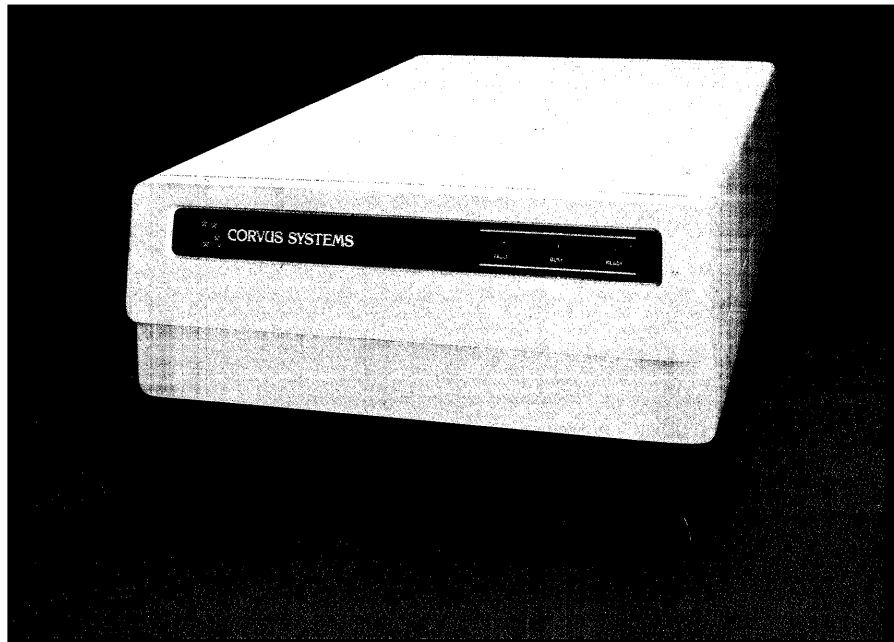


# THE CORVUS SERVICE MANUAL



11 and 20 Megabyte Drive

 **CORVUS SYSTEMS**

# 11/20MB Drive Service Manual ERRATA SHEET

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## ERRATA

**PAGE 10, section 4.3**

Delete "Omninet," insert "Corvus OMNINET™"

**PAGE 45, section 8.3.6.1**

Delete "Superbrain," insert "SuperBrain®"

Delete "Superbrain and TRS-80," insert "SuperBrain® and TRS-80®"

**PAGE 53, section 9.3**

Delete "Apple II+," insert "Apple II Plus®"

**CORVUS SYSTEMS  
11MB AND 20MB  
EIGHT-INCH WINCHESTER  
DISK DRIVE  
SERVICE MANUAL**

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**

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## SPECIFICATIONS

### Operational Specifications

	11MB	20MB
Disks per Drive	2	3
Data Surfaces per Drive	3	5
Servo Surfaces per Drive	1	1
Heads per Surface	1	1
Data Heads	3	5
Servo Heads	1	1
Number of Data Cylinders/Drive	358	388
Sectors per Track	20	20
Track Density (TPI)	300	300
Bytes per Sector (Formatted)	512	512
Bytes per Track (Formatted)	10,240	10,240
Bytes per Drive (Formatted)	10.9MB	19.7MB
Bit Density (BPI)	5,868	5,868
Average Latency (ms)	8.3	8.3
Average Access Time (ms)	35	35
Maximum Access Time (ms)	65	65
Maximum Access Time, Single-Track (ms)	6	6
Data Transfer Rate (Kb/s)	648	648
Recording Format	MFM	MFM
Rotational Speed (RPM)	3,600	3,600
Start Time (s)	15	25
Stop Time (s)	30	30

### Physical Dimensions (White Cabinet)

Height (In/Cm)	6.375 / 16.19
Length (In/Cm)	23.0 / 58.42
Width (In/Cm)	14.5 / 36.83
Weight (Lbs/Kgs)	48 / 22

### Environmental Requirements

Operating Temperature (F/C)	50° to 100° / 10° to 37°
Non-Operating Temperature (F/C)	-40° to 140° / -40° to 60°
Operating Relative Humidity (%)	10 to 80
Non-Operating Relative Humidity (%)	10 to 90
Operating Altitude (ft)	-1,000 to +10,000
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

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## CORVUS DEALER SERVICE

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### 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)	250
Line fuse (Amperes)	
for 100V-120V	4.0
for 220V-240V	2.0

### Reliability

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

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**CORVUS DEALER SERVICE**

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**CHAPTER 1**  
**GENERAL DESCRIPTION**

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## CHAPTER 1 GENERAL DESCRIPTION

### 1.1 Scope of Chapter

This chapter outlines the purpose of the 11-megabyte and 20-megabyte disk drives. Also provided is a brief description of the drive packaging and layout, and a definition of Winchester technology. Read the manual completely before attempting any service procedures.

### 1.2 Introduction

This document contains procedures and data required to service Corvus 11-Megabyte and 20-Megabyte eight-inch Winchester disk drives. Corvus five-inch Winchester drives and floppy drives are covered in separate service manuals, as are networks and peripheral equipment. Troubleshooting and repair of all equipment will be addressed on a modular level.

There exists two versions of the 11MB Corvus drive: the Revision A (RevA) and the Revision B (RevB). The 20MB drive was manufactured in a Revision B only. Service procedures for the eight-inch Corvus disk drives will apply to both the RevA and RevB drives, except where noted. Specific differences will be outlined later in this manual.

Also included in this publication is documentation on the Dealer Service Diagnostic Utility diskette supplied to each service center. The utilities provide for burn-in/reliability testing, adjustment, and troubleshooting of all Corvus disk drives.

Installation and operation of the Corvus disk drives will not be covered in detail in this document. Refer to the "Corvus Systems Installation Guide" and "Corvus Systems User Guide" for information on these subjects.

### 1.3 Model Identification

The Corvus eight-inch disk drives are very similar in appearance. Before any service procedures are attempted, the drive must be identified as to the model and serial number.

Locate the serial number tag on the rear bezel. The following is a sample serial number to be found on a Corvus eight-inch drive:

142-C350/M

and is decoded below:

- 14 represents the week of manufacture (14 for March/April)
- 2 represents the year of manufacture (2 for 1982)
- C represents a 20 MB eight-inch drive (B for a 11MB)
- 350 represents the serial number of that weeks' manufacture
- /M represents that the drive was shipped with an internal mirror

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

### 1.4 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 of digital information for instant retrieval at the request of the host system. The Corvus disk system consists of the disk drive with its Z-80 Intelligent Controller, power supply, host interface electronics, 34-pin interface flat-cable and Corvus Utility diskettes.

#### 1.4.1 Power Supplies

The power supply operates from either 110-120VAC or 220-240VAC, 50Hz or 60Hz single-phase power. Early models of the Corvus disk drive were stand-alone units. The latest model uses a white cabinet enclosure which contains the disk mechanism, cooling fan and power supply.

### 1.4.2 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. Mirror troubleshooting and repair is covered in the Corvus Mirror Service Manual.

### 1.5 Corvus Disk Systems

The Corvus Mass-Storage Disk System utilizes a sealed Winchester disk mechanism 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 user guide for the appropriate computer system.

Early versions of the eight-inch Corvus Disk System consist of the sealed drive mechanism with drive electronics, and power supply, either separate or on a common baseplate. Some RevA and RevB drives are configured this way. Recent, upgraded versions of the Corvus package consist of a white cabinet housing the sealed disk mechanism and drive electronics, power supply, Mirror (if that option is ordered), fan and cabling. Most RevB drives use this configuration.

Located in the bottom of the sealed unit, the PCA card cage contains the drive electronics responsible for servo control, read-write control, microprocessor interface/control. External to the drive, the interface card and cable transfer data to and from the host computer.

The Intelligent Controller PCA and internal Mirror PCA can be viewed through the access door in the bottom of the drive cabinet. Only the Mirror PCA may be removed through this door.

The RevA sealed mechanism was manufactured in 11-megabyte capacities only. The RevB is manufactured in both 11- and 20-megabyte capacities. There are no fundamental differences in the sealed mechanisms of the RevA and RevB 11MB units. This is not to say that all 11MB units are identical. Each unit should be inspected to determine its particular designation. Some of the drive electronics are different and are not compatible between RevA and RevB.

All Corvus disk mechanisms have some sort of carriage locking device which restrains the heads. Inherent in the Winchester drive design is the necessity for the heads to rest on the platter surface when the drive is powered off. Because of this contact, the heads must be parked safely off of the Data Area, onto an Outer Guardband Area of the platter surface. This is accomplished by either of two methods. Earlier versions of the drive used a manual headlock device, which is identified by a screw located on the side of the mechanism. Current versions of the drive use an electromechanical headlock which automatically secures the heads after the power is removed from the drive.

### 1.6 Winchester Technology

The Corvus disk drive uses the IMI Winchester disk mechanism. 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 powerdown. It is the contaminant-free environment that allows for reduction in clearance between head and recording media. This results in the heads riding on a 18-micron cushion of air. 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 mechanism is that it requires no regular maintenance.



**CHAPTER 2  
INSTALLATION**

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## CHAPTER 2 INSTALLATION

### 2.1 Scope of This Chapter

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

### 2.2 Introduction

Each drive, when it is received, should be checked for shipping damage, and tested for proper function. This chapter contains these 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 large number of failures upon receipt.

- 1) Locate the access door in the center of the drive basepan.
- 2) Remove the two allen screws and open the door. The Controller/Logic PCA is located directly behind the access door, facing outward.
- 3) Press firmly on all socketed chips, seating them securely into their sockets.
- 4) Replace allen screws.

#### 2.3.1 Headlock Mechanisms

All eight-inch sealed disk mechanisms have a locking device to ensure that the heads are secured during shipment. Early models use a manual locking device consisting of a locking screw accessible from the side of the mechanism. This screw must be used to lock the heads prior to shipping or unlock prior to use. (Turn the screw Clockwise to unlock the heads. Turn the screw Counter-Clockwise to lock the heads. Do not use excessive force when turning the headlock screw.) Current models use an automatic electro-mechanical headlock which secures the heads every time power is removed from the drive.

**CAUTION:**

**If the disk drive has a manual lock, the lock must be released before any attempt is made to operate the disk drive. Attempting to operate the drive before unlocking the heads will cause the servo electronics to be damaged. Do not transport the drive with the heads unlocked. This can cause the heads to impact onto the disk surface, damaging both, if the unit is jarred.**

**Manual locking drives must be FULLY unlocked before use. This requires the locking screw to be turned approximately 17½ turns clockwise. If tension is felt, STOP IMMEDIATELY and verify that the heads are unlocked by tilting up the rear of the drive mechanism (the end with the Backplane/Motherboard). If the heads slide freely across the disk, the heads are unlocked.**

**CAUTION: (continued)**

To lock the heads, tilt up the front of the drive mechanism (the end opposite the Backplane/Motherboard) to return the heads to the outside edge of the disk surface. While holding the drive in this position, tighten the locking screw by turning it counter-clockwise approximately 17½ turns. If tension is felt, STOP IMMEDIATELY and verify that the heads move no more than 1/8" when the rear end of the drive is tilted up.

Over-tightening or over-loosening of the headlock screw may result in destruction of the headlock mechanism, rendering the sealed unit defective. Care must be exercised whenever tightening or loosening this screw.

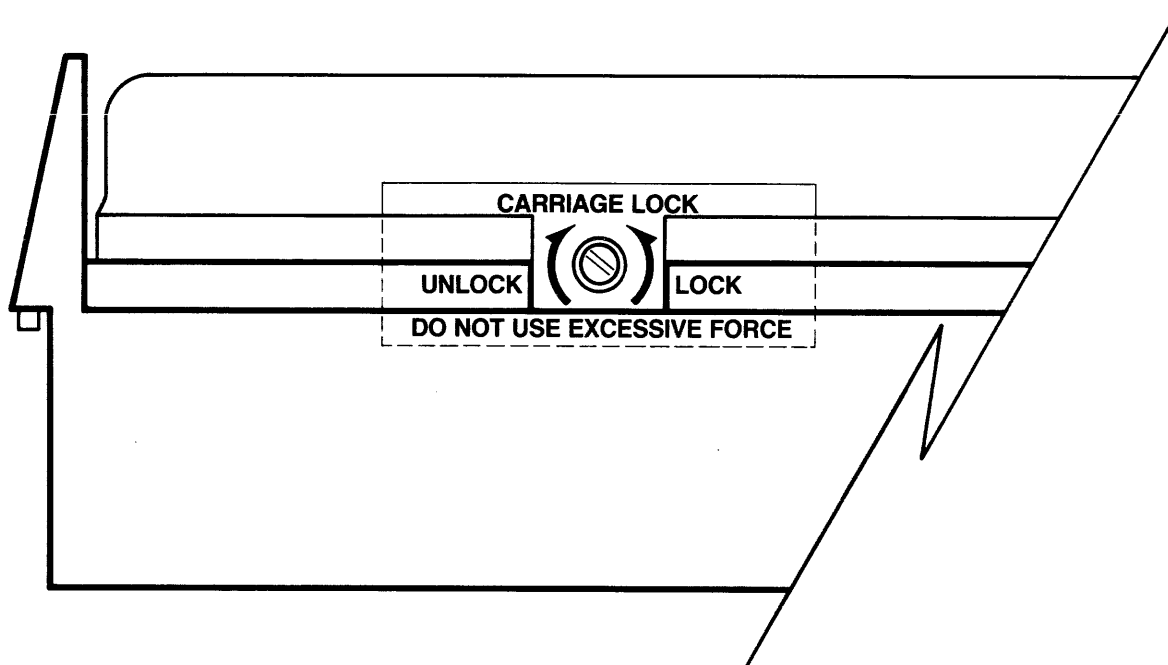


Figure 2.1 Manual Carriage Lock Location

**2.3.2 Diagnostic Test**

The drive should be subjected to a thorough diagnostic test and exercise as outlined in Chapter 8 ("Diagnostics") of this manual. A CRC-Format Check should be done for the drive, as well as verifying the Drive Parameters (specifically the Spare Track Table and the Virtual Drive Offset Table).

A new drive may be shipped with up to four tracks spared, and considered operational. When the Drive Parameters and the VDO Table is first checked, these parameters should be noted, recorded on a label, and attached to the drive. In the event that the drive format is disturbed in shipment, it may be necessary to reformat the drive. The drive will be reformatted with default parameters (Spare Track Table: no tracks spared. VDO Table: Drive 1=0. Interleaving Spec: 9). This will cause no problems as long as the drive has never had tracks spared. If the drive has ever had a track spared, the Spare Track Table must be reconstructed, as well as the VDO Table (20-MB only) before the data is restored. Knowing what tracks must be spared will speed this procedure. Note on the label any future tracks spared.

Installation and setup procedures are covered in the "Corvus Installation Guide" and "Corvus User Guide" for the particular system. These aspects will not be addressed further in this document.

#### 2.4 Installation Considerations

All electronic equipment needs cooling and the Corvus Disk is no exception. When installing, do not "pigeon-hole" the drive. There should be sufficient open air both front and rear. Place the drive on a level, hard surface without foam or carpeting which may restrict airflow.

Be sure the proper line voltage has been selected. Referring to figure 2-2, proceed with the following instructions:

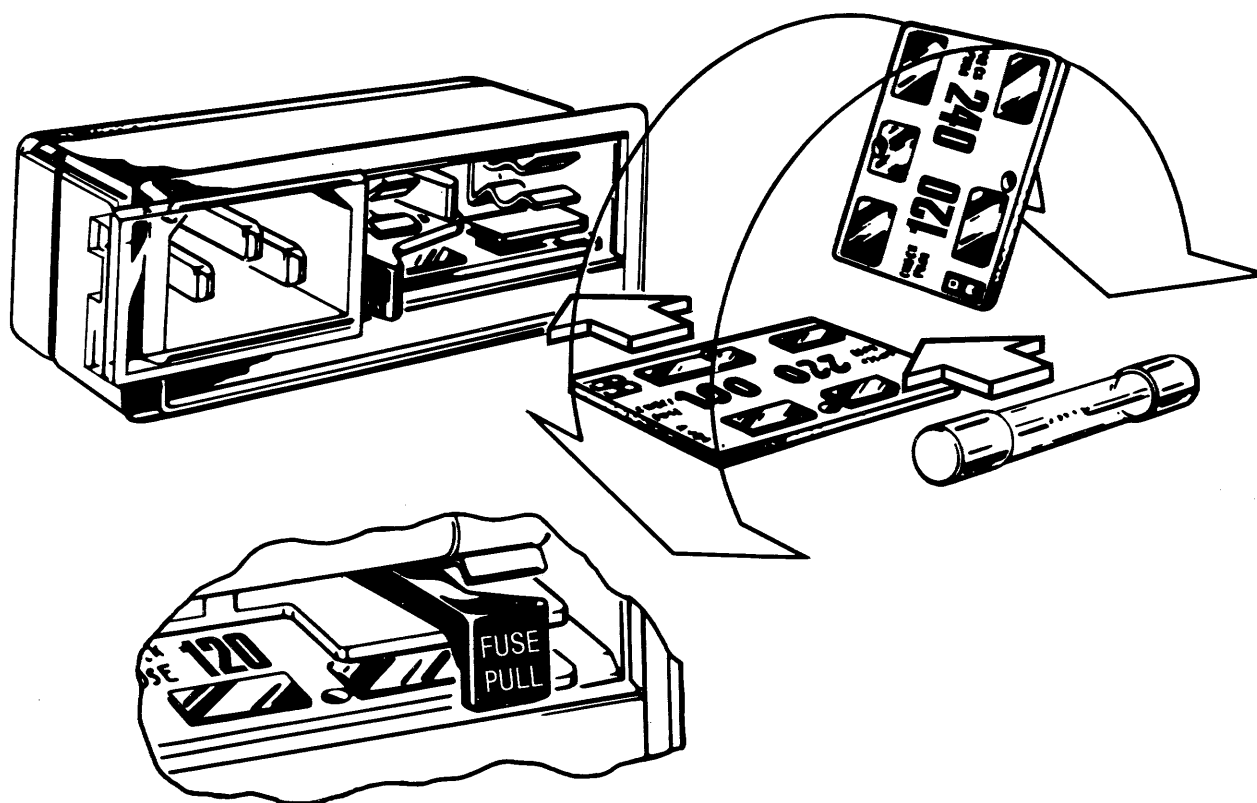


Figure 2-2. CORCOM Unit

1. Remove power cord from CORCOM unit at rear of drive.
2. Slide plastic door to the left, uncovering fuse.
3. Remove fuse.
4. Using a pair of needle-nose pliers, remove voltage selection PCB from just below fuse holder.
5. Position voltage selection PCB so that proper voltage is visible when PCB is inserted.
6. Reinsert fuse, using correct value: 4A/100-120VAC, 2A/220-240VAC.
7. Slide plastic door to right.
8. Connect power cord to CORCOM unit, and to power outlet.

Connect the interface cable between the connector on the interface card in the host computer, and the PROCESSOR connector on the rear bezel of the white cabinet Corvus disk drive. Be sure the "one" edge (edge with dark stripe) is to the right, when facing the rear of the drive unit. For instructions regarding host interface installation and connection, refer to the appropriate "Corvus Systems User Guide".

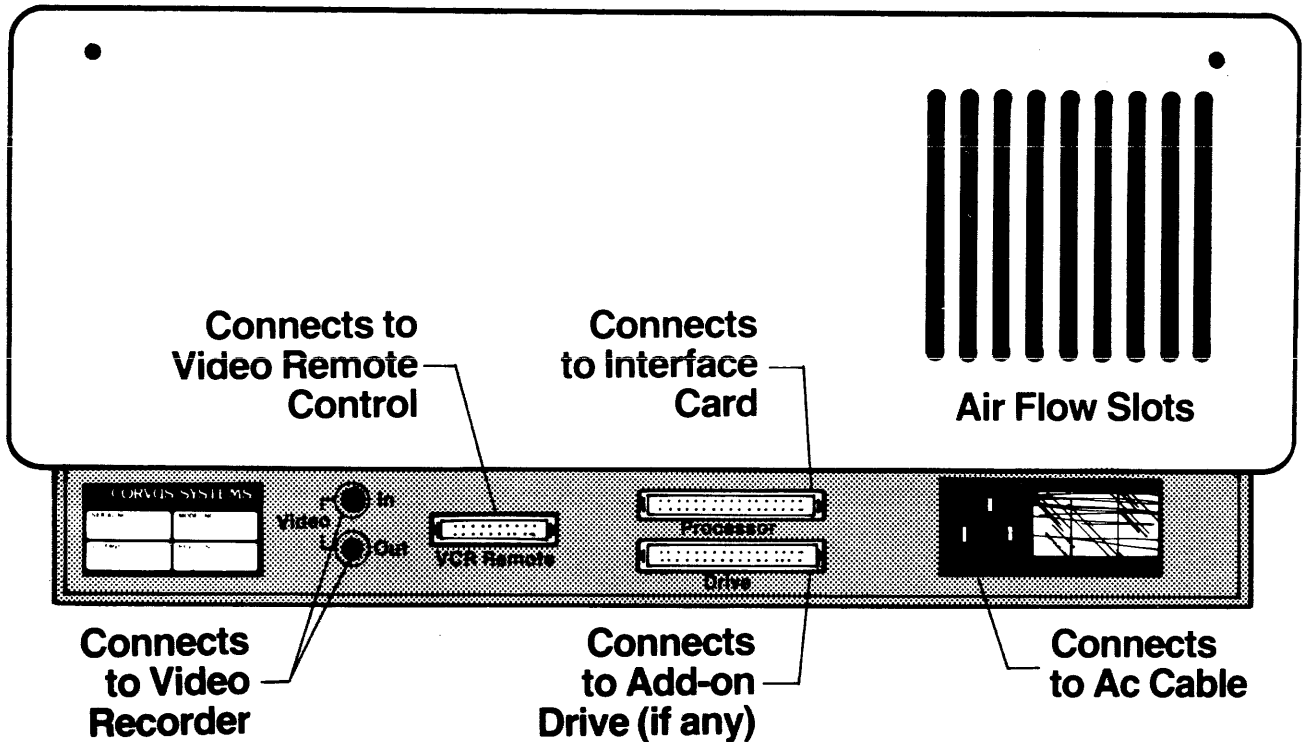


Figure 2-3. Rear Bezel Components

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 Constellation Multiplexer system, or to a DEC LSI-11 computer. If so, the appropriate switches should be set.

Locate the power switch beneath the front bezel, and turn it on. The drive will begin to spin up to speed, and all Light Emitting Diodes, or LEDs (front bezel indicator lights) will come on, steady. On drives with late model Controller ROMs the BUSY LED will begin to flash. 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.

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

### 2.5 Daisy-Chaining of Disk Drives

A maximum of four physical disk drives can be interfaced to the host computer. A maximum of 80 megabytes of on-line storage may be achieved by daisy-chaining four 20MB drives. This is accomplished by using a common input/output interface bus, commonly called daisy-chaining. A special add-on drive flat cable is available from Corvus specifically for this purpose. One add-on drive cable is required for each additional disk drive in the system.

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**CORVUS DEALER SERVICE**

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Changing the unit-select switches (positions 1-3) on the drive Z-80 Controller PCA for each add-on drive is required when daisy-chaining drives. Switches 1-3 are a binary-count with the first drive in the chain set to drive #1. Additional drives should be set accordingly, taking into account that a 20MB drive is two logical drives. Not all systems refer to 20MB drives as two logical drives (CP/M does not). Refer to the Corvus User Guide for the appropriate computer system.

**Table 1-1. Unit Address Options**

<b>SW1</b>	<b>SW2</b>	<b>SW3</b>	<b>DRIVE ADDRESS</b>
NOT USED			0
ON	ON	OFF	1
ON	OFF	ON	2
ON	OFF	OFF	3
OFF	ON	ON	4
OFF	ON	OFF	5
OFF	OFF	ON	6
OFF	OFF	OFF	7

SWITCH CLOSED = ON  
SWITCH OPEN = OFF

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**CORVUS DEALER SERVICE**

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**CHAPTER 3  
OPERATION**

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## CHAPTER 3 OPERATION

### 3.1 Scope of Chapter

This chapter describes operator controls and their uses 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 Systems User Guide" for the appropriate host operating system.

### 3.2 Introduction

Since the stand-alone drives do not have indicator lights or switches to read or manipulate, this chapter will deal only with the white cabinet models that do. These disk drives have controls that allow the operator to easily interface the drive to many single-user or network systems. These must be set properly for each different 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 power cord, fuse and power selection unit (CORCOM), video connectors, host processor connector and daisy-chained drive connector.

#### 3.3.1 Front Bezel LEDs

The LEDs are labeled READY, BUSY, and FAULT. During the power-up sequence all LEDs are on, and BUSY blinks while the drive motor reaches operating speed. When the motor has reached speed, all LEDs will go off. BUSY will flicker, and if the drive passes the self-test the READY signal will be set, and the READY LED will be on, and the BUSY and FAULT LEDs will be off.

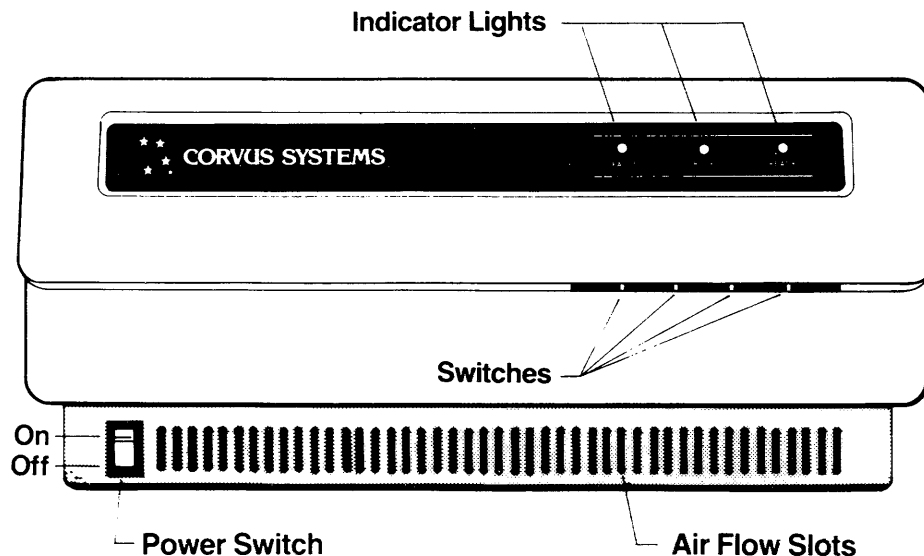


Figure 3-1. Front Bezel



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 a fault has been detected. The **FAULT LED** is an indicator of drive malfunction or operational error, although some software may cause this LED to light during normal operation.

### 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 software switches. The Controller ROM routine polls the switch at power-up to ascertain system configuration. Only the **RESET** switch directly affects the hardware.

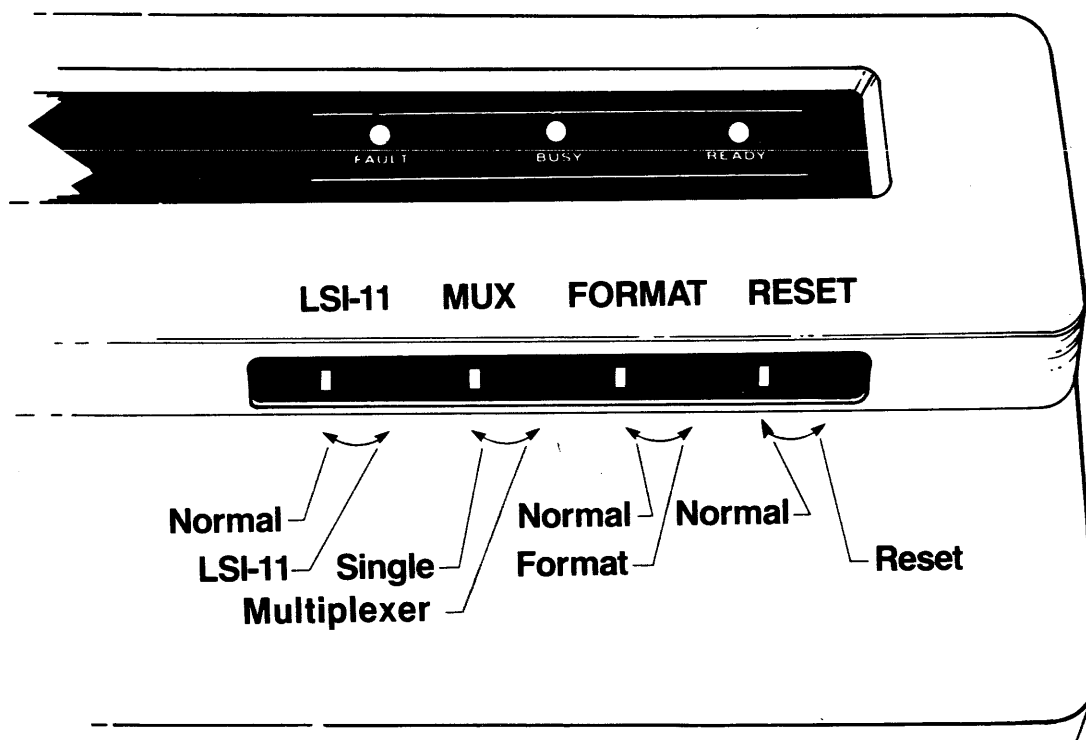


Figure 3-2. Function Switches

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. The heads re-zero and disk Controller Firmware is loaded in from the disk into the Controller RAM. The drive is then ready to accept new commands from host processor.

The **FORMAT** switch is a two-position switch; left position is normal, right position is **ON**. This switch must be on for a bottom-level format to be executed. The switch alone will not cause the drive to be formatted. Also, when the drive is powered on, or the **RESET** switch operated, the Controller will check the status of this switch. If the switch is off, the Controller code is read from the Controller Firmware area of the disk into the on-board ram of the Z-80 Controller in the drive. If the switch is on, no Controller code is read, and the drive comes **READY** if the self-test has succeeded, and the heads re-zero.

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## CORVUS DEALER SERVICE

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The **MUX** switch is also a two-position switch; left position is single-user position, right position is for use with a Constellation Network Multiplexer. System configuration software polls this switch to determine if a Constellation Multiplexer is attached, and the Multiplexer polling routine is to be used.

The **LSI** switch is a two-position switch; left position is normal, right position is for use with DEC System LSI-11. System configuration software polls this switch to determine if a DEC LSI-11 computer is connected to the Corvus. If the switch is on, Controller code is loaded from the Controller Firmware into the Controller RAM at boot time, which causes the Corvus to emulate DEC-System RL01 and RL02 disk drives.

### 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 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 environment, 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 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 photocopier machines, heating and cooling equipment, elevators, etc.

#### 3.5.3 Temperature

Although in most environments, the disk drive needs no actual warm-up time, there are restrictions that the drive must operate within (see specification chart 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**

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

Due to slight oxidation buildup on connectors, reseating flatcable connectors and power connectors periodically will also help insure reliability.

### **3.6.2 Groundstrap**

Located on the lower end of the motor spindle of the drive mechanism, a spring-tension arm keeps the static discharge brush in contact with the spindle. Although initial design studies maintained this brush (or groundstrap) as a necessity, further design considerations resulted in the elimination of it. This resulted in some drives being manufactured with groundstraps, and some without. Drives with groundstraps should retain them, while those without need not have them added.

The Corvus Disk System is designed to be used in an office environment, and hence, noise levels have been kept to a minimum. While every effort has been made to quiet the operation of the disk, some mechanical noise is inherent to all disk mechanisms.

During normal operation of the eight-inch disk drives a high-frequency squeal or chatter may be heard emitting from the static discharge brush. If a brush is making noise, it should be bent to increase contact tension and taped to help dampen vibrations. Be careful not to cover the fan intake, which will result in reduced cooling of the drive electronics and overheated components.

A faulty groundstrap, vibrating in this manner, can sometimes be the cause of hardware errors such as CRC errors and data errors, due to the build-up and sudden release of static charge from the spindle.

**CHAPTER 4**  
**DRIVE DESCRIPTION**

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## CHAPTER 4 DRIVE DESCRIPTION

### 4.1 Scope of Chapter

This chapter details the components of the Corvus disk drive, and the function of each. Some terms are defined to provide a clear foundation for the following descriptions.

### 4.2 Introduction

The Corvus disk drive is divided into five functional areas; Power Supply, Disk Sealed Mechanism, Servo Electronics, Read/Write Electronics, and Controller Electronics. Each of these constitutes a module and is field-replaceable as such.

### 4.3 Power Supply

The Corvus disk drive comes with a power supply which provides all voltages required by the disk sealed mechanism. Four different power supplies have been used with the eight-inch drive. In some early models, before the white cabinet was used, the power supply was either separate or on a common baseplate with the drive. All supplies use the same dc power connector to connect to the drive mechanism.

#### 4.3.1 CS100

The CS100 is a switching power supply, which shares a common baseplate with the drive unit. It is contained in a black plastic cabinet, nearly a cube in shape, and has the power switch, FORMAT and MUX switches and CORCOM ac power receptacle integrated into the rear panel. It is the only Corvus power supply to have an integral cooling fan. All voltages are adjusted simultaneously with one potentiometer, R25. If only one of the voltages is out of tolerance, the supply must be replaced. The CS100 is discontinued, and if a replacement is needed, the CP129 should be used.

#### 4.3.2 CP129

The CP129 is a fully enclosed, separate stand-alone unit. The CP129 is contained in a black, rectangular metal case. The power switch is located on the end of the supply, and a dc power cable connects to the disk mechanism. All voltages on the CP129 are adjustable.

#### 4.3.3 CP140

The CP140 is an open-chassis power supply used in early models of the enclosed Corvus disk cabinet. Three types of the CP140 exist: the CP140-10358, the CP145/M120-10463, both of which have a five-wire transformer primary ac wire harness, and the CP140/M110-10530, which has a six-wire transformer primary ac wire harness. All are black. The CP140 power supplies were manufactured with two different bolt patterns for securing it to the basepan. Because of the different ac primary wire harnesses and mounting bolt patterns, some of these models are not directly interchangeable. Three of the voltages are adjustable; use R10 to adjust -5V, R for +5V, and R13 for +12V.

#### **WARNING:**

***This applies to systems using power supplies CP140-10358 or CP145/M120-10463 having the five-wire transformer primary ac wire harness. If replaced by either a CP140/M110-10530 or CP411 using the six-wire transformer primary ac wire harness, be sure that the CORCOM power selection/line filter/ac wire harness assembly is replaced by part number 8010-08071, and ac power switch is replaced by the assembly number 8010-08067.***

***If one is not already in place, put a warning sticker on the transformer:***

***"IF THIS POWER SUPPLY IS REPLACED WITH MODEL CP140-M110 OR CP411, REPLACE LINE FILTER ASSEMBLY WITH TYPE 8010-08071 AND POWER SWITCH WITH TYPE 8010-08067 TO PREVENT SHOCK HAZARD"***

The ac CORCOM filter assembly consists of the CORCOM unit (on the rear bezel), cabling and connectors to the power switch and power supply primary wiring harness.



Figure 4-1. Stand-Alone Drive with CS100 Power Supply



Figure 4-2. Stand-Alone Drive with CP129 Power Supply

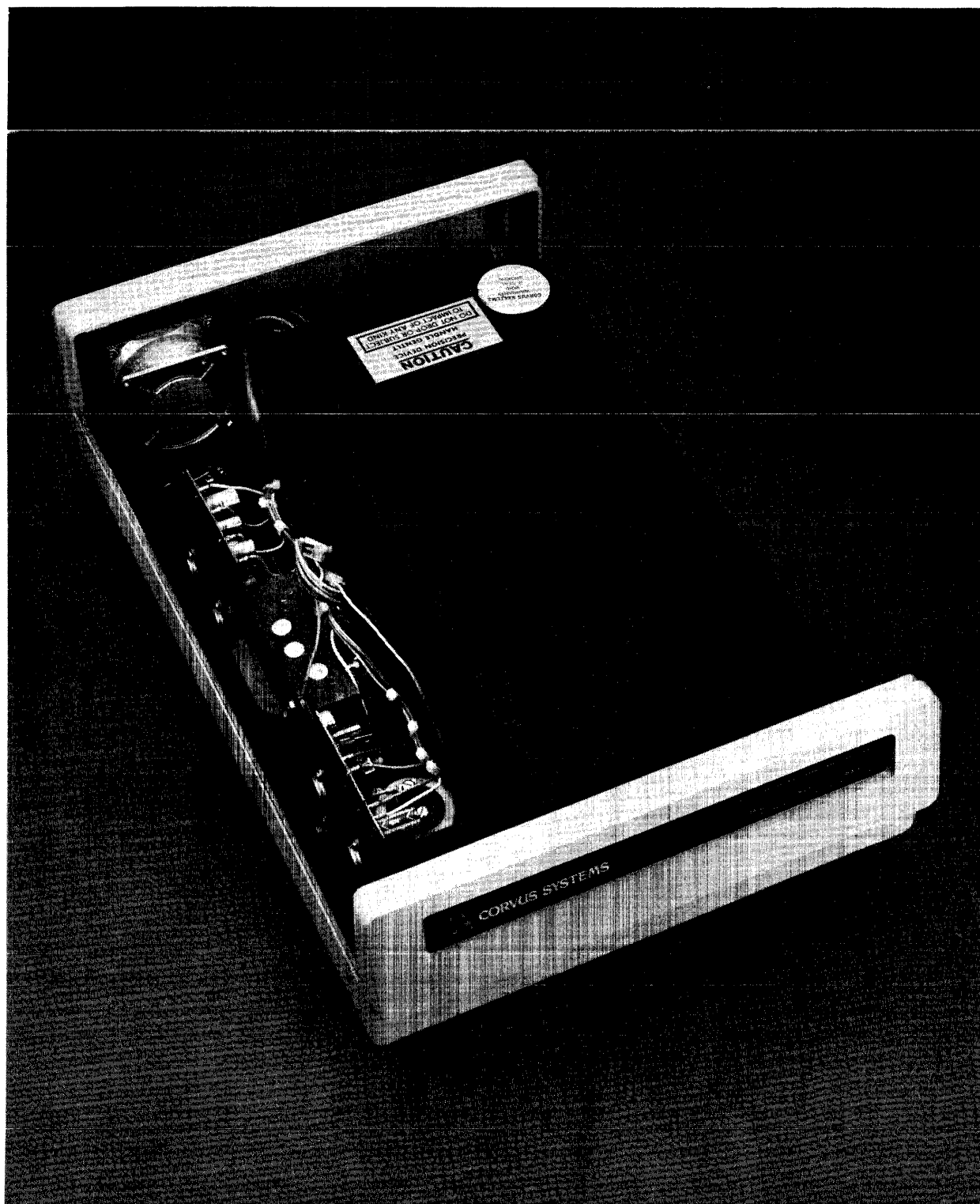


Figure 4-3. White Cabinet with CP140 Power Supply



#### 4.3.4 CP411

The CP411 is also an open-chassis supply used in later versions of the Corvus disk package. The CP411 uses a rectangular, unpainted aluminum chassis. Four voltages are adjustable; use R27 to adjust -5V, R14 for +5V, R7 for +12V, and R20 for +24V.

#### 4.4 dc Power Cables

All power supplies terminate with the same ten-pin dc power connector at the drive mechanism. The CP129 has connectors at both ends of the cable. All others use solder connections at the supplies.

The ten-pin power connector which connects to the drive Backplane is keyed, but if forced on backwards, will make connection. Take care to observe polarity when connecting the power cable to the drive.

#### 4.5 Definition of Terms

The recording media of the disk drive consists of magnetic-oxide coated aluminum disks referred to as platters. The 11-megabyte drive has two eight-inch circular platters, while the 20-megabyte has three. There are two heads for each platter, one on each side of each platter, suspended aerodynamically above each surface.

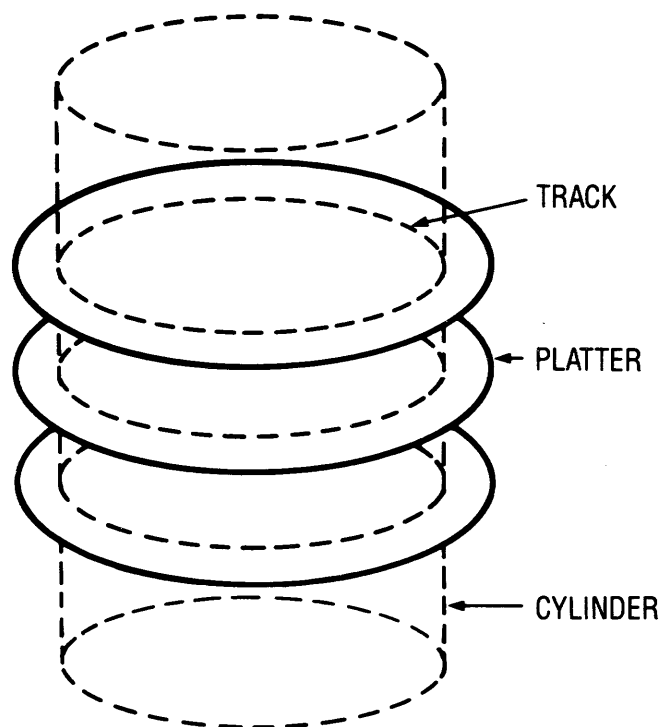
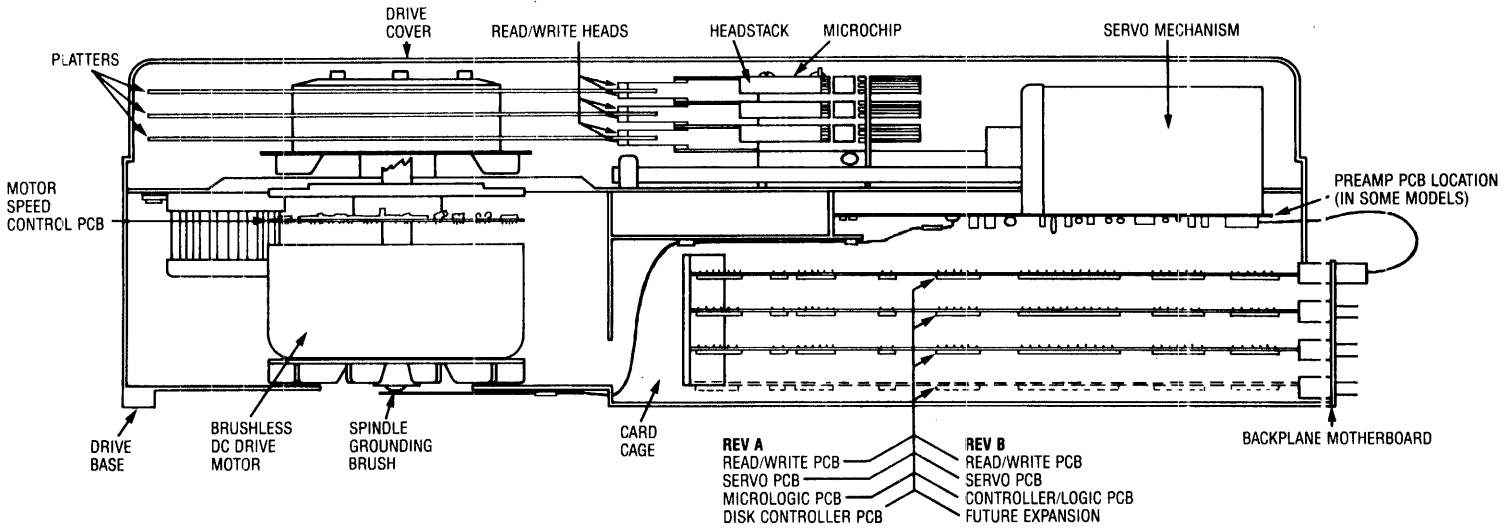


Figure 4-4. Data Configuration.

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 of 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 358 cylinders on the 11-megabyte drive, 388 on the 20-megabyte drive, cylinder 0 being located furthest from the center of the platters.

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.



DISK DRIVE SEALED MECHANISM

Figure 4-5. Disk Drive Sealed Mechanism

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 or reading 128, 256 or 512 bytes) depending on the type of operating system.

This does not cause a conflict, since the drive simply stores 1, 2, or 4 host-defined sectors for each 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.

#### 4.5.1 Disk Sealed Mechanism

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

The eight-inch platters revolve on a common spindle, driven by a brushless dc motor at a speed of 3600 RPM. Motor speed is monitored at the motor, and is independent of line frequency. An impeller fan at the lower end of the spindle cools the drive electronics in the card cage located in the bottom of the mechanism. A solenoid brake contacts the motor hub approximately 30 seconds after power off.

#### 4.5.2 Controller Firmware

Corvus reserves the first two cylinders of the drive for system information. This is referred to as Controller Firmware, and is not accessible to the host operating system. This Firmware contains programming and system information needed by the Z-80 Intelligent Controller, and is loaded into the disk drive RAM when the drive is powered-on or the RESET switch is toggled. The spare track table, Constellation parameters and semaphore status flags 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, the configuration of which depends upon the type of host operating system.

#### 4.5.3 Data Storage

Data storage arrangement is by concentric tracks aligned in vertical cylinders. Each track is sectioned into 20 sectors, each sector has a capacity of 512 eight-bit bytes. Logical sectors are numbered by using an interleaving specification of nine (see figure 4-6) for the eight-inch drive, except for use with the DEC LSI-11 which uses an interleaving specification of five.

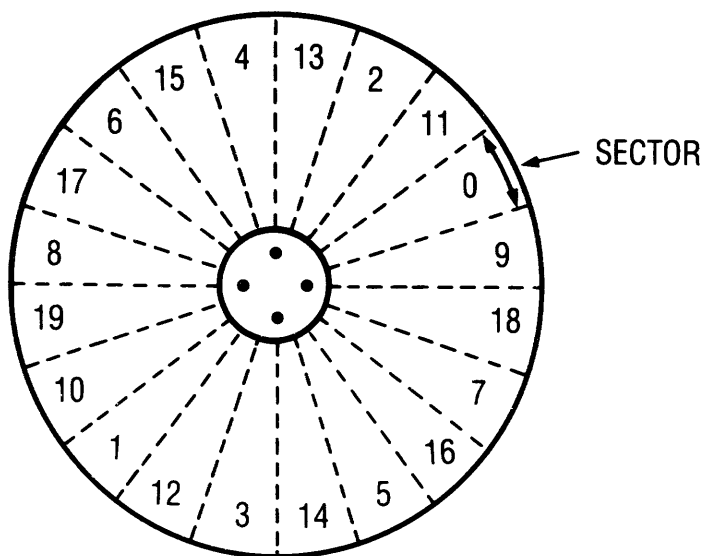


Figure 4-6. Sector Interleaving

All but one of the heads transfer digital information to and from the platters. The bottom head is reserved for reading servo information from the bottom surface, monitoring the current position of the head stack.

Each head glides above the platter surface on a 18-micron (18 millionths of one inch) cushion of air. A particle of smoke, dust, or a human hair could easily play havoc with these critical tolerances, and cause catastrophic failure of the disk device. The seal on the drive cover keeps the internal atmosphere contaminant-free. Breaking this seal for any reason, voids the warranty.

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 by a linear actuator mechanism, similar to a voice-coil in a loudspeaker. Attached to the head stack assembly, current flows through the voice coil and creates a magnetic field which attracts or repels the field of the permanent magnet surrounding the voice coil. Head travel is controlled by the magnitude and polarity of current flow in the coil; positive flow results in one direction, negative flow results in the opposite direction.

Contained in the head stack is the microchip. This select and driver microcircuitry, visible on the top of the stack, is responsible for selecting which head is being used, and transmitting the signal to the drive electronics for further amplification.

#### **4.5.4 Headlock Devices**

The purpose of the headlock device, either manual or electromechanical, is to keep the heads parked on the outer area of the platter where they rest during poweroff. For the electromechanical headlock, when power is supplied to the drive, the headlock solenoid is actuated, releasing the heads. When the drive is powered off, the heads are automatically retracted, and the solenoid de-energized, locking the heads in the parked position.

For drives with manual locking devices, the headlock screw must be used whenever the drive is shipped and received. Whenever a drive is received, the type of headlock device should be determined, and if the manual type, unlocked.

Before shipping any drive, verify proper headlock function by tipping the drive while observing the heads. If the headlock is functioning properly, the heads should not move. When the drive is received, unlock the heads (manual headlock drives), and verify that the heads are free by powering on and tipping the drive. The manual-lock drive should never be powered on with the heads locked in place. Failure to unlock the heads may result in damage to the drive.

#### **4.5.5 Preamp PCA**

Data stored on the media is picked up by the read/write heads and passed on to the Preamplifier PCA located in the bottom of the sealed mechanism. This circuit board is mounted on the underside of the sealed mechanism, and is visible when the drive electronics are removed from the drive.

Two types of the Preamp PCA exist; one version having discreet components on the PCA, one having no components. The former version amplifies the signal, and then passes it on to the Read/Write PCA for further processing, while the latter version simply passes the signal to the Read/Write PCA, and therefore has no circuitry on the Preamp PCA. Different Read/Write PCAs are used with each type of Preamp PCA, and are not interchangeable.

#### **4.5.6 Drive Electronics Revision**

The drive electronics are located in the card cage area in the bottom of the drive. Two basic versions of the drive electronics exist. The RevA drives contain four PCAs, while the RevB drives use three (see figure 4-5).

The RevA drive electronics consist of one Read/Write PCA, one Servo control PCA, one Micrologic PCA, one Controller PCA, and one Backplane/Motherboard having four PCA card slots which accept the above four cards.

Similarly, the RevB has one Read/Write PCA, one Servo control PCA, and one four-slot Backplane/Motherboard. This drive, however, uses one Controller/Logic PCA taking the place of the Micrologic PCA and disk Controller PCA, making a total of three circuit cards.

The RevA Micrologic PCA, Controller PCA, Backplane/Motherboard, the RevB Controller PCA and Backplane/Motherboard are unique to their revision, and are not interchangeable. Read/Write PCAs and some Servo PCAs are interchangeable between RevA and RevB as long as compatibilities are observed (preamp model and servo type).

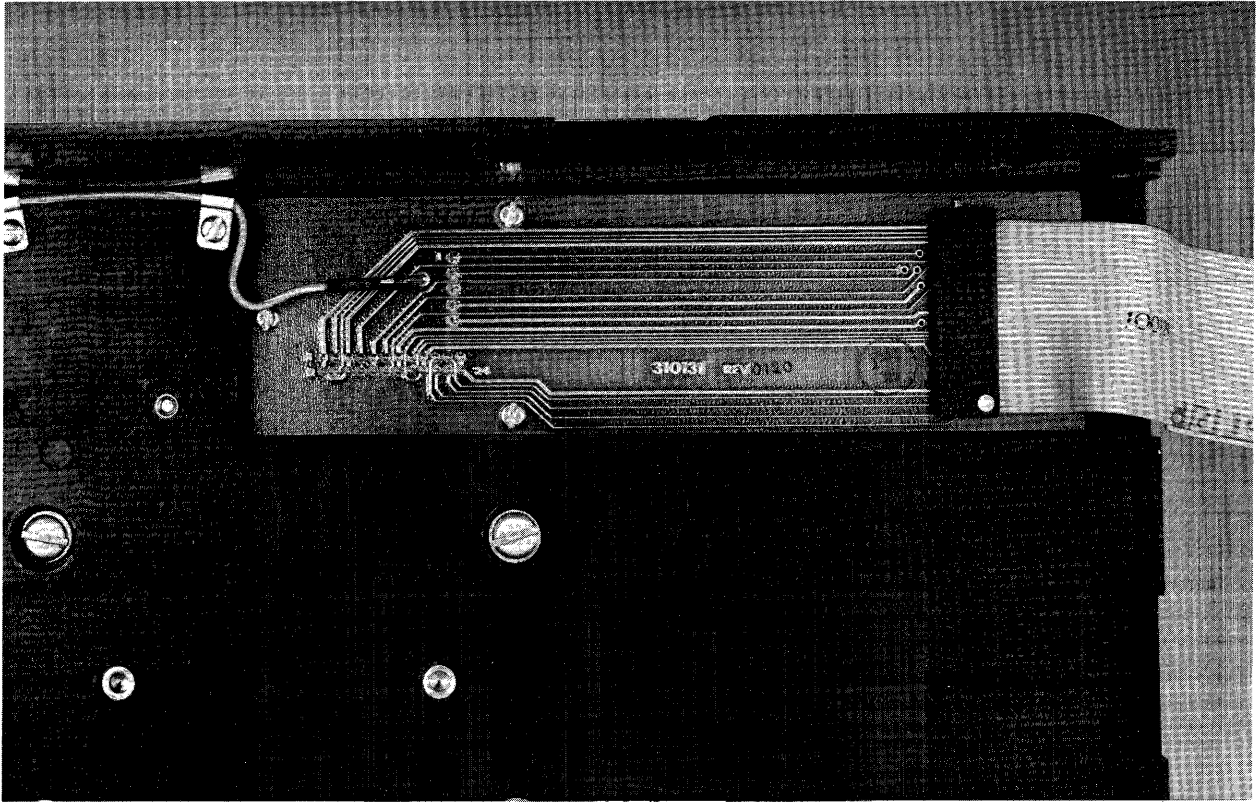


Figure 4-7. Preamp PCA Location

#### 4.6 Power-Up

As soon as power supply voltages have stabilized, the Z-80 Controller board begins a routine which initializes the Z-80 microprocessor, and then executes a ROM-based self-test. The test checks the on-board RAM, and then a bit-sum check is done to the ROM. If the self-test fails, the Z-80 halts execution, leaving the FAULT and BUSY LEDs on, and the READY LED off.

If the self-test executes successfully, the drive begins the boot routine. This consists of first re-zeroing the heads, bringing them over the first cylinder of the disk surfaces. The FORMAT switch (or jumper, in earlier drive configurations) is then tested. If the switch is on, 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 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 disk until all Controller Firmware is successfully loaded into the Controller RAM.

**CHAPTER 5**  
**THEORY OF OPERATION**

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## CHAPTER 5

# THEORY OF OPERATION

### 5.1 Scope of Chapter

The function of each component as well as the overall function of the drive is described. Details of the operation of Servo, Read/Write, Controller, Backplane, Preamp and Interface electronics are given.

### 5.2 Introduction

The Z-80 Intelligent Controller is responsible for interpreting the commands sent from the host system, and controlling the relevant sub-assemblies. The Read/Write Electronics translate the data signal into a usable format. Servo Electronics are responsible for seeking the requested cylinder, and maintaining that position once it has been reached. The Backplane transfers power and signals between drive electronics PCAs, power supply, drive sealed mechanism, Interface PCA, and Paddleboard PCA. Interface electronics are responsible for monitoring the status of the drive and sending and receiving bytes from the drive.

### 5.3 Servo Electronics

The Servo PCA is located in slot B of the card cage. The basic function of the servo is to position the read/write heads as instructed by the Z-80 Intelligent Controller, and maintain that position.

There exist three versions of Servo PCAs:

- 1) 310221 for use with drive mechanisms which have either manual or electromechanical headlocks, and either RevA or RevB electronics.
- 2) 310176 for use with drive mechanisms which have manual headlocks, and either RevA or RevB electronics.
- 3) 310006 for use with drive mechanisms which have manual headlocks, and RevA electronics.

(Refer to the PCA Compatibility Chart in the appendices for details.)

The Servo Electronics has two modes: seek mode, in which a command is received from the Intelligent Controller and the servo seeks a specific cylinder address, and position mode, in which the servo position circuitry, independent of the Controller, applies correction voltage to the servo mechanism whenever the heads are detected to have drifted off-cylinder. These two states can be observed by monitoring the POSITION MODE signal. When this signal is high, the drive is in position mode, and when it is low, the drive is in seek mode.

The Servo PCA also monitors the power supply voltages, and if a power fall is detected, will interrupt the Controller electronics. The Controller then determines the proper action to be taken, depending whether the interrupt was caused by a power failure or simply a temporary power drop-out.

#### 5.3.1 Servo Tracks

The servo surface (located on the lower side of the bottom platter) differs from the data surfaces. This surface contains servo tracks which are similar to data tracks, except that they are located midway between data cylinders. When the heads are positioned on a cylinder, the servo head is located between two servo tracks, and sums the two signals from the adjacent servo tracks, resulting in the tri-bit signal. This signal is in turn processed, resulting in the PES (Position Error Signal). It is by this signal that the drive electronics determines that the heads are on-cylinder.

The servo tracks are written at the time the drive is manufactured, and cannot be rewritten in the field. These tracks also contain timing information for index and the write clock. Damaged servo tracks are considered catastrophic failure of the sealed mechanism, which must be replaced as a module.

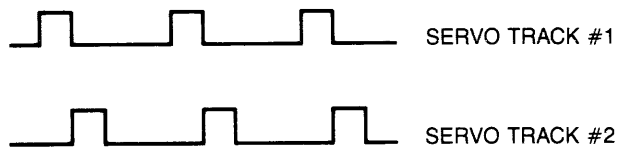
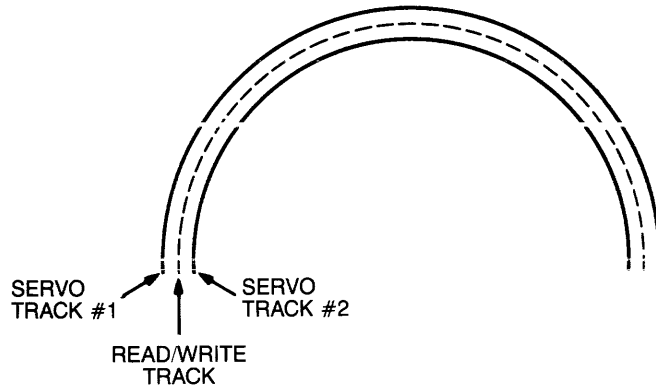


Figure 5-1. Servo Track Relationship

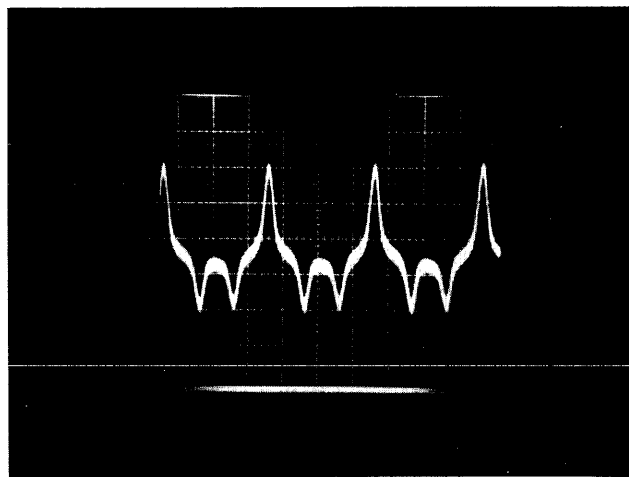


Figure 5-2. Tri-Bit Signal



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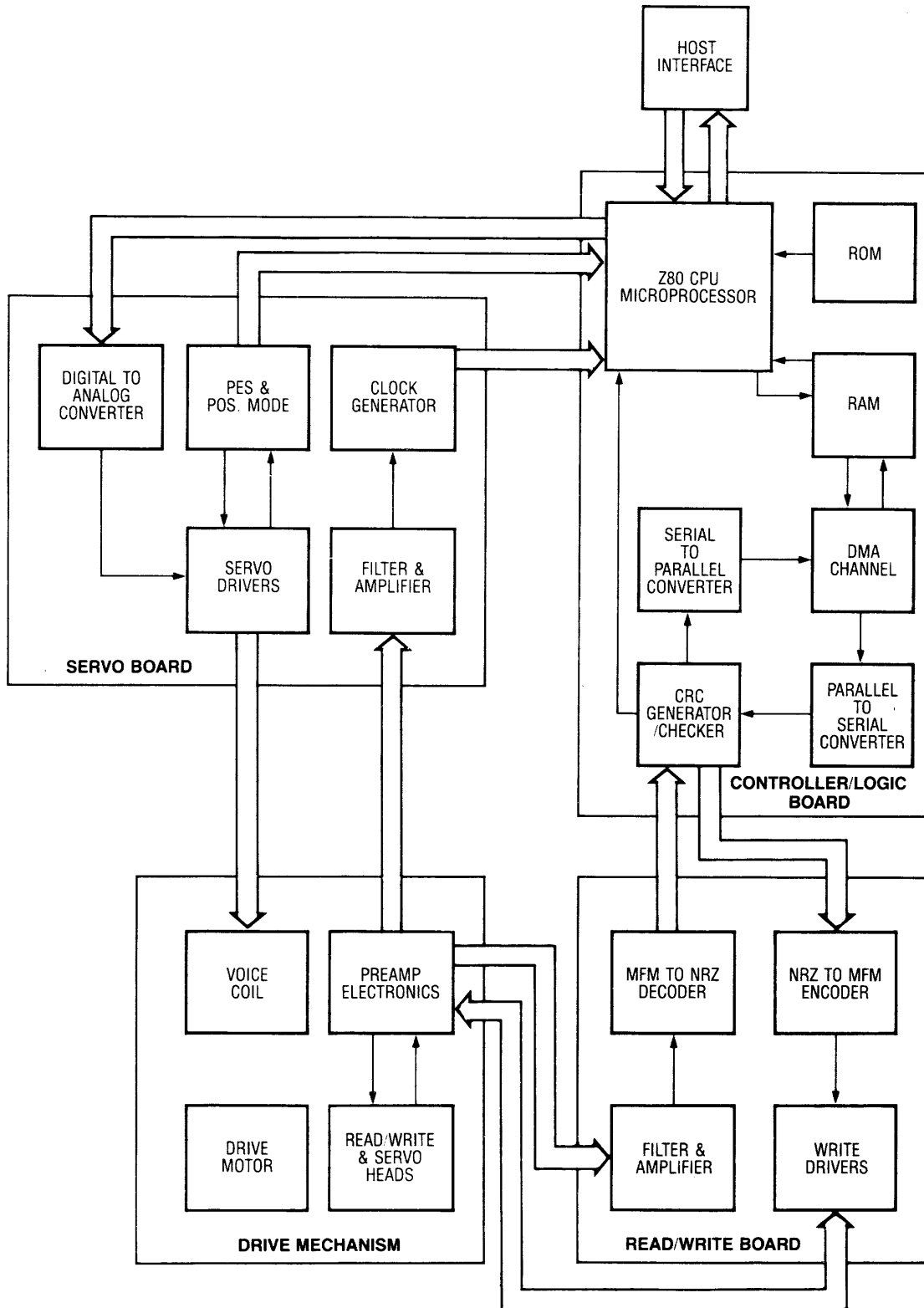


Figure 5-3. Corvus Rev B Block Diagram

### **5.3.2 Servo Control Signals**

#### **POSITION ERROR SIGNAL (PES):**

an analog signal available at Backplane pin B27 (B31 for RevA). The result of the servo head summing two adjacent servo tracks located on either side of the servo head is the tri-bit signal. Sampling peaks of the tri-bit signal and adding these, results in the PES. This will be zero if the heads are on-cylinder. As soon as the heads drift off-cylinder, the tri-bit signal will distort, and this will result in a non-zero PES.

During a seek command, POSITION MODE is low, and the heads travel across the servo surface, from one servo track to another. Crossing the servo tracks results in a sinusoidal PES. This continues until the head again rests between two servo tracks, on the destination cylinder.

When the drive is in position mode, the servo control circuitry closely monitors the PES, applying correction current to the servo mechanism for any non-zero value of the PES.

#### **POSITION MODE:**

a digital signal available at Backplane pin B24. A high level represents POSITION mode. A low level represents SEEK mode.

In POSITION mode, the servo control electronics have control of the servo mechanism, and maintain the position of the heads on the current cylinder.

In SEEK mode, the Intelligent Controller takes control of the servo mechanism and moves the heads towards the destination cylinder. When the heads have reached the destination cylinder, the signal returns to a high level and control is returned to the servo electronics.

### **5.3.3 Servo Operation**

During a seek, the Z-80 Controller calculates the difference between current and destination cylinders, resulting in a seven-bit digital value. This word is converted to an analog voltage by a digital-to-analog converter which in turn regulates drive current to the servo voice-coil mechanism. Full current is applied to the servo for the majority of the seek, tapering as the heads reach the destination cylinder.

The PES is monitored by a zero-crossing circuit on the Servo PCA, which sends an interrupt to the Z-80 Controller each time the heads cross a cylinder. The Controller decrements a counter each time it is interrupted, thus keeping count of cylinders crossed.

As the heads pass over the next-to-last cylinder, several things occur. The Servo PCA monitors the speed of the heads, and when they have slowed sufficiently to allow the position circuitry to take over, the Servo PCA brings TARGET VELOCITY true. If TARGET VELOCITY is not true, this means that the heads have not slowed, and the Controller applies reverse current to the servo mechanism in an attempt to slow head velocity. If TARGET VELOCITY still is not true, the Controller rezeros the heads and attempts the seek again. When POSITION MODE goes true, control is transferred from the Intelligent Controller to the position circuitry for settling onto the destination cylinder.

### **5.4 Read/Write Electronics**

The Read/Write PCA is located in slot A of the Backplane/Motherboard. The basic functions of the Read/Write electronics are:

- 1) Convert write data from NRZ (Non-Return-to-Zero) format to MFM (Modified-Frequency-Modulation) format before writing it to the platters.
- 2) Separates the clock signal from the read data and converts the data from MFM format to NRZ format after reading it from the platters.
- 3) Signal preamplification and conditioning take place on the Read/Write PCA (on later models).

Two versions of the Read/Write PCA exist:

- 1) 310101 for use with drive mechanisms which do not have preamp circuitry in the preamp location.
- 2) 310001 for use with drive mechanisms which have preamp circuitry in the preamp location.

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## CORVUS DEALER SERVICE

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The 310101 PCA may be used in either the 11MB or 20MB drive, however a jumper must first be configured to reflect the drive capacity. This jumper is located on the Read/Write PCA, below resistor R109. To use the 310101 PCA in a 20MB drive, the jumper must be installed, connecting the two pads. To be used in a 11MB drive, the jumper or trace must be cut.

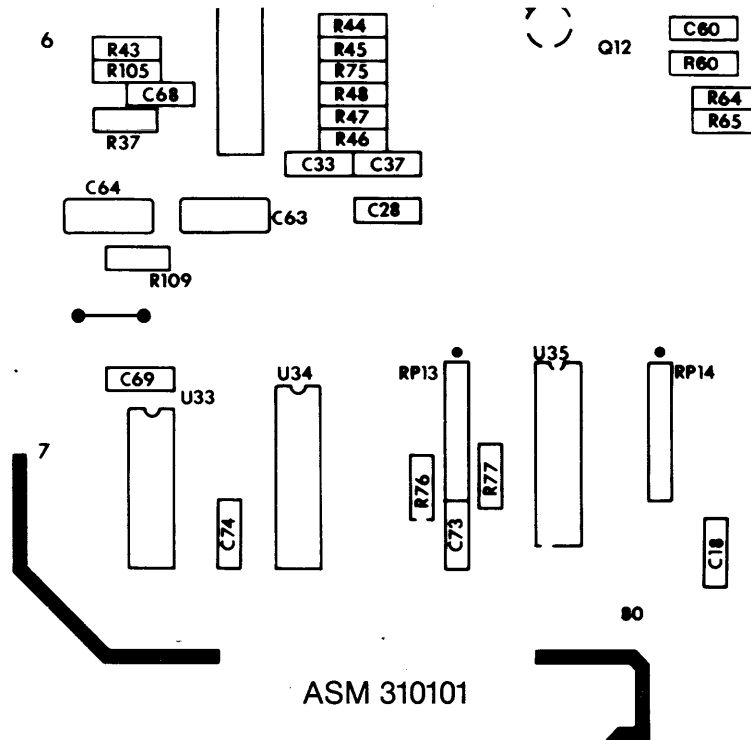


Figure 5-4. Read/Write PCA Jumper Location

### 5.4.1 Read Operation

Digital bits (ones and zeroes) are represented in NRZ (Non-Return-to-Zero) format by a high logic state (one) and a low logic state (zero). Converting these representative voltages into MFM (Modified-Frequency-Modulation) format, which uses changes of the state of the magnetic flux of the media to represent the digital information (flux change = one, absence of flux change = zero), makes it possible to record this digital information in a high density (see figure 5-5).

Through the use of a data separator, the clock signal is separated from the serial data stream. The clock signal is distributed to the Controller for clocking of all drive functions during the read command.

### 5.4.2 Write Operation

During a write command, the read/write electronics receives digital information from the Controller electronics in NRZ serial format, and converts this data to MFM format. It is then sent to the preamp/select microchip on the headstack assembly, and on to the heads for writing to the disk media.

During a read command, data is picked from the disk by the read/write heads, and then amplified by the preamp/select microchip in the headstack. Next, it is passed to the Read/Write PCA for further amplification and conversion back to NRZ format, and on to the Controller electronics.

During the write command only, the Servo PCA supplies the clock signal to the Controller/Logic PCA for synchronization of data.

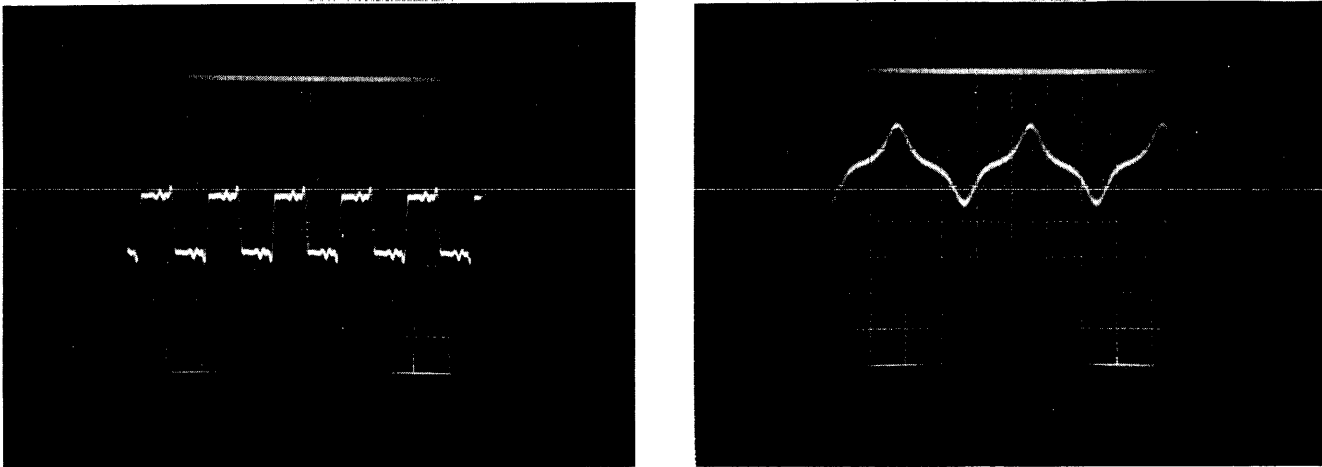


Figure 5-5. NRZ (left) and MFM Data Formats

## 5.5 Controller/Logic Electronics

The Controller/Logic PCA functions as the master controller over all operations of the drive. The Controller/Logic PCA is responsible for receiving commands from the host computer system, orchestrating the servo and read/write procedures, and sending a return code to the host computer at the completion of each command. The return code reports the error status of the drive after the command has been executed. The Controller generates the CRC bytes for each block written to the disk surface, and also checks the integrity of data read from the disk surface by checking the CRC bytes associated with each block.

The Controller/Logic PCA consists of the Z-80 CPU and support logic as well as Controller ROMs (containing procedural Z-80 code for the Intelligent Controller) and on-board RAM (used for buffering data to and from the disk, and utility code loaded from the Controller Firmware area of the disk). Also, four PIO ICs are used to buffer signals to and from the Corvus Mirror, Constellation Multiplexer, Read/Write PCA, and Servo PCA. In addition, the CRC generator/checker error signal is monitored by one of the PIO ICs, and informs the Z-80 CPU in the case of a CRC error or other error.

The Controller/PCA communicates with the host computer system through a 34-pin flatcable.

### 5.5.1 Host to Drive Handshaking Control Signals

Three signals handle the handshaking protocol. These are STROBE, READY, and BUS DIRECTION.

#### STROBE

This signal is generated by the host system, and acknowledges that the host has sent or received a byte.

#### READY

This signal is generated by the disk Controller, and informs the host system that the drive is ready to send or receive a byte. Data rate transfer is determined by this signal.

#### BUS DIRECTION

This signal is generated by the Z-80 Controller, and controls the direction of the bidirectional bus. The host system monitors this signal to determine whether the drive should expect to receive or send a byte of data.

#### **5.5.2 Controller During Seek Command**

When the Controller receives a read or write command, it must determine if the requested sector is in the current cylinder or another. If the required cylinder is other than the current cylinder, a calculation is done which results in a digital value representing the difference between the current cylinder and destination cylinder. If this value is zero, the Controller proceeds with the data read or write.

If the value is other than zero, the Controller must perform a seek operation. The sign of the difference determines the direction of the seek to be executed; if it is positive, the heads will be moved in towards the spindle, if it is negative, the heads will be moved out towards the edge of the platters.

The Controller begins the seek operation by bringing the POSITION MODE signal low. The unsigned digital value is sent to the Servo PCA which converts it to an analog value, and applies it to the servo mechanism which moves the head assembly. The Controller then awaits an interrupt.

When the heads cross a cylinder, the Servo PCA sends an interrupt to the Controller, which decrements the distance value by one each time. When the value reaches a value of one, the Controller then monitors the TARGET VELOCITY signal from the Servo PCA. When the heads have slowed sufficiently this signal goes true, and servo control transfers from the Controller circuitry to the position circuitry on the Servo PCA (POSITION MODE goes high), which settles the heads onto the destination cylinder.

To verify that the seek operation has been successful, the header information is read from the next sector that passes under the read heads. If the sector address is incorrect, the heads will be re-zeroed and the seek will be attempted again.

#### **5.5.3 Controller During Read and Write Commands**

The write command begins when the write command is received, along with the sector address. The Z-80 Controller determines whether the write command is for 128, 256 or 512 bytes, and relinquishes control to the DMA circuitry for transfer of the data from host memory to the on-board Controller RAM.

During the host-to-drive data transfer, the processor is put into a wait state while the DMA circuitry transfers the data from the host memory to the on-board RAM. The DMA circuitry uses the Z-80 processor as an address counter, and when the first byte is received from the host system, the DMA circuitry uses the address specified by the Z-80 to write the byte into on-board RAM. Between data byte transfers, the Z-80 is released from the wait state just long enough to increment its address counter.

Once the data is in RAM, control is returned to the Controller which performs a seek to the correct cylinder, if necessary, and reads the first available header to verify the seek. The DMA circuitry next clears the CRC generator/checker, and waits for the proper sector to pass under the head. If the required write function is less than 512 bytes, the block is read in from the sector and the host information is overlaid into the appropriate locations of the block.

Next, preparations are made for writing that block out to the disk. When the proper sector comes around, the Controller again turns control over to the DMA circuitry. The 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, and both are then sent to the read/write circuitry for output to the heads. The CRC information is used for checking data integrity when read from the disk.

The disk write operation is concluded by reading in the block to verify its success. The bus direction is then reversed, and a status byte sent to the host system indicating the result of the disk write.

The read command is similar to the write command except that the data flow direction is reversed. Data and its accompanying CRC byte is received from the read/write electronics and arithmetically summed by the CRC checker/generator. If the result is not equal to zero, a CRC error is generated. If the result is equal to zero, no error is generated, and the data is converted from serial form to eight-bit parallel form. The DMA electronics then transfers the data to the on-board RAM, using the address supplied by the processor.

After the read has successfully completed, the data bus is turned around, and the status of the read procedure is sent to the host. The data is then sent to the host using DMA.

### 5.6 Backplane/Motherboard PCA

The Backplane is responsible for transferring power and signals between all system components, and provides a physical mounting for all PCAs.

The Backplane, or Motherboard, contains four edge connectors to accept up to four PCA assemblies. All four of these in the RevA will be filled by the Read/Write PCA, Servo PCA, Micrologic PCA, and Disk Controller PCA. Three slots in the RevB will be filled by the Read/Write PCA, Servo PCA, and Controller/Logic PCA. The rear of the Backplane contains four double rows of wirewrap pins which accept flatcable connectors from the front bezel Paddleboard PCA, Interface PCA, and sealed mechanism Preamp PCA, as well as the dc power cable.

All eight-inch drives use one Backplane/Motherboard part number (310021), wiring changes on the Backplane making it either RevA compatible or RevB compatible. These are not interchangeable, and should not be substituted for one another. Refer to Backplane PCA wiring diagrams in the appendices for identification and current wiring configuration.

Revision-A drives require resistor packs inserted in the 16-pin sockets on the backplane. The Revision-B drives do not require these.

#### CAUTION:

**The connectors at the end of all 34-pin flatcables are available in two sizes: a 100-mil connector, and a 200-mil connector. The 100-mil connector has two closely-spaced rows of evenly-paired holes. The PROCESSOR port on the rear of the white cabinet accepts a 100-mil connector.**

**The 200-mil connector has two widely-spaced rows of holes. These two rows of holes are not evenly-paired, but offset by one hole, and each time it is connected, must be inspected carefully to avoid misconnection. This type of connector plugs onto the Backplane of the drive sealed mechanism, interfacing the front bezel Paddleboard PCA, Preamp PCA and Interface PCA to the drive electronics.**

**When placing the 200-mil connectors on the Backplane, be sure to match the first pair of destination pins with the first pair of holes in the connector. The one offset hole at each end of the connector will not match up to any of the 34 destination pins, but will instead mate with an adjacent pin, or no pin at all (i.e., when the destination pins are at the end of a row).**

The Paddleboard PCA connects to the left end of the row C, (C1-C34, "one" edge to the right). The cable from the PROCESSOR connector on the rear bezel also connects to the Backplane (RevA: D51-D84, "one" edge to the left), RevB: C87-C120, "one" edge to the right). The flatcable connecting the preamp PCB to the Backplane connects to row A (A1-A30), "one" edge (dark stripe) to the left. The ten-pin dc power connector from the power supply connects to the left end of the row of power pins located in the upper right corner of the Backplane. The two-wire motor power connector plugs onto the right-most power pins.

### 5.7 Preamp PCA

Located in the bottom of the sealed disk mechanism above the card cage, is the preamp PCA. Two versions of this PCA exist: the early version uses a discrete preamp in this position, and is identified by the components on this PCB. In the later version, the preamp was moved to the read/write PCA, and has a PCA blank in this position.

Two Read/Write PCAs are used with the eight-inch drive. These are not interchangeable, and must be matched to the different preamp configurations above (refer to the PCA compatibility chart in appendix C). Be sure to note Preamp PCA type whenever changing read/write electronics to insure compatibility.

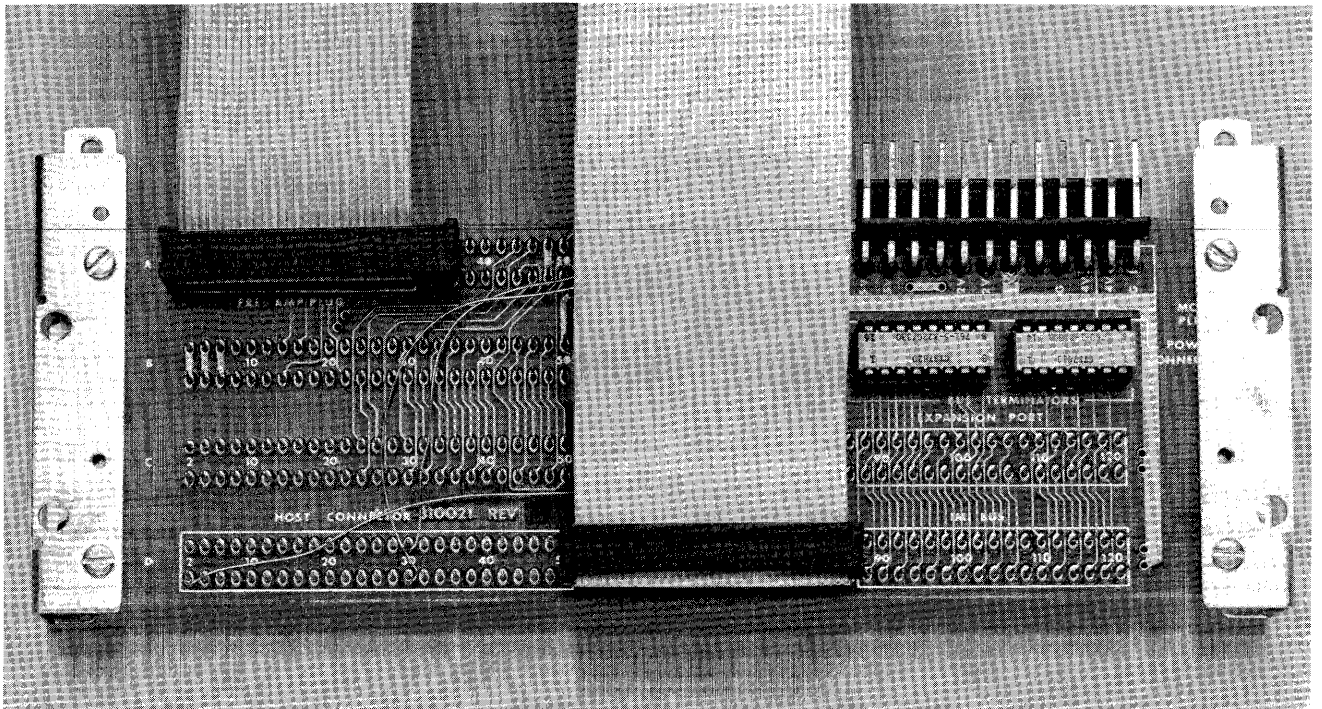


Figure 5-6. Rev A Cabling

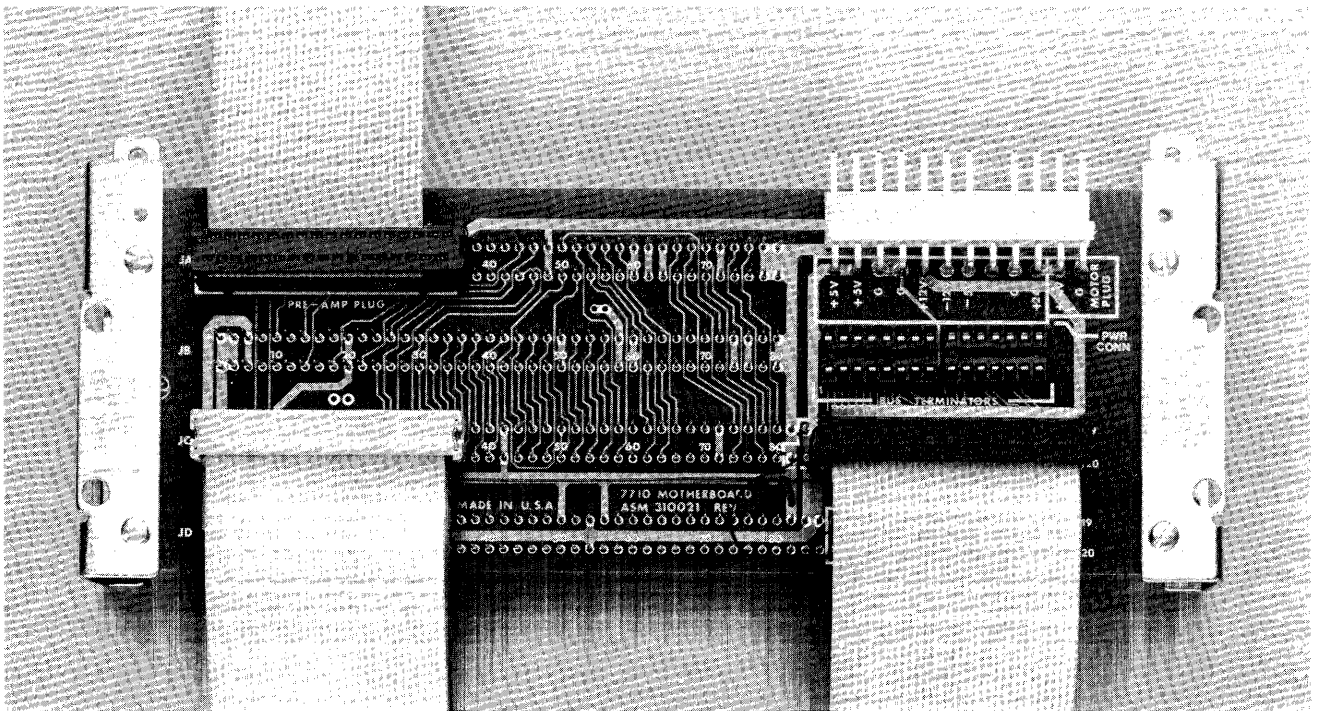


Figure 5-7. Rev B Cabling

Because this PCA is part of the drive sealed mechanism, removing this PCA will break the seal. **Do not remove the Preamp PCA.** If this PCA is found to be faulty, the drive sealed mechanism must be replaced.

### **5.8 Paddleboard PCA**

The Paddleboard PCA, located on the front bezel of the white drive enclosure, contains switches and LEDs. The function of these controls are detailed in section 3.3.

The Paddleboard PCA was manufactured in four revisions:

- 1) For RevA drives, identified by its three switches and 100-mil connector
- 2) For RevB drives, identified by its four switches and 100-mil connector
- 3) For RevB drives, identified by its 34-pin edge-connector and one IC
- 4) For RevB drives, identified by its 34-pin edge-connector and two ICs

Versions 2, 3 and 4 are all compatible with RevB drives, and are not interchangeable with the RevA version 1.

### **5.9 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 with 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 now 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.



**CHAPTER 6**  
**DISASSEMBLY**

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## CHAPTER 6 DISASSEMBLY

### 6.1 Scope of Chapter

Disassembly of Corvus disk drives is covered in two separate sections. Some RevA and RevB drives are not contained in a cabinet, and therefore require much less disassembly. Current drive configuration consists of a white cabinet containing the drive sealed mechanism, cooling fan and power supply.

### 6.2 Introduction

All phases of drive disassembly for both the current units and the early stand-alone units are covered in this section. Replacement is on a module basis, and disassembly will be to this modular level.

Corvus disk drives have been shipped in several different configurations. These include:

- 1) The stand-alone drive sealed mechanism has two different power supplies. The CS100 power supply shares a common baseplate with the drive, while the CP129 power supply stands separate from the drive, connected only by the dc power cable. Disassembly procedures for these configurations are covered in section 6.4, Stand-Alone Units.
- 2) Later versions of the drive consist of the drive sealed mechanism and either the CP140 or CP411 power supply sharing a white cabinet. Disassembly procedures for these configurations are covered in section 6.3, Metal Package.

**WARNING:**

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

**CAUTION:**

**Do not under any circumstances operate the drive without first insuring that PCA spacers have been installed between electronic circuit cards. Failure to do this will allow the PCAs to contact each other which may cause catastrophic damage if the drive is powered on.**

#### 6.2.1 Tools Required

Disassembly of the Corvus eight-inch Winchester disk drives can be accomplished with the following tools:

- 1) 5/64-inch hex allendriver
- 2) 3/32-inch hex allendriver
- 3) 3/16-inch blade screwdriver
- 4) 5/16-inch blade screwdriver (8½-inch long)
- 5) 1/4-inch nutdriver

### 6.3 Metal Package

The current package consists of a white cabinet containing the eight-inch disk sealed mechanism, power supply, fan, cabling, and Paddleboard PCA.

The cabinet is a four piece assembly. Details for disassembly follow.

#### 6.3.1 Top cover:

1. Remove the eight side allen screws securing the top cover to the basepan.
2. Remove the cover straight up.

#### 6.3.2 Rear bezel:

1. Remove the four allen screws securing the rear bezel to the basepan.
2. Remove the bezel straight rearward, being careful not to stress the ac wiring and flatcable wiring.

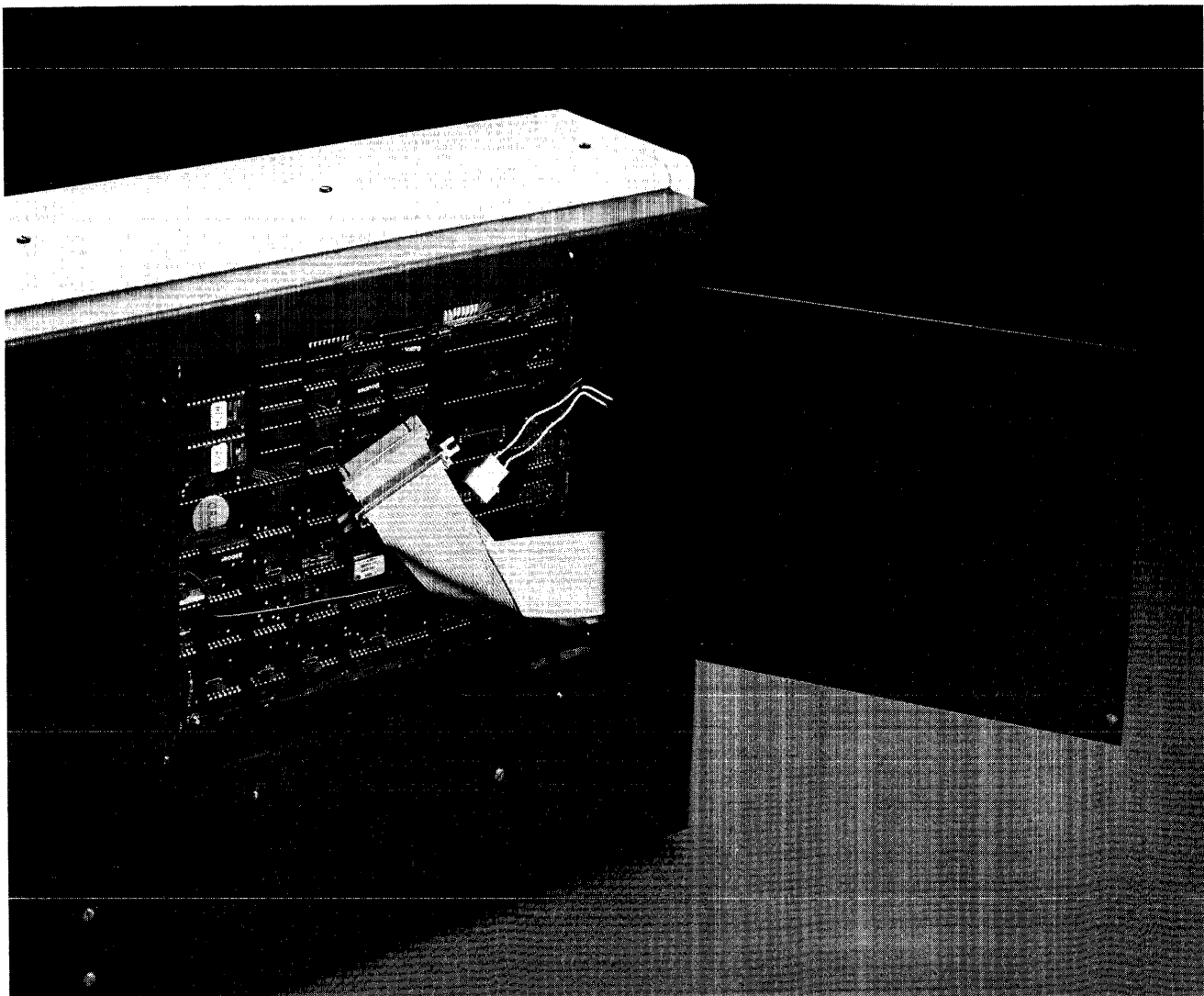


Figure 6-1. Access Door, Metal Package

**6.3.3 Backplane cover:**

1. Loosen the four slot screws securing the smoke-colored plastic cover to the Backplane/Motherboard, and remove it by sliding it up.

**6.3.4 Cabling:**

1. Disconnect the front bezel Paddleboard flatcable from the drive Backplane (extreme left end of row C).
2. Disconnect the interface ribbon cable from the Backplane (extreme right end of row C).
3. Disconnect the dc power cable from the power connectors on the Backplane (upper right-hand corner).

**6.3.5 Drive mechanism:**

1. Using a long 5/16" blade screwdriver, loosen the six large side slot screws securing the drive mechanism and side-brackets to the basepan.
2. Lift the drive mechanism straight up off of the rubber side strips. (The rubber strips are adhesive, and may require gentle prying under the brackets to free the mechanism. Be careful not to exert any force on the drive electronics while prying.)

**6.3.6 Power supply:**

1. Disconnect the dc power connector from the Backplane of the drive mechanism.
2. Disconnect the front bezel power switch connector from the ac wire harness.
3. Disconnect the six-pin transformer primary connector from the ac wire harness.
4. Disconnect the ac cable from the cooling fan.
5. Remove the four screws securing the supply to the basepan.
6. Remove the power supply straight up and out of the basepan.

**6.3.7 Front bezel:**

1. Disconnect the flatcable from the Paddleboard PCA on the front bezel.
2. Remove sealed mechanism and power supply from the basepan as described above.
3. Remove the four slot screws securing the bezel to the vertical support brackets.
4. Remove the bezel.

**6.4 Stand Alone Units**

Some RevA drives and RevB drives were shipped in a stand-alone configuration, either with a CS100 power supply mounted on a common baseplate or with a completely separate CP129 power supply. Disassembly of these is described below.

**6.4.1 Disassembly (CS100)**

1. Remove the four slot screws securing the power supply to the baseplate.
2. Tip up the rear of the power supply, exposing the voltage adjustment on the bottom. The voltages can be adjusted now (refer to section 7.3.2.2 for instructions), or the FORMAT and MUX switch wires and dc power cable disconnected from the Backplane, and the supply removed.
3. Remove the six slot screws securing the drive mechanism to the baseplate.
4. Remove the drive unit by lifting it straight up and out of the baseplate.

**6.5 Drive Electronics Removal and Disassembly**

All eight-inch disk drive mechanisms contain drive electronics in a card cage, located in the bottom of the drive unit. The complete card set must be removed to replace or adjust any of the electronics.

**6.5.1 Card set:**

1. Locate the drive Backplane at the rear of the drive sealed mechanism, and disconnect the preamp flatcable connector from the top left corner of the Backplane.
2. Remove the four slot screws and two nutplanes securing the Motherboard to the metal support brackets. The brackets will remain attached to the drive base.
3. Turn the mechanism on one side, being careful not to let it fall. Locate the two forward securing screws and supports, located at the corners of the PCAs. Remove these two slot screws.
4. The Backplane and all electronics PCAs may now be lifted straight away from the drive mechanism.

**CAUTION:**

**Do not under any circumstances operate the drive without first ensuring that PCA spacers have been installed between electronics circuit cards. Failure to do this will allow the PCAs to contact each other which may cause catastrophic damage if the drive is powered on.**

**6.5.2 PCA Replacement:**

1. Remove card set as outlined above.
2. Remove the PCA spacers from between the circuit cards.
3. Gently pull the PCA out of the Backplane slot.
4. Insert replacement PCA in its slot, making sure it has been seated securely.
5. Insert the two PCA spacers at the corners of the card set.
6. Install the complete card set, reversing the removal instructions above.

**CHAPTER 7**  
**ADJUSTMENTS AND MAINTENANCE**

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## CHAPTER 7 ADJUSTMENTS AND MAINTENANCE

### 7.1 Scope of Chapter

This chapter will cover the check and adjustment of Power Supply voltages, Servo electronics, and Brake mechanism.

### 7.2 Introduction

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

### 7.3 Power Supply Voltage Check and Adjustment

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

#### **WARNING:**

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

#### 7.3.1 CP140 and CP411

##### 7.3.1.1 Voltage Check:

1. Remove cover to the enclosure as outlined in section 6.3.1.
2. Locate voltage test points along the top side of the power supply. These are labeled +5V, COM, -5V, +12V, COM, -12V, COM, +24V.
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 for each voltage. All voltages must be within  $\pm 0.1$  volts of the specified voltage, except the +24V which has a tolerance of  $\pm 1.25$  volts.
5. If any of the voltages are out of tolerance, follow the adjustment procedure for this supply.

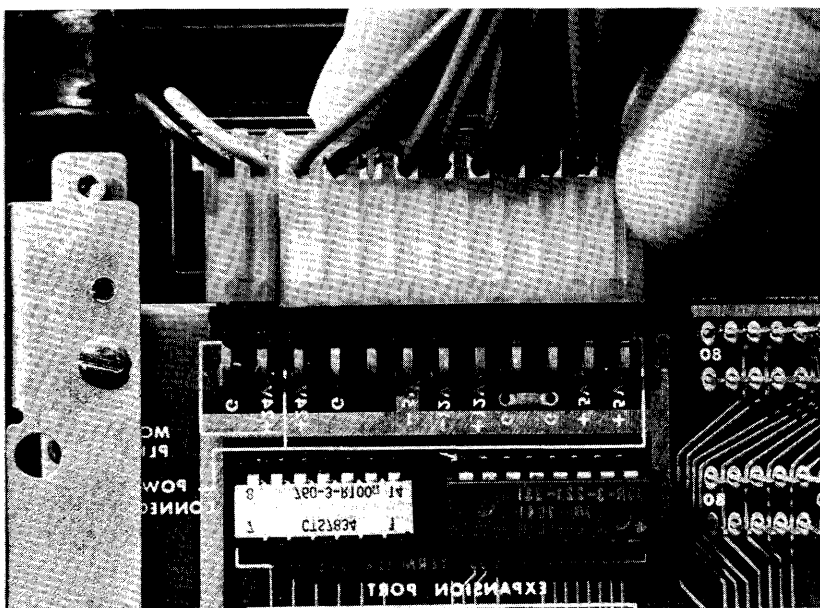


Figure 7-1. dc Power Cable Connection

### 7.3.1.2 Voltage Adjustment

1. Remove ac power from the disk drive.
2. Remove the cover of the drive.
3. Disconnect the dc power cable from the drive Backplane.
4. Connect ac power to the disk drive, and turn on the ac power switch.
5. Monitoring the dc voltages as outlined above, adjust the +5V, -5V, and +12V using the following adjustments:

CP140		CP411	
R-10	+5V	R-14	+5V
R	-5V	R-27	-5V
R-13	+12V	R-7	+12V
		R-20	+24V

If any voltages not listed above are out of tolerance, the power supply must be replaced.

**NOTE:**

*During adjustment, the +5V or -5V 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 -5V 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.*

6. Turn off the ac power switch.
7. Connect the dc power cable to the drive Backplane.
8. Turn on the ac power switch.
9. Recheck and, if necessary, readjust the voltages.

### 7.3.2 CS100 Voltage Check and Adjustment

**WARNING:**

***Under no condition is the CS100 to be powered on while disconnected from the disk drive unit. The CS100 power supply is a switching power supply, and must be under load to be adjusted properly. Attempting to adjust the CS100 while disconnected from the drive may result in severe damage to the supply and, possibly, harm to the technician.***

#### 7.3.2.1 Voltage Check:

1. Follow disassembly instructions for the CS100 power supply as outlined in section 6.4.1.
2. Turn on the ac power switch.
3. Using a DIGITAL voltmeter, check the power supply voltages at the drive Backplane power connector. These are labeled +5V, -5V, +12V, -12V, +24V. All voltages must be within  $\pm 0.1$  volts of the specified voltages, except the +24 which has a tolerance of  $\pm 1.25$  volts.
4. If any of the voltages are out of tolerance, follow the adjustment procedure for this supply.

#### 7.3.2.2 Voltage Adjustment

1. Remove ac power from the power supply.
2. Remove the power supply from the baseplate, leaving the dc power cable connected to the drive Backplane.
3. Connect ac power to the power supply and turn on the ac power switch.



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## CORVUS DEALER SERVICE

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- Monitoring the +5V output, adjust the dc voltages using the following adjustments:

CS100

R 25 All voltages

All other voltages track with the +5V, so monitoring this one voltage will result in proper adjustment of all voltages.

### 7.3.3 CP129

#### 7.3.3.1 Voltage check:

- Using a DIGITAL voltmeter, check the voltages at the power connections on the Backplane of the drive, using the corresponding COMMON power pin for each voltage. All voltages must be within  $\pm 0.1$  volts of the specified voltage, except the +24V which has a tolerance of  $\pm 1.25$  volts.
- If any of the voltages are out of tolerance, follow the adjustment procedures for this supply.

#### 7.3.3.2 CP129 Voltage Adjustment:

- Remove ac power to the power supply.
- Remove the eight screws securing cover to the power supply and remove the cover.
- Disconnect the dc power cable from the drive Backplane.
- Connect ac power to the power supply and turn on the ac power switch.
- Monitoring the dc voltages as outlined above, adjust all voltages using the following adjustments:

CP129

R 4 +5V  
R 14 -5V  
R 13 +12V  
R 17 -12V  
R 6 +24V

If any of the above voltages are not adjustable within tolerance, the power supply must be replaced.

#### NOTE:

*During adjustment, the +5V or -5V 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 -5V charge to ground using a 10K-ohm resistor. Set the trim resistor to its original position, turn on ac power and proceed with the adjustment.*

- Turn off the ac power switch.
- Connect the dc power cable to the drive Backplane.
- Turn on the ac power switch.
- Monitoring the dc voltages as outlined above, adjust the voltages if necessary.

#### CAUTION:

**When adjusting power supply voltages with the drive connected, it is essential that no one voltage be adjusted beyond its tolerance. This requires close monitoring and careful adjustment of the trim resistors. Adjustment of any voltage beyond its tolerance may cause damage to the drive electronics.**

#### 7.4 Servo Mechanism

Servo mechanism and electronics will change with time, and require occasional adjustment. The servo test monitors the average seek time it takes the heads to execute a full loop seek—from cylinder 0 to maximum cylinder. Adjustment of the servo requires the Dealer Service utilities, a host microcomputer, and an oscilloscope.

The servo mechanism timing may be checked either by dealer service software, or by oscilloscope. Complete documentation for the Dealer Service Utilities are detailed elsewhere in this document.

##### 7.4.1 Servo Adjustment: ASM 310176 and 310221

1. Remove ac power from the drive.
2. Remove the drive mechanism from the metal cabinet, if mounted in an enclosure.
3. Place the drive mechanism on one side.
4. Remove the PCA card assembly from the drive mechanism, leaving the 30-pin preamp cable and motor wires connected between the drive mechanism and the Backplane. Place the card assembly on its side, at a right angle to the drive mechanism. Connect the dc power cable to the drive backplane. Be sure the plastic PCA spacers at the corners of the PCAs remain intact during all service procedures.

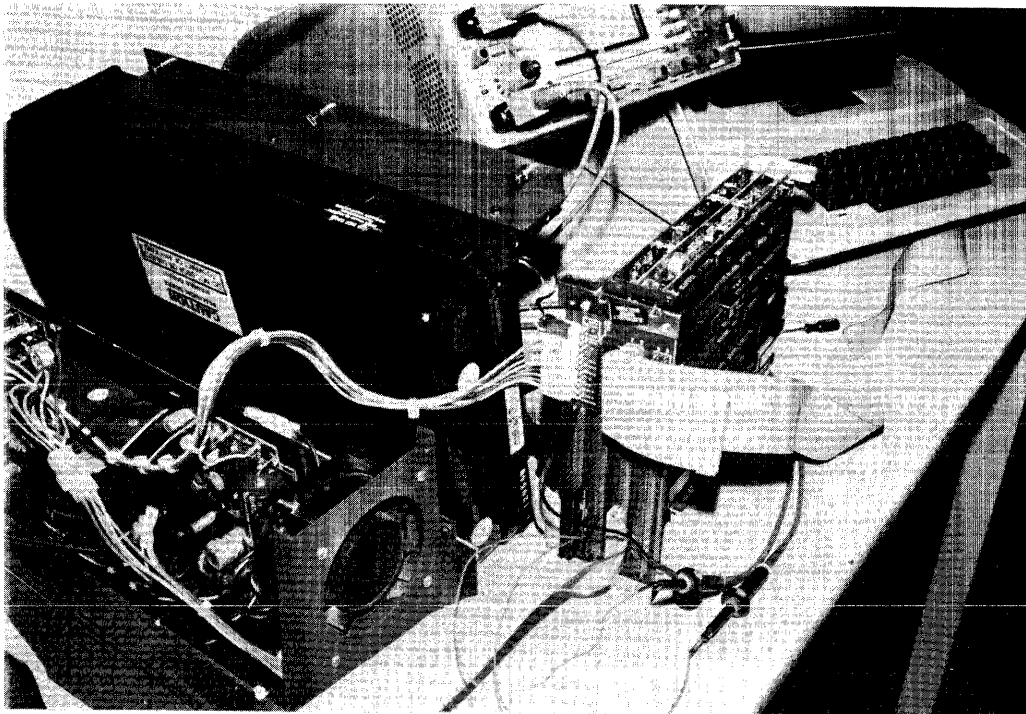


Figure 7-2. Drive Configuration During Servicing

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## CORVUS DEALER SERVICE

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5. Connect the oscilloscope as follows:  
Channel A: to Backplane pin B24, ground to pin A77-A80, select 2V/div., dc coupled  
Channel B: to Backplane pin B27, ground to pin A77-A80, select 2V/div., dc coupled  
Trigger: channel A, negative edge, dc coupled  
Timebase: 10ms/div.  
Timing: 70ms  $\pm$  2.5ms
6. Turn on the host microcomputer, then the Corvus drive, observing that the heads re-zero. The drive must come to READY for the diagnostics to communicate with the drive.
7. Boot the Corvus Dealer Service diskette, select "Controller Diagnostics", execute "DOWNLOAD DIAGNOSTICS" (utility D) and then "ANALYZE SERVO" (utility I). The program will return the average seek time required to execute a full loop seek. This should be 70ms,  $\pm$ 2.5ms. If the returned value is out of tolerance, follow the adjustment procedures below.
- 7A. Alternately, "FULL CYLINDER LOOPSEEK" (utility L) may be executed (in place of "ANALYZE SERVO"), which executes an infinite full cylinder loopseek, but does not return a timing value. Use this utility for adjusting the Servo electronics while observing the POSITION MODE and PES signals with the oscilloscope. If the displayed signals are out of tolerance, follow the adjustment procedures below.

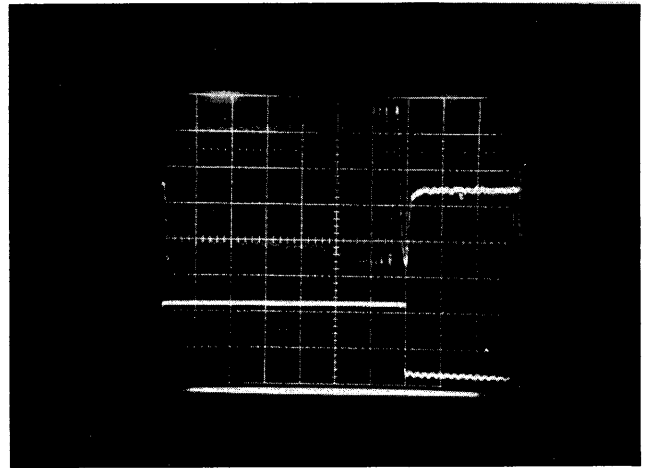
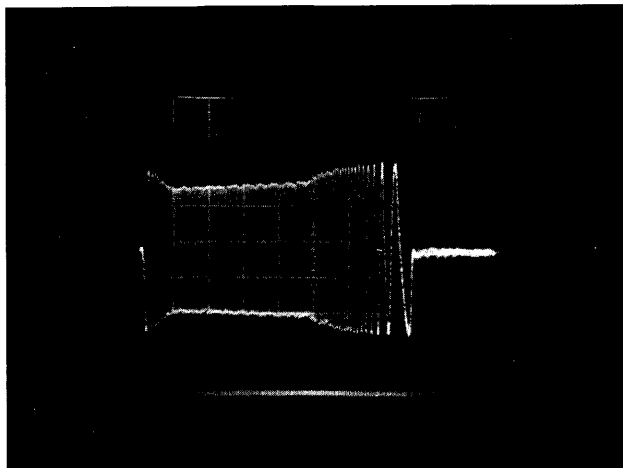


Figure 7-3. PES Signals Improperly Adjusted (left) and Properly Adjusted

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### NOTE:

*Each of the following adjustments affect all others. The procedure may need to be repeated several times in order to bring all signals into tolerance.*

9. Using R105, adjust POSITION MODE signal so the rising edge occurs  $70\text{ms} \pm 2.5\text{ms}$  after falling edge. (Refer to diagram 7-3.)
10. Using R62, adjust PES signal so that its peak-to-peak amplitude is 8.4 volts at the beginning or end of the waveform, whichever is least (Refer to diagram 7-3.)
11. Using R122, adjust PES signal for slight undershoot at the last zero-crossing, and minimum ringing after this point.

### 7.4.2 Servo Adjustment: ASM 310006

1. Remove ac power from the drive.
2. Remove the drive mechanism from the metal cabinet (if mounted in an enclosure) or remove from baseplate.
3. Place the drive mechanism on one side.
4. Remove the PCA card assembly from the drive mechanism, leaving the 30-pin preamp cable and motor wires connected between the drive mechanism and the Backplane. Place the card assembly on its side, at a right angle to the drive mechanism. Connect the dc power cable to the drive backplane. Be sure the plastic PCA spacers at the corners of the PCAs remain intact during all service procedures.
5. Connect the oscilloscope as follows:
  - Channel A: to Backplane pin B24, ground to pin A77-A80, select 2V/div., dc coupled
  - Channel B: to Backplane pin B31, ground to pin A77-A80, select 2V/div., dc coupled
  - Trigger: channel A, negative edge, dc coupled
  - Timebase: 10ms/div.
  - Timing:  $96\text{ms} \pm 2.5\text{ms}$
6. Turn on the host microcomputer, then the Corvus drive, observing that the heads re-zero. The drive must come to READY for the diagnostics to communicate with the drive.
7. Boot the Corvus Dealer Service diskette, select "REV A DIAGNOSTICS", and execute "SERVO ADJUST".
8. View the PES and POSITION MODE signals on the oscilloscope while this utility is executing. The POSITION MODE signal should be low for  $96\text{ms} \pm 2.5\text{ms}$ . The PES signal should have a peak-to-peak amplitude of 8.4 volts at the beginning or the end of the waveform, whichever is the lesser amplitude. The last zero-crossing of the PES signal should have minimum distortion, a maximum of 2 volts overshoot, while the last three zero-crossings of the PES should be linear with respect to time. If any of these are out of tolerance, follow the adjustment procedures below.

### NOTE:

*Each of the following adjustments affect all others. The procedure (steps 9-11) may need to be repeated several times in order to bring all signals into tolerance.*

9. Using R137, adjust POSITION MODE signal so that rising edge occurs  $96\text{ms} \pm 2.5\text{ms}$  after falling edge.
10. Using R194 adjust PES signal so that its peak-to-peak amplitude is 8.4 volts at the beginning or end of the waveform, whichever is least.
11. Using R151, adjust PES signal for a maximum overshoot of 2 volts at the last zero-crossing, and minimum ringing after this point.
12. Turn off the ac power switch.

13. Connect the oscilloscope as follows:

Channel A: pin 2, IC at location B3. Use a ground on the servo board (refer to schematic for this PCA). Select 2V/div, dc coupled.

Trigger: channel A, negative edge, dc coupled.

Timebase: 100ns/div.

Timing: 200ns, including ghost images.

14. Turn on the ac power switch, and observe that the heads re-zero.

15. Boot the Corvus Dealer Service diskette, select "REV A DIAGNOSTICS", and execute "PLO ADJUSTMENT".

16. View the waveform on the oscilloscope. The PLO pulsewidth should be less than 200ns, including ghost images. If this signal is out of tolerance, follow the adjustment procedures below.

17. Using R185, adjust the PLO so that the width of the pulse is a maximum of 200ns (adjusting R185 until the "whisker" trailing the waveform is eliminated, will result in proper adjustment). If this signal cannot be adjusted within this tolerance, this PCA must be replaced.

## **7.5 Brake Mechanism**

Inherent in the Winchester disk design is the direct contact between the heads and the disk surface after the drive has powered off. Contact between these two components can be minimized by very fast acceleration of the platters after power has been applied to the drive, and very fast deceleration after power-off. The latter is taken care of by the application of the solenoid brake mechanism applied to the motor hub after the platters have slowed sufficiently to no longer aerodynamically support the heads above the disk platters.

The brake mechanism should be adjusted only when it is observed not to function properly. Normally, the brake should "click" in and brake the spindle to a stop within 30 seconds after power-off. If this does not occur, the brake should be adjusted following the adjustment procedures below.

### **7.5.1 Brake Adjustment**

1. Remove ac power from the drive.
2. Remove the drive mechanism from the metal cabinet, if mounted in an enclosure.
3. Place the drive mechanism on one side.
4. Remove the four screws securing the unit bottom cover in place, and swing it aside being careful not to snare the spindle ground strap.

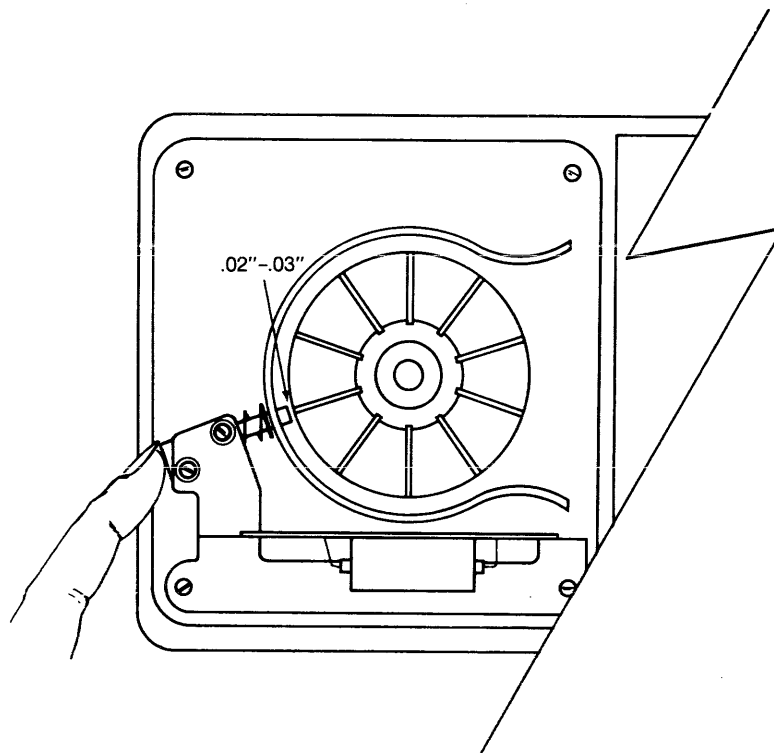
#### **CAUTION:**

**Do not loosen or remove any of the four studs that support the bottom cover. These secure the sealed mechanism bottom plate and help maintain the integrity of the mechanism. Breaking this seal will void the warranty.**

5. Loosen the two screws securing the brake solenoid to the bracket, and move the solenoid away from the hub.
6. Insert a .02 to .03-inch thickness gauge (a double-thickness business card will do) between the brake solenoid plunger and the hub.
7. Move the brake solenoid firmly up against the hub, with the gauge in place.
8. Tighten the screws securing the solenoid to the bracket, and remove the gauge from between the hub and plunger.
9. Connect the dc power cable to the drive Backplane, and turn on the ac power switch. Check that the solenoid functions when the power is applied to the drive.

#### **WARNING:**

**Be careful not to touch the fan while the motor is turning.**



**Figure 7-4. Mechanism Adjustment**

10. Power off the drive.
11. Replace the unit bottom cover.

**CHAPTER 8**  
**DEALER SERVICE DIAGNOSTICS**

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## CHAPTER 8 DEALER SERVICE DIAGNOSTICS

### 8.1 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.

### 8.2 Introduction

Each Corvus Authorized 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 disk drive utilities consist of standard Drive Diagnostic for RevA and RevB, 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 a 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.

### 8.3 Drive Diagnostics RevB

This program is essentially the same program provided on the Initialization 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.

#### 8.3.1 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 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 mismatched CRC bytes)

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 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.

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

#### 8.3.2 EXR

The exercise test 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 retries) 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.

#### 8.3.3 UPD

This utility rewrites the 2 copies of Controller Firmware into the first two cylinders of the drive. The Update utility does not rewrite the Spare Track Table, Virtual Drive Offset Table or Interleaving Specification, nor is it destructive to data.

Boot from the Corvus Utility diskette, and execute the Diagnostic program. Since it is not possible to update the firmware on the boot drive, the system MUST first be booted from diskette.



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The program will display the default Controller Firmware file resident on the diskette (that contains the Update utility). This will be in the form of:

ENTER CONTROLLER CODE FILE: CFxx.x

The current level of Controller Firmware for RevB drives at this writing is CF17.3.

If another version is to be used, it should be entered now. The highest (and therefore current) revision level should be used whenever updating the Controller Firmware.

### 8.3.4 VSN

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

DRIVE 1: Vxx.x CORVUS SYSTEMS DD-MM-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. CF17.3), and nn represents the suffix of the two Controller ROMs (i.e. 3.22 and 4.22). At this printing, the current versions are:

Controller Firmware: CF17.3  
Controller ROMs: 22

### 8.3.5 FMT

#### CAUTION:

**This utility will destroy data on the drive.**

The drive may at some time need formatting. This diagnostic-level, or bottom-level format writes the rudimentary magnetic pattern to the tracks required before data may be retained properly.

First turn the FORMAT to the ON (right) position, then execute the FORMAT program. 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.

The FORMAT program writes default Drive Parameters to the drive (no tracks spared, Interleaving Spec = 9, VDO Table: Drive 1 = 0), and should be updated as necessary after the FORMAT program terminates.

### 8.3.6 PRM

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

#### 8.3.6.1 MUX

Selecting this option displays the Multiplexer table:

M	M
M	M
M	M
M	M
	X

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Only if a Master Multiplexer is used in the Constellation 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 change 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.

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

Standard Polling parameters: 180,16,32,0  
For Superbrain and TRS-80: 180,32,32,0

### 8.3.6.2 DRIVE

Selecting this option displays the spare track table. Whenever a track is found to contain a faulty sector, 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 service)  
DELETE a track from the Spare Track Table (restore it to service)  
LIST the Spare Track Table  
QUIT or exit from the spare track routine

The track number containing the faulty sector must first be calculated. The formula for this is:

$$T = (C \times N) + H$$

where T is the track number to be calculated, C and H are the cylinder and head numbers respectively, returned by the CRC program. N is the number of data surfaces of the drive. These are as follows:

11MB = 3 data surfaces  
20MB = 5 data surfaces

The resulting track number should be spared.

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 sequential numbering of sectors. This value for 11MB and 20MB eight-inch 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 4-6.

Check the Interleaving Specification whenever 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 User Guide. This table should be checked when the drive is first received, and whenever the drive is formatted.

### 8.3.7 SET

This utility allows the user to change the slot number, drive number, or drive type of the drive to be tested.

### 8.3.8 QUIT

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

## 8.4 Controller Diagnostic

The purpose of the Controller Diagnostic program is to provide comprehensive testing for the Corvus disk drives.

**8.4.1 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.

**8.4.2 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.

**8.4.2.1 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>

**8.4.2.2 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 "D", and terminate with "END". The computer will then prompt you with:

DATA OK?

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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.

### 8.4.2.3 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>.

### 8.4.2.4 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>

### 8.4.2.5 I) ANALYZE SERVO:

This command allows the operator to measure the seek time of the servo without an oscilloscope. 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 70ms  $\pm$  2.5ms if the servo is in tolerance.

### 8.4.2.6 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 hexadecimal.

**8.4.2.7 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. The Controller will continue seeking until a new command is issued. The format for this command is:

I.<return>

**8.4.2.8 P) PRINT QUIET SUMMARY REPORT:**

This command allows the operator to view the results of the sector quiet command. 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 xxxxx 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.

**8.4.2.9 Q) SECTOR QUIET PROGRAM:**

**CAUTION:**

**This command will DESTROY data on the disk, including Controller Firmware.**

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 8.4.2.8. 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.

**8.4.2.10 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 8.4.2.8. The format for this command is:

S<return>

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

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### 8.4.2.11 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 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.

### 8.4.2.12 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 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.

### 8.4.2.13 Y) REZERO HEADS:

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

Y <return>

### 8.4.3 Error Codes

The error codes returned by the command documented in 8.4.2.8 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 adress 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

### 8.5 Burn-In Program

#### **CAUTION:**

**This command will DESTROY data on the disk.**

Selecting the Burn-In program (menu option #4) 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.

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## CORVUS DEALER SERVICE

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The Burn-In program is a rigorous read-write routine which steps through the drive one chunk 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 QUIT
```

### 8.5.1 C)ONT

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

### 8.5.2 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 that the disk drive is interfaced to. Current time refers to A) the pass number and B) the current chunk being tested.

Total errors refers to the total (hard and soft) errors encountered by this program on this drive since the beginning of this program. Hard 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 9.4 for detailed information on error codes).

### 8.5.3 R)ESTART

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

### 8.5.4 QUIT

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

## 8.6 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.

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### 8.7 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 option 3 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 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

#### 8.7.1 C)ONTINUE

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

#### 8.7.2 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 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.

#### 8.7.3 R)ESTART

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

#### 8.7.4 Q)UIT

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

### 8.8 Drive Diagnostics RevA

This diagnostic program offers many of the same options as the RevB Drive Diagnostics, as well as some adjustment utilities unique to the RevA drive. For those utilities not listed here, see Drive Diagnostics, RevB in this chapter.



**8.8.1 ADJ**

Selecting this option displays a submenu offering either the PLO adjustment, SERVO adjustment or QUIT.

The PLO option executes the proper signal sequence required for adjusting the PLO on the Servo PCA. Execute this utility and follow the instructions in chapter 7 for adjustment of the Servo PLO.

The SERVO option executes the proper full loop seek required for checking the timing of the Servo electronics. Execute this utility and follow the instructions in chapter 7 for adjustment of the Servo PCA.

Selecting the QUIT option returns the user to the RevA Drive Diagnostic menu.

**CHAPTER 9**  
**FAULT ISOLATION PROCEDURES**

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## CHAPTER 9 FAULT ISOLATION PROCEDURES

### 9.1 Scope of Chapter

This chapter contains procedures for testing and troubleshooting the Corvus disk system. Recommended test equipment is listed, as are error codes. A troubleshooting flowchart and list of common failures and procedures pertaining to this chapter may be found at the end of this chapter.

### 9.2 Introduction

Like any sophisticated electronic device, the Corvus disk drive may, at some time, fail. When failure occurs, it usually occurs when the drive is powered on. If the drive is used regularly each day (8 hours or more), leave the drive on indefinitely. This will avoid placing the maximum load on the drive at power-on and extend the life of all drive components.

### 9.3 Tools

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

1. Oscilloscope, dual trace, 35 MHz minimum bandwidth
2. Two calibrated X10 test probes with ground clips
3. Digital Multimeter ( $\pm 0.1$  percent accuracy) with test leads
4. Host microcomputer: Corvus Concept or Apple II+ (48K), Corvus Interface PCA and 34-pin flatcable
5. Corvus Dealer Service Diagnostic Utilities diskette (currently these are available for the Corvus Concept and Apple II computers)

### 9.4 Error Codes

For each command sent to the drive by the host operating system, a single-byte error code is returned. It is the responsibility of the operating system to interpret the error code and take appropriate action.

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

The format of the error code is shown below:

bit		bit		bit		bit		bit		bit		bit		
7		6		5		4		3		2		1		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 retries 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).

#### 9.4.1 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 retries were attempted. If the value is greater than or equal to 32, at least one retry was attempted before the error was reported.

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When no error has occurred, an original error code value of zero will be returned.

Consistent 171 or 235 errors at the same block location indicate bad disk media. Execute the CRC test and follow the instructions for sparing tracks (PRM options, Drive Diagnostics, chapter 8).

Consistent 255 errors indicate that the Controller PCA may need replacing.

**Table 9-1. Decimal Disk Error Codes**

<b>≤127 Non-Fatal</b>					<b>≥128 Fatal</b>
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)

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**Table 9-2. Hexidecimal Disk Error Codes**

<b>≤7FH Non-Fatal</b>					<b>≥80H Fatal</b>
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)

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**Table 9-3. Signed Decimal Disk Error Codes**

$\leq -129$ Non-Fatal				$\geq -128$ 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)

### **9.5 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 service.

Corvus provides its Dealer Service Centers 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 Chapter 8, "Dealer Service Diagnostics".

Also included in this chapter are a Disk Drive Troubleshooting Flowchart, and a list of Common Symptoms and Solutions. The text in this section follows the flowchart located at the end of the section and should be referred to while following the text.

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

1. Make sure all drives have the current version of Controller Firmware and Controller ROMs. Old versions of either may be incompatible with current versions of software.
2. Be sure to disconnect the ac power cord before replacing any modules.
3. Use only known good components when substituting.
4. Retest the system after each component has been substituted.
5. Check and adjust the Servo electronics each time the Servo PCA is replaced.

#### **9.5.1 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 CORCOM unit has the correct line voltage and fuse selected.
4. Verify that the interface cable is not damaged, and has been properly connected at both ends.
5. Check to see that the interface is in the correct bus slot (where applicable) of the host computer.
6. Communication with the drive must first be established in order to further diagnose any faults. The first indication of this is the READY LED. If this does not light, turn the FORMAT switch on (right position) and toggle the RESET switch. If the READY LED now lights, update the Controller Firmware on the drive (UPD option, Drive Diagnostics, Chapter 8).

#### **9.5.2 Isolate the Problem**

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

1. Magnetic (Controller Firmware integrity, data integrity, format integrity, boot image integrity),
2. Electronic (host computer function, Corvus drive Servo, Controller, Read/Write electronics function, power supply)
3. 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 Constellation and Omnet 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.

### **9.5.3 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.

#### **9.5.3.1 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 components, one at a time, to isolate the faulty module.

#### **9.5.3.2 Controller Firmware**

During the normal power-on sequence Controller Firmware is read into the Controller RAM. If the Controller Firmware has been disrupted and no longer contains the proper code, 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.

#### **9.5.3.3 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 received, 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 DVM, follow the voltage check and adjustment procedures outlined in section 7.3 of this manual. The ten-pin dc power connector and the two-pin motor power connector, located at the upper right corner of the drive Backplane, should be checked for a clean and tight fit. Measuring the voltages at the drive Backplane power pins will verify that the power connector and cable are in good condition.

Inspect the dc power cable for breaks. The CP129 has a cable with connectors at both ends, while most others use solder connections where the cable attaches to the supply. The power cable may be faulty if the voltages are not present at the drive Backplane.

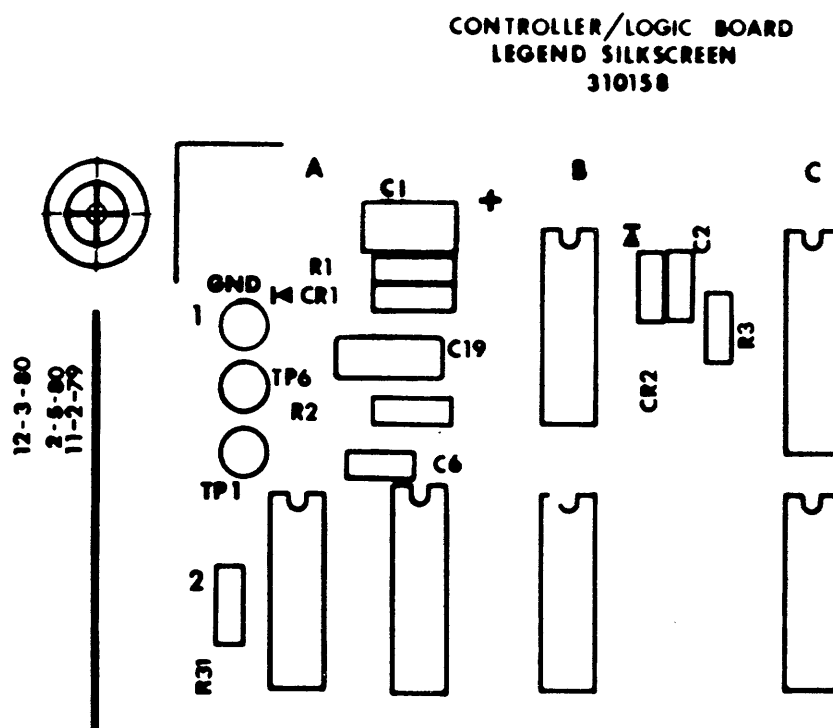
Symptoms indicating power supply failure include front bezel LEDs failing to light, drive motor failing to turn or speed fluctuating, heads slamming against inner crash stop, and drive going off-line (drive error 255).

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 change, be sure that the line fuse is also changed. (Refer to section 2.4 for instructions.) Symptoms indicating incorrect line voltage selection include dim or dark LEDs, low motor speed and extreme heat output.

#### **9.5.3.4 RESET Line**

If the READY LED still does not light, the RESET line may be held down by a faulty component. Using a DVM, check the voltages at both sides of pull-up resistor R3 on the Controller/Logic PCA. One side of the resistor is connected to the +5V supply, and should show a steady +5V. The other side of the resistor is connected to the RESET line, and should be a TTL-level high signal (+2.5V minimum). If the voltages are not within tolerance, replace the IC at loction B1 (74LS08) if it is socketed. If it is not socketed, replace the Controller/Logic PCA.





### 9.5.3.5 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 electronics.

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 on all gold edge connector pins will help eliminate any oxidation that may have built up, causing improper contact. Also, reseating socketed ICs on the Controller/Logic PCA will ensure good pin connections. Simply disassembling and reassembling the drive may eliminate symptoms that seem to indicate faulty electronics.

**WARNING:**

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

Replace the drive electronics with a known good set:

1. Remove power to the drive.
2. Disassemble the drive and remove the electronics card set as outlined in sections 6.3 and 6.5.
3. Install a known good electronics card set.
4. Power on the drive.

If one of the PCAs was faulty, the READY LED will now light. The next step is to isolate the faulty PCA by replacing the known good PCAs, one at a time, with the original ones:

1. Remove power to the drive.
2. Remove one known good PCA.
3. Install one original PCA.
4. Power on the drive.

Repeat the above four steps until either the READY LED light does not light after the drive has been powered on, or all original PCAs have been re-installed. If, after re-installing an original PCA, the drive is not READY, remove and label the original PCA last installed as faulty, and re-install the other originals.

If the servo mechanism is behaving irrationally, the servo parameters should be checked for proper adjustment as outlined in section 7.4. If after adjustment, the servo still behaves irrationally, the Servo PCA should be replaced, and the new one readjusted if necessary.

If, after installing all original PCAs the READY LED does not light, the drive mechanism should be replaced.

#### **9.5.3.6 Drive Sealed Mechanism**

The Drive Mechanism is a sealed unit with no internally serviceable parts. The only adjustment on the Drive Mechanism is that of the brake solenoid (section 7.5). Any other 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. Preamp failure (where applicable)
4. Servo track failure

Failure of the platters to turn could be caused by a misadjusted or defective brake mechanism. Check the brake for proper function and adjust if necessary (section 7.5).

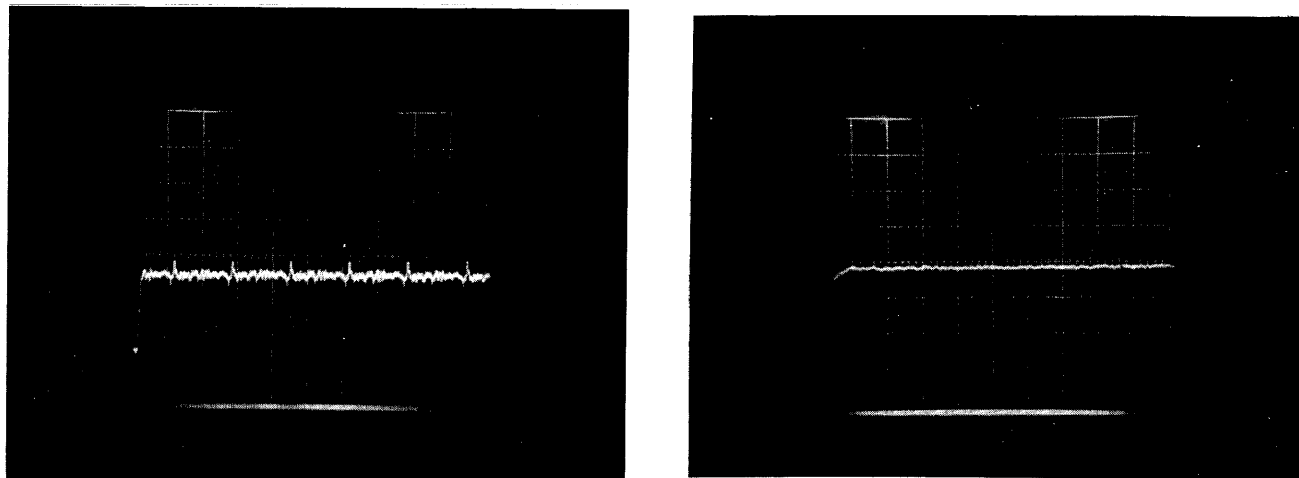
Servo tracks will weaken as the drive ages, and can be seen as noise on the PES. Connect an oscilloscope to the drive as outlined in the Servo Adjustment (section 7.4) and execute the CRC test. The PES should be quiet while positioned on a cylinder. The more noise seen in the signal, the weaker the servo track has become. A servo track that is defective will show distinct spikes in the PES (figure 9-2). Six-hundred millivolts of noise is considered the operable limit.

#### **9.5.4 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 DOS and executing the LINK program will establish the patch.

Corvus recommends that the 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 ensure that a new DOS copy may be substituted for the users' DOS for troubleshooting purposes.



**Figure 9-2. PES as a Result of Good Servo Track (left) and Bad Servo Track (right)**

**9.5.4.1 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.

**9.5.4.2 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.

**9.5.4.3 CRC Test**

Execute the CRC test. This will 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, as could incorrect Read/Write PCA jumper selection (refer to section 5.4). Check that these are set correctly. If a servo track is damaged, the heads will not seek past that cylinder, and the CRC test will fail. 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.

#### **9.5.4.4 Servo Test**

If servo action seems erratic or if read or write errors are encountered, the Servo Test (Drive Diagnostic utility EXR) should be executed. This program is not destructive to data.

The program commands the heads to seek random sectors and verify the block of data in that sector. Dots print on the screen for sector reads completed without error, an asterisk prints for hard errors encountered during a read, and a question mark prints for soft errors encountered during a read. Pressing RETURN will list all errors. If any errors are encountered, the Controller Diagnostic command Analyze Servo (I) should be executed, and the servo electronics checked and adjusted if out of tolerance (section 7.4).

#### **9.5.4.5 Controller Firmware**

Controller Firmware should be rewritten at this point 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 no indication that all the Controller Firmware code is intact. Rewrite the Controller Firmware using the Drive Diagnostic utility UPDATE. Rewriting Firmware is non-destructive to data.

#### **9.5.4.6 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.

#### **9.5.4.7 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.

#### **9.5.4.8 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 initialization 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 problem persisting after following the flowchart to this point lies 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.

### **9.6 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 service.

#### **9.6.1 Proper Headlock Operation**

First determine which type of headlock the sealed mechanism has. To check the headlock mechanism for proper function, power off the drive and, in the case of the manual headlock device, secure the heads by turning the headlock screw located on the side of the sealed mechanism (no action need be taken for autolock mechanisms). Tip the servo end of the drive (the end with the Backplane PCA) three to four inches off the working surface. If the headlock mechanism is functioning properly, the heads will not skate towards the spindle. If the heads move, this indicates a faulty headlock, and the drive mechanism must be replaced to remedy the problem.

**9.6.2 CRC Test**

The drive media must be verified reliable before the drive can be certified 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 (refer to section 8.3.6).

**9.6.3 Servo Check and Adjust**

Even though the servo electronics may have been checked and adjusted at some time during the troubleshooting procedures, they must be checked now, and adjusted if necessary. Changing PCAs or adjusting the power supply voltages will affect the servo action, as will changing the drive sealed mechanism itself.

**9.6.4 Install and Test Mirror**

If a Corvus Mirror backup device was part of the original disk system, it should have been removed from the 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.

**9.6.5 RESET Line**

Checking the RESET line should be a routine function performed each time the drive is serviced (refer to section 9.5.3.4 for instructions). Whether or not this procedure was previously performed on this drive, it should be done now. If the voltage of the TTL-high signal at R3 is not within tolerance, follow the replacement procedures outlined in section 9.5.3.4.

**9.6.6 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.

**9.6.7 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 ensure that the Burn-In test is testing a properly adjusted drive.

**9.6.8 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 utility PARAM).

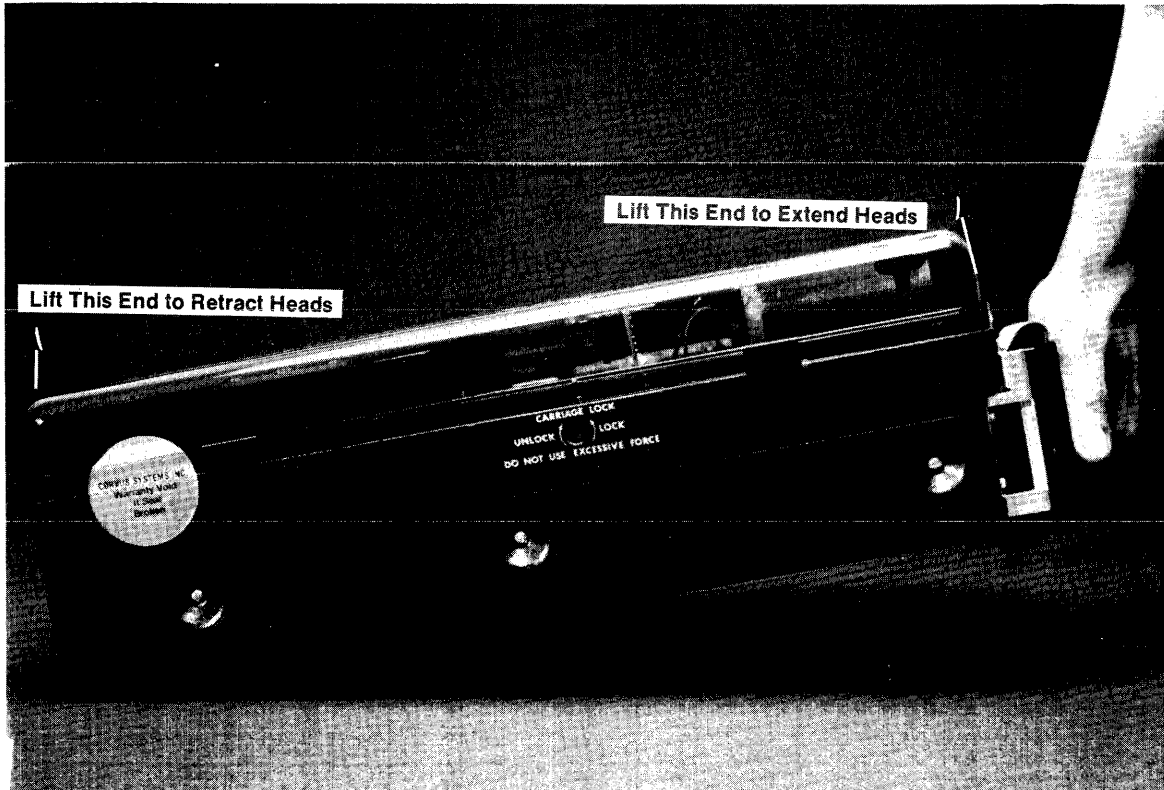
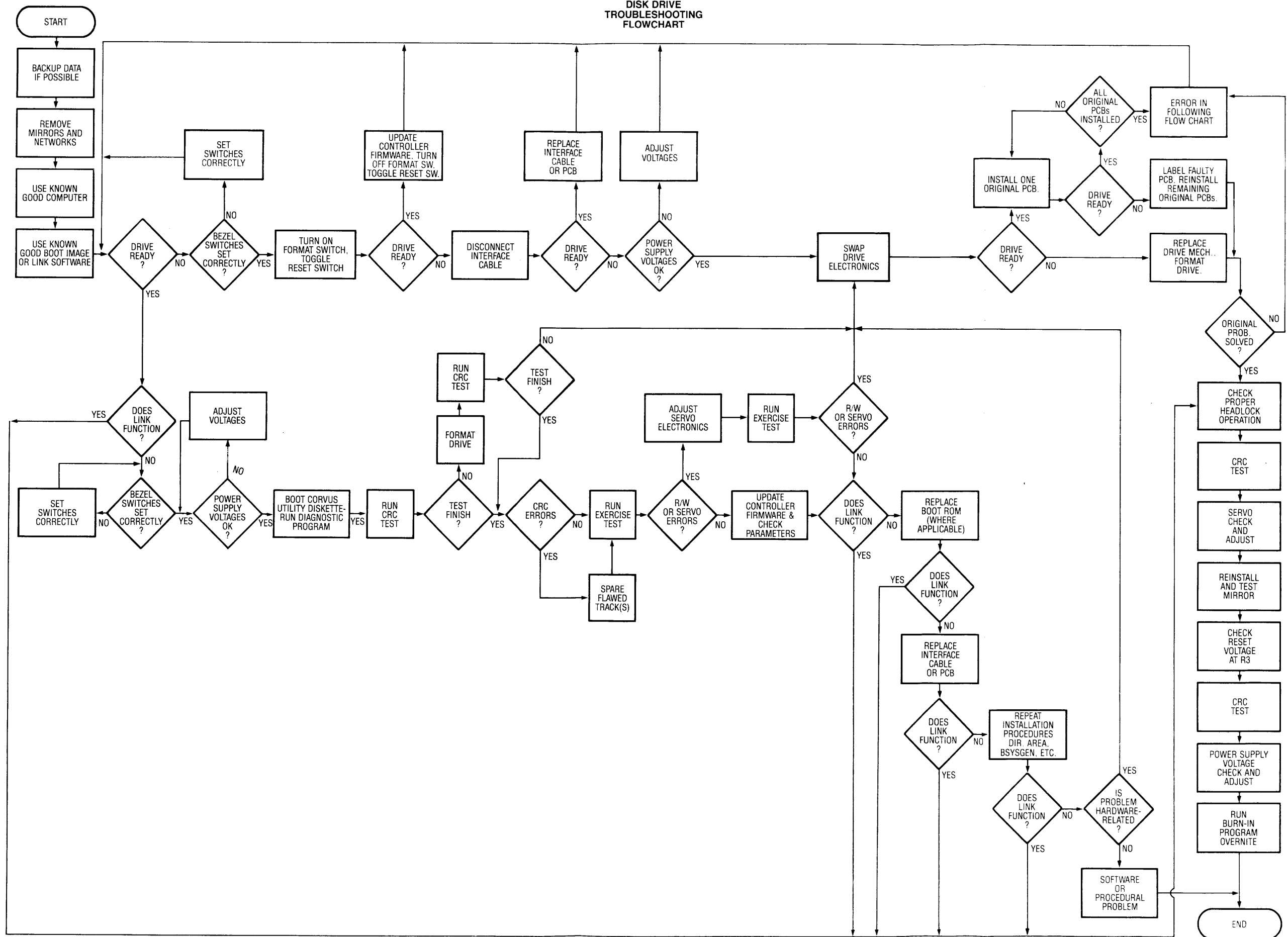


Figure 9-3. Checking Proper Headlock Operation.

**DISK DRIVE TROUBLESHOOTING FLOWCHART**



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<b>SYMPTOM</b>	<b>CAUSES</b>	<b>RECOMMENDED REPAIR</b>
1. Drive platters won't turn.		
A. All LEDs off and remain off.	ac power improperly selected. P.S. 24V misadjusted or non-existent. 24V not present at backplane.	Check and adjust. Check voltage and adjust. Check dc power connector and motor connector for continuity and proper connection at backplane.
B. All LEDs light then BUSY alone remains lit.	Power supply defective. Brake solenoid not releasing. Drive motor defective.	Replace power supply. Adjust brake mechanism. Replace drive sealed mechanism.
2. Unable to format drive.	Interface cable defective.	Replace interface cable.
A. READY remains lit.	Controller ROMs (3.xx and 4.xx) on the Controller PCA defective. Controller PCA defective. Defective software (either FORMAT or CFxx.x files).	Replace Controller ROMs. Replace Controller PCA. Obtain known good copy of software.
B. BUSY remains lit constantly.	Headlock is engaged.  Controller unit address set incorrectly. Read/Write PCA defective. Servo PCA defective. Controller ROMs (3.xx and 4.xx) on Controller PCA defective. Servo mechanism defective.	On manual-lock drives, disengage headlock. On auto-lock drives, verify that heads are free by observing heads as drive is spinning up to speed, while tilting drive. Set switches correctly. Replace Read/Write PCA. Replace Servo PCA. Replace Controller ROMs. Replace drive sealed mechanism.
3. Unable to update Controller Firmware (CFxx.x).		
A. All LEDs go off, remain off.	Drive is not "Ready".  Firmware is wrong level for revision of drive.  CRC error in Controller Firmware area. Servo needs adjustment.	Turn on FORMAT switch, toggle RESET switch.  RevA and RevB drives use different Firmware. Locate latest firmware for drive, copy to drive. Replace drive mechanism. Adjust Servo electronics.



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<b>SYMPTOM</b>	<b>CAUSES</b>	<b>RECOMMENDED REPAIR</b>
	Servo PCA defective.	Replace Servo PCA.
	Controller ROMs (3.xx and 4.xx) on Controller PCA defective.	Replace Controller ROMS.
	Controller Logic PCA defective.	Replace Controller PCA.
	Read/Write PCA defective.	Replace Read/Write PCA.
	Drive Sealed Mechanism defective.	Replace Drive Sealed Mechanism.
B. Busy LED lights and remains lit.	Servo needs adjustment.	Adjust Servo electronics.
	Servo PCA defective.	Replace Servo PCA.
	Controller ROMs (3.xx and 4.xx) on Controller PCA defective.	Replace Controller ROMS.
	Read/Write PCA defective.	Replace Read/Write PCA.
	Drive Sealed Mechanism defective.	Replace Drive Sealed Mechanism.
4. CRC FORMAT CHECK will not begin or will not finish.		
A. BUSY LED lights and remains lit, or FAULT LED only remains lit.	Front bezel switches incorrect.	Verify correct setting of switches.
	Servo needs adjustment.	Adjust Servo electronics.
	Controller ROMs (3.xx and 4.xx) on Controller PCA defective.	Replace Controller ROMS.
	Format not intact.	Format drive.
	Controller/Logic PCA defective.	Replace Controller/Logic PCA.
	Read/Write PCA is defective.	Replace Read/Write PCA.
	Drive Sealed Mechanism defective.	Replace Drive Sealed Mechanism.
	Servo PCA defective.	Replace Servo PCA.
5. Unable to spare track.		
A. All LEDs off and remain off.	Track is already spared.	No action necessary.
	Controller ROMs (3.xx and 4.xx) on Controller PCA defective.	Replace Controller ROMS.
	Controller/Logic PCA defective.	Replace Controller/Logic PCA.
	Drive Sealed Mechanism defective.	Replace Drive Sealed Mechanism.

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**CORVUS DEALER SERVICE**

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<b>SYMPTOM</b>	<b>CAUSES</b>	<b>RECOMMENDED REPAIR</b>
	Maximum number of tracks have been spared (maximum of 7 possible).	Replace Drive Sealed Mechanism.
	Defective Read/Write PCA.	Replace Read/Write PCA.
6. Servo Exercise Diagnostic will not execute.		
A. BUSY LED lights and remains lit.	Power Supply voltages mis-adjusted.	Check Power Supply voltages. Adjust if necessary.
	Servo needs adjustment.	Adjust Servo electronics.
	Servo PCA defective.	Replace Servo PCA.
	Read/Write PCA defective.	Replace Read/Write PCA.
	Drive Sealed Mechanism defective.	Replace Drive Sealed Mechanism.
7. Computer boots into monitor.		
A. All LEDs off and remain off, or BUSY LED lights and remains lit.	Boot image corrupted.	Recreate boot image (see user guide).
	Boot image contains improper values.	Recreate boot image using correct values.
	Boot program on Corvus Utility diskette corrupt.	Recreate boot image using known good copy of Corvus Utilities.
	Boot ROM (where applicable) or Interface PCA defective.	Replace Boot ROM. If problem persists, replace Interface PCA.
	Drive Sealed Mechanism defective.	Replace Drive Sealed Mechanism.
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 guide).
	Power Supply voltages out of tolerance.	Check voltages, adjust if necessary.
	Power Supply defective, dc power cable defective.	Check voltages at Power Supply. Replace Power Supply if non-existent. If voltages are present, check dc power cable.
	Boot ROM (where applicable) or Interface PCA defective.	Replace Boot ROM. If problem persists, replace Interface PCA.
	Controller ROMs (3.xx and 4.xx) on Controller PCA defective.	Replace Controller ROMS.
	Drive Sealed Mechanism defective.	Replace Drive Sealed Mechanism.

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**CORVUS DEALER SERVICE**

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SYMPTOM	CAUSES	RECOMMENDED REPAIR
9. I/O errors during normal operation.		
A. Normal LED display, or all LEDs off and remain off.	Software currently running on host computer defective. Boot image corrupted. Defective track.  Controller/Logic PCA defective. Drive Sealed Mechanism defective. Power Supply voltages out of tolerance. dc power cable defective. Controller ROMs (3.xx and 4.xx) on Controller PCA defective. Read/Write PCA defective. Servo needs adjustment. Servo PCA defective.	Replace software with known good copy, and reexecute. Recreate boot image (see user guide). Execute CRC FORMAT CHECK. Spare any tracks returning errors.  Replace Controller/Logic PCA. Replace Drive Sealed Mechanism.  Check voltages, adjust if necessary.  Replace power cable. Replace Controller ROMS.  Replace Read/Write PCA. Adjust Servo electronics. Replace Servo PCA.
10. Heads slam against inner crash stop (spindle seek).		
A. BUSY LED lights and remains lit.	Power Supply voltages out of tolerance. dc power cable defective. Power Supply voltages intermittent. Servo needs adjustment. Servo PCA defective. Controller Firmware corrupted. Controller ROMs (3.xx and 4.xx) on Controller PCA defective. Controller PCA defective. Read/Write PCA defective. Drive Sealed Mechanism defective.	Check voltages, adjust if necessary.  Replace power cable. Replace Power Supply.  Adjust Servo electronics. Replace Servo PCA. Update Controller Firmware. Replace Controller ROMS.  Replace Controller PCA. Replace Read/Write PCA. Replace Drive Sealed Mechanism.

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**CORVUS DEALER SERVICE**

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<b>SYMPTOM</b>	<b>CAUSES</b>	<b>RECOMMENDED REPAIR</b>
11. Sector destroyed during normal operation.		
A. BUSY LED lights and remains lit.	Magnetic-field-generating device (video monitor) located too near drive.	Position device further from drive.
	Boot ROM (where applicable) or Interface PCA defective.	Replace Boot ROM. If problem persists, replace Interface PCA.
	Servo needs adjustment.	Adjust Servo electronics.
	Servo PCA defective.	Replace Servo PCA.
	Power Supply voltages out of tolerance.	Check voltages, adjust if necessary.
	Ac power surge during Read/Write operation.	Determine quality of ac power supplied to Corvus and host computer. Determine types of electrical devices on same ac circuit. Large power-consuming devices should not share power with the disk drive. A dedicated ac circuit for the system is best.
	Controller/Logic PCA defective.	Replace Controller/Logic PCA.
	Read/Write PCA defective.	Replace Read/Write PCA.
	Weak media spot on platter surface.	Determine sector(s) affected, spare the track(s).
12. Motor speed varies.		
A. N/A	24V supply out of tolerance.	Check voltage, adjust if necessary.
	Motor wiring or connectors defective.	Check motor power connector at drive backplane. Verify proper connection.
	24V supply defective.	Replace power supply.
	Drive motor defective.	Replace Drive Sealed Mechanism.
13. Heads do not rezero after drive is turned on.		
A. BUSY LED lights and remains lit.	Power Supply voltages out of tolerance.	Check voltages, adjust if necessary.
	Power Supply voltages intermittent.	Check dc power cable for continuity. If problem persists, replace power supply.
	Controller unit address set incorrectly.	Set switches correctly.
	Servo needs adjustment.	Adjust Servo electronics.
	Servo PCA defective.	Replace Servo PCA.
	Controller/Logic PCA defective.	Replace Controller/Logic PCA.

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**CORVUS DEALER SERVICE**

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<b>SYMPTOM</b>	<b>CAUSES</b>	<b>RECOMMENDED REPAIR</b>
	Read/Write PCA defective.	Replace Read/Write PCA.
	Controller ROMs (3.xx and 4.xx) on Controller PCA defective.	Replace Controller ROMS.
	Drive Sealed Mechanism defective.	Replace Drive Sealed Mechanism.
<b>14. Head oscillates after drive is turned on.</b>		
<b>A. BUSY LED lights and remains lit.</b>	Controller Firmware corrupted.	Update Firmware to latest revision. If problem persists, reformat the drive using Diagnostic FORMAT utility.
	Front bezel switches incorrect.	Verify correct setting of switches.
	Power Supply voltages out of tolerance.	Check voltages, adjust if necessary.
	Power Supply defective.	Replace Power Supply.
	Servo needs adjustment.	Adjust Servo electronics.
	Servo PCA defective.	Replace Servo PCA.
	Controller ROMs (3.xx and 4.xx) on Controller PCA defective.	Replace Controller ROMS.
	Read/Write PCA defective.	Replace Read/Write PCA.
	Boot ROM (where applicable) or Interface PCA defective.	Replace Boot ROM. If problem persists, replace Interface PCA.

**APPENDIX A**  
**GLOSSARY**

## APPENDIX A GLOSSARY

**BACKPLANE OR MOTHERBOARD:** four-slot printed circuit board which receives up to four of the drive electronics printed circuit boards. The RevA drive uses all four of these slots, while the RevB uses only three. The backplanes for the RevA and RevB are not compatible and, therefore not interchangeable.

**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:** after power-down, before the motor speed has reached zero, so as to minimize contact time between heads and disk surface, the brake 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 OR WHITE CABINET:** the cabinet which contains the IMI drive mechanism, power supply and fan. The front and rear bezel attach to the cabinet basepan. A hinged access door in the bottom of the basepan allows access to the internal mirror PCA and drive electronics.

**CONTROLLER OR Z-80 CONTROLLER OR INTELLIGENT CONTROLLER:** the disk controller circuitry including the Z-80 microprocessor and support logic. In the RevB drives, this consists of the Controller/Logic PCA.

**CONTROLLER/LOGIC PCA:** the Revision-B circuit board assembly containing the Z-80 controller 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. The 10-megabyte drive has 358 concentric cylinders, the 20-megabyte drive has 388. There are three data tracks per cylinder for the 10-megabyte drive, and 5 for the 20-megabyte.

**DISK CONTROLLER PCA:** the Revision-A circuit board assembly containing the master Z-80 processor, PIO ICs, as well as RAM and ROM memory.

**DISK MECHANISM OR SEALED MECHANISM:** the IMI disk drive assembly consisting of platters, drive motor, head assembly and servo mechanism, all in a sealed environment covered by a translucent top assembly. The above components inside the sealed mechanism are not field-serviceable 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 CONTROLLER FIRMWARE:** Z-80 code contained in the first two cylinders of the drive consisting of routines for the Spare Track Table, Constellation Network Table, and Semaphore Status Flags. The appropriate routines are downloaded from the Firmware into the on-board RAM for execution by the Z-80 Controller at power-on time.

**FRONT BEZEL:** the front panel of the white 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.

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## CORVUS DEALER SERVICE

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**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. The heads float 18 microns 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 hybrid, 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.

**MICROLOGIC PCA:** the Revision-A printed circuit assembly which contains the master Z-80 processor and support logic. In later Revision-B drives, this circuitry was combined with the Drive Controller PCA to create the Controller/Logic PCA.

**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 into it. The PCB is the bare board without the usual components such as resistors, transistors and integrated circuits.

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

**PREAMP:** circuit responsible for initial amplification of analog signals. In the IMI drive, the first circuit downline from the headstack. In some drives, this is located on the underside of the drive mechanism, while later designs moved this to the Read/Write PCA.

**REAR BEZEL:** the rear panel most area of the cabinet, containing the flatcable connectors for the interface cable, video connectors, power cable and fuse holder. The 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, header information and trailer information required by the disk controller.

**SERVO PCA:** the printed circuit assembly responsible for positioning the servo mechanism and the read/write heads over the appropriate track.

**SERVO MECHANISM:** the device in the drive sealed mechanism which receives current from the servo electronics and positions the head stack.

**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 possibility 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 are 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 converting it to NRZ format before passing it on to the Controller circuitry for manipulation.



**APPENDIX B**  
**PARTS LIST FOR EIGHT-INCH DRIVES**

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**APPENDIX B**  
**PARTS LIST FOR EIGHT-INCH DRIVES**

**PARTS LIST FOR CORVUS 11MB/20MB DISK DRIVES**

<b>PART NUMBER</b>	<b>DESCRIPTION</b>
2400-01530	BOTTOM PAN ONLY
2400-01531	TOP COVER
2400-01636	SUPPORT BRACKET, DRIVE MECHANISM
2600-01143	FAN TORIN TA300
2600-01453	AC CORD FOR TORIN TA300
3010-08026	PCA MIRROR
3150-01844	R. BEZEL ONLY
3150-01846	F. BEZEL ONLY
4000-01665	CP411 POWER SUPPLY, COMPLETE
6010-01447	AC LINE CORD
8010-08001	PCA PADDLEBOARD
8010-08040	FLATCABLE, PADDLEBOARD-BACKPLANE
8010-08042	FLATCABLE, INTERFACE (5 FT.)
8010-08067	HARNESS, POWER SWITCH (4-WIRE)
8010-08071	HARNESS, AC (CORCOM, SWITCH CON., P.S. CON.)
8010-08078	FLATCABLE, MIRROR-DRIVE
8010-08079	FLATCABLE, MIRROR-PROCESSOR
8010-08103	8" DRIVE BASE, COMPLETE (FAN, F. and R. BEZELS)
8010-08109	F. BEZEL, COMPLETE (PADDLEBOARD, NAMEPLATE)
8010-08116	MIRROR PHONO HARNESS (MIRROR HALF ONLY)
8010-08118	R. BEZEL, COMPLETE (FLATCABLES, MIRROR HARNESS, CORCOM)
8010-08225	FLATCABLE, REMOTE VCR
MISC.	HARNESS, MIRROR PHONO
7710	11MB DISK MECHANISM
7720	20MB DISK MECHANISM
310001	R/W PCA w/o on-board preamp
310101	R/W PCA w/ on-board preamp
310006	Servo PCA, RevA, manual lock
310176	Servo PCA, RevA/RevB manual lock
310221	Servo PCA, RevA/RevB auto or manual lock
310071	Micrologic PCA, RevA 11MB
310181	Micrologic PCA, RevA 11MB
310156	Controller/Logic PCA, RevB 11MB/20MB
310062	Drive Controller PCA, RevA 11MB
310021	Backplane PCA, 11MB/20MB (specify RevA or RevB)
330020	PROM, Micrologic, RevA
330092	PROM, Micrologic, RevA
330063	PROM, Micrologic, RevA

Prices are to be found in the Corvus Dealer Service Administration Manual.

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**CORVUS DEALER SERVICE**

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**PCA PART NUMBER CROSS-REFERENCE**

<b>ASSEMBLY NUMBER</b>	<b>DESCRIPTION</b>	<b>MFR. PART NUMBER</b>
310001	R/W PCA w/o on-board preamp	811-01427-001
310101	R/W PCA w/ on-board preamp	811-01395-X02
310006	Servo PCA, RevA 11MB	811-01428-001
310176	Servo PCA, RevA/RevB manual lock	811-01398-001
310221	Servo PCA, RevA/RevB auto/manual lock	811-01368-X01
310071	Micrologic PCA, RevA 11MB	811-01441-001
310181	Micrologic PCA, RevA 11MB	811-01393-X01
310156	Controller/Logic PCA, RevB 11MB/20MB	811-01394-X01
310062	Drive Controller PCA, RevA 11MB	811-01439-001
310021	Backplane PCA, RevA/RevB 11MB/20MB	811-01431-X01
330020	PROM, Micrologic, RevA	814-00549-002
330092	PROM, Micrologic, RevA	814-00549-003
330063	PROM, Micrologic, RevA	814-00549-004

In the future, the manufacturer will be silkscreening PCAs with new eleven-digit part number. Above is the cross-reference chart for assembly numbers (which should be used when ordering PCAs from Corvus) as well as the new manufacturers' part numbers.

The "X" found in some manufacturers' part numbers refers to various revision level digits that may occupy that location.

**APPENDIX C**  
**PCA COMPATIBILITIES**

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**APPENDIX C  
PCA COMPATIBILITIES**

**SERVO PCA**

**REV A DRIVE  
MANUAL HEAD LOCK**

asm 310176  
(for use with micrologic  
PROM #330063)

asm 310006  
(for use with micrologic  
PROM #330020)

asm 310221  
(if used with micrologic  
asm 310071, use  
PROM #330063)  
(if used with micrologic  
asm 310181, use  
PROM #330092)

**REV A DRIVE  
AUTO HEAD LOCK**

asm 310221  
(if used with micrologic  
asm 310071, use  
PROM #330063)  
(if used with micrologic  
asm 310181, use  
PROM #330092)

**REV B DRIVE  
MANUAL HEAD LOCK**

asm 310176  
asm 310221

**REV B DRIVE  
AUTO HEAD LOCK**

asm 310221

**CONTROLLER PCA**

**REV A DRIVE  
MANUAL HEAD LOCK**

asm 310161

**REV A DRIVE  
AUTO HEAD LOCK**

asm 310161

**REV B DRIVE  
MANUAL HEAD LOCK**

asm 310156

**REV B DRIVE  
AUTO HEAD LOCK**

asm 310156

**MICROLOGIC PCA**

**REV A DRIVES  
MANUAL and AUTO HEAD LOCK**

asm 310071  
asm 310181  
(see SERVO PCB COMPATIBILITY above for servo  
pcb and ROM restrictions)

**REV B DRIVES  
MANUAL and AUTO HEAD LOCK**

none

**READ/WRITE PCA**

**REV A AND REV B DRIVES, MAUAL AND AUTO  
HEAD LOCK, HAVING PREAMP PCB asm 310026  
(discreet circuitry)**

asm 310001 (no on-board preamp)

**REV A AND REV B DRIVES, MANUAL AND AUTO  
HEAD LOCK, HAVING PREAMP PCB asm 310131  
OR asm 310211 (traces only)**

asm 310101 (with on-board preamp)

**BACKPLANE/MOTHERBOARD PCA**

**REV A DRIVES**

asm 310021 (with RevA jumpers installed on backplane)

**REV B DRIVES**

asm 310021 (with RevB jumpers installed on backplane)

**PADDLEBOARD PCA**

**REV A DRIVES**

PCB has "REV A DRIVE 7710" etched onto it, three  
function switches and 100-mil 34-pin flatcable connector

**REV B DRIVES**

asm 7710/20C  
asm 40010011

**APPENDIX D  
ASSEMBLY AND SCHEMATIC DRAWINGS**

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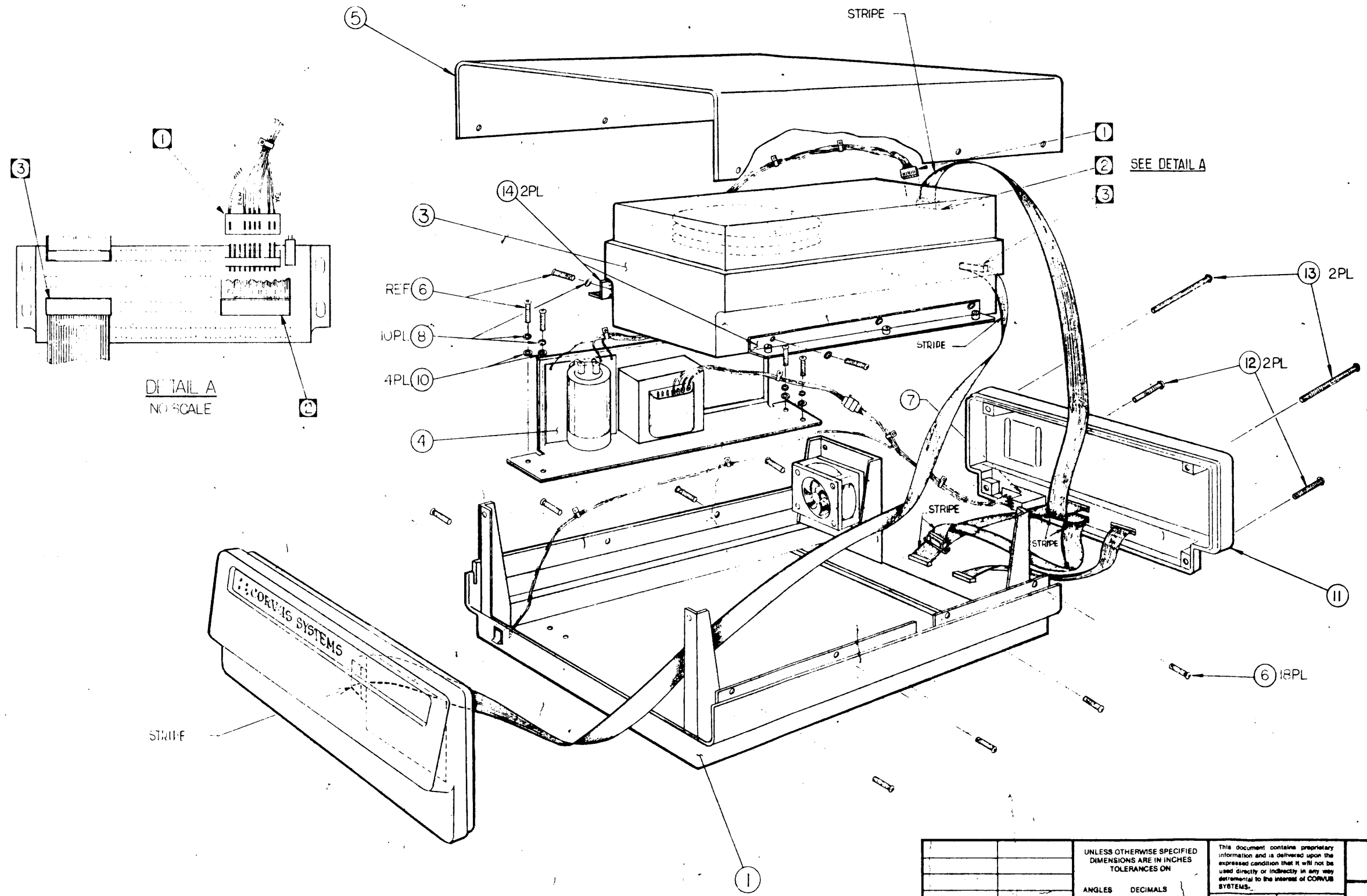
**CORVUS DEALER SERVICE**

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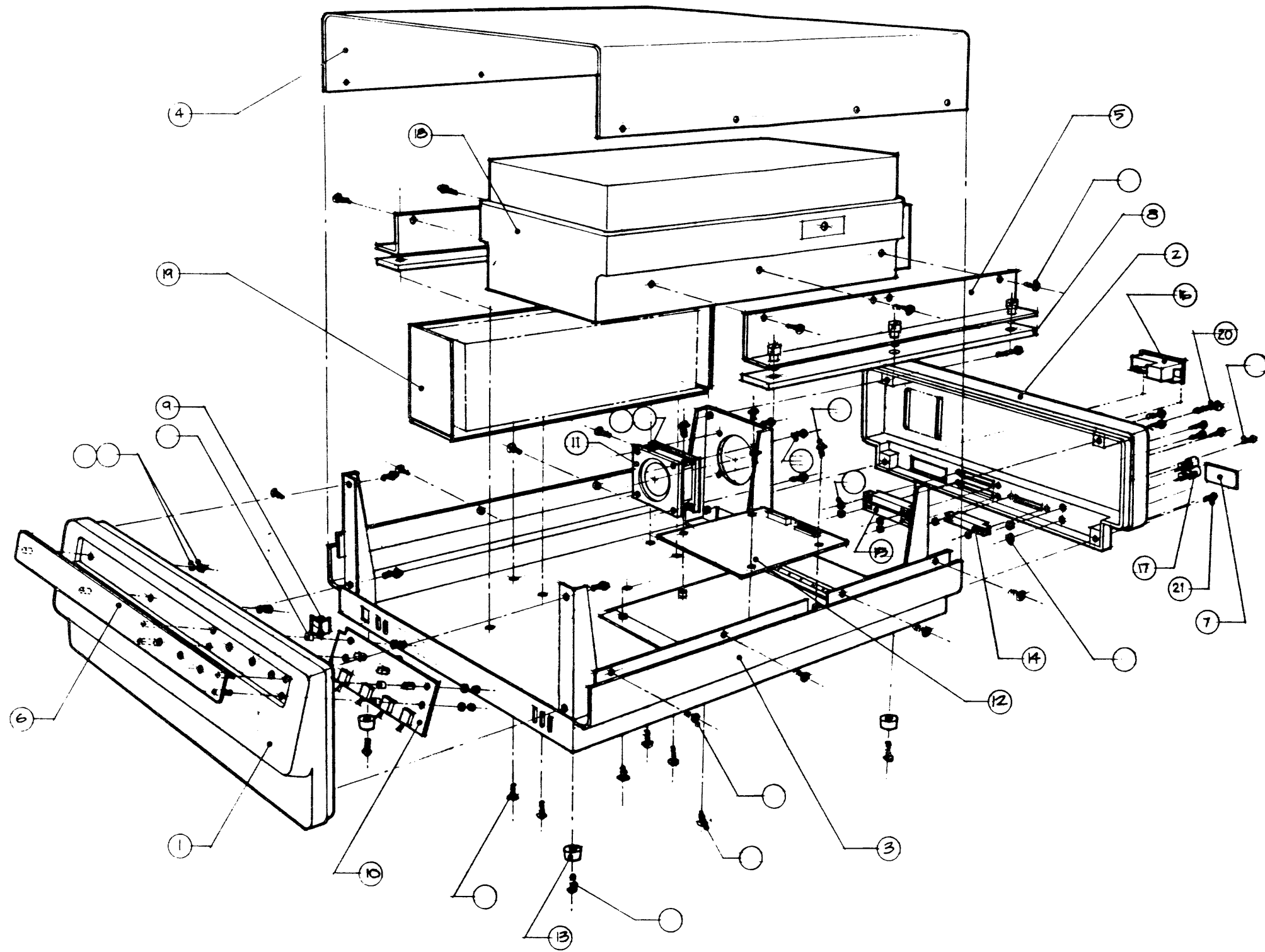
REVISIONS				
PCQ	REV	DESCRIPTION	DATE	APPROVED
345	F	ADD ITEMS 11, 12, 13	3/22/82	



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON		This document contains proprietary information and is delivered upon the expressed condition that it will not be used directly or indirectly in any way detrimental to the interest of CORVUS SYSTEMS.	★ ★ CORVUS SYSTEMS ★ ★ 2029 O'Toole Avenue, San Jose, CA 95131	
ANGLES	DECIMALS		TOP ZOMB DRIVE METAL	
±	.XX ±	DRAWN BY HUY B.	DATE OF DRAWING 12-81	ASSY DWG. 8005-06088
	.XXX ±	CHECKED BY	NUMBER	SCALE: NONE
NEXT ASSY	USED ON	APPROVED	APPROVED	SHEET 1 OF 1
APPLICATION	FINISH			

ASSEMBLY DWG, METAL CABINET

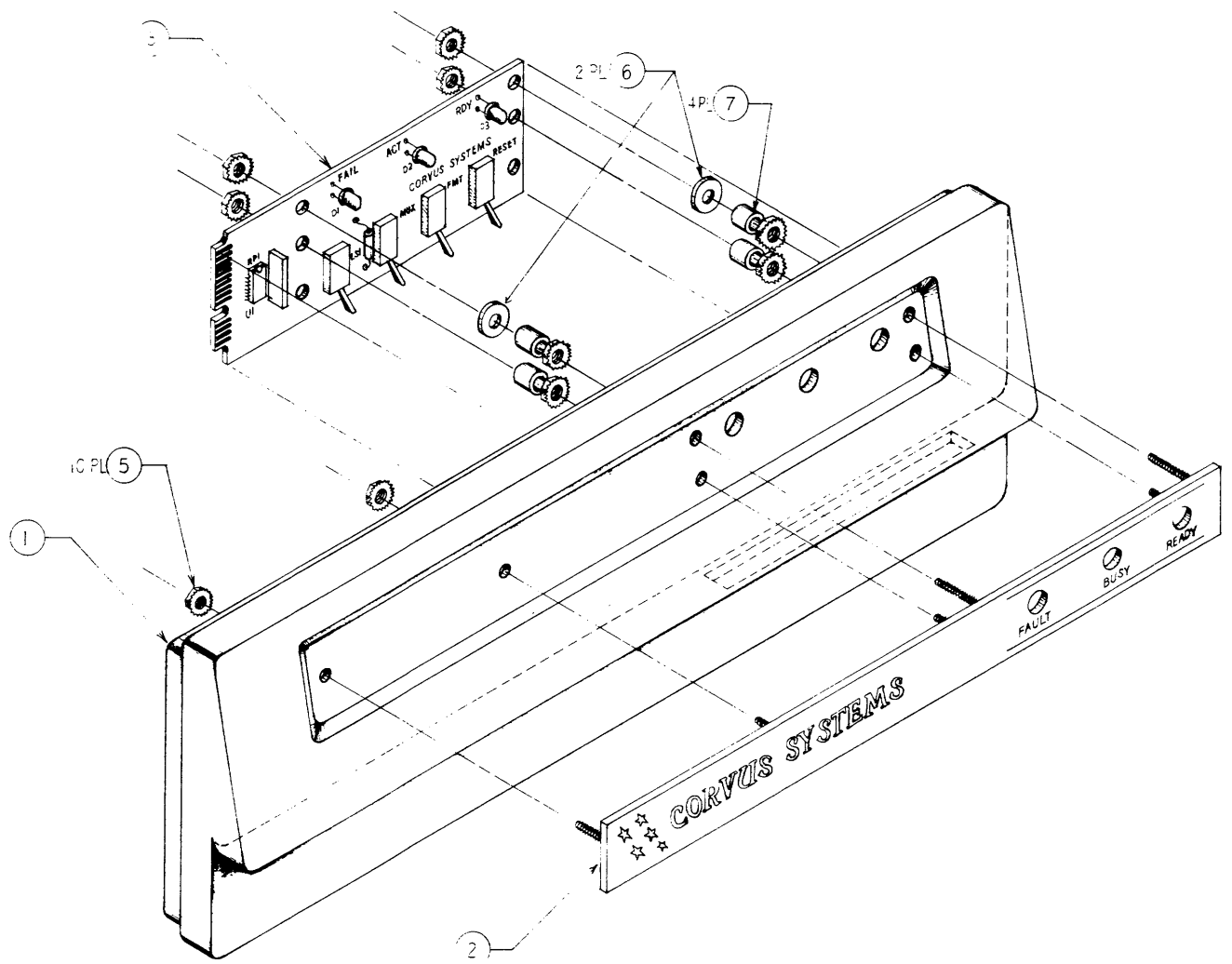




CORVUS SYSTEMS		
ASSY DETAIL		
SCALE NONE	DRAWN CON LEO	REVISION B
DATE NOV 11, 1980	SHEET 1 OF 1	DWG NO. DRV-10 MEG

ASSEMBLY DWG, DETAIL

REV NO	REV	DESCRIPTION	APPROVED	DATE
40	A	RELEASE FOR PROD	<i>[Signature]</i>	3-22-77
	C	DOC CHG.		
	D	PARTS CHG. ONLY	<i>[Signature]</i>	3-22-77
078	D	LM CHG ONLY	<i>[Signature]</i>	22-77

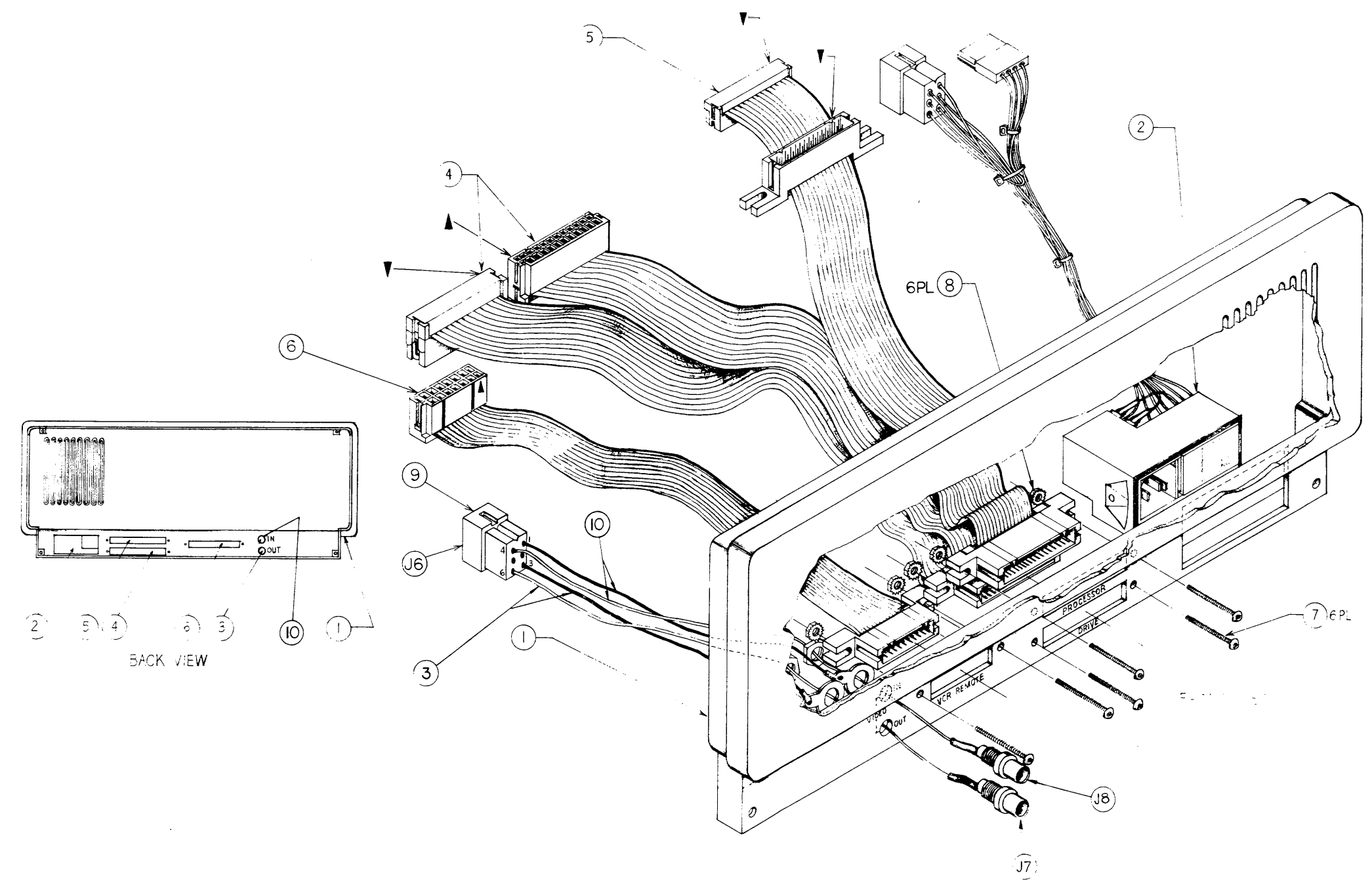


CORVUS SYSTEMS, INC.			
SCALE: NONE	APPROVED BY: <i>[Signature]</i>	DRAWN BY: <i>[Signature]</i>	
DATE: 6-22-81	<i>John Stuckland</i>	REVISED:	
DRAWING NUMBER: 9109			

ASSEMBLY DWG, FRONT BEZEL

REV	DESCRIPTION	APPROVED	DATE
C	REPLACE PWB VIDEO	<i>[Signature]</i>	1-2-61
D	DOC. UPGRADE	<i>[Signature]</i>	1-2-61
E	DOC. CHG.	<i>[Signature]</i>	10-1-61
F	CHG. NO. CHG.		
G	ADD MICRO CABLE	<i>[Signature]</i>	2-1-62
H	SHOW ITEMS #3 & 10	<i>[Signature]</i>	4-26-62

DCR 077



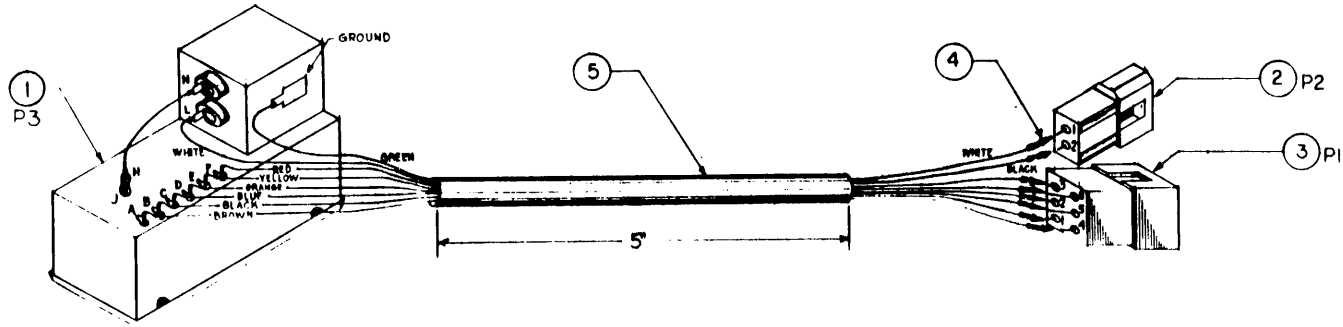
CORVUS SYSTEMS, INC.			
SCALE: NONE	APPROVED BY: <i>[Signature]</i>	CHECKED BY: <i>[Signature]</i>	DRAWN BY: TLM:G
DATE: 6-24-61			REVISED: G
REAR BEZEL			DRAWING NUMBER
APPL. DRAWING			1-1-C

ASSEMBLY DWG, REAR BEZEL

OBSOLETE: REDRAWN P2 changed to 4 Pos conn. PCO #133

REVISIONS				
PCB NO.	REV.	DESCRIPTION	DATE	APPROVED
102	A	RELEASE FOR PRODUCTION	5-15-81	J. Bailey

CONNECTION CHART						
ITEM	COLOR	FROM	TO	LENGTH	WIRE SIZE	NOTE
6	RED	P3-F	P1-1			
7	ORANGE	P3-D	P1-2			
8	YELLOW	P3-E	P1-3			
9	BROWN	P3-A	P1-4	12"	18 AWG	
10	BLUE	P3-C	P1-5			
11	GREEN	P3-G	P1-6			
12	WHITE	P3-L	P2-1			
13	BLACK	P3-B	P2-2			
14	ELUE	P3-H	N	3"	18 AWG	JUMPER



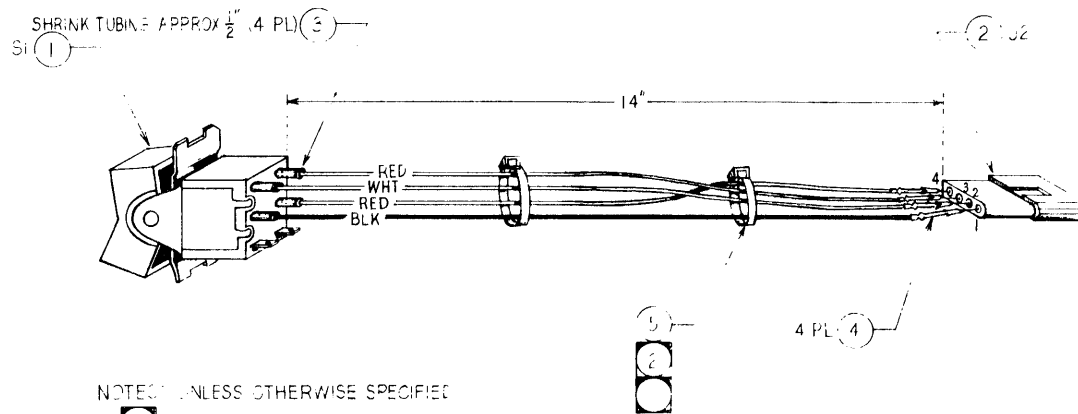
ASSEMBLY DWG, WIRING HARNESS/CORCOM

CORVUS SYSTEMS, INC.		
SCALE: UNCALCD	APPROVED BY: CK'D	DRAWN BY: J.R.O.
DATE: 4-9-81	JOAN S.	REVISION: A
WIRING HARNESS, 10/20 MB CORCOM		5-TERMINAL TRANSFORMER
ASSY. DRAWING		DRAWING NUMBER: 76010901

ASSEMBLY DWG, AC POWER SWITCH

CONNECTION CHART						
ITEM	COLOR	FROM	TO	LENGTH	WIRE SIZE	NOTE
	BLACK	S1	J2-1	14"	18 AWG	
	WHITE	S1	J2-2			
	RED	S1	J2-4			
	RED	S1	J2-3			

REVISION					
PCO NO	REV	DESCRIPTION	APPROVED	DATE	
180	C	REDRAWN	<i>[Signature]</i>	10/26/11	
	D	DOC. CHG	<i>[Signature]</i>	10/26/11	
	E	DWG NO. CHG			
	F	WIRE P/N CHG	<i>[Signature]</i>	10/26/11	
306		REMOVE SWITCH MOUNTING	<i>[Signature]</i>	10/26/11	



- NOTES: UNLESS OTHERWISE SPECIFIED
- 1 SPACE TIE WRAPS EVENLY ON CABLE
  - 2 SHOWN OPEN TIE WRAPS FOR CLARITY ONLY. WRAPS SHOULD BE PULLED TIGHTLY

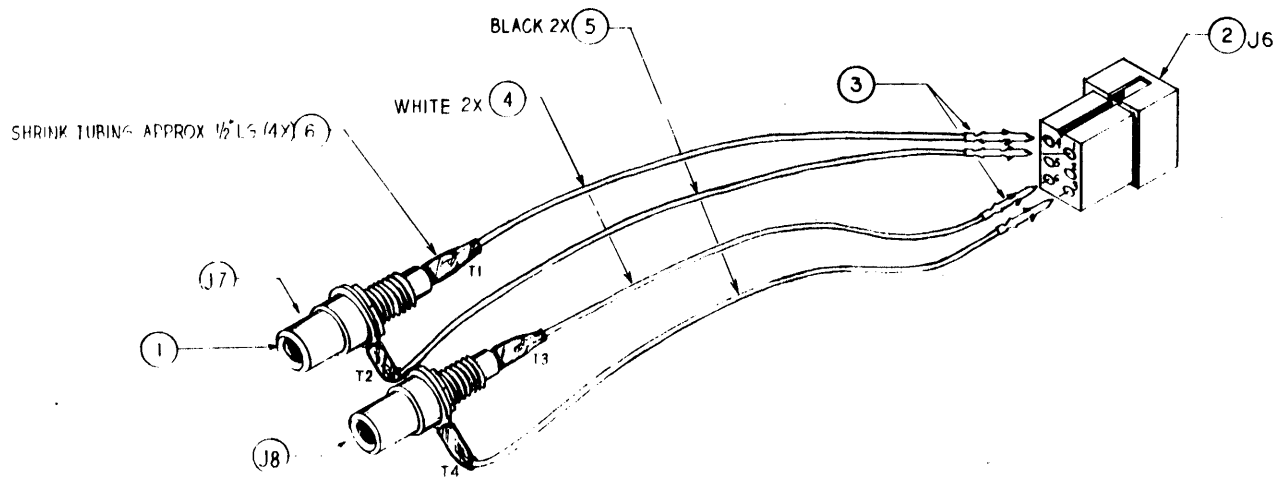
CORVUS SYSTEMS, INC.			
SCALE: NONE	APPROVED BY: <i>[Signature]</i>	DRAWN BY: <i>[Signature]</i>	
DATE: 10/26/11	<i>[Signature]</i>	REVISED:	
WIRING HARNESS FOR 10-AMB PWR SWITCH			
ASSY. DRAWING			DRAWING NUMBER: SOC

17-82 PRINTED ON 90-10000-10 CLEARPRINT PAPER

ASSEMBLY DWG, MIRROR PHONO HARNESS

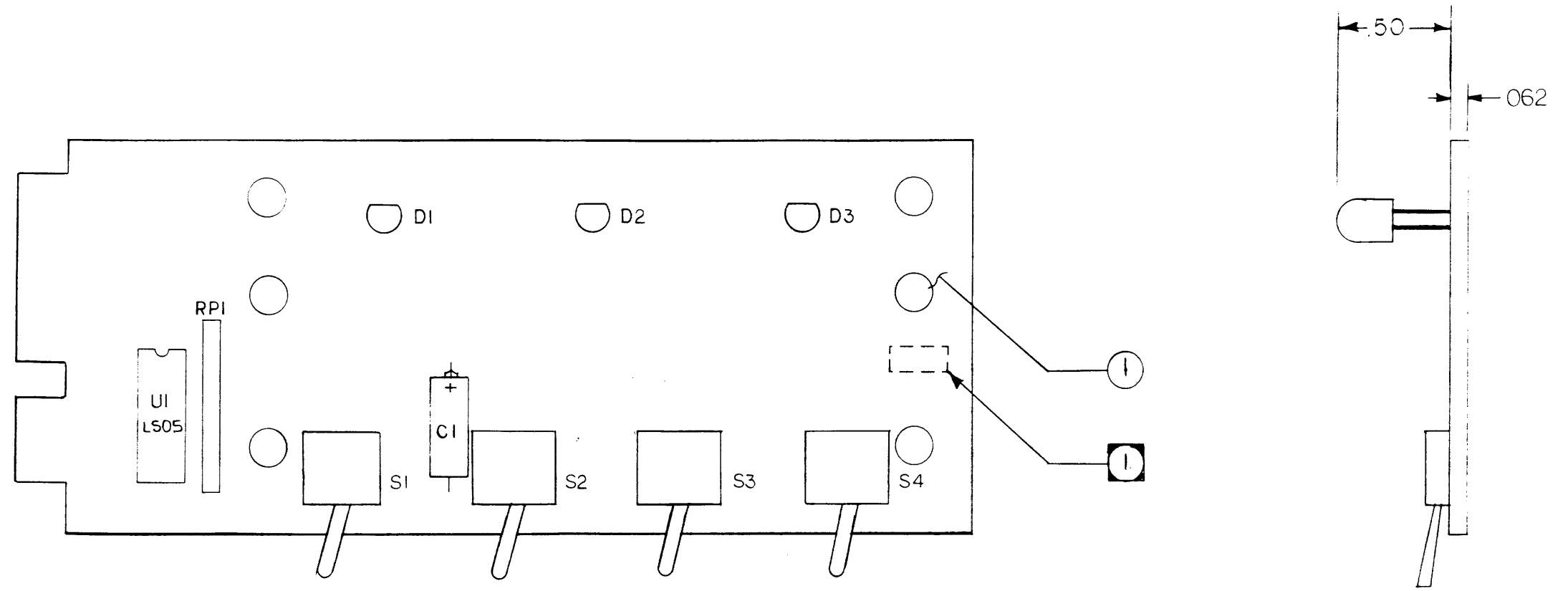
REVISIONS				
POD NO	REV.	DESCRIPTIONS	DATE	APPROVED
102	A	RELEASE FOR PRODUCTION	5-18-81	<i>J. Bandy</i>
	B	ADJ WIRE LENGTHS	6-4-81	<i>L. H. H. H.</i>
	C	ADD SHRINK TUBING		

CONNECTION CHART						
ITEM	COLOR	FROM	TO	LENGTH	WIRE SIZE	NOTE
1	WHITE	J7-T1	P6-4	7"	22 AWG	VIDEO IN
2	BLACK	J7-T2	P6-1	8"		
3	WHITE	J8-T3	P6-4	7"		
4	BLACK	J8-T4	P6-3	8"		



CORVUS SYSTEMS, INC.			
SCALE: UNSCALED	APPROVED BY: CK'D	DRAWN BY: JHO	
DATE: 4-13-81		REVISED: A	
HARNESS MIRROR PHONO			
Assy. DRAWING			DRAWING NUMBER: 76030201

REVISIONS				
PCB	REV	DESCRIPTION	APPROV	DATE
114	B	RELEASE TO PROD.		
110	C	ADD DIODE TO NOTE 2		
136	D	CAP. CHANGE		
		E PART NO. CH.		
310	F	DOC. CHG. ONLY		1-14-8-

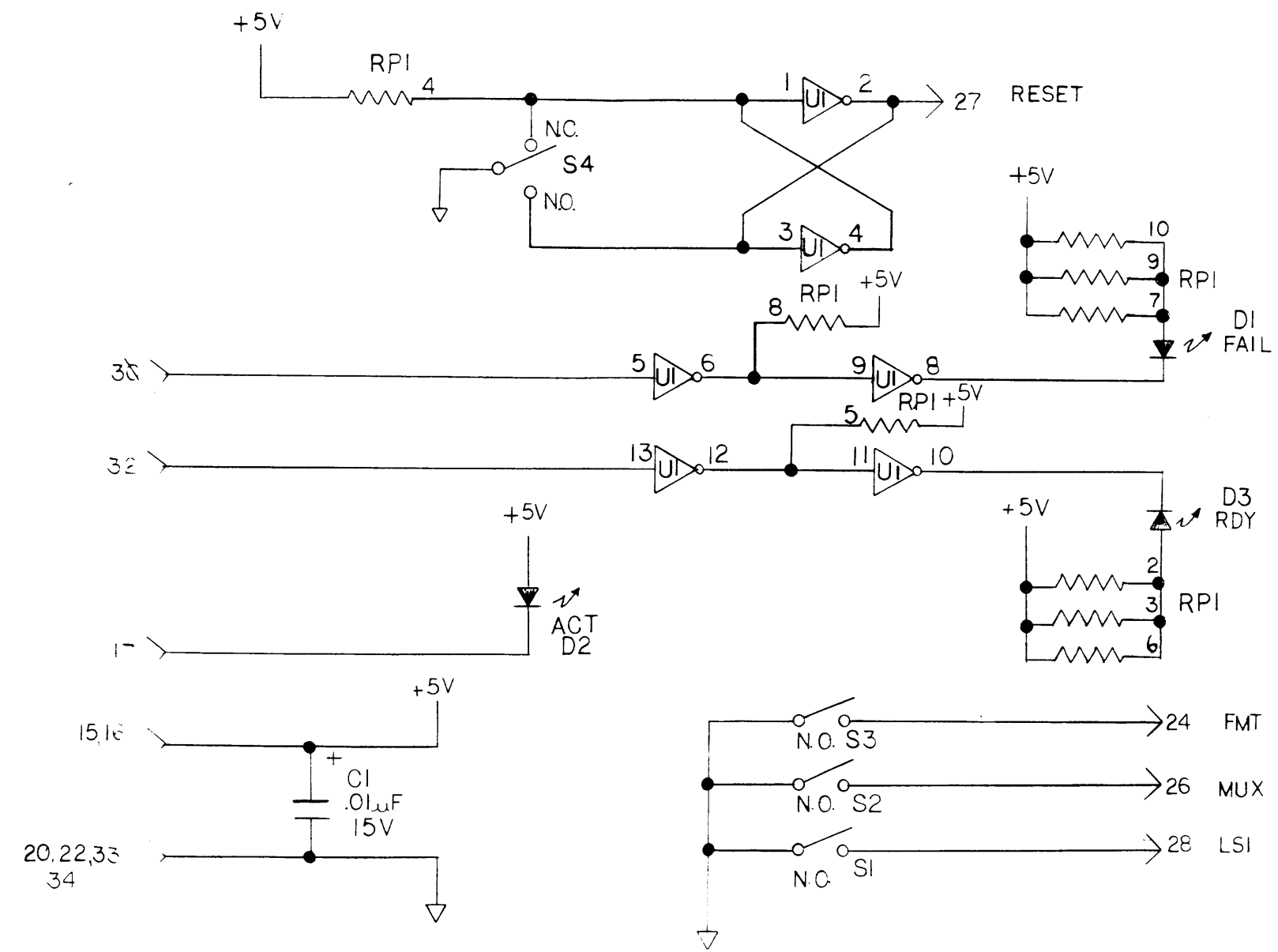


NOTES: UNLESS OTHERWISE SPECIFIED  
 ① PERMANENTLY MARK OR IDENTIFY REV. LEVEL APPROX WHERE S-CAN  
 2 SQUARE PAD INDICATES PIN 1 OF IC AND R-PAK POSITIVE END OF CAPACITOR, CATHODE OF DIODE.

SEE SEPERATE LIST OF MATERIALS

CORVUS SYSTEMS, INC.		
SCALE: 2/1	APPROVED BY: Nancy Allen 5/2/81	DRAWN BY: Jan G
DATE: 5-81		REVISED: E
PCA. PADDLEBOARD		
ASSY DWG		DRAWING NUMBER: 8001

REVISIONS				
PCO	REV	DESCRIPTION	APVC	DATE
114	B	RELEASE TO PROD.	PK	
110	C	CHANGE PER PCO	<i>[Signature]</i>	5-19-71
	D	DWG. NO. CHG.		10-21-71

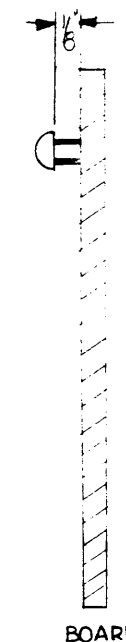
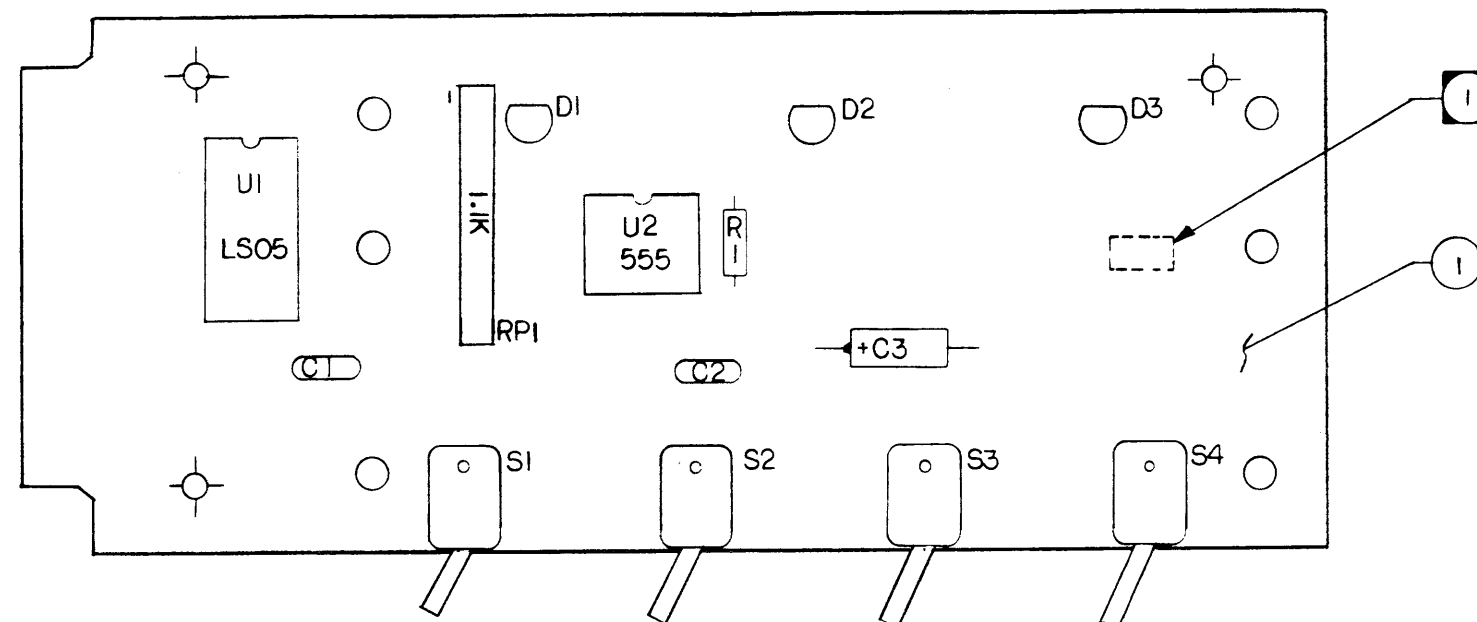


CORVUS SYSTEMS, INC.		
SCALE: NONE	APPROVED BY: CK'D	DRAWN BY: <i>[Signature]</i>
DATE: 5-81	<i>[Signature]</i>	REVISED: <i>[Signature]</i>
PADDLEBOARD		
SCHEMATIC DIAGRAM		DRAWING NUMBER: 1720-177-1

SCHEMATIC, PADDLEBOARD PCA



REVISIONS				
PCO	REV	DESCRIPTION	DATE	APPROVED
211	A	PROD REL	10-14-81	<i>[Signature]</i>
	B	DWG. NO. CHG.	11/2/81	
310	C	DOC. CHG. ONLY	1/14/82	



2. SQUARE PAD INDICATES PIN 1 OF IC AND R-PAK, ALSO CATHODE END OF LED.

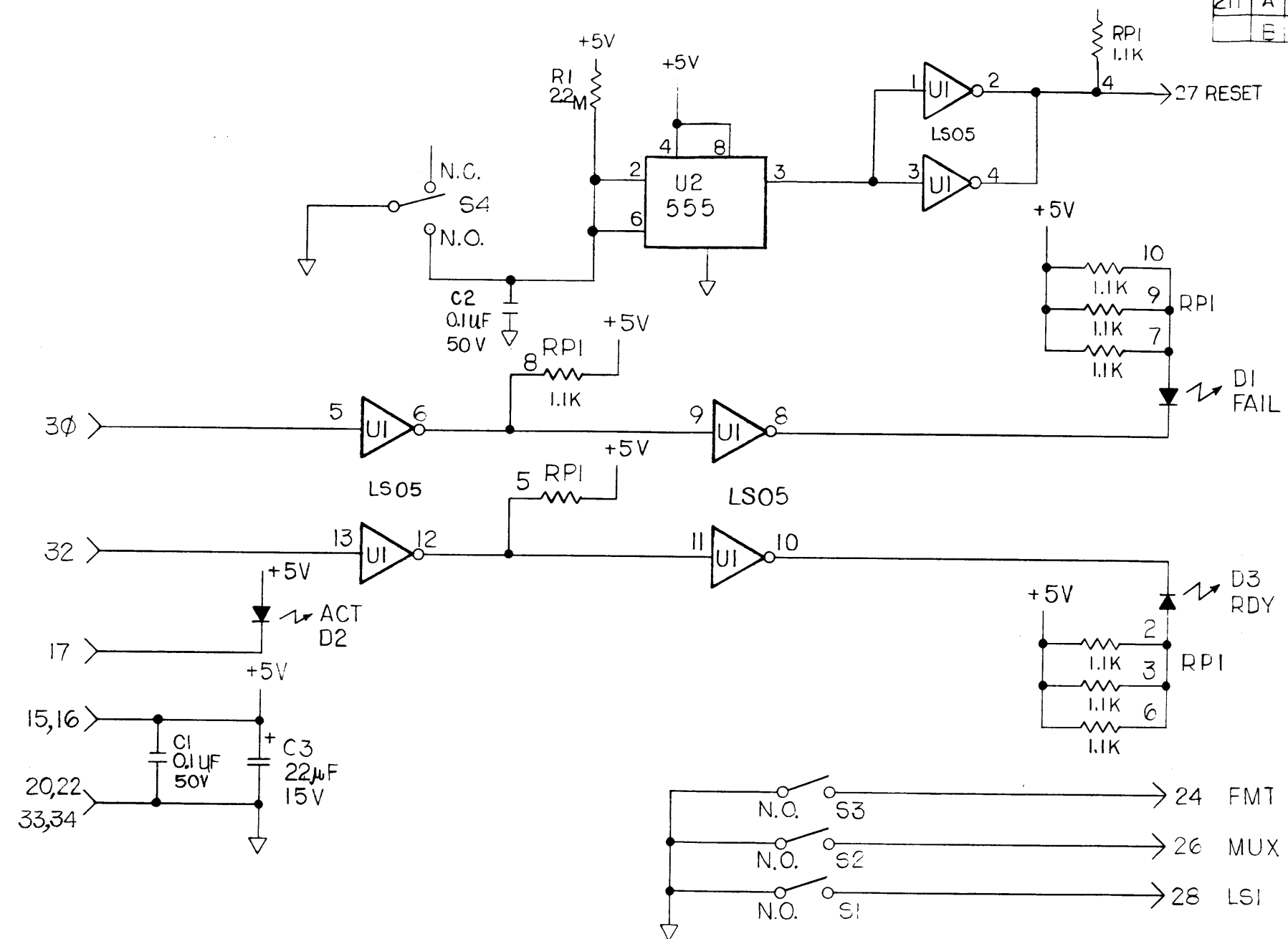
1 PERMANENTLY MARK OR IDENTIFY REV LEVEL APROX. WHERE SHOWN.

NOTES UNLESS OTHERWISE SPECIFIED.

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON		This document contains proprietary information and is delivered upon the expressed condition that it will not be used directly or indirectly in any way detrimental to the interest of CORVUS SYSTEMS		<b>★ ★ CORVUS SYSTEMS</b> ★ ★ 2029 O'Toole Avenue, San Jose, CA 95131	
		ANGLES	DECIMALS	DRAWN BY	DATE OF DRAWING	PADDLEBOARD II	
		±	.XX ± .XXX ±	<i>Roan S</i>	9/23/81		
		MATERIAL		CHECKED BY	ENGINEER	ASSY DRAWING	
				<i>[Signature]</i>			
		FINISH		APPROVED		8029	
NEXT ASSY	USED ON	APPLICATION		APPROVED		SCALE	SHEET OF

ASSEMBLY DWG, PADDLEBOARD II

REVISIONS				
PCO	REV	DESCRIPTION	DATE	APPROVED
211	A	PROD REL	10-14-81	<i>[Signature]</i>
	E	DWG. NO. CHG.	11/2/81	



		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON		This document contains proprietary information and is delivered upon the expressed condition that it will not be used directly or indirectly in any way detrimental to the interest of CORVUS SYSTEMS		<b>CORVUS SYSTEMS</b> 2029 O'Toole Avenue, San Jose, CA 95131	
		ANGLES	DECIMALS	DRAWN BY	DATE OF DRAWING	PADDLEBOARD II	
		±	.XX ± .XXX ±	HUY	9-2-81		
		MATERIAL		CHECKED BY	ENGINEER	SCHEMATIC DIAGRAM	
		FINISH		<i>[Signature]</i>		1720-1807	
NEXT ASSY	USED ON	APPLICATION		APPROVED	APPROVED	SCALE	SHEET   OF

SCHEMATIC DWG, PADDLEBOARD II

# Microcomputer Power, Inc.

2272 Calle de Luna, Santa Clara, CA 95050

(408) 988-0265 TWX 910 338-7694



## APPLICATION DATA INCLUDING:

1. SCHEMATIC
2. PARTS LIST
3. SPECIFICATION
4. OUTLINE & MOUNTING DRAWING

## MODEL

CP140

FIXED-DISK  
SERIES

### SPECIFICATIONS:

AC INPUT: 115/230VAC  $\pm 10\%$   
47-63Hz

DC OUTPUT:

VOLTAGE	CURRENT (AMPS)
5	8.0
24	2.5(4.0)Pk
12	1.2
-12	0.5
-5	3.0

LINE REGULATION:  $\pm 0.05\%$  FOR A 10%  
LINE CHANGE

LOAD REGULATION:  $\pm 0.05\%$  FOR A 50%  
LOAD CHANGE

OUTPUT RIPPLE: 3mV Pk-Pk MAX

TRANSIENT RESPONSE: 30 $\mu$ SECONDS  
FOR A 50% LOAD CHANGE

OVERLOAD AND SHORT CIRCUIT PROTECTION:  
AUTOMATIC CURRENT LIMIT/  
FOLDBACK

OVER-VOLTAGE PROTECTION: SET AT 6.2  
 $\pm 4$ VDC ON  $\pm 5$ V OUTPUT ONLY

STABILITY:  $\pm 0.3\%$  FOR 24HRS AFTER WARM-UP  
INPUT FUSING: RECOMMENDED, FUSE AT

6A FOR 115VAC, 3A FOR 230VAC

TEMPERATURE COEFFICIENT:  $\pm 0.03\%/^{\circ}$ C MAX

COOLING: UNITS ARE FULL RATED TO 50 $^{\circ}$ C  
IN FREE AIR, MUST BE FAN  
COOLED WHEN MOUNTED IN CON-  
FINED AREA

TEMPERATURE RATING:

0-50 $^{\circ}$ C - 100%

60 $^{\circ}$ C - 60%

70 $^{\circ}$ C - 40%

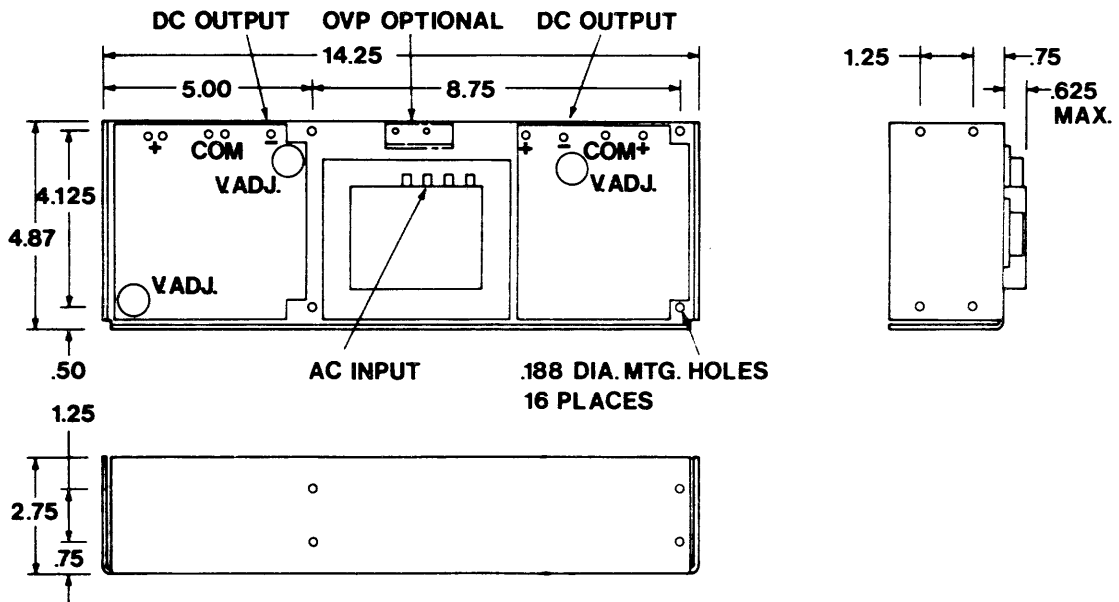
EFFICIENCY: COMBINED EFFICIENCY

APPROX. 55% @ 115VAC FULL

LOAD ON ALL OUTPUTS

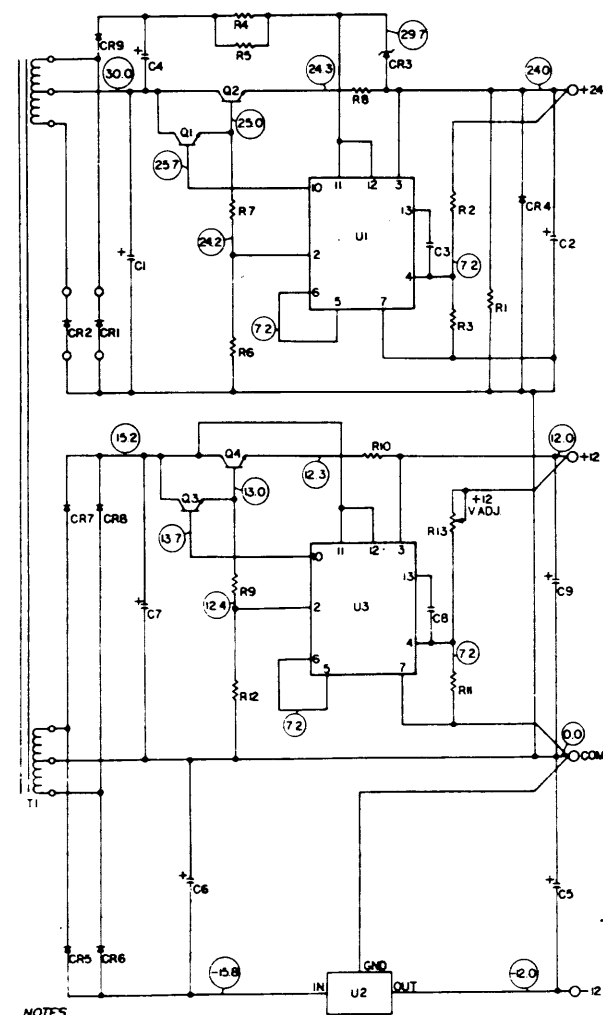
CONSTRUCTION: ALL ALUMINUM CHASSIS

WEIGHT: 11LBS (5.0KG)



ASSEMBLY DWG, CP140 POWER SUPPLY

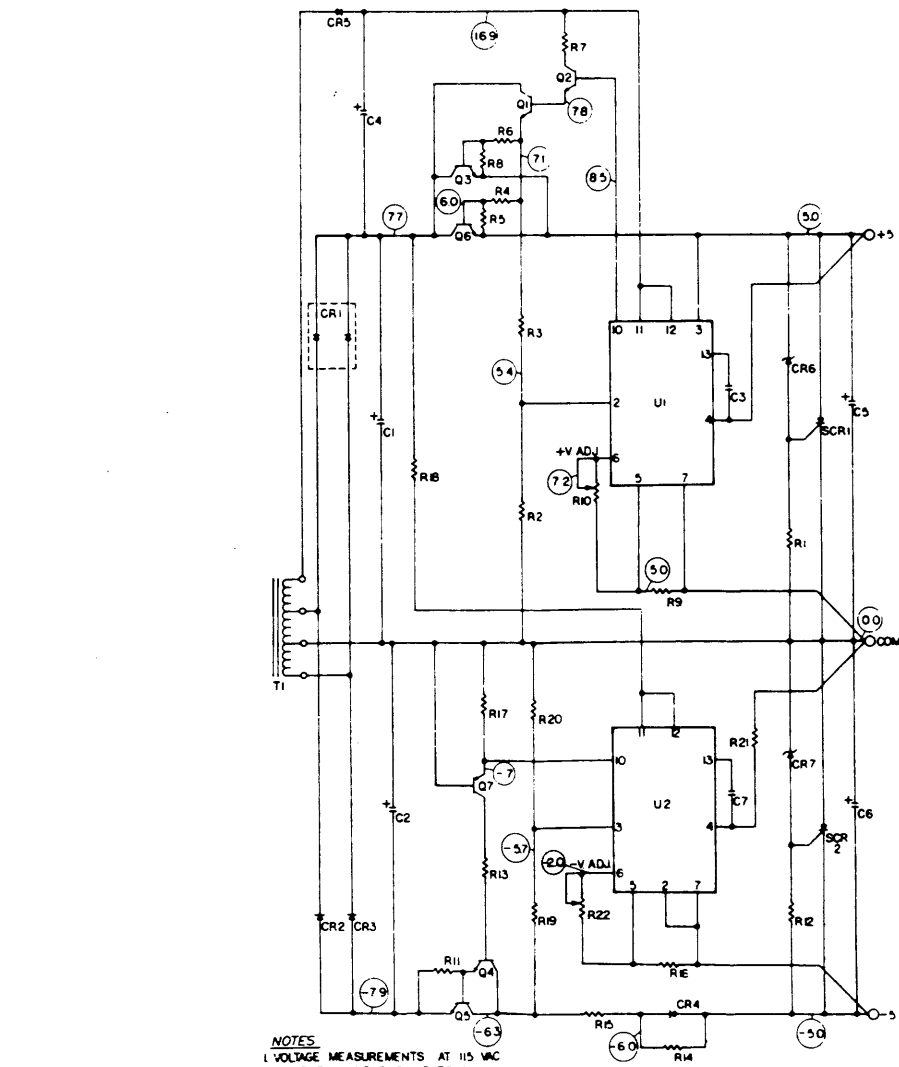
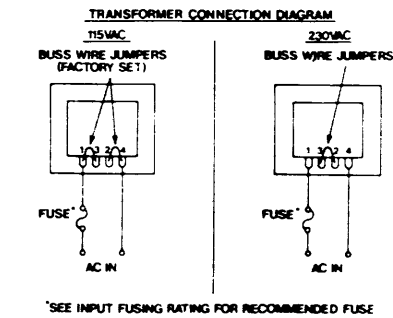
REF. DES.	CP139	CP140	DESCRIPTION
C1	4700/50V	4700/50V	CAPACITOR, ELECTROLYTIC
C2	330/35V	330/35V	
C4	47/50V	47/50V	
C5,9	100/25V	100/25V	
C6	470/35V	470/35V	
C7	2200/35V	2200/35V	
C3,8	.001/100V	.001/100V	CAPACITOR, FILM
CR1,2	MR751	MR751	RECTIFIER, 6A 100V
CR4-6,9	AE1C	AE1C	RECTIFIER, 1A 200V
CR7,8	AE3B	AE3B	RECTIFIER, 3A 100V
CR3	1N752A	1N752A	ZENER DIODE, 300MW
R1,11	1.1K	1.1K	RESISTOR, 1/2W CF 5%
R2	1.8K	1.8K	
R3	750	750	
R4-6	10K	10K	
R7,9	330	330	
R12	4.7K	4.7K	
R8	.12	.12	
R10	.22	.22	
R13	1500	1500	
R15	.22	.22	
R17,19	330	330	POTENTIOMETER, 2W WW
Q1	TIP31A	TIP31A	TRANSISTOR, POWER NPN
Q2,4	2N3055	2N3055	TRANSISTOR, POWER NPN
Q3	2N2219A	2N2219A	TRANSISTOR, SIGNAL NPN
U1,3	UA723C	UA723C	I.C. VOLTAGE REGULATOR
U2	LM320T-12	LM320T-12	I.C. VOLTAGE REGULATOR
T1	10357	10358	TRANSFORMER
P.C.B.	10354	10354	PRINTED CIRCUIT BOARD
CHASSIS	10088	10089	ALUMINUM, ANODIZED



NOTES  
1 VOLTAGE MEASUREMENTS AT 115 VAC  
INPUT FULL LOAD ON OUTPUT  
2 ALL VOLTAGES REFERENCED TO COM OUTPUT

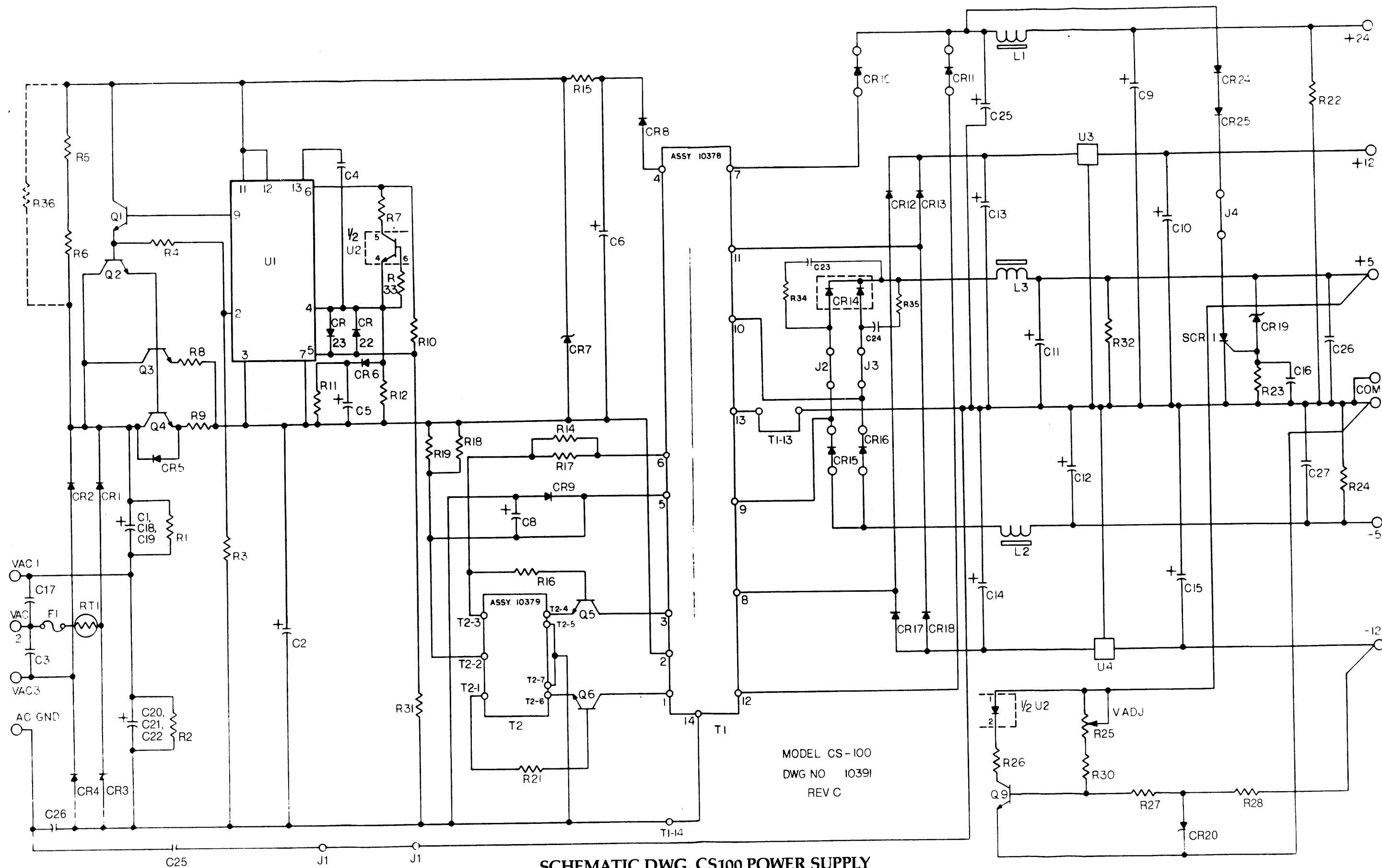
SCHMATIC DWG, CP140 POWER SUPPLY (1 OF 2)

REF. DES.	CP140	CP141	DESCRIPTION
C2	8800/15V	8800/15V	CAPACITOR, ELECTROLYTIC
C4,6	220/16V	220/15V	
C5	1000/16V	1000/16V	
C3,7	.005/100V	.005/100V	CAPACITOR, FILM
CR2,3,4	AE3B	AE3B	RECTIFIER, 3A 100V
CR5	AE1C	AE1C	RECTIFIER, 1A 200V
CR6	1N752A	1N752A	ZENER DIODE, 300MW
CR7	1N753A	1N753A	ZENER DIODE, 300MW
R1,7,12	47	47	RESISTOR, 1/2W CF 5%
R2,20	2.2K	2.2K	
R3	750	750	
R4,6	3.9	3.9	
R5,8,18	6.8	6.8	
R9,11,16	1.5K	1.5K	
R13	150	150	
R14	2.7	2.7	
R17,19	330	330	
R21	1.1K	1.1K	
R10,22	1500	1500	POTENTIOMETER, 2W WW
SCR1	S0308LS3	S0308LS3	SCR, 8A 30V
SCR2	S0303LS3	S0303LS3	SCR, 3A 50V
Q1,4	TIP31A	TIP31A	TRANSISTOR, POWER NPN
Q2	2N2219A	2N2219A	TRANSISTOR, SIGNAL NPN
Q7	2N2905	2N2905	TRANSISTOR, SIGNAL NPN
U1,2	UA723C	UA723C	I.C. VOLTAGE REGULATOR
T1	10358	10359	TRANSFORMER
P.C.B.	10354	10352	PRINTED CIRCUIT BOARD
CHASSIS	10089	10090	ALUMINUM, ANODIZED
Q3,5,6	2N3055	2N3055	TRANSISTOR, POWER NPN
CR1	R711	R711	RECTIFIER, 30A 100V



NOTES  
1 VOLTAGE MEASUREMENTS AT 115 VAC  
INPUT FULL LOAD ON OUTPUT  
2 ALL VOLTAGES REFERENCED TO COM OUTPUT

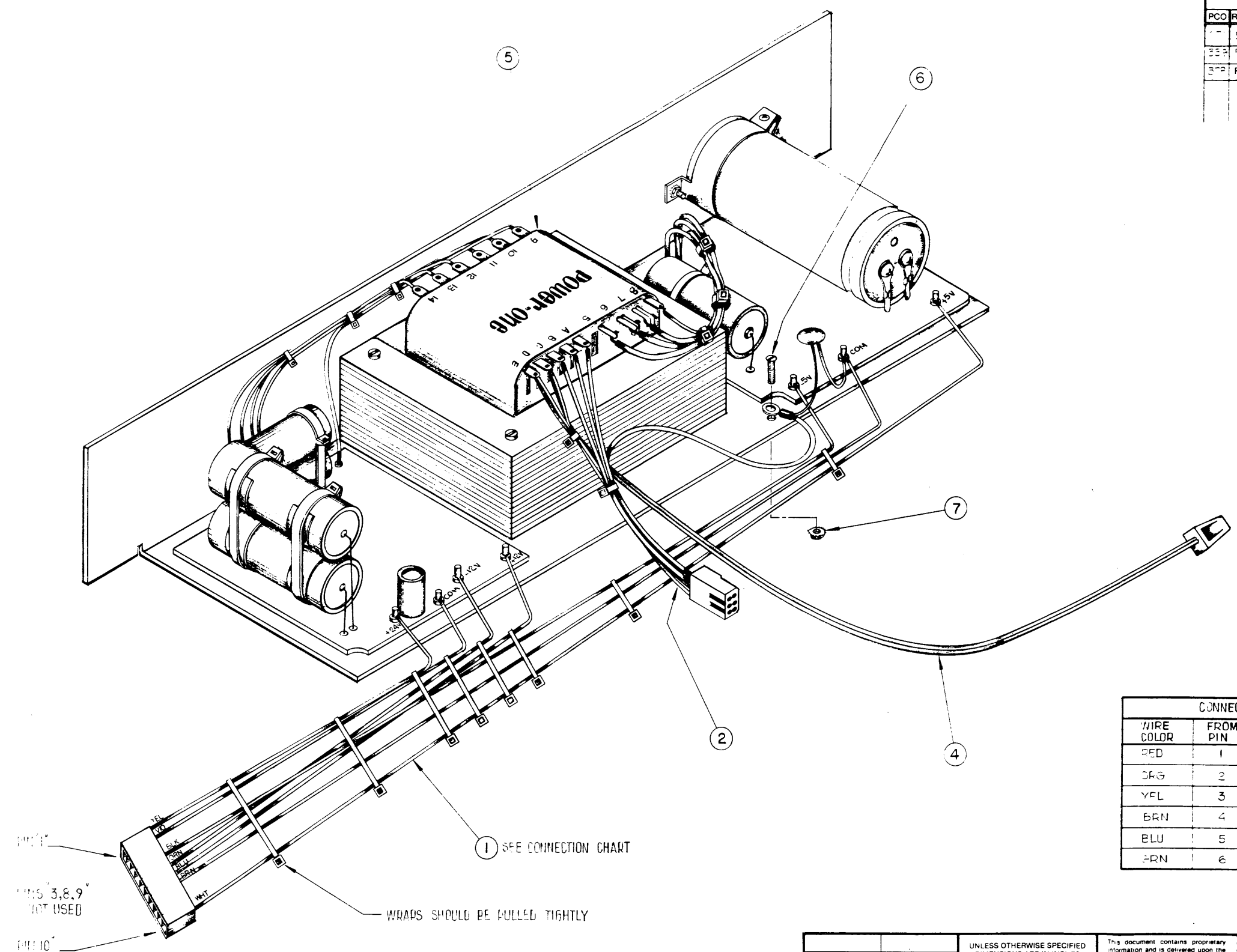
SCHMATIC DWG, CP140 POWER SUPPLY (2 OF 2)



MODEL CS-100  
 DWG NO 10391  
 REV C

SCHMATIC DWG, CS100 POWER SUPPLY

REVISIONS				
PCO	REV	DESCRIPTION	DATE	APPROVED
	1	DEL FOR PRINT	1/82	[Signature]
	2	ENG CHANGE	2/82	[Signature]
	3	REDRAW, DELETE # 6,9,10	4-30-82	[Signature]



WIRE COLOR	FROM PIN	TO X FORMER	NOTES
RED	1	E	FAN CORD
ORG	2	D	FAN CORD
YEL	3	C	
BRN	4	B	
BLU	5	A	
BRN	6	-	P3 CHASSIS

1 SEE CONNECTION CHART

WRAPS SHOULD BE PULLED TIGHTLY

DIM 3.8, 9  
NOT USED

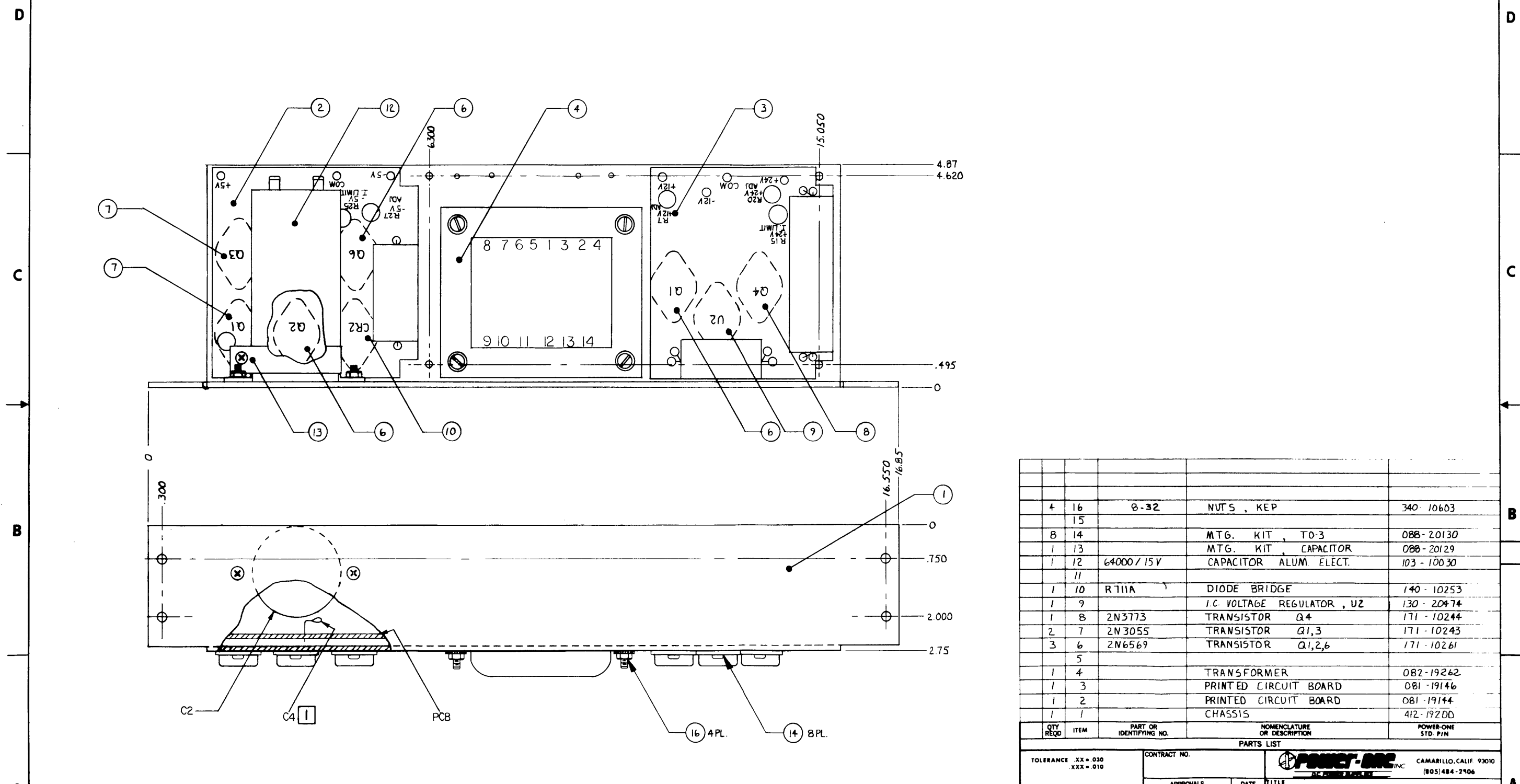
DIM 10

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON		This document contains proprietary information and is delivered upon the expressed condition that it will not be used directly or indirectly in any way detrimental to the interest of CORVUS SYSTEMS.		<b>CORVUS SYSTEMS</b> 2029 O'Toole Avenue, San Jose, CA 95131	
ANGLES	DECIMALS	DRAWN BY	DATE OF DRAWING	<b>WIRING . POWER SUPPLY CP411</b>	
±	.XX ± .XXX ±	H. F. III	4/82		
MATERIAL		CHECKED BY	ENGINEER	ASSEMBLY DRAWING 8010-08054	
FINISH		APPROVED	APPROVED		
NEXT ASSY	USED ON	APPLICATION		SCALE	SHEET 1 OF 1

ASSEMBLY DWG, CP411 POWER SUPPLY WIRING

This drawing and specifications, herein, are the property of POWER-ONE INC. and shall not be reproduced or copied or used in whole or in part as the basis for the manufacture or sale of items without written permission.

REVISIONS				
ECO	LTR	DESCRIPTION	DATE	APPROVED
	A	RELEASED FOR PRODUCTION	1-27-81	K.C.
4907	B	INC ECO	4-20-81	
5135	C	INC ECO	6-15-81	
6151	D	INC ECO	6-4-82	



QTY REQD	ITEM	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	POWER-ONE STD. P/N
4	16	8-32	NUTS, KEP	340-10603
	15			
8	14		MTG. KIT, T0-3	088-20130
1	13		MTG. KIT, CAPACITOR	088-20129
1	12	64000/15V	CAPACITOR ALUM. ELECT.	103-10030
	11			
1	10	R711A	DIODE BRIDGE	140-10253
1	9		I.C. VOLTAGE REGULATOR, U2	130-20474
1	8	2N3773	TRANSISTOR Q4	171-10244
2	7	2N3055	TRANSISTOR Q1,3	171-10243
3	6	2N6569	TRANSISTOR Q1,2,6	171-10261
	5			
1	4		TRANSFORMER	082-19262
1	3		PRINTED CIRCUIT BOARD	081-19146
1	2		PRINTED CIRCUIT BOARD	081-19144
1	1		CHASSIS	412-19200

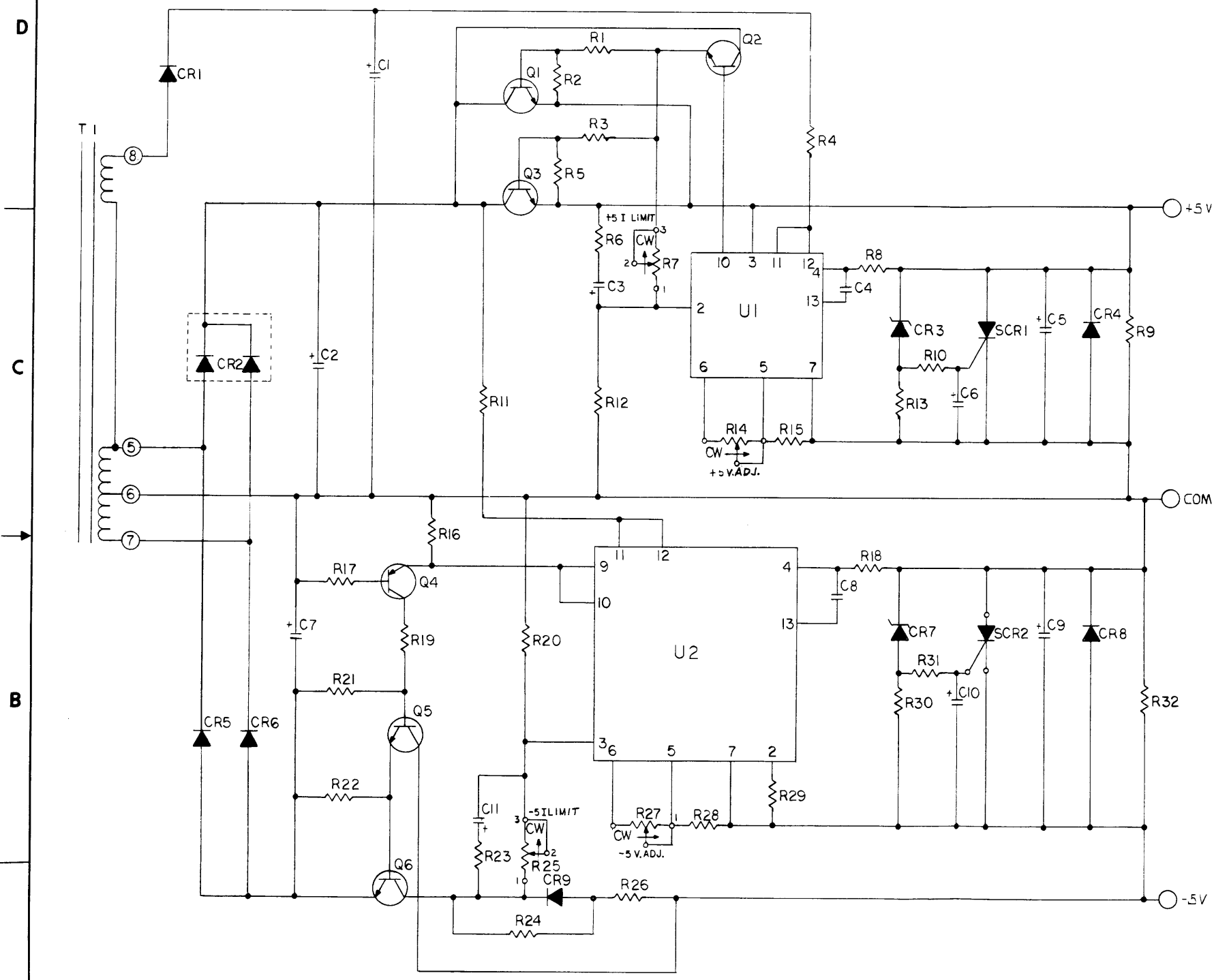
PARTS LIST		CONTRACT NO.		POWER-ONE INC. CAMARILLO, CALIF. 93010 (805) 484-2106	
TOLERANCE .XX ± .030 XXX ± .010	APPROVALS	DATE	TITLE	ASSEMBLY	
MATERIAL	DRAWN I.A.N.	12-15-80			
	CHECKED R.W.	12-18-80			
	ENG. APP. K. [Signature]	1-27-81			
	APPROVED				
FINISH	SIZE	CODE IDENT NO.	DRAWING NO.		
	D	54407	19138		
APPLICATION	SCALE	SHEET 1 OF			
	1/1				

1 SHOULD READ: BEND C4 TOWARD Q6 AT LEAST 70° BEFORE INSTALLING C2.  
NOTES: UNLESS OTHERWISE SPECIFIED

ASSEMBLY DWG, CP411 POWER SUPPLY

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REVISIONS				
ECO	LTR	DESCRIPTION	DATE	APPROVED
	A	RELEASED FOR PRODUCTION	-27-81	
5252	B	INC ECO	6/24/81	
5298	C	INC ECO	7-9-81	
6380	D	REV FOR PRODUCTION A.L.T.	8-22-81	



REF. DES.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	POWER-ONE STD. P/N
C1	1000/25	CAPACITOR ALUM ELECT	101 - 10240
C3,11	10/25V		1014
C5,9	220/16		10157
C6,10	1/50V		101 - 10111
C7	9000/15V		102 - 10097
C4	.0033/100V	MYLAR	104 - 10092
C8	.01/100V	MYLAR	104 - 10092
C2	64000/15V	CAPACITOR ALUM ELECT	103 - 10237
CR1,4,8	1N4003	DIODE 1A 200V	111 - 10231
CR5,6	1N5401	ZENER 3A 100V	111 - 10232
CR3,7	1N752 A	ZENER 400mA 5.6V	112 - 10006
CR2	711	DIODE 30A 100V	140 - 10253
CR9	MR750	DIODE 6A 50V	111 - 10256
Q1,3	2N3055	TRANSISTOR NPN POWER	171 - 10243
Q2,6	2N6569	POWER TRANS	171 - 10261
Q4	2N2907	PNP 5/6	172 - 10248
Q5	2N2219	TRANSISTOR NPN 5/6	172 - 10247
SCR1	50315L83	SCR 15A 30V	160 - 10259
SCR2	50303L83	SCR 3A 30V	160 - 10258
U1,2	uA723	I.C. VOLTAGE REGULATOR	130 - 10267
R2,5	22Ω	RESISTOR 1/2W 5% C.F.	151 - 10323
R4	470Ω	RESISTOR 1/2W 5% C.F.	151 - 10357
R1,3	3.9Ω	RESISTOR 1/2W	151 - 10307
R10,31	6.8Ω		10313
R11	270Ω		10351
R6,23	240Ω		10350
R8,18,22	1K		10365
R9,32	150Ω		10345
R12	7.5K		10386
R17,19,20,21	2.2K		10373
R13,29,30	47Ω		10333
R16	4.7K		10381
R24	.5Ω	RESISTOR 1/2W 5% C.F.	151 - 10299
R15,28	2.2K	RESISTOR 1/2W 2% MF	152 - 10513
R26	.12Ω	RESISTOR 2W WW BHW	158 - 10077
R7,14,25,27	2K, ±10%	POTENTIOMETER 02W CF	154 - 20020
PCB (A1)		PRINTED CIRCUIT BOARD	505 - 19144

1. THIS BOARD IS TESTED ON FAULTFINDER DO NOT CHANGE PCB. WITHOUT CONSULTING TEST ENGINEERING.  
 NOTES: UNLESS OTHERWISE SPECIFIED

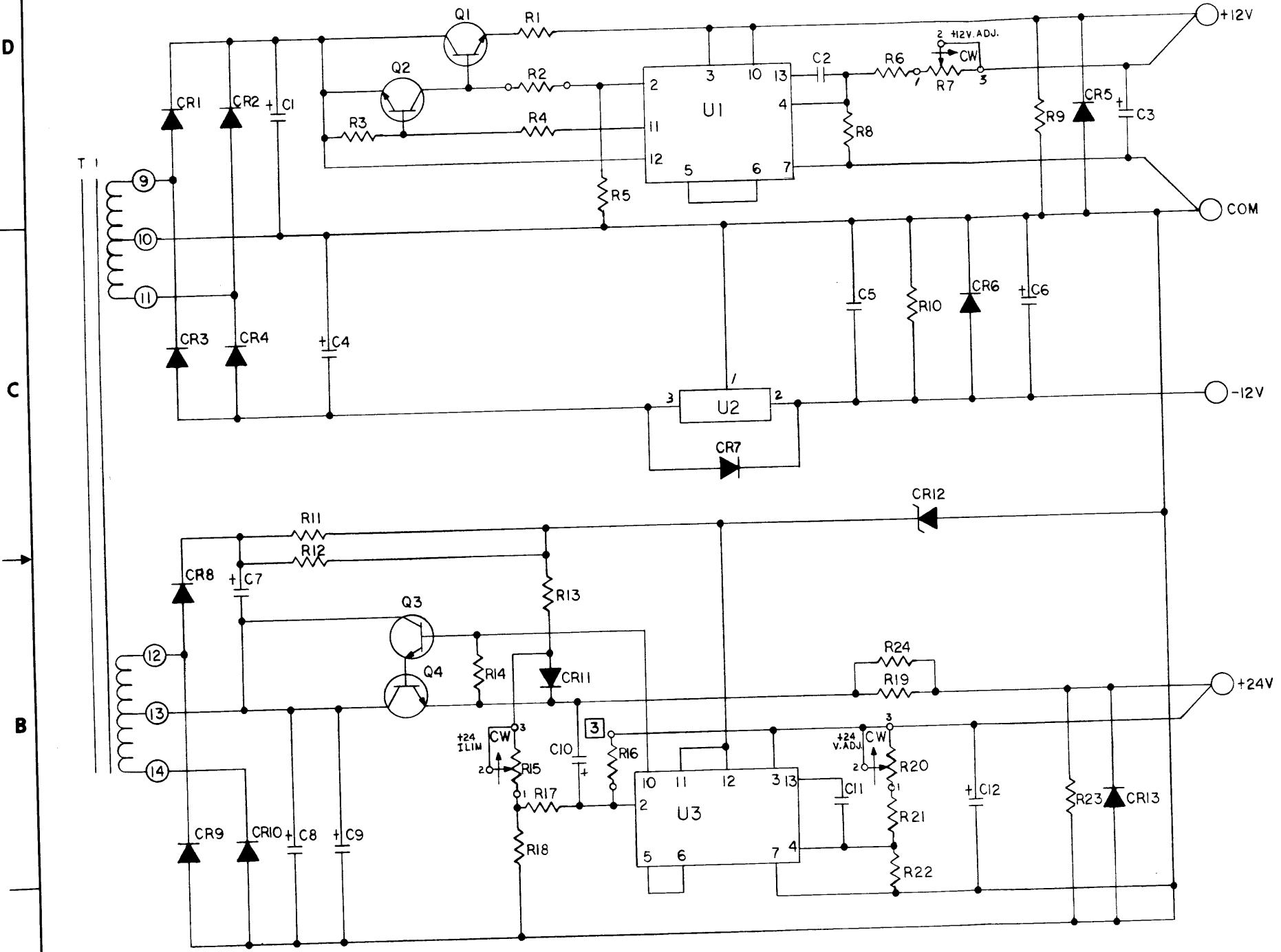
QTY	STD. P/N	DESCRIPTION	USED ON	LAST REFERENCE DESIGNATION USED	CP411
1	311-10441	TYWRAP 5/8"		C7	
1	319-20041	TRANSISTOR PAD		Q4	
2	321-10679	I.C. SOCKET		U1 & U2	
1	350-10433	.652 X 1"		SCR1	
1	402-15720	HEATSINK		SCR1	
				NOT USED	

TOLERANCE .XX = .030 XXX = .010	CONTRACT NO.	 CAMARILLO, CALIF. 93010 (805) 484-2806
APPROVALS	DATE	
DRAWN: Jeff Myster	11-11-80	
CHECKED: K.C.	11-11-80	
ENG APP: [Signature]	12-19-80	
APPROVED		
MATERIAL		TITLE: SCHEMATIC (2 OUTPUT)
FINISH		SIZE: D 54407
DO NOT SCALE DRAWING		CODE IDENT NO.: 19148
APPLICATION		DRAWING NO.: 19148
		SHEET / OF /

SCHEMATIC DWG, CP411 POWER SUPPLY (1 OF 2)



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4. THIS BOARD IS TESTED ON FAULTFINDER DO NOT CHANGE P.C.B. WITHOUT CONSULTING TEST ENGINEERING.
3. R16 MAY NEED TO BE TRIMMED TO MEET SHORT CIRCUIT SPEC'S.
2. RTV C1 & C4 TOGETHER AND HOT STUFF TYPWRAPS.
1. SLEEVE PLUS SIDE OF C1.
- NOTES: UNLESS OTHERWISE SPECIFIED

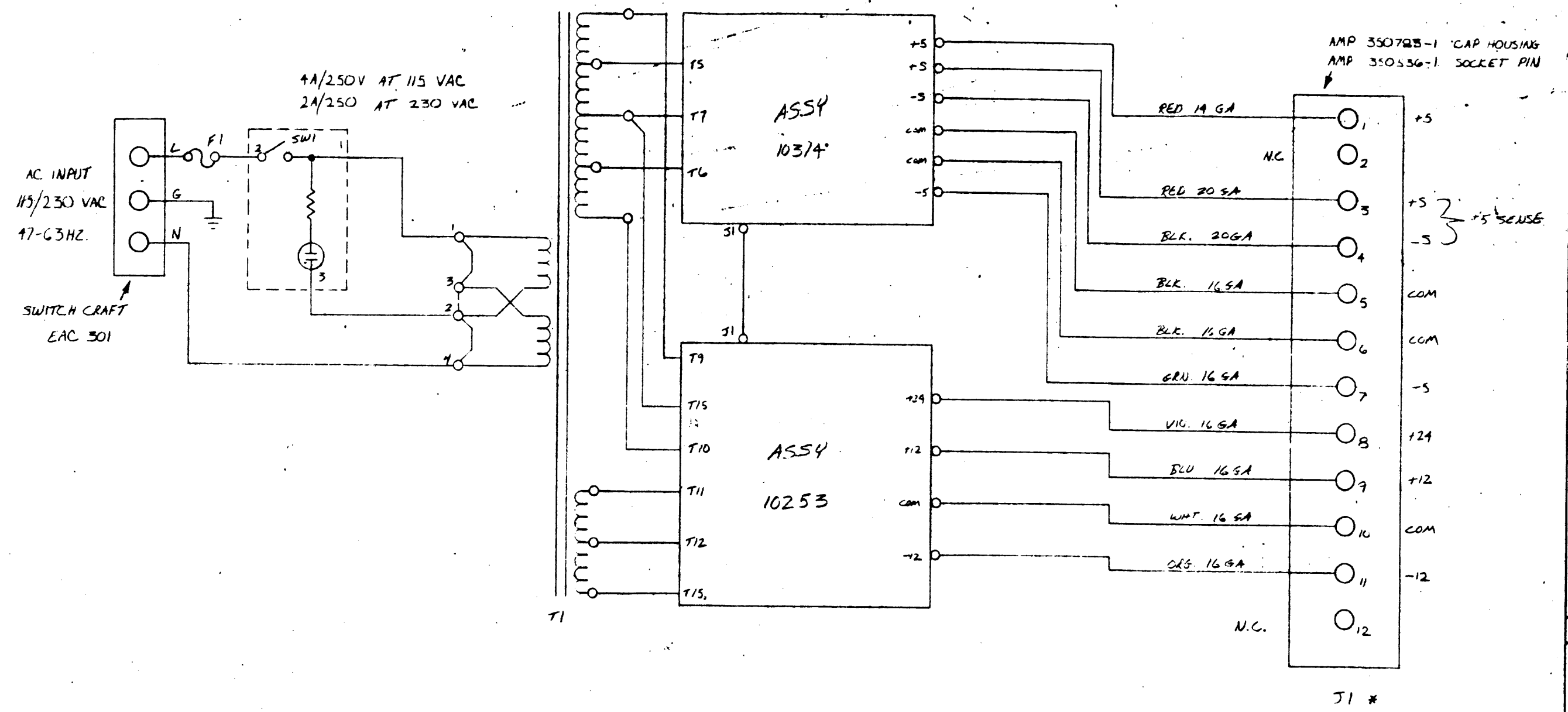
REVISIONS				
ECO	LTR	DESCRIPTION	DATE	APPROVED
6520	F	ADDED PRODUCTION ASSEMBLY	6-3-81	KC
5173	B	INC ECO	6/24/81	KC
5252	C	INC ECO	7/9/81	KC
5295	D	INC ECO	7-27-81	KC
5395	E	INC ECO		

REF	QTY	DESCRIPTION	UNIT	MANUFACTURER	DATE
C3,6	100	35V	CAPACITOR	MF ELECT	101 - 10110
C7	47	50V		MF	101 - 10112
C12	1000	35V		MF	101 - 20812
C10	1	50V		MF	101 - 10111
C1,4	2200	35V		MF	102 - 10100
C8,9	3700	60V		MF	102 - 10102
C2,5	.01	100V		PF	104 - 10095
C11	500PF	100V	CAPACITOR	PF ELECT	105 - 10089
CR1,2	1N5401	DIODE	100V 3A		111 - 10252
CR3,4,5,6,7	1N4003	DIODE	200V 1A		111 - 10251
CR9,10	MR756	DIODE	600V 6A		111 - 20014
CR12	1N973	DIODE	33V ZENER		112 - 10286
Q2	2N2907	TRANSISTOR	40V PNP		172 - 10248
Q1	2N6569	TRANSISTOR	40V NPN		171 - 10261
Q3	2N6551	TRANSISTOR	60V NPN		172 - 10249
Q4	2N3773	TRANSISTOR	70V NPN		171 - 10244
U1,3	4A723	IC VOLTAGE REGULATOR			130 - 10287
U2	4A7912	IC VOLTAGE REGULATOR			130 - 20474
T1		TRANSFORMER			
R2	360	RESISTOR	1/2W 5% CF		151 - 10354
R3	1.6K				10350
R4	330				10353
R5	4.7K				10381
R9,10	1K				10365
R11,12	7.5K				10386
R14,23	2.2K				10373
R16	5.1K				10382
R17	6.8				10313
R18	36K	RESISTOR	1/2W 5% CF		151 - 10402
R13	750	RESISTOR	1/2W 5% C.F		151 - 10362
R6	2.7K	RESISTOR	1/2W 2% MF		152 - 10515
R8,21	4.7K	RESISTOR	1/2W 2% MF		152 - 10521
R22	2.4K	RESISTOR	1/2W 2% MF		152 - 10514
R1	.56	RESISTOR	2W WW BWH		158 - 10082
R19,24	.22	RESISTOR	2W WW BWH		158 - 10079
R7,15,20	2K, ±10%	POTENTIOMETER	0.2W C.F.		154 - 20020
PCB		PRINTED CIRCUIT BOARD			505 - 19146
REF DES.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION		POWER-ONE STD. P/N	

QTY	STD. P/N	DESCRIPTION	USED ON	LAST REFERENCE DESIGNATION USED
1	56-10204	SCREW 1/2-32x5/16	Q3	CP411
1	519-20001	TRANSISTOR PAD	Q2	CP411
2	321-10679	IC SOCKET	U1, U3	
A/R	360-10673	SLEEVING 2.3" LG.	+C1	
2	3M-13570	CAPCRADLE, DUAL	C8, 9	
4	316-10682	TY-WRAP 11/2"	C1, 4, 6, 7	
				NOT USED

SCHEMATIC DWG, CP411 POWER SUPPLY (2 OF 2)

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE

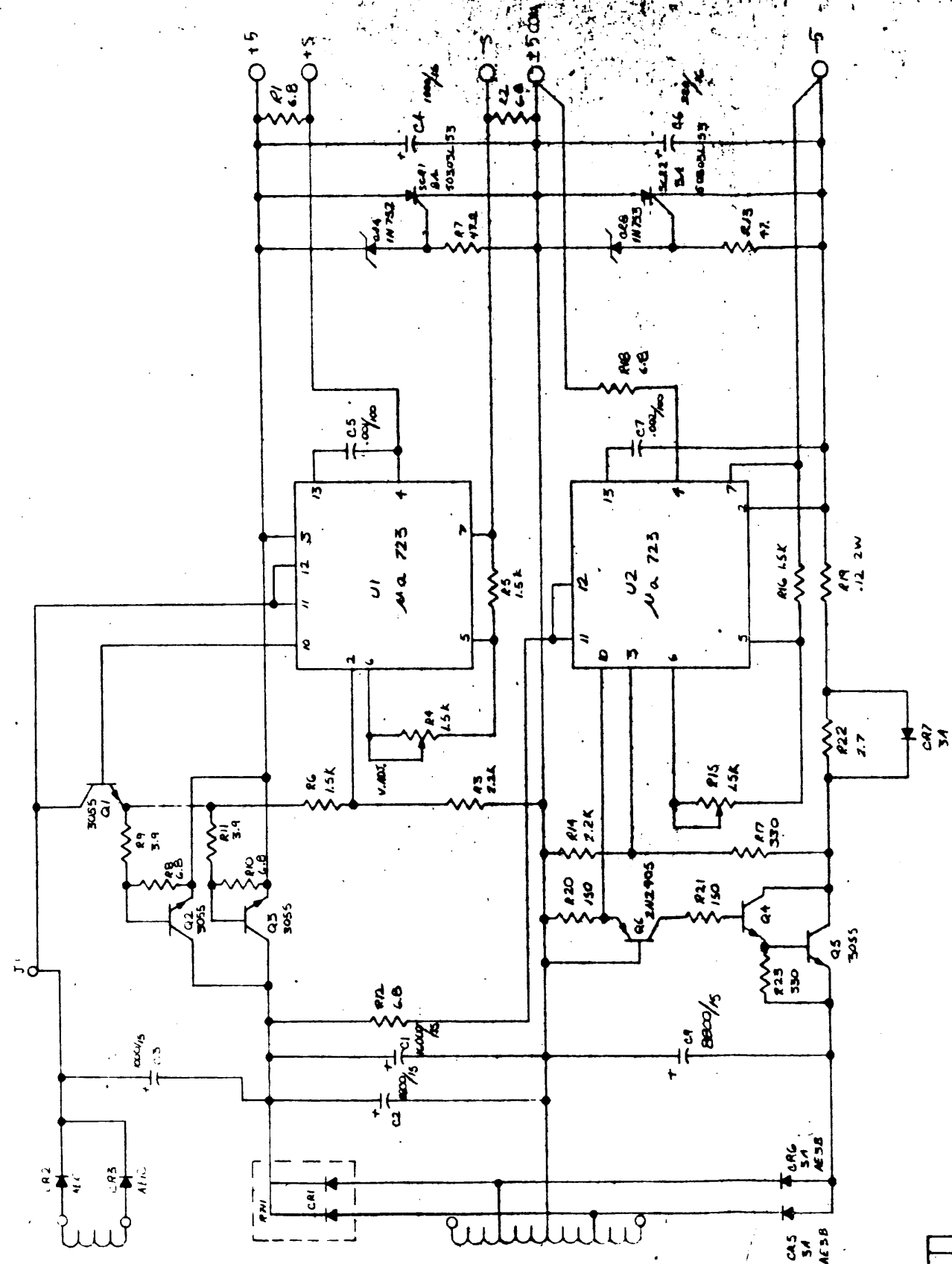


\* J1 MATES WITH:  
 AMP 350735-1 PLUG HOUSING  
 AMP 350218-1 PIN

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES			
MATERIAL		CONTRACT NO.	PARTS LIST
FINISH		APPROVALS	DATE
NEXT ASSY USED ON		DRAWN R.J. WALES	10-10-78
APPLICATION		CHECKED	10-3-78
DO NOT SCALE DRAWING		Microcomputer Power, Inc.	
SCALE		CP 129 WIRING DIAGRAM	
		SIZE	CODE IDENT NO
		D	10318
		DRAWING NO.	
		SCALE	SHEET OF

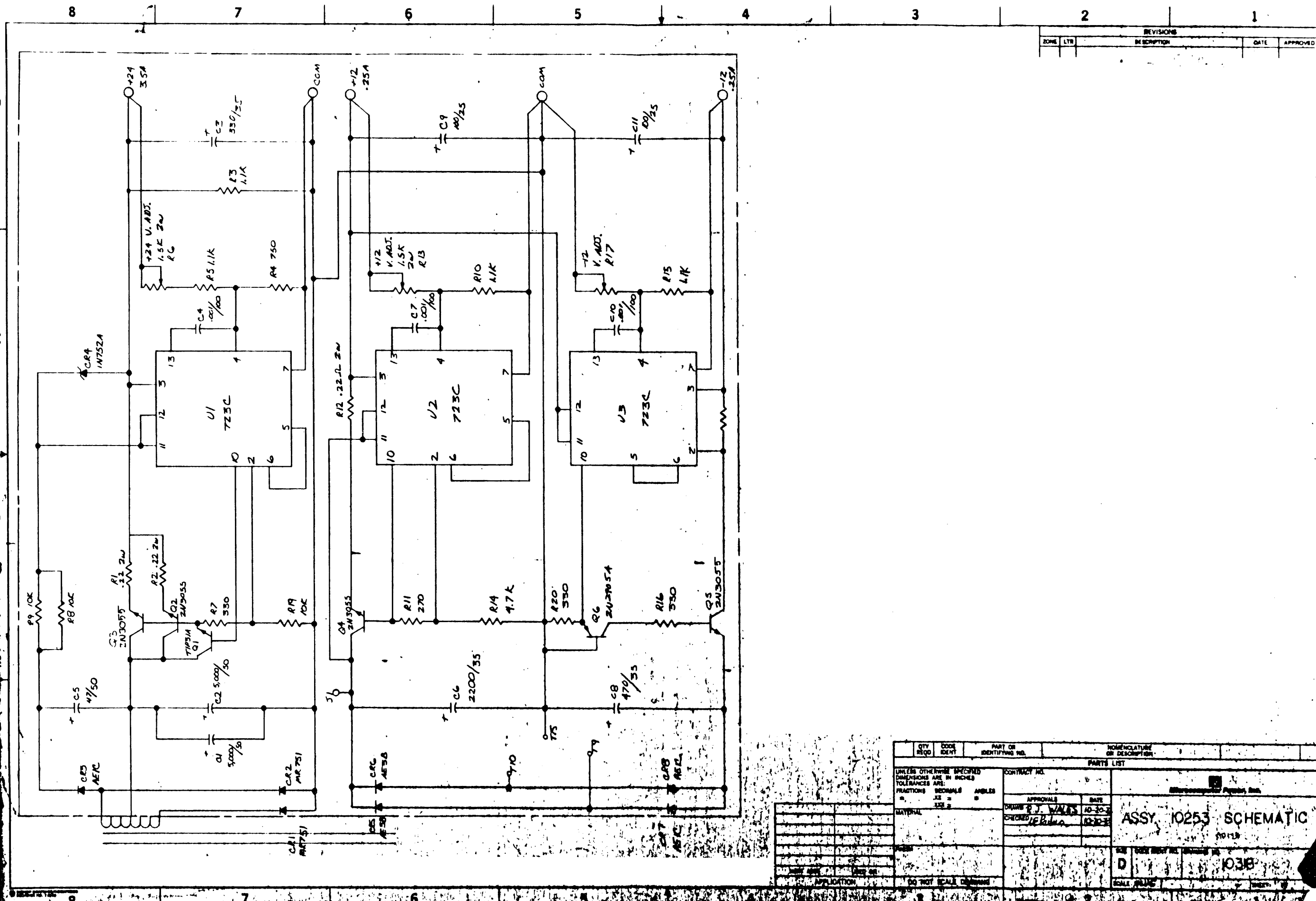
SCHMATIC DWG, CP129 POWER SUPPLY (1 OF 3)

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE



QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES ± . . . ± . . . ± . . .		CONTRACT NO.	
APPROVALS		DATE	
DRAWN P.J. WALES		10-20-76	
CHECKED P.E. JONES		10-20-76	
MATERIAL		ASSY. 10314 SCHEMATIC	
FINISH		SEE CODE IDENT NO. DRAWING NO.	
NEXT ASSY USED ON		D 10317	
APPLICATION		SCALE 10/16 SHEET 0F	
DO NOT SCALE DRAWING			

SCHEMATIC DWG, CP129 POWER SUPPLY (2 OF 3)



REVISIONS		DATE	APPROVED
ZONE	LTR	DESCRIPTION	

QTY	CODE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

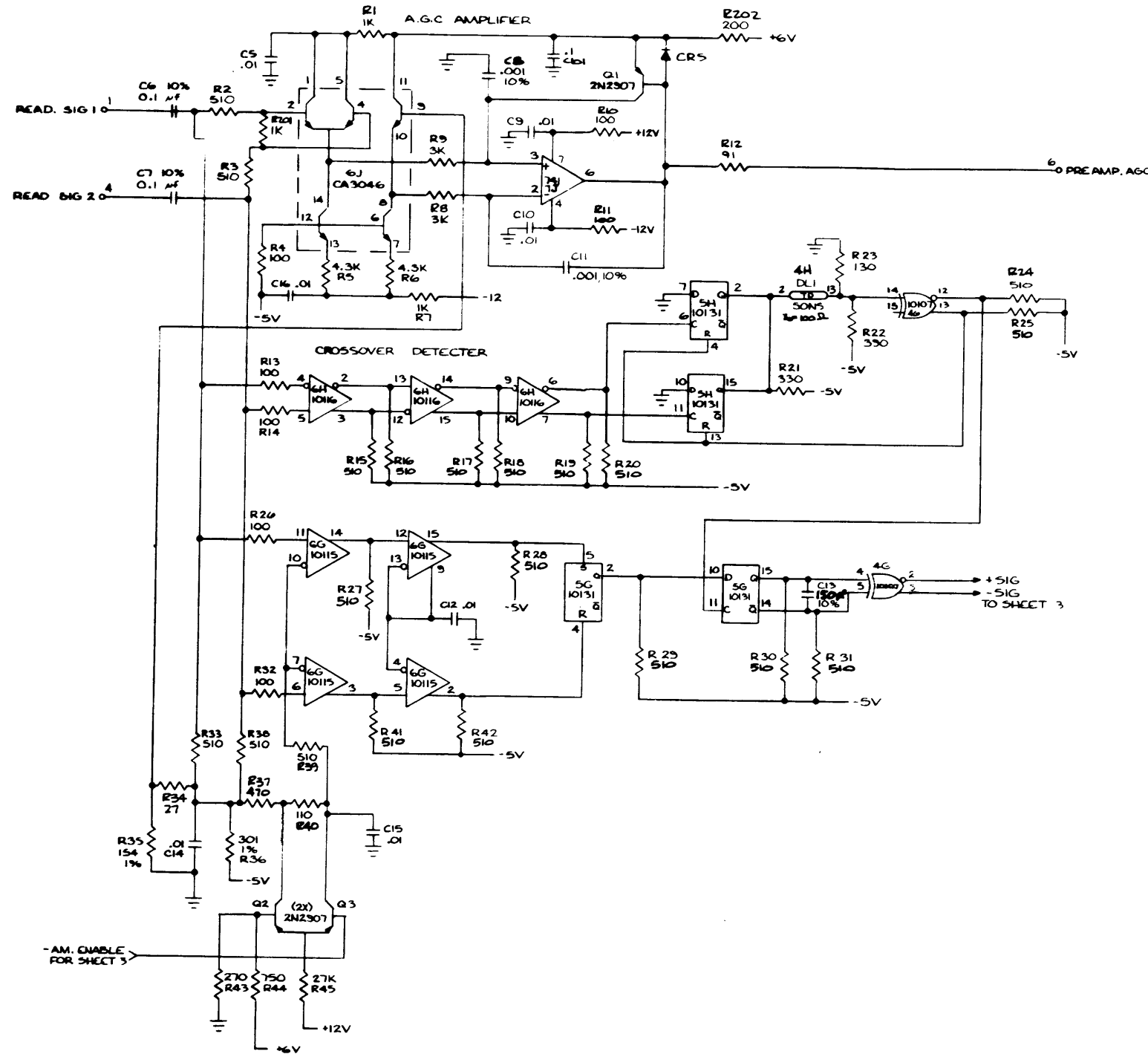
  

PARTS LIST	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES " ± .001" .010" "	CONTRACT NO.
APPROVALS DRAWN BY J. WALES CHECKED BY EB/ma	DATE 10-20-52 12-20-52
ASSY. 10253 SCHEMATIC	
SCALE: AS SHOWN	

SCHEMATIC DWG, CP129 POWER SUPPLY (3 OF 3)

Date	EC No	Date	EC No
A 12-1-78	029	G 7-26-79	088
D 2-2-79	054	J ?	?
B 2-26-79	039	L ?	?
E 5-3-79	063	N 11-15-79	094
S 4-29-80	132		
Y 5-16-80	140		

SHEET 1 OF 4



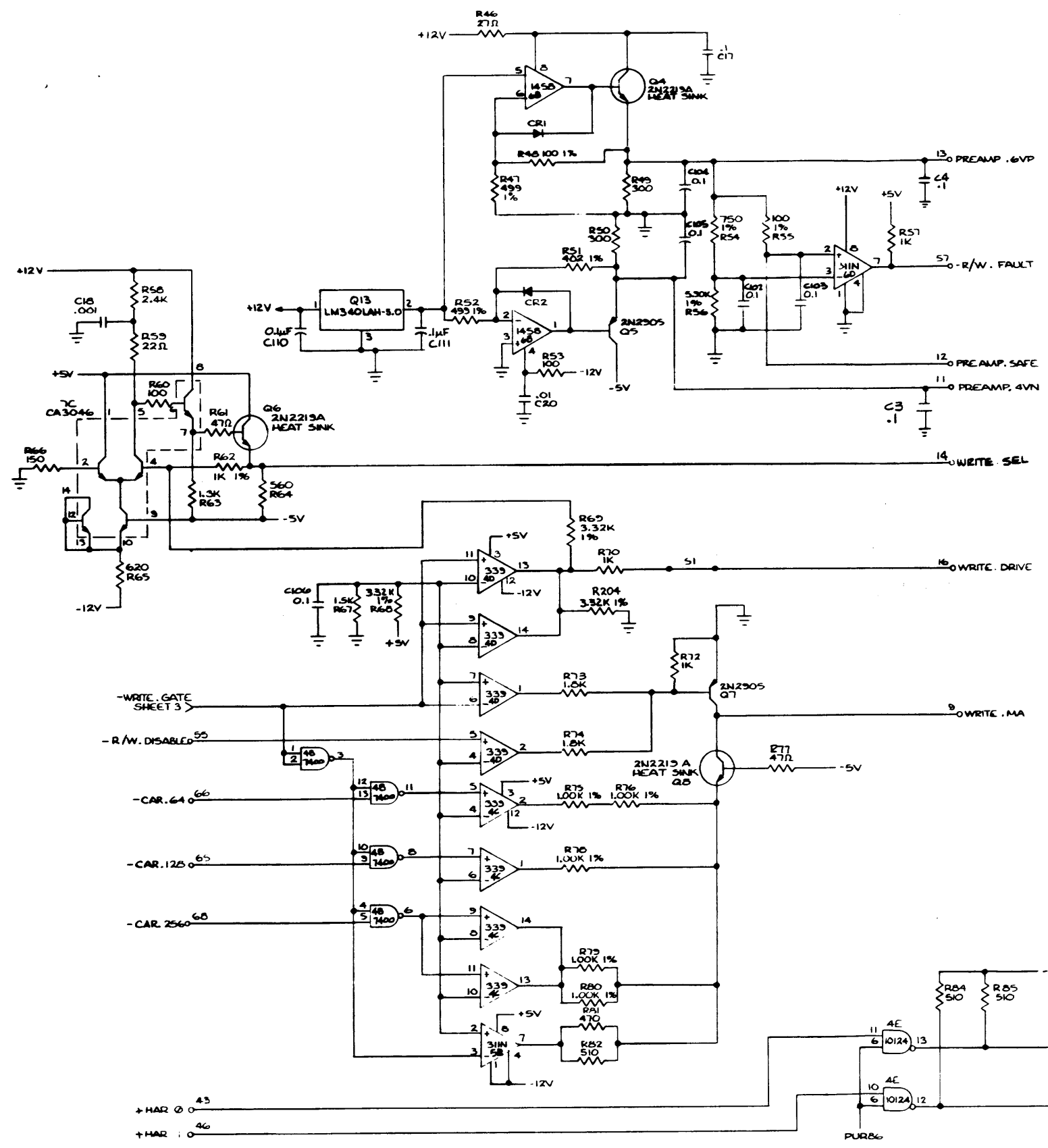
- 7. DIODES ARE 1N4148.
  - 6. CAPS ARE IN  $\mu$ F UNLESS OTHERWISE SPECIFIED.
  - 5. EACH ECL IC BYPASSED WITH A .01 $\mu$ F.
  - 4. CHOKES (L) ARE FERROXCUBE VK200 10/3B.
  - 3. SHEET 1 HAS SEPARATE GND AND -5V PLANE WITH GNDS BROUGHT IN FROM EDGE CONNECTOR.
  - 2. NOT USED
  - 1. ALL RESISTORS 1/4 W, UNLESS NOTED.
- NOTES :

<b>IMI</b> INTERNATIONAL MEMORIES INCORPORATED		
SCALE NONE	DATE 11-17-78	DESIGNED BY CANALHO
APPROVED BY <i>[Signature]</i>		REVISED
<b>SCHEMATIC READ WRITE PCB</b>		
MATERIAL		QUANTITY NUMBER 310002

99

Date	EC No	Date	EC No
A 12-11-78	029	G 9-16-79	085
D 2-22-79	054	J ?	?
B 2-26-79	039	L ?	?
E 5-3-79	063	N 11-15-79	099
S 4-29-80	132		
V 5-16-80	140		

SHEET 2



100

SCHMATIC DWG, ASM 310001 (2 OF 4)

**IMI** INTERNATIONAL MEMORIES INCORPORATED

DESIGNED BY: *[Signature]* DRAWN BY: *[Signature]*

DATE: 11-20-78

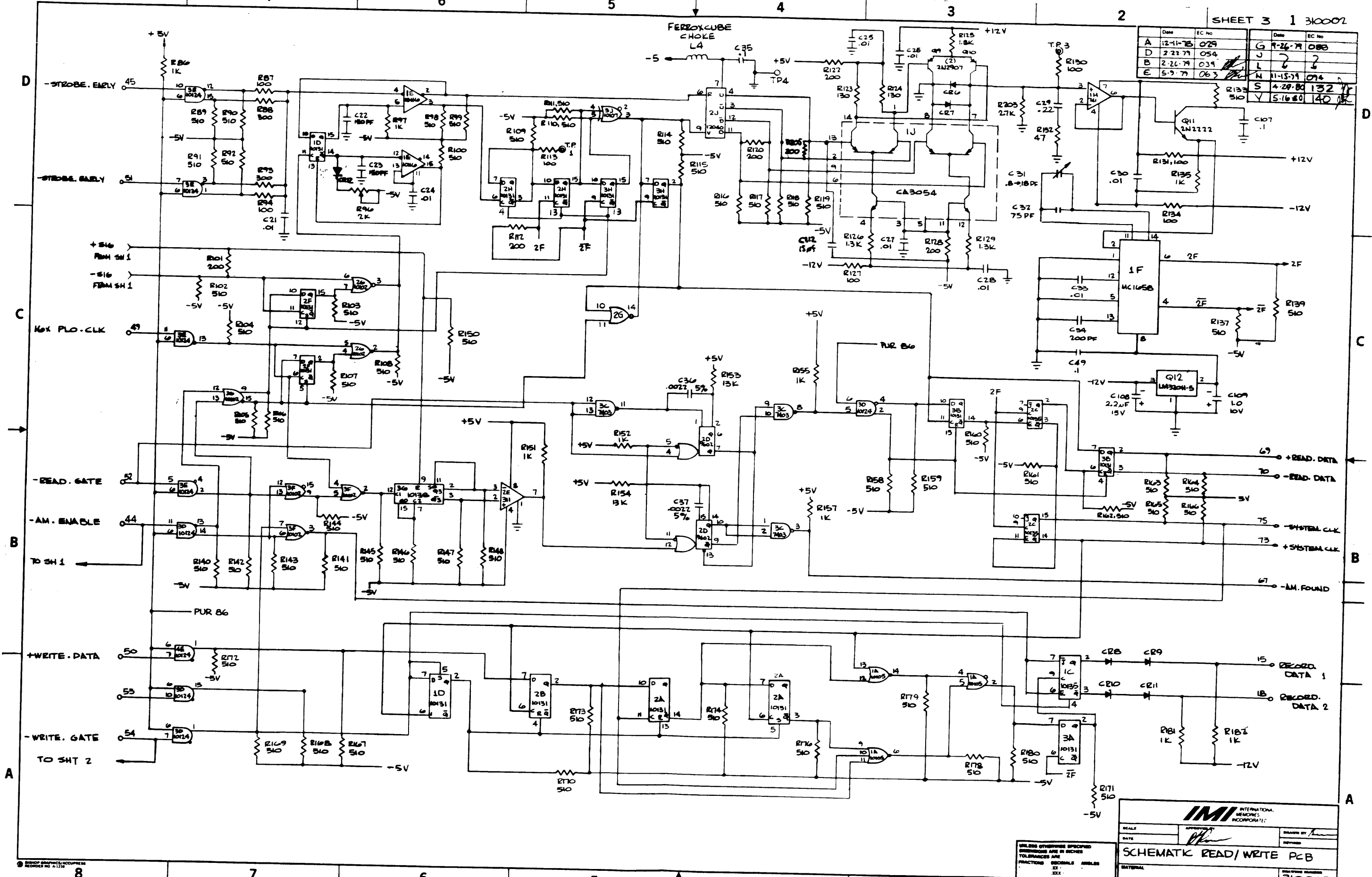
**SCHEMATIC READ WRITE PCB**

REVISION: 310002

SHEET 2

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES

Date	EC No	Date	EC No
A 12-11-75	029	G 7-26-79	088
D 2-27-79	054	J 7	2
B 2-26-79	039	L 7	2
E 5-9-79	063	M 11-15-79	074
		S 4-29-80	132
		V 5-16-80	140



SCHMATIC DWG, ASM 310001 (3 OF 4)

**IMI** INTERNATIONAL MEMORIES INCORPORATED

SCALE: \_\_\_\_\_ DATE: \_\_\_\_\_ DRAWN BY: \_\_\_\_\_

**SCHMATIC READ/WRITE PCB**

MATERIAL: \_\_\_\_\_

310002

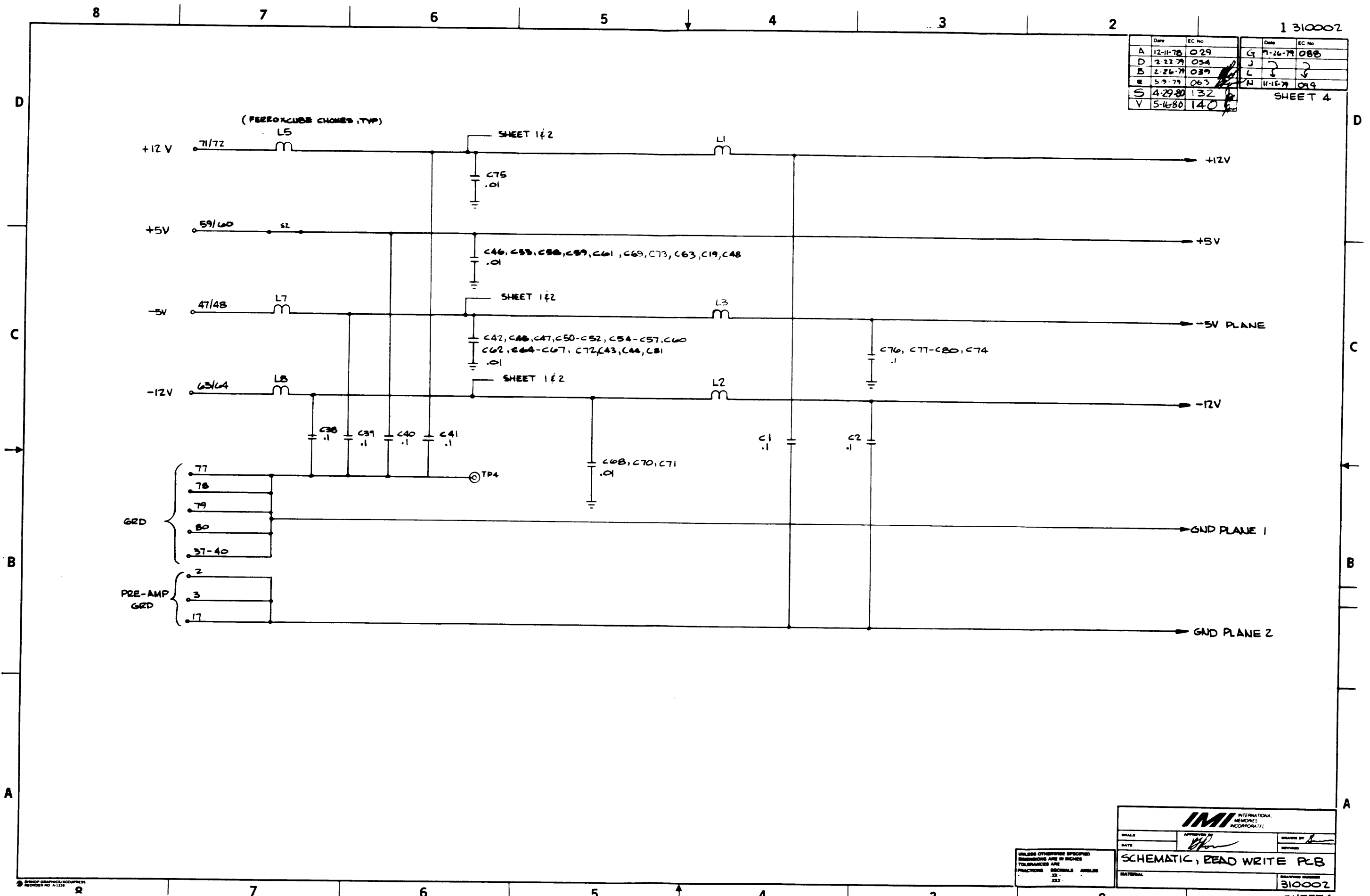
1 SHEET 3

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES

XX .XX

Date	EC No	Date	EC No
A 12-11-78	029	G 7-26-79	088
D 2-22-79	054	J	
B 2-26-79	039	L	
E 5-9-79	063	N 11-15-79	099
S 4-29-80	132		
V 5-16-80	140		

SHEET 4



SCHEMATIC DWG, ASM 310001 (4 OF 4)

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES ARE  
FRACTIONS DECIMALS ANGLES  
XX . . .  
XXX . . .

**IMI** INTERNATIONAL MEMORIES INCORPORATED

SCALE: \_\_\_\_\_ DATE: \_\_\_\_\_ DRAWN BY: \_\_\_\_\_

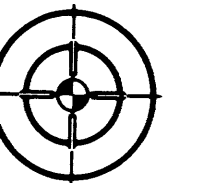
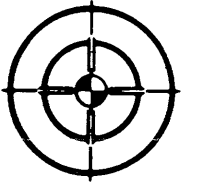
**SCHEMATIC, READ WRITE PCB**

MATERIAL: \_\_\_\_\_

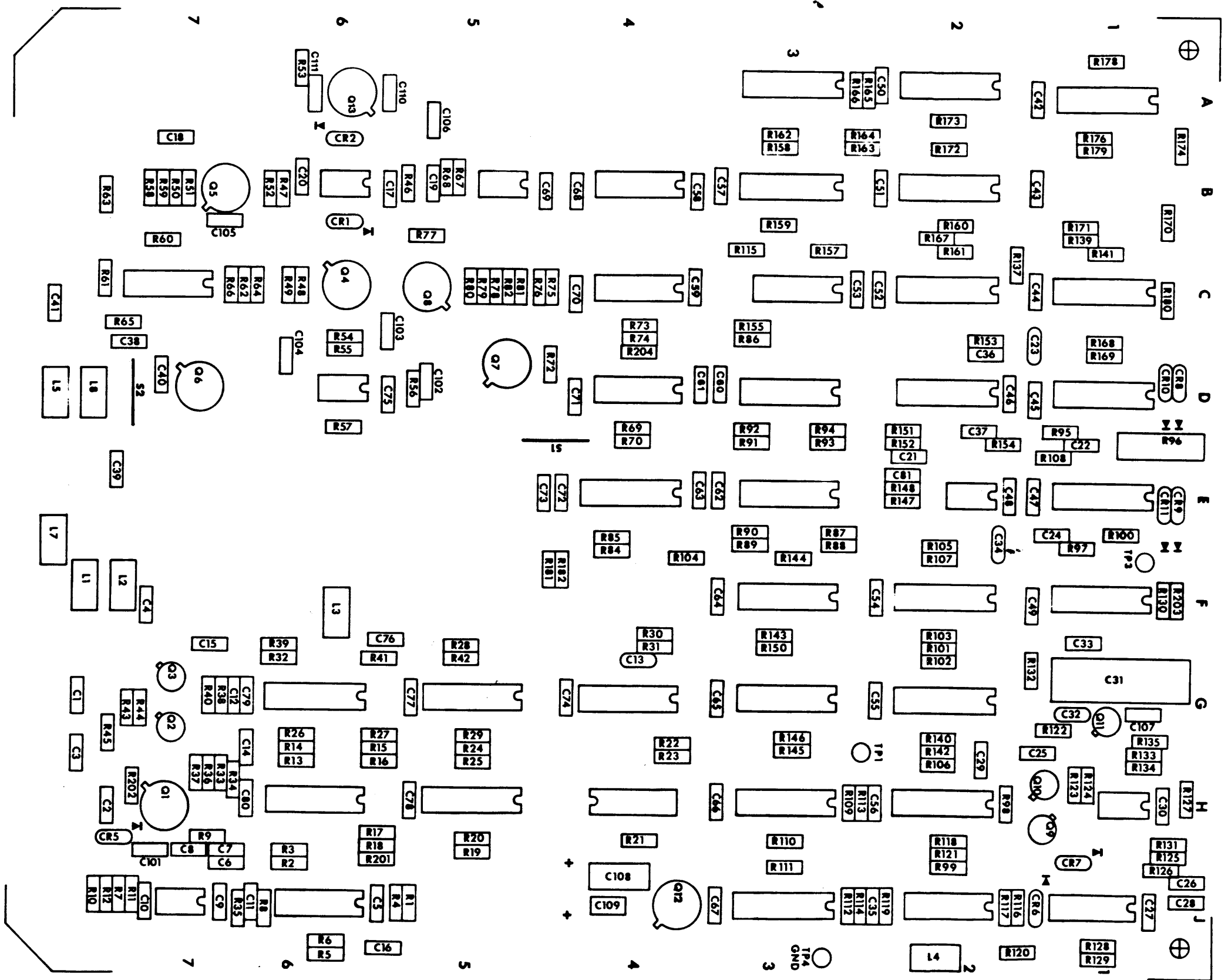
310002

1 SHEET 4





REDUCE TO 8.000 ± .005

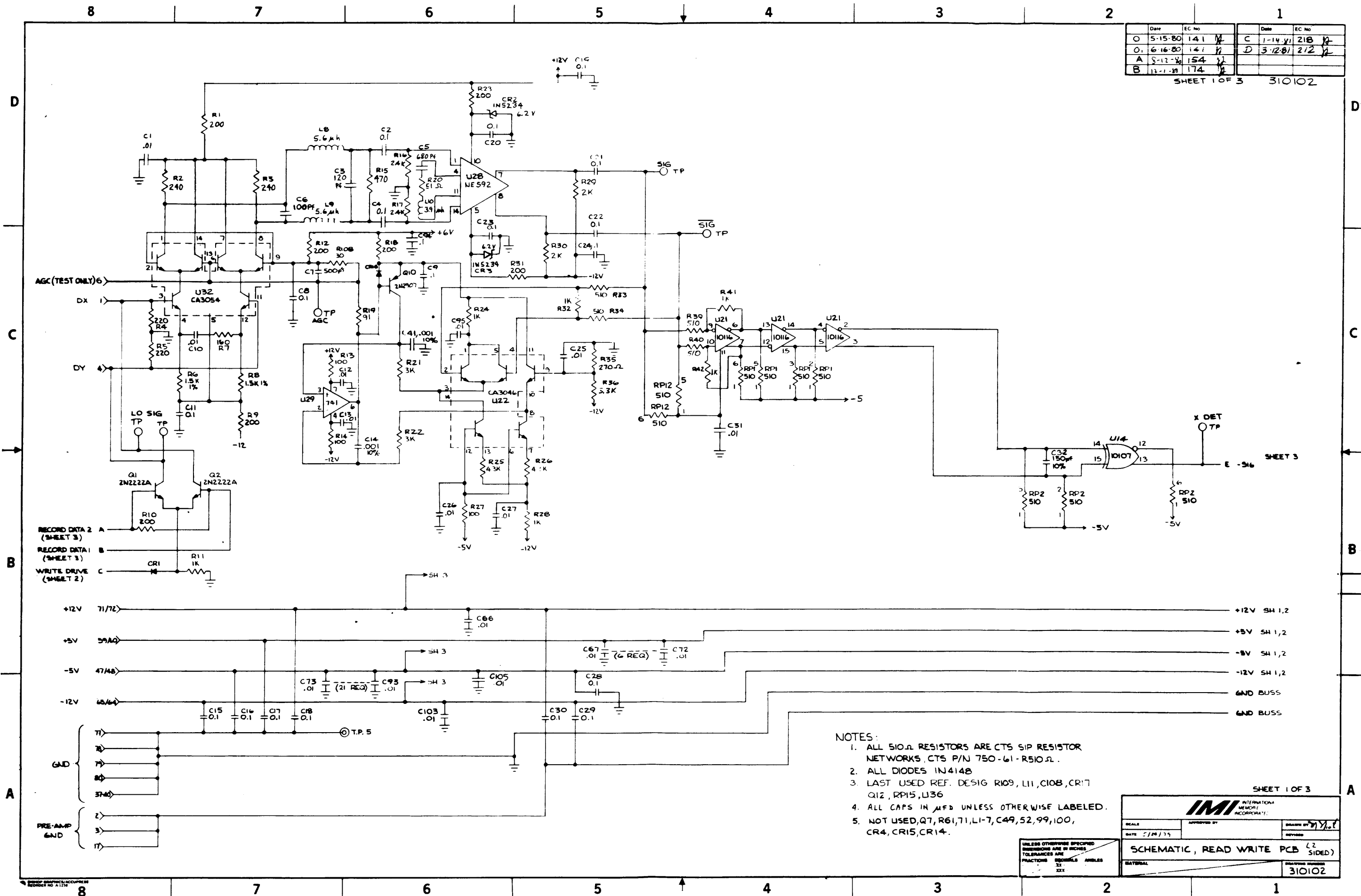


12-78 LEGEND READ/WRITE 310001 C

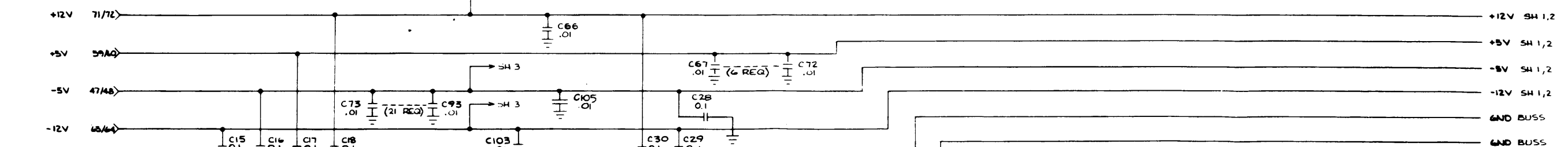
ASSEMBLY DWG, ASM 310001

Date	EC No	Date	EC No
O 5-15-80	141 M	C 1-14-81	218 K
O 6-16-80	141 N	D 3-12-81	212 K
A 8-12-80	154 J		
B 12-1-80	174 K		

SHEET 1 OF 3 310102



AGC (TEST ONLY) 6  
 DX 1)  
 DY 4)  
 RECORD DATA 2 (SHEET 3) A  
 RECORD DATA 1 (SHEET 3) B  
 WRITE DRIVE (SHEET 2) C



- NOTES:
1. ALL 510Ω RESISTORS ARE CTS SIP RESISTOR NETWORKS, CTS P/N 750-61-R510Ω.
  2. ALL DIODES IN4148
  3. LAST USED REF. DESIG R109, L11, C108, CR17 Q12, RP15, U36
  4. ALL CAPS IN μFD UNLESS OTHERWISE LABELED.
  5. NOT USED, Q7, R61, L1-7, CA9, 52, 99, 100, CR4, CR15, CR14.

SHEET 1 OF 3

**IMI** INTERNATIONAL MEMORY CORPORATION

SCALE: \_\_\_\_\_ APPROVED BY: \_\_\_\_\_ DATE: 5/18/79

REVISIONS: \_\_\_\_\_

SCHEMATIC, READ WRITE PCB (2 SIDED)

DATE: 5/18/79

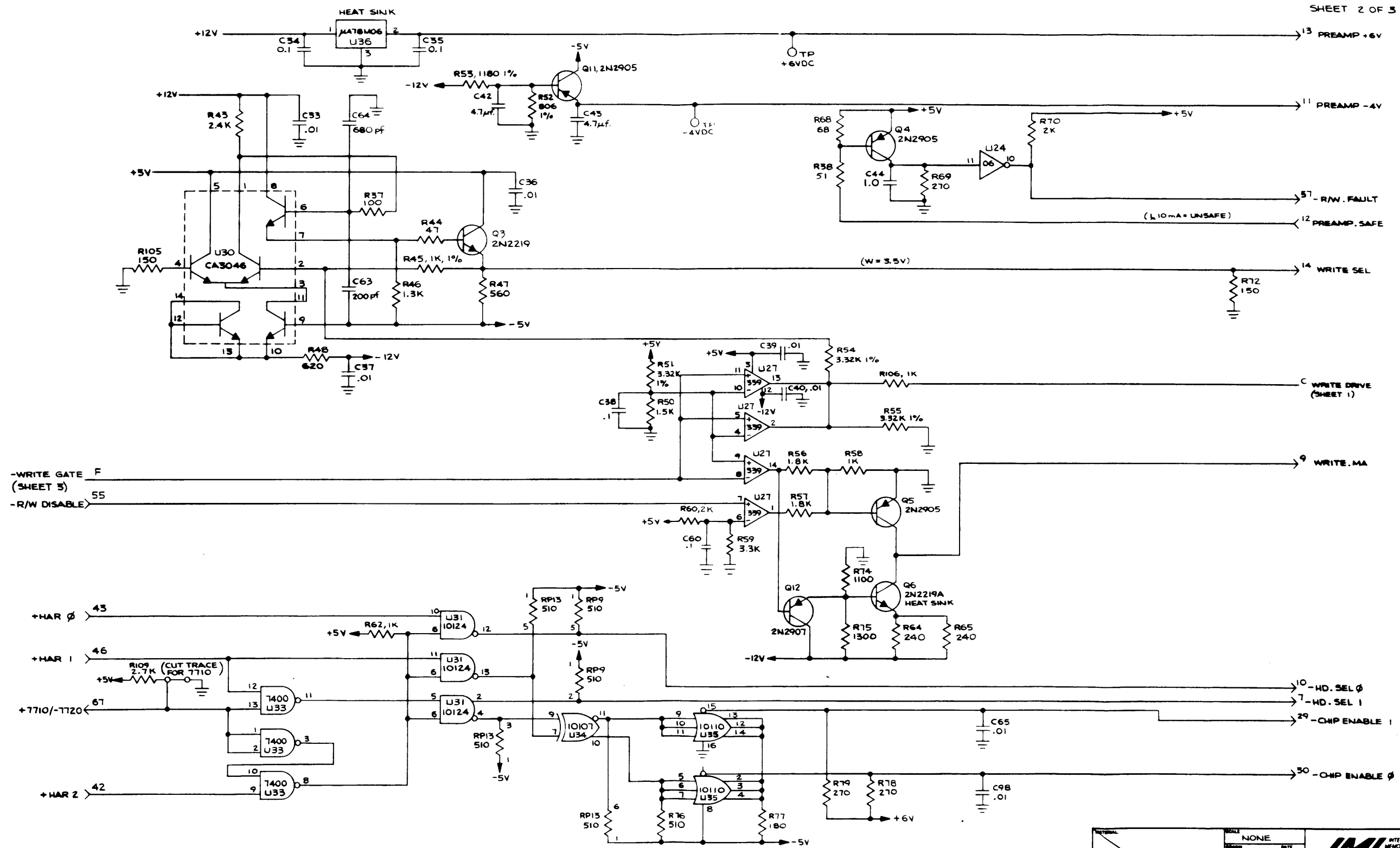
310102

SCHEMATIC DWG, ASM 310101 (1 OF 3)

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REV	DATE	BY	NO	REV	DATE	BY	NO
0	5-15-80	141	1	C	1-1-81	218	1
1	6-16-80	141	2	D	3-12-81	212	1
A	8-17-80	144	1				
B	12-1-80	174	1				

SHEET 2 OF 3



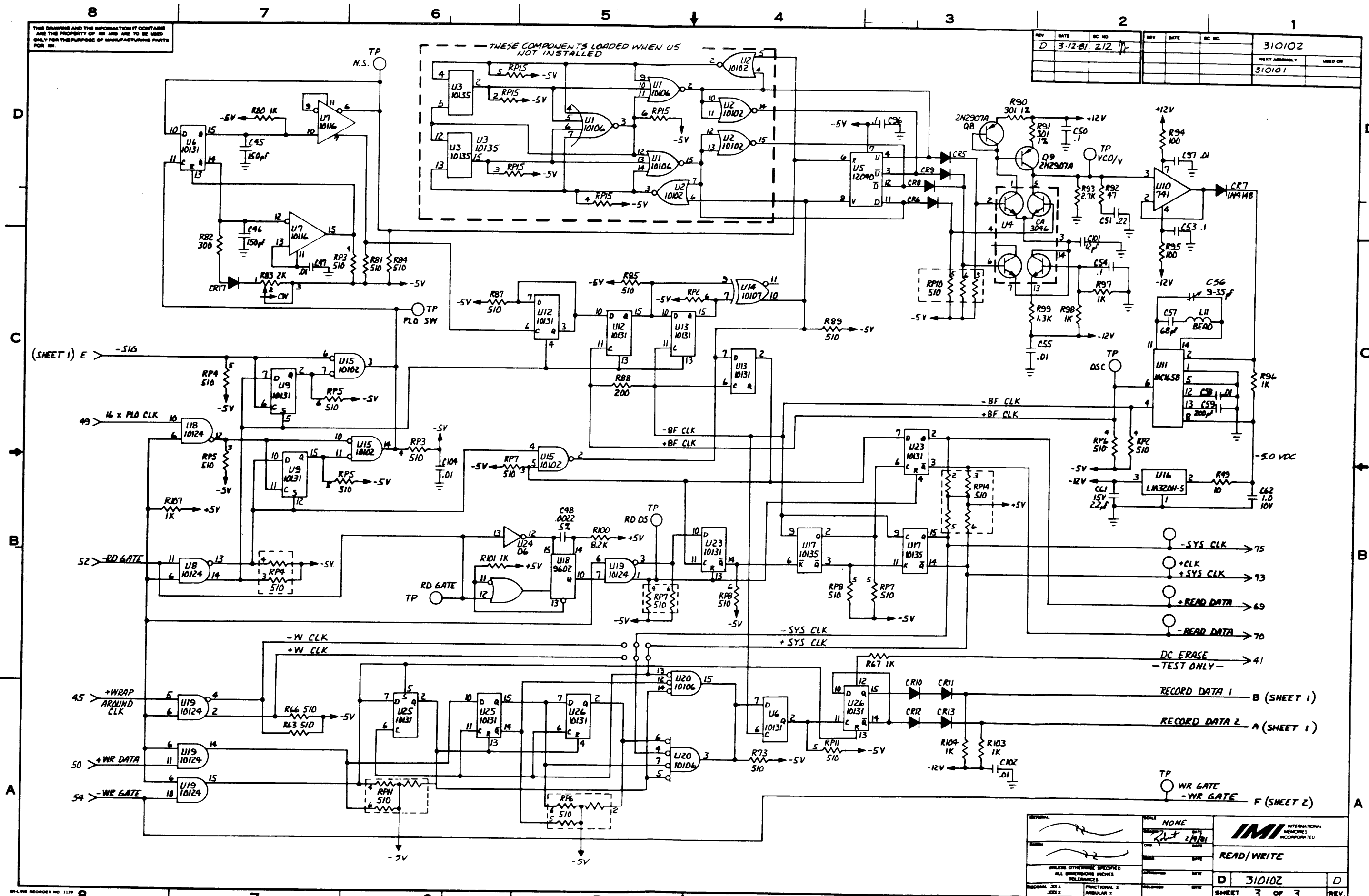
SCHEMATIC DWG, ASM 310101 (2 OF 3)

SCALE	NONE	DATE	
DESIGN	ITURRALDE 5-2-80	DATE	
DRAWN		DATE	
CHECKED		DATE	
APPROVED		DATE	
RELEASED		DATE	
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN INCHES		TOLERANCES	
FRACTIONAL 1/16	FRACTIONAL 1/32	DECIMAL	DATE
SHEET 2 OF 3		REV.	0

INTERNATIONAL MEMORIES INCORPORATED  
**IMI**  
 SCHEMATIC, READ / WRITE PCB (2 SIDED)  
 D 310102

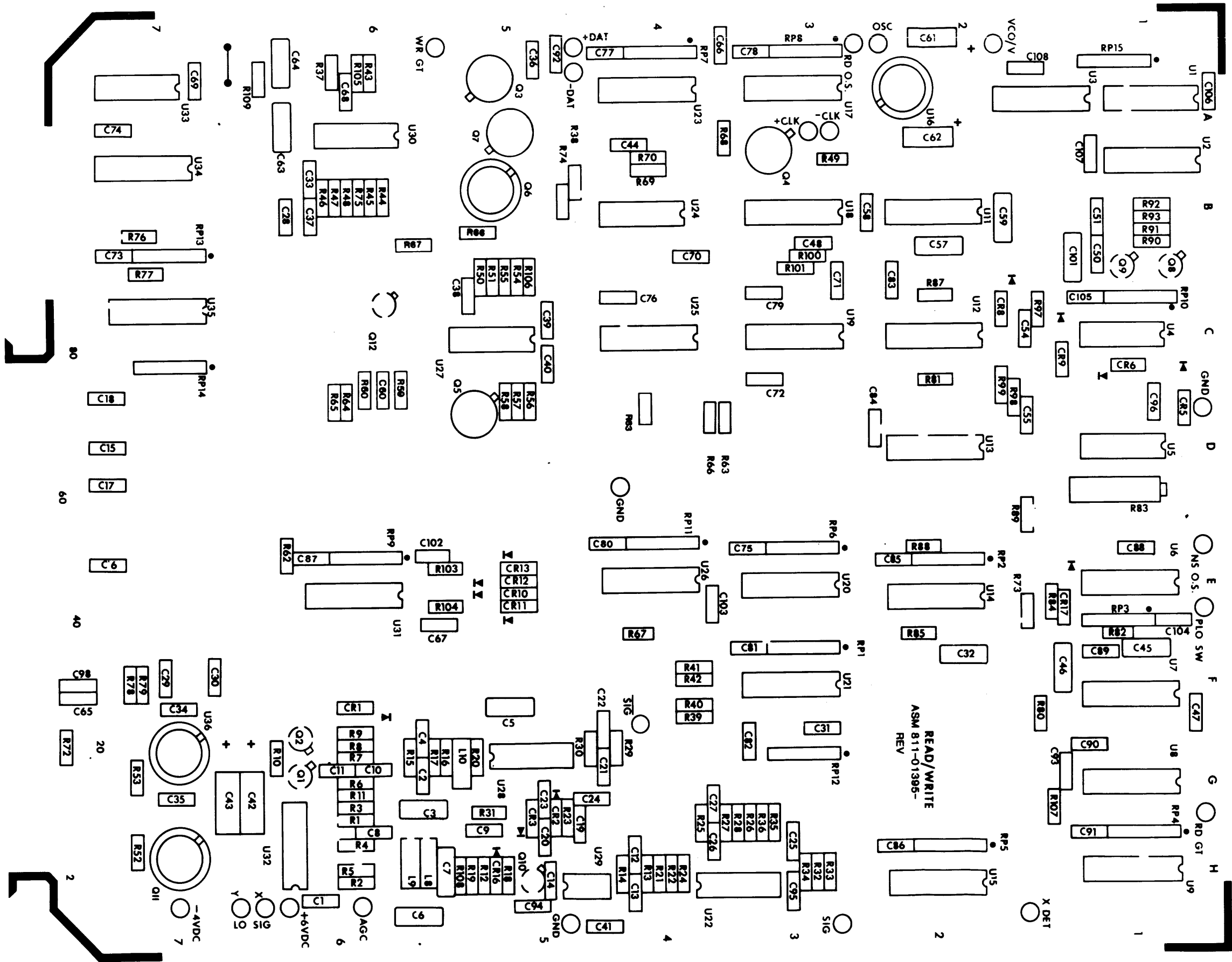
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REV	DATE	BY	NO.	REV	DATE	BY	NO.
D	3-12-81	ZJZ					
NEXT ASSEMBLY							310102
USED ON							310101



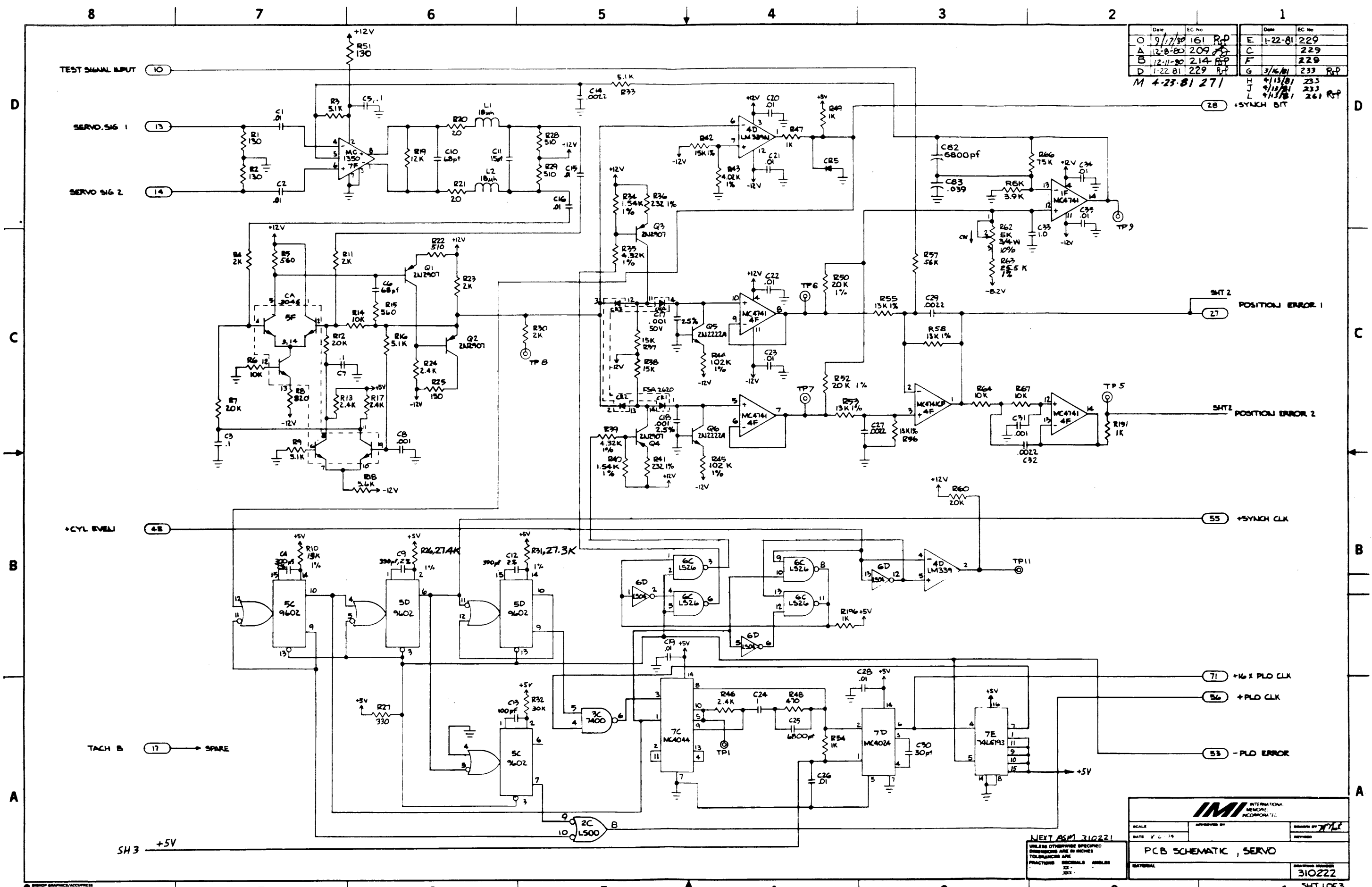
SCHEMATIC DWG, ASM 310101 (3 OF 3)

ORIGINAL SCALE NONE DATE 2/19/81 UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS IN INCHES TOLERANCES DECIMAL SIZE ± FRACTIONAL ± ANGULAR ±	NONE DATE 2/19/81 DATE DATE DATE	<b>IMI</b> INTERNATIONAL MEMORIES INCORPORATED READ/WRITE D 310102 SHEET 3 OF 3	REV. D
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ASSEMBLY DWG, ASM 310101

Date	EC No	Date	EC No
9/17/80	161 R.P.	E	1-22-81 229
A	2-8-80 209 R.P.	C	229
B	12-11-80 214 R.P.	F	229
D	1-22-81 229 R.P.	G	3/16/81 233 R.P.
M 4-23-81 271		H	4/15/81 233
		J	4/18/81 233
		L	4/13/81 261 R.P.



**IMI** INTERNATIONAL MEMORY CORPORATION

SCALE: APPROVED BY: DRAWN BY: *JPL*

DATE: 7-1-79 REVISION:

**PCB SCHEMATIC, SERVO**

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS DIMENSIONS

DATE: 3-10-81

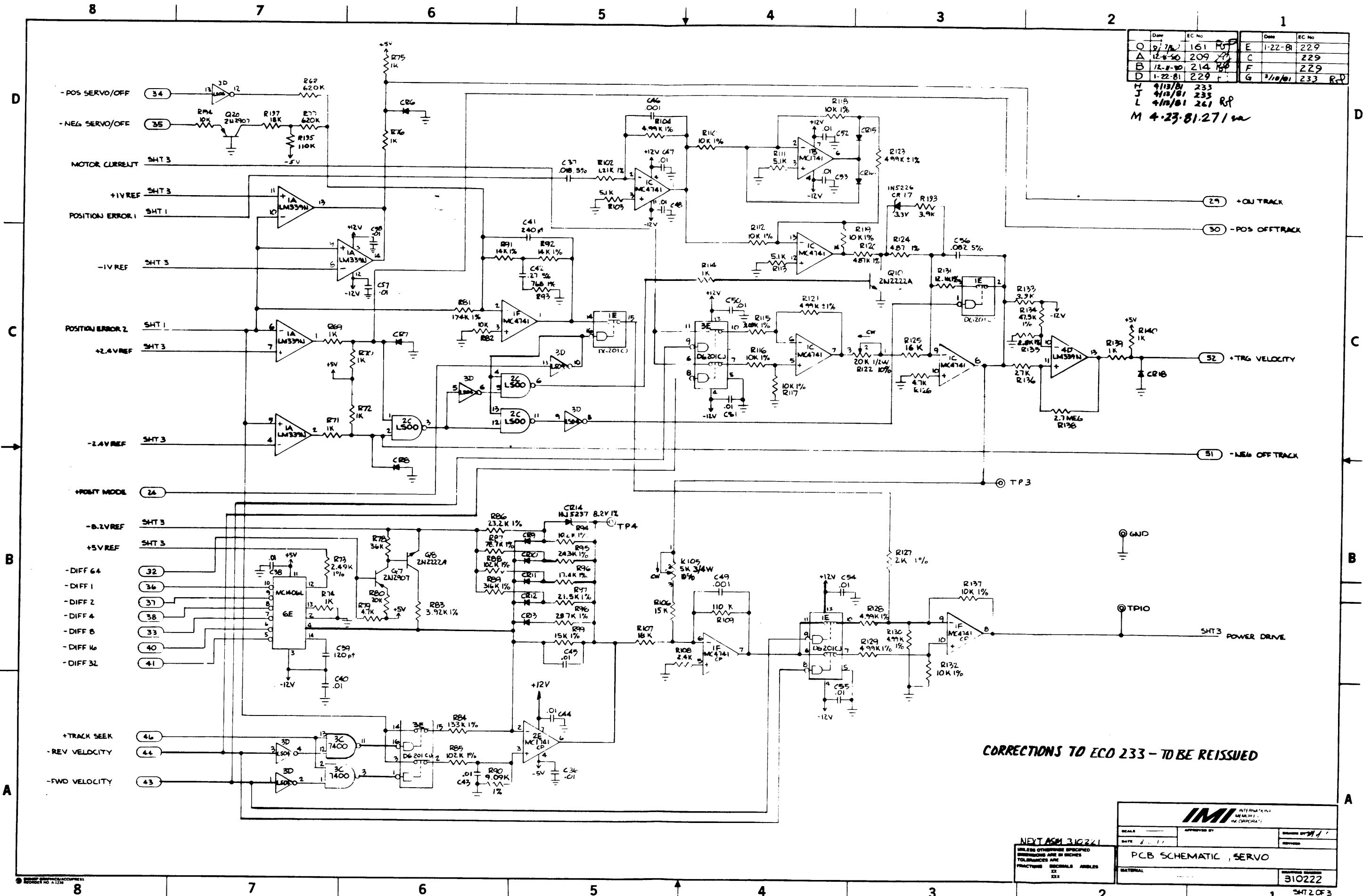
310222

SCHMATIC DWG, ASM 310221 (1 OF 3)

108

SHT 1 OF 3

Date	EC No	Date	EC No
O 9/78	161 RFP	E 1-22-81	229
A 12-8-80	209 RFP	F	229
B 12-8-80	214 RFP	F	229
D 1-22-81	229 RFP	G 3/10/81	233 RFP
H 4/15/81	233		
J 4/15/81	233		
L 4/15/81	261 RFP		
M 4-23-81	271 SA		

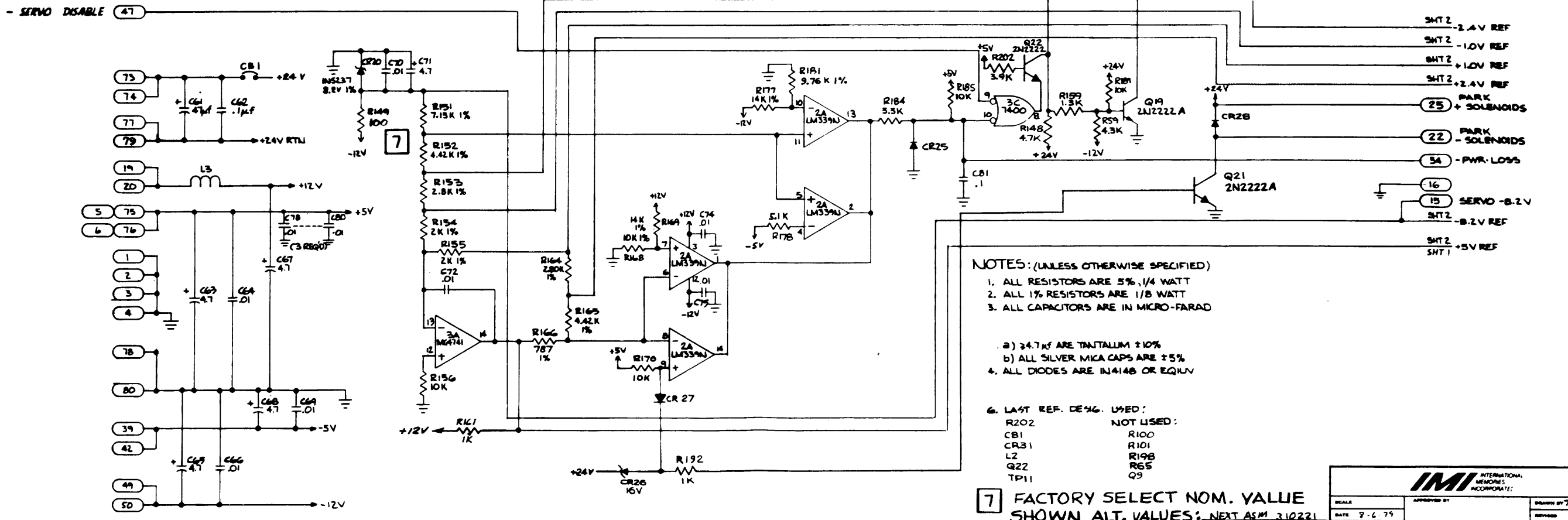
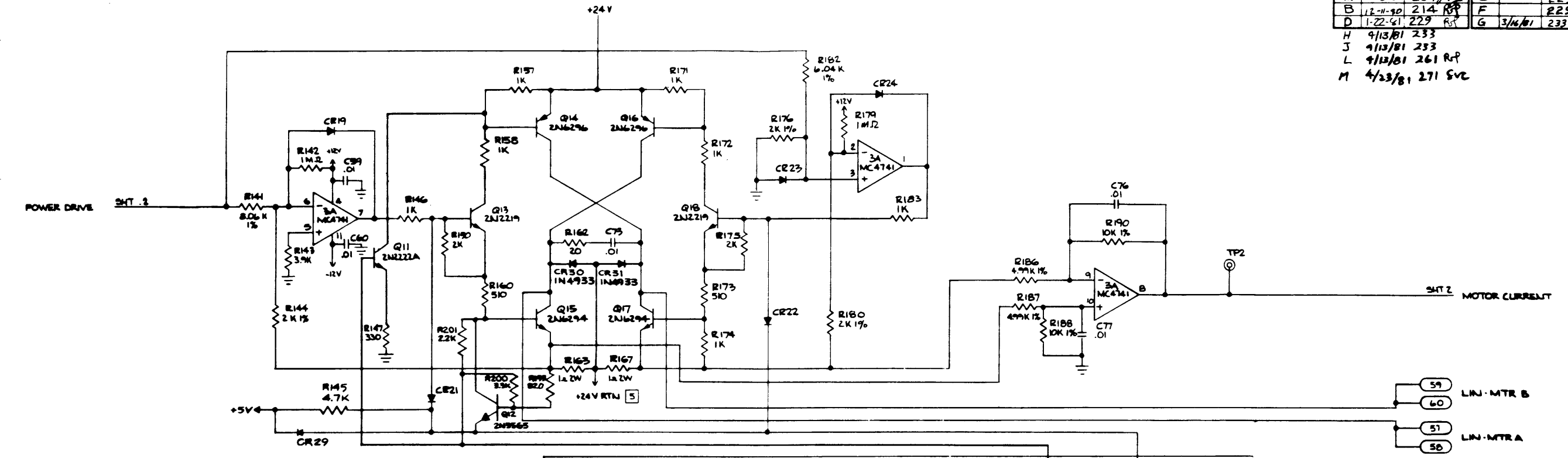


CORRECTIONS TO ECO 233 - TO BE REISSUED

<b>IMI</b> INTERNATIONAL MEASUREMENTS CORPORATION	
SCALE: _____	APPROVED BY: _____
DATE: 2.1.81	DRAWN BY: J.P.
PCB SCHEMATIC, SERVO	
MATERIAL: _____	QUANTITY: _____
310222	
SHT 2 OF 3	

SCHMATIC DWG, ASM 310221 (2 OF 3)

Date	EC No	Date	EC No
9-17-80	161 RSP	E	1-22-81 229
12-8-80	209 RSP	C	229
12-11-80	214 RSP	F	229
1-22-81	229 RSP	G	3/16/81 233 RSP
H	9/13/81 233		
J	9/13/81 233		
L	9/13/81 261 RSP		
M	4/23/81 271 SVC		



NOTES: (UNLESS OTHERWISE SPECIFIED)

- ALL RESISTORS ARE 5%, 1/4 WATT
- ALL 1% RESISTORS ARE 1/8 WATT
- ALL CAPACITORS ARE IN MICRO-FARAD

a) 24.7µF ARE TANTALUM ±10%  
 b) ALL SILVER MICA CAPS ARE ±5%  
 4. ALL DIODES ARE IN4148 OR EQUIV

6. LAST REF. DES'G. USED:  
 R202 NOT USED:  
 CB1 R100  
 CR31 R101  
 L2 R198  
 Q22 R65  
 TP11 Q9

7 FACTORY SELECT NOM. VALUE  
 SHOWN ALT. VALUES: NEXT ASM 310221  
 82 Ω  
 110 Ω

<b>IMI</b> INTERNATIONAL MEASURES INCORPORATED	
SCALE	APPROVED BY
DATE 9-6-79	DESIGNED BY M.J.V.
PCB SCHEMATIC, SERVO	
MATERIAL	REVISION NUMBER
	310221



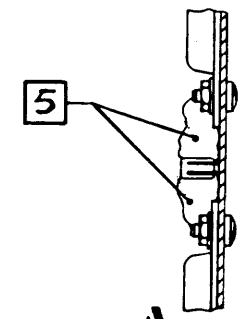
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REV	DATE	BY	NO	REV	DATE	BY	NO
0	9/17/80	161	RP	D	1-22-81	229	
1	10/3/80	161	RP	E	1-22-81	229	RP
A	12/01/80	209	RP	F		229	
B	12-11-80	214	RP	C		229	
M	4-23-81	27	RP	G	3/16/81	233	RP
				H	4/13/81	233	
				J	4/13/81	233	
				K	7/6/81	261	
				L	4/18/81	261	

- NOTES:
1. MAXIMUM COMPONENT HEIGHT NOT TO EXCEED .40 INCH.
  2. MARK REV LEVEL APPROXIMATELY AS SHOWN.
  3. INSTALL HARDWARE PRIOR TO SOLDERING (Q14, Q15, Q16 & Q17)
  4. R165 & R167 ARE TO BE INSTALLED SO THEY ARE MAKING PHYSICAL CONTACT WITH CB-1. CB-1 MUST BE INSTALLED FLUSH TO THE BOARD.
  5. FILL WITH THERMAL CEMENT, CONNECTING Q15, CB1, Q17. FLUSH WITH CB1 LEAVING NO VOIDS GREATER 1mm<sup>2</sup>. ADJACENT TO Q15 AND Q17.
  6. FAIRCHILD DEVICE AS SHOWN. OTHER VENDORS PHANTOM LINE
  7. FACTORY SELECT NOM. VALUE SHOWN.

\* ALTERNATE PARTS LIST (SEE SHEET 2 FOR PARTS LIST)

ITEM	DESCRIPTION	IMI P/N	QTY	LOCATION
7				
10B	IC SN74193	030838	0	7E
111	IC 17415CPI	030943	0	1B, 2E
112	IC MC3346	030990	0	5F
20	CAP. POLY. .001uf, 2.5%	031232	0	C17, C18
63	CAP. CERM. .039uf 10% 50V	030063	0	C83
104	TRANSISTOR 2N6295	031243	0	Q15, 17
104	TRANSISTOR 2N6300	031244	0	Q15, 17
104	TRANSISTOR 2N6301	031245	0	Q15, 17
7	59 RES. 1/4, 5%, 82.Ω	030702	0	R149
7	59 RES. 1/4, 5%, 110.Ω	030705	0	R149



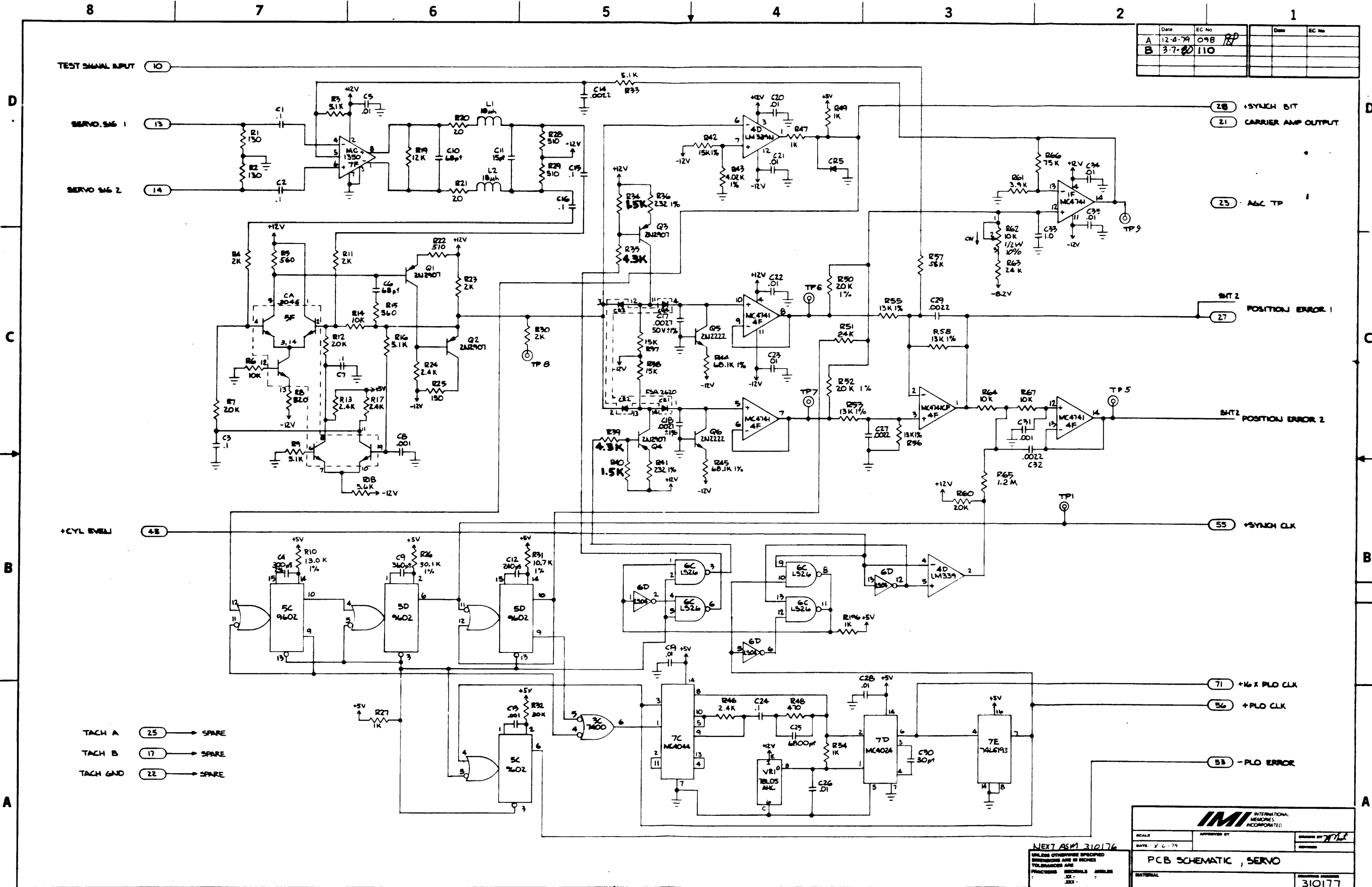
VIEW A  
SCALE: NONE

CORRECTIONS TO ECD 233- TO BE REISSUED

DATE	SCALE	N/A & NOTED	
REV	DATE	DATE	
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES			PCB ASM, SERVO
DECIMAL: .XX ± FRACTIONAL: XX/XX ± ANGULAR: ±	DECIMAL: .XX ± FRACTIONAL: XX/XX ± ANGULAR: ±	DATE: 7/27/81 BY: [Signature] CHECKED: [Signature]	D 310221 M SHEET 1 OF 2 REV.

ASSEMBLY DWG, ASM 310221

Date	EC No	Date	EC No
A 12-4-79	098		
B 3-7-80	110		



- TACH A (25) → SPARE
- TACH B (17) → SPARE
- TACH GND (22) → SPARE

**IMI** INTERNATIONAL MEMORIS INCORPORATED

SCALE: \_\_\_\_\_ APPROVED BY: \_\_\_\_\_ DRAWN BY: *ML*

DATE: 2-6-79

**PCB SCHEMATIC, SERVO**

NATURAL

310177

1 SH1 OF 3

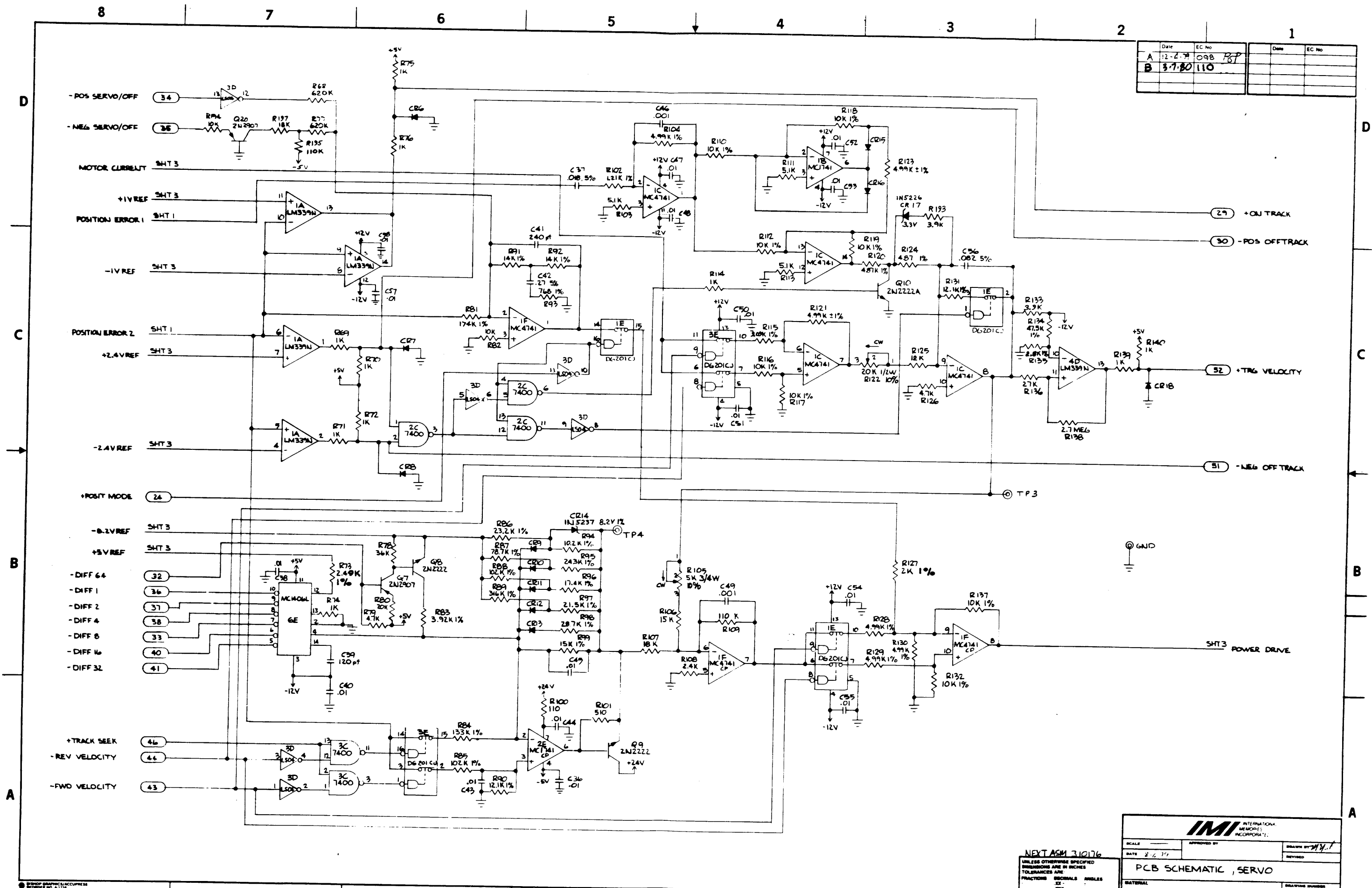
NEXT ASM 310176

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES

.XX - .XX - .XX

SCHEMATIC DWG, ASM 310176 (1 OF 3)

Date	EC No	Date	EC No
A 12-2-79	098		
B 3-7-80	110		



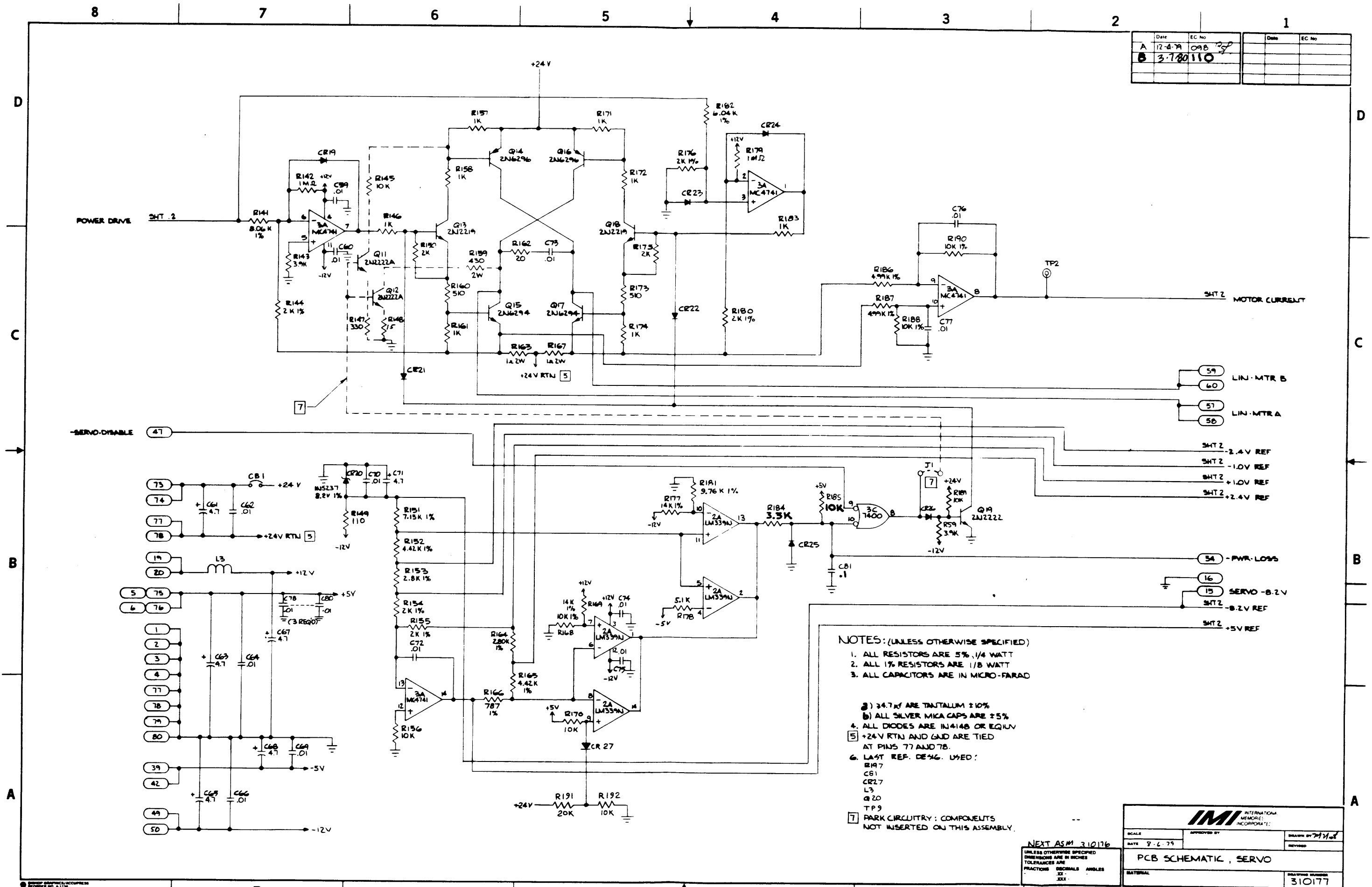
SCHEMATIC DWG, ASM 310176 (2 OF 3)

NEXT ASM 310176

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES .XX .XXX .XXX

<b>IMI</b> INTERNATIONAL MEMORIAL CORPORATION	
SCALE	APPROVED BY
DATE 8-6-79	DRAWN BY M.V.
<b>PCB SCHEMATIC, SERVO</b>	
MATERIAL	DRAWING NUMBER
	310177

Date	EC No	Date	EC No
A 12-4-79	09B 38		
B 3-7-80	110		



- NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL RESISTORS ARE 5% 1/4 WATT
  2. ALL 1% RESISTORS ARE 1/8 WATT
  3. ALL CAPACITORS ARE IN MICRO-FARAD
  - 3) 34.7K ARE TANTALUM 210%
  - 4) ALL SILVER MICA CAPS ARE 25%
  4. ALL DIODES ARE IN4148 OR EQUIV
  - 5) +24V RTN AND GND ARE TIED AT PINS 77 AND 78.
  6. LAST REF. DES'G. USED:
    - R197
    - CB1
    - CR27
    - L3
    - Q20
    - TP9
  - 7) PARK CIRCUITRY: COMPONENTS NOT INSERTED ON THIS ASSEMBLY.

IMM INTERNATIONAL MEMORE INCORPORATE

SCALE: APPROVED BY: DRAWN BY: M.V.

DATE: 9-2-79 REVISED:

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES

PCB SCHEMATIC, SERVO

REVISION NUMBER: 310177

DATE: 3-10-77

114

THIS DRAWING AND THE INFORMATION IT CONTAINS ARE THE PROPERTY OF IMI AND ARE TO BE USED ONLY FOR THE PURPOSE OF MANUFACTURING PARTS FOR IMI.

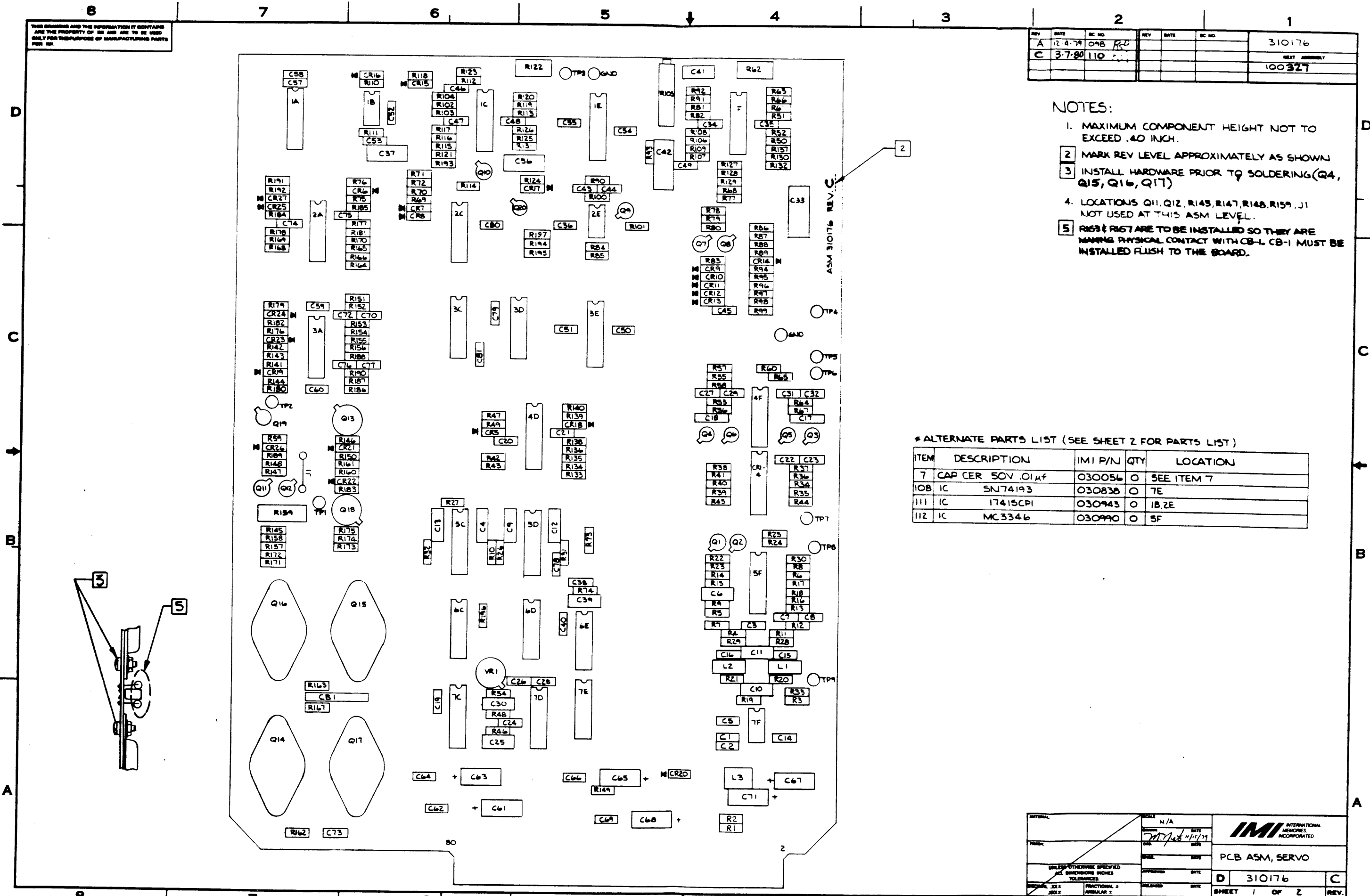
REV	DATE	BY	REV	DATE	BY
A	12-4-79	098 RD			
C	3-7-80	110			

310176  
BEST ASSEMBLY  
100327

- NOTES:
1. MAXIMUM COMPONENT HEIGHT NOT TO EXCEED .40 INCH.
  2. MARK REV LEVEL APPROXIMATELY AS SHOWN
  3. INSTALL HARDWARE PRIOR TO SOLDERING (Q4, Q15, Q16, Q17)
  4. LOCATIONS Q11, Q12, R145, R147, R148, R159, J1 NOT USED AT THIS ASM LEVEL.
  5. R153 & R157 ARE TO BE INSTALLED SO THEY ARE MAKING PHYSICAL CONTACT WITH CB-1. CB-1 MUST BE INSTALLED FLUSH TO THE BOARD.

\* ALTERNATE PARTS LIST (SEE SHEET 2 FOR PARTS LIST)

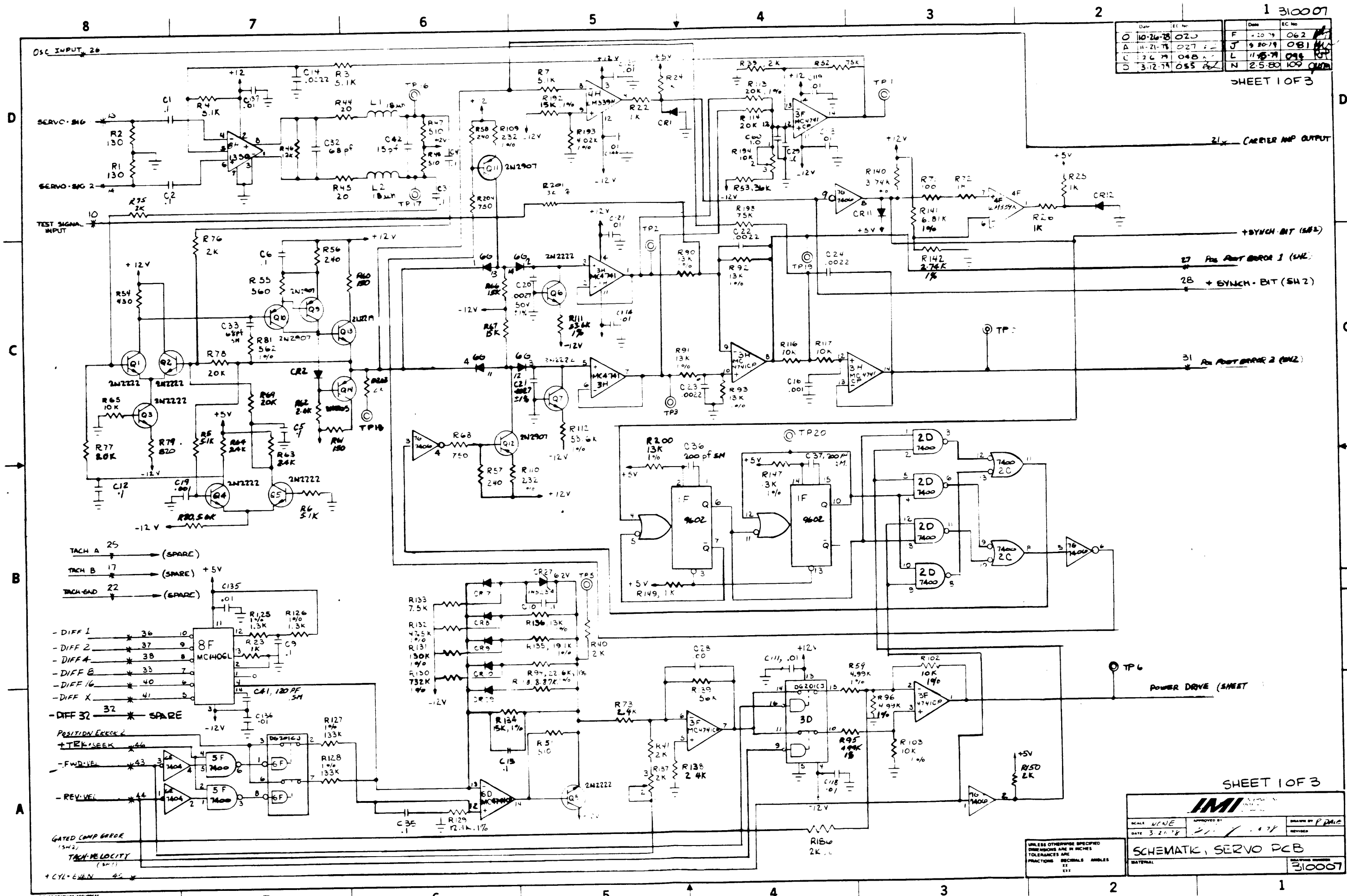
ITEM	DESCRIPTION	IMI P/N	QTY	LOCATION
7	CAP CER 50V .01uf	030056	0	SEE ITEM 7
108	IC SN74193	030838	0	7E
111	IC 17415CPI	030943	0	1B, 2E
112	IC MC3346	030990	0	5F



ASSEMBLY DWG, ASM 310176

DATE	N/A	DATE	
BY		BY	
CHECKED		CHECKED	
APPROVED		APPROVED	
DATE		DATE	
SCALE		SCALE	
TOLERANCES		TOLERANCES	
UNLESS OTHERWISE SPECIFIED		UNLESS OTHERWISE SPECIFIED	
ALL DIMENSIONS INCHES		ALL DIMENSIONS INCHES	
FRACTIONAL =		FRACTIONAL =	
DECIMAL =		DECIMAL =	
ANGULAR =		ANGULAR =	
		PCB ASM, SERVO	
D		310176	C
SHEET 1 OF 2		REV.	

Date	EC No	Date	EC No
O 10-26-78	020	F 1-20-79	062
A 11-21-78	027	J 5-20-79	081
C 2-6-79	048	L 11-15-79	098
D 3-12-79	055	N 2-5-80	109



OSC INPUT 26

SERVO-SIG 15

SERVO-SIG 2 4

TEST SIGNAL INPUT 10

TACH A 25 (SPARE)

TACH B 17 (SPARE)

TACH-EN 22 (SPARE)

- DIFF 1 36

- DIFF 2 37

- DIFF 4 38

- DIFF B 33

- DIFF 16 40

- DIFF X 41

- DIFF 32 32 SPARE

POSITION ERROR 2

+TEK-SEEK 43

-FWD-VEL 43

-REV-VEL 44

GATED COMP GATE 1542

TACH-VELOCITY 1542

+CYL-EVEN 45

21x CARRIER AMP OUTPUT

+SYNCH-BIT (SH 2)

27 Pos. REV. BURR 1 (SH 2)

28 + SYNCH-BIT (SH 2)

31 Pos. REV. BURR 2 (SH 2)

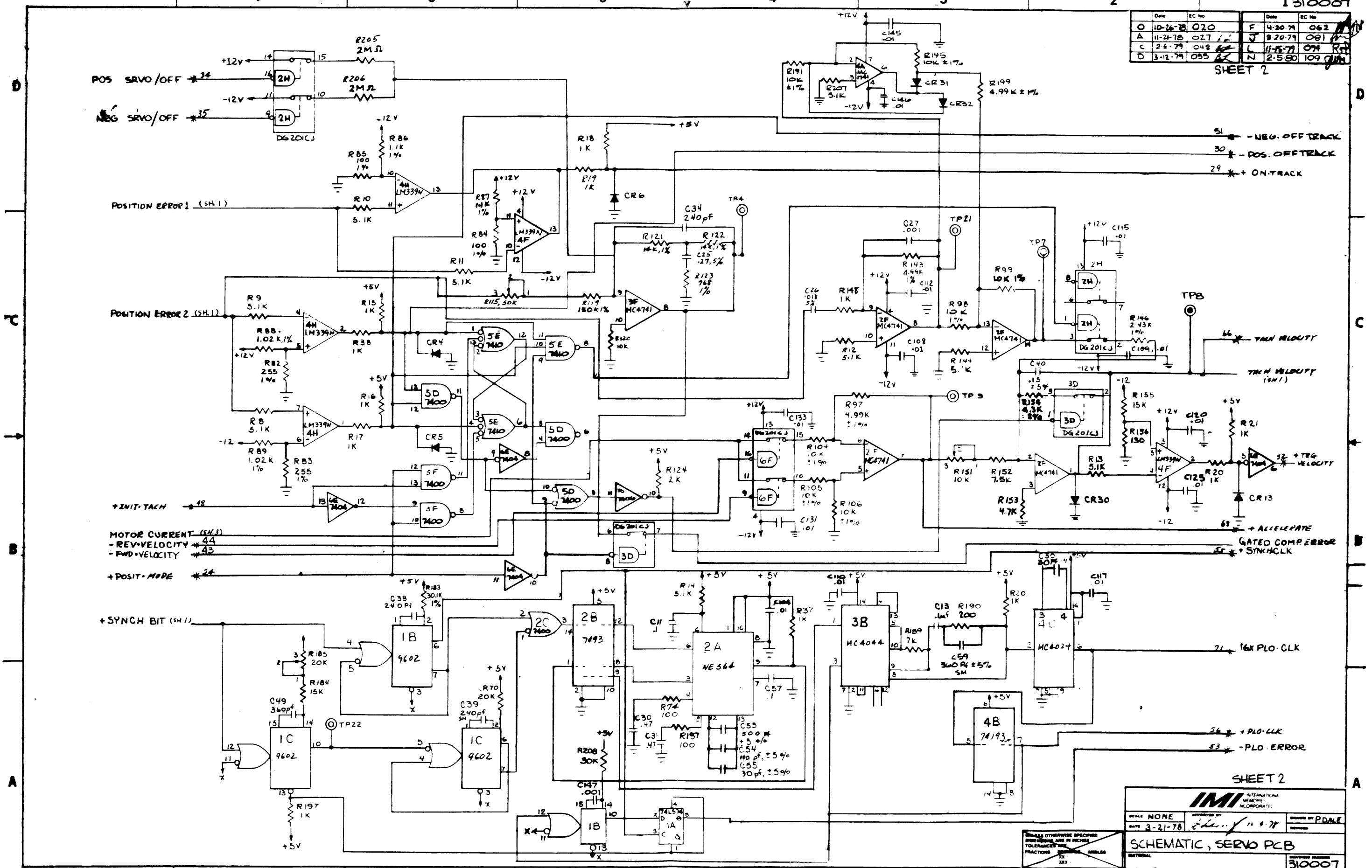
POWER DRIVE (SHEET 1)

IMC		DATE 3-21-78		APPROVED BY	DRAWN BY P. DALC
SCALE 1/16"	REVISED	DATE 3-21-78		REVISION	REVISION
SCHEMATIC, SERVO PCB					
MATERIAL				DRAWING NUMBER 310007	

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES ARE  
FRACTIONS DECIMALS ANGLES  
XX .XX

Date	EC No	Date	EC No
O 10-26-78	020	F 4-20-79	062
A 11-24-78	027	J 8-20-79	081
C 2-6-79	048	L 11-15-79	094
D 3-12-79	055	N 2-5-80	109

SHEET 2



SCHEMATIC DWG, ASM 310006 (2 OF 3)

SHEET 2

**IMI** INTERNATIONAL MEMORY CORPORATION

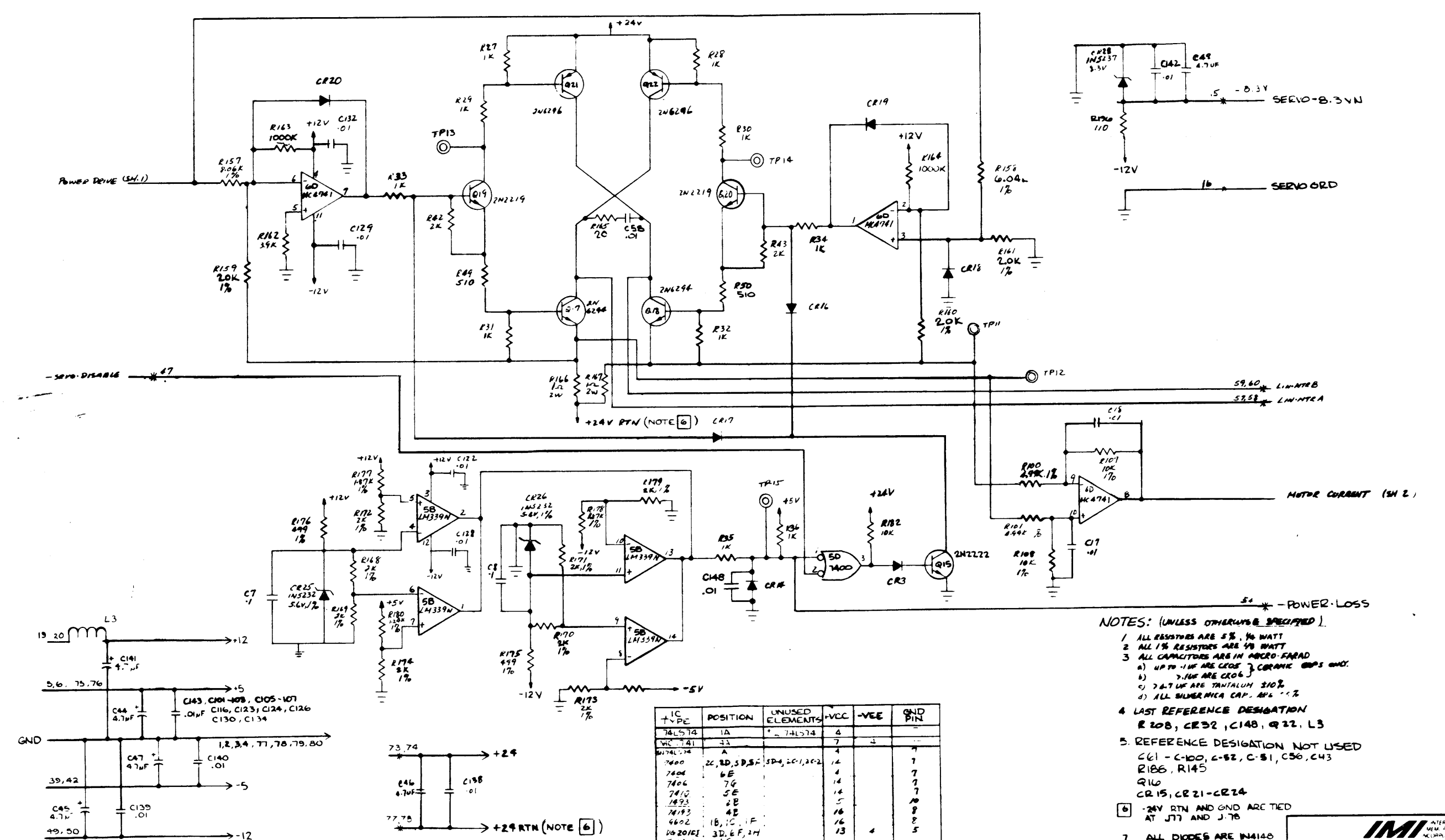
SCALE: NONE  
 DATE: 3-21-78  
 APPROVED BY: [Signature]  
 DRAWN BY: P. DALE

SCHEMATIC, SERVO PCB

310007

Date	EC No	Date	EC No
10-26-78	020	4/24/79	062
11-21-78	027	8-20-79	081
2-6-79	048	11-15-79	092
3-17-79	055	2-5-80	109

SHEET 3



- NOTES: (UNLESS OTHERWISE SPECIFIED)
- 1 ALL RESISTORS ARE 5%, 1/8 WATT
  - 2 ALL 1% RESISTORS ARE 1/8 WATT
  - 3 ALL CAPACITORS ARE IN MICRO-FARAD
    - a) UP TO .1UF ARE CERAMIC
    - b) .1UF ARE CERAMIC
    - c) .1UF ARE TANTALUM 50%
    - d) ALL SILVER MICA CAP. ARE 1%
  - 4 LAST REFERENCE DESIGNATION  
R 200, CR 22, C148, Q 22, L 3
  5. REFERENCE DESIGNATION NOT USED  
C 61 - C 100, C-82, C-81, C50, C43  
R166, R145  
Q16  
CR15, CR21-CR24
  - 6 -24V RTN AND GND ARE TIED AT J77 AND J-78
  7. ALL DIODES ARE IN4148 OR EQUIV.

IC	TYPE	POSITION	UNUSED ELEMENTS	+VCC	-VEE	GND PIN
74LS74	1A	2	74LS74	4	-	-
MC741	33	3	-	7	-	-
7400	2C, 2D, 2E, 2F	3D, 2C, 1, 2, 2	12	-	-	7
7404	6E	-	4	-	-	7
7406	7G	-	14	-	-	7
7410	5E	-	14	-	-	7
7413	2B	-	5	-	-	7
74193	4B	-	16	-	-	8
4602	1B, 1C, 1F	-	16	-	-	8
062016J	3D, 6F, 2H	-	13	4	-	5
521124	4G	-	-	-	-	-
LM339N	4F, 4H, 5B	4F-3	3	12	-	-
MC150	5H	-	2	-	2, 3	-
MC1462	8F	-	11	3	4	-
741	4C	-	10, 1	3	5, 7, 9	-
MC1444	3B	-	10, 1	-	7	-
MC4741	2F, 3F, 2H, 2V	-	4	-	11	-
74242	2A	-	1, 10	-	8	-

SCHMATIC DWG, ASM 310006 (3 OF 3)

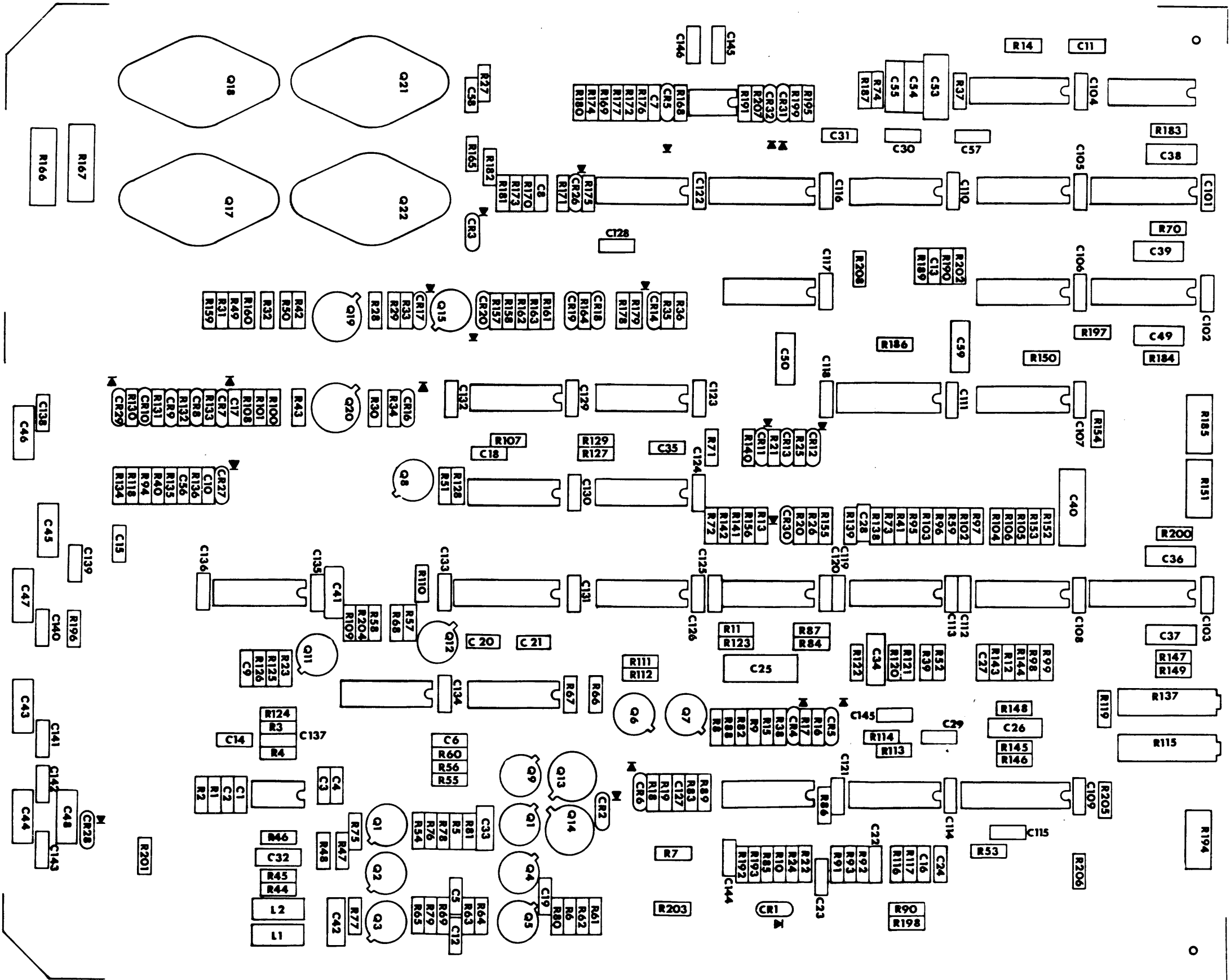
SHEET 3

**IMI** INTERNATIONAL  
MEMBER OF THE  
MICRO-MATEL

SCALE: NONE  
DATE: 3-21-78  
APPROVED BY: *[Signature]*  
DESIGNED BY: RDM  
REVIEWED:

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES ARE  
FRACTIONS DECIMALS ANGLES  
MATERIAL: 310006  
310007

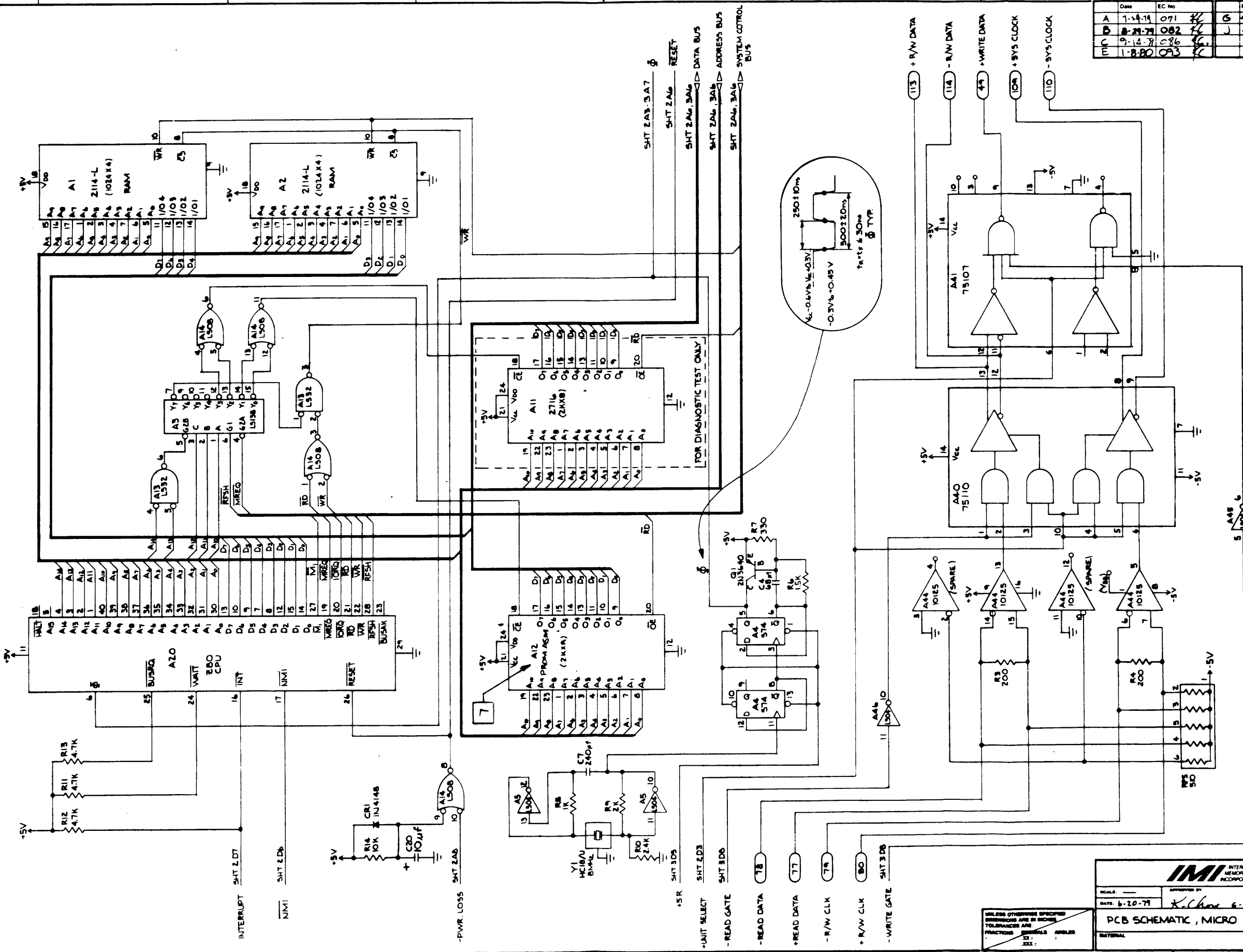




REDUCE TO 8.000T .005

ASSEMBLY DWG, ASM 310006

310072		1	
Date	EC No	Date	EC No
A 1-14-74	071	G 4-8-80	106
B 8-27-77	082	J 4-8-88	106
C 1-14-77	086		
D 8-8-80	093		



- NOTES (UNLESS OTHERWISE SPECIFIED)
- THIS SCHEMATIC REFLECTS ASM: 310071 W/O SKIP DEFECT CIRCUIT. SEE ASM 310086 FOR SKIP DEFECT CIRCUIT.
  - ALL SN74XX SERIES IC'S: (14 PIN) +5V AT PIN 14, GND AT PIN 7 (16 PIN) +5V AT PIN 16, GND AT PIN 8
  - INSTALLED AT PROGRAMMED ASM OPERATION
  - ALL CAPACITORS ARE IN  $\mu$ F
  - ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
  - (PIN) - DENOTES EDGE CONNECTOR PIN NO. PINS AND TYP ARE NOT USED ON PCB LEVEL.
  - ASMA REV. 7 FOR REV. 0 ONLY

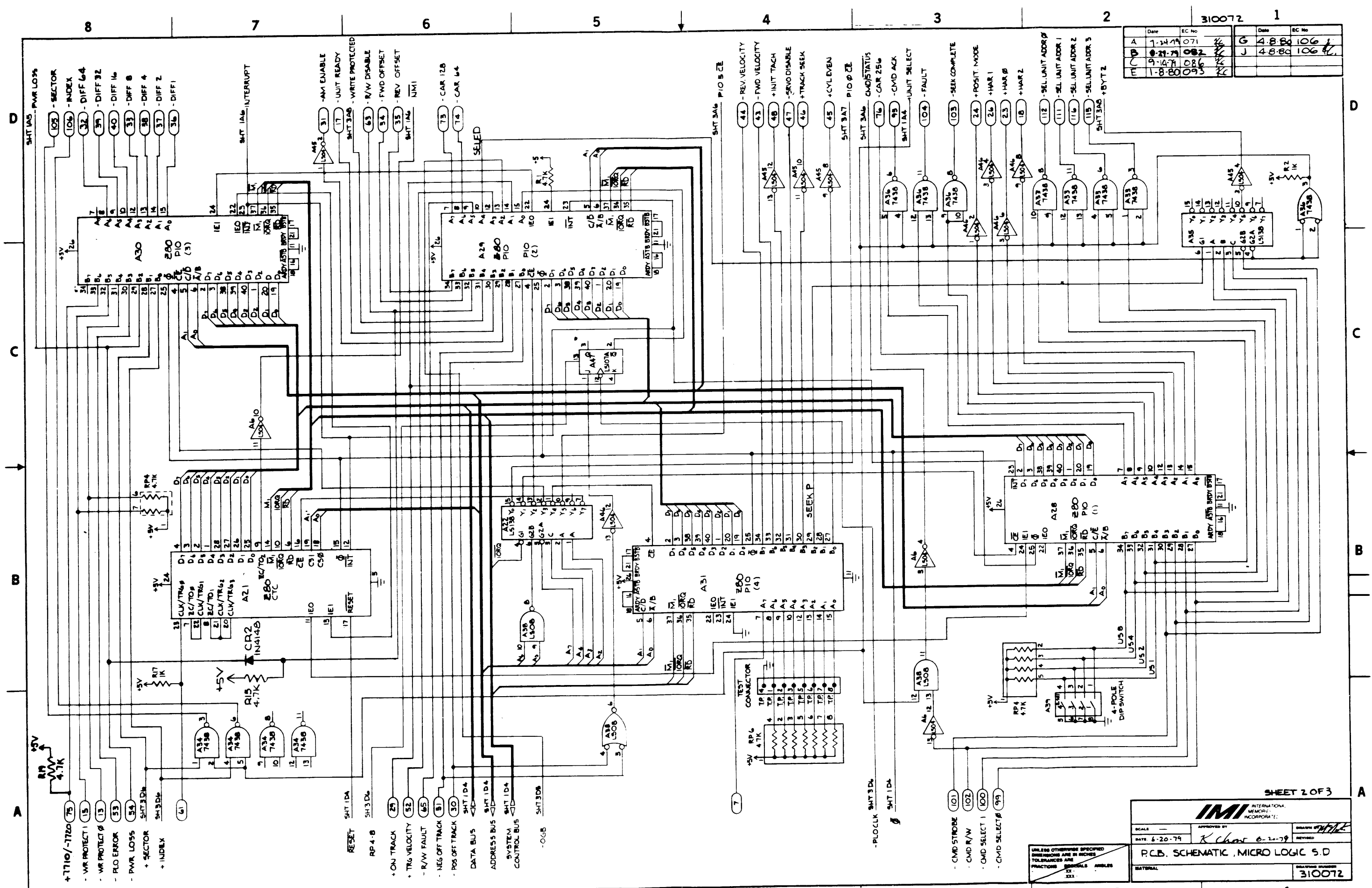
SHEET 1 OF 3

**IMI** INTERNATIONAL MEMORIES INCORPORATED

SCALE: \_\_\_\_\_ APPROVED BY: *K. Chow* 6-20-79  
 DATE: 6-20-79  
 DRAWN BY: *M. J. ...*  
 CHECKED BY: \_\_\_\_\_  
 PCB SCHEMATIC, MICRO LOGIC, S.D.  
 MATERIAL: \_\_\_\_\_  
 310072

SCHMATIC DWG, ASM 310071 (1 OF 3)

310072		1	
Date	EC No	Date	EC No
7-24-79	071	4-8-80	106
9-21-79	082	J	4880
1-8-80	086		106
	093		



SHEET 2 OF 3

**IMI** INTERNATIONAL  
MEMORIAL CORPORATION

APPROVED BY: *R. Chao* DATE: 6-20-79

DATE: 6-20-79

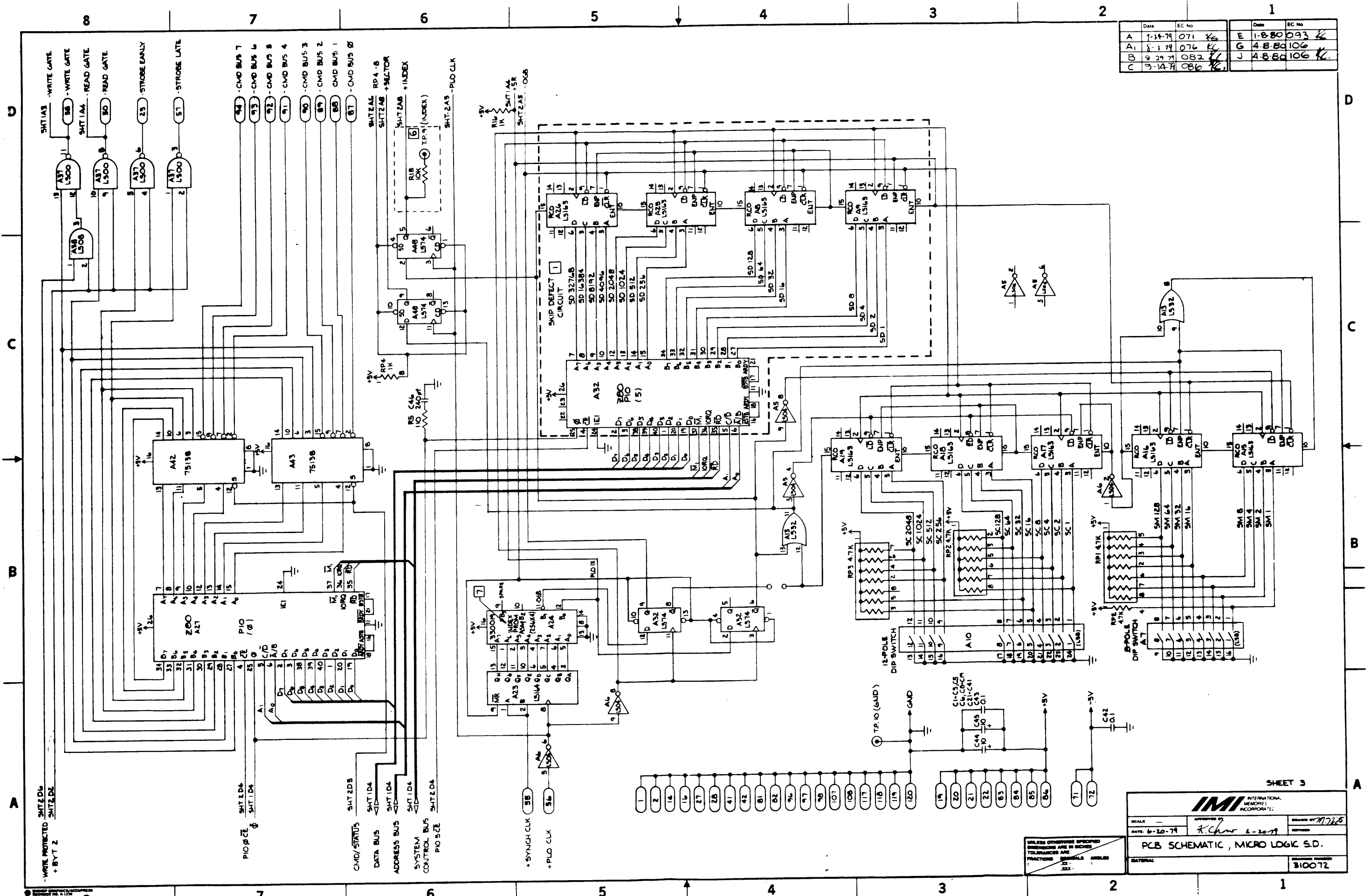
P.C.B. SCHEMATIC, MICRO LOGIC 5.0

MATERIAL: *XXXXXXXXXX*

310072

SCHEMATIC DWG, ASM 310071 (2 OF 3)

Date	EC No	Date	EC No
A 7-14-79	071 Ks	E 1-8-80	093 Ks
A1 8-1-79	076 Ks	G 4-8-80	106 Ks
B 9-24-79	082 Ks	J 4-8-80	106 Ks
C 9-14-79	086 Ks		

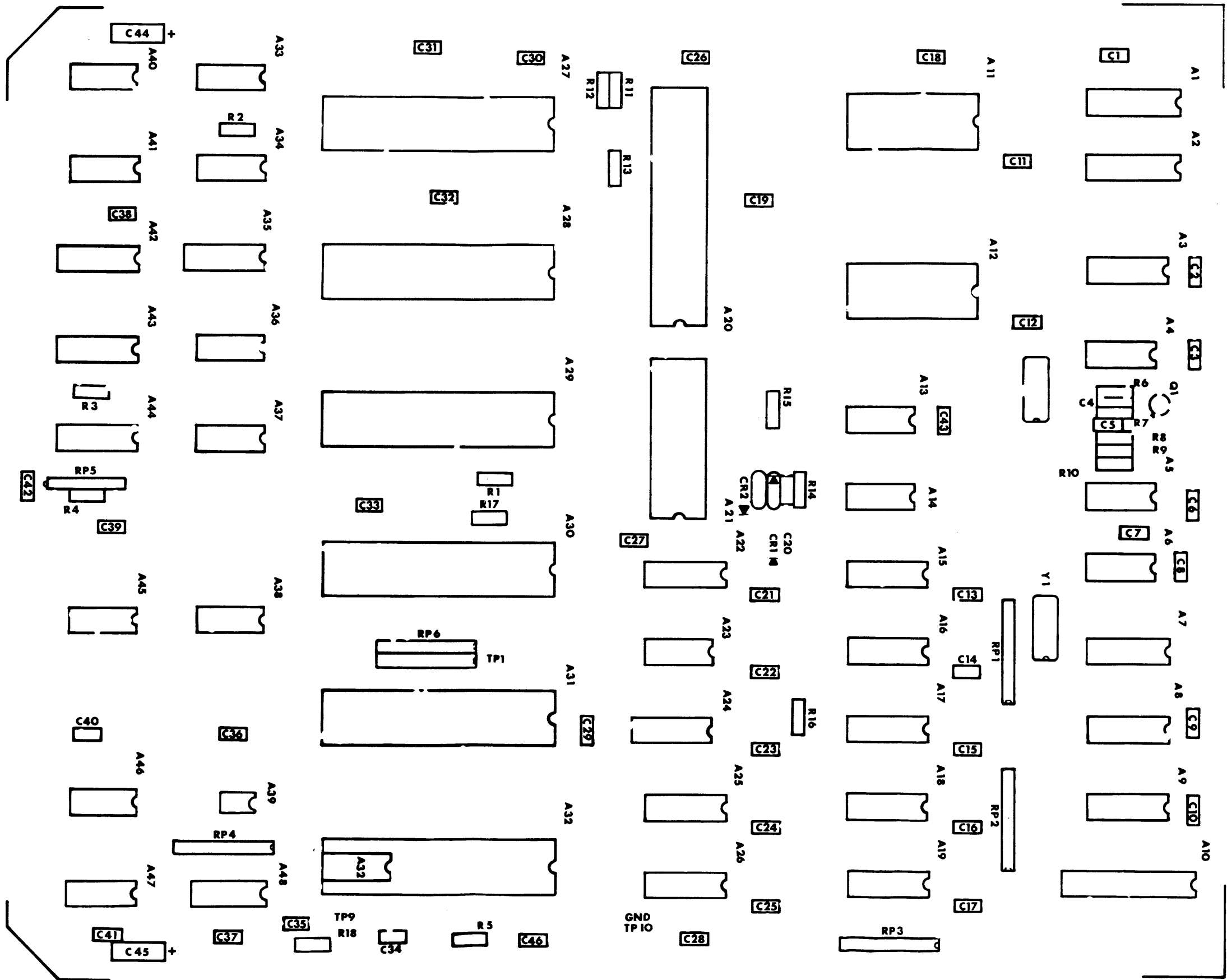


SCHEMATIC DWG, ASM 310071 (3 OF 3)

SHEET 3

<b>IMI</b> INTERNATIONAL MEMORIES INCORPORATED	
SCALE	APPROVED BY <i>R. Chow</i>
DATE 6-20-79	DESIGNED BY <i>M. J. 125</i>
PCB SCHEMATIC, MICRO LOGIC S.D.	
MATERIAL	
310072	

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES ARE  
FRACTIONS DECIMALS ANGLES  
XX  
XXX



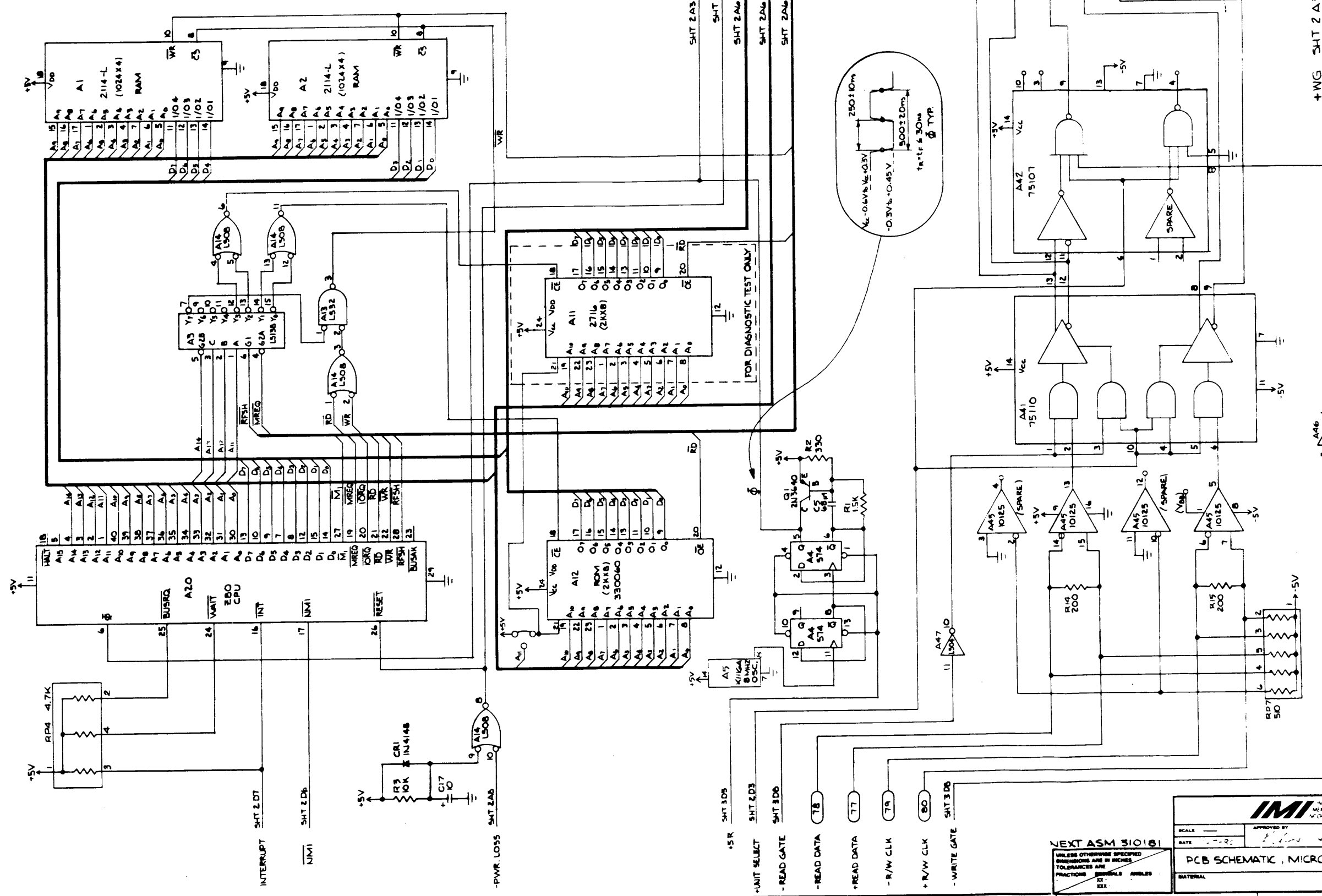
310073  
REV-B  
SH 4



ASSEMBLY DWG, ASM 310071



Date	EC No	
A 4-8-80	120	
Date	EC No	



- NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL SN74XX SERIES IC'S: (14 PIN) +5V AT PIN 14, GND AT PIN 7 (16 PIN) +5V AT PIN 16, GND AT PIN 8
  2. ALL CAPACITOR ARE IN  $\mu$ F.
  3. ALL RESISTORS ARE IN OHMS, 1/4 W 5%.
  4. (PIN#) - DFNOTES EDGE CONNECTOR PIN NO.

D  
C  
B  
A

D  
C  
B  
A

SCHMATIC DWG, ASM 310181 (1 OF 3)

IMM International Microelectronics

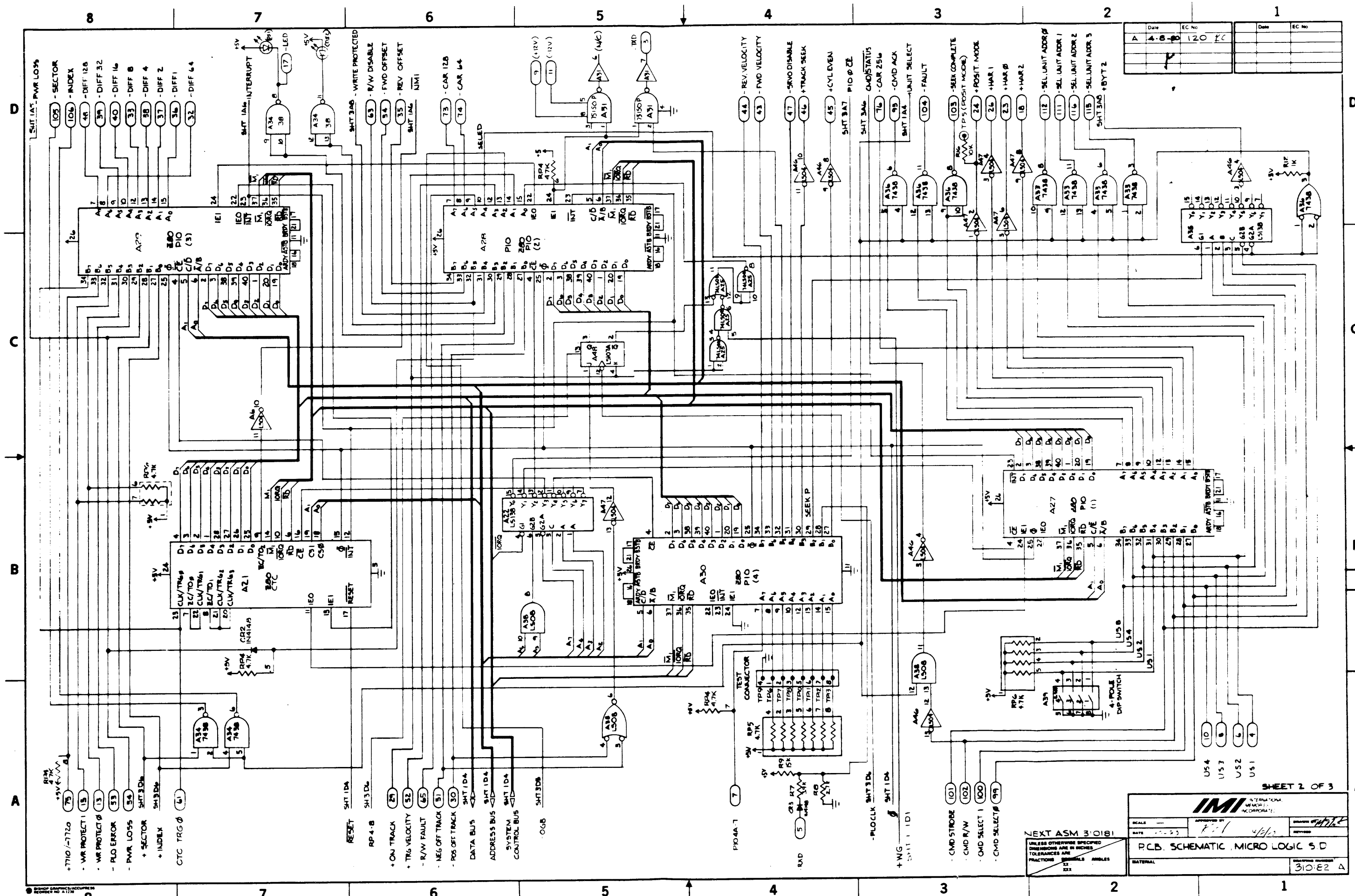
SCALE: --- DATE: 4-8-80 APPROVED BY: [Signature] DRAWN BY: [Signature] REVISED: ---

MATERIAL: PCB SCHEMATIC, MICRO LOGIC, S.D.

3 0182 A

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES DEG.

Date	EC No	Date	EC No
A 4-6-80	120 KC		

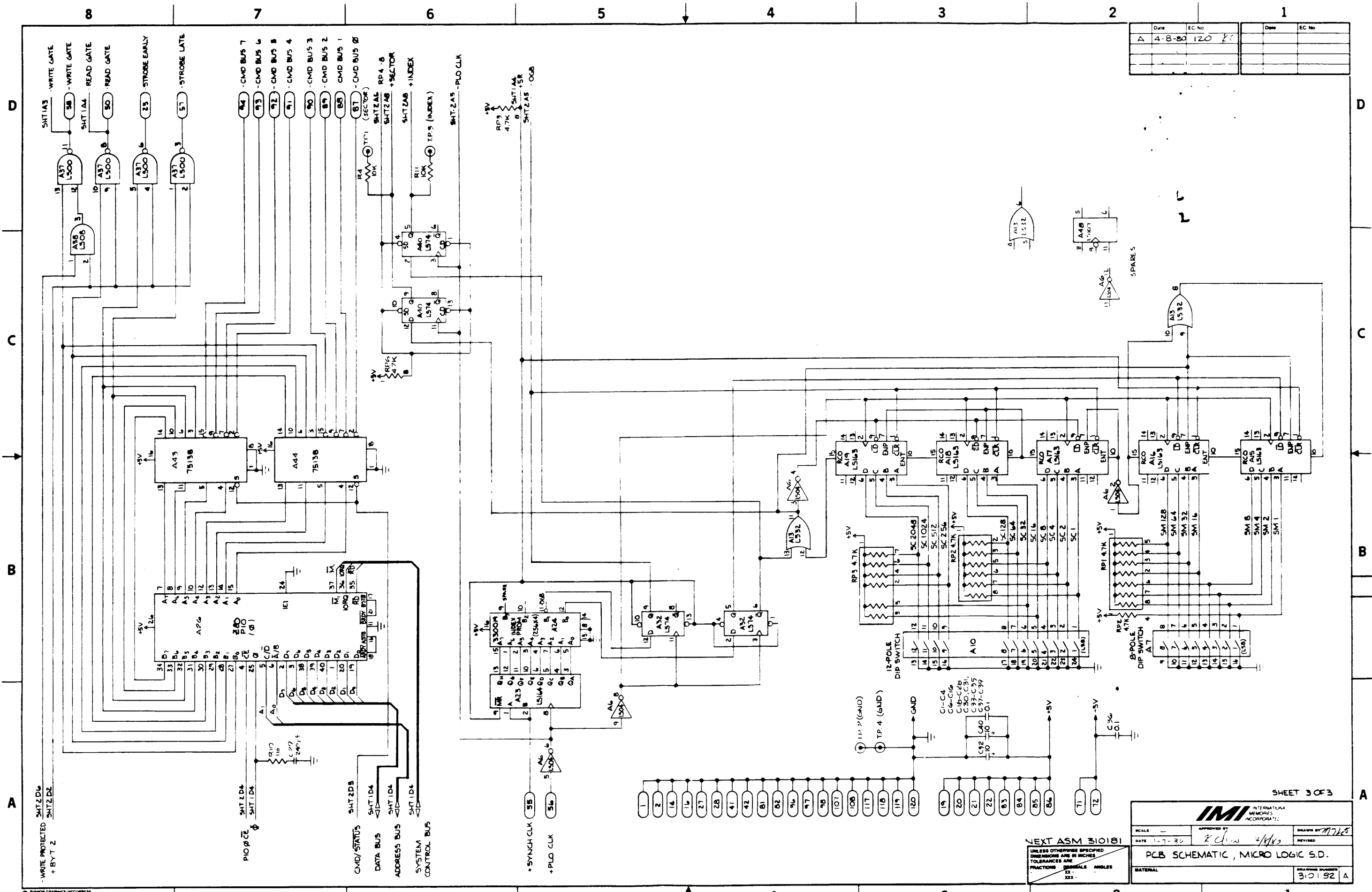


SHEET 2 OF 3

<b>IMI</b> INTERNATIONAL MICROLOGIC CORPORATION	
SCALE	APPROVED BY <i>[Signature]</i>
DATE	REVISED
P.C.B. SCHEMATIC MICRO LOGIC 5 D	
MATERIAL	
310-E2-A	

SCHEMATIC DWG, ASM 310181 (2 OF 3)

Date	EC No	Date	EC No
A 4-8-80	120 KC		

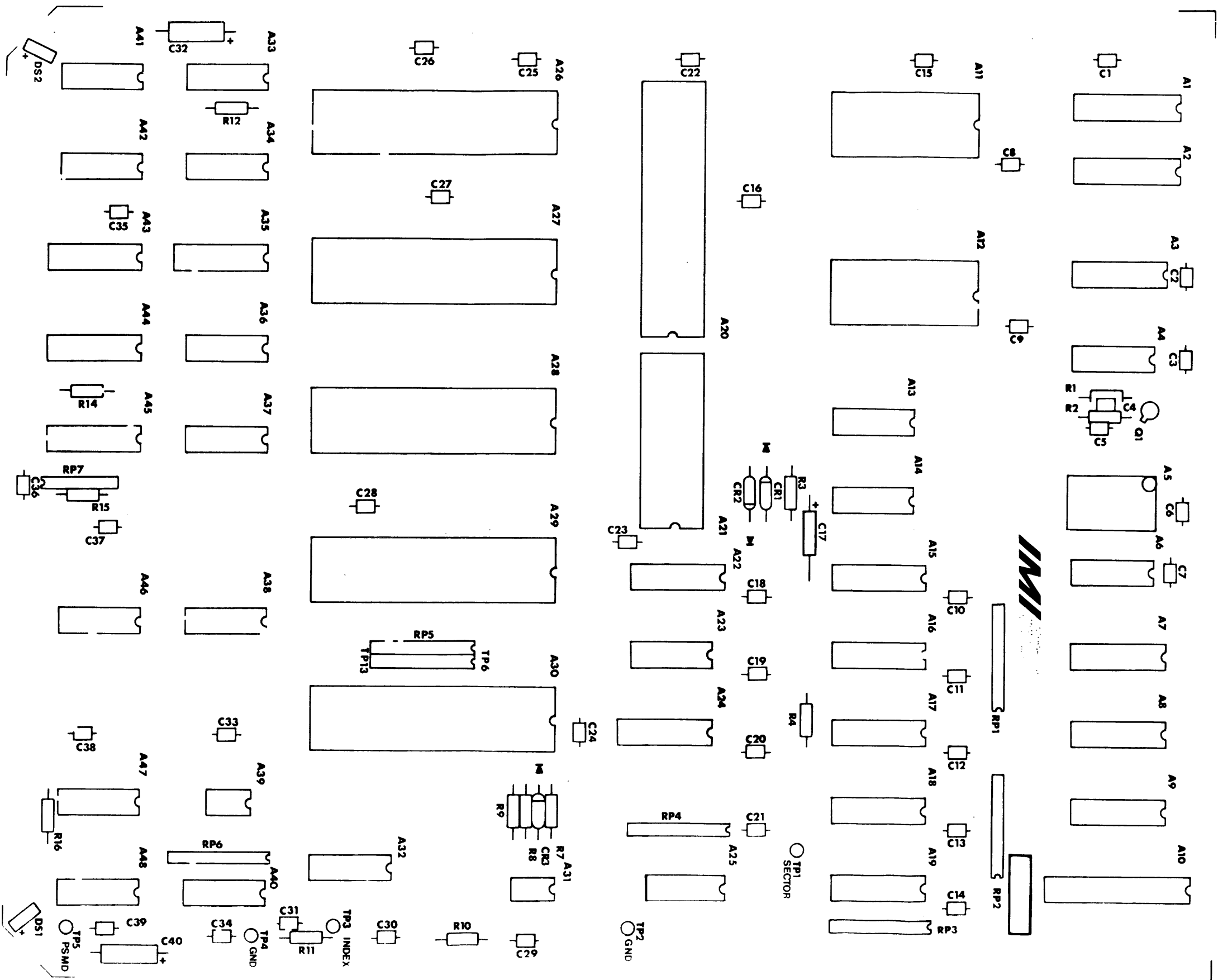


		DATE	APPROVED BY	DRAWN BY
		1-7-80	R. C. Jones	M. J. Jones
PCB SCHEMATIC, MICRO LOGIC 5.D.				
MATERIAL		DATE THIS NUMBER	310182 A	

NEXT ASM 310181  
 UNLESS OTHERWISE SPECIFIED  
 DIMENSIONS ARE IN INCHES  
 TOLERANCES ARE:  
 FRACTIONS DECIMALS ANGLES  
 .125 .010 .010

SCHEMATIC DWG, ASM 310181 (3 OF 3)





ASSEMBLY DWG, ASM 310181

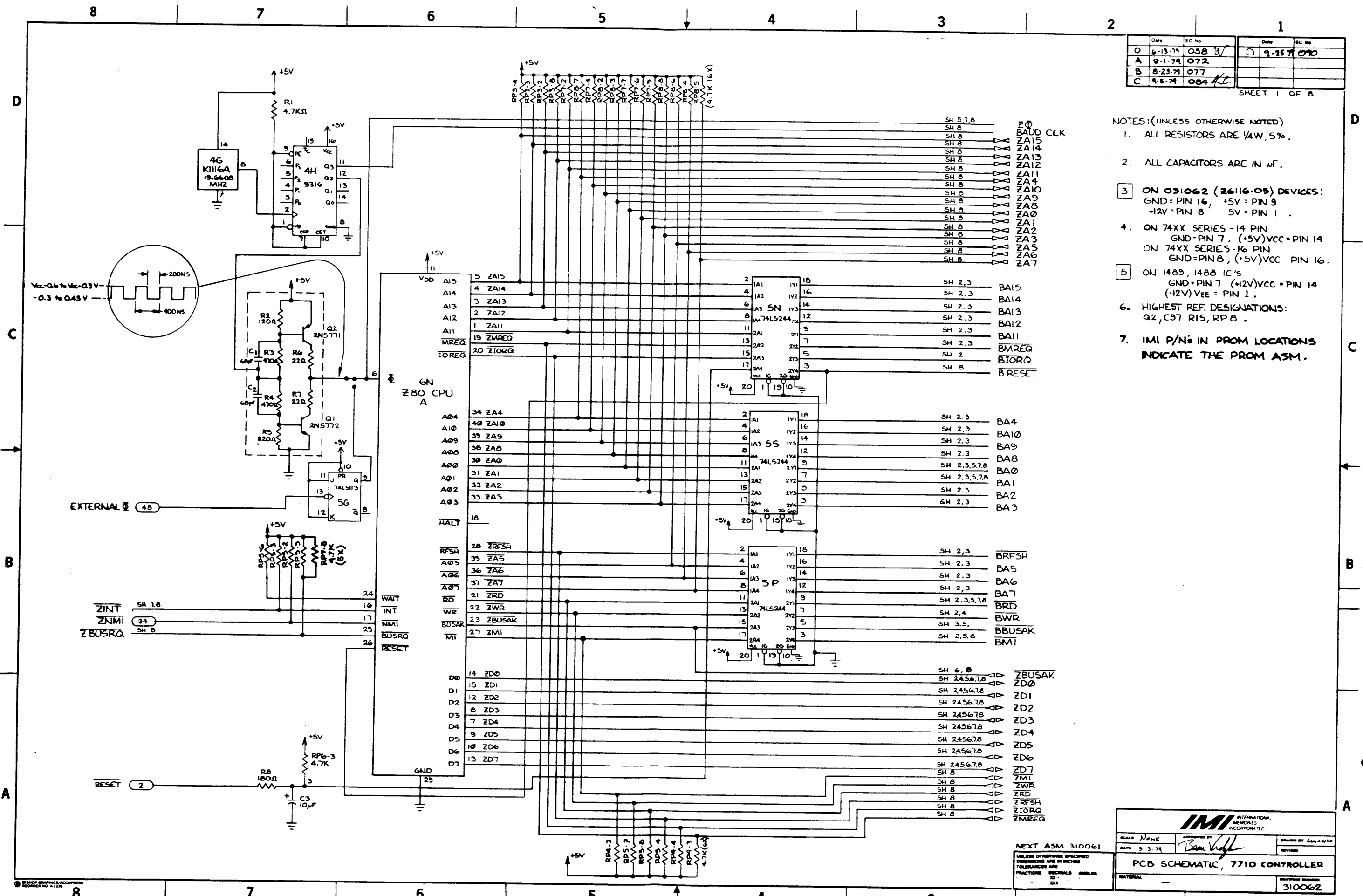
MICRO-LOGIC  
**310183**  
 REV - A  
 LEGEND  
 SHEET 4 of 4

Date	EC No	Date	EC No
0 6-13-79	058 B/	0 9-26-79	090
A 8-11-79	072		
B 8-23-79	077		
C 9-5-79	084 K.		

SHEET 1 OF 8

NOTES: (UNLESS OTHERWISE NOTED)

- ALL RESISTORS ARE 1/4W, 5%.
- ALL CAPACITORS ARE IN  $\mu$ F.
- ON 031062 (Z6116-05) DEVICES:  
GND = PIN 16, +5V = PIN 9  
+12V = PIN 8, -5V = PIN 1.
- ON 74XX SERIES -14 PIN  
GND = PIN 7, (+5V)VCC = PIN 14  
ON 74XX SERIES -16 PIN  
GND = PIN 8, (+5V)VCC = PIN 16.
- ON 1489, 1488 IC'S  
GND = PIN 7 (+12V)VCC = PIN 14  
(-12V) VEE = PIN 1.
- HIGHEST REF. DESIGNATIONS:  
Q2, C97 R15, RP8.
- IMI P/N'S IN PROM LOCATIONS  
INDICATE THE PROM ASM.



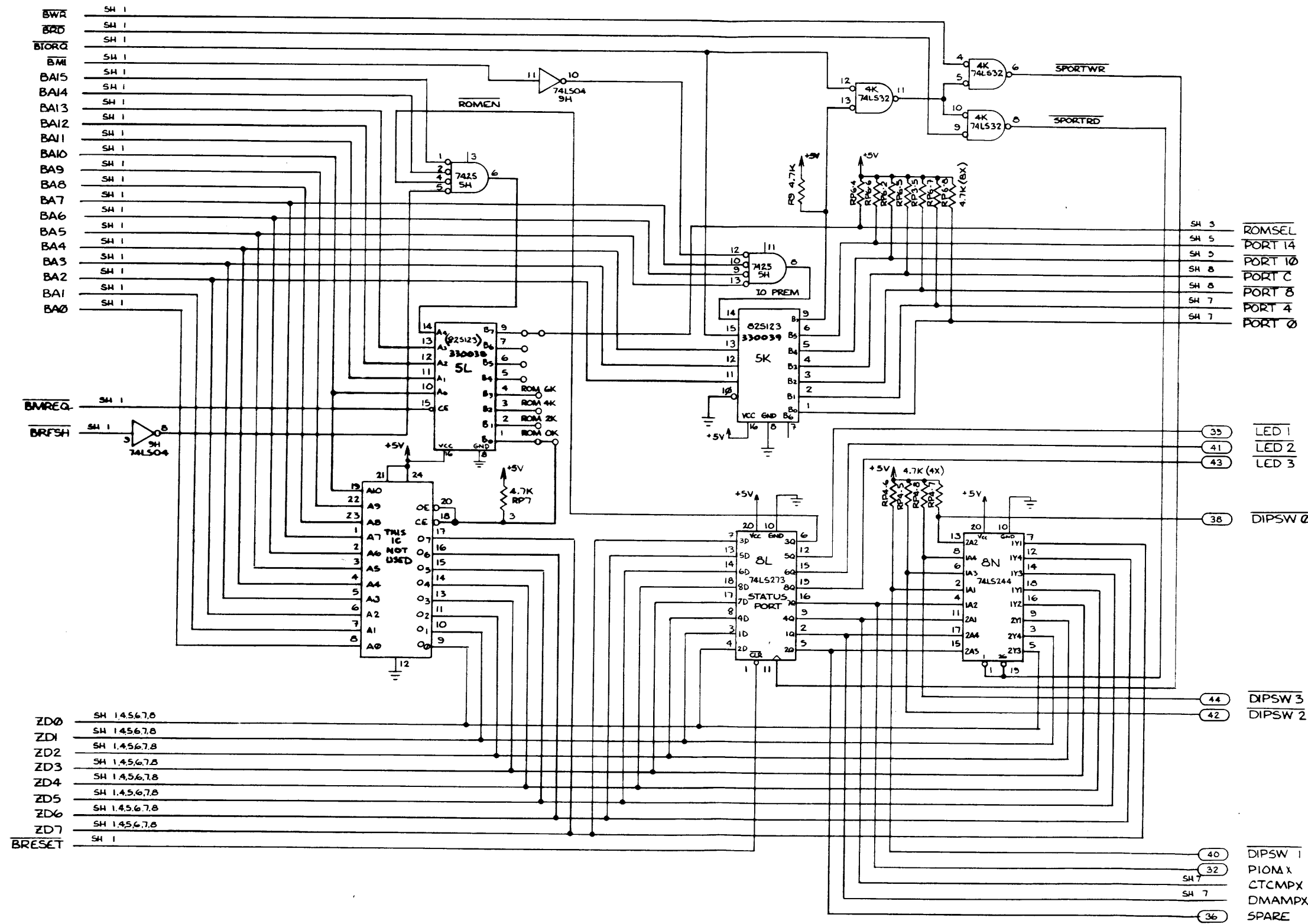
SCHEMATIC DWG, ASM 310061 (1 OF 8)

<b>IMI</b> INTERNATIONAL MEMORIES INCORPORATED	
SCALE NONE	APPROVED BY <i>Ben Hoff</i>
DATE 5-3-79	DESIGNED BY GARY GARDNER
<b>PCB SCHEMATIC, 7710 CONTROLLER</b>	
MATERIAL	
310062	

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REPRODUCED BY PERMISSION

Date	EC No	Date	EC No
0 6-13-79	058 JV	0 9-27-79	070
A 8-22-79	072		
B 8-23-79	077		
C 9-5-79	089		

SHEET 2



- ZD0 SH 1,4,5,6,7,8
- ZD1 SH 1,4,5,6,7,8
- ZD2 SH 1,4,5,6,7,8
- ZD3 SH 1,4,5,6,7,8
- ZD4 SH 1,4,5,6,7,8
- ZD5 SH 1,4,5,6,7,8
- ZD6 SH 1,4,5,6,7,8
- ZD7 SH 1
- BRESET SH 1

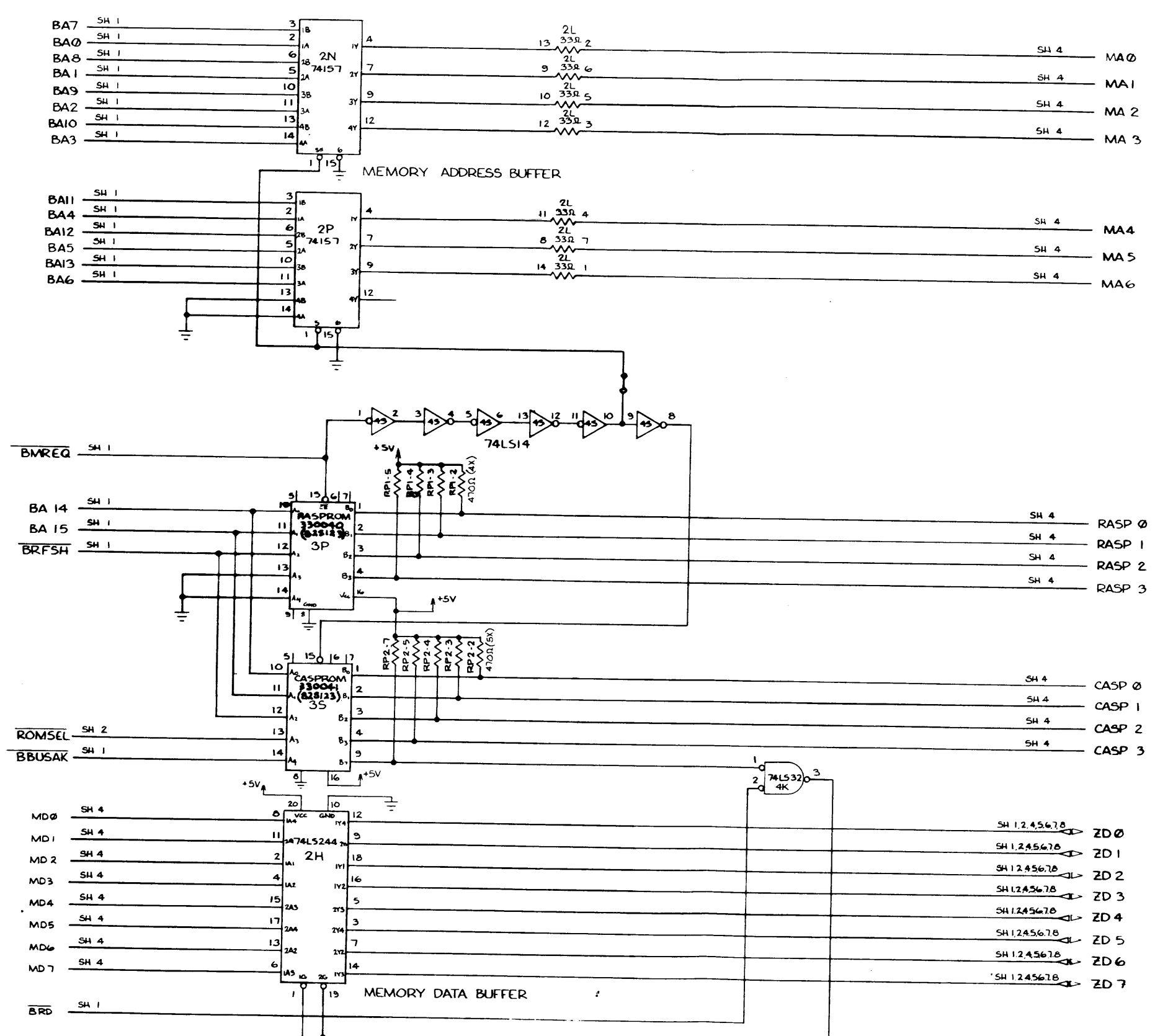
UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES ARE  
FRACTIONS DECIMALS ANGLES  
XXX .XXX .XXX

<b>IMI</b> INTERNATIONAL MEMORIES CORPORATION		
SCALE	APPROVED BY	DRAWN BY GUNNING
DATE	REVIEWED	
PCB SCHEMATIC, 7710 CONTROLLER		
MATERIAL	DRAWING NUMBER	
	310062	

SCHMATIC DWG, ASM 310061 (2 OF 8)

Date	EC No	Date	EC No
6-13-77	058	9-24-77	090
8-1-77	072		
8-23-77	077		
9-1-77	089		

SHEET 3



SCHEMATIC DWG, ASM 310061 (3 OF 8)

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES ARE  
FRACTIONS DECIMALS ANGLES  
XX .XXX

**IMI** INTERNATIONAL  
MEMPHIS, TENNESSEE

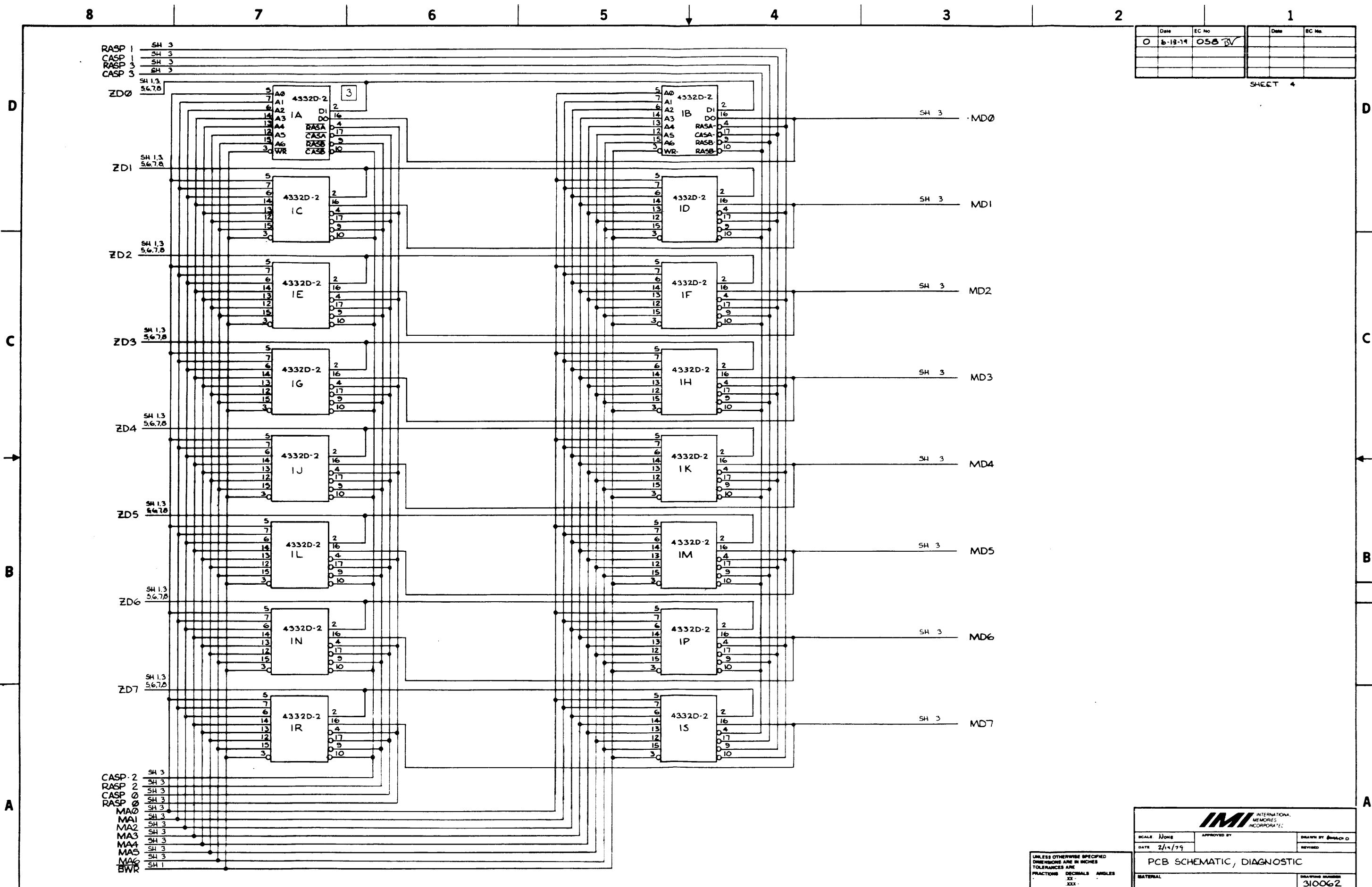
APPROVED BY: \_\_\_\_\_  
DATE: \_\_\_\_\_  
DRAWN BY: GUN, ALAN  
REVISED: \_\_\_\_\_

PCB SCHEMATIC, 7710 CONTROLLER

DRAWING NUMBER: 310062  
SHEET: 3

Date	EC No	Date	EC No
0	18-14	058	TV

SHEET 4



131

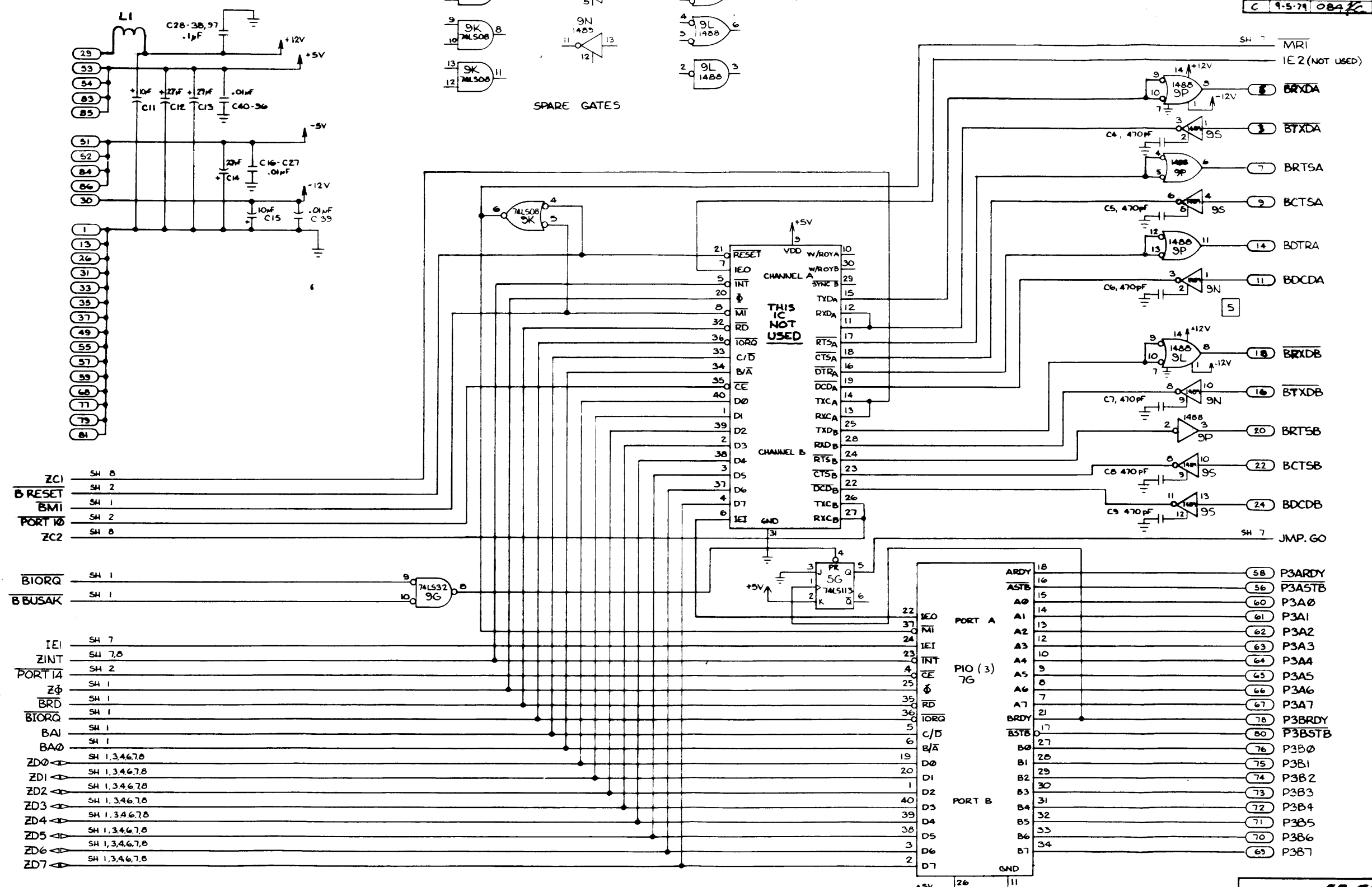
<b>IMI</b> INTERNATIONAL MEMORIES INCORPORATED	
SCALE: NONE	APPROVED BY:
DATE: 2/14/79	REVISION:
PCB SCHEMATIC, DIAGNOSTIC	
MATERIAL:	DRAWING NUMBER: 3100G2

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES ARE  
FRACTIONS DECIMALS ANGLES  
.XX  
.XXX

SCHMATIC DWG, ASM 310061 (4 OF 8)

Date	EC No	Date	EC No
6-13-74	050 RV	9-24-74	090
8-1-74	072		
8-23-74	077		
9-5-74	084 K		

SHEET 5



- ZC1 SH 8
- B RESET SH 2
- BMI SH 1
- PORT 10 SH 2
- ZC2 SH 8
- BIORQ SH 1
- B BUSAK SH 1
- IEI SH 7
- ZINT SH 7,8
- PORT 14 SH 1
- Zφ SH 1
- BRD SH 1
- BIORQ SH 1
- BAI SH 1
- BAφ SH 1
- ZD0 SH 1,3,4,6,7,8
- ZD1 SH 1,3,4,6,7,8
- ZD2 SH 1,3,4,6,7,8
- ZD3 SH 1,3,4,6,7,8
- ZD4 SH 1,3,4,6,7,8
- ZD5 SH 1,3,4,6,7,8
- ZD6 SH 1,3,4,6,7,8
- ZD7 SH 1,3,4,6,7,8

- ARDY 18
- ASTB 16
- A0 15
- A1 14
- A2 13
- A3 12
- A4 10
- A5 9
- A6 8
- A7 7
- BRDY 21
- BSTB 17
- B0 27
- B1 28
- B2 29
- B3 30
- B4 31
- B5 32
- B6 33
- B7 34
- P3ARDY 58
- P3ASTB 56
- P3A0 60
- P3A1 61
- P3A2 62
- P3A3 63
- P3A4 64
- P3A5 65
- P3A6 66
- P3A7 67
- P3BRDY 78
- P3BSTB 80
- P3B0 76
- P3B1 75
- P3B2 74
- P3B3 73
- P3B4 72
- P3B5 71
- P3B6 70
- P3B7 69

**IMI** INTERNATIONAL MEMORIES INCORPORATED

SCALE: None APPROVED BY: DRAWN BY: CAMBERG

DATE: REVISED:

**PCB SCHEMATIC, 7710 CONTROLLER**

SATERIAL: DRAWING NUMBER: 310062

SCHMATIC DWG, ASM 310061 (5 OF 8)

Date	EC No	Date	EC No
6-13-79	058 TW	9-24-79	090
8-1-79	072		
8-23-79	077		
9-3-79	084 KC		

SHEET 6

8 7 6 5 4 3 2 1

DMACLKSW SH 7  
ZBUSAK SH 1  
ZBUSRQ SH 8  
WRITE SH 7  
READ SH 7

SH 8 CPU → DMA  
SH 8 DMA → BUS  
SH 8 DSCXFER  
SH 8 DSC WRDTEN  
SH 8 CK SW

SH 8 RST  
SH 7 DSC RDY

SH 8 DMADSC CLK

SH 13, 15, 16 (BX)  
ZD0  
ZD1  
ZD2  
ZD3  
ZD4  
ZD5  
ZD6  
ZD7

SH 8 WRITE DATA  
SH 7 CRC ERROR  
SH 8 CRC DATA

CHANNELRST SH 8

SYSCLK SH 8

RDAT SH 8

D

C

B

A

D

C

B

A

133

8 7 6 5 4 3 2 1

SCHEMATIC DWG, ASM 310061 (6 OF 8)

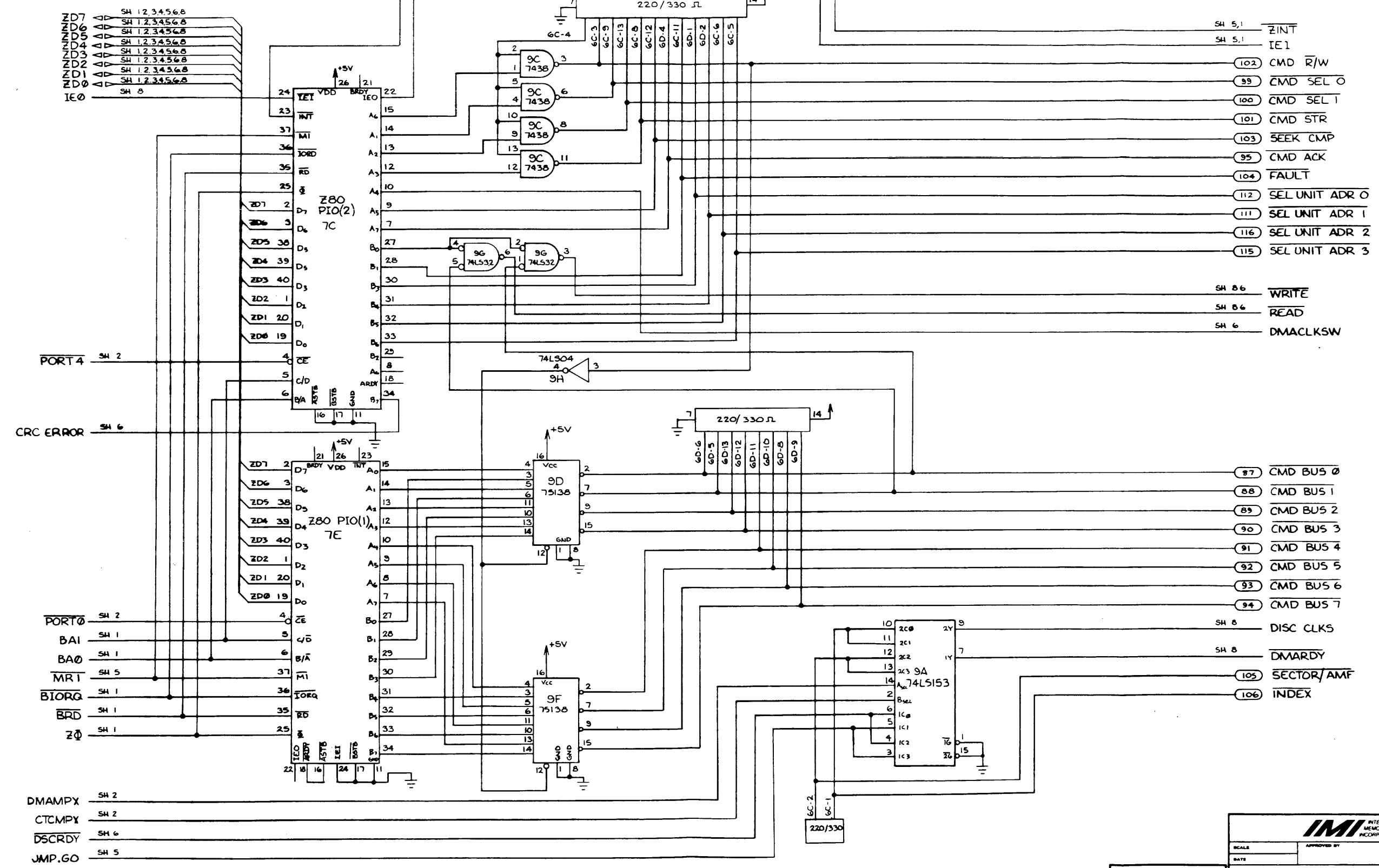
<b>IMI</b> INTERNATIONAL MEMORIES INCORPORATED	
SCALE	APPROVED BY
DATE	REVISION
<b>PCB SCHEMATIC, 7710 CONTROLLER</b>	
MATERIAL	DRAWING NUMBER
	<b>310062</b>

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES ARE:  
FRACTIONS DECIMALS ANGLES  
XX .XX .XX

1 SH 6

Date	EC No	Date	EC No
0 6-13-79	080 RV	D 9-24-79	090
A 8-1-79	072		
B 9-23-79	077		
C 9-5-79	084		

SHEET 7



- ZD7 SH 1,2,3,4,5,6,8
- ZD6 SH 1,2,3,4,5,6,8
- ZD5 SH 1,2,3,4,5,6,8
- ZD4 SH 1,2,3,4,5,6,8
- ZD3 SH 1,2,3,4,5,6,8
- ZD2 SH 1,2,3,4,5,6,8
- ZD1 SH 1,2,3,4,5,6,8
- ZD0 SH 8
- IE0 SH 8

- PORT 4 SH 2
- CRC ERROR SH 6

- PORT 0 SH 2
- BA1 SH 1
- BA0 SH 1
- MRI SH 5
- BIORG SH 1
- BRD SH 1
- ZQ SH 1

- DMAMPX SH 2
- CTCMPX SH 2
- DSCRDY SH 6
- JMP.GO SH 5

- SH 5,1 ZINT
- SH 5,1 IE1
- (102) CMD R/W
- (99) CMD SEL 0
- (100) CMD SEL 1
- (101) CMD STR
- (103) SEEK CMP
- (95) CMD ACK
- (104) FAULT
- (112) SEL UNIT ADR 0
- (111) SEL UNIT ADR 1
- (116) SEL UNIT ADR 2
- (115) SEL UNIT ADR 3
- SH 8,6 WRITE
- SH 8,6 READ
- SH 6 DMACKSW

- (87) CMD BUS 0
- (88) CMD BUS 1
- (89) CMD BUS 2
- (90) CMD BUS 3
- (91) CMD BUS 4
- (92) CMD BUS 5
- (93) CMD BUS 6
- (94) CMD BUS 7
- SH 8 DISC CLKS
- SH 8 DMARDY
- (105) SECTOR/AMF
- (106) INDEX

<b>IMI</b> INTERNATIONAL MEMORIES INCORPORATED	
SCALE	APPROVED BY
DATE	REVIEWED
<b>PCB SCHEMATIC, 7710 CONTROLLER</b>	
MATERIAL	DRAWING NUMBER
	<b>310062</b>

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES ARE:  
FRACTIONS DECIMALS ANGLES  
XXX .XXX .XXX

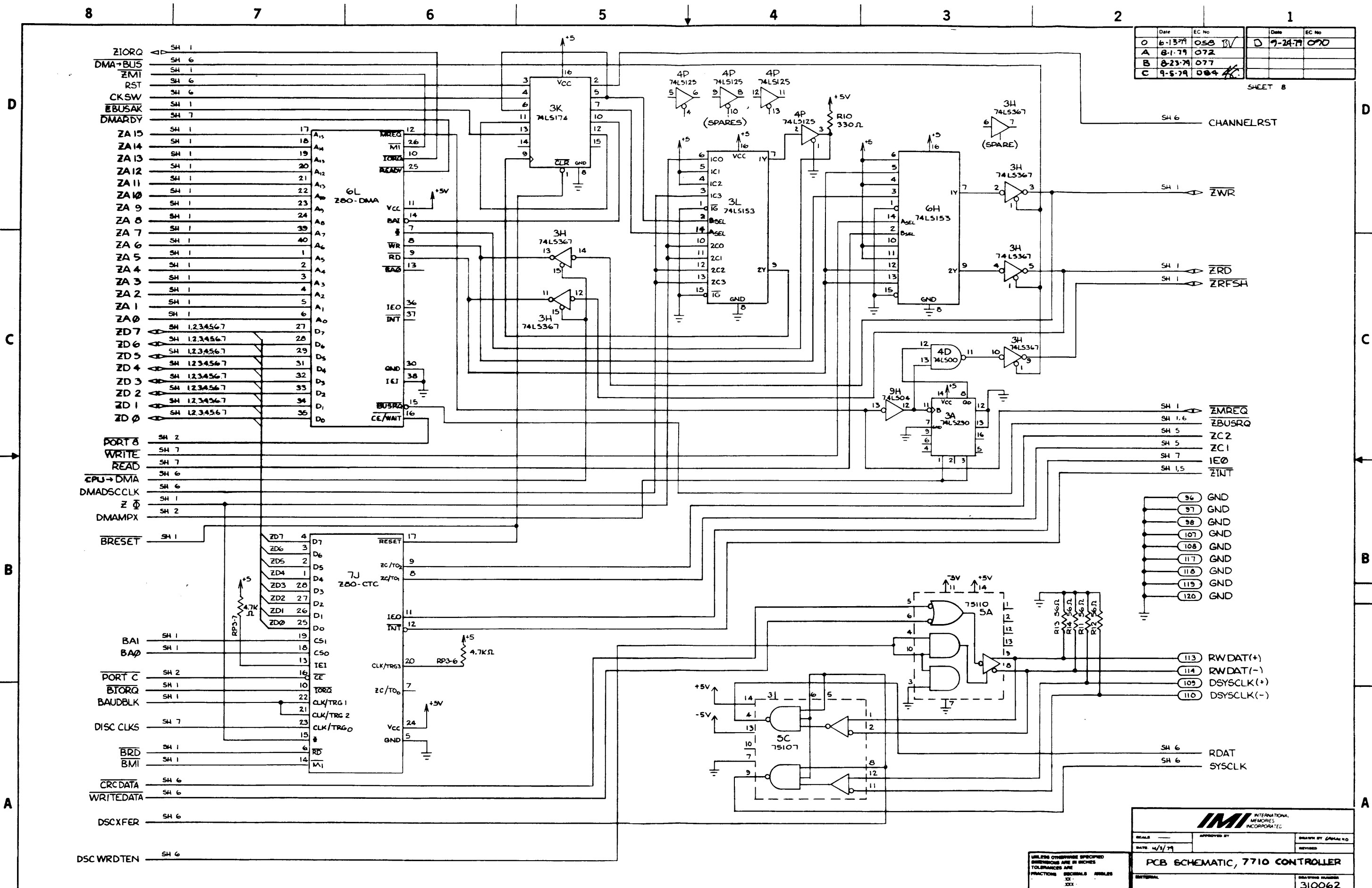
SCHMATIC DWG, ASM 310061 (7 OF 8)

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Date	EC No	Date	EC No
0 6-15-79	058 RV	0 7-24-79	070
A 8-1-79	072		
B 8-23-79	077		
C 9-5-79	084		

SHEET 8

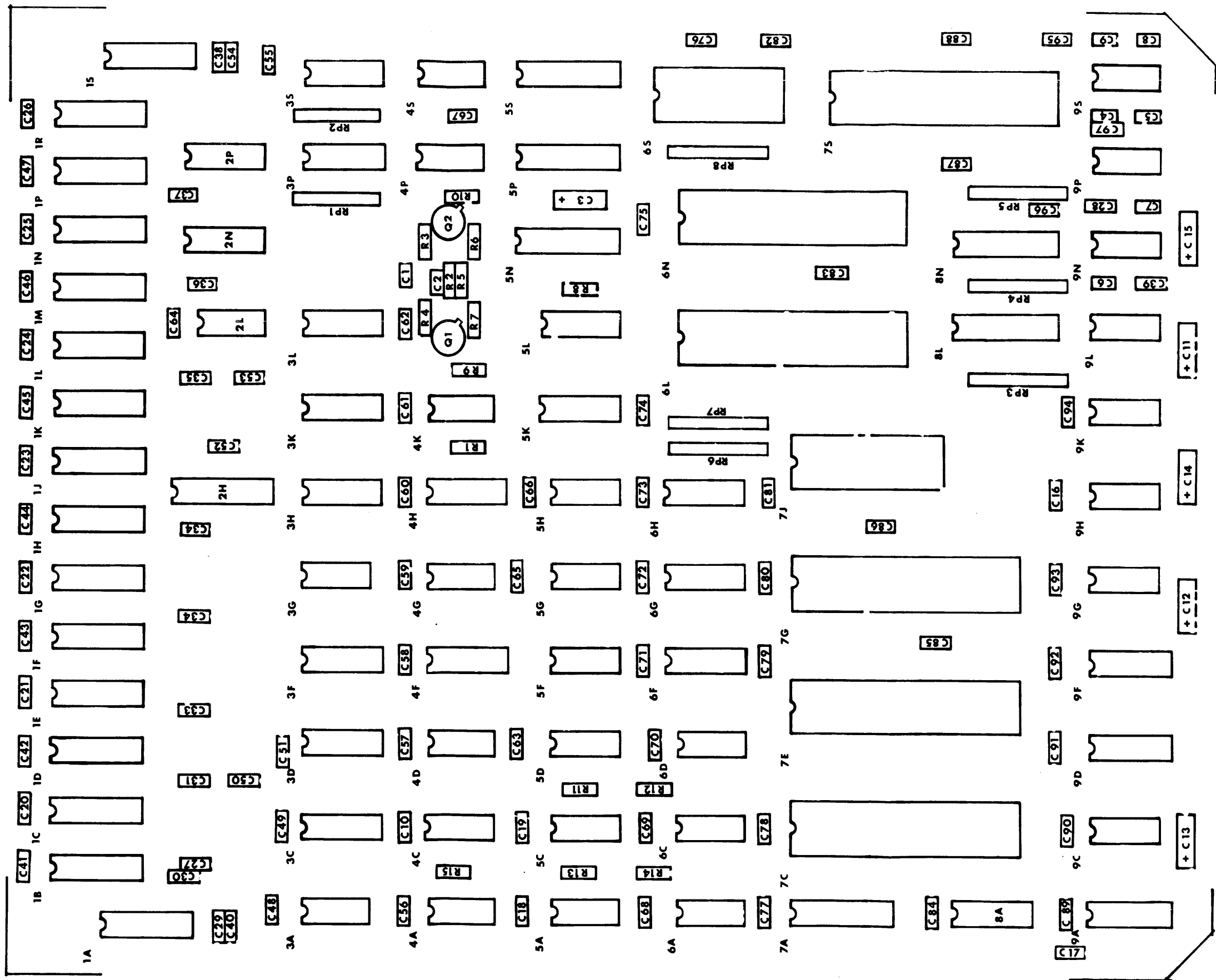


<b>IMI</b> INTERNATIONAL MEMORIES INCORPORATED		
DATE: 4/4/79	APPROVED BY:	DRAWN BY: LPH/NO
		REVISED:
<b>PCB SCHEMATIC, 7710 CONTROLLER</b>		
DRAWING NUMBER: 310062		REVISIONS:

SCHMATIC DWG, ASM 310061 (8 OF 8)

REPRODUCED BY MICROFILM/ACCOMPRESS REORDER NO. 6-1738

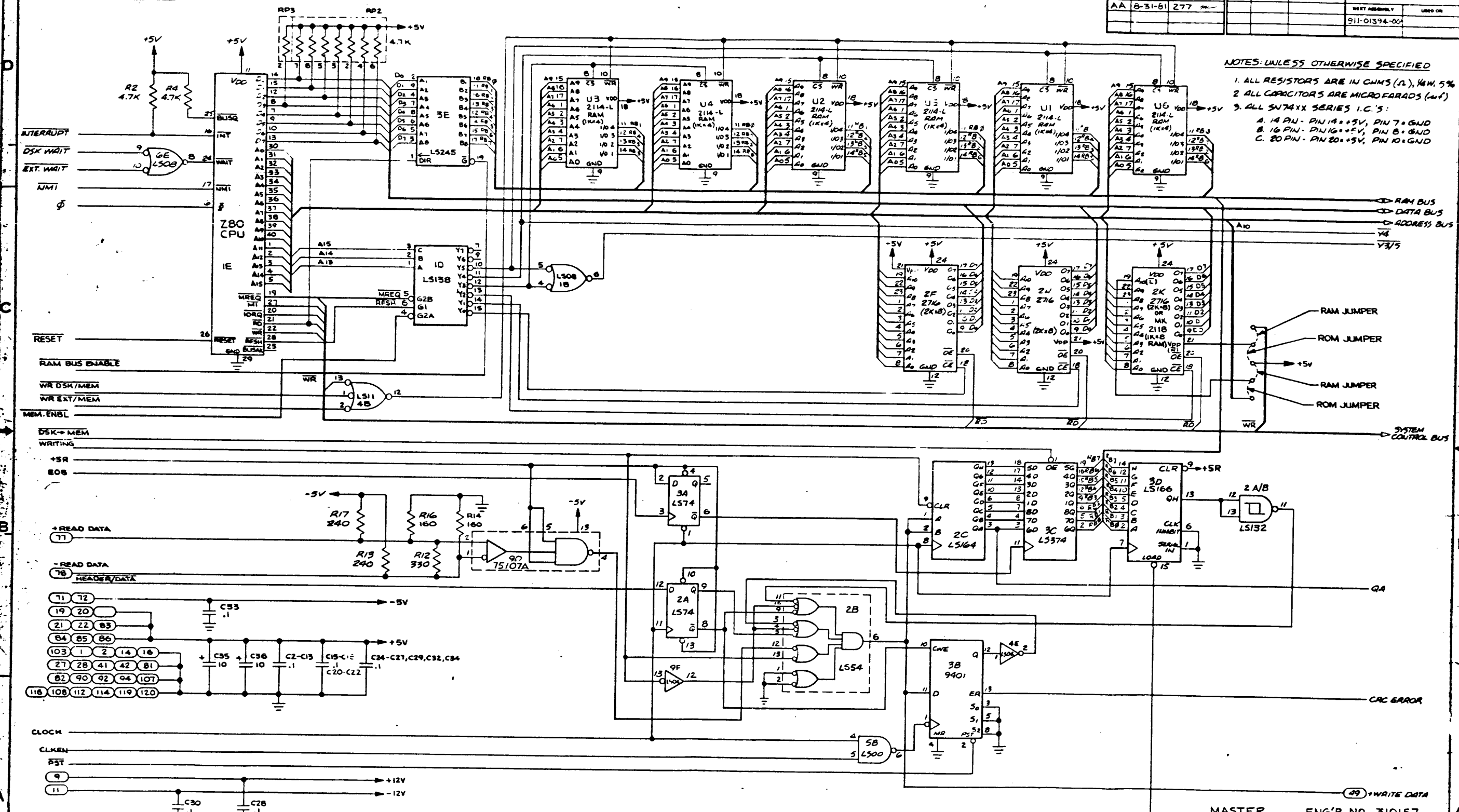
135



ASSEMBLY DWG, ASM 310061

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REV	DATE	EC NO	REV	DATE	EC NO	263-01394-001
1.1		223				
AA	8-31-61	277				
						911-01394-004



NOTES: UNLESS OTHERWISE SPECIFIED  
 1. ALL RESISTORS ARE IN OHMS (Ω), 1/4W, 5%  
 2. ALL CAPACITORS ARE MICROFARADS (μF)  
 3. ALL SN74XX 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 20 = +5V, PIN 10 = GND

MASTER ENG'R NO. 310157

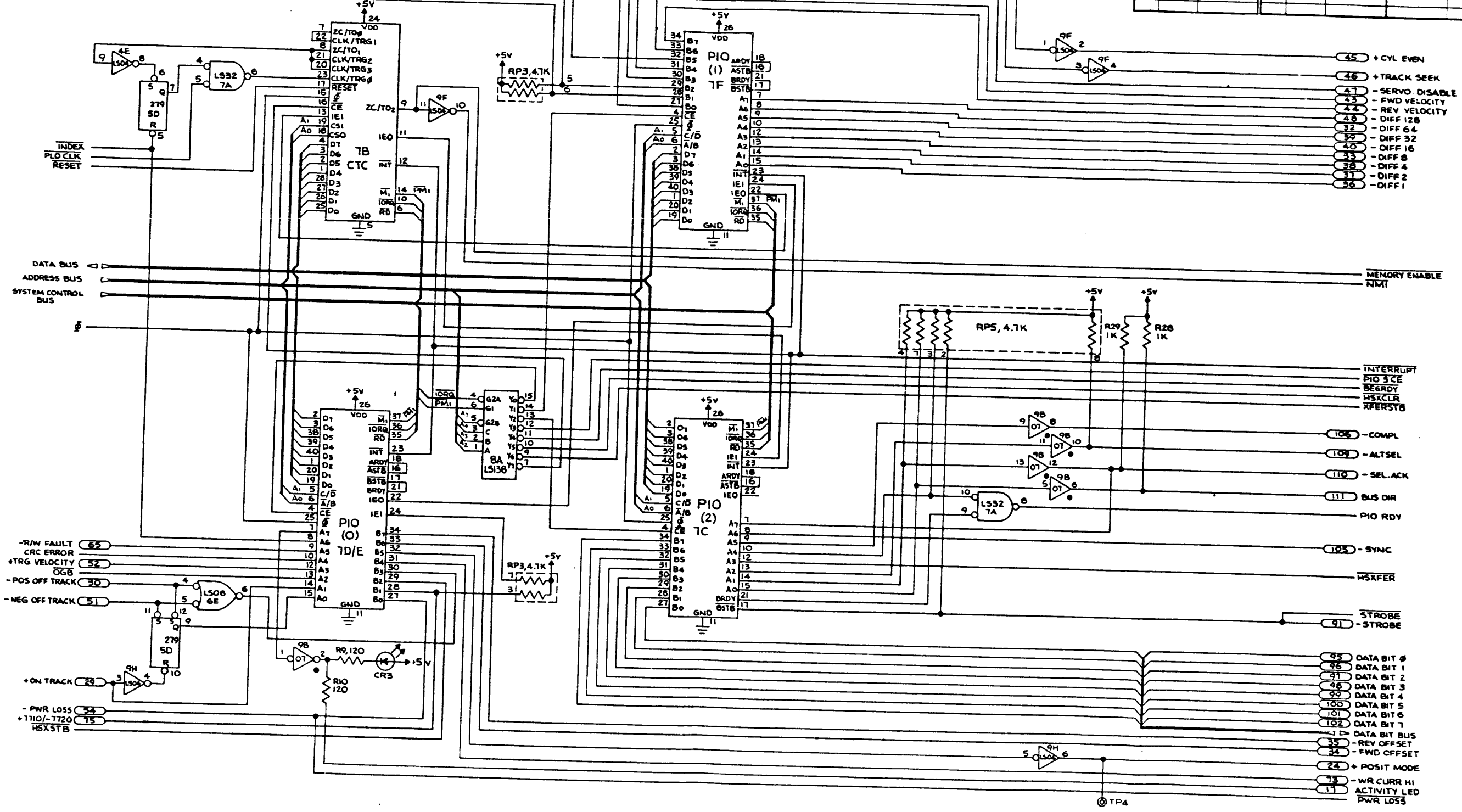
INTERNAL	SCALE	LINE	DATE	 INTERNATIONAL MEMORIES INCORPORATED
DRAWN	DATE			
DESIGNED	DATE			PCB SCHEMATIC, CONTROLLER/LOGIC
APPROVED	DATE			
DECIMAL EXP	FRACTIONAL	RELIEVED	DATE	D 263-01394-001 AA
				SHEET 1 OF 4 REV

SCHEMATIC DWG, ASM 310156 (1 OF 4)

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REV	DATE	EC NO	REV	DATE	EC NO	263-01394-001
N		223				
AA	8-31-81	277				

- PLO ERROR 53
- WR PROTECT 15
- WR PROTECT 15



- R/W FAULT 65
- CRC ERROR 52
- +TRG VELOCITY 06B
- POS OFF TRACK 30
- NEG OFF TRACK 51

- +ON TRACK 29
- PWR LOSS 54
- +T110/-T720 15
- H5X5TB

- 45 +CYL EVEN
- 46 - TRACK SEEK
- 47 -SERVO DISABLE
- 43 - FWD VELOCITY
- 44 - REV VELOCITY
- 48 - DIFF 128
- 32 - DIFF 64
- 30 - DIFF 32
- 40 - DIFF 16
- 33 - DIFF 8
- 38 - DIFF 4
- 31 - DIFF 2
- 36 - DIFF 1

- INTERRUPT
- PIO S CE
- BEGRDY
- H5XCLR
- XFER5TB

- 108 -COMPL
- 109 -ALTSSEL
- 110 -SEL.ACK
- 111 BUS DIR
- PIO RDY

- 105 - SYNC
- H5XFER

- STROBE
- STROBE

- 95 DATA BIT 0
- 96 DATA BIT 1
- 97 DATA BIT 2
- 98 DATA BIT 3
- 99 DATA BIT 4
- 100 DATA BIT 5
- 101 DATA BIT 6
- 102 DATA BIT 7

- DATA BIT BUS
- 35 -REV OFFSET
- 34 - FWD OFFSET
- 24 + POSIT MODE
- 73 - WR CURR HI
- 17 ACTIVITY LED
- PWR LOSS

MASTER ENG'R NO. 310157

MATERIAL	SCALE	DATE	DATE	DATE	DATE	DATE	DATE
	NCNE	MIKALE	12-9-80				
PROJ	CDR	ENGR	APPROV	DATE	DATE	DATE	DATE
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS INCHES TOLERANCES				DECIMAL .X1 FRACTIONAL .X1 ANGULAR .1			
RELEASED				DATE			
SHEET 2 OF 4				REV			

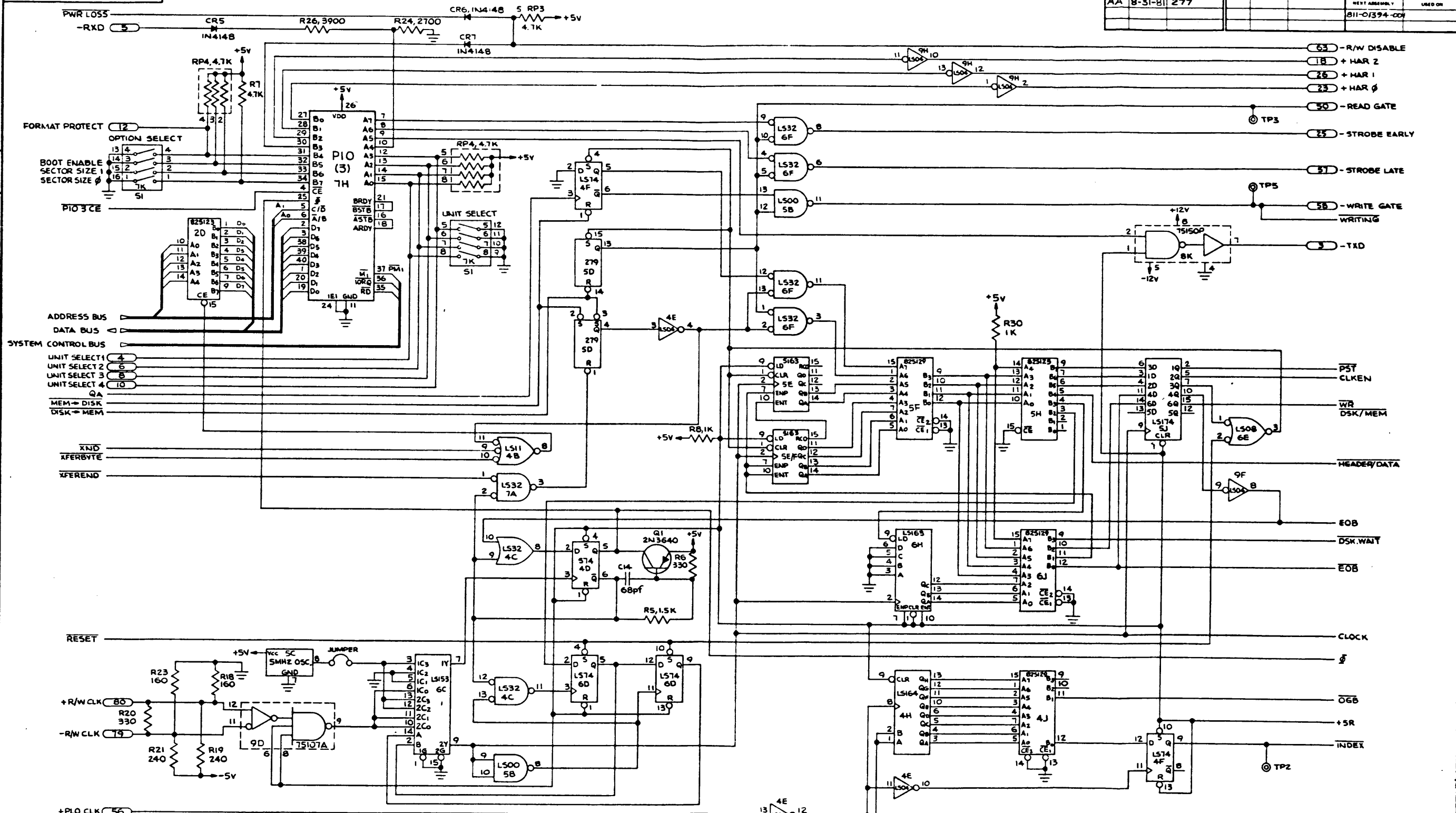
PCB SCHEMATIC, CONTROLLER/LOGIC

D 263-01394-001 AA

SCHEMATIC DWG, ASM 310156 (2 OF 4)

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REV	DATE	EC NO	REV	DATE	EC NO	263-01394-001
AA	8-31-81	277				
						TEST ASSEMBLY USED ON
						IBM-01394-001

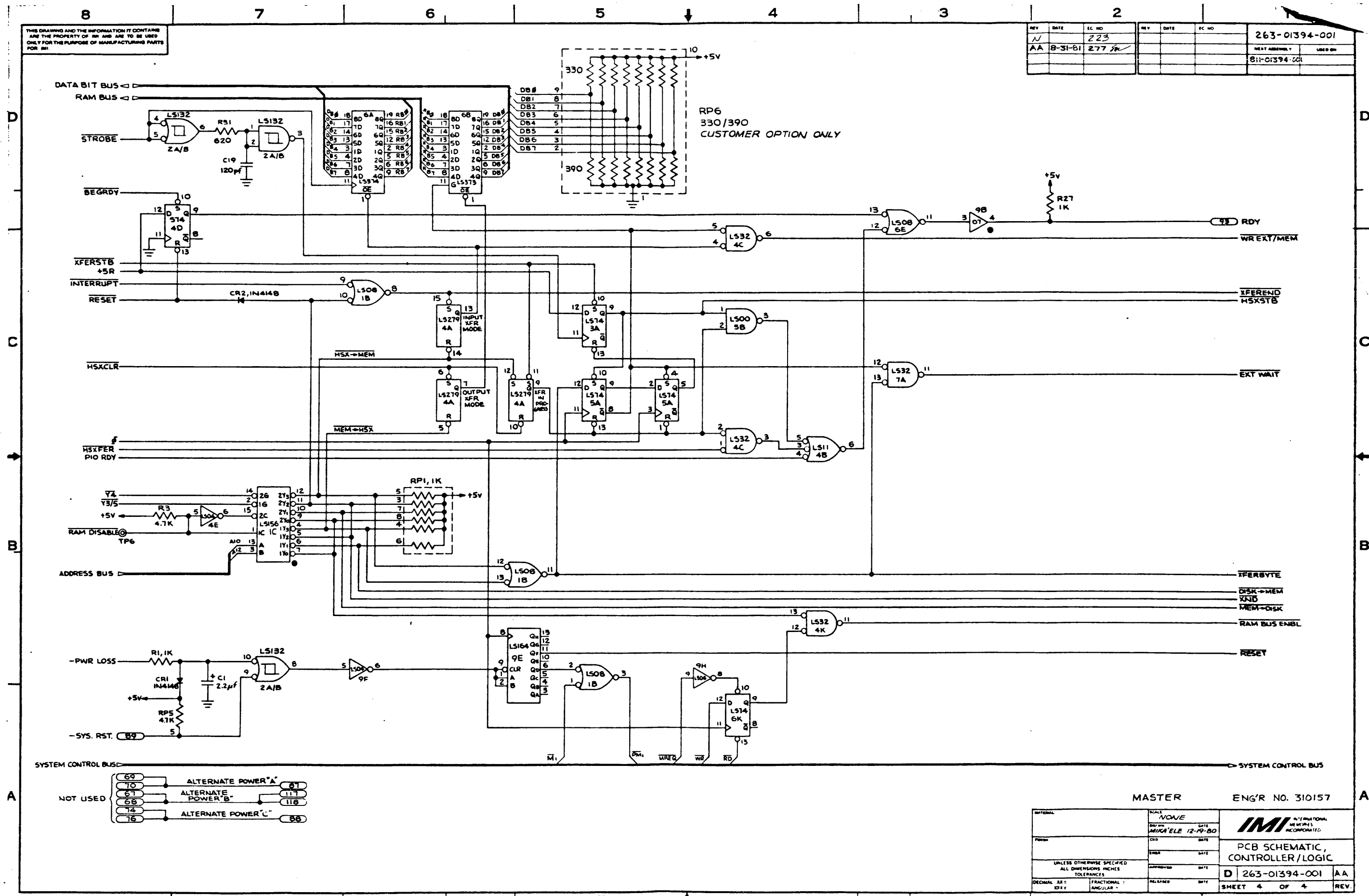


SCALE: NONE		DATE: 12-17-80		DRAWN BY: MIK/ELE	
CHECKED BY: [ ]		DATE: [ ]		APPROVED BY: [ ]	
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS IN INCHES TOLERANCES:		DECIMAL: ±0.005		FRACTIONAL: ±0.005	
RELEASED BY: [ ]		DATE: [ ]		REV: AA	
SHEET 3 OF 4		MASTER		ENG'R NO. 310157	
PCB SCHEMATIC, CONTROLLER, LOGIC		D 263-01394-001		REV. AA	

SCHEMATIC DWG, ASM 310156 (3 OF 4)

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REV	DATE	EC NO	REV	DATE	EC NO	263-01394-001
AA	8-31-81	277				
NEXT ASSEMBLY						USED ON
811-01394-G01						

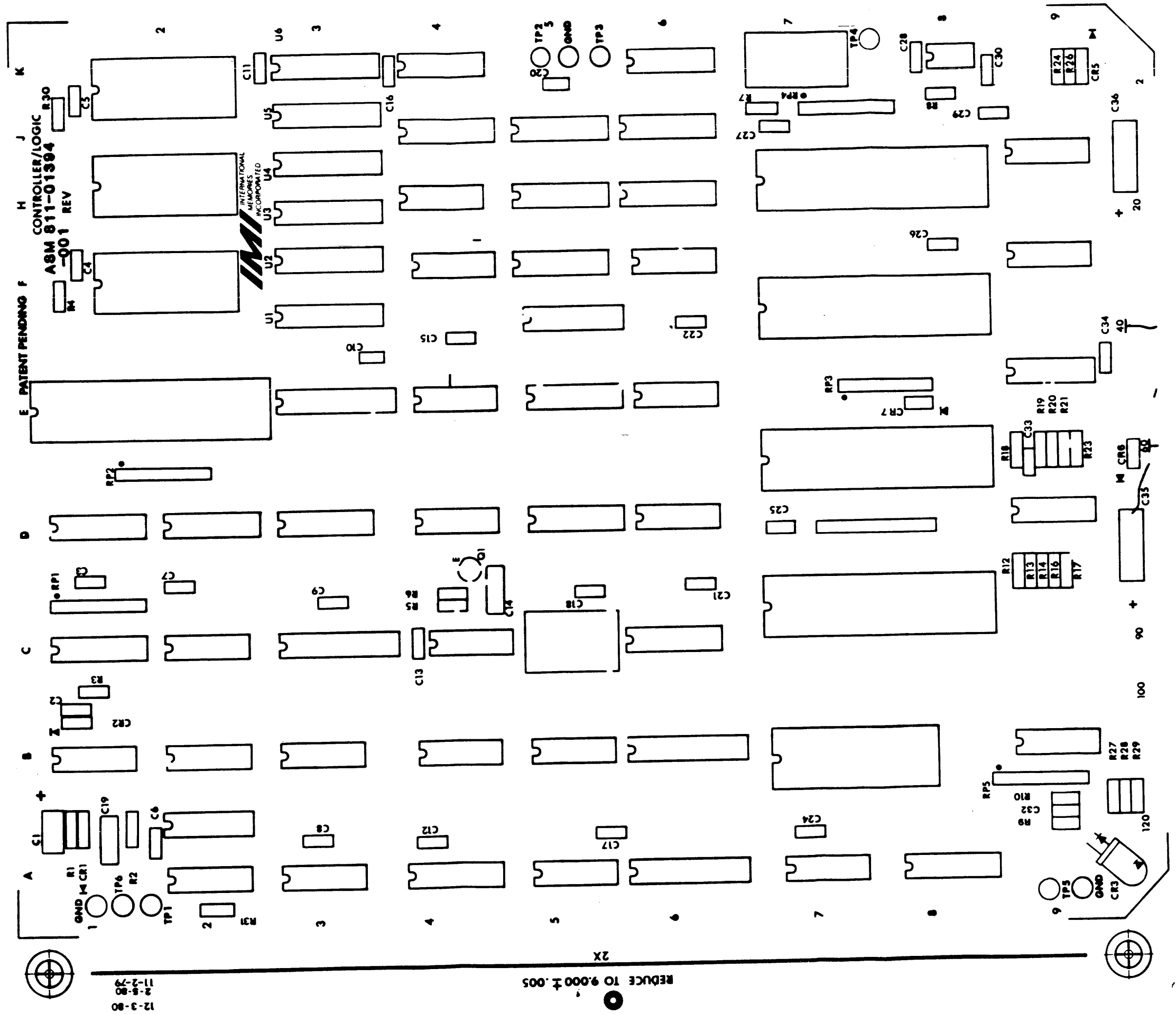


SCHEMATIC DWG, ASM 310156 (4 OF 4)

140

CONTROLLER/LOGIC BOARD  
LEGEND SILKSCREEN  
31015B

SH 5 OF 5  
REV D

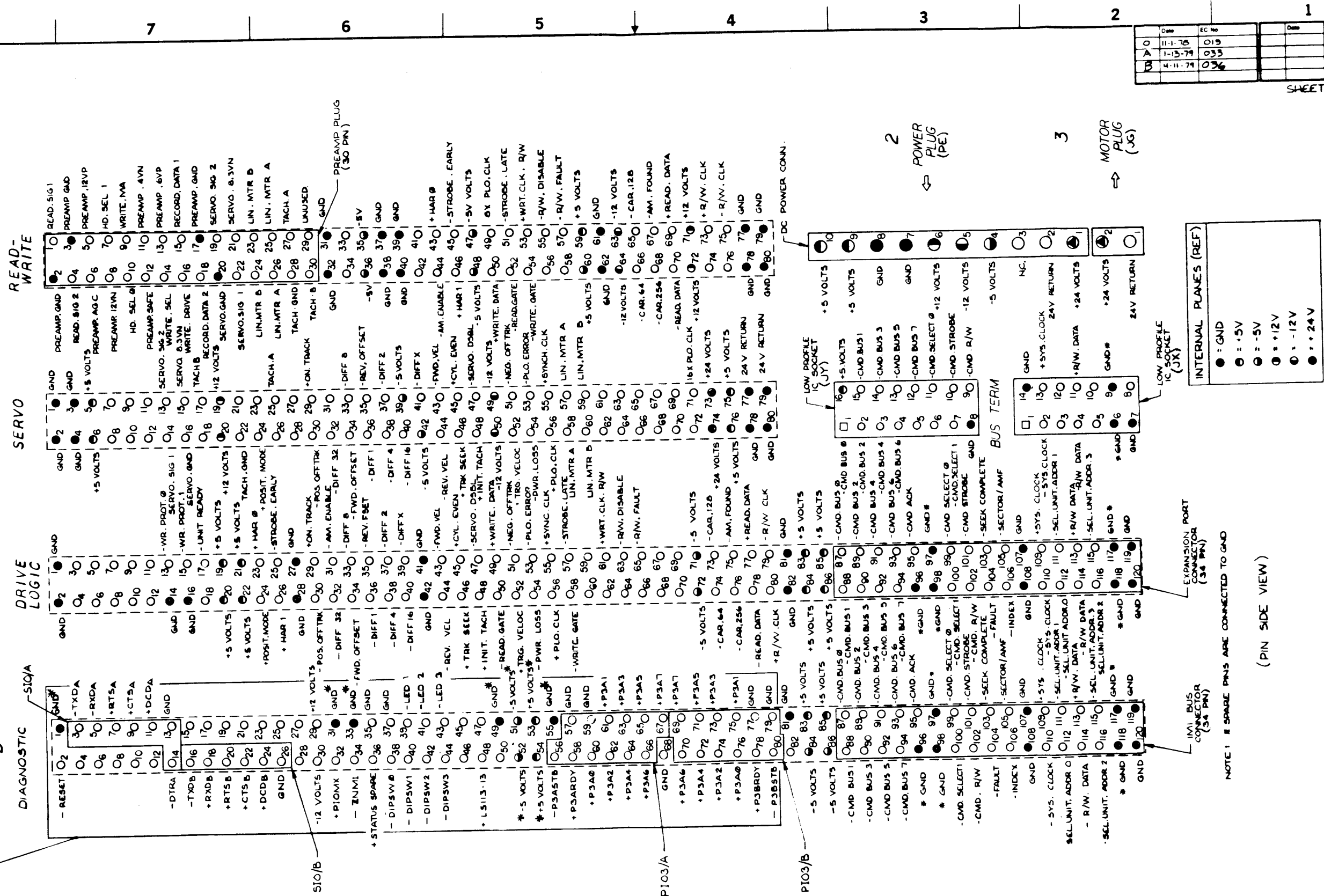


ASSEMBLY DWG, ASM 310156

Date	EC No.	Date	EC No.
0	11-1-76		
A	1-13-77		
B	4-11-79		

SHEET 1 OF 3

THESE SIGNAL DEFINITIONS ARE FOR REFERENCE. THEY ARE APPLICABLE WHEN USING DIAGNOSTIC PINS. PINS 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120 ARE PERMANENTLY CONNECTED POINTS. \* ALL OTHERS IN THIS AREA ARE UNUSED.



INTERNAL PLANE'S (REF)

- = GND
- = +5V
- = -5V
- = +12V
- = -12V
- = +24V

NOTE: 1 - SPARE PINS ARE CONNECTED TO GND

(PIN SIDE VIEW)

SCHMATIC DWG, ASM 310021 (FOR REV A DRIVES)

<p>IMMI INTERNATIONAL MEMORIES INCORPORATED</p>	
<p>DATE: 6-2-78</p>	<p>DESIGNED BY: [ ]</p>
<p>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:</p>	
<p>FRACTIONS DECIMALS ANGLES</p>	
<p>DATE: 6-2-78</p>	
<p>310022</p>	

1 SHEET 1 OF 3



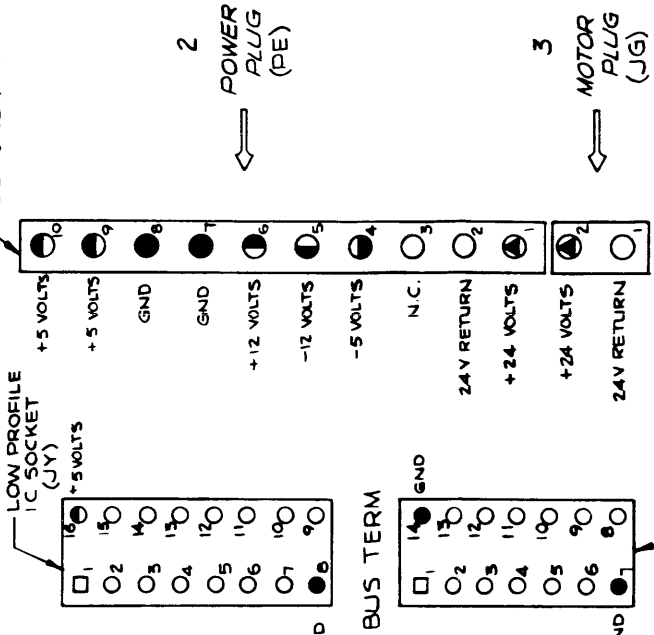
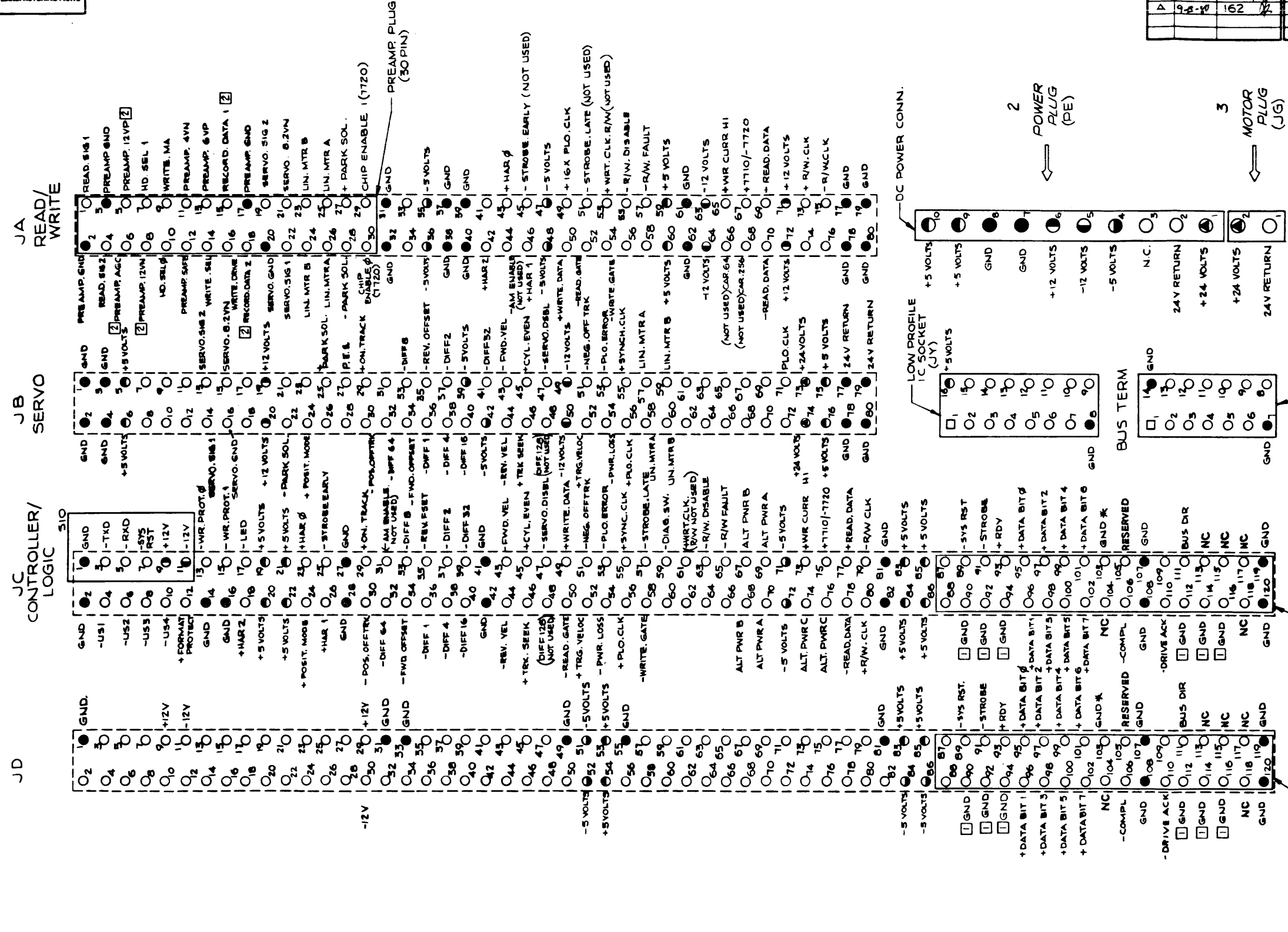
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REV	DATE	RC NO.	REV	DATE	RC NO.
0	4-11-80	116			
Δ	9-2-80	162			

310187  
NEXT ASSY: V    USED ON:

SHEET 1 OF 4

(PIN SIDE VIEW)



INTERNAL PLANES(REF.)

●	GND
○	+ 5V
○	- 5V
○	+ 12V
○	- 12V
○	+ 24 V

- NOTES: UNLESS OTHERWISE SPECIFIED:
- SPARE PINS - CONNECTED TO GROUND THROUGH CONTROLLER/LOGIC R/W PCB.
  - ON JA NOT USED WHEN DRIVE ASSEMBLED WITH 51010.
  - JC PINS B7 THROUGH 120 NOMENCLATURE REFERS TO 7710-C OR 7720-C MODELS ONLY.
  - JD PINS 1 THROUGH 120 NOMENCLATURE REFERS TO 7710-C OR 7720-C MODELS ONLY.

DESCRIPTION	NONE	DATE	11/1/80
DESIGNED BY	TURKALDE	REV	1
CHECKED BY		DATE	11/1/80
APPROVED BY		DATE	11/1/80
IMM INTERNATIONAL MEMORIES INCORPORATED			
SCHEMATIC, MOTHERBOARD, PCB			
FRAC. NO.	310187	REV	A
SHEET 1 OF 4			

SCHEMATIC DWG, ASM 310021 (FOR REV B DRIVES)

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## CORVUS DEALER SERVICE

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**Corvus Systems, Inc. / 2100 Corvus Drive / San Jose, California 95124 / (408) 559-7000 / Telex 278976**