Basic Four® Model 2500 Fixed Disc Drive Service Manual

BFISD 8006

Basic Four Information Systems®

AD: The drives seems to be from Century Data, at least one drive i have is a T80 (Trident) Documentation for these drives is available on Bitsavers.

BFISD 8006

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INTRODUCTION

1.1 GENERAL DESCRIPTION

The Model 2500 Disc Storage Unit (hereafter referred to as the Disc Drive) is a modular memory storage device. The Disc Drive is an integral part of the 610/730 data processing system. The disc controller, located in the data processing system, consisting of five PCB's, provides a means to control; power sequencing, head positioning, data handling, error corrections and diagnostics aids for the Disc Drive.

The Disc Drive with its removable disc pack is a modular memory device capable of storing 80 million bytes of readily accessible data. The removable pack becomes a semipermanent extension of the CPU memory in a data processing system. Programs and files are stored on the disc. Access time is sufficiently short that storage and retrieval of data appears to be instantaneous to the operator.

1.2 PURPOSE

This manual is the primary source of information for field maintenance. It contains the necessary information to repair and maintain the Disc Drive. It contains both physical and functional descriptions, installation/operation, maintenance procedures and equipment supplied. This information shall enable an experienced Service Engineer to identify, isolate, and repair the Disc Drive to a defective subassembly or printed circuit board.

1.3 PHYSICAL DESCRIPTION

The Disc Drive is packed as a single unit. The three main parts of the Disc Drive are: (1) Cabinet, (2) Disc Drive Assembly, and (3) Removable Disc Packs. The Disc Drive Cabinet has a control panel, pack area lid, front cover and rear cover. Figure 1-1 illustrates the locations of the main parts and their subassemblies (the removable Disc Pack is not shown).

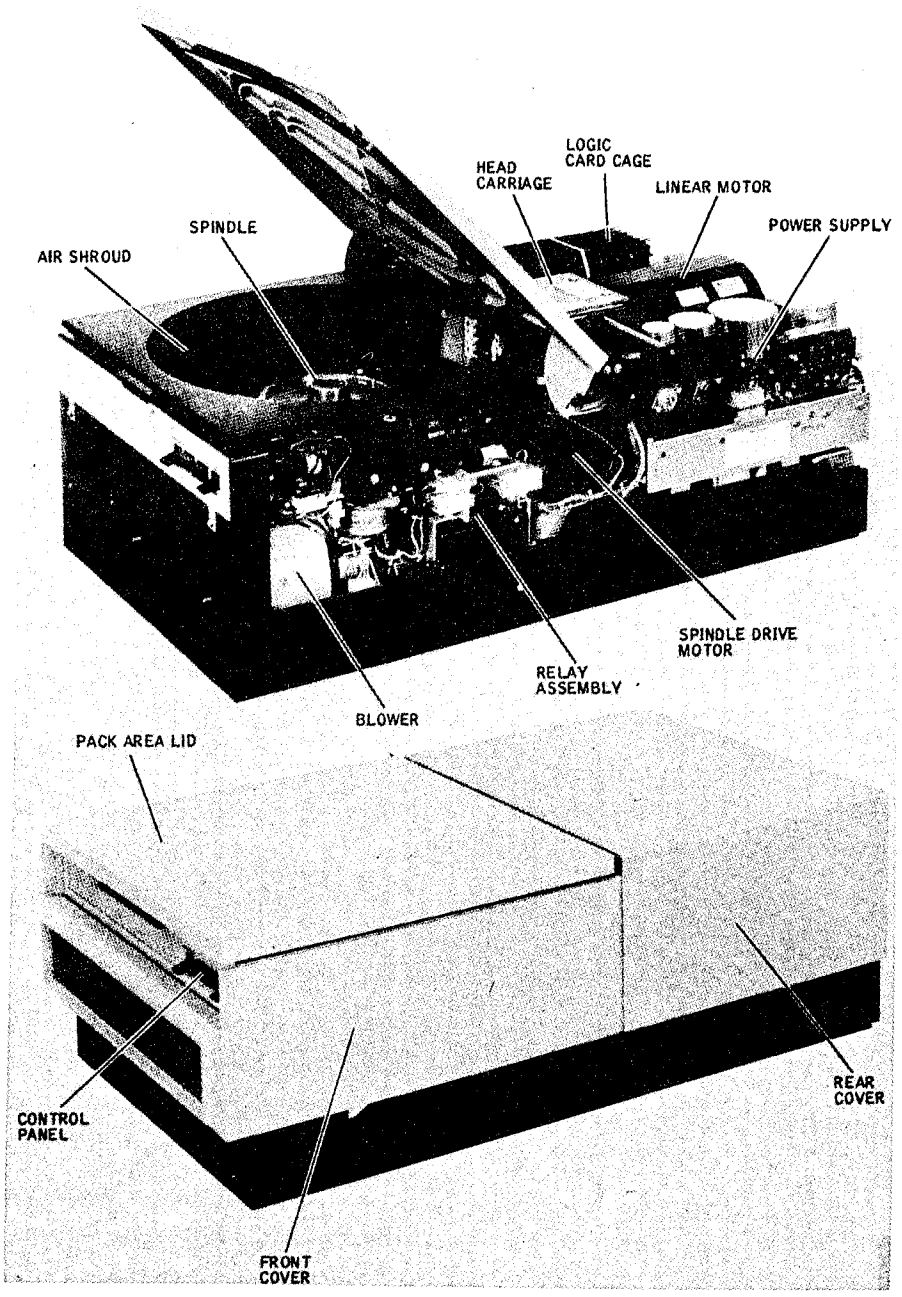


Figure 1-1. Locations of Major Components

The removable disc packs (BFC part number 902490) can be shipped with the Disc Drive or separately. The subassemblies located within the Disc Drive Assembly are the air shroud, spindle, spindle drive motor, head carriage, logic card cage, linear motor, power supply, relay assembly, and blower.

1. Air Shroud - The air shroud surrounds the disc pack. The air shroud contains and directs the filtered air which is forced through the Disc Drive.

2. Spindle/Spindle Drive Motor - The spindle drives the discs when the disc pack is in place. The spindle is driven by a spindle drive motor.

3. Head Carriage - The head carriage is the mounting for one servo read and five read/write heads. The carriage is moved to position the read/write heads over to a selected cylinder of the disc pack by reading the servo read head.

4. Logic Card Cage - The logic card cage holds six plug-in boards which contain the disc drive control logic, read/write logic, and servo circuits. The interface cables to the rest of the system also plug into the card cage.

5. Power Supply - The power supply provides all DC power for the Disc Drive. The power supply also contains the emergency head retracting circuits.

6. Relay Assembly - The relay assembly holds the relay and solid state switches that perform power-up and power-down sequencing.

1.4 SPECIFICATIONS

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications, as temporarily permitted by regulation. It has not been tested for compliance with the limits form Class A Computing Devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference, in which case the User at his own expense will be required to take whatever measures may be required to correct the interference.

Table 1-1 gives the operational specifications for the Disc Drive.

TABLE 1-1. SPECIFICATIONS

Parameters	Characteristics
PHYSICAL	
Height (with Cabinet)	29.8 inches (75.7 cm)
Height (without Cabinet)	10.5 inches (25.4 cm)
Width	17.8 inches (45.1 cm)
Depth	32.0 inches (81.3 cm)
Weight	285 pounds (129.3 kg)
POWER	
Voltage	115/230 VAC
Current	8.5/4.25 A 26/13 A to start
Power	977.5 VA
Frequency	60/50 Hz
Heat Output	2100 to 2550 Btu/hr
ENVIRONMENTAL	
Temperature	65°F to 75°F (18°C to 24°C)
Humidity	40% to 60% non-condensing
GENERAL	
Tracks per cylinder	5 (plus servo track)
Cylinders per pack	813 (numbered 000 thru 814)
Bytes per track	20,160
Bytes per cylinder	100,800
Bytes per pack (unformatted)	82.15 million M2580
Recording Density	6060 Bits per inch (nominal)

TABLE 1-1. SPECIFICATIONS (continued)

Parameters	Characteristics
GENERAL	
Access Time	
Track to Track	6 milliseconds
Maximum	55 milliseconds
Average	30 milliseconds
Pack rotational speed	3600 RPM $\pm$ 3%
Recording Method	Bit serial Triple Frequency (TFM)
Maximum latency time	17.6 milliseconds
Average latency time	8.3 milliseconds
Data transfer rate	1,209,000 Bytes/second
Start or stop time	20 seconds

CHAPTER 2

INSTALLATION

2.1 UNPACKING/PACKING PROCEDURE

All replaceable spares are shipped in specially designed containers which provide protection against moisture, dust, and contact damage. The following procedures apply upon receipt of the replacement unit.

1. Examine the shipping container for dents or cracks. If any are found, they shall be reported to the Branch Office immediately so that corrective action can be taken.

2. Open the container and remove the units, then examine for damage or missing parts per the shipping list.

2.2. PREINSTALLATION

Check that the ac line includes a third-wire earth ground that meets or exceeds the requirements of the National Electrical Code. This can be checked by the following procedures:

1. Locate the circuit breaker that supplies power to the Disc Drive. With a digital voltmeter set to measure 20 volts ac, and the circuit breaker turned on, measure the drop between the green and white wires at the power source (wall outlet). The measured voltage must be less than 1.8 volts ac.

2. Switch the source circuit breaker off. Measure the resistance between the green and white wires at the power source (wall outlet). The resistance must be less than the value shown below for the applicable circuit breaker rating.

CB Rating	Resistance
15 Amps	0.30 Ohms
20 Amps	0.25 Ohms
30 Amps	0.15 Ohms

If either measurement in step 1 or 2 above is not less than the value given, request the customer to provide a power source that meets these requirements.

2.3 VOLTAGE CONNECTIONS

The power supply for the Disc Drive is not contained in a single assembly. Single-phase AC power is brought to AC input control filter and then switched to the DC power supply. AC power connections must be verified and DC voltage checks make as a part of the installation procedures.

2.3.1 AC POWER CONNECTION

The unit power cable should be connected to the primary ac power source only after the preceding isolation checks and the following steps have been performed. This is a system of single phase units being connected to a three-phase power source. Proceed as follows:

1. Set START/STOP switch on the control panel to STOP and the PWR ON/OFF switch at the rear of the unit to OFF.

2. Verify that voltage, phase, and frequency of input power match the available power.

3. Check terminal board TB2 (Figure 2-1) on the power supply assembly for a jumper wire between the terminal marked OB/NTL and the terminal corresponding to the voltage available.

4. Disconnect the power supply circuit board shorting jumper from the OPEN spade terminal. Reconnect it to the spade terminal marked AC/DC GRD SHORT (located at E2). Remove after test is completed for system use.

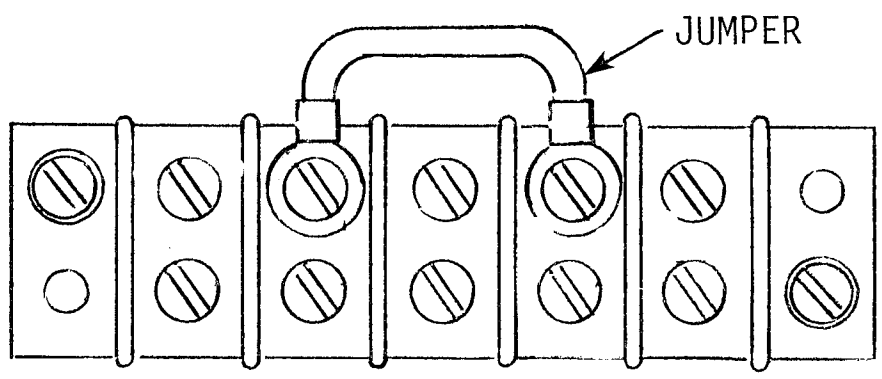


Figure 2-1. Voltage Select Terminal Board TB2

CAUTION

Never operate the disc drive as a standalone unit without ac and dc grounds being shorted together at the power supply. A potential as high as 60 volts can develop between the logic ground and the frame, resulting in damage to the Disc Drive.

When operated in a system environment the ac and dc grounds must not be shorted together.

5. Connect unit power cable to ac power source.

2.3.2 DC VOLTAGE

The following dc voltage checks are mandatory and must be performed on all units before offline operational checkout.

1. Set PWR ON/OFF switch to ON. The blower motor should start and the green File Ready indicator on control panel may start flashing but should go out within 20 seconds.

2. Locate connector J10 on the Power Supply circuit board (see Figure 2-2) and check for in-tolerance dc voltages between the pins listed below.

a. +8.0 to +10.5 volts between pin 4(+) and pin 9.

b. +30 to +35 volts between pin 1(+) and pin 2.

c. -30 to -35 volts between pin 3 and pin 2(+).

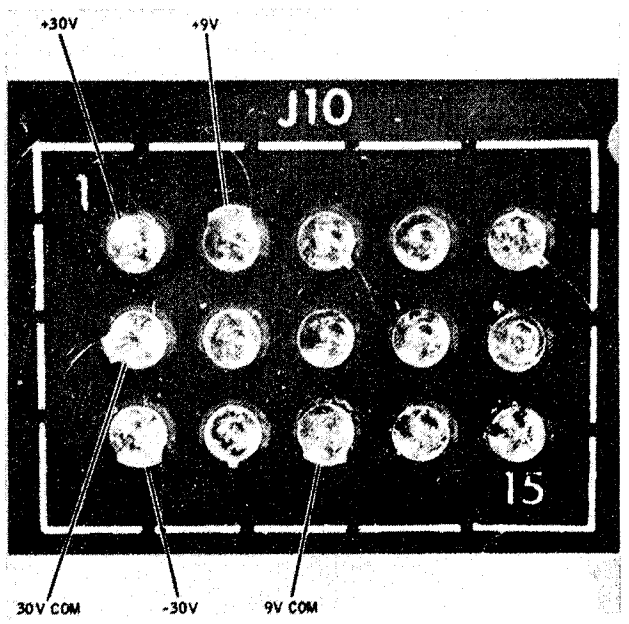
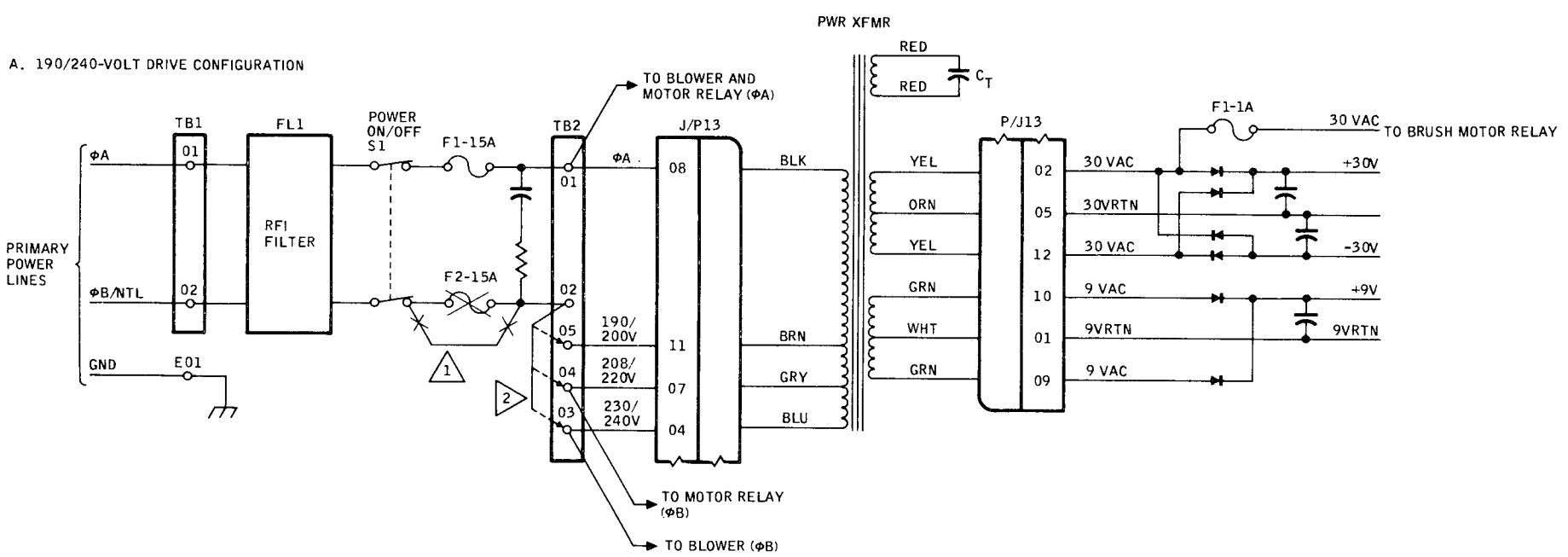


Figure 2-2. Dc Voltage Check Points

3. Use the DVM to measure the voltage between logic ground (card cage terminal E11) and power pins on any circuit board connector (connector A or B, pin 59 or 60). Dc voltage should be +4.75 to +5.25 volts with an ac ripple component less than 75 millivolts peak to peak.

2.3.3 DC POWER SUPPLY DIFFERENCES

Disc drives may be shipped with one of two power ranges to match the single-phase AC power available. Figure 2-3 is a simplified illustration of the two power ranges.



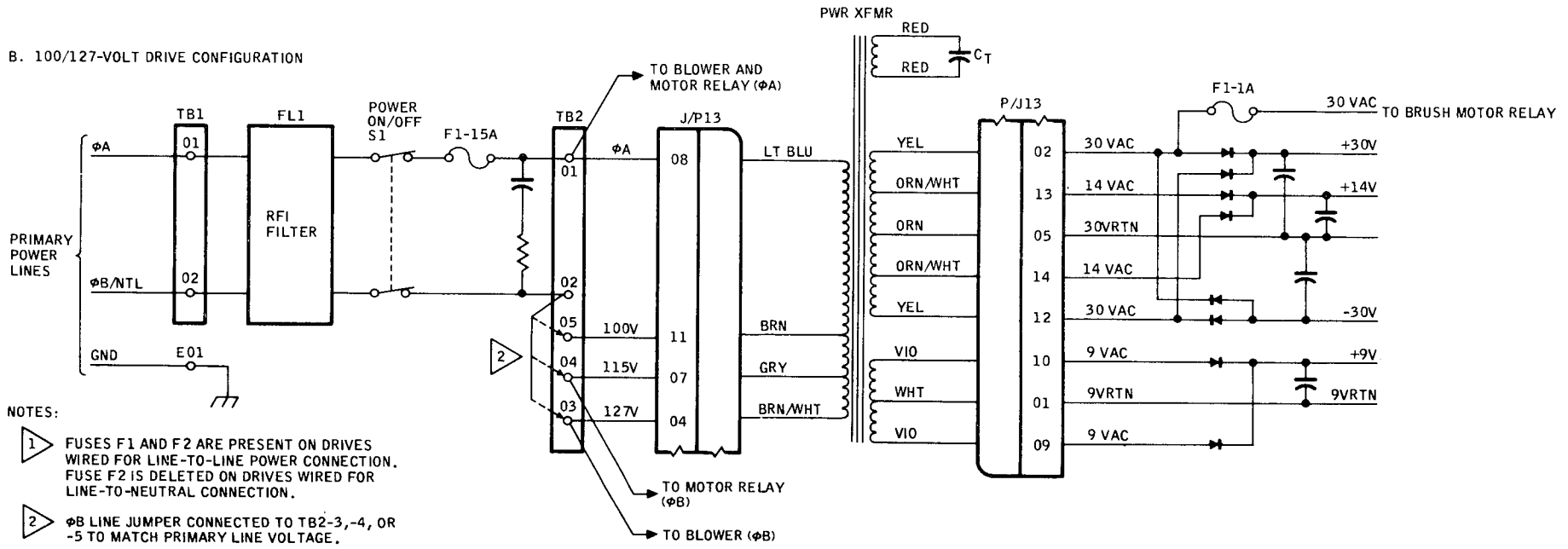


Figure 2-3. AC Power Distribution, Simplified

2.4 SYSTEM INITIALIZATION

Verify the controller cables are connected to the formatter chassis.

Radial Cable at J04
BUS IN at J03
BUS OUT at J02

Ensure the shorting jumper referred to in paragraph 2.3.1, step 4, has been moved to the OPEN position for system operation.

2.4.1 LOADING AND UNLOADING DISC PACK

To install a disc pack on a disc drive, perform the following procedures.

1. Verify that the control panel START/STOP switch is set to STOP and the green File Ready indicator is out.

2. Unlatch the pack area lid of the disc drive and open the lid.

3. Verify heads are retracted and air shroud area is clean.

4. Remove lower cover from disc pack and lower the top cover with disc pack carefully onto the disc drive spindle.

5. Press down the top cover handle to engage the spindle locking mechanism. Rotate the handle clockwise to lock the disc pack to the spindle and to disengage the top cover.

6. Lift and carefully remove the top cover from the disc drive and close pack area lid. Verify lid latch locks.

7. If the installed disc pack is a permanent record or a head alignment pack, set READ/WRITE switch on control panel to READ ONLY to protect the pack from being written on. If writing is allowed set this switch to READ/WRITE.

8. Store the top and bottom covers of the disc pack together inside cabinet or on top of the disc drive to minimize dust accumulation inside the case.

To remove a disc pack from the disc drive, perform the following procedures.

1. Power down the disc drive by setting START/STOP switch to STOP. The green File Ready indicator should start flashing.

2. Wait until File Ready indicator starts flashing (approximately 20 seconds) and then unlatch and open pack area lid.

3. Separate the top and bottom covers of the disc pack. Carefully lower by the handle on the top cover.

2.5 CONTROLS AND INDICATORS

The control panel contains the following toggle switches and indicators: READ ONLY/READ/WRITE Switch, DEVICE CHECK indicator, FILE READY indicator, START/STOP Switch (Figure 2-4). The function of the control panel switches and indicators is given in Table 2-1.

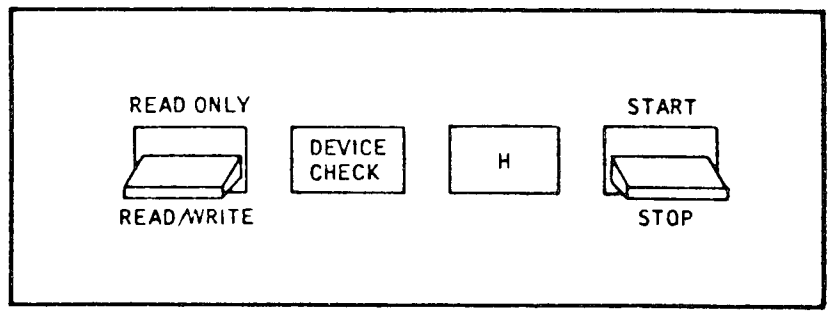


Figure 2-4. Operator Control Panel

TABLE 2-1. OPERATING CONTROL PANEL INDICATORS AND SWITCHES

Switch	Function
READ ONLY/READ/WRITE	A two-position toggle switch that provides disc pack file protection. In the READ ONLY position inhibit writing on the pack. The READ/WRITE position enables writing on the pack.
START/STOP	A two-position that causes manual power-up and power-down sequencing in normal operations. Switch in START position turns on spindle drive motor and loads heads. The STOP position retracts heads and turns off the spindle drive motor.
Indicator	**Function**
DEVICE CHECK	Indicator illuminates whenever an internal failure or control error is detected. Reset by the Disc Controller or power down.
FILE READY	Green file indicator blinks during power-up or power-down sequences. When indicator stops blinking and illuminates, the drive is ready to accept commands from the controller. The address file letter is stamped on the lens.

Figure 2-5 shows the location of the maintenance switches. These two toggle switches are not normally used by the operator. The function of these switches is given in Table 2-2.

WARNING

Ac power is still present at Ac Input Control Assembly when the PWR ON/OFF switch is OFF and poses a shock hazard if the terminal board cover is removed.

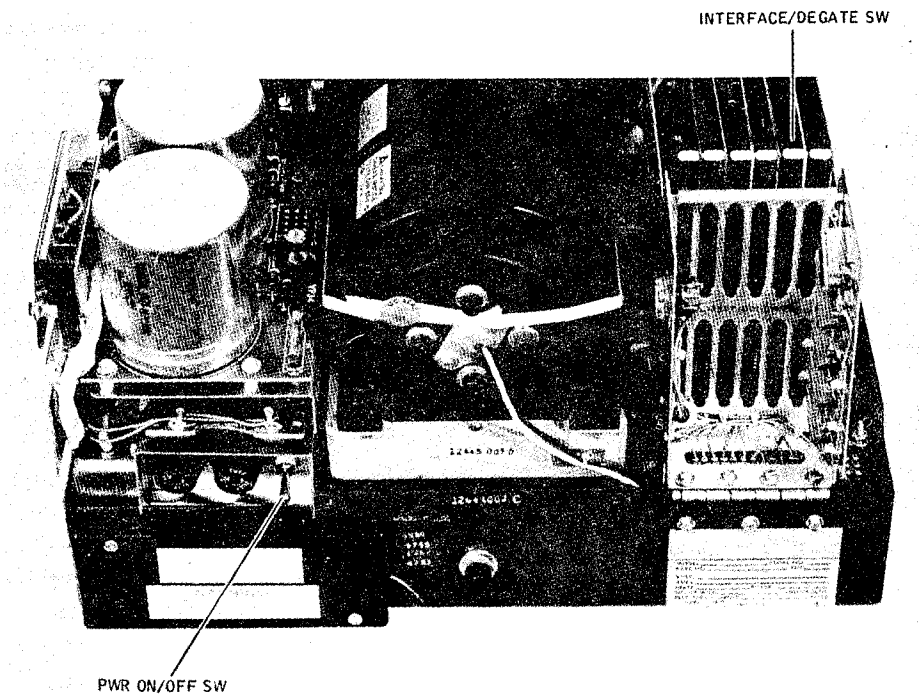


Figure 2-5. Location of Maintenance Switches

TABLE 2-2. MAINTENANCE SWITCHES

Switch	Function
PWR ON/OFF Switch	A two-position toggle switch that controls ac power to the disc drive's dc power supply. This switch is set to OFF before removing any circuit board or when replacing disc drive assemblies or components.
INTERFACE/DEGATE Switch	A two-position toggle switch located on the top edge of the Logic I card. (The switch is accessible only when the rear cover is off.) The INTERFACE position enables normal, online operation, permitting the disc drive to be selected by the controller. The DEGATE position disconnects the disc drive from the controller and enables T2000A Exerciser inputs for offline maintenance operation of the drive.

2.6 OPERATING PROCEDURES AND ADJUSTMENTS

Operating procedures for installing a disc pack are given in paragraph 2.4.1. The functions of the controls and indicators are given in paragraph 2.5. Besides changing disc packs, the only other operating procedures is clearing a Device Check. This occurs when the red DEVICE CHECK indicator comes on indicating a malfunction has occurred. Due to the DEVICE CHECK condition, use one of the four following methods to clear the DEVICE CHECK.

1. To clear a DEVICE CHECK, set the START/STOP switch to STOP. Wait for the green File Ready indicator to stop flashing and then set START/STOP switch to START.

2. The following Device Check conditions are reset using a Device Check Reset command from the controller firmware.

   a. Setting a cylinder address while not ready.

   b. Setting an offset while the drive is not ready.

   c. Writing while drive is not ready.

   d. Writing when more than 80 microinches off track center.

   e. Writing when READ ONLY switch is active.

   f. Writing while offset is active.

   g. No write transitions for 25 microseconds while writing.

   h. Write current is unsafe.

   i. No head or more than one head is selected during reading or writing (heads unsafe).

   The Device Check Reset command resets the head address register to zero.

3. The following Device Check conditions can be reset using a Rezero command.

   a. SEEK INCOMPLETE.

   b. Receiving an illegal cylinder address (greater than 814).

   c. Offset active and SETCYLTAG.

   The Rezero command resets the head address register to zero and resets offset.

4. Possible hardware problems are:

   a. Power Supply

   b. Cabling

   If the Device Check Indicator lights up immediately after power up, the problem is probably the power supply.

2.7 INTERCONNECTION

A typical interconnection diagram is illustrated in Figure 2-6 for the 610/730 Data Processing System.

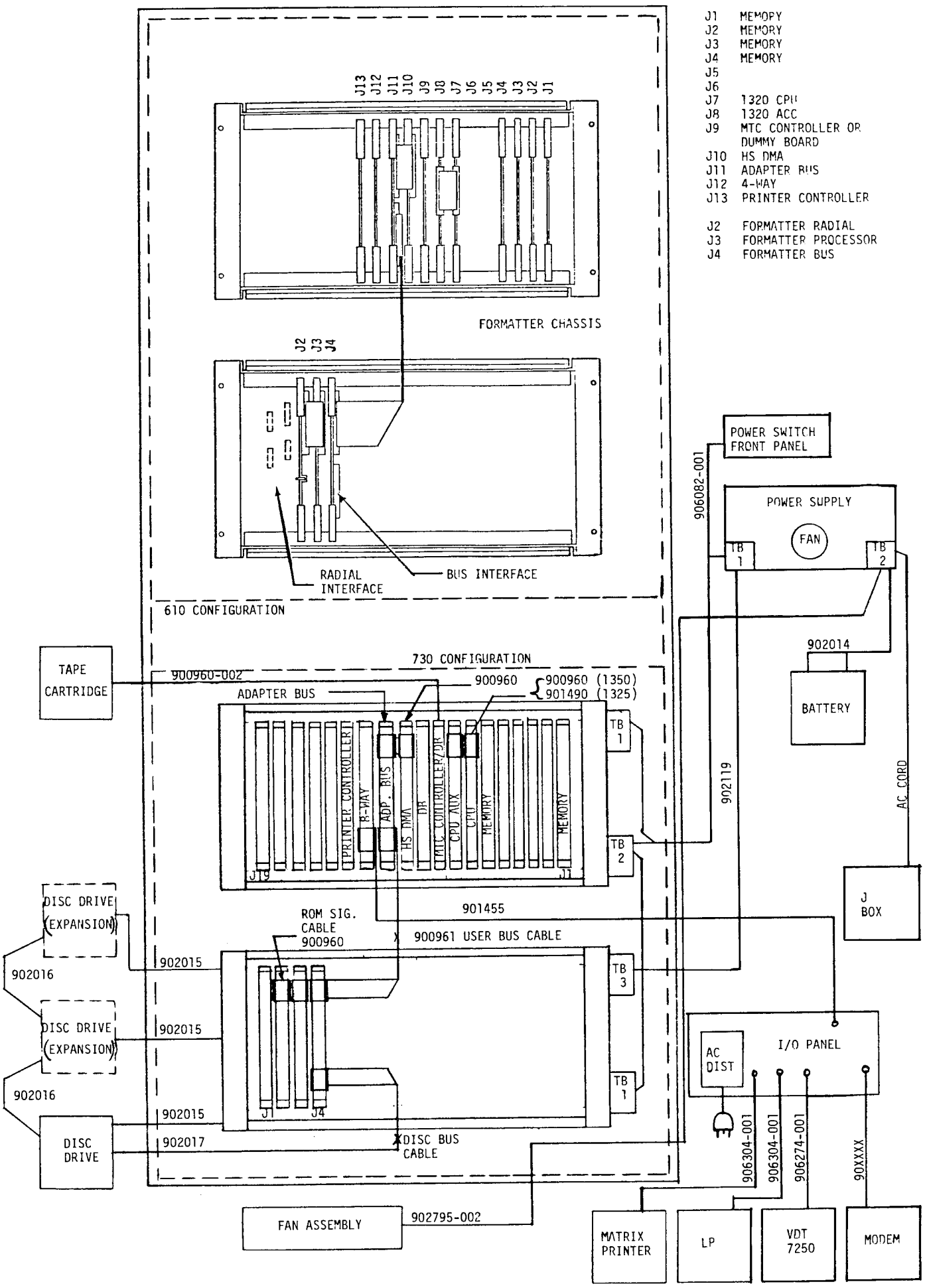


Figure 2-6. Interconnection Diagram 610/730 System

CHAPTER 3

MAINTENANCE

3.1 INTRODUCTION

This chapter contains information and instructions required to keep the drive in proper operating condition. Maintenance information includes a functional description of circuit operation and preventative/corrective maintenance procedures.

3.2 GENERAL DESCRIPTION

The Disc Drive Unit consists of two parts, the Disc Drive which is in its own cabinet, and the Disc Controller which consists of boards mounted in the CPU cabinet.

3.3 SPECIAL TOOLS

Special tools and test equipment required for performing maintenance are given in Table 3-1.

TABLE 3-1. SPECIAL TOOLS AND TEST EQUIPMENT

BFC Part Number	Description
249110	Head Caming Tool
249020	Head Positioning Tool
249030	Head Positioning Tool, Inl.
249040	Torque Wrench, Head Mount
249050	Pin Safety
249060	Tach Rod Insert/Remo. Tool
249100	T80-CE Pack
249010	Extender, PCB

3.4 FUNCTIONAL DESCRIPTION

Figure 3-1 is a general block diagram and shows the functional groups that execute disc drive oeprations and the interfacing command, data, and status lines that connect the disc drive to the controller.

1. The Interface and Control Circuits control access to the drive, generates the control signals for head positioning from the controller signals, and prevents further operations until a device check failure is reset.

2. The Disc Pack Drive Circuits controls the power-up and power-down sequences, loads the heads initially, and controls emergency head retraction.

3. The Head Positioning Servo Circuits controls head positioning and generates the bit rate and byte rate clocks.

4. The Read/Write Circuits enable the addressed read/write head, converts NRZ data to TFM and writes to the disc, read from the disc and converts TFM to NRZ, detects address sector and index markers, and provides the data clock to the controller.

5. The Error Detection and Status Circuits monitors status from the other circuit groups, generates status signals for the controller, and operates the DEVICE CHECK indicator.

6. The Power Circuits include the power protection and distribution of input power and the regulated DC power supplies.

3.4.1 DISC DRIVE OPERATIONS

The Disc pack contains five, 14-inch-diameter, ferrusoxide coated discs with precision spacers that are firmly mounted on a hub. Only the inner three discs are used; these provide five data-recording surfaces and one prerecorded track-reference servo surface. The top and bottom discs serve only as protective covers for the recording surface.

The five data-recording (read/write) heads and the servo (read-only) head are rigidly mounted to a head-positioning carriage as facing pairs and spaced and aligned to approach the upper and lower surfaces of the inner three discs precisely. The recording heads are assigned head address numbers 0 through 4 from top to bottom. The servo head reads from the top surface (servo surface) of the middle disc. Recording heads are aligned so their recording pole pieces are positioned axially within 50 microinches of the servo head pole pieces.

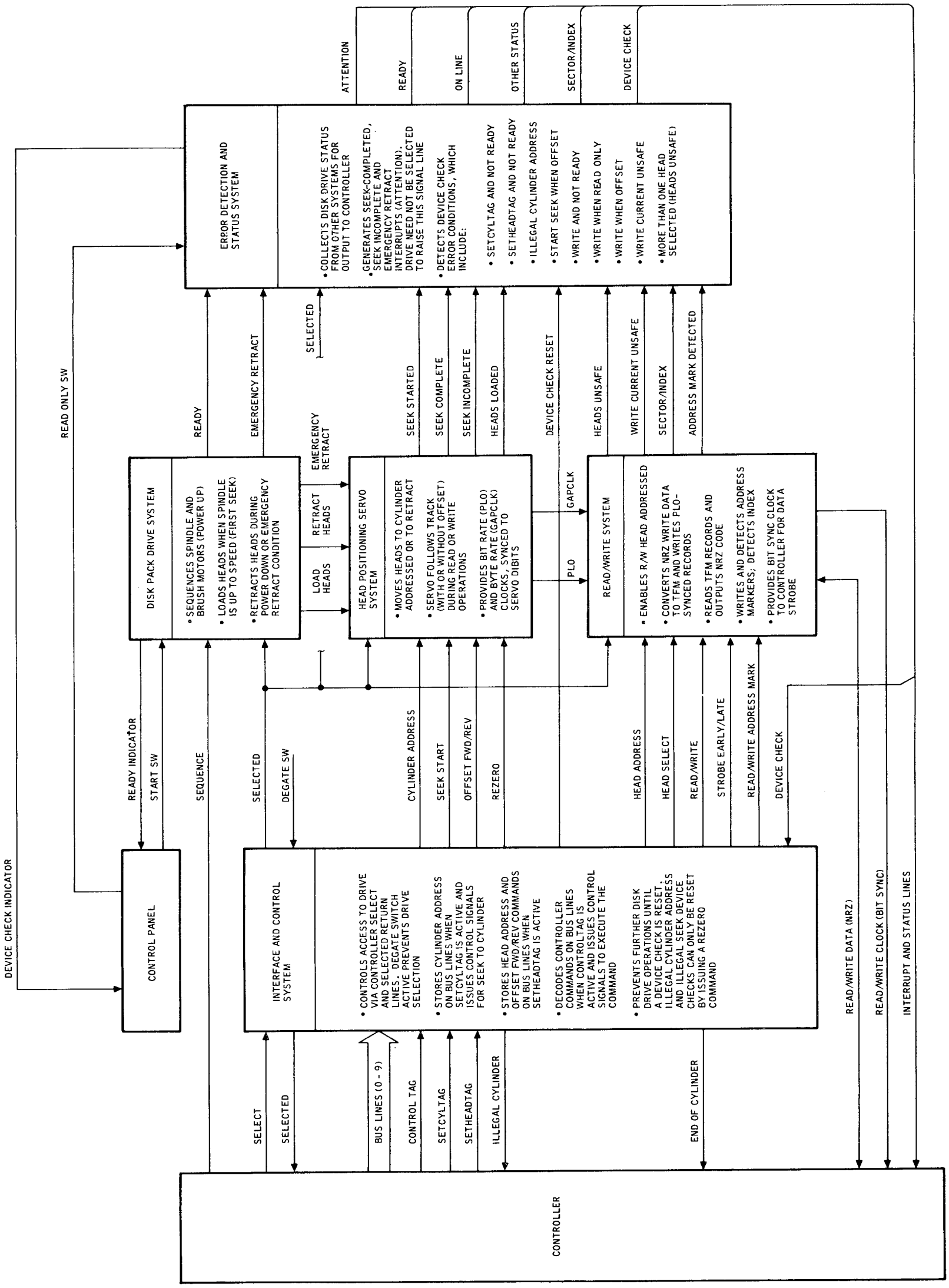


Figure 3-1. Disc Drive Functional Block Diagram

All heads are mounted on spring arms that are loaded to apply a pressure of approximately 350 grams toward their associated disc surfaces. However, the head pads and gimbaling are designed aerodynamically to "fly" the head on the air boundary layer that surrounds all moving surfaces. The aerodynamic lift equalizes the spring load pressure at some point above the disc surface so the heads never actually contact the rotating disc surface.

Head loading and unloading into and out of the disc pack area is carefully sequence-controlled to ensure that the disc pack is up to rotating speed before the heads are extended. When the heads are retracted, they are held apart by nylon camming surfaces that bear on the spring arms of each head.

The prerecorded servo surface in each disc pack is read continuously by the servo head whenever the heads are loaded onto the pack. Signals read by the servo head are processed by the head positioning servo system to provide references for a variety of functions. The servo signals are used to:

a. Delineate guard band and recording zones on the disc recording surfaces.

b. Position and space the data tracks on the recording surfaces.

c. Generate seek operation track-crossing clocks for positive track location.

d. Detect on-track null points and off-track error signals for servo track following.

e. Detect start-of-track index markers.

f. Used as a disc speed-related, byte-interval reference clock for synchronizing data recording and recovery.

Because the read/write heads are mechanically locked to the servo head by the carriage assembly, the data track positions are referenced to the pack servo tracks, rather than externally to the Disc Drive. This technique minimizes pack-to-pack and drive-to-drive interchangeability problems.

3.4.2 POWER-UP SEQUENCING

Initially, the linear motor bobbin and attached head carriage are in the fully retracted position with the heads drawn apart by camming surfaces on the head arms that make contact with the cam tower. When power is turned on, only the blower motor, power supply, and disc drive logic circuits are activated. Power-up sequencing is initiated by activating the START switch on the front panel (or by the controller through a sequence control line).

3.4.3 HEAD LOAD OPERATION

Head loading (also called "first seek") is always the final operation performed during a normal power-up sequence. When the disc pack has come up to a speed sufficient to fly the heads (95 percent of 3600 RPM), a load speed voltage is applied to the linear motor bobbin to drive the carriage and heads forward at a nominal speed of 7 to 10 inches per second. The heads continue to move forward under direct load speed control until they reach the outer margin of the head load zone of the disc pack. At this point, the camming surfaces of the head arms leave the cam tower and allow facing heads to be lowered onto the disc surface air boundary layer.

The Disc Drive switches from direct load speed control of head motion to a track-following mode as soon as the servo head begins picking up a signal from the recorded outer guard band. Track following is a servo mode of operation under control of the servo head signal. Since all 22 tracks of the outer guard band are of the plus pattern, no dibit signal will be detected. Instead, these identical tracks generate a head position error voltage that causes the servo-controlled linear motor to continue to drive the heads in the forward direction.

When the servo head approaches the track 000 position (intersection of the outer guard band and the minus-track pattern of the recording zone), servo system will lock on track 000 when the dibit signal becomes symmetrical.

Locking in (detenting) on cylinder 000 completes the power-up sequence and head load operation, and the Disc Drive goes into the drive-ready condition, sending an attention signal to the controller. The entire operation, from the start of power-up sequencing through the first seek to sylinder 000 to the drive-ready condition, takes approximately 20 seconds.

3.4.4 SEEK-TO-CYLINDER OPERATION

A cylinder is defined as all five recording tracks that are accessible to the read/write heads for a given track position of the servo head. A new cylinder address and a seek-start command are required to move the heads to a new position.

The controller initiates a programmed seek by placing a cylinder address on the bus lines. A minimum of 200 nanoseconds later, the controller activates the Set Cylinder Tag line to strobe the bus address into the subtractor. Here it is compared with the current head position address by an arithmetic subtractor to obtain a cylinder difference count. If the cylinder address on the bus lines is a legal address, raising the tag line strobes the subtractor output into a difference counter. If the cylinder address is illegal, a device check will result. The new cylinder address is stored by the drive in its cylinder address register 350 nanoseconds after the Set Cylinder Tag line goes active.

The value strobed into the difference counter indicates the number of tracks to be crossed by the servo head to reach the location of the new address. This number can be positive, negative, or zero. If positive, a forward (toward the spindle) seek will be enabled. And if the difference count is zero, no seek operation will occur.

Seek-starting begins when the controller terminates the Set Cylinder Tag line signal a minimum of 800 nanoseconds later. If the difference count is not zero, dropping the tag line signal places the head-positioning servo system in-to the seek-enable mode by changing from track-following mode to velocity mode. Starting the seek operation puts the drive in the not-ready condition.

The maximum velocity that the forward- or reverse-seek operation will attain is controlled by the magnitude of the difference count. A difference count of 256 or more will cause the head-positioning servo system to be driven by maximum linear motor current to an absolute maximum velocity of about 90 inches per second. Maximum velocity is limited when a balance is reached between the voltage applied to the linear motor and the voltage fed back from a velocity transducer (stationary coil and moving tach rod) inside the linear motor.

Each time the servo head crosses a servo track, a clock pulse that reduces the difference counter count by one generated. Maximum velocity will be maintained until the difference count falls below 256. Below the count of 256, the drive signal to the servo system is reduced proportionally, with the linear motor responding to balance out the signal with the output of the velocity transducer.

Imbalance due to the momentum of the bobbin and carriage causes a braking voltage to be applied to the linear motor to slow the heads as they approach the correct cylinder (difference count of zero).

When the difference count is reduced to zero, the servo head will be within approximately 0.002 inch of the desired track, and the head-positioning servo system is switched back to operating in the track-following mode. The servo system then locks onto the closest symmetrical dibit null point. Once this occurs, the seek-to-cylinder operation is complete, and following a 1-millisecond delay, the drive returns to the ready condition and sends a seek-completed interrupt on the Attention line. Head repositioning times vary from 6 milliseconds for a single-cylinder seek to either adjacent track to as long as 55 milliseconds for seeks across all cylinders. These times are measured from drive ready-to-drive ready.

3.4.5 TRACK-FOLLOWING OPERATION

Switching the head-positioning servo system to the track-following mode (detent on track after first seek, programmed seek to cylinder, or rezero), places the servo system uder control of the dibit signal picked up by the servo head. As long as the dibit signal is symmetrical, indicating that the servo head is exactly centered between two adjacent recording zone servo tracks, the integrated position-error voltage will be null, or zero volt.

Any asymmetry in the dibit signal indicates that the servo head has drifted off track and has produced an increasingly positive or negative position signal that is applied as a correction voltage to the linear motor to move the servo head back to the null point of dibit symmetry.

The position signal can swing positive or negative by as much as 2 volts if the servo head completely loses the signal from one of the adjacent plus or minus tracks. Also notice that the direction of correction (forward or reverse) to bring the servo head back on track, relative to the polarity of the position error voltage, depends upon whether the servo head is tracking an odd- or even-numbered cylinder. The least significant bit of the cylinder address is used as an odd or even indicator to ensure that error correction drive is always toward the position-error null point of track center.

An upper-threshold detector is activated whenever the position-error voltage indicates that the servo head is approximately 500 microinches off track. This upper-threshold detector produces a train of pulses from the sinusoidal position signal during seek-to-cylinder operations from which the difference counter down-count clocks are produced.

A fixed forward or reverse offset of 300 microinches can be applied to the servo system under program control for attempted recovery of data which cannot be read without errors when the heads are correctly powitioned. This is accomplished by setting Bus bit 2 active and activating the Set Head Tag line. The direction of offset is specified by the state of Bus bit 3. Offset is produced by summing a positive or negative bias with the position-error voltage so that null is obtained with the heads offset.

Head offset must be reset before writing or head repositioning is attempted, otherwise a device check error will result. Offset reset is accomplished by making the Set Head Tag line active with Bus bit 2 reset.

3.4.6 REZERO OPERATION

When an illegal cylinder address is received, or when a seek-to-cylinder operation is not completed within 700 milliseconds (seek incomplete), cylinder location reference is lost. A Rezero command is required to reestablish this location reference. This command is given by setting Rezero Bus bit 8 and activating the Control Tag line.

Rezero places the selected drive in the not-ready condition and causes a reverse-seek operation that repositions the heads over cylinder 000 and resets the head address to 0. It also resets the cylinder address to 000 and resets the error condition that made rezeroing necessary.

The rezero seek operation is initiated at the trailing edge of the Control Tag line signal after activating it with Rezero Bus bit 8 set. Servo control is switched to reverse drive, load-speed velocity is activated, and track following is disabled, causing the linear motor to move the heads toward the outer periphery of the disc at load speed. The heads continue their motion out of the recording zone, through the outer guard band, and into the head load zone of the disc pack.

As soon as the servo head signal is lost, servo control is switched to forward mode, reversing the head drive direction. As the heads move inward, still at load speed, the servo head begins to pick up a signal again from the outer guard band. Servo control is then switched from load speed to track following, and the heads continue to move forward under control of the position error voltage derived from the asymmetrical servo signal picked up in the outer guard

band. The servo locks in on the first dibit signal, which occurs over cylinder 000, stopping the heads on that cylinder with servo control in the track-following mode. After the rezero operation is completed, the Disc Drive ready signal is raised.

3.4.7 HEAD-RETRACT OPERATION

A head-retract operation unloads the heads from the disc pack and retracts them fully from the disc pack area at the start of the power-down sequence when the START/STOP switch is set to STOP. As soon as the power-on START switch signal is lost, the servo control is enabled to drive the heads in the reverse direction at load speed. This disables track following and puts the Disc Drive in the not-ready condition.

When the heads move into the head load zone at the outer periphery of the discs, the camming surfaces of the head arms make contact with the cam tower; this forces the heads away from each other ad away from the disc surfaces. The heads continue to move in the retract direction, causing the carriage to open the Heads-Extended microswitch. The microswitch action disables the head-positioning servo and permits the power relays for the spindle motor to drop out. A braking circuit is switched in and applies a 44 volt DC braking voltage to the field winding of the spindle motor for approximately 19 seconds. The disc pack should come to a complete stop in this time, completing the head-retract and power-down sequence operations.

3.5 DIAGNOSTIC TESTS

Use the following diagnostics that test the control panel and verify proper operation of the idsc drive.

3.5.1 INDICATOR TESTING

A continuity check of the control panel indicators is recommended before running BASS diagnostics.

3.5.2 BASIC ALL PURPOSE SERVICE SYSTEM (BASS) DIAGNOSTICS

It is recommended that the BASS diagnostics listed in Table 3-2 be run at the time of installing and repair to verify proper operation of the Disc Drive. For operating BASS, refer to BASIC ALL PURPOSE SERVICE SYSTEM (BASS) MANUAL by BFIS; manual #DM1102.

TABLE 3-2. RECOMMENDED BASS DIAGNOSTICS

Name	Description	Purpose
%D21	Long/Short Disc Seek Test	For burn-in verification of head seek functioning and head alignment.
%D22	Disc Scan Restore	For error isolation, or correction of marginally bad sectors or to check alignment.
%D23	Disc/DMA Write Verification	For burn-in verification of disc and DMA functioning.
%D24	Direct File Disc Exerciser	For exhaustive burn-in verification of disc and DMA functioning.

3.6 ADJUSTMENT PROCEDURES

The logic card age houses all the electronics on six plug-in circuit cards with the exception of circuits on the Read/Write Matrix and Servo Preamp cards. Figure 3-2 shows the correct locations for the plug-in circuit cards, as viewed from the Card locations are identified by slot numbers one thru six.

3.6.1 HEAD ALIGNMENT PROCEDURE USING VDT BOOT LOADER

Perform the following steps:

1. Load Alignment Pack and set disck drive Read/Write switch to READ ONLY.

NOTE

The Alignment Pack requires 30 minutes of running time for temperature stabilization.

2. Set SENSE switches 1 and 4 on (to the left).
3. Press the LOAD switch on the CPU panel.
4. Set terminal 0 the half-duplex mode.

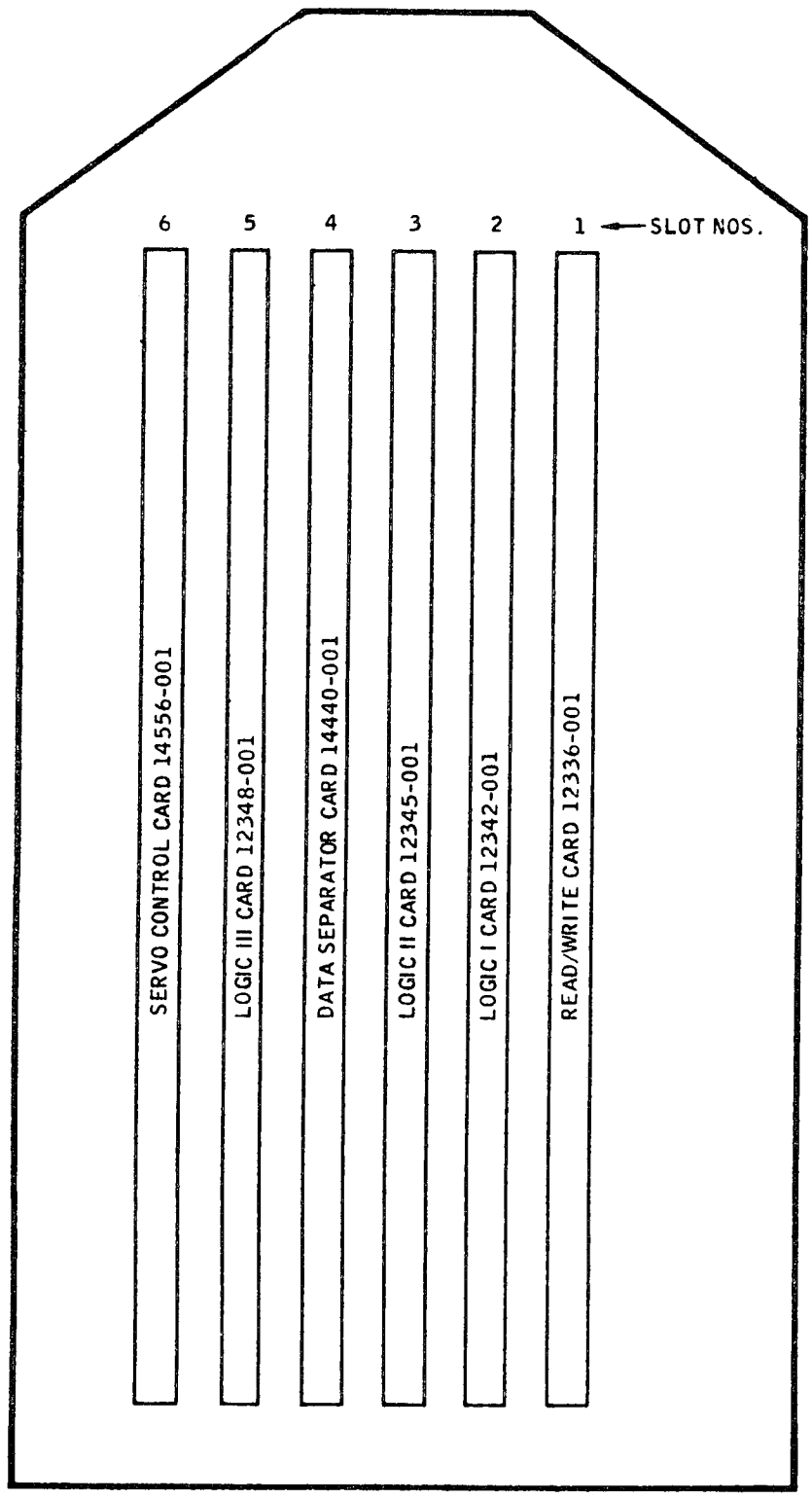


Figure 3-2. Plug-In Card Locations

5. Key in the following program on terminal 0 - starting with a four-digit address (0200); followed by the program; end the data input with the IV key. If a mistake is made, terminate data input with the IV key and restart with the address where the mistake was made.

```
0200-04
0201-E778008
0204-6906
0206-E759F0
0209-6901
020B-00
020C-0000
020E-3947
0210-2408
0212-3967
0214-63F6
```

NOTE

```
0201 - E78008=D0     D=disc
       E78009=D1
       E7800A=D2
       E7800B=D3

0206 - E759F0=cyl 496 head alignment track
       E75808=cyl 8 carriage way alignment check for 4219
       E75B20=cyl 800
```

6. Start the program by keying the starting address (0200) followed by the IV key. The disc will seek to the designated cylinder, and the system will halt. To restart, press the LOAD key and repeat step 5.

7. Remove the top rear cover held on by two screws and tilt the card cage back to access the read write matrix card. Attach the IC clip (P/N R999907) to IC A3 on the read write matrix card.

8. Attach a jumper on IC A3 pins to select the desired head as follows.

IC A3	From	To	Head
	12	1	0
	12	2	1
	12	3	2
	12	4	3
	12	5	4

9. Set up the oscilloscope as follows (see Figure 3-3).

```
Channel: 1 AC, 50 mV/div, TP6
Channel: 2 Ac, 50 mV/div, TP7
Sync: internal on channel 1, positive, 0.5 usec/div
Mode: add, invert channel 2
```

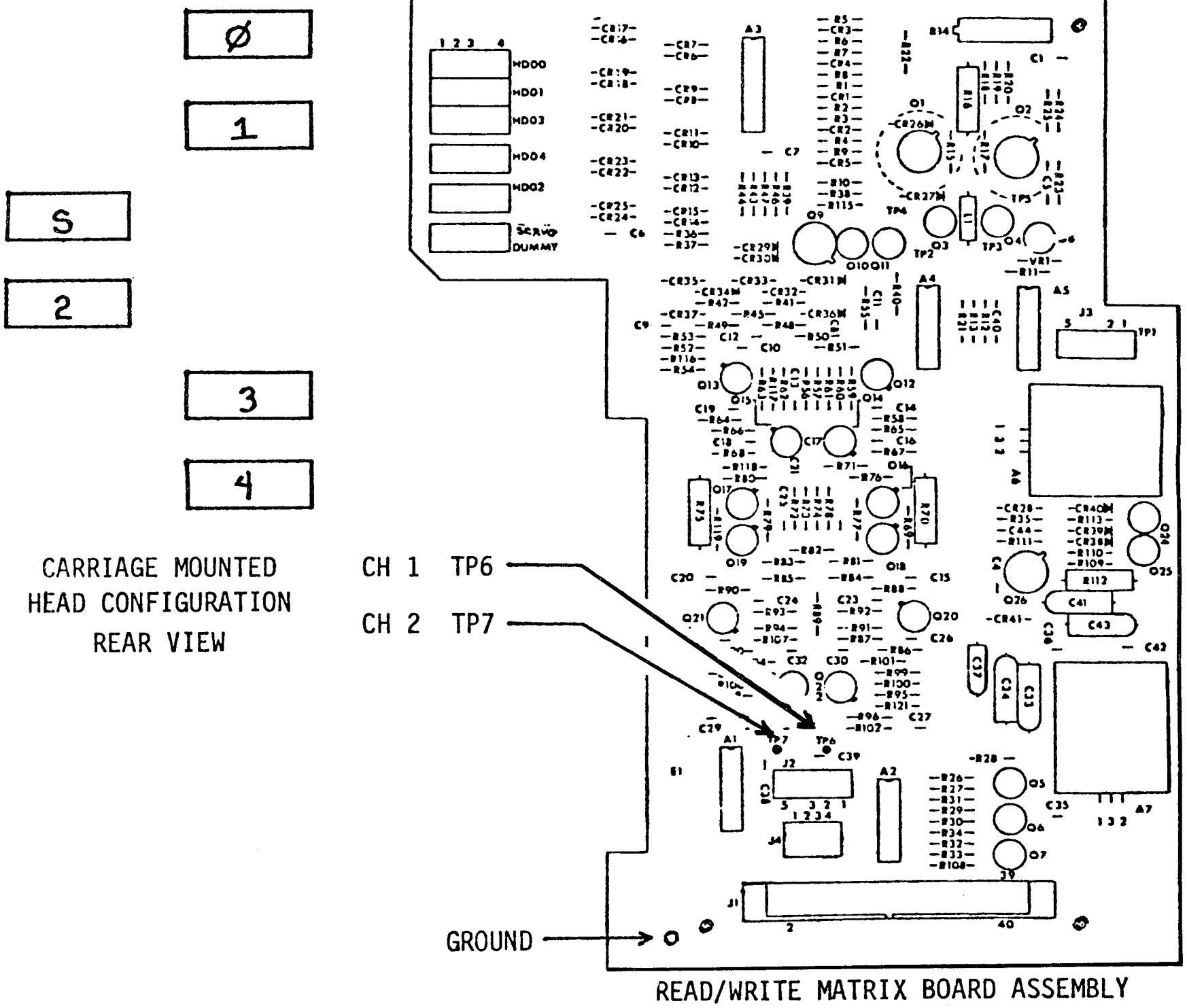


Figure 3-3. Read/Write Heads and Matrix Board Configuration

10. The dibit pattern shown in Figure 3-4 should be displayed on the oscilloscope. Adjustment of the scope sync may be necessary to display a good trace for each head.

    A comparison is made between amplitude arm A and B for equal amplitude (Figure 3-4). Alignment is accomplished when arm A and B are equal in amplitude.

NOTE

The alignment pack requires 30 minutes of running time for temperature stabilization.

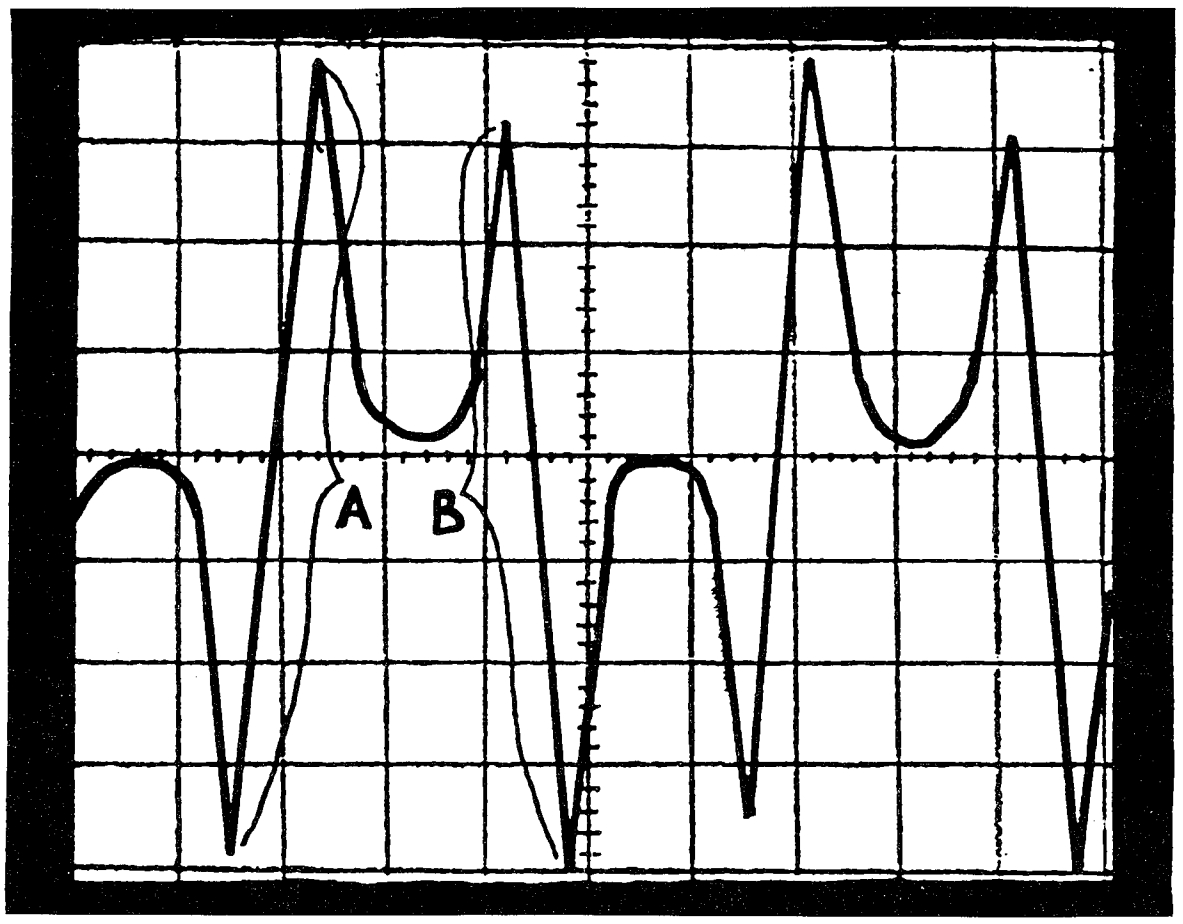


Figure 3-4. Ideal Dibit Pattern

11. Proceed only when the alignment pack has stabilized. Remove the transparent air shroud (held down by four screws) covering the carriage and heads, and insert the safety pin down through the hole in the top of the cam tower and into the T block assembly.

WARNING

Never place hands or tools in the T block area without having the safety pin installed. If the carriage attempts to retract, remove all tools and the safety pin, then manually pull the heads off the alignment pack as quickly as possible. If the drive must be left unattended for any period of time, remove the safety pin.

12. Loosen the mounting screw for the head to be aligned and torque it to 20 inch-ounces (see Figure 3-3 for head location). Adjust the head (see Figure 3-4), equal amplitude of arms A and B. Torque the mounting screw to 80 inch-ounces and recheck alignment. Don't lean on the drive during alignment as this will cause the alignment to change slightly.

13. Select the next head to be aligned and repeat step 11 until all heads are aligned.

14. Remove all tools and the safety pin from the T block area.

15. With all heads aligned and the safety pin removed, install the air shroud and rear cover. Remove the alignment pack.

16. Reload boss and verify proper disc operation by peforming a GET to all sectors with RTY=0. (GET 0, 1, RTY=0 A$)

Alignment capability with this method has proven to give alignment tolerances as close as ±10 microinches.

3.6.2 DATA SEPARATOR PCB ADJUSTMENT PROCEDURE

Perform the following steps.

1. Degate the drive interface.

2. With the drive stopped and power turned off, remove the emergency retract relay from its socket on the servo amp/power supply chassis and plastic cover over the heads.

3. Turn power on, install a boss or scratch pack, and start the drive.

4. When the ready light stops blinking, (approximately 20 seconds) grasp the head-mounting area of the carriage and manually load the heads onto the spinning pack by moving the carriage firmly towards the spindle until the ready light goes on.

CAUTION

When the emergency retract relay is removed, the access mechanism is completely disabled. It is possible to damage the heads and pack by allowing pack to stop rotating with the heads extended. Do not, therefore, allow the drive to be stopped, turned off, or left unattended without first manually unloading the heads by returning the carriage to its fully retracted position.

5. Scope Settings

   1 volt/division (use 10x probes).

   100 nanoseconds/division (X10 magnifier off initially).

   Display channel 1 - attach channel 1 probe to clock signal on TP1.

   Trigger = INTERNAL/CH1/NEG SLOPE (auto or normal mode).

6. Adjust the trigger level control for a stable trace and verify that the full cycle time of the clock signal is approximately 103 nanoseconds (10 full cycles display in slightly more than 10 divisions).

7. Manually position the carriage slowly away from the spindle until the ready light goes out (the head-load area). The clock is now free-running, having no dibit signal to control the oscillator. Adjust R14, if necessary, to set the fre-running period to approximately 103 nanoseconds (Figure 3-5).

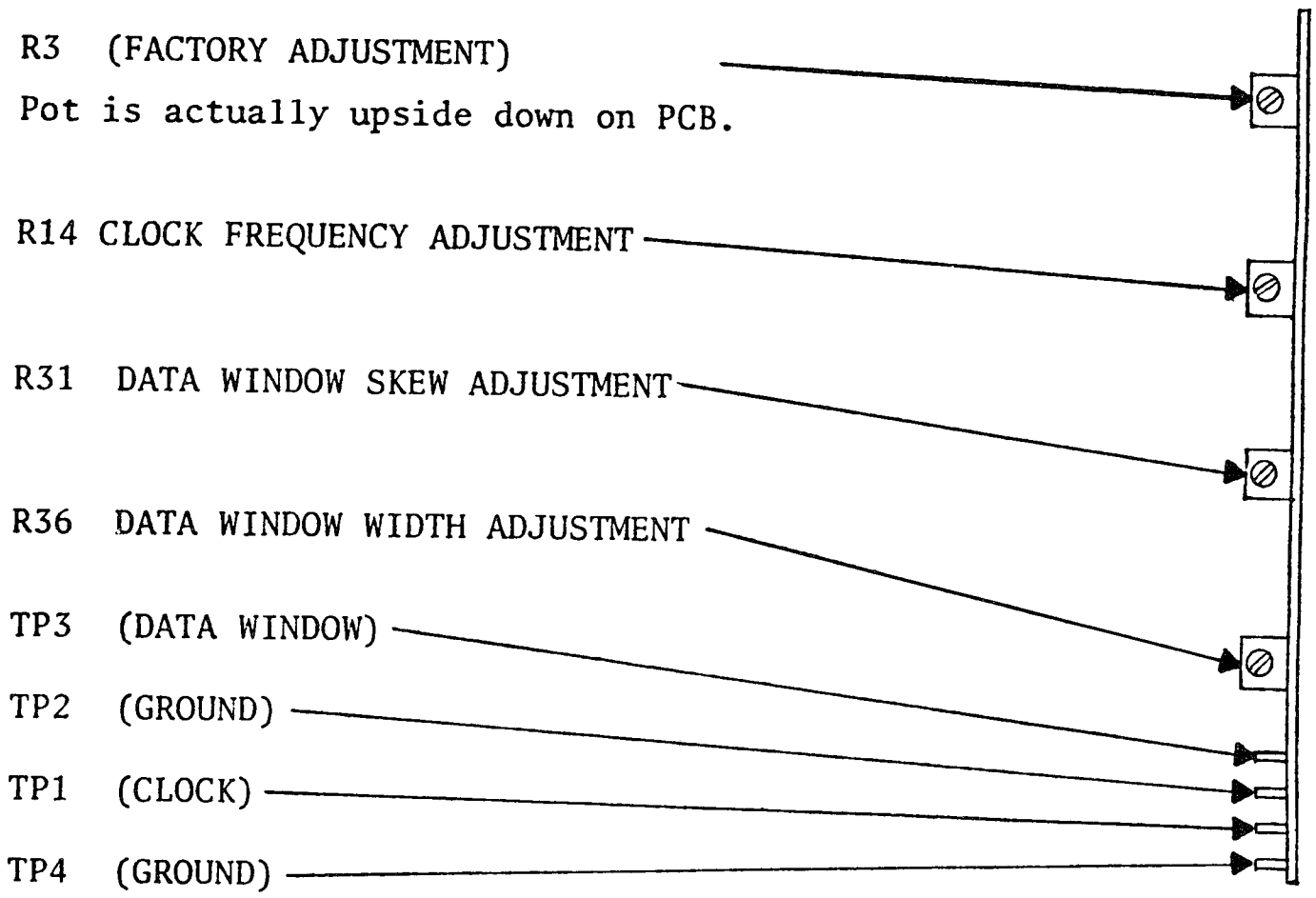


Figure 3-5. Data Separator and Test Point Location (End View)

8. Turn on the X10 magnifier and adjust the horizontal position to left until the last pulse is near the center of the screen. Center the trace vertically.

9. Move the carriage slowly toward the spindle until the ready light goes on. The servo head is now reading the outer servo band which may cause the trace to jitter. Move the heads further in, if necessary, to stabilize the trace. This is the vicinity of cylinder 0. Hold the carriage here for the first measurement.

10. Adjust the horizontal position control until the trailing edge of the last pulse is aligned with the center vertical line of the graticule at the mid amplitude point (Figure 3-6).

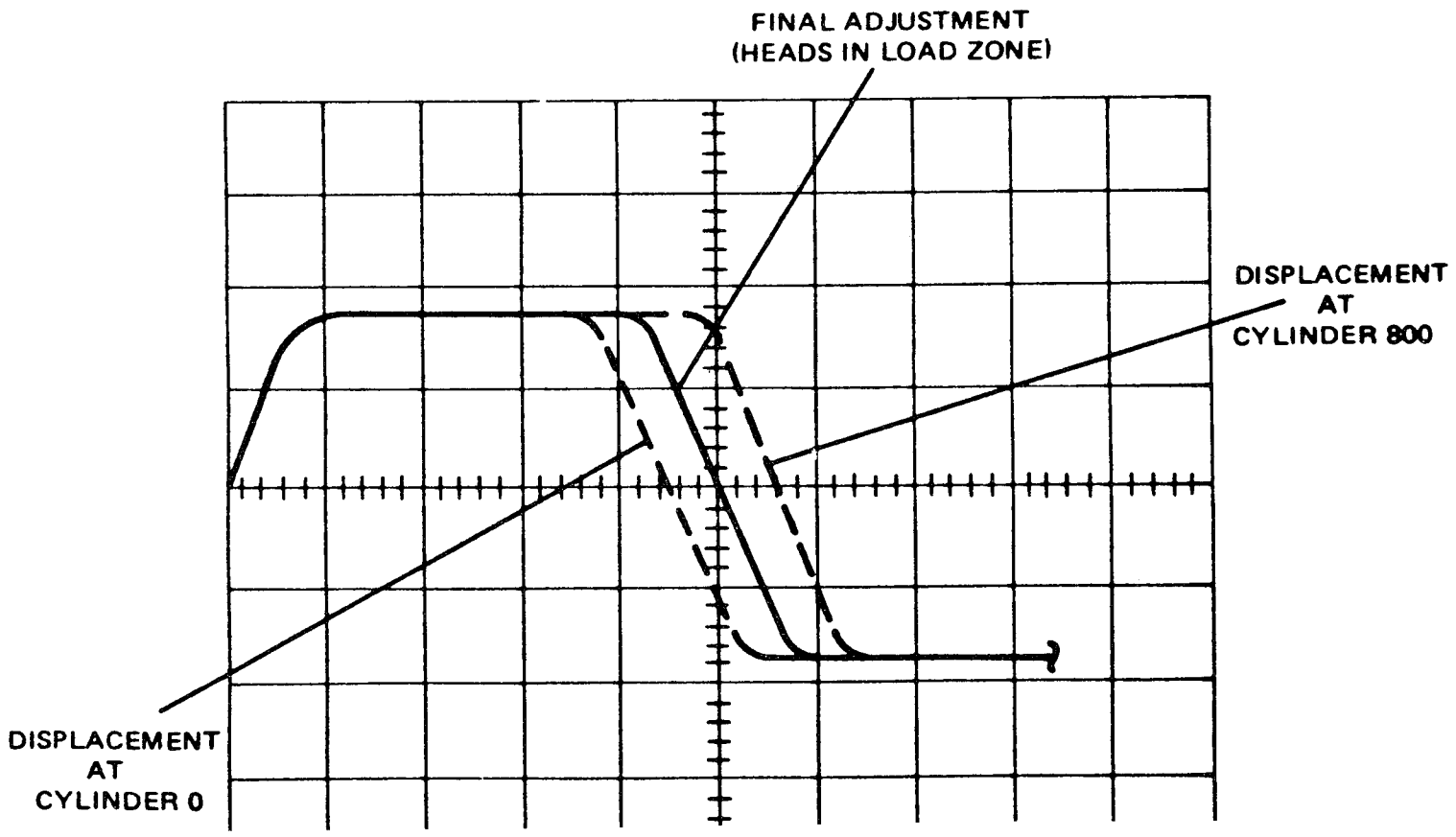


Figure 3-6. Clock Frequency Adjustment

11. Move the carriage toward the spindle slowly and observe that the pulse moves to the right as the VCO tracks the dibit signal. Allow 5 seconds for the speed to stabilize after reaching the vicinity of cylnder 800 and then note how far the pulse has shifted between cylinder 0 (highest pack speed) and cylinder 800 (lowest pack speed).

12. Move the carriage away from the spindle until the heads barely touch the lifting cams. With no dibit signal the clock is free-running at this time.

13. Adjust R14 (if necessary) to position the pulse halfway between the early and late extremes determined in step 11. (Approximately 5 nanoseconds of cumulative difference should exist for 10 clock cycles from track 0 to track 800).

14. Referring to Figure 3-6, verify that the clock pulse shifts left (earlier) when the heads are positioned in the vicinity of cylinder 0, then to the right of the free-running position (later) when positioned in the vicinity of cylinder 800. This completes the clock frequency adjustment.

15. Change the scope display to chop sweep mode and connect the channel 2 input to TP3 (data window). (See Figure 3-5).

16. Adjust the horizontal position control to display the second pulse of the channel 1 trace.

17. Position the carriage in the data cylinder area and adjust the scope vertical position controls to display the channel 2 waveform with its mid amplitude point centered vertically on the graticule.

18. Adjust R36 for a data window pulsewidth of 47.5 nanoseconds measured at the midamplitude points (Figure 3-7).

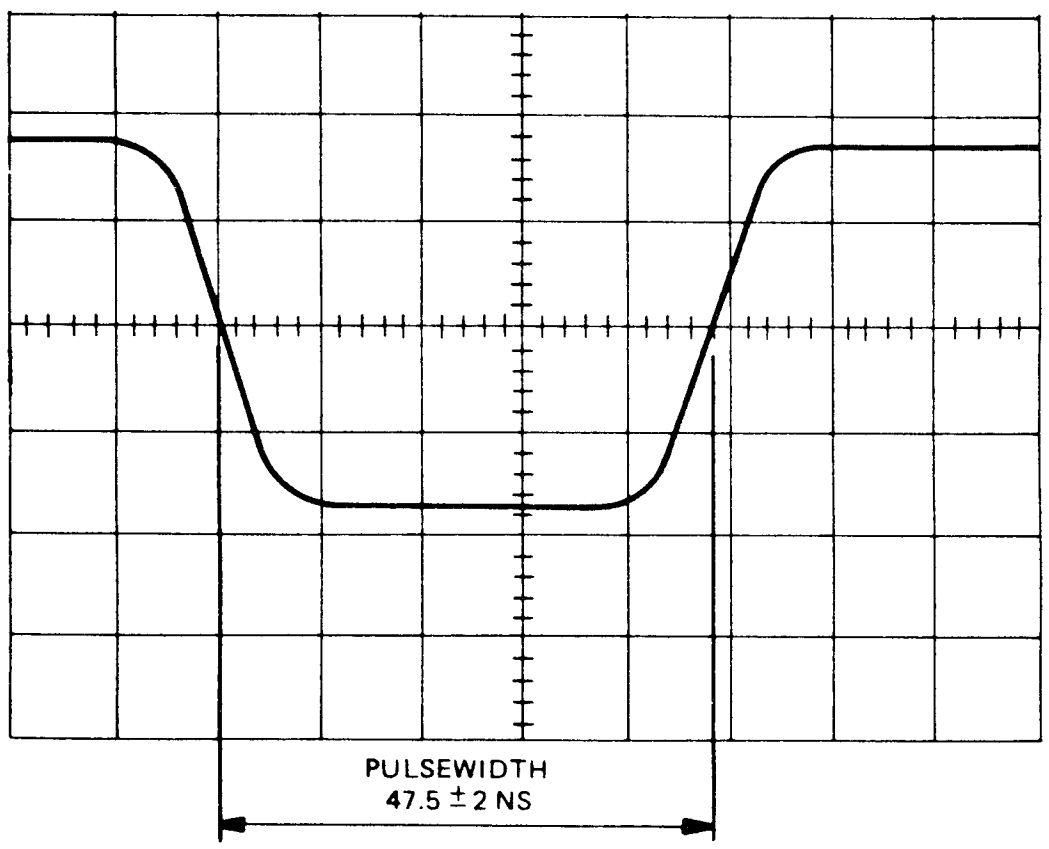


Figure 3-7. Data Window Width

19. Adjust the scope's position controls for the display shown in Figure 3-8.

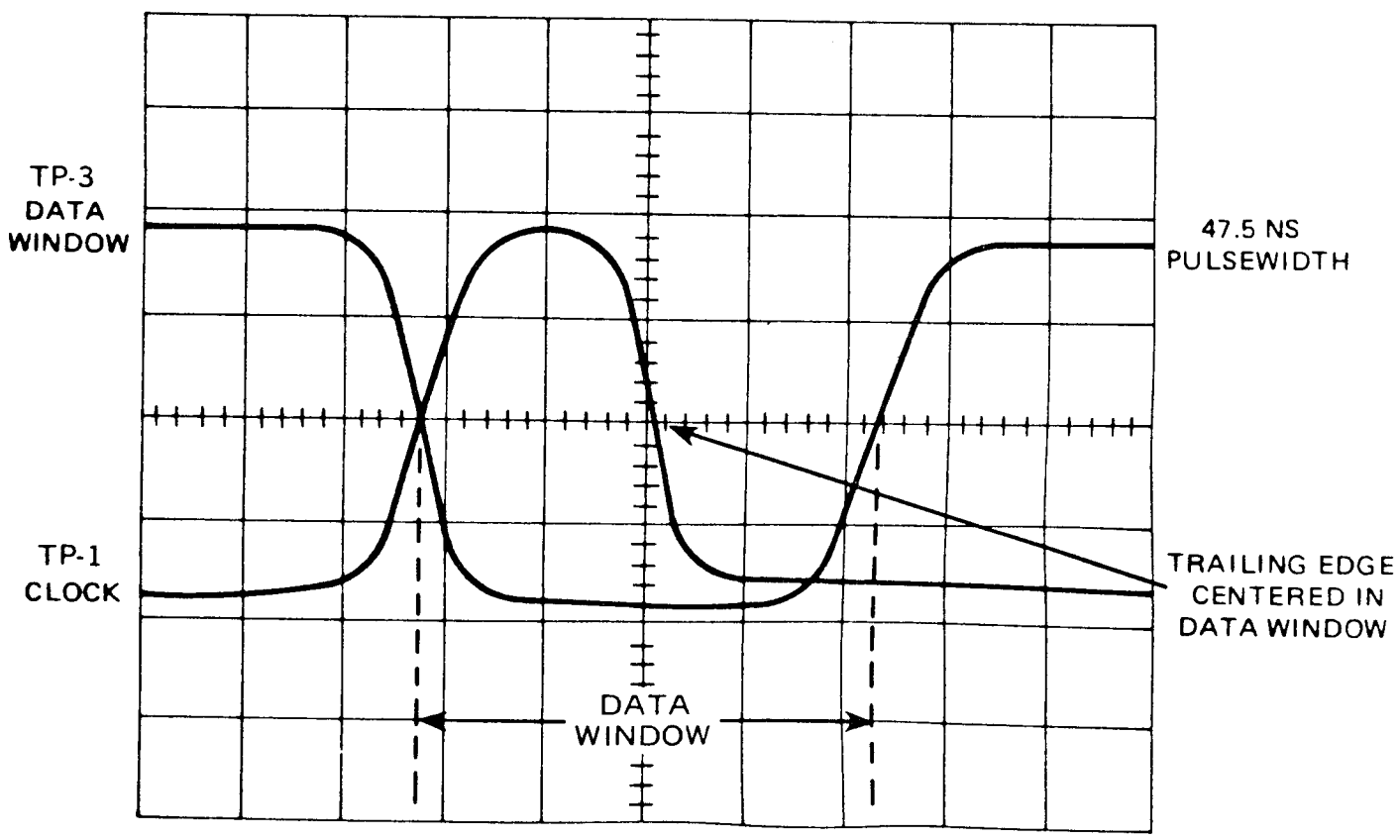


Figure 3-8. Data Window/Clock Relationship

20. Adjust R31 for minimum delay (fully clockwise). This is important! Now adjust R31 counterclockwise so the trailing (negative) slope of the clock signal (CH1) is centered in the negative portion of the data window ±1 nanosecond.

3.7 MECHANICAL ADJUSTMENTS

Mechanical adjustments are: Heads-extended Microswitch, Off-Rack Microswitch, and Cover Lid Spring Adjustment.

3.7.1 CARRIAGE-ACTUATED MICROSWITCHES

Two microswitches are actuated by the head carriage assembly over the full extent of its travel into the disc pack area. To gain access to these switches for checkout, adjustment, or replacement, raise the pack cover lid, remove the disc pack, and remove the access plate on the bottom of the air shroud, secured in place by four slotted screws. One microswitch is for head extended, the other is for off-rack adjustments.

Perform the following procedures for checkout and adjustments of the heads-extended microswitch.

1. Set the POWER ON/OFF switch to OFF, remove the disc pack, and make sure the heads are fully retracted.

2. Remove the maintenance access panel inside the air shroud (four slotted screws).

3. Disconnect plug P50 from the microswitch and measure contact resistances of the microswitch with an ohmmeter.

   a. Between NO and C lugs (should be shorted).

   b. Between NC and C lugs (should be open).

4. Actuate the microswitch manually by moving the carriage out slightly, and remeasure contact resistances to see if transfer occurs.

   a. Between NO and C lugs (should be open).

   b. Between NC and C lugs (should be shorted).

5. If a faulty microswitch was detected in steps 3 and 4, replace the microswitch, otherwise reconnect plug P50.

CAUTION

Do not extend heads past the cam tower or they will slam together, resulting in head damage.

6. Manually move the head carriage slightly forward. The microswitch should transfer (click heard) within 0.059 and 0.061 inch of travel from the fully retracted position. This can be measured with a dial indicator or with an inside caliper and feeler gauges.

7. If the step 6 check indicates the microswitch is out of adjustment, loosen the two screws that hold the switch mounting bracket to the way assembly, position the head carriage 0.060 inch from the fully retracted position, adjust the microswitch untl the contacts just transfer, and tighten the screws. Check microswitch adjustment by repeating step 6.

8. Reinstall the maintenance access cover.

3.7.2 OFF-RACK MICROSWITCH AND ADJUSTMENT

The Off-Rack Microswitch adjustment is performed in the following manner for checkout and adjustment.

1. Set the POWER ON/OFF switch to OFF, remove the disc pack, and make sure the heads are fully retracted.

2. Remove the maintenance access panel inside the air shroud (four slotted screws).

3. Disconnect plug P51 from the microswitch and measure contact resistances of the microswitch with a ohmmeter.

   a. Between NO and C lugs (should be open).

   b. Between NC and C lugs (should be shorted).

4. Actuate the microswitch manually and remeasure contact resistances to see if transfer occurs.

   a. Between NO and C lugs (should be shorted).

   b. Between NC and C lugs (should be open).

5. If a faulty microswitch was detected in steps 3 and 4, replace the microswitch. Otherwise, reconnect plug P51.

CAUTION

When the heads are extended past the cam tower, the head pads must be protected from making physical contact with each other. This is done by placing folded Kimwipes (at least four thicknesses) between opposing heads and moving them out slowly sothat they come together gently.

6. Protect the heads and move them off the cam tower slowly until they are resting on each other. Then move the carriage until contact is made with the forward end stop. The microswitch should transfer (click heard) within 0.000 and 0.005 inch before the carriage contacts the end stop. This measurement can be checked with feeler gauges.

7. If the step 6 check shows the microswitch to be out of adjustment, loosen the two screws that hold the switch mounting bracket to the way assembly, position the head carriage 0.0025 inch from the end stop, adjust the microswitch until the contacts just transfer, and tighten the screws. Check microswitch adjustment by repeating step 6.

8. Retract the heads manually and remove the tissue pads as the heads are cammed apart. Inspect the heads for contamination, and reinstall the maintenance access cover.

3.7.3 COVER LID SPRING ADJUSTMENT

The cover lid is held in the raised position by a torsion spring at the bottom of the lid. This spring, when adjusted properly, will maintain the lid in any position from half open to fully open. To adjust spring tension, proceed as follows:

1. Remove the air shroud assembly (refer to paragraph 4.2.2).

2. Put the lid in its half-open position, and tighten or loosen the self-locking nut on the underside of the right-hand spring keeper.

3. Lower the lid then raise it to the half-open position. The lid should remain in this position, if not, repeat step 2.

3.7.4 LID-CLOSED MICROSWITCH CHECKOUT AND ADJUSTMENT

The lid-closed microswitch is located beneath the air shroud and is actuated by a pin on the underside of the cover lid when the lid is closed. If the switch is suspected of faulty operation or misadjustment, proceed as follows:

1. Unplug connector P/J30.

2. Measure contact resistances of the microswitch at connector J30 by using an ohmmeter. (See Figure 3-9 for connector pin locations.)

   With cover open:

   Between pins 4 and 5 (should be shorted)

   Between pins 5 and 8 (should be open)

   With cover closed and latched:

   Between pins 4 and 5 (should be open)

   Between pins 5 and 8 (should be shorted)

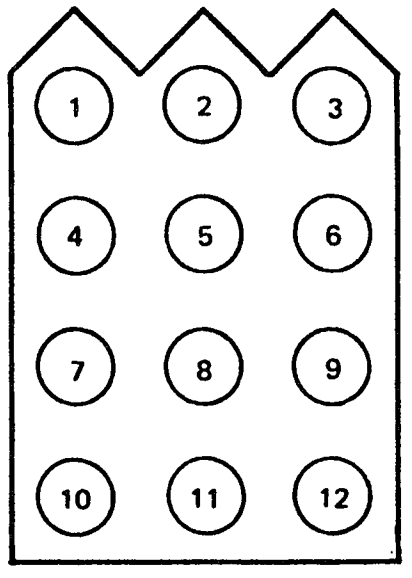


Figure 3-9. Connector J30 Pin Locations

3.7.5 SPINDLE LOCK ASSEMBLY ADJUSTMENT

1. Set the PWR ON/OFF switch to OFF.

2. Remove the maintenance access plate inside the air shroud (four slotted screws).

3. Loosen both screws (Figure 3-10) that secure the spindle lock to the base plate.

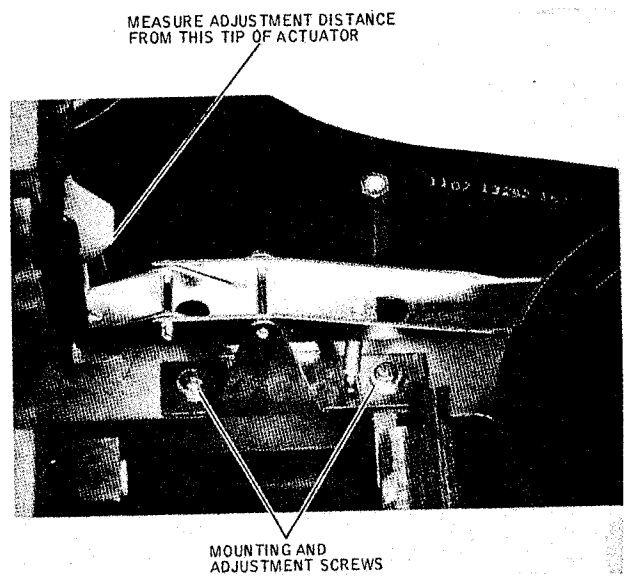


Figure 3-10. Spindle Lock Assembly

4. Adjust the spindle lock level mounting bracket for 7.100 ± 0.010 inches from the centerline of the spindle to the tip of the actuating button closest to spindle center. Tighten both screws to 100 inch-ounces.

5. Install a disc pack and cover on the spindle, and observe that the spindle locks with a pack cover on.

6. Remove the pack cover and observe that the spindle is free to rotate.

7. Remove the disc pack and install the maintenance plate.

3.7.6 SPEED TRANSDUCER CHECKOUT AND ADJUSTMENT

The Speed Transducer is a magnetic pickup coil located adjacent to the spindle pulley that generates one speed pulse per revolution of the spindle. The pick-up is from a carbon steel pin embedded in the spindle pulley over which the transducer is aligned. Transducer adjustment is usually necessary only if there has been shipping dmage or if the transducer has been replaced.

1. Set the PWR ON/OFF switch to OFF.

2. Extend the disc drive. Remove the bottom maintenance access cover.

3. Rotate the spindle pulley manually and check for noises that would indicate that the transducer is rubbing against the spindle pulley. If the transducer is rubbing, go directly to step 5.

4. Using nonmagnetic shim material as a feeler gauge, check the gap between the transducer and the carbon steel pin in the spindle pulley. It should be 0.006 $\pm$ 0.001 inch, as indicated in Figure 3-11. Also check that the end of the transducer coil is aligned with the pin.

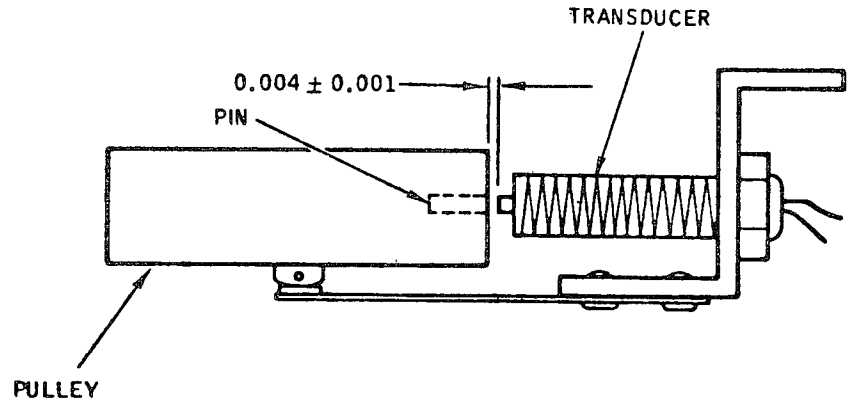


Figure 3-11. Speed Transducer Gap Limits

5. To adjust the gap between the transducer and the spindle, loosen the locknut on the bracket end of the transducer, turn the threaded transducer to move the transducer toward or away from the spindle until it lightly contact a feeler gauge of 0.006-inch-thick nonmagnetic shim stock, and tighten the locknut. Check output at connector backplane pin 6B 13. If a minimum of 5.0 volts cannot be attained with this new adjustment, replace the transducer.

6. Replace the bottom access cover and return the unit to its normal position.

3.7.7 MOTOR BOBBIN ALIGNMENT

The motor bobbin inside the linear motor is attached to the T-block and held in alignment by four screws (Figure 3-12). Bobbin alignment should not be necessary unless there has been shipping damage or the linear motor has been replaced. To align the bobbin, proceed as follows.

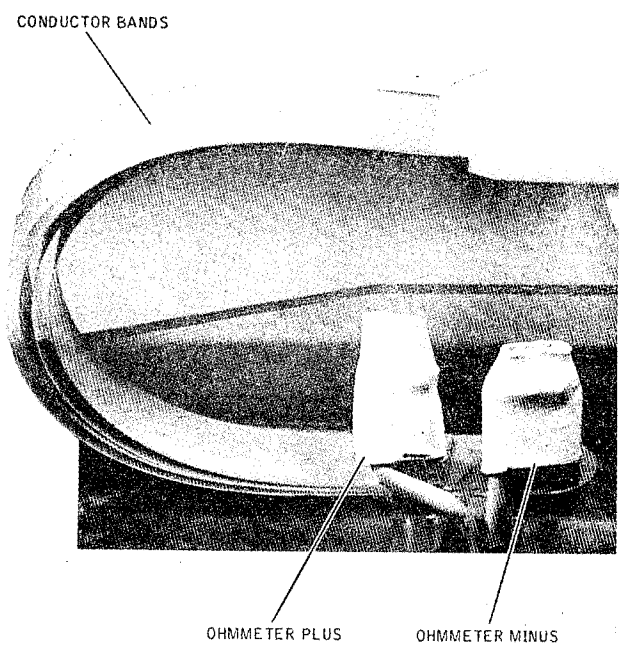


Figure 3-12. Bobbin Mounting Screw Location

1. Set the PWR ON/OFF switch to OFF.

2. Remove the rear cover and the transparent air shroud.

3. Swing out the logic card cage and power supply assemblies.

4. Make sure the carriage is fully retracted, and loosen the four bobbin-retaining screws (just enough so that the bobbin can be moved with the fingers).

5. Cut four 3/4 inch wide shims from filing card or punch card stock. These should be at least four inches long.

6. Placed folded Kimwipe tissue pads (at least four thicknesses) between opposing heads to cushion the head pads, and move the heads out slowly so that they come together gently and just clear the camming tower.

7. Place the four paper shims between the bobbin and the linear motor housing lengthwise; space them evenly around the bobbin.

CAUTION

Make sure that the shims protrude far enough beyond the T-block end of the bobbin that they can be pulled out after alignment is complete. Otherwise, removal of the entire linear motor may be necessary to retrieve them.

8. Move the heads back to the retracted position; make sure that the shims are clearly in sight.

9. Tighten and torque the four bobbin-retaining screws to 100 inch-ounces.

10. Remove the four paper shims.

11. Replace the Kimwipe tissue pads between the heads, let them come together gently, and check for any indication of bobbin drag over the full distance of carriage travel.

12. Move the heads back to the retracted position; remove the pads as the heads cam apart. Inspect the heads for lint, and clean them in place if necessary.

13. Close and secure the logic card cage and power supply assemblies; reinstall the transparent air shroud and rear cover.

3.8 CLEANING AND PREVENTIVE MAINTENANCE

Cleanliness is probably the single most important element in the maintenance program for the disc drive. With the exception of the read/write heads, cleaning operations are normally limited to the use of lint-free cloths dampened with a solution of 91 percent isopropyl alcohol. The disc pack and the mechanical assemblies are cleaned with this solution and then wiped dry with the lint-free cloth. The exterior panels of the drive and the disc access cover may be cleaned with a soft detergent, wiped with a damp cloth, and then wiped dry.

CAUTION

Do not use abrasive cleaners and chemical cleaning agents that contain acetone, toluene, xylene, or benzene. These cleaners may cause equipment damage that requires major repair.

Table 3-3 gives the monthly periodic maintenance procedures while Table 3-4 gives the semi-annual procedures.

TABLE 3-3. MONTHLY PREVENTIVE MAINTENANCE SCHEDULE

Component	Procedure	Remarks
External cabinet surfaces	Clean	Use soft cloth and commercial (soft) detergent.
Disc packs	Inspect	Inspect packs; clean only if visible contamination is present or if read errors have been observed.
Read/write heads check	Inspect	Refer to paragraph 3.8.1.
Power Supply	Test	Refer to paragraph 3.8.3.
Air shroud	Clean	Refer to paragraph 3.8.4.
Spindle surface	Inspect, clean, and lubricate	Refer to paragraph 3.8.5.
Spindle grounding brush	Check resistance	Refer to paragraph 3.8.2.
Intake air filter	Clean	Refer to paragraph 3.8.6.

TABLE 3-4. SEMI-ANNUAL PREVENTIVE MAINTENANCE SCHEDULE

Component	Procedure	Remarks
Perform all Monthly Preventive Maintenance Procedures		
Internal cabinet surfaces	Clean	Use a soft brush or vacuum cleaner or both.
Absolute air filter	Replace	Refer to paragraph 4.2.1.
Read/write circuits Carriage and Way	Check alignment	Refer to paragraph 3.6.1.
Spindle drive circuits	Check operation	Refer to paragraph 3.7.5.

3.8.1 READ/WRITE HEADS CHECK

For routine head maintenance, inspect the read/write heads while they are in place for contamination. Proceed as follows.

1. Make sure that the Disc Drive is powered down. Open the Disc Drive lid and remove the disc pack.

2. Remove the rear cover from the unit and remove the four screws that hold the transparent air shroud. Remove the shroud for access to the heads.

3. Move the carriage outward by hand no more than 3/8 inch to separate the heads for easier inspection. Hold the carriage in this position.

CAUTION

The head spring arms against the cam surfaces tend to pull the carriage further outward if not restrained and cause the heads to crash together. In step 4 do not touch the head surfaces with the inspecting tools.

4. Using a pen flashlight or other light source and a dental mirror, inspect each head for possible damage and contamination .

5. If a head has been damaged, it must be replaced. Refer to paragraph 4.2.12 for the head removal procedure. Dirty heads can usually be cleaned in place by following the head cleaning procedure given in paragraph 3.8.7.

6. After inspection is complete, return the heads to the fully retracted position and reinstall the transparent air shroud.

3.8.2 SPINDLE GROUNDING BRUSH AND BELT CHECK

The spindle grounding brush provides a ground for static discharge of the disc pack and spindle.

1. Remove the front black door on the front of the Disc Drive so that the bottom access cover can be reached.

2. Remove the bottom access cover.

3. Check the resistance between the spindle contact arm (Figure 3-13) and the spindle. Resistance must be less than one-half ohm. If the resistance is too high, replace the grounding brush (refer to paragraph 4.2.18).

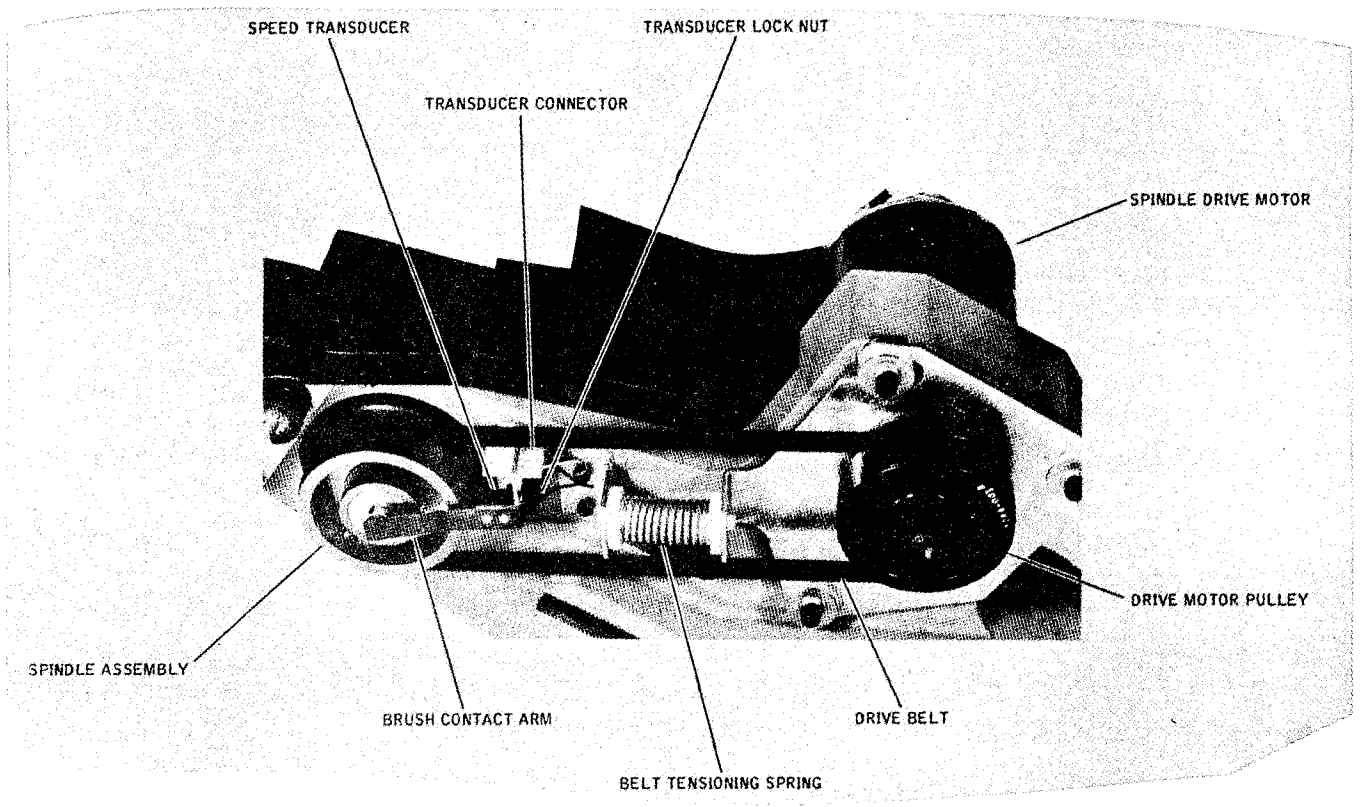


Figure 3-13. Spindle Drive Component Checks

4. Inspect the spindle drive belt (Figure 3-13) for fraying or other damage. If damage or belt stretch is apparent, replace the drive belt (refer to paragraph 4.2.6).

5. Replace the bottom access cover and return the Disc Drive to its normal position.

3.8.3 POWER SUPPLY CHECKOUT

Using a digital voltmeter, check the power supply voltages at power supply printed circuit board connector J10 as indicated in Table 3-5. The PWR ON/OFF switch must be turned ON. See Figure 3-14 for test point locations.

TABLE 3-5. POWER SUPPLY VOLTAGE CHECK

CONNECTOR J10

From Pin	To Pin	Output
02	01 (+)	+30 to +35V
02	03 (-)	-30 to -35V
09	04 (+)	+0.8 to +10.5V

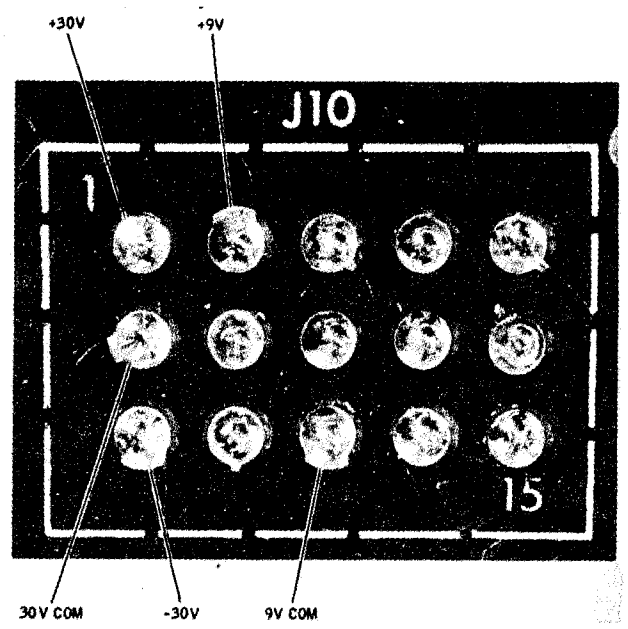


Figure 3-14. Dc Voltage Check Points

Alternatively, these voltages may be checked at the fuse block located on the frame base beneath the card cage assembly. Check voltages at these fuses with reference to dc ground (card cage terminal E11).

There are no power supply adjustments for these voltages. If any one is out of tolerance, the power supply should be replaced (refer to paragraph 4.2.10).

3.8.4 CLEANING THE DISC PACK AREA

1. Open the pack area lid and remove the disc pack.
2. Wipe the inside of the air shroud (Figure 3-15) with a lint-free cloth dampened with alcohol. Wipe it dry and remove all residue.

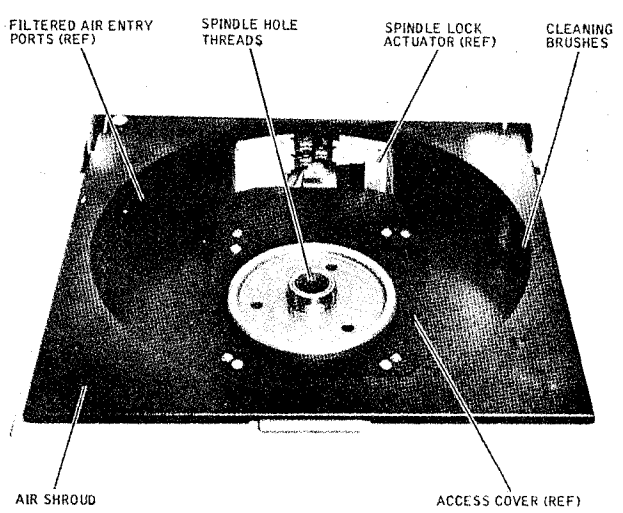


Figure 3-15. Disc Pack Area Components

3. Clean the inside of the pack area lid with the alcohol-dampened cloth. Wipe it dry and remove all residue.

4. Inspect the lid gasket for evidence of deterioration and wipe the gasket clean, if necessary.

3.8.5 CLEANING AND LUBRICATING THE SPINDLE

1. Open the pack area lid and remove the pack.

2. Inspect the spindle (Figure 3-15) for dirt or other contamination and for wear.

CAUTION

Do not saturate the spindle surface with alcohol. Alcohol runoff into the spindle bearing will cause damage.

3. Clean the spindle surface with alcohol and a lint-free cloth, and wipe the surface dry.

4. Use a lint-free cloth to remove contamination and grease from the threads of the spindle hole. Use a dry lint-free cloth to soak up any remaining alcohol.

5. Apply a light coat of Molybdenum Grease to a lint-free cloth, and lubricate the threads of the spindle hole. Do not allow lubricant to get on the surface of the spindle.

6. Place a disc pack on the spindle to make sure that it can be installed and removed easily.

7. Operate the spindle lock by hand to verify that it engages and disengages freely.

3.8.6 CLEANING THE INTAKE AIR FILTER

The intake air filter is a foam filter element located behind the Basic Four logo on the front cover. It prefilters all air going to the blower and should be cleaned monthly, as follows.

1. Remove the front cover to gain access to the intake filter.

2. Pull out the foam filter element from its recess in the front of the unit; wipe the inside of the recess with a damp, lint-free cloth, and dry the recess well.

CAUTION

Do not operate the machine with the intake air filter removed. This will cause the absolute air filter inside the unit to load up prematurely.

3. Wash the foam filter element in a weak solution of detergent in warm water, rinse the element thoroughly in cold water, and blow the element absolutely dry with air before reinstalling it.

4. Reinstall the clean, dry filter element (or a new filter element if deterioration had occurred) in the filter recess, and replace the front cover.

3.8.7 CLEANING THE READ/WRITE HEAD (Figure 3-16)

1. Dampen a lint-free cloth with Freon TF and clean the contaminated head pad surface.

2. Dry the head pad with a lint-free cloth.

3. Reinspect the head pad to make sure that the head is clean and free of residue. Also check adjacent heads to be sure they have not been contaminated by the cleaning operation.

4. If oxide cannot be removed in this way, the head will have to be removed for more thorough cleaning or for replacement.

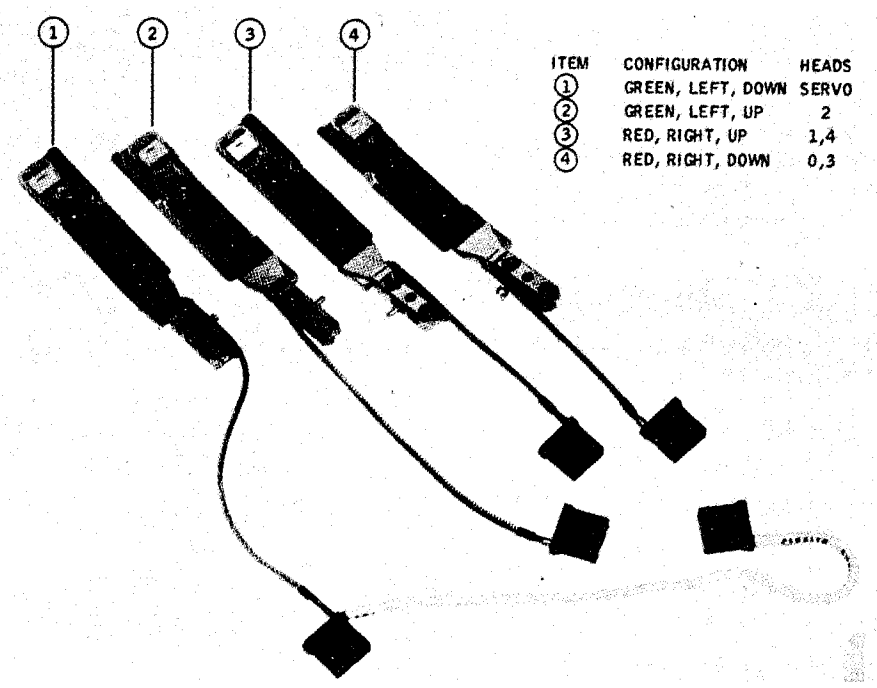


Figure 3-16. Read/Write Heads

CHAPTER 4

REMOVAL/REPLACEMENT PROCEDURES

4.1 SPARE PARTS LIST

TABLE 4-1. REPLACEMENT PARTS FOR DISC DRIVE

Item No.	MM Number	Manufacturer Part Number	Part Description
1	240010	12449-002	Assy, Power Supply 115V
2	240040	15847-001	PCB, Logic II
3	240080	18752-001	PCB, Servo Control T-80
4	240090	12452-002	Assy, Sequence Relay 115V
5	240330	R6060RGB3001R	Head, R/W 01, T-80
6	240340	R6060RGB4001R	Head, R/W 00,03, T-80
7	240350	R6060RGA1002	Head, R/W 02, T-80
8	240360	R4040NSA2002R	Head, Servo
9	240420	17589-001	PCBA, Read/Write Matrix
10	240430	17530-001	PCB, Data Separator T-80
11	240440	17771-001	PCBA, Read Limiter
12	240450	19508-001	PCB, Logic III (N/S)
13	240460	903050	PCB, Logic I (2530) 35MB
14	240470	100575	PCB, Terinator
15	248010	1233275G-001	Filter, Absolute

TABLE 4-1. REPLACEMENT PARTS FOR DISC DRIVE

Item No.	MM Number	Manufacturer Part Number	Part Description
16	248020	12560-001	Filter, Preliminary
17	249010	12427-001	Extender, PCB
18	249021	17209-001A	Head Positioning Tool O/S
19	249030	97769-001	Head, Positioning Tool N/S
20	249040	TS-100 UTICA	Torque Wrench, Head Mount
21	249050	97722-001	Pin Safety
22	249060	13445-001	Tach Rod Insert/Remo. Tool
23	249070	13484-001	Tool, Way Roll Adjust
24	249080	13484-001	Tool, Carriage & Way Align
25	249090	99129-001	Wrench, Way Screw
26	249100	12541-001	T80-CE Pack
27	249110	96803-001	Read Camming Tool
28	249130	1QS-6-PU	Way Torque Driver
29	249140	13378-001	Head Wright Set
30	249150	TAN	Shim, 004+/-001 NON MAG
31	249190	BH 3/32	Hex Key (Ball 3/32)

4.2 REMOVAL/REPLACEMENT PROCEDURES

4.2.1 REPLACING THE ABSOLUTE AIR FILTER

The absolute air filter inside the disc drive should be replaced every six months of normal use or more often in extreme environments. To replace this filter, proceed as follows.

1. Set the PWR ON/OFF switch to OFF, and remove the front and rear covers from the unit.

2. Open the pack area lid, remove the disc pack, and make sure that the heads are fully retracted.

3. Remove the air shroud assembly with its absolute air filter attached by following the air shroud removal procedure in paragraph 4.2.2.

4. Remove the three screws (one upper and two lower) that attach the rectangular air filter end cap to the air shroud, and lift out the air filter element.

5. Install a new filter element; make sure that the air flow is correct (arrow on the filter element should point to the rear of the assembly) and reintall the end cap with the three screws.

6. Reinstall the air shroud assembly, intake air filter, rear cover, and front cover.

4.2.2 AIR SHROUD ASSEMBLY REMOVAL

Access to certain parts and assemblies of the disc drive, such as the blower, spindle, and the absolute air filter, require the removal of the air shroud assembly with its attached lid. To remove and reinstall the air shroud assembly, proceed as follows.

1. Remove the disc pack, if applicable, and verify that the heads are fully retracted.

2. Set the PWR ON/OFF switch to OFF, and remove the front panel and rear cover from the disc drive.

3. Remove the front air intake (foam) filter element for access to the two screws, on the left-hand side of the filter recess, that fasten the air shroud to the blower plenum. Loosen these two captive screws.

4. Disconnect the connector leads from the lid-closed microswitch.

5. Raise the lid and remove the four slotted screws from the bottom of the air shroud access cover. Remove the four Phillips screws from the bottom of the air shroud to the standoffs on the deck plate.

6. Lift the air shroud carefully straight up and off.

7. Reinstall the air shroud assembly by following the removal procedures in reverse order. Check that the heads are fully retracted before starting the reinstallation. Also verify that the gasket along the baseplate and head cam tower is not damaged or deformed during installation.

4.2.3 CARD CAGE REMOVAL AND REPLACEMENT

1. Set the PWR ON/OFF switch to OFF.

2. Remove the rear cover.

3. Remove all circuit cards from the card cage. Note their locations for reinstallation.

4. Disconnect all interface cables and the terminator, if present.

5. Disconnect P1 thru P8. Swing the card cage out.

6. Tag and disconnect wires from the backplane.

7. Disconnect the Molex connector near the higed end of the card cage assembly.

8. Remove the ground strap.

9. Remove the restraining cable from the card cage.

10. Remove the card cage from the frame by removing three screws.

11. To install the replacement assembly, reverse the procedure. Be sure that the replacement assembly is positioned so that the hole lines up with the bracket in front of the card cage.

4.2.4 CARRIAGE AND WAY ASSEMBLY REPLACEMENT

The carriage, carriage way, and head mounting T-block are precisely adjusted and aligned at the factory. They must be replaced as an assembly whenever any component wears, becomes misaligned, or is damaged. Replacement because of wear is indicated when the assembly cannot be brough into Carriage and Way Alignment Check tolerances by performing the alignment procedure.

NOTE

This is a precision assembly and is easily damaged and rendered useless if the way bearing surfaces are scratched or if disassembly is attempted. Replacement and alignment require a high level of technical skill. It is recommended that only factory trained personnel attempt replacement. Special tools are also necessary.

To replace the carriage and way assembly, proceed as follows:

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source

2. Unload the disc pack, if installed, and remove the front and rear covers from the disc drive.

3. Remove the transparent air shroud, disconnect and remove all heads from the T-block, and store the heads safely.

4. Remove the air shroud assembly.

5. Remove the Read/Write Matrix board.

6. Remove the four screws, lockwashers, and flat washers that hold the head cam tower to the deck plate, and remove the cam tower.

7. Disconnect plugs P50 and P51 from the carriage-actuated microswitches, and remove the two microswitches with their mounting brackets attached. Remount the microswitches on the replacement assembly; torque the mounting screws to 100 inch-ounces.

8. Remove the four screws that attach the carriage to the linear motor bobbin. Note the position of the grounding wire for later reassembly.

9. Remove the three bolts and lockwashers that hold the carriage and way assembly to the deck plate, and carefully remove the assembly; tilt it to clear the conductor band support bracket.

CAUTION

Exercise great care in handling the replacement carriage and way assembly. Particularly the coating on the bearing surfaces which is easily damaged by careless tool handling.

10. Clean the mating surfaces of the dewck plate and the replacement carriage and way assembly with alcohol and wipe them dry.

11. Position the replacement carriage and way assembly on the base plate, and reinstall the three mounting bolts; leave them loose.

12. Perform the carriage and way alignment procedure.

13. Reconnect the carriage to the linear motor bobbin with the four screws removed in step 8, and perfpr, the motor bobbin alignment procedure (refer to paragraph 3.7.7).

14. Perform the heads-extended switch checkout and adjustment (refer to paragraph 3.7.1) and the off-rack switch checkout and adjustment procedures (refer to paragraph 3.7.2). Make sure that plugs P50 and P51 are reconnected to the microswitches after adjustment.

15. Reinstall the head cam tower by using the hardware removed in step 6. Torque the mounting screws to 45 inch-pounds.

16. Reinstall and reconnect the Read/Write Matrix board.

17. Reinstall the air shroud assembly.

18. Clean and reinstall the heads in their correct locations. Use the prepositioning tool for initial alignment, and torque the heads to the full 80 inch-ounces.

19. Reconnect the ac powre cable, set the PWR ON/OFF switch to ON, and perform the appropriate steps of the head alignment checkout and adjustment procedure to align the heads.

20. Perform the carriage and way alignment check procedure (refer to paragraph 3.6.1). If carriage and way alignment is out of tolerance, the alignment procedure will have to be repeated. The heads will have to be removed, but not that further disassembly is unnecessary, as the alignment procedure can be carried out through the access cutout in the air shroud.

21. When carriage and way alignment and head alignment check out, replace the transparent air shroud and the two covers.

4.2.5 COVER GASKET REPLACEMENT

1. Remove the air shroud assembly (refer to paragraph 4.2.2) from the drive and the cover lid from the air shroud assembly.

2. Note that the cover gasket is not multipositional but has a slight locating protrusion at the bottom of the cover. The new gasket must be installed in the same position.

3. Reactivate the adhesive that holds the old gasket in place by soaking the edges of the gasket with an activator solution of 92 percent 1.1.1 Trichloroethane and 8 percent isopropyl alcohol by volume.

4. Continue to pry and soa the gasket with activator solution until the gasket is free of the cover.

5. Clean the lid surface free of adhesive with more activator solution, and dry the cleaned surface.

6. Moisten the adhesive side of the new gasket with activator solution, and position it on the cover lid. Verify that the gasket is not deformed by having been stretched and that all edges are held down tight.

7. Reinstall the cover lid and air shroud assembly. Keep the lid closed for several hours to ensure a good adhesive bond.

4.2.6 DRIVE BELT REPLACEMENT

The spindle drive belt is made accessibel by removing the bottom maintenance access cover. Replacement is reuired if there is any evidence of belt deterioration, such as fraying or stretching. Proceed as follows to replace the belt.

1. Set the PWR ON/OFF switch to OFF.

2. Extend the disc drive unit. Remove the bottom access cover.

3. Pull the spindle drive motor toward the spindle and against the tensioning spring to slacken the belt, and slip the belt off the motor pulley.

4. Install a new belt in the same manner as the old belt was removed in step 3.

5. Spin the drive motor, belt, and spindle by hand to make sure that the belt rides in the center of both pulleys.

6. If the belt is not centered on both pulleys, slacken the belt, center it on the spindle pulley, and adjust the motor pulley height as necesswary. There are two setscrews on the motor pulley; one on the key and one on theflat part of the shaft.

7. Repeat step 5. When the belt rides correctly, replace the bottom access plate and return the unit to its normal position.

4.2.7 HEADS-EXTENDED MICROSWITCH REPLACEMENT

If the heads-extended checkout procedure indicates that the microswitch is faulty, replace the switch as follows.

1. Disconnect plug P50 from the microswitch.

2. Remove the two screws that fasten the switch mounting bracket to the way assembly, and remove the microswitch and bracket as a unit.

3. Install the new microswitchon the mounting bracket by using the original switch mounting hardware.

4. Reinstall the microswitch and bracket on the way assembly; leave the two bracket screws slightly loose. Reconnect plug P50.

5. Position the head carriage 0.060 inch from the fully retracted position, adjust the microswitch untl the contacts just transfer, and tighten the bracket screws.

6. Move the head carraige manually betwee the fully retracted position and the microswitch transfer point. The microswitch should transfer within 0.059 and 0.061 inch of ravel. If not, repeat step 5.

7. Reinstall the maintenance access cover.

4.2.8 LINEAR MOTOR REPLACEMENT

Linear motor replacement is necessary, usually, only if the bobbin is defective. The linear motor is supplied as a tested assembly that includes the motor housing, bobbin, front bracket, and conductor bands, but without velocity tachometer components. To replace the linear motor, proceed as follows.

1. Set the PWR ON/OFF switch to OFF, and disconnect the ac power cable from the source.

2. Remove the rear cover and the transparent air shroud. Make sure the heads are fully retracted.

3. Unlatch the power supply assembly and swing it out.

4. Disconnect and tag the two wires to the linear motor conductor band lugs.

5. Remove the tach rod and pickup coil from the linear motor. Refer to the Velocity Transducer Replacement procedure, paragrph 4.2.19.

6. Note the location of the ground wire, and remove the four screws that hold the bobbin to the T-block (Figure 4-1). When reinstalling the bobbin, verify that the ground wire is reconneced, and perform the Motor Bobbin Alignment procedure (paragraph 3.7.7).

CAUTION

Do not remove the T-block from the carriage. The T-block is factory aligned to the carriage and way assembly.

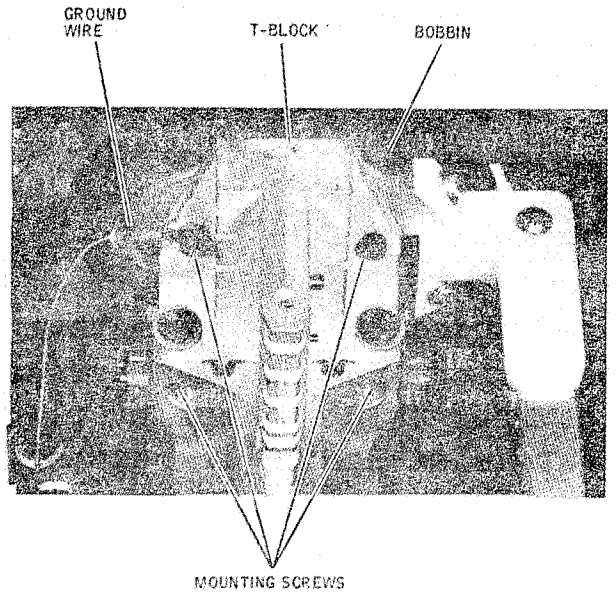


Figure 4-1. Bobbin Mounting Screw Location

7. Placed folded disposable tissue pads (at least four thicknesses) between opposing heads to cushion the head pads, and move the head out slowly so that they come together gently. Move the carriage forward to get it out of the way.

8. Remove the four screws that hold the linear motor to the deck plate. torque the screws to 80 inch-pounds when reinstalling them.

9. Lift the linear motor carefully straight up and out (a two-man job). Watch your fingers during replacement.

10. To install the replacement linear motor, reverse the procedure. Make sure that themating surfaces of the linear motor and deck plate are clean and that the linear motor is positioned squarely over the deck plate locating pins. The motor bobbin must also be aligned as per step 6.

4.2.9 OFF-RACK MICROSWITCH REPLACEMENT

If the Off-Rack Microswitch Checkout procedure indicates that the microswitch is faulty, replace the switch as follows.

1. Disconnect Plug P51 from the microswitch.

2. Remove the two screws that fasten the switch mounting bracket to the way assembly, and remove the switch and bracket as a unit.

3. Install the new microswitch on the mounting bracket by using the original switch mounting hardware.

4. Reinstall the microswitch and bracket on the way assembly; leave the two bracket screws slightly loose. Reconnect plug P51.

CAUTION

When the heads are extended past the cam tower, the pads must be protected from making physical contact with each other. This is done by placing folded disposable (at least four thicknesses) between opposing heads and moving them out slowly so that they come together gently.

5. Protect the heads and move them off the cam tower slowly until they are resting on each other. Then move the carriage until contact is made with the forward end stop.

6. Position the head carriage 0.0025 inch away from the end stop, adjust the microswitch until the contacts just transfer, and tighten the bracket screws.

7. Move the head carriage manually between the end stop and the microswitch transfer point. The microswitch should transfer within 0.000 and 0.005 inch of the end stop.

8. Retract the heads manually, and remove the tissue pads as the heads are cammed apart. Inspect the heads for contamination, and reinstall the maintenance access cover.

4.2.10 RELAY ASSEMBLY REPLACEMENT

The Sequency Relay Assembly is located between the blower and the spindle drive motor. It is hinged to the frame assembly so that it can be swung out for service. See Figure 4-2 for locations of major component parts. To remove and reinstall the relay assembly as a unit, proceed as follows.

1. Set the PWR ON/OFF switch to OF, and disconnect the ac power cable from the source.

2. Remove the front cover.

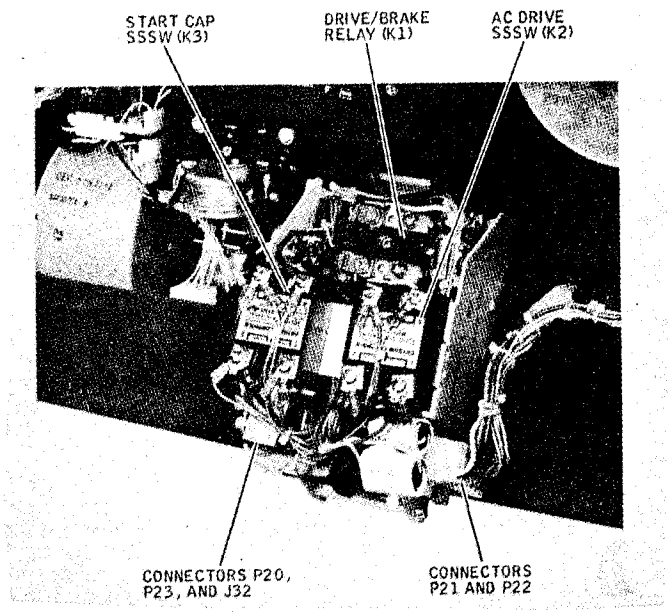


Figure 4-2. Sequence Relay Assembly Component Locations

3. Swing the relay assembly out to its service position, and disconnect connectors P20, P21, P22, P23, and J32. Clip any ties that attach the cables to the relay assembly.

4. Swing the relay assembly in, but not fully. Using a flathead screwdriver, spring the left-hand hinge from its pivot pin and remove the relay assembly.

5. To install the replacement relay assembly, reverse this procedure.

4.2.11 POWER SUPPLY REMOVAL/REPLACEMENT

If power supply voltage checks given in paragraph 3.8.3 indicate that outputs are out of tolerance, the power supply must be removed for replacement. To remove and replace the power supply, proceed as follows.

1. Disconnect the disc drive ac power cable from the power source, and remove both front and rear covers.

2. Diconnect and tag the two wires coming from the Ac Input Control Assembly at power supply terminal board TB2, terminals 1 and 2.

3. Disconnect plug P21 from the Sequence Relay Assembly (cut the harness ties as necessary).

4. Loosen the captive retaining screw that secures the power supply in its normal position, and swing out the power supply on its hinges.

5. Disconnect plugs P10 and P13 from the botto side of the power supply assembly.

6. Disconnect the two wires from the bobbin conductor band terminals.

7. Disconnect the two green wires from the ground stud under the front of the power supply chassis.

8. Slide the power supply assembly off its hinges and remove it.

9. To install the replacement power supply, reverse this procedure. Make sure that the connection from chassis ground to logic ground is reinstalled properly and that the voltage select jumper on terminal board TB2 matches the available voltage.

4.2.12 READ/WRITE HEAD REMOVAL/REPLACEMENT

NOTE

Certain procedures in this book call for manually extending the heads without a pack. When this is done, folded strips of lint-free disposable tissues should be placed between the facing heads, and the heads should be moved slowly outward so that they contact one another as gently as possible.

To remove a read/write head or the servo head for thorough bench cleaning or replacement, proceed as follows.

1. Power down the disc drive and remove the disc pack.

2. Remove the rear cover, set the INTERFACE/DEGATE switch to DEGATE and the PWR ON/OFF switch to OFF.

3. Take out the four screws that secure the transparent air shroud covering the carriage assembly and cam tower, and pull the shroud straight up and off.

4. Remove the head cable plug retainer from the Read/Write Matrix board, and disconnect the cable plug of the head being removed.

CAUTION

Do not overflex the head arm when installing the head camming tool during the next step, or permanent damage to the head will result.

5. Install the head camming tool on the head assembly to be replaced as shown in Figure 4-3.

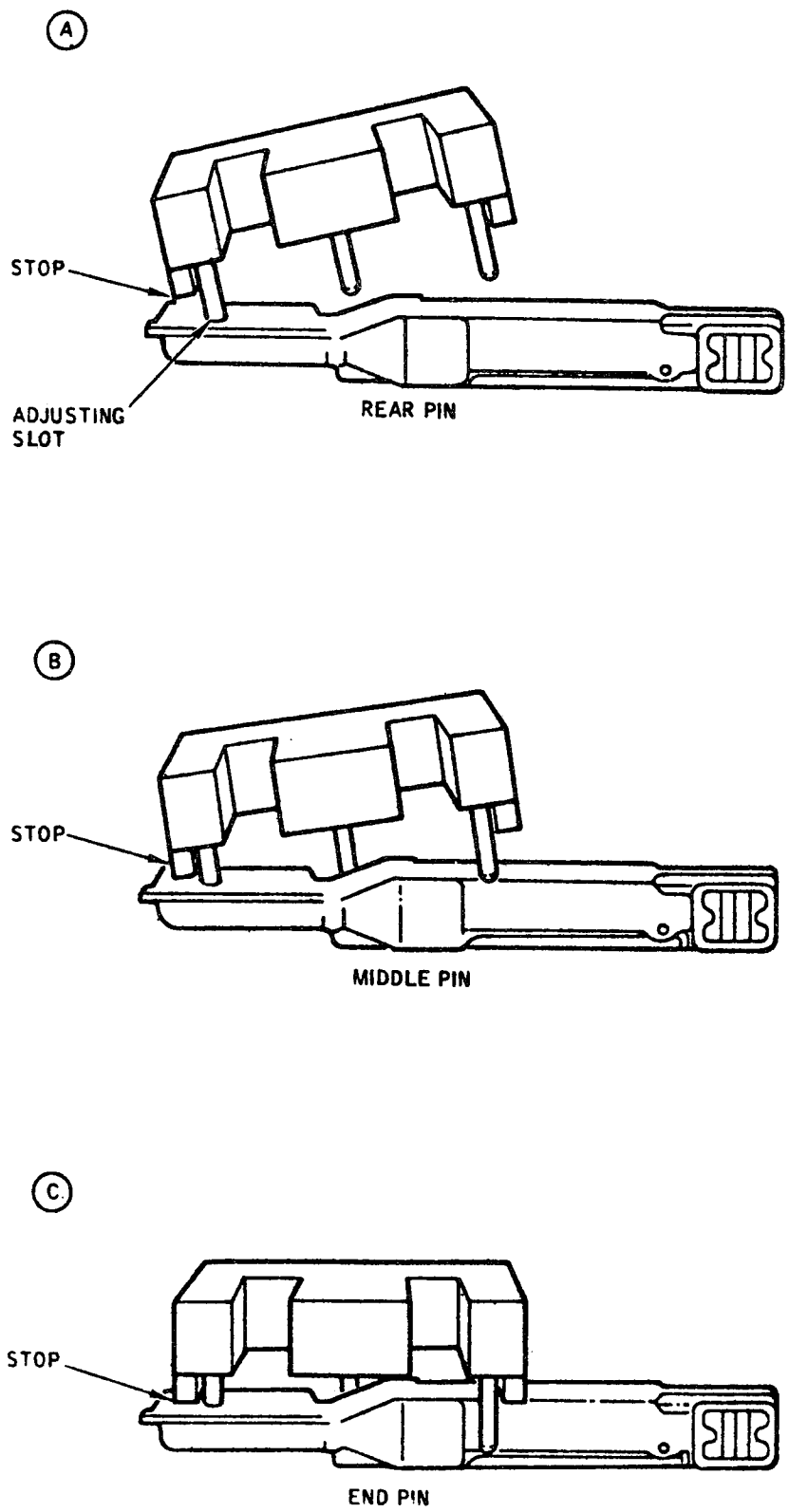


Figure 4-3. Head Camming Tool Installation

6. Unscrew the mounting screw that attaches the head assembly to the carriage T-block. Carefully remove the head.

To install a read/write head after bench cleaning and inspection (or to replace a head), proceed as follows.

CAUTION

Do not overflex the head arm when installing the the head camming tool during the first step, or permanent damage to the head will result.

1. Install the head camming tool on the head assembly to be replaced, as shown in Figure 4-3.

2. Insert the head assembly with the camming tool installed in the correct position by setting the arm on the proper cam and then sliding the head to the rear so that both front and rear tangs on the head mount mate with the proper T-block slots on the carriage assembly (Figure 4-4).

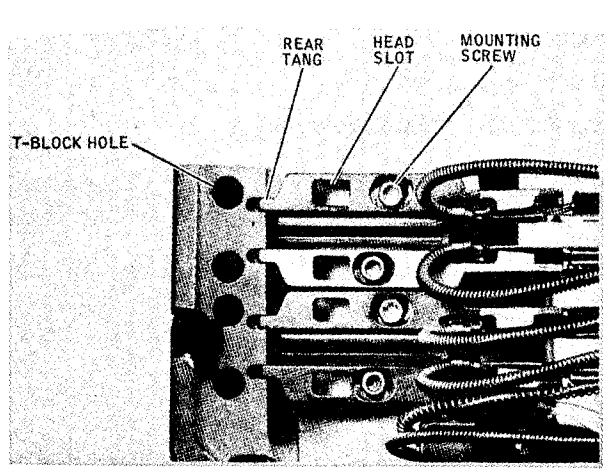


Figure 4-4. Head Positioning and Mounting Components

CAUTION

If the arm is allowed to slide forward toward the spindle during any of the following steps, the rear tang may disengage from the T-block slot. If this occurs, the head can rotate and slam into the opposing head, resulting in damage to both heads.

3. While holding the head firmly against the T-block, remove the head camming tool.

4. Install the two-prong prepositioning tool in the hole in the T-block and the slot in the head mount, and tighten the head mounting screw just tight enough to hold the head in place. Remove the tool.

5. Connect the head cable plug to the appropriate head receptacle on the Read/Write Matrix board, and secure it with the cable plug retainer after all heads have been installed.

6. After all heads to be installed have been prepositioned according to steps 1 thru 5, perform the head alignment checkout and adjustment procedure (refer to paragraph 3.6.1).

4.2.13 SERVO HEAD INSTALLATION

The servo head is installed with the head camming tool in a manner similar to the other read/write heads. However, the T-block has a positioning pin in the servo head locatin that makes the use of the prepositioning tool unnecessary. When installing the servo head, locate the head mount over the positioning pin, press the head rearward (into the T-block) against the pin, and tighten the securing screw with the head torque wrench to 80 inch-ounces.

When the servo head position has been disturbed by removal and replacement of the head, all other read/write heads must be realigned to the new servo head position by performing the head alignment checkout and adjustment procedure.

4.2.14 SPINDLE LOCK ASSEMBLY REPLACEMENT

If the Spindle Lock Assembly (Figure 4-5) cannot be adjusted properly replace assembly.

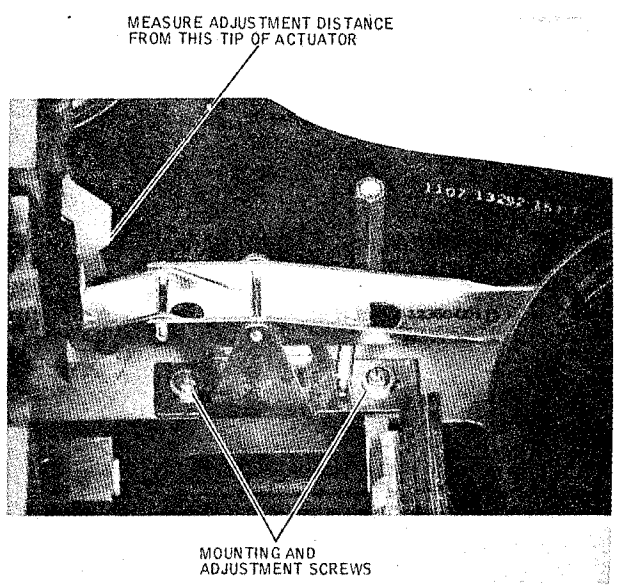


Figure 4-5. Spindle Lock Assembly.

1. Set the PWR ON/OFF switch to OFF.

2. Remove the maintenance access plate inside the air shroud (four slotted screws).

3. Remove the spindle lock assembly (Figure 4-5).

4. Install the replaement spindle lock assembly with hardware removed

5. Perform the Spindle Lock Assembly Adjustment procedure (refer to paragraph 3.7.5).

4.2.15 SPINDLE DRIVE MOTOR REPLACEMENT

The spindle drive motor is a single-phase, capacitor-start motor that provides high starting torque at low speed. A thermal cutout switch protects the motor against overheating. Repeated starting and stopping during troubleshooting may trip the thermal switch and is not necessarily an indication that the motor is defective. The motor may require up to 1 hour to cool depending on the ambient temperature.

Other drive motor components, such as starting capacitor C1, sequence relay and solid state switches K1, K2, and K3, can also prevent the drive motor from operating and should be checked out before drive motor replacement is consider ed. If the drive motor is defective, replace it as follows.

1. Set the PWR ON/OFF switch to OFF.
2. Remove the front and rear cover.
3. Remove the bottom maintenance access plate.
4. Disconnect P22 from the relay assembly.
5. Pull the drive motor toward the spindle and slip the drive belt from the motor pulley.
6. Remove the motor pulley from the end of the drive shaft.
7. Remove the four bolts that secure the drive motor to its mounting plate, swing out the power supply assembly, and remove the motor from the top.
8. To install the replacement motor, reverse the procedure.
9. Spin the pulley by hand to ensure that the drive belt runs straight and true. If necessary, adjust the vertical position of the pulley.

4.2.16 SPINDLE ASSEMBLY REPLACEMENT

The spindle assembly (Figure 4-6) is a precision unit with sealed bearings that requires an occasional cleaning and relubrication of the pack mounting threads. It should never be removed from the deck plate unless replacement is necessary, as removal requires complete reaignment of the head-positioning system. Replacement of the spindle assembly occurs only if pack mounting or unmounting difficulties are experienced (thread wear) or when bearing wear becomes excessive.

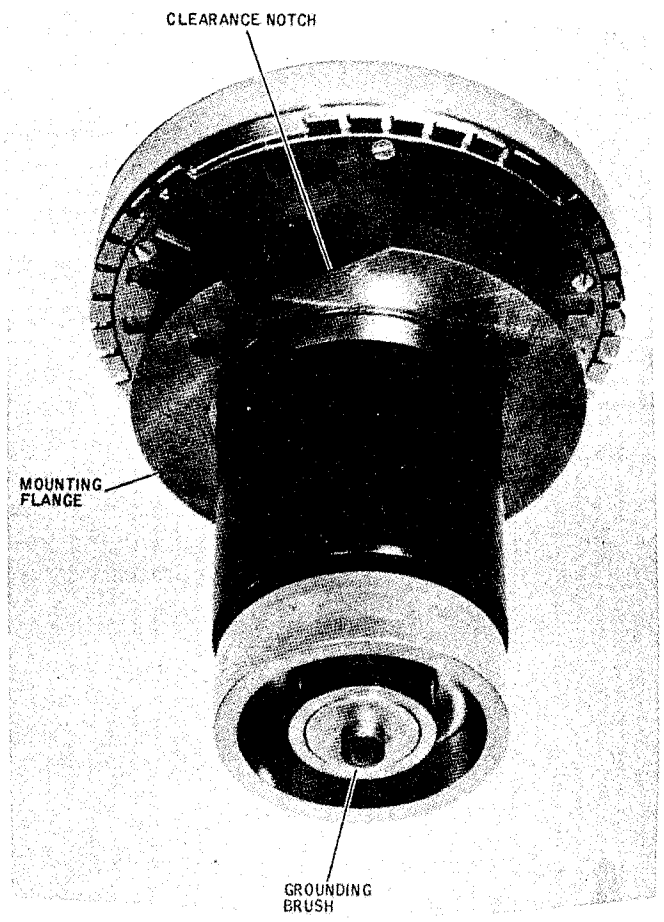


Figure 4-6. Spindle Assembly

To replace the spindle assembly proceed as follows:

1. Set the PWR ON/OFF switch to OFF.

2. Remove the maintenance access plate from the air shroud assembly (four slotted screws).

3. Remove the bottom maintenance access plate.

4. Remove the drive belt.

5. Remove the three bolts that secure the spindle to the deck plate. Clean old Loctite from the bolts.

6. Remove the spindle assembly from the deck plate by pulling the spindle assembly straight up and out.

CAUTION

The spindle and deck plate are machined to extremely close tolerances. Cocking the spindle will result in binding against the deck plate and may damage the machined surfaces.

7. Remove the grounding button and install it on the replacement spindle shaft, or use a new button as required.

8. Clean the deck plate and spindle mating surfaces with Freon TF to remove all foreign matter.

9. Install the replacement spindle. A notch on the spindle mounting flange provides clearance for the spindle lock mechanism during removal and installation. Do not force it!

10. Apply one drop of Locktite, grade C to the threads at the ends of the mounting bolts and install the bolts. Torque the bolts to 80 inch-pounds.

11. Install the drive belt.

12. To adjust the gap between the transducer and the spindle, loosen the locknut on the bracket end of the transducer. Turn the threaded transducer to move the transducer toward or away from the spindle until contacting a feeler gauge of 0.004 inch-thick nonmagnetic shim stock. Tighten the locknut.

13. Perform the spindle lock assembly adjustment procedure (paragraph 3.7.5).

14. Perform the carriage and way alignment check procedure (paragraph 3.6.1).

15. Perform the head alignment checkout and adjustment procedure (paragraph 3.6.1).

16. Reinstall all maintenance access covers.

4.2.17 VELOCITY TRANSDUCER REPLACEMENT

The velocity transducer consists of two components: the tachometer rod (tach rod) and the tachometer rod housing (pickup coil). (See Figure 4-7.)

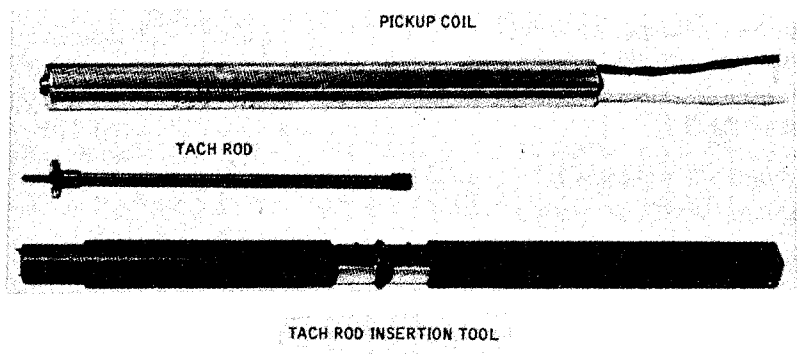


Figure 4-7. Velocity Transducer Components and Tool

Install and remove both of these components through the rear of the linear motor housing. The tach rod is fastened internally to the T-block, while the pickup coil is held stationary inside the linear motor. A spring holds the pickup coil in position. Replace velocity transducer a follows.

CAUTION

The tach rod is very brittle and will break if not handled carefully. Do not use a tach rod that has been dropped; even if it doesn't break, its magnetic characteristics may have been altered.

1. Set the PWR ON/OFF switch to OFF.
2. Remove the rear cover.
3. Swing out the logic card cage assembly.

4. Velocity transducer wires from the rear of the linear motor are connected to the card cage backplane.

5. Make sure that the heads are fully retracted.

6. Remove the velocity transducer retaining place from the rear of the linear motor (two slotted screws).

7. Remove the pickup coil and coil-retaining spring from the motor.

8. Note two pins on one end of the tach rod insertion tool, part no. 249-060. Insert this end of the tool as far as it will go into the linear motor location vacated by the pickup coil.

9. Turn the tool counterclockwise until the two pins engage holes in the tach rod flange. Continue turning it until the tach rod is free of the T-block, and remove the tool and rod together.

10. To install velocity transducer components, reverse this procedure. Place the tach rod inside the tool over the pins to install it. Make sure that the tach rod and tool are fully inserted into the linear motor (to the mark on the tool), and torque the tach rod to 80 inch-ounces with the head torque wrench.

11. When reinstalling the pickup coil, verify that it is inserted into the linear motor as far as it will go. Place the retainer spring over the wire leads, and use care in reinstalling the retainer plate to avoid cutting the leads.

CHAPTER 5

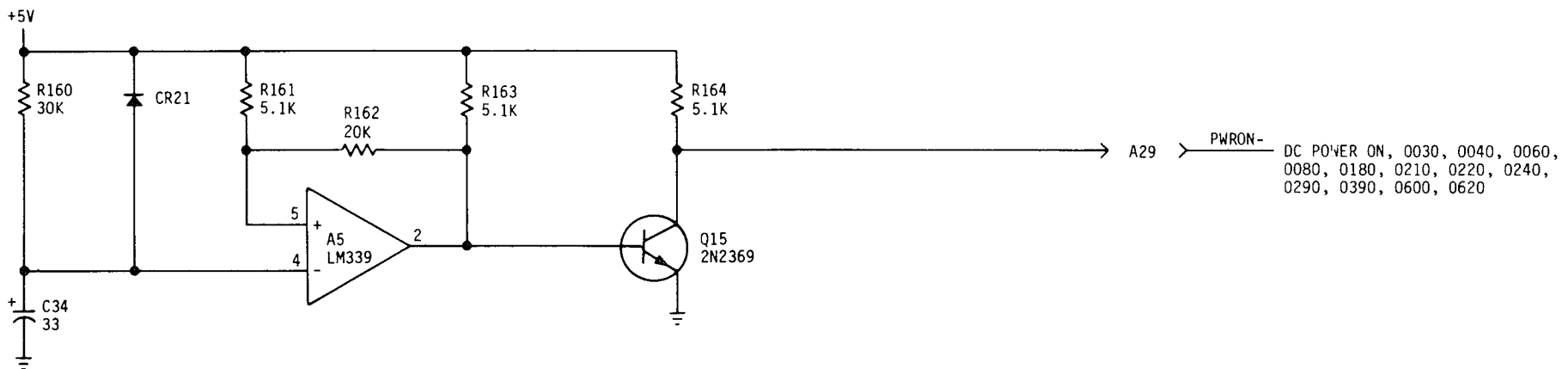
REFERENCE DATA

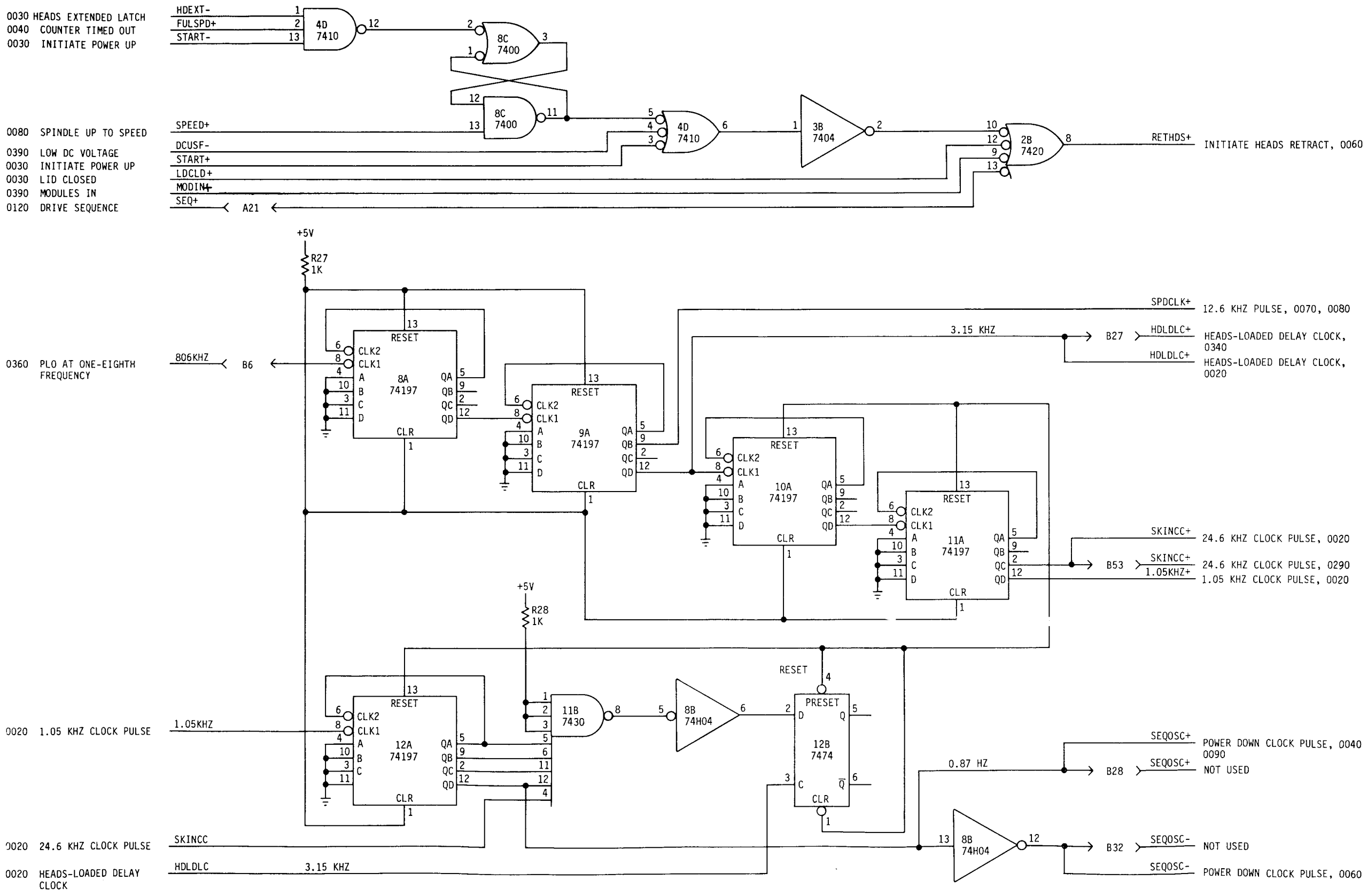
PCBA	Description	Logic Page Number
Servo Cont.	Power On	0010
Logic III	RETHDS, Clocks	0020
Logic III	Start/Stop & Micro Switches	0030
Logic III	Brake Latch, Pack On, RETHD	0040
Timing Chart		0050
Logic III	K1-Drive Motor, K2-AC, K3-Start Pick Signals	0060
Logic III	Up, Down Speed Counter	0070
Servo Cont.	Speed Transducer	0080
Logic III	Speed Counter	
Logic III	Ready, Spindle Alert	0090
Logic I	Bus 0-7	0100
Logic I	Bus 8 & 9, Cyl, Control & Head Address Tag Lines	0110
Logic I	Select Drive, Degate	0120
Logic I	Set Cyl, LD Car, LD Difs.	0130
Logic I	Cylinder Address Reg.	0140
Logic I	Illegal Address for 80 & 35 Mbyte Drives	0150
Logic I	End of Cylinder	0160
Logic II	Head Address Reg	
Logic II	Offset, Offset FWD/REV	1070
Logic I	Offset Start	

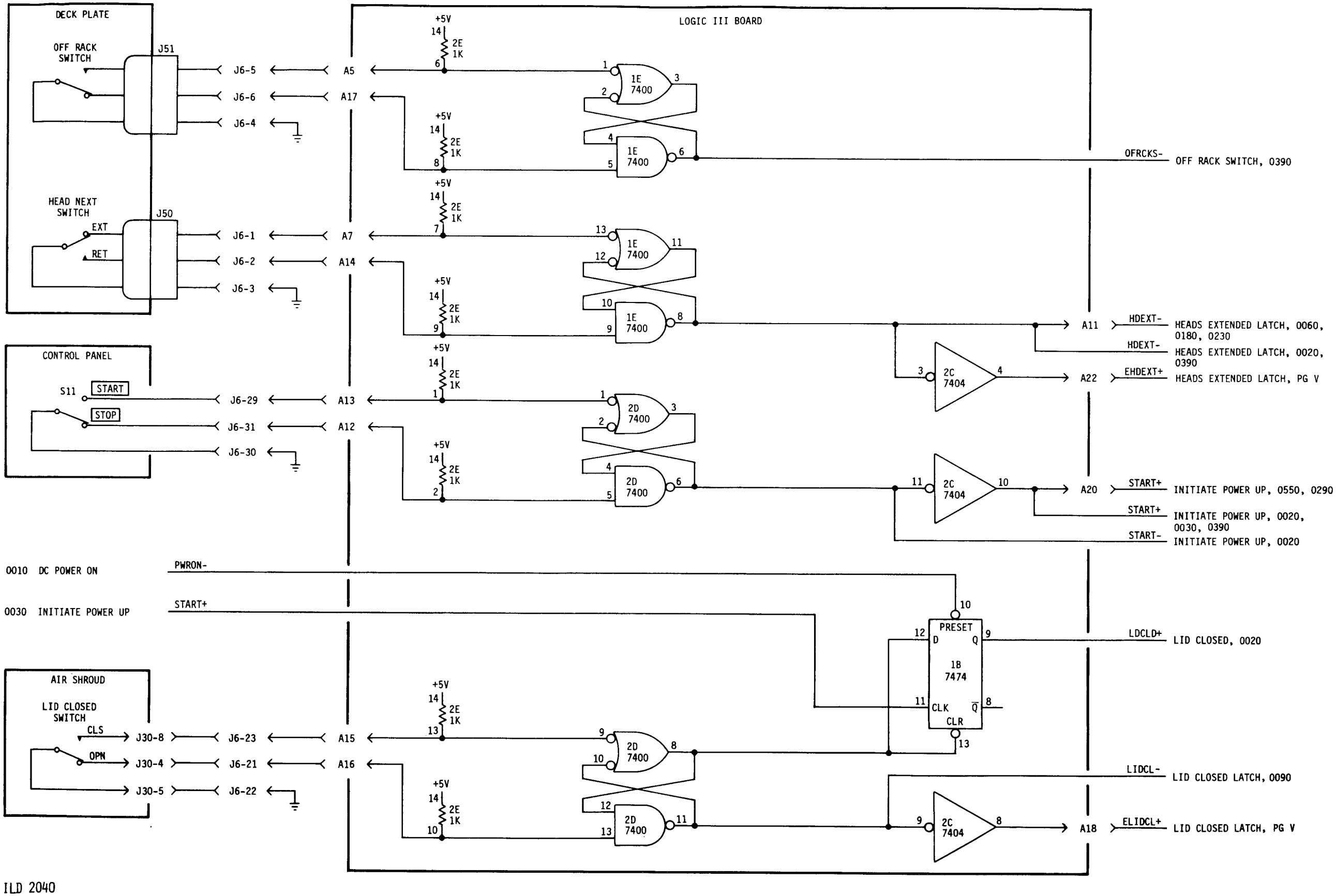
PCBA	Description	Logic Page Number
Logic I	Control Tags & Bus Bits	0180
Logic III	Index Pulse	0190
Logic III	Sector Count	0200
Logic II	Load Speed, Seek Enable	0210
Logic I	Set Forward Control	0220
Logic II	Carriage Forward, Rezero	
Logic II	RETHD, 1st Seek, Track Following Mode	0230
Logic I	Initiate Seek	0240
Logic I	Difference Counter	0250
Logic I	Difference Counter	0260
Logic I	Difference Counter	0270
Servo Control	Fwd./Rev. Voltage	0280
Logic II	RDY, Seek Incomplete	0290
Servo Pre Amp	DIBIT + & - From Servo HD,	0300
Servo Control	Phase Squared DIBITS	0310
Servo Control	Position Error Detect, Hod	0320
Servo Control	UTHP-, UTHM-	0330
Logic II	Difference Counter Clock, Heads Loaded Counter	0340
Servo Control	9.67 MHZ VCO (103.3 NSEC)	0350
Servo Control	1.6 MHZ, 806 KHZ, 403 KHZ Clocks	0360
Servo Control	Velocity Transducer	0370
Servo Control	Servo Drive + and -	0380
Logic III	Emergency Retract	0390
Servo Control	D.C. Voltage Unsafe	0400
Drive Amp	Carriage Motor Voltage & Current Feedback, K1 Retract Relay	0410

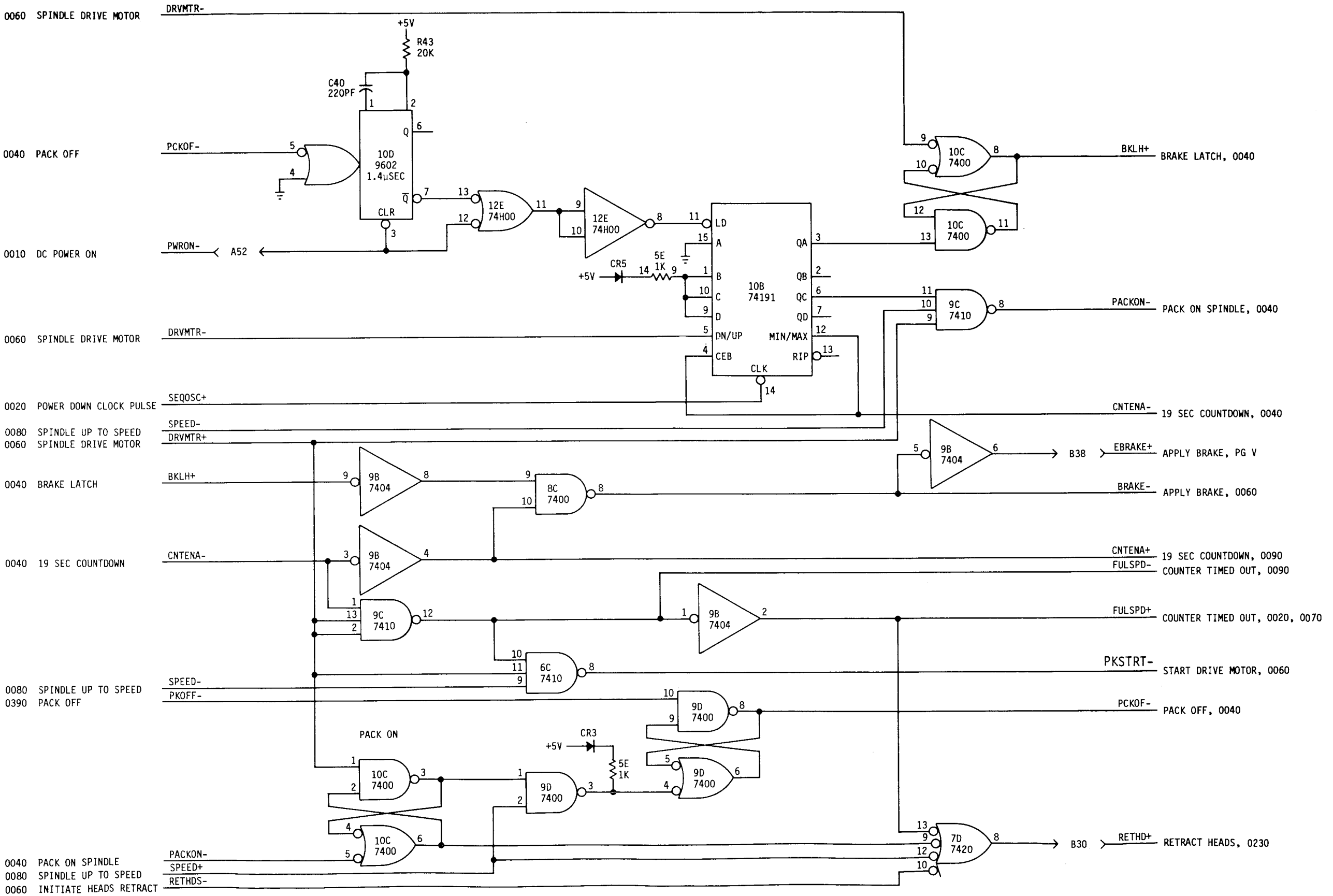
PCBA	Description	Logic Page Number
Read/Write Matrix	Head Address Decoder	0420
Read/Write Limiter	Heads Unsafe, Write Unsafe	0430
Data Separator	Write Data Look Ahead/Back F/F's	0440
Data Separator	Write Data	0450
Read/Write Matrix	Write Drive + & - (TP2&3) Cyl. Current Limiting	0460
Data Separator	Read To Controller, Write From Controller	0470
Data Separator	Write NRZ	480
R/W Matrix	Read Amplifiers	490
R/W Limiter	Read Data	500
R/W Limiter	Read Data	510
R/W Limiter	Read Data, Address Mark R/W	520
Data Separator	Read Address Mark, Write Address Mark	530
Data Separator	PLL	540
Data Separator	Address Mark Mode	550
Data Separator	Window Width	560
Data Separator	VCO Read	570
Logic II	Attention	580
Logic II	Read Only, Write Disable	590
Logic I	Device Check	600
Logic II	Reset Device Check, Error	
Logic III	Control Power Device Check Lamp	
Logic II	Error Circuits	610
Logic II	Bus Cable in Signals	620
Logic II	Bus Cable in Signals	630
Drive Amp	AC Power, + 9, + 14, + 30, -30 VDC	640

PCBA	Description	Logic Page Number
Sequence Relay Assy	Drive, Blower Motor Relays, Spindle Alert	650
	+ 5, + 18, - 18 VDC	660
	+ 5, + 12, + 24 VDC	670
	Ground & DC Voltages on PCBAs	680
	Location	
Read/Write Limiter	Slot - 1	
Logic I	Slot - 2	
Logic II	Slot - 3	
Data Separtor	Slot - 4	
Logic III	Slot - 5	
Servo Control	Slot - 6	
Servo Pre Amp	Under Card Cage	
Read/Write Matrix	To Right Side of Head Assy	
Servo Drive Amp & Retract	Power Supply	

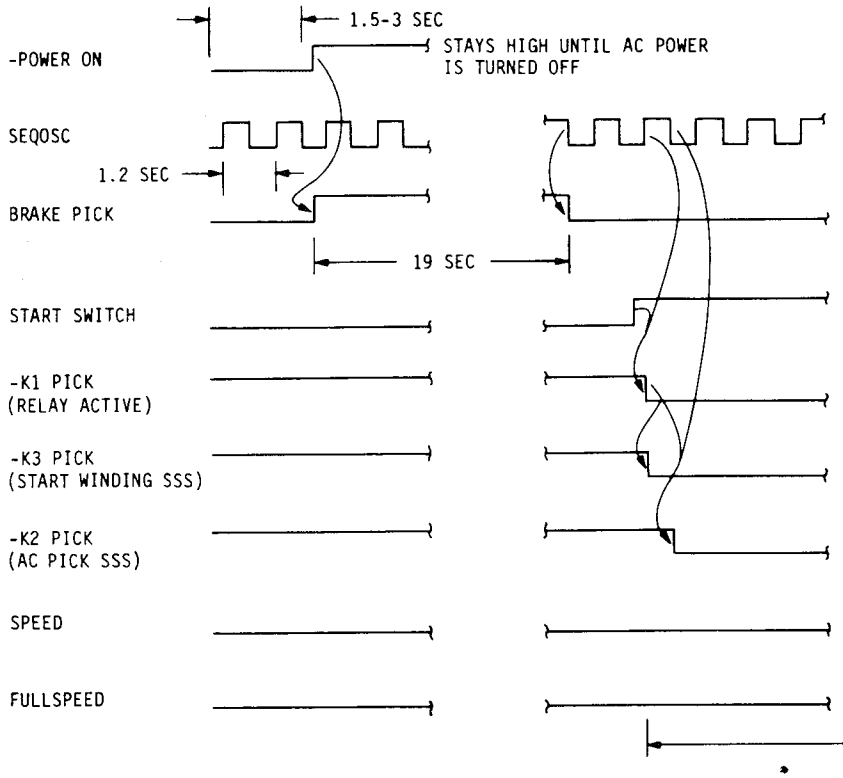

+5V
R160
30K
CR21
R161
5.1K
R162
20K
R163
5.1K
R164
5.1K
A29
PWRON-
DC POWER ON, 0030, 0040, 0060,
0080, 0180, 0210, 0220, 0240,
0290, 0390, 0600, 0620
5
4
2
A5
LM339
Q15
2N2369
C34
33


0030 HEADS EXTENDED LATCH
0040 COUNTER TIMED OUT
0030 INITIATE POWER UP
HDEXT-
FULSPD+
START-
4D 7410
8C 7400
8C 7400
0080 SPINDLE UP TO SPEED
0390 LOW DC VOLTAGE
0030 INITIATE POWER UP
0030 LID CLOSED
0390 MODULES IN
0120 DRIVE SEQUENCE
SPEED+
DCUSF-
START+
LDCLD+
MODIN+
SEQ+
A21
4D 7410
3B 7404
2B 7420
RETHDS+
INITIATE HEADS RETRACT, 0060
+5V
R27 1K
0360 PLO AT ONE-EIGHTH FREQUENCY
806KHZ
B6
8A 74197
9A 74197
10A 74197
11A 74197
RESET
CLR
CLK2
CLK1
SPDCLK+
12.6 KHZ PULSE, 0070, 0080
3.15 KHZ
B27
HDLDLC+
HEADS-LOADED DELAY CLOCK, 0340
HDLDLC+
HEADS-LOADED DELAY CLOCK, 0020
SKINCC+
24.6 KHZ CLOCK PULSE, 0020
B53
SKINCC+
24.6 KHZ CLOCK PULSE, 0290
1.05KHZ+
1.05 KHZ CLOCK PULSE, 0020
+5V
R28 1K
0020 1.05 KHZ CLOCK PULSE
1.05KHZ
12A 74197
11B 7430
8B 74H04
PRESET
12B 7474
SEQOSC+
POWER DOWN CLOCK PULSE, 0040 0090
0.87 HZ
B28
SEQOSC+
NOT USED
0020 24.6 KHZ CLOCK PULSE
SKINCC
8B 74H04
B32
SEQOSC-
NOT USED
0020 HEADS-LOADED DELAY CLOCK
HDLDLC
3.15 KHZ
SEQOSC-
POWER DOWN CLOCK PULSE, 0060

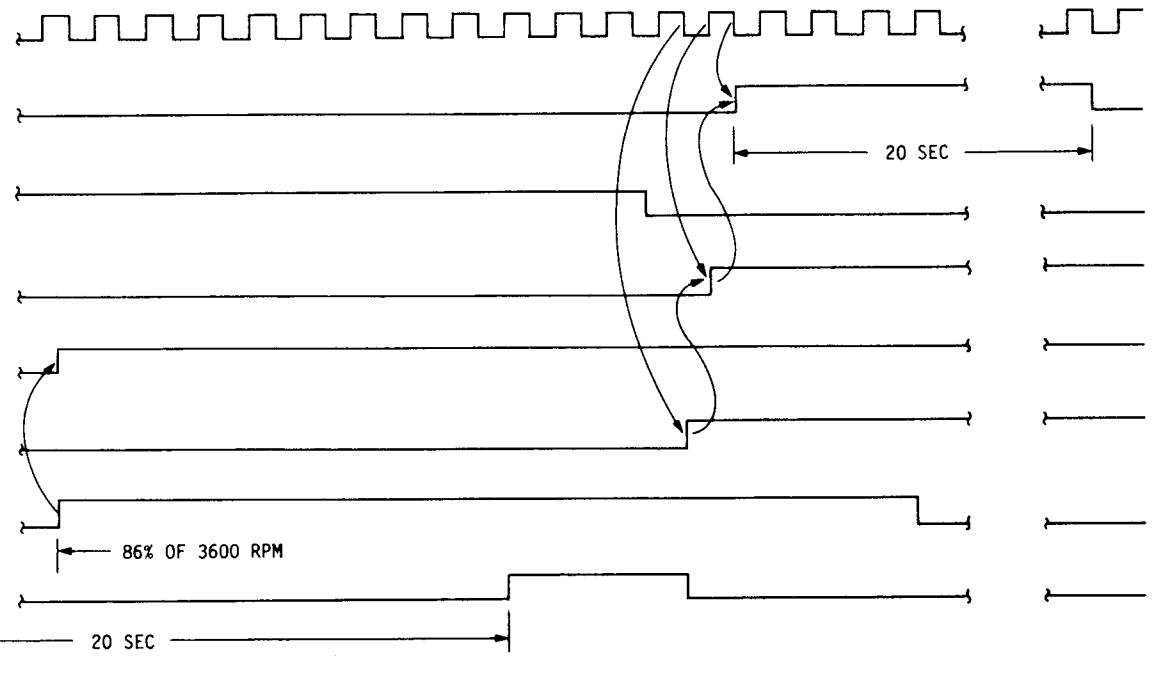

DECK PLATE
OFF RACK SWITCH
J51
J6-5
J6-6
J6-4
A5
A17
HEAD NEXT SWITCH
EXT
RET
J50
J6-1
J6-2
J6-3
A7
A14
CONTROL PANEL
S11
START
STOP
J6-29
J6-31
J6-30
A13
A12
AIR SHROUD
LID CLOSED SWITCH
CLS
OPN
J30-8
J30-4
J30-5
J6-23
J6-21
J6-22
A15
A16
LOGIC III BOARD
+5V
2E 1K
1E 7400
2D 7400
2C 7404
1B 7474
PRESET
CLR
CLK
D
Q
OFRCKS-
OFF RACK SWITCH, 0390
A11
HDEXT-
HEADS EXTENDED LATCH, 0060, 0180, 0230
HEADS EXTENDED LATCH, 0020, 0390
A22
EHDEXT+
HEADS EXTENDED LATCH, PG V
A20
START+
INITIATE POWER UP, 0550, 0290
INITIATE POWER UP, 0020, 0030, 0390
START-
INITIATE POWER UP, 0020
0010 DC POWER ON
PWRON-
0030 INITIATE POWER UP
START+
LDCLD+
LID CLOSED, 0020
LIDCL-
LID CLOSED LATCH, 0090
A18
ELIDCL+
LID CLOSED LATCH, PG V


0060 SPINDLE DRIVE MOTOR
DRVMTR-
+5V
R43
20K
C40
220PF
0040 PACK OFF
PCKOF-
10D
9602
1.4µSEC
Q
CLR
0010 DC POWER ON
PWRON-
A52
12E
74H00
12E
74H00
CR5
5E
1K
+5V
10B
74191
LD
A
B
C
D
DN/UP
CEB
QA
QB
QC
QD
MIN/MAX
RIP
CLK
10C
7400
10C
7400
BKLH+
BRAKE LATCH, 0040
9C
7410
PACKON-
PACK ON SPINDLE, 0040
0060 SPINDLE DRIVE MOTOR
DRVMTR-
0020 POWER DOWN CLOCK PULSE
SEQOSC+
CNTENA-
19 SEC COUNTDOWN, 0040
0080 SPINDLE UP TO SPEED
SPEED-
0060 SPINDLE DRIVE MOTOR
DRVMTR+
9B
7404
B38
EBRAKE+
APPLY BRAKE, PG V
0040 BRAKE LATCH
BKLH+
8C
7400
BRAKE-
APPLY BRAKE, 0060
0040 19 SEC COUNTDOWN
CNTENA-
CNTENA+
19 SEC COUNTDOWN, 0090
FULSPD-
COUNTER TIMED OUT, 0090
FULSPD+
COUNTER TIMED OUT, 0020, 0070
6C
7410
PKSTRT-
START DRIVE MOTOR, 0060
0080 SPINDLE UP TO SPEED
0390 PACK OFF
SPEED-
PKOFF-
9D
7400
PCKOF-
PACK OFF, 0040
PACK ON
CR3
+5V
5E
1K
0040 PACK ON SPINDLE
0080 SPINDLE UP TO SPEED
0060 INITIATE HEADS RETRACT
PACKON-
SPEED+
RETHDS-
7D
7420
B30
RETHD+
RETRACT HEADS, 0230

AC POWER ON TIME



PACK SEQUENCE UP



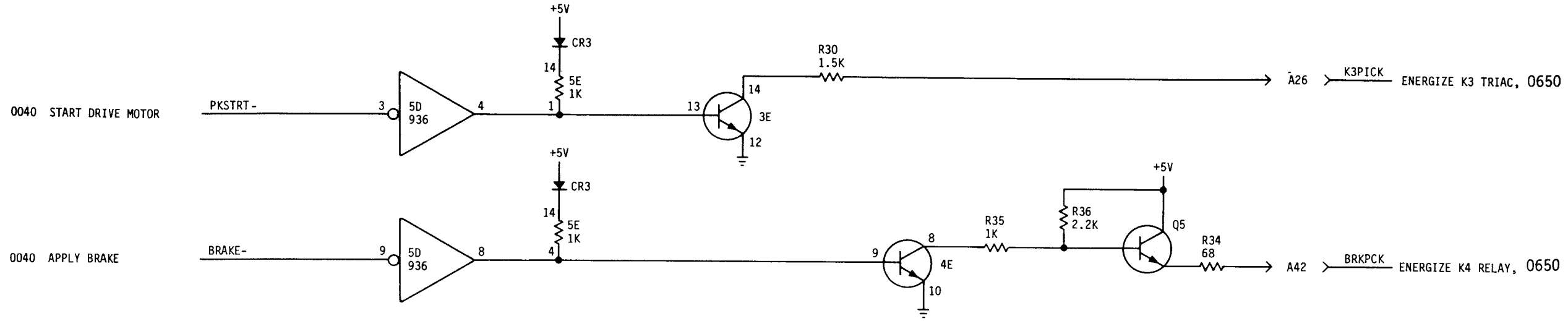
PACK SEQUENCE DOWN

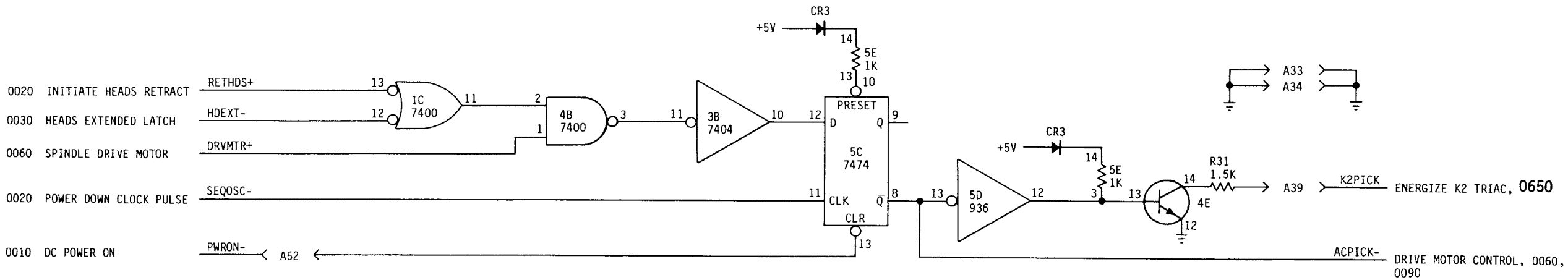
THE FOLLOWING CONDITIONS MUST BE MET TO INITIATE PACK SEQUENCE UP

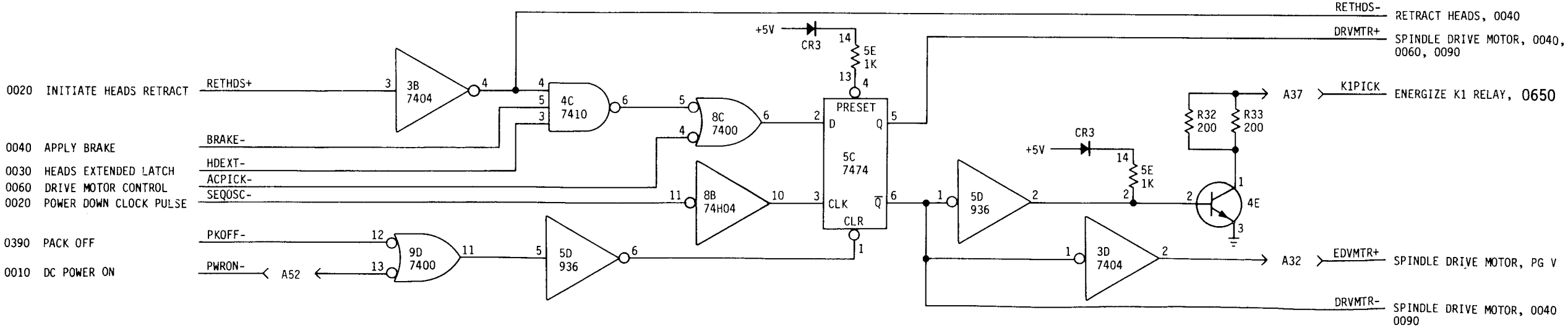
TERM		BACK PANEL PIN NUMBER	SIGNAL LEVEL
1	MODULSIN/	5A09	L
2	SEQUENCE	5A21	H
3	LIDCLSDSW	5A16	H
4	DCUSF	5A29	L
5	BRAKE/		H
6	HDEXT/	5A11	H
7	START	3B19	H

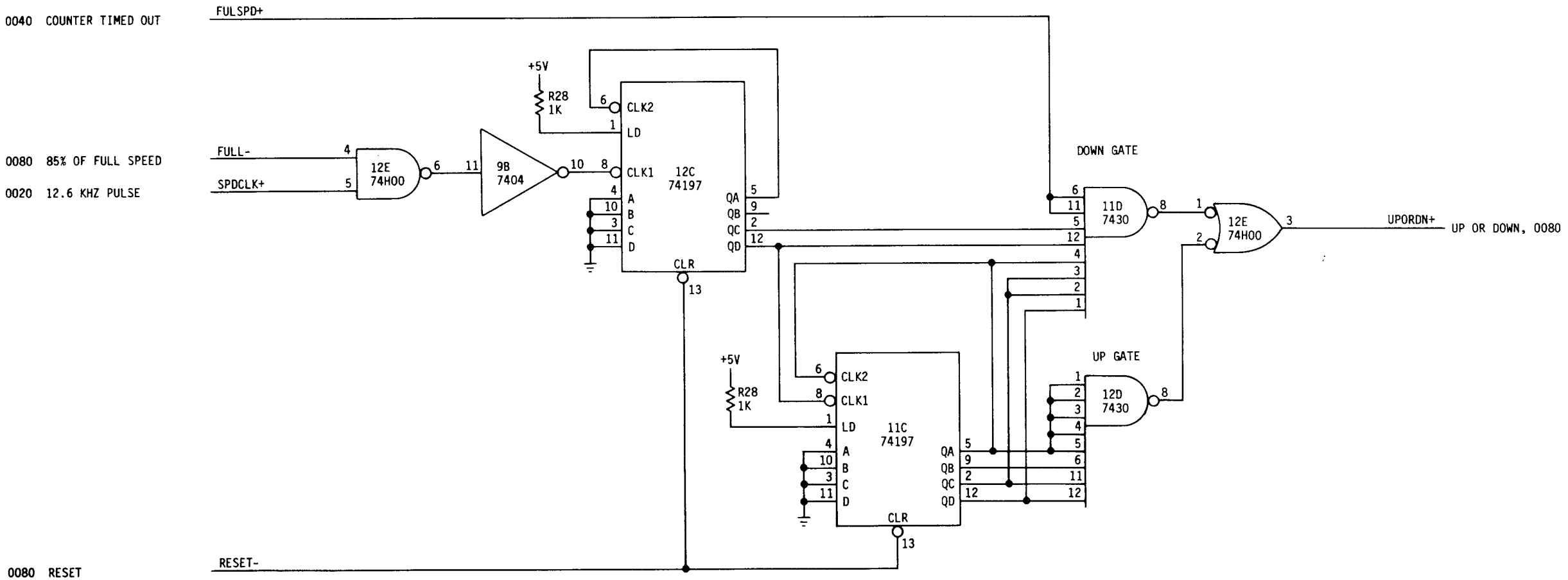
THE FOLLOWING CONDITIONS MUST BE MET TO INITIATE PACK SEQUENCE DOWN

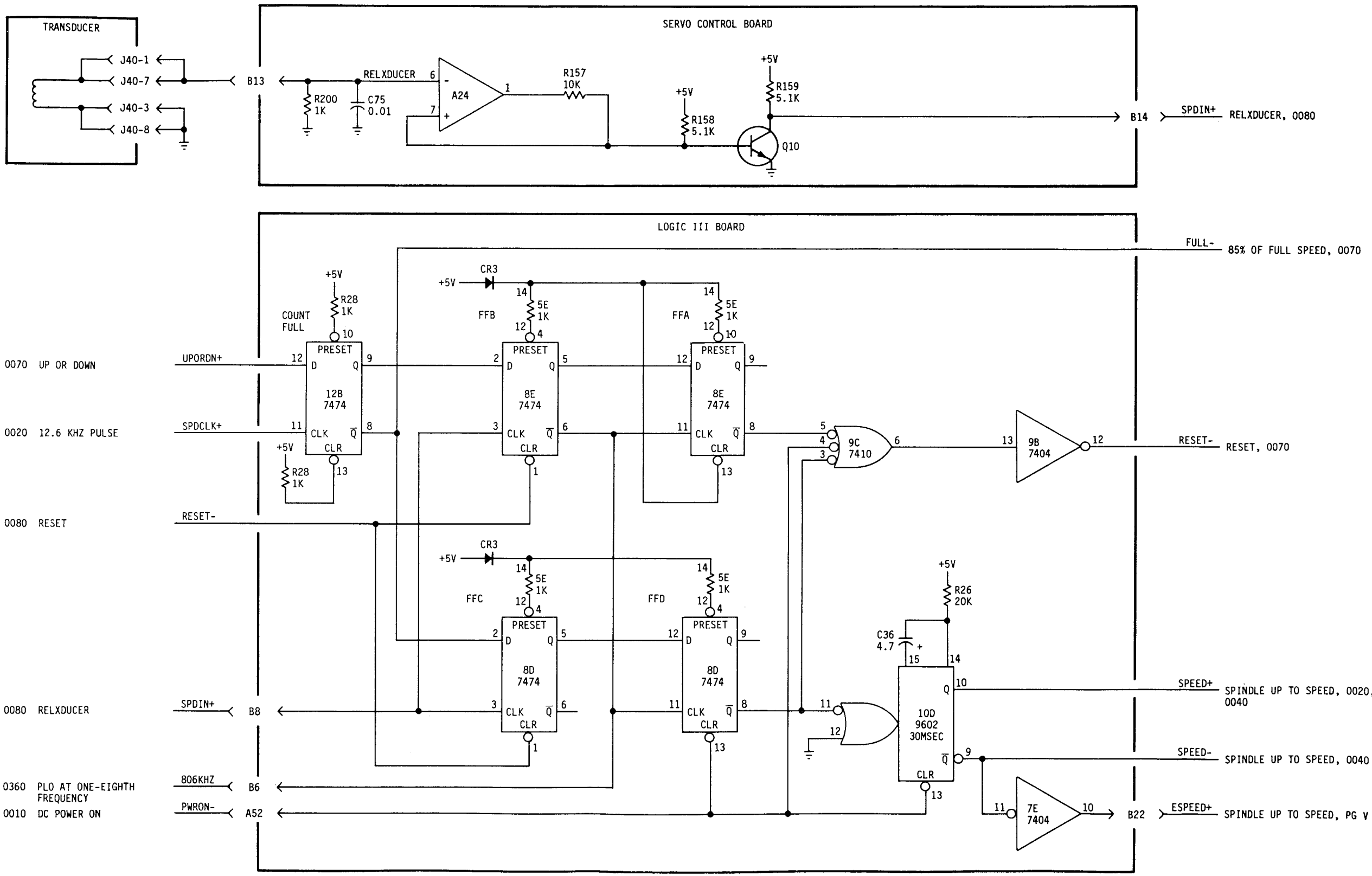
TERM		BACK PANEL PIN NUMBER	SIGNAL LEVEL
1	START	3819	L
2	HDEXT/	5A11	H
3	RETHD*S		H

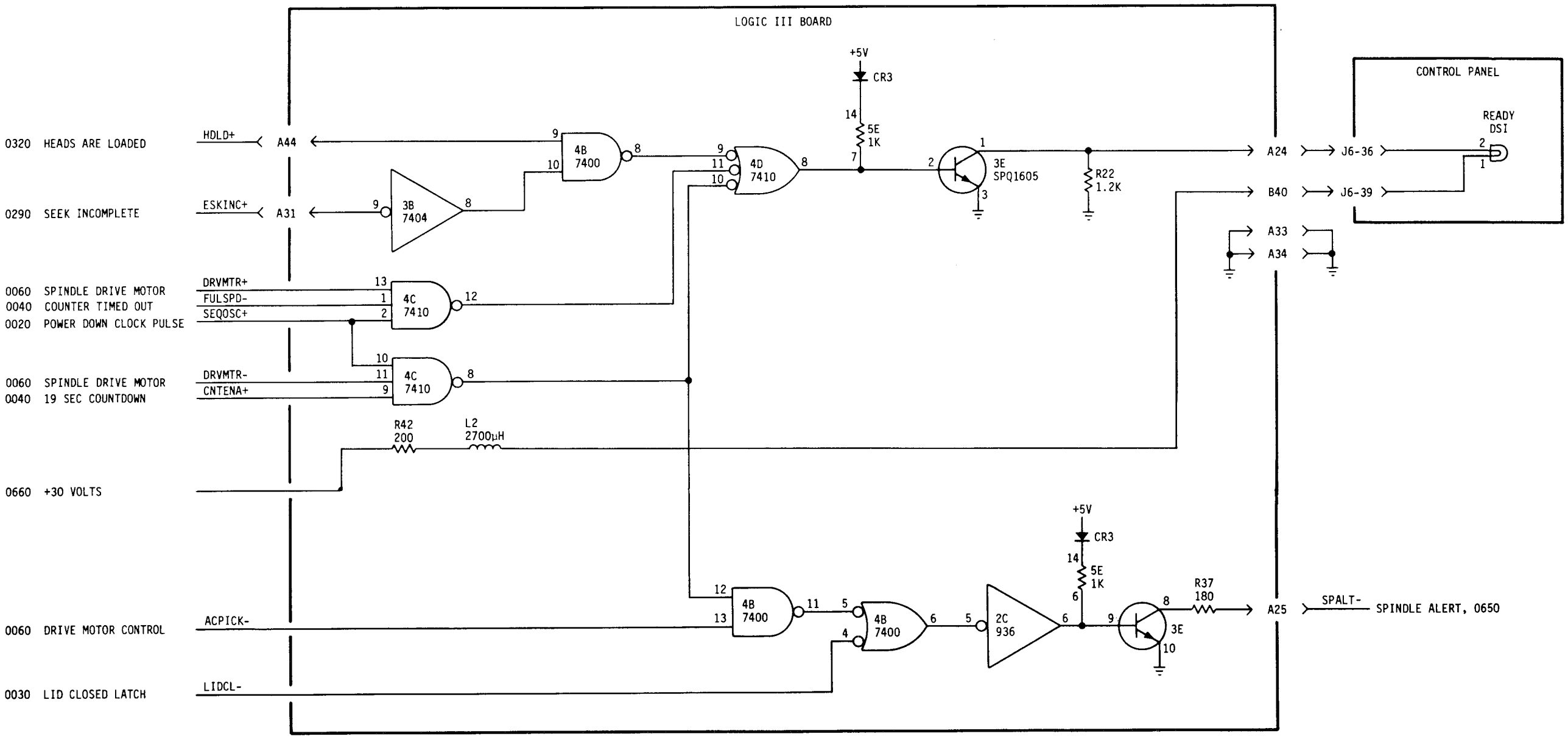

0040 START DRIVE MOTOR
PKSTRT-
5D 936
+5V
CR3
5E 1K
R30 1.5K
3E
A26
K3PICK
ENERGIZE K3 TRIAC, 0650
0040 APPLY BRAKE
BRAKE-
5D 936
+5V
CR3
5E 1K
R35 1K
R36 2.2K
Q5
R34 68
4E
A42
BRKPCK
ENERGIZE K4 RELAY, 0650


0020 INITIATE HEADS RETRACT
RETHDS+
0030 HEADS EXTENDED LATCH
HDEXT-
0060 SPINDLE DRIVE MOTOR
DRVMTR+
0020 POWER DOWN CLOCK PULSE
SEQOSC-
0010 DC POWER ON
PWRON-
A52
1C 7400
4B 7400
3B 7404
CR3
+5V
5E 1K
PRESET
5C 7474
CLR
A33
A34
5D 936
R31 1.5K
4E
A39
K2PICK
ENERGIZE K2 TRIAC, 0650
ACPICK-
DRIVE MOTOR CONTROL, 0060, 0090


RETHDS-
RETRACT HEADS, 0040
DRVMTR+
SPINDLE DRIVE MOTOR, 0040, 0060, 0090
0020 INITIATE HEADS RETRACT
RETHDS+
0040 APPLY BRAKE
BRAKE-
0030 HEADS EXTENDED LATCH
HDEXT-
0060 DRIVE MOTOR CONTROL
ACPICK-
0020 POWER DOWN CLOCK PULSE
SEQOSC-
0390 PACK OFF
PKOFF-
0010 DC POWER ON
PWRON-
A52
3B 7404
4C 7410
8C 7400
8B 74H04
9D 7400
5D 936
CR3
+5V
5E 1K
PRESET
5C 7474
CLR
A37
K1PICK
ENERGIZE K1 RELAY, 0650
R32 200
R33 200
4E
3D 7404
A32
EDVMTR+
SPINDLE DRIVE MOTOR, PG V
DRVMTR-
SPINDLE DRIVE MOTOR, 0040 0090


0040 COUNTER TIMED OUT
FULSPD+
+5V
R28
1K
6
CLK2
1
LD
0080 85% OF FULL SPEED
FULL-
4
12E
74H00
6
11
9B
7404
10
8
CLK1
12C
74197
0020 12.6 KHZ PULSE
SPDCLK+
5
4
A
10
B
3
C
11
D
QA
5
QB
9
QC
2
QD
12
CLR
13
DOWN GATE
6
11
5
11D
7430
8
1
12E
74H00
3
UPORDN+
UP OR DOWN, 0080
2
4
3
2
1
UP GATE
+5V
R28
1K
6
CLK2
8
CLK1
1
LD
11C
74197
4
A
10
B
3
C
11
D
QA
5
QB
9
QC
2
QD
12
CLR
13
1
2
3
4
5
12D
7430
8
6
11
12
0080 RESET
RESET-

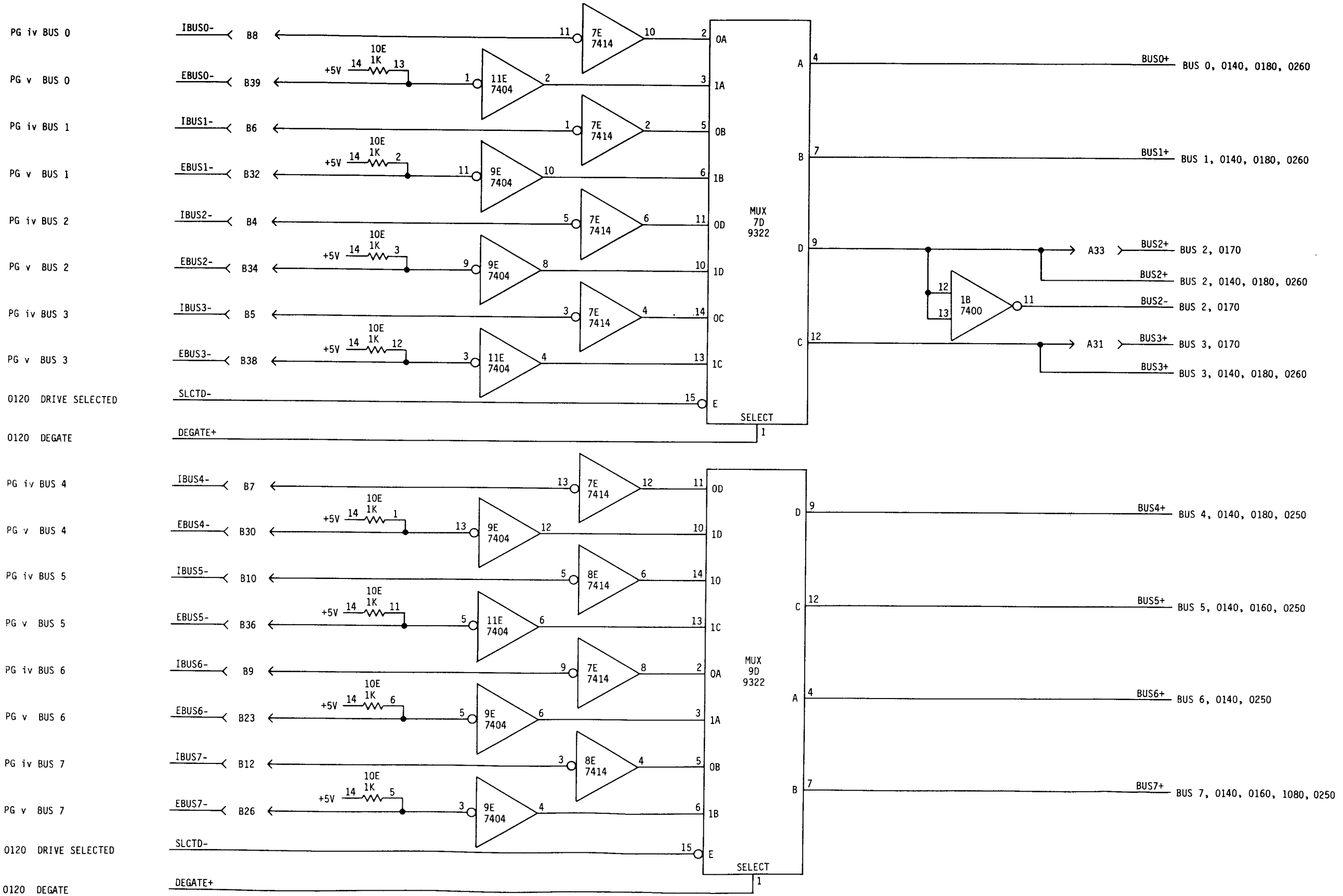

TRANSDUCER
J40-1
J40-7
J40-3
J40-8
B13
SERVO CONTROL BOARD
RELXDUCER
R200
1K
C75
0.01
A24
R157
10K
+5V
R158
5.1K
R159
5.1K
Q10
B14
SPDIN+
RELXDUCER, 0080
LOGIC III BOARD
FULL-
85% OF FULL SPEED, 0070
0070 UP OR DOWN
UPORDN+
COUNT FULL
R28
1K
12B
7474
PRESET
CLR
CR3
FFB
FFA
5E
1K
8E
7474
0020 12.6 KHZ PULSE
SPDCLK+
0080 RESET
RESET-
9C
7410
9B
7404
RESET-
RESET, 0070
FFC
FFD
8D
7474
R26
20K
C36
4.7
10D
9602
30MSEC
SPEED+
SPINDLE UP TO SPEED, 0020, 0040
SPEED-
SPINDLE UP TO SPEED, 0040
0080 RELXDUCER
SPDIN+
B8
0360 PLO AT ONE-EIGHTH FREQUENCY
806KHZ
B6
0010 DC POWER ON
PWRON-
A52
7E
7404
B22
ESPEED+
SPINDLE UP TO SPEED, PG V

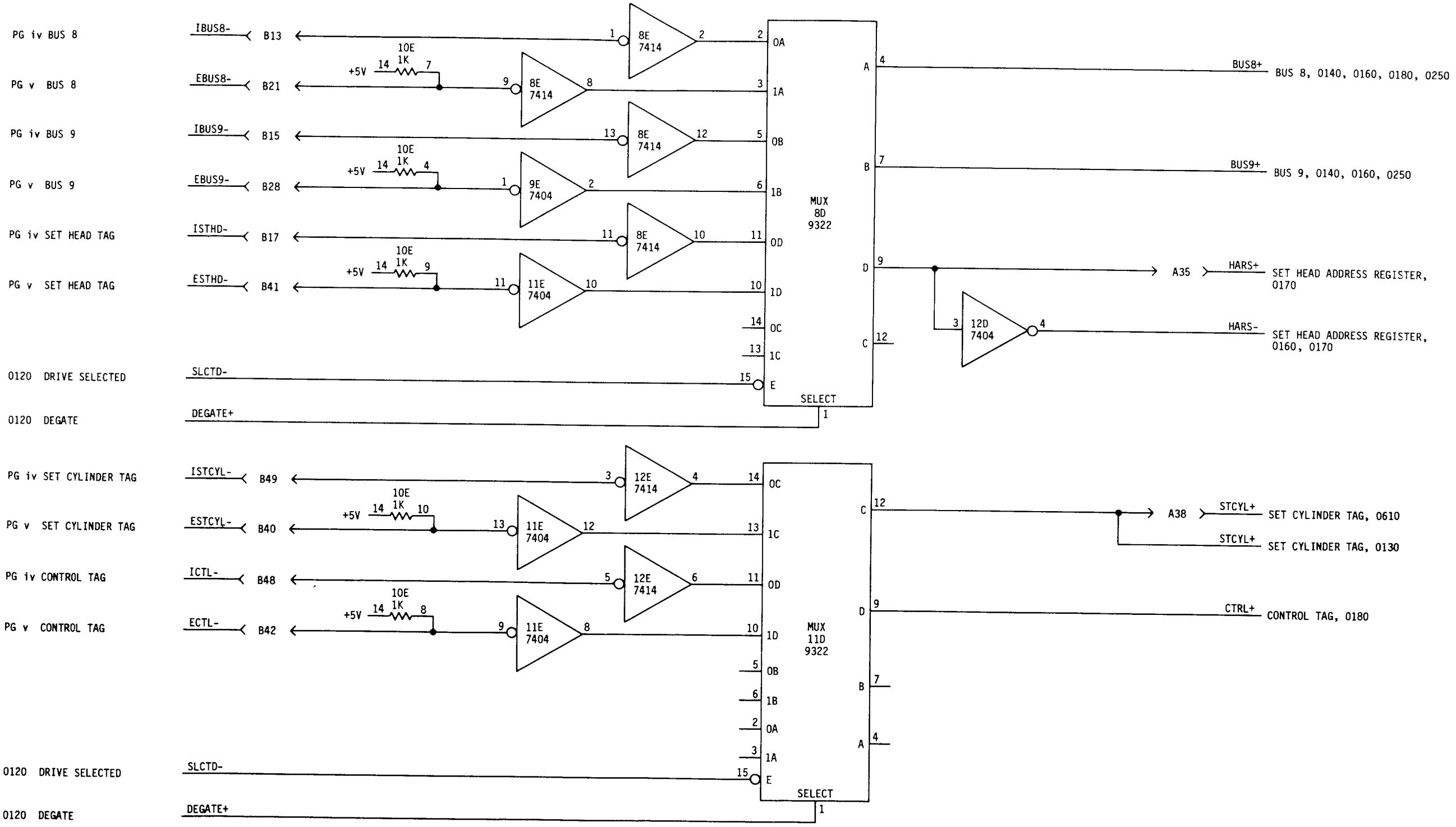

LOGIC III BOARD
0320 HEADS ARE LOADED
HDLD+
A44
0290 SEEK INCOMPLETE
ESKINC+
A31
0060 SPINDLE DRIVE MOTOR
0040 COUNTER TIMED OUT
0020 POWER DOWN CLOCK PULSE
DRVMTR+
FULSPD-
SEQOSC+
0060 SPINDLE DRIVE MOTOR
0040 19 SEC COUNTDOWN
DRVMTR-
CNTENA+
0660 +30 VOLTS
0060 DRIVE MOTOR CONTROL
ACPICK-
0030 LID CLOSED LATCH
LIDCL-
4B 7400
3B 7404
4C 7410
4C 7410
4D 7410
4B 7400
4B 7400
2C 936
+5V
CR3
5E 1K
3E SPQ1605
R22 1.2K
R42 200
L2 2700µH
R37 180
3E
A24
J6-36
B40
J6-39
A33
A34
A25
SPALT-
SPINDLE ALERT, 0650
CONTROL PANEL
READY DSI

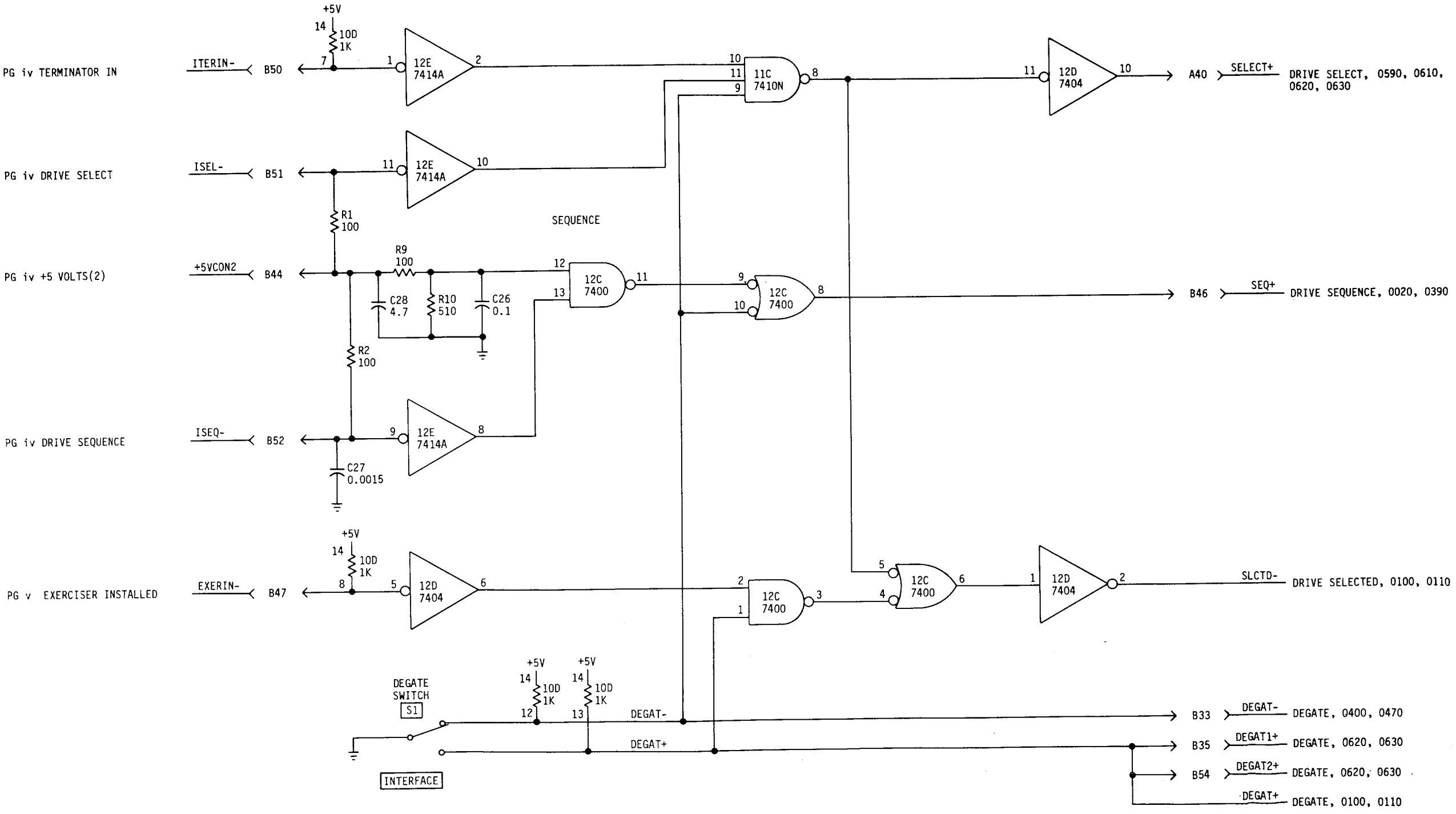
DISC STORAGE UNIT
ILD 2040

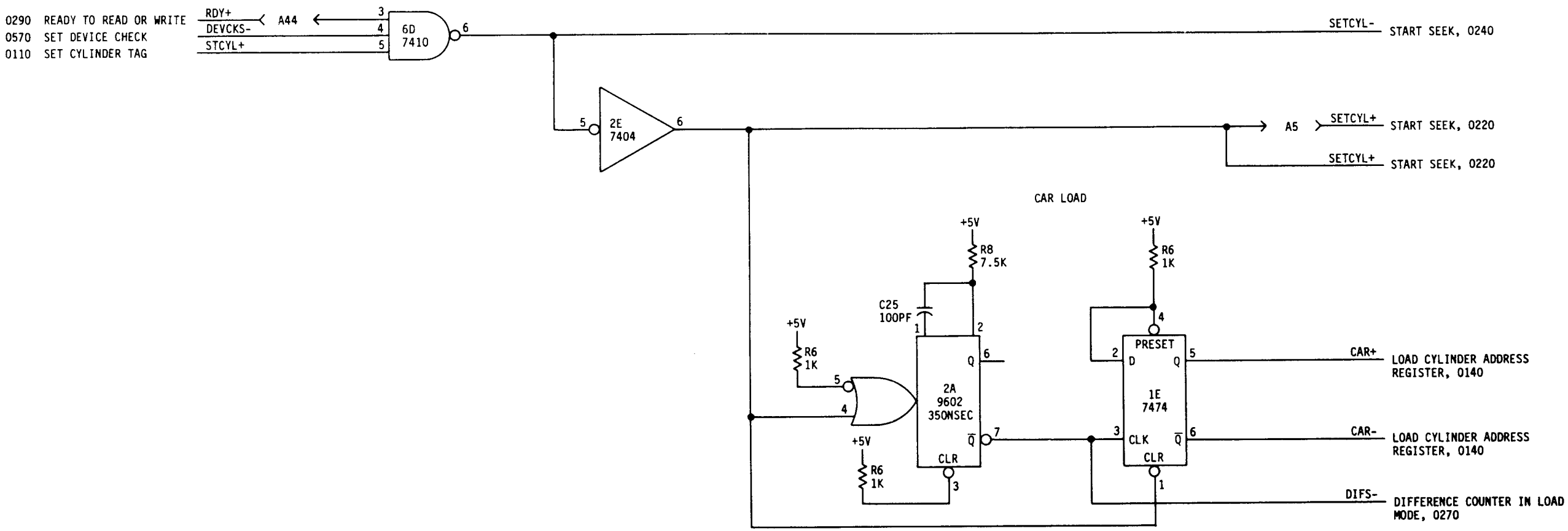
LOGIC I

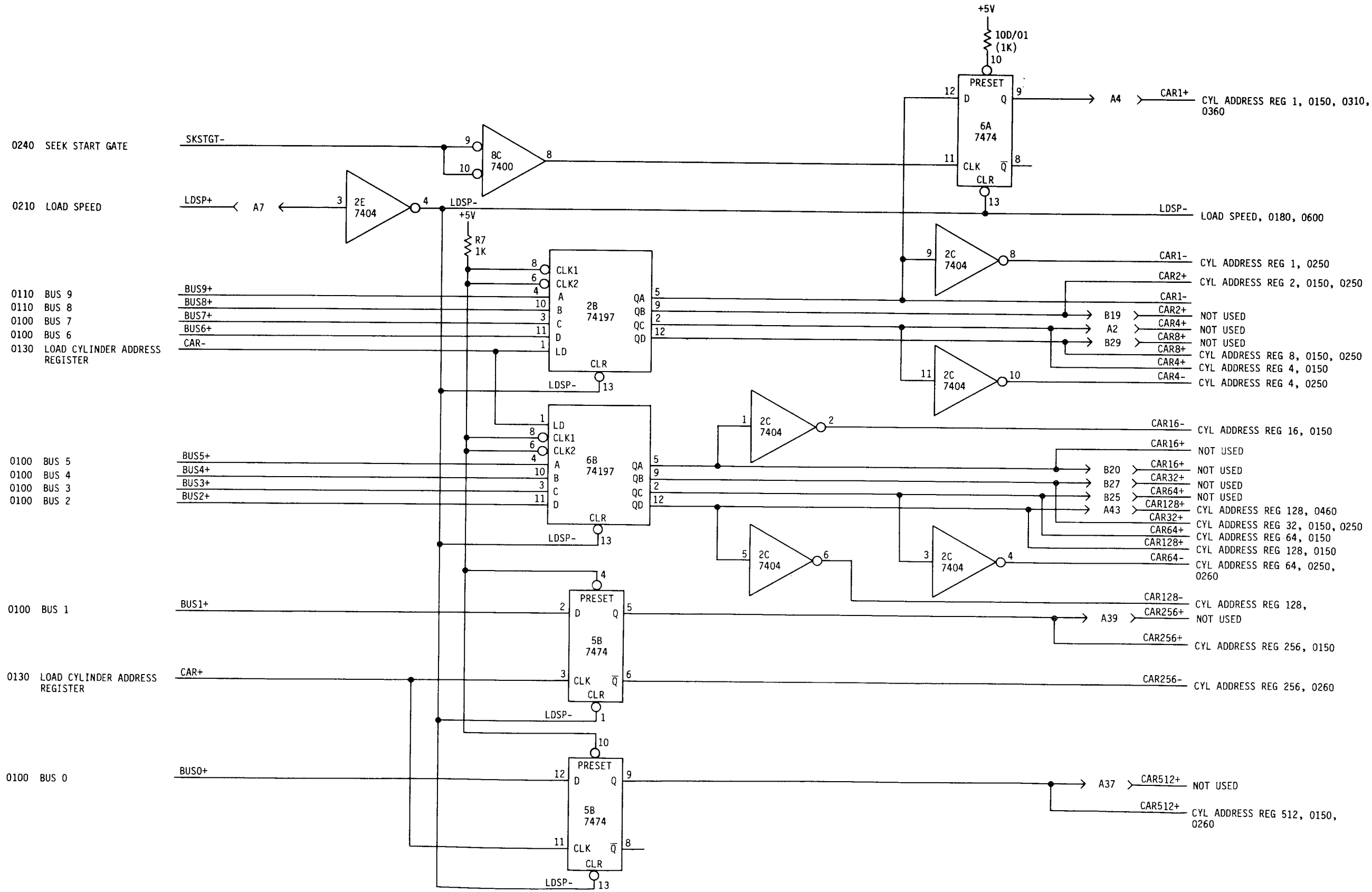
0100



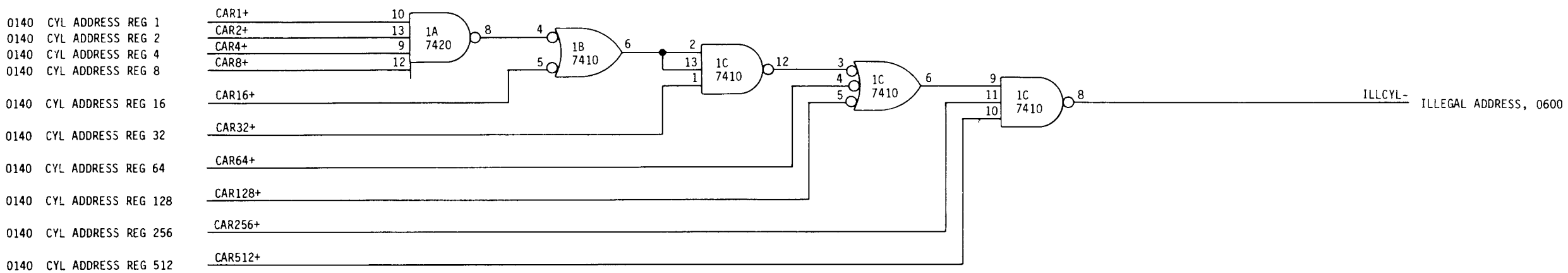

PG iv BUS 8
IBUS8-
B13
PG v BUS 8
EBUS8-
B21
PG iv BUS 9
IBUS9-
B15
PG v BUS 9
EBUS9-
B28
PG iv SET HEAD TAG
ISTHD-
B17
PG v SET HEAD TAG
ESTHD-
B41
10E
1K
+5V
8E 7414
9E 7404
11E 7404
MUX 8D 9322
OA
1A
OB
1B
OD
1D
OC
1C
E
SELECT
A
B
D
C
BUS8+
BUS 8, 0140, 0160, 0180, 0250
BUS9+
BUS 9, 0140, 0160, 0250
A35
HARS+
SET HEAD ADDRESS REGISTER, 0170
12D 7404
HARS-
SET HEAD ADDRESS REGISTER, 0160, 0170
0120 DRIVE SELECTED
SLCTD-
0120 DEGATE
DEGATE+
PG iv SET CYLINDER TAG
ISTCYL-
B49
PG v SET CYLINDER TAG
ESTCYL-
B40
PG iv CONTROL TAG
ICTL-
B48
PG v CONTROL TAG
ECTL-
B42
12E 7414
MUX 11D 9322
A38
STCYL+
SET CYLINDER TAG, 0610
SET CYLINDER TAG, 0130
CTRL+
CONTROL TAG, 0180
0120 DRIVE SELECTED
SLCTD-
0120 DEGATE
DEGATE+


PG iv TERMINATOR IN
ITERIN-
B50
+5V
14
10D
1K
7
1
12E
7414A
2
10
11
9
11C
7410N
8
11
12D
7404
10
A40
SELECT+
DRIVE SELECT, 0590, 0610, 0620, 0630
PG iv DRIVE SELECT
ISEL-
B51
11
12E
7414A
10
R1
100
SEQUENCE
PG iv +5 VOLTS(2)
+5VCON2
B44
R9
100
12
13
12C
7400
11
C28
4.7
R10
510
C26
0.1
R2
100
9
10
12C
7400
8
B46
SEQ+
DRIVE SEQUENCE, 0020, 0390
PG iv DRIVE SEQUENCE
ISEQ-
B52
9
12E
7414A
8
C27
0.0015
PG v EXERCISER INSTALLED
EXERIN-
B47
+5V
14
10D
1K
8
5
12D
7404
6
2
1
12C
7400
3
5
4
12C
7400
6
1
12D
7404
2
SLCTD-
DRIVE SELECTED, 0100, 0110
DEGATE
SWITCH
S1
INTERFACE
+5V
14
10D
1K
12
+5V
14
10D
1K
13
DEGAT-
DEGAT+
B33
DEGAT-
DEGATE, 0400, 0470
B35
DEGAT1+
DEGATE, 0620, 0630
B54
DEGAT2+
DEGATE, 0620, 0630
DEGAT+
DEGATE, 0100, 0110

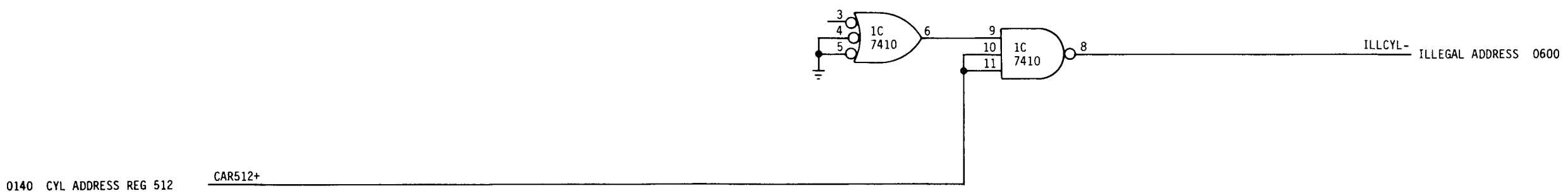

0290 READY TO READ OR WRITE
0570 SET DEVICE CHECK
0110 SET CYLINDER TAG
RDY+
DEVCKS-
STCYL+
A44
3
4
5
6D
7410
6
SETCYL-
START SEEK, 0240
5
2E
7404
6
A5
SETCYL+
START SEEK, 0220
SETCYL+
START SEEK, 0220
CAR LOAD
+5V
R8
7.5K
C25
100PF
1
2
+5V
R6
1K
5
4
2A
9602
350NSEC
Q
6
Q
7
CLR
3
+5V
R6
1K
+5V
R6
1K
4
PRESET
2
D
Q
5
1E
7474
3
CLK
Q
6
CLR
1
CAR+
LOAD CYLINDER ADDRESS REGISTER, 0140
CAR-
LOAD CYLINDER ADDRESS REGISTER, 0140
DIFS-
DIFFERENCE COUNTER IN LOAD MODE, 0270

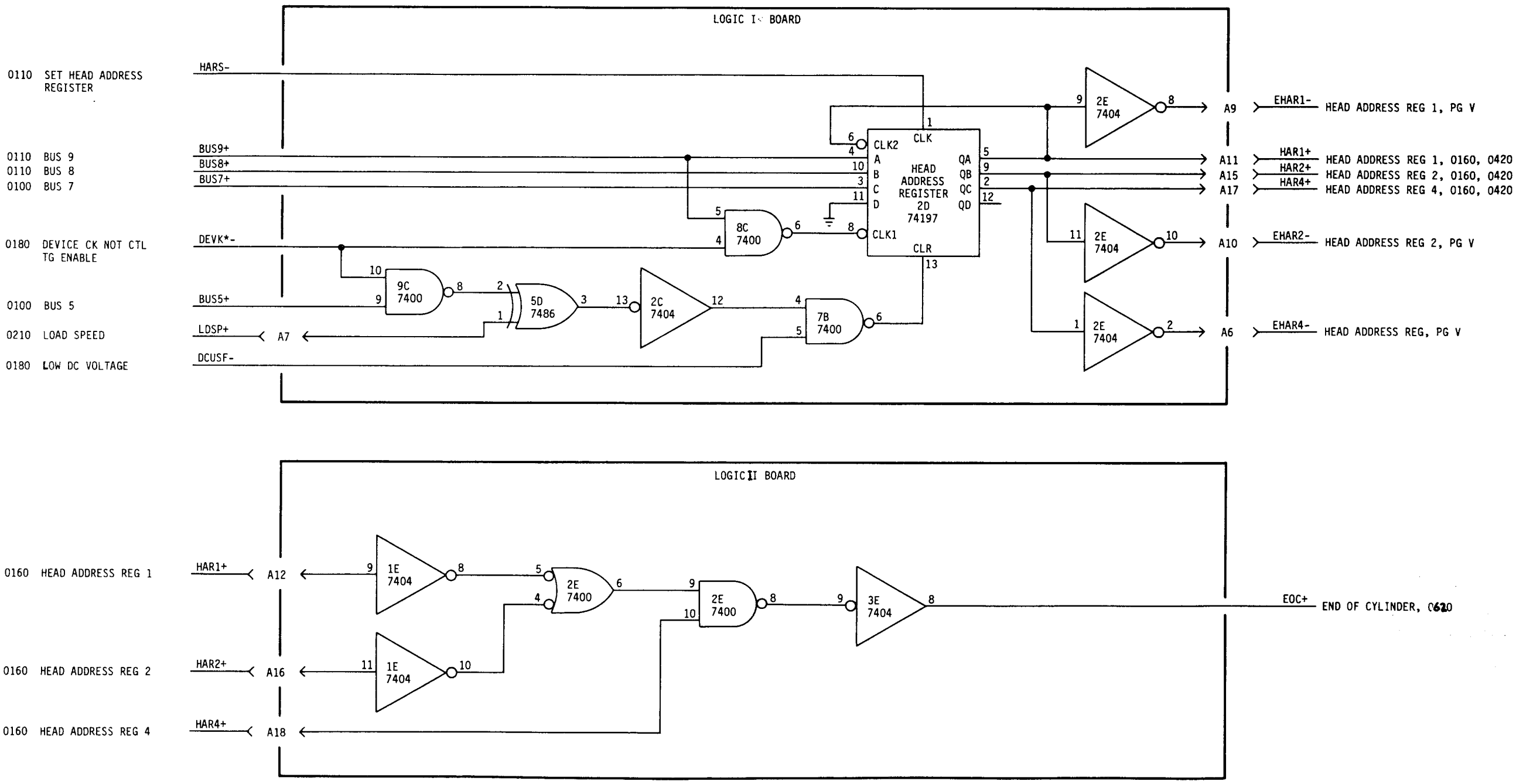

0240 SEEK START GATE
SKSTGT-
8C 7400
0210 LOAD SPEED
LDSP+
A7
2E 7404
LDSP-
+5V
R7 1K
0110 BUS 9
0110 BUS 8
0100 BUS 7
0100 BUS 6
0130 LOAD CYLINDER ADDRESS REGISTER
BUS9+
BUS8+
BUS7+
BUS6+
CAR-
2B 74197
CLK1
CLK2
A
B
C
D
LD
CLR
QA
QB
QC
QD
LDSP-
0100 BUS 5
0100 BUS 4
0100 BUS 3
0100 BUS 2
BUS5+
BUS4+
BUS3+
BUS2+
6B 74197
0100 BUS 1
BUS1+
0130 LOAD CYLINDER ADDRESS REGISTER
CAR+
5B 7474
PRESET
CLK
0100 BUS 0
BUS0+
+5V
10D/01 (1K)
6A 7474
CLR
CAR1+
A4
CYL ADDRESS REG 1, 0150, 0310, 0360
LDSP-
LOAD SPEED, 0180, 0600
2C 7404
CAR1-
CYL ADDRESS REG 1, 0250
CAR2+
CYL ADDRESS REG 2, 0150, 0250
CAR1-
CAR2+
B19
NOT USED
CAR4+
A2
NOT USED
CAR8+
B29
NOT USED
CAR8+
CYL ADDRESS REG 8, 0150, 0250
CAR4+
CYL ADDRESS REG 4, 0150
CAR4-
CYL ADDRESS REG 4, 0250
CAR16-
CYL ADDRESS REG 16, 0150
CAR16+
NOT USED
CAR16+
B20
NOT USED
CAR32+
B27
NOT USED
CAR64+
B25
NOT USED
CAR128+
A43
CYL ADDRESS REG 128, 0460
CAR32+
CYL ADDRESS REG 32, 0150, 0250
CAR64+
CYL ADDRESS REG 64, 0150
CAR128+
CYL ADDRESS REG 128, 0150
CAR64-
CYL ADDRESS REG 64, 0250, 0260
CAR128-
CYL ADDRESS REG 128,
CAR256+
A39
NOT USED
CAR256+
CYL ADDRESS REG 256, 0150
CAR256-
CYL ADDRESS REG 256, 0260
CAR512+
A37
NOT USED
CAR512+
CYL ADDRESS REG 512, 0150, 0260

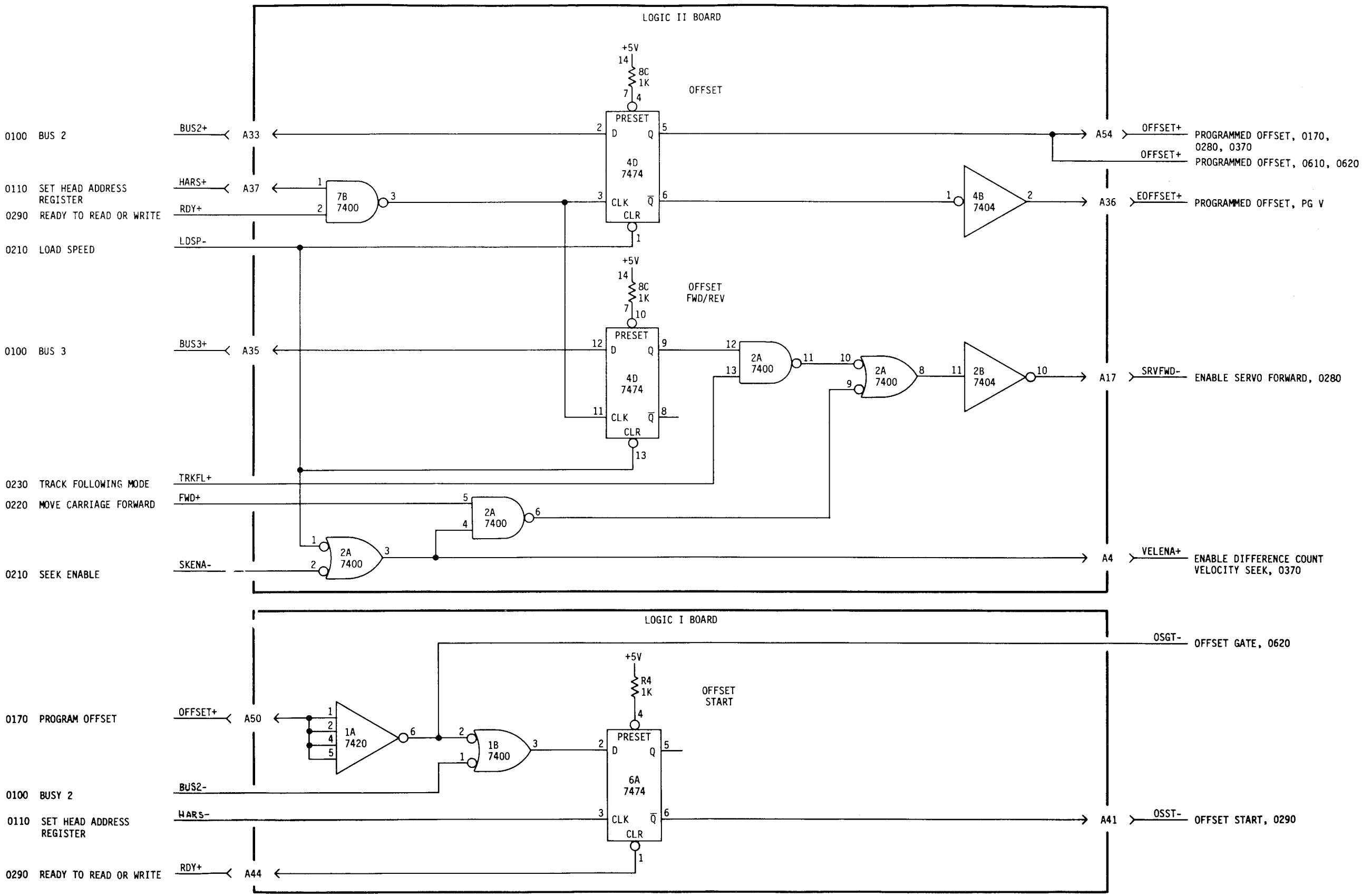
THIS CIRCUIT IS FOR M2580 ONLY

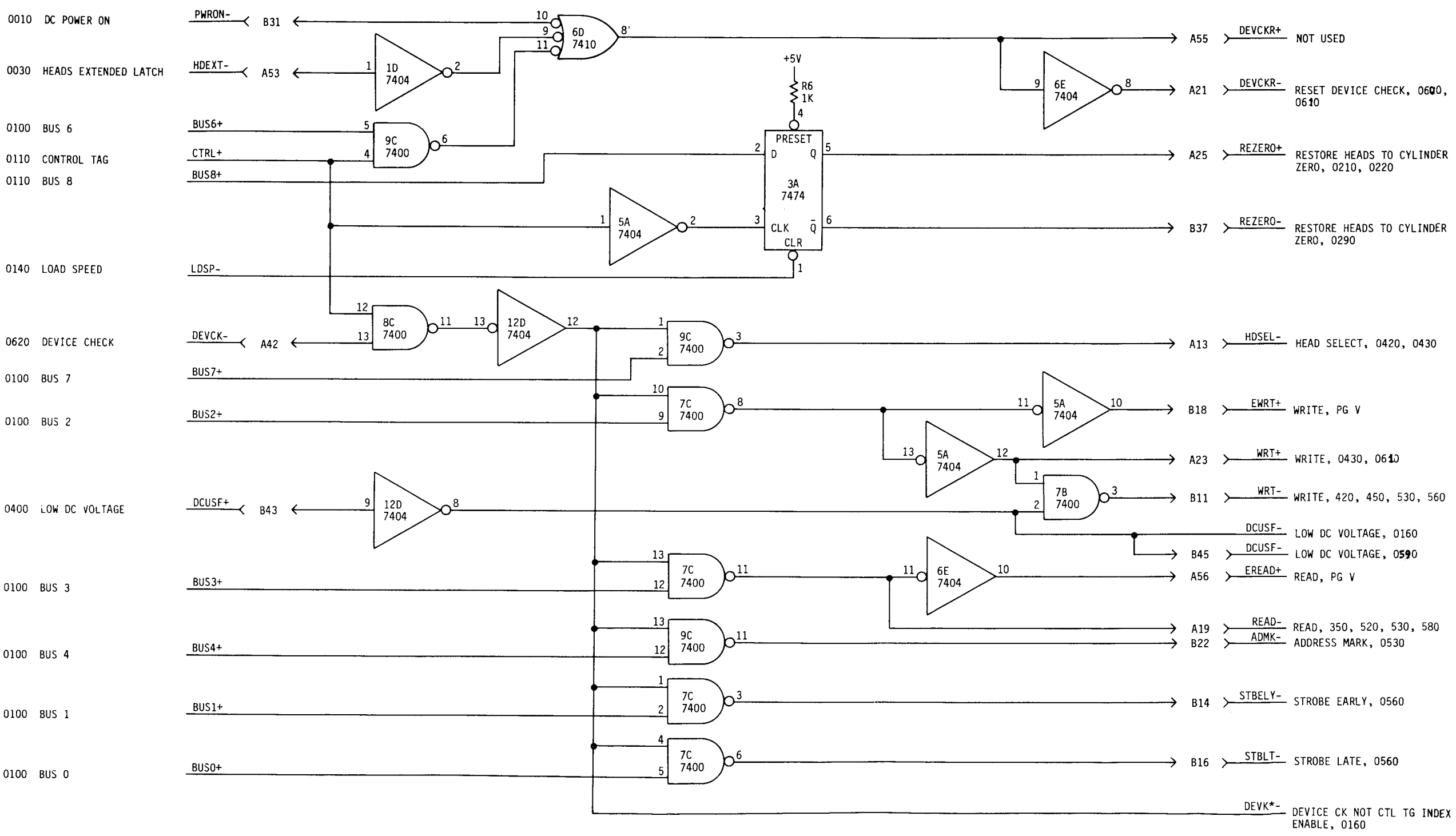


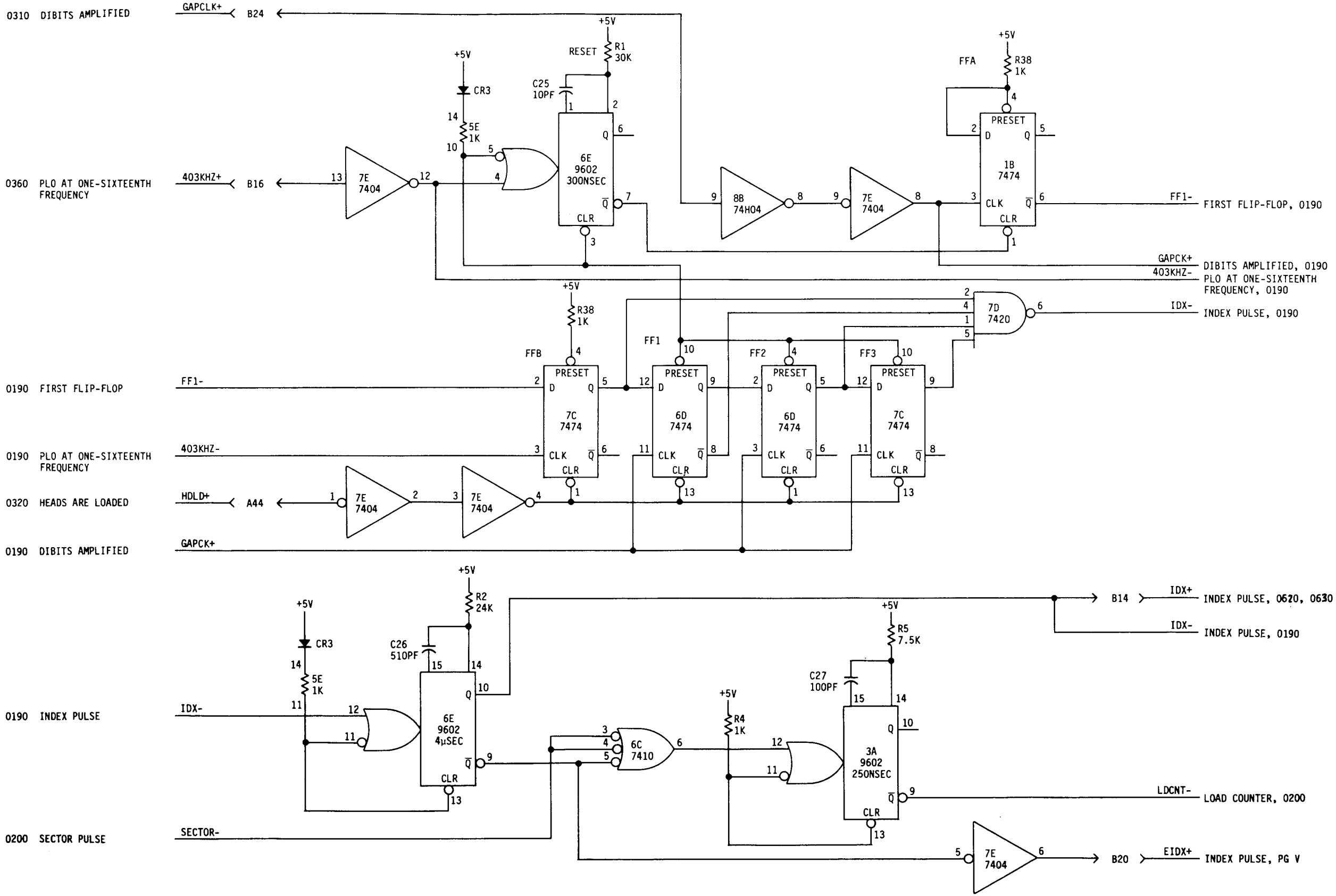
THIS CIRCUIT IS FOR M2530 ONLY

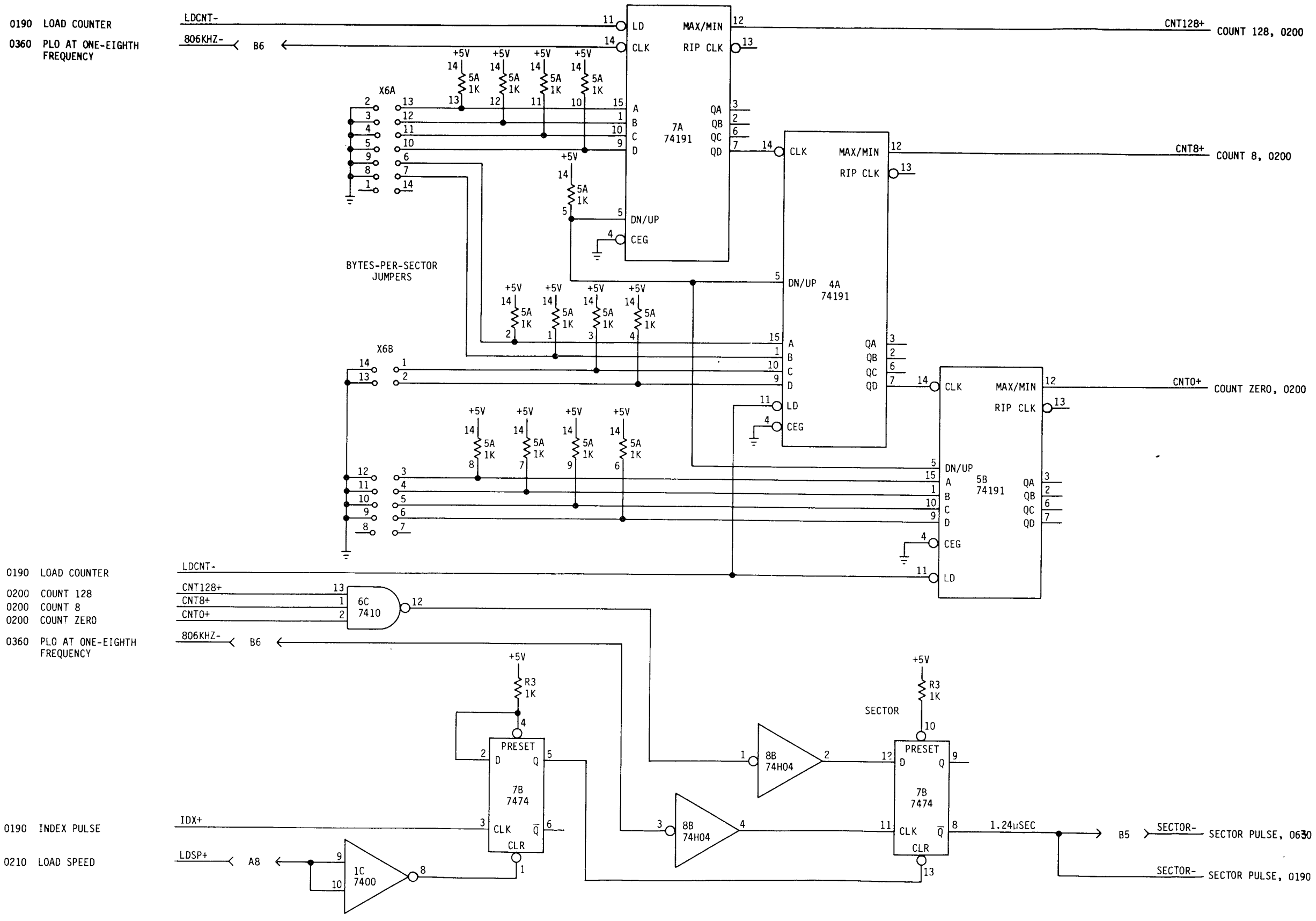


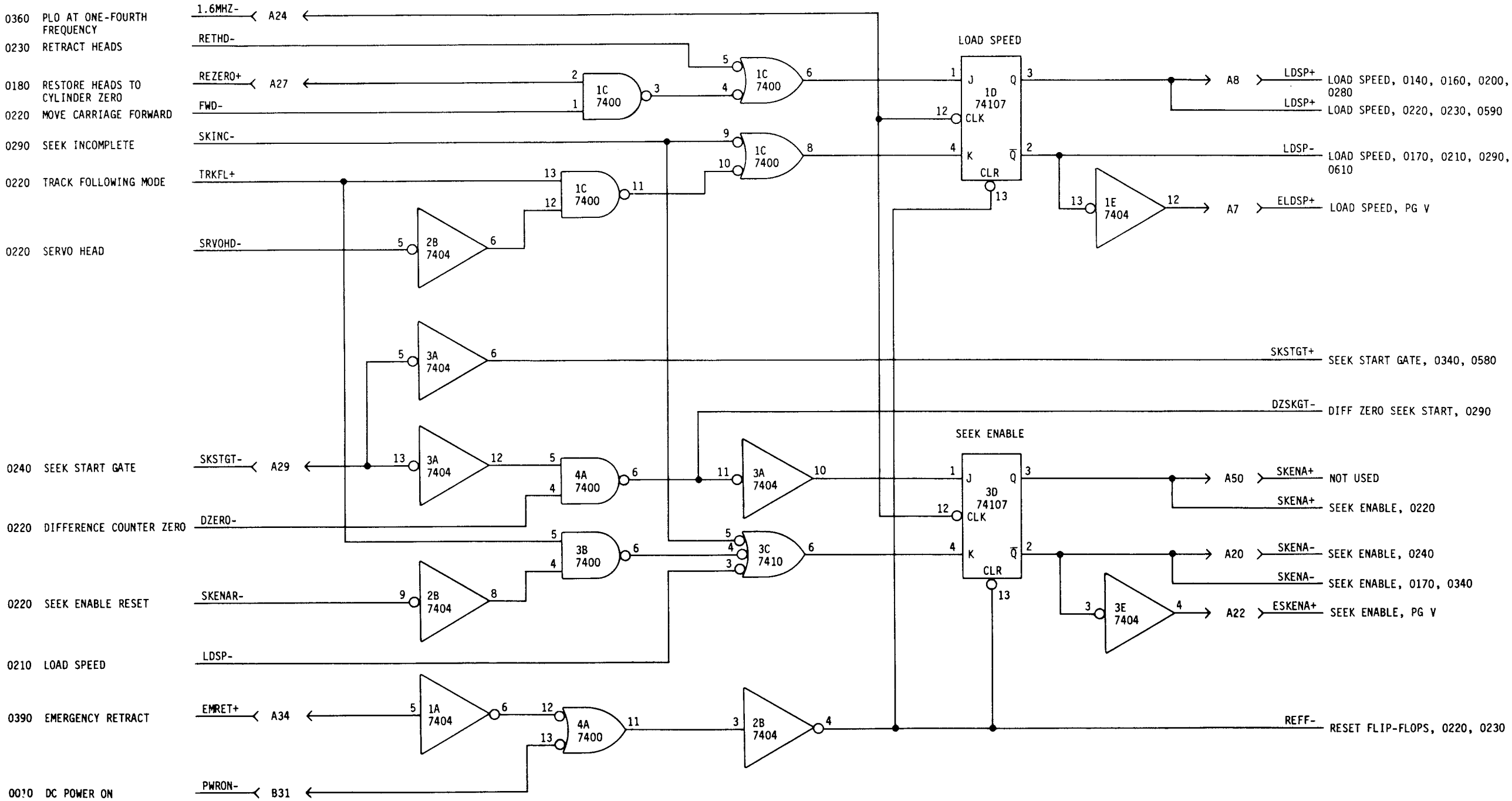

LOGIC I BOARD
0110 SET HEAD ADDRESS REGISTER
HARS-
0110 BUS 9
0110 BUS 8
0100 BUS 7
BUS9+
BUS8+
BUS7+
0180 DEVICE CK NOT CTL TG ENABLE
DEVK*-
0100 BUS 5
BUS5+
0210 LOAD SPEED
LDSP+
A7
0180 LOW DC VOLTAGE
DCUSF-
8C 7400
9C 7400
5D 7486
2C 7404
7B 7400
HEAD ADDRESS REGISTER 2D 74197
CLK2
CLK1
CLK
CLR
2E 7404
A9
A11
A15
A17
A10
A6
EHAR1-
HEAD ADDRESS REG 1, PG V
HAR1+
HEAD ADDRESS REG 1, 0160, 0420
HAR2+
HEAD ADDRESS REG 2, 0160, 0420
HAR4+
HEAD ADDRESS REG 4, 0160, 0420
EHAR2-
HEAD ADDRESS REG 2, PG V
EHAR4-
HEAD ADDRESS REG, PG V
LOGIC II BOARD
0160 HEAD ADDRESS REG 1
HAR1+
A12
0160 HEAD ADDRESS REG 2
HAR2+
A16
0160 HEAD ADDRESS REG 4
HAR4+
A18
1E 7404
2E 7400
3E 7404
EOC+
END OF CYLINDER, 0620

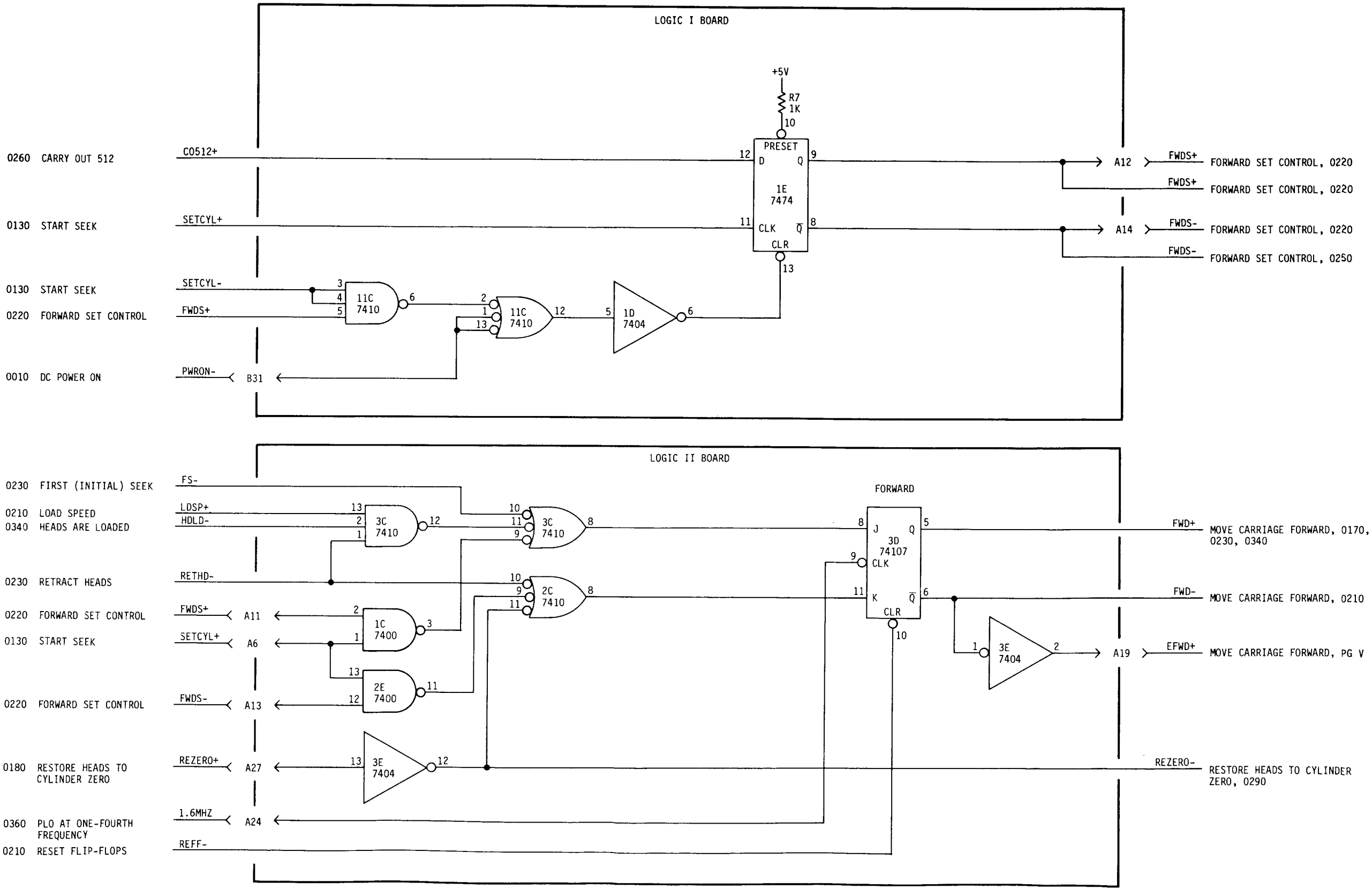

LOGIC II BOARD
0100 BUS 2
BUS2+
A33
+5V
14
8C
1K
7
4
OFFSET
PRESET
2
D
Q
5
4D
7474
3
CLK
Q
6
CLR
1
A54
OFFSET+
PROGRAMMED OFFSET, 0170, 0280, 0370
OFFSET+
PROGRAMMED OFFSET, 0610, 0620
0110 SET HEAD ADDRESS REGISTER
HARS+
A37
1
7B
7400
3
0290 READY TO READ OR WRITE
RDY+
2
1
4B
7404
2
A36
EOFFSET+
PROGRAMMED OFFSET, PG V
0210 LOAD SPEED
LDSP-
+5V
14
8C
1K
7
10
OFFSET
FWD/REV
0100 BUS 3
BUS3+
A35
PRESET
12
D
Q
9
4D
7474
11
CLK
Q
8
CLR
13
12
2A
7400
11
10
2A
7400
8
11
2B
7404
10
A17
SRVFWD-
ENABLE SERVO FORWARD, 0280
0230 TRACK FOLLOWING MODE
TRKFL+
0220 MOVE CARRIAGE FORWARD
FWD+
5
2A
7400
6
4
1
2A
7400
3
0210 SEEK ENABLE
SKENA-
2
A4
VELENA+
ENABLE DIFFERENCE COUNT VELOCITY SEEK, 0370
LOGIC I BOARD
OSGT-
OFFSET GATE, 0620
+5V
R4
1K
4
OFFSET
START
0170 PROGRAM OFFSET
OFFSET+
A50
1
2
4
5
1A
7420
6
2
1B
7400
3
1
PRESET
2
D
Q
5
6A
7474
3
CLK
Q
6
CLR
1
0100 BUSY 2
BUS2-
0110 SET HEAD ADDRESS REGISTER
HARS-
A41
OSST-
OFFSET START, 0290
0290 READY TO READ OR WRITE
RDY+
A44

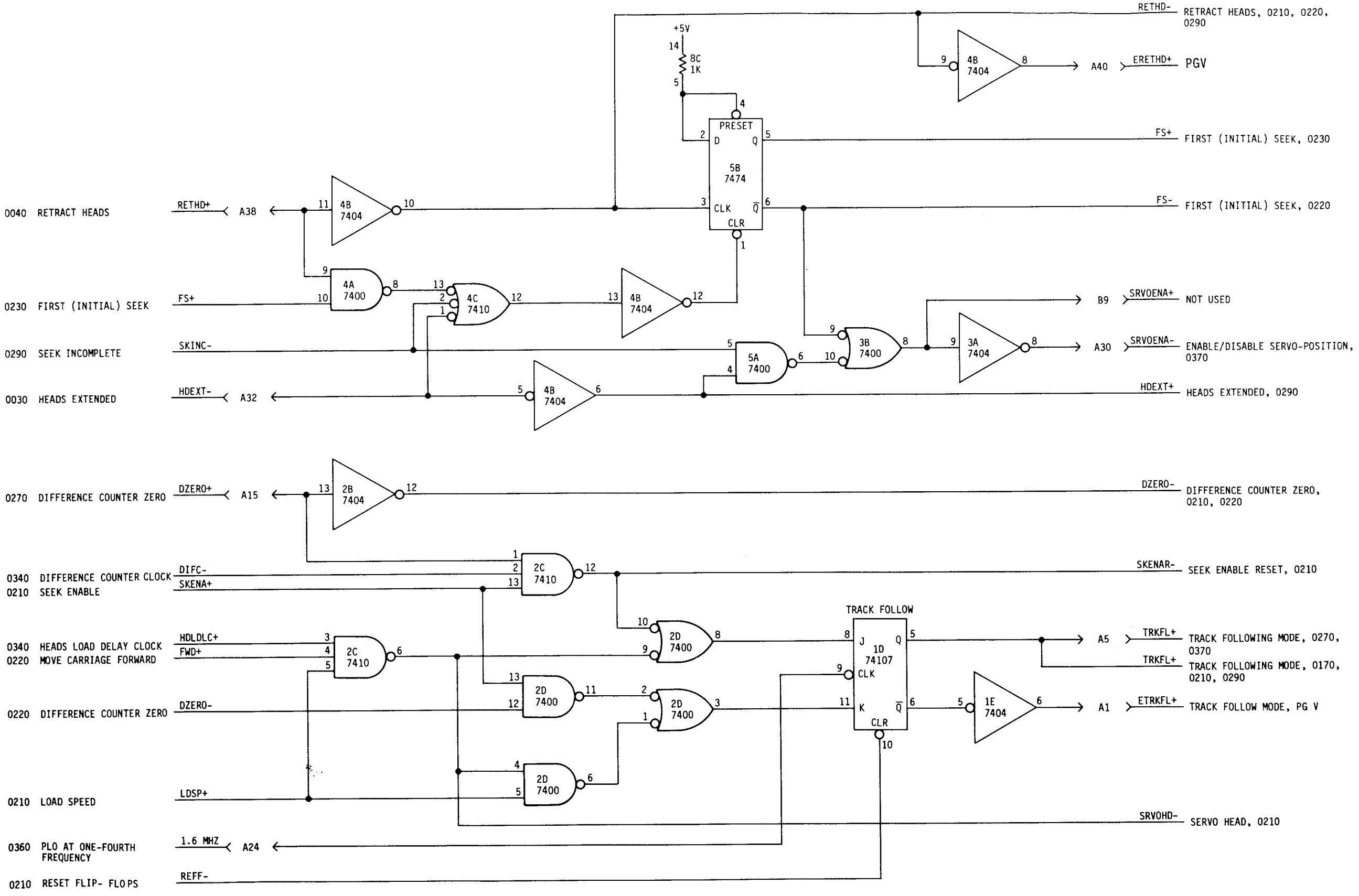

0010 DC POWER ON
PWRON-
B31
6D 7410
0030 HEADS EXTENDED LATCH
HDEXT-
A53
1D 7404
0100 BUS 6
BUS6+
9C 7400
0110 CONTROL TAG
CTRL+
0110 BUS 8
BUS8+
+5V
R6 1K
PRESET
3A 7474
CLR
5A 7404
0140 LOAD SPEED
LDSP-
A55
DEVCKR+
NOT USED
6E 7404
A21
DEVCKR-
RESET DEVICE CHECK, 0620, 0610
A25
REZERO+
RESTORE HEADS TO CYLINDER ZERO, 0210, 0220
B37
REZERO-
RESTORE HEADS TO CYLINDER ZERO, 0290
0620 DEVICE CHECK
DEVCK-
A42
8C 7400
12D 7404
9C 7400
A13
HDSEL-
HEAD SELECT, 0420, 0430
0100 BUS 7
BUS7+
0100 BUS 2
BUS2+
7C 7400
5A 7404
B18
EWRT+
WRITE, PG V
A23
WRT+
WRITE, 0430, 0610
7B 7400
B11
WRT-
WRITE, 420, 450, 530, 560
0400 LOW DC VOLTAGE
DCUSF+
B43
12D 7404
DCUSF-
LOW DC VOLTAGE, 0160
B45
DCUSF-
LOW DC VOLTAGE, 0590
0100 BUS 3
BUS3+
6E 7404
A56
EREAD+
READ, PG V
A19
READ-
READ, 350, 520, 530, 580
0100 BUS 4
BUS4+
9C 7400
B22
ADMK-
ADDRESS MARK, 0530
0100 BUS 1
BUS1+
B14
STBELY-
STROBE EARLY, 0560
0100 BUS 0
BUS0+
B16
STBLT-
STROBE LATE, 0560
DEVK*-
DEVICE CK NOT CTL TG INDEX ENABLE, 0160

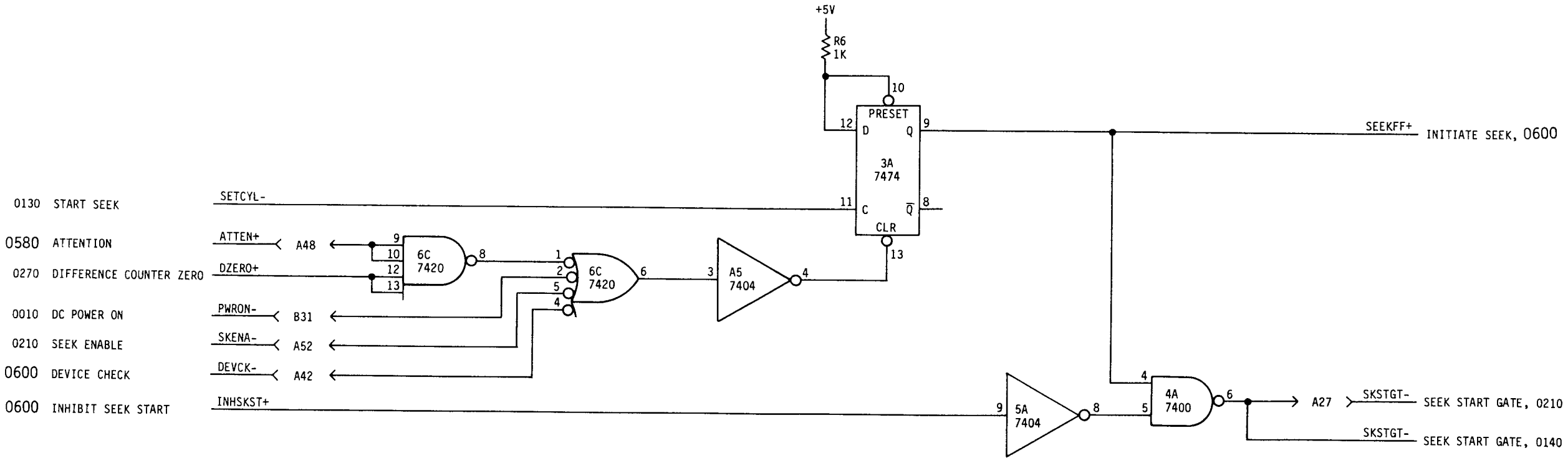

0310 DIBITS AMPLIFIED
GAPCLK+
B24
0360 PLO AT ONE-SIXTEENTH FREQUENCY
403KHZ+
B16
7E 7404
+5V
R1 30K
RESET
C25 10PF
CR3
5E 1K
6E 9602 300NSEC
Q
CLR
8B 74H04
FFA
R38 1K
1B 7474
PRESET
CLK
FF1-
FIRST FLIP-FLOP, 0190
GAPCK+
DIBITS AMPLIFIED, 0190
403KHZ-
PLO AT ONE-SIXTEENTH FREQUENCY, 0190
7D 7420
IDX-
INDEX PULSE, 0190
FFB
FF1
FF2
FF3
0190 FIRST FLIP-FLOP
7C 7474
6D 7474
0190 PLO AT ONE-SIXTEENTH FREQUENCY
0320 HEADS ARE LOADED
HDLD+
A44
0190 DIBITS AMPLIFIED
0190 INDEX PULSE
R2 24K
C26 510PF
6E 9602 4µSEC
6C 7410
R4 1K
R5 7.5K
C27 100PF
3A 9602 250NSEC
LDCNT-
LOAD COUNTER, 0200
0200 SECTOR PULSE
SECTOR-
B14
IDX+
INDEX PULSE, 0620, 0630
INDEX PULSE, 0190
B20
EIDX+
INDEX PULSE, PG V

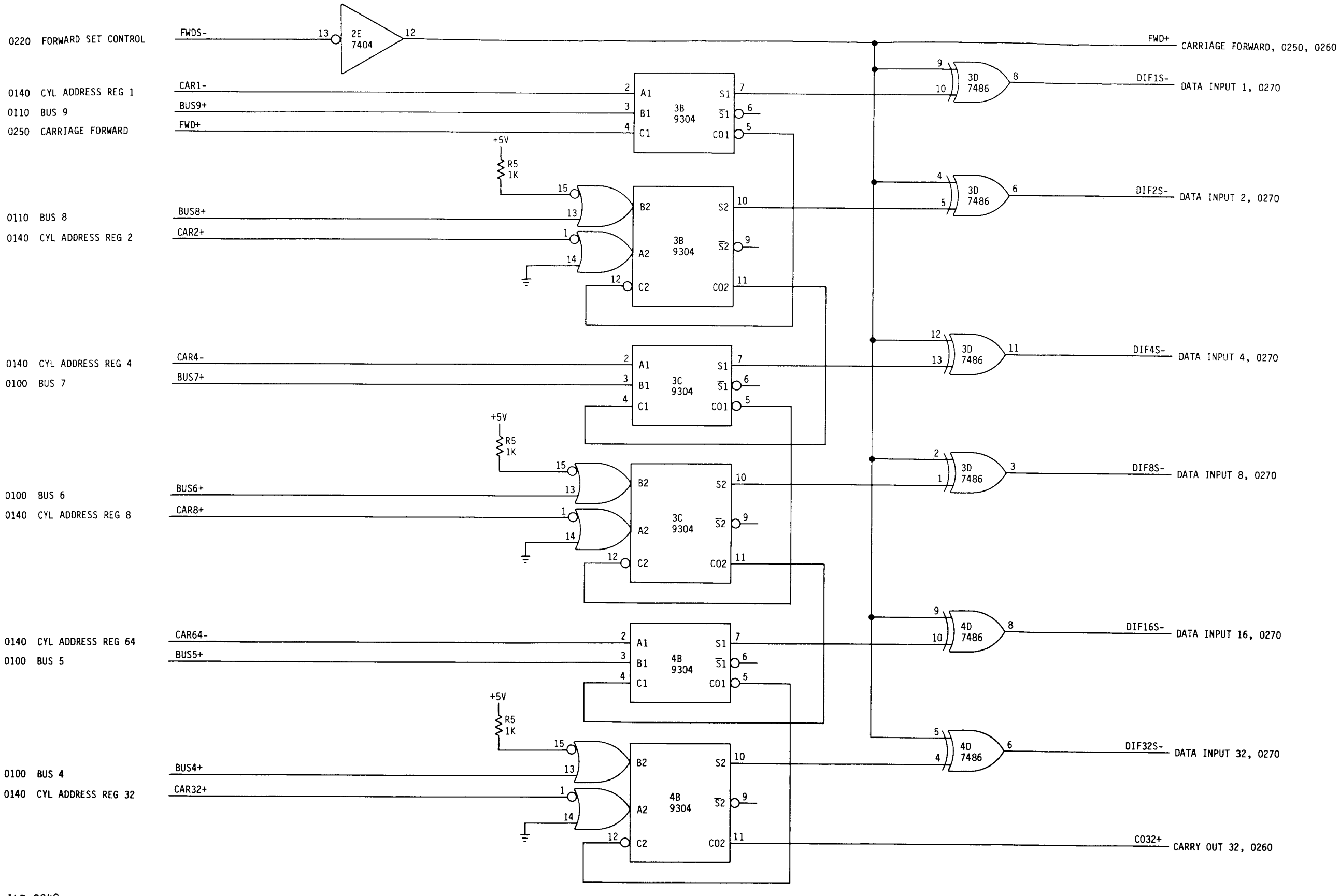

0190 LOAD COUNTER
0360 PLO AT ONE-EIGHTH FREQUENCY
LDCNT-
806KHZ-
B6
LD
CLK
MAX/MIN
RIP CLK
CNT128+
COUNT 128, 0200
+5V
5A 1K
X6A
A
B
C
D
QA
QB
QC
QD
7A 74191
DN/UP
CEG
CNT8+
COUNT 8, 0200
BYTES-PER-SECTOR JUMPERS
X6B
4A 74191
CNT0+
COUNT ZERO, 0200
5B 74191
0190 LOAD COUNTER
0200 COUNT 128
0200 COUNT 8
0200 COUNT ZERO
0360 PLO AT ONE-EIGHTH FREQUENCY
CNT128+
CNT8+
CNT0+
6C 7410
R3 1K
PRESET
CLR
7B 7474
8B 74H04
SECTOR
1.24μSEC
B5
SECTOR-
SECTOR PULSE, 0630
SECTOR PULSE, 0190
0190 INDEX PULSE
0210 LOAD SPEED
IDX+
LDSP+
A8
1C 7400

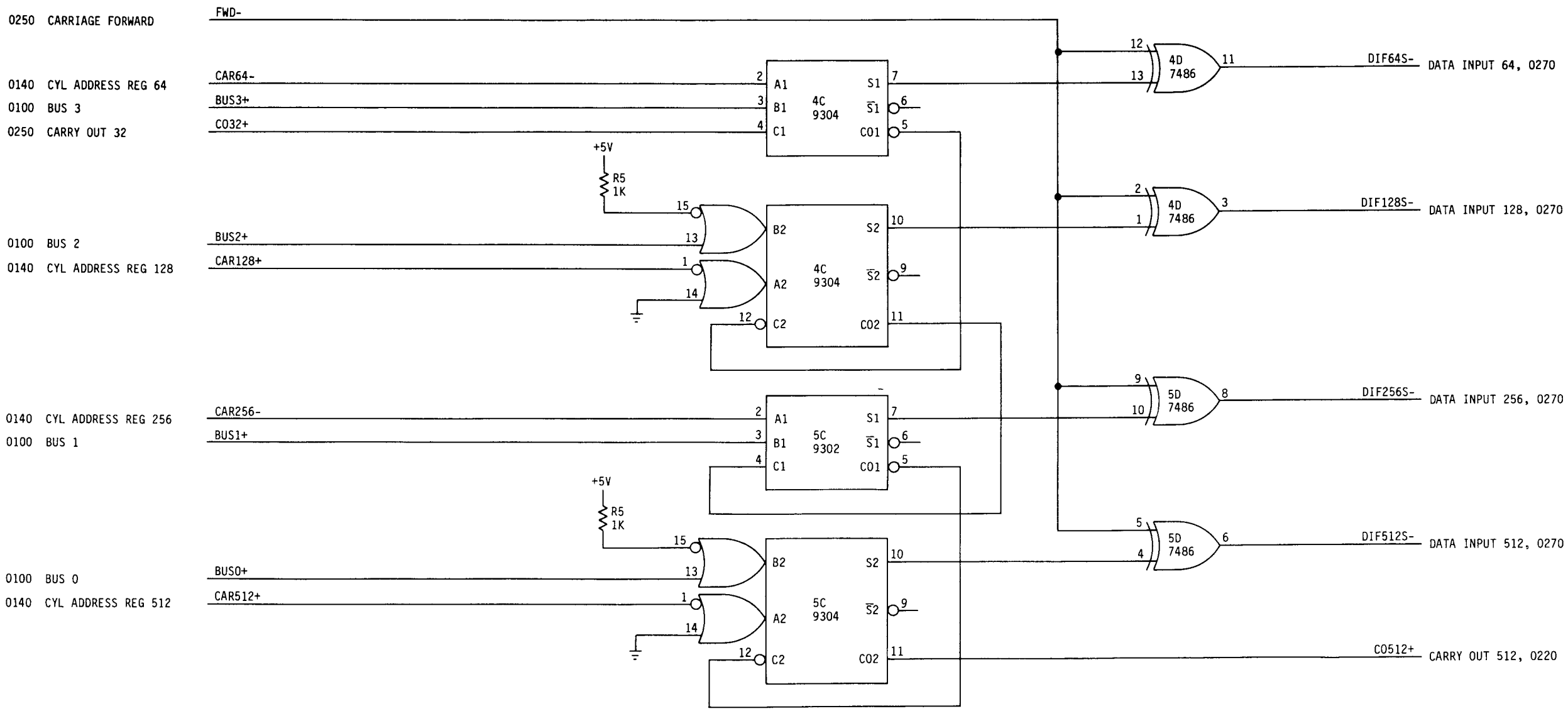

0360 PLO AT ONE-FOURTH FREQUENCY
0230 RETRACT HEADS
0180 RESTORE HEADS TO CYLINDER ZERO
0220 MOVE CARRIAGE FORWARD
0290 SEEK INCOMPLETE
0220 TRACK FOLLOWING MODE
0220 SERVO HEAD
0240 SEEK START GATE
0220 DIFFERENCE COUNTER ZERO
0220 SEEK ENABLE RESET
0210 LOAD SPEED
0390 EMERGENCY RETRACT
0010 DC POWER ON
1.6MHZ-
A24
RETHD-
REZERO+
A27
FWD-
SKINC-
TRKFL+
SRVOHD-
SKSTGT-
A29
DZERO-
SKENAR-
LDSP-
EMRET+
A34
PWRON-
B31
1C 7400
2B 7404
3A 7404
4A 7400
3B 7400
1A 7404
LOAD SPEED
1D 74107
J
K
CLK
CLR
Q
LDSP+
LOAD SPEED, 0140, 0160, 0200, 0280
LOAD SPEED, 0220, 0230, 0590
LDSP-
LOAD SPEED, 0170, 0210, 0290, 0610
1E 7404
A8
A7
ELDSP+
LOAD SPEED, PG V
SKSTGT+
SEEK START GATE, 0340, 0580
DZSKGT-
DIFF ZERO SEEK START, 0290
SEEK ENABLE
3D 74107
3C 7410
3E 7404
A50
A20
A22
SKENA+
NOT USED
SEEK ENABLE, 0220
SKENA-
SEEK ENABLE, 0240
SEEK ENABLE, 0170, 0340
ESKENA+
SEEK ENABLE, PG V
REFF-
RESET FLIP-FLOPS, 0220, 0230

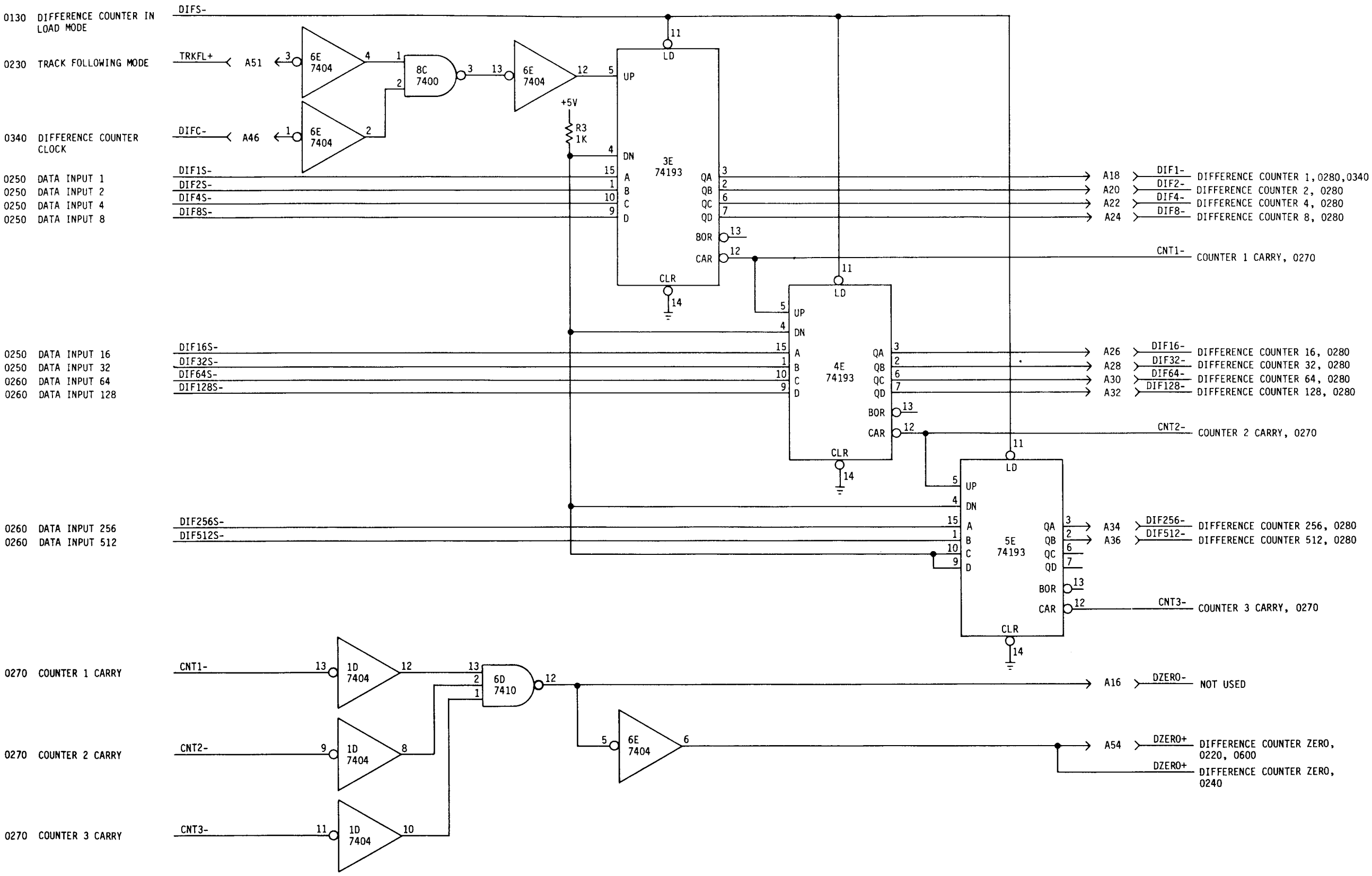

LOGIC I BOARD
0260 CARRY OUT 512
CO512+
0130 START SEEK
SETCYL+
0130 START SEEK
SETCYL-
0220 FORWARD SET CONTROL
FWDS+
0010 DC POWER ON
PWRON-
B31
+5V
R7
1K
10
PRESET
D
Q
1E
7474
CLK
Q
CLR
13
11C
7410
11C
7410
1D
7404
A12
FWDS+
FORWARD SET CONTROL, 0220
FWDS+
FORWARD SET CONTROL, 0220
A14
FWDS-
FORWARD SET CONTROL, 0220
FWDS-
FORWARD SET CONTROL, 0250
LOGIC II BOARD
0230 FIRST (INITIAL) SEEK
FS-
0210 LOAD SPEED
0340 HEADS ARE LOADED
LDSP+
HDLD-
0230 RETRACT HEADS
RETHD-
0220 FORWARD SET CONTROL
FWDS+
A11
0130 START SEEK
SETCYL+
A6
0220 FORWARD SET CONTROL
FWDS-
A13
0180 RESTORE HEADS TO CYLINDER ZERO
REZERO+
A27
0360 PLO AT ONE-FOURTH FREQUENCY
1.6MHZ
A24
0210 RESET FLIP-FLOPS
REFF-
3C
7410
3C
7410
2C
7410
1C
7400
2E
7400
3E
7404
FORWARD
J
Q
3D
74107
CLK
K
Q
CLR
3E
7404
A19
FWD+
MOVE CARRIAGE FORWARD, 0170, 0230, 0340
FWD-
MOVE CARRIAGE FORWARD, 0210
EFWD+
MOVE CARRIAGE FORWARD, PG V
REZERO-
RESTORE HEADS TO CYLINDER ZERO, 0290

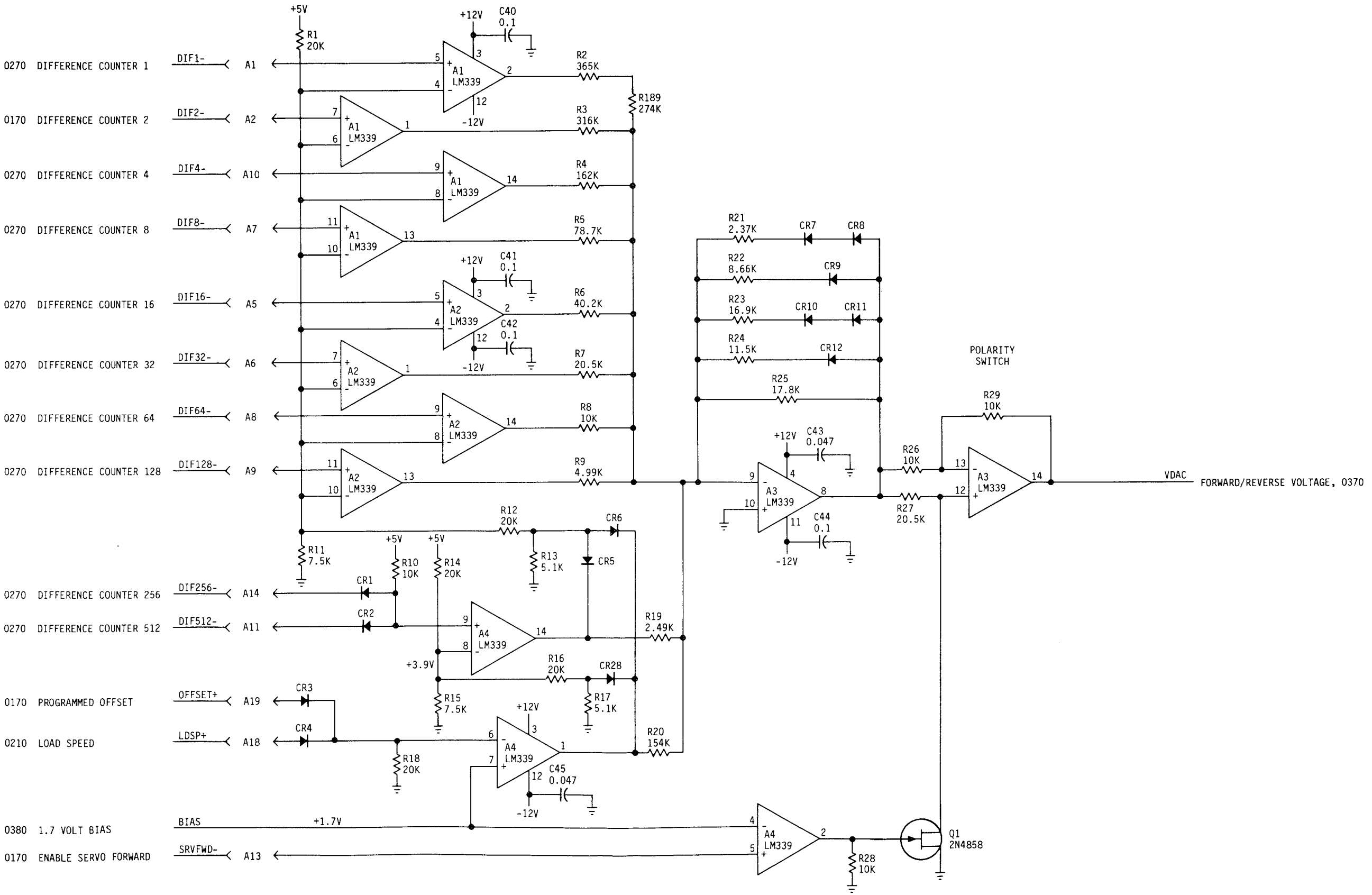

0040 RETRACT HEADS
0230 FIRST (INITIAL) SEEK
0290 SEEK INCOMPLETE
0030 HEADS EXTENDED
RETHD+
A38
FS+
SKINC-
HDEXT-
A32
+5V
8C 1K
PRESET
D
Q
5B 7474
CLK
Q
CLR
RETHD-
RETRACT HEADS, 0210, 0220, 0290
4B 7404
A40
ERETHD+
PGV
FS+
FIRST (INITIAL) SEEK, 0230
FS-
FIRST (INITIAL) SEEK, 0220
4A 7400
4C 7410
SRVOENA+
B9
NOT USED
3B 7400
3A 7404
SRVOENA-
A30
ENABLE/DISABLE SERVO-POSITION, 0370
5A 7400
HDEXT+
HEADS EXTENDED, 0290
0270 DIFFERENCE COUNTER ZERO
DZERO+
A15
2B 7404
DZERO-
DIFFERENCE COUNTER ZERO, 0210, 0220
0340 DIFFERENCE COUNTER CLOCK
0210 SEEK ENABLE
DIFC-
SKENA+
2C 7410
SKENAR-
SEEK ENABLE RESET, 0210
0340 HEADS LOAD DELAY CLOCK
0220 MOVE CARRIAGE FORWARD
HDLDLC+
FWD+
2D 7400
TRACK FOLLOW
J
Q
1D 74107
CLK
K
Q
CLR
A5
TRKFL+
TRACK FOLLOWING MODE, 0270, 0370
TRKFL+
TRACK FOLLOWING MODE, 0170, 0210, 0290
0220 DIFFERENCE COUNTER ZERO
DZERO-
1E 7404
A1
ETRKFL+
TRACK FOLLOW MODE, PG V
0210 LOAD SPEED
LDSP+
SRVOHD-
SERVO HEAD, 0210
0360 PLO AT ONE-FOURTH FREQUENCY
1.6 MHZ
A24
0210 RESET FLIP- FLOPS
REFF-

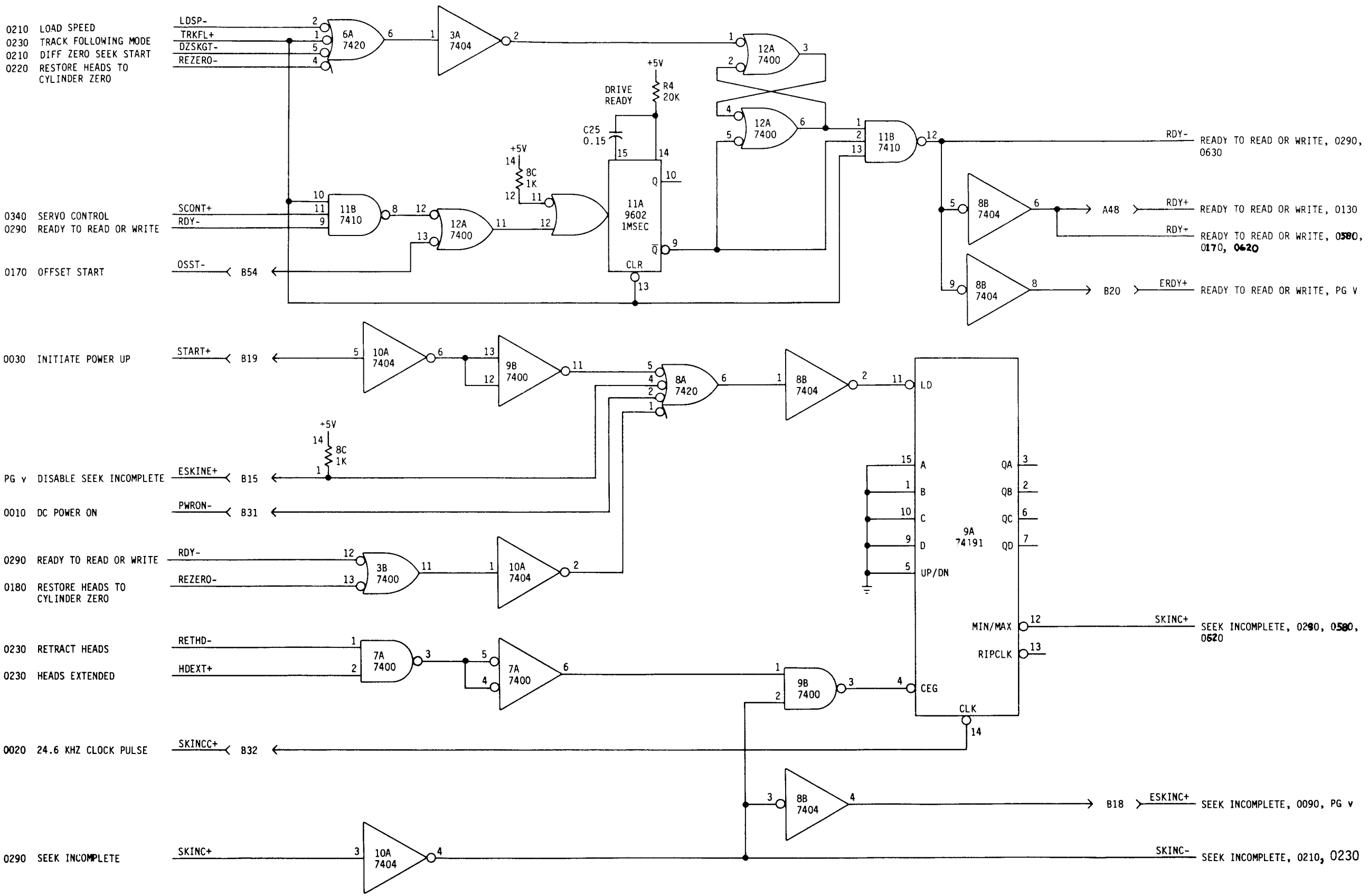

+5V
R6
1K
10
PRESET
12
D
Q
9
SEEKFF+
INITIATE SEEK, 0600
3A
7474
11
C
Q
8
CLR
13
0130 START SEEK
SETCYL-
0580 ATTENTION
ATTEN+
A48
0270 DIFFERENCE COUNTER ZERO
DZERO+
9
10
12
13
6C
7420
8
1
2
5
4
6C
7420
6
3
A5
7404
4
0010 DC POWER ON
PWRON-
B31
0210 SEEK ENABLE
SKENA-
A52
0600 DEVICE CHECK
DEVCK-
A42
0600 INHIBIT SEEK START
INHSKST+
9
5A
7404
8
4
5
4A
7400
6
A27
SKSTGT-
SEEK START GATE, 0210
SKSTGT-
SEEK START GATE, 0140

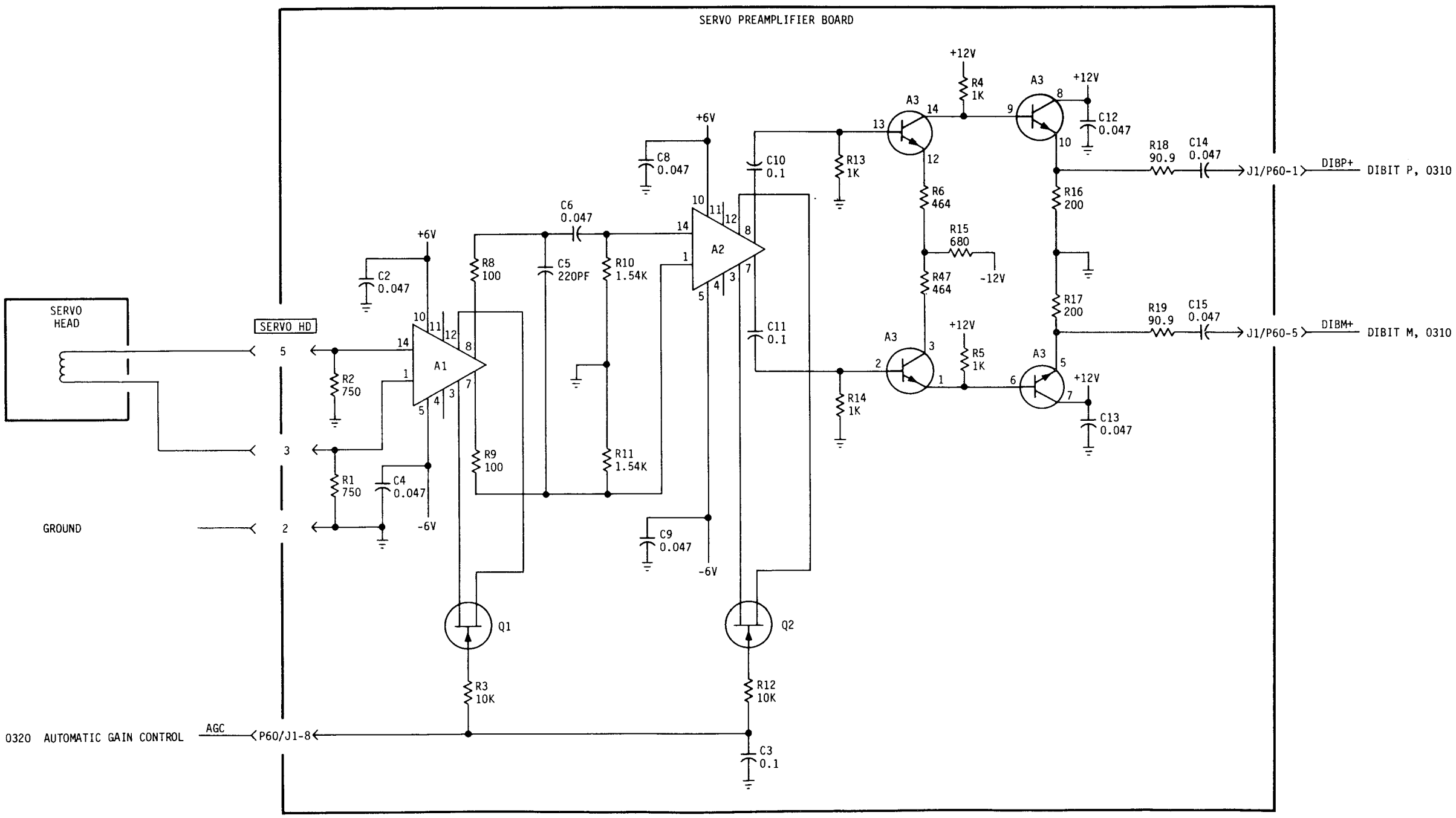

0220 FORWARD SET CONTROL
FWDS-
13
2E
7404
12
FWD+
CARRIAGE FORWARD, 0250, 0260
0140 CYL ADDRESS REG 1
0110 BUS 9
0250 CARRIAGE FORWARD
CAR1-
BUS9+
FWD+
2
3
4
A1
B1
C1
3B
9304
S1
S1
CO1
7
6
5
+5V
R5
1K
9
10
3D
7486
8
DIF1S-
DATA INPUT 1, 0270
0110 BUS 8
0140 CYL ADDRESS REG 2
BUS8+
CAR2+
15
13
1
14
12
B2
A2
C2
3B
9304
S2
S2
CO2
10
9
11
4
5
3D
7486
6
DIF2S-
DATA INPUT 2, 0270
0140 CYL ADDRESS REG 4
0100 BUS 7
CAR4-
BUS7+
2
3
4
A1
B1
C1
3C
9304
S1
S1
CO1
7
6
5
12
13
3D
7486
11
DIF4S-
DATA INPUT 4, 0270
+5V
R5
1K
0100 BUS 6
0140 CYL ADDRESS REG 8
BUS6+
CAR8+
15
13
1
14
12
B2
A2
C2
3C
9304
S2
S2
CO2
10
9
11
2
1
3D
7486
3
DIF8S-
DATA INPUT 8, 0270
0140 CYL ADDRESS REG 64
0100 BUS 5
CAR64-
BUS5+
2
3
4
A1
B1
C1
4B
9304
S1
S1
CO1
7
6
5
9
10
4D
7486
8
DIF16S-
DATA INPUT 16, 0270
+5V
R5
1K
0100 BUS 4
0140 CYL ADDRESS REG 32
BUS4+
CAR32+
15
13
1
14
12
B2
A2
C2
4B
9304
S2
S2
CO2
10
9
11
5
4
4D
7486
6
DIF32S-
DATA INPUT 32, 0270
CO32+
CARRY OUT 32, 0260

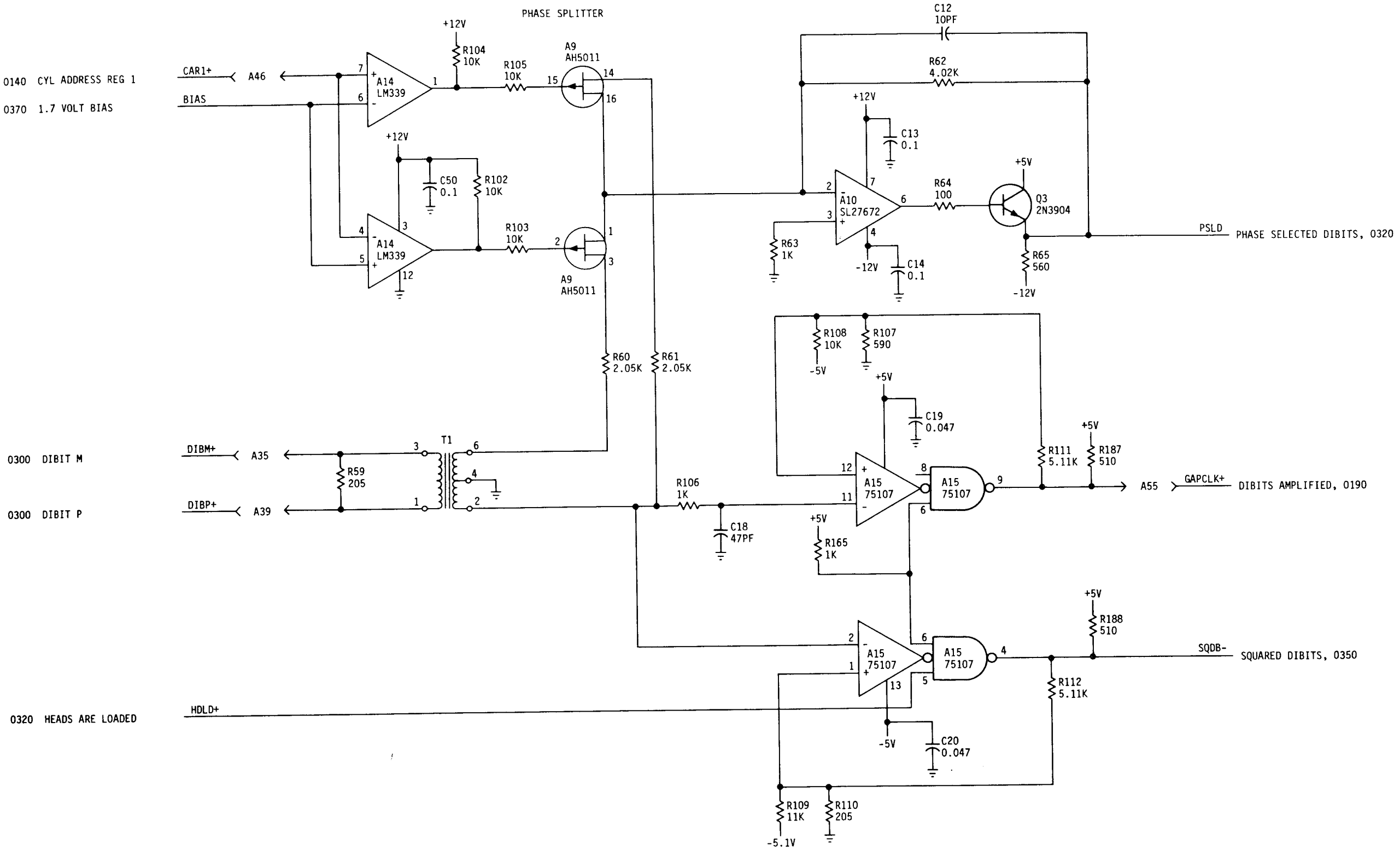

0250 CARRIAGE FORWARD
FWD-
0140 CYL ADDRESS REG 64
CAR64-
0100 BUS 3
BUS3+
0250 CARRY OUT 32
CO32+
+5V
R5
1K
4C
9304
A1
B1
C1
S1
S1
CO1
0100 BUS 2
BUS2+
0140 CYL ADDRESS REG 128
CAR128+
B2
A2
C2
S2
S2
CO2
4D
7486
DIF64S-
DATA INPUT 64, 0270
DIF128S-
DATA INPUT 128, 0270
0140 CYL ADDRESS REG 256
CAR256-
0100 BUS 1
BUS1+
5C
9302
5D
7486
DIF256S-
DATA INPUT 256, 0270
0100 BUS 0
BUS0+
0140 CYL ADDRESS REG 512
CAR512+
5C
9304
DIF512S-
DATA INPUT 512, 0270
CO512+
CARRY OUT 512, 0220

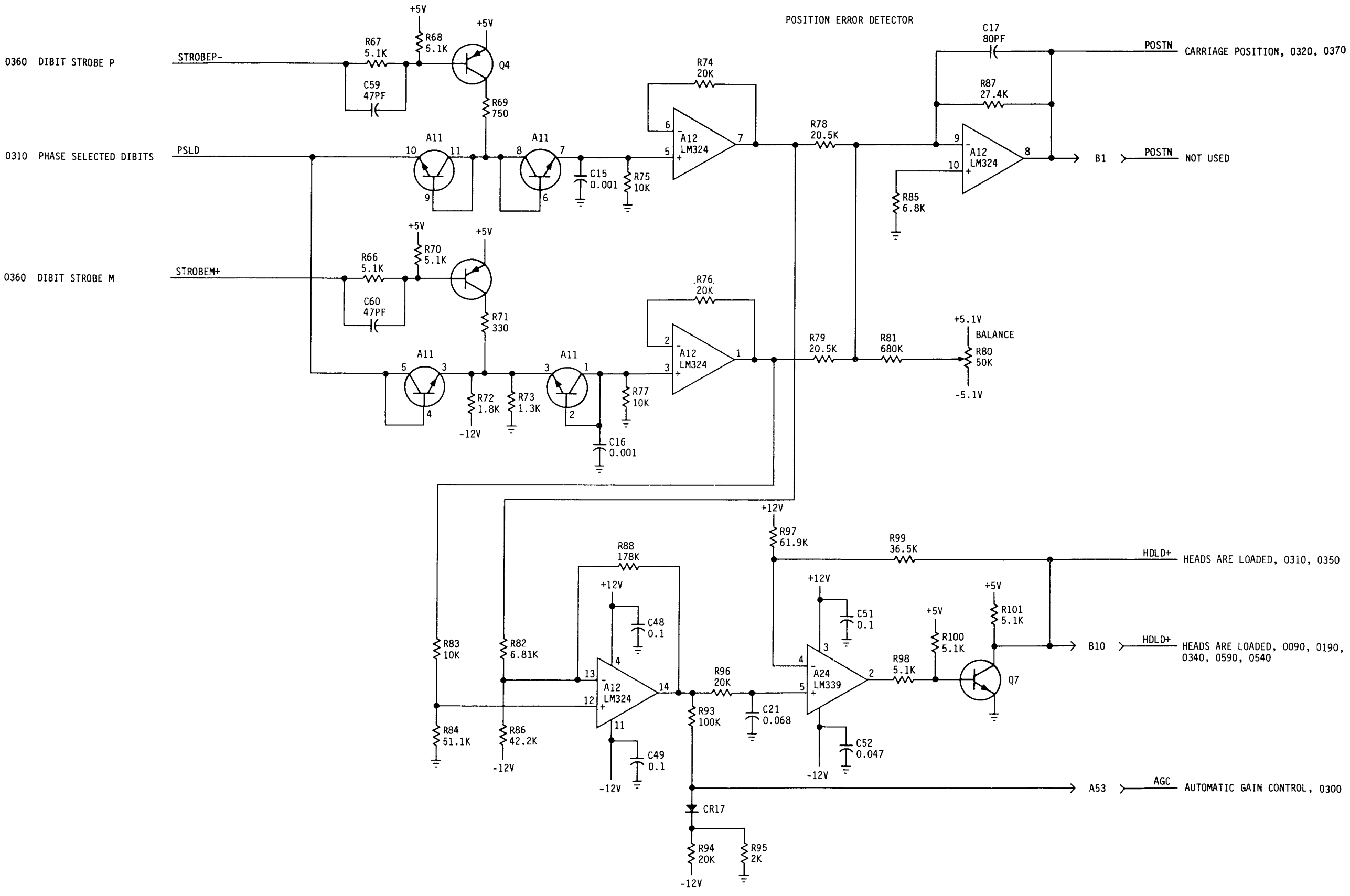

0130 DIFFERENCE COUNTER IN LOAD MODE
0230 TRACK FOLLOWING MODE
0340 DIFFERENCE COUNTER CLOCK
0250 DATA INPUT 1
0250 DATA INPUT 2
0250 DATA INPUT 4
0250 DATA INPUT 8
0250 DATA INPUT 16
0250 DATA INPUT 32
0260 DATA INPUT 64
0260 DATA INPUT 128
0260 DATA INPUT 256
0260 DATA INPUT 512
0270 COUNTER 1 CARRY
0270 COUNTER 2 CARRY
0270 COUNTER 3 CARRY
DIFS-
TRKFL+
A51
DIFC-
A46
6E 7404
8C 7400
+5V
R3 1K
3E 74193
4E 74193
5E 74193
UP
DN
LD
CLR
BOR
CAR
DIF1S-
DIF2S-
DIF4S-
DIF8S-
DIF16S-
DIF32S-
DIF64S-
DIF128S-
DIF256S-
DIF512S-
A18 DIF1- DIFFERENCE COUNTER 1,0280,0340
A20 DIF2- DIFFERENCE COUNTER 2, 0280
A22 DIF4- DIFFERENCE COUNTER 4, 0280
A24 DIF8- DIFFERENCE COUNTER 8, 0280
CNT1- COUNTER 1 CARRY, 0270
A26 DIF16- DIFFERENCE COUNTER 16, 0280
A28 DIF32- DIFFERENCE COUNTER 32, 0280
A30 DIF64- DIFFERENCE COUNTER 64, 0280
A32 DIF128- DIFFERENCE COUNTER 128, 0280
CNT2- COUNTER 2 CARRY, 0270
A34 DIF256- DIFFERENCE COUNTER 256, 0280
A36 DIF512- DIFFERENCE COUNTER 512, 0280
CNT3- COUNTER 3 CARRY, 0270
1D 7404
6D 7410
A16 DZERO- NOT USED
A54 DZERO+ DIFFERENCE COUNTER ZERO, 0220, 0600
DZERO+ DIFFERENCE COUNTER ZERO, 0240

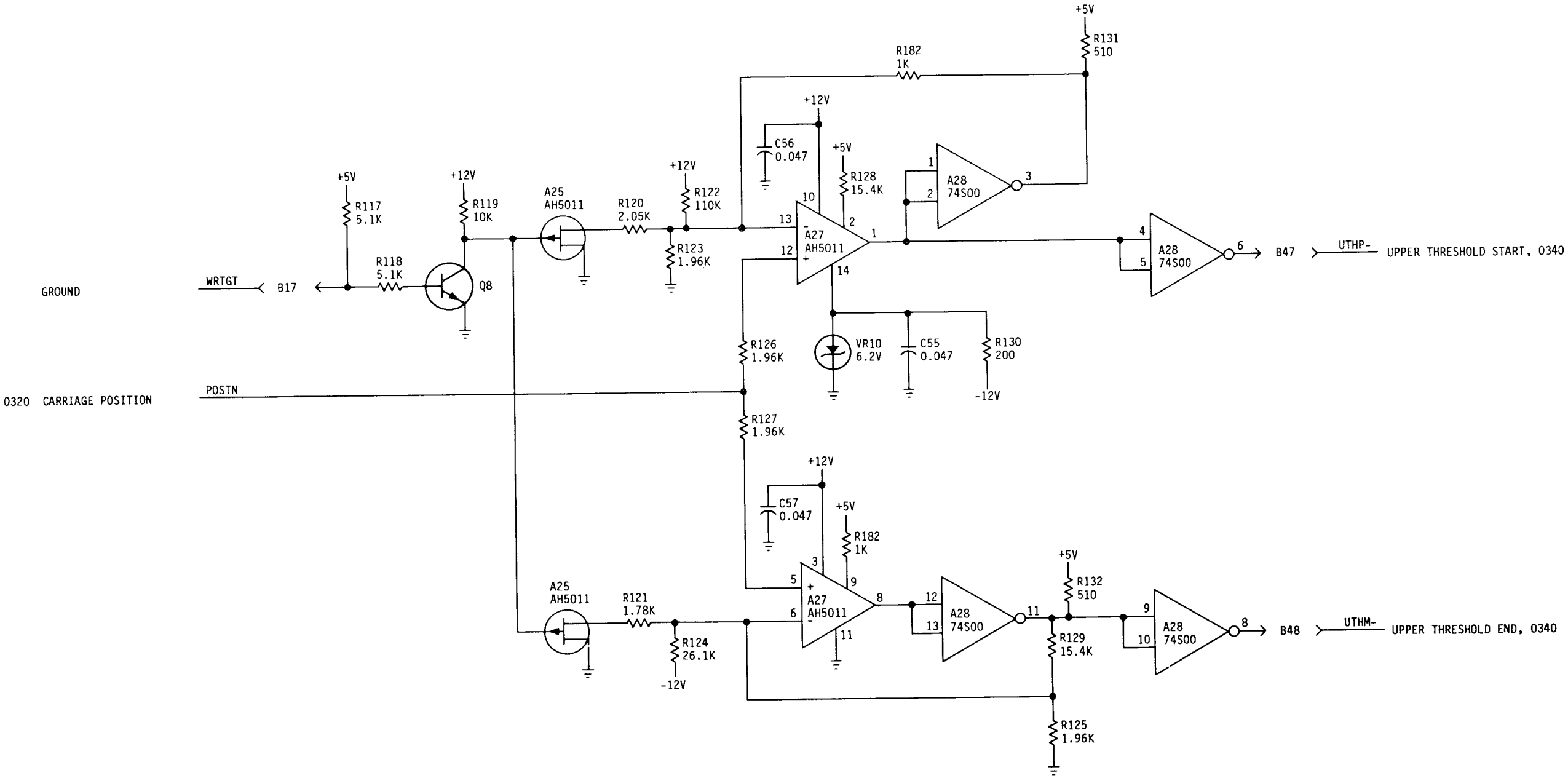

0270 DIFFERENCE COUNTER 1
DIF1- A1
0170 DIFFERENCE COUNTER 2
DIF2- A2
0270 DIFFERENCE COUNTER 4
DIF4- A10
0270 DIFFERENCE COUNTER 8
DIF8- A7
0270 DIFFERENCE COUNTER 16
DIF16- A5
0270 DIFFERENCE COUNTER 32
DIF32- A6
0270 DIFFERENCE COUNTER 64
DIF64- A8
0270 DIFFERENCE COUNTER 128
DIF128- A9
0270 DIFFERENCE COUNTER 256
DIF256- A14
0270 DIFFERENCE COUNTER 512
DIF512- A11
0170 PROGRAMMED OFFSET
OFFSET+ A19
0210 LOAD SPEED
LDSP+ A18
0380 1.7 VOLT BIAS
BIAS +1.7V
0170 ENABLE SERVO FORWARD
SRVFWD- A13
+5V
+12V
-12V
+3.9V
R1 20K
R2 365K
R3 316K
R4 162K
R5 78.7K
R6 40.2K
R7 20.5K
R8 10K
R9 4.99K
R10 10K
R11 7.5K
R12 20K
R13 5.1K
R14 20K
R15 7.5K
R16 20K
R17 5.1K
R18 20K
R19 2.49K
R20 154K
R21 2.37K
R22 8.66K
R23 16.9K
R24 11.5K
R25 17.8K
R26 10K
R27 20.5K
R28 10K
R29 10K
R189 274K
C40 0.1
C41 0.1
C42 0.1
C43 0.047
C44 0.1
C45 0.047
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
CR11
CR12
CR28
A1 LM339
A2 LM339
A3 LM339
A4 LM339
POLARITY SWITCH
VDAC
FORWARD/REVERSE VOLTAGE, 0370
Q1 2N4858

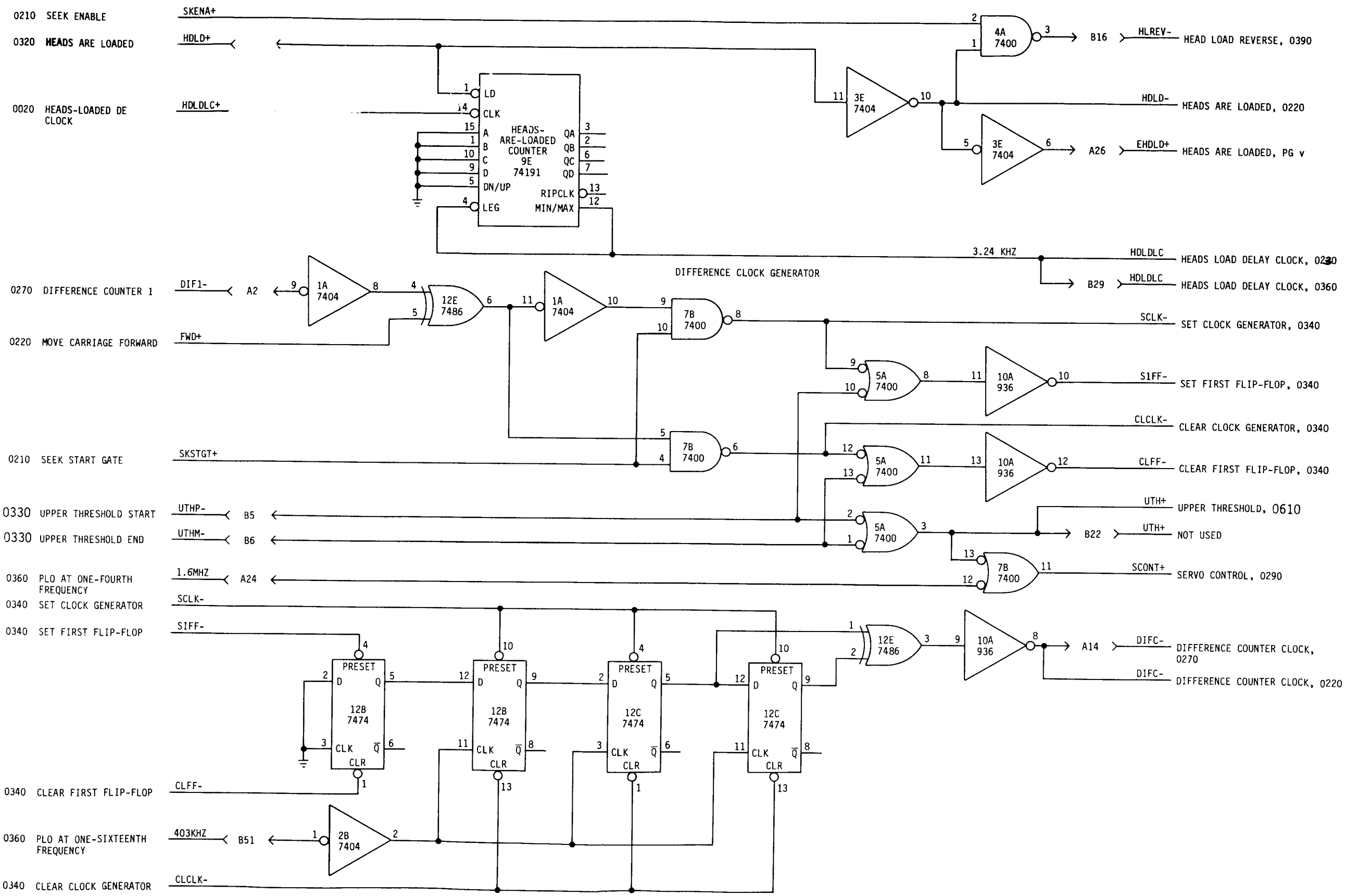

0210 LOAD SPEED
0230 TRACK FOLLOWING MODE
0210 DIFF ZERO SEEK START
0220 RESTORE HEADS TO CYLINDER ZERO
LDSP-
TRKFL+
DZSKGT-
REZERO-
6A 7420
3A 7404
12A 7400
12A 7400
11B 7410
DRIVE READY
+5V
R4 20K
C25 0.15
+5V
8C 1K
11A 9602 1MSEC
Q
CLR
RDY-
READY TO READ OR WRITE, 0290, 0630
8B 7404
A48
RDY+
READY TO READ OR WRITE, 0130
RDY+
READY TO READ OR WRITE, 0580, 0170, 0620
8B 7404
B20
ERDY+
READY TO READ OR WRITE, PG V
0340 SERVO CONTROL
0290 READY TO READ OR WRITE
SCONT+
RDY-
11B 7410
12A 7400
0170 OFFSET START
OSST-
B54
0030 INITIATE POWER UP
START+
B19
10A 7404
9B 7400
8A 7420
8B 7404
LD
+5V
8C 1K
PG v DISABLE SEEK INCOMPLETE
ESKINE+
B15
0010 DC POWER ON
PWRON-
B31
9A 74191
A
B
C
D
UP/DN
QA
QB
QC
QD
MIN/MAX
RIPCLK
SKINC+
SEEK INCOMPLETE, 0290, 0580, 0620
0290 READY TO READ OR WRITE
0180 RESTORE HEADS TO CYLINDER ZERO
RDY-
REZERO-
3B 7400
10A 7404
0230 RETRACT HEADS
0230 HEADS EXTENDED
RETHD-
HDEXT+
7A 7400
7A 7400
9B 7400
CEG
CLK
0020 24.6 KHZ CLOCK PULSE
SKINCC+
B32
8B 7404
B18
ESKINC+
SEEK INCOMPLETE, 0090, PG v
0290 SEEK INCOMPLETE
SKINC+
10A 7404
SKINC-
SEEK INCOMPLETE, 0210, 0230

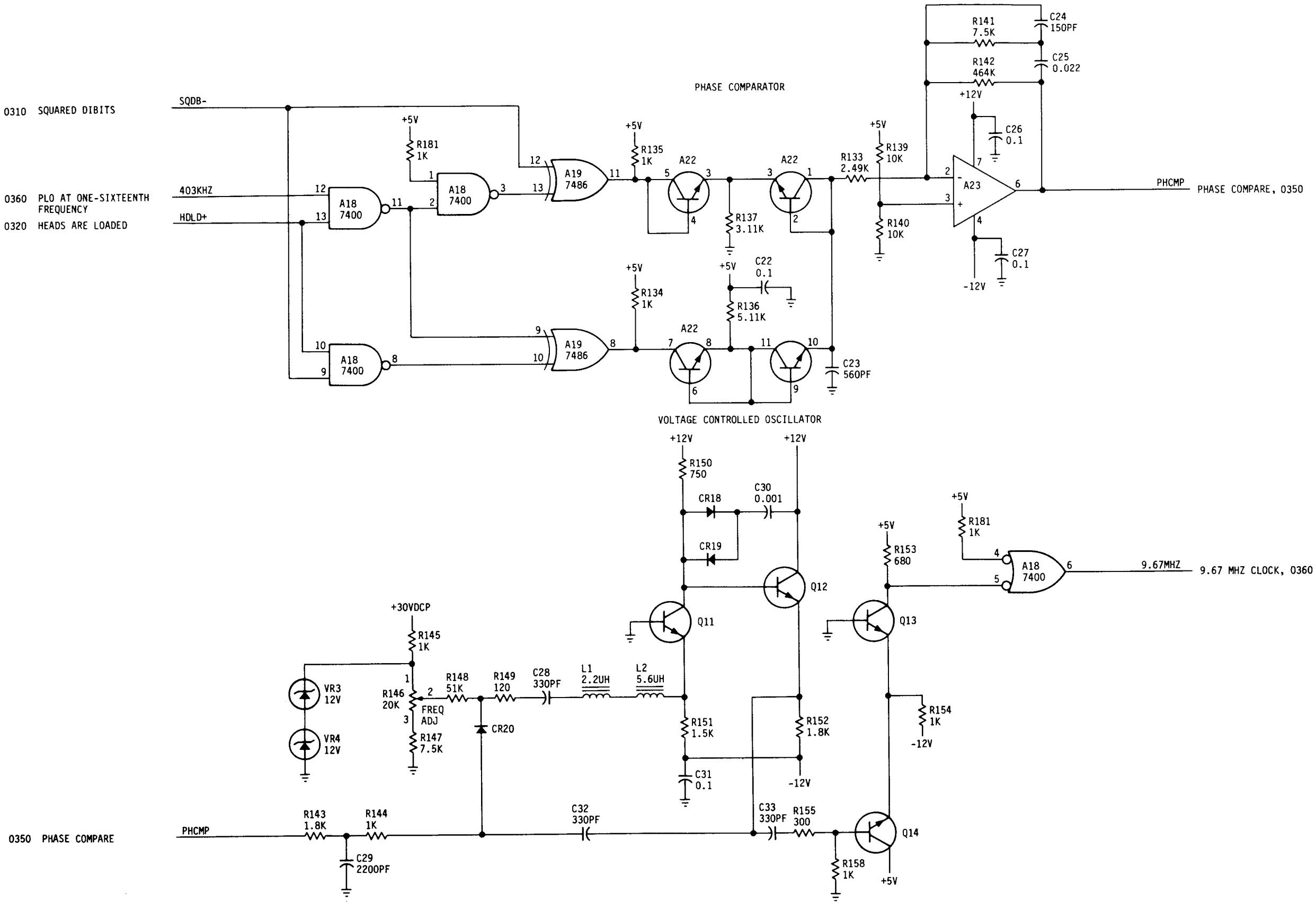

SERVO PREAMPLIFIER BOARD
SERVO HEAD
SERVO HD
5
3
2
GROUND
R2 750
R1 750
C4 0.047
-6V
+6V
C2 0.047
C8 0.047
C6 0.047
C5 220PF
R8 100
R10 1.54K
R9 100
R11 1.54K
C9 0.047
-6V
A1
A2
C10 0.1
C11 0.1
R13 1K
R14 1K
+12V
R4 1K
R5 1K
A3
C12 0.047
C13 0.047
R6 464
R47 464
R15 680
-12V
R16 200
R17 200
R18 90.9
C14 0.047
R19 90.9
C15 0.047
J1/P60-1
DIBP+
DIBIT P, 0310
J1/P60-5
DIBM+
DIBIT M, 0310
Q1
Q2
R3 10K
R12 10K
C3 0.1
0320 AUTOMATIC GAIN CONTROL
AGC
P60/J1-8

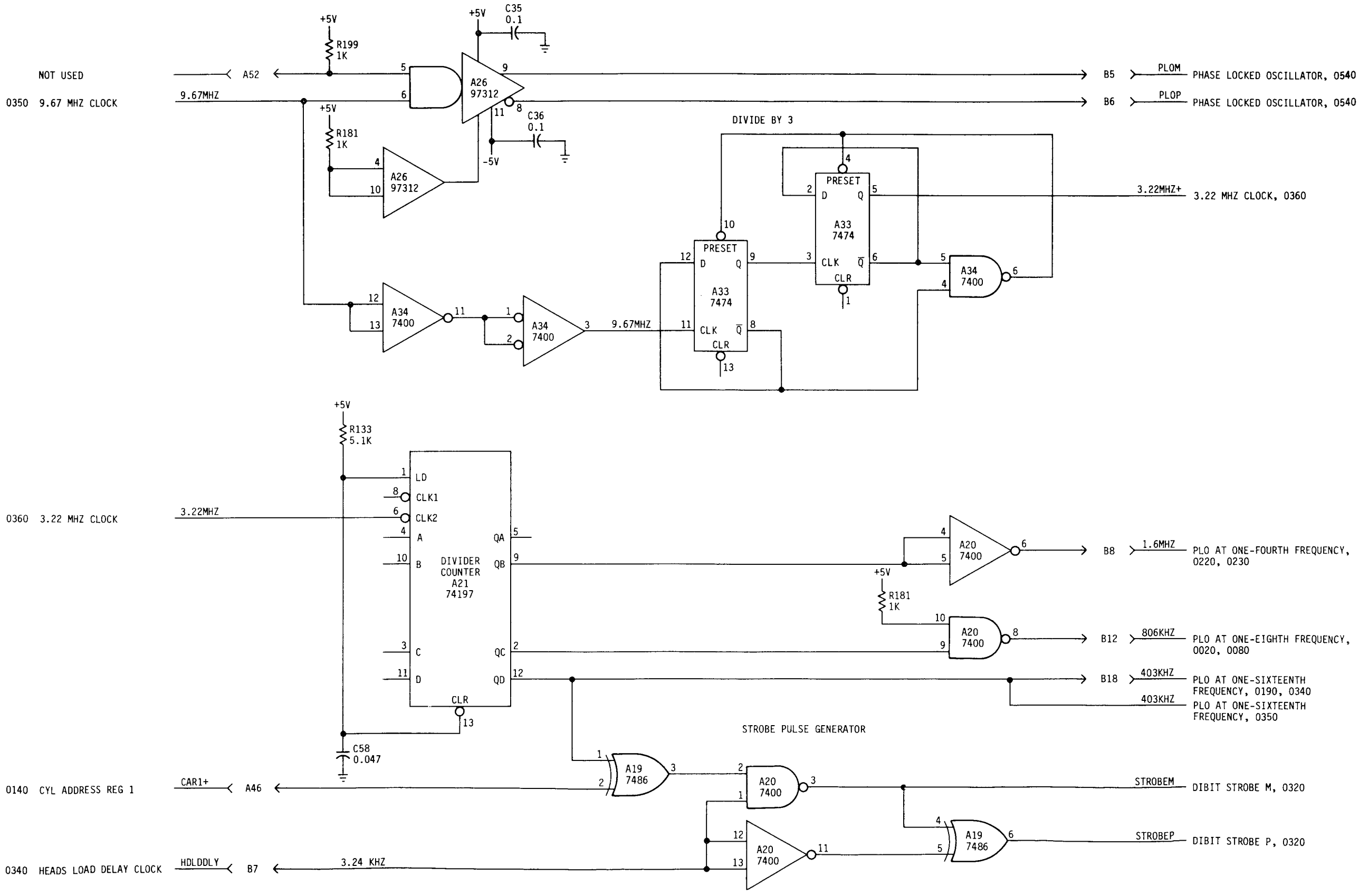

PHASE SPLITTER
0140 CYL ADDRESS REG 1
0370 1.7 VOLT BIAS
CAR1+
A46
BIAS
A14 LM339
+12V
R104 10K
R105 10K
A9 AH5011
C50 0.1
R102 10K
R103 10K
R60 2.05K
R61 2.05K
C12 10PF
R62 4.02K
C13 0.1
A10 SL27672
R64 100
Q3 2N3904
+5V
R63 1K
-12V
C14 0.1
R65 560
PSLD
PHASE SELECTED DIBITS, 0320
R108 10K
R107 590
-5V
C19 0.047
0300 DIBIT M
0300 DIBIT P
DIBM+
DIBP+
A35
A39
T1
R59 205
R106 1K
C18 47PF
R165 1K
A15 75107
R111 5.11K
R187 510
A55
GAPCLK+
DIBITS AMPLIFIED, 0190
R188 510
SQDB-
SQUARED DIBITS, 0350
R112 5.11K
C20 0.047
0320 HEADS ARE LOADED
HDLD+
R109 11K
R110 205
-5.1V

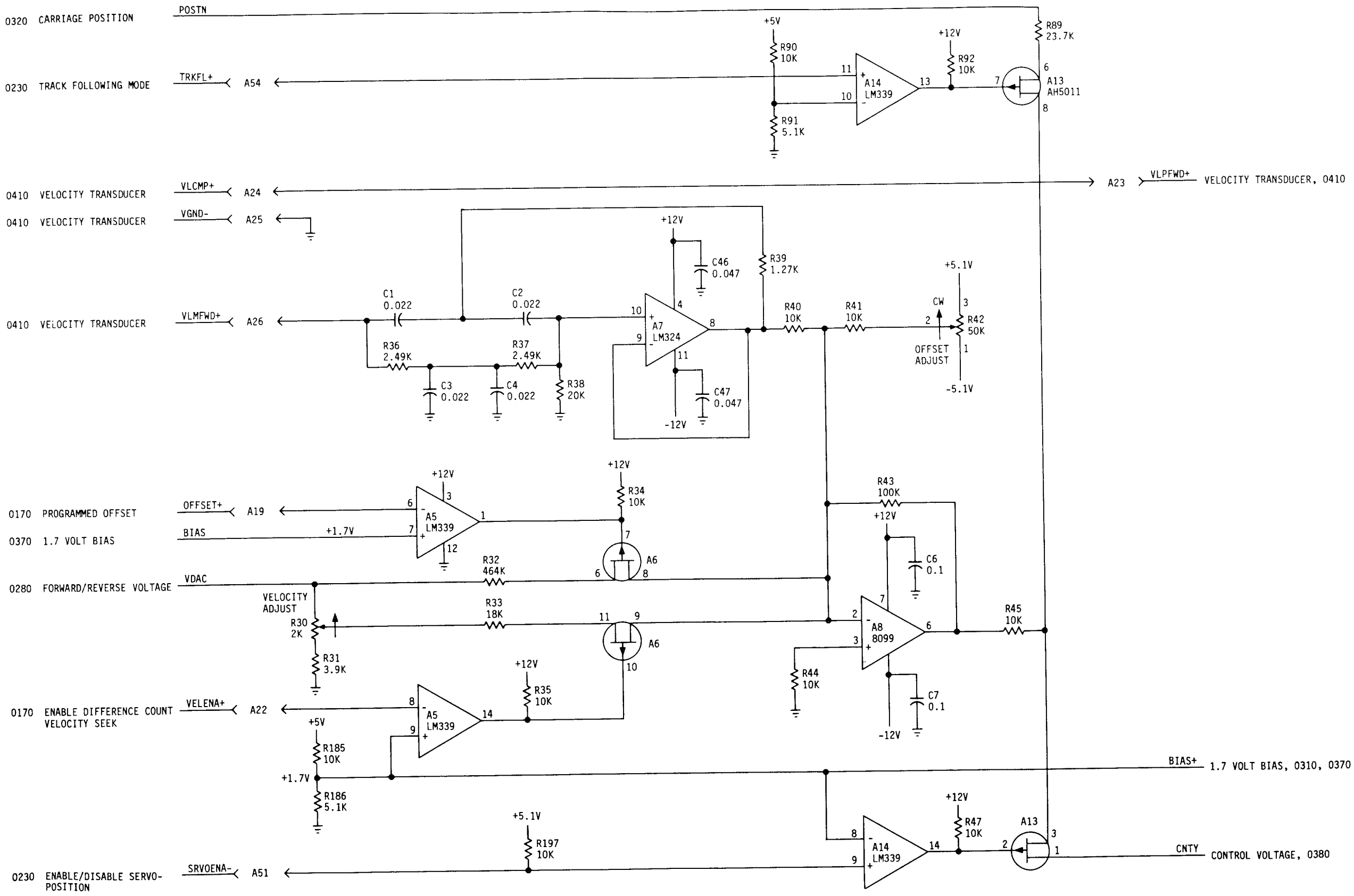

POSITION ERROR DETECTOR
0360 DIBIT STROBE P
STROBEP-
0310 PHASE SELECTED DIBITS
PSLD
0360 DIBIT STROBE M
STROBEM+
+5V
R67 5.1K
R68 5.1K
Q4
C59 47PF
R69 750
A11
R74 20K
A12 LM324
C15 0.001
R75 10K
R78 20.5K
C17 80PF
POSTN
CARRIAGE POSITION, 0320, 0370
R87 27.4K
R85 6.8K
B1
NOT USED
R66 5.1K
R70 5.1K
C60 47PF
R71 330
R76 20K
R79 20.5K
R81 680K
+5.1V
BALANCE
R80 50K
-5.1V
R72 1.8K
R73 1.3K
-12V
R77 10K
C16 0.001
+12V
R97 61.9K
R99 36.5K
HDLD+
HEADS ARE LOADED, 0310, 0350
R88 178K
C48 0.1
R83 10K
R82 6.81K
R84 51.1K
R86 42.2K
A24 LM339
C51 0.1
R100 5.1K
R101 5.1K
R98 5.1K
Q7
B10
HEADS ARE LOADED, 0090, 0190, 0340, 0590, 0540
R96 20K
C21 0.068
R93 100K
C49 0.1
C52 0.047
A53
AGC
AUTOMATIC GAIN CONTROL, 0300
CR17
R94 20K
R95 2K


GROUND
WRTGT
B17
+5V
R117
5.1K
R118
5.1K
+12V
R119
10K
Q8
A25
AH5011
R120
2.05K
+12V
R122
110K
R123
1.96K
+12V
C56
0.047
+5V
R128
15.4K
R182
1K
+5V
R131
510
A27
AH5011
A28
74S00
A28
74S00
B47
UTHP-
UPPER THRESHOLD START, 0340
R126
1.96K
VR10
6.2V
C55
0.047
R130
200
-12V
0320 CARRIAGE POSITION
POSTN
R127
1.96K
+12V
C57
0.047
+5V
R182
1K
A25
AH5011
R121
1.78K
R124
26.1K
-12V
A27
AH5011
A28
74S00
+5V
R132
510
R129
15.4K
A28
74S00
B48
UTHM-
UPPER THRESHOLD END, 0340
R125
1.96K


0210 SEEK ENABLE
SKENA+
0320 HEADS ARE LOADED
HDLD+
0020 HEADS-LOADED DE CLOCK
HDLDLC+
HEADS-ARE-LOADED COUNTER 9E 74191
LD
CLK
A
B
C
D
DN/UP
LEG
QA
QB
QC
QD
RIPCLK
MIN/MAX
4A 7400
3E 7404
B16
HLREV-
HEAD LOAD REVERSE, 0390
HDLD-
HEADS ARE LOADED, 0220
A26
EHDLD+
HEADS ARE LOADED, PG v
3.24 KHZ
HDLDLC
HEADS LOAD DELAY CLOCK, 0230
B29
HEADS LOAD DELAY CLOCK, 0360
DIFFERENCE CLOCK GENERATOR
0270 DIFFERENCE COUNTER 1
DIF1-
A2
1A 7404
12E 7486
0220 MOVE CARRIAGE FORWARD
FWD+
7B 7400
SCLK-
SET CLOCK GENERATOR, 0340
5A 7400
10A 936
S1FF-
SET FIRST FLIP-FLOP, 0340
CLCLK-
CLEAR CLOCK GENERATOR, 0340
0210 SEEK START GATE
SKSTGT+
CLFF-
CLEAR FIRST FLIP-FLOP, 0340
0330 UPPER THRESHOLD START
UTHP-
B5
UTH+
UPPER THRESHOLD, 0610
0330 UPPER THRESHOLD END
UTHM-
B6
B22
NOT USED
0360 PLO AT ONE-FOURTH FREQUENCY
1.6MHZ
A24
SCONT+
SERVO CONTROL, 0290
0340 SET CLOCK GENERATOR
0340 SET FIRST FLIP-FLOP
SIFF-
PRESET
D
Q
CLK
CLR
12B 7474
12C 7474
0340 CLEAR FIRST FLIP-FLOP
0360 PLO AT ONE-SIXTEENTH FREQUENCY
403KHZ
B51
2B 7404
0340 CLEAR CLOCK GENERATOR
A14
DIFC-
DIFFERENCE COUNTER CLOCK, 0270
DIFFERENCE COUNTER CLOCK, 0220


0310 SQUARED DIBITS
SQDB-
0360 PLO AT ONE-SIXTEENTH FREQUENCY
403KHZ
0320 HEADS ARE LOADED
HDLD+
PHASE COMPARATOR
+5V
R181 1K
A18 7400
A19 7486
R135 1K
A22
R137 3.11K
R133 2.49K
R139 10K
R140 10K
R141 7.5K
R142 464K
C24 150PF
C25 0.022
C26 0.1
A23
C27 0.1
+12V
-12V
PHCMP
PHASE COMPARE, 0350
R134 1K
C22 0.1
R136 5.11K
C23 560PF
VOLTAGE CONTROLLED OSCILLATOR
R150 750
CR18
CR19
C30 0.001
Q11
Q12
Q13
Q14
+30VDCP
R145 1K
VR3 12V
VR4 12V
R146 20K
FREQ ADJ
R147 7.5K
R148 51K
R149 120
C28 330PF
L1 2.2UH
L2 5.6UH
CR20
R151 1.5K
R152 1.8K
C31 0.1
R153 680
R154 1K
R181 1K
A18 7400
9.67MHZ
9.67 MHZ CLOCK, 0360
0350 PHASE COMPARE
PHCMP
R143 1.8K
R144 1K
C29 2200PF
C32 330PF
C33 330PF
R155 300
R158 1K

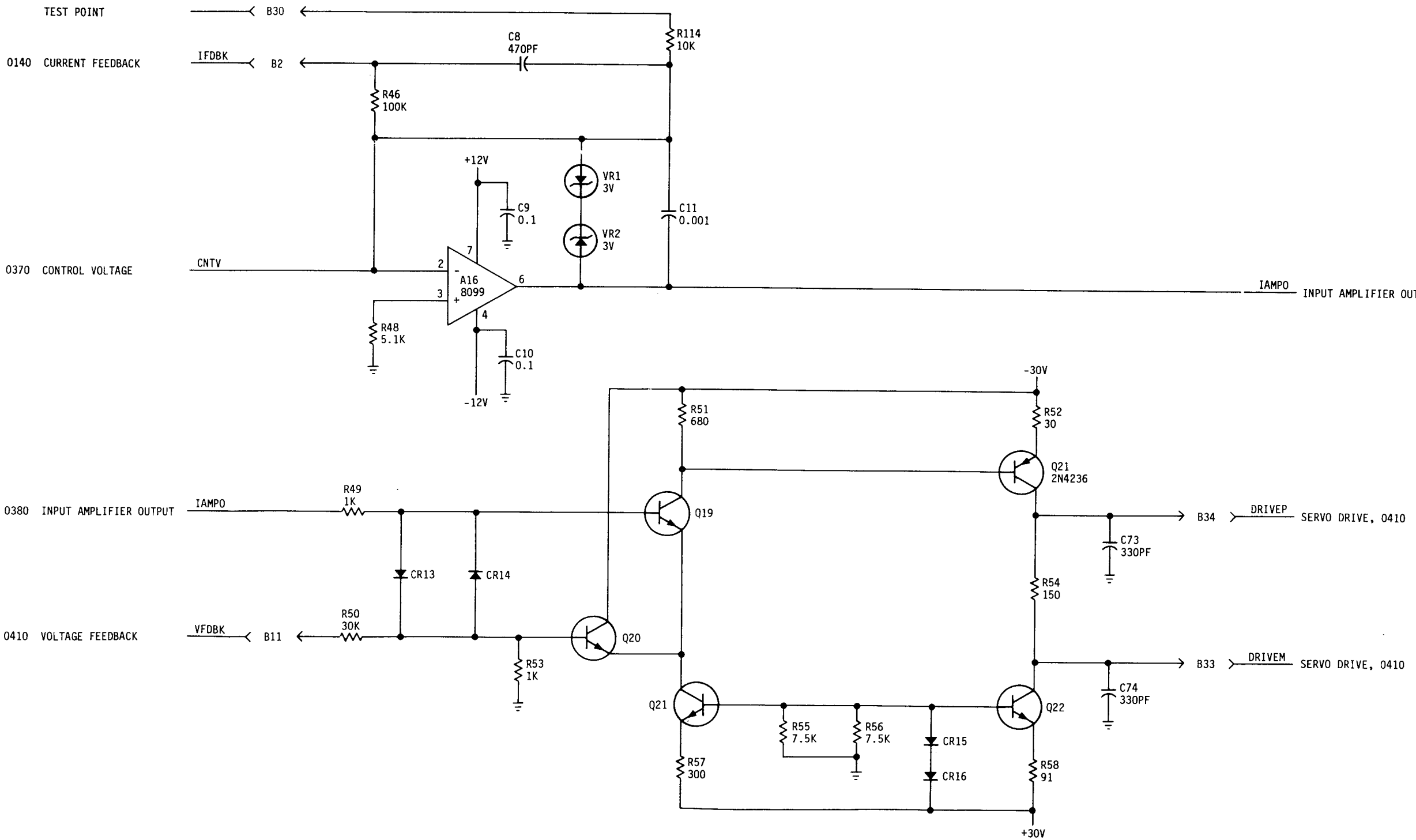

NOT USED
A52
0350 9.67 MHZ CLOCK
9.67MHZ
+5V
R199
1K
+5V
C35
0.1
A26
97312
B5
PLOM
PHASE LOCKED OSCILLATOR, 0540
B6
PLOP
PHASE LOCKED OSCILLATOR, 0540
C36
0.1
-5V
R181
1K
A26
97312
DIVIDE BY 3
PRESET
A33
7474
CLK
CLR
3.22MHZ+
3.22 MHZ CLOCK, 0360
A34
7400
A34
7400
A34
7400
9.67MHZ
0360 3.22 MHZ CLOCK
3.22MHZ
+5V
R133
5.1K
LD
CLK1
CLK2
A
B
C
D
QA
QB
QC
QD
CLR
DIVIDER
COUNTER
A21
74197
C58
0.047
A20
7400
1.6MHZ
B8
PLO AT ONE-FOURTH FREQUENCY,
0220, 0230
R181
1K
A20
7400
806KHZ
B12
PLO AT ONE-EIGHTH FREQUENCY,
0020, 0080
403KHZ
B18
PLO AT ONE-SIXTEENTH
FREQUENCY, 0190, 0340
403KHZ
PLO AT ONE-SIXTEENTH
FREQUENCY, 0350
STROBE PULSE GENERATOR
0140 CYL ADDRESS REG 1
CAR1+
A46
A19
7486
A20
7400
STROBEM
DIBIT STROBE M, 0320
0340 HEADS LOAD DELAY CLOCK
HDLDDLY
B7
3.24 KHZ
A20
7400
A19
7486
STROBEP
DIBIT STROBE P, 0320

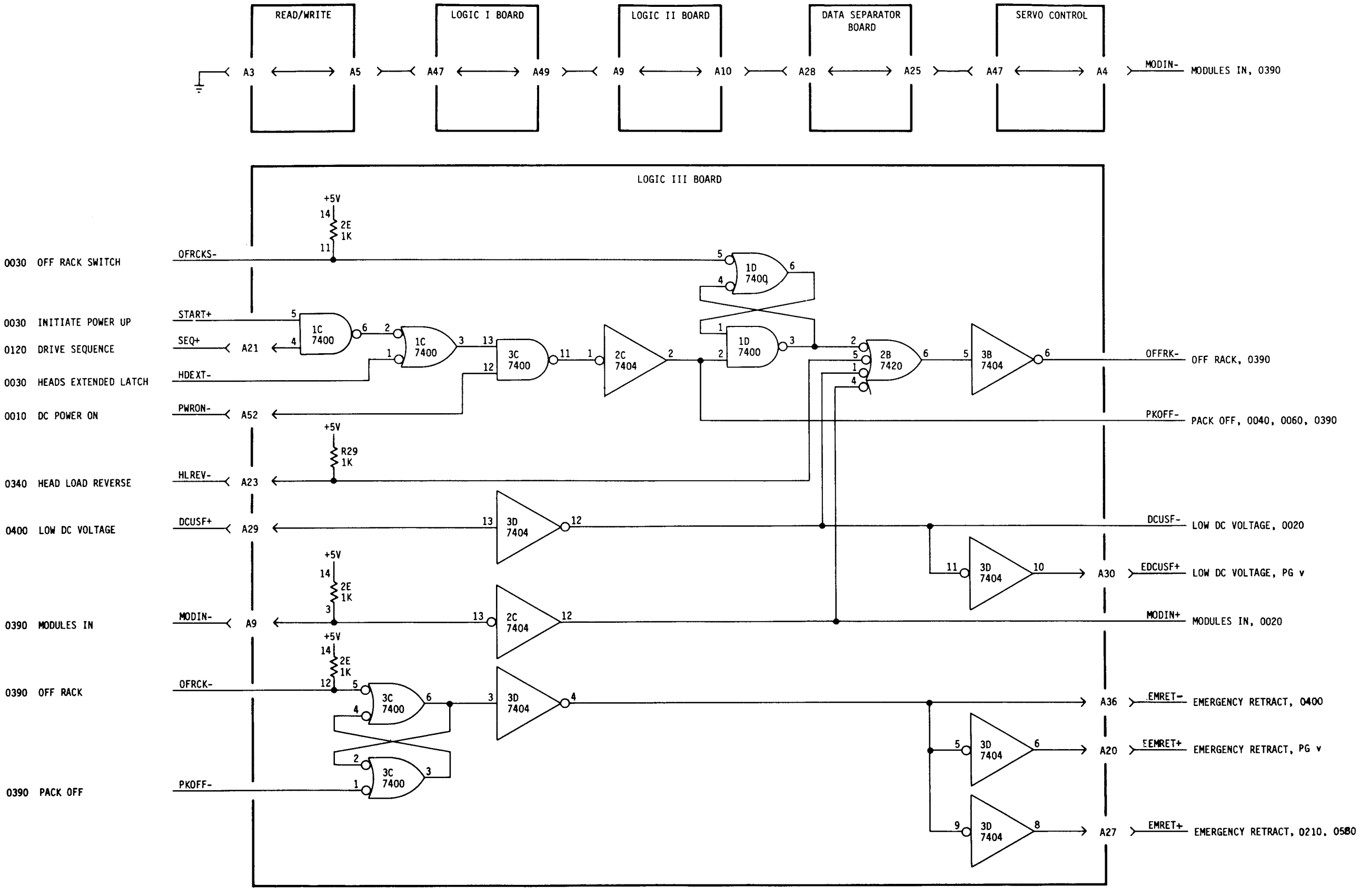


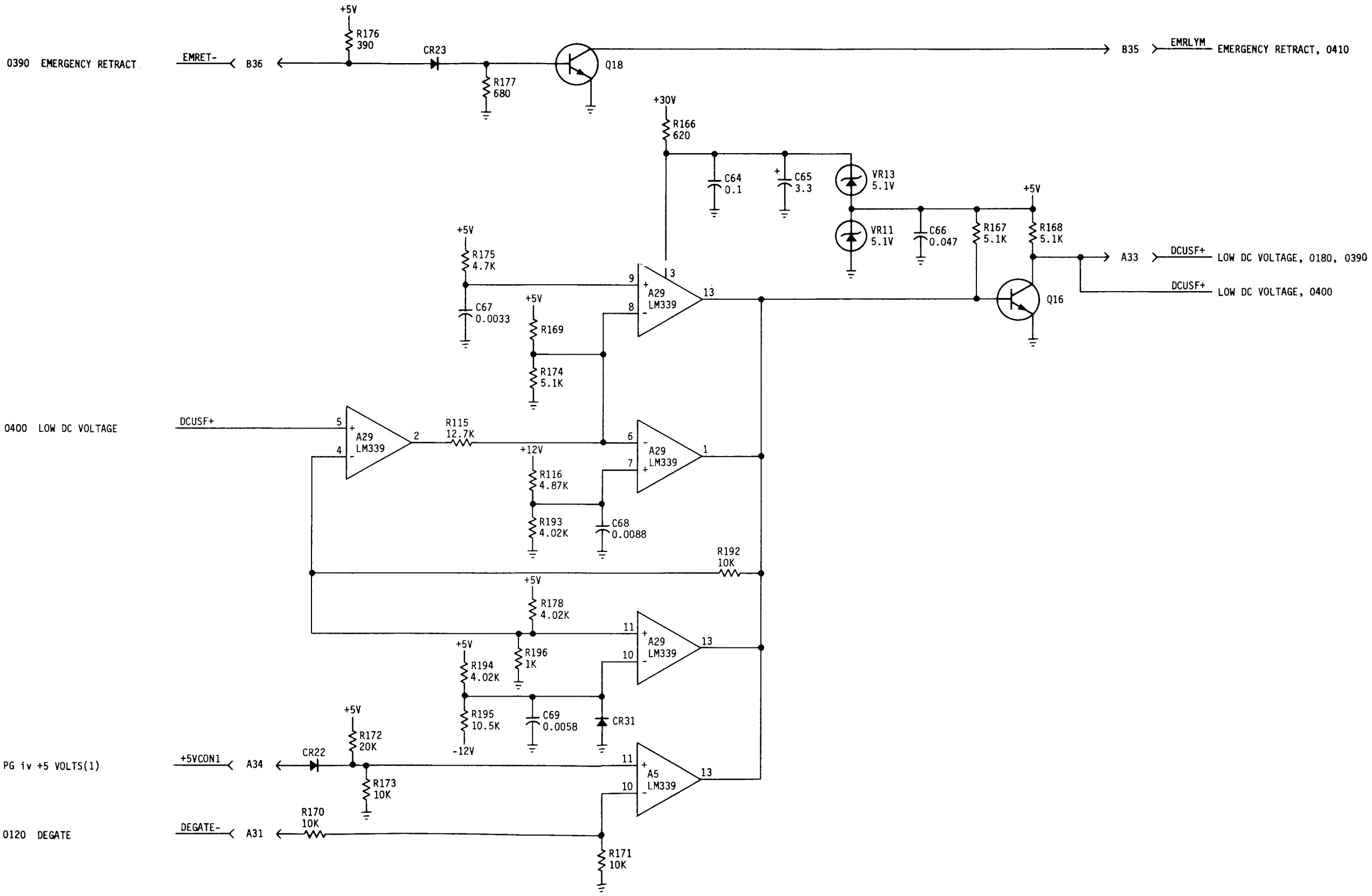
ILD 2040
DISC STORAGE UNIT

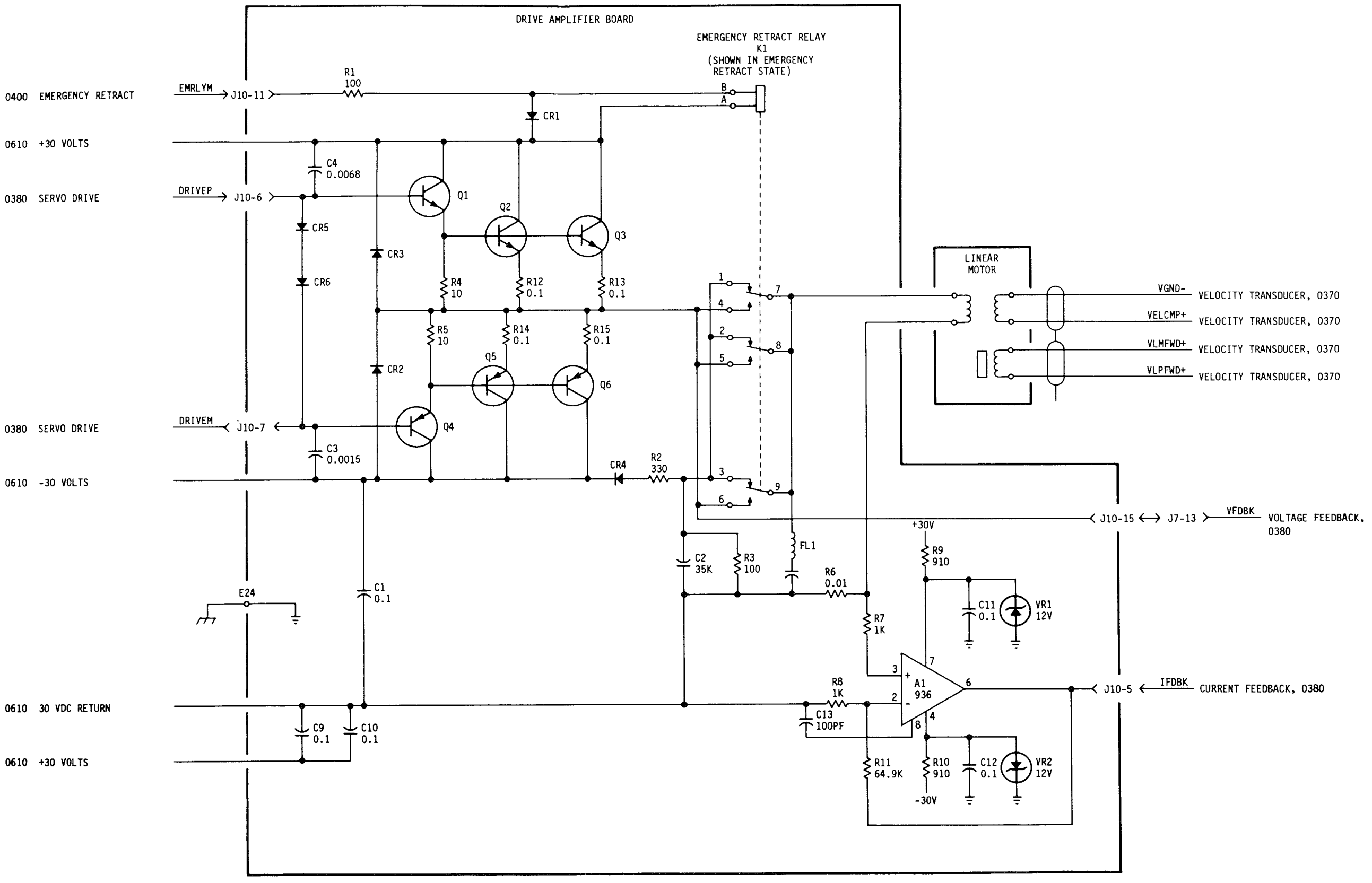
SERVO CONTROL

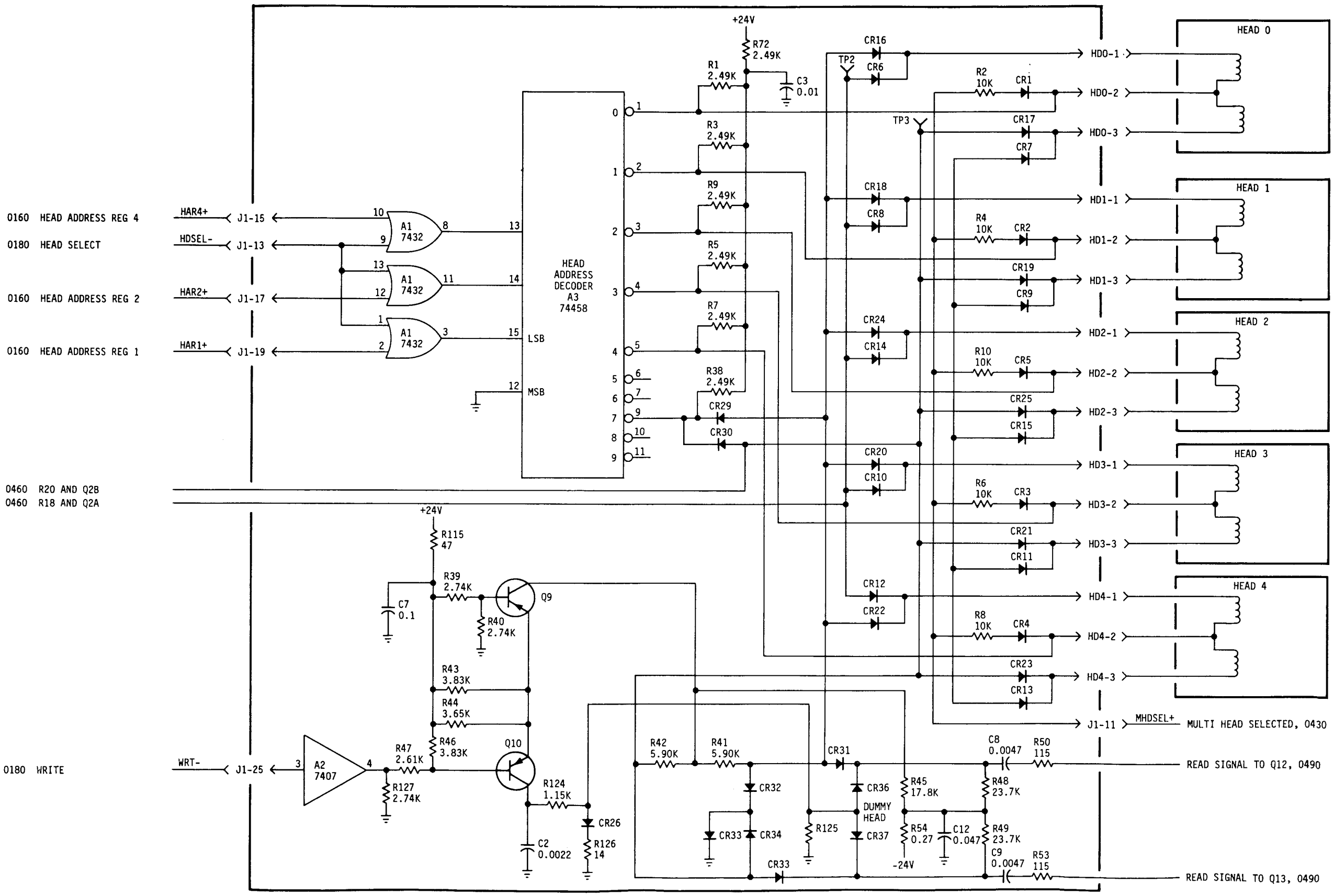
0370

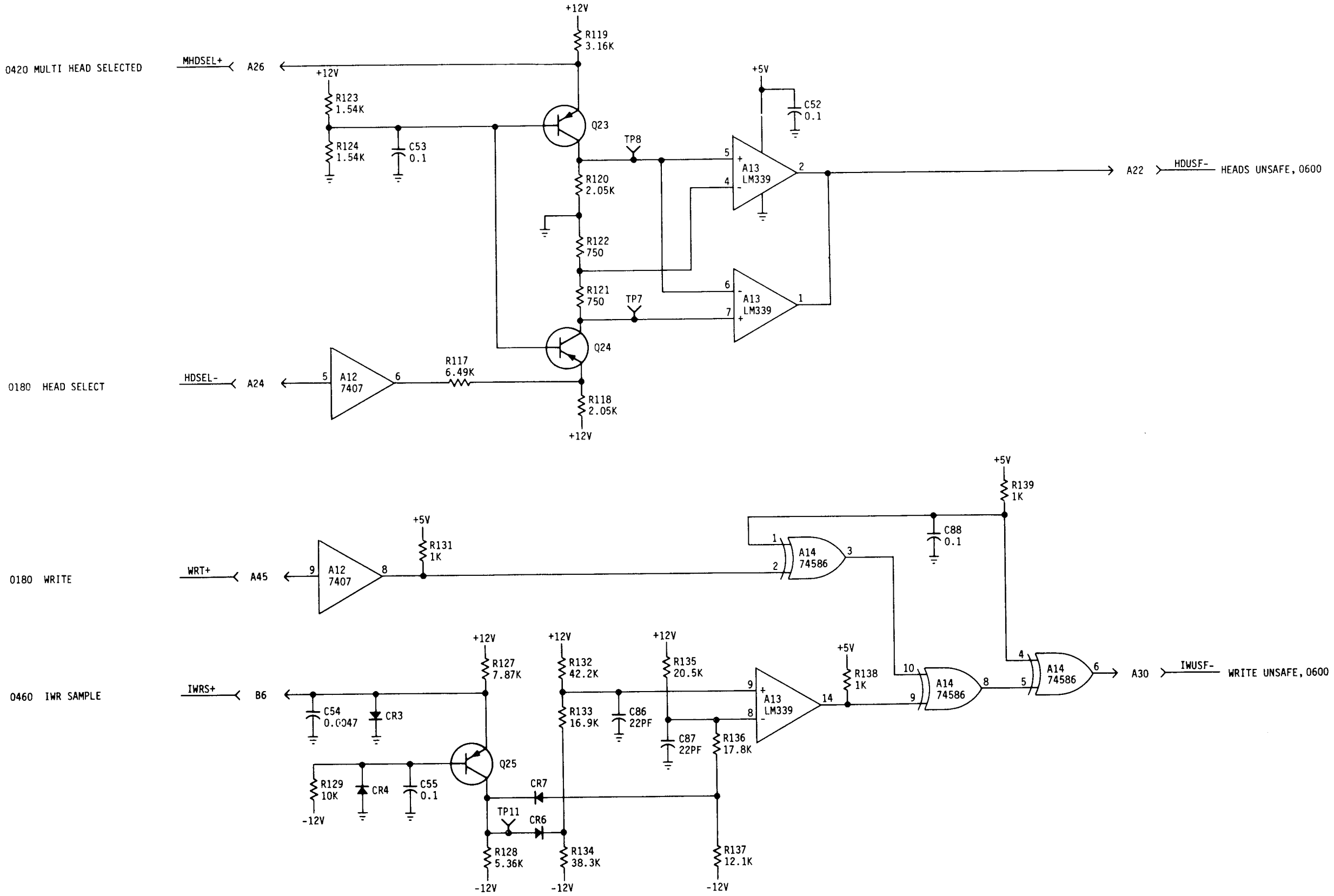

TEST POINT
B30
C8
470PF
R114
10K
0140 CURRENT FEEDBACK
IFDBK
B2
R46
100K
+12V
VR1
3V
C9
0.1
C11
0.001
VR2
3V
0370 CONTROL VOLTAGE
CNTV
2
7
A16
8099
6
3
4
IAMPO
INPUT AMPLIFIER OUTPUT, 0380
R48
5.1K
C10
0.1
-12V
-30V
R51
680
R52
30
Q21
2N4236
0380 INPUT AMPLIFIER OUTPUT
IAMPO
R49
1K
Q19
B34
DRIVEP
SERVO DRIVE, 0410
C73
330PF
CR13
CR14
R54
150
0410 VOLTAGE FEEDBACK
VFDBK
B11
R50
30K
Q20
R53
1K
B33
DRIVEM
SERVO DRIVE, 0410
C74
330PF
Q21
Q22
R55
7.5K
R56
7.5K
CR15
CR16
R57
300
R58
91
+30V


READ/WRITE
LOGIC I BOARD
LOGIC II BOARD
DATA SEPARATOR BOARD
SERVO CONTROL
A3
A5
A47
A49
A9
A10
A28
A25
A47
A4
MODIN-
MODULES IN, 0390
LOGIC III BOARD
+5V
2E 1K
OFRCKS-
0030 OFF RACK SWITCH
START+
0030 INITIATE POWER UP
SEQ+
A21
0120 DRIVE SEQUENCE
HDEXT-
0030 HEADS EXTENDED LATCH
PWRON-
A52
0010 DC POWER ON
R29 1K
HLREV-
A23
0340 HEAD LOAD REVERSE
DCUSF+
A29
0400 LOW DC VOLTAGE
MODIN-
A9
0390 MODULES IN
OFRCK-
0390 OFF RACK
PKOFF-
0390 PACK OFF
1C 7400
1D 7400
2C 7404
3C 7400
2B 7420
3B 7404
3D 7404
OFFRK-
OFF RACK, 0390
PKOFF-
PACK OFF, 0040, 0060, 0390
DCUSF-
LOW DC VOLTAGE, 0020
EDCUSF+
LOW DC VOLTAGE, PG v
MODIN+
MODULES IN, 0020
A30
A36
EMRET-
EMERGENCY RETRACT, 0400
A20
EMRET+
EMERGENCY RETRACT, PG v
A27
EMRET+
EMERGENCY RETRACT, 0210, 0580


0390 EMERGENCY RETRACT
EMRET-
B36
+5V
R176
390
CR23
R177
680
Q18
B35
EMRLYM
EMERGENCY RETRACT, 0410
+30V
R166
620
C64
0.1
C65
3.3
VR13
5.1V
VR11
5.1V
C66
0.047
R167
5.1K
R168
5.1K
+5V
A33
DCUSF+
LOW DC VOLTAGE, 0180, 0390
DCUSF+
LOW DC VOLTAGE, 0400
Q16
+5V
R175
4.7K
C67
0.0033
A29
LM339
+5V
R169
R174
5.1K
0400 LOW DC VOLTAGE
DCUSF+
A29
LM339
R115
12.7K
+12V
R116
4.87K
R193
4.02K
C68
0.0088
A29
LM339
R192
10K
+5V
R178
4.02K
A29
LM339
+5V
R194
4.02K
R196
1K
R195
10.5K
-12V
C69
0.0058
CR31
PG iv +5 VOLTS(1)
+5VCON1
A34
CR22
+5V
R172
20K
R173
10K
A5
LM339
0120 DEGATE
DEGATE-
A31
R170
10K
R171
10K


DRIVE AMPLIFIER BOARD
EMERGENCY RETRACT RELAY
K1
(SHOWN IN EMERGENCY
RETRACT STATE)
0400 EMERGENCY RETRACT
EMRLYM
J10-11
R1
100
B
A
CR1
0610 +30 VOLTS
C4
0.0068
0380 SERVO DRIVE
DRIVEP
J10-6
Q1
Q2
Q3
CR5
CR3
CR6
R4
10
R12
0.1
R13
0.1
R5
10
R14
0.1
R15
0.1
CR2
Q5
Q6
0380 SERVO DRIVE
DRIVEM
J10-7
Q4
C3
0.0015
CR4
R2
330
0610 -30 VOLTS
C2
35K
R3
100
FL1
R6
0.01
E24
C1
0.1
+30V
R9
910
C11
0.1
VR1
12V
R7
1K
R8
1K
A1
936
C13
100PF
0610 30 VDC RETURN
C9
0.1
C10
0.1
R11
64.9K
R10
910
C12
0.1
VR2
12V
-30V
0610 +30 VOLTS
LINEAR
MOTOR
VGND-
VELOCITY TRANSDUCER, 0370
VELCMP+
VELOCITY TRANSDUCER, 0370
VLMFWD+
VELOCITY TRANSDUCER, 0370
VLPFWD+
VELOCITY TRANSDUCER, 0370
J10-15
J7-13
VFDBK
VOLTAGE FEEDBACK,
0380
J10-5
IFDBK
CURRENT FEEDBACK, 0380

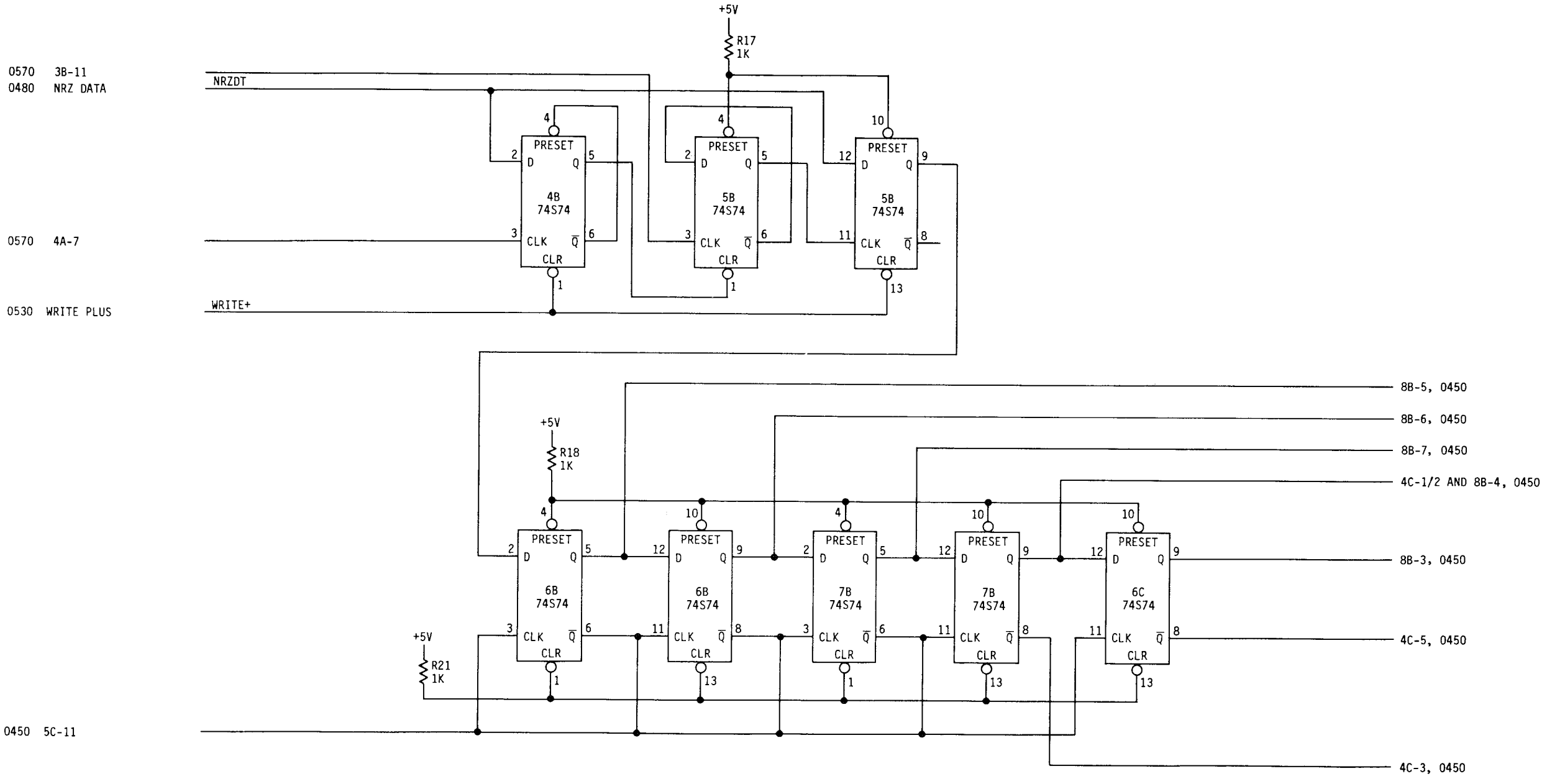

0160 HEAD ADDRESS REG 4
0180 HEAD SELECT
0160 HEAD ADDRESS REG 2
0160 HEAD ADDRESS REG 1
HAR4+
HDSEL-
HAR2+
HAR1+
J1-15
J1-13
J1-17
J1-19
A1 7432
A1 7432
A1 7432
HEAD ADDRESS DECODER A3 74458
LSB
MSB
+24V
R72 2.49K
C3 0.01
R1 2.49K
R3 2.49K
R9 2.49K
R5 2.49K
R7 2.49K
R38 2.49K
CR29
CR30
TP2
TP3
CR16
CR6
CR17
CR7
CR18
CR8
CR24
CR14
CR25
CR15
CR20
CR10
CR21
CR11
CR12
CR22
CR23
CR13
R2 10K
CR1
R4 10K
CR2
CR19
CR9
R10 10K
CR5
R6 10K
CR3
R8 10K
CR4
HEAD 0
HEAD 1
HEAD 2
HEAD 3
HEAD 4
HD0-1
HD0-2
HD0-3
HD1-1
HD1-2
HD1-3
HD2-1
HD2-2
HD2-3
HD3-1
HD3-2
HD3-3
HD4-1
HD4-2
HD4-3
J1-11
MHDSEL+
MULTI HEAD SELECTED, 0430
0460 R20 AND Q2B
0460 R18 AND Q2A
+24V
R115 47
R39 2.74K
C7 0.1
Q9
R40 2.74K
R43 3.83K
R44 3.65K
R46 3.83K
Q10
R47 2.61K
R127 2.74K
0180 WRITE
WRT-
J1-25
A2 7407
R124 1.15K
C2 0.0022
CR26
R126 14
R42 5.90K
R41 5.90K
CR31
CR32
CR33
CR34
R125
CR36
DUMMY HEAD
CR37
R45 17.8K
R54 0.27
-24V
C12 0.047
C8 0.0047
R50 115
R48 23.7K
R49 23.7K
C9 0.0047
R53 115
READ SIGNAL TO Q12, 0490
READ SIGNAL TO Q13, 0490

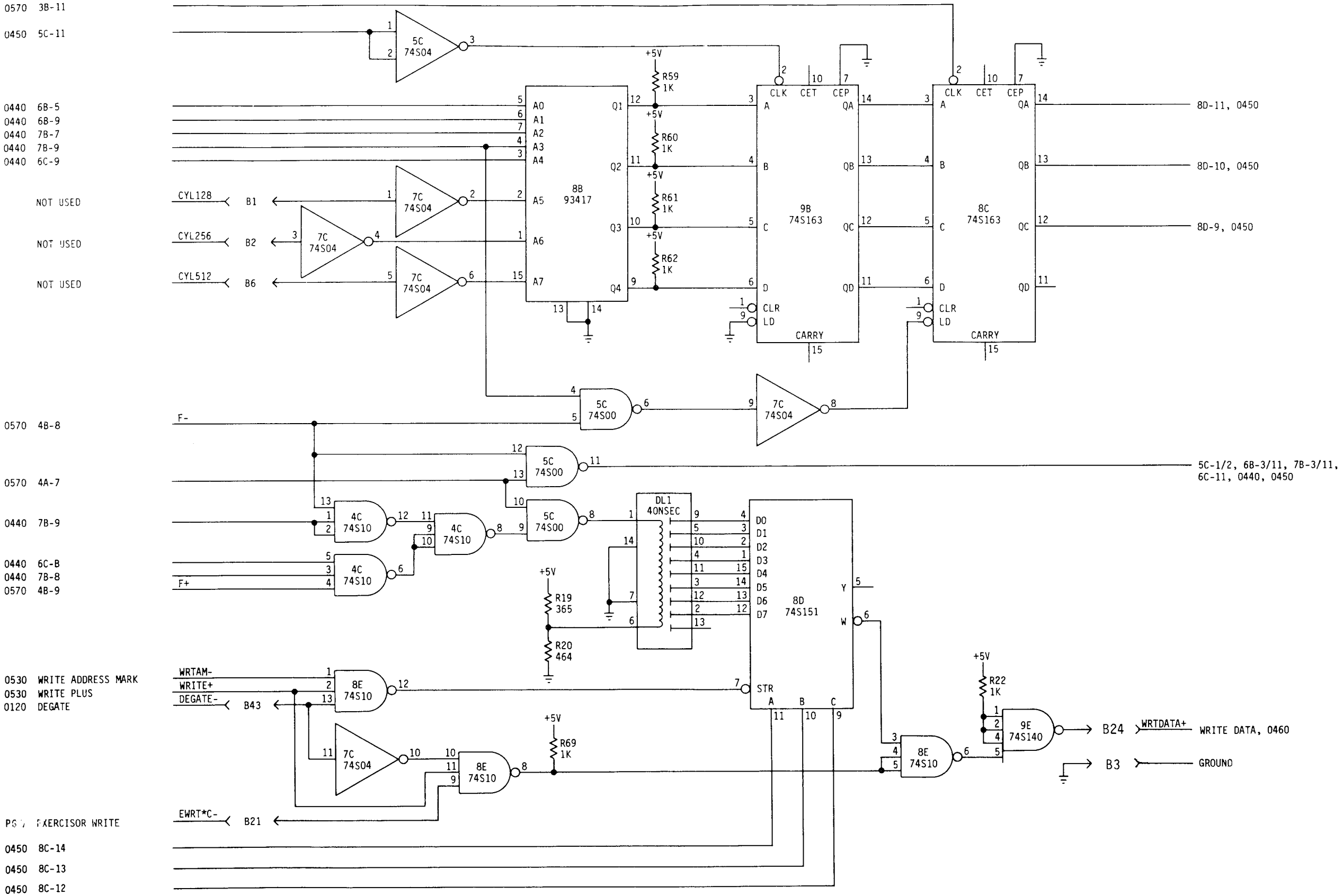


ILD 2040
DISC STORAGE UNIT

READ/WRITE LIMITER

0430

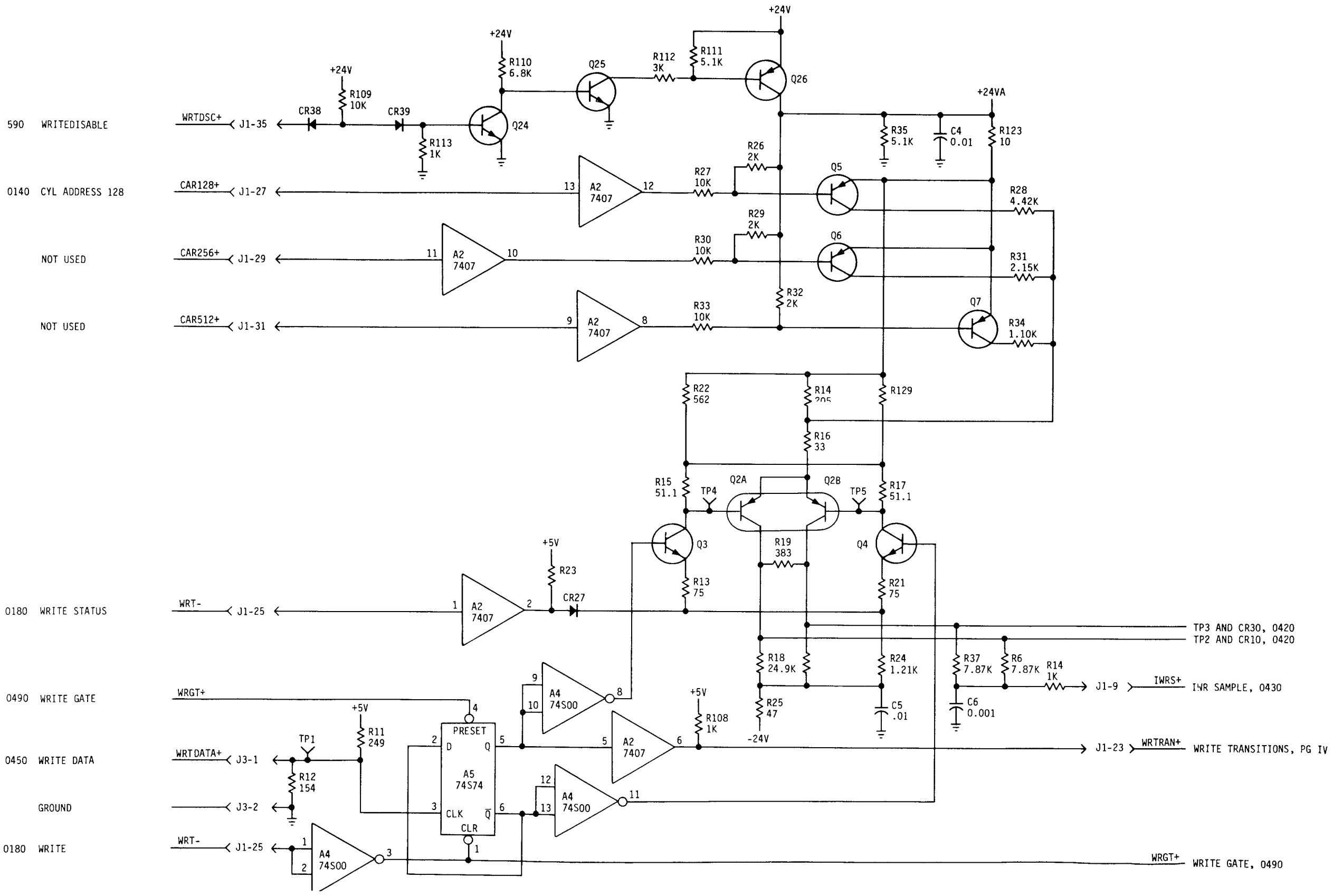

0570 3B-11
0480 NRZ DATA
NRZDT
0570 4A-7
0530 WRITE PLUS
WRITE+
+5V
R17
1K
4B
74S74
5B
74S74
5B
74S74
PRESET
D
Q
CLK
CLR
+5V
R18
1K
+5V
R21
1K
6B
74S74
6B
74S74
7B
74S74
7B
74S74
6C
74S74
0450 5C-11
8B-5, 0450
8B-6, 0450
8B-7, 0450
4C-1/2 AND 8B-4, 0450
8B-3, 0450
4C-5, 0450
4C-3, 0450

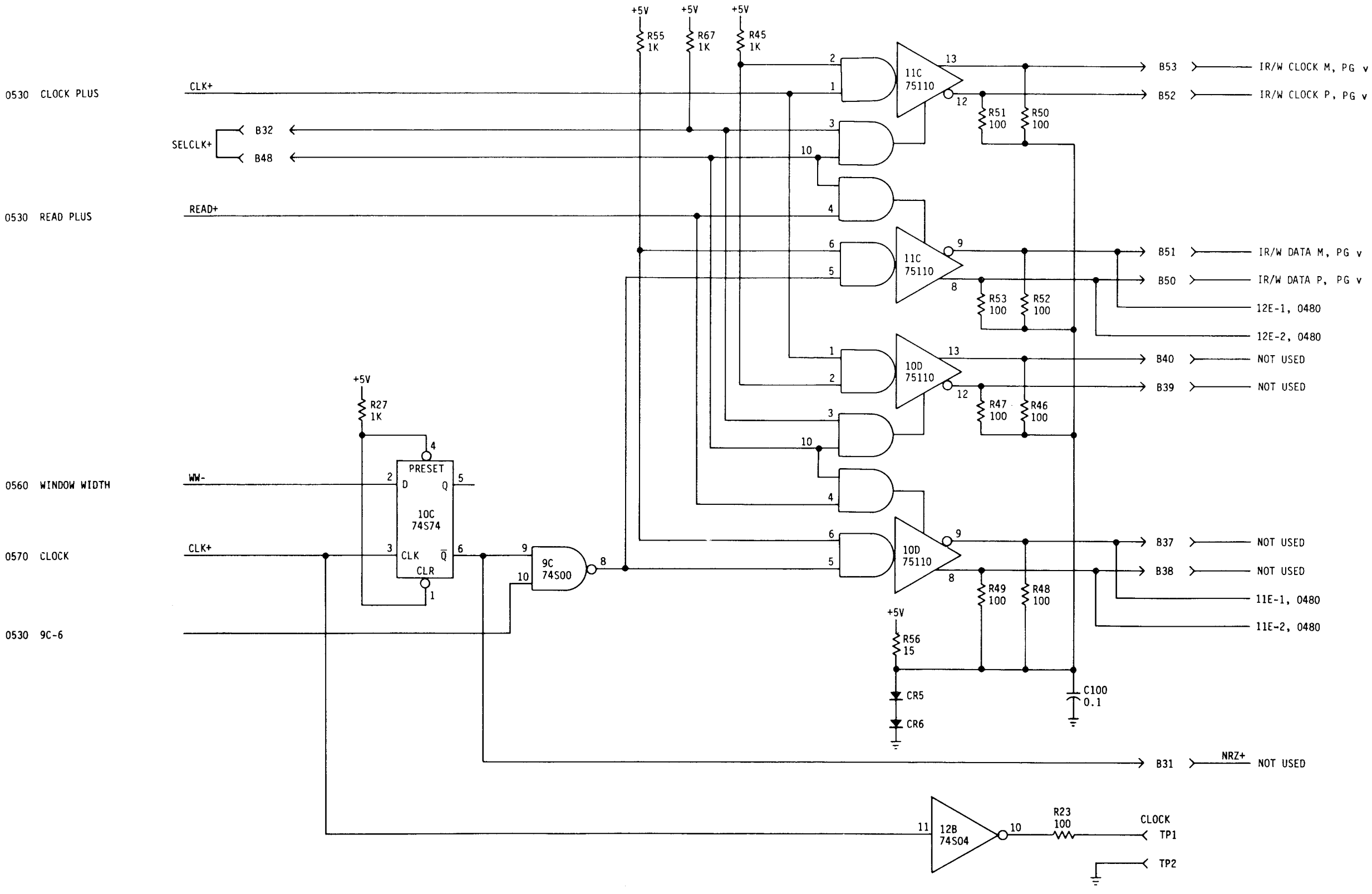


ILD 2040
DISC STORAGE UNIT

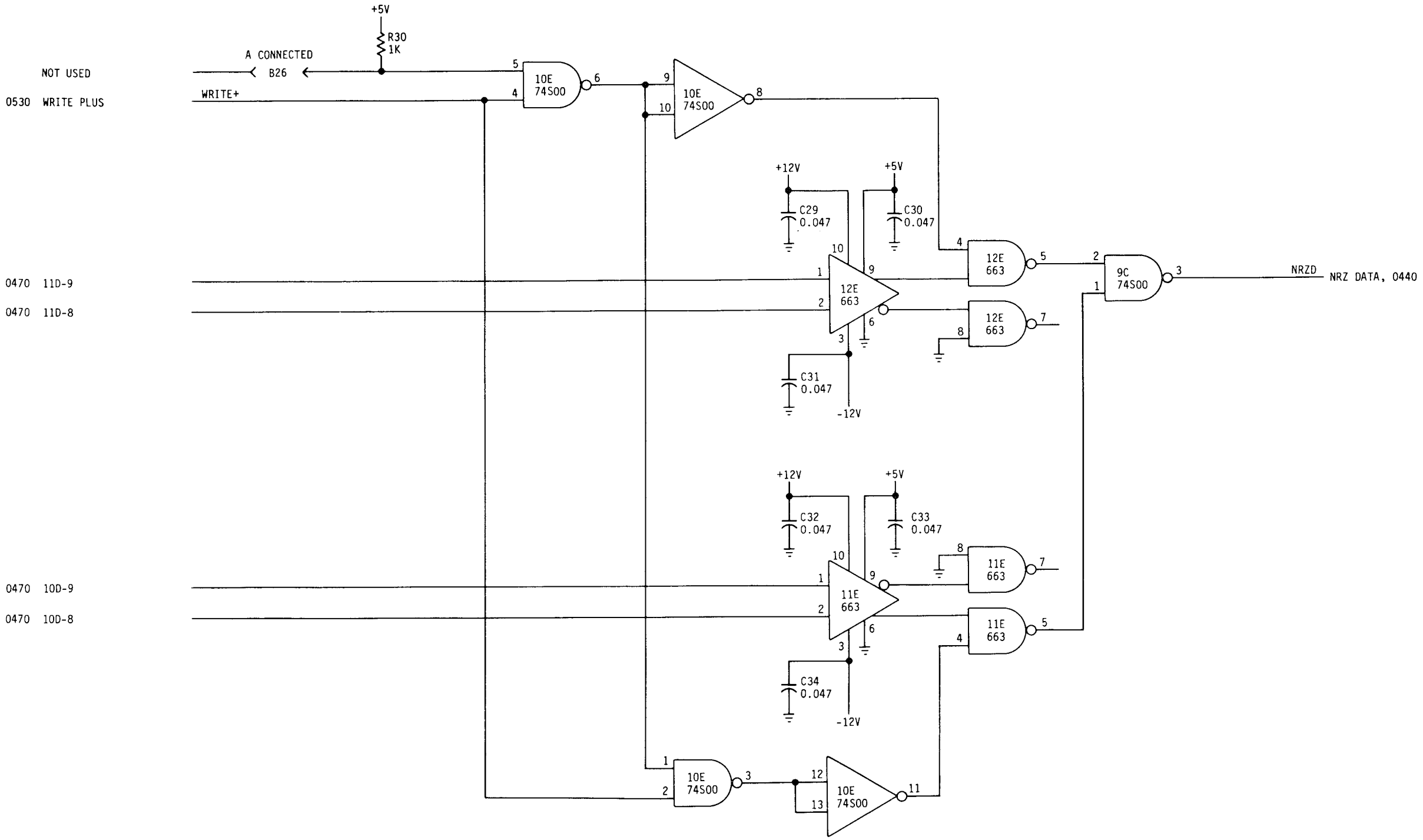
DATA SEPARATOR

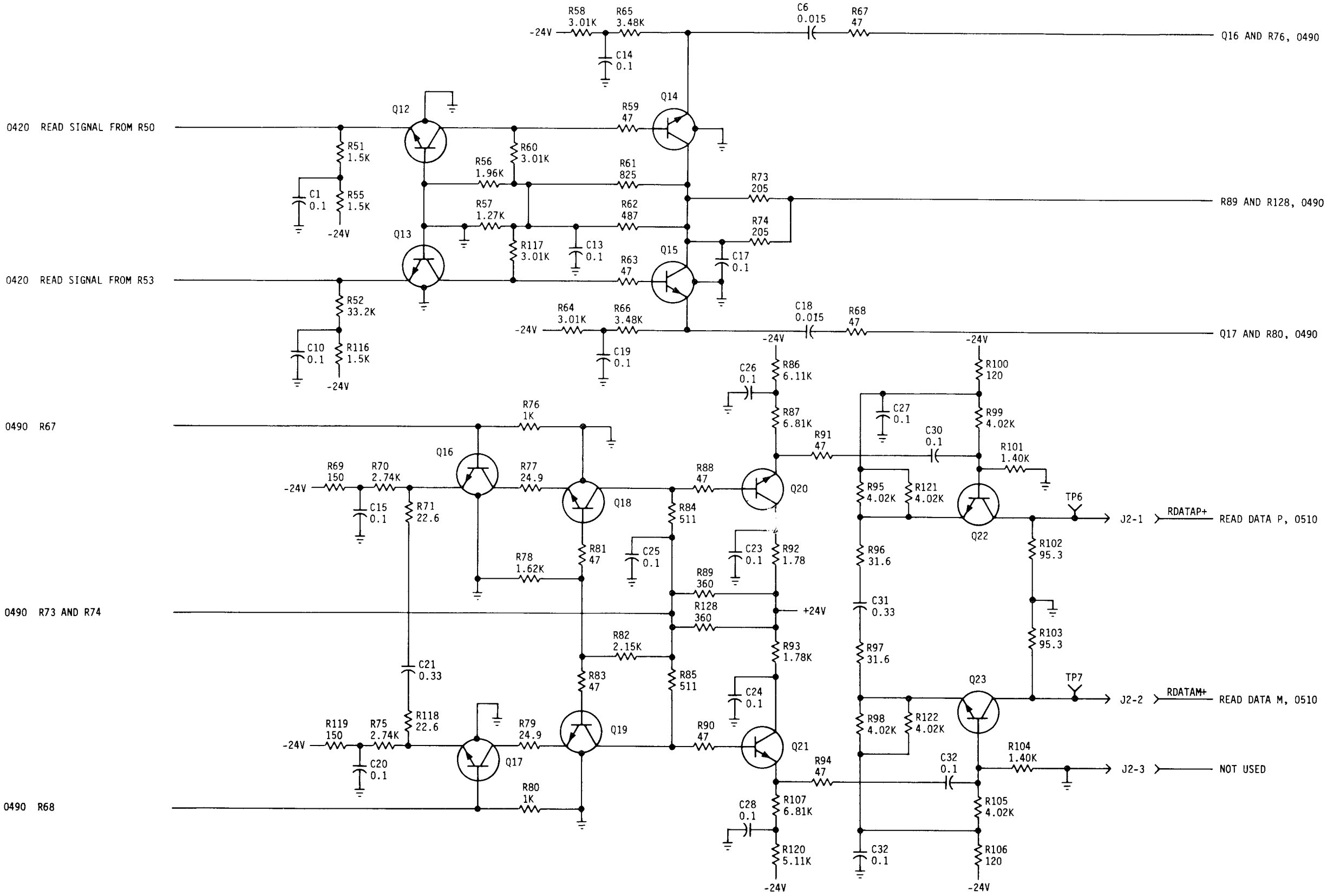
0450


590 WRITEDISABLE
0140 CYL ADDRESS 128
NOT USED
NOT USED
0180 WRITE STATUS
0490 WRITE GATE
0450 WRITE DATA
GROUND
0180 WRITE
WRTDSC+
J1-35
CAR128+
J1-27
CAR256+
J1-29
CAR512+
J1-31
WRT-
J1-25
WRGT+
WRTDATA+
J3-1
J3-2
+24V
+24VA
+5V
-24V
R109 10K
R110 6.8K
R111 5.1K
R112 3K
R113 1K
R123 10
R35 5.1K
C4 0.01
R26 2K
R27 10K
R28 4.42K
R29 2K
R30 10K
R31 2.15K
R32 2K
R33 10K
R34 1.10K
R22 562
R14 205
R129
R16 33
R15 51.1
R17 51.1
R19 383
R13 75
R21 75
R23
R18 24.9K
R24 1.21K
R25 47
R37 7.87K
R6 7.87K
R14 1K
C5 .01
C6 0.001
R108 1K
R11 249
R12 154
CR38
CR39
CR27
Q24
Q25
Q26
Q5
Q6
Q7
Q2A
Q2B
Q3
Q4
TP1
TP4
TP5
A2 7407
A4 74S00
A5 74S74
PRESET
CLR
D
Q
CLK
IWRS+
IWR SAMPLE, 0430
WRTRAN+
WRITE TRANSITIONS, PG IV
TP3 AND CR30, 0420
TP2 AND CR10, 0420
WRITE GATE, 0490

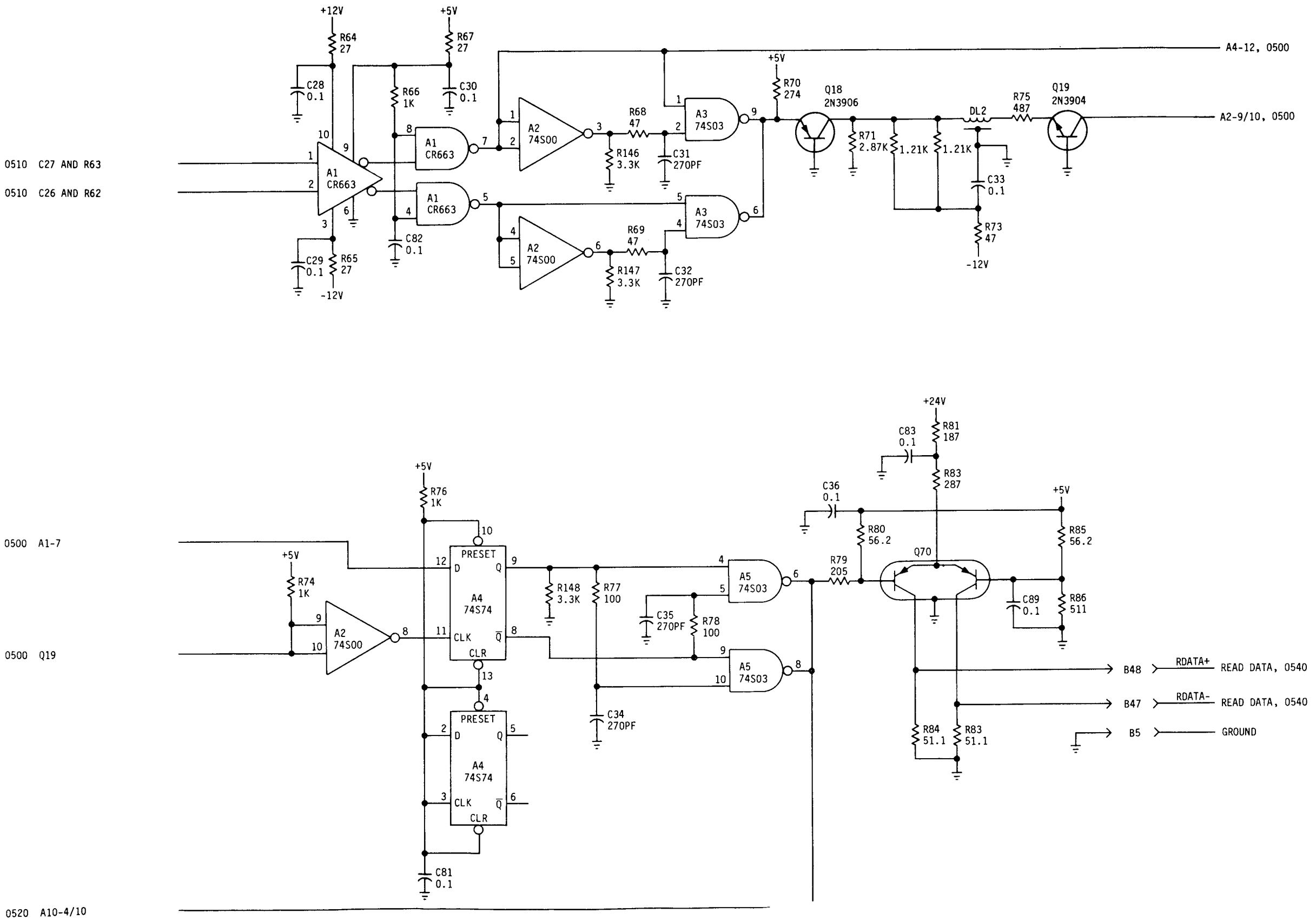

0530 CLOCK PLUS
CLK+
SELCLK+
B32
B48
0530 READ PLUS
READ+
0560 WINDOW WIDTH
WW-
0570 CLOCK
CLK+
0530 9C-6
+5V
R55 1K
R67 1K
R45 1K
R27 1K
10C 74S74
PRESET
CLR
9C 74S00
11C 75110
10D 75110
12B 74S04
R51 100
R50 100
R53 100
R52 100
R47 100
R46 100
R49 100
R48 100
R56 15
R23 100
CR5
CR6
C100 0.1
B53
B52
B51
B50
B40
B39
B37
B38
B31
IR/W CLOCK M, PG v
IR/W CLOCK P, PG v
IR/W DATA M, PG v
IR/W DATA P, PG v
12E-1, 0480
12E-2, 0480
NOT USED
NOT USED
NOT USED
NOT USED
11E-1, 0480
11E-2, 0480
NRZ+
CLOCK
TP1
TP2

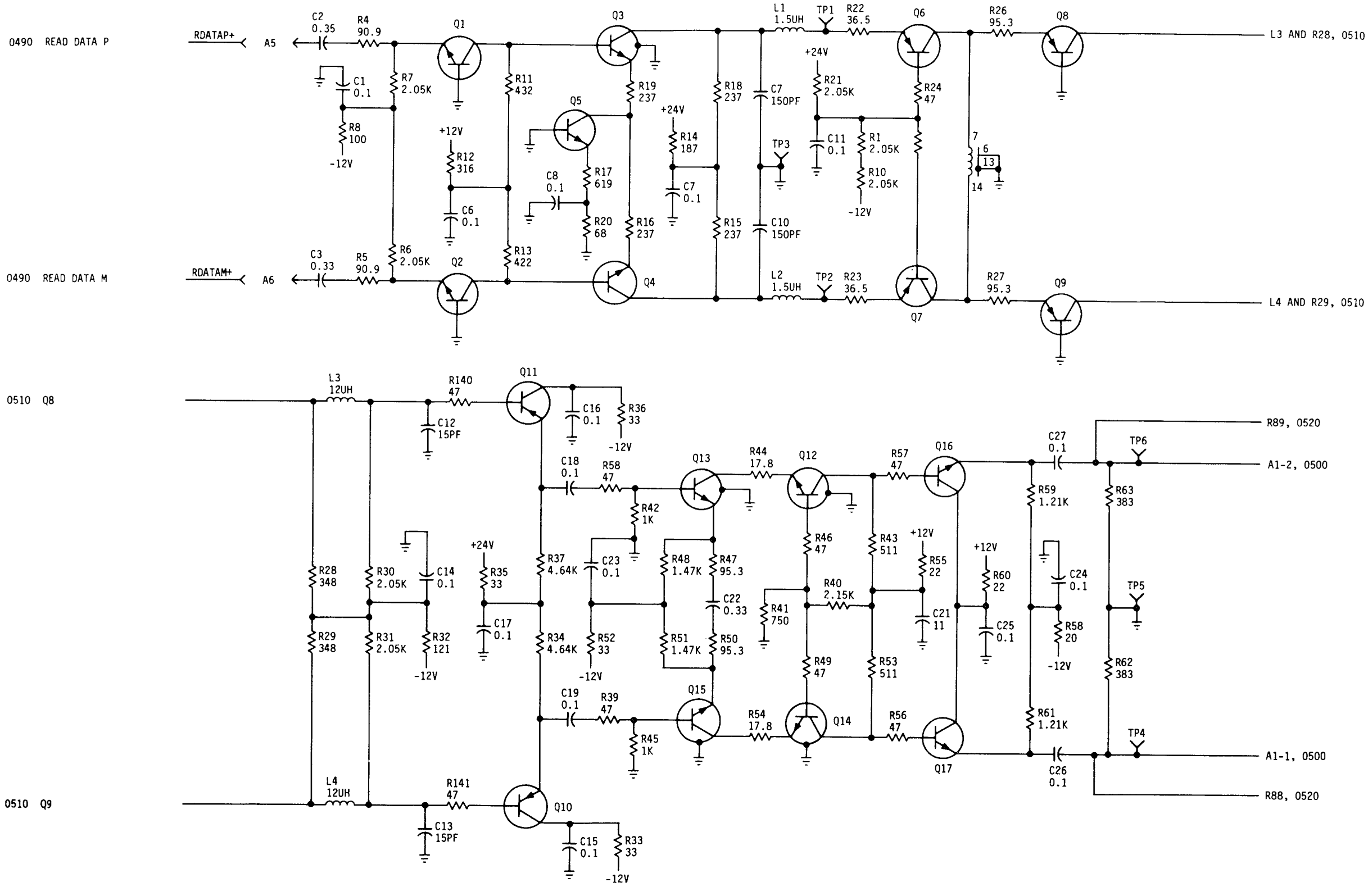
DATA SEPARATOR



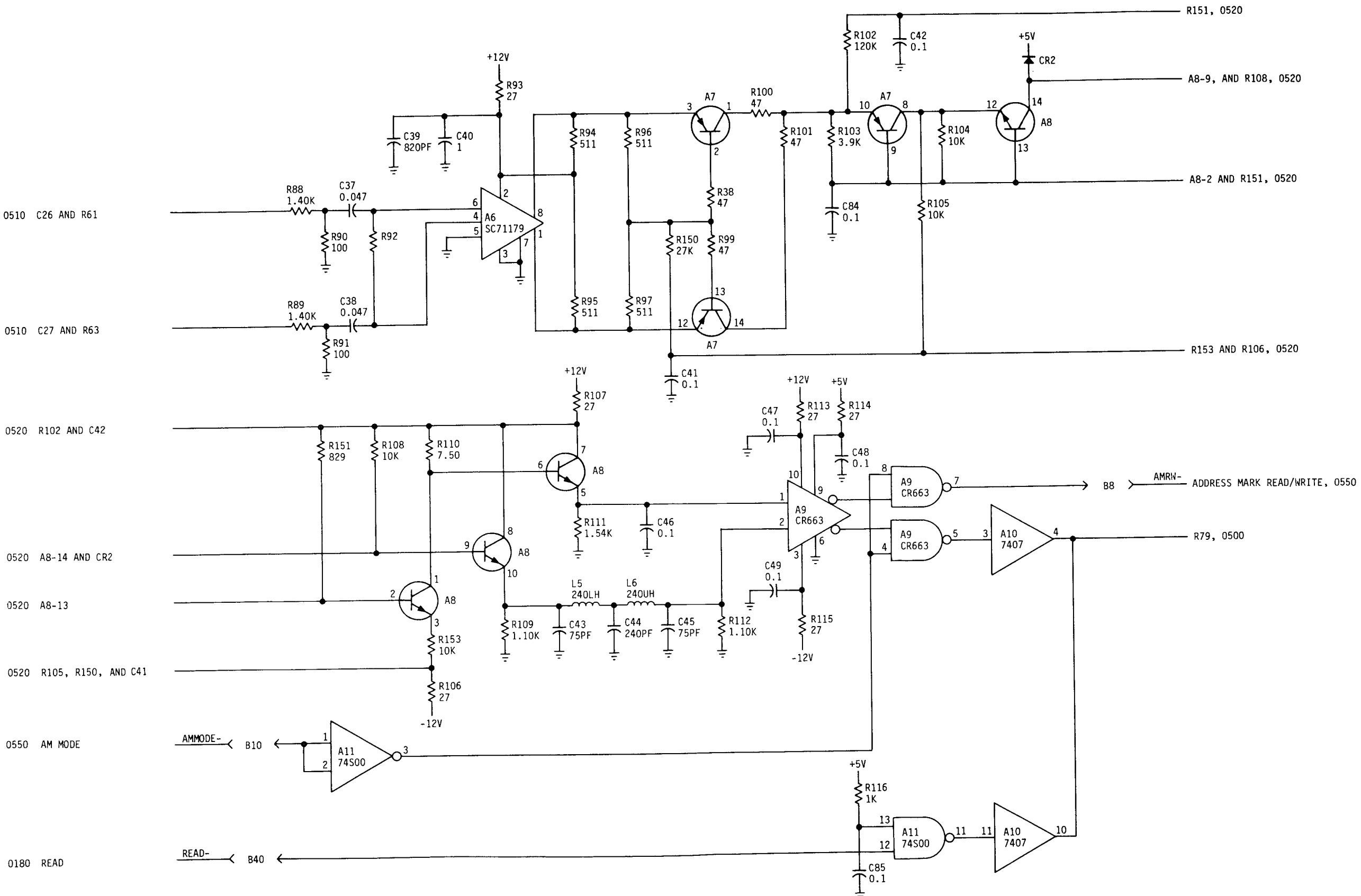

0420 READ SIGNAL FROM R50
0420 READ SIGNAL FROM R53
0490 R67
0490 R73 AND R74
0490 R68
R51 1.5K
C1 0.1
R55 1.5K
-24V
R52 33.2K
C10 0.1
R116 1.5K
Q12
Q13
R58 3.01K
R65 3.48K
C14 0.1
R59 47
R60 3.01K
R56 1.96K
R61 825
R57 1.27K
R62 487
R117 3.01K
C13 0.1
R63 47
Q14
Q15
C6 0.015
R67 47
R73 205
R74 205
C17 0.1
R64 3.01K
R66 3.48K
C19 0.1
C18 0.015
R68 47
Q16
Q17
R76 1K
R69 150
R70 2.74K
C15 0.1
R71 22.6
R77 24.9
R78 1.62K
R80 1K
Q18
Q19
R81 47
C25 0.1
R82 2.15K
R83 47
C21 0.33
R118 22.6
R119 150
R75 2.74K
C20 0.1
R79 24.9
R84 511
R85 511
R88 47
R89 360
R128 360
C23 0.1
C24 0.1
R90 47
Q20
Q21
R92 1.78
+24V
R93 1.78K
R94 47
R107 6.81K
C28 0.1
R120 5.11K
C26 0.1
R86 6.11K
R87 6.81K
R91 47
C27 0.1
C30 0.1
R100 120
R99 4.02K
R101 1.40K
R95 4.02K
R121 4.02K
R96 31.6
C31 0.33
R97 31.6
R98 4.02K
R122 4.02K
C32 0.1
R104 1.40K
R105 4.02K
R106 120
Q22
Q23
TP6
TP7
R102 95.3
R103 95.3
J2-1
J2-2
J2-3
RDATAP+
RDATAM+
Q16 AND R76, 0490
R89 AND R128, 0490
Q17 AND R80, 0490
READ DATA P, 0510
READ DATA M, 0510
NOT USED

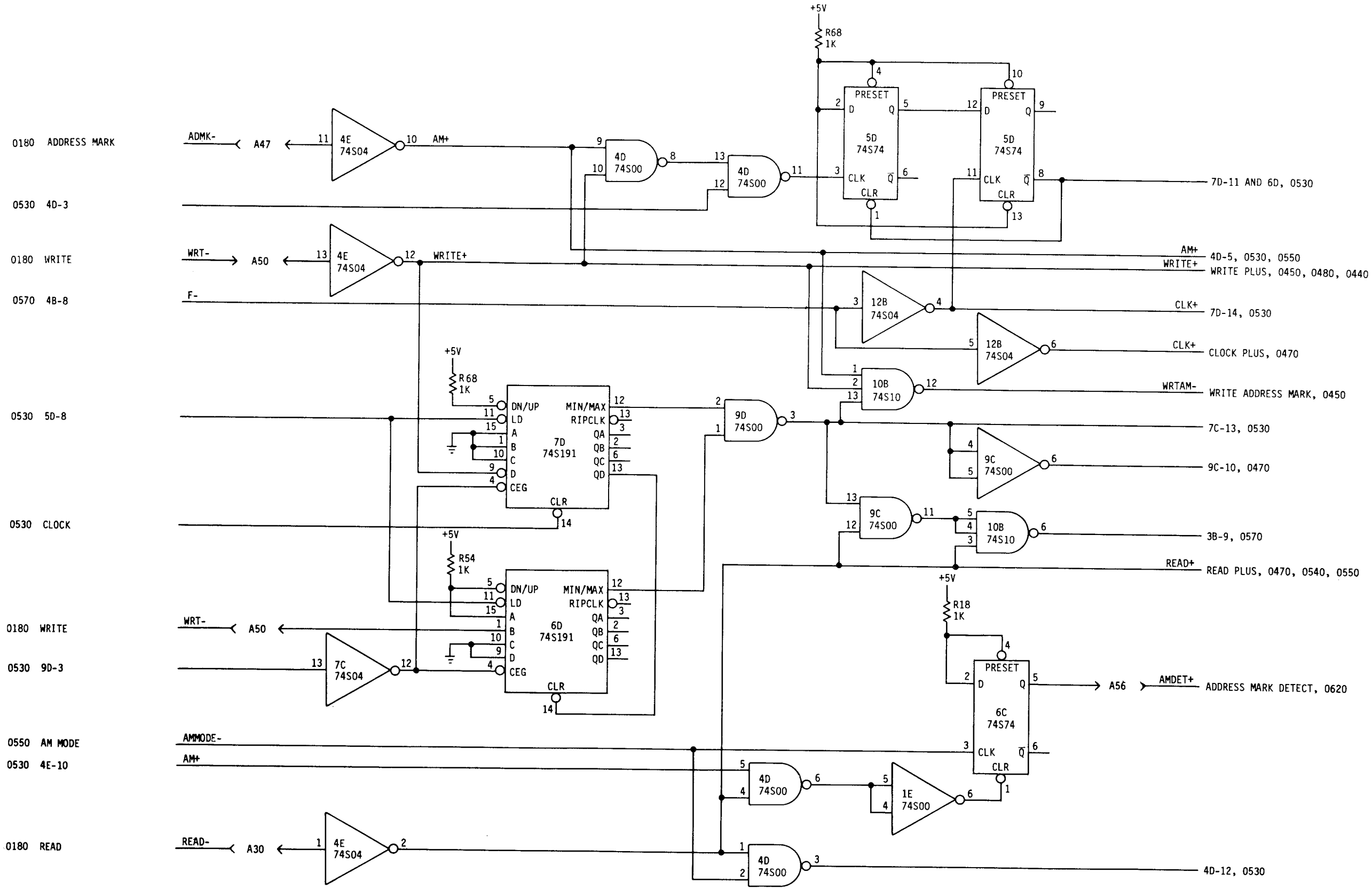
READ/WRITE LIMITER




0490 READ DATA P
RDATAP+
A5
0490 READ DATA M
RDATAM+
A6
C2 0.35
R4 90.9
C1 0.1
R8 100
-12V
R7 2.05K
Q1
R11 432
+12V
R12 316
C6 0.1
C3 0.33
R5 90.9
R6 2.05K
Q2
R13 422
Q3
R19 237
Q5
C8 0.1
R17 619
R20 68
R16 237
+24V
R14 187
C7 0.1
Q4
R18 237
R15 237
L1 1.5UH
TP1
R22 36.5
C7 150PF
TP3
C10 150PF
L2 1.5UH
TP2
R23 36.5
Q6
+24V
R21 2.05K
C11 0.1
R1 2.05K
R10 2.05K
-12V
R24 47
Q7
R26 95.3
Q8
L3 AND R28, 0510
7
6
13
14
R27 95.3
Q9
L4 AND R29, 0510
0510 Q8
L3 12UH
R140 47
C12 15PF
Q11
C16 0.1
R36 33
-12V
C18 0.1
R58 47
R42 1K
Q13
R44 17.8
Q12
R57 47
Q16
C27 0.1
TP6
R89, 0520
A1-2, 0500
R59 1.21K
R63 383
R46 47
R43 511
+12V
R55 22
C21 11
+12V
R60 22
C25 0.1
C24 0.1
TP5
R58 20
-12V
R62 383
R40 2.15K
R41 750
R49 47
R53 511
R61 1.21K
C26 0.1
TP4
A1-1, 0500
R88, 0520
R28 348
R30 2.05K
C14 0.1
R29 348
R31 2.05K
R32 121
-12V
+24V
R35 33
C17 0.1
R37 4.64K
R34 4.64K
C23 0.1
R52 33
-12V
R48 1.47K
R47 95.3
C22 0.33
R51 1.47K
R50 95.3
C19 0.1
R39 47
R45 1K
Q15
R54 17.8
Q14
R56 47
Q17
0510 Q9
L4 12UH
R141 47
C13 15PF
Q10
C15 0.1
R33 33
-12V

READ/WRITE LIMITER

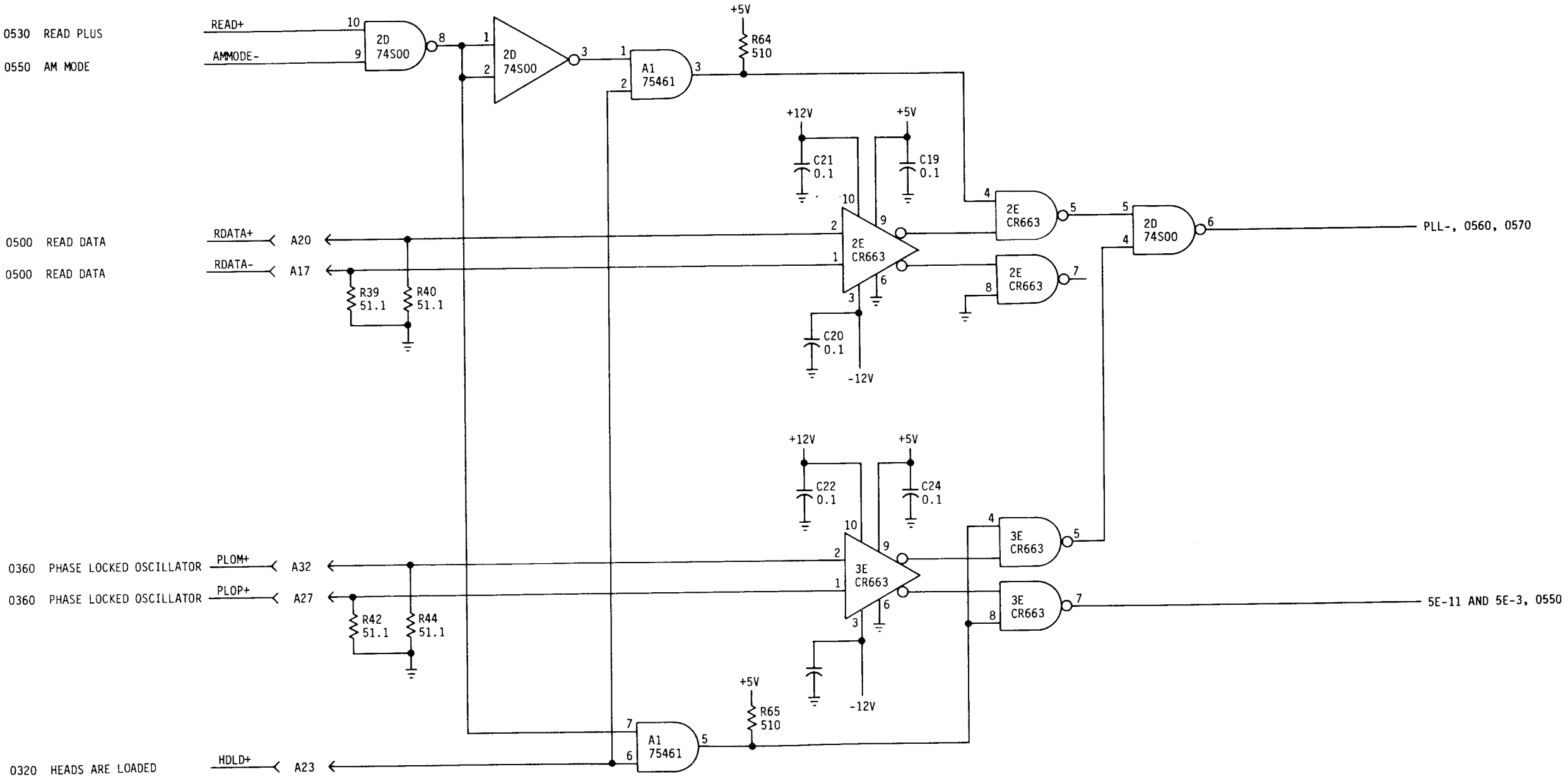


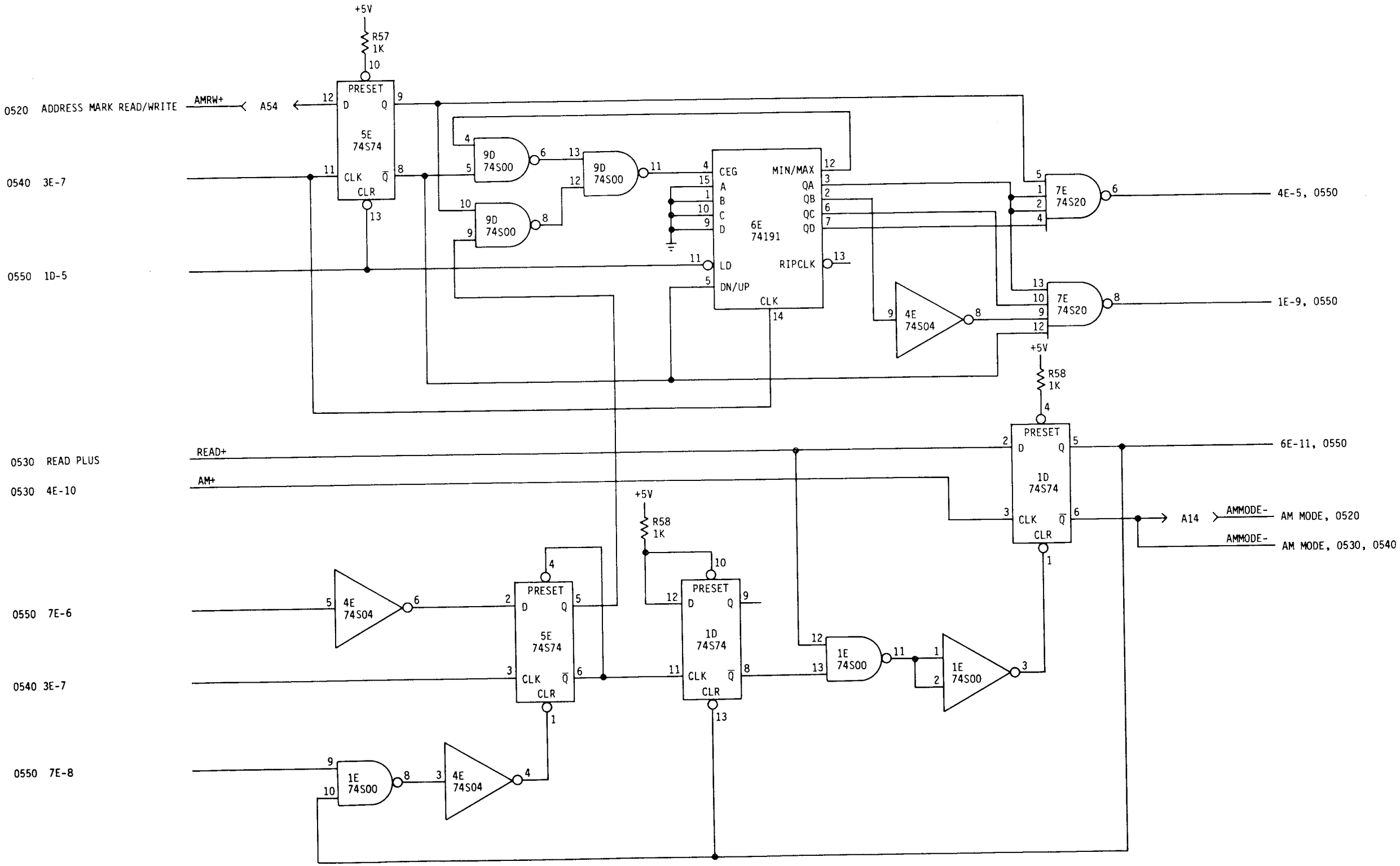


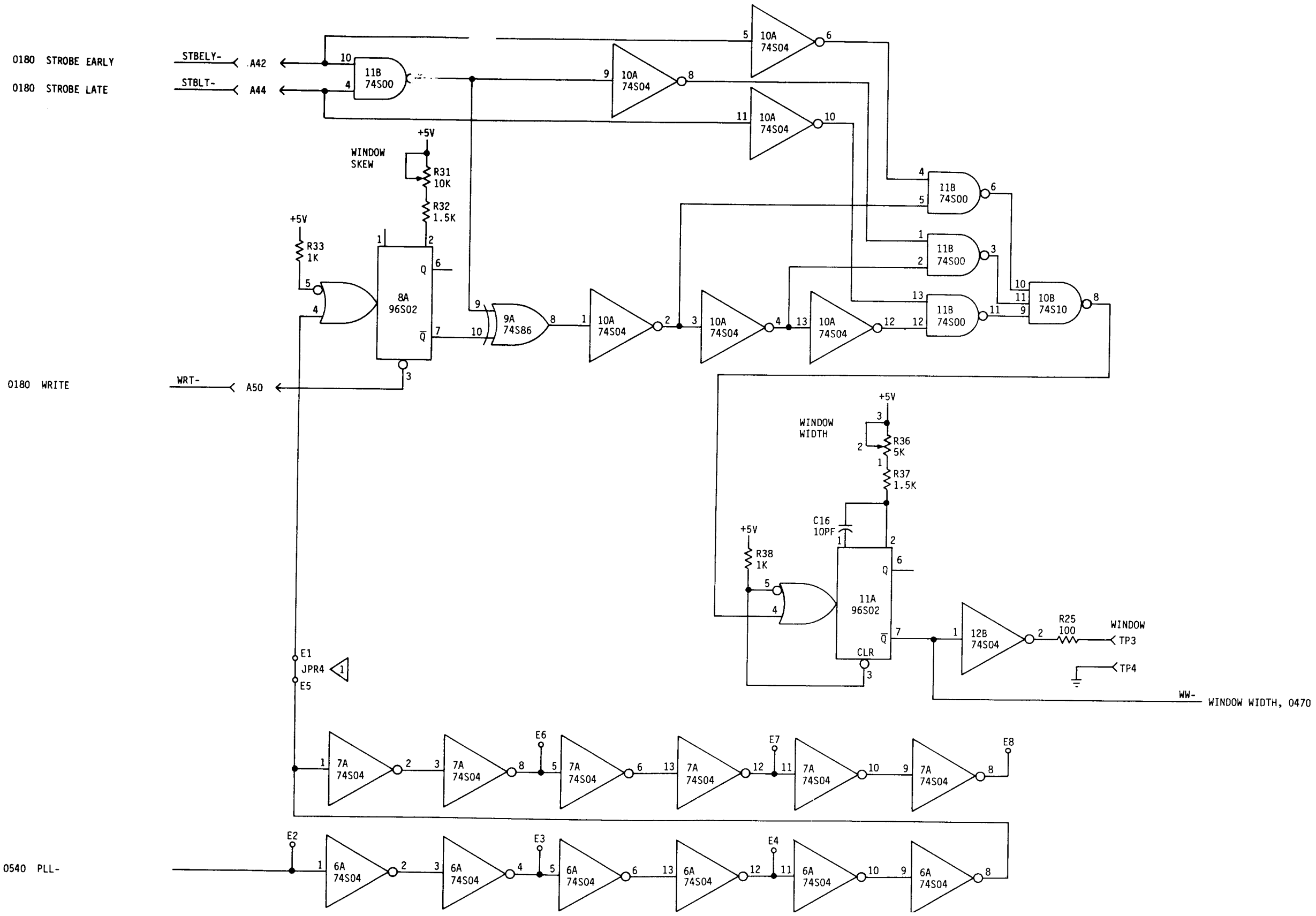
ILD 2040
DISC STORAGE UNIT

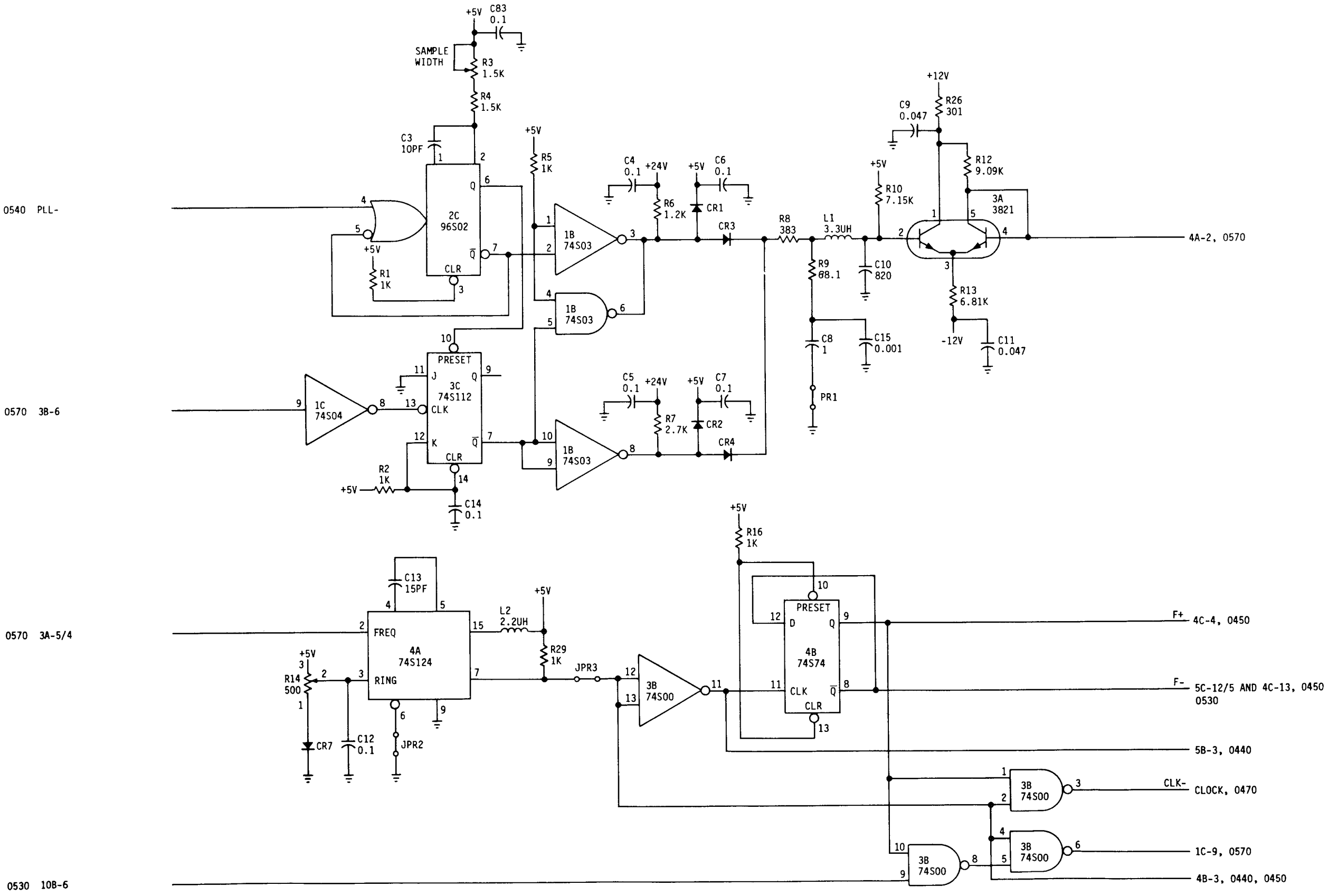
DATA SEPARATOR

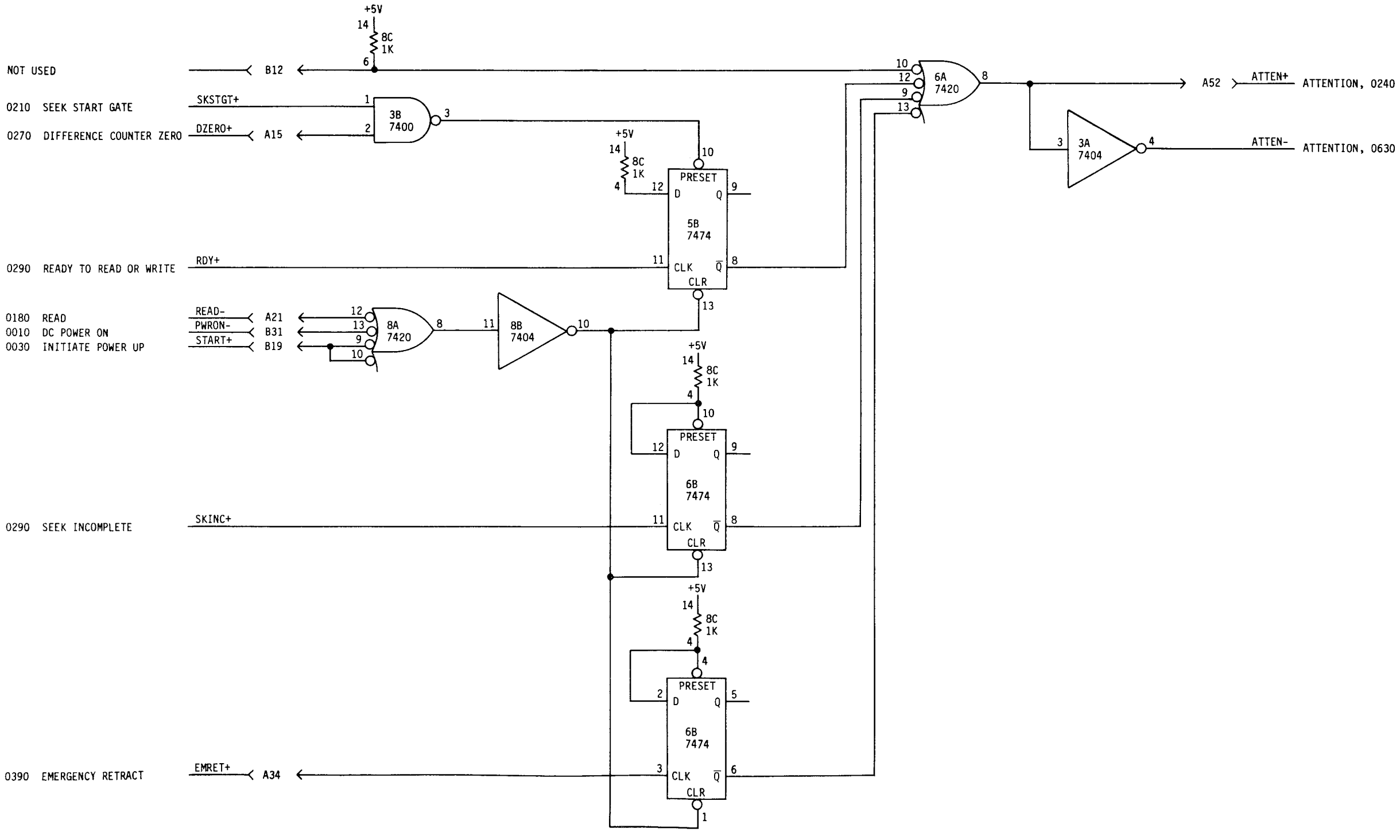
0530

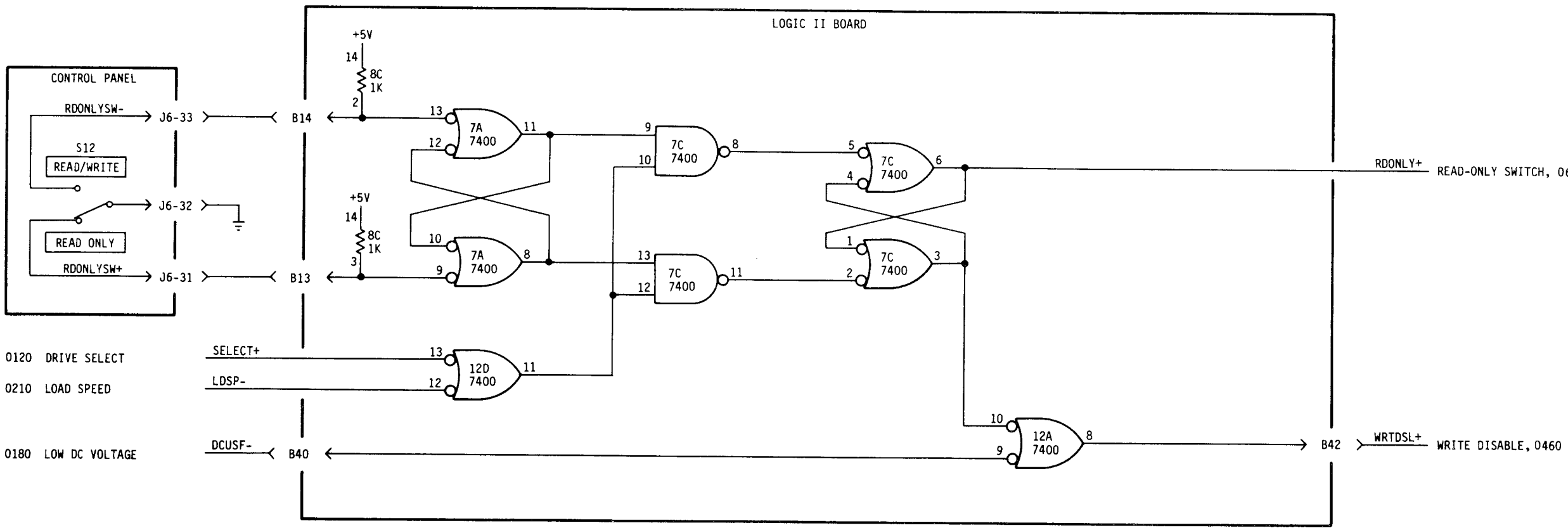

0530 READ PLUS
0550 AM MODE
READ+
AMMODE-
2D 74S00
2D 74S00
A1 75461
+5V
R64 510
+12V
+5V
C21 0.1
C19 0.1
2E CR663
2E CR663
2E CR663
2D 74S00
PLL-, 0560, 0570
0500 READ DATA
0500 READ DATA
RDATA+
RDATA-
A20
A17
R39 51.1
R40 51.1
C20 0.1
-12V
+12V
+5V
C22 0.1
C24 0.1
3E CR663
3E CR663
3E CR663
5E-11 AND 5E-3, 0550
0360 PHASE LOCKED OSCILLATOR
0360 PHASE LOCKED OSCILLATOR
PLOM+
PLOP+
A32
A27
R42 51.1
R44 51.1
+5V
R65 510
A1 75461
0320 HEADS ARE LOADED
HDLD+
A23

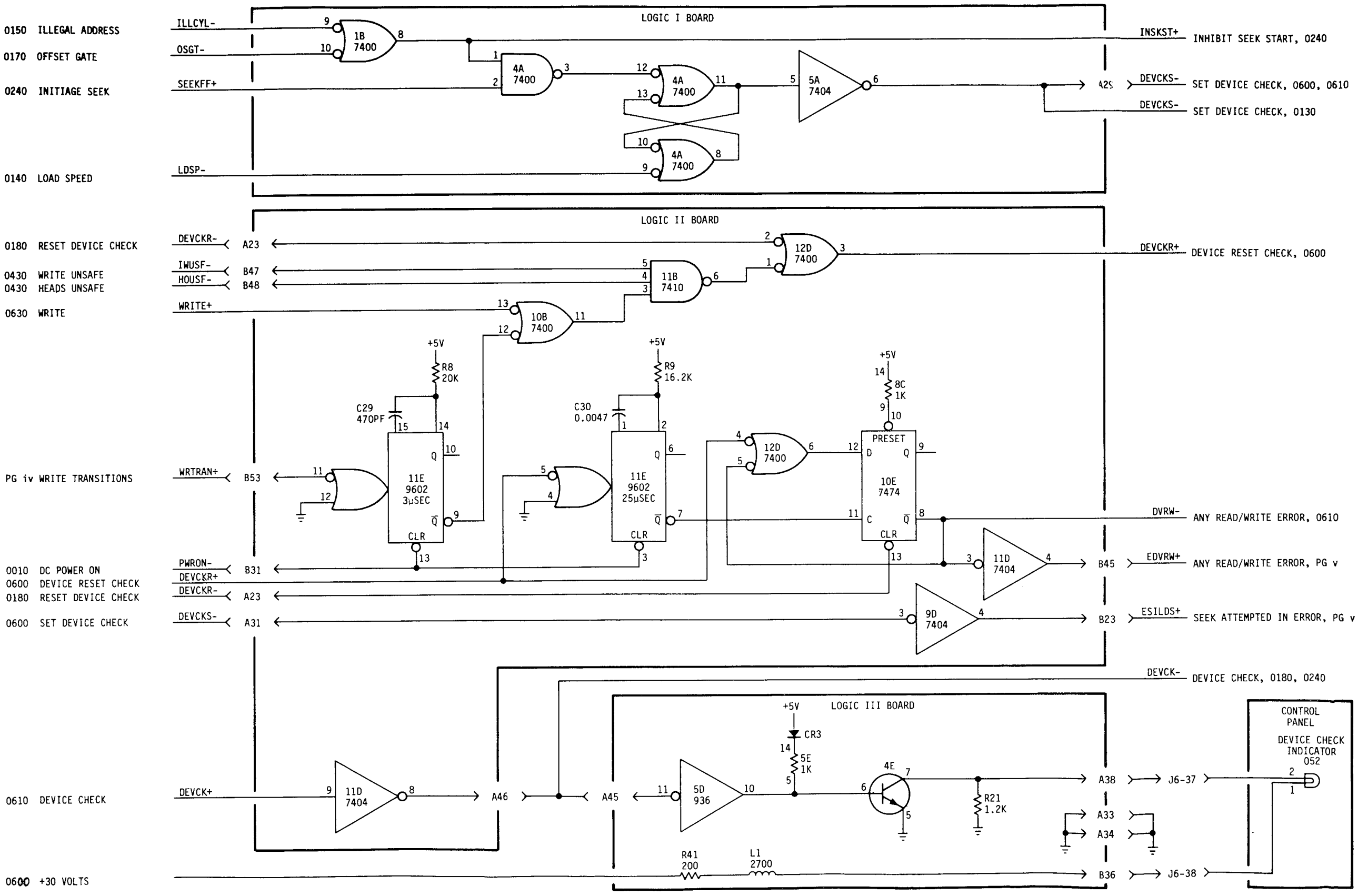

0520 ADDRESS MARK READ/WRITE
AMRW+
A54
0540 3E-7
0550 1D-5
0530 READ PLUS
0530 4E-10
0550 7E-6
0540 3E-7
0550 7E-8
+5V
R57
1K
PRESET
D
Q
5E
74S74
CLK
Q
CLR
9D
74S00
6E
74191
CEG
A
B
C
D
MIN/MAX
QA
QB
QC
QD
LD
RIPCLK
DN/UP
CLK
7E
74S20
4E
74S04
R58
1K
READ+
AM+
1D
74S74
1E
74S00
4E-5, 0550
1E-9, 0550
6E-11, 0550
A14
AMMODE-
AM MODE, 0520
AM MODE, 0530, 0540

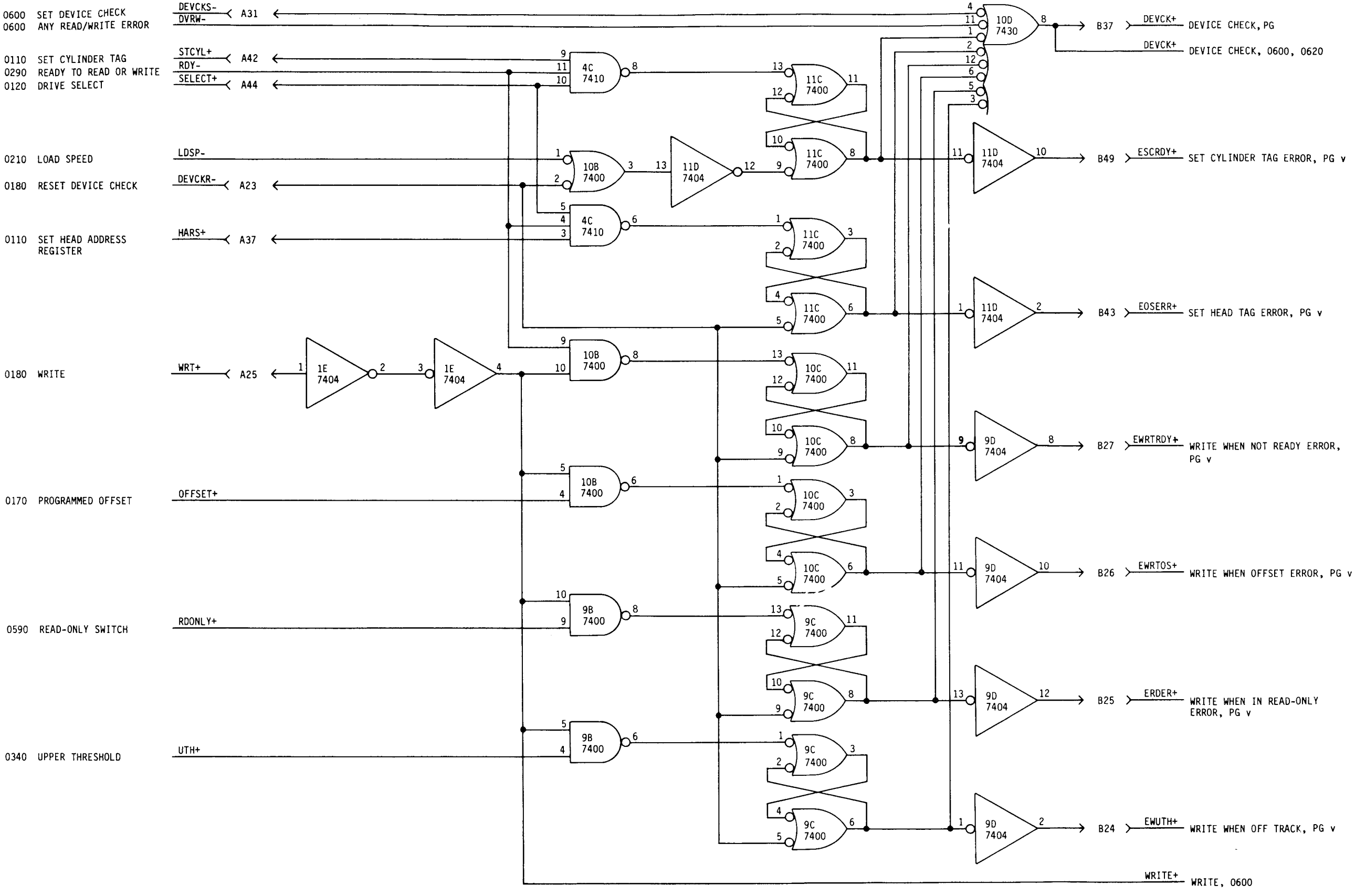

0180 STROBE EARLY
STBELY-
A42
0180 STROBE LATE
STBLT-
A44
11B 74S00
10A 74S04
WINDOW SKEW
+5V
R31 10K
R32 1.5K
R33 1K
8A 96S02
9A 74S86
10B 74S10
0180 WRITE
WRT-
A50
WINDOW WIDTH
R36 5K
R37 1.5K
C16 10PF
R38 1K
11A 96S02
12B 74S04
R25 100
WINDOW
TP3
TP4
WW-
WINDOW WIDTH, 0470
E1
JPR4
E5
7A 74S04
E6
E7
E8
0540 PLL-
E2
E3
E4
6A 74S04

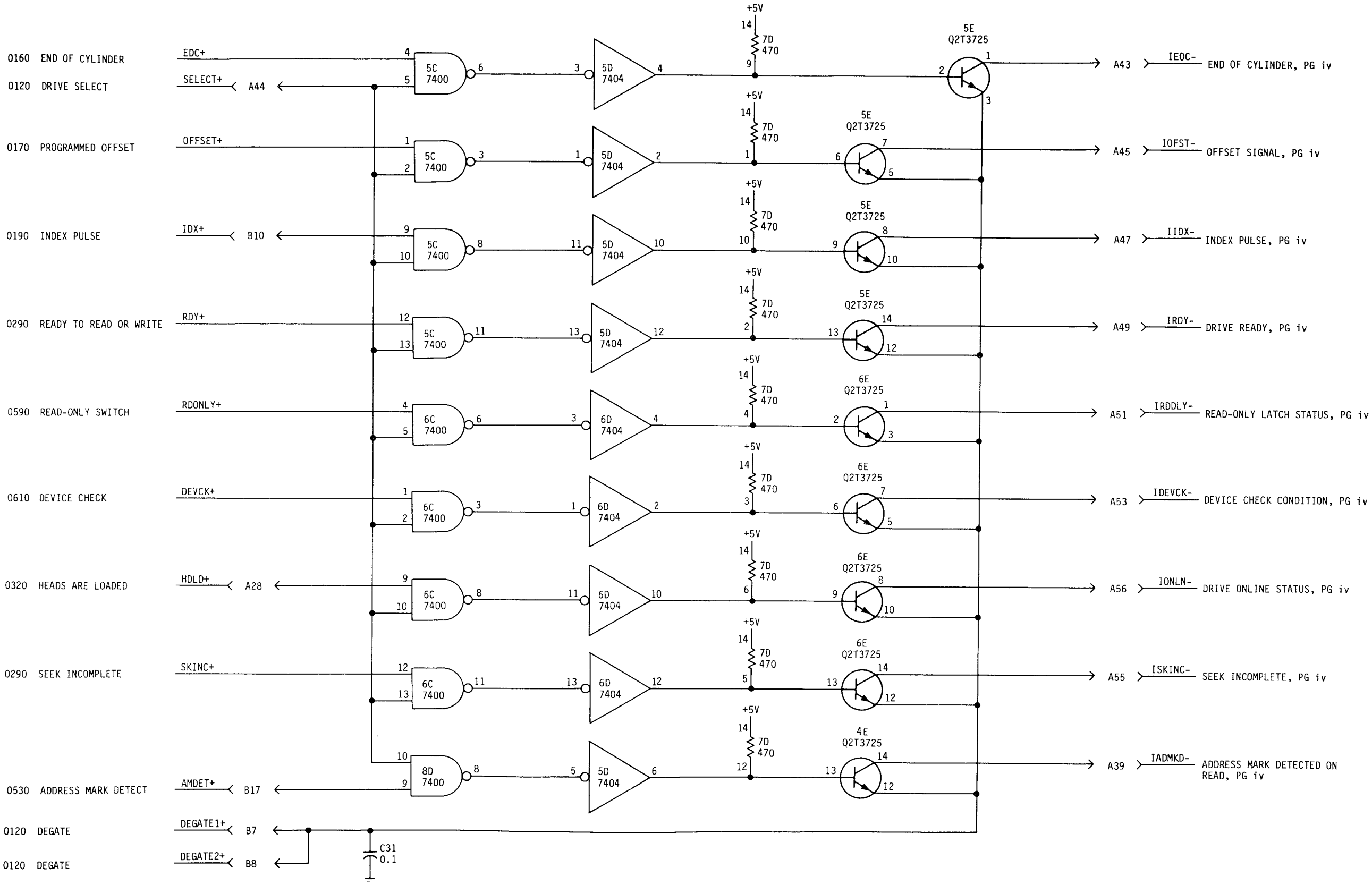

0540 PLL-
0570 3B-6
0570 3A-5/4
0530 10B-6
+5V
C83 0.1
SAMPLE WIDTH
R3 1.5K
R4 1.5K
C3 10PF
R5 1K
2C 96S02
R1 1K
1B 74S03
1B 74S03
C4 0.1
+24V
R6 1.2K
CR1
C6 0.1
CR3
R8 383
L1 3.3UH
+12V
C9 0.047
R26 301
R10 7.15K
R12 9.09K
3A 3821
R9 68.1
C10 820
R13 6.81K
C8 1
C15 0.001
-12V
C11 0.047
PR1
4A-2, 0570
1C 74S04
3C 74S112
PRESET
CLK
CLR
C5 0.1
R7 2.7K
CR2
C7 0.1
CR4
R2 1K
C14 0.1
R16 1K
C13 15PF
L2 2.2UH
R29 1K
JPR3
R14 500
CR7
C12 0.1
JPR2
4A 74S124
FREQ
RING
3B 74S00
4B 74S74
D
CLK
F+
4C-4, 0450
F-
5C-12/5 AND 4C-13, 0450 0530
5B-3, 0440
CLK-
CLOCK, 0470
1C-9, 0570
4B-3, 0440, 0450

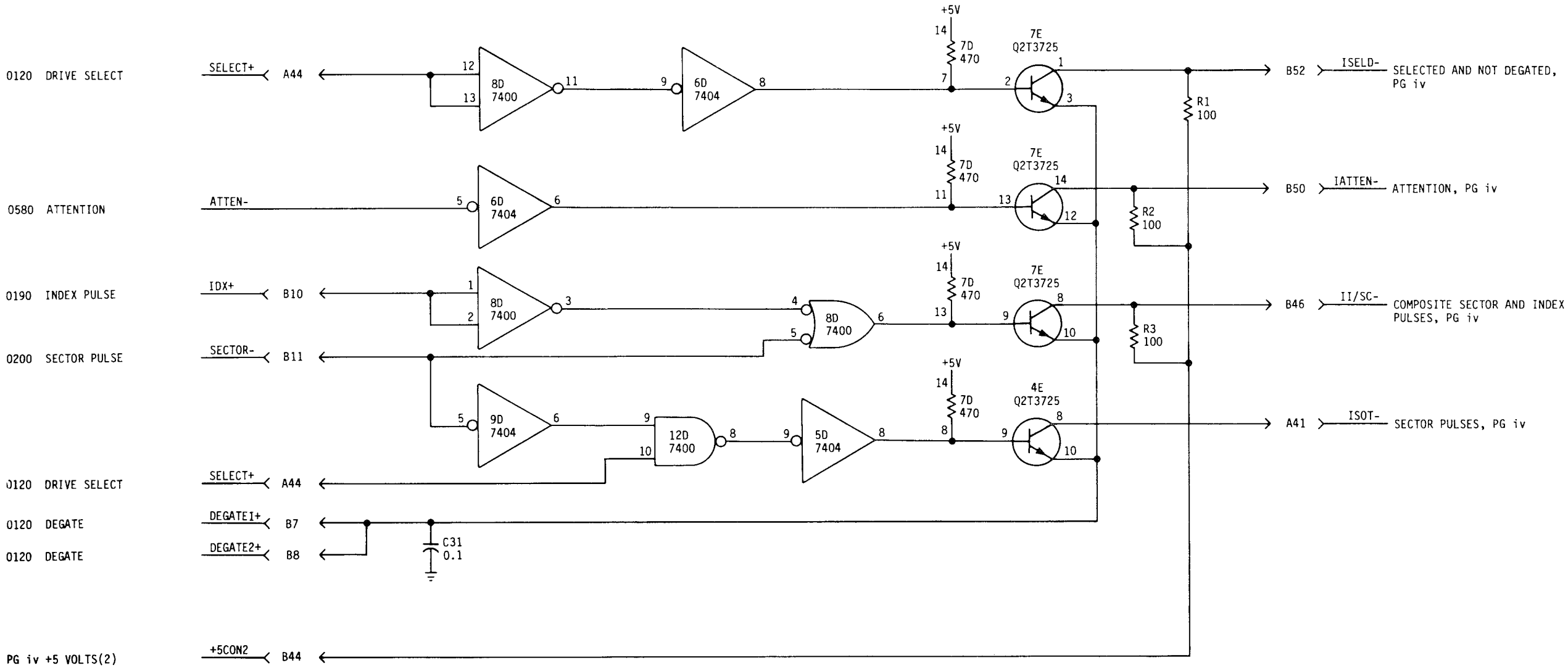

+5V
14
8C
1K
6
NOT USED
B12
0210 SEEK START GATE
SKSTGT+
1
2
3B
7400
3
0270 DIFFERENCE COUNTER ZERO
DZERO+
A15
+5V
14
8C
1K
4
10
12
PRESET
D
Q
9
5B
7474
0290 READY TO READ OR WRITE
RDY+
11
CLK
Q
8
CLR
13
0180 READ
0010 DC POWER ON
0030 INITIATE POWER UP
READ-
PWRON-
START+
A21
B31
B19
12
13
9
10
8A
7420
8
11
8B
7404
10
+5V
14
8C
1K
4
10
PRESET
12
D
Q
9
6B
7474
0290 SEEK INCOMPLETE
SKINC+
11
CLK
Q
8
CLR
13
+5V
14
8C
1K
4
4
PRESET
2
D
Q
5
6B
7474
0390 EMERGENCY RETRACT
EMRET+
A34
3
CLK
Q
6
CLR
1
10
12
9
13
6A
7420
8
A52
ATTEN+
ATTENTION, 0240
3
3A
7404
4
ATTEN-
ATTENTION, 0630

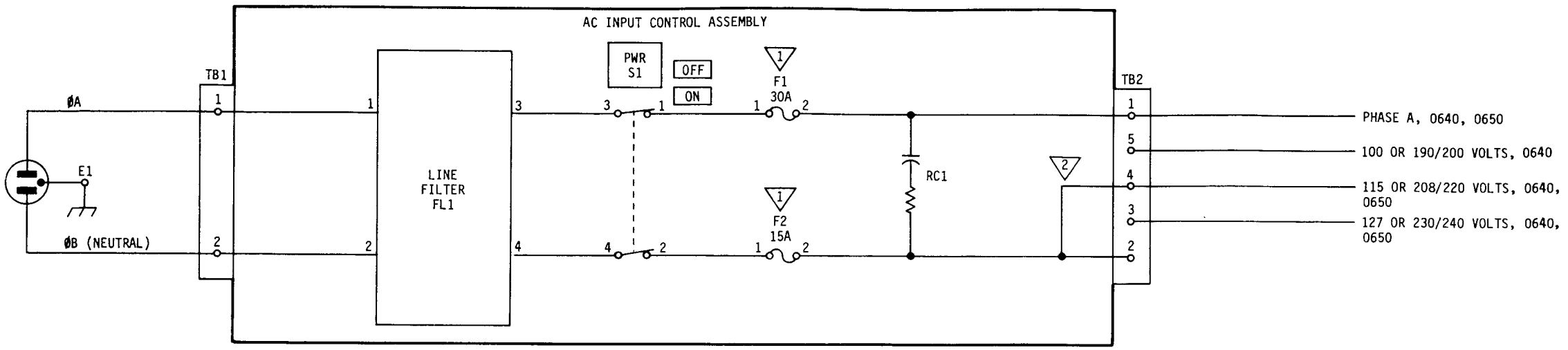

LOGIC II BOARD
CONTROL PANEL
RDONLYSW-
J6-33
B14
S12
READ/WRITE
J6-32
READ ONLY
RDONLYSW+
J6-31
B13
+5V
14
8C
1K
2
3
13
12
7A
7400
11
10
9
8
7C
7400
5
4
6
1
RDONLY+
READ-ONLY SWITCH, 0610, 0620
0120 DRIVE SELECT
SELECT+
0210 LOAD SPEED
LDSP-
12D
7400
0180 LOW DC VOLTAGE
DCUSF-
B40
12A
7400
B42
WRTDSL+
WRITE DISABLE, 0460

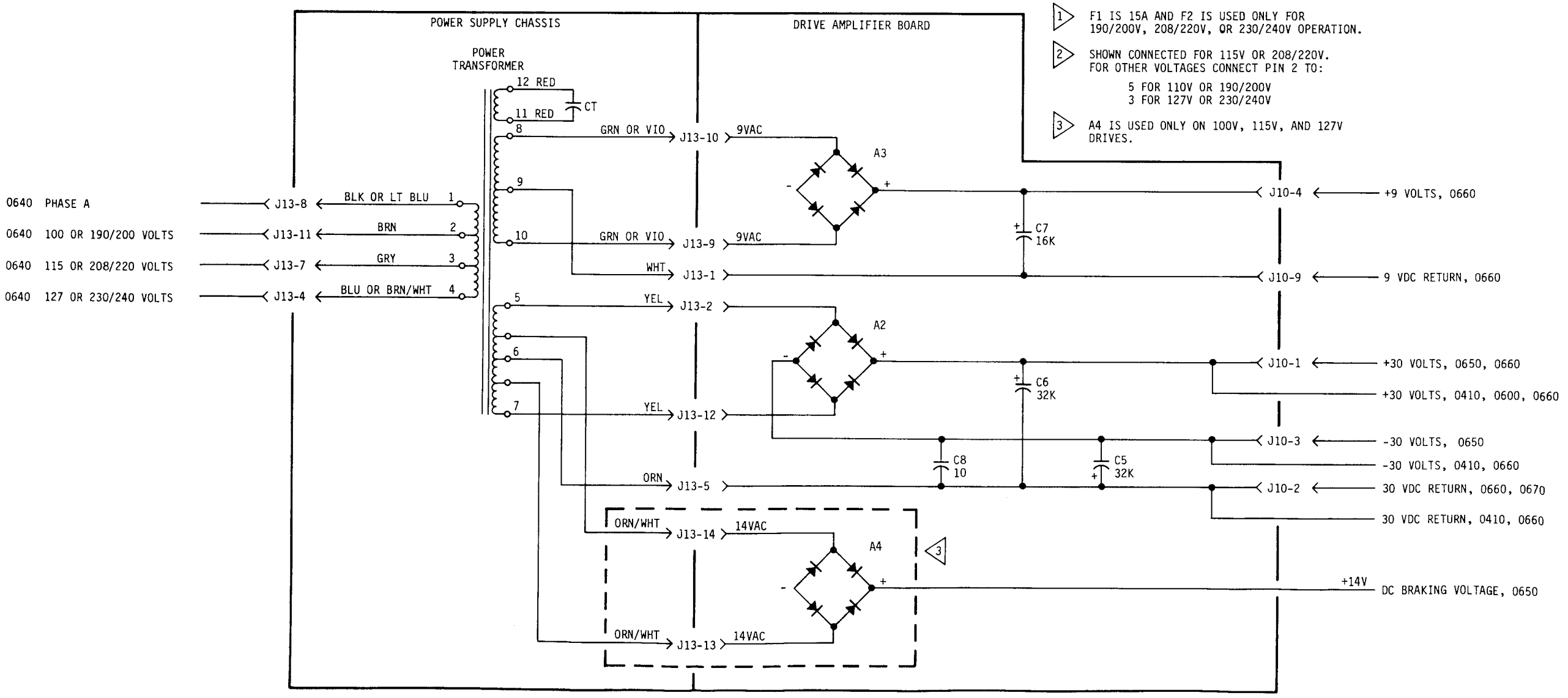

0150 ILLEGAL ADDRESS
0170 OFFSET GATE
0240 INITIAGE SEEK
0140 LOAD SPEED
LOGIC I BOARD
ILLCYL-
OSGT-
SEEKFF+
LDSP-
1B 7400
4A 7400
4A 7400
4A 7400
5A 7404
INSKST+
INHIBIT SEEK START, 0240
DEVCKS-
SET DEVICE CHECK, 0600, 0610
DEVCKS-
SET DEVICE CHECK, 0130
0180 RESET DEVICE CHECK
0430 WRITE UNSAFE
0430 HEADS UNSAFE
0630 WRITE
LOGIC II BOARD
DEVCKR- A23
IWUSF- B47
HOUSF- B48
WRITE+
12D 7400
11B 7410
10B 7400
DEVCKR+
DEVICE RESET CHECK, 0600
+5V
R8 20K
C29 470PF
11E 9602 3µSEC
+5V
R9 16.2K
C30 0.0047
11E 9602 25µSEC
12D 7400
+5V
8C 1K
PRESET
10E 7474
PG iv WRITE TRANSITIONS
WRTRAN+ B53
0010 DC POWER ON
0600 DEVICE RESET CHECK
0180 RESET DEVICE CHECK
0600 SET DEVICE CHECK
PWRON- B31
DEVCKR+
DEVCKR- A23
DEVCKS- A31
DVRW-
ANY READ/WRITE ERROR, 0610
11D 7404
B45
EDVRW+
ANY READ/WRITE ERROR, PG v
9D 7404
B23
ESILDS+
SEEK ATTEMPTED IN ERROR, PG v
DEVCK-
DEVICE CHECK, 0180, 0240
LOGIC III BOARD
+5V
CR3
5E 1K
4E
R21 1.2K
CONTROL PANEL
DEVICE CHECK INDICATOR 052
0610 DEVICE CHECK
DEVCK+
11D 7404
A46
A45
5D 936
A38
J6-37
A33
A34
R41 200
L1 2700
0600 +30 VOLTS
B36
J6-38


0600 SET DEVICE CHECK
0600 ANY READ/WRITE ERROR
DEVCKS-
DVRW-
A31
0110 SET CYLINDER TAG
0290 READY TO READ OR WRITE
0120 DRIVE SELECT
STCYL+
RDY-
SELECT+
A42
A44
0210 LOAD SPEED
LDSP-
0180 RESET DEVICE CHECK
DEVCKR-
A23
0110 SET HEAD ADDRESS REGISTER
HARS+
A37
0180 WRITE
WRT+
A25
0170 PROGRAMMED OFFSET
OFFSET+
0590 READ-ONLY SWITCH
RDONLY+
0340 UPPER THRESHOLD
UTH+
4C 7410
10B 7400
11D 7404
11C 7400
1E 7404
10C 7400
9B 7400
9C 7400
10D 7430
9D 7404
B37 DEVCK+ DEVICE CHECK, PG
DEVCK+ DEVICE CHECK, 0600, 0620
B49 ESCRDY+ SET CYLINDER TAG ERROR, PG v
B43 EOSERR+ SET HEAD TAG ERROR, PG v
B27 EWRTRDY+ WRITE WHEN NOT READY ERROR, PG v
B26 EWRTOS+ WRITE WHEN OFFSET ERROR, PG v
B25 ERDER+ WRITE WHEN IN READ-ONLY ERROR, PG v
B24 EWUTH+ WRITE WHEN OFF TRACK, PG v
WRITE+ WRITE, 0600


0160 END OF CYLINDER
0120 DRIVE SELECT
0170 PROGRAMMED OFFSET
0190 INDEX PULSE
0290 READY TO READ OR WRITE
0590 READ-ONLY SWITCH
0610 DEVICE CHECK
0320 HEADS ARE LOADED
0290 SEEK INCOMPLETE
0530 ADDRESS MARK DETECT
0120 DEGATE
0120 DEGATE
EDC+
SELECT+
A44
OFFSET+
IDX+
B10
RDY+
RDONLY+
DEVCK+
HDLD+
A28
SKINC+
AMDET+
B17
DEGATE1+
B7
DEGATE2+
B8
5C 7400
6C 7400
8D 7400
5D 7404
6D 7404
+5V
7D 470
C31 0.1
5E Q2T3725
6E Q2T3725
4E Q2T3725
A43 IEOC- END OF CYLINDER, PG iv
A45 IOFST- OFFSET SIGNAL, PG iv
A47 IIDX- INDEX PULSE, PG iv
A49 IRDY- DRIVE READY, PG iv
A51 IRDDLY- READ-ONLY LATCH STATUS, PG iv
A53 IDEVCK- DEVICE CHECK CONDITION, PG iv
A56 IONLN- DRIVE ONLINE STATUS, PG iv
A55 ISKINC- SEEK INCOMPLETE, PG iv
A39 IADMKD- ADDRESS MARK DETECTED ON READ, PG iv

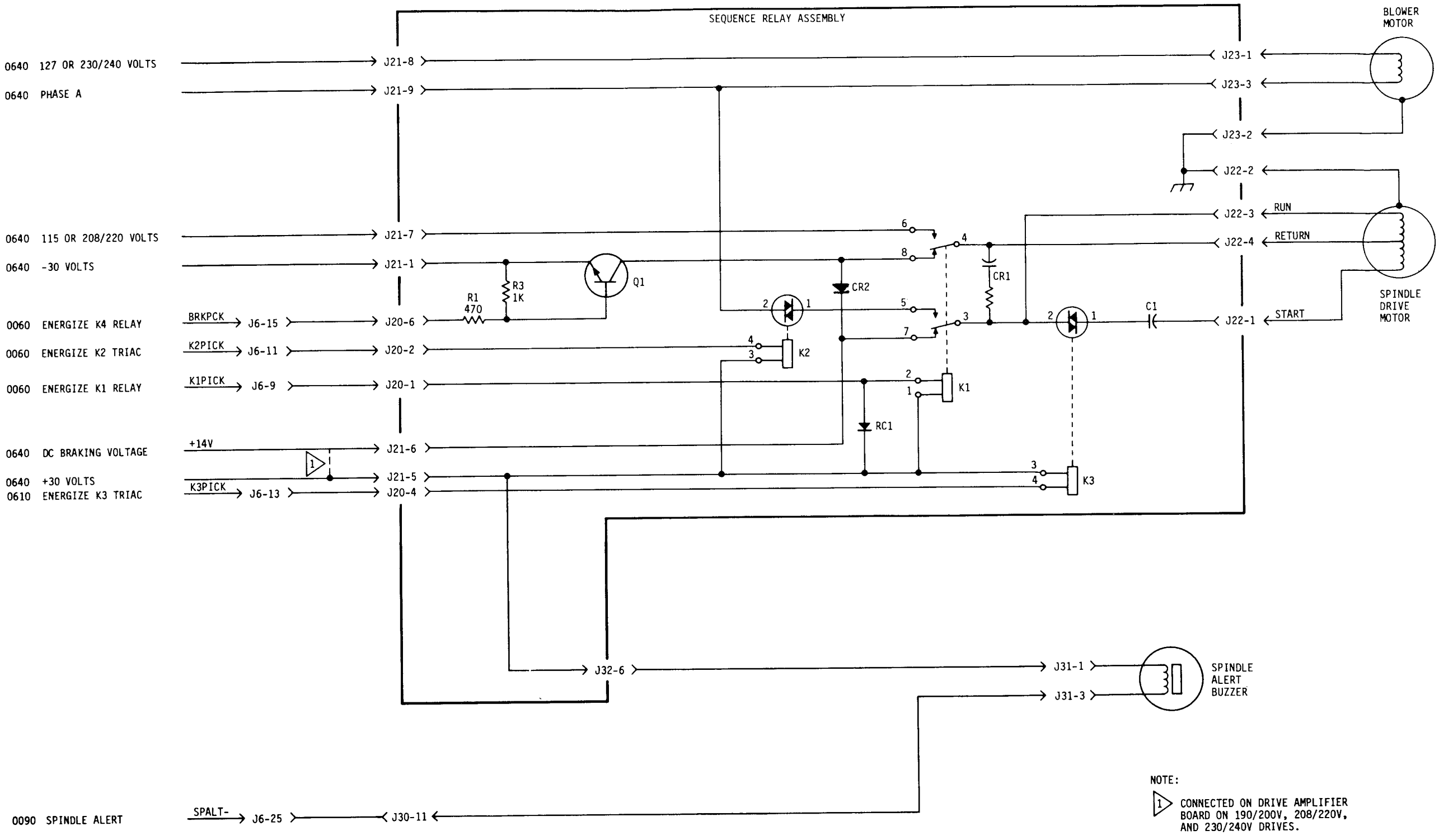

0120 DRIVE SELECT
SELECT+
A44
8D 7400
6D 7404
+5V
7D 470
7E Q2T3725
B52
ISELD-
SELECTED AND NOT DEGATED, PG iv
R1 100
0580 ATTENTION
ATTEN-
6D 7404
B50
IATTEN-
ATTENTION, PG iv
R2 100
0190 INDEX PULSE
IDX+
B10
8D 7400
8D 7400
B46
II/SC-
COMPOSITE SECTOR AND INDEX PULSES, PG iv
R3 100
0200 SECTOR PULSE
SECTOR-
B11
9D 7404
12D 7400
5D 7404
4E Q2T3725
A41
ISOT-
SECTOR PULSES, PG iv
0120 DRIVE SELECT
SELECT+
A44
0120 DEGATE
DEGATE1+
B7
C31 0.1
0120 DEGATE
DEGATE2+
B8
PG iv +5 VOLTS(2)
+5CON2
B44



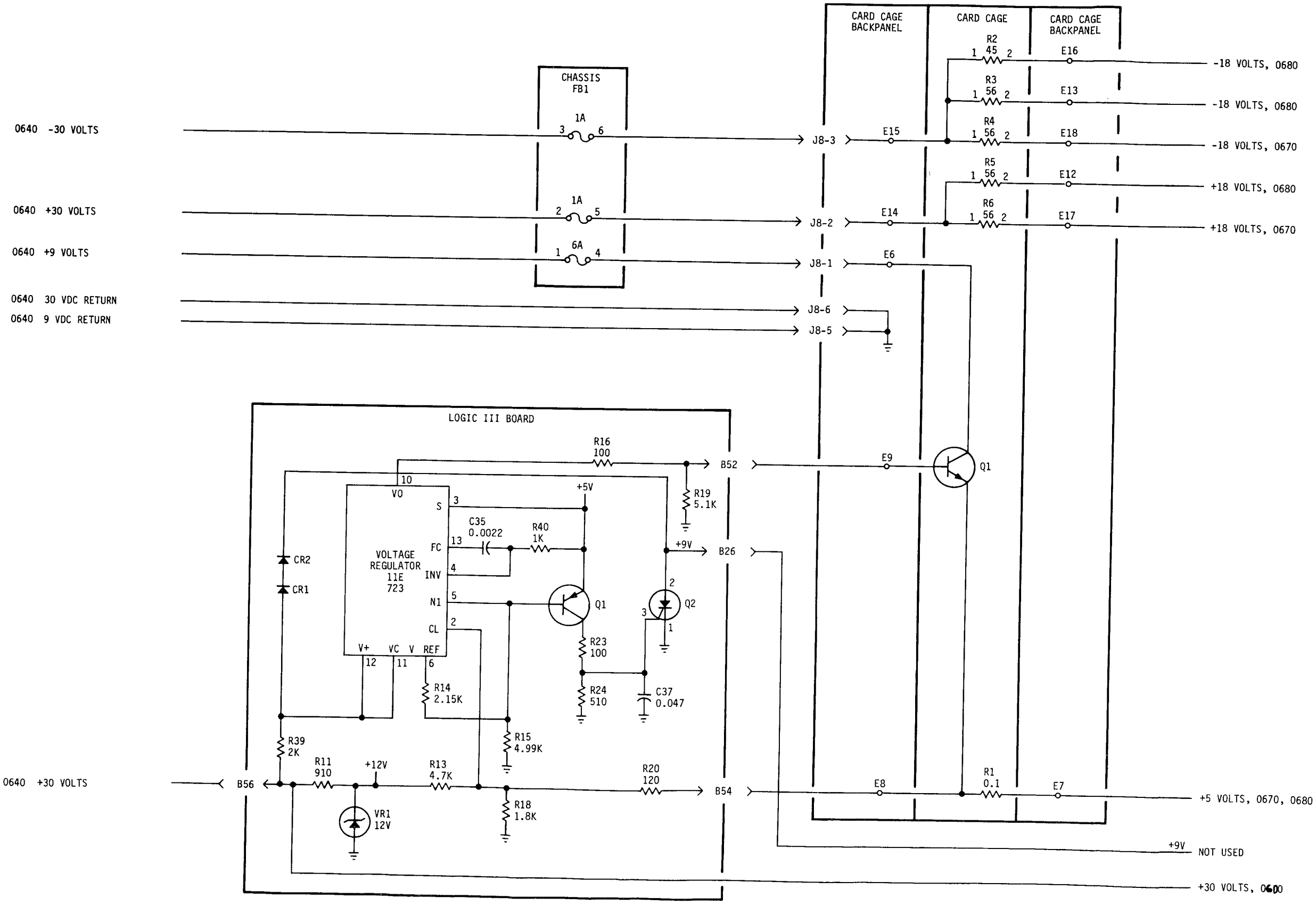


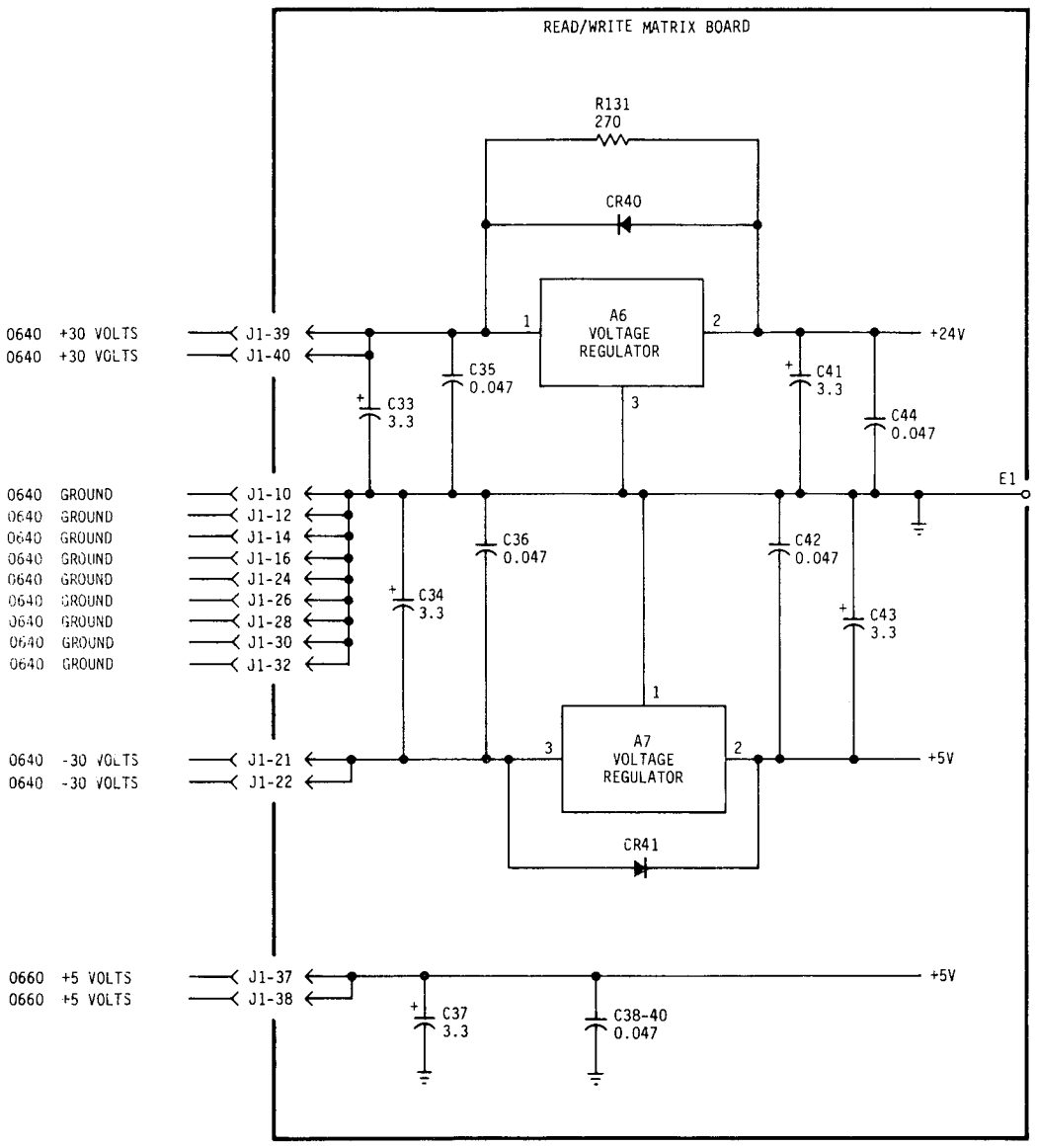
NOTES:

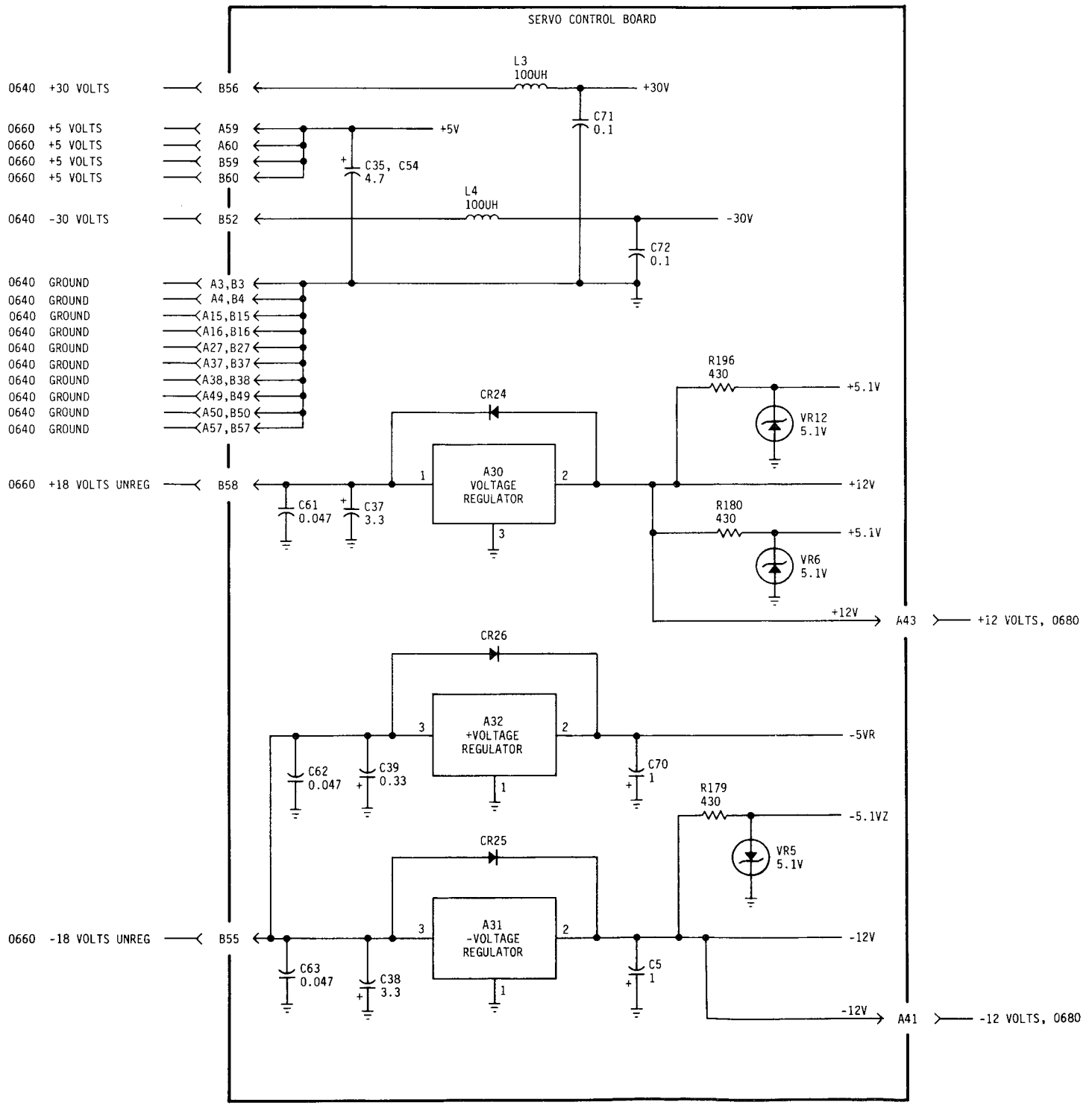
1. F1 IS 15A AND F2 IS USED ONLY FOR 190/200V, 208/220V, OR 230/240V OPERATION.
2. SHOWN CONNECTED FOR 115V OR 208/220V. FOR OTHER VOLTAGES CONNECT PIN 2 TO:
   5 FOR 110V OR 190/200V
   3 FOR 127V OR 230/240V
3. A4 IS USED ONLY ON 100V, 115V, AND 127V DRIVES.


SEQUENCE RELAY ASSEMBLY
BLOWER MOTOR
SPINDLE DRIVE MOTOR
SPINDLE ALERT BUZZER
0640 127 OR 230/240 VOLTS
0640 PHASE A
0640 115 OR 208/220 VOLTS
0640 -30 VOLTS
0060 ENERGIZE K4 RELAY
0060 ENERGIZE K2 TRIAC
0060 ENERGIZE K1 RELAY
0640 DC BRAKING VOLTAGE
0640 +30 VOLTS
0610 ENERGIZE K3 TRIAC
0090 SPINDLE ALERT
J21-8
J21-9
J21-7
J21-1
J20-6
J20-2
J20-1
J21-6
J21-5
J20-4
J32-6
J30-11
J23-1
J23-3
J23-2
J22-2
J22-3
J22-4
J22-1
J31-1
J31-3
J6-15
J6-11
J6-9
J6-13
J6-25
BRKPCK
K2PICK
K1PICK
K3PICK
SPALT-
+14V
RUN
RETURN
START
R1 470
R3 1K
Q1
CR2
CR1
C1
K2
K1
K3
RC1
NOTE:
1 CONNECTED ON DRIVE AMPLIFIER BOARD ON 190/200V, 208/220V, AND 230/240V DRIVES.

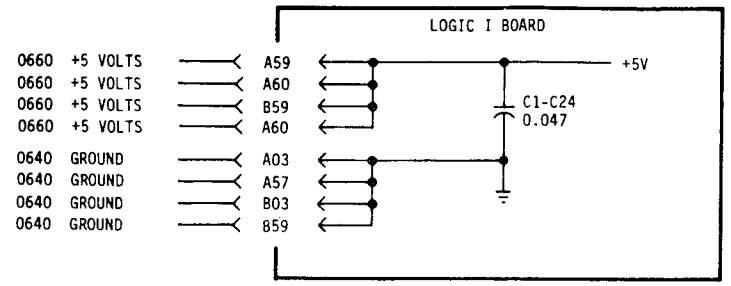
CHASSIS FB1, CARD CAGE BACKPANEL, CARD CAGE, LOGIC III BOARD

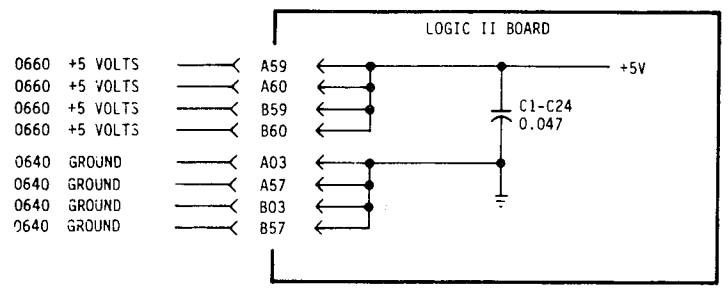


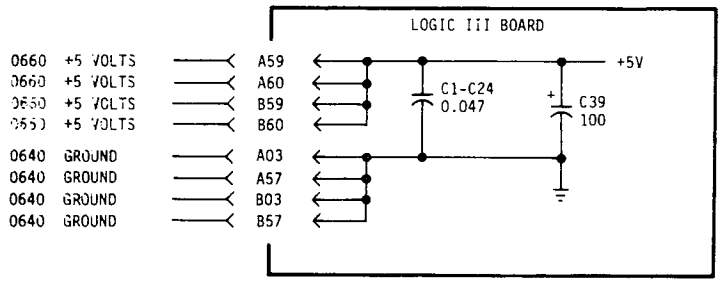

READ/WRITE MATRIX BOARD
R131
270
CR40
A6
VOLTAGE
REGULATOR
0640 +30 VOLTS
0640 +30 VOLTS
J1-39
J1-40
C35
0.047
C33
3.3
C41
3.3
C44
0.047
+24V
E1
0640 GROUND
J1-10
J1-12
J1-14
J1-16
J1-24
J1-26
J1-28
J1-30
J1-32
C36
0.047
C42
0.047
C34
3.3
C43
3.3
A7
VOLTAGE
REGULATOR
0640 -30 VOLTS
0640 -30 VOLTS
J1-21
J1-22
+5V
CR41
0660 +5 VOLTS
0660 +5 VOLTS
J1-37
J1-38
C37
3.3
C38-40
0.047

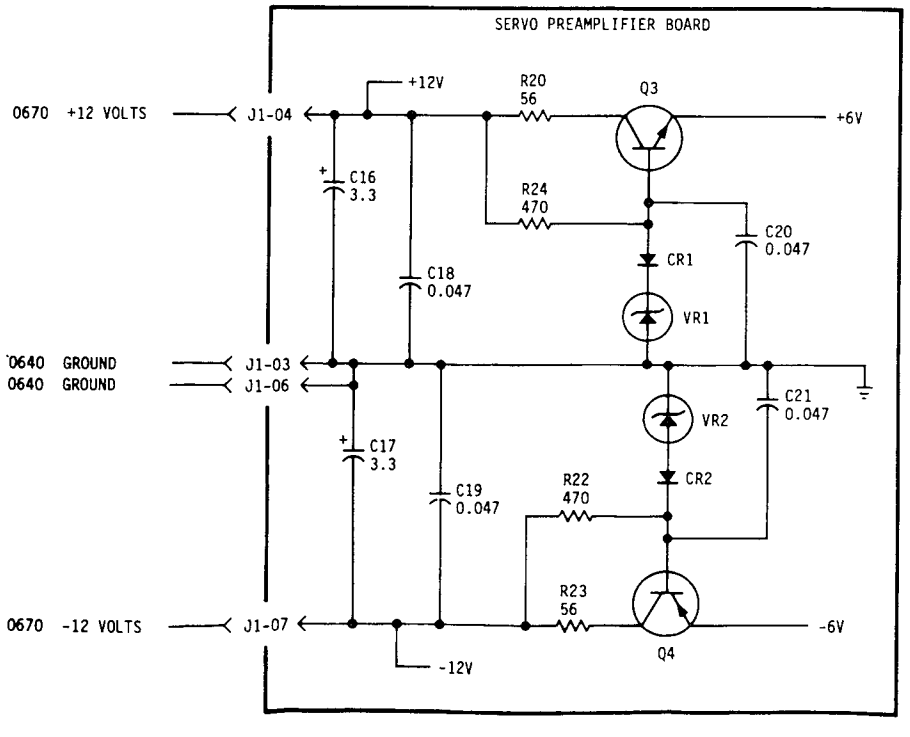

SERVO CONTROL BOARD
L3
100UH
0640 +30 VOLTS
B56
+30V
C71
0.1
0660 +5 VOLTS
0660 +5 VOLTS
0660 +5 VOLTS
0660 +5 VOLTS
A59
A60
B59
B60
+5V
C35, C54
4.7
L4
100UH
0640 -30 VOLTS
B52
-30V
C72
0.1
0640 GROUND
0640 GROUND
0640 GROUND
0640 GROUND
0640 GROUND
0640 GROUND
0640 GROUND
0640 GROUND
0640 GROUND
A3,B3
A4,B4
A15,B15
A16,B16
A27,B27
A37,B37
A38,B38
A49,B49
A50,B50
A57,B57
R196
430
+5.1V
VR12
5.1V
CR24
A30
VOLTAGE
REGULATOR
0660 +18 VOLTS UNREG
B58
C61
0.047
C37
3.3
+12V
R180
430
+5.1V
VR6
5.1V
+12V
A43
+12 VOLTS, 0680
CR26
A32
+VOLTAGE
REGULATOR
-5VR
C62
0.047
C39
0.33
C70
1
R179
430
-5.1VZ
VR5
5.1V
CR25
0660 -18 VOLTS UNREG
B55
A31
-VOLTAGE
REGULATOR
-12V
C63
0.047
C38
3.3
C5
1
-12V
A41
-12 VOLTS, 0680

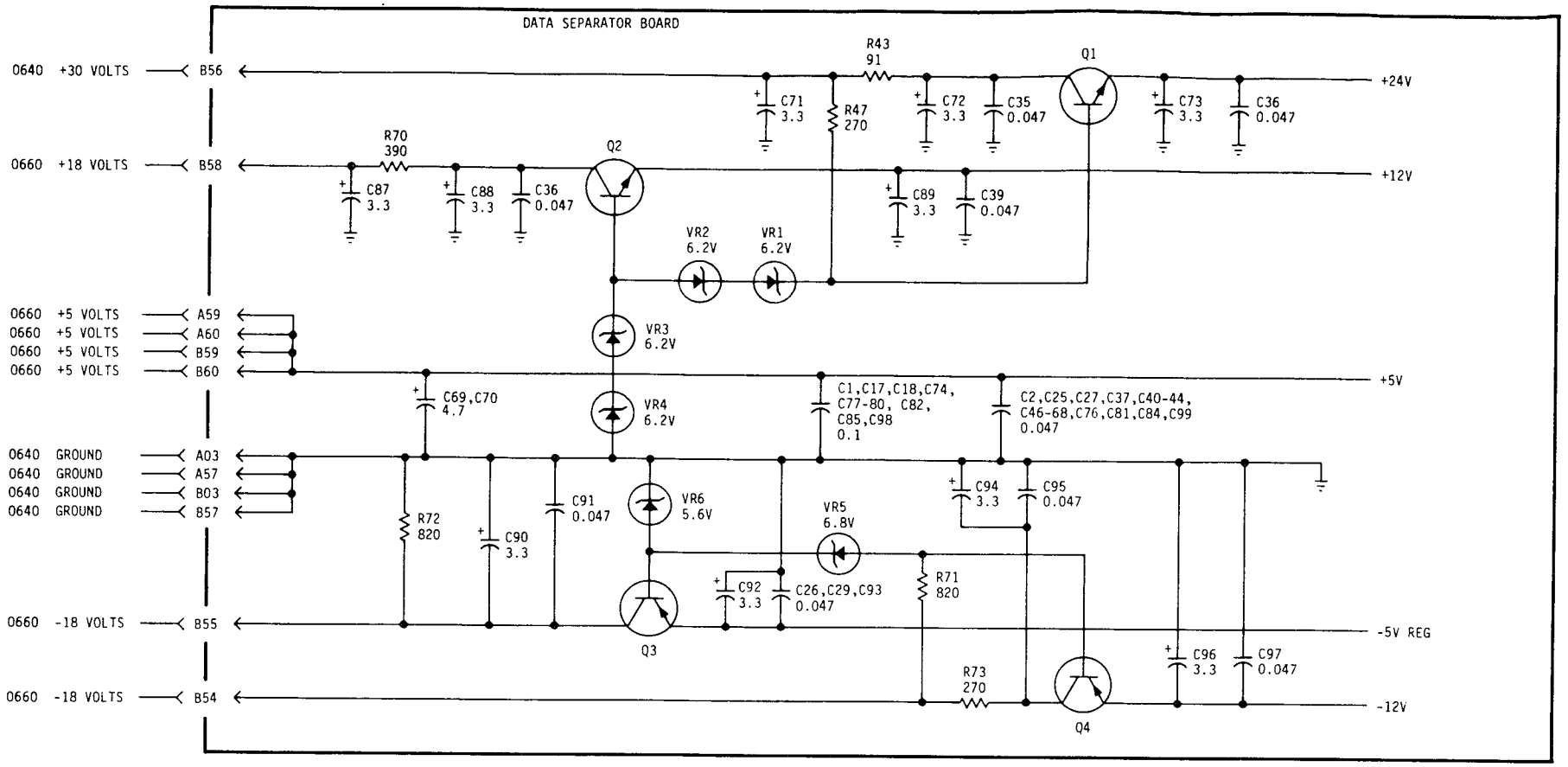
SERVO PREAMPLIFIER BOARD
LOGIC I, II, III BOARDS
DATA SEPARATOR BOARD
READ LIMITER BOARD

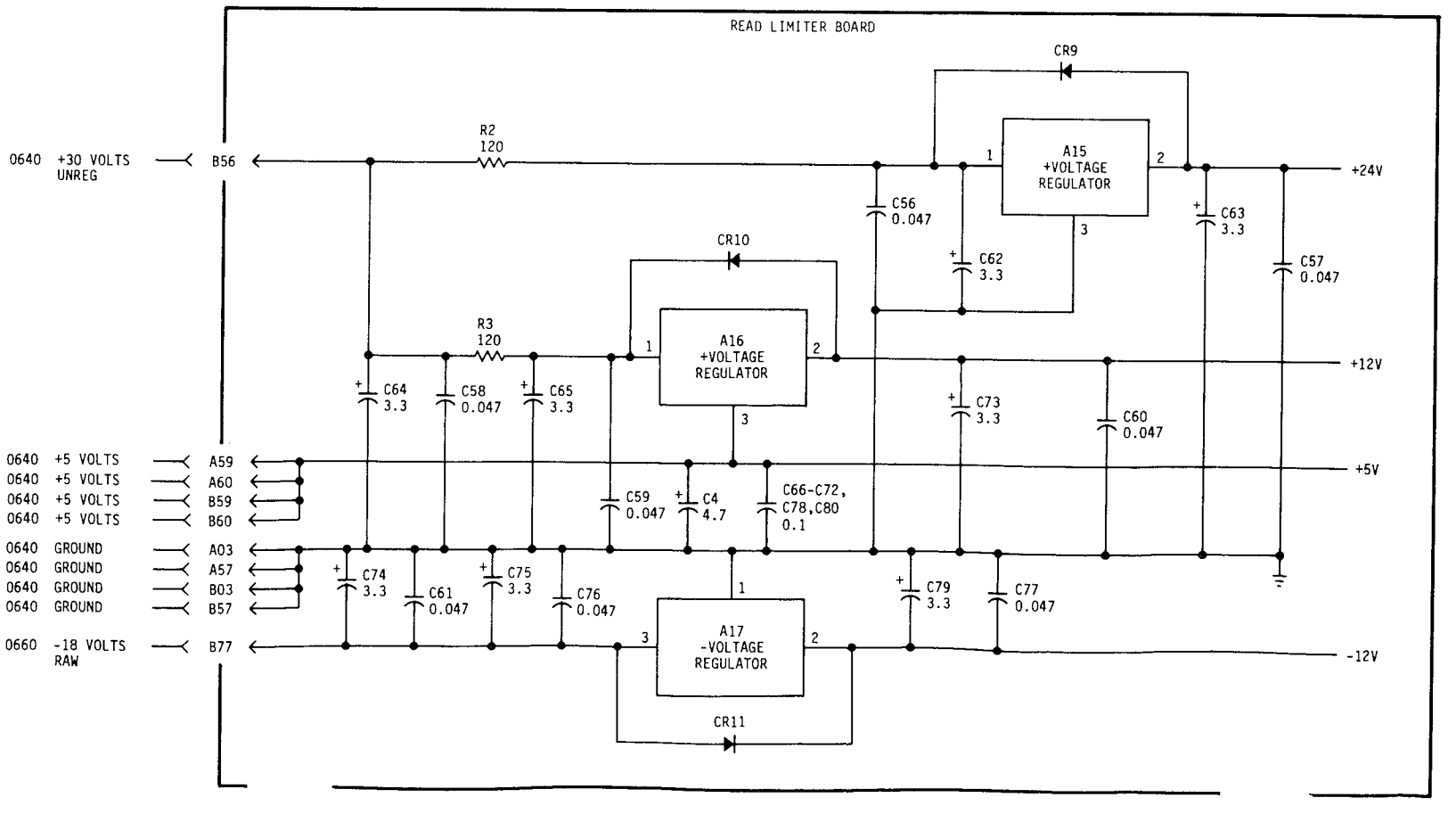












APPENDIX A

DISC CONTROLLER

APPENDIX A

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION 1

INTRODUCTION

A1.1 GENERAL DESCRIPTION

The Disc Controller consists of five cards located in the Central Processor Unit Cabinet. These provide the CPU with the means of controlling the power sequencing, head positioning, data handling, error corrections, and diagnostics aids for the Disc Storage Unit. Figure A-1 illustrates the Disc Controller Circuitry in a block diagram format.

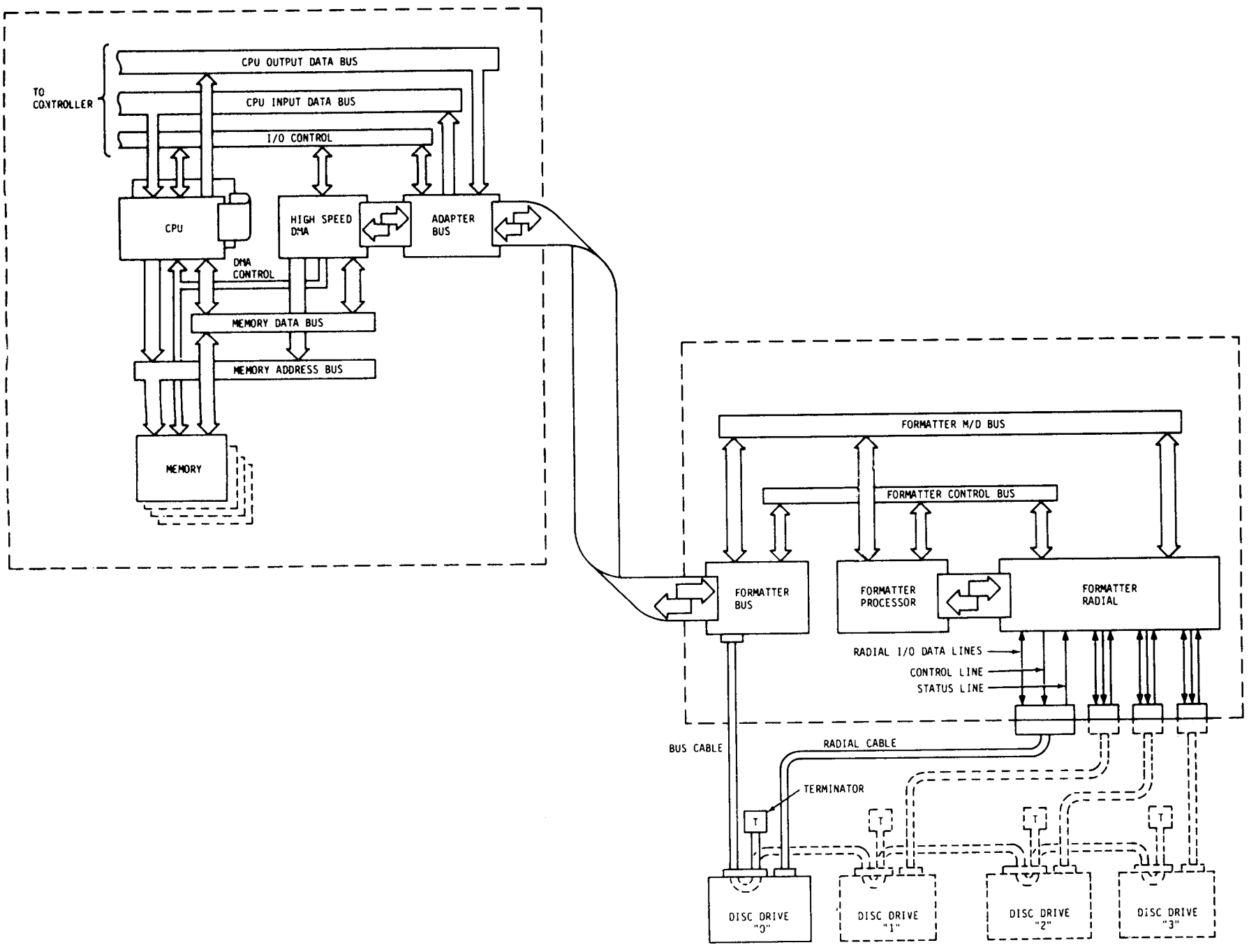


Figure A-1. Disc Controller Block Diagram

SECTION 2

INSTALLATION

A2.1 INSTALLATION

Installation of the Disc Controller boards is divided in two functions:

1. Adapter PCB's (2)
2. Formatter PCB's (3)

The Adapter PCB's are located in the Data Processor (CPU) cabinet's card cage. The Formatter PCB's are located in a special auxiliary card cage in the CPU.

Electrical requirements for the Disc Controller are DC voltages of +5 volts at 15A and -5 volts at 200 ma.

A2.2 DISC CONTROLLER INTERCONNECTION SYSTEM 610

The location of the controller PCB's for the Basic Four System 610 is illustrated in Figure A-2.

A2.3 DISC CONTROLLER INTERCONNECTION SYSTEM 700

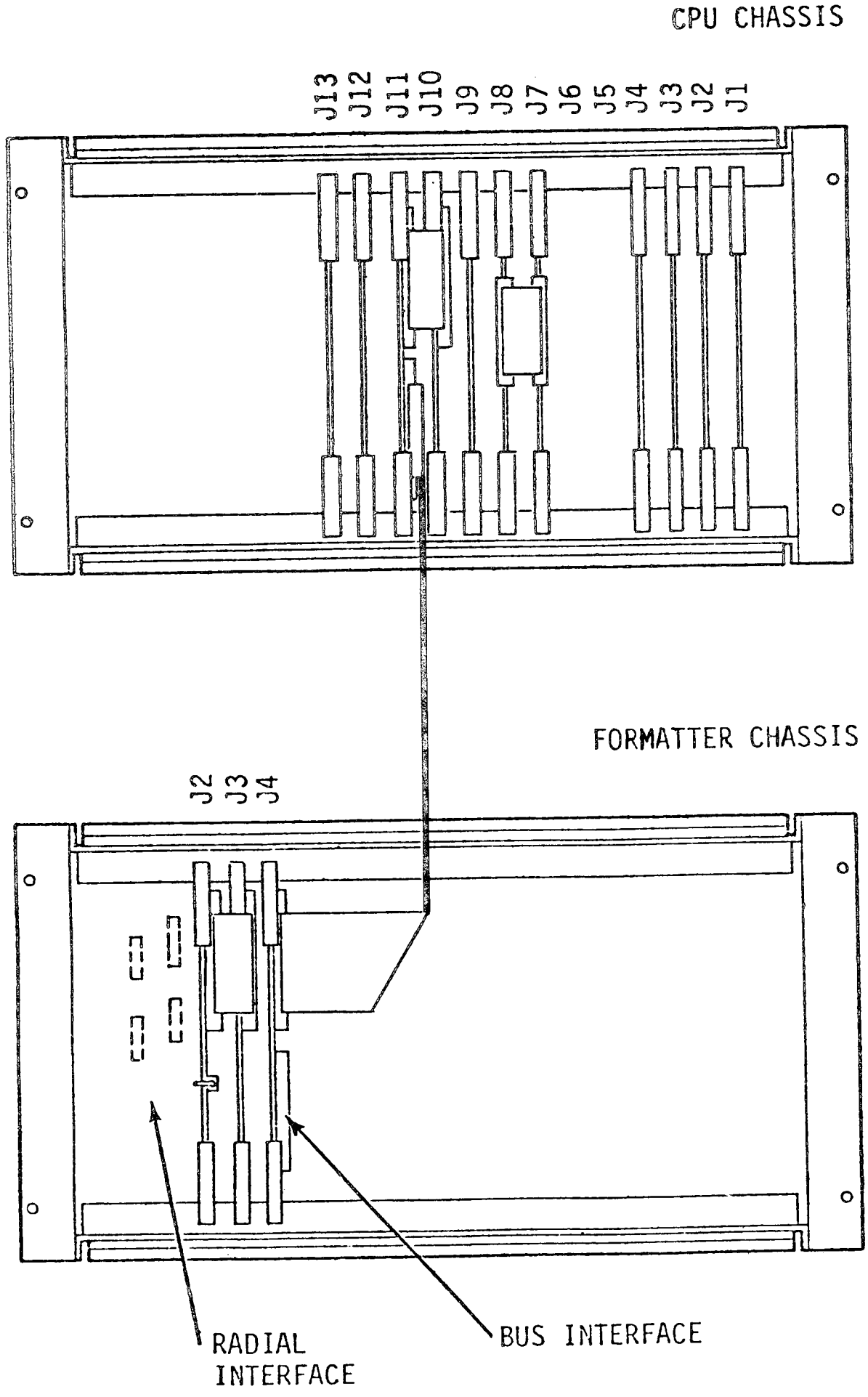
The location of the Controller PCB's for the Basic Four System 700 is illustrated in Figure A-3.

A2.4 INTERFACE REQUIREMENTS

Signal levels with the single exception of the drive unit clock and data lines, all signals will be at standard TTL levels.

0.0 to + 0.4	VDC equals logical low
+ 2.4 to Vcc	VDC equals logical high

The clock and data lines to the disk units will be differential balanced line driver/receivers.



J1	MEMORY
J2	MEMORY
J3	MEMORY
J4	MEMORY
J5	
J6	
J7	1320 CPU
J8	1320 ACC
J9	MTC CNTLR OR DUMMY BOARD
J10	HS DMA
J11	ADAPTER BUS
J12	4-WAY
J13	PRINTER CNTLR

J2	FORMATTER RADIAL
J3	FORMATTER PROCESSOR
J4	FORMATTER BUS

Figure A-2. Disc System Interconnection 610

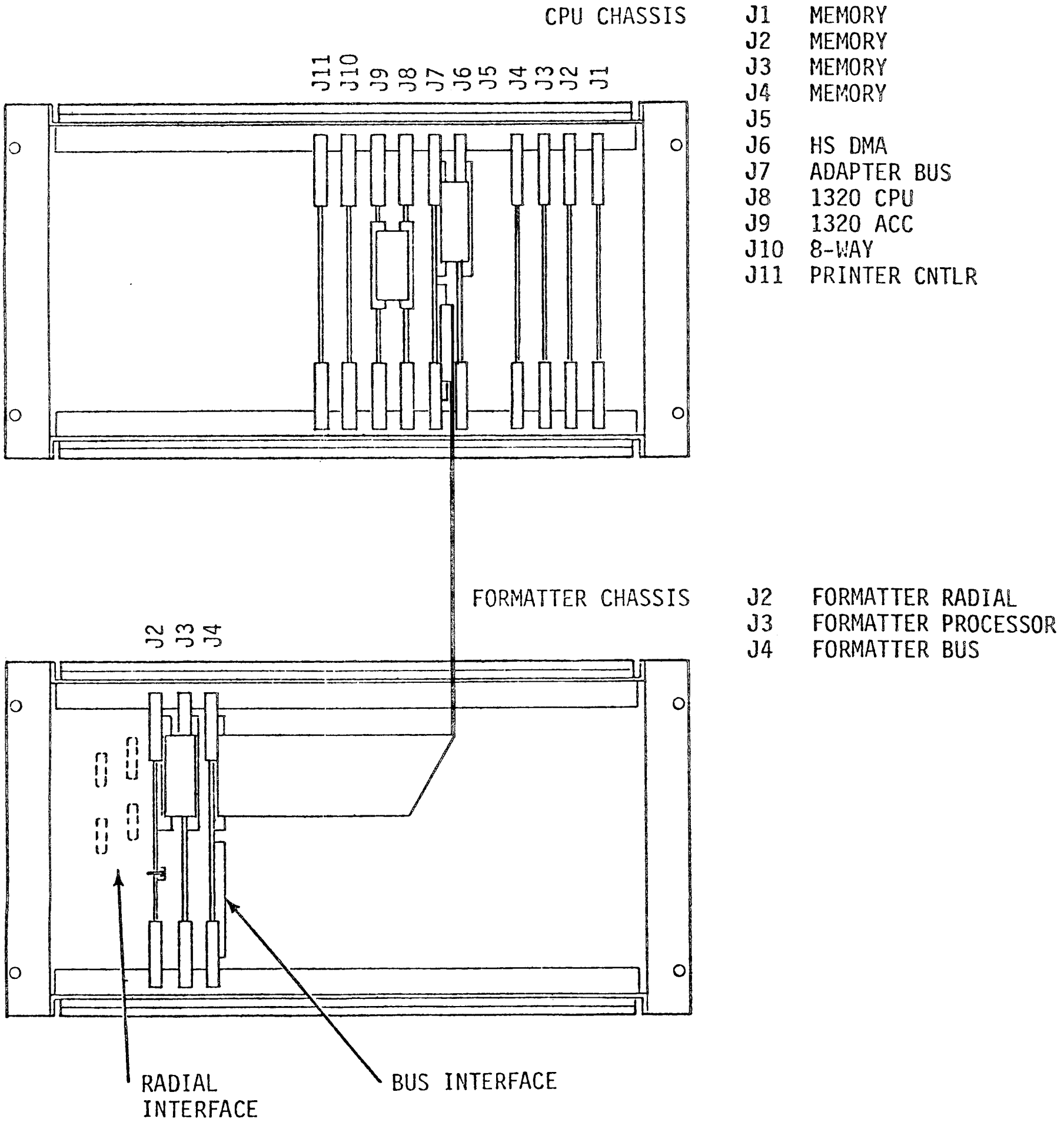


Figure A-3. Disc System Interconnection 700

SECTION 3

FUNCTIONAL DESCRIPTION

A3.1 GENERAL

The Disc Controller consists of five boards. Their functions are described in the following paragraphs.

Two boards, referred to as the Adapter, located in the main CPU card cage, are responsible for interfacing the Formatter to the system. The Adapter must handle the I/O, DMA, and Keysearch functions. The following functional parameters apply to the Adapter:

1. Key Size (Min and Max)
2. Max Search Length, and
3. Max DMA transfer.

There are also three boards referred to as the Formatter. They are located in the Auxiliary Card Cage in the lower portion of the CPU cabinet. The Formatter is responsible for interfacing and controlling the Disc Drives and for generating the formatting and timing. The following Disc Drive parameters are controlled by the Formatter:

1. Bytes per Sector
2. Sector per Track
3. Formatted Capacity
4. Average Latency
5. Seek Time (Min., Avg., and Max.)
6. Total Tracks, and
7. Data Transfer Rate.

A3.2 BLOCK DIAGRAMS

Block diagrams of the two different PCB's which make up the Disc Controller are shown in Figures A-4 and A-5.

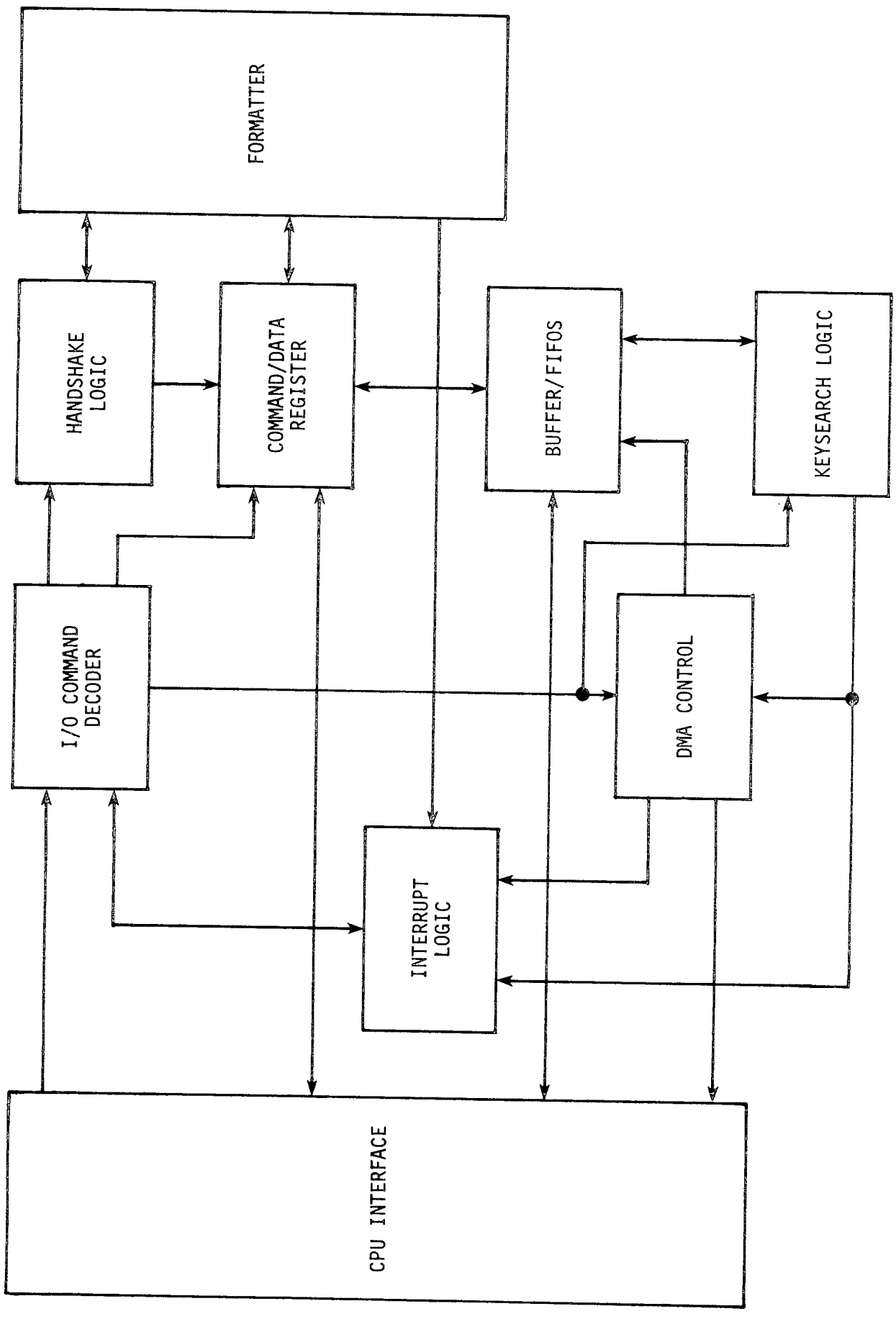


Figure A-4. Adapter Block Diagram

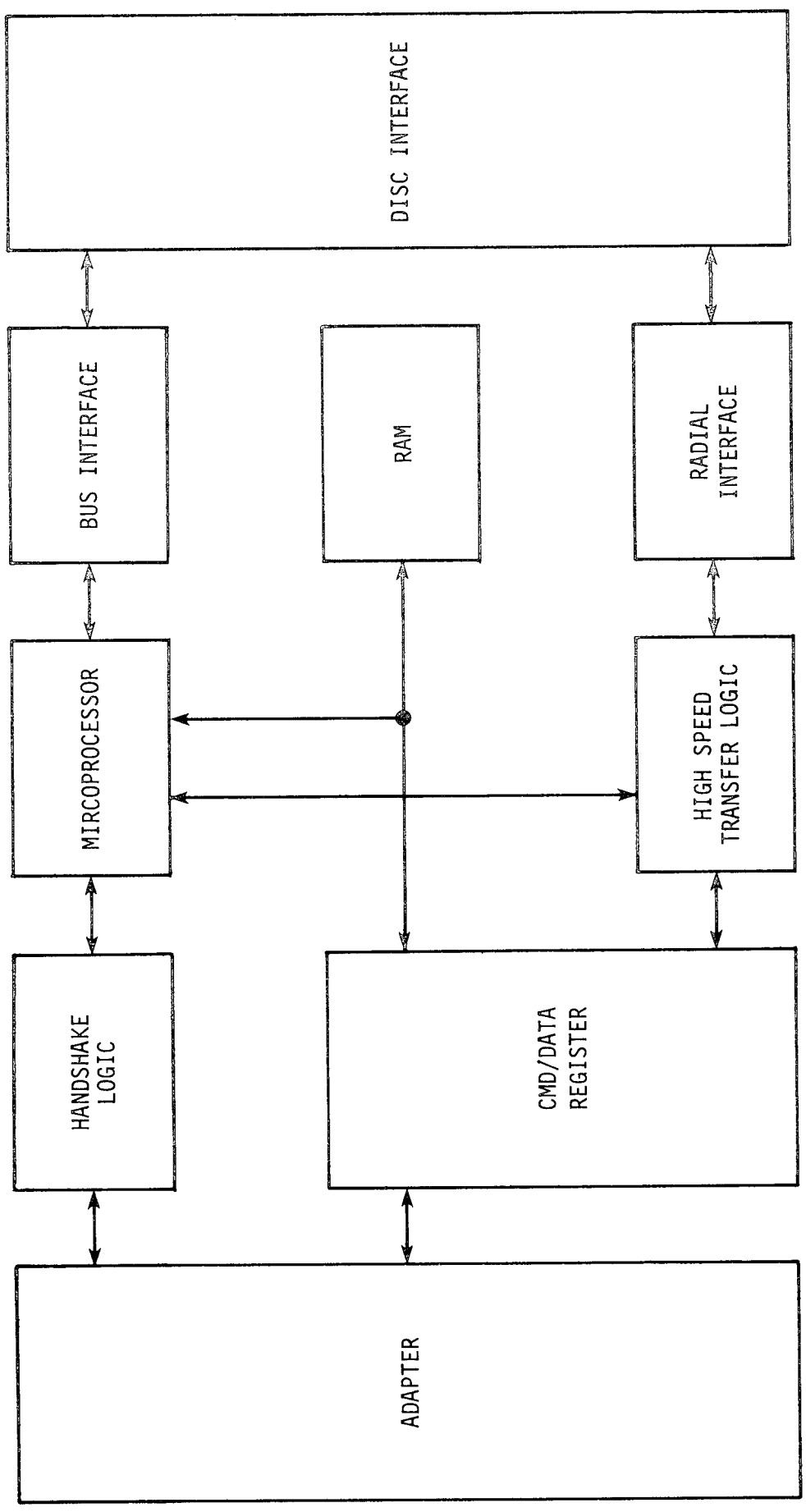


Figure A-5. Formatter Block Diagram

A3.3 INTERCONNECTION DIAGRAM

Figure A-6 illustrates the interconnections with cable part numbers.

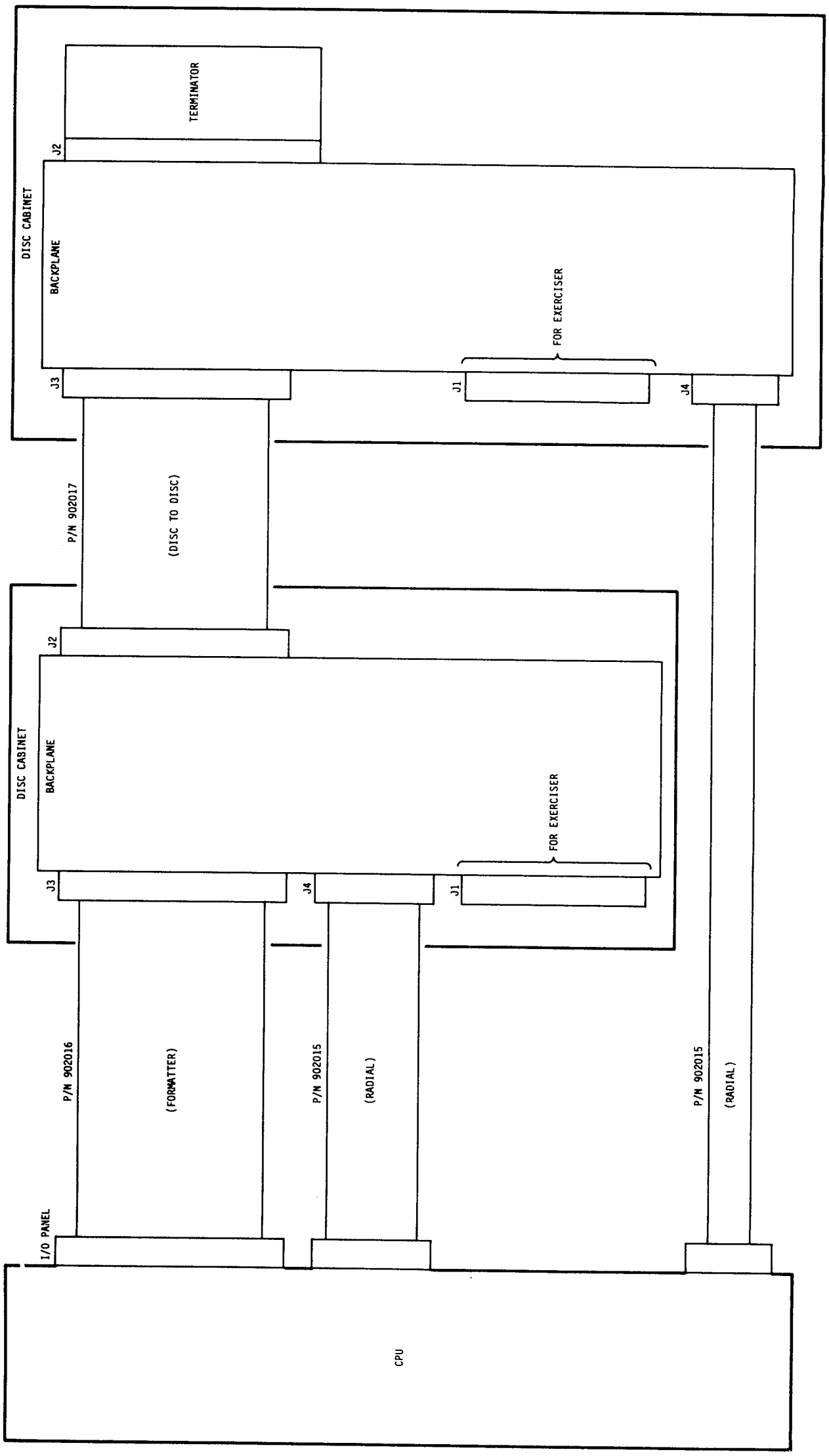


Figure A-6. Interconnection Diagram

SECTION 4

REFERENCE DATA

J1

RADIAL EXP.

A		B
GND	1	+5V
GND	2	+5V
	3	-16.75V
-16.75V	4	
	5	
	6	
	7	
	8	
CLK6P	9	R4ATTN-
CLK6M	10	R4SLCTD-
DATA6M	11	SEQ4-
DATA6P	12	SEL4-
SEL6-	13	DATA4P
SEQ6-	14	DATA4M
R6SLCTD-	15	CLK4P
R6ATTN-	16	CLK4M
	17	
	18	
	19	
	20	
	21	
R7ATTN-	22	
R7SLCTD-	23	
SEQ7-	24	
SEL7-	25	
DATA7P	26	
DATA7M	27	
CLK7P	28	R5ATTN-
CLK7M	29	R5SLCTD-
	30	SEQ5-
	31	SEL5-
	32	DATA5P
GND	33	DATA5M

J1

RADIAL EXP.

A		B
GND	34	CLK5P
GND	35	CLK5M
	36	GND
	37	GND
	38	
	39	
	40	
	41	
	42	
R6SEL-	43	R7SEL-
R4SEL-	44	R5SEL-
R6SLCTD-	45	R7SLCTD-
R4SLCTD-	46	R5SLCTD-
R6SEQ	47	R5SEQ
(RES)	48	R4SEQ
	49	
	50	
	51	
	52	
WRTGATE-	53	RDGATE-
BUS07-	54	STO-
R7SEQ	55	CTAG-
MDIBUS6-	56	MDIBUS7-
MDIBUS4-	57	MDIBUS5-
MDIBUS2-	58	MDIBUS3-
MDIBUS0-	59	MDIBUS1-
GND	60	ENBOUT
GND	61	WRDATA
GND	62	RDDATA
GND	63	DSCLOCK
GND	64	+5V
GND	65	+5V

RADIAL

A		B
GND	1	+5V
GND	2	+5V
	3	-16.75V
-16.75V	4	
	5	
	6	
	7	
	8	
R2ATTN-	9	ROATTN-
R2SLCTD-	10	ROSLCTD-
SEQ2-	11	SEQ0-
SEL2-	12	SEL0-
DATA2P	13	DATA0P
DATA2M	14	DATA0M
CLK2P	15	CLK0P
CLK2M	16	CLK0M
	17	
	18	
	19	
	20	
	21	
	22	
	23	
	24	
	25	
	26	
	27	
R3ATTN-	28	R1ATTN-
R3SLCTD-	29	R1SLCTD-
SEQ3-	30	SEQ1-
SEL3-	31	SEL1-
DATA3P	32	DATA1P
GND	33	DATA1M

OUTSTANDING ECN(s)

J2

RADIAL

A		B
GND	34	CLK1P
GND	35	CLK1M
CLK3M	36	GND
CLK3P	37	GND
DATA3M	38	
	39	
	40	
	41	
	42	
R6SEL-	43	R7SEL-
R4SEL-	44	R5SEL-
R6SLCTD-	45	R7SLCTD-
R4SLCTD-	46	R5SLCTD-
R6SEQ	47	R5SEQ
(RES)	48	R4SEQ
MDOBUS2-	49	MDOBUS3-
MDOBUS0-	50	MDOBUS1-
SYSRST	51	ONSET
ST9-	52	SLCTD
WRTGATE-	53	RDGATE-
BUS07-	54	STO-
R7SEQ	55	CTAG-
MDIBUS6-	56	MDIBUS7-
MDIBUS4-	57	MDIBUS5-
MDIBUS2-	58	MDIBUS3-
MDIBUS0-	59	MDIBUS1-
GND	60	ENBOUT
GND	61	WRDATA
GND	62	RDDATA
GND	63	DSCLOCK
GND	64	+5V
GND	65	+5V

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(1) ON PCBA 903284 ONLY.

NOTES: UNLESS OTHERWISE SPECIFIED

		DIMENSIONS ARE IN INCHES	basic / four corporation				
		TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1,0°	1335 South Claudina Street Anaheim, California 92805				
			DRAWN	K.JOECKS, J	12-15-76	TITLE: LOGIC DIAGRAM, FORMATTER BACKPLANE	
			CHKD	[illegible]	12-17-76		
			ENG	[illegible]	12-17-76		
			MFG	[illegible]	1/3/81	SIZE B	DWG NO 902042 REV A4
902040	REF	MACHINED SURFACES √	APP	K. [illegible]	12-17-76		
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	SAFETY	[illegible]	1-9-81	SCALE —	SH 1 OF 3

J3

PROCESSOR

A		B
GND	1	+5V
GND	2	+5V
IBUS6-	3	(RES)
(RES)	4	IBUS7-
(RES)	5	IBUS5-
IBUS2-	6	IBUS3-
IBUS0-	7	IBUS1-
(RES)	8	(RES)
BCOND	9	FLAGIN-
BRANCH-	10	LDMCU
DMC-	11	MA9
USREG-	12	PLREG-
ALDMCU-	13	SECC
LECC	14	CNT15
DWCZR	15	
GND	16	WCCLK
GND	17	ECINP
GND	18	FDBKE
GND	19	GND
	20	ECOUT
FULPUT-	21	STATUS
CDXND	22	TAKEFUL-
UNCZR	23	WST14-
ZROD-	24	EDXFER-
IBUS4-	25	
	26	
	27	
	28	
	29	
	30	
	31	
CLKGA	32	CLKC
GND	33	

J3

PROCESSOR

A		B
GND	34	STRCLKB
GND	35	GND
T2-	36	GND
	37	ESCLK
	38	
MDOBUS4-	39	
ST12-	40	ST23-
ST10-	41	ST11-
ST6-	42	ST7-
ST1-	43	ST2-
RK4	44	RK5
RK2	45	RK3
RK0	46	RK1
MDOBUS6-	47	MDOBUS7-
(RES)	48	MDOBUS5-
MDOBUS2-	49	MDOBUS3-
MDOBUS0-	50	MDOBUS1-
SYSRST	51	ONSET
ST9-	52	SLCTD-
WRTGATE-	53	RDGATE-
BUS07-	54	STO-
R7SEQ	55	CTAG-
MDIBUS6-	56	MDIBUS7-
MDIBUS4-	57	MDIBUS5-
MDIBUS2-	58	MDIBUS3-
MDIBUS0-	59	MDIBUS1-
GND	60	ENBOUT
GND	61	WRDATA
GND	62	RDDATA
GND	63	DSCLOCK
GND	64	+5V
GND	65	+5V

J4

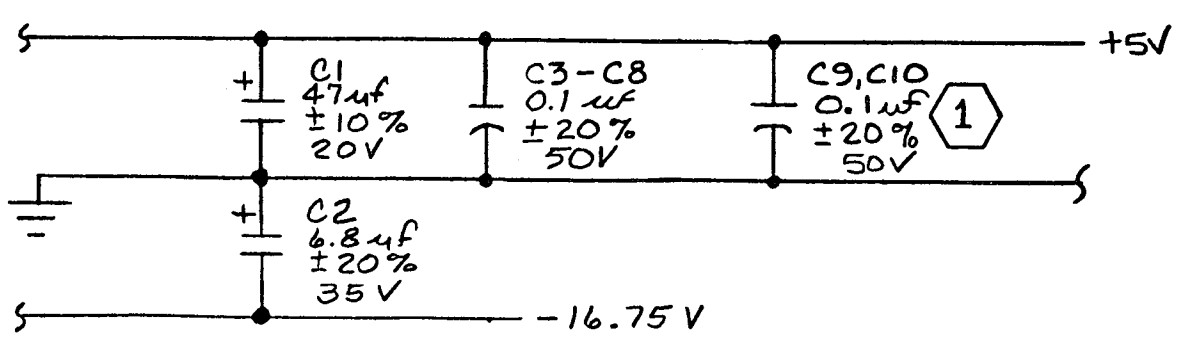
BUS

A		B
GND	1	+5V
GND	2	+5V
IBUS6-	3	(RES)
(RES)	4	IBUS7-
(RES)	5	IBUS5-
IBUS2-	6	IBUS3-
IBUS0-	7	IBUS1-
(RES)	8	(RES)
BCOND	9	FLAGIN-
BRANCH-	10	LDMCU
DMC-	11	MA9
USREG-	12	PLREG-
ALDMCU-	13	SECC
LECC	14	CNT15
DWCZR	15	
GND	16	WCCLK
GND	17	ECINP
GND	18	FDBKE
GND	19	GND
	20	ECOUT
FULPUT-	21	STATUS
CDXND	22	TAKEFUL-
UNCZR	23	WST14-
ZROD-	24	EDXFER-
IBUS4-	25	
	26	
	27	
	28	
	29	
	30	
	31	
CLKGA	32	CLKC
GND	33	

J4

BUS

A		B
GND	34	STRCLKB
GND	35	GND
T2-	36	GND
	37	ESCLK
	38	
MDOBUS4-	39	
ST12-	40	ST23-
ST10-	41	ST11-
ST6-	42	ST7-
ST1-	43	ST2-
RK4	44	RK5
RK2	45	RK3
RK0	46	RK1
MDOBUS6-	47	MDOBUS7-
(RES)	48	MDOBUS5-
MDOBUS2-	49	MDOBUS3-
MDOBUS0-	50	MDOBUS1-
SYSRST	51	ONSET
ST9-	52	SLCTD-
WRTGATE-	53	RDGATE-
BUS07-	54	STO-
R7SEQ	55	CTAG-
MDIBUS6-	56	MDIBUS7-
MDIBUS4-	57	MDIBUS5-
MDIBUS2-	58	MDIBUS3-
MDIBUS0-	59	MDIBUS1-
GND	60	ENBOUT
GND	61	WRDATA
GND	62	RDDATA
GND	63	DSCLOCK
GND	64	+5V
GND	65	+5V



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SIZE	DWG NO	REV
B	902042	A4
	SCALE -1-	SH 2 OF 3

	CH0	CH1	CH2	CH3	CH4	CH5	CH6	CH7
1	+5V	+5V	+5V	+5V	+5V	+5V	+5V	+5V
2	+5V	+5V	+5V	+5V	+5V	+5V	+5V	+5V
3								
4								
5	GND	GND	GND	GND	GND	GND	GND	GND
6	R0ATTN-(J2-B9)	R1ATTN-(J2-B28)	R2ATTN-(J2-A9)	R3ATTN-(J2-A28)	R4ATTN-(J1-B9)	R5ATTN-(J1-B28)	R6ATTN-(J1-A16)	R7ATTN-(J1-A22)
7	GND	GND	GND	GND	GND	GND	GND	GND
8	R0SLCTD-(J2-B10)	R1SLCTD-(J2-B29)	R2SLCTD-(J2-A10)	R3SLCTD-(J2-A29)	R4SLCTD-(J1-B10)	R5SLCTD-(J1-B29)	R6SLCTD-(J1-A15)	R7SLCTD-(J1-A23)
9	GND	GND	GND	GND	GND	GND	GND	GND
10	SEQ0-(J2-B11)	SEQ1-(J2-B30)	SEQ2-(J2-A11)	SEQ3-(J2-A30)	SEQ4-(J1-B11)	SEQ5-(J1-B30)	SEQ6-(J1-A14)	SEQ7-(J1-A24)
11	GND	GND	GND	GND	GND	GND	GND	GND
12	SEL0-(J2-B12)	SEL1-(J2-B31)	SEL2-(J2-A12)	SEL3-(J2-A31)	SEL4-(J1-B12)	SEL5-(J1-B31)	SEL6-(J1-A13)	SEL7-(J1-A25)
13								
14	DATA0P(J2-B13)	DATA1P(J2-B32)	DATA2P(J2-A13)	DATA3P(J2-A32)	DATA4P(J1-B13)	DATA5P(J1-B32)	DATA6P(J1-A12)	DATA7P(J1-A26)
15	GND	GND	GND	GND	GND	GND	GND	GND
16	DATA0M(J2-B14)	DATA1M(J2-B33)	DATA2M(J2-A14)	DATA3M(J2-A36)	DATA4M(J1-B14)	DATA5M(J1-B33)	DATA6M(J1-A11)	DATA7M(J1-A27)
17	GND	GND	GND	GND	GND	GND	GND	GND
18	CLK0P(J2-B15)	CLK1P(J2-B34)	CLK2P(J2-A15)	CLK3P(J2-A37)	CLK4P(J1-B15)	CLK5P(J1-B34)	CLK6P(J1-A9)	CLK7P(J1-A28)
19								
20	CLK0M(J2-B16)	CLK1M(J2-B35)	CLK2M(J2-A16)	CLK3M(J2-A38)	CLK4M(J1-B16)	CLK5M(J1-B35)	CLK6M(J1-A10)	CLK7M(J1-A29)

TB3

1	-16.75 V
2	GND
3	+5 V
4	+5 V
5	GND
6	

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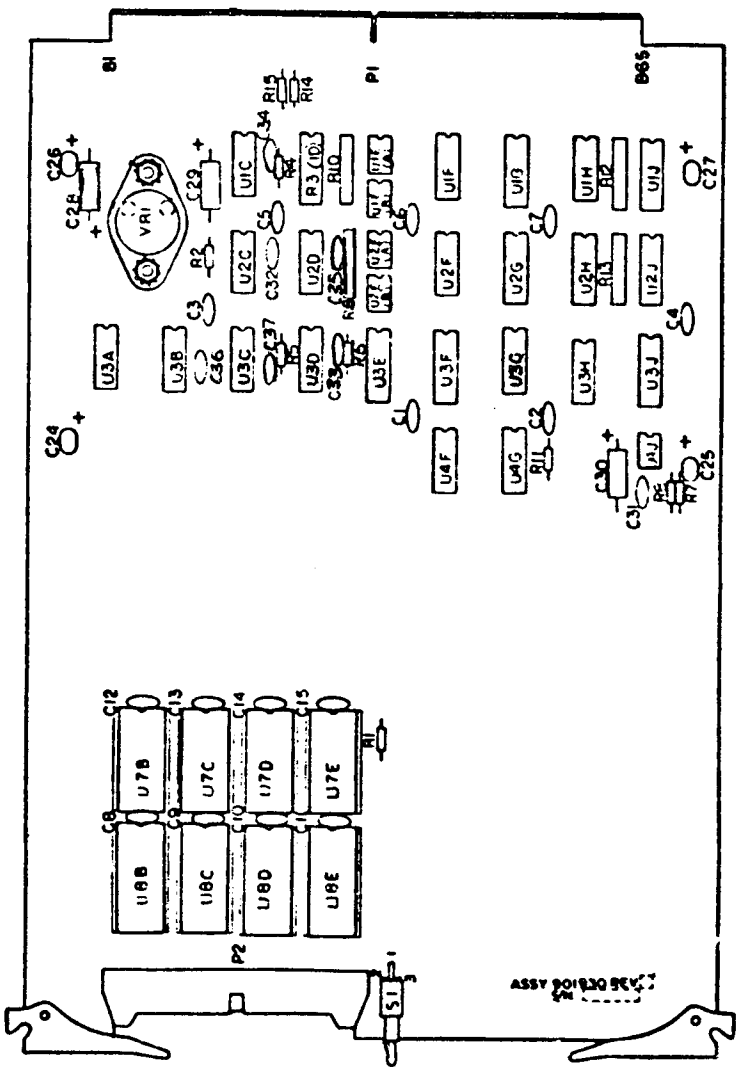
SIZE	DWG NO	REV
B	902042	A4
	SCALE —	SH 3 OF 3



901930-001	WITHOUT PROMS
901930	WITH PROMS
PART NO	DESCRIPTION

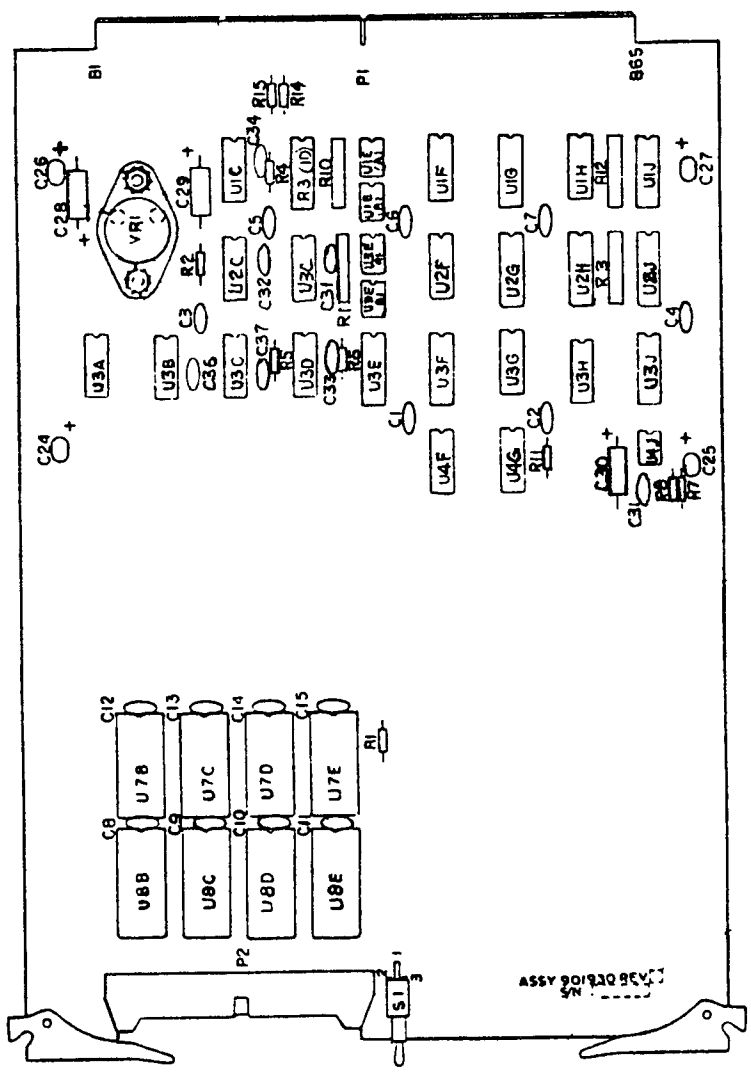
TABULATION CHART

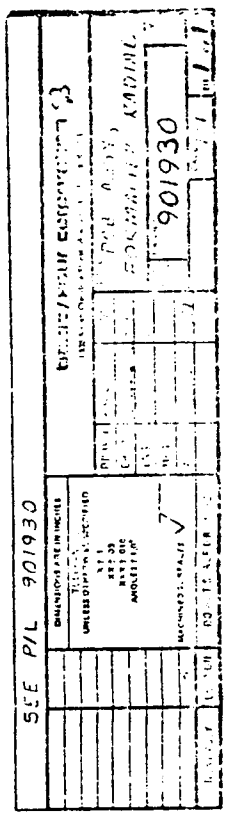
SEE P/L 901930

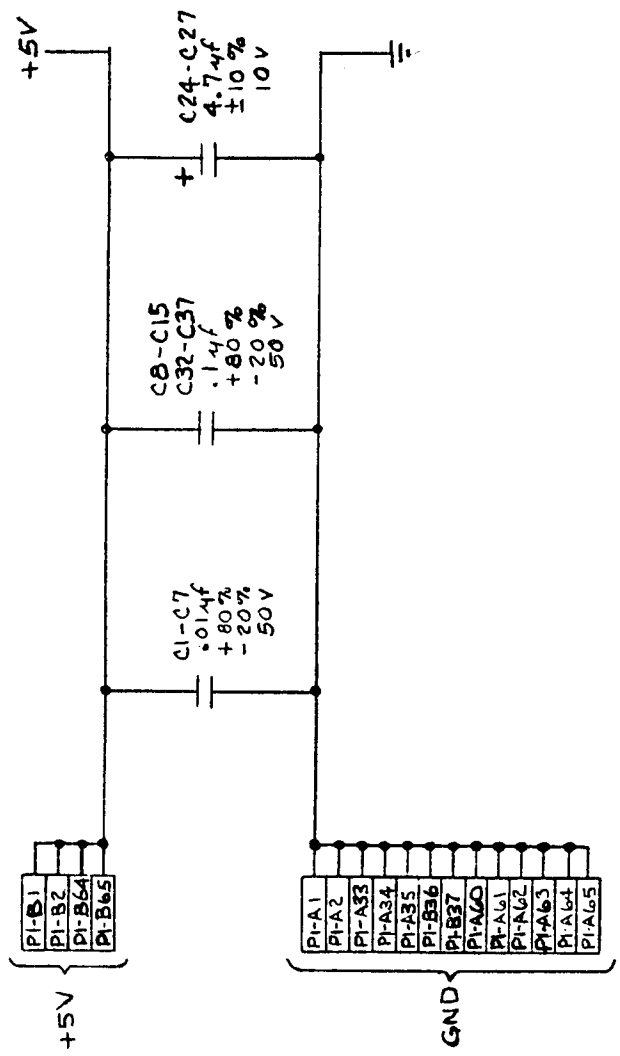
BASIC / FOUR CORPORATION

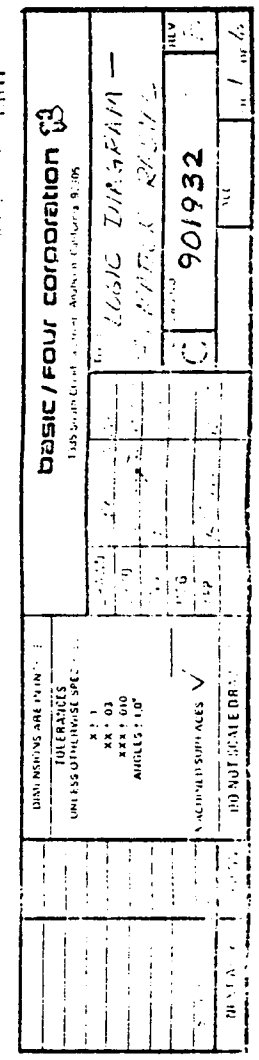
PCB Assy, FORMATTER RADIAL

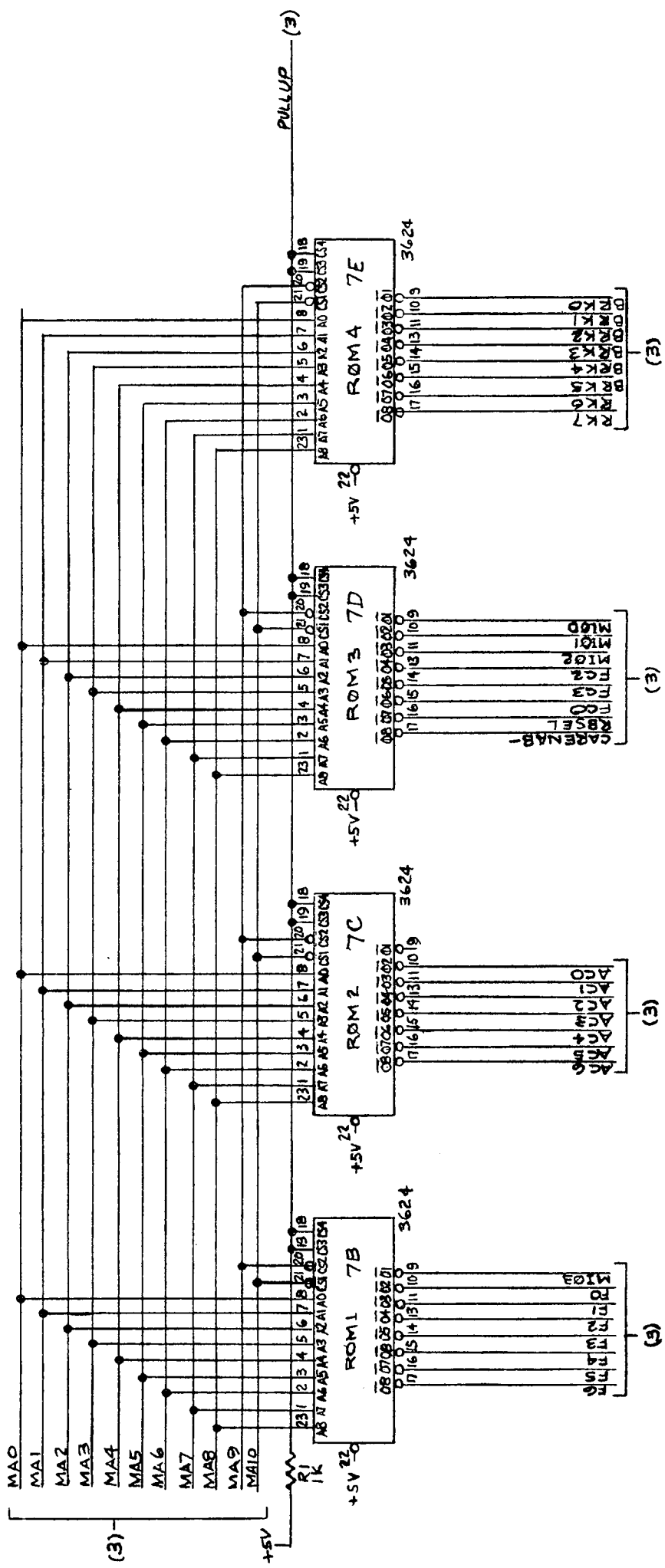
D 901930





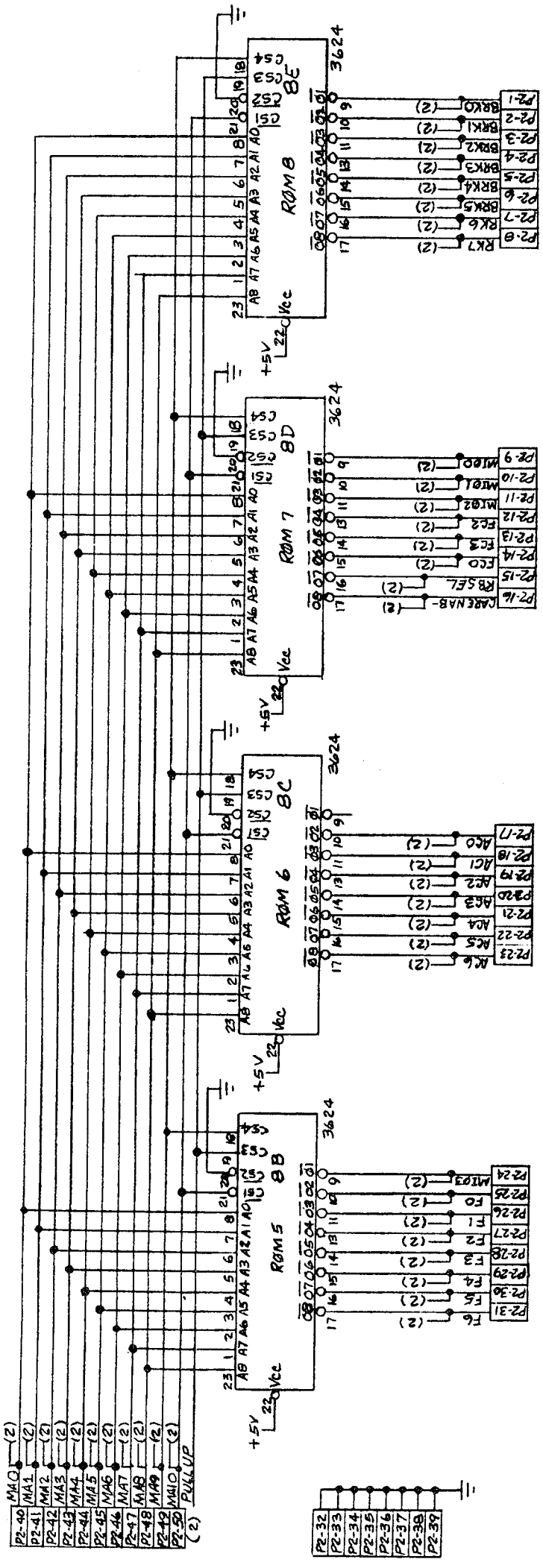






basic / four corporation

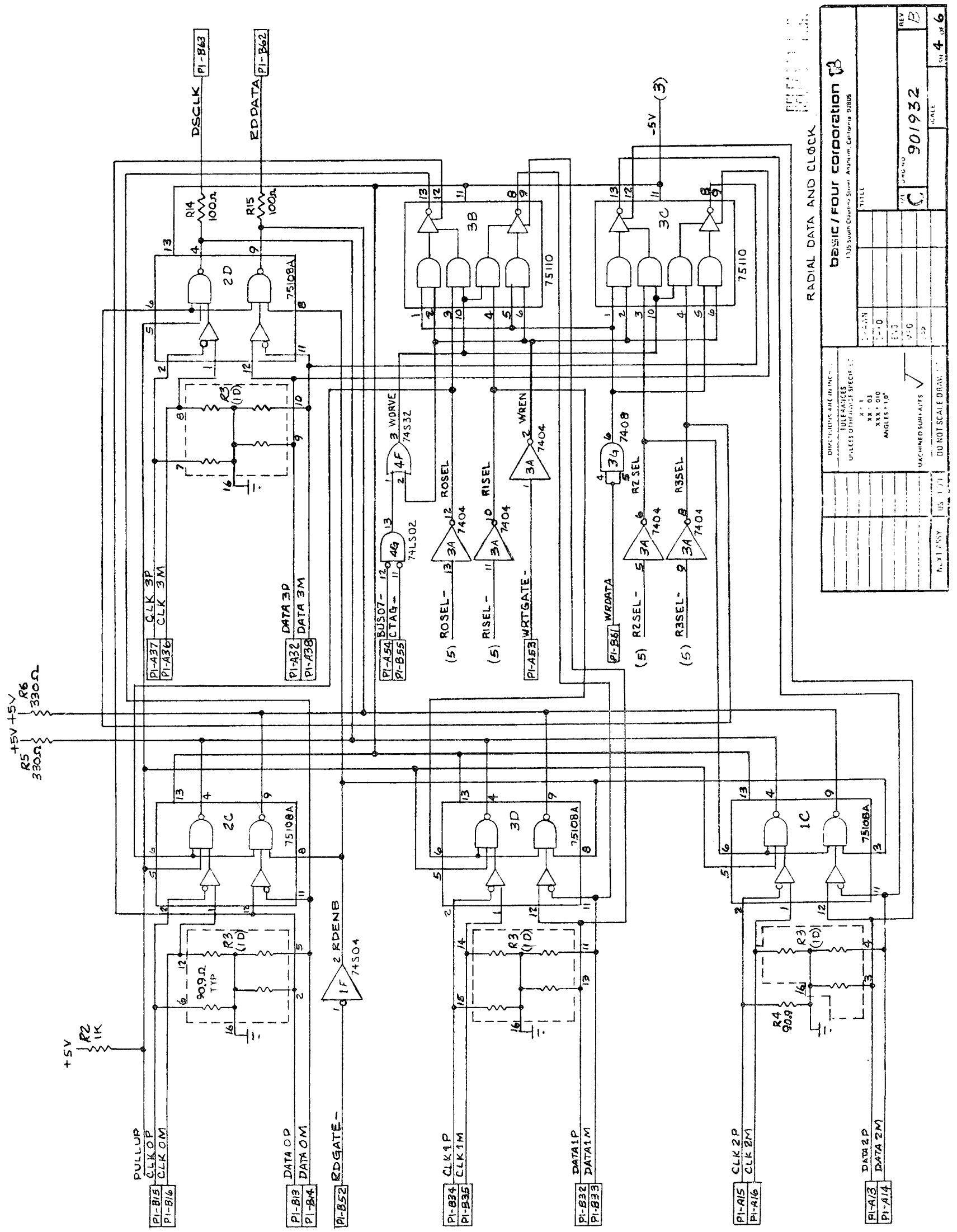
90/932

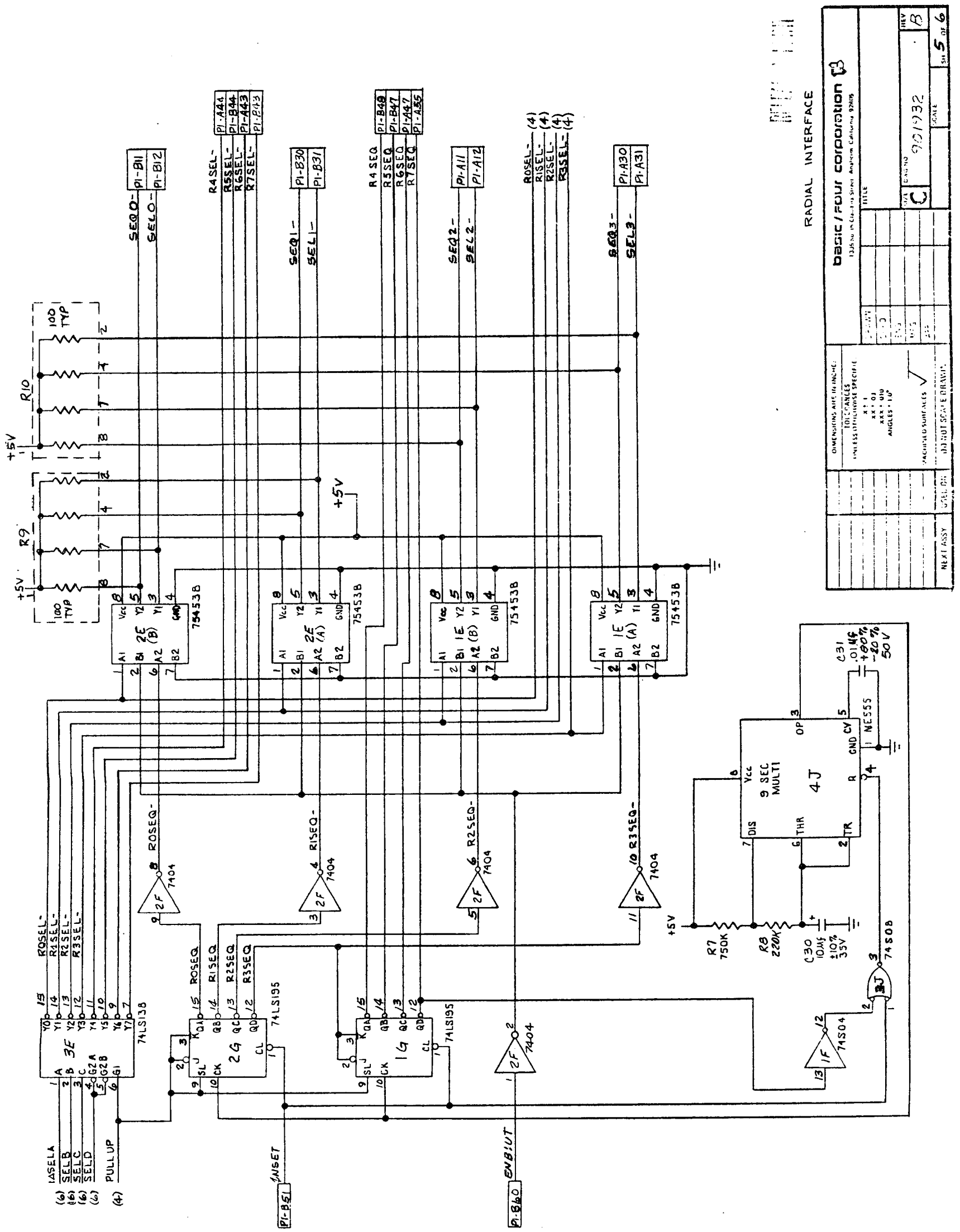


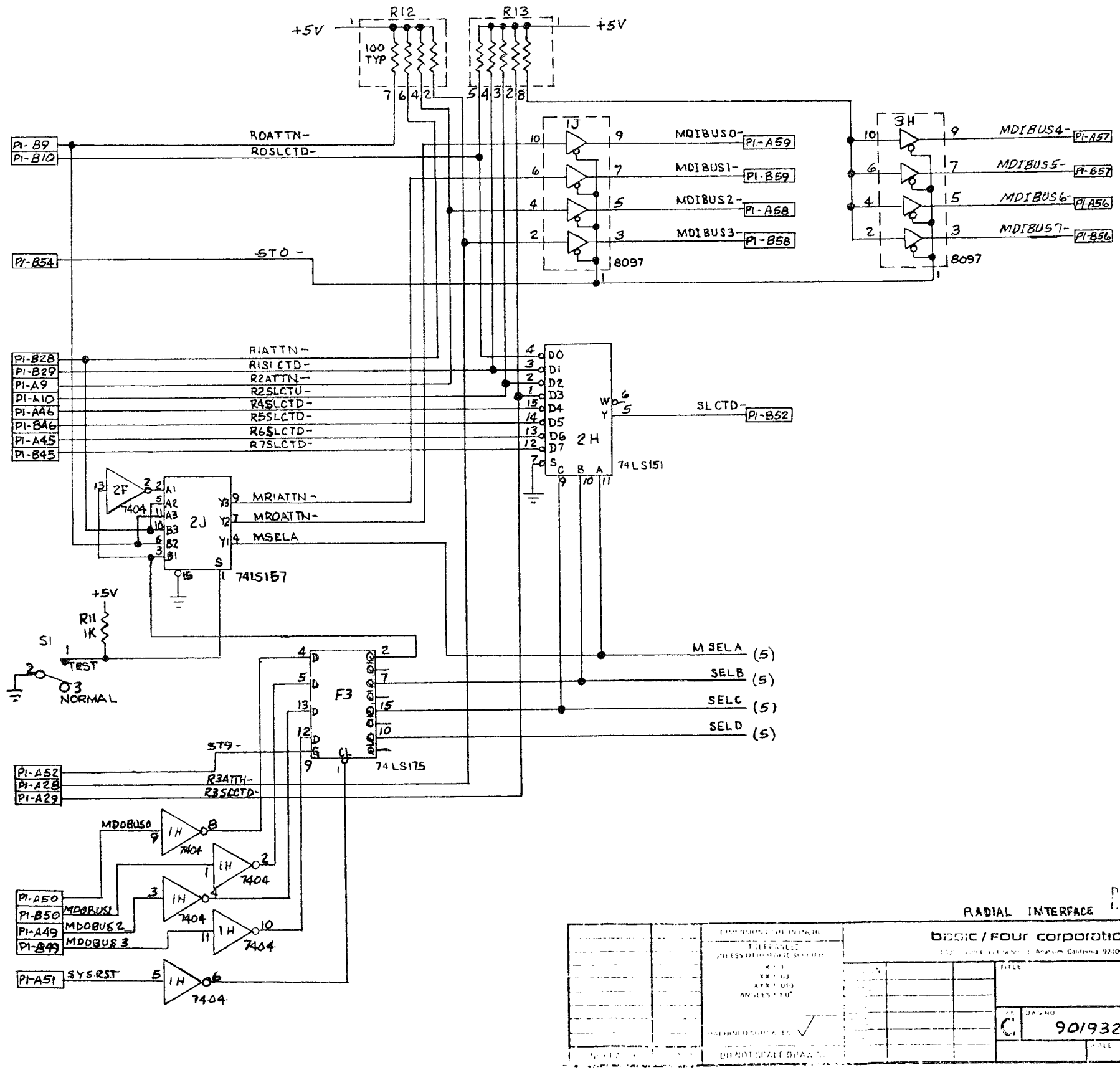
basic / four corporation

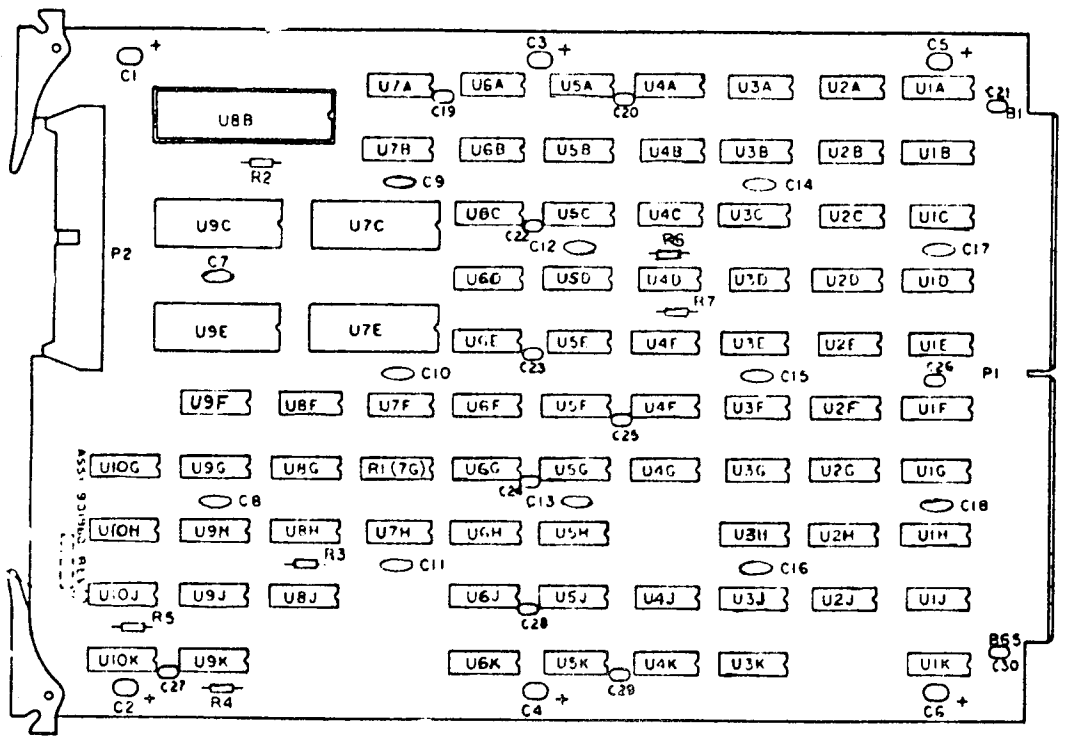
C 901932 REV E

SCALE SH 3 OF 6









PCB HISTORY	CORRESPONDING ASSY REV LETTER
901961-001	X3
902201 001	A
904056-001	B
904290-001	C

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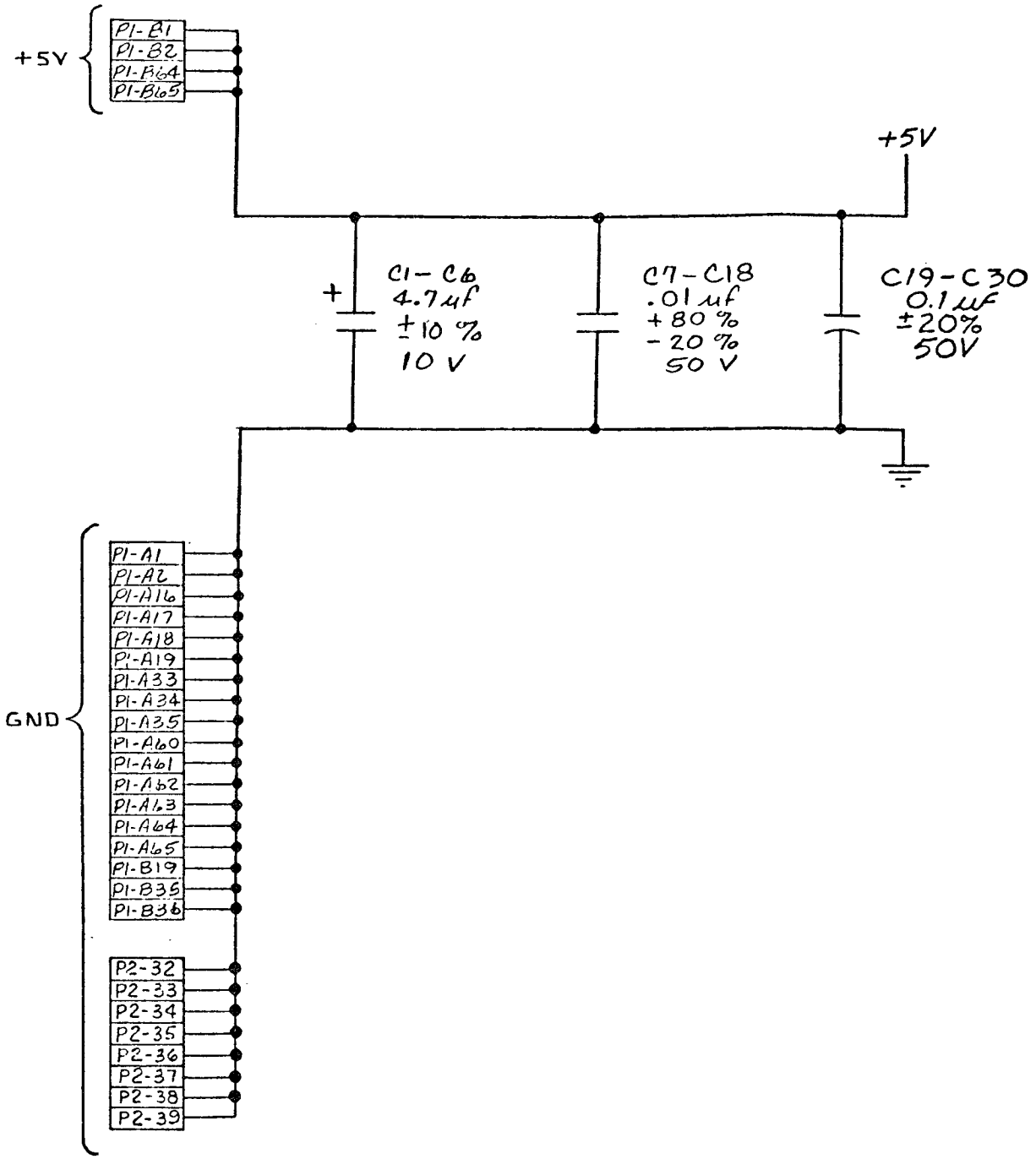
SEE P/L 901960

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 XX ± .03 XXX ± .010 ANGLES ± 1/2° MACHINED SURFACES √	basic / four corporation DRAWN CHKD ENG MFG APP	TITLE PCB ASSY, FORMATTER PROCESSOR SIZE D DWG NO 901960 REV C1	
NEXT ASSY	USED ON	DO NOT SCALE DRAWING		SCALE 1:1	SHT 1 OF 1



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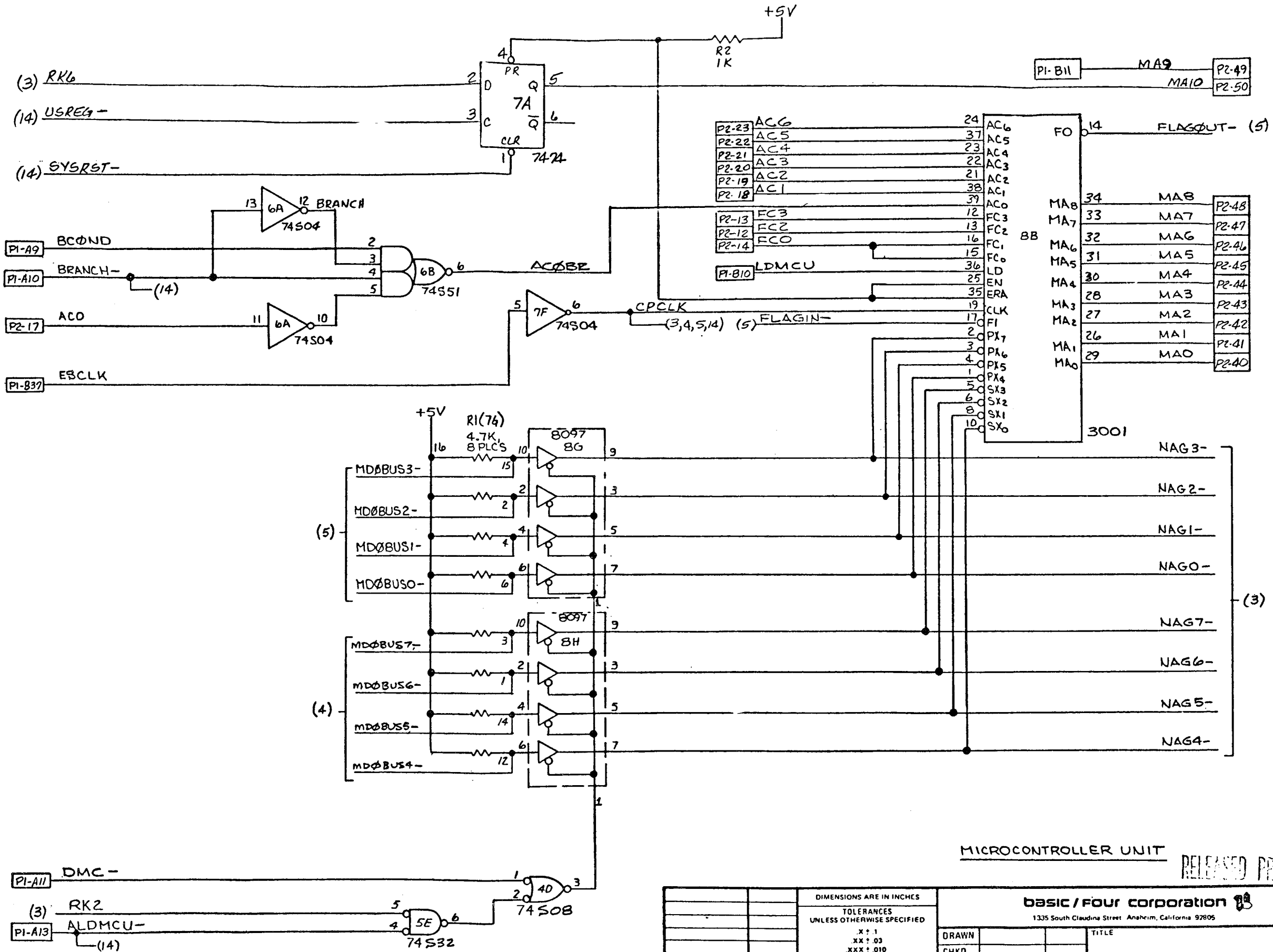
		DIMENSIONS ARE IN INCHES	basic/four corporation 1335 South Claudina Street Anaheim, California 92805				
		TOLERANCES UNLESS OTHERWISE SPECIFIED X ± .1 XX ± .03 XXX ± .010 ANGLES ± 1.0°	DRAWN	E. JAGGERS	11-4-76	TITLE: LOGIC DIAGRAM – FORMATTER PROCESSOR	
			CHKD		12-16-76		
			ENG		12-17-76	SIZE C DWG NO 901962	REV D
901960		MACHINED SURFACES √	MFG				
			APP		12-20-76		
NEXT ASSY	USED ON	DO NOT SCALE DRAWING				SCALE —	SH 1 OF 1



MICROCONTROLLER UNIT

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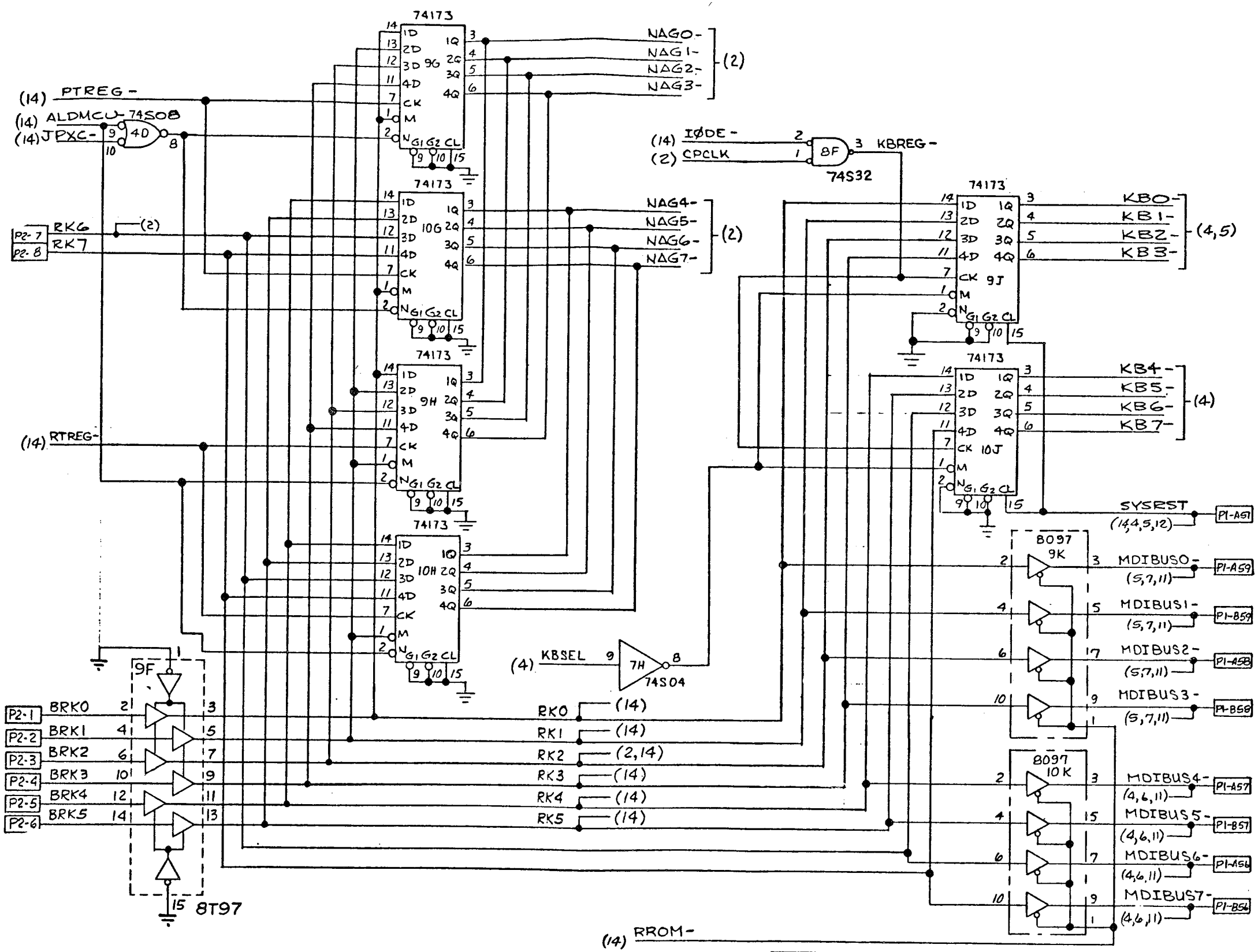
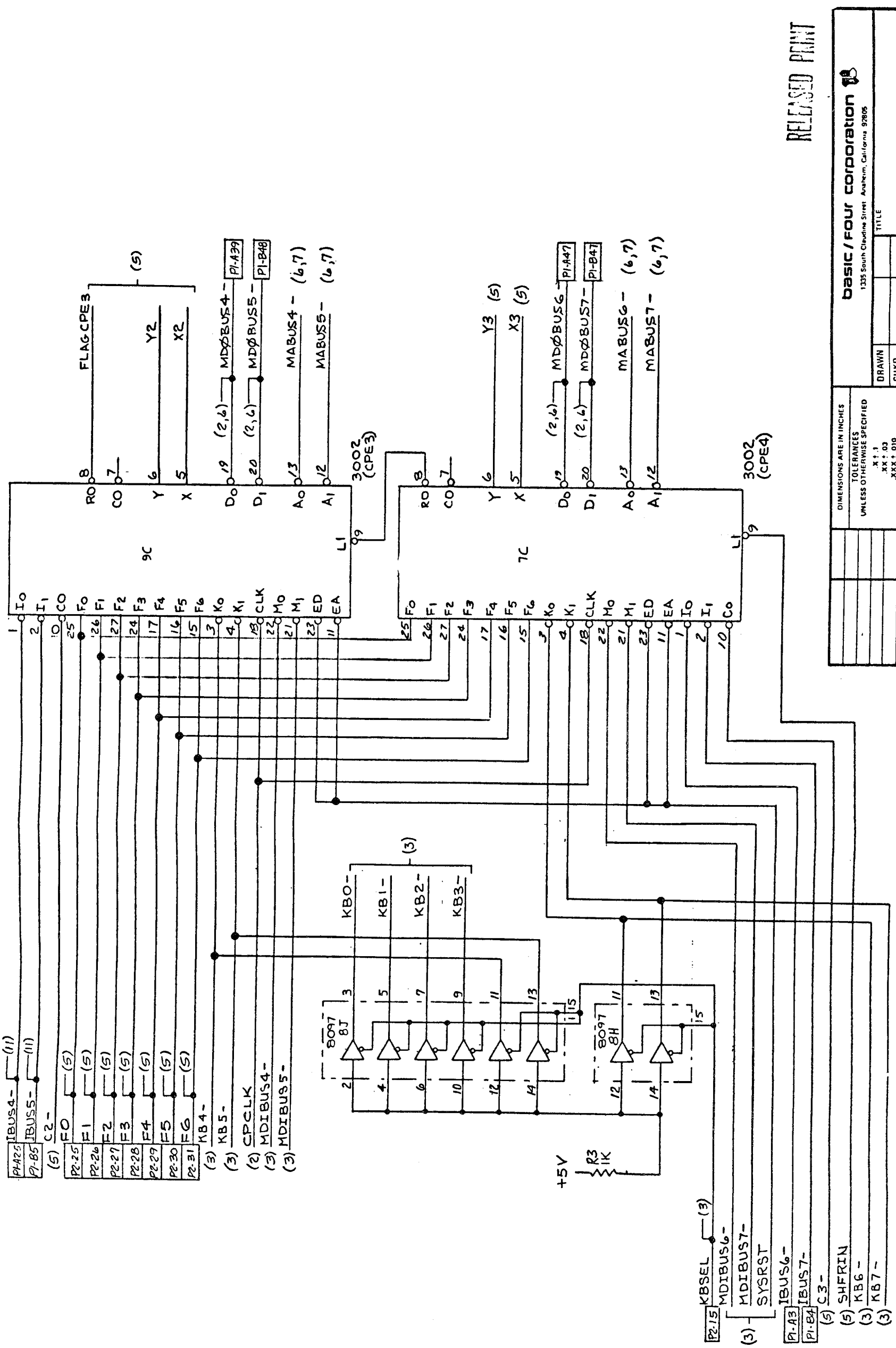
		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic / four corporation 1335 South Claudina Street Anaheim, California 92805		
			DRAWN	TITLE	
			CHKD		
			ENG		
			MFG	SIZE C DWG NO 901962	REV D
			APP		
NEXT ASSY	USED ON	DO NOT SCALE DRAWING		SCALE	SH 2 OF 14



RELEASED PRINT

		DIMENSIONS ARE IN INCHES	basic / four corporation	
		TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0°	1335 South Claudina Street Anaheim, California 92805	
			DRAWN	TITLE
			CHKD	
			ENG	
		MACHINED SURFACES √	MFG	SIZE C DWG NO 901962 REV D
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	APP	SCALE SH 3 OF 14



RELEASED PRINT

basic/four corporation
1335 South Claudina Street Anaheim, California 92805

DIMENSIONS ARE IN INCHES
TOLERANCES
UNLESS OTHERWISE SPECIFIED
X ± .1
.XX ± .03
.XXX ± .010
ANGLES ± 1.0°
MACHINED SURFACES

DRAWN
CHKD
ENG
MFG
APP

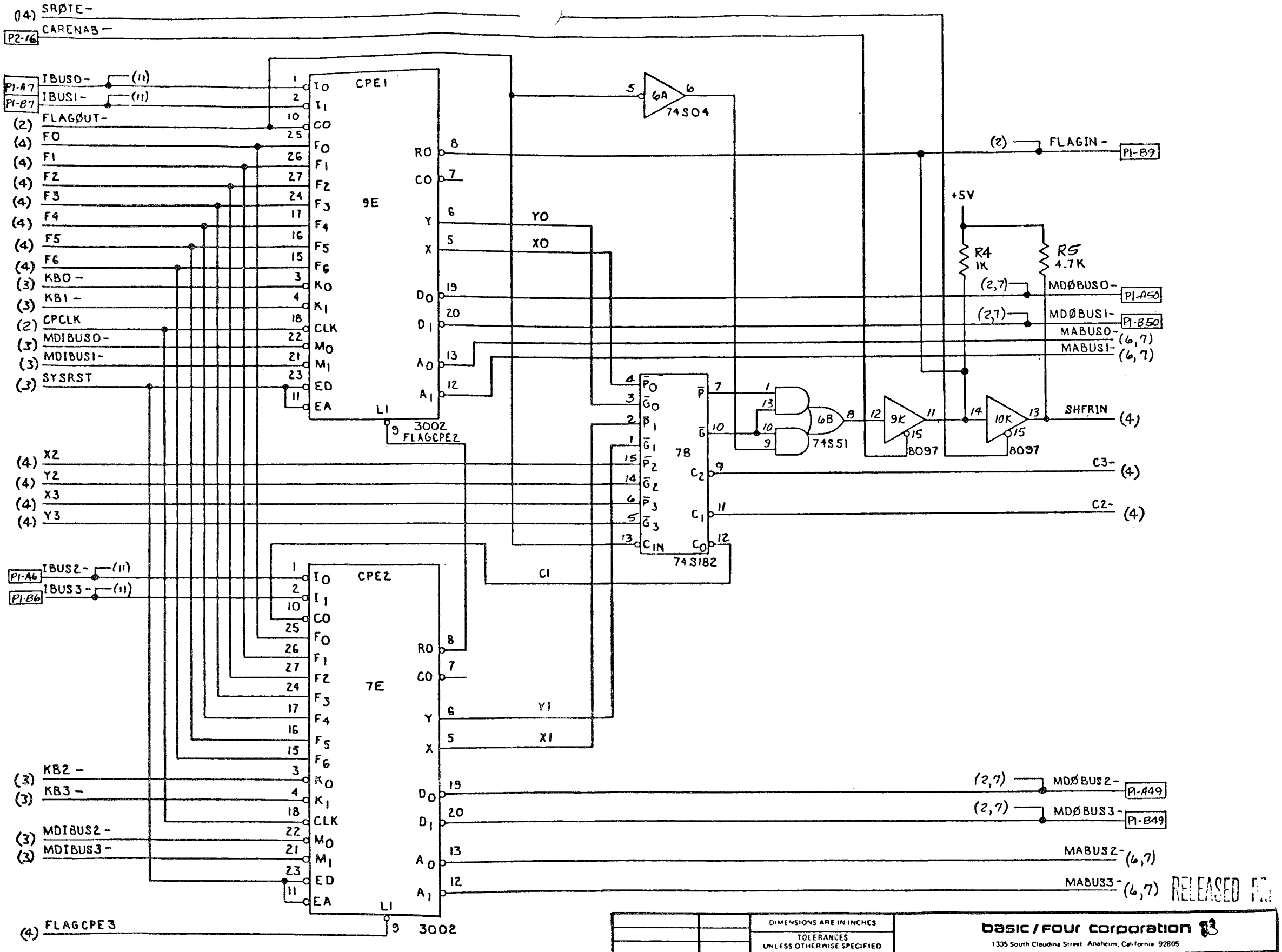
TITLE

SIZE C DWG NO 901962 REV D

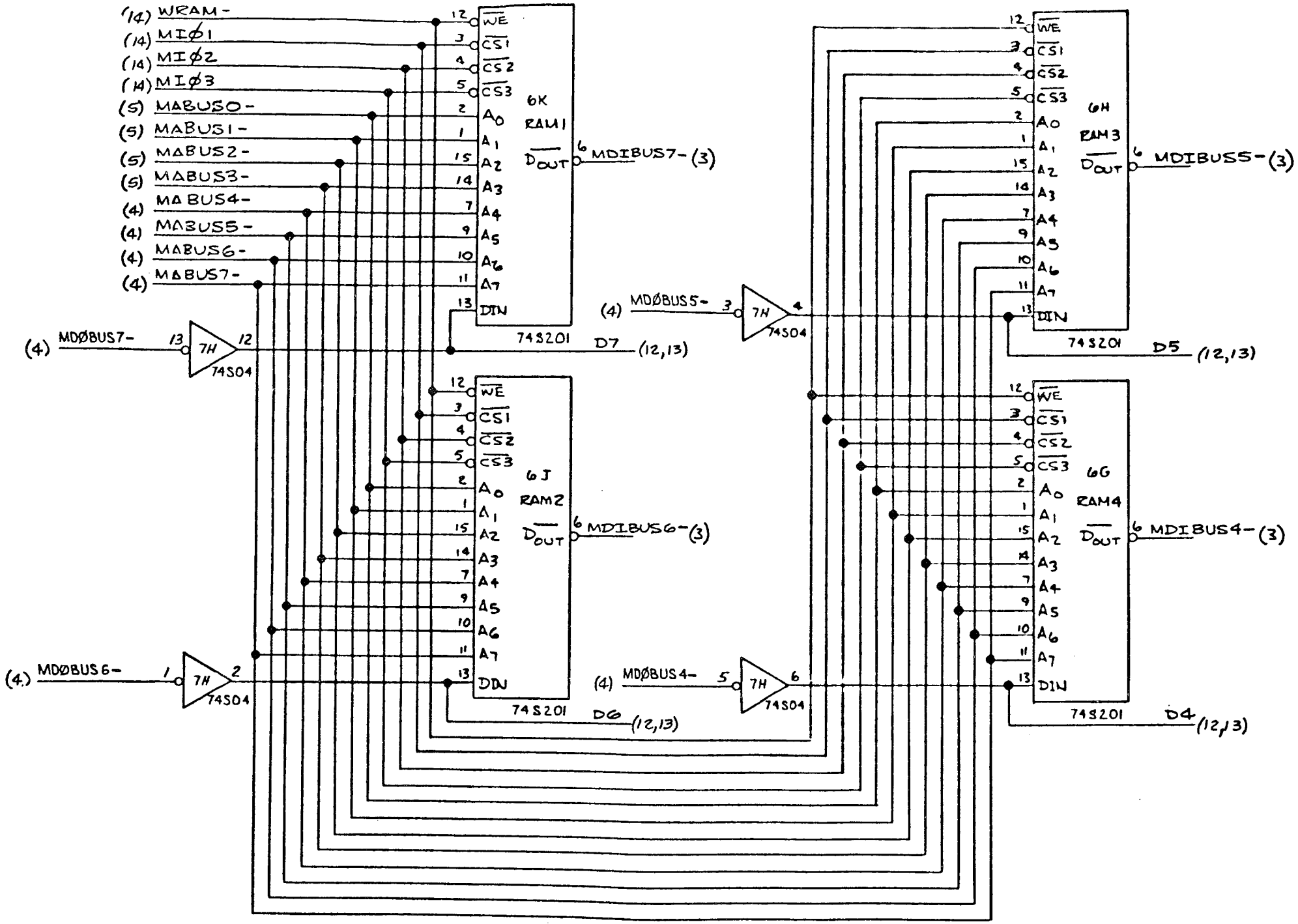
SCALE

SH 4 OF 14

NEXT ASSY | USED ON | DO NOT SCALE DRAWING



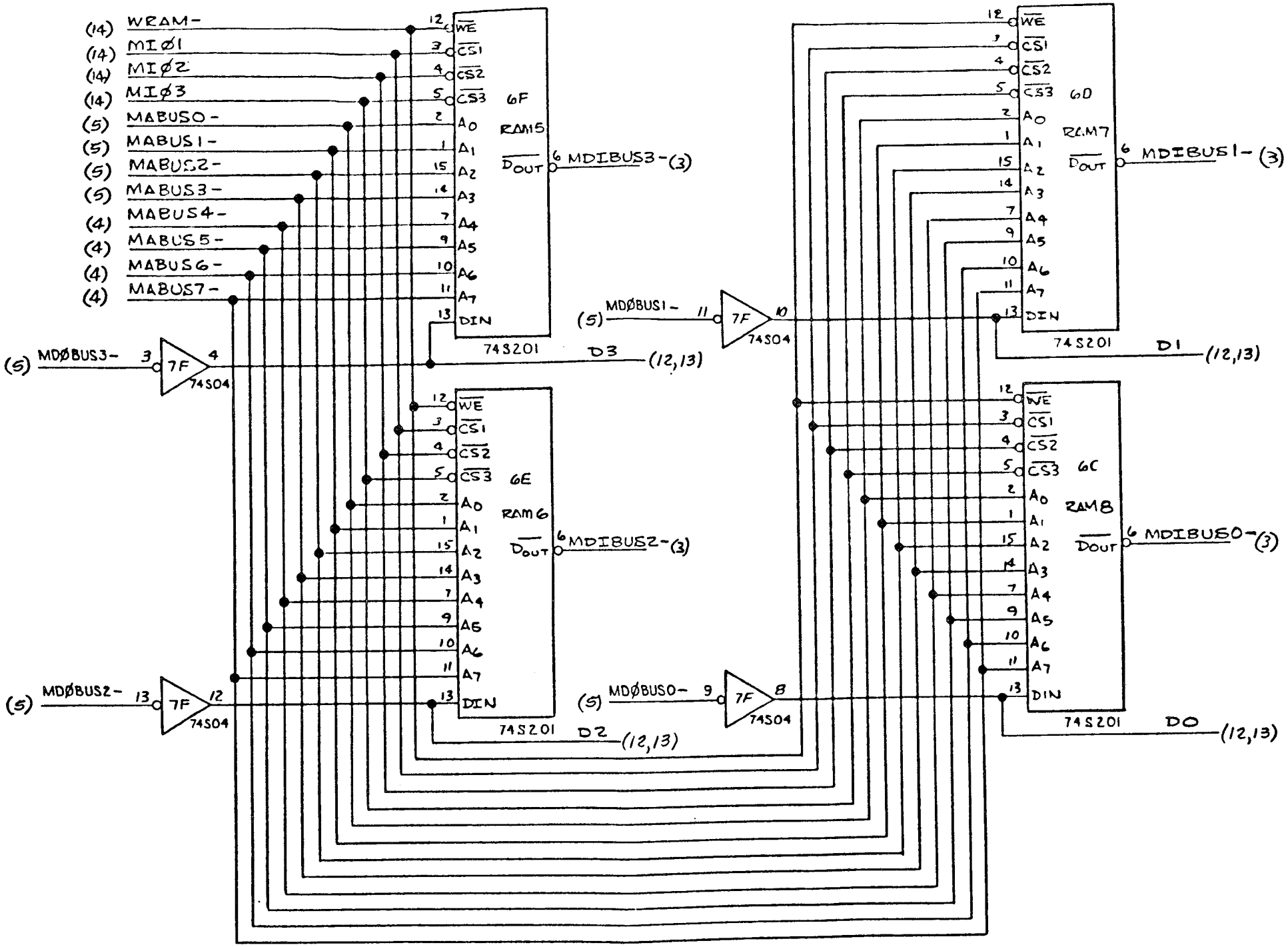
		DIMENSIONS ARE IN INCHES	basic / four corporation
		TOLERANCES UNLESS OTHERWISE SPECIFIED X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0°	1335 South Claudina Street Anaheim, California 92805
		MACHINED SURFACES √	DRAWN / CHKD / ENG / MFG / APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	TITLE SIZE C · DWG NO 901962 · REV D SCALE · SH 5 OF 14



HI SPEED RAM MEMORY (1)

RELEASED PRINT

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± .1 XX ± .03 XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic/four corporation 1335 South Claudina Street Anaheim, California 92805
			DRAWN / CHKD / ENG / MFG / APP
			TITLE
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	SIZE C · DWG NO 901962 · REV D · SCALE · SH 6 OF 14



HI SPEED RAM MEMORY (2)

RELEASED [illegible]

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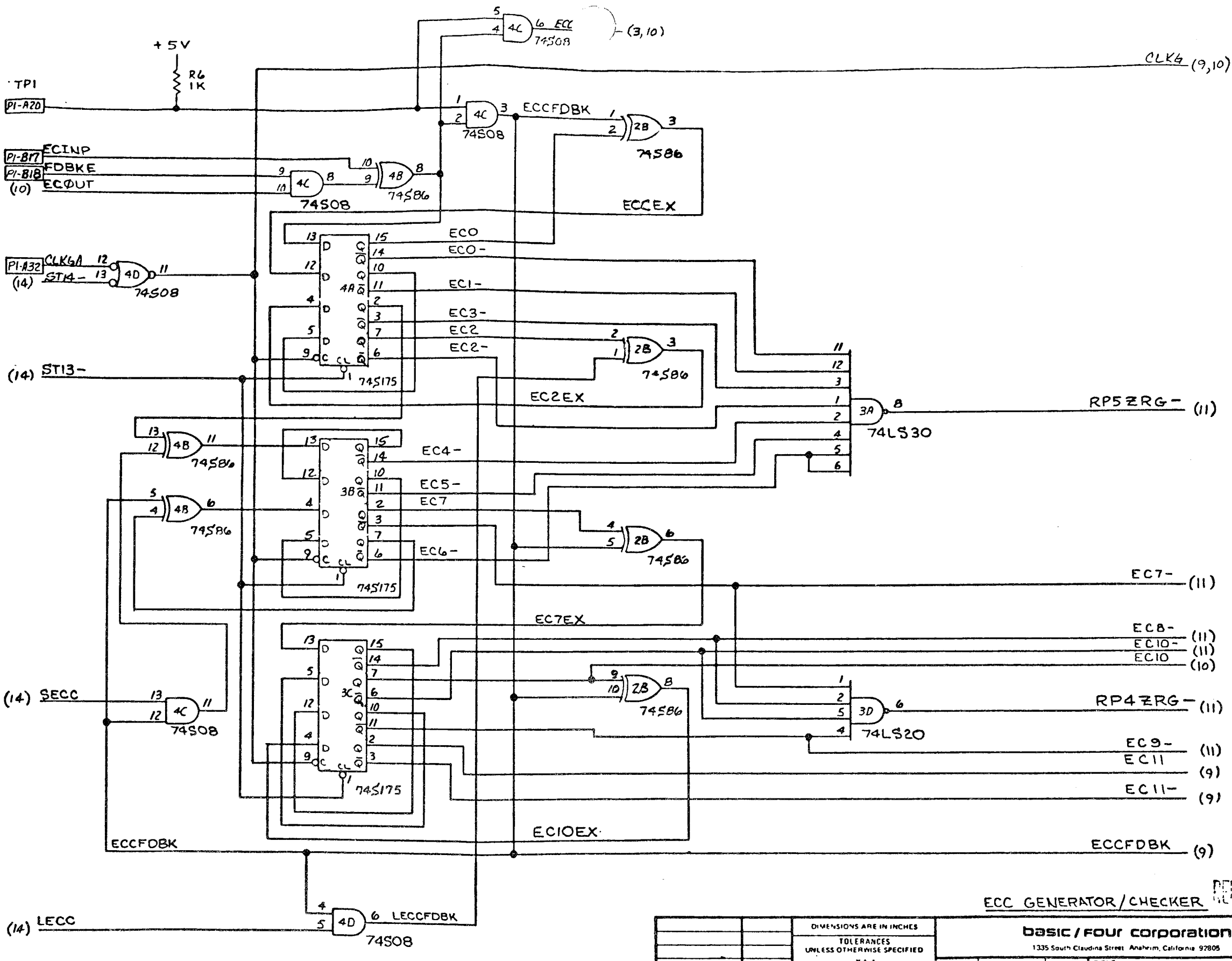
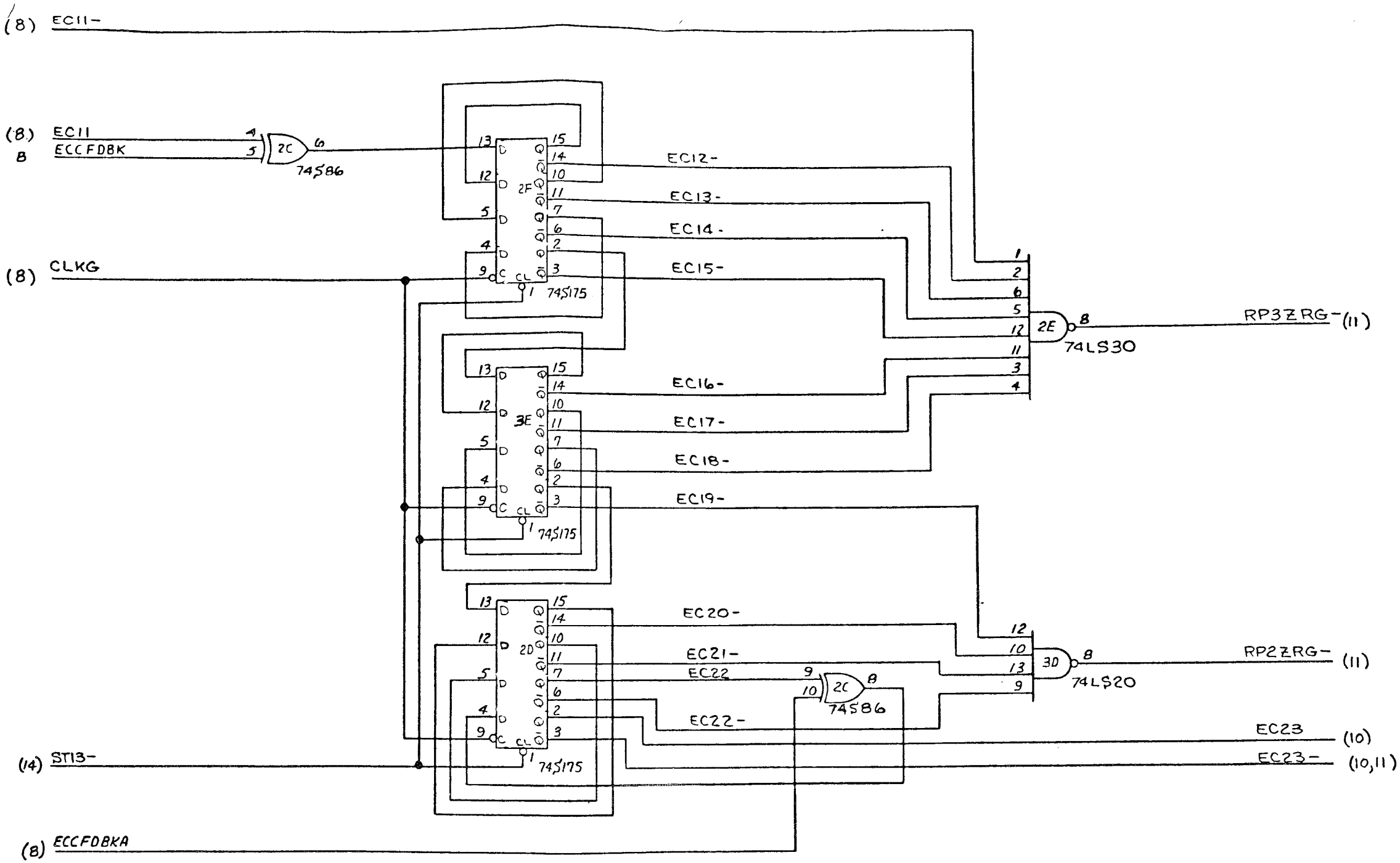
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	DRAWN / CHKD / ENG / MFG / APP TITLE SIZE C · DWG NO 901962 · REV D SCALE · SH 7 OF 14



ECC GENERATOR/CHECKER

RELEASED P...

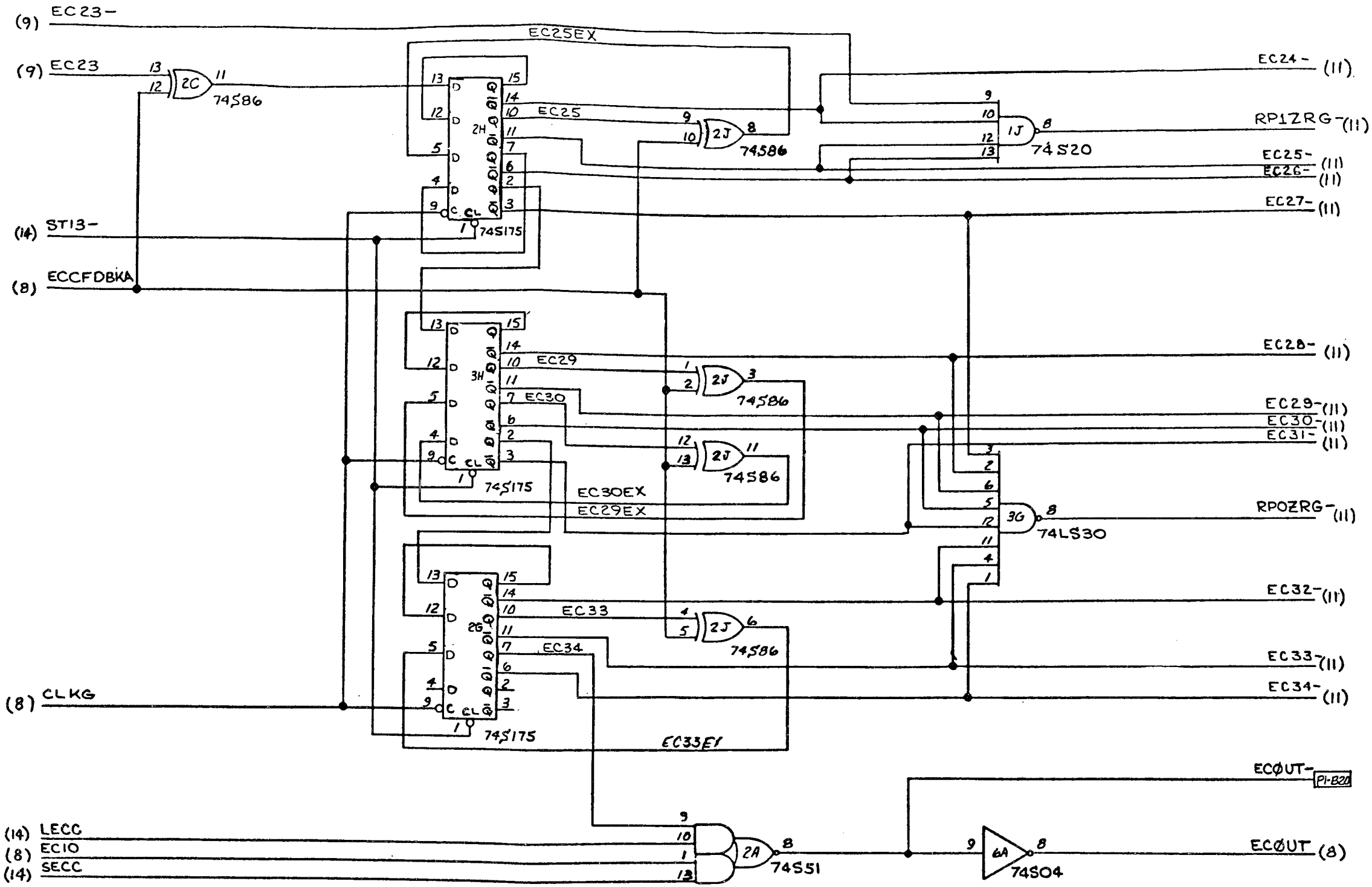
		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 XX ± 03 XXX ± 010 ANGLES ± 1.0° MACHINED SURFACES √	basic / four corporation 1335 South Claudina Street Anaheim, California 92805	
			DRAWN	TITLE
			CHKD	
			ENG	
			MFG	SIZE C DWG NO 901962 REV D
			APP	
NEXT ASSY	USED ON	DO NOT SCALE DRAWING		SCALE SH 8 OF 14



RELEASED PRINT

ECC GENERATOR/CHECKER

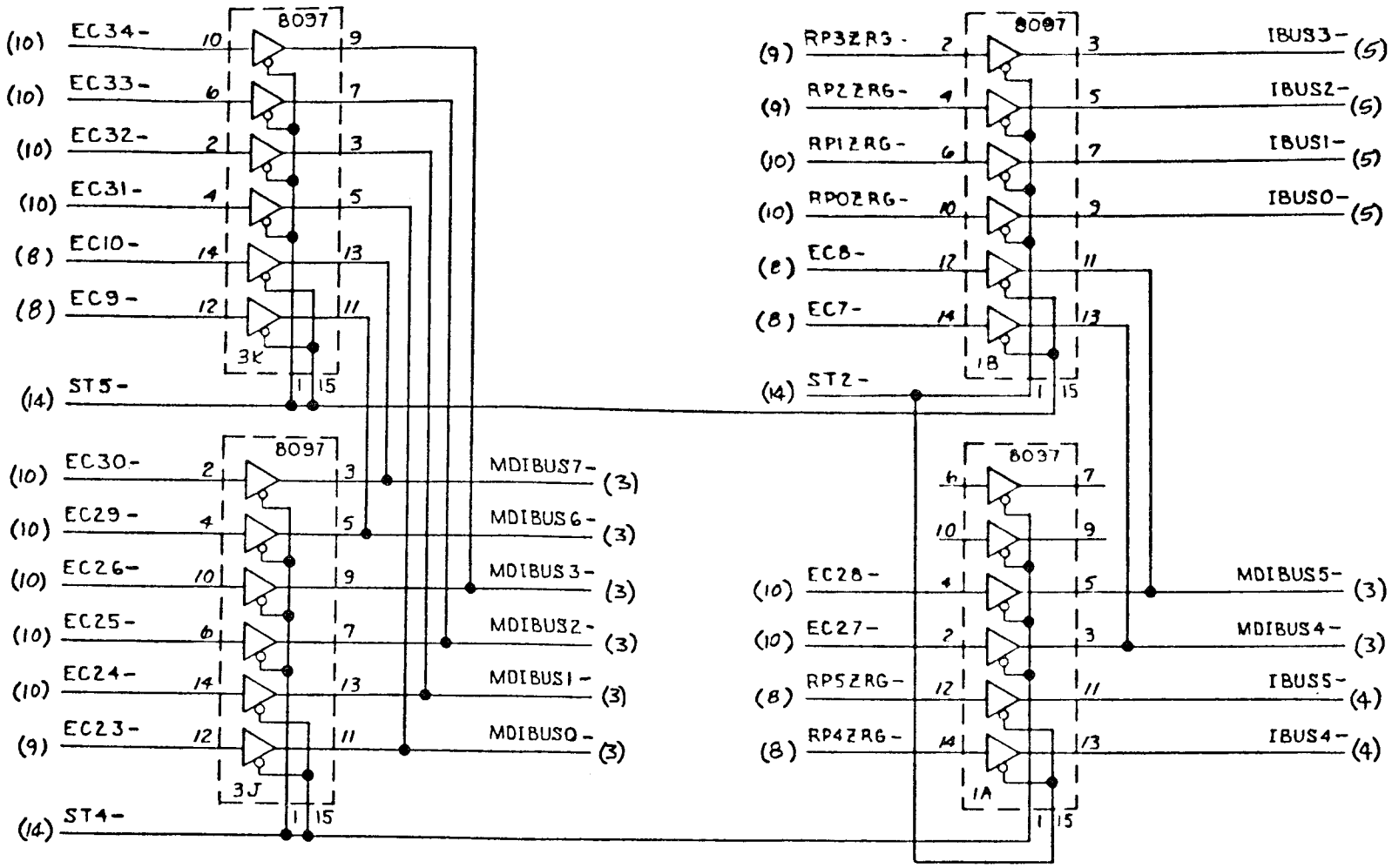
		DIMENSIONS ARE IN INCHES	basic/four corporation			
		TOLERANCES UNLESS OTHERWISE SPECIFIED	1335 South Claudina Street Anaheim, California 92805			
		x ± 1 xx ± 03 xxx ± 010 ANGLES ± 1.0°	DRAWN			TITLE
			CHKD			
			ENG			SIZE C DWG NO 901962 REV D
		MACHINED SURFACES √	MFG			
			APP			SCALE SH 9 OF 14
NEXT ASSY	USED ON	DO NOT SCALE DRAWING				



ECC GENERATOR/CHECKER

RELEASED PRINT

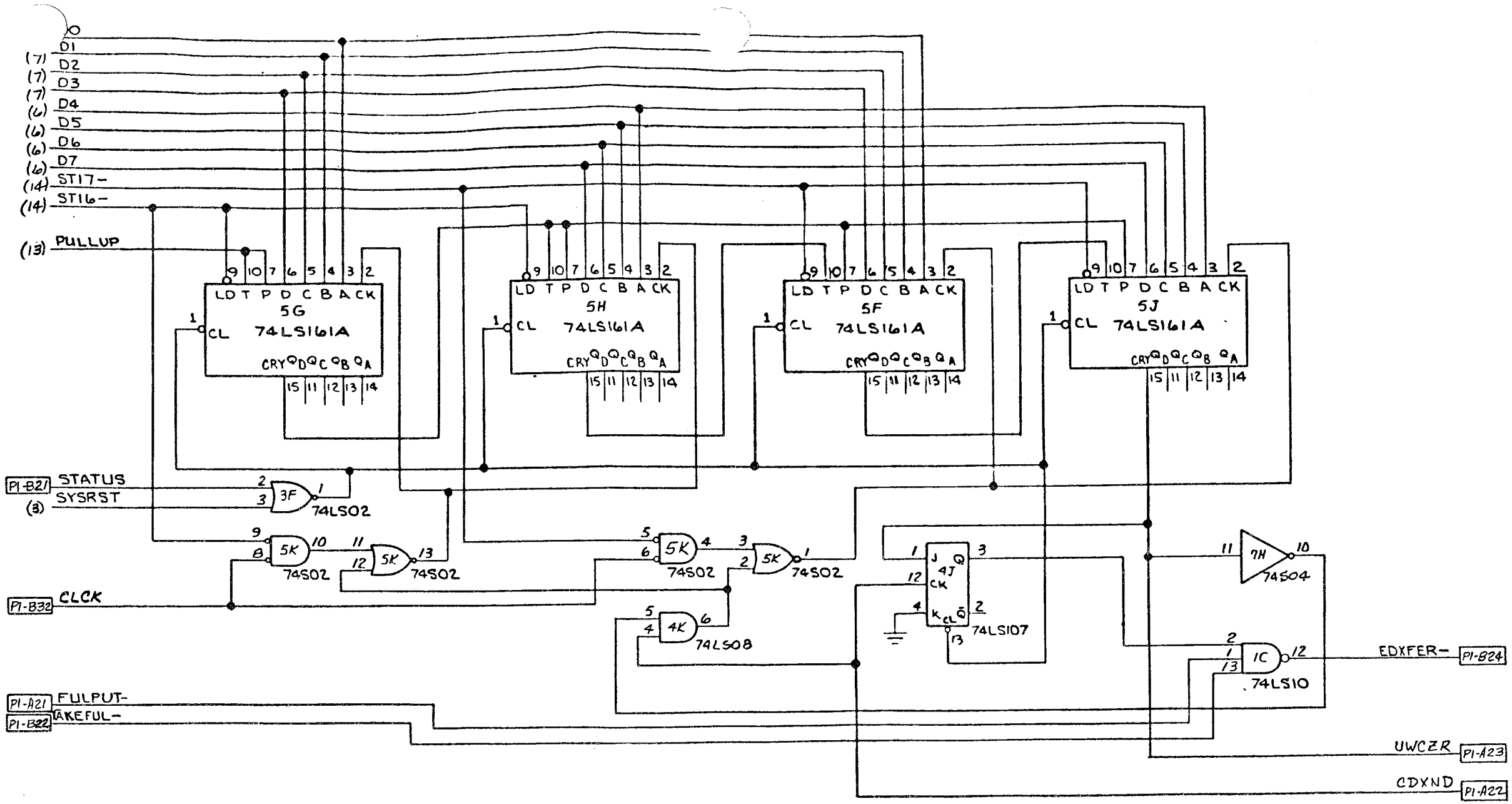
		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 .XX ± 03 XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic/four corporation 1335 South Claudina Street Anaheim, California 92805
			DRAWN / CHKD / ENG / MFG / APP
			TITLE
			SIZE C · DWG NO 901962 · REV D
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	SCALE · SH 13 OF 14



ECC OUTPUT TO MP

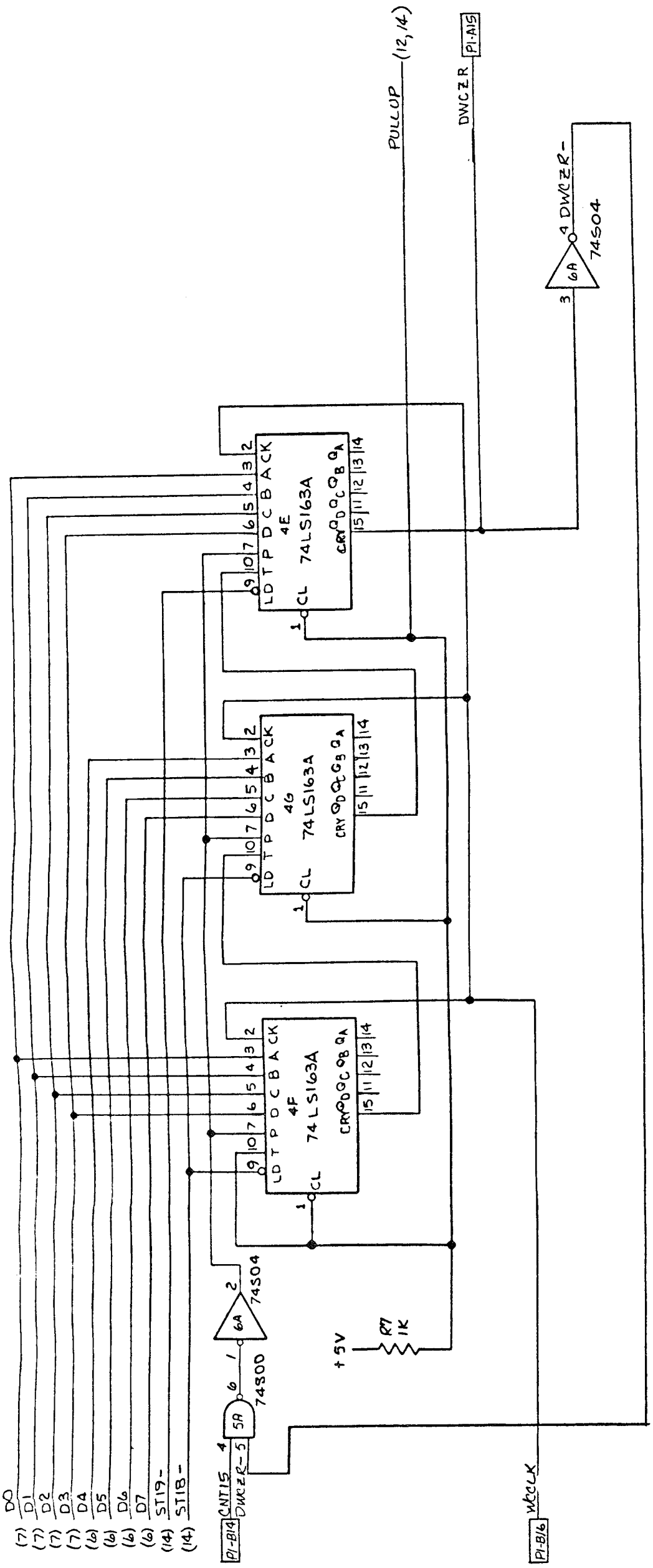
RELEASED PRINT

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 XX ± 03 XXX ± 010 ANGLES ± 1.0° MACHINED SURFACES √	basic/four corporation 1335 South Claudina Street Anaheim, California 92805		
			DRAWN	TITLE	
			CHKD		
			ENG		
			MFG	SIZE C DWG NO 901962	REV D
			APP		
NEXT ASSY	USED ON	DO NOT SCALE DRAWING		SCALE	SH 11 OF 14



RELEASED PRINT

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED x ± 1 xx ± 03 xxx ± 010 ANGLES ± 1.0° MACHINED SURFACES √	basic / four corporation 1335 South Claudina Street Anaheim, California 92805
			DRAWN / CHKD / ENG / MFG / APP
			TITLE
			SIZE C · DWG NO 901962 · REV D
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	SCALE · SH 12 OF 14



basic/four corporation
1335 South Claudina Street Anaheim, California 92805

DIMENSIONS ARE IN INCHES
TOLERANCES
UNLESS OTHERWISE SPECIFIED
X ± 1
XX ± 03
XXX ± 010
ANGLES ± 1.0°
MACHINED SURFACES

DRAWN
CHKD
ENG
MFG
APP

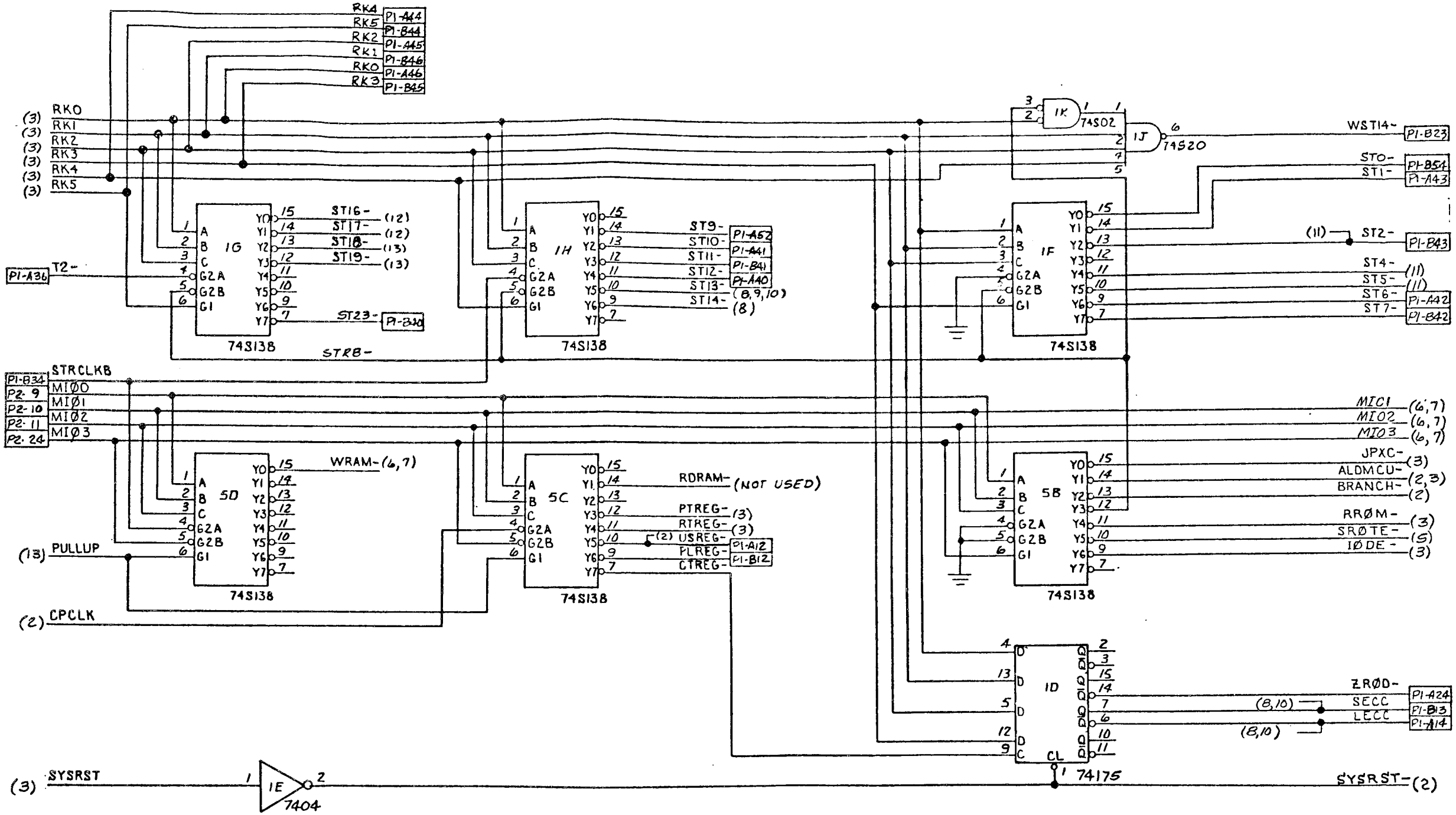
TITLE

SIZE C | DWG NO 901962 | REV D

SCALE

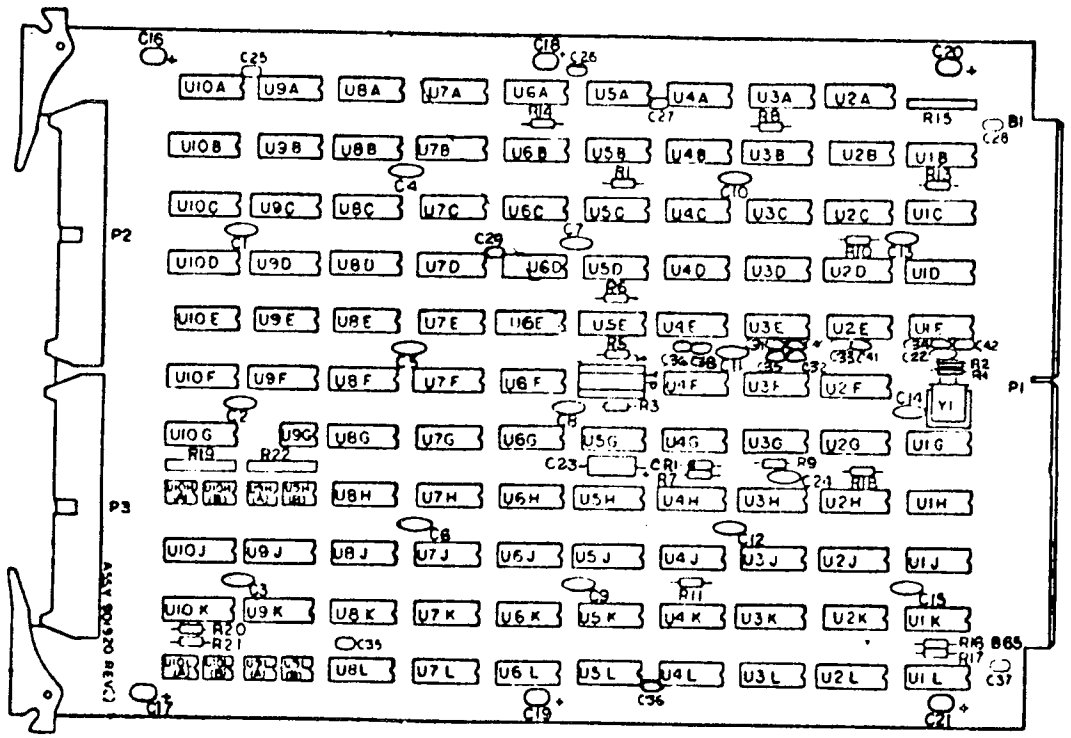
SH 13 OF 14

NEXT ASSY | USED ON | DO NOT SCALE DRAWING



RELEASED PRINT

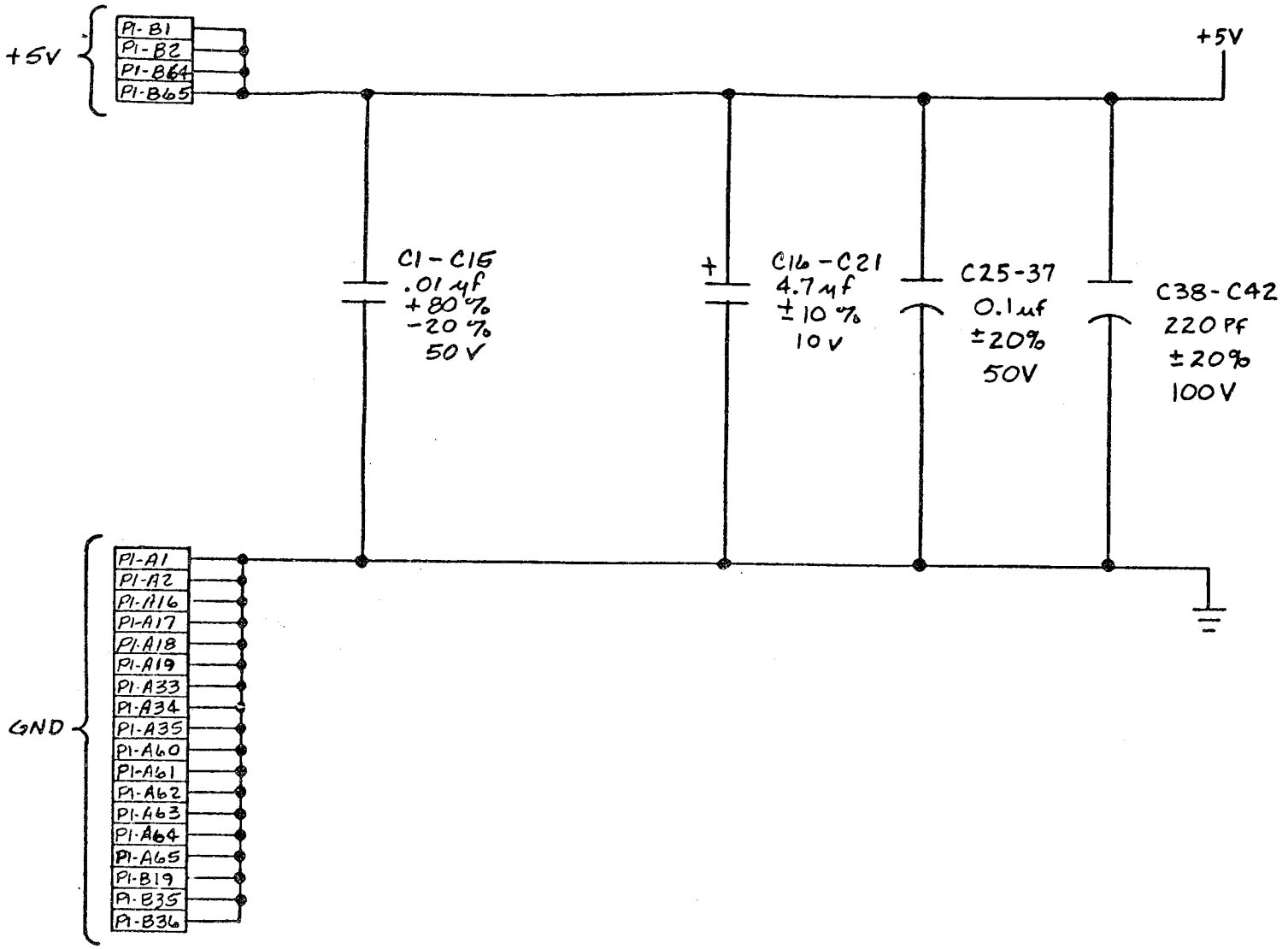
		DIMENSIONS ARE IN INCHES	basic / four corporation
		TOLERANCES UNLESS OTHERWISE SPECIFIED X ± .1 XX ± .03 XXX ± .010 ANGLES ± 1.0°	1335 South Claudina Street Anaheim, California 92805
		MACHINED SURFACES √	DRAWN / CHKD / ENG / MFG / APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	TITLE SIZE C · DWG NO 901962 · REV D SCALE · SH 14 OF 14



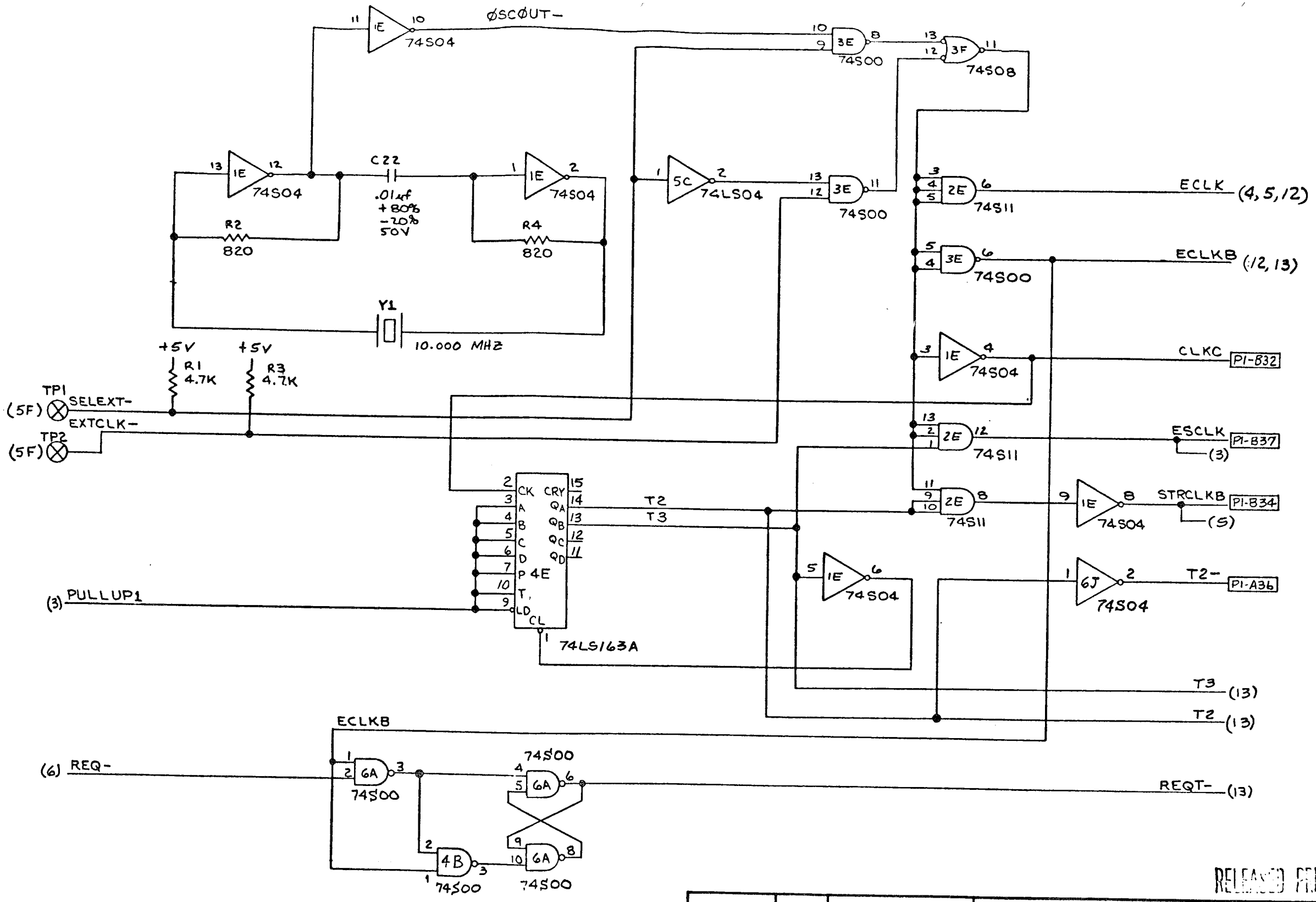
PCB HISTORY	CORRESPONDING ASSY REV. LTR
901921	X4
902181	A
904055	B

"REWORK PER ECN 5189"
B.F.C. PART NO. 901920

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED .XX ± .XXX ± ANGULAR ± MACHINED SURFACES	basic/four corporation		
			DRAWN		TITLE PCB ASSY, FORMATTER BUS
			CHKD		
			ENG		SIZE D DWG NO 901920 REV X4
			MFG		
			APP		
NEXT ASSY	USED ON	DO NOT SCALE DRAWING			SCALE 1:1 SHT 1 OF 1

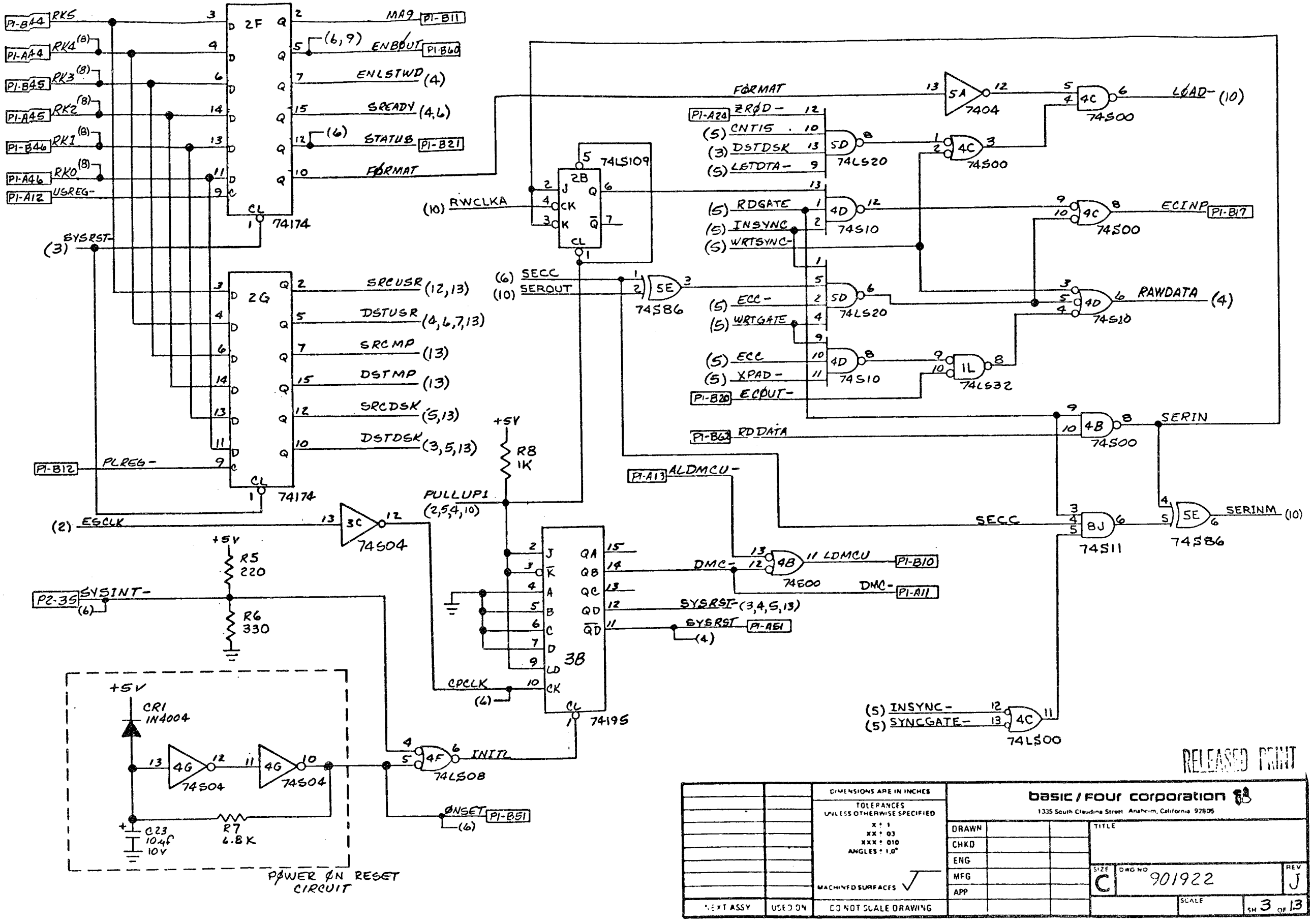


		DIMENSIONS ARE IN INCHES	basic/four corporation			
		TOLERANCES UNLESS OTHERWISE SPECIFIED	1335 South Claudina Street Anaheim, California 92805			
		.X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0°	DRAWN		11-17-76	TITLE LOGIC DIAGRAM — FORMATTER BUS
			CHKD		12-6-76	
			ENG		12-7-76	
		MACHINED SURFACES √	MFG			SIZE C DWG NO 901722 REV J
			APP		12-20-76	
NEXT ASSY	USED ON	DO NOT SCALE DRAWING				SCALE SH 1 OF 13



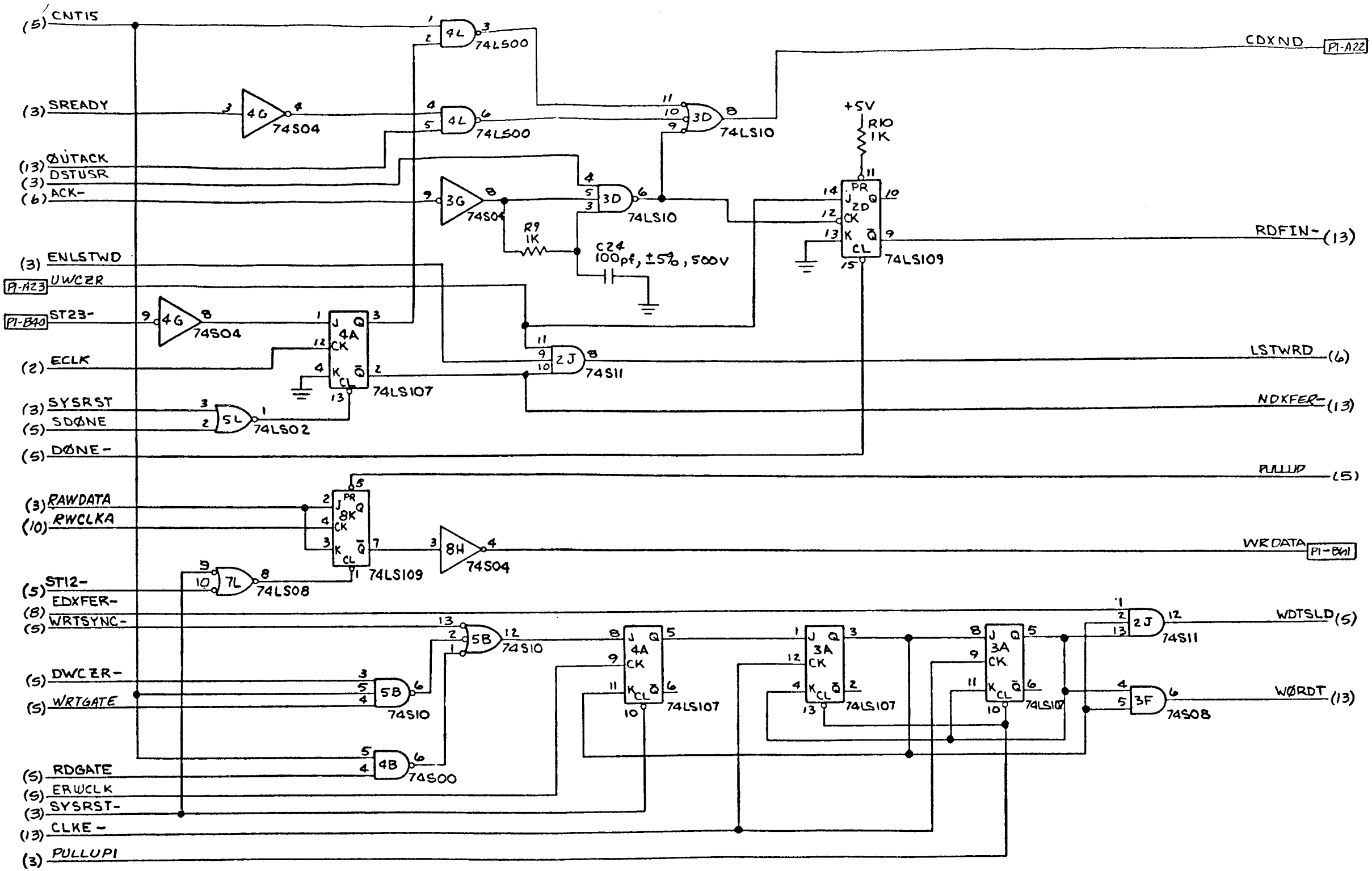
RELEASED PRINT

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 .XX ± 03 XXX ± 010 ANGLES ± 1.0° MACHINED SURFACES √	basic / four corporation 1335 South Claudina Street Anaheim, California 92805
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	DRAWN / CHKD / ENG / MFG / APP TITLE SIZE C · DWG NO 901922 · REV J SCALE · SH 2 OF 13



RELEASED PRINT

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 XX ± 03 XXX ± 010 ANGLES ± 1.0° MACHINED SURFACES √	basic / four corporation 1335 South Claudina Street Anaheim, California 92805			
			DRAWN			TITLE
			CHKD			
			ENG			SIZE C · DWG NO 901922 · REV J
			MFG			
			APP			
NEXT ASSY	USED ON	DO NOT SCALE DRAWING				SCALE · SH 3 OF 13



RELEASED PRINT

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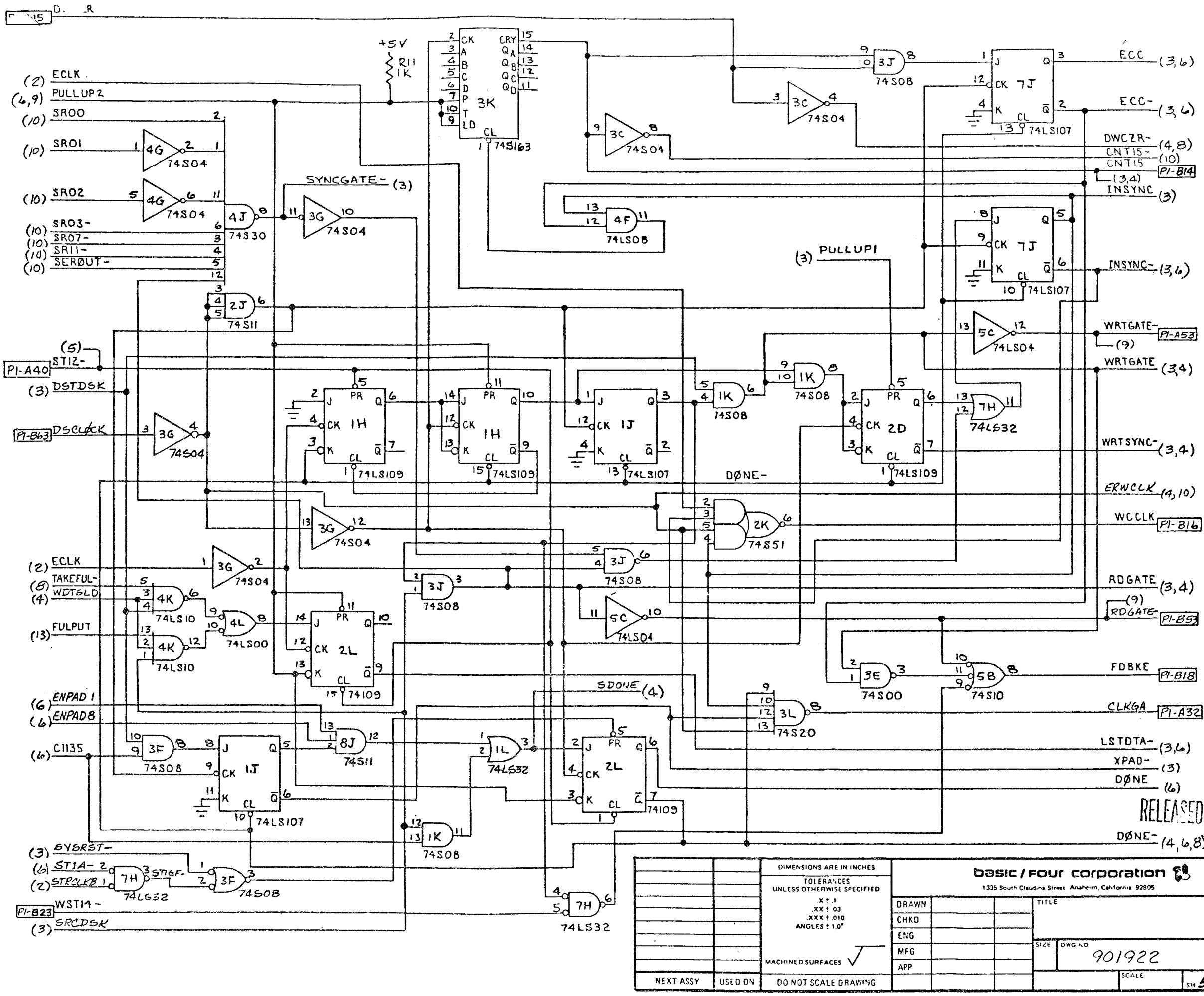
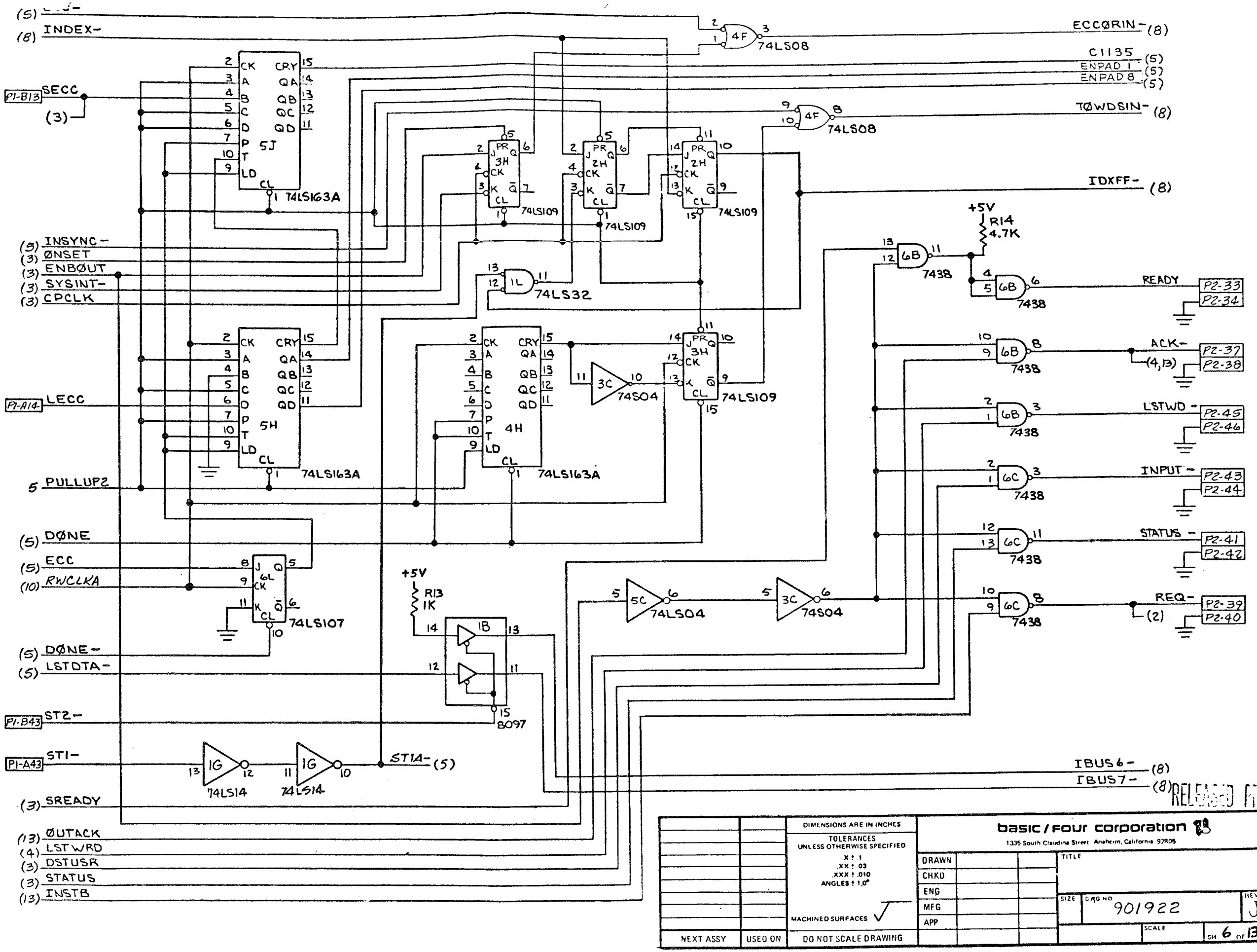
			DRAWN CHKD ENG MFG APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	TITLE SIZE DWG NO 901922 REV J SCALE SH 4 OF 13

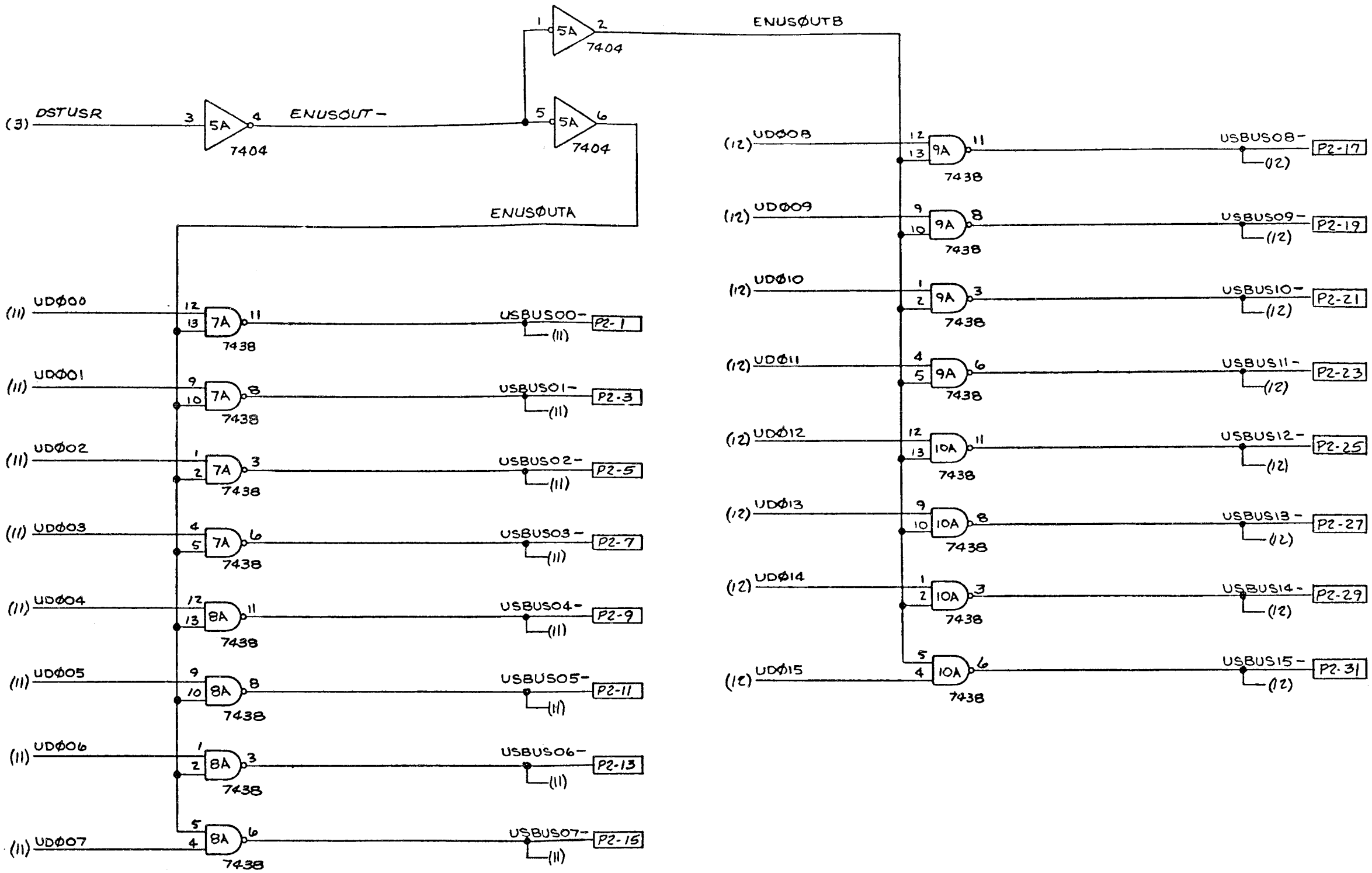
Reference Only - Will Not Be Maintained





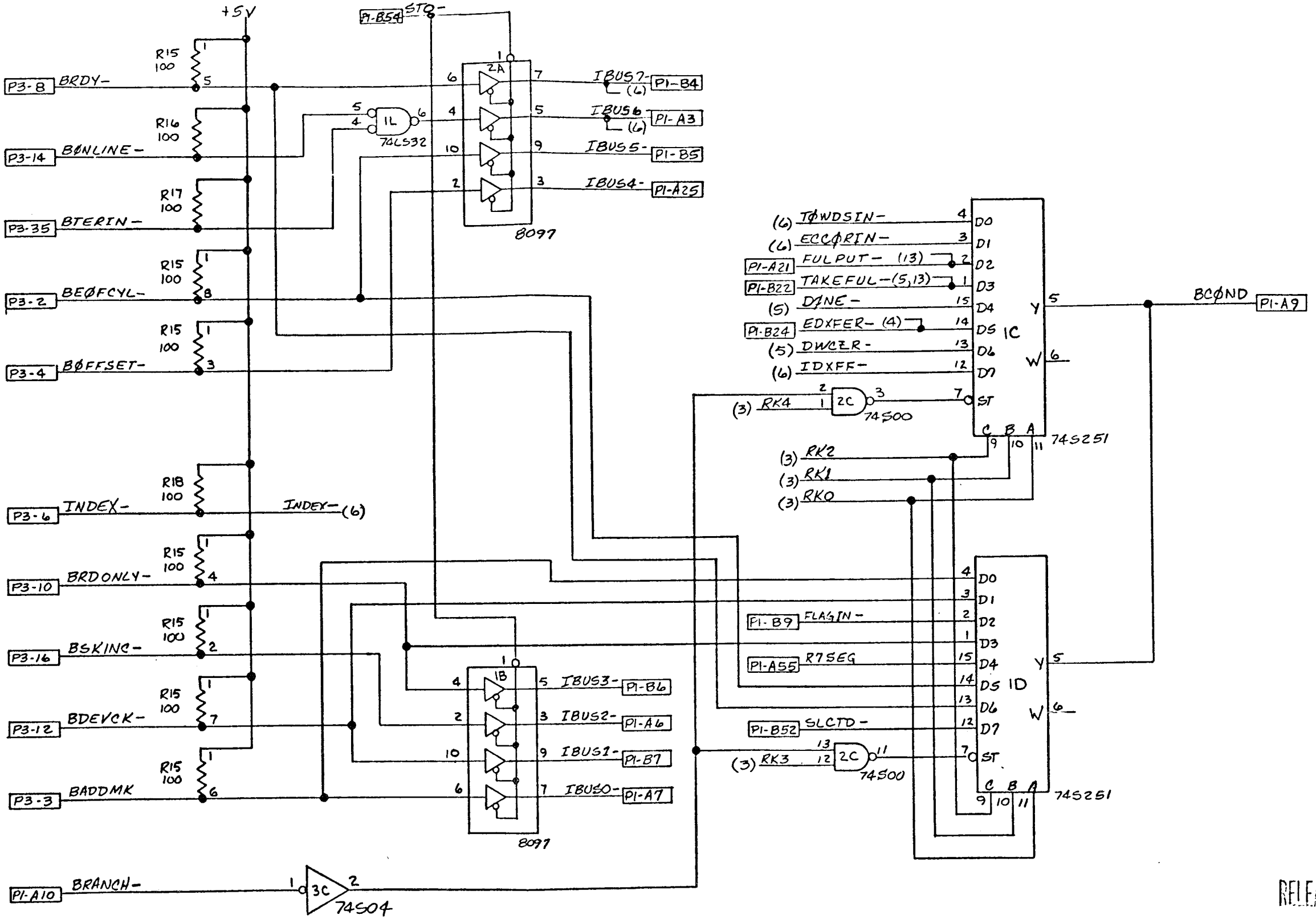
RELEASED

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic / four corporation 1335 South Claudina Street Anaheim, California 92805
			DRAWN CHKD ENG MFG APP
			TITLE
			SIZE D DWG NO 901922 REV J
			SCALE SH 6 OF 13
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	



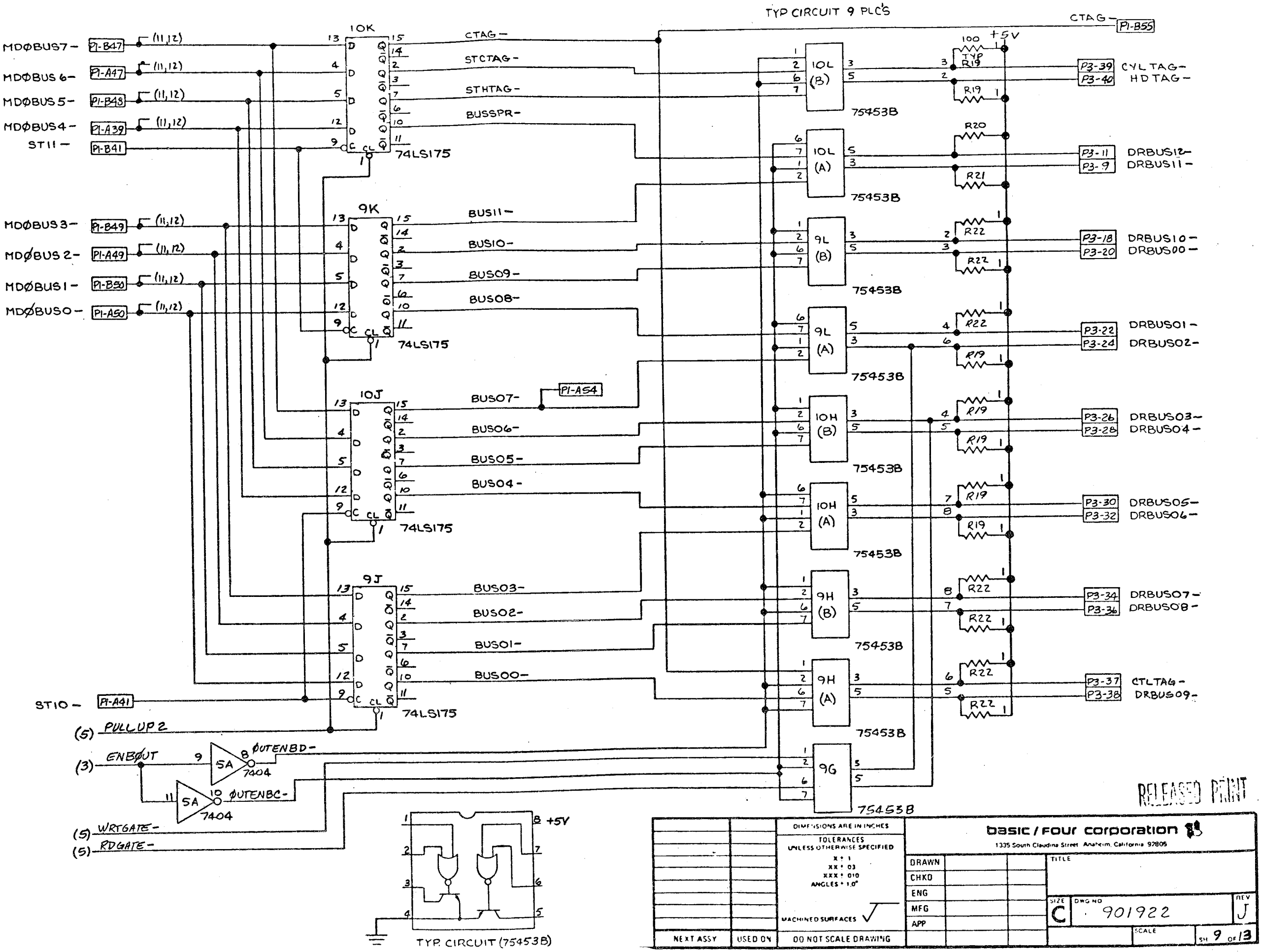
RELEASED PRINT

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 XX ± 03 XXX ± 010 ANGLES ± 1.0° MACHINED SURFACES √	basic/four corporation 1335 South Claudina Street Anaheim, California 92805
			DRAWN / CHKD / ENG / MFG / APP
			TITLE
			SIZE C · DWG NO 901922 · REV J
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	SCALE · SH 7 OF 13



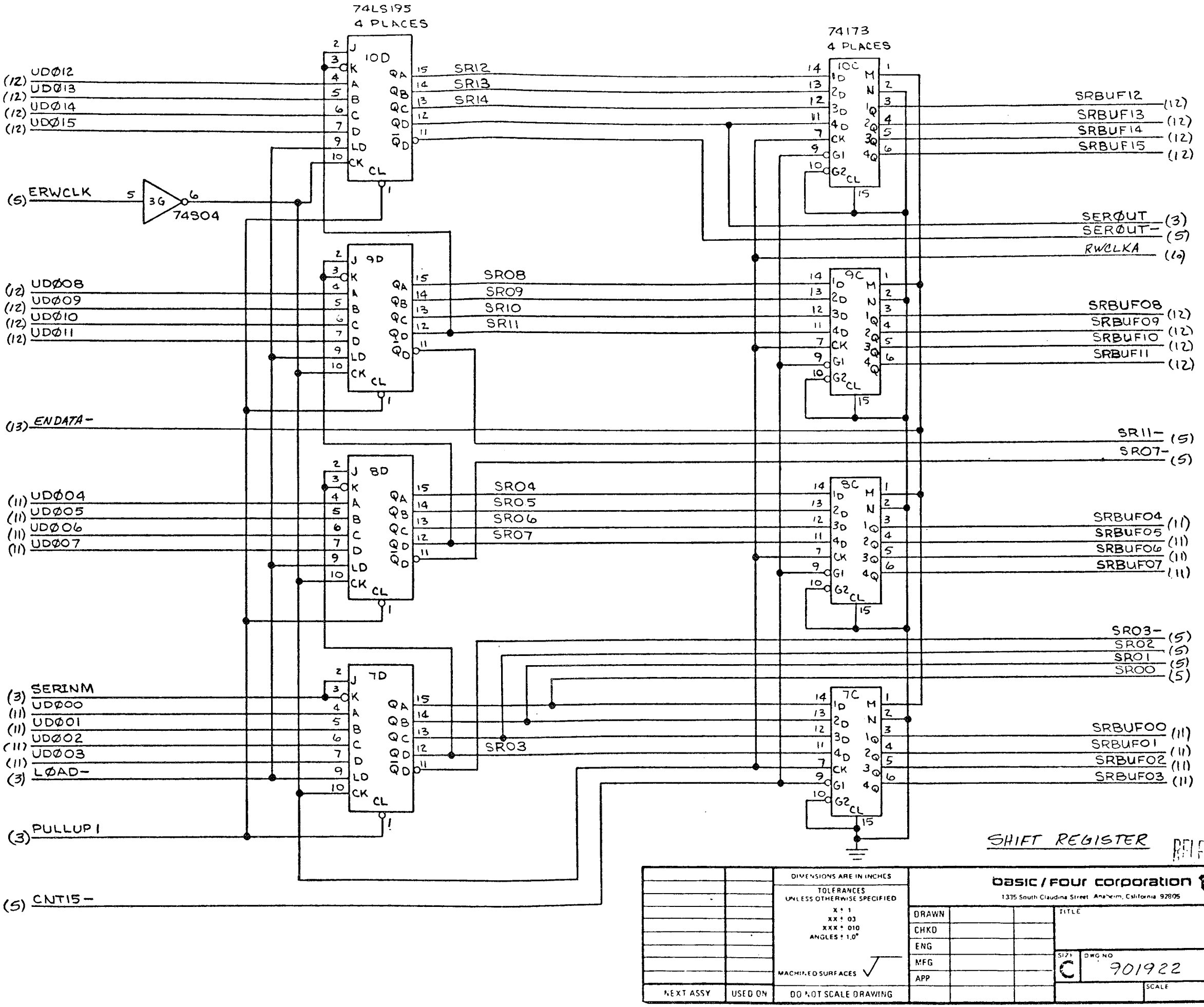
RELEASED PRINT

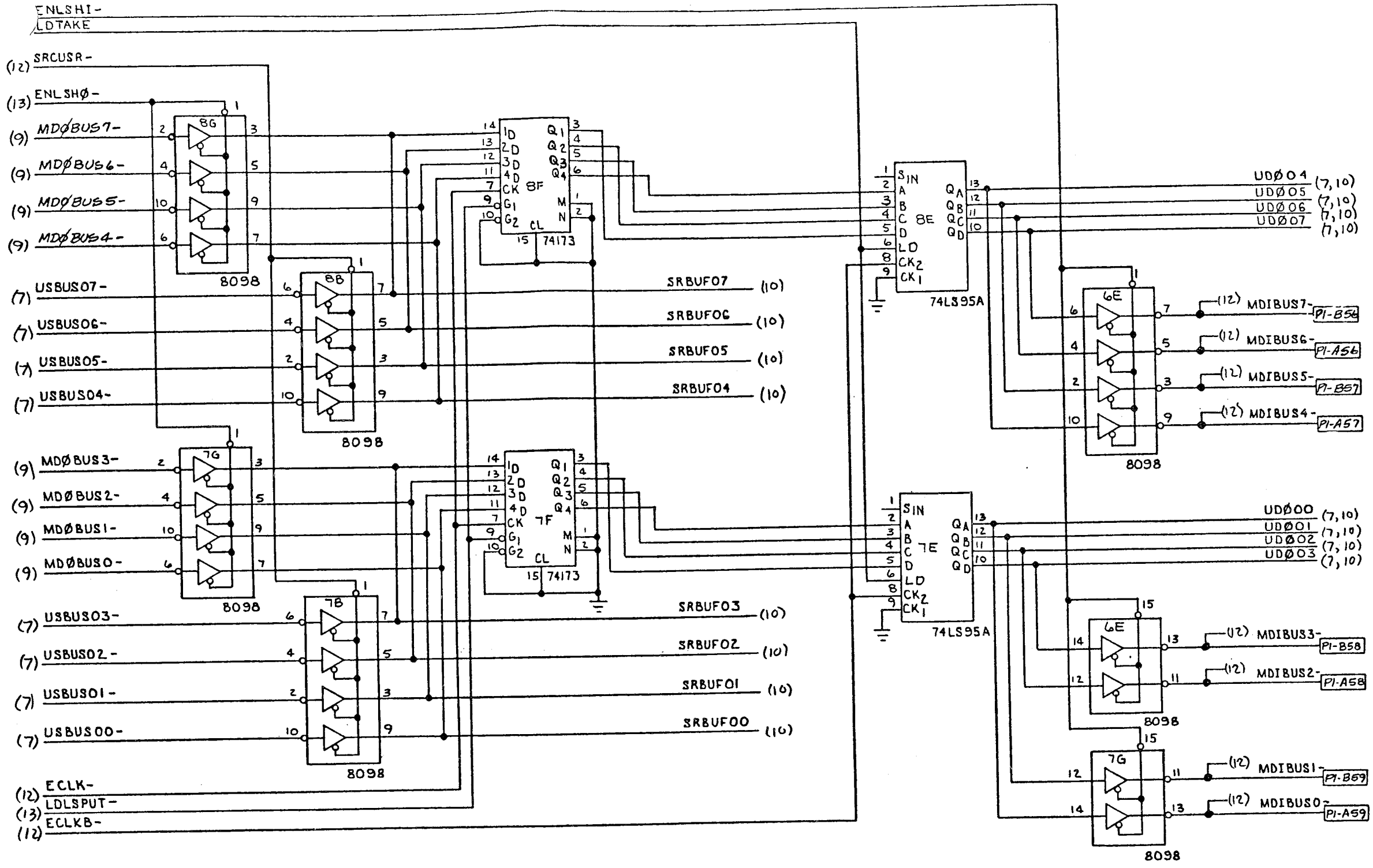
		DIMENSIONS ARE IN INCHES	basic / four corporation		
		TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± 1 .XX ± 03 .XXX ± 010 ANGLES ± 1.0°	1335 South Claudina Street Anaheim, California 92805		
			DRAWN	TITLE	
			CHKD		
			ENG	SIZE C DWG NO 901922	REV J
		MACHINED SURFACES √	MFG		
			APP	SCALE	SH 8 OF 13
NEXT ASSY	USED ON	DO NOT SCALE DRAWING			



RELEASED PRINT

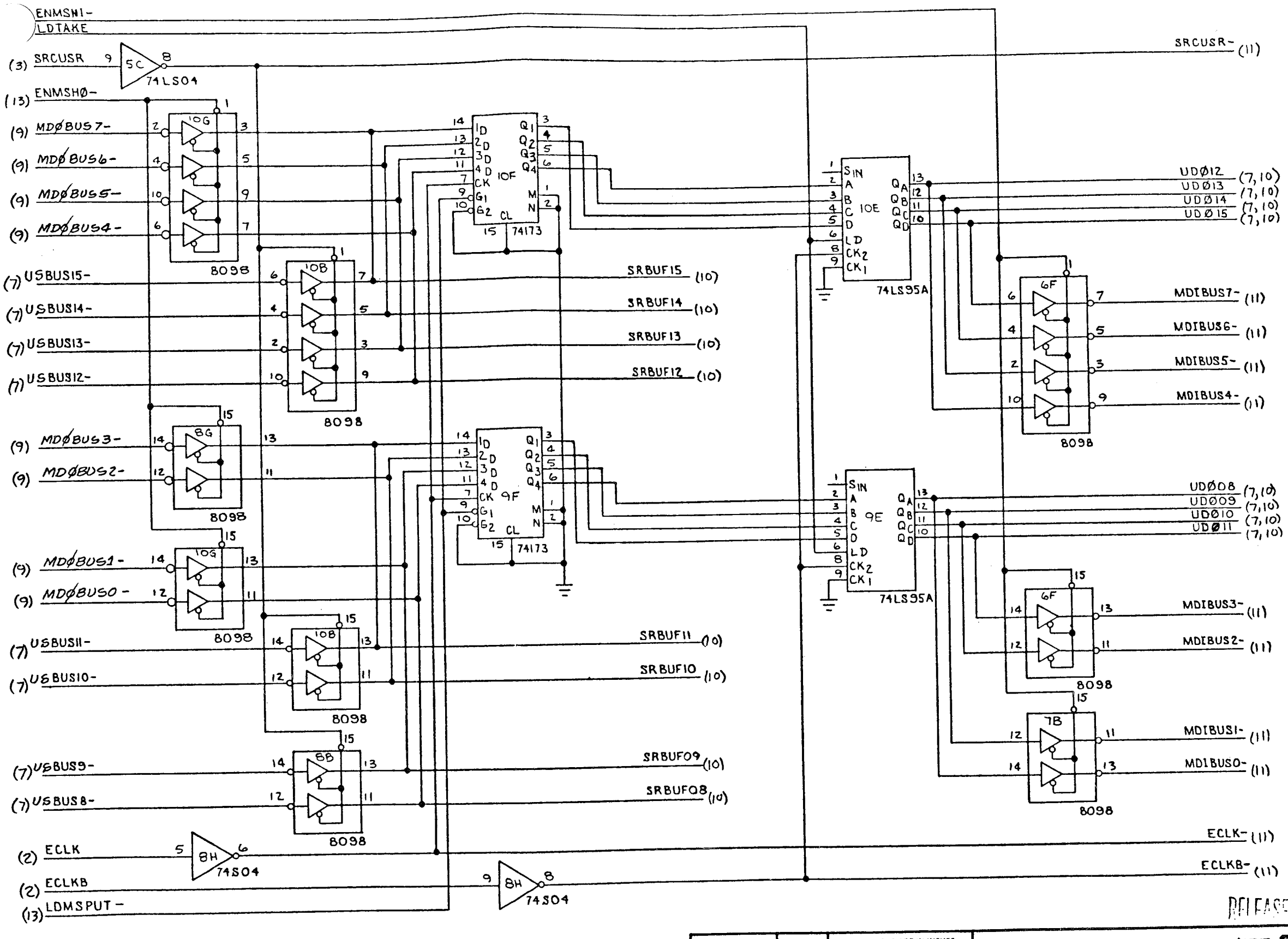
		DIMENSIONS ARE IN INCHES	basic / four corporation	
		TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 XX ± 03 XXX ± 010 ANGLES ± 1.0°	1335 South Claudina Street Anaheim, California 92805	
		MACHINED SURFACES √	DRAWN / CHKD / ENG / MFG / APP	TITLE
NEXT ASSY	USED ON	DO NOT SCALE DRAWING		SIZE C · DWG NO 901922 · REV J · SCALE · SH 9 OF 13





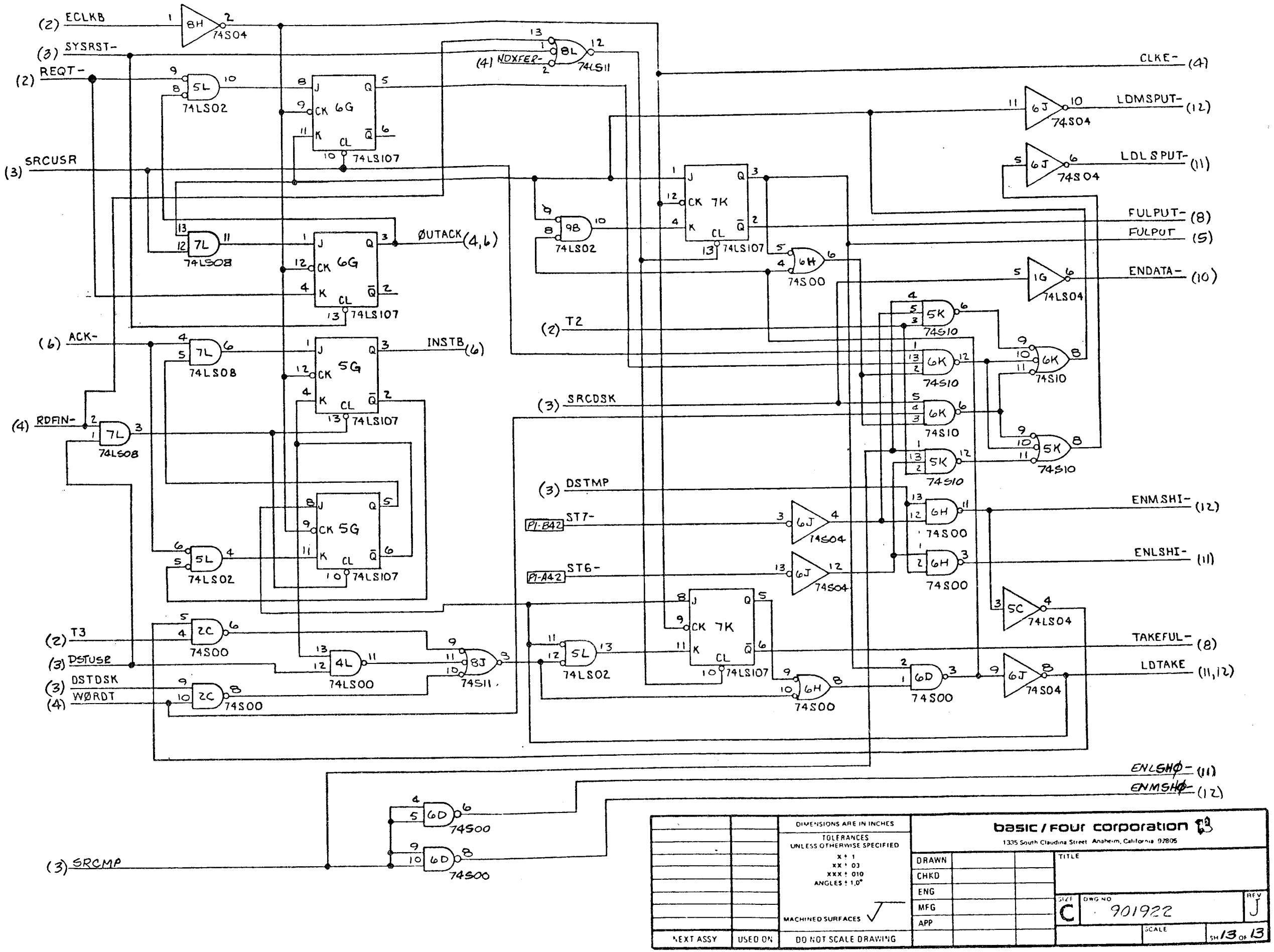
RELEASED PRINT

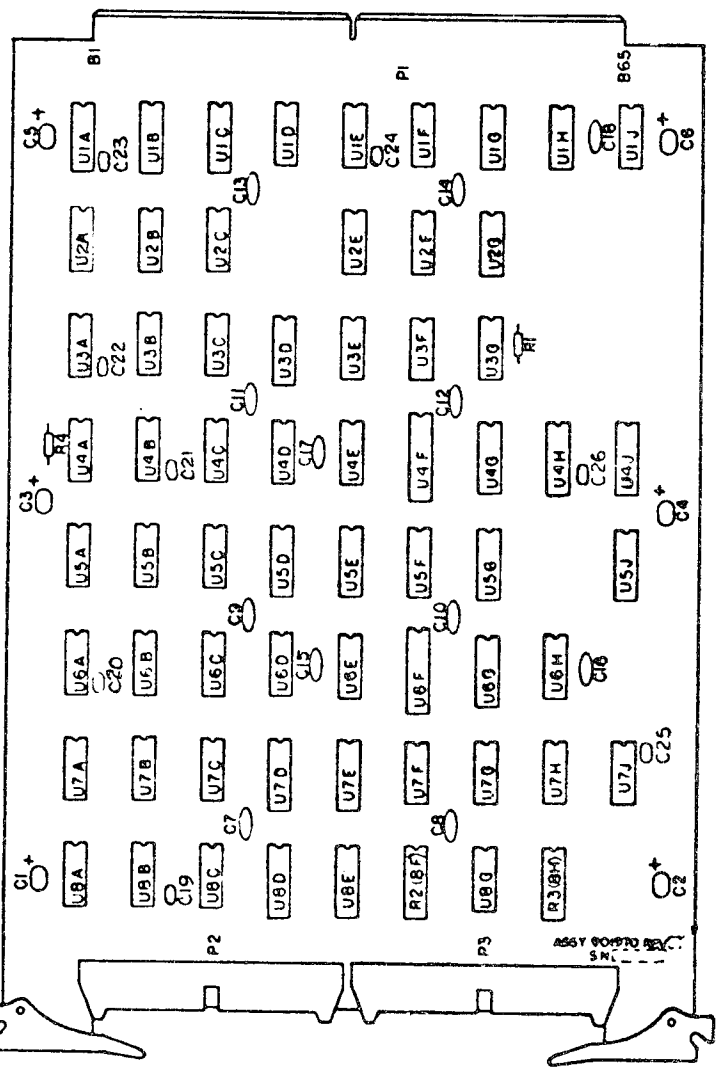
		DIMENSIONS ARE IN INCHES	basic / four corporation
		TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± 1 .XX ± 03 .XXX ± 010 ANGLES ± 1.0°	1335 South Claudina Street Anaheim, California 92805
		MACHINED SURFACES √	DRAWN / CHKD / ENG / MFG / APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	TITLE SIZE C · DWG NO 901922 · REV J SCALE · SH 11 OF 13



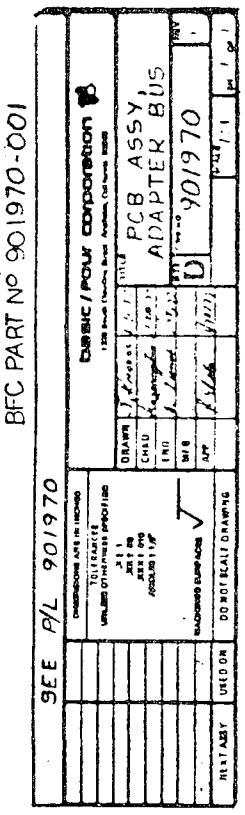
RELEASED PRINT

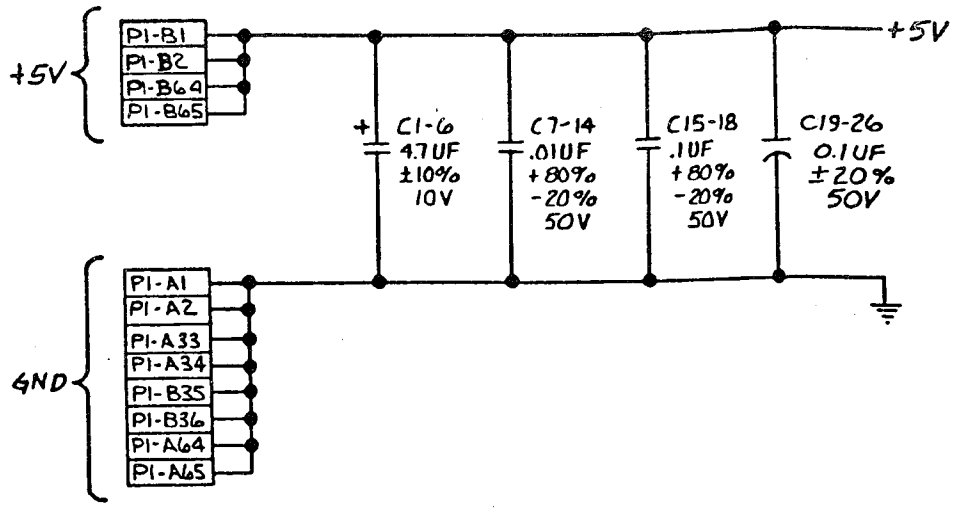
		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 XX ± .03 XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic/four corporation 1335 South Claudina Street Anaheim, California 92805
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	DRAWN / CHKD / ENG / MFG / APP TITLE SIZE C · DWG NO 901922 · REV J SCALE · SH 12 OF 13



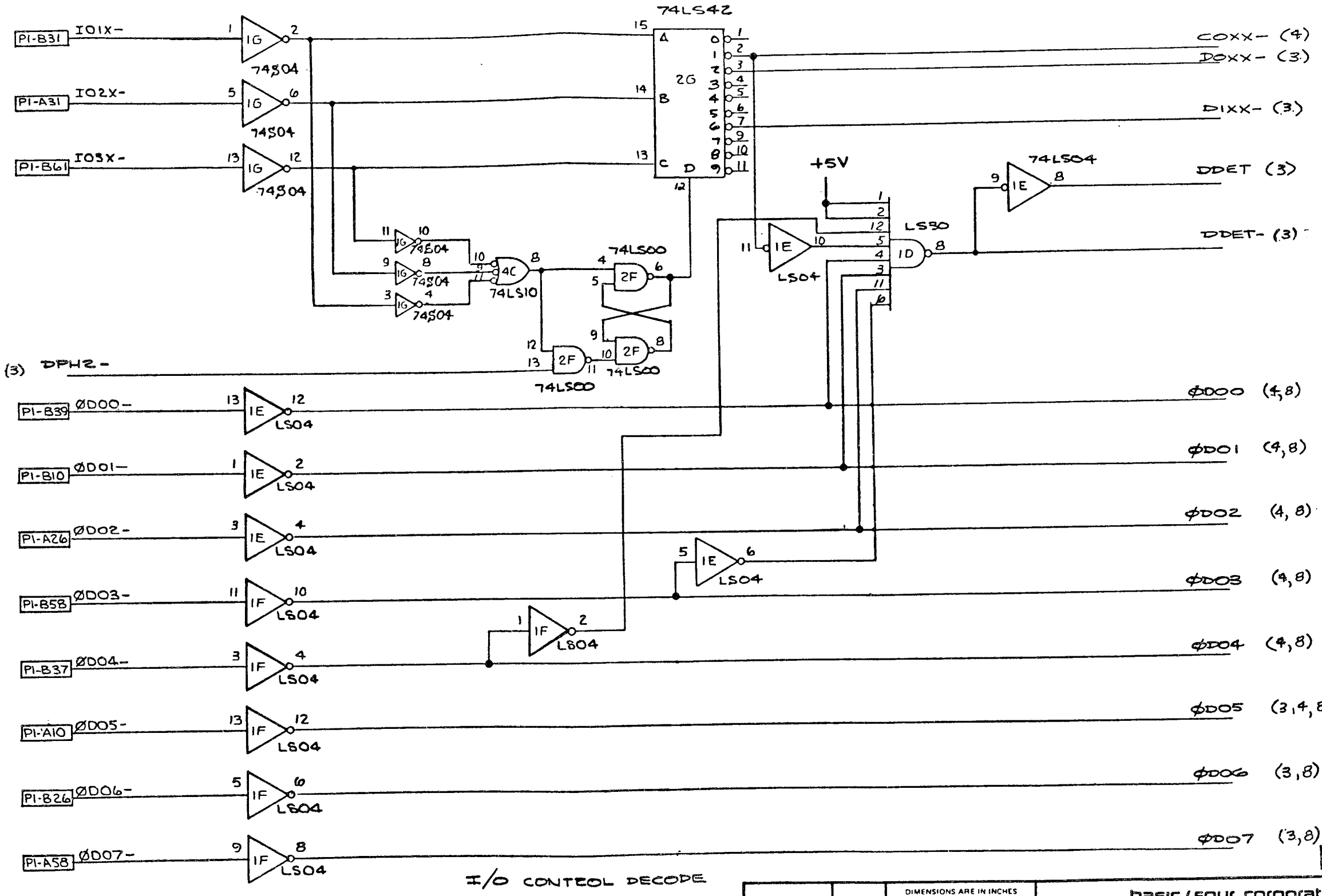


BFC PART Nº 901970-001





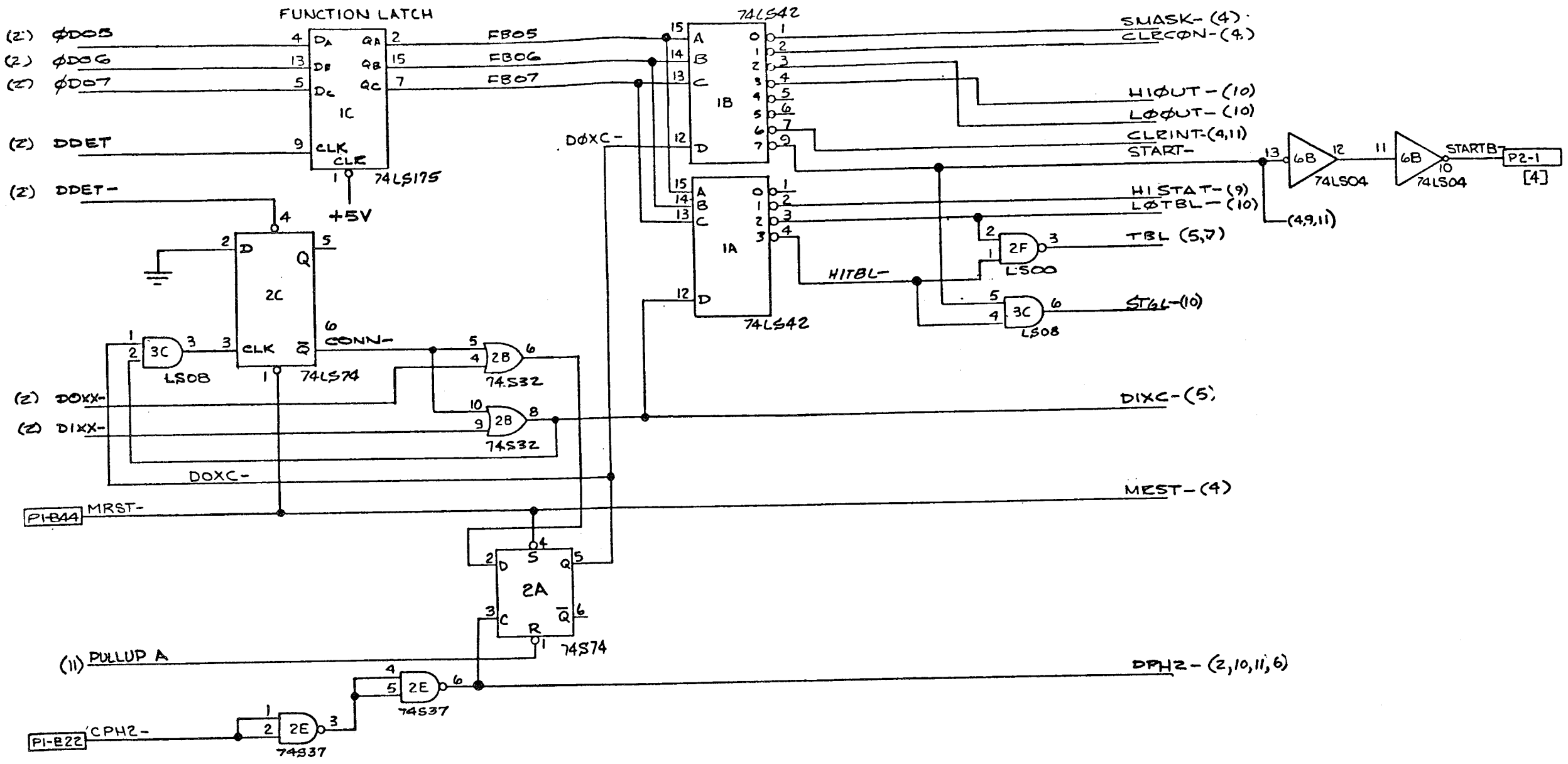
		DIMENSIONS ARE IN INCHES	basic / four corporation 1335 South Claudina Street Anaheim, California 92805			
		TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0°	DRAWN	E COLLINS	1/3	TITLE LOGIC DIAGRAM, ADAPTER BUS
			CHKD		9-25-74	
			ENG		12-17-	SIZE D / DWG NO 901972 / REV D
			MFG			
901970		MACHINED SURFACES √	APP		12-20-74	SCALE — / SH 1 OF 11
NEXT ASSY	USED ON	DO NOT SCALE DRAWING				



I/O CONTROL DECODE

RELEASED PRINT

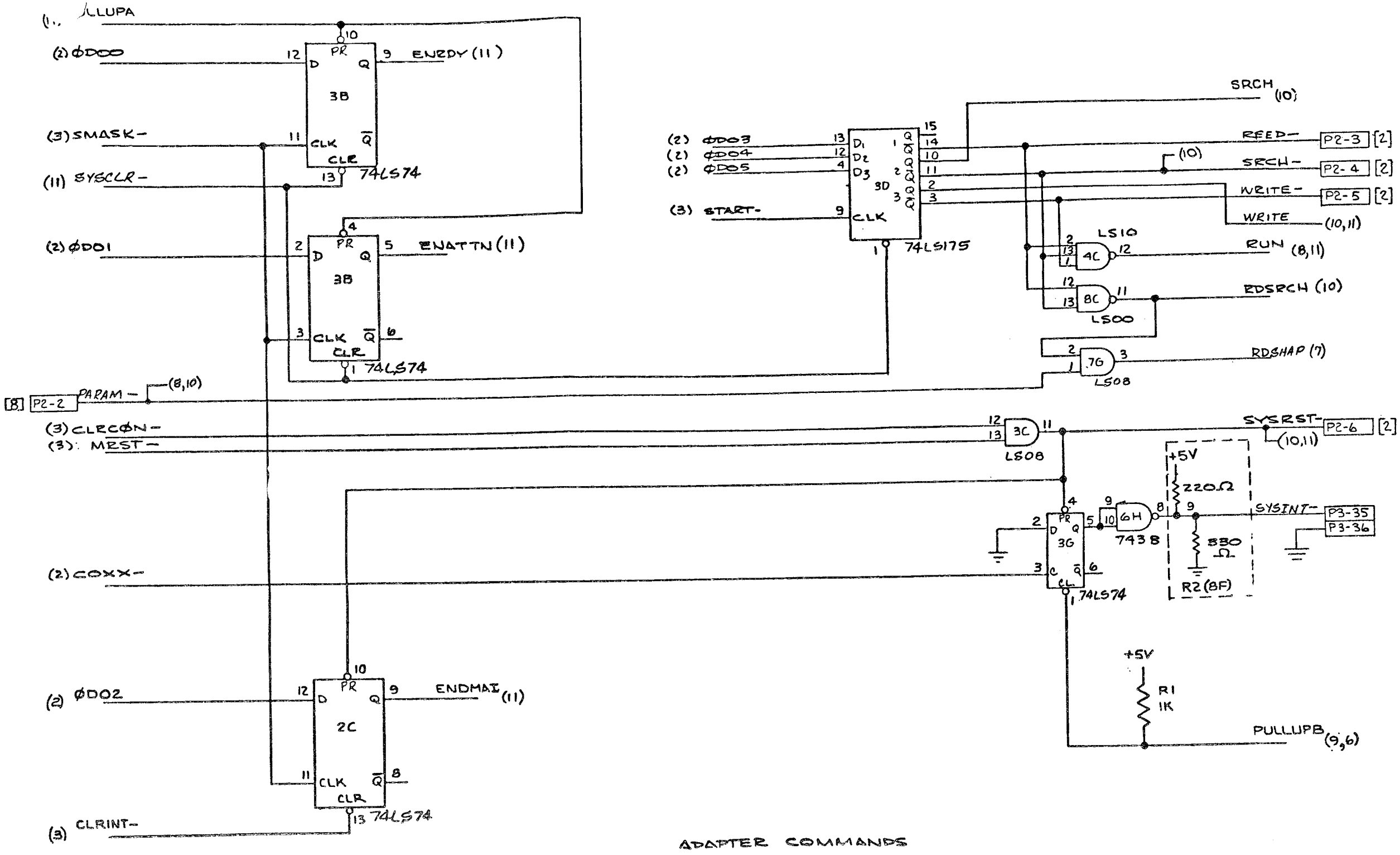
		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 XX ± .03 XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic/four corporation 1335 South Claudina Street Anaheim, California 92805
			DRAWN E. Collins — TITLE
			CHKD
			ENG
			MFG
			APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	SIZE C — DWG NO 901972 — REV D SCALE — SH 2 OF 11



I/O FUNCTION DECODE

RELEASED PRINT

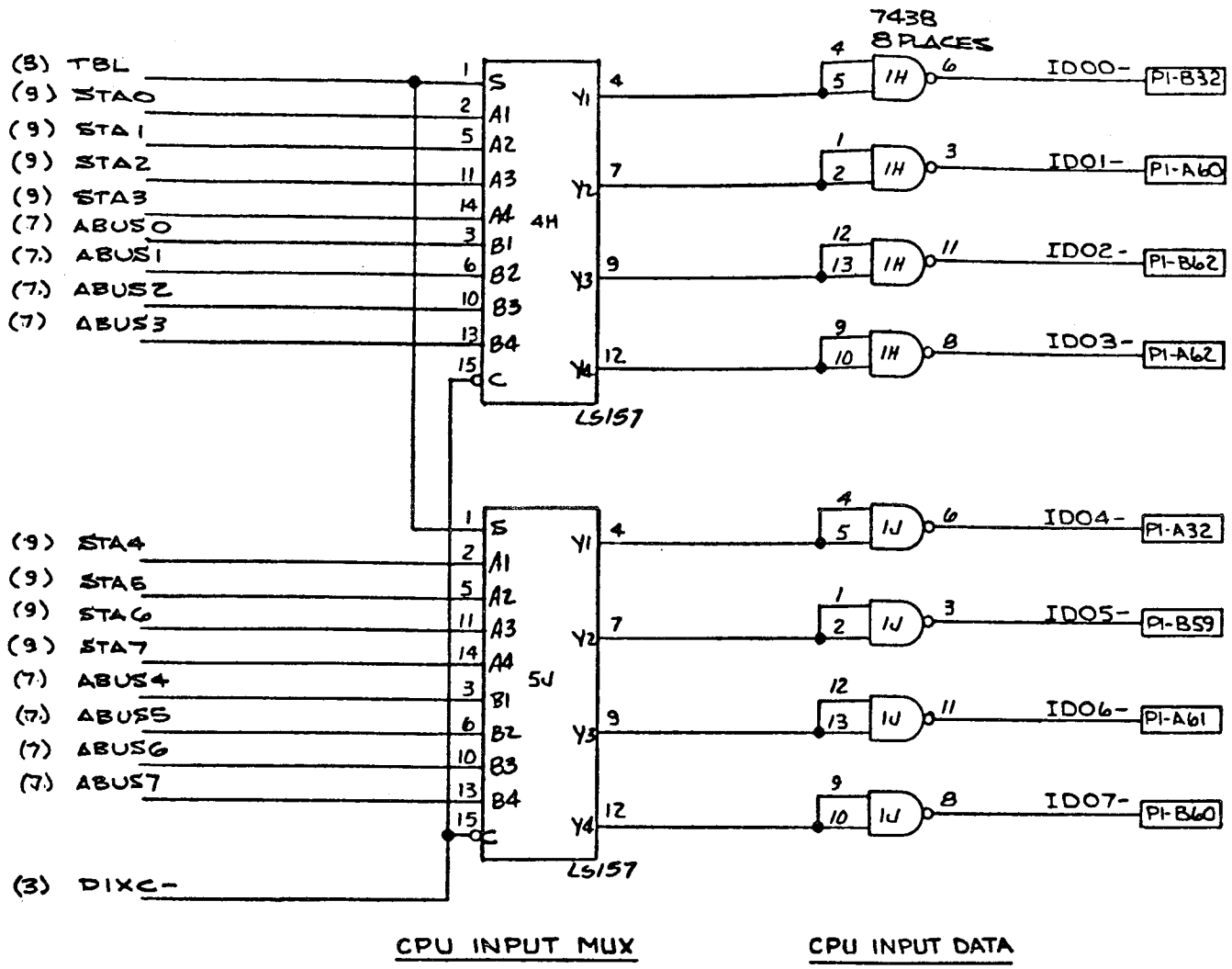
		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic/four corporation 1335 South Claudina Street Anaheim, California 92805
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	DRAWN S. Collins; CHKD; ENG; MFG; APP TITLE SIZE C; DWG NO 901972; REV D SCALE; SH 3 OF 11



ADAPTER COMMANDS

RELEASED PRINT

		DIMENSIONS ARE IN INCHES	basic / four corporation 1335 South Claudina Street Anaheim, California 92805
		TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 XX ± 03 XXX ± 010 ANGLES ± 1,0°	DRAWN CHKD ENG MFG APP
		MACHINED SURFACES √	TITLE
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	SIZE C DWG NO 901972 REV D SCALE SH 4 OF 11



RELEASED PRINT

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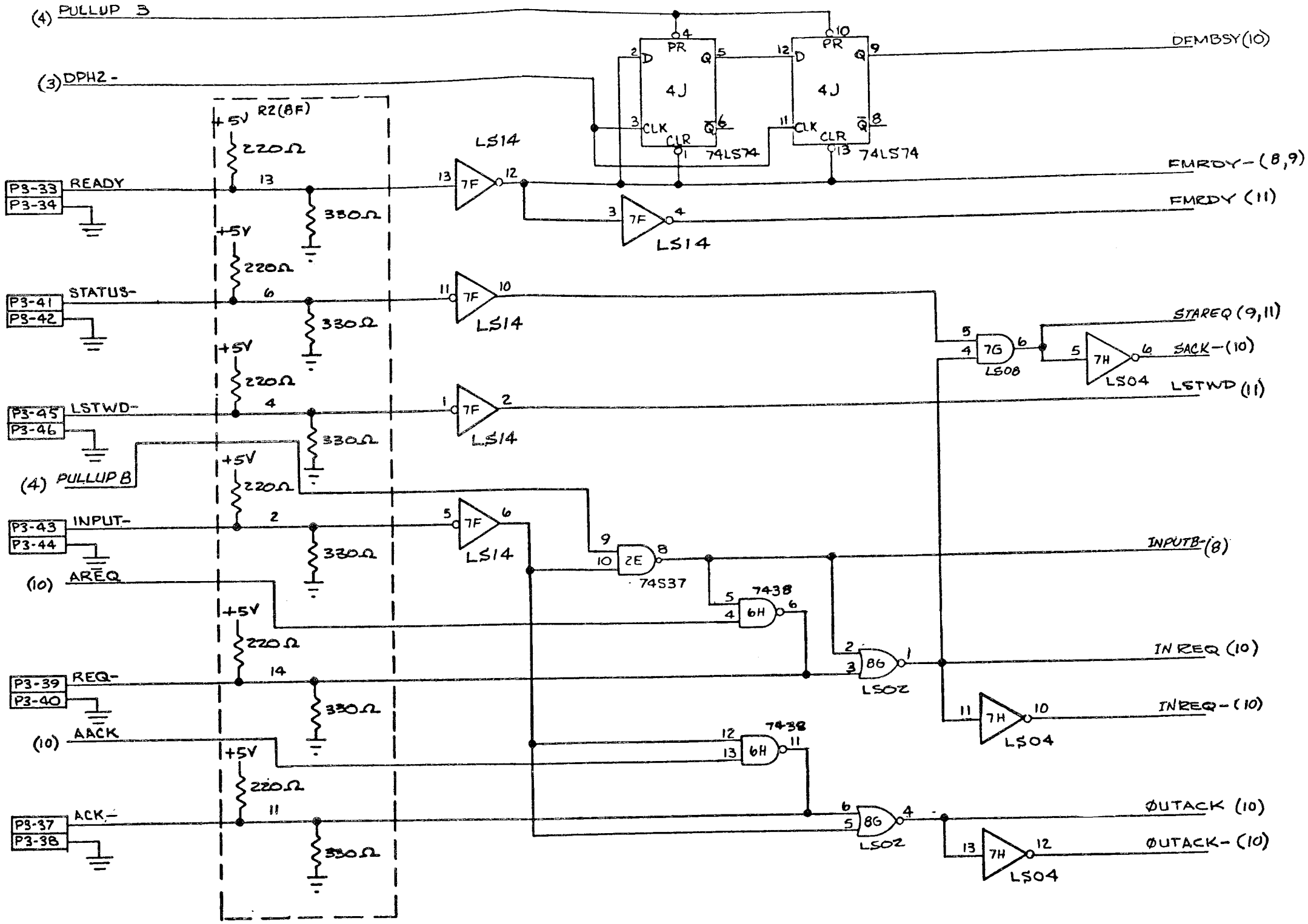
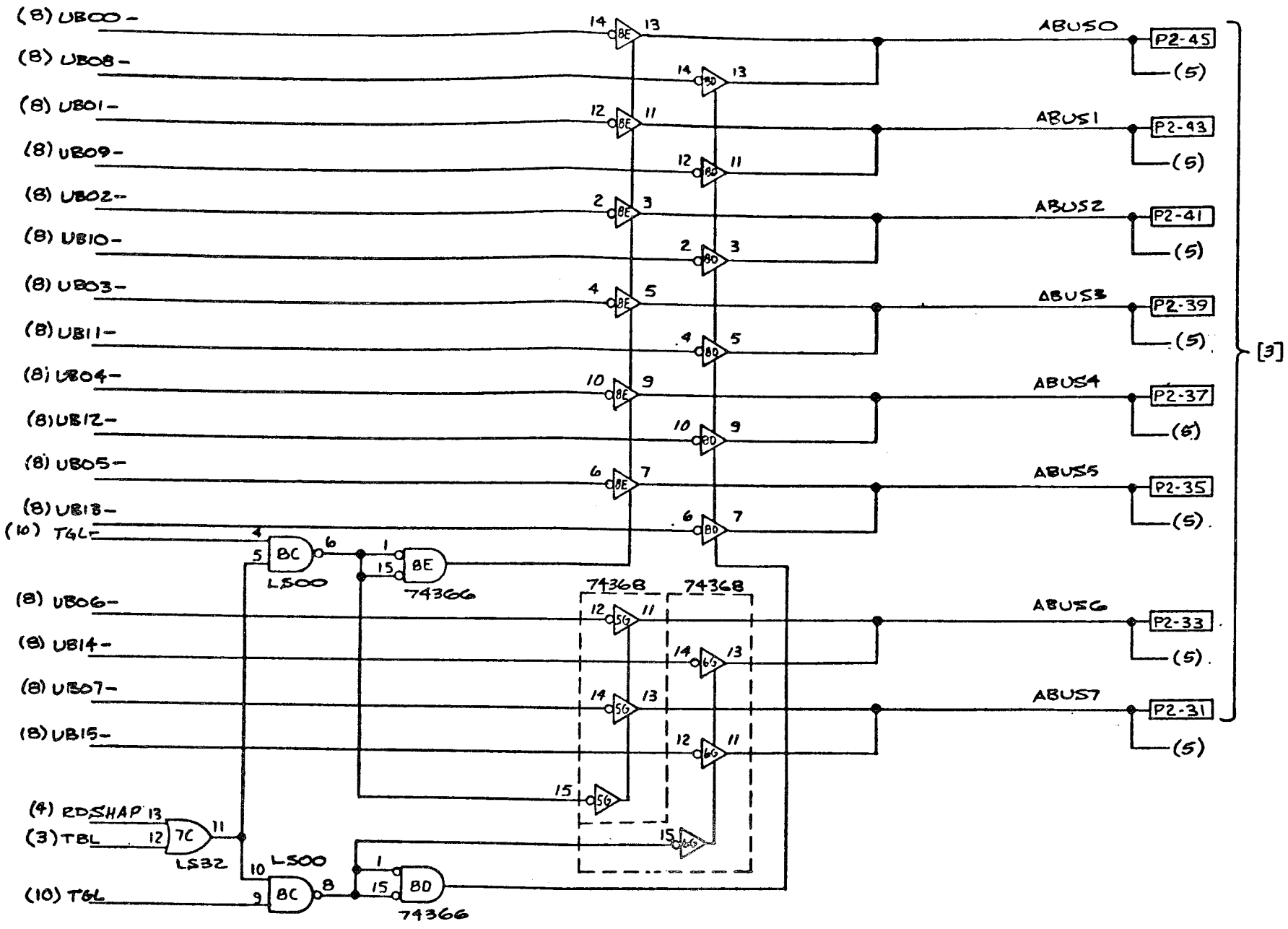
		TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± 1 .XX ± 03 XXX ± 010 ANGLES ± 1.0°	DRAWN			TITLE
			CHKD			
			ENG			SIZE C DWG NO 901972 REV D
		MACHINED SURFACES √	MFG			
			APP			
NEXT ASSY	USED ON	DO NOT SCALE DRAWING				SCALE SH 5 OF 11



CONTROL LINE TERMINATIONS

RELEASED PRINT

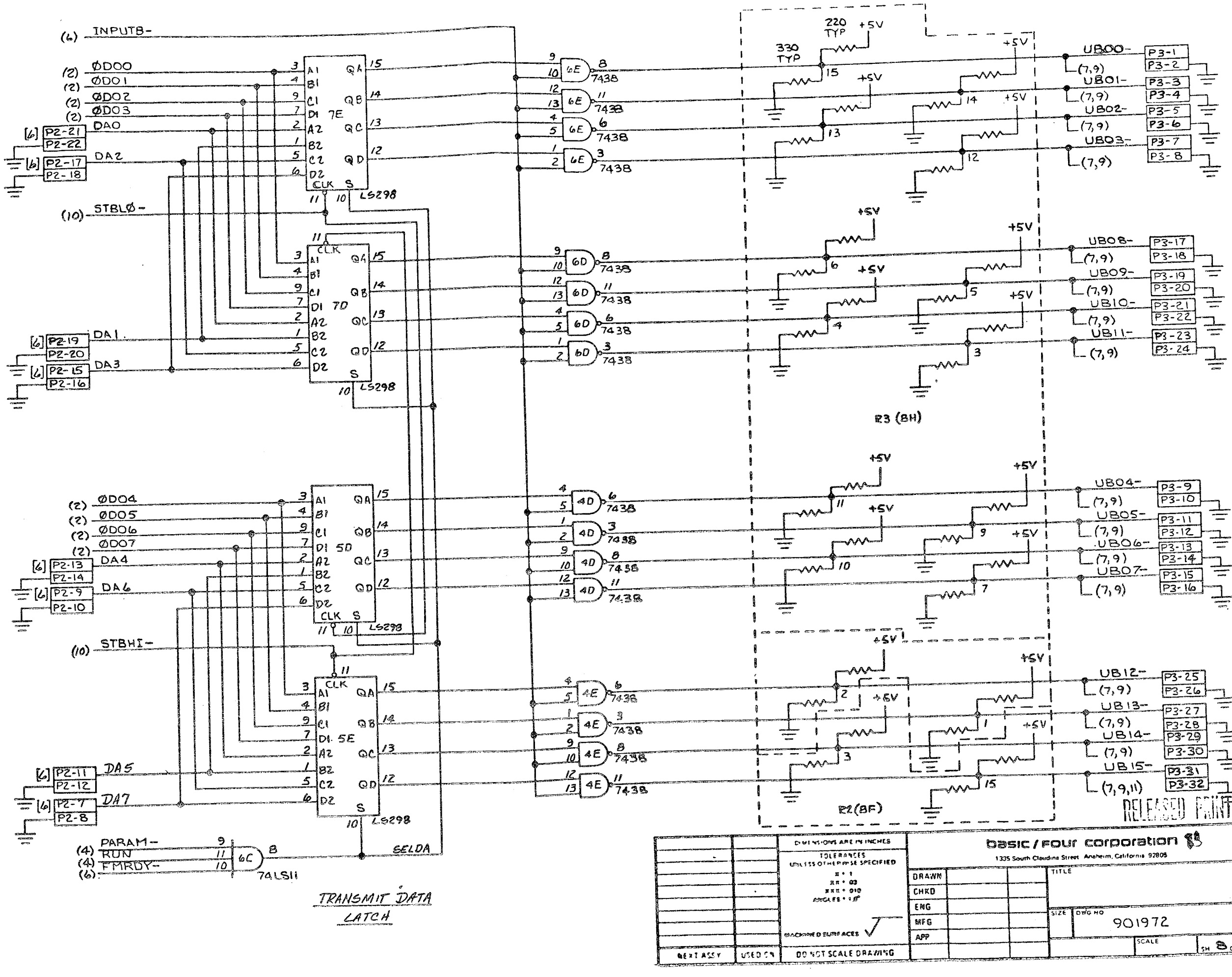
		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± 1 XX ± 03 XXX ± 010 ANGLES ± 1.0° MACHINED SURFACES √	basic/four corporation 1335 South Claudina Street Anaheim, California 92805
			DRAWN Scowins
			CHKD
			ENG
			MFG
			APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	TITLE SIZE C · DWG NO 901972 · REV D SCALE · SH 6 OF 11

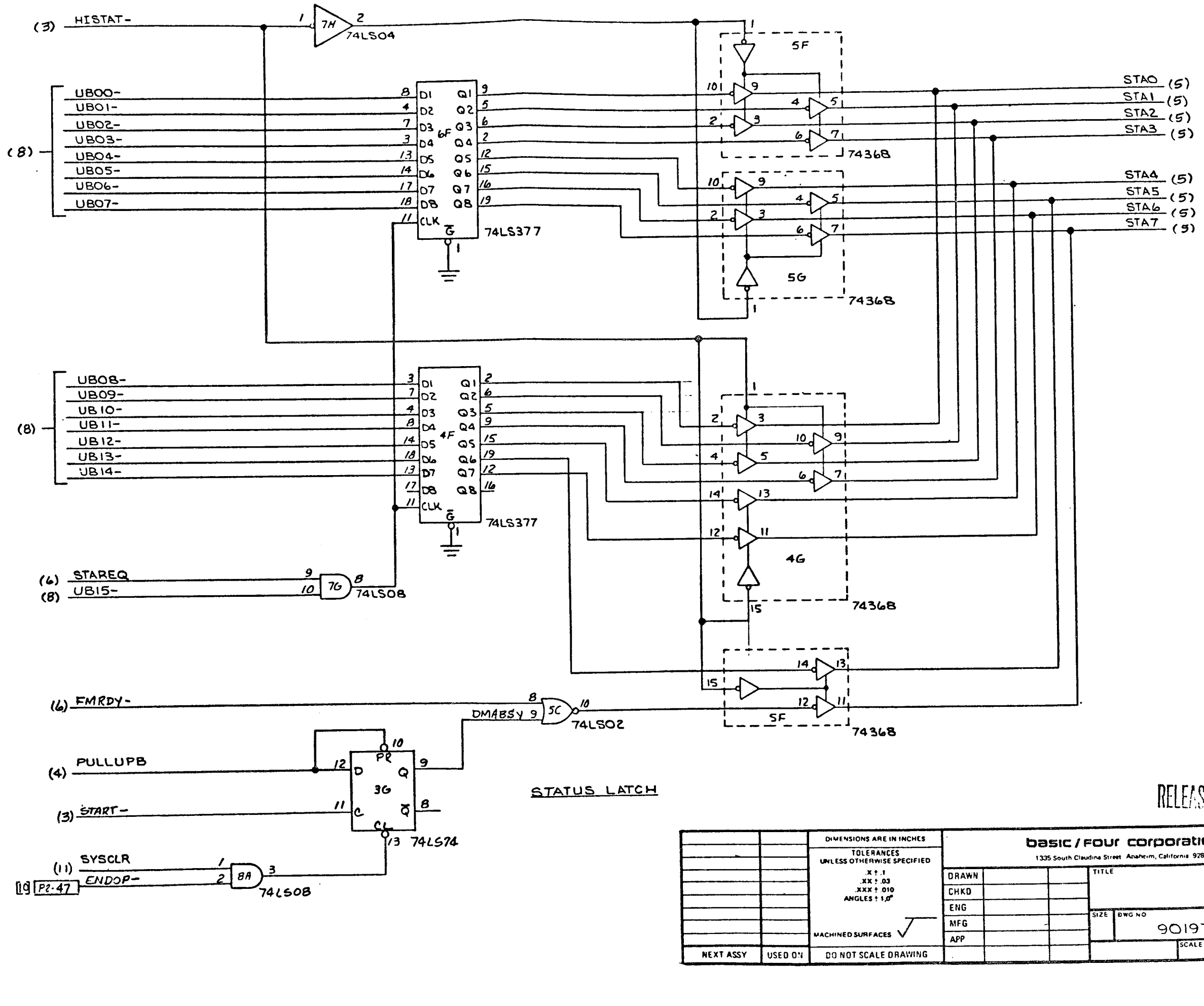


DATA RECEIVER

RELEASED PRINT

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± 1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic / four corporation 1335 South Claudina Street Anaheim, California 92805				
			DRAWN			TITLE	
			CHKD				
			ENG				
			MFG			SIZE C DWG NO 901972	REV D
			APP				
NEXT ASSY	USED ON	DO NOT SCALE DRAWING				SCALE	SH 7 OF 11

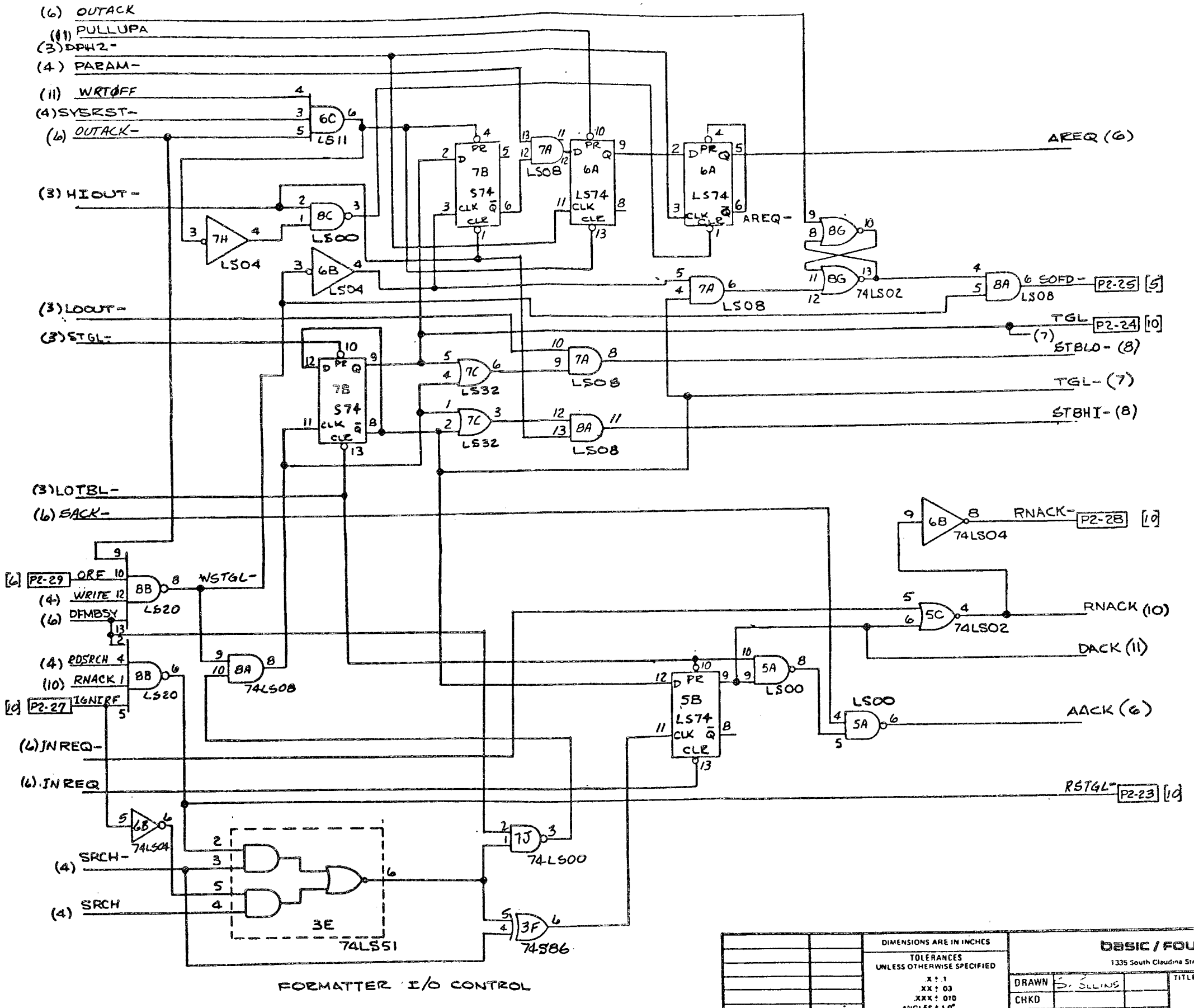




STATUS LATCH

RELEASED PRINT

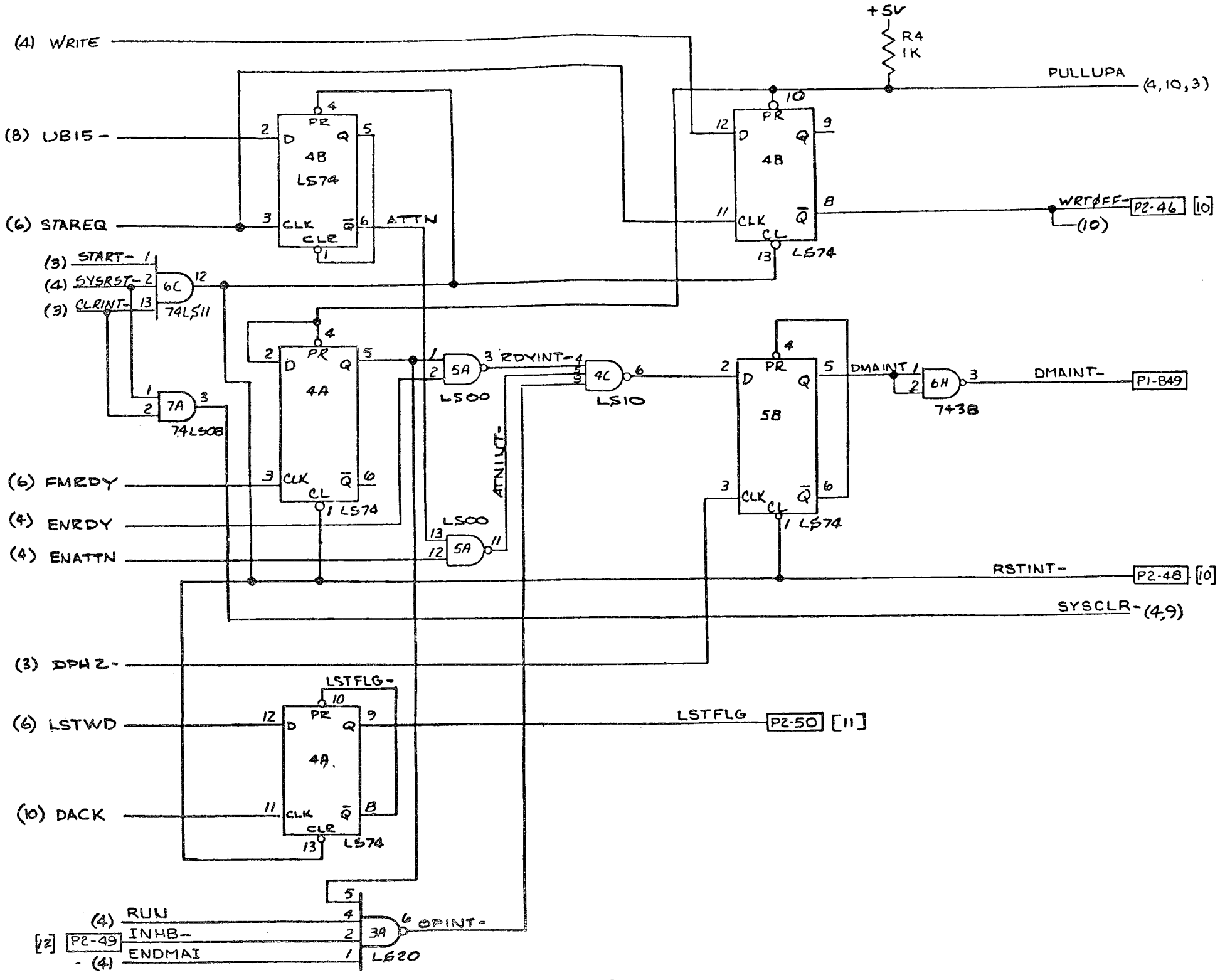
		DIMENSIONS ARE IN INCHES	basic / four corporation
		TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0°	1335 South Claudina Street Anaheim, California 92805
		MACHINED SURFACES √	DRAWN / CHKD / ENG / MFG / APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	TITLE
			SIZE D — DWG NO 901972 — REV D
			SCALE — SH 9 OF 11



FORMATTER I/O CONTROL

RELEASED PRINT

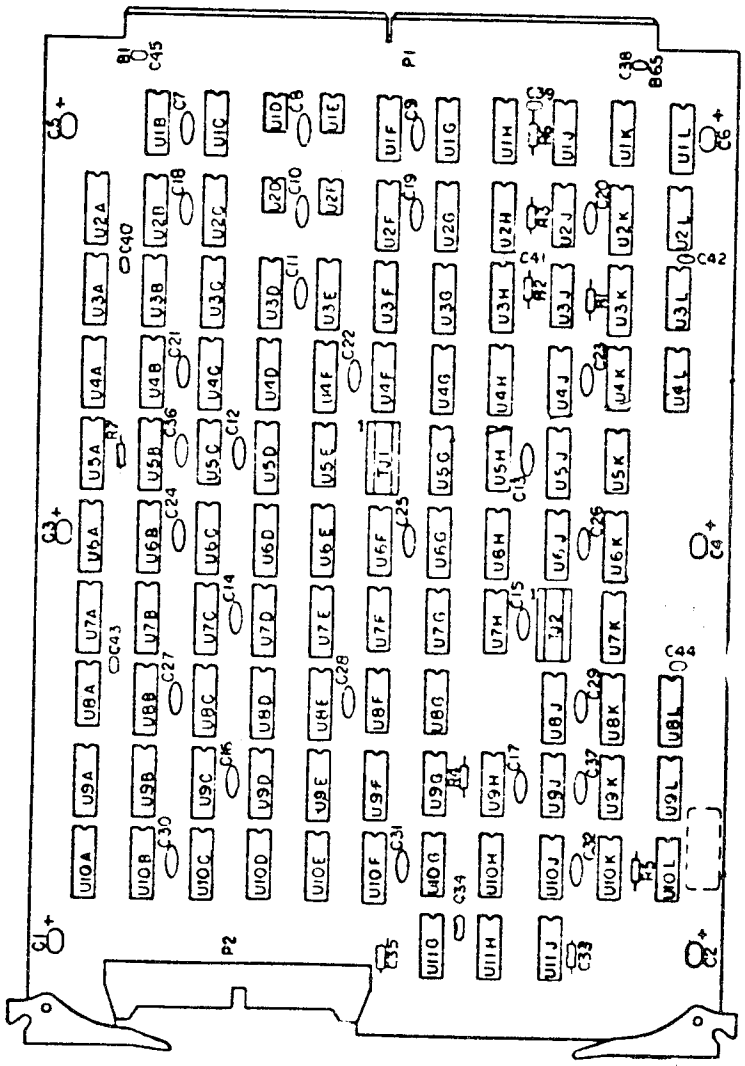
		DIMENSIONS ARE IN INCHES	basic / four corporation		
		TOLERANCES UNLESS OTHERWISE SPECIFIED	1335 South Claudina Street Anaheim, California 92805		
		x ± .1	DRAWN D. SELLINS	TITLE	
		xx ± .03	CHKD		
		xxx ± .010	ENG		
		ANGLES ± 1.0°	MFG	SIZE C	DWG NO 901972 REV D
		MACHINED SURFACES √	APP		
NEXT ASSY	USED ON	DO NOT SCALE DRAWING		SCALE	SH 10 OF 11

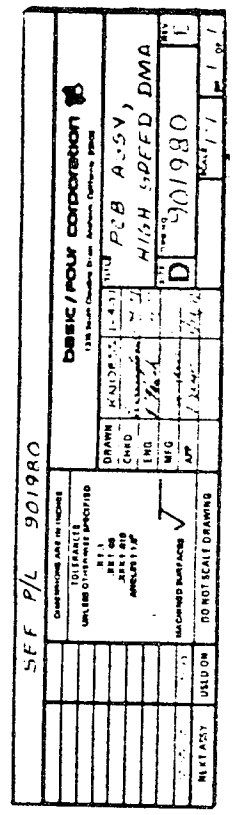


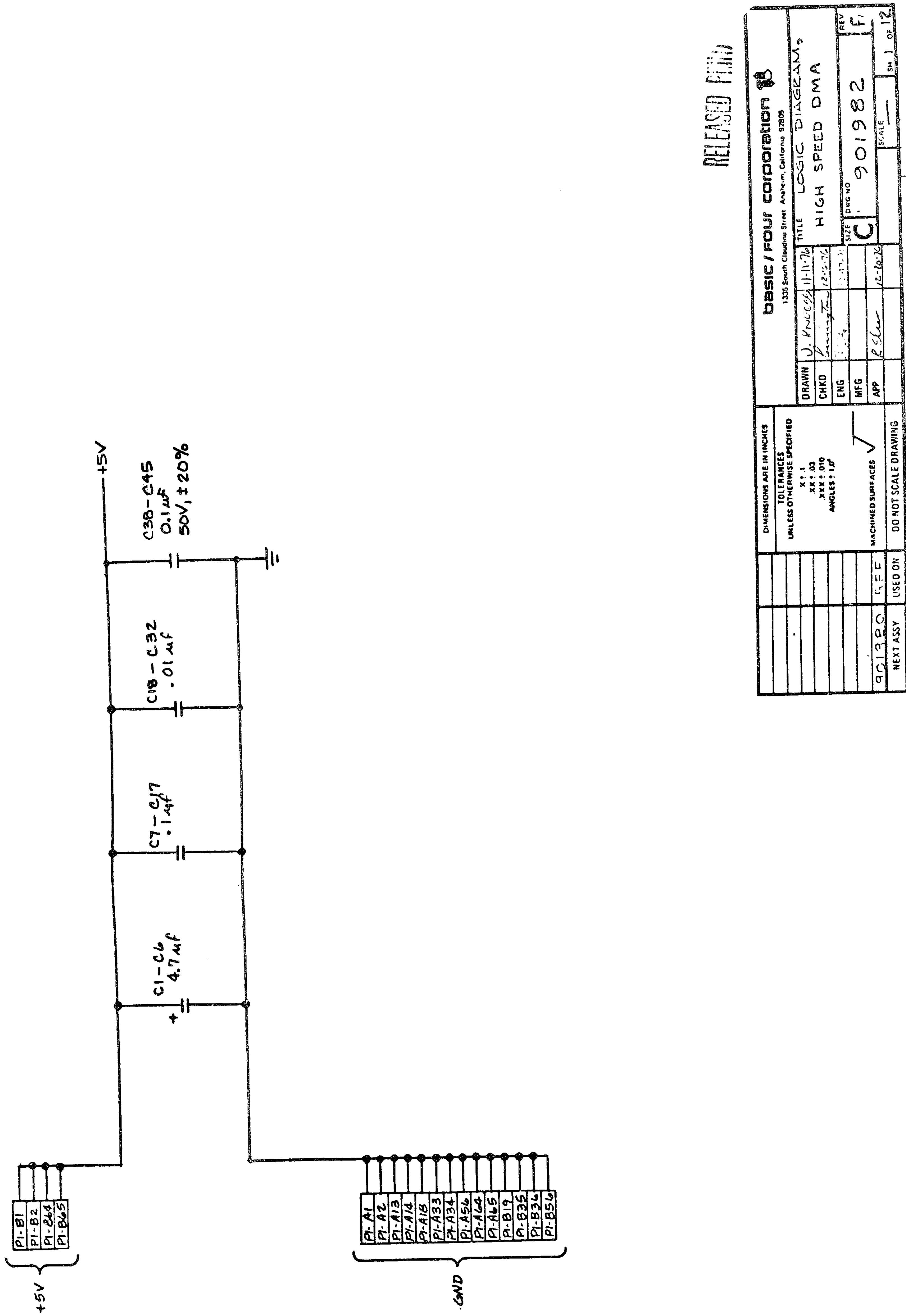
DMA INTERRUPT CONTROL

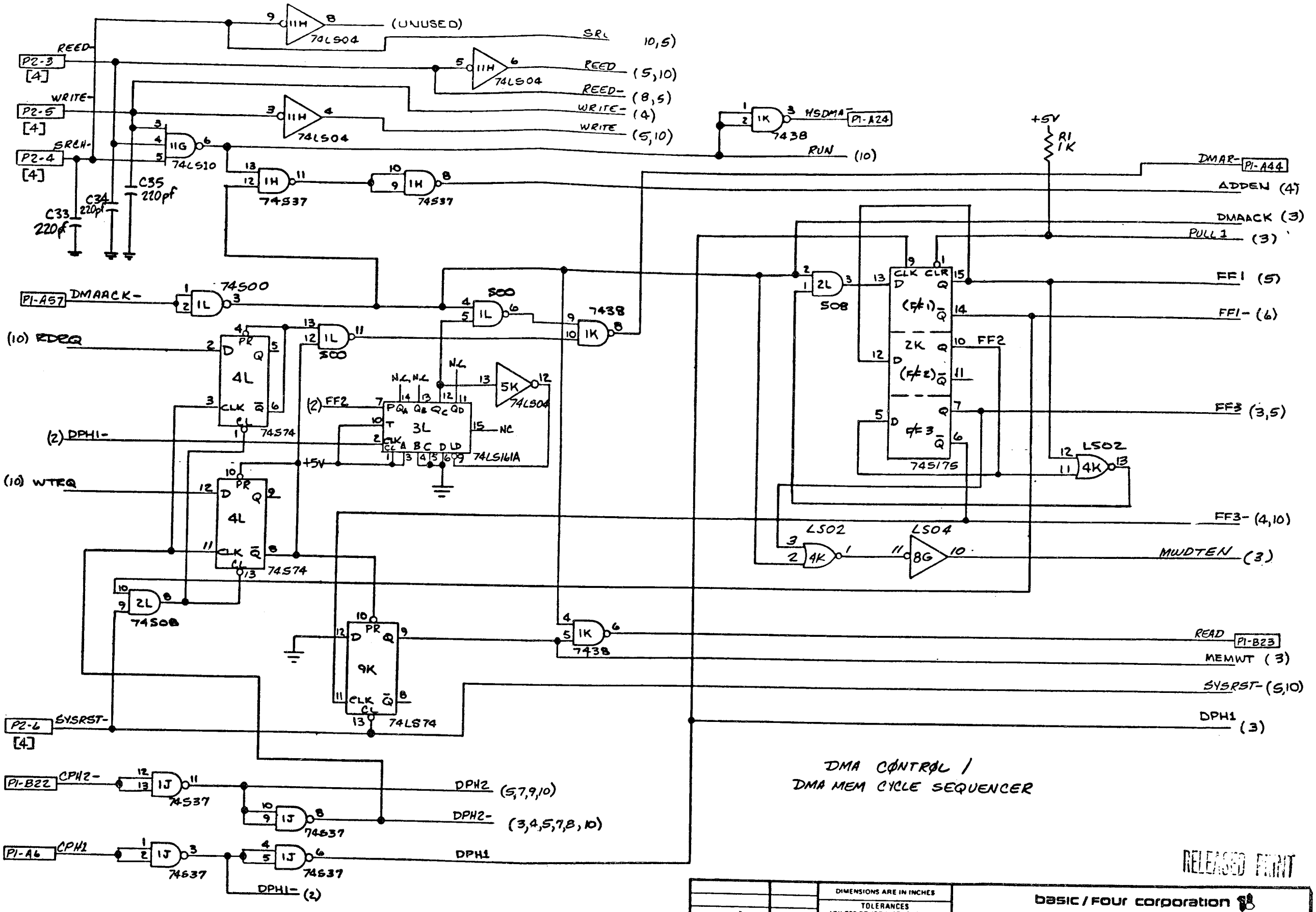
RELEASED PRINT

		DIMENSIONS ARE IN INCHES	basic / four corporation		
		TOLERANCES UNLESS OTHERWISE SPECIFIED	1335 South Claudina Street Anaheim, California 92805		
		X ± .1 XX ± .03 XXX ± .010 ANGLES ± 1.0°	DRAWN		TITLE
			CHKD		
			ENG		
		MACHINED SURFACES √	MFG		SIZE C DWG NO 901972 REV D
			APP		
NEXT ASSY	USED ON	DO NOT SCALE DRAWING		SCALE	SH 11 OF 11



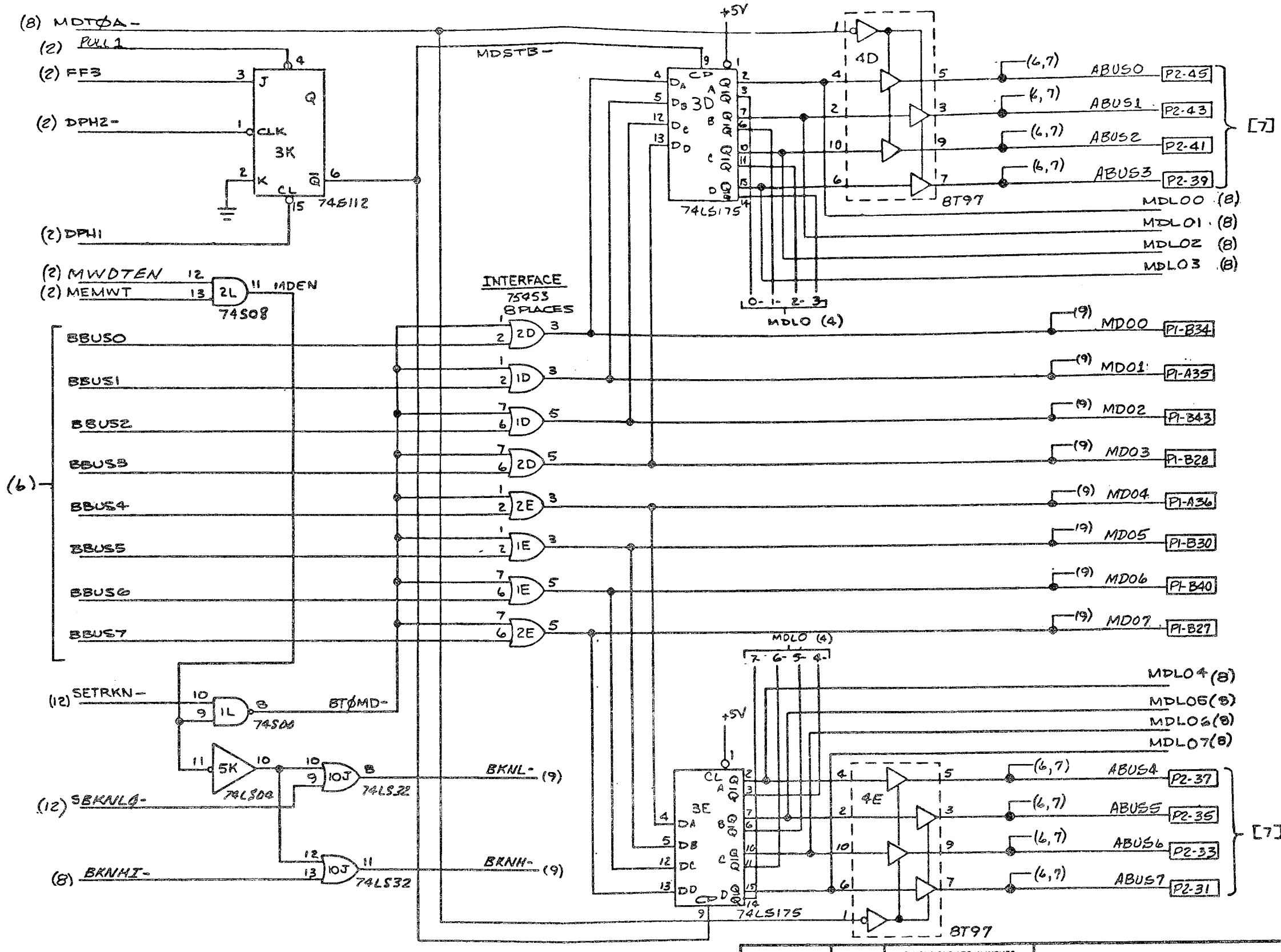



RELEASED PRINT
basic / four corporation
1335 South Claudina Street Anaheim, California 92805
TITLE LOGIC DIAGRAM, HIGH SPEED DMA
DRAWN J. KNUCCS 11-11-76
CHKD 12-15-76
ENG
MFG
APP 12-20-76
SIZE C
DWG NO 901982
REV F
SCALE —
SH 1 OF 12
DIMENSIONS ARE IN INCHES
TOLERANCES UNLESS OTHERWISE SPECIFIED
X ± .1
.XX ± .03
.XXX ± .010
ANGLES ± 1.0°
MACHINED SURFACES
DO NOT SCALE DRAWING
901380
REF
NEXT ASSY
USED ON
+5V
C38 - C45
0.1 µf
50V, ± 20%
C18 - C32
.01 µf
C7 - C17
.1 µf
C1 - C6
4.7 µf
+
P1-B1
P1-B2
P1-B64
P1-B65
+5V
P1-A1
P1-A2
P1-A13
P1-A14
P1-A18
P1-A33
P1-A34
P1-A56
P1-A64
P1-A65
P1-B19
P1-B35
P1-B36
P1-B56
GND



RELEASED PRINT

		DIMENSIONS ARE IN INCHES	basic / four corporation
		TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0°	1335 South Claudina Street Anaheim, California 92805
		MACHINED SURFACES √	DRAWN / CHKD / ENG / MFG / APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	TITLE
			SIZE C · DWG NO 901982 · REV F
			SCALE · SH 2 OF 12



DMA/MEMORY DATA INTERFACE

RELEASED PRINT

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic/four corporation 1335 South Cloudina Street Anaheim, California 92806
			DRAWN
			CHKD
			ENG
			MFG
			APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	TITLE SIZE C · DWG NO 901982 · REV F SCALE SH 3 OF 12

BYTE COUNTER

(12) LDBC-
(5) BCCLK-
5) BCEN-
(3)
MDL07-
MDL06-
MDL05-
MDL04-
MDL03-
MDL02-
MDL01-
MDL00-
(10) SPHI-
(12) SPEN-
(10) SPLØ-
PARAMETER PAD
(10) LDCAL-
(12) INCSPD
(2) DPH2-
(4) TERM-
(11) HSKEEP
SPFUL
SPFUL- (10)
(10) LDCA-
(2) FF3-
(10) INCCA-
(2) ADDEN
[3] P2-1 STARTB-
DPH2-
+5V
R2 1K
R3 1K
(2) WRITE-
TERM- (4,10)
IGNR- (5,9,10)
IGNR (5,11)
BCZ- (5,10,11)
74837 . 743B 16 PLACES
DMA15 PI-B57
MA14- PI-B9
MA13- PI-B18
MA12- PI-B7
MA11- PI-B13
MA10- PI-A12
MA09- PI-A11
MA08- PI-B14
MA07- PI-A9
MA06- PI-A15
MA05- PI-A54
MA04- PI-A53
MA03- PI-A50
MA02- PI-B55
MA01- PI-B53
MA00 PI-B51
INTERFACE
CURRENT ADDRESS REGISTER
74LS169 LS169
74LS161A
74S189
LS00 LS04 LS08 LS32 LS74 74368

RELEASED PRINT

CONTROL DATA REGISTERS

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic/four corporation 1335 South Claudina Street Anaheim, California 92805
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	DRAWN / CHKD / ENG / MFG / APP TITLE SIZE C DWG NO 901982 REV F SCALE SH 4 OF 12

FIFØ ØUTPUT CONTRØL

(2)REED
(2) FF1
(2) DPH2
[10] P2-25 SØFD-
P2-26
(10) FIFCMP-
(4) BCZ-
(6) ØRF
(2) DPH2-
(2) FF3
(2) WRITE
(8) LRSFIF-
(10) ARGFIF-
(10) PULLUPA
(6) IRF
(2) SYSRST-
(10) SIFD
4 IGNR
(12) LDBC-
(2) SRCH-
(12) DECBC-
(2) REED-
(4) IGNR-
(2) FF1

10H 74LS10 — SØFM-
10G 74LS20 — SØF (6)
10H 74LS10 — DUMP-
ØRFSYN
LS74 9G
9L LS00
9J LS08
PNDING
LS74 9H
SIFM-
10G LS20 — SIF (6)
LS74 9K
IRFSYC
9L 74LS00 — SIFD-
11G 74LS10
11H 74LS04
11H 74LS04
8F 74LS00
10J 74LS32
11J
74S51

+5V
R4 1K
PULB (10)

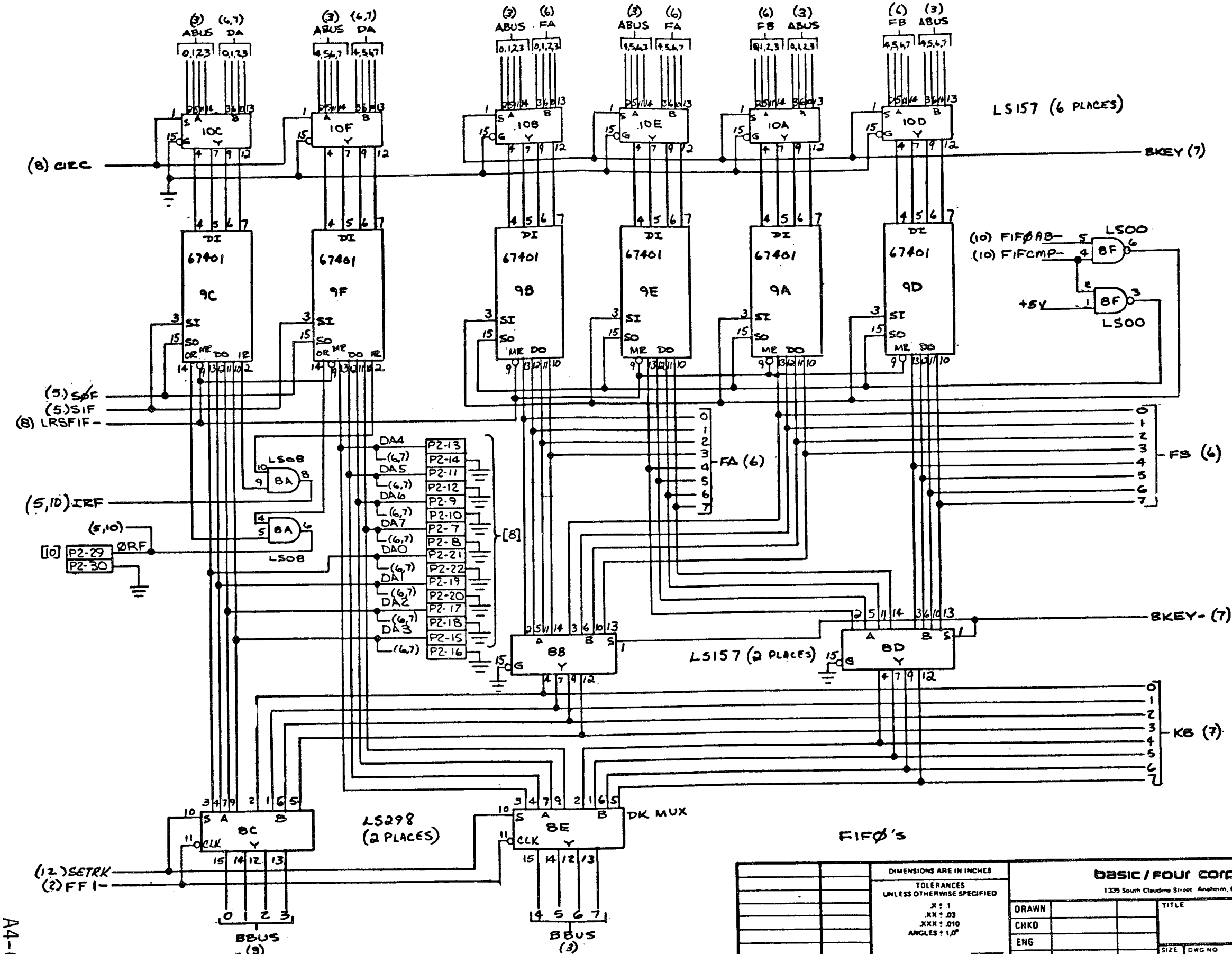
FIFØ INPUT CØNTRØL

BCCLK- (4)
BCEN- (4)

BYTE COUNTER CONTROL

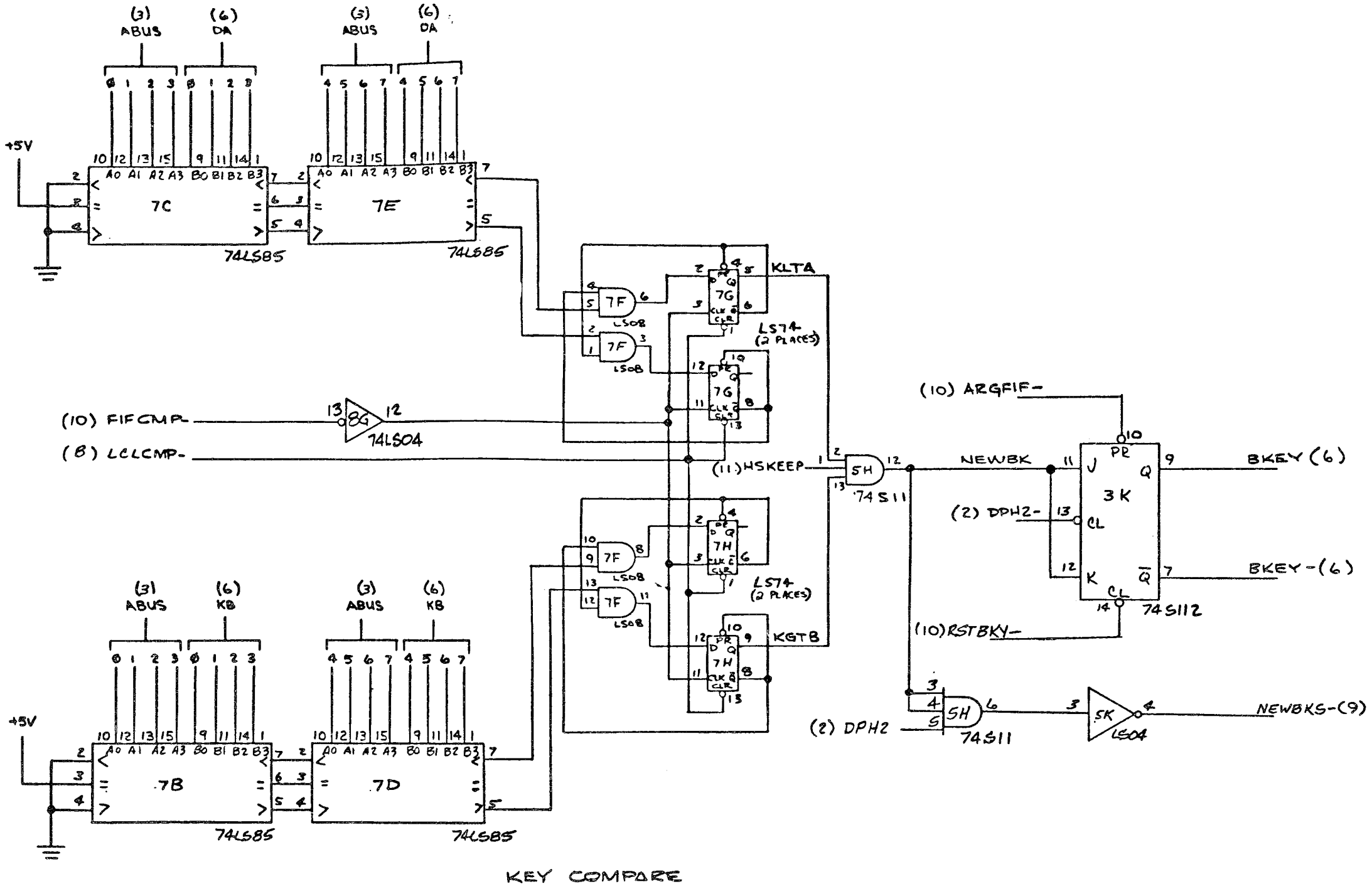
RELEASED PRINT

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic / four corporation 1335 South Claudina Street Anaheim, California 92805
			DRAWN CHKD ENG MFG APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	TITLE SIZE DWG NO 901982 REV F SCALE SH 5 OF 12



RELEASED PRINT

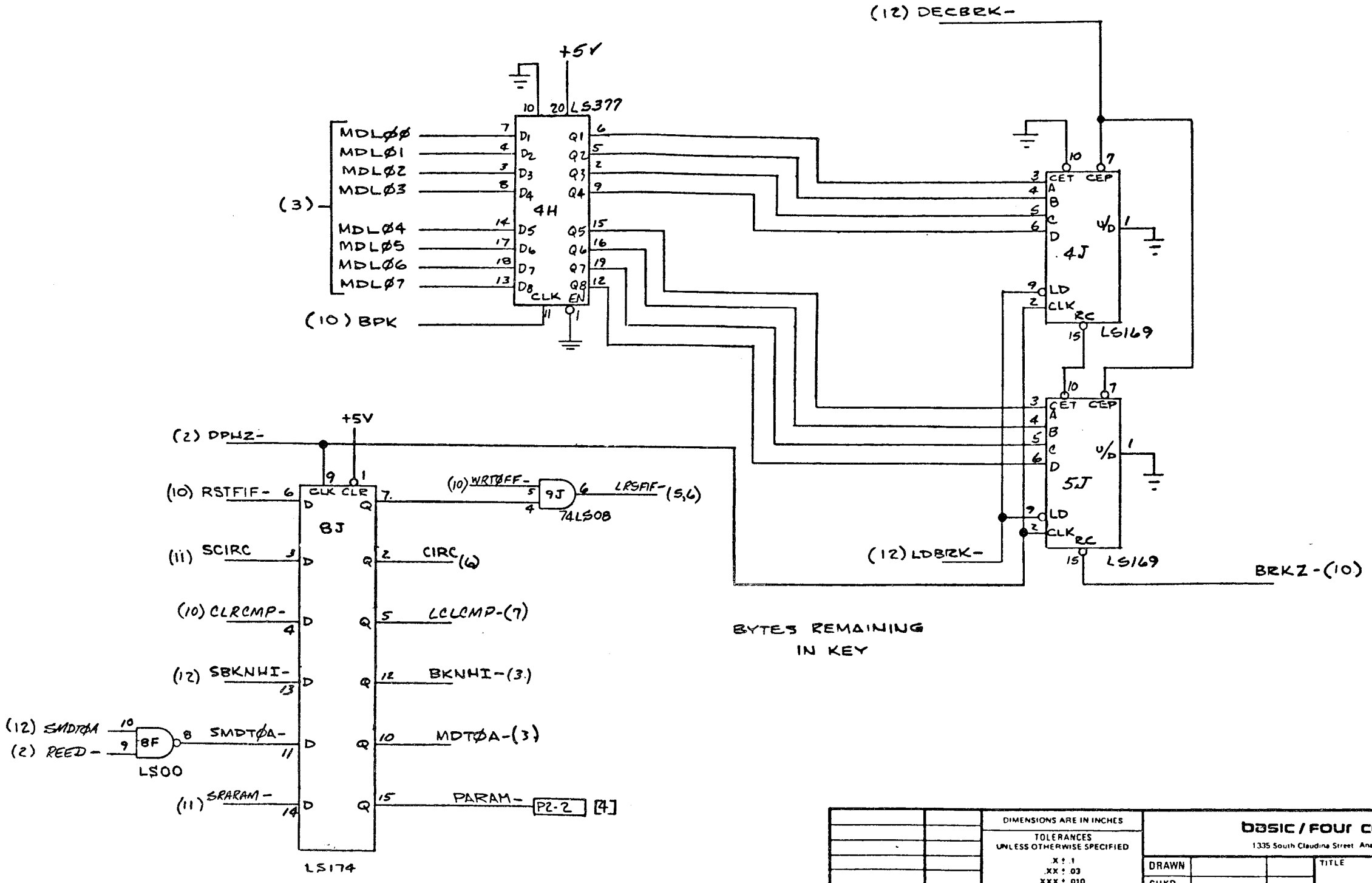
		DIMENSIONS ARE IN INCHES	basic/four corporation		
		TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0°	1335 South Claudina Street Anaheim, California 92806		
			DRAWN	TITLE	
			CHKD		
			ENG	SIZE C DWG NO 901982	REV F
		MACHINED SURFACES √	MFG		
			APP	SCALE	SH 6 OF 12
NEXT ASSY	USED ON	DO NOT SCALE DRAWING			



KEY COMPARE

RELEASED PRINT

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED X ± .1 XX ± .03 XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic / four corporation 1335 South Claudina Street Anaheim, California 92805
			DRAWN / CHKD / ENG / MFG / APP
			TITLE
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	SIZE C · DWG NO 901982 · REV F · SCALE · SH 7 OF 12



RELEASED PRINT

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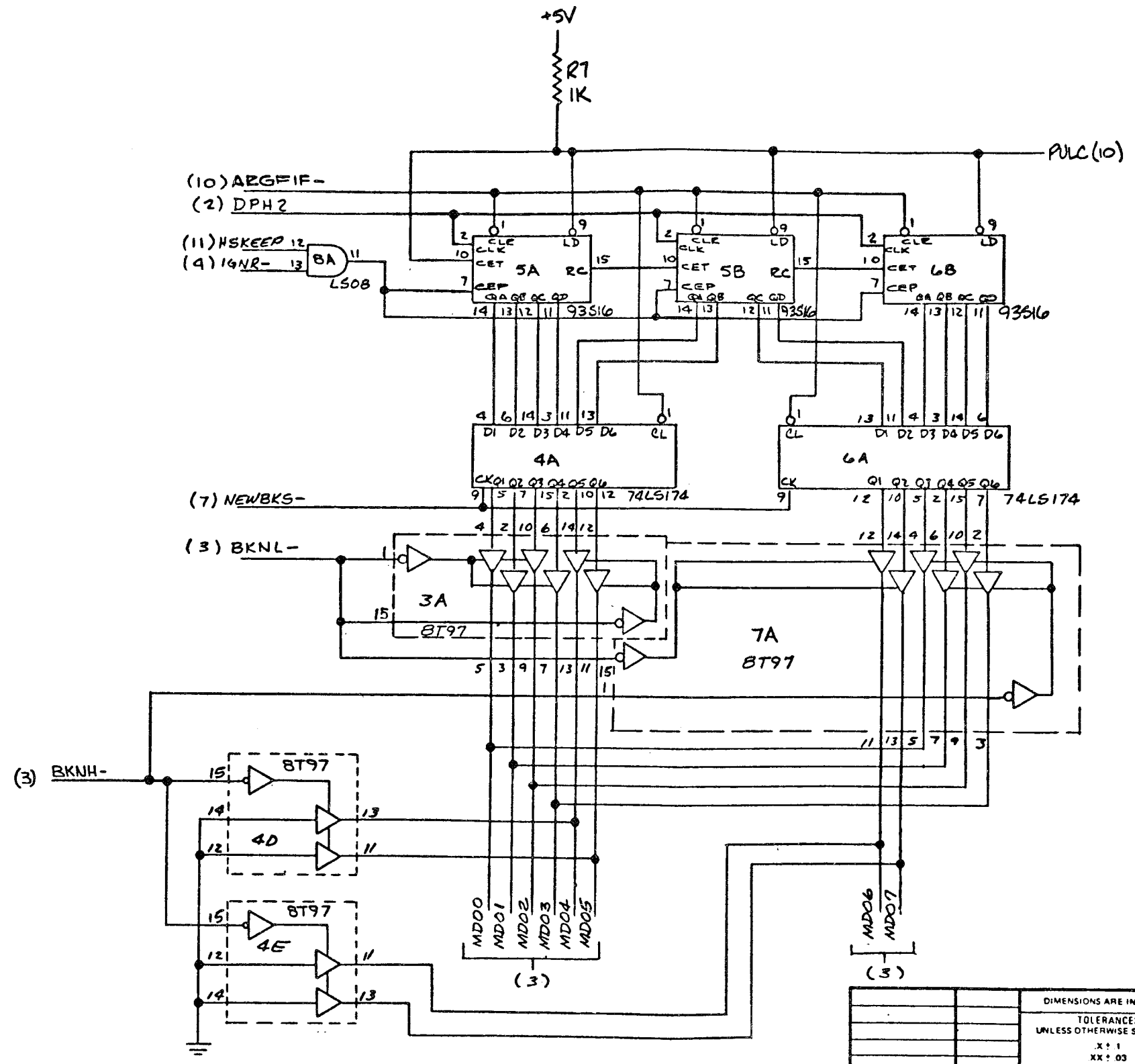
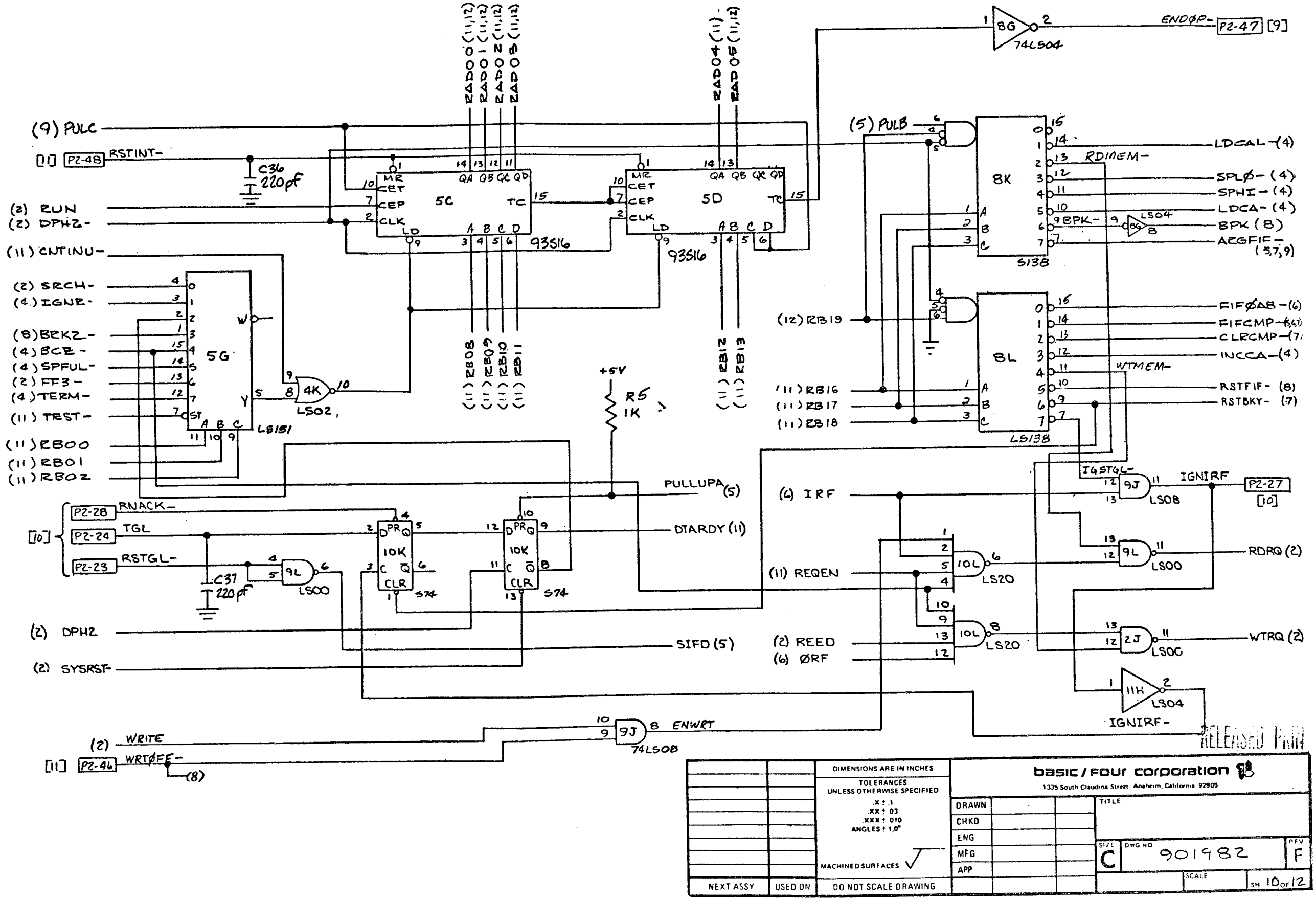
NEXT ASSY	USED ON		DRAWN	TITLE	
			CHKD		
			ENG		
			MFG	SIZE C DWG NO 901982 REV F	
			APP	SCALE SH 8 OF 12	



BEST KEY NUMBER

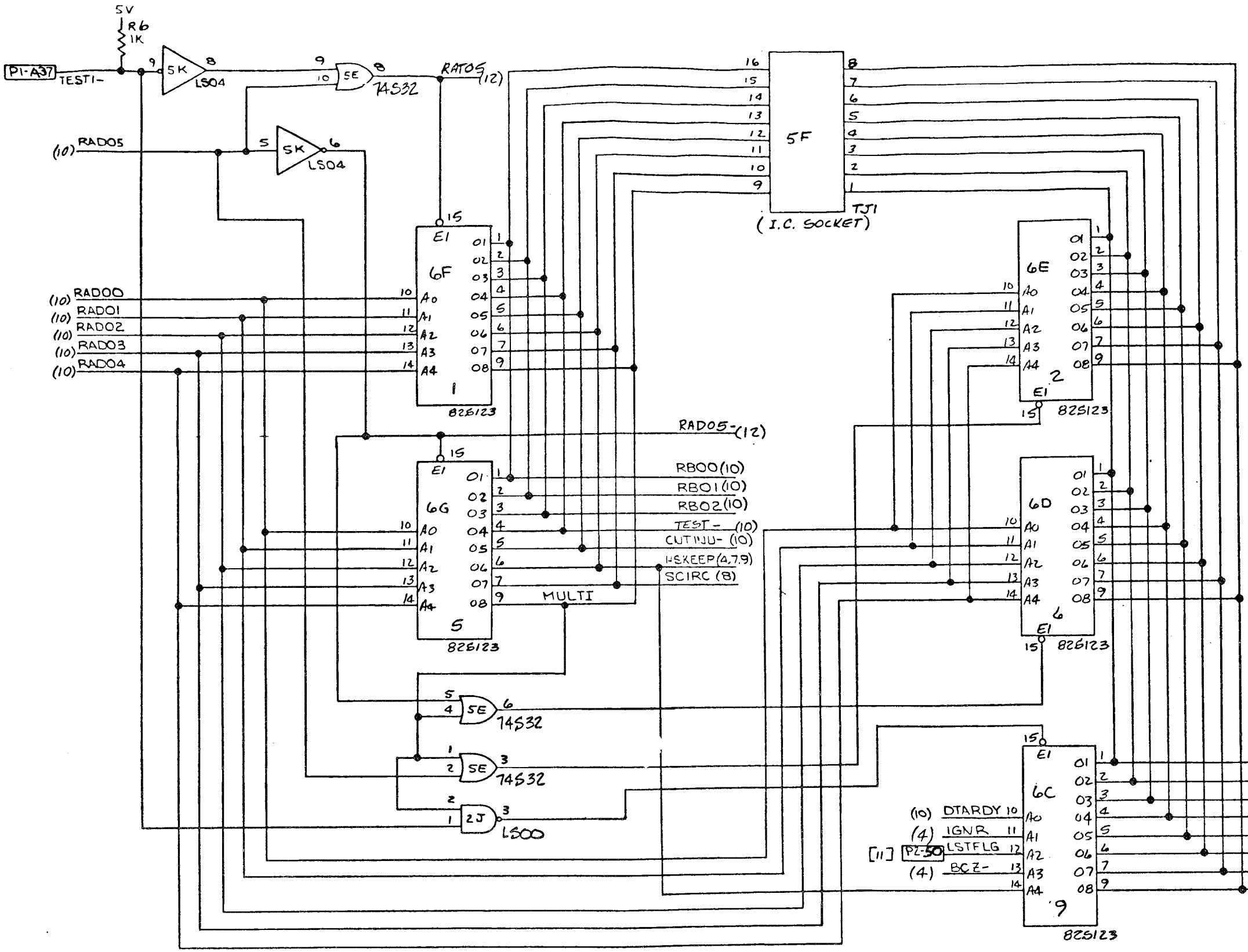
RELEASED PRINT

		DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± 1 XX ± .03 XXX ± .010 ANGLES ± 1.0° MACHINED SURFACES √	basic / four corporation 1335 South Claudina Street Anaheim, California 92805
			DRAWN / CHKD / ENG / MFG / APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	TITLE SIZE C · DWG NO 901982 · REV F SCALE SH 9 OF 12



RELEASED PRINT

		DIMENSIONS ARE IN INCHES	basic / four corporation		
		TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± 03 .XXX ± 010 ANGLES ± 1,0°	1335 South Claudina Street Anaheim, California 92805		
			DRAWN	TITLE	
			CHKD		
			ENG		
		MACHINED SURFACES √	MFG	SIZE C DWG NO 901982	REV F
			APP		
NEXT ASSY	USED ON	DO NOT SCALE DRAWING		SCALE	SH 10 OF 12



RELEASED PRINT

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		TOLERANCES UNLESS OTHERWISE SPECIFIED .X ± .1 .XX ± .03 .XXX ± .010 ANGLES ± 1.0°	1335 South Claudina Street Anaheim, California 92805
		MACHINED SURFACES √	DRAWN / CHKD / ENG / MFG / APP
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	TITLE
			SIZE: DWG NO 901982 REV F
			SCALE: SH 11 OF 12