IS&C SPECIFICATIONS

IMAGE SAVE AND CARRY

SCSI interface specifications
for IS&C magneto-optical disk drive

(Version 1.0)

IS&C COMMITTEE / February, 1993

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CONTENTS

CONTENTS

1. CONFORMANCE AND SPECIFICATIONS

1.1 Conformance

This specifications is in conformance with IS&C magneto-optical disk drive.

1.2 General Specifications

(1) Interface : The interface specifications is based on ANSI X3.1-1986 and contains additional and modified contents for the IS&C drive.

(2) Command : 15 commands are specified.

(3) Error informations : 10 Sense Keys are specified.

(4) Conformed disk : 130 mm magneto-optical disk cartridge conformed with IS&C specifications
Sector size is 1024 bytes.
User area is divided into one.

1.3 Defective Sector Management and Disk Initialization

The defective sector management method complies with ISO/10089(A). Figure1.3.1 shows the Format of User Zone.

The user zone on each side of the disk contains two Defect Management Areas (DMA) at the beginning of the zone and two DMAs at the end of the zone. Each DMA contains a Disk Definition Structure(DDS) on the structure of the disk, a Primary Defect List(PDL) and a Secondary Defect List(SDL). The first sector of the each DMA is assigned for the Disk Definition Structure and the second sector is assigned for the first PDL and the following sectors are assigned for SDL. The each DMA contains 25 sectors. The user area contains the data sectors in which user data are written and the spare sectors which is used as replacement for defective data sectors.The user area is located between the two groups of DMAs. The host can logically access the user data area.

The IS&C disk has been initialized to have 314,569 sectors for the user sectors and 2,048 sectors for the spare sectors. Initialization of the IS&C disk shall be completed at the factory before shipping.

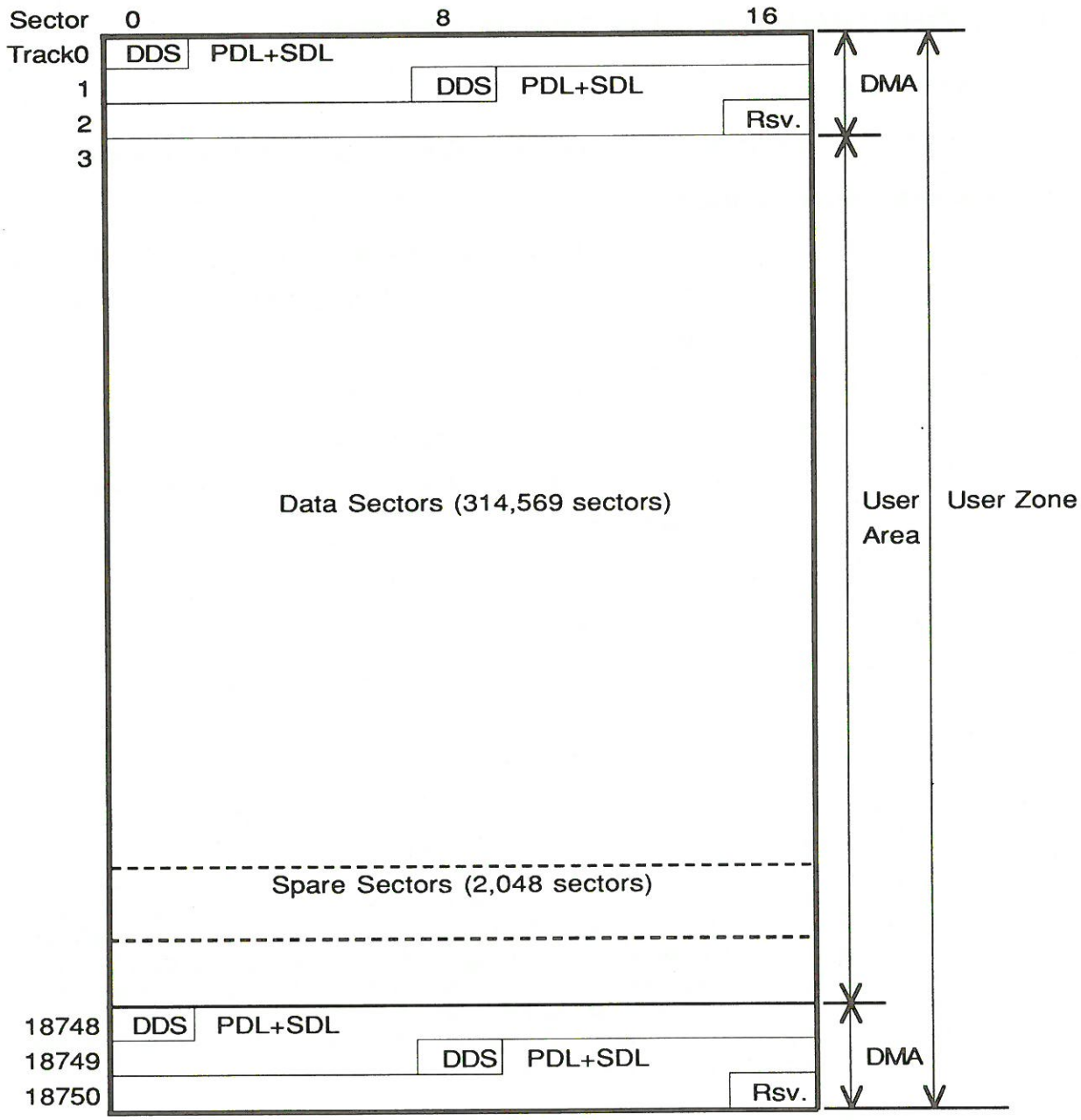

Fig. 1.3.1 Format of User Zone

DMA	:	Defect Management Area
DDS	:	Disk Definition Structure
PDL	:	Primary Defect List
SDL	:	Secondary Defect List
User Data Area	:	The host can logically access the User Data Area.
Rsv.	:	Reserved

2. PHYSICAL INTERFACE

2.1 Physical Characteristics

Up to eight SCSI devices can be connected on the SCSI bus with daisy chain. The bus shall be terminated at the both end. The type of drivers and receivers shall be implemented a single ended.

2.2 Cable Characteristics

A 25-signal twisted pair foil-shielded cable

Max. length ; shall be 6 meters.

Impedance ; shall be 90 Ω or more and less than 132 Ω.
The recommended impedance is 100 Ω or more.

2.3 Connector Characteristics

Cable with a shielded SCSI device connector, or a non-shielded type shall be applied.

2.4 Connector Pin Assignment

Fig. 2.4.1 Connector Pin Assignment

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

NOTES:
(1) Pins 1-12 and 14-25 are connected to ground. Pin 13 is left open.
(2) The minus sign prior to the signals indicates active low.

3. ELECTRICAL INTERFACE

3.1 Output Characteristics

The IS&C drive shall have the following output characteristics on the SCSI connector.

(1) True level(Signal assertion) 0.0~0.5V with current 48mA
(2) False level(Signal deassertion) 2.5~5.25V

3.2 Input Characteristics

The IS&C drive shall have the following input characteristics on the SCSI connector.

(1) True level(Signal assertion) 0.0~0.5V
(2) False level(Signal deassertion) 2.0~5.25V
(3) Minimum input hysteresis 0.2V

3.3 Terminator

The terminator shall be attached on the both end of SCSI devices. The resistor value shall be 220Ω among the power line and 330Ω among the ground.

3.4 Terminator power

The terminator power shall be provided from the host computer. The host computer will not require to be provided the terminator power from the target.

4. SCSI BUS

On the SCSI bus, only two SCSI devices can communicate. SCSI bus consists of nine control signal lines and nine data signal lines.

4.1 SCSI Bus Signal Description

BSY (I to T or T to I, I : Initiator, T : Target)
BUSY : A signal to indicate that the SCSI bus is being used. This is driven by a target or an initiator.

SEL (I to T or T to I)
SELECTION : A signal driven by an initiator to select a target or by a target to reselect an initiator.

C/D (T to I)
CONTROL/DATA : A signal driven by a target that indicates whether CONTROL or DATA information is on the bus. If C/D is true, this indicates CONTROL information.

I/O (T to I)
INPUT/OUTPUT : A signal driven by a target that controls the direction of data movement on the data bus with respect to an initiator. If I/O is true, this indicates input to the initiator.

MSG (T to I)
MESSAGE : A signal driven by a target during the MESSAGE phase.

REQ (T to I)
REQUEST : A signal driven by a target to indicate a request to an initiator for a REQ/ACK data transfer handshake.

ACK (I to T)
ACKNOWLEDGE : A signal driven by an initiator to indicate an acknowledgment to a target for REQ/ACK handshake.

ATN (I to T)
ATTENTION : A signal driven by an initiator to indicate the ATTENTION condition.

RST (I to T)
RESET : A signal driven by an initiator that indicates the RESET condition.

DB(7-0,P)
DATA BUS 7 - 0, P : Eight data bit signals and one parity bit signal form a DATA BUS. DB(7) is the most significant bit and DB(0) is the least significant bit. Data parity DB(P) is odd.

4.2 SCSI Bus Timing

4.2.1 Arbitration Delay (2.2 μS)

The minimum time that an SCSI device shall wait from asserting BSY signal for arbitration until the DATA BUS can be examined to see if arbitration has been won. There is no maximum time.

4.2.2 Assertion Period (90 nS)

The minimum time that a target shall assert REQ signal while using synchronous data transfers. Also, the minimum time that an initiator shall assert ACK signal while using synchronous data transfers.

4.2.3 Bus Clear Delay (800 nS)

The maximum time for an SCSI device to stop driving all bus signals after:
(1) The BUS FREE phase is detected (BSY and SEL both false for a bus settle delay)
(2) SEL is received from another SCSI device during the ARBITRATION phase
(3) The transition of RST to true.

4.2.4 Bus Free Delay (800 nS)

The minimum time that an SCSI device shall wait from its detection of the BUS FREE phase (BSY and SEL both false for a bus settle delay) until its assertion of BSY when going to the ARBITRATION phase.

4.2.5 Bus Set Delay (1.8 μS)

The maximum time for an SCSI device to assert BSY and its SCSI ID bit on the DATA BUS after it detects BUS FREE phase (BSY and SEL both false for a bus settle delay) for the purpose of entering the ARBITRATION phase.

4.2.6 Bus Settle Delay (400 nS)

The minimum time to wait for the bus to settle after changing certain control signals as called out in the protocol definitions.

4.2.7 Cable Skew Delay (10 nS)

The maximum difference in propagation time allowed between any two SCSI bus signals measured between any two SCSI devices.

4.2.8 Data Release Delay (400 nS)

The maximum time for an initiator to release the DATA BUS signals following the transition of the I/O signal from false to true.

4.2.9 Deskew Delay (45 nS)

The minimum time required for deskew of certain signals.

4.2.10 Hold Time (45 nS)

The minimum time added between the assertion of REQ or ACK and the changing of the data lines to provide hold time in the initiator or target while using synchronous data transfers.

4.2.11 Negation Period (90 nS)

The minimum time that a target shall negate REQ while using synchronous data transfers .Also, the minimum time that an initiator shall negate ACK while using synchronous data transfers.

4.2.12 Reset Hold Time (25 μS)

The minimum time for which RST is asserted. There is no maximum time.

4.2.13 Selection Abort Time (200 μS)

The maximum time that a target (or initiator) shall take from its most recent detection of being selected (or reselected) until asserting a BSY response. This time-out is required to ensure that a target (or initiator) does not assert BSY after a SELECTION (or RESELECTION) phase has been aborted.

4.2.14 Selection Time-out Delay (250 mS recommended)

The minimum time that an initiator (or target) should wait for a BSY response during the SELECTION (or RESELECTION) phase before starting the time-out procedure. This value will be recommended.

5. LOGICAL INTERFACE

5.1 SCSI Bus Phases

The IS&C drive supports eight distinct phases :

BUS FREE phase
ARBITRATION phase
SELECTION phase
RESELECTION phase
COMMAND phase
DATA phase
STATUS phase
MESSAGE phase

The SCSI bus can never be in more than one phase at any given time. In the following descriptions, signals that are not mentioned shall not be asserted.

5.1.1 BUS FREE Phase

The BUS FREE phase is used to indicate that no SCSI device is actively using the SCSI bus and that it is available. SCSI device shall detect the BUS FREE phase after SEL and BSY are both false for at least 400 ns(bus settle delay). SCSI devices shall release all SCSI bus signals within 800 ns(bus clear delay) after SBY and SEL become continuously false for 400 ns(bus sttle delay). If aSCSI device requires more than 400 ns(bus settle delay) to detect the BUS

FREE phase then it shall release all SCSI bus signals within 800 ns(bus clear delay) minus the excess time to detect the BUS FREE phase. The total time to clear the SCSI bus shall not exceed 1.2 μs(bus settle delay plus bus clear delay).
If more than 800 ns has passed since BUS FREE phase was observed, SCSI devices can change the phase to ARBITRATION phase.

5.1.2 ARBITRATION Phase

The ARBITRATION phase allows on SCSI device to gain control of the SCSI bus.

The procedure for an SCSI device to obtain control of the SCSI bus is as follows:
(1) The SCSI device shall first wait for the BUS FREE phase to occur.
(2) The SCSI device shall wait a minimum of a bus free delay after detection of the BUS FREE phase before driving any signal.
(3) Following the bus free delay in Step (2), the SCSI device may arbitrate for the SCSI bus by asserting both the BSY signal and its own SCSI ID, however the SCSI device shall not arbitrate if more than a bus set delay has passed since the BUS FREE phase was last observed.
(4) After waiting at least an arbitration delay (measured from its assertion of the BSY signal), the SCSI device shall examine the DATA BUS. If a higher priority SCSI ID bit is true on the DATA BUS (DB(7) is the highest), then the SCSI device has lost the arbitration and the SCSI device may release its signals and return to Step (1). If no higher priority SCSI ID bit is true on the DATA BUS, then the SCSI device has won the arbitration and it shall assert the SEL signal. An SCSI device that loses arbitration may return to Step (1).
(5) The SCSI device that wins arbitration shall wait at least a bus clear delay plus a bus settle delay(1.2μs) after asserting the SEL signal before changing any signals.

5.1.3 SELECTION Phase

The SELECTION phase allows an initiator to select a target for the purpose of initiating some target function. During the SELECTION phase the I/O signal is negated so that this phase can be distinguished from the RESELECTION phase.

The SCSI device that won the arbitration has both the BSY and SEL signals asserted and has delayed at least a bus clear delay plus a bus settle delay before ending the ARBITRATION phase. The SCSI device that won the arbitration becomes an initiator by not asserting the I/O signal.

The initiator shall set the DATA BUS to a value which is the OR of its SCSI ID bit and the target's SCSI ID bit and it shall assert the ATN signal(indicating that a MESSAGE OUT phase is to follow the SELECTION phase). The initiator shall then wait at least two deskew delays and release the BSY signal. The initiator shall then wait at least a bus settle delay before looking for a response from the target.

The target shall determine that it is selected when the SEL signal and its SCSI ID bit are true and the BSY and I/O signals are false for at least a bus settle delay. The selected target may examine the DATA BUS in order to determine the SCSI ID of the selecting initiator. The selected target shall then assert the BSY signal within a selection abort time of its most recent detection of being selected; this is required for correct operation of the selection time-out procedure.

The target shall not respond to a selection if bad parity is detected. Also if more than two SCSI ID bits are on the DATA BUS,the target shall not respond to selection.

5.1.4 RESELECTION Phase

Upon completing the ARBITRATION phase, the winning SCSI device has both the BSY and SEL signals asserted and has delayed at least a bus clear delay plus a bus settle delay. The winning SCSI device becomes a target by asserting the I/O signal. The winning SCSI device shall also set the DATA BUS to a value that is the logical OR of its SCSI ID bit and the initiator's SCSI ID bit. The target shall wait at least two deskew delays and release the BSY signal. The target shall then wait at least a bus settle delay before looking for a response from the initiator.

The initiator shall determine that it is reselected when the SEL and I/O signals and its SCSI ID bit are true and the BSY signal is false for at least a bus settle delay. The reselected initiator may examine the DATA BUS in order to determine the SCSI ID of the reselecting target. The reselected initiator shall then assert the BSY signal within a selection abort time of its most recent detection of being reselected; this is required for correct operation of the time-out procedure. The initiator shall not respond to a RESELECTION phase if bad parity is detected. Also, the initiator shall not respond to a RESELECTION phase if more than two SCSI ID bits are on the DATA BUS.

After the target detects the BSY signal is true, it shall also assert the BSY signal and wait at least two deskew delays and then release the SEL signal. After the reselected initiator detects the SEL signal is false, it shall release the BSY signal. The target shall continue asserting the BSY signal until it relinquishes the SCSI bus.

5.1.5 Information Transfer Phases

The COMMAND, DATA, STATUS, and MESSAGE phases are all grouped together as the information transfer phases.

The C/D, I/O, and MSG signals are used to distinguish between the different information transfer phases. The target drives these three signals and therefore controls all changes from one phase to another. The initiator can request a MESSAGE OUT phase by asserting the ATN signal, while the target can cause the BUS FREE phase by releasing the MSG, C/D, I/O, and BSY signals.

Table 5.1.1 Information Transfer Phases

Signal				
MSG	C/D	I/O	Phase Name	Direction of Transfer
0	0	0	DATA OUT	Initiator to target
0	0	1	DATA IN	Initiator from target
0	1	0	COMMAND	Initiator to target
0	1	1	STATUS	Initiator from target
1	0	0	*	
1	0	1	*	
1	1	0	MESSAGE OUT	Initiator to target
1	1	1	MESSAGE IN	Initiator from target

Key: 0 = False, 1 = True, * = Reserved for future standardization.

(1) Data Phase

The data phase is a term that encompasses both the DATA IN phase and the DATA OUT phase.

The DATA IN phase allows the target to request that data shall be sent to the initiator from the target.

The DATA OUT phase allows the target to request that data shall be sent from the initiator to the target.

(2) Command Phase

The COMMAND phase allows the target to request command information from the initiator.
tiator to the target.

(3) STATUS Phase

The STATUS phase allows the target to request that status information shall be sent from the target to the initiator.

The target shall assert the C/D and I/O signals and negate the MSG signal during the REQ/ACK handshake of this phase.

(4) Message Phase

The message phase is a term that references either a MESSAGE IN, or a MESSAGE OUT phase. Multiple messages may be sent during either phase. The first byte transferred in the either of these phases shall be either a single-byte message or the first byte of a multiple-byte message. Multiple-byte messages shall be wholly contained within a single message phase.

(i) MESSAGE IN Phase

The MESSAGE IN phase allows the target to request that messages shall be sent to the initiator from the target.

The target shall assert the C/D, I/O, and MSG signals during the REQ/ACK handshake (s) of this phase.

(ii) MESSAGE OUT Phase

The MESSAGE OUT phase allows the target to request that messages shall be set from the initiator to the target. The target invokes this phase in response to the attention condition created by the initiator (see Attention Condition).

The SCSI bus phase sequence is shown in Fig. 5.1.1. The bus phase transition is from bus free phase to arbitration phase, selection phase(or reselection phase) and information transfer phase. During the information transfer phase, there are no restriction for the sequence. For example, it is allowed phase transition from one data phase to the other data phase.

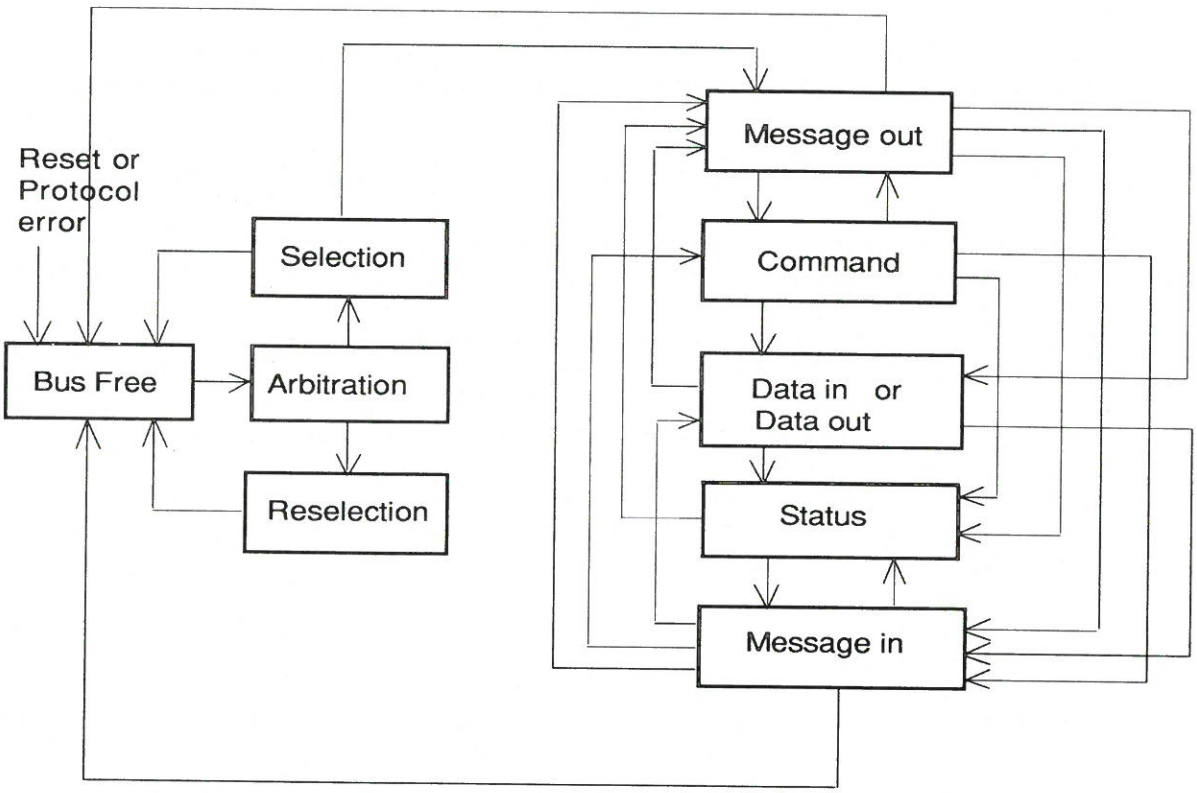

Fig. 5.1.1 Bus Phase Sequence

5.2. SCSI BUS CONDITIONS

The SCSI bus has two asynchronous conditions; the attention condition and the reset condition. These conditions cause the SCSI device to perform certain actions and can alter the phase sequence.

5.2.1 Attention Condition

The attention condition allows an initiator to inform a target that the initiator has a message ready. The target 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 phases.

The target shall respond with MESSAGE OUT phase as follows:
(1) If the ATN signal becomes true during a COMMAND phase, the target will enter MESSAGE OUT phase after transferring all of the command descriptor block bytes.
(2) If the ATN signal becomes true during a DATA phase, the target will enter anytime MESSAGE OUT phase. The initiator shall continue REQ/ACK handshakes until it detects the phase change.
(3) If the ATN signal becomes true during a STATUS phase, the target will enter MESSAGE OUT phase after the status byte has been acknowledged by the initiator.
(4) If the ATN signal becomes true during a MESSAGE IN phase, the target will enter MESSAGE OUT phase before it sends another message.
(5) If the ATN signal becomes true during a SELECTION phase and before the initiator release the BSY signal, the target will enter MESSAGE OUT phase immediately after that SELECTION phase.
(6) If the ATN signal becomes true during a RESELECTION phase, the target will enter MESSAGE OUT phase after the target has sent its IDENTIFY message for that RESELECTION phase.

5.2.2 Reset Condition

The reset condition is used to immediately clear all SCSI devices from the bus. This condition shall take precedence over all other phases and conditions. Any SCSI device may create the reset condition by asserting the RST signal for a minimum of a reset hold time.
All SCSI device shall release all SCSI bus signals (except the RST signal) within a bus clear delay of the transition of the RST signal to true. The BUS FREE phase always follows the reset condition.
SCSI devices execute the following operation by detecting RESET condition.
(1) Clear executing command.
(2) Release reservation of the SCSI device.
(3) Set the operation mode to default value.
(4) Set UNIT ATTENTION.

5.3 Message Description

The messages are listed along with their code value and their descriptions.

Table 5.3.1 Message Code

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

Key : In = Target to initiator, Out = Initiator to target.
: M = Command implementation is mandatory by ANSI.
: O = Command implementation is optional by ANSI.

5.3.1 COMMAND COMPLETE (00h)

This message is sent from a target to an initiator to indicate that the execution of an I/O process has completed and that valid status has been sent to the initiator. After successfully sending this message, the target will go to the BUS FREE phase by releasing the BSY signal.

5.3.2 SAVE DATA POINTER (02h)

This message is sent from a target to direct the initiator to copy the active data pointer to the saved data pointer for the current I/O process.

5.3.3 RESTORE POINTERS (03h)

This message is sent from a target to direct the initiator to copy the most recently saved command,data,and status pointers for the I/O process to the corresponding active pointers.The 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 occurred for that nexus.

5.3.4 DISCONNECT (04h)

This message is sent from a target to inform an initiator that the present connection is going to be broken. After successfully sending this message, the target will go to the BUS FREE phase by releasing the BSY signal.
This message may also be set from an initiator to a target to instruct the target to disconnect from the SCSI bus. After the DISCONNECT message is received, the target will switch to MESSAGE IN phase, send the DISCONNECT message to the initiator, and then disconnect by releasing the BSY signal.
Target shall send SAVE DATA POINTER message prior to this message if required.

5.3.5 INITIATOR DETECTED ERROR (05h)

This message is sent from an initiator to inform a target that an error has occurred that does not preclude the target from retrying the operation.

5.3.6 ABORT (06h)

This message is sent from the initiator to the target to clear the present I/O process. No status and ending message will be sent for the operation. The target will clear all pending data transferred from the initiator then the target will go to BUS FREE phase.

5.3.7 MESSAGE REJECT (07h)

This message is sent from either the initiator or target to indicate that the last message byte 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 byte that is to be rejected. If the target receives this message under any other circumstance, it will reject this message. When a target sends this message, it will change to MESSAGE IN phase and send this message prior to requesting additional message bytes from the initiator. This provides an interlock so that the initiator can determine which message byte is rejected.

5.3.8 NO OPERATION (08h)

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

5.3.9 MESSAGE PARITY ERROR (09h)

This message is sent from the initiator to the target to indicate that the last message byte it received had a parity error. In order to indicate its intention of sending this message, the initiator shall assert the ATN signal prior to its release of ACK for REQ/ACK handshake of the message that has the parity error.

5.3.10 BUS DEVICE RESET (0Ch)

This message is sent from an initiator to direct a target to clear all I/O processes on that SCSI device. This message forces a hard reset condition to the selected SCSI device. The target will go to the BUS FREE phase following successful receipt of this message. The target shall create a unit attention condition for all initiators.

5.3.11 IDENTIFY (80h,C0h)

This message (the following table) is sent by either the initiator or the target. This message should be sent in the MESSAGE OUT phase immediately after the SELECTION phase, and the target will respond with MESSAGE REJECT message for IDENTIFY message in other phases.
The Idntfy (Identify) bit shall be set to one to specify that this is an IDENTIFY message.
A DiscPrv (Disconnect Privilege) bit of one specifies that the initiator has granted the target the privilege of disconnecting. A DiscPrv bit of zero specifies that the target will not disconnect. This bit will be set to zero when an IDENTIFY message is sent by a target.

Table 5.3.2 IDENTIFY Message Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Idntfy	DiscPrv	Reserved			LUN		

The LUN (Logical Unit Number) field specifies a logical unit number .

The target will investigate ATN at the end of every phase. In data transfer phase, the target will investigate ATN at the end of each logical block transfer (see Attention Condition).

5.4 Unit Attention Condition

A unit attention condition will begin for each initiator whenever the target has been reset by a BUS DEVICE RESET message, a hard RESET condition, or by a power-on reset. A unit attention condition will also occur for the following:
(1) A medium may have been changed.
(2) The mode parameters in effect for this initiator have been changed by another initiator or by a medium having been changed.

The unit attention condition will persist for each initiator until that initiator clears the condition as described in the following paragraphs.

If an INQUIRY command is received from an initiator with a pending unit attention condition (before the target generates the contingent allegiance condition), the target will perform the INQUIRY command and will not clear the unit attention condition. If the INQUIRY command or any other command is received after the target has generated contingent allegiance condition on the logical unit for a pending unit attention condition, then the unit attention condition will be cleared, and the target will perform the INQUIRY command.

If a REQUEST SENSE command is received from an initiator with a pending unit attention condition, then the target will report the unit attention condition, discard any pending sense data, and clear the unit attention condition on the logical unit for that initiator.

If an initiator issues a command other than INQUIRY or REQUEST SENSE while a unit attention condition exists for that initiator (prior to reporting CHECK CONDITION for the unit attention condition), the target shall not perform the command and shall report CHECK CONDITION status unless a higher priority status (BUSY or RESERVATION CONFLICT status) is also pending.

If after returning CHECK CONDITION status to an initiator for a pending unit attention condition the next command received from that initiator is not REQUEST SENSE, then that command will be performed and the unit attention condition will be cleared for that initiator on that logical unit and the sense data is lost.

5.5 Command

The command consists of multiple byte, and is transferred from the initiator to the target in CDB(Command Description Block) format. The group 0 command which consists of 6 bytes is shown in Table 5.5.1 and the group 1 command which consists of 10 bytes is shown in Table 5.5.2.

Table 5.5.1 Group 0 CDB Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	LUN			Logical Block Address (MSB)				
2	Logical Block Address							
3	Logical Block Address (LSB)							
4	Transfer Length							
5	Control Byte							

Table 5.5.2 Group 1 CDB Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code							
1	LUN			Reserved				
2	Logical Block Address (MSB)							
3	Logical Block Address							
4	Logical Block Address							
5	Logical Block Address (LSB)							
6	Reserved							
7	Transfer Length (MSB)							
8	Transfer Length (LSB)							
9	Control Byte							

The each parameter is described below.

5.5.1 Operation Code

The operation code consist of group code and command code as shown in Fig. 5.5.3.

Table. 5.5.3 Operation code

Bit / Byte	7	6	5	4	3	2	1	0
0	Group Code			Command Code				

5.5.2 LUN (Logical Unit Number)

The LUN must be set to zero. When the target receives the command with unsupported LUN other than zero, the target will return CHECK CONDITION status.

5.5.3 Logical Block Address (LBA)

The LBA indicates logical block address on the disk. The group 0 command has 21 bit logical block address and the group 1 command has 32 bit logical block address.

5.5.4 Transfer Length

The transfer length specifies the number of contiguous logical blocks of data to be transferred.The transfer length for group 0 command has 8 bits, and the transfer length for group 1 command has 16 bits. For the group 0 command, the transfer length of 1 through FFh indicates that 1 through 255 blocks will be transferred respectively. The transfer length of zero indicates that 256 blocks shall be transferred. For the group 1 command, the transfer length of 1 through FFFFh indicates that 1 through 65535 blocks will be transferred respectively.

5.5.5 Control Byte

The last byte of CDB is the control byte. The each bit is defined as Fig. 5.5.4.

Table 5.5.4 Control Byte

Byte \ Bit	7	6	5	4	3	2	1	0
Last	VU		Reserved					

VU (Vendor Unique): The VU bit is defined by vendors. When the VU bit is not defined, this bit is set to zero. Each command is defined in detail in the command description described at section 6.

Reserved: The reserved field is set to zero. When this field is set other than zero, the target operation will not be guaranteed. The field will be reserved for the future extension.

GROUP 0 (6 bytes command)
The Group 0 commands are as shown below.

Table 5.5.5 Implemented Command (Group 0)

Operation Code	Type	Command Name (Original Device Command)
00h	M	TEST UNIT READY
01h	O	REZERO UNIT
03h	M	REQUEST SENSE
07h	O	REASSIGN BLOCKS
12h	M	INQUIRY
1Bh	O	START STOP UNIT
1Eh	O	PREVENT ALLOW MEDIUM REMOVAL

GROUP 1 (10 bytes command)
The Group 1 commands are as shown below.

Table 5.5.6 Implemented Command(Group 1)

Operation Code	Type	Command Name (Original Device Command)
25h	M	READ CAPACITY
28h	M	READ(10)
2Ah	M	WRITE(10)
2Bh	O	SEEK(10)
2Ch	O	ERASE(10)
2Eh	O	WRITE AND VERIFY(10)
2Fh	O	VERIFY(10)
37h	O	READ DEFECT DATA(10)

Type : M = Command implementation is mandatory by ANSI.
O = Command implementation is optional by ANSI.

<Caution>
The command operation of the target will not be guaranteed on power off or detecting of reset condition during command execution.

5.6 Status

A status byte will be sent from the target to the initiator during the STATUS phase at termination of each command as specified in Table below unless the command is cleared by "hardware" RESET condition, by an ABORT message, by a BUS DEVICE RESET message, or by an unexpected BUS FREE condition.

Table 5.6.1 Status Byte Code Bit Value

Bits of Status Byte								Status(es) Represented
7	6	5	4	3	2	1	0	
R	R	0	0	0	0	0	R	GOOD
R	R	0	0	0	0	1	R	CHECK CONDITION
R	R	0	0	1	0	0	R	BUSY
All Other Codes								Reserved

Key: R - Reserved bit

5.6.1 GOOD Status (00h)

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

5.6.2 CHECK CONDITION Status (02h)

This status indicates that a contingent allegiance condition has occurred. The REQUEST SENSE command should be issued following a CHECK CONDITION status, to determine the nature of the condition.

5.6.3 BUSY Status (08h)

The target is busy. This status will be returned whenever a target is unable to accept a command from an otherwise acceptable initiator.

5.7 Mode Parameter

The mode parameters are specified medium or logical unit parameter for the initiator to the target. Normally, the mode parameters are set by the initiator using MODE SELECT command. The mode parameters must be used as default value for the IS&C drive. The parameter list format is shown in Table 5.7.1. The parameter list consists of 4 byte mode select header and contiguous page descriptor.

Table 5.7.1 Mode Parameter List

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							
	0	0	0	0	0	0	0	0
1	Medium Type							
	0	0	0	0	0	0	0	0
2	Reserved							
	0	0	0	0	0	0	0	0
3	Block Descriptor Length							
	0	0	0	0	0	0	0	0
4	Reserved			Page Code				
5	Page Length							
6~n	Page Parameters							

Byte0 through byte3 specifies Mode Select Header. The following bytes(byte 4 to byte n) specifies the Page Descriptor.The each byte is specified as follows;

(1) the Medium Type(byte1) shall be set to zero.
(2) The block descriptor Length (byte 3) is set to zero.This field is not changeable.
(3) The page Descriptors specifies 2 pages in the page code field.
(4) The Page Length(byte5) specifies number of the Page Parameters.

Table 5.7.2 Page Code Description

Page Code	Description
1 h	Error Recovery Parameters
2 h	Disconnect/Reconnect Control Parameters

5.7.1 Error Recovery Parameters

The format of the Error Recovery Parameters is shown in Table 5.7.3.

Table 5.7.3 Error Recovery Parameters

Bit / Byte	7	6	5	4	3	2	1	0	Default Value
4	Reserved 0	0	0	0	Page Code 0	0	0	1	01h
5	Page Length 0	0	0	0	0	1	1	0	06h
6	AWRE 1	ARRE --	TB 1	RC --	EER --	PER --	DTE --	DCR --	Not specified
7	Retry Count								1~FFh
8	Correction Span								Not specified
9	Head Offset Count								Not specified
10	Data Strobe Offset								Not specified
11	Recovery Time Limit								Not specified

The each bit in byte 6 specifies as follows. The AWRE bit shall be set for the write operation, and the other bits are set for the read operation.

AWRE(Automatic Write Reallocation of defective data blocks Enabled)
The AWRE bit of one indicates that the target enables automatic reallocation of defective data blocks during verify operation of the WRITE AND VERIFY command. The AWRE bit of zero indicates that the target disables automatic reallocation of defective data blocks. The default value of this bit is set to one.

ARRE(Automatic Read Reallocation of defective data blocks Enabled)
The ARRE bit of one indicates that the target enables automatic reallocation of defective data blocks during read operations. The automatic reallocation shall be performed only if the target successfully recovers the data. The ARRE bit of zero indicates that the target disables automatic reallocation of defective data blocks.

TB(Transfer Block)
The TB bit of one indicates that a data block that is not recovered within the recovery limits specified is transferred to the initiator before CHECK CONDITION status is returned. The TB bit of zero indicates that such a data block is not transferred to the initiator.

RC(Read Continuous)
The RC bit of one indicates that the target transfers the entire requested length of data without adding delays to perform error recovery procedures. The target assigns priority to this bit over conflicting error control bits (EER,DCR,DTE and PER)within this bytes.

EER((Enable Early Recovery)
The EER bit of one indicates that the target uses of the most expedient form of error recovery first.This bit only applies to data error recovery and it does not affect positioning retries and the message system error recovery procedures. The EER bit of zero indicates that the target use an error recovery procedure that minimizes the risk of misdetection or miscorrection.

PER(Post Error)
The PER bit of one indicates that the target reports recovered errors. The PER bit of zero indicates the target does not report recovered errors.

DTE(Disable Transfer on Error)
The DTE bit of one indicates that the target terminates data phase upon detection of a recovered error. The DTE bit of zero indicates that the target does not terminate the data phase upon detection of a recovered error. The DTE bit is valid when the PER bit is set to one.

DCR(Disable CoRrection)
The DCR bit of one indicates that error correction codes are not used for data error recovery. The DCR bit of zero allows the use of error correction codes for data error recovery.

Byte 7 indicates the upper limit of the retry count for data error in one block. The value is selectable from 1 to 256 count.

5.7.2 Disconnect/Reconnect Control Parameters

The format of Disconnect/ Reconnect Control Parameters is shown in Table 5.7.4.

Table 5.7.4 Disconnect/Reconnect Control Parameters

Byte \ Bit	7	6	5	4	3	2	1	0	Default Value
4	Reserved 0	0	Page Code 0	0	0	0	1	0	02h
5	Page Length 0	0	0	0	1	0	1	0	0Ah
6	Buffer Full Ratio								Not specified
7	Buffer Empty Ratio								Not specified
8	Bus Inactivity Limit (MSB)								Not specified
9	Bus Inactivity Limit (LSB)								Not specified
10	Disconnect Time Limit (MSB)								Not specified
11	Disconnect Time Limit (LSB)								Not specified
12	Connect Time Limit (MSB)								Not specified
13	Connect Time Limit (LSB)								Not specified
14	Reserved								00h
15	Reserved								00h

Byte6 through byte 13 are not specified.

6. SCSI COMMANDS

GROUP 0 (6 bytes command)
The Group 0 commands are shown below.

Table 6.1 Group 0 Command

Operation Code	Type	Command Name (Original Device Command)
00h	M	TEST UNIT READY
01h	O	REZERO UNIT
03h	M	REQUEST SENSE
07h	O	REASSIGN BLOCKS
12h	M	INQUIRY
1Bh	O	START STOP UNIT
1Eh	O	PREVENT ALLOW MEDIUM REMOVAL

GROUP 1 (10 bytes command)
The Group 1 commands are shown below.

Table 6.2 Group 1 Command

Operation Code	Type	Command Name (Original Device Command)
25h	M	READ CAPACITY
28h	M	READ(10)
2Ah	M	WRITE(10)
2Bh	O	SEEK(10)
2Ch	O	ERASE(10)
2Eh	O	WRITE AND VERIFY(10)
2Fh	O	VERIFY(10)
37h	O	READ DEFECT DATA(10)

Key : M = Command implementation is mandatory by ANSI.
O = Command implementation is optional by ANSI.

TEST UNIT READY

The TEST UNIT READY command provides a means to check if the logical unit is ready.

REZERO UNIT

The REZERO UNIT command requests that the target sets the logical unit to seek a certain reference position (track 0).

REQUEST SENSE

The REQUEST SENSE command requests that the target transfers sense data to the initiator.

REASSIGN BLOCKS

The REASSIGN BLOCKS command requests the target to reassign the defective logical block(s) of the medium to the alternative block(s).

INQUIRY

The INQUIRY command requests that information regarding parameters of the target and the logical unit is sent to the initiator.

START STOP UNIT

The START STOP UNIT command requests that the target enables or disables the logical unit for medium access operation.

PREVENT ALLOW MEDIUM REMOVAL

The PREVENT ALLOW MEDIUM REMOVAL command requests that the target enables or disables the removal of the medium in the logical unit.

READ CAPACITY

The READ CAPACITY command requests that the target transfers information regarding the capacity of the inserted medium to the initiator.

READ

The READ command requests that the target transfers data to the initiator.

WRITE

The WRITE) command requests that the target writes the data transferred from the initiator to the medium.

SEEK

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

ERASE

The ERASE command requests that the target erases the specified logical block(s).

WRITE AND VERIFY

The WRITE AND VERIFY) command requests that the target writes the data transferred from the initiator to the medium and then verifies that the data is correctly written.

VERIFY

The VERIFY) command requests that the target verifies the data on the medium.

READ DEFECT DATA

The READ DEFECT DATA command requests that the target transfers defective data of the medium to the initiator.

6-1 TEST UNIT READY

The TEST UNIT READY command provides a means to check if the logical unit is ready

Table 6.1.1 TEST UNIT READY Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	L U N (0)			Reserved				
2	Reserved							
3	Reserved							
4								
5	0	0	0	Reserved			0	0

LUN (Byte1 Bit7~5) : Logical Unit Number
LUN must be set to zero.
When the target receives the TEST UNIT READY command with unsupported LUN, the target will return the CHECK CONDITION status.

The TEST UNIT READY command means not to request to execute the drive self-test.
If the logical unit is ready, the command will be terminated with a GOOD status.
If the logical unit is not ready, the command will be terminated with a CHECK CONDITION status. The ready condition means the logical unit is ready to accept READ or WRITE command.

6.2 REZERO UNIT

The REZERO UNIT command requests that the target sets the logical unit to seek a specified track.

Table 6.2.1 REZERO UNIT Command

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (01h)							
1	LUN (0)			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	0	0	Reserved				0	0

LUN (Byte1 Bit7~5) : Logical Unit Number
LUN must be set to zero.
When the target receives the REZERO UNIT command with unsupported LUN, the target will return the CHECK CONDITION status.

The target seeks to track 0 specified by the logical unit itself. After the head positioning at the specified track, the logical unit becomes ready status and still condition. If the logical unit is ready, the command will be terminated with a GOOD status.

6.3 REQUEST SENSE

The REQUEST SENSE command requests that the target transfers sense data to the initiator.

Table 6.3.1 REQUEST SENSE Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	LUN(0)			Reserved				
2	Reserved							
3	Reserved							
4	Allocation Length							
5	0	0	Reserved				0	0

LUN (Byte1 Bit7~5) : Logical Unit Number
When the prior command except INQUIRY and REQUEST SENSE command is issued with unsupported LUN, and the REQUEST SENSE command is issued with the same LUN, the target will return Illegal Request sense key with Unsupported Logical Unit sense code for the previous command.

The Allocation Length field (Byte 4) specifies the maximum number of bytes that the initiator has allocated for returned sense data. An allocation length of zero indicates that 4 bytes sense data will be transferred.

6.3.1 SENSE DATA DESCRIPTION

The sense data will be valid for a CHECK CONDITION status returned on the prior command and may be valid if a bus free error occurred or sense key 00h information is available. This sense data will be preserved by the target for the initiator until successfully 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 will be cleared upon receipt of any subsequent command to the logical unit from the initiator receiving the CHECK CONDITION status.

This sense data will be preserved by the target for the initiator until retrieved by the REQUEST SENSE command or until the receipt of any other command for same logical unit from the same initiator. Sense data will be cleared upon receipt of any subsequent command to the logical unit.

The additional sense codes contain command-specific, peripheral-device-specific data, or both kinds of data that further define the nature of the CHECK CONDITION status.

A Valid bit of zero indicates that the Information field is not valid. A Valid bit of one indicates the Information field contains valid information of the logical block address associated with the sense key.

The Error code field value 70h indicates the current errors,and value 71h indicates the deferred errors.

The Incorrect Length Indicator (ILI) bit indicates that the requested logical block length did not match the logical block length of the data on the medium.

Table 6.3.2 Extended Sense Data Format

Bit / Byte	7	6	5	4	3	2	1	0
0	Valid	Error Code(70h or 71h)						
1	Reserved							
2	Reserved		ILI	Rsv'd	Sense Key			
3 : 6	(MSB) Information Byte (Logical Block Address) (LSB)							
7	Additional Sense Length							
8 : 11	(MSB) Command-Specific Information (LSB)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Reserved							
15	SKSV	Sense Key Specific						
17								

The Sense Key, Additional Sense Code and Additional Sense Code Qualifier provide a hierarchy of information. The intention of the hierarchy is to provide top-down approach for an initiator to determine information relating to the error and exception conditions. The Sense Key Description is shown in Table 6.3.3. The Additional Sense Code and Additional Sense Code Qualifier can be used by initiators where sophisticated error recovery procedures require detailed information describing the error and exception conditions.
The Additional Sense Code and Additional Sense Code Qualifier are specified by each vendor. See the each vendor's specification.

Command-Specific Information field indicates the information related command during error occurred.

The Sense Key Specific field is valid when SKSV bit is one. If the SKSV bit is zero, the Sense Key Specific field is invalid.

During the following conditions for REQUEST SENSE command, the target will return a CHECK CONDITION and generate a new sense data.
(i) Data other than zero exist in the reserved field of CDB.
(ii) The target can not return sense data due to the hard error occurred in itself.
(iii) The target detects a parity error.

6.3.2 The specified sense code

The IS&C specification defines a temperature warning error code when the drive detects exceeding 55 degrees centigrade around the medium. The target should transfer the following sense code to the host computer.

SENSE KEY	:	04h
ADDITIONAL SENSE CODE	:	83h or DDh

Table 6.3.3 SENSE KEY Description

SENSE KEY		Description
0h	NO SENSE	Indicates that there is no specific sense key information to be reported for the designated logical unit. This would be the case for a successful command.
1h	RECOVERED ERROR	Indicates that the last command completed success fully with some recovery action performed by the tar get. Details may be determinable by examining the additional sense bytes and information field.
2h	NOT READY	Indicates that the logical unit cannot be accessed. Operator intervention may be required to correct this condition.
3h	MEDIUM ERROR	Indicates that the command terminated with a unrecovered error condition that was probably caused by a flaw in the medium or an error in the recorded data.
4h	HARDWARE ERROR	Indicates that the target detected an unrecoverable hardware failure while performing the command or during a self test.
5h	ILLEGAL REQUEST	Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands.
6h	UNIT ATTENTION	Indicates that the removable medium may have been changed or the target has been reset by hardware RESET condition.
7h	DATA PROTECT	Indicates that a command that is to write on the medium was attempted on the protected medium. The write operation is not performed.
8h	BLANK CHECK	Indicates that the target encountered a blank block while reading.
Bh	ABORTED COMMAND	Indicates that the target aborted the command. The initiator may be able to recover by trying the command again.

6.4 REASSIGN BLOCKS

The REASSIGN BLOCKS commands requests the target to reassign the defective logical blocks to an area on the logical unit reserved for this purpose and to record the defective logical blocks to SDL.

Table 6.4.1 REASSIGN BLOCKS Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (07h)							
1	LUN (0)			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	0	0	Reserved				0	0

LUN (Byte 1 Bit 7~5) : Logical Unit Number
The Logical Unit Number must be set to zero.
When the target receives the REASSIGN BLOCKS Command with improper logical unit number, the target will return the CHECK CONDITION status.

6.4.1 Description of REASSIGN BLOCKS Defect List

The REASSIGN BLOCKS defect list is a defect list transferred from the initiator to the target.It indicates the logical block address to be reassigned.

Table 6.4.2 REASSIGN BLOCKS Defect List

Byte	Defect List Header
0	Reserved
1	Reserved
2 3	(MSB) Defect List Length (LSB)

Defect Descriptor(s)

4 5 6 7	(MSB) Defect Logical Block Address (LSB)
8 : n	Repeat above 4 bytes

The Reassign Blocks Defect List contains a four-byte header followed by one or more defect descriptors. The length of each Defect Descriptor is four bytes.

The Defect List Length field specifies the total length in bytes of the Defect Descriptors that follow. The Defect List Length is equal to four times the number of Defect Descriptors and does not include the Defect List Header Length. When data except for zero or figures of four times in the Defect List Length are set, the command will terminate CHECK CONDITION status. The maximum number to be set in the Defect List Length is 2000h. If the number exceeds the maximum, the command will terminate CHECK CONDITION status.

The Defect Descriptor specifies a four-byte Defect Logical Block Address that contains the defect. The Defect Descriptors must be in ascending order.

When there is no Defect Logical Block Address in the Defect List, the Defect List length should be 0000h and the target will transfer the header byte only.

If the logical unit has insufficient capacity to reassign all of the logical blocks specified in the Defect Descriptors, the command will terminate with CHECK CONDITION status.

6.5 INQUIRY

The INQUIRY command requests that information regarding parameters of the target and the logical unit be sent to the initiator (See INQUIRY DATA DESCRIPTION).

Table 6.5.1 INQUIRY Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	L U N(0)			Reserved				
2	Reserved							
3	Reserved							
4	Allocation Length							
5	0	0	Reserved				0	0

LUN (Byte 1 Bit 7~5) : Logical Unit Number
When the target receives the INQUIRY command for a LUN other than zero, the target will return the INQUIRY DATA with 7Fh in Byte 0.

The Allocation Length field (Byte 4) specifies the maximum number of bytes that the initiator has allocated for returned inquiry data. An Allocation Length zero indicates that no inquiry data will be transferred.

If the INQUIRY command executes during UNIT ATTENTION condition, the condition won't be changed.

6.5.1 INQUIRY DATA Description

The INQUIRY data contains 36 bytes parameters which contain 5 bytes header and the following 31 bytes parameters. The contiguous bytes are optional parameters.The additional length specifies the length in bytes of the parameters.

Byte 0 which specifies Peripheral Device Qualifier and Peripheral Device Type depends on the connected logical unit parameters.

When a RMB (Removable Medium) bit is set to one, medium is removable. When the bit is set to zero, medium is not removable.

When bits in Byte 2 which specifies the ISO Version and the ECMA Version are set to zero, the target does not comply with the ISO and the ECMA. The ANSI approved version indicates the target complies with the ANSI version or not.

The Response Data Format field indicates the version defined above.

The Additional Length field is set the number of byte followed by fifth byte.

The Vendor ID is a manufacturer name by ASCII code. The product ID is a type of the target drive by ASCII code. The product revision level is a ROM version of the target drive by ASCII code.

Table 6.5.2 INQUIRY DATA

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
	(for LUN set to zero : 07h) (for LUN set to other than zero : 7Fh)							
1	RMB(1)	Reserved						
2	ISO Version (0)		ECMA Version (0)			ANSI Version(2)		
3	Reserved					Response Data Format(2)		
4	Additional Length							
5	Reserved							
6	Reserved							
7	Rel Adr	Reserved		Sync	Linked	Reserved		
8 : 15	(MSB) Vendor ID (LSB)							
16 : 31	(MSB) Product ID (LSB)							
32 : 35	(MSB) Product Revision Level (LSB)							
36 : 55	Vendor Specific							
56 : 95	Reserved							
96 : N	Vendor Specific Parameter Bytes							

6.6 START STOP UNIT

The START STOP UNIT command requests that the target enables or disables the logical unit for further medium access operation.

Table 6.6.1 START STOP UNIT Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Bh)							
1	L U N (0)			Reserved				I(0)
2	Reserved							
3	Reserved							
4	Reserved						LoEj	Start
5	0	0	Reserved				0	0

LUN (Byte 1 Bit 7~5) : Logical Unit Number
LUN must be set to zero.
When the target receives the START STOP UNIT command with unsupported LUN, the target will return the CHECK CONDITION status.

Immed (Byte 1 Bit 0) : Immediate
An Immed bit is set to zero indicates that status will be returned after the operation is completed. This bit is effective on START UNIT command. When the STOP UNIT command is issued, the status will be returned as soon as the operation is started whichever this bit is set.

LoEj(Byte 4 Bit 1) :Load Eject
A LoEj bit of zero indicates that loading or ejecting the medium does not occur with this command.If the Start bit is zero and a LoEj bit is one ,the target ejects the medium.

Start (Byte 4 Bit 0) :
A Start bit specifies the command is either START command or STOP command.

A Start bit is set to zero indicates that the command is STOP UNIT command. The target will stop the rotation of the spindle motor.

A Start bit is set to one indicates that the command is START UNIT command. The target will start the rotation of the spindle motor if the medium is in the logical unit.

Table 6.6.2 Operation of Eject and Stop bit

Eject	Stop	Operation	Byte 4
0	0	Stop	00h
1	0	Stop and eject	02h
0	1	Start	01h

6.7 PREVENT ALLOW MEDIUM REMOVAL

The PREVENT ALLOW MEDIUM REMOVAL command requests that the target enables or disables the removal of the medium in the logical unit.

Table 6.7.1 PREVENT ALLOW MEDIUM REMOVAL Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Eh)							
1	L U N (0)			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							Prevent
5	0	0	Reserved				0	0

LUN (Byte 1 Bit 7~5) : Logical Unit Number
LUN must be set to zero.
When the target receives the PREVENT ALLOW MEDIUM REMOVAL command with unsupported LUN, the target will return the CHECK CONDITION status.

Prevent(Byte 4 Bi t0) :
A Prevent bit specifies the command is either PREVENT MEDIUM REMOVAL command or ALLOW MEDIUM REMOVAL command.
A Prevent bit is set to one indicates that the command is PREVENT MEDIUM REMOVAL command. The target will inhibit mechanisms that normally allow removal of the medium.
A Prevent bit is set to zero indicates that the command is ALLOW MEDIUM REMOVAL command. The target will allow removal of the medium.

This prevention of the medium removal condition will terminate upon receipt of a ALLOW MEDIUM REMOVAL command issued by the initiators that have prevented the medium from removing, or by the receipt of a BUS DEVICE RESET message from any initiator or by a hard RESET condition.

6.8 READ CAPACITY

The READ CAPACITY command requests that the target transfers information regarding the capacity of the inserted medium to the initiator (See READ CAPACITY DATA DESCRIPTION).

Table 6.8.1 READ CAPACITY Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (25h)							
1	L U N (0)			Reserved				
2 : 5	(MSB) Logical Block Address (00000000h) (LSB)							
6	Reserved							
7	Reserved							
8	Reserved							PMI(0)
9	0	0	Reserved				0	0

LUN (Byte 1 Bit 7~5) : Logical Unit Number
LUN must be set to zero.
When the target receives the READ CAPACITY command with unsupported LUN, the target will return the CHECK CONDITION status.

Logical Block Address (Byte 2~Byte 5)
The Logical Block Address Field is set to the beginning logical block address of the logical block which the READ CAPACITY command handles.The beginning block address should be zero. If the address is not zero, the target will be terminated with CHECK CONDITION status.

PMI (Byte 8 Bit 0) : Partial Medium Indicator
A PMI bit of zero indicates that the information returned in the READ CAPACITY data will be the Logical Block Address and block length (in Bytes) of the last logical block of the inserted medium.

6.8.1 CAPACITY DATA DESCRIPTION

The READ CAPACITY DATA consists of four bytes of logical block address and four bytes of block length (physical sector size).

Logical Block Address means maximum logical block address of the inserted medium.

Block Length means physical sector size of the inserted medium.

Data of Logical Block Address and Block Length are in accordance with the medium type.

Table 6.8.1 READ CAPACITY DATA

Bit / Byte	7	6	5	4	3	2	1	0
0 : 3	(MSB) Returned Logical Block Address(0004CCC8h) (LSB)							
4 : 7	(MSB) Block Length in Byte (for 1024 Bytes/Sector type medium : 00000400h) (LSB)							

6.9 READ

The READ command requests that the target transfers data to the initiator.

Table. 6.9.1 READ Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (28h)							
1	L U N (0)			Reserved				
2 : 5	(MSB) Logical Block Address (LSB)							
6	Reserved							
7 8	(MSB) Transfer Length (LSB)							
9	0	0	Reserved				0	0

LUN (Byte 1 Bit 7~5) : Logical Unit Number
LUN must be set to zero.
When the target receives the READ command with unsupported LUN, the target will return the CHECK CONDITION status.

The Transfer Length specifies the number of contiguous logical blocks of data to be transferred. A transfer length of zero indicates that no logical blocks will be transferred. This condition shall not be considered as an error and no data shall be read.

6.10 WRITE

The WRITE command requests that the target writes the data transferred from the initiator to the medium.
The WRITE command is same as WRITE AND VERIFY command.

Table 6.10.1 WRITE) Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (2Ah)							
1	L U N (0)			Reserved		EBP	Reserved	
2 : 5	(MSB) Logical Block Address (LSB)							
6	Reserved							
7 8	(MSB) Transfer Length (LSB)							
9	0	0	Reserved				0	0

LUN (Byte 1 Bit 7~5) : Logical Unit Number
LUN must be set to zero.
When the target receives the WRITE command with unsupported LUN, the target will return the CHECK CONDITION status.

When the target receives the WRITE command, the target shall execute the-WRITE command with verify.

EBP (Byte 1 Bit 2) : Erase By-Pass
The EBP bit of zero indicates that the target will execute the erase operation before the write operation.
The EBP bit of one indicates that the target is allowed to by-pass the erase operation before the write operation.

The Logical Block Address field specifies the logical block at which the write operation will begin.

The Transfer Length specifies the number of contiguous logical blocks of data to be transferred. A transfer length of zero indicates that no logical blocks will be transferred. This condition shall not be considered as an error and no data shall be written.

6.11 SEEK

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

Table 6.11.1 SEEK Command

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	LUN (0)			Reserved				
2 : 5	(MSB) Logical Block Address (LSB)							
6	Reserved							
7	Reserved							
8	Reserved							
9	0	0	Reserved				0	0

LUN (Byte 1 Bit 7~5) : Logical Unit Number
LUN must be set to zero.
When the target receives the SEEK command with unsupported LUN, the target will return the CHECK CONDITION status.

The Logical Block Address field specifies the logical block to which the optical head will begin to move.

6.12 ERASE

The ERASE command requests that the target erases the specified number of blocks starting at the specified logical block address on the medium.

Table 6.12.1 ERASE Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (2Ch)							
1	LUN(0)			Reserved		ERA	Reserved	
2 : 5	(MSB) Logical Block Address (LSB)							
6	Reserved							
7 8	(MSB) Transfer Length (LSB)							
9	0	0	Reserved				0	0

LUN(Byte1 Bit7-5) : Logical Unit Number
The LUN must be set to zero.
When the target receives the ERASE) command with unsupported LUN, the target will return the CHECK CONDITION status.

ERA (Byte1 Bit2) : Erase All Bit
The ERA bit set to one indicates that all remaining blocks on the medium will be erased. If the ERA bit is set to one and if the number of blocks is not zero, the target will return CHECK CONDITION, and the sense key will be set to ILLEGAL REQUEST, with an additional sense code of INVALID FIELD IN CDB.

The Logical Block Address field specifies the logical block at which the erase operation will begin.

The Transfer Length specifies the number of contiguous logical blocks that will be erased when the ERA bit is zero. If the ERA bit is zero, a Transfer Length of zero indicates that no blocks will be erased. This condition shall not be considered as an error and no data will be erased.

6.13 WRITE AND VERIFY

The WRITE AND VERIFY command requests that the target writes the data transferred from the initiator to the medium and then verifies that the data is correctly written.

Table 6.13.1 WRITE AND VERIFY command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (2Eh)							
1	L U N (0)			Reserved		EBP	Reserved	
2 : 5	(MSB) Logical Block Address (LSB)							
6	Reserved							
7 8	(MSB) Transfer Length (LSB)							
9	0	0	Reserved				0	0

LUN (Byte 1 Bit 7~5) : Logical Unit Number
LUN must be set to zero.
When the target receives the WRITE AND VERIFY command with unsupported LUN, the target will return the CHECK CONDITION status.

EBP (Byte1 Bit 2) : Erase By-Pass
The EBP bit of zero indicates that the target will execute the erase operation before the write operation.
The EBP bit of one indicates that the target is allowed to by-pass the erase operation before the write operation.

The Logical Block Address field specifies the logical block at which the write and verify operation will begin.

The Transfer Length field (Byte 7,8) specifies the number of contiguous logical blocks of data to be transferred. A Transfer Length field of zero indicates that no logical blocks will be transferred.This condition shall not be considered as an error and no data will be written.

6.14 VERIFY

The VERIFY command requests that the target verifies the data on themedium.

Table 6.14.1 VERIFY command

Byte \ Bit	7	6	5	4	3	2	1	0
0	Operation Code (2Fh)							
1	LUN (0)			Reserved				
2 : 5	(MSB) Logical Block Address (LSB)							
6	Reserved							
7 8	(MSB) Verification Length (LSB)							
9	0	0	Reserved				0	0

LUN (Byte 1 Bit 7~5) : Logical Unit Number
LUN must be set to zero.
When the target receives the VERIFY command with unsupported LUN, the target will return the CHECK CONDITION status.

The Logical Block Address field specifies the logical block at which the verify operation will begin.

The Verification Length field (Byte 7,8) specifies the number of contiguous logical blocks of data to be verified. A Verification Length field of zero indicates that no logical blocks will be verified. This condition shall not be considered as an error.

6.15 READ DEFECT DATA

The READ DEFECT DATA command requests that the target transfers the medium defect data to the initiator.

Table 6.15.1 READ DEFECT DATA Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (37h)							
1	LUN (0)			Reserved				
2	Reserved			PList	GList	Defect List Format(5h)		
3 : 6	Reserved							
7	(MSB) Allocation Length							
8								(LSB)
9	0	0	Reserved				0	0

LUN (Byte 1 Bit 7~5) : Logical Unit Number
The LUN must be set to zero. When the target receives the READ DEFECT DATA(10) command with unsupported LUN, the target will return the CHECK CONDITION status.

PList (Byte 2 Bit 4) : Primary Defect List(PDL)
A PList bit of one request that the target will return the Primary Defect List.
If PList bit is one with the Defect List Format of 0h(Block Format) ,the target will return the CHECK CONDITION status.A PList bit of zero requests that the target will not return the Primary Defect List.

GList (Byte 2 Bit 3) : Grown Defect List(SDL;Secondary Defect List)
A GList bit of one requests that the target will return the Grown Defect List. A GList bit is zero requests that the target will not return the Grown Defect List.

Defect List Format (Byte 2 Bit 2~0)
The Defect List Format field shall be set to 5h. This format indicates that Defect List is a Physical Sector Format.

If the PList bit and GList bit are one, the target will return both of the primary defect list(PDL) and Grown Defect List.

If the Plist bit and GList bit are zero, the target will return the Defect List Header.

Table 6.15.2 READ DEFECT DATA Defect List

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							
1	Reserved			PList	GList	Defect List Format(5h)		
2	(MSB) Defect List Length							
3	(LSB)							

Defect Descriptors

4	Reserved
5	(MSB)
6	Track Address (LSB)
7 : 10	Reserved
11	Sector Address
12 : n	Repeat above 8 bytes

The READ DEFECT DATA defect list contains four-byte header and followed by zero or mote defect descriptors.

PList (Byte 1 Bit 4) : Primary Defect List(PDL)
A PList bit of one indicates that the data returned contains the Primary Defect List. A PList bit of zero indicates that the returned data does not contains the Primary Defect List.

GList (Byte 1 Bit 3) : Grown Defect List(SDL; Secondary Defect List)
A GList bit of one indicates that the data returned contains the Grown Defect List. A GList bit of zero indicates that the data returned does not contain the Grown Defect List.

Defect List Format (Byte 1 Bit 2~0)
The Defect List Format field indicates that the format of the Defect Descriptors returned by the target.

Defect LIst Length (Byte 2 ~ Byte 3)
The Defect List Length field specifies the length in bytes of the Defect Descriptors that follow. The Defect List Length is equal to eight times the number of Defect Descriptors depending on the format of the returned descriptors which indicates the defective address in the physical track and sector address. The maximum length is 4000h. The number of defective blocks is 2048.

Questions about IS&C Specification should be addressed to Headquarters of IS&C committee shown below.

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