MARCH 5 1991

# Specification

# of

# CD-ROM Drive

# (Model CR-501-S)

(Document Version : 1.00)

MATSUSHITA-KOTOBUKI ELECTRONICS
INDUSTRIES LTD.

MATSUYAMA DIVISION

# MKE CD-ROM DRIVE

## CR-501-S

(STAND ALONE TYPE)

### Summary

- Embedded SCSI Interface
- Manual Loading with CD Caddy
- Audio playback Capability
  (Headphone out with Volume control
  & Line out)
- MS-DOS CD-ROM Extensions Available
- Embedded Lens cleaning mechanism

# MKE CD-ROM DRIVE SPECIFICATIONS

## 1 PERFORMANCE

| | | |
|---|---|---|
| 1.1 | Data Capacity | 540 MBytes |
| 1.2 | Data Transfer Rate | |
| | sequential | 150 KBytes/sec (Mode 1) |
| | | 171 KBytes/sec (Mode 2) |
| | max | 1.3 MBytes/sec |
| 1.3 | Buffer Memory | 32 KBytes |
| | | (64 KBytes available) |
| 1.4 | Access Time | |
| | average access time | 0.5 Sec (See Note 1) |
| | maximum access time | 0.8 Sec (See Note 2) |
| 1.5 | Average Latency | |
| | at inner track | 60 msec |
| | at outer track | 140 msec |
| 1.6 | Set Up Time typical | 5.0 Sec (See Note 3) |

## 2 RELIABILITY

| | | |
|---|---|---|
| 2.1 | Error Rate | |
| | Soft Read Error | Less than $10^{-9}$ |
| | Hard Read Error | Less than $10^{-12}$ |
| | Seek Error | Less than $10^{-6}$ |
| 2.2 | MTBF | 25000Hr |

Notes:

1) Average Access Time: From 00 min 02 sec 00 block to 20 min 00 sec 00 block including latency and layered error correction time.
2) Maximum Access Time: From 00 min 02 sec 00 block to 59 min 58 sec 74 block including latency and layered error correction time.
3) Set up time: From loading till ready.It will be changed by TOC.

## 3 ENVIRONMENTAL CONDITIONS

| | | |
|---|---|---|
| 3.1 Temperature | | |
| operating | 5 to 45℃ | (No condensation) |
| non-operating | -20 to 55℃ | |
| 3.2 Humidity | | |
| operating | 20 to 80%Rh | (No condensation) |
| non-operating | 15 to 80%Rh | |
| 3.3 Vibration | | |
| operating | 0.2 Go-p | (5-500Hz) |
| non-operating | 2.0 Go-p | (5-300Hz) |
| 3.4 Shock | | |
| operating | 1.0 Go-p | at 11ms half sine wave |
| non-operating | 40 Go-p | at 11ms half sine wave |
| 3.5 Installation | Horizontal | |

## 4 Dimensions

| | |
|---|---|
| 4.1 Width | 158.0 mm |
| 4.2 Height | 58.2 mm |
| 4.3 Depth | 315.0 mm |
| 4.4 Weight | 2.4 kg |
| 4.5 CD Caddy (W×D×H) | 124.6 × 135 × 8 mm |

## 5 POWER REQUIREMENTS

| | | |
|---|---|---|
| 5.1 | INPUT VOLTAGE | AC 90~264 V |
| 5.2 | Frequency | 50 or 60 Hz |

## 6 AUDIO OUTPUT

| | | |
|---|---|---|
| 6.1 | Headphone | |
| | output level (32Ω load) | 0.6 Vrms typical |
| | output terminal | 3.5 mm dia. minijack |
| | location | frontpanel |
| 6.2 | Line out | |
| | output level (50KΩ load) | 0.8 Vrms typical |
| | output terminal | RCA Pin jack |
| | location | backside |
| 6.3 | Audio Specification | |
| | number of channels | 2 |
| | frequency response | 100-20000Hz (Headphone) |
| | | 20-20000Hz (Line out) |
| | dynamic range | 80dB |
| | s/n ratio | 80dB |
| | distortion | 0.2% at 1KHz |
| | separation | 50dB |

## 7 INTERFACE

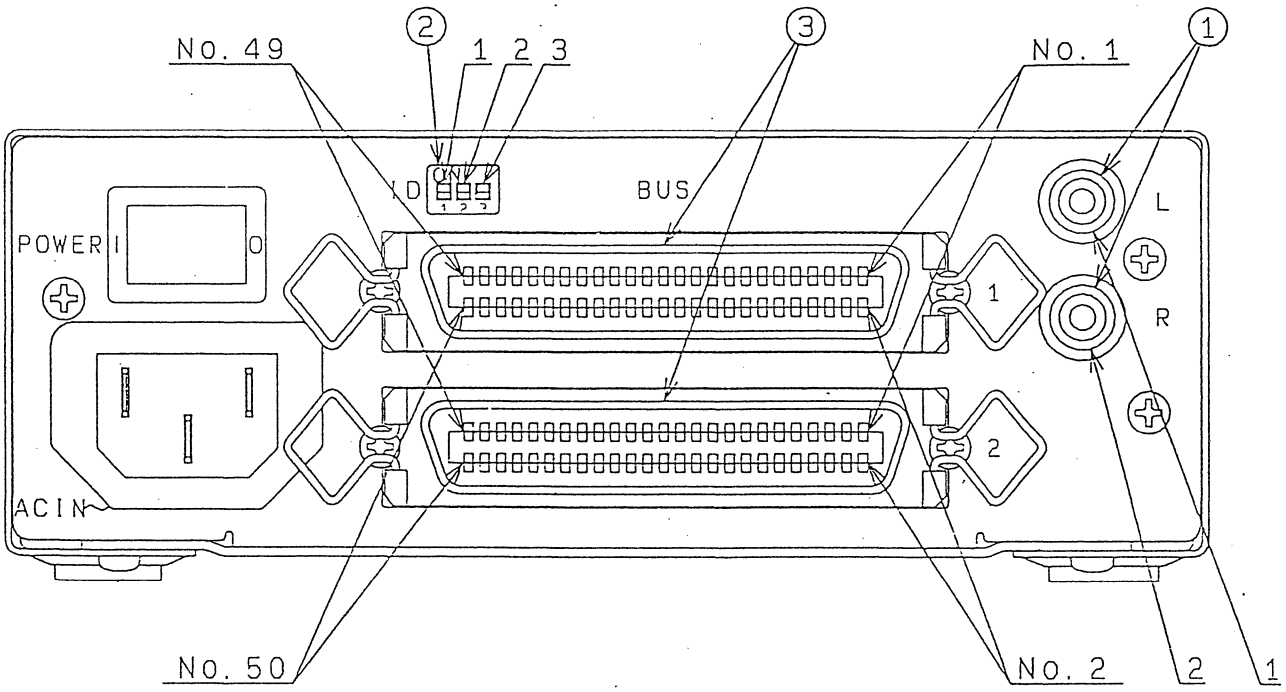
SCSI
ANSI X3.131-1986 Standard
(See attached Table 1)

Table 1. COMMAND LIST OF MKE CD-ROM

| Operation Code | Command Name |
|---|---|
| 00h | TEST UNIT READY |
| 01h | REZERO UNIT |
| 03h | REQUEST SENSE |
| 08h | READ |
| 0Bh | SEEK |
| 12h | INQUIRY |
| 15h | MODE SELECT |
| 16h | RESERVE |
| 17h | RELEASE |
| 1Ah | MODE SENSE |
| 1Bh | START/STOP UNIT |
| 1Ch | RECEIVE DIAGNOSTIC RESULTS |
| 1Dh | SEND DIAGNOSTIC |
| 25h | READ CAPACITY |
| 28h | READ EXTENDED |
| 2Bh | SEEK EXTENDED |
| C2h | READ SUB-CHANNEL |
| C3h | READ TOC |
| C4h | READ HEADER |
| C5h | PLAY AUDIO(10) |
| C7h | PLAY AUDIO MSF |
| C8h | PLAY AUDIO TRACK/INDEX |
| C9h | PLAY TRACK RELATIVE(10) |
| CBh | PAUSE/RESUME |
| E5h | PLAY AUDIO(12) |
| E9h | PLAY TRACK RELATIVE(12) |

## 8 CONNECTOR PIN ASSIGNMENT

Rear View




① Line Output Connector

| Pin | Signal |
|---|---|
| 1 | L-Ch |
| 2 | R-Ch |

② SCSI ID Switch

| CD-ROM ID number | DIP switch Number | | | Note |
|---|---|---|---|---|
| | 1 | 2 | 3 | |
| 0 | ON | ON | ON | Factory Preset |
| 1 | OFF | ON | ON | |
| 2 | ON | OFF | ON | |
| 3 | OFF | OFF | ON | |
| 4 | ON | ON | OFF | |
| 5 | OFF | ON | OFF | |
| 6 | ON | OFF | OFF | |
| 7 | OFF | OFF | OFF | Not used |

③ SCSI Connector

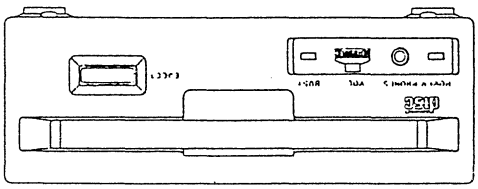
| No. | Signal | No. | Signal |
|---|---|---|---|
| 1 | GND | 2 | -DB(0) |
| 3 | GND | 4 | -DB(1) |
| 5 | GND | 6 | -DB(2) |
| 7 | GND | 8 | -DB(3) |
| 9 | GND | 10 | -DB(4) |
| 11 | GND | 12 | -DB(5) |
| 13 | GND | 14 | -DB(6) |
| 15 | GND | 16 | -DB(7) |
| 17 | GND | 18 | -DB(P) |
| 19 | GND | 20 | GND |
| 21 | GND | 22 | GND |
| 23 | GND | 24 | GND |
| 25 | OPEN | 26 | TERMPWR |
| 27 | GND | 28 | GND |
| 29 | GND | 30 | GND |
| 31 | GND | 32 | -ATN |
| 33 | GND | 34 | GND |
| 35 | GND | 36 | -BSY |
| 37 | GND | 38 | -ACK |
| 39 | GND | 40 | -RST |
| 41 | GND | 42 | -MSG |
| 43 | GND | 44 | -SEL |
| 45 | GND | 46 | -C/D |
| 47 | GND | 48 | -REQ |
| 49 | GND | 50 | -I/O |

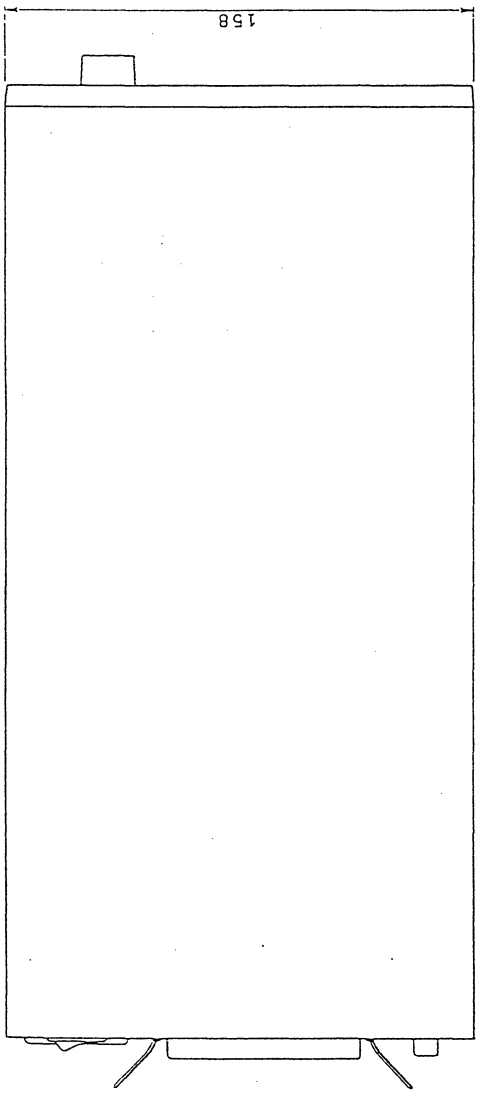
Recommended mating connector:
AMP 1-102387-0 or equivalent

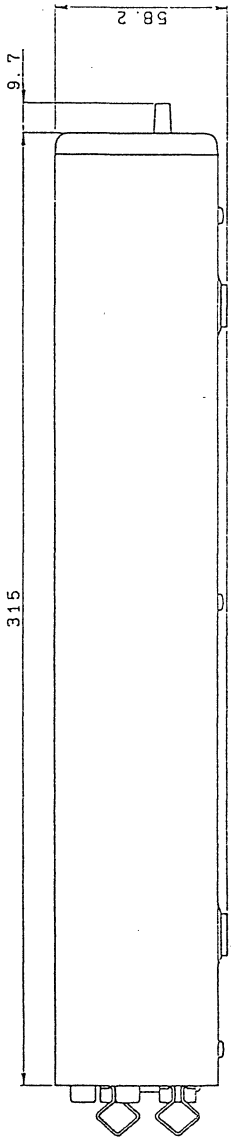
# CR-501-S
# APPEARANCE

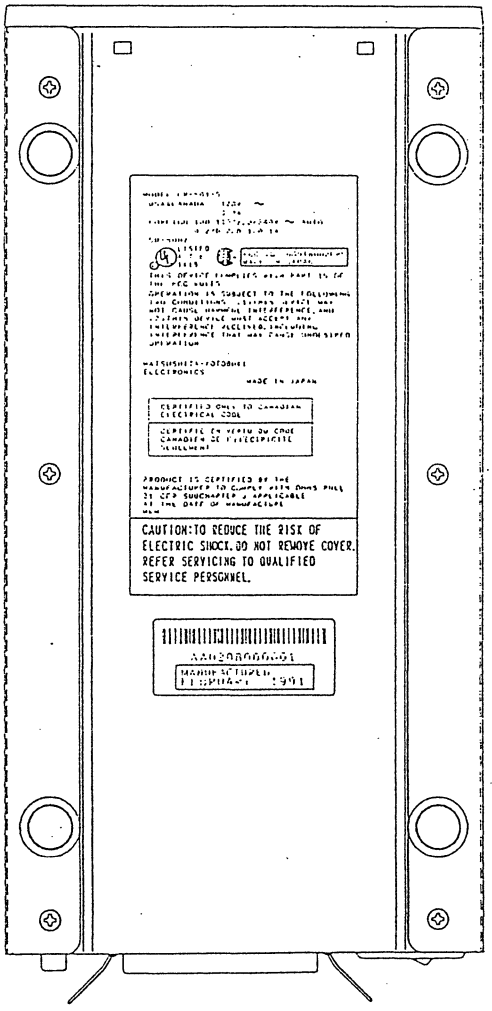
'91.2.12

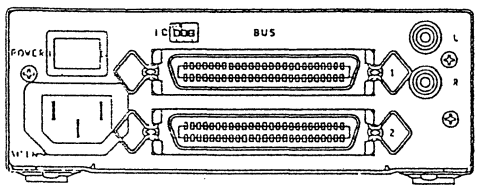
MATSUSHITA KOTOBUKI ELECTRONICS INDUSTRIES





DEC. 7 1990

# Interface Specification

# of

# CD-ROM Drive

(Model CR-501-S)

(Model CR-501-B)

(Document Version : 1.01)

(Firmware Revision : 1.0b)

MATSUSHITA-KOTOBUKI ELECTRONICS INDUSTRIES LTD.

MATSUYAMA DIVISION

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## 1.1 Preface

This document details the implementation of an SCSI command set for MKE's CD-ROM device. This implementation complies with the ANSI X3.131-1986 standard. There are extensions to the SCSI interface included for audio control.

## 1.2 Physical Characteristics

The MKE's SCSI controller uses a single-ended asynchronous SCSI interface that complies with the physical characteristics of ANSI X3.131-1986. Please refer to that standard for detailed information. The controller can supprot up to seven MKE's CD-ROM drives connected in a daisy-chain fashion through the MKE's CD-ROM interface.

## 1.3 Logical Characteristics

The logical characteristics of the controller comply with ANSI X3.131-1986 for a single-ended asynchronous implementation. The controller supports disconnect/reconnect. Several additional logical characteristics are disc issued here to aid in understanding the operation of the drive and the controller.

## 1.4 Conditions

This section describes certain conditions as they relate to the operation of the drive and the interface.

### 1.4.1 Power-on Condition

The power-on condition occurs when power is first applied to the unit. The controller performs power-on diagnostics and checks for logical units present. If a caddy is inserted, the drive attempts to read the table of contents and to seeks 0 minuite 2 secondes 0 flame. If a failure in power-on diagnostics occurs the controller will return a CHECK CONDITION status. If after the caddy is inserted it does not seat properly , or the drive is unable to focus, or the drive is unable to achieve spindle lock-up or the table of contents is not recovered the controller will return a CHECK CONDITION status.

### 1.4.2 Reset Condition

The reset condition occurs whenever the RST signal is asserted, or a BUS DEVICE RESET message is received.

### 1.4.3 Unit Attention Condition

The unit attention condition occurs following a power-on condition, a reset condition, the insertion of a caddy with the successful recovery of the table of contents or the receipt of a MODE SELECT command from another initiator.

The unit attention condition will persist for each initiator until that initiator issues a command to the logical unit for which the controller returns a CHECK CONDITION status. If the next command from that initiator to the logical unit (following the CHECK CONDITION status) is REQUEST SENSE, then the UNIT ATTENTION sense key is returned. If any command other than REQUEST SENSE is received, the unit attention condition is lost.

If more than one unit attention condition occurs the last unit attention condition be reported.

If an INQUIRY command is received from an initiator with a pending unit attention condition the controller will perform an INQUIRY command and will not clear the unit attention condition.

If a REQUEST SENSE command is received from an initiator with a pending unit attention condition then the controller will discard any pending sense data, report UNIT ATTENTION sense key, and clear the unit attention condition for that initiator. The additional sense code will be set to the appropriate value.

### 1.4.4 Ready Condition / Not Ready Condition

The ready condition occurs after a caddy is inserted and the table of contents has been recovered from the disc.

A not ready condition occurs for the following reasons:

1) These is no caddy inserted.
2) The drive is unable to recover the table of contents.
3) The controller cannot select drive. (This can only occur if the controller was previously able to select the drive).

A check condition status will be returned for the drive not ready condition only for commands that require or imply a disc access. The following commands will not return a check condition status for the not ready condition:

1) REQUEST SENSE
2) INQUIRY
3) MODE SELECT
4) RESERVE
5) RELEASE
6) MODE SENSE

The following commands will return a check condition status for the not ready condition:

1) TEST UNIT READY
2) REZERO UNIT
3) READ
4) SEEK
5) START/STOP UNIT
6) RECEIVE DIAGNOSTIC RESULT
7) SEND DIAGNOSTIC
8) READ CAPACITY
9) READ EXTENDED
10) SEEK EXTENDED
11) READ SUB-CHANNEL
12) READ TOC
13) READ HEADER
14) PLAY AUDIO(10)
15) PLAY AUDIO MSF
16) PLAY AUDIO TRACK/INDEX
17) PLAY TRACK RELATIVE
18) PAUSE/RESUME
19) PLAY AUDIO(12)
20) PLAY TRACK RELATIVE(12)

## 1.5 ATTENTION Condition

The ATTENTION Condition allows an initiator to inform the controller that the initiator has a message ready. The controller may get this message by performing a MESSAGE OUT phase.

The initiator creates the ATTENTION condition by asserting ATN at any time except during the ARBITRATION or BUS FREE phase.

The initiator will assert the ATN signal before releasing ACK for a byte transferred in a bus phase for the ATTENTION condition to be honored before transition to a new bus phase. An ATN asserted later might not be honored until a later bus phase and then may not result in the excepted action. A controller will respond with MESSAGE OUT phase.

Table 1-1
Message Codes

| Code | Type | Description | Direction | |
|---|---|---|---|---|
| 00h | M | COMMAND COMPLETE | In | |
| 02h | O | SAVE DATA POINTER | In | |
| 03h | M | RESTORE POINTERS | In | |
| 04h | O | DISCONNECT | In | |
| 05h | O | INITIATOR DETECTED ERROR | | Out |
| 06h | M | ABORT | | Out |
| 07h | M | MESSAGE REJECT | In | Out |
| 08h | M | NO OPERATION | | Out |
| 09h | O | MESSAGE PARITY ERROR | | Out |
| 0Ch | M | BUS DEVICE RESET | | Out |
| 0Dh - 7Fh | R | RESERVED | | |
| 80h - FFh | M | IDENTFY | In | Out |

Key: M = Mandatory
O = Optional
R = Reserved
In = Target to initiator
Out = Initiator to target

The single byte messages (Table 1-1) are listed along with their code values and their definitions.

COMMAND COMPLETE 00h.
This message is sent from a target to an initiator to indicate that the execution of a command has terminated and that valid status has been sent to the initiator. After successfully sending this message, the target shall go to the BUS FREE phase by releasing BSY.

SAVE DATA POINTER 02h.
This message is sent from a target to direct the initiator to save a copy of the present active data pointer for the currently attached logical unit.

RESTORE POINTERS 03h.
This message is sent from a target to direct the initiator to restore the most recently saved pointers (for the currently attached logical unit) to the active state. Pointers to the command, data, and status locations for the logical unit shall be restored to the active pointers.
Command and status pointers shall be restored to the beginning of the present command and status areas. The data pointer shall be restored to the value at the beginning of the data area in the absence of a SAVE DATA POINTER message or to the value at the point at which the last SAVE DATA POINTER message occured for that logical unit.

DISCONNECT 04h.

This message is sent from a target to inform an initiator that the present physical path is going to broken (the target plans to disconnect by releaseing BSY), but that a later reconnect will be required in order to complete the current operation. If the initiator detects the BUS FREE phase (other than as a result of RESET condition) without first receiving a DISCONNECT or COMMAND COMPLTETE message, the target intentionally creates this condition, the target shall clear the current command. This message shall not cause the initiator to save the data pointer.

INITIATOR DETECTED ERROR 05h.

This message is sent from an initiator to inform a target that an error (e.g., parity error) has occurred that does not preclude the target from retrying the operation. Although present pointer integrity is not assured, a RESTORE POINTERS message or a disconnect followed by a reconnect, shall cause the pointers to restored to their defined prior state.

ABORT 06h.

This message is sent from the initiator to the target to clear the present operation. If a logical unit has been identified, all pending data and status for the issuing initiator from the effected logical unit shall be cleared, and the target shall go to the BUS FREE phase.

Pending data and status for other initiator shall not be cleared. If a logical unit has not been identified, the target shall go to the BUS FREE phase. No status or ending message shall be sent for the operation. It is not an error to issue this message to an logical unit that is not currently performing an operation for the initiator.

MESSAGE REJECT 07h.

This meassage is sent from either the initiator or traget to indicate that the last message it received was inappropriate or has not been implemented.

In order to indicate its intentions of sending this message, the initiator shall assert the ATN signal prior to its release of ACK for the REQ/ACK handshake of the message that is to be rejected. When a target sends this message, it shall change to MESSAGE IN phase snd send this message prior to requesting additional message bytes from the initiator. This provides an interlock so that the initiator can determine which message is rejected.

This message shall be implemented if any other optional messages are implemented.

NO OPERATION 08h.

This message is sent from an initiator in response to a target's request fot a message when the initiator does not currently have any other valid message to send.

MESSAGE PARITY ERROR 09h.
This message is sent from the initiator to the target to indicate that one or more bytes in the last message it received had a parity error.

In order to indicate its intentions of sending this message, the initiator shall assert the ATN signal prior to its release of ACK for the REQ/ACK handshake of the message that has the parity error. This provides an interlock so that the target can determine which message has parity error.

BUS DEVICE RESET 0Ch.
This message is sent from an initiator to direct a target to clear all current commands on that SCSI device. This message forces the SCSI device to an initial state with no operations pending for any initiator.
Upon recognizing this message, the target shall go to the BUS FREE phase.

Reserved 0Dh to 7Fh.
These message codes are reserved for future standardization.

IDENTIFY 80h to FFh.
These message are sent by either the initiator or the target to establish the physical path connection between an initiator and target for a particular logical unit.

Table 1-2
Desiription of IDENTIFY Message Bit

| Bit | Description |
|---|---|
| 7 ..... | This bit always set to one distinguish these message from the other messages. |
| 6 ..... | This bit is only set to one by the initiator. When set to one, it indicates that the initiator has the ability to accommodate disconnection and reconnection. |
| 5 - 3 ..... | Reserved. |
| 2 - 0 ..... | These bits specify a logical unit number in a target. Only one logical unit number shall be identified for any one selection sequence; a second IDENTIFY message with a new logical unit number shall not be issued before the bus has been released (BUS FREE phase).<br>When sent from a target to an initiator during reconnection, an implied RESTORE POINTERS message shall be performed by the initiator prior to completion of this message. |

## 1.7 SCSI Error Conditions

This section describes the various SCSI bus related errors which can occur during the execution of a command and the actions taken by the target in response to these errors.

A proper handling of the SCSI bus related errors is by the implementation of:

- most message of the Error Recovery Set by both target and initiator.
- Bus Parity enabled in both target and initiator.

### 1.7.1 Target Mode Error Conditions

Under several error conditions the target may change the phase to BUS FREE without correctly terminating the command (i.e. No Disconnect or Command Complete message sent to the initiator). The target shall then clear all information regarding the command, to the exception of Sense Data (if any), and shall not attempt to reconnect to the initiator.

The initiator shall consider this as a catastrophic error.

The initiator may issue a REQUEST SENSE command attempting to recover further information concerning the catastrophic error.

### 1.7.2 Message Out Phase Parity Error

Parity is optional, the following does not apply to those SCSI devices communicating on the bus which are not configured with Parity enabled.

When the target detects a Parity error during the MESSAGE OUT Phase, it may retry the MESSAGE OUT phase using the following sequence:

1 - Continue the REQ/ACK handshakes until the initiator negates ATN (all message bytes received).
2 - Notify the initiator to resend all previous Message Out message bytes within the current phase, by not changing the phase and by asserting REQ.
3 - The initiator shall then resend all previous message bytes.

If the message is not received correctly, the target may process the error using one of the following sequences:

1 - Immediately go to BUS FREE phase with no Sense Key/Sense Code information set.
2 - Terminate the present command with a CHECK CONDITION status and set the Sense Key/Sense Code to "Aborted Command/SCSI Interface Parity Error". This error does not prevent the initiator from retrying the command.

### 1.7.3 Command Phase Parity Error

Parity is optional, the following does not apply to those SCSI devices communicating on the bus which are not configured with Parity enabled.

When the target detects a parity error during the COMMAND phase, it may retry the COMMAND phase using the following sequence:

1 - Change the phase to MESSAGE IN,
2 - Send the initiator a Restore Pointer message to reset the command pointer to the byte 0 of the command.
3 - Attempt to receive all command bytes over.

If the command is not received successfully, the target will abort the command using one of the following sequences:

1 - Immediately go to the BUS FREE phase with No Sense Key/Sense Code information set.
2 - Terminate the command with a CHECK CONDITION status and set the Sense Key/Sense Code to "Aborted Command/SCSI Interface Parity Error". This error does not prevent the initiator from retrying the command.

1.7.4 DATA OUT Phase Parity Error

Parity is optional, the following does not apply to those SCSI devices communicating on the bus which are not configured with Parity enabled.

When the target detects a parity error during the COMMAND phase, it may retry the COMMAND phase using the following sequence:

1 - Change the phase to MESSAGE IN,
2 - Send the initiator the Restore Pointer message to reset the data pointer to the first bytes.
3 - Change the phase to DATA OUT to receive the data over again.

If the data is not received successfully, the target will terminate the command with a CHECK CONDITION status and set the Sence Key/Sence Code to "Aborted Command/SCSI Interface Parity Error". This error does not prevent the initiator from retrying the command.

1.7.5 Initiator Detected Error Message

If the target receives an "Initiator Detected Error" message, it may retry the previous operation using the following sequence:

1 - Change the phase to MESSAGE IN,
2 - Send to the initiator the Restore Pointers message.
3 - Terminate the current command with a CHECK CONDITION status and set Sense Key/Sense Code to "Hardware error or Aborted Command/Initiator Detected Error". This error does not prevent the initiator from retryingthe command.

1.7.6 Reject Messages

When the target receives a "Message Reject" message from the initiator, it may retry the operation by resending the message. If the message cannot be sent successfully, the target will take the following action, based on which message was rejected.

COMMAND COMPLETE: The target shall go to BUS FREE phase and not consider this as an error.

SAVE DATA POINTER: The target shall assume that the initiator does not support the Save Data Pointer message, shall not attempt to disconnect from the bus, but shall complete the command.

RESTORE POINTERS: Since the Restore Pointers message is normally used during retries or error recovery, the target shall abort the retry or recovery attempt, assume that the error is unrecoverable, then complete the command according to the error condition.

DISCONNECT: The target shall not disconnect and shall continue the current command. This condition does not preclude the target from attempting to disconnect at a later time.

MESSAGE REJECT: The target shall immediately terminate the command with CHECK CONDITION status and set the Sense Key/Sense Code to "Hardware Error or Aborted Command/Message Reject Error.

IDENTIFY: Sent to reconnect. The target shall immediately go to the BUS FREE phase and abort the command. No further reconnection shall be attempted, and no STATUS or MESSAGE IN phase with Command Complete message shall be create by the target. The target shall set the Sense Key/Sense Code to "Hardware Error or Aborted Command/Message Reject Error".

### 1.7.7 Initiator Message Prity Error

When the target receives a Message Parity Error message from the initiator, it may retry the operation by resending the original message once. If the message cannot be sent successfully, the target shall immediately go to the BUS FREE phase and abort the current SCSI command. No further reconnection shall be attempted, no status or Command Complete message shall be returned for the command. The target shall set the Sense Key/Sense Code to "Hardware Error or Aborted Command/SCSI Interface Parity Error".

### 1.7.8 Reselection Timeout

When the target attempts to reselect to the initiator and the initiator does not respond within a Selection Timeout Delay, the reselection shall be aborted. The target may attempt reselection one or more times. The target shall determine after how many attempts to abort the command. No further reconnection shall be sttempted and no status or Command Complete message shall be created for the command. The target shall set Sense Key/Sense Code to "Hardware Error or Aborted Command/Select-Reselect Failed".

### 1.7.9 Internal Target Error

If an error occurs within the target which is related to the SCSI hardware or firmware, the target shall terminate the present command with a CHECK CONDITION status and set the Sense Key/Error Code to "Hardwaer Error or Aborted Command/Internal Controller Error". This error dose not prevent the initiator from retrying the command.

## 1.8 Status

A status byte shall be sent from the target to the initiator during the STATUS phase at the termination of each command as specified in Tables 1-3 and 1-4 unless the command is cleared by an ABORT message, by a BUS DEVICE RESET message, or by a "hard" RESET condition.

Table 1-3
Status Byte

| Bit Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | R | Vendor Unique | | | Status Byte Code | | | V |

Key: R = Reserved
V = Vendor Unique

Table 1-4
Status Byte Code Bit Values

| Status(es) Represented | Type | Bit of Status Byte 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| GOOD | M | R | V | V | 0 | 0 | 0 | 0 | V |
| CHECK CONDITION | M | R | V | V | 0 | 0 | 0 | 1 | V |
| BUSY | M | R | V | V | 0 | 1 | 0 | 0 | V |
| RESERVATION CONFLICT | M | R | V | V | 1 | 1 | 0 | 0 | V |

Key: M = Mondatory
R = Reserved bit
V = Vendor unique bit

A description of the status byte code is given below:

GOOD: This status indicates that the target has successfully completed the command.

CHECK CONDITION: Any error, excption, or abnormal condition that causes sense data to be set, shall cause a CHECK CONDITION status. The REQUEST SENSE command should be issued following a CHECK CONDITION status, to determine the nature of the condition.

BUSY: The target is busy. This status shall be returned whenever a target is unable to accept a command from an initiator. The normal initiator recovery action is to issue the command again at a later time.

RESERVATION CONFLICT: This status shall be returned whenever an SCSI device attempts to access a logical unit or an extent within a logical unit that is received for that type of access to another SCSI device.

## 1.9 Command Descriptor Block

The Command Descriptor Block (CDB) is a packet of six or ten bytes sentfrom the host computer during a COMMAND phase that requests the controller to perform some operation.
The common parts of CDB are described here.

### 1.9.1 Operation Code

The operation code is the first byte of CDB and indicates whether a six or ten byte is being sent. Each command has a unique operation code.

### 1.9.2 Relative Address Bit

The relative address bit is applicable to some ten byte commands. The controller does not implement relative addressing, that this bit must be set to zero.

### 1.9.3 Starting Logical Address

The starting logical address specifies the logical block at which the requested read, seek, or play operation is to begin. Not all CDB's have starting logical address.

### 1.9.4 Transfer Length

The transfer length specifies the number of logical blocks to be transferred. A transfer length value of zero has spcial meaning in some commands. The size of the logical blocks can be set using the MODE SELECT command.

### 1.9.5 Parameter Length

The parameter length specifies the exact number of bytes of sense data that the host will transfer to the controller.

### 1.9.6 Allocation Length

The allocation length specifies the maxmum number of bytes that the initiator has allocated for returned sense data. An allocation length of zero indicates that no sense data will be transferred. This condition will not be considered as an error. The controller will terminate 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.

### 1.9.7 Flag and Link Bits

The link bit set to one indicates that the initiator requests a link to the next command upon successful completion of the current command. The link bit set to zero indicates that initiator does not want the commands linked. If the link bit is set to zero, the flag bit shall be set to zero.

The controller does not implement the Flag and Link bits, that these bits must be set to zero.

### 1.9.8 Address Reporting Formats (MSF Bit)

Several CD-ROM specific commands can report addresses either in logical or in MSF format. The READ HEADER, READ SUB-CHANNEL and READ TABLE OF CONTENTS commands have this feature.

An MSF bit of zero requests that the logical block address format be used for the CD-ROM absolute address field or for the offset from the beginning of the current track expressed as a number of logical blocks in a CD-ROM track relative address field. This track relative logical address (TRLBA) value is reported as a negative value in twos-complement notation for transition areas that have decreasing MSF encoded relative addresses.

An MSF bit of one requests that the MSF format be used for these fields. In certain transition areas the relative MSF addresses are decreasing positive values. The absolute MSF addresses are always increasing positive values.

The M, S and F fields are expressed as binary numbers. The values match those on the media except for the encoding. The ratios of M field units to S field units and S field units to F field units is reported in the mode parameters page.

## 2.1 COMMAND DESCRIPTION

The following table lists the commands implemented in the controller.

Table 2-1
MKE'S CD-ROM Command List

| Operation Code | Type | Command Name | Section |
|---|---|---|---|
| 00h | M | TEST UNIT READY | 2.1.1 |
| 01h | O | REZERO UNIT | 2.1.2 |
| 03h | M | REQUEST SENSE | 2.1.3 |
| 08h | M | READ | 2.1.4 |
| 0Bh | O | SEEK | 2.1.5 |
| 12h | M | INQUIRY | 2.1.6 |
| 15h | O | MODE SELECT | 2.1.7 |
| 16h | M | RESERVE | 2.1.8 |
| 17h | M | RELEASE | 2.1.9 |
| 1Ah | O | MODE SENSE | 2.1.10 |
| 1Bh | O | START/STOP UNIT | 2.1.11 |
| 1Ch | O | RECEIVE DIAGNOSTIC RESULTS | 2.1.12 |
| 1Dh | M | SEND DIAGNOSTIC | 2.1.13 |
| 25h | M | READ CAPACITY | 2.1.14 |
| 28h | M | READ EXTENDED | 2.1.15 |
| 2Bh | O | SEEK EXTENDED | 2.1.16 |
| C2h | V | READ SUB-CHANNEL | 2.1.17 |
| C3h | V | READ TOC | 2.1.18 |
| C4h | V | READ HEADER | 2.1.19 |
| C5h | V | PLAY AUDIO(10) | 2.1.20 |
| C7h | V | PLAY AUDIO MSF | 2.1.21 |
| C8h | V | PLAY AUDIO TRACK/INDEX | 2.1.22 |
| C9h | V | PLAY TRACK RELATIVE(10) | 2.1.23 |
| CBh | V | PAUSE/RESUME | 2.1.24 |
| E5h | V | PLAY AUDIO(12) | 2.1.25 |
| E9h | V | PLAY TRACK RELATIVE(12) | 2.1.26 |

Key: M = Command implementation is mandatory on SCSI standard

O = Command implementation is optional on SCSI standard

V = Command implementation is vendor unique on SCSI standard

### 2.1.1 TEST UNIT READY Command

Table 2-2
TEST UNIT READY Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 00h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Reserved | | | | | | | |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The TEST UNIT READY command provides a means to check if the logical unit is ready. This is not a request for a self test. If the logical unit would accept an appropriate medium-access command without returning CHECK CONDITION status, this command shall return a GOOD status.

2.1.2 REZERO UNIT Command

Table 2-3
REZERO UNIT Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 01h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Reserved | | | | | | | |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The REZERO UNIT command requests that the controller set the logical unit to a specific state.

When the controller is received this command, the logical unit seeks 0 minute 2 secondes 0 flame.

### 2.1.3 REQUEST SENSE Command

Table 2-4
REQUEST SENSE Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 03h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Allocation Length ( 0Eh ) | | | | | | | |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The REQUEST SENSE command requests that the controller transfer sense data to the initiator.

The sense data shall be valid for a CHECK CONDITION status returned on the prior command. This sense data shall be preserved by the controller for the initiator until retrieved by the REQUEST SENSE command or until the receipt of any other command for the same logical unit from the initiator that issued the command resulting in the CHECK CONDITION status. Sense data shall be cleared upon receipt of any subsequent command to the logical unit from the initiator receiving the CHECK CONDITION status.

The allocation length specifies the number of bytes that the initiator has allocated for returned sense data. The controller shall terminate the DATA IN phase when allocation length bytes have been tranferred or when all available sense data have been tranferred to the initiator, whichever is less. Our cotroller usualy returns 14 bytes data to initiator.

The REQUEST SENSE command shall return the CHECK CONDITION status only to report fatal errors for the REQUEST SENSE command. For example:

(1) An unrecovered parity error occurs on the DATA BUS.
(2) A controller malfunction prevents return of the sense data.

If any nonfatal error occurs during the execution of the REQUST SENSE command, the controller shall return the sense data with a GOOD status.

Following a fatal error on a REQUEST SENSE command, sense data may be invalid.

Table 2-5
Error code 70h sense data format

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Valid | Error Code ( 70h ) | | | | | | |
| 1 | Reserved | | | | | | | |
| 2 | Reserved | | | | Sense Key | | | |
| 3 | (MSB) | Information Bytes | | | | | | |
| 6 | | | | | | | | (LSB) |
| 7 | Additional Sense Length ( 06h ) | | | | | | | |
| 8 | (MSB) | Command Specific Information Bytes | | | | | | |
| 11 | | | | | | | | (LSB) |
| 12 | Additional Sense Code | | | | | | | |
| 13 | Additional Sense Code Qualifier | | | | | | | |

A valid bit of zero indicates that the information bytes are not defined. A valid bit of one indicates the information bytes contain valid information as defined in this document.

The additional sense length specifies the number of additional sense bytes to follow. If the allocation length of the command descriptor block is too small to transfer all of the additional sense bytes, the additional sense length is not adjusted to reflect the truncation.

The sense keys are described in Table 2-6.

Table 2-6
Sense Key Descriptions

| Sense Key | Descriptions |
|---|---|
| 0h | NO SENSE.<br>Indicates that there is no specific sense key information to be reported for the designated logical unit. |
| 1h | RECOVERED ERROR.<br>Indicates that the last command completed successfully with some recovery action performed by the controller. Details may be determinable by examining the additional sense bytes and the information bytes. |
| 2h | NOT READY.<br>Indicates that the logical unit addressed cannot be accessed. Operator intervention may be required to correct this condition. |
| 3h | MEDIUM ERROR.<br>Indicates that the command terminated with a nonrecovered error condition that was probably caused by a flaw in the medium or an error in the recorded data. |
| 4h | HARDWARE ERROR.<br>Indicates that the controller detected a nonrecoverable hardware failure (for example, controller failure, device failure, parity error, etc) while performing the command or during a self test. |
| 5h | ILLEGAL REQUEST.<br>Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands.<br>If the controller detects an invalid parameter in the command descriptor block, then it shall terminate the command without altering the medium. If the controller detects an invalid parameter in the additional parameters supplied as data, then the controller may have already altered the medium. |
| 6h | UNIT ATTENTION.<br>Indicates that the removable medium may have been changed or the controller has been reset. |
| Bh | ABORTED COMMAND.<br>Indicates that the controller aborted the command. The initiator may be able to recover by trying the command again. |

## 2.1.4 READ Command

Table 2-7
READ Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 08h) | | | | | | | |
| 1 | Logical Unit Number | | | (MSB) Logical Block Address | | | | |
| 2 | Logical Block Address | | | | | | | |
| 3 | Logical Block Address | | | | | | | (LSB) |
| 4 | Transfer Length | | | | | | | |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The READ command requests that the controller transfer data to the initiator.

The logical block address specifies the logical block at which the read operation shall begin.

The transfer length specifies the number of contiguous logical blocks of data to be transferred. A transfer length of zero indicates that 256 logical blocks shall be trnsferred. Any other value indicates the number of logical blocks that shall be tranferred.

This command shall be terminated with a status of RESERVATION CONFLICT if any reservation access conflict exists and no data shall be tranferred.

If any of the following conditions occur, this command shall be terminated with a CHECK CONDITION status. The sense key shall be set as indicated in the following table. This table does not provide an exhaustive enumeration of all condition that may cause the CHECK CONDITION status.

| Condition | Sense Key |
|---|---|
| Invalid logical block address | ILLEGAL REQUEST |
| Target reset or medium change since the last command from this initiator | UNIT ATTENTION |
| Overrun or other error that might be resolved by repeating the command | ABORTED COMMAND |

NOTE: The extended sense information bytes shall be set to the logical block address of the first invalid address.

## 2.1.5 SEEK Command

Table 2-8
SEEK Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 0Bh) | | | | | | | |
| 1 | Logical Unit Number | | | (MSB) Logical Block Address | | | | |
| 2 | Logical Block Address | | | | | | | |
| 3 | Logical Block Address | | | | | | | (LSB) |
| 4 | Reserved | | | | | | | |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The SEEK command requests that the logical unit seek to the spcified logical block address.

## 2.1.6 INQUIRY Command

Table 2-9
INQUIRY Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 12h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Allocation Length ( 24h ) | | | | | | | |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The INQUIRY command requests that information regarding parameters of the controller and its attached peripheral device be sent to the initiator.

The allocation length specifies the number of bytes that the initiator has allocated for returned INQUIRY data. The maximum value of allocation length the controller supported is 24 hex. An allocation length of zero indicates that no INQUIRY data shall be transferred. This condition shall not be considered as an error. Any other value indicates the maximum number of bytes that shall be transferred. The target shall terminate the DATA IN phase when allocation length bytes have been transferred or when all available INQUIRY data have been transferred to the initiator, whichever is less.

The INQUIRY command shall return a CHECK CONDITION status only when the controller cannot return the requested INQUIRY data.

If an INQUIRY command is received from an initiator with a pending unit attention condition, the controller shall perform the INQUIRY command and shall not clear the unit attention condition.

The INQUIRY data contains a five-byte header, followed by the vendor unique parameters, if any.

Table 2-10
INQUIRY Data

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Peripheral Device Type ( 05h ) | | | | | | | |
| 1 | RMB | Device-Type Qualifier ( 00h ) | | | | | | |
| 2 | ISO Version | | ECMA Version | | | ANSI-Approved Version | | |
| 3 | Reserved | | | | Response Data Format | | | |
| 4 | Additional Length ( 1Fh ) | | | | | | | |
| 5 | Vendor Unique | | | | | | | |
| 6 | Reserved | | | | | | | |
| 7 | Reserved | | | | | | | |
| | Vendor Unique Parameters | | | | | | | |
| 8 -15 | Vendor Identification (ASCII code "MATSHITA") | | | | | | | |
| 16-31 | Product Identification (ASCII code "CD-ROM CR-5XX ") | | | | | | | |
| 32-35 | Product Revision Level (ASCII code "1.0b") | | | | | | | |

The peripheral device type code is set to 05h if the logical unit is present.

The RMB bit is set to one, because the disc is removable.

The device-type qualifier is set to zero.

The ISO vertion and the ECMA vertion fields are set to zero. A zero code value in these fields shall indicate that the controller does not claim compliance to the ISO vertion of SCSI (ISO DP 9316) or the ECMA vertion of SCSI (ECMA-111).

The ANSI-approved version is set to one. The one code value of this field specifies that the controller claims compliance to ANSI current version of SCSI (X3.131-1986).

The additional length specifies the length in bytes of the vendor unique parameters. This fiels is set to 1Fh. If the allocation length of the command descriptor block is too small to transfer all of the vendor unique parameters, the additional length will not be adjusted to reflect the truncation.

The vendor unique parameter bytes are specified MKE parameter in ASCII data as follows:

| Byte | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|
| ASCII | M | A | T | S | H | I | T | A |
| Code | 4Dh | 41h | 54h | 53h | 48h | 49h | 54h | 41h |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASCII | C | D | - | R | O | M | | C | R | - | 5 | X | X | | | |
| Code | 43h | 44h | 2Dh | 52h | 4Fh | 4Dh | 20h | 43h | 52h | 2Dh | 35h | 58h | 58h | 20h | 20h | 20h |

| Byte | 32 | 33 | 34 | 35 |
|---|---|---|---|---|
| ASCII | 1 | . | 0 | b |
| Code | 31h | 2Eh | 30h | 62h |

## 2.1.7 MODE SELECT Command

Table 2-11
MODE SELECT Command

| Bit Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 15h) | | | | | | | |
| 1 | Logical Unit Number | | | PF | Reserved | | | SP |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Parameter List Length | | | | | | | |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The MODE SELECT command provides a means for the initiator to specify medium, logical unit, or peripheral device parameters to the controller.

PF(Page Format) bit set to one indicates that the data sent by the initiator after the MODE SELECT Header and the Block Descriptors (if any) complies to the Page Format. PF bit set to zero indicates that the data sent by the initiator after the MODE SELECT Header and the Block Deriptors (if any) is vendor unique.

SP(Save Parameters) bit is set to zero because the CD-ROM cannot save parameters.

The parameter list length specifies the length in bytes of the MODE SELECT parameter list that will be transferred from the initiator to the controller. A parameter list length of zero indicates that no data shall be transferred. This condition shall not be considered as an error. The block descriptor and the pages which follow if any must be sent in their entirety. Truncation of a page due to an incorrect parameter list length will be terminated with a CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to INVALID FIELD IN PARAMETER LIST.

The MODE SELECT parameter list contains a four-byte header, followed by zero or one eight-byte block descriptors, followed by the pages, if any.

Table 2-12
MODE SELECT Parameter List

| Bit Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | Header(s) | | | | | | | |
| 0 | Reserved | | | | | | | |
| 1 | Reserved | | | | | | | |
| 2 | Reserved | | | | | | | EBC |
| 3 | Block Descriptor Length ( 00h or 08h ) | | | | | | | |
| | Block Descriptor(s) | | | | | | | |
| 0 | Reserved | | | | | | | |
| 1 | (MSB) Number of Blocks | | | | | | | |
| 2 | Number of Blocks | | | | | | | |
| 3 | Number of Blocks ( 00h ) | | | | | | | (LSB) |
| 4 | Reserved | | | | | | | |
| 5 | (MSB) Block Length | | | | | | | |
| 6 | Block Length | | | | | | | |
| 7 | Block Length | | | | | | | (LSB) |
| | Page(s) | | | | | | | |
| 0 | Reserved | | Page Code | | | | | |
| 1 | Page-Specific Parameter Length | | | | | | | |
| 2 | Page-Specific Parameters | | | | | | | |
| n | | | | | | | | |

An enable block check (EBC) bit of zero disables blank checking of the medium during write operations. This bit is set to zero.

The block descriptor length specifies the length in bytes of all the block descriptors. This field will be set to either 00h or 08h. A block descriptor length of zero indicates that no block descriptors shall be included in the parameter list. This condition shall not be considered as an error.

Each block descriptor specifies the medium characteristics for all or part of a logical unit. Each block descriptor contains a number of block send a block length.

The number of blocks field specifies the number of logical blocks on the medium that meet the density code and block length in the block descriptor. A number of blocks of zero indicates that all of the remaining logical blocks of the logical unit shall have the medium characteristics specified by the block descriptor. This field is set to zero.

The block length requests that the controller use the logical block length specified for data transfers. The block length accepted by controller is 256, 512, 1024, 2048, 2052, 2336 and 2340. Any other value will be considered an error. The command will be terminated with a CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to ILLEGAL FIELD IN CDB.

Each block descriptor specifies the medium characteristics for all or part of a logical unit. Each block descriptor contains a number of block send a block length.

The number of blocks field specifies the number of logical blocks on the medium that meet the density code and block length in the block descriptor. A number of blocks of zero indicates that all of the remaining logical blocks of the logical unit shall have the medium characteristics specified by the block descriptor. This field is set to zero.

The block length requests that the controller use the logical block length specified for data transfers. The block length accepted by controller is 256, 512, 1024, 2048, 2052, 2336 and 2340. Any other value will be considered an error. The command will be terminated with a CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to ILLEGAL FIELD IN CDB.

## 2.1.8 RESERVE Command

Table 2-13
RESERVE Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 16h) | | | | | | | |
| 1 | Logical Unit Number | | | 3rdPty | Third Parity Device ID | | | Extent |
| 2 | Reservation Identification (00h) | | | | | | | |
| 3 | (MSB) | Extent List Length | | | | | | |
| 4 | Extent List Length (00h) | | | | | | | (LSB) |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The RESERVE command is used to reserve logical units or, if the extent reservation optionis implemented, extents within logical units for the use of the initiator. If third-party reservation option is implemented, the logical units or extents may be reserved for another specified SCSI device. The RESERVE and RELEASE commands provide the basic mechanism for contention resolution in multiple-initiator systems.

If the extent bit is zero, this command shall request that the entire logical unit be reserved for the exclusive use of the initiator until the reservation is superseded by another valid RESERVE command from the initiator that made the reservation or until released by a RELEASE command from the same initiator, by a BUS DEVICE RESET message from any initiator, or by a "hard" RESET condition. A logical unit reservation shall not be granted if the logical unit or any extent is reserved by an other initiator. It shall be permissible for an initiator to reserve a logical unit that is currently reserved by that initiator.
If the extent bit is zero, the reservation identification and the extent list length shall be ignored.

If the logical unit, or any extent within the logical unit is reserved for another initiator, the target shall respond by either:

(1) Returning a RESERVATION CONFLICT status

(2) Queuing the reservation request and then disconnecting until all previously queued reservations have been released and the logical unit is available, then reconnecting to perform the reservation.

If, after honoring the reservation, any other initiator then subsequently attempts to perform any command on the reserved logical unit other than a RESERVE command, which may be queued, or a RELEASE command, which shall be ignored, then the command shall be rejected with RESERVATION CONFLICT status.

The extent reservation and the third-party reservation are not used. These fields must be set to zero.

## 2.1.9 RELEASE Command

Table 2-14
RELEASE Command

| Bit Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 17h) | | | | | | | |
| 1 | Logical Unit Number | | | 3rdPty | Third Parity Device ID | | | Extent |
| 2 | Reservation Identification | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Reserved | | | | | | | |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The RELEASE command is used to release previously reserved logical units, or, if the extent release option is implemented, previously reserved extents within logical units. It is not an error for an initiator to attempt to release a reservation that is not currently active. In this case, the target returns GOOD status without altering any other reservation.

If the extent bit is zero, this command shall cause the target to terminate all logical unit and extent reservations that are active from the initiator to the specified logical unit.

The extent reservation and the third-party reservation are not used. These fields must be set to zero.

## 2.1.10 MODE SENSE Command

Table 2-15
MODE SENSE Command

| Bit Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 1Ah) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | |
| 2 | PCF | | Page Code | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Allocation Length | | | | | | | |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The MODE SENSE command provides a means for a controller to report its medium, logical unit, or peripheral device parameters to the initiator. It is a complementary command to the MODE SELECT command.

The allocation length specifies the number of bytes that the initiator has allocated for returned MODE SENSE data. An allocation length of zero indicates that no MODE SENSE data shall be transferred. This condition shall not be considered as an error. Any other value indicates the maximum number of bytes that shall be transferred. The controller shall terminate the DATA IN phase when allocation length bytes have been transferred or when all vailable MODE SENSE data have been transferred to the initiator, whichever is less.

The MODE SENSE data contains a four-byte header, followed by zero or one eigth-byte block descriptors, followed by the pages, if any.

Table 2-16-1
Page Control Field

| 7 | 6 | Descriptions |
|---|---|---|
| 0 | 0 | REPORT CURRENT VALUES<br>If the Page Code is equal to 3Fh, all Pages implemented by the target are to be returned to the initiator with fields and bits set to Current values. Page Zero supported, shall be returned last.<br>If the Page Code is defferent than 3Fh, the Page defined by the Page Code, if supported by the target, is to be returned to the initiator with fields and bits set to Current values.<br>The Current values are either:<br>- as set in the last successfully completed MODE SELECT command.<br>- or are identical to the Saved values if saving is available and if no MODE SELECT commands were yet issued since the last power on.<br>- or are identical to the Default values if no saving is available or if no Saved values are available.<br>Fields and bits not supported by the target shall be set to zero.<br>The Page Length byte value of each Page returned by the target indicates up to which feilds are supported within the particular Page. |
| 0 | 1 | REPORT CHANGEABLE VALUES<br>If the Page Code is equal to 3Fh, all Pages implemented by the target are to be returned to the initiator with bits and fields that are allowed to be changed by the initiator set to one. Fields and bits not allowed to be changed by the initiator shall be set to zero. Page Zero, if supported, shall be returned last.<br>If the Page Code is defferent than 3Fh, the Page defined by the Page Code, if supported by the target, is to be returned to the initiator with bits and fields that are allowed to be changed by the initiator set to zero.<br><br>If no bits or fields are changeable within a Page, the target may or may not return bytes 0 and 1 of the Page. If the target returns these two bytes, the Page Length byte value shall be set to zero by the target.<br>The Page Length byte value of each Page returned by the target indicates up to which feild are supported within the particular page. |

Table 2-16-2
Page Control Field

| 7 | 6 | Descriptions |
|---|---|---|
| 1 | 0 | REPORT DEFAULT VALUES |
| 1 | 1 | If the Page Code is equal to 3Fh, all Pages implemented by the target are to be returned to the initiator with fields and bits set to the target's or device's default values. Page Zero, if supported, shall be returned last.<br>If the Page Code is defferent than 3Fh, the Page defined by the Page Code, if supported by the target, is to be returned to the initiator with fields and bits set to the target's or device's default values.<br>Fields and bits not supported by the target shall be set to zero.<br>The Page Length byte value of each Page returned by the target indicates up to which feild are supported within the particular page.<br>The value of the fields returned with this code is intended to avoid confusion over whether the value of zero is the default or the non supported value. |

Table 2-18
MODE SENSE Data

| Bit Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | Header(s) | | | | | | | |
| 0 | Sense Data Length | | | | | | | |
| 1 | Medium Type | | | | | | | |
| 2 | WP | Reserved | | | | | | EBC |
| 3 | Block Descriptor Length ( 00h or 08h ) | | | | | | | |
| | Block Descriptor(s) | | | | | | | |
| 0 | Reserved | | | | | | | |
| 1 | (MSB) Number of Blocks | | | | | | | |
| 2 | Number of Blocks | | | | | | | |
| 3 | Number of Blocks ( 00h ) | | | | | | | (LSB) |
| 4 | Reserved | | | | | | | |
| 5 | (MSB) Block Length | | | | | | | |
| 6 | Block Length | | | | | | | |
| 7 | Block Length | | | | | | | (LSB) |
| | Page(s) | | | | | | | |
| 0 | PS | Reserv | Page Code | | | | | |
| 1 | Page-Specific Parameter Length | | | | | | | |
| 2 | Page-Specific Parameters | | | | | | | |
| n | | | | | | | | |

The sense data length specifies the length in bytes of the following MODE SENSE data that is available to be transferred during the DATA IN phase. The sense data length does not include itself.

The medium type field is set to zero.

For read-only direct-access device, the enable blank check (EBC) bit is reserved. The EBC bit must be set to zero.

For read-only direct-access device, the write protected (WP) bit is reserved. The WP bit must be set to zero.

The block descriptor length specifies the length in bytes of all the block descriptors. This field will be set to either 00h or 08h. A block descriptor length of zero indicates that no block descriptors shall be included in the parameter list. This condition shall not be considered as an error.

Each block descriptor specifies the medium characteristics for a logical unit. Each block descriptor contains a number of blocks and a block length.

The number of blocks field specifies the number of logical blocks that have the block length specified in the block descriptor. A number of blocks of zero indicates that all of the remaining logical blocks of the logical unit have the medium characteristics specifiedby the block descriptor. This field must be set to zero.

The block length field indicates the length in bytes of each logical block. The default value is 2048.

The vendor unique field in MODE SENSE command is specified page parameter in MODE SENSE Data as Table 2-18.

Each parameter is specified the same format as MODE SELECT Pages.

## 2.1.11 START/STOP UNIT Command

Table 2-19
START/STOP UNIT Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 1Bh) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | Immed |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Reserved | | | | | | | Start |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The START/STOP UNIT Command requsets that the controller enable or disable the logical unit for further operations.

An immediate (Immed) bit of one indicates that status shall be returned as soon as the operation is initiated. An Immed bit of zero indicates that status shall be returned after the operation is completed. This field must be set to zero.

A start bit of one requests the logical unit be made ready for use. A start bit of zero requests that the logical unit be stopped.

## 2.1.12 RECEIVE DIAGNOSTIC RESULTS Command

Table 2-20
RECEIVE DIAGNOSTIC RESULTS Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 1Ch) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | |
| 2 | Reserved | | | | | | | |
| 3 | (MSB) | Allocation Length | | | | | | |
| 4 | Allocation Length ( 06h ) | | | | | | | (LSB) |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The RECEIVE DIAGNOSTIC RESULTS command requests analysis data be sent to the initiator after completion of a SEND DIAGNOSTIC command.

The allocation length shall specify the number of bytes that the initiator has allocated for returned diagnostic data. An allocation length of zero indicates that no diagnostic data shall be transferred. Any other value indicates the maximun number of bytes that shall be transferred. The controller terminates the DATA IN phase when allocation length bytes have been transferred or when all available diagnostic data have been transferred tothe initiator, whichever is less.

The controller will send six bytes data during DATA IN phase. The Table 2-21 indicates the Diagnostic Results Data returned the controller.

Table 2-21
Diagnostic Results Data

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Test Code (04h) | | | | | | | |
| 1 | (MSB) | CLV Value | | | | | | |
| 2 | CLV Value | | | | | | | (LSB) |
| 3 | Reserved | | | | | | | |
| 4 | Reserved | | | | | | | |
| 5 | Reserved | | | | | | | |

The CLV value specify the CLV value that controller has adopted for current disc. The unit of this value in hex is the mm/sec.

## 2.1.13 SEND DIAGNOSTIC Command

Table 2-22
SEND DIAGNOSTIC Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 1Dh) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | S_Test | DevOfL | UnitOf |
| 2 | Reserved | | | | | | | |
| 3 | (MSB) Parameter Length | | | | | | | |
| 4 | Parameter Length ( 00h or 01h ) | | | | | | | (LSB) |
| 5 | Vendor Unique | | Reserved | | | | Flag | Link |

The SEND DIAGNOSTIC command requests the controller to perform diagnostic tests on itself, on the attached peripheral devices, or on both. This command is usually followed by a RECEIVE DIAGNOSTIC RESULTS command, except when the self test (S_Test) bit is one.

The parameter list length specifies the length in bytes of the parameter list that shall be transferred during the DATA OUT phase. A parameter list length of zero indicates that no data shall be transferred. This condition shall not be considered as an error.

A logical unit off-line (UnitOf) bit and an SCSI device off-line (DevOfl) bit must be set to zero.

A self test bit of one directs the controller to complete its default self test that the controller requests a SEEK operation between inside and outside for 5 times. If the selftest is requested, the parameter list length shall be set to zero and no data shall be transferred. If the self test successfully passes, the command shall be terminated with a GOOD status; otherwise, the command shall be terminated with a CHECK CONDITION status and, if extended sense is implemented, the sense key shall be set to HARDWARE ERROR.

A self test bit of zero requests the another test. Those test codes are shown in Table 2-23. In this case, the only one byte of test code will be sent during DATA OUT phase, and allocation length field shall be set to one.

Table 2-23
Diagnostic Test Code

| Test Code | Description |
|---|---|
| 00h | RAM Diagnostic |
| 01h | ROM Diagnostic |
| 02h | Reserved |
| 03h | CLV Diagnostic (Initial Value) |
| 04h | CLV Diagnostic |
| 05h - FFh | Reserved |

## 2.1.14 READ CAPACITY Command

Table 2-24
READ CAPACITY Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 25h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | Reladr |
| 2 | (MSB) | Logical Block Address | | | | | | |
| 3 | Logical Block Address | | | | | | | |
| 4 | Logical Block Address | | | | | | | |
| 5 | Logical Block Address | | | | | | | (LSB) |
| 6 | Reserved | | | | | | | |
| 7 | Reserved | | | | | | | |
| 8 | Reserved | | | | | | | PMI |
| 9 | Vendor Unique | | Reserved | | | | Flag | Link |

The READ CAPACITY command provides a means for the initiator to request information regarding the capacity of the logical unit.

A partial medium indicator (PMI) bit shall be set to zero. The PMI bit of zero indicates that the infomation returned in the READ CAPACITY data shall be the logical block address and block length (in bytes) of the last logical block of the logical unit. The logical block address in the command descriptor block shall be to set zero for this option.

The eight bytes of READ CAPACITY data shown in Table 2-25 shall be sent during the DATA IN phase of the command.

Table 2-25
READ CAPACITY Data

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | (MSB) | | | Logical Block Address | | | | |
| 1 | | | | Logical Block Address | | | | |
| 2 | | | | Logical Block Address | | | | |
| 3 | | | | Logical Block Address | | | | (LSB) |
| 4 | (MSB) | | | Block Length | | | | |
| 5 | | | | Block Length | | | | |
| 6 | | | | Block Length | | | | |
| 7 | | | | Block Length | | | | (LSB) |

The logical block address field reports the address of the last user accessible block address on the disc.

## 2.1.15 READ EXTENDED Command

Table 2-26
RAED EXTENDED Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 28h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | Reladr |
| 2 | (MSB) | Logical Block Address | | | | | | |
| 3 | Logical Block Address | | | | | | | |
| 4 | Logical Block Address | | | | | | | |
| 5 | Logical Block Address | | | | | | | (LSB) |
| 6 | Reserved | | | | | | | |
| 7 | (MSB) | Transfer Length | | | | | | |
| 8 | Transfer Length | | | | | | | (LSB) |
| 9 | Vendor Unique | | Reserved | | | | Flag | Link |

The READ EXTENDED command requests that the controller transfer data to the initiator from the medium.

The logical block address specifies the logical block at which the read operation shall be begin.

The transfer length specifies the number of contiguous logical blocks of data that shall be transferred. A transfer length of zero indicates that no data shall be transferred. This condition shall not be considered as an error. Any other value indicates the number of logical blocks that shall be transferred.

If any of the following conditions occur, this command shall be terminated with a CHECK CONDITION status and, if extended sense is implemented, the sense key shall be set as indicated in the following table. This table does not provide an exhaustive enumeration of all conditions that may cause the CHECK CONDITION status.

| Condition | Sense Key |
|---|---|
| Invalid logical block address | ILLEGAL REQUEST |
| Target reset or medium change since the last command from this initiator | UNIT ATTENTION |
| Overrun or other error that might be resolved by repeating the command | ABORTED COMMAND |

NOTE: The extended sense information bytes shall be set to the logical block address of the first invalid address.

### 2.1.16 SEEK EXTENDED Command

Table 2-27
SEEK EXTENDED Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= 2Bh) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | Reladr |
| 2 | (MSB) | | | Logical Block Address | | | | |
| 3 | Logical Block Address | | | | | | | |
| 4 | Logical Block Address | | | | | | | |
| 5 | Logical Block Address | | | | | | | (LSB) |
| 6 | Reserved | | | | | | | |
| 7 | Reserved | | | | | | | |
| 8 | Reserved | | | | | | | |
| 9 | Vendor Unique | | Reserved | | | | Flag | Link |

The SEEK EXTENDED command requests that the logical unit seek to the specified logical block address.

## 2.1.17 READ SUB-CHANNEL Command

Table 2-28
READ SUB-CHANNEL Command

| Bit Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= C2h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | MSF | Reserv |
| 2 | Reserv | Sub Q | Reserved | | | | | |
| 3 | Sub-channel Data Format | | | | | | | |
| 4 | Reserved | | | | | | | |
| 5 | Reserved | | | | | | | |
| 6 | Track Number | | | | | | | |
| 7 | (MSB) | Allocation Length | | | | | | |
| 8 | Allocation Length | | | | | | | (LSB) |
| 9 | Vendor Unique | | Reserved | | | | Flag | Link |

The READ SUB-CHANNEL command requests that the controller return the requested sub-channel data plus the state of audio play operations.

Sub-channel data returned by this command may be from the last appropriate sector encountered by a current or privious media accessing operation. When there is no current audio play operation, the target may access the media to read the sub-channel data. The target is responsible that the data returned are current and consistent. For example with sub-channel data format 0, the International Standard Recording Code (ISRC) data reported must have been read from the same track as the reported current position data.

The Sub Q bit set to one requests the controller return the Q sub-channel data. The Sub Q bit set to zero requests that no sub-channel data be returned. This shall not be considered an error. The other bits in this byte are reserved for future standardization when they may be defined to request other sub-channel data.

The Sub-channel Data Format field specifies the returned Sub Channel Data. If this field is 00h, Sub-Q Channel data is returned. If this field is 01h, 02h or 03h, the requested Sub-Q data item is returned.

Table 2-29
Sub-channel Data Format Codes

| Format Code | Returned data |
|---|---|
| 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 | Vendor Specific |

The Track Number field specifies the track from which ISRC data is read. This field must have a value between 01h and 63h (99bcd), and is valid only when the Sub-Channel Data Format field is 03h. In this case, the target returns ISRC data for this track.

The READ SUB-CHANNEL command data formats (Tables 2-30, 2-34, 2-35, and 2-36) consist of a four-byte header followed by a sub-channel data block. The header contains the audio status byte and the sub-channel data length field. If the SUB-Q bit is zero, the target shall not return the sub-channel data block, in this case the sub-channel data length is 0.

Table 2-30
Sub_Q Channel Data Format

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | Sub-channel Data Header | | | | | | | |
| 0 | Reserved | | | | | | | |
| 1 | Audio Status | | | | | | | |
| 2 | (MSB) Sub-channel Data Length | | | | | | | |
| 3 | | | | | | | | (LSB) |
| | CD-ROM Current Position Data Block | | | | | | | |
| 4 | Sub Channel Data Format Code (00h) | | | | | | | |
| 5 | ADR | | | | Control | | | |
| 6 | Track Number | | | | | | | |
| 7 | Index Number | | | | | | | |
| 8 | (MSB) Absolute CD-ROM Address | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | (LSB) |
| 12 | (MSB) Track Relative CD-ROM Address | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | (LSB) |
| 16 | MCVal | Reserved | | | | | | |
| 17 | (MSB) Media Catalog Number (UPC/Bar Code) | | | | | | | |
| 31 | | | | | | | | (LSB) |
| 32 | TCVal | Reserved | | | | | | |
| 33 | (MSB) Track International-Standard-Recording-Code (ISRC) | | | | | | | |
| 47 | | | | | | | | (LSB) |

The audio status field indicates the status of audio play operations. The audio status values are defined in Table 2-31. Audio status values greater than zero are returned only to the initiator that requested the last audio pla operation. Audio status values 13h and 14h return information on privious audio operations; they are returned only once after the condition has occurred. If another audio play operation is not requested,the audio status returned for subsequent READ SUB-CHANNEL commands is 15h.

Table 2-31
Audio Status Codes

| Status | Description |
|---|---|
| 00h | Audio status byte not supported or 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 |

The Sub-Channel data length specifies the length in bytes of the following sub-channel data block. A sub-channel data length of zero indicates that no sub-channel data block is included in the returned data. Usual values for Sub-channel data length does not include the Sub Channel Header.

The Sub-Q Channel data block consists of control data (bytes 4-5) current position data (bytes 6-15) and indentification data (bytes 16-47). The control data and current position data is obtained from the Q sub-channel information of the current block. Identification data may be reported that was obtained from a previous block. If identification data is reported, the data shall be valid for the sector addressed by the current position data.

(1) If an audio play operation is proceeding is the background, position data for the last sector played shall be reported.
(2) In other cases, for instance after a READ command, the target may either report position data for the last sector processed for that operation or may report position data from the sector at the current read head position.

When the type of information encoded in the Q sub-channel of the current sector is the media catalog number or ISRC; the track, index, and address fields should be extrapolated from the previous sector.

The ADR field gives the type of information encoded in the Q sub-channel of this block, as shown in Table 2-32.

Table 2-32
ADR Sub-cannel Q Field

| ADR Code | Description |
|---|---|
| 0h | Sub-channel Q mode information not supplied. |
| 1h | Sub-channel Q encodes current position data. (i.e. track, index, absolute address, relative address.) |
| 2h | Sub-channel Q encodes media catalog number. |
| 3h | Sub-channel Q encodes ISRC. |
| 4h - Fh | Reserved |

The control bits are defined in Table 2-33.

Table 2-33
Sub-channel Q Control Bits

| Bit | equals zero | equals one |
|---|---|---|
| 0 | Audio without pre-emphasis | Audio with pre-emphasis |
| 1 | Digital copy prohibited | Digital copy permitted |
| 2 | Audio track | Data track |
| 3 | Two channel audio | Four channel audio |
| 4h - Fh | Reserved | |

The track number specifies the current track number.

The index number specifies the index number in the current track.

The absolute CD-ROM address field gives the current location relative to the logical beginning of the media. If the MSF bit is zero, this field is a logical block address. If the MSF bit is one, this field is an absolute MSF address.

The track relative CD-ROM address field gives the current location relative to the logical beginning of the current track. If the MSF bit is zero, this field is a track relative logical block address. (If the currnt block is in the pre-gap area of a track, this will be a negative value, expressed as a twos complement number.) If the MSF bit is one, this field is the relative MSF address from the Q sub-channel.

A media catalog valid (MCVal) bit of one indicates that the media catalog number field is valid. A MCVal bit of zero indicates that the media catalog number field is not valid.

The media catalog number field contains the identifying number of this media according to the uniform product code values (UPC/EAN Bar Coding) expressed in ASCII. Non-zero values in this field are controlled by the Uniform Product Code Council and the European Article Number Council. A value in this field of all ASCII zeros indicates that the media catalog number is not supported.

The track code valid (TCVal) bit of one indicates that the track ISRC field is valid. A TCVal bit of zero indicates that the track International-Standard-Recording-Code (ISRC) field is not valid.

The track ISRC field contains the identifying number of this media according to the ISRC standards (DIN-31-621) expressed in ASCII.

Table 2-34
CD-ROM Current Position Data Format

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | Sub-channel Data Header | | | | | | | |
| 0 | Reserved | | | | | | | |
| 1 | Audio Status | | | | | | | |
| 2 | (MSB) Sub-channel Data Length | | | | | | | |
| 3 | | | | | | | | (LSB) |
| | CD-ROM Current Position Data Block | | | | | | | |
| 4 | Sub Channel Data Format Code (01h) | | | | | | | |
| 5 | ADR | | | | Control | | | |
| 6 | Track Number | | | | | | | |
| 7 | Index Number | | | | | | | |
| 8 | (MSB) Absolute CD-ROM Address | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | (LSB) |
| 12 | (MSB) Track Relative CD-ROM Address | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | (LSB) |

Table 2-35
Media Catalog Number Data Format

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | Sub-channel Data Header | | | | | | | |
| 0 | Reserved | | | | | | | |
| 1 | Audio Status | | | | | | | |
| 2 | (MSB) Sub-channel Data Length | | | | | | | |
| 3 | | | | | | | | (LSB) |
| | Media Catalog Number Data Format | | | | | | | |
| 4 | Sub Channel Data Format Code (02h) | | | | | | | |
| 5 | Reserved | | | | | | | |
| 6 | Reserved | | | | | | | |
| 7 | Reserved | | | | | | | |
| 8 | MCVal | Reserved | | | | | | |
| 9 | (MSB) Media Catalog Number (UPC/Bar Code) | | | | | | | |
| 23 | | | | | | | | (LSB) |
| 24 | ADR | | | | Control | | | |

If Media Catalog Number data is found, the MCVal bit is set to one. If MCN data is not detected, the MCVal bit is set to zero to indicate the Media Catalog Number field is invalid.

Media Catalog Number data returned by this command with Sub-channel Data Format field code 02h may be from any block which has UPC/Bar Code Q sub-channel data. (This code is constant anywhere in every applicable disc.)

The data of 24th byte shall be used to MS-Extentions. This data is vendor unique.

Table 2-36
Track International Standard Recording Code Data Format

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | Sub-channel Data Header | | | | | | | |
| 0 | Reserved | | | | | | | |
| 1 | Audio Status | | | | | | | |
| 2 | (MSB) Sub-channel Data Length | | | | | | | |
| 3 | | | | | | | | (LSB) |
| | Track ISRC Data Block | | | | | | | |
| 4 | Sub Channel Data Format Code (03h) | | | | | | | |
| 5 | ADR | | | | Control | | | |
| 6 | Track Number | | | | | | | |
| 7 | Reserved | | | | | | | |
| 8 | TCVal | Reserved | | | | | | |
| 9 | (MSB) Track International-Standard-Recording-Code (ISRC) | | | | | | | |
| 23 | | | | | | | | (LSB) |

If ISRC data is detected, the TCVal bit is set to one. If ISRC data is not detected, the TCVal bit is set to zero to indicate the ISRC field is invalid.

Track ISRC data returned by this command with Sub-Channel Data Format field 03h may be from any block in the specified track which has ISRC data.

## 2.1.18 READ TOC Command

Table 2-37
READ TOC Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= C3h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | MSF | Reserv |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Reserved | | | | | | | |
| 5 | Reserved | | | | | | | |
| 6 | Starting Track | | | | | | | |
| 7 | (MSB) | Allocation Length | | | | | | |
| 8 | Allocation Length | | | | | | | (LSB) |
| 9 | Vendor Unique | | Reserved | | | | Flag | Link |

The READ TOC command requests the target transfers data from the table of contents (TOC) to the initiator. The format of the data returned is specified in Table 2-38.

The starting track field specifies the starting track number for which the data shall be returned. If this value is zero, the table of contents data shall begin with the first track on the medium. The data is returned in contiguous ascending track number order.

If the starting track field is not valid for the currently installed medium, the command shall be terminated with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

The maximum TOC data length possible on currently available CD-ROM media is 804 bytes, or 100 TOC track descriptors.

Table 2-38
READ TOC Data Format

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | TOC Data Header | | | | | | | |
| 0 | (MSB) | | | | | | | |
| 1 | TOC Data Length | | | | | | | (LSB) |
| 2 | First Track Number | | | | | | | |
| 3 | Last Track Number | | | | | | | |
| | TOC Track Descriptor(s) | | | | | | | |
| 4 | Reserved | | | | | | | |
| 5 | ADR | | | | Control | | | |
| 6 | Track Number | | | | | | | |
| 7 | Reserved | | | | | | | |
| 8 | (MSB) | | | | | | | |
| 9 | Absolute CD-ROM Address | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | (LSB) |

The TOC data block contains a four byte header followed by zero or more TOC track descriptors.

The TOC data length specifies the length in bytes of the following TOC data that is available to be transferred during the DATA IN phase. The TOC data length value does not include the TOC data length field itself.

The first track number field indicates the first track number in the table of contents.

The last track number field indicates the last track number in the table of contents before the lead-out track number.

The first track number is not required to be one. A disc may start at any valid track number. The track numbers between the first track number and the last track number are required to be in contiguous ascending order, except for the lead-out track.

The ADR field gives the type of information encoded in the Q Sub-channel of the block where this TOC entry was found. The possible ADR values are defined in Table 2-32.

The control field indicates the attributes of the track. The possible control field values are defined in Table 2-33.

The track number field indicates the track number for which the data in the TOC track descriptor is valid. A track number of 0AAh indicates the track descriptor is for the start of the lead-out area.

The absolute CD-ROM address contains the address of the first block with user information for that track number as read from the table of contents. An MSF bit of zero indicates that the absolute CD-ROM address field contains a logical block address. An MSF bit of one indicates the absolute CD-ROM address field contains an MSF address.

The starting logical block address value recovered from the TOC has a tolerance of zero for data tracks and plus or minus 75 CD sectors for audio tracks. This tolerance is multiplied by a factor dependent on the logical block length.

## 2.1.19 READ HEADER Command

Table 2-39
READ HEADER Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= C4h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | MSF | Reserv |
| 2 | (MSB) | Logical Block Address | | | | | | |
| 3 | Logical Block Address | | | | | | | |
| 4 | Logical Block Address | | | | | | | |
| 5 | Logical Block Address | | | | | | | (LSB) |
| 6 | Reserved | | | | | | | |
| 7 | (MSB) | Allocation Length | | | | | | |
| 8 | Allocation Length ( 08h ) | | | | | | | (LSB) |
| 9 | Vendor Unique | | Reserved | | | | Flag | Link |

The READ HEADER command requests that the device return the CD-ROM data block address header of the requested logical block.

The logical block address field specifies the logical block at which the read header operation shall begin.

See the READ command for exception handling. If the logical block size is other than the physical block size, it shall be mapped into the appropriate physical block from which the data would have been read.

Table 2-40
Header Data Format

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | CD-ROM Data Mode | | | | | | | |
| 1 | Reserved | | | | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | (MSB) | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | Absolute CD-ROM Address | | | | |
| 7 | | | | | | | | (LSB) |

The CD-ROM data mode field specifies the CD-ROM Data Mode of the logical blocks in this sector of data. The value in this field are defined in Table 2-41.

Table 2-41
CD-ROM Data Mode Codes

| CD-ROM Mode | User Data Field Contens (2048 bytes) | Auxiliary Field Contents (288 bytes) |
|---|---|---|
| 00h | All bytes zero | All bytes zero |
| 01h | User Data | L-EC symbols |
| 02h | User Data | User Data |
| 03h - FFh | Reserved | Reserved |

If the MSF bit is zero, the absolute address field gives the logical block address of the first logical block in the physical sector where the data for the requested logical block address is found. If the MSF bit is one, the absolute address field gives the MSF address of the sector where the data for the requested logical block address is found.

## 2.1.20 PLAY AUDIO(10) Command

Table 2-42
PLAY AUDIO(10) Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= C5h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | Reladr |
| 2 | (MSB) | | | | | | | |
| 3 | | | | Starting Logical Block Address | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | (LSB) |
| 6 | Reserved | | | | | | | |
| 7 | (MSB) | | | Transfer Length | | | | |
| 8 | | | | Transfer Length | | | | (LSB) |
| 9 | Vendor Unique | | | Reserved | | | Flag | Link |

The PLAY AUDIO command requests that the target to begin an audio playback operation. This command function (Immed and SOTC bits) and the output of audio signals shall be as specified by the settings of the mode parameters.

If an commands related to audio operations are implemented then the PLAY AUDIO command shall be implemented to allow a method for the initiator to determine if audio operations are supported. A target responding to a PLAY AUDIO command which has a transfer length of zero with CHECK CONDITION status and setting the sense key to ILLEGAL REQUEST does not support audio play operations.

The logical block address field specifies the logical block at which the audio playback operation shall begin.

The transfer length field specifies the number of contiguous logical blocks that shall be played. A transfer length field of zero indiocates that no audio operation shall occur. This condition shall not be considered as an error.

If the logical block length is not equal to the sector size the target may adjust the starting logical block address and the transfer length. In such case, it is recommended that the target start the audio play operation with the beginning of a sector whenever the starting logical address falls within that sector (MSF unit). If the requested transfer length causes the end of an audio play operation to fall within a sector the target may continue the play operation through the end of that sector.

If the starting address is not found, if the address is not within an audio track, or if a not ready condition exists, the command shall be terminated with CHECK CONDITION status.

If the CD-ROM information type (data vs. audio) changes the sense key shall be set to ILLEGAL REQUEST and the additional sense code set to END OF USER AREA ENCOUNTERED ON THIS TRACK.

If the logical block address requested is not within an audio track the command shall be terminated with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code set to ILLEGAL MODE FOR THIS TRACK.

## 2.1.21 PLAY AUDIO MSF Command

Table 2-43
PLAY AUDIO MSF Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= C7h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Starting M Field | | | | | | | |
| 4 | Starting S Field | | | | | | | |
| 5 | Starting F Field | | | | | | | |
| 6 | Ending M Field | | | | | | | |
| 7 | Ending S Field | | | | | | | |
| 8 | Ending F Field | | | | | | | |
| 9 | Vendor Unique | | Reserved | | | | Flag | Link |

The PLAY AUDIO MSF command requests the target to begin an audio playback operation The command function (Immed and SOTC bits) and the output of audio signals shall be as specified by the settings of the mode parameters.

The starting M field, the starting S field, the starting F field specify the absolute MSF address at which the audio play operation shall begin. The ending M field, the ending S field, the ending F field specify the absolute MSF address at which the audio play operation shall end. All contiguous audio sectors between the starting and the ending MSF address shall be played.

A starting MSF address equal to an ending MSF address causes no audio play operation to occur. This shall not be considered an error. If the starting MSF address is less than the ending MSF address, the command shall be terminated with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST.

If the starting address is not found, or if the address is not within an audio track, or if a not ready condition exists, the command shall be terminated with CHECK CONDITION staus.

## 2.1.22 PLAY AUDIO TRACK/INDEX Command

Table 2-44
PLAY AUDIO TRACK INDEX Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= C8h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Starting Track | | | | | | | |
| 5 | Starting Index | | | | | | | |
| 6 | Reserved | | | | | | | |
| 7 | Ending Track | | | | | | | |
| 8 | Ending Index | | | | | | | |
| 9 | Vendor Unique | | Reserved | | | | Flag | Link |

The PLAY AUDIO TRACK INDEX command requests the target to begin an audio play operation. The command function (Immed and SCTC bits) and the output of audio signals shall be as specified by the settings of mode parameters.

The starting track field specifies the track number of the audio track. The starting index field specifies the index number within the track at which the audio play operation shall begin.

The ending track field specifies the track number of the audio track. The ending index field specifies the index number within the track after which the audio play operation shall stop. The audio play operation shall terminate at the last block with an index number equal to the ending index. All contiguous audio sectors between the starting and the ending address shall be played.

If the starting address is less than the ending address, the command shall be terminated with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST.

If the starting address is not found, or if the address is not within an audio track, or if a not ready condition exists, the command shall be reporting information.

Valid values for the track and index fields are 1 to 99. A starting index value of one specifies that playback is to start with the first audio sector of the track following the (optional) pause. A last index value of 99 specifies that playback continues through the last sector of the track.

If the ending track is greater than the last information track on the media, the playback shall continue until the last track is complete. If the ending index is greater than the largest index value on the ending track, the playback shall continue until this track is complete then terminate. These conditions shall not be considered errors.

If the starting index is greater than the largest index value on the starting track, and the stop on track crossing (SOTC) bit of the audio control MODE SELECT parameters page is zero, the playback operation shall start at the beginning of the next track. This situation is not an error.

If the starting index is greater than the largest index value on the starting track, and the stop on track crossing (SOTC) bit of the audio control MODE SELECT parameters page is one, the playback shall not begin. The target shall return CHECK CONDITION, and the sense key shall be set to ILLEGAL REQUEST.

The operation of the SOTC bit described above comes about because the user may not be able to determine the largest index value on a track, either from the table of contents or by other means. The SOTC bit one case allows the user to determine the largest index. The SOTC bit zero case allows the user to set up play operations without complete knowledge of the media layout.

Table 2-45
PLAY AUDIO TRACK RELATIVE(10) Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= C9h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | |
| 2 | (MSB) | | | | | | | |
| 3 | | | | Track Relative Logical Block Address | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | (LSB) |
| 6 | Starting Track | | | | | | | |
| 7 | (MSB) | | | Transfer Length | | | | |
| 8 | | | | Transfer Length | | | | (LSB) |
| 9 | Vendor Unique | | | Reserved | | | Flag | Link |

The PLAY AUDIO TRACK RELATIVE command requests that the device begin an audio playback operation. The starting address is specified as a track relative logical block address within the specified starting track. The command function (Immed and SOTC bits) and the output of audio signals shall be as specified by the settings of the mode parameters.

The starting track field specifies the track number of the starting audio track.

The track relative logical block address (TRLBA) field specifies the two's complement starting logical block address relative to the beginning of the first sector on the track with an index value of one. Negative values indicate a starting location within the audio pause area at the beginning of the requested track.

The transfer length field specifies the number of contiguous logical blocks that shall be output as audio data. A transfer length field of zero indicates that no audio playback operation shall occur. This condition shall not be considered as an error. Any other value indicates the number of logical blocks that shall be output.

If the logical block length is not equal to the sector size the target may adjust the starting logical block address and the transfer length. In such case, it is recommended that the target start the audio play operation with the beginning of a sector whenever the starting logical address falls within that sector (MSF unit). If the requested transfer length causes the end of an audio play operation through the end of that sector.

If the starting address is not found, or if the address is not within an audio track, or if a not ready condition exists, the command shall be terminated with CHECK CONDITION staus.

## 2.1.24 PAUSE RESUME Command

Table 2-46
PAUSE RESUME Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= CBh) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Reserved | | | | | | | |
| 5 | Reserved | | | | | | | |
| 6 | Reserved | | | | | | | |
| 7 | Reserved | | | | | | | |
| 8 | Reserved | | | | | | | Resume |
| 9 | Vendor Unique | | Reserved | | | | Flag | Link |

The PAUSE RESUME command requests that the device stop or start an audio play operation. This command is used with PLAY AUDIO commands issued.

A resume bit of zero causes the drive to enter the hold track state with the audio output muted after the current block is played. A resume bit of one causes the drive to release the pause and begin play at the block following the last block played.

If an audio play operation cannot be resumed and the resume bit is one, the command is terminated with CHECK CONDITION status. If the resume bit is zero and an audio play operation cannot be paused, (no audio play operation has been requested, or the requested audio play operation has been completed) the command is terminated with CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to AUDIO PLAY OPERATION NOT IN PROGRESS.

It shall not be considered an error to request a resume when a play operation is in progress.

## 2.1.25 PLAY AUDIO(12) Command

Table 2-47
PLAY AUDIO(12) Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= E5h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | Reladr |
| 2 | (MSB) | | | | | | | |
| 3 | | | | Logical Block Address | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | (LSB) |
| 6 | (MSB) | | | | | | | |
| 7 | | | | Transfer Length | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | (LSB) |
| 10 | Reserved | | | | | | | |
| 11 | Vendor Unique | | Reserved | | | | Flag | Link |

The PLAY AUDIO(12) command requests that the device begin an audio playback operation. This command function (Immed and SOTC bits) and the output of audio signals shall be as specified by the settings of the mode parameters. See the PLAY AUDIO(10) command for a description of the fields in this command.

## 2.1.26 PLAY AUDIO TRACK RELATIVE(12) Command

Table 2-48
PLAY AUDIO TRACK RELATIVE(12) Command

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code (= E9h) | | | | | | | |
| 1 | Logical Unit Number | | | Reserved | | | | |
| 2 | (MSB) | | | | | | | |
| 3 | | | | | | | | |
| 4 | Track Relative Logical Block Address | | | | | | | |
| 5 | | | | | | | | (LSB) |
| 6 | (MSB) | | | | | | | |
| 7 | | | | | | | | |
| 8 | Transfer Length | | | | | | | |
| 9 | | | | | | | | (LSB) |
| 10 | Starting Track | | | | | | | |
| 11 | Vendor Unique | | Reserved | | | | Flag | Link |

The PLAY AUDIO TRACK RELATIVE(12) command requests that the device begin an audio playback operation. The starting address is specified as a track relative logical block address within the specified starting track. The command function (Immed and SOTC bits) and the output of audio signals shall be as specified by the settings of the mode parameters. See the PLAY AUDIO TRACK RELATIVE(10) command for a description of the fields in this command.

## 2.2 CD-ROM Page Descriptions

### 2.2.1 MODE SELECT Pages

Each page descriptor specifies parameter for the controller to use for subsequent operations on the specified logical unit. The page descriptors are specified as follows. The Table 2-49 specifies the page code. Each page descriptors are specified in from Table 2-50 to 2-54.

Table 2-49
Page Codes

| Page Code | Descriptions |
|---|---|
| 01h | Read Error Recovery Parameter |
| 2Dh | Shut Down Time Control Parameter |
| 2Eh | Audio Control Parameter |

#### 2.2.1.1 Page Code 01h

Table 2-50
Read Error Recovery Parameter (Page Code 01h)

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Reserved | | | Page Code ( 01h ) | | | | |
| 1 | Parameter Length( 06h ) | | | | | | | |
| 2 | Error Recovery | | | | | | | |
| 3 | Read Retry Count | | | | | | | |
| 4 | Reserved | | | | | | | |
| 5 | Reserved | | | | | | | |
| 6 | Reserved | | | | | | | |
| 7 | Reserved | | | | | | | |

The read error recovery parameters page (Table 2-50) specifies the error recovery parameter the target shall use during any command that performs a data read operation to the media (e.g., READ, READ TOC, etc.).

The correlation of the error recovery parameter and the bit settings defined for CD-ROM devices is given in Table 2-51. The interpretation of these bit settings for CD-ROM devices is given in Table 2-52-1, 2-52-2,2-52-3 and 2-52-4. If the error recovery parameter is set to any other value the command shall be terminated with 'CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The read retry count field specifies the number of times that the controller shall attempt its read recovery algorithm. The default value is eight.

Table 2-51
Error Recovery Level

| Bit<br>Byte<br>2<br>Value | 7 | 6 | 5<br>TB | 4 | 3 | 2<br>PER | 1<br>DTE | 0<br>DCR |
|---|---|---|---|---|---|---|---|---|
| 00 | | | 0 | | | 0 | 0 | |
| 01 | | | 0 | | | 0 | 0 | |
| 04 | | | 0 | | | 1 | 0 | 0 |
| 05 | | | 0 | | | 1 | 0 | 1 |
| 06 | | | 0 | | | 1 | 1 | 0 |
| 07 | | | 0 | | | 1 | 1 | 1 |
| 20 | | | 1 | | | 0 | 0 | 0 |
| 21 | | | 1 | | | 0 | 0 | 1 |
| 24 | | | 1 | | | 1 | 0 | 0 |
| 25 | | | 1 | | | 1 | 0 | 1 |
| 26 | | | 1 | | | 1 | 1 | 0 |
| 27 | | | 1 | | | 1 | 1 | 1 |

NOTE: Reserved bits are not shown and shall be zero.

DCR --- Disable Correction
DTE --- Disable Transfer on Error
PER --- Post Error
TB ---- Transfer Block

A CIRC recovered data error is defined as a block for which the CIRC based error correction algorithm was unsuccessful for a read attempt, but on a subsequent read operation no error was reported. The number of subsequent read operations is limited to the read retry count. Layered error correction was not used.

A CIRC recovered data error is defined as a block for which the CIRC based error correction algorithm was unsuccessful for a read attempts up to the read retry count. Layered error correction was not used.

An L-EC recovered data error is defined as a block for which the CIRC based error correction algorithm was unsuccessful but the layered error correction was able to correct the block within the read retry count.

An L-EC uncorrectable data error is defined as a block which could not be corrected by layered error correction within the read retry count.

Table 2-52-1
Error Recovery Parameters

| | Description |
|---|---|
| 00h | This is the default setting of error recovery parameter on when a power-on or reset condition occurs.<br>If an L-EC uncorrectable data error occurs data transfer is terminated with a UNRECV_ERROR (Unrecovered data error). The error block is not transferred. The error address is set to the address of the last block transferred to the host computer plus one. |
| 01h | Only CIRC and RETRY (retries of the read operation) are used. If a RETRY unrecovered data error occurs data transfer is terminated with a UNRECV_ERROR. The error block is not transferred. The error address is set to the address of the last block transferred to the host computer plus one. |
| 04h | If an L-EC recovered data error occurs data tranfer is not terminated. However, when the data transfer has completed a RECV_ECC (Recovered data error with ECC) is reported. The error address is set to the address of the last block for which an L-EC recovered data error was detected.<br><br>If an L-EC uncorrectable data error occurs data transfer is terminated with UNRECV_ERROR. The error block is not transferred. The error address is set to the address of last block on which an L-EC uncorrectable error was detected. |

Table 2-52-2
Error Recovery Parameters

| | Description |
|---|---|
| 05h | Only RETRY and CIRC are used.<br>If a RETRY recovered data error occurs data transfer is not terminated. However, when the data transfer has completed with RECV_RETRY (Recovered data error with retry). The error address is set to the address of last block for which a RETRY recovered data error was detected.<br><br>If a RETRY unrecovered data error occurs data transfer is terminated with UNRECV_ERROR. The error block is not transferred. The error address is set to the address of the last block on which a RETRY unrecovered error was detected. |
| 06h | If an L-EC recovered data error occurs data transfer is terminated with a RECV_ECC. The error block is not transferred. The error address is set to the address of the last block on which an L-EC recovered error was detected.<br><br>If an L-EC uncorrectable data error occurs data transfer is terminated with a UNRECV_ERROR. The error block is not transferred. The error address is set to the address of the last block on which an L-EC uncorrectable error was detected. |
| 07h | Only CIRC and RETRY are used.<br>If a RETRY recovered data error occurs data transfer is terminated with a RECV_RETRY. The error block is not transferred. The error address is set to the address of the last block on which a RETRY recovered data error was detected.<br><br>If a RETRY unrecovered data error occurs data transfer is terminated with a UNRECV_ERROR. The error block is not transferred. The error address is set to the address of the last block on which a RETRY unrecovered error was detected. |

Table 2-52-3
Error Recovery Parameters

| | Description |
|---|---|
| 20h | If an L-EC uncorrectable data error occurs data transfer is terminated with UNRECV_ERROR. The error block is transferred. The error address is set to the address of the last block on which an L-EC uncorrectable data error was detected. |
| 21h | Only CIRC and RETRY are used.<br>If a CIRC and RETRY unrecovered data error occurs data transfer is terminated with UNRECV_ERROR. The unrecovered error block is transferred. The error address is set to the address of the last block on which a CIRC and RETRY unrecovered data error was detected. |
| 24h | If an L-EC recovered data error occurs data transfer is not terminated. However, when the data transfer has completed a RECV_ECC is reported. The error address is set to the address of th last block on which an L-EC recovered data error was detected.<br><br>If an L-EC uncorrectable data error occurs data transfer is terminated with UNRECV_ERROR. The error block is transferred. The error address is set to the address of the last block on which an L-EC uncorrectable data error was detected. |

Table 2-52-4
Error Recovery Parameters

| | Description |
|---|---|
| 25h | Only CIRC and RETRY are used.<br>If a RETRY recovered data error occurs data transfer is not terminated. However, when the data transfer has completed a RECV_RETRY is reported. The error address is set to the address of the last block on which a RETRY recovered data error was detected.<br><br>If a RETRY unrecovered data error occurs data transfer is terminated with a UNRECV_ERROR. The error block is transferred. The error address is set to the address of the last block on which a RETRY unrecovered data error was detected. |
| 26h | If an L-EC recovered data error occurs data transfer is terminated with RECV_ECC. The recovered error block is transferred. The error address is set to the address of the last block on which an L-EC recovered data error was detected.<br><br>If an L-EC uncorrectable data error occurs data transfer is terminated with UNRECV_ERROR. The error block is transferred. The error address is set to the address of the last block on which an L-EC uncorrectable data error was detected. |
| 27h | Only CIRC and RETRY are used.<br>If a RETRY recovered data error occurs data transfer is terminated with RECV_RETRY. The recovered error block is transferred. The error address is set to the address of the last block on which a RETRY recovered data error was detected.<br><br>If a RETRY unrecovered data error occurs data transfer is terminated with UNRECV_ERROR. The error block is transferred. The error address is set to the address of the last block on which a RETRY unrecovered data error was detected. |

2.2.1.2 Page Code 2Dh

Table 2-53
Shut Down Time Control Parameter (Page Code 2Dh)

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Reserved | | | Page Code ( 2Dh ) | | | | |
| 1 | Parameter Length ( 06h ) | | | | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Reserved | | | | Inactivity Timer Multiplier | | | |
| 4 | (MSB) Number of MSF - S Units per MSF - M Unit | | | | | | | |
| 5 | | | | | | | | (LSB) |
| 6 | (MSB) Number of MSF - F Units per MSF - S Unit | | | | | | | |
| 7 | | | | | | | | (LSB) |

The CD-ROM parameters page specifies parameters that affect all CD-ROM data types.

The inactivity timer multiplier specifies the length of time that the drive shall remain in the hold track state after completion of a seek or read operation.

Higher values in this parameter may have an adverse effect on the drive MTBF, in some implementations.

Table 2-54
Inactivity Timer Multiplier Values

| Inactivity Timer Multiplier | Minimum Time in Hold Track State | Inactivity Timer Multiplier | Minimum Time in Hold Track State |
|---|---|---|---|
| 0h | 5 minutes | 8h | 16 Seconds |
| 1h | 125 milli Seconds | 9h | 32 seconds |
| 2h | 250 milli Seconds | Ah | 1 minute |
| 3h | 500 milli Seconds | Bh | 2 minutes |
| 4h | 1 Second | Ch | 4 minutes |
| 5h | 2 Seconds | Dh | 8 minutes |
| 6h | 4 Seconds | Eh | 16 minutes |
| 7h | 8 Seconds | Fh | 32 minutes |

The number of S Units per M Unit field gives the ratio of these MSF address value. For medi conforming to the CD-ROM and CD-DA standard, this value is 60.

The number of F Units per S Unit field gives the ratio of these MSF address value. For medi conforming to the CD-ROM and CD-DA standard, this value is 75.

2.2.1.3 Page Code 2Eh

Table 2-55
Audio Control Parameter (Page Code 2Eh)

| Bit / Byte | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Reserved | | Page Code ( 2Eh ) | | | | | |
| 1 | Parameter Length ( 0Eh ) | | | | | | | |
| 2 | Reserved | | | | | Immed | SOTC | Reserv |
| 3 | Reserved | | | | | | | |
| 4 | Reserved | | | | | | | |
| 5 | APRVal | Reserved | | | Format of LBAs / Sec. | | | |
| 6 | (MSB) Logical Block per Second of Audio Playback | | | | | | | |
| 7 | (LSB) | | | | | | | |
| 8 | Reserved | | | | Channel 0 Output Selection | | | |
| 9 | Output Port 0 and 1 Volume | | | | | | | |
| 10 | Reserved | | | | Channel 1 Output Selection | | | |
| 11 | Reserved | | | | | | | |
| 12 | Reserved | | | | | | | |
| 13 | Reserved | | | | | | | |
| 14 | Reserved | | | | | | | |
| 15 | Reserved | | | | | | | |

The CD-ROM audio control parameters page sets the playback modes and output controls for subsequent PLAY AUDIO commands and any current audio playback operation.

An immediate (Immed) bit of one indicates the target shall send completion status as soon as the playback operation has been started. But this bit is not supported and must be set to zero.

It is recommended that a Logical Unit type RESERVE be issued prior to starting audio play operations with an Immed bit of one in any multiple initiator environment.

A stop on track crossing (SOTC) bit of zero indicates the target shall terminate the audio playback operation when the transfer length is satisfied. Multiple tracks shall be played as necessary. Periods of time encoded as audio pause/silence at the beginning of tracks, (index 0,) shall also be played.

A stop on track crossing (SOTC) bit of one indicates the target shall terminate the audio playback operation when the beginning of a following track is encountered.

The audio playback rate valid (APRVal) bit value of one indicates that the format of logical blocks per second (Format of LBAs / Sec.) field and the logical blocks per second of audio playback field are valid. But Format of LBAs / Sec is not supported and APRVal bit must be set to zero.

The output port channel selection specifies the audio channels from the disc to which this output port should be connected. See Table 2-56. The default value for channel zero output is 01h and for channel one output is 02h.
If the channel zero output and the channel one output are the same value except for 00h, the command will be terminated with a CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to INVALID FIELD IN PARAMETER LIST.

Table 2-56
Channel Output Selection

| | |
|---|---|
| 0 0 0 0 | output port muted |
| 0 0 0 1 | connect audio channel 0 to this output port |
| 0 0 1 0 | connect audio channel 1 to this output port |

The channel volume control indicates the relative volume level for this audio output. A value of zero indicates the output is muted, a value of FFh indicates maxmum volume level.

The default volume level shall be set to the maximum level.

Table 2-57
Page Codes

| Page Code | Descriptions |
|---|---|
| 01h | Read Error Recovery Parameter |
| 2Dh | Shut Down Time Control Parameter |
| 2Eh | Audio Control Parameter |
| 3Fh | Return all Pages to the initiator, See PCF bit configuration. Page Code valid for MODE SENSE commands only. |

The target shall return the same Page Length value in each Page that it supports with the 3Fh Page Code whatever the value of each bit of the PCF field is.

## 2.3 Additional Sense Code

Table 2-58-1
Additional Sense Code Discriptions

| Additional Sense Code | Descriptions | Suggested Related Sense Keys |
|---|---|---|
| 00 | No Additional Sense Code | NO SENSE |
| 02 | No Seek Complete | HARDWARE ERROR |
| 04 | Drive Not Ready | NOT READY |
| 09 | Track Following error | HARDWARE ERROR |
| 11 | Unrecovered Read error of data blocks | MEDIUM ERROR |
| 17 | Recovered Read data with retries | RECOVERED ERROR |
| 18 | Recovered Read data with ECC | RECOVERED ERROR |
| 20 | Invalid Command Operation Code | ILLEGAL REQUEST |
| 24 | Illegal field in CDB | ILLEGAL REQUEST |
| 25 | Invalid LUN | ILLEGAL REQUEST |
| 26 | Invalid field in Parameter List | ILLEGAL REQUEST |
| 28 | Medium Changed | UNIT ATTENTION |
| 29 | Power On or Reset or Bus Device Reset occurred | UNIT ATTENTION |
| 2A | Mode Select Parameters Changed | UNIT ATTENTION |
| 40 | Ram failure | HARDWARE ERROR |
| 42 | Power On Diagnostic Failure | HARDWARE ERROR |
| 43 | Message Reject Error | ABORTED ERROR |
| 44 | Internal Controller Error | HARDWARE ERROR |
| 45 | Select/Reselect failed | ABORTED ERROR |
| 47 | SCSI Interface Parity Error | ABORTED ERROR |
| 48 | Initiator Detected Error | ABORTED ERROR |
| 49 | Invalid Message Error | ABORTED ERROR |

Table 2-58-2
Additional Sense Code Discriptions

| additional Sense Code | Descriptions | Suggested Related Sense Keys |
|---|---|---|
| A0 | Caddy Not Inserted | NOT READY |
| A1 | Unable to recover TOC | NOT READY |
| A2 | Focus servo failure | HARDWARE ERROR |
| A3 | Spindole servo failure | HARDWARE ERROR |
| A4 | Data path failure | HARDWARE ERROR |
| A5 | End of user area encountered on this track | ILLEGAL REQUEST |
| A6 | Illegal mode for this track | ILLEGAL REQUEST |
| A7 | ROM failure | HARDWARE ERROR |
| A8 | Audio Play Operation Not In Progress | ILLEGAL REQUEST |