned as soon as the command has been transferred.

Immed bit of zero indicates that the status shall be returned after completion of pre-fetch operation.

<RelAdr bit> : RelAdr (Relative Address) bit set to one indicates that the PRE-FETCH object block address field is a relative address (two's complement)

<PRE-FETCH Block Address> : Specifies the block address at which the pre-fetch operation shall begin.

The definition varies with Toshiba unique TYPE bit.

<Transfer Length> : The number of logical blocks to be transferred into the buffer memory.

<TYPE bit> : Specifies the block addressing mode as follows.

00b : Logical Block Address

01b : CD-ROM Header Address

10b : CD-ROM Track Number (TNO) Address

11b : Not Used

[DESCRIPTION]

This command requests the CD-ROM to transfer the CD-ROM data blocks specified with the PRE-FETCH block address and transfer length into the buffer memory.

Upon receipt of this command, the CD-ROM seeks to the specified block and then transfers the specified CD-ROM data into the buffer memory without transferring the data to the initiator.

The initiator can retrieve this stored CD-ROM data by issuing READ command later and the CD-ROM transfers from buffer memory directly (without implementing physical seek operation) and also burst transfer of large amount of blocks can be implemented in that case.

Namely it is possible to improve system throughput by issuing PRE-FETCH command and READ command sequentially.

Immed (Immediate) bit (Byte 01, Bit 1) of one indicates that the status shall be returned as soon as this command is transferred to the CD-ROM.

Immed bit of zero indicates that the status shall be transferred after the pre-fetch operation completes.

The PRE-FETCH Object Block Address field (Byte 02 to 05) specifies the block address at which the CD-ROM data transfer into the buffer memory (pre-fetch operation) shall begin.

The definition varies with the TYPE bit (Byte 09, Bit 7 & 6) as follows.

1) TYPE = 00b

Specified with logical block address just as READ(6) command.

2) TYPE = 01b

Specified with header address prescribed in CD-ROM standard.

3) TYPE = 10b

Specified with track number (TNO) prescribed in CD-ROM standard.

For further details, refer to 5-3.17 READ(10) command.

RelAdr (Relative Address) bit (Byte 01, Bit 0) of one indicates that the PRE-FETCH Object Block Address field is interpreted as a relative address.

When this command is issued as a linking command with other READ or SEEK commands, it is possible to specify the PRE-FETCH Object Block Address as a relative address which is expressed as two's complement displacement to the logical block address of the previous command.

However note that this function is only available for the definition of logical block address mode (TYPE =00b).

The transfer length field (Byte 07 and 08) specifies the number of logical blocks of data to be transferred into the buffer memory.

A transfer length of zero indicates that maximum available number of blocks shall be transferred into the buffer memory.

However note that the CD-ROM may elect not to transfer data actually when the specified data is already contained in the buffer memory.

If Immed bit is zero and the specified blocks were successfully transferred into the buffer memory, the CD-ROM returns CONDITION MET status.

If the Link bit is set to one, it returns INTERMEDIATE-CONDITION MET status.

If Immed bit is one and the buffer memory has enough capacity to accept all specified blocks, the CD-ROM returns CONDITION MET status.

If the Link bit is set to one, it returns INTERMEDIATE-CONDITION MET status.

If Immed bit is one and the buffer memory does not have sufficient capacity to accept all specified blocks, the CD-ROM returns GOOD status.

The CD-ROM transfers into the buffer memory as many blocks as will fit in this case.

If the Link bit is set to one, the CD-ROM returns INTERMEDIATE status.

5-3.21 READ SUB-CHANNEL Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 42h)								42h
01	0	0	0	Reserved			MSF	Reserve	
02	Reserve	SubQ	Reserved						
03	Sub-channel Data Format								
04	Reserved								00h
05	Reserved								00h
06	Track Number								
07	(MSB) Allocation Length								
08									(LSB)
09	0	0	Reserved			Flag	Link	Control	

[COMMAND FUNCTION]

Request the CD-ROM to transfer the requested sub-channel data plus the state of audio playback operation.

<Command Type> : TYPE 2

<SCSI Type> : Optional

<Execution Status> : READY condition

<MSF bit> : MSF(Min/Sec/Frame) bit of zero indicates that the logical block address format should be used for the CD-ROM address field.
MSF bit of one indicates that MSF format should be used.

<SubQ bit> : SubQ(Subcode-Q) bit of one indicates that the CD-ROM should return the Q sub-channel data.

<Sub-channel Data Format> : Specifies the format of returned sub-channel data.

<Track Number> : Specifies the track number from which ISRC data is read.

<Allocation Length> : Maximum number of bytes that the initiator has allocated for returned sub-channel data

[DESCRIPTION]

This command requests the CD-ROM to transfer the requested sub-channel (subcode-Q address data) and current status of audio playback operation.

MSF(Min/Sec/Frame) bit (Byte 01, Bit 1) set to zero indicates that the logical address format should be used for the CD-ROM address field in returned sub-channel data.

MSF bit set to one indicates that the MSF address format of SCSI-2 should be used. However note that this MSF format is different from the address format of CD or CD-ROM standard.

For instance, the Min field has a value between 00h to 63h (99d) in SCSI-2 definition, while it has a value between 00h to 99h in CD standard and so on.

SubQ(Subcode-Q) bit (Byte 01, Bit 6) of one indicates that audio playback status plus Q sub-channel data should be returned.

Sub-Q bit of zero indicates that only audio playback status (sub-channel data header) should be returned.

Sub-channel Data Format field (Byte 03) specified the data format of the sub-channel data to be returned as follows.

Data Format	Returned Data Format
00h	Sub-Q Channel Data
01h	CD-ROM Current Position
02h	Media Catalog Number (UPC/Bar Code)
03h	Track International-Standard-Recording-Code (ISRC)
04h - EFh	Reserved
F0h - FFh	Not Used

Table 5-3.21.1 Sub-channel Data Format

Track Number field (Byte 06) specifies the track number from which ISRC data (ADR 3 data) is read and this field is only valid when Sub-channel Data Format field is set to 03h.

The allocation length field (Byte 07 and 08) specifies the maximum number of bytes that the initiator has allocated for the returned sub-channel data. The CD-ROM terminates the DATA IN phase when the allocation length bytes have been transferred or when all available sub-channel data have been transferred to the initiator, whichever is less.

The sub-channel data consists of 4 bytes header followed by a sub-channel data block. The sub-channel data header consists of audio playback status field and sub-channel data length field as shown in Table 5-3.21.2.

	7	6	5	4	3	2	1	0	NOTE
00	Reserved								00h
01	Audio Status								
02 (MSB)	Sub-channel Data Length								
03									

Table 5-3.21.2 Sub-channel Data Header

Audio Status field (Byte 01) indicates the current status of audio playback operation (Refer to Table 5-3.21.3).

Status 00h is returned for the initiator that has not issued last valid audio playback command to the CD-ROM.

Status 11h to 15h is returned for the initiator that requested the last audio playback command.

11h and 12h is used during audio playback operation.

13h and 14h is prepared when the audio playback operation stopped and these statuses are returned only once after the condition has occurred.

After returning 13h or 14h, the CD-ROM returns 15h for subsequent READ SUB-CHANNEL command.

Status	Description
00h	Audio status byte not valid.
11h	Audio play operation in progress.
12h	Audio play operation paused.
13h	Audio play operation successfully completed.
14h	Audio play operation stopped due to error.
15h	No current audio status to return.

Table 5-3.21.3 Audio Status Code

Sub-channel Data Length field specifies the length in bytes of the following sub-channel data block.

If SubQ bit is set to zero, the CD-ROM does not return following sub-channel data block and set sub-channel data length field to zero.

Table 5-3.21.4 and 5-3.21.7 to 5-3.21.9 show four kinds of sub-channel data format.

1) Sub-Q Channel Data (Data format 00h)

	7	6	5	4	3	2	1	0	NOTE
00 - 03	Sub-channel Data Header								5-3.21.2
04	Sub Channel Data Format code (00h)								00h
05	ADR				Control				
06	Track Number								
07	Index Number								
08 - 11	(MSB)	Absolute CD-ROM Address						(LSB)	- -
12 - 15	(MSB)	Track Relative CD-ROM Address						(LSB)	- -
16	MCVa1	Reserved							
17 - 31	(MSB)	Media Catalog Number (UPC/Bar Code)						(LSB)	- -
32	TCVa1	Reserved							
33 - 47	(MSB)	Track International-Standard-Recording-Code (ISRC)						(LSB)	- -

Table 5-3.21.4 Sub-Q Channel Data Format

The Sub-Q Channel Data block consists of current data (Byte 5 to 15) and identification data (Byte 16 to 47).

Current data is obtained from the Q sub-channel information of the current block, however identification data may be the one of previous block.

ADR field (Byte 05) shows the type of information encoded in the Q sub-channel of this block that is prescribed in CD standard.

ADR Code	Description
00h	Sub-channel Q mode information not supplied.
01h	Sub-channel Q encodes current position data.
02h	Sub-channel Q encodes media catalog number.
03h	Sub-channel Q encodes ISRC.
04 - 0Fh	Reserved

Table 5-3.21.5 ADR Field

Control field (Byte 05) shows the kinds of information in a track defined in CD standard as shown in Table 5-3.21.6.

BIT	Equals zero	Equals one
0	Without Pre-Emphasis	With Pre-Emphasis
1	Digital Copy Prohibited	Digital Copy Permitted
2	Audio Track	Data Track
3	2 Audio Channels	4 Audio Channels

Table 5-3.21.6 Control Field

Track Number field (Byte 06) specifies the current track number which is a sub-division of a disc.

Index Number field (Byte 07) specifies the current index number which is a sub-division of a track.

Absolute CD-ROM Address field (Byte 08 to 11) shows the current location relative to the beginning of the media, or elapsed time on the media.

If MSF bit is zero, logical block addressing is used, and if MSF bit is one, absolute MSF addressing of SCSI-2 is used.

Track Relative CD-ROM Address field (Byte 12 to 15) shows the current location relative to the logical beginning of the current track, or running time within the current track.

If MSF bit is zero, track relative logical block addressing is used, and if current location is in pre-gap area of the track (Index Number is zero), negative value expressed as a two's complement is returned.

If MSF bit is one, relative MSF addressing of SCSI-2 is used.

MCVal (Media catalog valid) bit (Byte 16, Bit 7) of one indicates that the Media Catalog Number field (Byte 17 to 31) is valid.

MCVal bit of zero indicates that the Media Catalog Number field is not valid.

The media catalog number is used as the UPC/EAN code (Bar code) expressed in 13 digits BCD.

The catalog number does not change on a disc.

TCVal (Track code valid) bit (Byte 32, Bit 7) of one indicates that the track ISRC field (Byte 33 to 47) is valid.

TCVal bit of zero indicates that the track ISRC field is not valid.

The track ISRC is used to give a unique number to a track by International Standard Recording Code (ISRC) defined in DIN-31-621.

The ISRC only changes immediate after the track number has been changed.

2) CD-ROM Current Position Data (Data format 01h)

	7	6	5	4	3	2	1	0	NOTE
00 - 03	Sub-channel Data Header								5-3.21.2
04	Sub Channel Data Format code (01h)								01h
05	ADR				Control				
06	Track Number								
07	Index Number								
08 - 11	(MSB) - -	Absolute CD-ROM Address						- -	- -
12 - 15	(MSB) - -	Track Relative CD-ROM Address						- -	- -

Table 5-3.21.7 CD-ROM Current Position Data Format

The CD-ROM Current Position Data block consists of only current data obtained from the Q sub-channel information of the current block.

For further details, refer to description of Sub-Q Channel Data.

3) Media Catalog Number Data (Data format 02h)

	7	6	5	4	3	2	1	0	NOTE
00 - 03	Sub-channel Data Header								5-3.21.2
04	Sub Channel Data Format code (02h)								02h
05	Reserved								00h
06	Reserved								00h
07	Reserved								00h
08	MCVa1	Reserved							
09 - 23	(MSB) - -	Media Catalog Number (UPC/Bar code)						- -	- -

Table 5-3.21.8 Media Catalog Number Data Format

The Media Catalog Number Data block consists of the identification data of a disc. If media catalog number is detected, MCVa1 bit is set to one and valid Media Catalog Number data is returned.

If media catalog number is not detected, MCVa1 bit is set to zero.

4) Track International Standard Recording Code Data (Data format 03h)

	7	6	5	4	3	2	1	0	NOTE
00 - 03	Sub-channel Data Header								5-3.21.2
04	Sub Channel Data Format code (03h)								03h
05	ADR				Control				
06	Track Number								
07	Reserved								00h
08	TCVal	Reserved							
09 - 23	(MSB)	Track International-Standard-Recording-Code (ISRC)						(LSB)	- -

Table 5-3.21.9 Track ISRC Data Format

The Track ISRC Data block consists of the identification data of a track.
 If ISRC data is detected, TCVal bit is set to one and valid track ISRC data is returned.
 If ISRC data is not detected, TCVal bit is set to zero.

5-3.22 READ TOC Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 43h)								43h
01	0	0	0	Reserved			MSF	Reserve	
02	Reserved								00h
03	Reserved								00h
04	Reserved								00h
05	Reserved								00h
06	Starting Track								
07	(MSB)	Allocation Length						(LSB)	
08									
09	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to transfer TOC (Table Of Contents) data to the initiator.

<Command Type> : TYPE 2

<SCSI Type> : Optional

<Execution Status> : READY condition

<MSF bit> : MSF(Min/Sec/Frame) bit of zero indicates that the logical block address format should be used for the CD-ROM address field.

MSF bit of one indicates that MSF format should be used.

<Starting Track> : Specifies the starting track number for which the TOC data shall be returned.

<Allocation Length> : Maximum number of bytes that the initiator has allocated for the returned READ TOC data

[DESCRIPTION]

The command requests the CD-ROM to transfer the TOC (Table Of Contents) data which is prescribed in CD standard to the initiator.

MSF(Min/Sec/Frame) bit defines the addressing mode.

Refer to 5-3.21 READ SUB-CHANNEL command for the description MSF bit.

The Starting Track field (Byte 06) specifies the starting track number (TNO) for which the TOC data shall be returned.

This field must have a value between 00h to 63h (99d) and a value of zero specifies that the TOC data from first track on the medium shall be returned.

If the starting track number is not valid for currently installed medium, CHECK CONDITION status is returned.

The allocation length field (Byte 07,08) specifies the maximum number of bytes that the initiator has allocated for the returned READ TOC data.

The CD-ROM terminates the DATA IN phase when the allocation length bytes have been transferred or when all available READ TOC data have been transferred to the initiator, whichever is less.

The READ TOC data consists of 4 bytes header followed by zero or more TOC Track Descriptors as shown in Table 5-3.22.1.

	7	6	5	4	3	2	1	0	NOTE
00	(MSB) TOC Data Length								
01	(LSB)								
02	First Track Number								
03	Last Track Number								
TOC Track Descriptors									
00	Reserved								00h
01	ADR				Control				
02	Track Number								
03	Reserved								00h
04	(MSB) Absolute CD-ROM Address								
07	(LSB)								

Table 5-3.22.1 READ TOC Data Format

TOC Data Length field (Byte 00 and 01) specifies the length in bytes of the following TOC data and it does not include the TOC Data Length field itself.

First Track Number field (Byte 02) indicates the first (minimum) track number of the installed medium which has a value between 01h to 63h(99d).

Note that the first track number is not required to be one(1) and a medium may start at any valid (BCD) track number.

Last Track Number field (Byte 03) indicates the last (maximum) track number of the installed medium which has a value between 01h to 63h(99d).

ADR and Control field (Byte 01 in TOC Track Descriptor) indicates the type of information or attributes which denotes each track.

For further details, refer to 5-3.21 READ SUB-CHANNEL command.

Track Number field (Byte 02 in TOC Track Descriptor) indicates the track number for each TOC Track Descriptor.

TOC data is returned in contiguous ascending track number order and TOC Track Descriptor of the lead-out area (Track Number field is AAh) is returned last.

Absolute CD-ROM Address field (Byte 04 to 07) indicates the address of the first block with user information (Index 01) for that track.

Logical block addressing is used for MSF bit set to zero and MSF absolute addressing of SCSI-2 is used for MSF bit set to one.

Note that CD and CD-ROM standard allows that this starting address value has a tolerance of plus/minus one second for audio tracks and zero for data tracks.

5-3.23 READ HEADER Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 44h)								44h
01	0	0	0	Reserved			MSF	Reserve	
02	(MSB)								
03	Logical Block Address								
04									
05									(LSB)
06									Reserved
07	(MSB)								
08	Allocation Length								(LSB)
09	0	0	Reserved			Flag	Link	Control	

[COMMAND FUNCTION]

Request the CD-ROM to transfer CD-ROM header address data of the specified block to the initiator.

<Command Type> : TYPE 4

<SCSI Type> : Optional

<Execution Status> : READY condition

<MSF bit> : MSF(Min/Sec/Frame) bit of zero indicates that the logical block address format should be used for the CD-ROM address field.
MSF bit of one indicates that MSF format should be used.

<Logical Block Address> : The logical block address at which the read header operation shall be executed.

<Allocation Length> : Maximum number of bytes that the initiator has allocated for the returned READ HEADER data

[DESCRIPTION]

This command requests the CD-ROM to transfer CD-ROM header address data of the specified block to the initiator.

MSF(Min/Sec/Frame) bit defines the addressing mode.

Refer to 5-3.21 READ SUB-CHANNEL command for the description of MSF bit.

Logical block address (Byte 01 to 03) specifies the logical block at which read header operation shall be executed.

If the logical block length is other than physical block length (i.e. 512 or 1024 bytes), it is mapped into appropriate physical address and read header operation is executed.

The allocation length field (Byte 07,08) specifies the maximum number of bytes that the initiator has allocated for the returned READ HEADER data.

The CD-ROM terminates the DATA IN phase when the allocation length bytes have been transferred or when all available READ HEADER data have been transferred to the initiator, whichever is less.

Table 5-3.23.1 shows the READ HEADER data format.

	7	6	5	4	3	2	1	0	NOTE	
00	CD-ROM Data Mode									
01	Reserved								00h	
02	Reserved								00h	
03	Reserved								00h	
04 - 07	(MSB) - -	Absolute CD-ROM Address						- -	(LSB) -	-

Table 5-3.23.1 READ HEADER Data Format

CD-ROM Data Mode field (Byte 00) specifies the CD-ROM mode data in the specified block.

The values are defined in CD-ROM standard as shown in Table 5-3.23.2.

CD-ROM Mode	Description
00h	Consists of all zero data.
01h	Consists of user data (2048byte) plus ECC/EDC data (288 bytes)
02h	Consists of user data (2336 bytes)
03h - FFh	Reserved

Table 5-3.23.2 CD-ROM Mode

If MSF bit is set to zero, the absolute CD-ROM Address field (Byte 04 to 07) shows the logical block address of the first logical block in physical block where the specified logical block is found.

Namely this address may be different from the specified logical block address in CDB, if the block length is either 512 or 1024 bytes.

If MSF bit is set to one, the absolute CD-ROM Address field indicates the MSF address of SCSI-2 where the specified logical block is found.

5-3.24 PLAY AUDIO (10) Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 45h)								45h
01	0	0	0	Reserved			RelAdr		
02	(MSB)								
03	Logical Block Address								
04									
05									(LSB)
06	Reserved								00h
07	(MSB)								
08	Transfer Length								(LSB)
09	0	0	Reserved			Flag		Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to begin an audio playback operation from the specified logical block address.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

<RelAdr bit> : RelAdr (Relative Address) bit set to one indicates that the logical block address field is a relative address (two's complement)

<Logical Block Address> : Specifies the block address at which the audio playback operation shall begin.

<Transfer Length> : The number of logical blocks to be played.

[DESCRIPTION]

This command requests the CD-ROM to search and start an audio playback operation from the specified logical block address and to complete audio playback when specified blocks have been played.

The command function (Immed and SOTC bit) and the output of audio signals is specified by the Audio Control parameters page of MODE SELECT command.

Refer to 5-3.8 MODE SELECT command for the descriptions of these parameters.

Logical Block Address field (Byte 02 to 05) specifies the block address at which the audio playback operation shall begin.

RelAdr (Relative Address) bit (Byte 01, Bit 0) of one indicates that the Logical Block Address field is interpreted as a relative address.

When this command is issued as a linking command with other READ or PLAY AUDIO commands, it is possible to specify the Logical Block Address as a relative address which is expressed as two's complement displacement to the logical block address of the previous command.

If the requested logical block address is not in audio track, the CD-ROM terminates the command and returns CHECK CONDITION status.

The sense key is set to BLANK CHECK and the additional sense code is set to ILLEGAL MODE FOR THIS TRACK.

The transfer length field (Byte 07 and 08) specifies the number of logical blocks that shall be played.

When SOTC bit in Audio Control parameters page is set to zero, the CD-ROM terminates the audio playback operation when the requested transfer length is played. When SOTC bit is set to one, the CD-ROM terminates the audio playback operation either when the beginning of next track (Index 0 or 1) is encountered or when the requested transfer length is played.

A transfer length of zero indicates that no audio playback shall occur.

If the logical block length is not equal to the physical block size, the CD-ROM may start the audio playback operation with the beginning of the physical block in which the specified logical block is included.

It may continue the audio playback operation through the end of the physical block in which the calculated last requested logical block is included.

If the CD-ROM encounters data track during audio playback operation, it terminates the audio playback operation.

If Immed bit is set to zero, the CD-ROM returns CHECK CONDITION status with sense key set to BLANK CHECK and additional sense code set to END OF USER AREA ENCOUNTERED ON THIS TRACK.

5-3.25 PLAY AUDIO MSF Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 47h)								47h
01	0	0	0	Reserved					00h
02	Reserved								00h
03	Starting M Field								
04	Starting S Field								
05	Starting F Field								
06	Ending M Field								
07	Ending S Field								
08	Ending F Field								
09	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to begin an audio playback operation from the specified absolute MSF address.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

<Starting M/S/F Field> : Specifies the absolute MSF address at which the audio playback operation shall begin.

<Ending M/S/F Field> : Specifies the absolute MSF address at which the audio playback operation shall end.

[DESCRIPTION]

This command requests the CD-ROM to search and start an audio playback operation from the specified absolute MSF address (Starting address) and to complete audio playback when specified MSF address (Ending address) is encountered.

The command function (Immed and SOTC bit) and the output of audio signals is specified by the Audio Control parameters page of MODE SELECT command. Refer to 5-3.8 MODE SELECT command for the descriptions of these parameters.

Starting M Field (Byte 03), S Field (Byte 04) and F Field (Byte 05) specifies the absolute CD address (Minutes, Second and Frame) of SCSI-2 definition at which the audio playback operation shall begin.

M Field has a value between 00h to 63h (99d), S Field has a value between 00h to 3Bh (59d) and F Field has a value between 00h to 4Ah (74d).

Ending M Field (Byte 06), S Field (Byte 07) and F Field (Byte 08) specifies the absolute CD address (Minutes, Second and Frame) of SCSI-2 definition at which the audio playback operation shall end.

If the requested starting address is not in audio track, the CD-ROM terminates the command and returns CHECK CONDITION status.

Basically all audio sectors between starting and the ending MSF address is played, however the CD-ROM terminates the audio playback operation when the beginning of next track (Index 0 or 1) is encountered, if SOTC bit is set to one.

If the CD-ROM encounters data track during audio playback operation, it terminates the audio playback operation.

If the starting MSF address equal to the ending MSF address, no audio playback shall occur.

If the starting MSF address is less than the ending MSF address, the CD-ROM terminates the command with CHECK CONDITION status.

5-3.26 PLAY AUDIO TRACK INDEX Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 48h)								48h
01	0	0	0	Reserved					00h
02	Reserved								00h
03	Reserved								00h
04	Starting Track								
05	Starting Index								
06	Reserved								00h
07	Ending Track								
08	Ending Index								
09	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to begin an audio playback operation from the specified track number and/or index number.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

<Starting Track/Index> : Specifies the Track/Index number at which the audio playback operation shall begin.

<Ending Track/Index> : Specifies the Track/Index number at which the audio playback operation shall end.

[DESCRIPTION]

This command requests the CD-ROM to search and start an audio playback operation from the specified track number and/or index number (Starting Track/Index) and specifies the track/index number (Ending Track/Index) at which the audio playback operation shall end.

The command function (Immed and SOTC bit) and the output of audio signals is specified by the Audio Control parameters page of MODE SELECT command.

Refer to 5-3.8 MODE SELECT command for the descriptions of these parameters.

Starting Track (Byte 04) and Index (Byte 05) specifies the track number and index number of SCSI-2 definition at which the audio playback operation shall begin.

Both fields have a value between 01h to 63h (99d)

Starting index of one(1) specifies that the audio playback shall start with the first audio sector (Index 01) of the track.

If the requested track is not audio track, the CD-ROM returns CHECK CONDITION status.

If the starting index is greater than the largest actual index on the starting track, the CD-ROM implements followings depending upon SOTC bit.

1) If SOTC bit is set to zero;

Audio playback operation starts from the beginning of the next track.

2) If SOTC bit is set to one;

Terminates the command with CHECK CONDITION status.

Ending Track (Byte 07) specifies the track number of the ending audio track.

Ending Index (Byte 08) specifies the index number within the track after which the audio playback operation shall stop.

If the starting address is less than the ending address, the CD-ROM terminates the command with CHECK CONDITION status.

Basically the audio playback operation shall end at the last sector with the track number and index number of current sector is equal to the ending track and ending index.

If the ending track is greater than the last track on the medium, the audio playback operation shall continue until the last sector of the last track.

Also if the ending index is greater than the largest actual index on the ending track, the audio playback shall continue through the last sector of the track.

For instance, the ending track of 63h(99d) and ending index of 63h(99d) can specify to continue audio playback of whole medium even if the user does not know the medium layout.

SOTC bit is effective as well and the CD-ROM terminates the audio playback operation when the beginning of next track (Index 0 or 1) is encountered, if SOTC bit is set to one.

If the CD-ROM encounters data track during audio playback operation, it terminates the audio playback operation.

5-3.27 PLAY AUDIO TRACK RELATIVE (10) Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 49h)								49h
01	0	0	0	Reserved					00h
02	Track Relative Logical Block Address								---
03									---
04									---
05									---
05									(LSB)
06	Starting Track								
07	Transfer Length								---
08									(LSB)
09	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to begin an audio playback operation from the specified logical block address.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

<Track Relative Logical Block Address> : Specifies the block address within the specified starting track at which the audio playback operation shall begin.

<Starting Track> : Specifies the track number of the starting audio track.

<Transfer Length> : The number of logical blocks to be played.

[DESCRIPTION]

This command requests the CD-ROM to search and start an audio playback operation from the specified logical block address and to complete audio playback when specified blocks have been played.

The command function (Immed and SOTC bit) and the output of audio signals is specified by the Audio Control parameters page of MODE SELECT command.

Refer to 5-3.8 MODE SELECT command for the descriptions of these parameters.

Track Relative Logical Block Address field (Byte 02 to 05) (TRLBA) specifies the block address at which the audio playback operation shall begin.

Starting Track field (Byte 06) specifies the track number of the starting audio track and has a value between 01h to 63h (99d)

TRLBA field is relative logical block to the beginning of the first sector on the starting track with an index value of one (1) expressed as two's complement.

Negative value indicates that the audio playback operation shall start within the audio silent area (index 00) of the requested track.

If the requested logical block address is not in audio track or not in requested track number, the CD-ROM terminates the command and returns CHECK CONDITION status.

The transfer length field (Byte 07 and 08) specifies the number of logical blocks that shall be played.

When SOTC bit in Audio Control parameters page is set to zero, the CD-ROM terminates the audio playback operation when the requested transfer length is played. When SOTC bit is set to one, the CD-ROM terminates the audio playback operation either when the beginning of next track (Index 0 or 1) is encountered or when the requested transfer length is played.

A transfer length of zero indicates that no audio playback shall occur.

If the CD-ROM encounters data track during audio playback operation, it terminates the audio playback operation.

If the logical block length is not equal to the physical block size, the CD-ROM may start the audio playback operation with the beginning of the physical block in which the specified logical block is included.

It may continue the audio playback operation through the end of the physical block in which the calculated last requested logical block is included.

5-3.28 PAUSE RESUME Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= 4Bh)								4Bh
01	0	0	0	Reserved					00h
02	Reserved								00h
03	Reserved								00h
04	Reserved								00h
05	Reserved								00h
06	Reserved								00h
07	Reserved								00h
08	Reserved							Resume	
09	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to stop (pause) or to start (resume) an audio playback operation.

<Command Type> : TYPE 1

<SCSI Type> : Optional

<Execution Status> : READY condition

<Resume bit> : Resume bit of zero requests the CD-ROM to start pause during an audio playback operation.

Resume bit of one requests the CD-ROM to release pause status and resume audio playback operation.

[DESCRIPTION]

This command requests the CD-ROM to stop (pause) the audio playback operation temporary or to release the pause status and start (resume) the audio playback operation.

Resume bit (Byte 08, Bit 1) set to zero requests the CD-ROM to enter hold (pause) status with audio output muted.

During this hold status, the CD-ROM maintains the optical pickup head at an approximately constant position.

The CD-ROM returns CHECK CONDITION status to this command with Resume bit set to zero when an audio playback operation is not in progress.

Resume bit set to one requests the CD-ROM to release the pause status and start (resume) the audio playback operation.

The CD-ROM releases the pause status and audio playback resumes from the audio sector following the last block played before pause status.

It is not an error to request a pause when a pause is already in effect or to request a resume when an audio playback operation is in progress.

Note that it is also possible to release pause status by issuing another command such as PLAY AUDIO or READ command.

5-3.29 PLAY AUDIO (12) Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= A5h)								A5h
01	0	0	0	Reserved			RelAdr		
02	(MSB) _____ Logical Block Address _____								
03									
04									
05									(LSB)
06	(MSB) _____ Transfer Length _____								
07									
08									
09									(LSB)
10	Reserved								00h
11	0	0	Reserved			Flag	Link	Control	

[COMMAND FUNCTION]

Request the CD-ROM to begin an audio playback operation from the specified logical block address.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

<RelAdr bit> : RelAdr (Relative Address) bit set to one indicates that the logical block address field is a relative address (two's complement)

<Logical Block Address> : Specifies the block address at which the audio playback operation shall begin.

<Transfer Length> : The number of logical blocks to be played.

[DESCRIPTION]

This command requests the CD-ROM to search and start an audio playback operation from the specified logical block address and to complete audio playback when specified blocks have been played.

The function is same as PLAY AUDIO (10) command and the only difference is Transfer Length field.

This command can specify up to 4294967295d (FFFFFFFFh) blocks of transfer length and it covers entire address of one CD (CD-ROM) medium, while PLAY AUDIO (10) command covers 65535d (FFFFh) blocks which corresponds to 14min 33sec 60frame. For a description of each fields in this command, refer to 5-3.24 PLAY AUDIO (10) command.

5-3.30 READ (12) Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= A8h)								A8h
01	0	0	0	DPO(0)	FUA	Reserved		RelAdr	
02	(MSB) _____ READ Object Block Address _____								
03									
04									
05									(LSB)
06	(MSB) _____ Transfer Length _____								
07									
08									
09									(LSB)
10	Reserved								00h
11	TYPE		Reserved			Flag	Link		Control

[COMMAND FUNCTION]

Request the CD-ROM to transfer CD-ROM data specified by the READ object block address and transfer length.

<Command Type> : TYPE 4

<SCSI Type> : Mandatory

<Execution Status> : READY condition

<FUA bit> : FUA(Force Unit Access) bit of one indicates that the CD-ROM shall access the medium to perform the command.
FUA bit of zero indicates that the CD-ROM may transfer data from its buffer memory directly without implementing physical seek operation.

<RelAdr bit> : RelAdr (Relative Address) bit set to one indicates that the READ object block address field is a relative address (two's complement)

<READ Block Address> : Specifies the block address at which the read operation shall begin.

The definition varies with Toshiba unique TYPE bit.

<Transfer Length> : The number of blocks or tracks to be transferred.

The definition varies with Toshiba unique TYPE bit.

<TYPE bit> : Specifies the block addressing mode of both READ Block Address and Transfer Length field as follows.

00b : Logical Block Address

01b : CD-ROM Header Address

10b : CD-ROM Track Number (TNO) Address

11b : Not Used

[DESCRIPTION]

This command requests the CD-ROM to transfer CD-ROM data specified by the READ object block address and transfer length.

The command function is almost same as READ (10) command except for Transfer Length field.

For a description of each fields except for Transfer Length, refer to 5-3.17 READ (10) command.

As the transfer length field of READ (10) command is defined as logical blocks, READ (12) command enables to use three kinds of Toshiba unique addressing as well as READ Object Block Address.

The definition varies with also the TYPE bit (Byte 09, Bit 7 & 6) as follows.

1) TYPE = 00b

Specified with Logical Block just as READ(10) command.

	7	6	5	4	3	2	1	0	NOTE
06	(MSB)								
07	Logical Block								
08									
09									
	(LSB)								

2) TYPE = 01b

Specified with CD-ROM header address.

Address data is BCD data consisting of MIN = 00h to 99h, SEC = 00h to 59h and BLOCK = 00h to 74h.

Note that it does not specify the ending address but transfer length and addressing is Toshiba unique address.

For instance, if the CDB is;

A 8h 00h 11h,12h,13h,00h,04h,05h,06h,00h,00h,40h

The CD-ROM transfers the contiguous block from 11min 12sec 13block to 15min 17sec 18block (Total 18381d blocks).

	7	6	5	4	3	2	1	0	NOTE
06									(MIN)
07	CD-ROM Header Address								(SEC)
08									(BLOCK)
09	Reserved								00h

3) TYPE = 10b

Specified with CD-ROM track number (TNO).

TNO is a BCD data (01h to 99h) and note that it specifies the number of tracks to be transferred.

For instance, if the CDB is;

A 8h,00h,11h,00h,00h,00h,02h,00h,00h,00h,80h

The CD-ROM transfers the whole contiguous block of track number 11 and 12.

	7	6	5	4	3	2	1	0	NOTE
06	CD-ROM TNO (Track Number)								
07	Reserved								00h
08	Reserved								00h
09	Reserved								00h

5-3.31 PLAY AUDIO TRACK RELATIVE (12) Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= A9h)								A9h
01	0	0	0	Reserved					00h
02	Track Relative Logical Block Address								
03									
04									
05									(LSB)
06									(MSB)
07	Transfer Length								
08									
09									(LSB)
10	Starting Track								
11	0	0	Reserved			Flag	Link	Control	

[COMMAND FUNCTION]

Request the CD-ROM to begin an audio playback operation from the specified logical block address.

<Command Type> : TYPE 3

<SCSI Type> : Optional

<Execution Status> : READY condition

<Track Relative Logical Block Address> : Specifies the block address within the specified starting track at which the audio playback operation shall begin.

<Starting Track> : Specifies the track number of the starting audio track.

<Transfer Length> : The number of logical blocks to be played.

[DESCRIPTION]

This command requests the CD-ROM to search and start an audio playback operation from the specified logical block address and to complete audio playback operation when specified blocks have been played.

The function is same as PLAY AUDIO TRACK RELATIVE (10) command and the only difference is Transfer Length field.

This command can specify up to 4294967295d (FFFFFFFFh) blocks of transfer length and it covers entire address of one CD (CD-ROM) medium, while PLAY AUDIO (10) command covers 65535d (FFFFh) blocks which corresponds to 14min 33sec 60frame. For a description of each fields in this command, refer to 5-3.27 PLAY AUDIO TRACK RELATIVE (10) command.

5-3.32 AUDIO TRACK SEARCH Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= C0h)								C0h
01	0	0	0	Reserved			PLAY		
02	(MSB) SEARCH Block Address (LSB)								
03									
04									
05									
06	Reserved								00h
07	Reserved								00h
08	Reserved								00h
09	TYPE		Reserved			Flag	Link	Control	

[COMMAND FUNCTION]

Request the CD-ROM to search to the specified address and to begin an audio playback operation from there, if specified.

<Command Type> : TYPE 3

<SCSI Type> : Vendor Unique

<Execution Status> : READY condition

<PLAY bit> : PLAY bit set to one indicates that audio playback operation shall begin after search operation.

PLAY bit set to zero requests the CD-ROM to enter pause (hold track) status after search operation.

<SEARCH Block Address> : Specifies the block address at which the audio search operation shall begin.

The definition varies with Toshiba unique TYPE bit.

<TYPE bit> : Specifies the block addressing mode as follows.

00b : Logical Block Address for Toshiba Audio

01b : CD Subcode-Q Absolute Time (ATIME) Address

10b : CD Track Number (TNO) Address

11b : Not Used

[DESCRIPTION]

This command requests the CD-ROM to search to the specified address and to start an audio playback operation from there, if specified.

The CD-ROM returns GOOD status as soon as the search operation completes (or audio playback operation is initiated) just as Immed bit in Audio Control parameters page is set to one.

AUDIO TRACK SEARCH command has similar function to PLAY AUDIO commands (PLAY AUDIO, PLAY AUDIO MSF and PLAY AUDIO TRACK/INDEX) of SCSI-2 except that this command does not have a function to specify the ending address of audio playback.

PLAY bit (Byte 01, Bit 0) of one indicates that the audio playback operation shall begin from the specified address automatically after completion of search operation. PLAY bit of zero indicates that pause status (hold track status) shall begin after completion of search operation.

Pause here is defines as the operation to maintain the optical pickup head at an approximately constant position around SEARCH Object Address to prepare for the next command which request to start audio playback operation.

For instance, this pause status is released by the TOSHIBA PLAY AUDIO command.

SEARCH Object Address field (Byte 02 to 05) specifies the subcode-Q address at which the audio search operation shall be executed.

The definition varies with the TYPE bit (Byte 09, Bit 7 & 6) as follows.

1) TYPE = 00b

Specified with Logical Block Address defined for Toshiba audio commands.

The formula to convert the CD physical address to Logical Block Address for Toshiba Audio is defined as follows.

$$\text{Logical Block Address for Toshiba Audio} = \text{Min} \times 60 \times 75 + \text{Sec} \times 75 + \text{Frame} - 150$$

Note that the block length (size) specified with MODE SELECT command is ignored. (In other words, Block_Size is always set to one (1).)

	7	6	5	4	3	2	1	0	NOTE
02	(MSB)								
03	Logical Block Address for Toshiba Audio								
04									
05									
									(LSB)

2) TYPE = 01b

Specified with CD Subcode-Q Absolute Time Address (ATIME) which is the physical address prescribed in CD standard.

Address data is BCD data consisting of MIN = 00h to 99h, SEC = 00h to 59h and BLOCK = 00h to 74h.

For instance, the address (ten minutes, one seconds, two frame) is expressed;

10h : 01h : 02h or 16d : 01d : 02d

	7	6	5	4	3	2	1	0	NOTE
02	(MIN)								
03	CD Subcode-Q Absolute Time Address (ATIME) (SEC)								
04	(FRAME)								
05	Reserved								00h

3) TYPE = 10b

Specified with CD track number (TNO) which is also physical address prescribed in CD standard.

TNO is a BCD data (01h to 99h).

For instance, the tenth track number is expressed as 10h or 16d.

	7	6	5	4	3	2	1	0	NOTE
02	CD-ROM TNO (Track Number)								
03	Reserved								00h
04	Reserved								00h
05	Reserved								00h

If the TYPE field is 10b and if the requested track is not in audio track, the CD-ROM terminates the command and returns CHECK CONDITION status just as SCSI-2 audio commands.

The sense key is set to BLANK CHECK and the additional sense code is set to ILLEGAL MODE FOR THIS TRACK.

Note that the CD-ROM returns GOOD status even if the requested address is not in audio track, if the TYPE field is set to 00b or 01b (Logical Block Address or ATIME mode).

Followings show several remarks regarding audio playback operation initiated by AUDIO TRACK SEARCH command with PLAY bit set to one.

If the CD-ROM encounters data track during audio playback operation, it does not terminate but continues audio playback operation with audio output muted.

Since then if the CD-ROM encounters audio track again, the CD-ROM releases the muting and continues audio playback operation.

Note that this operation is Toshiba unique and differs from SCSI-2 definition.

SCSI-2 audio control commands, READ SUB-CHANNEL, REQUEST SENSE and Audio Control parameters page in MODE SELECT command are available except that SOTC bit in Audio Control parameters page is ignored.

The CD-ROM does not terminate audio playback operation when the beginning of next track is encountered even if SOTC bit is set to one.

In addition to above commands, Toshiba vendor unique audio control commands are naturally available.

The output channel selection mode is set to L/R stereo mode and Output Port x Channel Control field in Audio Control parameters page is rewrite to default value automatically when the CD-ROM begins audio playback operation.

This channel selection mode can be modified with MODE SELECT command or TOSHIBA PLAY AUDIO command later.

As the audio playback ending address is not specified, the CD-ROM continues the audio playback operation until the last sector of last track number.

It is possible to specify the ending address with TOSHIBA PLAY AUDIO command.

For further details, refer to 5-3.33 TOSHIBA PLAY AUDIO command.

5-3.33 TOSHIBA PLAY AUDIO Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= C1h)								C1h
01	0	0	0	Reserved		PLAY MODE			
02	(MSB)								
03	Audio Playback Ending Address								
04									
05									
05	(LSB)								
06	Reserved								00h
07	Reserved								00h
08	Reserved								00h
09	TYPE		Reserved			Flag	Link		Control

[COMMAND FUNCTION]

Request the CD-ROM to begin an audio playback operation and/or to change the output channel selection mode and/or to specify the audio playback operation ending address.

<Command Type> : TYPE 1

<SCSI Type> : Vendor Unique

<Execution Status> : READY condition

<Audio Playback Ending Address> : Specifies the subcode-Q absolute time address at which the audio playback operation shall end.

The definition varies with Toshiba unique TYPE bit.

<TYPE bit> : Specifies the block addressing mode as follows.

00b : Logical Block Address for Toshiba Audio

01b : CD Subcode-Q Absolute Time (ATIME) Address

10b : CD Track Number (TNO) Address

11b : Ignore address field.

[DESCRIPTION]

This command requests the CD-ROM to begin (or resume) an audio playback operation and/or to change the output channel selection mode and/or to specify the audio playback ending address.

This command has similar function to RESUME command, or Audio Control parameters page in MODE SELECT command, or the ending address field of PLAY AUDIO commands.

The first function of this command is to request the CD-ROM to release following status and to begin audio playback operation.

- 1) PAUSE status initiated by AUDIO TRACK SEARCH command with PLAY bit set to zero
- 2) STILL status initiated by PAUSE command or STILL command

The second function is to specify the output channel selection mode.

PLAY MODE field (Byte 01) specifies output channel selection mode as shown in below.

Output Port x Channel Control field in Audio Control parameters page is rewrote to appropriate value and unit attention condition is also generated for other initiators.

PLAY MODE	Function
000b (00h)	Output muted
001b (01h)	Left channel Mono
010b (02h)	Right channel Mono
011b (03h)	L/R channel Stereo
100b (04h)	Preserve current selection mode

Table 5-3.33.1 Channel Selection

The third function is to specify the audio playback ending address.

Playback Ending Address (Byte 02 to 05) specifies subcode-Q address at which the audio playback operation shall end.

The definition varies with the TYPE bit (Byte 09, Bit 7 & 6) as follows and refer to 5-3.32 AUDIO TRACK SEARCH command for further details.

1) TYPE = 00b

Specified with Logical Block Address defined for Toshiba audio commands.

2) TYPE = 01b

Specified with CD Subcode-Q Absolute Time Address (ATIME) which is the physical address prescribed in CD standard.

Address data is BCD data consisting of MIN = 00h to 99h, SEC = 00h to 59h and BLOCK = 00h to 74h.

3) TYPE = 10b

Specified with CD track number (TNO) which is also physical address prescribed in CD standard.

TNO is a BCD data (00h to 99h) and zero indicates that the audio playback operation shall continue until the last sector of the last track.

The CD-ROM terminates audio playback operation until one sector before the specified Playback Ending Address (track).

Note that this definition differs from SCSI-2 that the audio playback operation is continued until the last sector of the specifies track.

For instance, the CD-ROM continues audio playback operation until the last sector of track number of 5 if the specifies Playback Ending Address is 6.

4) TYPE = 11b

The specified Playback Ending Address is ignored and preserve the previous (current) ending address.

If the CD-ROM encounters data track during audio playback operation, it does not terminate but continues audio playback operation with audio output muted.

Since then if the CD-ROM encounters audio track again, the CD-ROM releases the muting and continues audio playback operation.

Note that this operation is Toshiba unique and differs from SCSI-2 definition.

SCSI-2 audio control commands, READ SUB-CHANNEL, REQUEST SENSE and Audio Control parameters page in MODE SELECT command are available except that SOTC bit in Audio Control parameters page is ignored.

The CD-ROM does not terminate audio playback operation when the beginning of next track is encountered even if SOTC bit is set to one.

In addition to above commands, Toshiba vendor unique audio control commands are naturally available.

5-3.34 STILL Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= C2h)								C2h
01	0	0	0	Reserved					00h
02	Reserved								00h
03	Reserved								00h
04	Reserved								00h
05	Reserved								00h
06	Reserved								00h
07	Reserved								00h
08	Reserved								00h
09	0	0	Reserved			Flag	Link	Control	

[COMMAND FUNCTION]

Request the CD-ROM to stop the audio playback operation and to begin still operation.

<Command Type> : TYPE 1
 <SCSI Type> : Vendor Unique
 <Execution Status> : READY condition

[DESCRIPTION]

This command requests the CD-ROM to stop the audio playback operation temporary and to begin still operation.

This command has similar function to PAUSE command of SCSI-2.

During this still operation, the CD-ROM maintains the optical pickup head at an approximately constant position with audio output muted.

The CD-ROM returns CHECK CONDITION status to this command when an audio playback operation is not in progress.

However it is not an error to request a still when a still is already in effect.

Still operation is released by TOSHIBA PLAY AUDIO command or RESUME command and audio playback operation resumes from the sector following the last sector played before still operation.

It is also possible to release still operation by issuing another command such as PLAY AUDIO or READ command.

5-3.35 SET STOP TIME Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= C3h)								C3h
01	0	0	0	Inactivity Time (MIN)					
02									(SEC)
03	Reserved								00h
04	Reserved								00h
05	Reserved								00h
06	Reserved								00h
07	Reserved								00h
08	Reserved								00h
09	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Specifies the length of time that the CD-ROM shall remain in hold-track mode after completion of several operations before shifting STOP status.

<Command Type> : TYPE 1

<SCSI Type> : Vendor Unique

<Execution Status> : IDLE, READY condition

<Inactivity Time> : Specifies the length of time that the CD-ROM shall remain in hold-track mode.

[DESCRIPTION]

This command is used to specify the length of time that the CD-ROM shall remain in hold-track mode after completion of following operations.

- 1) READ(6), READ(10) and READ(12) command execution
- 2) SEEK(6), SEEK(10) command execution
- 3) VERIFY or PRE-FETCH command execution
- 4) Completion of audio playback operation
- 5) Completion of SET UP operation initiated by Caddy insertion or START/STOP UNIT command with START bit set to one

During hold-track mode, the CD-ROM attempts to keep the optical pickup head around the position where previous operation has terminated.

Elapsing specified inactivity time, the CD-ROM goes to STOP status (turning off the spindle motor and laser beam).

This command has similar function to Inactivity Timer Multiplier in CD-ROM parameters page of MODE SELECT command.

Inactivity Time field (Byte 01 and 02) specifies the delay time before shifting STOP status.

This field is expressed by BCD data consisting of MIN = 00h to 19h and SEC = 00h to 59h.

Namely the maximum inactivity time specified with this command is 19 minutes 59 seconds and inactivity time of zero (00 min 00 sec) indicates that the CD-ROM shall not go to STOP status but continues hold-track mode eternally.

It is possible to specify inactivity time value with either SET STOP TIME command or CD-ROM parameters page, however note that the value specified with last issued command is valid.

This command does not rewrite the Inactivity Timer Multiplier field since covered range of them differ and it is impossible to convert to appropriate value.

5-3.36 CADDY EJECT Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= C4h)								C4h
01	0	0	0				Immed		
02	Reserved								00h
03	Reserved								00h
04	Reserved								00h
05	Reserved								00h
06	Reserved								00h
07	Reserved								00h
08	Reserved								00h
09	0	0	Reserved			Flag	Link		Control

[COMMAND FUNCTION]

Request the CD-ROM to eject (unload) the Caddy.

<Command Type> : TYPE 3

<SCSI Type> : Vendor Unique

<Execution Status> : IDLE, READY condition

<Immed bit> : Immed(Immediate) bit of one indicates that the status shall be returned as soon as the operation is initiated.

Immed bit of zero indicates that the status shall be returned after the operation completes.

[DESCRIPTION]

This command requests the CD-ROM to eject (unload) the disc Caddy.

The CD-ROM executes following operations if this command is received in READY condition which means that the Caddy is loaded.

- 1) Stop the spindle motor
- 2) Turn off the laser beam, focusing servo and tracking servo
- 3) Move the optical pickup head to the outermost position
- 4) Drive the loading motor and eject the disc Caddy

This command has similar function to START/STOP UNIT command with LoEj bit set to one and Start bit set to zero.

The CD-ROM returns GOOD status immediately if the Caddy is already ejected.

Even if prevent bit is set to one, the CD-ROM accepts this command and ejects the Caddy, while it only goes to STOP status if START/STOP UNIT command which request to eject the Caddy is issued under same condition.

Immed(Immediate) bit (Byte 01, Bit 1) of one indicates that the CD-ROM shall return GOOD status as soon as the operation is initiated upon receipt of CDBs and no status shall be returned after completion of the operation.

Immed bit of zero indicates that the status shall be returned after completion of the operation.

5-3.37 READ SUBCODE-Q & PLAYING STATUS Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= C6h)								C6h
01	0	0	0	Transfer Length					
02	Reserved								00h
03	Reserved								00h
04	Reserved								00h
05	Reserved								00h
06	Reserved								00h
07	Reserved								00h
08	Reserved								00h
09	0	0	Reserved			Flag	Link	Control	

[COMMAND FUNCTION]

Request the CD-ROM to transfer current subcode-Q address information plus the state of audio playback operation.

<Command Type> : TYPE 2

<SCSI Type> : Vendor Unique

<Execution Status> : READY condition

<Transfer Length> : The number of bytes to be transferred to the initiator

[DESCRIPTION]

This command requests the CD-ROM to transfer the information regarding current subcode-Q address plus the state of audio playback operation.

This command has similar function to READ SUB-CHANNEL command of SCSI-2.

Note that CHECK CONDITION status is returned if the CD-ROM is not in READY status.

Transfer Length field (Byte 01) specifies the number of bytes to be transferred during DATA IN phase.

As the returned information consists of 10 bytes, the CD-ROM terminates the DATA IN phase when the Transfer Length bytes have been transferred or when all (10 Bytes) available information have been transferred, whichever is less.

Transfer Length of zero indicates that no data shall be transferred.

Returned information consists of 10 bytes as shown in Table 5-3.37.1

	7	6	5	4	3	2	1	0	NOTE
00	Audio Playback Status								
01	Control Data								CONTROL
02	Track Number								TNO
03	Index Number								X
04	Time (Minutes)								MIN
05	Subcode-Q Address Data		Time (Seconds)						SEC
06	Time (Frames)								FRAME
07	Absolute Time (Minutes)								AMIN
08	Absolute Time (Seconds)								ASEC
09	Absolute Time (Frames)								AFRAME

Table 5-3.37.1 Subcode-Q Data and Playing Status Information Format

Audio Playback Status field (Byte 00) indicates the current status of audio playback operation (Refer to Table 5-3.37.2).

Status	Description
00h	Audio playback in progress.
01h	Audio play operation stilled initiated by STILL command or PAUSE/RESUME command with Resume bit set to zero
02h	Audio play operation paused initiated by AUDIO TRACK SEARCH command with PLAY bit set to zero
03h	Other conditions, such as audio playback completed

Table 5-3.37.2 Audio Playback Status Code

Subcode-Q Address Data field (Byte 01 to 09) indicates the current subcode-Q address (position) data (ADR =01).

Note that valid data is returned only during audio playback operation.

For a description of each field , refer to 5-3.21 READ SUB-CHANNEL command.

However note that this address data except for Control Data is expressed in BCD data consisting of;

Track Number : 01h to 99h

Index Number : 00h to 99h

Minutes (Time and Absolute Time) : 00h to 99h

Seconds (Time and Absolute Time) : 00h to 59h

Frames (Time and Absolute Time) : 00h to 74h

5-3.38 READ DISC INFORMATION Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= C7h)								C7h
01	0	0	0	Reserved			TYPE		
02	Track Number								
03	Reserved								00h
04	Reserved								00h
05	Reserved								00h
06	Reserved								00h
07	Reserved								00h
08	Reserved								00h
09	0	0	Reserved			Flag	Link	Control	

[COMMAND FUNCTION]

Request the CD-ROM to transfer TOC (Table Of Contents) data to the initiator.

<Command Type> : TYPE 2

<SCSI Type> : Vendor Unique

<Execution Status> : READY condition

<TYPE bit> : Specify the type of information to be returned as follows.

00b : The first and last track number of the installed medium

01b : The starting address of the lead-out track

10b : The starting address and attribute of the track pointed by Track Number field

11b : Disc identification (CD/CD-ROM, CD-I or CD-ROM XA) information

<Track Number> : Specify the track number of which TOC data shall be returned (TYPE =10b)

[DESCRIPTION]

This command requests the CD-ROM to transfer TOC (Table Of Contents) data of the installed medium to the initiator during the DATA IN phase.

READ DISC INFORMATION command has similar function to READ TOC command of SCSI-2.

Returned information data consists of 4 bytes and TYPE bit (Byte 01) specifies the type of information to be returned as follows.

1) TYPE = 00b

The first (minimum) track number and the last (maximum) track number of the installed medium are transferred.

Note that these fields are expressed in BCD format and has a value between 01h to 99h unlike READ TOC data of SCSI-2.

	7	6	5	4	3	2	1	0	NOTE
00	First (minimum) track number of the medium								
01	Last (maximum) track number of the medium								
02	Reserved								00h
03	Reserved								00h

2) TYPE = 01b

The starting point (Subcode-Q absolute time address data) of the lead-out track is transferred.

Note that these fields are expressed in BCD format consisting of MIN = 00h to 99h, SEC = 00h to 59h and FRAME = 00h to 74h unlike READ TOC data.

	7	6	5	4	3	2	1	0	NOTE
00								Minutes	
01	Starting Point of Lead-Out Track							Seconds	
02								Frames	
03	Reserved								00h

3) TYPE = 10b

The starting point (Subcode-Q absolute time address data) and control data (attribute information) of specified track is transferred.

Track Number field (Byte 02) in CDB specifies the track number of which this data shall be transferred and it has a value between 01h to 99h.

When the specified track number is not found in the installed medium, the CD-ROM returns CHECK CONDITION status.

The address fields of returned data are expressed in BCD format consisting of MIN = 00h to 99h, SEC = 00h to 59h and FRAME = 00h to 74h unlike READ TOC data. Note that this address data has no tolerance for a data track, however it has plus/minus one second tolerance for an audio track.

Control data field shows the attribute of the specified track.

For further details of Control field, refer to 5-3.21 READ SUB-CHANNEL command.

	7	6	5	4	3	2	1	0	NOTE
00								Minutes	
01	Starting Point of Specified Track							Seconds	
02								Frames	
03	Control Data of Specified Track								

3) TYPE = 11b

The disc identification information which is recorded at POINT/A0/PSEC field in TOC is transferred.

The definition is as follows.

00h ... CD Audio or CD-ROM Disc

10h ... CD-I Disc

20h ... CD-ROM XA Disc

	7	6	5	4	3	2	1	0	NOTE
00	Disc Identification Information								
01	Reserved								00h
02	Reserved								00h
03	Reserved								00h

5-3.39 READ CD-ROM MODE Command

	7	6	5	4	3	2	1	0	NOTE
00	Operation Code (= C8h)								C8h
01	0	0	0	Reserved					00h
02	Reserved								00h
03	Reserved								00h
04	Reserved								00h
05	Reserved								00h
06	Reserved								00h
07	Reserved								00h
08	Reserved								00h
09	0	0	Reserved				Flag	Link	Control

[COMMAND FUNCTION]

Request the CD-ROM to transfer CD-ROM mode data of the last sought block to the initiator.

- <Command Type> : TYPE 2
- <SCSI Type> : Vendor Unique
- <Execution Status> : READY condition

[DESCRIPTION]

This command requests the CD-ROM to transfer CD-ROM mode data of the last sought block executed by SEEK(6) or SEEK(10) command.

READ CD-ROM MODE command has similar function to READ HEADER command of SCSI-2.

Note that the CD-ROM returns CHECK CONDITION status when the previous seek operation has completed with error.

Returned information data consists of 1 bytes (refer to Table 5-3.39.1).

For details of CD-ROM mode, refer to 5-3.23 READ HEADER command.

	7	6	5	4	3	2	1	0	NOTE
00	CD-ROM Mode Data								

Table 5-3.39.1 CD-ROM mode data format

CHAPTER 6 STATUS

The CD-ROM sends a status information during the STATUS phase at the completion of each command, unless the command is terminated by one of followings.

- 1) RESET condition
- 2) BUS DEVICE RESET message
- 3) ABORT message
- 4) Unexpected disconnect

Table 6.1 shows the status byte format and Table 6.2 shows the status byte code list.

	7	6	5	4	3	2	1	0
00	Reserved		Status Byte Code					Reserve

Table 6.1 Status Byte Format

Status Byte								Hex	Status
7	6	5	4	3	2	1	0		
R	R	0	0	0	0	0	R	00h	GOOD
R	R	0	0	0	0	1	R	02h	CHECK CONDITION
R	R	0	0	0	1	0	R	04h	CONDITION MET
R	R	0	0	1	0	0	R	08h	BUSY
R	R	0	1	0	0	0	R	10h	INTERMEDIATE
R	R	0	1	0	1	0	R	14h	INTERMEDIATE-CONDITIONMET
R	R	0	1	1	0	0	R	18h	RESERVATION CONFLICT
R	R	1	0	0	0	1	R	22h	COMMAND TERMINATED
R	R	1	0	1	0	0	R	28h	QUEUE FULL
All Other Codes									Reserved

Table 6.2 Status Byte Code List

The definition of status byte supported by the CD-ROM is given below.

1) GOOD (00h)

Indicates that the CD-ROM has successfully completed the execution of the command.

2) CHECK CONDITION (02h)

Indicates that error, exception or peculiar condition have been occurred as illustrated below.

- a. Inappropriate parameters are found in requested command descriptor block or parameters.
- b. The CD-ROM can not execute the requested command.
- c. The CD-ROM detects error during command execution and the command does not complete successfully.

When CHECK CONDITION status is reported, the CD-ROM prepares sense data for the initiator at once.

The initiator can investigate the error information through REQUEST SENSE command.

For further details, refer to Chapter 7 SENSE DATA.

3) CONDITION MET (04h)

This status is returned when the specific operation of PRE-FETCH command execution is satisfied.

For further details, refer to 5-3.20 PRE-FETCH command.

4) BUSY (08h)

Indicates that the CD-ROM is busy and it can not accept the requested command. The initiator should issue the same command again to recover this error at a later time.

5) INTERMEDIATE (10h)

Indicates that the execution of the command in a series of linked command has been completed successfully and the CD-ROM informs to proceed to next linked command.

If the linked command does not complete successfully, the CD-ROM returns CHECK CONDITION status instead of INTERMEDIATE status and it does not execute the subsequent linked commands.

6) INTERMEDIATE-CONDITION MET (14h)

This is the combination of CONDITION MET and INTERMEDIATE status and used for PRE-FETCH command execution.

7) RESERVATION CONFLICT (18h)

Indicates that the CD-ROM is currently reserved with a conflicting reservation type for another initiator and can not accept the command.

The initiator should issue the same command again at a later time.

8) COMMAND TERMINATED (22h)

The CD-ROM does not send this status to the initiator.

9) QUEUE FULL (28h)

The CD-ROM does not send this status to the initiator.

CHAPTER 7 SENSE DATA

The sense data is available when the previous command terminates with CHECK CONDITION status or may be available if the command ended with unexpected disconnect.

The sense data is preserved by the CD-ROM for the initiator until receiving of REQUEST SENSE command or until receipt of any other command.

The CD-ROM supports extended sense data format as shown in Table 7.1 consisting of 18 bytes.

	7	6	5	4	3	2	1	0	NOTE	
00	Valid	Error Code (70h or 71h)								
01	Segment Number (= 00h)								00h	
02	FM(0)	EOM(0)	ILI(0)	Reserve	Sense Key					
03	(MSB)									
04	Information									
05										
06								(LSB)		
07	Additional Sense Length (= 0Ah)								0Ah	
08	(MSB)								00h	
09	Command Specific Information (= 00h)								00h	
10									00h	
11									00h	
12	Additional Sense Code								ASC	
13	Additional Sense Code Qualifier								ASCQ	
14	Field Replaceable Unit Code (= 00h)								00h	
15	SKSV	Sense-Key Specific								
16										
17										

Table 7.1 Sense Data Format

Valid bit (Byte 00, Bit 7) of zero indicates that the information field (Byte 03 to 06) is not valid.

Valid bit of one indicates that information field contains valid information.

Sense Key field (Byte 02) shows the generic categories of the error or exceptions as shown in Table 7.3.

Information Byte field (Byte 03 to 06) indicates the (error) address associated with the Sense Key and this field has valid information when Valid bit is set to one.

One of following address is used depending upon the requested command.

- a. Logical Block Address
- b. CD-ROM Header Address or CD Subcode-Q Address
- c. CD or CD-ROM Track Number (TNO)

Additional Sense Length field (Byte 07) specifies the additional sense bytes to follow and is fixed 10 (0Ah) bytes for the CD-ROM.

Additional Sense Code field (Byte 12) shows the further error information in Sense Key field.

Additional Sense Code Qualifier field (Byte 13) shows the detailed information related to the Additional Sense Code field.

Table 7.4 shows the list of Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ) defined for CD-ROM.

If the Sense Key is set to ILLEGAL REQUEST and the SKSV (Sense-Key Specific Valid) bit (Byte 15, Bit 7) is set to one, the Sense-Key Specific field is defined as Field Pointer Bytes field as shown in Table 7.2 which describes the location of the parameters in command or parameters which are in error.

	7	6	5	4	3	2	1	0	NOTE
15	SKSV	C/D	Reserve	Reserve	BPV	Bit Pointer			
16	(MSB) Field Pointer								
17									(LSB)

Table 7.2 Field Pointer Byte

C/D(Command/Data) bit (Byte 15, Bit 6) of one indicates that the illegal parameter is in the command descriptor blocks.

C/D bit of zero indicates that the error is in the parameters which was sent during DATA OUT phase.

BPV(Bit Pointer Valid) bit (Byte 15, Bit 3) of zero indicates that the value of Bit Pointer field is not valid.

BPV bit of one indicates that the Bit Pointer field specifies which bit is in error.

Bit Pointer (Byte 15, Bit 0 to 2) specifies which bit of the byte specified by the Field Pointer field is in error.

Field Pointer field (Byte 16 to 17) indicates which byte of the command descriptor or the parameters was in error.

Sense Key		Description
0h	NO SENSE	Indicates that there exists no specific sense data to return. This would be a case that the command executed preceding the REQUEST SENSE command completed successfully.
1h	RECOVERED ERROR	Indicates that the last command completed successfully with some error recovery operation, retry or error correction.
2h	NOT READY	Indicates that the CD-ROM is not ready and is not accessible.
3h	MEDIUM ERROR	Indicates that the command execution terminated with an error that was probably caused by a defect on medium
4h	HARDWARE ERROR	Indicates that the CD-ROM detected a non-recoverable hardware failure during command execution or during a self test
5h	ILLEGAL REQUEST	Indicates that there was an illegal parameter in CDB or parameters as shown in below. <ul style="list-style-type: none"> a. Illegal parameters are found in CDB or additional parameters b. The CD-ROM can not execute the requested command c. LUN other than zero is specified
6h	UNIT ATTENTION	Indicate following unit attention. <ul style="list-style-type: none"> a. The CD-ROM was reset by Power-On, RESET condition or BUS DEVICE RESET message b. MODE SELECT parameters were changed c. Medium may have been changed
7h	DATA PROTECT	Not used.
8h	BLANK CHECK	Indicates that the CD-ROM encountered format-defined end-of-data block (e.g. attempt to read a audio track)
9h	VENDOR SPECIFIC	Not used.

Table 7.3 Sense Key (00h to 09h)

Sense Key		Description
Ah	COPY ABORTED	Not used.
Bh	ABORTED COMMAND	Indicates that the CD-ROM aborted the command execution. The initiator can recover by issuing the command again.
Ch	EQUAL	Not used.
Dh	VOLUME OVERFLOW	Not used.
Eh	MISCOMPARE	Not used.
Fh		Reserved.

Table 7.3 Sense Key (0Ah to 0Fh)

Byte 12	Byte 13	Description
00h	00h	No Additional Sense Information
00h	06h	I/O Process Terminated
00h	11h	Audio Play Operation In Progress
00h	12h	Audio Play Operation Paused
00h	13h	Audio Play Operation Successfully Completed
00h	14h	Audio Play Operation Stopped Due To Error
00h	15h	No Current Audio Status To Return
02h	00h	No Seek Complete
04h	00h	Logical Unit Not Ready, Cause Not Reportable
04h	01h	Logical Unit Is In Process Of Becoming Ready
04h	02h	Logical Unit Not Ready, Initializing Command Required
04h	03h	Logical Unit Not Ready, Manual Intervention Required
05h	00h	Logical Unit Does Not Respond To SELECTION
06h	00h	No Reference Position Found
07h	00h	Multiple Peripheral Devices Selected
08h	00h	Logical Unit Communication Failure
08h	01h	Logical Unit Communication Time-Out
08h	02h	Logical Unit Communication Parity Error
09h	00h	Track Following Error
09h	01h	Tracking Servo Failure
09h	02h	Focus Servo Failure
09h	03h	Spindle Servo Failure
0Ah	00h	Error Log Overflow
11h	00h	Unrecovered Read Error
11h	05h	L-EC Uncorrectable Error
11h	06h	CIRC Unrecovered Error
14h	00h	Recorded Entity Not Found
14h	01h	Record Not Found
15h	00h	Random Positioning Error
15h	01h	Mechanical Positioning Error
15h	02h	Positioning Error Detected By Read Of Medium
17h	00h	Recovered Data With No Error Correction Applied
17h	01h	Recovered Data With Retries
17h	02h	Recovered Data With Positive Head Offset
17h	03h	Recovered Data With Negative Head Offset
17h	04h	Recovered Data With Retries And/Or CIRC Applied
17h	05h	Recovered Data Using Previous Sector ID
18h	00h	Recovered Data With Error Correction Applied
18h	01h	Recovered Data With Error Correction And Retries Applied
18h	02h	Recovered Data - Data Auto-Relocated
18h	03h	Recovered Data With CIRC
18h	04h	Recovered Data With LEC
18h	05h	Recovered Data - Recommend Reassignment
1Ah	00h	Parameter List Length Error
1Bh	00h	Synchronous Data Transfer Error
20h	00h	Invalid Command Operation Code

Table 7.4 Additional Sense Code/Qualifier List (00h to 20h)

Byte 12	Byte 13	Description
21h	00h	Logical Block Address Out Of Range
24h	00h	Invalid Field In CDB
25h	00h	Logical Unit Not Supported
26h	00h	Invalid Field In Parameter List
26h	01h	Parameter Not Supported
26h	02h	Parameter Value Invalid
26h	03h	Threshold Parameters Not Supported
28h	00h	Not Ready To Ready Transition (Medium May Have Changed)
29h	00h	Power ON, RESET, Or BUS DEVICE RESET Occurred
2Ah	00h	Parameters Changed
2Ah	01h	Mode Parameters Changed
2Ah	02h	Log Parameters Changed
2Bh	00h	Copy Cannot Execute Since Host Cannot Disconnect
2Ch	00h	Command Sequence Error
2Fh	00h	Commands Cleared By Another Initiator
30h	00h	Incompatible Medium Installed
30h	01h	Cannot Read Medium - Unknown Format
30h	02h	Cannot Read Medium - Incompatible Format
37h	00h	Rounded Parameter
39h	00h	Saving Parameters Not Supported
3Ah	00h	Medium Not Present
3Dh	00h	Invalid Bits In IDENTIFY Message
3Eh	00h	Logical Unit Has Not Self-Configured Yet
3Fh	00h	Target Operating Conditions Have Changed
3Fh	01h	Microcode Has Been Changed
3Fh	02h	Changed Operating Definition
3Fh	03h	Inquiry Data Has Changed
40h	80h	Diagnostic Failure On TC9220F
40h	81h	Diagnostic Failure On Memories
40h	82h	Diagnostic Failure On CD-ROM ECC Circuit
40h	83h	Diagnostic Failure On Gate-Array
40h	84h	Diagnostic Failure On Internal SCSI Controller
43h	00h	Message Error
44h	00h	Internal Target Failure
45h	00h	Select Or Reselect Failure
46h	00h	Unsuccessful Soft Reset
47h	00h	SCSI Parity Error
48h	00h	Initiator Detected Error Message Received
49h	00h	Invalid Message Error
4Ah	00h	Command Phase Error
4Bh	00h	Data Phase Error
4Ch	00h	Logical Unit Failed Self-Configuration
4Eh	00h	Overlapped Command Attempted
53h	00h	Media Load Or Eject Failed
53h	02h	Medium Removal Prevented
57h	00h	Unable To Recover Table-Of-Contents
5Ah	00h	Operator Request Or State Change Input (Unspecified)
5Ah	01h	Operator Medium Removal Request

Table 7.4 Additional Sense Code/Qualifier List (21h to 5Ah)

Byte 12	Byte 13	Description
5Bh	00h	Log Exception
5Bh	01h	Threshold Condition Met
5Bh	02h	Log Counter At Maximum
5Bh	03h	Log List Codes Exhausted
63h	00h	End Of User Area Encountered On This Track
64h	00h	Illegal Mode For This Track

Table 7.4 Additional Sense Code/Qualifier List (5Bh to 64h)

APPENDIX A REVISED INFORMATION FROM Ver 4.0

- 1) Following Commands are newly added.
 - 2Fh VERIFY (10)
 - 34h PRE-FETCH
 - 42h READ SUB-CHANNEL
 - 43h READ TOC
 - 44h READ HEADER
 - 45h PLAY AUDIO (10)
 - 47h PLAY AUDIO MSF
 - 48h PLAY AUDIO TRACK/INDEX
 - 49h PLAY AUDIO TRACK RELATIVE (10)
 - 4Bh PAUSE/RESUME
 - A5h PLAY AUDIO (12)
 - A8h READ (12)
 - A9h PLAY AUDIO TRACK RELATIVE (12)
- 2) The operation of the SEEK command of which the requested block is in audio track is changed. (SEEK(6) and SEEK(10) command)
- 3) INQUIRY data is changed to comply to SCSI-2. (INQUIRY command)
- 4) Block Lengths are extended and Density Code is newly defined to support CD-ROM XA format and so on. (MODE SELECT command)
- 5) EEC (Enable Early Correction) field and Recovery Time Limit field are deleted and the definition of RC (Read Continuous) bit is changed. (MODE SELECT command)
- 6) The page length of Page 02 (Disconnect/Reconnect Control parameters page) is changed. (MODE SELECT command)
- 7) Maximum Burst Size field and DTDC (Data Transfer Disconnect Control) field are supported. (MODE SELECT command)
- 8) Page 0D (CD-ROM parameters page) and Page 0E (Audio Control parameters page) are supported. (MODE SELECT command)
- 9) Third Party Reservation and Superseding reservation is supported. (RESERVE command)
- 10) Third Party Release is supported. (RELEASE command)
- 11) DBD (Disable Block Descriptors) bit is supported. (MODE SENSE command)
- 12) CHECK CONDITION status is returned if PC bit is set to 11b. (MODE SENSE command)
- 13) MODE SENSE data is changed in accordance with the MODE SELECT page parameters.
Also WP(Write Protect) bit is deleted.(MODE SENSE command)
- 14) LoEj (Load/Eject) bit is supported. (START/STOP UNIT command)
- 15) PMI (Partial Medium Indicator) function of READ CAPACITY command is supported. (READ CAPACITY command)
- 16) FUA (Force Unit Access) bit is supported. (READ(10) and READ(12) command)
- 17) READ DISC INFORMATION command (Toshiba vendor unique command) is extended to return disc identification information (TYPE =11b). (READ DISC INFORMATION command)
- 18) Additional Sense Code is changed and Additional Sense Code Qualifier is newly added. (SENSE data)
- 19) Support Field Pointer Bytes. (SENSE data)