THE CORVUS SERVICE MANUAL

H-Series Drives

CORVUS SYSTEMS

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CORVUS SYSTEMS
H-SERIES 5.25-INCH
WINCHESTER DISK DRIVE
SERVICE MANUAL

COVERING
MODEL 6, MODEL 11, MODEL 20

This document contains three types of notations. These are, in increasing order of importance, *NOTE*, **CAUTION**, and ***WARNING***. The *NOTE* indicates some action to be taken to speed or simplify a procedure. The **CAUTION** indicates that potential damage to the equipment or user data exists, and care should be taken to avoid this. The ***WARNING*** indicates that potential harm or injury to the service technician or operator exists, and extreme care should be taken to avoid these.

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SPECIFICATIONS

SPECIFICATIONS

Operational Specifications	**MODEL 6**	**MODEL 11**	**MODEL 20**
Disks per Drive	1	2	3
Disk Diameter (in/mm)	5.25/133	5.25/133	5.25/133
Data Surfaces per Drive	2	4	6
Heads per Surface	1	1	1
Data Heads	2	4	6
Number of Data Cylinders/Drive (including all spare tracks)	306	306	306
Sectors per Track	20	20	20
Track Density (TPI)	303	303	303
Bytes per Sector (Formatted)	512	512	512
Bytes per Track (Formatted)	10,240	10,240	10,240
Bytes per Drive (Formatted)	6.27MB	12.53MB	18.80MB
Bit Density, maximum (BPI)	9,706	9,706	9,706
Average Latency (ms)	8.3	8.35	8.3
Average Access Time (ms)	49	49	49
Maximum Access Time (ms)	99	99	99
Maximum Access Time, single-track	3	3	3
Data Transfer Rate (Kb/s)	625	625	625
Recording Format	MFM	MFM	MFM
Rotational Speed (RPM)	3,600	3,600	3,600
Start Time (s)	20	20	20
Stop Time (s)	15	15	15

Physical Dimensions	
Height (in/cm)	5.75 / 14.6
Length (in/cm)	15.0 / 38.1
Width (in/cm)	12.0 / 30.5
Weight (lbs/kgs)	

Environmental Requirements	
Operating Temperature (F/C)	39° to 122°/4° to 50°
Non-Operating Temperature (F/C)	-40° to 140°/-40° to 60°
Operating Relative Humidity (%)	8 to 80
Non-Operating Relative Humidity (%)	8 to 80
Operating altitude (ft)	-1,000 to +10,000
Non-Operating altitude (ft)	-1,000 to +50,000
Operating Vibration (g)	0.1 (5 cps linear increase to 100 cps)
Non-Operating Vibration (g)	1.0 (2 cps linear increase to 100 cps)
Non-Operating Shock (g)	5.0 for 5ms duration

Power Requirements

Line Voltage, Domestic (VAC)	100-120, 48Hz-62Hz, Single-Phase
Line Voltage, Foreign (VAC)	220-240, 48Hz-62Hz, Single-Phase
Power Consumption (Watts)	125
Line Fuse (Amperes)	
for 100V-120V	2.0 slow-blow
for 220V-240V	1.0 slow-blow

Reliability

Mean Time Between Failures (MTBF)	10,000+ operational hrs., within above requirements
Maximum Repair Time	Not more than 0.5 hrs.

CHAPTER 1
GENERAL DESCRIPTION

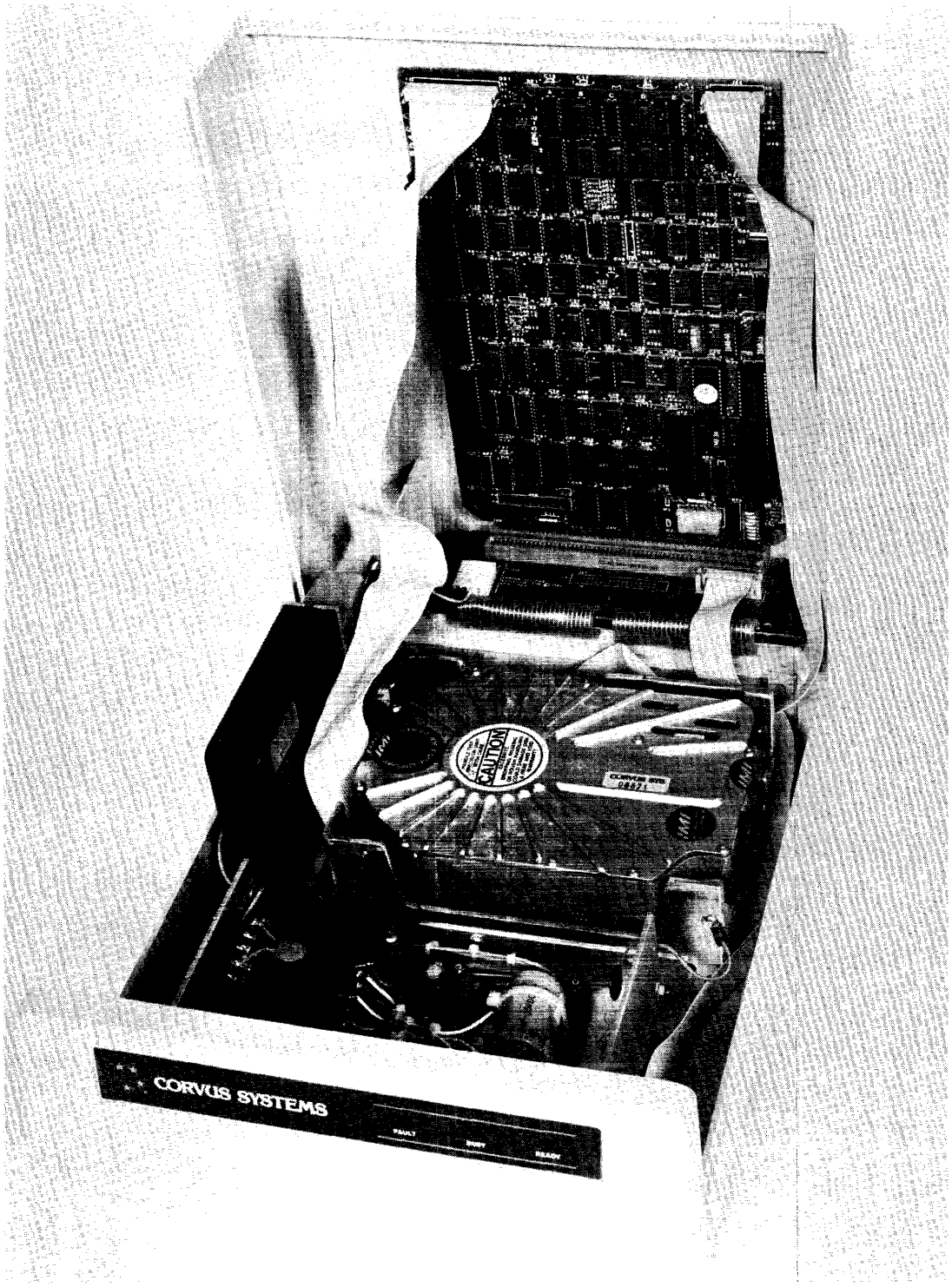

Figure 1. H-Series Drive

CHAPTER 1
GENERAL DESCRIPTION

1.1 Scope of Chapter

This chapter outlines the purpose of the Corvus Systems ™ H-Series™ Model 6, Model 11 and Model 20 disk drives. A Brief description and layout is include, as is a definition of Winchester technology.

1.2 Introduction

This document contains instructions for maintenance and repair of the Corvus Systems H-Series, 5.25-inch disk drive. Repair procedures for A-series (8-inch, 11-megabyte Rev A) drives and B-series (8-inch, 11- and 20-megabyte Rev B, and all non-H-Series, 5.25-inch, 6-megabyte) drives as are networks and other Corvus equipment. Corvus(tm) Level I Dealer Service is on a modular replacement basis, and this manual is written to address this policy.

The H-Series drives are manufactured in three capacities: 6-megabytes (Model 6), 12-megabytes (Model 11), and 18-megabytes (Model 20). These drives all use the same grey high-impact foam-injection plastic cabinet. This is the same drive enclosure used by several of the B-series, 5.25-inch, 6-megabyte drives. Checking the serial number will identify the type of drive to be serviced. Instructions for troubleshooting and repair for all H-Series drives are detailed in this document.

Also included in this manual is documentation on the Dealer Service Diagnostic Utilities supplied to each Corvus Servicing dealer. These utilities provide for burn-in/reliability testing, adjustment, and troubleshooting of all Corvus disk drives. The initialization and diagnostic utilities for the H-Series drives are unique to the H-Series, and contain software specific to these drive models. Use the appropriate A-, B- and H-Series software only for the proper drives.

Installation and operation of the disk drive are not covered in detail in this manual. For instructions in installation and operation, see the Corvus "Disk Systems Installation Guide" and Corvus "Disk Systems User Guide."

1.3 Purpose of Equipment

The Corvus disk drive is a high-speed, intelligent mass-storage peripheral disk device designed to provide the host microcomputer with storage and retrival of digital information instantly at the request of the host system. The Corvus disk system consists of the 5.25-inch disk mechansim, a Z-80™ intelligent controller and power supply, and may be ordered with a host interface, 34-pin interface flatcable and Corvus Utility diskettes.

1.4 Model Identification

The three Corvus H-Series disk drives are identical, differing only in the internal layout of the drive sealed mechansim. The Model 6 uses one platter, the Model 11 uses two, and the Model 20 uses three. The drive type, capacity, and manufacture date may be determined from the serial number tag located at the rear of the drive cabinet.

The following is a sample serial number to be found on a Corvus H-Series, Model 11 disk drive:

023-BH350/M

and is decoded below:

02	represents the week of manufacture (week 02)
3	represents the year of manufacture (3 for 1983)
B	represents a Model 11 drive (A=Model 6, C=Model 20)
H	represents an H-Series drive
350	represents the serial number of that years' manufacture
/M	represents that this drive was shipped with a Mirror™ installed internally

Whenever communicating with Corvus in reference to Corvus products, include the serial number of the equipment involved.

1.5 The Corvus Disk System

The Corvus Mass-Storage Disk System utilizes a sealed 5.25-inch Winchester disk mechansim manufactured by International Memories, Inc (IMI). The drive, with its intelligent controller, is designed as a plug-in device, requiring minimal software setup. Interfacing to host computers is via 34-pin flat-cable interface. Installation and setup procedures are covered in the corresponding "Disk System Installation Guide" and "Disk System User Guide" for the appropriate computer system.

All H-Series drives consist of a 5.25-inch drive mechansim (with integral Read/Write PCA) and Motor Control PCA, single power supply, Z-80 Controller PCA, and cooling fan mounted in a grey plastic cabinet.

The Mirror PCA (when installed) and Z-80 intelligent Controller PCA are plugged into the two card slots of the backplane, located inside the top cover.

1.5.1 Power Supply

All H-Series drives operate from either 110-120VAC or 220-240VAC, 50Hz or 60Hz single-phase power, and use a single power supply. These power supplies are interchangable between all H-Series drives.

1.5.2 Data Backup

Data backup is accomplished via the Corvus Mirror™. The Mirror converts the data from digital format to video format which is then stored on video cassette tape, using one of many commercial VCRs. The Corvus Mirror option comes internal to the drive when it is ordered, or added as an external device later. All Mirrors are available with a software-controlled, remote-control interface to a Panasonic™ VCR model NV-8200. Mirror troubleshooting and repair is covered in the Corvus Mirror Service Manual.

1.6 Winchester disk drive

The Corvus disk drive uses the IMI Winchester disk mechansim. This new generation of disk drive utilizes a sealed environment, and low-load, low-mass, aerodynamically-suspended read-write heads which rest directly on the disk surface after power-down. It is the contaminant-free environment that allows for reduction in clearance between head and recording media. This results in the heads riding on an 18-micro-inch air bearing, or air cushion. Since bit density is closely related to head-media clearance and head mass, disk drives utilizing Winchester technology can achieve large storage capacities at a premium of space. An added advantage of the Winchester sealed mechansim is that it requires no regular maintenance.

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CHAPTER 2
INSTALLATION

CHAPTER 2
INSTALLATION

2.1 Scope of Chapter

This chapter discusses installation of the disk drive hardware as it applies to environmental requirements, to insure proper operation. Installation and operation procedures for the Corvus disk system are outlined in the "Corvus Disk Systems Installation Guide" and "Corvus Disk Systems User Guide."

2.2 Introduction

Each drive, when it is received, should be checked for shipping damage, and tested for proper function. This chapter contains these check-out procedures as well as those for installing single drives and multiple-drive systems.

2.3 Receiving a Drive

Any time a drive is received, several checks should be performed before the drive is installed at the customer site. Each Corvus disk drive should be carefully unpacked and checked for shipping damage. External evidence of rough handling may be symptomatic of damage to fragile mechanisms within the drive.

NOTE:

Any damage claims must be reported to the local office of the shipper so an inspection may be made, and a damage report filed. Also, if the damaged equipment is a new product, Corvus Order Processing Department must be contacted for proper return procedures. If the damaged equipment is a recently serviced product being returned under an RMA number (Return Merchandise Authorization number), contact Corvus Customer Service Department for proper return procedures.

The disk drive mechanism in the Corvus disk system is an extremely sensitive device. Subjecting the drive to a one-g force (one gravity) will be amplified and transmitted to the heads, impacting them onto the platter with a 100-g force. This necessitates very careful handling of the drive mechanism both in shipping and operation.

When a drive is received, check that all chips in the Z-80 Controller PCA are seated well in their sockets. Chips coming loose during shipping account for a percentage of the failures upon reciept.

1) Remove the two screws securing the cabinet cover to the drive basepan at the rear, and remove the cover. Be careful not to stress the dc power cable and flatcables connecting to the Controller PCA and Backplane PCA.
2) Locate the Mirror PCA (if installed) plugged into the lower of the two card slots of the backplane, and remove it.
3) Locate the Controller PCA installed behind the Mirror PCA, and press firmly on all socketed chips, seating them securely into their sockets.
4) Replace Mirror PCA.
5) Replace drive cover and secure with screws.

2.3.1 Diagnostic Test

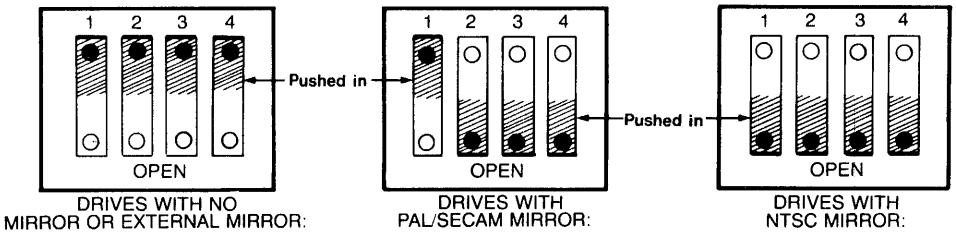
Upon reciept of a disk drive, several procedures must be exercised to verify the proper functioning of the equipment:

1) Verify front bezel switch positions
2) Verify Mirror Switch positions (on rear bezel)
3) Check Controller Firmware VERSION
4) Check power supply Voltages
5) Execute CRC Test
6) Check Parameters (drive and MUX) and record on paper
7) Execute EXERCISE Utility

8) Run BURN-IN Diagnostic (destructive to data)

9) Update Controller Firmware (drive Diagnostic option UPD) changing tables when prompted (answer "yes")

Any Corvus disk drive may be ordered with a Corvus Mirror PCA installed. In all 5.25-inch drives, the Mirror PCA plugs into the Backplane PCA alongside the Controller PCA, inside the cabinet cover. The drive has four DIP switches, located on the rear of the cabinet, which MUST be set to correctly reflect the internal Mirror configuration (whether installed or not). If these switches are not set properly, the drive may not function properly (refer to the chart below for proper switch configuration). Drives using a Mirror externally should use the "No Mirror Installed" switch combination.



The shaded area indicates that the switch should be pushed in on that side.

Figure 2. Mirror Configuration Switches

Check the drive power supply voltages and adjust if necessary (refer to Chapter 6, "Adjustments and Maintenance" for details).

Next, thoroughly test the drive, using the Dealer Service Diagnostics (as outlined in Chapter 7 "Diagnostics" of this manual). Execute a CRC-Format Check, as well as verify the drive Parameters (specifically the Spare Track table and the Virtual drive Offset table). If either of these tables display values out of range, use the PARAMETERS diagnostic utility to reset them to their appropriate values.

A new drive may be shipped with up to twenty-four tracks spared. There are a total of thirty-one spare tracks available on a new drive, which leaves a minimum of seven (and most likely more) for use in the field. When the drive Parameters are first checked, the values should be noted, recorded on a label, and attached to the drive for future reference.

In the event that the drive format is disturbed in shipment, it may be necessary to reformat the drive. The FORMAT utility should be used only as a last resort. Using the PARAMETERS diagnostic utility, first try to restore the drive parameters before attempting the FORMAT utility. The format program will restore default parameters to the drive, and therefore necessitate re-initialization of these parameters with the original values (i.e. previously spared tracks).

Default parameters are:

Spare Track table: no tracks spared

VDO table: Model 6 drive 1 = 0
Model 11 drive 1 = 0
Model 20 drive 1 = 0
(drive 2 = 911 must be added after FORMAT)

Interleaving Spec: all H-Series drives = 9

Be sure to check the drive parameters before and after formatting the drive. If the drive has ever had a track spared, the Spare Track table and VDO table may need reconstructing before the data is restored. Knowing what tracks are spared prior to formatting the drive will simplify this procedure. Note on the label, any future tracks spared.

2.4 Environmental Considerations

All electronic equipment needs cooling and the Corvus disk drive is no exception. When installing, do not "pigeon-hole" the drive. There should be sufficient open area both front and rear. Place the drive on a level, hard surface without cushion or carpet; the air intake slots are on the bottom of the cabinet, and must not be restricted. Do not place a video monitor on top of, or near the Corvus drive. Electromagnetic fields generated by this device may cause drive malfunction.

Be sure the proper line voltage has been selected and proper fuse size is installed.

Insure the interface cable is properly connected between the connector on the interface card in the host computer, and the PROCESSOR connector on the rear bezel of the Corvus disk drive cabinet. Be sure the "one" edge (edge with dark stripe) is to the right, when facing the rear of the drive unit.

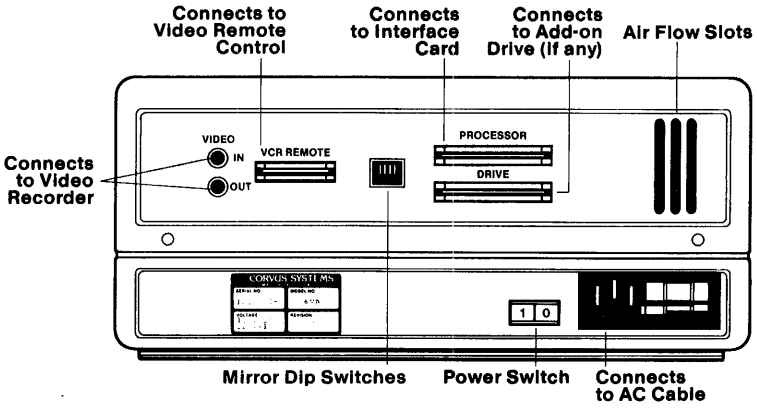


Figure 3. Rear Bezel

Check that all four front panel switches are in the correct position. Run your finger along from right to left, under the switches. All switches should be to the left, unless the disk drive is connected to a Corvus Multiplexer Network system, or to a DEC™ LSI-11™ computer. If so, the appropriate switches should be set.

Locate the power switch on the rear of the drive, and turn it on. The drive motor will begin to spin, and all LEDs (front bezel Light Emitting Diodes) will come on, and the BUSY LED will flash regularly. After approximately thirty seconds, the FAULT LED will go out, and the heads will rezero. LED activity will briefly alternate between READY and BUSY, after which the drive will set the READY signal, and all LED activity will cease, with the READY LED on. The disk drive is now ready for communication with the host system.

2.5 Daisy-Chaining of Disk Drives

A maximum of 80 megabytes of on-line storage may be achieved by daisy-chaining four Model 20 drives. This is accomplished by using a common input/output interface bus, commonly referred to as daisy-chaining. A special Corvus add-on drive flat cable is available specifically for this purpose. One add-on drive cable is required for each additional disk drive in the system. All series and Versions of disk drives may be daisy-chained together with the exception of the Rev A, 8-inch 11MB disk drive (Rev A drives may be daisy-chained only to other Rev A drives). All must use Controller Firmware version CF18.3 or later.

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Changing the unit-select switches (positions 1 and 4) on the drive Z-80 Controller PCA for each add-on drive is required when daisychaining drives. New drives are shipped with the switches configured as drive 1. Additional drives should be set according to their position in the daisy-chain (2, 3 or 4). Refer to the Corvus "Disk System Installation Guide" for the appropriate computer system.

For complete installation and initialization procedures, refer to the appropriate Corvus "Disk System Installation Guide" and "Disk System User Guide."

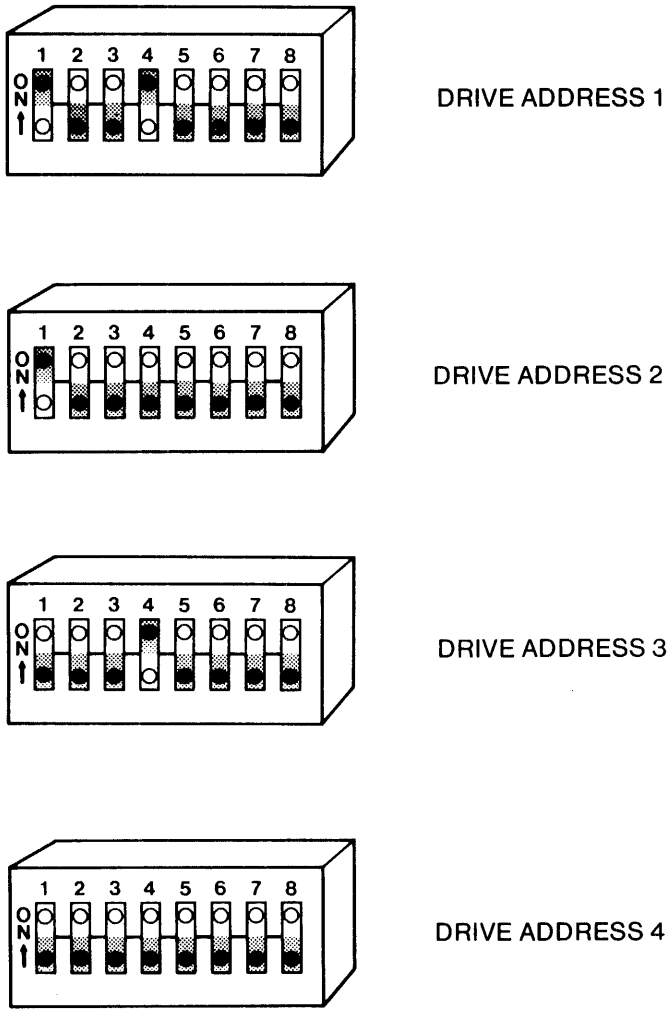

Figure 4. Controller Address Switches

CHAPTER 3
OPERATION

CHAPTER 3
OPERATION

3.1 Scope of Chapter

This chapter describes operator controls and their use as applies to troubleshooting and repair of the drive. Front bezel control switches and Light Emitting Diodes are described, and their functions detailed. Environmental requirements are discussed, and recommended regular checks for the drive are given.

Operation and initialization instructions are detailed in the Corvus "Disk System User Guide" for the appropriate host operating system.

3.2 Introduction

All Corvus 5.25-inch, H-Series drives have front bezel indicator lights and function switches. The switches must be set properly reflecting the system configuration in order for the drive to function properly. Indicator LEDs on the front bezel display the state of the drive, and help in diagnosing the condition of the drive at any time.

3.3 Controls

Operator controls are located on the front bezel of the enclosure. Three LEDs monitor the current state of the drive controller. Four function switches are located under the LEDs. Rear bezel components consist of fuse and power selection unit (CORCOM), power switch, video connectors, Mirror configuration DIP switches, connectors for host processor, daisy-chained drive, and remote control VCR interface cables.

3.3.1 Front Bezel LEDs

The LEDs are labled READY, BUSY, and FAULT. During the power-up sequence all LEDs are on, and BUSY blinks while the drive motor reaches operating speed. After the drive has completed the power-up sequence, the READY signal will be set, the READY LED will be on, and the BUSY and FAULT LEDs will be off.

During normal operation, the READY LED is active when the drive is ready to receive a command from the host processor. The BUSY LED is active when the drive is currently executing a command received from the host processor. The FAULT LED is active when command execution has been interrupted due to the occurence of an error. The FAULT LED is an indicator of drive malfunction or operational error, although some software may cause this LED to light during normal operation. FAULT LED function is accompanied by an error code displayed on the computer screen.

3.3.2 Front Bezel Switches

The function switches are located below the LEDs on the front bezel. These are (from left to right) LSI, MUX, FORMAT, RESET. During normal operation, in a single-user system without an LSI-11 computer, all switches should be set to the left.

All switches except for the RESET switch are polled by the controller ROM routines to determine system configuration. Only the RESET switch directly affects the hardware.

Located furthest to the left, the LSI switch is a two-position switch; the OFF (left) position is the normal position, the ON (right) position is for use with a DEC™ System LSI-11™. At power-on time, the controller polls this switch to determine if a DEC LSI-11 computer is attached, and loads the DEC RL01™ and RL02™ disk drive emulation routines from the Controller Firmware area into controller RAM.

The next switch, the MUX switch, is also a two-position switch; the OFF (left) position is the single-user position, the ON (right) position is for use with the Corvus Multiplexer Network™. At power-on time, the controller polls this switch to determine if a Multiplexer is attached, and loads the the Multiplexer polling routine from the Controller Firmware area into controller RAM.

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™Corvus Multiplexer Network is a registered trademark of Corvus Systems, Inc.

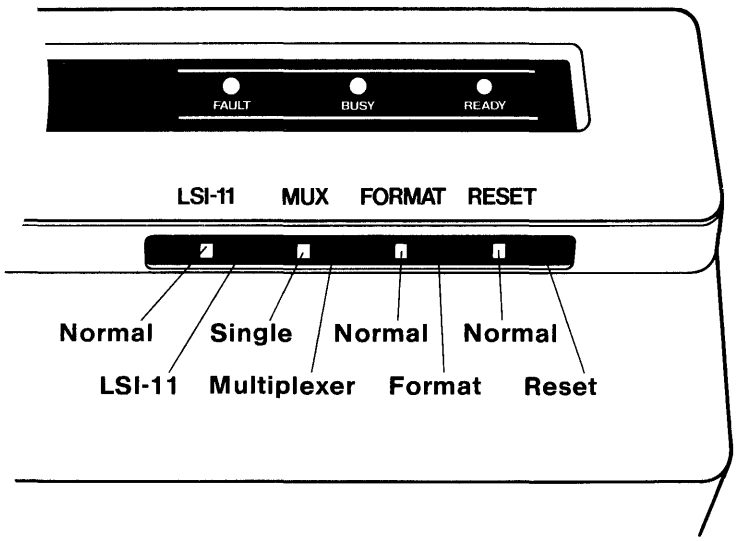


Figure 5. Front Bezel Configuration Switches

The FORMAT switch is a two-position switch; left position is OFF (normal), right position is ON. This switch serves two functions. First, when the drive is turned on, the controller checks all front bezel switches. If the FORMAT switch is ON (right) at this time, the drive will come READY if the ROM-based self-test completes successfully. If, however, this switch is OFF, the controller reads the Controller Firmware from cylinders 0 and 1 into the on-board controller RAM. If this procedure is successful, the controller sets the READY signal, and the READY LED is lit, and the BUSY and FAULT LEDs are extinguished. The drive is now ready to accept a command from the host system. Secondly, the FORMAT switch must be on for the diagnostic program F)ORMAT to execute (see chapter on DIAGNOSTICS). In this mode the switch acts only as a hardware safety switch. No one may execute the F)ORMAT program without having physical access to the drive. The switch being turned ON alone will not format the drive. Only the combination of the format software and the FORMAT switch will allow one to format the drive. If this switch is ON during normal operations, communication between the drive and the host system may be impaired.

Located furthest to the right, the RESET switch is a spring loaded, momentary-contact toggle switch. Toggling this switch initiates a reset signal which resets the intelligent controller in the drive to its original power-on state: the heads re-zero and disk Controller Firmware is again loaded in from the disk into the controller RAM. The drive is then ready to accept another command from the host processor.

3.4 Power-On Sequence

No specific sequence need be followed when powering on the Corvus disk system, with one exception. If the Corvus disk drive is used with an OMNINET local network, power on the Disk Server first. Next power on the disk drive, then the host computer. This procedure supersedes all other procedures that may be found in previous Corvus publications.

3.5 Environmental Requirements

All working environments contain possible hinderances to proper operation of electronic equipment. The following are some possible environmental problems and their solutions.

3.5.1 Static Electricity

Static voltages of thousands of volts can be generated in most office environments. If a system shows irregularities whenever an operator comes in contact with the host computer, network or peripheral equipment, supporting table or surface, static should be suspect.

Static is most easily generated in a cool and dry enviromnent, usually associated with cold weather. Since increased humidity helps prevent static electricity buildup, some type of humidifying device can be helpful. Ideal relative humidity is 70 percent to 75 percent.

3.5.2 Line Noise

Electrical noise on the power line is a major cause of inconsistent equipment operation. Voltage spikes, "brownouts" and dropouts as well as low line voltage are just some of the common causes of drive malfunction.

Located in the CORCOM power selection unit is a line filter capable of handling most minor electrical noise on the power line. Also, the power supply is capable of handling dropouts of up to three complete power cycles.

If power is suspect, the problem may lie in poor continuity of the building wiring, noisy or high power-consumption devices on the same circuit, or poor external supply to the building. Power can be improved by including a constant voltage regulator or isolation transformer in the power circuit. The constant voltage regulator will help minimize the effect of line voltage fluctuations on the Corvus drive, while the isolation transformer will be effective in protecting the Corvus drive from line noise caused by other high-load electrical equipment such as photocopy machines, heating and cooling equipment, elevators, etc. To lessen the impact of frequent power interruption, the use of an uninterrupted power supply (UPS) is recommended.

3.5.3 Temperature

Although in most environments, the disk drive needs no actual warm-up time, there are temperature limits that the drive must operate within (see "Specification" at beginning of this manual). The temperature change maximum for the Corvus disk is 15 degrees fahrenheit per hour.

3.6 Periodic Maintenance

Inherent in the design of the Winchester technology disk devices, is the freedom from the need for regular preventive maintenance. The sealed disk mechanism of the Corvus disk drive requires no maintenance, and contains no field-serviceable components.

CAUTION:

Since contamination of the atmosphere in the mechanism necessitates replacement of the unit, removing the cover to the sealed mechanism voids all warranties.

3.6.1 Regular Checks

Power supply voltages will change with time, and should be checked periodically. Each time the Corvus drive cabinet is opened, check the power supply voltages to verify that they are within specified tolerances (refer to chapter 7 for adjustment procedures).

Due to slight oxidation build-up on cable connectors and IC pins, reseating the flatcable and power connectors and socketed controller ICs periodically will also help insure reliability.

CHAPTER 4
DRIVE DESCRIPTION

CHAPTER 4
DRIVE DESCRIPTION

4.1 Scope of Chapter

This chapter provides a description of the Corvus 5.25-inch, Model 6, Model 11 and Model 20 disk drives and their component interactions. Some terms are defined to help provide a foundation for the following descriptions.

4.2 Introduction

The Corvus H-Series drives are functionally identical except for the drive capacity. They are:

Model 6: 5.6MB
Model 11: 12.8MB
Model 20: 18.3MB

Each drive is divided into three modules. power supply, disk sealed mechanism, and controller electronics. The individual components of these modules are:

— Disk sealed mechanism
— Read/Write PCA
— Motor Control PCA
— power supply or Supplies
— Backplane PCA
— Controller PCA
— Paddleboard PCA
— Drive Cabinet

All drive components of the H-Series drives are identical and are completely interchangible. These are the minimum accessable modules and are offered as replacement parts as listed above. No sub-assemblies are available as spares.

4.3 Drive Layout

The H-Series drive retains the high-impact plastic cabinet of the 6-megabyte Rev C through Rev E drives, but uses many new internal components. The new drive sealed mechanism can be identified by its aluminum casting (as opposed to the B-Series 6MB molded plastic drive mechanism). Mouted beneath the drive mechanism is a Read/Write PCA and a Motor Control PCA. These are also compatible between all three drive capacities.

The power supply is a single unit, supplying +12V and +5V. It is completely compatible with all H-Series drives.

The H-Series Backplane PCA is attached to the drive cover via standoffs. The Backplane PCA has two card slots which accept the Controller PCA (nearest the cover) and the Mirror PCA (when installed). The H-Series backplane is common to all three H-Series models, but cannot be interchanged between other 5.25-inch drives.

The Controller PCA is located in the uppermost slot (nearest the cover) of the drive Backplane PCA. This PCA is common to all three H-Series models, but cannot be interchanged between other 5.25-inch drives.

The Mirror PCA used with 5.25-inch drives is interchangable between all Revisions of the H-Series drives as well as all other 5.25-inch drives.

The front bezel Paddleboard PCA is the same PCA used in all revisions of the 5.25-inch drive and most versions of the 8-inch drives, and is interchangable between these drives.

4.3.1 Power Supply

Every Corvus H-Series drive comes with a power supply to provide all voltages required by the drive mechanism and drive electronics. The H-Series drives require only +12V and +5V. The CP512 is the only power supply required by all H-Series drive models.

4.3.2 dc Power Cables

All power supplies connect to a dc power cable which then connect to the disk mechanism and the drive Backplane PCA. All dc power cables attach to solder terminals on the power supply PCB. The H-Series drives use power cables which connect the single power supply to the Read/Write PCA on the underside of the disk mechanism, and to the Backplane PCA.

4.4 General Description

The recording media of the Corvus 5.25-inch Winchester disk drives consists of an nickel-oxide coating on aluminum disks called platters. There is one 5.25-inch platter in the Model 6 H-Series drive, two platters in the Model 11 drive, and three in the Model 20. All platter surfaces are utilized for data storage. One head rides above each surface on an 18-microinch air bearing (air cushion).

Data is stored magnetically on circular tracks, which are configured as concentric circles on each platter. Each track is further divided radially into 20 sectors, each sector containing one 512-byte block available for user data. The term track refers to a single head surface of a cylinder, each cylinder consisting of all tracks in common vertical alignment on all surfaces. There are 306 cylinders on the H-Series drives, with cylinder zero located furthest from the platter center.

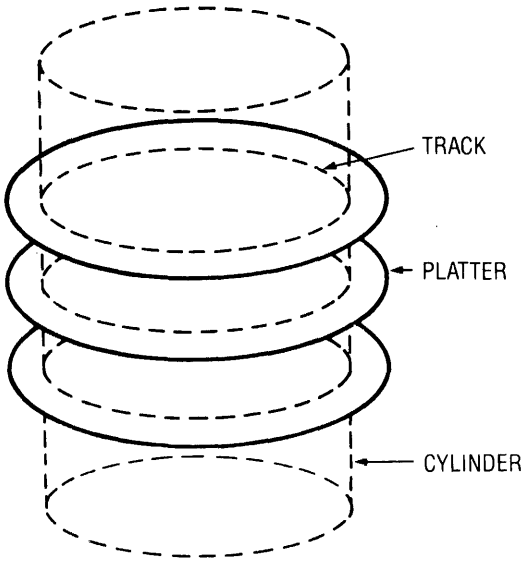


Figure 6. Data Configuration

A block is the smallest addressable unit within the drive. Internally, each block consists of 512 bytes of data. Externally, the drive handles data in sectors as defined by the host computer.

Typically, each host operating system defines a sector as 128 bytes, 256 bytes or 512 bytes. The Corvus interface software uses the appropriate read and write commands (one each for writing and reading 128, 256 or 512 bytes) depending on the requirements of the operating system.

This does not cause a conflict, since the drive simply stores 1, 2 or 4 host-defined sectors for each disk drive block. Read and write commands of less than 512 bytes are transparent to the host system, due to the intelligent controller's ability to handle data blocking internally.

4.5 Disk Sealed Mechanism

The Corvus mass-storage disk mechanism uses a combination of both new Winchester technology and traditional disk design.

The 5.25-inch platters revolve on a common spindle, driven by a brushless dc motor at 3600 RPM. Motor speed is monitored by the Motor Control PCA, located uppermost beneath the drive mechanism, and is independent of line frequency. The index pulse is generated by the magnetic index detector mounted to the underside of the drive base near the spindle. The Solenoid Brake is also located adjacent to the motor hub, and engages immediately after the drive is powered off. Adjustment procedure for the Solenoid Brake and index detector are located in the section titled "Adjustments and Maintenance."

Each head is suspended above the platter surface on an 18-microinch (.4572 microns) air bearing. A particle of smoke, dust, or a human hair could easily play havoc with with these critical tolerances, and cause catastrophic failure of the disk device. The seal on the drive mechanism prevents this from occurring by keeping the internal atmosphere contaminant-free. Breaking this seal for any reason, voids the warranty.

There are two heads for each platter in the drive mechanism. The heads are held by flexure arms, attached to a common head stack casting which moves on precision bearings and stainless steel rails. Positioning of the heads over the appropriate cylinder is accomplished by a four-phase stepper motor, via a split stainless steel band. Seeking to a specific cylinder is accomplished by stepping the motor through four phases for each cylinder. Reversing the sequence of these motor phases will result in reverse head movement. Each increment of the motor is equal to 0.9 degrees rotation.

Two Printed Circuit Assemblies are Mounted beneath the drive mechanism. These are the Read/Write PCA and the Motor Control PCA. The Motor Control PCA is responsible for monitoring the spindle motor speed and altering it as necessary. Index and track 0 signals are also buffered on this board. The Read/Write PCA, contains a 6801 microprocessor IC which makes the drive mechanism itself an intelligent device, freeing the Z-80 controller from many rudimentary tasks. The Read/Write PCA sends data to and receives data from the drive mechanism and the Controller PCA. Many motor control signals are also generated on the Read/Write PCA.

4.6 Controller Firmware

Corvus reserves the first two cylinders of the drive for special code. This is referred to as Controller Firmware, and is not accessable to the host operating system. This Firmware contains programming and system information required by the Z-80 drive controller and is loaded into the disk drive RAM when the drive is powered on or when the RESET switch is toggled. The spare track table, Multiplexer parameters, Semaphore and Pipe information are contained in the Controller Firmware. Identical copies of Firmware reside in each of the two cylinders. The rest of the disk area is available to the host system for data storage, the configuration of which depends upon the type of host operating system. Only Controller Firmware version CF18.3 or later may be used with H-Series drives.

When daisy-chaining one or more H-Series disk drives, it is necessary to update Controller Firmware on all drives in the system using the latest version of firmware data file (CF18.3 or newer).

4.7 Data Storage

Data storage arrangement is by concentric tracks vertically aligned as cylinders. Each track is sectioned into 20 sectors, each sector has a data capacity of one 512 byte block. Logical sectors are numbered by using an interleaving specification (sector skewing scheme) of nine for all H-Series drives.

All surfaces are used for data storage. Since this drive uses a stepper motor for head positioning, no servo tracks are required.

Contained in the head stack is the microchip. This select microcircuitry is responsible for selecting which head is being used. The microchip is also responsible for preamplification, and transmitting of the signal to the drive electronics for further amplification.

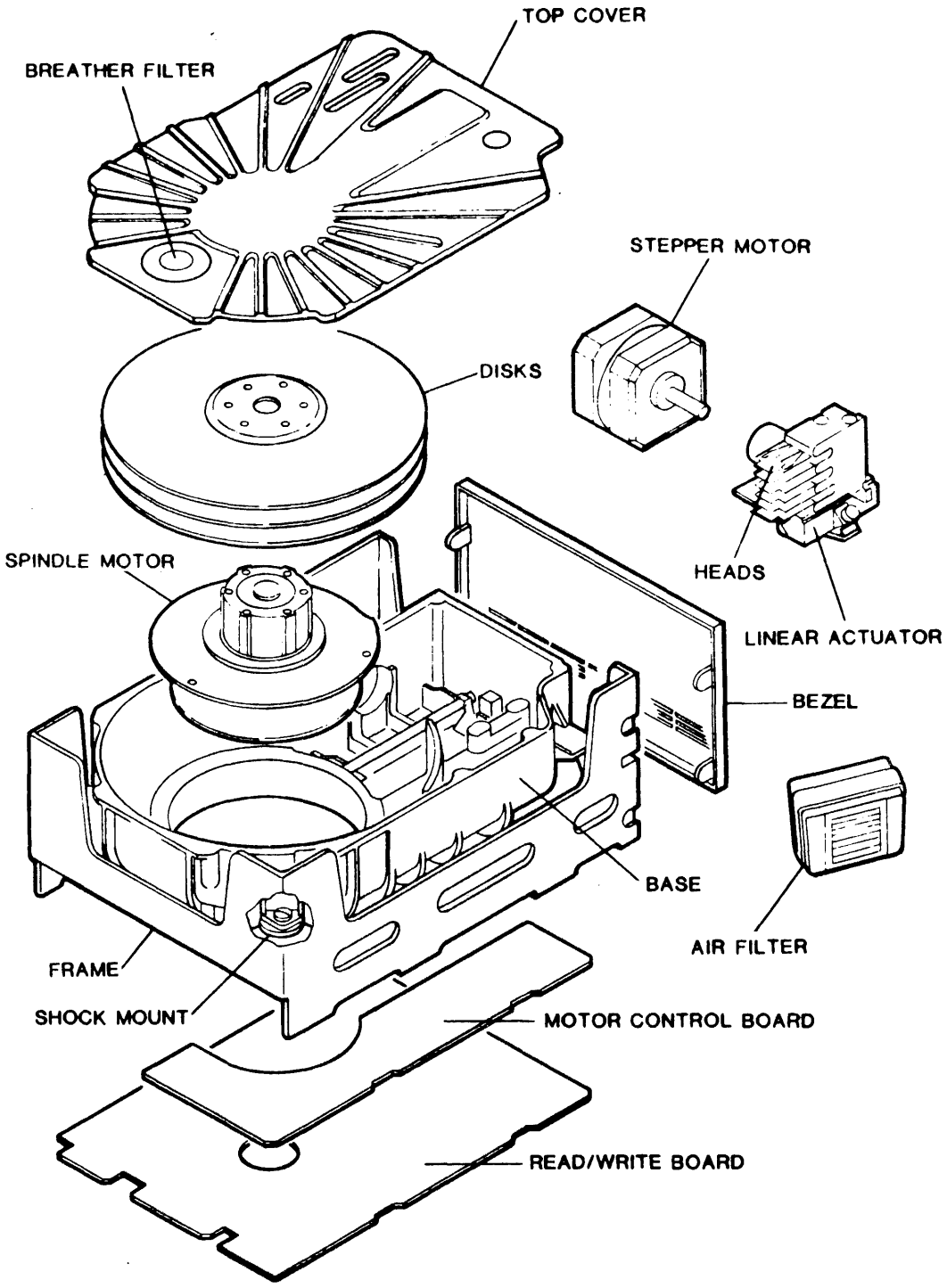


Figure 7 Drive Mechanism Components

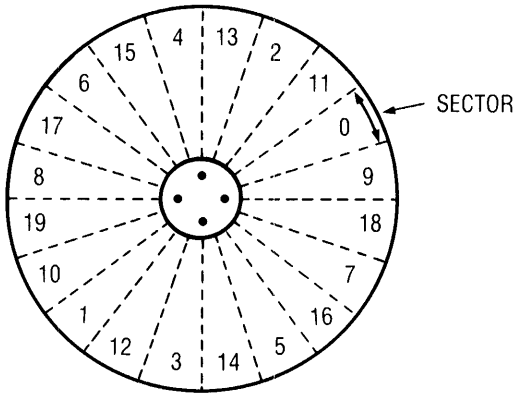


Figure 8. Sector Interleaving

4.8 Transportation Considerations

All Corvus H-Series, 5.25-inch disk drives have the capability of having the heads "parked" off of the data area of the platters. Refer to the chapter on "Diagnostics" in this document for the head parking procedure.

Parking the heads in this manner does not preclude the drive from the need for gentle handling. The disk drive is a delicate instrument. If, when the drive is transported, it is subjected to rough handling, the heads will impact the disk surface, possibly causing damage.

4.9 Theory of Operation

All communication between the drive and the host computer system is interfaced by the Controller Firmware, resident in the controller RAM after the drive is powered on. Without firmware the drive will not recognize commands sent from the host system.

The Corvus drive responds to a small list of commands generated by the disk interface software, which are patched into the host operating system when the drive is first initialized. These normal commands are:

Read 128-, 256- or 512- byte sector
Write 128-, 256- or 512- byte sector
Enter Prep Mode (download special firmware to RAM)
Mirror (Backup, Identify, Verify, Restore and Remote)
Semaphore (Lock, Unlock, Retry, and Error report)
Read Drive Parameters (Spare Track and Mux table)
Pipes (Initialize, Open, Read, Write, Close and Purge)

All normal drive operations are accomplished using the above commands, as the Controller Firmware contains all Z-80 routines for decoding these commands. Other commands are possible, and are accomplished by first executing the Enter Prep Mode command which replaces Controller Firmware with special firmware containing routines for decoding these commands (i.e. diagnostics).

4.9.1 Power-Up

As soon as the power supply voltages have stabilized, the Z-80 controller board executes a ROM routine which initializes the Z-80 microprocessor and then tests the controller RAM and ROM. If the self-test fails, the Z-80 halts execution, leaving the FAULT and BUSY LEDs on, and READY LED off.

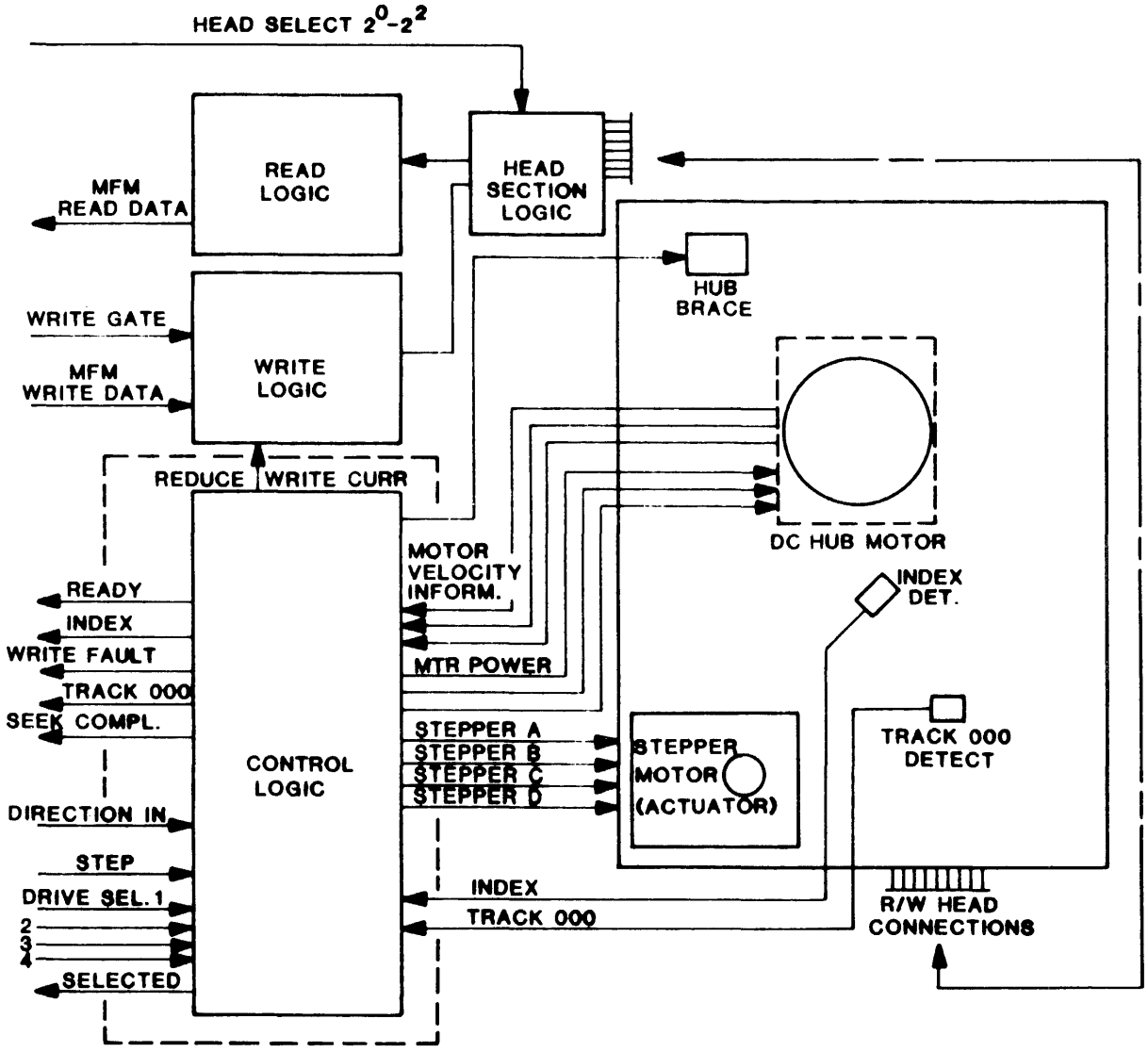


Figure 9. Drive Mechanism Block Diagram

If the self-test executes successfully, the drive begins the controller-boot routine. This consists of first re-zeroing the heads, bringing them over the first cylinder of the disk surfaces. The front bezel switches are then sampled. If the FORMAT switch is ON (right), the controller sets the READY signal. If it is OFF, the Controller Firmware is read from the first cylinder into the on-board RAM. If the Firmware is successfully read in, the drive comes READY. If a bad block (CRC error) is encountered while reading the firmware, the controller will attempt to read from the second copy, any bad sectors found in the first. It will continue to read alternate copies from the the first two cylinders until all Controller Firmware is successfully loaded into the controller RAM. The controller will then set the READY signal, and the READY LED will be on, with the BUSY and FAULT LEDs off.

4.9.2 Controller PCA

The Z-80 drive controller is responsible for interpreting commands sent from the host computer system and controlling the sub-assemblies (the drive mechanism and associated Read/Write PCA, and the Mirror PCA). The controller reports back to the Host Computer, via a 34-pin flatcable, the success of the command executed by means of a one byte return code. A return code of zero is returned if no errors occur. (See Error Code Chart in "Troubleshooting" section for non-zero return codes).

The Controller PCA contains the 4MHz Z-80A CPU and Z-80A support ICs as well a 4K controller ROM (containing elementary procedural Z-80 code for the intelligent controller) and 5K of on-board RAM (used for buffering data to and from the disk, and storing utility code loaded from the Controller Firmware area of the disk). The three Z-80A PIO ICs are used to buffer signals to and from the host Interface PCA, Corvus Mirror and network devices, drive sealed mechanism, and the front bezel controller switches and LEDs. In addition, one of the PIO ICs monitors the on-board CRC generator/checker IC, and informs the Z-80 CPU in the case of a CRC error.

All disk-to-controller memory and controller memory-to-disk data transfers as well as all controller memory-to-Host Computer memory and Host Computer memory-to-controller memory data transfers are handled by discrete Direct Memory Access (DMA) circuitry. This DMA state machine is responsible for fast memory transfer during the execution of read and write commands.

The Controller PCA receives MFM read data from the Read/Write PCA and converts it to NRZ read data before passing it on to the Host Computer. Similarly, the controller receives NRZ data from the Host Computer and converts it to MFM format before passing it on to the Read/Write PCA for writing to the disk media.

4.9.2.1 Controller During Seek Commmand

The Host Computer operating system sends a command to the drive controller in a one-, two- or four-byte format. The controller, using decoding routines contained in the Controller Firmware, decodes the command. The Z-80 microprocessor then calculates the difference between the current cylinder number (always held resident in RAM) and the requested cylinder. The resultant difference is stored in a RAM memory location and later decremented once for each cylinder the heads are moved.

Read/Write PCA is then commanded to strobe the stepper motor windings (PHASE A-D). The controller decrements the cylinder count one for each full motor phase sequence (A-D) and halts the stepper motor at the appropriate cylinder. At each cylinder, the controller applies a lock current to counteract the motor's momentum. If the present cylinder is not the destination cylinder, this current is very low. When the destination cylinder is reached, full locking current is applied to the motor windings which keep the heads on cylinder.

The next sector to move past the heads is read to verify the success of the seek. If the incorrect cylinder was reached, the heads are re-zeroed and the seek is attempted again. If the seek fails during this re-try, the drive halts operation, and a seek error is returned to the host operating system.

4.9.2.2 Controller During Read and Write Commands

The read command begins with the command bytes are received from the Host Computer in parallel form, via the Interface PCA. This command will be unique for either a 128-, 256- or 512-byte sector read. The requested sector number will accompany the command bytes.

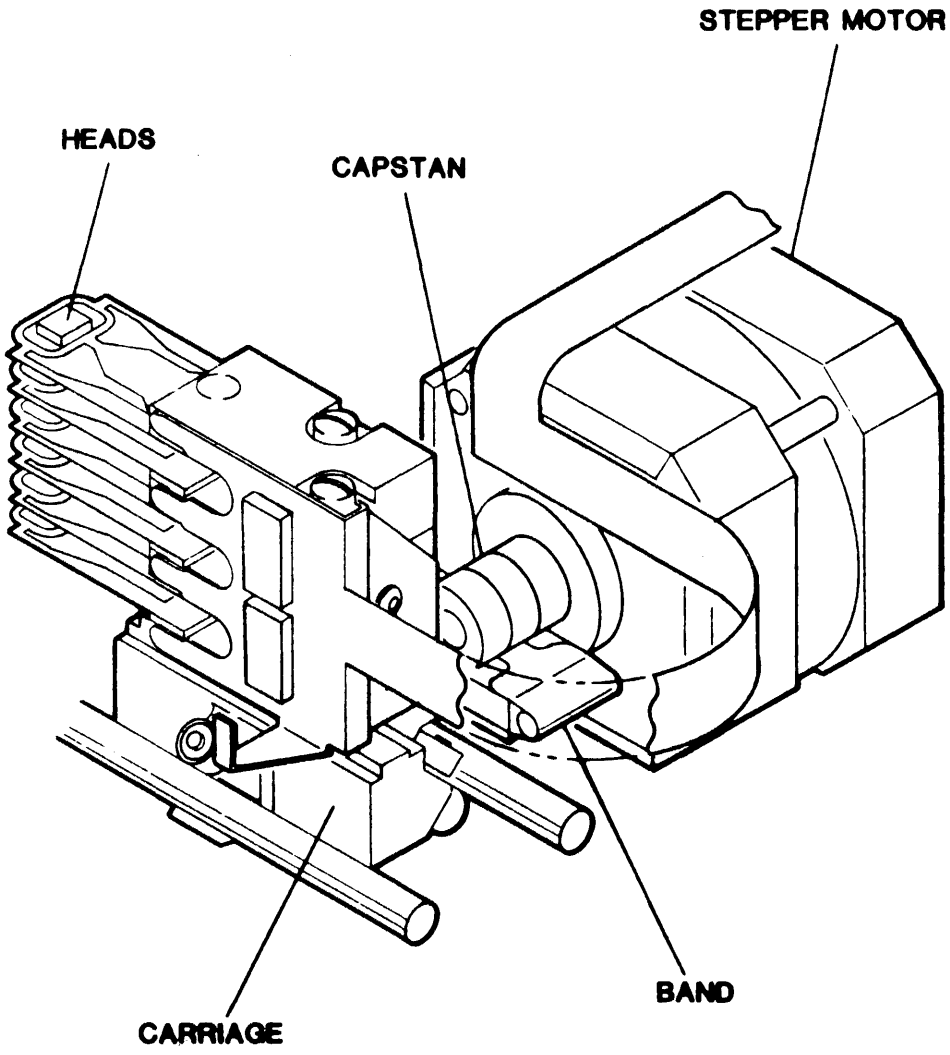


Figure 10. Stepper Motor Assembly

The controller will calculate a difference value between the current cylinder, and the cylinder containing the destination sector. The drive mechanism will be commanded to seek to the new cylinder, and the correct head selected. The controller is now ready to read in the data from the sector, and waits for the appropriate sector to be positioned under the head. READ GATE is asserted, and the Z-80 relinquishes control to the discrete DMA state machine which captures the data signal in MFM form from the headstack microchip via the bi-directional data bus. The data is amplified, filtered and shaped (squared) before being converted to to NRZ format. The Controller PCA handles CRC error checking, parallel-to-serial conversion, and transfer of the data to on-board RAM and then to Host Computer RAM once control is returned to the Z-80. A return code is sent to the host computer identifying the success of the command.

The drive controller handles data in 512-byte quanties only. Host-defined sector sizes less than 512 bytes are handled by storing multiple sectors in each 512-byte Corvus sector.

Similarly, the write command begins when the command bytes, along with the associated sector address(es) are received. The Z-80 controller then determines whether the write command is for 128, 256 or 512 bytes (depending on the host system's standards), and relinquishes control to the DMA circuitry for transfer of the data from host memory to the on-board controller RAM.

Next, preparations are made for writing that block out to the disk. If the quantity of data to be written is less than 512 bytes, the sector is first read into controller RAM. When the proper sector comes around, the controller again turns control over to the DMA circuitry. The drive processor again is put into a wait state while the DMA transfers data bytes one at a time to the parallel-to serial converter. A CRC value is generated from the serial data and inserted in the data stream. The data is converted from NRZ format into MFM format and then directed to the read/write heads for writing to the sector. The CRC information is used during a read, for checking data integrity.

The disk write operation is concluded by reading in the block and its associated CRC byte to verify its success. Every write command is followed by a verify (read) command. A status byte is then sent to the host system indicating the result of the disk write.

4.9.3 Backplane PCA

The Backplane is responsible for transfering power and signals between the Controller PCA, Mirror PCA, Paddleboard PCA and the Host Interface PCA (via the rear bezel 34-pin connector). The upper slot of the Backplane is reserved for the Controller PCA, and the lower slot is reserved for the Mirror PCA. These two PCA positions may not be interchanged.

This two-piece printed circuit assembly accepts flatcables from the front bezel Paddleboard PCA as well as from the Host Computer System. A single dc power cable supplies voltage to the Backplane PCA via a four-pin connector.

The Backplane PCA for the H-Series drives is unique to these products, and is not interchangeable with other Corvus drive products. The Backplane PCA for the Model 6, Model 11 and Model 20 is interchangeable only between these three drives.

4.9.4 Paddleboard PCA

The Paddleboard PCA, located on the front bezel of the drive enclosure contains switches and LEDs. The function of these controls are detailed in chapter 2.

All Paddleboard PCA revisions are compatible with all drive revisions, and are interchangeable.

4.9.5 Interface PCA

The Corvus disk system will interface to many different microcomputer systems, and may be purchased with any of several interface cards available.

The typical interface card contains address decoding, bidirectional data buffering, and handshaking circuitry. Some interface cards also have ROMs containing boot routines for booting the microcomputer from the Corvus disk; some do not, and these computers must boot from floppy diskette.

Connected to the 34-pin flatcable, the Interface PCA contains two input ports, and one output port and address decoder. One input port is an eight-bit tristate data buffer, used for receiving data bytes during drive-to-host transfers. The other input port is the status port, used for determining the state of the disk drive. The output port is an eight-bit latch, used in host-to-drive data transfers.

When the host system needs to access the disk, it first checks the BUS DIRECTION signal, and if the bus is in the host-to-drive direction, and the READY signal is high, the drive is ready to accept a new command. The host then sends command bytes to the drive.

During a read or write command, the bus will remain in one direction without turning around, until all bytes have been transferred. The drive will acknowledge the acceptance and execution of commands by setting the bus direction bit of the status port. This is a signal that the return code is on the data bus, which must be retrieved before the drive will accept new commands.

All of the above handshaking is taken care of by the Corvus interface software and is totally transparent to the user.

4.9.6 Read/Write PCA

The Read/Write PCA is located beneath the drive mechanism. The Read/Write PCA is responsible for buffering, filtering the read data, and supplying write current. Also, the sector and track 0 signals are generated here.

The Read/Write PCA contains a 6801 microprocessor IC, which handles much of the servo motor control, write current control and most of the drive mechanism control schemes.

The Read/Write PCA is available as a spare part, and is interchangeable between all H-Series drive mechanisms, regardless of capacity.

4.9.7 Motor Control PCA

Spindle motor speed is monitored by the circuitry on the Motor Control PCA. A tachometer feedback loop helps maintain spindle speed within 0.5% of 3600 RPM. The magnetic index detector delivers pulses to the Motor Control PCA, which generates the index signal. The Motor Control PCA monitors this signal, and adjusts motor speed as required.

The Motor Control PCA is available as a spare part, and is interchangeable between all H-Series drive mechanisms, regardless of capacity.

Two Motor Control PCAs exist, one (p/n 811-02410) for use with the two-wire brake mechanism, and one (p/n 811-01908) for use with the three-wire brake mechanism. Each of these PCAs must be matched with the appropriate brake mechanism, and may not be substituted for one another.

CHAPTER 5
DISASSEMBLY

CHAPTER 5
DISASSEMBLY

5.1 Scope of Chapter

This chapter contains disassembly instructions for all H-Series drives. These three drive models (Model 6, Model 11, and Model 20) are all physically identical. The disassembly instructions that follow apply to all.

5.2 Introduction

The Corvus H-Series drive consists of a high-impact plastic shell, the top and bottom halves held together with two screws at the rear of the cabinet. The backplane has two edge-connector slots which accept the Mirror PCA (when installed) and Controller PCA, and a 20-pin flatcable connector which accepts the cable from the front bezel Paddleboard PCA. All these are mounted to the drive cover. The drive sealed mechanism and power supply are both attached to the cabinet basepan.

WARNING:

Before disassembling any disk equipment, be sure the power is disconnected.

5.2.1 Tools Required

The following tools are required for disassembly of all Corvus H-series drives:

1) #2 phillips screwdriver
2) 5/64-inch hex driver
3) 3/32-inch nut driver
4) 3/16-inch blade screwdriver

5.3 Plastic Package

The H-Series drives share the grey plastic drive cabinet with the Corvus Rev C, D and E, 6MB disk drives. Disassembly is similar.

5.3.1 Top Cover

1. Remove the two phillips screws at the rear of the cover.
2. Remove the cover by sliding it back and lifting it straight up. Be careful not to stress the dc cabling and flatcables connected to the Controller PCA and the Backplane PCB.

5.3.2 Controller PCA

1. Remove the drive mechanism flatcables from the upper connectors of the Controller PCA noting their orientation (one edge to the left).
2. Note the orientation of the two flatcables (one-edge to the left) connecting the drive mechanism to the Controller PCA, and disconnect them.
3. If the drive has a Mirror PCA installed in the Backplane, remove it by gently disengaging it from the standoffs and pulling it out of the backplane slot.
4. Remove the two nylon standoffs securing the controller to the cover.
5. Remove the controller by gently pulling it out of the backplane slot.

5.3.3 Backplane PCA

1. Disconnect the one dc power cable and one flatcable from the Backplane, noting their orientation (one edge to the left).
2. Release the forward half of the Backplane PCA from the nylon standoffs.
3. Remove the five nylon standoffs securing the Backplane to the cover.
4. Remove the Backplane PCA by moving it down and forward.

NOTE:

The ground wire connecting the drive mechanism to the power supply MUST be connnected for the drive to perform properly.

5.3.4 Drive Mechanism

1. Disconnect the ground wire between the drive mechanism and the power supply.
2. Remove the four phillips screws securing the drive mechanism mounting brackets to the basepan.
3. Noting the orientation of the dc power cable and flatcables, disconnect them from the drive mechanism.
4. Remove the drive mechanism, with its brackets, up and out of the basepan.
5. Remove the four phillips screws securing the brackets to the drive mechanism, and remove the brackets.

5.3.5 Read/Write PCA

1. Remove the drive mechanism as outlined above.
2. Remove the mounting brackets.
3. Place the drive mechanism on its top, exposing the Read/Write PCA.
4. Disconnect the read-write/head-select mylar flatcable from the Read/Write PCA to the drive mechanism (see figure 11.)
5. Remove the three standoff securing the Read/Write PCA to the drive mechanism.

NOTE:

The central standoff securing the Read/Write PCA provides an electrical ground, and must be metal.

6. Gently lift the Read/Write PCA up, disconnecting the Motor Control PCA connector J-24 (refer to figure 11).
7. Once the Read/Write PCA is free of the Motor Control PCA connector, swing the PCA up to expose the stepper motor connector.
8. Noting the stepper motor cable orientation (yellow wire towards outside), disconnect it.

5.3.6 Motor Control PCA

1. Noting its position and orientation, unplug the brake mechanism connector (J-21) from the Motor Control PCA.
2. Noting its position and orientation, unplug the spindle motor connector (J-22) from the Motor Control PCA.
3. Noting its position and orientation, unplug the index sensor connector (J-25) from the Motor Control PCA.
4. Noting its position and orientation, unplug the track zero switch sensor connector (J-23) from the Motor Control PCA. This connector must be rotated 90 degrees from vertical before being re-connected.
5. Remove the two standoffs and one slot screw, noting their respective positions, and remove the Motor Control PCA.

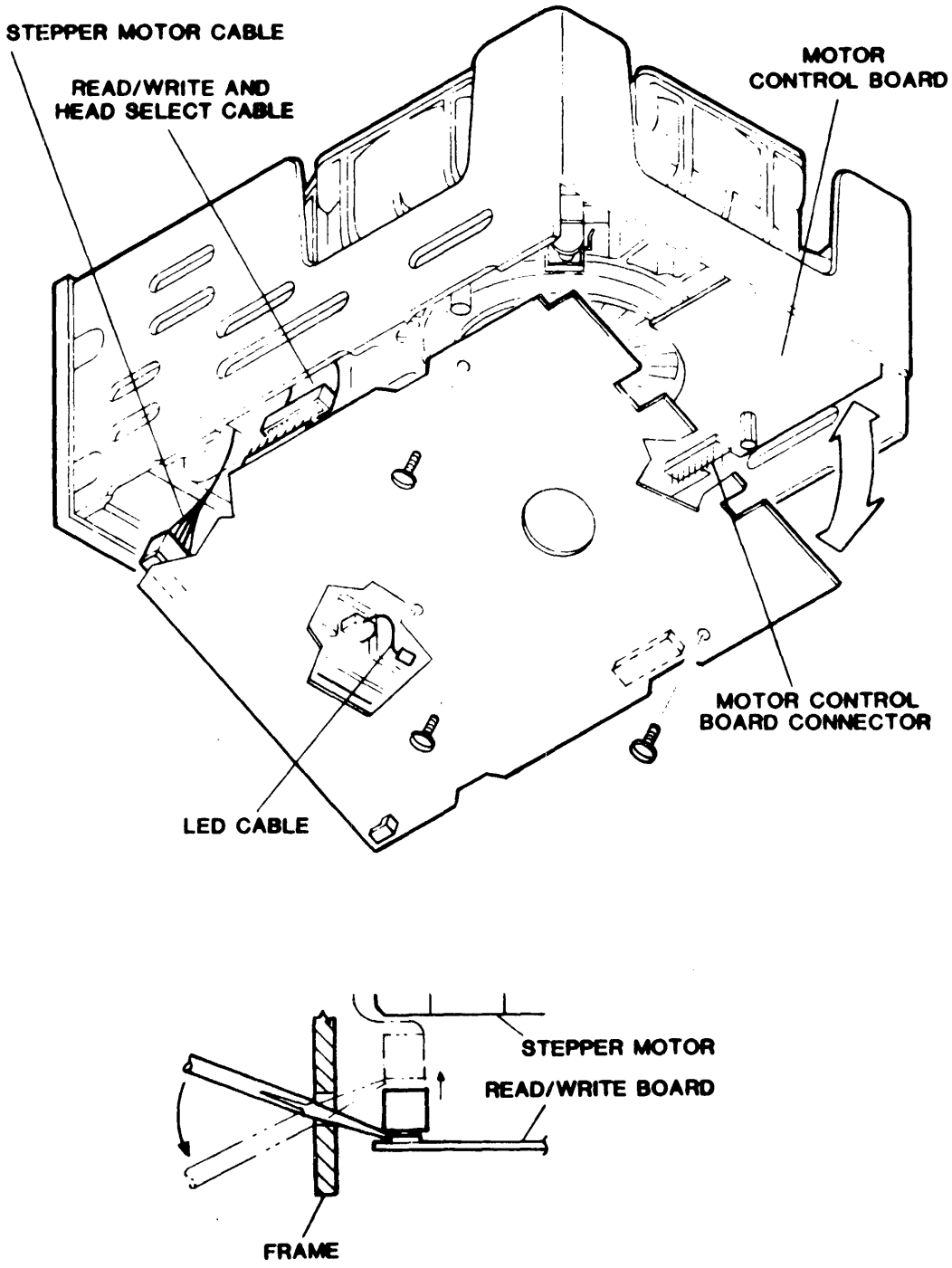


Figure 11. Read/Write PCA Removal

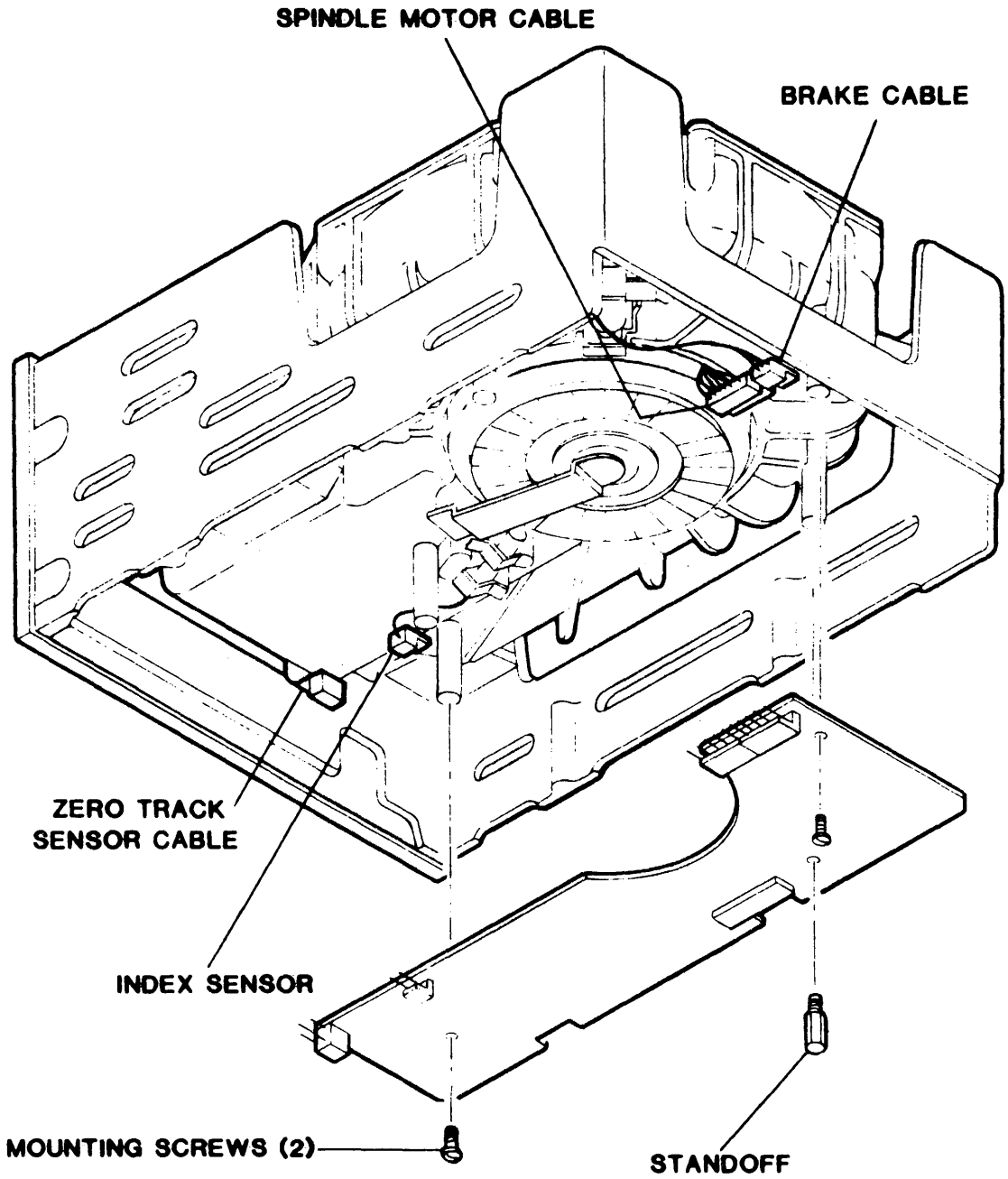


Figure 12. Motor Control PCA Removal

5.3.7 Power Supply

1. Disconnect the ac wiring harness connector from the rear bezel CORCOM unit and power switch.
2. Remove the screw securing the ac groundwire to the power supply.
3. Remove the screw securing the dc groundwire to the power supply.
4. Disconnect the dc wiring cables from the drive mechanism and the Backplane PCA.
5. Disconnect the ac fan cord from the cooling fan.
6. Remove the four phillips screws securing the power supply to the basepan.
7. Remove the power supply straight up and out of the basepan.

5.3.8 Front Bezel

1. Remove the flatcable from the front bezel Paddleboard PCA, noting its orientation (one edge down).
2. Remove the three phillips screws securing the front bezel to the basepan.
3. Remove the bezel straight forward.

CHAPTER 6
ADJUSTMENTS AND MAINTENANCE

CHAPTER 6
ADJUSTMENTS AND MAINTENANCE

6.1 Scope of Chapter

This chapter will cover check and adjustment of power supply voltages, brake solenoid and index detector.

6.2 Introduction

The Corvus disk system is based on a Winchester disk mechanism. Because of this storage device's sealed environment, the mechanism itself needs no preventive maintenance.

6.3 Power Supply Voltage Check and Adjustment

Aging of the power supply and normal heating and cooling of the drive electronics can cause the power supply voltages to drift. Voltages should be checked each time the installation is visited for system checkout.

All three H-Series drives use the same power supply, the CP510, and is interchangible between all three H-Series drives.

WARNING:

Extreme caution should be exercised when adjusting the power supply. High voltages present a potential hazard.

6.3.1 Voltage Check (CP510):

1. Remove cover to the enclosure as outlined in chapter 5.
2. Locate voltage test points at the edge of the CP510 power supply. These are labeled +12V, +12V COM, +5V, +5V COM.
3. Turn on the ac power switch.
4. Using a DIGITAL voltmeter, check the power supply voltages at these connections, using the corresponding COMMON test point. All voltages must be within ±0.1 volts of the specified voltage.
5. If any of the voltages are out of tolerance, follow the adjustment procedure for this supply.

6.3.2 Voltage Adjustment (CP510):

1. Remove cover to the enclosure as outlined in chapter 5.
2. Connect ac power to the disk drive, and turn on the ac power switch.
3. Monitoring the dc voltages as outlined above, adjust the +5V and +12V using the following adjustments:

CP510	
R-9	+12V
R-16	+5V

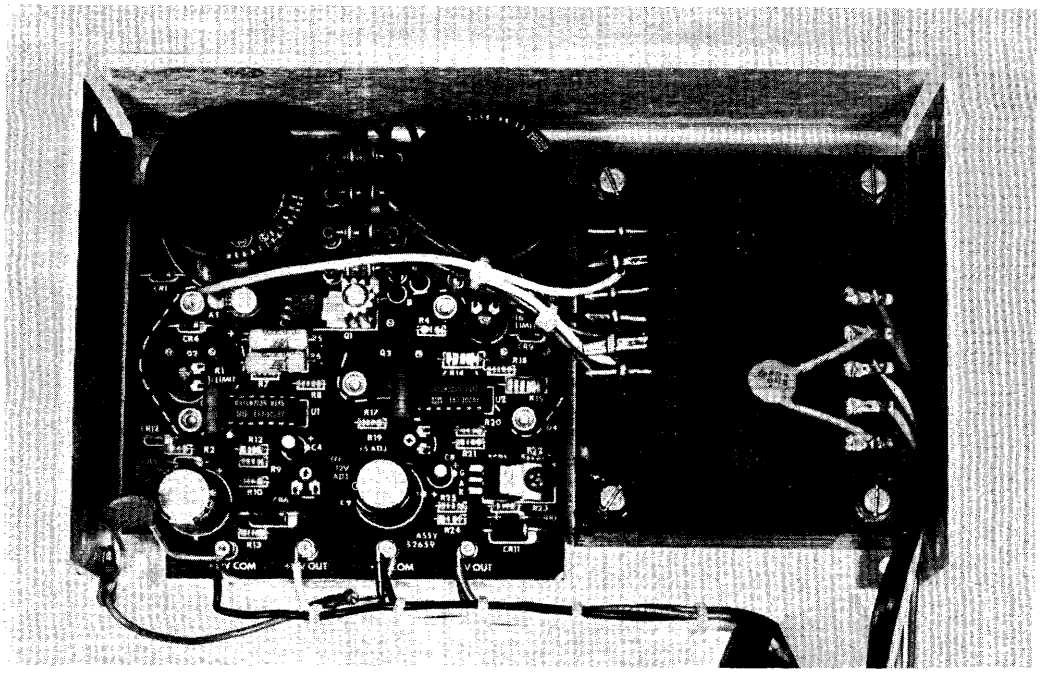


Figure 13. CP510 Power Supply

NOTE:

During adjustment, the +5V or +12V may drop to or near zero. This is due to the over-voltage protection circuitry being activated. To reset this condition, turn off the ac power switch, and bleed the +5V or +12V charge to ground using a 10-K resistor. Set the trim resistor to its original position, turn on ac power and proceed with the adjustment.

4. Remove ac power from the drive.
5. Replace the drive cover and screws.

CAUTION:
Do not manually spin the drive motor at any time.

6.4 Motor Brake Adjustment

1. Remove the drive mechanism from the cabinet and remove Read/Write PCA as described in Chapter 5.
2. Loosen the two brake mechanism assembly mounting screws.
3. Hold the brake solenoid assembly against the lateral location bosses.
4. Place the appropriate thickness gauge between the brake friction shoe and the motor hub.

   3-wire Motor Brake Assembly: 0.007″ ±0.003″
   2-wire Motor Brake Assembly: 0.012″ ±0.003″
5. While holding the brake plunger fully retracted, move brake assembly against thickness gauge and motor hub, and tighten brake mounting screws. Do not overtighten these screws.
6. Recheck the adjustment of the brake mechanism. With the brake plunger fully retracted, the hub-to-plunger clearance should be as described above.
7. Reinstall Read/Write PCA.

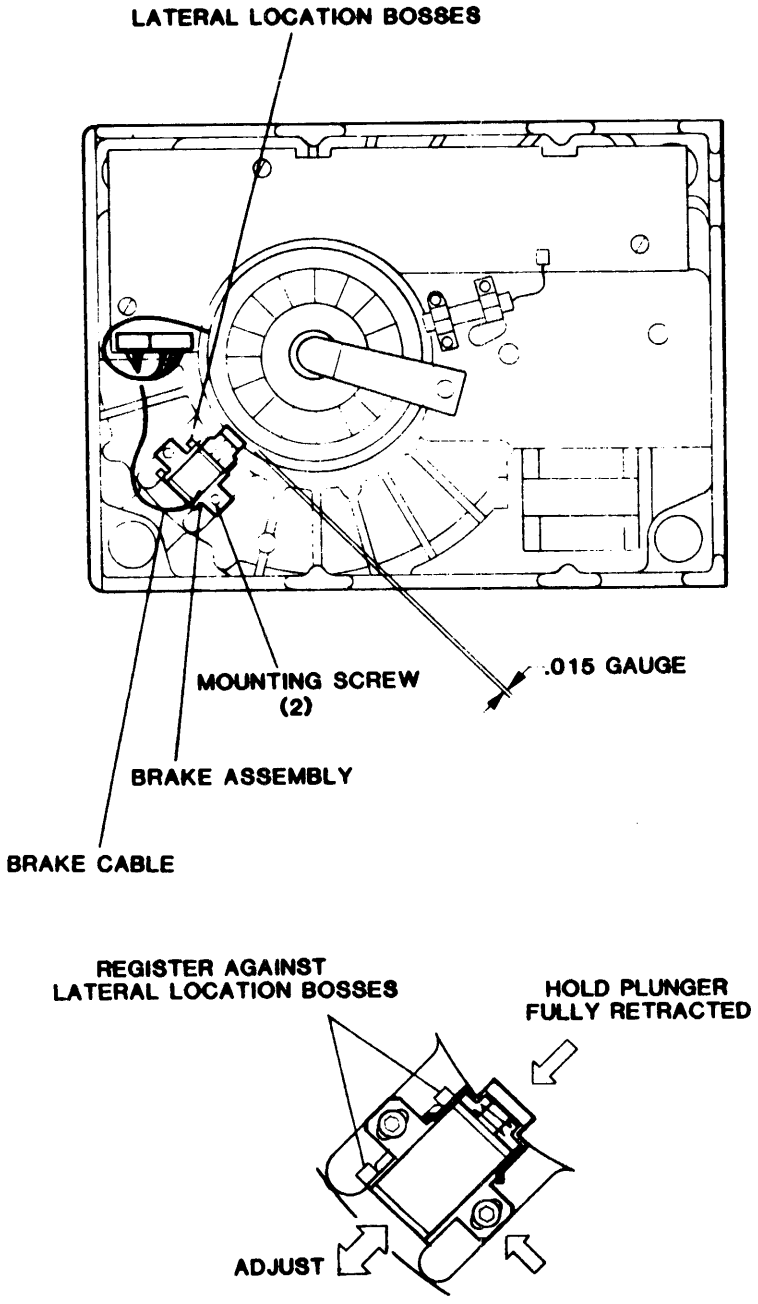


Figure 14. Brake Mechanism Adjustment

6.5 Index Sensor Adjustment

CAUTION:

Altering of the Index Sensor adjustment may cause loss of data on the drive mechanism. This adjustment should be attempted only if a backup of the drive data exists.

1. Remove the drive mechanism from the drive cabinet and remove Read/Write PCA as described in Chapter 5.
2. Loosen the two index sensor assembly screws.
3. Rotate motor until the the silver-colored timing tab lines up with the index sensor.
4. Place a 0.015″ thickness gauge between the sensor and the index tab on the motor.
5. Move the index sensor against thickness gauge and tighten mounting screws.
6. Recheck the adjustment of the index sensor. With the index timing tab aligned with the index sensor, the clearance should be 0.015″ ±0.003″.
7. Reinstall Read/Write PCA.

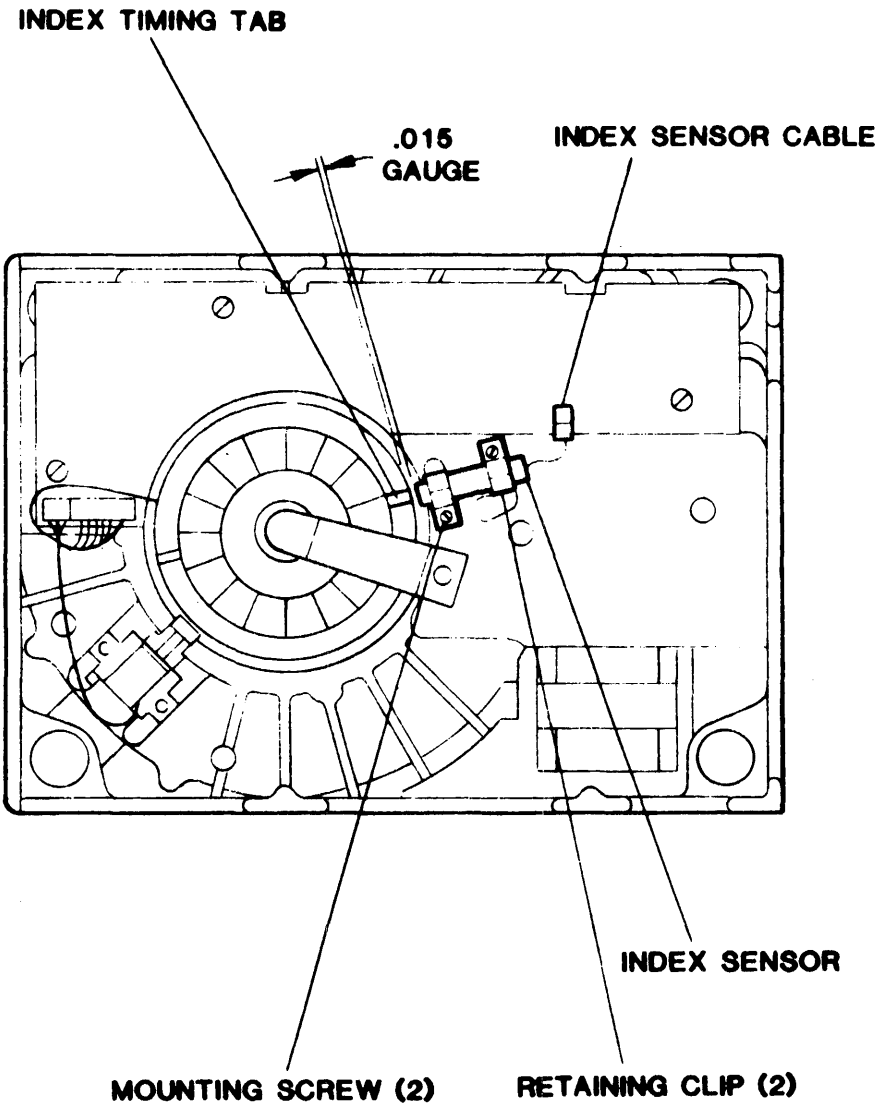


Figure 15. Index Sensor Adjustment

CHAPTER 7
DEALER SERVICE DIAGNOSTICS

CHAPTER 7
DEALER SERVICE DIAGNOSTICS

7.1 Scope of Chapter

The Dealer Service Diagnostic Utilities are supplied to aid the technician in tracing faults in the Corvus disk drive system, and speed the correction of these faults. The Drive Diagnostic, Controller Diagnostic and Track Diagnostic utilities are covered in this chapter. The Mirror and OMNINET Diagnostics are covered in the service manuals for those products.

7.2 Introduction

Each Authorized Corvus Dealer Service Center will be supplied with Dealer Service Utilities. These utilities will help the technician exercise and diagnose the Corvus disk and network systems.

The Dealer Service Utilities diskette is comprised of standard Drive Diagnostic for the all Corvus disk drives (including the H-Series drives), Controller Diagnostic which will exercise and diagnose the drive utilizing the drive Z-80 processor, and a rigorous Burn-In program which exercises and tests the drive system infinitely (i.e. overnight). Also included is a single-track read-write diagnostic, for determining the condition of an individual track.

Some versions of the diagnostic utilities display only 40 characters on the video monitor. When viewing the diagnostic menu under each specific item, typing a question mark (?) will display an additional 40 characters of menu options.

The latest release of Dealer Service Diagnostics cover all series of Corvus disk drives:

A-Series:
- 8-inch, 11-MB, Rev A drive

B-Series:
- 8-inch, 11-MB, Rev B drive
- 8-inch, 20-MB, Rev B drive
- 5.25-inch, 6MB, Rev A through Rev E

H-Series:
- 5.25-inch, 6-MB (Model 6) Rev A
- 5.25-inch, 12-MB (Model 11) Rev A, Rev B
- 5.25-inch, 18-MB (Model 20) Rev A, Rev B

Diagnose the H-Series drives using only diagnostics specifically labeled as service diagnostics for the H-Series drives. Previous diagnostics versions (pre-April 1, 1983) will not communicate with the Corvus disk drive properly.

7.3 Drive Diagnostics (DRVDIAG)

This program is essentially the same program provided on the Initialization Utility diskettes supplied with each Corvus drive. All options within this program are non-destructive to data on the drive, with the exception of the Format utility. While the PARAMETERS option of the diagnostic program does not actually destroy data, changing these values using this diagnostic option will change relative track and sector addresses which will make the data inaccessable.

7.3.1 CRC

A good sector is defined as one capable of retaining all bits in the order they were written. When a block is read from a sector, the CRC value is read with it and tested. Bit errors may occur due to a bad sector, damaged in one of two ways:

1) physically (faulty media resulting in dropped bits and mismatched CRC bytes)
2) magnetically (miscellaneous bits written to the block resulting in a mismatched CRC value)

The Cyclic Redundancy Code test is a non-destructive test which reads each block of data, and checks it against its CRC value. If for any reason, the CRC value in that sector does not match the block of data, the CRC checker/generator signals the controller that an error has been detected, and the processor halts operation. Any errors will be reported at the end of the program. CRC errors encountered during normal drive operation will halt disk drive operation with the error code displayed.

Run this test several times to determine whether the error is due to faulty media (where specific sectors will repeatedly will show errors) or random magnetic bit changes (where sectors will show one-time errors). Tracks containing sectors with repeated errors should be spared (using Drive Diagnostic utility PRM).

7.3.2 EXR

The exercise test (EXR) seeks random sectors and reads the header information from that sector to verify the success of the seek. Periods print to the video display for successful operations, asterisks for hard errors (errors that exist after ten retrys) and question marks for soft errors (operations that succeed after at least one retry).

Pressing RETURN displays the error list, consisting of total number of passes (seeks), hard and soft errors. Any errors reported should be followed by a CRC test to check for faulty sectors.

7.3.3 UPD

This Controller Firmware Update utility rewrites a new copy of Controller Firmware into each of the first two cylinders of the drive. All H-Series drives must use Controller Firmware version CF18.3 or greater.

Since it is not possible to update the firmware on the boot drive, the system MUST first be booted from another boot device (another Corvus Drive, or floppy diskette).

The H-Series version of this utility will prompt you with:

Change Tables? (Y/N)

A negative answer to this question will not endanger data resident on the drive. Although the UPDate utility is non-destructive to the data itself, answering affirmatively to this will result in these tables being rewritten with default values:

Spare Track table + No Tracks Spared
VDO table: Drive1 = 0
Interleaving Spec = 9

Be aware that whenever these default table values are written to the firmware area (by answering YES to "Change Tables?"), they replace previous values that may have been written at an earlier time. These may include spared tracks, and virtual drives in addition to the default of 1 drive. If data is resident on the drive when these values are changed, all relative references to the data (absolute sector addresses) will be changed, and the data will be inaccessable afterwards.

The Format program will also rewrite these default table values.

Next, the program will display a Controller Firmware file name. This will be in the form of :

ENTER CONTROLLER CODE FILE: CFxx.x

The current level of Controller Firmware at this writing is CF18.4AP. If another version is to be used, it should be entered now. The version of Controller Firmware used on the drive should be none other than that supplied with the Corvus initialization diskettes that were used when the drive was originally initialized.

7.3.4 VSN

This utility displays the current versions of the Controller Firmware and controller ROMs:

DRIVE 1: Vxx.x CORVUS SYSTEMS DD-MMM-YY
CONTROLLER ROM VERSION: nn

where DD-MM-YY represents the release date of that Controller Firmware version, xx.x represents the Controller Firmware version (i.e. CF18.4AP) and nn represents the suffix of the controller ROM (i.e. 7.63). At this printing, the current versions are:

Controller Firmware: CF18.4AP
Controller ROM: 7.63

7.3.5 FMT

WARNING:
This utility will destroy data on the drive.

Although the Format utility should be used only as a last resort when attempting to reestablish normal drive operations, the drive may at some time need reformatting. This diagnostic-level, or bottom-level format writes the rudimentary magnetic pattern to the tracks required before data may be retained properly. This format must be intact before the drive may be initialized for any operating system or data storage using Corvus initialization software.

First turn the FORMAT to the ON (right) position, then execute the Format utility. Some versions of this utility request a password, which is HAI. When the Format has completed, the program will display:

FORMAT COMPLETE - NOW UPDATING FIRMWARE
ENTER CONTROLLER CODE FILE: CFxx.x

The program will now rewrite the Controller Firmware using the input file displayed. If another version of firmware is to be used, enter the filename now. Use only the Controller Firmware version appropriate for the drive (see UPDATE utility above).

The Format program writes default Drive Parameters to the drive:

Spare Track table = No Tracks Spared
VDO table: Drive1 = 0
Interleaving Spec = 9

and should be updated as necessary after the Format program terminates (see UPDATE above, and PARAMETERS below).

7.3.6 PRM

The Parameter option of the diagnostic program allows the checking and alteration of the Constellation Mulitplexer parameters (including Master Multiplexer Configuration table and Polling Parameters) and Drive parameters (including Spare Track table, Sector Interleaving Specification and Virtual Drive Offset table)

7.3.6.1 MUX

Selecting this option displays the Multiplexer table:

```
M       M
M       M
M       M
M       M
    X
```

As displayed above, the Multiplexer table is not to be altered if the drive is not connected to a Corvus Multiplexer network, or is connected to a single, Host Multiplexer.

Only if a Master Multiplexer is used in the Multiplexer Network is this table to be changed. In the instance that a Master Mux is installed, each of the eight ports (M in the above table) should changed to either "N" if no device is connected to the port, "C" if a computer other than a DEC-System LSI-11 is connected to the port, or "L" when an LSI-11 is used, or left an "M" if a Host Mux is connected to that port.

There is only one MUX table, and it should be changed to reflect the configuration of the Master Multiplexer only, or left unchanged if only a Host Mux is used.

Polling Parameters is the next option of the program. When the drive is used with a Corvus Multiplexer local network with Intertec Superbrain* or Radio Shack TRS-80* computers, the Polling Parameters should be changed:

Standard Polling parameters: 180,26,32,0
For Superbrain and TRS-80: 180,52,32,0

7.3.6.2 DRIVE

Selecting this option displays the Spare Track table, Sector Interleaving Specification, and Virtual Drive Offset table.

Whenever a track is found to contain a faulty sector (via the CRC test), that track must be removed from service, and a spare track used. These bad tracks are eliminated by listing them in the Spare Track table. This utility enables the user to:

ADD a track to the Spare Track table (remove it from use)

DELETE a track from the Spare Track table (restore it to use)

LIST the Spare Track table

QUIT or exit from the spare track routine

By selecting the ADD option, the track number returned by the CRC test (see CRC below) can be entered, thereby ignoring the track with the erring sector.

The Sector Interleaving Specification is the next option of the program. Interleaving, or skewing, is defined as the use of an offset constant in the logical numbering of sectors. This value for all H-Series drives is nine for all computer systems except the DEC System LSI-11 which uses a value of five. Sector Interleaving is shown in Figure 8.

Check the Interleaving Specification when the drive is first received, and whenever it is formatted.

Next, the Virtual Drive Offset table should read:

DRIVE 1 0

unless otherwise instructed by the Corvus "Disk System Installation Guide." This table should be checked when the drive is first received, and whenever the drive is formatted. Model 20 disk drives must be configured as two virtual (logical) drives. This is accomplished by adding a second virtual drive, beginning at track 911.

7.3.7 SET

This utility allows the user to change the slot number, drive number, or drive type of the drive to be diagnosed. This allows the technician to connect several drives to one host computer, and test any one.

7.3.8 PARK HEADS

Whenever the H-Series drives are to be transported, the heads must first be parked off the data area. The PARK HEADS command accomplishes this by moving the heads onto a non-critical area of the drive platters. All drive indicator LEDs will be off after executing this diagnostic option. This indicates that the heads are parked, and the drive should now be powered off immediately. To restore the drive from the park mode, either toggle the RESET switch or power the drive on.

7.3.9 QUIT

Selecting this option exits the program, and returns the user to the main Dealer Service menu.

7.4 Controller Diagnostic

The purpose of the Controller Diagnostic program is to provide comprehensive testing for the Corvus disk drives. Some of these utilities are designed for use when adjusting the servo mechanisms on the Corvus 8-inch, 11-megabyte and 20-megabyte disk drives, and will not be used with the H-Series drives. These few utilities are included here only because they are provided on all Dealer Service Diskettes.

7.4.1 General Description

The Controller Diagnostic program is a combination of Z-80, host system machine code and high-level language programs which allow the technician to directly communicate to the intelligent controller of the disk drive. The code breaks down into three parts as follows:

High-level language terminal program: The high-level portion of the program makes the host computer a semi-intelligent terminal which can communicate with the drive controller. There are several features implemented in the high-level program, such as base conversions, slot selection and the driver which downloads the code to the drive controller.

Host system machine code: The machine code provides the low-level interface to the drive controller. It transmits and receives data from the controller according to the parameters passed to it by the high-level program. It is slot selectable and contains a one second time-out feature which allows the program to recover if the drive is not responding.

Z-80 code: The Z-80 code is the heart of the diagnostic and is the largest portion of the program. It performs the commands which are passed to it by the high-level program via ASCII characters. It consists of three blocks of code which are loaded to different locations in the controller memory.

7.4.2 Controller Diagnostic Commands

The following is a detailed description of each function of the Controller Diagnostic. Please note that there should be no spaces in the commands unless the notation <space> is specified.

Whenever the entry of a Controller Diagnostic command results in the response

"x (Y/N)?"

where x is the command entered, be sure the continuation of this test is appropriate; these commands are destructive to data.

During normal operation, when an error is encountered, the controller will repeat the operation in an attempt to succeed. All errors returned by the Controller Diagnostic are reported without retrying the command.

7.4.2.1 A) ABORT DIAGNOSTIC:

This command allows the operator to leave the diagnostic and return to the command level of the operating system. The format for this command is:

A<return>

7.4.2.2 B) MACRO MENU:

This command allows the operator to create a Macro program. The computer will prompt you with:

W)RITE MACRO X)ECUTE MACRO

Enter W to create a Macro program. The format for this command is:

W<return>

The computer will return with the prompt:

ENTER COMMANDS FOLLOWED BY<RETURN>
TO END ENTRY, TYPE 'END'<RETURN>

Enter single-letter Controller Diagnostic commands from this Controller Diagnostic menu, one at a time, each followed by<return>. The Macro list should begin with the DOWNLOAD command and terminate with "END." The computer will then prompt you with:

DATA OK?

Entering a "n" will return the Controller Diagnostic command prompt. Entering a "Y" will result in the computer prompt:

ENTER MACRO FILENAME =>

Enter the name you wish to call the Macro program you have just created (maximum 11 characters). The computer will respond with:

* MACRO FILE WRITTEN TO DISK *

The Macro file can be executed by selecting "X" from the Macro Menu. The computer will prompt you for the filename:

ENTER MACRO FILENAME =>

Enter the filename of the Macro program you have previously created, and press<return>. The Macro program will begin execution:

* EXECUTING MACRO ==> xx.MAC *

and finish with:

* END OF MACRO PROGRAM *

A sample Macro program with the name of "TEST" is on the Dealer Service Utilities diskette.

7.4.2.3 C) CHANGE SLOT NUMBER:

This command allows the operator to change the slot number of the drive under test. The default value is set to slot 2 at the start of execution. (Note: It is possible to have multiple drives under test by starting execution, then changing slot numbers. You will have to return to the original slot to view test results.) The format for this command is:

C<return>

The computer will prompt you for the slot number as follows:

ENTER SLOT NUMBER (DEFAULT=2) ?

Enter the slot number desired and press<return>.

7.4.2.4 D) DOWNLOAD DIAGNOSTIC:

This command must be executed before any of the tests can be performed on the drive. This command loads the Z-80 code into the memory of the drive controller. The FORMAT switch must be on before downloading the diagnostic in order for the program to function correctly. The format for this command is:

D<return>

7.4.2.5 I) ANALYZE SERVO:

This command allows the operator to measure the seek time of the servo without an oscilloscope. Since the 5.25-inch drives use a stepper motor servo mechanism which does not require any adjustment, this utility is for use with 8-inch Corvus drives only. The format of this command is as follows:

I<return>

The controller will perform 256 seeks and then report the average seek time in milliseconds. This number should be 70 ms ±2.5ms if the servo is within tolerance (8-inch drives only).

7.4.2.6 J) SINGLE DO SEEK:

This command instructs the controller to seek to the cylinder specified in the command. It is used to move the heads to a specific cylinder to observe servo tracks. The format for this command is:

ccc J<return>

where ccc represents the desired cylinder number in hexidecimal. Since the 5.25-inch drive has no servo tracks, this utility is limited to use on the 8-inch drives.

7.4.2.7 L) FULL CYLINDER LOOPSEEK:

This command instructs the controller to continuously seek from cylinder zero to maximum cylinder. This command can be used to check servo action and to adjust the servo board (8-inch drives only), or as a general servo exercise utility for all drives. The Controller will continue seeking until a new command is issued. The format for this command is:

L<return>

7.4.2.8 P) PRINT QUIET SUMMARY REPORT:

This command allows the operator to view the results of the sector quiet, seek scan, read scan and write scan commands. The results are printed in the following format:

1) SEEK ERRORS: Seek errors are represented in the following format:

   ccc:ddd:ee

   where ccc is the desired cylinder in decimal, ddd is the cylinder in decimal which was actually found and ee is the error code. See the error codes in section 8.4.3.

2) CRC ERRORS: CRC errors are represented in the following format:

   ccc-h xxxxx

   where ccc is the cylinder number in decimal, h is the head number in decimal, and xxxx is the number of errors in decimal.

3) TOTAL SEEKS: This number represents the number of seeks the controller has performed so far. The number will be in decimal.

4) SEEK TIME: This number represents the total time spent performing seeks in milliseconds. The average seek time can be calculated by dividing seek time by the number of seeks.

5) RPM: These numbers represent the minimum and maximum speed of the drive during the execution of the sector quiet diagnostic.

7.4.2.9 Q) SECTOR QUIET PROGRAM:

CAUTION:
This command will DESTROY data on the disk.

This command instructs the controller to begin executing the sector quiet diagnostic. This diagnostic is a very comprehensive test of the drive media and electronics. The controller performs continuous seeks, reads and writes at random locations on the disk. The results of this test are obtained by the command documented in 7.4.2.8. The format of this command is:

Q<return>

The controller will respond with:

Q (Y/N) ?

Enter Y<return> to begin the test, enter N to abort. The controller will continue this test until a new command is issued.

7.4.2.10 S) READ SCAN DISK:

This command instructs the controller to perform a sector verify pass (CRC check). The results of the scan will be added to the sector quiet results which are available thru the command documented in 7.4.2.8. The format for this command is:

S<return>

The controller will continue to read scan the disk until a new command is issued.

7.4.2.11 T) SINGLE CYLINDER SEEK SCAN:

This command instructs the controller to single step across the disk. This can be used to observe the servo tracks on the 8-inch drives as the heads move across the platters. The format of the command is:

T<return>

The controller will continue to seek scan until a new command is issued.

7.4.2.12 X) WRITE SCAN DISK:

CAUTION:
This command will DESTROY data on the disk.

This command instructs the controller to perform a bottom level format of the drive. This will not write Controller Firmware, it will simply format the entire disk. The format for this command is:

X<return>

The controller will respond with:

X (Y/N) ?

Enter Y to write scan the disk, enter N to abort. The controller will continue to write scan the disk until a new command is issued.

7.4.2.13 Y) REZERO HEADS:

This command instructs the controller to position the heads on cylinder zero. The format for this command is:

Y<return>

7.4.3 Error Codes

The errors codes returned by the command documented in 7.4.2.8 are as follows:

00 — Hardware detected fault in read or write
01 — heads move off track while not seeking
02 — seek time out
03 — Phase lock oscillator error (PLO)
04 — sector CRC error
05 — cylinder address mismatch
06 — read after write verify error
07 — guard band detected in data region
08 — read sector time out
09 — write sector time out
10 — bad track list overflow
11 — sector locate error

7.5 Burn-In Program

This program is destructive to data on the disk. Be sure a back-up of the data exists before proceeding.

Selecting the Burn-In program will automatically begin the polling of the host computer slots. The program determines the type of drive in that slot, and the burn-in procedure begins on all drives attached to the host system.

The Burn-In program is a rigorous read-write routine which steps through the drive one chunk (256-sector quantity) at a time, reading and writing specific patterns to each of the sectors. The program divides the disk media into chunks by dividing the total number of sectors by 256.

The Burn-In program begins with the highest chunk number. When the read/write test is completed for the current chunk, a random 256-sector read test is executed over the complete disk drive. When this is complete, the chunk number is decremented by one, and the test repeats.

The program may be halted at any time by pressing the <return> key or the SPACE bar. This displays a sub-menu:

C)ONT L)IST R)ESTART Q)UIT

7.5.1 C)ONT

Entering a "C" will cause the program to continue from where it left off.

7.5.2 L)IST

Entering a "L" will cause the error list to be displayed (for example):

```
*** SLOT NUMBER 2 ****
CURRENT TIME = 0,75
TOTAL ERRORS: 0
HARD ERRORS  : 0
SOFT ERRORS  : 0
DO YOU WANT A COMPLETE LIST (Y/N)?
```

Slot number refers to the host slot to which the disk drive is interfaced to. Current time refers to A) the pass number and B) the current chunk being tested.

Errors are those disk read or write errors which, after 15 re-reads or 3 re-writes, are still in error. Soft errors are those read or write errors which, after at least one retry, have been corrected. Requesting a complete list will result in a display of the specific tracks with the error results for each (refer to section 7.4 for detailed information on error codes).

7.5.3 R)ESTART

Entering an "R" will begin the program again from the beginning. All error counters will be re-zeroed.

7.5.4 Q)UIT

Entering a "Q" will return to the Dealer Service Diagnostic menu.

7.6 READ BURN-IN RESULTS

This program allows the burn-in results of all drives to be output to the video display or printer:

```
*** SLOT NUMBER n ***
CURRENT TIME = p,cc
TOTAL ERRORS: x
HARD ERRORS  : y
SOFT ERRORS  : z
[followed by a detailed listing of all errors]
```

where n is the number of the slot that the drive is connected to, p is the pass number, cc is the current chunk being tested, and x,y and z are the total errors, hard errors, and soft errors, respectively.

7.7 Track diagnostic

The Track Diagnostic Utility is a helpful tool for exercising a particular track suspected of having media problems. This program is destructive to data, and should be used only if a backup of the data exists.

Selecting this option from the Dealer Service Diskette will result in the Slot Number and Drive Number prompts. Enter the appropriate values. Pressing <escape> will exit the program.

The prompt SERVO ACTION (Y/N)? is displayed. If The servo mechanism is not suspect, enter an "N."

For each pass (or "pattern"), the test displays the pattern number, the track being tested, and the beginning sector for that track.

The Track Diagnostic begins with the a read from the first sector on the specified track. This is followed by a write of a specific pattern to that sector, and then a verification of the write. If this is all successful, a dot is printed on the screen. If an error is detected, an asterisk is printed. The test is then repeated on the next sector.

Pressing the <return> key or SPACE BAR will halt the test, and display the submenu:

```
C)ONTINUE L)IST ERRORS R)ESTART Q)UIT
```

7.7.1 C)ONTINUE

Entering a "C" will cause the program to continue on as it was before interruption.

7.7.2 L)IST

Entering a "L" will display an error summary (for example):

```
*** ERROR SUMMARY ***
PASS NUMBER: 0
2160 TOTAL READS
1080 TOTAL WRITES
0 TOTAL HARD ERRORS
0 TRACKS WITH HARD ERRORS
0 TOTAL SOFT ERRORS
0 TRACKS WITH SOFT ERRORS
```

The pass number refers to the total number of loops using 256 different patterns to write to those tracks.

The total reads and writes refers to the number of times the sector was written to and read from. The number of reads should always be twice the number of writes.

Hard errors are those disk read or write errors which, after 15 rereads or 3 re-writes, are still in error.

Soft errors are those read or write errors which, after at least one retry, have been corrected.

7.7.3 R)ESTART

Entering an "R" will begin the program again from the beginning. All error counters will be rezeroed.

7.7.4 Q)UIT

Entering a "Q" will return to the Dealer Service Diagnostic menu.

CHAPTER 8
FAULT ISOLATION PROCEDURES

CHAPTER 8
FAULT ISOLATION PROCEDURES

8.1 Scope of Chapter

This chapter contains procedures for diagnosing and testing the Corvus H-Series 5.25-inch disk drives. Recommended test equipment is listed, as are error codes. A list of common failures and procedures pertaining to this chapter may be found at the end of this chapter.

8.2 Introduction

The drive is a sophisticated electronic device, and may, at some time, fail. When failure occurs, it may be due to any of the drive components. The following procedures will aid the technician in isolating the faulty component.

8.3 Tools

The following test equipment is recommended as a minimum for troubleshooting and repair of the Corvus disk drive:

1. Digital voltmeter (±0.1 percent accuracy), with test leads
2. Host microcomputer: Corvus Concept (256K) or Apple II+ (48K), Corvus Interface PCA and 34-pin flatcable
3. Corvus Dealer Service Diagnostic Utilities diskette (currently these are available for the Corvus Concept and Apple II computers)

8.4 Error Codes

For each command sent to the drive by the host operating system, a single-byte error code is returned after the commmand is completed. It is the responsibility of the operating system to interpret the error code and take appropriate action. All errors reported by the Corvus Diagnostic Utilities are in hexidecimal notation.

Errors returned by the controller are listed below. Errors less than or equal to 127 are non-fatal. Those errors greater than or equal to 128 are fatal errors.

The bit format of the error code is shown below:

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0

The eight-bit error code is broken into four segments. Bit 7, when set, indicates that the reported error is a fatal error. Bit 6, when set, indicates that the reported error occurred during the verify (read after write) sequence of the write command. Bit 5, when set, indicates that one or more retrys were attempted before the error was reported. Bits 0-4 represent one of the 21 codes which describe the error (refer to the error lists in this section).

8.4.1 Interpreting Error Codes

Depending on the condition of bits 5-7, there are up to four different error codes for each error condition. To determine the actual error condition, these procedures should be followed:

1. If the error code value is greater than or equal to 128, a fatal error occurred. Subtract 128 if the value is greater than or equal to 128.
2. If the remaining value is less than 64, the error occurred during a disk read. If the value is greater than or equal to 64, the error occurred during the verify portion of a write command. Subtract 64 if the value is greater than or equal to 64.
3. If the remaining value is less than 32, no retrys were attempted. If the value is greater than or equal to 32, at least one retry was attempted before the error was reported.

If no error has occurred, the original error code value of zero will be returned.

Consistent 171 or 235 errors at the same block location indicates bad disk media. Execute the CRC test and follow the instructions for sparing tracks (PRM option, drive Diagnostics).

Consistent 255 errors indicate that the Controller PCA is not responding to command s sent from the Host Computer, and may need replacing.

Table 8-1. Decimal Disk Error Codes

≤127 Non-Fatal			≥128 Fatal		
32					soft error
	128	160	192	224	error in preparing R/W
	129	161	193	225	seek timeout
	130	162	194	226	seek fault
	131	163	195	227	seek error
	132	164	196	228	header CRC error
	133	165	197	229	rezero timeout
	134	166	198	230	rezero fault
	135	167	199	231	drive not online
	136	168	200	232	write fault
	137	169	201	233	format protected
	138	170	202	234	read fault
	139	171	203	235	data CRC error
	140	172	204	236	sector locate error
	141	173	205	237	write protected
	142	174	206	238	illegal sector address
	143	175	207	239	illegal command op code
	144	176	208	240	spare track table overflow
	145	177	209	241	overlay failure
				254	verify error (burn-in test)
				255	controller timeout (diagnostic utilities)

Table 8-2. Hexidecimal Disk Error Codes

≤7FH Non-Fatal	≥80H Fatal			
20				soft error
	80	A0	C0	E0	error in preparing R/W
	81	A1	C1	E1	seek timeout
	82	A2	C2	E2	seek fault
	83	A3	C3	E3	seek error
	84	A4	C4	E4	header CRC error
	85	A5	C5	E5	rezero timeout
	86	A6	C6	E6	rezero fault
	87	A7	C7	E7	drive not online
	88	A8	C8	E8	write fault
	89	A9	C9	E9	format protected
	8A	AA	CA	EA	read fault
	8B	AB	CB	EB	data CRC error
	8C	AC	CC	EC	sector locate error
	8D	AD	CD	ED	write protected
	8E	AE	CE	EE	illegal sector address
	8F	AF	CF	EF	illegal command op code
	90	B0	D0	F0	spare track table overflow
	91	B1	D1	F1	overlay failure
				FE	verify error (burn-in test)
				FF	controller timeout (diagnostic utilities)

Table 8-3. Signed Decimal Disk Error Codes

≤-129 Non-Fatal		≥-128 Fatal		
-224				soft error
	-128	-96	-64	-32	error in preparing R/W
	-127	-95	-63	-31	seek timeout
	-126	-94	-62	-30	seek fault
	-125	-93	-61	-29	seek error
	-124	-92	-60	-28	header CRC error
	-123	-91	-59	-27	rezero timeout
	-122	-90	-58	-26	rezero fault
	-121	-89	-57	-25	drive not online
	-120	-88	-56	-24	write fault
	-119	-87	-55	-23	format protected
	-118	-86	-54	-22	read fault
	-117	-85	-53	-21	data CRC error
	-116	-84	-52	-20	sector locate error
	-115	-83	-51	-19	write protected
	-114	-82	-50	-18	illegal sector address
	-113	-81	-49	-17	illegal command op code
	-112	-80	-48	-16	spare track table overflow
	-111	-79	-47	-15	overlay failure
				-2	verify error (burn-in test)
				-1	controller timeout (diagnostic utilities)

8.5 Troubleshooting Procedures

When a disk drive fails to function normally, the problem may range from a faulty sector to total drive failure. It is the responsibility of the service technician to interpret the symptoms, isolate the faulty component, substitute a replacement, and thoroughly test the drive before returning it to the user.

Corvus provides its Authorized Servicing Dealers with diagnostic utilities and service documentation to aid the technician in servicing Corvus products. The Dealer Service utility diskettes include diagnostics for testing all phases of drive operation. These utilities are described in the section titled "Diagnostics."

Also included in this chapter is a list of Common Symptoms and Solutions.

In using the troubleshooting aids provided, take the following precautions:

1. Make sure all drives have the appropriate version of Controller Firmware.
2. See that the drive has the latest release of controller ROMs.
3. Be sure to disconnect the ac power cord before replacing any modules.
4. Use only known good components when substituting.
5. Retest the system after each component has been substituted.

8.5.1 On-Site Checks

There are several quick checks that can be taken that do not require disassembly of the drive:

1. Be sure the ac power cable is plugged in, and the power switch is turned on.
2. Examine the front bezel switches to verify their proper settings.
3. On the rear bezel, check that the four Mirror DIP-switches are set correctly to reflect the internal Mirror configuration.
4. Check that the CORCOM unit (located on the rear bezel) has the correct line voltage and fuse selected.
5. Verify that the interface cable is not damaged, and has been properly connected at both ends.
6. Check to see that the Interface PCA is in the correct bus slot (where applicable) of the host computer.
7. Check that the drive's Controller Firmware is intact (section 8.5.3.2)

8.5.2 Isolate the Problem

Malfunctions in the Corvus disk system may be divided into three catagories:

1. Magnetic, or software (Controller Firmware integrity, data integrity, format integrity, boot image integrity),
2. Physical media damage (imperfections in media surface)
3. Electronic (host computer function, Corvus drive sealed mechanism and associated Read/Write PXCA and Logic PCA, Z-80 controller, or power supply)
4. Environmental (power stability, temperature and humidity limits).

The first step in analyzing faults in the Corvus disk system is to isolate the drive from other devices. This includes removing networks (such as the Corvus Multiplexer and OMNINET local networks) and backup devices (such as the Corvus Mirror). Using a known good Interface PCA and flatcable, connect the Corvus disk drive to a known good host computer.

Before any diagnosis of the Corvus disk drive can be carried out, the symptom must be duplicated. If the problem does not reoccur within a reasonable amount of time, run the burn-in diagnostic program overnight to thoroughly test the drive.

8.5.3 Drive Not READY

In order to troubleshoot faults in the Corvus disk drive, it must first be in the READY condition, indicated by the READY LED being lit. First, power on the drive and wait approximately 90 seconds. The READY LED alone should light, and if this does not occur, steps must be taken to correct it.

8.5.3.1 Interface

The host computer Interface PCA or cable could be defective, not allowing the drive to reach the READY condition. Disconnecting the flatcable from the drive PROCESSOR connector will isolate the drive. If the READY LED now lights, replace the Interface PCA and cable, one at a time, to isolate the faulty module.

8.5.3.2 Controller Firmware

During the normal power-on sequence Controller Firmware is read into the controller RAM. If the Controller Firmware has been disrupted or contains bad blocks, the drive will not be READY after the power-on sequence completes.

To determine if this is the cause of the symptom, turn on the FORMAT switch and toggle the RESET switch. This will reset the Z-80 Controller, and if the drive passes the hardware self-test, will ignore the Controller Firmware. If the READY LED now lights, faulty Controller Firmware is indicated and the UPDATE utility must be executed to rewrite the Controller Firmware code. After this has been done, turn off the FORMAT switch and toggle the RESET switch. This again will reset the Z-80 controller which will read the newly-written Controller Firmware into the on-board RAM. The READY LED should now light.

8.5.3.3 Power Supply Voltages

If the fault has been determined to be a drive hardware failure, the first action taken should be to check the power supply voltages.

Check the voltages when the drive is first recieved, and because of line voltage variations between locations, at the customer site also. If any of the dc output voltages cannot be brought within tolerance, the power supply must be replaced.

Using a Digital Voltmeter, follow the voltage check and adjustment procedures outlined in the Adjustments section of this manual. The dc power connectors (located on the PCA(s) underneath the sealed mechanism and on the backplane), should be checked for a clean and tight fit. Measuring the voltages at the drive Backplane power pins as well as at the power supply will verify that the power connector and cable are in good condition. Inspect the dc power cable, checking for breaks at both ends. The power cable may be faulty if the voltages are not present at the drive Backplane.

Symptoms indicating power supply failure or misadjustment include front bezel LEDs failing to light, drive motor failing to turn or speed fluctuating, and drive going off-line (drive error 255), and CRC errors.

Dc output of the power supply is a function of the correct ac input; the dc voltages will not be correct if the improper line voltage is selected. To verify that the proper line voltage has been selected, locate the CORCOM unit on the rear bezel of the drive cabinet. This unit contains the fuse and voltage selection PCA. If the voltage is changed, be sure that the line fuse is also changed. Symptoms indicating incorrect line voltage selection include dim or dark LEDs, low motor speed, and extreme heat output.

8.5.3.4 Drive Electronics

If the READY LED will not light, and the power supply is operating properly and the voltages are within tolerance, it is probably due to a faulty component within the drive.

Sometimes symptoms indicating a faulty drive PCA are in fact caused by poor contact between connectors. Power supply connectors, PCA edge connectors, IC sockets and switch contacts are some of the connectors which may lose contact, and result in a malfunctioning drive. Reseating all connectors and using an eraser, clean on all gold edge connector pins to help eliminate any oxidation that may have built up, causing improper contact. Also, reseating socketed ICs on the drive Controller PCA will ensure good pin connections.

WARNING:

Always turn off ac power and disconnect power cord before replacing any components.

Replace the drive controller with a known good unit:

1. Remove power to the drive.
2. Disassemble the drive and remove the Controller PCA.
3. Install a known good Controller PCA.
4. Power on the drive.

If the controller was faulty, the READY LED will now light. If the READY LED still fails to light, the next step is to replace the drive sealed mechanism with a known good unit.

8.5.3.5 Drive Sealed Mechanism

The drive mechanism is a sealed unit with no internally servicable parts. Any malfunctions with the drive mechanism necessitate replacing the drive module.

Drive mechanism failure may be due to any one of the following:

1. Microchip failure
2. Drive motor failure
3. Servo stepper motor failure

8.5.4 Link Inoperative

If the drive powers on, spins up to speed, passes the self-test and the READY LED lights, certain basic circuits and sub-systems within the drive are working. The test does not, however, verify the integrity of the disk Operating System (DOS), the disk media or much of the drive electronics and power supply. If the DOS is damaged or not properly patched for communication to the Corvus disk drive (initialization procedures, Corvus User Guide), the drive will not function properly.

Linking is the process of booting the host computer with the Corvus-patched DOS. The type of DOS depends on the type of computer system, and should be a known good copy, patched for the Corvus drive. For those systems that do not store a DOS image on the Corvus drive and then boot directly from the Corvus (CP/M does not), booting the standard floppy-based DOS and executing the LINK program will establish the patch.

Corvus recommends that Corvus Dealer Service Centers keep on hand archival, known good Corvus-patched copies of the DOS for the specific computers serviced at that location. This will insure that a new DOS copy may be substituted for the users' DOS for troubleshooting purposes.

8.5.4.1 Check Link Action

Boot the computer using a known good boot image or link software. When this has been done, list the directory of the drive or volume. If this fails or a drive error is returned, steps must be taken to correct this.

8.5.4.2 Power Supply

The power supply voltages should be checked and adjusted if necessary before any further testing is done. Without proper voltages, the read amplifier on the Read/Write PCA will be referencing incorrect thresholds for the data signal, possibly mistaking a good sector for a CRC error.

8.5.4.3 CRC Test

Execute the CRC test. This will test the controller's ability to decode drive commands, as well as the stepper motor and read-write electronics. This test will also verify the condition of the drive media. The CRC test will report either no errors or the cylinder, head and sector numbers of the faulty sector. If the CRC errors are encountered, the complete track must be spared (PRM option, drive Diagnostics, Corvus User Guide).

Sometimes the CRC test will not begin (READY LED remains lit) or will not finish (BUSY LED flickers momentarily, and then the READY LED alone lights). A misadjusted power supply or improper format could cause this. Also, a damaged copy of the CRC program could cause problems, making it impossible to trace problems without a known good copy of the utilities.

8.5.4.4 Controller Communication

If the drive does not respond to the CRC test, this may be due to several causes. First, some simple oversight may be the cause (see On-Site Checks, above). Alternately, the controller may not be properly decoding the commands sent from the Host Computer (due to incomplete Controller Firmware resident in RAM, or to a defective component on the Controller PCA), or the drive mechanism itself may have a defective component.

Executing the Controller Diagnostic DOWNLOAD command will attempt to establish communication with the Controller PCA. The diagnostic software will respond with "Programs Loaded To Controller Memory" if this succeeds. Further diagnostic commands should then be executed to determine if the controller is communicating with the drive mechanism. If the diagnostic DOWNLOAD command responds with "Download Aborted" this indicates that the Host Computer and the Controller PCA are not communicating.

8.5.4.5 Servo Action

Once communication with the Controller PCA has been established drive mechanism performance should be checked. Executing the servo exercise command (Controller Diagnostic LOOPSEEK command) will verify the drive mechanism's ability to seek, read and write. Fatal errors encountered during this diagnostic command indicate a possible defective drive mechanism.

8.5.4.6 Controller Firmware

If the controller and drive mechanism respond positively at this point, the Controller Firmware should be rewritten and the drive parameters checked (drive Diagnostic utility PARAM) if this has not been done already. The Z-80 controller does not check each block in the Controller Firmware area to check that it is legitimate Controller Firmware code, and will attempt to load it into the on-board RAM when the drive is powered on. If the READY LED lights after power-on, this is only an indication that no CRC errors have been encountered. Rewriting firmware is non-destructive to data.

8.5.4.7 Boot ROM

Some computer systems use a boot ROM on the Interface PCA to boot a DOS image from the boot area of the drive. A faulty memory location in this ROM may cause the drive to fail at boot time. Replace only with a tested, known good replacement.

8.5.4.8 Interface Components

A defective Interface PCA or cable may be the cause of problems with the drive. Replace both, only with tested, known good replacements, and reinstall originals, one at a time, retesting the drive after each.

8.5.4.9 Drive Initialization

Corvus provides drive initialization software for each computer operating system (CP/M, Apple DOS, UCSD Pascal, NEWDOS, IBMDOS, CCOS, etc). These utilities initialize the platter surface for accepting a DOS boot image (where applicable) as well as directory and data area.

These areas of the disk, if disturbed either physically or magnetically, will no longer retain the correct information sought by the CATALOG or DIRECTORY listing commands. In this case, the initilization procedures (i.e. PUTGET, PSYSGEN or BSYSGEN) must again be executed to properly initialize the disk surface (refer to the Corvus User Guide for initialization procedures). Be sure to use archival, known good copies of all software whenever initializing the drive.

Any problems persisting at this point lie either with the drive electronics or the disk media. The electronics should be tested, and if this is not found to be the cause of the problem, the drive should be re-initialized, using a new copy of the software utilities.

8.6 Final Adjustments and Tests

When the faulty module in the drive has been replaced and the problem eliminated, the repair process is only halfway completed. Final checks and adjustments must be made and the drive tested thoroughly overnight before it may be returned to the user.

8.6.1 CRC Test

The drive media must be verified reliable before the drive can be certified as usable. The CRC test should be executed before and after the drive image is restored with the Mirror, to check that no sectors have been destroyed. Tracks with faulty sectors should be spared using the PARAM option of the drive Diagnostics.

8.6.2 Install and Test Mirror

If a Corvus Mirror back-up device was part of the original disk system, it should have been removed from system as one of the first steps in troubleshooting the drive. Having traced and replaced the faulty component in the drive, the Mirror should now be installed and tested. Refer to the Corvus Mirror Service Manual for procedures on troubleshooting and servicing the Mirror.

8.6.3 CRC Test

Executing the CRC test once again, verifies that elementary communication exists, and that no sectors were accidentally destroyed by restoring a faulty Mirror image.

8.6.4 Power Supply

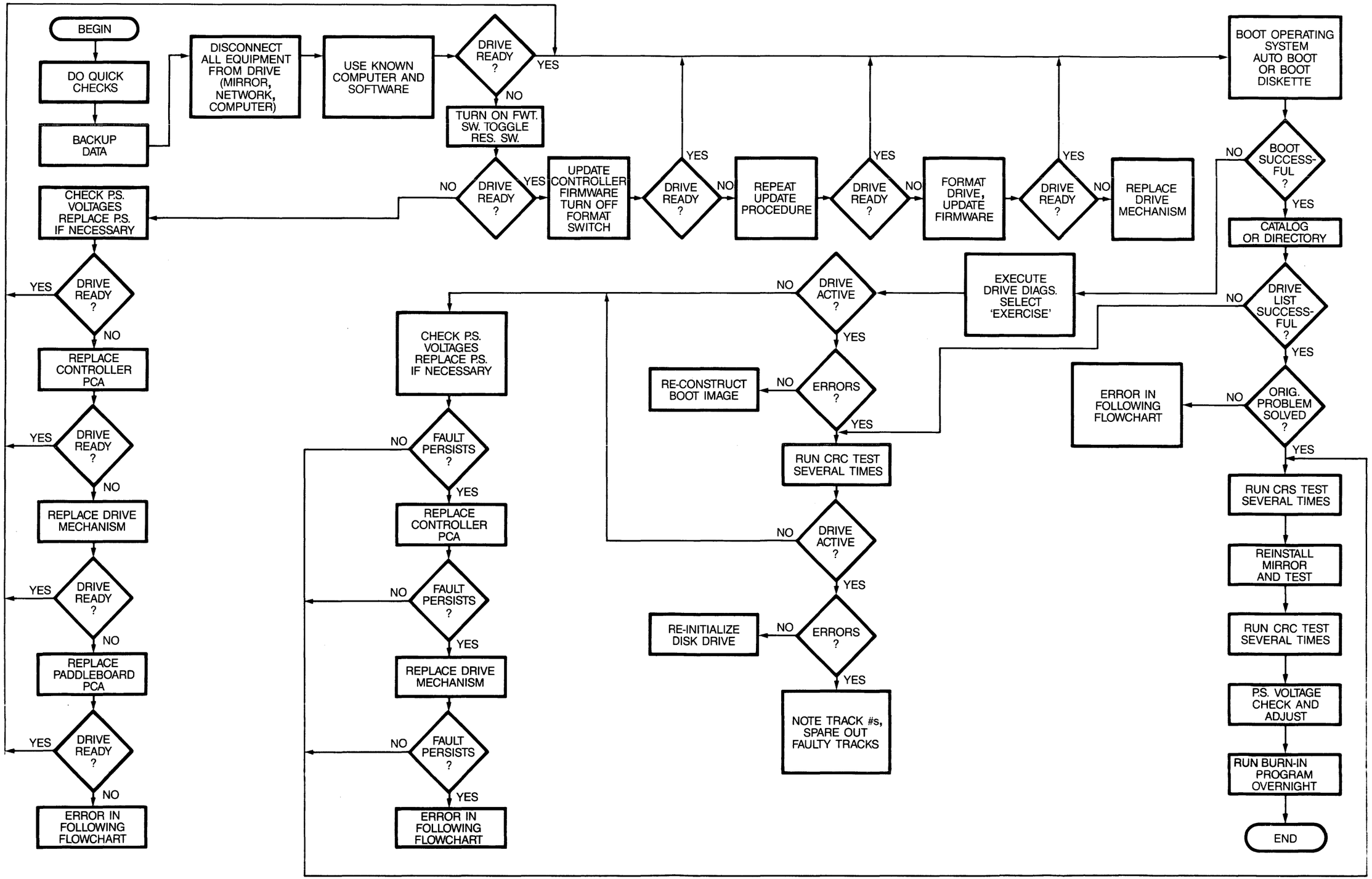
After troubleshooting procedures have been completed, the power supply voltages must be checked once again before the drive can be tested. This is to insure that the Burn-In test is testing a properly adjusted drive.

8.6.5 Burn-In Test

The Burn-In test is the final endurance test of the drive, revealing any malfunctions as hard or soft errors. This program tests the seeking, reading and writing abilities of all drives connected to the host computer.

The Burn-In test should be run, at a minimum, overnight after all repairs and adjustments on the drive have been completed. If any sectors experience errors, the Track Diagnostic program should be executed for all tracks containing suspect sectors to determine if these are recurring errors. If the errors persist, the tracks should be spared (drive Diagnostic utliity PARAM).

TROUBLESHOOTING FLOW CHART



SYMPTOM	CAUSES	RECOMMENDED REPAIR
1. Drive platters won't turn.		
A. All LEDs off and stay off.	ac power improperly selected.	Check and adjust.
	+12V misadjusted	Check voltage and adjust.
	+12V not present at drive mechanism	Check dc power connector for continuity and proper connection at drive
	+12V not existent or not adjustable	Replace power supply
B. All LEDs light then BUSY alone remains lit	Brake solenoid not releasing	Adjust brake mechanism
	Drive motor defective	Replace drive sealed mechanism
2. Unable to format drive		
A. READY remains lit	Mirror switches set wrong	Check and set properly
	Interface card defective	Replace interface card
	Interface cable defective	Replace interface cable
	Controller ROM defective	Replace Controller ROM
	Controller PCA defective	Replace Controller PCA
	Backplane defective	Replace backplane
B. BUSY remains lit constantly	Controller unit address switches set incorrectly	Set switches correctly
	Controller ROM defective	Replace Controller ROM
	Controller PCA defective	Replace Controller PCA
	Drive mechanism defective	Replace drive mechanism
3. Unable to update Controller firmware		
A. All LEDs go off, remain off	Drive not ready.	Turn on FORMAT switch, toggle RESET switch
	Bad track in firmware area HDA	Replace drive sealed mechanism
	Controller PCA defective	Replace Controller PCA
	Drive sealed mechanism defective	Replace drive sealed mechansim
B. Busy LED lights and remains lit	Drive format blown	Reformat drive
	Controller ROM defective	Replace Controller ROM
	Controller PCA defective	Replace Controller PCA
	Drive sealed mechanism defective	Replace drive mechanism

SYMPTOM	CAUSES	RECOMMENDED REPAIR
4. CRC FORMAT CHECK will not begin or finish		
A. Busy LED lights and remains lit, or FAULT LED only remains lit	Front bezel switches incorrect	Check switch settings
	Controller ROM defective	Replace Controller ROMs
	Format not intact	Reformat drive
	Controller PCA defective	Replace Controller
	Drive sealed mechanism defective	Replace drive mechanism
5. Unable to spare track		
A. All LEDs off and remain off	Controller ROM defective	Replace Controller ROM
	Controller PCA defective	Replace Controller PCA
	Drive sealed mechanism defective	Replace drive mechanism
	Maximum number of tracks already spared (31 total)	Replace drive mechanism
6. Drive will not execute Servo Exercise under Diagnostic		
A. Busy LED remains lit	Power supply voltages misadjusted	Check voltages, adjust or replace supply as needed
	Drive sealed mechanism defective	Replace drive mechanism
7. Computer boots into monitor (Apple)		
A. Drive goes BUSY, then READY	Boot image corrupted	Recreate boot image (see Corvus user guide)
	Boot program on Corvus utility diskette corrupt	Recreate boot image using good copy of utilities
	Boot ROM on interface PCA bad	Replace Boot ROM
	Interface PCA defective	Replace Interface PCA
8. Drive will not Boot		
A. Busy LED lights and remains lit	Drive does not contain boot image	Create boot image on drive (see user's manual
	Boot ROM on interface PCA defective	Replace Boot ROM
	Interface PCA defective	Replace Interface PCA

SYMPTOM	CAUSES	RECOMMENDED REPAIR
	Controller ROM defective	Replace Controller ROM
	Controller PCA defective	Replace Controller PCA
	Drive sealed mechanism defective	Replace drive mechanism
B. READY light remains lit	Mirror switches set incorrectly	Set switches properly
	Front panel switches set incorrectly	Set switches correctly
	Interface board defective	Replace interface board
	Interface cable defective	Replace interface cable
9. I/O errors during normal operation		
A. Normal LED display or all LEDs off and remain off	Software currently running on host system defective	Replace software with known good copy and reexecute
	Boot image corrupted	Recreate boot image (see user's manual)
	Defective track	Execute CRC FORMAT CHECK. Spare any tracks returning errors
	Controller ROM defective	Replace Controller ROM
	Controller PCA defective	Replace Controller PCA
	Power supply voltages out of tolerance	Adjust power supply
	Power supply voltages fluctuating	Replace power supply
	Drive sealed mechanism defective	Replace drive mechanism
10. Heads slam against inner crash stop (toward hub)		
A. Busy LED lights and remains lit	Controller Firmware corrupted	Update Controller Firmware
	Power supply voltages out of tolerance	Check voltages, adjust if necessary
	Power supply voltages intermittant or can't adjust	Replace supply
	Controller ROM defective	Replace Controller ROM
	Controller PCA defective	Replace Controller PCA
	Drive sealed mechanism defective	Replace drive mechanism
11. Sector destroyed during normal operation		
A. Busy LED lights and remains lit	Boot ROM (where applicable) or interface board defective	Replace boot ROM. If problem persists, replace Interface PCA

SYMPTOM	CAUSES	RECOMMENDED REPAIR
	ac power surge during read/write operation	Determine quality of ac power supplied to Corvus and host. Determine types of devices on same ac circuit. Large power consuming devices should not share power with the disk drive.
	Power supply voltages out of tolerance	Check and adjust voltages
	Controller PCA defective	Replace Controller PCA
	Weak media spot on platter surface	Determine tracks affected and spare
	Defective drive sealed mechanism	Replace drive mechanism
12. Motor speed varies	+12V out of tolerance	Check and adjust voltage
	dc cable to drive defective	Check wiring, replace supply if bad
	Loose dc connection at drive	Clean connector pins, make sure connector is seated properly
	+12 V non-existent or not adjustable	Replace power supply
	Drive motor defective	Replace drive sealed mechanism
13. Low motor speed	ac input voltage set incorrectly	Check and adjust
	See #12. above	
14. Heads not rezero		
A. BUSY LED lights and remains lit	Firmware corrupted	Update firmware
	Format corrupted	Reformat drive and update firmware
	Low motor speed	See #12 and 13 above
	Controller unit address set wrong	Set switches correctly
	Controller PCA defective	Replace Contoller PCA
	Drive sealed mechansim defective	Replace drive mechanism
B. FAULT and BUSY LEDs stay on, READY goes off	Controller ROM defective	Replace Controller ROM
	Controller RAM defective	Replace 4118 RAM on Controller PCA
	Controller PCA defective	Replace Controller PCA
C. All LEDs stay off	Incorrect ac power setting	Check and adjust
	Power supply voltages incorrect	Adjust or replace supply as necessary
	Defective Controller ROM	Replace Controller ROM
	Defective Controller PCA	Replace Controller PCA

SYMPTOM	CAUSES	RECOMMENDED REPAIR
	Paddleboard cable connected wrong	Check paddleboard cable connections
	Defective paddleboard	Replace paddleboard
	Defective paddleboard cable	Replace cable
	Defective drive sealed mechanism	Replace drive mechanism
	Defective backplane	Replace backplane
D. All LEDs stay on	Power supply voltages incorrect	Adjust or replace supply as necessary
	Defective Controller PCA	Replace Controller PCA
	Defective drive sealed mechanism	Replace drive mechanism
15. Head oscillates after drive is turned on		
A. BUSY LED lights and remains on	Controller Firmware corrupted	Update firmware
	Format corrupted	Reformat and update firmware
	Power supply voltages incorrect	Adjust power supply
	Power supply defective	Replace power supply
	Controller PCA defective	Replace Controller PCA
	Drive sealed mechanism defective	Replace drive mechanism

APPENDIX A
GLOSSARY

GLOSSARY

BACKPLANE OR MOTHERBOARD: two-slot printed circuit board which accepts the Mirror PCA (when installed) and Controller PCA.

BIT: single binary digit. Smallest representative unit of data, several of which make up characters (A-Z, 0-9, etc.). Bits may be either a one or a zero, on or off, set or reset. This may be shown by either a signal being present or not, or by a signal changing states or being constant.

BLOCK: a relative quantity of data bytes. The Corvus disk defines one block to contain 512 bytes of data, the smallest addressable unit within the drive. The host operating system may define a block as 128, 256 or 512 bytes in length. Externally, since the disk drive handles data in sectors, no apparent conflict appears to the host system.

BRAKE OR SOLENOID BRAKE: immediately after power-down, this mechanism engages, so as to minimize contact time between heads and disk surface, and brings the platters to a stop.

BYTE: any multi-bit digital value, usually eight bits long. The Corvus disk drives use eight-bit bytes.

CABINET OR ENCLOSURE: the cabinet which contains the IMI drive mechanism, power supply and fan. The front bezel attaches to the cabinet basepan. Two screws at the rear of the cabinet secure the cabinet top to the basepan.

CONTROLLER OR Z-80 CONTROLLER OR INTELLIGENT CONTROLLER: the disk controller circuitry including the Z-80 microprocessor and support logic.

CORCOM: the rear bezel unit which accepts the power cord, and contains the line filter, line voltage PCB and fuse.

CYLINDER: all data tracks in common vertical alignment. There are 306 concentric cylinders on all H-series drives. The Model 6 has two tracks per cylinder, the Model 11 has four, and the Model 20 has 6.

DISK MECHANISM OR SEALED MECHANISM: the IMI disk drive assembly consisting of platters, drive motor, head assembly and stepper-motor mechanism, all in a sealed, cast aluminum body. The above components inside the sealed mechanism are not field-servicable and the unit is not to be opened by any other than a Corvus factory facility, otherwise the warranty will be void.

DMA OR DIRECT MEMORY ACCESS: method by which data is transferred at a very high rate, independent of the processor. The processor is put into a "wait" state, where it does no data manipulation. The DMA circuitry takes care of all details, using the Z-80 address bus for destination or origin address for data transfer.

DVM: Digital Volt Meter. A meter used for measuring voltages, which shows output by means of a display consisting of changing digits, proportional to the voltage measured.

FIRMWARE or CONTROLLLER FIRMWARE: Z-80 code contained in the first two cylinders of the drive consisting of routines for the Spare Track Table, Virtual Drive Offset table, Pipes, and Semaphore Status Flags. The appropriate routines are downloaded from the Firmware are into the on-board RAM for execution by the Z-80 Controller at power-on time.

FRONT BEZEL: the front panel of the cabinet, containing the Paddleboard PCA and logo.

GROUNDSTRAP: located at the lower end of the spindle in the drive sealed mechanism, the groundstrap consists of a copper metal strip terminating with a carbon button which rides on the spindle end. This device discharges any static charge which may build up on the platters or spindle.

HEAD: in the Winchester disk, very low-mass glass-ferrite, aerodynamic-shaped component, containing a wire winding. There is one head for each data surface which float 18 microinches above the platters on a cushion of air. When current passes through the winding, an electromagnetic flux is induced into the platter surface representing a bit.

HEADSTACK: casting to which all heads are attached. Located in the top of the headstack is the microchip responsible for head selection and signal buffering.

IC: Integrated Circuit. A hybred, densely populated wafer of silicon containing many resistors and transistors.

MEGABYTE: one million bytes.

MFM (MODIFIED FREQUENCY MODULATION): a method of writing information on a magnetic surface which allows a higher bit density to be used, therefore increasing storage capacity while decreasing size.

MOTOR CONTROL PCA: printed circuit board responsible for monitoring the spindle motor speed and adjusting this as necessary.

NRZ (NON-RETURN TO ZERO): digital representation of information used by microprocessors.

PADDLEBOARD: the small PCA located on the front bezel, which contains the three LEDs and four function switches.

PCA: Printed Circuit Assembly. The Printed Circuit Board, assembled with all its components.

PCB: Printed Circuit Board. Epoxy board with a copper circuit etched onto it. The PCB is the bare board without the usual components such as resistors, transistors and integrated circuits.

PLATTER: circular disks coated with a magnetic oxide that will retain a magnetic flux induced by the read/write heads. Both surfaces of each platter contain data. The 10-megabyte drive has two platters, while the 20-megabyte has three.

REAR BEZEL: the rear most panel area of the cabinet, containing the flatcable connectors for the interface cable, video connectors, power cable and fuse holder. Serial number is located on the rear bezel, also.

SECTOR: each track is divided radially into 20 segments. Each segment is one sector, and contains one block of data, one CRC value, and header information required by the disk controller.

SINUSOIDAL WAVE: a wave form that represents periodic oscillations.

TRACK: all points on one surface with the same radius. Tracks are configured concentrically on each surface.

WINCHESTER TECHNOLOGY: a unique design first developed by IBM as a means to reduce the size of a disk drive while increasing its capacity and removing the posibility of contamination of the disk components. The result was a disk unit much smaller than the traditional 14-inch disk platters with equivalent capacity. This is due to new head design and the use of the sealed-environment used with the disk drive which does not allow the external atmosphere inside the disk mechanism. Inherent in this design is heads that rest on the platters after the drive is powered off. The Corvus disk system uses International Memories Incorporated (IMI) Winchester disk drives.

READ/WRITE PCA: the printed circuit assembly responsible for changing the data received from the heads in MFM format and amplifying and shaping the data signal before passing it on to the Controller circuitry for manipulation.

APPENDIX B
H-SERIES PARTS LIST

H-SERIES PARTS LIST

DESCRIPTION	PART NO.
CABINET COVER	8010-08056
CABINET BASE	8010-09321
FRONT BEZEL	3100-02071
IMI 5006H HDA	2200-02906
IMI 5012H HDA	2200-02907
IMI 5018H HDA	2200-02908
MOUNTING BRACKET	2400-02929
CONTROLLER PCA	8010-09348
BACKPLANE PCA	8010-08108
PADDLEBOARD PCA	8010-03029
5.25" MIRROR PCA	8010-08025
CP510 POWER SUPPLY	8010-09322
FAN, COOLING	2600-01145
FAN COWLING	2600-01707
DRIVE CABLE 34-PIN	8010-09074
DRIVE CABLE 20-PIN	8010-08046
PDLBD-BKPLN CABLE	8010-08046
AC POWER SWITCH	5100-02420
AC HARNESS	8010-08514
A/C POWER CORD	6010-01447
SCREW 8-32 X ⅜	2800-02975
SCREW 6-32 X 5/16	2800-02764
SCREW 4-40 X ⅜	2800-02650
SCREW 6-32 X ⅜	2800-01177
SCREW 8-32 X ⅜	2800-02776
SCREW 6-32 X 1 ½	2800-02774
SCREW 8-23 X ½	2800-02765
SCREW 6-32 X ½	2800-02666
SCREW 6-32 X ⅜	2800-02664
SCREW 4-40 X ½	2800-02652
WASHER FLAT #6	2800-01198
KEPNUT 4-40	2800-01189
KEPNUT 6-32	2800-01188
WASHER FLAT	2800-01171
NUT 6-32	2800-01165

APPENDIX C
INTERNAL CABLING CHART

H-Series Drive
Internal Cabling Chart

The following references of "left" and "right" are as seen from the front of the drive cabinet.

All H-Series Drives

Flatcables:

—Mechanism-to-Controller (34-pin)
Mechanism: One edge forward
Controller: one edge to the left

—Mechanism-to-Controller (20-pin)
Mechanism: one edge forward
Controller PCA: top connector only, one edge to the left

—Paddleboard-to-Backplane (20-pin)
Paddleboard: one-edge down
Backplane: one-edge to the left

—Backplane-to-Host Interface (34-pin)
Backplane: one edge to the left
Host Interface: refer to the Installation Guide

Dc Power Cables:

—To Drive Mechanism:
Yellow wire forward

—To Backplane:
Yellow wire right

The following references of "left" and "right" are to a drive mechanism that is held upside-down, with the IMI serial number label to the left.

Drive mechanism:

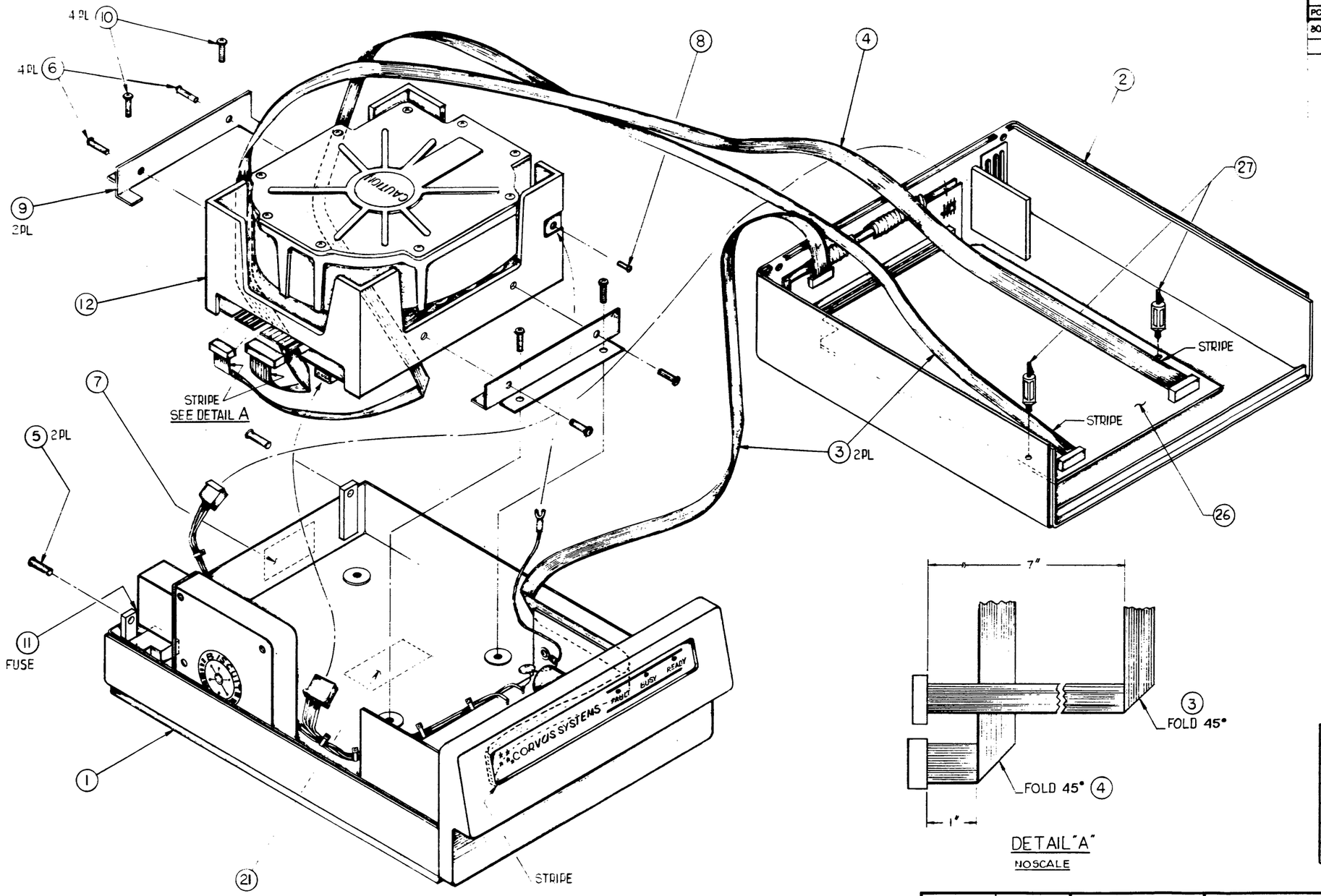
—Motor Control PCA:
Brake connector: located at left end
Drive motor connector: located at right end
Track zero switch flatcable connector: 90-degree rotation before connecting to molex pins

NOTE:

On Motor Control PCA assembly number 811-01908, the drive motor connector (J-22) will have an open pin after all connectors are attached. This open pin will be at the right end of the connector.

—Read/Write PCA:
Stepper motor connector: yellow wire nearest the case

REVISIONS				
PCO	REV	DESCRIPTION	DATE	APPROVED
805	A	REL FOR PROD	11-23-82	SVR



DETAIL "A"
NOSCALE

DRIVE \ VOLTAGE	110 V	220V
6MB	8005-09152	8005-09158
6MB/M	09155	09161
11MB	09153	09159
11MB/M	09156	09162
20MB	09154	09160
20MB/M	09157	09163

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
ANGLES ± DECIMALS .XX ±. .XXX ±.
MATERIAL
FINISH

DRAWN BY HUY B. DATE OF DRAWING 9-15-82
CHECKED BY Mike Mueller ENGINEER G. RYDQUIST
APPROVED
APPROVED

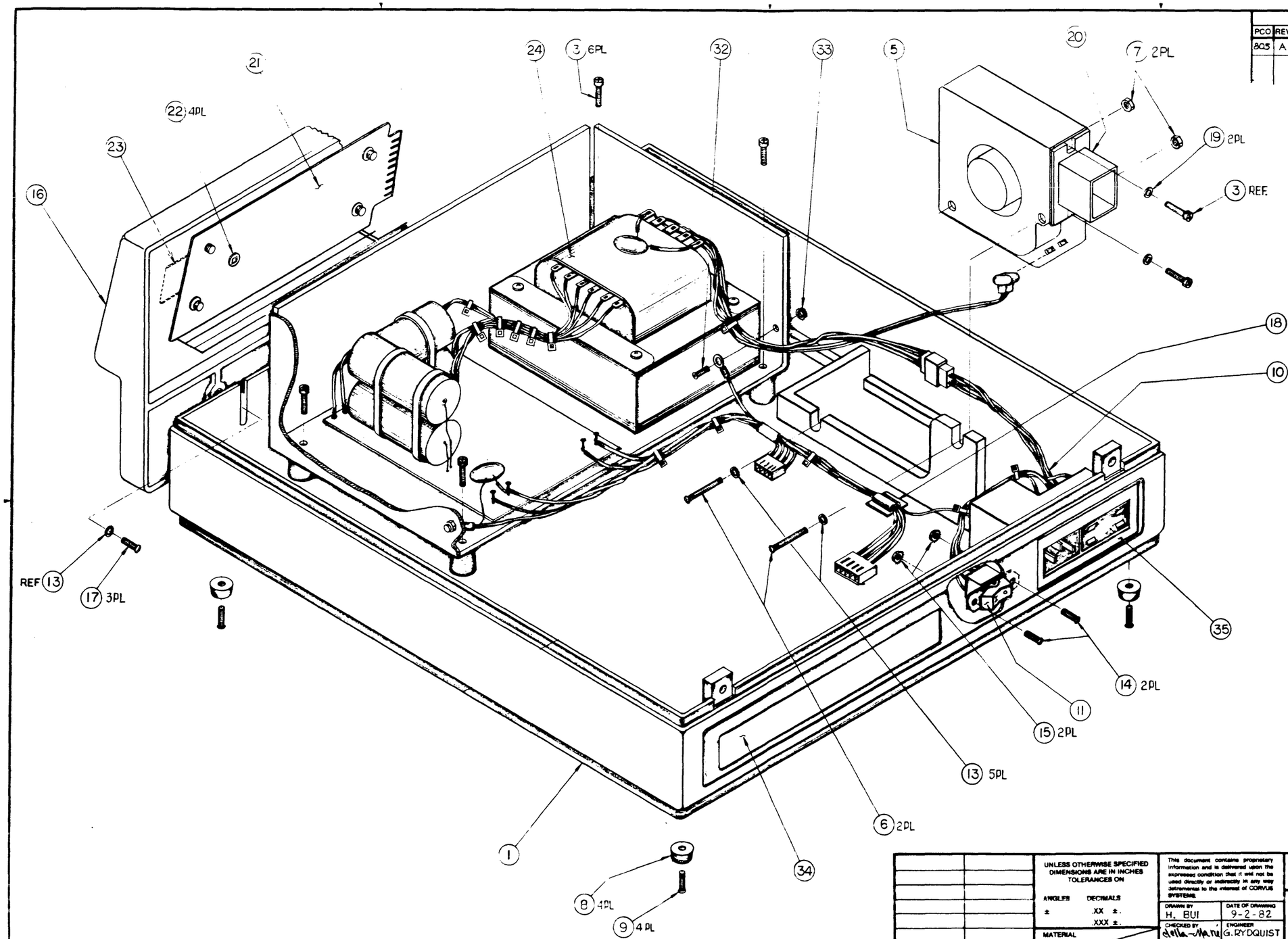
CORVUS SYSTEMS
2029 O'Toole Avenue, San Jose, CA 95131

FINAL ASSY 'H' DRIVE

ASSEMBLY DWG. 8005-09152 THRU. 8005-09163

SCALE NONE — SHEET 1 OF 1

REVISIONS				
PCO	REV	DESCRIPTION	DATE	APPROVED
805	A	REL FOR PROD	11-23-82	



NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
ANGLES ± DECIMALS .XX ± .XXX ±
MATERIAL
FINISH

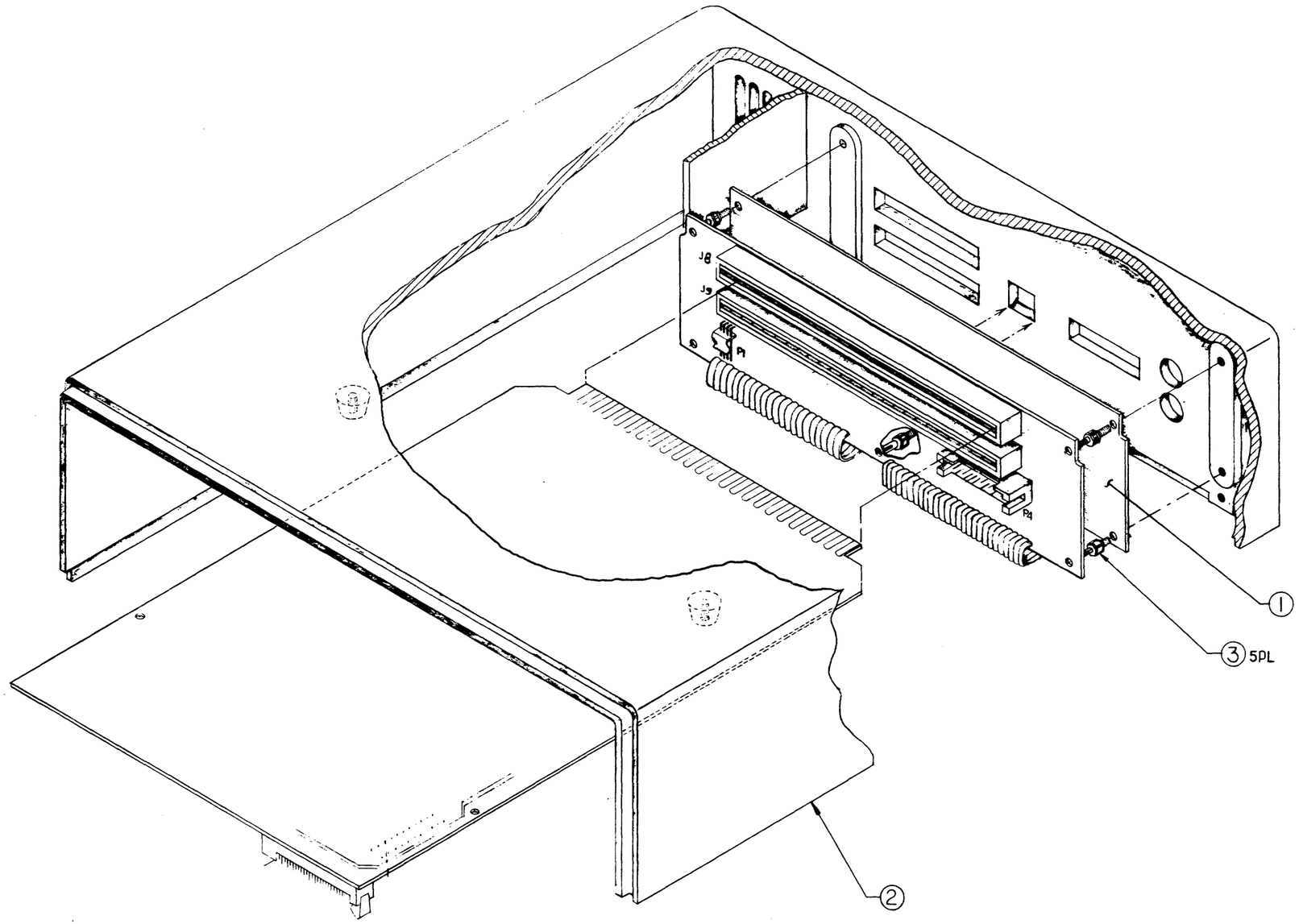
DRAWN BY	DATE OF DRAWING
H. BUI	9-2-82
CHECKED BY	ENGINEER
della-Maria	G. RYDQUIST
APPROVED	
APPROVED	

CORVUS SYSTEMS
2029 O'Toole Avenue, San Jose, CA 95131

6MB 'H' DRIVE BASE

ASSY DWG.	8010-09321
SCALE NTS	SHEET 1 OF 1

REVISIONS				
PCO	REV	DESCRIPTION	DATE	APPROVED
244	A	REL. FOR PROD.	—	—
210	B	HARDWARE CHANGE	1-7-82	
391	C	NEW TOP COVER	4-30-82	



SEE PARTS LIST

2090	TJP
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
ANGLES ± DECIMALS .XX ± .XXX ±
MATERIAL
FINISH

DRAWN BY HUY B — DATE OF DRAWING 9-22-81
CHECKED BY — ENGINEER
APPROVED
APPROVED

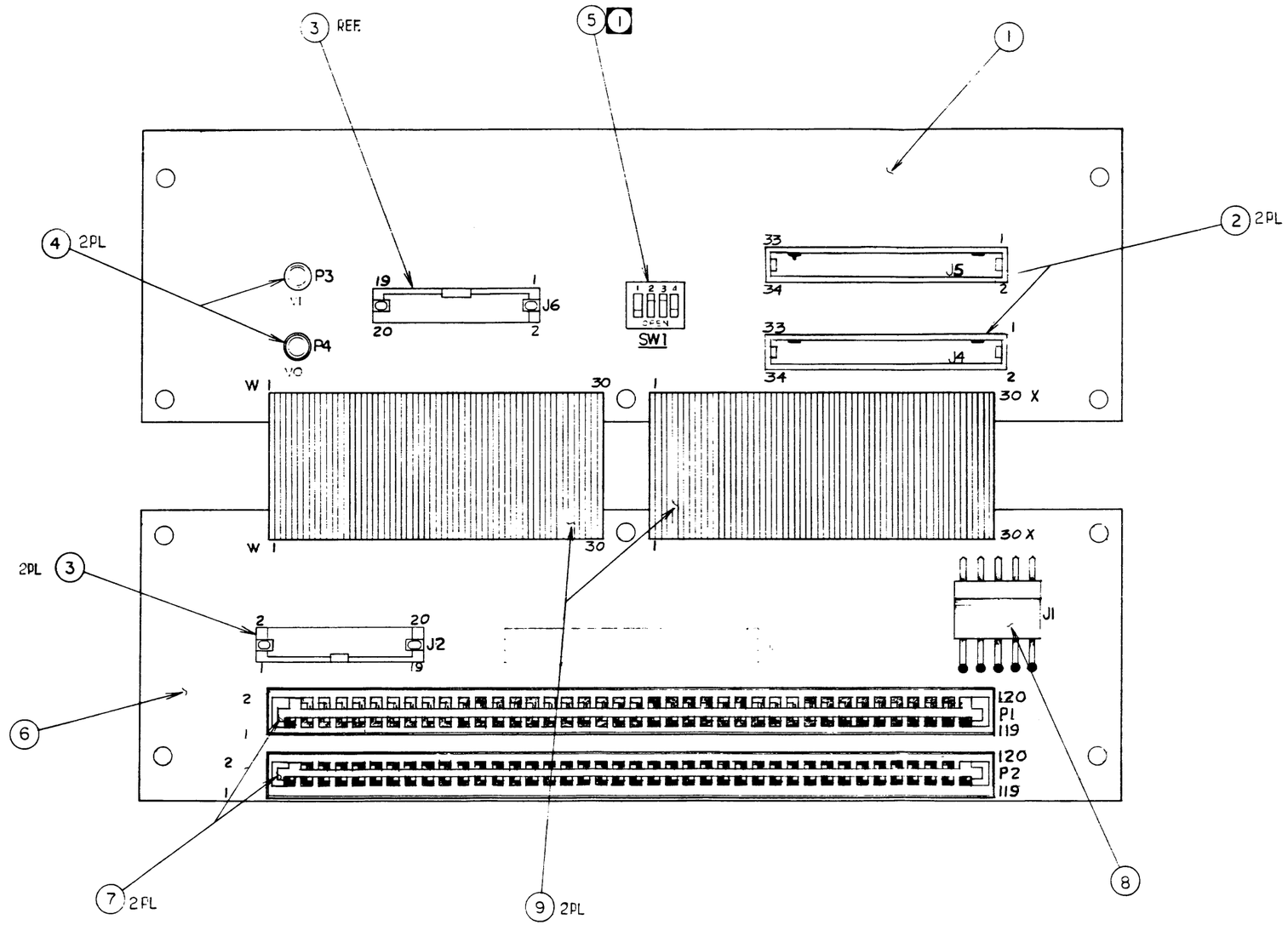
CORVUS SYSTEMS
2029 O'Toole Avenue, San Jose, CA 95131

6MB FOAM TOP COVER

ASSEMBLY DRAWING 8010-08056

SCALE 1:1 — SHEET 1 OF 1

REVISIONS				
PCO	REV	DESCRIPTION	DATE	APPROVED
247	A	REL. FOR PROD.	—	—
325	B	REMOVE NOTCHES	2-26-82	
380	C	DIP SW CHG-CORRECTIONS	4-14-82	
689	D	CHG ITEM 2, ADD ITEM 10	[illegible]-82	



[1] INSERT DIP SWITCH AS A SECONDARY OPERATION. (AFTER WAVE SOLDERING)

32 PIN	TOP CONN
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
ANGLES ± DECIMALS .XX ±. .XXX ±.
MATERIAL
FINISH

DRAWN BY LUIS S. DATE OF DRAWING [illegible]-81
CHECKED L. FRIEDMAN ENGINEER
APPROVED
APPROVED

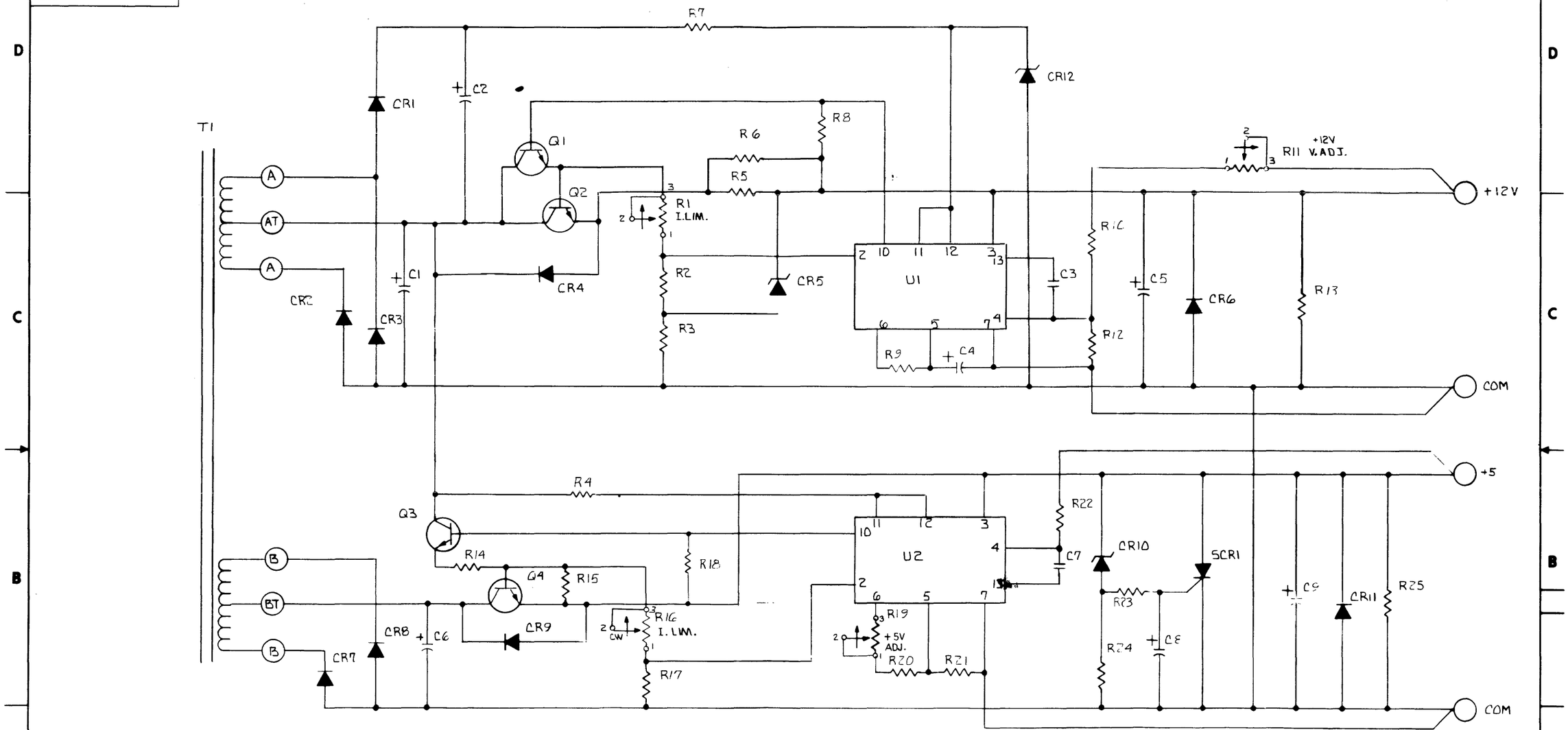
CORVUS SYSTEMS
2029 O'Toole Avenue, San Jose CA 95131

PCA, 6MB BACKPLANE ASSEMBLY 6MB FOAM

[illegible] DWG 8010-08108

SCALE [illegible] SHEET 1 OF 1

REVISIONS				
ECO	LTR	DESCRIPTION	DATE	APPROVED
	X2	RELEASE FOR PILOT PROD.	12-29-92	R.C.



FOR PARTS LIST, SEE P/L 52659-5

QTY REQD	ITEM	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	POWER-ONE STD. P/N
PARTS LIST				

TOLERANCE XX = .030, XXX = .010

CONTRACT NO

APPROVALS	DATE
DRAWN T. GUZMAN	10-14-92
CHECKED	
ENG APPD	
APPROVED	
MFG APPD	

MATERIAL

FINISH

DO NOT SCALE DRAWING

Power-One INC. CAMARILLO, CALIF 93010 (805)484-2806

TITLE: SCHEMATIC

SIZE	CODE IDENT NO	DRAWING NO.
D	54407	52639 X2

SCALE — SHEET 1 OF 1

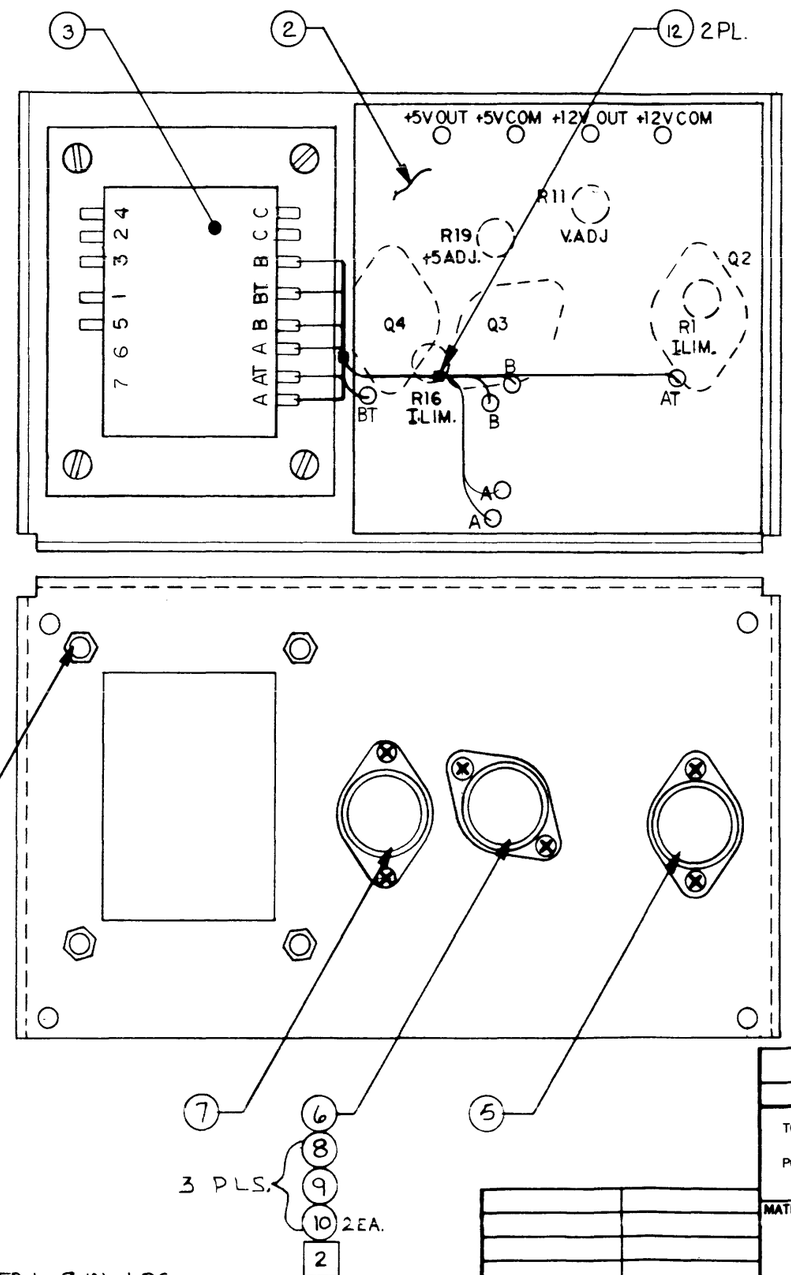
NEXT ASSY	USED ON
	CP510-A

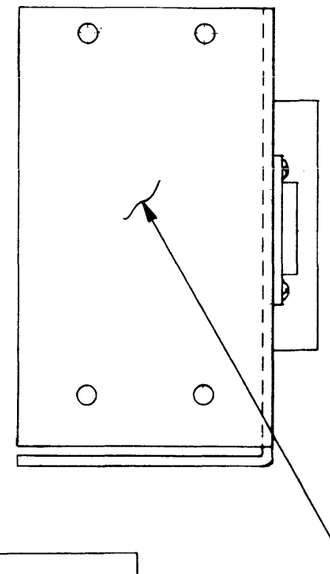
APPLICATION

5 FOR PARTS LIST DASH NUMBER SEE APPROPRIATE MODEL MDL
4. SEE PART LIST FOR COMPONENT VALUES
3. ALL RESISTORS ARE 1/4 W UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITOR VALUES ARE IN MICROFARADS / VOLTS
1. ALL RESISTOR VALUES ARE IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ECO	LTR	DESCRIPTION	DATE	APPROVED
	X2	PILOT RUN RELEASE	10-12-82	CC





WIRING TABLE	
FROM	TO
A1-A	T1-A
A1-AT	T1-AT
A1-B	T1-B
A1-BT	T1-BT

FOR PARTS LIST SEE P/L 52413-1

QTY REQD	ITEM	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	POWER ONE STD PART NO.
PARTS LIST				

2. TORQUE TO 6-9 IN LBS.
1. FOR PARTS LIST DASH # SEE APPROPRIATE M.D.L.

NOTES: UNLESS OTHERWISE SPECIFIED

TOLERANCE .XX = .030
.XXX = .010
PCB SHEAR TOLERANCE
.XXX = .050

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN Colleen Ortiz	10-12-82
CHECKED	
ENG. APPD.	10-26-82
APPROVED	
MFG. APPD.	

POWER-ONE INC. CAMARILLO, CALIF. 93010 (805)484-2806

TITLE: ASSEMBLY POWER SUPPLY

SIZE	CODE IDENT NO.	DRAWING NO.	
C	54407	52413	X2

SCALE FULL SHEET 1 OF 1

	CP 510-A
NEXT ASSY	USED ON
APPLICATION	

65

PARTS LIST

POWER-ONE D.C. POWER SUPPLIES

DWG. NO. PL. 52413-101 | SHEET 2 OF 2 | REV. SEE SHT. 1

ITEM NO.	NOTE	QTY REQD	POWER ONE STD PART NO.	DESCRIPTION.	VENDOR NO.	REF. DES.
1		1	412-52416	CHASSIS W/SS	52415	
2		1	081-52659-101	PRINTED WIRING BOARD	52420	A1
3		1	082-52775	TRANSFORMER		T1
4						
5		1	171-10245	TRANSISTOR	2N3771	Q2
6		1	171-10261	TRANSISTOR	2N6569	Q3
7		1	171-10262	TRANSISTOR	2N3055	Q4
8		3	320-10288	MICA,(INSULATOR)		
9		3	320-10290	MCNABB TO-3		
10		6	350-10206	SCREWS, B.H. 6-32 x 3/16		
11		4	340-10602	NUTS, KEP 5/16		T1
12		2	316-20664	TYWRAPS		
13		REF	52659	SCHEMATIC		

BISHOP GRAPHICS/ACCUPRESS REORDER NO A17629

PARTS LIST

POWER-ONE D.C. POWER SUPPLIES

DWG. NO. PL. 52659-101 | SHEET 2 OF 4 | REV. SEE SHT. 1

ITEM NO.	NOTE	QTY REQD	POWER ONE STD PART NO.	DESCRIPTION.	VENDOR NO.	REF. DES.
1		1	505-52421	PRINTED WIRING BOARD	52420	A1
2						
3		REF	———	TRANSFORMER	52775	T1
4						
5		2	154-20937	POTENTIOMETER 500Ω		R1,16
6		2	154-20938	POTENTIOMETER 2K		R11,19
7						
8		2	158-10179	RESISTOR .22Ω 2W BWH		R5,6
9		1	151-10210	1Ω ½W 5% CF		R14
10		1	151-10221	15Ω ½W 5% CF		R15
11						
12		3	150-21361	RESISTOR 1.2K ¼W 5% CF		R8,18,22
13		1	-20372	3.6K		R21
14		3	-20343	220Ω		R9,25,7
15		2	-20327	47Ω		R4,24
16						
17		2	-20367	2.2K		R10,17
18		1	150-20315	RESISTOR 4.7K ¼W 5% CF		R12

BISHOP GRAPHICS/ACCUPRESS REORDER NO A17629

PARTS LIST

POWER-ONE D.C. POWER SUPPLIES

DWG. NO. PL. 52659-101 | SHEET 3 OF 4 | REV. SEE SHT. 1

ITEM NO.	NOTE	QTY REQD	POWER ONE STD PART NO.	DESCRIPTION.	VENDOR NO.	REF. DES.
19		3	150-20356	RESISTOR 750Ω ¼W 5% CF		R13, 20, 3
20		1	150-20307	RESISTOR 6.8Ω ¼W 5% CF		R23
21		1	150-20373	RESISTOR 3.9K ¼W 5% CF		R2
22		2	130-10287	IC VOLTAGE REGULATOR	μA723	U1,2
23						
24		1	172-10249	TRANSISTOR	2N6551	Q1
25		REF	171-10245	"	2N3771	Q2
26		REF	171-10261	"	2N6569	Q3
27		REF	171-10262	TRANSISTOR	2N3055	Q4
28						
29		3	111-10251	DIODE 1A 200V	1N4003	CR1,4,9
30		4	111-10256	" 6A 50V	MR750	CR 2,3,7,8
31		2	111-10252	" 3A 100V	1N5401	CR6,11
32		1	112-10273	" ZENER 10V	1N758A	CR5
33		1	112-10006	DIODE ZENER 5.6V	1N752A	CR10
34		1	112-10608	DIODE ZENER 36V	1N974B	CR12
35		1	160-10013	SCR 8A 50V	S0508L53	SCR1
36						

PARTS LIST

POWER-ONE D.C. POWER SUPPLIES

DWG. NO. PL. 52659-101 | SHEET 4 OF 4 | REV. SEE SHT. 1

ITEM NO.	NOTE	QTY REQD	POWER ONE STD PART NO.	DESCRIPTION.	VENDOR NO.	REF. DES.
37		1	101-20951	CAPACITORS ELECT	10,000/35	C1
38		1	101-10110	"	100/35	C2
39		2	101-10111	"	1/50	C4,8
40		1	101-20812	"	1000/35	C5
41		1	101-10108	"	1000/16	C9
42		1	101-20950	" ELECT	22,000/16	C6
43		2	104-10093	CAPACITOR MYLAR	.001/100	C3,7
44						
45						
46		2	321-10679	I.C. SOCKET 14 PIN		FOR: U1,2
47		1	402-13920	HEATSINK		FOR: Q1
48		1	350-10663	SCREW 6-32 x 1" SELF TAP		FOR: Q1
49		1	352-10218	SCREW 6-32 x 5/16		FOR: SCR1
50						
51		2	916-21208	WIRE 16AWG BLK 6" 3/16 x 3/8 T		A, A
52		1	916-21032	WIRE 16AWG WHT 6½" 3/16 x 3/8 T		AT
53		2	916-21097	WIRE 16AWG BRN 5" 3/16 x 3/8 T		B, B
54		1	916-21292	WIRE 16AWG WHT 4½" 3/16 x ½ T		BT

AA	18-Sep-83	467 dc		263-02323-100

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE IN OHMS (Ω) 1/4W 5%
2. ALL CAPACITORS ARE MICROFARADS (μF)
3. ALL 6N74 SERIES I.C.S:
   A. 14 PIN - PIN 14 = +5V, PIN 7 = GND
   B. 16 PIN - PIN 16 = +5V, PIN 8 = GND
   C. 20 PIN - PIN 16 = +5V, PIN 10 = GND
4. MK4118 (1K x 8 RAM) IS CUSTOMER INSTALLED OPTION ONLY
5. SEE CHART FOR JUMPER LIST.

RAM BUS SH4
DATA BUS SH2,3,5
ADDRESS BUS SH2,3,4
YA SH4
YB/B SH4

SH2 INTERRUPT
SH3 DSK WAIT
SH4 EXT WAIT
SH2 NMI
SH3
SH4 RESET
SH2 MEMORY ENABLE
SH4 RAM BUS ENABLE
SH3 WR DSK MEM
SH4 WR EXT/MEM
SH4 DISK→MEM
SH4 WRITE GATE A
SH3 EOB
SH3 HEADER/DATA
SH3 +READ GATE
SH5 -READ DATA
SH3 CLOCK
SH3 CLKEN
SH3 PST
SH3 -EOB

RP7 RP4 4.7K +5V
RP5 4.7K RP6 4.7K
U68 LS08
U70 Z80A CPU
U65 LS245
U82 U78 U83 U79 U81 U77 2114-L RAM (1K x 4)
U69 LS138
U66 LS08
U62 U63 2716 (2K x 8) #1 #2
U48 LS11
U67 LS164
U66 LS374
U74 LS166
U57 LS04
U56 LS74
U58 LS54
U59 9401
U29 LS00
U55 O6
R36 R28 470Ω
W1 W2 W3 W4 W5
MREQ RFSH M1 IORQ RD WR RESET WAIT NMI
GND BUSRQ
SYSTEM CONTROL BUS SH2,3,4
MREQ SH4
QA (SH.3)
CRC ERROR SH 2
WRITE DATA SH5
-WRITE GATE J46-6
WRITE B SH-5

J40
71 72 +5V NOT CONNECTED
19 20 21 22 83 84 85 86 105 2 14 16 27 28 41 42 81 82 90 92 94 107 116 108 112 114 119 120
C12,C11 10μF
C1, C16-C90, C93 1μF

J46-3,5,7,18,21,22,25,27,29
J46-ALL ODD (1-33)
J46-16 TP-10
J44 & 45-2,4,6,8,11,12,15,16,19,20 TP-9
J3-2,3
J40-9
J3-1 +12V
J3-4 +5V

5

JUMPER LIST		
DASH	VERSION	JUMPERS
-101	ROM	W3-1 TO 2; W4-B TO C, D TO E; W5-1 TO 2
-102	RAM	W3-2 TO 3; W4-A TO B, C TO D; W5-2 TO 3

UNLESS OTHERWISE SPECIFIC ALL DIMENSIONS INCHES TOLERANCES
DECIMAL XX ± XXX ± FRACTIONAL ± ANGULAR ±

IMI
5000 H CONTROLLER
D 263-02323-100 AA
SHEET 1 OF 6 REV

ON-LINE REORDER NO. 1120

68

REV	DATE	EC NO.
AA	11-17-81	4671

REV	DATE	EC NO.

263-02323-100

NEXT ASSEMBLY	USED ON

+5V
VDD
ZC/TO0
CLK/TRG1
ZC/TO1
CLK/TRG2
CLK/TRG3
CLK/TRG0
RESET
B/
CE
IEI
CS1
CS0
D7
D6
D5
D4
D3
D2
D1
D0
ZC/TO2
IEO
CTC
ZBOA
INT
M1
IORQ
RD
GND
U45
U57
LS04
U36
LS32
U26
LS279
U46
LS138
G2B
G2A
G1
Y0
Y1
Y2
Y3
Y4
Y5
Y6
Y7
A
B
C
-INDEX SEL
-SECTOR SEL
-RESET
SH-5
SH-5
SH-4
MEMORY ENABLE SH1
NM1 SH1
PIO 3 CE SH3
BEGRDY SH4
H3XCLR SH4
XFERSTB SH4
SH1 DATA BUS
SH1 ADDRESS BUS
SH1 SYSTEM CONTROL BUS
SH3 B/
INTERRUPT SH1,4
U25
U64
Z80A PIO (0)
Z80A PIO (2)
RP1 1.0K
RP2 4.7K
RP2, 4.7K
RP7 4.7K
RP7, 4.7K
RP3, 4.7K
R101 4.7K
R2 120
R29 120
U84
U73
07
U5
06
DS1
WRITE FAULT
J46-12
SH1 CRC ERROR
-SECTOR SIZE 1
-SECTOR SIZE 2
J46-8
-SEEK COMPLETE
J46-22
SH-4
-READY
-HSXSTB
-COMPL
-ALT SEL
-DRV. ACK
BUS DIR
-SYNC
HSXFER SH4
PIO RDY SH4
-STROBE
COMMAND BUS
-REDUCE WR CURRENT
-HEAD SEL 2²
-HEAD SEL 2¹
-HEAD SEL 2⁰
-STEP
-DIRECTION IN
ACTIVITY LED
J48-19
J40-106
J48-24
J40-109
J48-23
J40-110
J48-26
J40-111
J40-20
J40-105
J40-91
J48-6
SH-4
J46-2
J46-4
J46-18
J46-14
J46-24
J46-34
J40-17

MATERIAL	SCALE: NONE
FINISH	DRAWN: MIKE 4-21-81
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES: DECIMAL .XX ± .XXX ± FRACTIONAL ± ANGULAR ±	CHECKED: DATE; APPROVED: 14 DEC 83 DATE; RELEASED: DATE

IMI INTERNATIONAL MEMORIES INCORPORATED

5000H CONTROLLER

D 263-02323-100 AA

SHEET 2 OF 6 REV.

REV	DATE	EC NO
--	--	-67 KL

REV	DATE	EC NO.

263-02323-100

NEXT ASSEMBLY | USED ON

-RXD
J40-5
J41-3
CR3, IN4148
R34, 3900
R33, 2700
WRITE PROTECT
W-2
R100, 1.0K
+5V
J46-10 -TRACK ØØ
RP6, 4.7K
RP5
J44-9 6MB1
J40-12 -FORMAT ENABLE
R50, 4.7K
W1
6MB2
J45-9 12MB1
J44-10, J40-43 12MB2
J45-10, J40-23 -P103CE
SH-2
8251?3
U72 Z80A PIO (3)
ADDRESS BUS
SH-1 DATA BUS
SH-1 SYSTEM CONTROL BUS
SH-1,4 - TIMEOUT DISABLE
J40-4 - UNIT SELECT 1
J40-6 - UNIT SELECT 2
J40-8 SYSTEM/-DIAG
J40-10 QA
SH-1 -MEM→DISK
SH-4 -DISK→MEM
UNIT SELECT
U84
-WRITE DISABLE
RP6, 4.7K
RP5 4.7K
U80 LS04
U55 7406
+DRV 2 SELECTED SH-5,6
-DRV 2 SEL J46-28
-DRV 1 SEL J46-26
+DRV 1 SELECTED SH-5,6
R32, 100
R31, 100
Q2 2N2222A
DS-3 WRITE
R103 120Ω
TP1
-TXD J40-3
COM J41-2, J40-1, J41-1
-WRITE GATE A SH-1
TP8
-READ GATE
U49 LS04
+READ GATE SH-1,6
DS-2 READ
R102 120Ω
U51 LS10
U50 LS32
U60 LS74
U61 279
U49 LS04
R35 1.0K
U41, 5163
U52, 825129
U53, 825123
U43, LS174
-PST CLKEN SH-1
-WR DSK/MEM SH-1
U68 LS08
PU2
-HEADER/DATA SH-1
Φ SH-1,2,4
EOB SH-1
-DSK.WAIT SH-1
-EOB SH-1
U42, 5163
U44 LS163
U54, 825129
SH-4 -XMD
SH-4 -XFERBYTE
SH-4 -XFEREND
U48 LS11
SH-4 -RESET
8MHz.-RCLK
Q1, 2N3640
C10, 47pF
R24 330
R23, 1.5K
R22 1.0K
U40 LS74
U32 LS74
U33 LS74
U35 8 MHz OSC
U34 LS02
4 MHz CLK SH-5
8MHz
CLOCK SH-1
SH-5 5.5 MHz R CLK
RCLK
R21 1.0K

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES: DECIMAL XX ± .XXX ± FRACTIONAL ± ANGULAR ±

SCALE NONE
DRAWN MIKE 11-29-82
CHKD
APPROVED
RELEASED

IMI INTERNATIONAL MEMORIES INCORPORATED

5000H, CONTROLLER

D 263-02323-100 AA
SHEET 3 OF 6 REV.

70

REV	DATE	EC NO.
AA	1-10-83	467

REV	DATE	EC NO.

263-02323-100

NEXT ASSEMBLY | USED ON

SH2 P10 RDY
SH2 HSXFER
SH2 XFERSTB
SH2 STROBE
SH3 Φ
SH2 HSXCLR
SH2 INTERRUPT
SH-2 -BEGRDY
COMMAND BUS SH2
SH1 Y4
SH1 MREQ
SH-1 -Y3I5
SH1 ADDRESS BUS
SH-5 -RESET CLK
J48-4
J40-89
J40-7 -SYS. RST
SYSTEM CONTROL BUS SH1

U47 LS132 · R27, 620 · C13 · -101=120pF -102=47pF · U27 LS08 · CR1 IN5818 · U27 LS08 · R22 U40 S74 · U30, LS156 · U29 LS00 · RP8, 1.0K · +5V · R25, 4.7K · LS132 · U47 · U57 LS04 · RP5 4.7K · R26 100 · C15, .01μF · U37, LS164 · R41 47K · R42 47K · CR2 IN4148 · U31 339 · C9 10μF · R40 47K

R22 U38 LS74 · U39 LS74 · U26 LS279 U53 · U26 LS279 · U26 LS279 · U75, LS374 · U76, LS373 · U28 LS32 · U48 LS11 · U68 LS08 · U73 07 · R30 1K +5V · U29 LS00 · U28 LS32 U63 · U28 LS32 U63 · U28 LS32 · U27 LS08 · U49 LS04 · U38 LS74

READY → J40-93, J48-8
HSXSTB → SH-2
XFERBYTE → SH-3
EXT WAIT SH1
WR EXT/MEM SH1
XFEREND → SH3
RAM BUS SH1 ▷
DATA BIT 0 → J48-10, J40-95
DATA BIT 1 → J48-9, J40-96
DATA BIT 2 → J48-12, J40-97
DATA BIT 3 → J48-11, J40-98
DATA BIT 4 → J48-14, J40-99
DATA BIT 5 → J48-13, J40-100
COMMAND BUS ▷ SH-4
DATA BIT 6 → J48-16, J40-101
DATA BIT 7 → J48-15, J40-102
DISK←MEM SH1,3,2
MEM←DISK SH3
RAM BUS ENABLE SH1
RESET SH1,3
SYSTEM CONTROL BUS ▷ SH-2,3
-R/W RESET → J44-5, J45-5

M1 · PMI · WR · RD

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES: DECIMAL .XX ± .XXX ± · FRACTIONAL ± · ANGULAR ±	NONE · MIKE 1-27-83 · RS 1-27-83	IMI INTERNATIONAL MEMORIES, INCORPORATED · 5000H CONTROLLER · D 263-02323-100 AA · SHEET 4 OF 6 · REV.

REV	DATE	EC NO
AA	[illegible]	467 [illegible]

REV	DATE	EC NO

263-02323-00

NEXT ASSEMBLY	USED ON

SH-6 –VCO CLK (11 MHz)
SH-1 WRITE DATA
U3 TM4030
NOT USED
NOT USED
5.5 MC RCLK SH-3
L2 5.6μH
L1 5.6μH
R4 560Ω
C2 10pF
C3 10pF
SH-1 WRITE B
SH-3 +DRIVE 1 SELECTED
U27 LS08
U4 3487
+WRITE DATA 1 J44-13
-WRITE DATA 1 J44-14
+WRITE DATA 2 J45-13
-WRITE DATA 2 J45-14
DECODER
R3 1.0K +5V
TP3
TP2
U2 S74
U1 S74
U1 S74
U2 S74
-READ DATA SH-1
SH-6 -DECODE DATA
SH-6 VCO ENABLE
SH-6 READ TIME
SH-6 +DRIVE 2 SELECTED
SH-3 +READ GATE
-RESET CLK SH-4
R8 1.0K
RP1 1.0K
U18 LS163
U7 LS163
U6 LS163
U16 LS02
U9 LS163
SH-3 4 MHZ CLK
U8 LSH4
-START 1 SH-6
-SECTOR SH-2
RP1 1.0K
J46-20 INDEX
360 μSEC.
U17 LS175
U16 LS02
-INDEX SH-2

MATERIAL:	SCALE	IMI INTERNATIONAL MEMORIES INCORPORATED
FINISH:	DRAWN [illegible] DATE 11-2-82	
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES	CKD DATE	5000H CONTROLLER
DECIMAL XX ± XXX ± FRACTIONAL ± ANGULAR ±	ENGR JR DATE 11/3/83	D 263-02323-100 AA
	APPROVED DATE	SHEET 5 OF 6 REV.
	RELEASED DATE	

BISHOP GRAPHICS/ACCUPRESS REORDER NO. A 13798

REV	DATE	EC NO.
AA	[illegible]	467 [illegible]

REV	DATE	EC NO

263-02323-100

NEXT ASSEMBLY	USED ON

+5V
RI 5K
CW
R20 1K
C8 10pF
R5 1K
C4
U14 26502
TP-7
-DECODE DATA SH-5
READ TIME SH-5
R21
5V
J44-17 +READ DATA DRIVE 1
J44-18 -READ DATA DRIVE 1
R6 220
U15 3486
SH-3 +DRIVE 1 SELECTED
SH-5 -START 1
SH-3 +DRIVE 2 SELECTED
J45-17 +READ DATA DRIVE 2
J45-18 -READ DATA DRIVE 2
R7 220
U15 3486
U22 LS74
U21 S00
U13 S74
TP-4
TP-6
U23 LS551
U23 LS551
U23 LS551
R21 H2
U22 LS74
SH-3 +READ GATE
U10 S04
U12 11C44
U11 S158
+5V
U24 OSC. 11MHz
+12V
R16 4.3K
R17 4.3K
U19 CA3046
TP-5 ERROR VOLTAGE +6±1V
R15 510
C6 .01
R9 510
R14 51
C5 470 pf
R10 2.7K
R11 2.7K
R12 2.7K
R13 2.7K
U10 S04
U10 S04
U10 S04
R18 1.2K
22 MHz
R19 4.7
C7 82pF
U21 S00
U21 S00
U20 S03
VCO ENABLE SH-5
U13 S74
-VCO CLK (11 MHz) SH-5
R21 H2

MATERIAL	SCALE	IMI INTERNATIONAL MACHINE TOOLS INCORPORATED
FINISH	DRAWN [illegible] DATE 11-30-92	CONTROLLER 5000H
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES: DECIMAL XX ± XXX ± FRACTIONAL ± ANGULAR ±	CHKD DATE	D 263-02323-100 AA
	ISSUED 14 Jan 93 DATE	SHEET 6 OF 6 REV.
	APPROVED DATE	
	MFG APPR DATE	

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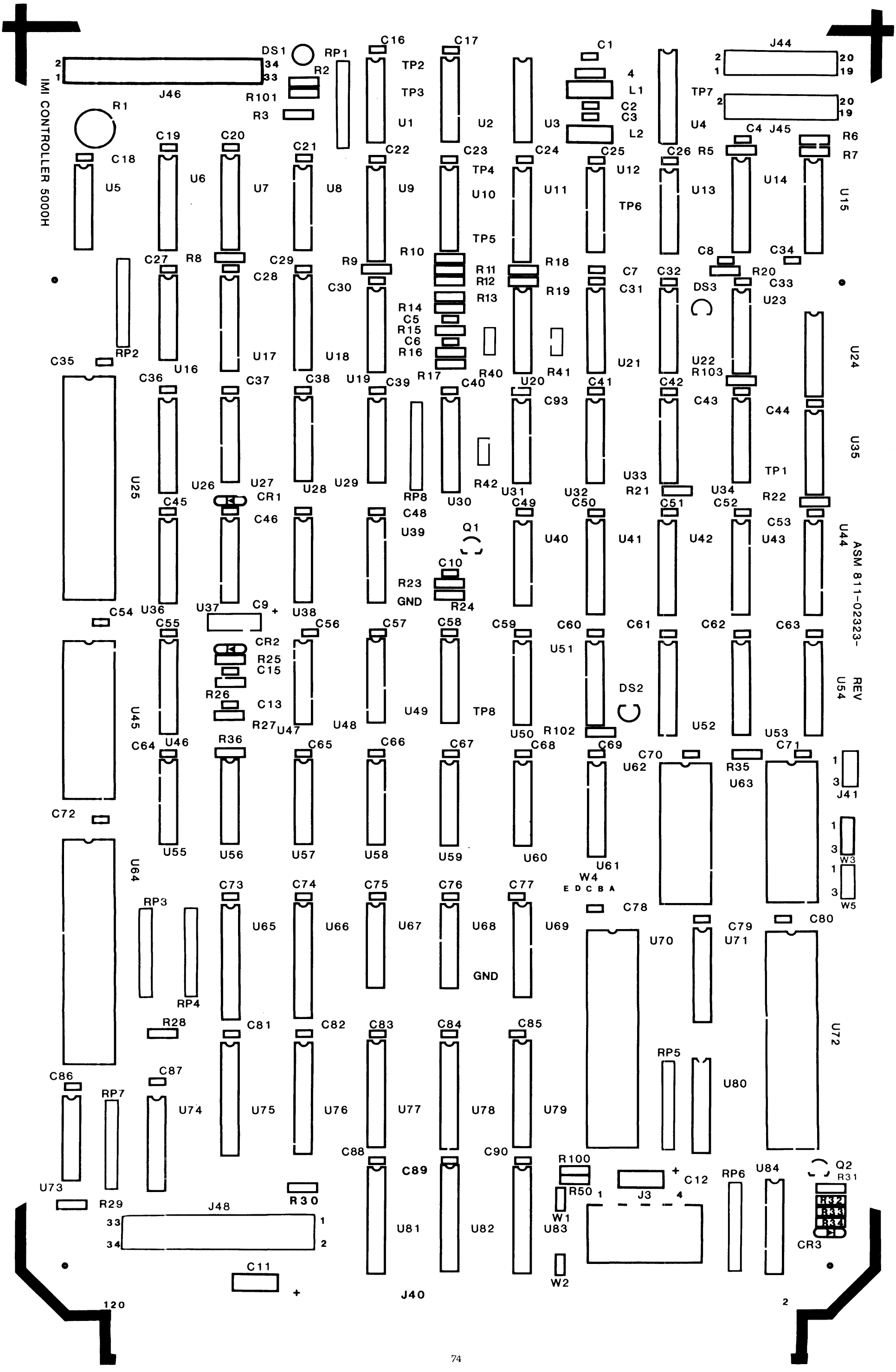
IMI CONTROLLER 5000H
ASM 811-02323- REV
J46
DS1
RP1
R2
R101
R3
C16
C17
C1
J44
TP2
TP3
U1
U2
U3
L1
C2
C3
L2
U4
TP7
C4
J45
R6
R7
R1
C18
U5
C19
U6
C20
U7
C21
U8
C22
C23
C24
C25
C26
R5
U12
U13
U14
U15
TP4
U10
U11
TP6
TP5
C27
R8
C28
C29
R9
R10
C30
C8
C34
R18
C7
C32
R20
C33
DS3
R11
R12
R13
R19
C31
U23
R14
C5
R15
C6
R16
RP2
C35
U16
U17
U18
U19
U20
U21
U22
R103
U24
C36
C37
C38
C39
R17
R40
C40
C41
C42
C43
C44
U35
C93
R41
U25
U26
U27
U28
U29
U31
U32
U33
TP1
R21
U34
R22
C45
CR1
C46
RP8
C48
U30
C49
C50
C51
C52
C53
U39
Q1
U40
U41
U42
U43
U44
C10
R23
GND
R24
C54
U36
U37
C9
U38
C55
C56
C57
C58
C59
C60
C61
C62
C63
CR2
U51
R25
C15
R26
C13
DS2
U45
R27
U47
U48
U49
TP8
U50
R102
U52
U53
U54
C64
U46
R36
C65
C66
C67
C68
C69
C70
R35
C71
U62
U63
J41
C72
U64
U55
U56
U57
U58
U59
U60
U61
W4
E D C B A
W3
W5
C73
C74
C75
C76
C77
C78
C79
C80
RP3
RP4
U65
U66
U67
U68
U69
U70
U71
U72
GND
R28
C81
C82
C83
C84
C85
RP5
C86
C87
RP7
U74
U75
U76
U77
U78
U79
U80
C88
C90
C89
R100
R50
C12
RP6
U84
Q2
R31
U73
R29
J48
R30
J3
W1
U83
CR3
33
34
C11
J40
W2
120
2

REV	DATE		
AA	11-7-82	480	RS
BB	1-25-83	491	

263-02410-001

J25-1 MAG. PICK UP
J25-2 -MAG. PICK UP
C5 10nF
R23 1.2K
R11 4.7K
R14 4.7K
R13 18K
R12 4.7K
R10 4.7K
U1 1/2 LM392
TP-1
360μS
-INDEX SH-2

R37, 1.2K +6.2V
+5V
R19 1.2K
J22-1 MOTOR TAC
U8 LS14
R17 1.2K
U8 LS14
R38 1.2K
R18 1.2K
C2 .1μF
CR2 IN4148
CR1 IN4148
C1 .22μF
R3 2.7MEG
R1 100K
R8 4.7K
R2 4.7K
U1 1/2 LM392
R4 1.2K
R21 1.2K
R22 4.7K
Q1 PN2907
R9 1.2K
R7 1.2K
R20 1.2K
Q2 PN2222
CR5 IN4148
CR6 IN4148
U2 ULN 2074B
R5 33Ω
C3 1mF
C11 1mF
R6 1Ω 25W 5%
COIL 1 J22-5
COIL 2 J22-6

256μS
-DEC SPEED
INC. SPEED
MOTOR

+12V R15 8.2Ω 2W, 5%
BRAKE J22-7
CR4 IN5818
BRAKE RET J22-8
MOTOR +12V J22-4
C4 10mF
MOTOR RET J22-2
MOTOR J22-3
+5V

U3 1 MHz
U11 CD4020
U10 LS02
U9 1/2 LS175
U12 LS30
U5 LS14
R34 270K
C14 10μF
U13 339
R36 8.2K
R35 3.3K
J24-15
J24-16
J24-7
J24-8
J24-14
J24-11
J24-12
C6 10μF
C7,8 100nF
H

SH-2 1 MHz CLK J24-4
SH-2 -POWER LOSS
U7 LS02
U8 LS14
-CPU RESET J24-9

UNLESS OTHERWISE SPECIFIED: DIMENSIONS IN INCHES, TOLERANCES: DECIMAL XX ±, XXX ±; FRACTIONAL ±; ANGULAR ±°	FINISH: NONE	DRAWN M. LIFF 8-10-82; CHK; ENG; APPR; MFG	IMI; MOTOR CONTROL 5000H; D 263-02410-001 BB; SHEET 1 OF 2 REV

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REV	ECO NO	DATE
AA	480	15
BB	491	

263-02410-001

+5V
R39
4.7K
U6 LS163
U5 LS163
U4 LS163
U7 LS02
SH-1 1 MHz CLK
U8 LS14
SECTOR → J24-2
SH-1 -INDEX
300µS
U9 1/2 LS175
INDEX CLK → J24-5
INDEX → J24-6
GND
TP-3 GND
+12V
R32 220Ω
J23-4 DIODE 1
J23-3 AMP RET
J23-2 DIODE RET
R28 220Ω
CR3 IN5234 6.2V 2%
R27 24K
R33 18K
U13 339
R25 4.7K
C10 10µF
SPARE → J24-10,13
R30 10K
+6.2V → SH-1
R29 24K
SH-1
-POWER LOSS → J24-1
R31 270K
R24 4.7K
J23-1 Ø SENSE
TP-2 CYL ØØ
CYL Ø → J24-3

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTORS ARE IN OHMS (Ω), 1/4W, 5%.
2. ALL CAPACITORS ARE MICROFARADS (µF).
3. NOT USED: C9, R16

MATERIAL	FINISH	UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES DECIMAL .XX .XXX FRACTIONAL ANGULAR
DRAWN M. LIFF 9-13-92	CHK	ENG APPROVED T. Stark 20 Jan 93
NEXT ASSY NONE		RELEASED

IMI
MOTOR CONTROL 5000 H
D 263-02410-001 BB
SHEET 2 OF 2 REV

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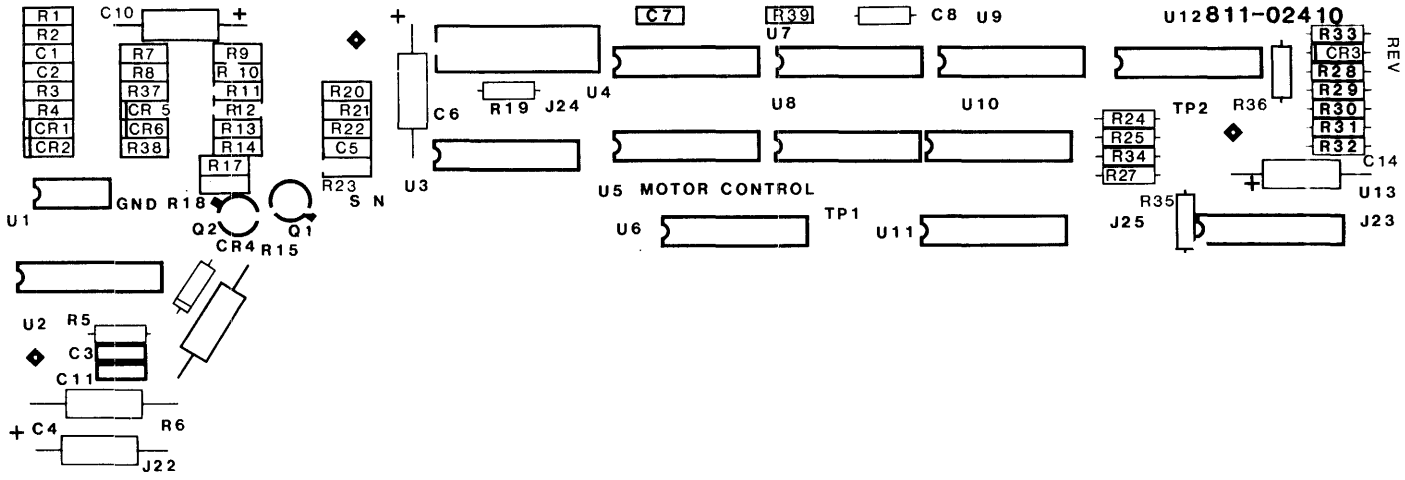

R1
R2
C1
C2
R3
R4
CR1
CR2
C10
R7
R8
R37
CR 5
CR6
R38
R9
R 10
R11
R12
R13
R14
R17
R18
GND
U1
Q2
CR4
R15
Q1
R20
R21
R22
C5
R23
S N
U3
C6
R19
J24
U4
C7
R39
U7
C8
U9
U8
U10
U5 MOTOR CONTROL
U6
TP1
U11
U12811-02410
R24
R25
R34
R27
TP2
R36
R33
CR3
R28
R29
R30
R31
R32
REV
C14
U13
R35
J25
J23
U2
R5
C3
C11
C4
R6
J22

REV	DATE	EC NO.
AA	11-23-82	466

263-01908-101

NEXT ASSEMBLY | USED ON

J25 - 1 MAG, PICK UP
J25-2 -MAG, PICK UP
C5 10nF
R11 4.7K
R23 1.2K
R14 4.7K
R13 18K
R12 4.7K
R10 4.7K
U1 1/2 LM392
TP-1
360µs
-INDEX SH-2

J22-1 MOTOR TAC
R37, 1.2K +6.2V
R19 1.2K
U8 LS14
R17 1.2K
R38 1.2K
R18 1.2K
C2 .1µF
C1 .22µF
R3 1.2 MEG
CR2 IN4148
CR1 IN4148
CR5 IN4148
CR6 IN4148
U2 ULN 2074B
R5 24Ω
C3 1µF
C11 1µF
COIL 1 J22-5
COIL 2 J22-6
R6 1Ω 1W

R21 1.2K
R22 4.7K
Q1 2N2907
R9 1.2K
R7 1.2K
R20 1.2K
Q2 2N2222
R1 47K
R8 4.7K
R2 4.7K
R4 1.2K
U1 1/2 LM392
256µs
-DEC SPEED
INC SPEED

U3 1 MHz
U10 LS02
U11 CD4020
U9 1/2 LS175
U12 LS30
MOTOR
H

R34 270K
C14 10µF
U13
R36 8.2K
R35 3.3K

R15 8.2Ω 1W
CR4 IN5818
C4 10µF
BRAKE J22-7
BRAKE RET J22-8
MOTOR +12V J22-4
MOTOR RET J22-2
MOTOR J22-3

J24-15
J24-16
J24-7
J24-8
J24-14
J24-11
J24-12
C6 10µF
C7,8 100nF
SH-2 -POWER LOSS
SH-2 1 MHz CLK J24-4

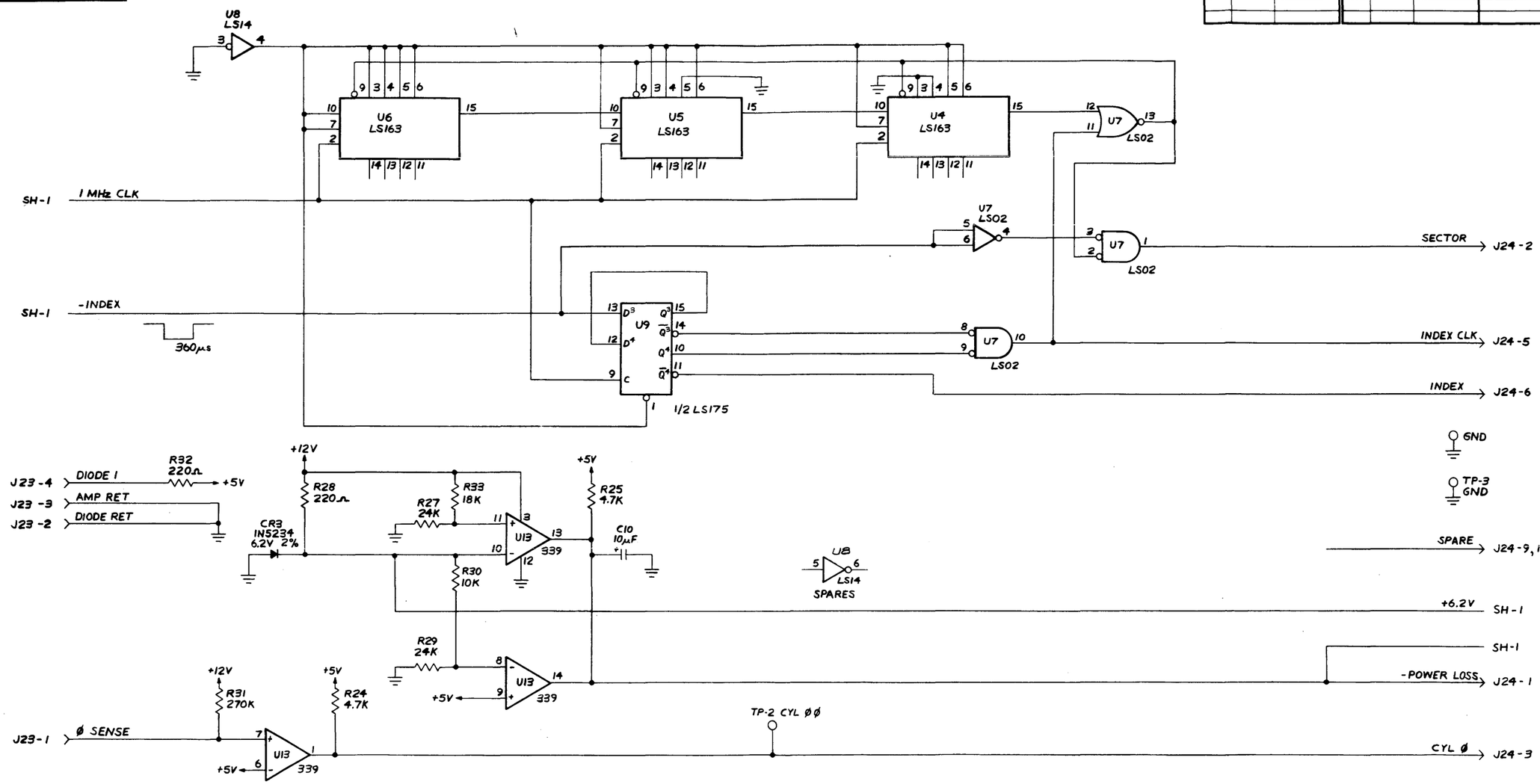
MATERIAL	SCALE NONE	IMI	
FINISH	DRAWN M. LIFF DATE 9-10-82	MOTOR CONTROL 5000H	
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES	CKD DATE / ENGR DATE / APPROVED DATE / RELEASED DATE	D 263-01908-201	AA
DECIMAL XX: XXX: FRACTIONAL: ANGULAR:		SHEET 1 OF 2	REV.

REV	DATE	EC NO.
AA	11-23-82	466

REV	DATE	EC NO.

263-01908-101

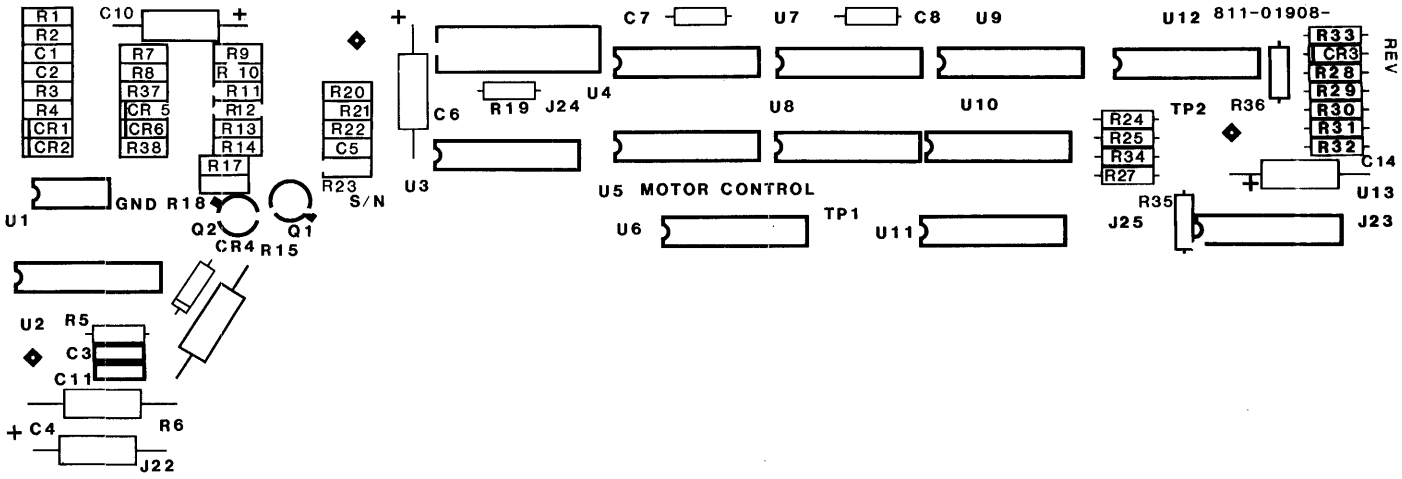
NEXT ASSEMBLY	USED ON

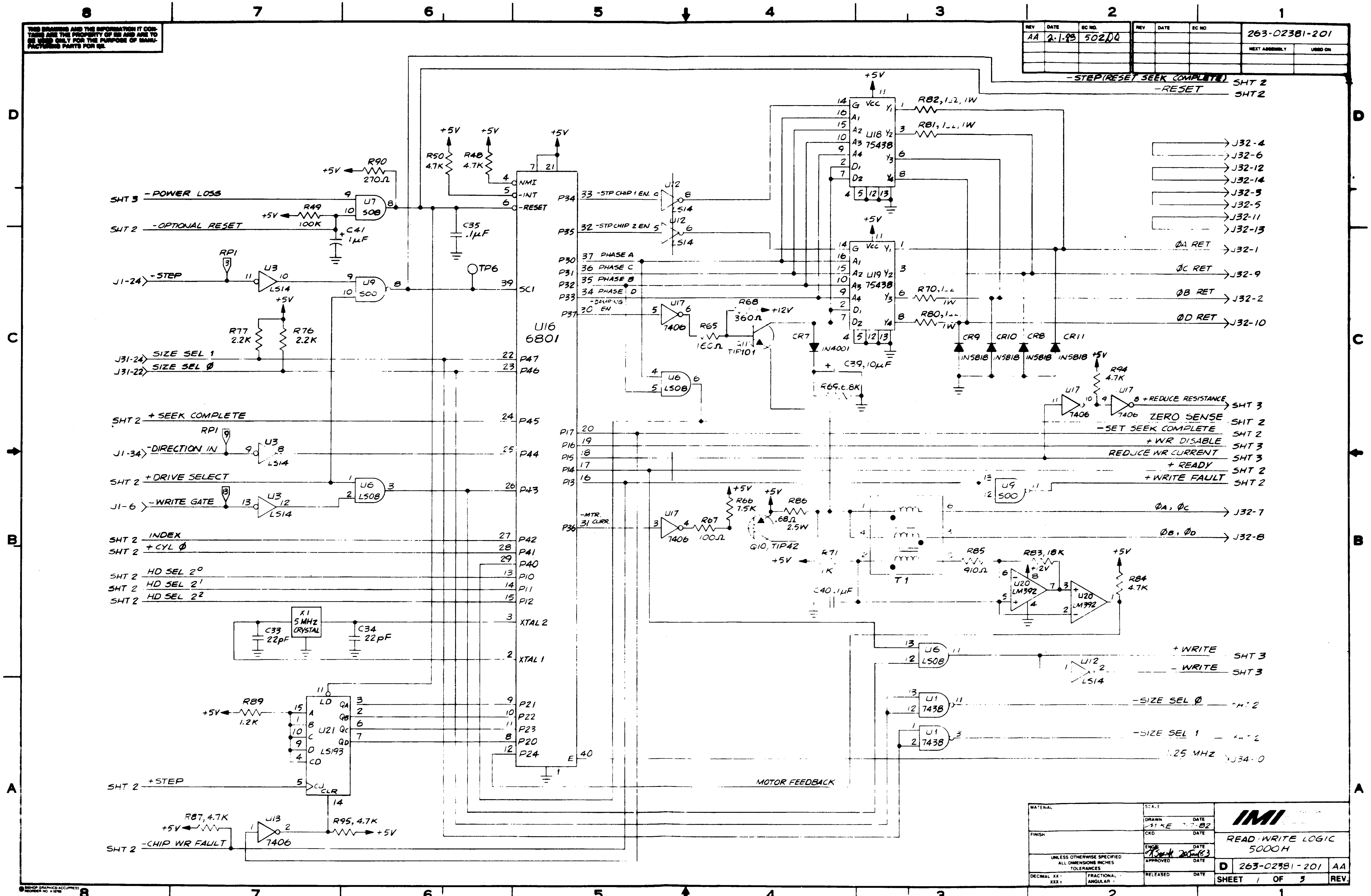


NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTORS ARE IN OHMS (Ω), 1/4W, 5%.
2. ALL CAPACITORS ARE MICROFARADS (µF).
3. NOT USED: C9, R16

MATERIAL:	SCALE NONE	INTERNATIONAL MEMORIES INCORPORATED
FINISH:	DRAWN M.LIFF 9-13-82 DATE	MOTOR CONTROL 5000 H
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES:	CKD. DATE	D 263-01908-201 AA
DECIMAL XX ± XXX ± FRACTIONAL ± ANGULAR ±	ENGR. DATE	SHEET 2 OF 2 REV.
	APPROVED DATE	
	RELEASED DATE	


R1
R2
C1
C2
R3
R4
CR1
CR2
C10
R7
R8
R37
CR 5
CR6
R38
R9
R 10
R11
R12
R13
R14
R17
R20
R21
R22
C5
R23
S/N
C6
R19
J24
U4
U3
C7
U7
C8
U9
U8
U10
U5 MOTOR CONTROL
U6
TP1
U11
U12 811-01908-
REV
R33
CR3
R28
R29
R30
R31
R32
R24
R25
R34
R27
TP2
R36
C14
U13
R35
J25
J23
U1
GND R18
Q2
Q1
CR4
R15
U2
R5
C3
C11
C4
R6
J22



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263-02381-201
AA 2-1-83 502DQ
-STEP(RESET SEEK COMPLETE) SHT 2
-RESET SHT 2
SHT 3 -POWER LOSS
SHT 2 -OPTIONAL RESET
R90 270Ω
R49 100K
C41 1µF
C35 .1µF
R50 4.7K
R48 4.7K
U7 S08
J1-24 -STEP
RP1
U3 LS14
U9 S00
TP6
R77 2.2K
R76 2.2K
J31-24 SIZE SEL 1
J31-22 SIZE SEL Ø
SHT 2 +SEEK COMPLETE
J1-34 -DIRECTION IN
SHT 2 +DRIVE SELECT
U6 LS08
J1-6 -WRITE GATE
SHT 2 INDEX
SHT 2 +CYL Ø
SHT 2 HD SEL 2⁰
SHT 2 HD SEL 2¹
SHT 2 HD SEL 2²
X1 5 MHz CRYSTAL
C33 22pF
C34 22pF
U16 6801
NMI
-INT
-RESET
SCI
XTAL 2
XTAL 1
R89 1.2K
U21 LS193
SHT 2 +STEP
R87, 4.7K
U13 7406
R95, 4.7K
SHT 2 -CHIP WR FAULT
33 -STP CHIP 1 EN.
32 -STP CHIP 2 EN
37 PHASE A
36 PHASE C
35 PHASE B
34 PHASE D
30 -DAMPING EN
U12 LS14
U17 7406
R68 360Ω
+12V
R65 100Ω
TIP101
CR7 IN4001
C39, 10µF
R69, 6.8K
U18 75438
U19 75438
R82, 1Ω, 1W
R81, 1Ω, 1W
R70, 1Ω 1W
R80, 1Ω 1W
CR9 CR10 CR8 CR11
IN5818
J32-4 J32-6 J32-12 J32-14 J32-3 J32-5 J32-11 J32-13
ØA RET J32-1
ØC RET J32-9
ØB RET J32-2
ØD RET J32-10
R94 4.7K
+REDUCE RESISTANCE SHT 3
ZERO SENSE SHT 2
-SET SEEK COMPLETE SHT 2
+WR DISABLE SHT 3
REDUCE WR CURRENT SHT 3
+READY SHT 2
+WRITE FAULT SHT 2
-MTR. CURR
R66 7.5K
R67 100Ω
Q10, TIP42
R86 .68Ω 2.5W
ØA, ØC J32-7
ØB, ØD J32-8
R71 1K
T1
R85 910Ω
R83, 18K
U20 LM392
R84 4.7K
C40 .1µF
+WRITE SHT 3
-WRITE SHT 3
U1 7438
-SIZE SEL Ø
-SIZE SEL 1
1.25 MHz J34-0
MOTOR FEEDBACK
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES
IMI
READ-WRITE LOGIC 5000H
D 263-02381-201 AA
SHEET 1 OF 3

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REV	DATE	EC NO.
AA	2.1.83	502 20

263-02381-201

NEXT ASSEMBLY | USED ON

J1-4 -HD SEL 2²
J1-18 -HD SEL 2¹
J1-14 -HD SEL 2°
J1-16
J2-7
J31-10
J31-18 WRITE UNSAFE
J34-15
J34-16
J3-4
J3-1
J34-7
J34-8
J34-11
J34-12
J34-14
J3-2,3
J1-(ODD)
J2-2,4,6,8 11,12,15,16,19,20

RP1 RP1 RP1

C7 1.0nF
C9 1.0nF
C8 1.0nF

U3 LS14 U3 LS14 U3 LS14

U13 7406 U12 LS14 U13 7406

R73, 1.8K
R72, 1.8K
R74 2.7K
R75 2.7K
+11.2V +11.2V

-CHIP 1 EN → J31-4
HD SEL 2² → SHT 1
-CHIP Ø EN → J31-2
HD SEL 2¹ → SHT 1

R2, 1.8K
R1, 1.8K
R7 1.2K
R8 1.2K
+5V
R10 7.5K
R9 7.5K

+HEAD SEL B → J31-6,14
HD SEL 2° → SHT 1
+HEAD SEL A/0 → J31-12,20

SPARE → J34-4
SPARE (SECTOR) → J34-2
SPARE → J34-13
INDEX CLK → J34-5

CR15 IN4001
+12V
C2 .1μF
C1 10μF
C3,5,6, 10,11, 38 .1μF
C4 10μF
+5V

+11.2V
R79 100Ω
U11 LM 392
C43 .1μF
+11.2V
R64 3.3K
R78 39K

CHIP WR FAULT → SHT 1
-6MB → J2-9
-12MB → J2-10

TP7

J34-6 +INDEX

INDEX → SHT 1
U2 7438
-INDEX → J1-20

SHT 1 +ZERO SENSE

U7 S08

-TRACK ØØ → J1-10

J34-3 +CYL Ø

+CYL Ø → SHT 1

SHT 1 +WRITE FAULT
SHT 1 +READY

U2 7438
-WRITE FAULT → J1-12

U2 7438
-READY → J1-22

J1-26 -DRV SELECT 1
J1-28 -DRV SELECT 2
J1-30 -DRV SELECT 3
J1-32 -DRV SELECT 4
J34-9
SHT 1 -OPTIONAL RESET
SHT 1 -SIZE SEL Ø
SHT 1 -SIZE SEL 1
J2-5 -CONTROLLER RESET

CR14, HP5082-2835
CR13 HP5082-2835
DS1

+5V R88 4.7K
U9 S00
U12 LS14

+5V R6 4.7K
U7 S08

U1 7438
-DRV SELECTED → J2-1

+DRIVE SELECT → SHT 1,3
-SEEK COMPLETE → J1-8
+SEEK COMPLETE → SHT 1

SHT 1 -SET SEEK COMPLETE

U6 LS08

+5V R97 220Ω
U12 LS14
R96 330Ω

TP8
U13 7406

-SEL LED → J33-2
LED RETURN → J33-1
+STEP → SHT 1

+5V R63, 160Ω

+5V R91 4.7K
U17 7406
U8 S74

(RESET SEEK COMPLETE)
SHT 1 -STEP
SHT 1 -RESET

MATERIAL		SCALE	
FINISH		DRAWN L.FUQUA 17MAY82	IMI INTERNATIONAL MEMORIES INCORPORATED
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES		CHD	R/W LOGIC
DECIMAL XX ± XXX ±	FRACTIONAL ± ANGULAR ±	ENGR 20 DEC 83	D 263-02381-201 AA
		APPROVED	SHEET 2 OF 3 REV.

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REV	DATE	EC NO.
AA	2-1-83	502[illegible]

263-02381-201

NEXT ASSEMBLY | USED ON

SHT 1, +REDUCE RESISTANCE

+12V
TP2
R53 100Ω
C36 1μF
C42 120pF
R55 240Ω
R54 240Ω
L2, 5.6μH
L1, 5.6μH
C27 120pF
C26 22pF
C25, .1μF
R45 470Ω
R44 24K
C23 .1μF
C24 .1μF
R43 24K
+5V
R93, 1K
+12V
CR12 HP5082-2835
Q12 J110
R92 82Ω
R42 200Ω
C22 240pF
U14 592
TP1
R23 220Ω
C21 .1μF
R51 2.7K
R52 2.7K
C20 .1μF
C16 220pF
C17 220pF
R26, 510Ω
R27, 1.0K
R24 510Ω
R22 510Ω
R25 510Ω
R28 1.0K
C15 .1μF
U10 116
R33 510Ω
R34 510Ω
R31 510Ω
R32 510Ω
R29 330Ω
R30 330Ω
R13 820Ω
R14 820Ω
C12, 220pF
Q1 Q2 2N5771
U9 S00
U5 LS31
+RD DATA → J2-17
-RD DATA → J2-18
R16 270Ω
R15 270Ω

SHT 2 +DRIVE SELECT
+12V
R46 1.2K
CR4 IN5234
C28 .1μF
R37 270Ω
C18 470pF
R36, 4.7K
R35, 4.7K
R38, 2.7K
CR2, IN4148
U15 CA3054
TP4
TP3
J31-8,16 DX
J31-5,13 DY
R61 220Ω
R62 220Ω
TP5
C37 10nF
R57 +70Ω
R58 820Ω
R56 820Ω
Q3 Q4 MPS2369
R18, 2.7K
C13 47 pF
R17 4.7K
U11 392
FALSE GND (+5V)
R60 510Ω
R59 510Ω
R19 2K 1%
J2-14 -WRITE DATA
J2-13 +WRITE DATA
SHT 1 +WRITE
R5 100Ω
U4 LS32
U8 S74
R3, 2.2K
CR3 HP 5082-2835
R41 1.5K
R20, 2.7K
Q6 2222A
CR1 IN4148
R11 150Ω 1%
Q5 2222A
R12 20Ω 1%
J34-1 - POWER LOSS
SHT-1 + WR DISABLE
SHT 1 + REDUCE WR CURRENT
SHT 1 -WRITE
U13 7406
U13 7406

+12V
R47, 20Ω
CR5 IN5234
Q9 LM 340 5V
C31 .1μF
C30 .1μF
VEE (+.7) → J31-11
CR6, IN4001
VCC (+11.2V) → J31-9,17
FALSE GND (+5V) → J31-3
+ WR CURRENT → J31-7,15
+12V
Q8 LM 340 5V
C32 .1μF
(5TO8.5)
WR SELECT → J31-1,19
GND → J31-21,23
R40 680Ω
R39 360Ω
C19 10nF
R21, 2.7K
Q7 2222A
- POWER LOSS → SHT 1

MATERIAL		SCALE	IMI
FINISH		DRAWN L.FUQUA 17 MAY 82	R/W LOGIC
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES		CHD DATE	
DECIMAL XX ± XXX ±	FRACTIONAL ± ANGULAR ±	ENGR DATE 10 Dec 83	D 263-02381-201 44
		APPROVED DATE	SHEET 3 OF 3 REV
		RELEASED DATE	

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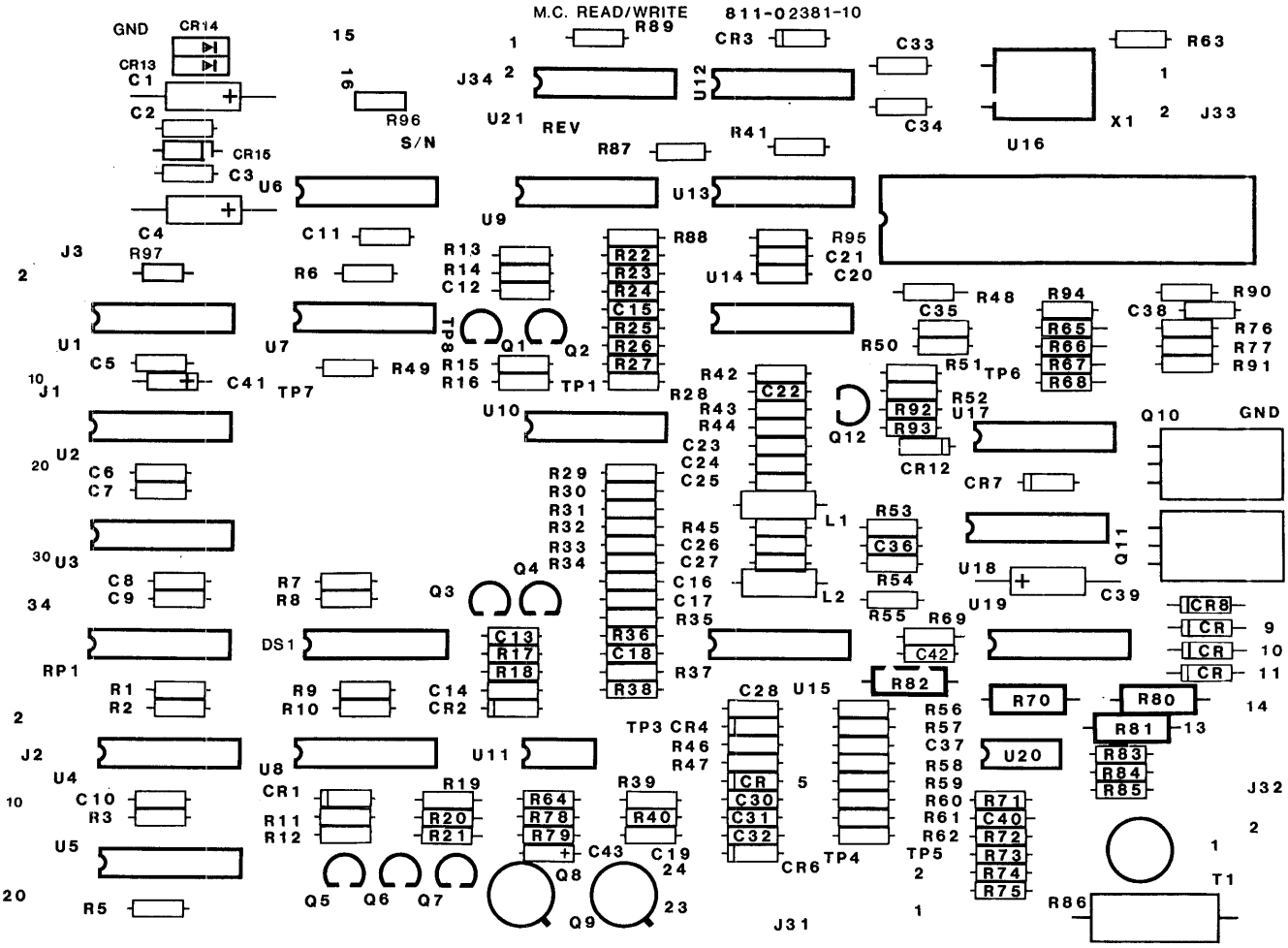
M.C. READ/WRITE
811-02381-10
GND
CR14
CR13
C1
C2
CR15
C3
C4
U6
U9
U13
U12
U21
REV
S/N
R96
R89
CR3
C33
C34
U16
X1
J33
R63
R87
R41
J34
J3
R97
R6
C11
R13
R14
C12
R88
R95
C21
C20
U14
R48
C35
R94
R65
R66
R67
R68
C38
R90
R76
R77
R91
U1
U7
TP8
Q1
Q2
R49
R15
R16
TP1
TP7
C5
C41
J1
R42
C22
R28
R43
R44
C23
C24
C25
R50
R51
TP6
R52
U17
R92
R93
Q12
CR12
Q10
GND
U10
U2
C6
C7
R29
R30
R31
R32
R33
R34
R45
C26
C27
C16
C17
R35
L1
L2
R53
C36
R54
R55
CR7
U18
C39
U19
Q11
U3
C8
C9
R7
R8
Q3
Q4
R69
C42
R82
CR8
CR
CR
CR
9
10
11
RP1
DS1
C13
R17
R18
R36
C18
R37
R38
R1
R2
R9
R10
C14
CR2
C28
U15
R56
R57
C37
R58
R59
R60
R61
R62
R70
R80
R81
R83
R84
R85
14
13
J32
2
TP3
CR4
R46
R47
CR
C30
C31
C32
5
CR6
TP4
TP5
U20
R71
C40
R72
R73
R74
R75
J2
U4
U8
U11
CR1
R11
R12
R19
R20
R21
R64
R78
R79
R39
R40
C43
C19
24
23
Q8
Q9
Q5
Q6
Q7
C10
R3
U5
R5
J31
T1
R86
1
2
10
20
30
34

REV	DATE	EC NO.
AA	MAY 15/86	465 VB

REV	DATE	EC NO.

263-02157-201

NEXT ASSEMBLY	USED ON

-STEP(RESET SEEK COMPLETE) SHT 2
-RESET SHT 2

SHT 3 -POWER LOSS
SHT 2 DS1-12
J1-24 -STEP
J31-24 SIZE SEL 1
J31-22 SIZE SEL Ø
SHT 2 + SEEK COMPLETE
J1-34 -DIRECTION IN
SHT 2 +DRIVE SELECT
J1-6 -WRITE GATE
SHT 2 INDEX
SHT 2 + CYL Ø
SHT 2 HD SEL 2⁰
SHT 2 HD SEL 2¹
SHT 2 HD SEL 2²
SHT 2 -CHIP WR FAULT

+5V R90 270Ω
R49 100K
C41 1µF
RP1
U3 LS14
U9 SOO
R77 2.2K
R76 2.2K
R50 4.7K
R48 4.7K
C35 .1µF
TP6
R95, 4.7K
R89 1.2K
R87, 4.7K

U16 6801
NMI
-INT
-RESET
P34 -STP CHIP 1 EN.
P35 -STP CHIP 2 EN
P30 PHASE A
P31 PHASE C
P32 PHASE B
P33 PHASE D
P37 -DRIVE IS EN
SCI
P47
P46
P45
P44
P43
P42
P41
P40
P10
P11
P12
XTAL 2
XTAL 1
P21
P22
P23
P20
P24
P17
P16
P15
P14
P13
-MTR. 3I CURR.
P36

U12 LS14
U17 7406
U6 LS08
R68 360
R65 IEC
Q11 TIP101
CR7 IN4001
C39, 10µF
R69, 6.8K
U118 75438
U119 75438
R82, 1Ω, 1W
R81, 1Ω, 1W
R70, 1Ω 1W
R80, 1Ω 1W
CR9 IN5818
CR10 IN5818
CR8 IN5818
CR11 IN5818
R66 1.5K
R86 .68Ω 2.5W
Q10, TIP42
R67 100Ω
R71 1K
C40 .1µF
T1
R85 910Ω
RB3, 18K +/2V
U20 LM392
R84 4.7K
R94 4.7K
U9 500
U1 7438
X1 5 MHz CRYSTAL
C33 22pF
C34 22pF

ØA RET J32-1
ØC RET J32-9
ØB RET J32-2
ØD RET J32-10
J32-4
J32-6
J32-12
J32-14
J32-3
J32-5
J32-11
J32-13
ØA, Øc J32-7
ØB, ØD J32-8
+ REDUCE RESISTANCE SHT 3
ZERO SENSE SHT 2
-SET SEEK COMPLETE SHT 2
+ WR DISABLE SHT 3
REDUCE WR CURRENT SHT 3
+ READY SHT 2
+ WRITE FAULT SHT 2
+ WRITE SHT 3
- WRITE SHT 3
-SIZE SEL Ø SHT 2
-SIZE SEL 1 SHT 2
1.25 MHz J34-0
MOTOR FEEDBACK

MATERIAL	SCALE	IMI
FINISH	DRAWN STEVE B2 DATE	READ/WRITE LOGIC 5000H
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES	CKD DATE	D 263-02157-201 AA
DECIMAL XX: XXX: FRACTIONAL: ANGULAR:	ENGR DATE	SHEET 1 OF 3 REV.
	APPROVED DATE	
	RELEASED DATE	

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REV	DATE	EC NO.
AA	NOV 5/82	465 rlb

REV	DATE	EC NO.

263-02157-201

NEXT ASSEMBLY	USED ON

J1-4 -HD SEL 2² — RP1 (1) — C7 1.0nF — U3 1 2 LS14 — U13 3 4 7406 — R73, 1.8K — +11.2V R74 2.7K — -CHIP 1 EN → J31-4; HD SEL 2² → SHT 1

J1-18 -HD SEL 2¹ — RP1 (10) — C9 1.0nF — U3 5 6 LS14 — U12 3 4 LS14 — U13 5 6 7406 — R72, 1.8K — +11.2V R75 2.7K — -CHIP Ø EN → J31-2; HD SEL 2¹ → SHT 1

J1-14 -HD SEL 2° — RP1 (12) — C8 1.0nF — U3 3 4 LS14 — R2, 1.8K — R7 1.2K — +5V R8 1.2K — +HEAD SEL B → J31-6,14; HD SEL 2° → SHT 1

R1, 1.8K — R10 7.5K — R9 7.5K — +HEAD SEL A → J31-12,20

+12V → J3-1; +5V → J3-4; J3-2; J3-4

J31-10, J31-18 WRITE UNSAFE — +5V — J34-15, J34-16, J34-7, J34-8, J34-14, J34-11, J34-12 — +12V — C1 10µF — C2,3,5,6,10,11,38 .1µF — + C4 10µF

C43 .1µF — +11.2V R79 100Ω — U11 LM 392 — R64 3.3K — +11.2V — R78 39K — CHIP WR FAULT → SHT 1

J34-4 SPARE

J34-2 SPARE (SECTOR)

J34-13 SPARE

J34-5 INDEX CLK

J34-6 +INDEX — TP7 — U2 7438 — INDEX → SHT 1; -INDEX → J1-20

SHT 1 +ZERO SENSE — U7 LS08 — U2 7438 — -TRACK ØØ → J1-10

J34-3 +CYL Ø — +CYL Ø → SHT 1

SHT 1 +WRITE FAULT — U2 7438 — -WRITE FAULT → J1-12

-SIZE SELECT Ø → J2-9

-OPTIONAL RESET → SHT 1

-SIZE SELECT 1 → J2-10

SHT 1 +READY — U2 7438 — -READY → J1-22

J34-9 — HP5082-2835

SW1 (DS1)

J1-26 -DRV SELECTED 1

J1-28 -DRV SELECTED 2

J1-30 -DRV SELECTED 3

J1-32 -DRV SELECTED 4

SHT 1 / J2-5 SHT 1 -SIZE SELECT Ø — HP5082-2835

SHT 1 -SIZE SELECT 1

SHT 1 - SET SEEK COMPLETE

+5V — R88 4.7K — U9 S00 — U12 LS14 — R6 4.7K — U7 LS08 — U1 7438 — -DRV SELECTED → J2-1

TP8 — U13 7406 — U7 LS08 — U1 7438 — +DRIVE SELECT → SHT 1, 3

-SEEK COMPLETE → J1-8

+SEEK COMPLETE → SHT 1

RP1 (6) — U12 LS14 — U6 LS08

J1-16 — J2-7 — J1 (ODD) J2-2,4,6,8,11,12,15,16,19,20 — (SEEK COMPLETE CLOCK)

+5V — R91 4.7K — U17 7406 — U8 S74

SHT 1 -STEP

SHT 1 -RESET

R63, 160Ω — +5V — J33-2; J33-1

+STEP → SHT 1

MATERIAL	SCALE	IMI INTERNATIONAL MEMORIES INCORPORATED
FINISH	DRAWN L FUQUA 17 MAY 82	R/W LOGIC
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES	CHK DATE	D 263-02157-201 AA
DECIMAL .XX ± .XXX ± FRACTIONAL ± ANGULAR ±	ENGR DATE	SHEET 2 OF 3 REV.
	APPROVED DATE	
	RELEASED DATE	

REV	DATE	EC NO.
AA	NOV 6/87	465 18

263-02157-201

NEXT ASSEMBLY | USED ON

SHT 1 +REDUCE RESISTANCE

+12V
C36 .1μF
R53 100Ω
C42 120pF
R55 240Ω
R54 240Ω
L2, 5.6μH
L1, 5.6μH
C25, .1μF
R45 470Ω
R44 24K
C27 120pF
C26 22pF
C23 .1μF
C24 .1μF
R43 24K
R93, 1K → +12V
CR12 HP5082-2835
Q12 J110
R92 82Ω
R42 300Ω
C22, 240pF
U14 592
+5V
TP 1
R23 220Ω
C21 .1μF
C20 .1μF
C16 220pF
C17 220pF
R51 2.7K
R52 2.7K
R26, 510Ω
R27, 1.0K
R24 510Ω
R22 510Ω
C15 .1μF
R25 510Ω
R28 1.0K
U10 116
R33 510Ω
R34 510Ω
R31 510Ω
R32 510Ω
R29 330Ω
R30 330Ω
R13 820Ω
R14 820Ω
C12, 220pF
Q1 Q2 2N5771
U9 S00
U5 LS31
+RD DATA → J2-17
-RD DATA → J2-18
R16 270Ω
R15 270Ω

SHT 2 +DRIVE SELECT
+12V
R46 1.2K
CR4 IN5234
C28 .1μF
U15 CA3054
R37 270Ω
C18 470pF
R38, 2.7K
R36, 4.7K
R35, 4.7K
CR2, IN4148
Q3 Q4 2N2369
R18, 2.7K
C13 47 pF
R17 4.7K
U11 392
TP 4
TP 3
J31-8,16 DX
J31-5,13 DY
R61 220Ω
R62 220Ω
C37 10nF
R57 470Ω
R58 820Ω
R56 820Ω
TP5
FALSE GND (+5V)
R60 510Ω
R59 510Ω
R47, 20Ω
CR5 IN5234
Q9 LM 340 5V
C31 .1μF
C30 .1μF
VEE (+7) → J31-11
CR6, IN4001 VCC (+11.2V) → J31-9,17
FALSE GND (+5V) → J31-3
+WR CURRENT → J31-7,15
R19 2K 1%
Q8 LM 340 5V
C32 .1μF
(5TO8.5)
WR SELECT → J31-1,19
R40 680Ω
C19 10nF
R39 360Ω
J31-10
J31-18
GND → J31-21,23
R21, 2.7K
Q7 2222A
J2-14 -WRITE DATA
J2-13 +WRITE DATA
SHT 1 +WRITE
R5 220Ω
U4 LS32
U8 74S74
R3, 2.2K +5V
CR3 HP 5082 -2835
R41 1.5K
R20, 2.7K
Q6 2222A
CR1 IN4148
R11 150Ω 1%
Q5 2222A
R12 20Ω 1%
J34-1 - POWER LOSS
SHT-1 + WR DISABLE
SHT 1 + REDUCE WR CURRENT
SHT 1 -WRITE
U13 7406
U13 7406
- POWER LOSS SHT 1

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES
DECIMAL XX ± .XXX ± FRACTIONAL ± ANGULAR ±

MATERIAL
FINISH
SCALE
DRAWN LFUQUA DATE 17MAY82
CHD DATE
ENGR DATE
APPROVED DATE
RELEASED DATE

IMI INTERNATIONAL MEMORIES INCORPORATED

R/W LOGIC

D 263-02157-201 AA

SHEET 3 OF 3 REV.

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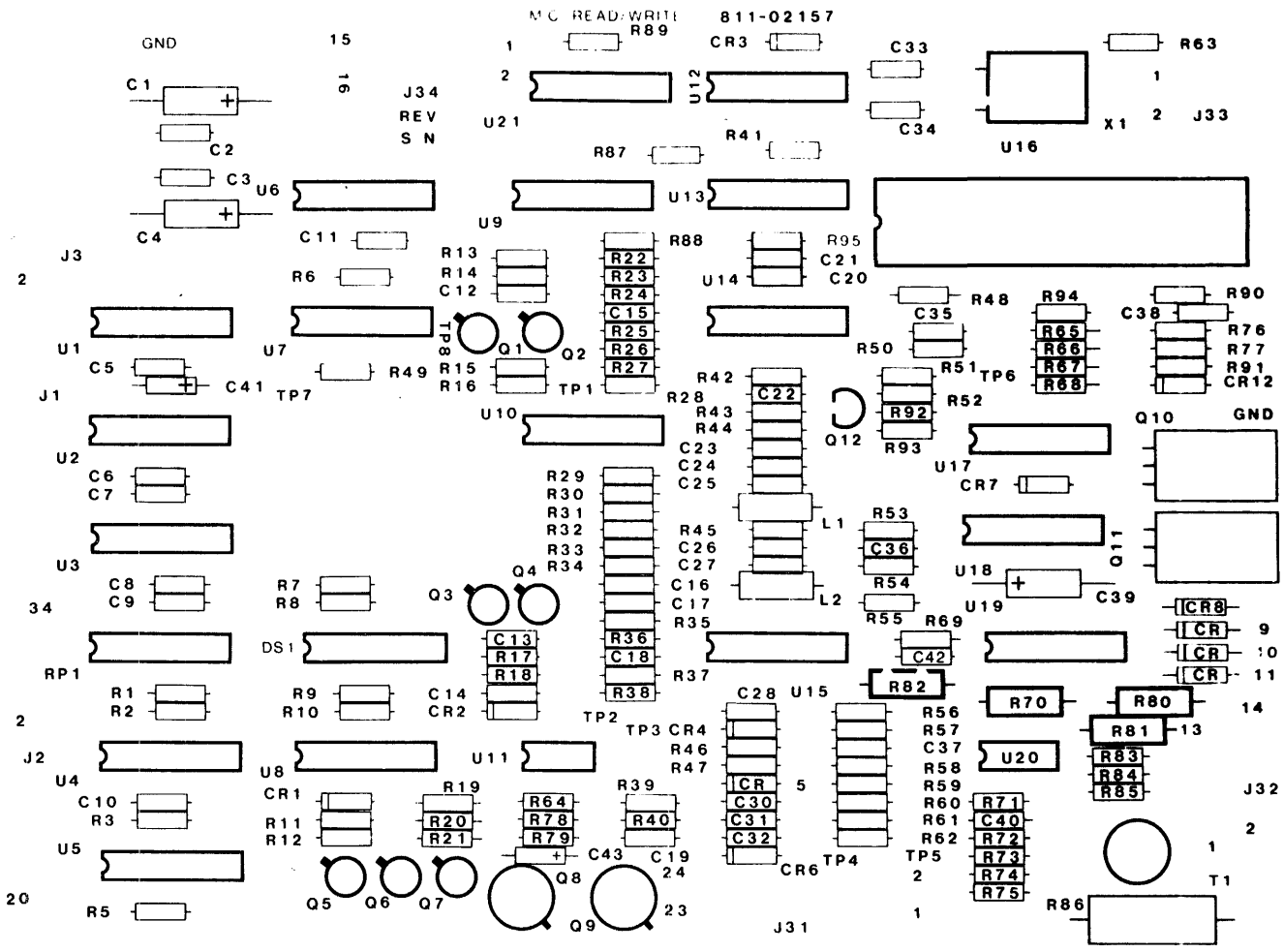
M C READ/WRITE
811-02157
GND
15
16
J34
REV
S N
1
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R89
CR3
C33
C34
R63
X1
J33
U16
U21
U12
R87
R41
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Q12
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R93
R52
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CR7
Q10
GND
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L1
L2
R53
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C42
R82
R1
R2
R9
R10
C14
CR2
TP2
TP3
CR4
R46
R47
C28
U15
R56
R57
C37
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R60
R61
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R84
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J2
U4
U8
U11
U20
J32
C10
R3
CR1
R11
R12
R19
R20
R21
R64
R78
R79
R39
R40
C43
C19
24
CR
C30
C31
C32
5
CR6
TP4
TP5
R71
C40
R72
R73
R74
R75
2
U5
20
R5
Q5
Q6
Q7
Q8
Q9
23
J31
1
T1
R86