

Shugart

Auto-Load Digital
Tape Drive

Model 9610/9660

Operation and Maintenance
Manual

P/N 93-09610-004

FCC CERTIFIED COMPUTER EQUIPMENT

This equipment, freestanding with shielded Data and Control Cables, complies with Part 15, Subpart J of FCC Rules Governing Class A Computing Devices Operated In A Commercial Environment. However, the equipment generates radio frequency energy and, when operated in a residential area, the user must take adequate precautions against interference to radio communications.

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SECTION I

GENERAL DESCRIPTION AND APPLICATION DATA

1.1 GENERAL DESCRIPTION

The Shugart Model 9610/9660 Tape Drive (Figure 1-1) is rack mountable (9610) and desk-top (9660) automatic load, tape drive that includes an embedded Formatter capable of communicating between an industry standard interface bus and ANSI-compatible PE 1600 and 3200 CPI, NRZI 800 CPI and GCR 6250 CPI tapes. The drive can operate in Streaming Mode at 100 ips or Start/Stop Mode at 50 ips, and can read in either forward or reverse direction in all densities.

1.1.1 HOST INTERFACE

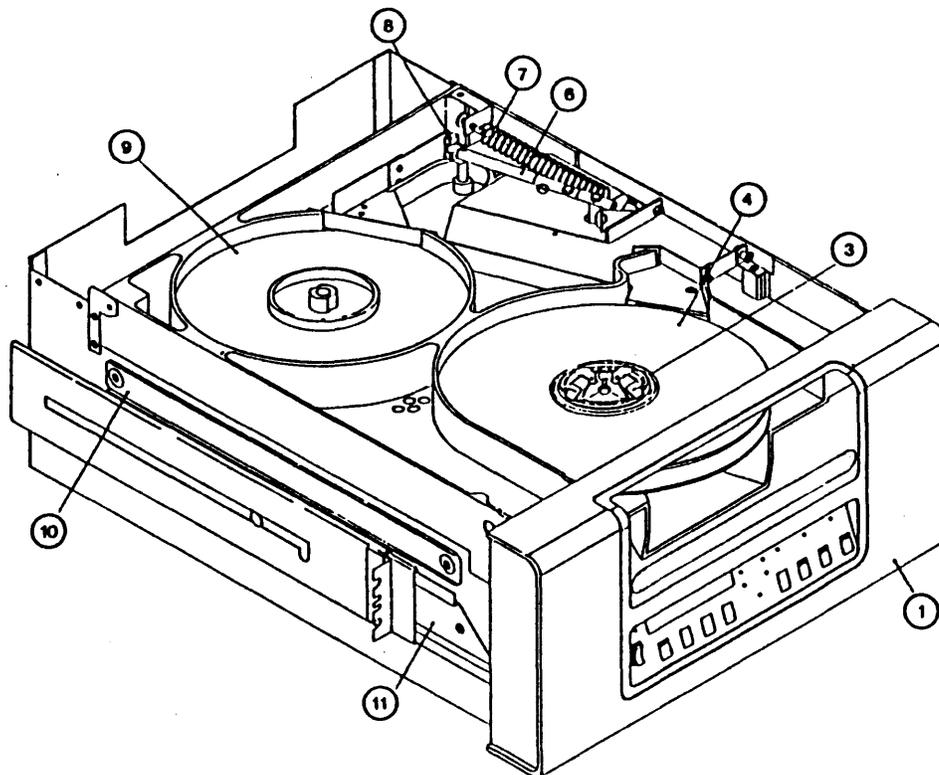
The 9610/9660 Drive has Industry Standard Interface for Formatted 1/2-inch Tape Drives.

1.1.2 MICROCOMPUTER BASED DESIGN

The 9610/9660 uses two microprocessors: one in the Formatter, and one in the Drive Control Electronics.

1.1.3 DIAGNOSTICS AND FAULT ISOLATION

The 9610/9660 includes built-in diagnostics with front-panel eight-character LED readout.



<u>Item</u>	<u>Part</u>	<u>Item</u>	<u>Part</u>
1	Panel Assembly	7	Spring, Extension
2	Supply Arm Assembly (bottom, hidden)	8	Take-up Arm Limit Sensor PCBA
3	Supply Hub Assembly	9	Vacuum Hub Assembly
4	Supply Reel Tape	10	Support Bar
5	Magnetic Head Assembly (hidden)	11	Slide Set
6	Take-up Arm Assembly (top)		

Figure 1-1. Model 9610/9660 Auto-load Tape Drive

1.2 SPECIFICATIONS

1.2.1 OPERATIONAL SPECIFICATIONS (Note: See Appendix A for parameter definitions.)

Table 1-1. Operational Specifications

TAPE					
Width	0.498 (±0.002) inch				
Thickness	1.9 or 1.3 mil (0.038 or 0.0226mm)				
Tension	8.75 ±0.5 ounces				
Reel Size (Open Reels - inches)	<u>6.0</u>	<u>7.0</u>	<u>8.5</u>	<u>10.5</u>	<u>Thickness</u>
Tape Length (feet):	200	600	1200	2400	1.9 mil
				3600	1.3 mil
Reel Capacity	(See Table 1-2)				
PERFORMANCE					
Recording Densities:			Tape Speed:		
NRZI	800 CPI		Start/Stop	50 ips	
PE	1600 CPI		Streaming	100 ips	
DDPE	3200 CPI		Rewind, nominal	200 ips	
GCR	6250 CPI				
Gap Length	NRZI/PE 0.6 inch (nominal-Read/Write), GCR 0.3 inch				
Data Access Time (nominal):					
			<u>Time</u>		
<u>Operation</u>	<u>Density</u>		<u>50 IPS</u>	<u>100 IPS</u>	<u>125 IPS</u>
Read	800/1600/3200		12.4 ms	20.6 ms	125.2 ms
	6250		16.4 ms	20.0 ms	122.7 ms
Write	800/1600/3200		8.6 ms	19.1 ms	124.0 ms
	6250		18.4 ms	18.2 ms	121.5 ms
Command Reconstruct Time (with Autospeed Disabled):					
			<u>Time</u>		
<u>Operation</u>	<u>Density</u>		<u>50 IPS</u>	<u>100 IPS</u>	<u>125 IPS</u>
Read	800/1600/3200		0.7 ms	4.2 ms	2.6 ms
	6250		0.7 ms	2.0 ms	1.45 ms
Write	800/1600/3200		0.7 ms	3.8 ms	2.70 ms
	6250		3.0 ms	1.2 ms	1.05 ms
Maximum Latency for Reinstruction on Ramp:					
<u>Operation</u>	<u>Density</u>		<u>Speed</u>	<u>Time</u>	
Read	800/1600/3200		50 IPS	3.2 ms	
	6250		50 IPS	2.9 ms	
Write	800/1600/3200		50 IPS	3.2 ms	
	6250		50 IPS	3.0 ms	
Reinstruct Time Limits for Auto Speed Transition to 100 IPS:					
<u>Operation</u>	<u>Density</u>		<u>Time</u>		
Read	800/1600/3200		3.6 ms		
	6250		1.5 ms		
Write	800/1600/3200		3.2 ms		
	6250		1.0 ms		

Table 1-1. Operational Specifications (Continued)

Reposition Time, Streaming Mode:				
<u>Operation</u>	<u>Density</u>	<u>Time</u>		
		<u>50 IPS</u>	<u>100 IPS</u>	<u>125 IPS</u>
Read	800/1600/3200		42.5 ms	355 ms
	6250	8 ms	43.5 ms	355 ms
Write	800/1600/3200		42.5 ms	355 ms
	6250	35 ms	41.5 ms	355 ms

Data Transfer Rate:			
<u>Speed</u>	<u>Density (CPI)</u>	<u>Rate (KB/SEC)</u>	
		<u>Normal</u>	<u>Maximum</u>
50 ips	NRZI 800	40	48
	PE 1600	80	96
	DDPE 3200	160	192
	GCR 6250	312.5	375
100 ips	NRZI 800	80	96
	PE 1600	160	192
	DDPE 3200	320	384
	GCR 6250	625	760
125 ips	NRZI 800	100	150
	PE 1600	200	250
	DDPE 3200	400	500
	GCR 6250	781	976

POWER REQUIREMENTS

AC Units		
<u>Input Voltage</u>	100, 120, 220, 240 VAC +15% -10%	
	50 or 60 Hz ±2 Hz	
<u>Input current</u>	<u>120 VAC</u>	<u>220 VAC</u>
	3.0 amps	1.5 amps
<u>Power: Nominal</u>	300 watts	300 watts
<u>Peak</u>	400 watts	400 watts
<u>Fuse: Standard</u>	6 amp at 110/120	3 amp at 220/240 VAC (Slo-Blo)
<u>Dual European (Optional)</u>	6.3T amp at 110/120	3.15T amp at 220/240 VAC
<u>Heat Dissipation</u>	1025 BTU/hr	

DC Units		
<u>Input Voltage</u>	48, 60VDC +20%-10%	
<u>Input Current</u>	<u>48 VDC</u>	<u>60 VDC</u>
	7.5 amps	5.5 amps
<u>Power: Nominal</u>	350 watts	350 watts
<u>Peak</u>	450 watts	450 watts
<u>Fuse</u>	12 amp	10 amp
<u>Heat Dissipation</u>	1194 BTU/hr	

Table 1-2. Tape Reel Capacities

Reel Size (inches)	Tape Thickness				1.3 mil	Blocks (Bytes)
	1.9 mil	1.9 mil	1.9 mil	1.9 mil		
NRZI (MBytes)	6	7	8.5	10.5	10.5	512
	1	3	6	10	15	2K
	1.5	5	9	17	25	8K
	1.8	5.5	11	21	32	64K
PE (MBytes)	2	6	12	23	34	512
	1.3	4	8	15	22	2K
	2.5	8	15	30	45	8K
	3.5	11	21	41	62	64K
DDPE (MBytes)	4	12	23	45	68	512
	2.5	8	15	30	44	2K
	5	15	30	60	90	8K
	7	21	41	82	120	64K
GCR (MBytes)	8	23	45	90	134	512
	3.2	10	19	37	56	2K
	8	23	46	91	136	8K
	12	37	73	145	218	64K
	15	44	88	175	262	

1.2.2 PHYSICAL/ENVIRONMENTAL SPECIFICATIONS (Table 1-3)

Table 1-3. Physical/Environmental Specifications

PHYSICAL SPECIFICATIONS		
Dimensions:		
Height	8.75 inches (22.23 cm)	
Width	17.00 inches (43.18 cm)	
Depth: From Mounting Surface	22.00 inches (55.88 cm)	
Depth: Overall	24.50 inches (62.23 cm)	
Mounting:	Slide Mount in standard 19-inch RETMA Rack	
Weight:	9610 (with Slides)	9660
No Packing Material	110 lbs (49.5 Kgm)	122 lbs. (54.9 Kgm)
With Packing Material	135 lbs (60.75 Kgm)	152 lbs (68.4 Kgm)
ENVIRONMENTAL SPECIFICATIONS		
Temperature, operating	60 to 90°F (15.6 to 32.2°C)	
Temperature, non-operating	-40 to +122°F (-40 to +50°C)	
Humidity, (with wet bulb)	Operating (+78° max) 20 to 80%	Storage (+83° max) 5 to 90%
Altitude, operating	-1300 to 10,000 ft. (-400 to 3000 meters)	
Altitude, shipping	-1300 to 50,000 ft. (-400 to 15000 meters)	

1.3 INTERFACE SPECIFICATIONS

1.3.1 GENERAL

This section describes the signal requirements and characteristics of the interface between the tape drive and the controller. The connectors and cable requirements are described, as well as the actual lines and the commands derived from the lines. The interface lines are summarized in Tables 1-4A and 1-4B while the command structure is summarized in Table 1-5.

1.3.2 INTERFACE CONNECTORS

The interface connectors on the Model 9610/9660 are designed for standard fifty line shielded cables. For each active connector pin there is an associated ground pin. The mating interface connectors are two 50-pin card cage connectors.

1.3.3 INTERFACE SIGNAL CHARACTERISTICS

Signals from the controller to the Model 9610/9660 must conform to the following specifications:

Levels:	1 = Low	= True	= 0V (+0.7 Vdc)	NOTE: Total edge transmission Delay =<200 nanosec over a 20-foot cable.
	0 = High	= False	= +3V (± 0.5 Vdc)	
Pulses:	1 = Low	= True	= 0V (+0.7 Vdc)	
	0 = High	= False	= +3V (± 0.5 Vdc)	

All output signals from the Model 9610/9660 are driven by open collector type line drivers capable of sinking up to 36 mA (25 standard unit loads) in the low true state. Open lines will result in false signal levels.

1.3.4 INTERFACE CABLES

To meet FCC and Electrostatic Discharge (ESD) specifications, interface cables should be braided and shielded with maximum allowable length of 20 feet.

1.3.5 RECEIVER/DRIVER CONFIGURATION AND TERMINATION

The input lines to the transport are terminated with a 220 ohm resistor to plus five volts, and a 330 ohm resistor to ground (Figure 1-2). All input circuits have low level input voltage of 0.7 V maximum and a high level input voltage of 2.0 V minimum. The input receivers are all 74LS type circuits.

All output lines must be terminated at the far end of the daisy chained cable with a 220 ohm resistor to plus five volts and a 330 ohm resistor to ground. Output circuits are 7438 open collector drivers as shown in Figure 1-2.

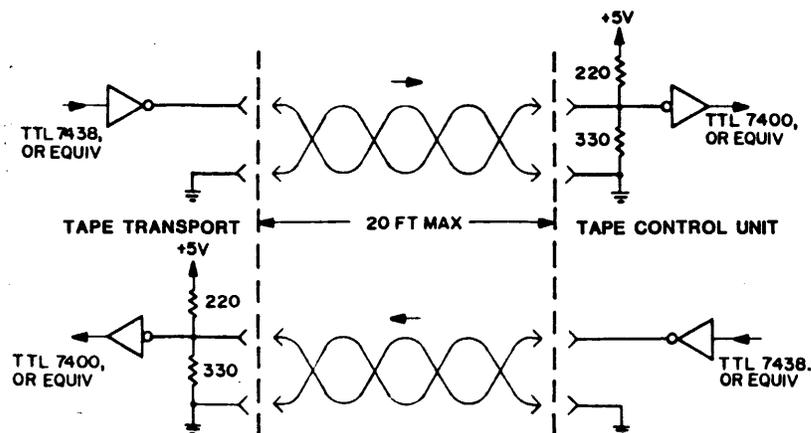


Figure 1-2. Receiver/Driver Interface Configuration

1.3.6 DAISY CHAINING

The 9610/9660 transport may be configured to allow operation of up to eight transports with a single controller as shown in Figure 1-3.

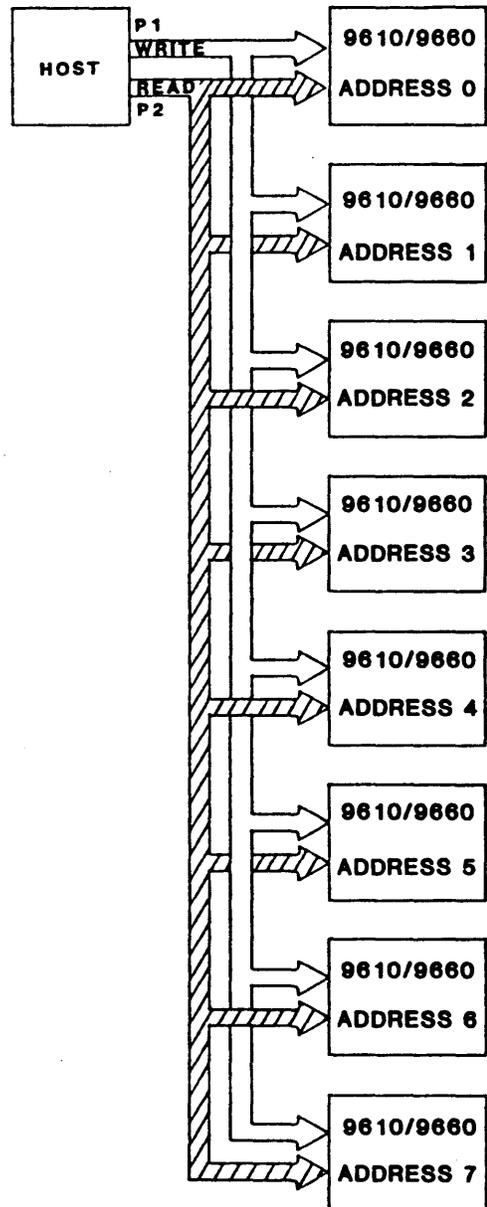


Figure 1-3. Daisy Chaining

1.4 INTERFACE INPUT AND OUTPUT SIGNALS

The following sections tabulate and describe Host/Drive interface signals. Input Signals (IN) are Signals from the Host; Output Signals (OUT) are Signals to the Host. Tables 1-4A and 1-4B list Host-to-Drive I/O Signals. Connector Signal/Pin assignments include Signal and Ground Pins and related Signal Mnemonic.

Table 1-4A. Drive Interface Summary, Connector P2

Pin Sig/Grd	Mnemonic	Signal Name	In/Out
P2-1/5	RP	Read Data P	Out
P2-2/5	R0	Read Data 0	Out
P2-3/5	R1	Read Data 1	Out
P2-4/5	LDP	Load Point	Out
P2-6/5	R4	Read Data 4	Out
P2-8/7	R7	Read Data 7	Out
P2-10/9	R6	Read Data 6	Out
P2-12/11	HER	Hard Error	Out
P2-14/13	FMK	File Mark	Out
P2-16/15	ID/CCG	ID Burst/Check Char Gate	Out
P2-18/17	FEN	Formatter Enable	In
P2-20/19	R5	Read Data 5	Out
P2-22/21	EOT	End of Tape	Out
P2-24/23	OFL	Off-Line	In
P2-26/25	DEN1	Density 1	Out
P2-28/27	RDY	Ready	Out
P2-30/29	RWG	Rewinding	Out
P2-32/31	FPT	File Protect	Out
P2-34/33	RSTR	Read Strobe	Out
P2-36/35	WSTR	Write Strobe	Out
P2-38/37	DBY	Data Busy	Out
P2-40/39	SPD	Speed	Out
P2-42/41	CER	Corrected Error	Out
P2-44/43	ONL	On-Line	Out
P2-46/45	TAD1	Transport Address 1	In
P2-48/47	FAD	Formatter Address	In
P2-50/49	HSP	High Speed	In

Table 1-4B. Drive Interface Summary, Connector P1

Pin Sig/Grd	Mnemonic	Signal Name	In/Out
P1-2/1	FBY	Formatter Busy	Out
P1-4/3	LWD	Last Word	In
P1-6/5	W4	Write Data 4	In
P1-8/7	GO	Initiate Command	In
P1-10/9	W0	Write Data 0	In
P1-12/11	W1	Write Data 1	In
P1-14/13	DEN0	Density 0	Out
P1-16/15	LOL	Load On-Line	In
P1-18/17	REV	Reverse/Forward	In
P1-20/19	REW	Rewind	In
P1-22/21	WP	Write Data P	In
P1-24/23	W7	Write Data 7	In
P1-26/25	W3	Write Data 3	In
P1-28/27	W6	Write Data 6	In
P1-30/29	W2	Write Data 2	In
P1-32/31	W5	Write Data 5	In
P1-34/33	WRT	Write/Read	In
P1-36/35	LGP	Long Gap	In
P1-38/37	EDT	Edit	In
P1-40/39	ERS	Erase	In
P1-42/41	WFM	Write File Mark	In
P1-44/43	EEOT	Early End of Tape	Out
P1-46/45	TAD0	Transport Address 0	In
P1-48/47	R2	Read Data 2	Out
P1-50/49	R3	Read Data 3	Out

1.4.1 INTERFACE INPUT SIGNALS (from Host to Drive)

1.4.1.1 TRANSPORT ADDRESS, FORMATTER ADDRESS

TAD0, TAD1, FAD Level P2-48, P1-46, P2-46

The states of these lines determine which of up to eight tape drives are selected by the controller. The following list defines the tape drives addresses produced as a result of the various TAD0, TAD1, FAD.

<u>FAD</u>	<u>TAD0</u>	<u>TAD1</u>	<u>ADDRESS</u>
0	0	0	SLT0
0	0	1	SLT1
0	1	0	SLT2
0	1	1	SLT3
1	0	0	SLT4
1	0	1	SLT5
1	1	0	SLT6
1	1	1	SLT7

1.4.1.2 INITIATE COMMAND - GO

GO Pulse P1-3

A pulse which initiates any command specified by the command lines described in the following paragraphs. Information on the command lines is copied into the unit on the trailing edge of the GO pulse. At the end of the reinstruct window in streaming write commands only, it is possible for the Host to extend the reinstruct window by asserting and holding the GO pulse in a true state. The unit will continue to stream for up to one inch waiting for the trailing edge of the GO pulse as the Host returns GO to the false state. If one inch is exceeded and the GO pulse has yet to be denied, the unit shall enter a reposition cycle. This feature in effect creates extended gaps.

1.4.1.3 REVERSE

REV Level P1-18

Command line refer to Table 1-5.

1.4.1.4 WRITE

WRT Level P1-34

Command line refer to Table 1-5.

1.4.1.5 WRITE FILE MARK

WFM Level P1-42

Command line refer to Table 1-5.

1.4.1.6 EDIT

EDT Level P1-38

Command line refer to Table 1-5.

1.4.1.7 ERASE

ERS Level P1-40

Command line refer to Table 1-5.

1.4.1.8 HIGH SPEED

HSP Level P2-50

When true, this signal causes the selected on-line unit to operate in the high speed mode (100 ips).

1.4.1.9 LONG GAP

LGP Level P1-36

When true during a Write Mode, this level causes the generation of a longer Interrecord Gap (erased area on tape) to allow ample reinstruct periods as required for Host system latencies. Long Gap Time is limited by its setting in Set-Up Options (described in Section IV), but terminates automatically if a Write Command is received before the selected limit.

1.4.1.10 REWIND

REW Pulse P1-20

A pulse which causes the selected transport to rewind to load point. This pulse does not cause the formatter to go busy. The Ready status will remain false during rewind. In daisy chained systems, the rewind pulse can be issued to one or more of the units in the chain while allowing data transfer operations to occur on any other unit in the chain.

1.4.1.11 OFF-LINE/UNLOAD

OFL Pulse P2-24

This pulse causes the transport to go off-line immediately, then rewind to load point and unload the tape.

1.4.1.12 LAST WORD

LWD Level P1-4

When this level is true during a write or variable erase command, it indicates that the next character to be strobed into the formatter is the last character of the record. LWD should go true when the last data character is placed on the interface lines.

1.4.1.13 FORMATTER ENABLE

FEN Level P2-18

When false this level causes all units in a daisy chain configuration to revert to the quiescent state. This line may be used to disable the units if controller power is lost or to clear unit logic when illegal commands or unusual conditions occur. When denied during command execution, the unit will abort the command in an orderly fashion and stop motion. The unit Set-Up Options (described in Section IV) allows the polarity of this level to be selected.

1.4.1.14 WRITE DATA LINES

WP, W0-W7 Level P1-22, 10, 12, 30, 26, 6, 32, 28, 24

These 9 lines transmit write data from the controller to the formatter. The 8 data bits appearing on W0-W7 are written onto the corresponding channels on tape; W7 corresponds to the least significant bit of the character. Line WP is optional and is utilized only if it is required to check the parity bit generated by the customer. The formatter generates odd parity internally on the basis of data contained on W0-W7.

The first character of a record should be available on these lines within one character period after DBY goes true and remain until the trailing edge of the first WSTR is issued by the unit. The next character of information must then be placed on these lines within one half of a character period. Subsequent characters of a record are processed in this manner until LWD is set true by the controller when the last character is transmitted.

<u>INPUT LINE</u>	<u>ANSI CHANNEL</u>	<u>ANSI TRACK</u>
W0	0	7
W1	1	6
W2	2	5
W3	3	3
W4	4	9
W5	5	1
W6	6	8
W7	7	2
WP	P	4

1.4.2.18 DENSITY

DEN0, DEN1

Level

P1-14, P2-26

Binary-coded signals that indicate the current density of the Drive. Two coding schemes are available. These schemes are:

DENSITY	DENS OUT NRZ ONLY		DENS OUT CODED	
	DEN 1	DEN 0	DEN 1	DEN 0
800	1	0	1	1
1600	0	0	0	1
3200	0	0	1	0
6250	0	0	0	0

The coding scheme used can be selected as one of the Set-Up Options (described in Section IV).

1.4.2.19 SPEED

SPD

Level

P2-40

SPD true (low) indicates the selected transport is in the high speed streaming mode. A false level indicates low speed (50 ips).

1.4.3 COMMAND EXECUTION

The following section describes the appropriate combinations of signal lines required to achieve Command Execution followed by a description of the responses of the Model 9610/9660. Command configuration for the Model 9610/9660 is shown in Table 1-5.

Table 1-5. Command Configuration

COMMAND	REV	WRT	WFM	EDT	ERS
READ FORWARD	0	0	0	0	0
READ REVERSE	1	0	0	0	0
READ REVERSE EDIT	1	0	0	1	0
WRITE	0	1	0	0	0
WRITE EDIT	0	1	0	1	0
WRITE FILE MARK	0	1	1	0	0
ERASE VARIABLE LENGTH	0	1	0	0	1
ERASE FIXED LENGTH	0	1	1	0	1
DATA SECURITY ERASE	0	1	1	1	1
SPACE FORWARD	0	0	0	0	1
SPACE REVERSE	1	0	0	0	1
FILE MARK SEARCH FORWARD	0	0	1	0	0
FILE MARK SEARCH REVERSE	1	0	1	0	0
FILE MARK SEARCH FORWARD*	0	0	1	0	1
FILE MARK SEARCH REVERSE*	1	0	1	0	1
DENSITY SELECT 800 CPI	0	1	1	1	0
DENSITY SELECT 1600 CPI	0	0	1	1	1
DENSITY SELECT 3200 CPI	1	0	1	1	1
DENSITY SELECT 6250 CPI	1	1	0	0	0
SCRUB	0	1	0	1	1

*(IGNORE DATA)

1.4.3.1 READ FORWARD

On receipt of the Read Forward command loaded into the unit with the GO pulse, the FBY signal goes true and the unit begins to accelerate the tape up to nominal velocity. When the tape is up to speed and the data block to be read is detected, DBY shall go true. Read Strobes (RSTR) accompany the decoded data. DBY will go false after the complete block has been read indicating readiness of the unit to accept a new command. If no command is received, the unit will either stop in the gap in 50 ips operation or enter a reposition operation in 100 ips operation and FBY will go false.

1.4.3.2 READ REVERSE

This command is similar to a read forward command except that the tape motion is in the reverse direction.

1.4.3.3 READ REVERSE EDIT

The Read Reverse Edit command besides providing data establishes the correct position of the tape relative to the magnetic head prior to the Host executing a Write Edit command.

1.4.3.4 WRITE

On receipt of the Write command loaded into the unit with the GO pulse, the FBY signal goes true and the unit begins to accelerate the tape up to nominal velocity. When the tape is up to speed and the data block is ready to be written, DBY shall go true. Write Strobes (WSTR) are transmitted to the Host by the unit and the Host presents each data byte to be written. When LWD is received by the unit from the Host, the unit will finish reading the block, error status shall be made available to the Host and then the unit shall force DBY false indicating the end of the block just written. FBY will remain true if a new command in the same direction is received within the command reinstruct period. If no command is received, the unit will either stop in the gap in 50 ips operation or enter a reposition operation in all 100 ips or 50 ips GCR write operation and FBY will go false.

1.4.3.5 WRITE EDIT

The Write Edit command must be preceded by a Read Reverse Edit command. The Write Edit command allows a block of the same length to be written over an already existing data block on the tape.

1.4.3.6 WRITE FILE MARK

This command invokes the writing of a file mark in the density selected.

1.4.3.7 ERASE VARIABLE LENGTH

This command causes the unit to execute a dummy write, erasing tape until Last Word (LWD) is issued by the Host. WSTR's are transmitted to the Host during the execution of this command.

1.4.3.8 ERASE FIXED LENGTH

This command invokes a 3.5 inch length of tape to be erased. This command is always executed in the forward direction of tape motion.

1.4.3.9 DATA SECURITY ERASE

This command invokes tape to be erased from the present tape position to a point 3 feet past End of Tape.

1.4.3.10 SPACE FORWARD AND SPACE REVERSE

These commands are similar to a Read Forward or Read Reverse command, except that no read strobes are returned to the Host and no error checking is performed. However, the unit will check and report if the record is a file mark.

1.4.3.11 FILE MARK SEARCH FORWARD/REVERSE

A file mark search forward command causes the unit to execute a series of read forward commands, and the reverse command, a series of read reverse commands searching for a file mark. Forward or reverse search is terminated by the presence of a file mark, 25 feet of blank tape, or BOT in reverse search. In the EOT region a gap of 5 feet results for a search termination. If the first block encountered is not a file mark and the command was issued at 50 ips, the unit will jump to 100 ips if autospeed is a selected option.

1.4.3.12 DENSITY SELECT (800 CPI / 1600 CPI / 3200 CPI / 6250 CPI)

The Density Select Command forces the unit to write tapes in the density specified. This Command is effective only when the unit is on-line, selected, the tape is at BOT, and the unit has been placed in a remote density mode (the remote density LED is ON). However, if the unit performs a read from BOT of the tape, the unit will automatically read tape at the density of the tape.

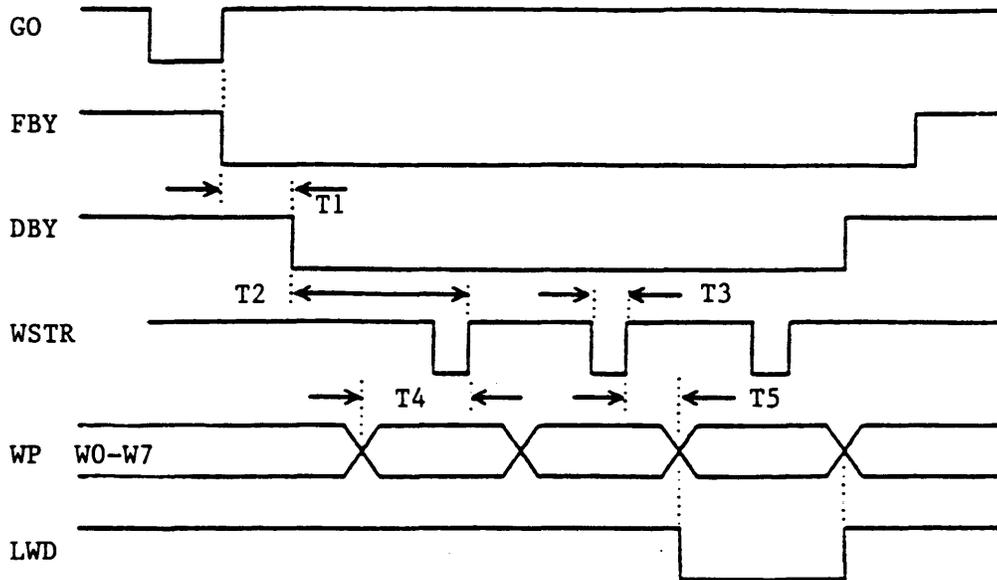
1.4.3.13 SCRUB

A Scrub Command would be issued instead of a Write Filemark to logically end a tape. The Scrub Command will cause a 25 foot gap to be written, beginning at it's current location. The Scrub Command may be ENABLED or DISABLED, depending upon the selection in the SET-UP menu (Section IV).

1.5 HOST INTERFACE TIMING

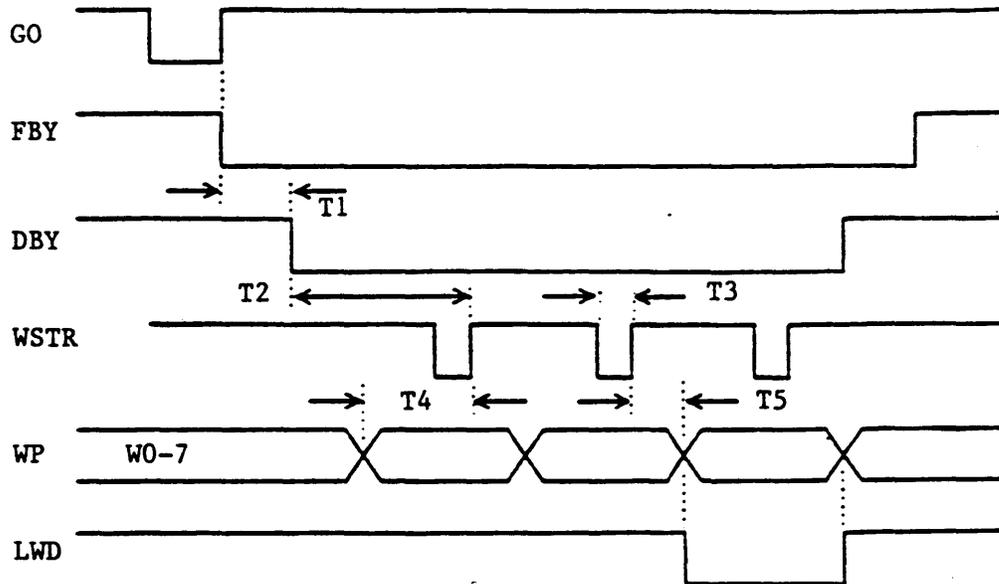
The following Figures 1-4 through 1-19 illustrate Host Interface Timing.

Note: Interface Timing diagrams are included for the 50/100 ips Drive only.



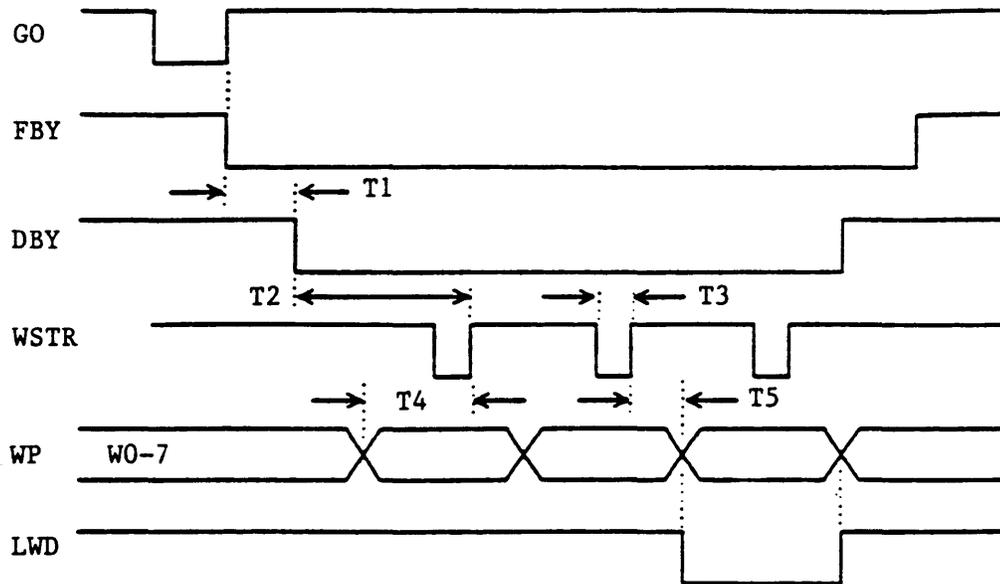
Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<4.0 mS	<8.0 mS	<5.0 mS
T2	>240 uS	>240 uS	>500 uS	>500 uS
T3	1.0 uS	1.0 uS	1.0 uS	1.0 uS
T4	>500 nS	>500 nS	>500 nS	>500 nS
T5	>250 nS	>250 nS	>250 nS	>250 nS

Figure 1-4. NRZI Write Data



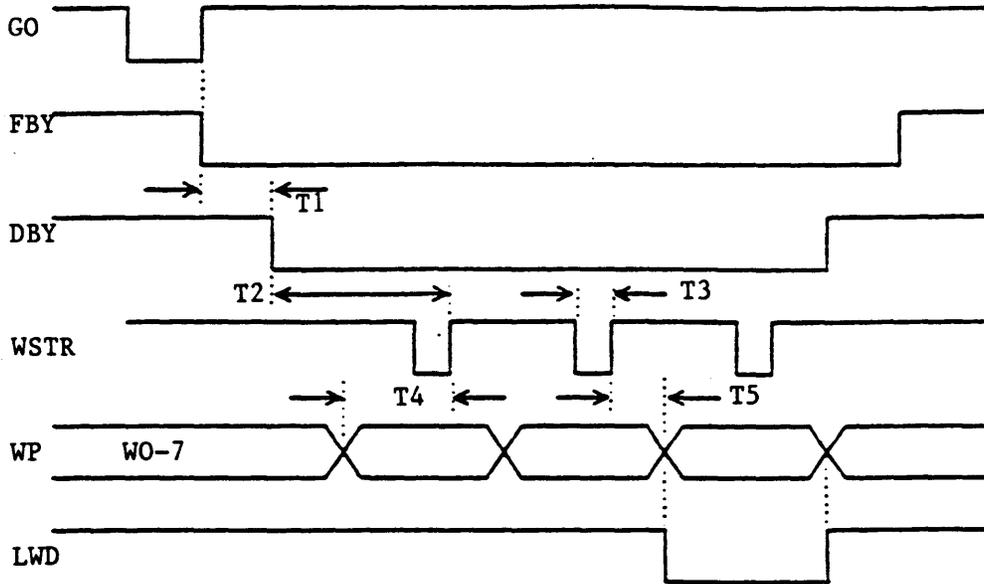
Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<4.0 mS	<8.0 mS	<5.0 mS
T2	>350 uS	>350 uS	>750 uS	>750 uS
T3	1.0 uS	1.0 uS	1.0 uS	1.0 uS
T4	>500 nS	>500 nS	>500 nS	>500 nS
T5	>250 nS	>250 nS	>250 nS	>250 nS

Figure 1-5. PE Write Data



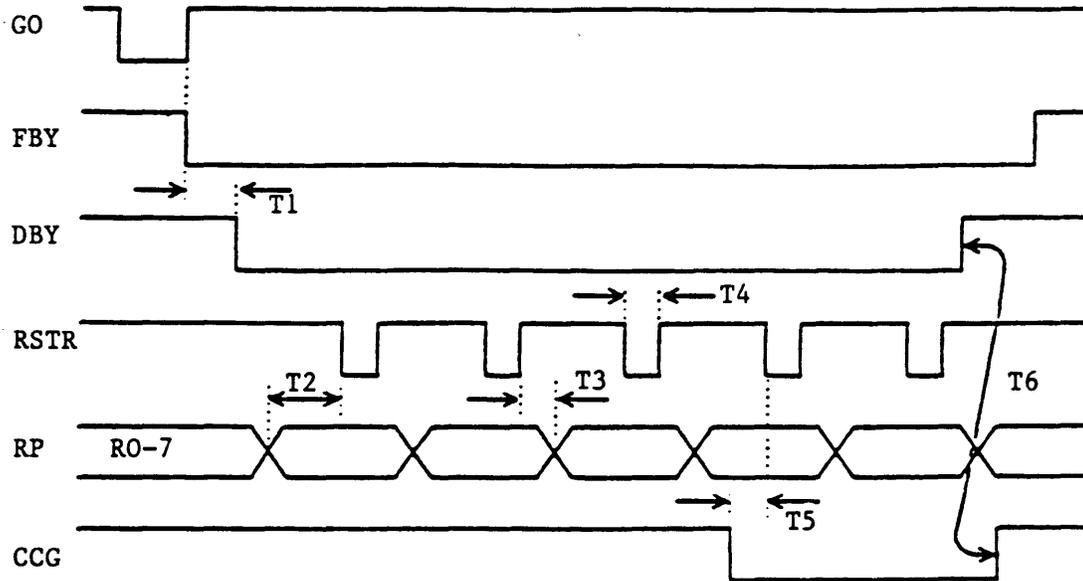
Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<4.0 mS	<8.0 mS	<5.0 mS
T2	>300 uS	>300 uS	>600 uS	>600 uS
T3	1.0 uS	1.0 uS	1.0 uS	1.0 uS
T4	>500 nS	>500 nS	>500 nS	>500 nS
T5	>250 nS	>250 nS	>250 nS	>250 nS

Figure 1-6. DDPE Write Data



Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<2.0 mS	<18.0 mS	<3.0 mS
T2	>100 uS	>100 uS	>150 uS	>150 uS
T3	530 nS	530 nS	1.0 uS	1.0 uS
T4	>500 nS	>500 nS	>500 nS	>500 nS
T5	>250 nS	>250 nS	>250 nS	>250 nS

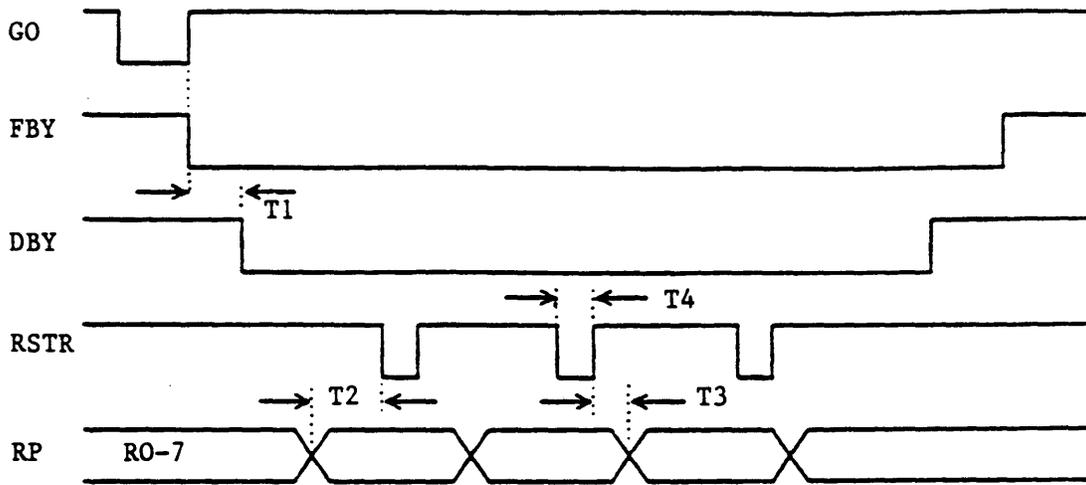
Figure 1-7. GCR Write Data



Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<4.0 mS	<8.0 mS	<5.0 mS
T2	>2.5 uS	>2.5 uS	>2.5 uS	>2.5 uS
T3	>250 nS	>250 nS	>250 nS	>250 nS
T4	2.36 uS	2.36 uS	2.36 uS	2.36 uS
T5	>2.5 uS	>2.5 uS	>2.5 uS	>2.5 uS
T6	* 70.5 uS	70.5 uS	67.3 uS	67.3 uS

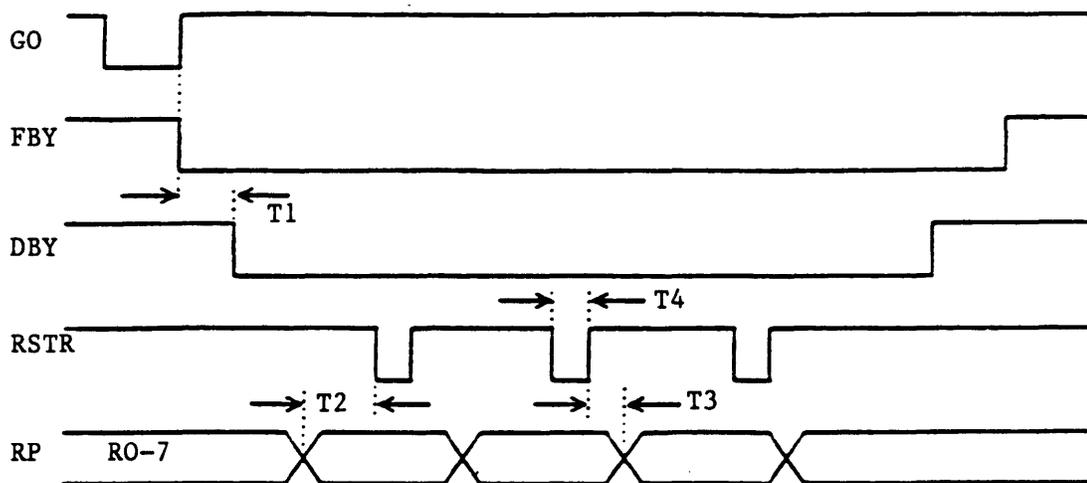
* Nominal values

Figure 1-8. NRZI Read Forward



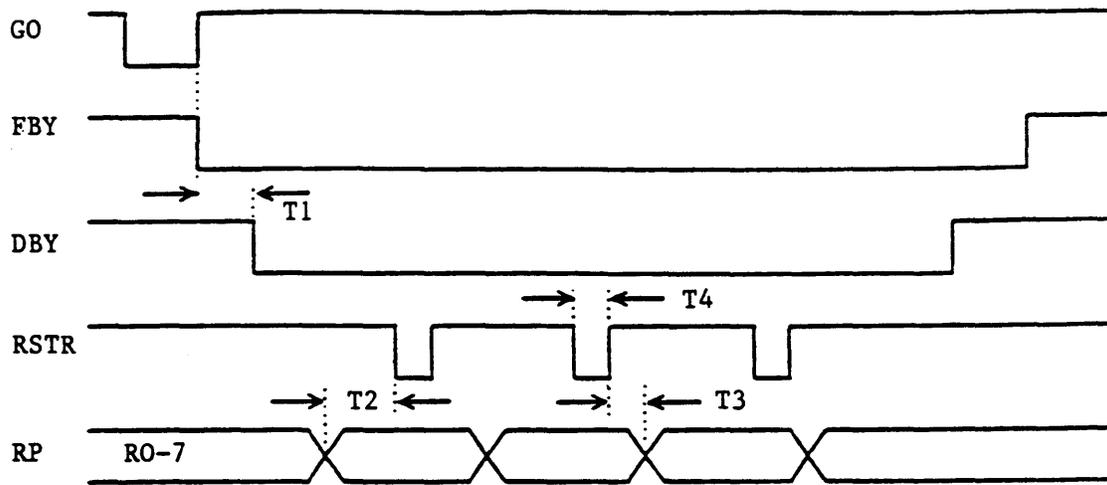
Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<4.0 mS	<8.0 mS	<5.0 mS
T2	>1.0 uS	>1.0 uS	>1.0 uS	>1.0 uS
T3	>250 nS	>250 nS	>250 nS	>250 nS
T4	670 nS	670 nS	670 nS	670 nS

Figure 1-9. PE Read Forward



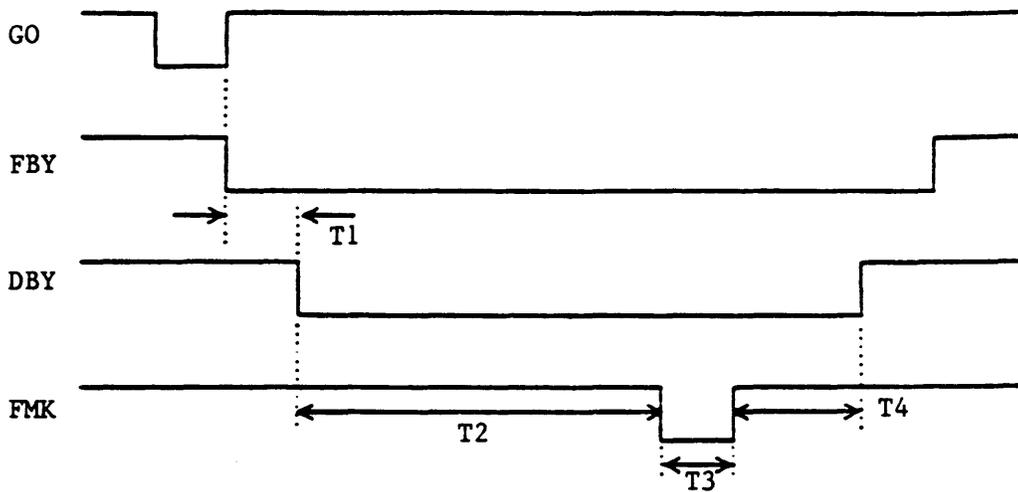
Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<4.0 mS	<8.0 mS	<5.0 mS
T2	>1.7 uS	>1.7 uS	>1.0 uS	>1.0 uS
T3	>250 nS	>250 nS	>250 nS	>250 nS
T4	670 nS	670 nS	670 nS	670 nS

Figure 1-10. DDPE Read Forward



Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<2.0 mS	<16.0 mS	<3.0 mS
T2	>500 nS	>500 nS	>1.0 uS	>1.0 uS
T3	>250 nS	>250 nS	>250 nS	>250 nS
T4	340 nS	340 nS	730 nS	730 nS

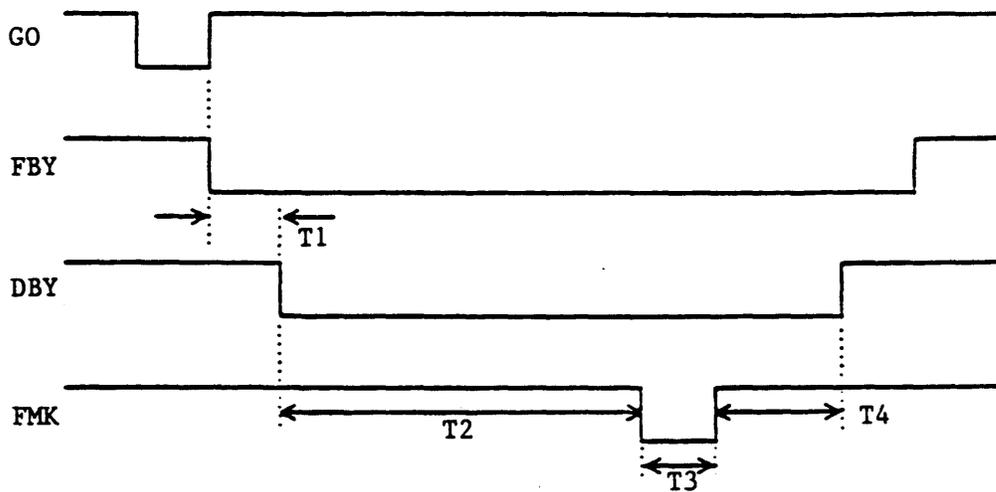
Figure 1-11. GCR Read Forward



Time		100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1		<54.0 mS	<40.0 mS	<80.0 mS	<80.0 mS
T2	*	1.8 mS	1.8 mS	3.6 mS	3.6 mS
T3		4.15 uS	4.15 uS	4.15 uS	4.15 uS
T4	*	53.0 uS	53.0 uS	53.0 uS	53.0 uS

* Nominal Values

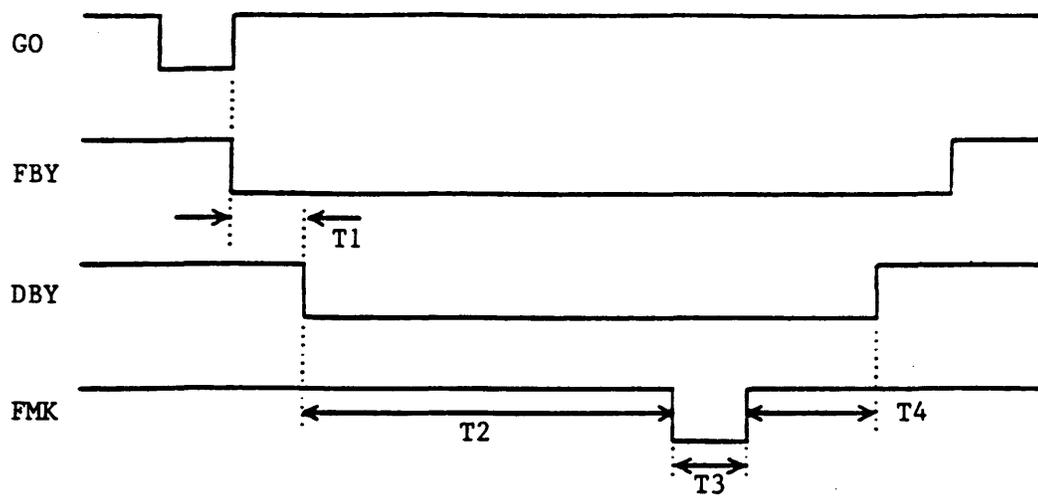
Figure 1-12. NRZI Write File Mark



Time		100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1		<54.0 mS	<40.0 mS	<80.0 mS	<80.0 mS
T2	*	1.8 mS	1.8 mS	3.6 mS	73.6 mS
T3		3.2 uS	3.2 uS	6.3 uS	6.3 uS
T4	*	220 uS	220 uS	220 uS	220 uS

* Nominal Values

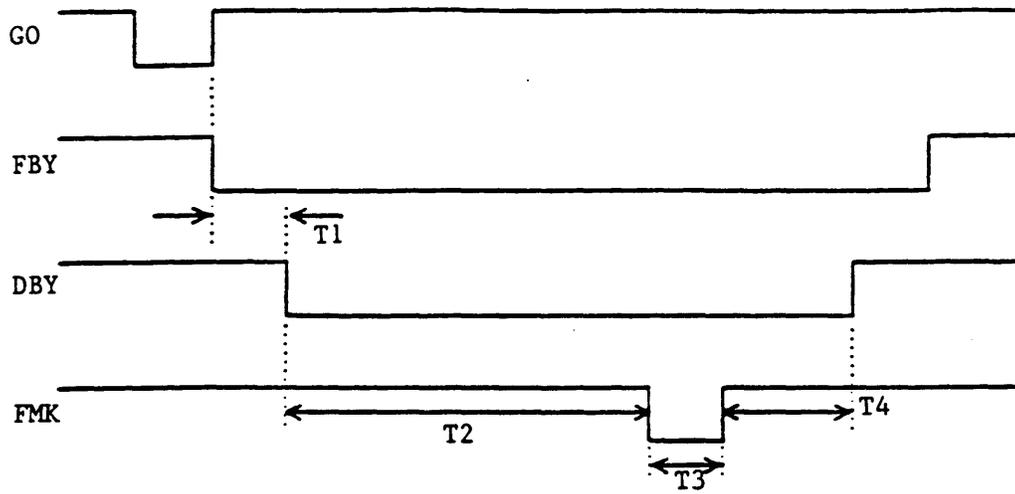
Figure 1-13. PE Write File Mark



Time		100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1		<54.0 mS	<40.0 mS	<80.0 mS	<80.0 mS
T2	*	1.8 mS	1.8 mS	3.6 mS	3.6 mS
T3		1.6 uS	1.6 uS	3.2 uS	3.2 uS
T4	*	220 uS	220 uS	220 uS	220 uS

* Nominal Values

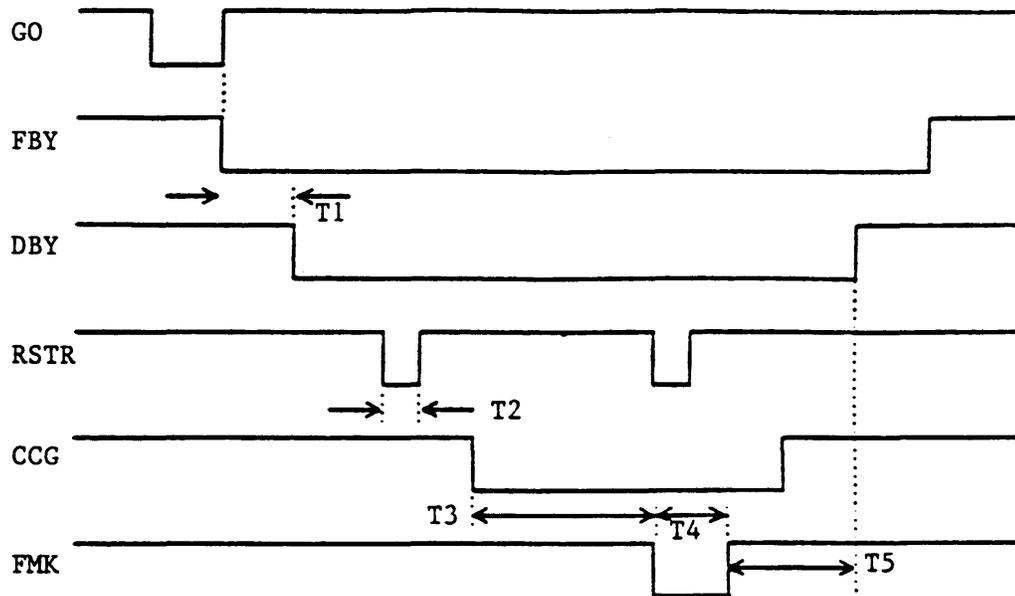
Figure 1-14. DDPE Write File Mark



Time		100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1		<18.0 mS	<2.0 mS	<18.0 mS	<3.0 mS
T2	*	1.8 mS	1.8 mS	3.6 mS	3.6 mS
T3		1.15 uS	1.15 uS	2.30 uS	2.30 uS
T4	*	220 uS	220 uS	220 uS	220 uS

* Nominal Values

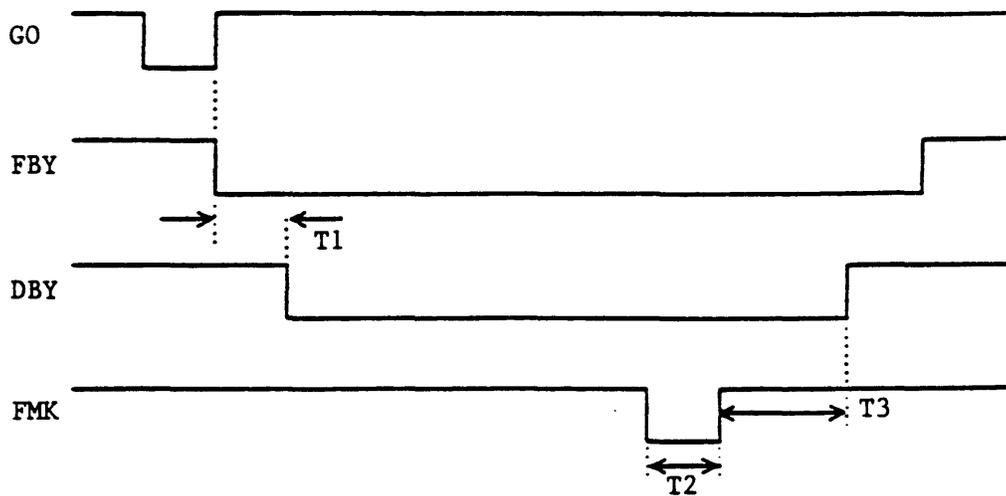
Figure 1-15. GCR Write File Mark



Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<4.0 mS	<8.0 mS	<5.0 mS
T2	2.36 uS	2.36 uS	2.36 uS	2.36 uS
T3 *	300 uS	300 uS	450 uS	450 uS
T4	4.2 uS	4.2 uS	4.2 uS	4.2 uS
T5 *	37.0 uS	37.0 uS	41.0 uS	41.0 nS

* Nominal Values

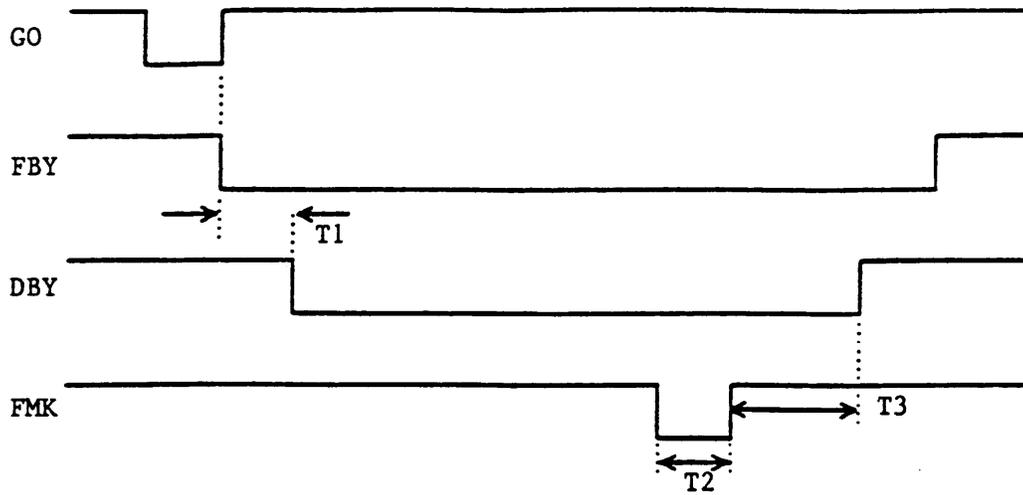
Figure 1-16. NRZI Read File Mark



Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<4.0 mS	<8.0 mS	<5.0 mS
T2	3.2 uS	3.2 uS	6.3 uS	6.3 uS
T3	* 190 uS	190 uS	190 uS	190 uS

* Nominal Values

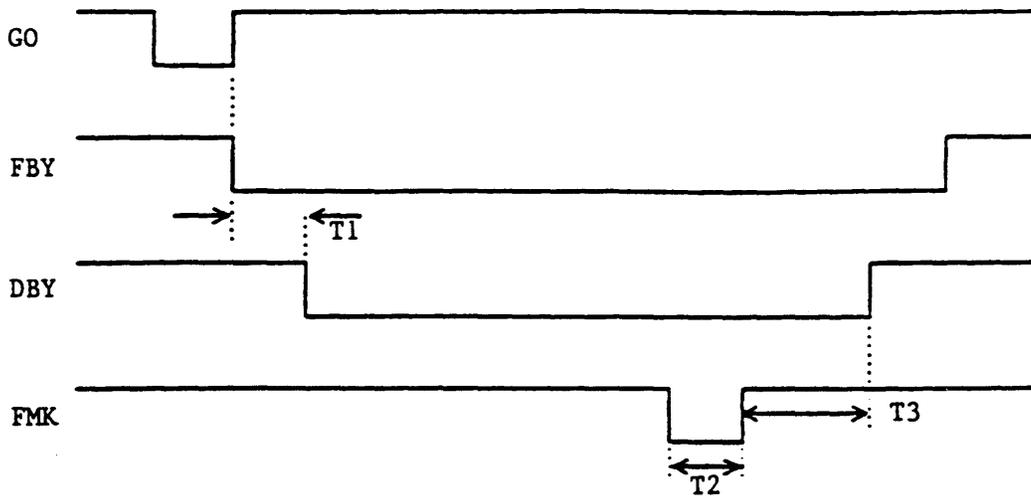
Figure 1-17. PE Read File Mark



Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<4.0 mS	<8.0 mS	<5.0 mS
T2	1.6 uS	1.6 uS	3.2 uS	3.2 uS
T3	* 190 uS	190 uS	190 uS	190 uS

* Nominal Values

Figure 1-18. DDPE Read File Mark



Time	100ips Start/Stop	100ips On the Fly	50ips Start/Stop	50ips On the Fly
T1	<18.0 mS	<2.0 mS	<16.0 mS	<3.0 mS
T2	1.15 uS	1.15 uS	2.30 uS	2.30 uS
T3	* 190 uS	190 uS	190 uS	190 uS

* Nominal Values

Figure 1-19. GCR Read File Mark

SECTION II

INSTALLATION AND OPERATION

2.0 INTRODUCTION

Section II describes unpacking, inspecting, installing, cabling, adjusting, and operating the Model 9610/9660 Tape Drive.

2.1 UNPACKING AND PACKING

2.1.1 UNPACKING

The 9610/9660 tape drive is shipped in a heavy-weight cardboard container equipped with cushioned, polyethylene foam supports. To safely remove the unit from its shipping container, complete the following procedure:

1. Place the shipping container on a flat, dry, nonslip surface.
2. Carefully cut the binding straps and remove the top lid.
3. Remove the cardboard sides of the shipping container. The drive can now be conveniently lifted from the shipping container and placed on a flat surface.

WARNING

The Model 9610 Tape Drive weighs a minimum of 110 pounds. Two persons (minimum) must be available to lift it during the installation process. Use safe lifting practices to remove the drive from its shipping container.

4. Locate the following items: AC power cord, 220/240-volt fuse kit, DC plug (as applicable) slide rails and attaching hardware (shipping retainer brackets, rack-latch angle bracket, screws, etc.). Lay these items in a safe place.
5. Retain the shipping container, polyethylene wrap, and the foam supports for possible future shipment.

Tape Drives shipped in racks may be held in place by the two Shipping Retainer Brackets mentioned above (Figure 2-1). These Brackets should be removed after the Rack is put in its final location at the installation site, and the Rack-Latch Angle Bracket (also mentioned above) must be installed in place of the left Retainer Bracket. This Bracket comprises the Catch (Figure 2-1) for the Retainer Latch located just inside the Front Panel.

2.1.2 PACKING

Before the unit is packed in the shipping container or is stored for a long period of time, the Buffer Arms should be relaxed. The procedure for relaxing the arms is as follows:

1. Turn power on.
2. After Power-Up testing is complete, enter diagnostic mode by pressing DIAG button. The readout will display DIAG.
3. Press the ENTER button to enter diagnostic mode. The readout will display "SELFTEST".
4. Press the SCAN button two times. The readout will display in sequence: "MOTION, DRV ADJ".
5. Press the ENTER button. The readout will display "BUF ARMS".
6. Press the ENTER button. The arms will relax and on completion the readout will display "TAKE XX".
7. Turn power off.
8. Repack the unit using the shipping container materials retained when the unit was unpacked.

2.2 INSPECTION

Inspect the drive for shipping damage such as scratches, dents, or cracks in the frame. On the Dust Cover (top of Drive), turn the two fastening screws 1/4 turn counterclockwise and open the dust cover. With the Cover Support Bar (Figure 2-2), latch the Dust Cover in Maintenance Position. Check for loose or missing parts, and foreign material. Open the Tape Path Cover and verify that all parts/areas of the tape path are clean. Remove the PCBA Cover and verify that all PC Boards (Figure 2-4) are seated properly. Reinstall PCBA Cover.

2.3 CABLING AND DAISY CHAINING REQUIREMENTS

The user must provide Host-to-Drive interconnect cables. Up to eight Drives can be daisy chained, but combined cable length must not exceed 20 feet. Terminators U3, U4, and U11 must be removed from all Drive Formatter Boards except from the last Formatter Board on the daisy chain. To remove the Terminators:

1. Remove Top Cover at rear top of the Drive.
2. As applicable, disconnect two cables from the Formatter Board (Figure 2-4).
3. Grasp the PCB Ejectors firmly, and pull Ejectors toward the side of the unit. Board should pop partially out of the slot.
4. Locate Terminators U3, U4, and U11 (Figure 2-4), and remove them.
5. Replace the Formatter Board and Top Cover.

Recommended connectors and cables are as follows: - Daisy chains may optionally require a Cable Connector Adapter (See Figures 2-3 and 2-5).

<u>Item</u>	<u>Vendor</u>	<u>Part Number</u>	<u>Specifications</u>
Connectors:			50-pin, card edge
Adapter:	Shugart	90-08018-002	50-pin, 3-port
Cables:			50-wire, 28-AWG, shielded/ flat/stranded/jacketed

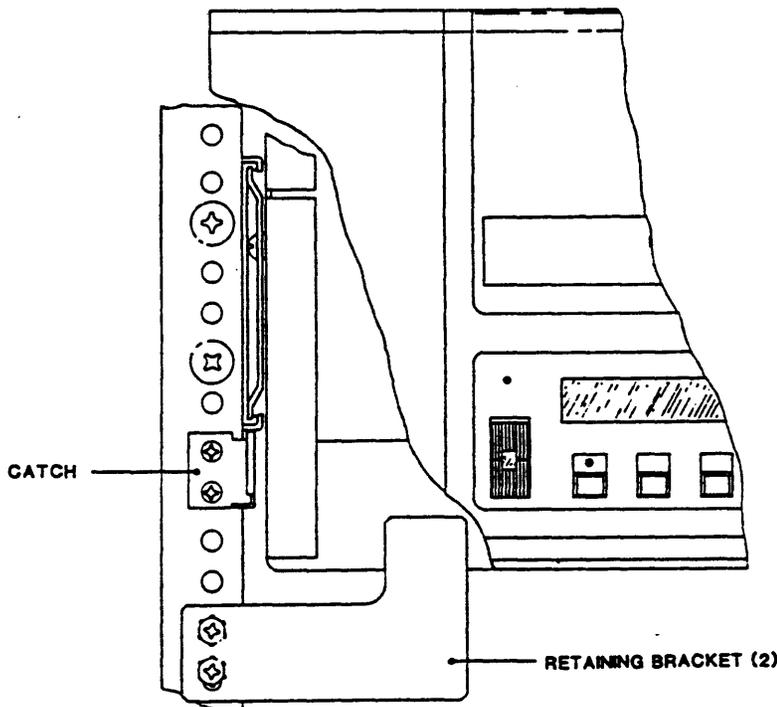


Figure 2-1. Shipping Retainer Bracket and Catch

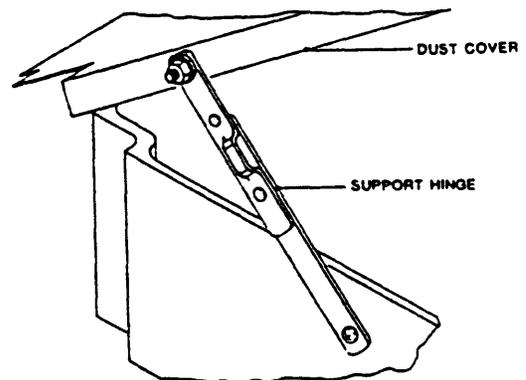


Figure 2-2. Dust Cover Support Bar

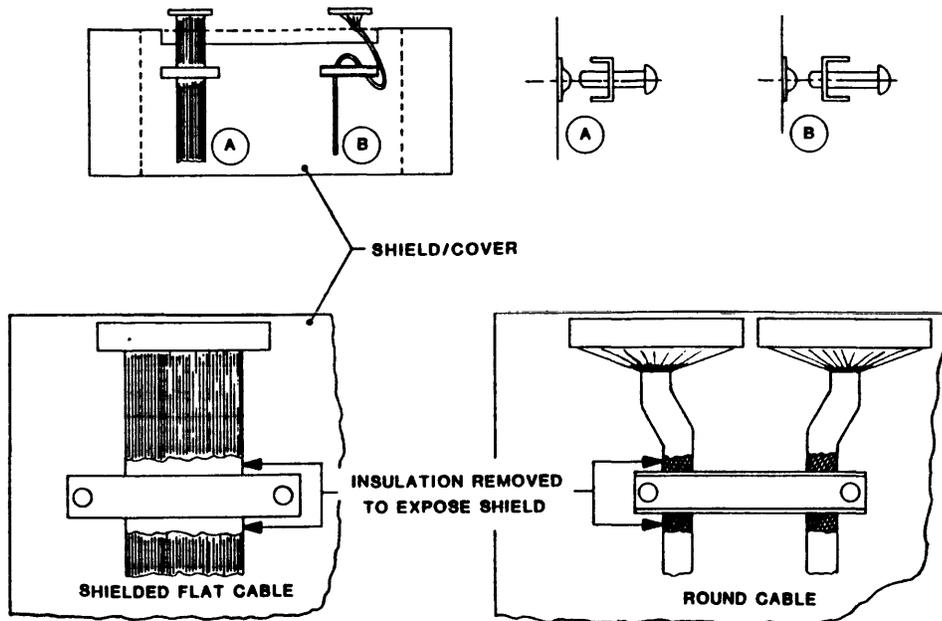


Figure 2-3. Grounding Cable Clamp Details

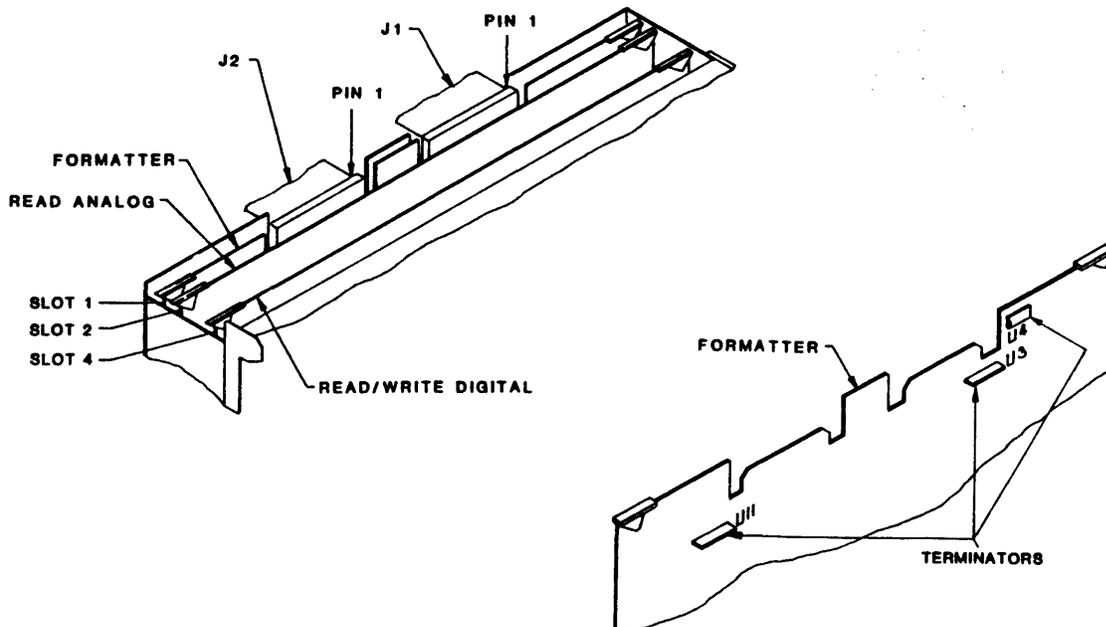
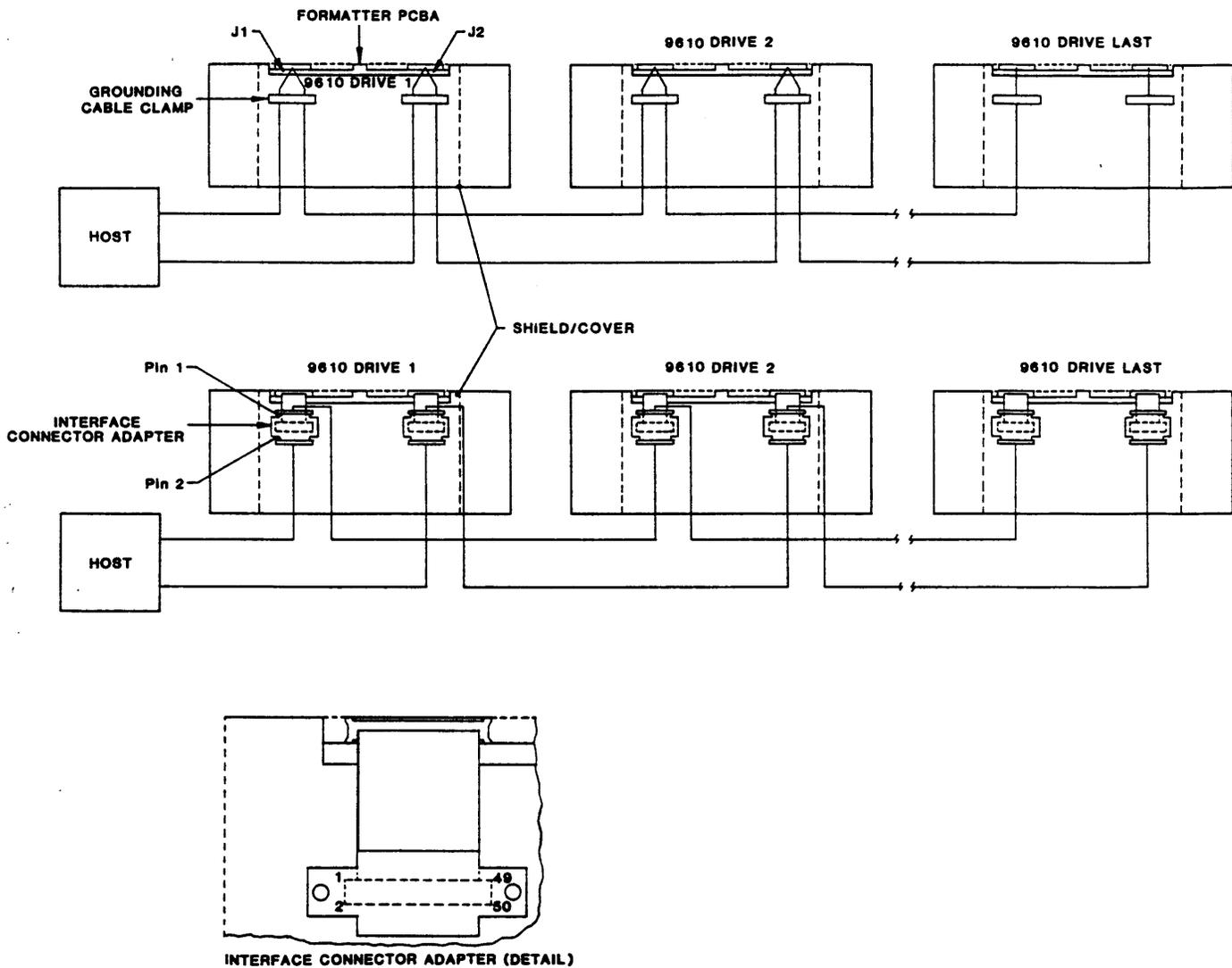


Figure 2-4. Card Cage, Cables and Terminators



Note:

1. Terminators removed from all but last Drive.
2. Shielded Cables are required to meet FCC Regulations. Ground the shields as illustrated. For Interface Connector Adapter (P/N 90-08018-002), remove some insulation from the cable and connect cable shield under an Adapter Mounting Screw.

Figure 2-5. Daisy Chaining

2.4 INSTALLATION

2.4.1 TABLE-TOP INSTALLATION

Place the Drive on a flat table top with dimensions to accommodate the Drive (Figure 2-6), of sufficient strength to support the weight of the Drive, and allow sufficient clearance for maintenance access. Do Steps E and F in paragraph 2.4.2.2.

2.4.2 RACK-MOUNT INSTALLATION

Mount the Tape Drive (Figure 2-7) in a standard EIA/RETMA 19-inch Rack allowing at least 8-3/4 inches vertical space. Install The Rack-Mount Rail Assembly supplied with the Drive as described in the following subparagraph 2.4.2.1.

2.4.2.1 RAIL ASSEMBLY COMPONENT CHECKOUT

The Rack-Mount Rail Assembly consists of two left/right interchangeable Track Subassemblies. Each consists of the following items:

<u>ITEM</u>	<u>Outer/Center Track Assembly</u>	<u>ITEM</u>	<u>Outer/Center Track Assembly</u>
1	Center Track	5	One Adjustable Mounting Bracket
2	Outer Track	6	Three Nut Plates
3	Fixed Mounting Bracket	7	Six 10-32 by 1/2-inch PH Screws
4	One Chassis Rail	8	Retention Latch Bracket

Note: The standard Rack-Mount Rail Assembly has rails that fit cabinets up to 24 inches deep (with rails up to 23 inches apart). For deeper cabinets, use Slide Extender P/N 28-00352-101. Order from:

Shugart Spare Parts Order Department, 9292 Jeronimo Rd., Irvine, CA 92718. Tel: (714) 770-1100.

2.4.2.2 MOUNTING PROCEDURE

- A. Install one of the Track Assemblies (Figure 2-8) on either side of the 19-inch Rack as follows:
 - 1. Using the 10-32 Slotted Screws (7) and Nut Plates (6)* provided, loosely assemble an Adjustable Mounting Bracket (5) to the rear of the Right Track Assembly.
 - * Nut Plates not required for Racks with threaded mounting holes.
 - 2. Measure upward 2 inches from the bottom of the Rack opening allotted for the Drive, and mark the Rack at that point.
 - 3. Aligning the bottom of the Fixed Mounting Bracket (3) at the 2-inch mark on the front of the 19-inch Rack, and using the 10-32 Screws (7) provided, mount the Fixed Mounting Bracket (3) to the front of the 19-inch Rack, and mount the Adjustable Mounting Bracket (5) (loosely attached to the rear of the Center Track) to corresponding holes in the rear of the 19-inch Rack. Level the Track and tighten all Screws.
 - 4. Repeat Steps 1 through 3 for mounting the other Track Assembly.
- B. Inspect all work and check that all screws are tight.
- C. Remove power cable from the Drive Chassis.
- D. With a minimum of two persons, one on each side of the Drive, lift and guide the Chassis Rails onto the Left and Right Center Tracks. Verifying that the rails are correctly aligned, push the Drive into the Rack.

- E. Remove about an inch of insulation from each Interface Cable at a point where the Cable will pass under the Grounding Cable Clamp(s). This will expose the cable shield. Run the Interface Cables under the Cable Clamp(s) as illustrated in Figure 2-3. Tighten the Clamp(s).
- F. Locate mounting holes on the front of the rack that align with Retention Latch on the Drive, located just within the front plastic access door to the left. Mount the Retention Latch Bracket (Item 8) so that it meshes with the Retention Latch Armature when the Drive is slid all the way into the rack.

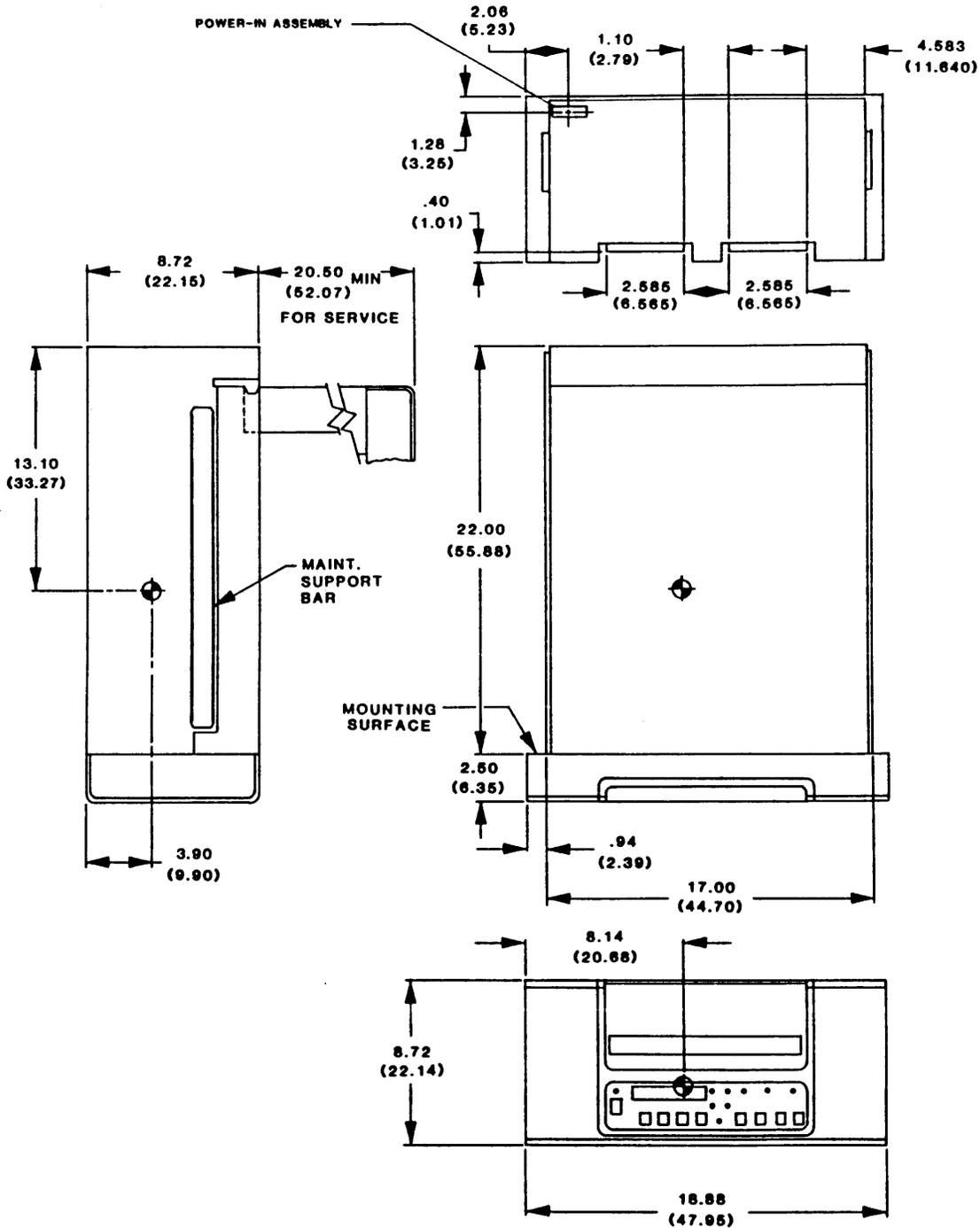


Figure 2-6. Outline and Installation Drawing, Model 9610

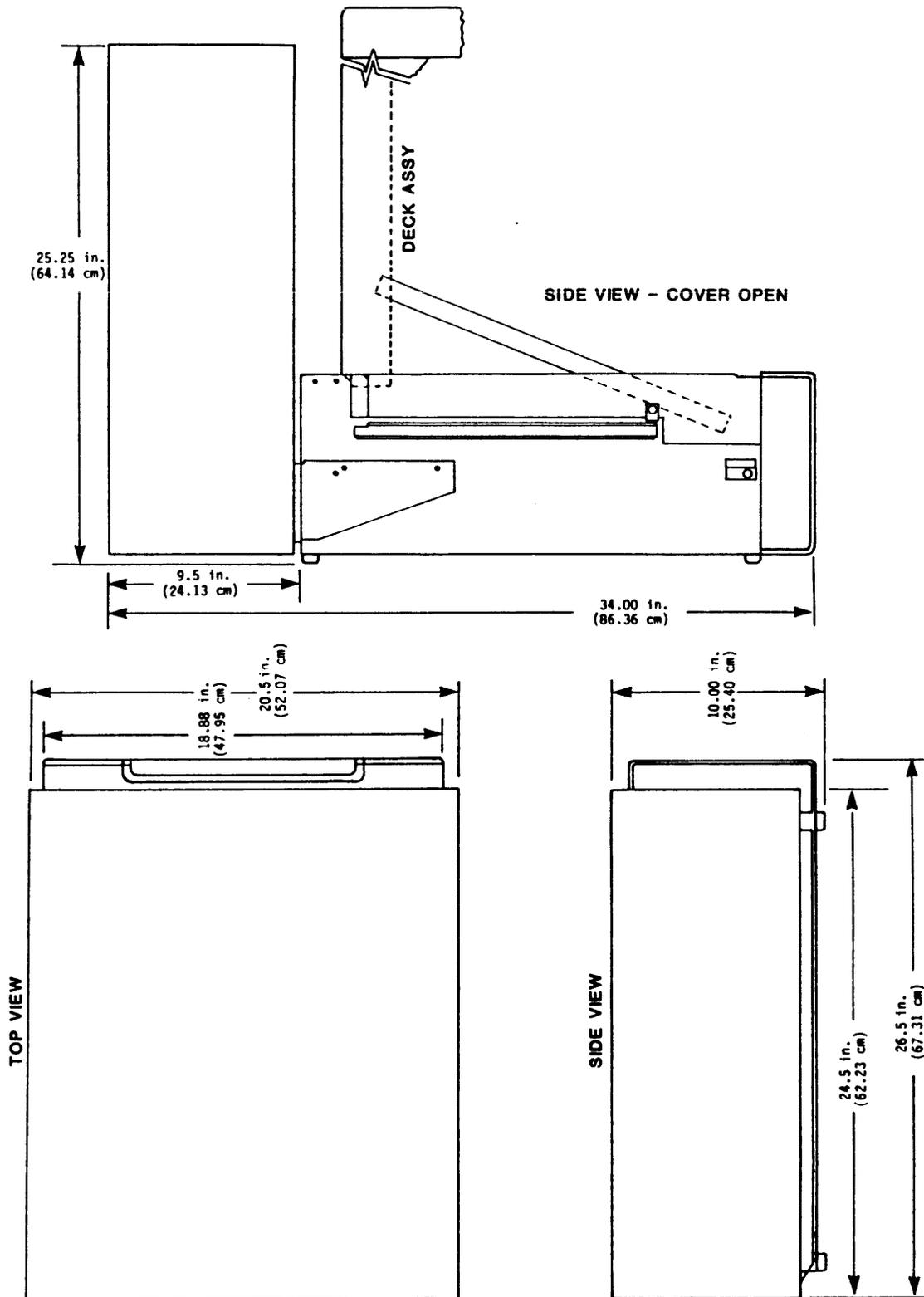


Figure 2-7. Outline and Installation Drawing, Model 9660

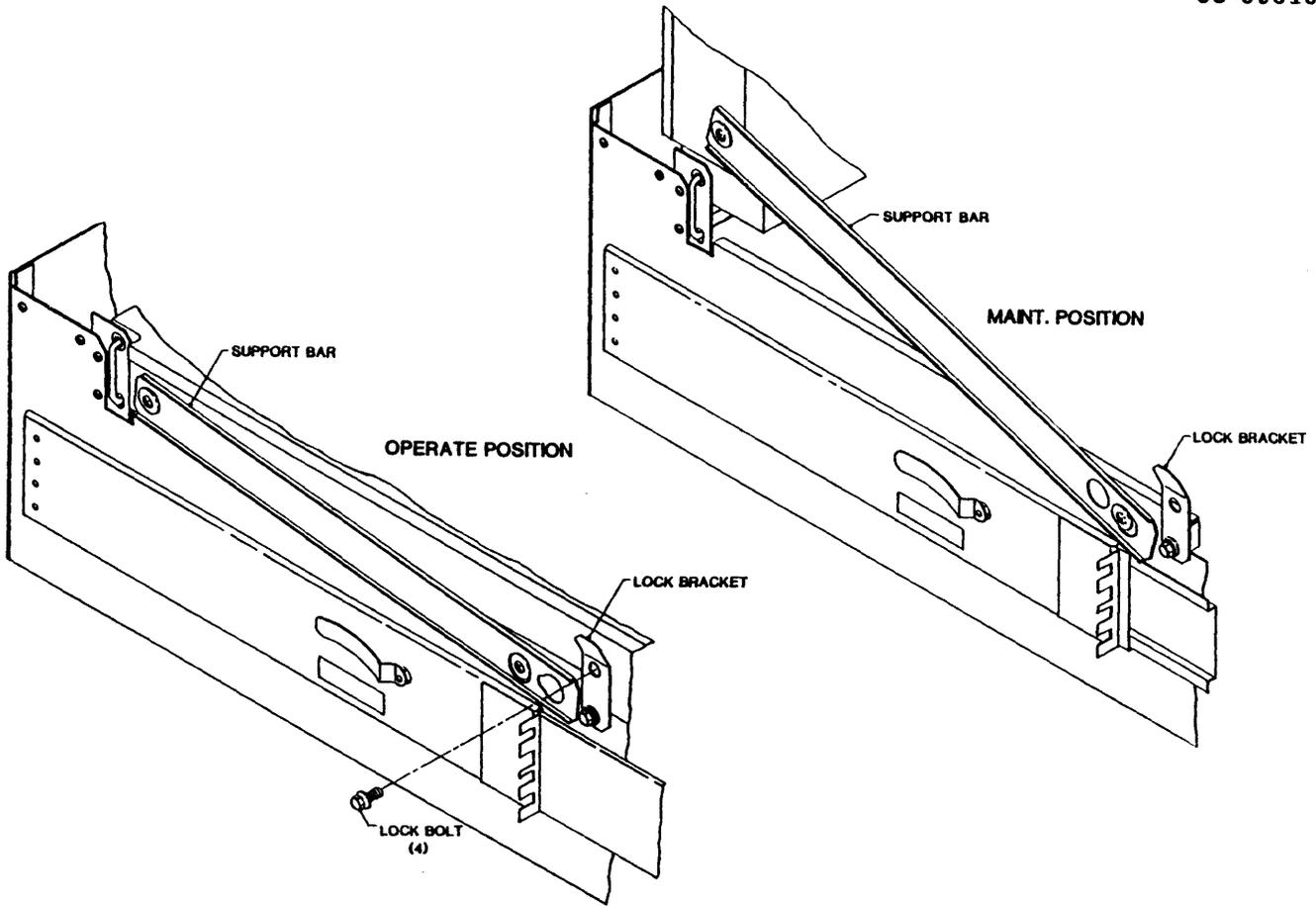


Figure 2-7A. Deck Assembly Support Bar

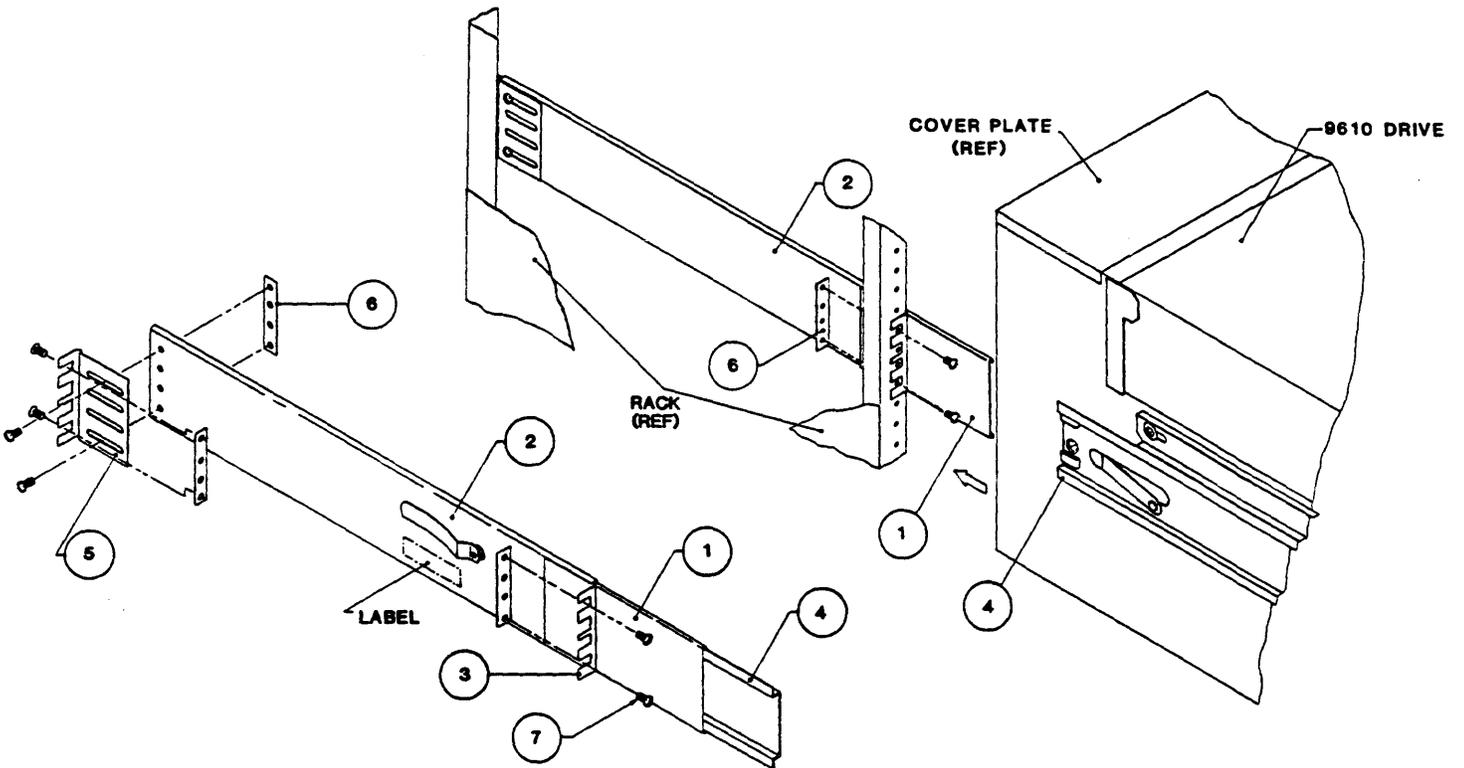


Figure 2-8. Track Subassembly

2.5 POWER-UP AND INITIAL CHECKOUT

2.5.1 LINE VOLTAGE

2.5.1.1 AC LINE VOLTAGE (100-, 120-, 220- or 240-Volt Operation)

2.5.1.1.1 SINGLE FUSE POWER-IN ASSEMBLY (Standard)

The Drive is normally factory-set for 120-volt operation. Other voltage choices can be 100, 220, or 240. Locate the Power-In Assembly (Figure 2-9A) at the rear of the unit (Figure 2-6). The Voltage Selector Card behind the plastic slide cover is installed with "120" legible. This indicates that the Drive is set for 120-volt operation. The following subparagraph describes changing this setting as necessary.

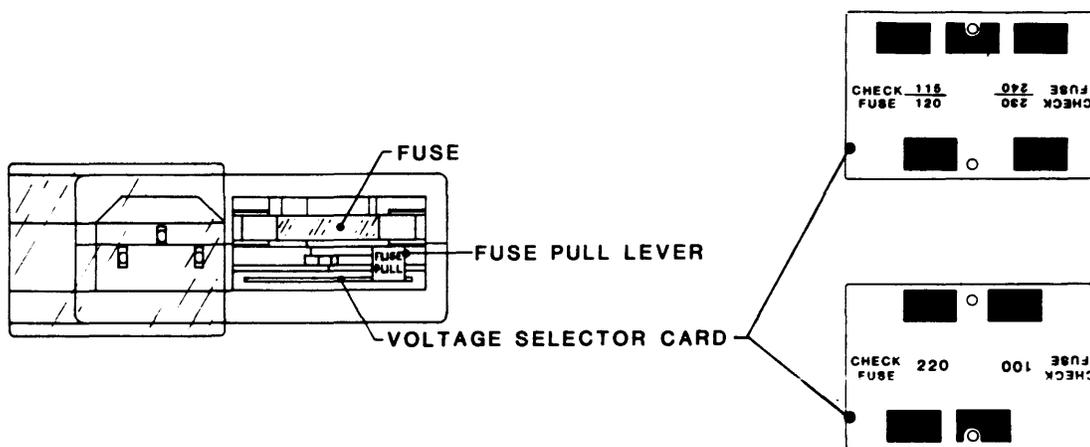


Figure 2-9A. Single Fuse Power-In Assembly

Changing Operating Voltage:

Assuming that the Voltage Selector Card setting is other than the site voltage, proceed as follows:

- A. Remove the AC power cord (if installed) from the Power-In Assembly (Figure 2-9A).
- B. Slide the plastic Fuse Cover to the left.
- C. Rotate the "FUSE PULL" lever to the left, and remove the fuse (if fuse is incorrect size).
- D. Using long nose pliers, remove the Voltage Selector Card.
- E. Position the Voltage Selector Card at the entrance to the card slot so that the correct voltage (100, 120, 220, or 240) is legible (facing upward), and install the Voltage Selector Card into the Power-In Assembly.
- F. Install the proper-size fuse (supplied: 3-amp slo-blo for 220/240-Volt; 6-amp for 100/120-Volt).
- G. Slide the plastic Fuse Cover to the right.
- H. Install (as applicable) an appropriate power plug on the source end of the power cord.
- I. Reconnect the power cord to the Power-In Assembly and plug the other end of the power cord into an appropriate AC outlet.

2.5.1.1.2 DUAL FUSE POWER-IN ASSEMBLY (Optional)

The Drive is normally factory-set for 120-volt operation. Other voltage choices can be 100, 220, or 240. Locate the Power-In Assembly (Figure 2-9B) at the rear of the unit (Figure 2-6). The Voltage Selector behind the plastic cover is installed with "120" legible. This indicates that the Drive is set for 120-volt operation. The following subparagraph describes changing this setting as necessary.

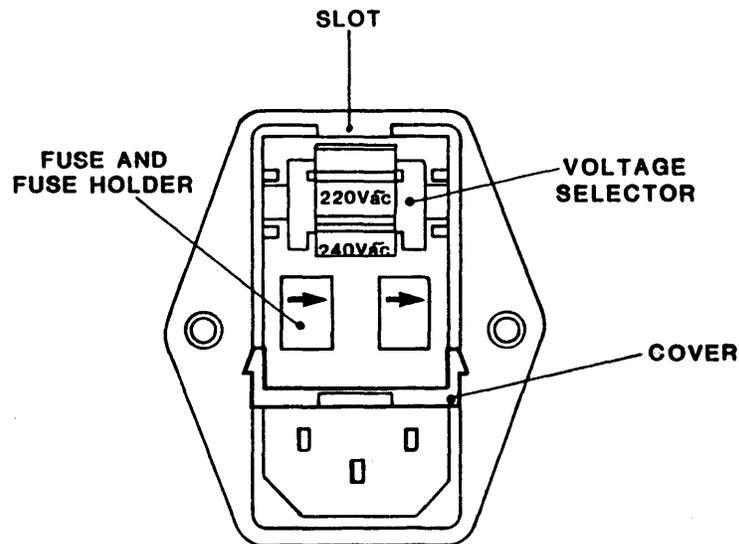


Figure 2-9B. Dual Fuse Power-In Assembly

Changing Operating Voltage:

Assuming that the Voltage Selector setting is other than the site voltage, proceed as follows:

- A. Remove the AC power cord (if installed) from the Power-In Assembly (Figure 2-9B).
- B. Open the plastic Fuse Cover by inserting flat blade screwdriver into slot.
- C. Pull the fuse holders out and remove the fuse (if fuse in incorrect size).
- D. Remove the Voltage Selector.
- E. Rotate the Voltage Selector so that the correct voltage (100, 120, 220 or 240) is centered, and install the Voltage Selector into the Power-In Assembly.
- F. Install the proper-size fuse (supplied: 3.15T amp for 220/240-Volt; 6.3T-amp for 100/120-Volt).
- G. Close the plastic Fuse Cover.
- H. Install (as applicable) an appropriate power plug on the source end of the power cord.
- I. Reconnect the power cord to the Power-In Assembly and plug the other end of the power cord into an appropriate AC outlet.

2.5.1.2 DC LINE VOLTAGE (48, 60VDC Operation)

The drive is factory wired for either 48 or 60VDC as specified on the voltage label on the rear of the unit.

2.5.2 POWER-UP

- A1. On AC units, check that the Voltage-Selector is set for the line voltage of the installation site per paragraph 2.5.1.1.1 or 2.5.1.1.2
- A2. On DC units, check that the voltage label specifies the correct line voltage.
- B. Turn Power ON-OFF switch ON (Figure 2-10).
- C. Check that the Power-On LED (unmarked, located above the Power switch), and that the Character Display Readout indicates "TESTING" for a short time followed by "UNIT X" (X represents the Drive Unit Number. The initial (default) readout is "UNIT 0").

2.5.3 CHECKOUT

2.5.3.1 LOADING TAPE

- A. Swing open the Tape Access Door as shown in Figure 2-11, and mount a reel of tape onto the Hub. The reel must be properly seated with Write-Enable Ring facing downward toward the Deck Plate, and the tape leader should be loose.
- B. Close the Tape Access Door.
- C. Depress LOAD. The Readout displays "LOADING". The supply reel spins slowly three turns in reverse to ensure that tape is properly wound on the Reel. The Drive vacuum system automatically threads and loads tape onto the Take-up Reel. The loading process continues until the tape reaches the Beginning of Tape (BOT). At BOT, the LOAD and LOAD PT (Load Point) LEDs light and the Readout displays "UNIT X". If the Supply Reel has the Write Enable Ring installed, the WRITE ENABLE LED should be lit.

Note: Some tapes fail to load because they develop an electrostatic charge. This can be recognized by observing the tendency for the tape to cling to itself around the Supply Reel. This can be remedied by trimming the end of the tape with a trimming/crimping tool.

2.5.3.2 LOAD DETAILS

- A. If the Load Sequence does not complete satisfactorily, an Error Message displays. See Section IV, Table 4-3 for error information and remedial action.

Note: The Vacuum Motor may be equipped with an optional 4 amp-3AG fuse, located on the left side of the Vacuum Motor Cover. Check fuse for possible failure.

- B. After the tape is wound on the Take-up Reel, the Buffer Arms move inward, their Rollers engaging and tensioning tape across the Magnetic Head.
- C. With tape tensioned, the Drive performs Autocalibration to set the Write Current as follows: Operating in the tape area before the BOT Marker, the Drive moves tape back and forth three times over the Head. During tape movement, the Drive writes a pattern of all ONES on tape, reads the pattern, and adjusts Write Current for optimum setting. Using the Write Current value, the Drive calculates and sets the correct values for all speeds and densities.

The Drive is factory set for optimum Write Current with nominally standard tape. If for any reason, the Drive fails to satisfactorily complete Autocalibration, the Drive defaults to the factory-set Write Current values.

- D. At the end of the Load Sequence, tape is tensioned, and at BOT, the Front Panel displays UNIT X, and the LOAD and LOAD PT LEDs are lit. If the tape is Write Enabled, the WRITE EN LED is lit.

2.5.3.3 CHECKOUT CONTINUED

Having loaded tape per 2.5.3.1 above:

- A. Depress ON-LINE. ON-LINE LED lights; the Readout continues to display "UNIT X". When the Drive is selected, the SELECT LED lights.
- B. Depress ON-LINE. ON-LINE LED goes out.
- C. Depress DIAG. DIAG LED lights and the Readout displays "DIAG".
- D. Depress ENTER. Readout displays "SELFTEST".
- E. Repeatedly press SCAN and verify that the Readout displays, in turn, the following: "SELFTEST, MOTION, DRV ADJ, SET UP, CAL, DATADIAG, SELFTEST, MOTION."
- F. With "MOTION" displayed, press ENTER. Readout displays "50 FWD" (50 ips Forward).
- G. Repeatedly press SCAN and verify that each time SCAN is pressed the Readout displays as indicated in Table 2-1 beginning with Step 2, then to Step 1 and repeating the sequence.
- H. Repeatedly press SCAN until Readout displays "100 FWD".
- I. Press ENTER. Tape moves forward at 100 ips, the LOAD PT LED goes out, and the DIAG LED blinks. Let Drive run to the End of Tape (EOT). Readout displays "EOT".

Table 2-1. Motion Control Sequence

STEP	DISPLAY			MOTION
	NORMAL *	AT EOT	AT BOT	
1	50 FWD	EOT		50 ips Forward
2	50 REV		BOT	50 ips Reverse
3	50 FSS	EOT		50 ips Forward Start/Stop
4	50 RSS		BOT	50 ips Reverse Start/Stop
5	50 FRF	EOT	BOT	50 ips Forward/Reverse/Forward
6	100 FWD	EOT		100 ips Forward
7	100 REV		BOT	100 ips Reverse
8	100 FSS	EOT		100 ips Forward/Start/Stop
9	100 RSS		BOT	100 ips Reverse/Start/Stop
10	100 FRF	EOT	BOT	100 ips Forward/Reverse/Forward
11	50/100 F	EOT		50 ips/100 ips Forward
12	50/100 R		BOT	50 ips/100 ips Reverse
13	BURN IN			50 ips/100 ips/50 ips (Forward) Auto Rewind/... (Repeat) etc.

***Note:** Normal display is defined as any display when the tape is neither at BOT or EOT.

- J. Scan through the entire menu. In the step for any Forward Motion Command, such as Step 1 (50 FWD), Step 3 (50 FSS), Step 5 (50 FRF), etc., the Display reads "EOT".
- K. Depress SCAN. Readout displays "100 REV".
- L. Depress ENTER. Tape runs at 100 ips in reverse. Let Drive run to the Beginning of Tape (BOT). Readout displays "BOT".
- M. Scan through the entire menu. In the step for any Reverse Motion Command, such as Step 2 (50 REV), Step 4 (50 RSS), etc., the Display reads "BOT" and the Command cannot be entered.
- N. Repeatedly depress DIAG until DIAG LED goes out and Readout displays "UNIT X".
- O. Depress RWND/UNL. Tape rewinds to the supply reel, and Readout displays "UNLDNG" until tape is unloaded (stops motion), then the readout displays "UNIT X".
- P. Open the Tape Access Door, remove the tape, and turn off power.
- Q. Run DATATEST in Checkout procedure to verify Write/Read performance.

2.5.3.4 MOTION TEST SUMMARY

All Motion Tests, with the exception of Burn In, automatically stop at either BOT (Reverse Tests) or EOT (Forward Tests). Burn In consists of a 100/50/100 ips forward sequence until EOT is reached. At EOT, the Drive automatically rewinds tape to BOT at 200 ips. At BOT, the Drive repeats the 100/50/100 ips sequence and continues to repeat until the operator intervenes. All Motion Tests, including Burn In, may be stopped by depressing START/STOP, except when rewinding.

2.5.4 UNIT SELECTION

The Drive is factory-set for Unit Address 0. In daisy-chained systems, set the Unit Address for each Drive (other than Drive 0) as follows:

- A. Turn power ON.
- B. In turn, depress DIAG, ENTER, SCAN, SCAN, SCAN. Readout displays in sequence: "DIAG", "SELFTST", "MOTION", "DRV ADJ", SET UP".
- C. Depress ENTER. Drive enters SET UP Mode; Readout displays "UNIT NUM"
- D. Depress ENTER. Readout displays "UNIT X".
- E. Repeatedly depress SCAN until the Readout displays the desired Unit Number.
- F. Depress ENTER. Readout displays "LOAD?".
- G. Depress LOAD to save new Unit Number. Drive displays "DENS SEL" (the next parameter).
- H. The Drive will now respond to the new Unit Number (address) sent from the Host.
- I. Depress DIAG twice to return the Drive to off-line status. The Readout displays the new Unit Number.

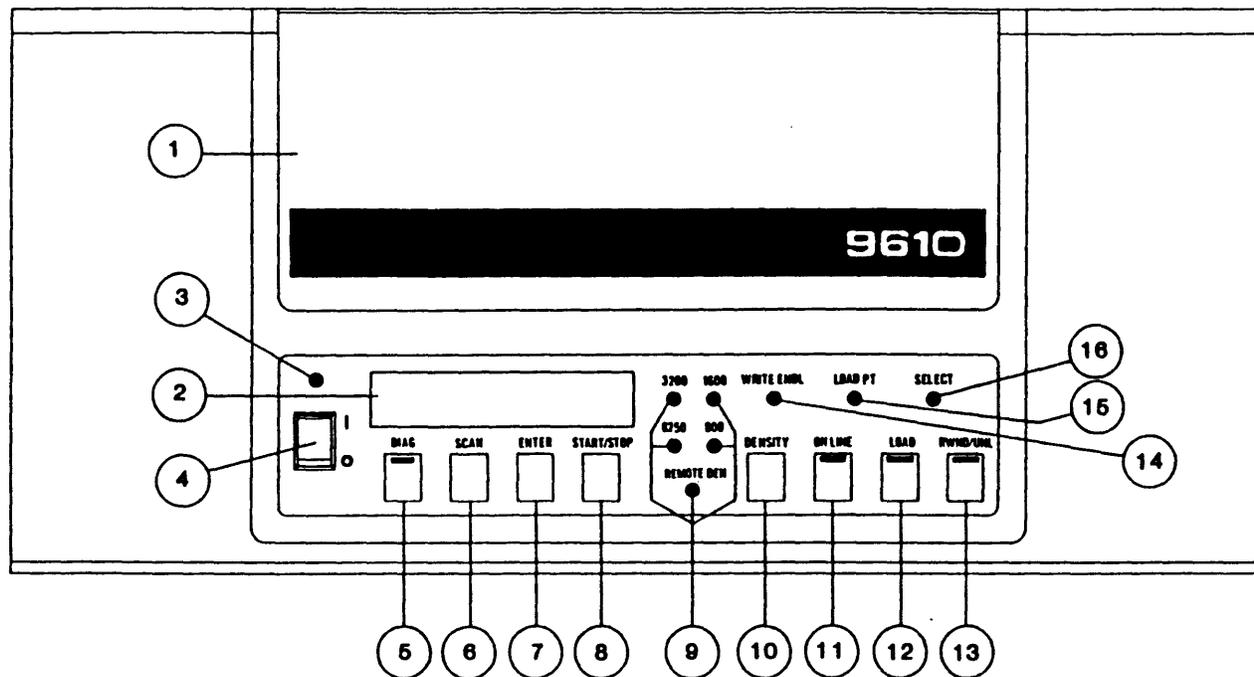
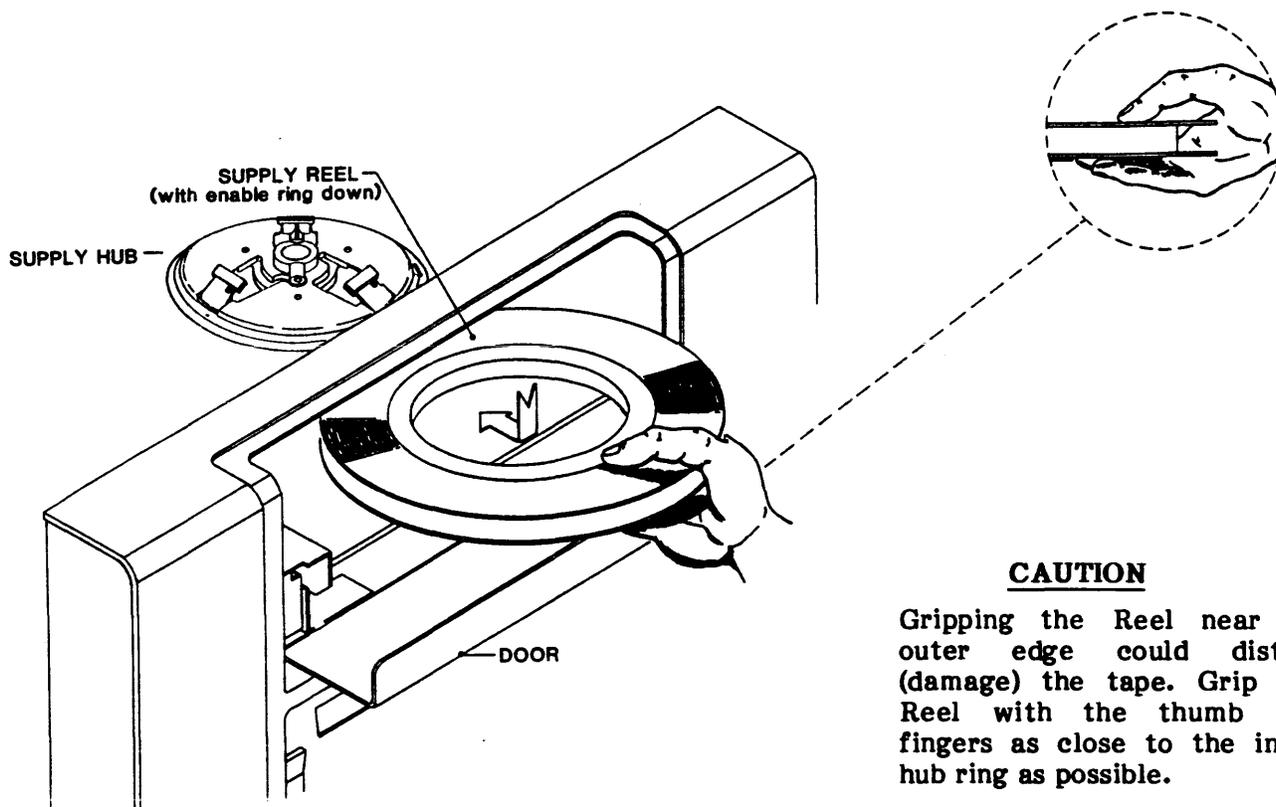


Figure 2-10. Panel Controls and Indicators

- (1) **Tape Access Door - Supply Hub Access (Ref).**
- (2) **Character Display Readout - Displays operating mode, status, parameters, and diagnostic messages.**
- (3) **Unmarked LED - Lights when power is applied to Drive.**
- (4) **ON/OFF Switch - Controls power to Drive.**
- (5) **DIAG Pushbutton - Turns diagnostics ON and OFF when Drive is off-line. Internal LED lights when in the diagnostics mode.**
- (6) **SCAN Pushbutton - Scans diagnostics and calibrate menus.**
- (7) **ENTER Pushbutton - Enters selected commands when in diagnostics or calibrate mode.**
- (8) **START/STOP Pushbutton - Starts or stops selected commands in the diagnostics or calibrate mode.**
- (9) **REMOTE DEN LED - Lights when density is selectable by Host.
800/1600/3200/6250 LEDs - Indicates selected density.**
- (10) **DENSITY Pushbutton - Selects data density (800, 1600, 3200, or 6250) and REMOTE.**
- (11) **ON-LINE Pushbutton - Puts unit on-line or takes unit off-line. Lights when Drive is on-line.**
- (12) **LOAD Pushbutton - Initiates Load sequence. Lights when drive is loaded.**
- (13) **RWND/UNL Pushbutton - Initiates Rewind or Unload when Drive is off-line.**
- (14) **WRITE ENBL LED - Lights when supply reel is not write protected.**
- (15) **LOAD PT LED - Lights when tape is at Load Point.**
- (16) **SELECT LED - Lights when Drive is selected by the Host.**

**CAUTION**

Gripping the Reel near its outer edge could distort (damage) the tape. Grip the Reel with the thumb and fingers as close to the inner hub ring as possible.

Figure 2-11. Installing Supply Reel

2.5.5 DATA DENSITY - INTRODUCTION

The Model 9610/9660 can operate at 800 CPI density in Nonreturn-to-Zero (NRZI) format, at 1600 CPI density in Phase-Encoded (PE) format, at 3200 CPI Density in Double Density PE (DDPE) format, and at 6250 CPI in Group Coded Recording (GCR) format. When powered up, the Drive automatically defaults* to 6250 REMOTE, in which the Host controls density selection for Write Operations.** The operator can override the defaulted operating density by operating the Front Panel DENSITY Switch as described under A below:

* Default Density is factory-set, but can be changed as described below under C. **Changing Default Density.**

** In Remote Density Mode, the Host controls Density by Command issued at BOT only; but when reading tape, the Drive automatically selects the density of the tape currently loaded.

A. Changing Operating Density:

1. If tape is loaded, rewind tape to BOT and set the Drive to off-line. The Readout displays UNIT X and the current operating density and mode on the density LEDs and the Remote LED. The Drive is in Remote PE Mode.

2. Repeatedly, as necessary, press DENSITY. The Indicators will light in the following sequence, putting the Drive in the corresponding Density Mode. Leave the Drive in the desired Mode.

<u>Mode</u>	<u>LEDs Lit</u>		<u>Mode</u>	<u>LEDs Lit</u>	
	<u>Dens</u>	<u>Control</u>		<u>Dens</u>	<u>Control</u>
a. Local NRZI	800		e. Local DDPE	3200	
b. Remote NRZI	800	REMOTE DEN	f. Remote DDPE	3200	REMOTE DEN
c. Local PE	1600		g. Local GCR	6250	
d. Remote PE	1600	REMOTE DEN	h. Remote GCR	6250	REMOTE DEN

Note: If the drive is configured to operate in REMOTE density only the local selections will be skipped.

B. Operation:

1. In Read operation, if the Drive is in Remote Mode, the Drive reads automatically in the density in which the tape was written.
2. In Write operations, the Drive writes in the density indicated by the Density LEDs.

C. Changing Default Density:

1. Enter diagnostics mode by pressing the DIAG button. The readout will display DIAG and the LED in the DIAG button will illuminate. Press the ENTER key to enter diagnostics mode.
2. Press the SCAN button 3 times. The readout will display, in sequence: "SELFTEST, MOTION, DRV ADJ, SET UP".
3. Press the ENTER button to enter set up mode. The readout will display "UNIT NUM".
4. Press the SCAN key once. The readout will display "DENS SEL".
5. Press the ENTER button. The readout will display "NORMAL" indicating the drive will allow execution in local density mode. If operation in remote mode only is desired, press the SCAN button and the readout will show "REM ONLY". When the desired option is shown, press the ENTER button to select it.
6. The readout will display "LOAD?". Press the LOAD button to save the selected option.
7. The readout will then display "DFLT DEN". Press the ENTER button to select the default density. The readout will display "6250 REM" (the factory set default density).
8. Repeatedly press SCAN until the desired default density is displayed. The sequence of displays is:

a. 800	c. 1600	e. 3200	g. 6250
b. 800 REM	d. 1600 REM	f. 3200 REM	h. 6250 REM

Note: Only the remote density selection will be shown if the REM ONLY option was selected in step 5.

9. When the desired default density is selected press ENTER. The readout will display "LOAD?". Press the LOAD button to save the selection.
10. Press the DIAG button repeatedly until the LED in the DIAG button turns off to exit diagnostics mode.

2.6 OPERATING INSTRUCTIONS

2.6.1 OPERATING PROCEDURE

- A. Turn power on. Readout displays "TESTING" and if the Drive passes all tests, the Readout displays "UNIT X". Fault Conditions that could occur during Power-Up, and possible related failures, are listed and described in Section IV.
- B. Place Tape Reel on Reel Hub with Write Enable Ring facing downward.
- C. Depress LOAD*. The Readout displays "LOADING" and the Drive automatically loads tape. When loading is successful, the Readout displays "UNIT X" and the WRITE ENBL, LOAD POINT, and LOAD LEDs light. If loading is unsuccessful, the Readout displays a diagnostic message such as: CHK HUB, ABORTED, REV REEL, etc., or a Failure Code, and the RWND/UNL LED flashes.

* Or Host can send a Load On-Line Command (ILOL) to start Load.

If loading is unsuccessful, correct the condition indicated by the Failure Code Readout per Section IV, and depress LOAD to reattempt the load operation.

- D. Depress ON-LINE. ON-LINE LED lights and the Readout continues to display the Unit Number.
- E. The Tape Drive is now ready to accept commands from the Host. The Drive can be taken off-line manually by the operator pressing ON-LINE or by the Host issuing an Off-Line Command.

2.6.2 OPERATION NOTES

A. On-line Operations:

When the Drive is on-line, the Readout displays the Unit Number whether or not the Drive is selected.

B. Load Operations:

1. If the Drive is unable to Load, the Readout will display a diagnostic message such as: "CHK HUB", "ABORTED", "REV REEL" etc., and the RWND/UNL LED will flash.
 - a. Pressing LOAD will start another Load attempt.
 - b. Pressing RWND/UNL will clear flashing LED and Error Message.
 - c. If nothing is done, after one minute, the Drive displays "UNIT X".
 - d. See NOTE under paragraph 2.5.3.1, Step C.
2. Pressing RWND/UNL while the Drive is Loading, aborts the Load Sequence.

C. Rewind Operations:

1. If the Drive is off-line, pressing RWND/UNLD once causes the Drive to rewind tape to BOT.
2. If the Drive is off-line, pressing RWND/UNL while the Drive is rewinding, or while positioned at BOT, will initiate an Unload Operation after the Drive has completed Rewind.

D. Recovering From Tape Running Off Reel:

The Drive has a built-in feature to prevent tape runaway: If a block of data is not encountered within 25 feet of tape motion before EOT, or 5 feet of tape motion after EOT, the Drive will normally stop tape motion. However, the 25-foot/5-foot limit feature can be defeated in the Set-Up Mode, or by continued Read Commands being received from the Host after EOT has been passed. Either of these conditions could result in tape being run completely off the Supply Reel. The following procedure is recommended to recover from this predicament.

1. The display will read **TAPE END** and the **RWND/UNL LED** will be flashing. Press the **RWND/UNL** switch and wait for the arms to retract.
2. Manually thread tape backwards through the tape path from the Take-up Reel to the Supply Reel. Refer to Figure 2-12.
3. Wrap tape around the Supply Reel in a counterclockwise direction.
4. Manually rotate the Supply Reel counterclockwise until the EOT Tab is on the Supply Reel.
5. Press **LOAD**. Tension Arms will tension tape and tape will rewind back to Load Point.

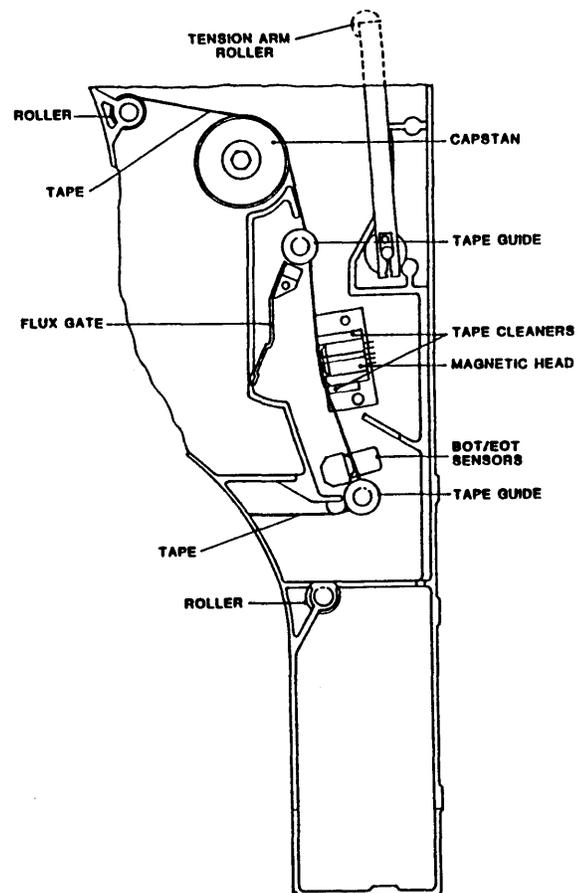


Figure 2-12. Tape Threading

E. Manually Locking/Unlocking Supply Reel on Supply Reel Hub:

The Supply Reel Hub normally automatically locks the Supply Reel in place during the loading sequence. However, the Supply Reel can be manually locked in place using the Manual Reel Locking Lever located just inside the Tape Access Door (illustrated in, Section VI, Figure 6-1).

To manually install (lock) a Supply Reel onto the Hub:

1. Open the Tape Access Door and the Top Cover of the Drive.
2. Place a Supply Reel onto the Supply Reel Hub.
3. Press the Manual Reel Locking Lever inward (toward the rear of the Drive) while slowly turning the Supply Reel and Hub clockwise until the Reel Locking Fingers of the Hub extend outward and lock the Reel in place.

To manually release the Supply Reel from the Hub:

1. Press the Manual Reel Locking Lever inward while slowly turning the Supply Reel and Hub counterclockwise until the Reel Locking Fingers of the Hub retract and release the Supply Reel.

F. Default Parameters:

The Tape Drive is factory set to the following parameters. These parameters can be changed as desired as described in the Section IV Diagnostics.

Table 2-2. Set-Up Menu

Parameter	Default Setting	Description	Other Options
UNIT NUM	UNIT 0	Drive Unit Number (Address).	1 thru 7
DENS SEL	NORMAL	Enables manual density selection.	REMOTE ONLY
DFLT DEN	6250 REM	Default Density, 6250 cpi Remote, Host selectable.	6250 800, 800 REM 1600, 1600 REM 3200, 3200 REM
SPEED	HOST SEL	Tape Speed, Host selects.	AUTO SPEED 50 ips, 100 ips
TIME OUT	25 FT ON	Drive times out if data not detected within 25 feet of tape run.	25 FT OFF
SECURITY	ENABLED	Host can command tape erasure from the tape's present position to a point 3 feet past End Of Tape.	DISABLED
EOD GAP	ENABLED	A 25 ft. erased gap is written following any write that isn't terminated with a filemark and the next command is a reverse motion, i.e. Read Reverse, Rewind, etc.	DISABLED
PARITY	IGNORE	Drive does not check Write Data Parity.	CHECK
LONG GAP	1.2 INCH	Long Gap Command from Host causes Interblock Gap of 1.2 inches.	0.45, 0.6, 2.5
ARA CAL	ENABLED	Drive automatically sets the gain of the Read Amplifiers when reading or writing in GCR Mode.	DISABLED
GCR CERR	DISABLED	Drive reports errors corrected internally when operating in GCR Mode.	ENABLED
NRZI CCG	ENABLED	Drive sends NRZI CRC & LRC Characters to Host following each data block.	DISABLED
CLR FBSY	POSTREPO	Drive clears FBSY after repositioning, following a 100 ips Command.	WITH DBY
IFEN	NORMAL	Formatter Enable Signal is normal (not inverted).	INVERT
DENS OUT *	CODED	Enables coded density selection.	NRZ ONLY
FMK GAPS	EXTENDED	4 inch gap between data block and file mark, in all densities.	NOMINAL
REPO	NOMINAL	Extends 100 ips repositions by 40 ms. Extends 50 ips GCR repositions by 80 ms.	LONG

Note: For full definition of parameters, see Section IV Diagnostics.
*Refer to 1.4.2.18 for definition of CODED and NRZ.

Table 2-3. Drv Adj Menu

Parameter	Default Setting	Description	Other Options
BUF ARMS		Calibration/Test Only	
HUB SENS		Calibration/Test Only	
RL SERVO		Calibration/Test Only	
CHK QUAD		Calibration/Test Only	
EEOT	DISABLED	Tape counter display is disabled, and normal "UNIT X" displayed. If option is set to ENABLED, then menu item TAPE LEN is available. Display will be as defined by the TAPE LEN option setting.	ENABLED
TAPE LEN	REGULAR	Normal "UNIT X" is displayed. If option is set for TAPE USE, the display will indicate tape used since BOT. If option is set for TAPE REM, the display will indicate tape remaining until EOT is reached.	TAPE USE TAPE REM
TIC SENS		Calibration/Test Only	
APR LOAD	APR OFF	If the option is set to "APR ON" the drive will initiate a Load and go ONLINE automatically at the completion of the power-on diagnostics.	APR ON
DLD LOAD	DLD OFF	If the option is set to "DLD ON" the drive will initiate a Load and go ONLINE when the tape access door is closed.	APR ON
<p>Note: TAPE LEN menu selection is only shown when the EEOT option is ENABLED.</p>			

SECTION III

FUNCTIONAL DESCRIPTION

3.0 GENERAL

This section describes general operation of the major components of the 9610/9660 Drive.

3.1 SYSTEM DESCRIPTION

3.1.1 OVERVIEW

The 9610/9660 Drive is organized around a Motherboard mounted flat in the bottom of the chassis at the rear of the unit. The Motherboard interconnects the four major circuit cards: The Formatter Board, Read Analog Board, and Read/Write Digital Board, which slide into a card cage accessible at the rear of the unit, and the Drive Electronics Board, which mounts flat in the chassis underneath the deck plate.

The Servo Amplifier Assembly is located on the chassis under the deck plate, adjacent to the Power Supply Assembly and the Drive Electronics Board. The Position Sensors Board and the Interconnect Board mount directly to the Deck Plate, and the Read Preamp Board is connected directly to the Read Head on the Deck Plate. The Operator Control Panel is located on the front of the Drive.

3.1.2 FORMATTER BOARD

Along the top edge of the Formatter Board, there are two 50-pin card edge connectors. Cables which attach to these connectors convey Commands, Data, and Status Information between the Drive and the Host. Connector signals and pin assignments are defined by Industry Interface Standard.

The Host Interface includes buffers and line receivers to interface with the host, decoders to accomplish unit selection, and a latch to hold command bytes.

Read/Write Compare Buffer: The Read/Write Compare Buffer is a 1k byte RAM memory with address counters to configure it as a circular data file. This Buffer accomplishes a byte-by-byte data comparison of Write and Read Data during Read-After-Write Operations.

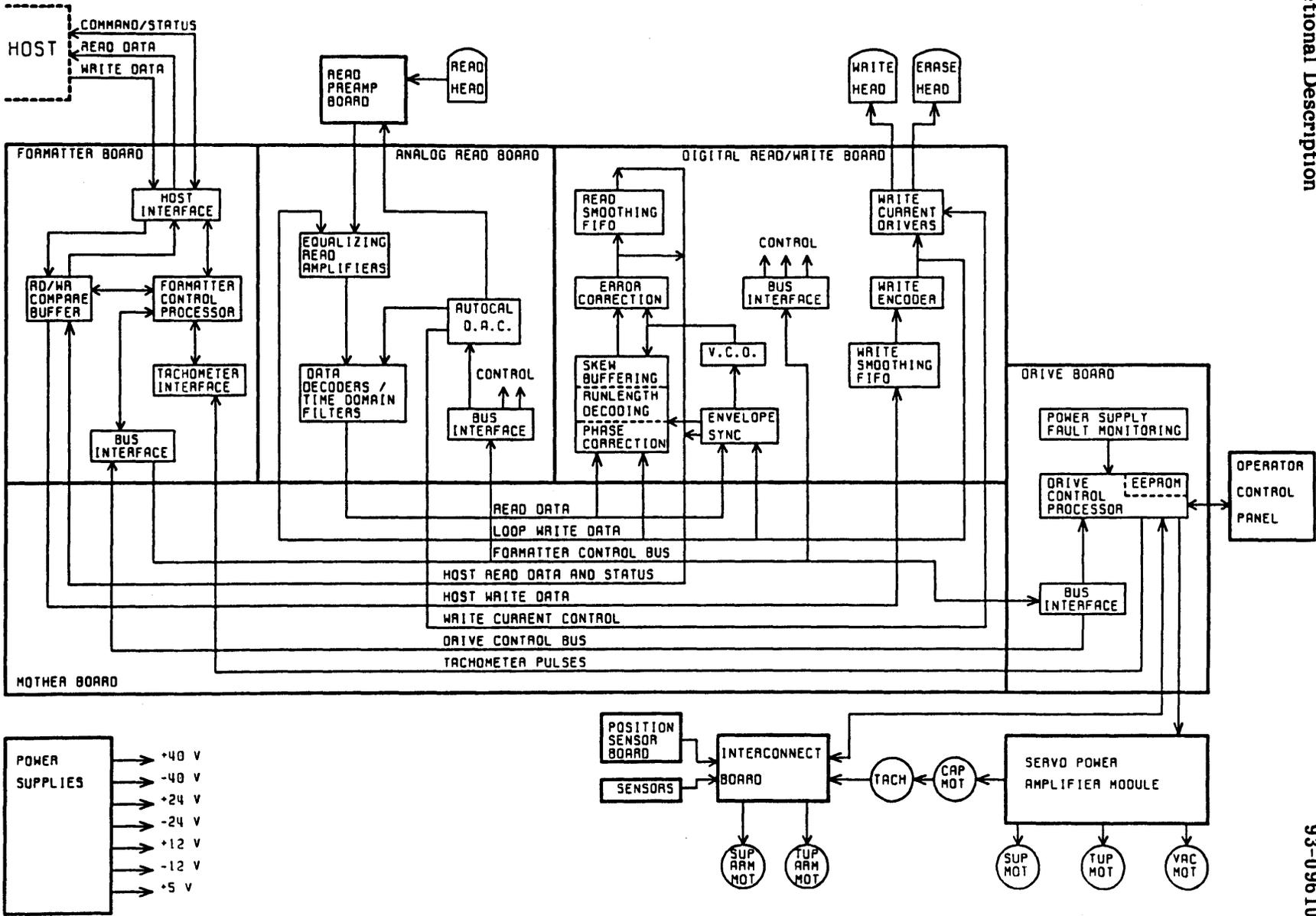
The Read/Write Compare Buffer momentarily stores Host Write Data that is currently being written to tape. The Drive, performing a Read After Write Operation, immediately reads the written data and sends it back to the Compare Buffer where it is compared with the stored Write Data. A favorable comparison allows the Drive to continue writing Data to tape. A comparison error is reported to the Host on the HER Status Lines along with Read data on the Read Data Lines.

The Buffer also serves during Data Diagnostics Operations as a data source for the Write Process, and evaluates the success of the Read Process.

Formatter Control Processor: The Formatter Control Processor is a micro-computer and its associated support devices. This device receives Commands from the Host Interface and schedules them for execution, sending them to the other functional units of the Drive via the Bus Interface and Formatter Control Bus.

The Formatter Control Processor tracks tape position by monitoring Counters in the Tachometer Interface that increment or decrement with the arrival of Tachometer Pulses from the Capstan Tachometer.

Figure 3-1. Model 9610/9660 Tape Drive General Block Diagram



Formatter Control Bus: The Formatter Control Bus consists of the 8-line Formatter Data Bus (FDB), the 7-line Formatter Select Bus (FSEL), and 5 handshaking lines. The Formatter Control Bus conveys Commands and Status to all major components of the Drive. The status of the Select lines determine distribution of Control and Status signals. The destination module signals acceptance or rejection of Control Signals by issuing an Acknowledge or Busy Signal.

The Formatter Control Bus also conveys all commands initiated by the Drive or Operator Control Panel to the Formatter to completely control the Read and Write Sections of the Drive. Note that the Formatter communicates with the Operator Control Panel via the Drive Electronics Board.

3.1.3 READ PREAMP BOARD

The Read Preamp Board contains a high-gain, low-noise preamplifier with electronic gain control, for each of the nine channels. For excellent noise performance, it is located very close to the magnetic Read Head. The Preamp connects to the Read Analog Board through a ribbon cable that passes under the deck plate.

3.1.4 READ ANALOG BOARD

Signals from the Read Preamp are processed by the Equalizing Read Amplifiers, which include CMOS switches that select the optimum equalization network for each speed and density.

Data Decoders: After equalization, the Read Signal is processed in the Data Decoders that include a time domain filter, which rejects any transitions which are too close together in time. This improves noise margins. The Data Decoders also verify threshold, squelching the Read Data if its amplitude falls below the threshold for several cell periods.

Digital-to-Analog Converter (DAC): The DAC is a multiplexed 8-bit digital-to-analog convertor with a small RAM used to hold digital calibration values. The DAC generates Gain control signals for the Read Preamp, and threshold values for the data detectors. Settings for the DAC come from the Control Processor in the Formatter Board via the Formatter Data Bus. These settings are written to the Read Analog Board at Power-Up or can be entered manually from the Front Panel.

The DAC also generates values that control Write Current generated by Write Current Drivers in the Read/Write Digital Board .

3.1.5 READ/WRITE DIGITAL BOARD

The Read/Write Digital Board Decodes Read Data, encodes Write Data, and performs Error Correction as required.

Envelope Synchronization: Read Data from the Data Decoders in the Read Analog Board are applied to the envelope/synchronization circuit where file marks and other special blocks are recognized, and envelopes (signal-presence) are provided for the Processor in the Formatter Board to use during Calibration.

Voltage Controlled Oscillator (VCO): At the beginning of each data block, the Envelope Synchronization provides a series of sync signals which control the Voltage Controlled Oscillator (VCO) in a Phase-Lock-Loop (PLL) Synchronization Acquisition Process. Based on available envelope information, the Envelope Synchronization selects one data track to use for synchronizing the Phase Lock Loop.

The PLL is a feedback system which maintains the Voltage-Controlled Oscillator as an internal clock in synchronization with the arriving data stream. If the data stream speeds up or slows down because of variations in tape speed, the VCO also change its frequency to maintain synchronization with the data. During the Interblock Gap, the PLL is synchronized to a crystal controlled clock known as the Gapclock.

Phase Correction: One VCO controls the decoding process for all 9 tracks. However, individual tracks may vary slightly in phase due to a phenomenon known as "dynamic skew." To correct for this problem, each track is provided with a phase-corrector circuit, which is a first-order digital phase-lock loop of very low bandwidth, synchronized with the VCO. The phase correctors also provide additional rejection for low-rate changes in tape speed.

Runlength Decoding: For the GCR code, five bits of Read Data must be decoded to every four bits of Write data; for the PE codes, the data transitions must be separated from the phase transitions. Also, the special control characters marking the beginning and end of each block must be recognized. These requirements are accomplished by the Runlength Decoding Circuitry.

Skew Buffering: Data from the various tracks may arrive from the Read Head at different times. The resulting skew may be as much as several character times. To bring the data from the nine tracks into correct time phase, each track is provided with a First-In, First-Out (FIFO) buffer. Track Data flows into the FIFO Buffers asynchronously, and flows out from the FIFOs synchronously and in parallel.

Error Correction: Using GCR format (and, to a limited extent, the PE format), data lost to tape defects may be restored during the decoding process. Error Correction, using redundant data bytes which were placed on the tape during the record process, reconstructs missing or corrupted data. The GCR format includes two redundant bytes for every seven bytes, making it possible to recover up to two tracks with dropout-caused errors. The Drive can recover one bad track of PE formatted data. The GCR and NRZI formats also include redundant checksum bytes, which may be used to verify that the data has been received correctly.

Read Smoothing FIFO: From Error Correction, Read Data flows through a small transfer rate matching FIFO, from where it is multiplexed with Status and Envelope information and sent through the Motherboard, to the Formatter Board.

Write Processing: The Read/Write Digital Board includes the Write Data Processing System. Write Data from the Read/Write Compare Buffer in the Formatter Board is applied to the Write Smoothing FIFO, from where it is applied to the Write Encoder. The Write Encoder prepares the Write Data for application to the Write Current Drivers, and generates the File Mark and special blocks, for all densities. The encoded Write Data may also be passed to the Phase Correction and Envelope Synchronization Circuitry, or directly to the Equalizing Read Amplifiers in the Read Analog Board, for diagnostic purposes. The Write Current Drivers consist of discrete transistor current sources, which apply Write Data or Erase Power to Write Head or Erase Head.

3.1.6 DRIVE ELECTRONICS BOARD

The Drive Electronics Board controls all electro-mechanical tape handling devices in the unit, including the Capstan, Supply and Take-up Reel Motors, the Servo Systems, the Take-up and Supply Buffer Arms, and the Autoload Mechanisms, including the Vacuum Blower, Supply Reel Hub Locking Mechanism, and various monitoring sensors. The Drive Electronics Board also interfaces between the Operator Control Panel and the Motherboard.

Drive Control Processor: To control the above-mentioned devices, the Drive Electronics Board includes the Drive Control Processor, which is a microcomputer with its support circuits, and an EEPROM for non-volatile data storage.

The Drive Control Processor receives commands from the Formatter via the Formatter Control Bus, and sends commands and data to the Formatter via the Drive Control Bus. The Drive Control Bus is a unidirectional bus consisting of 8 data lines, one strobe line, and two select lines.

The Drive Electronics Board includes circuitry to monitor the Tachometer and establish the correct tape speed, and the Power Supply Fault Monitor to gracefully shut down the Tape Transport if a fault occurs.

3.1.7 SERVO POWER AMPLIFIER

The Servo Power Amplifier consists of three sets of Power Drivers that drive the Supply Reel Motor, Take-up Reel Motor and Capstan Motor. A balancing circuit interacts between the positive and negative power sources, restoring any imbalances that occur by the operation of the three Power Drivers. When enabled by the Drive Control Processor, the feedback loops in the Reel Motor Servo cause the tape reels to move so as to maintain the Tape Buffer Arms in their linear operating region, regardless of tape motion caused by the Capstan. Meanwhile, the Capstan Motor Servo maintains tape speed at any value requested by the Drive Control Processor.

3.1.8 OPERATOR CONTROL PANEL

The Operator Control Panel includes an alphanumeric display that conveys status messages, control and diagnostics options to the operator. The Control Panel also includes an array of switches and LED indicators to operate the unit.

3.1.9 INTERCONNECT BOARD

The interconnect board consolidates wiring that connects the Drive Electronics Board to the various sensors, motors and solenoids mounted on the Deck Plate.

3.1.10 POSITION SENSORS BOARD

The Position Sensors Board monitors capacitive sensors mounted on the shafts of the Supply and Take-up Arms. These sensors are automatically calibrated each time power is turned on.

3.1.11 POWER SUPPLIES

The Power Supplies are mounted on the chassis under the Deckplate. Unregulated ± 40 Volt and ± 24 Volt Supplies apply power to the servos, and a switching 5-Volt Regulator supplies logic power for the Drive. Power supply fault monitoring is provided on the Drive Electronics Board.

SECTION IV

DIAGNOSTICS

4.0 GENERAL

The Model 9610/9660 Tape Drive incorporates extensive built-in Self-test and Front-Panel Diagnostics providing tests for maintenance and troubleshooting aids. Self-test Diagnostics occur automatically during Power-Up, displaying appropriate failure codes if failure occurs. Front Panel Diagnostics are manually-controlled operations that exercise the Tape Drive, displaying appropriate readouts to indicate Drive condition.

4.1 CONTROLS AND INDICATORS

Controls and Indicators used in Diagnostics and Calibration Modes are listed and described in Section II, Figure 2-10.

4.2 TROUBLESHOOTING

Troubleshooting the Tape Drive consists of using diagnostics, and self-tests to diagnose mechanical, electromechanical, and electronic malfunctions.

Diagnostics include firmware-controlled tests and exercises that can be initiated by the Operator from the Drive Front Panel. The Digital Display on the Front Panel provides diagnostic readouts.

Self-tests occur with each Power-Up, or can be manually initiated using the Diagnostics Menu. Self-tests include failure codes and diagnostic readouts on the Front Panel Digital Display.

4.2.1 ACCESSING THE DRIVE FOR TROUBLESHOOTING

CAUTION: A solidly grounded Electrostatic Discharge (ESD) Wrist Strap should be worn whenever touching or handling any Circuit Board or other electronic assembly in the Drive.

WARNING - AC UNITS: Dangerous AC voltage exists in and about the Voltage Selector, the EMI Filter, the Power Transformer, Fan, and the Power Switch on the Front Panel. ALWAYS UNPLUG THE AC LINE CORD BEFORE WORKING IN THESE AREAS. (See Schematic Diagram 7109 [sheet 2] for illustration of AC voltage distribution).

The Drive includes personnel safety interlocks that operate when the Tape Access Door or Top Dust Cover is opened. To operate the Drive for troubleshooting, the technician must defeat the Interlocks as follows:

- A. With power ON, unload tape (as applicable).
- B. Raise the Deck assembly to Maintenance Position per paragraph 5.2.2.
- C. On the Drive Electronics Board, move the Diagnostics Jumper (ST4 - Ref. Figure 5-31) from its present position as follows:
 1. If original position is EN: press and hold ENTER, and move from EN to DIS.
If original position is DIS: press and hold ENTER, and move from DIS to EN to DIS.
 2. If you intend to test, calibrate, or operate the Drive via Diagnostics Pushbuttons, move the Jumper from DIS to EN (Do not press ENTER).
 3. From Step 1 you have one minute to lower the Deck Assembly and load tape. If tape has not been loaded within one minute, repeat Step C.
- D. Display flashes "NO INTLK". Press DIAG to start Diagnostics.
- E. To reactivate the Interlock, unload tape.

4.3 POWER-UP

Upon Power-Up, and without a reel of tape inserted, the Readout normally displays: TESTING, for approximately 15 seconds. If TESTING continues to be displayed, this indicates that communication between Formatter and Drive is disrupted and no further testing can be accomplished. There is a problem in the Formatter or the interface between Formatter and Drive. Assuming that communication between Formatter and Drive is obtained, the Drive performs the Self-tests described below. In addition to the Failure Codes, The Drive can display Failures in the form of words or abbreviations. Tables 4-1 and 4-2 list and describe the Failures represented by this type of display, and also indicate the possible causes of failure. If a failure should occur during Power-Up, press REWIND/UNLOAD. This clears the error and permits the operator to load tape and perform diagnostics.

Each Power-Up Self-test exercises the following areas of the Drive:

- A. **Drive Electronics:**
 1. Power Supply
 2. Drive Electronics PCBA
 3. Front Panel
 4. Servo System including Reel and Capstan Motors.
- B. **Formatter and Read/Write Electronics:**
 1. Formatter Board
 2. Write/Read Board
 3. Read Analog Board

4.3.1 DRIVE ELECTRONICS FAILURE DISPLAYS

The Tape Drive is factory set to the following parameters.

<u>Parameter</u>	<u>Default Setting</u>	<u>Description</u>	<u>Other Options</u>
EEOT	ENABLED	Allows EEOT calculation.	DISABLED
TAPE_LEN	REGULAR	Displays normal "UNIT X" on front panel.	TAPE REM, TAPE USE

Table 4-1 lists failure displays.

Table 4-1. Drive Electronics Failure Displays

DISPLAY	FAULT CONDITION	PROBABLE FAILURE
TESTING	Formatter PCB not communicating with the drive: (diagnostics hangup).	Formatter PCB or Drive Electronics PCB failed.
FMT ERR? and REW flashes	Formatter PCB error (timeout).	Formatter PCB failed to interrogate, Drive Electronics PCB, or the Formatter PCB failed to send its identification (ID) after a request from the Drive Electronics.

Table 4-1. Drive Electronics Failure Displays (Continued)

DISPLAY	FAULT CONDITION	PROBABLE FAILURE
TAK ARM?	Take-up Arm fails to calibrate.	Take-up Arm Retract and Pivot Sensor Assembly, Position Sensor PCB, Drive Electronics PCB, or Interconnect PCB failed.
SUP ARM?	Supply Arm fails to calibrate.	Supply Arm Retract and Pivot Sensor Assembly, Position Sensor PCB, Drive Electronics PCB, or Interconnect PCB failed.
CAPSTAN?	No tachometer voltage.	Capstan Motor, Capstan Power Amplifier, or Tachometer failed.
T MOTOR?	Take-up Reel Motor not running.	Take-up Reel Motor, Servo Preamplifier PCB, Servo Power Amplifier PCB, or Drive Electronics PCB failed.
S MOTOR?	Supply Reel Motor not running.	Supply Reel Motor, Servo Preamplifier PCB, Servo Power Amplifier PCB, or Drive Electronics PCB failed.
BAD SCSI	SCSI PCB failed Power-Up.	SCSI PCB.
ROM?	Drive Electronics PCB program PROM	Checksum error detected. Non-zero checksum.
EEPROM? and REW flashes	Checksum error.	Non-zero checksum detected. Press RWND/UNL. The Drive will compute a new checksum and attempt to write it into the EPROM. Drive Electronics PCB failed.
+12V ? +40V ? -12V ? -40V ?	Voltage below +10V Voltage below +30V Voltage above -7V Voltage above -29V	Power Supply and/or Regulator failed.
FAIL XXX	(XXX refers to failure code, see Table 4-2)	

Table 4-1. Drive Electronics Failure Displays (Continued)

DISPLAY	FAULT CONDITION	PROBABLE FAILURE
ARM CAL?	Invalid or No Calibration present in the EEPROM.	Drive Electronics or Drive firmware replaced without arm recalibration.
ARM JPR?	Missing jumper on Position Sensor Board.	DL4 jumper position is W2. DL5 jumper position is W1.
CHK ARMS	Arm calibration off.	Recalibrate arm positions.
RETRACT?	Arms can't retract.	Retract and Pivot Assy. Interconnect PCB Drive Electronics PCB.
A-T CAL?	Invalid or No Capstan Calibration values present in EEPROM.	Drive Electronics Board or Capstan Motor replaced.
JUMPER?	No jumper at ST3 (program enable) on Drive Electronics	Jumper must be at ST3 position when EEPROM values are to be changed.
CHK CAPS	Tape Stiction or Capstan Failure	Speed Error - Clean Capstan Wheel & observe. If CHK CAPS persists, replace Capstan Motor.
CHK DRV	Capstan gain off during Autotune Calibration	Bad Capstan Motor or bad Drive Electronics.
DRV FAIL	Watchdog Timer Failure. A) Watchdog Timer Failure. B) Reset Circuit Failure.	Drive Electronics PCB.
<CLOSE DOOR>	Load button pushed when Front Door is open.	Close Door.
COVER?	Top Cover open or Interlock broken when Drive is loaded.	Close Top Cover.
DOOR SW?	Door opened during LOAD.	Close Door.
TAPE END	Tape has run off the Supply Reel (past EOT marker).	Host wrote or read too far beyond the EOT marker.

4.3.2 FORMATTER FAILURE CODES

Table 4-2 lists the Failure Codes that could display during Power-Up, indicating probable causes of failure. Note that Failure Codes 150 thru 159 include the option of obtaining a second Failure Code which indicates specific problems. If a Failure Code between 150 and 159 occurs, to obtain the second Failure Code, press DENSITY. **Note:** the Failure Code is preceded by the word FAIL.

Table 4-2. Power-Up Failure Codes

CODE	DESCRIPTION	PROBABLE FAILURE	
128	External RAM Data Error	Compare RAM Formatter 8951	
129	External RAM Addressing Error		
131	No RBSY for Read Amp Gain Values	Read Analog Board 9017	
132	Wrong Formatter Board for 9610/9660	Formatter Board 8951	
133	Wrong Analog Board for 9610/9660	Read Analog Board 9017	
134	Wrong Digital Board for 9610/9660	Read Digital Board 9060	
136	Address Counter Failure	Read Digital Board 9060	
140	Auto Adjust Ranging Error	Read Analog Board 9017	
141	Dead Track found in Auto Adjust		
142	Over Range Signal in Auto Adjust		
150	No RBSY in Loop RAW Test	Press DENSITY Pushbutton for Second Code listed below:	
151	No WBSY in Loop RAW Test		
152	Time-out on WBSY in Loop RAW Test		
153	Time-out on RBSY in Loop RAW Test		
154	WBSY ended too soon in Loop RAW Test		
155	Hard Error in Loop RAW Test		
156	Corrected Error in Loop RAW Test		
157	Compare Error in Loop RAW Test		
158	File mark during Loop RAW Test		
159	Block Size Error in Loop RAW Test		
ITEM	SECOND CODE	DESCRIPTION	
1	D-50 NRZ	Loop Write to Read Digital, 50 ips NRZI	Read Digital Board 9060
2	D-100NRZ	Loop Write to Read Digital, 100 ips NRZI	
3	D-50 PE	Loop Write to Read Digital, 50 ips PE	
4	D-100 PE	Loop Write to Read Digital, 100 ips PE	
5	D-50 DPE	Loop Write to Read Digital, 50 ips DDPE	
6	D-100DPE	Loop Write to Read Digital, 100 ips DDPE	
7	D-50 GCR	Loop Write to Read Digital, 50 ips GCR	
8	D-100GCR	Loop Write to Read Digital, 100 ips GCR	
9	A-100 PE	Loop Write to Read Analog, 100 ips PE	Read Analog 9017
10	A-50 DPE	Loop Write to Read Analog, 50 ips DPE	
11	A-100DPE	Loop Write to Read Analog, 100 ips DPE	
12	A-50 GCR	Loop Write to Read Analog, 50 ips GCR	
Legend:			
RBSY = Read Busy Signal		RAW = Read After Write	
WBSY = Write Busy Signal			

4.3.3 FORMATTER POWER-UP SELF-TEST DESCRIPTIONS

The Drive displays TESTING during the Power-Up Tests, and UNIT X when the testing is complete. If the Drive fails to power up, it displays either the failed module or a failure code. Power-Up Self-tests are described as follows:

- a. **Micro-processor Sanity Check:**
Verify operation of the Microprocessor.
- b. **Microprocessor RAM Check:**
Verify operation of 8031 internal RAM
- c. **External RAM Check, Data Pattern 55H: Failure Code 128.**
Verify operation of External RAM with Data Pattern 55H.
- d. **External RAM Check, Data Pattern AAH: Failure Code 128**
Verify operation of External RAM with Data Pattern AAH.
- e. **External RAM Check, Addressing: Failure Code 129**
Verify addressing capability of External RAM.
- f. **ID The Formatter: Failure Codes 132, 133, 134**
Verify that the Formatter, Read Analog, and Write/Read Boards are the proper type for 9610/9660 operation.
- g. **Address Counter Check: Failure Code 136**
Verify the operation of the data compare RAM address counter.
- h. **Send Test Amp Gain Values to Analog Board: Failure Code 131**
Verify operation of Read Analog Board.
- i. **Loop Write to Read Digital: Failure Codes 150-159**
Run data through the Write/Read Digital Board, looping it from the output of the Write Section back into the Read Section, and verify proper operation at all speeds and densities.
- j. **Loop Write to Read Analog: Failure Code 150-159**
Loop data from the output of the Write Section of the Write/Read Board to the input of the Read Analog Board, and verify proper operation.

4.4 LOADING FAILURE CODES

The 9610/9660 also includes automatic diagnostics that can detect loading failures, giving appropriate displays to indicate failures and their possible causes. Table 4-3 lists and describes the displays and related Fault Condition, and Possible Failures that could occur during Loading. After successfully completing Power-Up, load a reel of tape into the Drive. If there is a loading failure, one of the displays listed in Table 4-3 will appear.

Table 4-3. Loading Failures

DISPLAY	FAULT CONDITION	PROBABLE FAILURE
BOT?	No BOT mark detected.	Tape marker missing from tape, tape leader too short, faulty BOT Sensor, Drive Electronics PCB failed, or Interconnect PCB failed.
ABORTED*	Automatic load aborted.	No vacuum, Vacuum Motor Fuse, air leak in tape path, Position Sensors failed, tape clings to itself (electrostatic charge), tape leader failed to enter tape path, tape snagged while in tape path, tape would not adhere to the Take-up Reel, Drive Electronics PCB failed, Servo Preamplifier PCB failed or Servo Power Amplifier PCB failed.
REV REEL	Reverse reel.	Reel upside down.
PLC REEL	Place reel	Reel not installed.
TIC SENS	No Tape-In-Channel sensed.	Tape-In-Channel Sensor or Emitter failed.
CHK SLND	Check solenoid - Hub Lock Solenoid not locking.	Hub Lock Solenoid defective or needs adjustment, Drive Electronics PCB failed, or Interconnect PCB failed.

* If this message is displayed, do not attempt a second load without completely rewinding the tape and removing the reel from the unit. The tape should be inspected for electrostatic charge and other problems before reloading.

Table 4-3. Loading Failures (Continued)

DISPLAY	FAULT CONDITION	PROBABLE FAILURE
CHK HUB	Check hub - Supply Reel not detected.	Reel-In-Place Tab needs adjustment, Reel-In-Place Sensor failed, Drive Electronics PCB failed, or Interconnect PCB failed.
BKN TAPE	Broken tape - tape not detected.	Broken tape, no EOT mark, EOT Sensor failed, Interconnect PCB failed, or Drive Electronics PCB failed.
TAK ARM?	Take-up Arm not operating correctly.	Take-up Arm Position Sensor PCB failed (check with arm relaxed), Drive Electronics PCB failed, or Interconnect PCB failed.
SUP ARM?	Supply Arm not operating correctly.	Supply arm Position Sensor PCB failed (check with arm relaxed), Drive Electronics PCB failed or Interconnect PCB failed.
CHK TAPE	Automatic load aborted.	Tape leader is not properly trimmed, tape leader is folded.
ARM OFF	Tension Arm has exceeded preset travel limits.	Arm Position Sensor.
WEN SEN?	File Protect Sensor does not see RIP Flag during loading.	Write Enable Sensor out of adjustment.
BAD QUAD**	Bad quadrature found when performing EEOT calculation.	Write Enable and Reel-In-Place Sensor adjustment required using the CHK QUAD diagnostic aid.
<p>** If this message is displayed, the flashing REW/UNL button may be pressed and operation may continue. However, the drive will operate with the tape counter feature disabled.</p>		

4.5 FRONT PANEL DIAGNOSTICS

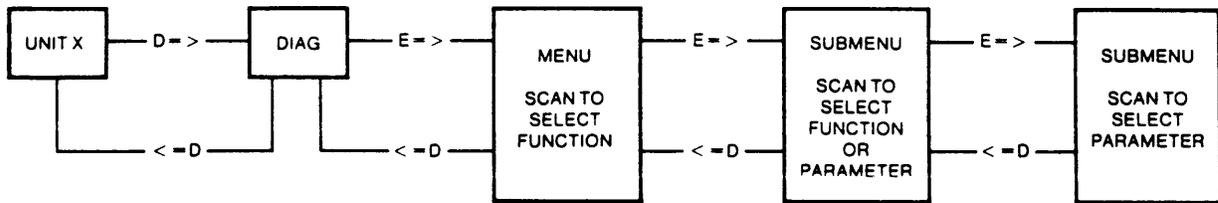
Note: To perform Diagnostics, Diagnostics Jumper ST4 (on Drive Electronics Board 8952) must be in ENABLE Position per Figure 5-31.

Diagnostics are divided into six major sections represented by Displays as indicated below:

<u>Chart</u>	<u>Section</u>	<u>Display</u>	<u>Chart</u>	<u>Section</u>	<u>Display</u>
A	Self-test	SELFTEST	D	Set-Up	SET UP
B	Motion	MOTION	E	Calibration	CAL
C	Drive Adjustment	DRV ADJ	F	Data Diagnostics	DATADIAG

Each section, when accessed, displays its own Menu which further divides into submenus. Figure 4-1 illustrates, and the following subparagraphs describe accessing the major diagnostic sections, their Menus and Submenus.

Note that although Set-Up and Calibration are contained in the Diagnostics Menu, they are not Diagnostic Functions. They are for setting up the Drive for operation and for calibrating as required.



LEGEND

- D = > PRESS THE DIAG SWITCH AND PROCEED TO THE RIGHT.
- < = D PRESS THE DIAG SWITCH AND PROCEED TO THE LEFT.
- E = > PRESS THE ENTER SWITCH AND PROCEED TO THE RIGHT.

Figure 4-1. Diagnostics Menu Dynamics (Simplified)

4.5.1 DIAGNOSTICS MENU

Table 4-4 illustrates the overall Diagnostics Menu structure. Each indent represents a Submenu accessible from the Main Menu, usually by pressing ENTER. Pressing SCAN accesses the next lower item in any Menu or Submenu.

Table 4-4. Diagnostics Menu Structure

<p>SELF-TEST</p> <p>1. Power-Up Test 2. Data Test</p> <p>MOTION Parameters (see note 1)</p> <p>1. 50 FWD 8. 100 FSS 2. 50 REV 9. 100 RSS 3. 50 FSS 10. 100FRF 4. 50 RSS 11. 50/100 F 5. 50 FRF 12. 50/100 R 6. 100 FWD 13. BURN IN 7. 100 REV</p> <p>DRV ADJ Functions (2)</p> <p>1. Buffer Arms a. Take-up b. Supply 2. Hub Sensor a. Not In b. In Place (Monitor) 3. RL Servo 4. Chk Quad 5. EEOT a. Enable b. Disable 6. Tape Length a. Regular c. Tape Remaining b. Tape Used 7. TIC Sensor a. OFF b. ON (Monitor) 8. APR Load 9. DLD Load</p> <p>SET-UP Functions/Parameters (2)</p> <p>1. Unit Number a. Unit 0 through Unit 7</p> <p>2. Density Select a. Normal b. Remote Only</p> <p>3. Default Density a. 800 e. 3200 b. 800 Remote f. 3200 Remote c. 1600 g. 6250 d. 1600 Remote h. 6250 Remote</p> <p>4. Speed a. Host Select c. 50 ips b. Auto SPD d. 100 ips</p> <p>5. Timeout a. 25 Ft On b. 25 Ft Off</p> <p>6. Security a. Enabled b. Disabled</p> <p>7. EOD Gap a. Enabled b. Disabled</p> <p>8. Parity a. Check b. Ignore</p> <p>9. Long Gap a. 0.45 Inch c. 1.20 Inch b. 0.60 Inch d. 2.50 Inch</p> <p>10. ARA CAL a. Enabled b. Disabled</p> <p>11. GCR CERR a. Enabled b. Disabled</p> <p>12. NRZI CCG a. Enabled b. Disabled</p> <p>13. CLR FBSY a. With DBY b. Postrepo</p> <p>14. IFEN a. Normal b. Invert</p> <p>15. DENS OUT a. Coded b. NRZ only</p>	<p>16. FMK GAPS a. Nominal c. Ext. All b. Extended</p> <p>17. REPO a. Nominal b. Long</p> <p>CALIBRATE Functions/Parameters (2)</p> <p>1. Auto a. All 1) Confirm? (3) b. 800 c. 1600 50 ips d. 3200 100 ips (4) e. 6250 f. WRT CURR 1) Confirm? (3)</p> <p>2. Manual a. NRZI b. PE 50 ips c. DDPE 100 ips (4) d. GCR</p> <p>DATA Diagnostics (2)</p> <p>1. Mode (Test Options) a. On Error 1) Continue 2) Stop b. At EOT 1) Rewind 2) Stop c. Block Size 1) 4 3) 513 2) 256 4) 1024 d. Data 1) All Ones 4) Random 2) All Zeros 5) Alternate 00-FF 3) Increment e. Speed 1) 50 ips 2) 100 ips f. Re-int 1) Stream 3) Single 2) Start/Stop</p> <p>2. Commands (5)</p> <p>a. Loop Dig f. Read Reverse b. Loop Alg g. Read/RR c. Write h. FMK Test d. Wrt W/RE i. WRT/WFMK e. Read j. WR/RR/RD</p> <p>3. Errors (Display) (6)</p> <p>a. EIC(0-7,P) XXX (7) b. WPAR XXX (Write Parity Error) c. CMP XXX (Compare Error) d. HER XXX (Hard Error) e. STE XXX Single-Track Error (Corrected) f. DTE XXX Double-Track Error g. FMK XXX (File mark Error)</p> <p>NOTES:</p> <p>1. Press the ENTER switch to start motion. 2. Press ENTER switch to enter parameter. 3. Press ON-LINE switch for yes, DIAG switch for no. 4. Pressing the ENTER switch displays CONFIRM? Press ON-LINE switch for yes, DIAG switch for no. 5. Press the START/STOP switch to enter parameter. 6. Where XXX is the quantity of errors. 7. Error in Channel.</p>
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4.5.2 OPERATING PROCEDURE

Running the diagnostics consists essentially of pressing specified pushbuttons on the front panel and following the direction provided by messages on the front panel display.

After a successful Power-Up Self-test, begin diagnostics by pressing the DIAG pushbutton. The Readout displays DIAG, and the Drive is ready to enter the Diagnostic Mode of operation. Subsequently, pressing the ENTER pushbutton accesses the Main Menu.

Generally, as illustrated in Figure 4-1, (proceeding from left to right) the Operator accesses a particular Menu or Submenu by pressing the ENTER pushbutton. He returns to a previous Menu or Submenu by pressing the DIAG pushbutton. Repeatedly pressing DIAG exits from the Diagnostics Mode.

In any Menu, repeatedly pressing the SCAN pushbutton scrolls through functions or parameters in that Menu. Generally, pressing ENTER activates that function or parameter. In certain Submenus, activating the parameter is done by pressing START/STOP, LOAD or ON-LINE - these variations are described as applicable in the following subparagraphs. Note that pressing ON-LINE in Diagnostics Mode does not place the Drive on-line with the Host.

4.5.2.1 ENTERING THE DIAGNOSTICS MODE

In Diagnostic Mode, repeatedly pressing SCAN displays the Diagnostic Functions. Pressing ENTER enables the function displayed. This sequence is illustrated by the following chart:

Note: Be sure Diagnostics Jumper is in ENABLE Position. Ref Figure 5-31.

General Chart: Entering the Diagnostics Mode

Step	ACTION (Press:)	DISPLAY	ACTION (Press:)	DISPLAY	ACTION
0		UNIT X			
1	DIAG	DIAG			Press ENTER to activate selected operation.
2			ENTER	SELFTEST	
3			SCAN	MOTION	
4			SCAN	DRV ADJ	
5			SCAN	SET UP	Press DIAG to exit from Menu.
6			SCAN	CAL	
7			SCAN	DATADIAG	

Having selected a diagnostic function by pressing ENTER, repeatedly pressing SCAN scrolls through the selected Functions Menus illustrated by the following charts.

4.5.2.2 SELF-TEST

The front panel controlled Self-test enables the Operator to rerun the Power-Up Self-tests (par. 4.3) without turning off power, and also to run a Data Write/Read Test. Chart A illustrates accessing the two Self-tests. The following subparagraphs describe the tests.

Chart A. Doing The Self-test

Step	ACTION (Press:)	DISPLAY	ACTION (Press:)	DISPLAY	ACTION
0	DIAG	SELFTEST			
1	ENTER	PWUPTEST	ENTER	CONFIRM?	Press ON-LINE to run test.
2	SCAN	DATATEST	ENTER	CONFIRM?	Press DIAG to abort test and exit from Diagnostics.

Notes:

- Do not install tape when running PWUPTEST. If tape is loaded when ON-LINE is pressed, the Readout displays LOADED, and the test is not run.
- When PWUPTEST is done, if Drive passes test, Drive exits from the Diagnostics Mode and displays UNIT X. When DATATEST is done, if Drive passes test, Display indicates PASSED. If Drive fails either test, Display indicates a Fail Code (Tables 4-2 and 4-3).

4.5.2.2.1 POWER-UP SELF-TEST

The Power-Up Self-test consists of tests described in paragraph 4.3.3. To run this test, unload tape (as applicable). Then with the Readout displaying UNIT X, press DIAG, then ENTER. Press ON-LINE to run test, DIAG to abort and exit from Diagnostics.

4.5.2.2.2 DATA TEST

For Data Test, if tape is not at BOT, Drive rewinds tape to BOT, then selects NRZI Density and proceeds with the Data Test. Note that the Data Test includes the Loop Write to Read Test to confirm operation of the Digital and Analog Modules. This test is also run in the Power-Up Self-test. Data Test consists of the following subtests in the order listed. The Subtest Event Number displays as TEST XX, where XX represents 01 thru 27. If a failure occurs, the Drive displays a Code per Table 4-5. Pressing DENSITY displays the Subtest Event Number.

The Drive Selects NRZI Density and after each complete series of tests, selects a new Density in the following sequence: NRZI, PE, DDPE, GCR.

Subtest Event

- A. Write with Retries 2 Blocks at 50 ips in Streaming Mode.
 - 1. Set Mode to Streaming.
 - 2. Write with Retry one block.
 - 3. Write with Retry one block.
- B. Write with Retries 2 Blocks at 50 ips in Start/Stop Mode.
 - 4. Set Mode to Start/Stop.
 - 5. Write with Retry one block.
 - 6. Write with Retry one block.
- C. Write with Retries 2 Blocks at 100 ips in Start/Stop Mode.
 - 7. Write with Retry one block.
 - 8. Write with Retry one block.
- D. Write with Retries 2 Blocks at 100 ips in Streaming Mode.
 - 9. Set Mode to Streaming.
 - 10. Write with Retry one block.
 - 11. Write with Retry one block.
- E. Write 1 File mark at 50 ips.
 - 12. Write with Retry one File menus, activating the parameter mark.

<u>Subtest</u>	<u>Event</u>
----------------	--------------

- | | |
|----|--|
| F. | Read Reverse 1 Block at 100 ips. Check for File mark Status.
13. Read Reverse one block.
14. Check Status. Should be File mark and not BOT. |
| G. | Read Reverse 8 Blocks at 100 ips, Streaming Mode. Confirm that Drive does not reach BOT.
15. Read Reverse one block.
16. Read Reverse one block.
17. Read Reverse one block.
18. Read Reverse one block.
19. Read Reverse one block.
20. Read Reverse one block.
21. Read Reverse one block.
22. Read Reverse one block. |
| H. | Rewind
23. Rewind. |
| I. | Read Forward 1 Block at 100 ips. Check proper ID Burst Detection.
24. Set Mode to Start/Stop.
25. Read Forward one Block. |
| J. | Read Forward 1 Block at 100 ips.
26. Read Forward one Block. |
| K. | Read Forward 2 Blocks at 100 ips in Streaming Mode.
27. Set Mode to Streaming.
28. Read Forward one block.
29. Read Forward one block. |
| L. | Read Forward 2 Blocks at 50 ips in Streaming Mode.
30. Read Forward one Block.
31. Read Forward one Block. |
| M. | Read Forward 2 Blocks at 50 ips in Start/Stop Mode.
32. Set Mode to Start/stop.
33. Read Forward one Block.
34. Read Forward one Block. |
| N. | Read Forward 1 Block at 50 ips. Check for File mark Status.
35. Read Forward one Block.
36. Check Status. Should be File mark. |
| O. | Rewind.
37. Rewind. |
| P. | Select next Density and go to Subtest A. If Density is GCR, abort test and display PASSED. |

- Note:**
1. Possible Messages that could occur during or after the Data Test are:
 DATATEST - Data Test is being performed.
 CAN'T WR - Tape not loaded or Write Protected.
 PASSED - Drive has passed all tests.
 2. Data Block = 2048 Bytes, Random Data.

Table 4-5. Data Test Failure Codes

CODE	SUBTEST EVENT ^	ORDER*	PROBABLE FAILURE**
131		1	9017 PCBA
		2	9060 PCBA
150 thru 159	Items 1 thru 8 (from Table 4-2)	1	9060 PCBA
		2	8951 PCBA
200	2, 3, 12 any other	1	9017 PCBA
		1	9060 PCBA
		2	9017 PCBA
201	Any	1	9060 PCBA
		2	8951 PCBA
202	19 Any other	1	9017 PCBA
		1	8951 PCBA
		2	9060 PCBA
203	Any	1	9017 PCBA
204	11 Any other	1	9060 PCBA
		1	8951 PCBA
205	2, 3, 25 Any other	1	9017 PCBA
		1	8951 PCBA
		2	9060 PCBA
206	Any	1	9017 PCBA
		2	9060 PCBA
CANT WR		1	Cable (P12) on 7228
Note - Meaning of Failure Codes:			
<u>Code</u>	<u>Meaning</u>		
200	Excessive Retries on Write Command.		
201	File mark Status not received when expected on Read Command.		
202	Hard Error reported on Read.		
203	Corrected Error reported on Read.		
204	Compare Error reported.		
205	Lost Position.		
206	ID Burst Detection problem.		
* Order of Probability: 1 = most probable			
^ Press DENSITY to display the Subtest Event Number. Display for Subtest Event is: TEST XX, where XX represents the Event Number (listed in 4.5.2.2.2).			
** Further diagnostics information may be available in terms of Channel Error by accessing Data Diagnostics (paragraph 4.5.2.8) and scanning through the Errors Menu.			

4.5.2.3 CONNECTOR OR CABLE FAILURES

Power-Up, Loading and Data Tests can also indicate PCBA interconnection faults related to cables and PCBA connectors. These Tests and Failure Messages with associated possible Cable or Connector Failures are listed in Tables 4-6 and 4-7.

Table 4-6. Cable or Connector Faults

TEST	FAILURE MESSAGE	FAULTY CABLE OR CONNECTOR *
(Switch On)	CAPSTAN (immediate)	Connector J2 on 7147 Servo Pre-Amp Board
Power-Up	CAPSTAN	P1 on 7228 Interconnect Board P6 on 7228 Interconnect Board P1 on 7111 Servo Amp Board
Power-Up	TESTING	P2 on 7228 Interconnect Board P14 on 7228 Interconnect Board P17 on 7228 Interconnect Board
Loading	CAPSTAN	P3 on 7228 Interconnect Board
Loading	CLSE DOOR	P7 on 7228 Interconnect Board
Loading	CHK SLND	P8 on 7228 Interconnect Board
Loading	CHK ARMS	P4 on 7228 Interconnect Board
Loading	BOT?	P9 on 7228 Interconnect Board
Loading	ABORTED	P10 on 7228 Interconnect Board P11 on 7228 Interconnect Board (P10 and P11 on 7228 reversed)
Loading	CHK HUB	P13 on 7228 Interconnect Board
Datatest	202, Subtest 25	P1 on 9060 R/W Digital Board
Datatest	205, Subtest 2	P1 on 9060 R/W Digital Board P1 on 9017 Analog Board P15 on 7228 Interconnect Board P16 on 7228 Interconnect Board
Datatest	CANT WR	P12 on 7228 Interconnect Board
<p>Note: *Connector not properly seated or open circuited. For further information concerning a malfunction, access Data Diagnostics (par. 5.4.2.7) and scan through the Errors Menu.</p>		

Table 4-7. Printed Circuit Board Assemblies in Card Cage

TEST	FAILURE CODE	PCBA NOT PROPERLY SEATED
Power-Up	133 134 FMTR ERR	9017 Analog 9060 R/W Digital Formatter
Datatest	131 + RWND/UNL LED flashes 150 + Subtest Item 1 FMTR ERR	9017 Analog 9060 R/W Digital 8951 Formatter

4.5.2.4 MOTION DIAGNOSTIC TESTS

In Motion Mode, the operator can check and adjust the tape path, and Check Motors and Servos. Perform Motion Diagnostics Tests as follows:

After autoloading a tape, press the DIAG pushbutton. The Readout will display DIAG. Pressing the ENTER pushbutton will cause the Readout to display SELFTTEST. Press SCAN and the Readout displays MOTION. Again pressing ENTER accesses the Motion Parameters Submenu. This sequence of events is illustrated in Chart B. Table 4-8 defines abbreviations displayed in the Motion Tests.

Chart B. Selection of Motion Parameters

Step	ACTION (Press:)	DISPLAY	ACTION (Press:)	DISPLAY	ACTION
0		MOTION			
1	ENTER			50 FWD	
2			SCAN	50 REV	
3			SCAN	50 FSS	Press START/STOP to select and initiate the displayed Test.
4			SCAN	50 RSS	
5			SCAN	50 FRF	
6			SCAN	100 FWD	
7			SCAN	100 REV	Press START/STOP again to stop motion.
8			SCAN	100 FSS	
9			SCAN	100 RSS	
10			SCAN	100 FRF	Press DIAG to exit from Menu.
11			SCAN	50/100 F	
12			SCAN	50/100 R	
13			SCAN	BURN IN	

Table 4-8. Motion Test Definitions

DISPLAY	DEFINITION	DISPLAY	DEFINITION
50 FWD	50 ips Forward	100 FSS	100 ips Forward Start/Stop
50 REV	50 ips Reverse	100 RSS	100 ips Reverse Start/Stop
50 FSS	50 ips Start/Stop	100 FRF	100 ips Fwd/Rev/Fwd
50 RSS	50 ips Reverse Start/Stop	50/100 F	50/100 ips Alternate Forward
50 FRF	50 ips Fwd/Rev/Fwd	50/100 R	50/100 ips Alternate Reverse
100 FWD	100 ips Forward	BURN IN	Continuous testing in Forward direction with Rewind at EOT.
100 REV	100 ips Reverse		

4.5.2.5 DRIVE ADJUSTMENT TESTS

Enter the Drive Adjustment Diagnostic Mode by repeatedly, as necessary, pressing DIAG until the Readout displays DIAG. Then press ENTER and SCAN until the Readout displays DRV ADJ. Chart C illustrates accessing the Submenus of the Drive Adjustment Mode.

Buffer Arm Test: Use the Buffer Arm Tests to verify if the calibration positions of each Buffer Arm are adjusted correctly per adjustment procedure, Section V.

Hub Sensor Test: The Hub Sensor Tests enable testing the operation of the Reel-In-Place Sensor and the File Protect Sensor. The digital display indicates the status of the tape reel (NOT IN = Not inserted; IN PLACE = Tape inserted). The WRITE ENBL light indicates the status of the Write Protect Sensor.

RL Servo (Reel Servo) -- This test exercises the servo system. The RL Servo Test requires that a tape reel be inserted (not loaded) before beginning the test. The test executes a diagnostic load but does not perform a BOT search. If a reel of tape is not inserted at the start of this test, the readout displays **LOADING**, then, **ABORTED**. In the event that the reel had been loaded before the start of the test, the readout displays **G = 1.XX**. In either case, the test is not performed.

CAUTION

The RL Servo Test is also used in a critical adjustment procedure required if any component of the Reel Servo System is replaced. This procedure includes setting up parameters that govern operation of the Executive Program in the Calibration EEPROM. **To prevent corrupting the Executive Program**, make sure that the Calibration Jumper (ST3) on the Drive Electronics Board is in **NON-ENABLE** Position (Ref Figure 5-31).

Chk Quad (Check Quadrature) -- The test verifies proper quadrature alignment between the Reel-In-Place and File Protect Sensors. This test need only be performed if the display indicates **BAD QUAD** during a Load procedure. If **BAD QUAD** is displayed during a Load, the **REW/ULD** button may be pressed, and On-Line operation may continue, however, the drive will operate with the tape counter feature disabled.

EEOT (Early End of Tape) -- Setting this option to **ENABLE** allows the drive to calculate the length of the tape mounted during the Load procedure. This option must be set to **ENABLE** for the tape counter display.

If the option is set to **DISABLE**, the tape length calculations will not be performed and the drive will operate with the tape counter disabled.

TAPE LEN (Tape Counter Display) -- This option will enable or disable the tape counter display. If the option is set to **REGULAR**, the normal "UNIT X" is displayed on the front panel. If the option is set to "TAPE USE", the display will indicate (in feet), how far the tape has moved from the BOT marker. If the option is set to "TAPE REM", the display will indicate the distance (in feet), remaining until the EOT marker is encountered.

Note: The TAPE LEN menu selection is only available when the EEOT option is **ENABLED**.

TIC SENS (Tape-In-Channel Sensor Test) -- This test should be performed with no tape loaded, and allows the operator to test the operation of the TIC Sensor/Emitter. When the diagnostic is entered, either **OFF** or **ON** will be displayed. If **OFF** is displayed, the beam between the Emitter and Sensor is intact, indicating no tape present in the channel. If **ON** is displayed, the beam has been broken and the sensor is not receiving the Emitter signal, indicating tape is present in the channel.

APR LOAD (Automatic Power-On Load) -- Setting this option to "APR ON" will allow the drive to Load the mounted tape and go **ONLINE** automatically at the completion of the power-on testing.

DLD LOAD (Automatic Door Load) -- Setting this option to "DLD ON" will allow the drive to Load and go **ONLINE** automatically when the tape access door is closed.

Chart C. Drive Adjustment Tests

Step	DISPLAY	ACTION (Press:)	DISPLAY	ACTION (Press:)	DISPLAY	NOTE
0	DRV ADJ					1
1		ENTER	BUF ARMS	ENTER	RELAXING	2
				SCAN	TAKE X.X SUPP X.X	
2		SCAN	HUB SENS	ENTER	NOT IN IN PLACE	3 3
3		SCAN	RL SERVO	ENTER	LOADING ABORTED	4 5
4		SCAN	CHK QUAD	ENTER	EARLY LATE BAD GOOD	6 7 8 9
5		SCAN	EEOT	ENTER	ENABLED DISABLED	10 10
6		SCAN	TAPE LEN	ENTER	REGULAR TAPE USE TAPE REM	11 11 11
7		SCAN	TIC SENS	ENTER	OFF ON	12 13
8		SCAN	APR LOAD	ENTER	APR ON APR OFF	
9		SCAN	DLD LOAD	ENTER	DLD ON DLD OFF	

Note:

- 1 Press DIAG to exit from any Menu or Submenu.
- 2 RELAXING displays as the Arm relaxes, then TAKE X displays. Pressing DIAG causes display to indicate: RETRACT, and the Arm retracts.
- 3 These displays indicate the state of the Supply Reel.
- 4 After LOADING completes, the final display indicates as follows:
G = 1.XX displays if test is satisfactory. XX represents Reel Servo Gain.
An Error Message per Table 4-3 displays if test fails.
- 5 ABORTED displays if RL Servo is attempted with tape already loaded.
- 6 The RIP Sensor appears too early (<1.5ms).
- 7 The RIP Sensor traveling edge is too late (>1.5 ms).
- 8 Both (6) and (7) are true.
- 9 Quadrature is properly adjusted.
- 10 See EEOT description above for a detailed description of these options.
- 11 See TAPE LEN description above for a detailed description of these options.
- 12 The Tape-In-Channel Sensor is OFF (no tape present).
- 13 The Tape-In-Channel Sensor is ON (tape present in channel).

4.5.2.6 SET-UP

In the Set-Up Mode, the operator sets the basic operating parameters of the Drive. Except for UNIT NUM, DENS SEL, and DEFL DENS, the Calibration Jumper* (ST3) must be placed in ENABLE Position (EN) for the Set-Up Procedures. Set-Up can be done with or without tape loaded. The basic parameters displayed and set up in this Mode are:

- * In most procedures of Set-Up Mode, and all of Calibration Mode, the Calibration Jumper must be installed in the ENABLE Position to store the selected parameters. If the jumper is not installed, and a store (LOAD) operation is attempted, the Readout displays, "JUMPER?" and the RWND/UNL LED flashes. Pressing RWND/UNL aborts the Set-Up or Calibration attempt. (See Section V - Calibration and Set-Up, Electronic - for Calibration Jumper installation.)

When Set-Up or Calibration is complete, replace the Calibration Jumper to its original position. **CAUTION: DO NOT TURN POWER OFF UNTIL CALIBRATION JUMPER IS RETURNED TO ITS ORIGINAL POSITION.** To do so could destroy vital data in the Calibration EEPROM.

- a. **UNIT NUM:** Unit Number. The Drive Unit Number (Address). This can be set to any logical number from 0 thru 7. (Cal Jumper can be in either position.)
- b. **DENS SEL:** Density selection. When set to normal the drive will operate in local or remote density modes, depending on the REMOTE light on the front panel. When in REM ONLY, the drive will only allow selection of REMOTE mode.
- c. **DEFL DEN:** Default Density. The Density to which the Drive will default to on Power-Up. Default Density can be set to 800, 1600, 3200, and 6250 cpi, and can be set for Local or Remote (Host) Control. (Cal Jumper can be in either position.)
- d. **SPEED:** The Speed to which the Drive will default to on Power-Up. Speed can be set to 50 or 100 ips, Host Select; or Automatic Select wherein the Drive automatically selects the speed for optimum performance, based on the Host Re-Instruct Time. In Host Select, if the Host does not designate, the speed is 50 ips.
- e. **TIMEOUT:** 25-foot Timeout. The 25-foot Timeout Parameter, when set to ON, causes the Drive to stop tape motion and report a Hard Error if no data is detected within 25 feet of tape. This feature prevents tape from running off the reel at the end of tape.
- f. **SECURITY:** Security Erase. Security Erase, when enabled, allows the Drive to accept a Security Erase Command from the Host which will cause the Drive to erase tape from its present position to 3 feet past EOT.
- g. **EOD GAP:** When enabled, a 25-foot erase is performed following any write that isn't terminated with a filemark and the next command is a reverse motion (i.e. Read Reverse, Rewind, etc.).
- h. **PARITY:** For Hosts that provide Parity, the Drive can be set either to check or ignore parity of Write Data from the Host.
- i. **LONG GAP:** Interrecord Gap. To accommodate certain Host requirements, the Interrecord Gap that results from the Host generated LONG GAP Command can be set to any one of the values: 0.45, 0.6, 1.2, or 2.5 inches. Regardless of its setting, Gap Length terminates if a Write Command is received before its set time.
- j. **ARA CAL:** Automatic Read Amplifier Calibration. With this feature enabled, the Drive automatically sets the gain of the Read Amplifiers when reading or writing the ARA Burst in GCR. With this feature disabled, the stored gain values are used.
- k. **GCR CERR:** GCR Corrected Error. When enabled, this feature causes the Drive to report errors corrected by the internal "on the fly" circuitry in GCR.
- l. **NRZI CCG:** NRZI Check Character Gate. When enabled, this option causes the Drive to send the CRC and LRC Characters to the Host following each data block.

- m. **CLR FBSY:** Clear Formatter Busy. Enabling this option, allows the Data Busy Signal (DBY) to clear the Formatter Busy Signal (FBSY). For Hosts that reinstruct after each FBSY, set this option to "WITH DBY" to facilitate streaming. To clear FBSY after repositioning, following a 100 ips Command, set to "POSTREPO".
- n. **IFEN:** Interface Enable Polarity. Setting this option to INVERT, inverts the FEN Signal from the Host. Setting this option to NORMAL, leaves the Signal uninverted. For Hosts that use FEN as a pulse to enable the Formatter, set IFEN to INVERT. For Hosts that support FEN, set IFEN to NORMAL.
- o. **DENS OUT:** Density coding method used on the Host interface. Choose either coded for reporting of all 4 densities or NRZ ONLY to report whether operating density is NRZI.
- p. **FMK GAPS:** When enabled, extended gaps of 3.5" will be recorded before filemark, except in GCR density.
- q. **REPO:** When set to LONG, extended reposition delays will be invokled adding 40ms to 100 ips repositions and 80 ms to 50 ips GCR repositions.

As required, install the Calibration Jumper in ENABLE Position; and set up the Drive by accessing the Set-Up Mode as illustrated in Chart D. With the Readout displaying SET-UP, press ENTER. Repeatedly press SCAN to access the desired Feature; then press ENTER to display the first of the available parameters. Repeatedly, as necessary, press SCAN to display and select the desired parameter. Now Press ENTER once more. The Readout displays LOAD?. Press LOAD to enter and save the parameter.

Chart D. Set-Up

Step	DISPLAY	ACTION (Press:)	DISPLAY	ACTION (Press:)	DISPLAY *
0	SET UP	***		*** ^	
1		ENTER	UNIT NUM	ENTER SCAN	UNIT X **
2		SCAN	DENS SEL	ENTER SCAN	NORMAL REM ONLY
3		SCAN	DEFL DEN	ENTER SCAN SCAN SCAN SCAN SCAN SCAN	800 800 REM 1600 1600 REM 3200 3200 REM 6250 6250 REM
4		SCAN	SPEED	ENTER SCAN SCAN SCAN	HOST SEL AUTO 50 IPS 100 IPS
5		SCAN	TIME OUT	ENTER SCAN	25FT ON 25FT OFF
6		SCAN	SECURITY	ENTER SCAN	ENABLED DISABLED
7		SCAN	EOD GAP	ENTER SCAN	ENABLED DISABLED

Chart D. Set-Up (Continued)

Step	DISPLAY	ACTION (Press:)	DISPLAY	ACTION (Press:)	DISPLAY *
8		SCAN	PARITY	ENTER SCAN	CHECK IGNORE
9		SCAN	LONG GAP	ENTER SCAN SCAN SCAN	0.45INCH 0.6 INCH 1.2 INCH 2.5 INCH
10		SCAN	ARA CAL	ENTER SCAN	ENABLED DISABLED
11		SCAN	GCR CERR	ENTER SCAN	ENABLED DISABLED
12		SCAN	NRZI CCG	ENTER SCAN	ENABLED DISABLED
13		SCAN	CLR FBSY	ENTER SCAN	WITH DBY POSTREPO
14		SCAN	IFEN	ENTER SCAN	NORMAL INVERT
15		SCAN	DENS OUT	ENTER SCAN	CODED NRZ ONLY
16		SCAN	FMK GAPS	ENTER SCAN	NOMINAL EXTENDED EXT ALL
17		SCAN	REPO	ENTER SCAN	NOMINAL LONG

Note: * The last parameter selected (in a previous Set-Up) displays when ENTER is pressed. Repeatedly press SCAN to select a new parameter. Then press LOAD to store the new parameter.
 ** X = Unit Number 0 thru 7.
 *** Press DIAG to exit from any Menu or Submenu.
 ^ Press ON-LINE to display Firmware Revision Level.

4.5.2.7 CALIBRATION

Note 1: See NOTE under par. 4.5.2.5.

Note 2: A reel of tape must be loaded to accommodate the Calibration Tests.

Note 3: After completing the Calibration sequence and with Drive power still ON, replace the Calibration Jumper to NON-ENABLE Position.

Using this menu, the operator can manually or automatically calibrate Read Analog Amplifiers for all the densities. Similarly, the Write Current can be calibrated automatically. Chart E illustrates the operating procedure using the ENTER-SCAN sequence. Confirming the selection is done by pressing ON-LINE in response to the Readout, CONFIRM?. Press DIAG to exit from any Menu.

Chart E. Calibration

Step	Display	Action (Press:)	Display	Action (Press:)	Display*	Action
0 1	CAL	*** ENTER	AUTO	*** ENTER SCAN SCAN SCAN SCAN SCAN	ALL 800 1600 3200 6250 WRT CURR	See CALIBRATE AUTO
2		ENTER	MANUAL	ENTER SCAN SCAN SCAN	NRZI PE DDPE GCR	See CALIBRATE MANUAL
CALIBRATE AUTO						
SCAN	ALL 800	ENTER ENTER SCAN	50 IPS 100 IPS	ENTER ENTER	CONFIRM? CONFIRM?	Press ON-LINE to confirm. Press SCAN to go to next Display.
SCAN	1600	ENTER SCAN	50 IPS 100 IPS	ENTER ENTER	CONFIRM? CONFIRM?	
SCAN	3200	ENTER SCAN	50 IPS 100 IPS	ENTER ENTER	CONFIRM? CONFIRM?	
SCAN	6250	ENTER SCAN	50 IPS 100 IPS	ENTER ENTER	CONFIRM? CONFIRM?	
SCAN	WRT CURR	ENTER SCAN	50 IPS 100 IPS	ENTER ENTER	CONFIRM? CONFIRM?	
CALIBRATE MANUAL						
SCAN	800	ENTER SCAN	50 IPS 100 IPS	ENTER ENTER	CONFIRM? CONFIRM?	Press ON-LINE to confirm.
SCAN	1600	ENTER SCAN	50 IPS 100 IPS	ENTER ENTER	CONFIRM? CONFIRM?	Press SCAN to go to next Display.
SCAN	3200	ENTER SCAN	50 IPS 100 IPS	ENTER ENTER	CONFIRM? CONFIRM?	
SCAN	6250	ENTER SCAN	50 IPS 100 IPS	ENTER ENTER	CONFIRM? CONFIRM?	
<p>Note: *The last parameter selected (in a previous Set-Up) displays when ENTER is pressed. Repeatedly press SCAN to select a new parameter. Then press LOAD to store the new parameter.</p> <p>*** Press DIAG to exit from any Menu or Submenu.</p> <p>Pressing ON-LINE displays: RANGE X (Calibration Range) Then pressing SCAN displays: AMP N X (Read Amp Channel N Gain) (See Section 5.4.2.9 for Calibration Procedure.)</p>						

4.5.2.8 DATA DIAGNOSTICS

Data Diagnostics allows off-line testing of the data path one module at a time. In this mode, to prevent the possibility of disturbing the calibration settings, the Calibration Jumper must be installed in Operate Position. There are three Submenus in Data Diagnostics:

- a. **MODE** Functions set up Drive Parameters for testing.
- b. **COMMANDS** select and initiate the test to be run.
- c. **ERRORS** display accumulated errors of various types in the error log.

Chart F illustrates entering Data Diagnostics. The following subparagraphs describe the three major categories of Diagnostics Tests. Load a reel of tape before starting Data Diagnostics Tests.

Chart F. Entering Data Diagnostics

Step	DISPLAY	ACTION (Press:)	DISPLAY	ACTION
1	DATADIAG	ENTER	MODE	Press ENTER to access selected Submenu
2		SCAN	COMMANDS	
3		SCAN	ERRORS	

MODE (Test Options). In this category, the Operator sets up the Drive to operate with specific parameters. He repeatedly presses SCAN to display the desired categories (listed above); then uses the ENTER-SCAN sequence to select the various Submenu Parameters. Submenu Parameters are defined as follows: NOTE: The first parameter listed for each Option is the default parameter. Chart G illustrates operating the Modes Menu.

<u>Option</u>	<u>Parameters</u>	<u>Description</u>
ON ERROR	CONTINUE STOP	Drive continues motion on detecting error. Drive stops on error.
AT EOT	REWIND STOP	Drive rewinds after detecting EOT. Drive stops at EOT.
BLK SIZE	4, 256, 513, or 1024	Drive generates selected-size data blocks.
DATA	ALL ONES, ALL ZERO, INCREMENT, RANDOM, ALT (00-FF), USER	Drive generates data pattern selected. See NOTE.
SPEED	50 IPS, 100 IPS	Drive operates at selected speed.
RE-INST	STREAM STRT/STP SINGLE	Drive operates in Streaming Mode. Drive operates in Start/Stop Mode. Drive reads or writes one block.

Note: The USER Display indicates that the last 1024 data bytes that accompanied the last Write Command to the Drive is presently available as test data. USER test data is destroyed and the USER Display cannot be accessed once any other data pattern has been entered.

Chart G. Accessing the Modes Submenu

Step	DISPLAY	ACTION (Press:)	DISPLAY	ACTION (Press:)	DISPLAY *
1	MODE	ENTER	ON ERROR	ENTER SCAN	STOP CONTINUE
2		SCAN	AT EOT	ENTER SCAN	REWIND STOP
3		SCAN	BLK SIZE	ENTER SCAN SCAN SCAN	4 256 513 1024
4		SCAN	DATA	ENTER SCAN SCAN SCAN SCAN SCAN	ALL ONES ALL ZEROS INCREMENT RANDOM ALT (00-FF) USER
5		SCAN	SPEED	ENTER SCAN	50 IPS 100 IPS
6		SCAN	RE-INST	ENTER SCAN SCAN	STREAM STRT/STP SINGLE

Note: * When ENTER is pressed, the option displayed is the last one selected (during a previous diagnostics session).

COMMANDS: Under the Commands Category, ENTER accesses the Submenu, and SCAN selects the test to be run, and START/STOP starts and ends the test. If a runaway occurs, due to module failure, pressing DIAG will force a hard stop but lose tape position. Commands are defined as follows:

Note: START/STOP executes the Commands using parameters set in the Mode Menu.

LOOP DIG Data loops from the Write Digital to the Read Digital Sections without going through the Read Analog Section or the Head. Tape not required.

LOOP ALG Data loops from the Write Section to the Read Digital Section through the Read Analog Module without going through the Head or the Pre-Amp. Tape not required. Command executes in all densities except NRZI.

WRITE Drive writes Data to tape per selected Mode Parameters (listed above). No retry on error. If tape is write protected, display is: "CAN'T WRITE".

- WRT W/RE** Drive writes Data to tape using Retry Sequence for Blocks In Error. Retry consists of: Backspace, Erase, Write.
- READ** Drive reads Data from tape in forward direction, comparing it to pattern selected in Mode Menu.
- READ REV** Drive Reads Data from tape in the reverse direction. No compare made.
- READ/RR** If last command caused a forward motion, the Drive alternately and repeatedly reads reverse and forward over the previous data block. If the last command caused a reverse motion, the Drive alternately and repeatedly reads forward and reverse over the next data block. To stop this test, press START/STOP. **Note:** Compare is made only in Read Forward Operations.
- FMK TEST** Drive continually writes File marks and confirms File mark Status.
- WRT/WFMK** Drive continually and alternately writes a Data Block and a File mark.
- WR/RR/RD** Drive writes a block, reads it in reverse, then reads it forward.
- Note:** These tests can be stopped by Pressing START/STOP; but, If in MODE Category, ON ERROR, STOP was selected, the Drive will stop whenever an error is detected.

Chart H. Accessing the Commands Submenu

Step	DISPLAY	ACTION (Press:)	DISPLAY	ACTION
1	COMMANDS	ENTER	LOOP DIG	Press ENTER to enable the parameter, and Press START/STOP to execute Command; or Press SCAN to advance to the next parameter.
2		SCAN	LOOP ALG	
3		SCAN	WRITE	
4		SCAN	WRT W/RE	
5		SCAN	READ	
6		SCAN	READ REV	
7		SCAN	READ/RR	
8		SCAN	FMK TEST	
9		SCAN	WRT/WFMK	
10		SCAN	WR/RR/RD	

Note: Commands execute using the parameters set up in Modes Menu.

ERRORS Display. The Errors Function displays selectable types of errors. Repeatedly pressing SCAN in turn causes each type of error to be **displayed**. Pressing ENTER resets the currently displayed error reading and scans to the next display. Errors are defined as follows: Chart H illustrates using the Errors Submenu

- EIC (0-7,P)** Error in Channel 0 thru 7 and P. Accumulation of Hard Errors and Corrected Errors.

- WPAR** Write Parity Errors. Hard Errors flagged because of a detected Parity Error of the Write Data Bus from the Host.
- CMP** Compare Errors. Data returned by Read Section does not match Data sent to the Write Section during a Write Command; or Data read does not match the pattern selected on Diagnostic Read Command.
- HER** Hard Error (Non-Recoverable) flagged by the Read Section. See Section I for detailed description of Hard Errors.
- STE** Single Track Error. Single Track Corrected Error in GCR, or any Corrected Error in PE or DDPE.
- DTE** Double Track Error reported and corrected in GCR.
- FMK** File mark Error. File mark Status Report was not returned following a Write File mark Command.

Note: Each Error display is followed by a number (XXX) or "OVR". This represents the number of errors detected (XXX) or a Counter Overflow (OVR = over 255).

Chart I. Accessing the Errors Submenu

Step	DISPLAY	ACTION (Press:)	DISPLAY	ACTION
1	ERRORS	ENTER	EIC (0-7,P) XXX	Press ENTER to clear the error count and advance to the next parameter. Press SCAN to advance to the next parameter without clearing error count.
2		SCAN	WPAR XXX	
3		SCAN	CMP XXX	
4		SCAN	HER XXX	
5		SCAN	STE XXX	
6		SCAN	DTE XXX	
7		SCAN	FMK XXX	

SECTION V

MAINTENANCE

5.0 GENERAL

Procedures described herein are limited to Preventive and Corrective Maintenance that can be accomplished in the field, and includes adjustment and replacement of PCBAs and other major components of the Drive. PCBAs are not considered field repairable and, if found defective, should be returned to the manufacturer for repair.

5.1 PREVENTIVE MAINTENANCE

To ensure continued trouble-free operation, complete the following preventive maintenance tasks regularly as recommended.

5.1.1 DAILY INSPECTION

All components in the tape path must be kept scrupulously clean. Daily, or after four hours of tape motion, inspect Deck Assembly, Read/Write/Erase Head, Rollers, and Sensors, for cleanliness. Look for dirt and oxide accumulation. Clean as required.

5.1.2 CLEANING

CAUTION

Using **non-recommended** cleaning fluids can damage components of the Tape Drive. Using excessive amounts of the recommended cleaning fluid can damage the Tape Drive by penetrating roller bearings, idler rollers, tape guides, capstan, or drive motor, and destroying lubrication.

5.1.2.1 TAPE REELS

Before installing any tape reel onto the Supply Hub, it is recommended that the inner surface of the Tape Reel Hub be cleaned with a lint free cloth dampened with clean water to remove any dirt, grease or other contamination.

5.1.2.2 ERASE/WRITE/READ HEAD CLEANING

Remove accumulation of oxide and/or dirt from the Erase/Write/Read Head surface (Fig. 5-1) using a clean lint-free cloth or cotton swab dampened with 1.1.1 trichloroethane or isopropyl alcohol (See CAUTION above). Wipe the Head with firm but gentle vertical strokes.

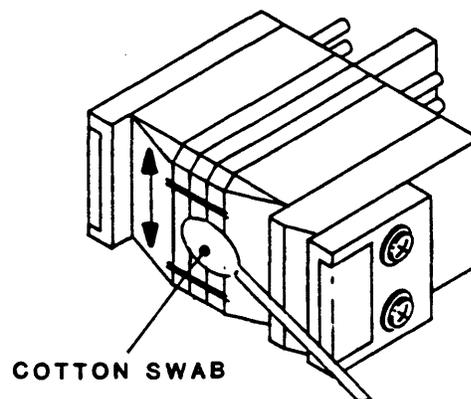


Figure 5-1. Erase/Write/Read Head Cleaning

5.1.2.3 TAPE PATH CLEANING

Miscellany (Figure 5-2)

Clean tape guides, rollers (except Capstan Roller), and the sapphire tape cleaners with a cotton swab dampened with isopropyl alcohol or 1.1.1 trichloroethane. Clean the Capstan rubber Roller with a cotton swab dampened with water or, if excessively dirty, dampened with mild soapy water. Dry thoroughly with a clean lint-free cloth.

Reel Locking Fingers (Figure 5-19)

With no tape reel on the Supply Hub, press the Manual Reel Locking Lever (See Section VI, Figure 6-1) while manually turning the Reel Hub clockwise until the Reel Locking Fingers extend fully outward. Then clean the Rubber Pads on the Fingers with a clean cotton swab or cloth dampened with water or if excessively dirty, with mild soapy water.

After cleaning the Rubber Pads, again press the Manual Reel Locking Lever and manually turn the Reel Hub counterclockwise until the Fingers retract to original position.

5.1.3 ROUTINE ADJUSTMENTS

There are no routine adjustments necessary to the Tape Drive. **DO NOT** make any adjustments except for corrective maintenance.

5.1.4 LUBRICATION

The Tape Drive uses only sealed, life-time lubricated bearings. No lubrication is required. **CAUTION: Do not lubricate.**

5.1.5 HEAD WEAR

The Kennedy Co. ceramic-coated Head normally lasts the lifetime of the Drive. However, the Head should be replaced after 5000 hours of tape motion.

5.2 CORRECTIVE MAINTENANCE

Corrective Maintenance consists of tests and diagnostics for isolating malfunctions to a field-replaceable component. Field replaceable components are itemized in the Recommended Spare Parts List (Section VI, Table 6-1).

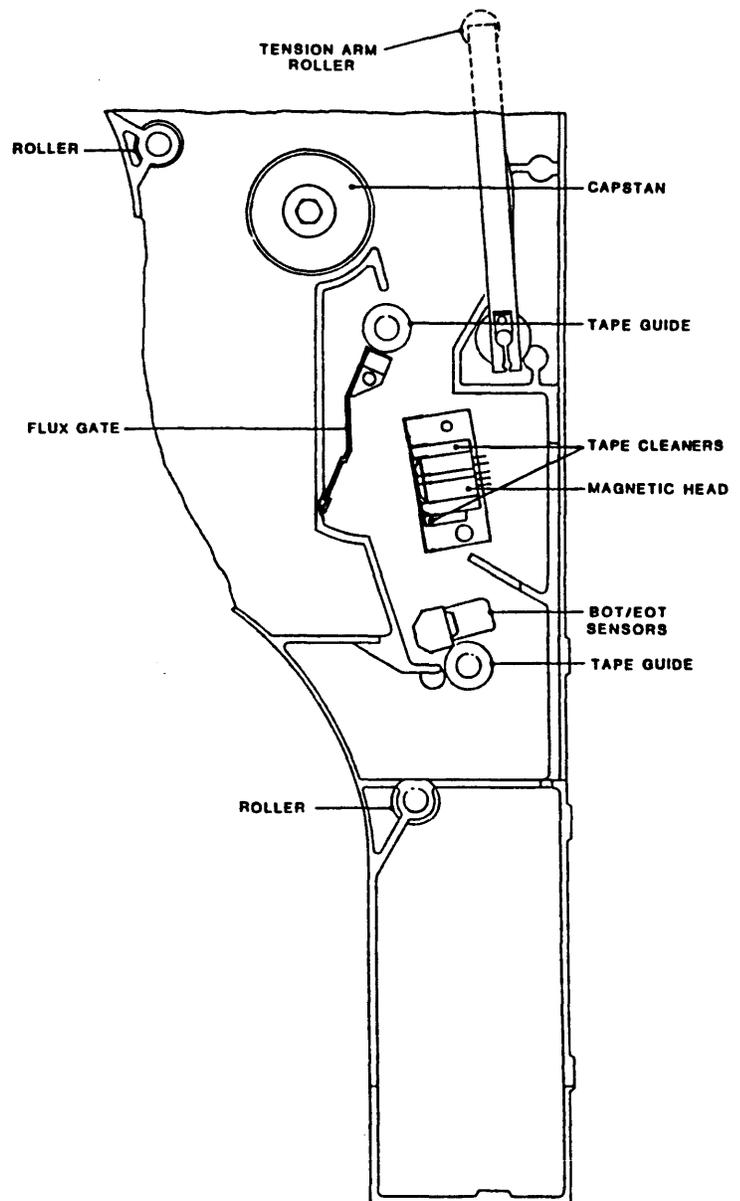


Figure 5-2. Tape Path Cleaning

5.2.1 TOOLS AND TEST EQUIPMENT REQUIRED (Table 5-1)**Table 5-1. Tools and Test Equipment Required**

ITEM	DESCRIPTION	ITEM	DESCRIPTION
Box Wrenches	Common	Skew Tape	P/N 54-00036-001
Capstan Puller	P/N 54-00100-001	Spring Hook	Common
Cleaner Fluid	1.1.1 Trichloroethane or Isopropyl Alcohol	Spring Scale	Common
Cloth or Q-Tip	Lint Free	Tape Guide Align Tool	P/N 54-00103-001
Gauge	Feeler	Torque Tool	Common
Hex Wrenches	3/32, 1/8, 5/32, 7/64, 9/64	Tracking Tape	P/N 13-00106-001
Multimeter	Digital	Collet Setting Tool	P/N 54-00173-001
Oscilloscope	Dual Trace	Take-up Arm Zero Pos Tool	P/N 99-00634-001*
Pliers	Long-nose	Take-up Arm TLIM Pos Tool	P/N 99-00635-001*
Pliers	C-Clip Retainer Removal	Sup. Arm Zero Pos Tool	P/N 99-00632-001*
Screwdriver	Spade Tip	Sup. Arm TLIM Pos Tool	P/N 99-00630-001*
Screwdriver	Stubby, No. 1 Phillips		
Screwdrivers (2)	Phillips, No. 1 and 2		
		* Included in Tool Kit P/N 54-00178-001	

5.2.2 ACCESSING THE DRIVE**A. Operating the Rack Mount Slides:**

1. Operate the Release Lever located just inside the Front Tape Access Door (Figure 6-1), and (for rack-mounted units) pull the Drive outward on its Slides, or (for Table top units) pull the Cabinet backward off the Drive.
2. To access the top of the Drive, turn the two Locks Screws, located on the top Cover, 1/4 turn ccw, and lift the Cover to full open position. Push the Dust Cover Support Bar into Lock Position (See Figure 2-2).

B. Access the Drive below the Deck Assembly as follows:

1. Close and lock the Dust Cover.
2. Remove two upper Lock Bolts on the sides of the Drive (See Figure 2-7A).
3. Lift the Deck Assembly and latch the Support Bar to hold the Deck Assembly in Maintenance Position (See Figure 2-7A).

C. Restore the Deck Assembly to Operate Position as follow:

1. Lift the Deck Assembly slightly, and unlatch the Support Bar.
2. Replace the Support Bar in its original position, and lower the Deck Assembly to its original position.
3. Replace and tighten the two Lock Bolts.

5.2.3 TROUBLESHOOTING

Troubleshooting the Tape Drive consists of using diagnostics, and self-tests to diagnose mechanical, electromechanical and electronic malfunctions.

Diagnostics include firmware-controlled tests and exercises that can be initiated by the Operator from the Drive Front Panel. The Digital Display on the Front Panel provides diagnostic readouts. Section IV describes how to operate Diagnostics.

Self-tests occur with each Power-Up, or can be manually initiated using the Diagnostics Menu. Self-tests include failure codes and diagnostic readouts on the Front Panel Digital Display. Section IV describes the Self-tests.

5.2.3.1 ACCESSING THE DRIVE FOR TROUBLESHOOTING

CAUTION: A solidly grounded Electrostatic Discharge (ESD) Wrist Strap should be worn whenever touching or handling any Circuit Board or other electronic assembly in the Drive.

WARNING - AC UNITS: Dangerous voltage exists in and about the Voltage Selector, the EMI Filter, the Power Transformer, Fan, and the Power Switch on the Front Panel. ALWAYS UNPLUG THE LINE CORD BEFORE WORKING IN THESE AREAS. (See Schematic Diagram 7109 [sheet 2] for illustration of voltage distribution).

5.2.3.2 SAFETY INTERLOCKS

The Drive includes personnel safety interlocks that operate when the Tape Access Door or Top Dust Cover is opened. To operate the Drive for troubleshooting, the technician must defeat the Interlocks as follows:

- A. With power ON, unload tape (as applicable).
- B. Raise the Deck assembly to Maintenance Position per 5.2.2.
- C. On the Drive Electronics Board, move the Diagnostics Jumper (ST4 - See Figure 5-31) from its present position as follows:
 1. If original position is EN: press and hold ENTER, and move from EN to DIS.
 - If original position is DIS: press and hold ENTER, and move from DIS to EN to DIS.
 2. If you intend to test, calibrate, or operate the Drive via Diagnostics Pushbuttons, move the Jumper from DIS to EN (Do not press ENTER).
 3. From Step 1 you have one minute to lower the Deck Assembly and load tape. If tape has not been loaded within one minute, repeat Step C.
- D. Display flashes "NO INTLK". Press DIAG to start Diagnostics.
- E. To reactivate the Interlock, unload tape.

5.3 PARTS REPLACEMENT

Components and Major Assemblies of the Drive are not considered to be field repairable. If found defective, replace the Component or Assembly with an appropriate spare part. The following subparagraphs describe replacement procedures for these Components and Assemblies. For these procedures, unless otherwise directed, place the Drive on a table top right side up, and raise the Deck to Maintenance Position per par. 5.2.2.

Torque Requirements: Torque screws to the following standards (inch pounds): #4-40: 4 to 6; #6-32: 7 to 9; #8-32: 8 to 10; #10-32: 18 to 20.

5.3.1 PRINTED CIRCUIT BOARDS IN CARD CAGE (Figure 5-3)

- A. Loosen two Cover Screws near ends of the Card Cage Cover, and remove Cover.
- B. As applicable, disconnect cables from PCB to be removed.
- C. Grasp PCB Ejectors firmly, and pull ejectors towards the side of the unit. Board should pop partly out of the slot.
- D. Grasp the PCB Ejectors and slide the Board out of the slot.

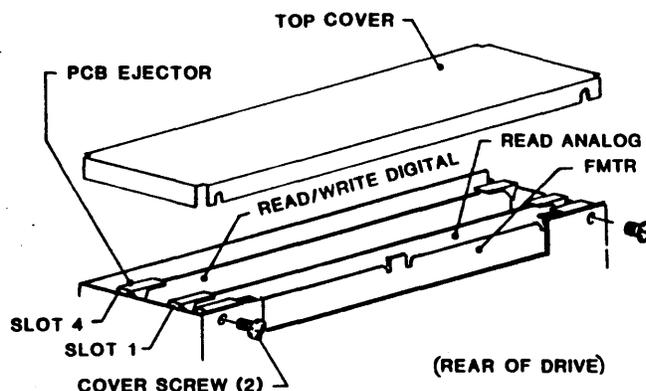


Figure 5-3. Card Cage

To replace: Insert PCB in Card Cage and press firmly downward until PCB is fully seated in Mother Board.

Replace Card Cage Cover.

5.3.2 DRIVE ELECTRONICS BOARD

Refer to Section VI, Figure 6-4 for illustration of the Drive Electronics Board.

- A. Remove four nuts that hold the Power Supply Bracket to the Chassis, and slide the Power Supply with Bracket to the left.
- B. Disconnect cables from the Drive Electronics Board.
- C. Remove six Mounting Screws that hold the Drive Electronics Board to the Chassis.
- D. Unplug the Drive Electronics Board from the Mother Board, and lift it from Drive.

To replace: Reverse removal procedure*.

***Note:** Following Drive Electronics Board replacement, all electronic Set-Ups and Calibration must be performed. See Sections 5.4.2.9 and 5.5.3.

5.3.3 INTERCONNECT PCBA

Refer to Section 6, Figure 6-3 for illustration of the Interconnect Board.

- A. Noting the location of each connector, disconnect all connectors from Interconnect Board, tagging each connector for identification and location.
- B. Remove four Board Mounting Screws.
- C. Lift the Interconnect Board out of the Drive.

To replace: Reverse removal procedure.

5.3.4 HUB LOCK SOLENOID

(Figure 5-4)

- A. Disconnect two wires from the Solenoid.
- B. Remove 2 screws holding Solenoid Mounting Bracket to Deck.
- C. Lift Bracket/Solenoid Assembly and detach it from Lock Actuator.
- D. Remove the Solenoid (2 screws) from the Bracket.

To replace: Reverse removal procedure. Adjust per paragraph 5.4.2.8. Torque screws to 13 ± 1 inch-pounds.

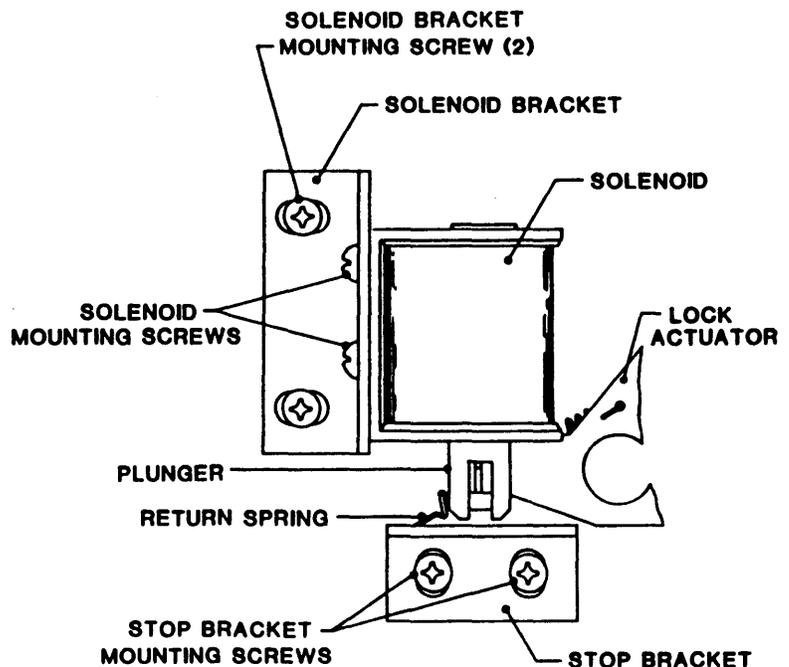


Figure 5-4. Hub Lock Solenoid

5.3.5 READ PREAMPLIFIER

Refer to Figure 5-27, and Section VI, Figure 6-3 for illustration of the Read Preamp Board.

- A. Remove Clamp Plate (below Deck) that clamps cables and the Read Preamp Board.
- B. Unplug the Read Preamp Board from the Magnetic Head (top of Deck).
- C. Cut tie wraps that secure Read Preamp Cable, and unplug Cable Connector from Read Analog Board 9017.
- D. Remove the Read Preamplifier Board from the Drive.

5.3.6 FAN (Figure 5-5)

- A. Remove all PCBs from Card Cage (paragraph 5.3.1).
- B. Unplug connector at Fan Body.
- C. Using stubby Phillips screwdriver, remove 4 screws holding Fan to sheet metal support.
- D. Remove Finger Guard from Fan, and install it on new Fan, using original hardware.

To replace: Reverse removal procedure. **Note direction of air flow.**

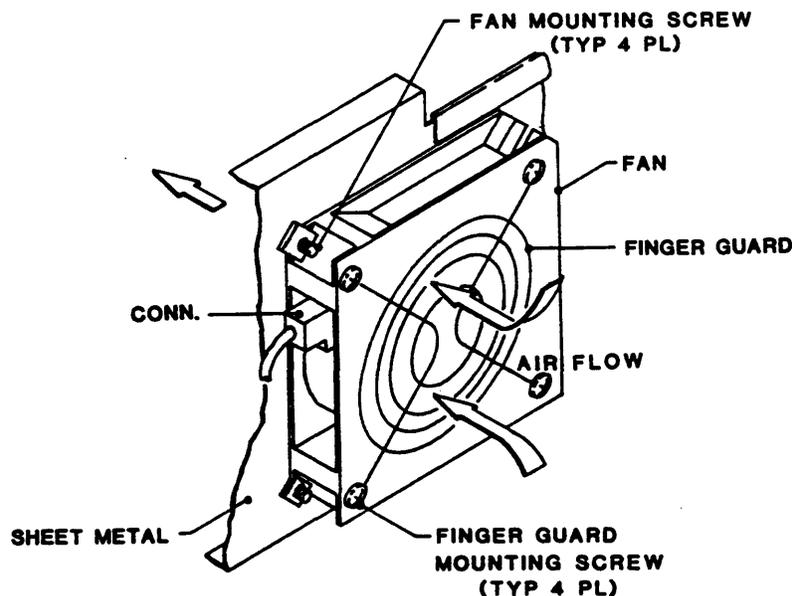
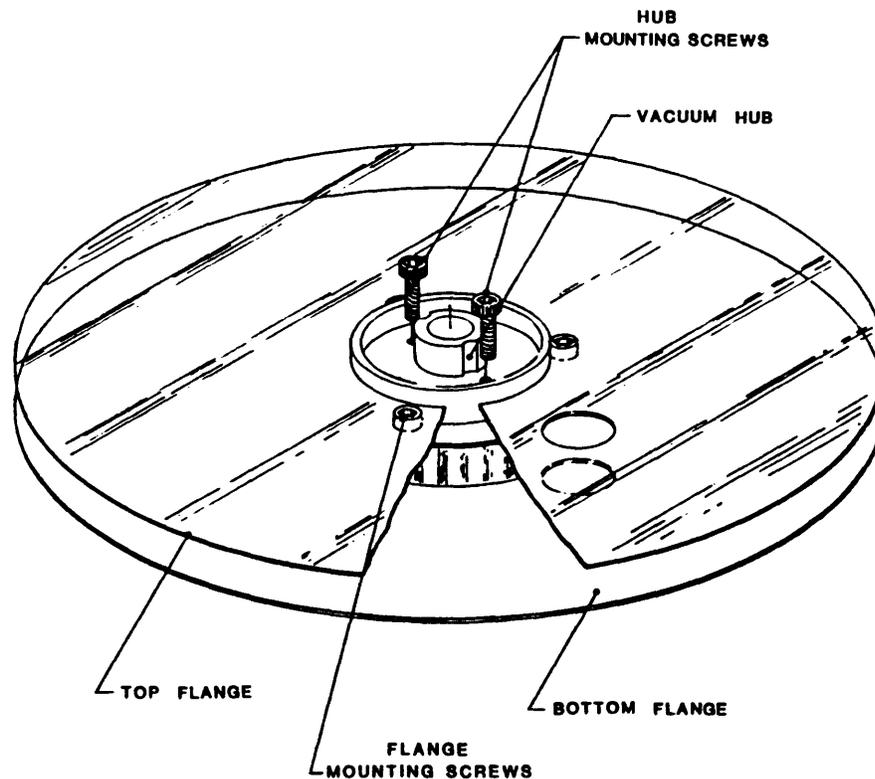


Figure 5-5. Fan

5.3.7 TAKE-UP REEL ASSEMBLY (Figure 5-6)**Tools Required:** 9/64th-inch Hex Wrench

- A. Lift open Top Cover of the Drive per 5.2.2.
- B. Remove three Socket-Head Cap Screws from Top Flange, and remove Top Flange.
- C. Remove two Socket-Head Cap Screws from the Vacuum Hub.
- D. Grasp the Vacuum Hub firmly with both hands and remove by pulling upwards.

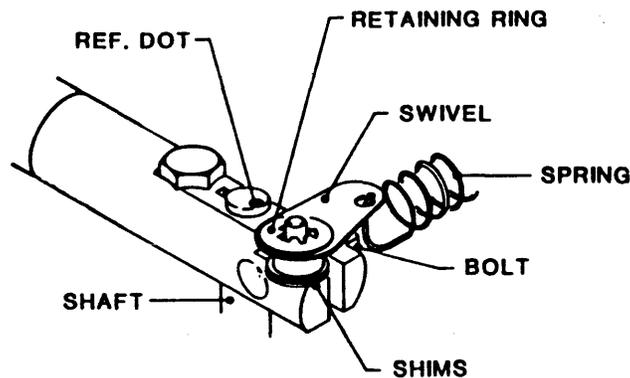
To replace: Reverse removal procedure.**Figure 5-6. Take-up Reel Assembly**

5.3.8 TAKE-UP ARM ASSEMBLY (Figure 5-7)

- A. To ensure that the new Arm will be installed in approximately the same angular position on the Shaft as the original Arm, and the zero point will not be altered, mark the orientation of the original Arm on the Shaft. A small dot on the shaft in line with the Arm (as illustrated) will suffice.
- B. Remove the Take-up Arm Retraction Spring as follows:
1. Turn power on. Do not turn power off during this procedure.
 2. Press DIAG, then ENTER, and scan to DRV ADJ. Mode.
 3. Again press ENTER. The Readout should display BUFF ARMS.
 4. Press ENTER again. The Readout should display RELAXING, and the Take-up Arm should unlock from its original position and move to the "relaxed" position.
 5. Remove the Retraction Spring from the Swivel with a Spring Hook or similar tool.
- C. Using a 1/4-inch box wrench, loosen the Clamp Bolt that secures the Arm to the Shaft, and lift the Arm Assembly off the Shaft being careful not to remove shims from under the Arm.

To replace: Reverse removal procedure:

- a. Snug the Clamp Bolt to prevent the Arm from turning on the Shaft.
- b. Check and as necessary adjust Buffer Arm Roller Height per paragraph 5.4.2.1.
- c. Check and as necessary adjust Spring Tension per paragraph 5.4.2.4.
- d. Torque Clamp Bolt to 20 inch-pounds.

**Figure 5-7. Take-up Arm and Supply Arm Assemblies****5.3.9 SUPPLY ARM ASSEMBLY (Figure 5-7)**

- A. Remove three Phillips screws and remove Supply Arm Cover Plate from the top of the Deck.
- B. Do procedure in paragraph 5.3.8.

5.3.10 RETRACT AND PIVOT SENSOR ASSEMBLIES, TAKE-UP ARM AND SUPPLY ARM (Figure 5-8)

From above Deck:

- A. Remove the Take-up Arm or Supply Arm Assembly per paragraph 5.3.8 or 5.3.9.
- B. Remove Hinge Bracket that holds the Tape Path Cover and remove the Tape Path Cover.
- C. For Take-up Arm only, remove screws that hold the Fixed Cover Plate and remove.
- D. For Supply Arm only, remove Supply Arm Cover Plate.

From below Deck:

- E. On Take-up Arm Assembly only, loosen the Lock Screw that attaches the Linkage to the Post, and remove the Linkage. Retain Linkage for later reinstallation.
- F. Cut tie-wraps and unplug connector P4 (for Take-up Assy) or P3 (for Supply Assy) from Interconnect Board 7228.
- G. Unplug P1 from Position Sensor PCBA 9069.

From above Deck:

- H. (In this step, support and lower the Retract and Pivot Sensor Assy. as the last Mounting Screw is unscrewed.) Using a Hex Wrench, completely unscrew, but do not remove, two Socket-Head Mounting Screws that attach the Retract and Pivot Sensor Assembly to the Deck. Note position of shim and retain for use when reinstalling retract assembly.

To replace:

Reverse removal procedure. Check and adjust Buffer Arm per par. 5.4.2.

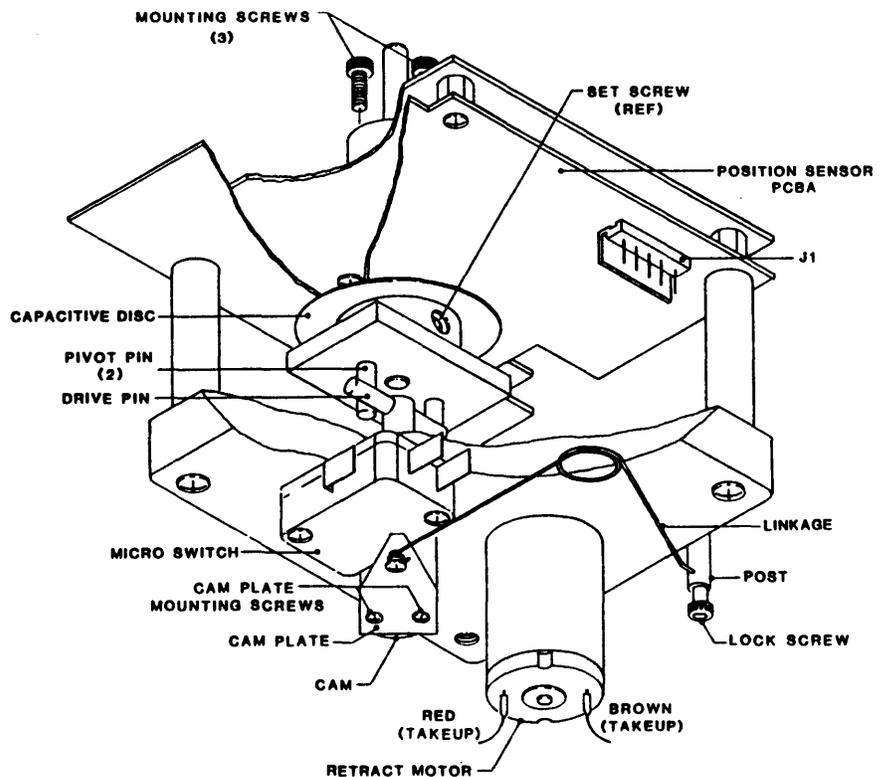
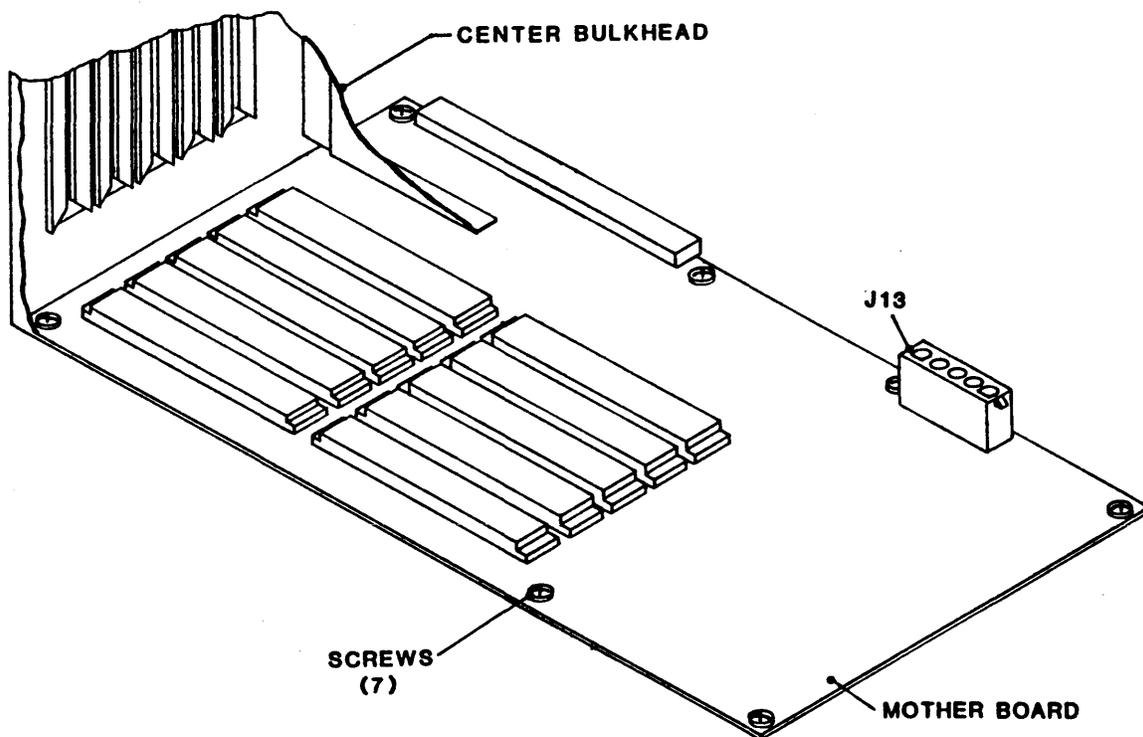


Figure 5-8. Take-up Arm Retract & Pivot Sensor Assembly

5.3.11 MOTHER BOARD PCBA (Figure 5-9)

- A. Remove Card Cage Cover (paragraph 5.3.1).
 - B. Remove all PCBAs from Card Cage.
 - C. Unplug power connector J13 from Mother Board.
 - D. Using Stubby or Offset Phillips Screwdriver, Remove six Mounting Screws and move Center Bulkhead out of way.
 - E. Remove seven Phillips Head Screws that secure the Mother Board to the Chassis.
 - F. Unplug Mother Board from Drive Electronics Board and, being careful not to damage the Connectors on the Mother Board, slide the Mother Board back and rotate it upward and out.
- To replace:** Reverse removal procedure.

**Figure 5-9. Mother Board**

5.3.12 OPERATOR CONTROL PANEL PCBA (Figure 5-10)

- A. Remove Panel Assembly from Deck per paragraph 5.3.22.
- B. Cut the tie wraps that attach the Switch and Solenoid Cable to the PCBA.
- C. Using A Nutdriver, remove six Mounting Nuts, and remove the Operator Control Panel PCBA.

To replace: Reverse removal procedure. Align the PCBA so that switch actuators can be moved freely in the openings in the Front Panel.

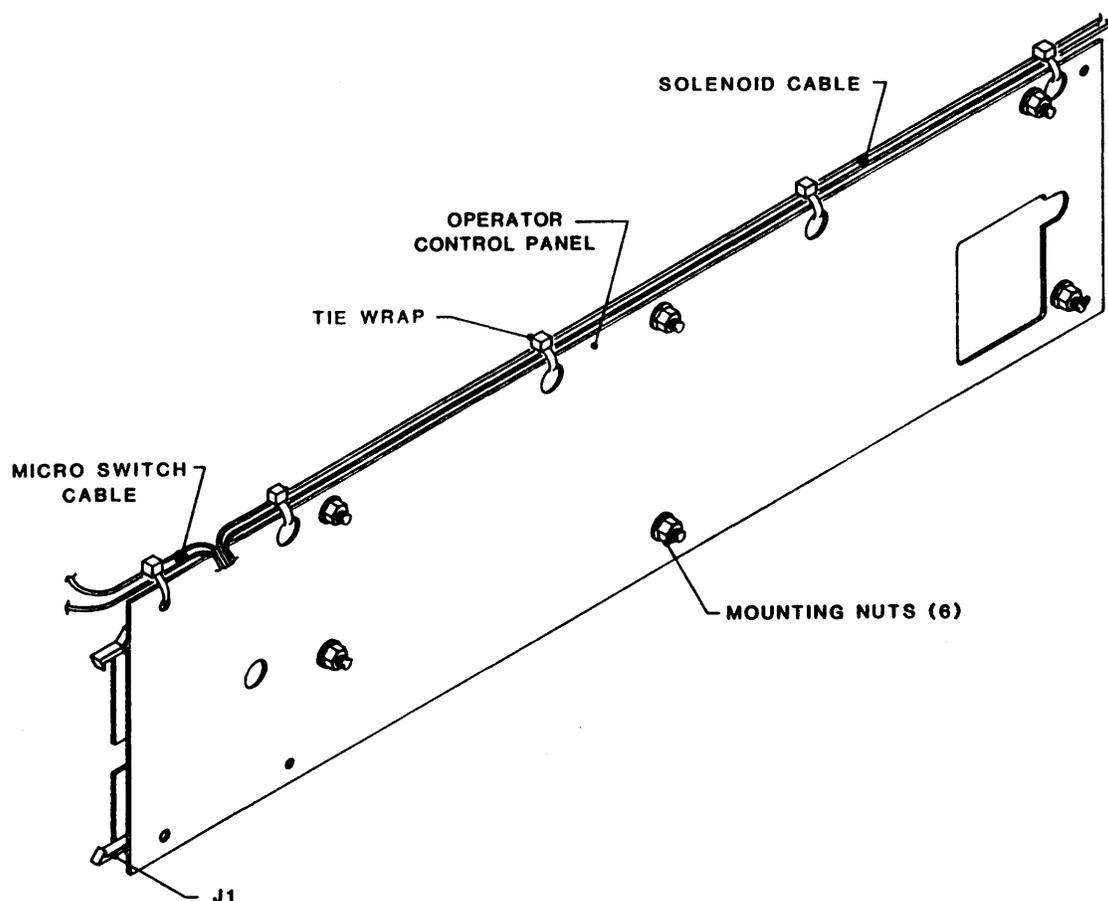


Figure 5-10. Operator Control Panel PCBA

5.3.13 EMI FILTER

Refer to Section VI, Figure 6-4 for illustration of EMI Filter.

- A. Turn off power and disconnect Line Cord from the power source.
- B. Lift Deck Assembly into Maintenance Position per 5.2.2.
- C. Disconnect input and output wires from EMI Filter.
- D. Remove two screws and remove EMI Filter.

To replace: Reverse removal procedure.

5.3.14 REEL-IN-PLACE SENSOR ASSEMBLY (Figure 5-11)

Refer to Figure 6-2 for top view location of Sensor Assemblies.

- A. Remove two Phillips screws.
- B. Cut away tie wraps, and unplug the Cable from J13 on the interconnect PCBA.
- C. Remove the Reel-In-Place Sensor Assembly.

To replace: Reverse removal procedure. Align the Reel In Place Sensor Assembly centered within the chassis flanges and parallel with the Flange Surfaces, and with the specified space between the Sensor Assembly and the Sensor Tab. Torque Mounting Screws to 7 ± 1 inch-pounds.

Enter DIAG and SCAN to DRV ADJ, push enter. Push SCAN until HUB SENSE, push enter. The Hub Lock Solenoid will engage.

Place a write enabled tape on the Supply Hub and rotate hub clockwise until fingers engage and Hub hits Stop. Display should change from NOT IN to IN PLACE.

If indication is not as described, adjust the position of the sensor assembly until the proper display is achieved.

- D. Perform CHK QUAD diagnostic as described in paragraph 5.5.3 (D).

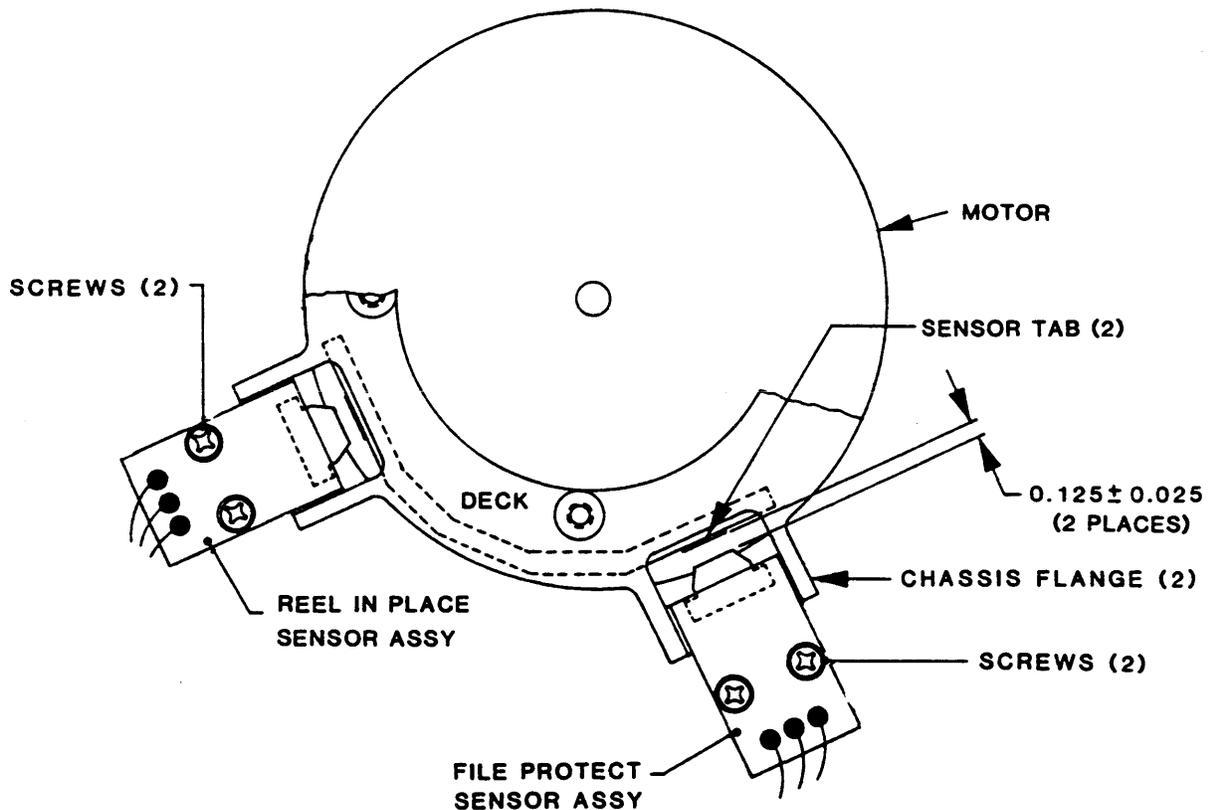


Figure 5-11. File-Protect and Reel-In-Place Sensor Assemblies (Bottom View)

5.3.15 FILE-PROTECT SENSOR ASSEMBLY (Fig. 5-11)

Refer to Figure 6-2 for top view location of Sensor Assemblies.

- A. Remove two Phillips screws.
- B. Cut away tie wraps, and unplug the Cable from J12 on the interconnect PCBA.
- C. Remove the File Protect Sensor Assembly.

To replace: Reverse removal procedure. Align the Reel In Place Sensor Assembly centered within the chassis flanges and parallel with the Flange Surfaces, and with the specified space between the Sensor Assembly and the Sensor Tab. Torque Mounting Screws to 7 ± 1 inch-pounds.

Enter DIAG and SCAN to DRV ADJ, push enter. Push SCAN until HUB SENSE, push enter. The Hub Lock Solenoid will engage.

Place a write enabled tape on the Supply Hub and rotate hub clockwise until fingers engage and Hub hits Stop. Write Enable LED should light.

If indication is not as described, adjust the position of the sensor assembly until the proper display is achieved.

Remove the Write Enable Ring and verify that when the Hub is rotated to its lock position, the Write Enable LED is off.

- D. Perform CHK QUAD diagnostic as described in paragraph 5.5.3 (D).

5.3.16 SUPPLY ARM LIMIT SENSOR

(Figure 5-12)

- A. Open Top Cover of the Drive per 5.2.2.
- B. Remove 3 phillips screws, and lift off the plate that covers the Supply Arm (See Figure 6-2).
- C. Remove 2 Phillips screws that hold the Limit Sensor to its Mounting Plate.
- D. Raise the Deck to Maintenance Position per 5.2.2.
- E. Unplug Connector P16 from the Interconnect PCBA.
- F. Remove two Cable Clamps from edge of Interconnect Board.
- G. Remove three Screws and move the Interconnect Board and its Mounting Plate out of the way.
- H. Remove tie wraps as necessary, and remove the Sensor.

To replace: Reverse removal procedure.
No adjustment required.

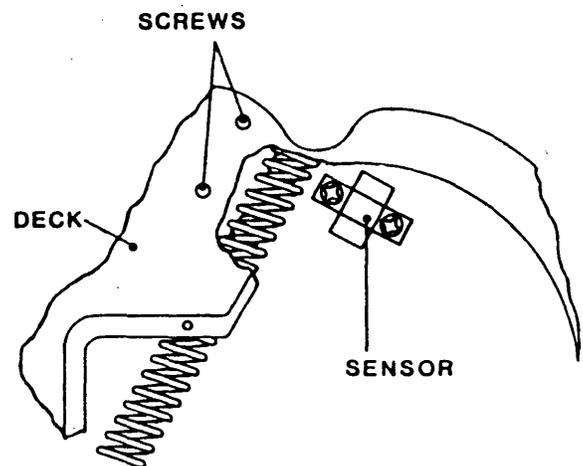


Figure 5-12.
Supply Arm Limit Sensor

5.3.17 TAKE-UP ARM LIMIT SENSOR (Figure 5-13)

- A. Open Top Cover of Drive and raise Deck to Maintenance Position per 5.2.2.
- B. Unplug Connector P15 from the Interconnect Board and remove tie wraps.
- C. Remove pins from connector housing, and pull the cable through the grommet in the Deck.

To replace: Reverse removal procedure. Adjust per specifications illustrated.

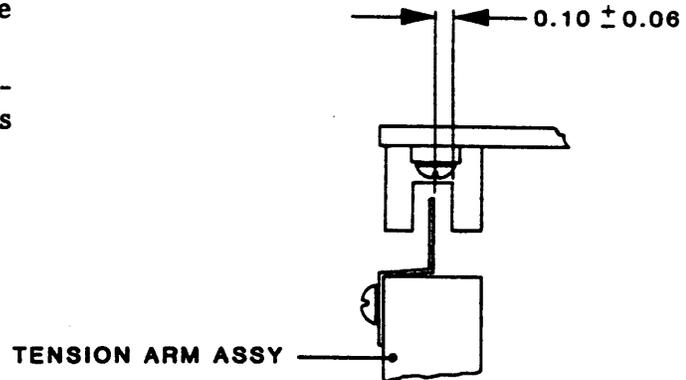


Figure 5-13.
Take-up Arm Limit Sensor

5.3.18 12-VDC REGULATOR ASSEMBLY (Figure 5-14)

- A. Unplug connector J1, and remove the Assembly and the Spacer under the Assembly.

To replace: Reverse removal procedure.

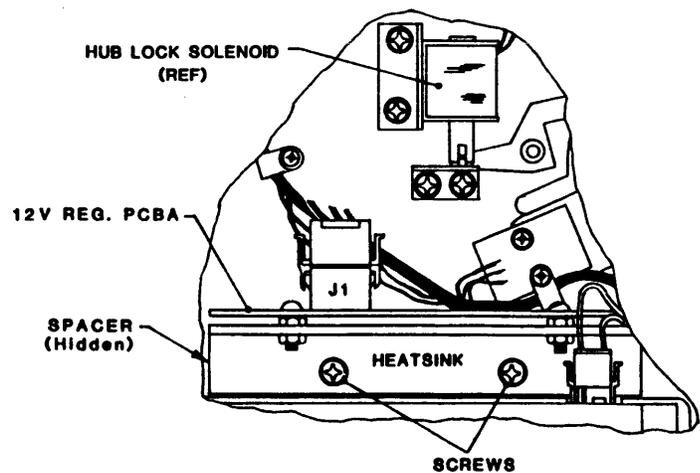


Figure 5-14.
12-VDC Regulator Power Supply

5.3.19 5-VDC REGULATOR POWER SUPPLY (Figure 5-15)

- A. Lift the Deck and secure it in Maintenance Position per 5.2.2.
- B. Unplug the five connectors indicated in Figure 5-15 from the Power Supply.
- C. Remove four kepsnuts that hold the Power Supply Bracket to the Chassis, and remove Power Supply.

To replace: Reverse removal procedure. Connectors Cables route as follows:

J1 to Power Transformer

J5 to Drive Electronics Board

J3 to 12VDC Regulator

J6 to Mother Board

J4 to Servo Power Amplifier

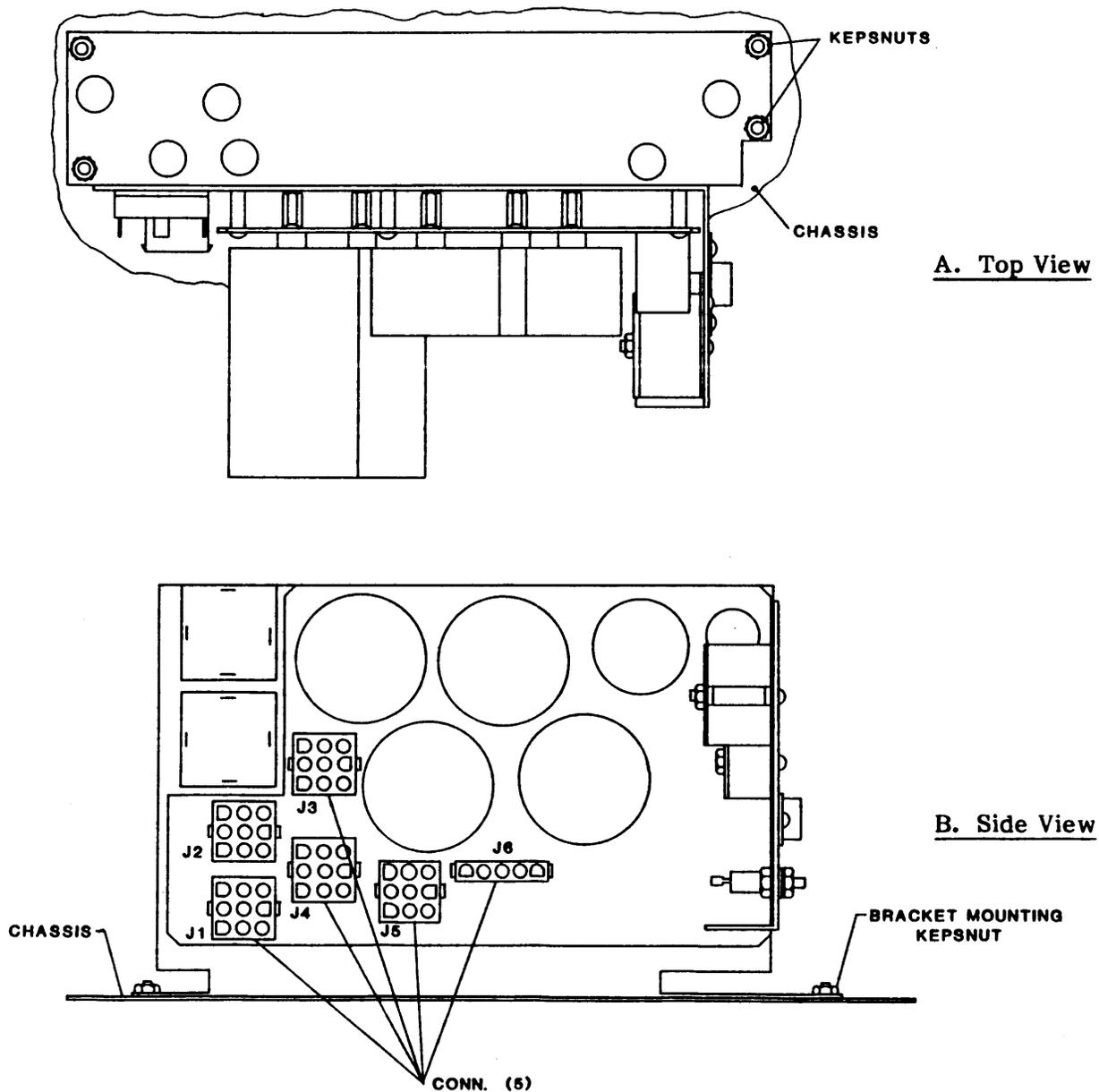


Figure 5-15. 5-VDC Regulator Power Supply

5.3.20 SERVO AMPLIFIER ASSEMBLY

The Servo Amplifier Assembly (Figure 5-16) consists of Servo Power Amplifier PCBA P/N 90-07111-XXX mounted on a Heatsink, and Servo Preamplifier PCBA P/N 90-07147-XXX. The Servo Amplifier Assembly is mounted on the inside surface of the Chassis as illustrated in Figure 6-4. Remove the Servo Amplifier Assembly as follows:

- A. Raise the Deck Assembly to Maintenance Position per 5.2.2.
- B. Remove top left transformer lamination securing bolt from Power Transformer.
- C. Unplug Power (J1) , Control (J1) , and Motor Drive (J2) Connectors.
- D. Remove two Phillips Head Screw that hold the Servo Power Amplifier to the side of the Chassis.
- E. Remove two Nuts that hold the Heatsink to the floor of the Chassis.
- F. Lift the Servo Amplifier Assembly up and off the Spacer and Mounting Studs.

To replace: Reverse removal procedure. Adjust RL SERVO per paragraph 5.5.3.

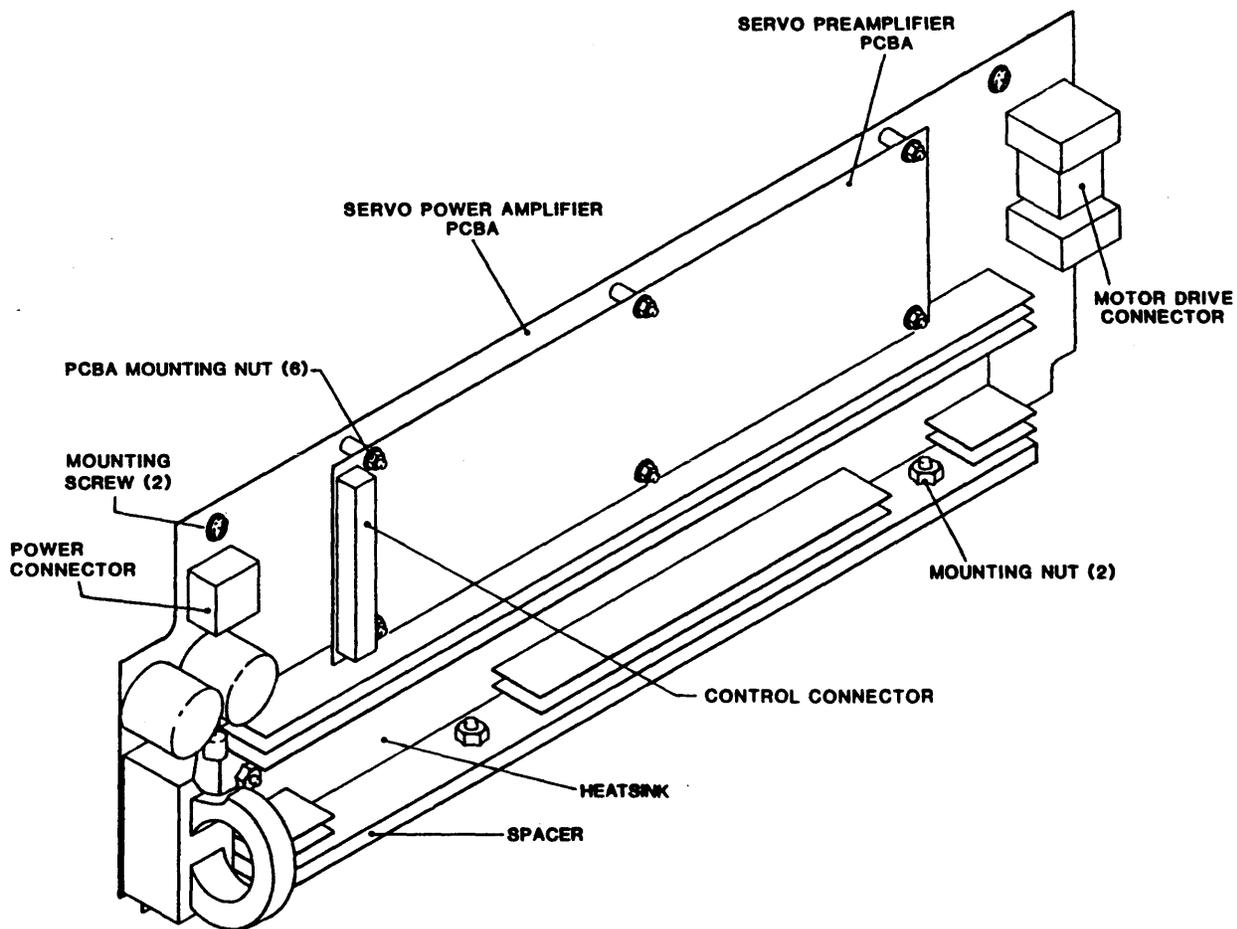


Figure 5-16. Servo Amplifier Assembly

5.3.21 BLOWER ASSEMBLY (Figure 5-17)

- A. Remove eight Phillips Screws that secure the Blower Assembly Cover to the Blower Assembly, and remove the Cover.
- B. Remove the Take-up Reel Assembly per paragraph 5.3.7 (to access Blower Assembly Mounting Screws).
- C. Unplug the two Reel Motor Connectors.
- D. Unplug the Control Cable Connector from the Power Amplifier.
- E. Remove eight Phillips Screws that attach the Blower Assembly to the Deck (these screws are accessible from the top of the Deck).
- F. Remove the Blower Assembly.

To replace: Reverse removal procedure.

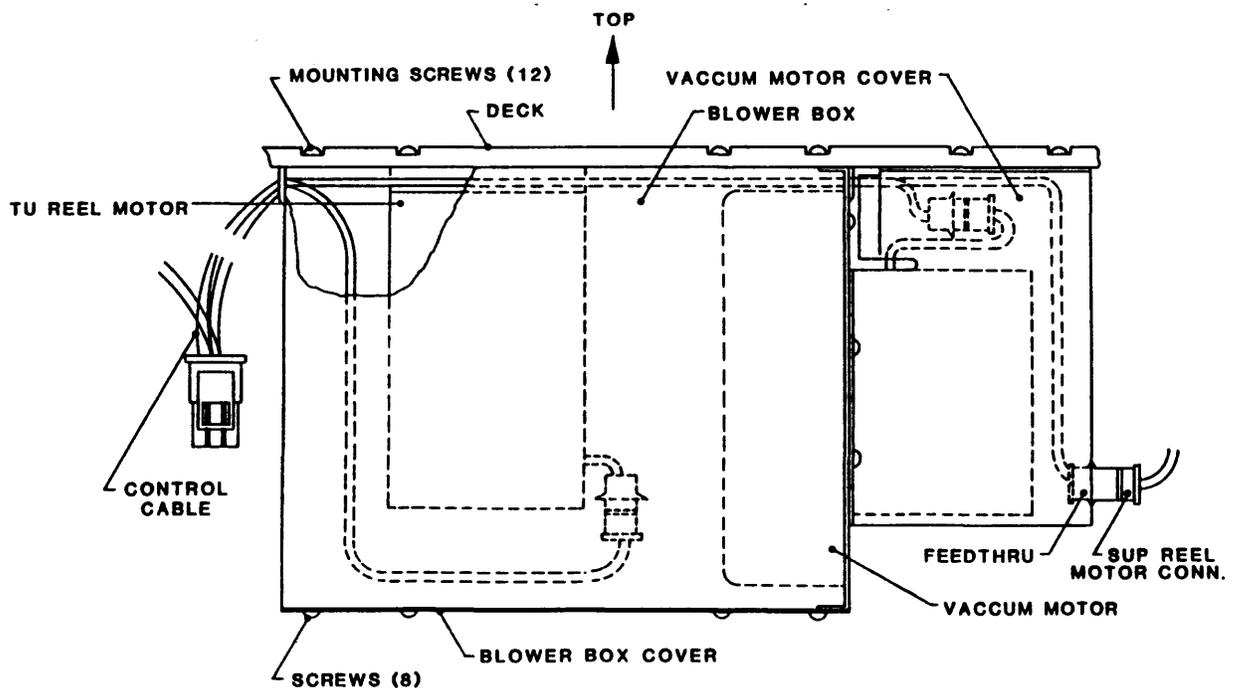


Figure 5-17. Blower Assembly

5.3.22 PANEL ASSY, DOOR MICROSWITCH, AND DOOR LOCK SOLENOID (Fig 5-18)

- A. Remove four Phillips screws (two at each side) that attach the Panel Mount Angle Brackets to the Deck.
- B. Slide the Panel forward, and disconnect wires from Power Switch.
- C. Remove Connector P1 from the Operator Control Panel. When the Panel is clear, slide the Panel back away from the Deck.
- D. Using a Phillips Screwdriver, as desired, remove the Door Microswitch or the Door Lock Solenoid:

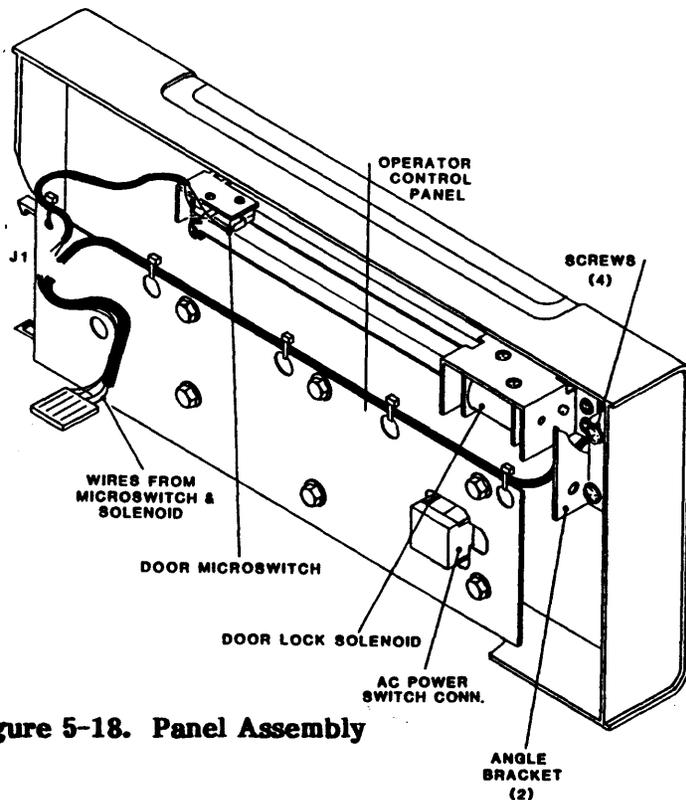


Figure 5-18. Panel Assembly

1. For **Microswitch**, lower the Access Door and remove two Mounting Screw (Go to 3).
2. For **Solenoid**, remove two Bracket Mounting Screws that attach the Solenoid to the Panel Assembly (Go to 3).
3. Pull Item away from Panel Assembly and disconnect wires. For **Solenoid**, remove Solenoid from Mounting Bracket.

To replace: Reverse removal procedure. However, when removing the Solenoid, it was necessary to disturb the Hinge that connects the Door to the Panel Assembly. When replacing the Solenoid, before tightening the Mounting Bracket Screws, adjust the Door so that it fits correctly when closed.

5.3.23 SUPPLY HUB ASSEMBLY (Figure 5-19)

- A. Open Top Cover per 5.2.2.
- B. Remove three Screws and remove Hub Cap.
- C. Remove two Hub Mounting Screws.
- D. Grasp the edges of the Hub firmly and pull upwards.

To replace: Reverse removal procedure.

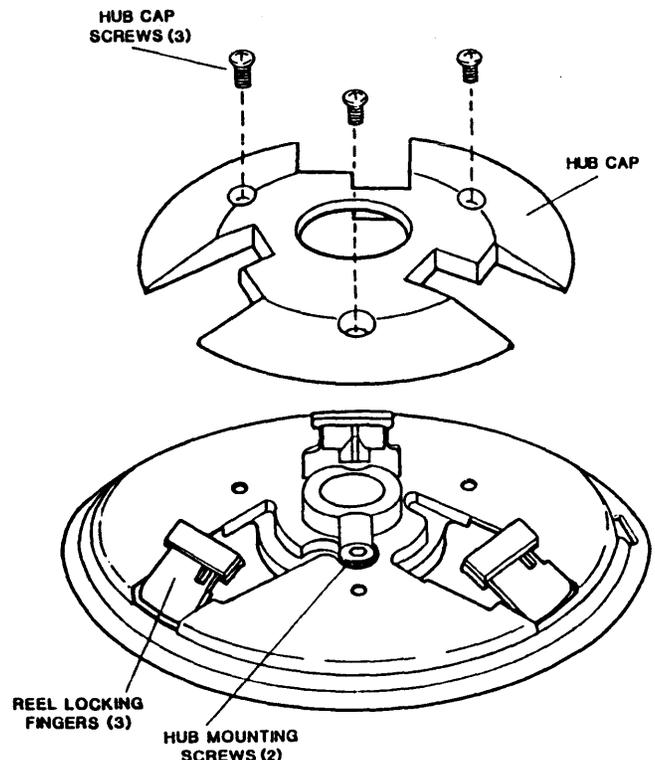


Figure 5-19. Supply Hub Assembly

5.3.24 FLUX GATE (Figure 5-20)

CAUTION: Do not disturb the two Nuts that hold the Flux Gate to the Mounting Block. To do so could throw the Flux Gate out of adjustment.

- A. Set the Drive so that the Buffer Arms are positioned all the way to the Limit Sensors (Buffer Arms fully retracted). This can be done by turning the Drive ON with no tape installed.
- B. Turn the Drive OFF.
- C. Tape a piece of plastic foam over the sensing surface of the Magnetic Head.
- D. Raise the Deck to Maintenance Position per 5.2.2.
- E. Loosen the Set Screw that holds the Spring at the base of the Flux Gate Shaft, and remove the Spring from the hole in the Shaft.
- F. Using Snap Ring Pliers, remove Retainer Ring.
- G. Slide the Flux Gate Shaft out of the Mounting Plate.

To replace: Reverse removal procedure.

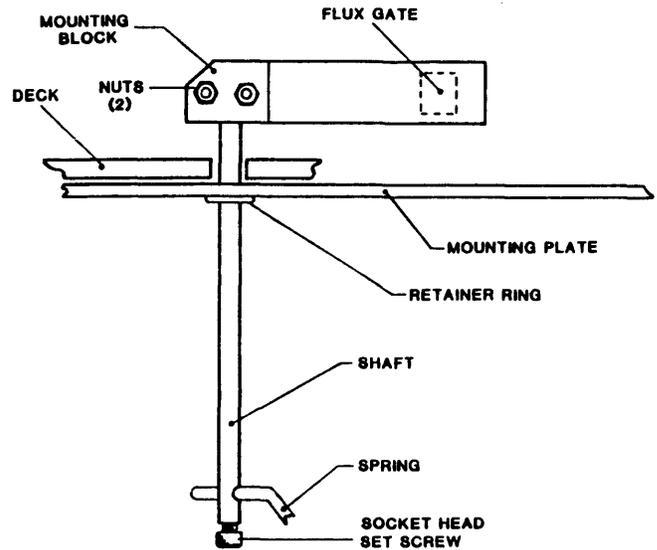


Figure 5-20.
Flux Gate Removal

In the Relaxed position the Flux Gate should make contact at the top and bottom of the Head. In the retracted position, the Flux Gate should be within .50 inch of casting wall.

Flux Gate travel may be adjusted by adjusting the position of the spring at the base of the Flux Gate Shaft.

5.3.25 CAPSTAN (Figure 5-21)

- A. Remove Hex-Head Screw and Washer from the center of the Capstan Wheel.
- B. Slide the Capstan Puller P/N 54-00100-001 over the Hub Flange. Tighten Thumb Screw to loosen the Capstan, and remove Capstan.

To replace: Reverse removal procedure.

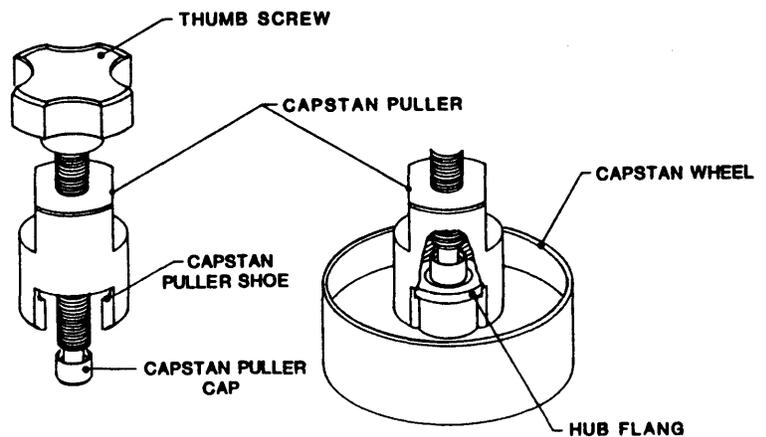


Figure 5-21.
Capstan Removal

CAUTION: Removing Capstan without a Capstan Puller could damage the Capstan. If Capstan is removed without a Puller, it is advisable to replace the Capstan.

5.3.26 CAPSTAN MOTOR

If the Capstan Motor is defective, and the Capstan Motor Mounting Plate is in good condition, replace the Capstan Motor as follows (DO NOT DISTURB THE MOUNTING OR ADJUSTMENT SCREWS FOR THE MOUNTING PLATE): (If the Mounting Plate is damaged, see paragraph 5.3.27.)

- A. Unplug two wires from the Capstan Motor, and unplug the Tachometer Cable from J6 on the Interconnect Board (remove tie wraps as required).
- B. Remove Capstan per 5.3.25.
- C. While supporting the Capstan Motor from below Deck, remove four Mounting Screws that hold the Capstan Motor to the Capstan Motor Mounting Plate.
- D. Lower and remove the Capstan Motor from the Deck.
- E. Calibrate the Capstan Servo per Section 5.5.3.

To replace: Remove Capstan and Capstan Motor Mounting Plate from Spare Capstan Motor Assembly. Reverse removal procedure. If the Capstan Motor Mounting Plate (still mounted on Deck) has not been damaged or disturbed, no adjustment is necessary.

5.3.27. CAPSTAN MOTOR ASSEMBLY (Figure 5-22)

Replace Capstan Motor Assembly ONLY IF CAPSTAN MOTOR MOUNTING PLATE IS DAMAGED OR DISTURBED:

- A. Unplug two wires from the Capstan Motor, and unplug the Tachometer Cable from J6 on the Interconnect Board (remove tie wraps as required).
- B. Remove three Phillips screws that hold the Capstan Assembly to the Deck (Access from the top).
- C. Remove the Capstan Motor Assembly by lowering it through the Deck. Retain the Spacer Washer that was between the Deck and the triangular Capstan Motor Mounting Plate. Note its position.

To replace: Reverse removal procedure. Adjust Capstan as follows:

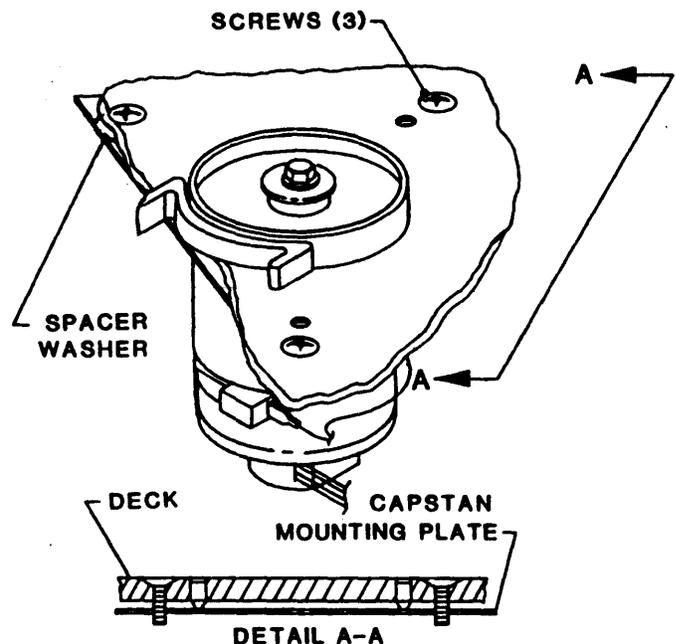


Figure 5-22. Capstan Motor Assembly

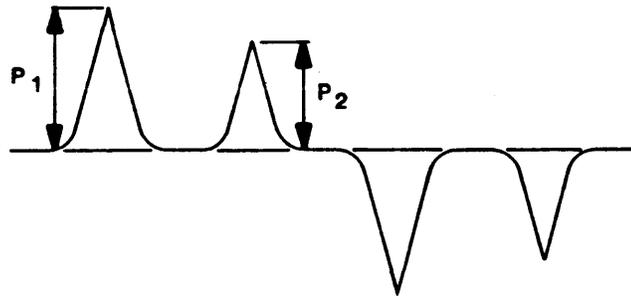
Capstan Adjustment

The Capstan Motor is suspended on a triangular Mounting Plate, one corner of which is held firmly in place by a Mounting Screw, while the other two corners are held in place by the clamping action of two other Mounting Screws and the Lock Screws (See Detail A-A). Adjustment of the Capstan consists of adjusting the gap between the two adjustable corners of the Mounting Plate and the Deck Plate. Proceed as follows:

- A. Tighten the Mounting Screw located at the center point of the Buffer Arm path to 8 ± 1 inch-pounds.
- B. Tighten the remaining two Mounting Screws until the Capstan Motor Mounting Plate rests lightly against the two Lock Screws.
- C. From this point, adjust the Capstan per the following Procedure 1 or Procedure 2:

Procedure 1. (The more accurate procedure)

- a. Install and load a write-protected Pericomp Tracking Tape (Pericomp P/N TRK06884).
- b. Using Data Diagnostics in the Diagnostics Menu, select MODE, SPEED, 50 IPS: then, COMMAND, READ. With Front Panel DENSITY Switch, set Density to 800 CPI.
- c. Connect the vertical input of an Oscilloscope to TP 501 on Read Analog Board 9017. Set Oscilloscope controls to: Vert 0.2v/div, Horiz 0.1uSec/div.
- d. Press START/STOP to start the Read Operation selected. The display on the Oscilloscope should be as illustrated:



Capstan Tracking Waveform

- e. Adjust the Scope Vertical Gain to obtain a waveform amplitude of the higher peak (P1) of 5 cm. The amplitude of the lower waveform (P2) should be $\approx 80\%$ of the higher waveform.
- f. If waveform fails to meet the specification per Step (e), loosen one of the Lock Screws slightly, and tighten the associated Mounting Screw, noting the effect on the waveform. If adverse, return Adjustment Screw and Mounting Screw to their original positions and repeat this step with the other Mounting Screw and Adjustment Screw. Note: During this adjustment, if necessary, readjust Scope Vertical Gain to keep higher peak at 5 cm.
- g. If in Step (f) the Capstan cannot be adjusted per specification, Loosen one of the Mounting Screws and tighten the associated Lock Screw. Then repeat as necessary with the other Mounting Screw and Lock Screw. Note: During this adjustment, if necessary, readjust Scope Vertical Gain to keep higher peak at 5 cm.
- h. Repeat Steps (f) and (g) until correct waveform relationship is obtained.

Procedure 2: (Do this Procedure only if Tracking Tape is not available)

- a. Install and load a reel of tape.
- b. Using the Diagnostic Menu and, while observing the tape as it runs over the Capstan, run tape in Forward/Reverse/Forward Mode at 50 ips.
Tape should run smoothly over the Capstan less than ± 0.01 inch sideward movement. If sideward movement is within tolerance, do all three of the following Substeps. If sideward movement is excessive, start with Substep 3.
 1. Evenly tighten the two Lock Screws.
 2. Recheck sideward movement. If satisfactory, adjustment is complete, omit the remaining steps in this procedure. If sideward movement is excessive, proceed with the following steps.
 3. With tape moving in Fwd/Rev/Fwd Mode, loosen one of the **Lock Screws** slightly, and **tighten** the associated **Mounting Screw**, noting its effect on lateral tape movement. If adverse, return Adjustment Screw and Mounting Screw to original positions and repeat this step with the other Mounting Screw and Adjustment Screw.
 4. Repeat Substeps 1 to 3 until adjustment is satisfactory or, If in Substep 3, proper adjustment cannot be obtained, **loosen** one of the **Mounting Screws** and **tighten** the associated **Lock Screw**. Then repeat as necessary with the other Mounting and Lock Screws.
 5. Calibrate the Capstan Servo per Section 5.5.3.

5.3.28 BOT/EOT SENSOR ASSEMBLY (Figure 5-23)

- A. Raise the Deck Assembly to Maintenance Position per paragraph 5.2.2.
- B. **Noting orientation of Connector in Receptacle**, unplug the Connector from J9 on the Interconnect Board (Remove tie wraps as required).
- C. **Noting wire color orientation**, using a small common screwdriver, remove the pins from the cable connector.
- D. Remove three Phillips Screws from Plate on which the Interconnect Board is mounted, and move the Plate and Interconnect Board out of the way.
- E. Remove two Phillips Screws that hold the Sensor in place.
- F. Remove the Sensor and pull wires through the hole in the Deck.

To replace: Reverse removal procedure: Reconnect pins with wire color oriented as illustrated, and as noted in Step C. Plug Connector into Receptacle properly oriented as noted in Step B.

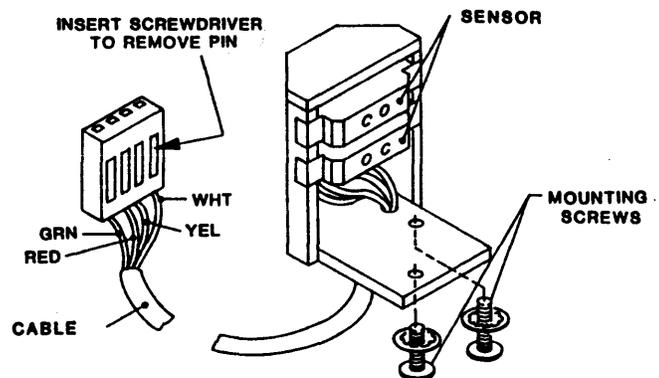


Figure 5-23.
EOT/BOT Sensor Assembly

5.3.29 TAPE-IN-CHANNEL EMITTER AND TAPE-IN-CHANNEL SENSOR ASSEMBLIES (Figure 5-24)

- A. Lift the Deck Assembly and latch it in Maintenance Position.
- B. To remove Tape-In-Channel Emitter Assembly only:
1. Unplug Connector J10 from the Interconnect Board.
 2. Using a small common screwdriver, remove the two Pins from the Connector Housing. Note their positions.
 3. Remove two Cable Clamps from edge of Interconnect Board.
 4. Remove the three screws securing the Interconnect Board Mounting Plate to the Deck. Pull the Interconnect Board and its Mounting Plate away from the Deck.
 5. Cut the tie wraps that hold the two wires in the Harness Assembly.
 6. Remove the Emitter Assembly Mounting Screw through the opening provided by removal of the Interconnect Board.
 7. Remove the Emitter Assembly through the top of the Deck, bringing the two wires up with the Assembly: Push each Connector Pin through the hole in the Deck one at a time.
- C. To remove Tape-In-Channel Sensor Assembly only:
1. Unplug J11 from the Interconnect Board.
 2. Do Steps B.2 thru B.5 above.
 3. Remove the Sensor Assembly Mounting Screw through the opening provided by removal of the Interconnect Board.
 4. Cut the tie wraps that hold the two wires in the Harness Assembly.
 5. Pull the Sensor Assembly through the top of the Deck, pushing the wires through the opening one at a time.

To replace: Reverse removal procedure. Insert a 2-inch straight piece of wire into the holes provided in the Sensor and Emitter Assemblies, and align the Emitter with Sensor Assemblies by pointing the two wires directly at one another.

Then, tighten the Assembly Mounting Screw to 3.5 \pm 0.5 inch-pounds.

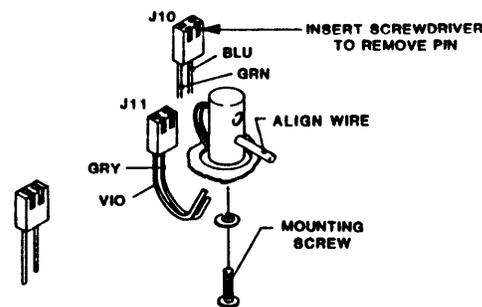


Figure 5-24.
Tape-In-Channel
Emitter Assembly
and Sensor Assembly

5.3.30 VACUUM MOTOR ASSEMBLY (Figure 5-25)

- Remove the Blower Assembly per paragraph 5.3.21.
- Remove four Phillips screws that hold the Vacuum Motor Cover to the Blower Box.
- On Vacuum Motor Assemblies equipped with fuses, remove the push-on tabs from the fuse holder.
- Lift the Vacuum Motor Cover from the Blower Box, disconnect the Feed thru Connector from the Vacuum Motor Cover, and remove the Vacuum Motor Cover.
- Unplug the Vacuum Motor Connector.
- Remove four Phillips Screws that hold the Vacuum Motor to the Blower Box.
- Cut tie wraps and remove Vacuum Motor Assembly from the Blower Box.

To replace: Reverse removal procedure.

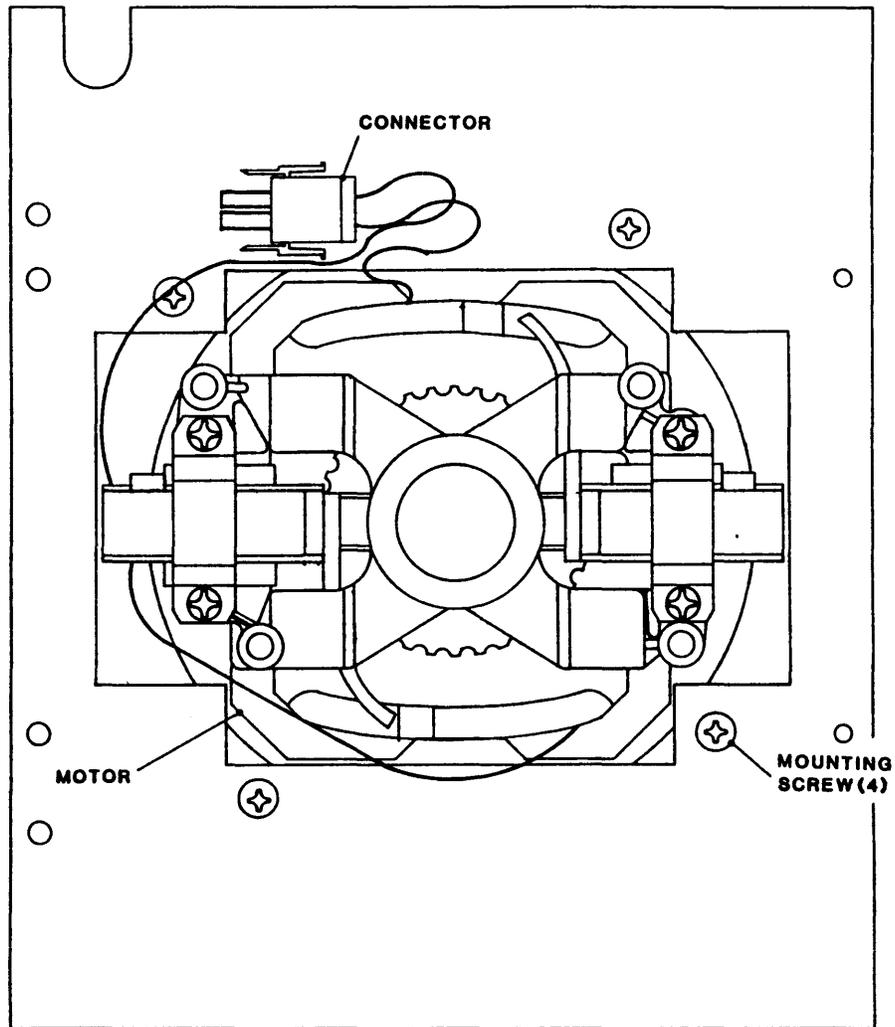


Figure 5-25. Vacuum Motor Assembly, Shaft End View (Cover Removed)

5.3.31 SUPPLY REEL MOTOR ASSEMBLY (Figure 5-26)

- A. Remove Supply Hub Assembly per paragraph 5.3.23.
- B. Remove four Phillips screws that attach The Reel Motor to the Deck.
- C. Unplug the Reel Motor Connector and remove the Reel Motor Assembly.
- D. Remove Collet from Reel Motor Assembly and transfer to new Reel Motor Assembly.

To replace: Reverse removal procedure. Adjust Collet with Collet Height Adjustment Tool P/N 54-00173-001 and Height Adjustment Tool 54-00171-001:

- a. Mount the Tool on the Collet. Tighten the Tool Mounting Screws.
- b. Slide the Collet and Tool onto the Motor Shaft. Set up Height Adjustment Tool per paragraph 5.4.2.1 (B), steps 1 through 3.
- c. Position the Height Gauge Foot on the Collet Tool indicator button.
- d. Turn the Collet Tool adjusting screw until the indicator reads between +0.5025 and +0.5045.
- e. Tighten the Collet Screw, and remove the Tool.
- f. Replace Supply Hub.

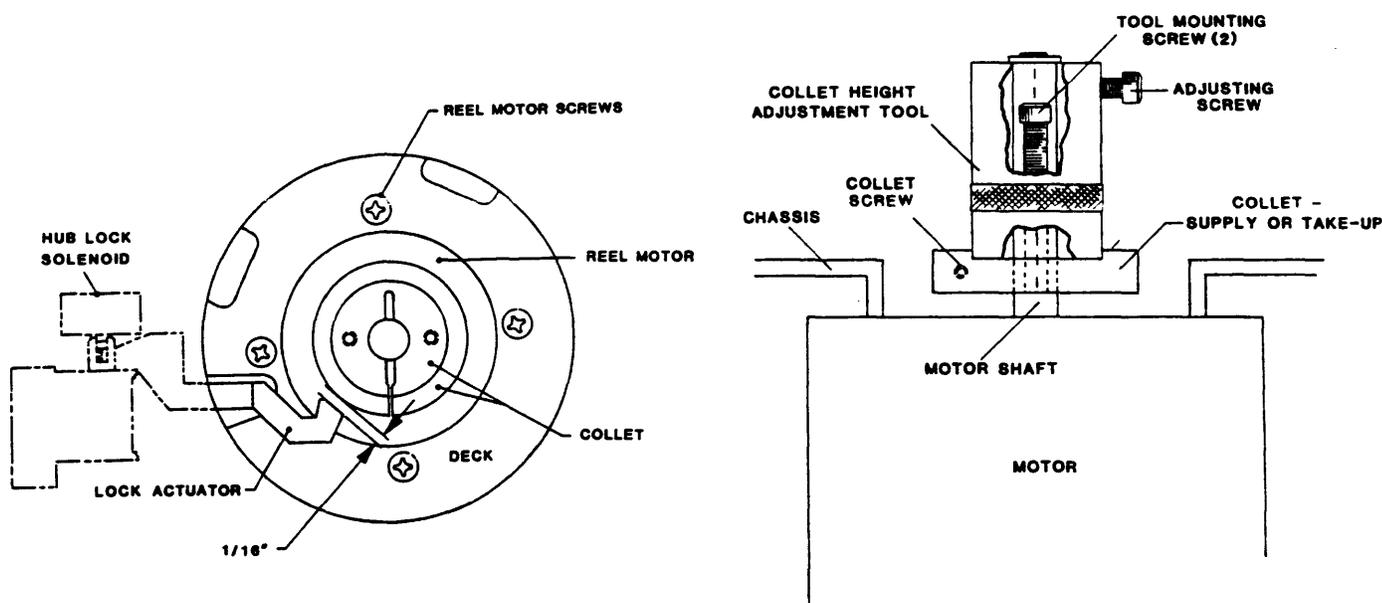


Figure 5-26. Supply Reel Motor Assembly

5.3.32 TAKE-UP REEL MOTOR ASSEMBLY

- A. Remove Take-up Reel Assembly per paragraph 5.3.7.
- B. Lift Deck Assembly and latch it in Maintenance Position.
- C. Remove eight Phillips Screws and remove Cover from Blower Box.
- D. Remove four Phillips Motor Mounting Screws (same as in Figure 5-26) and lower the Reel Motor enough to access the Motor Connector inside the Blower Box.
- E. Disconnect Motor Connector, and remove the Reel Motor.

To replace: Reverse removal procedure. Adjust Collet per 5.3.31, except set the indicator reading to +0.9455 to +0.9475.

5.3.33 MAGNETIC HEAD ASSEMBLY (Figure 5-27)

- A. Remove two Phillips head screws and remove Card Cage Cover.
- B. Unplug Erase Cable from the Read/Write Digital Board (9060) (Ref Fig. 6-5), or unplug the inline connector if present and skip steps D and H.
- C. Lift Deck Assembly to Maintenance Position per 5.2.2.
- D. Cut the tie wraps that secure the Erase Cable.
- E. Remove the Read Preamp-ifier per paragraph 5.3.5.
- F. Unlatch and lower the Deck Assembly.
- G. Open the Top Cover per 5.2.2 and brace it open.
- H. Open the Tape Path Cover and pull the Erase Cable through the Deck.
- I. Disconnect the Write Cable from the Magnetic Head.
- J. With a 7/64-inch Hex Wrench, remove the screw that holds the Magnetic Head, and remove the Magnetic Head.
- K. Retain the Shim(s) and reinstall under the new head.

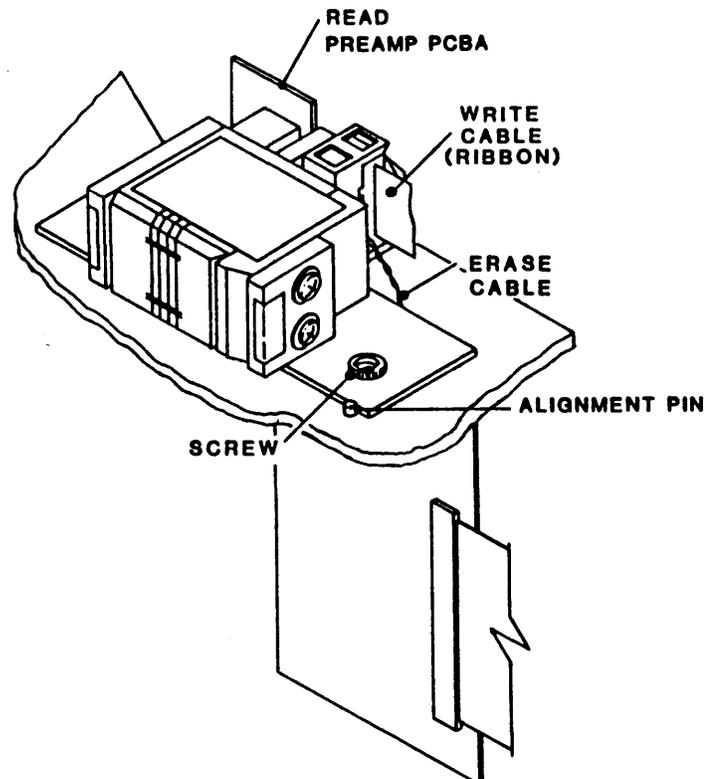


Figure 5-27.
Magnetic Head Assembly and
Read Preampifier PCBA

To replace: Reverse removal procedure. Be sure that the Magnetic Head is pushed tightly against the Alignment Pin and the point of the Skew Adjustment Screw is seated in the alignment hole in the Guide Plate before tightening the Hex Screw that holds the Head Plate, and that Shim(s) are properly aligned under the Head Plate. Adjust Read Skew per paragraph 5.4.2.9.2, Step F. Check Tracking per paragraph 5.4.2.9.2, Step G.

5.3.34 TAPE GUIDE REPLACEMENT (Figure 5-28)

Special Tool Required: Alignment Tool P/N 54-00103-001.

- A. Using a Hex Wrench, remove Mounting Screw and the applicable Tape Guide, retaining Shims.
- B. Install new Tape Guide with the Shims in place, but leave Mounting Screw loose.
- C. Align the Tape Guide by inserting the pins on the Alignment Tool into the holes in the top of both Tape Guides as illustrated. The Alignment Pins should insert all the way into the holes in the Tape Guides, and the Access Holes in the Tool should align with the Tape Guide Mounting Screws.
- D. Tighten the Mounting Screw by inserting the Hex Wrench through the Access Hole in the Alignment Tool. Torque screw to 18-20 in-lbs.

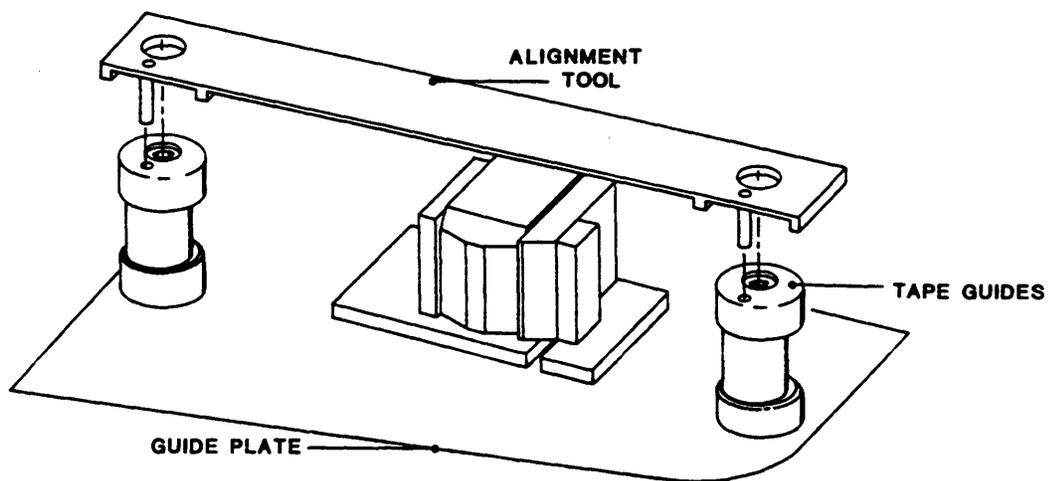


Figure 5-28. Tape Guide Alignment

5.4 ADJUSTMENTS**5.4.1 PRELIMINARY CHECKOUT**

Power Supply Check: Verify Power Supply operation as follows:

- A. Raise the Deck Assembly to Maintenance Position per 5.2.2.
- B. Disconnect Power Connectors P4 from the Drive-Electronics PCBA and P1 from the Servo Power Amplifier PCBA.
- C. Connect the Power Connector to the Drive and an outlet, and turn on power.
- D. Using a digital voltmeter, verify voltages at Power Connectors as follows:

<u>Conn</u>	<u>Pin</u>	<u>Voltage</u>	<u>Tolerance</u>	<u>Conn</u>	<u>Pin</u>	<u>Voltage</u>	<u>Tolerance</u>
P4	1	+5	+0.25/-0.05	P4	7	-50	±7.5V
P4	2	+12	±0.5	P4	8	+50	±7.5V
P4	3	-12	±0.5	P4	9	+24	±4.0V
				P3	1	-24	±4.0V

- E. Turn power off and wait about 10 seconds; then reconnect Power Connectors P4 and P1 to Drive Electronics and Servo Power Amplifier PCBAs.

5.4.2 BUFFER ARMS ADJUSTMENT**5.4.2.1 BUFFER ARM ROLLERS & FIXED ROLLERS HEIGHT ADJUSTMENT (Figure 5-29)**

- A. **General:** Height adjustment of the Fixed Rollers and Buffer Arm Rollers require the use of special Height Adjustment Tool Kit P/N 54-00171-001. Whenever one of these components is replaced, or its height disturbed, it must be checked for proper height and adjusted as necessary.

The Height Adjustment Tool Kit consists of three pieces; a Surface Plate that rests on the Deck Assembly at three points, and spans over the two Fixed Rollers and the two Buffer Arm Rollers at a specified height, and a Digital Height Gauge with a base that may be moved across the Surface Plate. The rollers must be adjusted vertically to the proper height.

- B. **Adjusting Buffer Arm Tape Roller Height:** Adjust the applicable Buffer Arm Tape Roller as follows:

Special Items Required: Set of Shims P/N 98-00208-001. These are of the following thicknesses: .003/.005/.010 inch.

1. Inspect and clean as required the Surface Plate, Height Gauge and the three mounting surfaces on the topside of the Deck. The surfaces are to be free of dirt and other matter.
2. Place the Surface Plate on the topside of the Deck, insuring that the two locating pins are in the holes provided on the Deck. Place the Height Gauge on the Surface Plate to begin tape path alignment. Verify distance from 0.500" spacer to top of split guide (supply side) is within tolerance ($.7745 \pm .0010$). See Figure 5-29.
3. Position Height Gauge so indicator pad contacts the top surface of the split tape guide on the supply side of the Head. Zero the Height Gauge. See Figure 5-29. Raise and lower deck gently until digimatic reading repeats to zero. Check the height of Collets and record the readings on data sheet. Re-set Collets to meet the required dimension. Torque the Collet Screw to 19-21 in-lbs. Re-assemble Supply Hub and Take-up Reel and torque the screw to 18-20 in-lbs.
4. Set height of Tension Arms by placing the required combinations of Shims as required between bottom of Arm Clamp and Pivot Assembly to obtain a Height Gauge reading of -0.2955 to -0.2975 Tighten the bolts to 16 in-lbs. Note: Any time Tension Arm is removed for shimming, Buffer Arm calibration is required. For Buffer Arm calibration see section 5.4.2.3.

- C. **Adjusting the Fixed Tape Rollers:** With the Height Gauge still mounted as described above (Step B. 1 thru 3), check, and as necessary adjust either Fixed Tape Roller as follows:

Special Items Required: Set of Shims P/N 98-00209-001. These are of the following thicknesses: .001/.003/.005/.010 inch.

1. Set height of Fixed Guides by placing different combinations of Shims, as required, between the Bearing and Fixed Guide Post to obtain a Height Gauge reading of -0.2505 to -0.2525 . Tighten screws to 7-9 in-lbs.

- D. Adjust Tape Guides per paragraph 5.3.34.

- E. Recalibrate the Buffer Arms per paragraph 5.4.2.3.

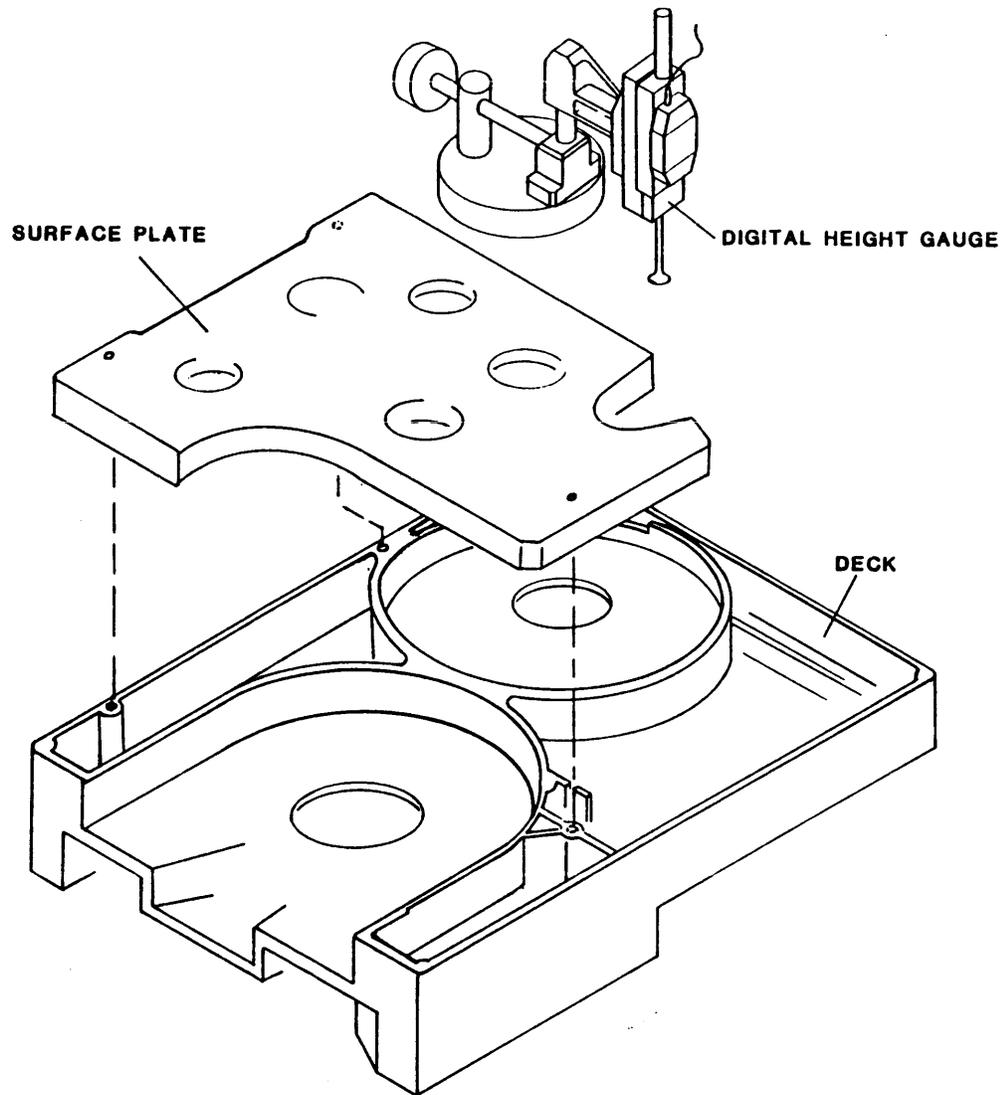


Figure 5-29. Tape Rollers Height Adjustment

5.4.2.2 CAPACITIVE DISK HEIGHT ADJUSTMENT

Use this procedure to adjust the distance of the Capacitive Disk from the Position Sensor PCB if the disk has been removed or replaced with the deck in the maintenance position per paragraph 5.2.2 and power is turned OFF.

- A. Using a 0.015-inch Plastic Feeler Gauge, measure the spacing between each Capacitive Disk and its respective Position Sensor PCBA (See Figure 5-8). The Feeler Gauge should slide freely but snugly between the disk and the PCBA.
- B. If spacing is not correct, loosen the Set Screw on the Capacitive Disk Hub, and adjust the spacing between the Capacitive Disk and the PCBA as required. Retighten the Set Screw.
- C. Calibrate the Buffer Arms per paragraph 5.4.2.3.

5.4.2.3 BUFFER ARM CALIBRATION

Throughout the Buffer Arm calibration and check procedure, while the Buffer Arm voltage is being displayed on the front panel, there may be jitter in the last digit. The jitter is ACCEPTABLE if it stops as the arm is moved slightly in one direction or the other.

Note: If the drive is equipped with 90-9069-004 retract assemblies, make sure that jumper **W1 IS** and **W2 IS NOT** installed. There will be no tape loaded during this test.

- A. Turn on power.
- B. Enter diagnostics mode by pressing DIAG, then ENTER. Press SCAN three times. The display will read: DRV ADJ. Press ENTER, the display will read: BUF ARMS. Press ENTER. The display will indicate: RELAXING while the arms relax and the gain of the Position Sensors is automatically calibrated. When complete, the display will indicate: TAKE-X.X (X.X = voltage reading).
- C. With the Buffer Arms still relaxed, raise the deck. Check that the gap between the Drive Pin in the Retract Motor Shaft and the Pivot Pin on the Capacitive Disk Assembly is 0.15 ± 0.05 inch (See Figure 5-30). Check both the Supply and Take-up Arms. If either is out of tolerance, adjust as follows:

CAUTION: Overtightening Cam Set Screw can damage the Cam. Do not overtighten Cam Set Screw.

Locate the Microswitch and the Cam on the bottom of the Retract Assembly. Loosen the Cam Set Screw and rotate the Cam on the Motor Shaft so that the Microswitch Actuator is just entering the notch in the Cam. Tighten the Cam Set Screw to 3.5 ± 0.5 inch-pounds.

Note: If the Cam Set Screw can not be accessed in the relaxed position, perform the following procedure:

Estimate the amount of adjustment required to bring the gap into tolerance. Press the DIAG switch and watch as the arms are retracted until the Cam Set Screw is accessible. When the Set Screw is in an accessible position, turn the power off. Loosen the Cam Set Screw and make the adjustment as estimated earlier. Tighten the Cam Set Screw to 3.5 ± 0.5 inch-pounds. Repeat steps A, B and C to re-check the adjustment.

- D. Press the START/STOP switch. The DIAG light will start to flash, indicating the reference voltage to the position sensors have been set to the default value.
- E. Manually move the Take-up Arm to its zero position, and install the Take-up Zero Position Tool (99-00634-001). Verify a display reading of exactly 0.0. If not, adjust per step I before continuing. If correct, skip to step J.
- F. With the Take-up Arm in its relaxed position, the display must show -3.2 to -3.4. If not, adjust per step I before continuing. If correct, skip to step J.
- G. Push SCAN. Display shows SUPP $\pm X.X$. Repeat step E above for Supply Arm, using Supply Zero Position Tool (99-00632-001). The same zero position voltage applies.
- H. With the Supply Arm in its relaxed position, the display must show -2.7 to 2.9. If not, adjust per step I before continuing. If correct, skip to step J.
- I. If either of the readings for a particular arm is out of tolerance, that arm must be adjusted as follows:
 1. To adjust the zero point of the arm, loosen the Lock Bolt that clamps the arm to its Pivot Shaft and rotate the shaft until the reading is within specification with the arm in the zero position. Retighten the Clamp Bolt to 13.0 ± 1.0 inch-pounds. Alternatively if a Height Adjustment Tool is not available, the Capacitive Disk may be rotated while maintaining the height adjustment per paragraph 5.4.2.2.
 2. Check the arm height per paragraph 5.4.2.1.

3. Move the arm to its relaxed position. If the reading is out of tolerance the distance of the Capacitive Disk from the Position Sensor PCB must be adjusted. To do this, raise the deck and locate the Capacitive Disk for the arm to be rotating the disk on the shaft. If the reading was too low the disk should be moved closer to the Position Sensor PCB. If it was too high, the disk should be moved farther away. After the height has been adjusted, go back to step 1 and re-check the zero position.
- J. Once the arms have been adjusted to within tolerance, press ENTER. The display will indicate: CONFIRM? Press ON-LINE to start the electronic calibration phase. The display will indicate: RELAXED? Make sure both arms are resting on their Mechanical Stops and press ENTER. The drive will automatically calibrate the gain of the Position Sensors. After about 3 seconds the display will indicate: TLIM X.X. If the drive failed to calibrate one of the arms, the display will read TAK ARM? or SUP ARM?, indicating which arm failed to adjust. If so, press DIAG and go back to step J and adjust that arm.
- K. With the display showing TLIM X.X, move the Take-up Arm to the TLIM position, by placing the Take-up Arm TLIM Tool (99-00635-001) between Fixed Roller and Capstan. At the TLIM position, the Select LED must be ON, indicating that the voltage is within acceptable limits. Push ENTER. Remove the TLIM Tool.
- L. The display will now show SLIM X.X in the display. Move the Supply Arm to the SLIM position, by placing the Supply Arm SLIM Tool (99-00630-001) on the Fixed Roller. Again, the Select LED must be ON. Push ENTER. The display will show RETRACT, then BUF ARMS. Remove the SLIM Tool.

5.4.2.4 STATIC ARM TENSION CALIBRATION (Figure 5-30)

With the Drive in BUFF ARMS Mode and relaxed per 5.4.2.3.1, Steps A and B:

- A. For each Buffer Arm, using a loop of string (or similar device), attach a static measuring device (such as a spring scale) to the tape guide on the end of the Arm. Using the Static Measuring Device, pull the Arm to the zero position and hold it there. The Measuring Device should indicate 17.5 ± 1.0 ounces.
- B. If Arm tension is out of tolerance, loosen the lock nut on the Spring Tension Adjusting Screw, and rotate the Spring Tension Adjustment Screw as required until the tension is within tolerance.
- C. Tighten the lock nut on the Spring Tension Adjusting Screw.

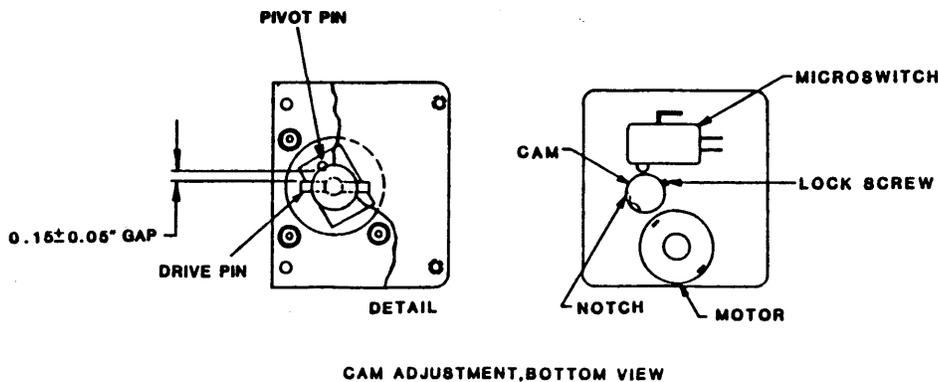
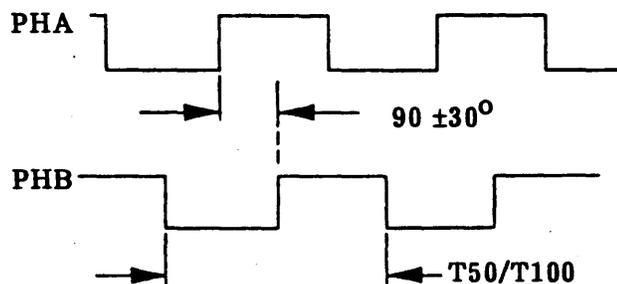


Figure 5-30. Buffer Arms Calibration

5.4.2.5 CAPSTAN CHECK

- A. Turn on power.
- B. Press DIAG. Display indicates: DIAG.
- C. Press ENTER. Display indicates: SELFTEST.
- D. Press SCAN. Display indicates: MOTION.
- E. Press ENTER. Display indicates: 50 FWD.
- F. Press ENTER. Capstan should move in forward direction.
- G. On the Drive Electronics Board: connect a dual trace oscilloscope to U37 Pin 2 (PHA), and U37 Pin 3 (PHB). The two signals should be approximate squarewaves $90 \pm 30^\circ$ out of phase with one another, as illustrated below:



Note:
 Waveforms can be asymmetrical by $\pm 30^\circ$.
 $V_{p-p} = \text{TTL Levels.}$
 $T50 = 126 \pm 0.75 \text{ us}$
 $T100 = 63 \pm 0.75 \text{ us}$

Capstan Drive Voltages Phase Relationship

- H. Check time period, T50.
- I. Press START/STOP. Capstan should stop motion.
- J. Repeatedly press SCAN until display indicates: 100 FWD.
- K. Check time period T100.

5.4.2.6 LOAD TEST

With the Drive in Diagnostic-Motion Mode per paragraph 5.4.2.5, Steps A thru D:

- A. Open the Tape Access Door and insert a 10-1/2 inch Test Reel.
- B. Leaving the Access Door open, Press LOAD. The display should indicate: CLOSE DOOR.
- C. Close the Tape Access Door. The Drive should now load with the following sequence:
 1. Display indicates: LOADING.
 2. Supply Hub Solenoid engages.
 3. Supply Hub reverses and locks the reel.
 4. Supply Hub Solenoid disengages.
 5. Vacuum Blowers starts.
 6. Tape threads onto Take-up Reel, and Vacuum shuts off.
 7. Tension Arms engage and apply tension to tape ($8.75 \pm 0.5 \text{ oz}$).
 8. Drive searches for Load Point.
 9. Drive reaches Load Point, adjusts the Write Current while shuttling back and forth, then stops at Load Point.
 10. Displays indicates: UNIT X, and Tension Arms move to Zero Point. If Write Ring is installed on Reel, WRITE ENABLE indicator lights.

5.4.2.7 DIAGNOSTIC WITH TAPE LOADED

With a Tape Reel in the Drive, and the Drive in Diagnostic-Motion Mode per paragraph 5.4.2.5:

A. Repeatedly press SCAN and verify the sequence of displays:

<u>Step</u>	<u>Display</u>	<u>Step</u>	<u>Display</u>	<u>Legend</u>
1	50 FWD	8	100 FSS	FWD = Forward
2	50 REV	9	100 RSS	REV = Reverse
3	50 FSS	10	100 FRF	FSS = Forward Start/Stop
4	50 RSS	11	50/100 F	RSS = Reverse Start/Stop
5	50 FRF	12	50/100 R	FRF = Forward/Reverse/Forward
6	100 FWD	13	BURN-IN	F = Forward; R = Reverse
7	100 REV			50 = 50 ips; 100 = 100 ips

- B. Repeat Step A., but after each substep, press ENTER, and verify that the Drive does the operation indicated by the display: for each test, allow the Drive to run for several seconds, then press START/STOP. Then do the next substep.
- C. Repeatedly press SCAN until display indicates: 100 FWD. Press ENTER and let the tape run to the end of tape. Verify that the display indicates: EOT.
- D. Press DIAG twice. Display indicates: DIAG, then UNIT X.
- E. Press RWND/UNLD. The tape should run to the beginning of tape, and the display should indicate: LOAD PT.

5.4.2.8 CALIBRATION, MECHANICAL

Hub Lock Solenoid Adjustment: (Figures 5-4 and 5-26)

With power off, adjust the Hub Lock Solenoid as follows:

- A. Remove Supply Hub per paragraph 5.3.23.
- B. Raise the Deck to Maintenance Position per paragraph 5.2.2.
- C. Referring to Figure 5-4, loosen the two Solenoid Bracket Mounting Screws until the Solenoid Body can be moved freely: **Do not remove screws.**
- D. Position the Solenoid Body so that the Plunger is centered in its channel and can move freely over its full range of travel while moving the Lock Actuator.
- E. Holding the Solenoid Body firmly in its location on the Deck, tighten the two Solenoid Bracket Mounting Screws. Verify that the Solenoid Plunger still moves freely in the Solenoid Bore. Repeat Steps C, D And E if necessary. Torque Mounting Screws to 13.0 ±1.0 inch-pounds.
- F. Loosen the two Solenoid Mounting Screws until the Solenoid can be moved freely on the Bracket.
- G. Push the Solenoid Plunger all the way into the Solenoid and, while holding it there, adjust the Solenoid until the Lock Actuator is at 0.062 ±0.030 inch (1/16 inch) from the Collet as illustrated (Figure 5-26).
- H. Holding the Solenoid firmly against the Solenoid Mounting Bracket, tighten the Solenoid Mounting Screws to 13.0 ±1.0 inch-pounds.
- I. Loosen the two Stop Bracket Mounting Screws.
- J. Move the Stop Bracket until the Lock Actuator aligns with the arc of the opening in the Deck for the Reel Motor (±0.30 inch).

- K. Holding the Stop Bracket firmly against the Deck, tighten the Mounting Screws to 13.0 ± 1.0 inch-pounds.
- L. Verify that the Hub rotates freely without contacting the Actuator.
- M. Enter DIAG and SCAN to DRV ADJ. Enter and SCAN to HUB SENSE, push enter. The Hub Lock Solenoid should engage. Verify that clockwise rotation of the Hub engages the fingers and that the Actuator locks the Hub.

5.4.2.9 CALIBRATION AND SET-UP, ELECTRONIC

A. General:

All Electronic Calibration procedures and most of the Electronic Set-Up procedures require that the Calibration Jumper on the Drive Electronics Board be placed in CALIBRATE position. The following Preparation Procedure describes installing the Calibration Jumper.

Note: The Set-up Procedures for UNIT NUMBER and DEFAULT DENSITY do not require the Calibration Jumper to be placed in ENABLE Position. These procedures are described in Section II.

B. Preparation:

1. Turn power on. The Readout displays "TESTING", then "UNIT X".

CAUTION

Turning power OFF or ON while the Calibration Jumper is in ENABLE position could cause loss of programmed parameters on the Drive Electronics Board. Such a loss could require re-entry of parameters by Kennedy service personnel. Therefore, during the following calibration procedures, **DO NOT TURN POWER OFF UNTIL CALIBRATION JUMPER HAS BEEN REPLACED TO ITS ORIGINAL (DISABLE) POSITION.**

2. Remove the Bolts on the sides of the unit, raise the Deck Assembly and, using the Support Bar, secure the Deck Assembly in Maintenance Position as shown in Figure 2-6 or 2-7 (Section II).
3. On Drive Electronics Board (Figure 5-31), move the Calibration Jumper to ENABLE Position.
4. Unlatch Support Bar and lower the Deck Assembly.
5. Install a reel of tape in the Drive, set the Drive to Diagnostic-Motion Mode, run tape to BOT by pressing LOAD.

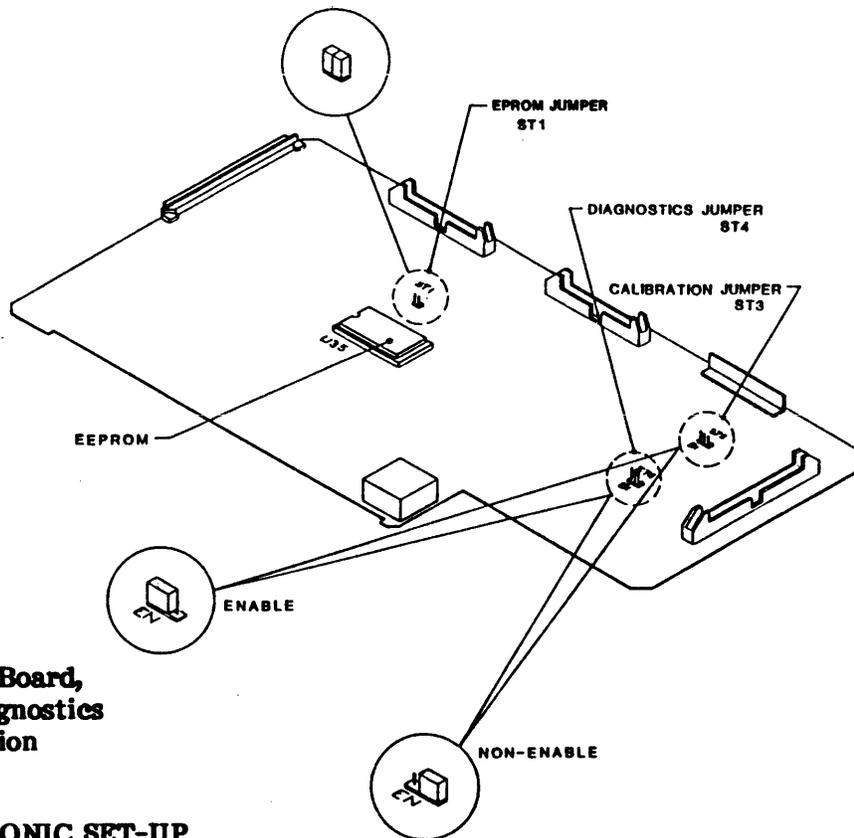


Figure 5-31.
Drive Electronics Board,
Calibration and Diagnostics
Jumpers Location

5.4.2.9.1. DRIVE ELECTRONIC SET-UP

- A. Press DIAG. Display indicates: DIAG.
- B. Press ENTER. Display indicates: SELFTEST (first Diagnostic parameter).
- C. Press SCAN three times. Display indicates: SET UP. Set-up Parameters are:
 - 1. **UNIT NUMBER** (Factory-set to 0) - (Don't care about Calibrate Jumper).
 - a. Repeatedly pressing SCAN displays each of eight Numbers: 0 through 7.
 - b. Pressing ENTER prepares the displayed Number for storage. The Readout indicates: LOAD?.
 - c. Pressing LOAD stores the displayed Number as the new Unit Number.
 - 2. **DENSITY SELECTION** (Factory set to NORMAL)
 - a. **NORMAL**: Allows selection and operation in local or remote density modes.
 - b. **REM ONLY**: Allows selection and operation in remote density modes.
 - 3. **DEFAULT DENSITY** (Factory set to 6250 REM) (Calibrate Jumper - Don't care).
 - a. Repeatedly pressing SCAN changes the Density Parameters and the corresponding Readout to each of the eight Density Configurations: 800, 800 REM, 1600, 1600 REM, 3200, 3200 REM, 6250, and 6250 REM.
 - b. Pressing ENTER prepares the displayed Density for storage. The Readout indicates: LOAD?.
 - c. Pressing LOAD stores the displayed Density as the new Default Density.

Note: The Default Density is effective only following Power-Up, and will not affect the present Operating Density.

FOLLOWING ITEMS REQUIRE CALIBRATE JUMPER IN ENABLE POSITION.

4. **SPEED** (Factory set to HOST SEL) The 9610/9660 Drive provides the following Speed options to match a variety of Hosts:
 - a. **HOST SEL:** Speed selection is made by Host.
 - b. **AUTO SPD:** Drive automatically overrides Host-selected speed and selects speed for optimum Throughput.
 - c. **50 IPS:** Drive performs at 50 ips regardless of Host selection.
 - d. **100 IPS:** Drive performs at 100 ips regardless of Host selection.
5. **TIME OUT** (Factory set to 25FT ON):
 - a. **25FT ON:** Drive stops motion and sets Hard Error Flag IHER if no data is detected within 25 feet after a Read or Read Space Command.
 - b. **25FT OFF:** Drive ignores no-data-detected information, if it occurs, and continues motion. (The use of a blank tape could cause a runaway.)
6. **SECURITY** (Factory set to ENABLED):
 - a. **ENABLE:** Drive can do a Security Erase on command.
 - b. **DISABLE:** Drive cannot do a Security Erase.
7. **EOD GAP**
 - a. **ENABLE:** Drive will produce a 25' Erase on any write not terminated with a filemark that is followed by a reverse motion command.
 - b. **DISABLE:** No 25' erase area will be produced.
8. **PARITY** (Factory set to IGNORE):
 - a. **CHECK:** Drive will check the parity of Write Data from the Host.
 - b. **IGNORE:** Drive will ignore the parity of Write Data from the Host.
9. **LONG GAP** (Factory set to 1.2 INCH): Choices are: 0.45, 0.6, 1.2, 2.5
The length of the Long Gap will affect the Re-Instruct Window to maintain streaming when writing at 100 ips. By increasing the Gap, the Re-Instruct Window will also increase in length. This setting only has an effect on Write Commands at 100 ips with LGP active on the Host Interface.
10. **ARA CAL** (Factory set to ENABLED):
 - a. **ENABLED:** The Drive automatically adjusts Read Gain when reading or writing the ARA (Automatic Read Amplitude) Burst from tape.
 - b. **DISABLED:** The Drive uses stored preset Gain Values for Read Gain.
11. **GCR CERR** (Factory set to DISABLED):
 - a. **ENABLED:** Drive will correct and report errors in GCR Mode.
 - b. **DISABLED:** Drive will correct but not report errors in GCR Mode.
12. **NRZI CCG** (Factory set to ENABLED):
 - a. **ENABLED:** In NRZI Mode, the CRC and LRC Characters will be sent to the Host following each Data Block.
 - b. **DISABLED:** In NRZI Mode, the CRC and LRC Characters will not be sent to the Host.

13. **CLR FBSY (Factory set to POSTREPO):** Effective in Streaming Mode. For Hosts that reinstruct with the removal of FBSY, this option should be set to WITH DBY.
 - a. WITH DBY: FBSY clears while tape is still at speed in Streaming Mode.
 - b. POSTREPO: FSBY clears after repositioning.
14. **IFEN (Factory set to NORMAL):** Hosts that do not support Formatter Enable (FEN), or that use FEN as a pulse (instead of a level) to activate the Formatter, should set this option to INVERT. Refer to Section I for a full definition of FEN.
 - a. NORMAL: Formatter Enable (FEN) is retained as received.
 - b. INVERT: Formatter Enable (FEN) is inverted.
15. **DENSITY OUTPUT (Factory set to CODED):** Determines how the density will be reported to the Host.
 - a. CODED: Density will be coded on DEN0 and DEN1.
 - b. NRZ ONLY: DEN0 will be true only for NRZI.
16. **FMK GAP:**
 - a. EXTENDED: 3.5" gaps will be recorded before filemarks, except GCR, where .3" gaps are recorded.
 - b. NOMINAL: Standard interrecord gaps (PE, DDPE, NRZI = .6", GCR = .3"), will be recorded preceding filemarks.

5.4.2.9.2 CALIBRATION, ELECTRONIC

A. General:

1. In Cal Mode, the Calibration Jumper must be installed in ENABLE Position to store the selected parameters. If the jumper is not installed, and a store operation is attempted, the Readout displays, "JUMPER?" and the RWND/UNL LED flashes. Pressing RWND/UNL aborts the calibration attempt.
2. In Cal Mode, pressing ENTER displays the Calibrate Functions: AUTO and MANUAL. Again pressing ENTER enables the currently displayed Function and displays the first related Parameter.
3. Once a Function has been enabled (by pressing ENTER), again repeatedly pressing SCAN displays the Parameters for that Function.
4. Once a Parameter has been selected per Step 3 above, pressing ENTER starts the operation.

B. Preparation:

With the Calibration Jumper in ENABLE position, load a scratch tape by pressing LOAD.

C. Read Amp Gain Adjustment, General Information:

With CAL Function entered per Item A.2. above, repeatedly pressing SCAN alternately displays: AUTO and MANUAL. Then, again pressing ENTER enables the displayed function.

1. **AUTO Selection.** Repeatedly pressing SCAN in turn displays the densities: ALL, 800, 1600, 3200 and 6250, and WRT CURR. Pressing ENTER selects the displayed density or WRT CURR.
 - a. **ALL.** When ALL is selected, the Readout indicates: CONFIRM. Then, pressing ON-LINE moves tape forward, and the Drive automatically calibrates for all densities at both 50 ips and 100 ips, and Write Current.
 - b. **800, 1600, 3200 and 6250.**
 - 1) For any Density, pressing ENTER selects the displayed density and displays: 50 IPS.
 - 2) Repeatedly pressing SCAN alternately displays 100 IPS and 50 IPS. Again pressing ENTER selects the displayed speed, and the Readout indicates: CONFIRM?.
 - 3) Pressing ON-LINE starts the calibration procedure. See Paragraph 5.4.2.9.2, Step B.
 - c. **WRT CURR.** Write current is automatically adjusted at 50 ips in GCR when this is selected. The readout will display CONFIRM? Pressing the ON-LINE switch starts the procedure.

2. **MANUAL Selection**

- a. Repeatedly pressing SCAN in turn displays the four densities: 800, 1600, 3200 and 6250.
- b. (Same as Step 1.b above.)

D. **Read Gain, Automatic Adjustment:**

1. Repeatedly press SCAN until display indicates: CAL.
2. Press ENTER. Display indicates: AUTO (Auto Amplifier-Adjust).
3. Press ENTER again. Display indicates: ALL (all Densities and all Speeds for all Channels).
4. Press ENTER again. Display indicates: CONFIRM?.
5. Press ON-LINE. Drive sequences through and adjusts Read Amplifier Gain at the four densities for 50 and 100 ips, and adjusts the Write Current. Front Panel Digital Display and the DENSITY LEDs operate to indicate each phase of automatic adjustment sequence.
6. After completing the sequence, tape motion stops, and the display indicates: AUTO, and the 6250 Density LED lights.

E. **Read Gain, Manual Adjustment:**

Note: Although Read Gain adjustments can be made manually, it is recommended that the Read Gain Manual feature be used only to verify the Automatic Read Gain adjustments.

1. Connect oscilloscope probe to TP401 on the Read Analog Board.
2. Turn power on.
3. Reconnect Calibrate Jumper to ENABLE position, install a reel of scratch tape, and load by pressing LOAD.
4. Press DIAG, then repeatedly press SCAN until display indicates: CAL.
5. Press ENTER. The display indicates: AUTO.
6. Press SCAN. The display indicates: MANUAL (Manual Gain Adjustment).

7. Press ENTER. The display will indicate: 800 (Density). If desired, press SCAN as often as necessary to select the desired Density.
8. Press ENTER again. The display will indicate: 50 IPS. If desired, press SCAN to select 100 IPS.
9. Press ENTER again. The display will indicate: CONFIRM?.
10. Setting Adjustment Parameters:
 - a. If you made a mistake when selecting the Density and Speed:
 - 1) Press DIAG to abort the adjustment. The display indicates: CAL.
 - 2) Repeat Steps 5 through 10.
 - b. If you have correctly selected Density and Speed, press ON-LINE. This stores the selected Density and Speed as adjustment parameters. The display indicates: RANGE XX (XX = number from 0 to 15, representing the Course Gain of the system). The Front Panel pushbuttons will now perform the following functions:

<u>Pushbutton</u>	<u>Function</u>
SCAN	Selects the parameter and the Data Amplifier Channel to be calibrated. RANGE (Course Gain - all Channels), AMP-0 through AMP-7 and AMP-P.
ENTER	Increments gain (high value = low gain)
START/STOP	Decrements gain. (low value = high gain)
DIAG	Stops the present operation.
LOAD	Enters (stores) Read gain values.

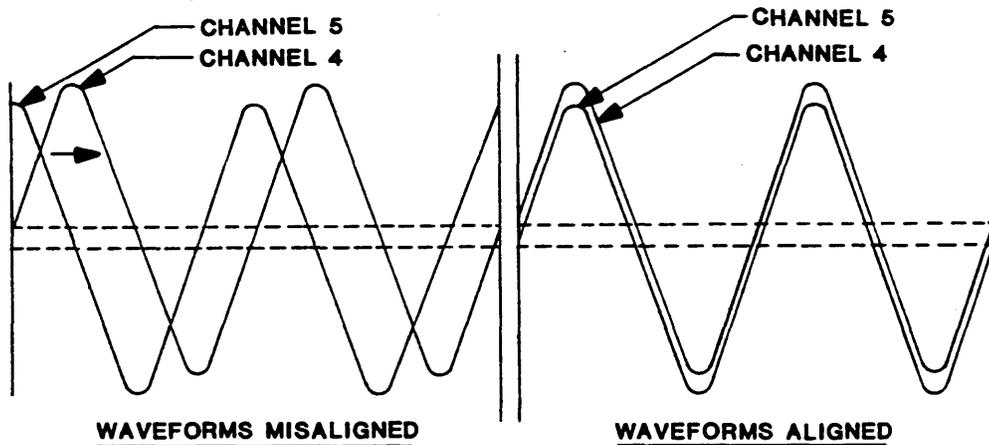
11. Repeatedly press SCAN until display indicates AMP-P XX.
12. Repeatedly press ENTER or START/STOP until display indicates AMP-P 8.
13. Repeatedly press SCAN until display indicates RANGE XX.
14. Repeatedly press ENTER or START/STOP until voltage amplitude at TP401 is nominally 3.5 volts p-p (for 800 CPI) or nominally 4.0 volts p-p (for all other densities). The RANGE has now been set to center voltage.
15. Press SCAN. The display indicates: AMP-5 XX (XX = number from 0 to 15, representing Gain of Channel 5).
16. Repeatedly press ENTER or START/STOP until the amplitude at the Test Point is 3.5 ±0.4V p-p (for 800 CPI) or 4.0 ±.04V p-p (for all other densities).
17. In turn, connect the oscilloscope probe to the Test Point in each successive Read Channel of the Read Analog Board, press SCAN to display the corresponding Channel, and repeat Step 19. The following table shows Track, Test-Point and Channel relationships.

<u>Track</u>	<u>Test Point</u>	<u>Channel</u>	<u>Track</u>	<u>Test Point</u>	<u>Channel</u>
1	101	5	6	601	1
2	201	7	7	701	0
3	301	3	8	801	6
4	401	P	9	901	4
5	501	2			

18. Press RWND/UNL. This stops the operation, and the display indicates: LOAD?.
19. Press LOAD. This stores the new adjustment values.

F. Read Skew Adjustment:

1. Load a Skew Tape into the Drive. Select 800 CPI.
2. Connect a dual-trace oscilloscope to the Read Analog Board, one probe to TP101, the other to TP901. Trigger on TP901.
3. In Diagnostic Motion Mode, run the tape forward at 50 ips.
4. Using a small flat-blade screwdriver and, with the tape in motion, and while observing the waveforms on the Oscilloscope, turn the adjustment screw on the Magnetic Head counterclockwise until there is no apparent waveform motion. Then, turn the screw slowly clockwise until the two waveforms move into phase as illustrated below: but continue to turn the screw clockwise until the two waveforms come in phase a second time.



5. Moving one probe to TP401 (Channel P), and triggering on TP401, in turn, connect the other probe to each Read Channel and record the waveform displacement in microseconds. Prepare a chart similar to:

<u>TP</u>	<u>Channel</u>	<u>Scatter Value</u>	<u>TP</u>	<u>Channel</u>	<u>Scatter Value</u>	<u>Max Scatter</u>
701	0	_____ us	901	4	_____ us	_____ us
601	1	_____ us	101	5	_____ us	
501	2	_____ us	801	6	_____ us	
301	3	_____ us	201	7	_____ us	

6. Subtract the largest positive value from the largest negative value. The difference constitutes the maximum scatter, which should not exceed 3.4 us. If maximum scatter is out of specification, repeat Steps 4 and 5.
7. Run the tape in Read Reverse, and repeat Steps 5 and 6. The maximum scatter should be within specification per the chart above. If maximum scatter is out of specification, repeat Steps 5, 6, and 7. If scatter is out of tolerance replace Head.
8. Press DIAG to exit from Motion Mode. Unload and remove the Skew Tape.

G. Tracking:

Special Items Required: Set of Shims P/N 98-00215-001. These are of the following thicknesses: .001/.003/.005/ inch.

1. Load a write protected tracking tape (P/N 13-00106-001). Initialize the read circuits and move the tape forward using the 50 IPS READ in 800 cpi density in the DATADIAG diagnostic. With the oscilloscope, monitor tract 5 of the Read Analog Board at TP501.
2. Refer to Figure 5-32 and measure the amplitude difference between the two positive peaks, +P1 and +P2. With the head properly positioned vertically on the tape, the amplitude of the least positive peak (+P1 or +P2) will be within 80% of the amplitude of the most positive peak (+P1 or +P2). 80% corresponds to 0.002" tracking error.

If P1 is greater than P2 in the forward direction, remove shim(s). If P1 is less than P2 in the Forward direction, add shim(s).

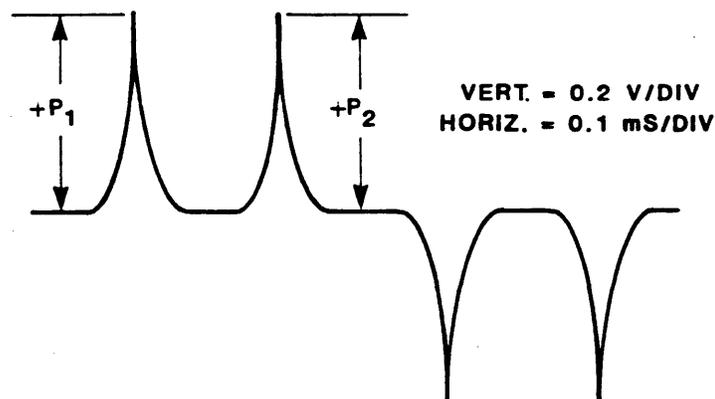


Figure 5-32.

3. Read Reverse at 50 ips, and verify reverse tracking is within the specifications in Step 2 above.
4. Allow the tracking tape to return to BOT at 50 ips. DO NOT REWIND the tape, as subtle tape damage, stretching, or excessive wear may occur which will reduce the accuracy, effectiveness and/or the life span of the standard.
 - a. Exit the diagnostics and unload and remove tracking tape.

5.5 DIAGNOSTICS

5.5.1 GENERAL

- A. In Diagnostic Mode, repeatedly pressing SCAN displays the Diagnostic Functions: SELFTEST, MOTION, DRV ADJ, SET-UP, CALIBRATE, and DATA DIAGNOSTICS. Pressing ENTER enables the function displayed.
- B. Having selected a diagnostic function per Step A, again repeatedly pressing SCAN displays the functional categories or parameters of the selected function.

5.5.2 MOTION DIAGNOSTICS

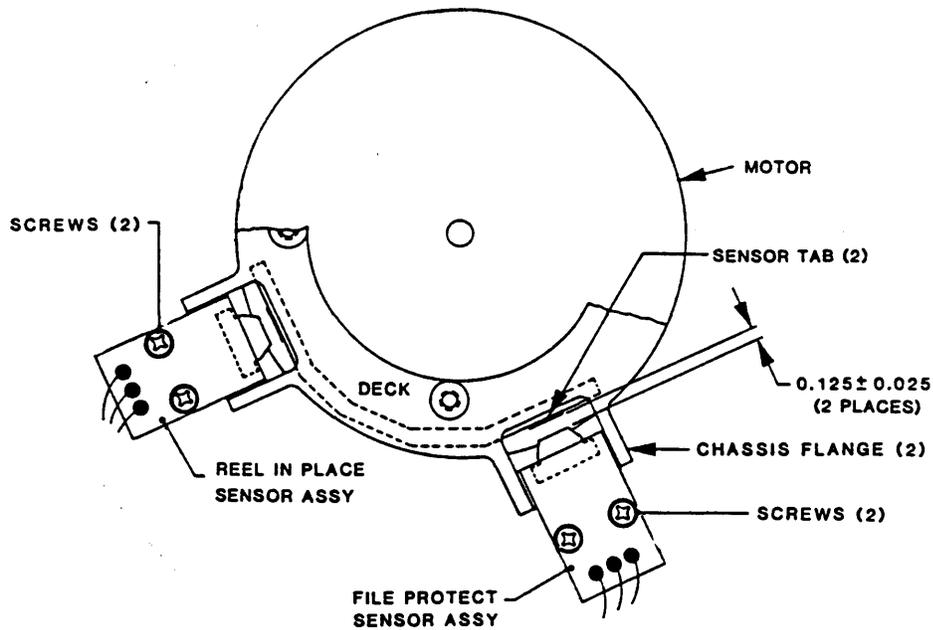
In Motion Mode, the operator can check and adjust the tape path, and Check Motors and Servos:

- A. After selecting Diagnostic Motion Mode per paragraph 5.5.1 Step A, repeatedly pressing SCAN displays the Motion Parameters listed in Paragraph 5.4.2.7.
- B. After selecting a Motion Parameter (Step A), pressing ENTER enables the Parameter.
- C. With the Motion Parameters enabled, pressing START/STOP starts the motion enabled. Again pressing START/STOP stops motion.
- D. When tape is in motion, the DIAG LED flashes at 0.5 Hz.

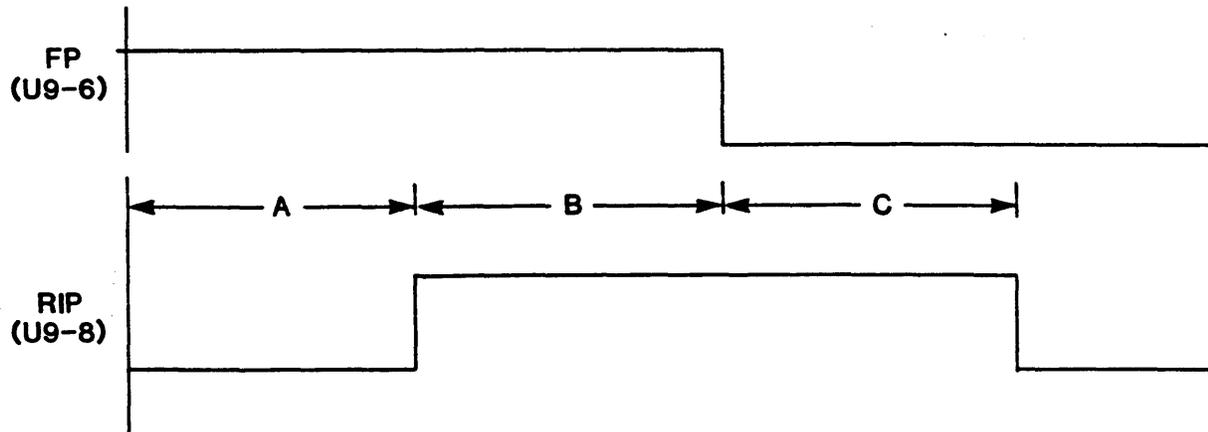
5.5.3 DRIVE ADJUST (DRV ADJ)

- A. **Buffer Arms:** The 9610/9660 Drive automatically adjusts the gain of the Buffer Arms Sensors on Power-Up. In Buffer Arms Mode, the Operator can check the gain of the Buffer Arms Sensors as indicated on the Digital display.
- B. **Hub Sensor:** In Hub Sensor Mode, the operator can manually rotate the Hub to check the status of the Reel-In-Place Sensor as indicated on the display, and adjust as necessary.
- C. **Reel Servo:** In Reel Servo Mode, the operator can check the operation of the Reel Servo System and make adjustment as necessary.
 1. **Checking the Reel Servo System.** See Diagnostics, Section IV, par 4.5.2.4.
 2. **Capstan Motor Calibration.** The Capstan must be calibrated with the Case of the Capstan Motor at a temperature of 25 to 28°C. This can be accomplished by setting the room (ambient) temperature between 25 and 28°C and running the Drive without tape movement (Fan cools Drive).
 - a. Access RL SERVO per Chart C in Section 4.5.2.4. The display should indicate: G = X.XX .
 - b. Operate Drive without tape movement for 40 minutes to lower the Capstan Case Temperature to within 25 to 28°C.
 - c. Press ENTER. Drive performs a Servo Test, changing the value of G.
 - d. Raise the Deck Assembly to Maintenance Position per 5.2.2.
 - e. Move Calibration Jumper (Ref Figure 5-31) to ENABLE Position.
 - f. Press LOAD. The Drive stores the new Gain Value.
 - g. Replace the Calibration Jumper to Non-Enable Position.
 - h. Lower the Deck Assembly per 5.2.2.

- D. **Check Quad:** The Quadrature of the Reel-In-Place and File Protect Sensors must now be adjusted to enable the EEOT calculation to be performed.
1. Power the unit on and load a small (7") **Write Enabled** reel.
 2. Connect an oscilloscope to U9-6 and U9-8 on the 8952 Drive Electronics board with the following set-up:
 - Probe A on U9-6 (FP)
 - Probe B on U9-8 (RIP)
 - 1 ms/div
 - Trigger on rising edge of "A"
 3. Enter DIAGnostics, DRV ADJ, CHK QUAD, press ENTER. The drive will run to EOT, then back up 60 turns. This results in approximately 100 ft. on the supply reel, simulating a worst case, small reel of tape. The drive will motion forward and backward within this 100 ft. region of tape.
 4. The display will show GOOD, EARLY, LATE, BAD or VERY BAD. The Position of the Reel-In-Place and File Protect Sensors must be adjusted to achieve the signal relationship as shown in Figure 5-33.



Reel-In-Place/File Protect (Bottom View)



GOOD = $A > 1.5\text{ms}$; $B > 1.5\text{ms}$; $C > 1.5\text{ms}$
EARLY = $A < 1.5\text{ms}$
LATE = $B < 1.5\text{ms}$
LATE = $C < 1.5\text{ms}$
BAD = Two or more above
VERY BAD = No waveform sensed, either RIP or FP

Figure 5-33. Quadrature Signal Relationship

The signal edges should be sharp with minimum slope with no pulses or glitches in front of or behind the quadrature signals. Glitches are indicative of a badly aligned sensor and can be as large as 50 uSec.

5. On attaining quadrature, the front panel will display "GOOD". The START/STOP button must be pressed to halt tape motion, followed by pressing ENTER and LOAD. This action will store in the EEPROM that quadrature has been set. Rewind and Unload the tape.
6. Enter the DIAGNOSTICS, DRV ADJ, CHK HUB, the Hub Lock Solenoid will engage. Rotate the Supply Reel clockwise by hand until the fingers engage and the hub hits the stop. Verify that the display changes from NOT IN to IN PLACE and that the Write Enable LED turns ON. If either of these two items do not occur, the appropriate sensor must be adjusted, and the QUAD CHK procedure must be run again.

SECTION VI**PARTS IDENTIFICATION****6.0 INTRODUCTION**

This Section contains parts ordering information and lists replacement and recommended spare parts. Figures 6-1 thru 6-5 include parts lists that identify each part illustrated. Parts Tables 6-1 and 6-2 list parts recommended as spares. Table 6-3 lists recommended Maintenance Tools.

Field-Repair and -Change Kits consist of parts assembled and adjusted at the factory. Repair Kits are for repair of Shugart products. Change Kits are for adding standard or special options not originally included in the equipment. Kits include installation instructions.

6.1 PARTS WARRANTY

Parts are warranted to be free from defects in materials and workmanship for 90 days from the date shipped from Shugart. This warranty does not apply to Shugart parts that have been neglected, misused, improperly installed, poorly maintained, or damaged by accident. Liability under this Warranty is limited to replacement or repair of defective parts at Shugart Co. option. The equipment user must obtain Return Authorization (RA) from Shugart Corporation before shipping the defective parts. The customer must send the package postage paid.

6.2 OUT OF WARRANTY EMERGENCY PARTS

Shugart Corporation expedites shipment of emergency orders for out-of-warranty parts. The price of expedited orders includes the standard price for the part plus a \$75.00 (per item, per quantity) Expediting Fee. Shugart ships emergency orders within one week of receipt of the order.

6.3 PARTS ORDERING INFORMATION

Spare Parts orders and inquiries should be directed to:

SHUGART CORPORATION	Tel: (714) 770-1100
9292 Jeronimo Road	Fax: (714) 859-4960
Irvine, CA 92718	(714) 770-0366

Include the following information in all orders:

- a. Company Name, shipping and billing address.
- b. Purchase Order Number.
- c. Authorized person's name and phone number.
- d. Preferred method of shipment (FOB Irvine, California).
- e. Name, Part Number, and quantity (Ref par. 6.3.3.d) of parts being ordered.

6.3.1 MINIMUM PARTS ORDERS

The minimum domestic and international order value is \$250.00. Refer to Parts Price List Manual for parts prices. For Emergency Orders, order value does not include the \$75.00 Expedite Fee (See paragraph 6.2).

6.3.2 RETURNING PARTS TO SHUGART

If a part must be returned for repair or replacement, the customer must first notify the nearest Customer Service Office listed in Paragraph 6.3.4 to obtain a Return Authorization Number (RA Number). If the part is available at that Office, the Shugart Agent will issue the RA Number and give further instruction for returning the part. If the part is not available at that local office, the customer must notify the Shugart Main Office at Irvine, California to obtain the RA Number. The part must be returned to the Office that issued the RA Number. Orders will be accepted via Telephone or Telex, but will not be shipped until a confirming Purchase Order is received from the customer.

Note 1: Parts sent to Shugart Corporation that do not include a Return Authorization Number will be returned to the sender COD unopened. The RA Number must be written on the outside of the package in a conspicuous place.

Note 2: Send only the item(s) needing repair or replacement. Use standard good packaging procedures. Shugart Corporation will not be responsible for any accessories to the repair item. **DO NOT SEND ACCESSORIES.**

6.3.3 PARTS ORDER LEADTIME

- a. Delivery of spare parts: 60-90 days After Receiving Order (ARO).
- b. Delivery of tools and special parts: 90 days ARO.
- c. Delivery of parts for obsolete equipment: 120 days ARO.
- d. For quantities of six or more of one item or for items not covered by these guidelines, consult your nearest Shugart Corporation Customer Service Department (Ref par. 6.3.4).

6.3.4 SHUGART CORPORATION CUSTOMER SERVICE ADDRESSES

For service and general information, contact the nearest Shugart Corporation Customer Service Office listed below:

United States:

Shugart Corporation
9292 Jeronimo Road
Irvine, CA 92718

Tel: (714) 770-1100
Fax: (714) 859-4960

Shugart Corporation
1501 W. 9th Street
Upland, CA 91786

Tel: (909) 931-3233
Fax: (909) 931-3239

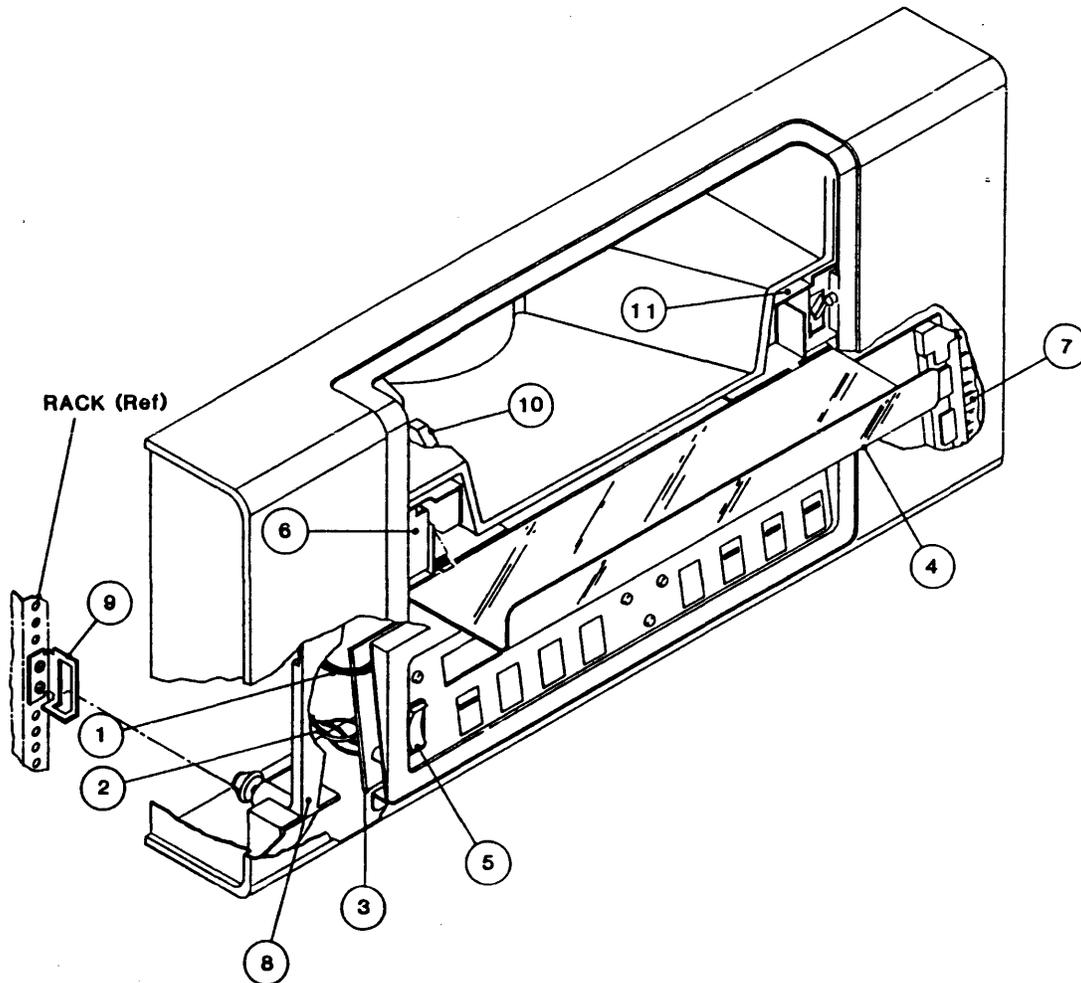
Shugart Corporation
25 Olympia Avenue
Woburn, MA 01801

Tel: (617) 935-9787
Fax: (617) 932-3351

United Kingdom:

Shugart Ltd.
11 Headley Park 10
Woodley, Berkshire
RG5 4SW England

Tel: 011-44-734-448044
Fax: 011-44-734-448080



Parts List: Front Panel Assembly P/N 90-09191-XXX

Item	Part Number	Description
1	90-07587-003	Wire Assembly
2	90-09159-002	Power Switch Cable Assembly
3	90-07947-312	Operator Control Panel PCBA
4	91-09051-001	Tape Access Door
5	51-00099-001	Switch, Power
6	22-00008-002	Door Lock Solenoid, 24 VDC
7	90-09304-003	Front Panel Shielded Cable Assembly
8	91-08082-001	Latch
9	91-08084-001	Bracket Catch
10	(Reference)	Manual Reel Locking Lever
11	51-00196-001	Microswitch

Figure 6-1. Front Panel Assembly

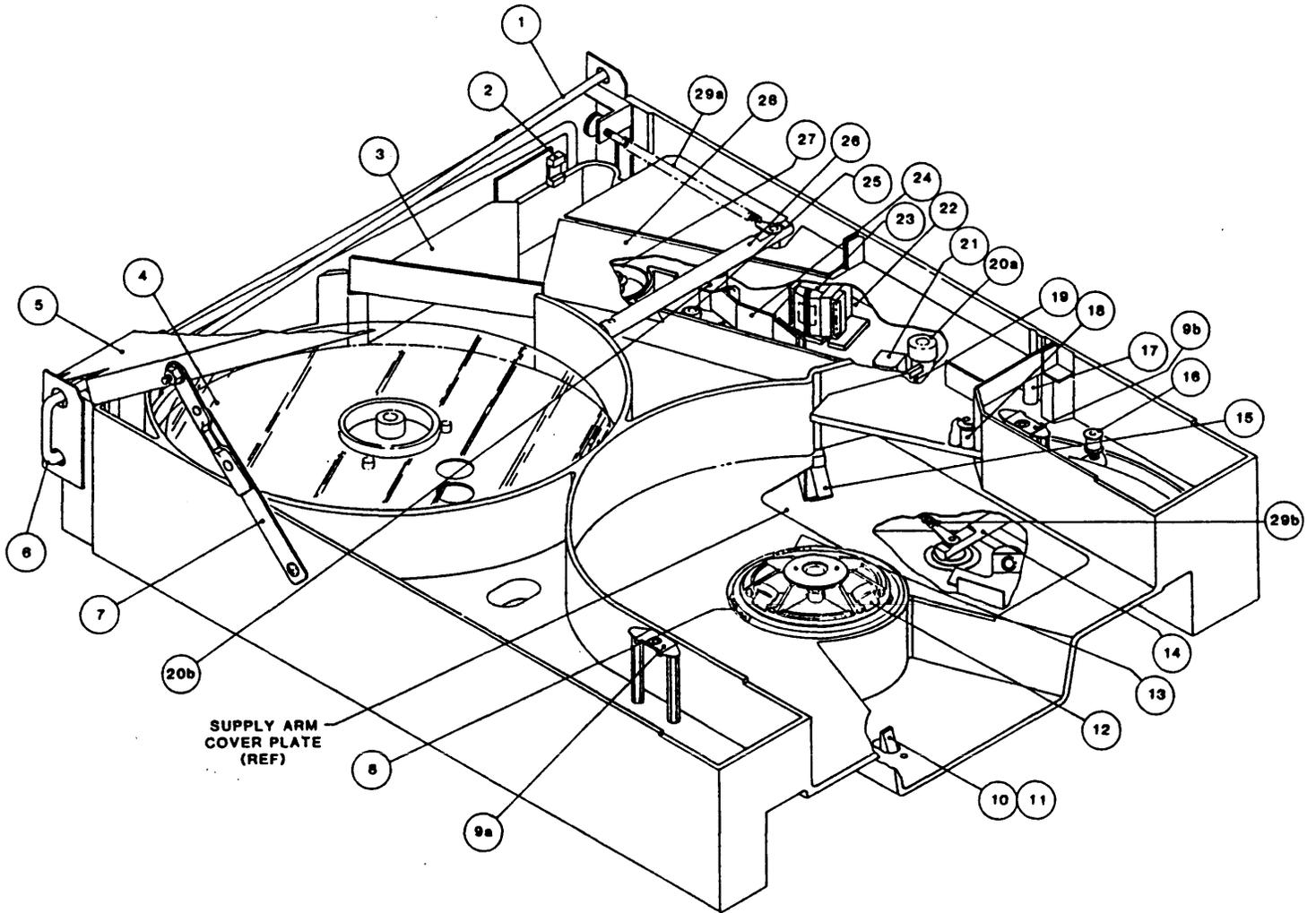


Figure 6-2. Deck Assembly, Top View (Sheet 1 of 2)

Parts List: Deck Assembly

Item	Part Number	Description
1	91-07731-401	Torsion Bar, Right
2	37-00053-102	Take-up Arm Limit Sensor
3	91-09110-001	Cover, Tape Path
4	90-09014-003	Take-up Hub Assembly
5	91-09197-002	Cover, Deck
6	91-07731-301	Torsion Bar, Left
7	90-08028-001	Brace Assembly
8	90-07119-104	Reel-In-Place Sensor Assembly (hidden)
9 (a,b)	28-00259-001	Fastener, 1/4-Turn, Rec., Clip-On
10	91-09037-001	Knob
11	91-09036-001	Release Lever
	91-09195-001	Release Lever (Low Profile Hub)
12	90-09021-004	Supply Hub Assembly
	90-09395-001	Supply Hub Assembly (Low Profile Hub)
13	90-07144-003	File Protect Sensor Assembly (hidden)
14	90-09042-107	Supply Arm Assy. (Bottom)
15	37-00053-002	Supply Arm Limit Sensor
16	91-09041-002	Tension (Buffer) Arm Roller
17	90-07334-101	Tape-In-Channel Sensor Assembly
18	91-07211-002	Fixed Roller
19	90-07334-003	Tape-In-Channel Emitter Assembly
20 (a,b)	90-09154-001	Split Tape Guide
21	90-05906-104	BOT/EOT Sensor Assembly
22	90-09002-002	Head/Guide-Plate Assembly
23	90-07524-005	Magnetic Head Assembly
24	90-09171-002	Shield Assembly
25	91-09167-002	Post
26	90-09042-207	Take-up Arm Assembly (Top)
27	91-08274-001	Capstan Wheel
28	91-09129-001	Tape Path Cover Assembly
29 (a,b)	91-09115-003	Spring, Tension Arm

Figure 6-2. Deck Assembly, Top View (Sheet 2 of 2)

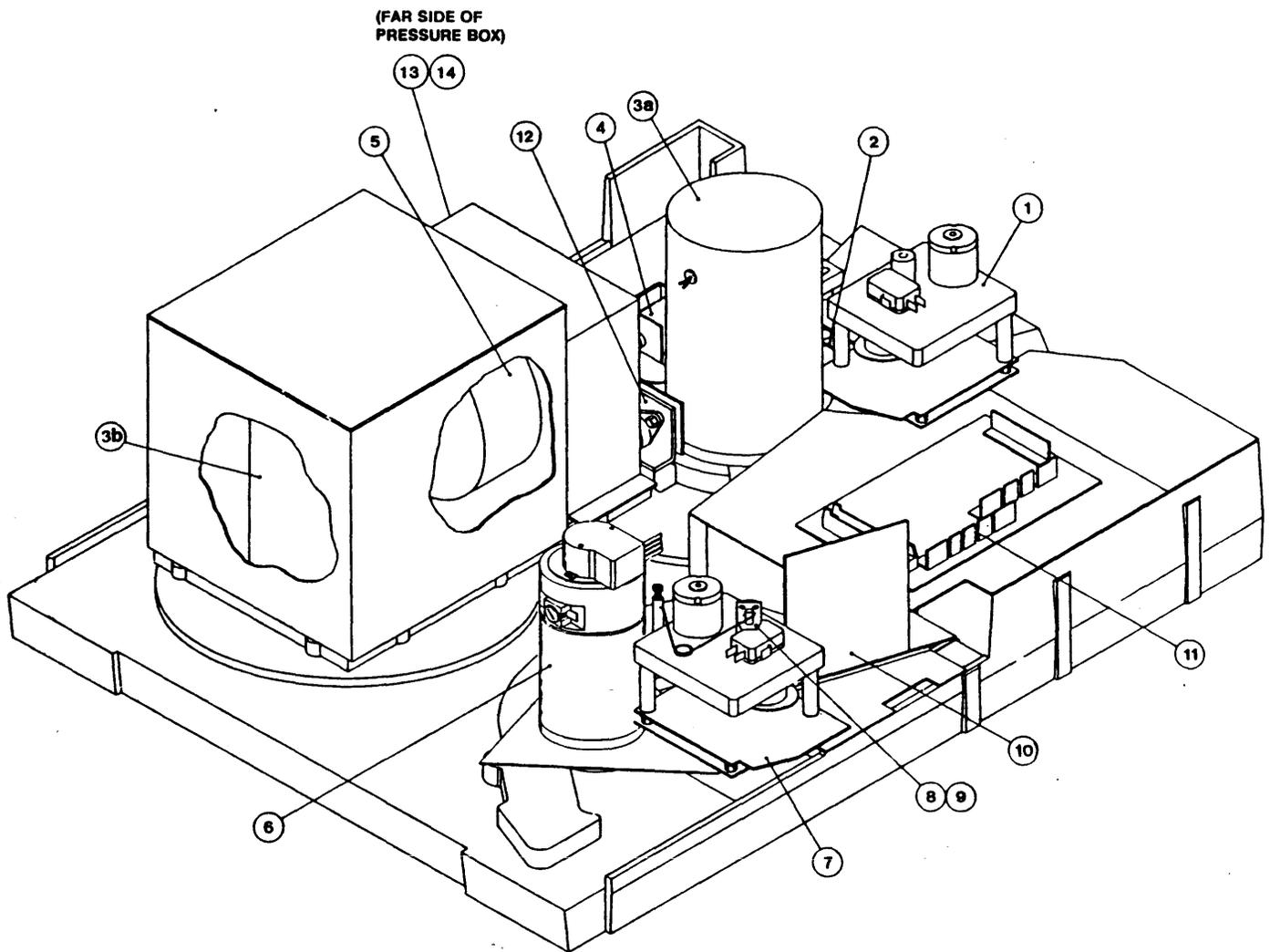


Figure 6-3. Deck Assembly, Bottom View (Sheet 1 of 2)

Parts List: Deck Assembly

Item	Part Number	Description
1	90-09048-301	Retract & Pivot Sensor Assembly (Supply)
2	90-09031-001	Actuator Arm Assembly
	90-08282-002	Actuator Arm Assembly (Low Profile Hub)
3 (a,b)	90-09020-001	Reel Motor Assembly
4	90-08287-001	Hub Lock Solenoid Assembly
5	90-07483-001	Vacuum Motor Assembly (without fuse)
	90-07483-101	Vacuum Motor Assembly (with fuse - VDE Option)
6	98-00224-001	Capstan Motor Assembly Kit
7	90-09048-401	Retract & Pivot Sensor Assembly (Take-up)
8	91-08180-001	Retract Cam Plate
9	91-08179-001	Linkage, Shield
10	90-06923-001	Read Preamplifier PCBA
11	90-07228-301	Interconnect PCBA
12	90-07295-002	±12 VDC Regulator Assembly
13	51-00087-140	Fuse, 4 Amp (VDE Option)
14	51-00087-002	Fuse Holder (VDE Option)

Figure 6-3. Deck Assembly, Bottom View (Sheet 2 of 2)

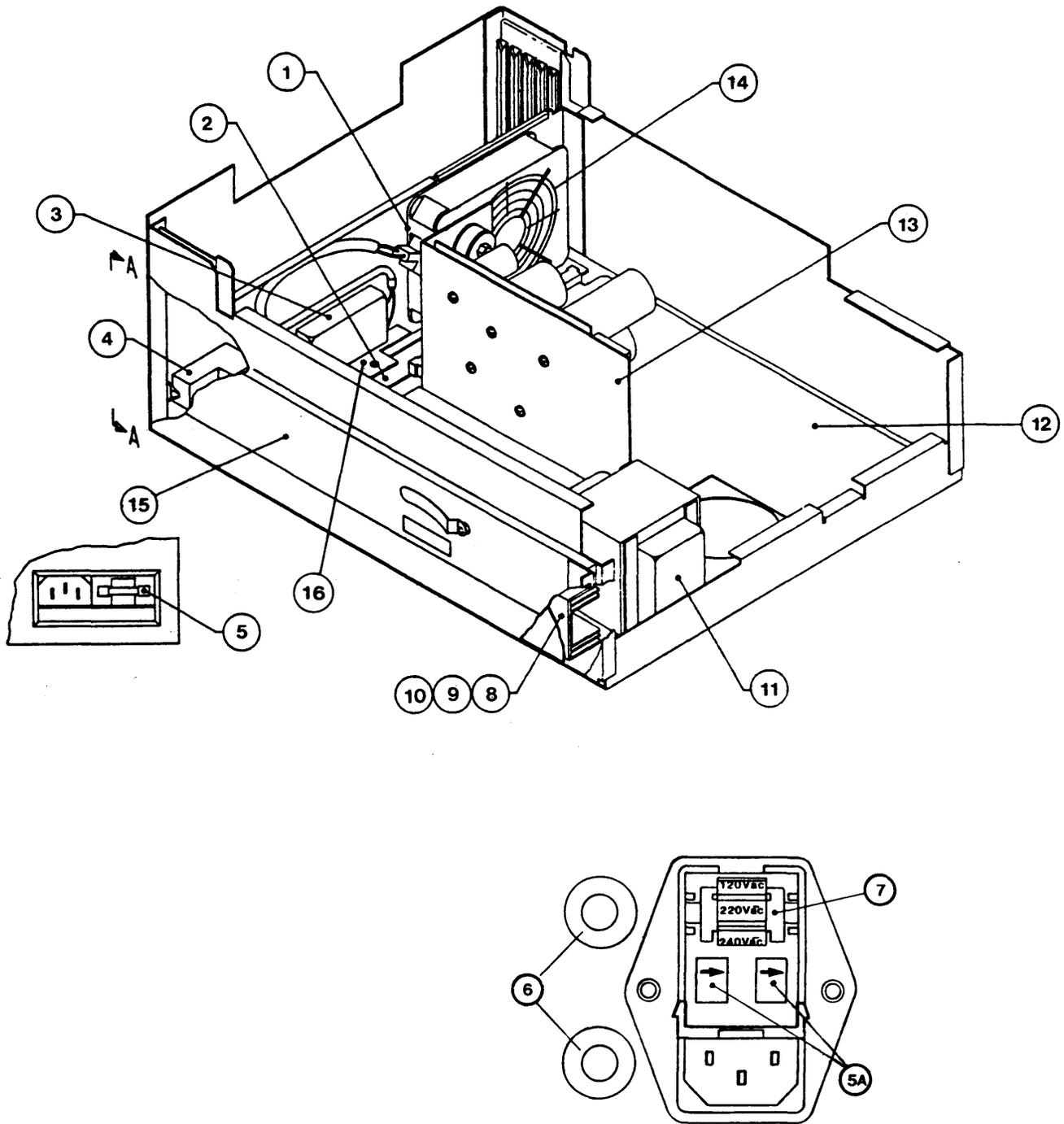


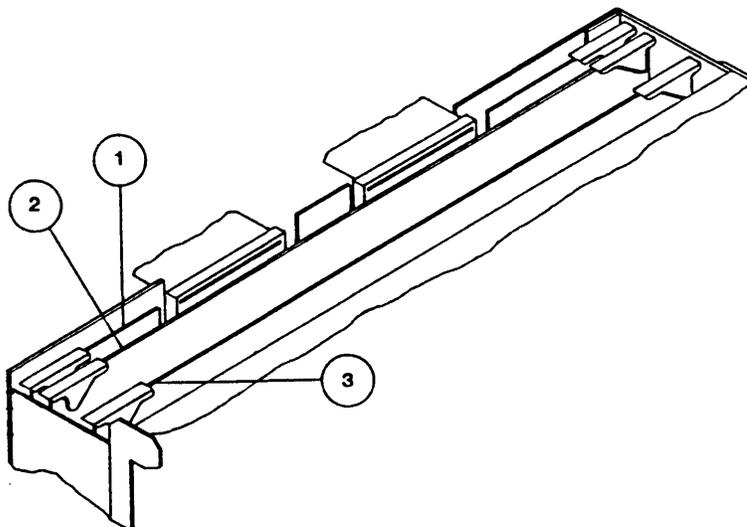
Figure 6-4. Chassis Assembly (Sheet 1 of 2)

Parts List: Chassis Assembly

Item	Part Number	Description
1	26-00027-004	Fan, 115 VAC
	** 26-00040-001	Fan, 24 VDC
2	90-07108-002	Mother Board PCBA
3	27-00012-101	Filter, EMI
	** 27-00009-001	Filter, EMI, 10A
4	90-09155-001	Single Power-In Assembly (Standard)
	90-09155-501	Dual Power-In Assembly (European Fuse Option)
5	** 21-00319-001	Power-In Connector
	51-00132-030	Fuse, 3A (for 220V Operation)
5A	51-00133-060	Fuse, 6A (for 115V Operation)
	** 51-00132-100	Fuse, 10A (for DC Operation)
	21-00321-301	Fuse Holder (Dual European Fuse Option)
	51-00087-131	Fuse, 3.15A (for 220V Operation - Dual European Fuse)
	51-00087-963	Fuse, 6.3A (for 115V Operation - Dual European Fuse)
6	51-00104-001	Circuit Breaker (Dual European Fuse Option)
7	21-00321-101	Voltage Selector (Dual European Fuse Option)
8	90-07516-006	Servo Amplifier Assembly
9	90-07111-016	Servo Power Amplifier PCBA (Part of Item 8)
10	90-07147-004	Servo Preamplifier PCBA (Part of Item 8)
11	90-07318-005	Transformer Assembly
	** 90-08153-002	DC/DC Converter, 48 VDC
	** 90-08153-502	DC/DC Converter, 60 VDC
12	90-08952-1XX	Drive Electronics PCBA
13	90-07296-302	Power Supply Assembly
	** 90-08196-102	Power Supply Assembly
14	26-00027-501	Finger Guard
15	28-00352-001	Chassis Slide 22" (pair)
	28-00352-101	Slide Extender 8" (pair)
16	** 90-08172-002	Relay PCB, 48 VDC
	** 90-08172-502	Relay PCB, 60 VDC

**DC Unit

Figure 6-4. Chassis Assembly (Sheet 2 of 2)



Parts List: Card Cage PCBAs

Item	Part Number	Description
1	90-08951-XXX	Formatter PCBA
2	90-09017-XXX	Read Analog PCBA
3	90-09060-XXX	Read/Write Digital PCBA

Figure 6-5. Card Cage Printed Circuit Boards

TABLE 6-1. RECOMMENDED SPARE PARTS
(Field Support)

Fig-Item	Part Number	Description	Recommended Quantity*
2-21	90-05906-104	EOT/BOT Sensor Assembly	
3-12	90-07295-002	±12 VDC Regulator Assembly	
4-5	51-00132-030	Fuse, Slo Blo, 3A 250V, Cer	
	51-00133-060	Fuse, Norm Blo, 6A 250V, AGC3	
	** 51-00132-100	Fuse, 10A (for DC Operation)	
4-9	90-07111-015	Servo Power Amplifier PCBA	
4-10	90-07147-004	Servo Preamp PCBA	
4-11	** 90-08153-002	DC/DC Converter, 48 VDC	
	** 90-08153-502	DC/DC Converter, 60 VDC	
4-12	90-08952-1XX	Drive Electronics PCBA	
4-13	90-07296-302	+5 VDC Regulated Power Supply	
	** 90-08196-102	+5 VDC Regulated Power Supply	
5-1	90-08951-XXX	Formatter PCBA	
5-2	90-09017-XXX	Read Analog PCBA	
5-3	90-09060-XXX	Read/Write Digital PCBA	

Note: * Unless otherwise specified, Recommended Quantity is 1.
**DC Unit

**TABLE 6-2. RECOMMENDED SPARE PARTS
(Depot Support)**

Fig-Item	Part Number	Description	Recommended Quantity*
All Items listed in Table 6-1.			
1-3	90-07947-312	Operator Control Panel PCBA	
1-6	22-00008-002	Door Lock Solenoid, 24VDC	
2-2	37-00053-102	Take-up Arm Limit Sensor	
2-8	90-07119-104	Reel-in-Place Sensor Assembly	
2-12	90-09395-001	Supply Hub Assembly	
	90-09091-001	Tab Assy (Reel in Place, and File Protect) (Part of Item 2-12)	1
2-13	90-07144-003	File Protect Sensor Assembly	
2-14	90-09042-107	Supply-Arm Assembly	
2-15	37-00053-002	Supply Arm Limit Sensor	
2-17	90-07334-101	Tape-in-Channel Sensor Assembly	
2-18	91-07211-002	Fixed Roller	2
2-19	90-07334-003	Tape-in-Channel Emitter Assembly	
2-20	90-09154-001	Split Tape Guide	2
2-21	90-05906-104	EOT/BOT Sensor Assembly	
2-23	90-07524-005	Magnetic Head Assembly	
2-26	90-09042-207	Take-up Arm Assy (Top)	
2-27	91-08274-001	Capstan Wheel (Part of Item 3-6)	
2-29	91-09115-003	Spring, Tension Arm	2
3-1	90-09048-301	Retract & Pivot Sensor Assy. (Supply)	1
3-7	90-09048-401	Retract & Pivot Sensor Assy. (Take-up)	1
3-3	90-09020-001	Reel Motor Assembly	2
3-4	90-08287-001	Hub Lock Solenoid Assembly	
3-5	90-07483-001	Vacuum Motor Assembly (without fuse)	
	90-07383-101	Vacuum Motor Assembly (with fuse - VDE Option)	
3-6	98-00224-001	Capstan Motor Assembly Kit	
3-10	90-06923-001	Read Preamplifier Assembly	
3-11	90-07228-301	Interconnect PCBA	
4-1	26-00027-004	Fan, 115 VAC	
	**26-00040-001	Fan, 24 VDC	
4-2	90-07108-002	Mother Board PCBA	
4-3	27-00012-101	Filter, EMI	
	**27-00009-001	Filter, EMI, 10A	
	98-00208-001	Arm Height Adjustment Shim Kit	2
	98-00209-001	Fixed Roller Height Adjust. Shim Kit	2
	98-00215-001	Head Height Adjustment Shim Kit	1
<hr/>			
Note:	* Unless otherwise specified, Recommended Quantity is 1.		
	**DC Unit		

TABLE 6-3. RECOMMENDED MAINTENANCE TOOLS

Part Number	Description
54-00036-001	Skewmaster Tape
54-00103-001	Alignment Tool, Tape Guides
54-00176-001	Buffer Arms & Collet Height Adjustment Tool Kit
54-00100-001	Capstan Puller
54-00178-001	Arm Position & Feeler Gauge Set Tool Kit
54-00126-001	Plastic Feeler Gauge Set
90-02324-001	Maintenance Kit
	Head Cleaner
	Hex Socket Key Set
	Reflective Marker Strips
	Lint-Free Swabs
	Loctite, Grade H
(Common)	Set of Nut Drivers or Open-End Wrenches
(Common)	Phillips and Standard Screwdrivers
13-00106-001	Tracking Tape

SECTION VII

WIRING AND SCHEMATIC DIAGRAMS

7.0 GENERAL

This section contains wiring and schematic diagrams for the Model 9610/9660 Tape Drive. Unless otherwise specified, electronic symbols conform to ANSI Y32.2, abbreviation to MIL-STD-12, and logic symbols to ANSI Y32.14 (MIL-STD-806C).

7.1 COMPONENTS

Unless otherwise specified:

- A. Resistor values are in ohms, $\pm 5\%$, 1/4-watt.
- B. Capacitor values are in microfarads.

7.2 LOGIC CONVENTIONS AND SYMBOLOGY

7.2.1 TTL LOGIC

The 9610/9660 Drive uses standard +5V TTL logic with the following state definitions and Logic Levels:

A. Logic States:

Logic ONE = high

Logic ZERO = low

B. TTL Medium Speed IC Logic Levels:

Input:

ONE = +2.0V to +5.5V (Abs Max)

Indeterminate = +0.8 to +2.0V

ZERO = +0.8V to -0.5V (Abs Min)

Output:

ONE = +2.4V to +5.25V (Abs Max)

Indeterminate = +0.4 to +2.4V

ZERO = +0.4V to 0.0V (Abs Min)

C. TTL Medium Speed Low Power Consumption IC Logic Levels:

Input:

ONE = +2.0V to +7.0V (Abs Max)

Indeterminate = +0.8 to +2.0V

ZERO = +0.8V to -0.3V (Abs Min)

Output:

ONE = +2.7V to +5.25V (Abs Max)

Indeterminate = +0.4 to +2.7V

ZERO = +0.4V to 0.0V (Abs Min)

D. TTL Super High Speed IC Logic Levels:

Input:

ONE = +2.0V to +5.5V (Abs Max)

Indeterminate = +0.8 to +2.0

ZERO = +0.8V to -0.3V (Abs Min)

Output:

ONE = +2.7V to +5.25V (Abs Max)

Indeterminate = +0.5 to +2.7V

ZERO = +0.5V to 0.0V (Abs Min)

7.2.2 LOGIC SYMBOLOGY

The following illustrations represent standard TTL logic symbols used in the 9610 Drive schematic diagrams.



7.3 SCHEMATIC FLOW

Schematic diagram are generally organized to show signal and/or function flow from left to right and from top to bottom. Exceptions to this rule may occur only in details where circuit simplicity is preferable.

7.4 TERMINALS

For a double-sided socket, terminals are designated with numbers for component-side connections and letters for circuit-side connections. These correspond to the actual socket designations. For a single-sided socket, all connections are designated by letters of the 22-character alphabet: ABCDEFHJKLMNPRSTUVWXYZ, or standard arabic numbers.

7.5 LIST OF SCHEMATICS (Item Numbers included for reference)

<u>Title</u>	<u>Number</u>	<u>Item</u>
9610 Interconnect (AC units) (Standard Single Fuse)	8502-000	1
+5 Volt Power Supply (AC units) (Standard Single Fuse)	7109-000	2
12V Regulator	7148-000	3
Interconnect Board	7228-000	4
Position Sensor	9069-000	5
Operator Control Panel	7947-000	6
Servo Power Amplifier	7111-000	7
Servo Preamp	7147-000	8
Motherboard	7108-000	9
Drive Electronics	8952-200	10
Formatter	8951-000	11
R/W Digital	9060-000	12
Read Preamplifier	6923-000	13
Read Analog	9017-100	14
Interconnect (DC units)	8502-600	15
9620 Power Supply Interconnect (DC units)	8222-000	16
Relay Board (DC units)	8172-000	17
+5 Volt Power Supply (DC units)	9378-500	18
Filter (DC units)	8229-000	19
Transformer (DC units)	8173-000	20
DC Converter (DC units)	8174-000	21
+5 Volt Power Supply (AC units) (Optional Dual Fuse)	7109-501	22

7.6 SYSTEM SIGNAL DISTRIBUTION

The following Chart shows signal flow among the circuit boards of the System. The Chart is organized in a "From-To" manner; that is: each listed signal is shown as flowing from one circuit board to another, referencing a schematic sheet and connector. The Circuit Board is identified by an acronym as defined in the Chart.

SYSTEM SIGNAL DISTRIBUTION CHART

FROM HOST

<u>Signal</u>	<u>To FMTR Sheet-Conn</u>	<u>LIST OF CIRCUIT-BOARD ACRONYMS</u>	
ILWD	2-J1	DIG R/W (9060)	Digital Read/Write
IERASE	4-J1	ELEC (8952)	Drive Electronics
IEDIT		FMTR (8951)	Formatter
IWFM		INTCON (7228)	Interconnect Board
IWRT		OCP (7947)	Operator Control Panel
IREV		POSENS (9069)	Position Sensor
ILOL		READA (9017)	Read Analog
ILGAP		READPRE (6923)	Read Preamplifier
IGO		SERVPA (7111)	Servo Power Amplifier
IREW	4-J1	SERVPRE (7147)	Servo Preamplifier
IOFL	4-J2		
IFEN	4-J2		
IHSP	4-J2		
ITADO	5-J1		
IFAD	5-J2		
ITAD1	5-J2		
IW(0-7,P)	6-J1		

FROM FORMATTER (FMTR)

<u>Signal</u>	<u>From FMTR Sheet-Conn</u>	<u>To:</u>	<u>Schematic Sheet-Conn</u>
IR(0,1,4-7,P)	7-J2	Host	
IR(2,3)	7-J1		
IRSTB	9-J2		
IWSTB	9-J2	Host	
WD(0-7)	6-P1	DIG R/W	5-P1
LST WORD	8-P1	DIG R/W	5-P1
FDB(0-7)	10-P1	ELEC	3-P1
"		READA	
"		DIG R/W	
FSEL(0,1)		ELEC	
FSEL(0-6)		DIG R/W	3-P1
FSEL(2-6)	10-P1	READA	2-P1
FMTR STRB	11-P1	ELEC	3-P1
"		DIG R/W	3-P1
"		READA	2-P1
FMTR BUSY		ELEC	3-P1
FMTR ACKN	11-P1	ELEC	3-P1
ERASE PWR EN	13-P1	DIG R/W	14-P1
WRT PWR EN	13-P1	DIG R/W	14-P1
IFPT	5-J2	Host	
IRWD			
IRDY			
IONL	5-J2	Host	

FROM FORMATTER (FMTR) Continued)

<u>Signal</u>	<u>From FMTR Sheet-Conn</u>	<u>To:</u>	<u>Schematic Sheet-Conn</u>
IEEOT	5-J1	Host	
IRSC	5-J1		
ILDP	5-J2		
IEOT			
INRZ			
ISPD			
IDENT	5-J2		
IFBY	5-J1		
IDBY	5-J2		
IHER			
ICER			
IFMK	5-J2	Host	

TO FORMATTER

<u>Signal</u>	<u>From Sheet-Conn</u>	<u>On PCBA</u>	<u>To FMTR Sheet-Conn</u>
FBREQ			10-P1
MSTR RES	3-P1	ELEC	2-P1
RD(0-7,P)	13-P2	DIG R/W	7-P2
RD DATA STRB	12-P2		9-P2
WRT DATA STRB	2-P1		9-P2
HRD ERROR	12-P1		10-P1
CRECTD ERROR	10-P1		10-P1
FILE MARK	10-P1	DIG R/W	10-P1
DDB(0-7)	3-P1	ELEC	11-P1
DRV SEL(0,1)	3-P1		
TACH	4-P1		
FWD/REV	4-P1		
DRV STRB	3-P1	ELEC	11-P1
RD BUSY		DIG R/W	13-P1
WRT BUSY		DIG R/W	
DRV BUSY		ELEC	
DRV ACKN	3-P1	ELEC	13-P1

FROM DRIVE ELECTRONICS (ELEC)

<u>Signal</u>	<u>From ELEC Sheet-Conn</u>	<u>To PCBA</u>	<u>Schematic Sheet-Conn</u>
DDB(0-7)	3-P1	FMTR	11-P1
DRV STRB	3-P1	FMTR	11-P1
DRV SEL(0,1)	3-P1	FMTR	11-P1
MSTR RES	3-P1	FMTR	2-P1
"	"	DIG R/W	3-P1
FWD/REV	4-P1	FMTR	11-P1
TACH	4-P1	FMTR	11-P1
DRV BUSY	3-P1	FMTR	13-P1
DRV ACKN	3-P1	FMTR	13-P1
NRZ LED	4-J6	OCP	2-J1
WEN LED	4-J6	OCP	2-J1
SLT LED	4-J6	OCP	2-J1

FROM DRIVE ELECTRONICS (ELEC) (Continued)

<u>Signal</u>	<u>From ELEC Sheet-Conn</u>	<u>To PCBA</u>	<u>Schematic Sheet-Conn</u>
LP LED	4-J6	OCP	
REUN LED			
LO LED			
ONLLED			
PE/1600 LED			
RMT LED			
DIAG LED			2-J1
WRP			1-J1
DB(0-5)			1-J1
DB6			1-J1
3200 LED	4-J6	OCP	2-J1
TU OFSE	5-J3	SERVPRE	4-J1
SUP OFSE			3-J1
VEL TUP			4-J1
VEL SUP		SERVPRE	3-J1
TU REFF	5-J5	INTCON	1-J1
SUP REFF	5-J5	INTCON	1-J1
SUMPT CPST	6-J3	SERVPRE	1-J1
E TU POS	7-J3		4-J1
E TU VL			4-J1
E SU POS			3-J1
E SU VL			3-J1
VAC MOT			1-J1
ENB CPST	7-J3		
BRAKE	9-J3		
SERVO EN	9-J3		1-J1
CUR SUP	7-J3		3-J1
CUR TUP	7-J3	SERVPRE	4-J1
HUB LOK SOL	8-J2	INTCONN	2-J2
DOOR LOK SOL			2-J2
+24V			2-J2
GND	8-J2		2-J2
OPTSW	10-J2		2-J2
MICSW	10-J2	INTCONN	2-J2

TO DRIVE ELECTRONICS (ELEC)

<u>Signal</u>	<u>From Sheet-Conn</u>	<u>On PCBA</u>	<u>To ELEC Sheet-Conn</u>
FDB(0-7)	10-P1	FMTR	3-P1
FSEL(0, 1)	10-P1		
FMTR STRB	11-P1		
FMTR BUSY			
FBGRANT			
FMTR ACKN	11-P1	FMTR	3-P1
TARMOT	2-J2	INTCON	10-J2
SURMOT	2-J2	INTCON	10-J2
REUN PB	2-J1	OCP	4-J6
LOAD PB			
ONL PB			
DEN PB	2-J1	OCP	4-J6

TO DRIVE ELECTRONICS (ELEC) (Continued)

<u>Signal</u>	<u>From Sheet-Conn</u>	<u>On PCBA</u>	<u>To ELEC Sheet-Conn</u>
RST PB	2-J1	OCP	4-J6
STRT PB			
SCAN PB			
DIAG PB	2-J1		4-J6
DSP FUL	1-J1	OCP	2-J6
TPHA		INTCON	4-J5
TPHB			4-J5
SUP POS			7-J5
TUP POS	1-J1	INTCON	
TUP MOV	4-J1	SERVPRE	
SUP MOV	3-J1	SERVPRE	7-J3

FROM OPERATOR CONTROL PANEL (OCP)

<u>Signal</u>	<u>From OPC Sheet-Conn</u>	<u>To:</u>	<u>Sheet-Conn</u>
REUN PB	2-J1	ELEC	4-J6
LOAD PB			
ONL PB			
DEN PB			
RST PB			
STRT PB			
SCAN PB			
DIAG PB	2-J1		
DSP FUL	1-J1	ELEC	4-J6

TO OPERATOR CONTROL PANEL (OCP)

<u>Signal</u>	<u>From Sheet-Conn</u>	<u>On PCBA</u>	<u>To OCP Sheet-Conn</u>
DB(0-6)	4-J6	ELEC	1-J1
WRP			1-J1
NRZ LED			2-J1
WEN LED			
SLT LED			
LP LED			
PWR ON LED			
REUN LED			
LO LED			
ON LED			
PE LED			
RMT LED			
STRT LED	4-J6	ELEC	2-J1

FROM READ ANALOG BOARD (READA)

<u>Signal</u>	<u>From READA Sheet-Conn</u>	<u>To:</u>	<u>Schematic Sheet-Conn</u>
EGC(1-9)	4-J1	READPRE	1-P2
ENV(0-7,P)	7-P2	READD	11-P2
TD(0-3)		DIG R/W	7-P2
TD(4-6)		DIG R/W	8-P2
TD(7, P)	7-P2	DIG R/W	9-P2

TO READ ANALOG BOARD (READA)

<u>Signal</u>	<u>From Sheet-Conn</u>	<u>On PCBA</u>	<u>To READA Sheet-Conn</u>
FSEL(2-6)	10-P1	FMTR	2-P1
FDB(0-7)	10-P1	FMTR	3-P1
FMTR STRB	11-P1	FMTR	2-P1
PE BLOCK	10-P1	DIG R/W	5-P1
HD(0-7,P)	15-P2	DIG R/W	8-P2
TRK(1-9)+	1-P2	READPRE	6-J1
TRK(1-9)-	1-P2	READPRE	6-J1

FROM READ PREAMPLIFIER (READPRE)

<u>Signal</u>	<u>From READPRE Sheet-Conn</u>	<u>To:</u>	<u>Sheet-Conn</u>
TRK(1-9)+	1-P2	READA	6-J1
TRK(1-9)-	1-P2	READA	6-J1

TO READ PREAMPLIFIER (READPRE)

<u>Signal</u>	<u>From Sheet-Conn</u>	<u>On:</u>	<u>To READPRE Sheet-Conn</u>
EGC(1-9)	4-J1	READA	1-P2
TRK(1-9)+	4-J1	READ HEAD	1-P1
TRK(1-9)-	4-J1	READ HEAD	1-P1

FROM DIGITAL READ/WRITE BOARD (DIG R/W)

<u>Signal</u>	<u>From DIG R/W Sheet-Conn</u>	<u>To:</u>	<u>Sheet-Conn</u>
RD(0-7,P)	13-P2	FMTR	7-P2
CRECTD ERROR	10-P1		10-P1
HRD ERROR	12-P1		10-P1
RD DATA STRB	12-P2		9-P2
RD BUSY	3-P1		13-P1
FILE MARK	10-P1		10-P1
WRT BUSY	3-P1		13-P1
WRT DATA STRB	2-P1	FMTR	9-P2
HD(0-7,P)	15-P2	READA	8-P2
ERASE HD+	14-J2	Erase Head (Black)	
ERASE HD-	14-J2	Erase Head (White)	
TRK(1-9)	15-J1	Write Head	
WRT VOL	15-J1	Write Head	

TO DIGITAL READ/WRITE BOARD (DIG R/W)

<u>Signal</u>	<u>From Sheet-Conn</u>	<u>On PCBA</u>	<u>To DIG R/W Sheet-Conn</u>
MSTR RES	3-P1	ELEC	3-P1
TD(0-3)	7-P2	READA	7-P2
TD(4-6)	7-P2		8-P2
TD(7,P)	7-P2		9-P2
ENV(0-7,P)	7-P2	READA	11-P2
FDB(0-7)	10-P1	FMTR	3-P1
FMTR STRB	11-P1		3-P1
FSEL(0-6)	10-P1		3-P1
WD(0-7)	6-P1		5-P1
ERASE PWR EN	13-P1		14-P1
WRT PWR EN	13-P1		14-P1
LST WORD	8-P1	FMTR	5-P1

FROM SERVO PREAMPLIFIER (SERVPRE)

<u>Signal</u>	<u>From SERVPRE Sheet-Conn</u>	<u>To:</u>	<u>Sheet-Conn</u>
VAC MOT	1-J3	SERVPA	3-J3
SUMPT CPST	1-J3		3-J3
ABRAKE	1-J3		3-J3
SERVO EN	1-J3		2-J3
ENB CPST	1-J3		2-J3
OSC	2-J3		3-J3
-REF	2-J3		4-J3
+REF	2-J3		
SUP MOD	3-J3		
TUP MOD	4-J3	SERVPA	4-J3
SUP MOV	3-J1	ELEC	8-J3
TUP MOV	4-J1	ELEC	8-J3

TO SERVO PREAMPLIFIER (SERVPRE)

<u>Signal</u>	<u>From Sheet-Conn</u>	<u>On PCBA</u>	<u>To SERVPRE Sheet-Conn</u>
VAC MOT	8-J3	ELEC	1-J1
SUMPT CPST	7-J3		
ENB CPST	8-J3		
BRAKE	8-J3		
SERVO EN	8-J3		1-J1
SUP OFSE	6-J3		3-J1
E SU POS	8-J3		
E SU VL	8-J3		
SUP OFST	6-J3		
CUR SUP	8-J3		
CUR SUP GND	8-J3		
VEL SUP	6-J3		3-J1
TU OFSE	6-J3		4-J1
E TU POS	8-J3		
E TU VL	8-J3		
CUR TUP	8-J3		
CUR TUP GND	8-J3		
TU OFST	8-J3		
VEL TUP	6-J3	ELEC	4-J1

TO SERVO PREAMPLIFIER (SERVPRE)

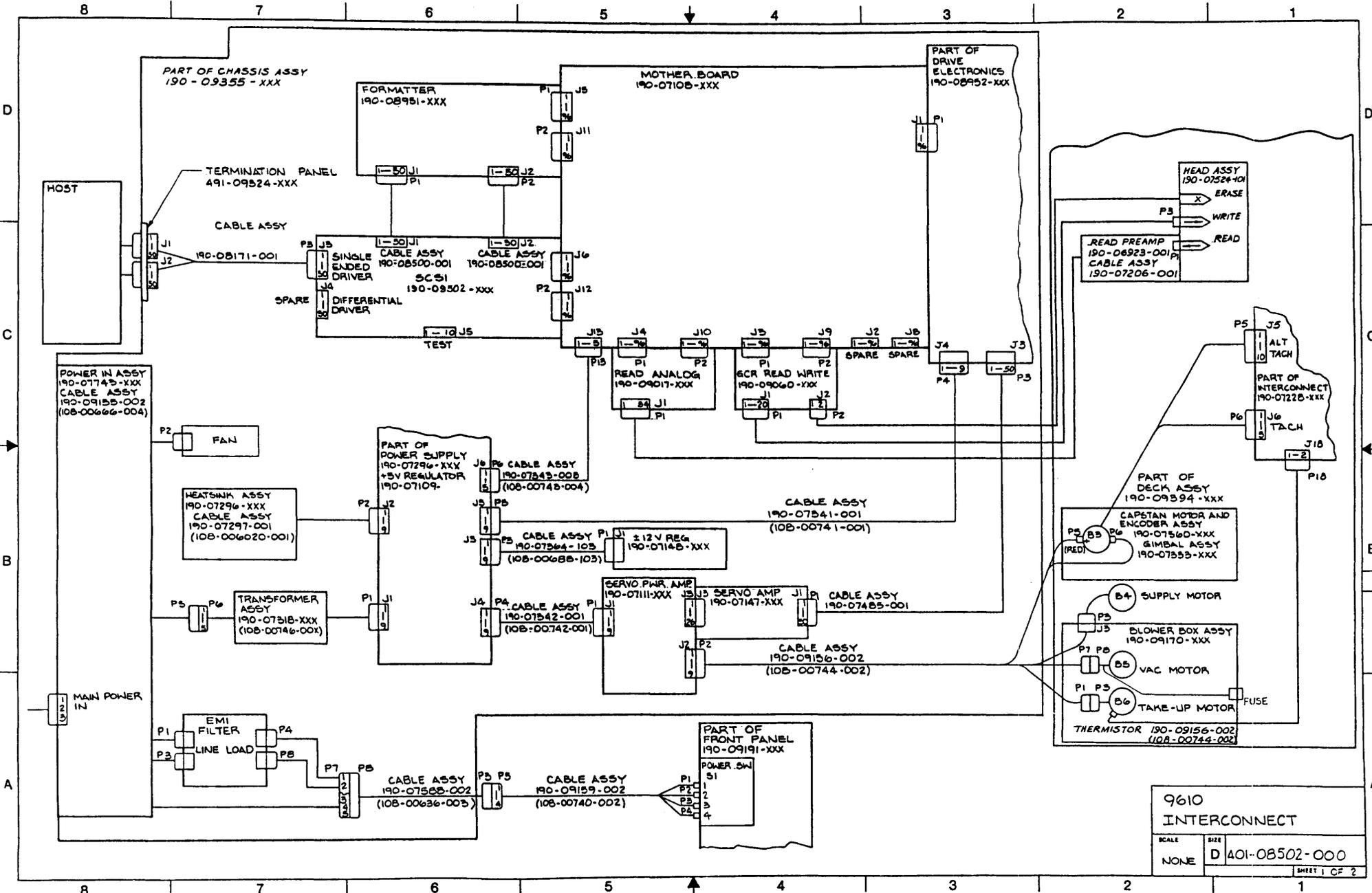
<u>Signal</u>	<u>From Sheet-Conn</u>	<u>On PCBA</u>	<u>To SERVPRE Sheet-Conn</u>
I SUP	1-J2	SERVPA	3-J3
V SUP	1-J2		3-J3
I TUP	1-J3		4-J3
V TUP	1-J3		4-J3
I SENS LO	1-J2	SERVPA	4-J3

FROM SERVO POWER AMPLIFIER (SERVPA)

<u>Signal</u>	<u>From SERVPA Sheet-Conn</u>	<u>To:</u>	<u>Sheet-Conn</u>
I SUP	1-J3	SERVPRE	1-J2
I TUP			4-J3
V TUP			1-J2
V TUP	1-J3		4-J3
V SUP	1-J2		3-J3
I SENS LO		SERVPRE	4-J3
TU MOT DRV		TAKEUP REEL MOTOR	
TU MOT RET		MOTOR RETURN	
SU MOT DRV		SUPPLY REEL MOTOR	
SU MOT RET	1-J2	MOTOR RETURN	
VAC MOT DRV	3-J2	VACUUM MOTOR	
VAC MOT RET		MOTOR RETURN	
CPSTN MOT DRV		CAPSTAN MOTOR	
CPSTN MOT RET	3-J2	MOTOR RETURN	

TO SERVO POWER AMPLIFIER (SERVPA)

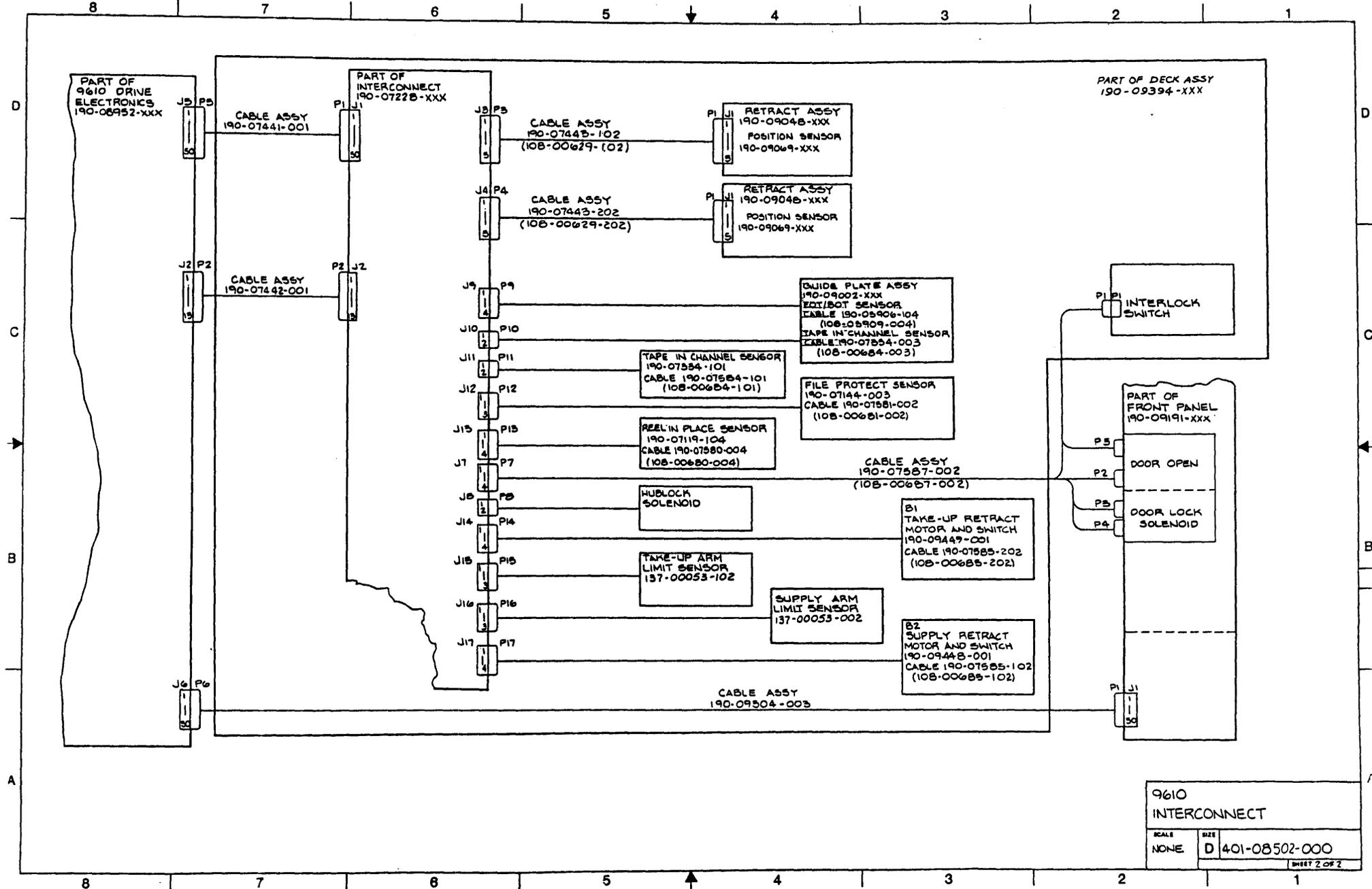
<u>Signal</u>	<u>From Sheet-Conn</u>	<u>On PCBA</u>	<u>To SERVPA Sheet-Conn</u>
VAC MOT	1-J3	SERVPRE	3-J3
SUMPT CPST			
BRAKE			
SERVO EN			
ENB CPST	1-J3		2-J3
OSC	2-J3		3-J3
-REF	2-J3		4-J3
+REF	2-J3		
SUP MOD	3-J3		
TUP MOD	4-J3	SERVPRE	4-J3



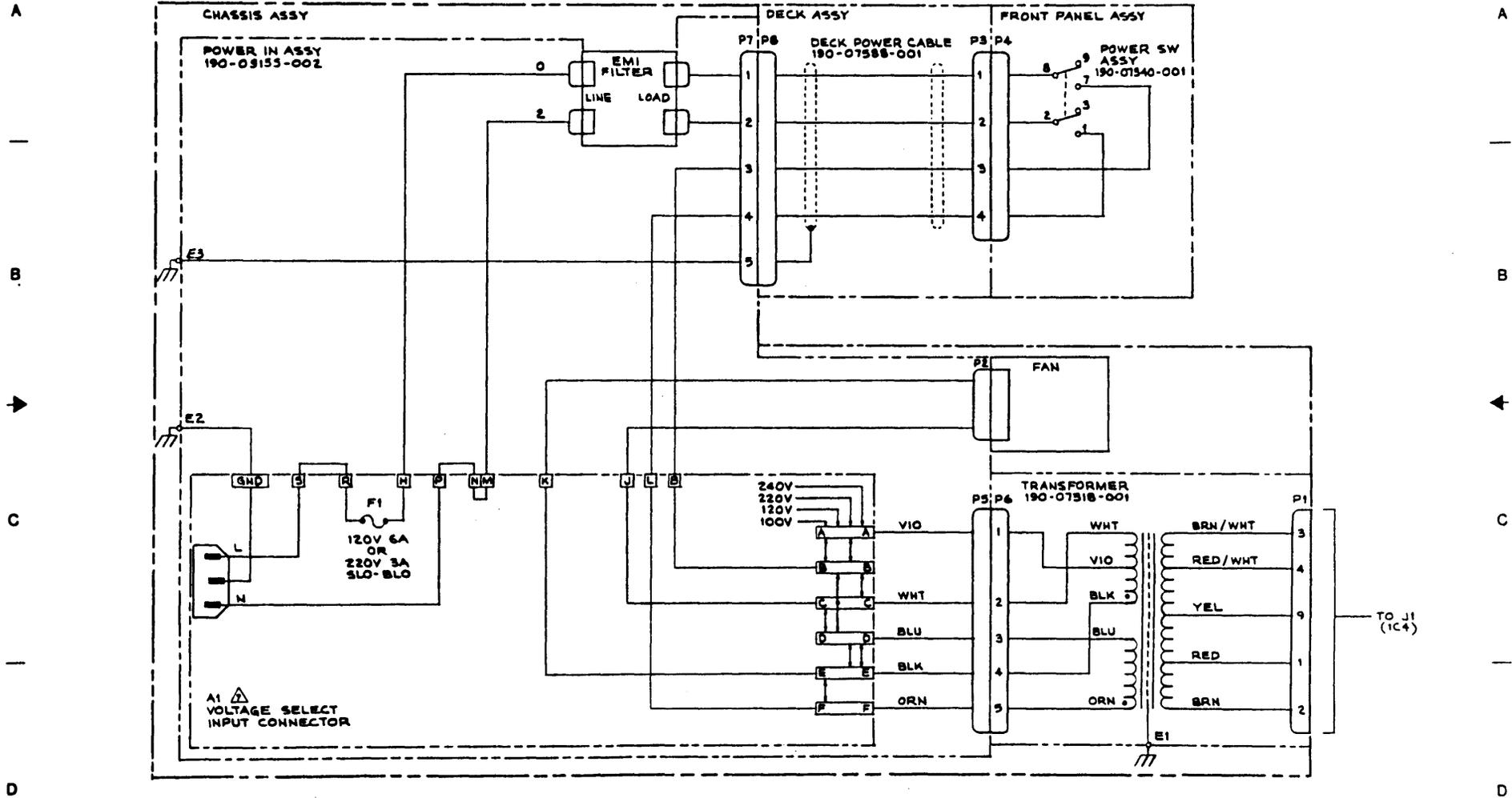
9610	
INTERCONNECT	
SCALE	SIZE
NONE	D
401-08502-000	
SHEET 1 OF 2	

1-1

1-2



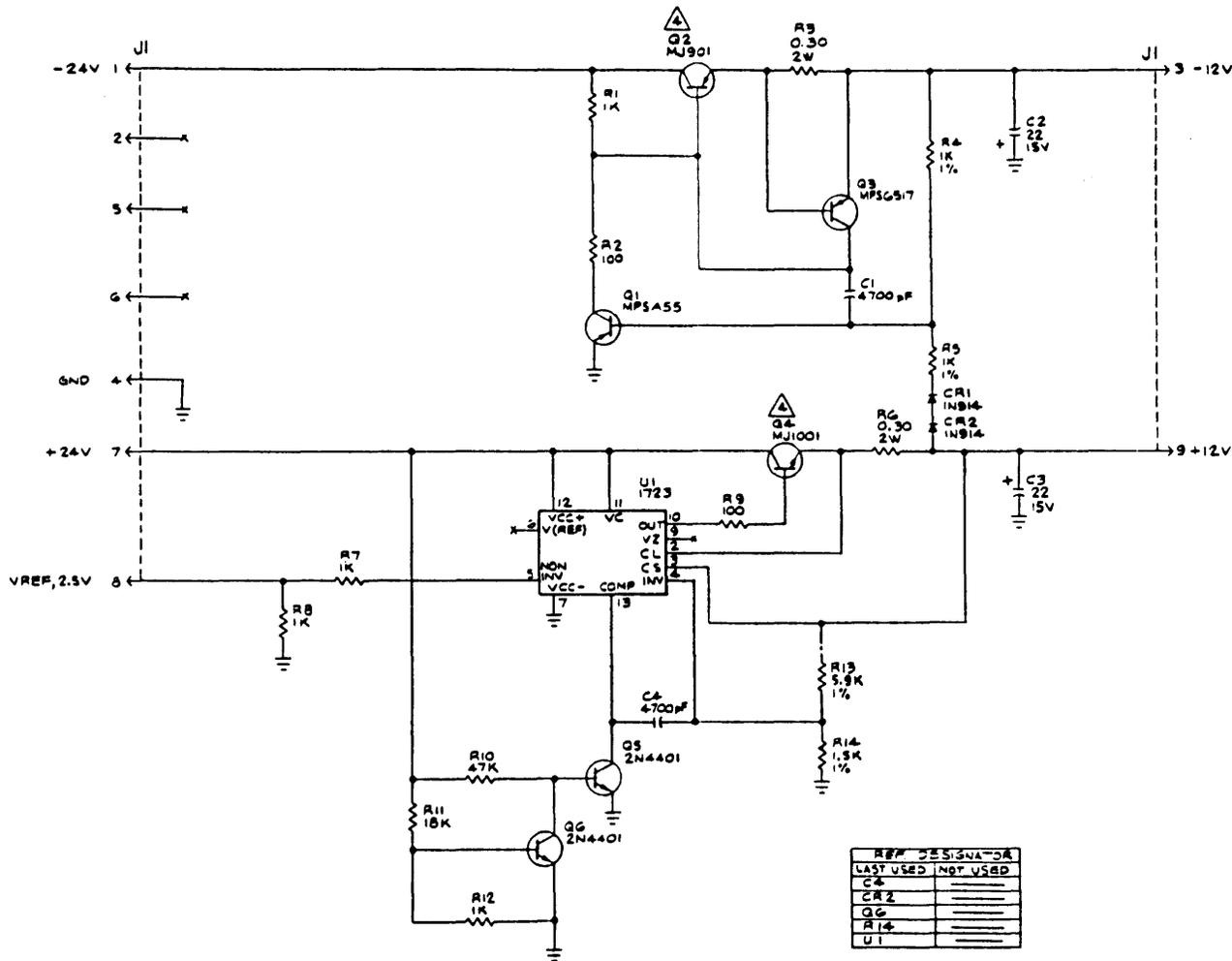
9610 INTERCONNECT	
SCALE NONE	SIZE D 401-08502-000
SHEET 2 OF 2	



Power Supply +5V DC
 TYPE 7109,7296,7443,7339,7482
 Schematic Diagram

90-07148-XXX TABULATION

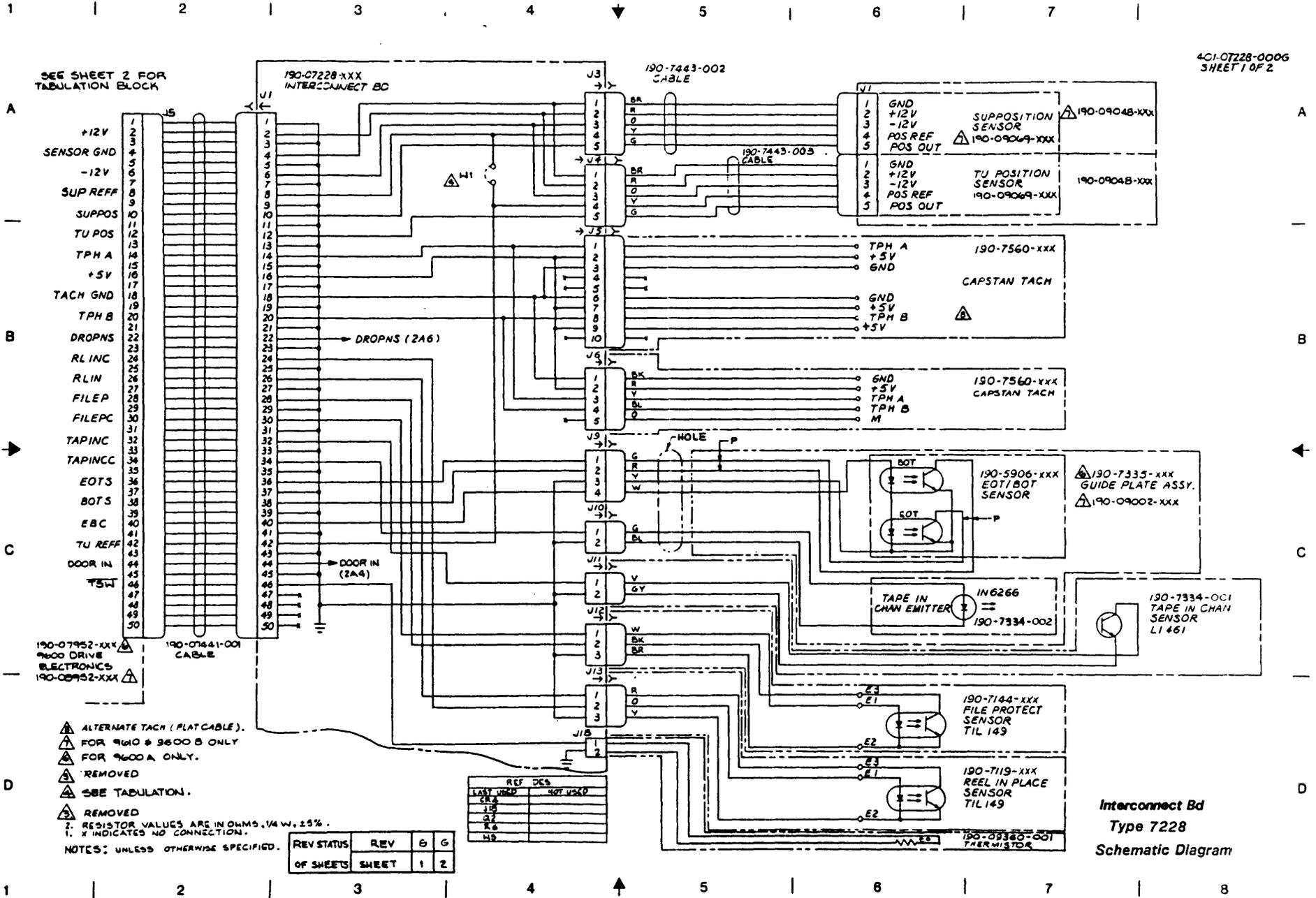
REF DES	QASH NO	REV
	-004	C



REF DESIGNATION	LAST USED	NOT USED
C1		
CR2		
Q6		
R14		
U1		

▲ MOUNT ON HEAT SINK 304-7295-001.
 3 ALL CAPACITOR VALUE ARE IN MICROFARADS.
 2 ALL RESISTOR VALUE ARE IN OHMS ±5% 1/4 W.
 1 X INDICATES NO CONNECTION.
 NOTES: UNLESS OTHERWISE SPECIFIED.

± 12V Regulator
 Type 7148
 Schematic Diagram

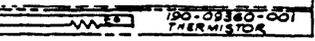
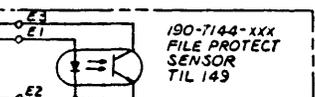
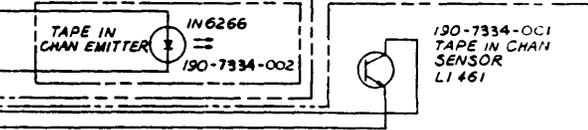
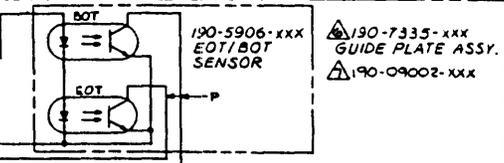
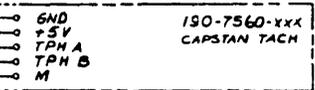
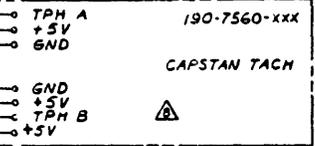
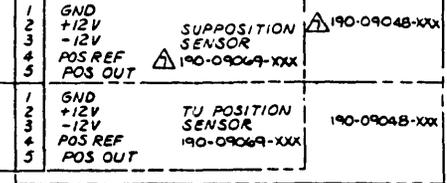


SEE SHEET 2 FOR
TABULATION BLOCK

190-07228-XXX
INTERCONNECT BC

190-7443-002
CABLE

190-7443-003
CABLE



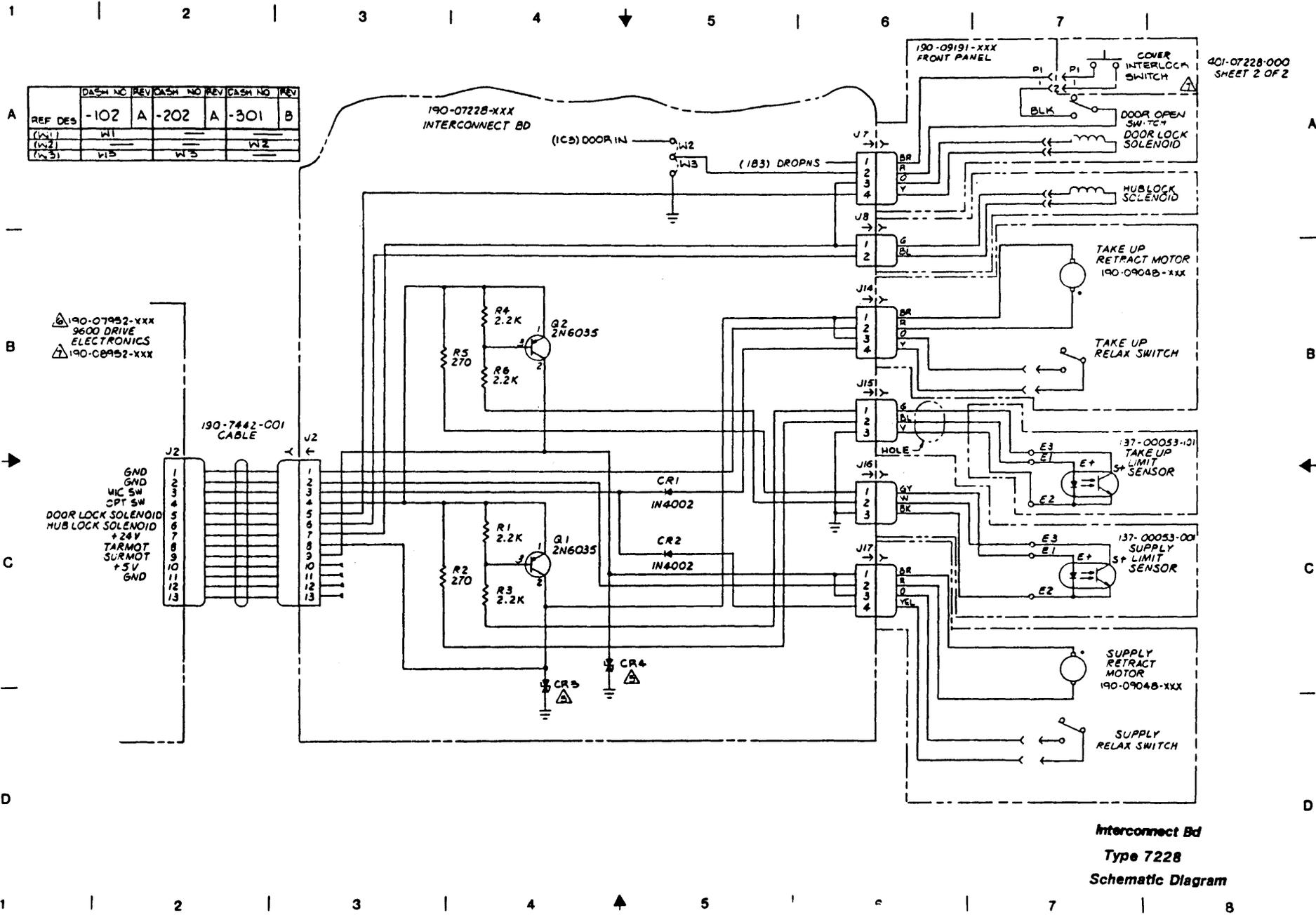
Interconnect Bd
Type 7228
Schematic Diagram

- A
- 1 +12V
 - 2 SENSOR GND
 - 3 -12V
 - 4 SUP REFF
 - 5 SUPPOS
 - 6 TU POS
 - 7 TPH A
 - 8 +5V
 - 9 TACH GND
 - 10 TPH B
 - 11 DROPNIS
 - 12 RL INC
 - 13 RLIN
 - 14 FILEP
 - 15 FILEPC
 - 16 TAPINC
 - 17 TAPINCC
 - 18 EOTS
 - 19 BOTS
 - 20 EBC
 - 21 TU REFF
 - 22 DOOR IN
 - 23 TSW
- B
- C

- D
- ▲ ALTERNATE TACH (FLAT CABLE).
 - ▲ FOR 9610 & 9600 B ONLY
 - ▲ FOR 9600 A ONLY.
 - ▲ REMOVED
 - ▲ SBE TABULATION.
 - ▲ REMOVED
2. RESISTOR VALUES ARE IN OHMS, 1/4 W, 25%.
1. X INDICATES NO CONNECTION.
- NOTES: UNLESS OTHERWISE SPECIFIED.

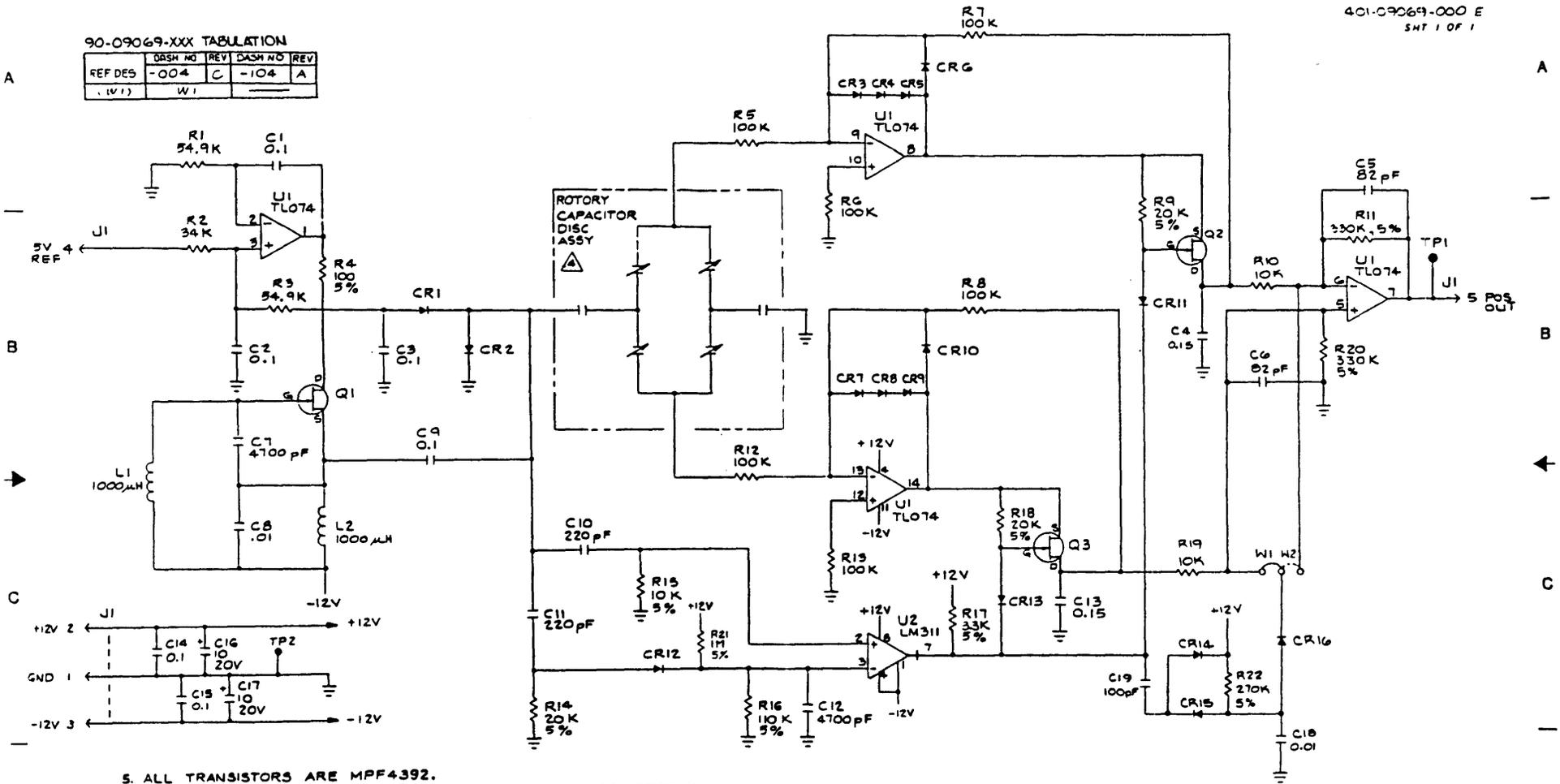
REV STATUS	REV	6	G
OF SHEETS	SHEET	1	2

REF	DES	LAST USED	NOT USED
CR4			
J18			
Q7			
R6			
NR			



90-09069-XXX TABULATION

REF DES	DASH NO	REV	DASH NO	REV
. (V1)	-004	C	-104	A
	W1			



5. ALL TRANSISTORS ARE MPF4392.
 ▲ CAPACITOR VALUES ARE CREATED BY CAPACITANCE DISC 204-T709-001.
 3. ALL DIODES ARE IN314.
 2. RESISTORS ARE IN OHMS /Ω, 1%
 1. CAPACITORS ARE IN MICROFARADS ± 10% 50V.
 NOTES: UNLESS OTHERWISE SPECIFIED.

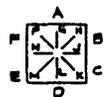
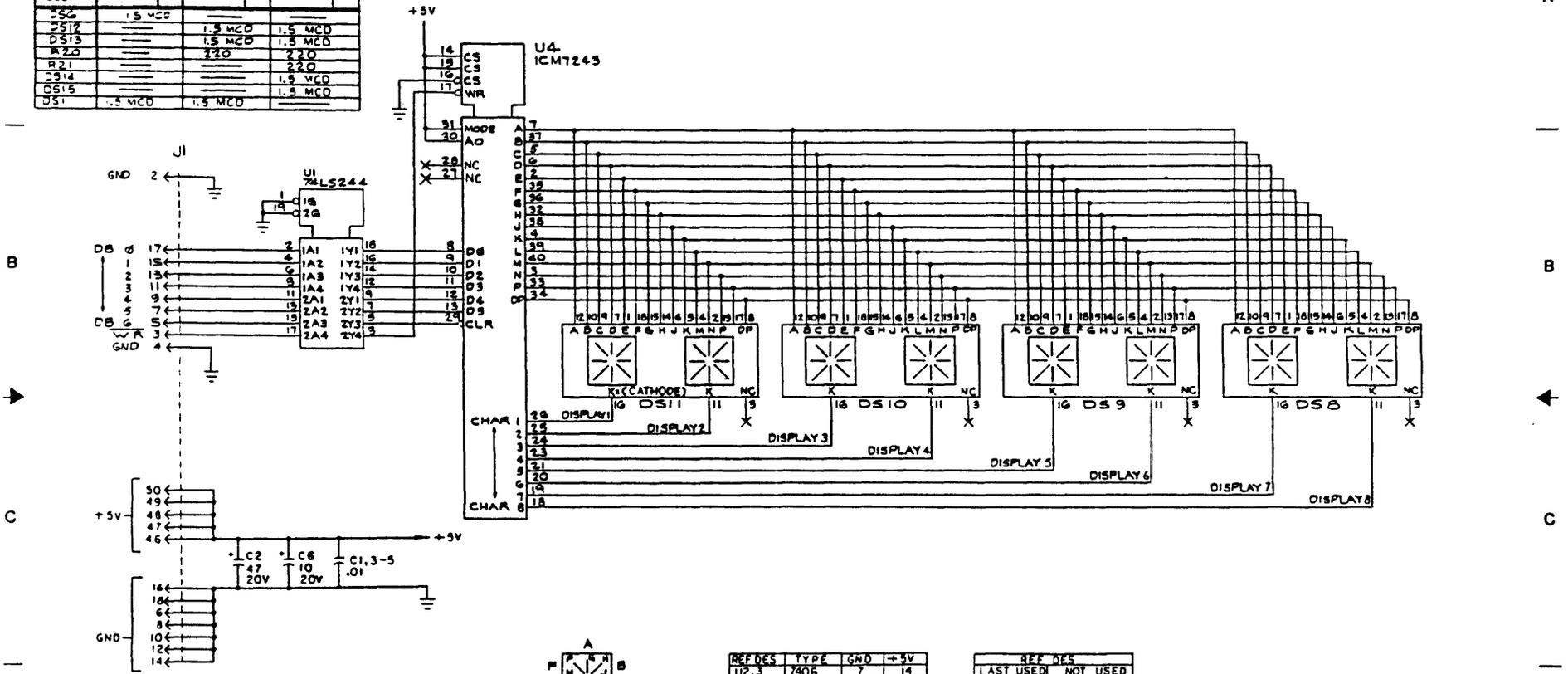
REF DESIGNATORS	
LAST USED	NOT USED
CR 15	_____
CR 16	_____
L 7	_____
Q 3	_____
R 22	_____
TP 2	_____
U 2	_____

REV STATUS OF SHEETS	REV SHEET	E
	1	

POSITION SENSOR
 TYPE 9069
 SCHEMATIC DIAGRAM

30-07947 TABULATION

REF DES	DASH NO	REV	DASH NO	REV	DASH NO	REV
DS6	1.5 MCD					
DS7			1.5 MCD		1.5 MCD	
DS13			1.5 MCD		1.5 MCD	
R20			220		220	
R21			220		220	
DS14			1.5 MCD		1.5 MCD	
DS15			1.5 MCD		1.5 MCD	
DS1	1.5 MCD		1.5 MCD			



REF DES	TYPE	GND	+5V
U2,3	7406	7	14
U4	7243	22	1
U1	74LS244	10	20

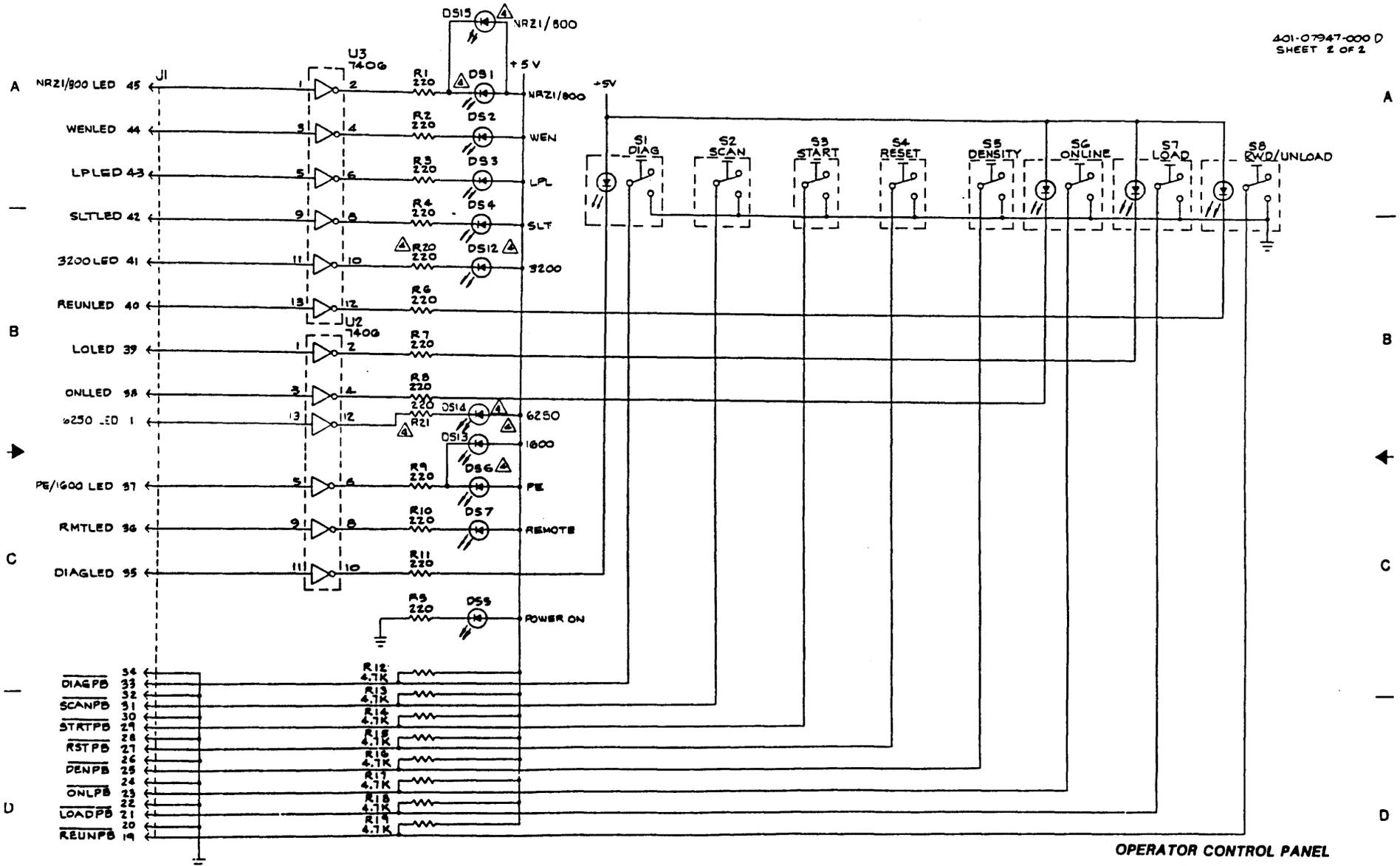
REF DES	
LAST USED	NOT USED
DS6	
DS15	
J1	
R21	
S8	
U4	

SEE TABULATION FOR COMPONENTS USED.
 3. ALL DIODES ARE 1.5 MCD
 2. RESISTORS ARE IN OHMS $\pm 5\%$, 1/4 W.
 1. CAPACITORS ARE IN MICROFARADS $\pm 10\%$, 50V

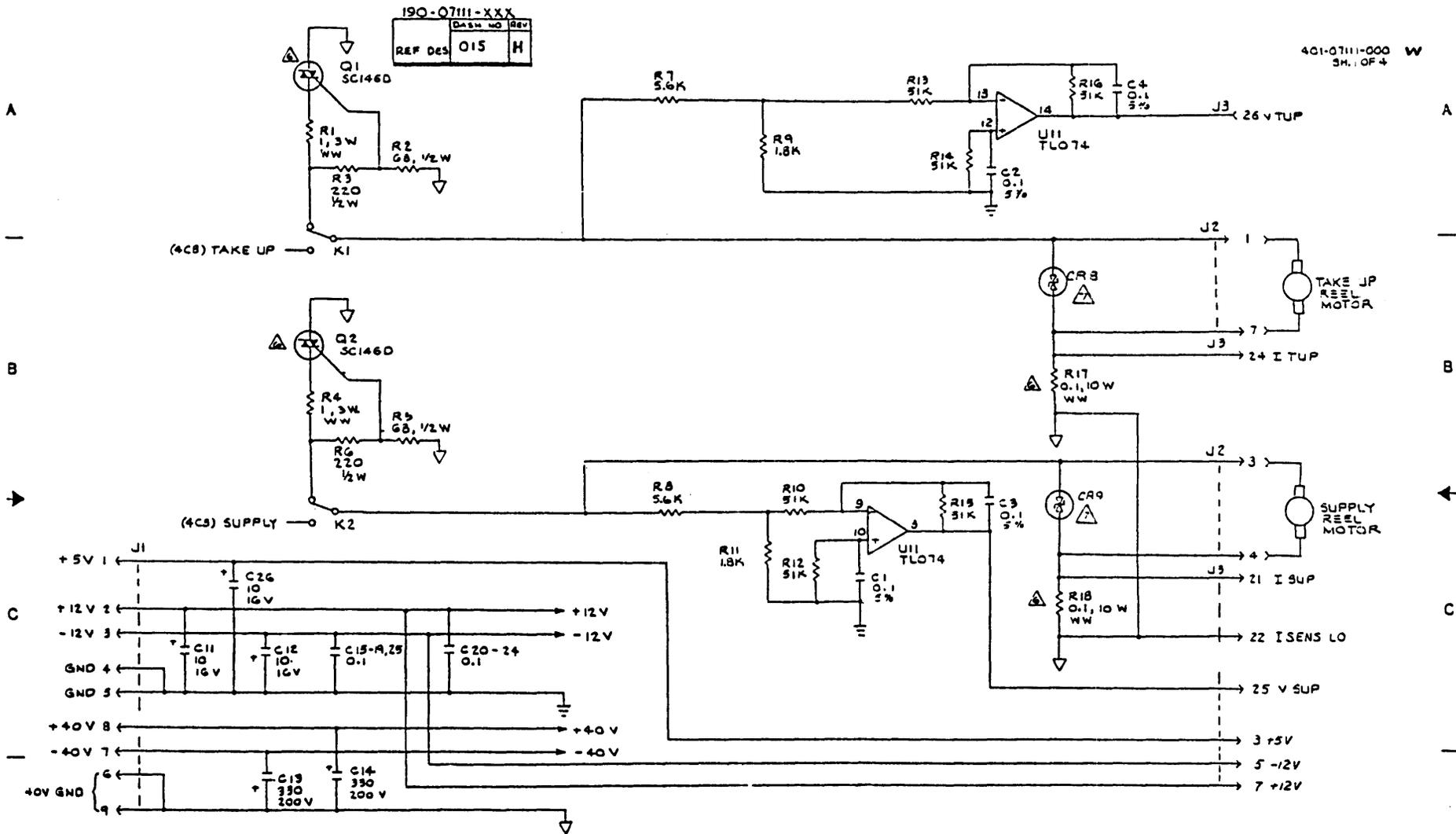
NOTES: UNLESS OTHERWISE SPECIFIED

REV STATUS OF SHEETS	REV SHEET	H	D
	1	1	2

OPERATOR CONTROL PANEL
TYPE 7947
SCHEMATIC DIAGRAM



OPERATOR CONTROL PANEL
TYPE 7947
SCHEMATIC DIAGRAM



190-07111-XXX		
DASH NO	REV	
REF DES	015	H

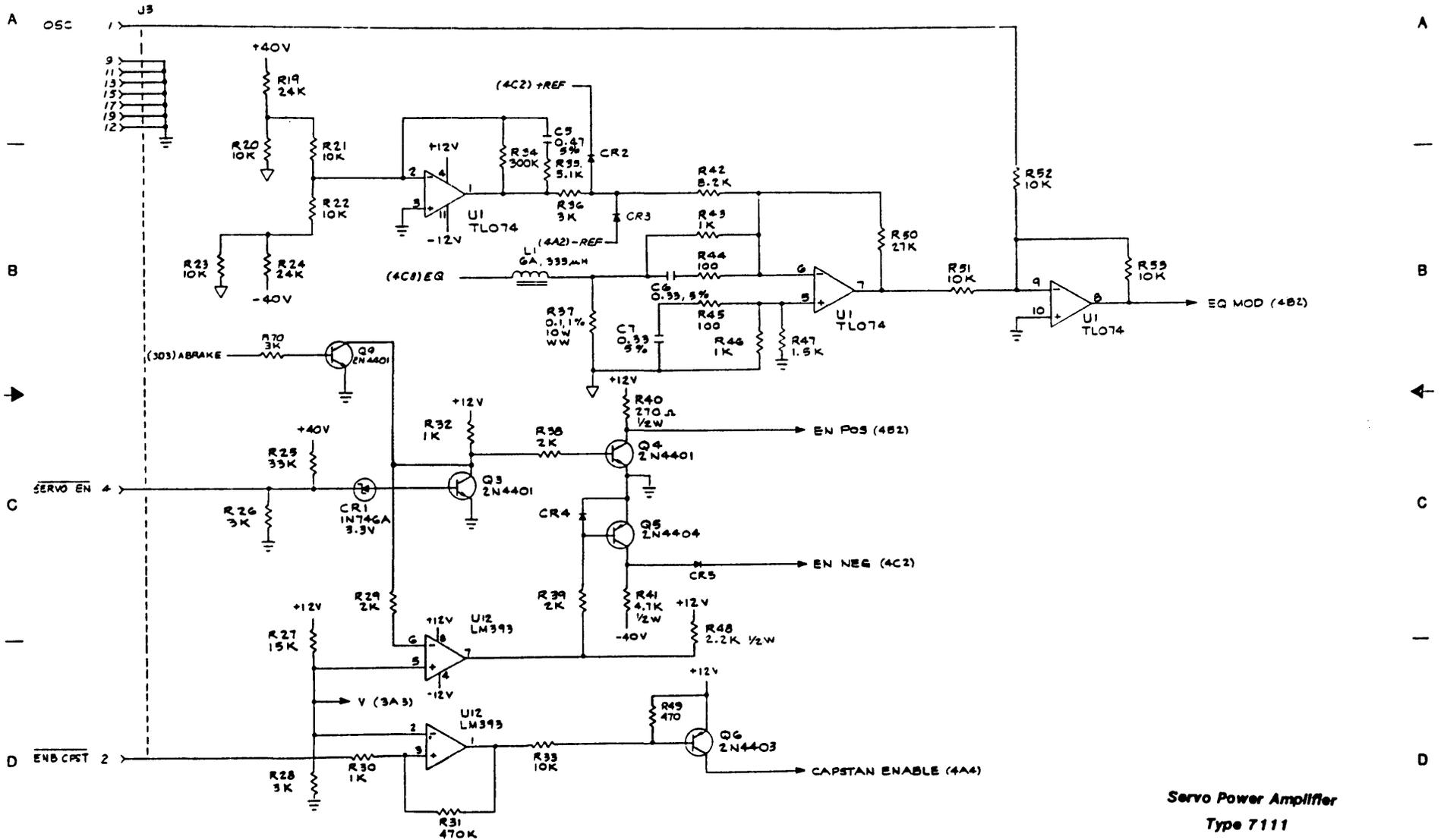
401-07111-000 W
SM. 1 OF 4

- △ COMPONENTS NOT USED, SHOWN FOR FULL CAPABILITY OF THE BOARD.
- ▲ COMPONENTS MOUNTED ON HEAT SINK. 190-7269-001
- 1. SEE SH. 4 FOR NOTES ON TYPICAL SECTION.
- 2. ALL DIODES ARE INM14
- 3. X INDICATES NO CONNECTION.
- 4. ALL RESISTOR VALUES ARE IN OHMS. ± 5% 1/4W.
- 5. ALL CAPACITOR VALUES ARE IN MICROFARADS.
- NOTES: UNLESS OTHERWISE SPECIFIED

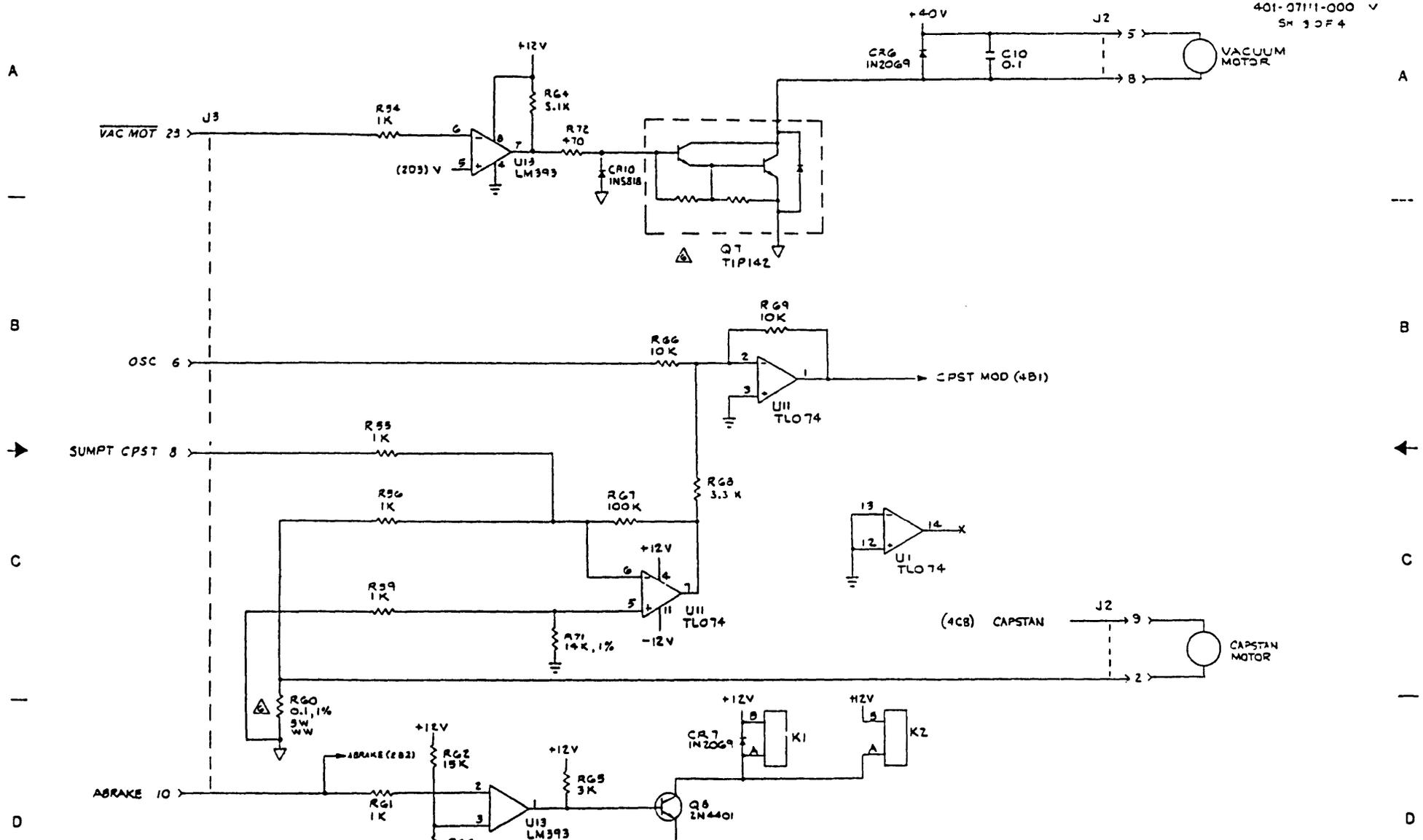
REF. DESIG.	
LAST USED	NOT USED
C 28	CB 9, C27
C 10	
K 2	
L 1	
Q 5	
A 7	Q1, 5B
U 1	U2, 10

REV STATUS	REV	W	P	V	P
OF SHEETS	SHEET	1	2	3	4

Servo Power Amplifier
Type 7111
Schematic Diagram

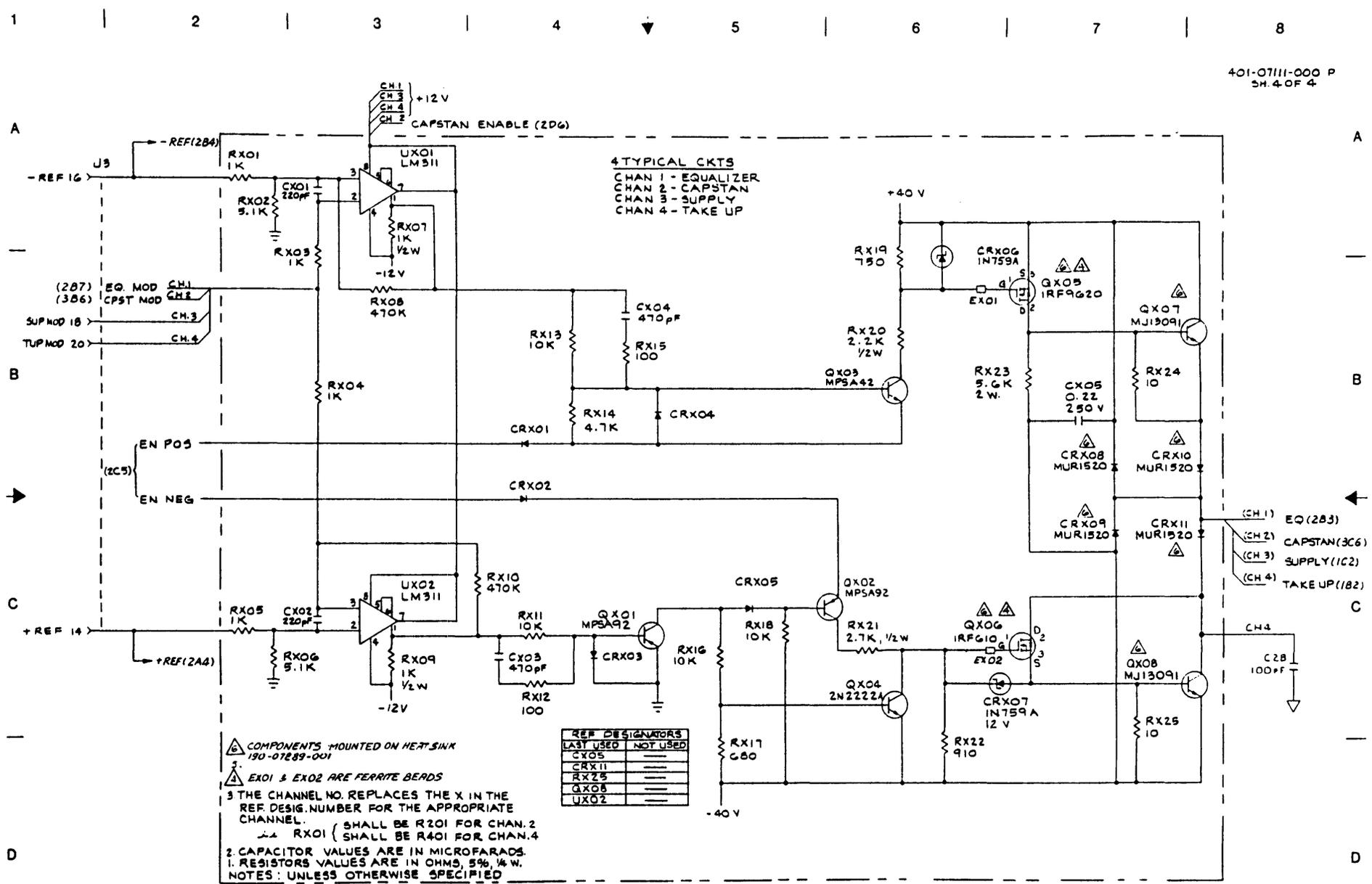


Servo Power Amplifier
Type 7111
Schematic Diagram



401-07111-000 V
SM 30F 4

Servo Power Amplifier
Type 7111
Schematic Diagram



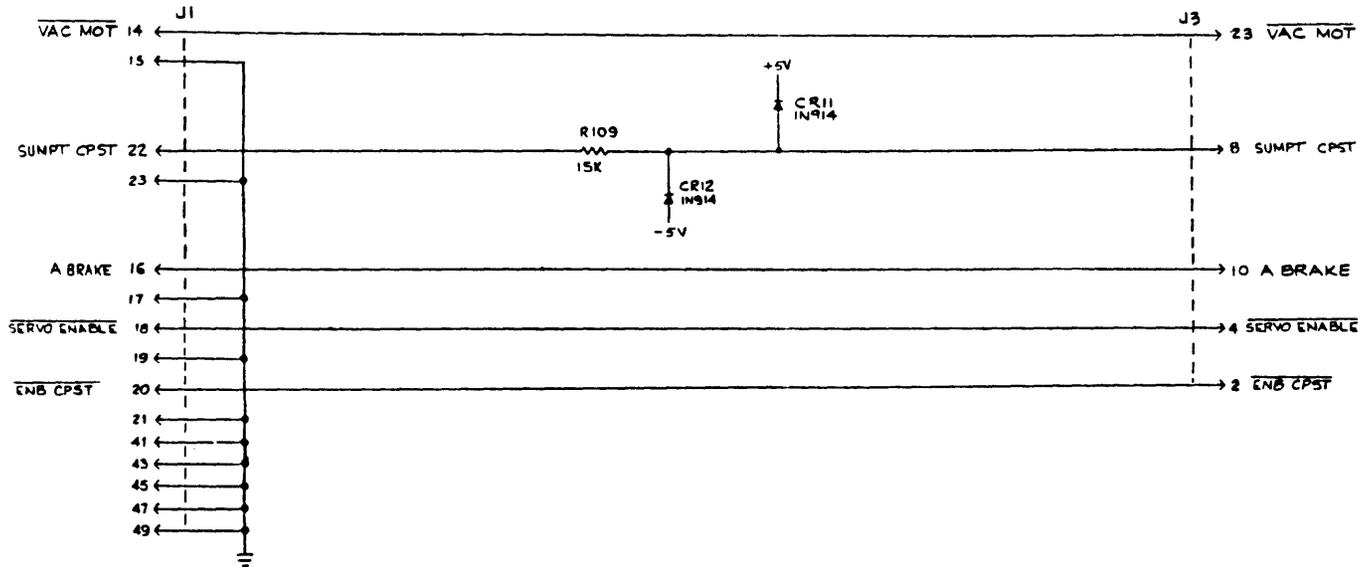
Servo Power Amplifier
Type 7111
Schematic Diagram

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

	DASH NO/REV	
REF DES	004	C

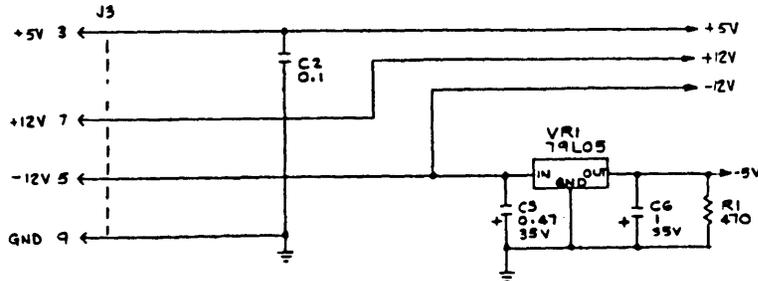
401-7147-000 F
SHT. 1 OF 4

A | | | | | | | | A



B | | | | | | | | B

C | | | | | | | | C



REF DES	TYPE	QTY	REV
U2	74LS02	2	7
U5	74LS32	14	7

REFERENCE DESIGN	
USED	NOT USED
C41	C1
CR12	
Q2	
R13	
U11	
VR1	

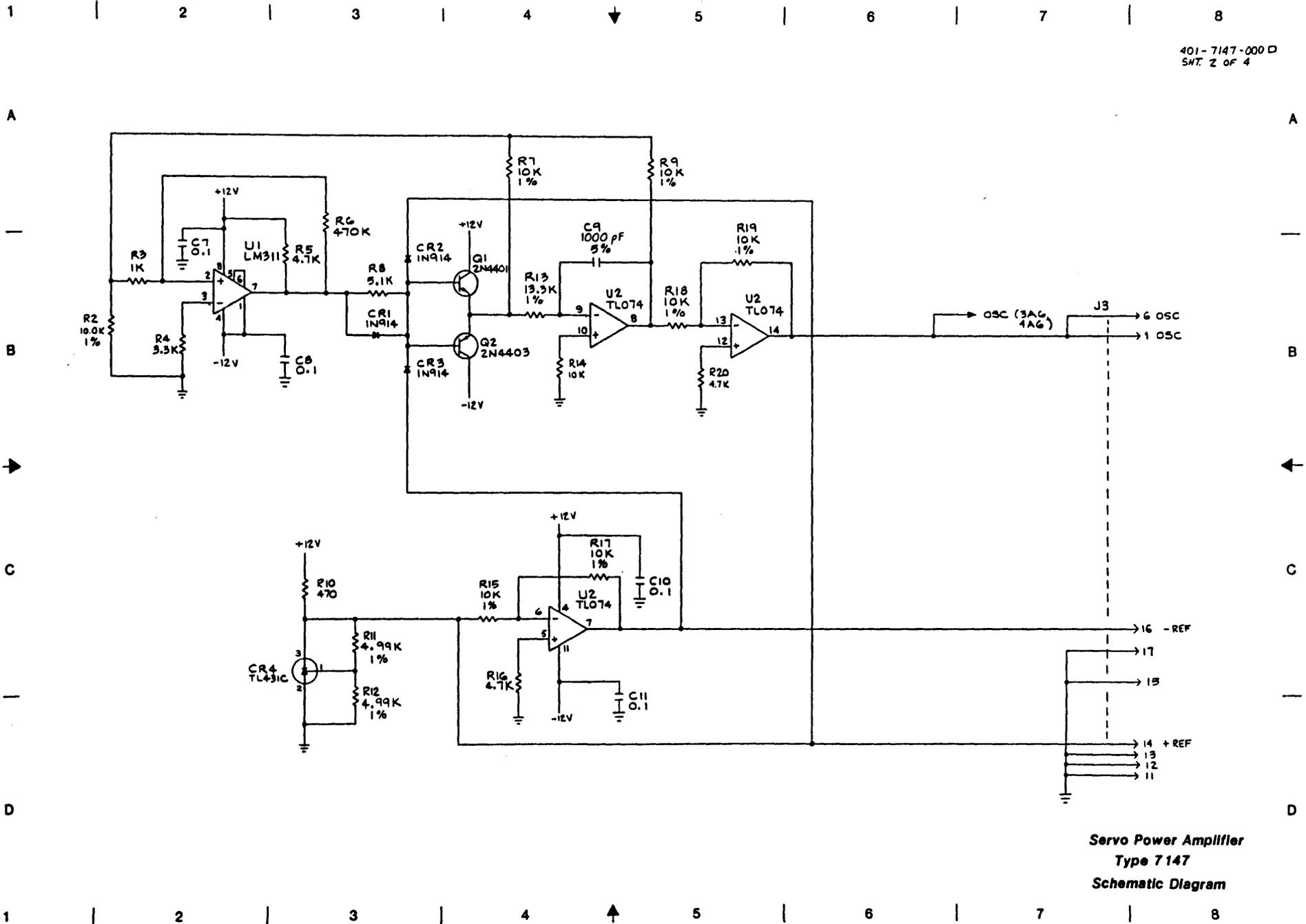
D | | | | | | | | D

3. ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. ALL RESISTOR VALUES ARE IN OHMS ± 5% 1/4 W.
1. X INDICATES NO CONNECTION.
NOTES: UNLESS OTHERWISE SPECIFIED

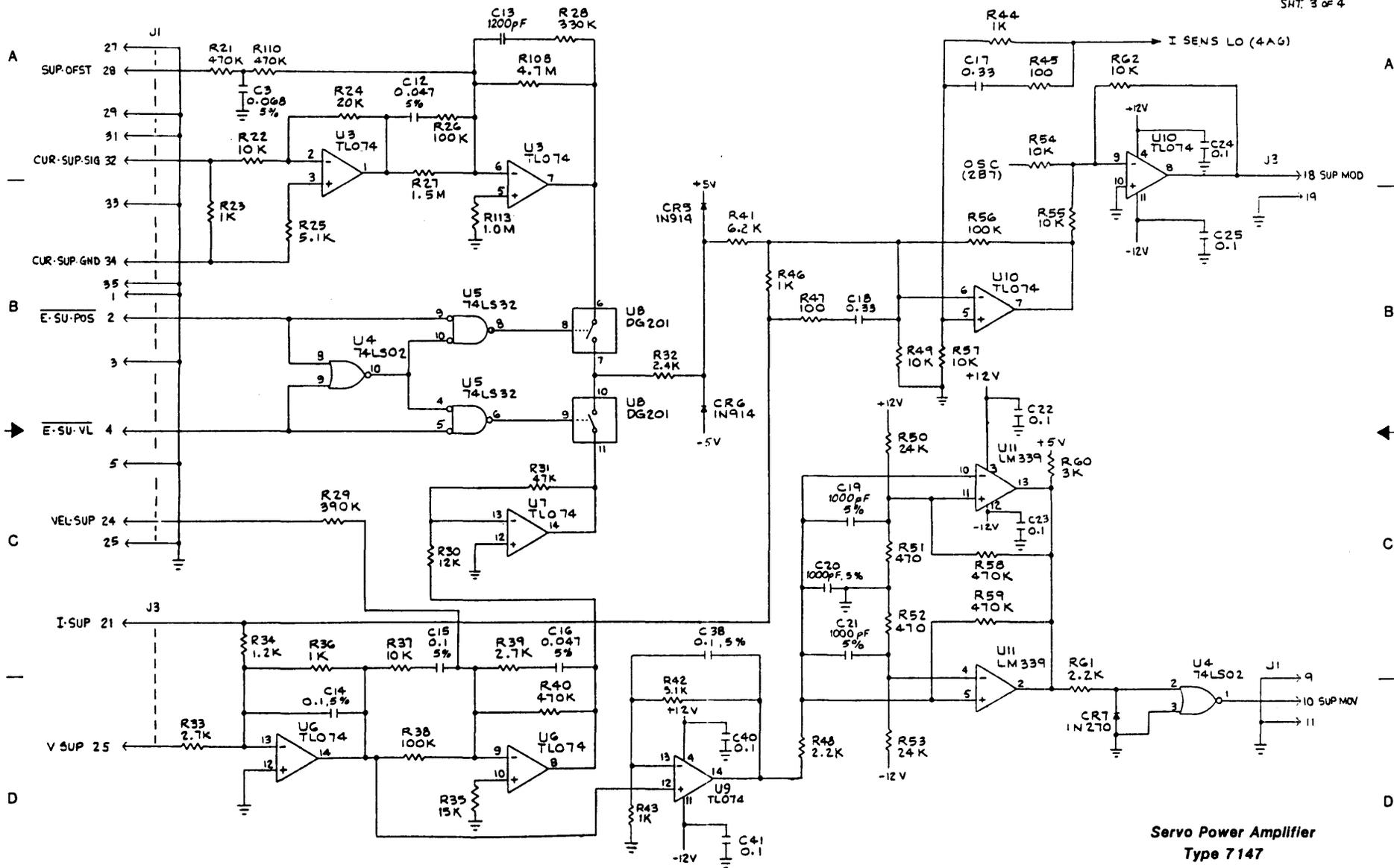
REV STATUS OF SHEETS	REV	F	D	E	B
SHEET	1	2	3	4	

Servo Power Amplifier
Type 7147
Schematic Diagram

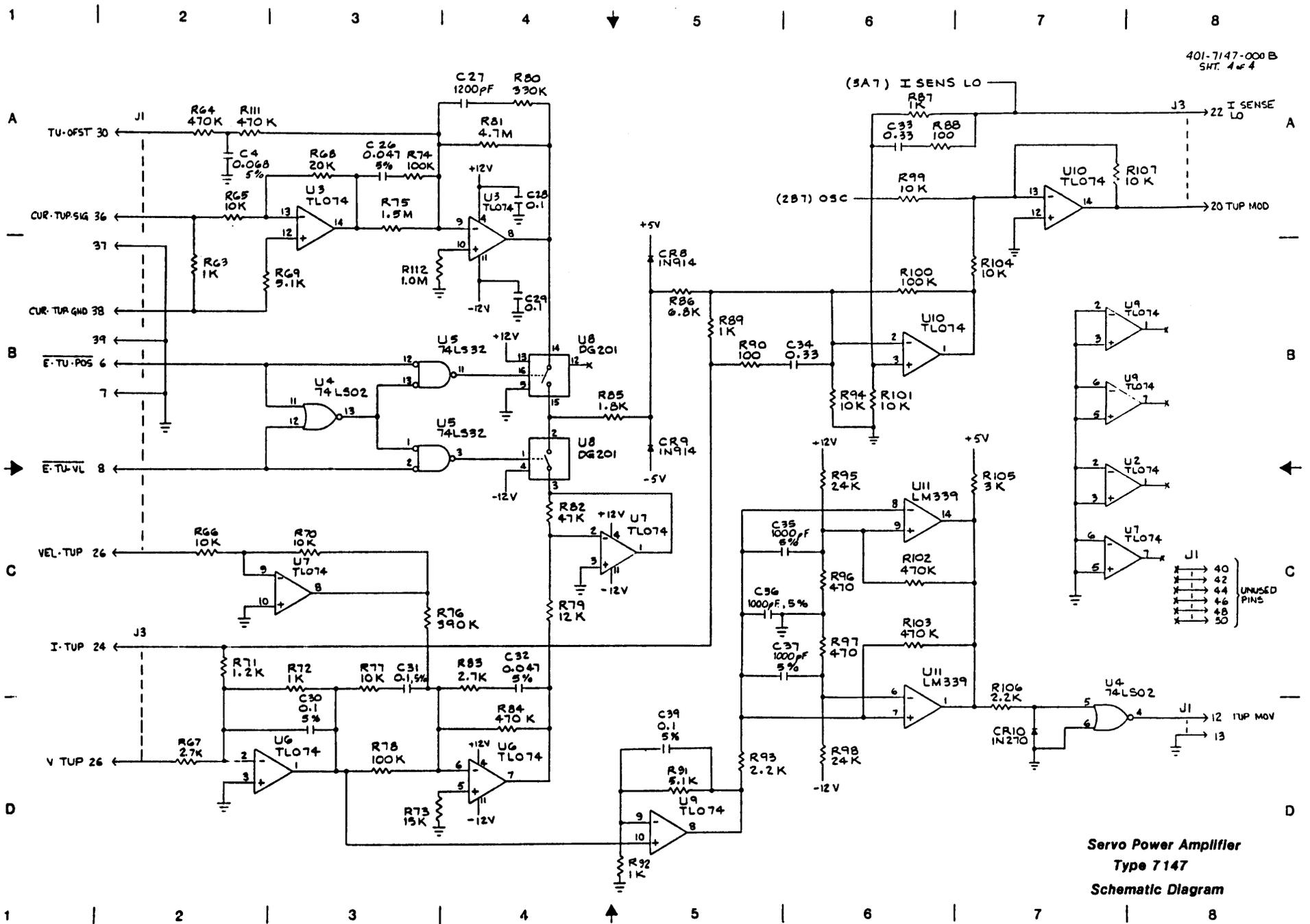
1 | 2 | 3 | 4 | 5 | 6 | 7 | 8



Servo Power Amplifier
Type 7147
Schematic Diagram



Servo Power Amplifier
Type 7147
Schematic Diagram



Servo Power Amplifier
Type 7147
Schematic Diagram

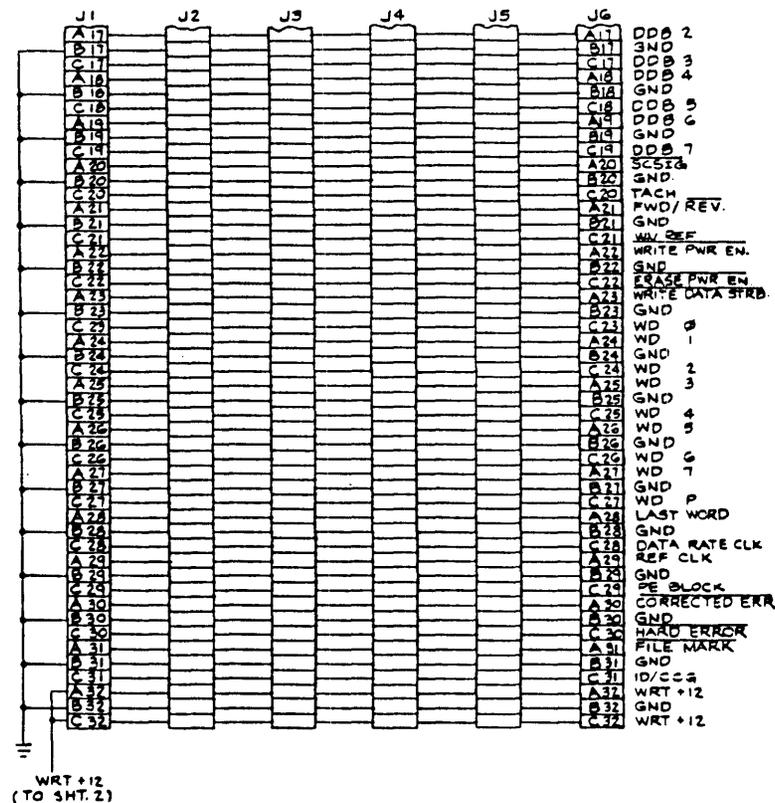
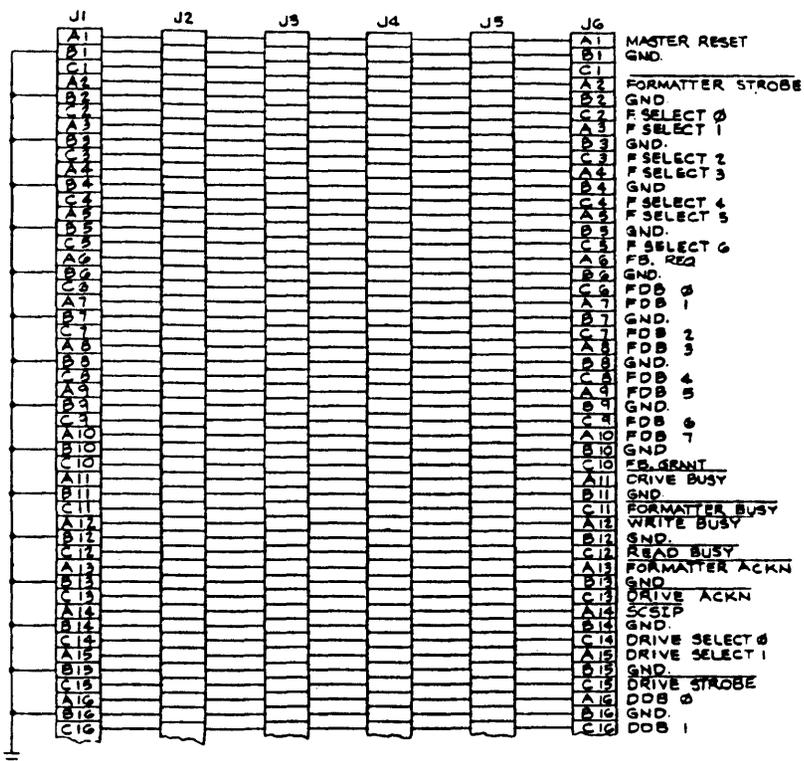
30-7108 TABULATION

DASH NO	REV
-002	B

REF. P1

REF. P1

CONTINUATION



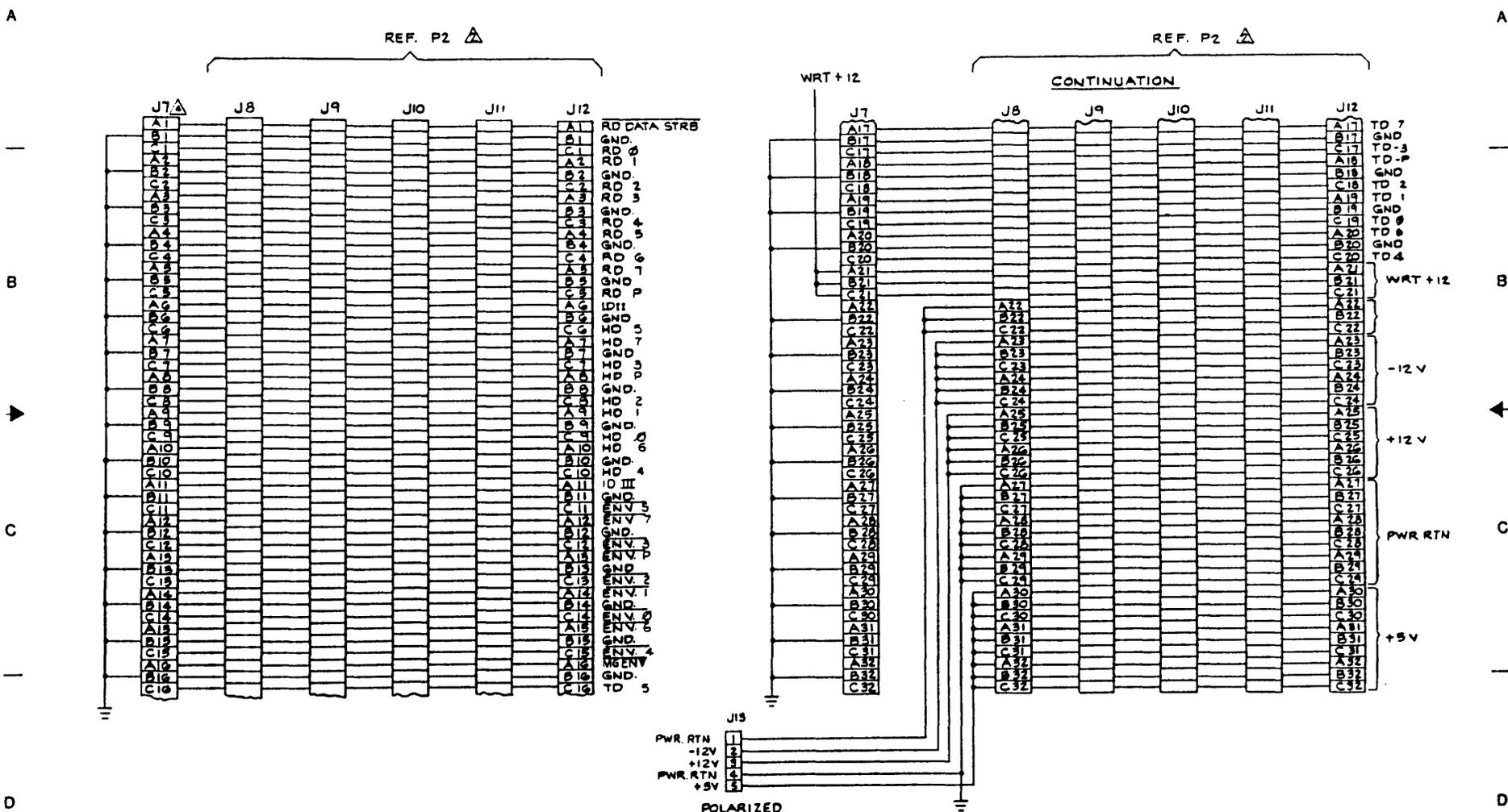
WRT +12
(TO SHT. 2)

REV STATUS OF SHEETS	REV SHEET	K	K
	1	2	

3 A CHANGE TO THIS DRAWING SHALL REQUIRE COORDINATION WITH ALL ASSOCIATED DRAWINGS. ALL BOARDS PLUGGED INTO J2-J6 AND J8-J12 ON THE MOTHER BOARD SHALL HAVE CONNECTORS IDENTIFIED AS P1 AND P2. P1'S MATE WITH J2-J6. P2'S MATE WITH J8-J12. UNASSIGNED PINS ARE AVAILABLE FOR FUTURE USE. NOTES: UNLESS OTHERWISE SPECIFIED

REMOVED

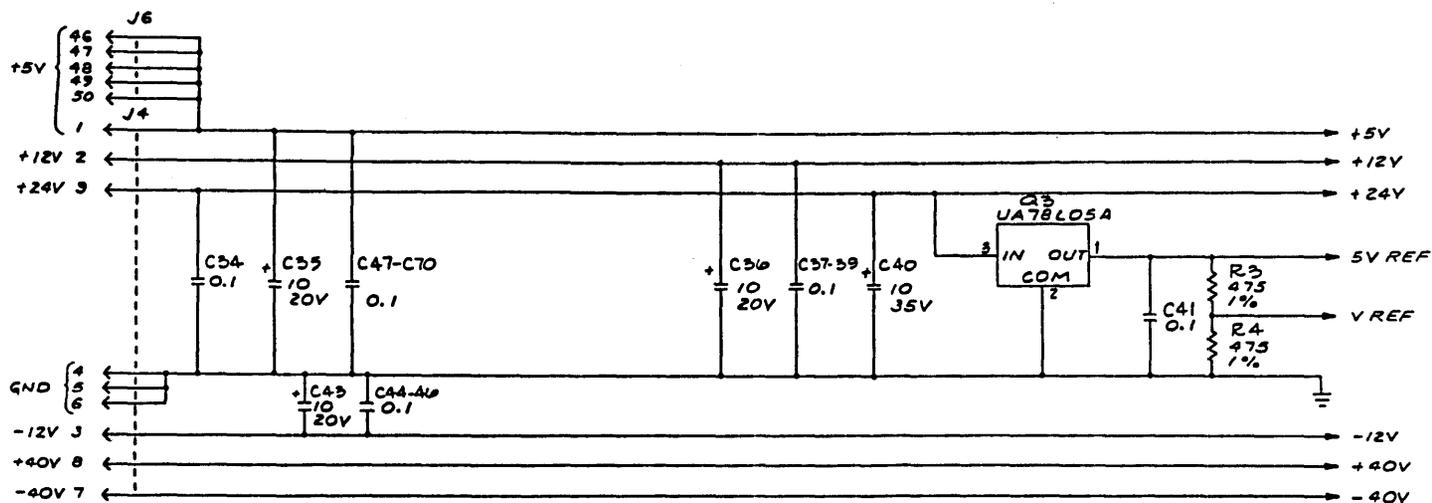
9600 Motherboard Signal Assignments
Type 7108
Schematic Diagram



9600 Motherboard Signal Assignments
Type 7108
Schematic Diagram

190-08952 TABULATION

REF DES	REV	BY	QTY	FRM NO.	REV
U24	-017	A	-117	A	
U24	146-00779-023			146-00229-023	
U27	146-00191-002			146-00191-002	
U51	146-00192-001			146-00192-002	
ST5	ENABLE			ENABLE	
ST4	ENABLE			ENABLE	
ST1	IN			IN	



⚠ COMPONENTS NOT INSTALLED WHEN BEOT IS IMPLEMENTED.

⚠ COMPONENT LOCATIONS PROVIDED ON THE PCB, BUT ARE NOT USED.

⚠ CIRCUIT SHOWN USING 772% IC TYPES 2712B AND 2764 ARE INTERCHANGEABLE WITH 272% WITH THE EXCEPTION OF FUNCTIONS IN THE CONTROL BLOCK. SEE DIAGRAMS TO THE RIGHT.

3. ALL DIODES ARE 1N914.

⚠ P1 CONNECTOR PIN AND FUNCTIONS SHALL BE COORDINATED WITH THE MOTHER BOARD (401-07100-001). FOR PINS NOT SHOWN ON DRAWING.

3. ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. ALL RESISTOR VALUES ARE IN OHMS 5%, 1/4 W
1. X INDICATES NO CONNECTION.

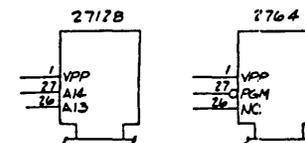
NOTES: UNLESS OTHERWISE SPECIFIED.

REV STATUS OF SHEETS	REV	B	A	A	A	A	A	A	A	A
SHEET	1	2	3	4	5	6	7	8	9	10

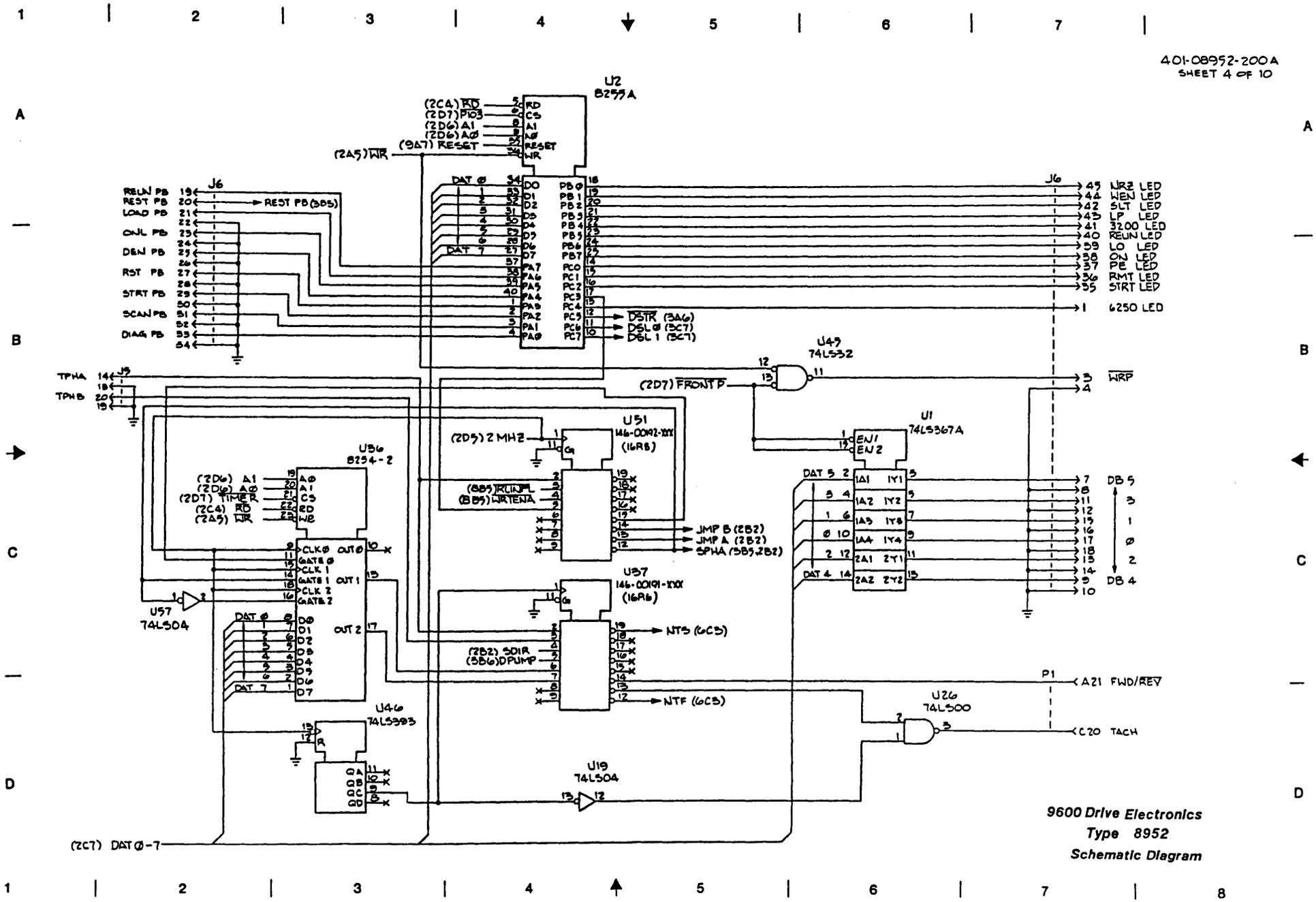
REF DES	TYPE	QTY	SY
U26,27,28	74LS00	7	14
U19,27	74LS04	7	14
U7	74LS08	7	14
U7B	74LS16	7	14
U45,52	74LS32	7	14
U32,22	74LS74	7	14
U4	74LS92	10	2
U16,5	74LS107	7	14
U13	74LS137	7	14
U44	74LS155	8	16
U26	74LS155	8	16
U12,22,40,41,63	74LS244	10	20
U25	74LS245	10	20
U3	74LS04	7	14

REF DES	TYPE	QTY	SY
U64	74LS240	7	14
U15,16	74LS247	8	16
U29	74LS375	8	20
U46	74LS593	7	14
U30,39,46,67	74LS670	8	16
U24	74LS74	14	28
U8	74NCT04	7	14
U9,10	MCT024B	7	14
U14	8051	-	40
U20	B294-2	17	24
U2,13,23,34	B255A	7	26
U30,39,60	HI-201	3	-
U31	1688	10	20
U37	1688	10	20
U49,53	74	7	14
U43,50,64	74	10	20

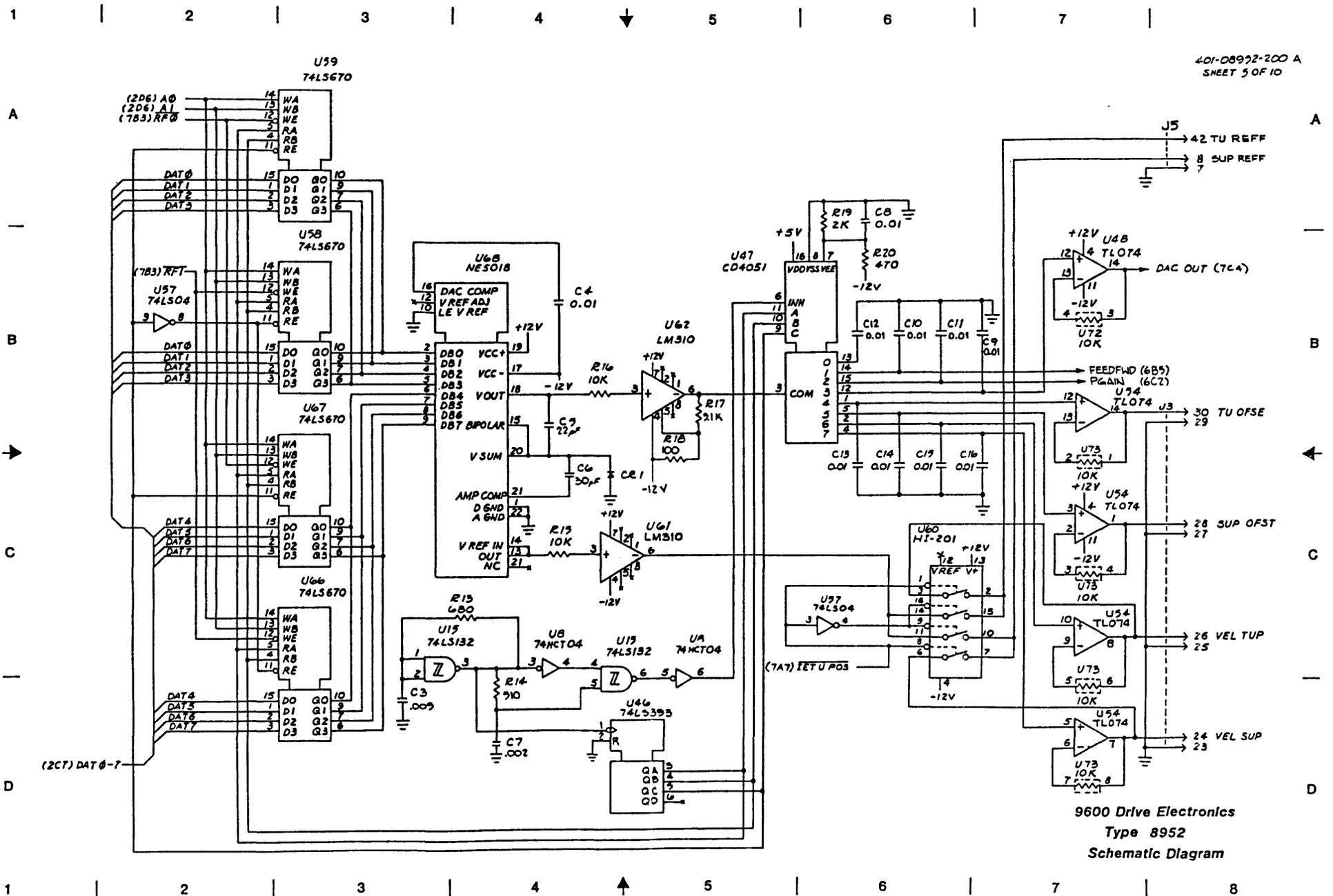
REF DES	LAST USED	NOT USED
C74		CR4.5,20
Q10		R12,16
R169		
ST4		
V1		
U73		U70
U3		



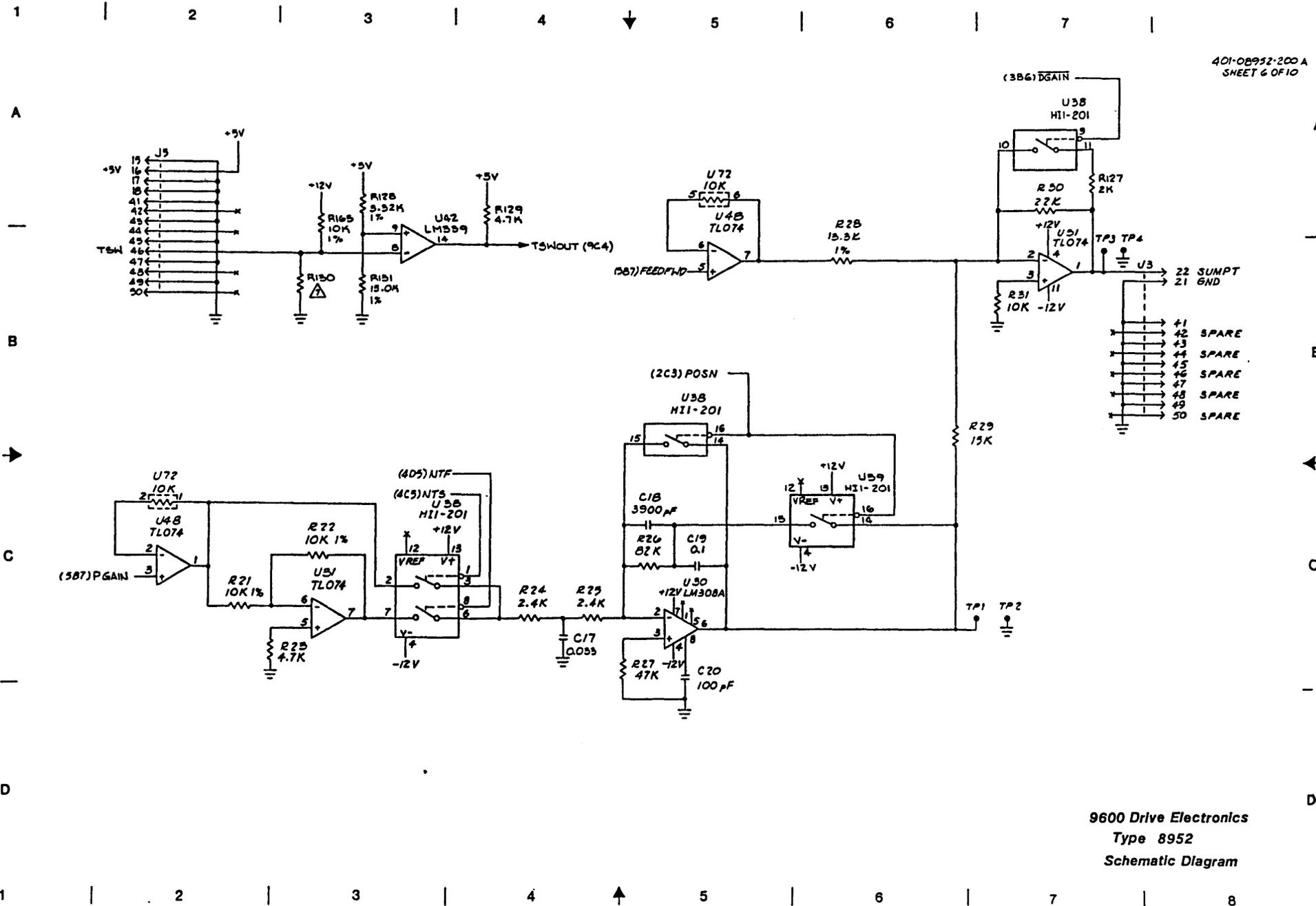
9600 Drive Electronics
Type 8952
Schematic Diagram



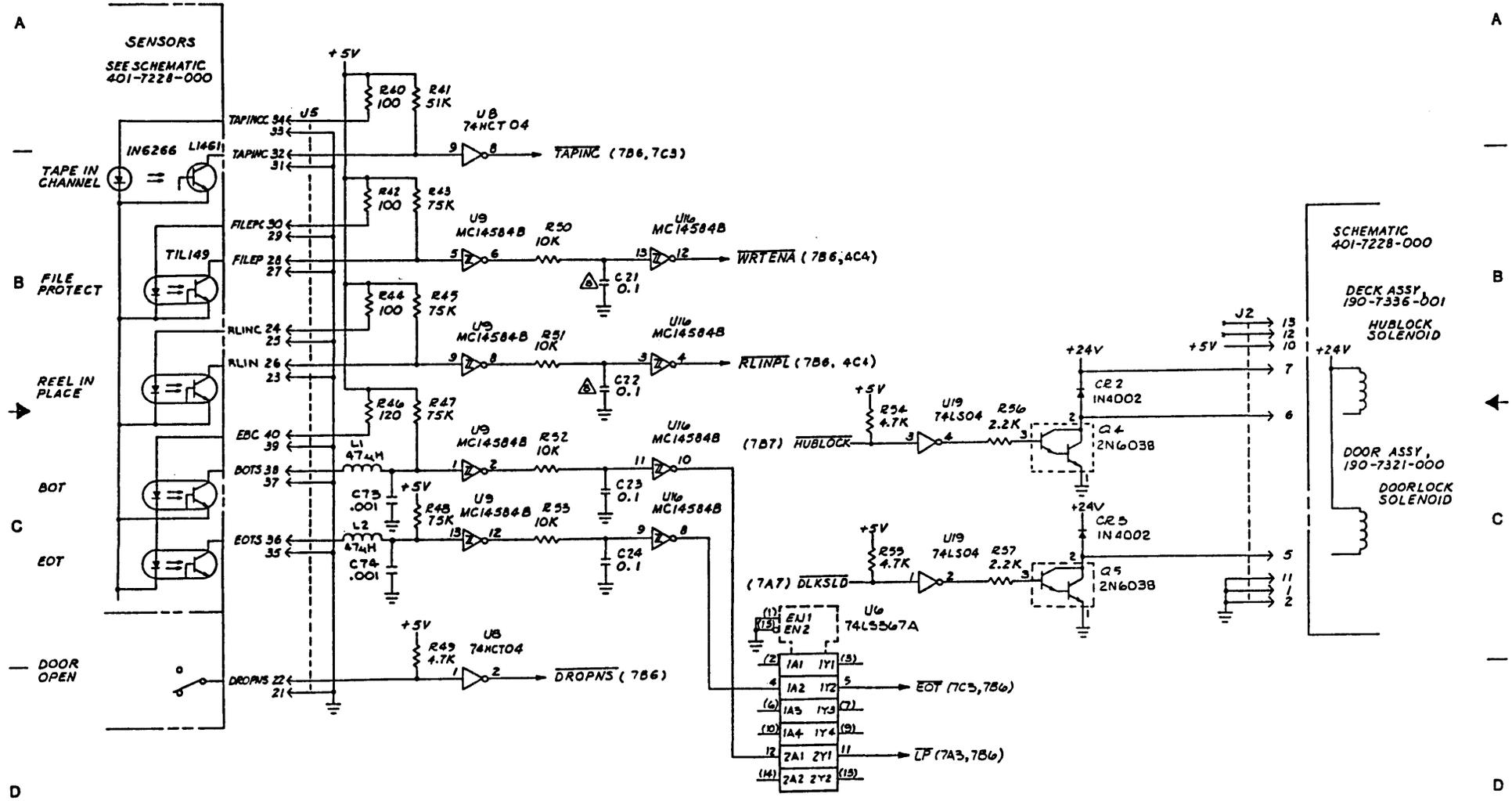
9600 Drive Electronics
Type 8952
Schematic Diagram



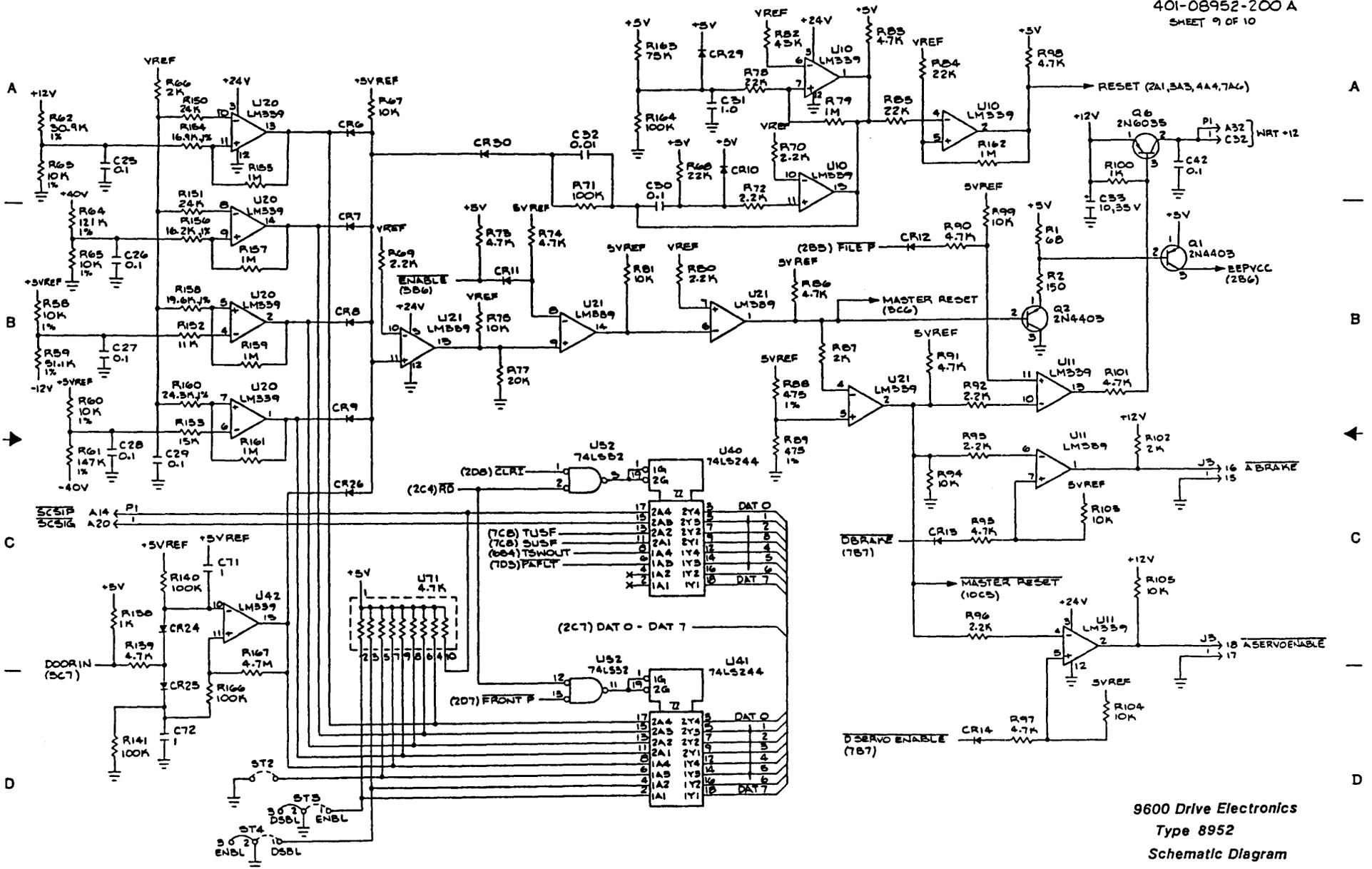
9600 Drive Electronics
Type 8952
Schematic Diagram



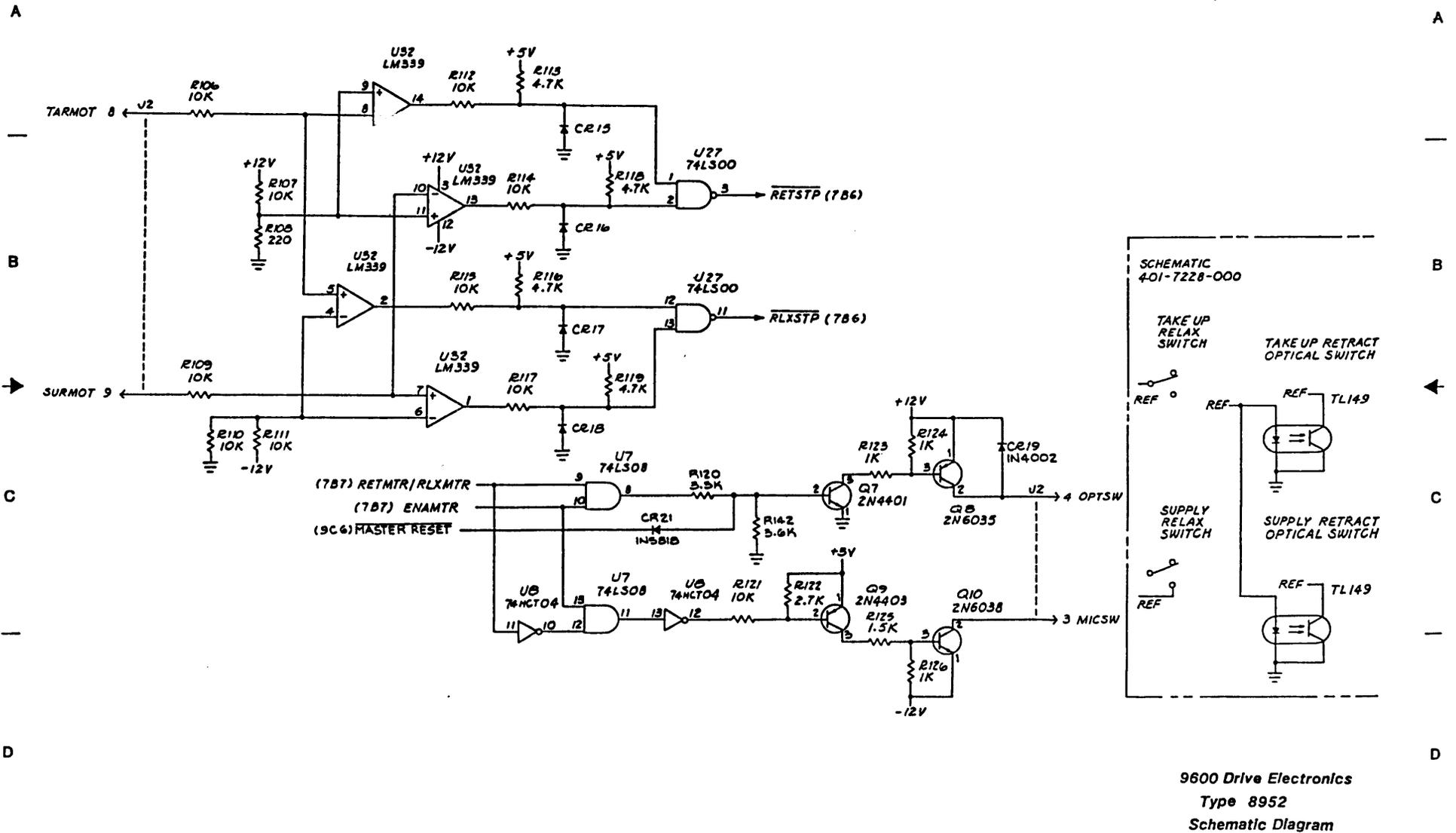
9600 Drive Electronics
Type 8952
Schematic Diagram



9600 Drive Electronics
Type 8952
Schematic Diagram



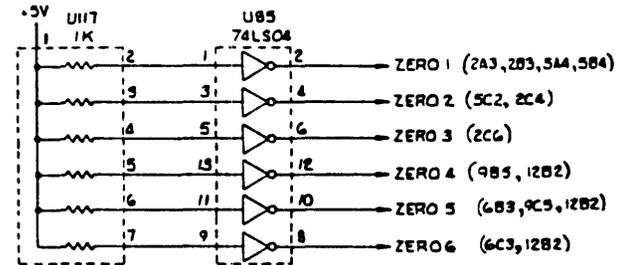
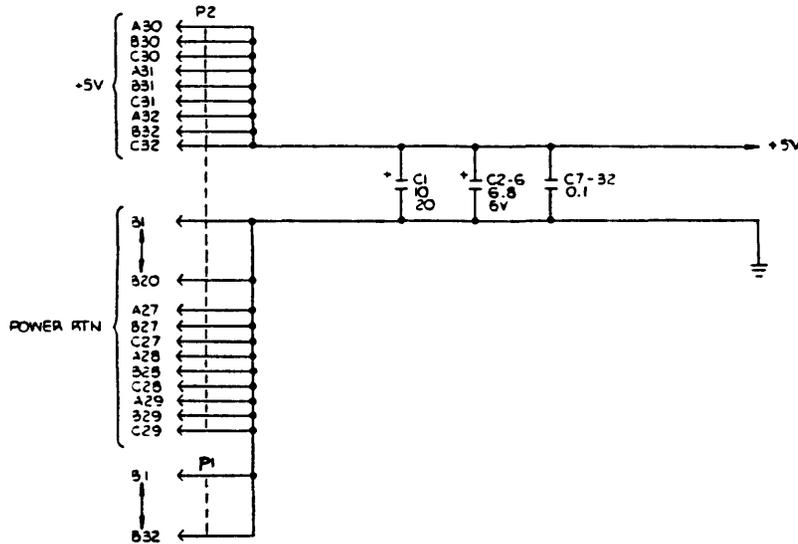
9600 Drive Electronics
Type 8952
Schematic Diagram



9600 Drive Electronics
Type 8952
Schematic Diagram

190-08951 TABULATION

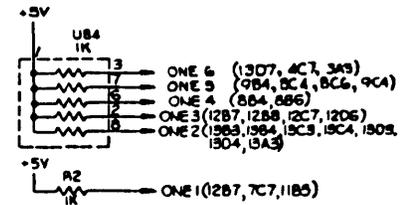
REF DES	QSNM NO	REV
U61	146-00277-01B	A
W1	USED	
W2		
W3		
W4	USED	



REF DES	TYPE	QND	+5V
U1, U115	74LS164	10	20
U45, 34, 67	74LS164A	10	20
U57, 60, 69, 71	74LS00	7	14
U114	74LS02	7	14
U7, 30, 25, 95	74LS04	7	14
U4	74LS04	7	14
U8, 31, 85	74LS04	7	14
U42	74LS10	7	14
U9	74LS11	7	14
U6, 24, 27, 89	74LS138	8	16
34-36	74LS138	8	16
U50	74LS139	8	16
U28, 64	74LS161	8	16
U18, 29, 41	74LS169	8	16
54, 56, 73, 74	74LS20	7	14
U52	74LS20	7	14
U16, 17, 21, 81	74LS240	10	20
93	74LS240	10	20
U62	74LS240	7	14

REF DES	TYPE	QND	+5V
U40, 46, 53, 58	74LS244	10	20
75, 77, 80, 81	74LS244	10	20
83, 90, 107	74LS244	10	20
U91, 92	74LS244	10	20
U55	74LS245	7	14
U70, 38	248	8	16
U20, 19, 32, 48	74LS279	8	16
U47, 97, 98	74LS32	7	14
U108	74LS373	10	20
U56, 39, 43, 78	74LS374	10	20
16, 78, 79, 85	74LS374	10	20
101, 102, 103	74LS374	10	20
110, 111	7438	7	14
U33, 22, 15, 14	7438	7	14
137, 10	74LS682	10	20
U400	74LS682	10	20
U43, 44, 51, 63	74LS74	7	14
64, 82, 94, 96	74LS74	7	14
105, 105, 106	74LS74	7	14
113	74LS85	8	16
U23	74LS86	7	14
U1	8051	7	40
U28	8051	7	40
U71	8051	7	40
U116	8051	7	40
Ver. 15	21316	14	28

REF DES	LAST USED	NOT USED
P2		
W2		
U117		
A10		
C37	C34, 35	
C41		
Y2	Y1	



▲ COMPONENT LOCATIONS PROVIDED ON THE PCB BUT NOT USED

9. P1 & P2 CONNECTOR PIN AND FUNCTION SHALL BE COORDINATED WITH THE MOTHER BOARD (401-708-000) FOR PINS NOT SHOWN ON THIS DRAWING.

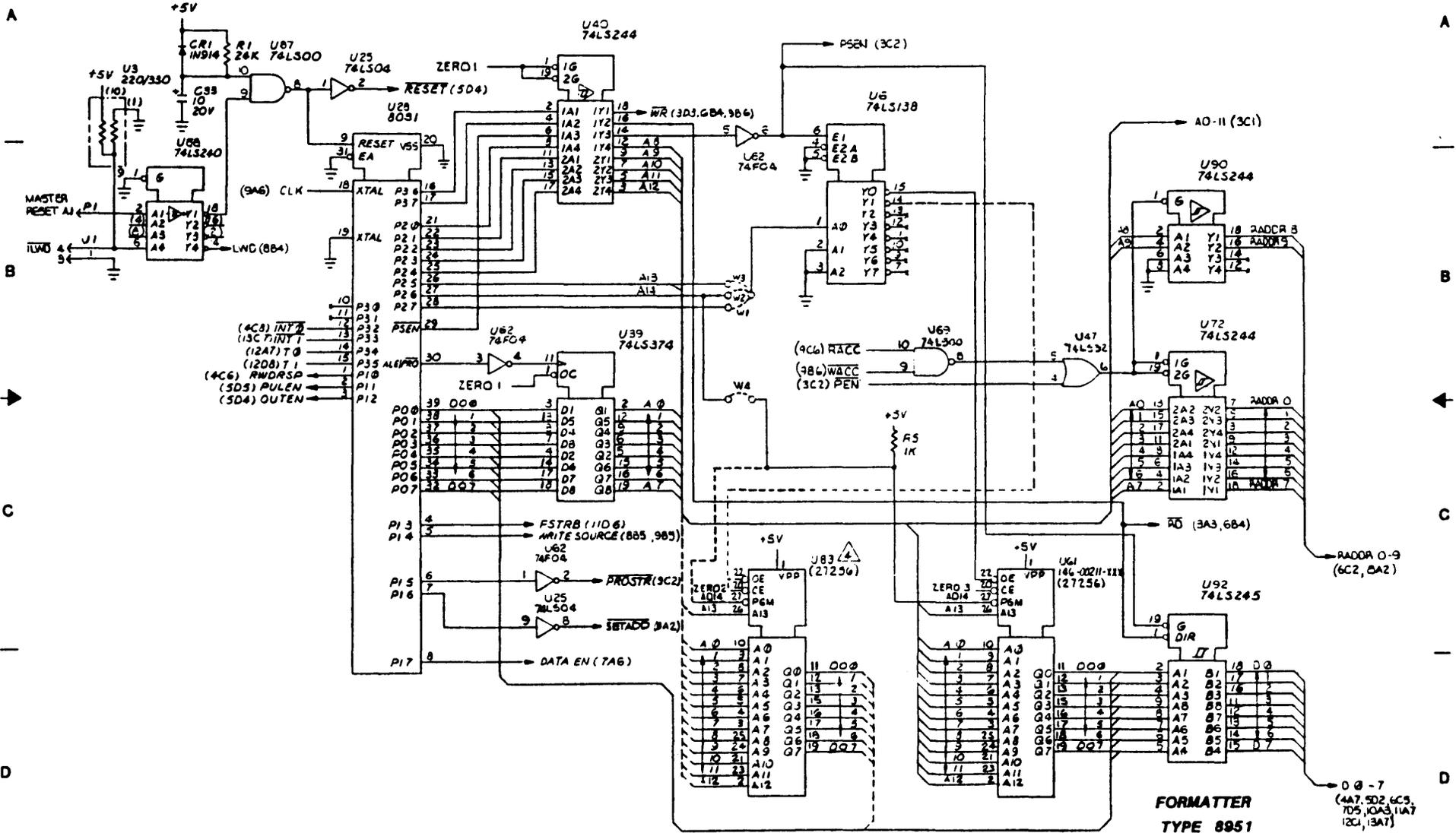
8. RESISTORS ARE IN OHMS UNLESS SPECIFIED.

1. CAPACITORS ARE IN MICROFARADS UNLESS SPECIFIED.

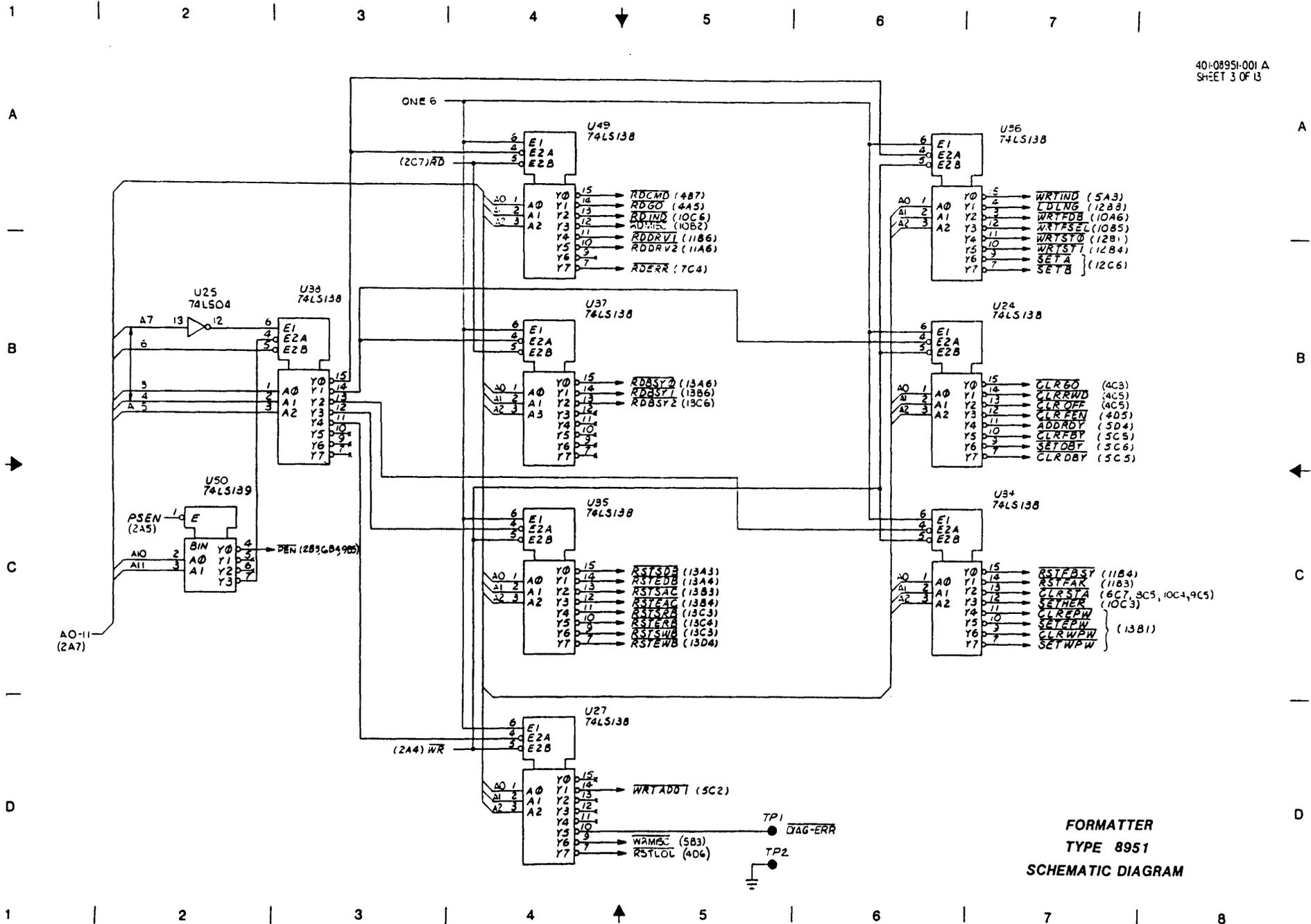
NOTED: UNLESS OTHERWISE SPECIFIED

REV STATUS OF SHEETS	REV	V	V	A	A	A	A	A	A	A	A	A	A
SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13

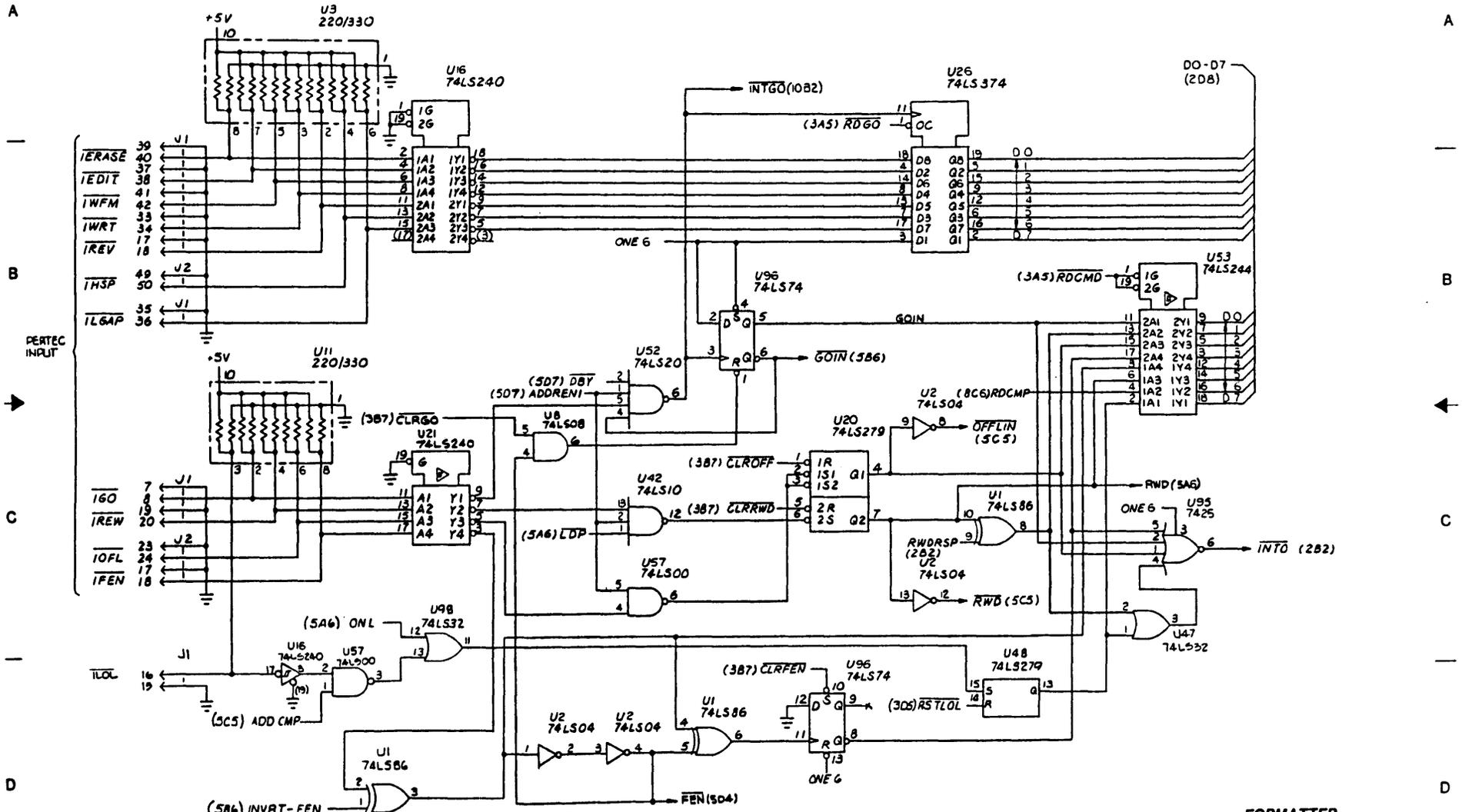
FORMATTER
TYPE 8951
SCHEMATIC DIAGRAM

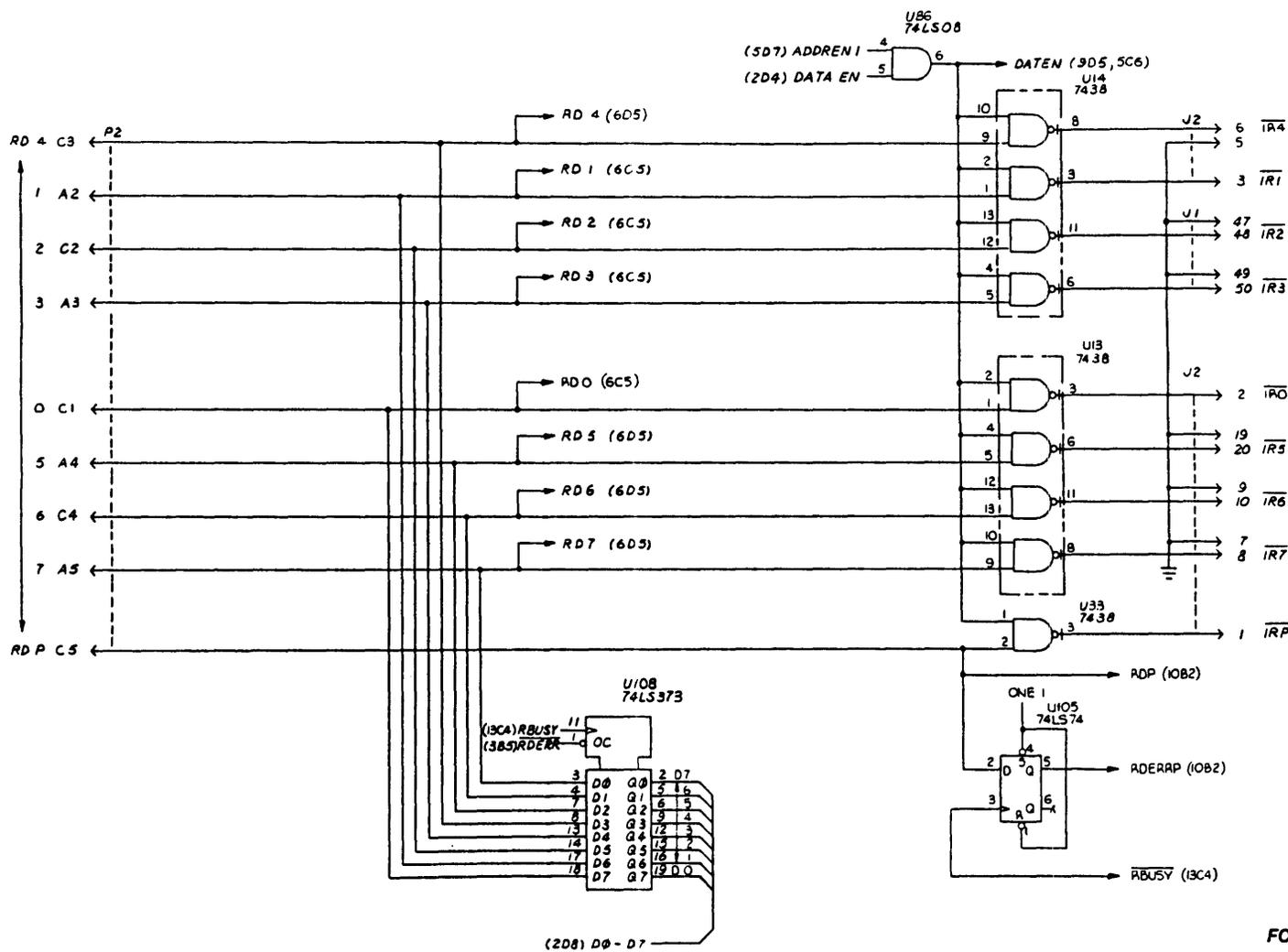


**FORMATTER
TYPE 8951
SCHEMATIC DIAGRAM**

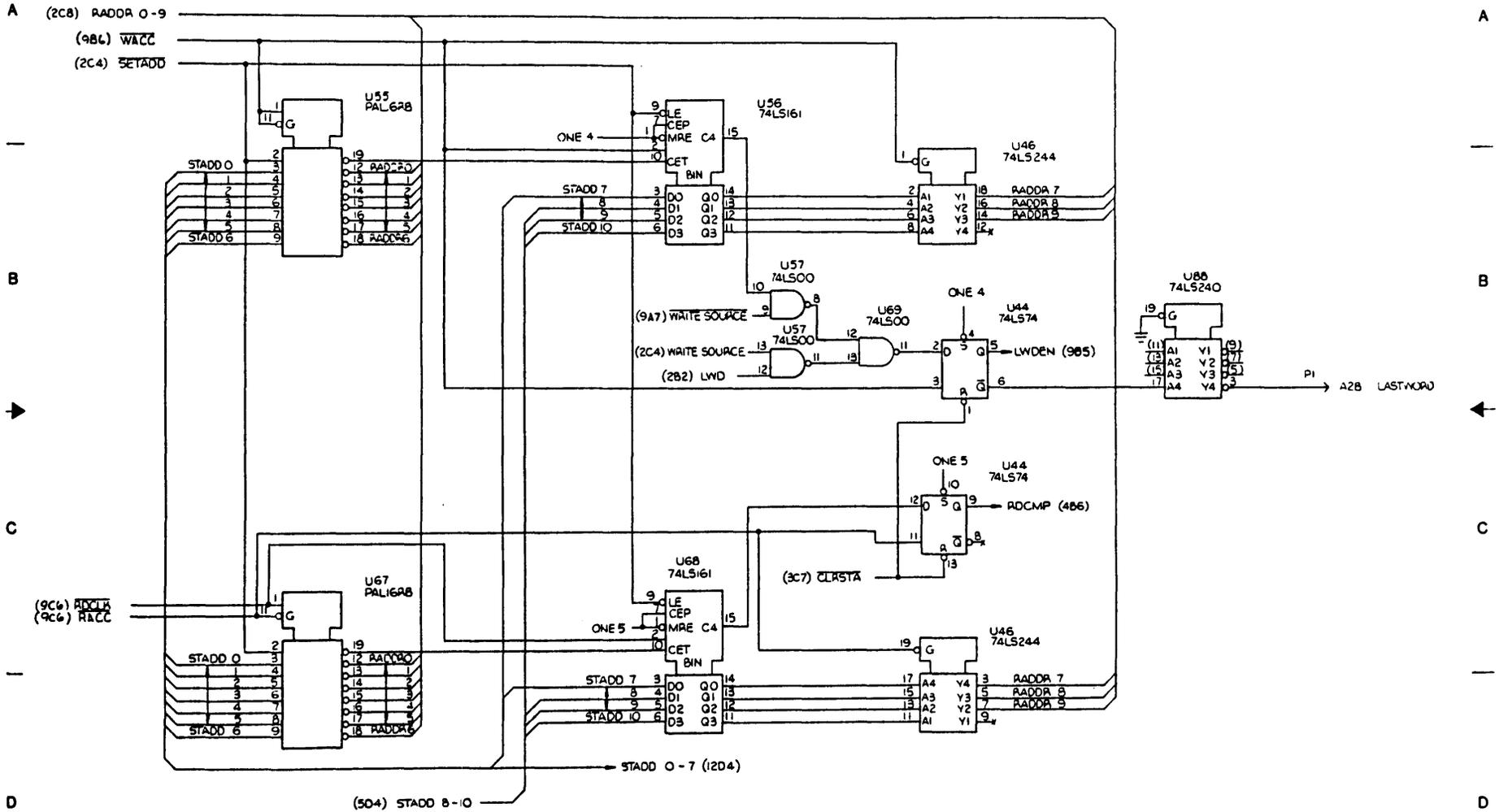


FORMATTER
TYPE 8951
SCHEMATIC DIAGRAM

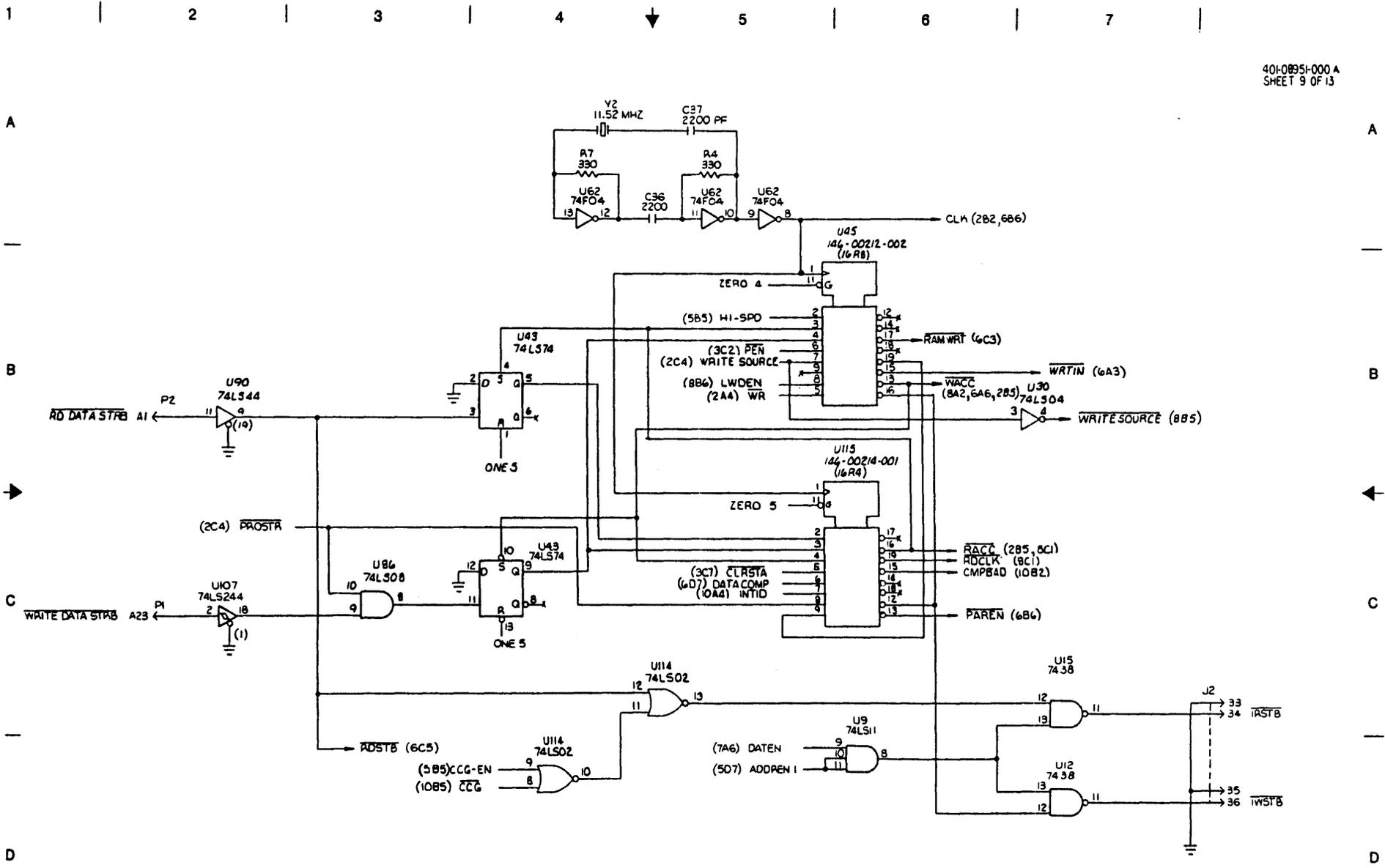




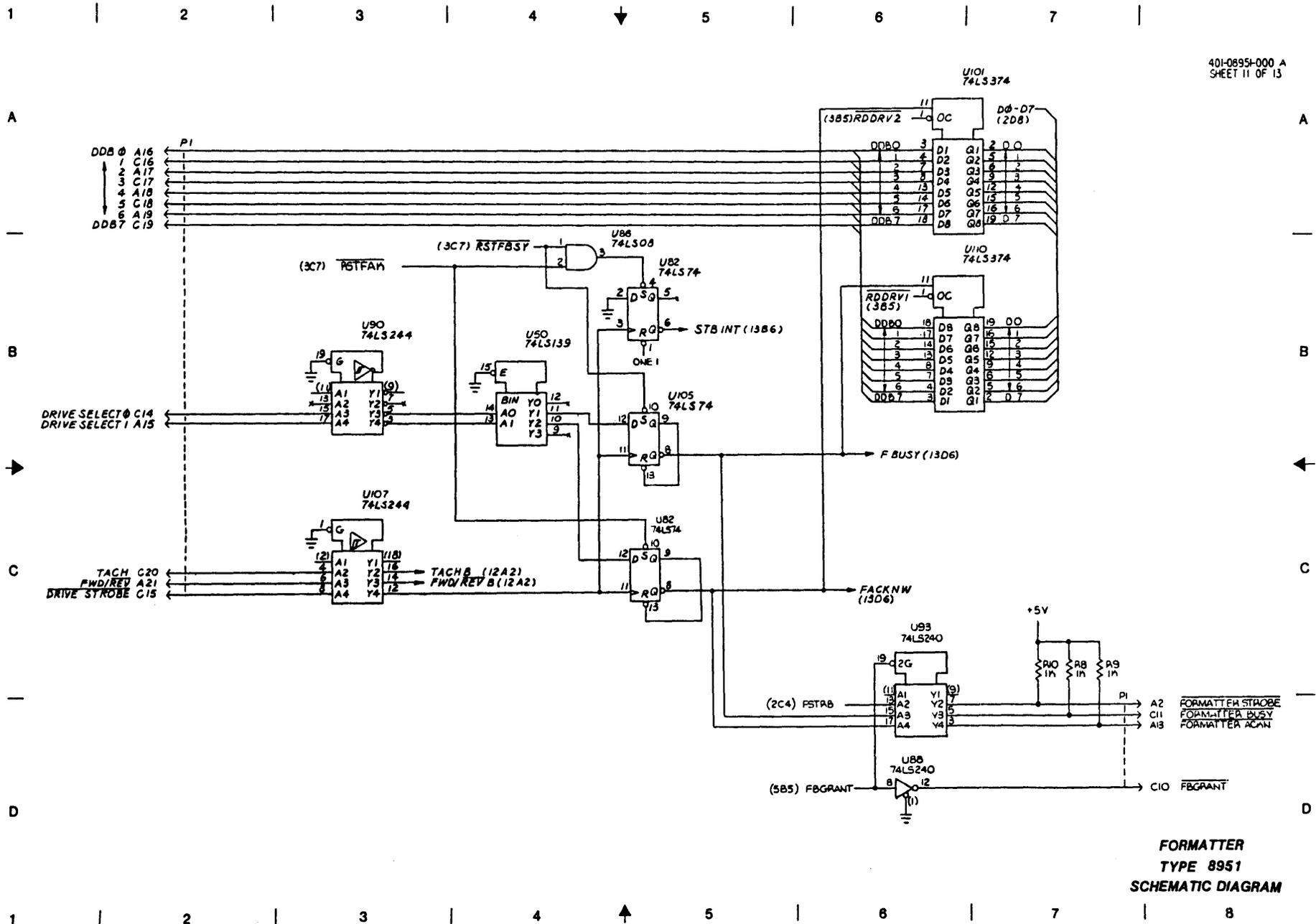
**FORMATTER
TYPE 8951
SCHEMATIC DIAGRAM**



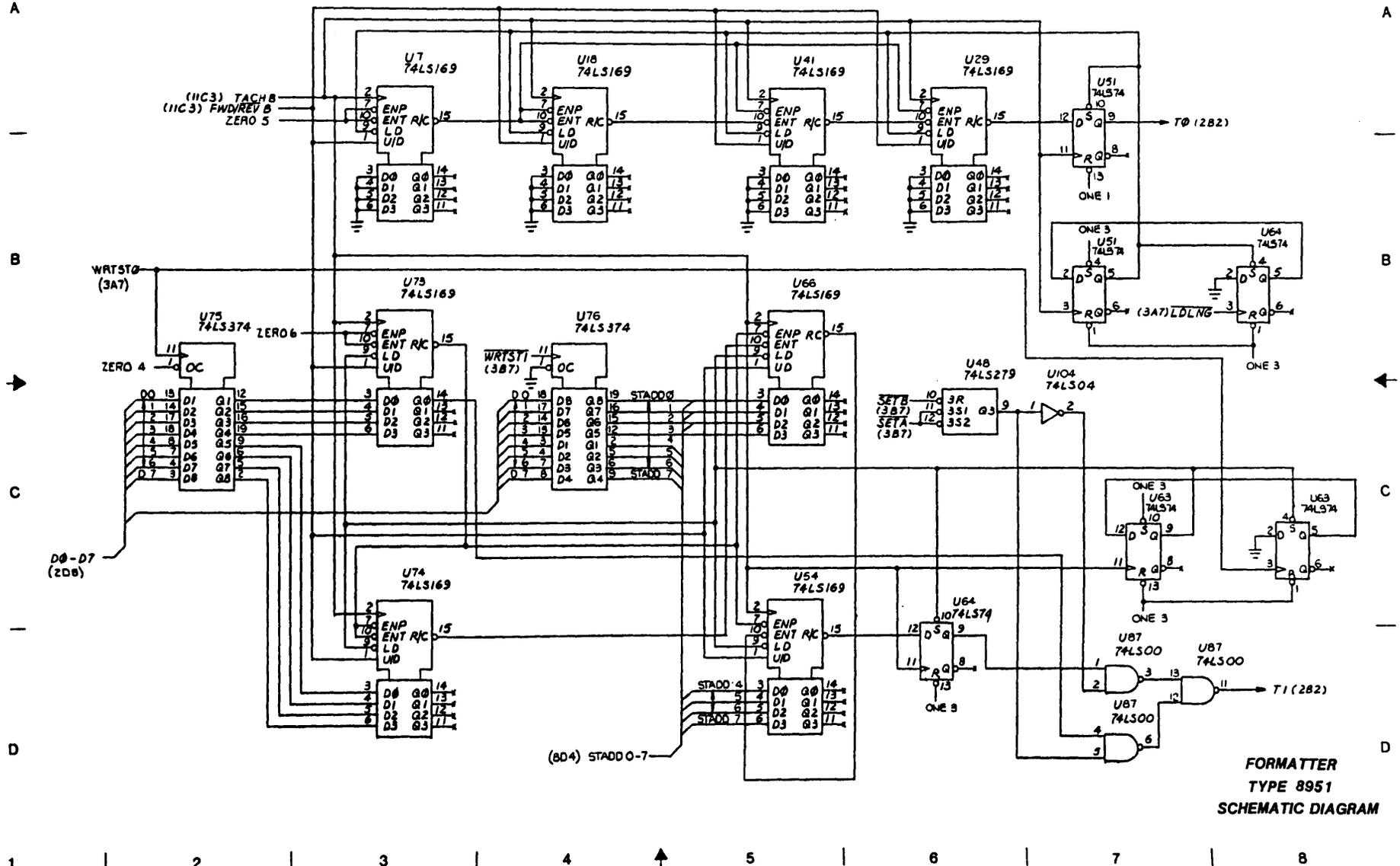
FORMATTER
TYPE 8951
SCHEMATIC DIAGRAM



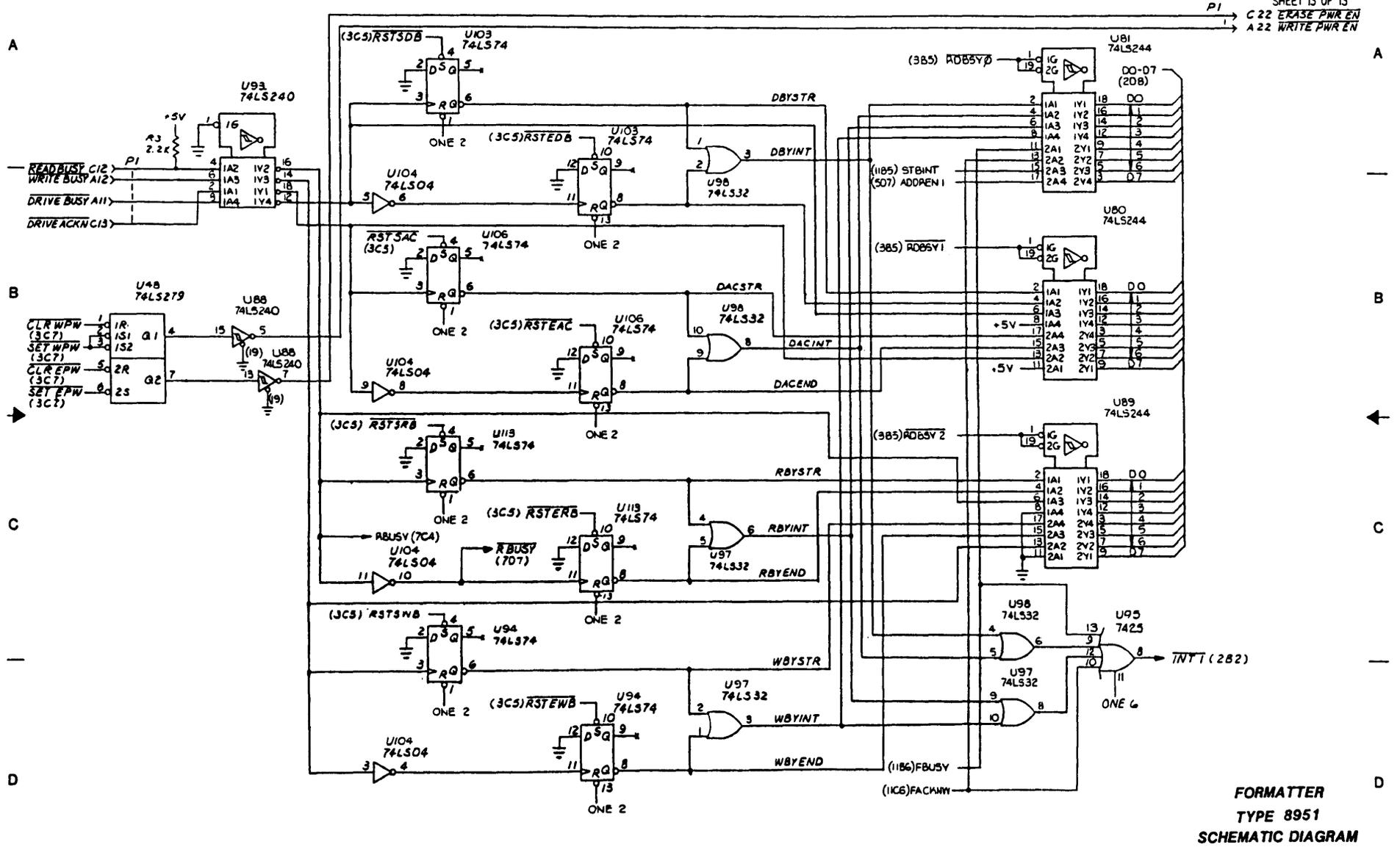
**FORMATTER
TYPE 8951
SCHEMATIC DIAGRAM**



**FORMATTER
TYPE 8951
SCHEMATIC DIAGRAM**



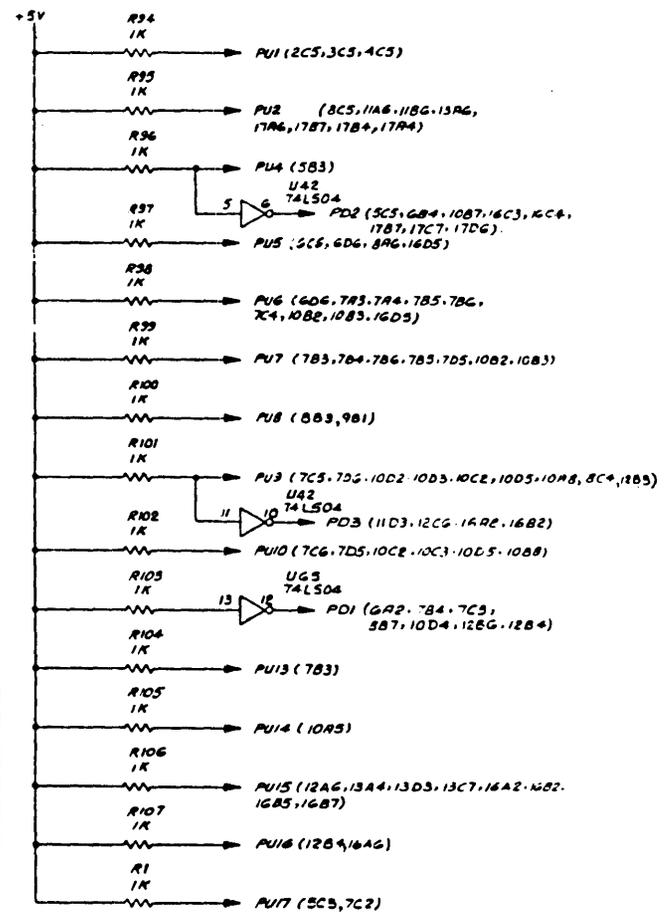
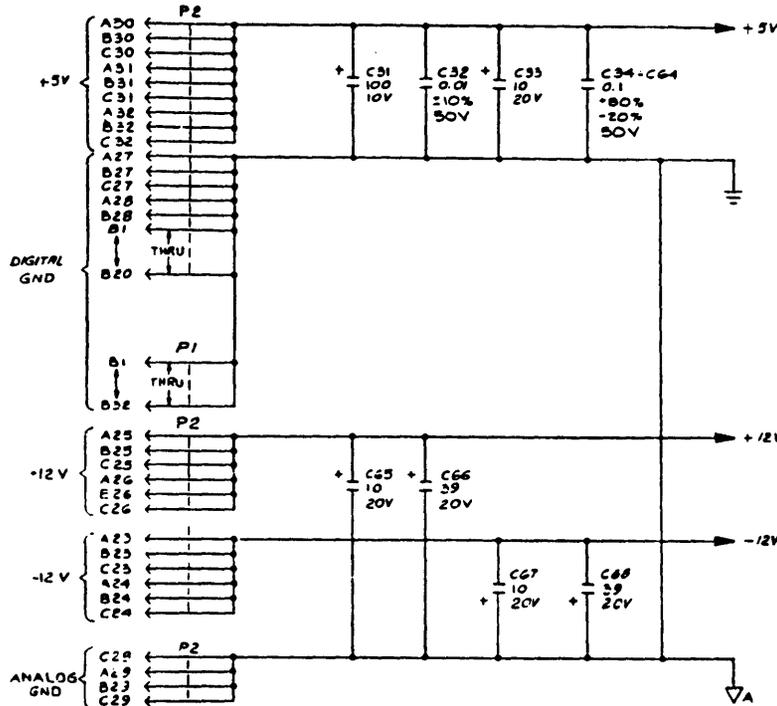
**FORMATTER
TYPE 8951
SCHEMATIC DIAGRAM**



FORMATTER
 TYPE 8951
 SCHEMATIC DIAGRAM

190-09060-TABULATION

REF DES	DASH NO		REV
	-011	A	
U12	146-00222-001		
U30	146-00224-001		
U33	146-00218-001		
U34	146-00219-001		
U44	146-00221-001		
U45	146-00220-001		
U79	146-00215-002		
U80	146-00223-002		
U48	146-00216-001		
U74	146-00217-001		
U40	146-00240-002		
U57	146-00240-002		
U90	146-00240-002		
W1	USED		
W2			
W3	USED		
W4			
W5	USED		

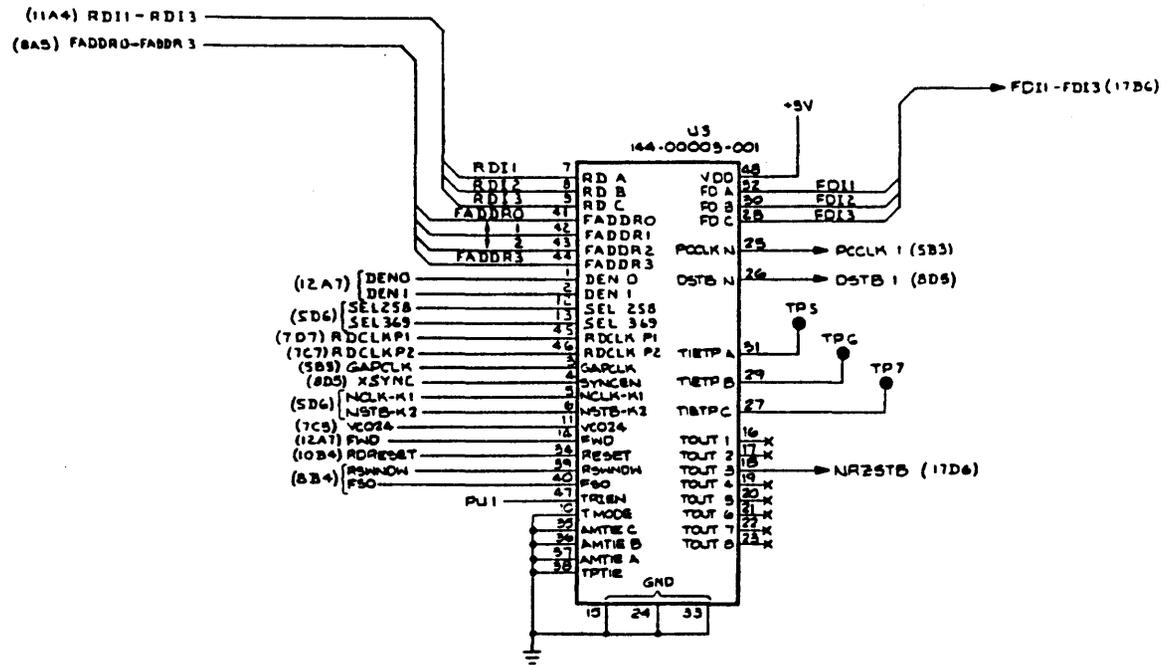


REF DES	TYPE	GND	+3V	REF DES	TYPE	GND	+5V	REF DES	TYPE	GND	+5V
U17, 18, 19	74265	8	16	U66, 75, 84	74LS243	10	20	LAST USED	NOT USED		
U43, 55, 61, 62	74LS223	10	20	U23, 64, 73	74LS257	8	16	C77			
U50	74LS00	7	14	U32, 54	74LS374	10	20	C83			
U76	74LS02	7	14	U16, 57	74LS393	7	14	L1			
U42, 63, 77	74LS04	7	14	U7	74F00	7	14	Q43			
U49, 68	74LS08	7	14	U25	74F02	7	14	R117	R33		
U52	74LS10	7	14	U6, 46, 22	74F04	7	14	TP20			
U20	74LS27	7	14	U3, 5, 29, 35, 37, 38	74F72	7	14	U23			
U36, 63, 83	74LS32	7	14	U28	74F163	8	16	U25			
U10, 26, 27, 38, 59, 60, 71	74LS74	7	14	U47	74F253	8	16	U25			
U74	74LS183	7	14	U35	74F257	8	16	YZ			
U24	74LS163	8	16	U30, 33, 34, 44, 45, 79, 80	16A48-2	10	20				
U31, 41	74LS164	7	14	U78	16A68-2	10	20				
U70	74LS175	8	16	U40, 42, 51, 90	16A88-2	10	20				
U69	74LS240	10	20	U12	16A98-2	10	20				
U54, 58, 83	74LS244	10	20	U4	74NCT98	8	16				
87, 88, 89	74LS244	10	20	U8	74NCT100	7	14				
				U26	A	7	14				

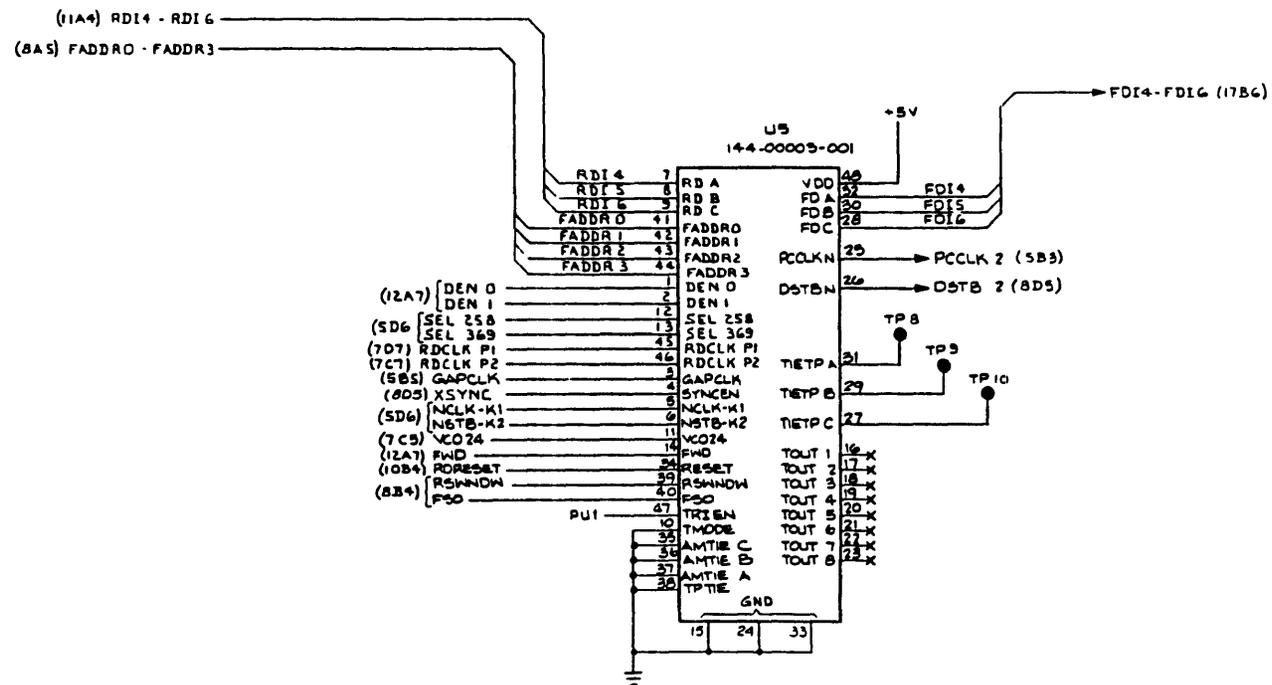
- COMPONENT LOCATION PROVIDED ON THE PCB BUT NOT USED.
- ALL TRANSISTORS ARE 2N4403
- SIGNAL OUTPUTS TO DATA AND SIGLOS (NUMBERED 1-9) CORRESPOND TO PHYSICAL TRACK LOCATIONS ON THE TAPE. THESE OUTPUTS ARE CONNECTED TO THE DATA PATH SIGNAL LINES TO AND FROM (NUMBERED 10-P) PER THE EBCD CONVENTION.
- ALL DIODES ARE 1N514.
- RESISTORS ARE IN OHMS 5%, 1/4 W.
- CAPACITORS ARE IN MICROFARADS 10% 50V

REV STATUS OF SHEETS	REV	L	L	E	E	A	E	E	J	E	E	A	J	A	E	E	E	E
SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	

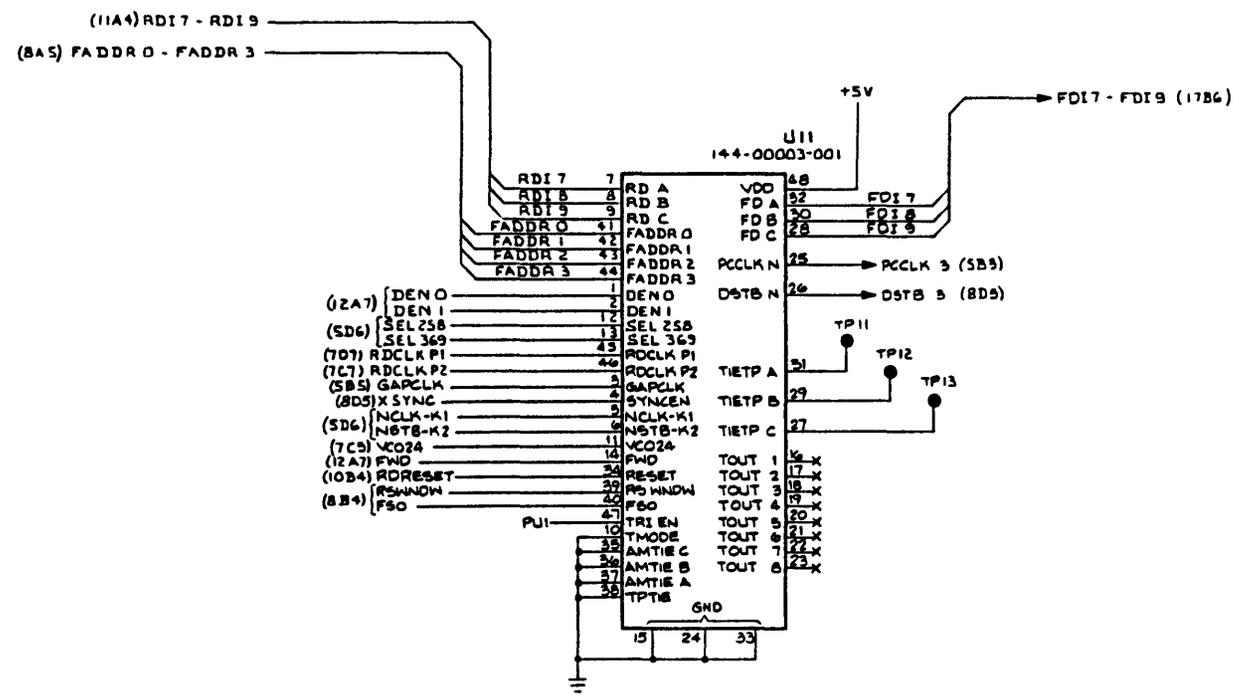
GCR Read-Write
Type 9060
Schematic Diagram



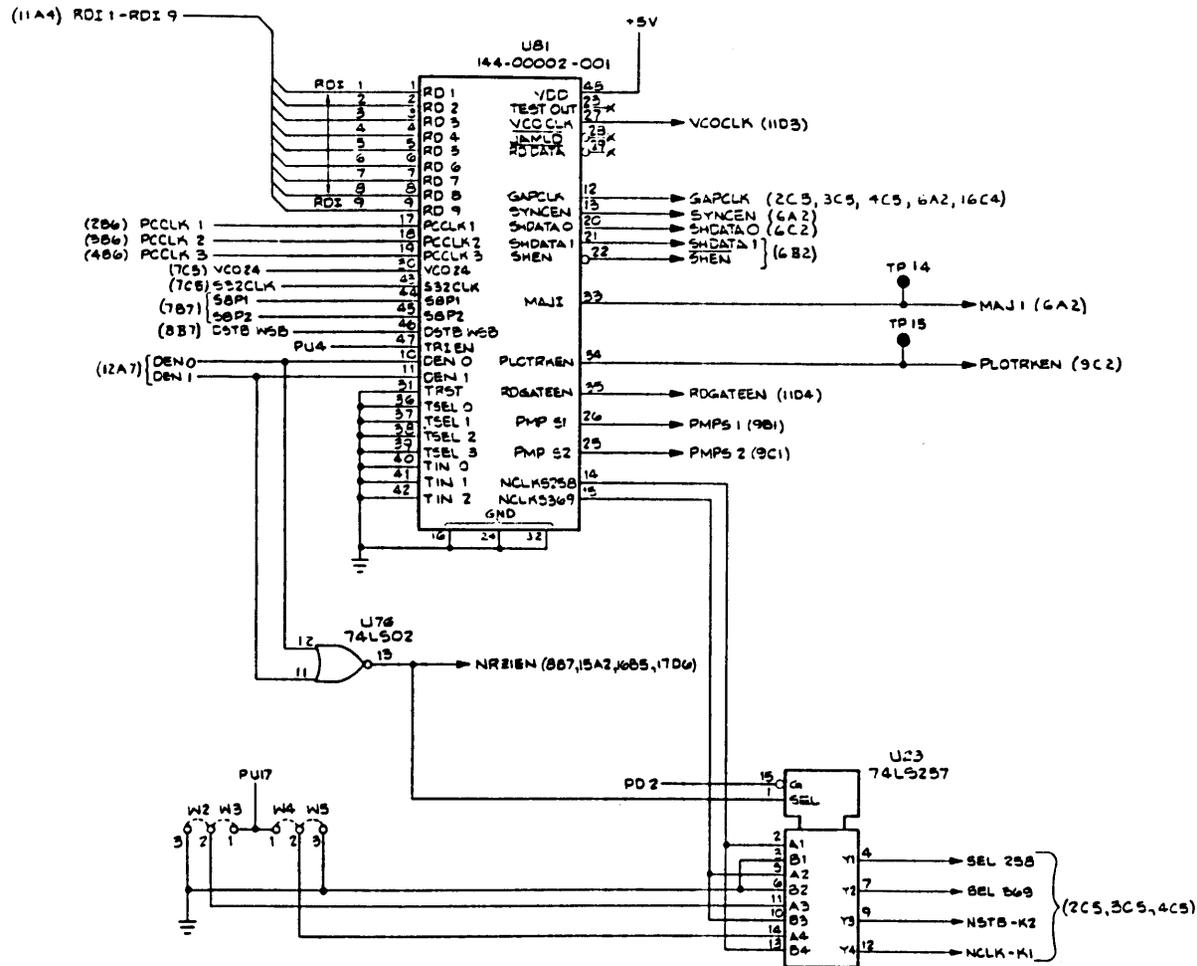
GCR Read-Write
Type 9060
Schematic Diagram



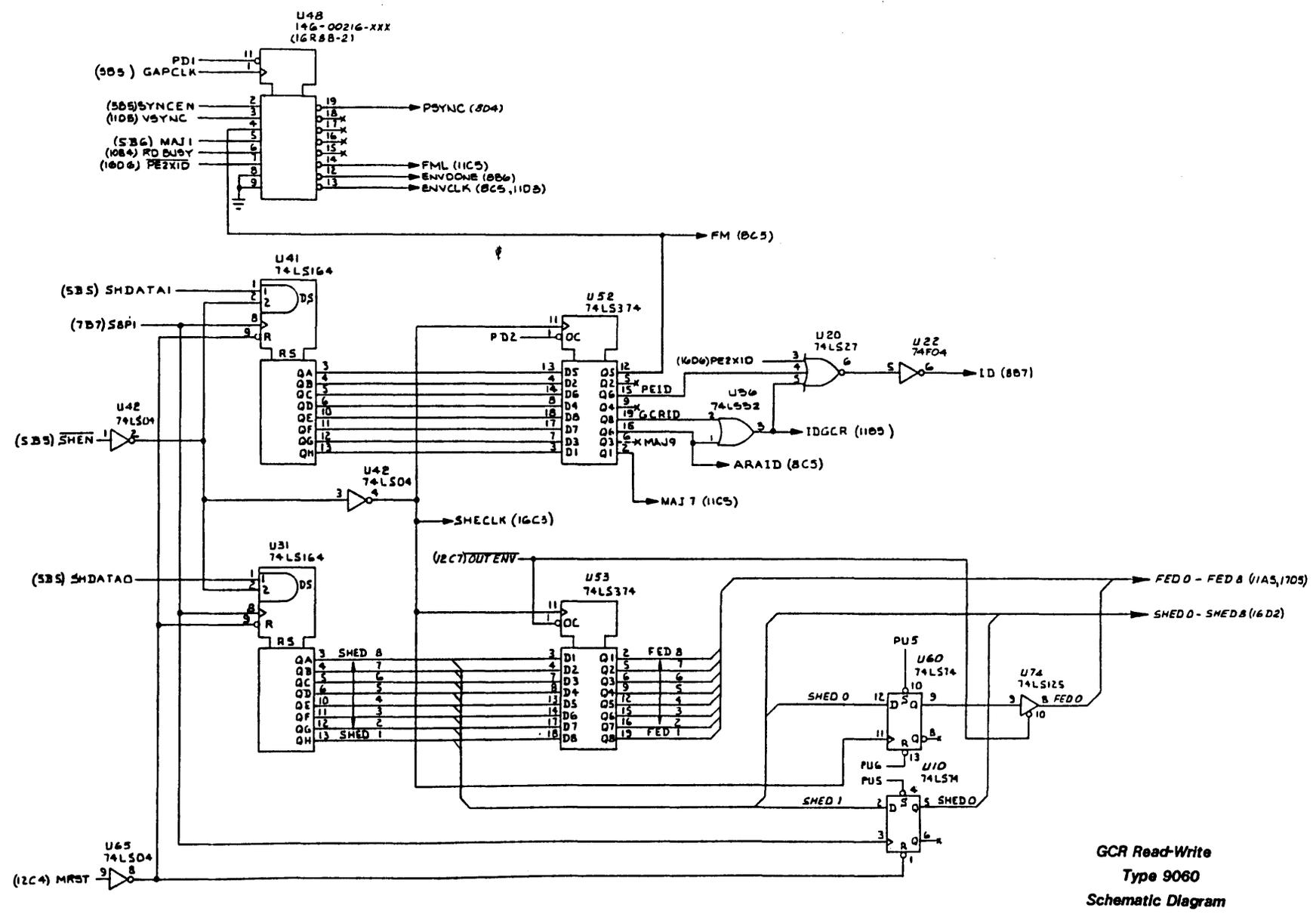
GCR Read-Write
Type 9060
Schematic Diagram



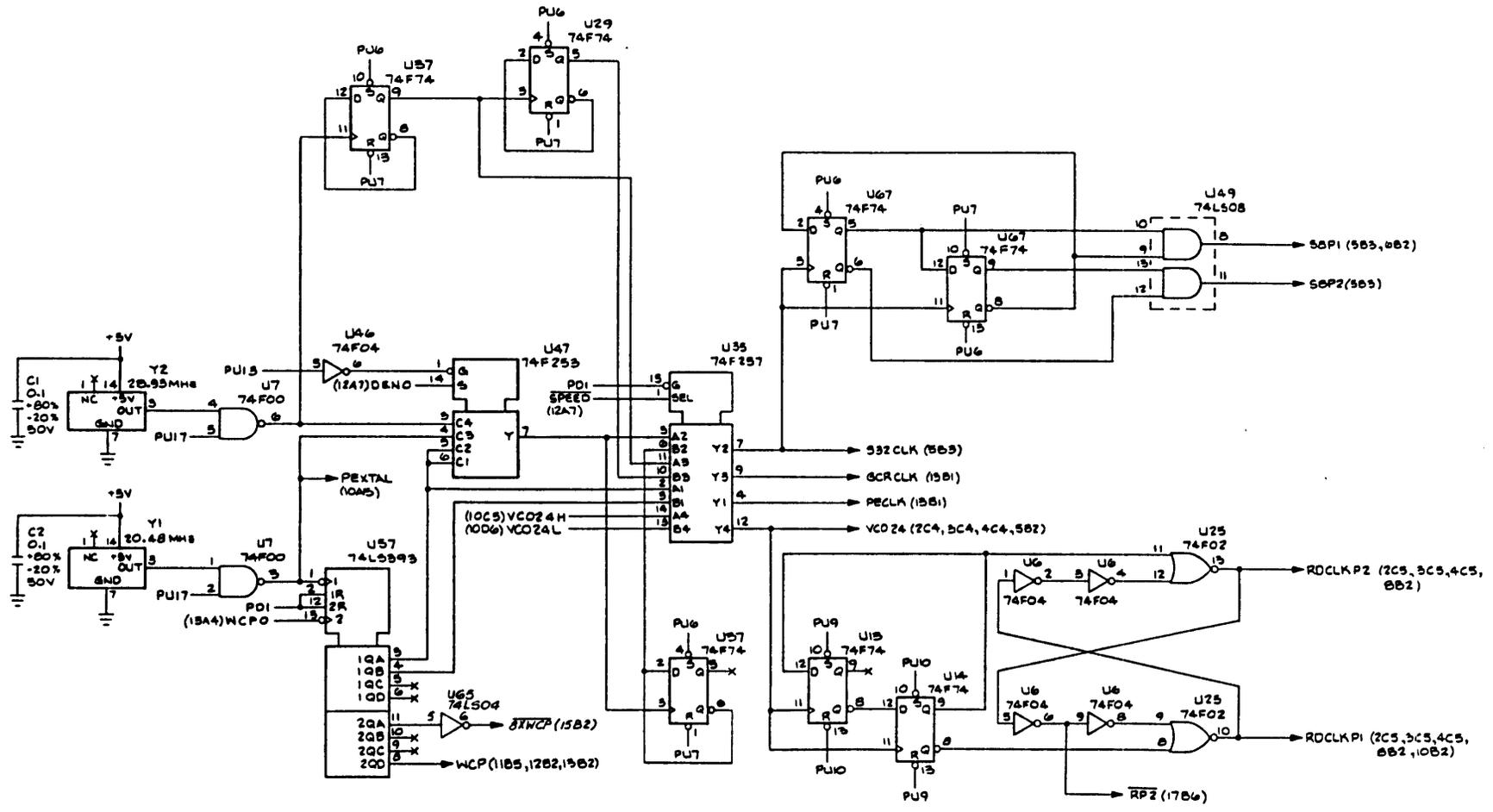
GCR Read-Write
Type 9060
Schematic Diagram



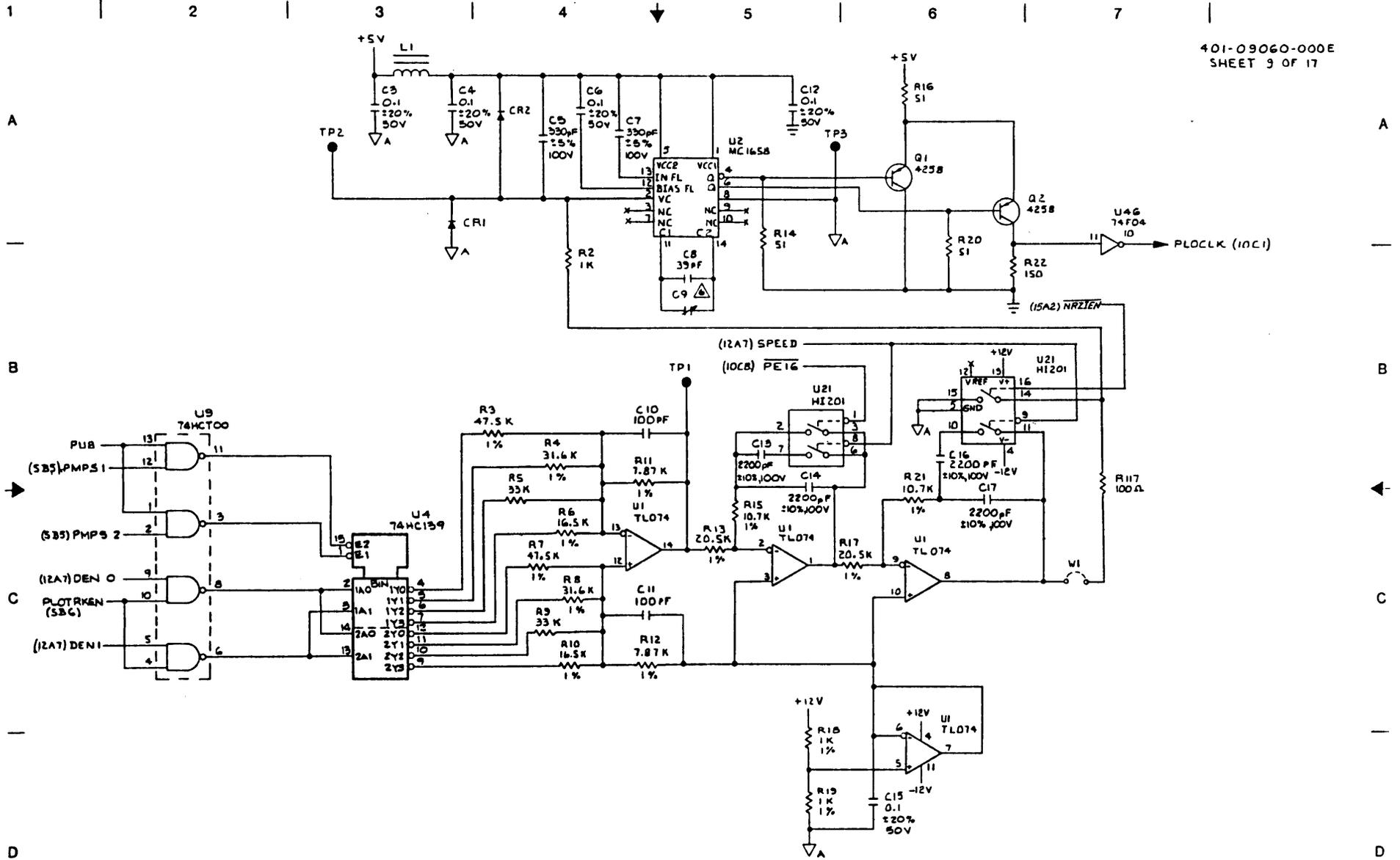
GCR Read-Write
Type 9060
Schematic Diagram



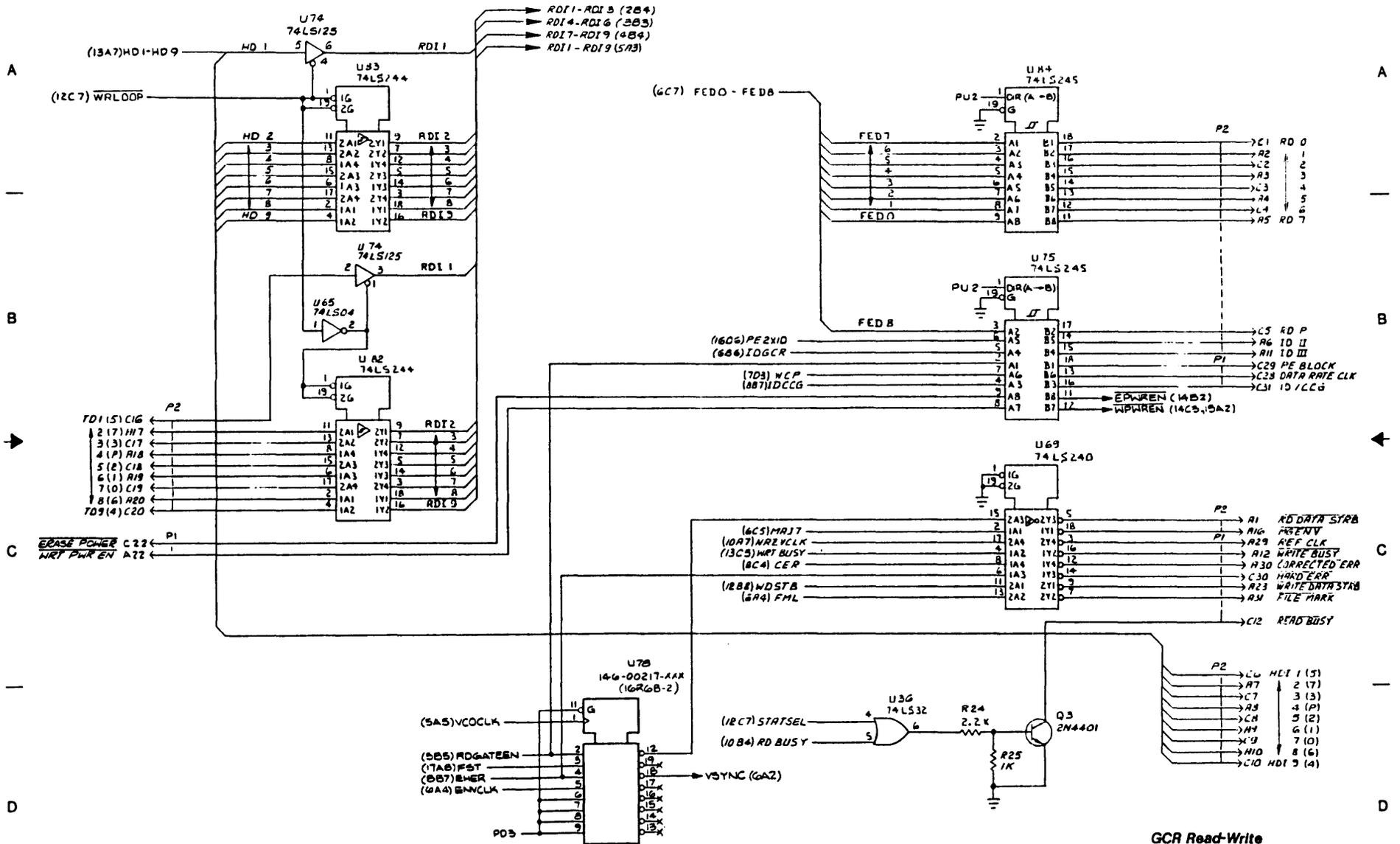
GCR Read-Write
Type 9060
Schematic Diagram



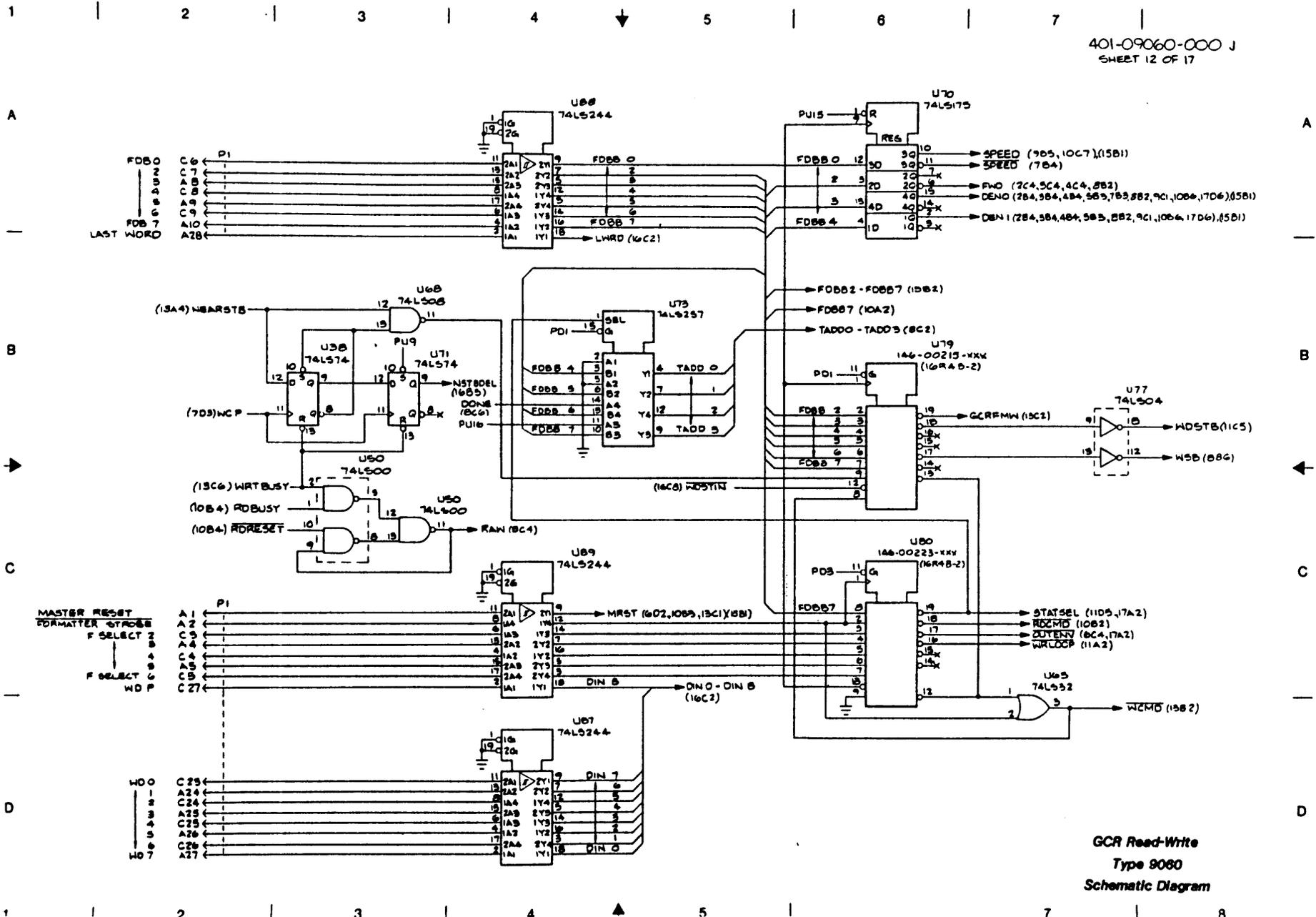
GCR Read-Write
Type 9060
Schematic Diagram



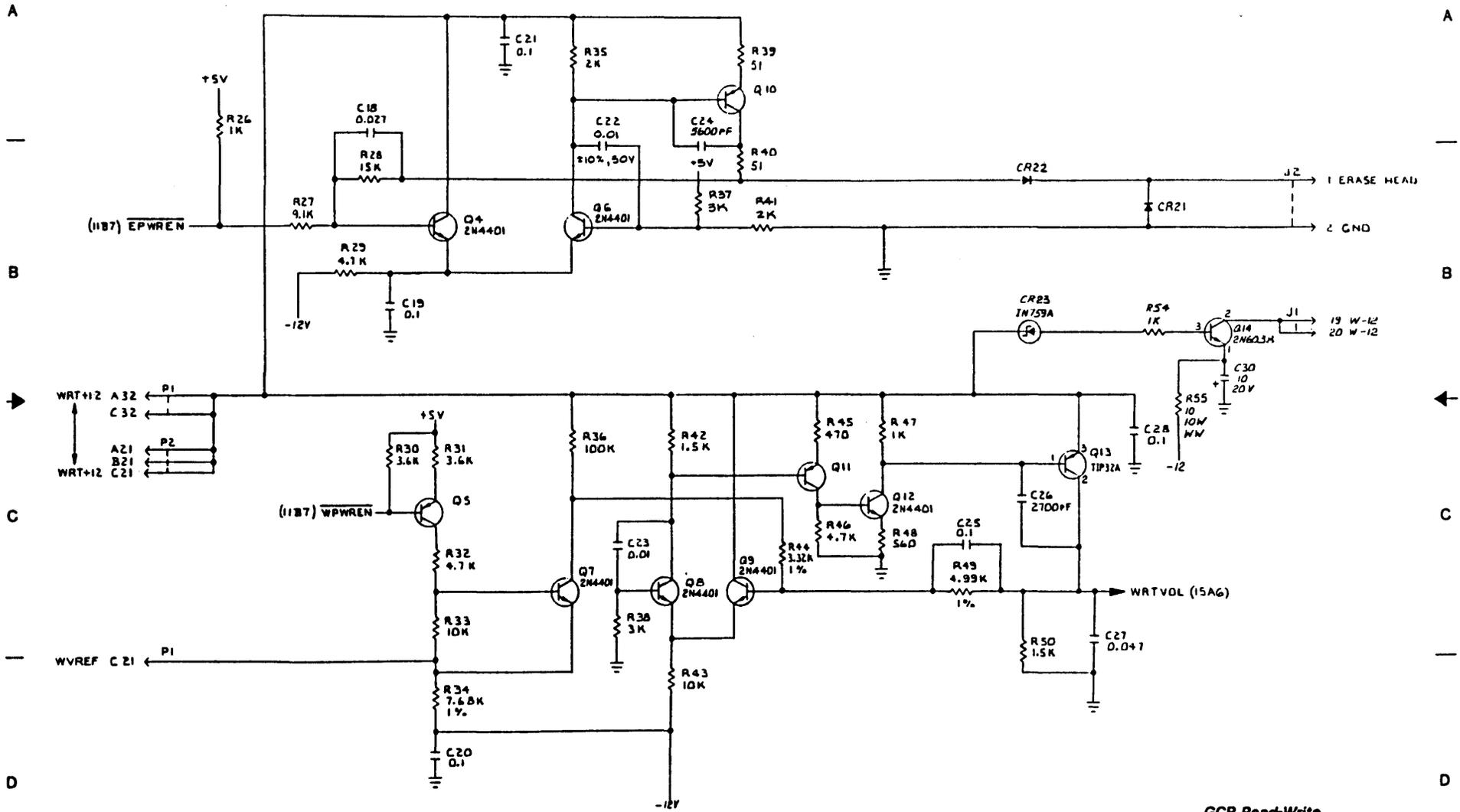
GCR Read-Write
Type 9060
Schematic Diagram



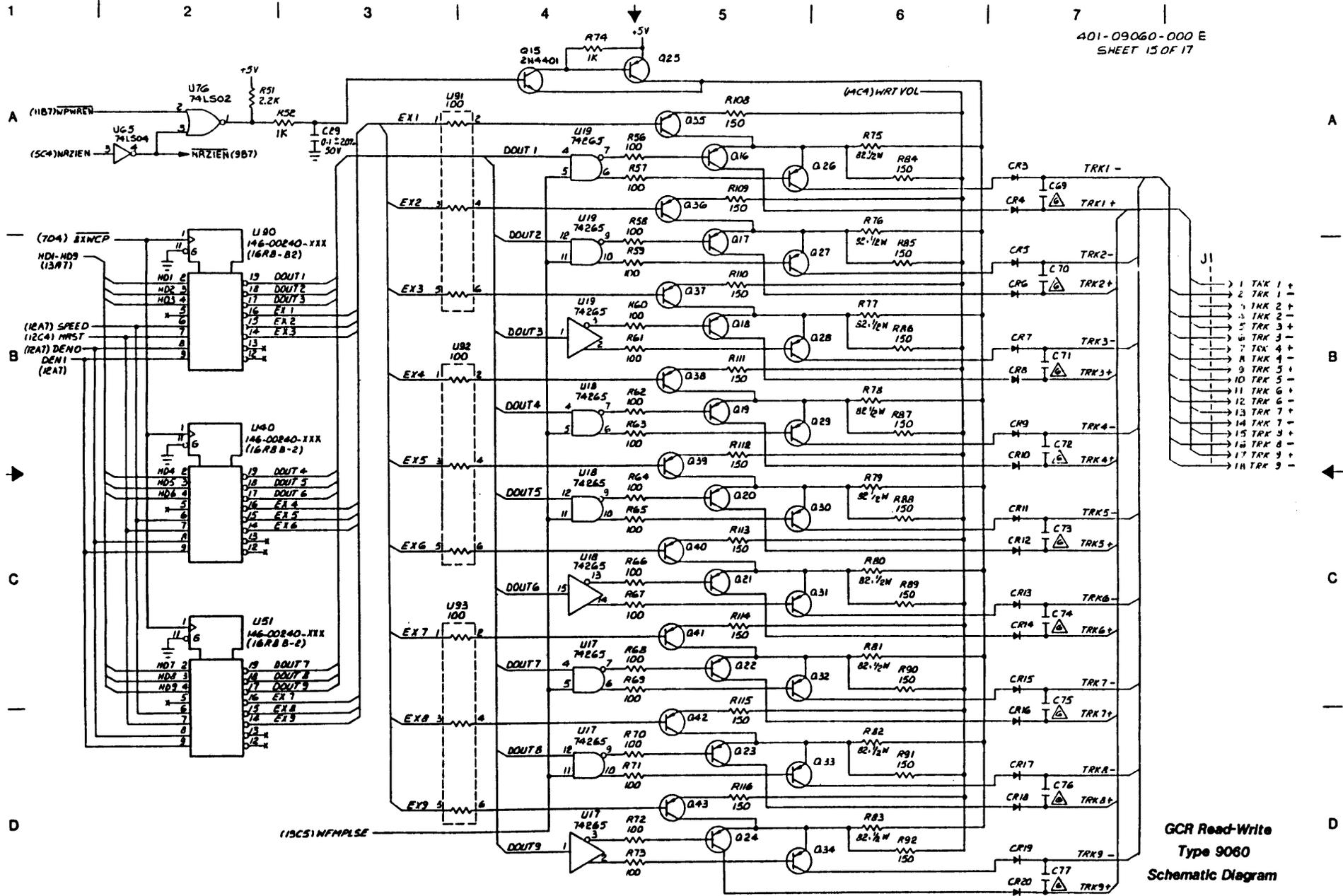
GCR Read-Write
Type 9060
Schematic Diagram



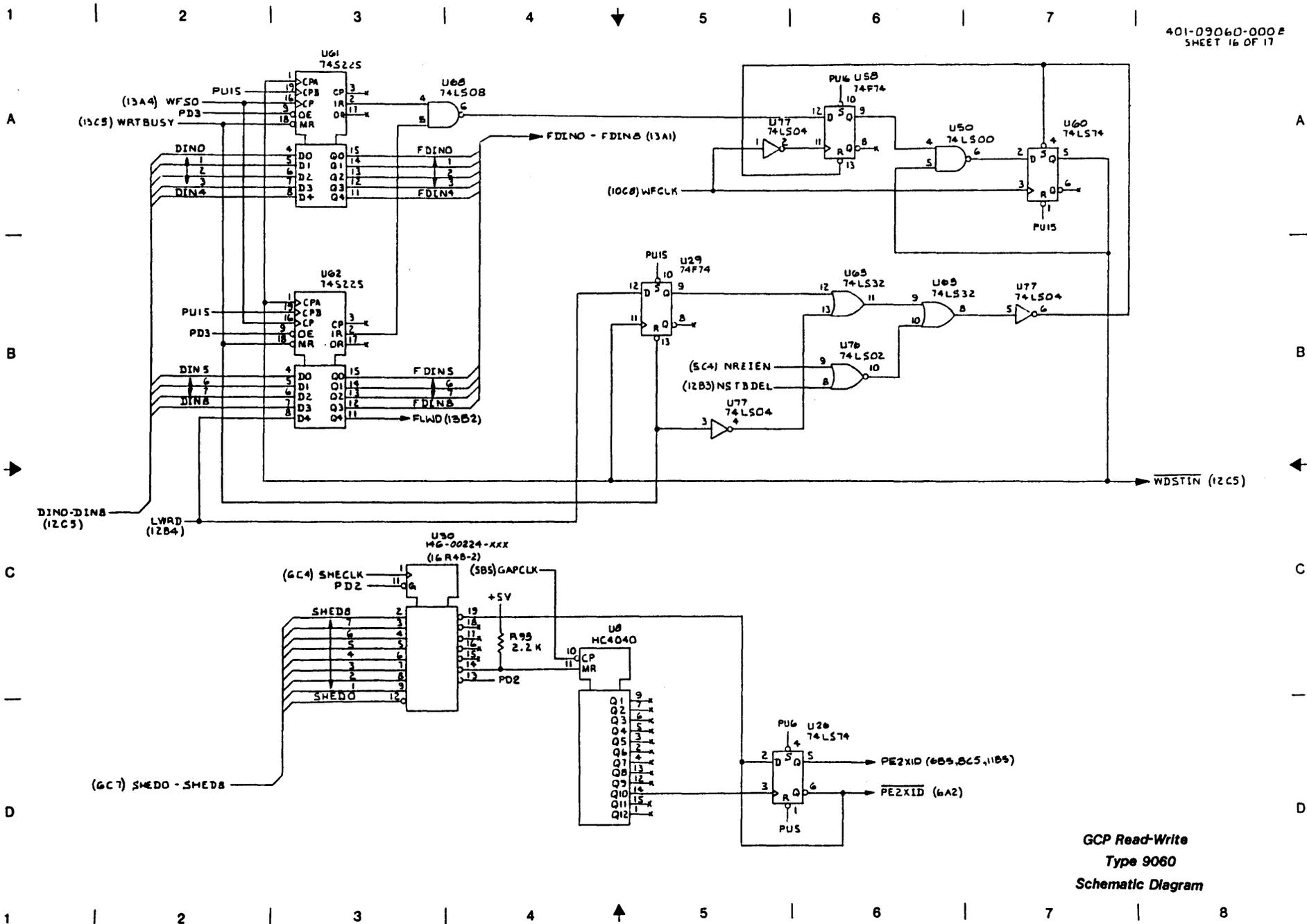
GCR Read-Write
Type 9060
Schematic Diagram



GCR Read-Write
Type 9060
Schematic Diagram

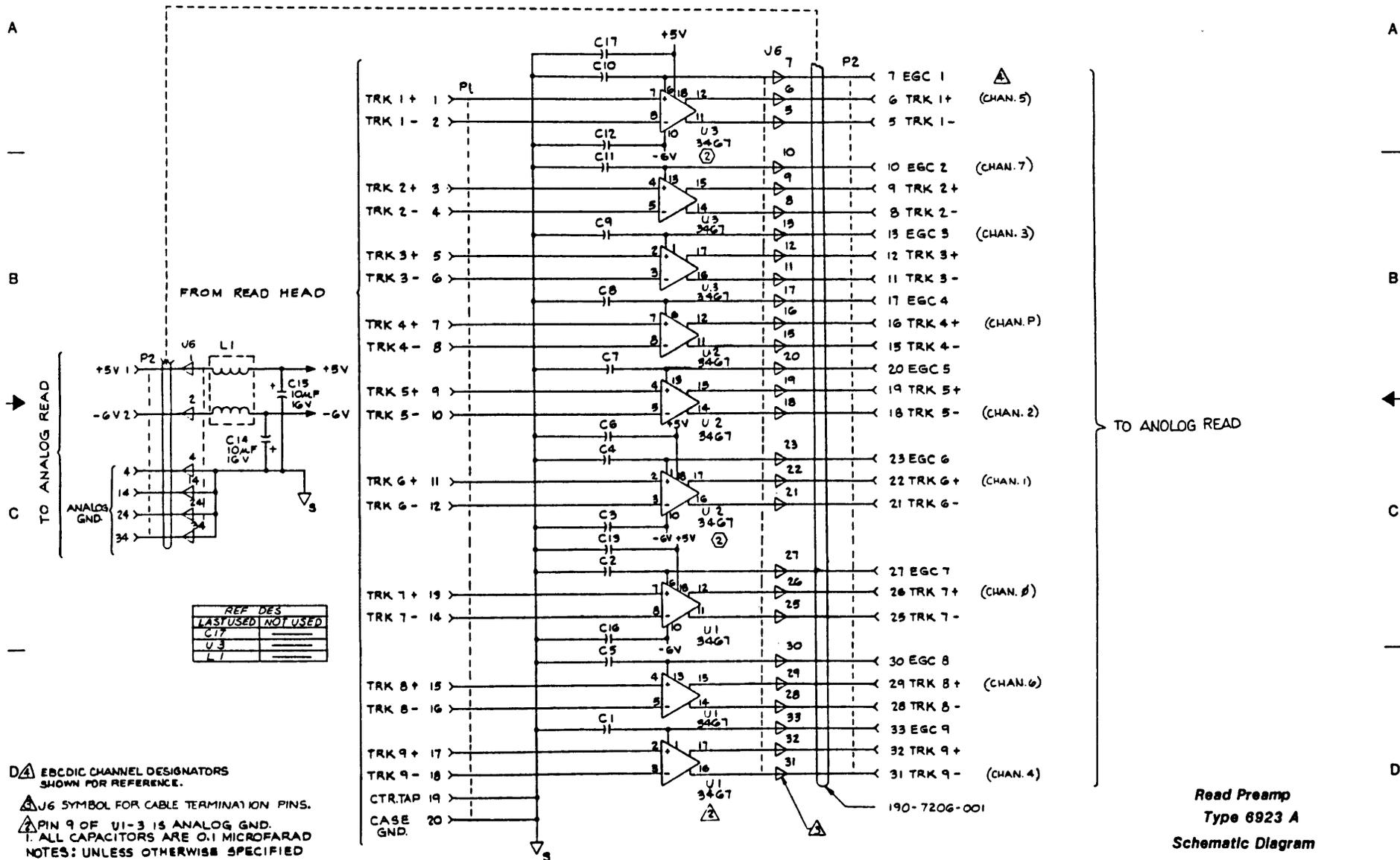


GCR Read-Write
Type 9060
Schematic Diagram



GCP Read-Write
Type 9060
Schematic Diagram

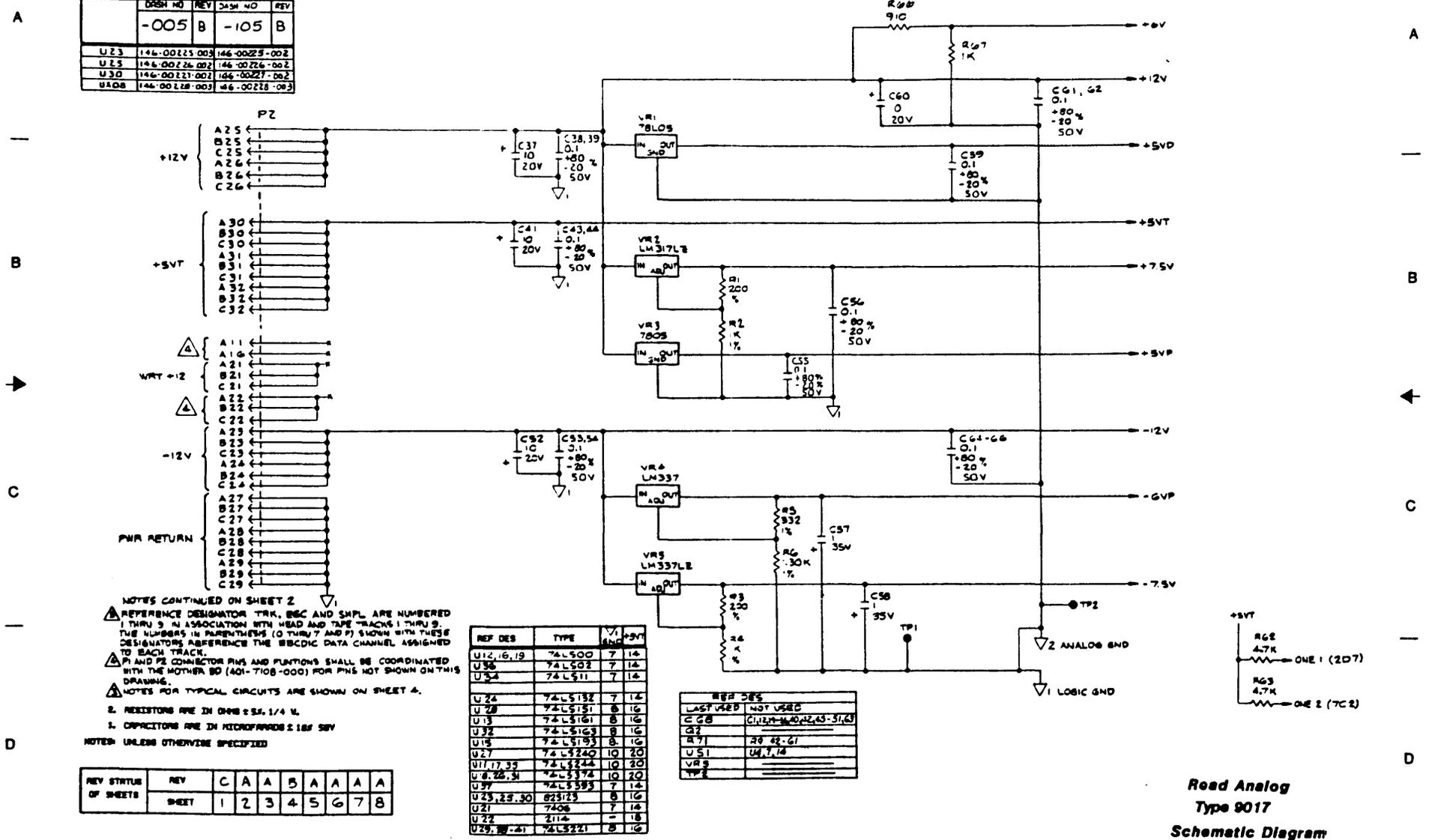
1 | 2 | 3 | 4 | 5 | 6 | 7 | 8



1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

190-09017-XXX REGULATION

DESIGN NO	REV	ISSUE NO	REV
-005	B	-105	B
U 23	146-00223-003	146-00223-002	
U 25	146-00225-002	146-00226-002	
U 30	146-00227-002	146-00227-002	
U 40B	146-00228-003	146-00228-003	



- NOTES CONTINUED ON SHEET 2
- ▲ REFERENCE DESIGNATOR TRK, SEC AND SPL ARE NUMBERED 1 THRU 9 IN ASSOCIATION WITH HEAD AND TAPE TRACKS 1 THRU 9. THE NUMBERS IN PARENTHESES (10 THRU 7 AND P) SHOWN WITH THESE DESIGNATORS REFERENCE THE BSCDIC DATA CHANNEL ASSIGNED TO EACH TRACK.
 - ▲ P1 AND P2 CONNECTOR PINS AND FUNCTIONS SHALL BE COORDINATED WITH THE MOTHER BD (401-7108-000) FOR PINS NOT SHOWN ON THIS DRAWING.
 - ▲ NOTES FOR TYPICAL CIRCUITS ARE SHOWN ON SHEET A.

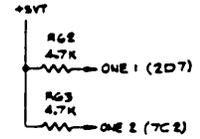
1. RESISTORS ARE IN OHMS ± 5%, 1/4 W.
2. CAPACITORS ARE IN MICROFARADS ± 10% 50V

NOTES UNLESS OTHERWISE SPECIFIED

REV STATUS OF SHEETS	REV	C	A	A	B	A	A	A	A
SHEET	1	2	3	4	5	6	7	8	

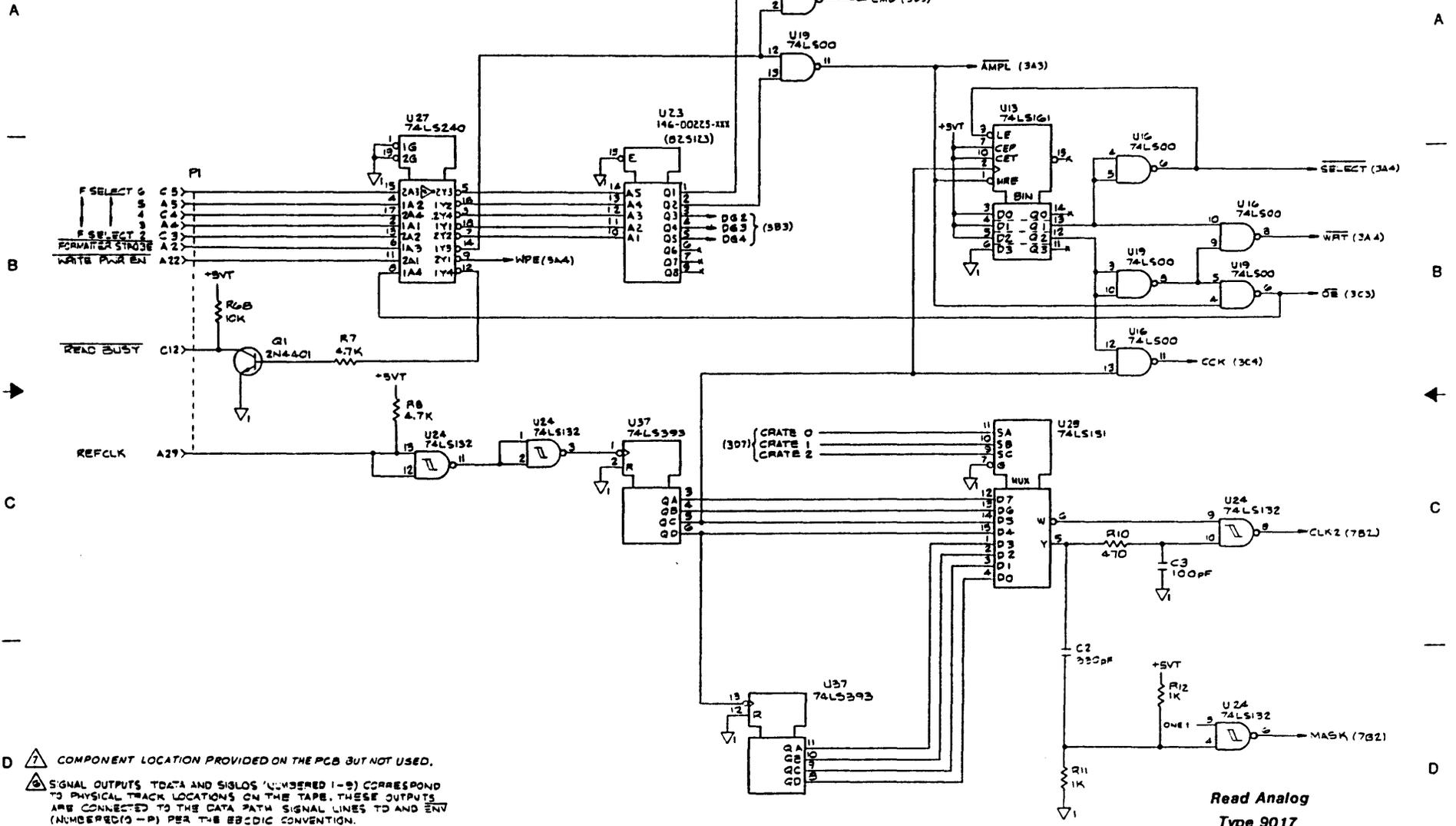
REF DES	TYPE	QTY	REV
U12, 16, 19	74LS00	7	1A
U30	74LS02	7	1A
U34	74LS11	7	1A
U 24	74LS132	7	1A
U 28	74LS151	8	1G
U 13	74LS161	8	1G
U 32	74LS163	8	1G
U 15	74LS193	8	1G
U 17	74LS240	10	2D
U 17, 35	74LS244	10	2D
U 8, 26, 31	74LS374	10	2D
U 37	74LS593	7	1A
U 23, 25, 30	82S123	8	1G
U 21	7406	7	1A
U 22	214	-	1B
U 29, 30, 41	74LS221	8	1G

REF DES	LAST USED	NOT USED
C 28	01/27/80	02/24/81
R 71	08/22/81	
U 51	04/7/80	
VR 5		
TP 2		



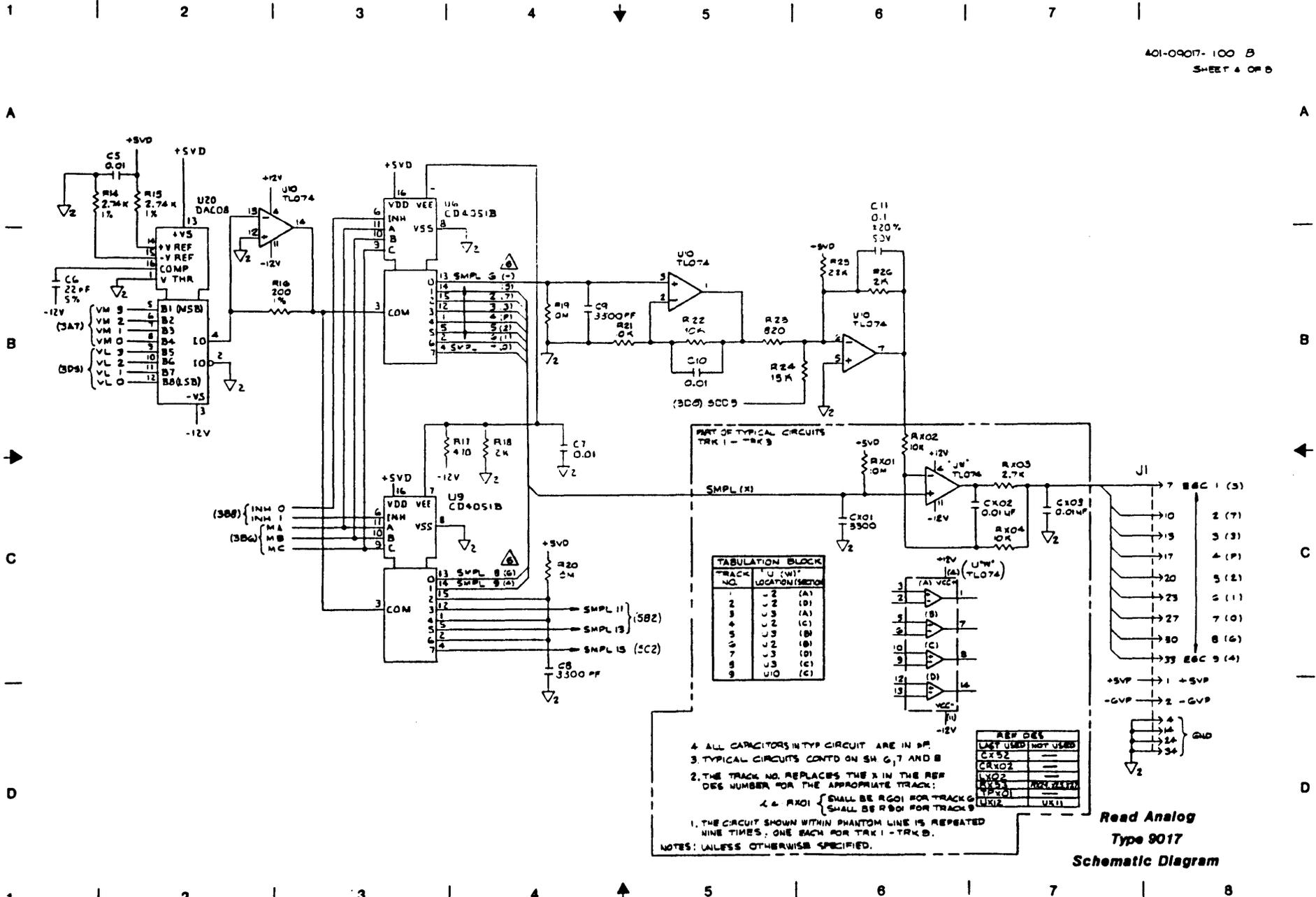
Read Analog
Type 9017
Schematic Diagram

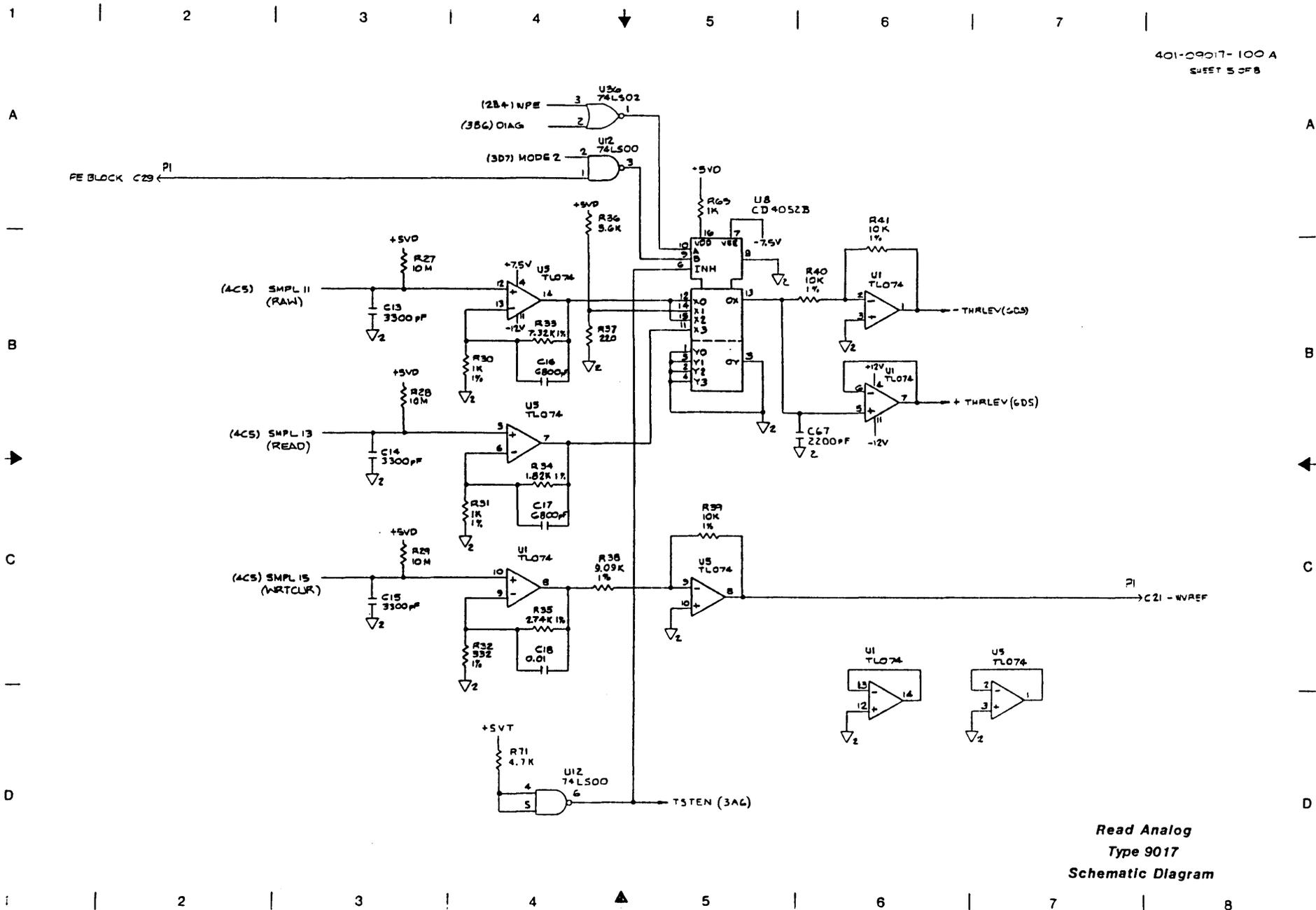
These drawings and specifications are the property of General Company and shall not be reproduced or used in the manufacture or sale of equipment without permission.



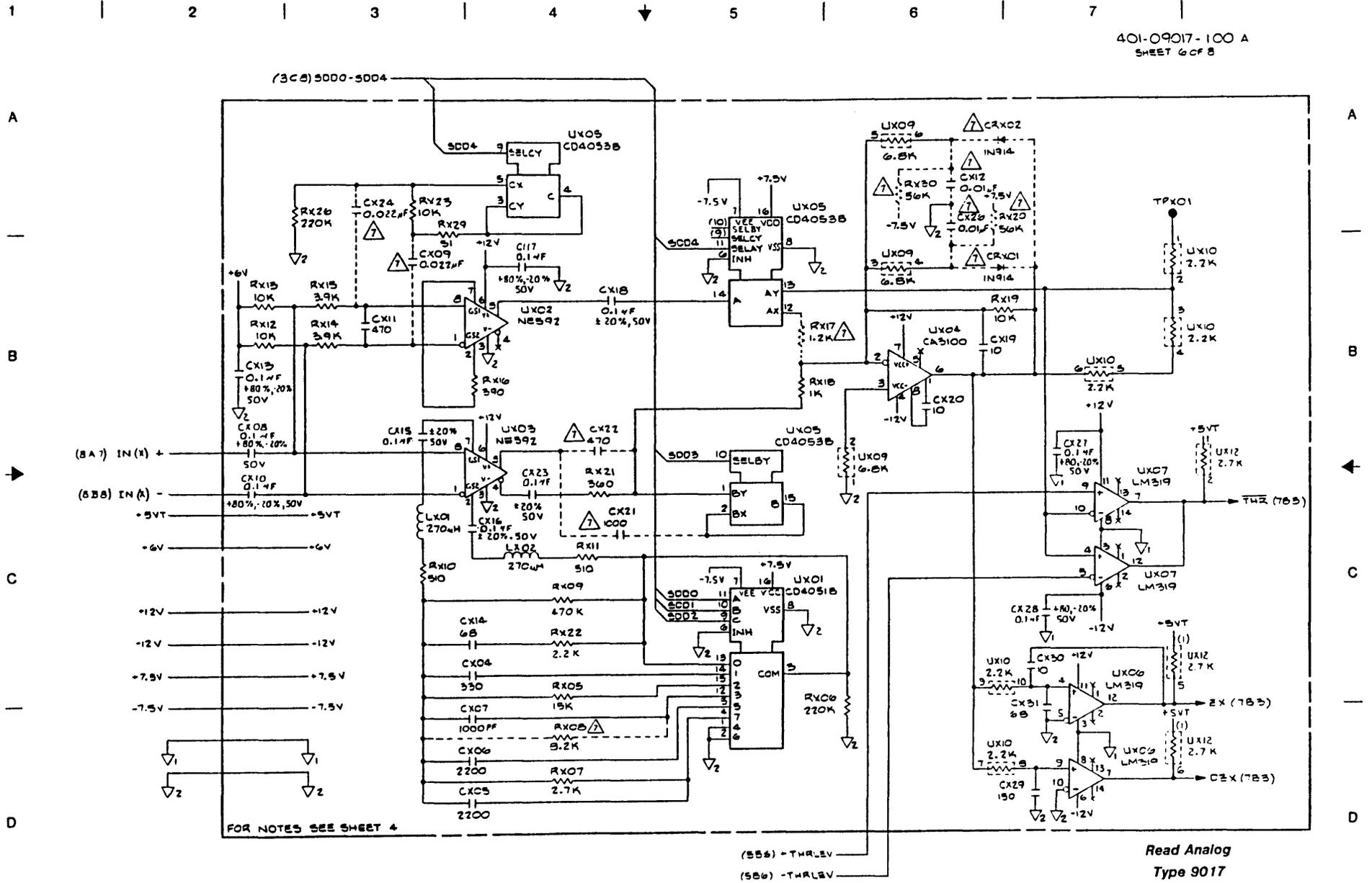
- D COMPONENT LOCATION PROVIDED ON THE PCB BUT NOT USED.
- SIGNAL OUTPUTS TDATA AND SISLOS (NUMBERED 1-8) CORRESPOND TO PHYSICAL TRACK LOCATIONS ON THE TAPE. THESE OUTPUTS ARE CONNECTED TO THE DATA PATH SIGNAL LINES TO AND ENV (NUMBERED 10-17) PER THE EBCDIC CONVENTION.

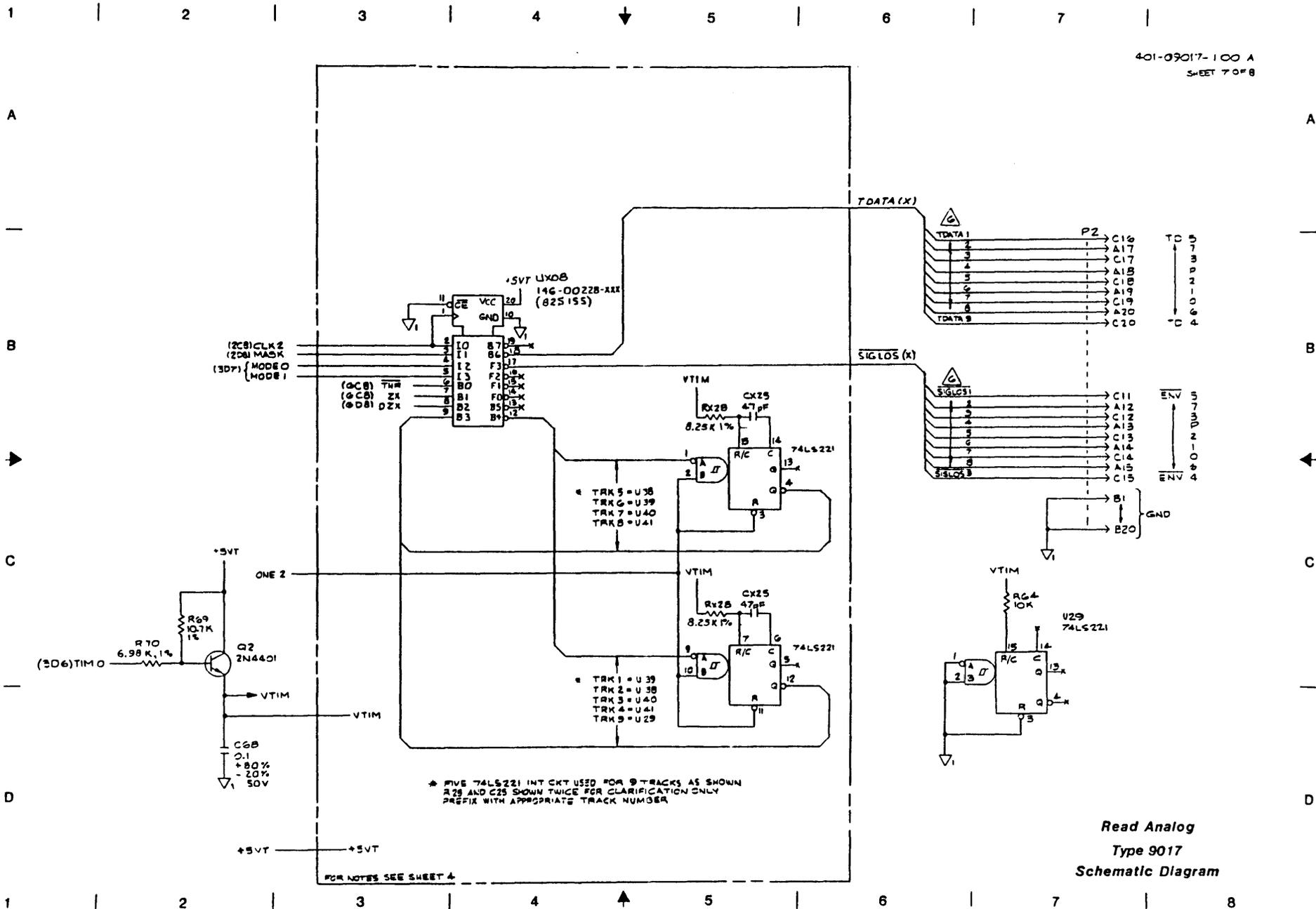
Read Analog
Type 9017
Schematic Diagram

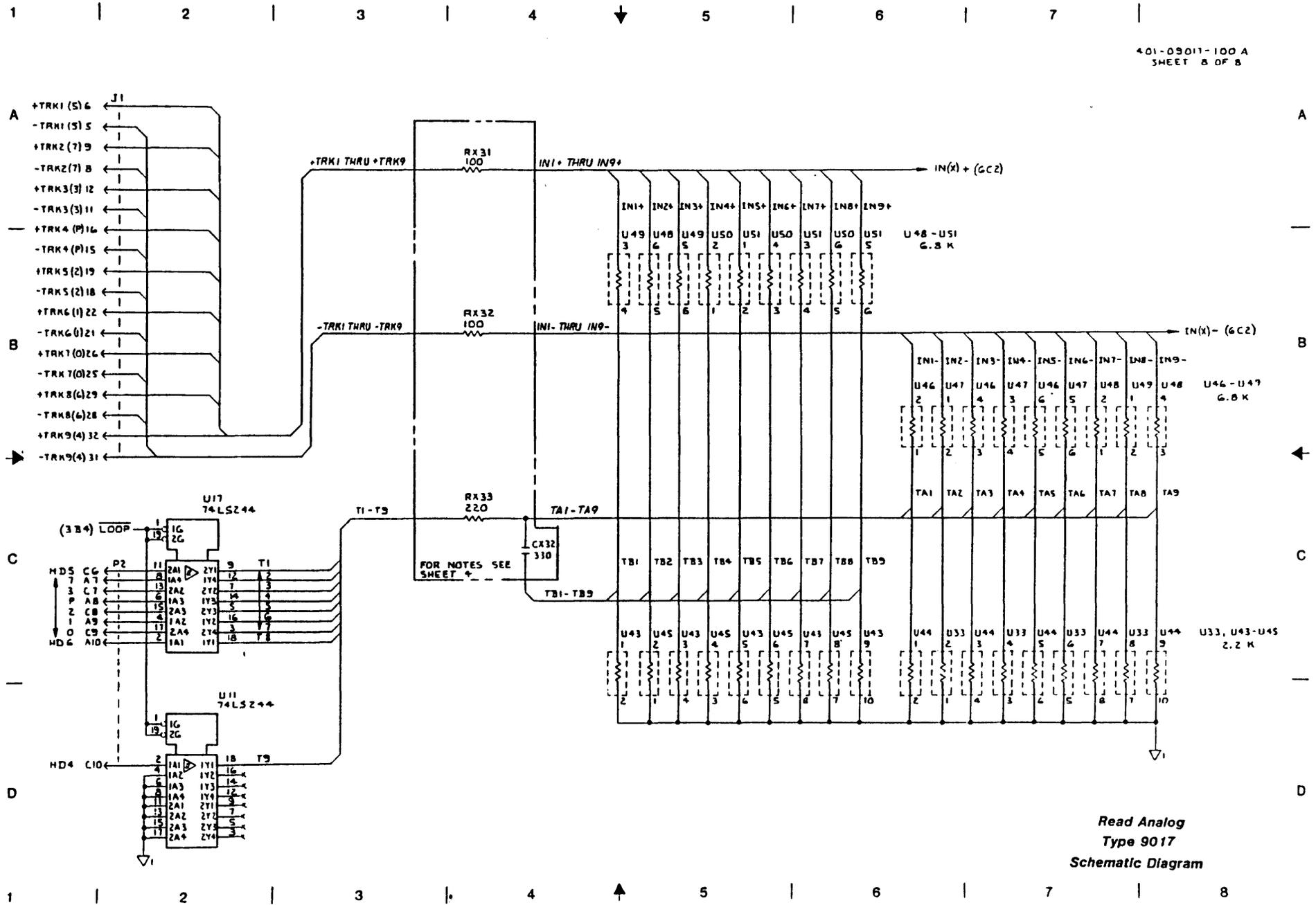




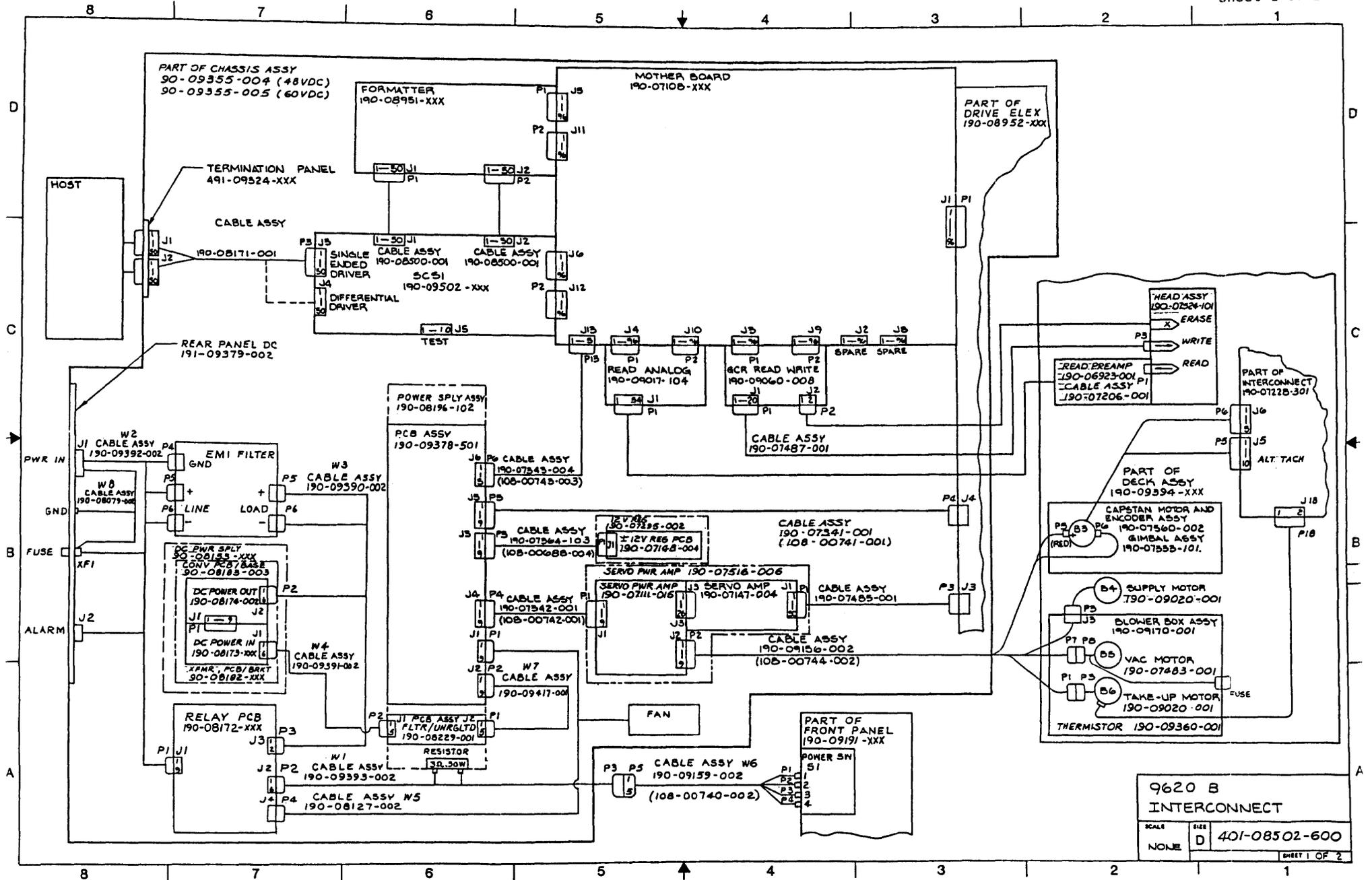
Read Analog
Type 9017
Schematic Diagram



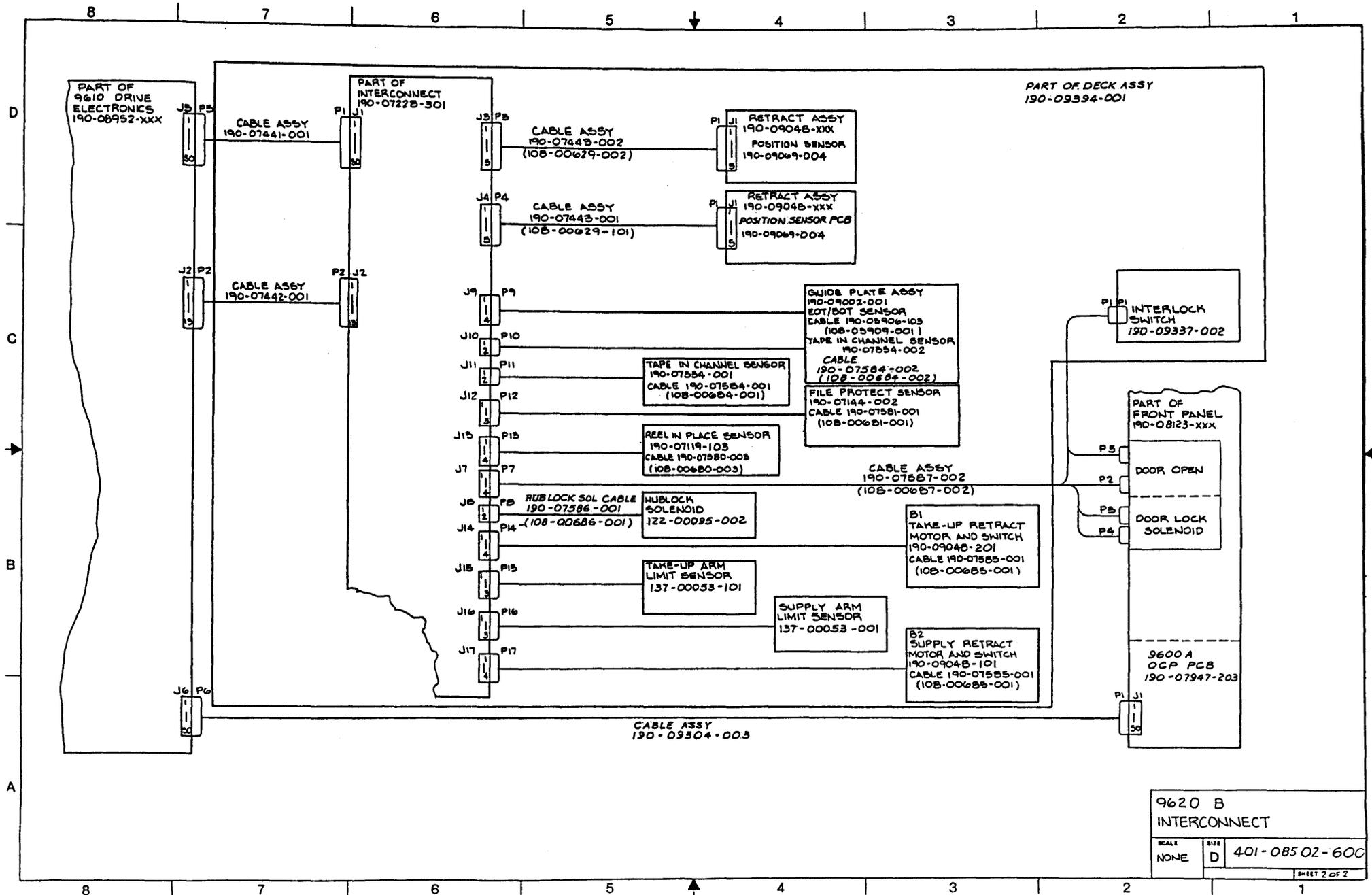




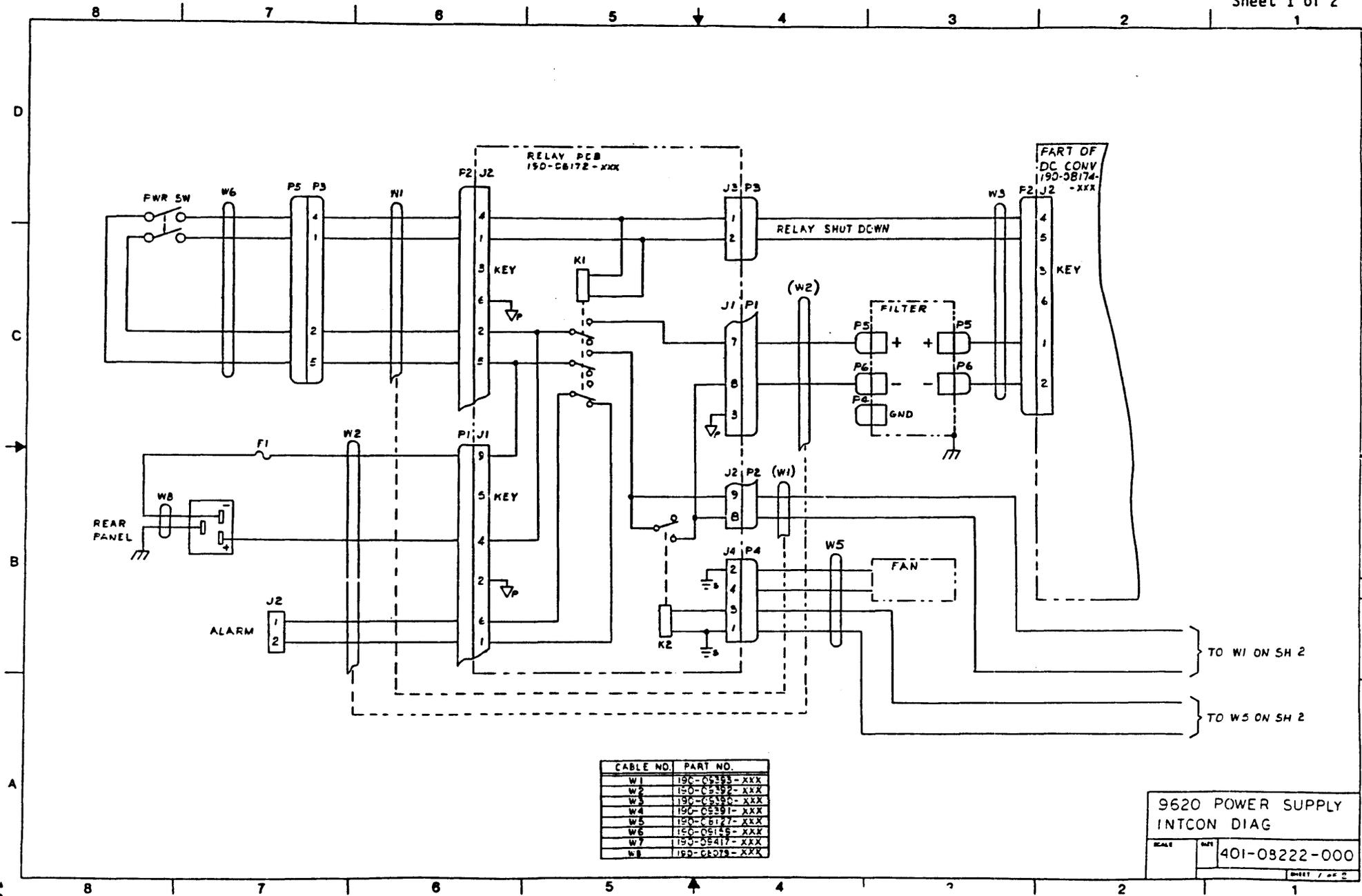
Read Analog
Type 9017
Schematic Diagram



9620 B	
INTERCONNECT	
SCALE	NONE
SIZE	D
401-08502-600	
SHEET 1 OF 2	



9620 B INTERCONNECT	
SCALE NONE	SIZE D 401-08502-600
SHEET 2 OF 2	

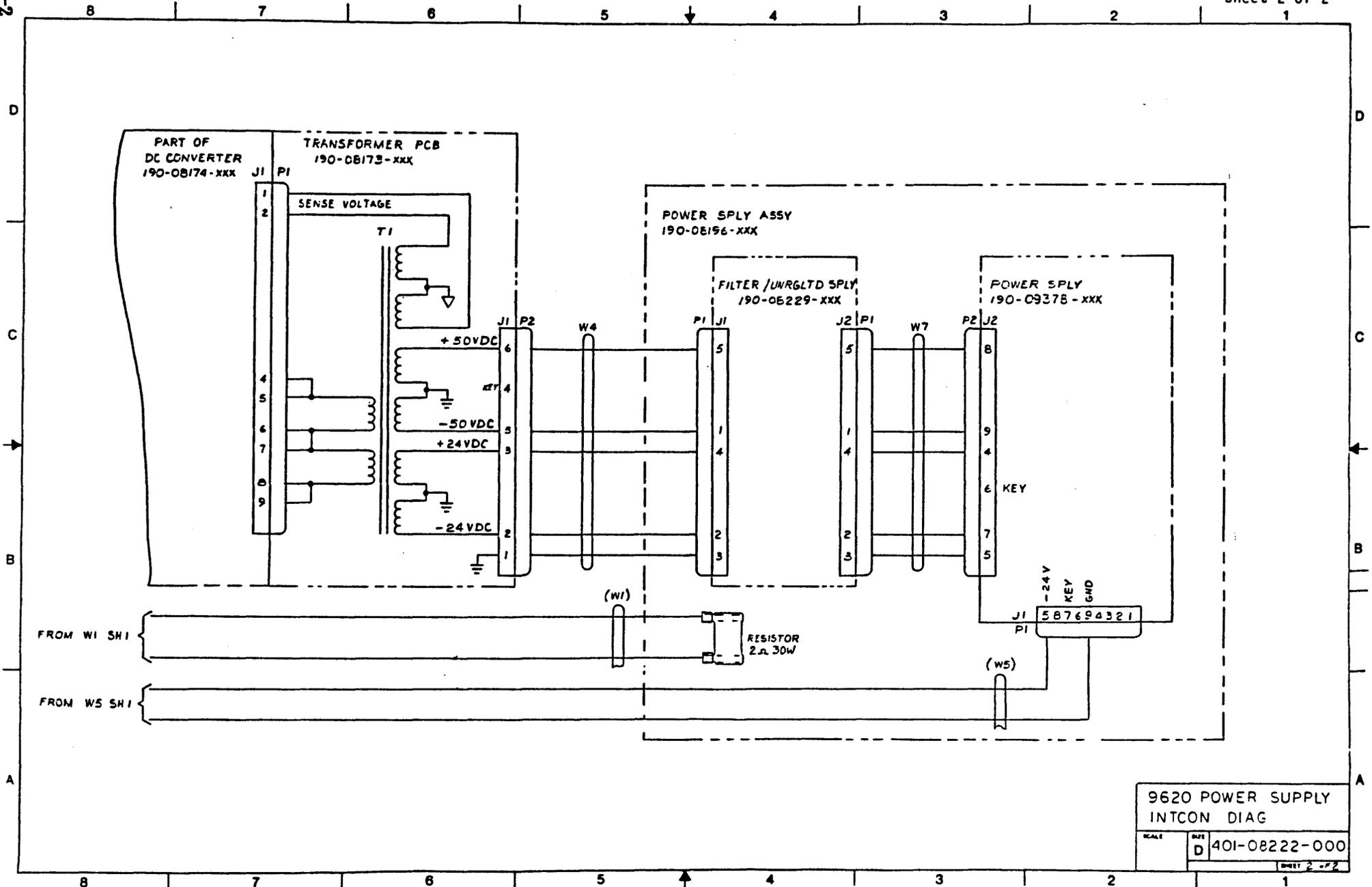


CABLE NO.	PART NO.
W1	190-C5383-XXX
W2	150-C5392-XXX
W3	190-C5350-XXX
W4	190-C5391-XXX
W5	150-C6172-XXX
W6	150-C6145-XXX
W7	150-C6417-XXX
W8	190-C6079-XXX

9620 POWER SUPPLY
INTCON DIAG

SCALE	DATE	401-08222-000
		SHEET 1 OF 2

16-2

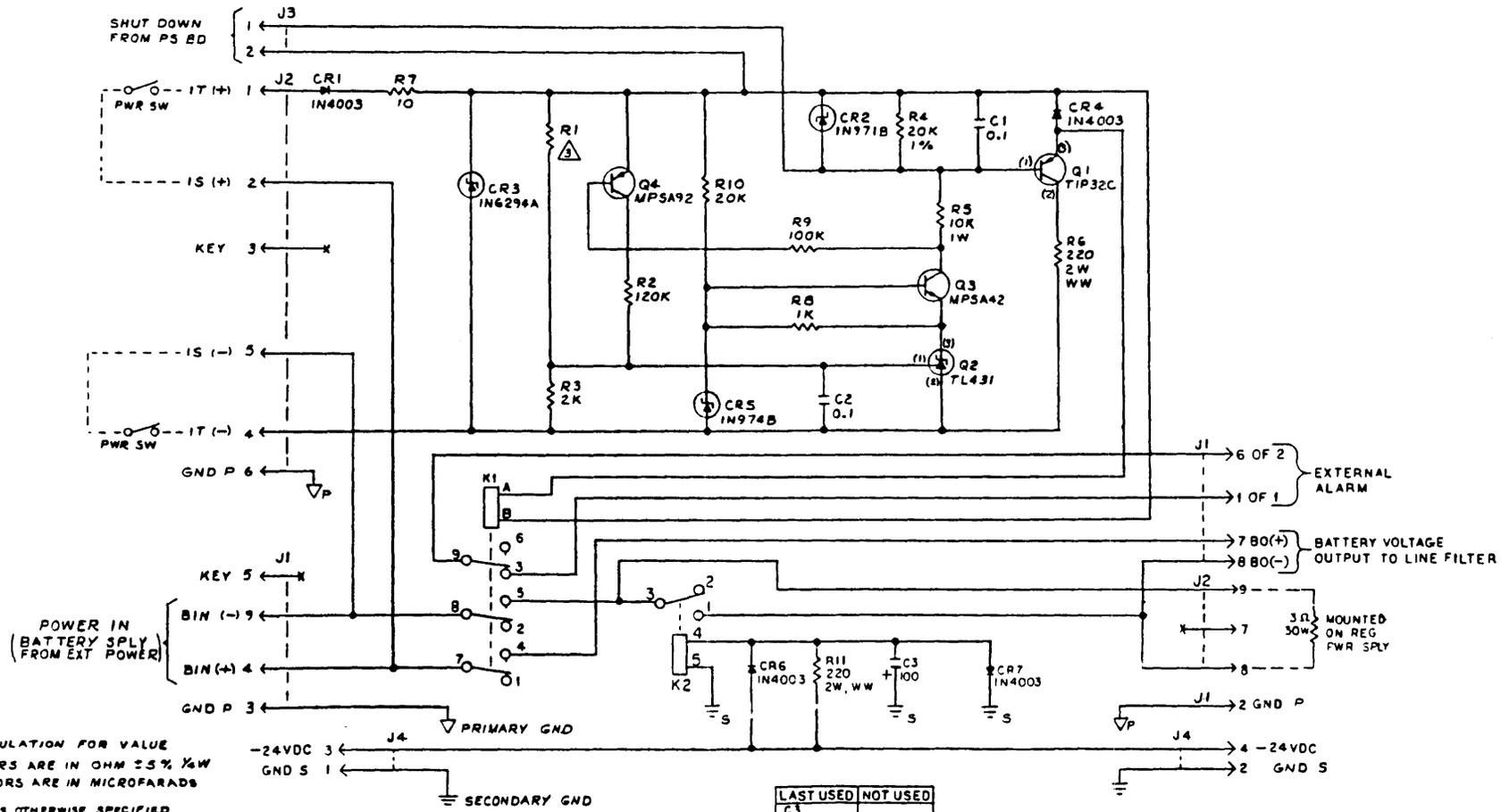


9620 POWER SUPPLY
INTCON DIAG

SCALE	REF
	D
401-08222-000	
SHEET 2 OF 2	

90-08172-XXX TABULATION

REF DES	DASH NO	REV	CASH NO	REV
3	-002	B	-502	B
48 VDC P3 40VDC P3				
R1 31.6K 1% 40.2K 1%				



SEE TABULATION FOR VALUE
 2. RESISTORS ARE IN OHM 5% 1/4W
 1. CAPACITORS ARE IN MICROFARADS

NOTES UNLESS OTHERWISE SPECIFIED

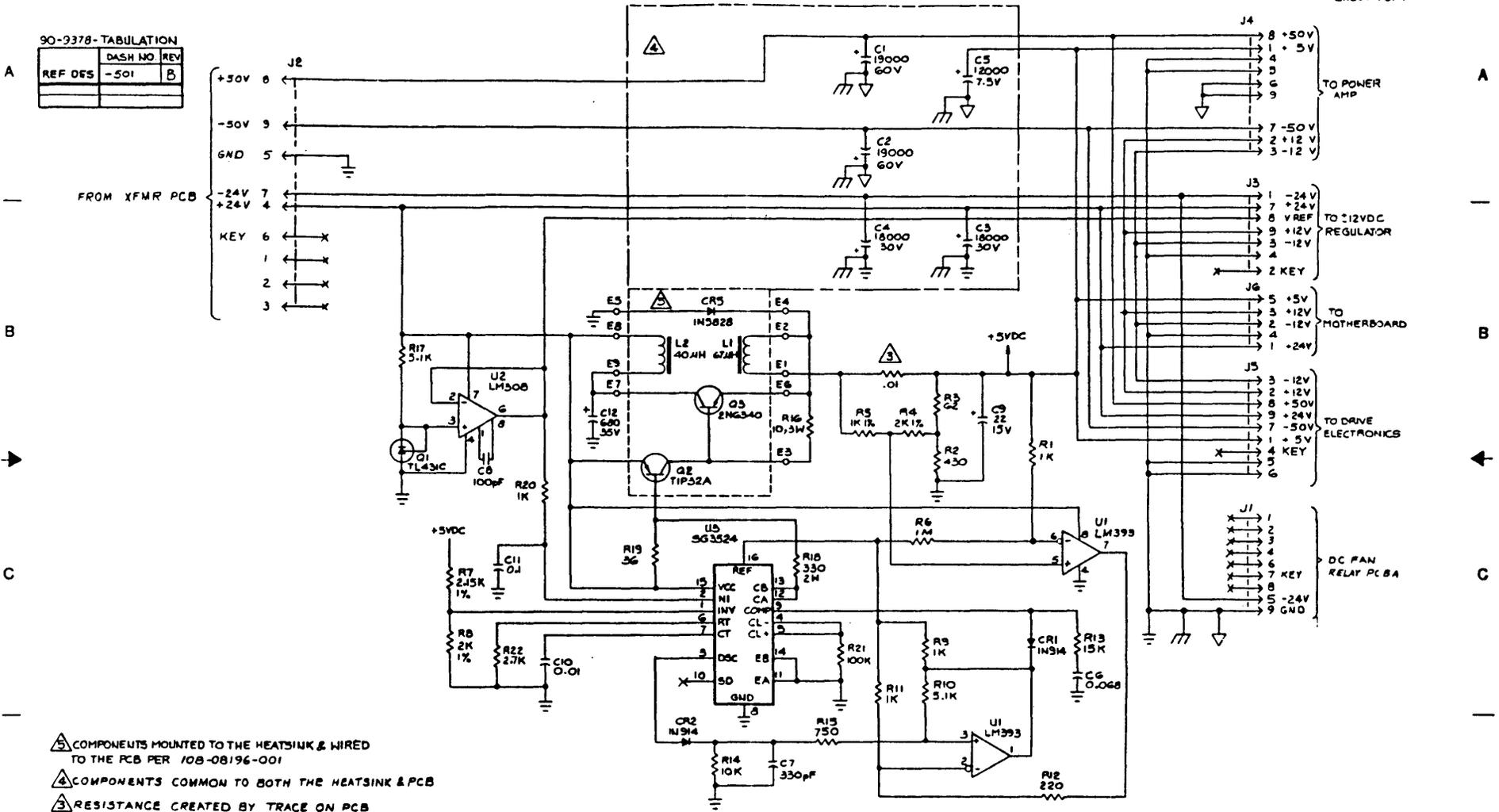
REV STATUS	REV	D
OF SHEETS	SHEET	1

LAST USED	NOT USED
C1	
CR7	
J4	
Q4	
R11	
K2	

Relay Board
 Type 8172
 Schematic Diagram

90-9378-TABULATION

REF DES	DASH NO	REV
	-501	B

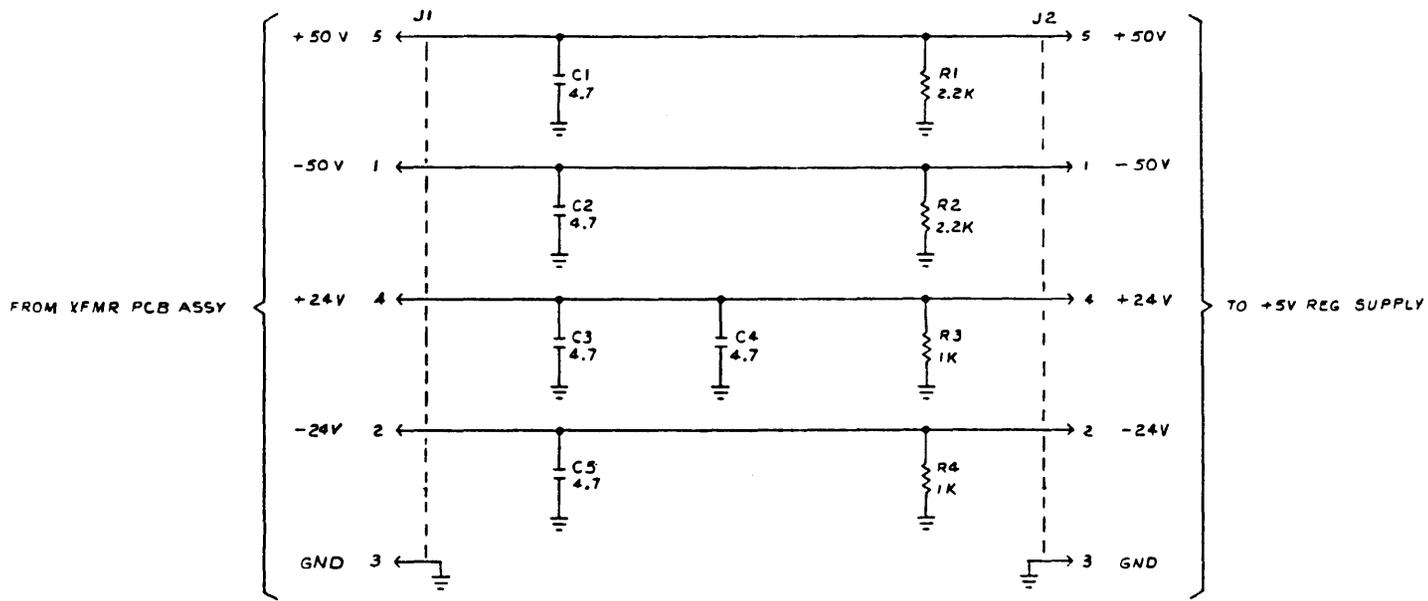


- ▲ COMPONENTS MOUNTED TO THE HEATSINK & WIRED TO THE PCB PER 108-08196-001
- ▲ COMPONENTS COMMON TO BOTH THE HEATSINK & PCB
- ▲ RESISTANCE CREATED BY TRACE ON PCB
- 2. RESISTORS ARE IN OHMS ± 5% ¼ W
- 1. CAPACITORS ARE IN MICROFARADS ± 10% 50V
- NOTES: UNLESS OTHERWISE SPECIFIED

LAST USED	NOT USED
R22	CR3, CR4
CR3	
L2	
U3	
E3	
C12	
J6	

Power Supply +5V DC
Type 9378 DC
Schematic Diagram

REV STATUS OF SHEETS	REV SHEET	C
	1	1

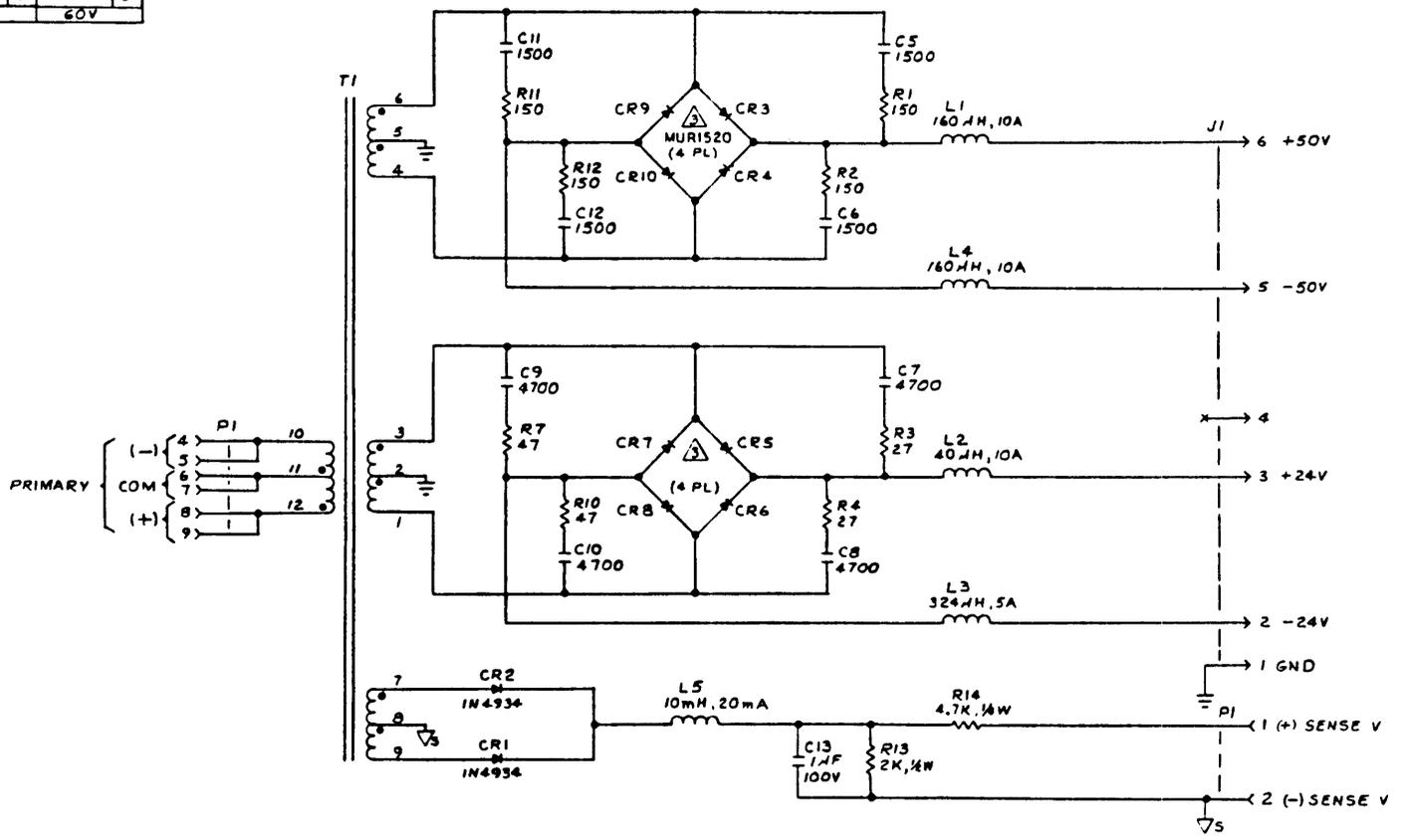


2 RESISTORS ARE 3W, WW
 1 CAPACITORS ARE IN, I/F ± 20% 100V
 NOTES: UNLESS OTHERWISE SPECIFIED

FLTR/ UNRGLTD SPLY
 Type 8229
 SCHEMATIC DIAGRAM

90-08173-XXX TABULATION

REF DES	DASH NO	REV	
F1	-002	B	-502 B
	48V		60V

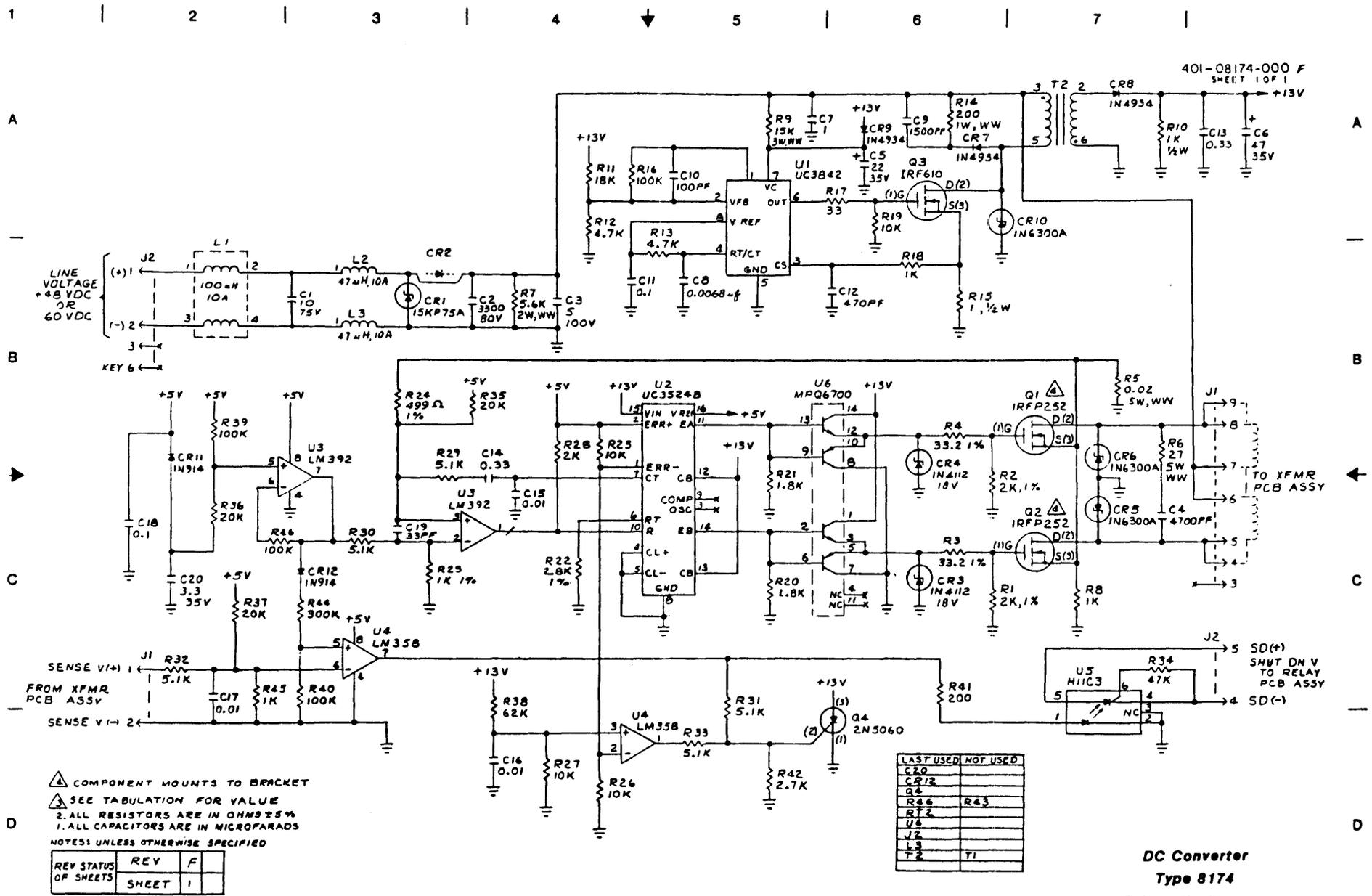


▲ DIODES ARE MOUNTED ON HEATSINK 90-09376-001
 2. RESISTORS ARE IN OHMS ±5% 2W, 1/4W
 1. CAPACITORS ARE IN PICOFARADS
 NOTES: UNLESS OTHERWISE SPECIFIED

LAST USED	NOT USED
C13	C1-C4
CR10	R5, 6, 8, 9
L5	
J1	
T1	
PI	

REV STATUS	REV	D
OF SHEETS	SHEETS	1

Transformer PCB
Type 8173
Schematic Diagram

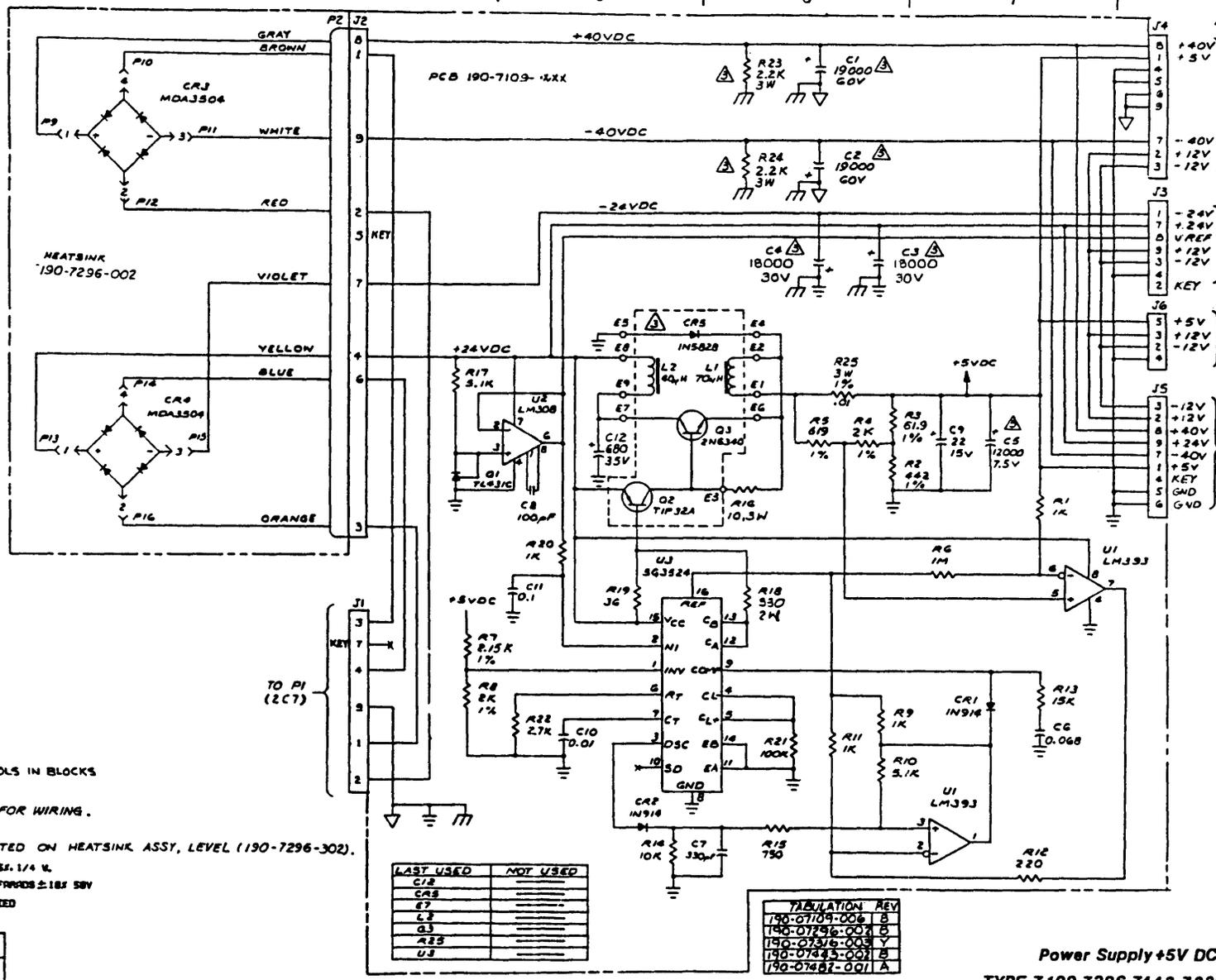


DC Converter
Type 8174
Schematic Diagram

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

190-7109 TABULATION

DASH NO	REV
-501	B



- ⚠ LETTERS AND SYMBOLS IN BLOCKS ARE TERMINALS.
- G. REF. 108-0666-001
- H. SEE 190-7145-001 FOR WIRING.
- ⚠ REMOVED
- ⚠ COMPONENTS MOUNTED ON HEATSINK ASSY, LEVEL (190-7296-302).
- 2. RESISTORS ARE IN OHMS ± 5% 1/4 W.
- 1. CAPACITORS ARE IN MICROFARADS ± 10% 50V

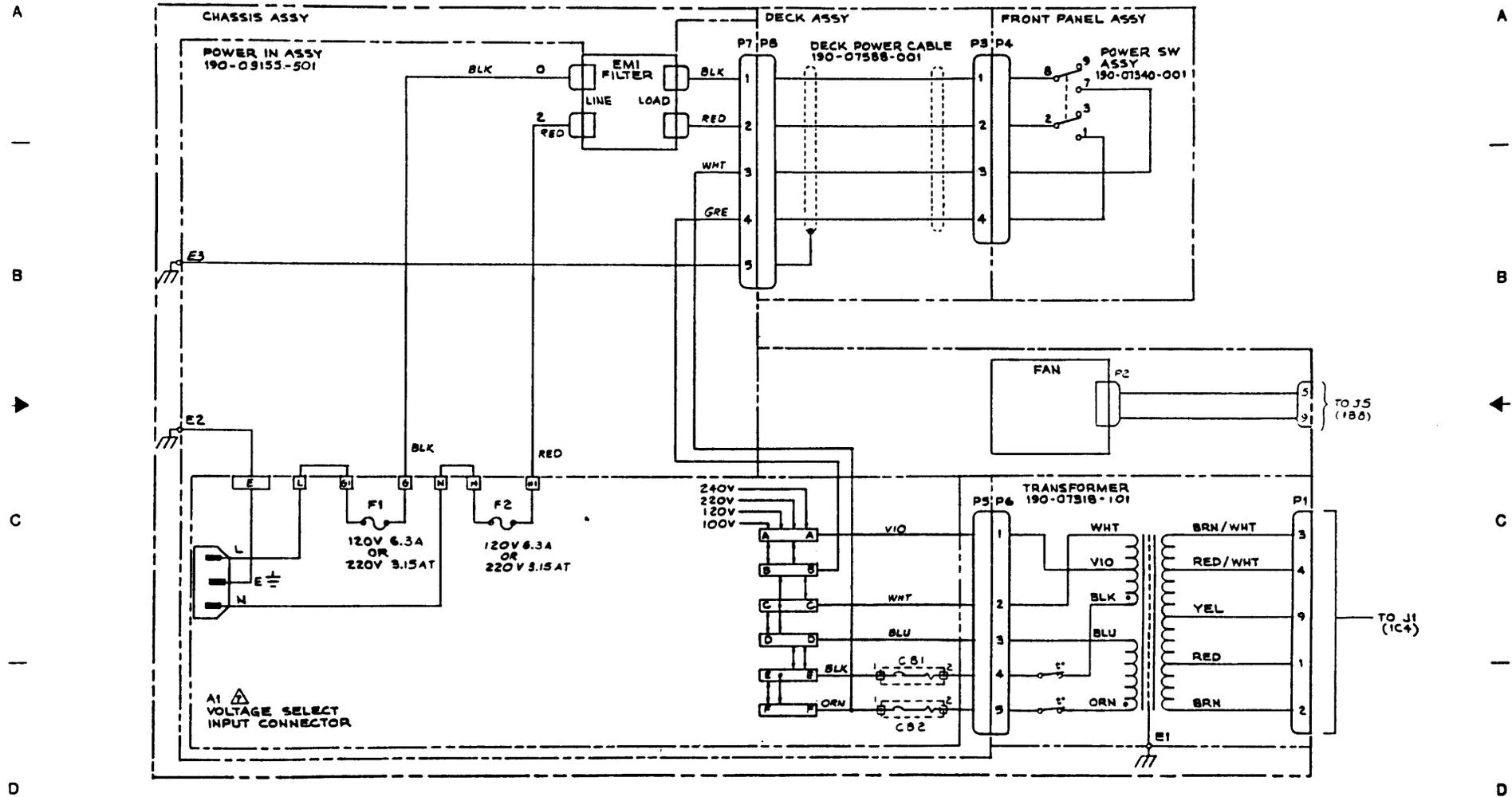
REV STATUS OF SHEETS	REV	B	B
	SHEET	1	2

LAST USED	NOT USED
C12	_____
CR5	_____
C7	_____
C2	_____
Q3	_____
R25	_____
U3	_____

TABULATION	REV
190-07109-001	B
190-07296-001	B
190-07316-001	Y
190-07443-001	B
190-07482-001	A

Power Supply +5V DC
TYPE 7109,7296,7443,7339,7482
Schematic Diagram

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8



Power Supply +5V DC
TYPE 7109,7296,7443,7339,7482
Schematic Diagram

APPENDIX A - GLOSSARY**A.0 GENERAL**

This appendix defines terms, acronyms, and abbreviations used in the manual.

ARA Level Burst. Automatic Read Amplification Level Burst: A string of bits that occurs at the beginning of all tracks. Used in GCR Mode for calibrating Read Amplifiers

ACRC Character. Auxiliary Cyclic Redundancy Check Character: A polynomial check character used for error detection.

Auto Speed. Operation of the Tape Drive whereby it shifts to an operating speed (50 or 100 ips) to accommodate the data throughput to/from the Host Computer.

BOT. Beginning of Tape: The section of tape near the physical beginning of tape that constitutes the approach to the beginning of the recording area. This section is marked by a photo-reflective Marker.

Block. A group of contiguous bytes considered and transmitted as a unit.

Byte. A group of eight contiguous bits that are acted on as a unit.

Character. A unit of information consisting of one byte plus a parity bit recorded as a unit.

CRC Character. Cyclic Redundancy Check Character:

In **NRZI Mode**, the next-to-last character placed in 9-track, 800-cpi, data blocks where a modified cyclic code is used. The CRC Character can be used for error detection.

In **GCR Mode**, the CRC is a polynomial character used for error detection.

Data Density. The number of single-byte characters stored per unit length of tape - usually expressed as Characters per Inch (CPI) or Bytes per Inch (BPI).

Data Access Time. Time required for tape to accelerate from a stopped state to nominal velocity and the Drive to start reading or writing data.

DDPE. Double-Density Phase-Encoded Data Format: Density is 3200 cpi which is double that of PE (Phase-Encoded Format).

EOT. End-of-Tape: A section of tape near the physical end of tape that constitutes the approach to the end of the recording area. This section is marked by a photo-reflective marker.

FMK. File Mark or Tape Mark: A control block recorded on tape to separate data files from one another. A data file can consist of one or more data blocks.

Flux Transition. The change of magnetic flux from saturation in one direction to saturation in the opposite direction.

GCR. Group-Encoded Recording: A recording technique whereby groups of bits are collected and encoded before putting them on tape. Recording density for GCR is 6250 cpi. Physical density is 9042 ftpi (Flux Transitions per Inch).

ID Burst. Density Identification Burst: A burst of data recorded near the beginning of tape, before BOT, that identifies the tape recording density as PE, DDPE, or GCR.

IPS. Inches Per Second: Parameter for expressing tape speed.

IBG. Interblock Gap: A dc-erased section of tape used to separate data blocks.

Latency. For On-The-Fly Operations, Latency refers to the time between the end of a data block and the point after which the Drive will not immediately implement the next Command before tape comes to a complete stop.

Local Operation. Operation set up or controlled from the Front Panel of the Drive with no influence from the Host Computer.

LRC Character. Longitudinal Redundancy Check Character: Used in NRZI Mode. This character is the last character in each data block. It constitutes a set of longitudinal parity bits for checking data and restoring all tracks to the dc-erase polarity.

NRZI. Nonreturn-to-Zero, Change-on-ONE Data Format: Recording technique characterized by having any transition from ONE to Zero or ZERO to ONE represent a Logic ONE; all steady states (no change) represents Logic ZERO. Recording density is 800 cpi.

On-The-Fly Operation. Refers to Start/Stop Mode: Operation whereby each successive Command is issued in rapid enough sequence to keep the tape moving continuously - not stopping in IBGs.

PE. Phase-Encoded Data Format: Recording technique whereby a specific change in magnetic flux polarity represents one logic level. The opposite change in polarity represents the other logic level. Recording density is 1600 cpi.

Physical Recording Density. The number of recorded flux transitions per unit length of tape. This parameter is usually given in ftpi (Flux Transitions per Inch).

Remote Operation. Operation of the Tape Drive by the Host Computer.

Reinstruction Time. Time allowed after the Drive has written or read a data block, and before the tape comes to a complete stop, for the Host Computer to issue the next Command and continue tape motions. (Ref Figure A-1)

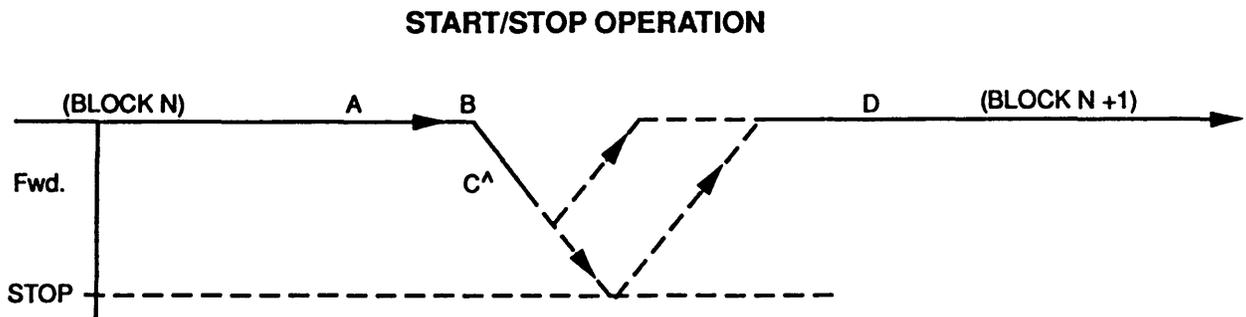
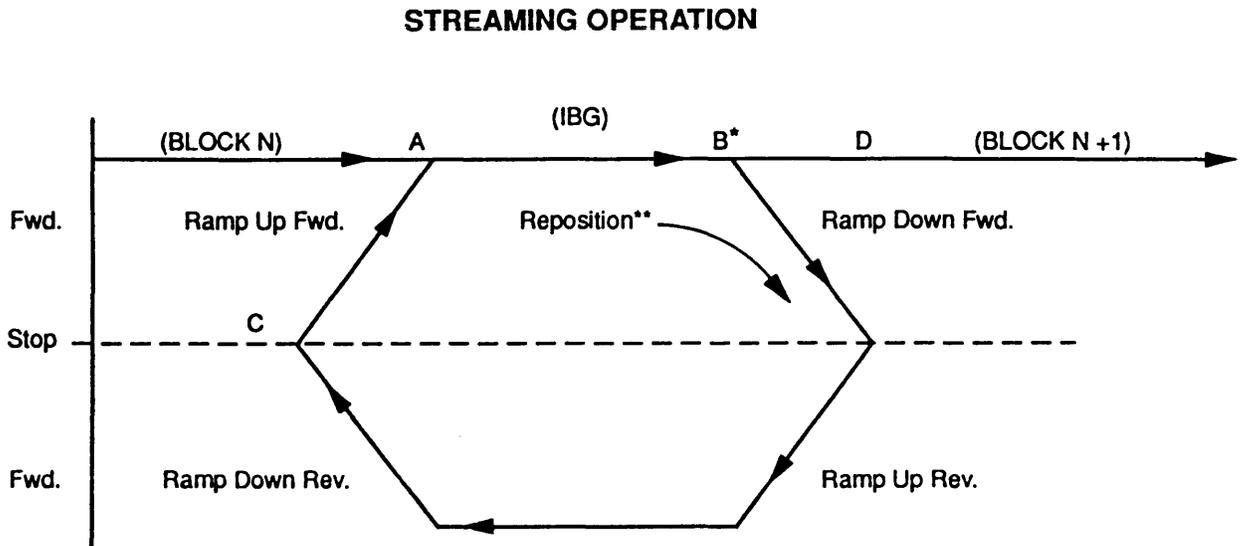
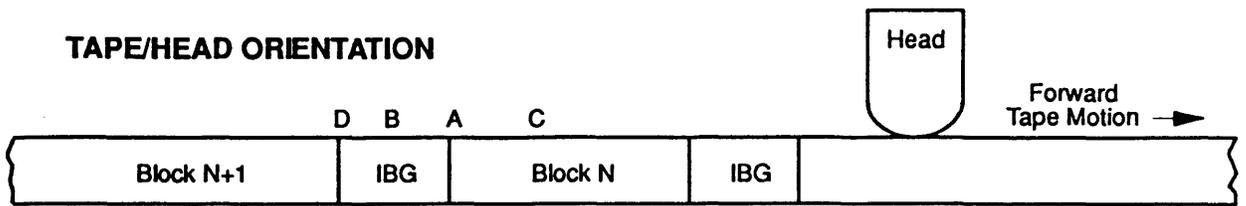
Reinstruction Time On Ramp. For Start/Stop Mode only - Time allowed after tape has begun to ramp down in the IBG for the Host to issue a new Command and reaccelerate tape before it comes to a complete stop in the IBG. (Ref Figure A-1)

Reposition Time. Time required for Drive to reposition tape for the next Command if the next Command was issued too late to maintain tape motion. (Ref Figure A-1)

Start/Stop Operation. Operation of the Tape Drive whereby the tape stops and starts within each Interblock Gap. Start/Stop Operation can be done at any density, but is limited to 50 ips tape speed. See On-The-Fly Operation.

Streaming Operation. Operation whereby the tape moves continuously (with some exceptions) without stopping in the Interblock Gaps. The Host Computer is allowed a full IBG period (dependent on density and tape speed) to send a valid Command (that does not change tape motion direction). If the Command is not received, within the Interblock, the Drive enters a Reposition Routine that stops the tape in an area just before the related IBG. The next Command resumes tape motion. (Ref Figure A-1)

VPE. Vertical Parity Error: Each character transmitted occupies 8 tracks for data and one track for a Parity Bit. Vertical Parity Error is one based on the parity of each character on tape.



NOTES:

- * Point B is the End of Reconstruct Window, the last point where the next Command can be executed without repositioning.
- ** Repositioning occurs from B to C.
- ^ Point C is last point where new Command can be executed without ramping to a complete stop.

Figure A-1. Velocity Profiles

WARRANTY

The Company warrants its devices against faulty workmanship or the use of defective material (except in those cases where the materials are supplied by OEM) for a period of one year from the date of shipment to OEM.

The liability of the Company under this warranty is limited to replacing, repairing, or issuing credit (at the Company's discretion) for any devices which are returned by OEM during such period provided that (a) the Company is promptly notified in writing upon discovery of such defects by OEM; (b) the defective unit is returned to the Company, transportation charges prepaid by OEM; and (c) that Company's examination of such unit shall disclose to its satisfaction that such defects have not been caused by misuse, neglect, improper installation, repair alteration or accident.

Shugart Corporation is continually striving to provide improved performance, value and reliability in its products and reserves the right to make these changes without being obligated to retrofit delivered equipment.

Shugart

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