

ADAPTEC

ACB-5500 Preliminary OEM Manual

Addendum to ACB-4000 Winchester Disk Controller OEM Manual

dated 10/14/83

## Introduction

This addendum describes the functions provided by the ACB-5500 that are additional to or different from those described in the ACB-4000 OEM Manual.

### 1.1 Basic Description

The ACB-5500 is optimized for multi-user/multi-tasking applications by implementing the full SASI/ANSI SCSI specification and supporting up to four Seagate ST-506/412 equivalent Winchester drives.

### 1.2 Feature Set

- A) The controller has a 2K byte FIFO data buffer which is dual ported for rapid data transfers. No sector interleaving is required for sectors of 1K bytes or less.
- C) Disk defect handling is on a sector level. The host can choose to request that spare sectors be reserved on a cylinder basis, allowing formatting of disks with a constant data capacity and allowing cylinder level reformatting for grown defects.
- E) Relative addressing of sectors is supported.
- G) The ACB-5500 supports a fully arbitrating SCSI system with up to 7 other controllers or hosts sharing the SCSI bus.
- H) The ACB-5500 supports disconnection and reconnection to free the SCSI bus while drives are seeking.
- I) The ACB-5500 provides internal buffer checking and SCSI bus parity and parity checking for improved reliability.
- J) The ACB-5500 supports extent level reservation.
- K) The ACB-5500 supports command linking.
- L) The ACB-5500 supports command queueing for all commands except the RESERVE command.

## 2.0 Physical Specifications

### 2.1 Size

Length 8.75"

Width 5.75"

Height .75"

### 2.2 Power Requirements

The power is applied through J7, with unchanged pin assignments and mating connectors. Power requirement is:

+5VDC + 5% at 1.5 Amps (max)

+12VDC + 10% at 300 ma (max)

## 3.0 Host and Drive Interfaces

### 3.1 Host Adapter Interface

The SCSI is connected at J8.

The parity bit is implemented at pin 18 as specified by the SCSI standard.

Only the bus units fastened at the ends of the SCSI cable may have their terminators installed. The terminators are located at positions RP15 and RP17.

### 3.3 Disk Drive Interface - Signals

Figure 3-4 shows conceptually the interfaces to an Adaptec disk controller. The ACB-5500 connector assignments are:

|    |                                       |
|----|---------------------------------------|
| J1 | ST506 Control/Data                    |
| J2 | Drive 0, ST506 Radial Data Connection |
| J3 | Drive 1, ST506 Radial Data Connection |
| J4 | Drive 2, ST506 Radial Data Connection |
| J5 | Drive 3, ST506 Radial Data Connection |
| J7 | DC Power                              |
| J8 | SCSI Interface                        |

The other specifications of section 3.3.1 are still valid.

### 4.4 Bus Phases

An additional bus phase, the arbitration phase, is supported by the Adaptec ACB-5500 preparatory to the selection phase.

#### 4.4.2 Arbitration Phase

The ARBITRATION phase allows one SCSI DEVICE to gain control of the bus so that this device can assume the role of an INITIATOR or TARGET.

4.6 The normal progression of phases for an ACB-5500 operating on a bus that supports arbitration is as follows:

BUS FREE to ARBITRATION to SELECTION to INFORMATION  
TRANSFER PHASES.

## 5.0 Message Specification

### 5.1 Message System

The message system is also essential to proper handling of linked commands and disconnected commands.

A typical disconnected command uses the following sequence:

BUS FREE PHASE

ARBITRATION PHASE                      Allows priority selection of units competing for use of bus.

SELECTION PHASE                        Identifies target bus unit.

DATA TRANSFER PHASES

MESSAGE OUT  
IDENTIFY                                Identifies LUN and disconnection.

COMMAND                                Command requires disconnection.

MESSAGE IN  
(SAVE POINTERS)                      Host saves command, data, and status pointers.

MESSAGE IN  
(DISCONNECT)

BUS FREE PHASE                        During disconnection period

After the operation requiring the disconnection is prepared to reconnect and continue, the command is continued using the following sequence:

BUS FREE PHASE

ARBITRATION PHASE      Allows priority selection of units competing for use of the bus.

RESELECTION PHASE      Target identifies original initiating host, and notifies host of its own address.

DATA TRANSFER PHASES

MESSAGE IN

IDENTIFY              Target identifies original LUN so that host may restore pointers.

DATA IN/OUT            Data to be transferred

STATUS IN              Target posts ending status

MESSAGE IN  
COMPLETION            Target indicates command is complete.

BUS FREE PHASE

If command linking is to be executed, the target is notified by a bit in the Command Descriptor Block (CDB). The following sequence would be typical of two linked commands:

BUS FREE PHASE

ARBITRATION PHASE

SELECTION PHASE

DATA TRANSFER PHASES

MESSAGE OUT  
IDENTIFY  
COMMAND

DATA IN/OUT

STATUS

MESSAGE IN

LINKED COMMAND COMPLETE or

LINKED COMMAND COMPLETE WITH FLAG

COMMAND

DATA IN/OUT

STATUS

MESSAGE IN

COMPLETION

BUS FREE PHASE

Linked commands must always be for the identified LUN. Relative addresses may be used for consecutive linked commands.

### 5.1.1 Single Byte Messages

The following single Byte Messages may be transmitted between the host and the ACB-5500:

Command Completion (00 Hex)

Save Data Pointer (02 Hex)

This code is sent from a TARGET to direct the INITIATOR to save a copy of the present active data pointer for the currently attached LUN. See the SCSI specification for a definition of pointers.

Restore Pointers (03 Hex)

This code is sent from a TARGET to direct the INITIATOR to restore the most recently saved pointers (for the currently identified LUN) to the active state. Pointers to the COMMAND, DATA, and STATUS locations for the LUN will be restored to the active pointers. COMMAND and STATUS pointers will be restored at the beginning of the present command. The DATA POINTER shall be restored to the value as at the beginning of the command in the absence of a SAVE DATA POINTER message or at the point at which the last SAVE DATA POINTER message occurred.

Disconnect (04 Hex)

Sent from a TARGET to inform an INITIATOR that the present physical path is going to be broken (the TARGET will disconnect by releasing BSY), but that a later reconnect will be required in order to complete the current operation. By not sending this message or the COMMAND COMPLETE message before going to BUS FREE phase (other than as a result of reset), the TARGET indicates that an error condition has occurred on the current command. This message does not save the DATA POINTER.

Initiator Detected Error (05 Hex)

Sent from an INITIATOR to inform a TARGET that an INITIATOR detected retryable error has occurred since the last time the state of the DATA POINTER was saved. Note: Commonly, this is for a data parity error.

Abort (06 Hex)

The message is sent from the INITIATOR to direct the TARGET to:

1. Clear any operation for the specified LUN from the selecting INITIATOR. Only an operation for the selecting INITIATOR is affected. If no LUN has been selected by the IDENTIFY message then only the operation in process on the bus shall be cleared by the TARGET.

2. Cause the bus to 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 LUN that is not currently performing an operation for the INITIATOR.

Message Reject (07 Hex)

No Operation (08 Hex)

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.

Linked Command Complete (0A Hex)

Sent from a TARGET to an INITIATOR to indicate that the execution of a linked command has completed and that status has been sent. The INITIATOR is then allowed to set up the pointers for the initial state for the next linked command.

### Linked Command Complete with Flag (0B Hex)

Sent from a TARGET to an INITIATOR to indicate that the execution of a linked command (with the FLAG set) has completed and that status has been sent. The INITIATOR is then allowed to set up the pointers for the initial state of the next linked command. Typically the FLAG would cause an interrupt in the INITIATOR.

### Bus Device Reset (0C Hex)

This message can be sent from an INITIATOR to direct a TARGET to reset all current I/O operations on that BUS DEVICE. This message forces the BUS 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.

### Identify (80 to FF Hex)

Bit 6 will be used by the ACB-5500 to accept an initiator's ability to disconnect and reconnect.

## 6.2.8 Control Byte

The control byte is the last byte in either a group 0 or a group 1 command. The bits are defined as follows:

- Bits 7 - 2      Reserved, must be zero
- Bit 1            FLAG - This bit is only meaningful when Bit 0 (LINK) is set and means an interrupt is requested for this command in a group of linked commands.
- Bit 0            LINK - The use of this bit is optional and means an automatic link to the next command upon successful completion of the current command for this INITIATOR. Status shall be returned for each command executed.

### 6.2.9 Relative Address Bit

The RELATIVE ADDRESS BIT (Bit 0 of Byte 01) of the Group 1 commands is set to indicate that the block address portion of the CDB is a two's complement displacement. This displacement is to be added to the Block Address last accessed on the unit to form the Block Address for this command. This feature is only available when linking commands. The feature requires that a previous command in the linked group has accessed a block of data on the device.

### 6.3 Command Descriptions

With a few exceptions, all unchanged commands are executed identically to normal ACB-4000 operations. Three exceptions are disconnection, linking, and command queuing.

Disconnection is executed for any read command, write command, or seek command that demands actual physical head movement. Disconnection will only be executed against these hosts that have indicated an ability to handle disconnection in their IDENTIFY message. Those commands that may disconnect are:

|    |                  |
|----|------------------|
| 01 | REZERO UNIT      |
| 08 | READ             |
| 0A | WRITE            |
| 0B | SEEK             |
| 28 | READ (EXTENDED)  |
| 2A | WRITE (EXTENDED) |
| 2E | WRITE AND VERIFY |
| 2F | VERIFY           |

One performance characteristic of disconnection is that seek complete status will not be presented until the SEEK command is actually complete, although disconnection will free the SCSI during the seek movement. Thus, no busy state will be presented when a SEEK is complete since actual seek completion and SEEK command completion will coincide. For optimum performance, the SEEK command should not be used on the ACB-5500, since the read and write commands will correctly disconnect anyway.

Linking will change the characteristics of certain commands, extending parameter control from previous commands over future commands. In particular, relative sector addressing will provide precise access of blocks following a previous search, read, or write command.

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Command queuing will allow any host to transmit a command to a LUN that is busy executing a command on behalf of a different host. The command is received by the ACB-5500 and stored in an internal queue. The SCSI bus is then disconnected in a normal manner. When the LUN is finished with the commands for the host with which it was busy, then the queued commands are examined and one is selected for reconnection. The LUN then proceeds normally with the operation on the new host. Effectively, busy states and software attempts to find the LUN not busy are all avoided. The RESERVE command will not be queued.

The commands are summarized in the following sections. Those different than the ACB-4000 are described in detail.

### 6.3.1 Class 0 Command Descriptions

The following commands are supported by the ACB-5500. All are supported exactly as in the ACB-4000 except where otherwise specified.

Table 6-5a Group 0 Command Summary

| OP CODE | COMMAND                  | ACB4000 | ACB5500   |
|---------|--------------------------|---------|-----------|
| 00      | TEST UNIT READY          | X       | UNCHANGED |
| 01      | REZERO UNIT              | X       | UNCHANGED |
| 03      | REQUEST SENSE            | X       | UNCHANGED |
| 04      | FORMAT UNIT              | X       | EXTENDED  |
| 08      | READ                     | X       | EXTENDED  |
| 0A      | WRITE                    | X       | EXTENDED  |
| 0B      | SEEK                     | X       | UNCHANGED |
| 0F      | TRANSLATE                | X       | UNCHANGED |
| 10      | SET THRESHOLD            |         | NEW       |
| 11      | READ/RESET USAGE COUNTER |         | NEW       |
| 12      | INQUIRY                  |         | NEW       |
| 13      | WRITE BUFFER             | X       | EXTENDED  |
| 14      | READ BUFFER              | X       | EXTENDED  |
| 15      | MODE SELECT              | X       | UNCHANGED |
| 16      | RESERVE                  |         | NEW       |
| 17      | RELEASE                  |         | NEW       |
| 1A      | MODE SENSE               | X       | UNCHANGED |
| 1B      | START/STOP UNIT          | X       | UNCHANGED |
| 1C      | RECEIVE DIAGNOSTIC       | X       | UNCHANGED |
| 1D      | SEND DIAGNOSTIC          | X       | EXTENDED  |

## Format Unit (04<sub>H</sub>)

The command format and bit definition is the same as that described for the ACB-4000. Additional function is provided to address two special requirements. Certain disks may be suspected of running normally for most data patterns, but microdefects could cause sectors to appear to become defective after disk shipment. The FORMAT command extensions provide for reformatting the defects of single cylinders with no requirement for overall reformatting. The second requirement is for host management of physical seeks. Those systems desiring such management require all cylinders to have the same number of blocks regardless of the number of defects.

These two goals are achieved by providing a number of spare sectors on each cylinder. The option of such sparing and the number of spare sectors is selected by the user.

To facilitate the ACB-5500 defect skipping method, the format command is redefined as below:

Command -- Same as ACB-4000

Data -- Byte 0, 00 for format drive and 01 for format cylinder.

-- Byte 1, Number of spare sectors per cylinder, 0 for no spares.

-- Byte 2-3, length of defect lists

-- Byte 4-11, for format drive, first defect descriptor for format cylinder, starting sector number.

-- Byte 12-19, defect descriptor

-- Byte 20-27, defect descriptor

Note, when byte 0 of the format data is 01, the ACB-5500 will format only one cylinder. The first defect descriptor should specify the cylinder number and the starting sector number. To determine the starting sector number of each cylinder, the user should use the READ CAPACITY command. Note, the READ CAPACITY only sends back the last sector address of a cylinder. The user could use this command repeatedly to determine the change of cylinder boundaries, hence, to get the starting sector number of a cylinder.

## Flagging a Defective Sector

Assume sector 450 has become unusable because of a field grown defect. To ensure sector 450 is usable again, the user should do the following:

- a. Save the cylinder 5 by reading sector 392 to 489.
- b. Use the FORMAT CYLINDER command and specify the displacement of sector 450 as defective and sector 392 as the starting sector.
- c. Restore cylinder 5 by writing sector 392 to 489.

Now the sector map of the disk should look like the chart on the next section. Note, one spare sector on cylinder five is used and record 450 is written on the next sector location.

## Spare Sector Overflow

If sector 199 in the above example becomes unusable, there would be no more spare sectors on this cylinder. The user could throw the disk away, or he could format two cylinders to use the spare sector on the next cylinder. After reformat, the disk looks like the following:

|     |     |     |     |       |       |       |     |       |     |       |     |     |
|-----|-----|-----|-----|-------|-------|-------|-----|-------|-----|-------|-----|-----|
| 0   | 1   | 2   | 3   | ..... | 97    | rrr   | rrr |       |     |       |     |     |
| 98  | 99  | xxx | 100 | 101   | ..... | 194   | 195 | rrr   |     |       |     |     |
| 196 | 197 | 198 | xxx | xxx   | 199   | ..... | 253 | xxx   | 254 | ..... | 291 | 292 |
| 293 | 294 | 295 | 296 | ..... | 390   | 391   | rrr |       |     |       |     |     |
| 392 | 393 | 394 | 395 | ..... | 449   | xxx   | 450 | ..... | 489 | rrr   |     |     |

Note, cylinder 4 no longer has sector 294 as the starting sector number. In addition, it has 99 sectors instead of 98. Cylinder 3 has 97 sectors only. When cylinder 3 is used, other than a small performance sacrifice, there is no other damage.

When sector 296 becomes unusable, the user formats cylinder 4 with sector 296 flagged as defective. He uses the following format command:

```
command -- 04 1C 00 00 01 00
data      -- 01 02 00 10
           00 00 04 00 00 00 02 93-- starting
                                           sector number
           00 00 04 00 00 00 0D 83 -- defect
                                           descriptor
```

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The user uses the following process to find the starting sector number of cylinder 4. It is no longer 294 because sector 293 is pushed down from previous cylinder. The READ CAPACITY command is used. When sector number 296 is used for the READ CAPACITY command, the ACB-5500 returns sector 391 as the last sector of the cylinder on which the sector 296 resides. When the user backs his sector number in READ CAPACITY up to sector 292, the ACB-5500 returns 292 as the last sector number of the cylinder. Hence, the starting sector for the next cylinder must be 293.

READ (08 Hex)

READ commands requiring physical seeks will disconnect during the seek process.

WRITE (0A Hex)

WRITE commands requiring physical seeks will disconnect during the seek process.

SEEK (0B Hex)

SEEK commands requiring physical seeks will disconnect during the seek process.

SET THRESHOLD (10 Hex)

| BYTE | BIT                 |    |    |    |              |    |    |    |
|------|---------------------|----|----|----|--------------|----|----|----|
|      | 07                  | 06 | 05 | 04 | 03           | 02 | 01 | 00 |
| 00   | 0                   | 0  | 0  | 0  | 0            | 0  | 0  | 0  |
| 01   | LOGICAL UNIT NUMBER |    |    |    | RESERVED (0) |    |    |    |
| 02   | RESERVED (0)        |    |    |    |              |    |    |    |
| 03   | RESERVED (0)        |    |    |    |              |    |    |    |
| 04   | THRESHOLD           |    |    |    |              |    |    |    |
| 05   | LINK CONTROL        |    |    |    |              |    |    |    |

The seek and data check overflow value can be changed from its default value of 128 by execution of the SET THRESHOLD command. See READ AND RESET USAGE COUNTER for further details.

READ AND RESET USAGE COUNTER (11 Hex)

| BYTE | COMMAND FIELD       |   |   |   |              |   |   |   |
|------|---------------------|---|---|---|--------------|---|---|---|
|      | 0                   | 1 | 2 | 3 | 4            | 5 | 6 | 7 |
| 00   | 0                   | 0 | 0 | 0 | 0            | 0 | 0 | 1 |
| 01   | LOGICAL UNIT NUMBER |   |   |   | RESERVED (0) |   |   |   |
| 02   | RESERVED (0)        |   |   |   |              |   |   |   |
| 03   | RESERVED (0)        |   |   |   |              |   |   |   |
| 04   | RESERVED (0)        |   |   |   |              |   |   |   |
| 05   | LINK CONTROL        |   |   |   |              |   |   |   |

There are five usage counters supported by the ACB-5500:

1. Read usage counter
2. Seek usage counter
3. Uncorrectable data check counter
4. Correctable data check counter
5. Seek check counter

The counter is updated when the corresponding event occurs. For example, the read usage counter is incremented by one whenever one sector is read; the seek usage counter is incremented whenever disk arm motion is initiated.

The seek and read usage counters overflow when they reach 8,388,608. The other counters overflow when they reach 128. When the counter overflows, a check condition will be given to the next host request (code = 2C). The host must then issue a READ AND RESET USAGE COUNTER command to clear the usage counter. Otherwise, each time the counter is incremented, the host will receive another 2C error.

The seek and data check counter overflow value can be changed by a SET THRESHOLD command. The overflow value can be set between 0 and 255.

Data Returned

Bytes 0:2 Read usage counter  
 Bytes 3:5 Seek Usage counter  
 Byte 6 Uncorrectable data check counter  
 Byte 7 Correctable data check counter  
 Byte 8 Seek check counter

INQUIRY (12 Hex)

| BYTE | BIT                       |   |   |   |          |   |   |      |      |
|------|---------------------------|---|---|---|----------|---|---|------|------|
|      | 7                         | 6 | 5 | 4 | 3        | 2 | 1 | 0    |      |
| 00   | 0                         | 0 | 0 | 1 | 0        | 0 | 1 | 0    |      |
| 01   | LOGICAL UNIT NUMBER       |   |   |   | RESERVED |   |   |      |      |
| 02   | RESERVED                  |   |   |   |          |   |   |      |      |
| 03   | RESERVED                  |   |   |   |          |   |   |      |      |
| 04   | NUMBER OF BYTES ALLOCATED |   |   |   |          |   |   |      |      |
| 05   | VENDOR UNIQUE             |   |   |   | RESERVED |   |   | FLAG | LINK |

This command requests that information regarding TARGET parameters be sent to the INITIATOR.

Byte 04 in the CDB of this command will specify the number of bytes that the host has allocated for returned UNIT data. A value of 0 indicates no DATA TRANSFER. This condition shall not be considered as an error. CHECK CONDITION status shall be reported only when the TARGET cannot return the Inquiry Data.

BYTE

|    |  |
|----|--|
| 00 | DEVICE TYPE CODE (00 HEX = DASD)       |
| 01 | DEVICE TYPE QUALIFIER (00 HEX = FIXED) |
| 02 | REVISION LEVEL (01 HEX = STANDARD)     |
| 03 | RESERVED (00 HEX)                      |
| 04 | ADDITIONAL BYTES (00 HEX)              |

The Device Type Qualifier (Byte 01) is defined as follows:

Bit 7 set to 1 shall be Removable media.  
Bit 7 set to 0 shall be Fixed media.  
Bit 6 to 0 are reserved and must be 0.

The Revision Level is 0L (Hex) indicating compliance with the SCSI standard.

WRITE DATA BUFFER (13 Hex)

The buffer length and data transmission length is changed to 2048 bytes.

READ DATA BUFFER (14 Hex)

The buffer length and data transmission length is changed to 2048 bytes.

RESERVE (16 Hex)

| BYTE | BIT                        |   |   |          |   |   |        |      |
|------|----------------------------|---|---|----------|---|---|--------|------|
|      | 7                          | 6 | 5 | 4        | 3 | 2 | 1      | 0    |
| 00   | 0                          | 0 | 0 | 1        | 0 | 1 | 1      | 0    |
| 01   | LOGICAL UNIT NUMBER        |   |   | RESERVED |   |   | EXTENT |      |
| 02   | RESERVATION IDENTIFICATION |   |   |          |   |   |        |      |
| 03   | EXTENT LIST LENGTH (MSB)   |   |   |          |   |   |        |      |
| 04   | EXTENT LIST LENGTH (LSB)   |   |   |          |   |   |        |      |
| 05   | VENDOR UNIQUE              |   |   | RESERVED |   |   | FLAG   | LINK |

This command is used to reserve logical units or extents within units for the use of the Initiator.

Reserve Unit:

If the Extent bit (Bit 0 of Byte 01) is zero, and no extent within the unit is currently reserved by another Initiator, then this command shall cause the unit to be reserved for exclusive use of the Initiator until the reservation is released by a RELEASE UNIT command issued by the same Initiator or by a BUS DEVICE RESET message from any Initiator or a "Hard" RESET condition. It is permissible for an Initiator to reserve a logical unit that is currently reserved for that Initiator. The Reservaton Identification (Byte 02) and the Extent List Length (Bytes 03 through 04) shall be ignored. If the unit, or any extent within the unit are previously reserved, then the unit shall respond by a RESERVATION CONFLICT Status indication.

If any other Initiator then subsequently attempts to perform a READ or WRITE operation on the reserved unit, that command shall be rejected with RESERVATION CONFLICT Status.

## Extent Reservation Option:

The Reservation Identification (Byte 02) provides a means for an Initiator to identify each Extent Reservation. This allows an Initiator in a multi-tasking environment to have multiple reservations outstanding. The Reservation Identification is used in the RELEASE command to specify which reservation is to be released.

Extents within a unit may be reserved, each with a separate Reservation Type. If the reservation cannot be granted because of conflicts with a previous reservation, then a RESERVATION CONFLICT status indication is posted. Reservations are only made active when all extents are free from conflict with active or previously queued reservations.

If the extent bit is one, then:

- (1) The Extent List shall be checked for number of extents in the reservation request. The ACB-5500 supports only one extent. If the Extent List contains more than one extent, then the command shall be rejected with CHECK CONDITION Status and a Sense Key of ILLEGAL REQUEST.
- (2) The Extent List shall be checked for valid extent block addresses. If any address is invalid for this unit, then the command shall be rejected with the CHECK CONDITION Status and a Sense Key of ILLEGAL REQUEST. The Extent List shall be checked for extent overlaps and if overlaps are found, then the command shall be rejected with CHECK CONDITION Status and a Sense Key of ILLEGAL REQUEST.
- (3) If there already is an active unit reservation for the unit, the command shall be rejected with CHECK CONDITION Status and a Sense Key of ILLEGAL REQUEST.
- (4) If the requested reservation does not conflict with any active reservation, then the extent specified shall be reserved until released by a RELEASE command from this Initiator or by a BUS DEVICE RESET message from any Initiator or a "Hard" RESET condition. The occurrence of the last two conditions is indicated by a Sense Key of UNIT ATTENTION on the next operation following the condition.

RESERVE COMMAND  
 EXTENT DESCRIPTOR FORMAT

| BYTE | BIT                         |   |   |   |                      |   |   |   |
|------|-----------------------------|---|---|---|----------------------|---|---|---|
|      | 7                           | 6 | 5 | 4 | 3                    | 2 | 1 | 0 |
| 00   | RESERVED                    |   |   |   | REL ADR RESERV. TYPE |   |   |   |
| 01   | NUMBER OF BLOCKS (MSB)      |   |   |   |                      |   |   |   |
| 02   | NUMBER OF BLOCKS            |   |   |   |                      |   |   |   |
| 03   | NUMBER OF BLOCKS (LSB)      |   |   |   |                      |   |   |   |
| 04   | LOGICAL BLOCK ADDRESS (MSB) |   |   |   |                      |   |   |   |
| 05   | LOGICAL BLOCK ADDRESS       |   |   |   |                      |   |   |   |
| 06   | LOGICAL BLOCK ADDRESS       |   |   |   |                      |   |   |   |
| 07   | LOGICAL BLOCK ADDRESS (LSB) |   |   |   |                      |   |   |   |

The size of the Extent List shall be defined by the Extent List Length parameter. The ACB-5500 requires the length to be 8 or 0. The Extent List shall consist of no more than one descriptor as shown in the above table. The Extent Descriptor defines an extent beginning at the specified Logical Block Address (Bytes 04 through 07) for the specified Number of Blocks (Bytes 01 through 03). If the Number of Blocks is zero, the extent shall begin at the specified Logical Block Address and continue through the last Logical Block Address on the unit.

The Reservation Type field (Bits 1 through 0 of Byte 00) shall determine the type of reservation to be effected for each extent. Four types of reservations are possible as follows:

| Code | Reservation Type |
|------|------------------|
| 10   | Read Exclusive   |
| 01   | Write Exclusive  |
| 11   | Exclusive Access |
| 00   | Read Shared      |

Read Exclusive - While this reservation is active, no other Initiator shall be permitted READ access to the indicated extent. This reservation shall not inhibit WRITE accesses from any Initiator or conflict with a Write Exclusive reservation; however, Read Exclusive, Exclusive Access, and Read Shared reservations which overlap this extent shall conflict with this reservation.

Write Exclusive - While this reservation is active, no other Initiator shall be permitted WRITE access to the extent. This reservation shall not inhibit READ accesses from any Initiator or conflict with a Read Exclusive reservation from any Initiator. This reservation shall conflict with Write Exclusive, Exclusive Access, and Read Shared reservations which overlap this extent.

Exclusive Access - While this reservation is active, no other Initiator shall be permitted any access to the indicated extent. All Reservation Types which overlap this extent shall conflict with this reservation.

Read Shared - While this reservation is active, no WRITE accesses shall be permitted by any Initiator to the indicated extent. This reservation shall not inhibit READ accesses from any Initiator or conflict with a Read Shared reservation. Read Exclusive, Write Exclusive, and Exclusive Access reservations which overlap with this extent shall conflict with this reservation.

If the RELATIVE ADDRESS bit (Bit 2 of Byte 00) is one, the Logical Block Address shall be treated as a two's complement displacement. This displacement shall be added to the Block Address last accessed on the unit to form the Block Address for this extent. This feature is only available when linking commands and requires that a previous command in the linked group has accessed a block of data on the unit; if not, the RESERVE Command shall be rejected with CHECK CONDITION Status and a Sense Key of ILLEGAL REQUEST.

If an Initiator attempts to access (READ or WRITE) a block which has been reserved and that access is prohibited by the reservation, then the command shall not be performed and the operation shall terminate with RESERVATION CONFLICT Status. If any access conflict exists, none of the operation shall be performed. If any extent in a unit is reserved in any way, a FORMAT UNIT Command shall be rejected with RESERVATION CONFLICT Status.

Note that RESERVE commands, whether for a unit or for an extent, are not queued. Host software is responsible for queueing reserve functions, since improper management of reservations can easily create deadlock situations. Only host software can detect and circumvent potential deadlocks. In multi-host systems, deadlock prevention may require an auxiliary communication path or very restrictive programming conventions.

Host software is responsible for monitoring and clearing reservations generated by attached hosts that have failed with reservations outstanding. This may require an auxiliary communications path. The reservations for failing hosts may be cleared using the BUS DEVICE RESET message. Note that non-failing hosts must be aware of and provide permission for execution of a BUS DEVICE RESET since reservations on their behalf will also be destroyed.

RELEASE (17 Hex)

| BYTE | BIT                        |   |   |          |   |   |   |        |      |
|------|----------------------------|---|---|----------|---|---|---|--------|------|
|      | 7                          | 6 | 5 | 4        | 3 | 2 | 1 | 0      |      |
| 00   | 0                          | 0 | 0 | 1        | 0 | 1 | 1 | 1      |      |
| 01   | LOGICAL UNIT NUMBER        |   |   | RESERVED |   |   |   | EXTENT |      |
| 02   | RESERVATION IDENTIFICATION |   |   |          |   |   |   |        |      |
| 03   | RESERVED                   |   |   |          |   |   |   |        |      |
| 04   | RESERVED                   |   |   |          |   |   |   |        |      |
| 05   | VENDOR UNIQUE              |   |   | RESERVED |   |   |   | FLAG   | LINK |

This command is used to release previously Reserved LUNs or previously reserved extents within units.

If the Extent bit (Bit 0 of Byte 01) is zero, this command shall cause the unit to terminate any reservation from the Initiator which is active or queued. If the Extent bit is one, this command shall cause any reservation from the requesting Initiator with a matching Reservation Identification (Byte 02) which is active or queued to be terminated. Other reservations from the requesting Initiator shall remain in effect. It is not an error for an Initiator to attempt to release a reservation which is not currently active or queued.

SEND DIAGNOSTIC (10 Hex)

The second data byte is reserved and must be zero. The qualifier byte function is removed.

### 6.3.2 Class 01 Command Descriptions

The following commands are implemented by the ACB-5500. Only modified ACB-5500 commands are described in detail.

#### Group 1 Command Summary

| OP CODE | COMMAND           | ACB4000 | ACB5500   |
|---------|-------------------|---------|-----------|
| 25      | READ CAPACITY     | X       | UNCHANGED |
| 28      | READ (EXTENDED)   | X       | UNCHANGED |
| 2A      | WRITE (EXTENDED)  | X       | UNCHANGED |
| 2E      | WRITE AND VERIFY  | X       | UNCHANGED |
| 2F      | VERIFY            | X       | UNCHANGED |
| 31      | SEARCH DATA EQUAL | X       | UNCHANGED |
| 33      | SET LIMITS        |         | NEW       |

SET LIMITS (33 Hex)

| BYTE | BIT                         |   |   |   |          |   |        |        |
|------|-----------------------------|---|---|---|----------|---|--------|--------|
|      | 7                           | 6 | 5 | 4 | 3        | 2 | 1      | 0      |
| 00   | 0                           | 0 | 1 | 1 | 0        | 0 | 1      | 1      |
| 01   | LOGICAL UNIT NUMBER         |   |   |   | RESERVED |   | Rd Inh | Wr Inh |
| 02   | LOGICAL BLOCK ADDRESS (MSB) |   |   |   |          |   |        |        |
| 03   | LOGICAL BLOCK ADDRESS       |   |   |   |          |   |        |        |
| 04   | LOGICAL BLOCK ADDRESS       |   |   |   |          |   |        |        |
| 05   | LOGICAL BLOCK ADDRESS (LSB) |   |   |   |          |   |        |        |
| 06   | RESERVED                    |   |   |   |          |   |        |        |
| 07   | NUMBER OF BLOCKS (MSB)      |   |   |   |          |   |        |        |
| 08   | NUMBER OF BLOCKS (LSB)      |   |   |   |          |   |        |        |
| 09   | VENDOR UNIQUE               |   |   |   | RESERVED |   | FLAG   | LINK   |

This command defines the addresses outside of which any following linked commands may not operate. A second SET LIMITS command may not be linked to a chain of commands in which a SET LIMITS command has already been issued. The two low order bits of the Byte 01 define the legal operations within the limits of the specified addresses. Bit 0 indicates WRITE INHIBIT, and Bit 1 indicates READ INHIBIT.

When the Number of Blocks field (Bytes 07 to 08) is zero, the limits shall extend from the Logical Block Address (Bytes 02 to 05) to the last block on the unit.

REQUEST SENSE (03 Hex)

Table 6-10: CLASS 00 ERROR CODES IN SENSE BYTE  
(DRIVE ERRORS)

| CODE | ERROR            |
|------|------------------|
| 00   | NO SENSE         |
| 01   | NO INDEX SIGNAL  |
| 02   | NO SEEK COMPLETE |
| 03   | WRITE FAULT      |
| 04   | DRIVE NOT READY  |
| 06   | NO TRACK 00      |

Table 6-11: CLASS 01 ERROR CODES IN SENSE BYTE  
(TARGET ERRORS)

| CODE  | ERROR                          |
|-------|--------------------------------|
| 10    | I.D. CRC ERROR                 |
| 11    | UNCORRECTABLE DATA ERROR       |
| 12    | I.D. ADDRESS MARK NOT FOUND    |
| 13    | DATA ADDRESS MARK NOT FOUND    |
| 14    | RECORD NOT FOUND               |
| 15    | SEEK ERROR                     |
| 16-17 | NOT ASSIGNED                   |
| 18    | DATA CHECK IN NO RETRY MODE    |
| 19    | ECC ERROR DURING VERIFY        |
| 1A    | INTERLEAVE ERROR               |
| 1B    | NOT ASSIGNED                   |
| 1D    | SELF TEST FAILED               |
| 1E    | DEFECTIVE TRACK (MEDIA ERRORS) |
| 1F    | NOT ASSIGNED                   |

Table 6-12: CLASS 02 ERROR CODES  
(SYSTEM-RELATED ERRORS)

| CODE  | ERROR  |
|-------|--|
| 20    | INVALID COMMAND  |
| 21    | ILLEGAL BLOCK ADDRESS                                  |
| 22    | NOT ASSIGNED   |
| 23    | VOLUME OVERFLOW  |
| 24    | BAD ARGUMENT   |
| 25    | INVALID LOGICAL UNIT NUMBER                            |
| 26-2B | NOT ASSIGNED   |
| 2C    | USAGE/ERROR COUNTER OVERFLOW                           |
| 2D    | INITIATOR DETECTED ERROR<br>(SCSI BUS IN PARITY CHECK) |
| 2E    | SCSI BUS OUT PARITY CHECK                              |
| 2F    | ADAPTER ERROR  |

#### 6.4 Completion Status Byte

Status is always sent at the end of a command or set of listed commands. Intermediate status is sent at the completion of a linked command. Any abnormal condition encountered during command execution causes command termination and ending status.

##### 6.12.1 Status Byte 00

Status Byte 00, bits 6,5, and 0, are Reserved and must be 0.

The meaning of Status Byte 00, bits 4 through 1, shall be as specified below:

| Bits |   |   |   |  |
|------|---|---|---|--|
| 4    | 3 | 2 | 1 |  |
| 0    | 0 | 0 | 1 | CHECK CONDITON. Any error, exception or abnormal condition which causes sense information to be set, shall cause CHECK CONDITION Status. The REQUEST SENSE Command should be issued following CHECK CONDITON Status, to determine the nature of the condition. |

|   |   |   |   | Bits   |  |  |  |  |
|---|---|---|---|--|--|--|--|--|
| 4 | 3 | 2 | 1 |  |  |  |  |  |
| 0 | 0 | 1 | 0 | CONDITION MET. The SEARCH DATA Commands shall send this status whenever a search condition is satisfied. This status does not break a chain of linked commands. The address of the block which satisfies the search may be determined with a REQUEST SENSE Command.  |  |  |  |  |
| 0 | 1 | 0 | 0 | BUSY. The unit is busy. This status shall be sent whenever a Target is unable to accept a command from an Initiator. The most common instance of this condition arises when an Initiator that does not allow reconnection requests an operation from a busy device.  |  |  |  |  |
| 1 | 0 | 0 | 0 | INTERMEDIATE STATUS SENT. This status shall be sent for every command in a series of Linked Commands (except the last command), unless an error, exception or abnormal condition causes CHECK CONDITION or RESERVATION CONFLICT to be set. If this status is not sent, the chain of linked commands is broken; no further commands in the series are executed. |  |  |  |  |
| 1 | 1 | 0 | 0 | RESERVATION CONFLICT. This status shall be sent whenever a READ, WRITE, SEARCH, COPY, RESERVE, or FORMAT UNIT Command attempts to access a unit or an extent within a unit which is reserved for that type of access by another Initiator.   |  |  |  |  |
| 0 | 0 | 0 | 0 | GOOD STATUS. This status indicates that the Target successfully completed the command.   |  |  |  |  |

## APPENDIX A

The information in this appendix is independent of which controller is used, with the following exceptions:

- 1) The Host Adapter must not indicate it supports disconnection unless it supports the SCSI specified disconnection sequence and message structure.
- 2) If the Host Adapter does not support arbitration, only one host adapter and one controller may be attached to the SCSI if disconnection is allowed.
- 3) If multiple Host Adapters are attached to the SCSI bus, all must support arbitration.
- 4) The ACB-5500 jumper configuration is different from the ACB-4000 jumper configuration.

### JUMPER ASSIGNMENT - ACB-5500

|      |                         |
|------|-------------------------|
| A-B  | RESERVED                |
| C-D  | RESERVED                |
| E-F  | RESERVED                |
| G-H  | RESERVED                |
| J-K  | DMA SPEED CONTROL       |
| DIAG | DIAGNOSTIC MODE BIT     |
| PAR  | ENABLE PARITY BIT       |
| A4   | CONTROLLER ADDRESS BITS |
| A2   | CONTROLLER ADDRESS BITS |
| A1   | CONTROLLER ADDRESS BITS |

Write precompensation is provided from format parameters and is not a jumper option on the ACB-5500.