

MICROPOLIS
MODEL 1015/1016
OEM FLOPPY DISK DRIVES

MAINTENANCE MANUAL



MICROPOLIS™

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CHANGE RECORD

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SECTION I GENERAL INFORMATION

1.1 INTRODUCTION

This manual provides maintenance information for the Model 1015 and 1016 series of OEM Floppy Disk Drives, manufactured by Micropolis Corporation, Canoga Park, California. The manual provides data to aid in installing and maintaining the equipment.

1.2 SCOPE OF MANUAL

This manual is primarily directed to service personnel, either field service engineers or repair technicians in an OEM repair depot. The manual consists of eight sections, as follows:

Section I, General Information, provides introductory information of a general nature. This includes a brief description of the drives, maintenance philosophy, operator troubleshooting and maintenance, test equipment and tools required, and spare parts ordering procedures.

Section II, Installation, provides procedures for unpacking the drive, installing the drive, configuring multi-drive systems, and supplying power.

Section III, Theory of Operation, provides a detailed description of the disk drive, covering the drive mechanism, the interface, and each version of the drive electronics board.

Section IV, Tests and Adjustments, provides procedures to test and adjust all parameters of the disk drive.

Section V, Troubleshooting, provides information to assist in isolating a fault to a replaceable component or subassembly in a logical manner.

Section VI, Removal and Replacement Procedures, provides step-by-step instructions for replacing assemblies, subassemblies, or components of the disk drive.

Section VII, Parts List, provides part numbers of the replaceable parts of the disk drive.

Section VIII, Assembly Drawings and Schematic Diagrams, provides component layout drawings and engineering schematic diagrams for the drive electronics boards used in the OEM Floppy Disk Drives.

1.3 DESCRIPTION OF DRIVES

Each Micropolis OEM Floppy Disk Drive (see figure 1-1) consists of a drive mechanism and a drive electronics PCBA. A protective mounting sleeve, not shown in figure 1-1, is optional. Since the drives are intended to be mounted within an OEM system and receive regulated DC power from the system, an enclosure and the regulated power supplies are not included. Also, since the system requirements determine the drive controller specifications, the controller is not supplied by Micropolis.

The following OEM Floppy Disk Drives are described in this manual:

- a. Model 1015 MOD I.
- b. Model 1015 MOD II.
- c. Model 1016 MOD II.

MOD I drives have a track density of 48 tracks per inch (TPI) with a total of 35 tracks. MOD II drives have a track density of 100TPI with 77 total tracks. The difference in track density and total tracks results from using a different lead screw in the positioner, a different read/write/erase head, and different components and adjustments on the PCBA.

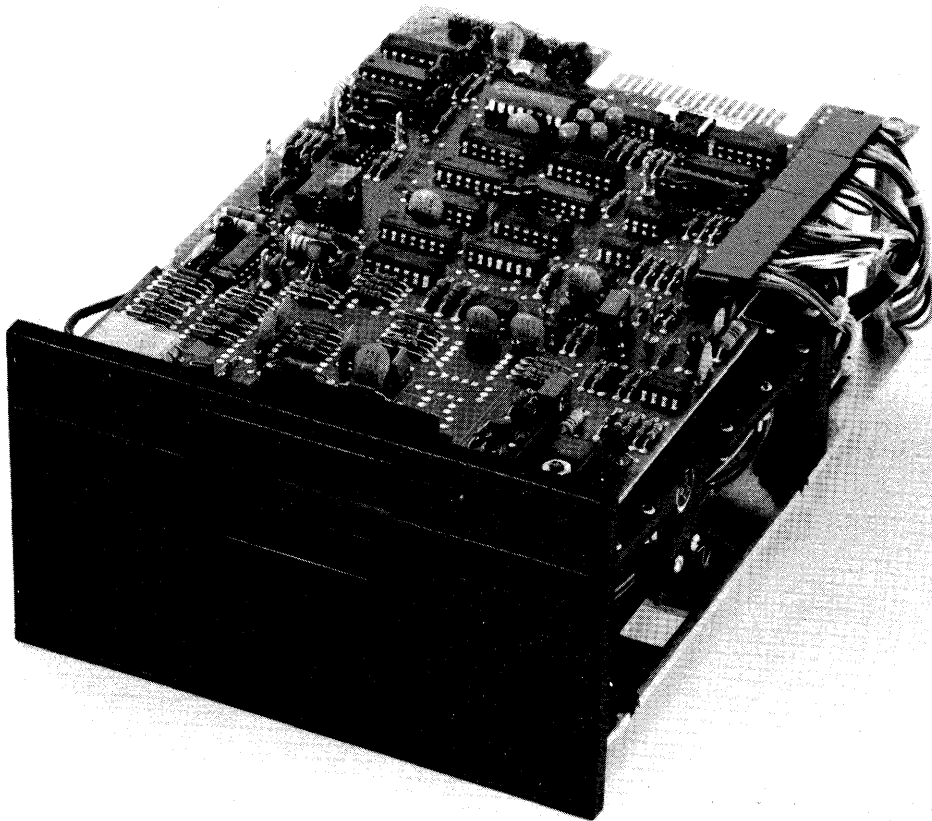


Figure 1-1. Micropolis OEM Floppy Disk Drive (typical)

Table 1-1 summarizes the specifications of the OEM Floppy Disk Drives.

TABLE 1-1. SPECIFICATIONS

Physical (without sleeve)	
Height	3 3/8 in (86 mm)
Width	5 7/8 in (149 mm)
Depth	8 1/2 in (216 mm)
Weight	3.9 lbs (1.77 kg)
Environmental	
Operating temperature: 50°-105°F (10°-41°C)	
Relative humidity: 20%-80% (without condensation)	
Power Dissipation	
Standby	8 watts
Operating	16 watts
Unformatted capacity (per drive)	
1015 MOD I	
Single Density	110 Kbytes
Double Density	220 Kbytes
1015 MOD II	
Single Density	240 Kbytes
Double Density	480 Kbytes
1016 MOD II	585 Kbytes
Drive Characteristics	
Rotational speed	300 rpm
Rotational latency	100 milliseconds (average)
Drive motor start time	1 second
Head load time	75 milliseconds
Access time	
Track-to-track	30 milliseconds
Settling time	10 milliseconds
Transfer rate	250 Kbits/second

TABLE 1-1. SPECIFICATIONS (cont.)

Drive Characteristics (cont.)

Recording density

1015/MOD I: 5162 bits per inch
1015/MOD II: 5248 bits per inch
1016/MOD II: 6380 bits per inch

Track density

MOD I: 48 tracks per inch
MOD II: 100 tracks per inch

Total tracks per surface

MOD I: 35
MOD II: 77

Media size: 5¼ inch

Reliability/Maintainability

MTBF 8000 hours
MTTR 0.5 hour

Media life: 3×10^6 passes on single track
Head life: 10,000 hours

Soft error rate: 1 in 10^9
Hard error rate: 1 in 10^{12}
Seek error rate: 1 in 10^6

1.4 MAINTENANCE PHILOSOPHY

Micropolis Floppy Disk Drives are designed for trouble-free operation. Most maintenance operations require a high degree of technical sophistication, the proper training, and the proper equipment. Non-technical end users should NOT attempt to perform either preventive or corrective maintenance.

1.4.1 End User Maintenance

The isolation and correction of faults within the disk drive requires sophisticated test equipment and experience in the field of analog and digital troubleshooting. Unless you have been trained by Micropolis and have the necessary tools and equipment, you should make no attempt to perform tests, adjustments, or replacements. If the checks in table 1-2 do not isolate or correct the fault, notify the appropriate service personnel.

TABLE 1-2. END USER TROUBLESHOOTING

Symptom	Probable Cause/Corrective Action
<p>Motor does not turn and select indicator never lights.</p> <p>Select indicator never lights.</p> <p>Drive is always selected.</p> <p>Program cannot be loaded (procedure in the system user's manual has been followed).</p> <p>Permanent I/O errors occur.</p>	<p>No power to drive.</p> <ol style="list-style-type: none"> 1. Interface cable not connected to drive or plugged into controller. 2. Controller not plugged into computer or computer not turned on. 3. Computer power supply voltages are incorrect. <p>Interface cable is reversed at one end.</p> <p>Inadequate memory - the memory requirements for the high data transfer rates associated with the Micropolis drives may exceed the capabilities of the computer's memory. Try substituting memory made by a different manufacturer.</p> <ol style="list-style-type: none"> 1. Inadequate memory (see above). 2. Computer timing problem - there have been many changes/improvements made to various brands of microcomputers to improve operation with disk memory systems. Check with Micropolis Product Support and/or the computer manufacturer to determine whether these changes have been incorporated in your system. 3. Drive fault - try using a known good drive. 4. Controller fault - try substituting a known good controller.
<p>NOTE: This chart is intended only as a first level diagnostic aid for system level troubleshooting. Section V contains a more thorough guide for qualified service personnel to troubleshoot the disk drive.</p>	

1.4.2 Dealer Service Centers

Micropolis dealers and OEMs that have received formal training on the theory of operation and maintenance of Micropolis equipment, and that possess adequate test equipment and spare parts, are designated as Micropolis Service Centers. These Service Centers are best able to provide high quality and timely warranty and nonwarranty service on Micropolis products.

1.4.3 Micropolis Repair Depot

Micropolis maintains a fully equipped repair depot which provides warranty and nonwarranty repairs and emergency spares support. Contact Micropolis Customer Service to obtain a Return Goods Authorization (RGA) prior to returning any drive for repair.

1.5 MAINTENANCE EQUIPMENT REQUIRED

The following tools, test equipment, and special items are required for maintaining and/or servicing Micropolis OEM Floppy Disk Drives. Where a manufacturer's part number is given, equivalent equipment may be used.

a. Tools:

- 3/16-inch nut driver
- 1/4-inch nut driver
- Screwdriver, Phillips #1
- Tweezers - Clause 231
- 7/64-inch hex driver
- 7/64-inch hex key, long handle
- 3/32-inch hex key
- Spring Hook Set - National Camera S1390
- 1/4-inch combination wrench
- 5/16-inch box end wrench
- 3/8-inch box end wrench
- Pot screwdriver - Bouvus H-90
- Spring scale, 0-10 lbs
- Cotton swabs

b. Test Equipment:

- Oscilloscope - Tektronix 453
- Digital multimeter - Simpson 461
- Frequency counter, 0 to 10 MHz (optional)
- Micropolis Flexible Disk Exerciser, Model 1099 (optional)

c. Special Items:

- Freon TF or isopropyl alcohol
- Maintenance standoff - Micropolis 100100-02-3
- Lubricant, Saunders Magnalube - Micropolis 732-0001
- C.E. Alignment Diskette - Dysan 282 (see paragraph 1.5.1)

1.5.1. Alignment Diskette

The alignment diskette is a Dysan P/N 282 (Micropolis P/N 641 0590-1). The following tracks of this diskette are used:

Track 1 (MOD I)	}	Index/photo transistor alignment
Track 5 (MOD II)		
Track 16 (MOD I)	}	Radial "cat's eye" alignment, also reference track for absolute track positioning (i.e., correct track 0 switch setting)
Track 36 (MOD II)		
Track 35 (MOD I)	}	Used in conjunction with track 1 (MOD I) or track 5 (MOD II) for setting of azimuth (perpendicular head movement).
Track 76 (MOD II)		

CAUTION

Care should be exercised not to erase the prerecorded alignment tracks. Do not defeat or override the write protect feature of the drive or diskette. Do not install the alignment diskette in a drive with a suspected write logic or write protect logic failure. NEVER unplug the drive's head connector with any diskette installed.

1.6 PREVENTIVE MAINTENANCE

Micropolis Floppy Disk Drives do not require preventive maintenance when used in the following environment:

- a. Dustfree
- b. 65° to 80° ambient
- c. Eight hours of operation per day (or less), with power applied, motor running, and a head load cycle of 25% or less.

If the operating conditions exceed these, the preventive maintenance operations specified in table 1-3 should be performed.

TABLE 1-3. PREVENTIVE MAINTENANCE SCHEDULE

Operation	Frequency	Time Required (Hours)	Manual Paragraph Reference
Replace Head Load Pad	2000 hrs of diskette access	0.1	6.5
Clean Head	2000 hrs of diskette access	0.1	1.6.1
Lubricate Lead Screw	2000 hrs of diskette access	0.1	1.6.2
Replace Drive motor	5000 hrs of motor operation	0.5	6.4
Lubricate Latch Mechanism	Every two years	0.1	1.6.3
NOTE: These maintenance operations are required only when operating conditions exceed normal.			

1.6.1 Cleaning the Head

CAUTION

Rough or abrasive cloth must NOT be used to clean the head. Use only isopropyl alcohol or DuPont Freon TF; use of other solvents, such as carbon tetrachloride, may damage the head lamination adhesive.

To gain access to the head, it will usually be necessary to first remove the drive from the system enclosure (see paragraph 6-2 for procedure).

Clean the magnetic head with a soft, lint-free cloth or cotton swab moistened with isopropyl alcohol or DuPont Freon TF. Wipe the head carefully to remove all accumulated oxide and dirt. Dry the head with a lint-free cloth.

NOTE

The head must be cleaned after head load pad replacement.

1.6.2 Lead Screw Lubrication

To gain access to the lead screw, first remove the drive from the system enclosure (see paragraph 6-2) and then temporarily move the PCBA out of the way (see paragraph 6-3, but do not cut the head cable tie wraps).

Prior to lubrication, the stepper motor lead screw should be cleaned. Wipe the lead screw with a lint-free cloth lightly moistened with isopropyl alcohol.

CAUTION

Do not contaminate the magnetic recording head or the head load pad with lubricant. Damage to the diskette's recording surface can be caused by lubricant deposited on the head or head load pad.

Lubricate the lead screw and the part of the head carriage that rides on the platen with a thick coat of Saunders Magnalube (Micropolis P/N 732-0001-6).

1.6.3 Latch Mechanism Lubrication

To gain access to the latch mechanism, it will usually be necessary to first remove the drive from the system enclosure (see paragraph 6-2 for procedure).

To ensure smooth, positive action of the door latch mechanism, apply a heavy coat of Saunders Magnalube (Micropolis P/N 732-0001-6) to the entire latch mechanism.

1.7 CORRECTIVE MAINTENANCE

Corrective maintenance consists of isolating a fault to a defective or misadjusted assembly or component, replacing or adjusting the assembly or component, and verifying that the repair has eliminated the fault. The following suggested sequence will help to make the most effective and efficient use of this manual:

- a. Isolate the malfunction to the faulty assembly, subassembly, or component. See the Troubleshooting Chart in Section 5.
- b. If a more thorough understanding of the operation of a circuit or a mechanical or electrical component is desired, see the Theory of Operation in Section 3. The circuit descriptions reference the Assembly Drawings and Schematic Diagrams in Section 8.
- c. If necessary, test the suspected circuit or mechanical assembly. See Section 4, Tests and Adjustments. Also using Section 4, it may be possible to perform an adjustment to eliminate the fault.

- d. Order a replacement component, subassembly, or assembly. See Section 7, Parts List.
- e. Replace the component, subassembly, or assembly. See Section 6, Removal and Replacement Procedures.
- f. Adjust and/or test the circuit or mechanism after replacing the part. See Section 4, Tests and Adjustments.

1.8 SPARE PARTS

Section 7 provides part numbers for the replaceable parts of the OEM Floppy Disk Drives. Information on recommended spares levels for field engineers and for repair depots can be obtained from Micropolis Customer Service. These levels should be maintained to reduce down-time.

Routine orders for spare parts should be placed through Order Entry, not Customer Service. Orders for routine spares are treated and scheduled in the same manner as orders for disk drives, accessories, etc.

Emergency spares will be shipped within 24 hours and will not be discounted. Emergency spare orders should be placed with Customer Service.

An identification label is attached to the underside of the chassis, near the large pulley. It shows the model number; part number, and serial number of the drive. These numbers should be quoted in all correspondence. Drives shipped with the optional protective sleeve have the label attached to the back panel.

SECTION II INSTALLATION

2.1 INTRODUCTION

This section provides information necessary for installing the drive. Included are instructions for unpacking the drive (and re-packing the drive for shipment if necessary), visually inspecting the drive, installing the drive, configuring multi-drive disk systems, and supplying power.

2.2 UNPACKING THE DRIVE

The drive is packed so as to minimize the possibility of damage during shipment. Use the following procedure to unpack the drive, and save ALL packing material in case it is necessary to re-pack the drive for shipping.

- a. Place the shipping carton on a flat work surface.
- b. Carefully cut the sealing tape on the carton top; open the top flaps.
- c. Remove and SAVE the six-inch wide foam strip that covers the inner carton.

CAUTION

Use extreme care when handling the inner carton; the drive (inside it) is subject to damage if dropped.

- d. Carefully remove the inner carton and place it on the work surface.
- e. Cut the sealing tape on the carton top; open the top flaps.

CAUTION

When the drive and fiberboard base are removed from the carton, the drive mechanism and circuit board will be exposed. Handle VERY carefully.

- f. Lift the drive out of the carton. SAVE the cardboard insert in the carton.
- g. Remove the three screws (and spacers) that hold the drive to the fiberboard base. SAVE the base, the screws, and the spacers. In addition, save both cartons and the six-inch and ten-inch foam strips.

2.3 RE-PACKING THE DRIVE FOR SHIPMENT

If it is necessary to re-pack the drive for shipment, the following procedure must be used.

CAUTION

Do not attempt to ship the drive except in the original packing.

- a. Attach the drive to the fiberboard shipping base using three screws and spacers.
- b. The drive, suspended from the base, fits in the smaller (inner) carton; the base rests on the cardboard insert.
- c. Close the flaps and seal with tape.
- d. If the ten-inch wide foam strip has been removed from the larger (shipping) carton, form it into a "U-shaped" cradle in the carton.
- e. Place the inner carton (with the drive) in the foam cradle, with equal space on either end.
- f. Form the six-inch wide foam strip into a wide inverted U, and place it over the inner carton, with the legs of the U inside the shipping carton on either end of the inner carton.
- g. Close the flaps and seal securely with tape.

2.4 UNPACKING/RE-PACKING DRIVES WITH SLEEVES

Drives shipped with the optional protective sleeve are not attached to a fiberboard shipping base, and the inner carton does not have a cardboard insert. The drive is enclosed in a large plastic bag, wrapped in Kimpack shipping insulation, and placed directly in the inner carton.

2.5 VISUAL INSPECTION

When the drive is unpacked, inspect it for any damage. If shipping damage of any kind is evident, notify the carrier at once.

NOTE

Do not return the damaged drive until the shipping company inspector has reviewed the damage, since an insurance claim will be made.

2.6 INSTALLING THE DRIVE

2.6.1 General Guidelines

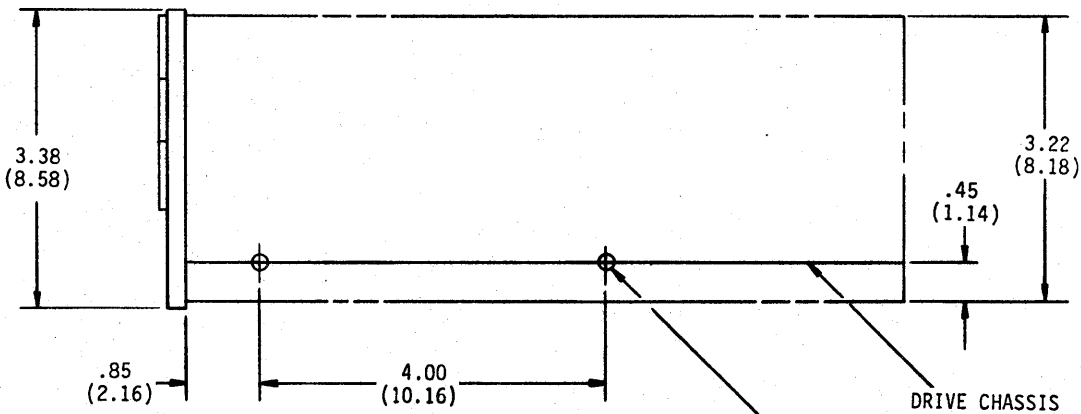
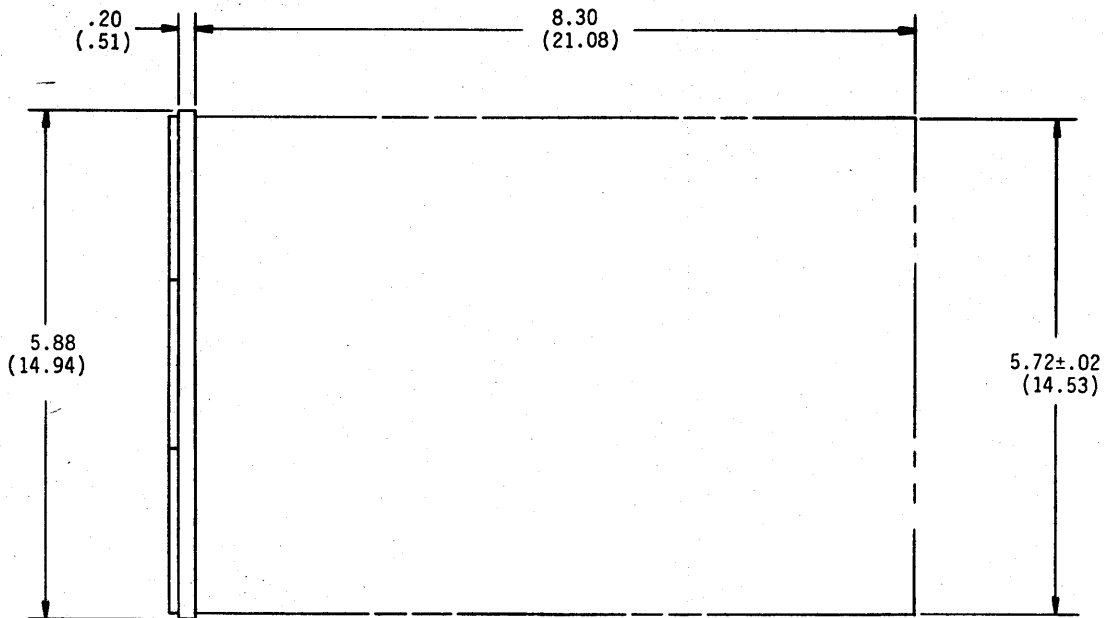
The following general guidelines should be adhered to when planning the installation:

- a. The ambient temperature must be in the range of 50°-105°F (10°-41°C).
- b. Do not install a drive close to sources of strong electromagnetic or electrostatic fields (i.e., large transformers, CRTs, motors, etc.).
- c. Avoid dirty, dusty, or smoky areas.
- d. Avoid static discharging to any part of the system (use anti-static spray on carpets).
- e. Ensure that adequate regulated DC power (as specified in section 2.8) is available.
- f. For drives with the optional protective sleeve, ensure that the cooling slots are not obstructed.

2.6.2 Specific Mounting Requirements

Refer to figure 2-1 and ensure that the following mounting requirements are met:

- a. The drive may be mounted in any orientation except upside down. If the drive is to be mounted with the bezel up, it should be ordered as such so the disk eject system can be suitably adjusted.
- b. Use the recommended panel opening given in figure 2-1, and insert the drive through the panel opening from the front.
- c. On no account should the mounting scheme rely on the plastic bezel for support.
- d. The three holes in the chassis that are used to hold the drive to the fiberboard shipping base are NOT to be used for mounting the drive. Use the two front and either one of the rear plastic mounting nuts on the chassis edges. For drives with the optional protective sleeve, use the outside two holes on either side, or the three holes on the sleeve bottom, or (preferred) the two front and either one of the rear holes that secure the sleeve to the drive chassis. See figure 2-1 for details. Spacers against the sleeve should be at least 0.5 inch outside diameter.
- e. Use care that mounting screws do not protrude more than 0.2 inch into the drive mechanism.
- f. The holes in the base chassis to which the drive is to be mounted must have sufficient clearance to allow for tolerances and thermal expansion. This also precludes the use of flat-head screws.
- g. Mounting brackets should be made of 0.060 inch thick (min) steel, attached to the base chassis, and with holes large enough that when all screws are tight, stress is not communicated to the drive.



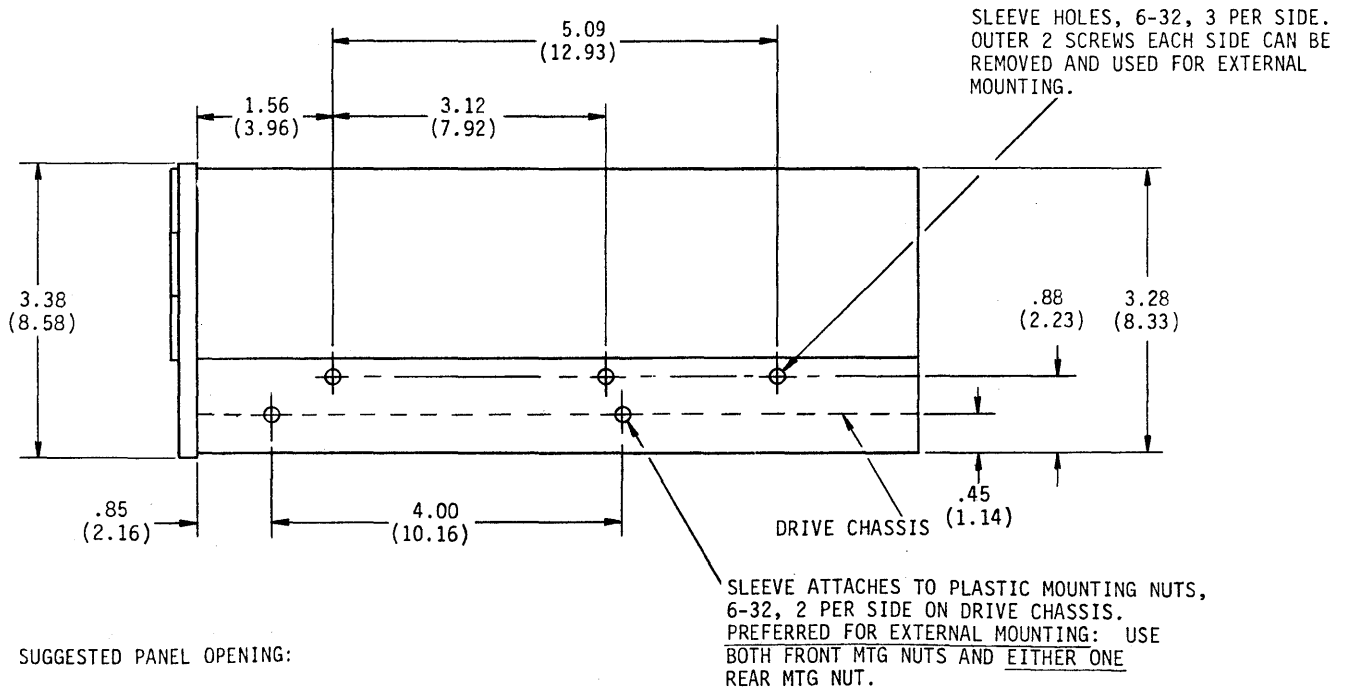
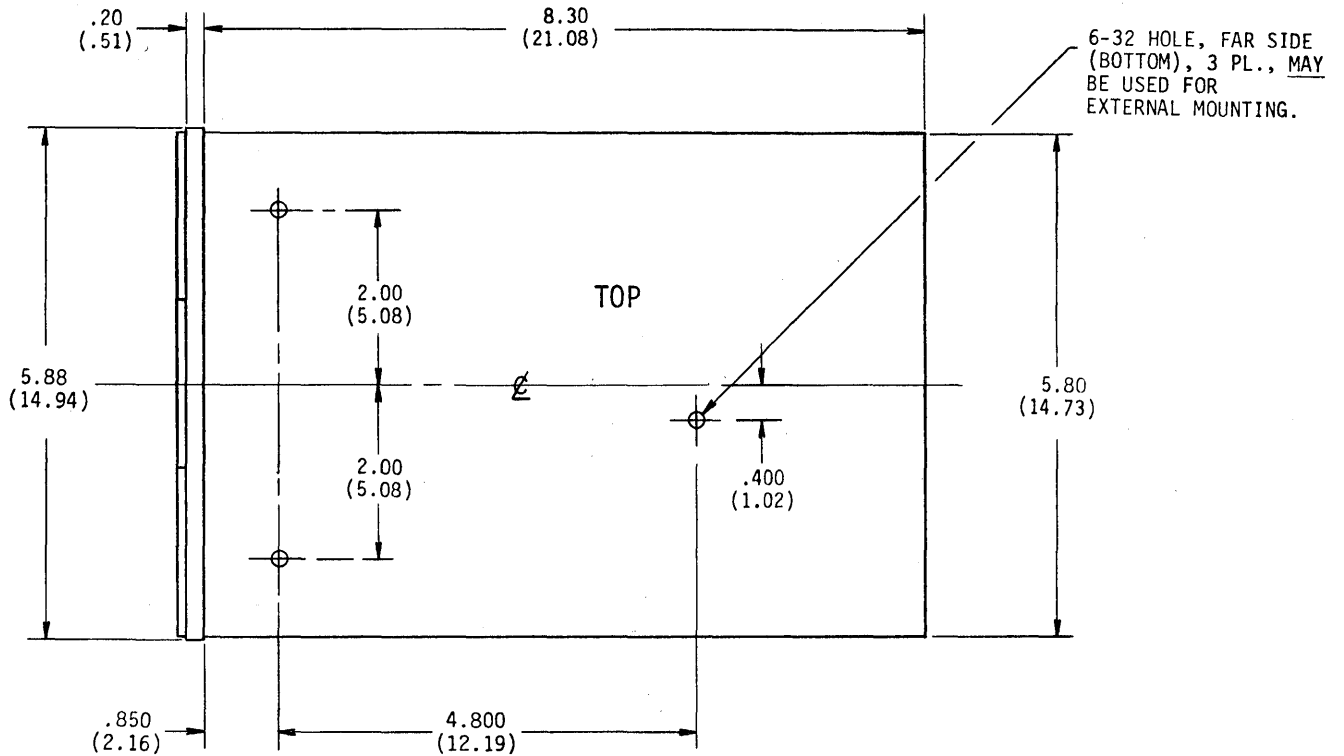
PLASTIC MOUNTING NUTS, 6-32, 2 PER SIDE, ON DRIVE CHASSIS. USE BOTH FRONT MTG NUTS AND EITHER ONE REAR MTG NUT FOR EXTERNAL MOUNTING.

SUGGESTED PANEL OPENING:

5.825 $\begin{smallmatrix} +.010 \\ -.005 \end{smallmatrix}$ BY 3.305 $\begin{smallmatrix} +.010 \\ -.005 \end{smallmatrix}$ INCHES
 14.795 $\begin{smallmatrix} +.025 \\ -.012 \end{smallmatrix}$ BY 8.395 $\begin{smallmatrix} +.025 \\ -.012 \end{smallmatrix}$ CM

DIMENSIONS: $\frac{\text{INCHES}}{\text{CM}}$

Figure 2-1. Drive Mounting Details
 (Sh 1 of 2 - Without Optional Protective Sleeve)



SUGGESTED PANEL OPENING:

5.825 $\begin{matrix} +.010 \\ -.005 \end{matrix}$ BY 3.305 $\begin{matrix} +.010 \\ -.005 \end{matrix}$ INCHES

14.795 $\begin{matrix} +.025 \\ -.012 \end{matrix}$ BY 8.395 $\begin{matrix} +.025 \\ -.012 \end{matrix}$ CM

DIMENSIONS: $\frac{\text{INCHES}}{\text{(CM)}}$

Figure 2-1. Drive Mounting Details
(Sh 2 of 2 - With Optional Protective Sleeve)

2.7 MULTI-DRIVE DISK SYSTEMS

Micropolis 1015/1016 drives can be configured into multi-drive systems, with up to four disk drives. This section provides the technical information necessary to implement a multi-drive system.

2.7.1 Daisy-Chaining Drives

A multi-drive system consists of two, three, or four drives, connected to the host controller with a "Daisy-Chain" interface cable. A typical multiple drive system is shown in figure 2-2.

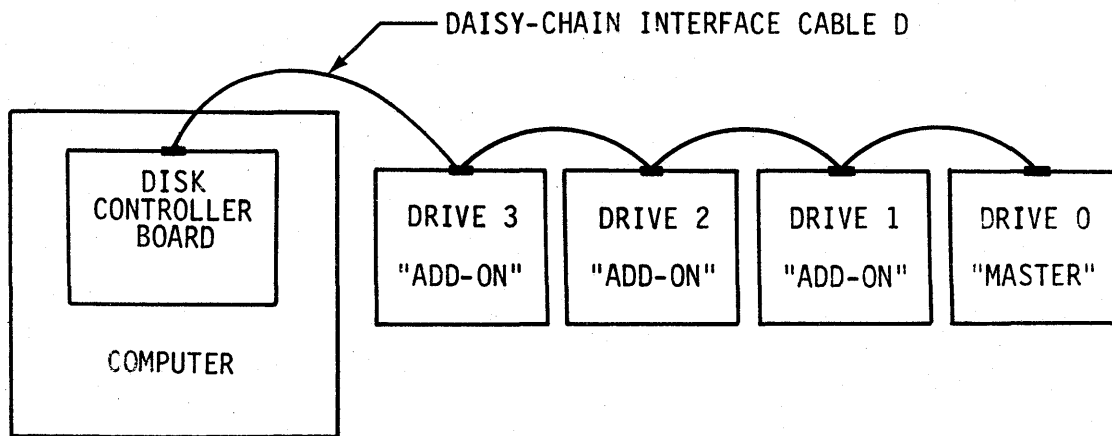


Figure 2-2. Typical Multiple Drive System

The interface cable consists of a set of common input/output lines and four disk select lines. All lines are applied to all drives. Address comparison logic in each drive enables the drive to respond to one and only one disk select line. (Instructions for setting the address comparison logic are given in paragraph 2.7.2.) A single drive may be set to respond to address 0, 1, 2, or 3 (normally, if there is only one drive it will be set for address 0). In a multi-drive system, no two drives may be set to respond to the same disk select line.

In a multi-drive system a distinction is made between the "master" drive and the "add-on" drives. The master drive includes a resistor network for terminating the interface lines. An add-on drive does not contain terminators. All 1015/1016 drives are shipped as master drives; instructions for converting a master drive to an add-on drive are given in paragraph 2.7.2. The master/add-on distinction does not effect the address selection; any drive may have any address.

The following Daisy-Chain interface cables are available from Micropolis:

Model No.	Name	Usage
1083-02	Interface Cable B	Two drives
1083-03	Interface Cable C	Three drives
1083-04	Interface Cable D	Four drives

The Daisy-Chain interface cable is connected in place of the standard Interface Cable A. The Master drive (the one with the terminators) must be connected to the last connector on the cable, i.e., the furthest from the controller, to provide proper termination.

2.7.2 Master to Add-On Conversion

To convert a master drive to an add-on drive, remove the terminators as follows:

- a. Locate the terminator resistor pack (U15 on a Single A PCBA, U17 on a Single B PCBA).
- b. With a small flat-blade screwdriver, carefully pry the resistor pack from its socket. The resistor pack should be saved in case it is desired to convert the drive back in the future.

2.7.3 Address Changing

To change the drive address, reconfigure the address comparison logic as follows:

- a. Locate address jumper locations W1 through W4 on the PCBA. Model 1015/1016 drives are shipped with W1 installed. Only ONE of the jumpers W1 through W4 may be installed on a PCBA.
- b. Remove the jumper from the socket. Replace the jumper in the socket for the desired address, as follows:

Drive Address	Install Jumper	No Jumper
0	W1	W2,W3,W4
1	W2	W1,W3,W4
2	W3	W1,W2,W4
3	W4	W1,W2,W3

2.8 SUPPLYING DC POWER

The 1015/1016 drives require user-supplied DC power. +5V and +12V regulated DC power is supplied to 10 pin connector J5 on the drive PCBA. The mating connector is Molex Part No. 22-01-2101. Pin assignments are:

Pin	Connection
1	Not used
2	Key
3	+12V return
4	+12V
5	Not used
6	+5V return
7	+5V
8	Not used
9	Not used
10	Not used

Current requirements are as follows:

	Standby (Door Open)	Operating	
		Average	Peak
+12V	0.3A	1.0A	1.3A
+ 5V	0.5A	0.5A	0.5A

The +5V return and +12V return must be connected together at the power supply. The drive chassis must be connected to the computer chassis or directly to earth ground.

SECTION III
THEORY OF OPERATION

3.1 INTRODUCTION

This section describes the operation of the drive. First the drive mechanism is described, followed by the signal interface, and then the drive electronics PCBA (both the Single A and the Single B PCBAs are described). Each of these components is described in sufficient detail to assist fault isolation and troubleshooting.

3.2 DRIVE MECHANISM

The drive mechanism, shown in figure 3-1, consists of the following elements:

- a. Spindle Drive System
- b. Head/Carriage Assembly
- c. Positioner Control Mechanism
- d. Electrical and Mechanical Interlocks
- e. Index Sensor

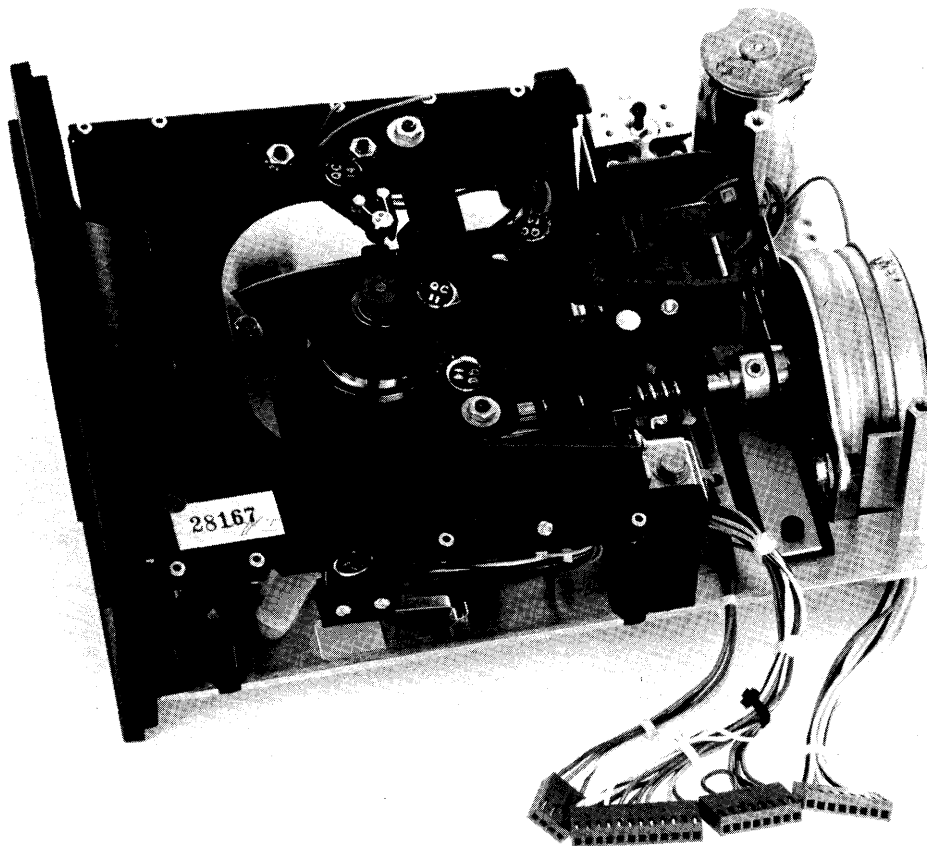


Figure 3-1. Typical Drive Mechanism

All drive mechanisms use the same mechanical elements except:

- a. The lead screw has a pitch of 8.33 threads per inch for a 100TPI (MOD II) drive, or 4 threads per inch for a 48TPI (MOD I) drive.
- b. A different magnetic head is used for 100TPI (MOD II) drives, having narrower read/write and erase gaps than the 48TPI (MOD I) drives.

3.2.1. Spindle Drive System

The spindle is driven by an integral DC motor/AC tachometer (which provides a closed-loop velocity servo action) via a belt which yields an 8-to-1 speed reduction from motor to spindle. When the drive door is closed, a spring-loaded clamp attached to the receiver assembly lowers and forces the diskette over a precision cone on the spindle assembly. The cone profile is such as to provide an interference fit centering the diskette on the spindle. Centering is promoted by the rotation of the spindle during the diskette clamping process. The door switch is adjusted so the spindle begins to rotate before the diskette is clamped to the spindle.

3.2.2 Head/Carriage Assembly

The head consists of a ferrite read/write (R/W) element and two tunnel erase elements mounted in a barium titanate slider. The head is mounted in a carriage assembly which is both supported and driven by the lead screw via a steel follower and is also referenced to the platen. When the drive is selected, the head load solenoid is energized, allowing the load arm and pressure pad to force the diskette into contact with the head with a load of 15 to 18 grams. A foam rubber pad on the solenoid arm ensures the diskette jacket is loaded against the platen surface. In this way an accurate relationship is established between the diskette and the head surface yielding a controlled penetration. When the head load solenoid is deenergized, the diskette has little or no contact with the head.

3.2.3 Positioner Control Mechanism

The head/carriage assembly is positioned by a four-phase permanent magnet stepper motor via a ground stainless steel follower. The positioner control and lead screw are preloaded against a bearing in the spindle housing by a flexure spring. This referencing technique substantially removes the base plate from the thermal expansion and mechanical stability loops.

The lead screw pitch is chosen so that four "ministeps" are taken to move one track. This reduces by a factor of four the effects of stepper motor inaccuracy and hysteresis effects caused by friction. Sequencing of the phases is organized by the control electronics (see paragraph 3.4.5 for Single A or 3.5.6 for Single B). A track zero switch is mounted on the chassis such that an extension of the head carriage activates the switch between tracks 0 and 1. A mechanical stop prevents the carriage from moving behind the track zero position.

3.2.4 Interlocks

There are two electrical switch interlocks and a mechanical interlock.

The door open switch is an interlock that deenergizes the drive motor and causes loss of the Ready status when the door is open. The switch is adjusted to close as soon as the receiver assembly is lowered so the motor is rotating before the diskette is actually clamped to the spindle.

The write protect switch senses the presence or absence of a notch in the diskette jacket for write protection. The normal write protect convention specifies that the diskette is write-protected if the write enable notch is covered by a write protect tab, thereby keeping the switch actuator from entering the notch.

The mechanical interlock is a mechanism associated with the diskette ejector, that prevents the door from closing if no diskette has been loaded into the drive receiver assembly. It also ejects the diskette when the door handle is lifted after the door is opened.

3.2.5 Index Sensor

Index and sector information is sensed by a combination of a light emitting diode (LED) mounted on the receiver assembly and an index transducer (photo transistor) mounted in the platen. Index-to-data adjustment is provided by moving the platen assembly.

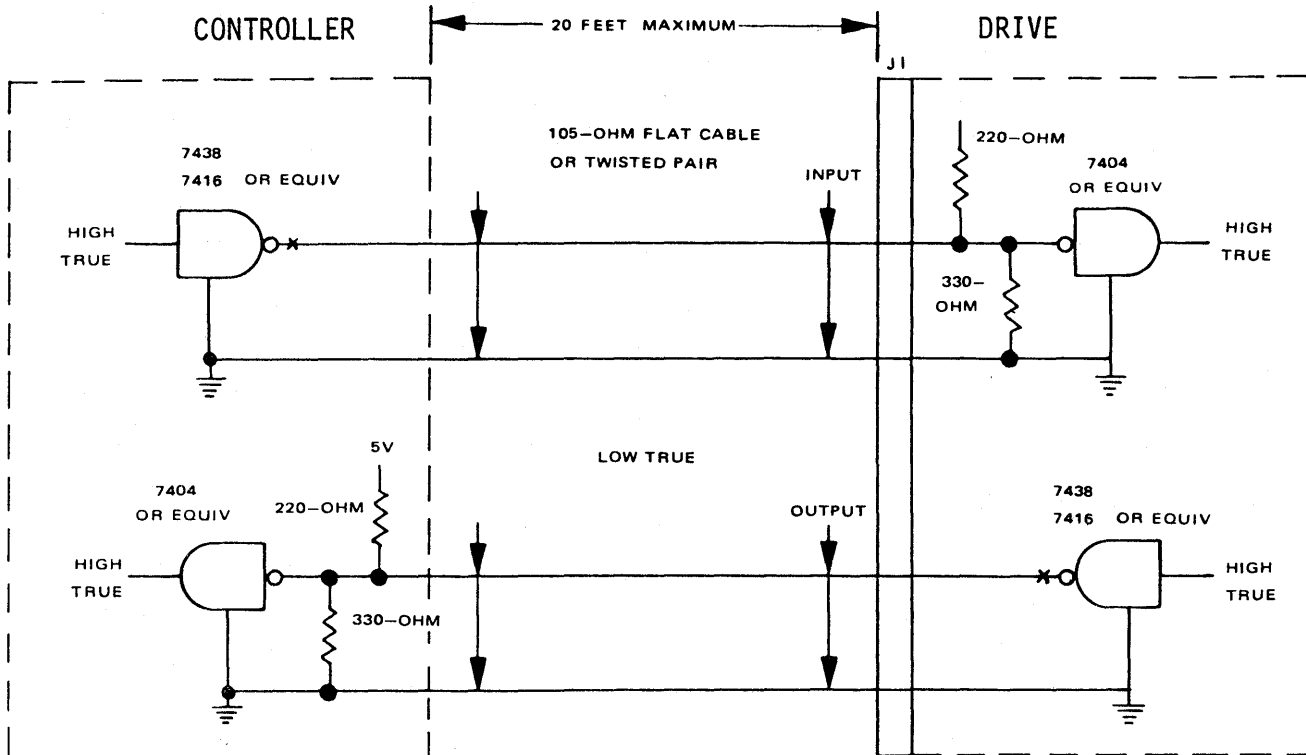
3.3 INTERFACE

This section describes the interface signals and timing requirements from a general viewpoint. This description applies to drives using either the Single A or the Single B PCBA. Specific references are covered in the appropriate sections of the Single A and Single B PCBA descriptions.

Interface connector J1 is located on the drive electronics PCBA. J1 provides the interface connection between the disk drive and the host controller. The interface consists of 11 input lines and 5 output lines. All interface lines are low true with the following logic levels:

True = Logic Zero = 0 - 0.4V
False = Logic One = 2.5 - 5.25V

A maximum of four drives can be connected to one host controller with a daisy chain cable. Termination resistors for the input lines are provided on the drive electronics PCBA (for daisy chain connections, they are installed in the last drive only). Figure 3-2 shows the typical receiver/driver characteristics for the interface. Either flat cable or twisted pairs may be used, with a maximum total cable length of 20 feet.



NOTES

Input Lines: TRUE = Logic Zero = 0 to 0.4V @ 25 ma max
 FALSE = Logic One = 2.5 to 5.25V @ 0 ma (open)

Output Lines: TRUE = Logic Zero = 0 to 0.4V @ 48 ma max
 FALSE = Logic One = 2.5 to 5.25V @ 250 ua max (open collector)

INPUT LINES ARE TERMINATED IN LAST DRIVE ONLY.

USER MAY USE 150 OHM TO +5V TERMINATION ON

OUTPUT LINES IF DESIRED.

Figure 3-2. Interface Characteristics

Table 3-1 lists the interface signals. Detailed information about each signal is given in the Single A and Single B PCBA descriptions. Figures 3-3, 3-4, and 3-5 show the general timing requirements.

TABLE 3-1. INTERFACE SIGNALS

J1 Connector Pin		Signal	Description	Source
Signal	Ground			
2	1	HDLD/	Head Load	Controller
4	3	-	Spare	-
6	5	RDY/	Ready	Drive
8	7	SECP/	Sector/Index Pulse	Drive
10	9	DS1/	Drive Select 1	Controller
12	11	DS2/	Drive Select 2	Controller
14	13	DS3/	Drive Select 3	Controller
16	15	MTRN/	Drive Motor On	Controller
18	17	DIRN/	Step Direction	Controller
20	19	STEP/	Step Command	Controller
22	21	WDA/	Write Data	Controller
24	23	WRT/	Write Gate	Controller
26	25	TRK0/	Track Zero	Drive
28	27	WPT/	Write Protect	Drive
30	29	RDA/	Read Data	Drive
32	31	HSLT/	Head Select	Controller
34	33	DS4/	Drive Select 4	Controller

Note: J1 Mating Connector is Scotchflex P/N 3463-001 or equivalent.

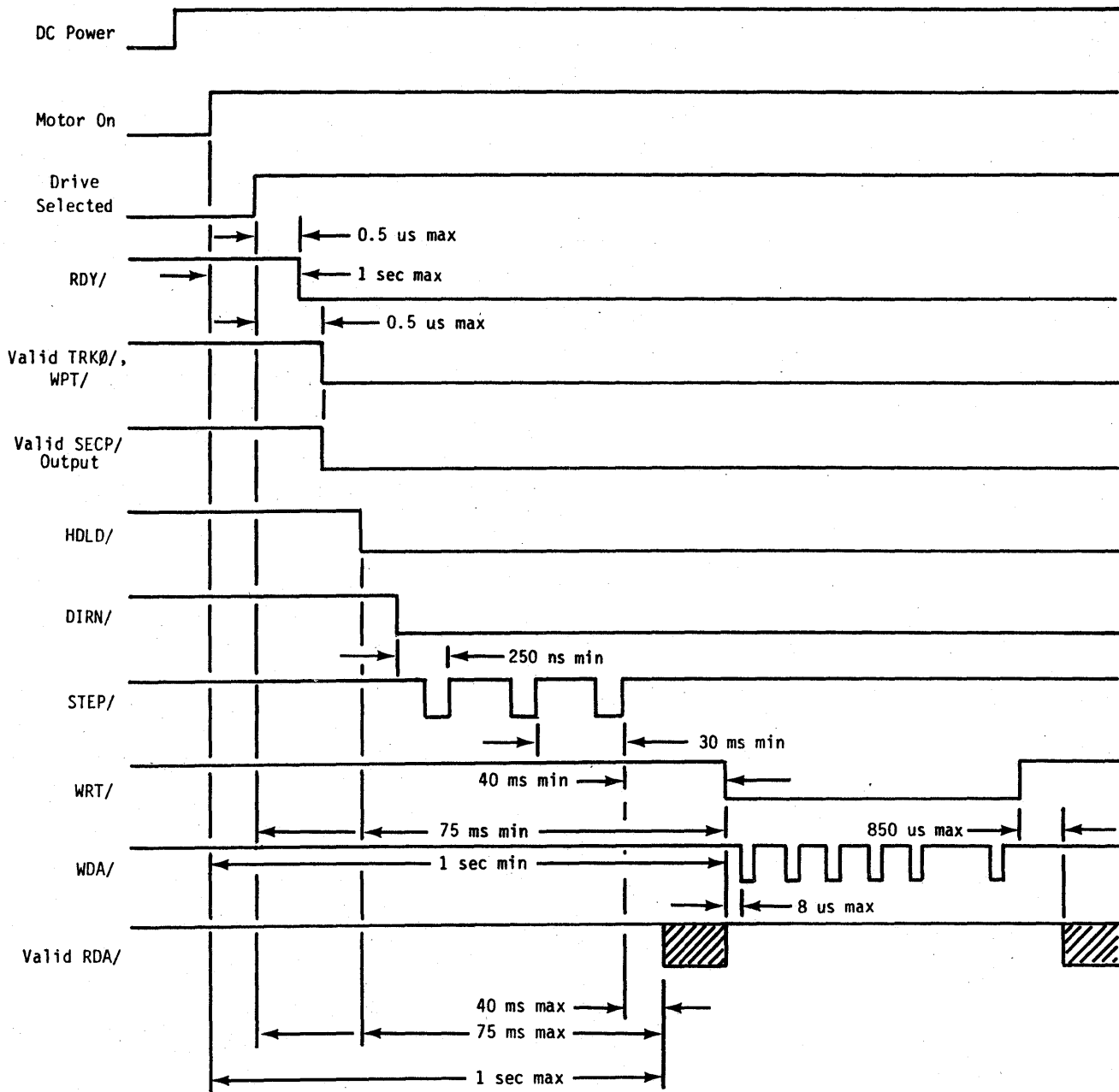


Figure 3-3. Major Signal General Timing Requirements

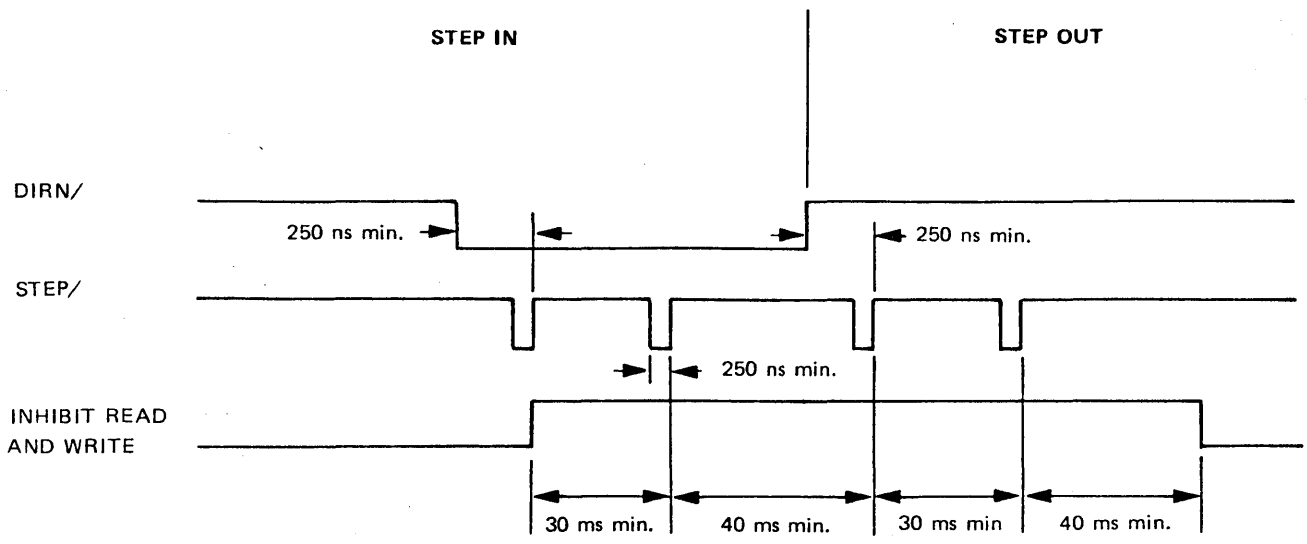


Figure 3-4. Positioner Control General Timing Requirements

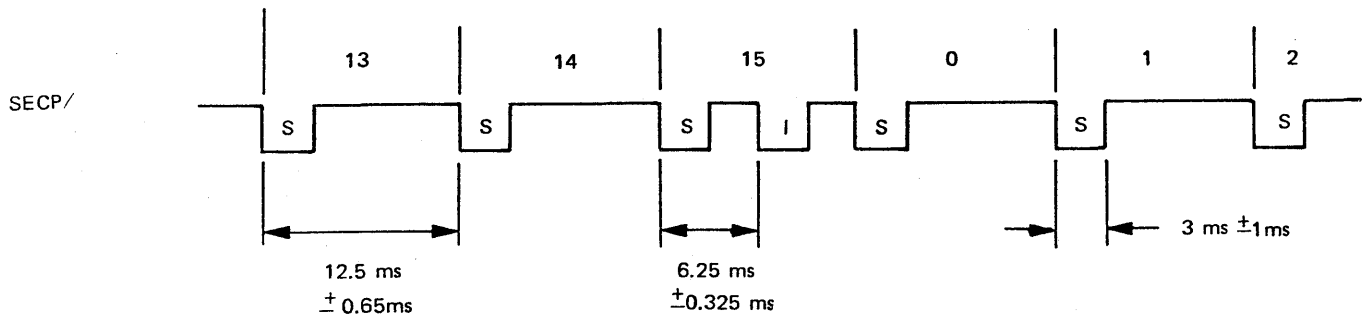


Figure 3-5. Index/Sector General Timing Requirements

3.4 SINGLE A DRIVE ELECTRONICS

The Single A Drive Electronics PCBA, P/N 100071, contains the control circuitry for the drive. The Single A PCBA controls the operation of the drive mechanism as well as reading and writing of data. The PCBA connects to the drive mechanism with a number of molex connectors; the interface connection to the host controller is discussed in section 3.3.

The Single A PCBA consists of the following functional elements:

- a. Interface Circuits
- b. Motor Control Circuit
- c. Read Circuitry
- d. Write Circuitry
- e. Positioner Control Circuit
- f. Miscellaneous Control Circuits

These elements are shown in block diagram form in figure 3-6. The paragraphs

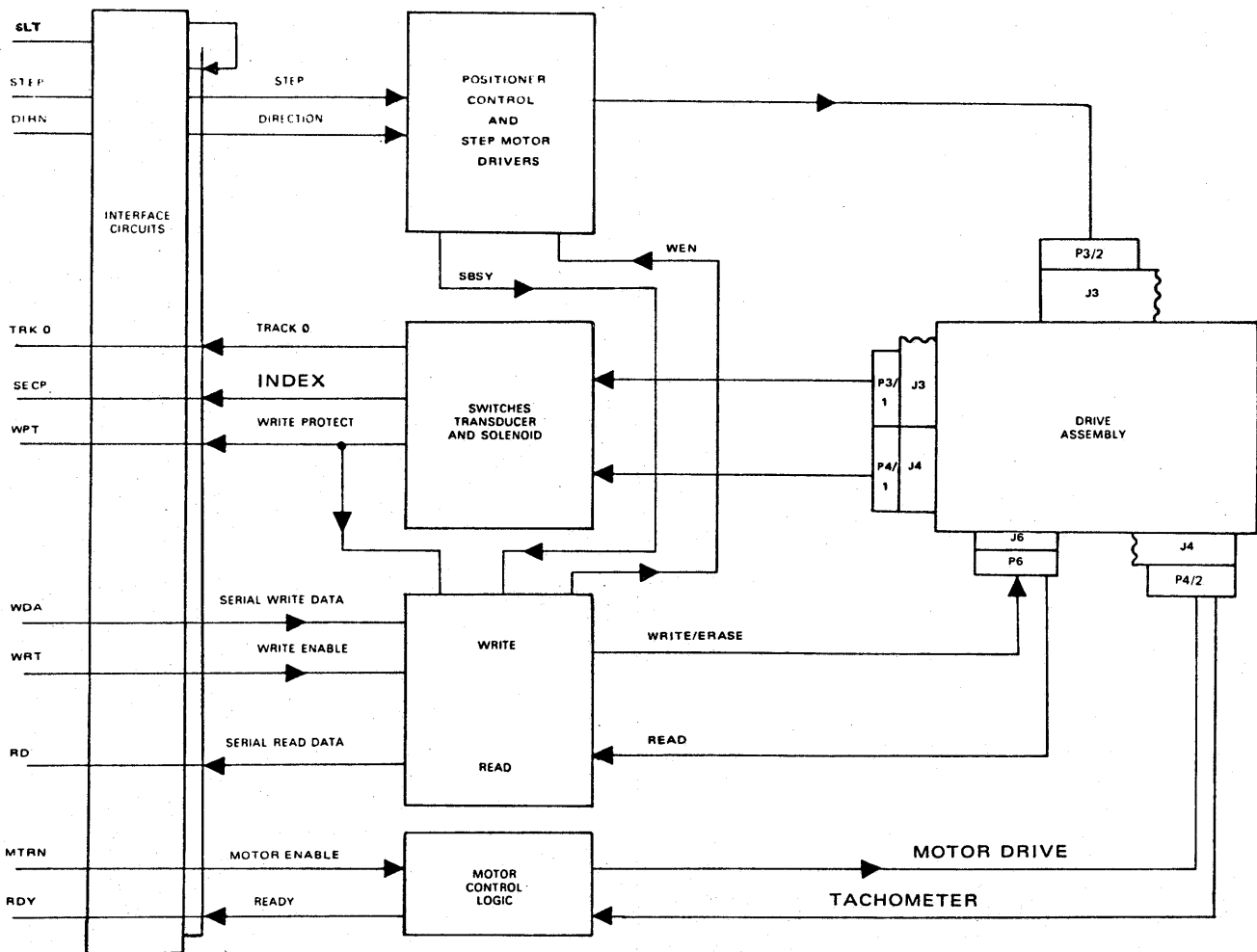


Figure 3-6. Single A Overall Block Diagram

that follow provide a detailed explanation of each functional element. The circuit descriptions are supported by block diagrams; detailed schematic diagrams are located in Section 8 of this manual. The schematics are referenced by drawing and sheet number to facilitate their use.

3.4.1 Interface Circuits (Sh 2 of Dwg 100072)

The interface circuits consist of line receivers, input terminators, line drivers, and drive selection logic. Input signals are terminated by 220/330 ohm terminator pack U15. (As discussed in paragraph 2.7.1, add-on drives have the terminator removed.)

A jumper in one of the positions W1, W2, W3, or W4 causes the drive selection logic to respond to the corresponding drive select input line DS1, DS2, DS3, or DS4. The appropriate select line is terminated by R1 and received by U16-2. The select signal gates the output signals directly via drivers U1-6, U1-8, U1-11, and U1-3, and indirectly via U16-12 (on Sh 7 of Dwg 100072) for the read data signal. The select signal also drives a LED panel indicator via driver U20-4, to indicate that the drive is selected.

3.4.2 Motor Control Circuit (Sh 8 of Dwg 100072)

The motor control circuit is a closed loop servo, which controls the spindle drive system. The spindle drive consists of a DC motor and AC tachometer mounted on a common shaft. The DC motor shaft rotation is converted by the tachometer to an AC signal whose amplitude is proportional to the speed of the motor. This feedback signal is rectified and filtered to produce an equivalent DC signal. An operational amplifier compares the feedback signal with a reference level generated on the PCBA. The net output from the operational amplifier drives a power amplifier which in turn powers the DC motor. Figure 3-7 is a block diagram of the motor control circuit.

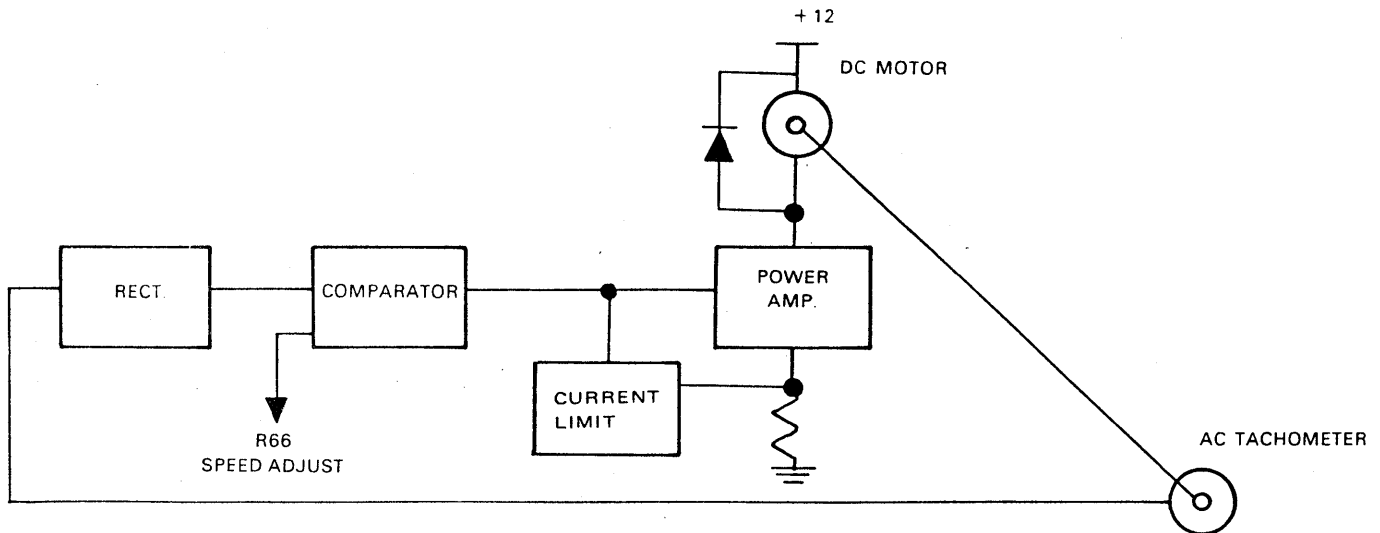


Figure 3-7. Single A Motor Control Circuit Block Diagram

- a. Rectifier and Filter. The AC tachometer signal enters the Single A PCBA at J4-14 and -15. Diode CR20 and resistor R64 form a half-wave rectifier whose output is filtered by capacitor C41. The filtered signal is applied to the next stage through resistor R68.
- b. Comparator and Reference Circuit. Operational amplifier U6 compares the output of the previous stage with a reference level established by potentiometer R66 and its associated components. The reference voltage is developed by a voltage divider network consisting of resistor R65 and zener diode CR21. Potentiometer R66 is connected across the constant voltage source CR21 and in series with temperature compensating diode CR22 and resistor R67. The effect of this network is to produce a temperature compensated adjustable reference level at input U6-3. Resistors R70 and R72 form the feedback loop with a DC gain of 36. The output of U6 feeds the power amplifier drivers through DC coupling network R73, R74.
- c. Power Amplifier Circuits. The power amplifier circuits consist of Darlington pair transistor Q5, current limiter circuit Q4, and associated components. The operation of power amplifier driver Q5 is controlled by the state of the MOT signal. This signal is coupled into the base of Q5 by diode CR23.

When MOT is low, CR23 conducts, and the base of Q5 goes to 0.8V, cutting off Q5. When MOT goes high, CR23 is cut off, allowing the base of Q5 to attain its operational value (approx. 1.4V). Resistors R77, R75, and R76, and transistor Q4, form a feedback circuit that reduces the current surge caused by motor startup. When the motor-on command is received, transistor Q5 goes into saturation and collector current would normally rise to a larger value since the motor is still stationary. However, the current feedback network consisting of Q4 and its associated components will limit this initial surge to a maximum of 0.8 amp. Resistor R77 provides a convenient point to monitor the motor current. Diode CR24 protects Q5 from inductive kickback caused by commutation. L6, C37, C38, C39, and C40 provide filtering to prevent high frequency transients generated by the motor from propagating into the drive electronics through the power supply.

3.4.3 Read Circuitry (Sh 7 of Dwg 100072)

The read circuitry processes the low-level information from the read head during the read cycle, reshaping it into a digital pulse stream. Figure 3-8 is a block diagram of the read circuitry. The +12V supplied to the elements in these circuits is filtered through L5 to provide additional noise isolation. Voltage divider R47, R48 and filter capacitor C22 develop a reference voltage (referred to as V1) of approximately 6V used in the circuits discussed below.

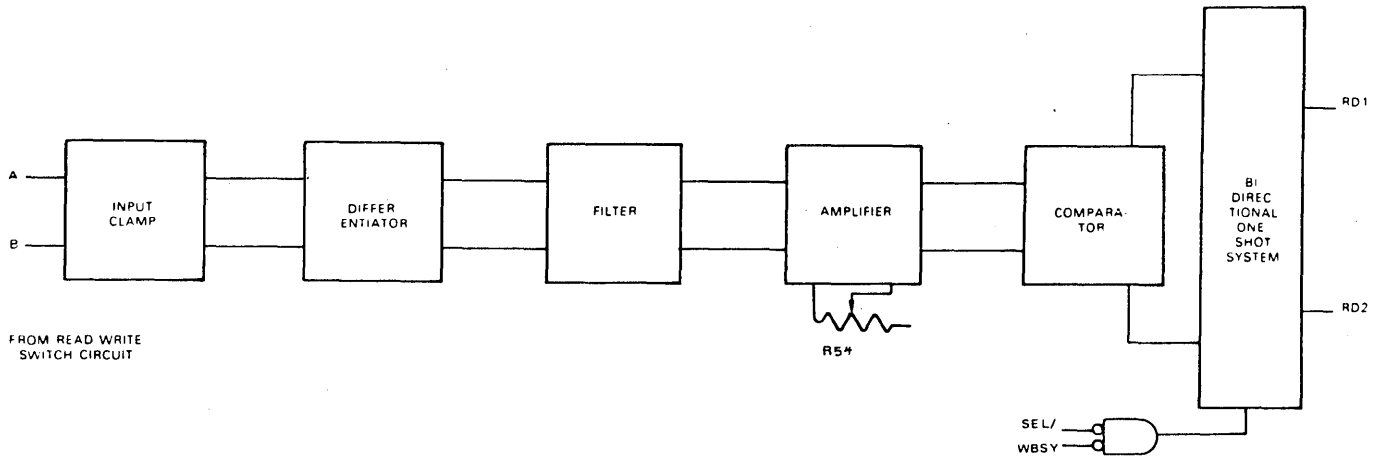


Figure 3-8. Single A Read Circuitry Block Diagram

- a. Input Clamp. The low-level signal (approx. 1.5 mV pp) from the read head is fed to differentiator U24. Input diodes CR18 and CR19 constitute a clamp circuit that prevents transients generated by the write circuit from propagating through the read circuits. The junction of diodes CR18 and CR19 at V2 is held at approximately +6.7V. This voltage is generated in voltage divider R37, R36, R38 (refer to the discussion of PSEN generation in paragraph 3.4.4a).
- b. Differentiator. The differentiator consists of U24 and its associated components. This element, with U22 and U23, functions as a peak detector that generates the signal illustrated in the timing diagram of figure 3-9, which shows the read waveforms for a sequence of "1's." Thus the output of U24 crosses the zero-base line each time a peak is detected on the input signal. Capacitor C25 yields the required 6 dB per octave rising characteristic of a differentiator. Resistor R51 terminates this characteristic at 250 kHz. This stage has an approximate gain of 40 at 125 kHz.
- c. Filter. The balanced output of U24 at pins 7 and 8 is applied to an LCR filter that provides a phase shift as a function of frequency. This is the linear function required for true data reproduction of the read data. R52 and R53, and V1, maintain the read signal at the center of U23's linear range.

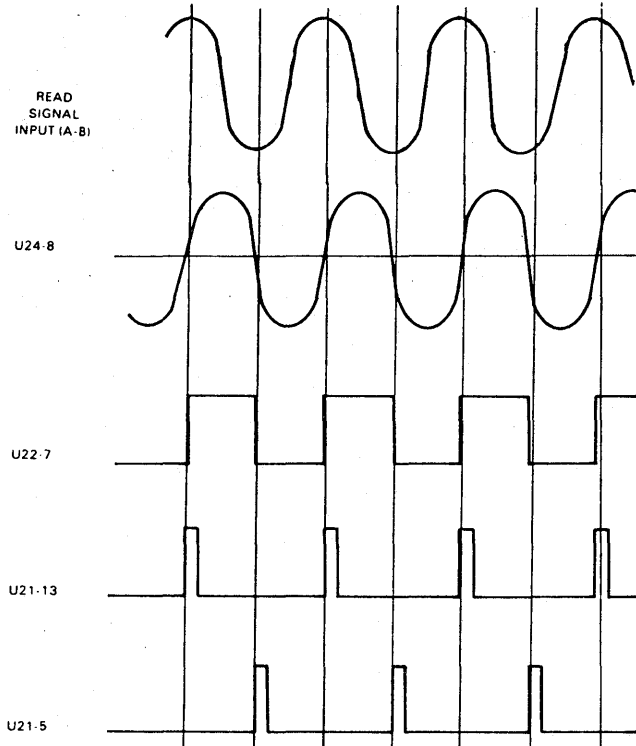


Figure 3-9. Single A Read Waveforms

- d. Amplifier. The amplifier consists of U23 and resistors R54 and R55. The gain of this stage is approximately 50, and can be adjusted by R54. The balanced output of this amplifier is AC-coupled into a comparator by capacitors C31 and C32 and resistors R58 and R59. Resistors R56 and R57 center the output signal from U23 at the V1 reference potential.
- e. Comparator. The output of the amplifier is processed by low pass filter network R58, R59, C48, thus providing additional noise rejection for this stage. Comparator U22 converts the essentially sinusoidal wave shape input into a square wave. Figure 3-9 shows this waveform conversion and timing. Capacitor C34 and resistor R61 provide a delay for the output of U22. This compensates for the inherently longer turn-on delay of U22, thus providing a symmetrical square wave to the next stage.
- f. Bidirectional One-Shot System. The output of the comparator at pin 7 is connected to the inputs of dual one-shot U21. These one-shots are connected so that they each produce a pulse of fixed width corresponding to the positive and the negative edges respectively of the input waveform. Resistor R62 and capacitor C35 control the pulse width of one-shot U21-13, while resistor R63 and capacitor C36 perform that function for U21-5. These two signals are ORed together in the interface circuits described in paragraph 3.4.1. The bidirectional one-shot is reset by U16-3. If the drive is not selected, SEL is high causing U16-3 to go low, resetting U21. Similarly if the drive

is in the write mode, WBSY is also high, causing U21 to reset. This logic prevents noise signals from being transmitted to the interface circuits whenever the drive is in the write mode, or the drive is not selected.

3.4.4 Write Circuitry (Sh 6 of Dwg 100072)

The write circuitry consists of a power supply enable circuit, write control logic, write current drivers, an erase current driver, and the read/write switch. Figure 3-10 is a block diagram of the write circuitry.

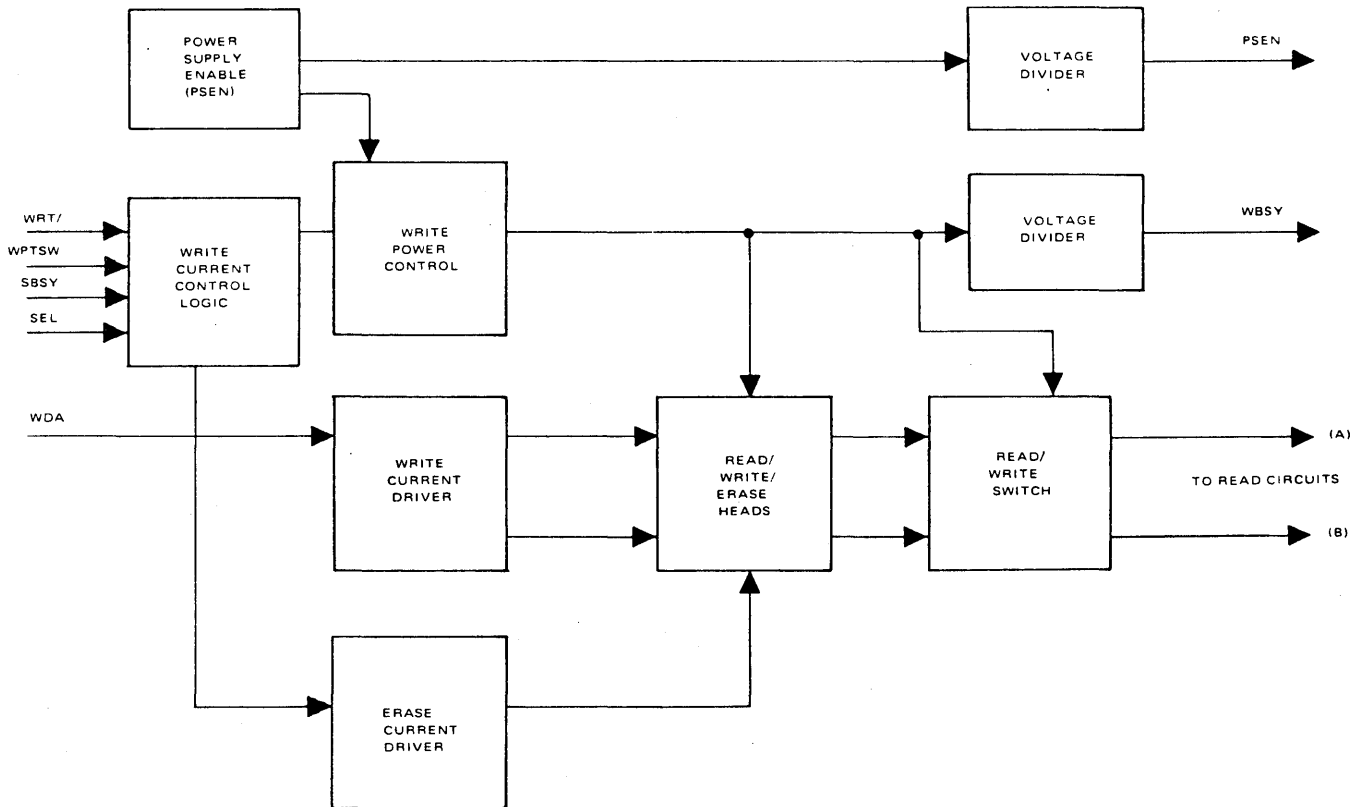


Figure 3-10. Single A Write Circuitry Block Diagram

- a. Power Supply Enable Circuit. The power supply enable (PSEN) circuit allows the write current to flow only when the power supply voltages (+5V and +12V) are within operational tolerances. This prevents writing on the diskette during power-up or power-down sequences of the disk drive, or during accidental power loss. The PSEN circuit consists of transistors Q1 and Q2 and associated components. Initially, as +5V power rises to operational level, transistor Q1 conducts as soon as the base voltage exceeds the zener voltage of CR6 plus the emitter base drop of Q1, or about 3.4V. When the collector current of Q1 is sufficient to drop 0.7V across R23, transistor Q2 conducts, providing +12V to the remaining circuits if the +12V power is present. At the same time, voltage divider

R43, R44 generates a high status signal PSEN. The +12V is also divided by R36, R37, and R38. This divider produces about +6.7V, which is used in the input clamp of the read circuits (see paragraph 3.4.3a). Divider R38, R36 also develops approximately +6V. This voltage is applied to the center tap of the R/W head, providing the correct bias for U24 in the read mode.

- b. Write Control Logic. The write control logic provides the necessary signals to gate and control the write circuits. The write control logic consists of elements U18, U10, U20, and U9. This logic controls the operation of the write current driver, the erase current driver, and the write busy (WBSY) generator. The write control signal for these circuits is generated by four external logic signals gated by U18 and U10. When WRT/ is low (TRUE), write protect (WPTSW) is low (FALSE), and stepper busy (SBSY) is low (FALSE), U18-8 is high, enabling gate U10-8. If the drive is selected, SEL is high and U10-8 goes low. This condition is coupled to the base of Q3 via U20-2, generating the write busy (WBSY) signal.

As U10-8 goes low, inverter U9-10 releases the set and clear direct inputs at pins 10 and 13 of U19. This condition enables U19 to respond to the state of the write data input, WDA. The low state of 10-8 also enables the erase current generator through U9-10 and U20-12. Note that when U19 pins 10 and 13 were both held low, pins 8 and 9 of U19 were both in a high state.

- c. Write Current Driver. When the write control logic removes the set and clear direct inputs to write flip-flop U19, write data (WDA) pulses from the interface can be processed by the write current driver circuit. (When both set and clear were low, both outputs were in a high state.) The flip-flop is connected in such a manner that each time a write pulse occurs, the flip-flop toggles on the trailing edge of that pulse. The two complementary outputs of U19 are coupled by power drivers into the read/write head through resistors R30 and R31. As the flip-flop toggles, power drivers U20-10 and U20-8 are energized sequentially, thus alternately driving a current through the two halves of the read/write head. Diodes CR9 and CR10 are used to isolate the write circuits from the head during the read operation, to increase noise immunity. Resistors R28 and R29 ensure that CR9 and CR10 are back biased when the write operation is concluded.
- d. Erase Current Driver. Resistors R25 and R26, diode CR7, capacitor C16, and timer U13 combine the functions of an erase current driver with a delay generator that generates two different delays from the leading edge and the trailing edge of the input waveform. This causes the erase current to be switched on approximately 400 μ sec after the write control signal has been activated, and off 800 μ sec after the control signal is removed, to accommodate the time delay between head write gap and erase gap using a tunnel erase head. When the circuits are not in the write mode, U20-12 is low and the output of erase driver U13-3 is high. When the write operation is initiated, U20-12 goes high. The output of driver U13 does not

follow the change of state until delay network R26, C16 times out (approximately 400 μ sec). At this time, U13 senses the high state of U20-12, and U13-3 goes low. This condition causes the erase current to flow from the center tap of the head through the erase winding and diode CR11. The amount of erase current is determined by the values of R34 and R35.

At the conclusion of the write operation, U20-12 goes low. As in the previous paragraph, the output of U13 does not follow this state until another delay circuit, consisting of R25 and C16, times out (approximately 800 μ sec). At the end of that period, U13-3 goes high, and the erase current stops flowing. Diode CR8 absorbs the inductive emf when the head winding current stops.

- e. Read/Write Switch. The read/write switch consists of diodes CR12 through CR17 and resistors R39, R40, R45, and R46. The function of this switch is to isolate the read circuit from the considerable voltage excursions which occur when a write operation is in effect, and to allow the read circuits to access the head when the read mode is selected.

When the write command occurs and Q3 conducts, the anodes of CR14 and CR15 go to about 11.5V. Thus all the cathode junctions of diodes CR12 through CR17 are at about 11V. Since the anodes of diodes CR16 and CR17 cannot rise above the 6.7V clamp in the read circuits (paragraph 3.4.3), CR16 and CR17 are back biased and the read circuits are effectively isolated from the read/write head. When the read mode is selected, Q3 is cut off, since the WRT/signal is high at U18-9. Under these conditions, the circuit stabilizes with CR14 and CR15 cut off and diodes CR12, CR13, CR16, and CR17 conducting. The anodes of CR12 and CR13 are at approximately +6V since they are connected through the low impedance head to voltage divider R36, R38. Approximately 0.25 ma is supplied through resistors R45 and R46, and diodes CR16 and CR17. About 0.5 ma is drawn through R39 and R40. Thus each of the four diodes have approximately 0.25 ma of current flowing through them. In this way, the diode bridge provides a low impedance path for the head signal to differentiator U24 (Sh 7 of Dwg 100072).

3.4.5 Positioner Control Circuit (Sh 3 of Dwg 100072)

The positioner control circuit, shown in block diagram form in figure 3-11, generates signals which cause the stepper motor to move the head from track to track in response to a step command. Four sequential signals, designated phase 1 ($\phi 1$), phase 2 ($\phi 2$), phase 3 ($\phi 3$), and phase 4 ($\phi 4$), are applied to the stepper motor drive circuits to cause track-to-track positioning. Initially the system is in the hold state with $\phi 4$ on. If a step-in command is received, the signal sequence $\phi 1, \phi 2, \phi 3, \phi 4$ is generated. If a step-out command is received, the signal sequence $\phi 3, \phi 2, \phi 1, \phi 4$ is generated.

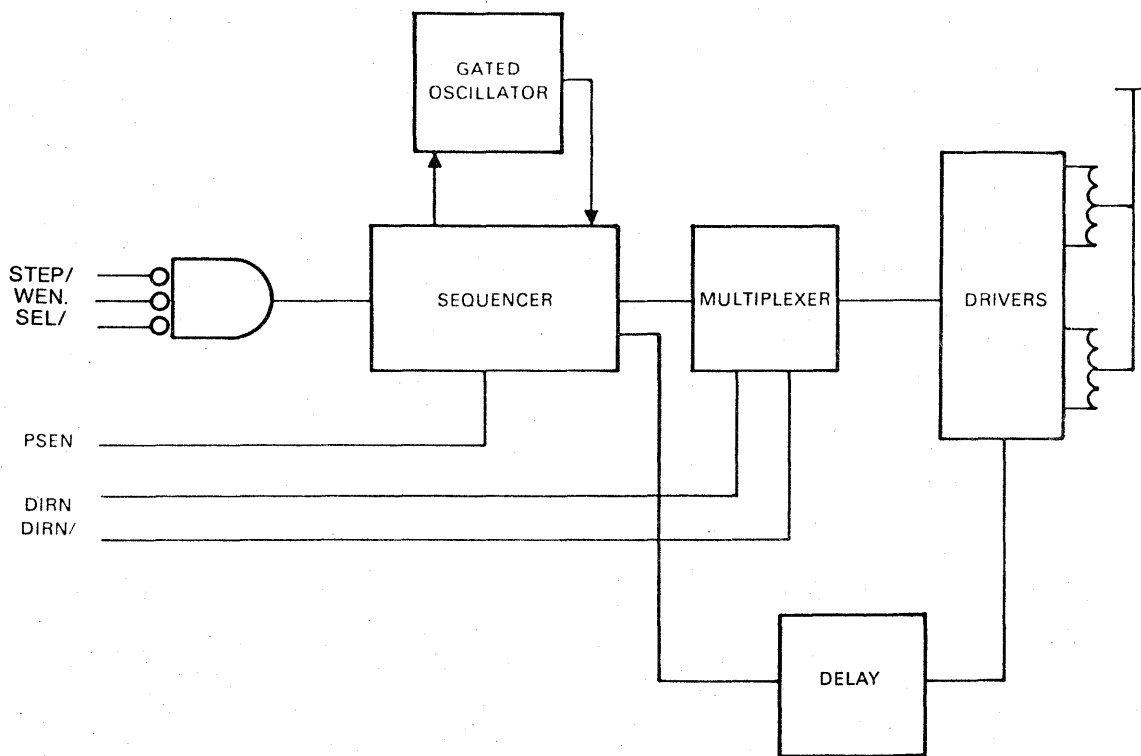


Figure 3-11. Positioner Control Circuit Block Diagram

The positioner control circuit consists of an NE555 timer connected as a gated oscillator (U12), a dual and/or gate (U17) which is used as a multiplexer, and three flip-flops (U11-5, U11-9, and U19-5), which comprise the sequencer. Figure 3-12 shows the timing relationships for the positioner control circuit operation.

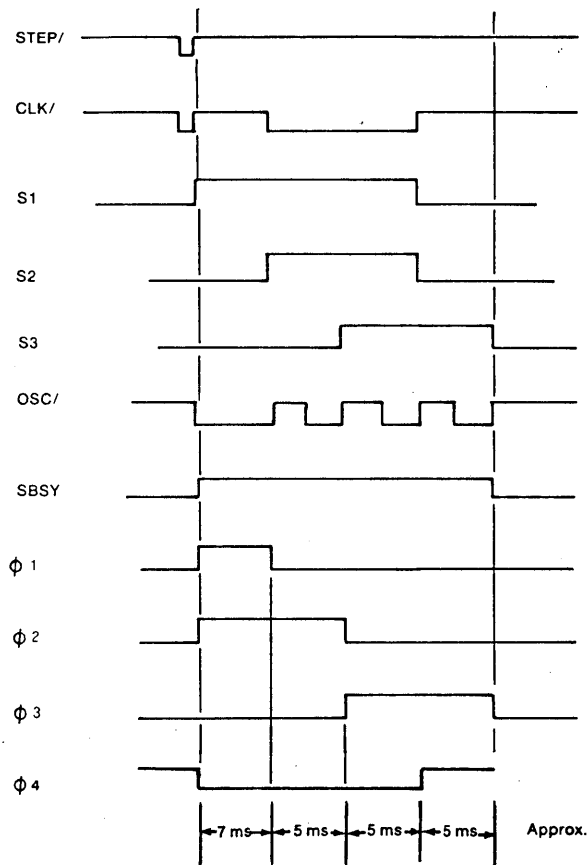


Figure 3-12. Positioner Control Circuit Timing Diagram

Initially, the oscillator is held clear and the flip-flops are reset. When a step pulse occurs (with the drive selected and not writing), a positive-going pulse is generated at U18-12. The trailing edge of this pulse sets flip-flop U11-5 so that:

- a. Hold driver U5 is deenergized.
- b. The SBSY line is set high, starting the NE555 oscillator and inhibiting writing via U18-10 (Sh 6 of Dwg 100072) for the duration of the stepping cycle.

The oscillator then sets U11-9 and U19-5 in turn. The sequencer logic outputs are applied to the multiplexer. The polarity of the direction signal (DIRN or DIRN/) conditions the multiplexer to produce the appropriate phase sequence. These sequential signals are applied to drivers U4-3, U3-5, U4-5, U5-3, and U5-5 causing the stepper motor to step-in (DIRN low) or step-out (DIRN high).

Diodes CR2, CR3, CR4, and CR5, in conjunction with zener diode CR1, limit the turnoff transient to +20V. Referring to figure 3-12, it can be seen that the step sequence is complete at the end of SBSY (approximately 23 ms). If after a further 12 ms, i.e. a total of 35 ms after a step pulse, a further step command has not been received, hold driver U5-5 is deenergized via the delay circuit U7-10, U8-6, R3, and C49. A hold current of about half the original value is then supplied via U5-3 and resistors R5, R6, R7, and R8. This scheme allows a system and motor power reduction in the standby mode.

3.4.6 Miscellaneous Control Circuits

These circuits perform several functions:

- a. Debounce the drive switch closures.
- b. Reshape the pulses from the index transducer.
- c. Control the head load solenoid.
- d. Generate the drive ready (RDY) status signal.

3.4.6.1 Switch Debouncers. (Sh 5 of Dwg 100072)

The door open switch and the track zero switch closures are applied to latched gates U2-11 and U2-3 to eliminate the effects of contact bounce.

3.4.6.2 Transducer Pulse Shaper. (Sh 5 of Dwg 100072)

The index transducer (photo transistor) output is applied to Schmitt trigger U8. The output at U8-12 is the sector pulse SECP, which in turn is applied to interface driver U1-9. U8-10 provides positive feedback to produce hysteresis, thus preventing the circuit from responding to small discontinuities in the input signal.

3.4.6.3 Head Load Solenoid Driver. (Sh 4 of Dwg 100072)

The head load solenoid is energized whenever the drive is selected or the HDLD signal is true. This latter mode allows the head to remain loaded even when the drive is deselected - for example, to avoid incurring a head load time in overlap operations such as drive-to-drive disk copying.

Whenever the SEL/ or HDLD/ signal is low, the output of U10-11 goes high. This energizes the head load solenoid driver U3-3 if the motor is enabled (MTRN/ low), PSEN is high, and the drive door is closed (DOOR/ is low).

3.4.6.4 Drive Ready Signal. (Sh 4 of Dwg 100072)

When the MTRN, PSEN, and DOOR signals become true, a 1½-second delay circuit consisting of U7-12, R12, C14, C15, and U8-4 is enabled. After the delay, the drive ready (RDY) signal is produced. This delay allows the drive motor to reach operational speed before proceeding.

3.5 SINGLE B DRIVE ELECTRONICS

The Single B Drive Electronics PCBA, P/N 100163, contains the control circuitry for the drive. The Single B PCBA controls the operation of the drive mechanism as well as reading and writing of data. The PCBA connects to the drive mechanism with a number of molex connectors; the interface connection to the host controller is discussed in section 3.3.

The Single B PCBA consists of the following functional elements:

- a. Interface Circuits
- b. Motor Control Circuit
- c. Read Circuitry
- d. Write Circuitry
- e. Positioner Control Circuit
- f. Miscellaneous Control Circuits

These elements are shown in block diagram form in figure 3-13. The paragraphs

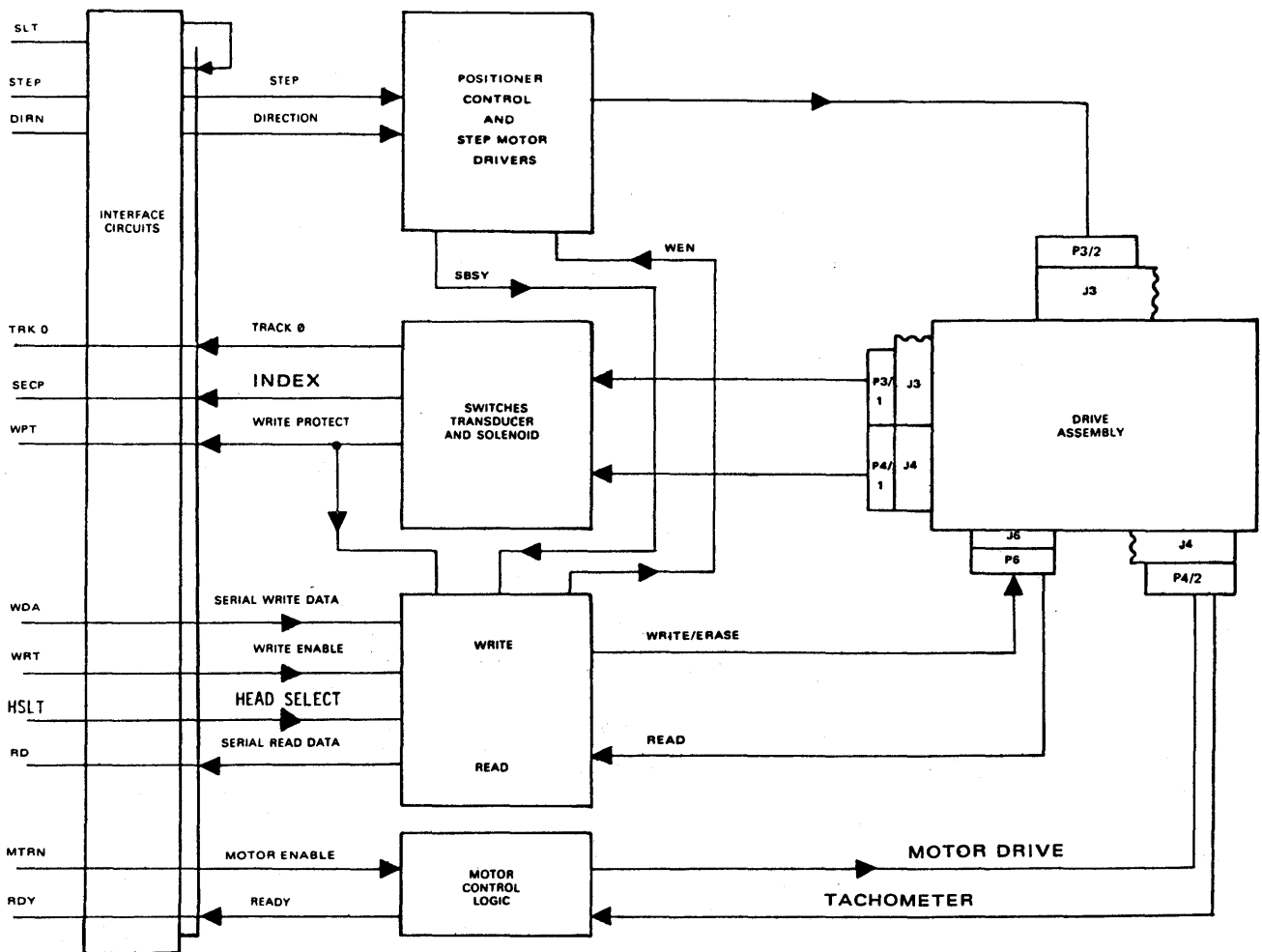


Figure 3-13. Single B Overall Block Diagram

that follow provide a detailed explanation of each functional element. The circuit descriptions are supported by block diagrams; detailed schematic diagrams are located in Section 8 of this manual. The schematics are referenced by drawing and sheet number to facilitate their use.

3.5.1 Comparison With Single A PCBA

The Single B PCBA is similar to the Single A PCBA that it replaces. Three additional features are included on the Single B:

- a. Optional circuits to accommodate dual heads for double-sided operation.
- b. Automatic drive motor turn-on for two seconds to seat the diskette.
- c. Digital noise filtering.

The Single B PCBA is compatible with the older Single A PCBA, and may be used as a replacement for the Single A. The interface, interconnection, and power requirements are essentially unchanged.

3.5.2 Interface Circuits (Sh 2 of Dwg 100164)

The interface circuits consist of line receivers, input terminators, line drivers, and drive selection logic. Input signals are terminated by 220/330 ohm terminator pack U17. (As discussed in paragraph 2.7.1, add-on drives have the terminator removed.)

A jumper in one of the positions W1, W2, W3, or W4 causes the drive selection logic to respond to the corresponding drive select input line DS1, DS2, DS3, or DS4. The appropriate select line is terminated by RN1 and received by U10-1. The select signal gates the output signals directly via drivers U1-6, U1-8, U1-11, and U1-3, and indirectly via U20-8 (on Sh 7 of Dwg 100164) for the read data signal. The select signal also drives a LED panel indicator via driver U9-4, to indicate that the drive is selected.

3.5.3 Motor Control Circuit (Sh 8 of Dwg 100164)

The motor control circuit is a closed loop servo, which controls the spindle drive system. The spindle drive consists of a DC motor and AC tachometer mounted on a common shaft. The DC motor shaft rotation is converted by the tachometer to an AC signal whose amplitude is proportional to the speed of the motor. This feedback signal is rectified and filtered to produce an equivalent DC signal. An operational amplifier compares the feedback signal with a reference level generated on the PCBA. The net output from the operational amplifier drives a power amplifier which in turn powers the DC motor. Figure 3-14 is a block diagram of the motor control circuit.

- a. Rectifier and Filter. The AC tachometer signal enters the Single B PCBA at J4-14 and -15. Diode CR30 and resistor R70 form a half-wave rectifier whose output is filtered by capacitor C44. The filtered signal is applied to the next stage through resistor R74.

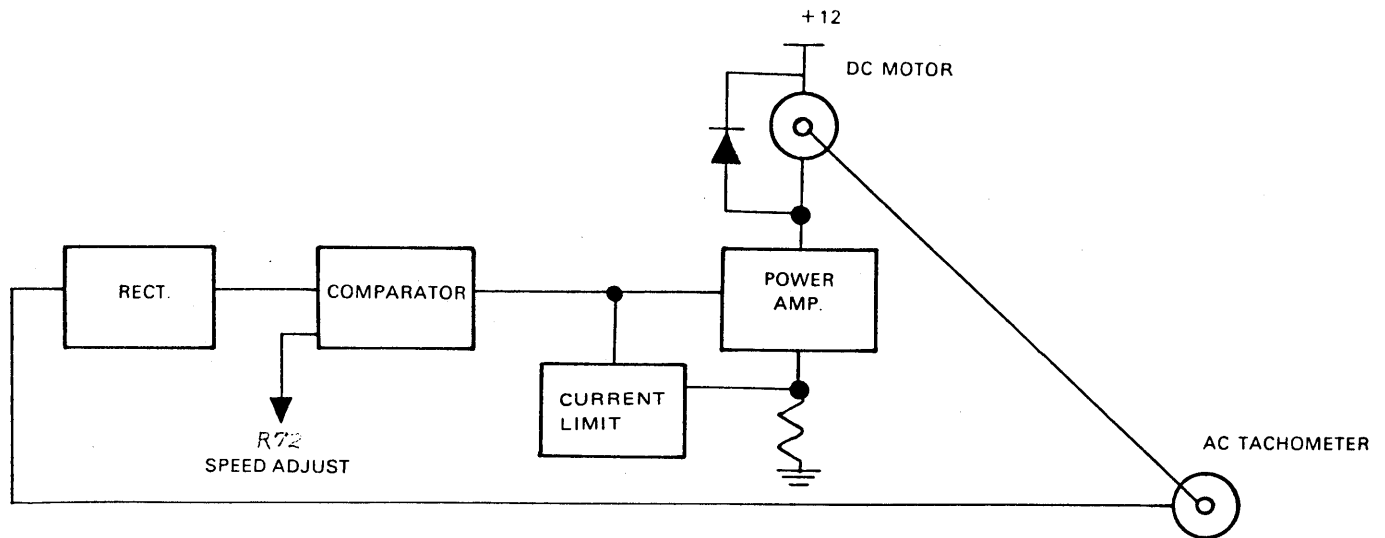


Figure 3-14. Single B Motor Control Circuit Block Diagram

- b. Comparator and Reference Circuit. Operational amplifier U7 compares the output of the previous stage with a reference level established by potentiometer R72 and its associated components. The reference voltage is developed by a voltage divider network consisting of resistor R71 and zener diode CR31. Potentiometer R72 is connected across the constant voltage source CR31 and in series with temperature compensating diode CR32 and resistor R73. The effect of this network is to produce a temperature compensated adjustable reference level at input U7-3. Resistors R76 and R78 form the feedback loop with a DC gain of 36. The output of U7 feeds the power amplifier drivers through DC coupling network R79, R80.
- c. Power Amplifier Circuits. The power amplifier circuits consist of Darlington pair transistor Q7, current limiter circuit Q6, and associated components. The operation of power amplifier driver Q7 is controlled by the state of the MOT signal. This signal is coupled into the base of Q7 by diode CR33.

When MOT is low, CR33 conducts, and the base of Q7 goes to 0.8V, cutting off Q7. When MOT goes high, CR33 is cut off, allowing the base of Q7 to attain its operational value (approx. 1.4V). Resistors R83, R81, and R82, and transistor Q6, form a feedback circuit that reduces the current surge caused by motor startup. When the motor-on command is received, transistor Q7 goes into saturation and collector current would normally rise to a larger value since the motor is still stationary. However, the current feedback network consisting of Q6 and its associated components will limit this initial surge to a maximum of 0.8 amp. Resistor R83 provides a convenient point to monitor the motor current.

Diode CR34 protects Q7 from inductive kickback caused by commutation. L6, C40, C41, C42 and C43 provide filtering to prevent high frequency transients generated by the motor from propagating into the drive electronics through the power supply.

3.5.4 Read Circuitry (Sh 7 of Dwg 100164)

The read circuitry processes the low-level information from the read head during the read cycle, reshaping it into a digital pulse stream. Figure 3-15 is a block diagram of the read circuitry. The +12V supplied to the elements in these circuits is filtered through L5 to provide additional noise isolation. Voltage divider R54, R55 and filter capacitor C24 develop a reference voltage (referred to as V1) of approximately 6V used in the circuits discussed below.

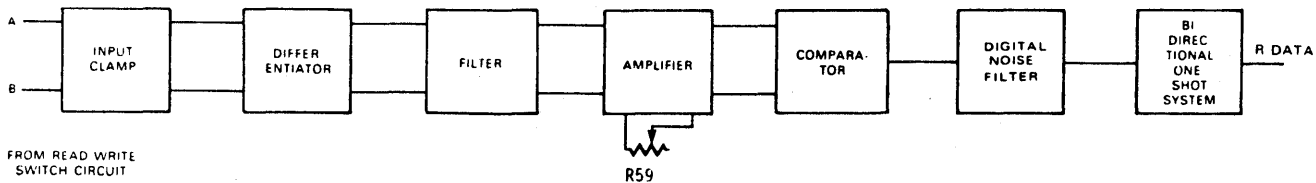


Figure 3-15. Single B Read Circuitry Block Diagram

- a. Input Clamp. The low-level signal (approx. 1.5 mV pp) from the read head is fed to differentiator U28. Input diodes CR28 and CR29 constitute a clamp circuit that prevents transients generated by the write circuit from propagating through to the read circuits. The junction of diodes CR28 and CR29 at V2 is held at approximately +6.7V. This voltage is generated in voltage divider R41, R42, R43 (refer to the discussion of PSEN generation in paragraph 3.5.5a).
- b. Differentiator. The differentiator consists of U28 and its associated components. This element, with U26 and U27, functions as a peak detector that generates the signal illustrated in the timing diagram of figure 3-16, which shows the read waveforms for a sequence of "1's." Thus the output of U28 crosses the zero-base line each time a peak is detected on the input signal. Capacitor C25 yields the required 6 dB per octave rising characteristic of a differentiator. Resistor R56 terminates this characteristic at 250 kHz. This stage has an approximate gain of 40 at 125 kHz.
- c. Filter. The balanced output of U28 at pins 7 and 8 is applied to an LCR filter that provides a phase shift as a function of frequency. This is the linear function required for true data reproduction of the read data. R57 and R58, and V1, maintain the read signal at the center of U27's linear range.

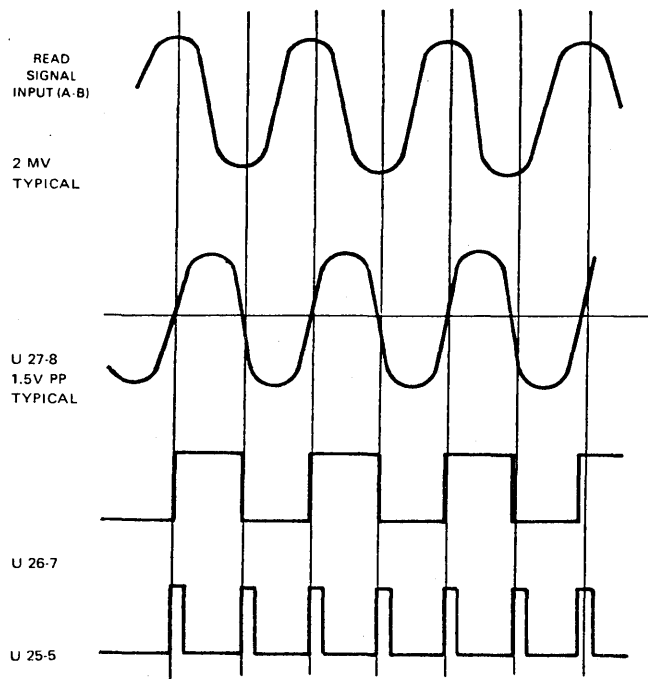


Figure 3-16. Single B Read Waveforms

- d. Amplifier. The amplifier consists of U27 and resistors R59 and R60. The gain of this stage is approximately 50, and can be adjusted by R59. The balanced output of this amplifier is AC coupled into a comparator by capacitors C32 and C33 and resistors R63 and R64. Resistors R61 and R62 center the output signal from U27 at the V1 reference potential.
- e. Comparator. The output of the amplifier is processed by low pass filter network R63, R64, C35, thus providing additional noise rejection for this stage. Comparator U26 converts the essentially sinusoidal wave shape input into a square wave. Figure 3-16 shows this waveform conversion and timing.
- f. Digital Noise Filter. The output of comparator U26 is connected to one-shot U25-13 via exclusive "OR" gate U24-6, and to flip-flop U23-9. These three logic elements and their associated components form a digital noise filter that rejects short duration pulse-type noise. The filter will reject noise pulses of a duration of less than 3 μsec (approx.) in an MFM (Model 1015) version of the PCBA, or less than 1.3 μsec in a GCR (Model 1016) version.

Since U24-6 is an exclusive "OR" gate, a short duration high-going pulse will be generated at U24-6 for every change in state of U26-7. This is due to the delay at U24 pin 5 created by R66 and C36. U25-13 will therefore fire for every transition. R67 and C37 determine the

one-shot pulse width. U23 pin 11 will clock at the end of 3 μ sec (1.3 μ sec for GCR); if the change in state which fired U25-13 is still present at U23 pin 12, then U23 pin 9 will assume the same state. U23 pin 12 will not change in less than 3 μ sec (1.3 for GCR) for normal data transition. U23-9 will not change state for a short duration noise pulse occurring at U26-7, since by the time the clock edge generated by the noise pulse is available at U23-11, the enable input at U23-12 is false.

- g. Bidirectional One-Shot. The operation of exclusive "OR" gate U24-8 is identical to that described for U24-6. Every change in state of U23-9 (every data transition) will cause a high-going pulse to be generated by U24-8. Element U25-5, a 0.9 μ sec one-shot, will fire for all transitions generating RDATA (see figure 3-16). R69 and C39 determine the one-shot pulse width. U20 holds U25 reset whenever the drive is not selected or is in a write mode. This prevents noise from being transmitted to the interface.

3.5.5 Write Circuitry (Sh 6 of Dwg 100164)

The write circuitry consists of a power supply enable circuit, a head select circuit, write control logic, write current drivers, an erase current driver, and the read/write switch. Figure 3-17 is a block diagram of the write circuitry.

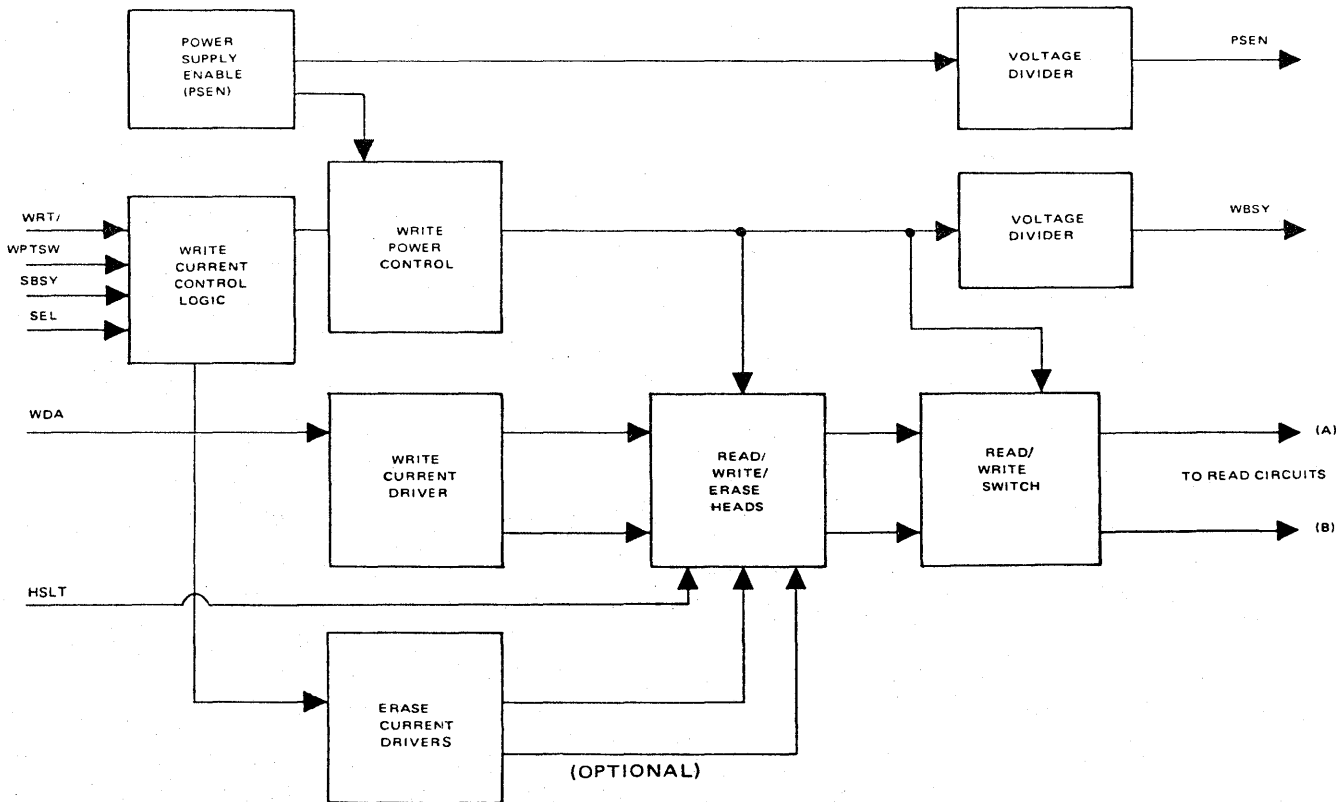


Figure 3-17. Single B Write Circuitry Block Diagram

- a. Power Supply Enable Circuit. The power supply enable (PSEN) circuit allows the write current to flow only when the power supply voltages (+5V and +12V) are within operational tolerances. This prevents writing on the diskette during power-up or power-down sequences of the disk drive, or during accidental power loss. The PSEN circuit consists of transistors Q1 and Q2 and associated components. Initially, as +5V power rises to operational level, transistor Q1 conducts as soon as the base voltage exceeds the zener voltage of CR8 plus the emitter base drop of Q1, or about 3.4V. When the collector current of Q1 is sufficient to drop 0.7V across R19, transistor Q2 conducts, providing +12V to the remaining circuits if the +12V power is present. At the same time, voltage divider R50, R51 generates a high status signal PSEN. The +12V is also divided by R41, R42, and R43. This divider produces about +6.7V, which is used in the input clamp of the read circuits (see paragraph 3.5.4a). The divider also develops approximately +6V. This voltage is applied to the center tap of the selected R/W head via Q4 or Q5, providing the correct bias for U28 in the read mode.
- b. Head Select Circuit. The Single B PCBA is used in both single and double head drive mechanisms. Enclosed within the dotted line on sheet 6 are the write current supply (Q5), upper R/W/E erase head (J8), and erase timer/current driver (U8) for the upper head. These components are absent on versions of the PCBA for use with single-sided (one head) drives.

The head selection levels HSLT and HSLT/, from Sh 2, are applied to U14-3 and U14-5 to enable respectively the lower or upper head erase drivers and to U22-10 and U22-8. If the lower (normal) head is selected, U22-10 will be low, turning on Q4. Q5 in turn will be turned off by HSLT/ being high. Write current from Q3 or read bias from R41, R42, and R43 will therefore be coupled to the correct head.

- c. Write Control Logic. The write control logic provides the necessary signals to gate and control the write circuits. The write control logic consists of elements U18, U20, U22, and U24. This logic controls the operation of the write current driver, the erase current driver, and the write busy (WBSY) generator. The write control signal for these circuits is generated by four external logic signals gated by U18 and U20. When WRT/ is low (TRUE), write protect (WPTSW) is low (FALSE), and stepper busy (SBSY) is low (FALSE), U20-12 is high, enabling gate U18-13. If the drive is selected, SEL is high and U18-11 goes low. This condition is coupled to the base of Q3 via U22-6, generating the write busy (WBSY) signal.

As U18-11 goes low, exclusive "OR" gate U24-11 goes high, releasing the set and clear direct inputs at pins 10 and 13 of U21. This condition enables U21 to respond to the state of the write data input, WDA. The low state of U18-11 also enables the erase current generator through U24-11, U14-3, and U14-5. Note that when U21 pins 10 and 13 were both held low, pins 8 and 9 of U21 were both in a high state.

- d. Write Current Driver. When the write control logic removes the set and clear direct inputs to write flip-flop U21, write data (WDA) pulses from the interface can be processed by the write current driver circuit. (When both set and clear were low, both outputs were in a high state.) The flip-flop is connected in such a manner that each time a write pulse occurs, the flip-flop toggles on the trailing edge of that pulse. The two complementary outputs of U21 are coupled by power drivers into the read/write head through resistors R31 and R32. As the flip-flop toggles, power drivers U22-2 and U22-12 are energized sequentially, thus alternately driving a current through the two halves of the read/write head. Diodes CR14 and CR15 are used to isolate the write circuits from the head during the read operation to increase noise immunity. Resistors R27 and R28 ensure that CR14 and CR15 are back biased when the write operation is concluded.
- e. Erase Current Driver. Resistors R21 and R22, diode CR9, capacitor C10, and timer U15 combine the functions of an erase current driver with a delay generator that generates two different delays from the leading edge and the trailing edge of the input waveform. This causes the erase current to be switched on approximately 400 μ sec after the write control signal has been activated, and off 800 μ sec between head write gap and erase gap using a tunnel erase head. When the circuits are not in the write mode, U14-3 is low and the output of erase driver U15-3 is high. When the write operation is initiated, U14-3 goes high. The output of driver U15 does not follow the change of state until delay network R21, C10 times out (approximately 400 μ sec). At this time, U15 senses the high state of U14-3, and U15-3 goes low. This condition causes the erase current to flow from the center tap of the head through the erase winding and diode CR18. The amount of erase current is determined by the value of R35.

At the conclusion of the write operation, U14-3 goes low. As in the previous paragraph, the output of U15 does not follow this state until another delay circuit, consisting of R22 and C10, times out (approximately 800 μ sec). At the end of that period, U15-3 goes high, and the erase current stops flowing. Diode CR8 absorbs the inductive emf when the head winding current stops. The operation of U8 and its associated circuitry within the dashed lines is identical to that described above. This circuitry is only present for double head drives. Jumper W9 is required on single headed versions of the PCBA to prevent Q3 from switching to a read mode prior to the conclusion of the erase operation.

- f. Read/Write Switch. The read/write switch consists of diodes CR16, CR17, CR19, CR20, and CR22 through CR27, and resistors R44, R45, R48, and R49. The function of this switch is to isolate the read circuit from the considerable voltage excursions which occur when a write operation is in effect, and to allow the read circuits to access the head when the read mode is selected.

When the write command occurs and Q3 conducts, the anodes of CR24 and CR25 go to about 11.5V. Thus all the cathode junctions of diodes CR22 through CR27 are at about 11V. Since the anodes of diodes CR26 and

CR27 cannot rise above the 6.7V clamp in the read circuits (paragraph 3.5.4), CR26 and CR27 are back biased and the read circuits are effectively isolated from the read/write head. When the read mode is selected, Q3 is cut off, since the WRT/ signal is high at U20-1. Under these conditions, the circuit stabilizes with CR24 and CR25 cut off and diodes CR22, CR23, CR26, and CR27 conducting. The anodes of CR22 and CR23 are at approximately +6V as established by the voltage dividers consisting of R41, R42, and R43, and Q4 and R37 or Q5 and R40. Approximately 0.25 ma is supplied through resistors R48 and R49, and diodes CR26 and CR27. About 0.5 ma is drawn through R44 and R45. Thus each of the four diodes have approximately 0.25 ma of current flowing through them. In this way, the diode bridge provides a low impedance path for the head signal to differentiator U28 (Sh 7 of Dwg 100164).

3.5.6 Positioner Control Circuit (Sh 3 of Dwg 100164)

The positioner control circuit, shown in block diagram form in figure 3-18, generates signals which cause the stepper motor to move the head from track to track in response to a step command. Four sequential signals, designated phase 1 (ϕ), phase 2 (ϕ 2), phase 3 (ϕ 3), and phase 4 (ϕ 4), are applied to the stepper motor drive circuits to cause track-to-track positioning. Initially the system is in the hold state with ϕ 4 on. If a step-in command is received, the signal sequence ϕ 1, ϕ 2, ϕ 3, ϕ 4 is generated. If a step-out command is received, the signal sequence ϕ 3, ϕ 2, ϕ 1, ϕ 4 is generated.

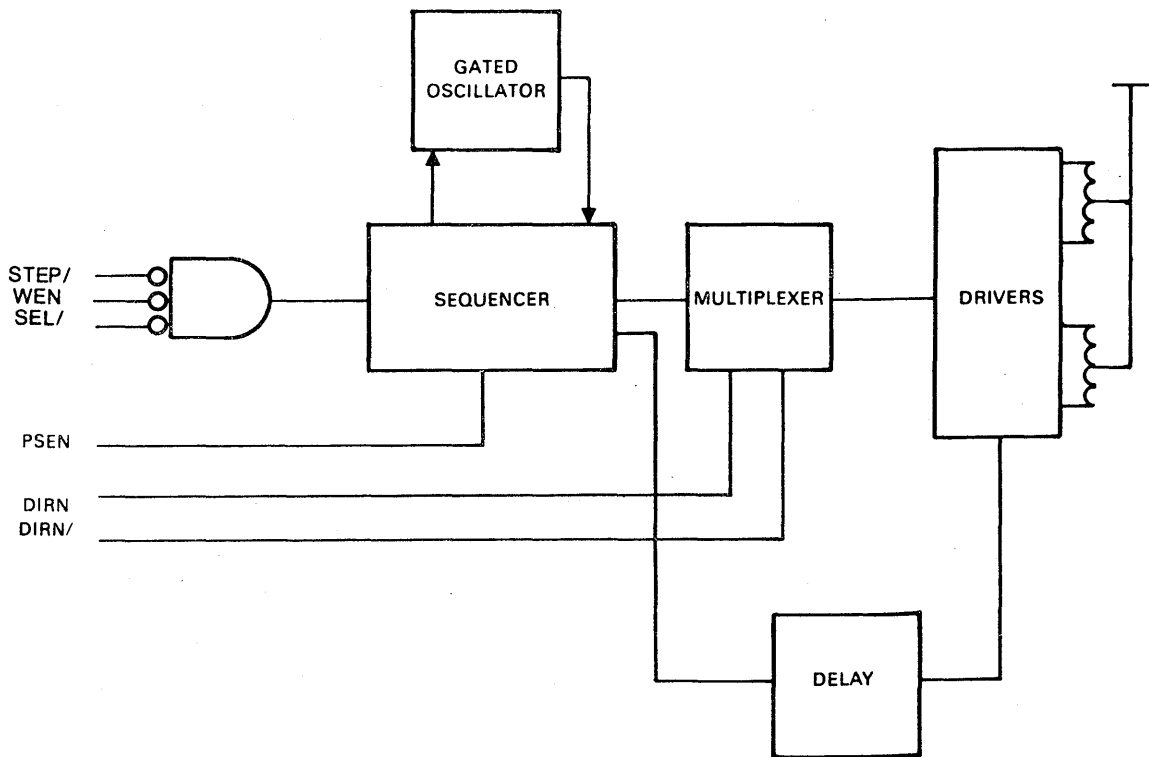


Figure 3-18. Positioner Control Circuit Block Diagram

The positioner control circuit consists of an NE555 timer connected as a gated oscillator (U6), a dual and/or gate (U19) which is used as a multiplexer, and three flip-flops (U13-9, U13-5, and U21-5), which comprise the sequencer. Figure 3-19 shows the timing relationships for the positioner control circuit operation.

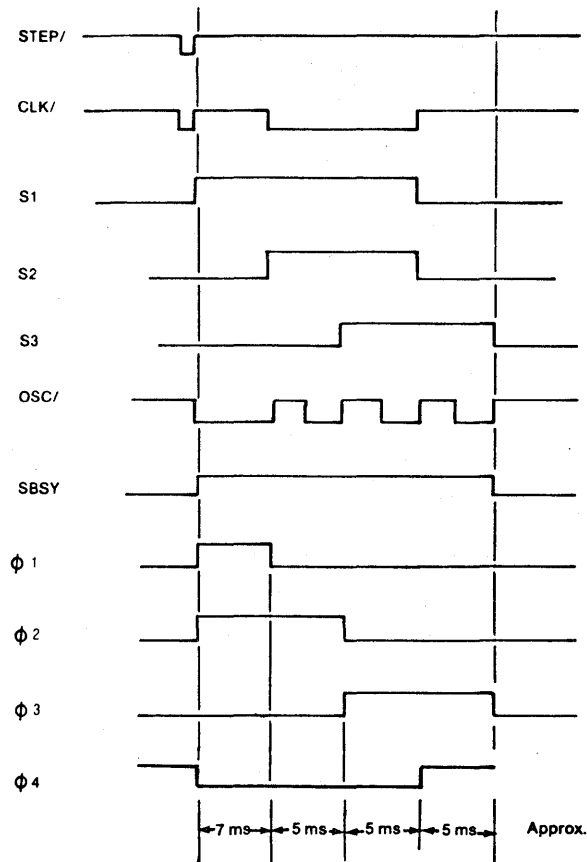


Figure 3-19. Positioner Control Circuit Timing Diagram

Initially, the oscillator is held clear and the flip-flops are reset. When a step pulse occurs (with the drive selected and not writing), a positive-going pulse is generated at U11-10. The trailing edge of this pulse sets flip-flop U13-9 so that:

- a. Hold driver U5 is deenergized.
- b. The SBSY line is set high, starting the NE555 oscillator and inhibiting writing via U20-13 (Sh 6 of Dwg 100164) for the duration of the stepping cycle.

The oscillator then sets U13-5 and U21-5 in turn. The sequencer logic outputs are applied to the multiplexer. The polarity of the direction signal (DIRN or DIRN/) conditions the multiplexer to produce the appropriate phase sequence. These sequential signals are applied to drivers U4-3, U3-3, U4-5, U5-5, and U5-3, causing the stepper motor to step-in (DIRN low) or step-out (DIRN high).

Diodes CR3, CR4, CR5, and CR6, in conjunction with zener diode CR2, limit the turnoff transient to +20V. Referring to Figure 3-19, it can be seen that the step sequence is complete at the end of SBSY (approximately 23 ms). If after a further 12 ms, i.e. a total of 35 ms after a step pulse, a further step command has not been received, hold driver U5-3 is deenergized via the delay circuit U9-12, U10-8, R6, and C33. A hold current of about half the original value is then supplied via U5-5 and resistors R7, R8, R9, and R10. This scheme allows a system and motor power reduction in the standby mode.

3.5.7 Miscellaneous Control Circuits

These circuits perform several functions:

- a. Debounce the drive switch closures.
- b. Reshape the pulses from the index transducer.
- c. Control the head load solenoid.
- d. Generate the drive ready (RDY) status signal.
- e. Initialize the drive motor.

3.5.7.1 Switch Debouncers. (Sh 5 of Dwg 100164)

The door open switch, track zero switch, and write protect switch closures are applied to latched gates U2-2, U2-4, and U2-8, respectively, to eliminate the effects of contact bounce.

3.5.7.2 Transducer Pulse Shaper. (Sh 5 of Dwg 100164)

The index transducer (photo transistor) output is applied to Schmitt trigger U10. The output at U10-4 is the sector pulse SECP, which in turn is applied to interface driver U1-8. U10-10 provides positive feedback to produce hysteresis, thus preventing the circuit from responding to small discontinuities in the input signal.

3.5.7.3 Head Load Solenoid Driver. (Sh 4 of Dwg 100164)

The head load solenoid is energized whenever the drive is selected or the HDLD signal is true. This latter mode allows the head to remain loaded even when the drive is deselected - for example, to avoid incurring a head load time in overlap operations such as drive-to-drive disk copying.

Whenever the SEL/ or HDLD/ signal is low, the output of U12-11 goes high. This energizes the head load solenoid driver U3-5 if the motor is enabled (MTRN/ low), PSEN is high, and the drive door is closed (DOOR/ is low).

3.5.7.4 Drive Ready Signal. (Sh 4 of Dwg 100164)

When the MTRN, PSEN, and DOOR signals become true, a 1½-second delay circuit consisting of U9-2, R12, C7, C8, and U10-6 is enabled. After the delay, the drive ready (RDY) signal is produced. This delay allows the drive motor to reach operational speed before proceeding.

3.5.7.5 Drive Motor Initialization. (Sh 4 of Dwg 100164)

To insure registration of the media whenever a diskette is inserted into the drive, the drive motor is automatically turned on for two seconds, independent of the state of MTRN. The delay circuit, consisting of U9-10, R11, R13, C5, C6, and U10-2, generates a high MOT signal for two seconds after DOOR/ goes low.

SECTION IV TESTS AND ADJUSTMENTS

4.1 INTRODUCTION

This section provides information on testing a drive and (if necessary) adjusting the electrical and mechanical parameters. The tests and adjustments should be performed in an order dictated by the operating condition of the drive; this may or may not be the order in which they are presented in this section.

In general, the test requirements for the different drive configurations are the same. When the test requirements differ, the relevant paragraphs specify those differences. Figures 4-1 and 4-2 show the location of PCBA-mounted components referenced in these procedures for the Single A PCBA and the Single B PCBA, respectively. Tools and test equipment required are listed in Section 1.

4.2 ADJUSTMENT PHILOSOPHY

Acceptable limits are specified in each test and adjustment procedure, taking into account the assumed accuracy of the test equipment specified. If the measured value of any parameter is within the acceptable limits, NO ADJUSTMENT should be made. If the measured value is outside of the acceptable limits, the accompanying adjustment should be performed.

4.3 DRIVE MOTOR SPEED

Drive motor speed should be checked whenever:

- a. The motor is replaced.
- b. The PCBA is replaced.
- c. Any drive motor circuit components are replaced.
- d. Diskette interchange compatibility problems are encountered.

Two methods are available for checking the drive motor speed. These are:

- a. Using the strobe disk attached to the large pulley on the drive (note that earlier drives do not have this strobe disk); or
- b. Measuring the period between index pulses using a counter.

4.3.1 Strobe Method

- a. Apply power to the drive.
- b. Apply a low signal to the MTRN interface line (J1, pin 16).
- c. Insert a work diskette in the drive and load it.
- d. Apply interface signals that cause the drive to be selected and positioned at track zero. (The head should be loaded at this time.)

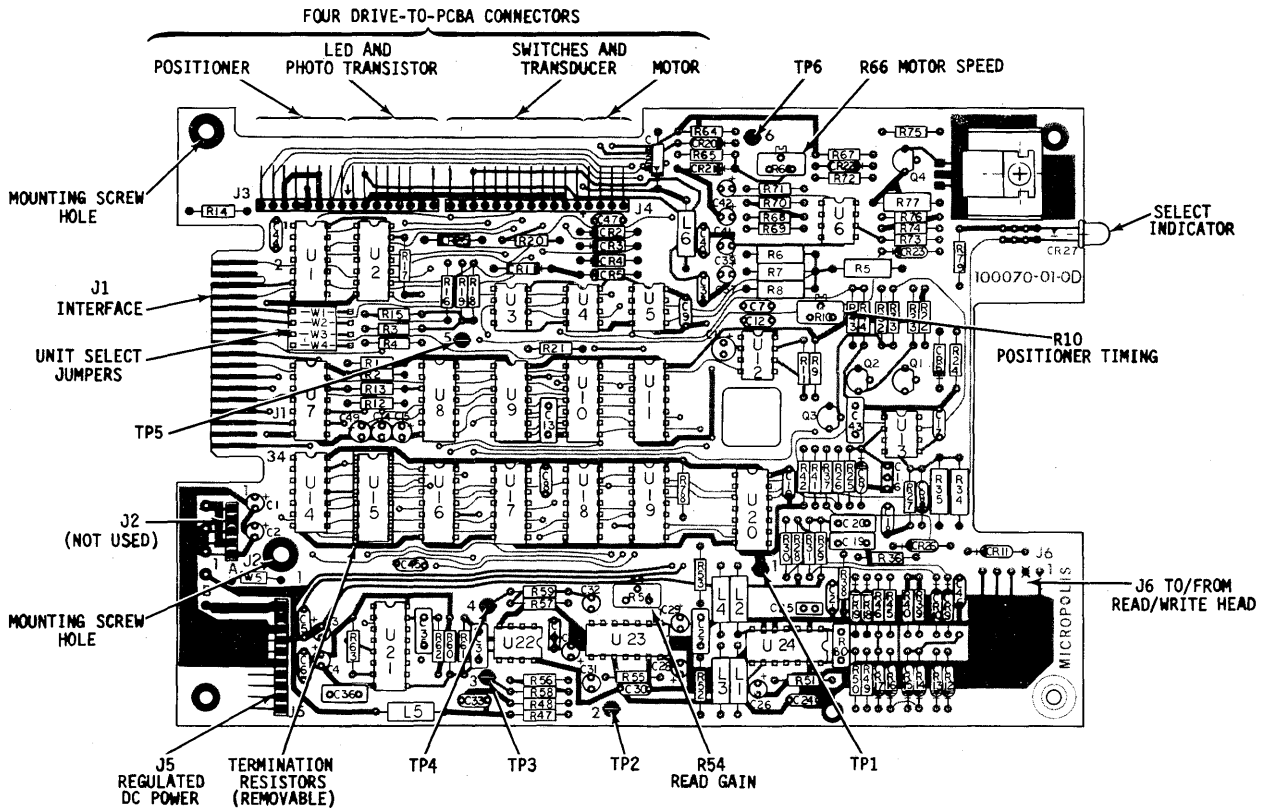


Figure 4-1. Single A PCBA-Mounted Components

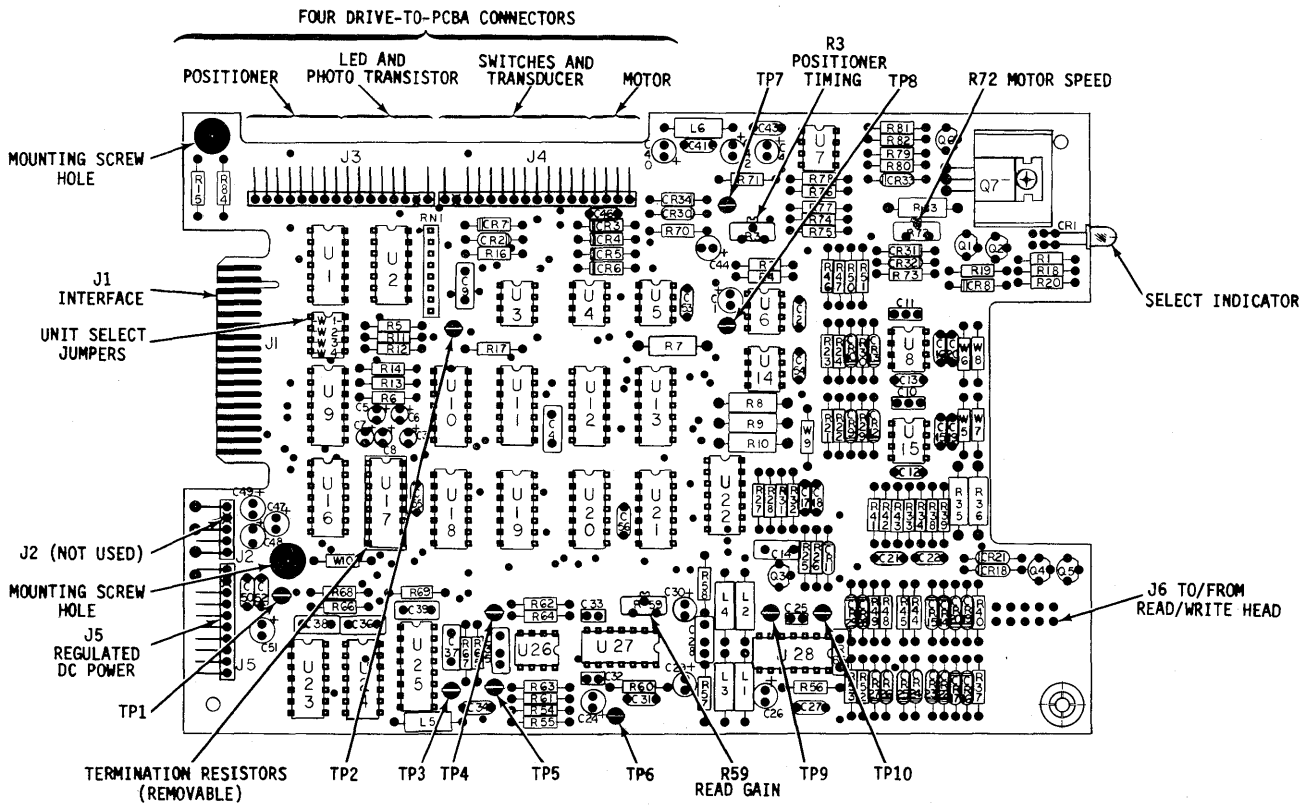


Figure 4-2. Single B PCBA-Mounted Components

- e. Illuminate the strobe disk with a fluorescent lamp.
- f. Observe the outer strobe pattern for 60Hz lamp power (or the inner strobe pattern for 50Hz power) and time the pattern rotation speed. Ideally the pattern will be stationary; a maximum of 9 revolutions per minute clockwise or counterclockwise is acceptable.
- g. If necessary, adjust potentiometer R66 on the Single A PCBA (or R72 if a Single B PCBA) for a stationary strobe pattern.

4.3.2 Counter Method

- a. Apply power to the drive.
- b. Apply a low signal to the MTRN interface line (J1, pin 16).
- c. Insert a SINGLE HOLE (soft-sectored) work diskette in the drive and load it.
- d. Apply interface signals that cause the drive to be selected and positioned at track zero. (The head should be loaded at this time.)
- e. Connect a counter/timer to the index/sector test point:
 - Single A - TP5 and TP2 (GND)
 - Single B - TP2 and TP6 (GND)
- f. The index pulse period should be in the range of 194 to 206 ms. If not, adjust R66 on the Single A PCBA (or R72 on the Single B PCBA) for a period of 200 ms.

4.4 INSTANTANEOUS SPEED VARIATION

Instantaneous speed variation (ISV) is the change of rotational speed over a short period of time. The period used in this test is approximately one and one-half revolutions of the large pulley. Factors that cause ISV include worn motor bearings, a defective motor, or a defective drive belt.

ISV should be checked whenever:

- a. The drive motor is replaced.
- b. The PCBA is replaced.
- c. Any drive motor circuit components are changed.
- d. The drive belt is replaced.
- e. Diskette interchange compatibility problems are encountered.

4.4.1 Procedure

- a. Apply power to the drive.
- b. Apply a low signal to the MTRN interface line (J1, pin 16).
- c. Insert a work diskette in the drive and load it.
- d. Apply interface signals that cause the drive to be selected and an all ones pattern to be written on track zero of the diskette.

e. Connect the oscilloscope to:

Single A - TP3 and TP2 (GND)

Single B - TP4 and TP6 (GND)

Set the vertical scale to 0.2V/cm and the time base to 0.5 μ sec/cm; then adjust the time base so that one cycle of the waveform fills the calibrated part of the screen.

f. ISV will appear as the width of the trace, as shown in figure 4-3. The maximum allowable amount of ISV is eight percent of the overall width of one cycle of the waveform. If the ISV is greater than 8%, troubleshoot to the defective component; there is no adjustment.

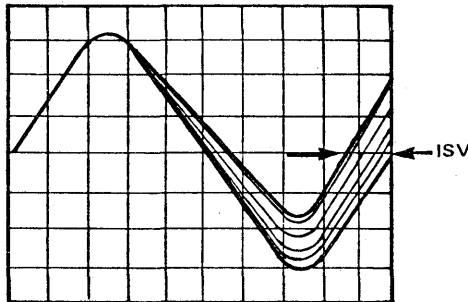


Figure 4-3. ISV Test Waveform

4.5 POSITIONER STEP TIMING

The phase-to-phase internal timing for the 4-phase stepper motor positioner is determined by the period for which the gated oscillator (U12 for Single A PCBA, U6 for Single B PCBA) is enabled (SBSY high). This adjustment should be checked whenever:

- The PCBA is replaced.
- Components in the positioner timing circuits are replaced.
- There is any indication of incorrect positioning.

4.5.1 Procedure

- Apply power to the drive.
- Apply a low signal to the MTRN interface line (J1, pin 16).
- Insert a work diskette in the drive and load it.
- Apply interface signals that cause the drive to be selected and perform a continuous full track seek.

e. Connect the oscilloscope to:

Single A - U12-4 and TP1 (GND)

Single B - TP8 and TP1 (GND)

Set the vertical scale to 2V/cm and the time base to 5 ms/cm.
Trigger internally positive.

f. The positioner step timing will be as shown in figure 4-4. The positive portion of the waveform should be within the following limits:

100TPI (MOD II) 23.5 ms max
21.5 ms min

48TPI (MOD I) 26 ms max
24 ms min

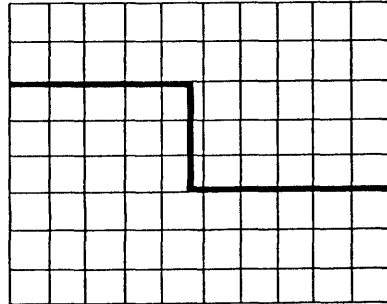


Figure 4-4. Positioner Step Timing Waveform

g. If these limits are not met, adjust the step timing using:

Single A - potentiometer R10

Single B - potentiometer R3

Adjust the timing to:

100TPI (MOD II) 22.5 ms

48TPI (MOD I) 25.0 ms

h. For reference, the duration of the individual "step times" can be observed at U12-4 on the Single A PCBA (or TP8 on the Single B PCBA). These are shown in figure 3-12 for correctly adjusted step-timing. The individual step times are not adjustable; if they are out of tolerance troubleshoot to the defective component.

4.6 READ AMPLIFIER GAIN

The read amplifier gain control sets the signal level at the output of the amplifier chain. The adjustment should be checked whenever:

- a. The head is replaced.
- b. The PCBA is replaced.
- c. Components in the R/W switch, differentiator, or amplifier circuits are replaced.

4.6.1 Procedure

- a. Apply power to the drive.
- b. Apply a low signal to the MTRN interface line (J1, pin 16).
- c. Insert a work diskette in the drive and load it.
- d. Apply interface signals that cause the drive to be selected and an all ones pattern to be written on track zero of the diskette.
- e. Connect the oscilloscope to:
 - Single A - TP3 and TP2 (GND)
 - Single B - TP5 and TP6 (GND)Set the vertical scale to 0.5V/cm and the time base to 10 μ sec/cm. Trigger internally.
- f. Measure the peak-to-peak amplitude of the read signal. The signal should be in the range of 1.0V to 2.0V peak-to-peak. If not, adjust potentiometer R54 on the Single A PCBA (or R59 on the Single B PCBA) for a read signal amplitude of 1.5V peak-to-peak.

4.7 HEAD COMPLIANCE

The head compliance test checks for the presence of the correct contact between the head and the diskette. Good compliance is assured when the head load pad presses the diskette uniformly against the head. Compliance should be checked whenever:

- a. Data errors are encountered.
- b. It is suspected that the load pad may have become worn or contaminated with oxide or dirt.

4.7.1 Procedure

- a. Apply power to the drive.
- b. Apply a low signal to the MTRN interface line (J1, pin 16).
- c. Insert a work diskette in the drive and load it.
- d. Apply interface signals that cause the drive to be selected and an all ones pattern to be written on Track 76 of a 100TPI (MOD II) drive or Track 35 of a 48TPI (MOD II) drive.

- e. Apply interface signals that cause the drive to be selected and positioned at the track indicated in step d.
- f. Connect the oscilloscope to:
 - Single A - TP3 and TP2 (GND)
 - Single B - TP5 and TP6 (GND)

Monitor the signal amplitude while increasing the force on the head load arm. Note that the application of too much force will cause the diskette to slow down.

- g. The maximum increase in signal amplitude should be 15%. If it increases more than 15%, replace the head load pad (see paragraph 6.5).

4.8 CIRCUMFERENTIAL/AZIMUTH ALIGNMENT

The circumferential/azimuth alignment test checks that:

- a. The relationship between the head and the index/sector photo transistor is correct.
- b. The head moves along a line which passes through the center of the diskette (i.e., is a radius).

The circumferential/azimuth alignment should be checked whenever:

- a. The head is replaced.
- b. The positioner subassembly is replaced.
- c. The platen assembly or photo transistor is replaced.
- d. The LED assembly or the LED is replaced.
- e. Diskette interchange compatibility problems are encountered.

4.8.1 Procedure

- a. Apply power to the drive.
- b. Apply a low signal to the MTRN interface line (J1, pin 16).
- c. Insert an alignment diskette, Micropolis P/N 641 0590-1 (Dysan P/N 282), in the drive and load it.
- d. Connect the oscilloscope to:

- Single A - TP3 and TP2 (GND)
- Single B - TP5 and TP6 (GND)

Set the vertical scale to 0.5V/cm and the time base to 50 μ sec/cm. Trigger external positive on the leading edge of the index/sector pulse at:

- Single A - TP5
- Single B - TP2

- e. Apply interface signals that cause the drive to be selected and positioned at Track 5 for a 100TPI (MOD II) drive or at Track 1 for a 48TPI (MOD I) drive.
- f. Measure the time between the leading edge of the index pulse and the first peak of the index alignment burst (see figure 4-5). The time should be in the range of 100 to 300 μ sec. Note the value and proceed to step g.

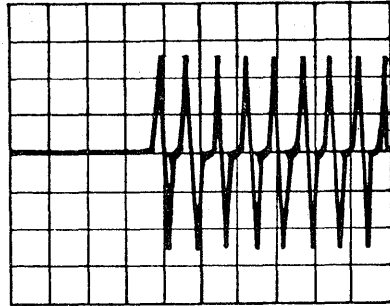


Figure 4-5. Circumferential/Azimuth Alignment Waveform

- g. Apply interface signals that cause the drive to be selected and positioned at Track 76 for a 100TPI (MOD II) drive or at Track 35 for a 48TPI (MOD I) drive.
- h. Again, measure the time between the leading edge of the index pulse and the first peak of the index alignment burst. This time and the time noted in step f should differ by no more than 100 μ sec.
- i. If the 100 μ sec difference in step h is exceeded, perform the Azimuth Adjustment (paragraph 4.8.2) and then the Circumferential Adjustment (paragraph 4.8.3). If the difference in step h is 100 μ sec or less but the time noted in step f is outside the 100-300 μ sec range, perform the Circumferential Adjustment (paragraph 4.7.3) only. If both steps f and h are satisfactory, no adjustment is needed. If the bursts cannot be obtained, Radial Alignment (paragraph 4.9) or the Track Zero Switch Adjustment (paragraph 4.10) may be required.

4.8.2 Azimuth Adjustment

NOTE

As the positioner azimuth is adjusted, significant changes of burst amplitude will occur. In extreme cases it may be necessary to readjust the radial alignment (see paragraph 4.9) to re-establish an on-track condition.

- a. Temporarily install the maintenance standoff at the rear of the drive mechanism so the mechanism does not rest on the step motor.
- b. Apply power to the drive.
- c. Apply a low signal to the MTRN interface line (J1, pin 16).
- d. Insert the alignment diskette (Micropolis P/N 641 0590-1, Dysan P/N 282) in the drive and load it.
- e. Connect the oscilloscope as specified in paragraph 4.8.1, step d. Apply interface signals as specified in paragraph 3.8.1, step e.

NOTE

Step f below is performed to ensure that steps g through j can be achieved.

- f. Loosen two platen assembly mounting screws (see figure 4-6), and temporarily move the platen (use a screwdriver as a wedge between the tongue on the platen and slots in the chassis) until the index-to-burst time after reclamping the platen is 300 μ sec. Too much force can damage the polycarbonate platen material.

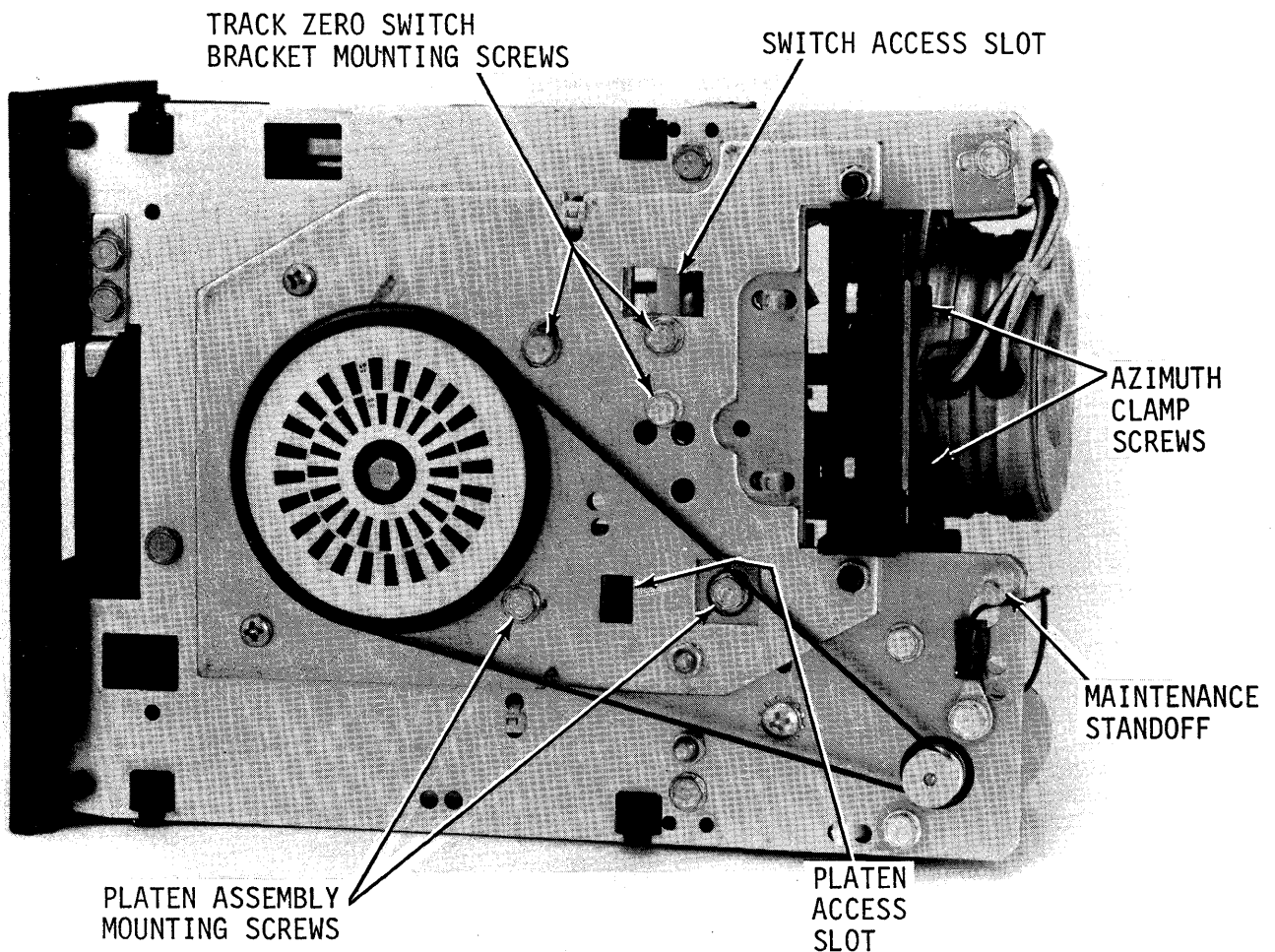


Figure 4-6. Drive Adjustment Access

- g. Loosen two positioner azimuth clamp screws (visible from below at the rear of the step motor, see figures 4-6 and 4-8), that hold the positioner spring plate to the mounting block.
- h. If the time measured in paragraph 4.8.1, step f (Track 5 or Track 1) exceeds that of 4.8.1 step h (Track 76 or Track 35), the positioner should be moved toward the drive motor. This will decrease both of the times, but will also tend to equalize them.
- i. If the time measured in 4.8.1 step f is less than that of 4.8.1 step h, the positioner should be moved away from the drive motor.
- j. After each movement in step h or i above, tighten the azimuth clamp screws and repeat steps a through h of paragraph 4.8.1 until the difference of times is approximately zero.

NOTE

After adjusting the azimuth, the radial alignment (see section 4.9) must be checked and adjusted if necessary. Also, after adjustment of the azimuth, it is possible that misstepping will occur. This should be checked using steps a through e of paragraph 4.12.1.

- k. Proceed to the Circumferential Adjustment, Paragraph 4.8.3.

4.8.3 Circumferential Adjustment

NOTE

It is assumed that the conditions established by steps a through e of paragraph 4.8.2 are still in effect.

- a. Turn the drive on its side. Loosen the two platen assembly mounting screws (see figure 4-6) and move the platen (use a screwdriver as a wedge between the tongue on the platen and slots in the chassis) until the index-to-burst time is now the optimum 200 ± 30 μ sec after reclamping the platen.
- b. After the azimuth and circumferential adjustments are both satisfactory, remove the maintenance standoff.

4.9 RADIAL ALIGNMENT

Radial alignment ensures that the head is operating at the required radius for the particular track. The alignment utilizes a "cat's eye" pattern on the alignment diskette, centered on Track 36 for a 100TPI (MOD II) drive or Track 16 for a 48TPI (MOD I) drive.

Radial alignment should be checked whenever:

- a. The head has been replaced.
- b. The positioner assembly has been replaced.
- c. The positioner assembly has been adjusted for preload or azimuth.
- d. Diskette interchange compatibility problems are encountered.

4.9.1 Procedure

- a. Apply power to the drive.
- b. Apply a low signal to the MTRN interface line (J1, pin 16).
- c. Insert the alignment diskette (Micropolis P/N 641 0590-1, Dysan P/N 282) in the drive and load it.
- d. Connect the oscilloscope to:

Single A - TP3 and TP2 (GND)

Single B - TP5 and TP6 (GND)

Set the vertical scale to 0.2V/cm and the time base to 20 ms/cm. Trigger external positive on the leading edge of the index/sector pulse at:

Single A - TP5

Single B - TP2

- e. Apply interface signals that cause the drive to be selected and positioned at Track 36 for a 100TPI (MOD II) drive or Track 16 for a 48TPI (MOD I) drive.
- f. Observe the read signal (see figure 4-7). Adjust the vertical scale so the peak amplitude of the larger lobe is five major divisions (5 cm) and note the amplitude of the smaller lobe.

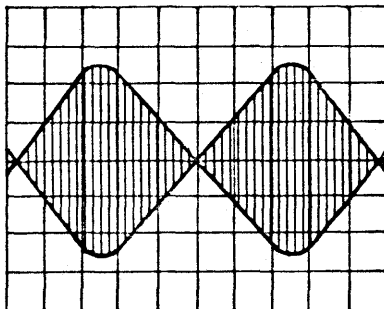


Figure 4-7. Cat's Eye Pattern for Radial Alignment

- g. Apply interface signals that cause the positioner to move off track by at least two tracks and then return to the track in step e. Note the amplitude of the smaller lobe.
- h. Apply interface signals that cause the positioner to move off track in the other direction and return. Again note the amplitude of the smaller lobe.
- i. Acceptable track alignment is indicated if the peak-to-peak amplitude of the two lobes (in steps f, g, and h) are within one major division (1 cm) of being equal, when the larger lobe is set to five major divisions. If the track alignment is not acceptable, proceed to step j.
- j. Loosen the two positioner flange mounting screws that clamp the positioner flange to the spring plate (see figure 4-8).

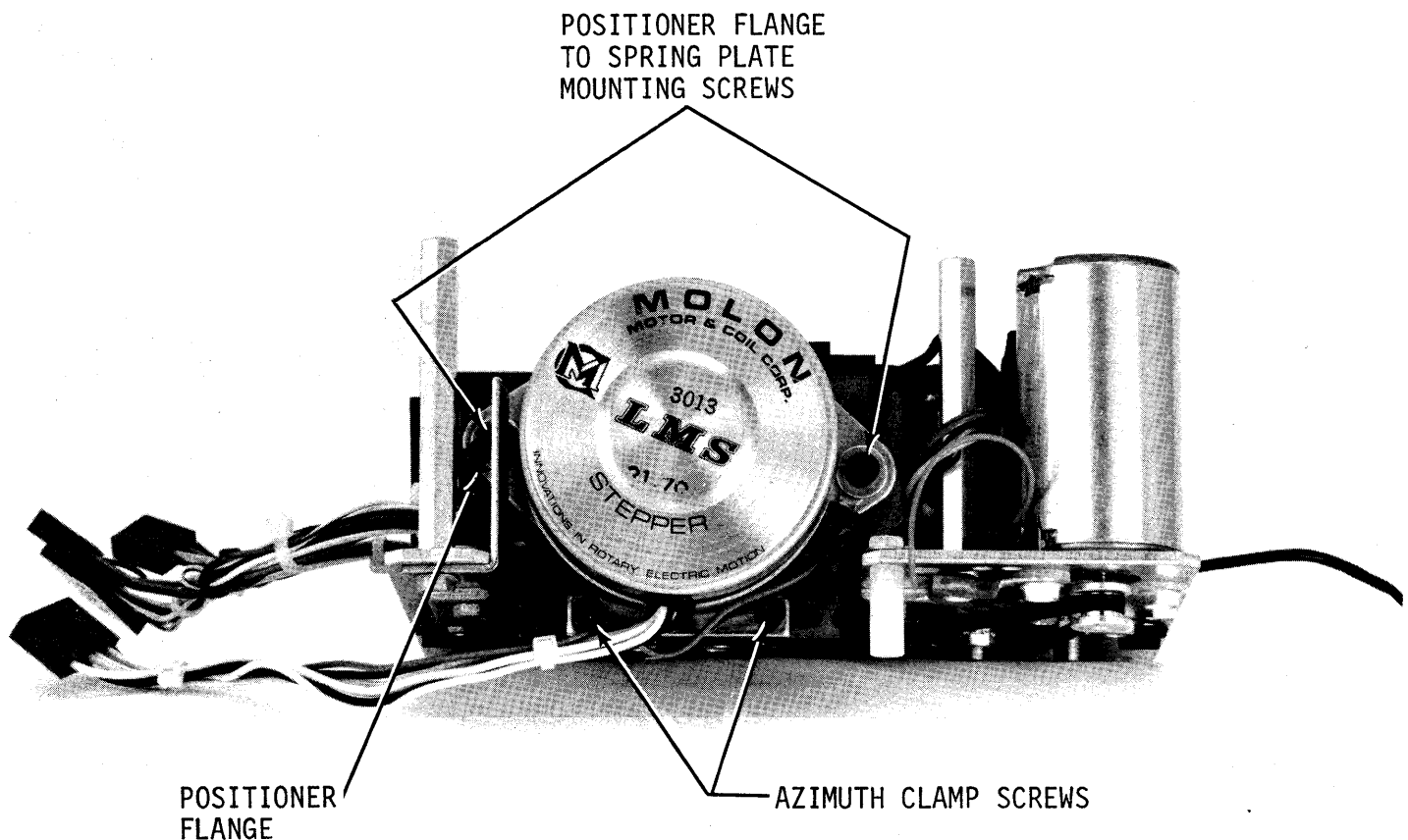


Figure 4-8. Positioner Adjustments

- k. Rotate the positioner body as required to equalize the lobes. Rotate CW if the first lobe is greater than the second, or CCW if the second lobe is greater.

NOTE

If the adjustment range is inadequate to equalize the lobes, the track zero switch must be moved one full track. See section 4.10.

- l. Retighten the positioner flange screws; torque to 18 inch-lbs.
- m. Repeat steps g and h, observing the read envelope. Repeat the adjustment as necessary to obtain equal amplitudes.

NOTE

Sometimes the lobe amplitudes cannot be equalized for conditions of both steps g and h. In this case, adjust the radial alignment so that the differential between lobes is equal and opposite for steps g and h. If under these conditions the limit of step i is still not met, check the Positioner Step Timing (section 4.5) and the Positioner Mechanical Adjustment (section 4.12).

4.10 TRACK ZERO SWITCH AND ZERO STOP

The track zero switch indicates to the controller that the head is at track zero. The zero stop is a mechanical stop on the lead screw that prevents the head from moving behind track zero.

The track zero switch and zero stop should be checked whenever:

- a. The positioner has been replaced.
- b. The head has been replaced.
- c. The switch has been replaced.
- d. Radial alignment has been performed or unsuccessfully attempted.
- e. The head carriage is heard hitting against the mechanical stop.

4.10.1 Procedure

- a. Apply power to the drive.
- b. Apply a low signal to the MTRN interface line (J1, pin 16).
- c. Insert a work diskette in the drive and load it.
- d. Apply interface signals that cause the drive to be selected and alternately positioned to Track 0 and Track 1 with a turnaround time of approximately 200 ms.
- e. Connect the oscilloscope to:

Single A - channel 1 to the SBSY signal at U12-4, channel 2 to the track zero switch output at U2-3.

Single B - channel 1 to the SBSY signal at TP8, channel 2 to the track zero switch output at U2-4.

Set the vertical scale for both channels to 2V/cm. Set the time base to 2 ms/cm. Trigger on the positive-going edge of the channel 1 input signal (SBSY).

- f. Observe the waveform on channel 2. Figure 4-9 shows alternate sweeps of the signal. The track zero switch and stop settings are acceptable if the high-to-low and low-to-high transitions occur within two major divisions (4 ms) of each other on alternate sweeps. If so, skip step g and proceed directly to step h; if not, proceed with step g.

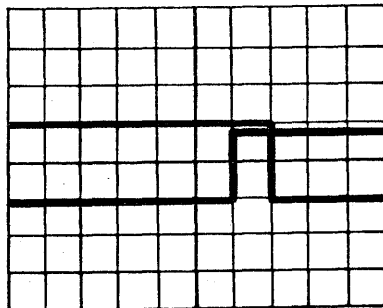


Figure 4-9. Track Zero Switch Test Waveform

- g. Slightly loosen the three track zero switch mounting screws (see figure 4-6). Use a screwdriver as a wedge through the track zero switch access slot to move the switch bracket backward or forward to line up the transitions referred to in step f above. Tighten the track zero switch mounting screws.
- h. The track zero stop (see figure 4-11) should be set so that when the head is positioned at track zero, the positioner cannot move the head more than one-third of a step behind track zero. If necessary, loosen the track zero stop set screw and reset the stop so that the drive screw can rotate 5° to 10° past track zero before the carriage hits the stop. The 5° to 10° free movement must be provided to prevent the

head carriage from hitting the stop due to overshoot when positioning to track zero normally.

4.11 DOOR OPEN SWITCH

The door open switch (see figure 4-10) is set to activate when the receiver assembly has been moved the minimum amount from its full open position. The door open switch should be adjusted whenever:

- a. The door open switch has been replaced.
- b. The receiver assembly has been replaced.
- c. There is evidence of diskette misclamping.

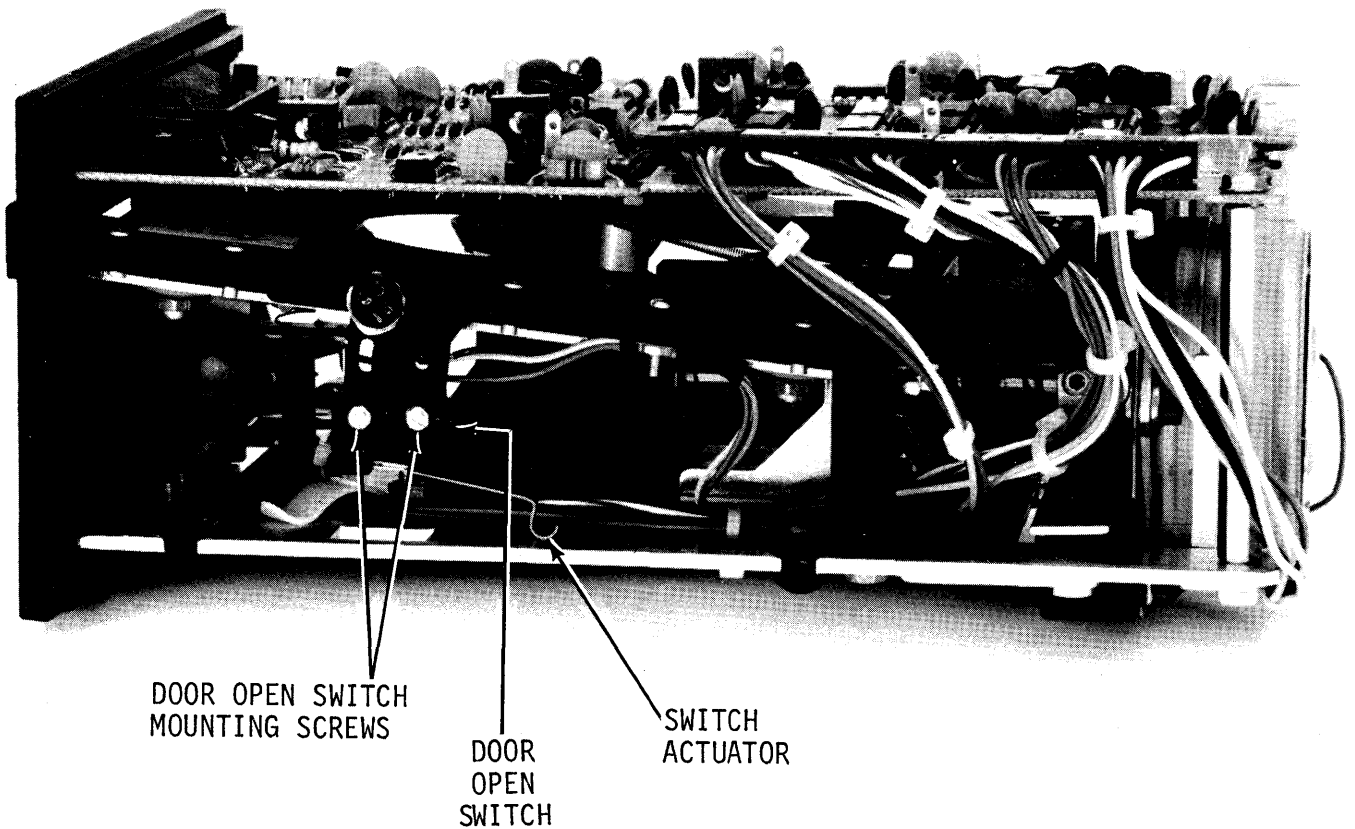


Figure 4-10. Door Open Switch and Mounting Location

4.11.1 Procedure

NOTE

This procedure can be performed on-line or off-line.

- a. (On-line) Apply power to the drive. Apply a low signal to the MTRN interface line (J1, pin 16).

(Off-line) Connect an ohmmeter between the yellow and green wires in the 12-position Molex connector on the drive mechanism.
- b. Press the receiver assembly until the motor turns (on-line) or the ohmmeter indicates continuity (off-line). The switch should activate before the top of the receiver is more than 1/8 inch below the slot in the front panel. If necessary, loosen the two switch mounting screws and move the switch as required.

4.12 POSITIONER MECHANICAL ADJUSTMENT

The positioner mounting block incorporates adjustments for the preload of the lead screw against the spindle housing and for azimuth alignment of the axis of travel of the headgap. The positioner mounting block adjustment is critical and complex, and should only be performed if:

- a. The positioner is replaced or removed in order to install a new head.
- b. The positioner shows evidence of misstepping even after the Step Timing (Section 4.5) has been adjusted.

4.12.1 Procedure

- a. Temporarily install the maintenance standoff at the rear of the drive mechanism so the mechanism does not rest on the step motor.
- b. Apply power to the drive.
- c. Manually move the lock bar/diskette rear stop (see figure 4-11) toward the rear of the drive until it locks, simulating the existence of a diskette.
- d. Apply interface signals that cause the drive to be selected and that can cause the positioner to step inwards and then return to track zero. If misstepping occurs, proceed directly to the note before step f.

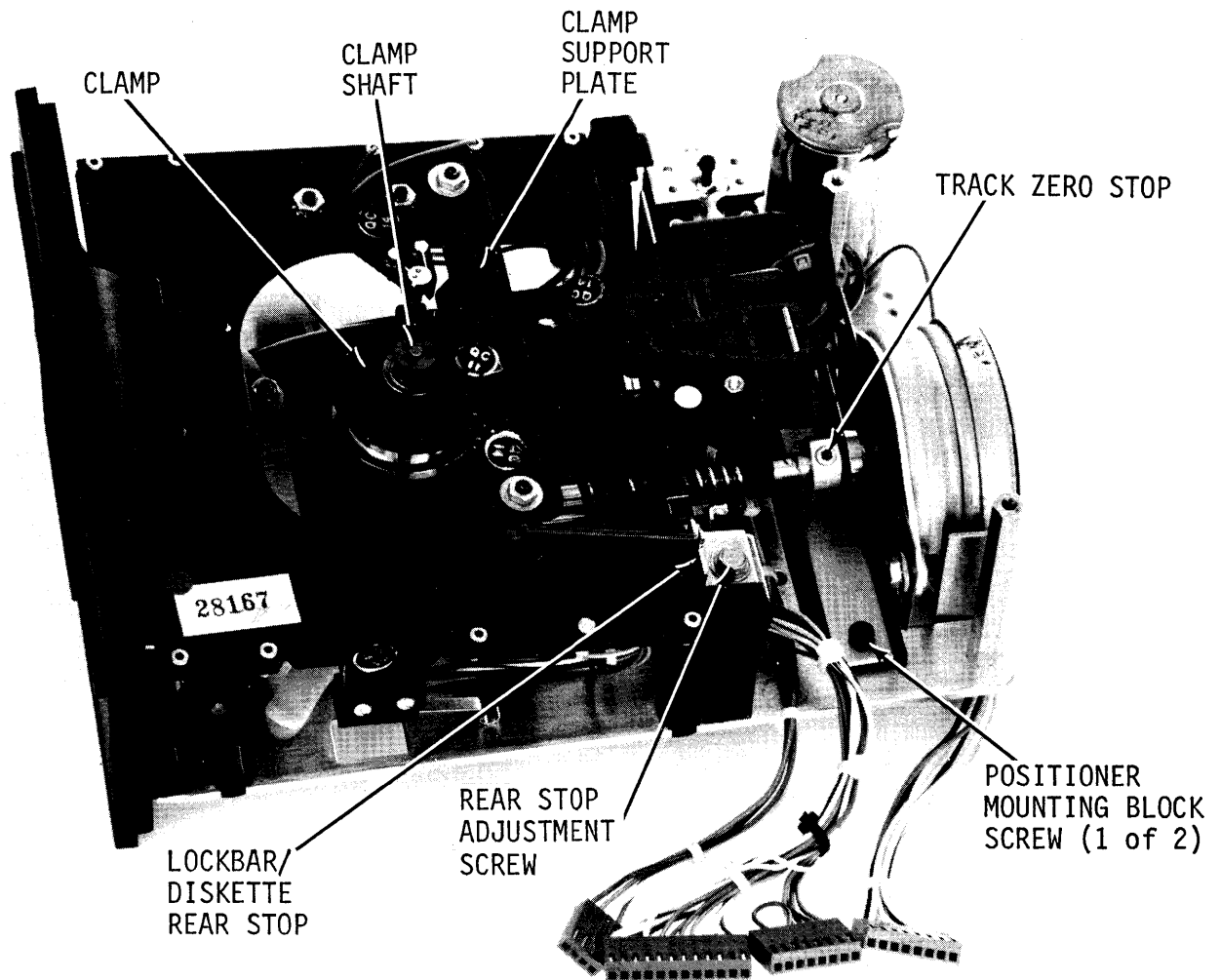


Figure 4-11. Drive Mechanism, Top Rear View

- e. As the positioner steps, apply gentle pressure to the body of the step motor at the points indicated (1, 2, 3, and 4) in figure 4-12, until misstepping occurs. Assess qualitatively the pressure required to cause misstepping. If the pressure is equal at all four points, and/or if a small region of free rocking exists in both axes, this is acceptable; proceed directly to step p.

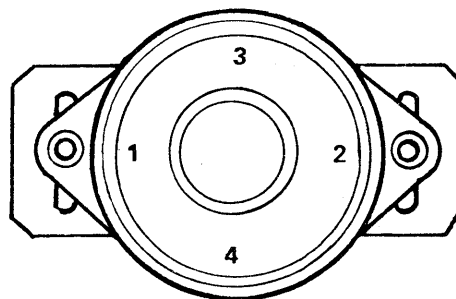


Figure 4-12. Pressure Points on Positioner

NOTE

Begin adjustment with step f if the positioner is being newly installed. If the positioner is already in place but requires adjustment, proceed directly to step m.

- f. Loosen the positioner mounting block screws (see figure 4-11) so the block can be moved.
- g. Move one side of the block and then the other toward the spindle until the C-clip at the end of the lead screw just comes into contact with the bearing at the end of the lead screw.
- h. Push the positioner mounting block forward on one side about 1/32 inch, and tighten the mounting screw on that side just enough to hold the block in place.
- i. Push the other side of the block forward the same amount and tighten both of the mounting screws. The block should now be parallel to the slot in which the block sits. If it is not, readjust as necessary. The block must be parallel to the slot before continuing.
- j. Use a force gauge to measure the force required to pull the positioner so that the C-clip just starts to leave the bearing in the spindle housing. This force should be between 2½ and 3 pounds.
- k. If the force in step j is too high, move the positioner mounting block away from the spindle; if the force is too low, move the block toward the spindle. Repeat steps j and k until the force is correct.
- l. Repeat steps a through e. If misstepping still occurs or the limits of step e are not met, it is because the mounting block is not set exactly parallel to the slot; proceed to step m for fine adjustment. If the block is set correctly, proceed to step p.

NOTE

Steps m and n which follow can be interactive, so the fine adjustment process can be iterative.

- m. Ability to apply more pressure at point 1 than point 2 (in step e) indicates that the "1" side of the mounting block should be moved toward the spindle, and vice-versa.
- n. Ability to apply more pressure at point 4 than point 3 indicates that the block as a whole should be moved toward the spindle, and vice versa. The block should only be moved approximately 1/64 inch at a time.
- o. Repeat steps d and e, and readjust per steps m and n, as necessary until misstepping is eliminated and the limits of step e are met.
- p. When the block is correctly adjusted, remove the maintenance standoff.

4.13 WRITE PROTECT SWITCH

The write protect switch is mounted on a tab on the receiver (on the opposite side from the door open switch). It senses the presence of a slot or no slot (covered by a write protect tab to inhibit writing) on the diskette. The write protect switch should be adjusted whenever:

- a. The switch is replaced.
- b. False detection of either a write protected or a write enabled condition occurs.

4.13.1 Procedure

- a. Connect an ohmmeter between the Black and the Write/Brown wires in the 12-position Molex connector on the drive mechanism.
- b. Normally with no diskette inserted, the switch is open (no continuity indication).
- c. Insert feeler gauges from the front of the drive on the left side of the receiver slot. Use feelers ranging from 0.020 inch to 0.050 inch, and observe the ohmmeter for a continuity indication. Use the following acceptance criteria:

Continuity indication for gauge thicknesses in range 0.025 to 0.045 inch is acceptable. Below 0.025 inch no continuity is required. Above 0.045 inch, continuity is unacceptable.

NOTE

When adjusting the switch, use care not to break the mounting tab on the receiver.

- d. To adjust the write protect switch, slightly loosen the two screws that hold the switch to the receiver tab. Rotate the switch so the first continuity indication occurs with a feeler gauge of 0.035 inch.

4.14 CLAMP SUPPORT PLATE

The clamp support plate (see figure 4-11) provides the mounting surface for the clamp. The clamp shaft must be centered in the support plate hole such that the shaft does not touch the support plate, either on the side or via the C-clip which secures the clamp shaft, when the receiver assembly is in the loaded position.

This adjustment should be checked whenever:

- a. The support plate is removed for any reason.
- b. The spindle assembly is replaced.
- c. There is evidence of severe diskette wear at the center in the clamp area.

4.14.1 Procedure

- a. Remove the PCBA from the drive and reconnect it using extender cables as necessary.
- b. Apply power to the drive.
- c. Apply a low signal to the MTRN interface line (J1, pin 16).
- d. Insert a diskette in the drive and load it.
- e. Clearance should exist between the clamp shaft and the clearance hole in the clamp support plate (see figure 4-13). If clearance does not exist, adjust per steps f and g.

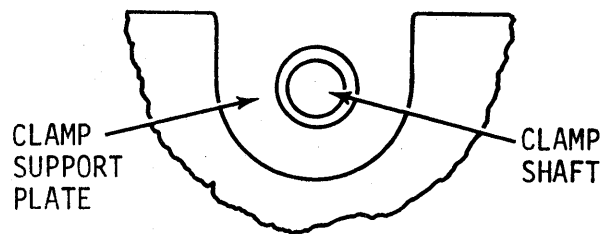


Figure 4-13. Clamp Support Plate Clearance

- f. Loosen the clamp support plate mounting nuts.
- g. Move the plate as required to center the clearance hole around the clamp shaft. Retighten the nuts.
- h. With a diskette loaded, clearance should also exist between the clamp C-clip and the top of the support plate, to ensure that full clamp spring force exists. Otherwise, diskette slippage and wear will occur. If necessary, add or remove shim washers on the clamp support plate spacers so clearance does exist.
- i. Unload and reload the diskette several times and check that clearance still exists.

4.15 DISKETTE REAR STOP

The diskette rear stop (see figure 4-11) positions the diskette with respect to the spindle. The rear stop also serves to eject the diskette when it is being removed.

This adjustment should be checked whenever:

- a. There is evidence of uneven wear on the diskette.
- b. The diskette cannot be fully inserted in the drive or does not eject properly.

4.15.1 Procedure

- a. Remove the PCBA from the drive and reconnect it using extender cables as necessary.
- b. Apply power to the drive.
- c. Apply a low signal to the MTRN interface line (J1, pin 16).
- d. Insert a diskette in the drive. If it is close to its correct position, load it and proceed to step e. If it is significantly out of position, do not load it, but still proceed to step e.
- e. Loosen the rear stop adjustment screw and slide the rear stop on the lock bar so that with the diskette jacket seated against the stop, the opening in the center of the jacket is centered around the clamp.
- f. Tighten the rear stop adjustment screw.
- g. Unload the diskette, then reload it and recheck the adjustment.

SECTION V
TROUBLESHOOTING

5.1 INTRODUCTION

This section provides a troubleshooting chart to aid in isolating a fault symptom to a specific circuit, component, or subassembly. In most cases, there is a paragraph reference for more information or a detailed procedure.

TABLE 5-1. TROUBLESHOOTING CHART

Symptom	Possible Cause	Action	Reference
Select indicator always lit.	Interface cable reversed at one end.	Reverse cable.	3.3
Drive motor does not rotate when diskette is inserted and door is latched down. (J1-16 low)	Drive controller not connected to drive.	Check interface cable.	3.3
	No power to drive.	Check for +5V at J5-7 and for +12V at J5-4 on the PCBA.	2.7
	Drive motor is defective.	Measure motor current (voltage across 1 ohm current limiting resistor; R77-Single A or R83-Single B). Nominal head loaded, motor turning current is 300 to 500 ma, rising to 700 ma with motor stalled. Replace motor if defective.	6.4
	Drive motor circuits on PCBA are defective.	Troubleshoot drive motor circuits or replace PCBA.	3.4.2 or 3.5.3; 6.3
	Door open switch is defective.	Check/replace switch.	6.14

TABLE 5-1. TROUBLESHOOTING CHART (cont.)

Symptom	Possible Cause	Action	Reference
Drive motor rotates much more rapidly than 300 rpm and cannot be adjusted.	Intermittent connector on drive motor.	Repair/replace connector.	6.4 3.4.2 or 3.5.3; 6.3
	Defective drive motor (open tachometer winding).	Replace drive motor.	
	Failure in drive servo circuit on PCBA.	Troubleshoot servo circuit or replace PCBA.	
Head will not load.	Head load solenoid open.	Replace solenoid.	6.8 3.4.6.3 or 3.5.7.3; 6.3
	Failure in head load solenoid circuit on PCBA.	Troubleshoot solenoid logic and driver circuit or replace PCBA.	
Head will not unload.	Solenoid driver shorted.	Troubleshoot driver circuit or replace PCBA.	3.4.6.3 or 3.5.7.3; 6.3
	Solenoid binding.	Remove obstruction to free movement.	
Positioner missteps, head ends up at wrong track.	Stepper motor defective.	Replace positioner.	6.6 4.7, 4.8, 4.9 3.4.5 or 3.5.6; 6.3
	Positioner binding.	Readjust positioner.	
	Failure in positioner circuits on PCBA.	Troubleshoot positioner circuits or replace PCBA.	
Diskette slips after door is closed.	Insufficient clamping force. No gap between C-clip and top of support plate when door is closed.	Replace plate to ensure a minimum gap of 0.005" when door is shut and a diskette is in place.	6.9

TABLE 5-1. TROUBLESHOOTING CHART (cont.)

Symptom	Possible Cause	Action	Reference
Diskette jams or miscenters.	Clamp miscentered.	Adjust clamp support.	4.14
	Oxide on clamp or spindle.	Clean with alcohol.	
	Diskette rear stop out of position.	Adjust diskette rear stop.	4.15
	Clamp defective.	Replace clamp.	6.9
"Crunching" sound when closing drive door.	Not enough lubricant on the latch or on the bezel latch tabs.	Apply heavy coat of lubricant.	1.6.3
Door will not latch or unlatch.	Defective latch mechanism.	Replace latch mechanism.	6.17
Soft (non-permanent) read errors.	Degraded surface on diskette.	Change diskette.	
	Head dirty or contaminated with oxide.	Clean head.	1.6.1
	Head load pad is dirty or contaminated with oxide.	Replace head load pad.	6.5
	Excessive instantaneous speed variation (ISV).	Check ISV. Check or replace drive belt and motor.	4.4, 6.4
	Excessive pulse-type noise in read signal (appears as spikes on read amplifier waveform).	May be internal (faulty drive motor, etc.) or external (high bus noise level, noisy cabling, radiating CRT, poor electrical ground). Isolate source and repair/replace.	

TABLE 5-1. TROUBLESHOOTING CHART (cont.)

Symptom	Possible Cause	Action	Reference
Soft (non-permanent) read errors (cont.).	Intermittent or marginal component in read circuit on PCBA.	Troubleshoot read circuits (including amplifiers, one-shots, and input select diodes) or replace PCBA.	3.4.3 or 3.5.4; 6.3
Hard (permanent) read errors.	Failure of read circuit component on PCBA.	Check for read data at interface pin 30. Check for read signal at read test point. Check for read signal at output of first read amplifier.	3.4.3 or 3.5.4
Write errors.	Head is dirty or contaminated with oxide.	Clean head.	1.6.1
	Head load pad is dirty or contaminated with oxide.	Replace head load pad.	6.5
	Intermittent write protect switch or circuit.	Check switch for noisy contacts. Troubleshoot write protect circuit.	3.4.4b or 3.5.5c
	Intermittent diode(s) in read/write head switch circuit.	Troubleshoot head switch diodes.	3.4.4e or 3.5.5f
	Erase current driver in write circuitry has incorrect delays.	Troubleshoot or replace PCBA.	3.4.4d or 3.5.5e; 6.3
	Failure in write circuitry on PCBA.	Troubleshoot or replace PCBA.	3.4.4 or 3.5.5; 6.3

TABLE 5-1. TROUBLESHOOTING CHART (cont.)

Symptom	Possible Cause	Action	Reference
Write errors. (cont.)	Defective head.	If replacing the PCBA does not correct the problem, replace the head.	6.7
Drive is always or never write protected.	Write protect switch failure.	Check/adjust/replace switch.	4.13, 6.13
	Failure in write protect circuitry on PCBA.	Troubleshoot or replace PCBA.	3.4.4b or 3.5.5c; 6.3
Diskette incompatibility between drives.	Drive motor speed incorrect.	Check/adjust motor speed.	4.3
	Excessive instantaneous speed variation (ISV).	Check ISV. Check or replace drive belt and motor.	4.4, 6.4
	Circumferential/Azimuth alignment out of adjustment.	Check/adjust circumferential/azimuth alignment.	4.8
	Radial alignment out of adjustment.	Check/adjust radial alignment.	4.9
	Marginal head or marginal read/write circuits in one or both drives.	Troubleshoot read/write circuits or replace PCBA. If problem persists, replace head.	6.3, 6.7

SECTION VI
REMOVAL AND REPLACEMENT PROCEDURES

6.1 INTRODUCTION

This section provides detailed procedures for replacing subassemblies and parts of the drive. Components are replaced at their spared level; i.e., a subassembly is replaced as a unit. Tests and adjustments in Section 4 are referenced as applicable for each replacement procedure. Tools required for these procedures are listed in Section 1. All procedures assume that the sleeve, if present, has been removed.

6.2 DISK DRIVE REPLACEMENT

Use this procedure to replace the entire disk drive, consisting of the drive mechanism and the drive electronics PCBA.

- a. Disconnect DC power at J5 and the interface cable to the controller at J1 on the PCBA.
- b. Remove the screws that attach the disk drive to the base chassis or brackets. Remove the disk drive through the panel opening.
- c. Insert the replacement drive through the panel opening from the front.
- d. Reattach the drive to the base chassis or mounting brackets.
(See section 2.6 for more information.)
- e. Reconnect the interface cable at J1 and the DC power at J5.

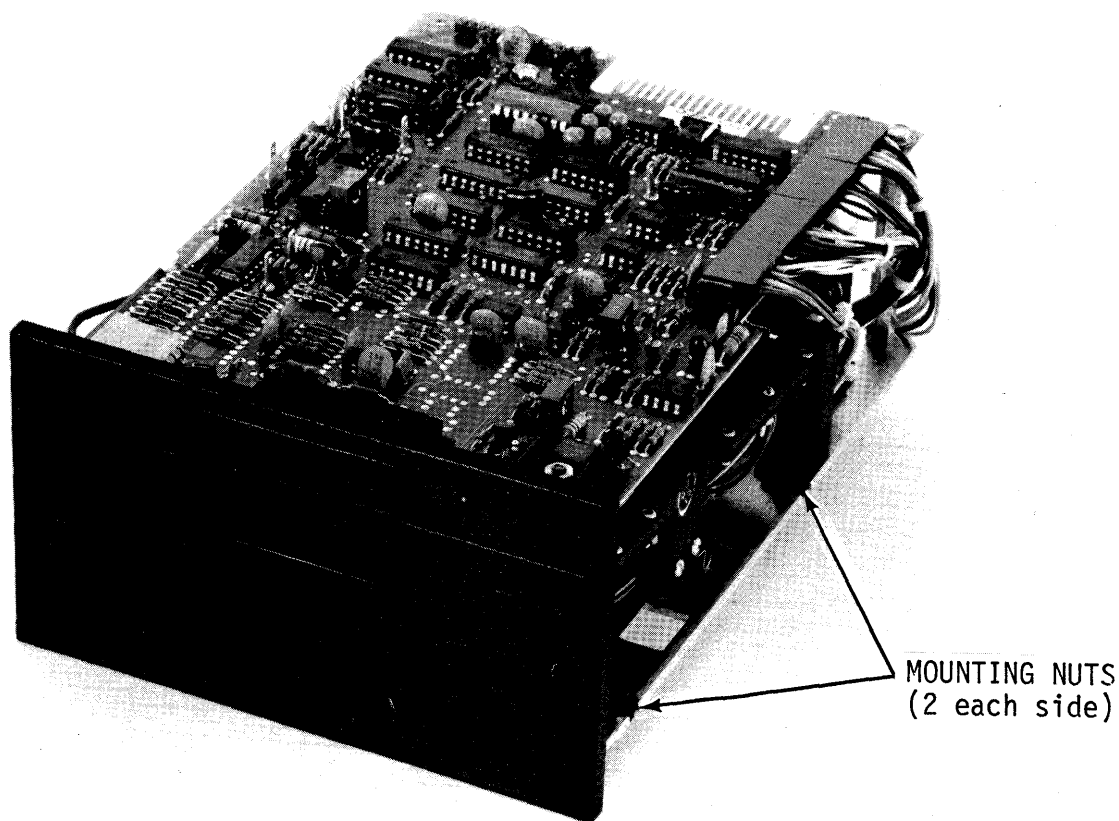


Figure 6-1. Mounting Nut Location

6.3 DRIVE ELECTRONICS PCBA

The drive electronics PCBA is mounted on top of the drive mechanism. The replacement procedure is the same for the Single A or Single B PCBA.

- a. Note the location and orientation of the four drive-to-PCBA connectors at J3 and J4 on the PCBA, then disconnect the four connectors.

CAUTION

During the next two steps, handle the head cable and cable connector very carefully because they are fragile and irreparable.

- b. Note the location of the tie wraps securing the head cable to the PCBA, then cut the tie wraps.
- c. Disconnect the head cable at PCBA connector J6.
- d. Remove two PCBA mounting screws, then lift the PCBA off the drive mechanism.

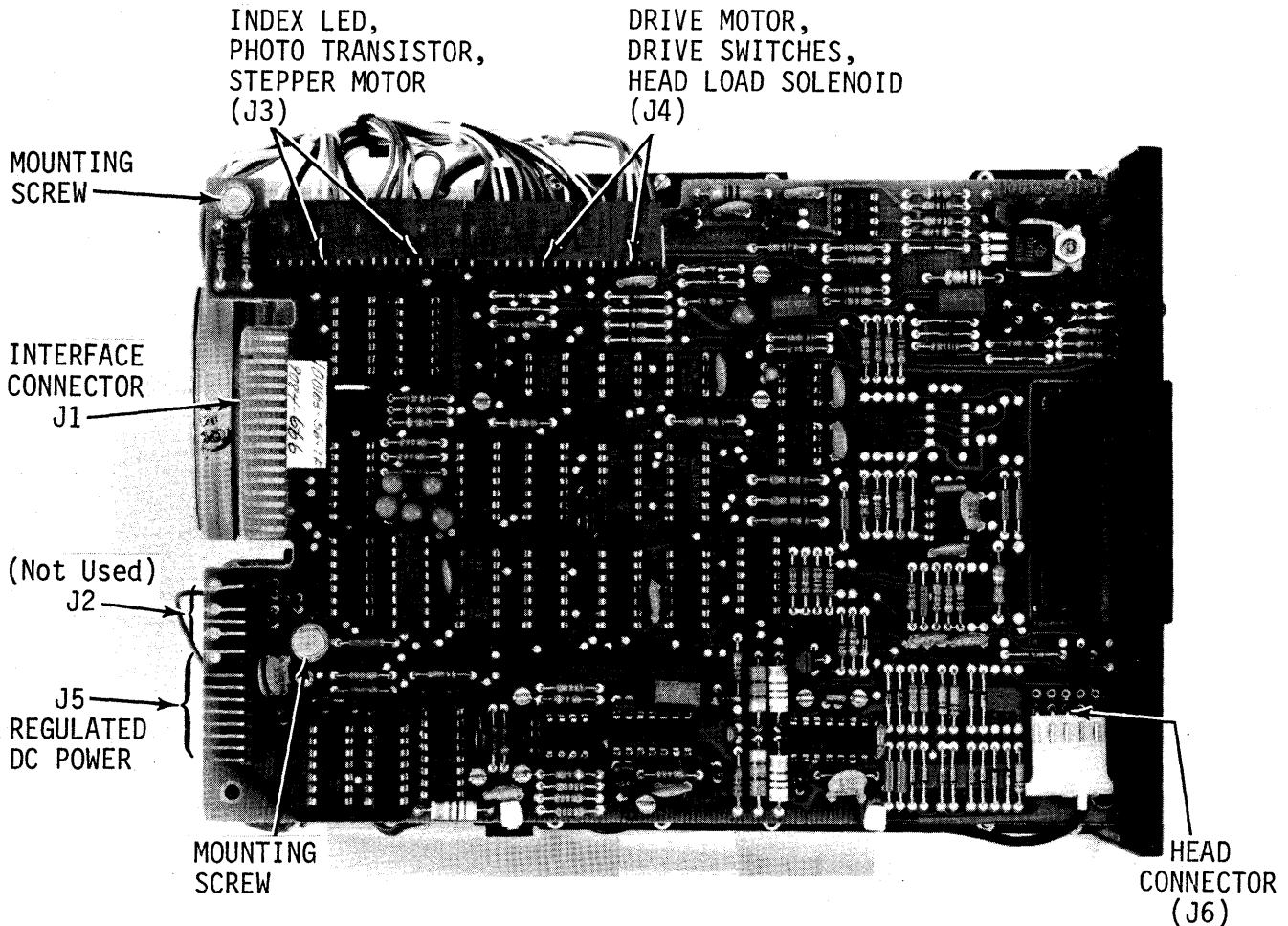


Figure 6-2. PCBA Mounting Details

- e. Position the replacement PCBA so that it is supported between the fingers on the bezel.
- f. Install the two PCBA mounting screws.

CAUTION

During the next two steps, handle the head cable very carefully.

- g. Mate the head cable connector with J6 on the PCBA.

CAUTION

During the following step, loosely install the tie wraps to prevent crushing the head cable.

- h. Install tie wraps around head cable, locating them as noted in step b.
- i. Mate the four drive-to-PCBA connectors with the PCBA, orienting them as noted in step a. Note that on the Single B PCBA (P/N 100163) there is one extra pin on P4 (mates with J4) nearest the front of the PCBA.
- j. Perform the following tests and adjustments in the order listed:

Procedure	Paragraph
Drive Motor Speed	4.3
Positioner Step Timing	4.5
Read Amplifier Gain	4.6

6.4 DRIVE MOTOR OR DRIVE BELT

Depending on how the disk drive is mounted, the drive motor and/or drive belt may be accessible without first removing the drive. If it is necessary to remove the drive, follow the procedure given in section 6.2.

CAUTION

If the drive belt is to be reused, do not stretch or kink it during removal. If this happens the drive belt must be replaced.

- a. Slip the drive belt off the large pulley (with the strobe disk) and remove it from the drive motor pulley (see figure 6-3). Retain the belt if it is acceptable for reuse. Note which surface of the belt is in contact with the pulleys. If the drive belt is to be replaced and the existing drive motor is acceptable, proceed directly to step i.

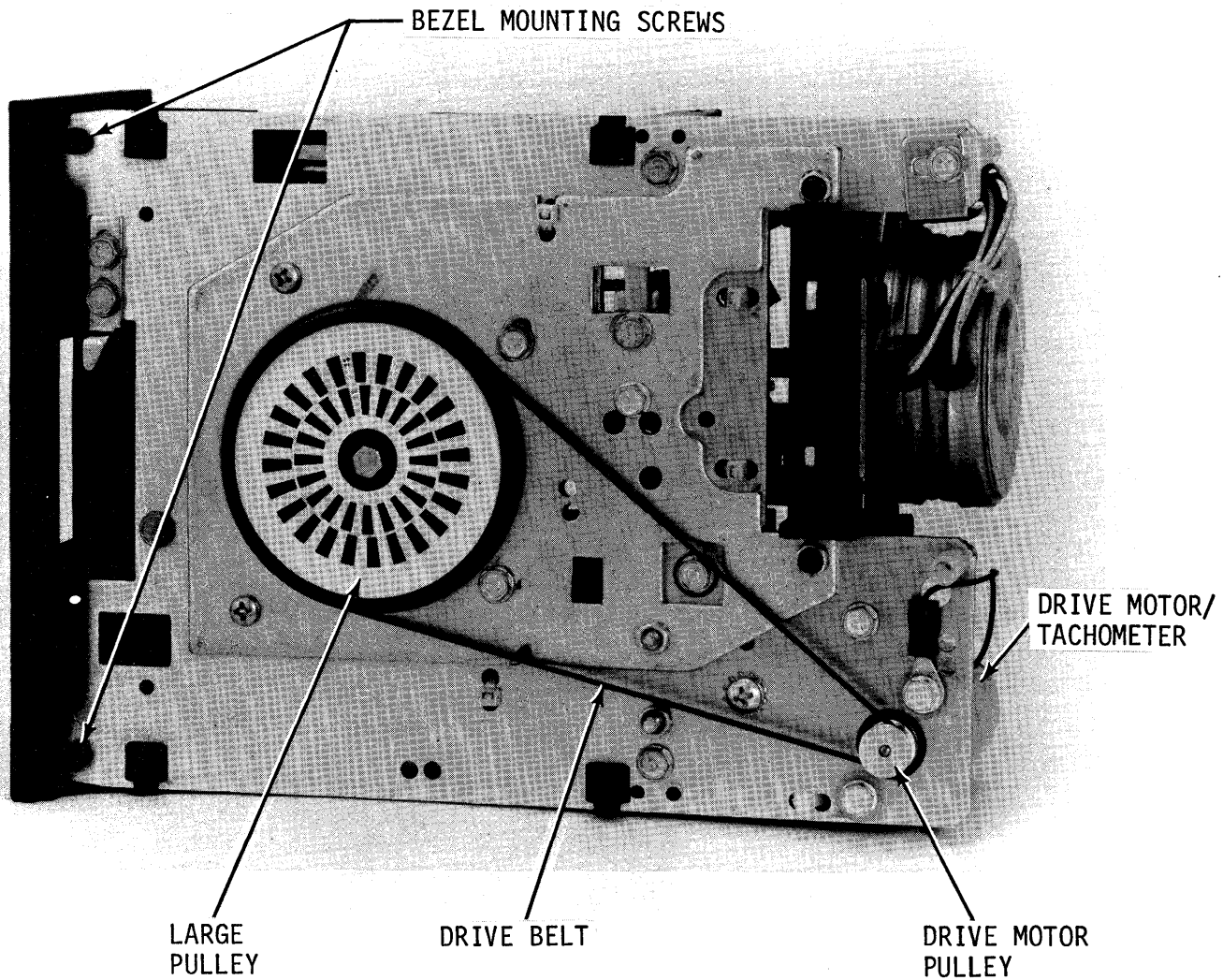


Figure 6-3. Drive Motor and Belt Details

- b. Disconnect the cable from the drive motor at J4 on the PCBA. Clip the tie wraps on the cable.
- c. Two mounting screws secure the drive motor to the chassis. On some drive mechanisms one of these screws secures a ground lug. In this case the motor is insulated from the chassis by a plastic disk and two insulating shoulder washers. On other drive mechanisms the ground lug is attached by a third screw; when removing the drive motor from one of these mechanisms, remove this (third) screw before removing the motor mounting screws.

- d. While holding the drive motor, remove the two drive motor mounting screws. Retain the plastic disk and shoulder washers, if present. Remove the drive motor from the chassis.
- e. Hold the replacement drive motor (and plastic insulator disk, if present) against the chassis.
- f. Install the right side motor mounting screw (and shoulder washer, if present).
- g. If the drive motor ground lug is secured by the left side motor mounting screw, run the screw through the ground lug and shoulder washer, and install (see figure 6-4). If the ground lug is secured by the third screw, install the right side motor mounting screw and attach the ground lug to the chassis with the third screw.

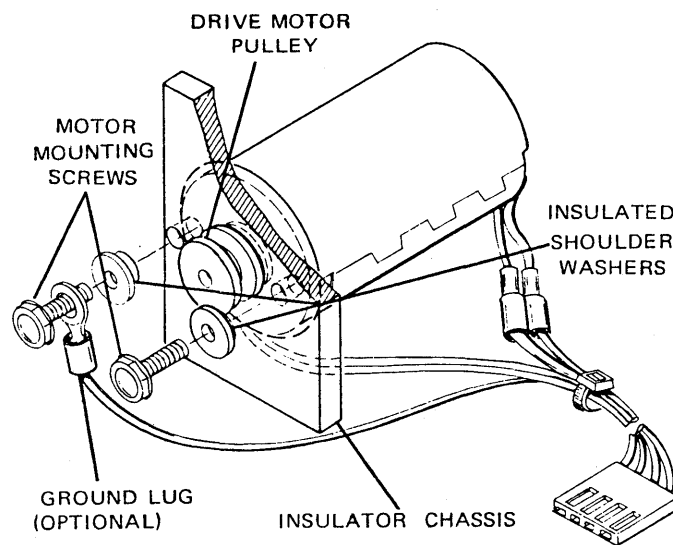


Figure 6-4. Drive Motor Ground Lug

- h. Connect the cable from the drive motor to J4 on the PCBA. Secure the cable with tie wraps.
- i. Place the original or replacement drive belt over the drive motor pulley, then rotate the large pulley while slipping the belt over it. Ensure that the correct surface of the belt is in contact with the pulleys (see step a).
- j. Perform the Drive Motor Speed test and adjustment (paragraph 4.3) and the Instantaneous Speed Variation test (paragraph 4.4).

6.5 HEAD LOAD PAD

The head load pad seats into a recess in the head load arm, and is held in place with adhesive. The head load pad and arm are accessible when the PCBA is removed from the drive.

- a. Position the head carriage assembly to the middle of its stroke.
- b. Pivot the head load arm up until it is vertical and hold it in this position, using care to keep the spring and pins in place (see figure 6-5).

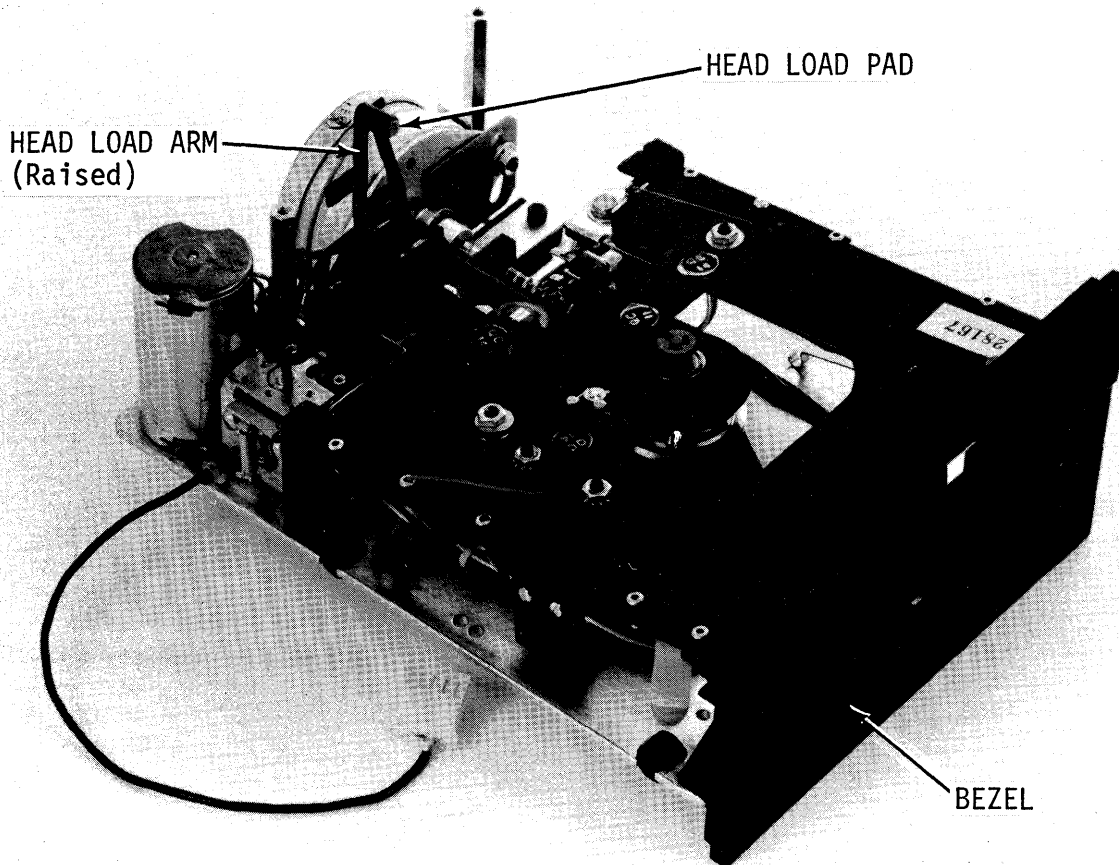


Figure 6-5. Head Load Arm and Pad

- c. Using tweezers, carefully remove the old head load pad from the arm. Adhesive will usually remain stuck in the recess in the head load arm. Using caution to avoid damaging the head load arm, remove all bits of residual adhesive.

- d. Being careful not to touch the adhesive surface, peel the protective strip from the back of the replacement head load pad.

CAUTION

During the following step, make sure that the head load pad is flat. An off-center and/or off-level pad will cause data errors.

- e. Position the head load pad in the head load arm recess, then use a flat tool to press it into place.
- f. Lower the head load arm to the head load solenoid plate.
- g. Perform the Read Amplifier Gain test and adjustment (paragraph 4.6) and the Head Compliance test (paragraph 4.7).

6.6 POSITIONER

The positioner, consisting of the stepper motor and lead screw, is replaced as a unit. The positioner should not be removed until the PCBA is removed, since the head carriage is removed along with the positioner.

CAUTION

During the next step, handle the head cable very carefully.

- a. Note the routing of the head cable, then cut the tie wraps and free the cable from the drive mechanism.
- b. Rotate the lead screw until the head carriage is fully forward (away from the stepper motor).

- c. Loosen the screw securing the positioner protection bracket (see figure 6-6) and turn the bracket out of the way so the positioner can be removed.

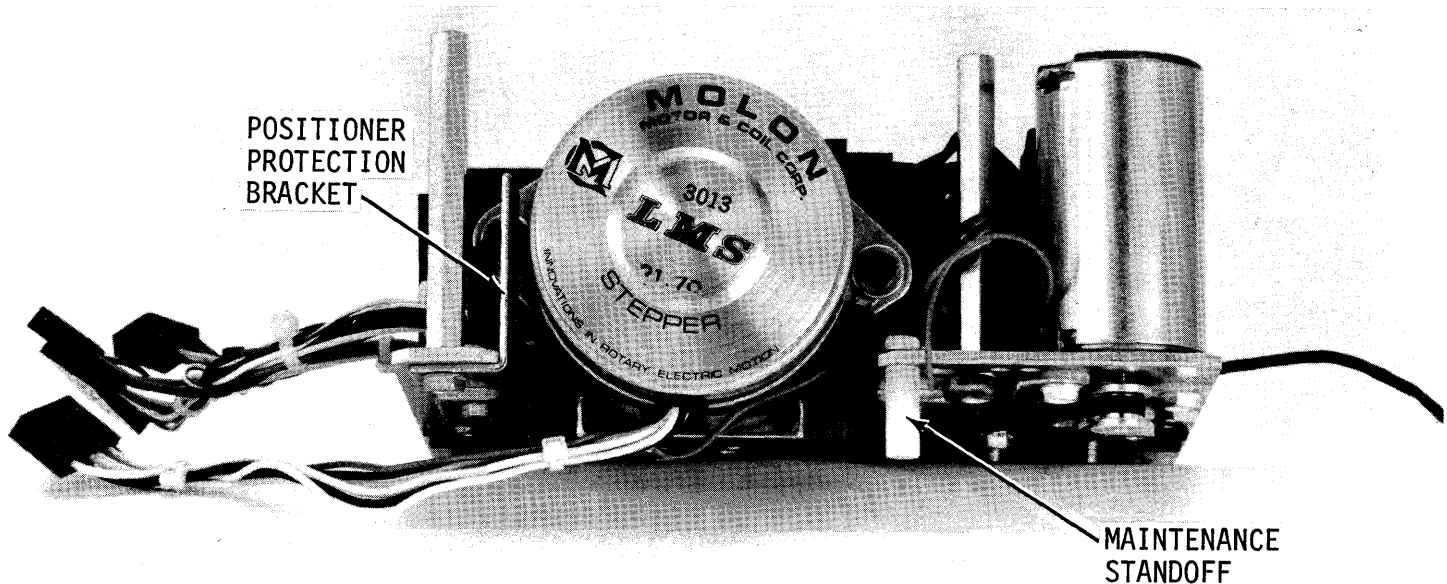


Figure 6-6. Positioner Mounting Screws and Protection Bracket

- d. Remove the two positioner mounting screws that attach the positioner mounting block to the chassis.
- e. Move the positioner (with the head carriage) away from the spindle housing until the lead screw clears the spindle housing bearing.

CAUTION

If the original head is going to be installed on the replacement positioner, be careful to avoid touching the head face.

- f. Carefully remove the positioner and head carriage from the drive mechanism.

- g. Remove the three screws that hold the head carriage spring plate against the lead screw (see figure 6-7). Remove the spring plate and the head carriage from the positioner.

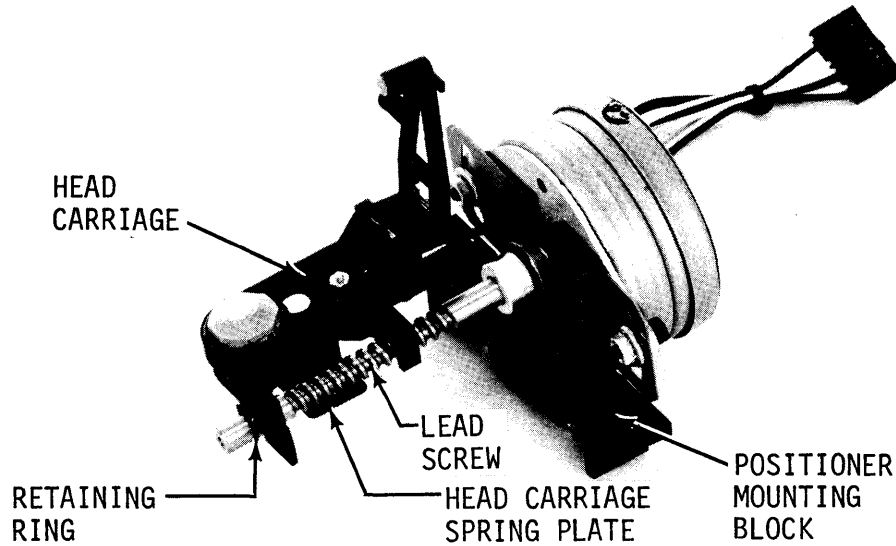


Figure 6-7. Head Carriage Mounting Details

NOTE

For the following step, use the replacement head carriage and/or replacement positioner.

- h. Install three screws that hold the spring plate against the lead screw and attach the spring plate to the head carriage. If using a replacement head carriage, use the attaching hardware that comes with it. Check that the spring plate is perpendicular to the head carriage and to the lead screw, and adjust if necessary.
- i. Place the positioner (with head carriage) on the chassis near its installed position, but without inserting the lead screw in the spindle housing bearing.

CAUTION

During the next step, handle the head cable very carefully.

- j. Route the head cable as noted in step a. Install tie wraps over cable sleeving, but leave them loose to avoid crushing the cable. Make sure a service loop is left at the head end.

- k. Rotate the lead screw until the head carriage is just inside the retaining ring at the far end (the spindle housing end) of the lead screw.

CAUTION

During the following step, force is NOT needed. If the lead screw does not slip into position easily, it is not correctly aligned with the spindle housing bearing. Using force will damage the drive mechanism.

- l. Make sure the projection on the head load arm will be above the solenoid actuator arm, then gently insert the lead screw into the spindle housing bearing.
- m. Loosely install the two positioner mounting screws through the spacer plate and positioner mounting block.
- n. Adjust the positioner to obtain as accurate a side-to-side centering as possible, then tighten the mounting screws to 18 inch-lbs.
- o. Apply a coat of grease (Micropolis P/N 732-0001) to the lead screw.
- p. Manually rotate the lead screw. The head carriage should move smoothly on the lead screw but not be so loose that the spring plate does not hold the carriage against the lead screw.
- q. Perform the following tests and adjustments in the order listed:

Procedure	Paragraph
Positioner Mechanical Adjustment	4.12
Radial Alignment	4.9
Circumferential/Azimuth Alignment	4.8
Track Zero Switch and Zero Stop	4.10
Radial Alignment (second time)	4.9
Read Amplifier Gain	4.6
Head Compliance	4.7

- r. Loosen the screw securing the positioner protection bracket, turn the bracket to its normal position (where it will prevent the lead screw from coming out of the spindle housing bearing), then tighten the screw.

6.7 HEAD CARRIAGE

The head is supplied permanently mounted in the head carriage. Since the head carriage is removed and installed along with the positioner, follow the procedure given in paragraph 6.6 to replace the head carriage.

6.8 HEAD LOAD SOLENOID

The head load solenoid is accessible when the drive is removed.

- a. Remove the head load solenoid mounting screw, then slide the head load solenoid out of the drive mechanism far enough to disconnect the wires from the solenoid terminals. Then remove the head load solenoid. It may be necessary to clip the tie wrap holding the head cable to the chassis to perform this step.

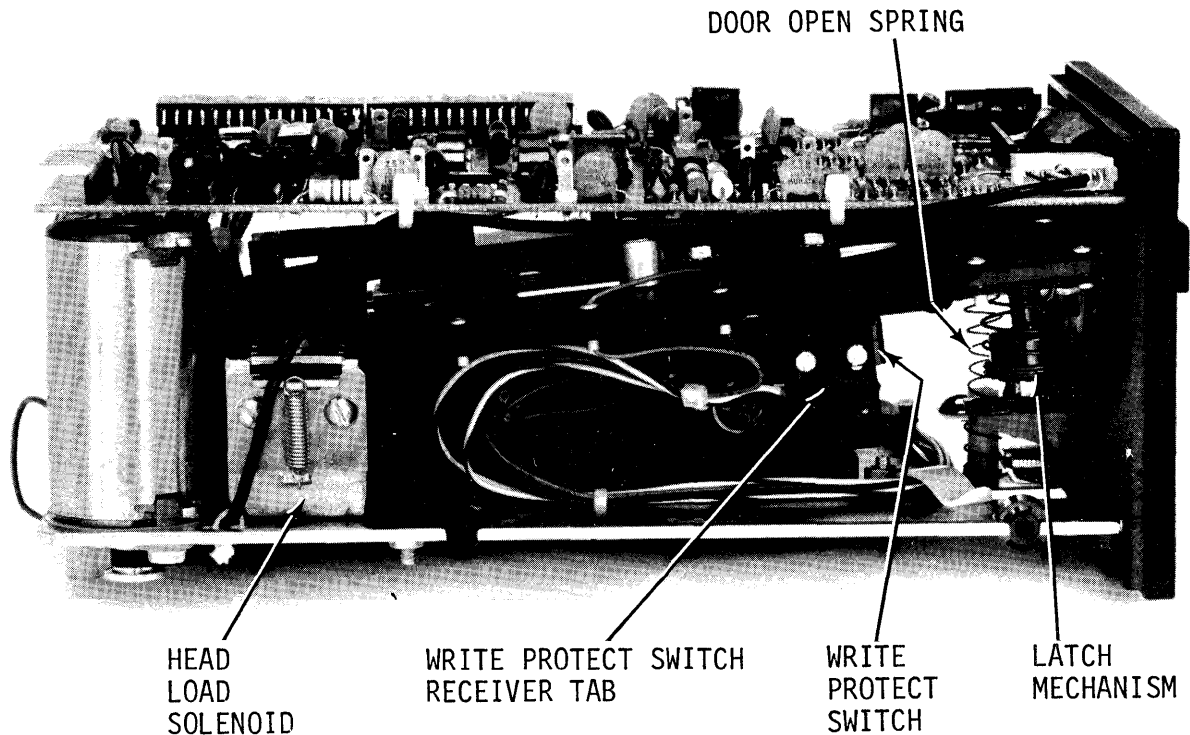


Figure 6-8. Head Load Solenoid, Write Protect Switch, and Latch Mechanism

- b. Connect wires to the replacement solenoid.
- c. Lift the head load arm and slide the head load solenoid into position on the chassis.
- d. Align the solenoid mounting hole and key with respective holes in the chassis, then install the mounting screw and lockwasher.
- e. Check freedom of solenoid action by manually operating the solenoid plate.
- f. If the tie wrap was cut in step a, replace it loosely to avoid crushing the head cable.

6.9 CLAMP ASSEMBLY

The clamp assembly consists of the clamp and clamp support plate. The clamp assembly is accessible when the PCBA is removed.

- a. Remove the two clamp support plate retaining nuts and washers (see figure 6-9).

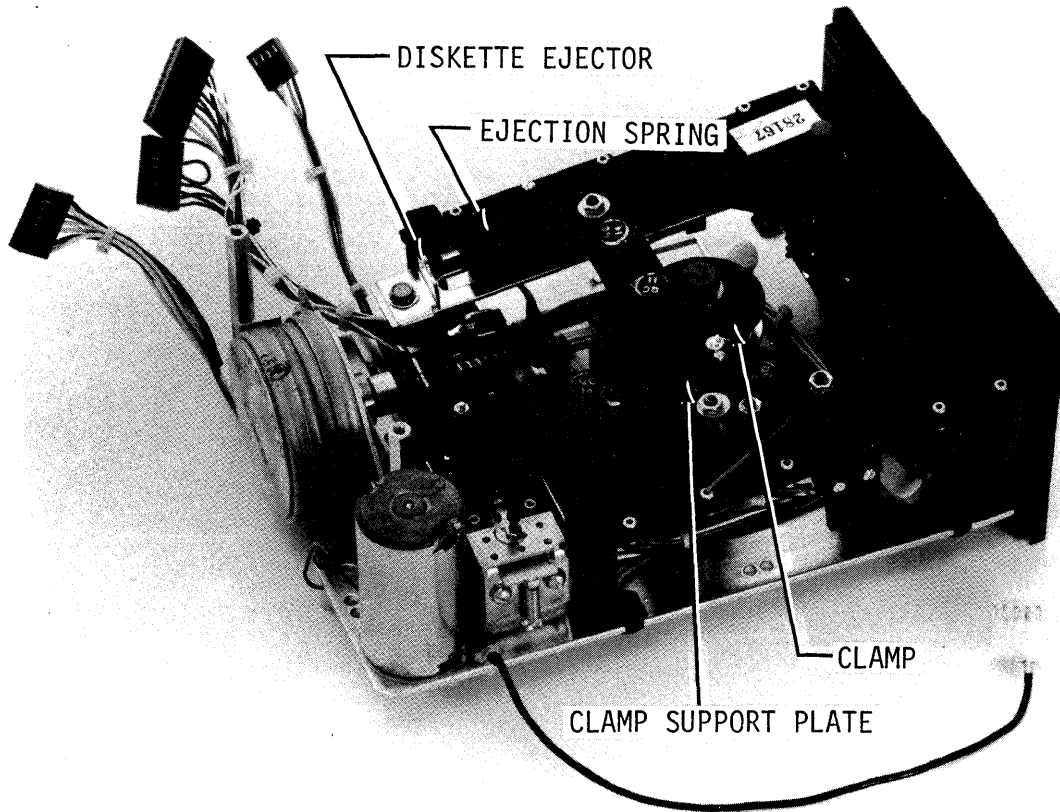


Figure 6-9. Clamp and Clamp Support Plate

- b. Disconnect the ejection spring from the clamp support plate, then remove the clamp support plate and clamp from the drive mechanism.
- c. Install the replacement clamp support plate (with clamp) and secure with nuts and flat washers.
- d. Reattach the ejection spring to the clamp support plate.
- e. Perform the Clamp Support Plate test and adjustment (paragraph 4.14).

6.10 SPINDLE ASSEMBLY

The spindle assembly consists of the spindle and spindle housing, the large drive pulley and strobe disk, and the spindle and lead screw bearings. The spindle assembly is accessible when the drive is removed, and the PCBA and clamp assembly are removed.

- a. Remove the drive belt (see paragraph 6.4 for procedure).
- b. While holding the large pulley with one hand, remove the retaining screw, then remove the large pulley.
- c. Remove the clamp assembly (see paragraph 6.9 for procedure).
- d. Remove the two or three spindle housing mounting screws and remove the spindle housing (and spindle) from the drive mechanism by raising the housing from the chassis and sliding it toward the bezel (toward the front of the drive) until the lead screw is free of the bearing in the housing. See figure 6-10.

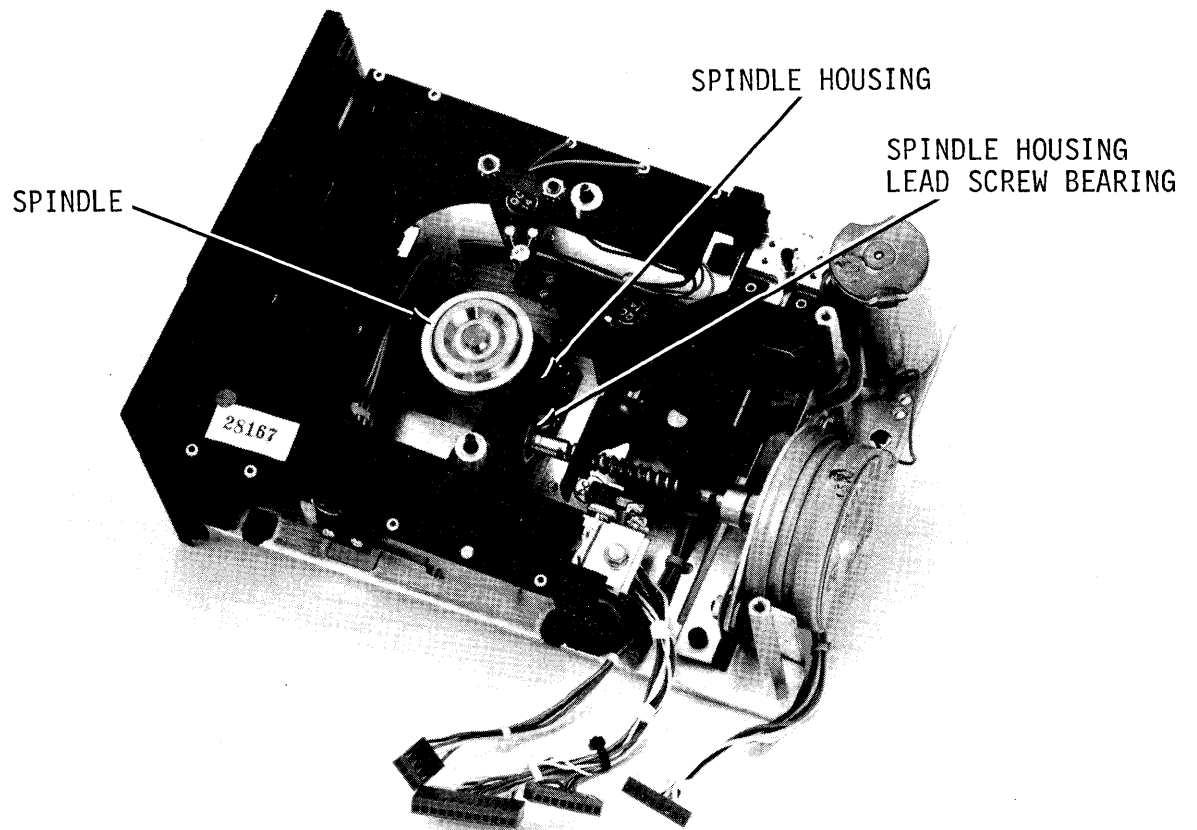


Figure 6-10. Spindle Housing Details

- e. Slide the replacement spindle housing (with replacement spindle) over the end of the lead screw. Align the spindle housing mounting holes and key with the respective holes in the chassis.
- f. Install the spindle housing mounting screws and tighten them securely.
- g. Replace the clamp assembly (see paragraph 6.9).
- h. Place the large pulley (with strobe disk) against the spindle and install the retaining screw.
- i. Replace the drive belt (see paragraph 6.4).
- j. Perform the following tests and adjustments in the order listed:

Procedure	Paragraph
Clamp Support Plate	4.14
Circumferential/Azimuth Alignment	4.8
Radial Alignment	4.9
Track Zero Switch and Zero Stop	4.10

6.11 INDEX/SECTOR LED ASSEMBLY

The Index/Sector LED Assembly consists of a light emitting diode (LED) on a bracket. It is accessible when the PCBA is removed.

- a. Remove the two LED Assembly retaining nuts and washers (see figure 6-11).
- b. Turn the LED Assembly on end to gain access to the two terminals. Note the wire color coding for each terminal, then unsolder the wires and remove the LED Assembly.
- c. Solder the wires to the feed-through terminals on the replacement LED Assembly, ensuring that the color coding is as noted in step b.
- d. Route the wires through the notch on the underside of the bracket, then install the bracket over the studs and secure with two washers and nuts.
- e. Perform the Circumferential/Azimuth Alignment (paragraph 4.8).

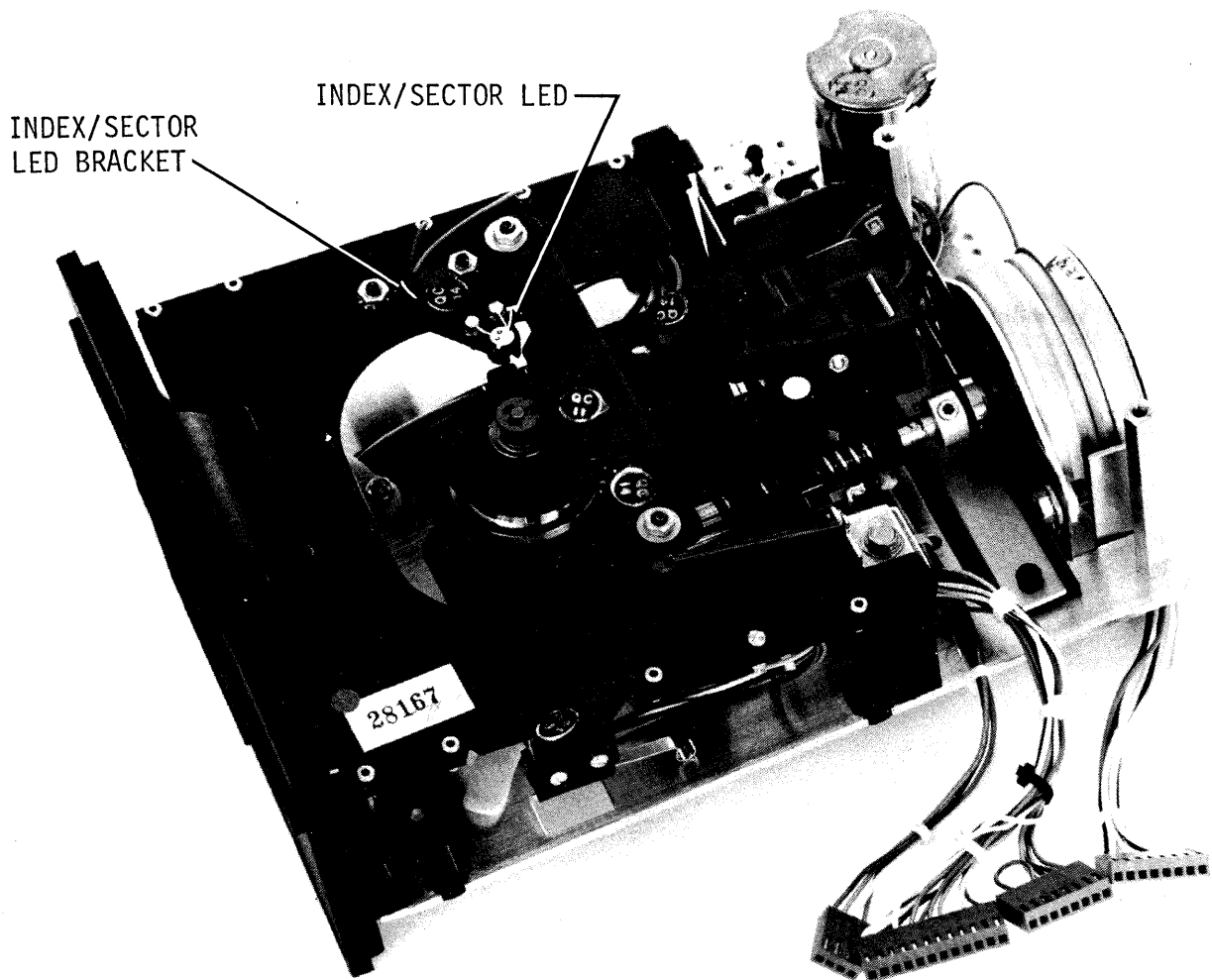


Figure 6-11. Index/Sector LED Assembly Details

6.12 INDEX/SECTOR PHOTO TRANSISTOR

The Index/Sector Photo Transistor is part of the Platen Assembly. The Platen Assembly is accessible when the drive is removed.

- a. While holding the platen (see figure 6-12) in place, remove two platen mounting screws.
- b. Slide the platen toward the side of the chassis until it is freed from the head carriage and spring plate.

CAUTION

Perform the next step carefully, since the photo transistor wires will still be attached.

- c. Tilt the platen and slide it out between the receiver and the chassis.
- d. Note the wire color coding for the two terminals on the platen, then unsolder the two wires and remove the platen.

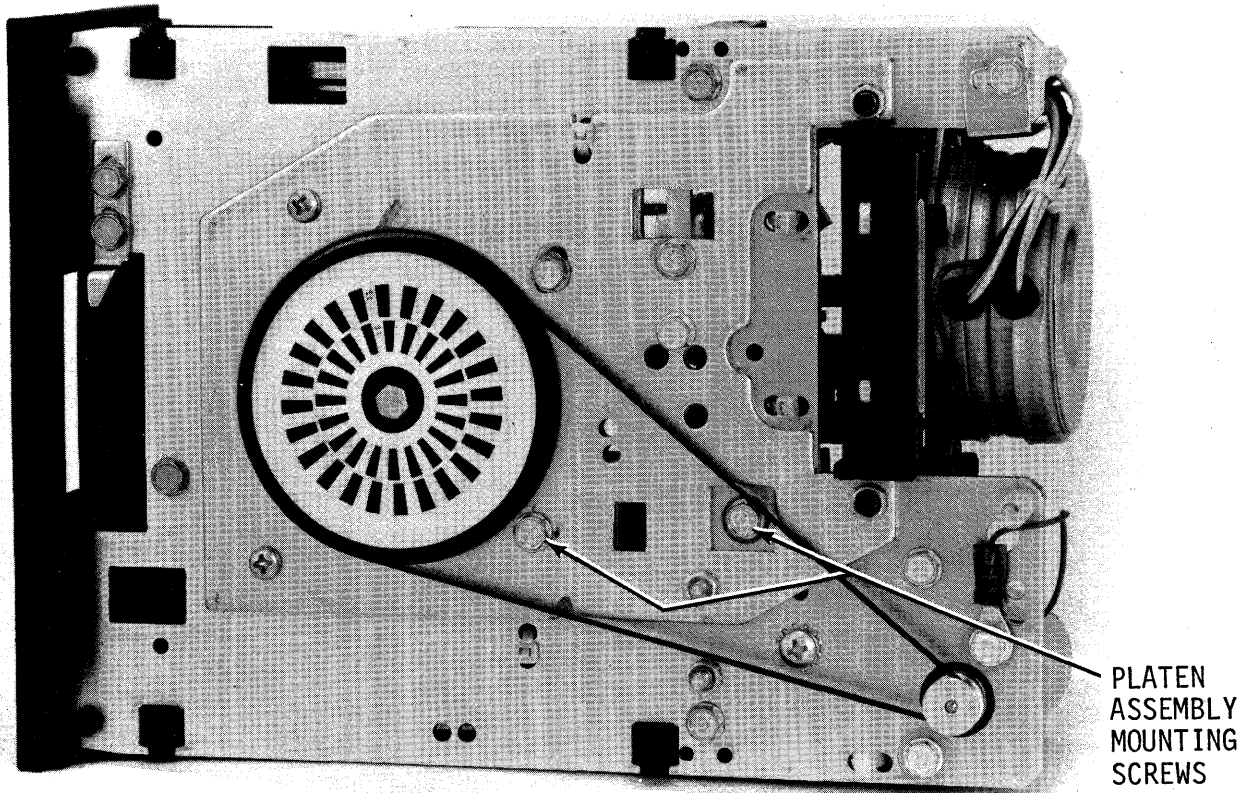
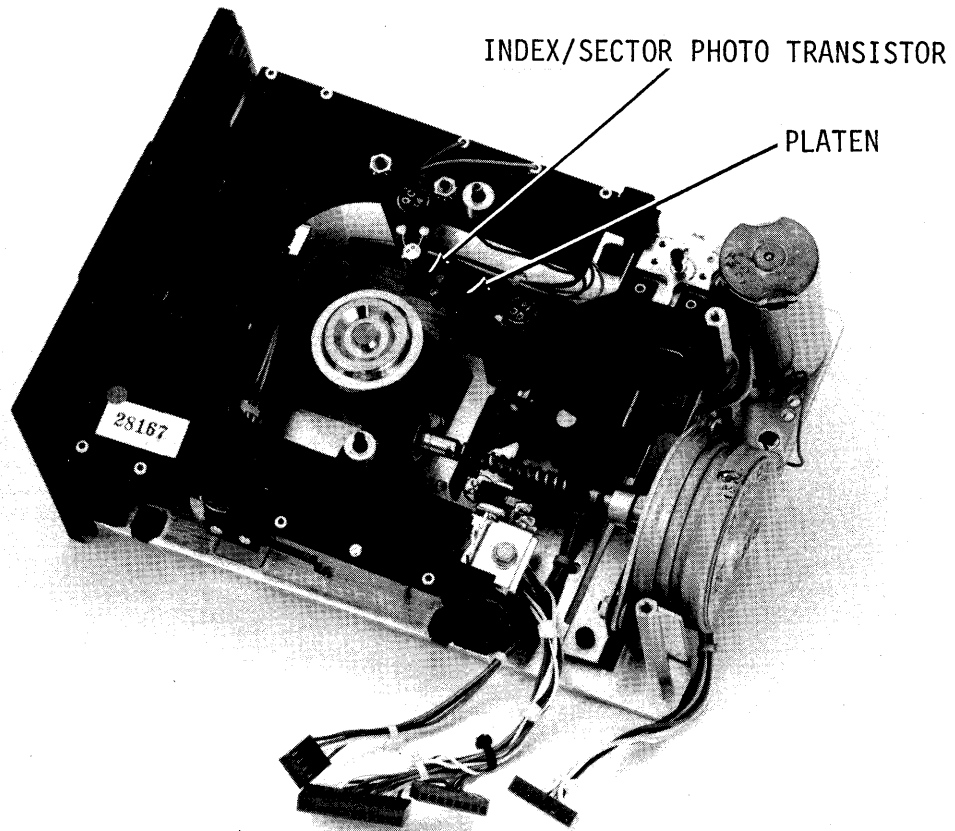


Figure 6-12. Platen Details

- e. Solder the wires to the terminals on the replacement platen, ensuring that the color coding is as noted in step d. Ensure that the blue wire is at the terminal that will be nearer the spindle housing.
- f. Lubricate both sides of the platen lip with Magnalube grease (Micropolis P/N 732-0001).
- g. Tilt the platen and slide it into approximate position on the chassis.
- h. Position the platen so that the photo transistor is toward the front of the drive mechanism, the spring plate on the head carriage assembly is below the platen lip and the head carriage is above it, and the platen mounting holes are aligned over the holes in the chassis.
- i. Verify that the head cable is not underneath the platen, then install the platen mounting screws.
- j. Perform the Circumferential/Azimuth Alignment (paragraph 4.8).

6.13 WRITE PROTECT SWITCH

The write protect switch is attached to a tab on the drive motor side of the receiver. It is accessible when the drive is removed.

CAUTION

When performing this procedure, do not apply stress to the fragile tab to which the switch is mounted. If the tab is damaged, the entire receiver must be replaced (paragraph 6-15).

- a. While holding the receiver tab and the write protect switch, remove the two switch mounting screws (see figure 6-8). When the second screw is removed, the nut plate (on the inward side of the switch) will be freed.
- b. Note the color coding of the wires at the three switch terminals, then unsolder the wires and remove the switch.
- c. Observing the color coding noted in step b, solder the three wires to the replacement switch.
- d. Hold the switch in place and insert two mounting screws through the receiver tab and through the switch. Hold the nut plate against the screws, and loosely run the screws into the nut plate. Ensure the switch actuator is in the receiver notch.
- e. Perform the Write Protect Switch adjustment (paragraph 4.13).

6.14 DOOR OPEN SWITCH

The door open switch is attached to a tab on the diskette ejector side of the receiver. It is accessible when the drive is removed.

CAUTION

When performing this procedure, do not apply stress to the fragile tab to which the switch is mounted. If the tab is damaged, the entire receiver must be replaced (paragraph 6.15).

- a. While holding the receiver tab and the door open switch, remove the two switch mounting screws. When the second screw is removed, the nut plate (on the inward side of the switch) will be freed.

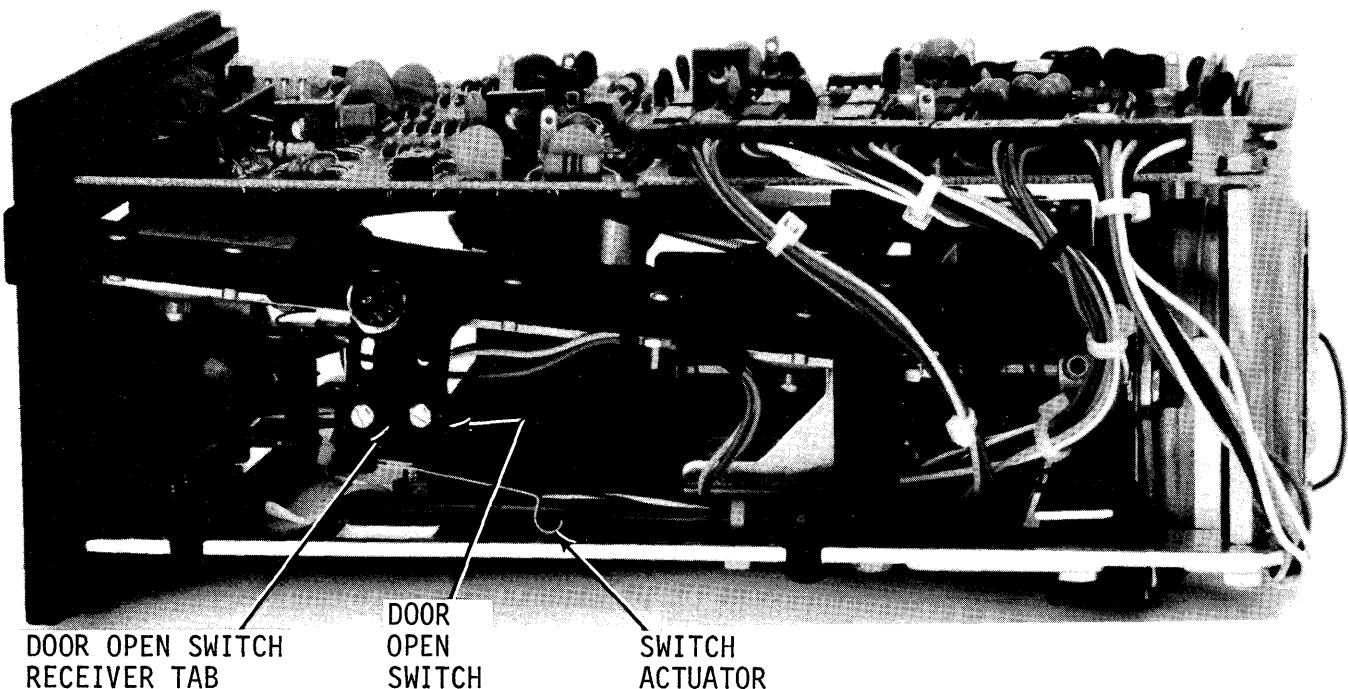


Figure 6-13. Door Open Switch Details

- b. Note the color coding of the wires at the three switch terminals, then unsolder the wires and remove the switch.
- c. Observing the color coding noted in step b, solder the three wires to the replacement switch.
- d. Hold the switch in place and insert two mounting screws through the receiver tab and through the switch. Hold the nut plate against the screws, and loosely run the screws into the nut plate. The switch actuator should be positioned down and toward the rear of the drive.
- e. Perform the Door Open Switch adjustment (paragraph 4.11).

6.15 RECEIVER

The Receiver Assembly includes the receiver, write protect switch, door open switch, index/sector LED, and diskette ejector mechanism; it does not include the clamp assembly. The Receiver Assembly is accessible when the drive is removed and the PCBA is removed from the drive.

- a. Loosen the two bezel mounting screws (see figure 6-3).
- b. Slide the diskette ejector rearward until it latches.
- c. Move the bezel forward and upward until it clears the door handle, then remove the bezel.
- d. Loosen the left hand pivot post mounting screw, then separate the receiver from the left hand pivot (see figure 6-14).

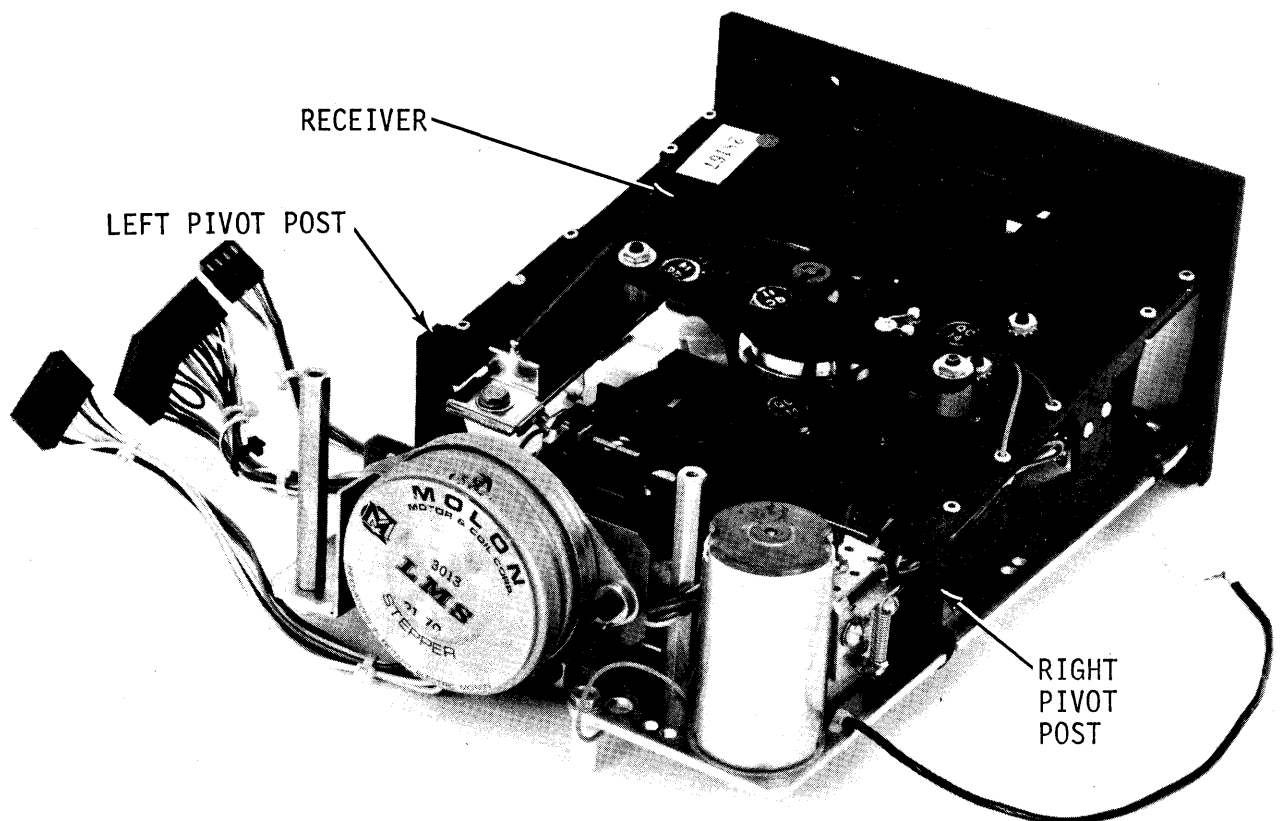


Figure 6-14. Receiver Details

- e. Rotate the receiver on the right hand pivot post, while moving the receiver to the left, until the receiver is free of the right hand pivot. Retain door open spring.
- f. Note the location of the tie wraps securing the receiver wires to the chassis, then cut the tie wraps.
- g. Separate the receiver wires from the remainder of the drive mechanism wires.

- h. With the original receiver assembly still attached to the drive mechanism by wires, position the replacement receiver assembly so that its wires can be routed in the same manner as the original's.
- i. Select a wire from the original receiver and trace it to the PCBA connector.
- j. Insert a pointed tool (such as a scribe) into the connector window adjacent to the selected wire and press the metal tab that locks the contact in the connector body.
- k. Slide the contact toward the wire end of the connector, then gently pull on the wire while using the scribe to push the contact out of the connector body.
- l. Select the corresponding wire from the replacement receiver, align its contact with the connector body socket (metal tab toward window), and push the contact into the connector until seated.
- m. Repeat steps i through l for all remaining receiver wires.
- n. Ensure the door open spring is in place, then position the replacement receiver in the right pivot with the left side up.
- o. Install the left pivot post in place over the receiver pivot. Install the left pivot post mounting screw; do not overtighten.
- p. Slide the diskette ejector rearward until it latches.
- q. Slide the bezel over the door handle, then move the bezel down and rearward until it can be attached to the chassis with two screws and nuts.
- r. Install tie wraps at locations noted in step f.
- s. Lift the door handle to release the diskette ejector.
- t. Remove the clamp assembly from the original receiver and reinstall it on the replacement receiver (see paragraph 6.9).
- u. Perform the following tests and adjustments in the order listed:

Procedure	Paragraph
Door Open Switch	4.11
Write Protect Switch	4.13
Clamp Support Plate	4.14
Diskette Rear Stop	4.15

6.16 TRACK ZERO SWITCH

The track zero switch and its bracket are replaced as an assembly. The track zero switch assembly is accessible after the drive is removed and the PCBA is removed from the drive.

- a. Remove the three mounting screws securing the switch bracket to the chassis (see figure 6-15).

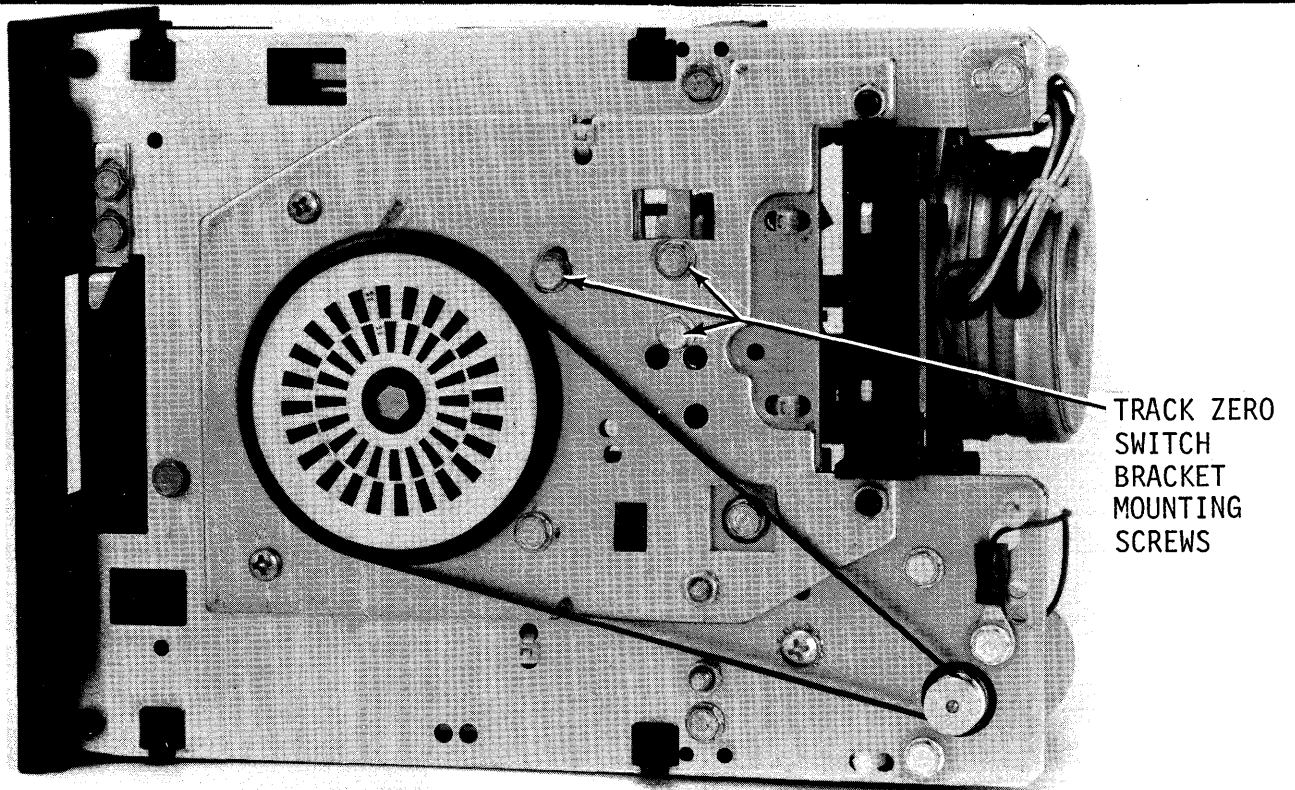
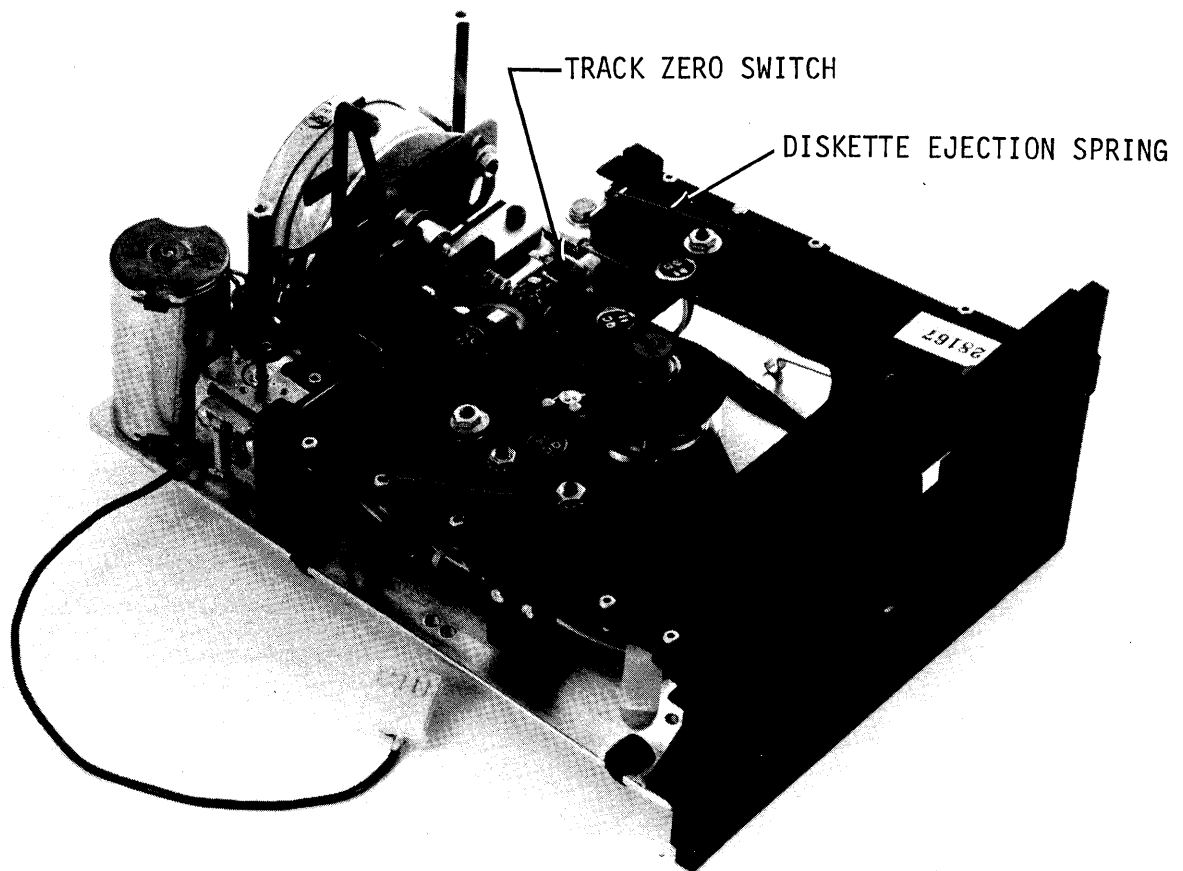


Figure 6-15. Track Zero Switch Details

- b. Tilt the switch bracket for better access to the switch terminals, then note the color coding of the wires at the three switch terminals. Unsolder the wires. The switch and bracket can now be removed between the lead screw and the diskette ejector.
- c. Position the replacement track zero switch assembly approximately in place. Observing the color coding noted in step b, solder the three wires to the switch.
- d. Loosely install the three mounting screws.
- e. Perform the Track Zero Switch and Zero Stop adjustment (paragraph 4.10).

6.17 LATCH MECHANISM

The latch mechanism is part of the Receiver Assembly. The latch mechanism should be replaced whenever the door cannot be latched or unlatched without difficulty (i.e., if it is binding, not latching or releasing properly, etc.). The latch mechanism is accessible when the drive is removed and the PCBA is removed from the drive.

- a. Loosen the two bezel mounting screws.
- b. Slide the diskette ejector rearward until it latches.
- c. Move the bezel forward and upward until it clears the door handle, then remove the bezel.
- d. The receiver may now be tilted upward to gain access to the two nuts securing the latch mechanism to the receiver (see figure 6-8). Remove the two nuts, and remove the latch mechanism. Retain the spacer plate.
- e. Place the spacer plate and the replacement latch mechanism on the two mounting studs.
- f. Install and tighten the two mounting nuts.
- g. Apply a heavy coat of grease (Micropolis P/N 732-0001) to the entire latch mechanism.
- h. Lower the receiver to its normal position.
- i. Slide the bezel over the door handle, then move the bezel down and rearward until it can be attached to the chassis with two screws and nuts.

SECTION VII
PARTS LIST

7.1 INTRODUCTION

This section provides part numbers for various replaceable parts of the 1015/1016 Floppy Disk Drives. Parts information for the Single A and Single B PCBAs are given on the respective schematics.

TABLE 7-1. OEM FLOPPY DISK DRIVE PARTS LIST

Description	Figure Ref.	Part No.
Single A Drive Electronics PCBA (see schematic dwg 100072 for versions)	4-1	100071-XX-X
Single B Drive Electronics PCBA (see schematic dwg 100164 for versions)	4-2	100163-XX-X
Drive Mechanism - MOD I (48TPI) - MOD II (100TPI)	3-1	100075-01-9 100075-02-7
Bezel	6-5	100028-01-8
Clamp Assy	6-9	100078-01-3
Door Open Switch	6-13	612-0001-0
Drive Belt	6-3	725-1201-5
Drive Motor/Tachometer	6-3	100012-01-2
Drive Pulley (Large)	6-3	100007-01-2
Head/Carriage Assy - Single Side, 48TPI	6-7	100034-01-6
- Single Side, 100TPI		100037-01-9
Head Load Arm	6-5	100036-01-1
Head Load Pad	6-5	100074-01-2
Head Load Solenoid Assy	6-8	100079-01-1
Latch Mechanism	6-8	709-0001-4

TABLE 7-1. OEM FLOPPY DISK DRIVE PARTS LIST (cont.)

Description	Figure Ref.	Part No.
LED Assy	6-11	100023-01-9
Molex Pin		681-0003-1
Mounting Nut, #6 Plastic	6-1	710-0605-0
Pin, Dowel, Carriage Assy (Lower)	6-7	717-0602-2
Pin, Dowel, Carriage Assy (Upper)	6-7	717-0601-4
Pivot	6-14	100014-01-8
Platen Assy	6-12	100029-01-6
Positioner Assy - 48TPI 100TPI	6-7	100076-01-9 100076-02-7
Receiver Assy - MOD I MOD II	6-14	100015-01-5 100015-02-3
Screw, 5/16 Taptite		703-0605-5
Spindle Assy	6-10	100077-01-5
Spring (Carriage Assy)	6-7	715-2002-7
Spring (Door Open)	6-8	715-1002-8
Spring (Diskette Eject)	6-15	715-2001-9
Standoff (Maintenance)	6-6	100100-02-3
Standoff (Shipping)		709-0002-2
Track Zero Switch Assy	6-15	100081-01-7
Write Protect Switch	6-8	612-0001-0

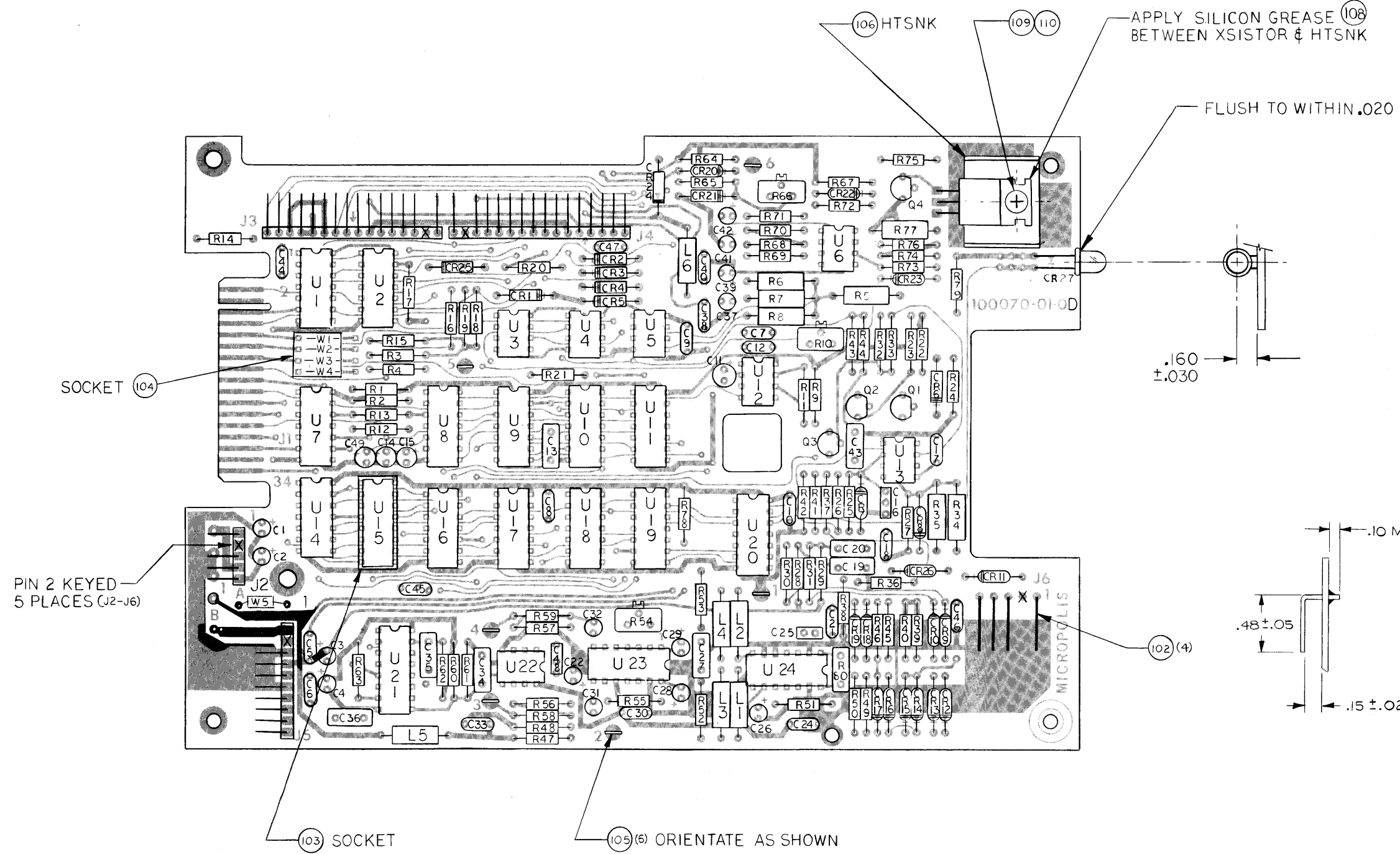
SECTION VIII
ASSEMBLY DRAWINGS AND SCHEMATIC DIAGRAMS

8.1 INTRODUCTION

This section consists of engineering documentation for the Single A and Single B Drive Electronics PCBAs. Documentation provided is (in order):

- a. Single A PCBA Assembly Drawing, 100071.
- b. Single A PCBA Schematic, 100072.
- c. Single B PCBA Assembly Drawing, 100163.
- d. Single B PCBA Schematic, 100164.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	REVISED AND REDRAWN	5-15-77	S.M.C.
	C	REVISED EN 0079	2-27-78	S.M.C.
	D	EN 0161	9-13-78	S.M.C.
	E	EN 0198	2-26-79	S.M.C.



SEE P/L

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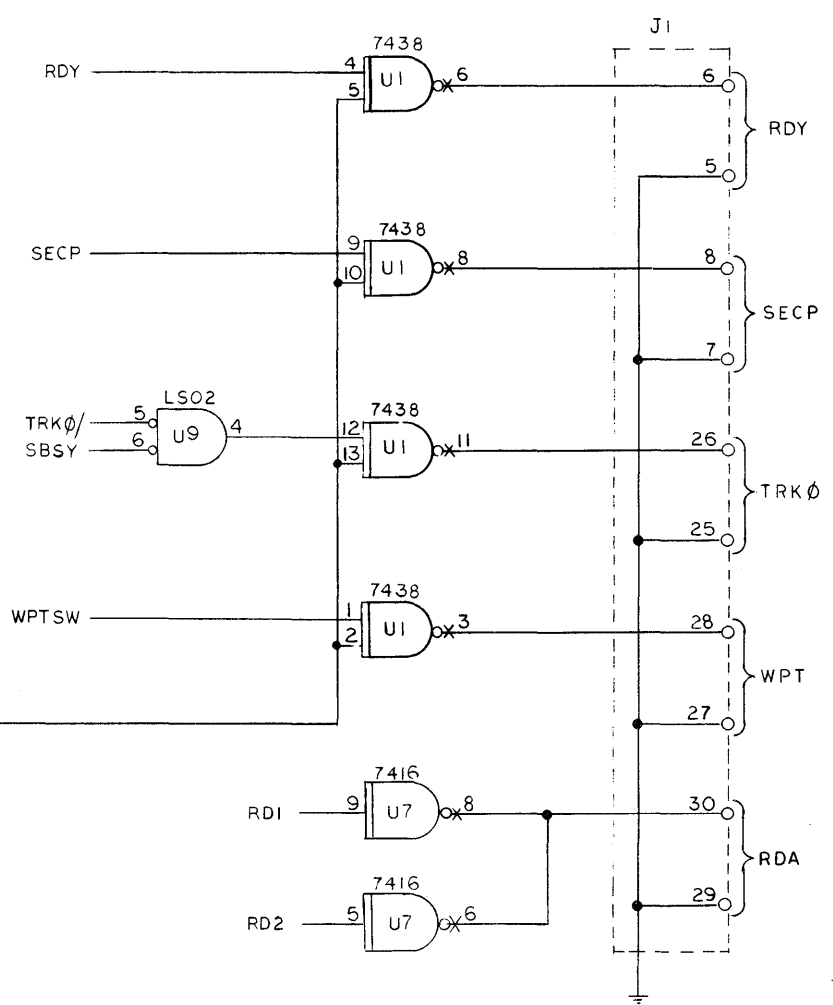
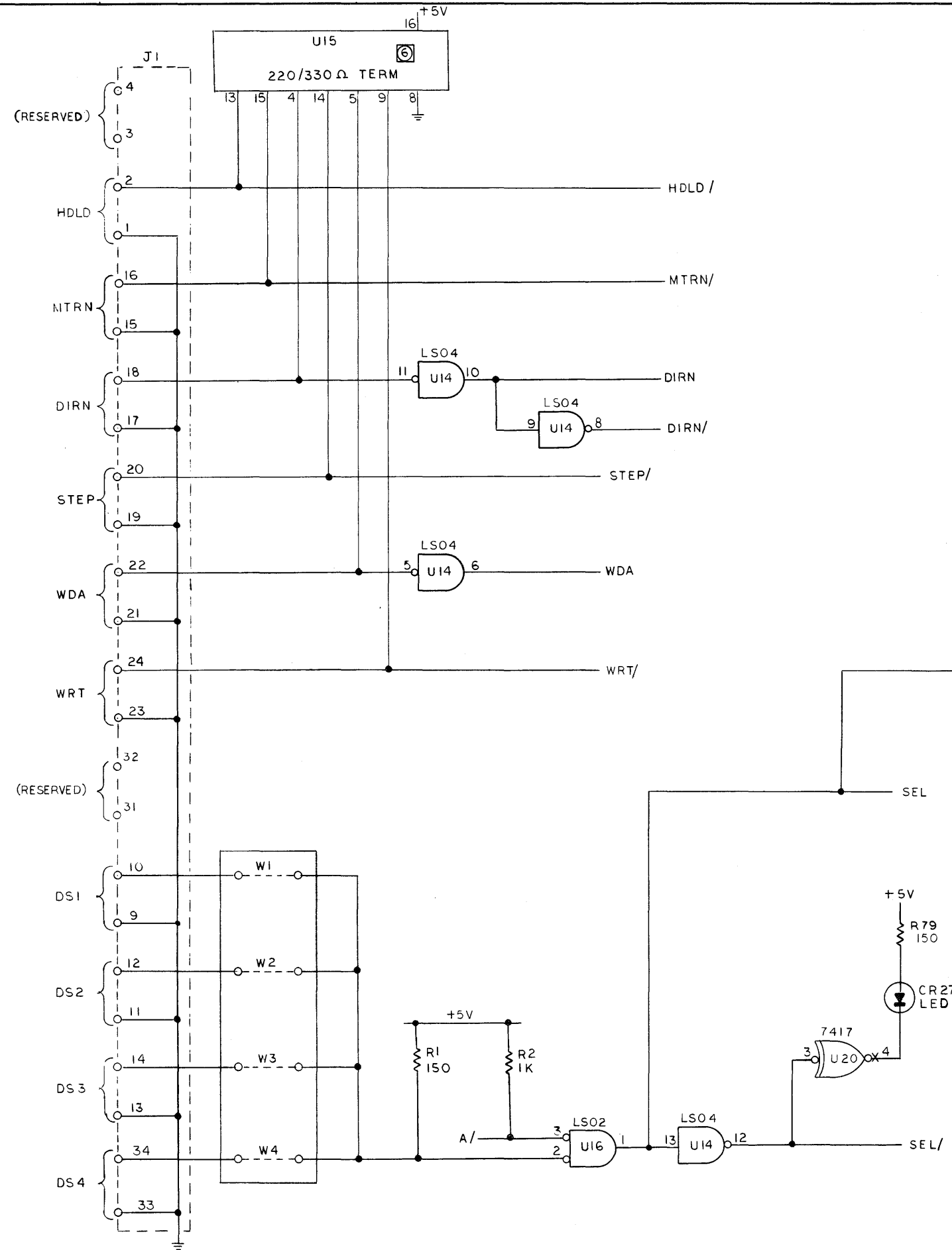
QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE
PARTS LIST				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON:		CONTRACT NO.		
FRAC-	DECIMALS	ANGLES	DR BY J. Fazio	5-15-77
TIONS	.XX	XXX ±	CHK BY	
±	±	±	APPROVED BY	
MATERIAL		E.M. Janssen 7-22-77		
FINISH		S.M.C. 7-22-77		
NEXT ASSY	USED ON	SIZE	CODE IDENT NO.	DWG NO.
APPLICATION	DO NOT SCALE DRAWING	D	100071	100071
		SCALE	2/1	SHEET OF

MICROPOLIS™

PCBA, FD SINGLE A

REV E

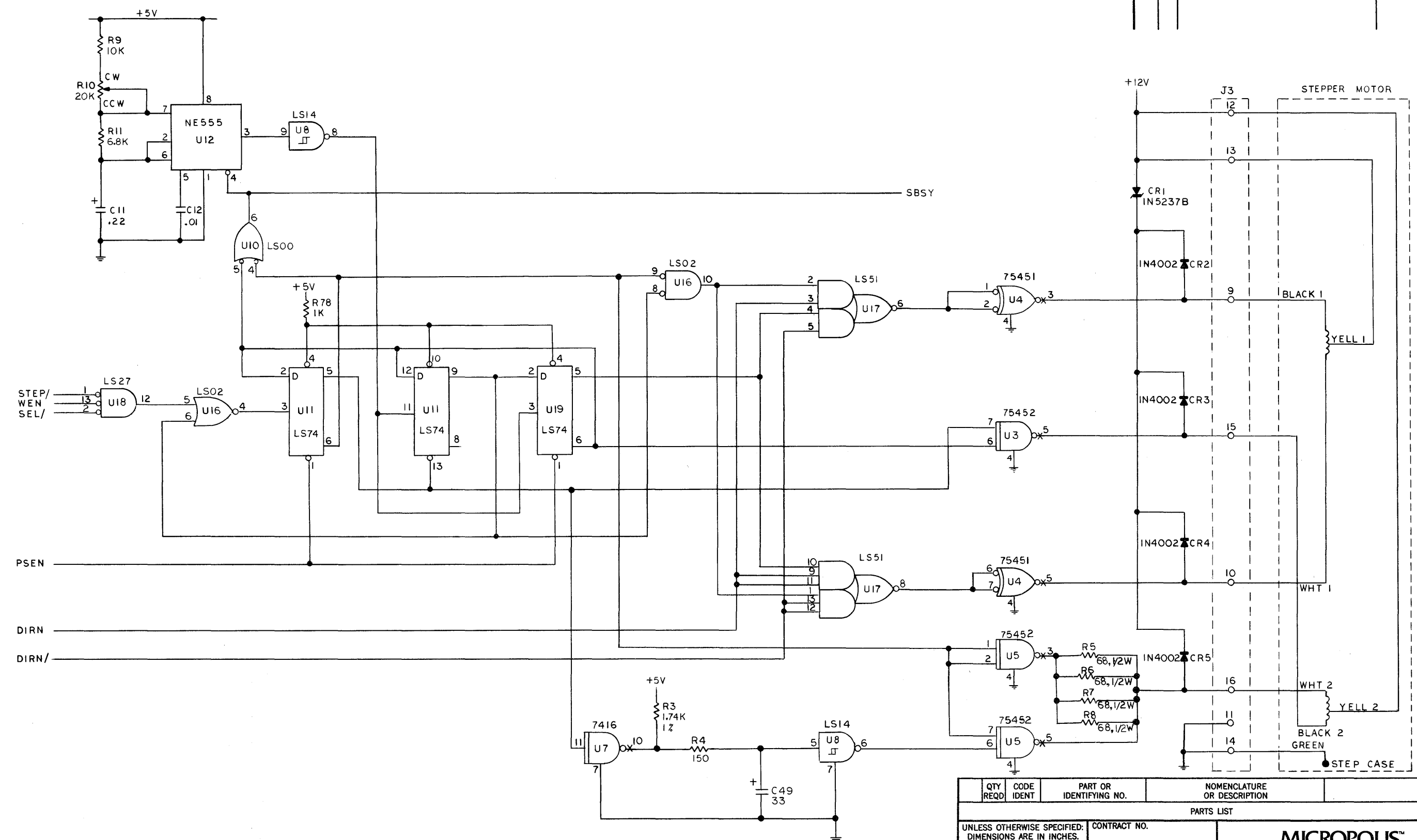
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



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PARTS LIST				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRACTIONS .X .XX .XXX ± DECIMALS .X .XX .XXX ± ANGLES ± ± ± ±		CONTRACT NO.		MICROPOLIS™ F. D. SINGLE A
MATERIAL		DR BY		
FINISH		CHK BY		
NEXT ASSY		APPROVED BY		SIZE
APPLICATION		DO NOT SCALE DRAWING		CODE IDENT NO. DWG NO. D 100072
				SCALE
				SHEET 2 OF 9

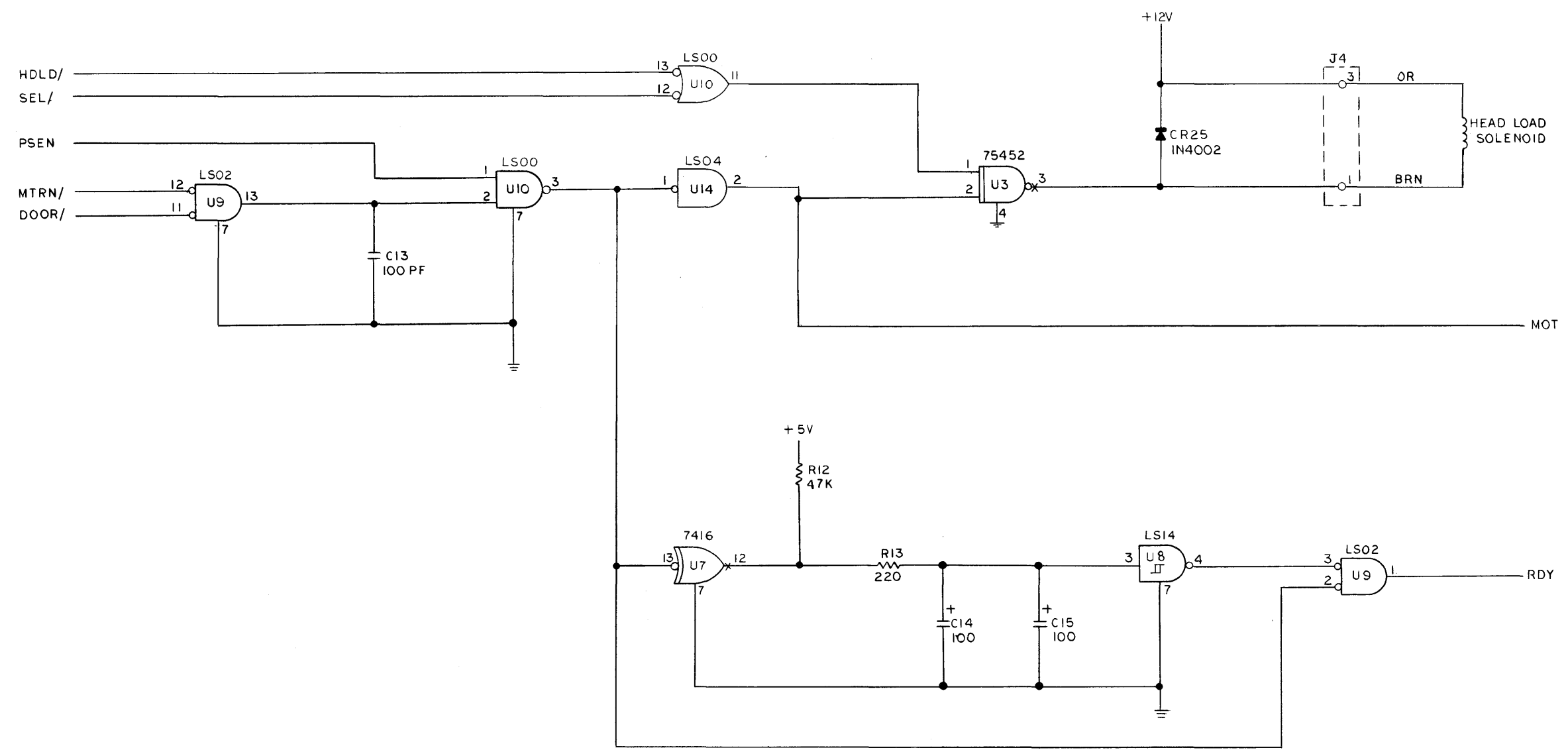
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE
PARTS LIST				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRAC. DECIMALS ANGLES X XX XXX ± ± ± ±			CONTRACT NO.	
MATERIAL			DR BY	
FINISH			CHK BY	
NEXT ASSY			USED ON	
APPLICATION			DO NOT SCALE DRAWING	
APPROVED BY			MICROPOLIS™	
SCALE			F.D. SINGLE A	
SIZE			CODE IDENT NO. DWG NO.	
D			100072	
SHEET 3 OF 9				

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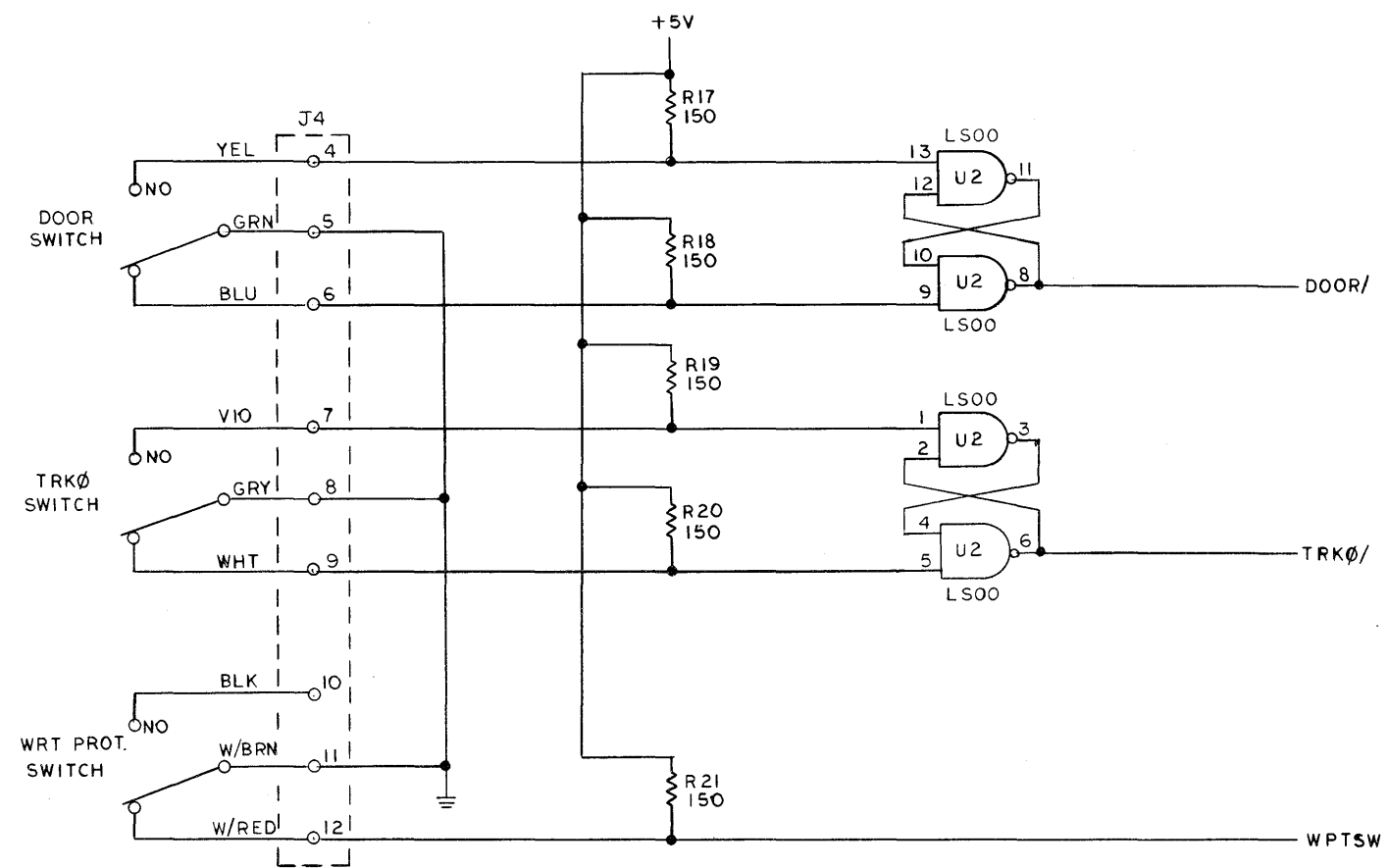
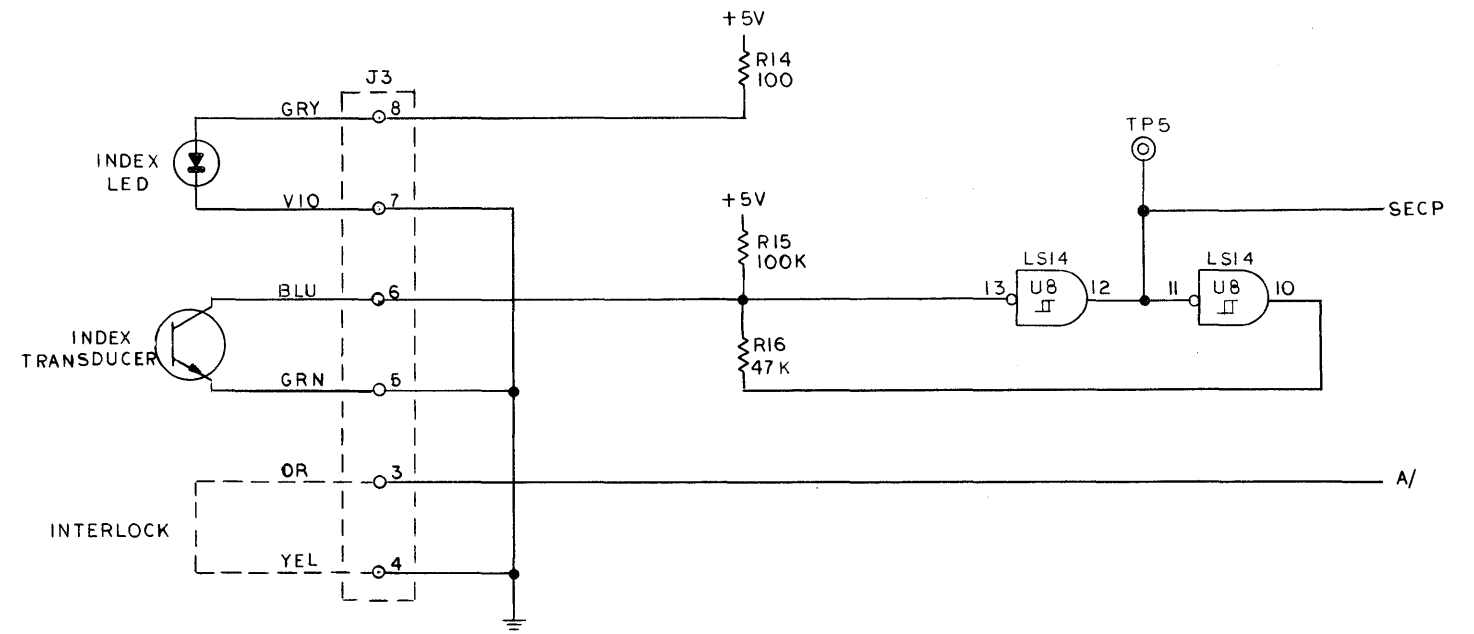
REVISIONS				
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QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE
PARTS LIST				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES.		CONTRACT NO.		MICROPOLIS™
TOLERANCES ON:		DR BY		
FRAC. TIONS	DECIMALS	ANGLES	CHK BY	
±	±	±	±	APPROVED BY
MATERIAL		FINISH		SIZE [CODE IDENT NO.] DWG NO.
NEXT ASSY	USED ON	APPLICATION		D 100072
DO NOT SCALE DRAWING		SCALE		SHEET 4 OF 9

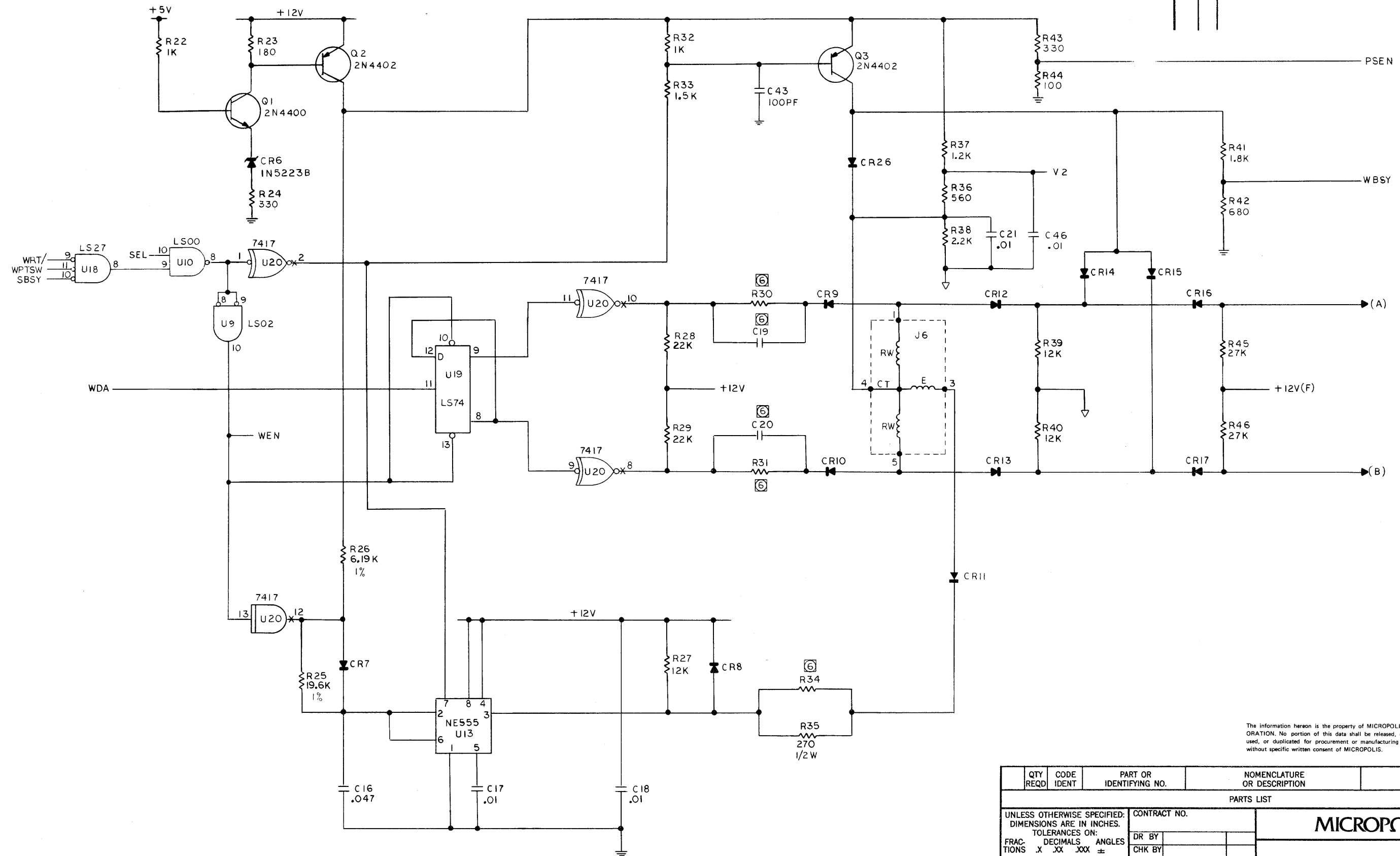
REVISIONS				
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PARTS LIST				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRAC. DECIMALS ANGLES X XX XXX ± ± ± ±		CONTRACT NO.		MICROPOLIS™ F. D. SINGLE A
MATERIAL		DR BY		
FINISH		CHK BY		
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APPLICATION		DO NOT SCALE DRAWING		SCALE SHEET 5 OF 9

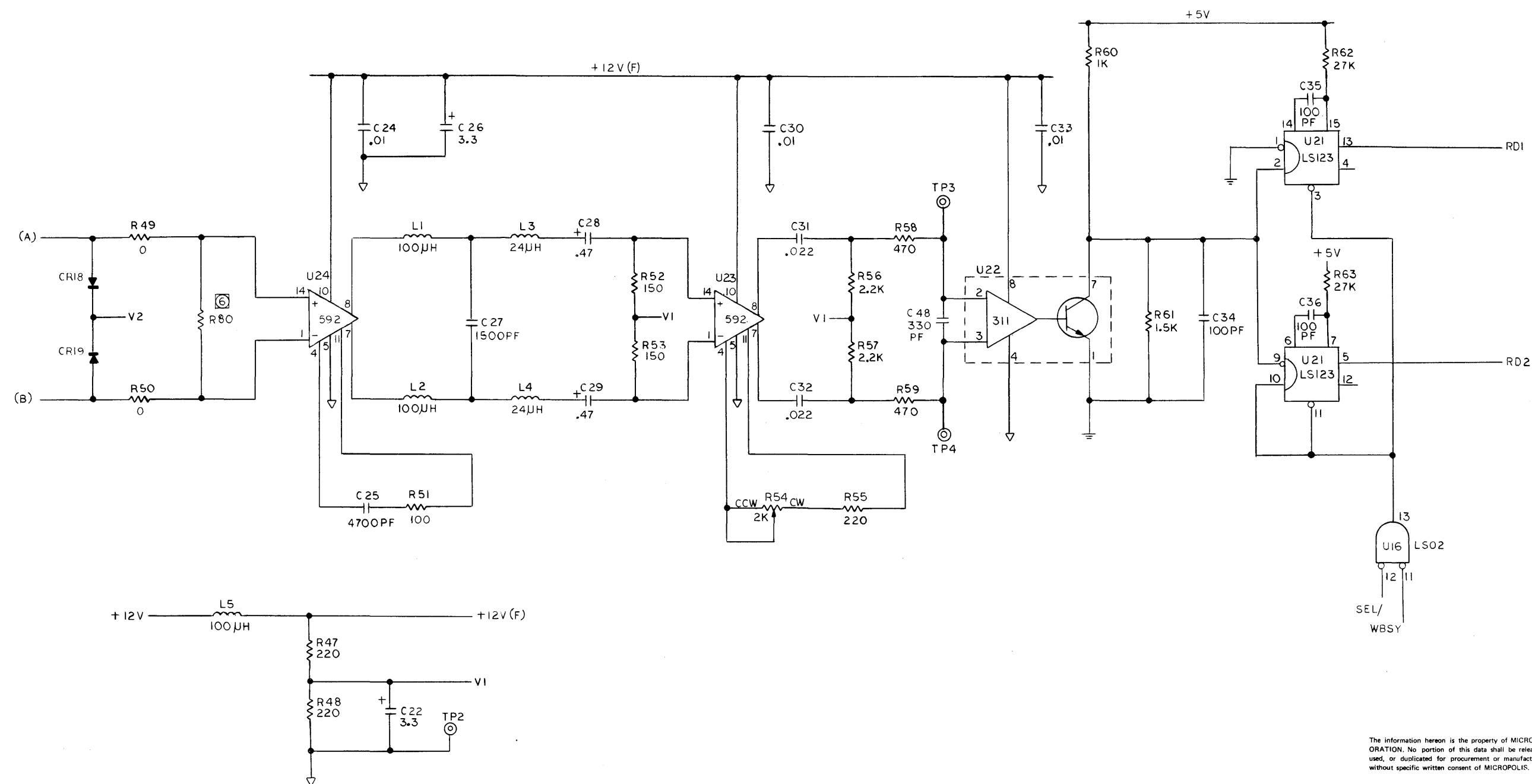
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PARTS LIST				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRAC- TIONS X XX XXX ± DECIMALS ± ANGLES ° ±		CONTRACT NO.		MICROPOLIS™ F. D. SINGLE A
MATERIAL		APPROVED BY		
FINISH		SCALE		
NEXT ASSY		USED ON		SIZE CODE IDENT NO. DWG NO. D 100072
APPLICATION		DO NOT SCALE DRAWING		SHEET 6 OF 9

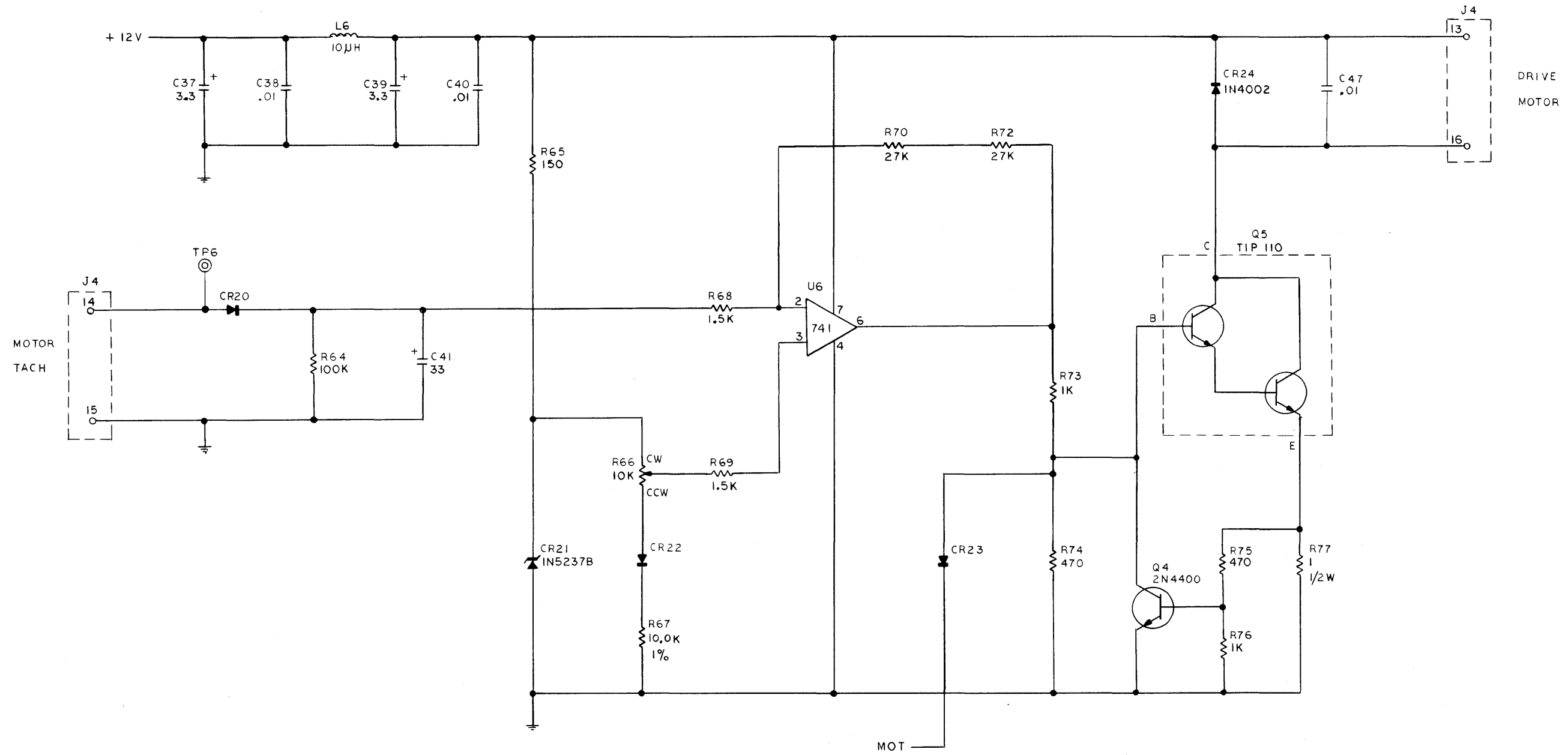
REVISIONS				
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PARTS LIST				
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MATERIAL		DR BY		
FINISH		CHK BY		
NEXT ASSY		USED ON		F.D. SINGLE A
APPLICATION		DO NOT SCALE DRAWING		SIZE CODE IDENT NO. DWG NO. D 100072
				SCALE SHEET 7 OF 9

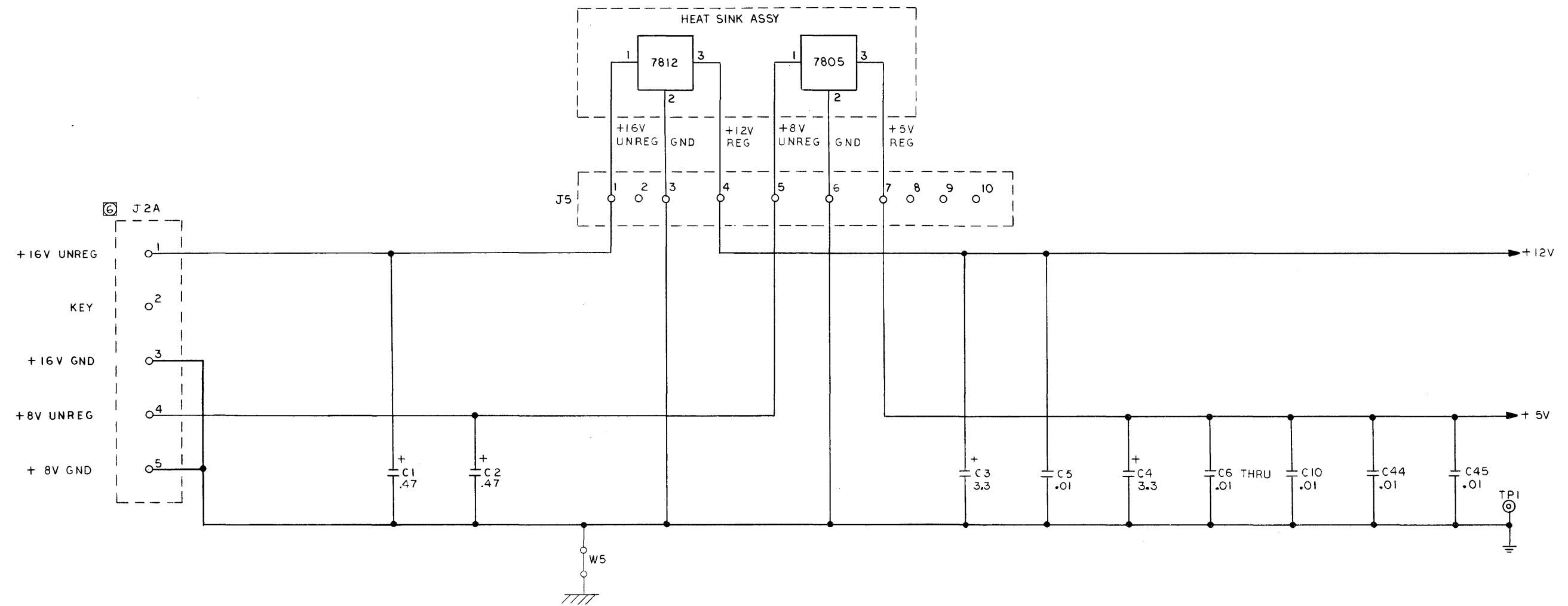
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PARTS LIST				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRAC. DECIMALS ANGLES TIONS .X .XX .XXX ± ± ± ±		CONTRACT NO.		MICROPOLIS™
MATERIAL		DR BY		
FINISH		CHK BY		
NEXT ASSY		USED ON		APPROVED BY
APPLICATION		DO NOT SCALE DRAWING		F.D. SINGLE A
SCALE		SIZE CODE IDENT NO. DWG NO.		100072
				SHEET 8 OF 9

REVISIONS				
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PARTS LIST				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRAC: DECIMALS ANGLES TIONS X XX XXX ± ± ± ± ±		CONTRACT NO.		MICROPOLIS™ F.D. SINGLE A
MATERIAL		DR BY		
FINISH		CHK BY		
NEXT ASSY		USED ON		APPROVED BY
APPLICATION		DO NOT SCALE DRAWING		SCALE
SIZE CODE IDENT NO. DWG NO.			100072	
D			SHEET 9 OF 9	

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
A		PROD RELEASE EN 0118	5/22/78	
B		EN0122 CHANGE U6,U7	6/9/78	SBL
C		EN 0198	2/26/79	JJB
D		EN 0390	10/16/79	D.E.T.
E		EN 0451	12/19/79	D.E.T.
F		EN 0456	12/20/79	D.E.T.

HTSNK (124) (127) (128) APPLY SILICON GREASE (125) BETWEEN XSISTOR & HTSNK

FLUSH TO WITHIN .020

SOCKET (119)

REMOVE PIN 2 BY TWISTING OFF RIGHT ANGLE SIDE

PIN 2 KEYED 4 PLACES

.10 MAX

PIN 1
4 PIN HEADER
100163-58-3
100163-59-1

ASSY VERSIONS
100163-52-6
100163-54-2
100163-56-7
100163-57-5
100163-58-3
100163-59-1

ASSY VERSIONS
100163-51-8
100163-53-4

(20) SOCKET

(122) (10) ORIENTATE AS SHOWN

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QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE
PARTS LIST				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES.		CONTRACT NO.		
TOLERANCES ON:		DR BY		
FRAC.	DECIMALS	ANGLES	CHK BY	
±	±	±	APPROVED BY	
MATERIAL		FAD/MS/2 5/21/78		
FINISH		FAD/MS/2 5/21/78		
NEXT ASSY USED ON		FAD/MS/2 5/21/78		
APPLICATION		DO NOT SCALE DRAWING		
SCALE 2/1		SIZE CODE IDENT NO. DWG NO.		REV
		D 100163		F
		SHEET 1 OF 1		

MICROPOLIS™

PCBA, FD SINGLE B

F/D
APPLICATION

ZONE LTR				DATE APPROVED				DESCRIPTION				REVISIONS					
ZONE	LTR	DATE	APPROVED	ZONE	LTR	DATE	APPROVED	ZONE	LTR	DESCRIPTION	DATE	APPROVED	ZONE	LTR	DESCRIPTION	DATE	APPROVED
J		11-8-79	DET	D		2/24/78	SLA	A		PROD RELEASE EN0118	5/24/78	SLA	B		EN0122 R41,R42 VALUES	6/9/78	SLA
K		12-19-77	DET	E		2/24/78	SLA	C		EN0186	11/29/78	SLA	C1		EN0188	11/29/78	SLA
L		12-20-79	DET	F		5/29/79	SLA	G		EN0343	8-23-9	SLA	H		EN0390	10-6-9	DET

TABLE II

ASSY VERSION	VERSION CHARACTERISTIC	U8	Q5	CR10,CR13,CR19,CR20,CR21	J6	J8	W6 W8	W9	R23	R24	R30 R40	R31 R32	R35	R36	R38	R39	R56	U8	R67	R85	C11	C13 C16
-51-8	100 TPI, GCR DUAL HEAD	NE 555 410-0555-4	2N4402 300-4402-8	IN4446 200-4446-7	HEADER 680-0506-5	HEADER 680-0505-7	IN		6.19K,1%	19.6K,1%	12K	2.80K,1%	390Ω,1/2W	390Ω,1/2W	1.5K	1K	47Ω		17.8K,1%	22K	.047UF	.01UF
-52-6	100 TPI, GCR SINGLE HEAD				HEADER 680-0505-7			IN				2.80K,1%	390Ω,1/2W				47Ω		17.8K,1%	22K		
-53-4	48 TPI, MFM DUAL HEAD	NE555 410-0555-4	2N4402 300-4402-8	IN4446 200-4446-7	HEADER 680-0506-5	HEADER 680-0505-7	IN		6.19K,1%	19.6K,1%	12K	1.82K,1%	120Ω,1/2W	120Ω,1/2W	1.5K	1K	100Ω		35.7K,1%	4.7K	.047UF	.01UF
-54-2	48 TPI, MFM SINGLE HEAD				HEADER 680-0505-7			IN				1.82K,1%	120Ω,1/2W				100Ω		35.7K,1%	4.7K		
-55-9	100TPI, MFM DUAL HEAD	NE 555 410-0555-4	2N4402 300-4402-8	IN4446 200-4446-7	HEADER 680-0506-5	HEADER 680-0505-7	IN		6.19K,1%	19.6K,1%	12K	2.80K,1%	390Ω,1/2W	390Ω,1/2W	1.5K	1K	100Ω		35.7K,1%	22K	.047UF	.01UF
-56-7	100TPI, MFM SINGLE HEAD				HEADER 680-0505-7			IN				2.80K,1%	390Ω,1/2W				100Ω		35.7K,1%	22K		
-58-3	96 TPI, MFM SINGLE HEAD				HEADER 680-0505-7			IN				2.80K,1%	390Ω,1/2W				100Ω	HEADER 680-0401-9	35.7K,1%	22K		
-59-1	96 TPI, MFM DUAL HEAD	NE 555 410-0555-4	2N4402 300-4402-8	IN4446 200-4446-7	HEADER 680-0506-5	HEADER 680-0505-7	IN		6.19K,1%	19.6K,1%	12K	2.80K,1%	390Ω,1/2W	390Ω,1/2W	1.5K	1K	100Ω	HEADER 680-0401-9	35.7K,1%	22K	.047UF	.01UF

PART NO.	REF. DESIGNATION
100-0000-8	R42,52,53 W5,7,10,86
100-1000-7	R15,51
100-1500-6	R1,6, 57,58
100-1800-0	R19
100-2200-2	R13,14,54,55,60
100-3300-9	R20,50,66,68
100-4700-3	R65,80,81,63,64
100-5600-0	R41
100-6800-5	R47
100-1001-5	R18,25,34,79,82,84
100-2700-1	R71
100-1501-4	R26,33
100-1801-8	R46
100-2201-0	R43,61,62
100-6801-3	R4
100-1002-3	R2
100-1202-9	R29,37,44,45,69,74,75
100-2202-8	R27,28,
100-2702-7	R48,49
100-4702-5	R11,12,17,78
100-1003-1	R16
100-1503-0	R70
101-0010-5	R83
101-0680-5	R7,8,9,10
105-1741-5	R5
105-6191-8	R21
105-1002-2	R73
105-1962-7	R22
130-2002-9	R3
130-2001-1	R59
131-5001-6	R72

TABLE I

PART NO.	REF. DESIGNATION
116-0002-0	RN1
115-0001-4	U17
160-3300-3	C35
160-1000-1	C4,14,39
160-1500-0	C37
160-4700-3	C9
160-7500-4	C38,36
161-1501-6	C28
161-4701-9	C25
161-2202-0	C32,33
162-4702-5	C10
162-1004-9	C57
163-2203-4	C1
163-4703-1	C29,30,47,48
163-3304-9	C24,26,40,42,44,49,51
163-3305-6	C3
163-1006-2	C5,6,7,8
165-1002-6	C2,12,15,19,20,21,22,27,31,34,41,43,46,50,52,53,54,55,56
190-0240-9	L3,L4
190-1000-8	L1,2,5
191-0100-5	L6
200-4446-7	CR9,11,12,14,15,16,17,18,22,23,24,25,26,27,28,29,30,33
210-5223-8	CR8
210-5235-2	CR31
210-5237-8	CR2
220-4002-6	CR3,4,5,6,7,34
300-4400-2	Q1,6
300-4402-8	Q2,3,4

TABLE I (CONT.)

PART NO.	REF. DESIGNATION
340-0110-7	Q7
400-0000-2	U12,18
400-0002-8	U11
400-0014-3	U10,16
400-0027-5	U20
400-0051-5	U19
400-0074-7	U13,21,23
400-0086-1	U24
400-0123-2	U25
401-0016-6	U2,9
401-0017-4	U22
401-0038-0	U1
406-0451-4	U4,14
406-0452-2	U3,5
410-0311-2	U26
410-0555-4	U6,15
410-0592-7	U27,28
410-0741-0	U7
622-0001-9	CR1
680-0401-9	J2B
680-0503-2	J2A
680-1001-6	J5
680-1601-3	J3
680-1701-1	J4
680-0804-4	W1,2,3,4
680-1603-9	U17
684-0001-9	W1,2,3,4
684-0003-5	TP1 THRU 10
650-0001-0	

TABLE I (CONT.)

LAST USED	NOT USED	DELETED
U28		
CR34		CR32
Q7		
R86		R76
RN1		
C57	C17,18,19,20,23	
L6		
J8		J7
W10		
TP10		

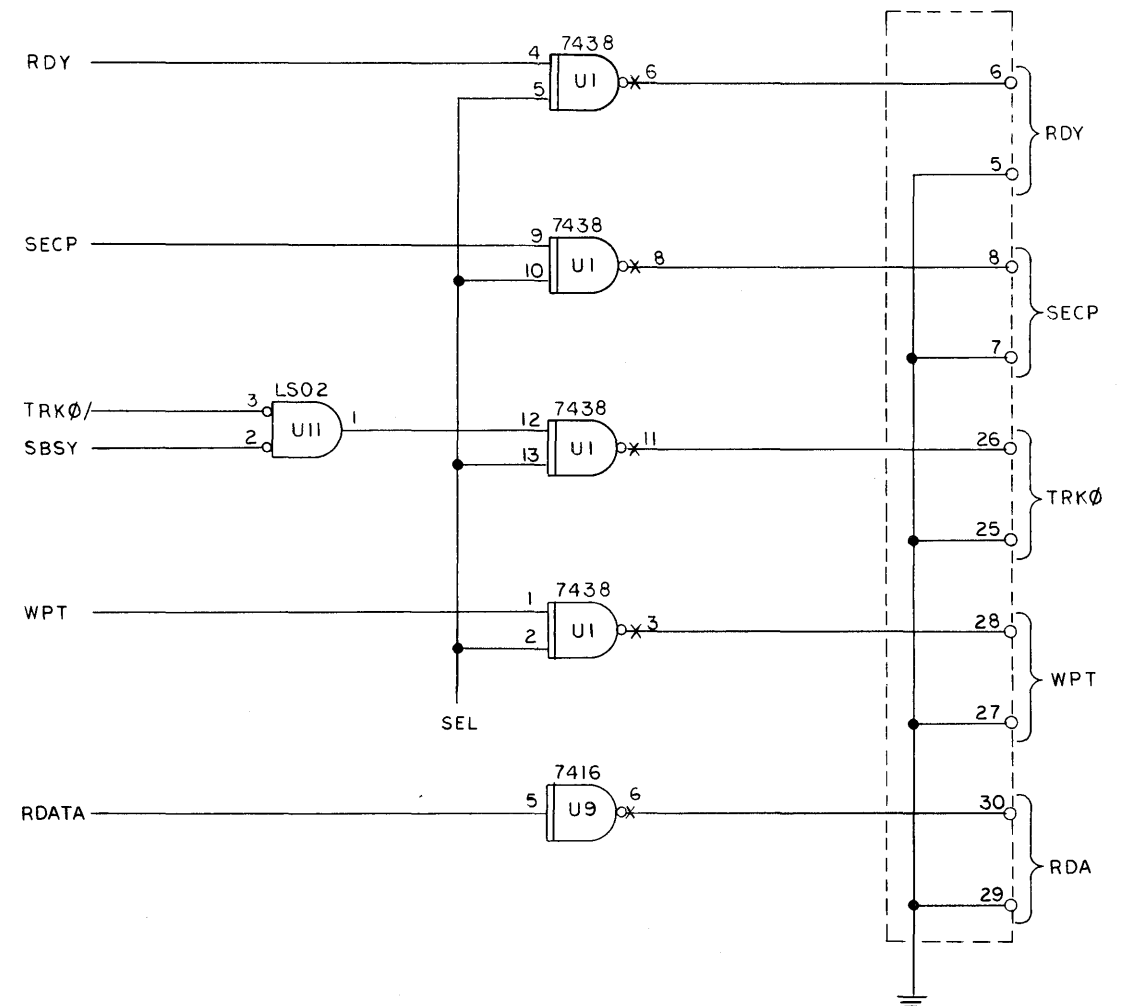
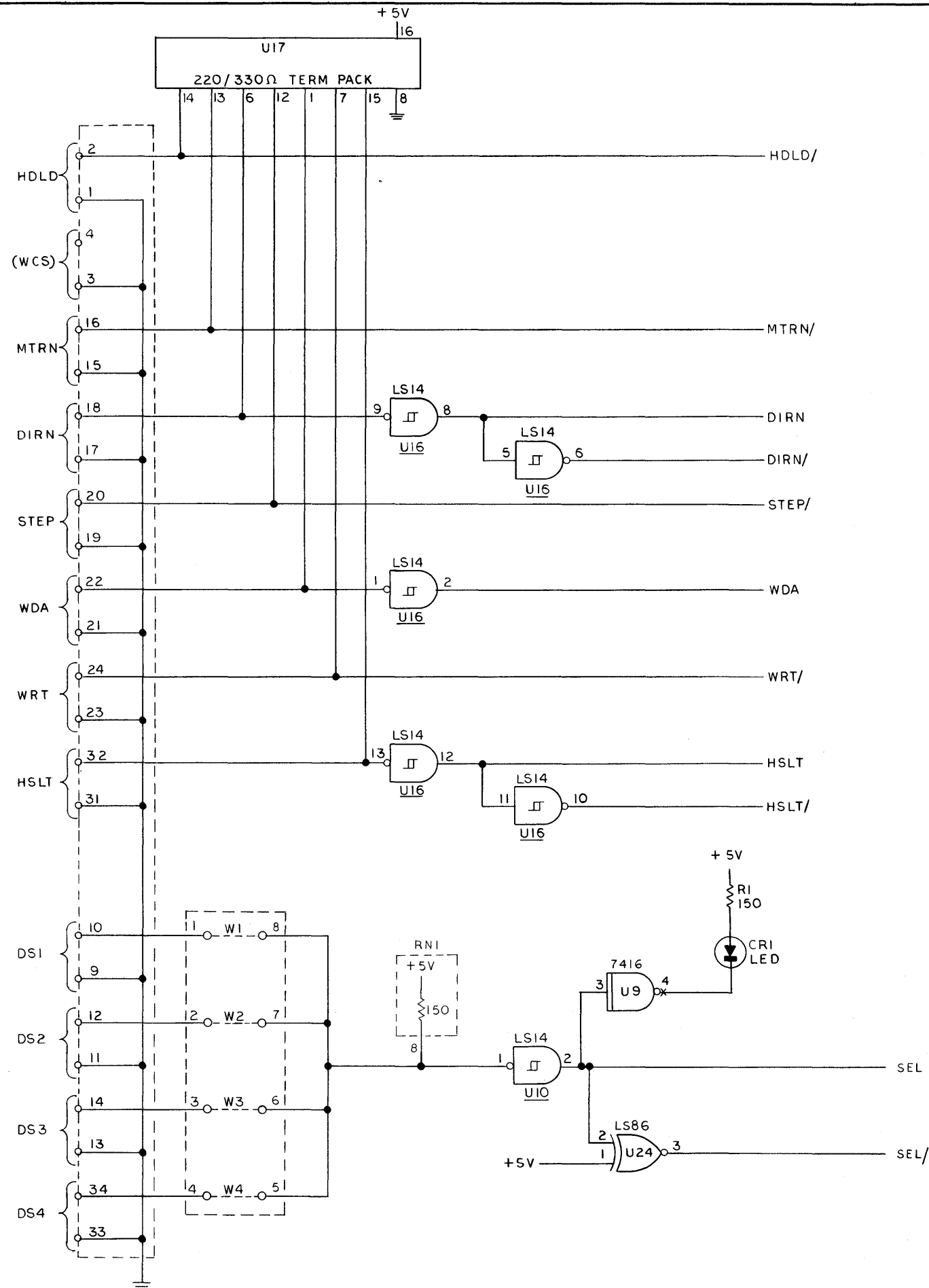
TABLE III

- FOR LAST USED, NOT USED, AND DELETED REF DESIGNATION SEE TABLE III.
- FOR COMPONENTS AFFECTED BY VERSION SEE TABLE II.
- FOR PART NO. OF COMPONENTS NOT AFFECTED BY VERSION SEE TABLE I.
- 4. FOR PCBA SEE DRAWING NO. 100163.
- 3. ALL DIODES ARE IN4446
- 2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
- 1. ALL RESISTOR VALUES ARE IN OHMS.

NOTE: UNLESS OTHERWISE SPECIFIED:

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QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ZONE
PARTS LIST				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES ON: FRAC. DECIMALS ANGLES TIONS X XX XXX ± ± ± ±		CONTRACT NO.		MICROPOLIS™ SCHEMATIC F. D. SINGLE B
MATERIAL		APPROVED BY <i>[Signature]</i> 5/24/78 <i>[Signature]</i> 5/24/78		
FINISH		SIZE CODE IDENT NO. DWG NO. REV. D 100164 L		
NEXT ASSY USED ON		SCALE		SHEET 1 OF 9
APPLICATION		DO NOT SCALE DRAWING		

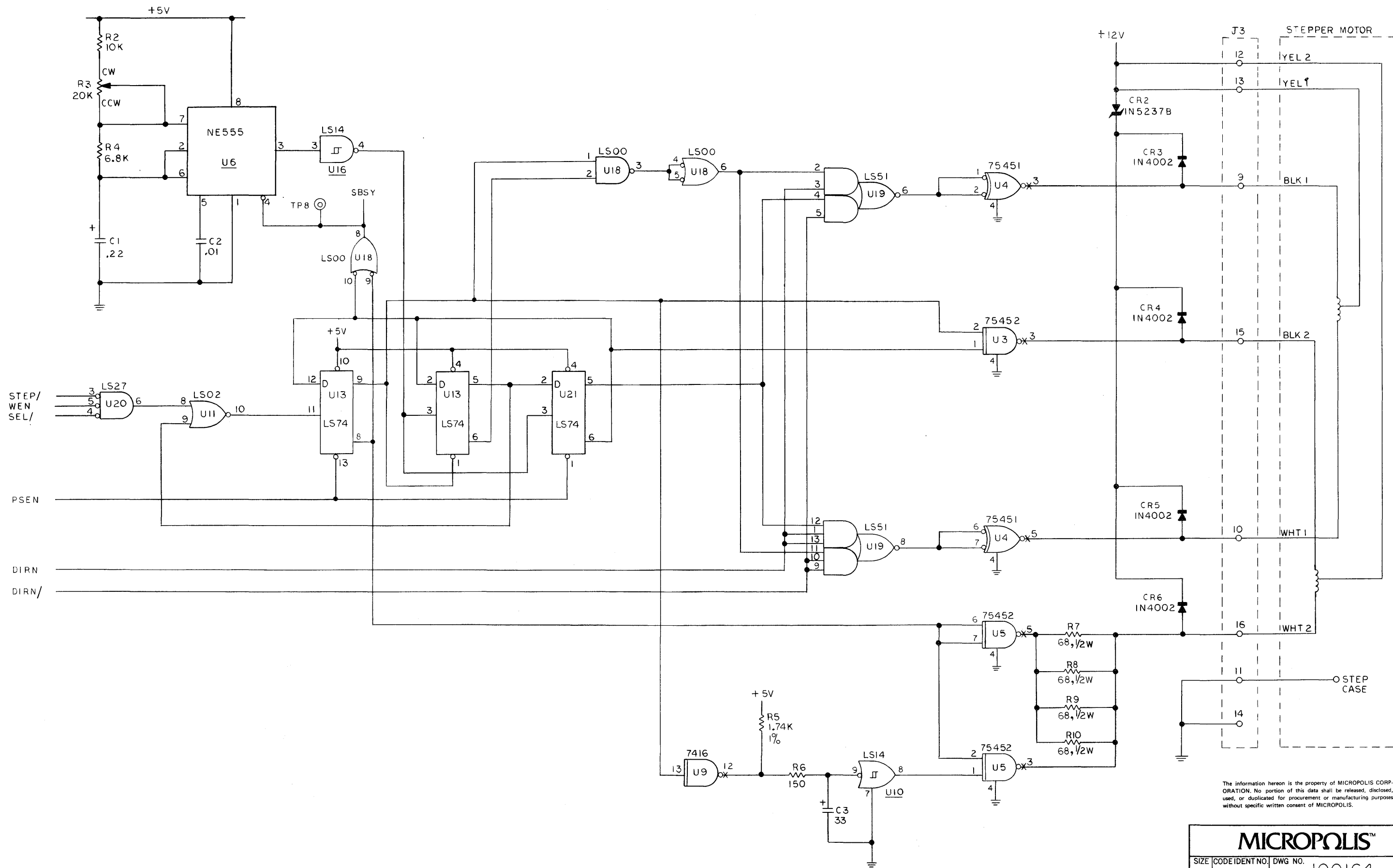


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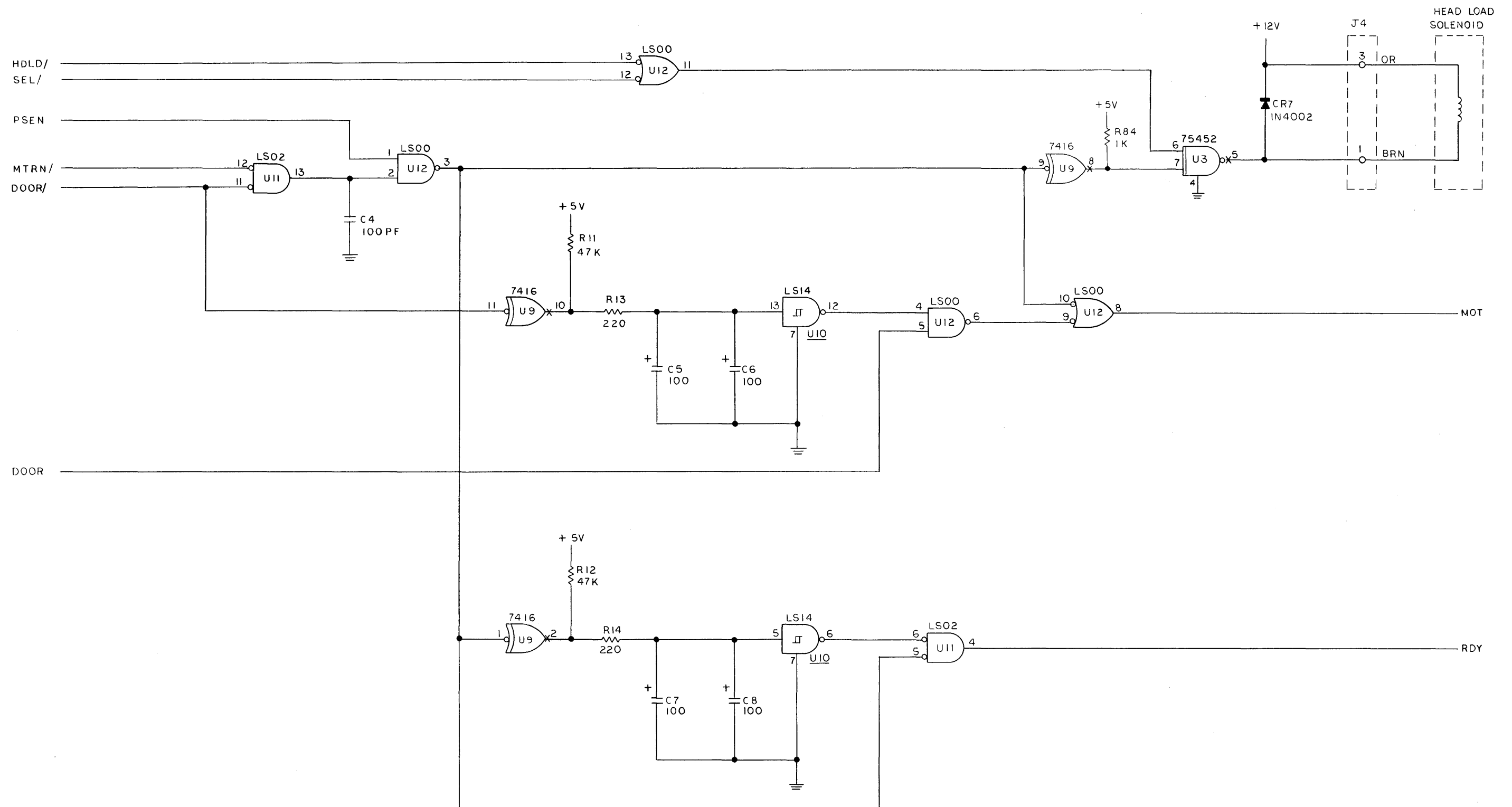
SIZE CODE IDENT NO. DWG NO.
D 100164

SCALE SHEET 2 OF 9



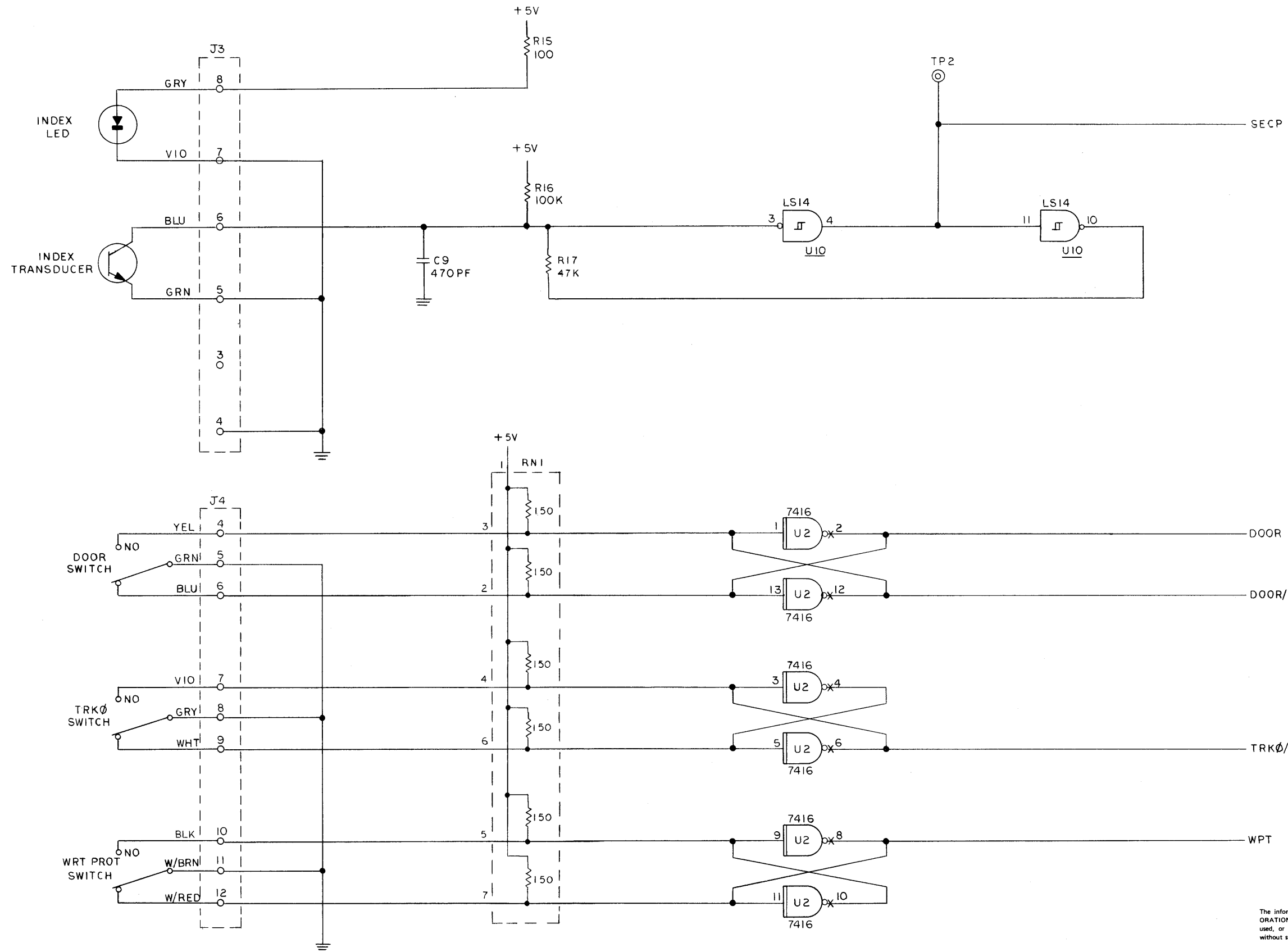
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MICROPOLIS™	
SIZE	CODE IDENT NO. DWG NO.
D	100164
SCALE	SHEET 3 OF 9



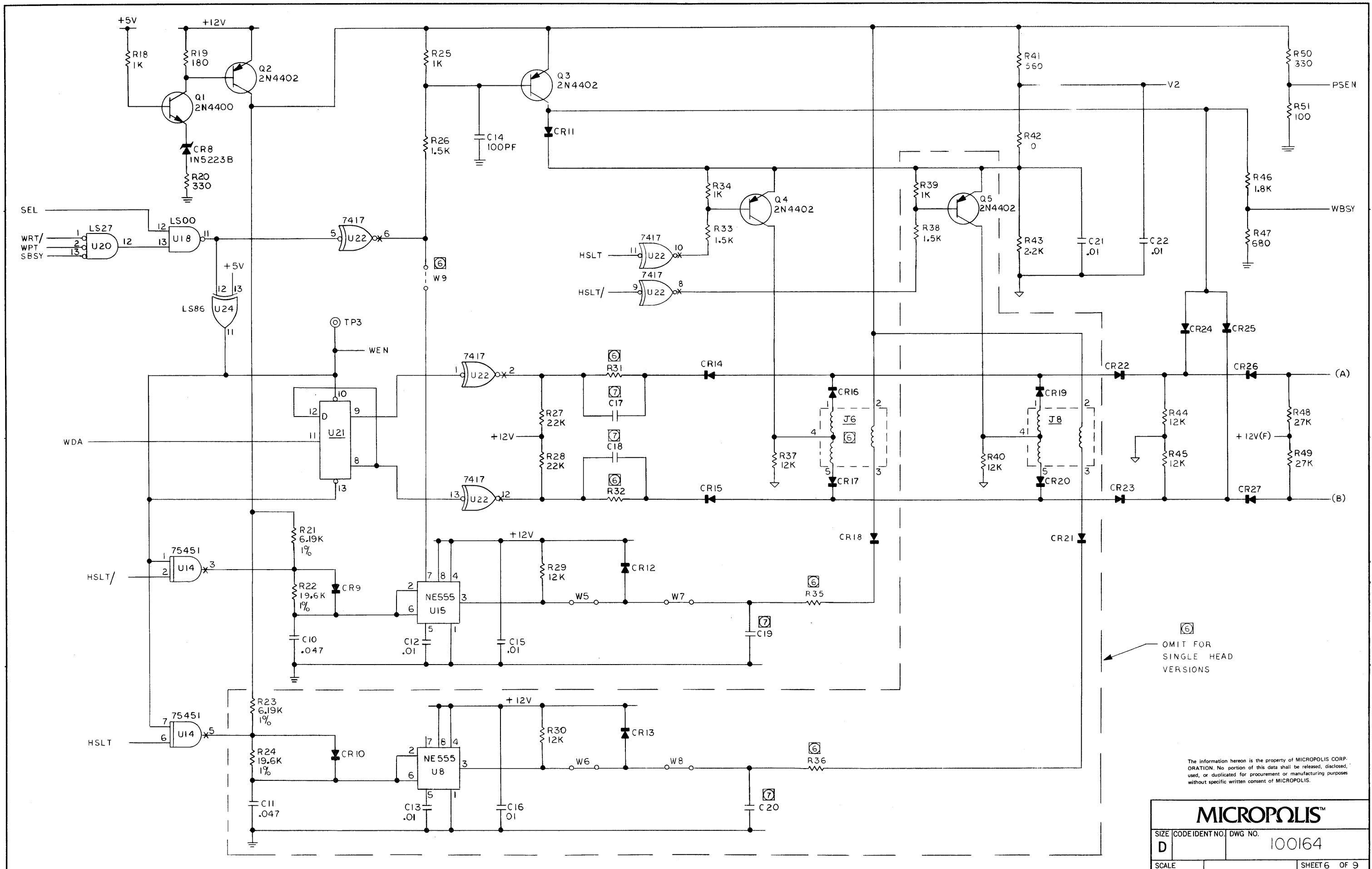
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MICROPOLIS™		
SIZE	CODE/IDENT NO.	DWG NO.
D		100164
SCALE		SHEET 4 OF 9



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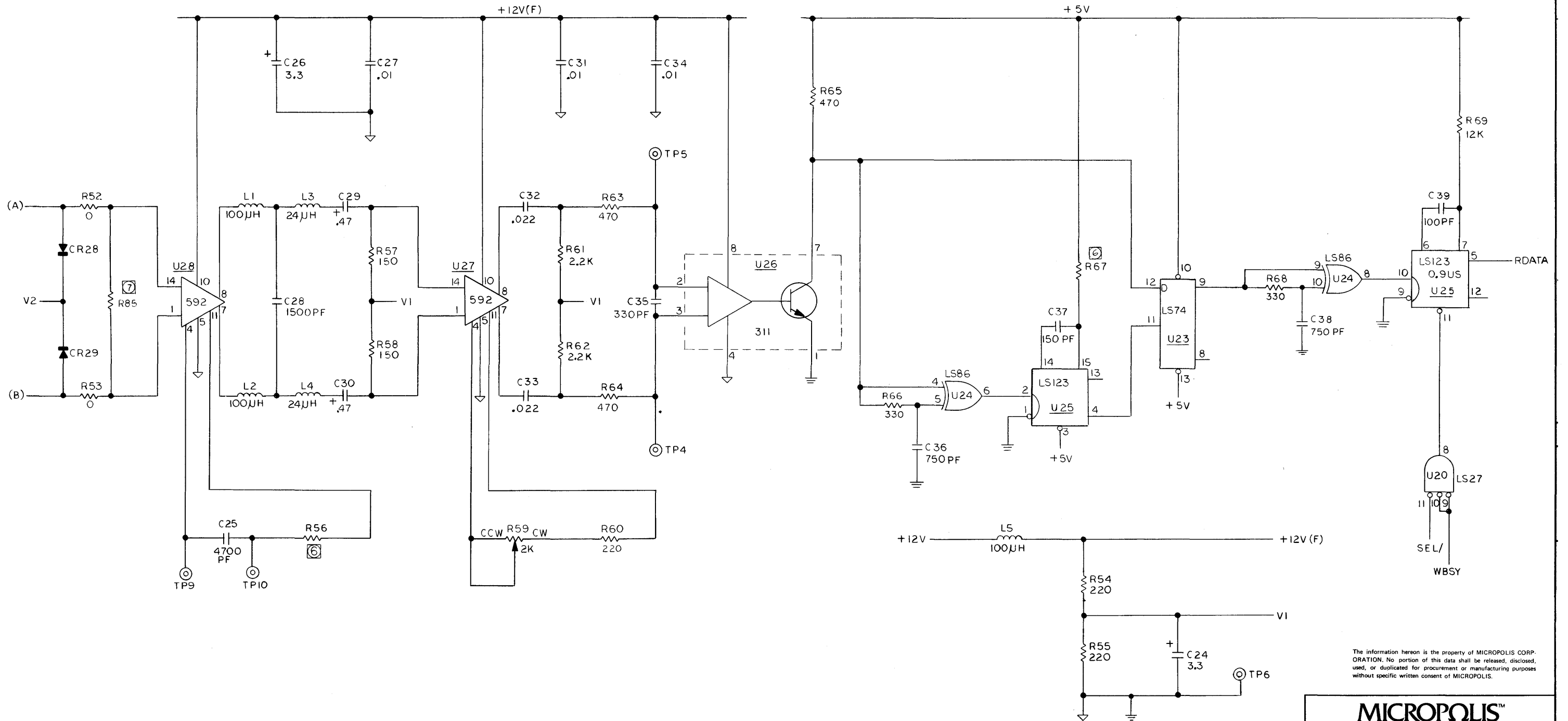
MICROPOLIS™		
SIZE	CODE IDENT NO.	DWG NO.
D		100164
SCALE		SHEET 5 OF 9



Ⓢ OMIT FOR SINGLE HEAD VERSIONS

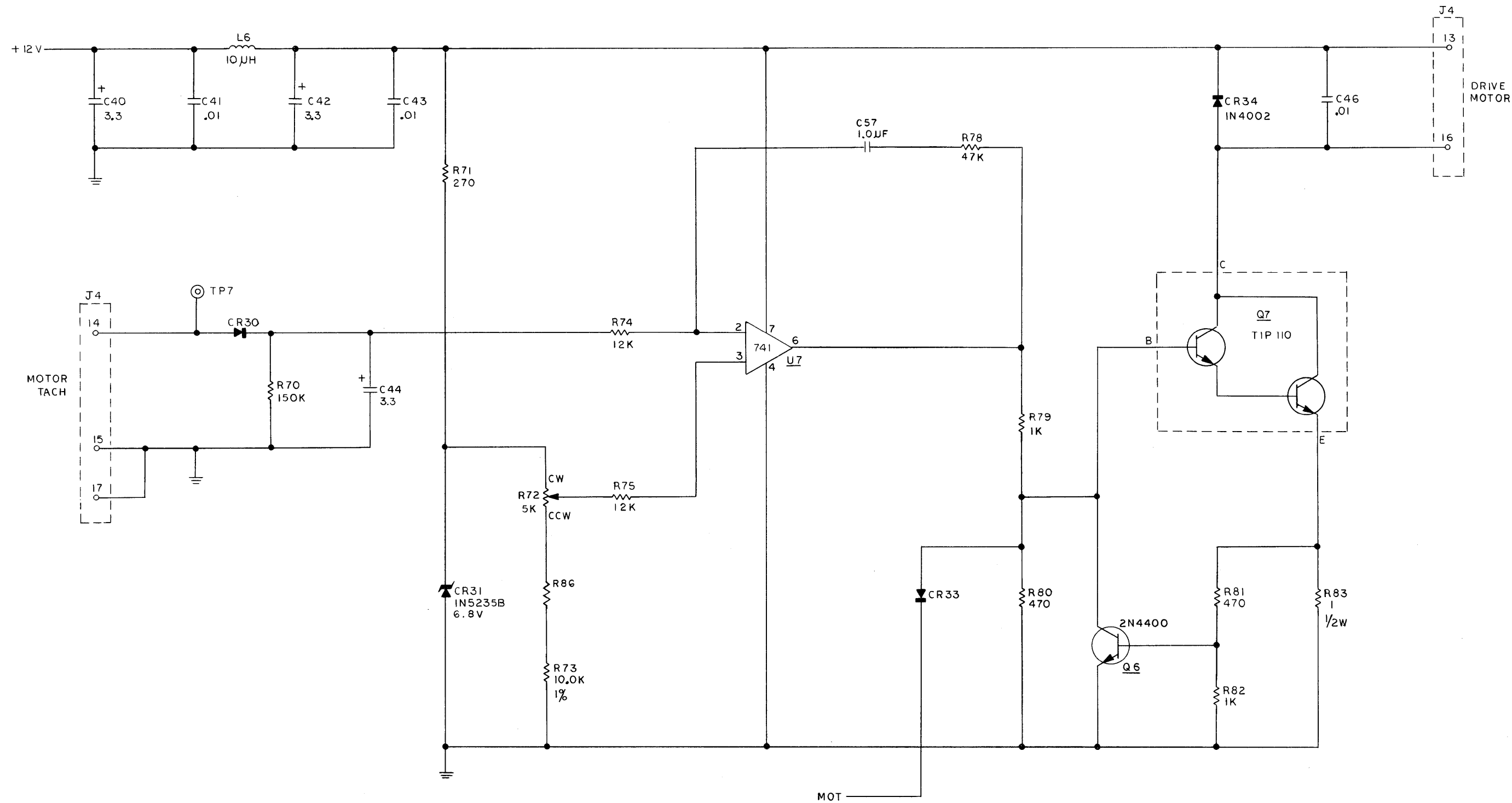
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MICROPOLIS™	
SIZE	CODE IDENT NO. DWG NO.
D	100164
SCALE	SHEET 6 OF 9



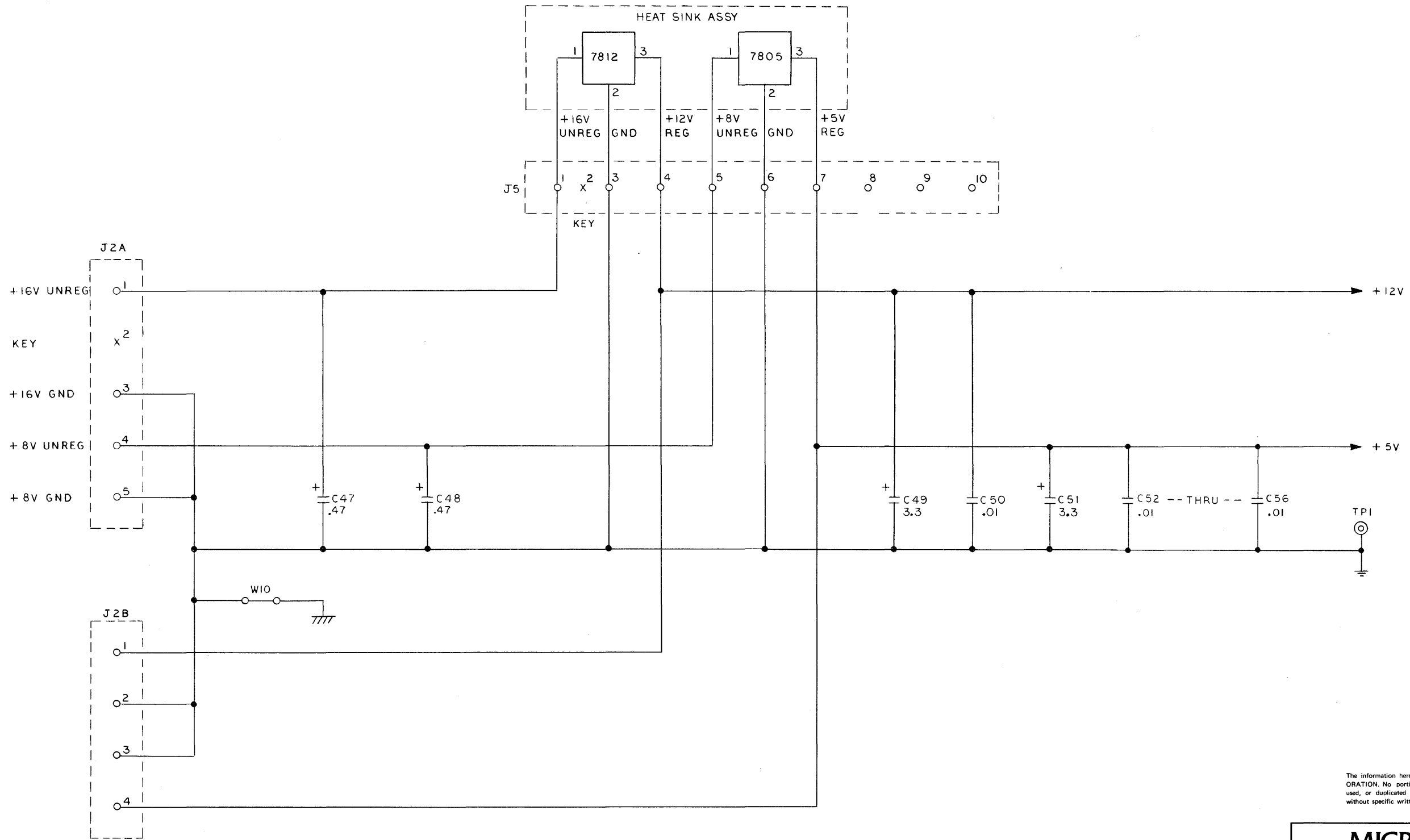
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MICROPOLIS™	
SIZE	CODE IDENT NO. DWG NO.
D	100164
SCALE	SHEET 7 OF 9



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SIZE	CODE/IDENT NO.	DWG NO.
D		100164
SCALE		SHEET 8 OF 9



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MICROPOLIS™		
SIZE	CODE IDENT NO.	DWG NO.
D		100164
SCALE	SHEET 9 OF 9	