adaptec, inc.

ACB-4000 Series User's Manual
5-¼" Winchester Disk Controller

ARE INSTALLATION

ODUCTION

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RONMENTAL REQUIREMENTS

000 Series Controllers will perform properly over the range of conditions:

	Operating	Storage
	o o o o	o o o o
re (F/C)	32/0 to 131/55	-40/-40 to 167/75
	10% to 95%	10% to 95%
feet	Sea level to 10,000	Sea level to 20,000
rs	20,000 POH @ 55° C	

CKING

ier is responsible for damage incurred during shipment. f damage, have the carrier note the damage on both the receipt and the freight bill, then notify your freight epresentative so that the necessary insurance claims can ated.

ening the shipping container, use the packing slip to eceipt of the individual items listed on the slip. he shipping container and packing material for possible use should return of the equipment to the factory be y.

4000A AND ACB-4070, LIKE ALL ELECTRONIC EQUIPMENT, ARE SENSITIVE. PLEASE TAKE THE PROPER PRECAUTIONS WHEN G THE BOARD. KEEP THE BOARD IN ITS CONDUCTIVE WRAPPING IS CONFIGURED AND READY TO BE INSTALLED IN YOUR SYSTEM.

RD LAYOUT

4000A is shown in Figure 3-1. The ACB-4070 is shown in 3-2. These figures show the location of the firmware, ponents, terminators, jumpers and connectors.

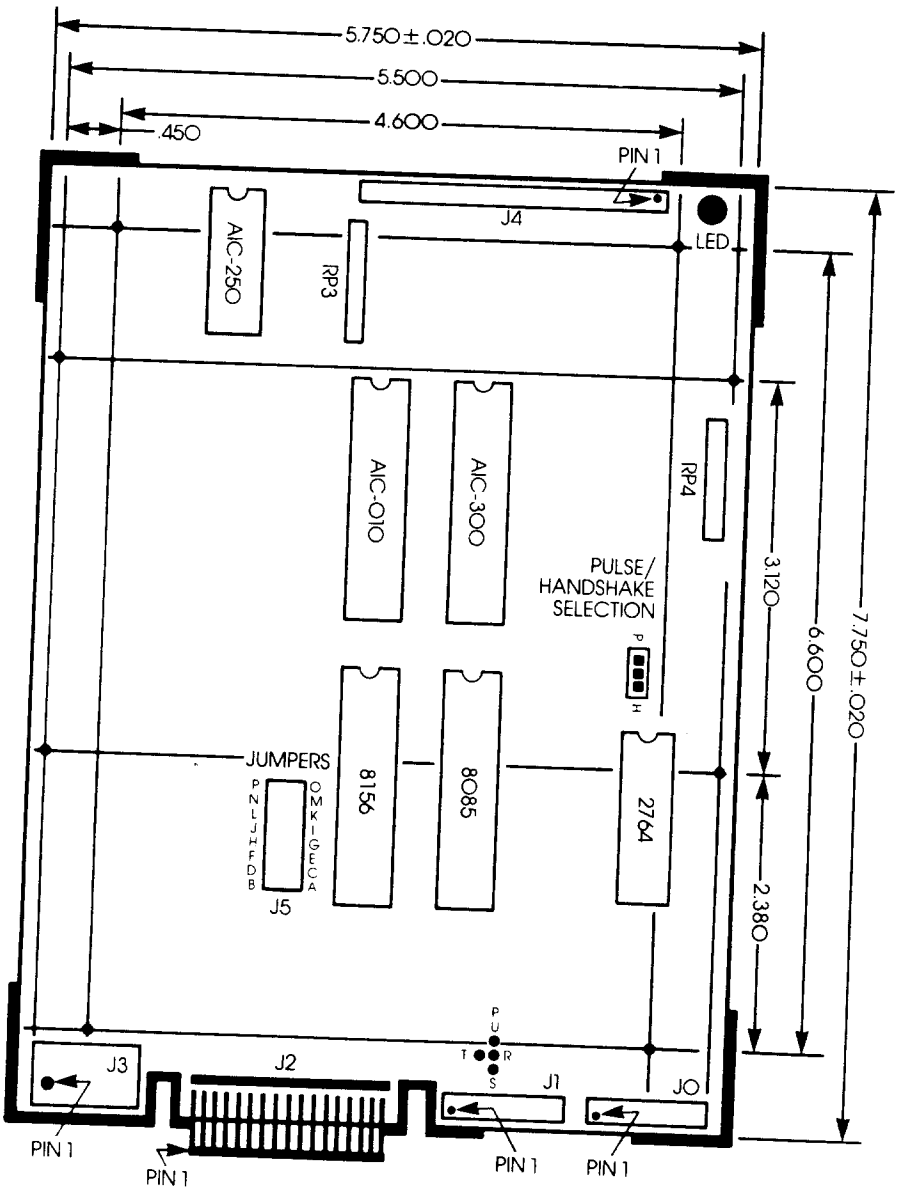


FIGURE 3-1. ACB-4000A BOARD LAYOUT

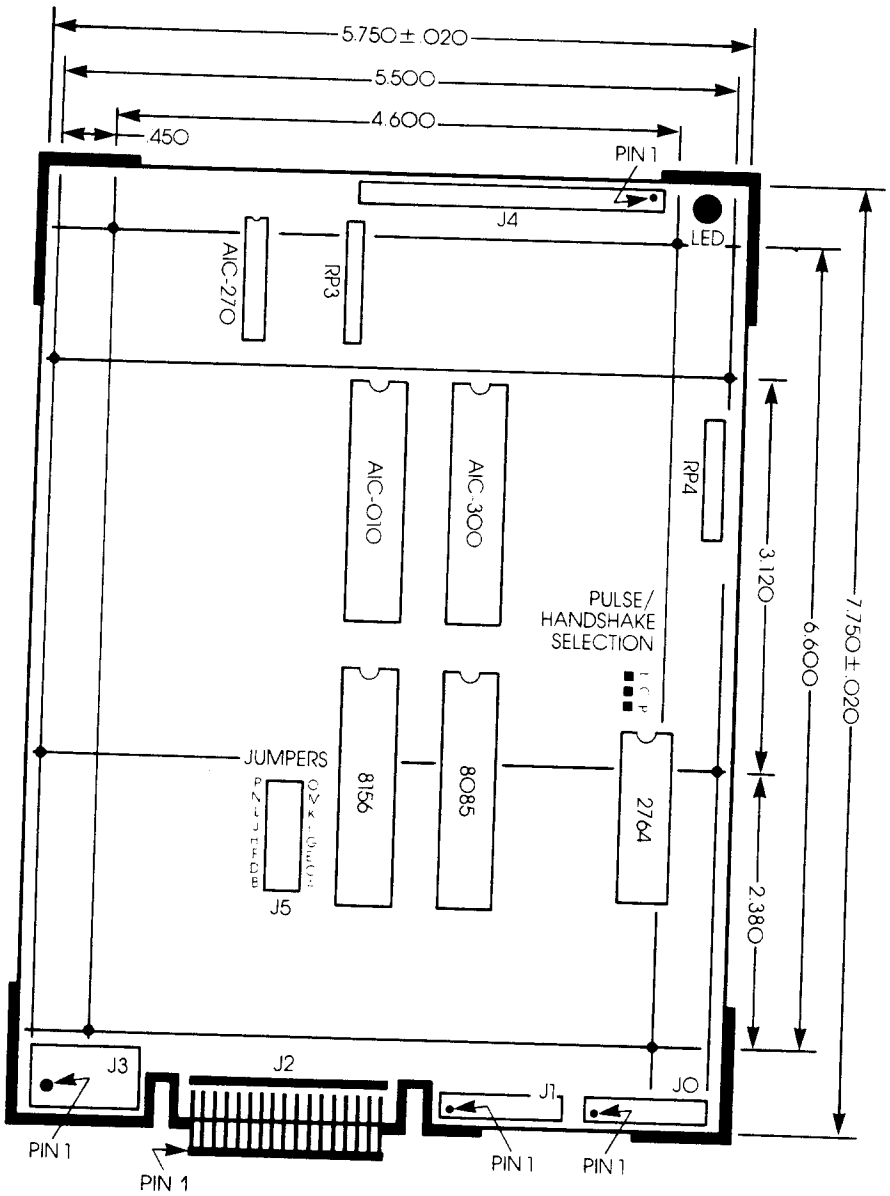


FIGURE 3-2. ACB-4070 BOARD LAYOUT

3.5 INTEGRATION OF CONTROLLER AND DRIVE

To install the Adaptec ACB-4000A or ACB-4070 board into your system you must first configure the drive(s), set the controller jumpers and connect the drive cables properly. This section describes all the necessary steps needed to successfully install this hardware.

In order to configure the drives, you need the Disk Drive OEM Manual that was supplied with your drive. (If you do not have this manual call your drive vendor for assistance.) This manual is required to obtain the drive characteristics for your particular drive.

3.5.1 DRIVE SELECTION AND TERMINATION

The drive changeable parameters are the drive selection switches (or jumpers) and the drive termination. These parameters allow a drive to be selected as drive 0, 1, 2 or 3. This is accomplished by changing the drive address selection switches or jumpers.

NOTE:
SOME DRIVE MANUFACTURERS HAVE DESIGNATED THE DRIVE ADDRESSES TO BE 1,2,3,4 INSTEAD OF 0,1,2,3. DO NOT SET THE DRIVE AS A RADIAL SELECTED DRIVE. RADIAL SELECTION WILL SET ALL DRIVE OUTPUT SIGNALS TO BE ACTIVE, EVEN IF THE DRIVE IS NOT SELECTED. IN THIS CASE, THE DRIVE LED WILL BE ON AT ALL TIMES.

Use the two lowest drive addresses available as drive "0" and drive "1" to be seen by the controller.

Before the drives can be cabled to the controller the drive cable terminator must be properly set. The terminator is used to reduce signal "ringing" in the cables. The terminator, as its name implies, must be at the end of each cable in order to have the controller and drive communicate properly. The controller has a permanent terminator built-in. The disk drives, since they can be connected in a daisy chain configuration have a removable terminator. This is usually a 16-pin DIP resistor package. The last physical drive in the chain must have its terminator installed (see Figures 3-3 and 3-4).

ple 1: When one drive and one controller are used, both be terminated.

FIGURE 3-3. ONE DRIVE, ONE CONTROLLER TERMINATION EXAMPLE

ample 2: When two drives and one controller are used, only he last one in the chain is terminated.

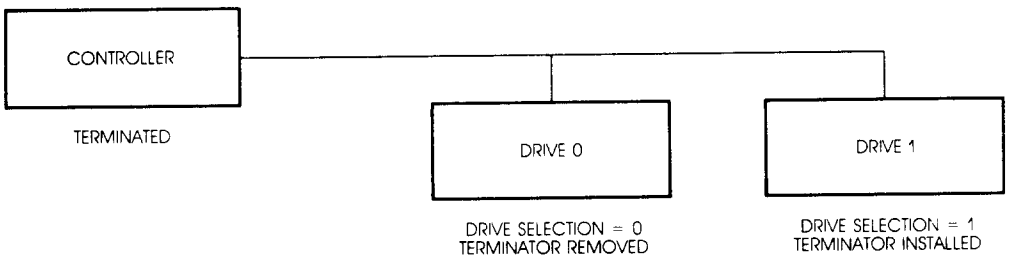


FIGURE 3-4. TWO DRIVES, ONE CONTROLLER TERMINATION EXAMPLE

Now select the proper drive addresses and remove or install the required terminators for your configuration.

3.5.2 CONTROLLER JUMPER SELECTION

The controller changeable parameters are defined as the variables that can be changed on the controller to accommodate the different drive characteristics. These parameters can easily be changed by use of the MODE SELECT command and by the use of the jumpers defined in Table 3-1.

TABLE 3-1. DEFINITION OF JUMPERS

Jumper	Definition	Installed	Removed
A-B	LSB of Controller's SCSI Address	bit = 1	bit = Ø
C-D	Controller's SCSI Address	bit = 1	bit = Ø
E-F	MSB of Controller's SCSI Address	bit = 1	bit = Ø
G-H	DMA Transfer Rate	SYSCLOCK/4	DATACLOCK/2
I-J	Extended Command Set (See Appendix D)	Enabled	Disabled
K-L	Not Used		
M-N	Support of Syquest 312, DMA 360 and drives that drop SEEK COMPLETE signal during head switching	Enabled	Disabled
O-P	Self Diagnostics	Enabled	Disabled
R-PU *	Write Precompensation turned off for both drives	Enabled	Disabled
R-S *	Write Precomp starts at same cylinder as reduced write current for both drives	Enabled	Disabled
R-T *	Write Precomp is applied to all tracks for both drives	Enabled	Disabled

NOTE: * denotes that these jumpers are for the ACB-4000A only, they are not present on the ACB-4070.

mpers are divided into five categories: SCSI address, host r options, drive options, write precompensation options and iagnostics.

rs A-B, C-D and E-F are used to select the controller's SCSI e ID or address. They determine how the controller will be ified when installed in the SCSI bus.

er G-H is used to select two DMA transfer rates on the SCSI When removed, the controller will transfer data at the mum rate allowed by the controller, equal to DATACLOCK/2. host adapters cannot support this data rate. When this er is installed, the data transfer rate is reduced to run at te of SYSCLOCK/4 on single-sector transfers. This is one-half he controller's maximum DMA speed. Multisector transfers are ys made at the maximum rate of DATACLOCK/2, with or without jumper.

per I-J is used to enable the extended command set. This is d only when replacing SASI-type controllers. See Appendix D details.

per M-N is installed to support drives that drop the SEEK PLETE line on the ST506/412 interface during head switches. t-sectored removable media drives that have wedge servo ormation of all surfaces require this jumper to be installed. uest 312 10 MB and DMA 360 10 MB drives require this jumper to installed. The installation of this jumper does not affect eration of drives that do not drop SEEK COMPLETE between head itches.

mpers R-PU, R-S and R-T are used to select write ecompensation for both drives. Only one of these options can be ed at a time. This hardware jumper overrides any software election made in the MODE SELECT command (see Section 5). The rite precompensation used is 12ns. The ACB-4070 controller does ot have these jumpers since 2,7 RLL encoding does not use write precompensation. Please see Figure 3-1 for location of these umpers.

OTE:
ON THE ACB-4000A, THESE JUMPERS ARE ORIENTED DIFFERENTLY THAN ON THE ACB-4000.

Jumper O-P is used to enable the ACB-4000 Series Controllers' Self Diagnostics. These diagnostics test the internal circuitry of the controller and can be used for incoming inspection of boards and test the internal circuitry of the controller. See Section 6 for operation and associated error codes.

Configure the jumpers at this time to meet your drive and system requirements.

3.5.3 CONTROLLER AND DRIVE CABLING

Now that the drive and controller are configured, they can be connected together. The controller has three drive cable connectors J0, J1 ,and J2. These are described in Table 3-2.

TABLE 3-2. CONTROLLER TO ST506/412 CONNECTOR DEFINITIONS

Connector	Signals	Cable
J0	Data	20-pin flat ribbon cable Connected to drive 0
J1	Data	20-pin flat ribbon cable Connected to drive 1
J2	Control	34-pin flat ribbon cable Connected to both drives 0 and 1

Connector	Recommended Plug	Maximum Length
J0	3M Part # 3421	20 feet (6 meters)
J1	3M Part # 3421	20 feet (6 meters)
J2	3M Part # 3414	20 feet (6 meters)

The connector locations and pin orientation for the ACB-4000A connectors are shown in Figure 3-1, and for the ACB-4070 in Figure 3-2.

NOTE:
PIN 1 OF J0, J1 AND J2 IS LOCATED ON THE SIDE CLOSEST TO THE POWER CONNECTOR.

Connect the cables as shown in Figure 3-5.

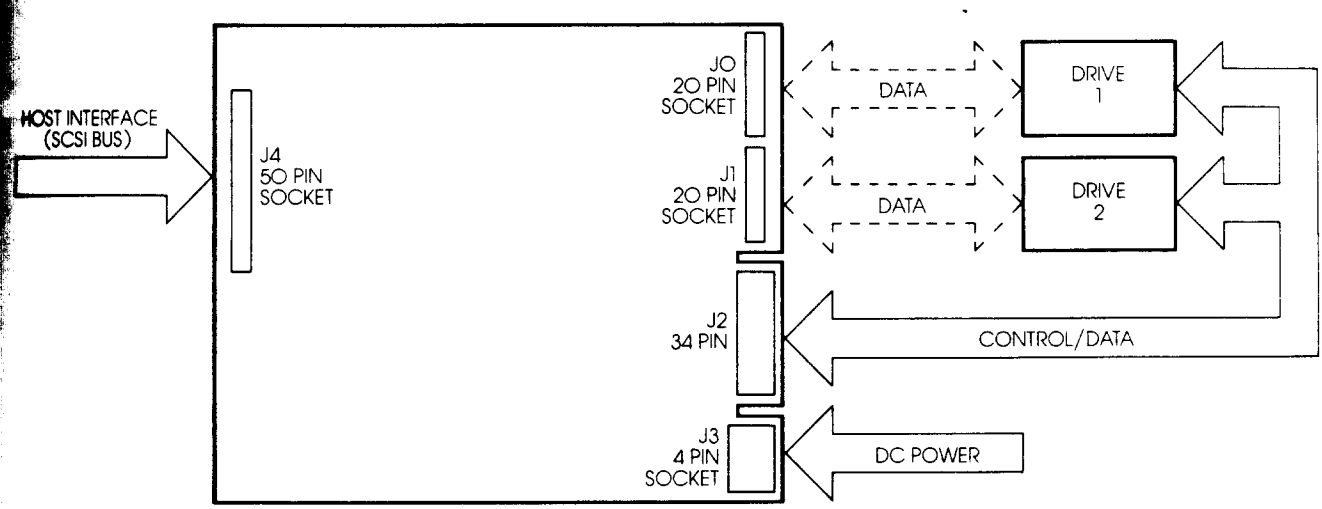


FIGURE 3-5. CONTROLLER CABLING

3.5.4 CONTROLLER POWER REQUIREMENTS AND GROUNDING

The power requirements for the ACB-4000 Series Controllers are shown in Table 3-3.

TABLE 3-3. POWER REQUIREMENTS

Voltage (Volts)	Tolerance	Current (Max. Amps)	Ripple (Volts, RMS)
+5 VDC	+/- 5%	1.5 A	150 mV
+12 VDC	+/- 10%	300 mA	150 mV

The power is applied through the four-pin connector J3. The recommended mating connector is AMP Part # 1-480424-0. Connector J3 pin assignments are shown in Figure 3-6.

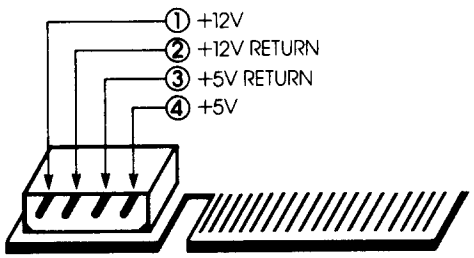


FIGURE 3-6. POWER CONNECTOR J3

000 Series Controller and attached Disk Drives should be using a Single-Point Grounding Scheme. This scheme all grounds from controller, drives, plus all other omponents within the cabinet to one point that is then to the chassis ground. See Figure 3-7.

R GROUNDING IS NOT FOLLOWED, RANDOM FORMAT, WRITE AND ORS MAY OCCUR.

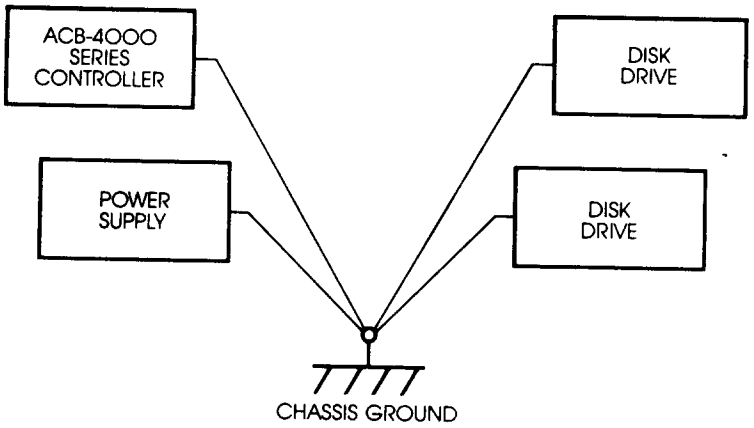


FIGURE 3-7. SINGLE-POINT GROUNDING SCHEME

INTEGRATION OF CONTROLLER AND HOST ADAPTER

that the controller and drive have been configured, the troller must now be attached to the SCSI host adapter. The essful integration of controller and host adapter must take account controller addressing, termination, cabling and the ct implementation of SCSI used by the host adapter and troller. This section addresses these topics.

E:
A SASI-TYPE HOST ADAPTER IS USED, OR IF YOU ARE REPLACING A I-TYPE CONTROLLER WITH THE ACB-4000 SERIES CONTROLLERS, PLEASE APPENDIX D FOR TIMING AND SOFTWARE CONSIDERATIONS.

6.1 ACB-4000 SERIES SCSI HARDWARE IMPLEMENTATION

e ACB-4000 Series Controllers support the proposed ANSI tandard X3T9.2/82-2 Revision 14, Small Computer System Interface SCSI).

The ACB-4000 Series supports 17 active lines and 25 ground lines in a 50-pin flat cable. All odd number pins are ground. This is known as an unbalanced SCSI bus. The bus has open-collector drivers and is terminated at both ends by a 220 ohm pull-up resistor to +5V and a 330 ohm pull-down resistor to ground. The bus is low-active, thus a grounded line is considered active or asserted.

Eight of the lines are the byte-wide bidirectional data bus. The ACB-4000 Series supports DB7-0 data lines and does not support the data parity line. The data parity line is not terminated at the controller.

Nine of the lines are the control and status lines. The ACB-4000 Series supports all nine lines including BSY, SEL, C/D, I/O, MSG, REQ, ACK, ATN AND RST.

The RST, reset line, is a "hard" reset and causes the controller to abort its current operation and to get off of the bus. Any outstanding operation is aborted. The SCSI specification has a minimum RST pulse width of 25 microseconds. The ACB-4000 Series allows a minimum RST pulsewidth of 50 nanoseconds to accommodate older SASI-type host adapters.

3.6.2 SASI AND SCSI HOST ADAPTER CONSIDERATIONS

When using a SASI or SCSI host adapter the following areas must be considered: SCSI handshake timing, transfer rate of controller, use of ATN line, and I/O driver design termination. Appendices A, B, C, and D address these topics.

3.6.3 CONTROLLER ADDRESSING AND TERMINATION

In order for the ACB-4000 Series Controllers to operate properly in a system environment, the controller must be properly selected and terminated. The controller can be jumpered to be selected as SCSI device ID or address 0 through 7. See Table 3-1 for the definition of these jumpers and install any that are needed.

In a single controller system use the controller SCSI ID = 0 which requires no jumpers for locations A-B, C-D and E-F on the controller.

The SCSI bus is a daisy-chained bus between host adapter and I/O controllers. In order to reduce signal ringing, the two ends of the bus must be terminated. This termination consists of a 220-ohm resistor to +5 Volts and a 330-ohm resistor to ground for each signal line. Check your host adapter to see if it is terminated. The ACB-4000 Series Controllers have socketed terminator packs located at RP3 and RP4 for this termination as noted in Figures 3-1 and 3-2.

troller system both must be terminated, i.e. RP3 be installed. In a multiple I/O controller system controller must be terminated, i.e. RP3 and RP4 lled only if the ACB-4000 Series Controller is the e chain.

LLER AND HOST ADAPTER CABLING

e controller and host adapter are addressed and roperly, they can be cabled together.

er 50-pin connector J4 is the SCSI bus connector. A ribbon cable with a maximum length of 20 feet (6 required. A 3M Part #3425-3000 cable connector is .

UP OPERATION

ve is correctly formatted, the controller will seek the he last cylinder and read the largest block address The parameter information and largest block address are the ACB-4000 Series Controller.

last block address has been read, the controller will drive back to Track 0, stopping several times in 'zones' way back to read the defect count at that point. This count is also saved in the controller to allow the ler to better predict the location of the block on the

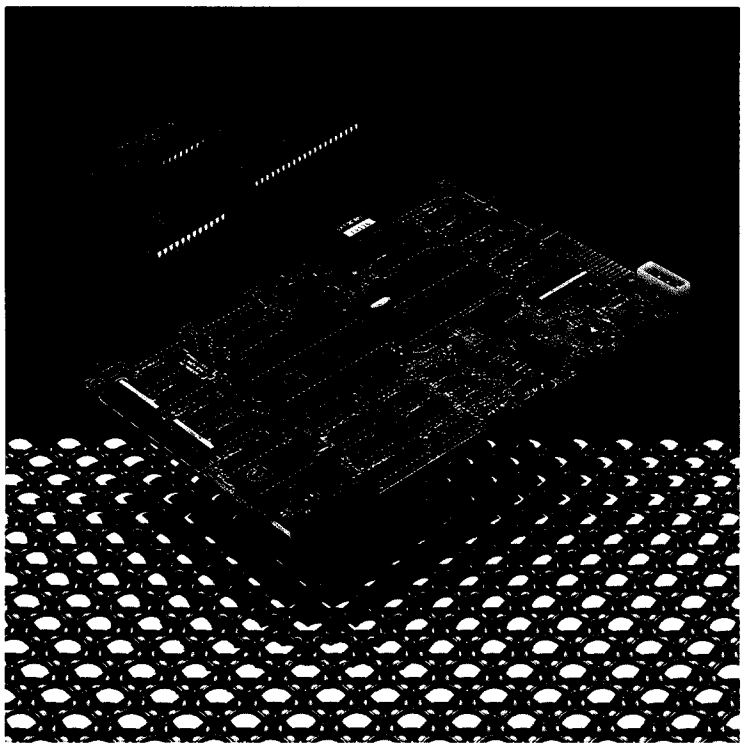
ition to the drive seeks and reads, the Adaptec ACB-4000 Controllers do a series of self-diagnostics after power- Immediate selection of the disk and movement of the heads g this period is a sign of properly functioning c ACB-4000 Series Controllers.

power is supplied to the system, the controller will enter wer-up mode and wait for a minimum of 18 seconds for the to become ready. During the 18-second power-on sequence, controller is checking for drive 0 and drive 1 to become y (nine seconds/drive). If the host senses a command uiring access to a drive before it has become ready (and ore 18 seconds have elapsed) the controller will accept the mand and continue to check for a ready status. Once the ve comes ready, the controller will then execute the mand; if 18 seconds elapse and the drive does not come ready, DRIVE NOT READY (04 hex) error will result. The controller ll then check for a ready status on the next command requiring cess to that drive.

Once a drive comes ready, the controller will recalibrate the head to track Ø if needed. If the drive started at track Ø, the controller will step the head off of track Ø to confirm that the drive can seek and that the track Ø signal was valid. With the drive's ability to seek confirmed, the controller then seeks back to track Ø. The drive actuator (if it can be seen) appears to make a short 'blip.'

The controller then attempts to read from track Ø parameter information which is written during formatting. If the drive is unformatted or had been formatted by another vendors controller, the parameter information is not present so the controller then sets a bit in its memory called 'blown format' to warn the user that the drive is unusable. If the drive format is blown, the reset sequence is stopped and the controller is ready for a command. The drive must be formatted to allow a READ or WRITE access to disk data.

NOTE:
IF THE CONTROLLER DOES NOT OPERATE AS DESCRIBED, PLEASE SEE SECTION 6 FOR TROUBLESHOOTING PROCEDURES.



Adaptec ACB-4000 Winchester controller products are intelligent, high performance/low cost devices which utilize proprietary LSI chips and a commercially available MOS microprocessor. These products are designed specifically for the OEM and system integrator markets for use in cost sensitive, high performance Winchester disk drive applications.

These boards are among the easiest and most efficient controllers to interface with your system because Adaptec controller products use the industry standard SASI/ANSI SCSI bidirectional bus interface, and its associated high level command set.

Non-interleaved operation is standard on all ACB-4000's, making possible a minimum of twice the throughput of competitive controllers. A dual-ported FIFO buffer eliminates data overruns and controls non-interleaved operation. Programmable interleaving is provided for those who desire this feature.

After formatting, a "perfect" disk is presented to the system. Long seeks to alternate tracks are eliminated and the effective data capacity of the drive is increased since disk media defects are skipped at the sector level. Instead of skipping an entire track and subsequently seeking to a spare track, Adaptec controllers simply skip a bad sector and allocate its logical address to the next good one.

Error detection and correction is provided by a 32 bit ECC designed for 5.25" Winchester disk drives. Error correction is transparent to the user.

Device independent host software is now possible with Adaptec controllers. All physical characteristics of the disk drive (number of heads, cylinders, bytes per sector, etc.) are stored on the disk during formatting. The ACB-4000 reads this data when powered on and configures itself to support the attached drives.

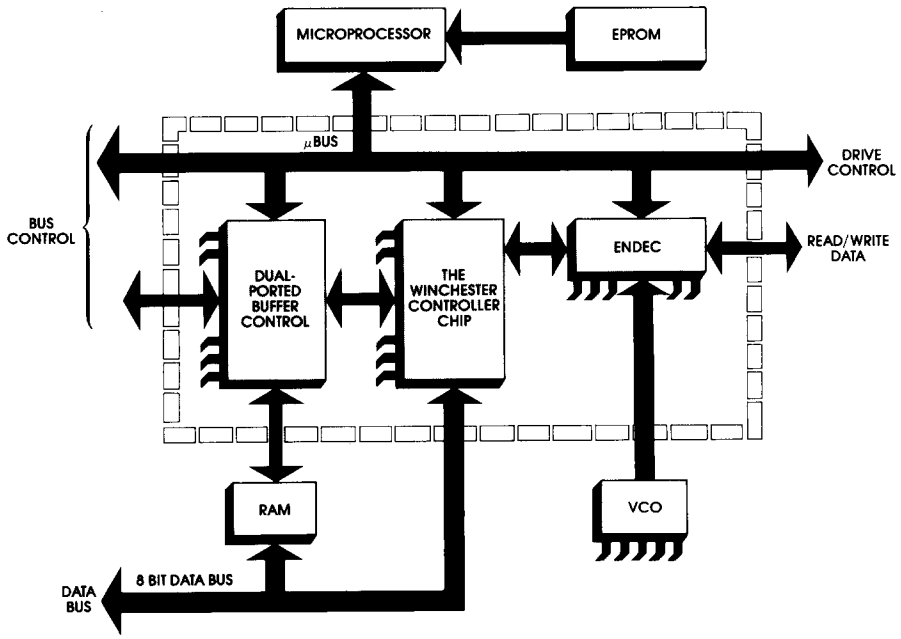
This high performance feature set is made possible through the use of proprietary LSI devices designed and manufactured by Adaptec. These chips are used exclusively in the high speed data path, leaving low speed functions to microprocessor control. The Encode/Decode functions, along with write precompensation, delay lines, and address mark handling are combined in one device, the AIC-250. The resulting NRZ data is fed to the controller chip for deserializing and ECC checking and error correction. Disk data format control is also provided by this part. High speed buffer control is also accomplished by a custom device, the AIC-300.

Adaptec controllers are the best you can make... or buy. To further lower your system cost, Adaptec licenses manufacturing rights to the ACB-4000. Adaptec also provides complete manufacturing data and controller software. Add the ACS-4000 Chip Set and off the shelf components to complete a very low cost controller.

adaptec, inc.

Features

- **Complete Device Independence**
  One software driver works with all "ST-506" disk sizes
- **Industry standard host interface (SASI/SCSI; ANSI X3T9.2)**
  Over 150,000 SASI Bus Interfaces Delivered
- **Drive compatibility**
  Seagate Technology ST-500 Series and Compatible Drives (Buffered seek)
- **Ease of use**
  One Pass Rapid Formatting
  Logical Block Addressing
  Variable Block Size (256, 512 or 1024)
  Multiple Block Data Transfer (up to 64K blocks)
  Implied Seek
- **Versatility**
  Multiple Controllers/Channel
  Multiple Hosts/Channel
  Five Megabits/Second Disk Transfer Rate
- **High Performance**
  Read/Write Without Interleaving
  Dual-Ported FIFO Buffer
  Fully Transparent Defect Skipping at the Sector Level
  Error Detection/Correction (32-bit ECC)
  High Speed Data Search
  16 Head support
  High Speed Seek Pulses
- **Host Bus Signals**
  I/O (Input/Output) Data Direction
  C/D (Command/Data) Data type
  REQ (Request) Data or command available
  BSY (Busy) Controller Busy
  MSG (Message) Controller/Host Adapter Comm.
  ACK (Acknowledge) Data or Command received
  RST (Reset) Reset all Controllers/Host Adapters
  SEL (Select) Selects or Reselects SCSI Device
  ATN (Attention) Message Request



ACB 4000 SERIES
SIMPLIFIED BLOCK DIAGRAM
SASI (ANSI SCSI)
WINCHESTER DISK CONTROLLER

Controller Commands

READ
SEEK
RECEIVE DIAGNOSTIC
TEST UNIT READY
FORMAT UNIT
WRITE
SEND DIAGNOSTIC
VERIFY
REZERO UNIT
MODE SELECT
READ CAPACITY
SEARCH DATA EQUAL
REQUEST SENSE
WRITE AND VERIFY
MODE SENSE
TRANSLATE

Board Physical Dimensions

Width 5.75 inches
Length 7.75 inches
Height .5 inches
Weight 1 lb (shipping)

Environmental

Operating

Temperature 0°C (32°F) to 55°C (131°F)
Humidity 10% to 95% Non-condensing

Storage

Temperature -40°C (-40°F) to 75°C (167°F)
Humidity 10% to 95% Non-condensing

Power Requirements

+5VDC @ 1.5A (Max)
+12VDC @ 300 mA (Max)

adaptec, inc. 580 Cottonwood Drive, Milpitas, CA 95035 Telephone (408) 946-8600

AP100002-001 9/83 15M

DWARE INSTALLATION

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ity	10% to 95%	10% to 95%
tude, feet	Sea level to 10,000	Sea level to 20,000
, Hours	20,000 POH @ 55° C	

UNPACKING

carrier is responsible for damage incurred during shipment. ase of damage, have the carrier note the damage on both the ivery receipt and the freight bill, then notify your freight pany representative so that the necessary insurance claims can initiated.

er opening the shipping container, use the packing slip to ify receipt of the individual items listed on the slip. ain the shipping container and packing material for possible ter reuse should return of the equipment to the factory be cessary.

TE:
E ACB-4000A AND ACB-4070, LIKE ALL ELECTRONIC EQUIPMENT, ARE ATIC SENSITIVE. PLEASE TAKE THE PROPER PRECAUTIONS WHEN NDLING THE BOARD. KEEP THE BOARD IN ITS CONDUCTIVE WRAPPING TIL IT IS CONFIGURED AND READY TO BE INSTALLED IN YOUR SYSTEM.

3.4 BOARD LAYOUT

The ACB-4000A is shown in Figure 3-1. The ACB-4070 is shown in Figure 3-2. These figures show the location of the firmware, key components, terminators, jumpers and connectors.